Institute for
Interlaboratory Studies

Results of Proficiency Test
Turbine Oil (used)
May 2022

Organized 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 scheme for the analysis of used Turbine Oil every year. During the annual proficiency testing program 2021/2022 it was decided to continue the round robin for the analysis of used Turbine Oil.

In this interlaboratory study 45 laboratories in 32 countries registered for participation, see appendix 2 for the number of participants per country. In this report the results of the 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 analyzes for fit-for-use and homogeneity testing were subcontracted to an ISO/IEC17025 accredited laboratory.
It was decided to send one sample of used Turbine Oil in a 1-liter bottle labelled #22077.
The participants were requested to report rounded and unrounded test results. The unrounded test results were preferably used for statistical evaluation.

2.1 ACCREDITATION

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

2.2 PROTOCOL

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

2.3 CONFIDENTIALITY STATEMENT

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

2.4 SAMPLES

A batch of approximately 65 liters of used Turbine Oil was obtained from a local supplier. After homogenization 60 amber glass bottles of 1 L were filled and labelled #22077.
The homogeneity of the subsamples was checked by determination of Density at 15 °C in accordance with ISO12185 on 8 stratified randomly selected subsamples.

	Density at 15 °C in kg/L
sample #22077-1	0.88739
sample #22077-2	0.88739
sample #22077-3	0.88738
sample #22077-4	0.88739
sample #22077-5	0.88739
sample #22077-6	0.88738
sample #22077-7	0.88739
sample #22077-8	0.88739

Table 1: homogeneity test results of subsamples #22077

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

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

Table 2: evaluation of the repeatability of subsamples #22077

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

To each of the participating laboratories one 1 L bottle of used Turbine Oil labelled #22077 was sent on April 13, 2022. An SDS was added to the sample package.

2.5 STABILITY OF THE SAMPLES

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

2.6 ANALYZES

The participants were requested to determine: Total Acid Number, Color ASTM, Density at 15 °C, Flash Point (C.O.C. and PMcc), Insoluble Color Bodies, Kinematic Viscosity at 40 °C and 100 °C, Viscosity Index, Oxidation Stability RPVOT, Water, Water Separability at 54 °C distilled water and Level of Contamination (counts/mL and ISO4406 scale).
Some extra information was asked about the determination of Total Acid Number.

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

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

3 RESULTS

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

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

3.1 STATISTICS

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

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

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

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

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

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

3.2 GRAPHICS

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

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

3.3 Z-SCORES

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

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

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

The z-scores were calculated according to:

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

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

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

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

4 EVALUATION

Some problems were encountered with the dispatch of the samples due to COVID-19 pandemic. Therefore, the reporting time on the data entry portal was extended with another week. One participant reported test results after the extended reporting date and three other participants were not able to report any test results. Not all participants were able to report all tests requested.
In total 42 participants reported 517 numerical test results. Observed were 21 outlying test results, which is 4.1%. In proficiency tests outlier percentages of 3% - 7.5% are quite normal.

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

4.1 EVALUATION PER TEST

In this section the reported test results are discussed per test. The test methods which were used by the various laboratories were taken into account for explaining the observed differences when possible and applicable. These test methods are also in the tables together with the original data in appendix 1. The abbreviations, used in these tables, are explained in appendix 3.

In the iis PT reports ASTM test methods are referred to with a number (e.g. D2270) and an added designation for the year that the test method was adopted or revised (e.g. D2270:10). When a method has been reapproved an “R” will be added and the year of approval (e.g. D2270:10R16).

Total Acid Number: This determination was not problematic. Three statistical outliers were observed. The calculated reproducibility after rejection of the statistical outliers is in agreement with the requirements of ASTM D664-A:18e2 BEP and IP at 60 mL, but not with BEP and IP at 125 mL.
When the test results for IP and BEP were evaluated separately, the calculated reproducibilities of the test results are also not in agreement with the end points at 125 mL titration volume.
Remarkably, three participants still used pH 11 for BEP instead of pH 10. In test method ASTM D664:18e2 pH 10 is mentioned.

Color ASTM: This determination was not problematic. Two statistical outliers were observed. The calculated reproducibility after rejection of the statistical outliers is in agreement with ASTM D1500:12R17.

Density at 15 °C: This determination was not problematic. Four statistical outliers were observed. The calculated reproducibility after rejection of the statistical outliers is in agreement with the requirements of ISO12185:96.

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

Flash Point PMcc: This determination was not problematic. Two statistical outliers were observed. The calculated reproducibility after rejection of the statistical outliers is in agreement with the requirements of ASTM D93:20 procedure A. Only three participants used procedure B.

Insoluble Color Bodies: This determination was not problematic. No statistical outliers were observed. The calculated reproducibility is in agreement with the requirements of ASTM D7843:21.

Kinematic Viscosity at 40 °C: This determination was problematic. Two statistical outliers were observed. The calculated reproducibility after rejection of the statistical outliers is not in agreement with the requirements of ASTM D445:21e1.

Kinematic Viscosity at 100 °C: This determination was very problematic. Two statistical outliers were observed. The calculated reproducibility after rejection of the statistical outliers is not at all in agreement with the requirements of ASTM D445:21e1.

Viscosity Index: This determination was problematic. No statistical outliers were observed but four test results were excluded. The calculated reproducibility after rejection of the suspect data is not in agreement with the requirements of ASTM D2270:10R16.

Oxidation Stability RPVOT: This determination was problematic. Three statistical outliers were observed. The calculated reproducibility after rejection of the statistical outliers is not in agreement with the requirements of ASTM D2272:22.

Water: This determination was not problematic. No statistical outliers were observed. The calculated reproducibility is in agreement with the requirements of ASTM D6304:20 procedure B, A and C.

Water Separability at 54 °C, distilled water: This determination was problematic. No statistical outliers were observed over 3 parameters. All calculated reproducibilities are not in agreement with the requirements of ASTM D1401:21.

Level of Contamination: This determination was problematic. Three statistical outliers were observed and five other test results were excluded over 6 parameters. The calculated reproducibilities for the determinations in counts/mL and ISO4406 scale numbers after rejection of the suspect data are not in agreement with the requirements of ASTM D7647:10R18.

4.2 PERFORMANCE EVALUATION FOR THE GROUP OF LABORATORIES

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

Parameter	unit	n	average	2.8 * sd	R(lit)
Total Acid Number	mg KOH/g	37	0.27	0.10	0.15
Color ASTM		31	4.3	0.8	1
Density at 15 °C	kg/L	33	0.8874	0.0004	0.0005
Flash Point C.O.C.	°C	28	224.1	27.7	18
Flash Point PMcc	°C	29	177.9	10.1	12.6
Insoluble Color Bodies		12	8.4	6.0	8.6
Kinematic Viscosity at 40 °C	mm^2/s	37	30.65	0.25	0.22
Kinematic Viscosity at 100 °C	mm^2/s	36	5.516	0.085	0.041
Viscosity Index		30	118.0	3.8	2

Parameter	unit	n	average	2.8 * sd	R(lit)
Oxidation Stability RPVOT	minutes	13	929	263	213
Water	mg/kg	35	174.0	59.3	193.7
Water Separability at 54 °C, distilled water					
Time ≤ 3 mL emulsion	minutes	8	24.4	30.2	20
Time 37 mL water	minutes	7	27.8	37.1	20
Time to complete break	minutes	5	22.8	31.9	20
Level of Contamination					
≥ 4 µm (c)	counts/mL	18	1314	1787	1485
≥ 6 µm (c)	counts/mL	20	168	264	127
≥ 14 µm (c)	counts/mL	20	14	23	19
≥ 4 µm (c)	ISO scale	20	17	3	2
≥ 6 µm (c)	ISO scale	22	14	3	1
≥ 14 µm (c)	ISO scale	22	11	4	2

Table 3: reproducibilities of tests on sample #22077

Without further statistical calculations, it can be concluded that for many tests there is not a good compliance of the group of participants with the reference test methods. The problematic tests have been discussed in paragraph 4.1.

4.3 COMPARISON OF THE PROFICIENCY TEST OF MAY 2022 WITH PREVIOUS PTS

	May 2022	May 2021	May 2020	May 2019	May 2018
Number of reporting laboratories	42	45	35	42	43
Number of test results	517	547	440	600	581
Number of statistical outliers	21	24	25	13	10
Percentage of statistical outliers	4.1%	4.4%	5.7%	2.2%	1.7%

Table 4: comparison with previous proficiency tests

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

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

Parameter	May 2022	May 2021	May 2020	May 2019	May 2018
Total Acid Number	+	+/-	-	+	--
Color ASTM	+	-	+	+	+
Density at 15 °C	+	+/-	+/-	+	+
Flash Point C.O.C.	-	-	+/-	+/-	-
Flash Point PMcc	+	+	+	+	+
Insoluble Color Bodies	+	+	+	+/-	+
Kinematic Viscosity at 40 °C	-	+	-	-	+
Kinematic Viscosity at 100 °C	--	-	--	-	+/-

Parameter	May 2022	May 2021	May 2020	May 2019	May 2018
Viscosity Index	-	-	--	-	(--)
Oxidation Stability RPVOT	-	--	--	(--)	-
Water	++	-	++	++	++
Water Separability	-	++	+	+	++
Level of Contamination	-	--	--	(--)	-

Table 5: comparison determinations to the reference test methods

For results between brackets: no z-scores are calculated

The following performance categories were used:

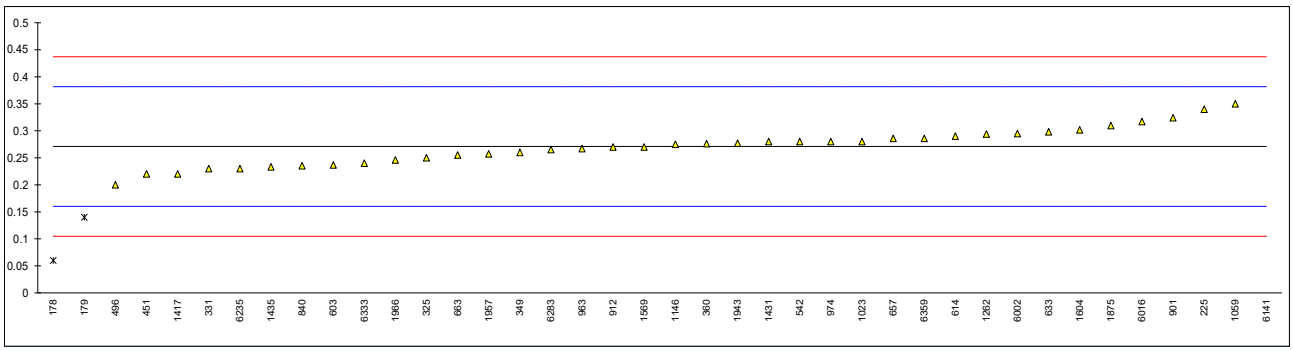
- ++ : group performed much better than the reference test method
- + : group performed better than the reference test method
- +/- : group performance equals the reference test method
- - : group performed worse than the reference test method
- -- : group performed much worse than the reference test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

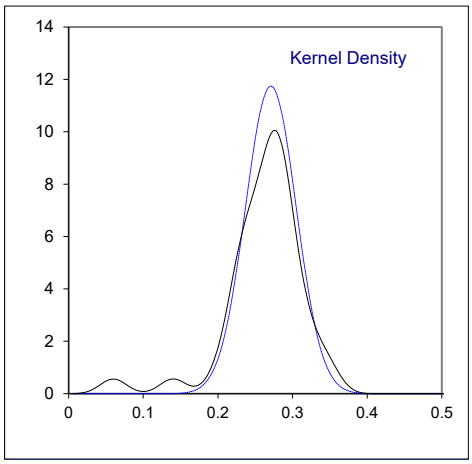
APPENDIX 1

Determination of Total Acid Number on sample #22077; results in mg KOH/g

lab	method	value	mark	z(targ)	end point determination	vol. titration solvent	remarks
178	D664-A	0.06	R(0.01)	-3.81	---	---	
179	D664-A	0.14	R(0.05)	-2.37	Inflection Point	60 mL	
225	D974	0.34		1.25	---	---	
237	D664-A	<0.1		<-3.09	Inflection Point	125 mL	false -?
325	D664-A	0.25		-0.38	Buffer End Point pH 10	125 mL	
331	D664Mod.	0.23		-0.74	Inflection Point	60 mL	
349	D664-A	0.26		-0.20	Inflection Point	125 mL	
360	D664-A	0.276		0.09	Inflection Point	60 mL	
432		-----		-----	---	---	
451	D664-A	0.22		-0.92	Buffer End Point pH 10	60 mL	
496	D664-A	0.20		-1.28	Buffer End Point pH 10	60 mL	
542	D974	0.28		0.16	---	---	
603	D664-A	0.237		-0.61	Inflection Point	125 mL	
614	D664-A	0.29		0.34	---	60 mL	
633	D664-A	0.29815		0.49	Inflection Point	125 mL	
657	D664-A	0.286		0.27	Inflection Point	60 mL	
663	D664-A	0.255		-0.29	Buffer End Point pH 10	60 mL	
704		-----		-----	---	---	
840	D664-B	0.235		-0.65	Buffer End Point pH 10	60 mL	
862		-----		-----	---	---	
901	D664-A	0.324		0.96	---	---	
912	D974	0.27		-0.02	---	---	
962		-----		-----	---	---	
963	D664-B	0.267		-0.07	Inflection Point	60 mL	
974	D664-A	0.28		0.16	Inflection Point	125 mL	
1023	D8045	0.28		0.16	---	---	
1059	ISO6619	0.35		1.43	Buffer End Point pH 11	60 mL	
1146	D664-A	0.275		0.07	Buffer End Point pH 10	125 mL	
1262	ISO6618	0.294		0.42	---	60 mL	
1417	D664-A	0.220		-0.92	Buffer End Point pH 10	60 mL	
1431	D664-A	0.2798		0.16	Inflection Point	60 mL	
1435	D664-A	0.233		-0.69	Buffer End Point pH 10	100 ml	
1569	D664-A	0.27		-0.02	Inflection Point	125 mL	
1604	D664-A	0.3016		0.55	Inflection Point	60 mL	
1875	ISO6618	0.3097		0.70	---	---	
1943	ISO6618	0.277		0.11	---	---	
1957	D664-A	0.257		-0.25	Buffer End Point pH 11	125 mL	
1966	ISO6618	0.2457		-0.46	---	---	
6002	D664-A	0.295		0.44	Inflection Point	60 mL	
6016	D664-A	0.317		0.83	Inflection Point	60 mL	
6141	D974	1.11	R(0.01)	15.16	---	---	
6235	D664-A	0.230		-0.74	Inflection Point	60 mL	
6283	D664-A	0.265		-0.11	Buffer End Point pH 11	60 mL	
6333	D8045	0.24		-0.56	Inflection Point	60 mL	
6359	D664-A	0.286		0.27	---	60 mL	

			Buffer End Point only	Inflection Point only
	normality	OK	suspect	OK
	n	37	15	15
	outliers	3	0	1
	mean (n)	0.2709	0.2580	0.2712
	st.dev. (n)	0.03399	0.03707	0.02724
	R(calc.)	0.0952	0.1038	0.0763
	st.dev.(D664-A:18e2 BEP, 60mL)	0.05534	0.05276	---
	R(D664-A:18e2 BEP, 60mL)	0.1550	0.1477	---
Compare				
	R(D664-A:18e2 BEP, 125mL)	0.0801	0.0760	---
	R(D664-A:18e2 IP, 60mL)	0.1379	---	0.1380
	R(D664-A:18e2 IP, 125mL)	0.0560	---	0.0561


0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
178 179 496 451 1417 331 6235 1435 840 603 6333 1966 325 663 1957 349 6283 963 912 1569 1146 360 1943 1431 542 974 1023 657 6359 614 1262 6002 633 1604 1875 6016 901 225 1059 6141

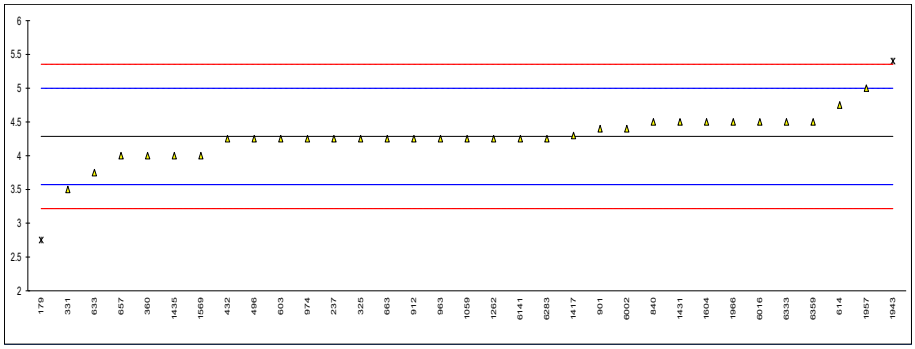

Kernel Density
14
12
10
8
6
4
2
0
0 0.1 0.2 0.3 0.4 0.5

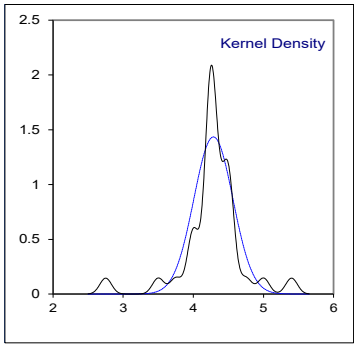
Determination of Color ASTM on sample #22077;

lab	method	reported test result	iis conversion *)	mark	z(targ)	remarks
178		-----	-----		-----	
179	D1500	L3.0	2.75	R(0.01)	-4.30	
225		-----	-----		-----	
237	D1500	L4.5	4.25		-0.10	
325	D6045	L4.5	4.25		-0.10	
331	D1500	3.5	3.5	C	-2.20	first reported 3
349		-----	-----		-----	
360	D1500	4.0	4.0		-0.80	
432	D1500	L4,5	4.25		-0.10	
451		-----	-----		-----	
496	D1500	L4.5	4.25		-0.10	
542		-----	-----		-----	
603	D1500	L4.5	4.25		-0.10	
614	D1500	<5.0	4.75		1.30	
633	D1500	L4.0	3.75	C	-1.50	first reported 3.5
657	D1500	4.0	4.0		-0.80	
663	D1500	L4.5	4.25		-0.10	
704		-----	-----		-----	
840	D1500	4.5	4.5		0.60	
862		-----	-----		-----	
901	D1500	4.4	4.4		0.32	
912	D1500	<4.5	4.25		-0.10	
962		-----	-----		-----	
963	D1500	L4.5	4.25		-0.10	
974	D1500	L4.5	4.25		-0.10	
1023		-----	-----		-----	
1059	D1500	L4,5	4.25		-0.10	
1146		-----	-----		-----	
1262	ISO2049	L 4.5	4.25		-0.10	
1417	D6045	4.3	4.3		0.04	
1431	D1500	4.5	4.5		0.60	
1435	D1500	4.0	4.0		-0.80	
1569	D1500	4.0	4.0		-0.80	
1604	D1500	4.5	4.5		0.60	
1875		-----	-----		-----	
1943	ISO2049	5.4	5.4	R(0.05)	3.12	
1957	D1500	5.0	5.0		2.00	
1966	D1500	4.5	4.5		0.60	
6002	In house	4.4	4.4		0.32	
6016	D1500	4.5	4.5		0.60	
6141	D1500	L4.5	4.25		-0.10	
6235		-----	-----		-----	
6283	D1500	L4.5	4.25		-0.10	
6333	D1500	4.5	4.5		0.60	
6359	D1500	4.5	4.5		0.60	

normality	not OK
n	31
outliers	2
mean (n)	4.29
st.dev. (n)	0.278
R(calc.)	0.78
st.dev.(D1500:12R17)	0.357
R(D1500:12R17)	1

*) In the calculation of the mean, standard deviation and the reproducibility in this column, a reported value of 'L y' is changed tot y-0.25 (for example L5.5 into 5.25).

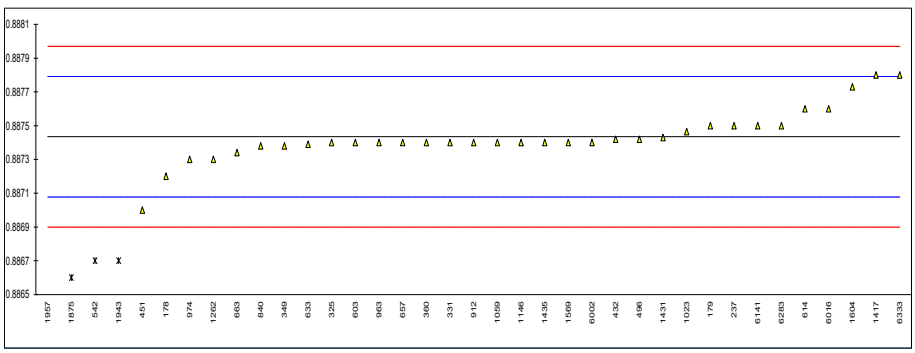


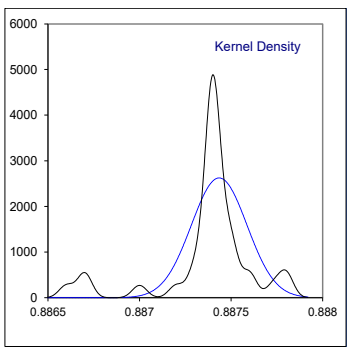


Determination of Density at 15 °C on sample #22077; results in kg/L

lab	method	value	mark	z(targ)	remarks
178	D4052	0.8872		-1.32	
179	D4052	0.8875		0.36	
225		-----		-----	
237	D4052	0.8875	C	0.36	first reported 888.6 kg/m^3
325	D4052	0.8874		-0.20	
331	ISO12185	0.8874		-0.20	
349	D4052	0.88738		-0.31	
360	D4052	0.8874		-0.20	
432	ISO12185	0.88742		-0.08	
451	D4052	0.8870		-2.44	
496	ISO12185	0.88742		-0.08	
542	D7042	0.8867	C,R(0.01)	-4.12	first reported 887 kg/m^3
603	D4052	0.8874		-0.20	
614	D4052	0.8876		0.92	
633	D4052	0.88739		-0.25	
657	D4052	0.8874		-0.20	
663	D4052	0.88734		-0.53	
704		-----		-----	
840	D4052	0.88738		-0.31	
862		-----		-----	
901		-----		-----	
912	D4052	0.8874		-0.20	
962		-----		-----	
963	D4052	0.8874		-0.20	
974	D4052	0.8873		-0.76	
1023	D4052	0.887465		0.17	
1059	ISO12185	0.8874		-0.20	
1146	D4052	0.8874		-0.20	
1262	D4052	0.8873		-0.76	
1417	IP365	0.8878	C	2.04	
1431	ISO12185	0.88743		-0.03	
1435	D4052	0.8874		-0.20	
1569	ISO12185	0.8874		-0.20	
1604	D1298	0.88773		1.65	
1875	D51757	0.8866	R(0.01)	-4.68	
1943	ISO3675	0.8867	C,R(0.01)	-4.12	first reported 886.9 kg/m^3
1957	D4052	0.8862	R(0.01)	-6.92	
1966		-----	W	-----	test result withdrawn, reported 886.83 kg/m^3
6002	ISO12185	0.8874		-0.20	
6016	D4052	0.8876		0.92	
6141	D4052	0.8875		0.36	
6235		-----		-----	
6283	D4052	0.8875		0.36	
6333	D7042	0.8878	C	2.04	first reported 0.8878
6359		-----	W	-----	test result withdrawn, reported 0.8878

normality	not OK
n	33
outliers	4
mean (n)	0.88744
st.dev. (n)	0.000152
R(calc.)	0.00043
st.dev.(ISO12185:96)	0.000179
R(ISO12185:96)	0.0005

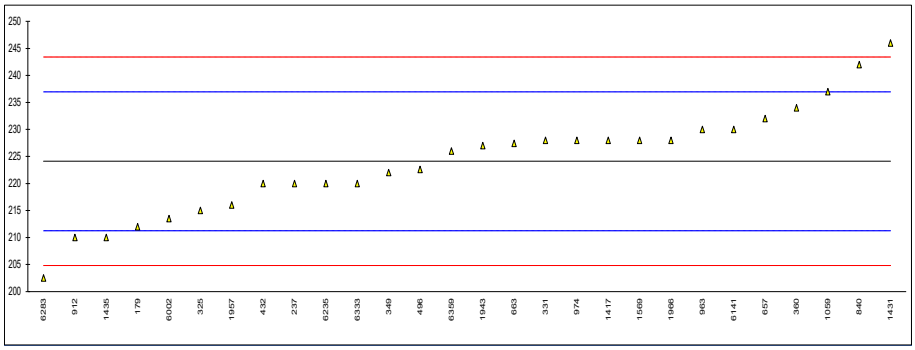


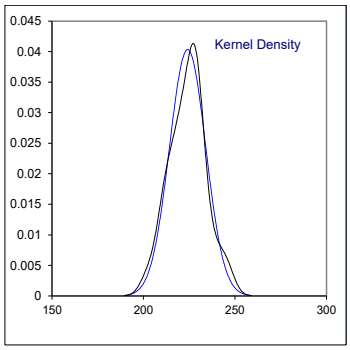


Determination of Flash Point C.O.C. on sample #22077; results in °C

lab	method	value	mark	z(targ)	remarks
178		-----		-----	
179	D92	212		-1.88	
225		-----		-----	
237	D92	220		-0.64	
325	D92	215		-1.42	
331	D92	228		0.61	
349	D92	222		-0.33	
360	ISO2592	234		1.54	
432	D92	220		-0.64	
451		-----		-----	
496	D92	222.6		-0.23	
542		-----		-----	
603		-----		-----	
614		-----		-----	
633		-----		-----	
657	D92	232		1.23	
663	D92	227.4	C	0.51	first reported 175.48
704		-----		-----	
840	D92	242		2.78	
862		-----		-----	
901		-----		-----	
912	D92	210		-2.19	
962		-----		-----	
963	D92	230.0		0.92	
974	D92	228		0.61	
1023		-----		-----	
1059	ISO2592	237		2.01	
1146		-----		-----	
1262		-----		-----	
1417	D92	228		0.61	
1431	D92	246	C	3.41	first reported 252
1435	D92	210.0		-2.19	
1569	D92	228		0.61	
1604		-----		-----	
1875		-----		-----	
1943	ISO2592	227		0.45	
1957	D92	216		-1.26	
1966	D92	228		0.61	
6002	ISO2592	213.5		-1.65	
6016		-----		-----	
6141	D92	230		0.92	
6235	ISO2592	220		-0.64	
6283	D92	202.5		-3.36	
6333	D92	220	C	-0.64	first reported 266
6359	D92	226		0.29	

normality	OK
n	28
outliers	0
mean (n)	224.11
st.dev. (n)	9.890
R(calc.)	27.69
st.dev.(D92:18)	6.429
R(D92:18)	18

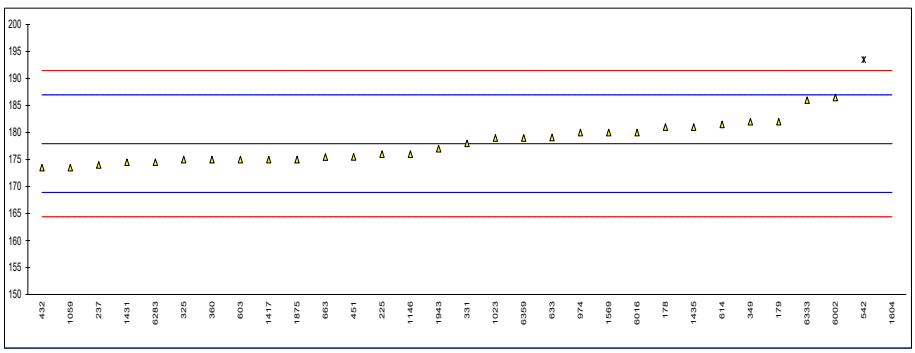


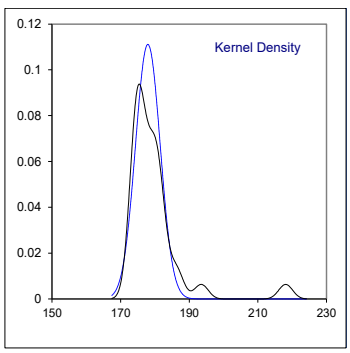


Determination of Flash Point PMcc on sample #22077; results in °C

lab	method	value	mark	z(targ)	remarks
178	D93-A	181		0.68	
179	D93-A	182.0		0.90	
225	D93-B	176.0		-0.43	
237	D93-B	174.0		-0.87	
325	D93-A	175.0		-0.65	
331	D93-A	178		0.01	
349	D93-A	182		0.90	
360	ISO2719-A	175.0		-0.65	
432	D93-A	173.5		-0.98	
451	D93-A	175.5		-0.54	
496		-----		-----	
542	D7094	193.5	C,R(0.01)	3.45	first reported 195
603	D93-A	175.0		-0.65	
614	D93-A	181.5		0.79	
633	D93-A	179.075		0.25	
657		-----		-----	
663	D93-A	175.48	C	-0.54	first reported 227.4
704		-----		-----	
840		-----		-----	
862		-----		-----	
901		-----		-----	
912		-----		-----	
962		-----		-----	
963		-----		-----	
974	D93-A	180		0.46	
1023	D93-A	179.0		0.24	
1059	ISO2719-A	173.5		-0.98	
1146	D93-A	176.0		-0.43	
1262		-----		-----	
1417	D93-A	175		-0.65	
1431	D93-A	174.5		-0.76	
1435	D93-A	181.0		0.68	
1569	D93-A	180		0.46	
1604	D93-A	218.1	R(0.01)	8.90	
1875	ISO2719-B	175		-0.65	
1943	ISO2719-A	177		-0.21	
1957		-----		-----	
1966		-----		-----	
6002	ISO2719-A	186.5		1.90	
6016	D93-A	180		0.46	
6141		-----		-----	
6235		-----		-----	
6283	D93-A	174.5		-0.76	
6333	D7094	186		1.79	
6359	D93-A	179		0.24	

normality	OK
n	29
outliers	2
mean (n)	177.93
st.dev. (n)	3.591
R(calc.)	10.06
st.dev.(D93-A:20)	4.512
R(D93-A:20)	12.63

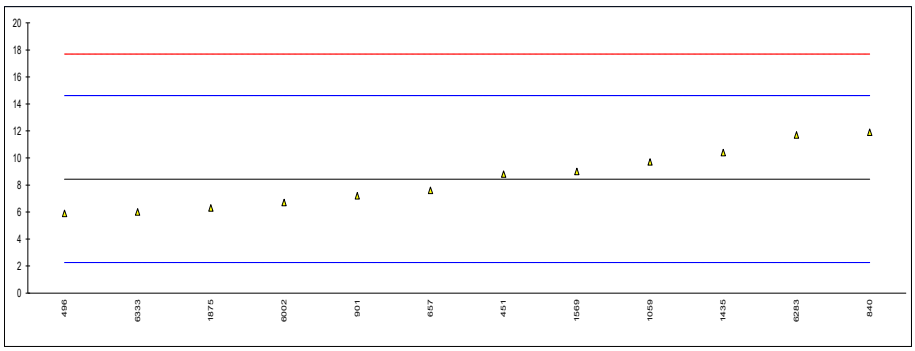


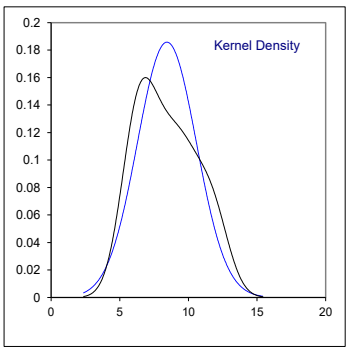


Determination of Insoluble Color Bodies, membrane patch colorimetry on sample #22077;

lab	method	value	mark	z(targ)	remarks
178		-----		-----	
179		-----		-----	
225		-----		-----	
237		-----		-----	
325		-----		-----	
331		-----		-----	
349		-----		-----	
360		-----		-----	
432		-----		-----	
451	D7843	8.8		0.12	
496	D7843	5.9		-0.82	
542		-----		-----	
603		-----		-----	
614		-----		-----	
633		-----		-----	
657	D7843	7.6		-0.27	
663		-----		-----	
704		-----		-----	
840	D7843	11.9		1.12	
862		-----		-----	
901	D7843	7.2		-0.40	
912		-----		-----	
962		-----		-----	
963		-----		-----	
974		-----		-----	
1023		-----		-----	
1059	D7843	9.7		0.41	
1146		-----		-----	
1262		-----		-----	
1417		-----		-----	
1431		-----		-----	
1435	D7843	10.4		0.64	
1569	D7843	9		0.18	
1604		-----		-----	
1875	D7843	6.3		-0.69	
1943		-----		-----	
1957		-----		-----	
1966		-----		-----	
6002	D7843	6.7		-0.56	
6016		-----		-----	
6141		-----		-----	
6235		-----		-----	
6283	D7843	11.7		1.06	
6333	D7843	6		-0.79	
6359		-----		-----	

normality	OK
n	12
outliers	0
mean (n)	8.43
st.dev. (n)	2.147
R(calc.)	6.01
st.dev.(D7843:21)	3.087
R(D7843:21)	8.64

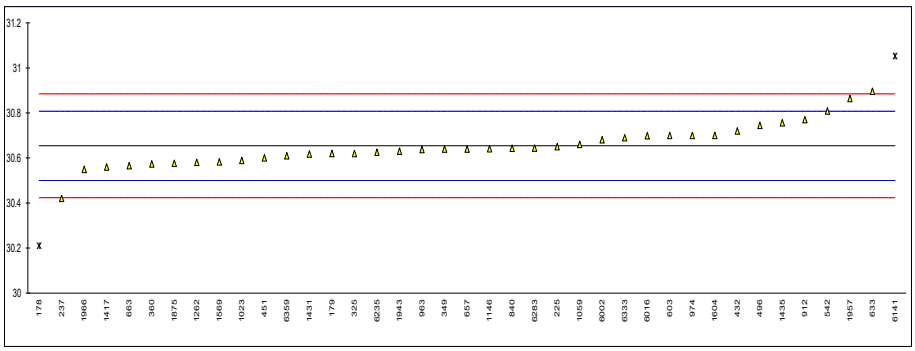


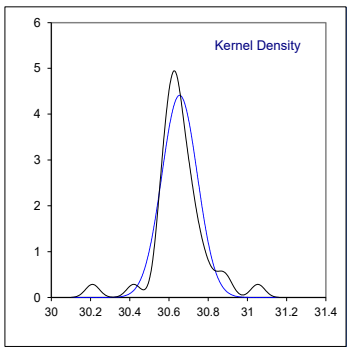


Determination of Kinematic Viscosity at 40 °C on sample #22077; results in mm^2/s

lab	method	value	mark	z(targ)	remarks
178	D7279 corrected to D445	30.21	R(0.01)	-5.77	
179	D445	30.62		-0.44	
225	D445	30.65		-0.05	
237	D445	30.42		-3.04	
325	D445	30.62		-0.44	
331		-----		-----	
349	D445	30.64		-0.18	
360	D445	30.573		-1.05	
432	ISO3104	30.72		0.86	
451	D7279 corrected to D445	30.6		-0.70	
496	D445	30.745		1.18	
542	D7042	30.8085		2.00	
603	D7042	30.70		0.60	
614		-----		-----	
633	D445	30.896		3.14	
657	D445	30.64		-0.18	
663	D445	30.566		-1.15	
704		-----		-----	
840	D445	30.643		-0.14	
862		-----		-----	
901		-----		-----	
912	D445	30.77		1.50	
962		-----		-----	
963	D445	30.638		-0.21	
974	D445	30.70		0.60	
1023	D445	30.5890		-0.85	
1059	ISO3104	30.66		0.08	
1146	D445	30.641		-0.17	
1262	ISO3104	30.58		-0.96	
1417	D445	30.56		-1.22	
1431	D7042	30.6175		-0.48	
1435	D7042	30.756		1.32	
1569	D445	30.583		-0.92	
1604	D445	30.70		0.60	
1875	D7042	30.576		-1.02	
1943	ISO3104	30.63		-0.31	
1957	D7042	30.864		2.73	
1966	D445	30.549		-1.37	
6002	ISO3104	30.681		0.35	
6016	D7042	30.699		0.58	
6141	D445	31.0529	R(0.01)	5.18	
6235	ISO3104	30.625		-0.38	
6283	D7042	30.644		-0.13	
6333	D7042	30.69		0.47	
6359	D445	30.61		-0.57	

normality	suspect
n	37
outliers	2
mean (n)	30.6542
st.dev. (n)	0.09040
R(calc.)	0.2531
st.dev.(D445:21e1)	0.07698
R(D445:21e1)	0.2155

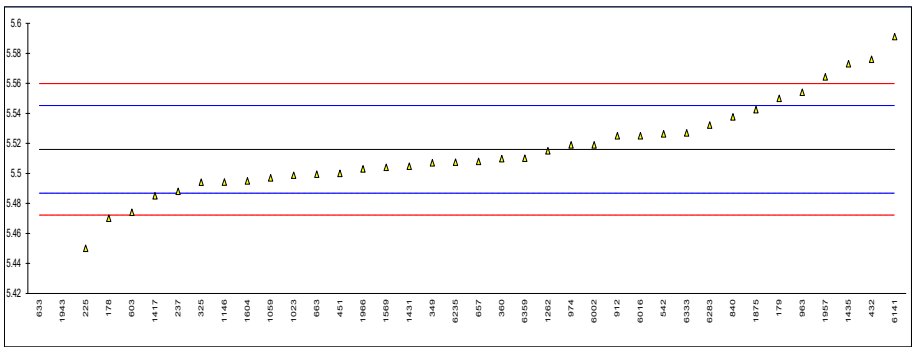


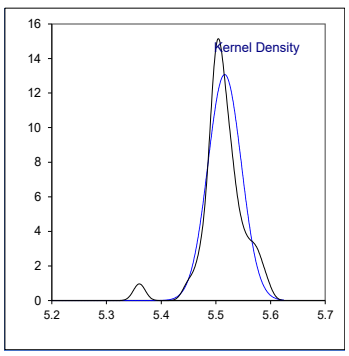


Determination of Kinematic Viscosity at 100 °C on sample #22077; results in mm²/s

lab	method	value	mark	z(targ)	remarks
178	D7279 corrected to D445	5.47		-3.15	
179	D445	5.55		2.33	
225	D445	5.450		-4.52	
237	D445	5.488		-1.92	
325	D445	5.494		-1.51	
331		-----		-----	
349	D445	5.507		-0.62	
360	D445	5.5097		-0.43	
432	ISO3104	5.576		4.11	
451	D7279 corrected to D445	5.50		-1.10	
496		-----		-----	
542	D7042	5.5263		0.71	
603	D7042	5.474	C	-2.88	first reported 5.465
614		-----		-----	
633	D445	5.161	C,R(0.01)	-24.31	first reported 5.1852
657	D445	5.508		-0.55	
663	D445	5.4995		-1.13	
704		-----		-----	
840	D445	5.5376		1.48	
862		-----		-----	
901		-----		-----	
912	D445	5.525		0.62	
962		-----		-----	
963	D445	5.554		2.60	
974	D445	5.519		0.21	
1023	D445	5.4987		-1.18	
1059	ISO3104	5.497		-1.30	
1146	D445	5.4941		-1.50	
1262	ISO3104	5.515		-0.07	
1417	D445	5.485		-2.12	
1431	D7042	5.5047		-0.77	
1435	D7042	5.573		3.90	
1569	D445	5.504		-0.82	
1604	D445	5.495		-1.44	
1875	D7042	5.5424		1.81	
1943	ISO3104	5.36	C,R(0.01)	-10.68	first reported 5.38
1957	D7042	5.5643		3.31	
1966	D445	5.503		-0.89	
6002	ISO3104	5.519		0.21	
6016	D7042	5.525		0.62	
6141	D445	5.5911		5.14	
6235	ISO3104	5.5075		-0.58	
6283	D7042	5.5322		1.11	
6333	D7042	5.527		0.75	
6359	D445	5.510		-0.41	

normality	OK
n	36
outliers	2
mean (n)	5.5160
st.dev. (n)	0.03050
R(calc.)	0.0854
st.dev.(D445:21e1)	0.01461
R(D445:21e1)	0.0409

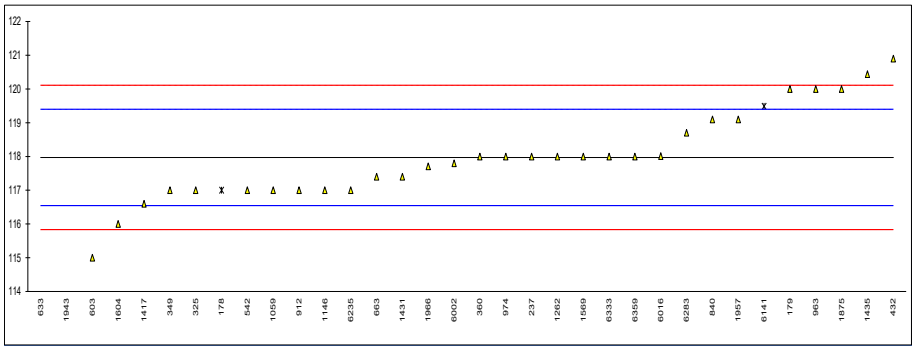


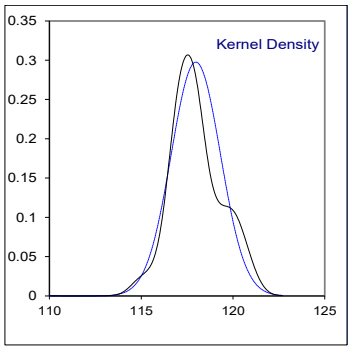


Determination of Viscosity Index on sample #22077;

lab	method	value	mark	z(targ)	remarks
178	D2270	117	ex,E	-1.36	test result excluded as statistical outlier in KV 40 °C, iis calc. 118
179	D2270	120		2.84	
225		-----		-----	
237	D2270	118		0.04	
325	D2270	117		-1.36	
331		-----		-----	
349	D2270	117		-1.36	
360	ISO2909	118.0		0.04	
432	ISO2909	120.9		4.10	
451		-----		-----	
496		-----		-----	
542	D2270	117		-1.36	
603	D2270	115	C	-4.16	first reported 114
614		-----		-----	
633	D2270	93.5	C,ex,E	-34.26	fr. 95.341, test result excluded as statist. outlier in KV 100 °C, iis calc. 95
657		-----		-----	
663	D2270	117.4		-0.80	
704		-----		-----	
840	D2270	119.1		1.58	
862		-----		-----	
901		-----		-----	
912	D2270	117		-1.36	
962		-----		-----	
963	D2270	120		2.84	
974	D2270	118		0.04	
1023		-----		-----	
1059	ISO2909	117		-1.36	
1146	D2270	117		-1.36	
1262	ISO2909	118		0.04	
1417	D2270	116.6		-1.92	
1431	D2270	117.4		-0.80	
1435	D2270	120.441		3.46	
1569	D2270	118		0.04	
1604	D2270	116		-2.76	
1875	ISO2909	120		2.84	
1943	ISO2909	108.2	C,ex	-13.68	fr. 109.7, test result excluded as statistical outlier in KV 100 °C
1957	D2270	119.1		1.58	
1966	D2270	117.71		-0.37	
6002	ISO2909	117.8		-0.24	
6016	D2270	118.013		0.06	
6141	D2270	119.484	ex	2.12	test result excluded as statistical outlier in KV 40 °C
6235	ISO2909	117		-1.36	
6283	D2270	118.7		1.02	
6333	D2270	118		0.04	
6359	D2270	118		0.04	

normality	OK
n	30
outliers	0+4ex
mean (n)	117.97
st.dev. (n)	1.340
R(calc.)	3.75
st.dev.(D2270:10R16)	0.714
R(D2270:10R16)	2

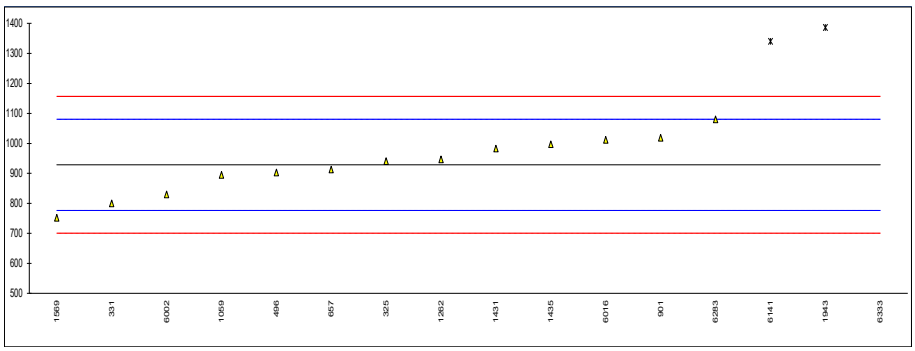


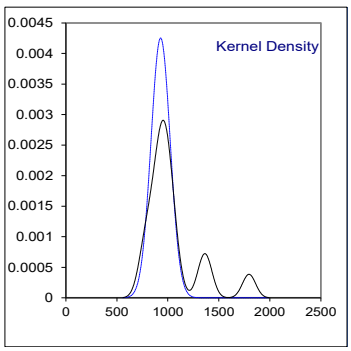


Determination of Oxidation Stability RPVOT on sample #22077; results in minutes

lab	method	value	mark	z(targ)	remarks
178		-----		-----	
179		-----		-----	
225		-----		-----	
237		-----		-----	
325	D2272-A	941		0.16	
331	D2272-B	800		-1.69	
349		-----		-----	
360		-----		-----	
432		-----		-----	
451		-----		-----	
496	D2272-B	903		-0.34	
542		-----		-----	
603		-----		-----	
614		-----		-----	
633		-----		-----	
657	D2272-B	913		-0.21	
663		-----		-----	
704		-----		-----	
840		-----		-----	
862		-----		-----	
901	D2272-A	1019		1.19	
912		-----		-----	
962		-----		-----	
963		-----		-----	
974		-----		-----	
1023		-----		-----	
1059	D2272-B	895		-0.44	
1146		-----		-----	
1262	D2272-A	947		0.24	
1417		-----		-----	
1431	D2272-B	983		0.72	
1435	D2272-A	997		0.90	
1569	D2272-B	752		-2.32	
1604		-----		-----	
1875		-----		-----	
1943	D2272-B	1386	DG(0.01)	6.01	
1957		-----		-----	
1966		-----		-----	
6002	D2272-B	830		-1.30	
6016	D2272-A	1012		1.10	
6141	D2272-A	1340	DG(0.01)	5.41	
6235		-----		-----	
6283	D2272-A	1080		1.99	
6333	D2272-B	1796	G(0.01)	11.41	
6359		-----		-----	

normality	OK
n	13
outliers	3
mean (n)	928.6
st.dev. (n)	93.83
R(calc.)	262.7
st.dev.(D2272:22)	76.04
R(D2272:22)	212.9





Determination of Water on sample #22077; results in mg/kg

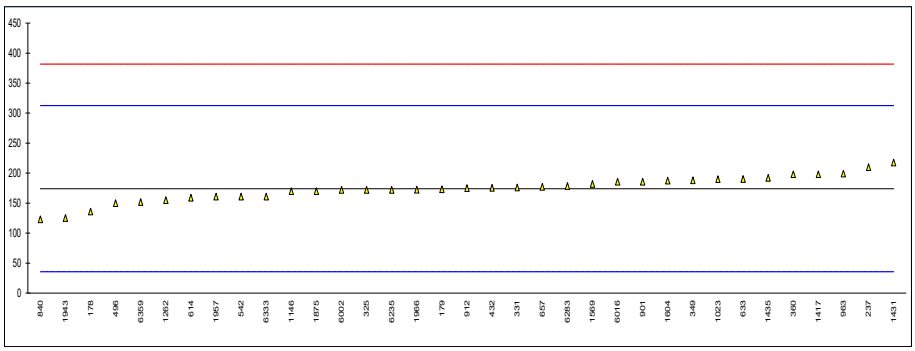
lab	method	value	mark	z(targ)	remarks
178	D6304-C:20	136		-0.55	
179	D6304-C:20	173		-0.01	
225		-----		-----	
237	D6304-C:16e1	210		0.52	
325	D6304-C:20	172		-0.03	
331	D6304Mod.	176		0.03	
349	D6304-A:16e1	188		0.20	
360	ISO12937	198.0		0.35	
432	D6304-B:20	175.58		0.02	
451		-----		-----	
496	D6304-B:20	150		-0.35	
542	D6304-A:20	160.9		-0.19	
603		-----		-----	
614	D6304-B:20	159		-0.22	
633	D6304-B:20	190.16		0.23	
657	D6304-C:16e1	177.2		0.05	
663		-----		-----	
704		-----		-----	
840	D6304-B:20	123		-0.74	
862		-----		-----	
901	D6304-A:20	185.7		0.17	
912	D6304-B:20	175		0.01	
962		-----		-----	
963	D6304-B	199.2		0.36	
974		-----		-----	
1023	D6304-A:20	189.9		0.23	
1059		-----		-----	
1146	D6304-B:20	170		-0.06	
1262	ISO760	155		-0.27	
1417	D6304-A:20	198		0.35	
1431	D6304-A:16e1	217.61		0.63	
1435	D6304-A:20	192		0.26	
1569	D6304-B:16e1	182		0.12	
1604	D6304-B:16e1	187.5		0.20	
1875	ISO12937	170		-0.06	
1943	EN60814	125.04		-0.71	
1957	D6304-A:16e1	160.8		-0.19	
1966	EN60814	172.27		-0.02	
6002	In house	171.98		-0.03	
6016	D6304-A:20	185.6		0.17	
6141		-----		-----	
6235	In house	172		-0.03	
6283	D6304-A:20	178.4		0.06	
6333	D6304-B:20	161		-0.19	
6359	D6304-A:20	152		-0.32	

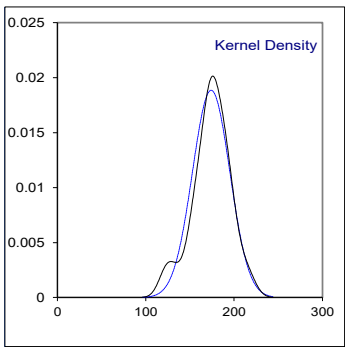
	normality	OK
	n	35
	outliers	0
	mean (n)	174.00
	st.dev. (n)	21.161
	R(calc.)	59.25
	st.dev.(D6304-B:20)	69.181
	R(D6304-B:20)	193.71
Compare		
	R(D6304-A:20)	88.96
	R(D6304-C:20)	69.77

range 30 – 2100 mg/kg

range 20 – 25000 mg/kg

range 20 – 360 mg/kg



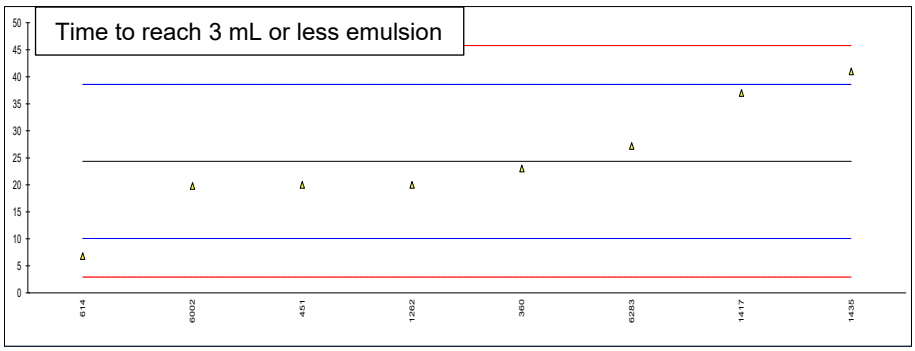


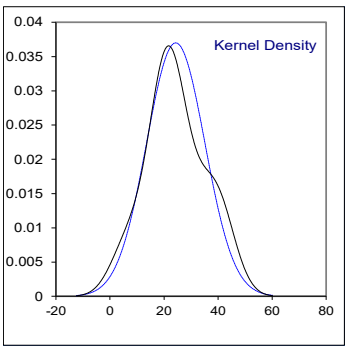
Determination of Water Separability at 54 °C, distilled water on sample #22077; results in minutes

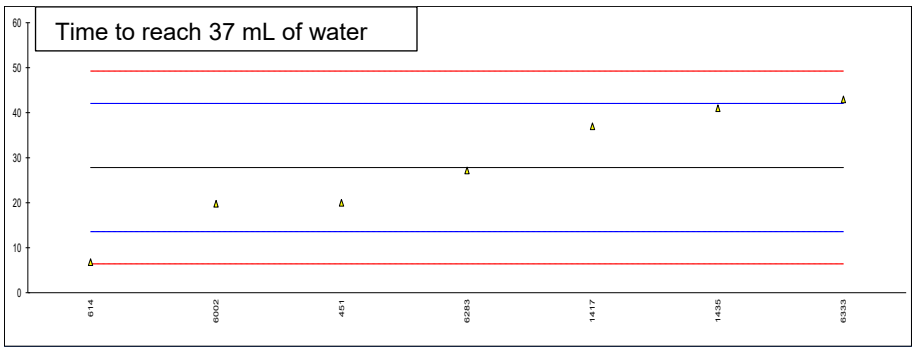
lab	method	3 mL or less emulsion		z(targ)	37 mL of water		z(targ)	complete break (40-40-0)		z(targ)	test aborted	time aborted
178		-----		-----	-----		-----	-----		-----		-----
179		-----		-----	-----		-----	-----		-----	No	30
225		-----		-----	-----		-----	-----		-----		-----
237		-----		-----	-----		-----	-----		-----	Yes	30
325		-----		-----	-----		-----	-----		-----	Yes	30
331	ISO6614	>60	f+?	>4.99	>60	f+?	>4.50	>60	f+?	>5.21	No	60
349		-----		-----	-----		-----	-----		-----		-----
360	ISO6614	23		-0.19	-----		-----	-----		-----	Yes	30
432		-----		-----	-----		-----	-----		-----		-----
451	D1401	20		-0.61	20		-1.10	20		-0.39		-----
496		-----		-----	-----		-----	-----		-----	Yes	30
542		-----		-----	-----		-----	-----		-----		-----
603		-----		-----	-----		-----	-----		-----		-----
614	D1401	6.8	C	-2.46	6.8		-2.94	7		-2.21	No	-----
633		-----		-----	-----		-----	-----		-----		-----
657		-----		-----	-----		-----	-----		-----	Yes	30
663		-----		-----	-----		-----	-----		-----		-----
704		-----		-----	-----		-----	-----		-----		-----
840	D1401	>30		-----	>30		-----	>30		-----	Yes	30
862		-----		-----	-----		-----	-----		-----		-----
901	D1401	>30		-----	>30		-----	-----		-----	Yes	30
912		-----		-----	-----		-----	-----		-----		-----
962		-----		-----	-----		-----	-----		-----		-----
963		-----		-----	-----		-----	-----		-----		-----
974		-----		-----	-----		-----	-----		-----		-----
1023		-----		-----	-----		-----	-----		-----		-----
1059		-----		-----	-----		-----	-----		-----		-----
1146		-----		-----	-----		-----	-----		-----		30
1262	ISO6614	20		-0.61	> 60	f+?	>4.50	> 60	f+?	>5.21	Yes	60
1417	D1401	37		1.77	37		1.28	37		1.99	No	-----
1431		-----		-----	-----		-----	-----		-----		30
1435	D1401	41		2.33	41		1.84	-----		-----	No	-----
1569		-----		-----	-----		-----	-----		-----	Yes	30
1604		-----		-----	-----		-----	-----		-----		-----
1875		-----		-----	-----		-----	-----		-----		-----
1943		-----		-----	-----		-----	-----		-----		-----
1957		-----		-----	-----		-----	-----		-----		-----
1966		-----		-----	-----		-----	-----		-----		-----
6002	ISO6614	19.8		-0.64	19.8		-1.12	19.8		-0.41	No	-----
6016		-----		-----	-----		-----	-----		-----	Yes	30
6141		-----		-----	-----		-----	-----		-----		-----
6235		-----		-----	-----		-----	-----		-----		-----
6283	D1401	27.2		0.40	27.2		-0.09	30		1.01	No	-----
6333		-----		-----	43		2.12	-----		-----	Yes	60
6359		-----		-----	-----		-----	-----		-----		-----

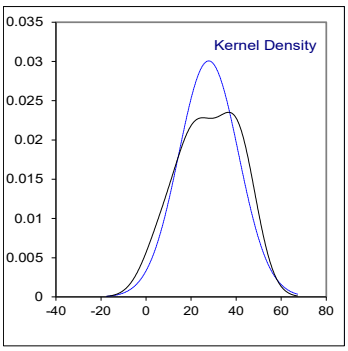
normality	unknown	unknown	unknown
n	8	7	5
outliers	0	0	0
mean (n)	24.35	27.83	22.76
st.dev. (n)	10.782	13.267	11.401
R(calc.)	30.19	37.15	31.92
st.dev.(D1401:21)	7.143	7.143	7.143
R(D1401:21)	20	20	20

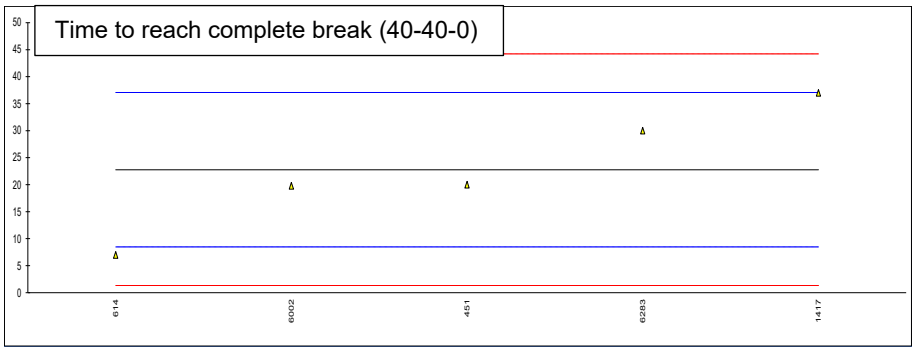
Lab 614 first reported for time to reach 3 mL or less emulsion: 6 min 50 sec and for time to reach 37 mL or water: 6 min 50 sec


Time to reach 3 mL or less emulsion
614
6002
451
1262
360
6283
1417
1435


Kernel Density


Time to reach 37 mL of water
614
6002
451
6283
1417
1435
6333


Kernel Density


Time to reach complete break (40-40-0)
614
6002
451
6283
1417

Determination of Water Separability at 54 °C, distilled water on sample #22077; results in mL

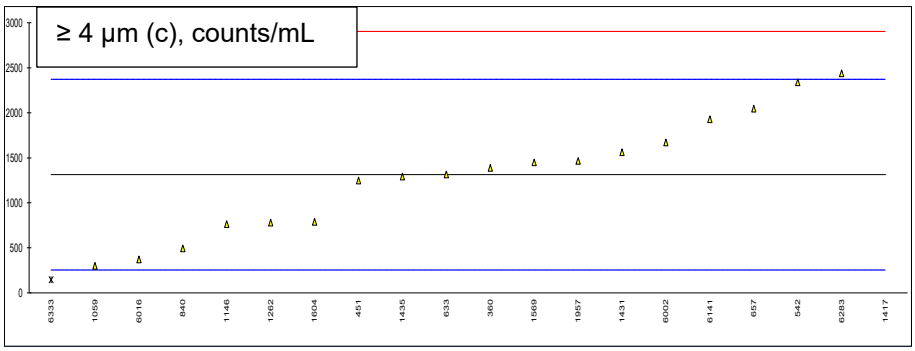
lab	method	volume oil phase	mark	volume water phase	mark	volume emulsion phase	mark
178		-----		-----		-----	
179	D1401	40		30		10	
225		-----		-----		-----	
237	D1401	39	C	37	C	4	C
325	D1401	40		35		5	
331	ISO6614	40		35		5	
349		-----		-----		-----	
360	ISO6614	42		35		3	
432		-----		-----		-----	
451	D1401	40		40		0	
496	D1401	5		32		43	
542		-----		-----		-----	
603		-----		-----		-----	
614	D1401	40		40		0	
633		-----		-----		-----	
657	D1401	40	C	20		20	C
663		-----		-----		-----	
704		-----		-----		-----	
840	D1401	41		35		4	
862		-----		-----		-----	
901	D1401	42		33		5	
912		-----		-----		-----	
962		-----		-----		-----	
963		-----		-----		-----	
974		-----		-----		-----	
1023		-----		-----		-----	
1059		-----		-----		-----	
1146		43		30		7	
1262	ISO6614	41		36		3	
1417	D1401	40		40		0	
1431		40	C	37	C	3	
1435		-----		-----		-----	
1569	D1401	40		35		5	
1604		-----		-----		-----	
1875		-----		-----		-----	
1943		-----		-----		-----	
1957		-----		-----		-----	
1966		-----		-----		-----	
6002	ISO6614	40		37		3	
6016	D1401	40	C	30	C	10	C
6141		-----		-----		-----	
6235		-----		-----		-----	
6283		-----		-----		-----	
6333	D1401	42		38		0	
6359		-----		-----		-----	

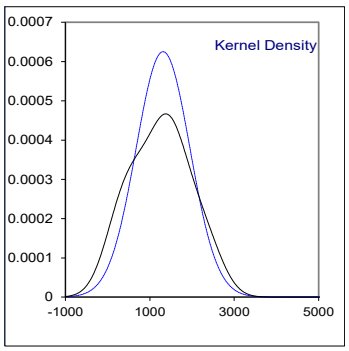
Lab 237 first reported for volume of oil phase: 36, for volume of water phase: 25 and for volume of emulsion phase: 19
Lab 657 first reported for volume of oil phase: 6 and for volume of emulsion phase: 65
Lab 1431 first reported for volume of oil phase: 45 and volume of water phase: 32
Lab 6016 first reported for volume of oil phase: 0, for volume of water phase 27 and for volume of emulsion phase: 53

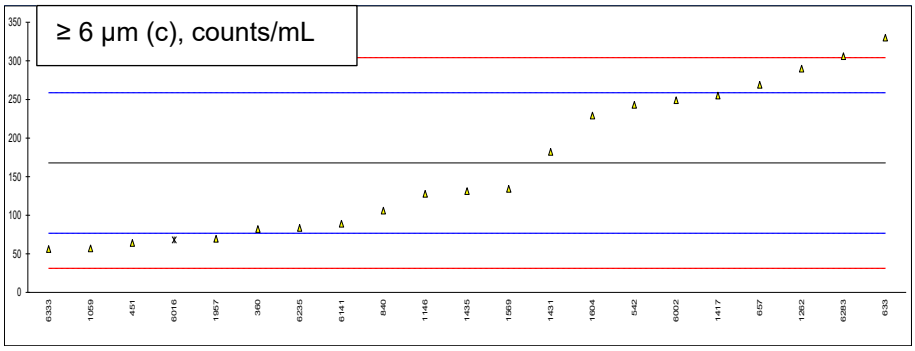
Determination of Level of Contamination on sample #22077; results in counts/mL

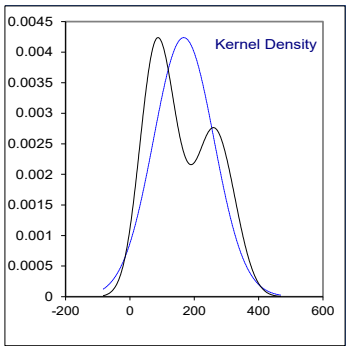
lab	method	≥ 4 µm (c)	mark	z(targ)	≥ 6 µm (c)	mark	z(targ)	≥ 14 µm (c)	mark	z(targ)
178		-----		-----	-----		-----	-----		-----
179		-----		-----	-----		-----	-----		-----
225		-----		-----	-----		-----	-----		-----
237		-----		-----	-----		-----	-----		-----
325		-----		-----	-----		-----	-----		-----
331		-----		-----	-----		-----	-----		-----
349		-----		-----	-----		-----	-----		-----
360	ISO4406	1388.7		0.14	82.0		-1.88	10.2		-0.56
432		-----		-----	-----		-----	-----		-----
451	ISO11500	1248		-0.12	64		-2.28	2		-1.78
496		-----		-----	-----		-----	-----		-----
542	ISO11500	2341		1.94	243		1.66	109	R(0.01)	14.12
603		-----		-----	-----		-----	-----		-----
614		-----		-----	-----		-----	-----		-----
633	ISO4407	1315		0.00	330		3.57	29		2.24
657	ISO4406	2046		1.38	269		2.23	21		1.05
663		-----		-----	-----		-----	-----		-----
704		-----		-----	-----		-----	-----		-----
840	D7647	493.5		-1.55	105.9		-1.36	11.1		-0.42
862		-----		-----	-----		-----	-----		-----
901		-----		-----	-----		-----	-----		-----
912		-----		-----	-----		-----	-----		-----
962		-----		-----	-----		-----	-----		-----
963		-----		-----	-----		-----	-----		-----
974		-----		-----	-----		-----	-----		-----
1023		-----		-----	-----		-----	-----		-----
1059	D7647	301		-1.91	57		-2.43	4		-1.48
1146		764.87		-1.04	127.60		-0.88	11.13		-0.42
1262	ISO11500	780		-1.01	290		2.69	24		1.49
1417		8122	R(0.01)	12.84	255		1.92	24		1.49
1431	ISO4407	1563		0.47	182		0.32	14		0.01
1435	ISO4407	1291.63		-0.04	131.13		-0.80	9.63		-0.64
1569	ISO11500	1449		0.26	134		-0.74	8		-0.89
1604	ISO4407	790		-0.99	229		1.35	21		1.05
1875		-----		-----	-----		-----	-----		-----
1943		-----		-----	-----		-----	-----		-----
1957	ISO4407	1465.3		0.29	69.3		-2.16	15.0		0.15
1966		-----		-----	-----		-----	-----		-----
6002	D7647	1670.8		0.67	249.0		1.79	25.1		1.66
6016	D7596	371		-1.78	68	ex	-2.19	6		-1.18
6141	ISO4406	1930.2		1.16	88.75		-1.73	5.42		-1.27
6235		-----		-----	83.44		-1.85	11.44		-0.37
6283	ISO4407	2438.73		2.12	306.13		3.04	20.93		1.04
6333	D7596	144.6	ex	-2.21	56.2		-2.45	6.2		-1.15
6359		-----		-----	-----		-----	-----		-----
	normality	OK			OK			OK		
	n	18			20			20		
	outliers	1+1ex			0+1ex			1		
	mean (n)	1313.8			167.6			14.0		
	st.dev. (n)	638.29			94.11			8.05		
	R(calc.)	1787.2			263.5			22.5		
	st.dev.(D7647:10R18)	530.20			45.50			6.73		
	R(D7647:10R18)	1484.6			127.4			18.8		

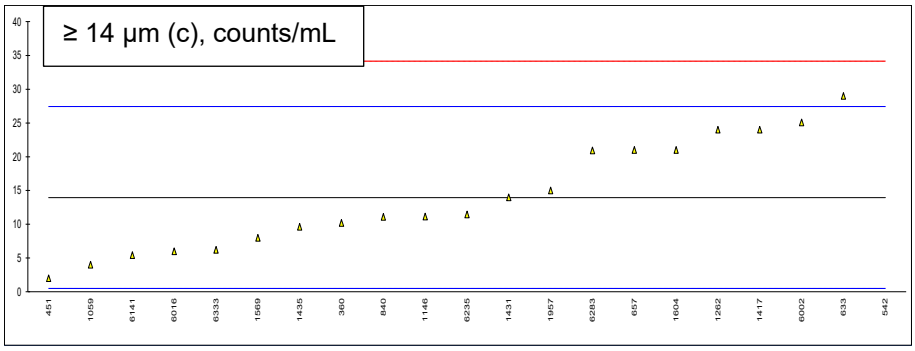
Lab 6016 test result excluded at ≥ 6 µm as test result in counts/mL and ISO4406 scale number did not match
Lab 6333 test result excluded at ≥ 4 µm because of statistical outlier at related measurement in ISO4406 scale number

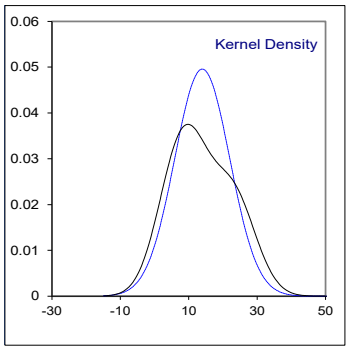

≥ 4 µm (c), counts/mL
3000
2500
2000
1500
1000
500
0
6333 1059 6016 840 1146 1262 1604 451 1435 633 360 1569 1957 1431 6002 6141 657 542 6283 1417


Kernel Density
0.0007
0.0006
0.0005
0.0004
0.0003
0.0002
0.0001
0
-1000 1000 3000 5000


≥ 6 µm (c), counts/mL
350
300
250
200
150
100
50
0
6333 1059 451 6016 1957 360 6235 6141 840 1146 1435 1569 1431 1604 542 6002 1417 657 1262 6283 633


Kernel Density
0.0045
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
-200 0 200 400 600


≥ 14 µm (c), counts/mL
40
35
30
25
20
15
10
5
0
451 1059 6141 6016 6333 1569 1435 360 840 1146 6235 1431 1957 6283 657 1604 1262 1417 6002 633 542

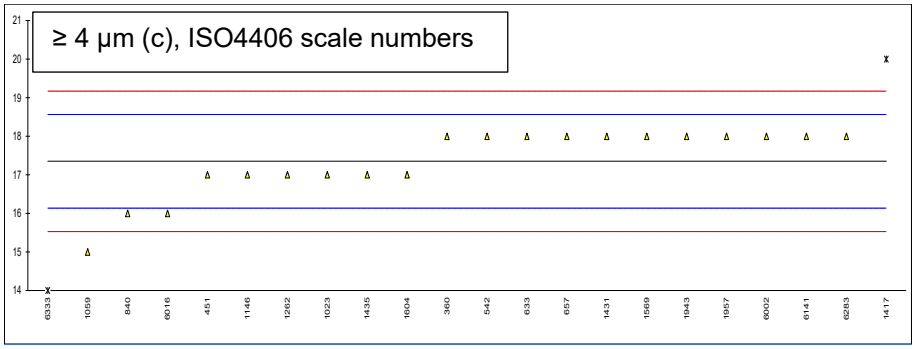

Kernel Density
0.06
0.05
0.04
0.03
0.02
0.01
0
-30 -10 10 30 50

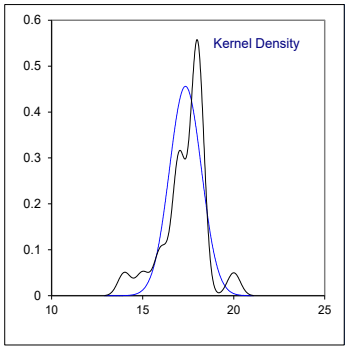
Determination of Level of Contamination on sample #22077; results in ISO4406 scale numbers

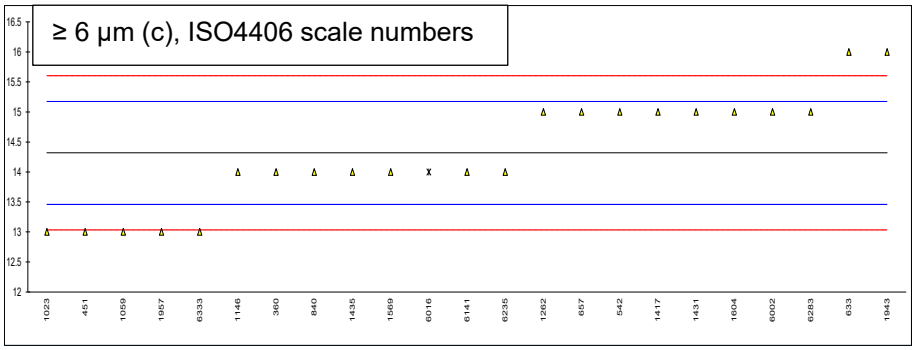
lab	method	≥ 4 µm (c)	mark	z(targ)	≥ 6 µm (c)	mark	z(targ)	≥ 14 µm (c)	mark	z(targ)
178		-----		-----	-----		-----	-----		-----
179		-----		-----	-----		-----	-----		-----
225		-----		-----	-----		-----	-----		-----
237		-----		-----	-----		-----	-----		-----
325		-----		-----	-----		-----	-----		-----
331		-----		-----	-----		-----	-----		-----
349		-----		-----	-----		-----	-----		-----
360	ISO4406	18		1.07	14		-0.74	11		0.32
432		-----		-----	-----		-----	-----		-----
451	ISO4406	17		-0.58	13		-3.08	8		-3.88
496		-----		-----	-----		-----	-----		-----
542	ISO4406	18		1.07	15		1.59	14	ex	4.52
603		-----		-----	-----		-----	-----		-----
614		-----		-----	-----		-----	-----		-----
633	ISO4406	18		1.07	16		3.92	12		1.72
657	ISO4406	18		1.07	15		1.59	12		1.72
663		-----		-----	-----		-----	-----		-----
704		-----		-----	-----		-----	-----		-----
840	ISO4406	16		-2.22	14		-0.74	11		0.32
862		-----		-----	-----		-----	-----		-----
901		-----		-----	-----		-----	-----		-----
912		-----		-----	-----		-----	-----		-----
962		-----		-----	-----		-----	-----		-----
963		-----		-----	-----		-----	-----		-----
974		-----		-----	-----		-----	-----		-----
1023	ISO4406	17		-0.58	13		-3.08	8		-3.88
1059	ISO4406	15		-3.87	13		-3.08	9		-2.48
1146	ISO4406	17		-0.58	14		-0.74	11		0.32
1262	ISO4406	17		-0.58	15		1.59	12		1.72
1417	ISO4406	20	ex	4.36	15		1.59	12		1.72
1431	ISO4406	18		1.07	15		1.59	11		0.32
1435	ISO4406	17		-0.58	14		-0.74	10		-1.08
1569	ISO11500	18		1.07	14		-0.74	10		-1.08
1604	ISO4406	17		-0.58	15		1.59	12		1.72
1875		-----		-----	-----		-----	-----		-----
1943	ISO4406	18		1.07	16		3.92	12		1.72
1957	ISO4406	18		1.07	13		-3.08	11		0.32
1966		-----		-----	-----		-----	-----		-----
6002	D7647	18		1.07	15		1.59	12		1.72
6016	ISO4406	16		-2.22	14	ex	-0.74	10		-1.08
6141	ISO4406	18		1.07	14		-0.74	10		-1.08
6235		-----		-----	14		-0.74	11		0.32
6283	ISO4406	18		1.07	15		1.59	12		1.72
6333		14	R(0.05)	-5.52	13		-3.08	10		-1.08
6359		-----		-----	-----		-----	-----		-----

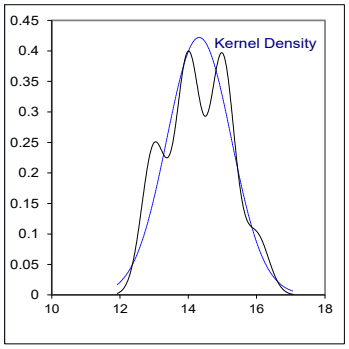
normality	suspect	OK	OK
n	20	22	22
outliers	1+1ex	0+1ex	0+1ex
mean (n)	17.4	14.3	10.8
st.dev. (n)	0.88	0.95	1.27
R(calc.)	2.5	2.6	3.6
st.dev.(D7647:10R18)	0.61	0.43	0.71
R(D7647:10R18)	1.7	1.2	2.0

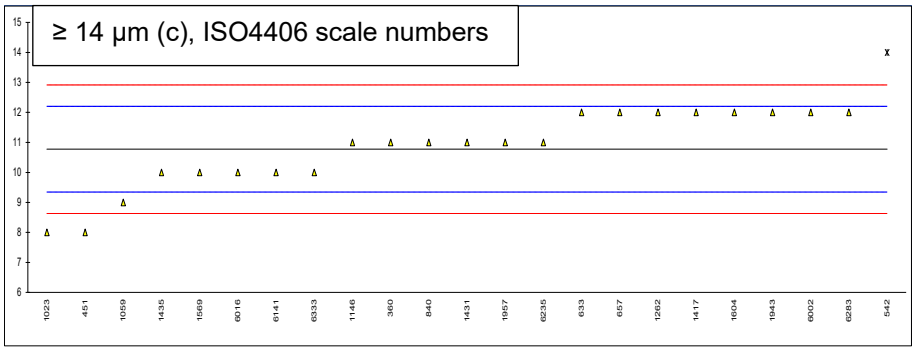
Lab 542 test result excluded at ≥14 µm because of statistical outlier at related measurement in counts/mL
Lab 1417 test result excluded at ≥4 µm because of statistical outlier at related measurement in counts/mL
Lab 6016 test result excluded at ≥6 µm as test result in counts/mL and ISO4406 scale number did not match

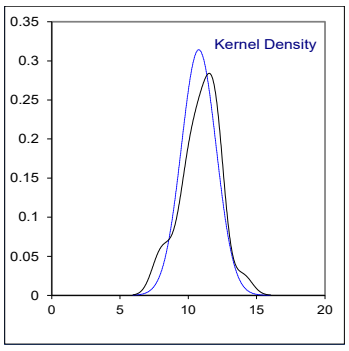

≥ 4 µm (c), ISO4406 scale numbers


Kernel Density


≥ 6 µm (c), ISO4406 scale numbers


Kernel Density


≥ 14 µm (c), ISO4406 scale numbers


Kernel Density

APPENDIX 2

Number of participants per country

1 lab in	ARGENTINA
1 lab in	AUSTRALIA
1 lab in	AUSTRIA
2 labs in	BELGIUM
2 labs in	BULGARIA
1 lab in	CHINA, People's Republic
1 lab in	COTE D'IVOIRE
1 lab in	FRANCE
1 lab in	GEORGIA
2 labs in	GERMANY
1 lab in	GREECE
1 lab in	INDIA
2 labs in	ITALY
1 lab in	KAZAKHSTAN
1 lab in	LATVIA
2 labs in	MALAYSIA
1 lab in	NETHERLANDS
1 lab in	NIGERIA
1 lab in	NORWAY
1 lab in	PHILIPPINES
3 labs in	POLAND
3 labs in	SAUDI ARABIA
1 lab in	SINGAPORE
1 lab in	SLOVENIA
3 labs in	SPAIN
1 lab in	THAILAND
1 lab in	TURKEY
1 lab in	UKRAINE
1 lab in	UNITED ARAB EMIRATES
2 labs in	UNITED KINGDOM
2 labs in	UNITED STATES OF AMERICA
1 lab in	VIETNAM

APPENDIX 3

Abbreviations

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

Literature

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