Results of Proficiency Test
Transformer Oil (used)
November 2018

Organised by: Institute for Interlaboratory Studies
Spijkenisse, the Netherlands

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1 INTRODUCTION

Since 2014 the Institute for Interlaboratory Studies (iis) organizes a proficiency scheme for used Transformer Oil and for Furanics in used Transformer Oil, both in accordance with the latest applicable version of the specification IEC60296 and/or ASTM D3487 every year. During the annual proficiency testing (PT) program 2018/2019, it was decided to continue the PT for the analysis of used Transformer Oil in combination with the PT on Furanics in used Transformer Oil.
In this interlaboratory study 76 laboratories from 35 different countries registered for participation for the PT on used Transformer Oil and 50 laboratories from 29 different countries registered for participation for the PT on Furanics in Transformer Oil. See appendix 3 for the number of participants per PT and per country. In this report, the results of the 2018 proficiency tests on used Transformer Oil and Furanics in Transformer Oil are presented and discussed. This report is also electronically available through the iis website www.iisnl.com.

2 SET UP

The Institute for Interlaboratory Studies (iis) in Spijkenisse, the Netherlands, was the organizer of this proficiency test (PT). Sample analyses for fit-for-use and homogeneity testing were subcontracted to an ISO/IEC 17025 accredited laboratory.
Dependent on registration it was decided to send for the main used Transformer Oil round 1L labelled #18231 and for the Furanics in used Transformer Oil round 100mL labelled #18232. The participants were requested to report rounded and unrounded test results. The unrounded test results were preferably used for the statistical evaluation.

2.1 ACCREDITATION

The Institute for Interlaboratory Studies in Spijkenisse, the Netherlands, is accredited in agreement with ISO/IEC 17043:2010 (R007), since January 2000, by the Dutch Accreditation Council (Raad voor Accreditatie). This PT falls under the accredited scope. This ensures strict adherence to protocols for sample preparation and statistical evaluation and 100% confidentiality of participant's data. Feedback from the participants on the reported data is encouraged and customer's satisfaction is measured on regular basis by sending out questionnaires.

2.2 PROTOCOL

The protocol followed in the organisation 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 100 litres of used Transformer Oil was obtained from a third party laboratory. After homogenisation in a pre-cleaned drum, 88 amber glass bottles of 1 litre were filled and labelled #18231. The homogeneity of the subsamples #18231 was checked by determination of Density in accordance with ASTM D4052 on 8 stratified randomly selected samples.

	Density at 20°C in kg/m^3
Sample #18231-1	870.22
Sample #18231-2	870.22
Sample #18231-3	870.20
Sample #18231-4	870.21
Sample #18231-5	870.19
Sample #18231-6	870.18
Sample #18231-7	870.21
Sample #18231-8	870.19

Table 1: homogeneity test results of subsamples #18231

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

	Density at 20°C in kg/m^3
r (observed)	0.04
reference test method	ISO3675:98
0.3 x R (ref. test method)	0.36

Table 2: evaluation of the repeatability of subsamples #18231

The calculated repeatability was less than 0.3 times the corresponding reproducibility of the reference test method. Therefore, homogeneity of the subsamples #18231 was assumed.

The necessary bulk material for the PT on Furanics was obtained from a third party. After homogenisation in a pre-cleaned can 68 amber glass bottles of 100 mL were filled and labelled #18232. The homogeneity of the subsamples #18232 was checked by determination Density in accordance with ASTM D4052 on 8 stratified randomly selected samples.

	Density at 20°C in kg/m^3
Sample #18232-1	874.34
Sample #18232-2	874.35
Sample #18232-3	874.34
Sample #18232-4	874.34
Sample #18232-5	874.35
Sample #18232-6	874.35
Sample #18232-7	874.34
Sample #18232-8	874.35

Table 3: homogeneity test results of subsamples #18232

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

	Density at 20°C in kg/m^3
r (observed)	0.01
reference test method	ISO3675:98
0.3 x R (ref. test method)	0.36

Table 4: evaluation of the repeatability of subsamples #18232

The calculated repeatability was less than 0.3 times the corresponding reproducibility of the reference test method. Therefore, homogeneity of the subsamples #18232 was assumed.

To each of the participating laboratories, depending on the registration, 1 * 1 litre bottle, labelled #18231 and/or 1 * 100mL bottle, labelled #18232 was sent on October 31, 2018. An SDS was added to the sample package.

2.5 STABILITY OF THE SAMPLES

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

2.6 ANALYSES

The participants were requested to determine on sample #18231; Total Acidity (Potentiometric and Colorimetric), Breakdown Voltage, Density at 20°C, Di-electric Dissipation Factor (DDF) at 90°C and Specific Resistance at 90°C, Flash Point (Cleveland Open Cup and Pensky-Martens Closed Cup), Interfacial Surface Tension, Kinematic Viscosity at 40°C and Water. Also, some analytical details were asked for the Total Acidity (Potentiometric) and for the Breakdown Voltage determination.
The participants were requested to determine on sample #18232; Total Furanic Compounds, 2-Acetyl Furan, 2-Furfural, 2-Furfurylalcohol, 5-Hydroxy Methyl-2-Furfural and 5-Methyl-2-Furfural.

It was explicitly requested to treat the samples as if they were routine samples and to report the test results using the indicated units on the report form and not to round the 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 appropriate reference test methods that will be used during the evaluation. The detailed report form and the letter of instructions are both made available on the data entry portal www.kpmd.co.uk/sgs-iis/. The participating laboratories are also requested to confirm the sample receipt on this data entry portal. The letter of instructions can also be downloaded from the iis website www.iisnl.com.

3 RESULTS

During five weeks after sample dispatch, the test results of the individual laboratories were gathered via the data entry portal www.kpmd.co.uk/sgs-iis/. The reported test results are tabulated per determination in appendix 1 of this report. The laboratories are presented by their code numbers.

Directly after the deadline, a reminder was sent to those laboratories that had not reported test results at that moment.
Shortly after the deadline, the available test results were screened for suspect data. A test result was called suspect in case the Huber Elimination Rule (a robust outlier test) found it to be an outlier. The laboratories that produced these suspect data were asked to check the 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 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 organisation of this proficiency test was the one as described for proficiency testing in the report 'iis Interlaboratory Studies: Protocol for the Organisation, Statistics and Evaluation' of 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 ISO 5725 the original test results per determination were submitted to Dixon's and/or Grubbs' and/or Rosner's outlier tests. Outliers are marked by D(0.01) for the Dixon's test, by G(0.01) or DG(0.01) for the Grubbs' test and by R(0.01) for the Rosner's test. Stragglers are marked by D(0.05) for the Dixon's test, by G(0.05) or DG(0.05) for the Grubbs' test and by R(0.05) for the Rosner's test. Both outliers and stragglers were not included in the calculations of averages and standard deviations.

For each assigned value, the uncertainty was determined in accordance with ISO13528. Subsequently the calculated uncertainty was evaluated against the respective requirement based on the target reproducibility in accordance with ISO13528. 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 these with a factor of 2.8.

3.2 GRAPHICS

In order to visualize the data against the reproducibilities from literature, Gauss plots were made, using the sorted data for one determination (see appendix 1). On the Y-axis, the reported 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. The Kernel Density Graph is a method for producing a smooth density approximation to a set of data that avoids some problems associated with histograms. Also, a normal Gauss curve was projected over the Kernel Density Graph for reference.

3.3 Z-SCORES

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

The target standard deviation was calculated from the literature reproducibility by division with 2.8. In case no literature reproducibility was available, other target values were used. In some cases, a reproducibility based on former iis proficiency tests could be used.

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

The z-scores were calculated according to:

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

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

Absolute values for z<2 are very common and absolute values for z>3 are very rare. The usual interpretation of z-scores is as follows:

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

4 EVALUATION

In this interlaboratory study, a number of laboratories encountered problems with sample dispatch. For the main PT: three participants reported test results after the final reporting date and three participants did not report any test results at all.
For the PT on Furanics: one participant reported the test results after the final reporting date and three participants did not report any test results at all.
Not all laboratories were able to report all analyses requested.
The 75 reporting participants sent in 805 numerical test results. Observed were 41 outlying test results, which is 5.1% of the numerical test results. 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.

4.1 EVALUATION PER SAMPLE AND PER TEST

In this section, the reported test results are discussed per sample and 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 listed in appendix 4.

For the Furanics the observed reproducibilities were compared against the (strict) reproducibilities estimated from the Horwitz equation. It is remarkable that the precision requirements of IEC 61198:93 are stricter than the requirements estimated from the Horwitz equation.

Sample #18231

Acidity, total (Potentiometric): This determination was problematic. One statistical outlier was observed. The calculated reproducibility after rejection of the statistical outlier is not in agreement with the requirements of ASTM D664-A:17a (BEP- 60mL and 125mL and IP- 60mL) nor with the requirements of EN62021-1:03, but is in good agreement with the requirements of ASTM D664-A:17a (IP- 125mL).

Acidity, total (Colorimetric): This determination was not problematic depending on the test method used. Two statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in good agreement with the requirements of ASTM D974:14e2, but not at all in agreement with the very strict requirements of EN162021-2:07.

Breakdown Voltage: This determination was problematic. One statistical outlier was observed. The calculated reproducibility after rejection of the statistical outlier is not in agreement with the requirements of EN60156:95. A number of analytical details were requested to be reported by the participants to try to clarify the large variation. For this sample, no conclusions could be drawn from the reported analytical details.

Density at 20°C: This determination was problematic for a number of participants. Four statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in full agreement with the requirements of ISO3675:98.

DD-Factor: 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 EN60247:04.

Spec. Resistance: This determination was not problematic. One statistical outlier was observed. However, the calculated reproducibility after rejection of the statistical outlier is in good agreement with the requirements of EN60247:04.

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

Flash Point PMcc: This determination was not problematic. No statistical outliers were observed. The calculated reproducibility is in good agreement with the requirements of ISO2719-B:16, but also with the requirements of ISO2719-A:16, ASTM D93-A:18 and ASTM D93-B:18.

Interf. Surf. Tension: This determination was very problematic. One statistical outlier was observed. The calculated reproducibility after rejection of the statistical outlier is not at all in agreement with the requirements of ASTM D971:12.

Kinematic Viscosity: Till 2017 a precision statement for used oils was not present in ASTM D445. In the version of 2017 of ASTM D445 a precision statement is given for used (in-service) formulated oils. However, it appears that this reproducibility is very strict. It is decided to continue with the target reproducibility as calculated from the reproducibilities found in iis PT's on used oils (see appendix 4, ref. 18).
This determination was problematic. Four statistical outliers were observed. The calculated reproducibility after rejection of the statistical outliers is not in agreement with the average reproducibility found for used oils in previous iis PTs (to 2015).

Water: This determination was 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 EN60814:98 and ASTM D1533:12. However, the calculated reproducibility is in good agreement with the requirements of ASTM D6304:16e1.

Sample #18232

Total Furanics: This determination may not be problematic. Two statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in good agreement with the estimated requirements calculated using the Horwitz equation based on 5 components, but not with the strict requirements of IEC61198:93.

2-Acetyl Furan: This determination was problematic for a number of participants. Three statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in agreement with the estimated requirements calculated using the Horwitz equation (1 component), but not with the strict requirements of IEC61198:93.

2-Furfural: This determination was problematic for a number of participants. Five statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in agreement with the estimated requirements calculated using the Horwitz equation (1 component), but not with the strict requirements of IEC61198:93.

2-Furfurylalcohol: This determination was problematic for a number of participants. Four statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in agreement with the estimated requirements calculated using the Horwitz equation (1 component), but not with the strict requirements of IEC61198:93.

5-Hydroxymethyl-2-Furfural: This determination was problematic for a number of participants. Five statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in agreement with the estimated requirements calculated using the Horwitz equation (1 component), but not with the strict requirements of IEC61198:93.

5-Methyl-2-Furfural: This determination was problematic for a number of participants. Three statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in agreement with the estimated requirements calculated using the Horwitz equation (1 component), but not with the strict requirements of IEC61198:93.

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 results, the calculated reproducibility (2.8 * standard deviation) and the target reproducibility derived from literature reference test methods (in casu ASTM, EN standards) are presented in the next tables.

Parameter	unit	n	average	2.8 * sd	R(lit)
Acidity, total (Potentiometric)	g KOH/kg	43	0.035	0.035	0.017
Acidity, total (Colorimetric)	g KOH/kg	33	0.034	0.036	0.04
Breakdown Voltage	kV/2.5 mm	63	11.4	11.0	5.5
Density at 20°C	kg/m^3	51	870.2	1.1	1.2
Di-electric Dissipation Factor at 90°C		52	0.009	0.007	0.021
Specific Resistance at 90°C	GΩm	43	30.1	20.0	31.6
Flash Point COC	°C	22	156.9	15.0	18
Flash Point PMcc	°C	45	149.1	9.1	16
Interfacial Surface Tension	mN/m	55	24.7	7.1	2.5
Kinematic Viscosity at 40°C	mm^2/s	46	10.628	0.266	0.191
Water	mg/kg	67	59.9	24.3	11.6

Table 5: reproducibilities of tests on sample #18231

Component	unit	n	average	2.8 * sd	R(lit)
Total Furanics	mg/kg	31	3.04	1.09	2.58
2-Acetyl Furan	mg/kg	43	0.60	0.23	0.29
2-Furfural	mg/kg	42	0.61	0.19	0.29
2-Furfurylalcohol	mg/kg	42	0.64	0.29	0.31
5-Hydroxy Methyl-2-Furfural	mg/kg	42	0.62	0.26	0.30
5-Methyl-2-Furfural	mg/kg	44	0.57	0.21	0.28

Table 6: reproducibilities of tests on sample #18232

Without further statistical calculations, it could 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 2018 WITH PREVIOUS PTS.

	November 2018	November 2017	November 2016	November 2015	November 2014
Number of reporting labs	75	74	76	68	63
Number of test results reported	805	667	660	561	508
Statistical outliers	41	35	31	25	23
Percentage outliers	5.1%	5.2%	4.7%	4.5%	4.5%

Table 7: comparison with previous proficiency tests

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

The performance of the determinations of the proficiency tests was compared against the requirements of the respective reference test methods. The conclusions are given the following table:

Parameter	November 2018	November 2017	November 2016	November 2015	November 2014
Acidity, total (Potentiometric)	--	--	-	-	--
Acidity, total (Colorimetric)	+/-	++	++	++	n.e.
Breakdown Voltage	--	+/-	+/-	++	+
Density at 20°C	+/-	+	+/-	+	-
Di-electric Dissipation Factor	++	++	++	++	++
Specific Resistance	+	++	++	++	++
Flash Point COC	+	++	+/-	n.e.	n.e.
Flash Point PMcc	+	++	+	+	+/-
Interfacial Surface Tension	--	--	--	--	--
Kinematic Viscosity at 40°C	-	--	+	-	--
Water	--	-	+/-	+/-	-
Total Furanics	++	++	++	+	n.e.
2-Acetyl Furan	+	n.e.	n.e.	n.e.	n.e.
2-Furfural	+	++	+/-	-	+
2-Furfurylalcohol	+/-	n.e.	+/-	-	+
5-Hydroxy Methyl-2-Furfural	+	n.e.	n.e.	n.e.	n.e.
5-Methyl-2-Furfural	+	n.e.	+	+	++

Table 8: comparison determinations against the reference test method

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

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

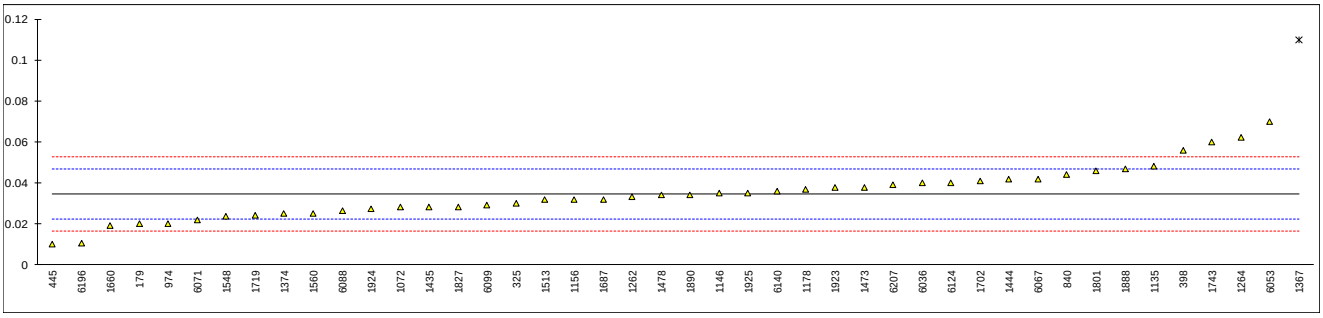
APPENDIX 1:

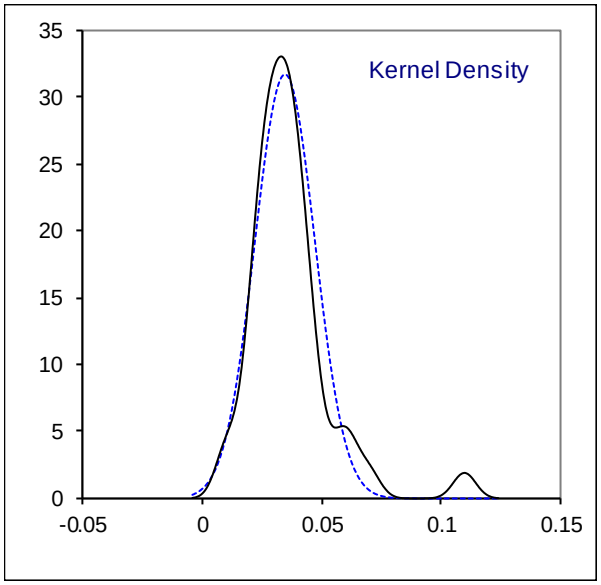
Determination of Acidity, Total (Potentiometric) on sample #18231; results in g KOH/kg

lab	method	value	mark	z(targ)	End Point	Vol. titration solv.	remarks
179	D664-A	0.02		-2.41	Inflection Point	60 mL	
237	D664-A	<0.1		-----	Inflection Point	125 mL	
325	D664-A	0.03		-0.76	Buffer EP (pH 11)	125 mL	
331	D664Mod.	<0.05		-----	---	---	
398	EN62021-1	0.056		3.53	Inflection Point	60 mL	
445	D664-A	0.01		-4.06	Inflection Point	60 mL	
511		-----		-----	---	---	
614		-----		-----	---		
840	D664-A	0.044		1.55	Inflection Point	60 mL	
862	D664-A	<0.1		-----	Inflection Point	60 mL	
902		-----		-----	---	---	
912		-----		-----	---	---	
913		-----		-----	---	---	
962		-----		-----	---	---	
963		-----		-----	---	---	
974	D664-A	0.02		-2.41	Inflection Point	125 mL	
1072	In house	0.0280		-1.09	Inflection Point	60 mL	
1135	D664-A	0.048		2.21	Inflection Point	125 mL	
1146	D664-A	0.035		0.06	Buffer EP (pH 11)	125 mL	
1156	IEC62021-1	0.032		-0.43	Buffer EP (pH 11)	50mL	
1178	EN62021-1	0.037		0.39	---	---	
1262	D664-A	0.033		-0.27	Inflection Point	125 mL	
1264	D664-A	0.062		4.52	Inflection Point	60 mL	
1301		-----		-----	---	---	
1304		-----		-----	---	---	
1352		-----		-----	---	---	
1361		-----		-----	---	---	
1367	IP177	0.11	R(0.01)	12.44	---	---	
1374	D664-A	0.025		-1.58	Inflection Point	---	
1430		-----		-----	---	---	
1435	D664-A	0.028		-1.09	Buffer EP (pH 11)	---	
1442		-----		-----	---	---	
1444	IEC62021-1	0.042		1.22	Inflection Point	60 mL	
1458		-----		-----	---		
1461		-----		-----	---	---	
1473	D664-A	0.0378		0.53	Inflection Point	125 mL	
1478	IEC62021-1	0.0339		-0.12	Buffer EP (pH 11)	---	
1505		-----		-----	---	---	
1513	IEC62021-1	0.032		-0.43	Buffer EP (pH 11)	60 mL	
1516		-----		-----	---	---	
1545		-----		-----	---	---	
1548	IEC62021-1	0.0236		-1.82	Buffer EP (pH 11)	---	
1560	IEC62021-1	0.025		-1.58	Buffer EP (pH 11)	---	
1660	IEC62021-1	0.019		-2.57	Buffer EP (pH 11)	60 mL	
1687	D664-A	0.032		-0.43	Buffer EP (pH 11)	60 mL	
1702	IEC62021-1	0.041		1.05	---	---	
1719	D664-A	0.024		-1.75	Inflection Point	60 mL	
1743	IEC62021-1	0.06		4.19	Buffer EP (pH 11)	60 mL	
1801	EN62021-1	0.046		1.88	Buffer EP (pH 11)	125 mL	
1827	D664-A	0.028		-1.09	---	---	
1885		-----		-----	---	---	
1888	EN62021-1	0.047		2.04	---	---	
1890	ISO6619	0.034		-0.10	Inflection Point	60 mL	
1891		-----		-----	---	---	
1897		-----		-----	---	---	
1923	EN62021-1	0.0377		0.51	Buffer EP (pH 11)	60 mL	
1924	EN62021-1	0.0274		-1.19	---	---	
1925	EN62021-1	0.035		0.06	Buffer EP (pH 11)	60 mL	
1966		-----		-----	---	60 mL	
6015		-----		-----	---	---	
6031		-----		-----	---	---	
6036	EN62021-1	0.04		0.89	Buffer EP (pH 11)	---	
6053	IEC62021-1	0.07		5.84	Buffer EP (pH 11)	60 mL	
6067	IEC62021-1	0.042		1.22	Buffer EP (pH 11)	125 mL	
6071	IEC62021-1	0.0217		-2.13	---	---	
6085		-----		-----	---	---	
6088	IEC62021-1	0.0264		-1.35	Inflection Point	60 mL	
6099	IEC62021-1	0.029		-0.92	Buffer EP (pH 11)	---	
6124	IEC62021-1	0.04		0.89	Buffer EP (pH 11)	60 mL	
6140	D664-A	0.036		0.23	---	---	
6141		-----		-----	---	---	
6165		-----		-----	---	---	
6167		-----		-----	---	---	
6196	IEC62021-1	0.0104		-3.99	Buffer EP (pH 11)	60 mL	
6207	IEC62021-1	0.0392		0.76	Buffer EP (pH 11)	60 mL	
6211		-----		-----	---	---	

		Only EN62021-1
normality	OK	OK
n	43	25
outliers	1	0
mean (n)	0.0346	0.0365
st.dev. (n)	0.01262	0.01317
R(calc.)	0.0353	0.0369
st.dev.(D664-A:17a BEP–60mL)	0.00606	--
R(D664-A:17a BEP–60mL)	0.0170	--
Compare		
R(EN62021-1:03)	0.0121	0.0128
R(D664-A:17a IP–125mL)	0.1459	--
R(D664-A:17a IP–60mL)	0.0255	--
R(D664-A:17a BEP–125mL)	0.0152	--

Application range for precision ASTM D664: 0.1 – 150 g KOH/kg

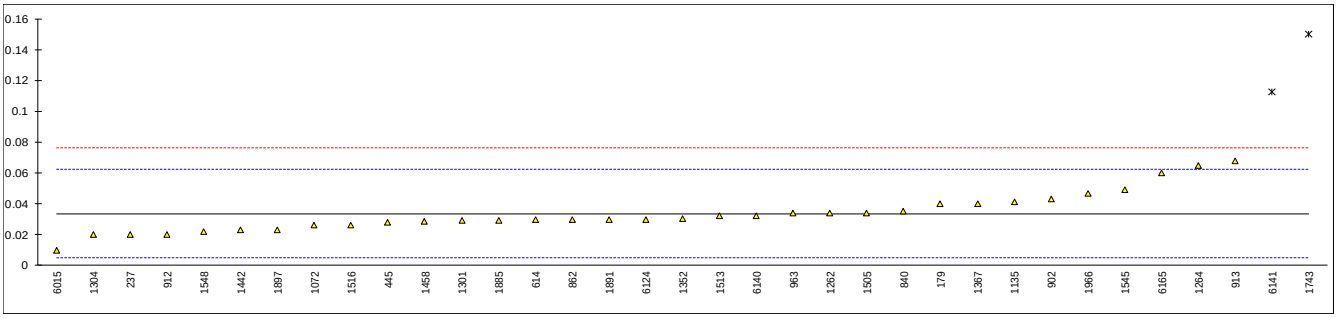


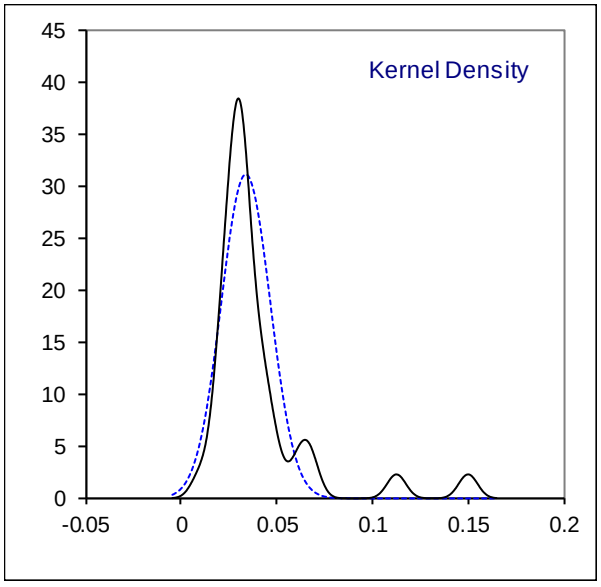


Determination of Acidity, Total (Colorimetric) on sample #18231; results in g KOH/kg

lab	method	value	mark	z(targ)	remarks
179	D974	0.04		0.45	
237	D974	0.02		-0.95	
325		-----		-----	
331		-----		-----	
398		-----		-----	
445	D974	0.028		-0.39	
511		-----		-----	
614	D974	0.03	C	-0.25	First reported 0.16
840	D974	0.035		0.10	
862	D974	0.03		-0.25	
902	D974	0.043		0.66	
912	D974	0.020		-0.95	
913	D974	0.068		2.41	
962		-----		-----	
963	D974	0.034		0.03	
974		-----		-----	
1072	IEC62021-2	0.0260		-0.53	
1135	D974	0.041		0.52	
1146		-----		-----	
1156		-----		-----	
1178		-----		-----	
1262	ISO6618	0.034		0.03	
1264	D974	0.065		2.20	
1301	IEC62021-2	0.029		-0.32	
1304	INH-122	0.02		-0.95	
1352	IEC62021-2	0.0305		-0.22	
1361		-----		-----	
1367	IP139	0.04		0.45	
1374		-----		-----	
1430		-----		-----	
1435		-----		-----	
1442	IEC62021-2	0.023		-0.74	
1444		-----		-----	
1458	D974	0.0287		-0.34	
1461		-----		-----	
1473		-----		-----	
1478		-----		-----	
1505	D974	0.034		0.03	
1513	IEC62021-2	0.032		-0.11	
1516	D974	0.026		-0.53	
1545	D974	0.049		1.08	
1548	IEC62021-2	0.022		-0.81	
1560		-----		-----	
1660		-----		-----	
1687		-----		-----	
1702		-----		-----	
1719		-----		-----	
1743	ISO6618	0.15	R(0.01)	8.15	
1801		-----		-----	
1827		-----		-----	
1885	D974	0.029		-0.32	
1888		-----		-----	
1890		-----		-----	
1891	IEC62021-2	0.03		-0.25	
1897	IEC62021-2	0.0232		-0.73	
1923		-----		-----	
1924		-----		-----	
1925		-----		-----	
1966	ISO6618	0.0465		0.90	
6015	D974	0.010		-1.65	
6031		-----		-----	
6036		-----		-----	
6053		-----		-----	
6067		-----		-----	
6071		-----		-----	
6085		-----		-----	
6088		-----		-----	
6099		-----		-----	
6124	IEC62021-2	0.03		-0.25	
6140	D974	0.032		-0.11	
6141	D974	0.1125	R(0.01)	5.52	
6165	IEC62021-2	0.06		1.85	
6167		-----		-----	
6196		-----		-----	
6207		-----		-----	
6211		-----		-----	

		Only ASTM D974 / ISO6618	Only EN62021-2
normality	not OK	suspect	not OK
n	33	20	10
outliers	2	2	0
mean (n)	0.0336	0.0351	0.0306
st.dev. (n)	0.01280	0.01391	0.01094
R(calc.)	0.0358	0.0389	0.0306
st.dev.(D974:14e2)	0.01429	0.01429	---
R(D974:14e2)	0.04	0.04	---
Compare			
R(EN62021-2:07	0.0067	---	0.0061

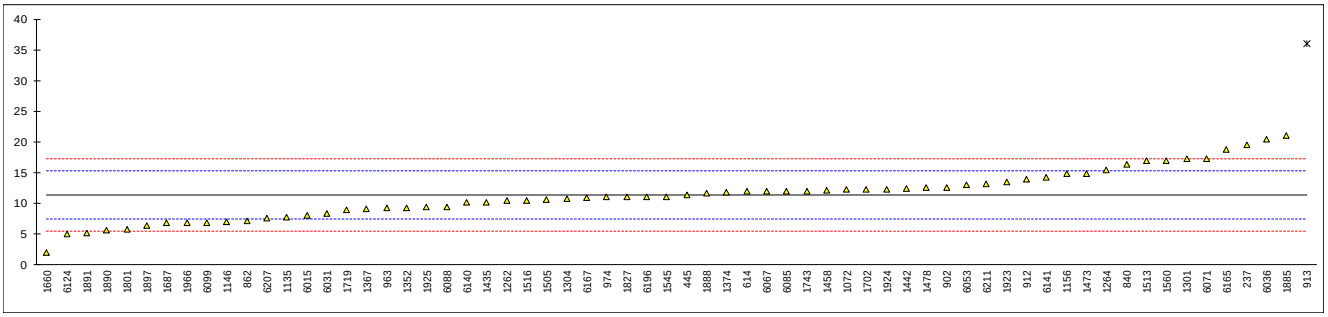


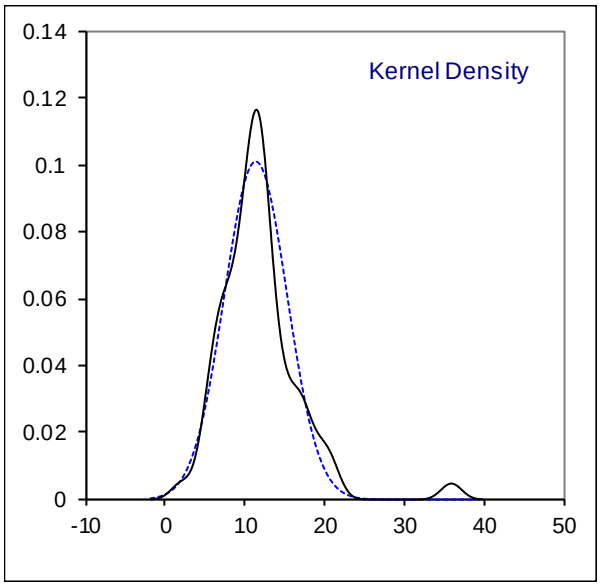


Determination of Breakdown Voltage on sample #18231, results in kV/2.5 mm

lab	method	value	mark	z(targ)	remarks
179		-----		-----	
237	IEC60156	19.5	C	4.18	First reported 25.7
325		-----		-----	
331		-----		-----	
398		-----		-----	
445	IEC60156	11.4		0.02	
511		-----		-----	
614	IEC60156	11.9		0.28	
840	IEC60156	16.4	C	2.59	First reported 29.0
862	IEC60156	7.2	C	-2.14	First reported 29
902	EN60156	12.6		0.64	
912	IEC60156	14		1.35	
913	EN60156	36	R(0.01)	12.65	
962		-----		-----	
963	IEC60156	9.3		-1.06	
974	IEC60156	11		-0.19	
1072	EN60156	12.2		0.43	
1135	IEC60156	7.8		-1.83	
1146	IEC60156	7		-2.24	
1156	IEC60156	14.8		1.76	
1178		-----		-----	
1262	EN60156	10.4		-0.49	
1264	IEC60156	15.4		2.07	
1301	IEC60156	17.3		3.05	
1304	INH-124	10.8		-0.29	
1352	IEC60156	9.3		-1.06	
1361		-----		-----	
1367	EN60156	9.17		-1.13	
1374	IEC60156	11.8		0.22	
1430		-----		-----	
1435	IEC60156	10.20		-0.60	
1442	IEC60156	12.40		0.53	
1444		-----		-----	
1458	IEC60156	12.1		0.38	
1461		-----		-----	
1473	IEC60156	14.9		1.82	
1478	IEC60156	12.5		0.58	
1505	IEC60156	10.6		-0.39	
1513	IEC60156	16.9		2.84	
1516	IEC60156	10.4		-0.49	
1545	IEC60156	11.1		-0.13	
1548		-----		-----	
1560	EN60156	17		2.89	
1660	IEC60156	2		-4.81	
1687	EN60156	6.8		-2.34	
1702	IEC60156	12.2		0.43	
1719	IEC60156	8.9		-1.26	
1743	IEC60156	12		0.33	
1801	EN60156	5.7		-2.91	
1827	EN60156	11		-0.19	
1885	IEC60156	21		4.95	
1888	EN60156	11.6		0.12	
1890	IEC60156	5.6		-2.96	
1891	IEC60156	5.2		-3.16	
1897	IEC60156	6.4		-2.55	
1923	EN60156	13.5		1.10	
1924	EN60156	12.3		0.48	
1925	EN60156	9.4		-1.01	
1966	EN60156	6.9		-2.29	
6015	EN60156	8.0		-1.73	
6031	IEC60156	8.3000		-1.57	
6036	EN60156	20.5		4.69	
6053	IEC60156	13		0.84	
6067	EN60156	11.9		0.28	
6071	IEC60156	17.3		3.05	
6085	IEC60156	11.9		0.28	
6088	IEC60156	9.4		-1.01	
6099	IEC60156	6.9		-2.29	
6124	IEC60156	4.95		-3.29	
6140	IEC60156	10.1		-0.65	
6141	IEC60156	14.3		1.51	
6165	IEC60156	18.7		3.77	
6167	IEC60156	10.9		-0.24	
6196	IEC60156	11		-0.19	
6207	IEC60156	7.6		-1.93	
6211	IEC60156	13.2		0.94	

		Did stir during test	Did not stir during test	Shaked before filling	Not shaked before filling
normality	OK	OK	OK	OK	suspect
n	63	41	16	32	22
outliers	1	0	0	0	0
mean (n)	11.362	10.722	12.500	11.052	11.177
st.dev. (n)	3.9442	3.5369	5.0459	4.5043	3.4291
R(calc.)	11.044	9.903	14.129	12.612	9.602
st.dev.(EN60156:95)	1.9482	1.8384	2.1433	1.8949	1.9165
R(EN60156:95)	5.455	5.148	6.001	5.306	5.366

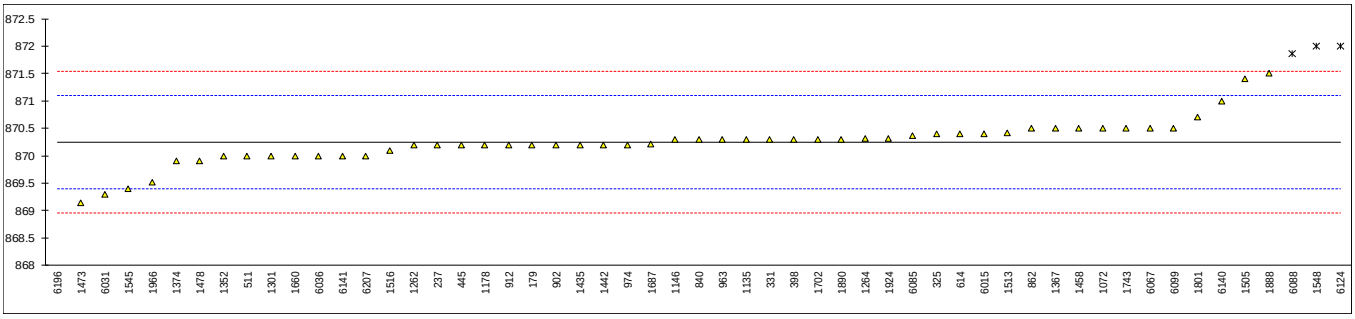


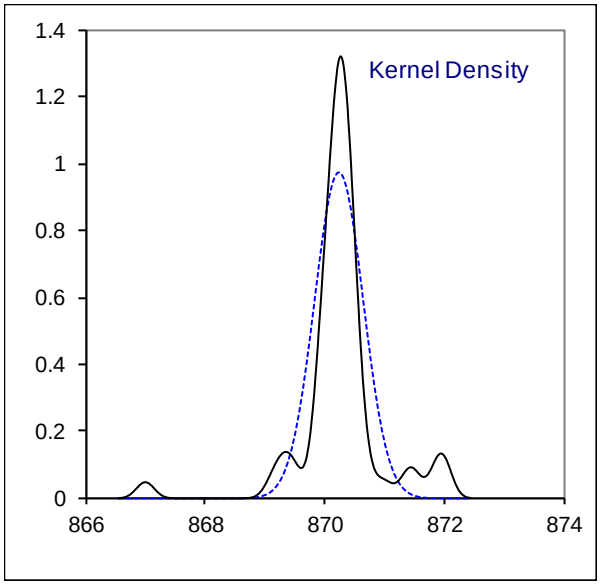


Determination of Density at 20°C on sample #18231; results in kg/m^3

lab	method	value	mark	z(targ)	remarks
179	D4052	870.2		-0.11	
237	D4052	870.2		-0.11	
325	D4052	870.4		0.36	
331	ISO12185	870.30		0.13	
398	ISO12185	870.3	C	0.13	First reported 876.5
445	D4052	870.2		-0.11	
511	D4052	870.0		-0.57	
614	D4052	870.4		0.36	
840	D4052	870.30		0.13	
862	D4052	870.5		0.59	
902	D4052	870.2		-0.11	
912	D4052	870.2		-0.11	
913		-----		-----	
962		-----		-----	
963	D4052	870.3		0.13	
974	D4052	870.2		-0.11	
1072	ISO3675	870.5		0.59	
1135	ISO12185	870.3	C	0.13	Reported 0.8703 kg/m^3
1146	D4052	870.30		0.13	
1156		-----		-----	
1178	ISO12185	870.2		-0.11	
1262	D4052	870.19		-0.13	
1264	D4052	870.31	C	0.15	Reported 0.87031 kg/m^3
1301	ISO3675	870.0		-0.57	
1304		-----		-----	
1352	D4052	870.0		-0.57	
1361		-----		-----	
1367	ISO3675	870.5		0.59	
1374	D4052	869.9		-0.81	
1430		-----		-----	
1435	D4052	870.2	C	-0.11	Reported 0.8702 kg/m^3
1442	ISO12185	870.2		-0.11	
1444		-----		-----	
1458	D4052	870.5	C	0.59	First reported 867.25
1461		-----		-----	
1473	D1217	869.15	C	-2.56	First reported 863.37
1478	ISO12185	869.9		-0.81	
1505	D7042	871.4		2.69	
1513	ISO12185	870.412		0.39	
1516	ISO3675	870.1		-0.34	
1545	ISO3675	869.4		-1.97	
1548	ISO3675	872	C,R(0.05)	4.09	Reported 0.872 kg/m^3
1560		-----		-----	
1660	D7042	870.0		-0.57	
1687	ISO12185	870.21	C	-0.08	Reported 0.87021 kg/m^3
1702	ISO3675	870.3		0.13	
1719		-----		-----	
1743	ISO12185	870.5		0.59	
1801	ISO3675	870.7		1.06	
1827		-----		-----	
1885		-----		-----	
1888	ISO3675	871.5	C	2.93	Reported 0.8715 kg/m^3
1890	ISO12185	870.3		0.13	
1891		-----		-----	
1897		-----		-----	
1923		-----		-----	
1924	ISO3675	870.32		0.17	
1925		-----		-----	
1966	ISO3675	869.51	C	-1.72	First reported 868.41
6015	ISO12185	870.40		0.36	
6031	D1298	869.3	C	-2.21	First reported 859.3
6036	ISO3675	870		-0.57	
6053		-----		-----	
6067	D4052	870.5		0.59	
6071		-----		-----	
6085	D7042	870.36		0.27	
6088	ISO3675	871.87	C,R(0.05)	3.79	First reported 873.97
6099	ISO12185	870.5		0.59	
6124	D4052	872	C,R(0.05)	4.09	First reported 0.858116 kg/L
6140	ISO3675	871.0		1.76	
6141		870		-0.57	
6165		-----		-----	
6167		-----		-----	
6196	ISO12185	867	C,R(0.01)	-7.57	Reported 0.867 kg/m^3
6207	ISO3675	870.0	C	-0.57	Reported 0.8700 kg/m^3
6211		-----		-----	

normality	not OK
n	51
outliers	4
mean (n)	870.246
st.dev. (n)	0.4083
R(calc.)	1.143
st.dev.(ISO3675:98)	0.4286
R(ISO3675:98)	1.2

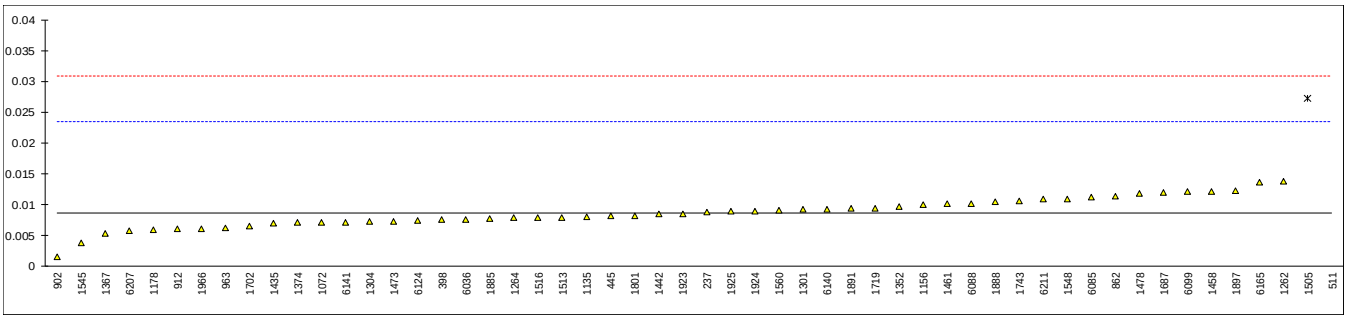


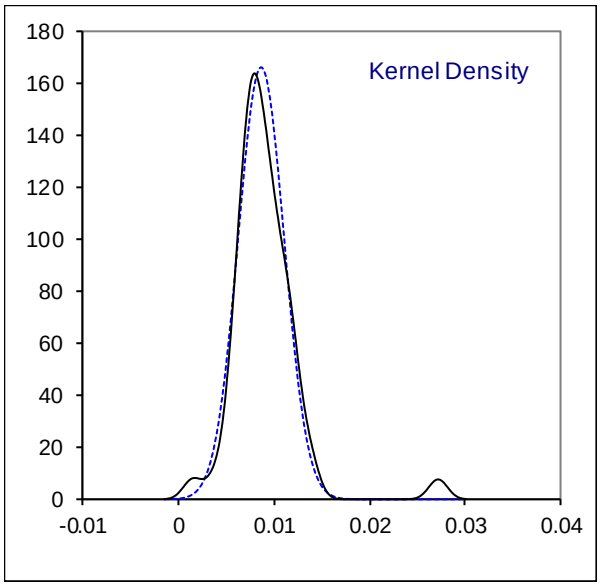


Determination of Di-electric Dissipation Factor (DDF) at 90°C on sample #18231

lab	method	value	mark	z(targ)	remarks
179		-----		-----	
237	IEC60247	0.008729		0.01	
325		-----		-----	
331		-----		-----	
398	EN60247	0.007577		-0.15	
445	IEC60247	0.00818		-0.07	
511	D924	0.7430	R(0.01)	99.15	
614		-----		-----	
840		-----		-----	
862	IEC60247	0.0113		0.35	
902	EN60247	0.0015		-0.97	
912	IEC60247	0.0060		-0.36	
913		-----		-----	
962		-----		-----	
963	IEC60247	0.0063		-0.32	
974		-----		-----	
1072	EN60247	0.00711		-0.21	
1135	IEC60247	0.0080		-0.09	
1146		-----		-----	
1156	IEC60247	0.00993		0.17	
1178	EN60247	0.00591		-0.37	
1262	EN60247	0.01383		0.69	
1264	IEC60247	0.007861		-0.11	
1301	IEC60247	0.00918		0.07	
1304	INH-125	0.007338		-0.18	
1352	IEC60247	0.00976		0.15	
1361		-----		-----	
1367	EN60247	0.005336		-0.45	
1374	IEC60247	0.007089		-0.22	
1430		-----		-----	
1435	EN60247	0.006972		-0.23	
1442	IEC60247	0.008422		-0.04	
1444		-----		-----	
1458	IEC60247	0.01211		0.46	
1461	IEC60247	0.0100835		0.19	
1473	IEC60247	0.007356		-0.18	
1478	IEC60247	0.011759		0.42	
1505	IEC60247	0.02725	R(0.01)	2.51	
1513	IEC60247	0.00792		-0.10	
1516	IEC60247	0.00791		-0.10	
1545	IEC60247	0.00385		-0.65	
1548	IEC60247	0.01098		0.31	
1560	IEC60247	0.009171		0.07	
1660		-----		-----	
1687	EN60247	0.012020		0.45	
1702	IEC60247	0.00655		-0.29	
1719	IEC60247	0.009455		0.10	
1743	IEC60247	0.0106		0.26	
1801	EN60247	0.00819		-0.07	
1827		-----		-----	
1885	IEC60247	0.00775		-0.13	
1888	EN60247	0.010390		0.23	
1890		-----		-----	
1891	IEC60247	0.009339		0.09	
1897	IEC60247	0.01224		0.48	
1923	EN60247	0.00849		-0.03	
1924	EN60247	0.00900		0.04	
1925	EN60247	0.00895		0.04	
1966	EN60247	0.00606		-0.35	
6015		-----		-----	
6031		-----		-----	
6036	EN60247	0.007581		-0.15	
6053		-----		-----	
6067		-----		-----	
6071		-----		-----	
6085	IEC60247	0.011140		0.33	
6088	IEC60247	0.0101		0.19	
6099	IEC60247	0.012073		0.46	
6124	IEC60247	0.007379		-0.18	
6140	EN60247	0.009250		0.08	
6141	IEC60247	0.007135		-0.21	
6165	IEC60247	0.013678	C	0.67	First reported 1.3678
6167		-----		-----	
6196		-----		-----	
6207	IEC60247	0.00578		-0.39	
6211	IEC60247	0.01089		0.30	

normality	OK
n	52
outliers	2
mean (n)	0.00868
st.dev. (n)	0.002404
R(calc.)	0.00673
st.dev.(EN60247:04)	0.007406
R(EN60247:04)	0.02074

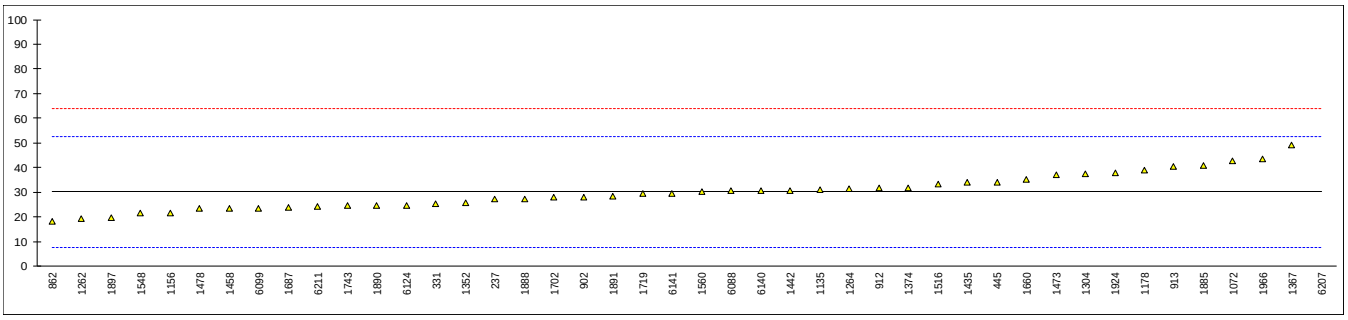


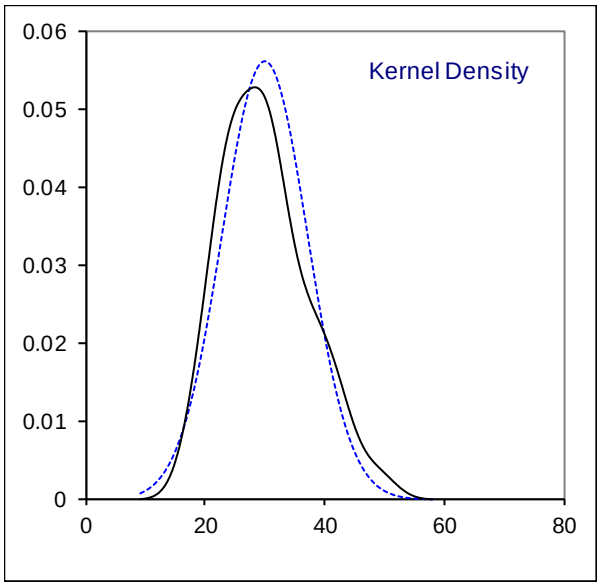


Determination of Specific Resistance at 90°C on sample #18231; results in GΩm

lab	method	value	mark	z(targ)	remarks
179		-----		-----	
237	IEC60247	27.13		-0.27	
325		-----		-----	
331	IEC60247	25.24		-0.43	
398		-----		-----	
445	IEC60247	34.21		0.36	
511		-----		-----	
614		-----		-----	
840		-----		-----	
862	IEC60247	18.39		-1.04	
902	IEC60247	28.12		-0.18	
912	IEC60247	31.8	C	0.15	First reported 0.00318
913	EN60247	40.68		0.93	
962		-----		-----	
963		-----		-----	
974		-----		-----	
1072	EN60247	42.75		1.12	
1135	IEC60247	30.89		0.07	
1146		-----		-----	
1156	IEC60247	21.7		-0.75	
1178	EN60247	39.1		0.79	
1262	EN60247	19.5		-0.94	
1264	IEC60247	31.37		0.11	
1301		-----		-----	
1304	INH-125	37.52		0.65	
1352	IEC60247	25.71		-0.39	
1361		-----		-----	
1367	EN60247	49.08		1.68	
1374	IEC60247	31.81		0.15	
1430		-----		-----	
1435	EN60247	34.00		0.34	
1442	IEC60247	30.77		0.06	
1444		-----		-----	
1458	IEC60247	23.32		-0.60	
1461		-----		-----	
1473	IEC60247	37.10		0.62	
1478	IEC60247	23.31		-0.60	
1505		-----		-----	
1513		-----		-----	
1516	IEC60247	33.5		0.30	
1545		-----		-----	
1548	IEC60247	21.50		-0.76	
1560	IEC60247	30.24		0.01	
1660	IEC60247	35.1		0.44	
1687	EN60247	23.88		-0.55	
1702	IEC60247	27.93		-0.19	
1719	IEC60247	29.37500	C	-0.07	Reported 29375000000 (possibly a different unit)
1743	IEC60247	24.5		-0.50	
1801		-----		-----	
1827		-----		-----	
1885	IEC60247	41		0.96	
1888	EN60247	27.38		-0.24	
1890	IEC60247	24.65	C	-0.48	First reported 0.009849
1891	IEC60247	28.45		-0.15	
1897	IEC60247	19.73		-0.92	
1923		-----		-----	
1924	EN60247	37.95		0.69	
1925		-----		-----	
1966	EN60247	43.64		1.20	
6015		-----		-----	
6031		-----		-----	
6036		-----		-----	
6053		-----		-----	
6067		-----		-----	
6071		-----		-----	
6085		-----		-----	
6088	IEC60247	30.5		0.03	
6099	IEC60247	23.48		-0.59	
6124	IEC60247	24.69		-0.48	
6140	EN60247	30.67		0.05	
6141	IEC60247	29.62		-0.04	
6165		-----		-----	
6167		-----		-----	
6196		-----		-----	
6207	IEC60247	4461	R(0.01)	392.22	
6211	IEC60247	24.08		-0.54	

normality	OK
n	43
outliers	1
mean (n)	30.1248
st.dev. (n)	7.12570
R(calc.)	19.9520
st.dev.(EN60247:04)	11.29679
R(EN60247:04)	31.6310

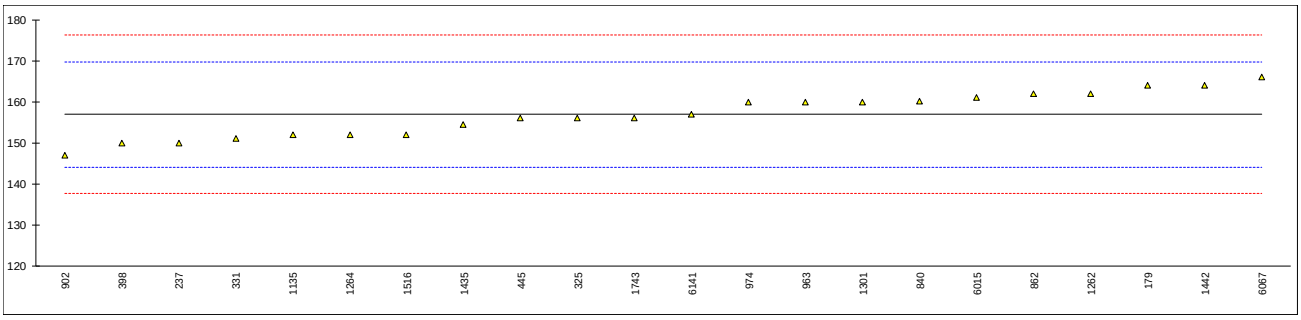


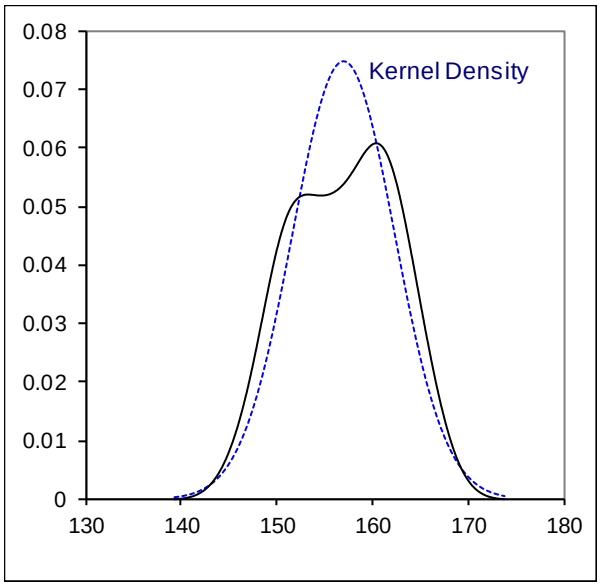


Determination of Flash Point C.O.C. on sample #18231; results in °C

lab	method	value	mark	z(targ)	remarks
179	D92	164		1.10	
237	D92	150		-1.08	
325	D92	156		-0.15	
331	D92	151.0		-0.92	
398	ISO2592	150		-1.08	
445	D92	156		-0.15	
511		-----		-----	
614		-----		-----	
840	D92	160.1		0.49	
862	D92	162		0.79	
902	D92	147.0		-1.55	
912		-----		-----	
913		-----		-----	
962		-----		-----	
963	D92	160		0.48	
974	D92	160		0.48	
1072		-----		-----	
1135	D92	152		-0.77	
1146		-----		-----	
1156		-----		-----	
1178		-----		-----	
1262	D92	162		0.79	
1264	D92	152		-0.77	
1301	ISO2592	160		0.48	
1304		-----		-----	
1352		-----		-----	
1361		-----		-----	
1367		-----		-----	
1374		-----		-----	
1430		-----		-----	
1435	D92	154.5		-0.38	
1442	ISO2592	164		1.10	
1444		-----		-----	
1458		-----		-----	
1461		-----		-----	
1473		-----		-----	
1478		-----		-----	
1505		-----		-----	
1513		-----		-----	
1516	D92	152		-0.77	
1545		-----		-----	
1548		-----		-----	
1560		-----		-----	
1660		-----		-----	
1687		-----		-----	
1702		-----		-----	
1719		-----		-----	
1743	ISO2592	156		-0.15	
1801		-----		-----	
1827		-----		-----	
1885		-----		-----	
1888		-----		-----	
1890		-----		-----	
1891		-----		-----	
1897		-----		-----	
1923		-----		-----	
1924		-----		-----	
1925		-----		-----	
1966		-----		-----	
6015	D92	161.0		0.63	
6031		-----		-----	
6036		-----		-----	
6053		-----		-----	
6067	D92	166	C	1.41	First reported 182
6071		-----		-----	
6085		-----		-----	
6088		-----		-----	
6099		-----		-----	
6124		-----		-----	
6140		-----		-----	
6141	D92	157		0.01	
6165		-----		-----	
6167		-----		-----	
6196		-----		-----	
6207		-----		-----	
6211		-----		-----	

normality	OK
n	22
outliers	0
mean (n)	156.94
st.dev. (n)	5.344
R(calc.)	14.96
st.dev.(D92:18)	6.429
R(D92:18)	18

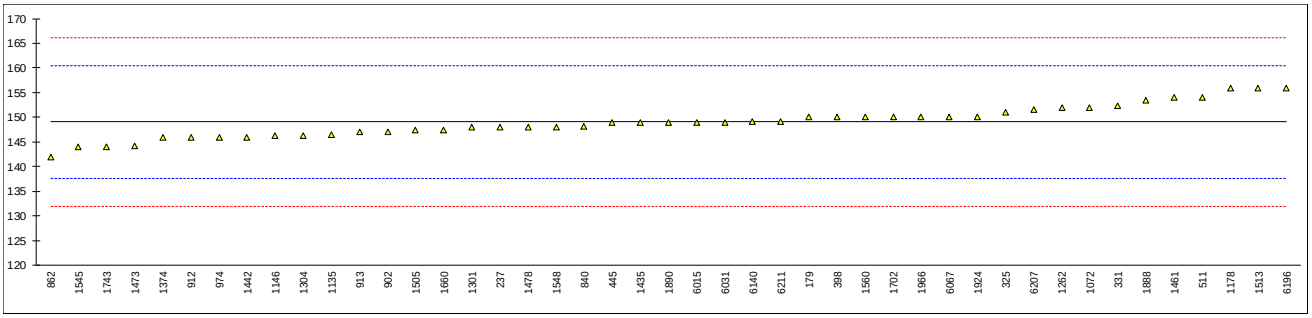


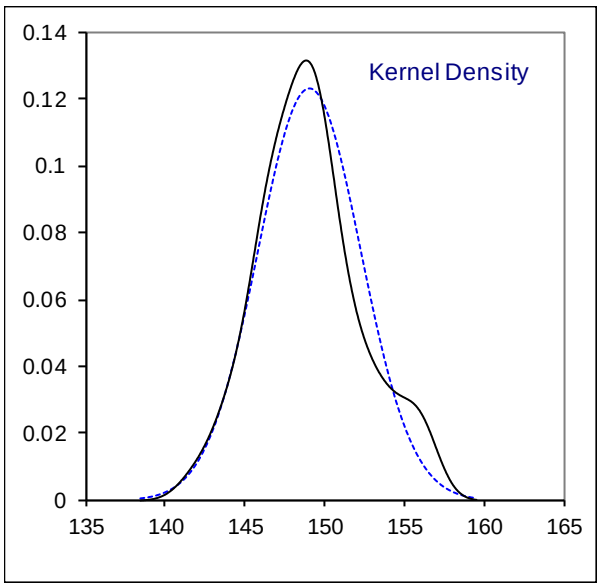


Determination of Flash Point PMcc on sample #18231; results in °C

lab	method	value	mark	z(targ)	remarks
179	D93-A	150	C	0.16	First reported 80
237	D93-B	148		-0.19	
325	D93-A	151		0.34	
331	D93	152.3		0.57	
398	ISO2719-A	150		0.16	
445	D93-A	149.0		-0.01	
511	D93	154.1		0.88	
614		-----		-----	
840	D93-B	148.1		-0.17	
862	D93-A	142		-1.24	
902	D93-A	147.0		-0.36	
912	D93-B	146		-0.54	
913	ISO2719	147		-0.36	
962		-----		-----	
963		-----		-----	
974	D93-A	146.0		-0.54	
1072	ISO2719-A	152		0.51	
1135	ISO2719-C	146.5		-0.45	
1146	D93-A	146.2		-0.50	
1156		-----		-----	
1178	ISO2719-B	156.0		1.21	
1262	D93-A	152		0.51	
1264		-----		-----	
1301	ISO2719-A	148.0		-0.19	
1304	INH-115	146.2		-0.50	
1352		-----		-----	
1361		-----		-----	
1367		-----		-----	
1374	D93-A	145.9		-0.55	
1430		-----		-----	
1435	D93-A	149.0		-0.01	
1442	ISO2719-B	146.000		-0.54	
1444		-----		-----	
1458		-----		-----	
1461	ISO2719-A	154		0.86	
1473	D93-A	144.2		-0.85	
1478	ISO2719-A	148.0		-0.19	
1505	D93-A	147.5		-0.27	
1513	ISO2719-A	156.0		1.21	
1516		-----		-----	
1545	ISO2719-A	144		-0.89	
1548	ISO2719-A	148		-0.19	
1560	ISO2719-A	150		0.16	
1660	D93-A	147.5		-0.27	
1687		-----		-----	
1702	ISO2719-A	150.0		0.16	
1719		-----		-----	
1743	D93-A	144		-0.89	
1801		-----		-----	
1827		-----		-----	
1885		-----		-----	
1888	D93-B	153.4		0.76	
1890	ISO2719-A	149		-0.01	
1891		-----		-----	
1897		-----		-----	
1923		-----		-----	
1924	ISO2719-A	150.15		0.19	
1925		-----		-----	
1966	ISO2719-A	150		0.16	
6015	ISO2719-A	149.0		-0.01	
6031	D93-A	149		-0.01	
6036		-----		-----	
6053		-----		-----	
6067	D93-C	150		0.16	
6071		-----		-----	
6085		-----		-----	
6088		-----		-----	
6099		-----		-----	
6124		-----		-----	
6140	ISO2719-A	149.1		0.01	
6141		-----		-----	
6165		-----		-----	
6167		-----		-----	
6196	ISO2719-B	156		1.21	
6207	ISO2719-A	151.5		0.43	
6211	ISO2719-A	149.2		0.02	

normality	OK
n	45
outliers	0
mean (n)	149.06
st.dev. (n)	3.239
R(calc.)	9.07
st.dev.(ISO2719-B:16)	5.714
R(ISO2719-B:16)	16
Compare	
R(ISO2719-A:16)	10.58
R(D93-A:18)	10
R(D93-B:18)	10.58

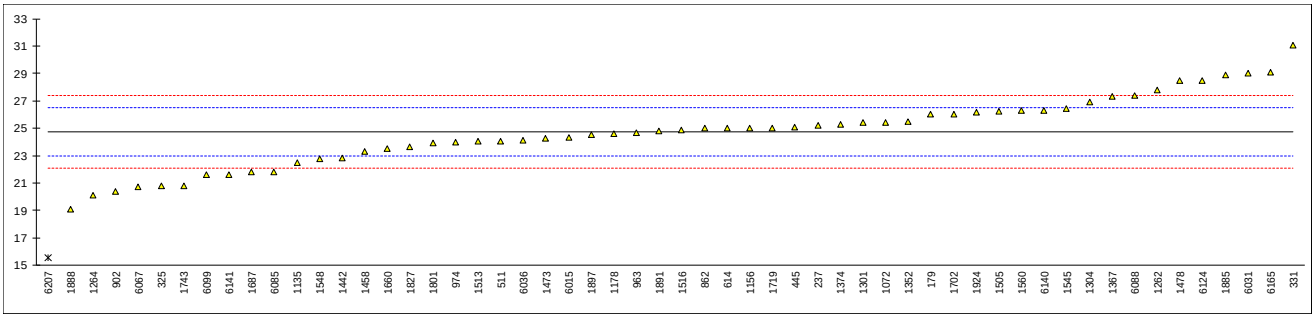


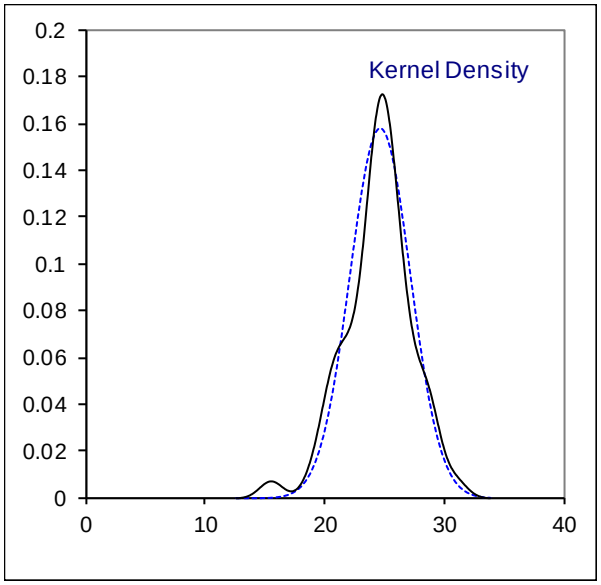


Determination of Interfacial Surface Tension on sample #18231; results in mN/m

lab	method	value	mark	z(targ)	remarks
179	D971	26		1.46	
237	D971	25.2		0.55	
325	In house	20.8		-4.44	
331	D971	31.04		7.17	
398		-----		-----	
445	D971	25.1		0.44	
511	D971	24.06		-0.74	
614	D971	25		0.32	
840		-----		-----	
862	D971	25		0.32	
902	D971	20.4		-4.89	
912		-----		-----	
913		-----		-----	
962		-----		-----	
963	D971	24.7		-0.02	
974	D971	24.0		-0.81	
1072	D971	25.45		0.83	
1135	EN14210	22.5		-2.51	
1146		-----		-----	
1156	D971	25.0		0.32	
1178	D971	24.6		-0.13	
1262	D971	27.8		3.50	
1264	D971	20.1		-5.23	
1301	D971	25.4		0.78	
1304	INH-123	26.9		2.48	
1352	D971	25.5		0.89	
1361		-----		-----	
1367	D971	27.295		2.92	
1374	D971	25.3		0.66	
1430		-----		-----	
1435		-----		-----	
1442	EN14210	22.83		-2.14	
1444		-----		-----	
1458	D971	23.29		-1.61	
1461		-----		-----	
1473	D971	24.24		-0.54	
1478	D971	28.5		4.29	
1505	D971	26.2		1.68	
1513	D971	24.05		-0.75	
1516	D971	24.9		0.21	
1545	D971	26.43		1.94	
1548	D971	22.76		-2.21	
1560	D971	26.3		1.80	
1660	D971	23.5		-1.38	
1687	D971	21.8	C	-3.30	First reported 8.5
1702	D971	26.028		1.49	
1719	D2285	25.03		0.36	
1743	D971	20.8		-4.44	
1801	D971	23.94		-0.88	
1827	D971	23.63		-1.23	
1885	D971	28.9		4.74	
1888	ISO6295	19.1		-6.36	
1890		-----		-----	
1891	D971	24.8		0.10	
1897	D971	24.5		-0.24	
1923		-----		-----	
1924	D971	26.17		1.65	
1925		-----		-----	
1966		-----		-----	
6015	D971	24.350		-0.41	
6031	D971	29.0199		4.88	
6036	IEC62961	24.1		-0.70	
6053		-----		-----	
6067	D971	20.7		-4.55	
6071		-----		-----	
6085	D971	21.802		-3.30	
6088	ISO6295	27.4		3.04	
6099	EN14210	21.6		-3.53	
6124	D971	28.5		4.29	
6140	D971	26.3		1.80	
6141	D971	21.61		-3.52	
6165	D971	29.1		4.97	
6167		-----		-----	
6196		-----		-----	
6207	D971	15.572	R(0.05)	-10.36	
6211		-----		-----	

normality	OK
n	55
outliers	1
mean (n)	24.715
st.dev. (n)	2.5268
R(calc.)	7.075
st.dev.(D971:12)	0.8827
R(D971:12)	2.472





Determination of Kinematic Viscosity at 40°C on sample #18231; results in mm²/s

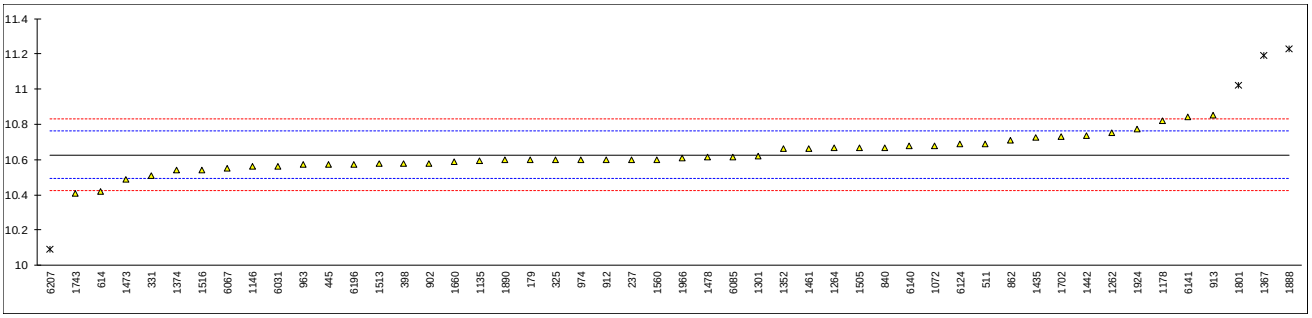
lab	method	value	mark	z(targ)	remarks
179	D445	10.60		-0.40	
237	D445	10.60		-0.40	
325	D445	10.60		-0.40	
331	D7299Mod.	10.51		-1.72	
398	D7042	10.58	C	-0.70	First reported 9.7914
445	D445	10.57		-0.84	
511	D445	10.69		0.91	
614	D445	10.42		-3.04	
840	D445	10.670		0.62	
862	D445	10.71		1.21	
902	D445	10.58		-0.70	
912	D445	10.60		-0.40	
913	D445	10.85		3.26	
962		-----		-----	
963	D445	10.57		-0.84	
974	D445	10.60		-0.40	
1072	ISO3104	10.68		0.77	
1135	ISO3104	10.595		-0.48	
1146	D445	10.56		-0.99	
1156		-----		-----	
1178	ISO3104	10.82		2.82	
1262	D7042	10.75		1.79	
1264	D7042	10.666		0.56	
1301	ISO3104	10.62		-0.11	
1304		-----		-----	
1352	D7042	10.662		0.50	
1361		-----		-----	
1367	D445	11.19	R(0.01)	8.23	
1374	D445	10.54		-1.28	
1430		-----		-----	
1435	D7042	10.726		1.44	
1442	D7042	10.734		1.56	
1444		-----		-----	
1458		-----		-----	
1461	ISO3104	10.6636		0.53	
1473	D445	10.4877		-2.05	
1478	D7042	10.615		-0.18	
1505	D7042	10.666		0.56	
1513	ISO3104	10.578		-0.72	
1516	ISO3104	10.54		-1.28	
1545		-----		-----	
1548		-----		-----	
1560	ISO3104	10.6		-0.40	
1660	D7042	10.59		-0.55	
1687		-----		-----	
1702	ISO3104	10.731		1.51	
1719		-----		-----	
1743	D7279 to D445	10.41		-3.18	
1801	ISO3104	11.022	R(0.01)	5.77	
1827		-----		-----	
1885		-----		-----	
1888	D445	11.23	R(0.01)	8.82	
1890	ISO3104	10.597		-0.45	
1891		-----		-----	
1897		-----		-----	
1923		-----		-----	
1924	ISO3104	10.7709		2.10	
1925		-----		-----	
1966	ISO3104	10.61		-0.26	
6015		-----		-----	
6031	D445	10.56		-0.99	
6036		-----		-----	
6053		-----		-----	
6067	D445	10.55		-1.13	
6071		-----		-----	
6085	D7042	10.616		-0.17	
6088		-----		-----	
6099		-----		-----	
6124	D7042	10.688		0.89	
6140	D7042	10.679		0.75	
6141	D7279 to D445	10.84		3.11	
6165		-----		-----	
6167		-----		-----	
6196	ISO3104	10.57		-0.84	
6207	ISO3104	10.09136	R(0.01)	-7.85	
6211		-----		-----	

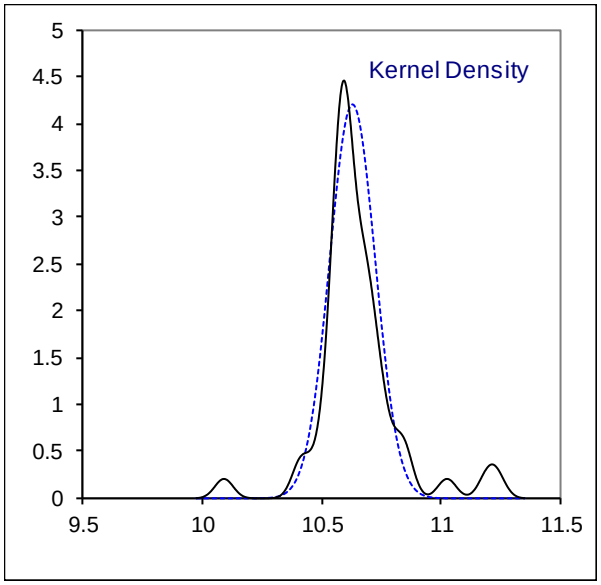
normality	OK
n	46
outliers	4
mean (n)	10.6275
st.dev. (n)	0.09495
R(calc.)	0.2659
st.dev.(iis)	0.06832
R(iis)	0.1913

R(iis) = 1.8% of the mean for used oils at 40°C (see lit. 18)

Compare

R(D445:17a)	0.0348

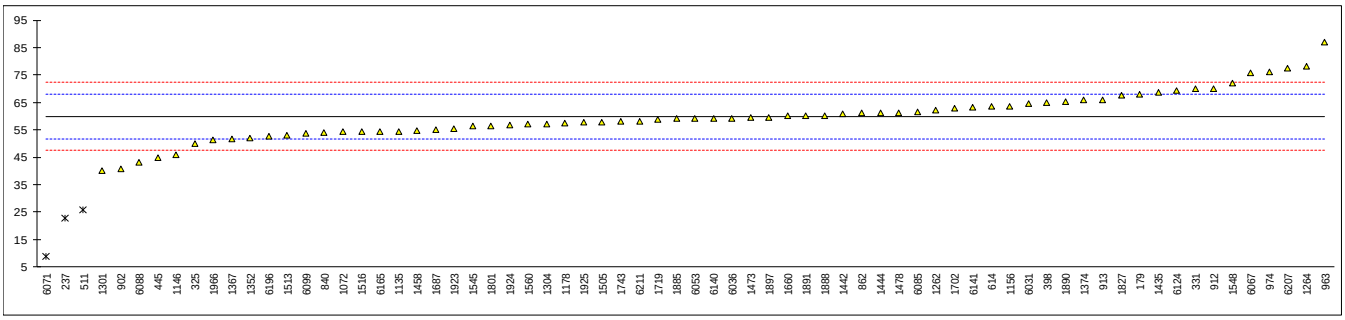


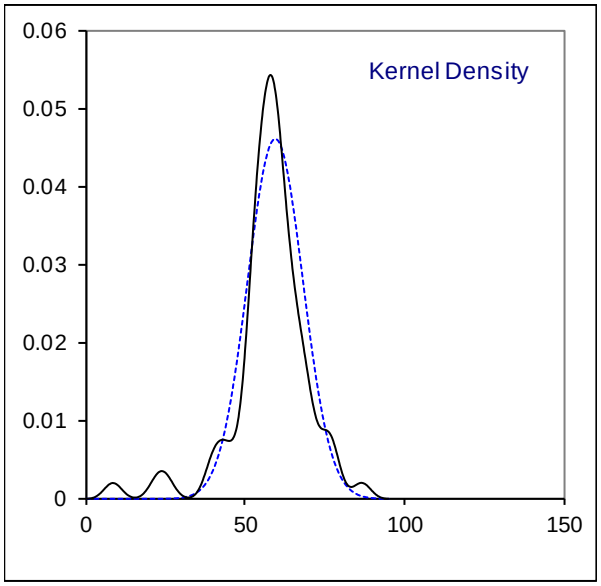


Determination of Water on sample #18231; results in mg/kg

lab	method	value	mark	z(targ)	remarks
179	D6304-C	68		1.97	
237	D6304-C	22.8	C,R(0.05)	-8.94	First reported 34.43
325	D6304-C	50		-2.38	
331	ISO12937	70.0		2.45	
398	D6304-C	65		1.24	
445	D6304-A	44.8		-3.63	
511	D6304	25.7	R(0.05)	-8.24	
614	IEC60814	63.5		0.88	
840	IEC60814	53.9		-1.44	
862	D6304-A	61		0.28	
902	D1533	40.6		-4.64	
912	D6304-C	70		2.45	
913	EN60814	66		1.48	
962		-----		-----	
963	D1533	87		6.55	
974	D1533	76		3.90	
1072	EN60814	54.2		-1.36	
1135	IEC60814	54.4		-1.31	
1146	D6304-C	46		-3.34	
1156	IEC60814	63.7		0.93	
1178	EN60814	57.4		-0.59	
1262	EN60814	62.3		0.59	
1264	D1533	78.2		4.43	
1301	IEC60814	40		-4.79	
1304	INH-121	57.1		-0.66	
1352	IEC60814	52.09		-1.87	
1361		-----		-----	
1367	D1533	51.54		-2.01	
1374	IEC60814	66.0		1.48	
1430		-----		-----	
1435	IEC60814	68.7		2.14	
1442	IEC60814	60.90		0.25	
1444	IEC60567	61.1639		0.32	
1458	IEC60814	54.7		-1.24	
1461		-----		-----	
1473	D1533	59.55		-0.07	
1478	IEC60814	61.3		0.35	
1505	D1533	57.8		-0.49	
1513	IEC60814	53.0		-1.65	
1516	IEC60814	54.2		-1.36	
1545	IEC60814	56.25		-0.87	
1548	IEC60814	72.1		2.96	
1560	EN60814	57		-0.69	
1660	IEC60814	60		0.04	
1687	EN60814	54.89		-1.20	
1702	IEC60814	63.0		0.76	
1719	IEC60814	58.725		-0.27	
1743	IEC60814	58		-0.45	
1801	EN60814	56.3		-0.86	
1827	D6304-A	67.5		1.85	
1885	D1533	59		-0.21	
1888	IEC60814	60.23		0.09	
1890	IEC60814	65.22		1.30	
1891	IEC60814	60		0.04	
1897	IEC60814	59.56		-0.07	
1923	EN60814	55.55		-1.04	
1924	EN60814	56.85		-0.72	
1925	EN60814	57.7		-0.52	
1966	IEC60814	51.47		-2.02	
6015		-----		-----	
6031	IEC60814	64.42		1.10	
6036	EN60814	59.1		-0.18	
6053	IEC60814	59		-0.21	
6067	IEC60814	75.8		3.85	
6071	IEC60814	8.9358	C,R(0.01)	-12.28	First reported 8.4621
6085	IEC60814	61.60185		0.42	
6088	D1533	43		-4.07	
6099	IEC60814	53.7		-1.48	
6124	IEC60814	69.2		2.26	
6140	EN60814	59.0		-0.21	
6141	D1533	63.2		0.81	
6165	IEC60814	54.3		-1.34	
6167		-----		-----	
6196	IEC60814	52.6		-1.75	
6207	IEC60814	77.46		4.25	
6211	IEC60814	58.17		-0.41	

normality	suspect
n	67
outliers	3
mean (n)	59.850
st.dev. (n)	8.6762
R(calc.)	24.293
st.dev.(EN60814:98)	4.1444
R(EN60814:98)	11.604
Compare	
R(D1533:12)	14
R(D6304:16e1)	196.749



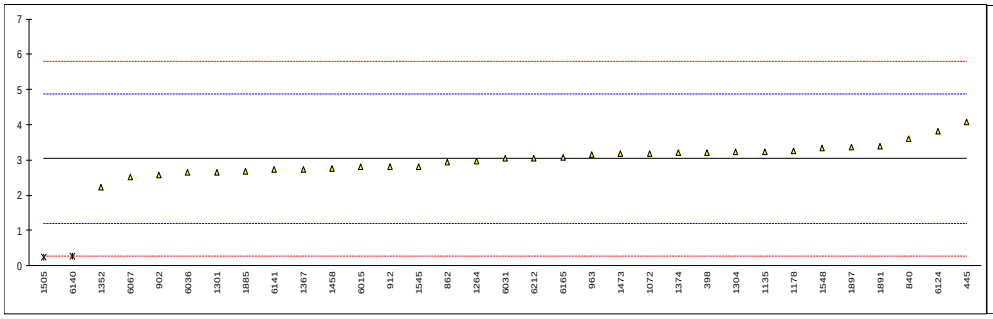


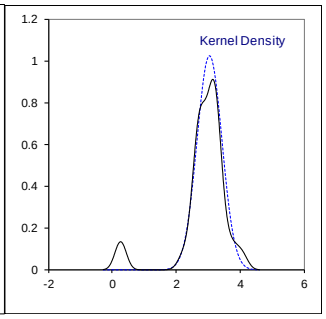
Determination of Total Furanics on sample #18232; results in mg/kg

lab	method	value	mark	z(targ)	remarks
331		-----		-----	
398	EN61198	3.205		0.18	
445	IEC61198	4.07		1.12	
614		-----		-----	
840	D5837	3.608		0.62	
862	IEC61198	2.95		-0.10	
902	D5837	2.56		-0.52	
912	IEC61198	2.817		-0.24	
963	D5837	3.158		0.13	
1072	EN61198	3.180		0.15	
1135	IEC61198	3.24		0.22	
1156		-----		-----	
1178	EN61198	3.268		0.25	
1264	D5837	2.972	C	-0.08	First reported 2972
1301	IEC61198	2.650		-0.43	
1304	INH-126	3.234		0.21	
1352	IEC61198	2.22525		-0.89	
1367	IEC61198	2.7374		-0.33	
1374	D5837	3.198		0.17	
1430		-----		-----	
1435		-----		-----	
1442		-----		-----	
1458	IEC61198	2.7522		-0.31	
1473	IEC61198	3.1769		0.15	
1478		-----		-----	
1505	D5837	0.25	R(0.01)	-3.03	
1513		-----		-----	
1516		-----		-----	
1545	IEC61198	2.8182		-0.24	
1548	IEC61198	3.35		0.34	
1560		-----		-----	
1660		-----		-----	
1702		-----		-----	
1743		-----		-----	
1801		-----		-----	
1872		-----		-----	
1885	D5837	2.681		-0.39	
1888		-----		-----	
1891	IEC61198	3.395		0.38	
1897	IEC61198	3.356		0.34	
6015	EN61198	2.816		-0.25	
6031	IEC61198	3.046865		0.01	
6036	EN61198	2.642		-0.43	
6067	IEC61198	2.530158	C	-0.56	First reported 5.78727
6085		-----		-----	
6124	IEC61198	3.8110		0.84	
6140	D5837	0.26	R(0.01)	-3.02	
6141	D5837	2.717923		-0.35	
6165	IEC61198	3.07		0.03	
6212	IEC61198	3.0525		0.01	

normality	OK
n	31
outliers	2
mean (n)	3.0416
st.dev. (n)	0.39024
R(calc.)	1.0927
st.dev.(Horwitz 5 comp.)	0.92043
R(Horwitz 5 comp.)	2.5772

Compare R(IEC61198:93) = 0.3042

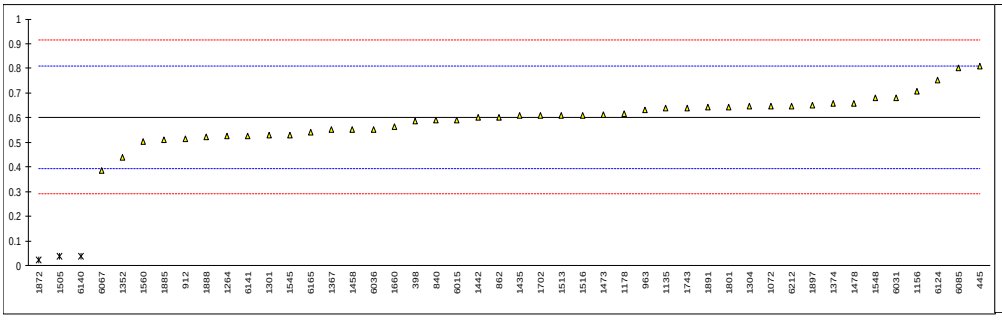


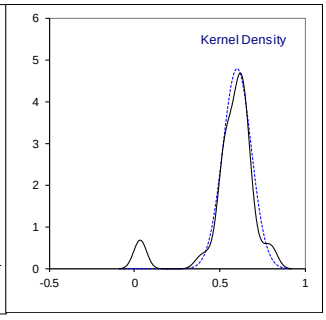


Determination of 2-Acetyl Furan on sample #18232; results in mg/kg

lab	method	value	mark	z(targ)	remarks
331		-----		-----	
398	EN61198	0.588		-0.14	
445	IEC61198	0.81		1.99	
614		-----		-----	
840	D5837	0.590		-0.12	
862	IEC61198	0.60		-0.02	
902	D5837	<0.05		<-5.31	Possibly a false negative test result?
912	IEC61198	0.514		-0.85	
963	D5837	0.632		0.28	
1072	EN61198	0.647		0.43	
1135	IEC61198	0.64		0.36	
1156	IEC61198	0.707		1.00	
1178	EN61198	0.6162		0.13	
1264	D5837	0.525	C	-0.75	First reported 525
1301	IEC61198	0.528		-0.72	
1304	INH-126	0.646		0.42	
1352	IEC61198	0.43773		-1.58	
1367	IEC61198	0.5506		-0.50	
1374	D5837	0.657		0.52	
1430		-----		-----	
1435	IEC61198	0.608		0.05	
1442	IEC61198	0.60		-0.02	
1458	IEC61198	0.5530		-0.48	
1473	IEC61198	0.6120		0.09	
1478	IEC61198	0.657		0.52	
1505	D5837	0.04	R(0.01)	-5.41	
1513	IEC61198	0.6090		0.06	
1516	IEC61198	0.610		0.07	
1545	IEC61198	0.5294		-0.70	
1548	IEC61198	0.680		0.74	
1560	IEC61198	0.502		-0.97	
1660	IEC61198	0.562		-0.39	
1702	IEC61198	0.608		0.05	
1743	IEC61198	0.64		0.36	
1801	EN61198	0.6436		0.39	
1872	EN61198	0.0230	C,R(0.01)	-5.57	First reported 0.0218
1885	D5837	0.511		-0.88	
1888	EN61198	0.5238		-0.76	
1891	IEC61198	0.643		0.39	
1897	IEC61198	0.652		0.47	
6015	EN61198	0.591		-0.11	
6031	IEC61198	0.68146		0.76	
6036	EN61198	0.554		-0.47	
6067	IEC61198	0.385707	C	-2.08	First reported 1.02969
6085	In house	0.8		1.90	
6124	IEC61198	0.75325		1.45	
6140	D5837	0.04	R(0.01)	-5.41	
6141	D5837	0.525526		-0.74	
6165	IEC61198	0.54		-0.60	
6212	IEC61198	0.6481		0.44	

normality	suspect		
n	43		
outliers	3		
mean (n)	0.6026		
st.dev. (n)	0.08349		
R(calc.)	0.2338		
st.dev.(Horwitz)	0.10405		
R(Horwitz)	0.2913		Compare R(IEC61198:93) = 0.0904

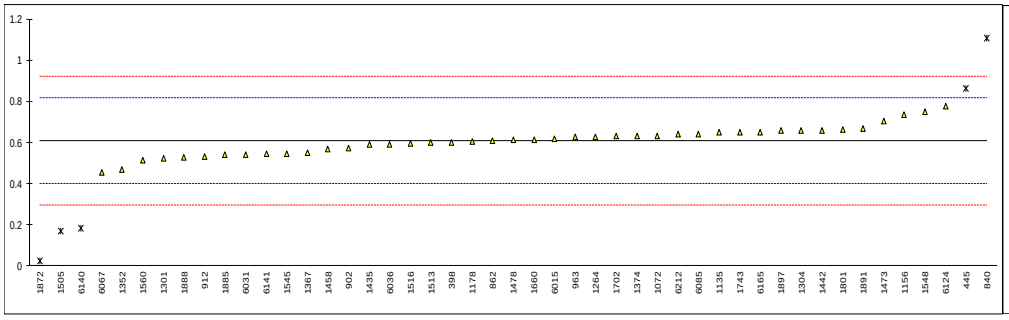


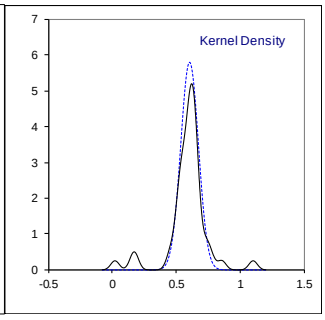


Determination of 2-Furfural on sample #18232; results in mg/kg

lab	method	value	mark	z(targ)	remarks
331		-----		-----	
398	EN61198	0.599		-0.09	
445	IEC61198	0.86	R(0.05)	2.40	
614		-----		-----	
840	D5837	1.105	R(0.01)	4.74	
862	IEC61198	0.61		0.02	
902	D5837	0.57		-0.37	
912	IEC61198	0.532		-0.73	
963	D5837	0.627		0.18	
1072	EN61198	0.633		0.24	
1135	IEC61198	0.65		0.40	
1156	IEC61198	0.734		1.20	
1178	EN61198	0.6018		-0.06	
1264	D5837	0.627	C	0.18	First reported 627
1301	IEC61198	0.522		-0.82	
1304	INH-126	0.660		0.49	
1352	IEC61198	0.46994		-1.32	
1367	IEC61198	0.5502		-0.55	
1374	D5837	0.631		0.22	
1430		-----		-----	
1435	IEC61198	0.589		-0.18	
1442	IEC61198	0.66		0.49	
1458	IEC61198	0.5685		-0.38	
1473	IEC61198	0.7043		0.92	
1478	IEC61198	0.614		0.05	
1505	D5837	0.17	R(0.01)	-4.18	
1513	IEC61198	0.5973		-0.10	
1516	IEC61198	0.596		-0.12	
1545	IEC61198	0.5469		-0.59	
1548	IEC61198	0.750		1.35	
1560	IEC61198	0.511		-0.93	
1660	IEC61198	0.614		0.05	
1702	IEC61198	0.629		0.20	
1743	IEC61198	0.65		0.40	
1801	EN61198	0.6633		0.52	
1872	EN61198	0.0249	C,R(0.01)	-5.56	First reported 0.0220
1885	D5837	0.539		-0.66	
1888	EN61198	0.5253		-0.79	
1891	IEC61198	0.669		0.58	
1897	IEC61198	0.657		0.46	
6015	EN61198	0.616		0.07	
6031	IEC61198	0.540875		-0.64	
6036	EN61198	0.590		-0.17	
6067	IEC61198	0.453480	C	-1.48	First reported 1.08027
6085	In house	0.64		0.30	
6124	IEC61198	0.77525		1.59	
6140	D5837	0.18	R(0.01)	-4.08	
6141	D5837	0.543069		-0.62	
6165	IEC61198	0.65		0.40	
6212	IEC61198	0.6397		0.30	

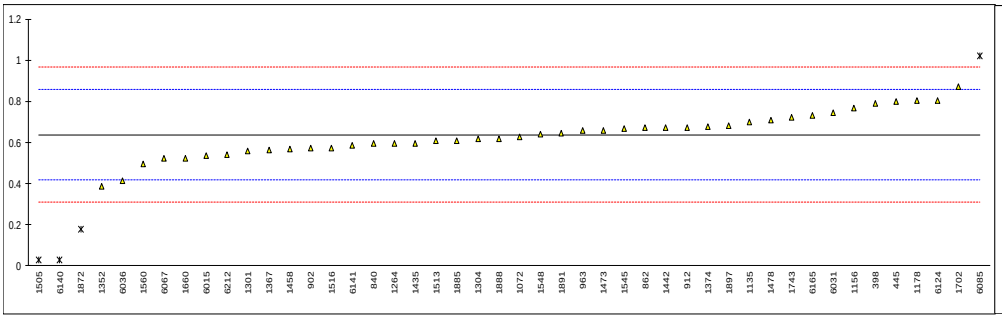
	normality	OK	
	n	42	
	outliers	5	
	mean (n)	0.6083	
	st.dev. (n)	0.06890	
	R(calc.)	0.1929	
	st.dev.(Horwitz)	0.10489	
	R(Horwitz)	0.2937	Compare R(IEC61198:93) = 0.0912

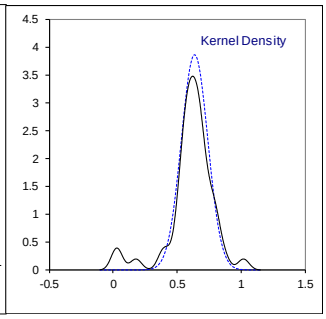




Determination of 2-Furfurylalcohol on sample #18232; results in mg/kg

lab	method	value	mark	z(targ)	remarks
331		-----		-----	
398	EN61198	0.790		1.40	
445	IEC61198	0.80		1.49	
614		-----		-----	
840	D5837	0.596		-0.38	
862	IEC61198	0.67		0.30	
902	D5837	0.57		-0.62	
912	IEC61198	0.673		0.32	
963	D5837	0.658		0.19	
1072	EN61198	0.626		-0.11	
1135	IEC61198	0.70		0.57	
1156	IEC61198	0.765		1.17	
1178	EN61198	0.8050		1.53	
1264	D5837	0.596	C	-0.38	First reported 596
1301	IEC61198	0.559		-0.72	
1304	INH-126	0.616		-0.20	
1352	IEC61198	0.38682		-2.30	
1367	IEC61198	0.5616		-0.70	
1374	D5837	0.676		0.35	
1430		-----		-----	
1435	IEC61198	0.597		-0.37	
1442	IEC61198	0.67		0.30	
1458	IEC61198	0.5687		-0.63	
1473	IEC61198	0.6601		0.21	
1478	IEC61198	0.708		0.64	
1505	D5837	0.03	R(0.01)	-5.57	
1513	IEC61198	0.6082		-0.27	
1516	IEC61198	0.571		-0.61	
1545	IEC61198	0.6680		0.28	
1548	IEC61198	0.640		0.02	
1560	IEC61198	0.497		-1.29	
1660	IEC61198	0.522		-1.06	
1702	IEC61198	0.872		2.15	
1743	IEC61198	0.72		0.75	
1801		-----		-----	
1872	EN61198	0.1797	C,R(0.05)	-4.19	First reported 0.0714
1885	D5837	0.610		-0.25	
1888	EN61198	0.6194		-0.17	
1891	IEC61198	0.645		0.07	
1897	IEC61198	0.683		0.42	
6015	EN61198	0.535		-0.94	
6031	IEC61198	0.743055		0.97	
6036	EN61198	0.412		-2.07	
6067	IEC61198	0.520736	C	-1.07	First reported 1.03445
6085	In house	1.02	R(0.05)	3.50	
6124	IEC61198	0.80525		1.53	
6140	D5837	0.03	R(0.01)	-5.57	
6141	D5837	0.587150		-0.46	
6165	IEC61198	0.73		0.85	
6212	IEC61198	0.5412		-0.88	
	normality	OK			
	n	42			
	outliers	4			
	mean (n)	0.6377			
	st.dev. (n)	0.10328			
	R(calc.)	0.2892			
	st.dev.(Horwitz)	0.10918			
	R(Horwitz)	0.3057			Compare R(IEC61198:93) = 0.0957

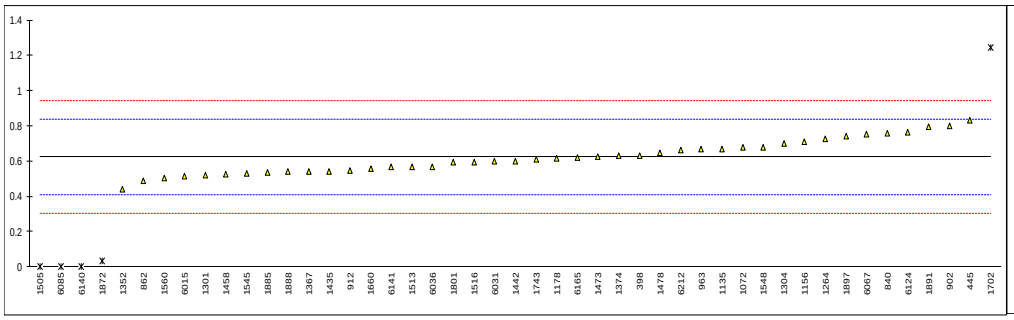


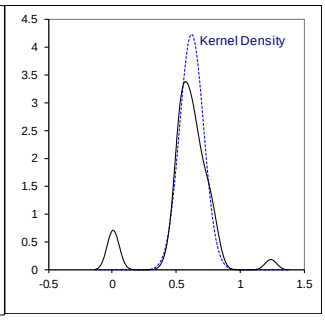


Determination of 5-Hydroxymethyl-2-Furfural on sample #18232; results in mg/kg

lab	method	value	mark	z(targ)	remarks
331		-----		-----	
398	EN61198	0.631		0.07	
445	IEC61198	0.83		1.93	
614		-----		-----	
840	D5837	0.755		1.23	
862	IEC61198	0.49		-1.24	
902	D5837	0.80		1.65	
912	IEC61198	0.548		-0.70	
963	D5837	0.665		0.39	
1072	EN61198	0.679		0.52	
1135	IEC61198	0.67		0.44	
1156	IEC61198	0.708		0.79	
1178	EN61198	0.6144		-0.08	
1264	D5837	0.726	C	0.96	First reported 728
1301	IEC61198	0.518		-0.98	
1304	INH-126	0.698		0.70	
1352	IEC61198	0.44211		-1.69	
1367	IEC61198	0.5398		-0.78	
1374	D5837	0.631		0.07	
1430		-----		-----	
1435	IEC61198	0.540		-0.78	
1442	IEC61198	0.60		-0.21	
1458	IEC61198	0.5258		-0.91	
1473	IEC61198	0.6230		0.00	
1478	IEC61198	0.646		0.22	
1505	D5837	0.00	R(0.01)	-5.82	
1513	IEC61198	0.566		-0.53	
1516	IEC61198	0.594		-0.27	
1545	IEC61198	0.5283		-0.88	
1548	IEC61198	0.680		0.53	
1560	IEC61198	0.502		-1.13	
1660	IEC61198	0.557		-0.62	
1702	IEC61198	1.245	R(0.01)	5.81	
1743	IEC61198	0.61		-0.12	
1801	EN61198	0.5908		-0.30	
1872	EN61198	0.0328	C,R(0.01)	-5.51	First reported 0.0031
1885	D5837	0.533		-0.84	
1888	EN61198	0.5387		-0.79	
1891	IEC61198	0.796		1.62	
1897	IEC61198	0.743		1.12	
6015	EN61198	0.515		-1.01	
6031	IEC61198	0.59804		-0.23	
6036	EN61198	0.568		-0.51	
6067	IEC61198	0.753831	C	1.22	First reported 1.46530
6085	In house	0	R(0.01)	-5.82	
6124	IEC61198	0.76375		1.32	
6140	D5837	0.00	R(0.01)	-5.82	
6141	D5837	0.565502		-0.54	
6165	IEC61198	0.62		-0.03	
6212	IEC61198	0.6622		0.37	

	normality	OK	
	n	42	
	outliers	5	
	mean (n)	0.6230	
	st.dev. (n)	0.09460	
	R(calc.)	0.2649	
	st.dev.(Horwitz)	0.10704	
	R(Horwitz)	0.2997	Compare R(IEC61198:93) = 0.0934

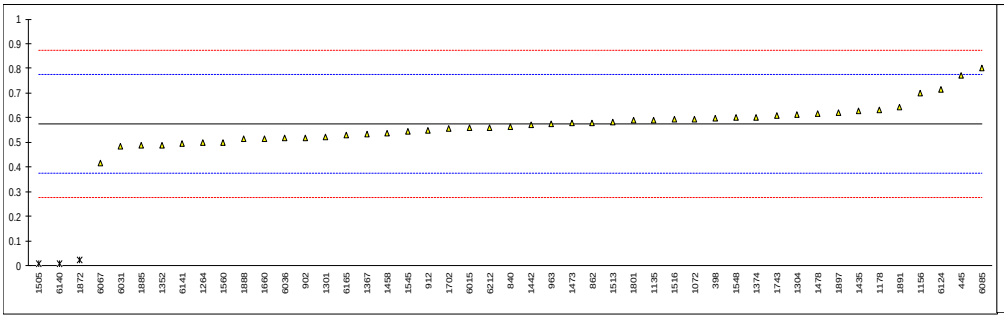


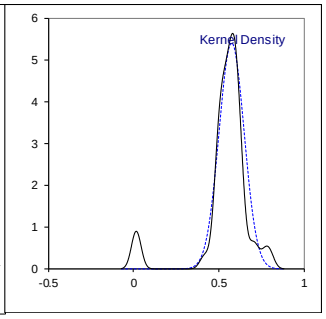


Determination of 5-Methyl-2-Furfural on sample #18232; results in mg/kg

lab	method	value	mark	z(targ)	remarks
331		-----		-----	
398	EN61198	0.597		0.22	
445	IEC61198	0.77		1.95	
614		-----		-----	
840	D5837	0.562		-0.13	
862	IEC61198	0.58		0.05	
902	D5837	0.52		-0.55	
912	IEC61198	0.55		-0.25	
963	D5837	0.575		0.00	
1072	EN61198	0.595		0.20	
1135	IEC61198	0.59		0.15	
1156	IEC61198	0.698		1.23	
1178	EN61198	0.6306		0.56	
1264	D5837	0.498	C	-0.77	First reported 496
1301	IEC61198	0.523		-0.52	
1304	INH-126	0.614		0.39	
1352	IEC61198	0.48865		-0.86	
1367	IEC61198	0.5352		-0.40	
1374	D5837	0.603		0.28	
1430		-----		-----	
1435	IEC61198	0.629		0.54	
1442	IEC61198	0.57		-0.05	
1458	IEC61198	0.5362		-0.39	
1473	IEC61198	0.5775		0.03	
1478	IEC61198	0.618		0.43	
1505	D5837	0.01	R(0.01)	-5.65	
1513	IEC61198	0.5837		0.09	
1516	IEC61198	0.593		0.18	
1545	IEC61198	0.5456		-0.29	
1548	IEC61198	0.600		0.25	
1560	IEC61198	0.498		-0.77	
1660	IEC61198	0.514		-0.61	
1702	IEC61198	0.556		-0.19	
1743	IEC61198	0.61		0.35	
1801	EN61198	0.5885		0.14	
1872	EN61198	0.0230	C,R(0.01)	-5.52	First reported 0.0002
1885	D5837	0.488		-0.87	
1888	EN61198	0.5134		-0.61	
1891	IEC61198	0.642		0.67	
1897	IEC61198	0.622		0.47	
6015	EN61198	0.559		-0.16	
6031	IEC61198	0.483435		-0.91	
6036	EN61198	0.518		-0.57	
6067	IEC61198	0.416404	C	-1.58	First reported 1.17756
6085	In house	0.8		2.25	
6124	IEC61198	0.71350		1.39	
6140	D5837	0.01	R(0.01)	-5.65	
6141	D5837	0.496676		-0.78	
6165	IEC61198	0.53		-0.45	
6212	IEC61198	0.5613		-0.14	

	normality	suspect	
	n	44	
	outliers	3	
	mean (n)	0.5748	
	st.dev. (n)	0.07378	
	R(calc.)	0.2066	
	st.dev.(Horwitz)	0.09997	
	R(Horwitz)	0.2799	Compare R(IEC61198:93) = 0.0862





APPENDIX 2 Analytical details of the determination: Breakdown Voltage

lab	brand type of test equipment	type of electrodes	determination started after test cell was filled	stirred during the determination	temperature during the determination	Preparation of the sample before filling the test cell	Any remarks
179				---			
237	BAUR	DISK FORM	1 MINUTE	No	24°C	SWIRLING & ENSURING NO AIR BUBBLES	
325				---			
331				---			
398	BAUR DPA	brass made and hemi-spherical shape. 3cm diameter	less than 1 minute	Yes	N/A	gently agitated by turning-over of the bottle (approx. 10 times). No bubble air formed.	The sample contained visible suspended matter (probably cellulose residue). Test aborted.
445	Megger OTS 100AF	Spherical, brass	5	Yes	18.5	Bottle inverted by hand	
511				---			
614	Megger	Spherical electrode	5 min	Yes	22	Rinsed with new oil and wiped clean	
840	BA100 - Portable Breakdown Analyzer for Oil Testing	GB0055 Mushroom	immediately	Yes	32	Clean outside the bottle of sample. Test Breakdown Voltage at the first.	
862	BAUR	brass polished, partially spherical of shape(13mm diameter)	5min	No	20°C	The sample container is gently agitated and turn over without causing the formation of air bubbles.	
902	Baur			Yes	90C		
912				---			
913				---			
962				---			
963	Baur DT 100	2.5 mm sperical electrode	2 min	No	21°C	Agitated & turned over several times to make homogenious	
974	Baur Tester DTA	spherical	5	Yes	24.0	Gently agitated and turned over several times to make homogeneous	
1072	BAUR	EN60156	5	Yes	20±5	shake and homogenize	-
1135	DPA75 - supplier Vandentempel	Brass made, partially shaped	5 minutes	No	21	Sample is tested as such without any pretreatment	
1146	Megger Foster OTS 80 AF/2	spherical electrode	Approx..15 minutes	Yes	20	Gently agitate for 15min, then 2hrs rest	
1156	BAUR / Megger	Partially spherical VDE	5 minutes	No	23,5	The bottle was turn over several times	
1178				---			Breakdown was not measured because of large mechanical impurities (>10mm) in sample.
1262	BAUR DPA 75C	IEC 60156 fig.II	5 min	Yes	24.8 °C	tempered at room temperature and filled in the cell	
1264	BAUR OIL TESTER DPA 75C	MUSHROOM TYPE	5 MINUTES	Yes	25	NA	
1301				---			
1304	Baur	Round balls	5	Yes	20-23	Gently rotate bottle so that it mixes without introducing bubbles	
1352	MEGGER FOSTER OTS 100AF/2	Spherical, 12.5 - 13 mm, brass or bronze	5 minutes until application of first voltage as per method.	No	21	Sample was gently agitated and turned over several times to ensure a homogeneous mixture.	

lab	brand type of test equipment	type of electrodes	determination started after test cell was filled	stirred during the determination	temperature during the determination	Preparation of the sample before filling the test cell	Any remarks
1361				---			
1367				---			
1374	Baur	Mushroom	5mins	Yes	20	Gently agitate (no bubbles)	
1430				---			
1435	Baur	spheric	5	No		not	
1442	Baur	spherical electrodes according IEC 60156	5 minutes according IEC 60156	Yes	21,0	gently agitated and turn the bottle, fill without bubbles (according IEC 60156)	
1444				---			
1458	BAUR DTA	DTA electrodes		Yes	20.9	rinse the test cell with the sample before filling the test cell	
1461				---			
1473	Megger OTS 100 AF	Mashroom Electrode	5 min.	Yes	20 °C	Shaking gently the bottle and pouring gently to avoid air bubbles formation.	
1478	BAUR DTA 100	partially sphericial electrodes	10 minutes	Yes	25C	we turn sample bottle over 3 times	
1505	BAUR	12.5mm spherical	5 minutes	Yes	16°C	Homogenize and leave it for 1h to rest before filling	
1513	B2 HV	Spherical electrodes	5	Yes	21	Gently agitated and turned over several times	
1516	BAUR DTA	Mushroom electrodes according to IEC 60156 (figure 2)	5 minutes	Yes	20ºC	No preparation	
1545	Megger 80kV	Mushroom type	5 min	Yes	25		
1548				---			
1560	Megger OTS100AF	IEC 60156 Fig. II	5	Yes	24	Gently shaking to homogenize the sample	
1660	B2	VDE		Yes	24	GENTLE SHAKING	
1687	Baur DTA 100	half spherical electrodes	immediately after filling the test cell	No	22°C	Smooth shaking and rotating for homogenization, then pouring out with care	
1702				---			
1719	Megger	round	5 minutes	Yes	21	no	
1743	BAUR	Spherical electrode		No	22	The sample is mixt before filling the test cell	
1801	BAUR	SEMISPHERIC	5	Yes	22	NO	
1827				---			
1885	Megger	Hemi spherical	2 minutes	No	22	Shaken	
1888				---			
1890	baur	type II	2hours	Yes	22	homogenisation on rolling equipment	
1891	Baur	Mushroom	5	Yes	22	Sample was agitated gently by inversion, then poured slowly to avoid bubbles.	
1897	Baur	Mushroom	5	Yes	22	Gently agitate sample before pouring in slowly.	
1923	OTS 80AF/2 MEGGER	Mushroom electrodes	5 (five) minutes	Yes	22,2	The sample equilibrate to ambient temperature	
1924	MEGGERÂ®, FOSTER, AVO INTERNATIONAL - OTS 80AF/2	mushroom-shape electrodes	2	No	25	The bottle with the sample was shaked softly and the oil was spilled slowly in the test cell	

lab	brand type of test equipment	type of electrodes	determination started after test cell was filled	stirred during the determination	temperature during the determination	Preparation of the sample before filling the test cell	Any remarks
1925	BAUR OIL Tester DTA 100	Mushroom electrodes	5(five) minutes	No	24.0	The simple equilibrate to ambient temperature.	
1966	DTA 100	IEC156 Fig II	5 min	Yes	22	Without prior preparation	
6015	Baur	polished spherical disc electrodes	5	Yes	25	moderate shaking	Automatic measuring program including stirring and waiting times.
6031	Megger	Spherical	five minutes	Yes	26.8°C.	Allow the sample container to achieve ambient temperature, than proceeded for analysis.	
6036	Baur DTA 100 C	spherical	30	No	20	Just pour in, no agitation or turning over of the bottle	
6053	Megger	Spherical	3 min	Yes	25	Remove all residues of the previous liquid with an appropriate solvent, rinse the assembly with clean, dry wiper then refill with test specimen	
6067	HV Diagnostics, BA 100	Spherical (mushroom-shaped)	10	Yes	25	Rinsed with small amount of sample then filled with the same sample without air bubbles	
6071				Yes			
6085	BAUR DTA E	ROGOWSKI	5	Yes	22	THE SAMPLE CONTAINER WAS GENTLY AGITATED & TURNED OVER SEVERAL TIMES	
6088	BAUR DTA 100C	IEC 60156 Fig. II partially spherical	5 min	Yes	26	Cold the sample in can to laboratory temperature	
6099	BAUR DTA 100 C	Spherical (figure 1 IEC60156:1995-07)	5 minutes	No	21°C	shake gently by turning the bottle over	
6124	BAUR DTA 100C	Mashroom Shape	5	Yes	25	Slow bottle rotation to mix the sample avoiding air incorporation. Rinse of the cell test with the …	
6140	BAUR			---			
6141	Megger OTS100AF	Mushroom	1	No	25	Rinsing twice the test cell before final filling for the test.	
6165	Baur	Spherical	1 minute	No	22.8	manual shaking	
6167	FOSTER (AVO) MEGGER UK - OTS 100 AF/2	MUSHROOM	5 MIN	Yes	23	CLEAN DRIED CELL IS RINSED WITH A PORTION OF THE SAMPLE BEFORE FILLING THE SAMPLE INTO THE TEST CELL	
6196	MEGGER OTS-100	Mushroom Shape	5 minutes	Yes	23.4°C	The test cell was washed with the same oil, electrodes were washed with the same oil to be tested.	
6207	Megger U.K.	Spherical	05 minutes	Yes	27	The test cell washed with oil sample. It may be noted that oil sample had minor visible contaminants	
6211	Beijing SINDIA	Brass mushroom shape electrodes	5min	Yes	20.9℃	Before the sample is poured into the cup, the sample is gently flipped several times in the containe	

APPENDIX 3

Number of participants per country

iis18L12 (main round)

7 labs in	AUSTRALIA
4 labs in	BELGIUM
7 labs in	BULGARIA
2 labs in	CHINA, People's Republic
1 lab in	CROATIA
2 labs in	FRANCE
1 lab in	GEORGIA
3 labs in	GERMANY
2 labs in	GREECE
1 lab in	HONG KONG
3 labs in	INDIA
2 labs in	ITALY
1 lab in	KINGDOM OF BAHRAIN
1 lab in	KUWAIT
3 labs in	MALAYSIA
1 lab in	MOROCCO
1 lab in	NETHERLANDS
1 lab in	NEW ZEALAND
1 lab in	NIGERIA
2 labs in	PAKISTAN
1 lab in	PERU
2 labs in	PORTUGAL
1 lab in	QATAR
3 labs in	SAUDI ARABIA
1 lab in	SERBIA
2 labs in	SINGAPORE
1 lab in	SLOVENIA
5 labs in	SPAIN
2 labs in	SWITZERLAND
1 lab in	TURKEY
5 labs in	UNITED ARAB EMIRATES
3 labs in	UNITED KINGDOM
1 lab in	UNITED STATES OF AMERICA
1 lab in	URUGUAY
1 lab in	VIETNAM

iis18L12F (Furanics round)

7 labs in	AUSTRALIA
2 labs in	BELGIUM
1 lab in	BULGARIA
1 lab in	CHINA, People's Republic
1 lab in	CROATIA
2 labs in	FRANCE
2 labs in	GERMANY
2 labs in	GREECE
1 lab in	INDIA
2 labs in	ITALY
1 lab in	KINGDOM OF BAHRAIN
2 labs in	MALAYSIA
1 lab in	MOROCCO
1 lab in	PAKISTAN
1 lab in	POLAND
2 labs in	PORTUGAL
1 lab in	QATAR
2 labs in	SAUDI ARABIA
1 lab in	SERBIA
1 lab in	SINGAPORE
1 lab in	SLOVENIA
1 lab in	SOUTH KOREA
4 labs in	SPAIN
1 lab in	SWITZERLAND
1 lab in	TURKEY
3 labs in	UNITED ARAB EMIRATES
3 labs in	UNITED KINGDOM
1 lab in	URUGUAY
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	= possibly an error in calculations
U	= test result possibly reported in a different unit
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
SDS	= Safety Data Sheet

Literature:

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