Results of Proficiency Test
Base Oil
May 2020

Organized by: Institute for Interlaboratory Studies
Spijkenisse, The Netherlands

Author: ing. C.M. Nijssen-Wester
Correctors: ing. A.S. Noordman - de Neef & ing. M. Meijer

Report: iis20L03

August 2020

CONTENTS

1 INTRODUCTION

Since 2013 the Institute for Interlaboratory Studies (iis) organizes a proficiency test for Base Oil every year. During the annual proficiency testing program 2019/2020, it was decided to continue the round robin for the analysis of Base Oil.

In this interlaboratory study 62 laboratories in 35 different countries registered for participation. See appendix 2 for the number of participants per country. In this report the results of this Base Oil 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/IEC17025 accredited laboratory. It was decided to send one sample of Base Oil in a 1 liter bottle labelled #20065.
The participants were requested to report rounded and unrounded test results. The unrounded test results were preferably used for statistical evaluation.

2.1 ACCREDITATION

The Institute for Interlaboratory Studies in Spijkenisse, the Netherlands, is accredited in agreement with ISO/IEC17043:2010 (R007), since January 2000, by the Dutch Accreditation Council (Raad voor Accreditatie). This PT falls under the accredited scope. This ensures strict adherence to protocols for sample preparation and statistical evaluation and 100% confidentiality of participant's data. Feedback from the participants on the reported data is encouraged and customer's satisfaction is measured on regular basis by sending out questionnaires.

2.2 PROTOCOL

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

2.3 CONFIDENTIALITY STATEMENT

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

2.4 SAMPLES

Approximately 120 liters of Base Oil was obtained from a local supplier. After homogenization 90 amber glass bottles of 1 liter were filled and labelled #20065. The homogeneity of the subsamples was checked by determination of Density at 15°C in accordance with ISO12185 on 8 stratified randomly selected subsamples.

	Density at 15°C in kg/L
Sample #20065-1	0.83179
Sample #20065-2	0.83179
Sample #20065-3	0.83180
Sample #20065-4	0.83179
Sample #20065-5	0.83179
Sample #20065-6	0.83180
Sample #20065-7	0.83179
Sample #20065-8	0.83179

Table 1: homogeneity test results of subsamples #20065

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

	Density at 15°C in kg/L
r (observed)	0.00001
reference test method	ISO12185:96
0.3 x R (reference test method)	0.00015

Table 2: evaluation of the repeatability of subsamples #20065

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

To each of the participating laboratories one bottle of 1 liter labelled #20065 was sent on April 22, 2020. An SDS was added to the sample package.

2.5 STABILITY OF THE SAMPLES

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

2.6 ANALYZES

The participants were requested to determine on Base Oil sample #20065: Total Acid Number, Air Release time at 50°C, Color ASTM, Conradson Carbon Residue, Ramsbottom Carbon Residue, Density at 15°C, Evaporation loss by Noack test, Flash Point C.O.C., Kinematic Viscosity at 40°C and 100°C, Viscosity Index, Viscosity Stabinger at 40°C and 100°C, Pour Point (Manual and Automated), Rust prevention (synthetic seawater), Sulfur, Water and Water Separability at 54°C.

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

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

3 RESULTS

During five weeks after sample dispatch, the test results of the participants 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 test results are placed under 'Remarks' in the test result tables in appendix 1. Test results that came in after the deadline were not taken into account in this screening for suspect data and thus these participants were not requested for checks.

3.1 STATISTICS

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

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

According to ISO5725 the original test results per determination were submitted to Dixon’s, Grubbs’ and/or Rosner’s outlier tests. Outliers are marked by D(0.01) for the Dixon’s test, by G(0.01) or DG(0.01) for the Grubbs’ test and by R(0.01) for the Rosner’s test. Stragglers are marked by D(0.05) for the Dixon’s test, by G(0.05) or DG(0.05) for the Grubbs’ test and by R(0.05) for the Rosner’s test. Both outliers and stragglers were not included in the calculations of averages and standard deviations.

For each assigned value the uncertainty was determined in accordance with ISO13528. Subsequently the calculated uncertainty was evaluated against the respective requirement based on the target reproducibility in accordance with ISO13528. In this PT, the criterion of ISO13528, paragraph 9.2.1 was met for all evaluated tests, therefore, the uncertainty of all assigned values may be negligible and need not be included in the PT report.
Finally, the reproducibilities were calculated from the standard deviations by multiplying them with a factor of 2.8.

3.2 GRAPHICS

In order to visualize the data against the reproducibilities from literature, Gauss plots were made, using the sorted data for one determination (see appendix 1). On the Y-axis the reported test results are plotted. The corresponding laboratory numbers are on the X-axis.

The straight horizontal line presents the consensus value (a trimmed mean). The four striped lines, parallel to the consensus value line, are the +3s, +2s, -2s and -3s target reproducibility limits of the selected reference test method. Outliers and other data, which were excluded from the calculations, are represented as a cross. Accepted data are represented as a triangle.
Furthermore, Kernel Density Graphs were made. This is a method for producing a smooth density approximation to a set of data that avoids some problems associated with histograms. Also, a normal Gauss curve was projected over the Kernel Density Graph for reference.

3.3 Z-SCORES

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

The target standard deviation was calculated from the literature reproducibility by division with 2.8. In case no literature reproducibility was available, other targets values were used. In some cases a reproducibility based on former iis proficiency tests could be used.
When a laboratory did use a test method with a reproducibility that is significantly different from the reproducibility of the reference test method used in this report, it is strongly advised to recalculate the z-score, while using the reproducibility of the actual test method used, this in order to evaluate whether the reported test result is fit-for-use.

The z-scores were calculated according to:

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

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

Absolute values for z<2 are very common and absolute values for z>3 are very rare.
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

Some problems were encountered with the dispatch of the samples due to COVID-19 pandemic. Therefore, the reporting time on the data entry portal was extended with another three weeks. One participant reported test results after the final reporting date and nine participants did not report any test results. Not all participants were able to report test results for all requested tests.

In total 53 participants reported 444 numerical test results. Observed were 12 outlying test results, which is 2.7%. 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 reported test results are discussed per test. The test methods, which were used by the various laboratories, were taken into account for explaining the observed differences when possible and applicable. These methods are also in the tables together with the original data. The abbreviations, used in these tables, are explained in appendix 3.

In the iis PT reports ASTM methods are referred to with a number e.g. D1500 and an added designation for the year that the method was adopted or revised e.g. D1500:12. If applicable, a designation in parentheses is added to designate the year of reapproval e.g. D1500:12(2017). In the results tables of appendix 1 only the method number and year of adoption or revision e.g. D1500:12 will be used.

Total Acid Number: This determination was not problematic. No statistical outliers were observed. The calculated reproducibility is in agreement with the requirements of ASTM D974:14e2.

Air Release time: The majority of the reporting laboratories agreed that the air release time was smaller than or equal to 1 minute. No z-scores were calculated.

Color ASTM: This determination was not problematic. One statistical outlier was observed and one other test result was excluded. However, the calculated reproducibility after rejection of the suspect data is in agreement with the requirements of ASTM D1500:12(2017).

Conradson CR: This determination may not be problematic. The majority of the reporting laboratories agreed that the Conradson Carbon Residue was smaller than 0.1 %M/M. No z-scores were calculated.

Ramsbottom CR: This determination was not problematic. No statistical outliers were observed. The calculated reproducibility is in agreement with the requirements of ASTM D524:15(2019).

Density at 15°C: 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 ISO12185:96.

Evaporation loss by Noack test: This determination was problematic. No statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is not agreement with the requirements of ASTM D5800-B:20.

Flash Point C.O.C.: This determination was not problematic. No statistical outliers were observed. The calculated reproducibility is in agreement with the requirements of ASTM D92:18.

Kin.Viscosity at 40°C: This determination was not problematic. Three statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in agreement with the requirements of ASTM D445:19a.

Kin.Viscosity 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 D445:19a.

Viscosity Index: This determination was problematic. No statistical outliers were observed but three test results were excluded from the statistical evaluation. The calculated reproducibility after rejection of the suspect data is not in agreement with the requirements of ASTM D2270:10(2016).

Viscosity Stab. at 40°C: This determination was not problematic. One statistical outlier was observed. The calculated reproducibility after rejection of the statistical outlier is in full agreement with the requirements of ASTM D7042:19e1.

Viscosity Stab. at 100°C: This determination was problematic. No statistical outliers were observed. However, the calculated reproducibility is not in agreement with the requirements of ASTM D7042:19e1.

Pour Point, Manual: This determination was very problematic. No statistical outliers were observed. However, the calculated reproducibility is not at all in agreement with the requirements of ASTM D97:17b.

Pour Point, Automated: 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 D5950:14.

Rust prevention: Regretfully, only five participants reported a test result. Four participants reported the presence of rust (Fail/ Severe rusting) and one participant reported “Pass”.

Sulfur: This determination may not be problematic. The majority of the reporting laboratories agreed that the Sulfur concentration was lower than 17 mg/kg. No z-scores were calculated.

Water: 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 D6304:16e1.

Water separability: This determination was not problematic. No statistical outliers were observed. All calculated reproducibilities are in agreement with the requirements of ASTM D1401:19.

4.2 PERFORMANCE EVALUATION FOR THE GROUP OF LABORATORIES

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

Parameter	unit	n	average	2.8 * sd	R(lit)
Total Acid Number	mg KOH/g	17	0.013	0.019	0.04
Air Release time at 50°C	minutes	9	≤1	n.a.	n.a.
Color ASTM		42	0.23	0.21	1
Conradson Carbon Residue	%M/M	24	<0.1	n.a.	n.a.
Ramsbottom Carbon Residue	%M/M	5	0.030	0.020	0.024
Density at 15°C	kg/L	50	0.8319	0.0004	0.0005
Evaporation loss by Noack	%M/M	21	3.61	0.90	0.63
Flash Point C.O.C.	°C	39	261	11	18
Kinematic Viscosity at 40°C	mm^2/s	44	46.92	0.29	0.64
Kinematic Viscosity at 100°C	mm^2/s	48	7.962	0.066	0.151
Viscosity Index		41	141.1	2.6	2
Viscosity Stabinger at 40°C	mm^2/s	9	47.04	0.30	0.28
Viscosity Stabinger at 100°C	mm^2/s	8	7.974	0.118	0.038
Pour Point, Manual	°C	8	-56.6	21.1	9
Pour Point, Automated (1°C interval)	°C	17	-60.9	8.9	4.5
Rust Prevention (synth.seawater)		4	Fail	n.a.	n.a.
Sulfur	mg/kg	25	<17	n.a.	n.a.
Water	mg/kg	23	13.4	17.6	80.3
Water Separability at 54°C					
- Time to reach ≤ 3mL	minutes	11	3.5	8.5	20
- Time to reach 37mL of water	minutes	9	3.0	5.6	20
- Time complete break	minutes	14	3.7	5.5	20

Table 3: reproducibilities of tests on sample #20065

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

4.3 COMPARISON OF THE PROFICIENCY TEST OF MAY 2020 WITH PREVIOUS PTS

	May 2020	May 2019	May 2018	May 2017	May 2016
Number of reporting laboratories	53	59	57	56	50
Number of test results	444	567	462	547	542
Number of statistical outliers	12	15	19	19	22
Percentage of statistical outliers	2.7%	2.6%	4.1%	3.5%	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 to the requirements of the respective reference test methods. The conclusions are given in the following table.

Parameter	May 2020	May 2019	May 2018	May 2017	May 2016
Total Acid Number	++	++	+/-	+	++
Air Release time at 50°C	n.e.	+/-	+/-	+	+/-
Color ASTM	++	++	n.e.	n.e.	+
Conradson Carbon Residue	n.e.	+/-	++	+	++
Ramsbottom Carbon Residue	+	+/-	-	+/-	+/-
Density at 15°C	+	+	+/-	+/-	+
Evaporation loss by Noack	-	+/-	+/-	+	+
Flash Point C.O.C.	+	+	+	+/-	+
Kinematic Viscosity at 40°C	++	+	+	++	++
Kinematic Viscosity at 100°C	++	+	++	+	++
Viscosity Index	-	n.e.	+/-	-	--
Viscosity Stabinger at 40°C	+/-	+	+/-	-	-
Viscosity Stabinger at 100°C	--	-	-	-	-
Pour Point, Manual	--	++	--	+	++
Pour Point, Automated (1°C interval)	--	+	-	-	+
Rust Prevention (synth.seawater)	n.e.	n.e.	n.e.	n.e.	n.e.
Sulfur	n.e.	+	n.e.	n.e.	+/-
Water	++	++	++	++	++
Water Separability at 54°C	++	++	++	++	++

Table 5: comparison determinations against the respective reference test methods

The following performance categories were used:

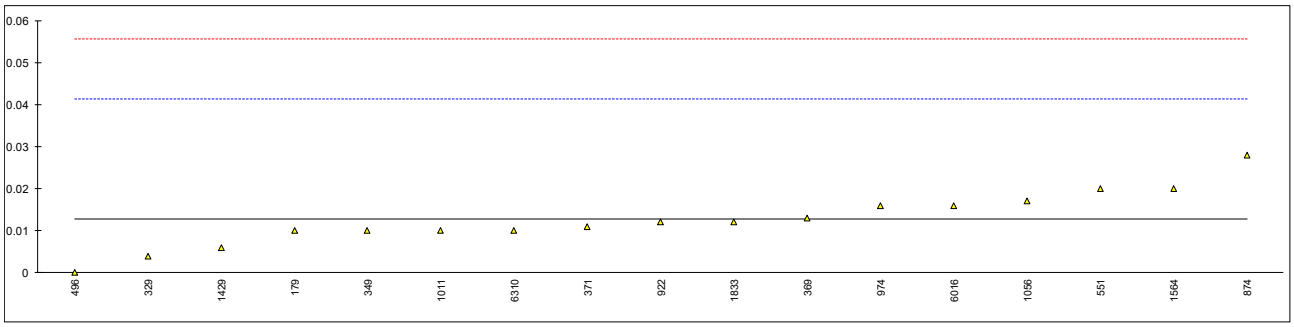
++: group performed much better than the reference test method
+ : group performed better than the reference test method
+/-: group performance equals the reference test method
- : group performed worse than the reference test method
-- : group performed much worse than the reference test method
n.e.: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

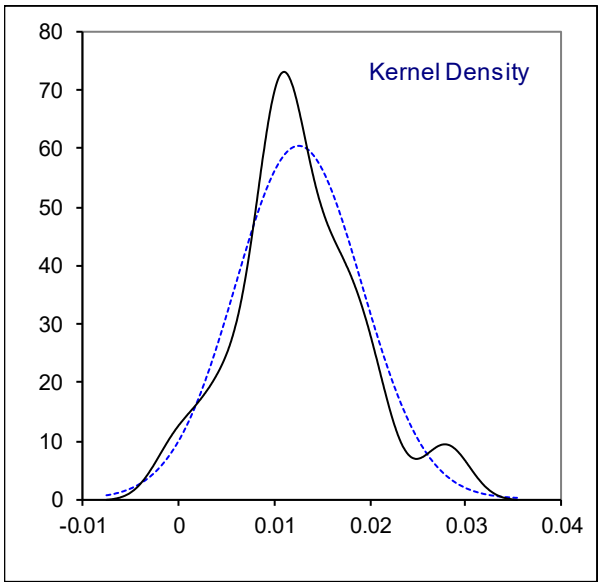
APPENDIX 1

Determination of Total Acid Number on sample #20065; results in mg KOH/g

lab	method	value	mark	z(targ)	remarks
150	D664-A	<0.10		-----	
171		-----		-----	
173		-----		-----	
178	D974	<0.01		-----	
179	D974	0.01		-0.19	
237	D664-A	<0.1		-----	
273		-----		-----	
311		-----		-----	
323	D974	<0.02		-----	
325	D664-A	<0.01		-----	
329	D974	0.004		-0.61	
333		-----		-----	
343	D664-A	<0.05		-----	
349	D664-A	0.01		-0.19	
357		-----		-----	
369	D664-A	0.013		0.02	
371	D974	0.011		-0.12	
396	D974	<0,02		-----	
432		-----		-----	
485		-----		-----	
496	D974	0.00		-0.89	
551	D974	0.02		0.51	
601		-----		-----	
603		-----		-----	
614	D664-A	<0.02		-----	
657	D974	<0.02		-----	
704	D664-A	< 0.1		-----	
785		-----		-----	
823	D974	<0.02		-----	
862		-----		-----	
874	D974	0.028		1.07	
875		-----		-----	
886		-----		-----	
912		-----		-----	
913		-----		-----	
922	D664-A	0.012		-0.05	
962		-----		-----	
963		-----		-----	
974	D974	0.016		0.23	
982		-----		-----	
1011	D974	0.01		-0.19	
1047	ISO6618	<0,01		-----	
1056	D664-A	0.017	C	0.30	first reported: 0.088
1081		-----		-----	
1082		-----		-----	
1145		-----		-----	
1191		-----		-----	
1349		-----		-----	
1389		-----		-----	
1429	D974	0.006		-0.47	
1510		-----		-----	
1564	D664-A	0.02		0.51	
1748		-----		-----	
1833	ISO6618	0.012		-0.05	
1862		-----		-----	
1877		-----		-----	
6016	D664-A	0.016		0.23	
6048	D974	<0,01		-----	
6113		-----		-----	
6163		-----		-----	
6262	D974	<0.02		-----	
6310	D664-A	0.01		-0.19	

normality	OK
n	17
outliers	0
mean (n)	0.0126
st.dev. (n)	0.00659
R(calc.)	0.0185
st.dev.(D974:14e2)	0.01429
R(D974:14e2)	0.04


0.06
0.05
0.04
0.03
0.02
0.01
0
496
329
1429
179
348
1011
6310
371
922
1833
369
974
6016
1056
551
1564
874


Kernel Density
80
70
60
50
40
30
20
10
0
-0.01
0
0.01
0.02
0.03
0.04

Determination of Air Release time at 50°C on sample #20065; results in minutes

lab	method	value	mark	z(targ)	remarks
150		-----		-----	
171		-----		-----	
173		-----		-----	
178		-----		-----	
179	D3427	0.3		-----	
237		-----		-----	
273		-----		-----	
311		-----		-----	
323		-----		-----	
325	D3427	<0.42		-----	
329		-----		-----	
333		-----		-----	
343		-----		-----	
349		-----		-----	
357		-----		-----	
369		-----		-----	
371		-----		-----	
396		-----		-----	
432	ISO9120	1.0		-----	
485		-----		-----	
496	D3427	<0.3		-----	
551		-----		-----	
601		-----		-----	
603		-----		-----	
614	D3427	<1.0		-----	
657	D3427	0.08		-----	
704		-----		-----	
785		-----		-----	
823		-----		-----	
862		-----		-----	
874		-----		-----	
875		-----		-----	
886		-----		-----	
912		-----		-----	
913		-----		-----	
922		-----		-----	
962		-----		-----	
963		-----		-----	
974		-----		-----	
982		-----		-----	
1011		-----		-----	
1047	D3427	<0,5		-----	
1056		-----		-----	
1081		-----		-----	
1082		-----		-----	
1145		-----		-----	
1191		-----		-----	
1349		-----		-----	
1389		-----		-----	
1429		-----		-----	
1510		-----		-----	
1564	D3427	0.4		-----	
1748		-----		-----	
1833		-----		-----	
1862		-----		-----	
1877		-----		-----	
6016	D3427	0.2		-----	
6048		-----		-----	
6113		-----		-----	
6163		-----		-----	
6262		-----		-----	
6310	D3427	3.0		-----	possibly a false positive test result?
				-----	
	n	9			
	mean (n)	≤1			

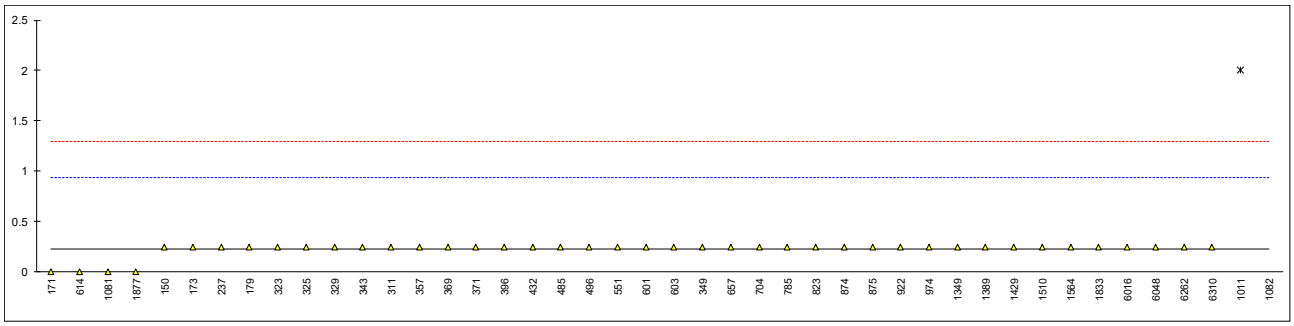
- empty page -

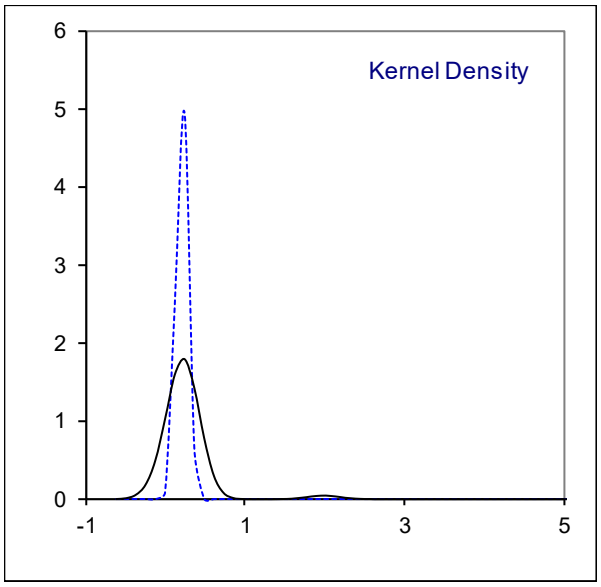
Determination of Color ASTM on sample #20065;

lab	method	reported test value	iis conversion*	mark	z(targ)	remarks
150	D6045	L0.5	0.25		0.07	
171	D1500	0	0		-0.63	
173	D1500	L0.5	0.25		0.07	
178		-----	-----		-----	
179	D1500	L0.5	0.25		0.07	
237	D1500	L0.5	0.25		0.07	
273		-----	-----		-----	
311	D1500	L0.5	0.25		0.07	
323	D1500	L0.5	0.25		0.07	
325	D6045	L0.5	0.25		0.07	
329	D1500	L0.5	0.25		0.07	
333		-----	-----		-----	
343	D1500	<0.5	0.25		0.07	
349	D6045	<0,5	0.25		0.07	
357	D6045	L0,5	0.25		0.07	
369	D1500	<0.5	0.25		0.07	
371	D6045	<0.5	0.25		0.07	
396	D1500	L 0,5	0.25		0.07	
432	D1500	L0,5	0.25		0.07	
485	D1500	L 0.5	0.25		0.07	
496	D1500	L 0.5	0.25		0.07	
551	D1500	L 0.5	0.25		0.07	
601	D1500	L0.5	0.25		0.07	
603	D1500	L0.5	0.25		0.07	
614	D1500	0.0	0.0		-0.63	
657	D1500	L0.5	0.25		0.07	
704	D1500	L 0.5	0.25		0.07	
785	D6045	<0.5	0.25		0.07	
823	D1500	L0.5	0.25		0.07	
862		-----	-----		-----	
874	D1500	<0.5	0.25		0.07	
875	D6045	< 0.5	0.25		0.07	
886		-----	-----		-----	
912		-----	-----		-----	
913		-----	-----		-----	
922	D1500	L0.5	0.25		0.07	
962		-----	-----		-----	
963		-----	-----		-----	
974	D1500	L0.5	0.25		0.07	
982		-----	-----		-----	
1011	D1500	2	2	G(0.01)	4.97	
1047		-----	-----		-----	
1056		-----	-----		-----	
1081	D6045	0.0	0.0		-0.63	
1082	D6045	30	30	ex	83.37	value not in terms of ASTM color
1145		-----	-----		-----	
1191	D6045	>30	>30		>83.37	value not in terms of ASTM color
1349	D6045	L0.5	0.25		0.07	
1389	D1500	L0.5	0.25		0.07	
1429	D1500	<0.5	0.25		0.07	
1510	D1500	L0.5	0.25		0.07	
1564	D1500	L0.5	0.25		0.07	
1748		-----	-----		-----	
1833	D1500	<0.5	0.25		0.07	
1862		-----	-----		-----	
1877	D6045	0.0	0.0		-0.63	
6016	D1500	L0.5	0.25		0.07	
6048	D1500	L0,5	0.25		0.07	
6113		-----	-----		-----	
6163		-----	-----		-----	
6262	D1500	L0.5	0.25		0.07	
6310	D1500	L0.5	0.25		0.07	

normality	not OK
n	42
outliers	1 (+1ex)
mean (n)	0.23
st.dev. (n)	0.074
R(calc.)	0.21
st.dev.(D1500:12)	0.357
R(D1500:12)	1

* In the calculation of the mean, standard deviation and the reproducibility of this column, a reported value of ‘L y’ is converted by iis into y-0.25 (for example L0.5 into 0.25)


2.5
2
1.5
1
0.5
0
171
614
1081
1877
150
173
237
179
323
325
329
343
311
357
369
371
396
432
485
496
551
601
603
349
657
704
785
823
874
875
922
974
1349
1389
1429
1510
1564
1833
6016
6048
6262
6310
1011
1082


Kernel Density
6
5
4
3
2
1
0
-1
1
3
5

Determination of Conradson Carbon Residue on sample #20065; results in %M/M

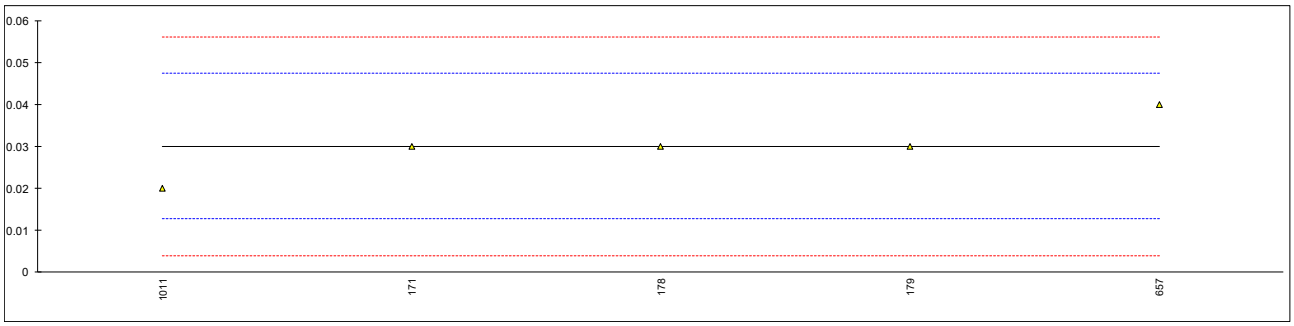
lab	method	value	mark	z(targ)	remarks
150	D4530	<0.10		-----	
171	D189	<0.01		-----	
173		-----		-----	
178		-----		-----	
179		-----		-----	
237	D189	0.007		-----	
273		-----		-----	
311	D4530	<0.10		-----	
323	D4530	0.01		-----	
325	D4530	0.0012		-----	
329		-----		-----	
333		-----		-----	
343		-----		-----	
349	D189	0.01		-----	
357		-----		-----	
369	D4530	<0.01		-----	
371	D189	0.001		-----	
396	D189	<0,01		-----	
432		-----		-----	
485		-----		-----	
496		-----		-----	
551	D189	<0.01		-----	
601		-----		-----	
603		-----		-----	
614	D189	0.001998		-----	
657	D4530	<0.10		-----	
704	D4530	< 0.1		-----	
785	D4530	<0.10		-----	
823	D189	0.01		-----	
862		-----		-----	
874	D4530	0.0058		-----	
875		-----		-----	
886		-----		-----	
912		-----		-----	
913		-----		-----	
922	D4530	<0.01		-----	
962		-----		-----	
963		-----		-----	
974	D189	<0.01		-----	
982		-----		-----	
1011		-----		-----	
1047	D4530	<0,10		-----	
1056		-----		-----	
1081		-----		-----	
1082		-----		-----	
1145		-----		-----	
1191		-----		-----	
1349		-----		-----	
1389	D189	<0.10		-----	
1429		-----		-----	
1510		-----		-----	
1564		-----		-----	
1748		-----		-----	
1833	D4530	<0.1		-----	
1862		-----		-----	
1877		-----		-----	
6016		-----		-----	
6048	D4530	<0,01		-----	
6113		-----		-----	
6163		-----		-----	
6262	D4530	< 0.01		-----	
6310		-----		-----	
	n	24			
	mean (n)	<0.1			

- empty page -

Determination of Ramsbottom Carbon Residue on sample #20065; results in %M/M

lab	method	value	mark	z(targ)	remarks
150		-----		-----	
171	D524	0.03		0.00	
173		-----		-----	
178	D524	0.03		0.00	
179	D524	0.03		0.00	
237		-----		-----	
273		-----		-----	
311		-----		-----	
323		-----		-----	
325		-----		-----	
329		-----		-----	
333		-----		-----	
343		-----		-----	
349		-----		-----	
357		-----		-----	
369		-----		-----	
371		-----		-----	
396		-----		-----	
432		-----		-----	
485		-----		-----	
496		-----		-----	
551		-----		-----	
601		-----		-----	
603		-----		-----	
614		-----		-----	
657	D524	0.04		1.15	
704		-----		-----	
785		-----		-----	
823		-----		-----	
862		-----		-----	
874		-----		-----	
875		-----		-----	
886		-----		-----	
912		-----		-----	
913		-----		-----	
922		-----		-----	
962		-----		-----	
963		-----		-----	
974		-----		-----	
982		-----		-----	
1011	D524	0.02		-1.15	
1047		-----		-----	
1056		-----		-----	
1081		-----		-----	
1082		-----		-----	
1145		-----		-----	
1191		-----		-----	
1349		-----		-----	
1389		-----		-----	
1429		-----		-----	
1510		-----		-----	
1564		-----		-----	
1748		-----		-----	
1833		-----		-----	
1862		-----		-----	
1877		-----		-----	
6016		-----		-----	
6048		-----		-----	
6113		-----		-----	
6163		-----		-----	
6262		-----		-----	
6310		-----		-----	

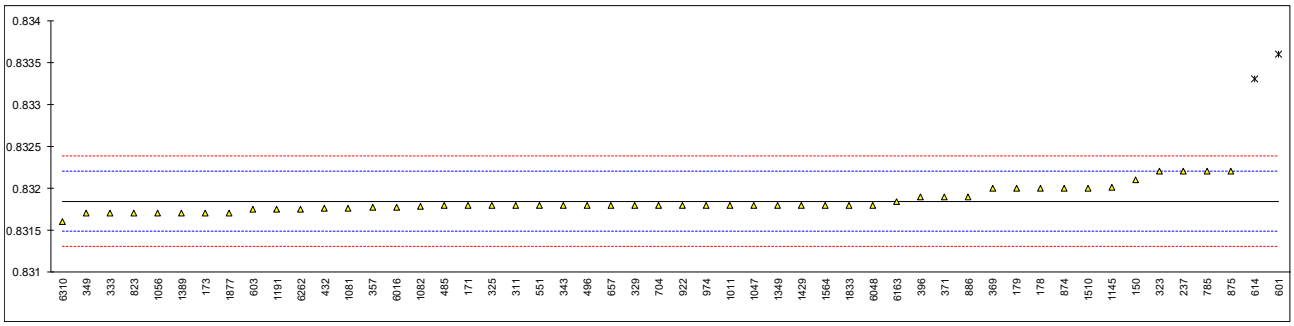
normality	unknown
n	5
outliers	0
mean (n)	0.0300
st.dev. (n)	0.00707
R(calc.)	0.0198
st.dev.(D524:15)	0.00869
R(D524:15)	0.0243

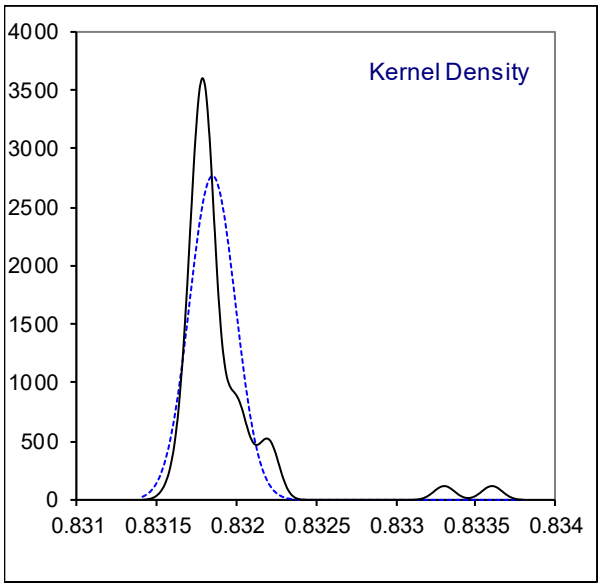

0.06
0.05
0.04
0.03
0.02
0.01
0
1011
171
178
179
657

Determination of Density at 15°C on sample #20065; results in kg/L

lab	method	value	mark	z(targ)	remarks
150	D4052	0.8321		1.43	
171	D4052	0.8318		-0.25	
173	D4052	0.83171		-0.76	
178	D4052	0.832		0.87	
179	D4052	0.832		0.87	
237	D4052	0.8322		1.99	
273		-----		-----	
311	D4052	0.8318		-0.25	
323	D4052	0.8322		1.99	
325	D4052	0.8318		-0.25	
329	D4052	0.8318		-0.25	
333	D4052	0.8317		-0.81	
343	D4052	0.8318		-0.25	
349	D4052	0.83170		-0.81	
357	D4052	0.83177		-0.42	
369	D4052	0.8320		0.87	
371	D4052	0.8319		0.31	
396	D4052	0.8319		0.31	
432	D4052	0.83176		-0.48	
485	D4052	0.8318	C	-0.25	first reported: 0.8318 kg/m3
496	D4052	0.83180		-0.25	
551	d4052	0.8318		-0.25	
601	D4052	0.8336	R(0.01)	9.83	
603	D4052	0.83175		-0.53	
614	D4052	0.8333	R(0.01)	8.15	
657	D4052	0.8318		-0.25	
704	D4052	0.8318		-0.25	
785	D4052	0.8322		1.99	
823	D4052	0.8317		-0.81	
862		-----		-----	
874	D4052	0.8320		0.87	
875	D4052	0.8322		1.99	
886	D4052	0.8319		0.31	
912		-----		-----	
913		-----		-----	
922	D4052	0.8318		-0.25	
962		-----		-----	
963		-----		-----	
974	D4052	0.8318		-0.25	
982		-----		-----	
1011	D4052	0.8318		-0.25	
1047	ISO12185	0.8318		-0.25	
1056	D4052	0.8317		-0.81	
1081	D4052	0.83176		-0.48	
1082	ISO12185	0.83178		-0.37	
1145	D4052	0.83201		0.92	
1191	ISO12185	0.83175		-0.53	
1349	IP365	0.8318		-0.25	
1389	ISO12185	0.8317		-0.81	
1429	D4052	0.8318		-0.25	
1510	D4052	0.8320		0.87	
1564	D4052	0.8318		-0.25	
1748		-----		-----	
1833	ISO12185	0.8318		-0.25	
1862		-----		-----	
1877	D4052	0.83171		-0.76	
6016	D4052	0.83177		-0.42	
6048	ISO12185	0.8318		-0.25	
6113		-----		-----	
6163	ISO12185	0.8318376		-0.04	
6262	D4052	0.83175		-0.53	
6310	D4052	0.8316		-1.37	

normality	suspect
n	50
outliers	2
mean (n)	0.83185
st.dev. (n)	0.000144
R(calc.)	0.00040
st.dev.(ISO12185:96)	0.000179
R(ISO12185:96)	0.0005

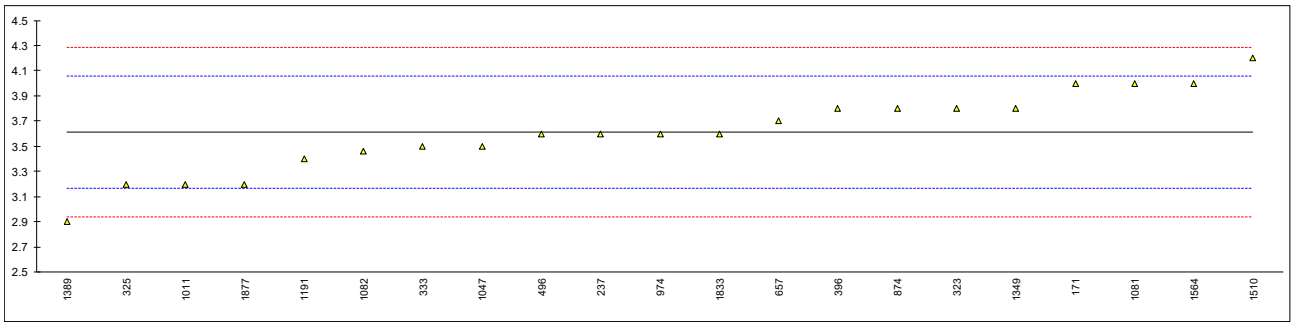

0.834
0.8335
0.833
0.8325
0.832
0.8315
0.831
6310 349 333 823 1056 1389 173 1877 603 1191 6262 432 1081 357 6016 1082 485 171 325 311 551 343 496 657 329 704 922 974 1011 1047 1349 1429 1564 1833 6048 6163 396 371 886 369 179 178 874 1510 1145 150 323 237 785 875 614 601

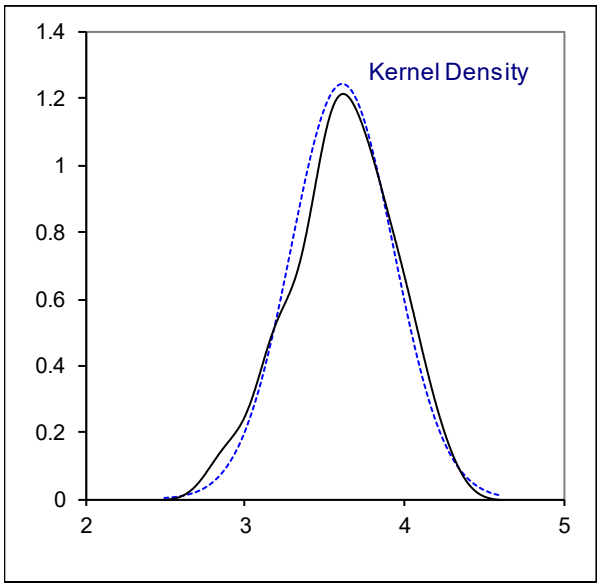

Kernel Density
4000
3500
3000
2500
2000
1500
1000
500
0
0.831 0.8315 0.832 0.8325 0.833 0.8335 0.834

Determination of Evaporation loss by Noack test on sample #20065; results in %M/M

lab	method	value	mark	z(targ)	remarks
150		-----		-----	
171	D5800-B	4.0		1.73	
173		-----		-----	
178		-----		-----	
179		-----		-----	
237	D5800-B	3.6		-0.06	
273		-----		-----	
311		-----		-----	
323	D5800-B	3.8		0.84	
325	CEC L-40-93	3.2		-1.84	
329		-----		-----	
333	CEC L-40-93	3.5		-0.50	
343		-----		-----	
349		-----		-----	
357		-----		-----	
369		-----		-----	
371		-----		-----	
396	D5800-B	3.8		0.84	
432		-----		-----	
485		-----		-----	
496	D5800-B	3.6		-0.06	
551		-----		-----	
601		-----		-----	
603		-----		-----	
614		-----		-----	
657	D5800-B	3.7		0.39	
704		-----		-----	
785		-----		-----	
823		-----		-----	
862		-----		-----	
874	D5800-B	3.8		0.84	
875		-----		-----	
886		-----		-----	
912		-----		-----	
913		-----		-----	
922		-----		-----	
962		-----		-----	
963		-----		-----	
974	D5800-B	3.6		-0.06	
982		-----		-----	
1011	CEC L-40-93	3.2		-1.84	
1047	DIN51581	3.50		-0.50	
1056		-----		-----	
1081	D5800-B	4.0		1.73	
1082	CEC L-40-93	3.46		-0.68	
1145		-----		-----	
1191	D5800-C	3.40206		-0.94	
1349	D5800-B	3.8		0.84	
1389	D5800-B	2.9		-3.18	
1429		-----		-----	
1510	D5800-B	4.2		2.62	
1564	CEC L-40-93	4.0		1.73	
1748		-----		-----	
1833	D5800-B	3.6		-0.06	
1862		-----		-----	
1877	CEC L-40-93	3.2		-1.84	
6016		-----		-----	
6048		-----		-----	
6113		-----		-----	
6163		-----		-----	
6262		-----		-----	
6310		-----		-----	

normality	OK
n	21
outliers	0
mean (n)	3.612
st.dev. (n)	0.3206
R(calc.)	0.898
st.dev.(D5800-B:20)	0.2240
R(D5800-B:20)	0.627

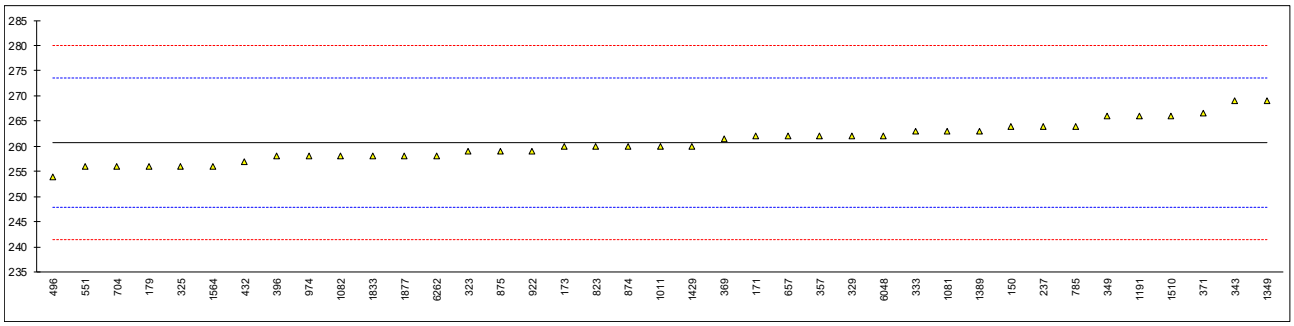

4.5
4.3
4.1
3.9
3.7
3.5
3.3
3.1
2.9
2.7
2.5
1389
325
1011
1877
1191
1082
333
1047
496
237
974
1833
657
396
874
323
1349
171
1081
1564
1510

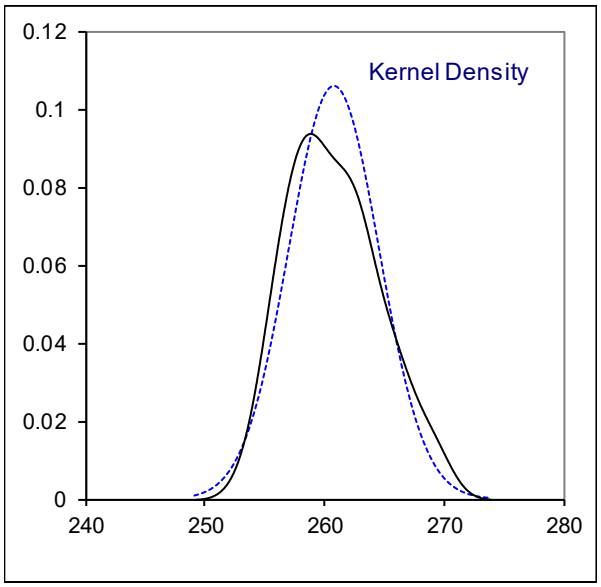

Kernel Density
1.4
1.2
1
0.8
0.6
0.4
0.2
0
2
3
4
5

Determination of Flash Point C.O.C. on sample #20065; results in °C

lab	method	value	mark	z(targ)	remarks
150	D92	264		0.50	
171	D92	262		0.19	
173	D92	260		-0.12	
178		-----		-----	
179	D92	256		-0.75	
237	D92	264		0.50	
273		-----		-----	
311		-----		-----	
323	D92	259		-0.28	
325	D92	256		-0.75	
329	D92	262		0.19	
333	D92	263		0.34	
343	D92	269		1.28	
349	D92	266		0.81	
357	D92	262.0		0.19	
369	D92	261.5		0.11	
371	D92	266.5		0.89	
396	D92	258		-0.43	
432	D92	257.0		-0.59	
485		-----		-----	
496	D92	254		-1.06	
551	D92	256		-0.75	
601		-----		-----	
603		-----		-----	
614		-----		-----	
657	D92	262		0.19	
704	D92	256		-0.75	
785	D92	264		0.50	
823	D92	260		-0.12	
862		-----		-----	
874	D92	260		-0.12	
875	D92	259		-0.28	
886		-----		-----	
912		-----		-----	
913		-----		-----	
922	D92	259		-0.28	
962		-----		-----	
963		-----		-----	
974	D92	258		-0.43	
982		-----		-----	
1011	D92	260		-0.12	
1047		-----		-----	
1056		-----		-----	
1081	D92	263.0		0.34	
1082	ISO2592	258.0		-0.43	
1145		-----		-----	
1191	ISO2592	266		0.81	
1349	D92	269		1.28	
1389	D92	263		0.34	
1429	D92	260.0		-0.12	
1510	D92	266		0.81	
1564	D92	256		-0.75	
1748		-----		-----	
1833	ISO2592	258		-0.43	
1862		-----		-----	
1877	D92	258		-0.43	
6016		-----		-----	
6048	ISO2592	262		0.19	
6113		-----		-----	
6163		-----		-----	
6262	D92	258		-0.43	
6310		-----		-----	

normality	OK
n	39
outliers	0
mean (n)	260.79
st.dev. (n)	3.759
R(calc.)	10.52
st.dev.(D92:18)	6.429
R(D92:18)	18

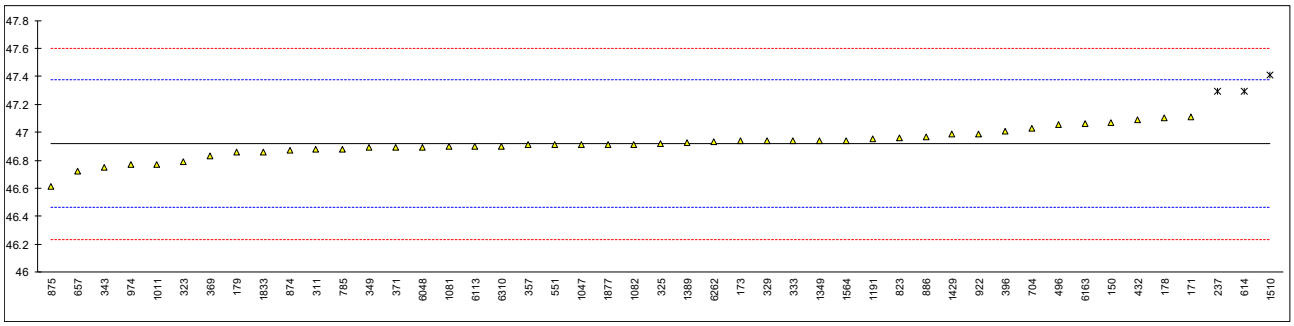

285
280
275
270
265
260
255
250
245
240
235
496
551
704
179
325
1564
432
396
974
1082
1833
1877
6262
323
875
922
173
823
874
1011
1429
369
171
657
357
329
6048
333
1081
1389
150
237
785
349
1191
1510
371
343
1349

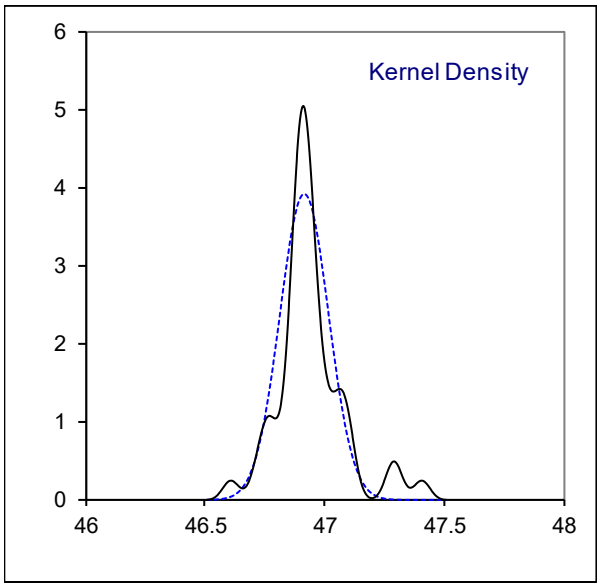

Kernel Density
0.12
0.1
0.08
0.06
0.04
0.02
0
240
250
260
270
280

Determination of Kinematic Viscosity at 40°C on sample #20065; results in mm²/s

lab	method	value	mark	z(targ)	remarks
150	D445	47.07		0.67	
171	D445	47.11		0.84	
173	D445	46.94		0.10	
178	D445	47.1		0.80	
179	D445	46.86		-0.25	
237	D445	47.29	R(0.05)	1.63	
273		-----		-----	
311	D445	46.88		-0.16	
323	D445	46.79		-0.56	
325	D445	46.92		0.01	
329	D445	46.94		0.10	
333	D445	46.94		0.10	
343	D445	46.75		-0.74	
349	D445	46.89		-0.12	
357	D445	46.91		-0.03	
369	D445	46.83		-0.38	
371	D445	46.89		-0.12	
396	D445	47.01		0.41	
432	D445	47.09		0.76	
485		-----		-----	
496	D445	47.058		0.62	
551	D445	46.91		-0.03	
601		-----		-----	
603		-----		-----	
614	D7042	47.296	R(0.05)	1.66	
657	D445	46.72		-0.87	
704	D445	47.026		0.48	
785	D445	46.88		-0.16	
823	D445	46.96		0.19	
862		-----		-----	
874	D445	46.87		-0.21	
875	D445	46.61		-1.35	
886	D445	46.97		0.23	
912		-----		-----	
913		-----		-----	
922	D445	46.99		0.32	
962		-----		-----	
963		-----		-----	
974	D445	46.768		-0.66	
982		-----		-----	
1011	D445	46.77		-0.65	
1047	ISO3104	46.91		-0.03	
1056		-----		-----	
1081	D445	46.90		-0.08	
1082	ISO3104	46.913		-0.02	
1145		-----		-----	
1191	ISO3104	46.952		0.15	
1349	D445	46.94		0.10	
1389	D445	46.924		0.03	
1429	D445	46.985		0.30	
1510	D445	47.41	R(0.05)	2.16	
1564	D445	46.94		0.10	
1748		-----		-----	
1833		46.86		-0.25	
1862		-----		-----	
1877	D445	46.91		-0.03	
6016		-----		-----	
6048	D445	46.89		-0.12	
6113	D445	46.90		-0.08	
6163	ISO3104	47.0606		0.63	
6262	D445	46.934		0.07	
6310	D7279 corr. to D445	46.9		-0.08	

normality	suspect
n	44
outliers	3
mean (n)	46.918
st.dev. (n)	0.1020
R(calc.)	0.286
st.dev.(D445:19a)	0.2279
R(D445:19a)	0.638

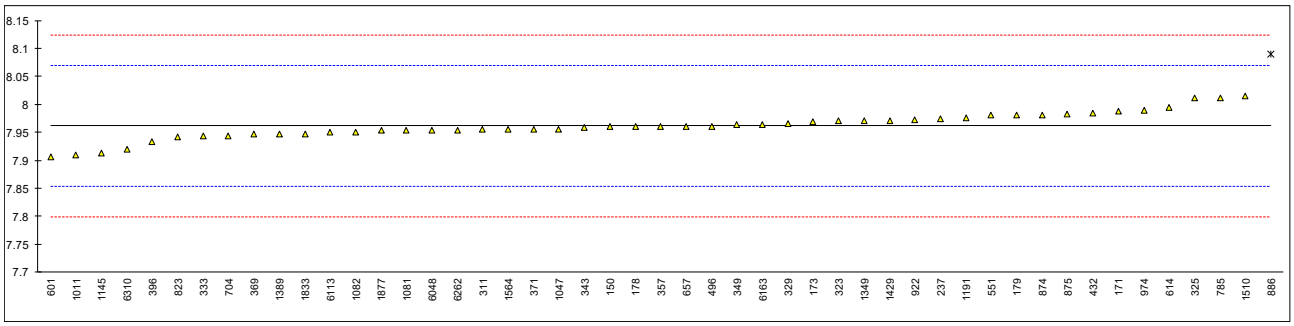

47.8
47.6
47.4
47.2
47
46.8
46.6
46.4
46.2
46
875 657 343 974 1011 323 369 179 1833 874 311 785 349 371 6048 1081 6113 6310 357 551 1047 1877 1082 325 1389 6262 173 329 333 1349 1564 1191 823 886 1429 922 396 704 496 6163 150 432 178 171 237 614 1510

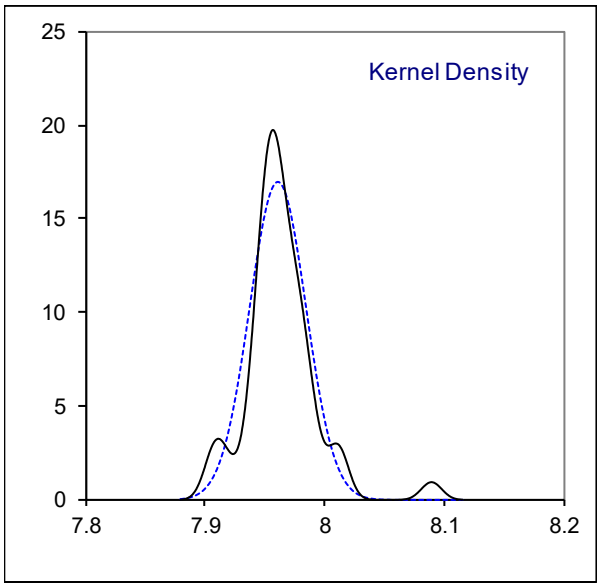

Kernel Density
6
5
4
3
2
1
0
46
46.5
47
47.5
48

Determination of Kinematic Viscosity at 100°C on sample #20065; results in mm²/s

lab	method	value	mark	z(targ)	remarks
150	D445	7.960		-0.03	
171	D445	7.988		0.49	
173	D445	7.969		0.14	
178	D445	7.96		-0.03	
179	D445	7.98		0.34	
237	D445	7.974		0.23	
273		-----		-----	
311	D445	7.955		-0.12	
323	D445	7.970		0.15	
325	D445	8.011		0.91	
329	D445	7.965		0.06	
333	D445	7.943		-0.35	
343	D445	7.959		-0.05	
349	D445	7.963		0.02	
357	D445	7.961		-0.01	
369	D445	7.946		-0.29	
371	D445	7.956		-0.10	
396	D445	7.934		-0.51	
432	D445	7.985		0.43	
485		-----		-----	
496	D445	7.9612		-0.01	
551	D445	7.98		0.34	
601	D445	7.906		-1.03	
603		-----		-----	
614	D7042	7.994		0.60	
657	D445	7.961		-0.01	
704	D445	7.9439		-0.33	
785	D445	8.011		0.91	
823	D445	7.942		-0.36	
862		-----		-----	
874	D445	7.980		0.34	
875	D445	7.982		0.38	
886	D445	8.090	R(0.01)	2.38	
912		-----		-----	
913		-----		-----	
922	D445	7.973		0.21	
962		-----		-----	
963		-----		-----	
974	D445	7.9895		0.52	
982		-----		-----	
1011	D445	7.910		-0.96	
1047	ISO3104	7.956		-0.10	
1056		-----		-----	
1081	D445	7.954		-0.14	
1082	ISO3104	7.9507		-0.20	
1145	D445	7.9124		-0.91	
1191	ISO3104	7.9764		0.27	
1349	D445	7.971		0.17	
1389	D445	7.946		-0.29	
1429	D445	7.971		0.17	
1510	D445	8.014		0.97	
1564	D445	7.955		-0.12	
1748		-----		-----	
1833		7.947		-0.27	
1862		-----		-----	
1877	D445	7.953		-0.16	
6016		-----		-----	
6048	D445	7.954		-0.14	
6113	D445	7.95		-0.22	
6163	ISO3104	7.963		0.02	
6262	D445	7.9542		-0.14	
6310	D7279 corr. to D445	7.92		-0.77	

normality	OK
n	48
outliers	1
mean (n)	7.9617
st.dev. (n)	0.02353
R(calc.)	0.0659
st.dev.(D445:19a)	0.05403
R(D445:19a)	0.1513

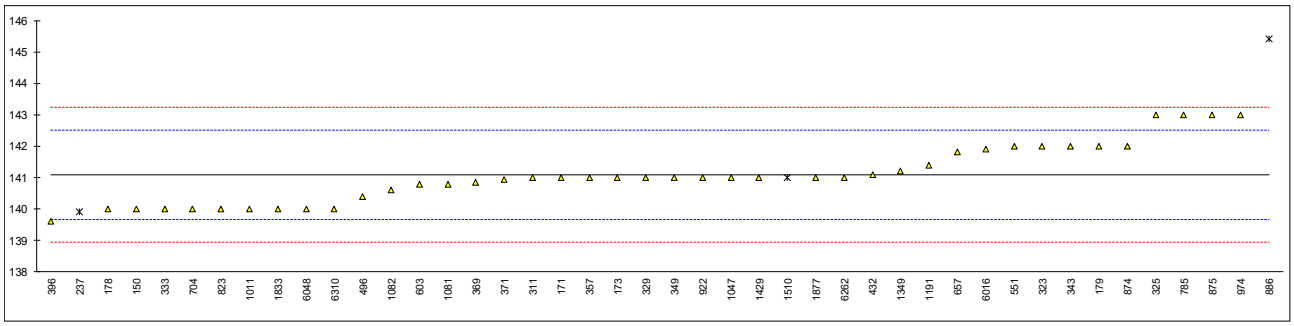

8.15
8.1
8.05
8
7.95
7.9
7.85
7.8
7.75
7.7
601 1011 1145 6310 396 823 333 704 369 1389 1833 6113 1082 1877 1081 6048 6262 311 1564 371 1047 343 150 178 357 657 496 349 6163 329 173 323 1349 1429 922 237 1191 551 179 874 875 432 171 974 614 325 785 1510 886

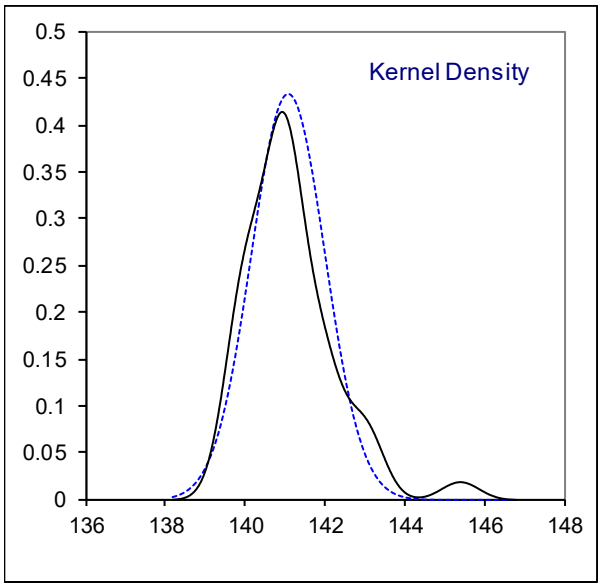

Kernel Density
25
20
15
10
5
0
7.8
7.9
8
8.1
8.2

Determination of Viscosity Index on sample #20065

lab	method	value	mark	z(targ)	remarks
150	D2270	140		-1.52	
171	D2270	141		-0.12	
173	D2270	141		-0.12	
178	D2270	140		-1.52	
179	D2270	142		1.28	
237	D2270	139.9	ex	-1.66	excluded, outlier in kinematic viscosity at 40°C
273		-----		-----	
311	D2270	141		-0.12	
323	D2270	142		1.28	
325	D2270	143		2.68	
329	D2270	141		-0.12	
333	D2270	140		-1.52	
343	D2270	142	C	1.28	first reported: 132
349	D2270	141		-0.12	
357	D2270	141		-0.12	
369	D2270	140.85		-0.33	
371	D2270	140.95		-0.19	
396	D2270	139.6		-2.08	
432	D2270	141.1		0.02	
485		-----		-----	
496	D2270	140.4		-0.96	
551	D2270	142		1.28	
601		-----		-----	
603	D2270	140.8		-0.40	
614		-----		-----	
657	D2270	141.8		1.00	
704	D2270	140		-1.52	
785	D2270	143		2.68	
823	D2270	140		-1.52	
862		-----		-----	
874	D2270	142		1.28	
875	D2270	143		2.68	
886	D2270	145.4	ex	6.04	excluded, outlier in kinematic viscosity at 100°C
912		-----		-----	
913		-----		-----	
922	D2270	141		-0.12	
962		-----		-----	
963		-----		-----	
974	D2270	143		2.68	
982		-----		-----	
1011	D2270	140		-1.52	
1047	ISO2909	141		-0.12	
1056		-----		-----	
1081	D2270	140.8		-0.40	
1082	D2270	140.6181		-0.65	
1145		-----		-----	
1191	D2270	141.4		0.44	
1349	D2270	141.2		0.16	
1389		-----		-----	
1429	D2270	141		-0.12	
1510	D2270	141	ex	-0.12	excluded, outlier in kinematic viscosity at 40°C
1564		-----		-----	
1748		-----		-----	
1833		140	E	-1.52	possibly a calculation error, iis calculated 140.76
1862		-----		-----	
1877	D2270	141		-0.12	
6016	D2270	141.9		1.14	
6048	D2270	140	E	-1.52	possibly a calculation error, iis calculated 140.88
6113		-----		-----	
6163		-----		-----	
6262	D2270	141		-0.12	
6310	D2270	140		-1.52	

normality	OK
n	41
outliers	0 (+3ex)
mean (n)	141.08
st.dev. (n)	0.921
R(calc.)	2.58
st.dev.(D2270:10)	0.714
R(D2270:10)	2

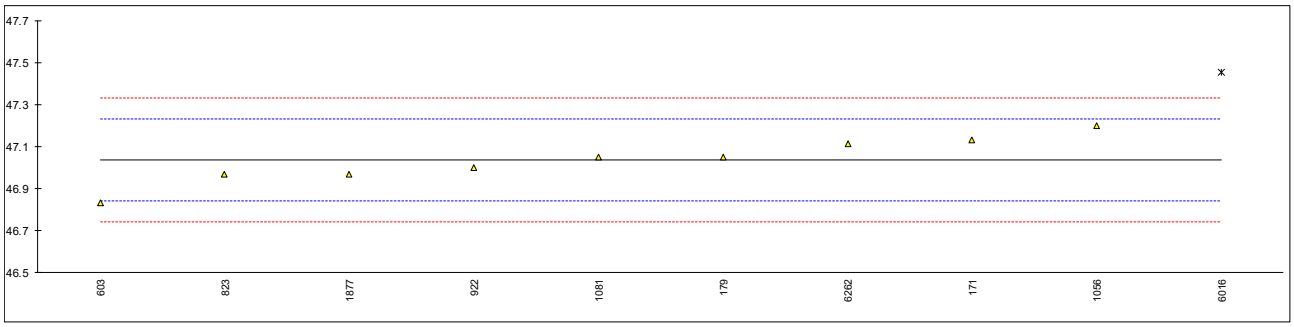

146
145
144
143
142
141
140
139
138
396 237 178 150 333 704 823 1011 1833 6048 6310 486 1082 603 1081 369 371 311 171 357 173 329 349 922 1047 1429 1510 1877 6262 432 1349 1191 657 6016 551 323 343 179 874 325 785 875 974 886

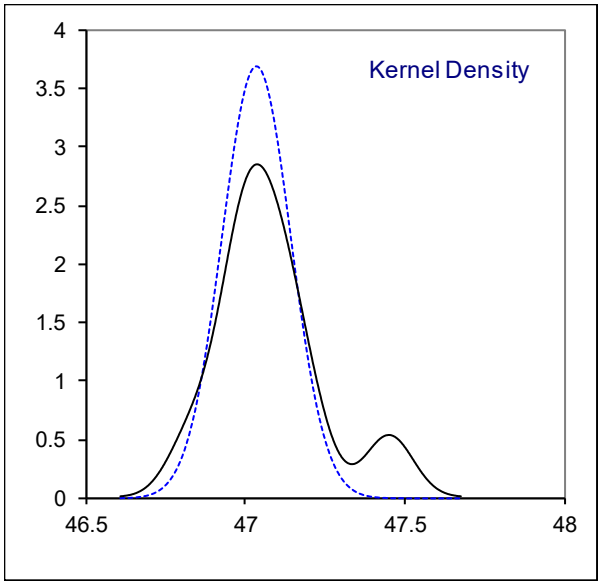

Kernel Density
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
136 138 140 142 144 146 148

Determination of Viscosity Stabinger at 40°C on sample #20065; results in mm^2/s

lab	method	value	mark	z(targ)	remarks
150		-----		-----	
171	D7042	47.13		0.97	
173		-----		-----	
178		-----		-----	
179	D7042	47.05		0.15	
237		-----		-----	
273		-----		-----	
311		-----		-----	
323		-----		-----	
325		-----		-----	
329		-----		-----	
333		-----		-----	
343		-----		-----	
349		-----		-----	
357		-----		-----	
369		-----		-----	
371		-----		-----	
396		-----		-----	
432		-----		-----	
485		-----		-----	
496		-----		-----	
551		-----		-----	
601		-----		-----	
603	D7042	46.833		-2.06	
614		-----		-----	
657		-----		-----	
704		-----		-----	
785		-----		-----	
823	D7042	46.97		-0.66	
862		-----		-----	
874		-----		-----	
875		-----		-----	
886		-----		-----	
912		-----		-----	
913		-----		-----	
922	D7042	47.00		-0.36	
962		-----		-----	
963		-----		-----	
974		-----		-----	
982		-----		-----	
1011		-----		-----	
1047		-----		-----	
1056	D7042	47.2		1.68	
1081	D7042	47.049		0.14	
1082		-----		-----	
1145		-----		-----	
1191		-----		-----	
1349		-----		-----	
1389		-----		-----	
1429		-----		-----	
1510		-----		-----	
1564		-----		-----	
1748		-----		-----	
1833		-----		-----	
1862		-----		-----	
1877	D7042	46.97		-0.66	
6016	D7042	47.453	C,G(0.05)	4.26	first reported: 47.479
6048		-----		-----	
6113		-----		-----	
6163		-----		-----	
6262	D7042	47.114		0.80	
6310		-----		-----	

normality	OK
n	9
outliers	1
mean (n)	47.035
st.dev. (n)	0.1080
R(calc.)	0.303
st.dev.(D7042:19e1)	0.0981
R(D7042:19e1)	0.275

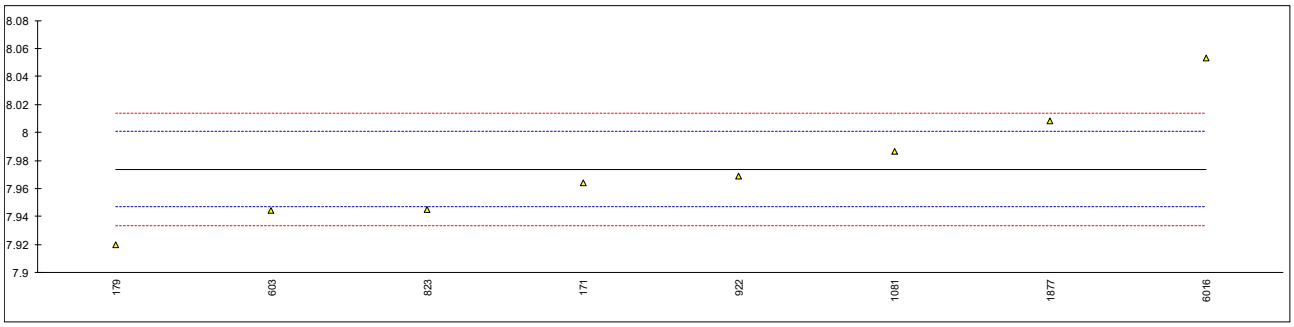

47.7
47.5
47.3
47.1
46.9
46.7
46.5
603
823
1877
922
1081
179
6282
171
1056
6016

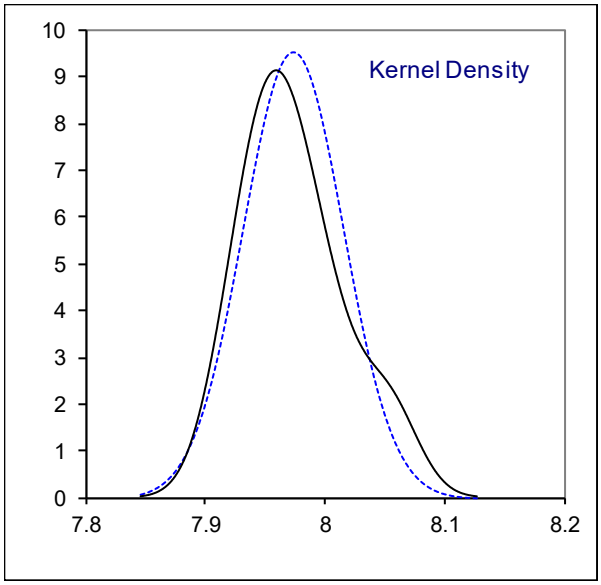

Kernel Density
4
3.5
3
2.5
2
1.5
1
0.5
0
46.5
47
47.5
48

Determination of Viscosity Stabinger at 100°C on sample #20065; results in mm^2/s

lab	method	value	mark	z(targ)	remarks
150		-----		-----	
171	D7042	7.964		-0.73	
173		-----		-----	
178		-----		-----	
179	D7042	7.92		-4.01	
237		-----		-----	
273		-----		-----	
311		-----		-----	
323		-----		-----	
325		-----		-----	
329		-----		-----	
333		-----		-----	
343		-----		-----	
349		-----		-----	
357		-----		-----	
369		-----		-----	
371		-----		-----	
396		-----		-----	
432		-----		-----	
485		-----		-----	
496		-----		-----	
551		-----		-----	
601		-----		-----	
603	D7042	7.9441		-2.21	
614		-----		-----	
657		-----		-----	
704		-----		-----	
785		-----		-----	
823	D7042	7.945		-2.14	
862		-----		-----	
874		-----		-----	
875		-----		-----	
886		-----		-----	
912		-----		-----	
913		-----		-----	
922	D7042	7.969		-0.35	
962		-----		-----	
963		-----		-----	
974		-----		-----	
982		-----		-----	
1011		-----		-----	
1047		-----		-----	
1056		-----		-----	
1081	D7042	7.9866		0.96	
1082		-----		-----	
1145		-----		-----	
1191		-----		-----	
1349		-----		-----	
1389		-----		-----	
1429		-----		-----	
1510		-----		-----	
1564		-----		-----	
1748		-----		-----	
1833		-----		-----	
1862		-----		-----	
1877	D7042	8.008		2.56	
6016	D7042	8.053		5.92	
6048		-----		-----	
6113		-----		-----	
6163		-----		-----	
6262		-----		-----	
6310		-----		-----	

normality	unknown
n	8
outliers	0
mean (n)	7.9737
st.dev. (n)	0.04197
R(calc.)	0.1175
st.dev.(D7042:19e1)	0.01339
R(D7042:19e1)	0.0375

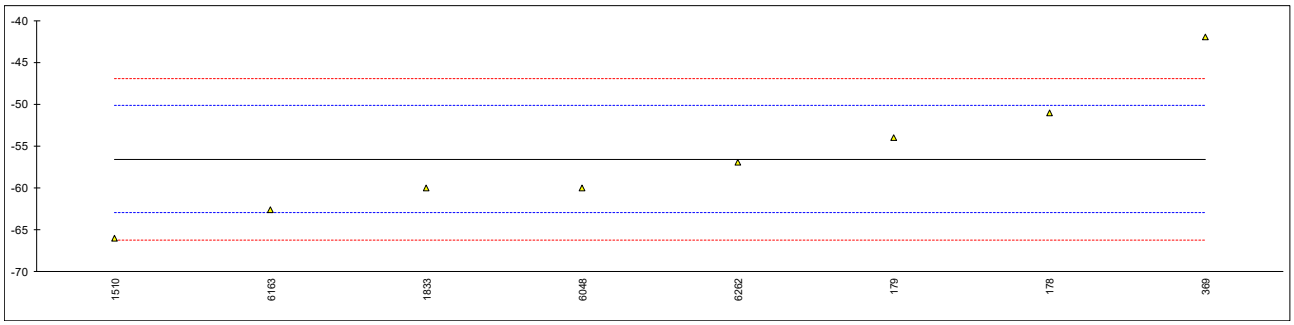

8.08
8.06
8.04
8.02
8
7.98
7.96
7.94
7.92
7.9
179
603
823
171
922
1081
1877
6016

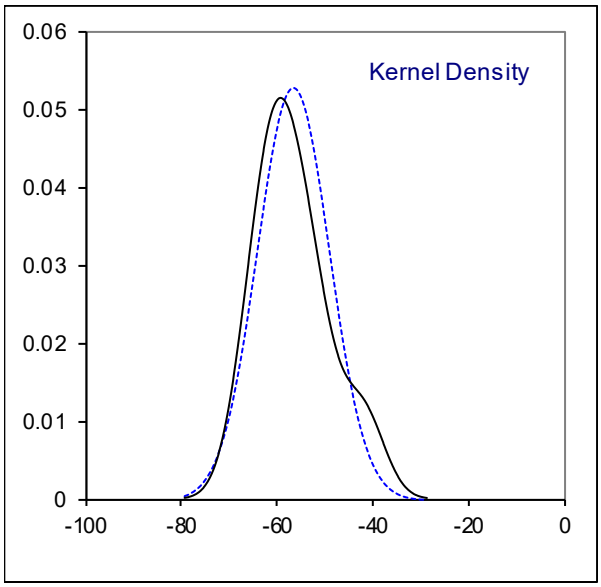

Kernel Density
10
9
8
7
6
5
4
3
2
1
0
7.8
7.9
8
8.1
8.2

Determination of Pour Point, Manual on sample #20065; results in °C

lab	method	value	mark	z(targ)	remarks
150	D97	<-33		-----	
171	D97	<-60		-----	
173		-----		-----	
178	D97	-51		1.73	
179	D97	-54		0.80	
237		-----		-----	
273		-----		-----	
311	D97	<-30		-----	
323		-----		-----	
325		-----		-----	
329		-----		-----	
333		-----		-----	
343		-----		-----	
349		-----		-----	
357		-----		-----	
369	D97	-42		4.53	
371	D97	<-42		-----	
396	D97	<-36		-----	
432		-----		-----	
485		-----		-----	
496		-----		-----	
551		-----		-----	
601		-----		-----	
603		-----		-----	
614		-----		-----	
657	D97	<-51		-----	
704	D97	< - 42		-----	
785	D97	<-42		-----	
823	ISO3016	<-54		-----	
862		-----		-----	
874	D97	<-39		-----	
875		-----		-----	
886		-----		-----	
912		-----		-----	
913		-----		-----	
922	D97	<-51		-----	
962		-----		-----	
963		-----		-----	
974	D97	<-42		-----	
982		-----		-----	
1011		-----		-----	
1047		-----		-----	
1056		-----		-----	
1081		-----		-----	
1082		-----		-----	
1145		-----		-----	
1191		-----		-----	
1349		-----		-----	
1389	D97	<-21		-----	
1429	D97	<-30		-----	
1510	D97	-66		-2.93	
1564		-----		-----	
1748		-----		-----	
1833	D97	-60		-1.07	
1862		-----		-----	
1877		-----		-----	
6016		-----		-----	
6048	ISO3016	-60		-1.07	
6113		-----		-----	
6163	ISO3016	-62.6	C	-1.87	
6262	D97	-57		-0.13	
6310		-----		-----	

normality	unknown
n	8
outliers	0
mean (n)	-56.58
st.dev. (n)	7.549
R(calc.)	21.14
st.dev.(D97:17b)	3.214
R(D97:17b)	9

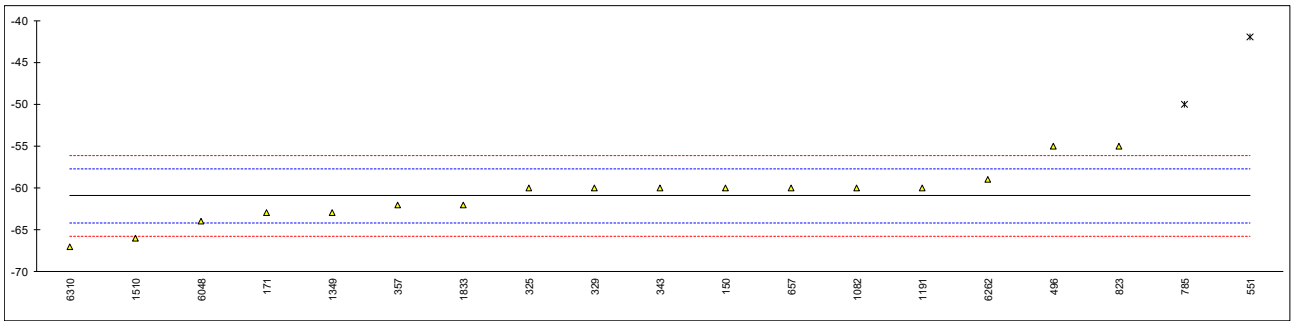

-40
-45
-50
-55
-60
-65
-70
1510
6163
1833
6048
6262
179
178
369

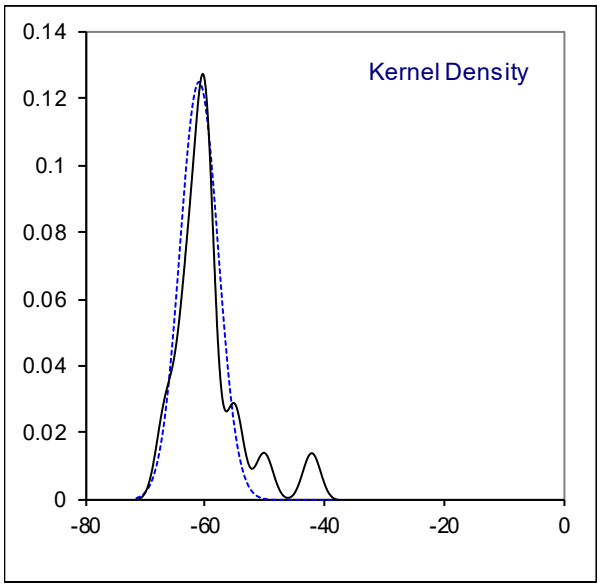

Kernel Density
0.06
0.05
0.04
0.03
0.02
0.01
0
-100
-80
-60
-40
-20
0

Determination of Pour Point, Automated 1°C interval on sample #20065; results in °C

lab	method	value	mark	z(targ)	remarks
150	D5950	-60		0.59	
171	D5950	-63		-1.28	
173		-----		-----	
178		-----		-----	
179		-----		-----	
237		-----		-----	
273		-----		-----	
311		-----		-----	
323	D5950	<-60		-----	
325	D5950	-60		0.59	
329	Automatic acc. to D97	-60		0.59	
333		-----		-----	
343	Automatic acc. to D97	-60		0.59	
349		-----		-----	
357	D5950	-62		-0.66	
369		-----		-----	
371		-----		-----	
396		-----		-----	
432		-----		-----	
485		-----		-----	
496	D5950	-55		3.70	
551	D5950	-42	G(0.01)	11.79	
601		-----		-----	
603		-----		-----	
614		-----		-----	
657	D5950	-60		0.59	
704		-----		-----	
785	D6749	-50	G(0.05)	6.81	
823	D5950	-55		3.70	
862		-----		-----	
874		-----		-----	
875		-----		-----	
886		-----		-----	
912		-----		-----	
913		-----		-----	
922		-----		-----	
962		-----		-----	
963		-----		-----	
974		-----		-----	
982		-----		-----	
1011		-----		-----	
1047		-----		-----	
1056		-----		-----	
1081		-----		-----	
1082	D5950	-60		0.59	
1145		-----		-----	
1191	D5950	-60		0.59	
1349	In house	-63		-1.28	
1389		-----		-----	
1429		-----		-----	
1510	D5950	-66		-3.15	
1564		-----	W	-----	first reported: -48
1748		-----		-----	
1833	D5950	-62		-0.66	
1862		-----		-----	
1877		-----		-----	
6016		-----		-----	
6048	D7346	-64		-1.90	
6113		-----		-----	
6163		-----		-----	
6262	D5950	-59		1.21	
6310	D5950	-67		-3.77	

normality	OK
n	17
outliers	2
mean (n)	-60.94
st.dev. (n)	3.191
R(calc.)	8.94
st.dev.(D5950:14)	1.607
R(D5950:14)	4.5


-40
-45
-50
-55
-60
-65
-70
6310
1510
6048
171
1349
357
1833
325
329
343
150
657
1092
1191
6262
496
823
785
551


Kernel Density
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
-80
-60
-40
-20
0

Determination of Rust prevention (synthetic seawater) on sample #20065

lab	method	value	mark	z(targ)	remarks
150		-----		-----	
171		-----		-----	
173		-----		-----	
178		-----		-----	
179	D665	Pass		-----	possibly a false positive test result?
237		-----		-----	
273		-----		-----	
311		-----		-----	
323		-----		-----	
325	D665	severe		-----	
329		-----		-----	
333		-----		-----	
343		-----		-----	
349		-----		-----	
357		-----		-----	
369		-----		-----	
371		-----		-----	
396		-----		-----	
432		-----		-----	
485		-----		-----	
496		-----		-----	
551		-----		-----	
601		-----		-----	
603		-----		-----	
614		-----		-----	
657		-----		-----	
704		-----		-----	
785		-----		-----	
823		-----		-----	
862		-----		-----	
874		-----		-----	
875		-----		-----	
886		-----		-----	
912		-----		-----	
913		-----		-----	
922		-----		-----	
962		-----		-----	
963		-----		-----	
974		-----		-----	
982		-----		-----	
1011		-----		-----	
1047	D665	strong corrosion		-----	
1056		-----		-----	
1081		-----		-----	
1082		-----		-----	
1145		-----		-----	
1191		-----		-----	
1349		-----		-----	
1389		-----		-----	
1429		-----		-----	
1510		-----		-----	
1564	D665	Fail		-----	
1748		-----		-----	
1833		-----		-----	
1862		-----		-----	
1877		-----		-----	
6016	D665	Fail		-----	
6048		-----		-----	
6113		-----		-----	
6163		-----		-----	
6262		-----		-----	
6310		-----		-----	
	n	4			
	mean (n)	Fail			

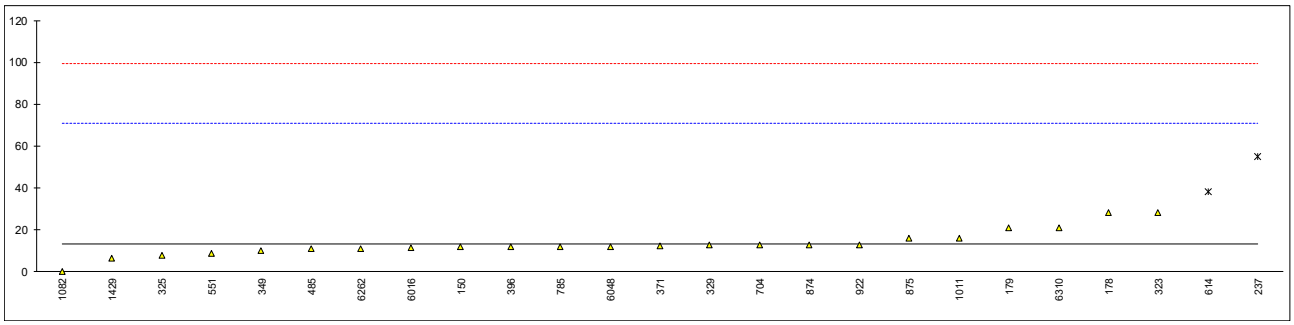
Determination of Sulfur on sample #20065; results in mg/kg

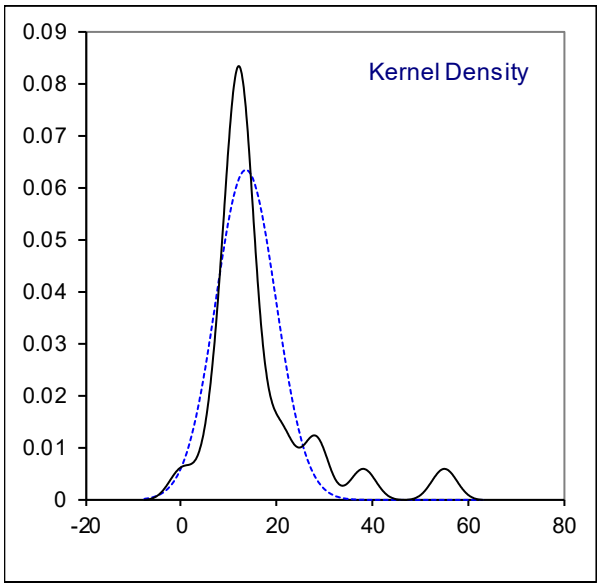
lab	method	value	mark	z(targ)	remarks
150	D4294	<20		-----	
171	D2622	<3.0		-----	
173		-----		-----	
178		-----		-----	
179		-----		-----	
237	D5453	<1		-----	
273		-----		-----	
311	D2622	<3		-----	
323	D2622	<3		-----	
325	D5185	<50		-----	
329	D4294	<1		-----	
333		-----		-----	
343	IP336	<300		-----	
349	D2622	0.12		-----	
357		-----		-----	
369	D4294	<10		-----	
371	D5453	0.12		-----	
396		-----		-----	
432		-----		-----	
485		-----		-----	
496	D4294	<0.01		-----	
551	D4294	8.9		-----	
601		-----		-----	
603		-----		-----	
614		-----		-----	
657	D5453	<1		-----	
704	D4294	< 17		-----	
785	D2622	<0.2		-----	
823	D5453	<1		-----	
862		-----		-----	
874	D2622	<3		-----	
875	D4294	3		-----	
886		-----		-----	
912		-----		-----	
913		-----		-----	
922	D4294	<17		-----	
962		-----		-----	
963		-----		-----	
974		-----		-----	
982		-----		-----	
1011	IP336	<60		-----	
1047		-----		-----	
1056	D4294	0.009		-----	
1081	D2622	0.01		-----	
1082		-----		-----	
1145		-----		-----	
1191	ISO8754	1.8		-----	
1349	D7039	<0.1		-----	
1389		-----		-----	
1429		-----		-----	
1510	D4294	<17		-----	
1564	D4294	<100		-----	
1748		-----		-----	
1833	ISO8754	<300		-----	
1862		-----		-----	
1877		-----		-----	
6016		-----		-----	
6048	D4294	0		-----	
6113		-----		-----	
6163	ISO8754	< 300		-----	
6262	D5453	<0.5		-----	
6310	D7751	<1		-----	
	n	25			Application range D4294: 17 mg/kg - 4.6%M/M
	mean (n)	<17			Application range D2622: 3 mg/kg - 4.6%M/M

Determination of Water on sample #20065; results in mg/kg

lab	method	value	mark	z(targ)	remarks
150	D6304-A	12		-0.05	
171	D6304-A	<100		-----	
173	D6304-C	<10		-----	
178	D6304-C	28		0.51	
179	D6304-C	21		0.26	
237	D6304-C	55	R(0.01)	1.45	
273		-----		-----	
311	D6304-A	<30		-----	
323	D6304-A	28		0.51	
325	D6304-C	8		-0.19	
329	D6304-C	13		-0.02	
333		-----		-----	
343	D6304-A	<10		-----	
349	D6304-A	10		-0.12	
357	D6304-A	< 10		-----	
369	ISO12937	<30		-----	
371	D6304-A	12.2		-0.04	
396	D6304-A	12		-0.05	
432		-----		-----	
485	D6304-A	11		-0.08	
496	D6304-C	<10		-----	
551	D6304-A	8.6		-0.17	
601		-----		-----	
603		-----		-----	
614	D6304-C	38	R(0.01)	0.86	
657	D6304-C	<10		-----	
704	D6304-A	13		-0.02	
785	D6304-A	12		-0.05	
823	D6304-A	<10		-----	
862		-----		-----	
874	D6304-A	13		-0.02	
875	D6304-A	16		0.09	
886		-----		-----	
912		-----		-----	
913		-----		-----	
922	D6304-A	13		-0.02	
962		-----		-----	
963		-----		-----	
974		-----		-----	
982		-----		-----	
1011	D6304-A	16		0.09	
1047		-----		-----	
1056		-----		-----	
1081		-----		-----	
1082	D6304-C	0.1		-0.47	
1145		-----		-----	
1191	D6304-C	<10		-----	
1349		-----		-----	
1389		-----		-----	
1429	IP438	6.45		-0.24	
1510	D6304-A	<10		-----	
1564	D6304-C	<10		-----	
1748		-----		-----	
1833	ISO12937	<30		-----	
1862		-----		-----	
1877	D6304-C	<10		-----	
6016	D6304-A	11.6		-0.06	
6048	ISO12937	12		-0.05	
6113		-----		-----	
6163		-----		-----	
6262	D6304-A	11		-0.08	
6310	D6304-C	21		0.26	

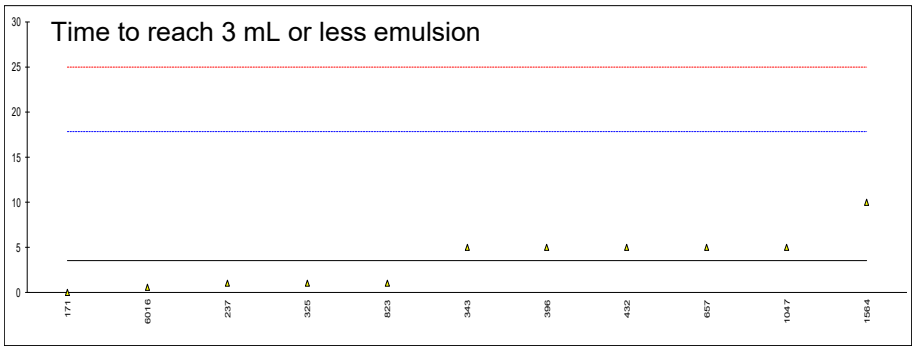
	normality	suspect	
	n	23	
	outliers	2	
	mean (n)	13.43	
	st.dev. (n)	6.285	
	R(calc.)	17.60	
	st.dev.(D6304:16e1)	28.669	
	R(D6304:16e1)	80.27	Application range 10 - 25000 mg/kg

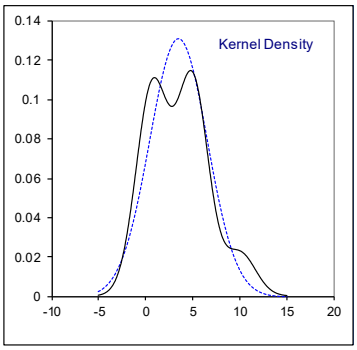

120
100
80
60
40
20
0
1082
1429
325
551
349
485
6262
6016
150
396
785
6048
371
329
704
874
922
875
1011
179
6310
178
323
614
237

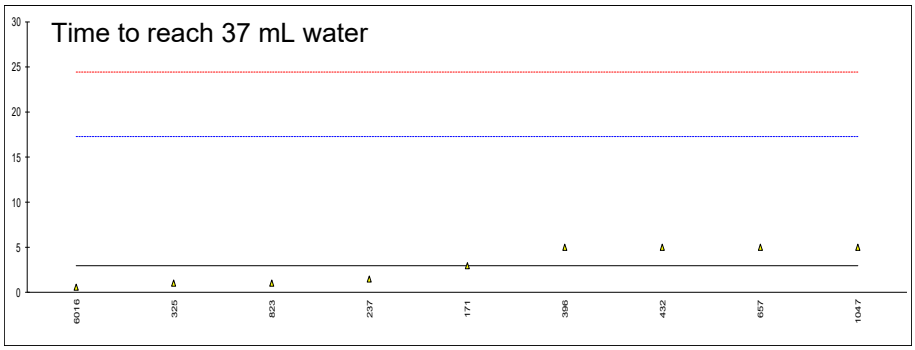

Kernel Density
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
-20
0
20
40
60
80

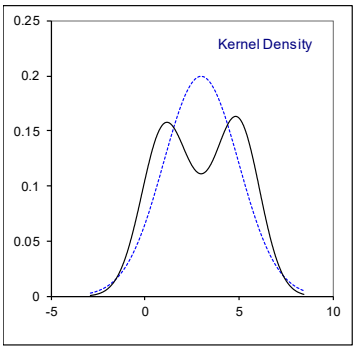
Determination of Water Separability at 54°C, distilled water on sample #20065; results in minutes

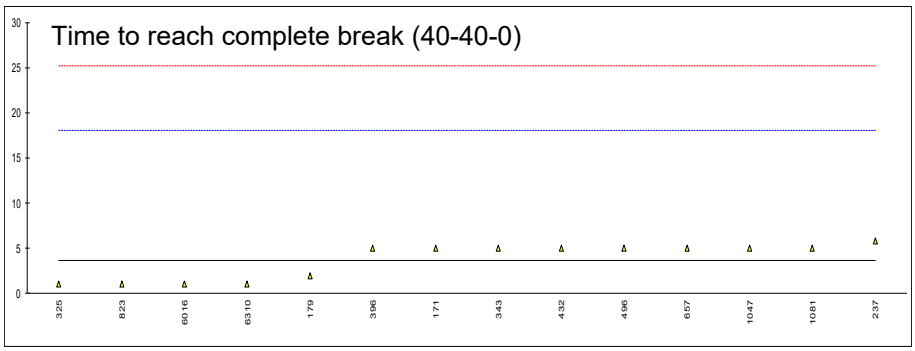
lab	method	3mL or less emulsion	mark	z(targ)	37mL of water	mark	z(targ)	complete break (40-40-0)	mark	z(targ)	test aborted	time test aborted
150		-----		-----	-----		-----	-----		-----	-----	-----
171	D1401	0		-0.49	3		0.00	5		0.18	NO	-----
173		-----		-----	-----		-----	-----		-----	-----	-----
178		-----		-----	-----		-----	-----		-----	-----	-----
179		-----		-----	-----		-----	2		-0.24	NO	-----
237	D1401	1.0		-0.35	1.50		-0.21	5.81		0.30	NO	-----
273		-----		-----	-----		-----	-----		-----	-----	-----
311		-----		-----	-----		-----	-----		-----	-----	-----
323		-----		-----	-----		-----	-----		-----	-----	-----
325	D1401	1		-0.35	1		-0.28	1		-0.38	-----	-----
329	D1401	<1		-----	<1		-----	<1		-----	NO	-----
333		-----		-----	-----		-----	-----		-----	-----	-----
343	D1401	5		0.21	-----		-----	5		0.18	NO	5
349		-----		-----	-----		-----	-----		-----	-----	-----
357		-----		-----	-----		-----	-----		-----	-----	-----
369		-----		-----	-----		-----	-----		-----	-----	-----
371		-----		-----	-----		-----	-----		-----	-----	-----
396	D1401	5		0.21	5		0.28	5		0.18	NO	-----
432	D1401	5		0.21	5		0.28	5		0.18	NO	-----
485		-----		-----	-----		-----	-----		-----	-----	-----
496	D1401	-----		-----	-----		-----	5		0.18	-----	-----
551		-----		-----	-----		-----	-----		-----	-----	-----
601		-----		-----	-----		-----	-----		-----	-----	-----
603		-----		-----	-----		-----	-----		-----	-----	-----
614		-----		-----	-----		-----	-----		-----	-----	-----
657	D1401	5		0.21	5		0.28	5		0.18	NO	-----
704		-----		-----	-----		-----	-----		-----	-----	-----
785		-----		-----	-----		-----	-----		-----	-----	-----
823	D1401	1		-0.35	1		-0.28	1		-0.38	NO	5
862		-----		-----	-----		-----	-----		-----	-----	-----
874		-----		-----	-----		-----	-----		-----	-----	-----
875		-----		-----	-----		-----	-----		-----	-----	-----
886		-----		-----	-----		-----	-----		-----	-----	-----
912		-----		-----	-----		-----	-----		-----	-----	-----
913		-----		-----	-----		-----	-----		-----	-----	-----
922		-----		-----	-----		-----	-----		-----	-----	-----
962		-----		-----	-----		-----	-----		-----	-----	-----
963		-----		-----	-----		-----	-----		-----	-----	-----
974		-----		-----	-----		-----	-----		-----	-----	-----
982		-----		-----	-----		-----	-----		-----	-----	-----
1011		-----		-----	-----		-----	-----		-----	-----	-----
1047		5		0.21	5		0.28	5		0.18	YES	5
1056		-----		-----	-----		-----	-----		-----	-----	-----
1081		-----		-----	-----		-----	5		0.18	-----	-----
1082		-----		-----	-----		-----	-----		-----	-----	-----
1145		-----		-----	-----		-----	-----		-----	-----	-----
1191		-----		-----	-----		-----	-----		-----	-----	-----
1349		-----		-----	-----		-----	-----		-----	-----	-----
1389		-----		-----	-----		-----	-----		-----	-----	-----
1429		-----		-----	-----		-----	-----		-----	-----	-----
1510		-----		-----	-----		-----	-----		-----	-----	-----
1564	D1401	10		0.91	-----		-----	-----		-----	-----	-----
1748		-----		-----	-----		-----	-----		-----	-----	-----
1833		-----		-----	-----		-----	-----		-----	-----	-----
1862		-----		-----	-----		-----	-----		-----	-----	-----
1877		-----		-----	-----		-----	-----		-----	-----	-----
6016	D1401	0.6		-0.41	0.6		-0.34	1		-0.38	NO	-----
6048		-----		-----	-----		-----	-----		-----	-----	-----
6113		-----		-----	-----		-----	-----		-----	-----	-----
6163		-----		-----	-----		-----	-----		-----	-----	-----
6262		-----		-----	-----		-----	-----		-----	-----	-----
6310	D1401	<1		-----	<1		-----	1		-0.38	NO	1
	normality	OK			OK			OK				
	n	11			9			14				
	outliers	0			0			0				
	mean (n)	3.51			3.01			3.70				
	st.dev. (n)	3.048			2.000			1.962				
	R(calc.)	8.53			5.60			5.49				
	st.dev.(D1401:19)	7.143			7.143			7.143				
	R(D1401:19)	20			20			20				

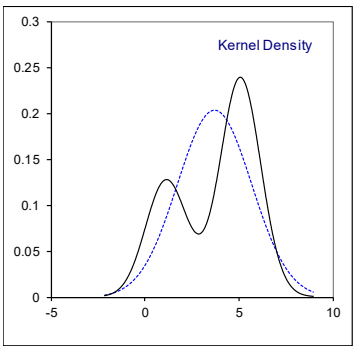

Time to reach 3 mL or less emulsion
30
25
20
15
10
5
0
171
6016
237
325
823
343
396
432
657
1047
1564


Kernel Density
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
-10
-5
0
5
10
15
20


Time to reach 37 mL water
30
25
20
15
10
5
0
6016
325
823
237
171
396
432
657
1047


Kernel Density
0.25
0.2
0.15
0.1
0.05
0
-5
0
5
10


Time to reach complete break (40-40-0)
30
25
20
15
10
5
0
325
823
6016
6310
179
396
171
343
432
496
657
1047
1081
237


Kernel Density
0.3
0.25
0.2
0.15
0.1
0.05
0
-5
0
5
10

Determination of Water Separability at 54°C, distilled water sample #20065; results in mL

lab	method	oil phase	mark	water phase	mark	emulsion phase	mark
150		-----		-----		-----	
171		-----		-----		-----	
173		-----		-----		-----	
178		-----		-----		-----	
179		40		40		0	
237	D1401	40		40		0	
273		-----		-----		-----	
311		-----		-----		-----	
323		-----		-----		-----	
325		-----		-----		-----	
329		-----		-----		-----	
333		-----		-----		-----	
343	D1401	40		40		0	
349		-----		-----		-----	
357		-----		-----		-----	
369		-----		-----		-----	
371		-----		-----		-----	
396		-----		-----		-----	
432		-----		-----		-----	
485		-----		-----		-----	
496	D1401	40		40		0	
551		-----		-----		-----	
601		-----		-----		-----	
603		-----		-----		-----	
614		-----		-----		-----	
657	D1401	40		40		0	
704		-----		-----		-----	
785		-----		-----		-----	
823	D1401	40		40		0	
862		-----		-----		-----	
874		-----		-----		-----	
875		-----		-----		-----	
886		-----		-----		-----	
912		-----		-----		-----	
913		-----		-----		-----	
922		-----		-----		-----	
962		-----		-----		-----	
963		-----		-----		-----	
974		-----		-----		-----	
982		-----		-----		-----	
1011		-----		-----		-----	
1047		40		40		0	
1056		-----		-----		-----	
1081		40		40		0	
1082		-----		-----		-----	
1145		-----		-----		-----	
1191		-----		-----		-----	
1349		-----		-----		-----	
1389		-----		-----		-----	
1429		-----		-----		-----	
1510		-----		-----		-----	
1564		-----		-----		-----	
1748		-----		-----		-----	
1833		-----		-----		-----	
1862		-----		-----		-----	
1877		-----		-----		-----	
6016	D1401	40		40		0	
6048		-----		-----		-----	
6113		-----		-----		-----	
6163		-----		-----		-----	
6262		-----		-----		-----	
6310	D1401	40		40		0	

APPENDIX 2

Number of participants per country

1 lab in AUSTRALIA
1 lab in AUSTRIA
6 labs in BELGIUM
1 lab in BRAZIL
1 lab in CHINA, People's Republic
3 labs in FINLAND
1 lab in FRANCE
2 labs in GERMANY
2 labs in INDIA
1 lab in IRAN, Islamic Republic of
1 lab in ITALY
1 lab in JORDAN
1 lab in KAZAKHSTAN
2 labs in LATVIA
1 lab in LITHUANIA
2 labs in MALAYSIA
2 labs in NETHERLANDS
1 lab in NIGERIA
1 lab in NORWAY
1 lab in PAKISTAN
2 labs in POLAND
1 lab in PORTUGAL
4 labs in RUSSIAN FEDERATION
2 labs in SAUDI ARABIA
1 lab in SINGAPORE
1 lab in SOUTH AFRICA
1 lab in SOUTH KOREA
5 labs in SPAIN
1 lab in TAIWAN
1 lab in THAILAND
1 lab in TURKEY
1 lab in UKRAINE
1 lab in UNITED ARAB EMIRATES
3 labs in UNITED KINGDOM
5 labs in UNITED STATES OF AMERICA

APPENDIX 3

Abbreviations

C	= final test result after checking of first reported suspect test result
D(0.01)	= outlier in Dixon's outlier test
D(0.05)	= straggler in Dixon's outlier test
G(0.01)	= outlier in Grubbs' outlier test
G(0.05)	= straggler in Grubbs' outlier test
DG(0.01)	= outlier in Double Grubbs' outlier test
DG(0.05)	= straggler in Double Grubbs' outlier test
R(0.01)	= outlier in Rosner's outlier test
R(0.05)	= straggler in Rosner's outlier test
E	= possibly an error in calculations
W	= test result withdrawn on request of participant
ex	= test result excluded from statistical evaluation
n.a.	= not applicable
n.e.	= not evaluated
n.d.	= not detected
fr.	= first reported test result
SDS	= Safety Data Sheet

Literature

1 iis Interlaboratory Studies, Protocol for the Organisation, Statistics & Evaluation, June 2018
2 ASTM E178:89
3 ASTM E1301:89
4 ISO5725:86
5 ISO5725, 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 IP367:84
10 DIN38402 T41/42
11 P.L. Davies, Fr. Z. Anal. Chem, 331, 513, (1988)
12 J.N. Miller, Analyst, 118, 455, (1993)
13 Analytical Methods Committee Technical brief, No 4, January 2001
14 P.J. Lowthian and M.Thompson, The Royal Society of Chemistry, Analyst, 127, 1359-1364, (2002)
15 Bernard Rosner, Percentage Points for a Generalized ESD Many-Outlier Procedure, Technometrics, 25(2), 165-172, (1983)
16 Horwitz, R. Albert, J. AOAC Int, 79, 3, 589, (1996)