Results of Proficiency Test
Turbine Oil (used)
May 2017

Organised by: Institute for Interlaboratory Studies
Spijkenisse, the Netherlands

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1 INTRODUCTION

Since 2013, the Institute for Interlaboratory Studies (iis) organizes a proficiency test for used Turbine Oil. During the annual proficiency testing program 2016/2017, it was decided to continue the round robin for the analysis of used Turbine Oil. In this interlaboratory study 37 laboratories in 29 different countries registered for participation. See appendix 2 for the number of participants per country. In this report, the results of the 2017 used Turbine Oil proficiency test are presented and discussed. This report is also electronically available through the iis website www.iisnl.com.

2 SET UP

The Institute for Interlaboratory Studies (iis) in Spijkenisse, The Netherlands, was the organizer of this proficiency test (PT). Sample analyses for fit-for-use and homogeneity were subcontracted to an ISO/IEC 17025 accredited laboratory. It was decided to send one bottle of 1L (labelled #17076) of used Turbine Oil.
The participants were requested to report rounded and unrounded test results. The unrounded test results were preferably used for statistical evaluation.

2.1 ACCREDITATION

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

2.2 PROTOCOL

The protocol followed in the organization of these proficiency test was the one as described for proficiency testing in the report 'iis Interlaboratory Studies: Protocol for the Organization, Statistics and Evaluation' of March 2017 (iis-protocol, version 3.4). This protocol is electronically available through the iis website www.iisnl.com, from the FAQ page.

2.3 CONFIDENTIALITY STATEMENT

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

2.4 SAMPLES

The necessary bulk material was obtained from a third party. The 60 litre bulk material was homogenized and transferred into 49 brown glass bottles of 1 litre (labelled #17076). The homogeneity of the subsamples #17076 was checked by determination of Density at 15°C in accordance with ASTM D4052 and Water in accordance with ASTM D6304 on 8 stratified randomly selected samples.

	Density at 15°C in kg/m^3	Water in mg/kg
Sample #17076-1	857.67	10
Sample #17076-2	857.67	10
Sample #17076-3	857.67	10
Sample #17076-4	857.67	10
Sample #17076-5	857.67	10
Sample #17076-6	857.67	10
Sample #17076-7	857.67	10
Sample #17076-8	857.67	10

Table 1: homogeneity test results of subsamples #17076

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

	Density at 15°C in kg/m^3	Water in mg/kg
r (sample #17076)	0	0
reference test method	ASTM D1298:12b	ASTM D6304:16
0.3 x R(reference test method)	0.45	20

Table 2: evaluation of the repeatabilities of the subsamples #17076

Both calculated repeatabilities are less than 0.3 times the corresponding reproducibility of the reference test method. Therefore, homogeneity of the subsamples #17076 was assumed.

To each of the participating laboratories, one sample of 1 L brown glass bottle (labelled #17076) was sent on April 26, 2017.

2.5 STABILITY OF THE SAMPLES

The stability of the Turbine Oil (used), packed in the brown 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 #17076: Acid Number, Color ASTM, Density at 15°C, Flash Point (C.O.C. & PMcc), Insoluble Color Bodies, Kinematic Viscosity at 40°C and at 100°C, Viscosity Index, Oxidation Stability RPVOT, Water by KF, Water separability and Level of contamination (parts per ml and ISO Class).

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

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

3 RESULTS

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

Directly after the deadline, a reminder was sent to those laboratories that had not reported test results at that moment.

Shortly after the deadline, the available test results were screened for suspect data. A test result was called suspect in case the Huber Elimination Rule (a robust outlier test) found it to be an outlier. The laboratories that produced these suspect data were asked to check the reported test results (no reanalyses). Additional or corrected test results are used for data analysis and original test results are placed under 'Remarks' in the test result tables in appendix 1. Test results that came in after the deadline were not taken into account in this screening for suspect data and thus these participants were not requested for checks.

3.1 STATISTICS

The protocol followed in the organization of this proficiency test was the one as described for proficiency testing in the report ‘iis Interlaboratory Studies: Protocol for the Organisation, Statistics and Evaluation’ of March 2017 (iis-protocol, 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 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, Grubbs' and/or Rosner's outlier tests. Outliers are marked by D(0.01) for the Dixon's test, by G(0.01) or DG(0.01) for the Grubbs' test and by R(0.01) for the Rosner's test. Stragglers are marked by D(0.05) for the Dixon's test, by G(0.05) or DG(0.05) for the Grubbs' test and by R(0.05) for the Rosner's test. Both outliers and stragglers were not included in the calculations of averages and standard deviations.

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

Finally, the reproducibilities were calculated from the standard deviations by multiplying 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 one determination (see appendix 1). On the Y-axis the reported test results are plotted. The corresponding laboratory numbers are on the X-axis.

The straight horizontal line presents the consensus value (a trimmed mean). The four striped lines, parallel to the consensus value line, are the +3s, +2s, -2s and -3s target reproducibility limits of the selected reference test method. Outliers and other data, which were excluded from the calculations, are represented as a cross. Accepted data are represented as a triangle.

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

3.3 Z-SCORES

To evaluate the performance of the participating laboratories the z-scores were calculated. As it was decided to evaluate the performance of the participants in this proficiency test (PT) against the literature requirements, e.g. ASTM 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.

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 in appendix 1.
Absolute values for z<2 are very common and absolute values for z>3 are very rare.
The usual interpretation of z-scores is as follows:

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

4 EVALUATION

In this interlaboratory study, no problems were encountered with the dispatch of the samples to laboratories. Three participants were not able to report any test results due to several problems. Not all laboratories were able to report all analyses requested. In total 34 participants reported 508 test results. Observed were 16 outlying results, which is 3.1% 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 results are discussed per test. The methods, which are used by the various laboratories, are 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 3.

In the iis PT reports, ASTM methods are referred to with a number (e.g. D2270) and an added designation for the year that the method was adopted or revised (e.g. D2270:10). If applicable, a designation in parentheses is added to designate the year of reapproval (e.g. D2270:10(2016). In the results tables of Appendix 1 only the method number and year of adoption or revision e.g. D2270:10 will be used.

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

Acid Number: This determination was problematic. No statistical outliers were observed. However, the calculated reproducibility is not in agreement with the requirements of ASTM D664:11ae1(2016).

Color ASTM: This determination was not problematic. No statistical outliers were observed. The calculated reproducibility is in agreement with ASTM D1500:12.

Density at 15°C: This determination was not problematic. No statistical outliers were observed. The calculated reproducibility is in agreement with the requirements of ASTM D1298:12b.

Flash Point C.O.C.: This determination was not problematic. Two statistical outliers were observed and the suspect test results of two other laboratories were excluded (the COC test result was smaller than the PMcc test result). However, the calculated reproducibility after rejection of the suspect data is in agreement with the requirements of ASTM D92:16b.

Flash Point PMcc: This determination was not problematic. No statistical outliers were observed but the suspect test results of two laboratories were excluded (the COC test result was smaller than the PMcc test result). However, the calculated reproducibility after rejection of the suspect data is in agreement with the requirements of ASTM D93:16a, procedure A. When evaluated separately for procedure A (19 participants), the calculated reproducibility is also in agreement with the method. When evaluated separately for procedure B (6 participants), the calculated reproducibility is not in agreement with the method.

Insoluble Color Bodies: This determination was problematic. No statistical outliers were observed. However, the calculated reproducibility is not in agreement with the requirements of ASTM D7843:16.

Kin.Visco.at 40°C: This determination was problematic. Five statistical outliers were observed. The calculated reproducibility after rejection of the statistical outliers is not in agreement with the strict requirements of ASTM D445:17a. When compared to the estimated reproducibility based on the reproducibilities as observed in a large number of iis PTs on used oils (ref. 16), the calculated reproducibility is in agreement.

Kin.Visco.at 100°C: This determination was problematic. Four statistical outliers were observed. The calculated reproducibility after rejection of the statistical outliers is not in agreement with the strict requirements of ASTM D445:17a. When compared to the estimated reproducibility based on the reproducibilities as observed in a large number of iis PTs on used oils (ref. 16), the calculated reproducibility is in agreement.

Viscosity Index This determination was problematic. No statistical outliers were observed, but four test results were excluded as the test results were a statistical outlier in the Kinematic Viscosity determinations.
The calculated reproducibility after rejection of the suspect data is not in agreement with ASTM D2270:10(2016).
From the test results reported for kinematic viscosity at 40°C and at 100°C, iis calculated the Viscosity Indices and compared the results with the reported Viscosity Indices. Only one participant did not calculate the VI index correctly, possibly because the VI index result was corrected, while the

viscosity results were not. A separate statistical evaluation was done on the group of (iis) calculated viscosity indices without the values of the laboratories that had outlying test results in the Viscosity D445 tests. The calculated reproducibility after rejection of the suspect data is somewhat smaller than for the reported VI test results, but again not in agreement with ASTM D2270:10(2016).

Oxidation Stability RPVOT: This determination was problematic. No statistical outliers were observed. However, the calculated reproducibility is not in agreement with the requirements of ASTM D2272:14a.

Water by KF: This determination was not problematic. Two statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in agreement with the requirements of ASTM D6304:16.

Water separability: This determination was not problematic. No statistical outliers were observed. All laboratories, except one (lab 1026), reported a complete break of (40-40-0) or emulsion less than 3 ml. The calculated reproducibilities for time to reach 3 ml or less emulsion, time to reach 37 ml of water and time to reach complete break (40-40-0) are all in agreement with the requirements of ASTM D1401:12e1.

Level of Cont: This determination was problematic. In total three statistical outliers were observed and four other test results were excluded from the statistical evaluation as the reported tests results for parts/ml did not match the reported ISO-class. The calculated reproducibilities for number of particles in counts/ml for ≥4µm, ≥6µm and ≥14µm after rejection of the suspect data are not in agreement with the requirements of ASTM D7647:10.
This determination was also problematic for the test results reported in ISO scalenumbers. No statistical outliers were observed, but four test results were excluded as the reported tests results ISO-class for did not match the reported parts/ml. The calculated reproducibilities for number of particles in ISO scalenumbers for ≥4µm, ≥6µm and ≥14µm after rejection of the suspect data are not in agreement with the requirements of ASTM D7647:10.

4.2 PERFORMANCE EVALUATION FOR THE GROUP OF LABORATORIES

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

Parameter	unit	n	Average	2.8 * sd	R(lit)
Acid Number, total	mg KOH/g	31	0.08	0.05	0.04
Color ASTM		17	3.0	0.6	1
Density at 15°C	kg/m^3	31	857.7	1.1	1.5
Flash Point C.O.C.	°C	21	220	13	18
Flash Point PMcc	°C	26	209	13	15
Insoluble Color Bodies		9	11.9	8.0	6.9
Kinematic Viscosity at 40°C	mm^2/s	28	31.54	0.27	0.23
Kinematic Viscosity at 100°C	mm^2/s	26	5.55	0.08	0.04
Viscosity Index		24	114	4	2
Oxidation Stability RPVOT	minutes	14	859	278	197
Water by KF	mg/kg	25	21	32	104
Water Separability at 54°C					
- Time to reach 3 ml or less emulsion	minutes	18	21	9	20
- Time to reach 37 of water	minutes	18	21	9	20
- Time to reach complete break	minutes	13	23	10	20
Level of Contamination ≥4µm (c)	parts/ml	20	455	851	515
Level of Contamination ≥6µm (c)	parts/ml	18	171	306	130
Level of Contamination ≥14µm (c)	parts/ml	18	13	31	18
Level of Contamination ≥4µm (c)	ISO scale	24	16	3	2
Level of Contamination ≥6µm (c)	ISO scale	23	14	4	1
Level of Contamination ≥14µm (c)	ISO scale	24	11	5	2

Table 3: reproducibilities of tests of sample #17076

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

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

	May 2017	May 2016	May 2015	May 2014	May 2013
Number of reporting labs	34	38	39	29	27
Number of results reported	508	474	398	301	336
Statistical outliers	16	15	36	10	14
Percentage outliers	3.1%	3.2%	9.0%	3.3%	4.2%

Table 4: comparison with previous proficiency tests

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

The performance of the determinations of the proficiency tests was compared to the requirements of the respective standards. The conclusions are given in the following table:

Determination	May 2017	May 2016	May 2015	May 2014	May 2013
Acid Number, total	-	-	+	--	-
Color ASTM	+	+/-	+	++	-
Density at 15°C	+	++	++	+/-	--
Flash Point C.O.C.	+	(--)	n.e.	n.e.	n.e.
Flash Point PMcc	+	+/-	+/-	-	-
Insoluble Color Bodies	-	+/-	n.e.	n.e.	n.e.
Kinematic Viscosity at 40°C	-	++	++	++	+
Kinematic Viscosity at 100°C	--	+/-	+	+/-	+
Viscosity Index	--	--	--	--	--
Oxidation Stability RPVOT	-	++	n.e.	n.e.	n.e.
Water by KF	++	++	++	++	++
Water Separability	++	n.e.	+	n.e.	+
Level of Contamination ≥4µm	-	--	--	n.e.	n.e.
Level of Contamination ≥6µm	--	--	--	n.e.	n.e.
Level of Contamination ≥14µm	-	-	--	n.e.	n.e.

Table 5: comparison determinations against the standard

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

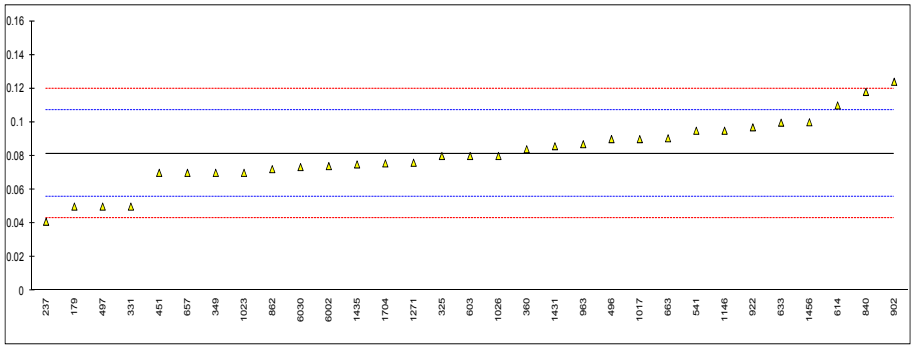
- ++: group performed much better than the standard
- + : group performed better than the standard
- +/-: group performance equals the standard
- - : group performed worse than the standard
- -- : group performed much worse than the standard
- n.e.: not evaluated

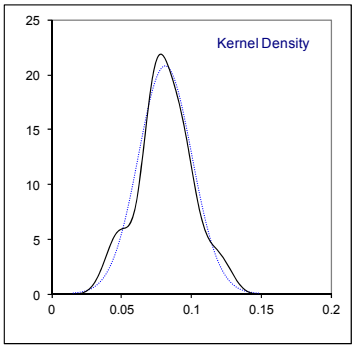
APPENDIX 1

Determination of Acid Number (total) on sample #17076; results in mg KOH/g

lab	method	value	mark	z(targ)	remarks
178	INH-118	<0.10		-----	
179	D664-A	0.05		-2.45	
214		-----		-----	
237	D974	0.041		-3.16	
325	D664-A	0.08		-0.11	
331	In house	0.05		-2.45	
349	D664-A	0.07		-0.89	
360	D974	0.084		0.20	
432		-----		-----	
451	INH-0327	0.07		-0.89	
473		-----		-----	
496	D664-A	0.09		0.67	
497	D664-A	0.05		-2.45	
541	D974	0.095		1.06	
603	D664-A	0.08		-0.11	
614	D664-A	0.11		2.24	
633	D664-A	0.09975		1.44	
657	D664-A	0.070		-0.89	
663	D664-A	0.0905		0.71	
840	D664-A	0.118		2.86	
862	D664-A	0.0722		-0.72	
902	D664-A	0.124		3.33	
922	D664-A	0.097		1.22	
963	D664-A	0.087		0.44	
1017	D664-A	0.09		0.67	
1023	In house	0.07		-0.89	
1026	D664-A	0.08		-0.11	
1146	D664-A	0.095		1.06	
1271	ISO6618	0.076		-0.42	
1431	D664-A	0.0858		0.34	
1435	D664-A	0.075		-0.50	
1456	D974	0.10		1.45	
1660		-----		-----	
1704	D664-A	0.0756		-0.45	
1957		-----	W	-----	first reported: 0.14
6002	D664-A	0.074		-0.58	
6030	GOST5985	0.0734		-0.63	

normality	OK
n	31
outliers	0
mean (n)	0.0814
st.dev. (n)	0.01913
R(calc.)	0.0536
R(D664:11ae1)	0.0358

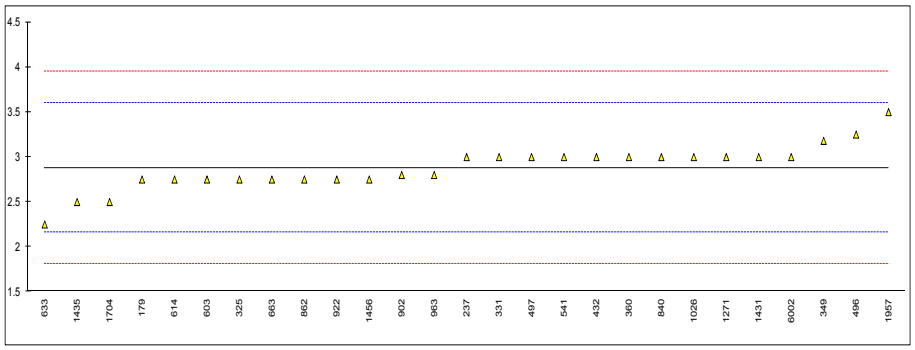


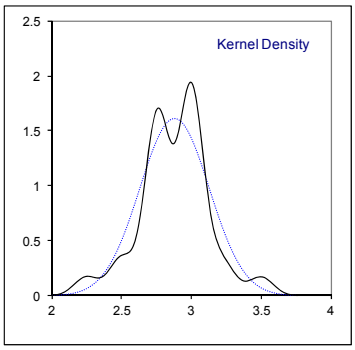


Deter mination of Color ASTM on sample #17076

lab	method	value	mark	z(targ)	calc. value*)	mark	remarks
178		-----		-----	-----		
179	D1500	L3.0		-----	2.75		
214		-----		-----	-----		
237	D1500	3.0		0.12	3		
325	D6045	L3.0		-----	2.75		
331	D1500	3.0		0.12	3		
349	D6045	3.18		0.62	3.18		
360	D1500	3.0		0.12	3		
432	D1500	3.0		0.12	3		
451		-----		-----	-----		
473		-----		-----	-----		
496	D1500	L3.5		-----	3.25		
497	D1500	3.0		0.12	3		
541	D1500	3.0		0.12	3		
603	D1500	L3.0		-----	2.75		
614	D1500	<3		-----	2.75		
633	D1500	L2.5		-----	2.25		
657		-----		-----	-----		
663	D1500	L 3.0		-----	2.75		
840	D1500	3.0		0.12	3		
862	D1500	L3.0		-----	2.75		
902	D1500	2.8		-0.44	2.8		
922	D1500	L3.0		-----	2.75		
963	D1500	2.8		-0.44	2.8		
1017		-----		-----	-----		
1023		-----		-----	-----		
1026	D1500	3.0		0.12	3		
1146		-----		-----	-----		
1271	D6045	3.0		0.12	3		
1431	D1500	3		0.12	3		
1435	D1500	2.50		-1.28	2.5		
1456	D1500	L 3.0		-----	2.75		
1660		-----		-----	-----		
1704	D1500	2.5		-1.28	2.5		
1957	D1500	3.5		1.52	3.5		
6002	D1500	3.0		0.12	3		
6030		-----		-----	-----		
	normality	not OK			suspect		
	n	17			27		
	outliers	0			0		
	mean (n)	2.96			2.88 (L3.0)		
	st.dev. (n)	0.228			0.248		
	R(calc.)	0.64			0.70		
	R(D1500:12)	1			1		

*) In the calculation of the mean, standard deviation and the reproducibility of this column, a reported value of 'L y' is changed into y-0.25 (for example L3.0 into 2.75)

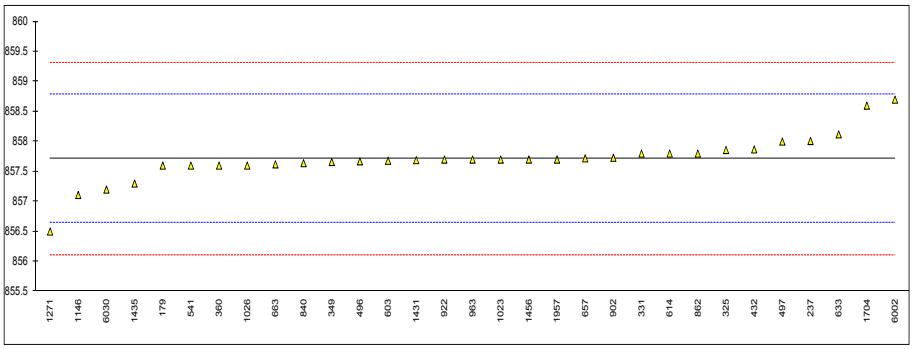


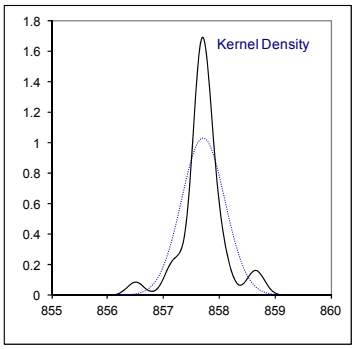


Determination of Density at 15°C on sample #17076; results in kg/m^3

lab	method	value	mark	z(targ)	remarks
178		-----		-----	
179	D1298	857.6		-0.20	
214		-----		-----	
237	D4052	858.01		0.56	
325	D4052	857.86		0.28	
331	ISO12185	857.8		0.17	
349	D4052	857.66		-0.09	
360	D4052	857.6		-0.20	
432	ISO12185	857.87		0.30	
451		-----		-----	
473		-----		-----	
496	D4052	857.67		-0.07	
497	D7042	858.0		0.54	
541	D4052	857.6		-0.20	
603	D4052	857.68		-0.05	
614	D4052	857.8		0.17	
633	D4052	858.12		0.77	
657	D4052	857.72		0.02	
663	D4052	857.62		-0.17	
840	D4052	857.64		-0.13	
862	D4052	857.8		0.17	
902	D4052	857.73		0.04	
922	D4052	857.7		-0.02	
963	D4052	857.7		-0.02	
1017		-----		-----	
1023	D4052	857.7		-0.02	
1026	D4052	857.6		-0.20	
1146	D4052	857.11		-1.12	
1271	ISO12185	856.5		-2.26	
1431	D4052	857.69		-0.04	
1435	D4052	857.3		-0.76	
1456	D4052	857.7		-0.02	
1660		-----		-----	
1704	D1298	858.6		1.66	
1957	D4052	857.7		-0.02	
6002	ISO3675	858.7		1.85	
6030	GOST3900	857.2	C	-0.95	first reported: 853.3

normality	not OK
n	31
outliers	0
mean (n)	857.71
st.dev. (n)	0.388
R(calc.)	1.09
R(D1298:12b)	1.5

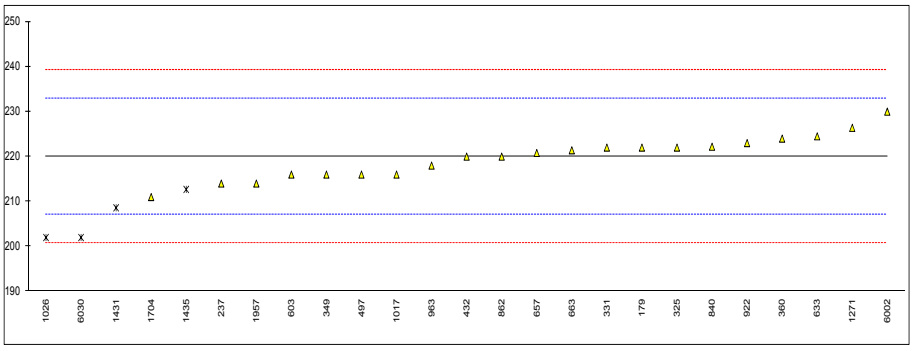


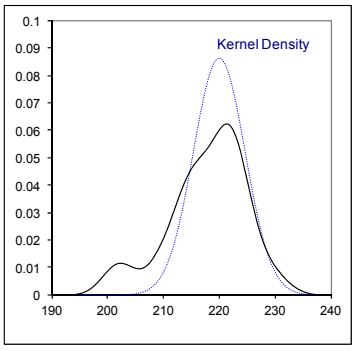


Determination of Flash Point C.O.C. on sample #17076; results in °C

lab	method	value	mark	z(targ)	remarks
178		-----		-----	
179	D92	222		0.32	
214		-----		-----	
237	D92	214.0		-0.93	
325	D92	222		0.32	
331	D92	222.0		0.32	
349	D92	216		-0.62	
360	D92	224		0.63	
432	D92	220		0.01	
451		-----		-----	
473		-----		-----	
496		-----		-----	
497	ISO2592	216		-0.62	
541		-----		-----	
603	D92	216		-0.62	
614		-----		-----	
633	D92	224.5		0.71	
657	D92	220.8		0.13	
663	D92	221.4		0.22	
840	D92	222.2		0.35	
862	D92	220		0.01	
902		-----		-----	
922	D92	223		0.47	
963	D92	218		-0.31	
1017	D92	216		-0.62	
1023		-----		-----	
1026	D92	202	R(0.05)	-2.79	
1146		-----		-----	
1271	ISO2592	226.4		1.00	
1431	D92	208.6	ex	-1.77	test result excluded for COC result < PMCC result, see §4
1435	D92	212.7	ex	-1.13	test result excluded for COC result < PMCC result, see §4
1456		-----		-----	
1660		-----		-----	
1704	D92	211		-1.39	
1957	D92	214.0		-0.93	
6002	ISO2592	230		1.56	
6030	GOST4333	202	R(0.05)	-2.79	

normality	OK
n	21
outliers	2 (+2ex)
mean (n)	219.97
st.dev. (n)	4.619
R(calc.)	12.93
R(D92:16b)	18

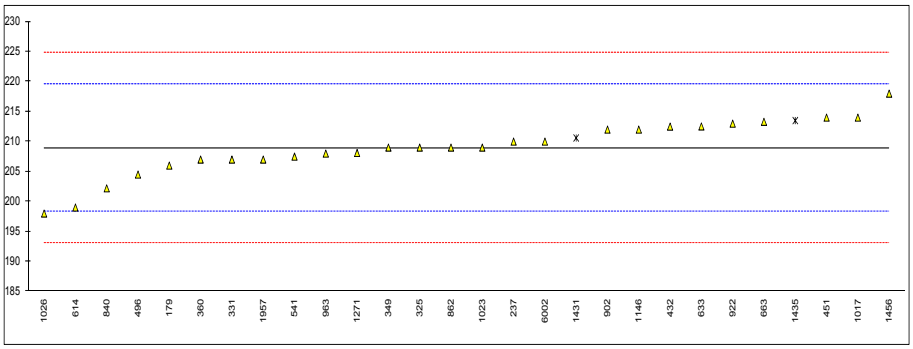


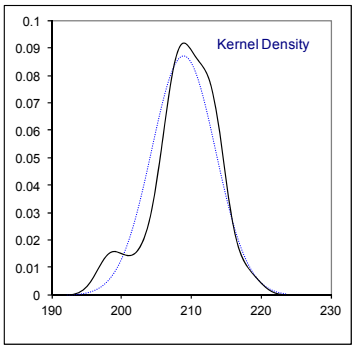


Determination of Flash Point PMcc on sample #17076; results in °C

lab	method	value	mark	z(targ)	remarks
178		-----		-----	
179	D93-A	206.0		-0.55	
214		-----		-----	
237	D93-A	210.0		0.21	
325	D93-A	209		0.02	
331	D93-B	207.00		-0.36	
349	D93-A	209		0.02	
360	D93-B	207.0		-0.36	
432	D93-A	212.5		0.68	
451	D93-A	214		0.96	
473		-----		-----	
496	D93-B	204.5		-0.83	
497		-----		-----	
541	D93-A	207.5		-0.27	
603		-----		-----	
614	D93-A	199		-1.87	
633	D93-A	212.525		0.68	
657		-----		-----	
663	D93-B	213.3		0.83	
840	D93-B	202.2		-1.27	
862	D93-A	209		0.02	
902	D93-A	212.0		0.58	
922	D93-A	213		0.77	
963	D93-A	208		-0.17	
1017	D93-A	214		0.96	
1023	D93-A	209		0.02	
1026	D93-A	198		-2.06	
1146	D93-Amod.	212.0		0.58	
1271	ISO2719-A	208.1		-0.15	
1431	D93-A	210.6	ex	0.32	test result excluded for COC result < PMCC result, see §4
1435	D93-A	213.5	ex	0.87	test result excluded for COC result < PMCC result, see §4
1456	D93-B	218.0		1.72	
1660		-----		-----	
1704		-----		-----	
1957	D93-A	207.0		-0.36	
6002	ISO2719-A	210.0		0.21	
6030		-----		-----	

			Only D93/ISO2719 method A	Only D93 method B
	normality	OK	suspect	OK
	n	26	19	6
	outliers	0 (+2ex)	0 (+2ex)	0
	mean (n)	208.91	208.82	208.67
	st.dev. (n)	4.572	4.341	5.888
	R(calc.)	12.80	12.15	16.49
	R(D93:16a-A)	14.83	14.83	10
		Comp. R(D93:16a-B) = 10		

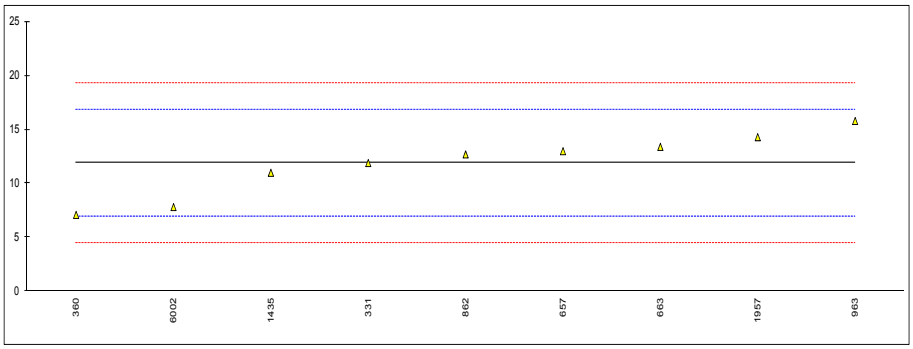


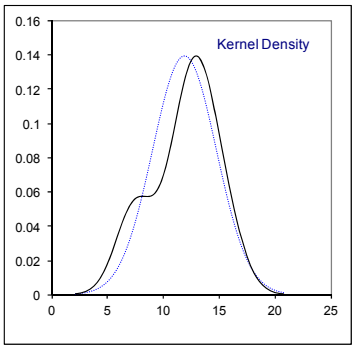


Determination of Insoluble Color Bodies, membrane patch colorimetry on sample #17076;

lab	method	value	mark	z(targ)	remarks
178		-----		-----	
179		-----		-----	
214		-----		-----	
237		-----		-----	
325		-----		-----	
331	D7843	11.9		0.00	
349		-----		-----	
360	D7843	7.1		-1.95	
432		-----		-----	
451		-----		-----	
473		-----		-----	
496		-----		-----	
497		-----		-----	
541		-----		-----	
603		-----		-----	
614		-----		-----	
633		-----		-----	
657	D7843	13.0		0.45	
663	D7843	13.4		0.61	
840		-----		-----	
862	D7843	12.7		0.33	
902		-----		-----	
922		-----		-----	
963	D7843	15.8		1.59	
1017		-----		-----	
1023		-----		-----	
1026		-----		-----	
1146		-----		-----	
1271		-----		-----	
1431		-----		-----	
1435	D7843	11		-0.36	
1456		-----		-----	
1660		-----		-----	
1704		-----		-----	
1957	D7843	14.3		0.98	
6002	D7843	7.82		-1.65	
6030		-----		-----	

normality	OK
n	9
outliers	0
mean (n)	11.89
st.dev. (n)	2.863
R(calc.)	8.02
R(D7843:16)	6.90



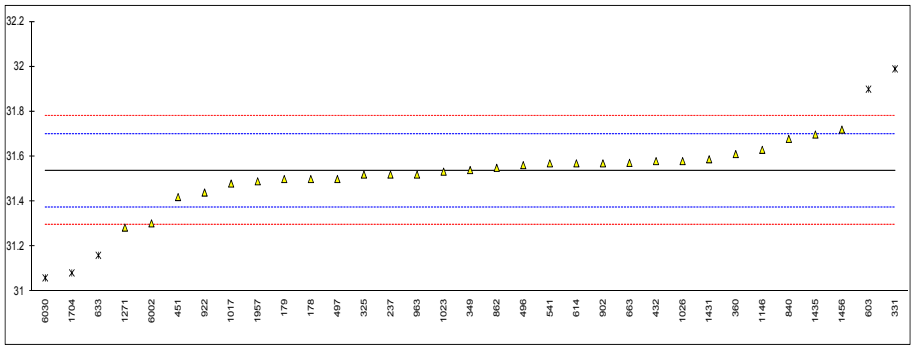


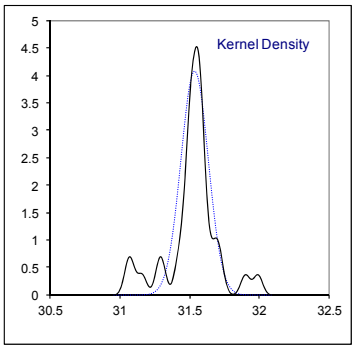
Determination of Kinematic Viscosity at 40°C on sample #17076; results in mm^2/s

lab	method	value	mark	z(targ)	remarks
178	D445	31.50		-0.46	
179	D445	31.50		-0.46	
214		-----		-----	
237	D445	31.52		-0.21	
325	D445	31.52		-0.21	
331	D7279Mod.	31.99	R(0.05)	5.61	
349	D445	31.54		0.04	
360	D445	31.611		0.92	
432	D445	31.58		0.54	
451	D7279 corr. to D445	31.42		-1.45	
473		-----		-----	
496	D445	31.562		0.31	
497	D7279	31.50		-0.46	
541	D7042	31.570		0.41	
603	D7042	31.90	R(0.05)	4.50	
614	D445	31.57		0.41	
633	D445	31.161	R(0.05)	-4.65	
657		-----		-----	
663	D445	31.572		0.44	
840	D7042	31.679		1.76	
862	D445	31.55		0.16	
902	D445	31.57		0.41	
922	D7042	31.44		-1.20	
963	D445	31.52		-0.21	
1017	D445	31.48		-0.70	
1023	D445	31.5330		-0.05	
1026	D445	31.58		0.54	
1146	D445	31.63		1.15	
1271	ISO3104	31.284		-3.13	
1431	D7042	31.588		0.63	
1435	D7042	31.698	C	2.00	first reported: 5.592
1456	D7042	31.72		2.27	
1660		-----		-----	
1704	D445	31.0825	C,R(0.05)	-5.62	first reported: 32.259
1957	D7042	31.49		-0.58	
6002	ISO3104	31.303		-2.89	
6030	GOST33	31.0604	R(0.05)	-5.90	

	normality	suspect
	n	28
	outliers	5
	mean (n)	31.537
	st.dev. (n)	0.0977
	R(calc.)	0.273
	R(D445:17a)	0.226

compare R(iis, see ref. 16) = 0.568



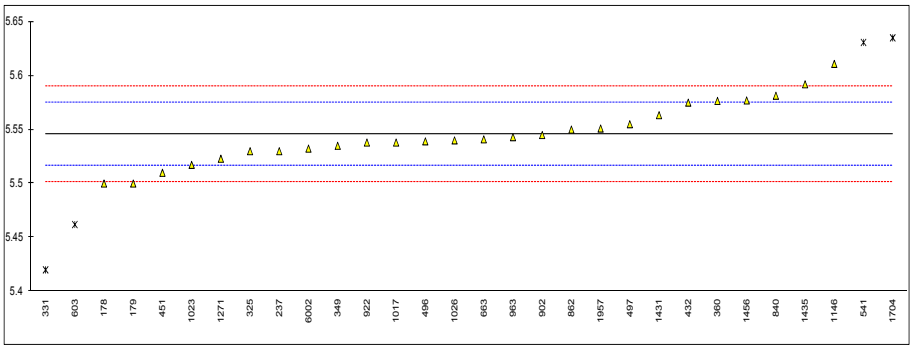


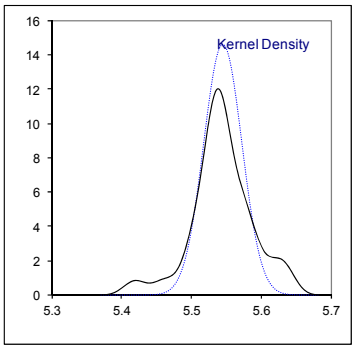
Determination of Kinematic Viscosity at 100°C on sample #17076; results in mm^2/s

lab	method	value	mark	z(targ)	remarks
178	D445	5.500		-3.12	
179	D445	5.500		-3.12	
214		-----		-----	
237	D445	5.530	C	-1.08	first reported: 5.468
325	D445	5.53		-1.08	
331	D7279Mod.	5.42	R(0.05)	-8.55	
349	D445	5.535		-0.74	
360	D445	5.5766		2.08	
432	D445	5.575		1.97	
451	D7279 corr. to D445	5.51		-2.44	
473		-----		-----	
496	D445	5.5391		-0.46	
497	D7279	5.555		0.62	
541	D7042	5.6308	R(0.05)	5.77	
603	D7042	5.462	R(0.05)	-5.70	
614		-----		-----	
633		-----		-----	
657		-----		-----	
663	D445	5.5410		-0.33	
840	D7042	5.5814		2.41	
862	D445	5.550		0.28	
902	D445	5.545		-0.06	
922	D7042	5.538		-0.54	
963	D445	5.543		-0.20	
1017	D445	5.538		-0.54	
1023	D445	5.5173		-1.94	
1026	D445	5.54		-0.40	
1146	D445	5.6109		4.41	
1271	ISO3104	5.523		-1.56	
1431	D7042	5.5634		1.19	
1435	D7042	5.592	C	3.13	first reported: 31.698
1456	D7042	5.577		2.11	
1660		-----		-----	
1704	D445	5.635	R(0.05)	6.05	
1957	D7042	5.551		0.34	
6002	ISO3104	5.5324		-0.92	
6030		-----		-----	

normality	OK
n	26
outliers	4
mean (n)	5.546
st.dev. (n)	0.0273
R(calc.)	0.077
R(D445:17a)	0.041

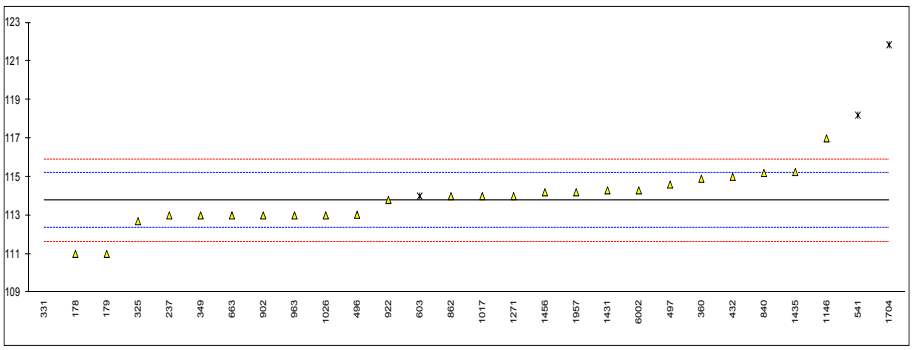
compare R(iis, see ref. 16) = 0.122

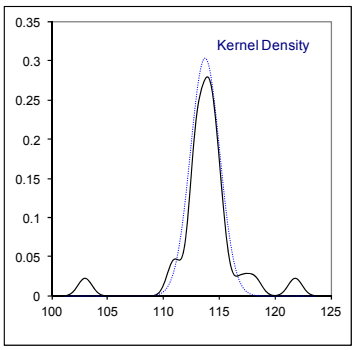




Determination of Viscosity Index on sample #17076

lab	method	value	mark	z(targ)	iis calc.	mark	remarks
178	D2270	111		-3.88	111.1		
179	D2270	111		-3.88	111.1		
214		-----		-----	-----		
237	D2270	113	C	-1.08	112.8		first reported: 109
325	D2270	112.7		-1.50	112.8		
331	D2270Mod.	103	ex	-15.08	103.4	ex	outlier in kin. visc. at 40°C + 100°C
349	D2270	113		-1.08	112.9		
360	ISO2909	114.9		1.58	114.9		
432	D2270	115.0		1.72	115.0		
451		-----		-----	112.3		
473		-----		-----	-----		
496	D2270	113.03		-1.04	113.0		
497	D2270	114.6		1.16	114.4		
541	D2270	118.2	ex	6.20	118.3	ex	outlier in kin. visc. at 100°C
603	D2270	114	ex,C, E	0.32	106.4	ex	fr: 106, calc. error, outlier in kin.visc. 40°C + 100°C
614		-----		-----	-----		
633		-----		-----	-----		
657		-----		-----	-----		
663	D2270	113		-1.08	113.1		
840	D2270	115.2		2.00	114.7		
862	D2270	114		0.32	113.7		
902	D2270	113		-1.08	113.3		
922	D2270	113.8		0.04	113.8		
963	D2270	113		-1.08	113.5		
1017	D2270	114		0.32	113.5		
1023		-----		-----	111.9		
1026	D2270	113		-1.08	113.0		
1146	D2270	117		4.52	116.7		
1271	ISO2909	114		0.32	113.9		
1431	D2270	114.3		0.74	114.3		
1435	D2270	115.25		2.07	115.2		
1456	D2270	114.20		0.60	114.2		
1660		-----		-----	-----		
1704	D2270	121.854	ex,C	11.32	121.8	ex	fr: 114.02, outlier in kin.visc. at 40°C + 100°C
1957	D2270	114.2		0.60	114.2		
6002	ISO2909	114.3		0.74	114.3		
6030		-----		-----	-----		
	normality	suspect			OK		
	n	24			26		
	outliers	0 (+4ex)			0 (+4ex)		
	mean (n)	113.77			113.61		
	st.dev. (n)	1.316			1.254		
	R(calc.)	3.68			3.51		
	R(D2270:10)	2			2		

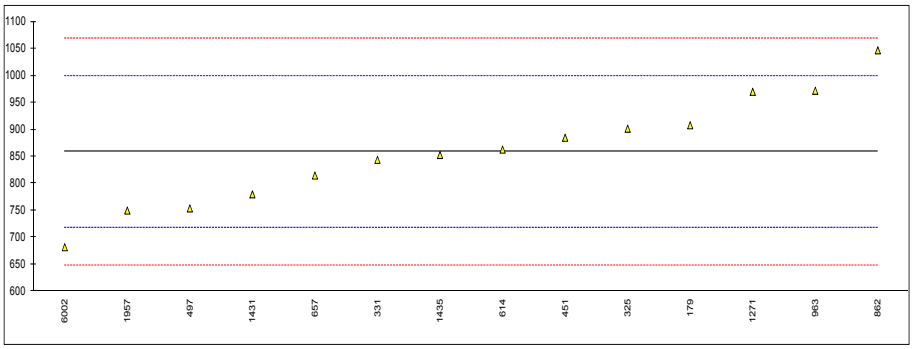


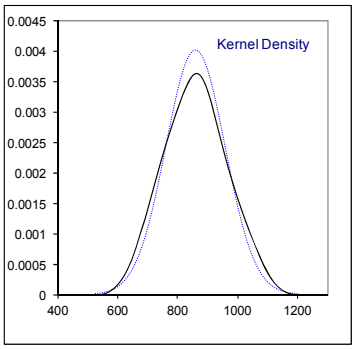


Determination of Oxidation Stability RPVOT on sample #17076; results in minutes

lab	method	value	mark	z(targ)	remarks
178		-----		-----	
179	D2272	908		0.70	
214		-----		-----	
237		-----		-----	
325	D2272	901.72		0.61	
331	D2272	844		-0.21	
349		-----		-----	
360		-----		-----	
432		-----		-----	
451	D2272	885		0.37	
473		-----		-----	
496		-----		-----	
497	D2272	754		-1.49	
541		-----		-----	
603		-----		-----	
614	D2272	863		0.06	
633		-----		-----	
657	D2272	815		-0.63	
663		-----		-----	
840		-----		-----	
862	D2272	1047		2.68	
902		-----		-----	
922		-----		-----	
963	D2272	972		1.61	
1017		-----		-----	
1023		-----		-----	
1026		-----		-----	
1146		-----		-----	
1271	D2272	970		1.58	
1431	D2272	780		-1.12	
1435	D2272	853		-0.08	
1456		-----		-----	
1660		-----		-----	
1704		-----		-----	
1957	D2272	750		-1.55	
6002	D2272	682		-2.52	
6030		-----		-----	

normality	OK
n	14
outliers	0
mean (n)	858.9
st.dev. (n)	99.24
R(calc.)	277.9
R(D2272:14a)	196.6

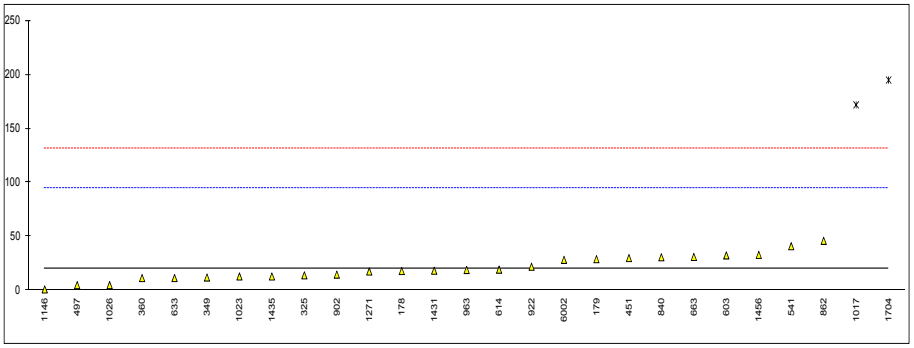


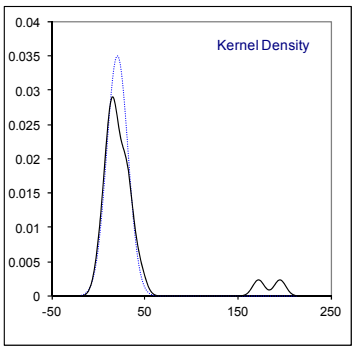


Determination of Water by KF on sample #17076; results in mg/kg

lab	method	value	mark	z(targ)	remarks
178	D6304-C	18		-0.07	
179	D6304-C	29		0.22	
214		-----		-----	
237		-----		-----	
325	D6304-C	14		-0.18	
331	In house	<20		-----	
349	D6304-A	12		-0.23	
360	D6304-A	11.5		-0.25	
432		-----		-----	
451	D6304-C	30		0.25	
473		-----		-----	
496	D6304-C	<10		-----	
497	D6304-C	5		-0.42	
541	D6304-A	41.0		0.55	
603	D6304-C	32.5		0.32	
614	EN60814	19.3		-0.04	
633	D6304-C	11.5		-0.25	
657	D6304-C	<10		-----	
663	D6304-C	31.1		0.28	
840	D6304-A	30.8		0.27	
862	D6304-A	46		0.68	
902	D6304-A	14.68		-0.16	
922	D6304-A	22		0.04	
963	D6304-A	19		-0.04	
1017	D6304-A	172	R(0.01)	4.08	
1023	D6304-A	13		-0.21	
1026	D6304-A	5		-0.42	
1146	D6304-C	1		-0.53	
1271	ISO12937	17.6		-0.08	
1431	D6304-A	18.32		-0.06	
1435	D1744	13		-0.21	
1456	D6304-C	33		0.33	
1660		-----		-----	
1704	D4377	195	R(0.01)	4.70	
1957		-----		-----	
6002	ISO12937	28.329		0.21	
6030		-----		-----	

normality	OK
n	25
outliers	2
mean (n)	20.67
st.dev. (n)	11.404
R(calc.)	31.93
R(D6304:16e1)	103.95

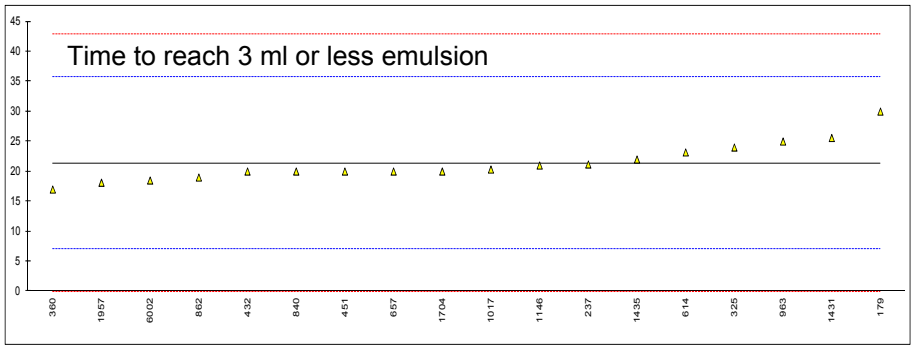


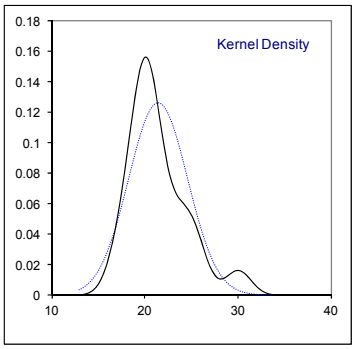


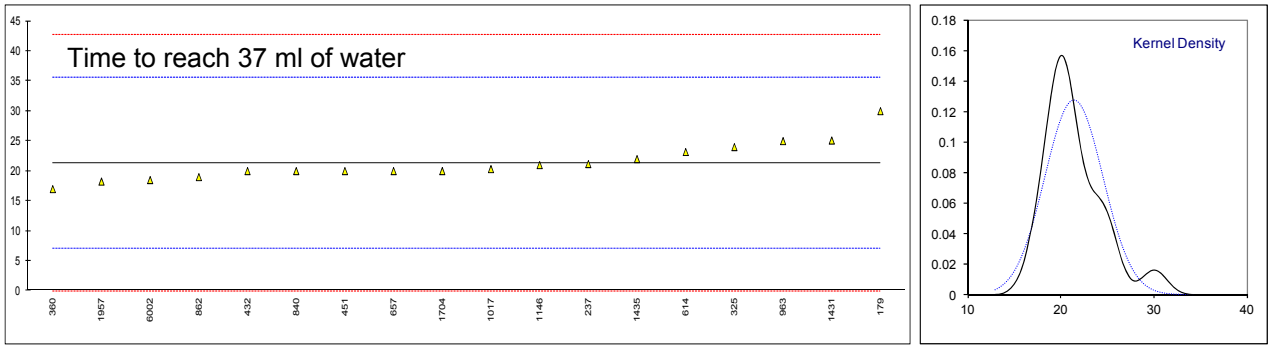
Determination of Water Separability at 54°C on sample #17076; results in minutes

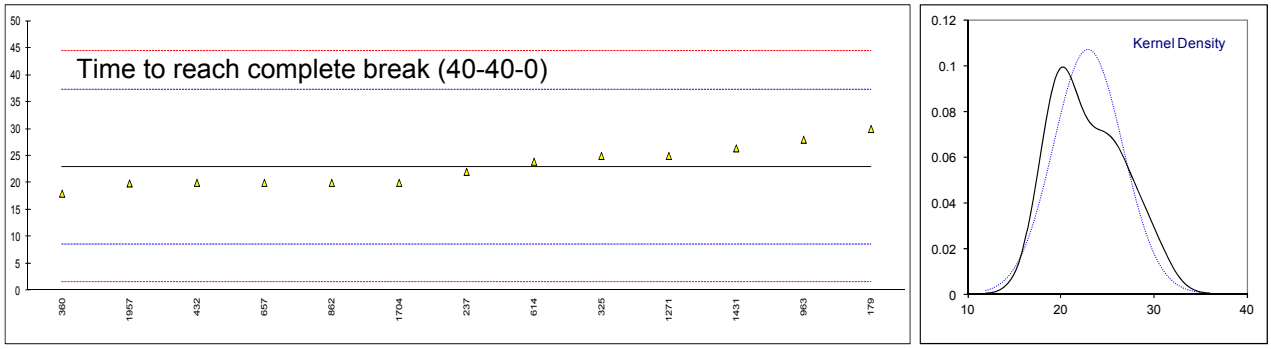
lab	method	time to reach 3 ml or less emulsion	mark	z(targ)	time to reach 37 ml of water	mark	z(targ)	time to reach complete break (40-40-0)	mark	z(targ)	test aborted	time test aborted
178		-----		-----	-----		-----	-----		-----	-----	-----
179	D1401	30		1.21	30		1.21	30		0.99	-----	-----
214		-----		-----	-----		-----	-----		-----	-----	-----
237		21.17		-0.03	21.17		-0.03	22.04		-0.13	-----	-----
325	D1401	24		0.37	24		0.37	25		0.29	-----	-----
331		-----		-----	-----		-----	-----		-----	-----	-----
349		-----		-----	-----		-----	-----		-----	-----	-----
360	ISO6614	17		-0.61	17		-0.61	18		-0.69	-----	-----
432	D1401	20		-0.19	20		-0.19	20		-0.41	-----	-----
451	D1401	20		-0.19	20		-0.19	-----		-----	-----	-----
473		-----		-----	-----		-----	-----		-----	-----	-----
496		-----		-----	-----		-----	-----		-----	-----	-----
497		-----		-----	-----		-----	-----		-----	-----	-----
541		-----		-----	-----		-----	-----		-----	-----	-----
603		-----		-----	-----		-----	-----		-----	-----	-----
614	D1401	23.18		0.25	23.18		0.25	23.92		0.14	-----	-----
633		-----		-----	-----		-----	-----		-----	-----	-----
657	D1401	20		-0.19	20		-0.19	20		-0.41	NO	No
663		-----		-----	-----		-----	-----		-----	-----	-----
840	D1401	20		-0.19	20		-0.19	>30		-----	-----	-----
862	D1401	19		-0.33	19		-0.33	20		-0.41	-----	-----
902		-----		-----	-----		-----	-----		-----	-----	-----
922		-----		-----	-----		-----	-----		-----	-----	-----
963	D1401	25		0.51	25		0.51	28		0.71	NO	No
1017	D1401	20.33		-0.15	20.33		-0.14	-----		-----	YES	20.33
1023		-----		-----	-----		-----	-----		-----	-----	-----
1026	D1401	-----		-----	-----		-----	-----		-----	-----	-----
1146	D1401	21		-0.05	21		-0.05	-----		-----	-----	-----
1271	ISO6614	-----		-----	-----		-----	25		0.29	-----	-----
1431	D1401	25.59		0.59	25.10		0.52	26.40		0.48	-----	-----
1435		22		0.09	22		0.09	-----		-----	-----	-----
1456		-----		-----	-----		-----	-----		-----	-----	-----
1660		-----		-----	-----		-----	-----		-----	-----	-----
1704	D1401	20		-0.19	20		-0.19	20		-0.41	-----	-----
1957	D1401	18.13		-0.46	18.25		-0.44	19.90		-0.43	NO	No
6002	ISO6614	18.5		-0.40	18.5		-0.40	>30		-----	YES	30
6030		-----		-----	-----		-----	-----		-----	-----	-----
	normality	not OK			not OK			OK				
	n	18			18			13				
	outliers	0			0			0				
	mean (n)	21.38			21.36			22.94				
	st.dev. (n)	3.164			3.120			3.718				
	R(calc.)	8.86			8.74			10.41				
	R(D1401)*	20			20			20				

*) R(D1401:12e1)









Determination of Water Separability at 54°C on sample #17076; results in ml

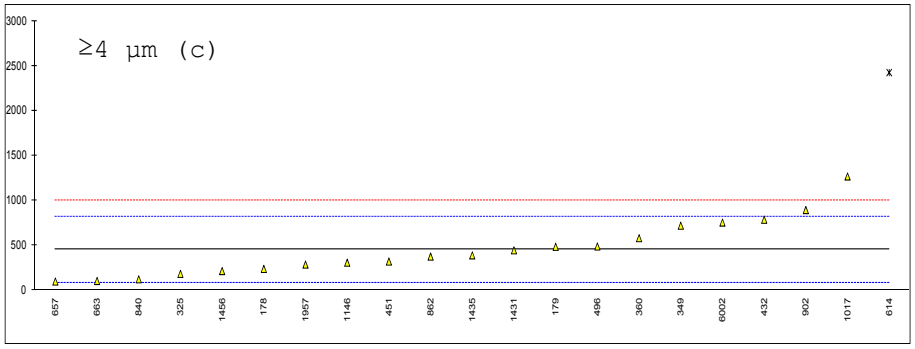
lab	method	volume oil phase	volume water phase	volume emulsion phase	test OK/NOK	remark
178		-----	-----	-----		
179	D1401	40	40	0	OK	reported 30 min. to complete break
214		-----	-----	-----		
237		40.0	40.0	0.0	OK	reported 22 min. to complete break
325		-----	-----	-----		
331		-----	-----	-----		
349		-----	-----	-----		
360	ISO6614	40	40	0	OK	reported 18 min. to complete break
432	D1401	40	40	0	OK	reported 20 min. to complete break
451	D1401	40	37	3	NOK*	did not report an abort time
473		-----	-----	-----		
496		-----	-----	-----		
497		-----	-----	-----		
541		-----	-----	-----		
603		-----	-----	-----		
614	D1401	40	40	0	OK	reported 24 min. to complete break
633		-----	-----	-----		
657	D1401	40	40	0	OK	reported 20 min. to complete break
663		-----	-----	-----		
840	D1401	41	39	0	OK	reported a complete break >30 min.
862	D1401	40	40	0	OK	reported 20 min. to complete break
902		-----	-----	-----		
922		-----	-----	-----		
963	D1401	40	40	0	OK	reported 28 min. to complete break
1017	D1401	40	37	3	OK	
1023		-----	-----	-----		
1026	D1401	3	15	62	NOK*	did not report an abort time, possible false negative test result
1146	D1401	40	37	3	NOK*	did not report an abort time
1271	ISO6614	-----	-----	-----		
1431	D1401	40	40	0	OK	reported 26 min. to complete break
1435		-----	-----	-----		
1456		-----	-----	-----		
1660		-----	-----	-----		
1704	D1401	-----	-----	-----		
1957	D1401	40	40	0	OK	reported 20 min. to complete break
6002	ISO6614	40	37	3	OK	reported a complete break >30 min.
6030		-----	-----	-----		

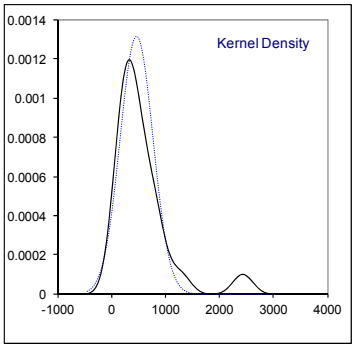
* according to ASTM D1401 the amount of ml oil, ml water and ml emulsion should be reported as well as either the time the different volume requirements are met or when these are not reached, the time when the test is aborted (usually 30 minutes for tests at 54°C).

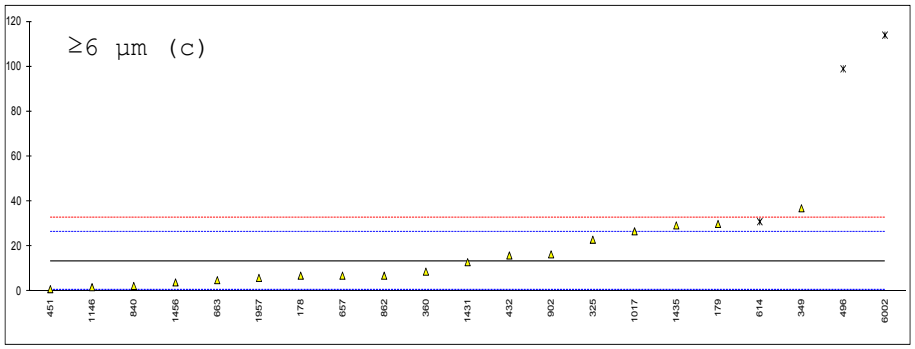
Determination of Level of contamination on sample #17076; results in counts per ml

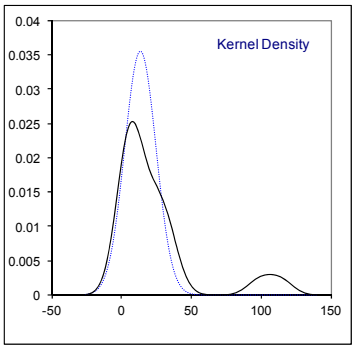
lab	method	≥ 4 µm(c)	mark	z(targ)	≥ 6 µm(c)	mark	z(targ)	≥ 14 µm(c)	mark	z(targ)
178	INH-1185	241	C	-1.17	72	C	-2.13	7	C	-0.99
179	D7647	487		0.17	265		2.02	30	C	2.56
214		-----		-----	-----		-----	-----		-----
237		-----		-----	-----		-----	-----		-----
325	ISO11500/ISO4406	186		-1.47	121		-1.08	23		1.48
331		-----		-----	-----		-----	-----		-----
349	ISO4407	722		1.45	282		2.39	37		3.64
360	ISO4406	582.7		0.69	225.9		1.18	8.8		-0.72
432	ISO11500	788		1.81	393		4.78	16		0.40
451		323		-0.72	131		-0.86	1		-1.92
473		-----		-----	-----		-----	-----		-----
496	D7647	490.5		0.19	318		3.16	99	R(0.01)	13.22
497		-----		-----	-----		-----	-----		-----
541		-----		-----	-----		-----	-----		-----
603		-----		-----	-----		-----	-----		-----
614	ISO4407	2424	ex	10.71	505	ex	7.19	31	ex	2.71
633		-----		-----	-----		-----	-----		-----
657	ISO4406	101		-1.93	64		-2.31	7		-0.99
663	D7647	107		-1.90	32		-3.00	5		-1.30
840	D7647	125.3		-1.80	40.9		-2.80	2.43		-1.70
862	ISO11500	378		-0.42	108		-1.36	7		-0.99
902	D7647	895.3		2.39	419.8	ex	5.35	16.5		0.47
922		-----		-----	-----		-----	-----		-----
963		-----		-----	-----		-----	-----		-----
1017	ISO11500	1268.88		4.43	589.71	G(0.05)	9.01	26.74		2.06
1023		-----		-----	-----		-----	-----		-----
1026		-----		-----	-----		-----	-----		-----
1146	ISO11500	310		-0.79	83		-1.90	1.9		-1.78
1271		-----		-----	-----		-----	-----		-----
1431	ISO4407	448		-0.04	223		1.12	13		-0.07
1435	ISO4407	391.37		-0.35	247.43		1.64	29.37		2.46
1456	ISO4406	217		-1.30	66		-2.26	4		-1.46
1660		-----		-----	-----		-----	-----		-----
1704		-----		-----	-----		-----	-----		-----
1957	ISO4406	288.8		-0.91	125.8		-0.98	6.0		-1.15
6002	ISO4407	756.2		1.64	282.7		2.40	114	C,R(0.01)	15.53
6030		-----		-----	-----		-----	-----		-----
	normality	not OK			OK			OK		
	n	20			18			18		
	outliers	0 (+1ex)			1 (+2ex)			2 (+1ex)		
	mean (n)	455.35			171.15			13.43		
	st.dev. (n)	303.816			109.131			11.215		
	R(calc.)	850.68			305.57			31.40		
	R(D7647:10)	514.55			130.08			18.13		

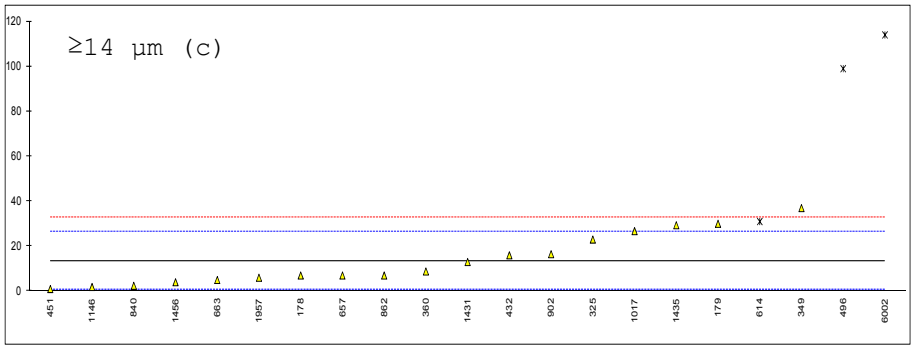
Lab 178 first reported for ≥4 µm(c): 16787, for for ≥6 µm(c): 5616 and for ≥14 µm(c): 961
Lab 179 first reported for ≥14 µm(c): 96
Lab 614 all test results were excluded for the test results in counts/ml did not match the ISO scale number
Lab 902 the test result for ≥6 µm(c) was excluded for the test result in counts/ml did not match the ISO scale number
Lab 6030 first reported for ≥14 µm(c): 97.3

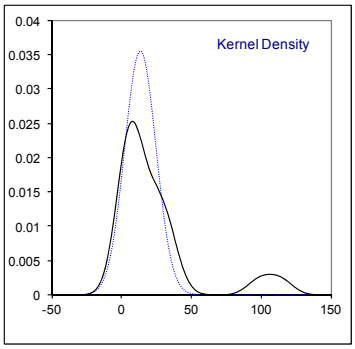

≥4 µm (c)
3000
2500
2000
1500
1000
500
0
657 663 840 325 1456 178 1957 1146 451 862 1435 1431 179 496 360 349 6002 432 902 1017 614


Kernel Density
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
-1000 0 1000 2000 3000 4000


≥6 µm (c)
120
100
80
60
40
20
0
451 1146 840 1456 663 1957 178 657 862 360 1431 432 902 325 1017 1435 179 614 349 496 6002


Kernel Density
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
-50 0 50 100 150

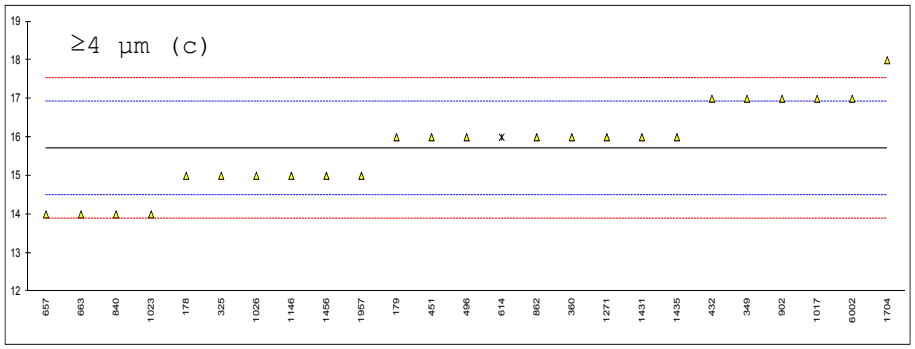

≥14 µm (c)
120
100
80
60
40
20
0
451 1146 840 1456 663 1957 178 657 862 360 1431 432 902 325 1017 1435 179 614 349 496 6002

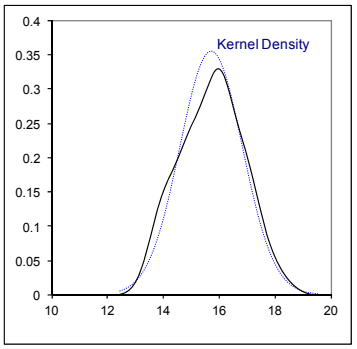

Kernel Density
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
-50 0 50 100 150

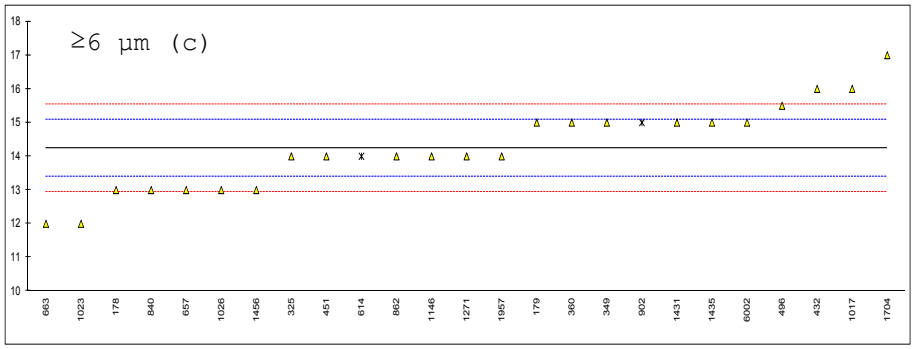
Determination of Level of contamination on sample #17076; results in ISO 4406 scalenumbers

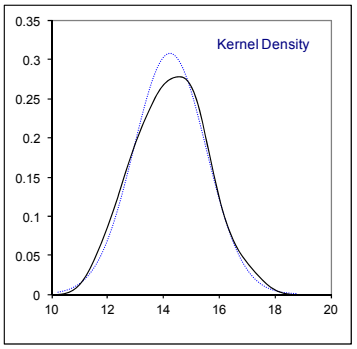
lab	method	≥ 4 µm(c)	mark	z(targ)	≥ 6 µm(c)	mark	z(targ)	≥ 14 µm(c)	mark	z(targ)
178	INH-1185	15		-1.17	13		-2.89	10		-1.11
179	ISO4406	16		0.48	15		1.78	12		1.69
214		-----		-----	-----		-----	-----		-----
237		-----		-----	-----		-----	-----		-----
325	ISO4406	15		-1.17	14		-0.56	12		1.69
331		-----		-----	-----		-----	-----		-----
349	ISO4406	17		2.13	15		1.78	12		1.69
360	ISO4406	16		0.48	15		1.78	10		-1.11
432	ISO4406	17		2.13	16		4.11	11		0.29
451	ISO4406	16		0.48	14		-0.56	7		-5.31
473		-----		-----	-----		-----	-----		-----
496	ISO4406	16		0.48	15.5		2.94	14		4.49
497		-----		-----	-----		-----	-----		-----
541		-----		-----	-----		-----	-----		-----
603		-----		-----	-----		-----	-----		-----
614	ISO4406	16	ex	0.48	14	ex	-0.56	10	ex	-1.11
633		-----		-----	-----		-----	-----		-----
657	ISO4406	14		-2.81	13		-2.89	10		-1.11
663	ISO4406	14		-2.81	12		-5.22	9		-2.51
840	ISO4406	14		-2.81	13		-2.89	8		-3.91
862	ISO4406	16		0.48	14		-0.56	10		-1.11
902	ISO4406	17		2.13	15	ex	1.78	11		0.29
922		-----		-----	-----		-----	-----		-----
963		-----		-----	-----		-----	-----		-----
1017	ISO4406	17		2.13	16		4.11	12		1.69
1023	ISO4406	14		-2.81	12		-5.22	10		-1.11
1026	ISO4406	15		-1.17	13		-2.89	11		0.29
1146	ISO4406	15		-1.17	14		-0.56	8		-3.91
1271	ISO4406	16		0.48	14		-0.56	12		1.69
1431	ISO4406	16		0.48	15		1.78	11		0.29
1435	ISO4406	16		0.48	15		1.78	12		1.69
1456	ISO4406	15		-1.17	13		-2.89	9		-2.51
1660		-----		-----	-----		-----	-----		-----
1704	ISO4406	18		3.77	17		6.44	14		4.49
1957		15		-1.17	14		-0.56	10		-1.11
6002	ISO4406	17		2.13	15		1.78	14		4.49
6030		-----		-----	-----		-----	-----		-----
	normality	OK			OK			OK		
	n	24			23			24		
	outliers	0 (+1ex)			0 (+2ex)			0 (+1ex)		
	mean (n)	15.7			14.2			10.8		
	st.dev. (n)	1.12			1.30			1.86		
	R(calc.)	3.1			3.6			5.2		
	R(D7647:10)	1.7			1.2			2		

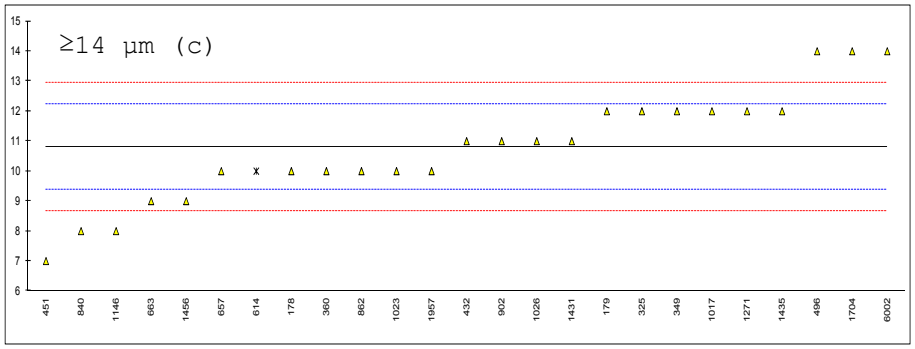
Lab 614 all test results were excluded for the test results in counts/ml did not match the ISO scale number
Lab 902 the test result for ≥6 µm(c) was excluded for the test result in counts/ml did not match the ISO scale number

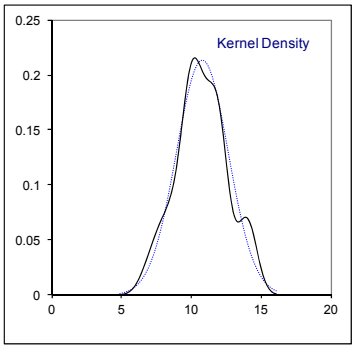

≥4 µm (c)
657 663 840 1023 178 325 1026 1146 1456 1957 179 451 496 614 862 360 1271 1431 1435 432 349 902 1017 6002 1704


Kernel Density


≥6 µm (c)
663 1023 178 840 657 1026 1456 325 451 614 862 1146 1271 1957 179 360 349 902 1431 1435 6002 496 432 1017 1704


Kernel Density


≥14 µm (c)
451 840 1146 663 1456 657 614 178 360 862 1023 1957 432 902 1026 1431 179 325 349 1017 1271 1435 496 1704 6002


Kernel Density

APPENDIX 2

Number of participants per country

1 lab in	ALGERIA
1 lab in	ARGENTINA
2 labs in	AUSTRALIA
1 lab in	AUSTRIA
3 labs in	BELGIUM
1 lab in	BOSNIA and HERZEGOVINA
1 lab in	BULGARIA
1 lab in	CHINA, People's Republic
1 lab in	FRANCE
1 lab in	GEORGIA
2 labs in	GERMANY
1 lab in	GREECE
1 lab in	INDIA
1 lab in	ITALY
2 labs in	MALAYSIA
2 labs in	NETHERLANDS
1 lab in	NIGERIA
2 labs in	NORWAY
1 lab in	PAKISTAN
1 lab in	PHILIPPINES
1 lab in	POLAND
1 lab in	SAUDI ARABIA
1 lab in	SINGAPORE
1 lab in	SPAIN
1 lab in	THAILAND
1 lab in	TURKEY
1 lab in	UNITED KINGDOM
2 labs in	UNITED STATES OF AMERICA
1 lab in	VIETNAM

APPENDIX 3

Abbreviations:

C	= final result after checking of first reported suspect test result
D(0.01)	= outlier in Dixon's outlier test
D(0.05)	= straggler in Dixon's outlier test
G(0.01)	= outlier in Grubbs' outlier test
G(0.05)	= straggler in Grubbs' outlier test
DG(0.01)	= outlier in Double Grubbs' outlier test
DG(0.05)	= straggler in Double Grubbs' outlier test
R(0.01)	= outlier in Rosner's outlier test
R(0.05)	= straggler in Rosner's outlier test
ex	= test result excluded from the statistical calculations
U	= reported test result in a different unit
W	= test result withdrawn on request of the participants
fr.	= first reported test result
n.a.	= not applicable
n.e.	= not evaluated
SDS	= Material Safety Data Sheet

Literature:

1 iis Interlaboratory Studies, Protocol for the Organization, Statistics and Evaluation, March 2017
2 ASTM E178:89
3 ASTM E1301:89
4 ISO 5725:86
5 ISO 5725, parts 1-6, 1994
6 ISO13528:05
7 M. Thompson and R. Wood, J. AOAC Int, 76, 926, (1993)
8 W.J. Youden and E.H. Steiner, Statistical Manual of the AOAC, (1975)
9 IP 367:84
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