Results of Proficiency Test
Transformer Oil (fresh)
November 2021

SUMMARY OF CHANGES

This revised report replaces the original report iis21L11 of March 2022.

One of the participants informed iis that the estimation of the reproducibility for Breakdown Voltage according to test method IEC60156:18 used for the calculation of the z-scores of the parameter Breakdown Voltage was not interpreted correctly. In IEC60156:18 in paragraph 12.2 about the reproducibility the test method mentions that from experience the reproducibility is in the range of 30%. Therefore, iis used 30% for the reproducibility for the calculation of the z-scores in the published report of iis21L11 of March 2022. After discussion with the participant iis investigated this with historical data of Breakdown Voltage from iis proficiency tests and came to the same conclusion as the participant that the word 'reproducibility' in paragraph 12.2 of test method IEC60156:18 cannot be correct and should be interpreted as the relative standard deviation of the reproducibility (RSD_R) and therefore multiplied with the factor 2.8 to obtain the reproducibility. More background is given in paragraph 5 of this report. A revised report is prepared because this has an effect on the statistical evaluation, z-scores and the graphics of this parameter.

The following pages in this report has been revised:
- Content: H5 Discussion is added (page 2 in the original report)
- Evaluation of the Breakdown Voltage (page 8 in the original report)
- Table 3: R(lit) of the Breakdown Voltage (page 10 in the original report)
- Table 5: comparison of the Breakdown Voltage of November 2021 (page 11 in the original report)
- Appendix 1: determination of Breakdown Voltage (page 17 and 18 in the original report)
- H5 Discussion is added (new in the report)

CONTENTS

Appendices:

1   INTRODUCTION

Since 2001 the Institute for Interlaboratory Studies (iis) organizes a proficiency scheme for the analysis of Transformer Oil (fresh) in accordance with the latest version of IEC60296 and ASTM D3487 every year. During the annual proficiency testing program of 2021/2022 it was decided to continue the round robin for the analysis of Transformer Oil (fresh).

In this interlaboratory study 66 laboratories in 34 different countries registered for participation. See appendix 3 for the number of participants per country. In this report the results of the Transformer 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/IEC17025 accredited laboratory.
It was decided to send one sample Transformer Oil (fresh) in a 1L bottle labelled #21240. The participants were requested to report rounded and unrounded test results. The unrounded test results were preferably used for statistical evaluation.

2.1   ACCREDITATION

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

2.2   PROTOCOL

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

2.3   CONFIDENTIALITY STATEMENT

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

2.4   SAMPLES

A batch of approximately 85 liters of Transformer Oil (fresh) was obtained from a local supplier. After homogenization 82 amber glass bottles of 1L were filled and labelled #21240. The homogeneity of the subsamples was checked by the determination of Density at 20°C in accordance with ASTM D4052 on 8 stratified randomly selected subsamples.

	Density at 20°C in kg/m^3
sample #21240-1	874.61
sample #21240-2	874.65
sample #21240-3	874.64
sample #21240-4	874.64
sample #21240-5	874.63
sample #21240-6	874.63
sample #21240-7	874.66
sample #21240-8	874.59

Table 1: homogeneity test results of subsamples #21240

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

	Density at 20°C in kg/m^3
r (observed)	0.06
reference test method	ISO3675:98
0.3 x R (reference test method)	0.36

Table 2: evaluation of the repeatability of subsamples #21240

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 sample of Transformer Oil (fresh) labelled #21240 was sent on October 27, 2021. An SDS was added to the sample package.

2.5   STABILITY OF THE SAMPLES

The stability of Transformer Oil (fresh) 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: Total Acidity (Potentiometric and Colorimetric), Appearance, Breakdown Voltage, Color ASTM, Density at 20°C, Di-electric loss at 90°C (Di-electric Dissipation Factor and Specific Resistance), Flash Point (C.O.C. and PMcc), Interfacial Surface Tension, Kinematic Viscosity at 40°C, Water and Additives (2,6-Ditertiary-butyl phenol (DBP), 2,6-Ditertiary-butyl paracresol (DBPC), Dibenzyl disulfide (DBDS), Benzotriazole (BTA) and Irgamet 39). Also, an extra question regarding stirring during the determination of the Breakdown Voltage was requested.

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

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

3   RESULTS

During five weeks after sample dispatch, the test results of the individual laboratories were gathered via the data entry portal www.kpmd.co.uk/sgs-iis/. The reported test results are tabulated per determination in appendix 1 and 2 of this report. The laboratories are presented by their code numbers.
Directly after the deadline, a reminder was sent to those laboratories that had not reported test results at that moment. Shortly after the deadline, the available test results were screened for suspect data. A test result was called suspect in case the Huber Elimination Rule (a robust outlier test) found it to be an outlier. The laboratories that produced these suspect data were asked to check the reported test results (no reanalyzes). Additional or corrected test results are used for data analysis and the original test results are placed under 'Remarks' in the result tables in appendix 1 or 2. Test results that came in after the deadline were not taken into account in this screening for suspect data and thus these participants were not requested for checks.

3.1   STATISTICS

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

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

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

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

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

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

3.2   GRAPHICS

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

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

3.3 Z-SCORES

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

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

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

z(target) = (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. Therefore, the usual interpretation of z-scores is as follows:

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

4 EVALUATION

In this proficiency test some problems were encountered with the dispatch of the samples. Eight participants reported the test results after the final reporting date and two other participants did not report any test results. Not all participants were able to report all test requested.
In total 64 participants reported 436 numerical test results. Observed were 20 outlying test results, which is 4.6%. In proficiency tests outlier percentages of 3% - 7.5% are quite normal.

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

4.1 EVALUATION PER TEST

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

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 (sub) and the year of adoption or revision (e.g. D1500:12) will be used.

Total Acidity (Potentiometric): This determination may not be problematic. The Total Acidity was below the quantification limit of 0.014 mg KOH/g as given in test method EN62021-1:03 and also below the application range of ASTM D664-A:18e2 (0.1 – 150 mg KOH/g). Therefore, no z-sores were calculated.

Total Acidity (Colorimetric): This determination was not problematic. No statistical outliers were observed. The calculated reproducibility is in agreement with the requirements of ASTM D974:21.

Appearance: The determination was not problematic. Almost all reporting laboratories agreed on the appearance of the oil being 'Clear and Bright' or remarked in similar words to this.

Breakdown Voltage: In the specification of IEC60296:12 both the test method IEC60156 and the test method EN60156 were mentioned for the determination of the Breakdown Voltage. However, the specification IEC60296:12 is replaced with IEC60296:20, and in this specification only the test method IEC60156 is mentioned. Therefore, it was decided to use the test method IEC60156 for the evaluation of the test results of the Breakdown Voltage in this PT. This determination was not problematic. No statistical outliers were observed. The calculated reproducibility is in agreement with the requirements of IEC60156:18. See also the discussion in paragraph 5. No significant effect is observed when the test results with stirring and without stirring were evaluated separately.

Color ASTM: This determination was not problematic. Three statistical outliers were observed. The calculated reproducibility after rejection of the statistical outliers is in agreement with the requirements of ASTM D1500:12(2017). Please note: the test values reported as "text" (e.g. L0.5) were converted to a numerical value before calculating z-scores, see also appendix 1.

Density at 20°C: This determination may be problematic depending on the test method used. Three statistical outliers were observed. The calculated reproducibility after rejection of the statistical outliers is in agreement with the requirements of ISO3675:98 but is not in agreement with the requirements of ASTM D4052:18a or ISO12185:96.
When evaluated separately over the test methods the calculated reproducibility is in agreement with the requirements of ASTM D4052:18a/ISO12185:96 or with the requirements of ISO3675.

DD-Factor: This determination was not problematic. Three statistical outliers were observed. The calculated reproducibility after rejection of the statistical outliers is in agreement with the requirements of EN60247:04.

Specific Resistance: 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 EN60247:04.
Please note that it is well known that specific resistance of new oils can vary over a wide range. This is due to randomly tiny amounts of impurities (maybe present in the air or in the test cell) which can dramatically change the value. In used oils, however, due to already present ion flow of the polar compounds, these problems are not observed.

Flash Point COC: This determination was not problematic. No statistical outliers were observed. The calculated reproducibility is in full agreement with the requirements of ASTM D92:18 and ISO2592:17.

Flash Point PMcc: This determination was not problematic. No statistical outliers were observed. The calculated reproducibility is in full agreement with the requirements of ISO2719-A:16 and ASTM D93-A:20.

Interfacial Surface Tension: This determination was problematic. No statistical outliers were observed. However, the calculated reproducibility is not in agreement with the requirements of ASTM D971:20.

Kinematic Viscosity: This determination may be problematic depending on the test method used. Three statistical outliers were observed. The calculated reproducibility after rejection of the statistical outliers is not in agreement with the requirements of ASTM D445:21 nor with ISO3104:20 but it is in agreement with the requirements of ASTM D7042:21a.
When evaluated separately over the test methods the calculated reproducibility is still not in agreement with the requirements of ASTM D445:21 or ISO3104:20.

Water: This determination may be problematic for a number of participants. Five statistical outliers were observed. The calculated reproducibility after rejection of the statistical outliers is in agreement with the requirements of EN60814:97.

Additives: The majority of the participants agreed that 2,6-Ditertiary-butyl phenol (DBP), 2,6-Ditertiary-butyl paracresol (DBPC), Dibenzyl disulfide (DBDS), Benzotriazole (BTA) and Irgamet 39 were below the level of quantification. Therefore, these components were not further evaluated. The reported test results are given in appendix 2.

4.2 PERFORMANCE EVALUATION FOR THE GROUP OF LABORATORIES

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

Parameter	unit	n	average	2.8 * sd	R(lit)
Total Acidity (Potentiometric)	mg KOH/g	29	0.007	0.006	(0.002)
Total Acidity (Colorimetric)	mg KOH/g	21	0.008	0.011	0.04
Appearance		36	C&B	n.a.	n.a.
Breakdown Voltage	kV/2.5 mm	56	52.2	34.0	43.8
Color ASTM		44	0.23	0.16	1
Density at 20°C	kg/m^3	42	874.65	0.68	1.2
Di-electric Dissipation Factor 90°C		47	0.0015	0.0015	0.0024
Specific Resistance at 90°C	GΩm	33	712	1448	747
Flash Point C.O.C.	°C	24	161.4	16.7	18
Flash Point PMcc	°C	30	151.8	11.3	10.8
Interfacial Surface Tension	mN/m	41	47.3	6.1	4.7
Kinematic Viscosity at 40°C	mm^2/s	38	10.01	0.18	0.12
Water	mg/kg	46	16.7	5.0	6.1

Table 3: reproducibilities of tests on sample #21240

For results between brackets no z-scores are calculated

C&B = Clear and Bright

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

4.3 COMPARISON OF THE PROFICIENCY TEST OF NOVEMBER 2021 WITH PREVIOUS PTS

	November 2021	November 2020	November 2019	November 2018	November 2017
Number of reporting laboratories	64	59	48	50	55
Number of test results	436	404	377	371	405
Number of statistical outliers	20	28	24	24	18
Percentage of statistical outliers	4.6%	6.9%	6.4%	6.5%	4.4%

Table 4: comparison with previous proficiency tests

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

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

Parameter	November 2021	November 2020	November 2019	November 2018	November 2017
Total Acidity (Potentiometric)	(--)	(--)	(--)	(--)	(--)
Total Acidity (Colorimetric)	++	++	++	++	++
Breakdown Voltage	+	+	+	+/-	-
Color ASTM	++	++	++	n.e.	n.e.
Density at 20°C	+	+	+	++	++
Di-electric Dissipation Factor	+	+	+	+	+
Specific Resistance	-	--	-	-	--
Flash Point C.O.C.	+/-	+	+	+	-
Flash Point PMcc	+/-	+/-	+	+	+/-
Interfacial Surface Tension	-	-	+/-	+/-	-
Kinematic Viscosity at 40°C	-	-	-	+/-	-
Water	+	+/-	-	+/-	-
DBPC Antioxidant Additive	n.e.	n.e.	n.e.	+	+/-

Table 5. comparison of group performances against the reference test methods

Results between brackets should be used with due care

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

5   Discussion

<u>Evaluation of the Breakdown Voltage in Transformer Oil (fresh and used)</u>
In iis PTs from 2016 till 2020 the target reproducibility for Breakdown Voltage was determined using test method EN60156:95 according to the iis memo 1702 (see lit. 13). In iis memo 1702 the determination of the target reproducibility is based on a graphical representation. However, test method IEC60156:18 describes that this graphical representation is for information only and that it does not represent acceptance criteria. Therefore, it was decided not to continue with iis memo 1702 for the estimation of the target reproducibility and to go further with the precision as mentioned in test method IEC60156:18.

In test method IEC60156:18 (paragraph 12.2) the reproducibility is described as "experience has shown that the reproducibility of individual dielectric breakdown values is in the range of ±30%". This can be interpreted in different ways and therefore the calculation of the target reproducibility can be done differently:
1) The target reproducibility is estimated as 30% of the mean. This results in the following calculation: R(target) = 0.3 * mean of the PT.
2) The relative standard deviation (RSD) is estimated as 30%. This results in the following calculation: R(target) = 0.3 * mean of the PT * 2.8.

To verify both calculations iis started an investigation. The calculated R(target) was compared to observed reproducibility (R(calc)) from iis PTs from 2001 -2021, see Figure 1 below. We also added the R(target) calculated according to iis memo 1702 which was used from 2016-2020. NB: In the graph is calculation 1 = reproducibility 30% and RSD 30% is calculation 2.

The target reproducibility describes the observed precision best when R(target) = R(calc).
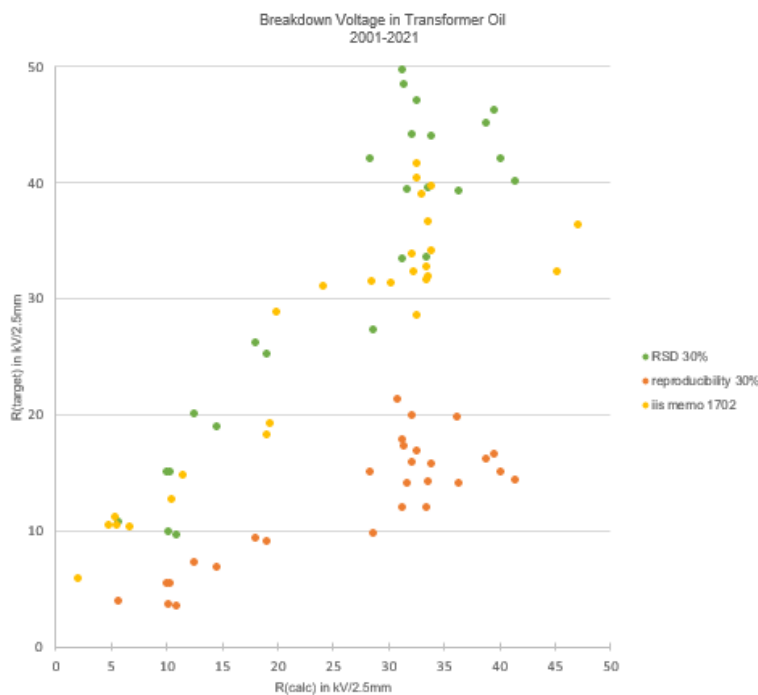
Figure 1: The target reproducibility vs the calculated reproducibility of the Breakdown Voltage in iis PTs from 2001 to 2021

It can be concluded that the target reproducibility based on a relative standard deviation of 30% is more in line with the target reproducibility based iis memo 1702. And that the best precision (R(target) = R(calc)) is best described with R(target) = 0.3 * mean of the PT * 2.8. The target reproducibility based on a reproducibility of 30% gives an underestimation when compared to the observed reproducibility.

Therefore, iis decided that starting from the 2021 PT the target reproducibility will be determined using the calculation of the relative standard deviation estimated as 30%: R(target) = 0.3 * mean of the PT * 2.8.

APPENDIX 1

Determination of Total Acidity (Potentiometric) on sample #21240; results in mg KOH/g

lab	method	value	mark	z(targ)	remarks
173		-----		-----	
179	D664	<0.01		-----	
273		-----		-----	
325		-----		-----	
360		-----		-----	
398		-----		-----	
446		-----		-----	
614		-----		-----	
657	D664-A	<0.1		-----	
862	D664-A	0.01		-----	
902		-----		-----	
912		-----		-----	
913		-----		-----	
963		-----		-----	
974	D664-A	0.01		-----	
1146	D664	0.026	R(0.01)	-----	possibly a false positive test result?
1178	IEC62021-1	0.0065		-----	
1213		-----		-----	
1262	EN62021-1	0.0082		-----	
1264	D664-A	0.004		-----	
1304		-----		-----	
1306		-----		-----	
1326	EN62021-1	0.0059		-----	
1381		-----		-----	
1442	EN62021-1	<0,01		-----	
1444	IEC62021-1	0.004		-----	
1458		-----		-----	
1461		-----		-----	
1478	IEC62021-1	0.0055		-----	
1513	IEC62021-1	0.0032		-----	
1529	IEC62021-1	0.0075		-----	
1560	IEC62021-1	0.006		-----	
1660	IEC62021-1	0.005		-----	
1687	D664-A	0.007		-----	
1702	IEC62021-1	0.008		-----	
1719	D664-A	0.01		-----	
1747	IEC62021-1	0.0063		-----	
1801	EN62021-1	0.009		-----	
1885		-----		-----	
1890	ISO6619	0.009		-----	
1923	EN62021-1	0.005		-----	
1924	EN62021-1	0.005		-----	
1925	EN62021-1	0.005		-----	
1943		-----		-----	
6000		-----		-----	
6015		-----		-----	
6048		-----		-----	
6053	IEC62021-1	0.007		-----	
6067	EN62021-1	0.006		-----	
6071		-----		-----	
6074		-----		-----	
6085	D8045	0.01		-----	
6088	IEC62021-1	0.01		-----	
6099	IEC62021-1	0.008		-----	
6120		-----		-----	
6141	D664-A	0.01		-----	
6167		-----		-----	
6169		-----		-----	
6253		-----		-----	
6275	IEC62021-1	0.0033		-----	
6278		-----		-----	
6280	IEC62021-1	0.0041		-----	
6334		-----		-----	
6382	EN62021-1	<0,01		-----	
6425		-----		-----	
6428		-----		-----	

normality	OK
n	29
outliers	1
mean (n)	0.0068
st.dev. (n)	0.00225
R(calc.)	0.0063
st.dev.(EN62021-1:03)	(0.00068)
R(EN62021-1:03)	(0.0019)
compare	
R(D664-A:18e2, IP 60mL)	(0.0068)

quantification limit EN62021-1:03: >0.014 mg KOH/g

application range ASTM D664-A:18e2: 0.1 – 150 mg KOH/g

Kernel Density

Determination of Total Acidity (Colorimetric) on sample #21240; results in mg KOH/g

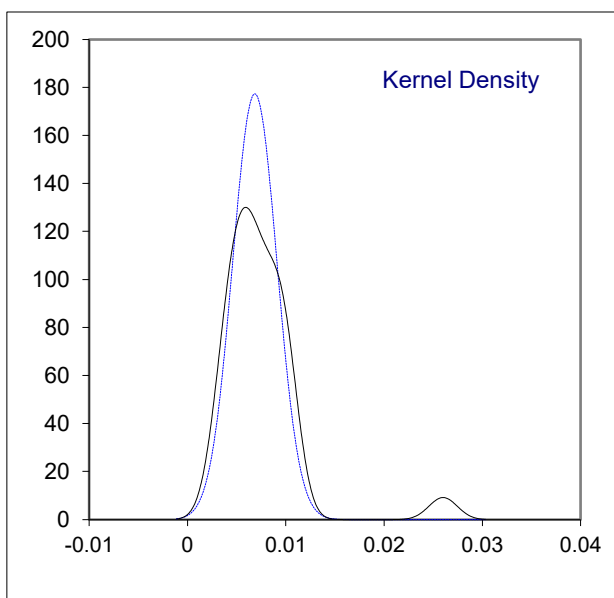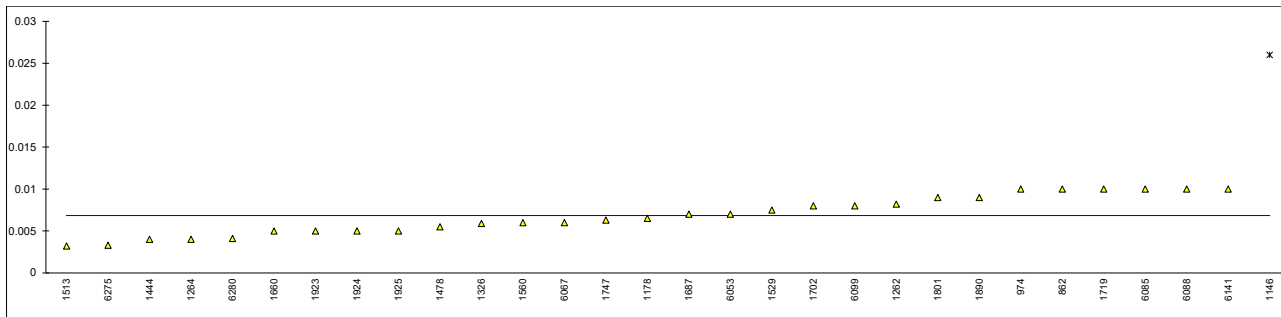| lab	method	value	mark	z(targ)	remarks
173		-----		-----	
179	D974	<0.02		-----	
273	D974	0.008		0.03	
325		-----		-----	
360	EN62021-2	0.008		0.03	
398		-----		-----	
446	D974	<0.02		-----	
614	D974	0.006		-0.11	
657	D974	<0.02		-----	
862	D974	0.0086		0.07	
902	D974	0.01		0.17	
912	D974	0.0022		-0.38	
913		-----		-----	
963	D974	0.0064		-0.09	
974	D974	0.006		-0.11	
1146		-----		-----	
1178		-----		-----	
1213	D974	<0.02		-----	
1262	ISO6618	0.010		0.17	
1264	D974	0.005201		-0.17	
1304	In house	<0.01		-----	
1306	D974	0.00974		0.15	
1326		-----		-----	
1381		-----		-----	
1442		-----		-----	
1444		-----		-----	
1458	D974	<0.01		-----	
1461		-----		-----	
1478		-----		-----	
1513	IEC62021-2	0.0021		-0.39	
1529		-----		-----	
1560		-----		-----	
1660		-----		-----	
1687		-----		-----	
1702		-----		-----	
1719		-----		-----	
1747		-----		-----	
1801		-----		-----	
1885	D974	0.007		-0.04	
1890		-----		-----	
1923		-----		-----	
1924		-----		-----	
1925		-----		-----	
1943	ISO6618	0.008	C	0.03	first reported 0.022
6000		-----		-----	
6015		-----		-----	
6048	D974	<0,01		-----	
6053		-----		-----	
6067	D974	0.01		0.17	
6071	D974	<0.01		-----	
6074		-----	W	-----	test result withdrawn, first reported 0.045
6085		-----		-----	
6088		-----		-----	
6099		-----		-----	
6120		-----		-----	
6141	D974	0.012		0.31	
6167		-----		-----	
6169		-----		-----	
6253		-----		-----	
6275	D974	0.0058		-0.13	
6278	D974	0.001		-0.46	
6280	IEC62021-2	0.0023		-0.37	
6334	IEC62021-2	0.015		0.52	
6382		-----		-----	
6425		-----		-----	
6428	ISO6618	0.017		0.66	

normality	OK
n	21
outliers	0
mean (n)	0.0076
st.dev. (n)	0.00408
R(calc.)	0.0114
st.dev.(D974:21)	0.01429
R(D974:21)	0.04
compare	
R(IEC62021-2:07)	(0.003)

quantification limit IEC62021-2:07: >0.01 mgKOH/g
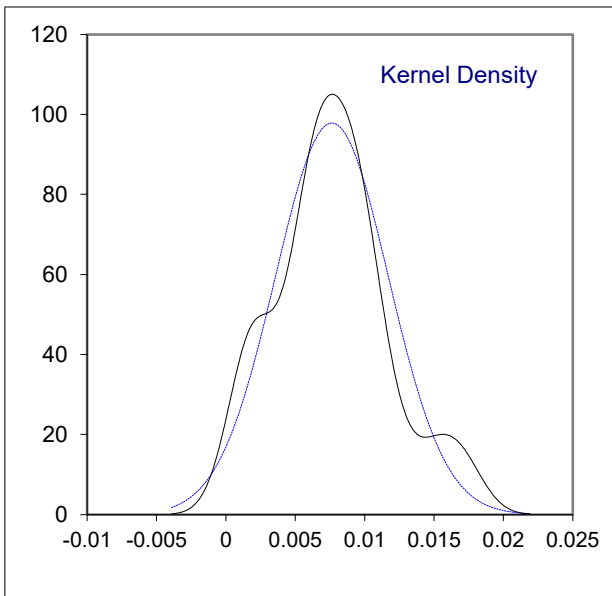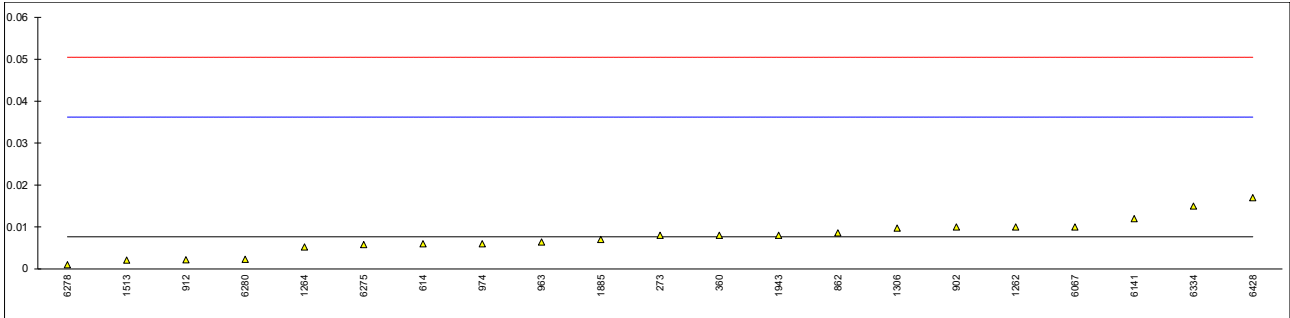
Determination of Appearance on sample #21240;

lab	method	value	mark	z(targ)	remarks
173	Visual	Clear & Bright		-----	
179		-----		-----	
273	Visual	Clear & Bright		-----	
325		-----		-----	
360	Visual	Clear and Bright		-----	
398	Visual	Clear		-----	
446	Visual	Pass		-----	
614		-----		-----	
657	Visual	Clear		-----	
862		Clear & Bright		-----	
902		-----		-----	
912	Visual	Clear		-----	
913		-----		-----	
963	D1524	Bright & Clear		-----	
974	Visual	Clear and Bright		-----	
1146		Clear		-----	
1178	Visual	bright, clear		-----	
1213		-----		-----	
1262	IEC60296	clear		-----	
1264	D1524	Clear		-----	
1304		-----		-----	
1306	Visual	Clear		-----	
1326		-----		-----	
1381		-----		-----	
1442	Visual	clear		-----	
1444		clear		-----	
1458	Visual	Clear slight Yellow		-----	
1461		-----		-----	
1478	IEC60296	clear		-----	
1513	Visual	Clear		-----	
1529	Visual	clear/no deposits		-----	
1560	Visual	Clear & Bright		-----	
1660	Visual	Clear		-----	
1687		-----		-----	
1702	Visual	Clear		-----	
1719		-----		-----	
1747		-----		-----	
1801		-----		-----	
1885	Visual	clear bright		-----	
1890	Visual	CLEAR		-----	
1923		-----		-----	
1924		-----		-----	
1925		-----		-----	
1943		-----		-----	
6000		-----		-----	
6015		-----		-----	
6048	Visual	clear & bright		-----	
6053	Visual	Straw		-----	
6067		Clear and free from sediments and suspended matter		-----	
6071		-----		-----	
6074	Visual	Amber		-----	
6085		-----		-----	
6088	Visual	clear and bright		-----	
6099	Visual	clair		-----	
6120		-----		-----	
6141	Visual	Clear & Bright		-----	
6167		-----		-----	
6169		-----		-----	
6253		-----		-----	
6275	Visual	Clear		-----	
6278	Visual	Bright and Clear		-----	
6280		-----		-----	
6334	Visual	Clear		-----	
6382	Visual	Clear, free from sediments		-----	
6425		-----		-----	
6428	Visual	clear transparent without sediment and separated w		-----	
	n	36			
	mean (n)	Clear and Bright			

Determination of Breakdown Voltage on sample #21240, results in kV/2.5 mm

lab	method	value	mark	z(targ)	stirred	remarks
173		-----		-----	---	
179	D877	49.1		-0.20	Yes	
273	IEC60156	49.96		-0.14	Yes	
325		-----		-----	---	
360	EN60156	53.3		0.07	Yes	
398	EN60156	44.6		-0.49	---	
446	EN60156	43		-0.59	Yes	
614	EN60156	74		1.39	Yes	
657	IEC60156	39.80		-0.79	No	
862	IEC60156	64.3		0.77	Yes	
902	D877	52		-0.01	Yes	
912	IEC60156	48		-0.27	---	
913		-----		-----	---	
963	IEC60156	47.7		-0.29	---	
974	EN60156	55		0.18	Yes	
1146	IEC156	44.3		-0.50	Yes	
1178	IEC60156	61.9		0.62	Yes	
1213		-----		-----	---	
1262	EN60156	62.6		0.66	Yes	
1264	EN60156	71.66		1.24	No	
1304	IEC60156	76.0		1.52	Yes	
1306	IEC60156	31.9		-1.30	Yes	
1326	EN60156	52.7		0.03	---	
1381		-----		-----	---	
1442	IEC60156	51.4		-0.05	Yes	
1444	IEC60156	47.0		-0.33	Yes	
1458	IEC60156	57.3		0.33	Yes	
1461		-----		-----	Yes	
1478	IEC60156	53.4		0.08	Yes	
1513	IEC60156	38.2		-0.89	Yes	
1529	IEC60156	51.1		-0.07	Yes	
1560	IEC60156	47.6		-0.29	Yes	
1660	IEC60156	64.5		0.79	Yes	
1687	EN60156	63.2		0.70	No	
1702	IEC60156	26.0		-1.67	Yes	
1719	IEC60156	77.9		1.64	Yes	
1747	IEC60156	46		-0.40	Yes	
1801	EN60156	32.8		-1.24	Yes	
1885	IEC60156	68.1		1.02	No	
1890	IEC60156	43.4		-0.56	Yes	
1923	EN60156	46.4		-0.37	No	
1924	EN60156	38.5		-0.87	Yes	
1925	EN60156	39.5		-0.81	No	
1943	EN60156	43.63		-0.55	Yes	stirred between breakdowns, breakdown moment without stirring
6000	EN60156	50.5		-0.11	Yes	
6015	EN60156	65.05		0.82	Yes	
6048		-----		-----	---	
6053	IEC60156	64.7		0.80	Yes	
6067	EN60156	70.95		1.20	Yes	
6071	IEC60156	44.2		-0.51	Yes	
6074		-----		-----	No	
6085	IEC60156	45.0		-0.46	Yes	
6088	IEC60156	55.1		0.19	Yes	
6099	IEC60156	69.1		1.08	No	
6120	IEC60156	51.2		-0.06	Yes	
6141	IEC60156	54.6		0.15	Yes	
6167	IEC60156	53.1		0.06	Yes	
6169		-----		-----	---	
6253	EN60156	33.9		-1.17	No	
6275	IEC60156	38.9		-0.85	No	
6278	IEC60156	56.43		0.27	No	
6280	IEC60156	46.9		-0.34	Yes	
6334	IEC60156	36.0		-1.03	Yes	
6382	IEC60156	74.2		1.40	Yes	
6425		-----		-----	---	
6428	EN60156	55.65		0.22	Yes	

		'stirred' only	'not stirred' only
normality	OK	OK	OK
n	56	42	11
outliers	0	14	45
mean (n)	52.20	52.46	52.75
st.dev. (n)	12.139	12.187	13.836
R(calc.)	33.99	34.12	38.74
st.dev.(IEC60156:18)	15.660	15.737	15.826
R(IEC60156:18)	43.85	44.06	44.31

Kernel Density
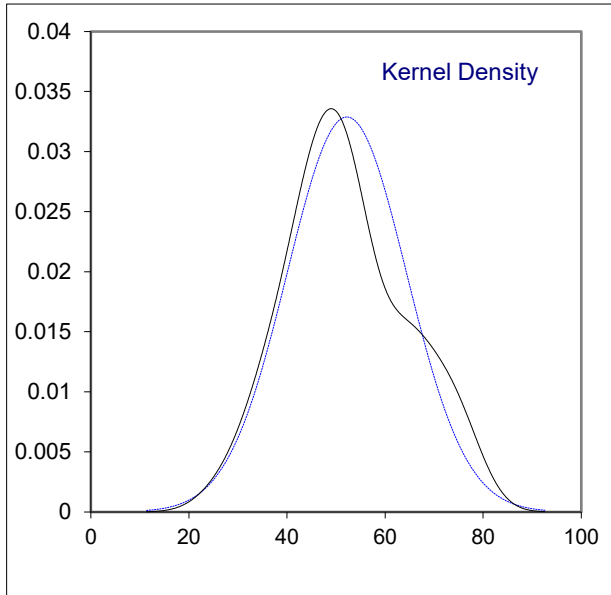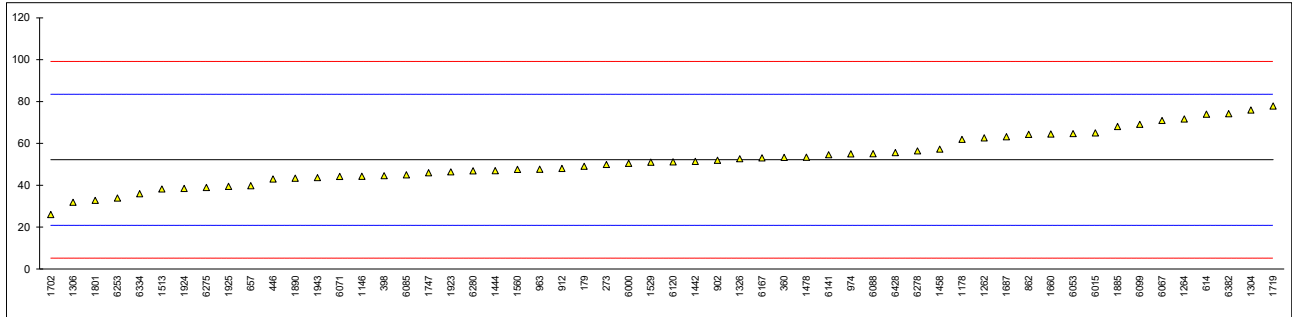
Determination of Color ASTM on sample #21240;

lab	method	value	iis conversion *	mark	z(targ)	remarks
173	D1500	L0.5	0.25		0.04	
179		-----	-----		-----	
273	D1500	L0.5	0.25		0.04	
325		-----	-----		-----	
360	ISO2049	L 0.5	0.25		0.04	
398	ISO2049	L0.5	0.25		0.04	
446	D1500	<0.5	0.25		0.04	
614	D1500	<0.5	0.25		0.04	
657	D1500	L 0.5	0.25		0.04	
862	D1500	L0.5	0.25		0.04	
902	D1500	L0.5	0.25		0.04	
912		-----	-----		-----	
913		-----	-----		-----	
963	D1500	L0.5	0.25		0.04	
974	D1500	L0.5	0.25		0.04	
1146		-----	-----		-----	
1178	ISO2049	0.2	0.2		-0.10	
1213	D1500	<0.5	0.25		0.04	
1262	ISO2049	L0.5	0.25		0.04	
1264	D1500	L0.5	0.25		0.04	
1304	In house	0.0	0.0	R(0.01)	-0.66	
1306	D1500	0.1	0.1		-0.38	
1326		-----	-----		-----	
1381	D6045	<0.5	0.25		0.04	
1442	ISO2049	L0,5	0.25		0.04	
1444	ISO2049	0.3	0.3		0.18	
1458	D1500	L1.0	0.75	R(0.01)	1.44	
1461		-----	-----		-----	
1478	ISO2049	0.2	0.2		-0.10	
1513	ISO2049	L0,5	0.25		0.04	
1529	ISO2049	L0.5	0.25		0.04	
1560	ISO2049	L0.5	0.25		0.04	
1660	D1500	0.1	0.1		-0.38	
1687		-----	-----		-----	
1702	D1500	L 0.5	0.25		0.04	
1719	D1524	<0.5	0.25		0.04	
1747	ISO2049	<1 [STRAW]	0.75	R(0.01)	1.44	
1801	ISO2049	<0.5	0.25		0.04	
1885	D1500	<0.5	0.25		0.04	
1890	D1500	<0,5	0.25		0.04	
1923		-----	-----		-----	
1924		-----	-----		-----	
1925		-----	-----		-----	
1943	ISO2049	0.2	0.2		-0.10	
6000		-----	-----		-----	
6015		-----	-----		-----	
6048	D1500	L0.5	0.25		0.04	
6053	ISO2049	Straw	-----		-----	
6067	ISO2049	L0.5	0.25		0.04	
6071		-----	-----		-----	
6074	D1500	0.1	0.1		-0.38	
6085	D1500	< 0.5	0.25		0.04	
6088	D1500	L0.5	0.25		0.04	
6099	D1500	0.4	0.4		0.46	
6120		-----	-----		-----	
6141	D1500	L0.5	0.25		0.04	
6167		-----	-----		-----	
6169		-----	-----		-----	
6253	ISO2049	L0.5	0.25		0.04	
6275	D1500	L 0.5	0.25		0.04	
6278	D1500	<0.5	0.25		0.04	
6280	D1500	0.1	0.1		-0.38	
6334	D1500	<0.5	0.25		0.04	
6382	ISO2049	0.1	0.1		-0.38	
6425	D1500	<0,5	0.25		0.04	
6428		-----	-----		-----	

normality	not OK
n	44
outliers	3
mean (n)	0.23
st.dev. (n)	0.056
R(calc.)	0.16
st.dev.(D1500:12)	0.357
R(D1500:12)	1

*) In the calculation of the mean, standard deviation and the reproducibility in this column, a reported value of 'L y' or '<y' is changed to y-0.25 (for example L0.5 is changed into 0.25).
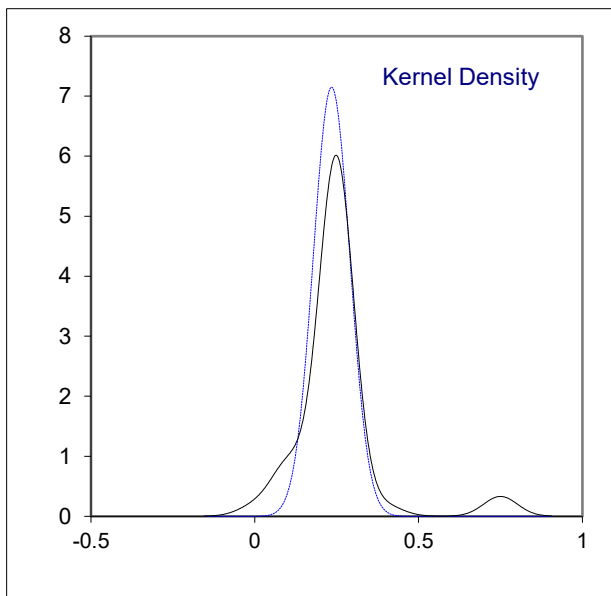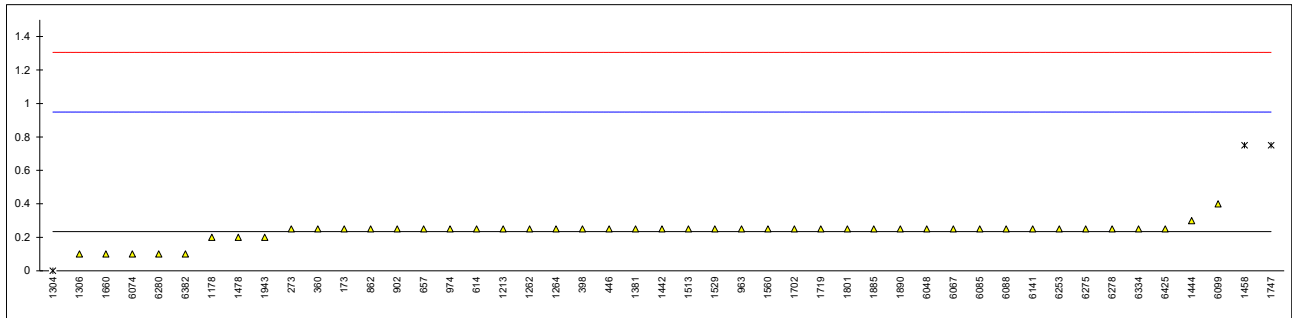
Determination of Density at 20°C on sample #21240; results in kg/m^3

lab	method	value	mark	z(targ)	remarks
173	D4052	874.6		-0.11	
179	D4052	874.8		0.36	
273	D4052	874.8		0.36	
325		-----		-----	
360	ISO12185	874.6		-0.11	
398	ISO12185	874.7		0.13	
446	ISO12185	874.8		0.36	
614	D4052	874.8		0.36	
657	D4052	874.7		0.13	
862	D4052	874.7		0.13	
902		-----		-----	
912	D4052	874.6		-0.11	
913		-----		-----	
963	D4052	874.7		0.13	
974	D4052	874.7		0.13	
1146	D4052	874.7	C	0.13	reported 0.8747 kg/m^3
1178	ISO12185	874.7		0.13	
1213		-----		-----	
1262	ISO3675	874.6		-0.11	
1264	D4052	874.59		-0.13	
1304		-----		-----	
1306	D4052	874.5		-0.34	
1326	D4052	874.8		0.36	
1381		-----		-----	
1442	ISO12185	874.70		0.13	
1444		-----		-----	
1458	D4052	874.8		0.36	
1461		874.1		-1.27	
1478	ISO12185	874.8		0.36	
1513	ISO12185	874.831		0.43	
1529		-----		-----	
1560		-----		-----	
1660	D7042	874.5	C	-0.34	first reported 0.8745 kg/m^3
1687	ISO12185	874.64		-0.01	
1702	ISO12185	874.67		0.06	
1719		-----		-----	
1747		-----		-----	
1801	ISO3675	874.8		0.36	
1885		-----		-----	
1890	ISO12185	874.6		-0.11	
1923		-----		-----	
1924		-----		-----	
1925		-----		-----	
1943	ISO3675	874.5	C	-0.34	first reported 873.6
6000		-----		-----	
6015	ISO12185	874.90		0.59	
6048	ISO12185	874.7		0.13	
6053		-----		-----	
6067	ISO3675	875.3		1.53	
6071		-----		-----	
6074	D4052	874.82	C	0.41	first reported 0.87482 kg/m^3
6085	D7042	874.51		-0.32	
6088	ISO3675	873.77	C,R(0.05)	-2.04	first reported 871.96
6099	ISO12185	874.9		0.59	
6120		-----		-----	
6141	D4052	874.7		0.13	
6167		-----		-----	
6169	ISO12185	874.84		0.45	
6253	ISO3675	877.9	R(0.01)	7.59	
6275	D4052	874.1		-1.27	
6278	D1298	874.44948		-0.46	
6280		874	C	-1.51	reported 0.874 kg/m^3
6334		-----		-----	
6382	DIN51757	874		-1.51	
6425	D4052	874.6		-0.11	
6428	ISO3675	881	C,R(0.01)	14.83	first reported 871

		D4052/ISO12185 only	ISO3675 only
normality	not OK	not OK	not OK
n	42	32	5
outliers	3	0	3
mean (n)	874.646	874.700	874.780
st.dev. (n)	0.2443	0.1468	0.3114
R(calc.)	0.684	0.411	0.872
st.dev.(ISO3675:98)	0.4286	-----	0.4286
R(ISO3675:98)	1.2	-----	1.2
compare			
R(D4052:18a)	0.50	0.50	-----
R(ISO12185:96)	0.5	0.5	-----

Kernel Density
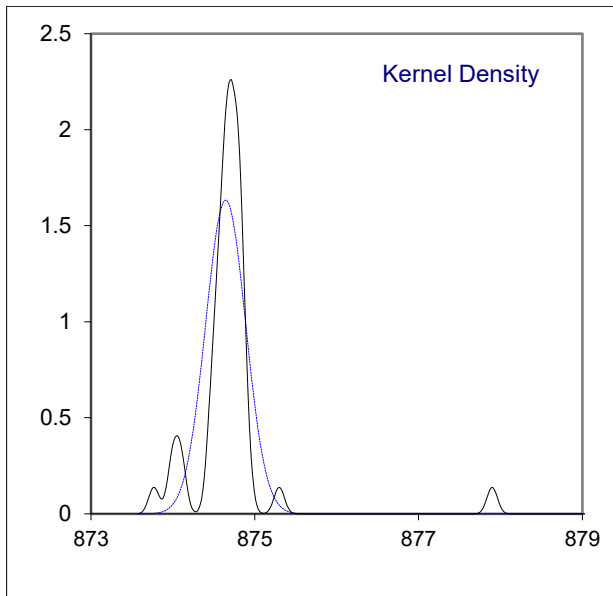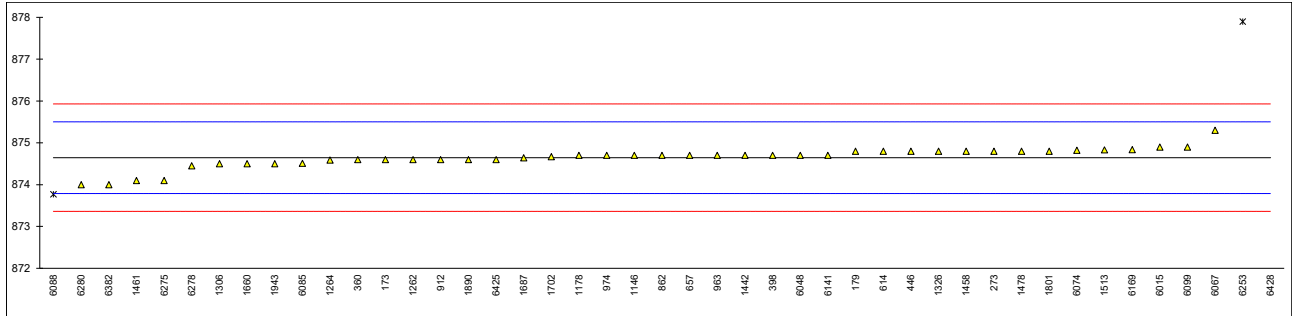
Determination of Di-electric Dissipation Factor (DDF) at 90°C on sample #21240

lab	method	value	mark	z(targ)	frequency	remarks
173		-----		-----	-----	
179		-----		-----	-----	
273	IEC60247	0.00084		-0.74	-----	
325		-----		-----	-----	
360	EN60247	0.00092		-0.65	-----	
398	EN60247	0.002032		0.66	-----	
446	EN60247	0.0010		-0.55	50	
614		-----		-----	-----	
657	IEC60247	0.001728		0.30	50	
862	IEC60247	0.0019		0.50	50	
902	EN60247	0.002100		0.74	50	
912	IS6262	0.0023	C	0.97	-----	first reported 0.0113
913		-----		-----	-----	
963	IEC60247	0.0009		-0.67	-----	
974	EN60247	0.00121		-0.31	60	
1146		-----		-----	-----	
1178	IEC60247	0.00225		0.91	50.0	
1213		-----		-----	-----	
1262	EN60247	0.00139		-0.10	50	
1264	EN60247	0.001503		0.04	60	
1304	IEC60247	0.001740		0.31	50	
1306	IEC60247	0.001257		-0.25	-----	
1326	EN60247	0.001060		-0.48	50	
1381	IEC60247	0.00095		-0.61	-----	
1442	IEC60247	0.00133		-0.17	55	
1444	IEC60247	0.001254		-0.25	-----	
1458	IEC60247	0.002655		1.39	50	
1461		0.001214		-0.30	-----	
1478	IEC60247	0.001113		-0.42	-----	
1513	IEC60247	0.00238		1.06	-----	
1529	IEC60247	0.00149		0.02	50	
1560	IEC60247	0.000428	R(0.05)	-1.22	50	
1660	IEC60247	0.002790		1.54	60	
1687	EN60247	0.00115		-0.38	50	
1702	IEC60247	0.00112		-0.41	-----	
1719	IEC60247	0.00218		0.83	-----	
1747	IEC60247	0.000822	C	-0.76	-----	first reported 0.0822
1801	EN60247	0.00238		1.06	-----	
1885	IEC60247	0.000919		-0.65	60	
1890	IEC60247	0.001164		-0.36	60Hz	
1923	EN60247	0.00121		-0.31	-----	
1924	EN60247	0.00108		-0.46	-----	
1925	EN60247	0.00111		-0.42	-----	
1943	EN60247	0.001418		-0.06	50	
6000		-----		-----	-----	
6015	EN60247	0.0014080		-0.07	50	
6048	IEC60247	0.000827		-0.75	-----	
6053		-----		-----	-----	
6067	EN60247	0.002407		1.10	50	
6071		-----		-----	-----	
6074		-----		-----	-----	
6085	IEC60247	0.001147		-0.38	50	
6088	IEC60247	0.00096		-0.60	-----	
6099	IEC60247	0.003491	R(0.05)	2.36	-----	
6120		-----		-----	-----	
6141	IEC60247	0.001312		-0.19	50	
6167		-----		-----	-----	
6169		-----		-----	-----	
6253		-----		-----	-----	
6275	IEC60247	0.001268		-0.24	55	
6278	IEC60247	0.001575		0.12	-----	
6280	IEC60247	0.001379		-0.11	50	
6334	IEC60247	0.00172		0.29	-----	
6382	IEC60247	0.00129		-0.21	-----	
6425		-----		-----	-----	
6428	EN60247	0.033	C,R(0.01)	36.90	-----	first reported 0.0033

normality	OK
n	47
outliers	3
mean (n)	0.001471
st.dev. (n)	0.0005304
R(calc.)	0.001485
st.dev.(EN60247:04)	0.0008545
R(EN60247:04)	0.002393
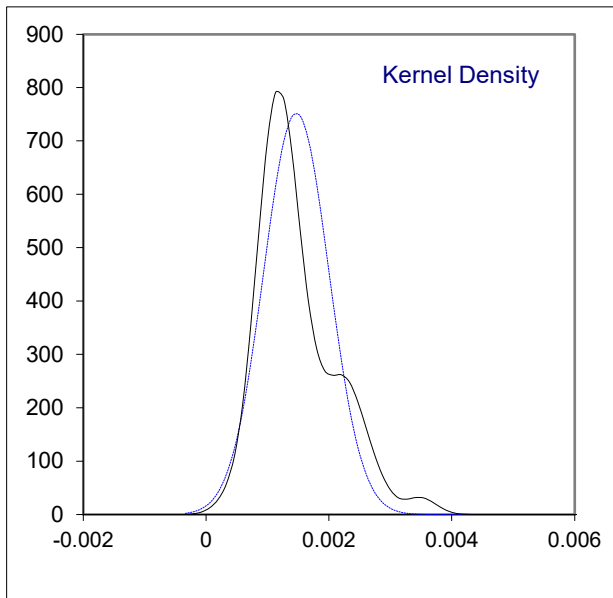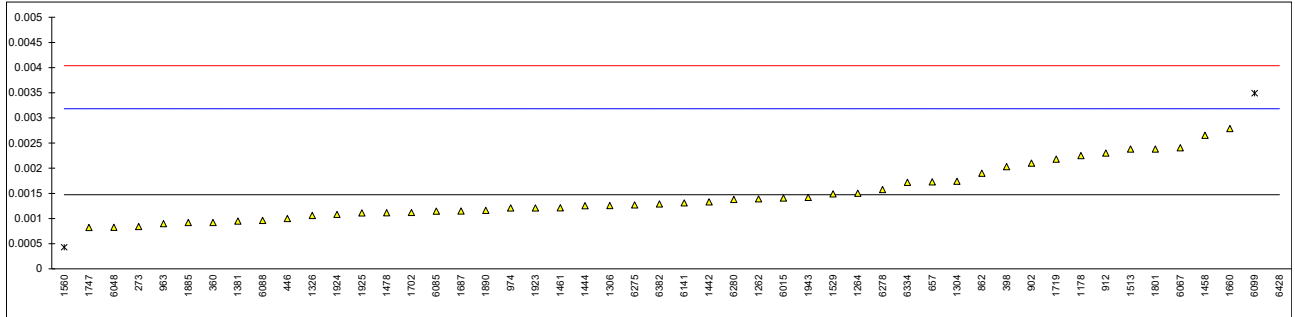
Determination of Specific Resistance at 90°C on sample #21240; results in GΩm

lab	method	value	mark	z(targ)	remarks
173		-----		-----	
179		-----		-----	
273		-----		-----	
325		-----		-----	
360	EN60247	1024		1.17	
398		-----		-----	
446		-----		-----	
614		-----		-----	
657	IEC60247	3720	R(0.01)	11.27	
862		-----		-----	
902	IEC60247	444.5		-1.00	
912	IEC60247	25.78		-2.57	
913		-----		-----	
963	IEC60247	401		-1.16	
974		-----		-----	
1146		-----		-----	
1178	IEC60247	864.5		0.57	
1213		-----		-----	
1262	EN60247	653.9		-0.22	
1264	EN60247	526.09		-0.70	
1304	IEC60247	1890		4.42	
1306	IEC60247	253.61		-1.72	
1326		-----		-----	
1381		-----		-----	
1442	IEC60247	1081		1.38	
1444	IEC60247	471.29		-0.90	
1458	IEC60247	585.5		-0.47	
1461		-----		-----	
1478	IEC60247	4650	R(0.01)	14.76	
1513		-----		-----	
1529	IEC60247	313.5		-1.49	
1560	IEC60247	711.71		0.00	
1660	IEC60247	189.05		-1.96	
1687	EN60247	185.90		-1.97	
1702	IEC60247	343.47		-1.38	
1719	IEC60247	328.55		-1.44	
1747	IEC60247	2070		5.09	
1801		-----		-----	
1885	IEC60247	1350		2.39	
1890	IEC60247	1033.6		1.21	
1923		-----		-----	
1924		-----		-----	
1925		-----		-----	
1943		-----		-----	
6000		-----		-----	
6015	EN60247	820.3		0.41	
6048	IEC60247	1430		2.69	
6053		-----		-----	
6067	EN60247	346.88		-1.37	
6071		-----		-----	
6074		-----		-----	
6085	IEC60247	1060		1.31	
6088	IEC60247	1540		3.10	
6099	IEC60247	185.65		-1.97	
6120		-----		-----	
6141	IEC60247	1210		1.87	
6167		-----		-----	
6169		-----		-----	
6253		-----		-----	
6275	IEC60247	551.5		-0.60	
6278	IEC60247	191		-1.95	
6280	IEC60247	643.05		-0.26	
6334	IEC60247	585.9		-0.47	
6382		-----		-----	
6425		-----		-----	
6428	EN60247	173	C	-2.02	first reported 1,737*10^11

normality	suspect
n	33
outliers	2
mean (n)	711.64
st.dev. (n)	516.988
R(calc.)	1447.57
st.dev.(EN60247:04)	266.866
R(EN60247:04)	747.23
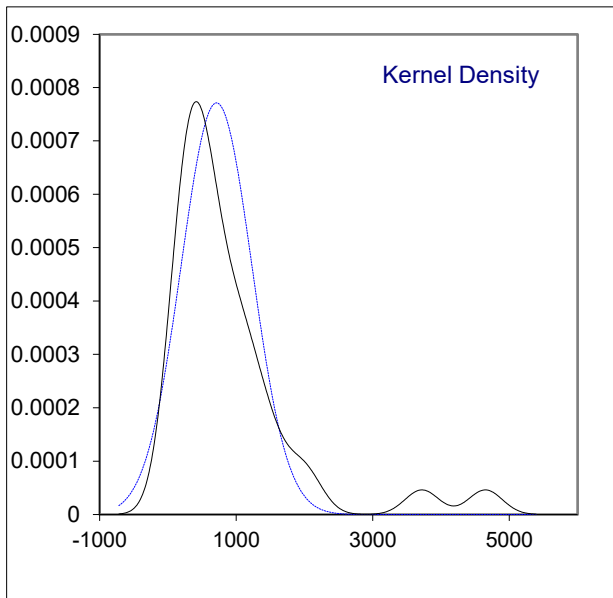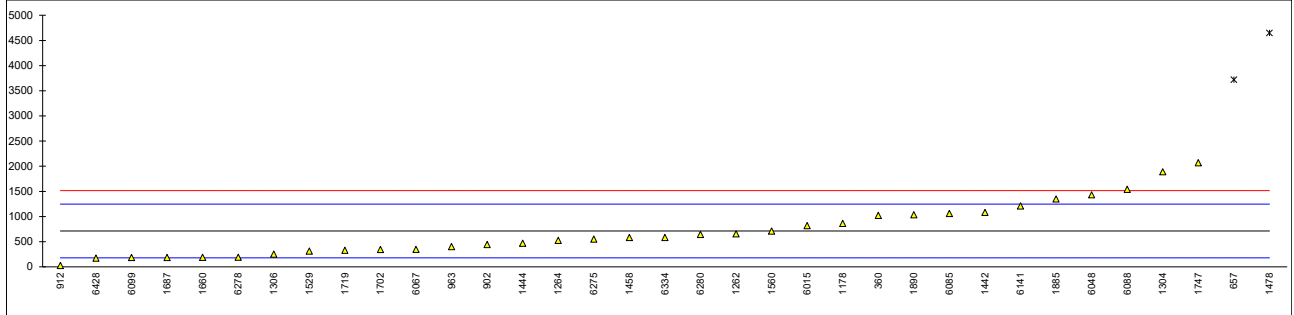
Determination of Flash Point C.O.C. on sample #21240; results in °C

lab	method	value	mark	z(targ)	remarks
173	D92	171.0		1.49	
179	D92	150		-1.78	
273		-----		-----	
325		-----		-----	
360	ISO2592	162		0.09	
398	D92	157		-0.69	
446		-----		-----	
614		-----		-----	
657	D92	162.4		0.15	
862	D92	164		0.40	
902		-----		-----	
912		-----		-----	
913		-----		-----	
963	D92	162		0.09	
974	D92	160		-0.22	
1146		-----		-----	
1178	ISO2592	168.0		1.02	
1213	D92	169.7		1.29	
1262	D92	164		0.40	
1264	D92	154		-1.15	
1304		-----		-----	
1306		-----		-----	
1326		-----		-----	
1381	ISO2592	159.0		-0.38	
1442	D92	171.0		1.49	
1444		-----		-----	
1458		-----		-----	
1461		-----		-----	
1478		-----		-----	
1513		-----		-----	
1529		-----		-----	
1560		-----		-----	
1660	D92	159		-0.38	
1687		-----		-----	
1702		-----		-----	
1719		-----		-----	
1747		-----		-----	
1801		-----		-----	
1885		-----		-----	
1890		-----		-----	
1923		-----		-----	
1924		-----		-----	
1925		-----		-----	
1943	ISO2592	164		0.40	
6000		-----		-----	
6015	ISO2592	163.0		0.25	
6048	D92	164		0.40	
6053		-----		-----	
6067		-----		-----	
6071		-----		-----	
6074	D92	162		0.09	
6085		-----		-----	
6088		-----		-----	
6099		-----		-----	
6120		-----		-----	
6141	D92	158		-0.53	
6167		-----		-----	
6169		-----		-----	
6253	ISO2592	154		-1.15	
6275	D92	168		1.02	
6278		-----		-----	
6280		-----		-----	
6334		-----		-----	
6382		-----		-----	
6425	ISO2592	159		-0.38	
6428	ISO2592	149	C	-1.93	first reported 140

normality	OK
n	24
outliers	0
mean (n)	161.42
st.dev. (n)	5.954
R(calc.)	16.67
st.dev.(D92:18)	6.429
R(D92:18)	18
compare	
R(ISO2592:17)	18
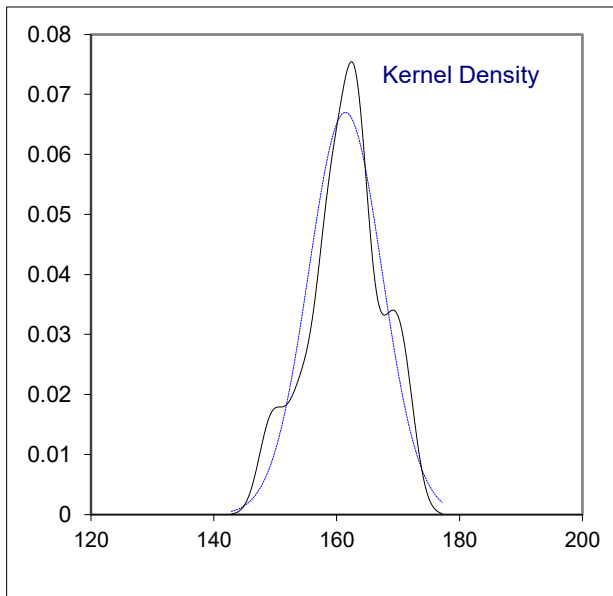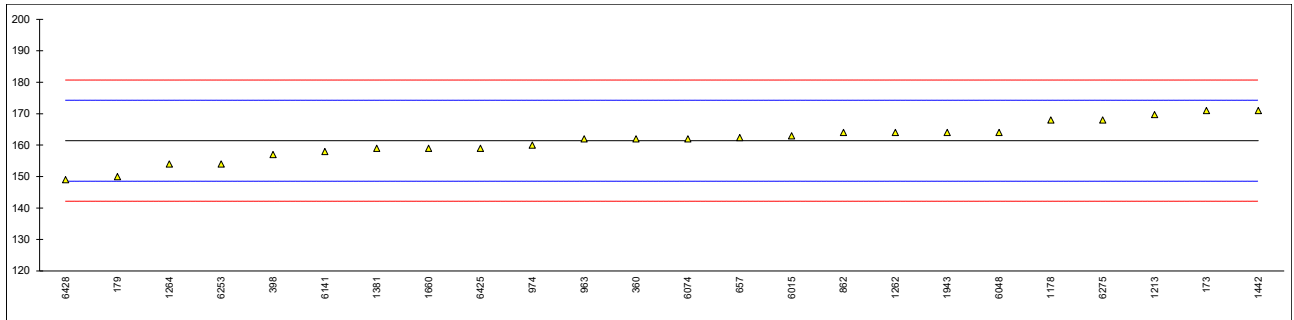
Determination of Flash Point PMcc on sample #21240; results in °C

lab	method	value	mark	z(targ)	remarks
173		-----		-----	
179	D93	154.5		0.71	
273	D93-A	153.0		0.32	
325		-----		-----	
360	ISO2719-A	151.0		-0.20	
398		-----		-----	
446	ISO2719-A	150.0		-0.46	
614	D93-A	160		2.14	
657		-----		-----	
862	D93-A	148		-0.98	
902		-----		-----	
912	D93-C	144		-2.02	
913		-----		-----	
963		-----		-----	
974	D93-A	152.0		0.06	
1146	D93-A	152.0		0.06	
1178		-----		-----	
1213		-----		-----	
1262	ISO2719-A	152.0		0.06	
1264	D93-A	152		0.06	
1304	In house	146.2		-1.44	
1306	D93-A	144.4		-1.91	
1326	D93-A	153.0		0.32	
1381	ISO2719-A	152.50		0.19	
1442	ISO2719-A	152.0		0.06	
1444		-----		-----	
1458		-----		-----	
1461		152	C	0.06	first reported 164
1478	ISO2719-A	152.0		0.06	
1513	ISO2719-A	154.0		0.58	
1529		-----		-----	
1560	ISO2719-A	152.5		0.19	
1660	D93-A	152		0.06	
1687		-----		-----	
1702	ISO2719-A	160.5		2.27	
1719		-----		-----	
1747		-----		-----	
1801		-----		-----	
1885		-----		-----	
1890		-----		-----	
1923		-----		-----	
1924		-----		-----	
1925		-----		-----	
1943	ISO2719-A	152		0.06	
6000	ISO2719-A	153.5713		0.47	
6015	ISO2719-A	154.0		0.58	
6048	D93-A	150.0		-0.46	
6053		-----		-----	
6067		-----		-----	
6071		-----		-----	
6074		-----		-----	
6085		-----		-----	
6088		-----		-----	
6099		-----		-----	
6120		-----		-----	
6141		-----		-----	
6167		-----		-----	
6169	ISO2719-A	152.0		0.06	
6253		-----		-----	
6275	D93-A	155		0.84	
6278		-----		-----	
6280		-----		-----	
6334		-----		-----	
6382		-----		-----	
6425	ISO2719-A	155.5		0.97	
6428	ISO2719-A	141	C	-2.80	first reported 135

normality	suspect
n	30
outliers	0
mean (n)	151.76
st.dev. (n)	4.053
R(calc.)	11.35
st.dev.(ISO2719-A:16)	3.848
R(ISO2719-A:16)	10.77
compare	
R(D93-A:20)	10.77
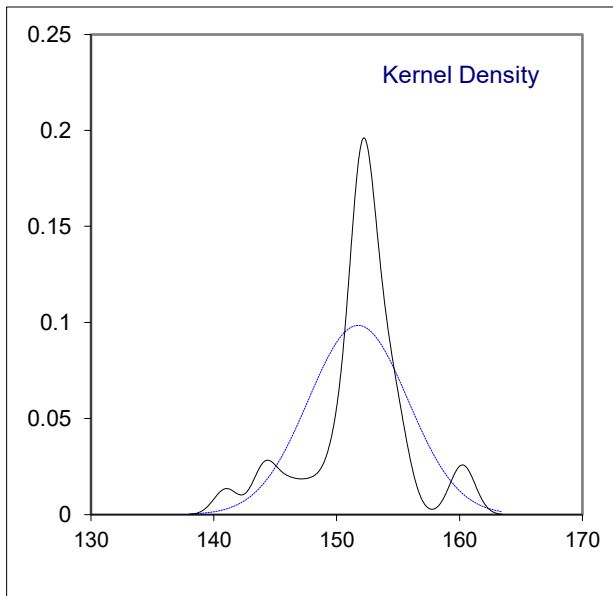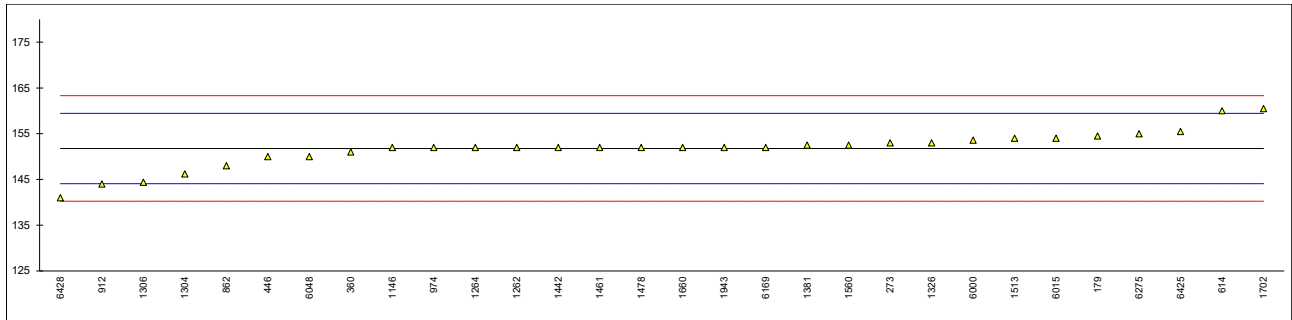
Determination of Interfacial Surface Tension on sample #21240; results in mN/m

lab	method	value	mark	z(targ)	remarks
173		-----		-----	
179	D971	49		1.01	
273		-----		-----	
325		-----		-----	
360	D971	47.2		-0.06	
398		-----		-----	
446		-----		-----	
614	D971	49		1.01	
657	D971	42.993		-2.55	
862	D971	50.2		1.72	
902	D971	49.27		1.17	
912	D971	45.1		-1.30	
913		-----		-----	
963	D971	49		1.01	
974	D971	46.20		-0.65	
1146		-----		-----	
1178	D971	47.54		0.14	
1213		-----		-----	
1262	D971	44.9		-1.42	
1264	D971	44.325		-1.76	
1304	In house	47.75		0.27	
1306	D971	47.54		0.14	
1326	D971	48.42		0.66	
1381		-----		-----	
1442	EN14210	45.3		-1.18	
1444		48.41		0.66	
1458	D971	48.3		0.59	
1461		-----		-----	
1478	D971	49.85		1.51	
1513	D971	47.9		0.36	
1529	D971	49.75		1.45	
1560	D971	47.5		0.12	
1660	D971	44.6		-1.60	
1687	D971	44.74		-1.52	
1702	D971	47.725		0.25	
1719	D2285	43.2		-2.43	
1747		-----		-----	
1801	D971	46.18		-0.66	
1885	D971	45.6		-1.01	
1890		-----		-----	
1923		-----		-----	
1924		-----		-----	
1925		-----		-----	
1943		-----		-----	
6000		-----		-----	
6015	D971	45.300		-1.18	
6048	D971	48.5		0.71	
6053		-----		-----	
6067	D971	47.9		0.36	
6071		-----		-----	
6074		-----		-----	
6085	D971	48.193		0.53	
6088	ISO6295	51		2.19	
6099	ISO6295	43.5		-2.25	
6120		-----		-----	
6141	D971	46.36		-0.56	
6167		-----		-----	
6169	EN14210	48.851		0.92	
6253		-----		-----	
6275	D971	52.7		3.20	
6278	D971	45.7		-0.95	
6280	D971	48.8		0.89	
6334	D971	48.61		0.78	
6382	ISO6295	46.4		-0.53	
6425		-----		-----	
6428		-----		-----	

normality	OK
n	41
outliers	0
mean (n)	47.300
st.dev. (n)	2.1816
R(calc.)	6.109
st.dev.(D971:20)	1.6893
R(D971:20)	4.730
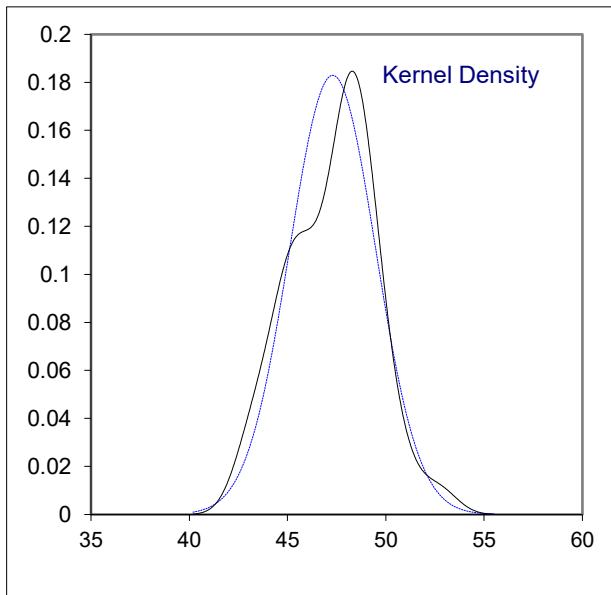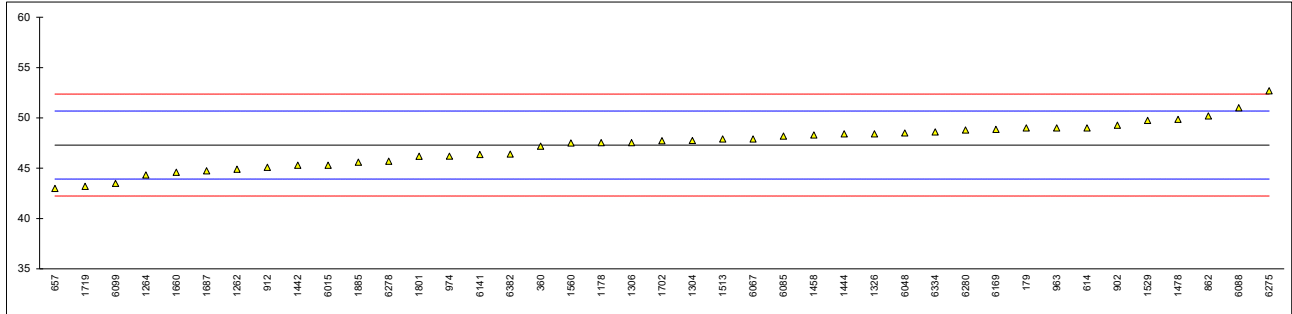
Determination of Kinematic Viscosity at 40°C on sample #21240; results in mm^2/s

lab	method	value	mark	z(targ)	remarks
173	D445	10.05		0.99	
179	D445	10.04		0.76	
273	D445	9.931		-1.74	
325		-----		-----	
360	ISO3104	9.9915		-0.35	
398		-----		-----	
446	D445	9.968	C	-0.89	first reported 9.676
614	D7042	9.9711		-0.82	
657		-----		-----	
862	D445	10.01		0.07	
902		-----		-----	
912	D445	10.12		2.59	
913		-----		-----	
963	D445	9.971		-0.82	
974	D445	10.04		0.76	
1146	D445	9.985		-0.50	
1178	D7042	10.013		0.14	
1213	D445	10.00		-0.16	
1262	D445	9.996		-0.25	
1264	D7042	10.1495		3.27	
1304		-----		-----	
1306	D445	10.00		-0.16	
1326	D445	10.09		1.91	
1381	ISO3104	9.9820		-0.57	
1442	D7042	9.97		-0.85	
1444		-----		-----	
1458		-----		-----	
1461		10.1295		2.81	
1478	D7042	10.109		2.34	
1513	ISO3104	10.019		0.28	
1529		-----		-----	
1560	ISO3104	9.865		-3.25	
1660	D7042	9.9580		-1.12	
1687		-----		-----	
1702	D7042	10.03		0.53	
1719		-----		-----	
1747		-----		-----	
1801	ISO3104	9.914		-2.13	
1885		-----		-----	
1890	ISO3104	9.9755		-0.72	
1923		-----		-----	
1924		-----		-----	
1925		-----		-----	
1943	ISO3104	9.91		-2.22	
6000	ISO3104	10.0035		-0.08	
6015		-----		-----	
6048	D445	9.975		-0.73	
6053		-----		-----	
6067	D445	10.69	R(0.01)	15.67	
6071		-----		-----	
6074	D445	9.954		-1.21	
6085	D7042	10.036		0.67	
6088		-----		-----	
6099		-----		-----	
6120		-----		-----	
6141	D445	10.0835		1.76	
6167		-----		-----	
6169	EN16896	9.9344		-1.66	
6253	ISO3104	10.05		0.99	
6275	D445	10.07		1.45	
6278	D445	11.1446	C,R(0.01)	26.09	first reported 11.04037
6280		-----		-----	
6334		-----		-----	
6382	DIN51562-1	10.01		0.07	
6425	D7042	9.672	C,R(0.01)	-7.68	first reported 9.3472
6428	ISO3104	9.9565		-1.16	

		D445 only	ISO3104 only	D7042 only
normality	OK	OK	OK	OK
n	38	17	10	8
outliers	3	2	0	1
mean (n)	10.007	10.017	9.967	10.030
st.dev. (n)	0.0634	0.0531	0.0562	0.0688
R(calc.)	0.178	0.149	0.157	0.193
st.dev.(D445:21)	0.0436	0.0436	-----	-----
R(D445:21)	0.122	0.122	-----	-----
compare				
R(ISO3104:20)	0.122	-----	0.122	-----
R(D7042:21a)	0.244	-----	-----	0.244
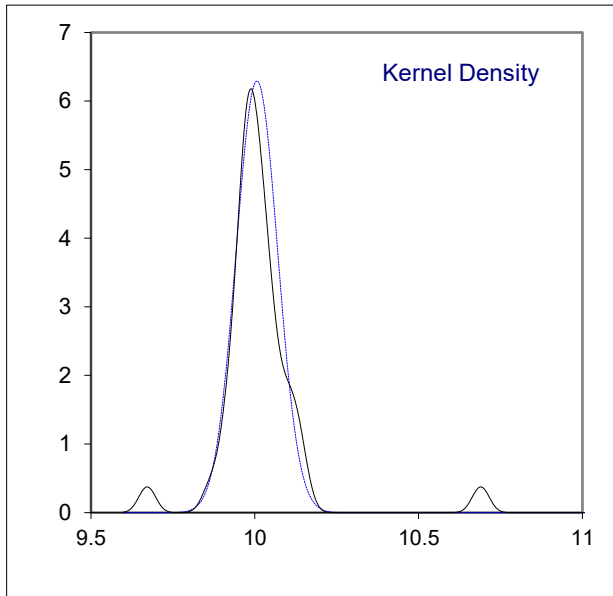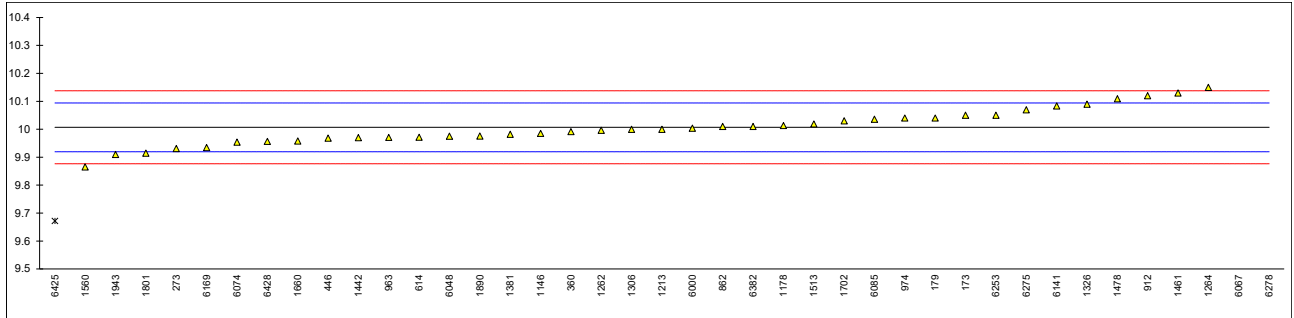
Determination of Water on sample #21240; results in mg/kg

lab	method	value	mark	z(targ)	remarks
173	D6304-C	10.2288	R(0.05)	-2.96	
179	D1533	35	R(0.01)	8.34	
273	IEC60814	19.6		1.31	
325		-----		-----	
360	EN60814	18.1		0.63	
398		-----		-----	
446	EN60814	18		0.58	
614	IEC60814	19.5		1.27	
657	D6304-A	11.69		-2.30	
862	D6304-A	15		-0.79	
902	D1533	17		0.13	
912	IS13567	15		-0.79	
913		-----		-----	
963	D1533	21		1.95	
974		-----		-----	
1146	D6304-C	<100		-----	
1178	IEC60814	16.8		0.04	
1213		-----		-----	
1262	EN60814	15.0		-0.79	
1264	D1533	27.4	R(0.01)	4.87	
1304	In house	14.9		-0.83	
1306	D1533	16.75		0.01	
1326		-----		-----	
1381	IEC60814	17.50		0.36	
1442	IEC60814	16.90		0.08	
1444	IEC60814	16.72430		0.00	
1458	IEC60814	16.2		-0.24	
1461		-----		-----	
1478	IEC60814	17.05		0.15	
1513	IEC60814	16.1		-0.28	
1529	IEC60814	13.4		-1.52	
1560	IEC60814	16		-0.33	
1660	IEC60814/IEC60247	15		-0.79	
1687	EN60814	17.5		0.36	
1702	IEC60814	17.6		0.40	
1719	IEC60814	13.8		-1.33	
1747	IEC60814	17		0.13	
1801	EN60814	18.2		0.67	
1885	D1533	19.9		1.45	
1890	IEC60814	19.27		1.16	
1923	EN60814	16.2		-0.24	
1924	EN60814	15.26		-0.67	
1925	EN60814	17.45		0.33	
1943	EN60814	14.04		-1.22	
6000		-----		-----	
6015		-----		-----	
6048	ISO12937	17		0.13	
6053	IEC60814	17.2		0.22	
6067	EN60814	17.95		0.56	
6071	IEC60814	17.6		0.40	
6074		-----	W	-----	first reported 9.7153
6085	D6304-C	19		1.04	
6088	D1533	10	C,R(0.05)	-3.07	first reported 32.4
6099	IEC60814	16.3		-0.19	
6120		-----		-----	
6141	D1533	15		-0.79	
6167		-----		-----	
6169		-----		-----	
6253		-----		-----	
6275	IEC60814	16.38		-0.16	
6278	D1533	16.62		-0.05	
6280	IEC60814	17.7		0.45	
6334	IEC60814mod	15.41		-0.60	
6382	EN60814	37.8	R(0.01)	9.62	
6425	D6304-A	16		-0.33	
6428	EN60814	17.6	C	0.40	first reported 22.9

normality	OK
n	46
outliers	5
mean (n)	16.722
st.dev. (n)	1.7969
R(calc.)	5.031
st.dev.(EN60814:97)	2.1906
R(EN60814:97)	6.134
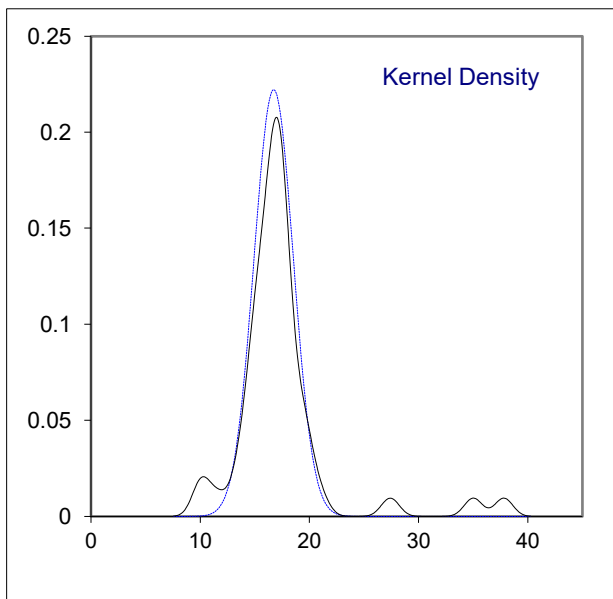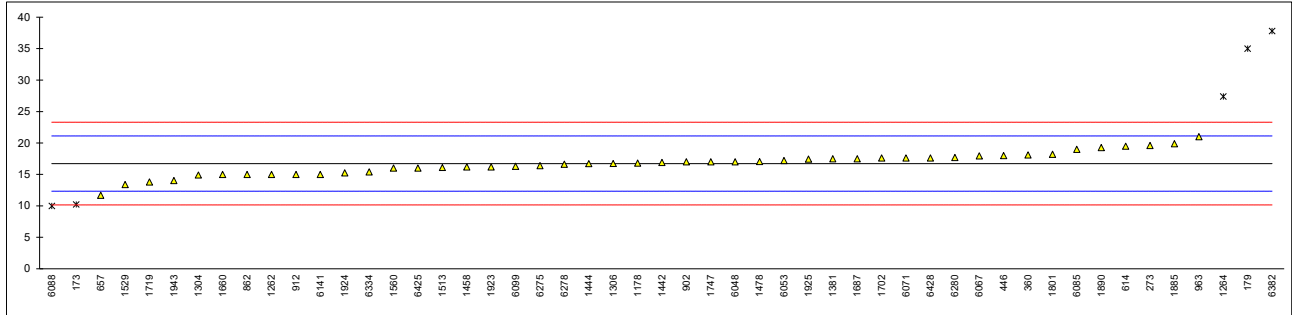
APPENDIX 2   Other reported test results on sample #21240

2,6-Ditertiary-butyl phenol (DBP) in %M/M, 2,6-Ditertiary-butyl paracresol (DBPC) in %M/M, Dibenzyl disulfide (DBDS) in mg/kg, Benzotriazole (BTA) in mg/kg and Irgamet 39 in mg/kg

lab	DBP	DBPC	DBDS	BTA	Irgamet 39	remarks
173	-----	-----	-----	-----	-----	
179	-----	-----	-----	-----	-----	
273	-----	-----	-----	-----	-----	
325	-----	-----	-----	-----	-----	
360	-----	< 0.01	-----	-----	-----	
398	-----	-----	-----	-----	-----	
446	-----	-----	-----	-----	-----	
614	-----	-----	-----	-----	-----	
657	0.066865	0.063388	-----	-----	-----	
862	<0.05	<0.01	-----	<5	-----	
902	-----	<0.05	-----	-----	-----	
912	-----	-----	-----	-----	-----	
913	-----	-----	-----	-----	-----	
963	<0.02	<0.02	<5	<1	<1	
974	-----	-----	-----	-----	-----	
1146	-----	-----	-----	-----	-----	
1178	-----	0.009	-----	-----	-----	
1213	-----	-----	-----	-----	-----	
1262	-----	0	-----	-----	-----	
1264	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	
1304	-----	<0.01	-----	-----	-----	
1306	-----	0	0	-----	-----	
1326	-----	-----	-----	-----	-----	
1381	-----	-----	-----	-----	-----	
1442	-----	<0,03	<0,05	<0,04	<5	
1444	-----	-----	-----	-----	-----	
1458	-----	<0.02	-----	-----	-----	
1461	-----	-----	-----	-----	-----	
1478	-----	0.00	-----	-----	-----	
1513	-----	<0,01	<5	-----	<5	
1529	0	0.014	0	0	0	
1560	-----	Not detected	-----	-----	-----	
1660	-----	0.013	0	0	0	
1687	-----	-----	-----	-----	-----	
1702	-----	Not Detected	Not Detected	-----	Not Detected	
1719	-----	-----	-----	-----	-----	
1747	-----	-----	-----	-----	-----	
1801	-----	0.00	-----	-----	0.00	
1885	0.000	-----	-----	-----	-----	
1890	-----	-----	-----	-----	-----	
1923	-----	-----	-----	-----	-----	
1924	-----	-----	-----	-----	-----	
1925	-----	-----	-----	-----	-----	
1943	-----	-----	-----	-----	-----	
6000	-----	-----	-----	-----	-----	
6015	-----	0.006	-----	-----	-----	
6048	-----	-----	-----	-----	-----	
6053	-----	-----	-----	-----	-----	
6067	0	0	0	0	0	
6071	-----	-----	-----	-----	-----	
6074	-----	-----	-----	-----	-----	
6085	-----	-----	-----	-----	-----	
6088	-----	0.05	-----	-----	-----	
6099	-----	0.04	-----	-----	-----	
6120	-----	-----	-----	-----	-----	
6141	0	0	0	0	0	
6167	-----	-----	-----	-----	-----	
6169	-----	-----	-----	-----	-----	
6253	-----	-----	-----	-----	-----	
6275	-----	-----	-----	-----	-----	
6278	-----	-----	-----	-----	-----	
6280	-----	-----	-----	-----	-----	
6334	-----	0.02	<1	-----	0.54	
6382	-----	-----	-----	-----	-----	
6425	-----	-----	-----	-----	-----	
6428	-----	-----	-----	-----	-----	

APPENDIX 3

Number of participants per country

4 labs in AUSTRALIA

2 labs in BELGIUM

8 labs in BULGARIA

2 labs in CHINA, People's Republic

1 lab in CROATIA

1 lab in ESTONIA

6 labs in GERMANY

1 lab in GREECE

1 lab in HONG KONG

2 labs in INDIA

1 lab in INDONESIA

2 labs in ITALY

1 lab in KOREA, Republic of

1 lab in KUWAIT

1 lab in LATVIA

1 lab in MALAYSIA

1 lab in MOROCCO

2 labs in NETHERLANDS

1 lab in NEW ZEALAND

1 lab in PHILIPPINES

2 labs in POLAND

1 lab in PORTUGAL

1 lab in QATAR

3 labs in SAUDI ARABIA

3 labs in SINGAPORE

1 lab in SLOVENIA

2 labs in SOUTH AFRICA

2 labs in SPAIN

1 lab in SWITZERLAND

2 labs in TURKEY

3 labs in UNITED ARAB EMIRATES

2 labs in UNITED KINGDOM

2 labs in UNITED STATES OF AMERICA

1 lab in VIETNAM

APPENDIX 4

Abbreviations

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

Literature

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