

**Results of Proficiency Test
Engine Oil (Fresh)
June 2017**

Organised by: Institute for Interlaboratory Studies
Spijkenisse, the Netherlands

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1 INTRODUCTION

Since 1997, a proficiency test for fresh Engine Oil (Lubricating Oil) is organised every year by the Institute for Interlaboratory Studies. During the annual proficiency testing program 2016/2017, it was decided to continue the proficiency test for the analysis of Engine Oil (fresh) in accordance with the latest applicable version of ASTM D4485 and ACEA European Oil Sequences. In this interlaboratory study, 69 laboratories in 41 different countries registered for participation. See appendix 2 for the number of participants per country. In this report, the results of the 2017 Engine Oil (fresh) 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 analyses for fit-for-use and homogeneity testing were subcontracted to an ISO/IEC 17025 accredited laboratory. It was decided to send to each laboratory two bottles (1 * 1 litre bottle and 1 * 0.5 litre bottle) of the same Engine Oil (Fresh), both labelled #17095. 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/IEC 17043:2010 (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 organisation 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 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

The necessary bulk material, a Zinc free SAE20W-40 engine oil, was obtained from a local supplier. From this 200 litre batch, after homogenization, 100 brown glass bottles of 1 litre and 100 brown glass bottles of 0.5 litre were filled (both labelled #17095). The homogeneity of the subsamples #17095 was checked by determination of Density at 15°C in accordance with ASTM D4052 and Kinematic Viscosity at 40°C in accordance with ASTM D445 on 8 stratified randomly selected samples.

	Density at 15°C in kg/L	Kinematic Viscosity at 40°C in mm ² /s
Sample #17095-1	0.89374	164.7
Sample #17095-2	0.89374	165.0
Sample #17095-3	0.89374	164.1
Sample #17095-4	0.89374	164.2
Sample #17095-5	0.89374	164.1
Sample #17095-6	0.89374	164.2
Sample #17095-7	0.89374	164.1
Sample #17095-8	0.89374	164.1

Table 1: homogeneity test results of subsamples #17095

From the above test results, the repeatabilities were calculated and compared with 0.3 times the corresponding reproducibility of ASTM D4052 and the repeatability of ASTM D445, in agreement with the procedure of ISO 13528, Annex B2 in the next table:

	Density at 15°C in kg/L	Kinematic Viscosity at 40°C in mm ² /s
r (observed)	0	0.96
reference test method	ASTM D4052:16	ASTM D445:17a
0.3 x R (ref. test method)	0.00015	0.60
r (ref. test method)	-----	1.22

Table 2: evaluation of the repeatabilities of the subsamples #17095

The calculated repeatability of Density was less than 0.3 times the reproducibility and the calculated repeatability of kinematic viscosity was less than the repeatability of the corresponding target methods. Therefore, homogeneity of the subsamples #17095 was assumed.

To each of the participating laboratories 1 * 1 litre bottle and 1 * 0.5 litre (both labelled, #17095) were sent on May 24, 2017. An SDS was added to the sample package.

2.5 ANALYSES

The participants were requested to determine on sample #17095: Acid Number, Base Number, Color ASTM, Conradson Carbon Residue, Ramsbottom Carbon Residue, Carbon Residue (Micro method), Density at 15°C, Evaporation loss by Noack, Flash Point COC, Flash Point PMcc, Foaming Tendency, Foam Stability, Kinematic Viscosity at 40°C and at 100°C, Viscosity Index, Viscosity Stabinger at 40°C and at 100°C, Viscosity Apparent (CSS), Viscosity High Temperature

High Shear, Nitrogen, Pour Point (manual and automated), Sulphated Ash, Sulphur, Water, Calcium, Phosphorus and Zinc.

It was explicitly requested to treat the samples as if they were routine samples and to report the test results using the indicated units on the report form and not to round the results, but report as much significant figures as possible. It was also requested not to report 'less than' 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 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 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 reanalyses). Additional or corrected test results are used for data analysis and original 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 organisation of this proficiency test was the one as described in the report 'iis Interlaboratory Studies: Protocol for the Organisation, Statistics and Evaluation' (iis-protocol, version 3.4) of March 2017.

For 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

dataset does not have a normal distribution, the (results of the) statistical evaluation should be used with due care.

According to ISO 5725 the original test results per determination were submitted to Dixon's and/or Grubbs' and/or Rosner's outlier tests. 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. 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 these 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 analysis 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 standard. Outliers and other data, which were excluded from the calculations, are represented as a "x". 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 was projected over the Kernel Density Graph.

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.

This target standard deviation was calculated from the literature reproducibility by division with 2.8.

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:

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

The $Z_{(\text{target})}$ scores are listed in the result tables of 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:

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

4 EVALUATION

In this interlaboratory study no problems with sample dispatch were encountered. One participant reported after the final reporting date and two participants did not report any test results at all. Not all laboratories were able to report all analyses requested. In total 67 participants reported 940 numerical test results. Observed were 45 outlying results, which is 4.8%. In proficiency studies, outlier percentages of 3% - 7.5% are quite normal.

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.

4.1 EVALUATION PER TEST

In this section, the results are discussed per test. The specified test methods and requirements were taken into account for explaining the observed differences when possible and applicable. These methods are also in the tables together with the reported 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. D189) and an added designation for the year that the method was adopted or revised (e.g. D189:06). If applicable, a designation in parentheses is added to designate the year of reapproval (e.g. D189:06(2014)). In the results tables of Appendix 1 only the method number and year of adoption or revision will be used.

- Acid Number : This determination was very problematic. Two statistical outliers and two possibly false negative test results were observed. The test results of four other laboratories were excluded, for using ASTM D974 or ISO6618, which is not equivalent to ASTM D664-A.
The calculated reproducibility after rejection of the suspect data is not at all agreement with the requirements of ASTM D664-A:11a(2017). In Table 1 of ASTM D664:11a the recommended size of the test portion is given. Results using smaller sample size may not be equivalent to results obtained with the recommended sample size (See note 13 of ASTM D664).
- Base Number : This determination was problematic. Four statistical outliers were observed. The calculated reproducibility after rejection of the statistical outliers is not in agreement with the requirements of ASTM D2896:15.
When the reported data of ASTM D2896 were evaluated separately for procedure A and B, the calculated reproducibility for procedure A is in good agreement with the requirements of the test method. The calculated reproducibility for procedure B is not in agreement.
- Color ASTM: 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 D1500:12.

iis also calculated a value for all results that were reported as 'less than' for example L7.5 or <7.5. This test method uses color standards with values that are 0.5 points apart, ranging from 0.5 – 8.0. Since this color test is determined by comparing the color of the sample to these standards, it is assumed when for example L7.5 is reported, the actual colour lies between 7.0 and 7.5. iis calculated this value as 7.25 (7.5 minus 0.25).
- Conradson CR: This determination was not problematic. No statistical outliers were observed. The calculated reproducibility is in agreement with the requirements of ASTM D189:06(2014).
- Ramsbottom CR: Only four participants reported a test result. No statistical outliers were observed. The calculated reproducibility is in agreement with the requirements of ASTM D524:15.
- Carbon Residue (micro method): This determination was not problematic. No statistical outliers were observed. The calculated reproducibility is in agreement with the requirements of ASTM D4530:15.
- Density at 15°C: This determination was not problematic. Four statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in agreement with the requirements of ASTM D4052:16.

Evaporation loss: This determination was not problematic. One statistical outlier was observed.
by Noack The calculated reproducibility after rejection of the statistical outlier is in agreement with the requirements of ASTM D5800:15a procedure A and B.

Flash Point COC: This determination was problematic. No statistical outliers were observed. However, the calculated reproducibility is not in agreement with the requirements of ASTM D92:16b.

Flash Point PMcc: This determination was not problematic. One statistical outlier was observed. The calculated reproducibility after rejection of the statistical outlier is in agreement with ASTM D93-A:16a.

Foaming Tendency: This determination may be (somewhat) problematic. One statistical outlier was observed. The calculated reproducibility for the Sequences I and III are in agreement with the requirements of ASTM D892:13e1. However, the calculated reproducibility of Sequence II is not in agreement.

The participants were requested to report whether a stone diffuser or a metal diffuser was used for the test. A difference in the consensus value was found depending on the type of diffuser used. When evaluated separately for the different diffuser used, the mean of the group using a stone diffuser was 5.0 ml foam and that of the group using a metal diffuser was 11.1 ml foam. Still both groups did not meet the requirements of method ASTM D893:13e1

Foam Stability: None of the reporting laboratories reported a positive result for the settling period after 10 min. Therefore all reporting participants agreed on a result of 0 (Nil).

Kin.Visco. at 40°C: This determination was not problematic. One statistical outlier was observed. The calculated reproducibility after rejection of the statistical outlier is in agreement with the requirements of ASTM D445:17a.

Kin.Visco.at 100°C: This determination was not problematic. One statistical outlier was observed. The calculated reproducibility after rejection of the statistical outlier is in agreement with the requirements of ASTM D445:17a.

Viscosity Index: This determination was not problematic. Two statistical outliers were observed. One test result was excluded, for having an outlier in the kinematic viscosity at 100°C test. However, the calculated reproducibility after rejection of the suspect data is in agreement with the requirements of ASTM D2270:10 (2016). Five calculation errors were observed, taking into account that the method describes that rounding should be done to the nearest whole number and when the number is exactly halfway between the nearest two whole numbers, it is rounded to the nearest even number.

Visco. Stab. at 40°C: This determination was problematic. Two statistical outliers were observed. The calculated reproducibility after rejection of the statistical outliers is not in agreement with the requirements of ASTM D7042:16ε3.

Visco. Stab. at 100°C: 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 ASTM D7042:16ε3.

Visco. App. at -15°C: This determination was problematic for a number of laboratories. Two statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in good agreement with the requirements of ASTM D5293:15.
By error the temperature of apparent viscosity was initially requested at -20°C instead of -15°C. This was corrected during the PT and likewise communicated to the participants per e-mail. As a result only 5 participants reported a result at -20°C and four of them also reported a result at -15°C. The test results at a temperature of -20°C were higher than maximum viscosity of the method and therefore no z-scores were calculated.

Visco. HTHS: Only three participants reported a test result. This determination may not be problematic. No statistical outliers were observed. The calculated reproducibility is in agreement with the requirements of ASTM D4683:17.

Nitrogen: This determination was problematic. No statistical outliers were observed. However, the calculated reproducibility is not in agreement with the requirements of ASTM D5762:12(2017). When the results according to ASTM D5762 were evaluated separately, the calculated reproducibility is still not in agreement with ASTM D5762:12(2017).

Pour Point (man): This determination was problematic. No statistical outliers were observed. However, the calculated reproducibility is not in agreement with the requirements of ASTM D97:17a.

Pour Point (auto): This determination was problematic. Three statistical outliers were observed. The calculated reproducibility after rejection of the statistical outliers is not in agreement with the requirements of ASTM D5950:14.

Sulphated Ash: This determination was not problematic. Two statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in agreement with the requirements of ASTM D874:13a.

- Sulphur: This determination was problematic. Three statistical outliers were observed. The calculated reproducibility after rejection of the statistical outliers is not in agreement with the requirements of ASTM D4294:16e1. A matrix mismatch between sample and standards (e.g. different C/H ratio and/or the presence of interfering molecules) may (partly) explain the large variation.
- Water: This determination was problematic for a number of laboratories. The preferred method to use for a product containing interfering components is ASTM D6304 method C. This method is applicable for oils with difficult matrix interferences only. Twenty laboratories reported results determined according ASTM D6304 method C. Six statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in agreement with the requirements of ASTM D6304:16e1.
- Calcium: This determination was not problematic. Four statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in agreement with the requirements of ASTM D5185:13e1.
- Phosphorus: Twenty-six participants reported a numerical result, averaging around 3 mg/kg. Other laboratories reported <1, <5 or <10. Three statistical outliers were observed and two results were excluded, for zero is not a real value. Since the average found for this element is below the range of ASTM D5185, it was decided not to calculate z-scores.
- Zinc: Thirty-four participants reported a numerical result, averaging around 3 mg/kg. Other laboratories reported <1, <20 or <60. One statistical outlier was observed and two results were excluded, for zero is not a real value. Since the average found for this element is below the range of ASTM D5185, it was decided not to calculate z-scores.

4.2 PERFORMANCE EVALUATION FOR THE GROUP OF LABORATORIES

A comparison has been made between the reproducibility as declared by the relevant standard and the reproducibility as found for the group of participating laboratories that participated. The average results, calculated reproducibilities and reproducibilities derived from literature standards (in casu ASTM, ISO and IP standards), are compared in the next table.

Parameter	unit	n	average	2.8 * sd	R(lit)
Acid Number	mg KOH/g	36	0.48	0.81	0.21
Base Number	mg KOH/g	42	14.33	1.24	1.00
Color ASTM		24	7.0	1.2	1
Conradson Carbon Residue	%M/M	17	1.67	0.22	0.35
Ramsbottom Carbon Residue	%M/M	4	1.61	0.12	0.21
Carbon Residue (micro method)	%M/M	26	1.68	0.22	0.22
Density at 15°C	kg/L	50	0.8938	0.0004	0.0005
Evaporation loss by Noack	%M/M	15	5.68	0.69	0.88
Flash Point COC	°C	43	252.0	23.1	18
Flash Point PMcc	°C	44	211.3	16.1	15.0
Foaming Tendency,	ml	18	1.9	10.9	14.8
Foaming Tendency,	ml	20	8.3	21.4	17.5
Foaming Tendency,	ml	19	1.3	9.2	14.5
Foam Stability, Sequence I	ml	19	0	n.a.	n.a.
Foam Stability, Sequence II	ml	20	0	n.a.	n.a.
Foam Stability, Sequence III	ml	19	0	n.a.	n.a.
Kinematic Viscosity at 40°C	mm ² /s	59	164.86	1.31	2.01
Kinematic Viscosity at 100°C	mm ² /s	53	17.09	0.20	0.24
Viscosity Index		51	111.3	2.0	2
Stabinger Viscosity at 40°C	mm ² /s	21	165.01	2.52	1.91
Stabinger Viscosity at 100°C	mm ² /s	22	17.10	0.20	0.16
Viscosity, Apparent at -15°C	mPa·s	9	13495	1012	988
Viscosity, HTHS	mPa·s	3	4.64	0.16	0.19
Nitrogen	mg/kg	15	685	267	182
Pour Point, manual	°C	39	-24.1	12.1	9
Pour Point, automated	°C	10	-29.0	5.1	4.5
Sulphated Ash	%M/M	31	1.59	0.12	0.20
Sulphur	%M/M	23	6493	979	550
Water	mg/kg	29	211	412	419
Calcium	mg/kg	40	4690	774	888
Phosphorus	mg/kg	26	3.3	3.7	(7.8)*
Zinc	mg/kg	34	2.6	1.4	(0.2)*

Table 3: reproducibilities of tests on sample #17095

*) Results between brackets should be used with care, because the average was near the upper or lower limit of the application range

Without further statistical calculations it can be concluded that for a number of tests there is not a good compliance of the group of participants with the relevant standards. The problematic tests have been discussed in paragraph 4.1.

4.3 COMPARISON OF THE PROFICIENCY TEST OF JUNE 2017 WITH PREVIOUS PTS

	June 2017	June 2016	June 2015	June 2014	May 2012	May 2012
Number of reporting labs	67	69	72	87	78	78
Number of results reported	940	1007	961	996	879	804
Statistical outliers	45	25	40	20	29	33
Percentage outliers	4.8%	2.5%	4.2%	2.0%	3.3%	4.1%

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 standards. The conclusions are given the following table:

Determination	June 2017	June 2016	June 2015	June 2014	May 2012	May 2012
Acid Number	--	--	--	--	--	+/-
Base Number	-	-	--	+	-	--
Color ASTM	-	+	+	++	++	++
Conradson Carbon Residue	+	+	++	+	++	-
Ramsbottom Carbon Residue	+	--	--	--	--	-
Carbon Residue (micro method)	+/-	+	++	-	+	
Density at 15°C	+	+	--	--	--	-
Evaporation loss by Noack	+	-	+/-	n.e.	n.e.	n.e.
Flash Point COC	-	+	++	+/-	+	+/-
Flash Point PMcc	+/-	+	++	+	++	++
Foaming Tendency	+/-	+/-	+/-	n.e.	n.e.	n.e.
Kinematic Viscosity at 40°C	+	+/-	+/-	-	-	-
Kinematic Viscosity at 100°C	+	+	++	--	--	--
Viscosity Index	+/-	-	--	--	--	n.e.
Stabinger Viscosity at 40°C	-	-	+/-	-	--	--
Stabinger Viscosity at 100°C	-	-	+/-	+/-	--	--
Viscosity, Apparent (CSS)	+/-	+	+/-	+	+	n.e.
Viscosity, HTHS	+	+	+	n.e.	n.e.	n.e.
Nitrogen	-	-	--	--	-	--
Pour Point, manual	-	+	++	+	-	+/-
Pour Point, automated	-	-	--	+/-	+	-
Sulphated Ash	+	-	--	+	-	--
Sulphur	-	-	--	--	--	--
Water	+/-	+	++	+	+	++
Calcium	+	--	--	+	-	--
Phosphorus	n.e.	--	--	-	-	--
Zinc	n.e.	--	--	-	-	-

Table 5: comparison determinations of sample #17095 against the standard

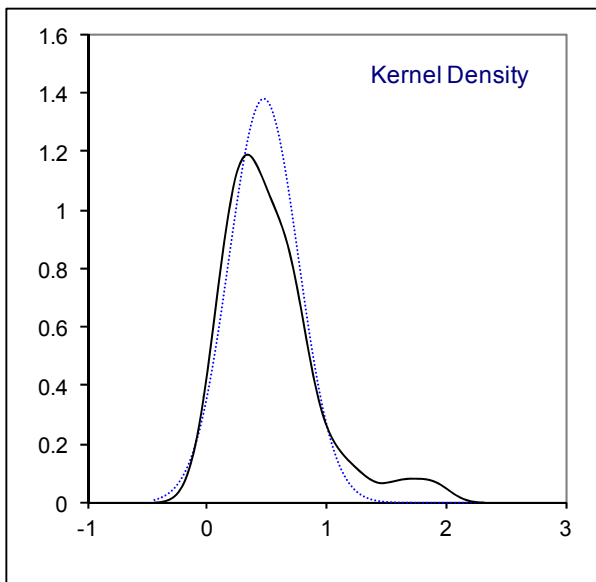
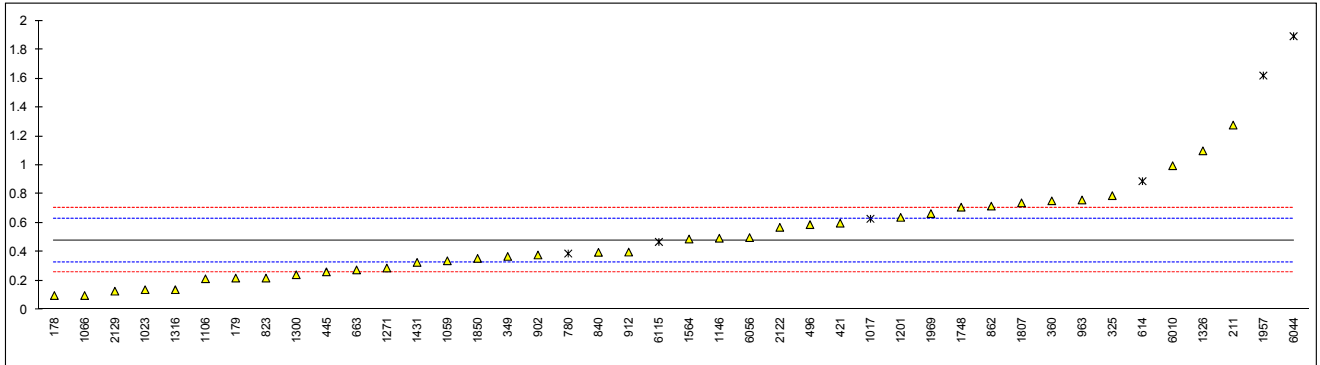
The performance of the determinations against the requirements of the respective standards is listed in the above table. The following performance categories were used:

- ++: group performed much better than the standard
- + : group performed better than the standard
- +/-: group performance equals the standard
- : group performed worse than the standard
- : group performed much worse than the standard
- n.e.: not evaluated

APPENDIX 1**Determination of Acid Number on sample #17095; results in mg KOH/g**

lab	method	value	mark	z(targ)	remarks
173		----		----	
178	INH-1118	0.10		-5.11	
179	D664-A	0.22		-3.50	
211	D664-A	1.278		10.69	
237		----		----	
252		----		----	
254		----		----	
255		----		----	
325	D664-A	0.79		4.15	
333		----		----	
349	D664-A	0.37		-1.49	
360	D664-A	0.754		3.66	
421	ISO6619	0.6		1.60	
432		----		----	
445	D664-A	0.263		-2.92	
494	D664-A	<0.1		<-5.11	Possibly false negative test result?
496	D664-A	0.59		1.46	
614	D974	0.89	ex	5.49	result excluded, see §4
621		----		----	
634		----		----	
657		----		----	
663	D664-A	0.277		-2.73	
780	D974	0.39	ex	-1.22	result excluded, see §4
823	D664-A	0.22		-3.50	
840	D664-A	0.398		-1.11	
862	D664-A	0.7176		3.17	
875		----		----	
902	D664-A	0.38		-1.35	
912	D664-A	0.4		-1.08	
922	D664-A	<0.1		<-5.11	Possibly false negative test result?
963	D664-A	0.76		3.74	
994		----		----	
1017	D974	0.63	ex	2.00	result excluded, see §4
1023	In house	0.14		-4.57	
1059	ISO6619	0.34		-1.89	
1066	D664-A	0.100		-5.11	
1106	D664-B	0.2154		-3.56	
1107		----		----	
1146	D664-A	0.496		0.20	
1150		----		----	
1173		----		----	
1201	D664-A	0.64		2.13	
1213		----		----	
1235		----		----	
1271	D664-A	0.29		-2.56	
1300	D664-A	0.2431		-3.19	
1316	D664-A	0.14		-4.57	
1324		----		----	
1326	D664-A	1.100		8.30	
1431	D664-A	0.3287		-2.04	
1564	D664-A	0.49		0.12	
1748	D664-A	0.71		3.07	
1770		----		----	
1797		----		----	
1807	D664-A	0.74		3.48	
1850	ISO6619	0.356		-1.67	
1877		----		----	
1883		----		----	
1957	D664-A	1.62	R(0.05)	15.28	
1969	D664-A	0.666		2.48	
2122	IP177	0.5708266		1.21	
2129	D664-A	0.130		-4.70	
6010	D664-A	0.997		6.92	
6031		----		----	
6044	D664-A	1.892	R(0.05)	18.92	
6056	SAE ARP 5088	0.500		0.26	
6115	D974	0.47	ex	-0.15	result excluded, see §4
7002		----		----	
7015		----		----	

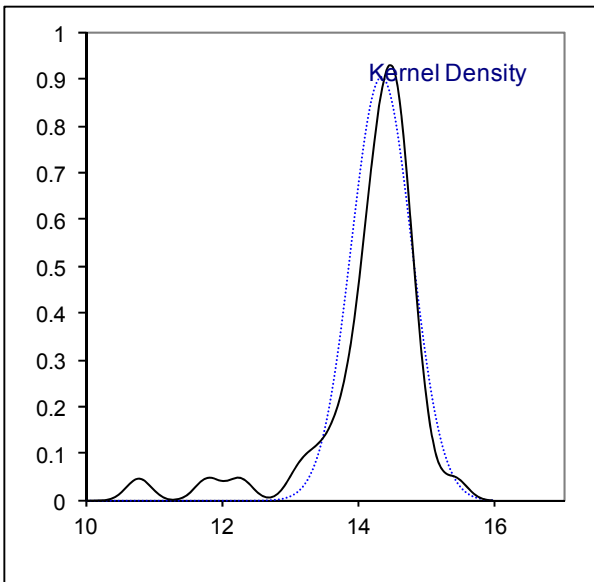
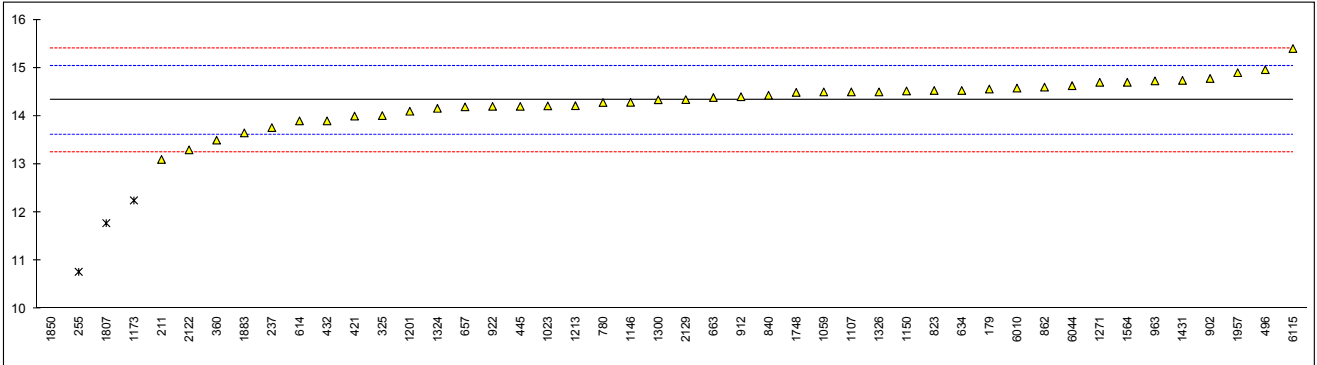
normality OK
 n 36
 outliers 2 (+4ex)
 mean (n) 0.481
 st.dev. (n) 0.2894
 R(calc.) 0.810
 R(D664:11a-A) 0.209



Determination of Base Number on sample #17095; results in mg KOH/g

lab	method	value	mark	z(targ)	remarks
173		----		----	
178		----		----	
179	D2896 - B	14.56		0.65	
211	D2896 - B	13.10		-3.42	
237	D2896 - B	13.76		-1.58	
252		----		----	
254		----		----	
255	D2896 - A1	10.77	C,R(0.01)	-9.93	first reported: 8.00
325	D2896 - B	14.01		-0.88	
333		----		----	
349		----		----	
360	D2896 - B	13.50		-2.31	
421	ISO3771	14.0		-0.91	
432	D2896 - B	13.90		-1.19	
445	D2896 - B	14.20		-0.35	
494		----		----	
496	D2896 - B	14.96		1.77	
614	D2896 - B	13.9		-1.19	
621		----		----	
634	D2896 - B	14.53		0.57	
657	D2896 - B	14.19		-0.38	
663	D2896 - B	14.385		0.16	
780	D2896 - B	14.28		-0.13	
823	D2896 - A1	14.53		0.57	
840	D2896 - B	14.43		0.29	
862	D2896 - B	14.6	C	0.76	first reported: 9.5
875		----		----	
902	D2896 - B	14.78		1.27	
912	D2896 - B	14.40		0.21	
922	D2896 - B	14.2		-0.35	
963	D2896 - A1	14.73		1.13	
994		----		----	
1017		----		----	
1023	D2896/IP276	14.21		-0.32	
1059	ISO3771	14.5		0.49	
1066		----		----	
1106		----		----	
1107	D2896 - B	14.5		0.49	
1146	D2896 - A1	14.285		-0.11	
1150	ISO3771	14.520		0.54	
1173	In house	12.25	R(0.01)	-5.80	
1201	D2896 - B	14.10		-0.63	
1213	D2896 - B	14.215		-0.31	
1235		----		----	
1271	ISO3771	14.70		1.04	
1300	D2896 - B	14.336		0.03	
1316		----		----	
1324	D2896 - A1	14.160		-0.46	
1326	D2896 - B	14.50		0.49	
1431	D2896 - B	14.7385		1.15	
1564	D2896 - B	14.7		1.04	
1748	D2896 - A1	14.49		0.46	
1770		----		----	
1797		----		----	
1807	D2896 - A1	11.78	R(0.01)	-7.11	
1850	ISO3771	0.995	R(0.01)	-37.22	
1877		----		----	
1883	D2896 - A2	13.65	C	-1.89	first reported: 12.45
1957	D2896 - A1	14.9		1.60	
1969		----		----	
2122	IP400	13.2994		-2.87	
2129	D2896 - A1	14.34		0.04	
6010	D2896 - B	14.58		0.71	
6031		----		----	
6044	D2896 - A1	14.63		0.85	
6056		----		----	
6115	D2896 - B	15.4	C	3.00	first reported: 16.0
7002		----		----	
7015		----		----	

normality	suspect	<u>Only D2896-A</u>	<u>Only D2896-B</u>
n	42	suspect 9	suspect 27
outliers	4	2	0
mean (n)	14.326	14.413	14.316
st.dev. (n)	0.4416	0.3661	0.4575
R(calc.)	1.236	1.025	1.281
R(D2896:15)	1.003	1.010	1.002

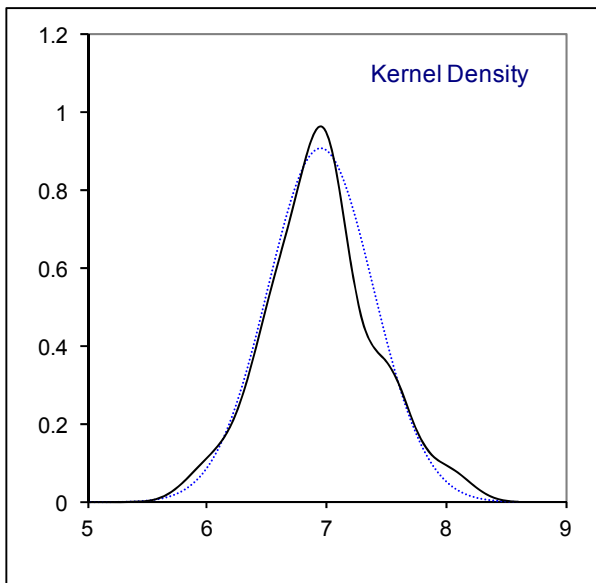
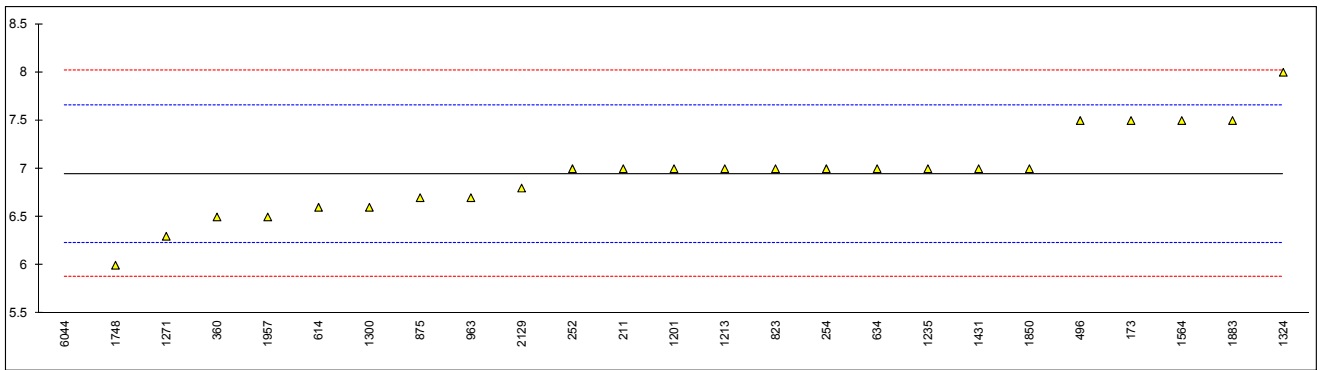


Determination of Color ASTM on sample #17095

lab	method	value	mark	z(targ)	calc. value*)	mark	remarks
173	D1500	7.5		1.55	7.5		
178		----		----	----		
179	D1500	L6.5		----	6.25		
211	D1500	7.0		0.15	7.0		
237	D1500	L 7.5		----	7.25		
252	D1500	7.0		0.15	7.0		
254	D1500	7.0		0.15	7.0		
255		----		----	----		
325	D6045	L7.0		----	6.75		
333		----		----	----		
349	D6045	L6.5		----	6.25		
360	D1500	6.5		-1.25	6.5		
421		----		----	----		
432	D1500	L7.5		----	7.25		
445	D1500	<7.0		----	6.75		
494	D1500	L 7,5		----	7.25		
496	D1500	7.5		1.55	7.5		
614	D1500	6.6		-0.97	6.6		
621		----		----	----		
634	D1500	7.0		0.15	7.0		
657	D1500	L7.0		----	6.75		
663	D1500	L 8.0		----	7.75		
780	D1500	L7.5		----	7.25		
823	D6045	7.0		0.15	7.0		
840	D1500	L7.5		----	7.25		
862	D1500	L6.0		----	5.75		
875	D6045	6.7		-0.69	6.7		
902	D1500	L7.0		----	6.75		
912	D1500	<7.0		----	6.75		
922	D1500	L7.5		----	7.25		
963	D1500	6.7		-0.69	6.7		
994	D1500	L.7.5		----	7.25		
1017		----		----	----		
1023		----		----	----		
1059	D1500	L6,5		----	6.25		
1066	D1500	L7.0		----	6.75		
1106		----		----	----		
1107		----		----	----		
1146		----		----	----		
1150		----		----	----		
1173		----		----	----		
1201	D1500	7.0		0.15	7.0		
1213	D1500	7.0		0.15	7.0		
1235	ISO2049	7.0		0.15	7.0		
1271	ISO2049	6.3		-1.81	6.3		
1300	D1500	6.6		-0.97	6.6		
1316		----		----	----		
1324	D1500	8.0		2.95	8.0		
1326		----		----	----		
1431	D1500	7		0.15	7		
1564	D1500	7.5		1.55	7.5		
1748	D1500	6.0		-2.65	6.0		
1770	D6045	<7.5		----	7.25		
1797		----		----	----		
1807	D1500	<7		----	6.75		
1850	ISO2049	7.0		0.15	7.0		
1877	D6045	L6.5		----	6.25		
1883	D1500	7.5		1.55	7.5		
1957	D1500	6.5		-1.25	6.5		
1969		----		----	----		
2122		----		----	----		
2129	D6045	6.8	C	-0.41	6.8		first reported: 4.6
6010		----		----	----		
6031		----		----	----		
6044	D1500	0.5	R(0.01)	-18.05	0.5	R(0.01)	
6056		----		----	----		
6115		----		----	----		
7002		----		----	----		
7015		----		----	----		

normality	OK	<u>all values calculated: *)</u>
n	24	OK
outliers	1	45
mean (n)	6.95	1
st.dev. (n)	0.440	6.90 (L7.0)
R(calc.)	1.23	0.462
R(D1500:12)	1	1.29
		1

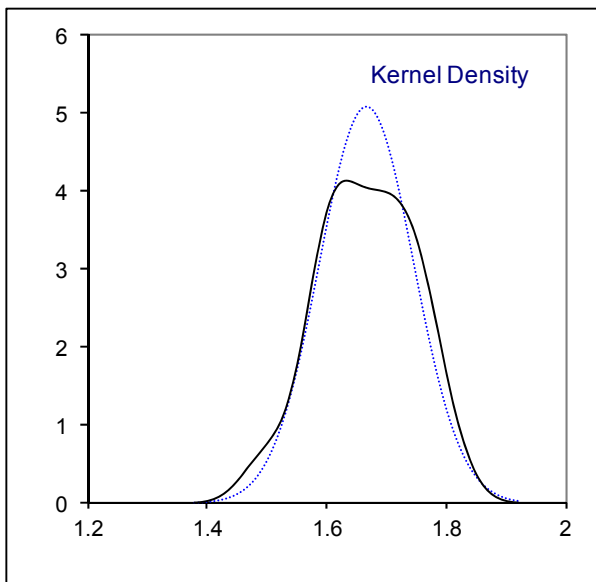
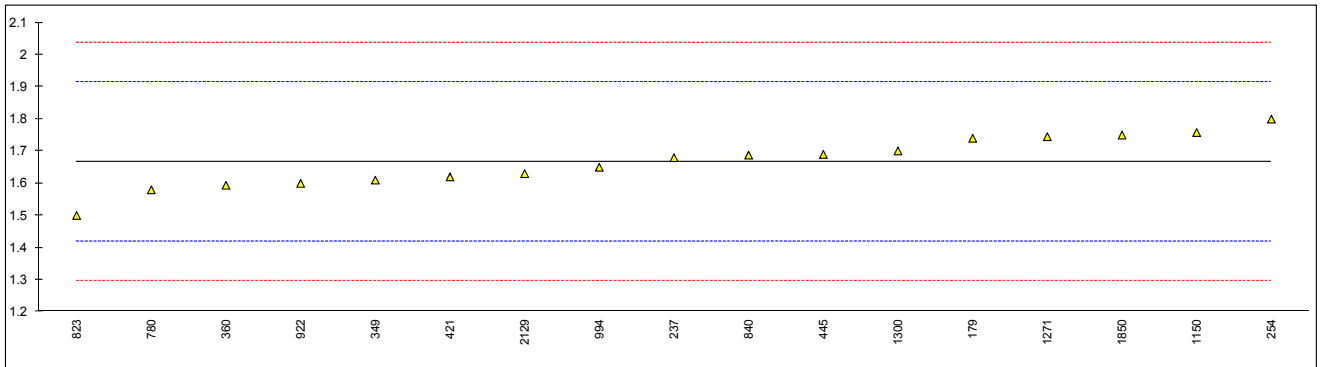
*) In the calculation of the mean, standard deviation and the reproducibility of this column, a reported value of 'L y' is changed into y-0.25 (for example L7.0 into 6.75)



Determination of Conradson Carbon Residue on sample #17095; results in %M/M

lab	method	value	mark	z(targ)	remarks
173		----		----	
178		----		----	
179	D189	1.74		0.59	
211		----		----	
237	D189	1.68		0.11	
252		----		----	
254	D189	1.80		1.08	
255		----		----	
325		----		----	
333		----		----	
349	D189	1.61		-0.46	
360	ISO6615	1.594		-0.59	
421	ISO6615	1.62		-0.38	
432		----		----	
445	D189	1.69		0.19	
494		----		----	
496		----		----	
614		----		----	
621		----		----	
634		----		----	
657		----		----	
663		----		----	
780	D189	1.58		-0.70	
823	D189	1.50		-1.35	
840	D189	1.6877		0.17	
862		----		----	
875		----		----	
902		----		----	
912		----		----	
922	D189	1.60		-0.54	
963		----		----	
994	D189	1.65		-0.14	
1017		----		----	
1023		----		----	
1059		----		----	
1066		----		----	
1106		----		----	
1107		----		----	
1146		----		----	
1150	ISO6615	1.7579		0.74	
1173		----		----	
1201		----		----	
1213		----		----	
1235		----		----	
1271	ISO6615	1.745		0.63	
1300	D189	1.7008		0.28	
1316		----		----	
1324		----		----	
1326		----		----	
1431		----		----	
1564		----		----	
1748		----		----	
1770		----		----	
1797		----		----	
1807		----		----	
1850	ISO6615	1.75		0.67	
1877		----		----	
1883		----		----	
1957		----		----	
1969		----		----	
2122		----		----	
2129	D189	1.63		-0.30	
6010		----		----	
6031		----		----	
6044		----		----	
6056		----		----	
6115		----		----	
7002		----		----	
7015		----		----	

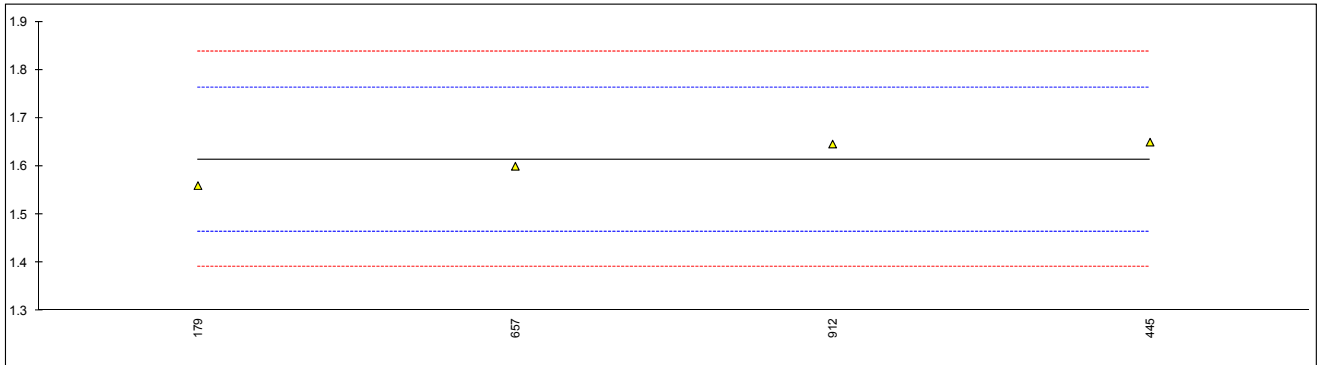
normality OK
 n 17
 outliers 0
 mean (n) 1.667
 st.dev. (n) 0.0786
 R(calc.) 0.220
 R(D189:06) 0.346



Determination of Ramsbottom Carbon Residue on sample #17095; results in %M/M

lab	method	value	mark	z(targ)	remarks
173		----		----	
178		----		----	
179	D524	1.56		-0.73	
211		----		----	
237		----		----	
252		----		----	
254		----		----	
255		----		----	
325		----		----	
333		----		----	
349		----		----	
360		----		----	
421		----		----	
432		----		----	
445	D524	1.65		0.48	
494		----		----	
496		----		----	
614		----		----	
621		----		----	
634		----		----	
657	D524	1.6		-0.19	
663		----		----	
780		----		----	
823		----		----	
840		----		----	
862		----		----	
875		----		----	
902		----		----	
912	D524	1.646		0.43	
922		----		----	
963		----		----	
994		----		----	
1017		----		----	
1023		----		----	
1059		----		----	
1066		----		----	
1106		----		----	
1107		----		----	
1146		----		----	
1150		----		----	
1173		----		----	
1201		----		----	
1213		----		----	
1235		----		----	
1271		----		----	
1300		----		----	
1316		----		----	
1324		----		----	
1326		----		----	
1431		----		----	
1564		----		----	
1748		----		----	
1770		----		----	
1797		----		----	
1807		----		----	
1850		----		----	
1877		----		----	
1883		----		----	
1957		----		----	
1969		----		----	
2122		----		----	
2129		----		----	
6010		----		----	
6031		----		----	
6044		----		----	
6056		----		----	
6115		----		----	
7002		----		----	
7015		----		----	

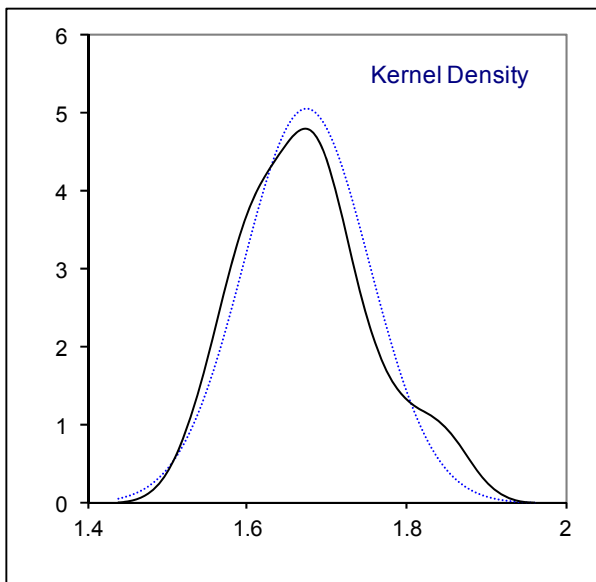
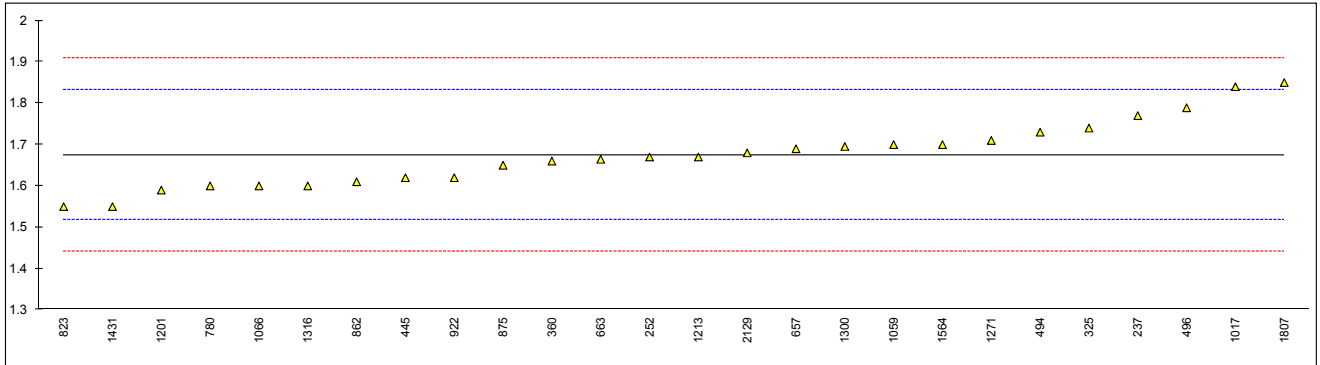
normality	unknown
n	4
outliers	0
mean (n)	1.614
st.dev. (n)	0.0426
R(calc.)	0.119
R(D524:15)	0.208



Determination of Carbon Residue (micro method) on sample #17095; results in %M/M

lab	method	value	mark	z(targ)	remarks
173		----		----	
178		----		----	
179		----		----	
211		----		----	
237	D4530	1.77		1.22	
252	D4530	1.67		-0.06	
254		----		----	
255		----		----	
325	D4530	1.74		0.83	
333		----		----	
349		----		----	
360	ISO10370	1.660		-0.19	
421		----		----	
432		----		----	
445	D4530	1.62		-0.70	
494	D4530	1.73		0.70	
496	D4530	1.7891		1.46	
614		----		----	
621		----		----	
634		----		----	
657	D4530	1.69		0.19	
663	D4530	1.6645		-0.13	
780	D4530	1.60		-0.96	
823	D4530	1.55		-1.60	
840		----		----	
862	D4530	1.61		-0.83	
875	D4530	1.65		-0.32	
902		----		----	
912		----		----	
922	D4530	1.62		-0.70	
963		----		----	
994		----		----	
1017	ISO10370	1.84		2.11	
1023		----		----	
1059	ISO10370	1.70		0.32	
1066	D4530	1.60		-0.96	
1106		----		----	
1107		----		----	
1146		----		----	
1150		----		----	
1173		----		----	
1201	D4530	1.59		-1.09	
1213	D4530	1.67		-0.06	
1235		----		----	
1271	ISO10370	1.71		0.45	
1300	D4530	1.6955		0.26	
1316	D4530	1.60		-0.96	
1324		----		----	
1326		----		----	
1431	D4530	1.55		-1.60	
1564	D4530	1.7		0.32	
1748		----		----	
1770		----		----	
1797		----		----	
1807	D4530	1.85		2.24	
1850		----		----	
1877		----		----	
1883		----		----	
1957		----		----	
1969		----		----	
2122		----		----	
2129	ISO10370	1.68		0.06	
6010		----		----	
6031		----		----	
6044		----		----	
6056		----		----	
6115		----		----	
7002		----		----	
7015		----		----	

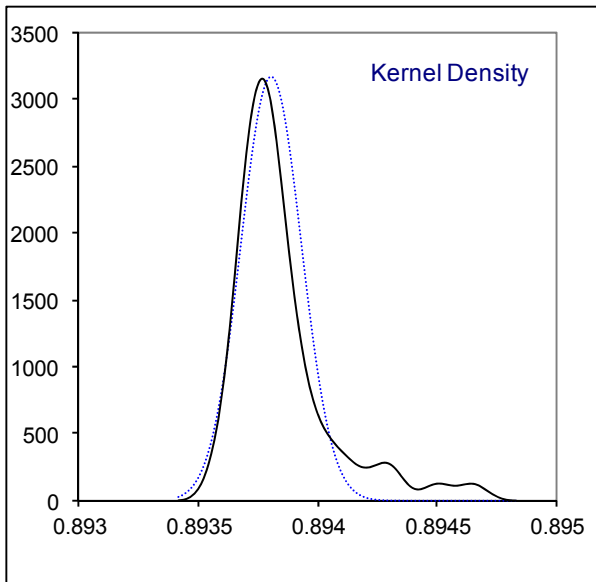
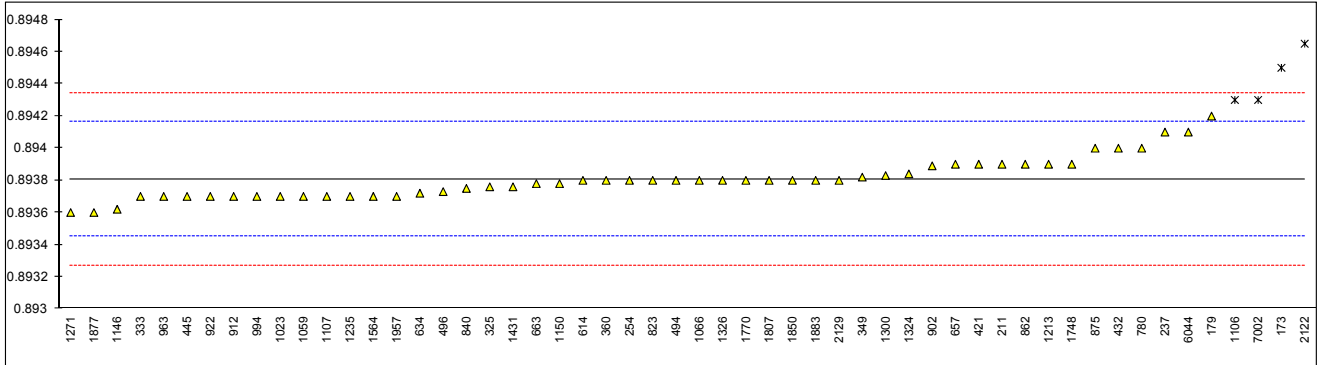
normality OK
 n 26
 outliers 0
 mean (n) 1.675
 st.dev. (n) 0.0792
 R(calc.) 0.222
 R(D4530:15) 0.219



Determination of Density at 15°C on sample #17095; results in kg/L

lab	method	value	mark	z(targ)	remarks
173	D1298	0.8945	C,R(0.01)	3.89	first reported: 0.8976 (according to D4052)
178		-----		-----	
179	D4052	0.8942		2.21	
211	D4052	0.8939		0.53	
237	D4052	0.8941		1.65	
252		-----		-----	
254	D4052	0.8938		-0.03	
255		-----		-----	
325	D4052	0.89376		-0.26	
333	D4052	0.8937		-0.59	
349	D4052	0.89382		0.08	
360	D4052	0.8938		-0.03	
421	ISO12185	0.8939		0.53	
432	D4052	0.89400		1.09	
445	D4052	0.8937		-0.59	
494	D4052	0.8938		-0.03	
496	D4052	0.89373		-0.43	
614	D4052	0.8938		-0.03	
621		-----		-----	
634	D4052	0.89372		-0.48	
657	D4052	0.8939		0.53	
663	D4052	0.89378		-0.15	
780	D4052	0.8940		1.09	
823	D4052	0.8938		-0.03	
840	D4052	0.89375		-0.31	
862	D4052	0.8939		0.53	
875	D4052	0.8940	C	1.09	first reported: 0.8944
902	D4052	0.89389		0.47	
912	D4052	0.8937		-0.59	
922	D4052	0.8937		-0.59	
963	D4052	0.8937		-0.59	
994	D4052	0.8937		-0.59	
1017		-----		-----	
1023	D4052	0.8937		-0.59	
1059	D4052	0.8937		-0.59	
1066	D4052	0.8938		-0.03	
1106	D5002	0.8943	R(0.05)	2.77	
1107	D4052	0.8937		-0.59	
1146	D4052	0.89362		-1.04	
1150	ISO12185	0.89378		-0.15	
1173		-----		-----	
1201		-----		-----	
1213	D4052	0.8939	C	0.53	first reported: 0.89296
1235	ISO12185	0.8937		-0.59	
1271	ISO12185	0.8936	C	-1.15	first reported: 895.6 kg/m ³
1300	D4052	0.89383		0.13	
1316		-----		-----	
1324	D4052	0.89384		0.19	
1326	D4052	0.8938		-0.03	
1431	D4052	0.89376		-0.26	
1564	D4052	0.8937		-0.59	
1748	D4052	0.8939		0.53	
1770	D4052	0.8938		-0.03	
1797		-----		-----	
1807	D4052	0.8938		-0.03	
1850	D4052	0.8938		-0.03	
1877	D4052	0.8936		-1.15	
1883	D1298	0.8938		-0.03	
1957	D4052	0.8937	C	-0.59	reported: 896.7 kg/L (probably a unit error)
1969		-----		-----	
2122	D4052	0.89465	R(0.01)	4.73	
2129	D4052	0.8938		-0.03	
6010		-----		-----	
6031		-----		-----	
6044	D4052	0.8941		1.65	
6056		-----		-----	
6115		-----		-----	
7002		0.8943	R(0.05)	2.77	
7015		-----		-----	

normality	not OK
n	50
outliers	4
mean (n)	0.89381
st.dev. (n)	0.000126
R(calc.)	0.00035
R(D4052:16)	0.00050

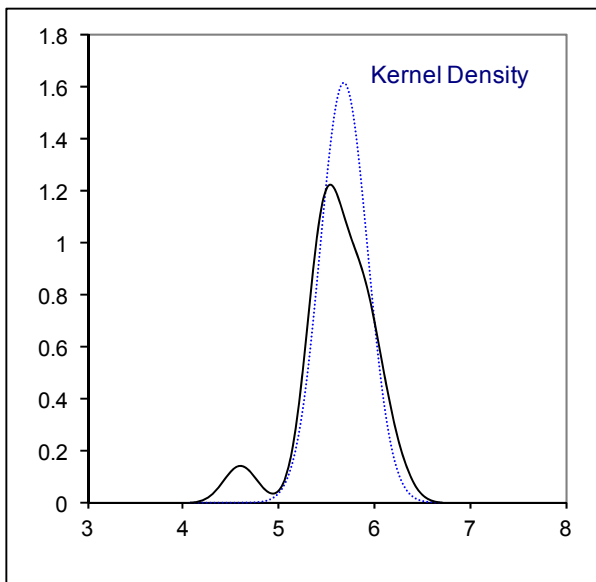
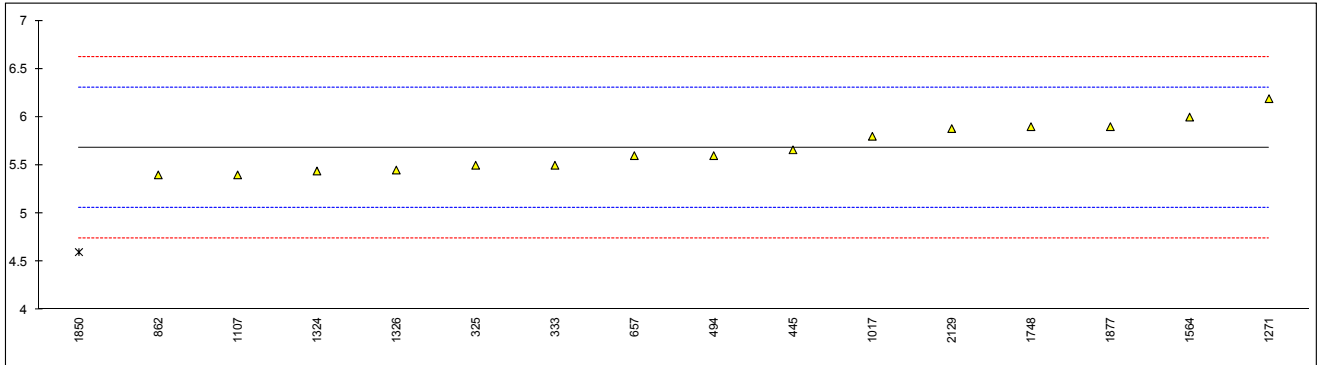


Determination of Evaporation loss by Noack on sample #17095; results in %M/M

lab	method	value	mark	z(targ)	remarks
173		----		----	
178		----		----	
179		----		----	
211		----		----	
237		----		----	
252		----		----	
254		----		----	
255		----		----	
325	CEC L-40-93	5.5		-0.58	
333	CEC L-40-93	5.5		-0.58	
349		----		----	
360		----		----	
421		----		----	
432		----		----	
445	D5800 - B	5.66		-0.07	
494	D5800 - B	5.6		-0.26	
496		----		----	
614		----		----	
621		----		----	
634		----		----	
657	D5800 - B	5.6		-0.26	
663		----		----	
780		----		----	
823		----		----	
840		----		----	
862	D5800 - B	5.4		-0.90	
875		----		----	
902		----		----	
912		----		----	
922		----		----	
963		----		----	
994		----		----	
1017	CEC L-40-93	5.8		0.38	
1023		----		----	
1059		----		----	
1066		----		----	
1106		----		----	
1107	D5800 - B	5.4		-0.90	
1146		----		----	
1150		----		----	
1173		----		----	
1201		----		----	
1213		----		----	
1235		----		----	
1271	DIN51581	6.19	C	1.62	first reported: 4.49
1300		----		----	
1316		----		----	
1324	D5800 - B	5.44		-0.77	
1326	D5800 - B	5.45		-0.74	
1431		----		----	
1564	DIN51581	6.0		1.02	
1748	D5800 - B	5.9		0.70	
1770		----		----	
1797		----		----	
1807		----		----	
1850	DIN51581	4.6	G(0.05)	-3.45	
1877	D5800 - B	5.9		0.70	
1883		----		----	
1957		----		----	
1969		----		----	
2122		----		----	
2129	D5800 - A	5.88		0.63	
6010		----		----	
6031		----		----	
6044		----		----	
6056		----		----	
6115		----		----	
7002		----		----	
7015		----		----	

normality OK
 n 15
 outliers 1
 mean (n) 5.681
 st.dev. (n) 0.2477
 R(calc.) 0.694
 R(D5800B:15a) 0.878

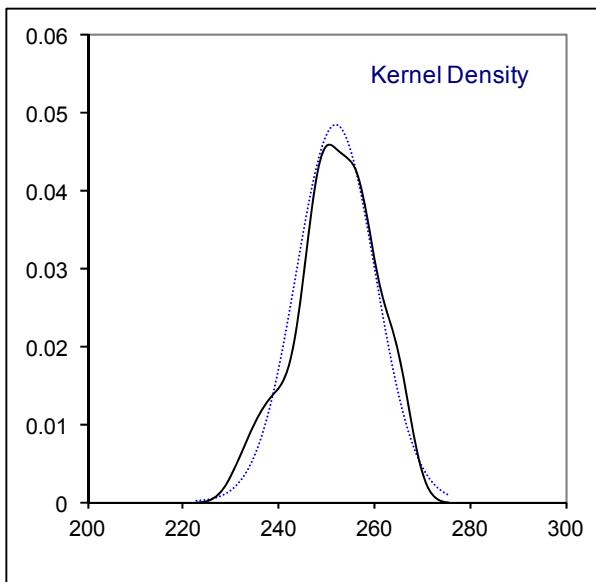
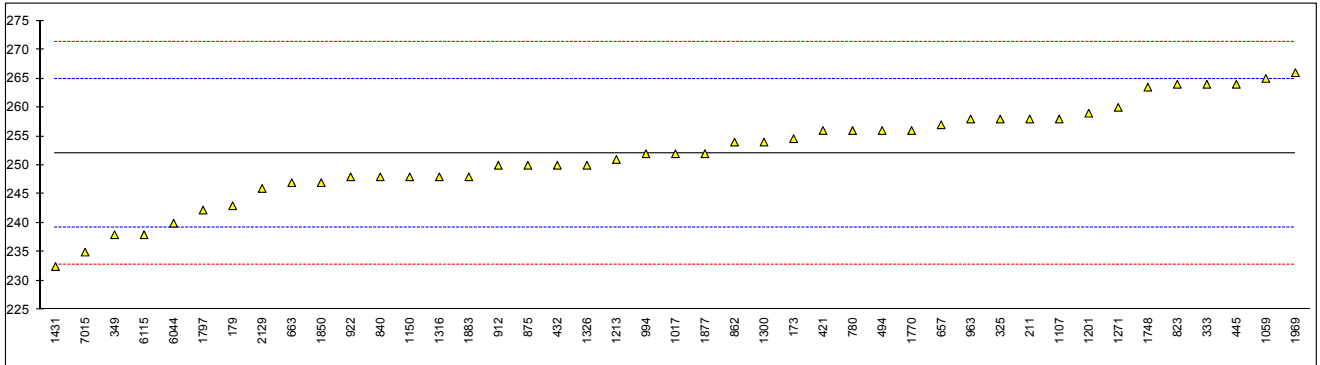
compare R(D5800A:15a) = 1.040



Determination of Flash Point COC. on sample #17095; results in °C

lab	method	value	mark	z(targ)	remarks
173	D92	254.6		0.40	
178		----		----	
179	D92	243		-1.40	
211	D92	258		0.93	
237		----		----	
252		----		----	
254		----		----	
255		----		----	
325	D92	258		0.93	
333	D92	264		1.86	
349	D92	238		-2.18	
360		----		----	
421	ISO2592	256		0.62	
432	D92	250		-0.31	
445	D92	264		1.86	
494	D92	256		0.62	
496		----		----	
614		----		----	
621		----		----	
634		----		----	
657	D92	257		0.77	
663	D92	247		-0.78	
780	D92	256		0.62	
823	D92	264.0		1.86	
840	D92	248.0		-0.63	
862	D92	254		0.31	
875	D92	250		-0.31	
902		----		----	
912	D92	250		-0.31	
922	D92	248		-0.63	
963	D92	258		0.93	
994	D92	252		0.00	
1017	D92	252		0.00	
1023		----		----	
1059	ISO2592	265		2.02	
1066		----		----	
1106		----		----	
1107	D92	258		0.93	
1146		----		----	
1150	ISO2592	248		-0.63	
1173		----		----	
1201	D92	259.0		1.09	
1213	D92	251		-0.16	
1235		----		----	
1271	ISO2592	260		1.24	
1300	D92	254		0.31	
1316	D92	248		-0.63	
1324		----		----	
1326	D92	250		-0.31	
1431	D92	232.5	C	-3.04	first reported: 212.5
1564		----		----	
1748	D92	263.5		1.79	
1770	D92	256		0.62	
1797	ISO2592	242.25		-1.52	
1807		----		----	
1850	ISO2592	247		-0.78	
1877	D92	252		0.00	
1883	D92	248		-0.63	
1957		----		----	
1969	ISO2592	266		2.17	
2122		----		----	
2129	D92	246.0		-0.94	
6010		----		----	
6031		----		----	
6044	D92	240		-1.87	
6056		----		----	
6115	D92	238		-2.18	
7002		----		----	
7015		235		-2.65	

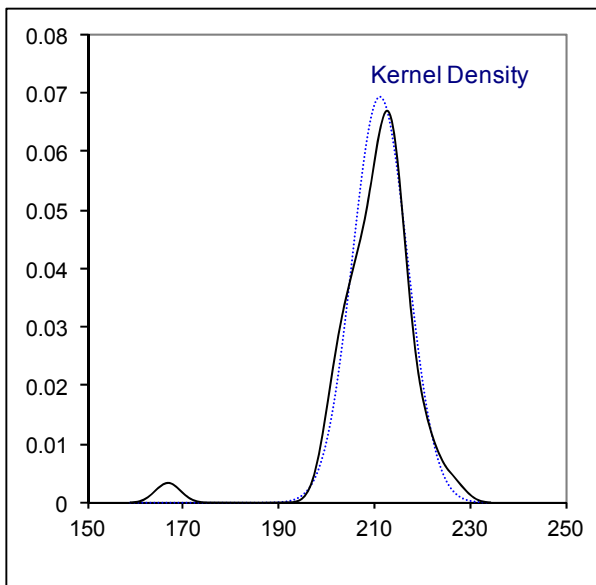
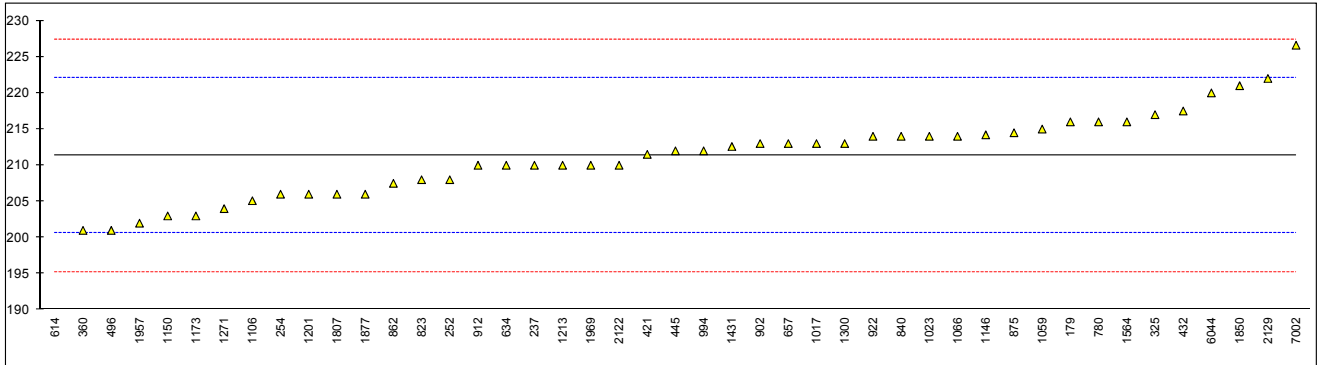
normality	OK
n	43
outliers	0
mean (n)	252.02
st.dev. (n)	8.244
R(calc.)	23.08
R(D92:16b)	18



Determination of Flash Point PMcc on sample #17095; results in °C

lab	method	value	mark	z(targ)	remarks
173		----		----	
178		----		----	
179	D93-B	216.0		0.87	
211		----		----	
237	D93-B	210		-0.25	
252	D93-A	208		-0.62	
254	D93-A	206		-0.99	
255		----		----	
325	D93-A	217		1.06	
333		----		----	
349		----		----	
360	ISO2719-A	201.0		-1.93	
421	ISO2719-A	211.5		0.03	
432	D93-A	217.5		1.15	
445	D93-A	212.0		0.13	
494		----		----	
496	D93-A	201		-1.93	
614	D93-A	167.0	R(0.01)	-8.27	
621		----		----	
634	D93-A	210.0		-0.25	
657	D93-A	213		0.31	
663		----		----	
780	D93-A	216.0		0.87	
823	D93-A	208.0		-0.62	
840	D93-A	214.0		0.50	
862	D93-A	207.5		-0.71	
875	D93-A	214.5		0.59	
902	D93-A	213.0		0.31	
912	D93-B	210		-0.25	
922	D93-A	214		0.50	
963		----		----	
994	D93-A	212		0.13	
1017	D93-A	213.0		0.31	
1023	D93-A	214		0.50	
1059	ISO2719-A	215.0		0.68	
1066	D93-A	214.0		0.50	
1106	D93-A	205.1		-1.16	
1107		----		----	
1146	D93-AMod.	214.2		0.54	
1150	ISO2719-A	203		-1.55	
1173	D93-A	203		-1.55	
1201	D93-A	206.0		-0.99	
1213	D93-A	210		-0.25	
1235		----		----	
1271	ISO2719-A	204		-1.37	
1300	D93-A	213		0.31	
1316		----		----	
1324		----		----	
1326		----		----	
1431	D93-A	212.6		0.24	
1564	D93-A	216.0		0.87	
1748		----		----	
1770		----		----	
1797		----		----	
1807	D93-A	206.0		-0.99	
1850	ISO2719-A	221		1.80	
1877	D93-A	206		-0.99	
1883		----		----	
1957	D93-A	202.0		-1.74	
1969	ISO2719-A	210		-0.25	
2122	D93-B	210		-0.25	
2129	D93-A	222.0		1.99	
6010		----		----	
6031		----		----	
6044	D93-A	220		1.62	
6056		----		----	
6115		----		----	
7002		226.6		2.85	
7015		----		----	

normality OK
 n 44
 outliers 1
 mean (n) 211.33
 st.dev. (n) 5.743
 R(calc.) 16.08
 R(D93-A:16a) 15.00



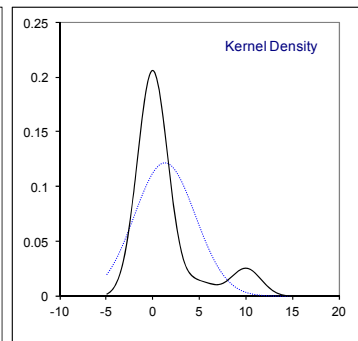
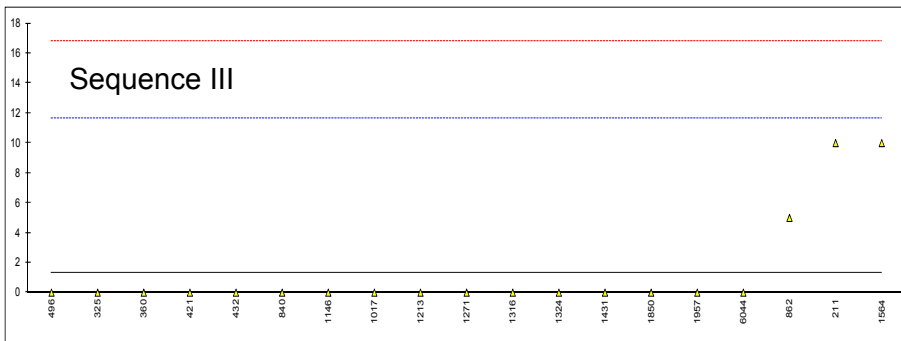
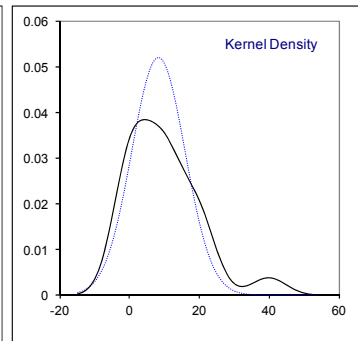
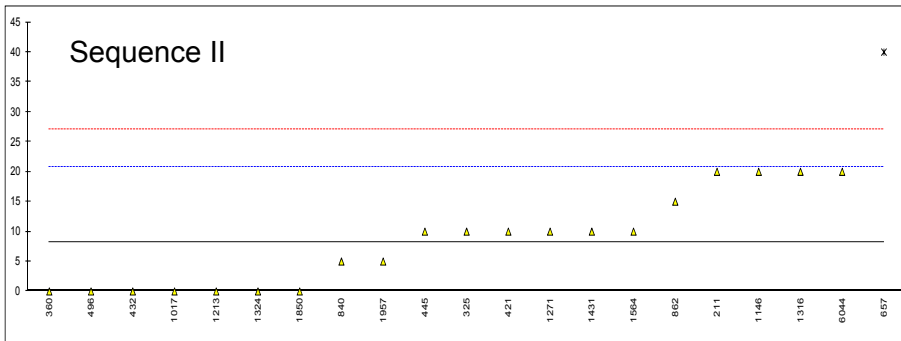
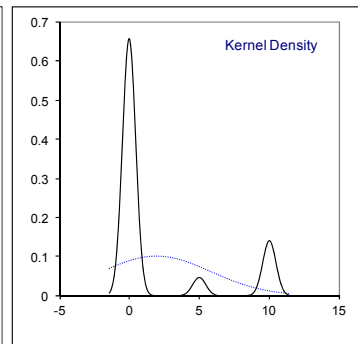
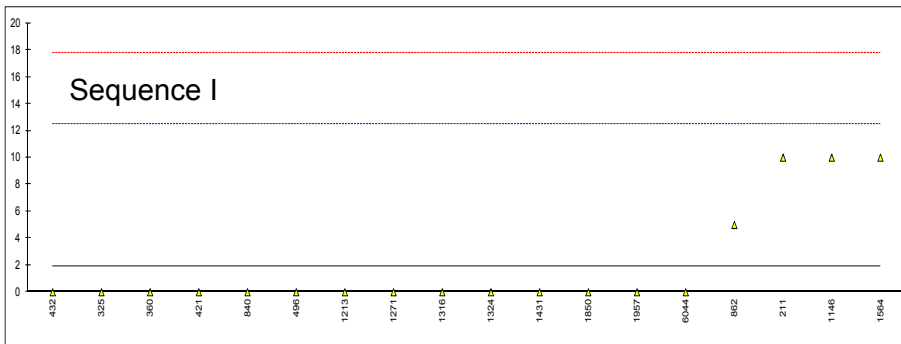
Determination of Foaming Tendency, 5 min blowing period on sample #17095; results in ml

lab	method	sample used	diffuser	Seq. I	mark	z(targ)	Seq. II	mark	z(targ)	Seq. III	mark	z(targ)
173				----		----	----		----	----		----
178				----		----	----		----	----		----
179		As received	Metal	Nil		----	Nil		----	Nil		----
211	D892	After agitation, opt. A	Stone	10		1.53	20		1.88	10		1.68
237				----		----	----		----	----		----
252				----		----	----		----	----		----
254				----		----	----		----	----		----
255				----		----	----		----	----		----
325	D892	As received	Metal	0		-0.37	10		0.28	0		-0.25
333				----		----	----		----	----		----
349				----		----	----		----	----		----
360	D892	As received	Stone	0		-0.37	0		-1.32	0		-0.25
421	ISO6247	As received	Stone	0		-0.37	10		0.28	0		-0.25
432	D892	As received	Stone	0		-0.37	0		-1.32	0		-0.25
445	D892	After agitation, opt. A	Metal	Nil		----	10		0.28	Nil		----
494				----		----	----		----	----		----
496				0		-0.37	0		-1.32	0		-0.25
614				----		----	----		----	----		----
621				----		----	----		----	----		----
634				----		----	----		----	----		----
657	D892	As per meth. specified	Stone	NIL		----	40	R(0.05)	5.07	NIL		----
663				----		----	----		----	----		----
780				----		----	----		----	----		----
823				----		----	----		----	----		----
840	D892	As received	Stone	0		-0.37	5		-0.52	0		-0.25
862	D892	As received	Metal	5		0.58	15		1.08	5		0.71
875				----		----	----		----	----		----
902				----		----	----		----	----		----
912				----		----	----		----	----		----
922				----		----	----		----	----		----
963				----		----	----		----	----		----
994				----		----	----		----	----		----
1017	D892	As received	Stone	<10		----	0		-1.32	0		-0.25
1023				----		----	----		----	----		----
1059				----		----	----		----	----		----
1066				----		----	----		----	----		----
1106				----		----	----		----	----		----
1107				----		----	----		----	----		----
1146	ISO6247	As received	Metal	10		1.53	20		1.88	0		-0.25
1150				----		----	----		----	----		----
1173				----		----	----		----	----		----
1201				----		----	----		----	----		----
1213			Stone	0		-0.37	0		-1.32	0		-0.25
1235				----		----	----		----	----		----
1271	ISO6247		Stone	0		-0.37	10		0.28	0		-0.25
1300				----		----	----		----	----		----
1316	D892	As received	Metal	0		-0.37	20		1.88	0		-0.25
1324	D892	After agitation, opt. A	Metal	0		-0.37	0		-1.32	0		-0.25
1326				----		----	----		----	----		----
1431	D892	As received	Stone	0		-0.37	10		0.28	0		-0.25
1564	D892	As received		10		1.53	10		0.28	10		1.68
1748				----		----	----		----	----		----
1770				----		----	----		----	----		----
1797				----		----	----		----	----		----
1807				----		----	----		----	----		----
1850	ISO6247	As received	Stone	0		-0.37	0		-1.32	0		-0.25
1877				----		----	----		----	----		----
1883				----		----	----		----	----		----
1957	D892	As received	Metal	0		-0.37	5		-0.52	0		-0.25
1969				----		----	----		----	----		----
2122				----		----	----		----	----		----
2129				----		----	----		----	----		----
6010				----		----	----		----	----		----
6031				----		----	----		----	----		----
6044	D892	As received	Metal	0		-0.37	20		1.88	0		-0.25
6056				----		----	----		----	----		----
6115				----		----	----		----	----		----
7002				----		----	----		----	----		----
7015				----		----	----		----	----		----

normality		not OK	OK	not OK
n		18	20	19
outliers		0	1	0
mean (n)		1.94	8.25	1.32
st.dev. (n)		3.888	7.656	3.267
R(calc.)		10.89	21.44	9.15
R(D892:13e1)		14.76	17.53	14.48

Sequence II – stone or metal diffuser:

	Only stone diffuser	Only metal diffuser
normality	OK	OK
n	11	9
outliers	1	0
mean (n)	5.00	11.11
st.dev. (n)	6.708	8.207
R(calc.)	18.78	22.98
R(D892:13e1)	16.10	18.79



Determination of Foam Stability, 10 min settling point on sample #17095; results in ml

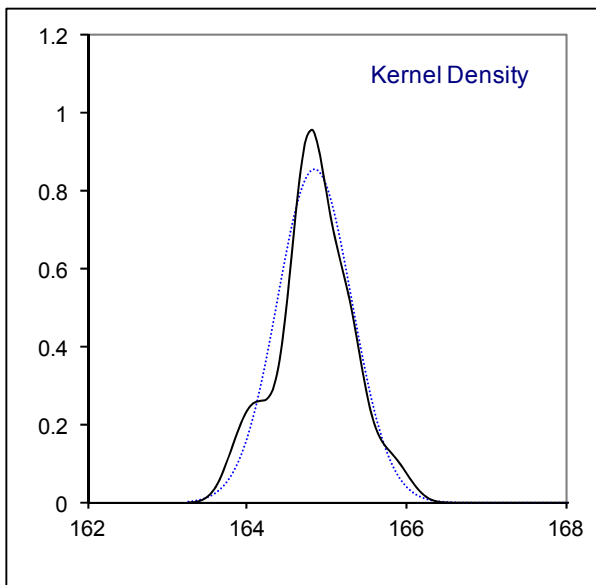
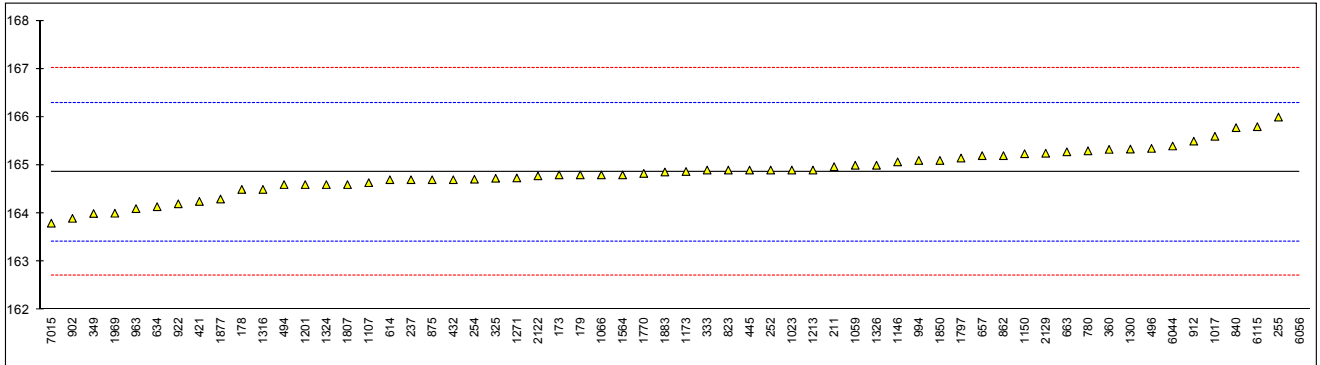
lab	method	Seq. I	mark	z(targ)	Seq. II	mark	z(targ)	Seq. III	mark	z(targ)
173		----		----	----		----	----		----
178		----		----	----		----	----		----
179		Nil		----	0		----	Nil		----
211	D892	0		----	0		----	0		----
237		----		----	----		----	----		----
252		----		----	----		----	----		----
254		----		----	----		----	----		----
255		----		----	----		----	----		----
325	D892	0		----	0		----	0		----
333		----		----	----		----	----		----
349		----		----	----		----	----		----
360	D892	0		----	0		----	0		----
421	ISO6247	0		----	0		----	0		----
432	D892	0		----	0		----	0		----
445	D892	Nil		----	Nil		----	Nil		----
494		----		----	----		----	----		----
496		0		----	0		----	0		----
614		----		----	----		----	----		----
621		----		----	----		----	----		----
634		----		----	----		----	----		----
657	D892	NIL		----	NIL		----	NIL		----
663		----		----	----		----	----		----
780		----		----	----		----	----		----
823		----		----	----		----	----		----
840	D892	0		----	0		----	0		----
862	D892	0		----	0		----	0		----
875		----		----	----		----	----		----
902		----		----	----		----	----		----
912		----		----	----		----	----		----
922		----		----	----		----	----		----
963		----		----	----		----	----		----
994		----		----	----		----	----		----
1017	D892	0		----	0		----	0		----
1023		----		----	----		----	----		----
1059		----		----	----		----	----		----
1066		----		----	----		----	----		----
1106		----		----	----		----	----		----
1107		----		----	----		----	----		----
1146	ISO6247	0		----	0		----	0		----
1150		----		----	----		----	----		----
1173		----		----	----		----	----		----
1201		----		----	----		----	----		----
1213		0		----	0		----	0		----
1235		----		----	----		----	----		----
1271	ISO6247	0		----	0		----	0		----
1300		----		----	----		----	----		----
1316	D892	0		----	0		----	0		----
1324	D892	0		----	0		----	0		----
1326		----		----	----		----	----		----
1431	D892	0		----	0		----	0		----
1564	D892	0		----	0		----	0		----
1748		----		----	----		----	----		----
1770		----		----	----		----	----		----
1797		----		----	----		----	----		----
1807		----		----	----		----	----		----
1850	ISO6247	0		----	0		----	0		----
1877		----		----	----		----	----		----
1883		----		----	----		----	----		----
1957	D892	0		----	0		----	0		----
1969		----		----	----		----	----		----
2122		----		----	----		----	----		----
2129		----		----	----		----	----		----
6010		----		----	----		----	----		----
6031		----		----	----		----	----		----
6044	D892	0		----	0		----	0		----
6056		----		----	----		----	----		----
6115		----		----	----		----	----		----
7002		----		----	----		----	----		----
7015		----		----	----		----	----		----
n		19			20			19		
mean (n)		0			0			0		

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Determination of Kinematic Viscosity at 40°C on sample #17095; results in mm²/s

lab	method	value	mark	z(targ)	remarks
173	D445	164.8		-0.08	
178	D445	164.5		-0.50	
179	D445	164.8		-0.08	
211	D445	164.97		0.16	
237	D445	164.7		-0.22	
252	D445	164.9		0.06	
254	D445	164.71		-0.21	
255	D7279	166.00		1.59	D7279 result corrected to D445
325	D445	164.73		-0.18	
333	D445	164.9		0.06	
349	D445	164.0		-1.19	
360	ISO3104	165.33		0.66	
421	ISO3104	164.25		-0.85	
432	D445	164.7		-0.22	
445	D445	164.9		0.06	
494	D445	164.6		-0.36	
496	D445	165.35		0.69	
614	D445	164.7		-0.22	
621		----		----	
634	D445	164.14		-1.00	
657	D445	165.2		0.48	
663	D445	165.28		0.59	
780	D445	165.3		0.62	
823	D445	164.9		0.06	
840	D445	165.78		1.28	
862	D445	165.2		0.48	
875	D445	164.7		-0.22	
902	D445	163.9		-1.33	
912	D445	165.5		0.89	
922	D445	164.2		-0.92	
963	D445	164.1		-1.05	
994	D445	165.1		0.34	
1017	D445	165.6		1.03	
1023	D445	164.9		0.06	
1059	ISO3104	165.0		0.20	
1066	D445	164.8		-0.08	
1106		----		----	
1107	D445	164.64		-0.30	
1146	D445	165.07		0.30	
1150	ISO3104	165.2402		0.53	
1173	IP71	164.87		0.02	
1201	D445	164.6		-0.36	
1213	D445	164.9		0.06	
1235		----		----	
1271	ISO3104	164.737		-0.17	
1300	D445	165.335		0.66	
1316	ISO3104	164.5		-0.50	
1324	D445	164.6		-0.36	
1326	D445	165.0		0.20	
1431		----		----	
1564	D445	164.8		-0.08	
1748		----		----	
1770	D445	164.83		-0.04	
1797	ISO3104	165.15		0.41	
1807	D445	164.6		-0.36	
1850	ISO3104	165.1		0.34	
1877	D445	164.3		-0.78	
1883	D445	164.86		0.00	
1957		----		----	
1969	ISO3104	164.0063		-1.19	
2122	In house	164.78		-0.11	
2129	D445	165.25		0.55	
6010		----		----	
6031		----		----	
6044	D445	165.4		0.75	
6056	D445	183.65	R(0.01)	26.16	
6115	D445	165.8	C	1.31	first reported: 167.3
7002		----		----	
7015		163.8		-1.47	

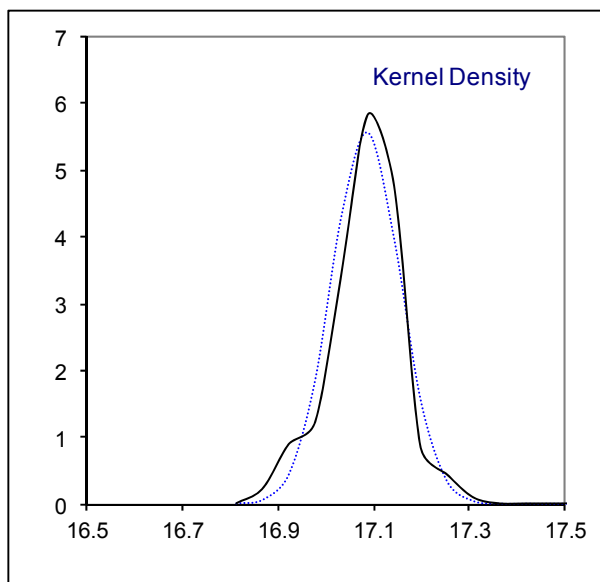
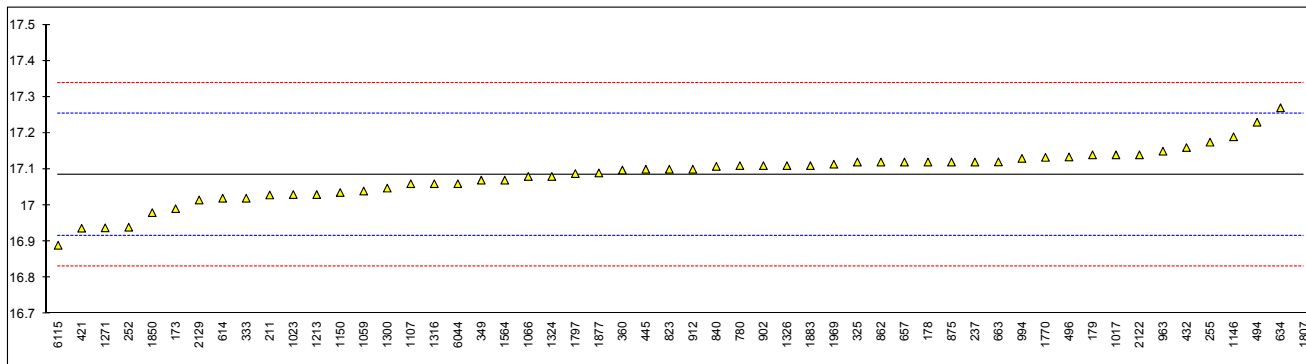
normality OK
 n 59
 outliers 1
 mean (n) 164.858
 st.dev. (n) 0.4671
 R(calc.) 1.308
 R(D445:17a) 2.011



Determination of Kinematic Viscosity at 100°C on sample #17095; results in mm²/s

lab	method	value	mark	z(targ)	remarks
173	D445	16.991		-1.11	
178	D445	17.12		0.42	
179	D445	17.14		0.66	
211	D445	17.029		-0.66	
237	D445	17.12		0.42	
252	D445	16.94		-1.72	
254		----		----	
255	D7279	17.175		1.07	D7279 result corrected to D445
325	D445	17.12		0.42	
333	D445	17.02		-0.77	
349	D445	17.07		-0.18	
360	ISO3104	17.098		0.16	
421	ISO3104	16.937		-1.76	
432	D445	17.16		0.89	
445	D445	17.1		0.18	
494	D445	17.23		1.72	
496	D445	17.134		0.58	
614	D445	17.02		-0.77	
621		----		----	
634	D445	17.27		2.20	
657	D445	17.12		0.42	
663	D445	17.1205		0.42	
780	D445	17.11		0.30	
823	D445	17.10		0.18	
840	D445	17.108		0.28	
862	D445	17.12		0.42	
875	D445	17.12		0.42	
902	D445	17.11		0.30	
912	D445	17.10		0.18	
922		----		----	
963	D445	17.15		0.77	
994	D445	17.13		0.54	
1017	D445	17.14	C	0.66	first reported: 7.14
1023	D445	17.03		-0.65	
1059	ISO3104	17.04		-0.53	
1066	D445	17.08		-0.06	
1106		----		----	
1107	D445	17.06		-0.29	
1146	D445	17.19		1.25	
1150	ISO3104	17.0357		-0.58	
1173		----		----	
1201		----		----	
1213	D445	17.03		-0.65	
1235		----		----	
1271	ISO3104	16.938		-1.74	
1300	D445	17.048		-0.44	
1316	ISO3104	17.06		-0.29	
1324	D445	17.08		-0.06	
1326	D445	17.11		0.30	
1431		----		----	
1564	D445	17.07		-0.18	
1748		----		----	
1770	D445	17.133		0.57	
1797	ISO3104	17.088		0.04	
1807	D445	30.76	R(0.01)	162.41	
1850	ISO3104	16.98		-1.24	
1877	D445	17.09		0.06	
1883	D445	17.11		0.30	
1957		----		----	
1969	ISO3104	17.1140		0.35	
2122	In house	17.14		0.66	
2129	D445	17.015		-0.83	
6010		----		----	
6031		----		----	
6044	D445	17.06		-0.29	
6056		----		----	
6115	D445	16.89		-2.31	
7002		----		----	
7015		----		----	

normality OK
 n 53
 outliers 1
 mean (n) 17.085
 st.dev. (n) 0.0716
 R(calc.) 0.200
 R(D445:17a) 0.236

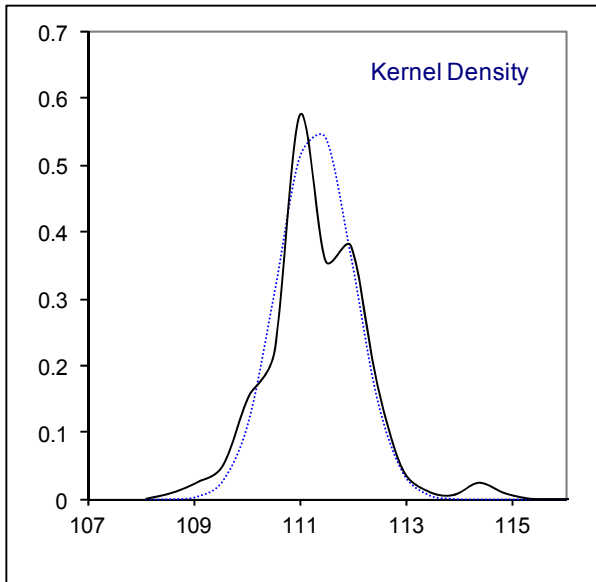
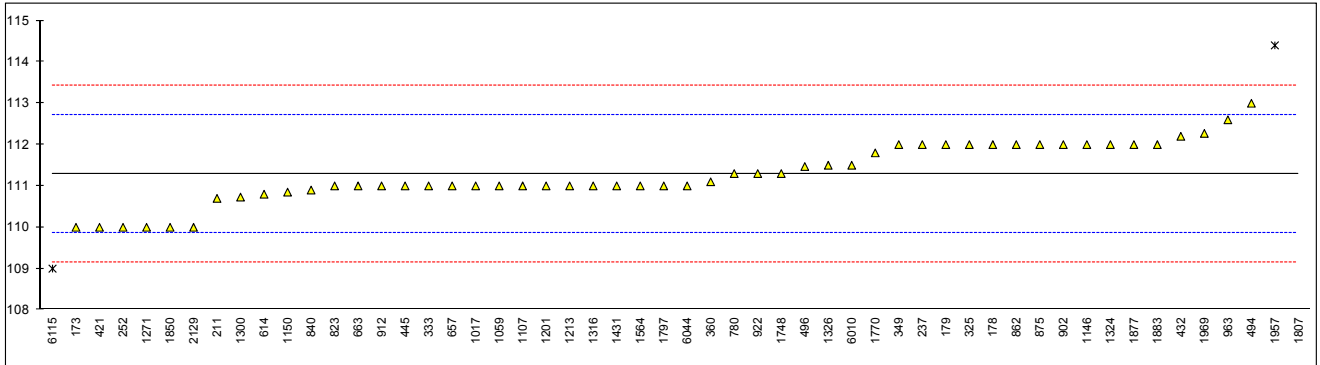


Determination of Viscosity Index on sample #17095

lab	method	value	mark	z(targ)	iis calculated	mark	remarks
173	D2270	110		-1.79	110.44		
178	D2270	112		1.01	111.96		
179	D2270	112		1.01	111.95		
211	D2270	110.7		-0.81	110.69		
237	D2270	112		1.01	111.81		
252	D2270	110		-1.79	109.82		
254		----		----	----		
255		----		----	111.42		
325	D2270	112		1.01	111.79		
333	D2270	111		-0.39	110.66		
349	D2270	112		1.01	111.82		
360	ISO2909	111.1		-0.25	111.11		
421	ISO2909	110		-1.79	110.27		
432	D2270	112.2		1.29	112.23		
445	D2270	111		-0.39	111.45		
494	D2270	113		2.41	113.04		
496	D2270	111.47		0.26	111.47		
614	D2270	110.8		-0.67	110.81		
621		----		----	----		
634		----		----	113.81	R(0.05)	
657	D2270	111		-0.39	111.44		
663	D2270	111		-0.39	111.38		
780	D2270	111.3		0.03	111.26		
823	D2270	111		-0.39	111.45		
840	D2270	110.9		-0.53	110.88		
862	D2270	112		1.01	111.44		
875	D2270	112		1.01	111.81		
902	D2270	112		1.01	112.30		
912	D2270	111		-0.39	111.00		
922	D2270	111.3		0.03	111.30		VI based on Stabinger results
963	D2270	112.6		1.85	112.58		
994		----		----	111.62		
1017	D2270	111		-0.39	111.35		
1023		----		----	110.76		
1059	ISO2909	111		-0.39	110.78		
1066		----		----	111.33		
1106		----		----	----		
1107	D2270	111		-0.39	111.25		
1146	D2270	112		1.01	112.27		
1150	ISO2909	110.85	E	-0.60	110.56		calculation error
1173		----		----	----		
1201	D2270	111		-0.39	----		
1213	D2270	111		-0.39	110.76		
1235		----		----	----		
1271	ISO2909	110		-1.79	109.92		
1300	D2270	110.73	E	-0.77	110.61		calculation error
1316	D2270	111		-0.39	111.35		
1324	D2270	112		1.01	111.47		
1326	D2270	111.5		0.31	111.48		
1431	D2270	111	C, E	-0.39	111.90		first reported: 108.78, calculation error, only
1564	D2270	111		-0.39	111.23		Stabinger results for calc. of VI
1748	D2270	111.3		0.03	111.30		VI based on Stabinger results
1770	D2270	111.8		0.73	111.85		
1797	ISO2909	111		-0.39	111.15		
1807	D2270	230	ex, E	166.21	239.36	ex	outlier in viscosity at 100°C, calculation error
1850	ISO2909	110		-1.79	110.10		
1877	D2270	112		1.01	111.80		
1883	ISO2909	112		1.01	111.58		
1957	D2270	114.4	R(0.01), E	4.37	110.40		VI based on Stabinger results, calculation error
1969	ISO2909	112.27		1.38	112.27		
2122		----		----	111.96		
2129	D2270	110		-1.79	110.35		
6010	D2270	111.5		0.31	111.50		VI based on Stabinger results
6031		----		----	----		
6044	D2270	111		-0.39	110.68		
6056		----		----	----		
6115	D2270	109	C, R(0.05)	-3.19	108.63	R(0.05)	first reported: 108
7002		----		----	114.70	ex	outlier in Stab. at 40°V, VI based on Stabinger
7015		----		----	----		

normality OK
 n 51
 outliers 2 (+1ex)
 mean (n) 111.28
 st.dev. (n) 0.714
 R(calc.) 2.00
 R(D2270:10) 2

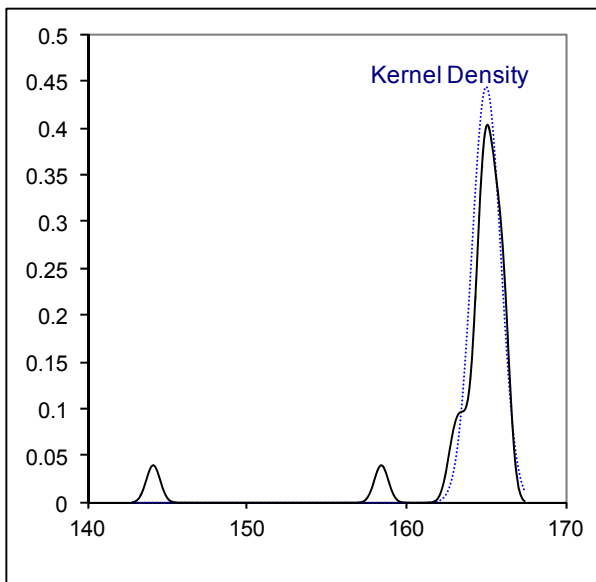
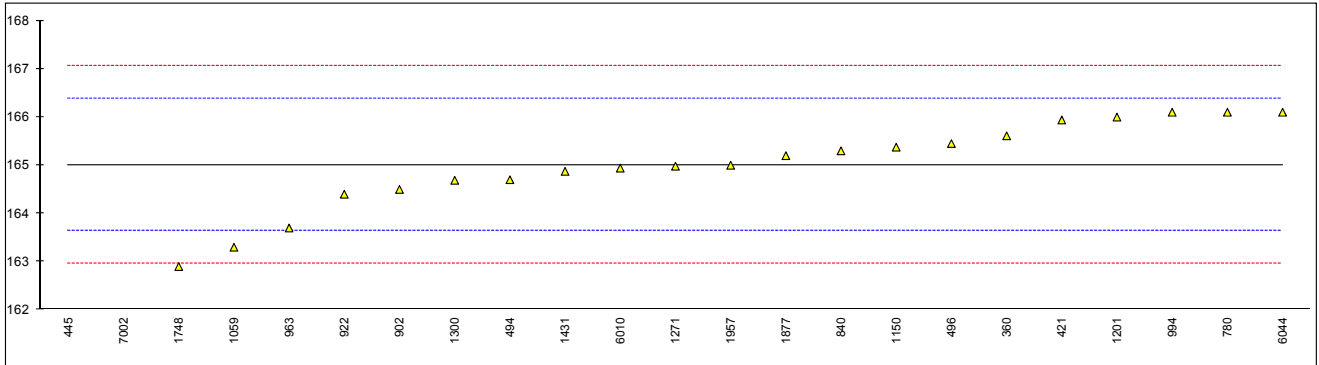
iis calculated:
 OK
 56
 2 (+2ex)
 111.31
 0.671
 1.88
 2



Determination of Viscosity Stabinger at 40°C on sample #17095; results in mm²/s

lab	method	value	mark	z(targ)	remarks
173		----		----	
178		----		----	
179		----		----	
211		----		----	
237		----		----	
252		----		----	
254		----		----	
255		----		----	
325		----		----	
333		----		----	
349		----		----	
360	D7042	165.61		0.88	
421	D7042	165.94		1.37	
432		----		----	
445	D7042	144.17	R(0.01)	-30.57	
494	D7042	164.7		-0.45	
496	D7042	165.45		0.65	
614		----		----	
621		----		----	
634		----		----	
657		----		----	
663		----		----	
780	D7042	166.1		1.60	
823		----		----	
840	D7042	165.30		0.43	
862		----		----	
875		----		----	
902	D7042	164.5		-0.74	
912		----		----	
922	D7042	164.4		-0.89	
963	D7042	163.7		-1.92	
994	D7042	166.1		1.60	
1017		----		----	
1023		----		----	
1059	D7042	163.3		-2.50	
1066		----		----	
1106		----		----	
1107		----		----	
1146		----		----	
1150	D7042	165.3756		0.54	
1173		----		----	
1201	D7042	166.0		1.46	
1213		----		----	
1235		----		----	
1271	D7042	164.980		-0.04	
1300	D7042	164.689		-0.47	
1316		----		----	
1324		----		----	
1326		----		----	
1431	D7042	164.875		-0.19	
1564		----		----	
1748	D7042	162.9		-3.09	
1770		----		----	
1797		----		----	
1807		----		----	
1850		----		----	
1877	D7042	165.2		0.28	
1883		----		----	
1957	D7042	165.0		-0.01	
1969		----		----	
2122		----		----	
2129		----		----	
6010	D7042	164.94		-0.10	
6031		----		----	
6044	D7042	166.1		1.60	
6056		----		----	
6115		----		----	
7002		158.4429	R(0.01)	-9.63	
7015		----		----	

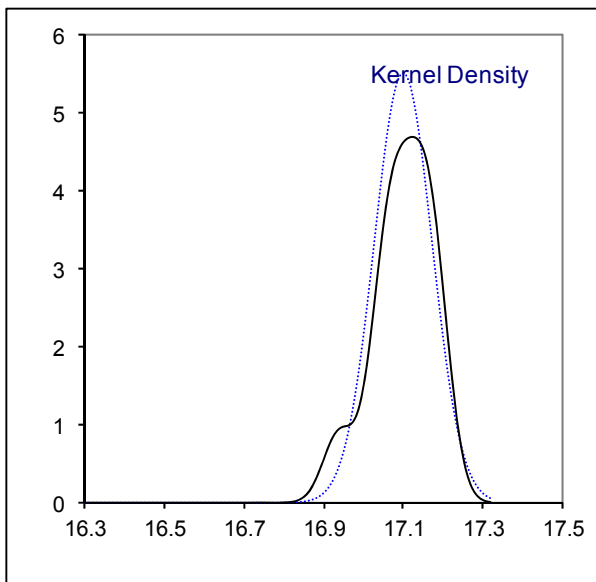
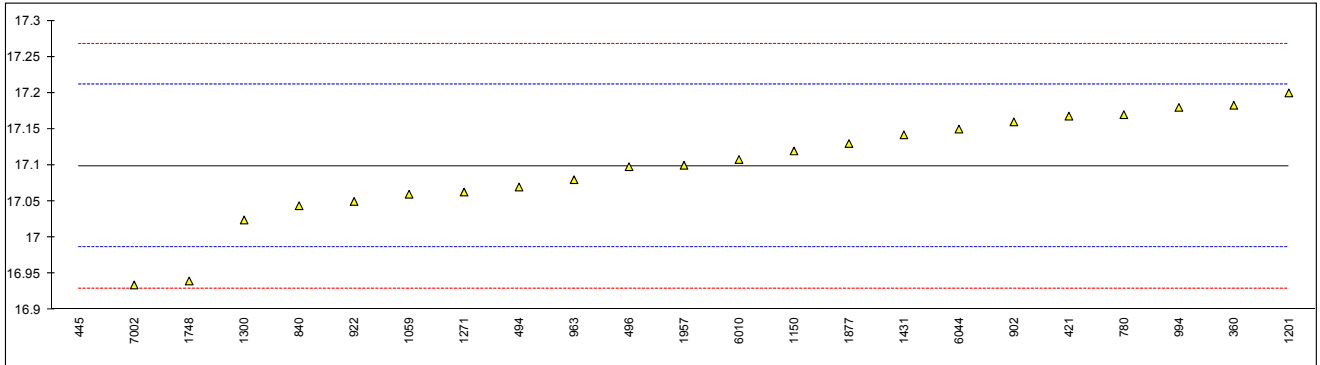
normality OK
 n 21
 outliers 2
 mean (n) 165.008
 st.dev. (n) 0.8990
 R(calc.) 2.517
 R(D7042:16ε3) 1.909



Determination of Viscosity Stabinger at 100°C on sample #17095; results in mm²/s

lab	method	value	mark	z(targ)	remarks
173		----		----	
178		----		----	
179		----		----	
211		----		----	
237		----		----	
252		----		----	
254		----		----	
255		----		----	
325		----		----	
333		----		----	
349		----		----	
360	D7042	17.183		1.49	
421	D7042	17.168		1.23	
432		----		----	
445	D7042	14.405	R(0.01)	-47.79	
494	D7042	17.07		-0.51	
496	D7042	17.098		-0.02	
614		----		----	
621		----		----	
634		----		----	
657		----		----	
663		----		----	
780	D7042	17.17		1.26	
823		----		----	
840	D7042	17.044		-0.97	
862		----		----	
875		----		----	
902	D7042	17.16		1.08	
912		----		----	
922	D7042	17.05		-0.87	
963	D7042	17.08		-0.33	
994	D7042	17.18		1.44	
1017		----		----	
1023		----		----	
1059	D7042	17.06		-0.69	
1066		----		----	
1106		----		----	
1107		----		----	
1146		----		----	
1150	D7042	17.1198		0.37	
1173		----		----	
1201	D7042	17.20		1.79	
1213		----		----	
1235		----		----	
1271	D7042	17.063		-0.64	
1300	D7042	17.0244		-1.32	
1316		----		----	
1324		----		----	
1326		----		----	
1431	D7042	17.1420		0.77	
1564		----		----	
1748	D7042	16.94		-2.82	
1770		----		----	
1797		----		----	
1807		----		----	
1850		----		----	
1877	D7042	17.13		0.55	
1883		----		----	
1957	D7042	17.10		0.02	
1969		----		----	
2122		----		----	
2129		----		----	
6010	D7042	17.108		0.16	
6031		----		----	
6044	D7042	17.15		0.91	
6056		----		----	
6115		----		----	
7002		16.9345		-2.92	
7015		----		----	

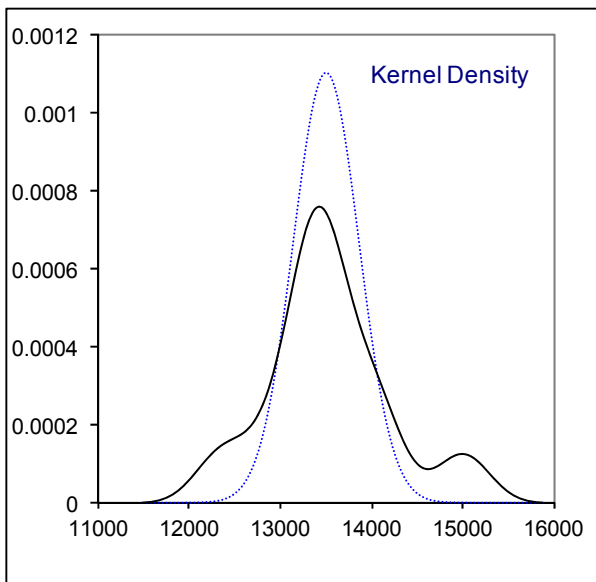
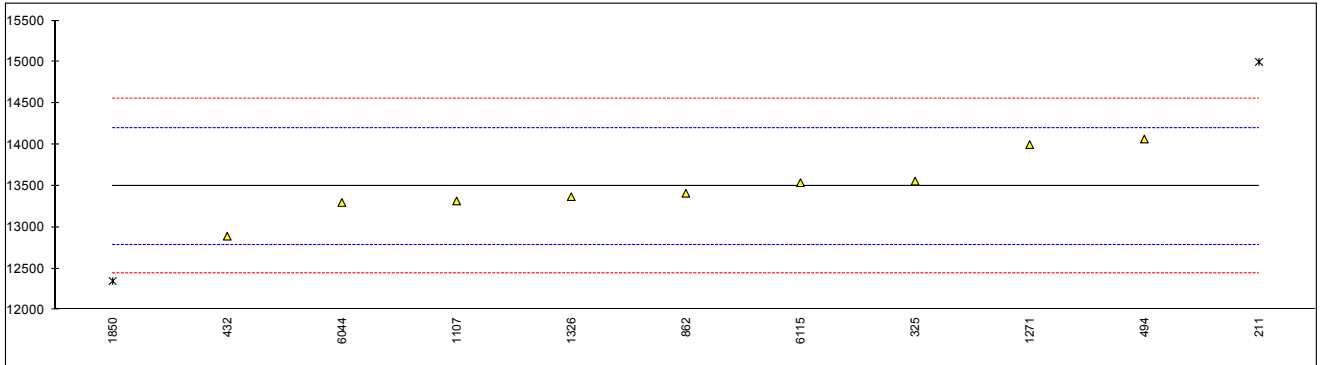
normality OK
 n 22
 outliers 1
 mean (n) 17.099
 st.dev. (n) 0.0726
 R(calc.) 0.203
 R(D7042:16ε3) 0.158



Determination of Viscosity, Apparent (CCS) at -15°C on sample #17095; results in mPa·s

lab	method	value	mark	z(targ)	remarks
173		----		----	
178		----		----	
179		----		----	
211	D5293	15000	R(0.05)	4.28	
237		----		----	
252		----		----	
254		----		----	
255		----		----	
325	D5293	13559		0.18	
333		----		----	
349		----		----	
360		----		----	
421		----		----	
432	D5293	12892		-1.72	
445		----		----	
494	D5293	14068		1.63	
496		----		----	
614		----		----	
621		----		----	
634		----		----	
657		----		----	
663		----		----	
780		----		----	
823		----		----	
840		----		----	
862	D5293	13412		-0.24	
875		----		----	
902		----		----	
912		----		----	
922		----		----	
963		----		----	
994		----		----	
1017		----		----	
1023		----		----	
1059		----		----	
1066		----		----	
1106		----		----	
1107	D5293	13318		-0.50	
1146		----		----	
1150		----		----	
1173		----		----	
1201		----		----	
1213		----		----	
1235		----		----	
1271	D5293	14000		1.43	
1300		----		----	
1316		----		----	
1324		----		----	
1326	D5293	13370		-0.36	
1431		----		----	
1564		----		----	
1748		----		----	
1770		----		----	
1797		----		----	
1807		----		----	
1850	D5293	12350	R(0.05)	-3.26	
1877		----		----	
1883		----		----	
1957		----		----	
1969		----		----	
2122		----		----	
2129		----		----	
6010		----		----	
6031		----		----	
6044	D5293	13300		-0.56	
6056		----		----	
6115	D5293	13540		0.13	
7002		----		----	
7015		----		----	

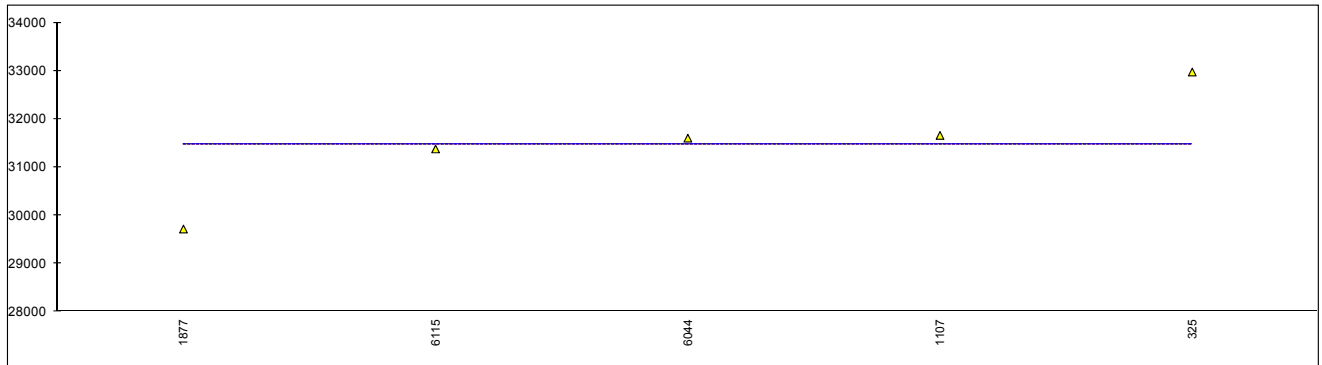
normality	OK
n	9
outliers	2
mean (n)	13495.4
st.dev. (n)	361.41
R(calc.)	1012.0
R(D5293:15)	987.6



Determination of Viscosity, Apparent (CCS) at -20°C on sample #17095; results in mPa·s

lab	method	value	mark	z(targ)	remarks
173		----		----	
178		----		----	
179		----		----	
211		----		----	
237		----		----	
252		----		----	
254		----		----	
255		----		----	
325	D5293	32974		----	
333		----		----	
349		----		----	
360		----		----	
421		----		----	
432	D5293	>25000		----	
445		----		----	
494		----		----	
496		----		----	
614		----		----	
621		----		----	
634		----		----	
657		----		----	
663		----		----	
780		----		----	
823		----		----	
840		----		----	
862		----		----	
875		----		----	
902		----		----	
912		----		----	
922		----		----	
963		----		----	
994		----		----	
1017		----		----	
1023		----		----	
1059		----		----	
1066		----		----	
1106		----		----	
1107	D5293	31661		----	
1146		----		----	
1150		----		----	
1173		----		----	
1201		----		----	
1213		----		----	
1235		----		----	
1271		----		----	
1300		----		----	
1316		----		----	
1324		----		----	
1326		----		----	
1431		----		----	
1564		----		----	
1748		----		----	
1770		----		----	
1797		----		----	
1807		----		----	
1850		----		----	
1877	D5293	29720		----	
1883		----		----	
1957		----		----	
1969		----		----	
2122		----		----	
2129		----		----	
6010		----		----	
6031		----		----	
6044	D5293	31603		----	
6056		----		----	
6115	D5293	31380		----	
7002		----		----	
7015		----		----	

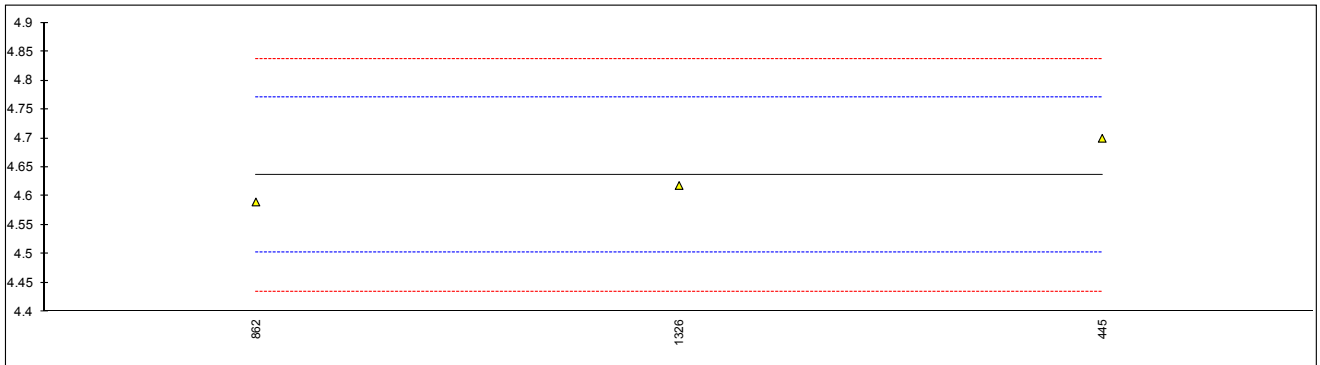
normality	unknown
n	5
outliers	0
mean (n)	31467.6
st.dev. (n)	1160.47
R(calc.)	3249.3
R(D5293:15)	(2297.1)



Determination of Viscosity HTHS by Tapered Bearing Simulator on sample #17095; results in mPa·s

lab	method	value	mark	z(targ)	remarks
173		----		----	
178		----		----	
179		----		----	
211		----		----	
237		----		----	
252		----		----	
254		----		----	
255		----		----	
325		----		----	
333		----		----	
349		----		----	
360		----		----	
421		----		----	
432		----		----	
445	D4741	4.70		0.95	
494		----		----	
496		----		----	
614		----		----	
621		----		----	
634		----		----	
657		----		----	
663		----		----	
780		----		----	
823		----		----	
840		----		----	
862	D4741	4.59		-0.69	
875		----		----	
902		----		----	
912		----		----	
922		----		----	
963		----		----	
994		----		----	
1017		----		----	
1023		----		----	
1059		----		----	
1066		----		----	
1106		----		----	
1107		----		----	
1146		----		----	
1150		----		----	
1173		----		----	
1201		----		----	
1213		----		----	
1235		----		----	
1271		----		----	
1300		----		----	
1316		----		----	
1324		----		----	
1326	D5481	4.6185		-0.26	
1431		----		----	
1564		----		----	
1748		----		----	
1770		----		----	
1797		----		----	
1807		----		----	
1850		----		----	
1877		----		----	
1883		----		----	
1957		----		----	
1969		----		----	
2122		----		----	
2129		----		----	
6010		----		----	
6031		----		----	
6044		----		----	
6056		----		----	
6115		----		----	
7002		----		----	
7015		----		----	

normality	unknown
n	3
outliers	0
mean (n)	4.636
st.dev. (n)	0.0571
R(calc.)	0.160
R(D4683:17)	0.188

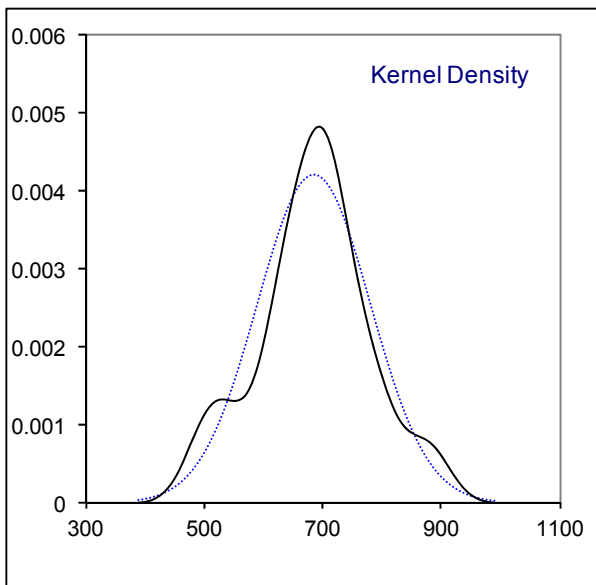
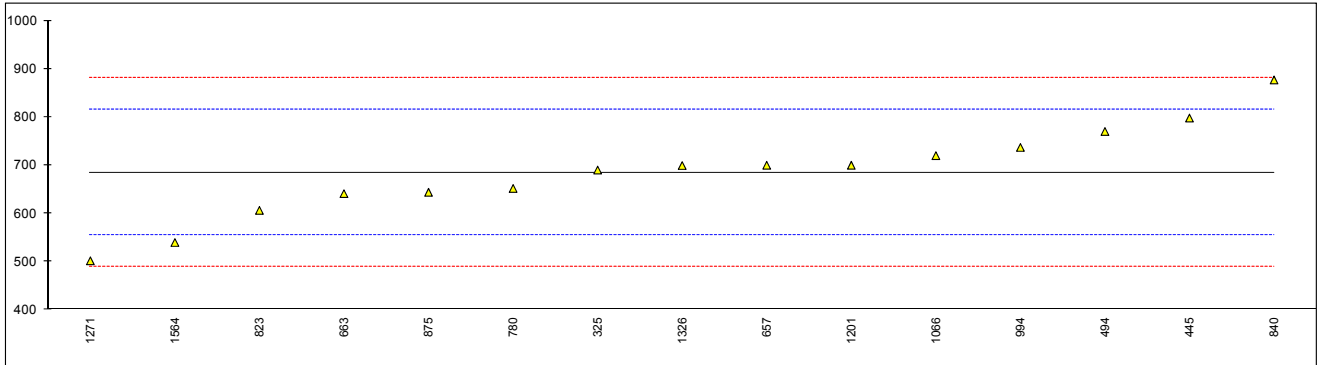


Determination of Nitrogen on sample #17095; results in mg/kg

lab	method	value	mark	z(targ)	remarks
173		----		----	
178		----		----	
179		----		----	
211		----		----	
237		----		----	
252		----		----	
254		----		----	
255		----		----	
325	D5762	690		0.07	
333		----		----	
349		----		----	
360		----		----	
421		----		----	
432		----		----	
445	D5762	798		1.73	
494	D5762	770		1.30	
496		----		----	
614		----		----	
621		----		----	
634		----		----	
657	D5762	700		0.23	
663	D5762	641.16		-0.68	
780	D5762	652		-0.51	
823	D5762	606.5		-1.21	
840	D3228	877	C	2.95	first reported: 438.5
862		----		----	
875	D5762	644		-0.63	
902		----		----	
912		----		----	
922		----		----	
963		----		----	
994	D5762	737		0.80	
1017		----		----	
1023		----		----	
1059		----		----	
1066	D5762	720		0.54	
1106		----		----	
1107		----		----	
1146		----		----	
1150		----		----	
1173		----		----	
1201	D5762	700		0.23	
1213		----		----	
1235		----		----	
1271	D5762	502		-2.81	
1300		----		----	
1316		----		----	
1324		----		----	
1326	D5762	699.5		0.22	
1431		----		----	
1564	D4629	539.9		-2.23	
1748		----		----	
1770		----		----	
1797		----		----	
1807		----		----	
1850		----		----	
1877		----		----	
1883		----		----	
1957		----		----	
1969		----		----	
2122		----		----	
2129		----		----	
6010		----		----	
6031		----		----	
6044		----		----	
6056		----		----	
6115		----		----	
7002		----		----	
7015		----		----	

normality	OK	<u>Only D5762:</u>
n	15	suspect
outliers	0	2
mean (n)	685.137	681.551
st.dev. (n)	95.1950	75.7170
R(calc.)	266.546	212.008
R(D5762:12)	182.247	181.293

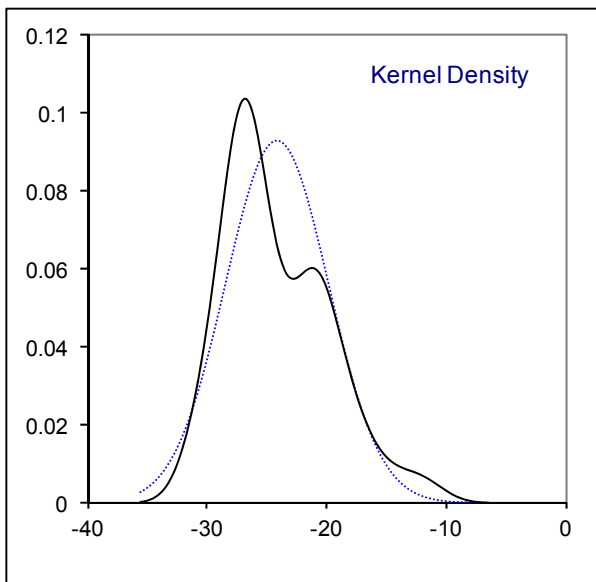
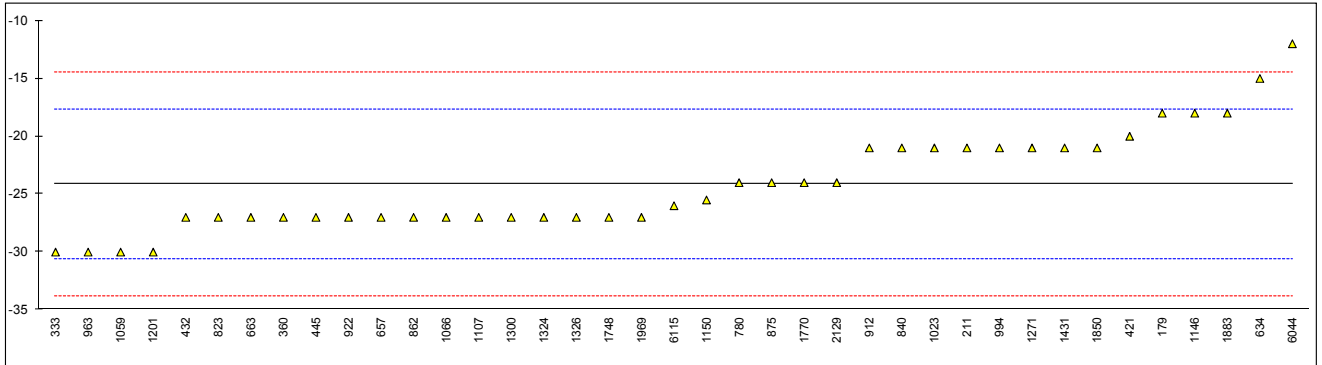
compare R(D3228:08) = 200



Determination of Pour Point, Manual on sample #17095; results in °C

lab	method	value	mark	z(targ)	remarks
173		----		----	
178		----		----	
179	D97	-18		1.91	
211	D97	-21		0.98	
237		----		----	
252		----		----	
254	D97	<-18		----	
255		----		----	
325		----		----	
333	D97	-30		-1.82	
349		----		----	
360	ISO3016	-27		-0.89	
421	ISO3016	-20		1.29	
432	D97	-27		-0.89	
445	D97	-27		-0.89	
494		----		----	
496		----		----	
614		----		----	
621		----		----	
634	D97	-15		2.84	
657	D97	-27		-0.89	
663	D97	-27		-0.89	
780	D97	-24		0.04	
823	D97	-27		-0.89	
840	D97	-21		0.98	
862	D97	-27		-0.89	
875	D97	-24		0.04	
902		----		----	
912	D97	-21		0.98	
922	D97	-27		-0.89	
963	D97	-30		-1.82	
994	D97	-21		0.98	
1017		----		----	
1023	D97	-21		0.98	
1059	ISO3016	-30		-1.82	
1066	D97	-27		-0.89	
1106		----		----	
1107	D97	-27		-0.89	
1146	D97	-18		1.91	
1150	ISO3016	-25.5		-0.42	
1173		----		----	
1201	D97	-30		-1.82	
1213	D97	<-27		----	
1235		----		----	
1271	ISO3016	-21		0.98	
1300	D97	-27		-0.89	
1316		----		----	
1324	D97	-27		-0.89	
1326	D97	-27		-0.89	
1431	D97	-21		0.98	
1564		----		----	
1748	D97	-27		-0.89	
1770	D97	-24		0.04	
1797		----		----	
1807		----		----	
1850	ISO3016	-21		0.98	
1877		----		----	
1883	D97	-18		1.91	
1957		----		----	
1969	ISO3016	-27		-0.89	
2122		----		----	
2129	D97	-24		0.04	
6010		----		----	
6031		----		----	
6044	D97	-12		3.78	
6056		----		----	
6115	D97	-26		-0.58	
7002		----		----	
7015		----		----	

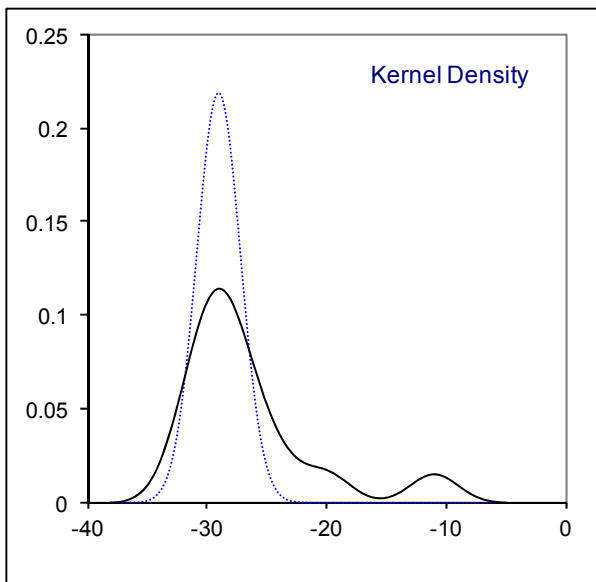
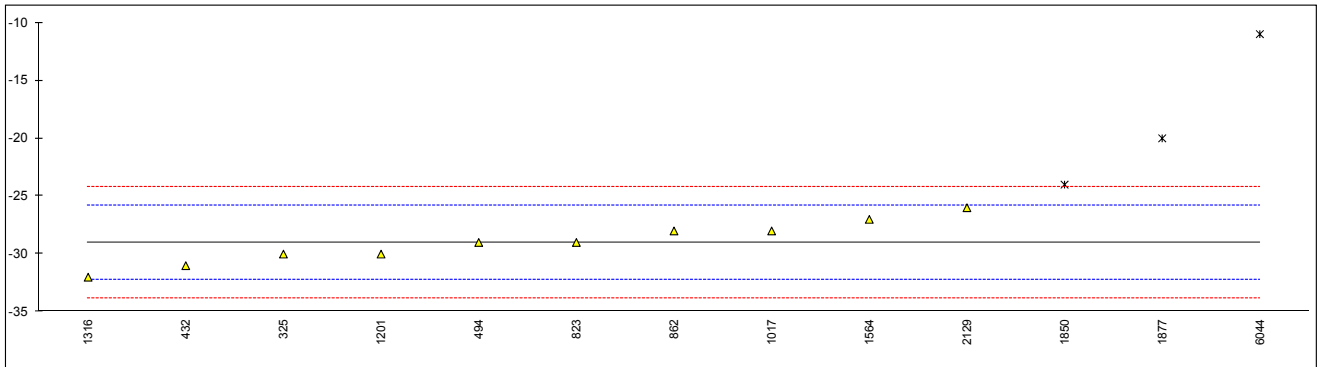
normality OK
 n 39
 outliers 0
 mean (n) -24.14
 st.dev. (n) 4.309
 R(calc.) 12.06
 R(D97:17a) 9



Determination of Pour Point, Automated, 1°C interval on sample #17095; results in °C

lab	method	value	mark	z(targ)	remarks
173		----		----	
178		----		----	
179		----		----	
211		----		----	
237		----		----	
252		----		----	
254		----		----	
255		----		----	
325	D5950	-30		-0.62	
333		----		----	
349		----		----	
360		----		----	
421		----		----	
432	D5950	-31		-1.24	
445		----		----	
494	D5950	-29		0.00	
496		----		----	
614		----		----	
621		----		----	
634		----		----	
657		----		----	
663		----		----	
780		----		----	
823	D5950	-29		0.00	
840		----		----	
862	D5950	-28		0.62	
875		----		----	
902		----		----	
912		----		----	
922		----		----	
963		----		----	
994		----		----	
1017	D5950	-28		0.62	
1023		----		----	
1059		----		----	
1066		----		----	
1106		----		----	
1107		----		----	
1146		----		----	
1150		----		----	
1173		----		----	
1201	D5950	-30		-0.62	
1213		----		----	
1235		----		----	
1271		----		----	
1300		----		----	
1316	D5950	-32.0		-1.87	
1324		----		----	
1326		----		----	
1431		----		----	
1564	D5950	-27		1.24	
1748		----		----	
1770		----		----	
1797		----		----	
1807		----		----	
1850		-24	DG(0.05)	3.11	
1877	D5950	-20	DG(0.05)	5.60	
1883		----		----	
1957		----		----	
1969		----		----	
2122		----		----	
2129	D5950	-26		1.87	
6010		----		----	
6031		----		----	
6044	D6749	-11	G(0.01)	11.20	
6056		----		----	
6115		----		----	
7002		----		----	
7015		----		----	

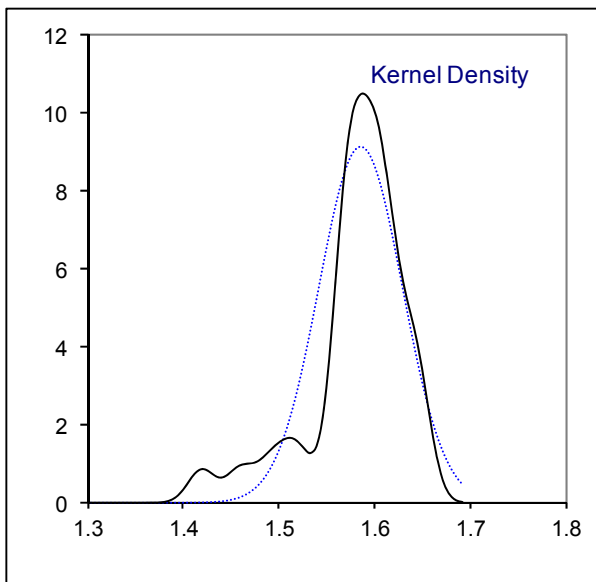
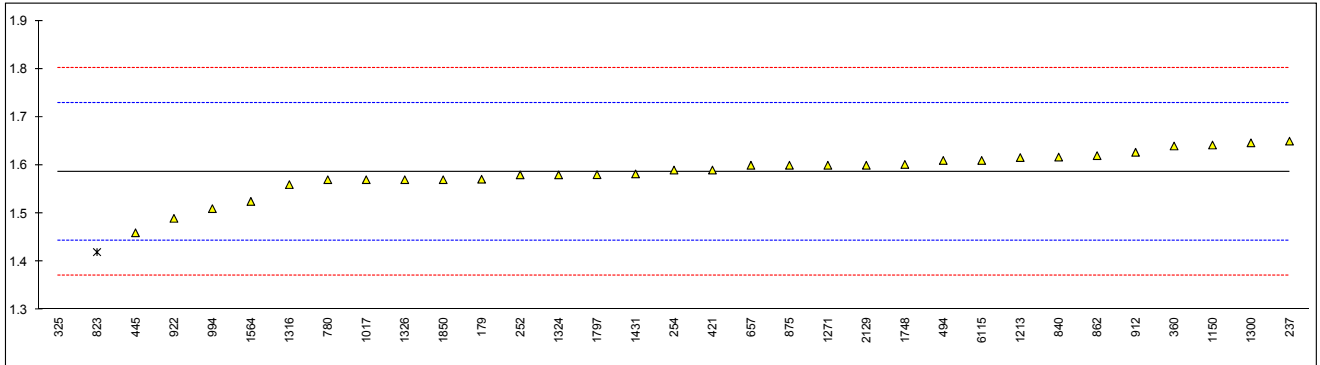
normality	OK
n	10
outliers	3
mean (n)	-29.00
st.dev. (n)	1.826
R(calc.)	5.11
R(D5950:14)	4.5



Determination of Sulphated Ash on sample #17095; results in %M/M

lab	method	value	mark	z(targ)	remarks
173		----		----	
178		----		----	
179	D874	1.571		-0.21	
211		----		----	
237	D874	1.65		0.89	
252	D874	1.58		-0.09	
254	D874	1.59		0.05	
255		----		----	
325	D874	0.03906	R(0.01)	-21.58	
333		----		----	
349		----		----	
360	ISO3987	1.640		0.75	
421	ISO3987	1.59		0.05	
432		----		----	
445	D874	1.46		-1.76	
494	ISO3987	1.61		0.33	
496		----		----	
614		----		----	
621		----		----	
634		----		----	
657	D874	1.60		0.19	
663		----		----	
780	D874	1.57		-0.23	
823	D874	1.42	R(0.05)	-2.32	
840	D874	1.617		0.43	
862	D874	1.62		0.47	
875	D874	1.60		0.19	
902		----		----	
912	D874	1.627		0.57	
922	D874	1.49		-1.34	
963		----		----	
994	D874	1.51		-1.07	
1017	D874	1.57		-0.23	
1023		----		----	
1059		----		----	
1066		----		----	
1106		----		----	
1107		----		----	
1146		----		----	
1150	ISO3987	1.642		0.78	
1173		----		----	
1201		----		----	
1213	D874	1.616		0.41	
1235		----		----	
1271	ISO3987	1.60		0.19	
1300	D874	1.6465		0.84	
1316	D874	1.56		-0.37	
1324	D874	1.580		-0.09	
1326	D874	1.57		-0.23	
1431	D874	1.582		-0.06	
1564	D874	1.525		-0.86	
1748	D874	1.6017		0.21	
1770		----		----	
1797	ISO3987	1.5804		-0.08	
1807		----		----	
1850	ISO3987	1.57		-0.23	
1877		----		----	
1883		----		----	
1957		----		----	
1969		----		----	
2122		----		----	
2129	D874	1.600		0.19	
6010		----		----	
6031		----		----	
6044		----		----	
6056		----		----	
6115	D874	1.61		0.33	
7002		----		----	
7015		----		----	

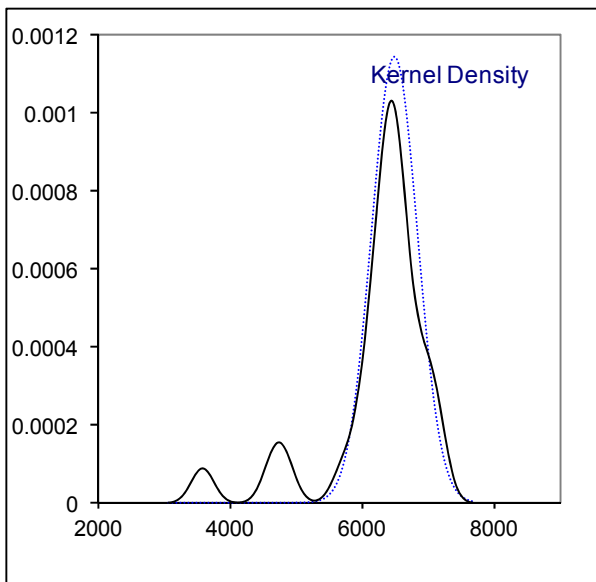
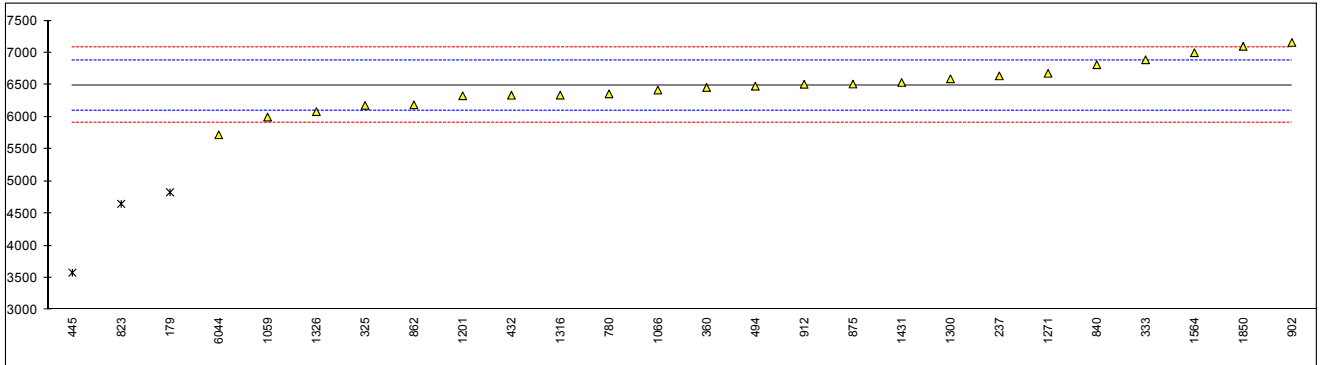
normality	suspect
n	31
outliers	2
mean (n)	1.586
st.dev. (n)	0.0437
R(calc.)	0.122
R(D874:13a)	0.201



Determination of Sulphur on sample #17095; results in mg/kg

lab	method	value	mark	z(targ)	remarks
173		----		----	
178		----		----	
179	D4294	4829	R(0.01)	-8.47	
211		----		----	
237	D4294	6640	C	0.75	first reported: 0.664 mg/kg
252		----		----	
254		----		----	
255		----		----	
325	D6443	6180		-1.59	
333	D4294	6890		2.02	
349		----		----	
360	ISO8754	6460	C	-0.17	first reported: 0.646 mg/kg
421		----		----	
432	D4951	6339		-0.79	
445	D4294	3580	R(0.01)	-14.83	
494	D4294	6480		-0.07	
496		----		----	
614		----		----	
621		----		----	
634		----		----	
657		----		----	
663		----		----	
780	D4294	6360		-0.68	
823	D4294	4650	C,R(0.01)	-9.38	first reported: 0.465 mg/kg
840	D4294	6813		1.63	
862	D2622	6190		-1.54	
875	D4294	6513		0.10	
902	D4294	7160		3.39	
912	D4294	6510		0.09	
922		----		----	
963		----		----	
994		----		----	
1017		----		----	
1023		----		----	
1059	ISO14596	6000		-2.51	
1066	D2622	6420		-0.37	
1106		----		----	
1107		----		----	
1146		----		----	
1150		----		----	
1173		----		----	
1201	D4294	6330		-0.83	
1213		----		----	
1235		----		----	
1271	D4294	6680		0.95	
1300	D4294	6595		0.52	
1316	D7551	6340		-0.78	
1324		----		----	
1326	D4294	6083.5		-2.09	
1431	D4294	6538	C	0.23	first reported: 0.6538 mg/kg
1564	D5453	7000		2.58	
1748		----		----	
1770		----		----	
1797		----		----	
1807		----		----	
1850	ISO8754	7100		3.09	
1877		----		----	
1883		----		----	
1957		----		----	
1969		----		----	
2122		----		----	
2129		----		----	
6010		----		----	
6031		----		----	
6044	D4294	5724		-3.92	
6056		----		----	
6115		----		----	
7002		----		----	
7015		----		----	

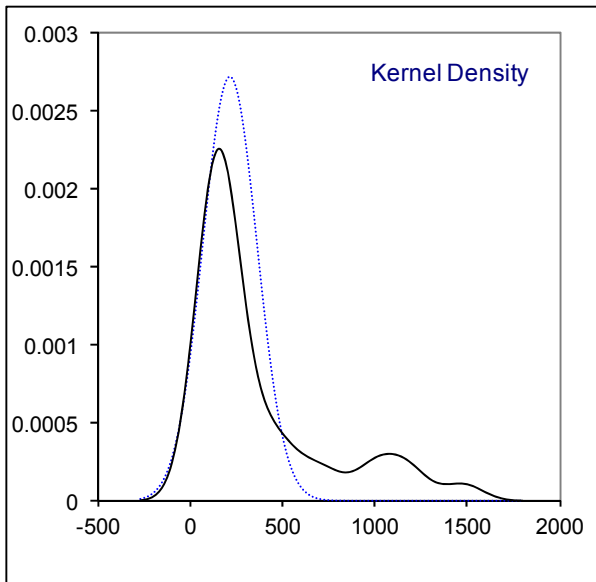
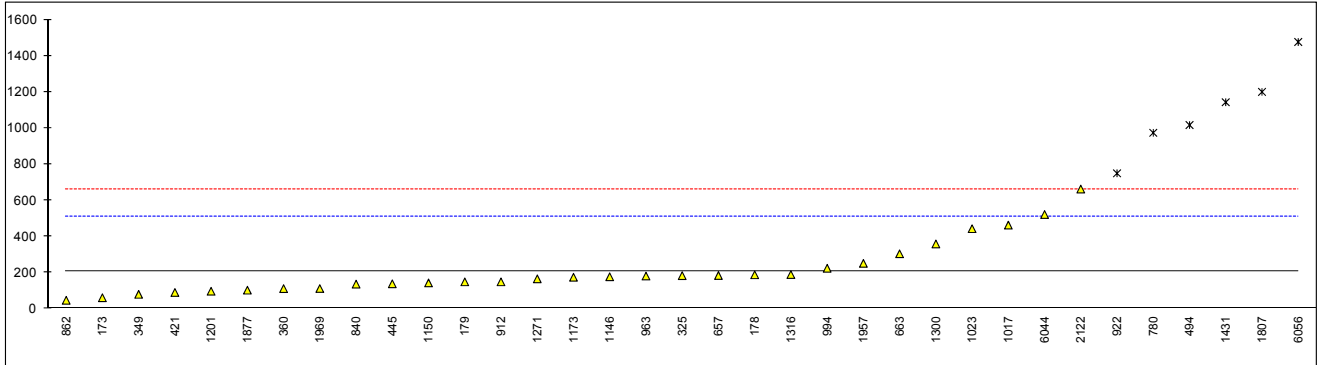
normality OK
 n 23
 outliers 3
 mean (n) 6493.3
 st.dev. (n) 349.67
 R(calc.) 979.1
 R(D4294:16e1) 550.1



Determination of Water content by KF on sample #17095; results in mg/kg

lab	method	value	mark	z(targ)	remarks
173	D6304-C	62		-0.99	
178	D6304-C	189		-0.15	
179	D6304-C	150		-0.41	
211		----		----	
237		----		----	
252		----		----	
254		----		----	
255		----		----	
325	D6304-C	184		-0.18	
333		----		----	
349	D6304-A	81		-0.87	
360	D6304-C	112.6		-0.66	
421	D6304-C	91		-0.80	
432		----		----	
445	D6304-B	139		-0.48	
494	ISO12937	1017	R(0.01)	5.39	
496		----		----	
614		----		----	
621		----		----	
634		----		----	
657	D6304-C	185.05		-0.17	
663	D6304-C	305		0.63	
780	D6304-A	974	R(0.01)	5.10	
823		----		----	
840	D6304-C	137.2		-0.49	
862	D6304-C	48		-1.09	
875		----		----	
902		----		----	
912	D6304-C	150		-0.41	
922	D6304-C	750	R(0.05)	3.60	
963	D6304-C	182		-0.19	
994	ISO12937	225	C	0.09	first reported: 912
1017	D6304-A	463.54		1.69	
1023	D6304-C	443.8		1.56	
1059	D6304-Cmod.	<30		----	
1066		----		----	
1106		----		----	
1107		----		----	
1146	D6304-C	178		-0.22	
1150	ISO12937	144		-0.45	
1173	In house	175.4		-0.24	
1201	D6304-C	98		-0.75	
1213		----		----	
1235		----		----	
1271	ISO12937	166.45		-0.30	
1300	D6304-A	359.42	C	0.99	first reported: 1371.5
1316	D6304-C	190		-0.14	
1324		----		----	
1326		----		----	
1431	D6304-A	1143	R(0.01)	6.23	
1564		----		----	
1748		----		----	
1770		----		----	
1797		----		----	
1807	D6304-A	1200	R(0.01)	6.61	
1850		----		----	
1877	D6304-C	104		-0.71	
1883		----		----	
1957	D6304-C	252		0.28	
1969	ISO12937	113		-0.65	
2122	In house	663		3.02	
2129		----		----	
6010		----		----	
6031		----		----	
6044	D6304-A	522		2.08	
6056	ISO12937	1476	R(0.01)	8.46	
6115		----		----	
7002		----		----	
7015		----		----	

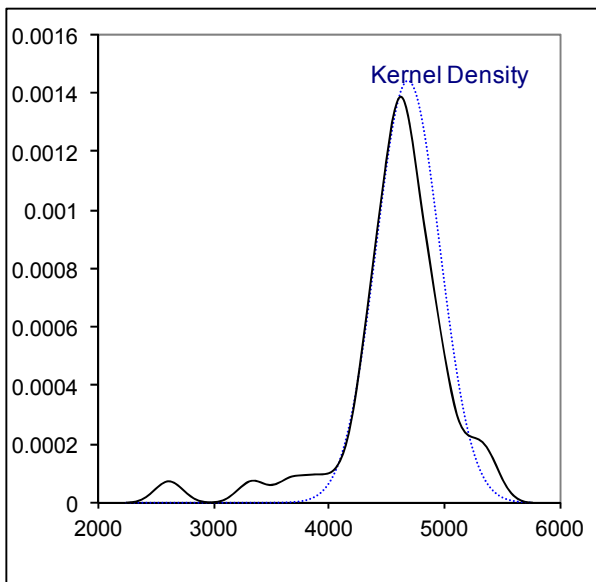
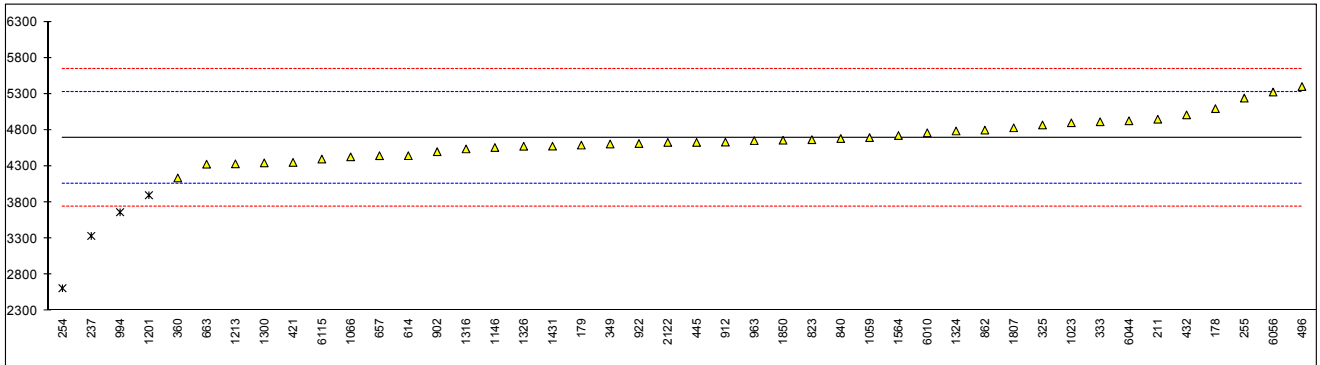
normality	not OK
n	29
outliers	6
mean (n)	210.809
st.dev. (n)	147.0402
R(calc.)	411.713
R(D6304:16e1)	418.800



Determination of Calcium as Ca on sample #17095; results in mg/kg

lab	method	value	mark	z(targ)	remarks
173		-----		-----	
178		5097		1.28	
179	D5185	4593		-0.31	
211	D6595	4950		0.82	
237		3337	C,G(0.05)	-4.26	first reported: 6564
252		-----		-----	
254	INH-018	2614.66	C,G(0.01)	-6.54	first reported: 3431.849
255		5243		1.74	
325	D5185	4871		0.57	
333		4915		0.71	
349	D5185	4608		-0.26	
360	D5185	4139		-1.74	
421	D5185	4354		-1.06	
432	D5185	5010		1.01	
445	D5185	4630		-0.19	
494		-----		-----	
496		5402.2		2.24	
614	D5185	4447		-0.77	
621		-----		-----	
634		-----		-----	
657	D5185	4446		-0.77	
663	D5185	4329.3		-1.14	
780		-----		-----	
823	D5185	4668		-0.07	
840	D5185	4683		-0.02	
862	D5185	4800		0.35	
875		-----		-----	
902		4501		-0.60	
912		4634		-0.18	
922	D5185	4614		-0.24	
963		4655		-0.11	
994	D5185	3665	C,DG(0.05)	-3.23	first reported: 2919
1017		-----		-----	
1023	D5185	4901		0.66	
1059	In house	4696		0.02	
1066	D4951	4430		-0.82	
1106		-----		-----	
1107		-----		-----	
1146	INH-5185/4951	4559		-0.41	
1150		-----		-----	
1173		-----		-----	
1201	D5185	3900	C,DG(0.05)	-2.49	first reported: 3440
1213	D4628	4333		-1.13	
1235		-----		-----	
1271		-----		-----	
1300	D5185	4347.2	C	-1.08	first reported: 3510.99
1316	D5185	4540		-0.47	
1324	D4951	4788		0.31	
1326		4576.5		-0.36	
1431	In house	4578		-0.35	
1564	D4951	4725		0.11	
1748		-----		-----	
1770		-----		-----	
1797		-----		-----	
1807		4832		0.45	
1850		4660		-0.09	
1877		-----		-----	
1883		-----		-----	
1957		-----		-----	
1969		-----		-----	
2122		4629.63		-0.19	
2129		-----		-----	
6010		4762.2		0.23	
6031		-----		-----	
6044	D5185	4928		0.75	
6056		5326		2.00	
6115	D6596	4400		-0.91	
7002		-----		-----	
7015		-----		-----	

normality OK
 n 40
 outliers 4
 mean (n) 4690.03
 st.dev. (n) 276.595
 R(calc.) 774.46
 R(D5185:13e1) 888.42

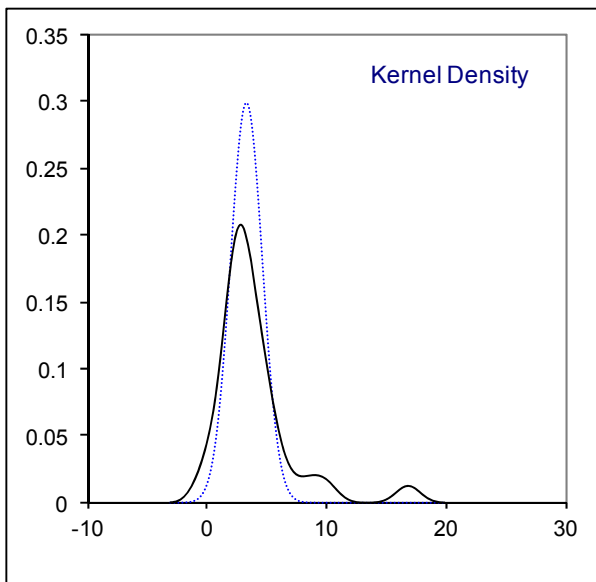
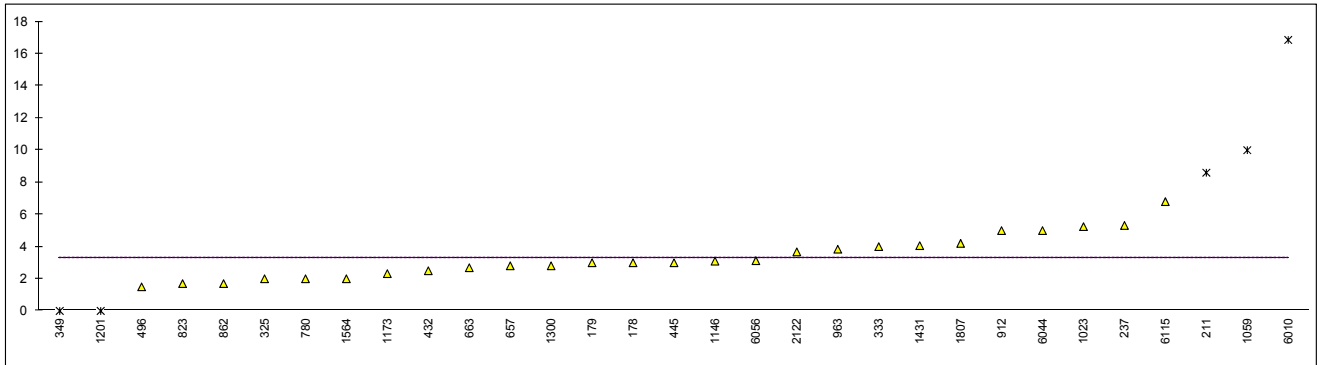


Determination of Phosphorus as P on sample #17095; results in mg/kg

lab	method	value	mark	z(targ)	remarks
173		----		----	
178		3		----	
179	D5185	3		----	
211	D6595	8.6	R(0.05)	----	
237		5.316		----	
252		----		----	
254		----		----	
255		<0.1		----	
325	D5185	2		----	
333		4		----	
349	D5185	0	ex	----	test result excluded, for zero is not a real value
360	D5185	< 10		----	
421	D5185	<1		----	
432	D5185	2.5		----	
445	D5185	3		----	
494		----		----	
496		1.5		----	
614	D5185	<2		----	
621		----		----	
634		----		----	
657	D5185	2.807		----	
663	D5185	2.69		----	
780	D5185	2		----	
823	D5185	1.7		----	
840	D5185	<1.0		----	
862	D5185	1.7		----	
875		----		----	
902		<10		----	
912		5		----	
922	D5185	<10		----	
963		3.84		----	
994	D5185	L.1.0		----	
1017		----		----	
1023	D5185	5.244		----	
1059	In house	10	R(0.05)	----	
1066	D4951	<5		----	
1106		----		----	
1107		----		----	
1146	INH-5185/4951	3.098		----	
1150		----		----	
1173	In house	2.32		----	
1201	D5185	0	ex	----	test result excluded, for zero is not a real value
1213	D4628	<1		----	
1235		----		----	
1271		----		----	
1300	D5185	2.807		----	
1316		----		----	
1324		----		----	
1326		----		----	
1431	In house	4.06		----	
1564	D4951	2		----	
1748		----		----	
1770		----		----	
1797		----		----	
1807		4.2		----	
1850		----		----	
1877		----		----	
1883		----		----	
1957		----		----	
1969		----		----	
2122		3.675		----	
2129		----		----	
6010		16.86	C,R(0.01)	----	first reported: 70.38; possibly false positive test result?
6031		----		----	
6044	D5185	5		----	
6056		3.125		----	
6115	D6596	6.8		----	
7002		----		----	
7015		----		----	

normality OK
 n 26
 outliers 3 (+2ex)
 mean (n) 3.32
 st.dev. (n) 1.333
 R(calc.) 3.73
 R(D5185:13e1) (7.84)

method range: 10-1000 mg/kg

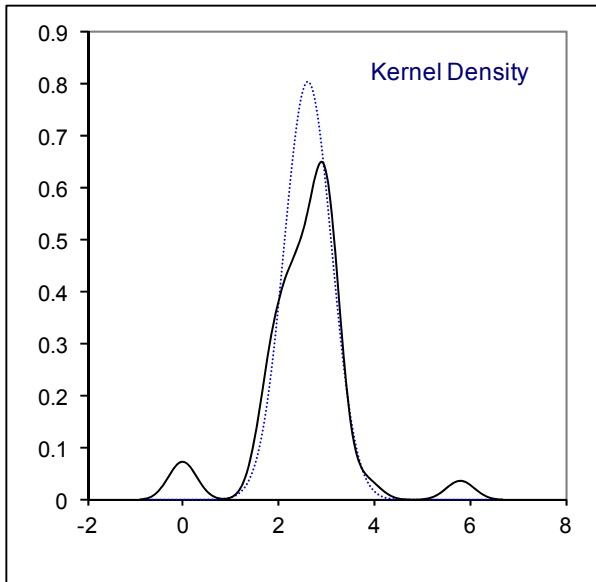
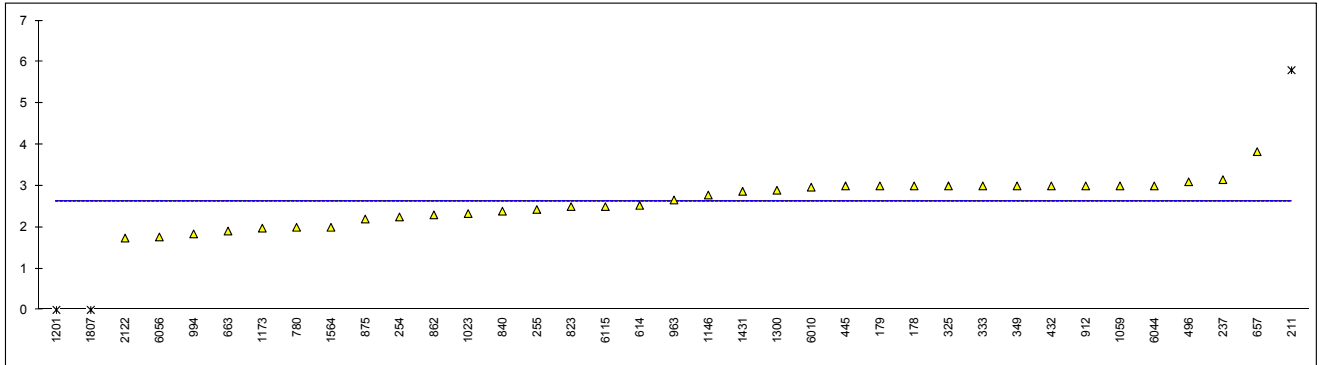


Determination of Zinc as Zn on sample #17095; results in mg/kg

lab	method	value	mark	z(targ)	remarks
173		----		----	
178		3		----	
179	D5185	3		----	
211	D6595	5.8	R(0.01)	----	
237		3.151		----	
252		----		----	
254	INH-018	2.251		----	
255		2.43		----	
325	D5185	3		----	
333		3		----	
349	D5185	3		----	
360	D5185	< 60		----	
421	D5185	<1		----	
432	D5185	3.0		----	
445	D5185	3		----	
494		----		----	
496		3.1		----	
614	D5185	2.53		----	
621		----		----	
634		----		----	
657	D5185	3.83		----	
663	D5185	1.91		----	
780	D5185	2		----	
823	D5185	2.5		----	
840	D5185	2.39		----	
862	D5185	2.3		----	
875		2.2		----	
902		<60		----	
912		3		----	
922	D5185	<60		----	
963		2.66		----	
994	D5185	1.84		----	
1017		----		----	
1023	D5185	2.332		----	
1059	In house	3		----	
1066	D4951	<5		----	
1106		----		----	
1107		----		----	
1146	INH-5185/4951	2.779		----	
1150		----		----	
1173	In house	1.98		----	
1201	D5185	0	ex	----	test result excluded, for zero is not a real value
1213	D4628	<20		----	
1235		----		----	
1271		----		----	
1300	D5185	2.895		----	
1316		----		----	
1324		----		----	
1326		----		----	
1431	In house	2.87		----	
1564	D4951	2		----	
1748		----		----	
1770		----		----	
1797		----		----	
1807		0	ex	----	test result excluded, for zero is not a real value
1850		----		----	
1877		----		----	
1883		----		----	
1957		----		----	
1969		----		----	
2122		1.74	C	----	first reported: 5.595
2129		----		----	
6010		2.97		----	
6031		----		----	
6044	D5185	3		----	
6056		1.765		----	
6115	D6596	2.5		----	
7002		----		----	
7015		----		----	

normality OK
 n 34
 outliers 1 (+2ex)
 mean (n) 2.62
 st.dev. (n) 0.496
 R(calc.) 1.39
 R(D5185:13e1) (0.24)

method range: 60-1600 mg/kg



APPENDIX 2

Number of participants per country

1 lab in AUSTRALIA	2 labs in MOROCCO
1 lab in AUSTRIA	3 labs in NETHERLANDS
1 lab in AZERBAIJAN	1 lab in NIGERIA
4 labs in BELGIUM	1 lab in NORWAY
1 lab in BOSNIA and HERZEGOVINA	2 labs in PAKISTAN
1 lab in BRUNEI	1 lab in PHILIPPINES
2 labs in BULGARIA	2 labs in ROMANIA
3 labs in CHINA, People's Republic	2 labs in RUSSIAN FEDERATION
1 lab in CROATIA	1 lab in SAUDI ARABIA
1 lab in CZECH REPUBLIC	1 lab in SINGAPORE
1 lab in ESTONIA	1 lab in SLOVENIA
1 lab in FRANCE	2 labs in SOUTH KOREA
4 labs in GERMANY	4 labs in SPAIN
2 labs in GREECE	1 lab in SWEDEN
1 lab in INDIA	1 lab in TANZANIA
1 lab in INDONESIA	1 lab in THAILAND
2 labs in IRAN, Islamic Republic of	1 lab in TURKEY
1 lab in JORDAN	4 labs in UNITED KINGDOM
2 labs in KENYA	3 labs in UNITED STATES OF AMERICA
1 lab in LEBANON	2 labs in VIETNAM
1 lab in MALAYSIA	

APPENDIX 3

Abbreviations:

C	= final 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
ex	= test result excluded from the statistical evaluation
U	= reported in different unit
W	= test result withdrawn on request of the participant
fr.	= first reported
n.a.	= not applicable
n.e.	= not evaluated
SDS	= Safety Data Sheet

Literature:

- 1 iis Interlaboratory Studies, Protocol for the Organization, Statistics and Evaluation, March 2017
- 2 ASTM E178:89
- 3 ASTM E1301:89
- 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 Manual 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 The Royal Society of Chemistry, Analyst, 127 1359-1364 (2002), P.J. Lowthian and M. Thompson
- 15 Bernard Rosner, Percentage Points for a Generalized ESD Many-Outlier Procedure, *Technometrics*, 25(2), pp. 165-172, (1983)