

Results of Proficiency Test
Transformer Oil (fresh)
November 2017

Organised by: Institute for Interlaboratory Studies
Spijkenisse, the Netherlands

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1 INTRODUCTION

Since 2001, the Institute for Interlaboratory Studies organizes a proficiency test for the analysis of Transformer Oil (fresh) every year. During the annual program 2017/2018, it was decided to continue the round robin for Transformer Oil (fresh) in accordance with the latest applicable version of the specification IEC60296 and of ASTM D3487.

In this interlaboratory study, 56 laboratories from 31 different countries registered for participation. See appendix 4 for a list of number of participants per country.

In this report, the results of the 2017 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 Spijkensisse, the Netherlands, was the organiser of this proficiency test (PT). Sample analyses for fit-for-use and homogeneity testing were subcontracted to an ISO/IEC 17025 accredited laboratory. It was decided to send a bottle of 1 litre of Transformer Oil (fresh), labelled #17230. 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 Spijkensisse, 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 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 March 2017 (iis-protocol, version 3.4). This protocol is electronically available from the FAQ-page of the iis website www.iisnl.com.

2.3 CONFIDENTIALITY STATEMENT

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

2.4 SAMPLES

The necessary bulk material was obtained from a local supplier. The 80 litre bulk material was homogenised in a pre-cleaned drum. After homogenisation, 79 subsamples were transferred to 1 litre amber glass bottles and labelled #17230. The homogeneity of the subsamples #17230 was checked by determination of Density and Water in accordance with ASTM D4052 on 8 stratified randomly selected samples.

	Density at 20°C in kg/m ³	Water in mg/kg
Sample #17230-1	804.13	16.64
Sample #17230-2	804.14	17.12
Sample #17230-3	804.13	17.10
Sample #17230-4	804.14	17.18
Sample #17230-5	804.13	16.72
Sample #17230-6	804.13	16.38
Sample #17230-7	804.14	16.50
Sample #17230-8	804.13	17.52

Table 1: homogeneity test results of subsamples #17230

From the above test results, the repeatabilities were calculated and compared with 0.3 times the corresponding reproducibilities of the reference test methods in agreement with the procedure of ISO 13528, Annex B2 in the next table.

	Density at 20°C in kg/m ³	Water in mg/kg
r (sample #17230)	0.01	1.10
reference test method	ISO3675:98	EN60814:98
0.3 x R _(reference test method)	0.36	1.85

Table 2: evaluation of the repeatability of subsamples #17230

Both calculated repeatabilities on sample #17230 were less than 0.3 times the corresponding reproducibilities of the reference test methods. Therefore, homogeneity of the subsamples #17230 was assumed.

To each of the participating laboratories, 1*1 litre bottle (labelled #17230) was sent on November 1, 2017. An SDS was added to the sample package.

2.5 STABILITY OF THE SAMPLES

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

2.6 ANALYSES

The participants were asked to determine tests mentioned in either ASTM D3487 or IEC 60296 on sample #17230: Acidity (Total, both 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 (both COC and PMcc), Interfacial Surface Tension, Kinematic Viscosity at 40°C, Water and additives (DBP and DBPC, DBDS, BTA and Irgamet 39).

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' results, which are above the detection limit, because such test results cannot be used for meaningful statistical evaluations.

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

3 RESULTS

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

Directly after the deadline, a reminder was sent to those laboratories that had not reported test results at that moment. Shortly after the deadline, the available test results were screened for suspect data. A test result was called suspect in case the Huber Elimination Rule (a robust outlier test) found it to be an outlier. The laboratories that produced these suspect data were asked to check the reported test results (no reanalyses).

Additional or corrected test results are used for data analysis and original results are placed under 'Remarks' in the result tables in appendix 1. Test results that came in after the deadline were not taken into account in this screening for suspect data and thus these participants were not requested for checks.

3.1 STATISTICS

The protocol followed in the organisation of this proficiency test was the one as described for proficiency testing in the report 'iis Interlaboratory Studies: Protocol for the Organisation, Statistics and Evaluation' (iis-protocol, March 2017 version 3.4).

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 judgment of the normality being either 'unknown', 'OK', 'suspect' or 'not OK'. After removal of outliers, this check was repeated. If a data set does not have a normal distribution, the (results of the) statistical evaluation should be used with due care.

In accordance to ISO 5725 the original test results per determination were submitted subsequently to Dixon's, Grubbs' and 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 the averages and the standard deviations.

For each assigned value, the uncertainty was determined in accordance with ISO13528. Subsequently the calculated uncertainty was evaluated against the respective requirement based on the target reproducibility in accordance with ISO13528. When the uncertainty passed the evaluation, no remarks are made in the report. However, when the uncertainty failed the evaluation it is mentioned in the report and it will have consequences for the evaluation of the test results.

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

3.2 GRAPHICS

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

The straight horizontal line presents the consensus value (a trimmed mean). The four striped lines, parallel to the consensus value line, are the +3s, +2s, -2s and -3s target reproducibility limits of the selected standard. Outliers and other data, which were

excluded from the calculations, are represented as a cross. Accepted data are represented as a triangle.

Furthermore, Kernel Density Graphs were made. This is a method for producing a smooth density approximation to a set of data that avoids some problems associated with histograms. Also a normal Gauss curve was projected over the Kernel Density Graph.

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.

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

The z-scores were calculated in accordance with:

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

The $Z_{(\text{target})}$ scores are listed in the 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 maybe as follows:

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

4 EVALUATION

In this proficiency test, no major problems were encountered with the despatch of the samples. Four participants reported the results after the final reporting date and one participant did not report at all. Not all participants were able to report results for all tests.

In total 55 participants reported 405 numerical results. Observed were 18 outlying results, which is 4.4% of the numerical results. In proficiency studies, outlier percentages of 3% - 7.5% are quite normal.

4.1 EVALUATION PER TEST

In this section, the reported test results are discussed per test. The specified test methods and requirements were taken into account for explaining the observed differences when possible and applicable. These methods are also in the tables together with the reported data. The abbreviations, used in these tables, are listed in appendix 4.

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.

Acidity, Potentiometric: No significant conclusions were drawn as the Acidity was below the quantification limit (0.014 g KOH/kg) of the test method EN62021-1:03. The reproducibility stated in ASTM D664:11ae1 can be used from a value of 0.1 g KOH/kg, and is thus not applicable for this sample.

Acidity, Colorimetric : This determination was not problematic. No statistical outliers were observed. The calculated reproducibility is in agreement with the requirements of ASTM D974:2014e2.

Appearance: All reporting laboratories agreed on the appearance of the oil being ‘Bright and Clear’ or remarked in similar words to this.

Color ASTM: The majority of the reporting participants agreed that the color was lower than 0.5.

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. Some analytical details were requested when reporting the test result (see appendix 2). Remarkably, stirring during the test did give a significant different consensus value than not stirring during the test, resp. 53.8 (stirred) and 72.9 (not stirred). The reproducibility of EN60156:95 was determined from Figure 3 of method EN60156:95, according to iis memo of December 2017. The black line in Figure 3 shows the relative standard deviation (=SD/mean or RSDr) as a function of the value of the mean based on six breakdown measurements. To calculate the repeatability RSDr was multiplied with a factor 2.8. The reproducibility can be estimated from the repeatability by multiplication with a factor 3, which is an empirical factor and divided by $\sqrt{6}$, because the reported result is an average of 6 measurements.

- Density at 20°C: This determination was problematic for a number of laboratories. Four statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in agreement with the requirements of ISO3675:98.
- DD-Factor: This determination was not problematic. One statistical outlier was observed. However, the calculated reproducibility after rejection of the statistical outlier is in agreement with the requirements of EN60247:04.
- Spec. Resistance: This determination was very problematic. The reported test results vary over a large range: 224 - 17000 GΩm. No statistical outliers were observed. Because of this high variation in test results, no reliable consensus value could be determined and therefore no z-scores were calculated.
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 problematic. No statistical outliers were observed. The calculated reproducibility is not in agreement with the requirements of ASTM D92:2016b.
- Flash Point (PMcc): This determination was problematic for a number of laboratories. Four statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in full agreement with the requirements of ISO2719:2016-procedure A.
- Interf. Surf. Tension: 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 D971:2012.
- Kinematic Viscosity: This determination was problematic. Four statistical outliers were observed. The calculated reproducibility after rejection of the statistical outliers is not in agreement with the requirements of ASTM D445:17a and ISO3104:94.
When the test results, performed according to ISO3104 and ASTM D445, were evaluated separately, the calculated reproducibilities are not different. Also test results were reported according to ASTM D7042 (Stabinger viscosity) and ASTM D7279 (Houillon viscosity).

Water: 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 EN60814:98.

DBPC: This determination was not problematic. No statistical outliers were observed. The calculated reproducibility is in full agreement with the requirements of IEC60666:2010.

Other anti-oxidant additives: The majority of the participants agreed that DBP (2,6-di-tertiary-butyl-phenol), DBDS (di-butyl-di-sulphide), BTA (benzotriazole) and Irgamet 39 were not present in the sample.

4.2 PERFORMANCE EVALUATION FOR THE GROUP OF LABORATORIES

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

Parameter	unit	n	average	2.8 * sd	R(lit)
Acidity, Total (Potentiometric Titration)	g KOH/kg	22	0.007	0.009	(0.002)*
Acidity, Total (Colorimetric Titration)	g KOH/kg	19	0.007	0.014	0.04
Appearance		31	B&C	n.a.	n.a.
Color ASTM		38	<0.5	n.a.	n.a.
Breakdown Voltage	kV/2.5 mm	48	55.0	39.6	34.0
Density at 20°C	kg/m ³	37	804.22	0.55	1.2
Di-electric Dissipation Factor at 90°C		37	0.0003	0.0008	0.0012
Specific Resistance at 90°C	GΩm	25	(5913)**	14072	(6208)**
Flash Point (COC)	°C	21	193.9	26.1	18
Flash Point (PMcc)	°C	25	189.6	13.2	13.5
Interfacial Surface Tension	mN/m	35	51.5	7.9	5.1
Kinematic Viscosity at 40°C	mm ² /s	37	9.67	0.19	0.12
Water	mg/kg	45	18.0	8.9	6.4
DBPC Antioxidant Additive	mg/kg	18	0.23	0.10	0.10

Table 3: Reproducibilities of tests on sample #17230

()* = Results were near or below detection limit, these results should be used with care

()** = No reliable consensus value could be determined

B&C = Bright and Clear

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

4.3 COMPARISON OF THE NOVEMBER 2017 PROFICIENCY TEST WITH PREVIOUS PTS.

	November 2017	November 2016	November 2015	November 2014	November 2013
Number of reporting labs	55	51	49	52	60
Number of results reported	405	383	330	340	491
Statistical outliers	18	29	26	13	32
Percentage outliers	4.4%	7.6%	7.9%	3.8%	6.5%

Table 4: comparison with previous proficiency tests

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

The performance of the determinations of the proficiency tests was compared against the target requirements. The conclusions are given the following table:

Parameter	November 2017	November 2016	November 2015	November 2014	November 2013
Acidity, Total (Potentiometric)	(--)	(--)	(--)	(--)	(--)
Acidity, Total (Colorimetric)	++	++	n.e.	n.e.	n.e.
Breakdown Voltage	-	++	++	++	--
Density at 20°C	++	++	+	+/-	+/-
Di-electric Dissipation Factor	+	+	++	++	++
Specific Resistance	--	--	--	--	--
Flash Point (COC)	-	+/-	n.e.	n.e.	n.e.
Flash Point (PMcc)	+/-	+	+/-	-	+/-
Interfacial Surface Tension	-	+/-	--	+/-	--
Kinematic Viscosity at 40°C	-	+/-	-	--	--
Water	-	+/-	-	-	-
DBPC Antioxidant Additive	+/-	n.e.	n.e.	n.e.	n.e.

Table 5: comparison determinations against the standard

() = Results between brackets were near or below detection limit, these results should be used with care

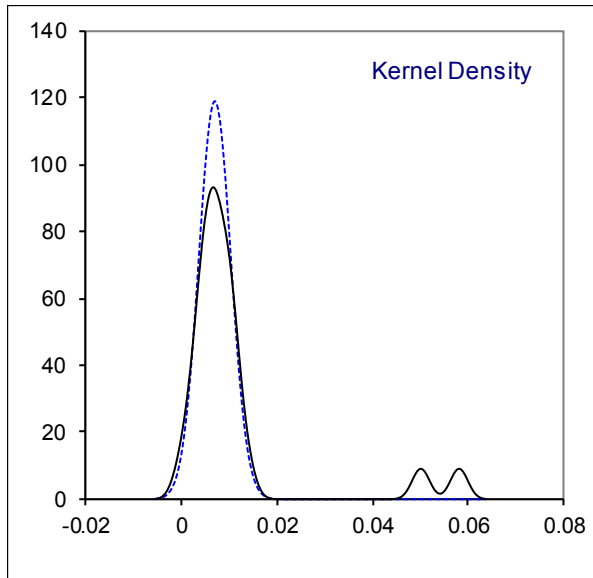
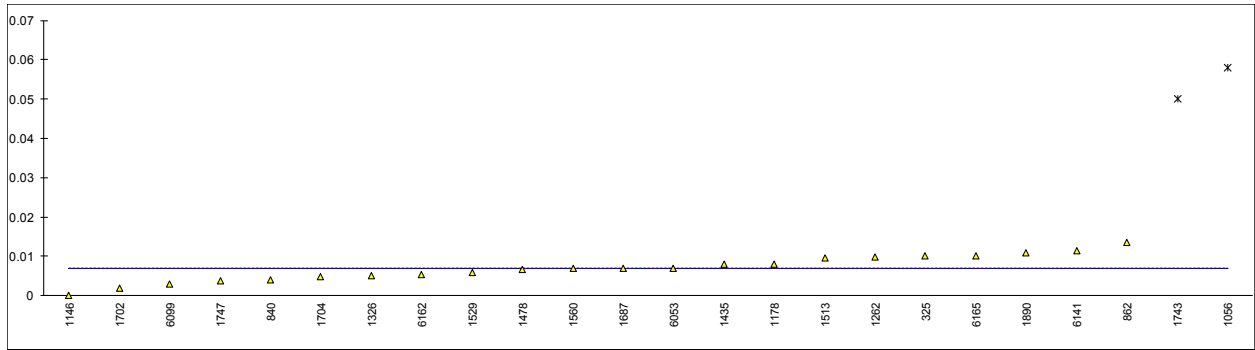
The performance of the determinations against the requirements of the respective standards is listed in the above table. The following performance categories were used:

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

APPENDIX 1

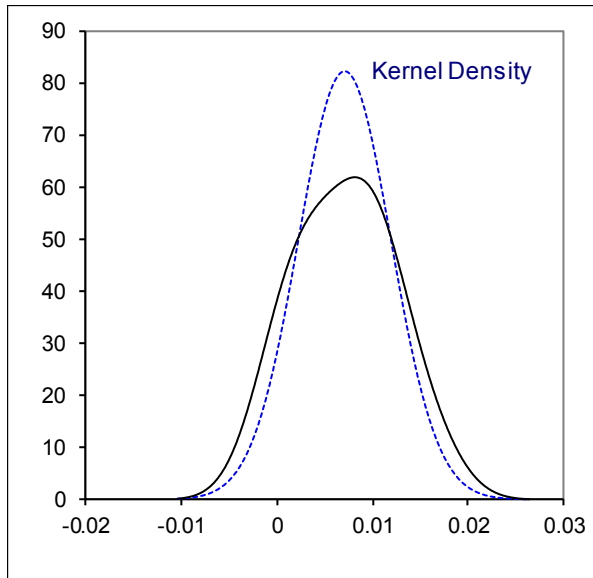
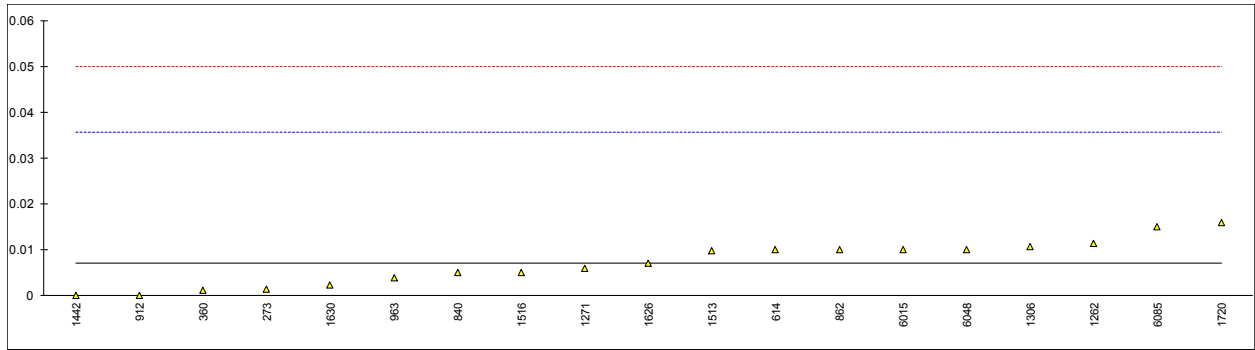
Determination of Acidity, Total (Potentiometric Titration) on sample #17230; results in g KOH/kg

lab	method	value	mark	z(targ)	remarks
173		----		----	
179	D664-A	<0.01		----	
237	D664-A	<0.1		----	
273		----		----	
325	D664-A	0.01		----	
360		----		----	
446		----		----	
614		----		----	
840	IEC62021-1	0.004		----	
862	D664-A	0.0136		----	
912		----		----	
913		----		----	
962		----		----	
963		----		----	
1056	D664-A	0.058	C,R(0.01)	----	first reported; 0.084
1146	D664-A	0.000008		----	
1178	EN62021-1	0.008		----	
1262	EN62021-1	0.0098		----	
1271		----		----	
1304		----		----	
1306		----		----	
1326	IEC62021-1	0.005		----	
1435	IEC62021-1	0.008		----	
1442		----		----	
1444		----		----	
1461		----		----	
1478	IEC62021-1	0.0066		----	
1513	IEC62021-1	0.009631		----	
1516		----		----	
1529	IEC62021-1	0.006		----	
1560	IEC62021-1	0.007		----	
1626		----		----	
1628		----		----	
1630		----		----	
1660	IEC62021-1	<0.01		----	
1687	D664-A	0.007		----	
1702		0.002		----	
1704	IEC62021-1	0.00481		----	
1719	D664-A	<0.01		----	
1720		----		----	
1743	IEC62021-1	0.05	R(0.01)	----	
1747	IEC62021-1	0.0038		----	
1885		----		----	
1890	ISO6619	0.011		----	
6015		----		----	
6048		----		----	
6053	IEC62021-1	0.007		----	
6085		----		----	
6099	IEC62021-1	0.003		----	
6120		----		----	
6141	D664-A	0.01146		----	
6157		----		----	
6162	EN62021-1	0.0054		----	
6165	IEC62021-1	0.01		----	
6167		----		----	
6169		----		----	
	normality	OK			
	n	22			
	outliers	2			Compare R(D664:17, AN Inflection) = 0.0068
	mean (n)	0.0070			Compare R(D664:17, AN Buffer EP) = 0.0036
	st.dev. (n)	0.00335			Compare R(D664:11ae1) = 0.1420
	R(calc.)	0.0094			D664 precision is applicable >0.1 g KOH/kg
	st.dev.(EN62021-1:03)	(0.00070)			
	R(EN62021-1:03)	(0.0019)			Quantification limit > 0.014 g KOH/kg



Determination of Acidity, Total (Colorimetric Titration) on sample #17230; results in g KOH/kg

lab	method	value	mark	z(targ)	remarks
173		----		----	
179	D974	<0.01		----	
237	D974	<0.01		----	
273	D974	0.0015		-0.39	
325		----		----	
360	ISO6618	0.0011		-0.42	
446	D974	<0.02		----	
614	D974	0.01		0.20	
840	D974	0.005		-0.15	
862	D974	0.01		0.20	
912	D974	0.0000034		-0.50	
913		----		----	
962	D974	<0.02		----	
963	D974	0.004		-0.22	
1056		----		----	
1146		----		----	
1178		----		----	
1262	ISO6618	0.0113		0.29	
1271	ISO6618	0.006		-0.08	
1304	INH-122	<0.01		----	
1306	D974	0.010772		0.26	
1326		----		----	
1435		----		----	
1442	IEC62021-2	0.00		-0.50	
1444		----		----	
1461		----		----	
1478		----		----	
1513	IEC62021-2	0.0098		0.19	
1516	D974	0.005		-0.15	
1529		----		----	
1560		----		----	
1626	D974	0.007		-0.01	
1628		----		----	
1630	D974	0.0022		-0.34	
1660		----		----	
1687		----		----	
1702		----		----	
1704		----		----	
1719		----		----	
1720	D974	0.016		0.62	
1743	ISO6618	<0.1		----	
1747		----		----	
1885	D974	<0.01		----	
1890		----		----	
6015	D974	0.01		0.20	
6048	D974	0.01		0.20	
6053		----		----	
6085	D974	0.015		0.55	
6099		----		----	
6120		----		----	
6141		----		----	
6157	IEC62021-2	<0.01		----	
6162		----		----	
6165		----		----	
6167		----		----	
6169		----		----	
	normality	OK			
	n	19			
	outliers	0			
	mean (n)	0.0071			
	st.dev. (n)	0.00486			
	R(calc.)	0.0136			
	st.dev.(D974:14e2)	0.01429			Compare R(IEC62021-2:07) = 0.0025
	R(D974:14e2)	0.04			IEC62021:07 Quantification limit > 0.01 g KOH/kg



Determination of Appearance on sample #17230;

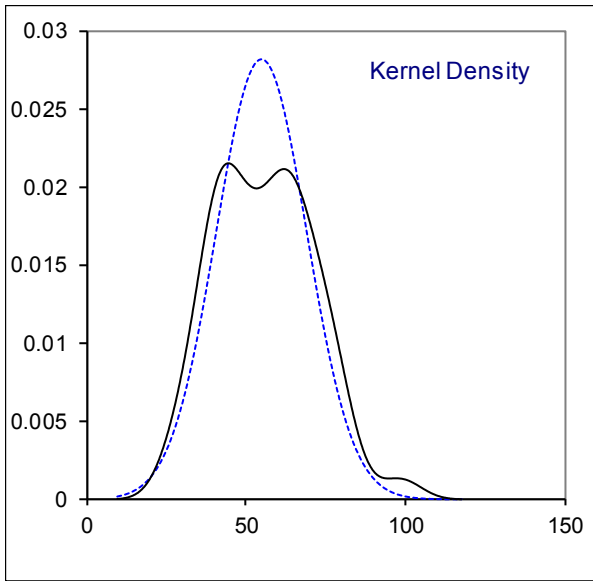
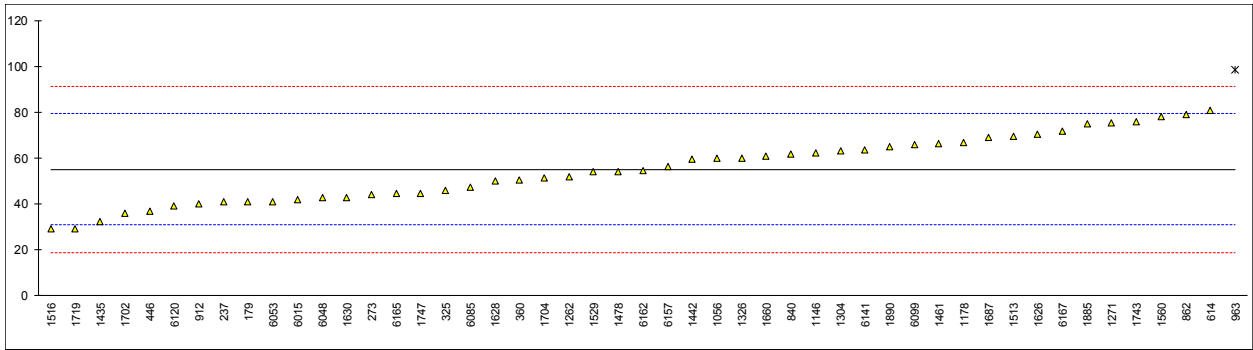
lab	method	value	mark	remarks
173	Visual	clear & free		
179		----		
237	Visual	C&B		
273	Visual	Bright & Clear		
325	Visual	waterwhite		
360	Visual	Clear and Bright		
446	Visual	Cl & Br		
614		----		
840	Visual	Pass		
862	Visual	Colorless		and Transparent Liquid
912	Visual	clear		
913		----		
962		----		
963	Visual	Bright & Clear		
1056		----		
1146		----		
1178	Visual	clear		
1262		bright and clear		
1271	Visual	clear and bright		
1304		----		
1306		----		
1326		----		
1435	Visual	clear		
1442	Visual	Clear		
1444		clear		
1461		----		
1478		clear		
1513	IEC60296	Limpid		
1516	ISO2049	Clear		
1529		----		
1560	Visual	Clear		and free from sediment and suspended matter
1626	Visual	Clear and bright		
1628		----		
1630	Visual	Clear, colourless		
1660	Visual	Clear		
1687		----		
1702		Clear		
1704	IEC60296	Clear		and free from sediment and suspended matter
1719		----		
1720		----		
1743	Visual	Limpid		
1747		----		
1885		----		
1890	Visual	clear		
6015	Visual	bright and clear		
6048	Visual	Clear & Bright		
6053		----		
6085		----		
6099	Visual	Claire		
6120		----		
6141		----		
6157		----		
6162	Visual	Clear		and free from sediment and suspended matter
6165		----		
6167		----		
6169		----		
n		31		
mean (n)		Bright and Clear		

Determination of Color ASTM on sample #17230;

lab	method	value	mark	z(targ)	remarks
173	D1500	L0.5		----	
179	D1500	L0.5		----	
237	D1500	0		----	
273	D1500	L0.5		----	
325	D6045	L0.5		----	
360	ISO2049	L 0.5		----	
446	D1500	L0.5		----	
614	D1500	<0.5		----	
840	D1500	L0.5		----	
862	D1500	L0.5		----	
912		----		----	
913		----		----	
962	D1500	L0.5		----	
963	D1500	L0.5		----	
1056		----		----	
1146		----		----	
1178	ISO2049	<0,5		----	
1262	ISO2049	L 0.5		----	
1271	D6045	0		----	
1304		----		----	
1306	D1500	0		----	
1326		----		----	
1435	ISO2049	0.5		----	
1442	ISO2049	0		----	
1444	ISO2049	0.0		----	
1461	ISO2049	L0.5		----	
1478	ISO2049	0.0		----	
1513	ISO2049	L0,5		----	
1516	IOS2049	0		----	
1529		----		----	
1560	ISO2049	L0.5		----	
1626	D1500	<0,5		----	
1628		----		----	
1630		----		----	
1660	D1500	0.1		----	
1687		----		----	
1702		L0.5		----	
1704	D1500	<0.5		----	
1719	D1524	<0.5		----	
1720		----		----	
1743	ISO2049	L0.5		----	
1747	ISO2049	L0.5		----	
1885		----		----	
1890	D1500	0.0		----	
6015	ISO2049	<0.5		----	
6048	D1500	0.0		----	
6053	ISO2049	L0.5		----	
6085	D1500	<0.5		----	
6099	D1500	0.0		----	
6120		----		----	
6141		----		----	
6157		----		----	
6162	D1500	< 0,5		----	
6165		----		----	
6167		----		----	
6169		----		----	
	n	38			
	mean (n)	<0.5			

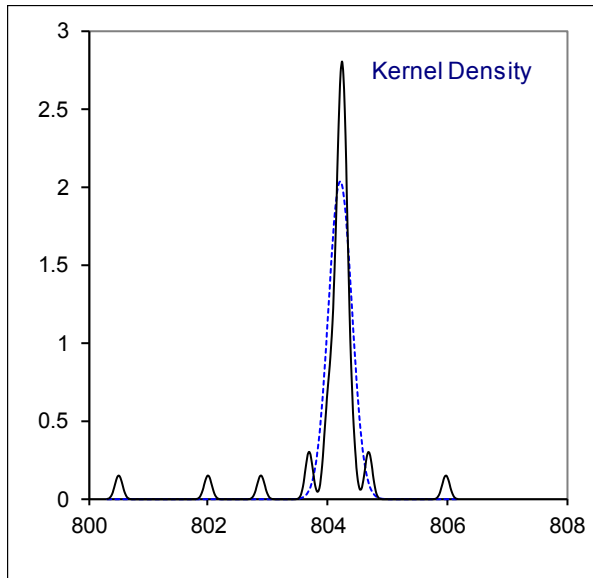
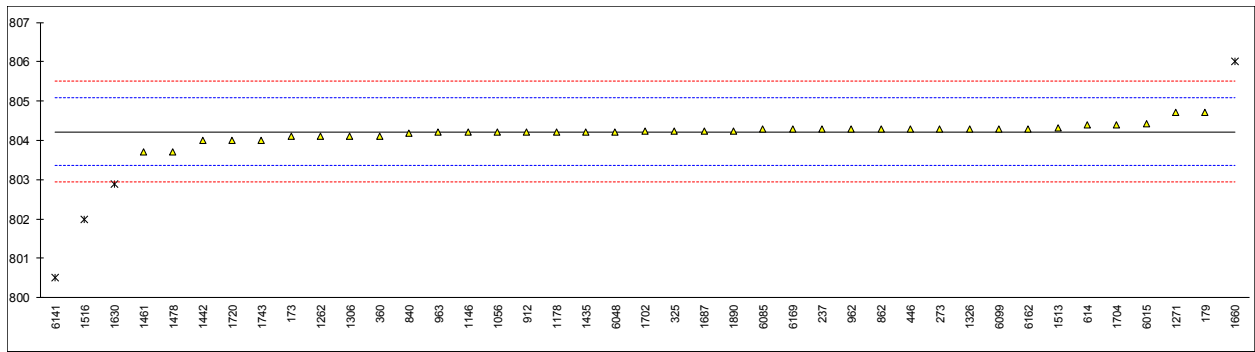
Determination of Breakdown Voltage on sample #17230, results in kV/2.5 mm

lab	method	value	mark	z(targ)	remarks
173		----		----	
179	D877	41.0		-1.15	
237	IEC60156	41.0		-1.15	
273	IEC60156	43.9		-0.92	
325	D1816	46		-0.74	
360	EN60156	50.5		-0.37	
446	IEC60156	37		-1.48	
614	IEC60156	80.8		2.13	
840	IEC60156	61.8		0.56	
862	IEC60156	79		1.98	
912	IEC60156	40		-1.24	
913		----		----	
962		----		----	
963	IEC60156	98.4	R(0.05)	3.58	
1056		60		0.41	
1146	IEC60156	62.1		0.59	
1178	EN60156	66.8		0.97	
1262	EN60156	51.8		-0.26	
1271	IEC60156	75.16		1.66	
1304	INH-124	63		0.66	
1306		----		----	
1326	IEC60156	60.1		0.42	
1435	IEC60156	32.5		-1.86	
1442	IEC60156	59.6		0.38	
1444		----		----	
1461	EN60156	66.1		0.92	
1478	IEC60156	54.1		-0.07	
1513	IEC60156	69.4		1.19	
1516	IEC60156	29.0		-2.14	
1529	IEC60156	53.9		-0.09	
1560	IEC60156	78.2		1.91	
1626	IEC60156	70.3		1.26	
1628	IEC60156	50.0		-0.41	
1630	IS6792 2	42.6		-1.02	
1660	IEC60156	60.7		0.47	
1687	IEC60156	69		1.15	
1702		35.9		-1.58	
1704	IEC60156	51.2		-0.31	
1719	IEC60156	29		-2.14	
1720		----		----	
1743	IEC60156	76		1.73	
1747	IEC60156	44.5		-0.87	
1885	IEC60156	75		1.65	
1890	EN60156	65.0		0.82	
6015	EN60156	41.75		-1.09	
6048	IEC60156	42.55		-1.03	
6053	IEC60156	41		-1.15	
6085	IEC60156	47.2		-0.64	
6099	IEC60156	65.9		0.90	
6120	EN60156	39.1		-1.31	
6141	IEC60156	63.6		0.71	
6157	IEC60156	56.5		0.12	
6162	IEC60156	54.6		-0.03	
6165	IEC60156	44.4		-0.87	
6167	IEC60156	71.6		1.37	
6169		----		----	
	normality	OK		Results 'stirred'	Results 'not stirred'
	n	48		OK	not OK
	outliers	1		29	11
	mean (n)	55.00		0	0
	st.dev. (n)	14.157		53.81	72.89
	R(calc.)	39.64		12.794	10.226
	st.dev.(EN60156:95)	12.126		35.82	28.63
	R(EN60156:95)	33.95		11.863	8.927
				33.22	25.00



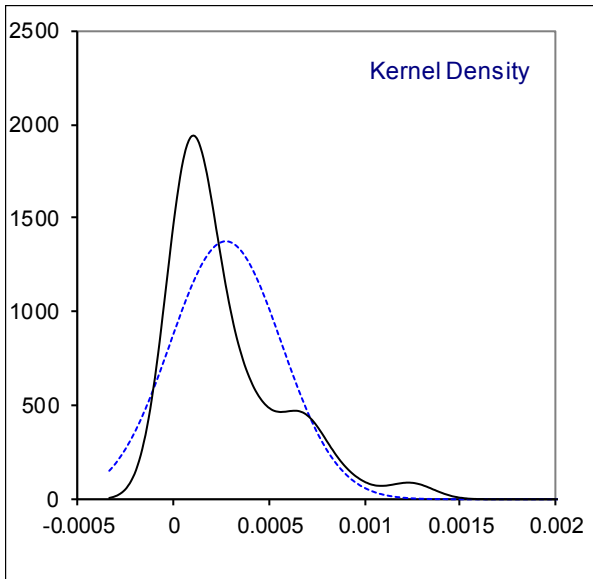
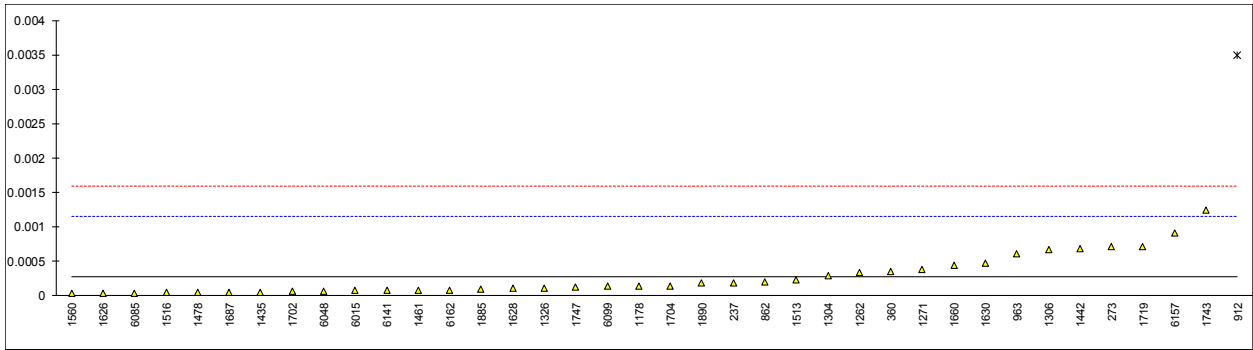
Determination of Density at 20°C on sample #17230; results in kg/m³

lab	method	value	mark	z(targ)	remarks
173	D4052	804.1		-0.29	
179	D4052	804.7	C	1.11	first reported: 0.8047
237	D4052	804.3		0.18	
273	D4052	804.3		0.18	
325	D4052	804.24		0.04	
360	D4052	804.1		-0.29	
446	D4052	804.3		0.18	
614	D4052	804.4		0.41	
840	D4052	804.19		-0.08	
862	D4052	804.3		0.18	
912	D4052	804.2		-0.05	
913		----		----	
962	D4052	804.3		0.18	
963	D4052	804.2		-0.05	
1056	D5002	804.2		-0.05	
1146	D4052	804.2		-0.05	
1178	ISO12185	804.2		-0.05	
1262	ISO3675	804.1		-0.29	
1271	D5002	804.7	C	1.11	first reported: 800.3
1304		----		----	
1306	D4052	804.1		-0.29	
1326	D4052	804.3		0.18	
1435	D7042	804.2	C	-0.05	first reported: 0.8042
1442	D7042	804.0		-0.52	
1444		----		----	
1461	ISO3675	803.7		-1.22	
1478	ISO12185	803.7		-1.22	
1513	ISO12185	804.307		0.20	
1516	ISO3675	802.0	R(0.01)	-5.19	
1529		----		----	
1560		----		----	
1626		----		----	
1628		----		----	only reported result at 15°C: 807.3 kg/m ³
1630	D4052	802.89	C,R(0.01)	-3.11	first reported: 802.24
1660	D7042	806.0	R(0.01)	4.15	
1687	ISO12185	804.24		0.04	
1702		804.224		0.00	
1704	ISO3675	804.4		0.41	
1719		----		----	
1720	D4052	804.0		-0.52	
1743		804		-0.52	
1747		----		----	
1885		----		----	
1890	ISO12185	804.24		0.04	
6015	ISO12185	804.43		0.48	
6048	D4052	804.2		-0.05	
6053		----		----	
6085	D7042	804.28		0.13	
6099	ISO12185	804.3		0.18	
6120		----		----	
6141	D1298	800.5	C,R(0.01)	-8.69	first reported: 0.8005 g/cc
6157		----		----	
6162	ISO12185	804.3		0.18	
6165		----		----	
6167		----		----	
6169	ISO12185	804.28		0.13	
	normality	not OK			
	n	37			
	outliers	4			
	mean (n)	804.223			
	st.dev. (n)	0.1961			
	R(calc.)	0.549			
	st.dev.(ISO3675:98)	0.4286			Compare R(D4052:16) = R(ISO12185:96) = 0.5
	R(ISO3675:98)	1.2			Compare R(D7042:16e3) = 1.3



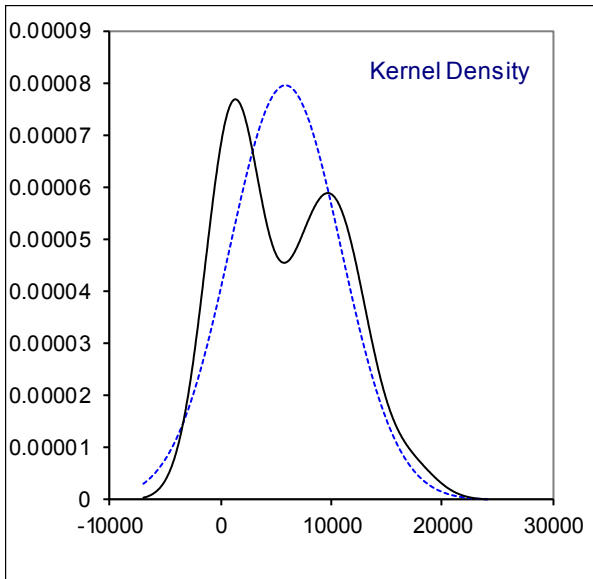
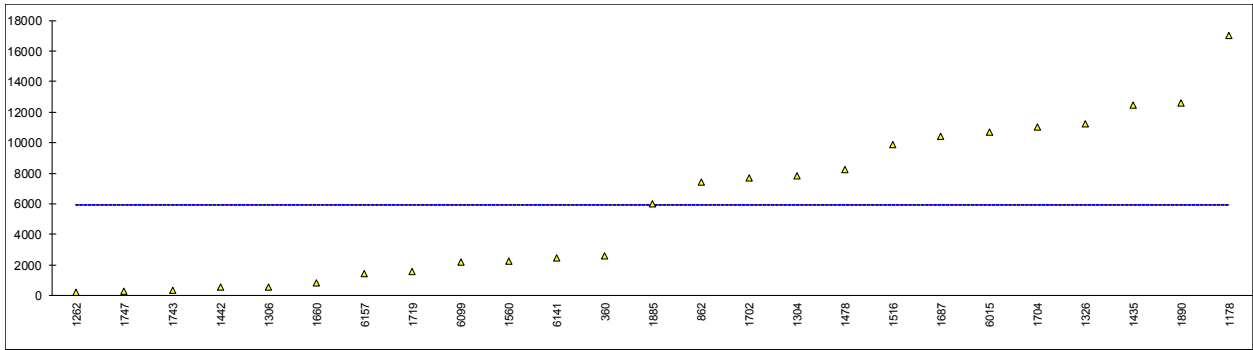
Determination of Di-electric Dissipation Factor (DDF) at 90°C on sample #17230

lab	method	value	mark	z(targ)	remarks
173		----		----	
179		----		----	
237	IEC60247	0.00019		-0.19	
273	IEC60247	0.00071		0.99	
325		----		----	
360	EN60247	0.00035		0.17	
446	IEC60247	<0.001		----	
614		----		----	
840		----		----	
862	IEC60247	0.0002		-0.17	
912	D924	0.0035	C,R(0.01)	7.34	first reported: 0.0053
913		----		----	
962		----		----	
963	IEC60247	0.0006		0.74	
1056		----		----	
1146		----		----	
1178	EN60247	0.00014		-0.31	
1262	EN60247	0.00033		0.13	
1271	IEC60247	0.000384		0.25	
1304	INH-125	0.000283		0.02	
1306	IEC60247	0.000664		0.89	
1326	IEC60247	0.000112		-0.37	
1435	IEC60247	0.000055		-0.50	
1442	IEC60247	0.00069		0.94	
1444		----		----	
1461	EN60247	0.000084		-0.43	
1478	IEC60247	0.000051		-0.51	
1513	IEC60247	0.000226		-0.11	
1516	IEC60247	0.000044		-0.53	
1529		----		----	
1560	IEC60247	0.000029		-0.56	
1626	IEC60247	0.00003		-0.56	
1628	IEC60247	0.00011		-0.38	
1630	IS6262 3	0.00047		0.44	
1660	IEC60247	0.00044		0.38	
1687	IEC60247	0.000054		-0.50	
1702		0.00006		-0.49	
1704	IEC60247	0.00014		-0.31	
1719	IEC60247	0.00071		0.99	
1720		----		----	
1743	IEC60247	0.00124		2.20	
1747	IEC60247	0.00012		-0.35	
1885	IEC60247	0.00009		-0.42	
1890	IEC60247	0.00018		-0.22	
6015	EN60247	0.0000755		-0.45	
6048	IEC60247	0.000067		-0.47	
6053		----		----	
6085	IEC60247	0.000038		-0.54	
6099	IEC60247	0.000136		-0.32	
6120		----		----	
6141	IEC60247	0.000076		-0.45	
6157	EN60247	0.000912		1.45	
6162	IEC60247	0.000085		-0.43	
6165		----		----	
6167		----		----	
6169		----		----	
	normality	not OK			
	n	37			
	outliers	1			
	mean (n)	0.000275			
	st.dev. (n)	0.0002907			
	R(calc.)	0.000814			
	st.dev.(EN60247:04)	0.0004393			
	R(EN60247:04)	0.001230			



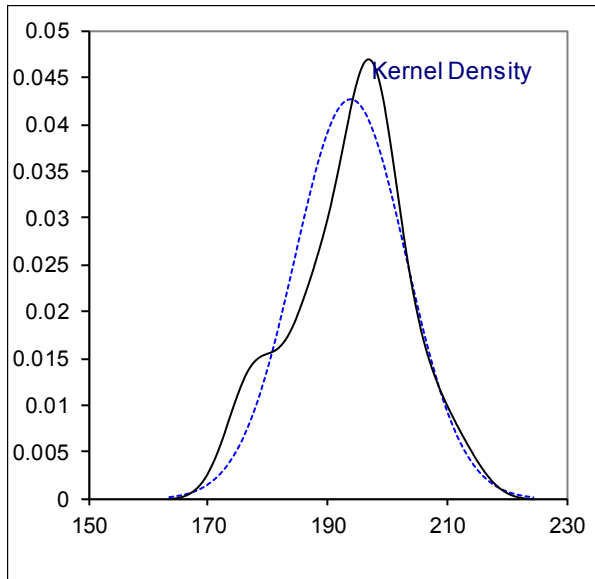
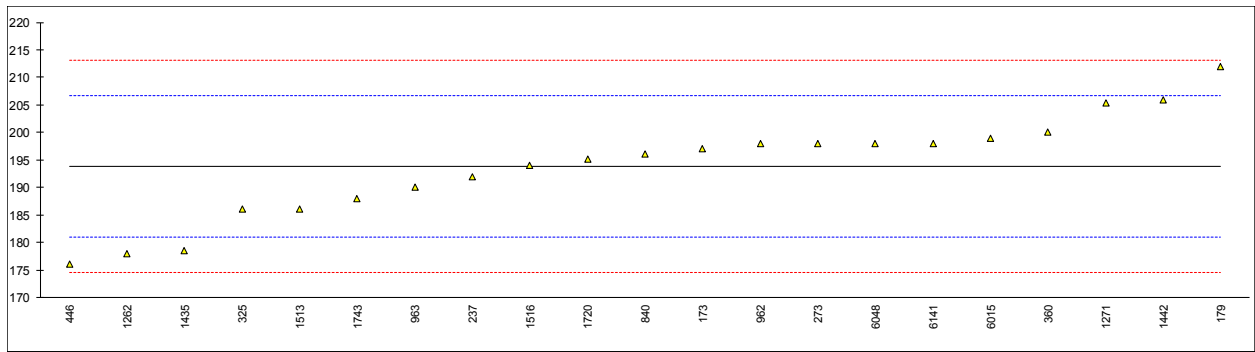
Determination of Specific Resistance at 90°C on sample #17230; results in GΩm

lab	method	value	mark	z(targ)	remarks
173		----		----	
179		----		----	
237		----		----	
273		----		----	
325		----		----	
360	EN60247	2610		----	
446		----		----	
614		----		----	
840		----		----	
862	IEC60247	7440		----	
912		----		----	
913		----		----	
962		----		----	
963		----		----	
1056		----		----	
1146		----		----	
1178	EN60247	17000		----	
1262	EN60247	224		----	
1271		----		----	
1304	INH-125	7820		----	
1306	IEC60247	579.19		----	
1326	IEC60247	11250		----	
1435	IEC60247	12460		----	
1442	IEC60247	558.52		----	
1444		----		----	
1461		----		----	
1478	IEC60247	8270		----	
1513		----		----	
1516	IEC60247	9860		----	
1529		----		----	
1560	IEC60247	2233		----	
1626		----		----	
1628		----		----	
1630		----	W	----	first reported: 80320
1660	IEC60247	822.2		----	
1687	IEC60247	10410		----	
1702		7715		----	
1704	IEC60247	11000	C	----	first reported: 13000
1719	IEC60247	1575		----	
1720		----		----	
1743	IEC60247	349		----	
1747	IEC60247	253.2		----	
1885	IEC60247	6014		----	
1890	IEC60247	12600		----	
6015	EN60247	10710.0		----	
6048		----		----	
6053		----		----	
6085		----		----	
6099	IEC60247	2180		----	
6120		----		----	
6141	IEC60247	2470		----	
6157	IEC60247	1410		----	
6162		----		----	
6165		----		----	
6167		----		----	
6169		----		----	
	normality	OK			
	n	25			
	outliers	0			
	mean (n)	(5912.52)			Consensus value is not reliable
	st.dev. (n)	5025.707			
	R(calc.)	14071.98			
	st.dev.(EN60247:04)	(2217.197)			
	R(EN60247:04)	(6208.15)			



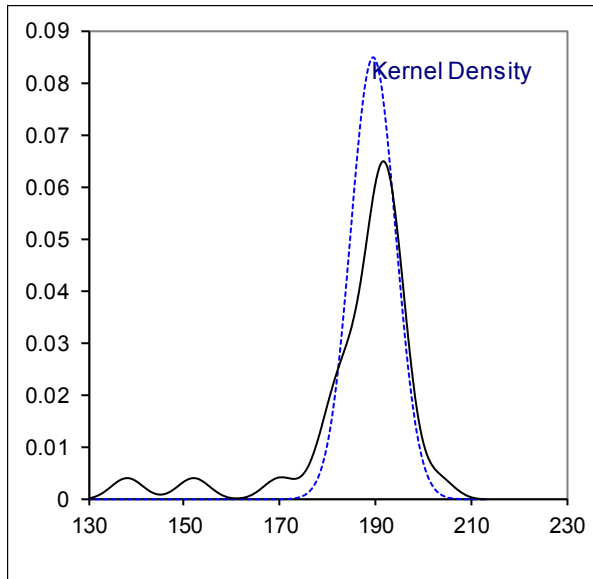
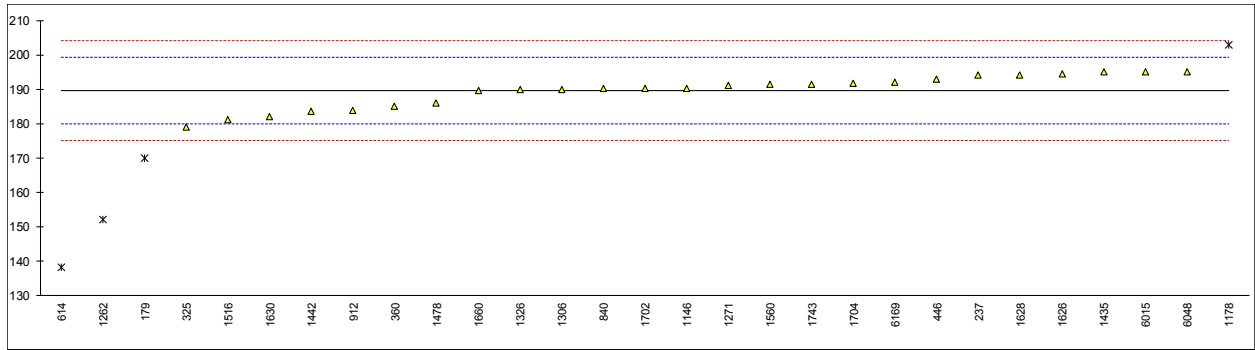
Determination of Flash Point C.O.C. on sample #17230; results in °C

lab	method	value	mark	z(targ)	remarks
173	D92	197		0.49	
179	D92	212		2.82	
237	D92	192		-0.29	
273	D92	198		0.64	
325	D92	186		-1.22	
360	ISO2592	200		0.95	
446	D92	176		-2.78	
614		----		----	
840	D92	196.1		0.35	
862		----		----	
912		----		----	
913		----		----	
962	D92	198		0.64	
963	D92	190		-0.60	
1056		----		----	
1146		----		----	
1178		----		----	
1262	ISO2592	178		-2.47	
1271	ISO2592	205.4		1.79	
1304		----		----	
1306		----		----	
1326		----		----	
1435	D92	178.6		-2.38	
1442	D92	206		1.89	
1444		----		----	
1461		----		----	
1478		----		----	
1513	ISO2592	186.0		-1.22	
1516	D92	194		0.02	
1529		----		----	
1560		----		----	
1626		----		----	
1628		----		----	
1630		----		----	
1660		----		----	
1687		----		----	
1702		----		----	
1704		----		----	
1719		----		----	
1720	D92	195.2		0.21	
1743	ISO2592	188		-0.91	
1747		----		----	
1885		----		----	
1890		----		----	
6015	ISO2592	199.0		0.80	
6048	ISO2592	198		0.64	
6053		----		----	
6085		----		----	
6099		----		----	
6120		----		----	
6141	D92	198		0.64	
6157		----		----	
6162		----		----	
6165		----		----	
6167		----		----	
6169		----		----	
	normality	OK			
	n	21			
	outliers	0			
	mean (n)	193.87			
	st.dev. (n)	9.324			
	R(calc.)	26.11			
	st.dev.(D92:16b)	6.429			
	R(D92:16b)	18			R(D82:16b) = R(ISO2592:17)



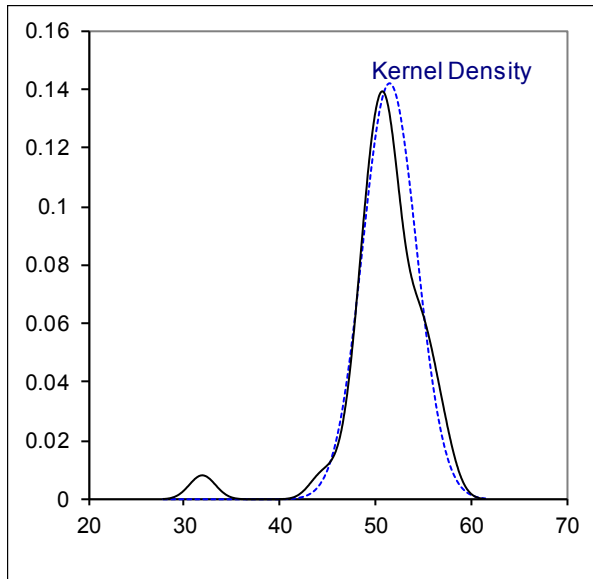
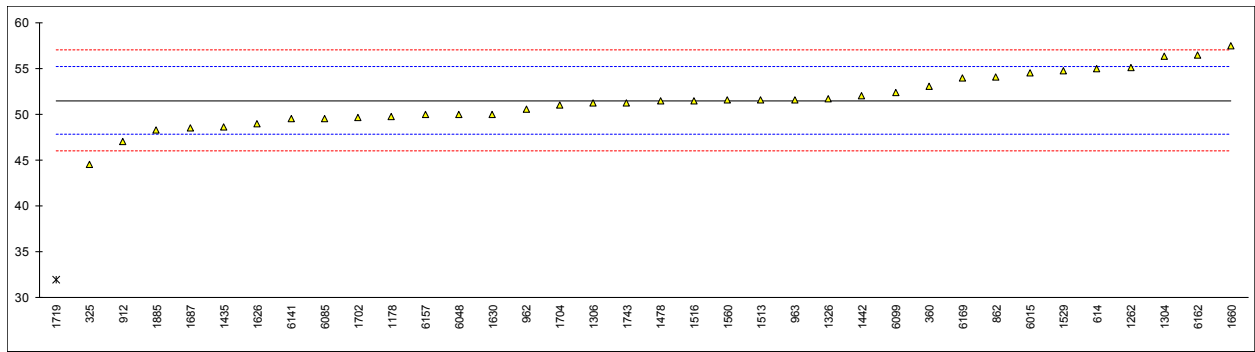
Determination of Flash Point PMcc on sample #17230; results in °C

lab	method	value	mark	z(targ)	remarks
173		----		----	
179	D93-B	170.0	R(0.05)	-4.07	
237	D93-B	194.0		0.93	
273		----		----	
325	D93-A	179		-2.20	
360	D93-A	185.0		-0.95	
446	D93-A	193.0		0.72	
614	D93-A	138.1	R(0.01)	-10.70	
840	D93-A	190.1		0.11	
862		----		----	
912	D93-A	184		-1.15	
913		----		----	
962		----		----	
963		----		----	
1056		----		----	
1146	D93-A	190.2		0.14	
1178	ISO2719-A	203.0	R(0.05)	2.80	
1262	ISO2719-A	152.0	C,R(0.01)	-7.81	first reported: 162
1271	ISO2719-A	191.2		0.34	
1304		----		----	
1306	D93-A	190		0.09	
1326	D93-A	190		0.09	
1435	D93-A	195.0		1.13	
1442	ISO2719-A	183.5		-1.26	
1444		----		----	
1461		----		----	
1478	ISO2719-A	186.0		-0.74	
1513		----		----	
1516	ISO2719	181		-1.78	
1529		----		----	
1560	ISO2719-A	191.5		0.41	
1626	D93-A	194.5		1.03	
1628	ISO2719-A	194.0		0.93	
1630	D93-A	182		-1.57	
1660	D93-A	189.5		-0.01	
1687		----		----	
1702		190.1		0.11	
1704	ISO2719	191.67		0.44	
1719		----		----	
1720		----		----	
1743	ISO2719-A	191.5		0.41	
1747		----		----	
1885		----		----	
1890		----		----	
6015	D7236	195.0		1.13	
6048	D93-A	195		1.13	
6053		----		----	
6085		----		----	
6099		----		----	
6120		----		----	
6141		----		----	
6157		----		----	
6162		----		----	
6165		----		----	
6167		----		----	
6169	ISO2719-A	192		0.51	
	normality	OK			
	n	25			
	outliers	4			
	mean (n)	189.55			
	st.dev. (n)	4.697			
	R(calc.)	13.15			
	st.dev.(ISO2719:16-A)	4.806			
	R(ISO2719:16-A)	13.46			R(ISO2719:16-A) = R(D93:16a-A) = R(IP34:03-A)



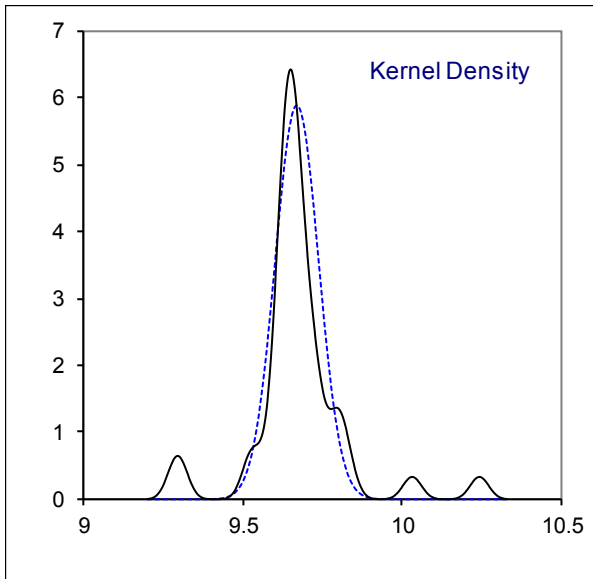
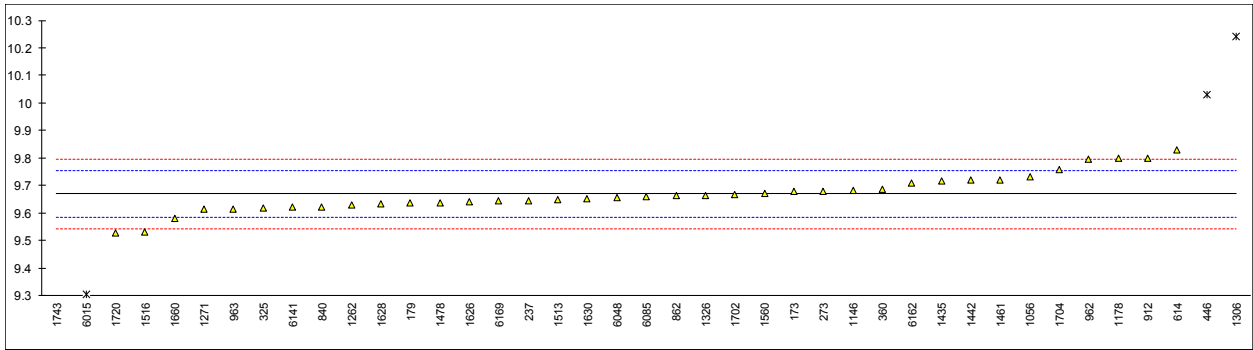
Determination of Interfacial Surface Tension on sample #17230; results in mN/m

lab	method	value	mark	z(targ)	remarks
173		----		----	
179		----		----	
237		----		----	
273		----		----	
325	In house	44.5		-3.80	
360	D971	53.0		0.82	
446		----		----	
614	D971	55		1.91	
840		----		----	
862	D971	54		1.36	
912	D971	47.0		-2.44	
913		----		----	
962	D971	50.5		-0.54	
963	D971	51.6		0.06	
1056		----		----	
1146		----		----	
1178	D971	49.7		-0.97	
1262	D971	55.1		1.96	
1271		----		----	
1304	INH-123	56.3		2.61	
1306	D971	51.20		-0.16	
1326	D971	51.72		0.12	
1435	D971	48.6		-1.57	
1442	EN14210	52.0		0.28	
1444		----		----	
1461		----		----	
1478	D971	51.40		-0.05	
1513	D971	51.54		0.03	
1516	D971	51.4		-0.05	
1529	D971	54.7		1.74	
1560	D971	51.5		0.00	
1626	D971	48.97		-1.37	
1628		----		----	
1630	IS6104 5	50.0116		-0.80	
1660	D971	57.4		3.21	
1687	D971	48.5		-1.63	
1702		49.686		-0.98	
1704	D971	51.03		-0.25	
1719	D2285	32	R(0.01)	-10.60	
1720		----		----	
1743	D971	51.2		-0.16	
1747		----		----	
1885	D971	48.3		-1.74	
1890		----		----	
6015	D971	54.480		1.63	
6048	D971	49.99		-0.82	
6053		----		----	
6085	D971	49.558		-1.05	
6099	EN14210	52.4		0.49	
6120		----		----	
6141	D971	49.52		-1.07	
6157	D971	49.96		-0.83	
6162	D971	56.47		2.71	
6165		----		----	
6167		----		----	
6169	EN14210	53.96		1.34	
	normality	OK			
	n	35			
	outliers	1			
	mean (n)	51.491			
	st.dev. (n)	2.8094			
	R(calc.)	7.866			
	st.dev.(D971:12)	1.8390			
	R(D971:12)	5.149			



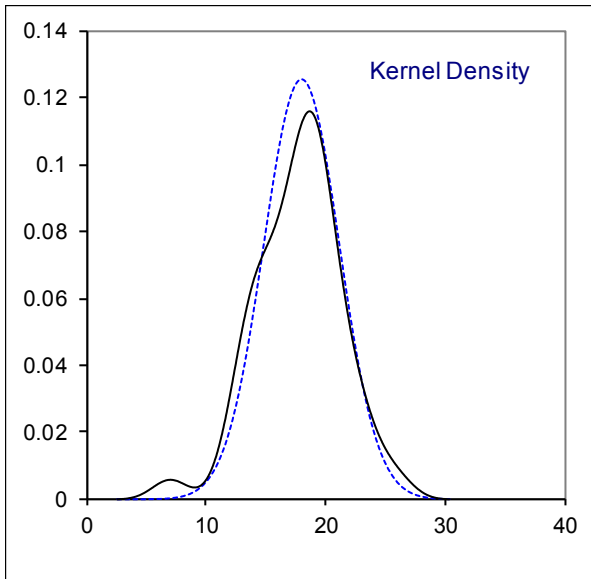
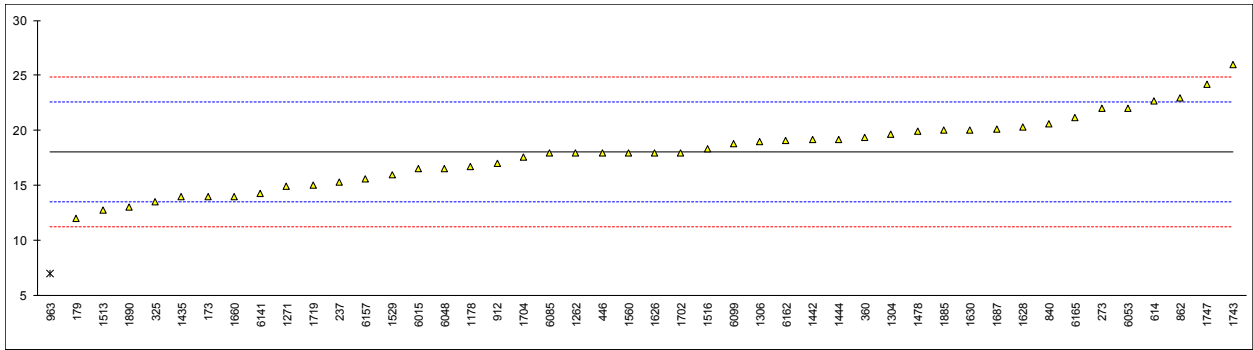
Determination of Kinematic Viscosity at 40°C on sample #17230; results in mm²/s

lab	method	value	mark	z(targ)	remarks
173	D445	9.677		0.17	
179	D445	9.638		-0.76	
237	D445	9.645		-0.59	
273	D445	9.679		0.22	
325	D445	9.6188		-1.21	
360	D445	9.6843		0.34	
446	D445	10.03	R(0.01)	8.55	
614	D445	9.83		3.80	
840	D7042	9.6223		-1.13	
862	D445	9.664		-0.14	
912	D445	9.80		3.09	
913		----		----	
962	D445	9.796		2.99	
963	D445	9.616		-1.28	
1056	D7042	9.73		1.43	
1146	D445	9.6827		0.31	
1178	ISO3104	9.80		3.09	
1262	ISO3104	9.63		-0.95	
1271	ISO3104	9.615		-1.30	
1304		----		----	
1306	D445	10.24	R(0.01)	13.53	
1326	D445	9.665		-0.12	
1435	D7042	9.7151		1.07	
1442	D7042	9.7194		1.18	
1444		----		----	
1461	ISO3104	9.7211		1.22	
1478	D7042	9.6382		-0.75	
1513	ISO3104	9.64726		-0.54	
1516	ISO3104	9.53		-3.32	
1529		----		----	
1560	ISO3104	9.6704		0.01	
1626	D445	9.642		-0.66	
1628	ISO3104	9.634		-0.85	
1630	D445	9.6521		-0.42	
1660	D7042	9.58		-2.13	
1687		----		----	
1702		9.6654		-0.11	
1704	ISO3104	9.7575		2.08	
1719		----		----	
1720	D7042	9.527		-3.39	
1743	D7279 corr. to D445	9.29	R(0.01)	-9.02	
1747		----		----	
1885		----		----	
1890		----		----	
6015	D7279 corr. to D445	9.305	C,R(0.01)	-8.66	first reported: 9.0150
6048	D445	9.657		-0.30	
6053		----		----	
6085	D7042	9.6602		-0.23	
6099		----		----	
6120		----		----	
6141	D7279 corr. to D445	9.620		-1.18	
6157		----		----	
6162	D445	9.7102		0.96	
6165		----		----	
6167		----		----	
6169	EN16896	9.6445		-0.60	
					<u>Only D445/ISO3104:</u>
	normality	OK			OK
	n	37			27
	outliers	4			2
	mean (n)	9.670			9.679
	st.dev. (n)	0.0678			0.0680
	R(calc.)	0.190			0.190
	st.dev.(D445:17a)	0.0421			0.0421
	R(D445:17a)	0.118			0.118
comp	R(ISO3104:94)	0.073			0.074
comp	R(D7042:16e3)				0.220
					<u>Only D7042/EN16896:</u>
					OK
					9
					0
					9.649
					0.0676
					0.189



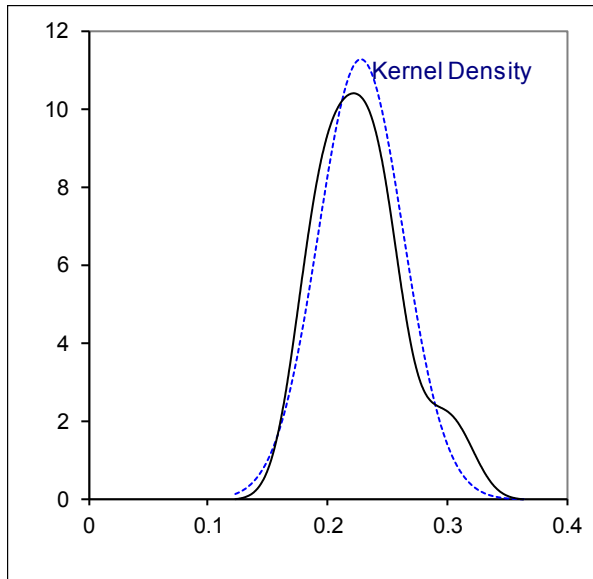
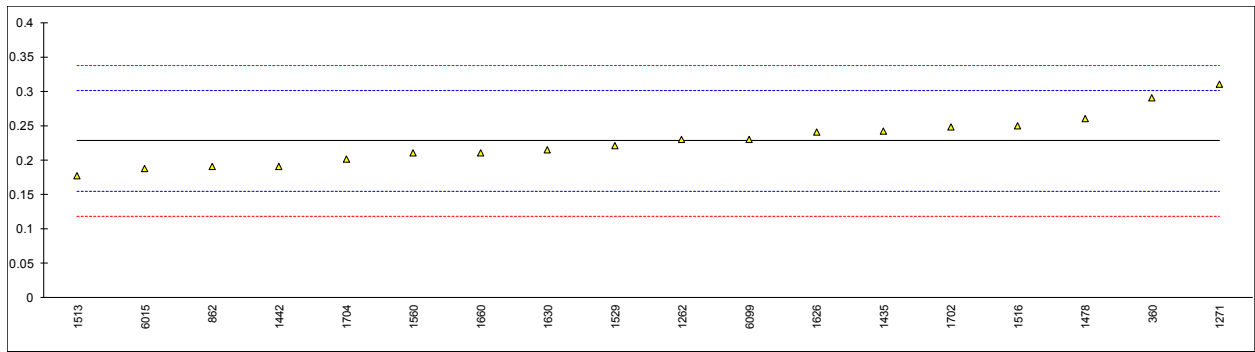
Determination of Water on sample #17230; results in mg/kg

lab	method	value	mark	z(targ)	remarks
173	D6304-C	14		-1.77	
179	D6304-C	12		-2.65	
237	D6304-A	15.29	C	-1.20	first reported: 29.96
273	IEC60814	22		1.75	
325	D6304-C	13.5		-1.99	
360	EN60814	19.4		0.60	
446	IEC60814	18		-0.01	
614	IEC60814	22.7		2.05	
840	IEC60814	20.60		1.13	
862	D6304-A	23		2.19	
912	D6304-C	17		-0.45	
913		----		----	
962		----		----	
963	D1533	7	R(0.05)	-4.85	
1056		----		----	
1146	D6304-C	<100		----	
1178	EN60814	16.7		-0.58	
1262	EN60814	18		-0.01	
1271	ISO12937	14.9	C	-1.38	first reported: 47
1304	INH-121	19.7		0.73	
1306	D1533	19		0.43	
1326		----		----	
1435	IEC60814	14		-1.77	
1442	IEC60814	19.2		0.51	
1444	IEC60814	19.2157		0.52	
1461		----		----	
1478	IEC60814	19.9		0.82	
1513	IEC60814	12.81		-2.29	
1516	IEC60814	18.3		0.12	
1529	IEC60814	16		-0.89	
1560	IEC60814	18		-0.01	
1626	IEC60814	18.0		-0.01	
1628	IEC60814	20.3		1.00	
1630	IS13567	20.05		0.89	
1660	IEC60814	14		-1.77	
1687	IEC60814	20.121		0.92	
1702		18		-0.01	
1704	IEC60814	17.6		-0.19	
1719	IEC60814	15		-1.33	
1720		----		----	
1743	IEC60814	26		3.50	
1747	IEC60814	24.15		2.69	
1885	D1533	20		0.87	
1890	IEC60814	13	C	-2.21	first reported: 8.8
6015	DIN51777	16.50		-0.67	
6048	ISO12937	16.5		-0.67	
6053	IEC60814	22		1.75	
6085	IEC60814	17.9503		-0.03	
6099	IEC60814	18.8		0.34	
6120		----		----	
6141	D1533	14.234		-1.67	
6157	EN60814	15.60		-1.07	
6162	EN60814	19.1		0.47	
6165	IEC60814	21.2		1.39	
6167		----		----	
6169		----		----	
	normality	OK			
	n	45			
	outliers	1			
	mean (n)	18.029			
	st.dev. (n)	3.1753			
	R(calc.)	8.891			Compare R(D1533:12) = 14, range 0-50
	st.dev.(EN60814:98)	2.2747			Compare R(D6304:16e1-C) = 95.777, range 10-25000
	R(EN60814:98)	6.369			Compare R(SIO12937:00) = 29.200, range 30-10000



Determination of 2,6-Ditertiary-butyl paracresol on sample #17230; results in %M/M

lab	method	value	mark	z(targ)	remarks
173		----		----	
179		----		----	
237		----		----	
273		----		----	
325		----		----	
360	IEC60666	0.2900		1.69	
446		----		----	
614		----		----	
840		----		----	
862	IEC60666	0.19		-1.04	
912		----		----	
913		----		----	
962		----		----	
963		----		----	
1056		----		----	
1146		----		----	
1178		----		----	
1262	IEC60666	0.23		0.06	
1271	IEC60666	0.31		2.24	
1304		----		----	
1306		----		----	
1326		----		----	
1435	IEC60666	0.2420		0.38	
1442	IEC60666	0.191		-1.01	
1444		----		----	
1461		----		----	
1478	IEC60666	0.26		0.87	
1513	IEC60666	0.1768		-1.40	
1516	IEC60666	0.249		0.57	
1529	IEC60666	0.2210		-0.19	
1560	IEC60666	0.21		-0.49	
1626	IEC60666	0.24		0.33	
1628		----		----	
1630	IS13567	0.2154		-0.34	
1660	IEC60666	0.210		-0.49	
1687		----		----	
1702		0.248		0.55	
1704	IEC60666	0.2020		-0.71	
1719		----		----	
1720		----		----	
1743		----		----	
1747		----		----	
1885		----		----	
1890		----		----	
6015	IEC60666	0.188		-1.09	
6048		----		----	
6053		----		----	
6085		----		----	
6099	IEC60666	0.23		0.06	
6120		----		----	
6141		----		----	
6157		----		----	
6162		----		----	
6165		----		----	
6167		----		----	
6169		----		----	
	normality	OK			
	n	18			
	outliers	0			
	mean (n)	0.2280			
	st.dev. (n)	0.03544			
	R(calc.)	0.0992			
	st.dev.(IEC60666:10)	0.03664			
	R(IEC60666:10)	0.1026			



Determination of 2,6-Ditertiary-butyl phenol (DBP); results in %M/M and determination of Dibenzyl disulphide (DBDS), Benzotriazole (BTA) and Irgamet 39; results in mg/kg, all on sample #17230

lab	DBP	DBDS	BTA	Irgamet 39	remarks
173	----	----	----	----	
179	----	----	----	----	
237	----	----	----	----	
273	----	----	----	----	
325	----	----	----	----	
360	----	----	----	----	
446	----	----	----	----	
614	----	----	----	----	
840	----	----	----	----	
862	<0.5	----	----	----	
912	----	----	----	----	
913	----	----	----	----	
962	----	----	----	----	
963	----	ND	----	ND	
1056	----	----	----	----	
1146	----	----	----	----	
1178	----	----	----	----	
1262	----	----	----	----	
1271	----	----	----	----	
1304	----	----	----	----	
1306	----	----	----	----	
1326	2.100	----	0	0	
1435	<0.005	<3.0	<1.0	<5.0	
1442	<0.00010	<5	<0,03	<5	
1444	----	----	----	----	
1461	----	----	----	----	
1478	----	----	----	----	
1513	----	<5	----	<5	
1516	----	<5	----	<5	
1529	<0.00050	<5	----	----	
1560	----	----	----	----	
1626	----	----	----	----	
1628	----	----	----	----	
1630	----	----	----	----	
1660	<0.01	<5	<5	<5	
1687	----	----	----	----	
1702	----	not detected	----	not detected	
1704	----	not detectable	----	not detectable	
1719	----	----	----	----	
1720	----	----	----	----	
1743	----	----	----	----	
1747	----	----	----	----	
1885	0.275	----	----	<1.0	
1890	----	----	----	----	
6015	----	----	----	----	
6048	----	----	----	----	
6053	----	----	----	----	
6085	----	----	----	----	
6099	----	----	----	----	
6120	----	----	----	----	
6141	----	----	0.941	1.413	
6157	----	----	----	----	
6162	----	----	----	----	
6165	----	----	----	----	
6167	----	----	----	----	
6169	----	----	----	----	

APPENDIX 2 Analytical details for the test method on Breakdown Voltage

lab	Brand of test equipment	Type of electrode	Test started after min	Stirring during test?	Temp. sample	Preparation of the sample
173						
179						
237						
273						
325	Foster OTS 100 AF	VDE Electrodes	Acc. to D1816	Yes	20-30	according ASTM D1816 described (Cell cleaning - dry at 60°C - 5 min. in exicator)
360	BAUR Oil breakdown voltage tester DTA 100C	Pairs of electrodes in accordance with IEC 60156 Fig. II	5	Yes	29	As received - it is mixed carefully without air bubbles.
446	Baur DPA 75		5	Yes	18.8	
614	Megger	partially spherical electrodes	5	Yes	22.8	no preparation
840	BA100 - Portable Breakdown Analyzer for Oil Testing	GB0055 Mushroom	5	Yes	30	Clean outside the bottle of sample. Test Breakdown Voltage at the first.
862	BAUR	brass polished, partially spherical of shape(13mm diameter)	5	No	20	The sample container is gently agitated and turn over without causing the formation of air bubbles.
912						
913						
962						
963	Baur DTA 100 C	2.5 mm spherical electrodes	2	No	22	agitated & turned over several times to make homogeneous
1056						
1146	Megger Foster OTS80 AF/2	Bol elektrode	15	Yes	20	15minuten geschud daarna 2uur rusten
1178	Megger OTS100AF	36 mm height mushroom	5	Yes	22	Sample was conditioned to room temperature and homogenized by turning of bottle
1262	BAUR DTA 100C	IEC 60156 fig.II	5	Yes	25	tempered at room temperature and fill
1271	EI UI 300 NIA , SRBIJA	Cu (spherical electrods)	5	No	22	The sample container gently agitated and turned over several times.
1304	Foster	Small round balls	3	Yes	19-22	Gentle turning of the sample bottle to mix sample without adding air bubbles
1306						
1326	Megger.	Ball cap electrode.	5	Yes	19	Before the sample is poured into the cup, the sample is gently flipped several times in the container
1435	Baur	Partially spherical electrodes fig2 IEC60156	5	Yes	21	no preparation
1442	Baur	spherical electrodes according 60156	5	Yes	20.8	gently agitated and turn the bottle, fill without bubbles
1444						
1461	Baur DPA75C	hemispherical electrodes	10	No	23	
1478	BAUR DTA 100	partially spherical electrodes	10	Yes	24.1	we turn sample bottle over 3 times
1513	Baur	Spherical electrodes	5	Yes	21	Gently agitated and turned over several times
1516						
1529	Bauer	Spherical electrodes	10	Yes	20	homogenize sample without introducing air bubbles
1560	Megger	IEC60156	5	Yes	24	As per IEC60156
1626	Megger OTS100AF	Mushroom	5	No	19	The sample was homogenized by cautious turning the bottle upside down
1628	Baur DTA 100E	IEC 156/95 Fig.2 36 mm diam., 25 mm rad. Spacing 2,5 mm	5	Yes	20	The sample is only mixed.
1630	Megger OTS 100 AF/2	spherical polished electrodes with dimension conforming to Indian Standard: 6792	10	Yes	27	Agitate the sampling vessel containing oil gently and turn over several times for homogenous sample.
1660	B2 Electronics	VDE	5	No	24	Gentle shaking (rolling)
1687	EA_Electronics	partially spherical electrodes acc. to IEC60156, Fig. 2	12	Yes	23.6	homogenization of the sample by gentle rotation of the bottle.
1702						
1704	B2 Electronics Model	Polished Brass	10	Yes	25.2	The oil sample container is gently shaken to

lab	Brand of test equipment	Type of electrode	Test started after min	Stirring during test?	Temp. sample	Preparation of the sample
	BA100	electrode with Spherical shape (12.5 mm dia) having a 2.5 mm gap between 2 electrodes				ensure the homogeneous of the oil for the impurities present in the oil and then test cell was rinsed with the oil sample to be tested and then performed the test.
1719	Megger	round electrodes	5	Yes	21	invert sample bottle once, rinse empty cell then fill to clean empty cell
1720						
1743	BAUR	spherical electrodes		No	21	The sample is mixt before filling the test cell
1747	Baur Oil Tester DTA 100C	Partially Spherical Electrodes	15	Yes	30	
1885	Megger	Mushroom	1	No	22	nothing special
1890	BAUR	VDE	10	Yes	19	homogenise on rolling equipment
6015	Baur	Polished disk electrodes (spherical)	5	Yes	25	Moderate shaking
6048	Baur	VDE acc. to standard	5	Yes	23	no further preparation
6053						
6085	BAUR DTA E	PARTIALLY SPHERICAL	5	Yes	21	THE SAMPLE CONTAINER WAS GENTLY AGITATED & TURNED OVER SEVERAL TIMES
6099	Baur DTA 100 C	Spherical (figure 1 IEC60156)	5	No	21	Shaked
6120	Oil test set, OTS 100AF, serial number 101637481, Megger	The electrodes, which were used, are hemispherical, brass.	15	Yes	21	Before filling the test cell, the sample (the bottle) was carefully shaken, several times.
6141	MEGGER OTS100AF	Mushroom	1	No	24	Cleaning very well by rinsing twice by other clean oil and ensure pouring it out completely.
6157	Foster OTS60	Spherical with 2.5mm gap	15	Yes	N/A	Sample was agitated to ensure a homogeneous representative sample
6162	MEGGER OTS 100 AF	MUSHROOM	5	Yes	25,8	The gap of the electrodes was set at 2.5 mm. Electrodes and test cell were washed with sample.
6165						
6167	FOSTER (AVO) MEGGER, UK	2.5 MM Gap Spheres	5	No	23	Clean dried test cell is rined with a portion of the sample liquid before filling the sample
6169						

APPENDIX 3

Number of participants per country

3 labs in AUSTRALIA
3 labs in BELGIUM
1 lab in BOSNIA and HERZEGOVINA
4 labs in BULGARIA
2 labs in CHINA, People's Republic
1 lab in CROATIA
1 lab in ESTONIA
1 lab in FRANCE
5 labs in GERMANY
1 lab in GREECE
4 labs in INDIA
1 lab in ITALY
1 lab in KUWAIT
1 lab in MALAYSIA
2 labs in NETHERLANDS
1 lab in NEW ZEALAND
1 lab in NIGERIA
1 lab in NORWAY
2 labs in PORTUGAL
3 labs in SAUDI ARABIA
2 labs in SINGAPORE
1 lab in SLOVENIA
2 labs in SOUTH AFRICA
1 lab in SUDAN
1 lab in SWEDEN
1 lab in SWITZERLAND
1 lab in TURKEY
2 labs in UNITED ARAB EMIRATES
3 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	= probably an error in calculations
U	= test result probably reported in a different unit
W	= test result withdrawn on request 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
B&C	= Bright & Clear

Literature:

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