Results of Proficiency Test
Liquefied Propane &
Sulfur (total) in LPG
October 2019

Organised by: Institute for Interlaboratory Studies
Spijkenisse, the Netherlands

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1 INTRODUCTION

Since 2009, the Institute for Interlaboratory Studies organizes a proficiency test for the analysis of Liquefied Propane every year. In 2017, at the request of several participants, the Institute of Interlaboratory Studies decided to organize an interlaboratory study for Sulfur (total) in LPG together with the Liquified Propane proficiency test. It was decided to continue both the interlaboratory study for Liquefied Propane as well as the interlaboratory study for Sulfur during the annual program 2019/2020.
Because iis has limited gas-handling facilities in place to prepare gas samples, a co-operation with EffecTech (Uttoxeter, United Kingdom) was set up for the Liquefied Propane PT (iis19S03P) and a co-operation with Praxair NV (Belgium) was set up for the Sulfur in LPG PT (iis19S03S). Both EffecTech and Praxair are fully equipped and have experience in the preparation of gas mixtures.
In the interlaboratory studies for Liquefied Propane 56 laboratories in 31 different countries and for Sulfur (total) in LPG 20 laboratories in 13 different countries registered for participation. In this report, the results of the 2019 proficiency tests Liquefied Propane and Sulfur (total) in LPG 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).
To optimize the costs for the participants for the Liquefied Propane PT (iis19S03P), it was decided to prepare one Liquefied Propane mixture for composition analyzes. The mixture was divided over a batch of 61 cylinders (1L cylinder with dip tube device). Each cylinder, filled with approximately 250 grams of Liquefied Propane mixture, was labelled #19215 and uniquely coded.
For the Sulfur in LPG PT (iis19S03S) it was decided to use a batch of 21 cylinders, filled with approximately 1500 grams of LPG, each spiked with Dimethyl Sulfide (DMS). Each cylinder (5L cylinder with dip tube device), was labelled #19216 and uniquely coded.
The limited cylinder sizes (1L and 5L) are chosen to optimize sample stability, cylinder costs, transport and handling costs.
The preparation and testing of the sample cylinders were subcontracted to ISO17025 accredited laboratories. Participants were requested to report rounded and unrounded test results. The unrounded test results were preferably used for statistical evaluation.

2.1 QUALITY SYSTEM

The Institute for Interlaboratory Studies in Spijkenisse, the Netherlands, has implemented a quality system based on ISO/IEC17043:2010. 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 a regular basis by sending out questionnaires.
EffecTech is accredited in conformance with ISO/IEC17043:2010 by UKAS (no. 4719) and ISO17025:2005 by UKAS (no. 0590). Praxair is accredited in conformance with ISO9001-2008, ISO14001-2004, ISO17025-No 159 Cal and ISO/TS16949.

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

Liquefied Propane: sample #19215

One batch of 61 one liter cylinders with artificial Liquefied Propane mixture was prepared and tested for homogeneity by EffecTech (Uttoxeter, United Kingdom) in conformance with ISO guide 35:2006 and ISO17025:2005 (job 19/0968, August 2019). Each cylinder was labelled #19215 and uniquely coded. Every cylinder in the batch was analysed using 5 replicate measurements. The within bottle and between bottle variations were assessed in accordance with ISO Guide 35:2006 (Annex A.1). This procedure showed that the between bottle variations were small compared to the uncertainties on the reference values on each component. Hence, a single reference value could be safely assigned to the entire batch of samples.

The repeatability values (r) were calculated per component by multiplication of the respective standard deviation by 2.8. Subsequently, the calculated repeatabilities were compared with 0.3 times the corresponding reproducibility of the reference method in agreement with the procedure of ISO13528, Annex B2 in the next table.

Component	r(observed) in %mol/mol	reference test method	0.3*R(ref. test method) in %mol/mol
Ethane	0.0028	D2163:14e1	0.0534
Propane	0.0285	D2163:14e1	1.2527
Propene	0.0040	D2163:14e1	0.0679
iso-Butane	0.0231	D2163:14e1	0.0658
n-Butane	0.0104	D2163:14e1	0.0576
1-Butene	0.0012	D2163:14e1	0.0192
iso-Butene	0.0026	D2163:14e1	0.0199
n-Pentane	0.0093	D2163:14e1	0.0257

Table 1: evaluation of the repeatabilities of samples #19215

Each calculated repeatability is less than 0.3 times the corresponding reproducibility of the reference method ASTM D2163:14e1(2019). Therefore, homogeneity of the subsamples #19215 was assumed.

Sulfur (total) in LPG: sample #19216
In this proficiency test, one batch of twenty-one 5L cylinders with artificial LPG mixture with Dimethylsulfide in Propane/n-Butane was prepared and tested for homogeneity by Praxair NV (Belgium) in conformance with ISO9001-2008, ISO14001-2004, ISO17025-No 159 Cal and ISO/TS 16949 in September 2019. Each cylinder was labelled #19216 and uniquely coded.

From the test results for Sulfur for all cylinders, the repeatability of the test results of this batch were calculated by multiplication of the deviation by 2.8. Subsequently, the calculated repeatability was compared with 0.3 times the corresponding reproducibility of the reference method in agreement with the procedure of ISO13528, Annex B2 in the next table.

	Sulfur in mg/kg
r (observed)	2.9
reference test method	ASTM D6667:14
0.3 * R (ref. test method)	4.5

Table 2: evaluation of the repeatability of subsamples #19216

The calculated repeatability is less than 0.3 times the corresponding reproducibility of the reference test method ASTM D6667:14(2019). Therefore, homogeneity of the subsamples #19216 was assumed.

Depending on their registration to each of the participating laboratories one 1L cylinder of Liquefied Propane labelled #19215 and/or one 5L cylinder of Sulfur in LPG labelled #19216 was sent on October 2, 2019. An SDS was added to the sample package.

2.5 STABILITY OF THE SAMPLES

The shelf life time of the prepared gas cylinders is sufficient for the period of the proficiency test.

2.6 ANALYSES

The participants were asked to determine on the Liquefied Propane sample #19215 the composition: Ethane, Propane, Propene, iso-Butane, n-Butane, 1-Butene, iso-Butene, n-Pentane and to calculate several physical parameters from the composition: Molar Mass, Relative Density at 60°F, Absolute and Relative Vapor pressure at 100°F, Absolute and Relative Vapor pressure at 40°C, MON, Ideal Gross Heating Value and Ideal Net Heating Value at 14.696 psia and 60°F.
On the LPG sample #19216 the total Sulfur content was requested.

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

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

3 RESULTS

During five weeks after sample dispatch, the test results of the individual laboratories were gathered via the data entry portal www.kpmd.co.uk/sgs-iis/. The reported test results are tabulated per determination in appendix 1 of this report. The laboratories are presented by their code numbers.
Directly after the deadline, a reminder was sent to those laboratories that had not reported test results at that moment.
Shortly after the deadline, the available test results were screened for suspect data. A test result was called suspect in case the Huber Elimination Rule (a robust outlier test) found it to be an outlier. The laboratories that produced these suspect data were asked to check the reported test results (no reanalysis). 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 June 2018 (iis-protocol, version 3.5).
For the statistical evaluation the *unrounded* (when available) figures were used instead of the rounded test results. Test results reported as ‘<…’ or ‘>…’ were not used in the statistical evaluation.

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

According to ISO5725 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. 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 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 or ISO reproducibilities, the z-scores were calculated using a target standard deviation. This results in an evaluation independent of the variation in this interlaboratory study.

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

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

The z-scores were calculated according to:

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

The $z_{(target)}$ scores are listed in the test 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, some problems were encountered with the dispatch of the samples. For the Liquefied Propane PT (iis19S03P), not all laboratories did report all test results requested. One participant reported test results after the deadline and ten participants did not report any test result at all.
In total 46 participants reported 574 numerical test results. Observed were 48 outlying test results, which is 8.4%. In proficiency studies outlier percentages of 3% - 7.5% are quite normal.
For the Sulfur in LPG PT (iis19S03S), seven participants did not report any result at all. In total 13 participants reported 13 numerical test results. No outlying test results were observed.

Not all original data sets proved to have 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 SAMPLE AND PER TEST

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

In the iis PT reports, ASTM methods are referred to with a number (e.g. D2163) and an added designation for the year that the method was adopted or revised (e.g. D2163:14e1). If applicable, a designation in parentheses is added to designate the year of reapproval (e.g. D2163:14e1(2019)). In the test results tables of appendix 1 only the method number and year of adoption or revision (e.g. D2163:14e1) will be used.

Because the majority of the participating laboratories used ASTM D2163 as test method for the determination of the Propane Composition, it was decided to use the reproducibilities of this test method as target reproducibilities, and to mention the reproducibilities of EN27941 (identical to IP405 and ISO7941) for reference only. In ASTM D2163 no reproducibilities of 1-

butene and iso-butene are mentioned, the reproducibilities of n-butane were used to calculate the reproducibilities of these two components.

Two laboratories (1011 and 1528) reported deviating test results for many of the gas composition test results. At least six of the eight test results were statistical outliers. As the eight test results are not independent, it was decided not to use any of the reported results of these two laboratories for the statistical evaluation.

For comparison to the reported test results for the Physical Properties, iis calculated these Physical Properties for all laboratories that reported composition results. In the statistical evaluation of these calculated properties, the calculated results of above mentioned two laboratories were excluded as well as the calculated results of four other laboratories (333, 334, 337 and 508) with three or four outliers in the composition. For extra information on the calculated parameters, see paragraph 5 Discussion.

Liquefied Propane: sample #19215

Ethane: The determination of this component 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 D2163:14e1(2019) and also with the reproducibility requirements of EN27941:93 (identical to IP405 and ISO7941).

Propane: The determination of this component was not problematic. One statistical outlier was observed and one other test result was excluded. However, the calculated reproducibility after rejection of the suspect data is in agreement with the requirements of ASTM D2163:14e1(2019) and also in agreement with the reproducibility requirements of EN27941:93 (identical to IP405 and ISO7941).

Propene: The determination of this component was not problematic. Four statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in good agreement with the requirements of ASTM D2163:14e1(2019) and also with the reproducibility requirements of EN27941:93 (identical to IP405 and ISO7941).

iso-Butane: The determination of this component was not problematic. Six statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in agreement with the requirements of ASTM D2163:14e1(2019) and also with the reproducibility requirements of EN27941:93 (identical to IP405 and ISO7941).

n-Butane: The determination of this component was not problematic. Six statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in agreement with the requirements of ASTM D2163:14e1 (2019) and also with the reproducibility requirements of EN27941:93 (identical to IP405 and ISO7941).

1-Butene: The determination of this component may not be problematic. Two statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in agreement with the estimated requirements of ASTM D2163:14e1(2019) and also with the reproducibility requirements of EN27941:93 (identical to IP405 and ISO7941).

iso-Butene: The determination of this component may not be problematic. Two statistical outliers were observed and one other test result was excluded. However, the calculated reproducibility after rejection of the suspect data is in agreement with the estimated requirements of ASTM D2163:14e1(2019) and also with the reproducibility requirements of EN27941:93 (identical to IP405 and ISO7941).

n-Pentane: The determination of this component was problematic for several laboratories. Seven statistical outliers were observed. The calculated reproducibility after rejection of the statistical outliers is in agreement with the requirements of ASTM D2163:14e1(2019) and also with the reproducibility requirements of EN27941:93 (identical to IP405 and ISO7941).

Molar Mass: This calculated parameter may not be problematic. Two statistical outliers were observed and two test results were excluded. The calculated reproducibility after rejection of the suspect data is in line with the calculated reproducibility using the published molar mass factors obtained from ASTM D2421:18 over all reported component concentrations (0.08 vs. 0.07 g/mol).

Rel. Density at 60°F: This calculated parameter may not be problematic. Three statistical outliers were observed and one other test result was excluded. The calculated reproducibility after rejection of the suspect data is in line with the calculated reproducibility using the published relative density factors obtained from ASTM D2598:16 over all reported component concentrations (0.0004 vs. 0.0004).

Abs. VP at 100°F: As the reported results calculated via ISO8973 and ASTM D2598 are not identical, it was decided to evaluate the test results for both methods separately.
ISO8973; This calculated parameter may not be problematic. Two statistical outliers were observed (both calculation errors). The calculated reproducibility after rejection of statistical outlier is smaller than the calculated reproducibility using the published vapor pressure factors obtained from ISO8973:97 over all reported component concentrations (0.25 *vs* 0.97 psi).
ASTM D2598; This calculated parameter may not be problematic. No statistical outliers were observed. The calculated reproducibility is in line with the calculated reproducibility using the published vapor pressure factors obtained from ASTM D2598:16 over all reported component concentrations (0.80 vs. 0.96 psi).

Rel. VP at 100°F: As the reported results calculated via ISO8973 and ASTM D2598 are not identical, it was decided to evaluate the test results for both methods separately.
ISO8973; This calculated parameter may not be problematic. Two statistical outliers were observed. The calculated reproducibility after rejection of statistical outliers is smaller than the calculated reproducibility using the published vapor pressure factors obtained from ISO8973:97 over all reported component concentrations (0.26 *vs* 0.97 psi).
ASTM D2598; This calculated parameter may be problematic. One statistical outlier was observed and one other test result excluded (both also calculation errors). The calculated reproducibility after rejection of the suspect data is larger than the calculated reproducibility using the published vapor pressure factors obtained from ASTM D2598:16 over all reported component concentrations (1.27 vs. 0.96 psi).

Abs. VP at 40°C: This determination may not be problematic. Two statistical outliers were observed (both calculation errors) and one test result was excluded. The calculated reproducibility after rejection of the suspect data is smaller than the calculated reproducibility using the published vapor pressure factors obtained from ISO8973:97 over all reported component concentrations (4.8 vs. 6.9 kPa).

Rel. VP at 40°C: This determination may not be problematic. Two statistical outliers were observed (both calculation errors) and three other test results were excluded. The calculated reproducibility after rejection of the suspect data is in line with the calculated reproducibility using the published vapor pressure factors obtained from ISO8973:97 over all reported component concentrations (5.4 vs. 6.9 kPa).

MON: As the reported results calculated via EN589 and ASTM D2598 are not identical, it was decided to evaluate the test results for both methods separately.
EN589; This calculated parameter may not be problematic. Two statistical outliers were observed and two test results were excluded. The calculated reproducibility after rejection of suspect data is smaller than the calculated reproducibility using the published vapor pressure factors obtained from EN589:18 over all reported component concentrations (0.03 *vs* 0.05).
D2598; Five test results were reported, so no conclusions could be drawn.

Ideal Gross Heating Value at 14.696 psia / 60°F: Almost all laboratories reported to have calculated according to ASTM D3588. This calculated parameter may not be problematic. One statistical outlier was observed (also a calculation error) and one test result was excluded. The calculated reproducibility after rejection of the suspect data is in line with the calculated reproducibility using the published Ideal Gross Heating Values obtained from EN3588:98(2017) over all reported component concentrations (3 *vs* 3).

Ideal Net Heating Value at 14.696 psia / 60°F: Almost all laboratories reported to have calculated according to ASTM D3588. This calculated parameter may not be problematic. One statistical outlier was observed (also a calculation error) and one test result was excluded. The calculated reproducibility after rejection of the suspect data is in line with the calculated reproducibility using the published Ideal Net Heating Values obtained from EN3588:98(2017) over all reported component concentrations (3 *vs* 3).

Sulfur in LPG: sample #19216

Sulfur, total: The determination of this component was not problematic. No statistical outliers were observed. The calculated reproducibility is in agreement with the requirements of ASTM D6667:14(2019).

4.2 PERFORMANCE EVALUATION FOR THE GROUP OF LABORATORIES

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

Component	unit	n	average	2.8 * sd	R(D2163) in **%mol**	R(EN27941) in **%mol**
Ethane	%mol/mol	44	0.351	0.112	0.163	0.299
Propane	%mol/mol	44	93.39	0.69	4.17	1.02
Propene	%mol/mol	42	0.688	0.057	0.223	0.213
iso-Butane	%mol/mol	40	2.095	0.175	0.222	0.386
n-Butane	%mol/mol	40	2.177	0.189	0.195	0.386
1-Butene	%mol/mol	44	0.189	0.031	0.065	0.160
iso-Butene	%mol/mol	43	0.202	0.035	0.067	0.160
n-Pentane	%mol/mol	39	0.850	0.084	0.087	0.311

Table 3: reproducibilities of composition tests on sample #19215

Parameter	unit	n	average	2.8 * sd	R (all calc.)
Molar Mass	g/mol	24	44.92	0.08	0.07
Rel. Density at 60°F		27	0.5119	0.0004	0.0004
Abs. VP at 100°F-ISO	psi	10	185.8	0.3	1.0
Abs. VP at 100°F-ASTM	psi	7	181.8	0.8	1.0
Rel. VP at 100°F-ISO	psi	12	171.1	0.3	1.0
Rel. VP at 100°F-ASTM	psi	10	167.1	1.3	1.0
Abs. VP at 40°C	kPa	22	1317	5	7
Rel. VP at 40°C	kPa	20	1216	5	7
MON – EN589		13	95.09	0.03	0.05
MON – D2598		5	96.29	(1.00)*	0.06

Parameter	unit	n	average	2.8 * sd	R (all calc.)
Ideal Gross HV	kJ/mol	11	2259	3	3
Net Gross HV	kJ/mol	11	2079	3	3

Table 4: reproducibilities of calculated parameters on sample #19215
*) results in brackets based on only five test results.
all calc. = calculated over all reported composition test results excluded the suspect data.

Component	unit	n	average	2.8 * sd	R(lit)
Sulfur, total	mg/kg	13	44.0	12.4	13.9

Table 5: reproducibility of test on sample #19216

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

4.3 COMPARISON OF THE PROFICIENCY TEST OF OCTOBER 2019 WITH PREVIOUS PTS

	October 2019	October 2018	October 2017	October 2016	October 2015
Number of reporting laboratories	46	44	47	43	41
Number of test results reported	574	495	536	472	468
Number of statistical outliers	48	20	30	34	24
Percentage outliers	8.4%	4.0%	5.6%	7.2%	5.1%

Table 6: comparison with previous proficiency tests on Liquefied Propane (excluded Sulfur in LPG)

	October 2019	October 2018	October 2017
Number of reporting laboratories	13	15	8
Number of test results reported	13	15	8
Number of statistical outliers	0	1	1
Percentage outliers	0%	6.7%	12.5%

Table 7: comparison with previous proficiency tests on Sulfur in LPG only

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

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

Component	October 2019	October 2018	October 2017	October 2016	October 2015
Ethane	+	++	++	++	++
Propane	++	++	++	++	++
Propene	++	++	++	++	+
iso-Butane	+	-	+/-	-	+
n-Butane	+/-	--	-	-	-
1-Butene	++	+	++	++	++
iso-Butene	+	+	++	+	++
n-Pentane	+/-	-	-	-	-

Table 8: comparison determinations on Liquefied Propane against the requirements of the reference test methods

Component	October 2019	October 2018	October 2017
Sulfur, total	+	-	+

Table 9: comparison determinations on Sulfur in LPG against the requirements of the reference test methods

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

5 DISCUSSION

Because several of the reproducibility requirements of ASTM D2163 differ significantly from the reproducibility requirements of EN27941 (for liquid injection), the outcome of the evaluation will be strongly dependent on the target test method selected for the evaluation.

The consensus values as determined in this PT are compared with the average values from the homogeneity testing by EffecTech, United Kingdom in the following table.

Parameter	Average by EffecTech in %mol/mol	Average from participants in %mol/mol	Difference in %mol/mol	z-score
Ethane	0.401	0.351	0.051	0.87
Propane	93.570	93.394	0.176	0.12
Propene	0.706	0.688	0.018	0.23
iso-Butane	2.037	2.095	-0.058	-0.73
n-Butane	2.095	2.177	-0.082	-1.17
1-Butene	0.182	0.189	-0.007	-0.31
iso-Butene	0.198	0.202	-0.004	-0.16
n-Pentane	0.811	0.850	-0.040	-1.30

Table 10: comparison of consensus values with values determined by EffecTech

From this comparison it is clear that all consensus values as determined in this PT are in line with the values as determined by EffecTech during the preparation of the cylinders.

For the calculation of the Molar Mass, Relative Density, Vapor Pressure, Motor Octane Number and Heating Value several standardized test methods are available, e.g. ASTM D2421 for the interconversion of the units to gas-volume, liquid-volume or mass basis. Also, different test methods for the calculation of the Vapor Pressure do exist. In ISO8973 (identical to IP432) the Vapor Pressure is calculated from the mole fraction per component and a Vapor Pressure factor of that component (given for all components). In ASTM D2598 the Vapor Pressure is calculated from the liquid volume percentage per component and a Vapor Pressure factor of that component (given for only several components). The selection of the tables to be used for the calculations may cause additional variation.

It is remarkable to see that the results for Vapor Pressure from the ASTM D2598 calculation are significantly lower than the results from the ISO8973/IP432 calculation.
The observed difference is caused by a difference in the VP factor of Ethane. ASTM (Subcommittee D02.H) commented (see also appendix 3, literature: 15):

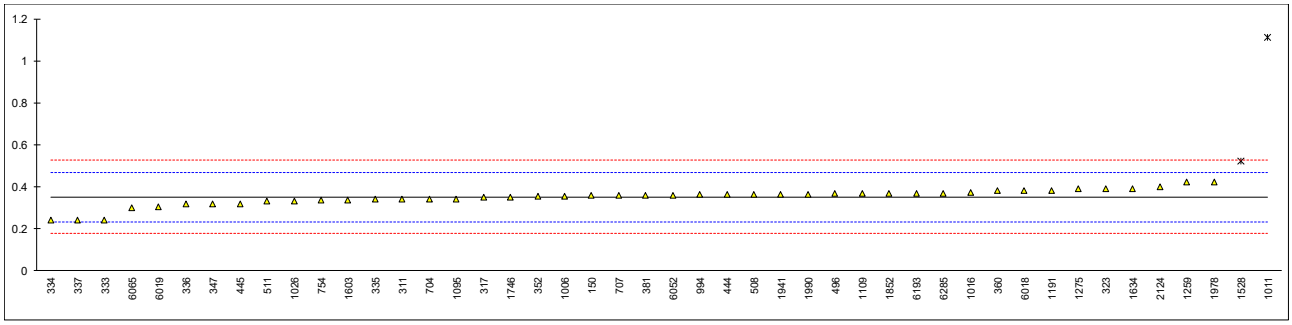
"*The vapor pressure of ethane in D2598 was revised a few times prior to 2002. The current value, 611 psi, has remained the same for the last ten years. The revision of ethane was done because components in LPG blends do not necessarily behave as ideal gases. In particular, properties of ethane and ethylene appear to differ from ideality. Factors for these two components have been modified from 'ideal gas' values to make the calculated vapor pressure results more closely approximate actual measured vapor pressures of LPG blends. (i.e. D1267). Chapter 2 of Fuels and Lubricants Handbook (George Totten, © 2003), states that calculated vapor pressure were found to be biased high relative to experimental vapor pressure measured by D1267 for high ethane samples in earlier versions of D2598*".

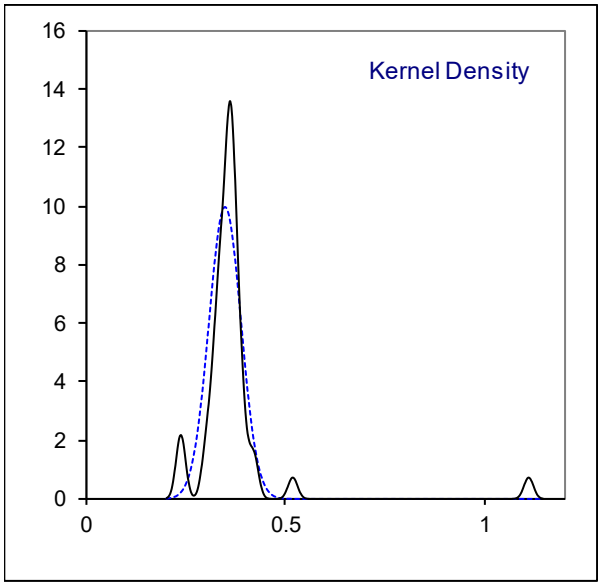
APPENDIX 1

Determination of Ethane on sample #19215; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
150	D2163	0.360		0.16	
171		-----		-----	
311	D2163	0.34		-0.18	
317	D2163	0.35		-0.01	
323	D2163	0.39		0.68	
333	D2163	0.24		-1.90	
334	D2163	0.24		-1.90	
335	D2163	0.34		-0.18	
336	EN27941	0.32		-0.53	
337	D2163	0.24		-1.90	
347	D2163	0.320		-0.53	
352	EN27941	0.3541		0.06	
360	EN27941	0.38		0.51	
381	EN27941	0.36		0.16	
444	IP405	0.362		0.20	
445	D2163	0.32		-0.53	
496	D2163	0.369		0.32	
508	D2163	0.362675		0.21	
511	D2163	0.33	C	-0.35	first reported: 0.19
529		-----		-----	
704	D2163	0.340		-0.18	
707	D2163	0.360		0.16	
754	D2163	0.335		-0.27	
868		-----		-----	
994	D2163	0.3614		0.19	
1006	D2163	0.356		0.09	
1011	ISO7941	1.11	C,R(0.01)	13.05	first reported: 1.1
1012		-----		-----	
1016	ISO7941	0.373		0.39	
1026	ISO7941	0.3336		-0.29	
1095	ISO7941	0.34		-0.18	
1109	IP405	0.37		0.33	
1191	IP473	0.381		0.52	
1197		-----		-----	
1198		-----		-----	
1259	EN27941	0.422		1.23	
1275	EN27941	0.38895		0.66	
1528	EN27941	0.52	R(0.01)	2.91	
1603	In house	0.3371		-0.23	
1634	ISO7941	0.39		0.68	
1720		-----		-----	
1746	D2163	0.35		-0.01	
1786		-----		-----	
1852	DIN51619	0.37		0.33	
1941	DIN51619	0.364		0.23	
1978	D2163	0.4228		1.24	
1990	IP473	0.365		0.25	
2124	D2163	0.401		0.87	
6018	ISO7941	0.380		0.51	
6019	ISO7941	0.304		-0.80	
6052	D2163	0.36		0.16	
6065	D2163	0.3020		-0.83	
6193	D2163	0.37		0.33	
6201		-----		-----	
6215		-----		-----	
6285	EN27941	0.37		0.33	

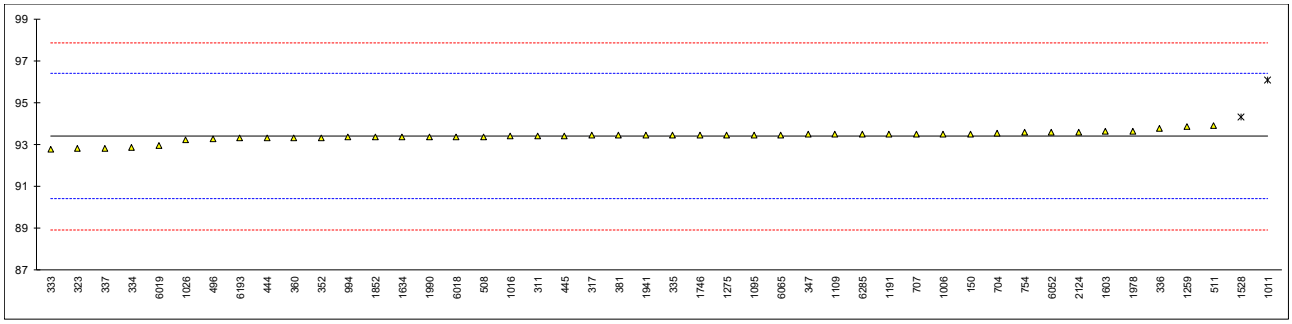
	normality	not OK	
	n	44	
	outliers	2	
	mean (n)	0.3506	
	st.dev. (n)	0.04012	
	R(calc.)	0.1123	
	st.dev.(D2163:14e1)	0.05818	
	R(D2163:14e1)	0.1629	Compare R(EN27941:93(liq)) = 0.2986

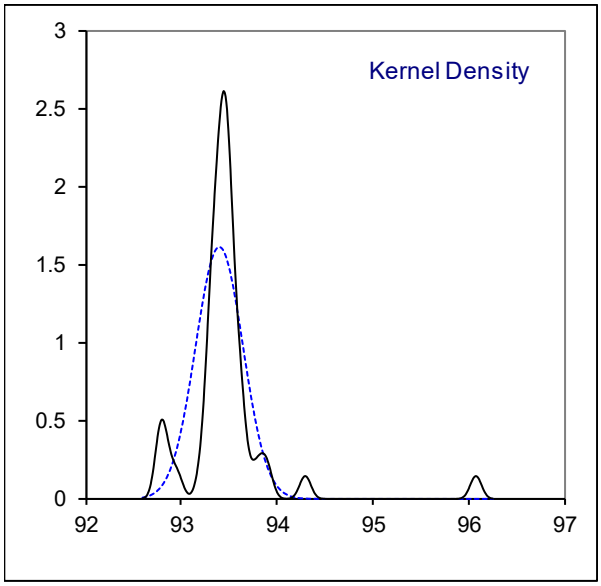

1.2
1
0.8
0.6
0.4
0.2
0
334 337 333 6065 6019 336 347 445 511 1026 754 1603 335 311 704 1095 317 1746 352 1006 150 707 381 6052 994 444 508 1941 1990 496 1109 1852 6193 6285 1016 360 6018 1191 1275 323 1634 2124 1259 1978 1528 1011


Kernel Density
16
14
12
10
8
6
4
2
0
0
0.5
1

Determination of Propane on sample #19215; results in %mol/mol

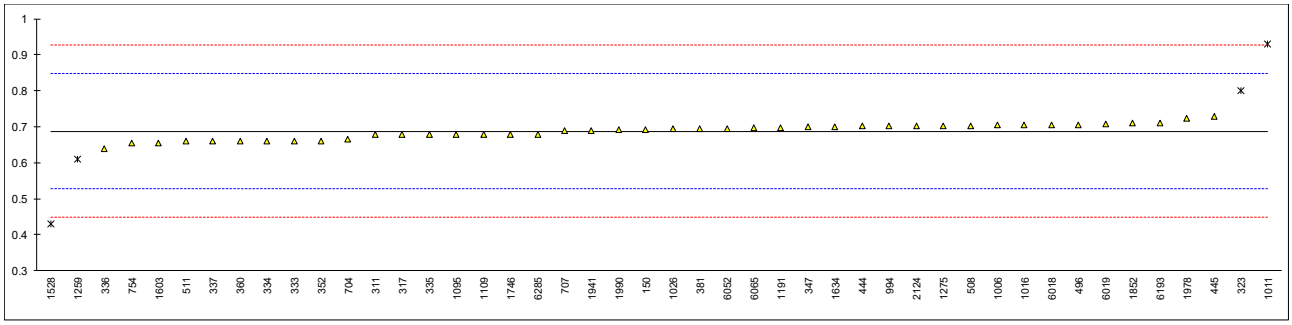
lab	method	value	mark	z(targ)	remarks
150	D2163	93.514		0.08	
171		-----		-----	
311	D2163	93.41		0.01	
317	D2163	93.43		0.02	
323	D2163	92.79		-0.41	
333	D2163	92.77		-0.42	
334	D2163	92.86		-0.36	
335	D2163	93.44		0.03	
336	EN27941	93.76		0.25	
337	D2163	92.79		-0.41	
347	D2163	93.479		0.06	
352	EN27941	93.31		-0.06	
360	EN27941	93.30		-0.06	
381	EN27941	93.435		0.03	
444	IP405	93.297		-0.06	
445	D2163	93.41		0.01	
496	D2163	93.282		-0.07	
508	D2163	93.375151		-0.01	
511	D2163	93.9		0.34	
529		-----		-----	
704	D2163	93.528		0.09	
707	D2163	93.506		0.08	
754	D2163	93.575		0.12	
868		-----		-----	
994	D2163	93.3338		-0.04	
1006	D2163	93.507		0.08	
1011	ISO7941	96.07	C,R(0.01)	1.80	first reported: 97.0
1012		-----		-----	
1016	ISO7941	93.399		0.00	
1026	ISO7941	93.2066		-0.13	
1095	ISO7941	93.46		0.04	
1109	IP405	93.49		0.06	
1191	IP473	93.503		0.07	
1197		-----		-----	
1198		-----		-----	
1259	EN27941	93.839		0.30	
1275	EN27941	93.4409		0.03	
1528	EN27941	94.29	ex	0.60	test result excluded, see paragraph 4.1
1603	In house	93.6161		0.15	
1634	ISO7941	93.36		-0.02	
1720		-----		-----	
1746	D2163	93.44		0.03	
1786		-----		-----	
1852	DIN51619	93.35		-0.03	
1941	DIN51619	93.436		0.03	
1978	D2163	93.6441		0.17	
1990	IP473	93.366		-0.02	
2124	D2163	93.600		0.14	
6018	ISO7941	93.373		-0.01	
6019	ISO7941	92.957		-0.29	
6052	D2163	93.5934		0.13	
6065	D2163	93.4660		0.05	
6193	D2163	93.29		-0.07	
6201		-----		-----	
6215		-----		-----	
6285	EN27941	93.49		0.06	
	normality	suspect			
	n	44			
	outliers	1 (+1ex)			
	mean (n)	93.3937			
	st.dev. (n)	0.24677			
	R(calc.)	0.6910			
	st.dev.(D2163:14e1)	1.48932			
	R(D2163:14e1)	4.1701			Compare R(EN27941:93(liq)) = 1.0181

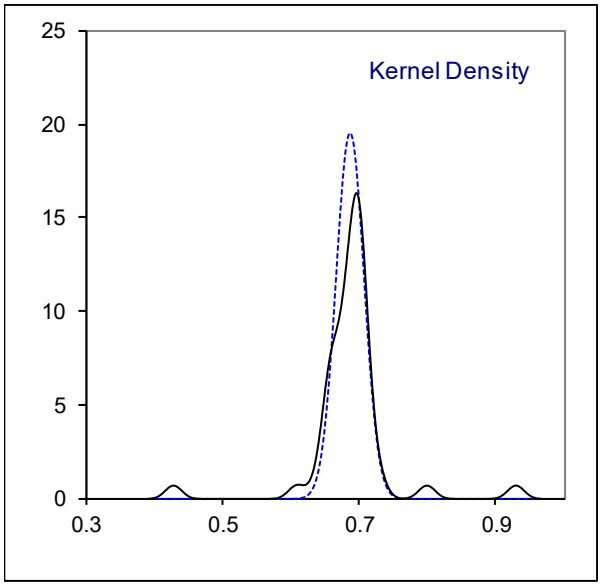

99
97
95
93
91
89
87
333 323 337 334 6019 1026 496 6193 444 360 352 994 1852 1634 1990 6018 508 1016 311 445 317 381 1941 335 1746 1275 1095 6065 347 1109 6285 1191 707 1006 150 704 754 6052 2124 1603 1978 336 1259 511 1528 1011


Kernel Density
3
2.5
2
1.5
1
0.5
0
92
93
94
95
96
97

Determination of Propene on sample #19215; results in %mol/mol

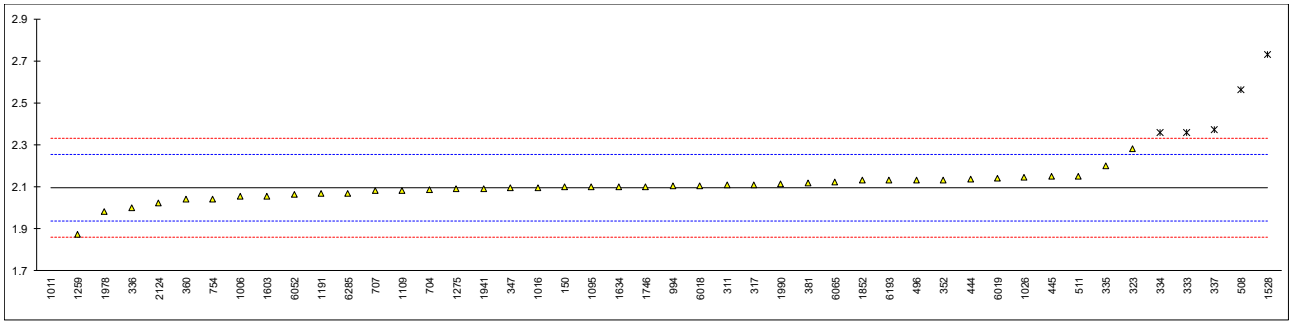
lab	method	value	mark	z(targ)	remarks
150	D2163	0.693		0.07	
171		-----		-----	
311	D2163	0.68		-0.10	
317	D2163	0.68		-0.10	
323	D2163	0.80	R(0.01)	1.41	
333	D2163	0.66		-0.35	
334	D2163	0.66		-0.35	
335	D2163	0.68		-0.10	
336	EN27941	0.64		-0.60	
337	D2163	0.66		-0.35	
347	D2163	0.700		0.15	
352	EN27941	0.6610		-0.34	
360	EN27941	0.66		-0.35	
381	EN27941	0.694		0.08	
444	IP405	0.7015		0.17	
445	D2163	0.73		0.53	
496	D2163	0.705		0.22	
508	D2163	0.703672		0.20	
511	D2163	0.66		-0.35	
529		-----		-----	
704	D2163	0.666		-0.27	
707	D2163	0.690		0.03	
754	D2163	0.655		-0.41	
868		-----		-----	
994	D2163	0.7016		0.17	
1006	D2163	0.704		0.20	
1011	ISO7941	0.93	C,R(0.01)	3.05	first reported: 0.9
1012		-----		-----	
1016	ISO7941	0.704		0.20	
1026	ISO7941	0.6934		0.07	
1095	ISO7941	0.68		-0.10	
1109	IP405	0.68		-0.10	
1191	IP473	0.697		0.12	
1197		-----		-----	
1198		-----		-----	
1259	EN27941	0.610	R(0.05)	-0.98	
1275	EN27941	0.70235		0.18	
1528	EN27941	0.43	R(0.01)	-3.24	
1603	In house	0.6552		-0.41	
1634	ISO7941	0.70		0.15	
1720		-----		-----	
1746	D2163	0.68		-0.10	
1786		-----		-----	
1852	DIN51619	0.71		0.28	
1941	DIN51619	0.690		0.03	
1978	D2163	0.7231		0.44	
1990	IP473	0.691		0.04	
2124	D2163	0.702		0.18	
6018	ISO7941	0.704		0.20	
6019	ISO7941	0.708		0.25	
6052	D2163	0.6951		0.09	
6065	D2163	0.6966		0.11	
6193	D2163	0.71		0.28	
6201		-----		-----	
6215		-----		-----	
6285	EN27941	0.68		-0.10	
	normality	OK			
	n	42			
	outliers	4			
	mean (n)	0.6878			
	st.dev. (n)	0.02041			
	R(calc.)	0.0572			
	st.dev.(D2163:14e1)	0.07951			
	R(D2163:14e1)	0.2226			Compare R(EN27941:93(liq)) = 0.2134

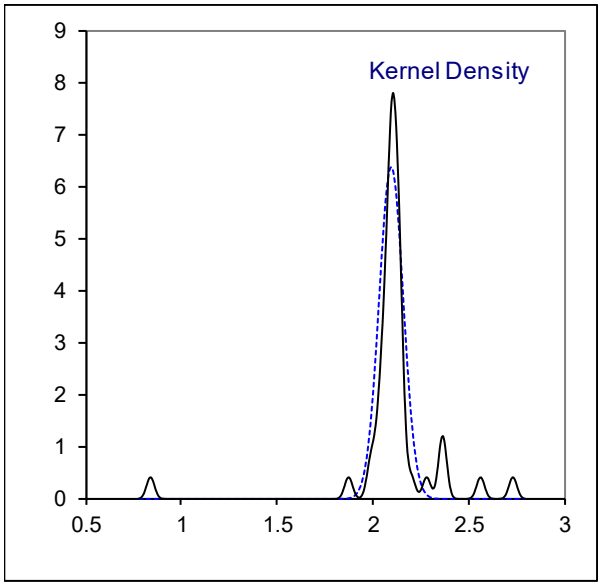

1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
1528 1259 336 754 1603 511 337 360 334 333 352 704 311 317 335 1095 1109 1746 6285 707 1941 1990 150 1026 381 6052 6065 1191 347 1634 444 994 2124 1275 508 1006 1016 6018 496 6019 1852 6193 1978 445 323 1011


Kernel Density
25
20
15
10
5
0
0.3
0.5
0.7
0.9

Determination of iso-Butane on sample #19215; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
150	D2163	2.099		0.05	
171		-----		-----	
311	D2163	2.11		0.19	
317	D2163	2.11		0.19	
323	D2163	2.28		2.33	
333	D2163	2.36	R(0.01)	3.34	
334	D2163	2.36	R(0.01)	3.34	
335	D2163	2.20		1.32	
336	EN27941	2.00		-1.20	
337	D2163	2.37	R(0.01)	3.47	
347	D2163	2.094		-0.01	
352	EN27941	2.1334		0.48	
360	EN27941	2.04		-0.70	
381	EN27941	2.12		0.31	
444	IP405	2.134		0.49	
445	D2163	2.15		0.69	
496	D2163	2.133		0.48	
508	D2163	2.561268	R(0.01)	5.88	
511	D2163	2.15		0.69	
529		-----		-----	
704	D2163	2.088		-0.09	
707	D2163	2.080		-0.19	
754	D2163	2.04		-0.70	
868		-----		-----	
994	D2163	2.1052		0.13	
1006	D2163	2.054		-0.52	
1011	ISO7941	0.84	C,R(0.01)	-15.84	first reported: 0.8
1012		-----		-----	
1016	ISO7941	2.095		0.00	
1026	ISO7941	2.1436		0.61	
1095	ISO7941	2.10		0.06	
1109	IP405	2.08		-0.19	
1191	IP473	2.066		-0.37	
1197		-----		-----	
1198		-----		-----	
1259	EN27941	1.873		-2.80	
1275	EN27941	2.09215		-0.04	
1528	EN27941	2.73	R(0.01)	8.01	
1603	In house	2.0540		-0.52	
1634	ISO7941	2.10		0.06	
1720		-----		-----	
1746	D2163	2.10		0.06	
1786		-----		-----	
1852	DIN51619	2.13		0.44	
1941	DIN51619	2.093		-0.03	
1978	D2163	1.9840		-1.40	
1990	IP473	2.113		0.23	
2124	D2163	2.025		-0.89	
6018	ISO7941	2.106		0.14	
6019	ISO7941	2.142		0.59	
6052	D2163	2.0655		-0.37	
6065	D2163	2.1235		0.36	
6193	D2163	2.13		0.44	
6201		-----		-----	
6215		-----		-----	
6285	EN27941	2.07		-0.32	
	normality	not OK			
	n	40			
	outliers	6			
	mean (n)	2.0952			
	st.dev. (n)	0.06265			
	R(calc.)	0.1754			
	st.dev.(D2163:14e1)	0.07922			
	R(D2163:14e1)	0.2218			Compare R(EN27941:93(liq)) = 0.3862


2.9
2.7
2.5
2.3
2.1
1.9
1.7
1011
1259
1978
336
2124
360
754
1006
1603
6052
1191
6285
707
1109
704
1275
1941
347
1016
150
1095
1634
1746
994
6018
311
317
1990
381
6065
1852
6193
496
352
444
6019
1026
445
511
335
323
334
333
337
508
1528

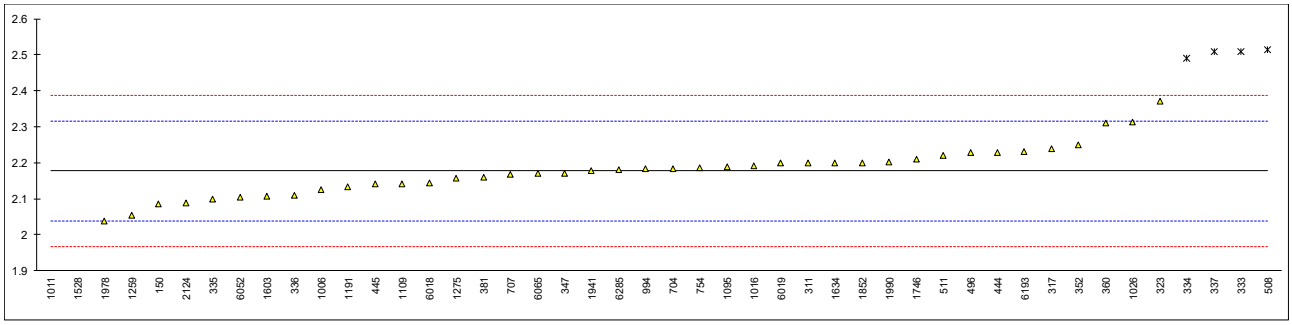

Kernel Density
9
8
7
6
5
4
3
2
1
0
0.5
1
1.5
2
2.5
3

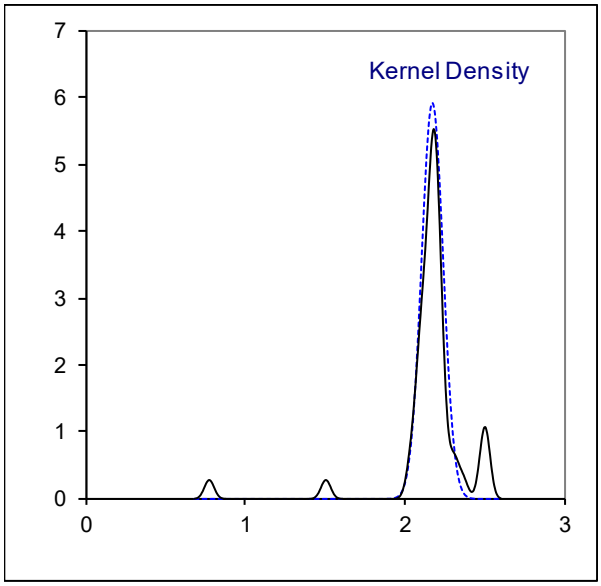
Determination of n-Butane on sample #19215; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
150	D2163	2.085		-1.32	
171		-----		-----	
311	D2163	2.20		0.33	
317	D2163	2.24		0.90	
323	D2163	2.37		2.77	
333	D2163	2.51	R(0.01)	4.77	
334	D2163	2.49	R(0.01)	4.49	
335	D2163	2.10		-1.11	
336	EN27941	2.11		-0.96	
337	D2163	2.51	R(0.01)	4.77	
347	D2163	2.171		-0.09	
352	EN27941	2.2489		1.03	
360	EN27941	2.31		1.91	
381	EN27941	2.159		-0.26	
444	IP405	2.229		0.74	
445	D2163	2.14		-0.53	
496	D2163	2.229		0.74	
508	D2163	2.514374	R(0.01)	4.84	
511	D2163	2.22	C	0.61	first reported: 1.85
529		-----		-----	
704	D2163	2.184		0.10	
707	D2163	2.168		-0.13	
754	D2163	2.185		0.11	
868		-----		-----	
994	D2163	2.1839		0.10	
1006	D2163	2.126		-0.73	
1011	ISO7941	0.78	C,R(0.01)	-20.03	first reported: 0.8
1012		-----		-----	
1016	ISO7941	2.192		0.21	
1026	ISO7941	2.3122		1.94	
1095	ISO7941	2.19		0.18	
1109	IP405	2.14		-0.53	
1191	IP473	2.132		-0.65	
1197		-----		-----	
1198		-----		-----	
1259	EN27941	2.054		-1.77	
1275	EN27941	2.1567		-0.29	
1528	EN27941	1.51	R(0.01)	-9.57	
1603	In house	2.1062		-1.02	
1634	ISO7941	2.20		0.33	
1720		-----		-----	
1746	D2163	2.21		0.47	
1786		-----		-----	
1852	DIN51619	2.20		0.33	
1941	DIN51619	2.179		0.03	
1978	D2163	2.0389		-1.98	
1990	IP473	2.201		0.34	
2124	D2163	2.087		-1.29	
6018	ISO7941	2.144		-0.47	
6019	ISO7941	2.199		0.31	
6052	D2163	2.1032		-1.06	
6065	D2163	2.1707		-0.09	
6193	D2163	2.23		0.76	
6201		-----		-----	
6215		-----		-----	
6285	EN27941	2.18		0.04	

normality	suspect
n	40
outliers	6
mean (n)	2.1771
st.dev. (n)	0.06750
R(calc.)	0.1890
st.dev.(D2163:14e1)	0.06974
R(D2163:14e1)	0.1953

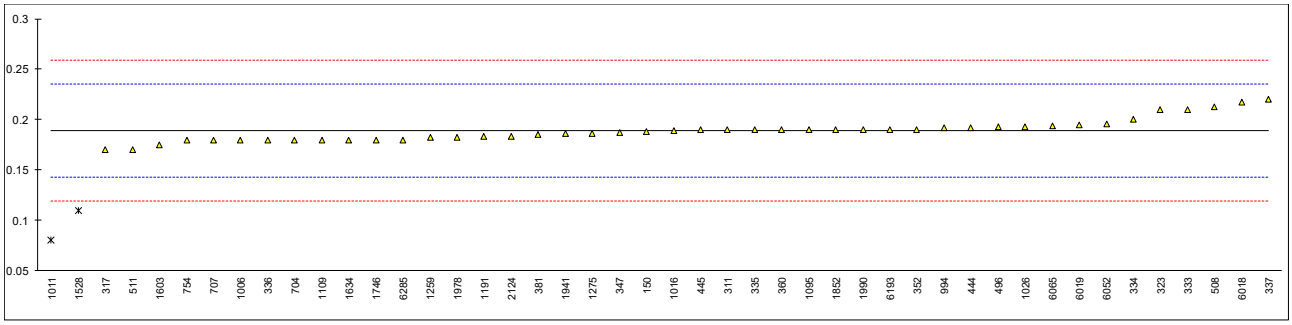
Compare R(EN27941:93(liq)) = 0.3862

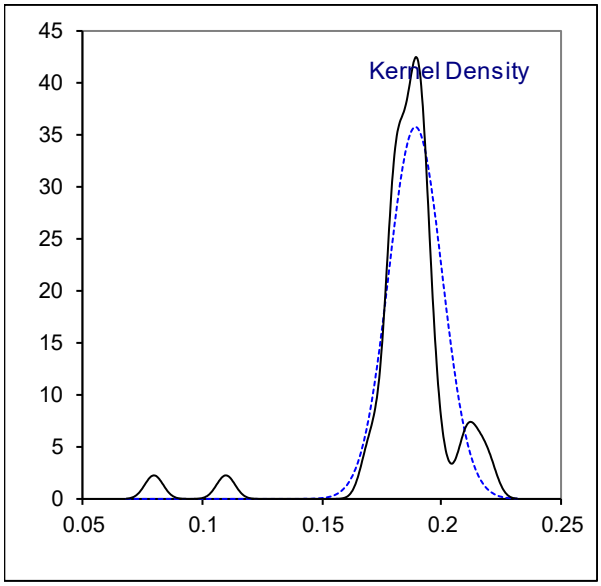

2.6
2.5
2.4
2.3
2.2
2.1
2
1.9
1011 1528 1978 1259 150 2124 335 6052 1603 336 1006 1191 445 1109 6018 1275 381 707 6065 347 1941 6285 994 704 754 1095 1016 6019 311 1634 1852 1990 1746 511 496 444 6193 317 352 360 1026 323 334 337 333 508


Kernel Density
7
6
5
4
3
2
1
0
0
1
2
3

Determination of 1-Butene on sample #19215; results in %mol/mol

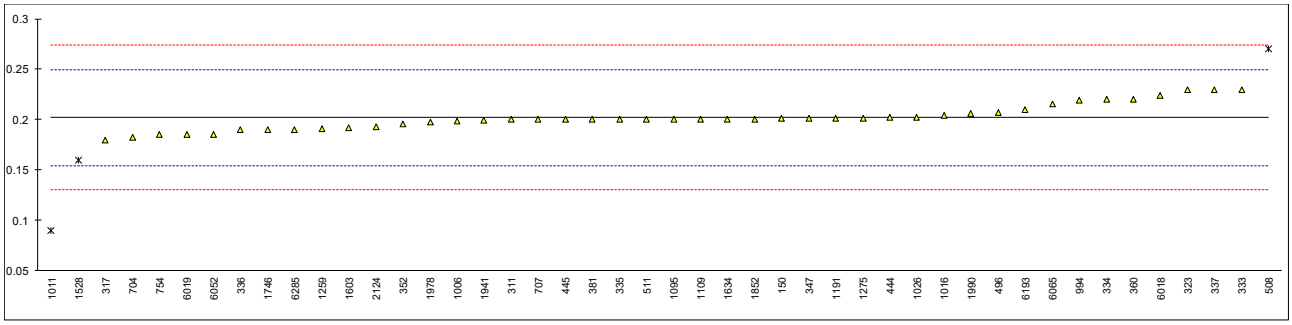
lab	method	value	mark	z(targ)	remarks
150	D2163	0.188		-0.05	
171		-----		-----	
311	D2163	0.19		0.04	
317	D2163	0.17		-0.82	
323	D2163	0.21		0.90	
333	D2163	0.21		0.90	
334	D2163	0.20		0.47	
335	D2163	0.19		0.04	
336	EN27941	0.18		-0.39	
337	D2163	0.22		1.33	
347	D2163	0.187		-0.09	
352	EN27941	0.1902		0.05	
360	EN27941	0.19		0.04	
381	EN27941	0.185		-0.18	
444	IP405	0.192		0.12	
445	D2163	0.19		0.04	
496	D2163	0.193		0.17	
508	D2163	0.212737		1.02	
511	D2163	0.17		-0.82	
529		-----		-----	
704	D2163	0.180		-0.39	
707	D2163	0.180		-0.39	
754	D2163	0.18		-0.39	
868		-----		-----	
994	D2163	0.1917		0.11	
1006	D2163	0.180		-0.39	
1011	ISO7941	0.08	C,R(0.01)	-4.70	first reported: 0.1
1012		-----		-----	
1016	ISO7941	0.189		0.00	
1026	ISO7941	0.1932		0.18	
1095	ISO7941	0.19		0.04	
1109	IP405	0.18		-0.39	
1191	IP473	0.183		-0.26	
1197		-----		-----	
1198		-----		-----	
1259	EN27941	0.182		-0.31	
1275	EN27941	0.18645		-0.11	
1528	EN27941	0.11	R(0.01)	-3.41	
1603	In house	0.1744		-0.63	
1634	ISO7941	0.18		-0.39	
1720		-----		-----	
1746	D2163	0.18		-0.39	
1786		-----		-----	
1852	DIN51619	0.19		0.04	
1941	DIN51619	0.186		-0.13	
1978	D2163	0.1822		-0.30	
1990	IP473	0.190		0.04	
2124	D2163	0.183		-0.26	
6018	ISO7941	0.217		1.20	
6019	ISO7941	0.195		0.25	
6052	D2163	0.1958		0.29	
6065	D2163	0.1942		0.22	
6193	D2163	0.19		0.04	
6201		-----		-----	
6215		-----		-----	
6285	EN27941	0.18		-0.39	
	normality	not OK			
	n	44			
	outliers	2			
	mean (n)	0.1891			
	st.dev. (n)	0.01115			
	R(calc.)	0.0312			
	st.dev.(D2163:14e1)	0.02323			
	R(D2163:14e1)	0.0650			Compare R(EN27941:93(liq)) = 0.1600

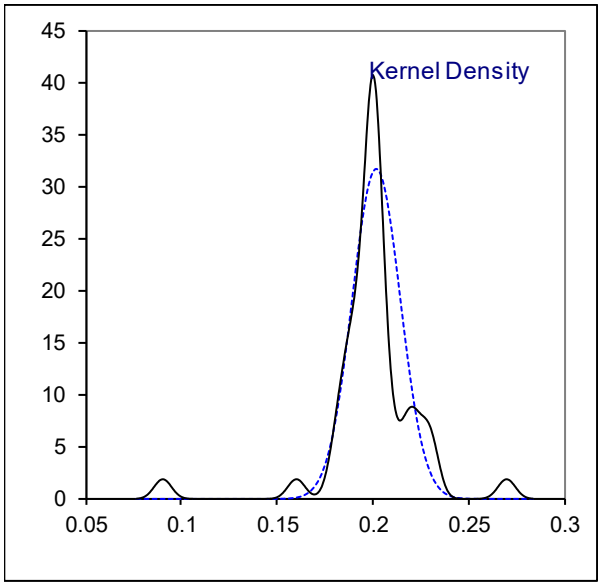

0.3
0.25
0.2
0.15
0.1
0.05
1011 1528 317 511 1603 754 707 1006 336 704 1109 1634 1746 6285 1259 1978 1191 2124 381 1941 1275 347 150 1016 445 311 335 360 1095 1852 1990 6193 352 994 444 496 1026 6065 6019 6052 334 323 333 508 6018 337


Kernel Density
45
40
35
30
25
20
15
10
5
0
0.05
0.1
0.15
0.2
0.25

Determination of iso-Butene on sample #19215; results in %mol/mol

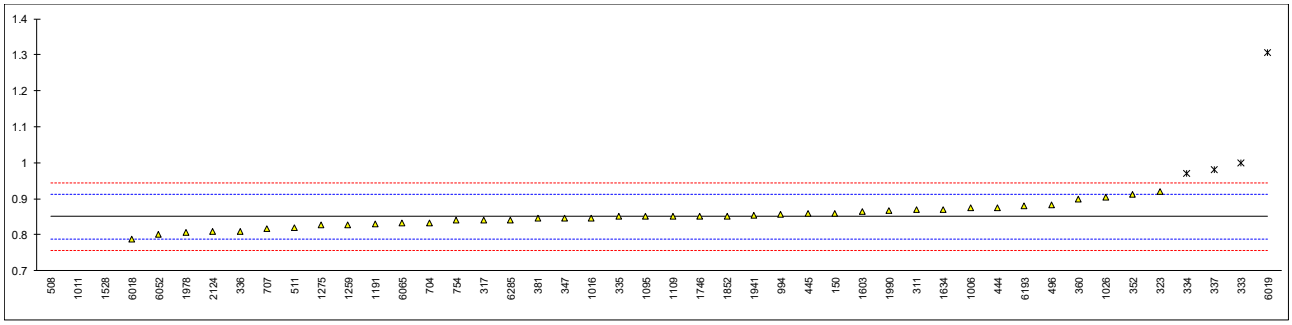
lab	method	value	mark	z(targ)	remarks
150	D2163	0.201		-0.03	
171		-----		-----	
311	D2163	0.20		-0.08	
317	D2163	0.18		-0.91	
323	D2163	0.23		1.18	
333	D2163	0.23		1.18	
334	D2163	0.22		0.76	
335	D2163	0.20		-0.08	
336	EN27941	0.19		-0.49	
337	D2163	0.23		1.18	
347	D2163	0.201		-0.03	
352	EN27941	0.1956		-0.26	
360	EN27941	0.22		0.76	
381	EN27941	0.2		-0.08	
444	IP405	0.202		0.01	
445	D2163	0.20		-0.08	
496	D2163	0.207		0.22	
508	D2163	0.270123	R(0.01)	2.86	
511	D2163	0.20	C	-0.08	first reported: 0.25
529		-----		-----	
704	D2163	0.182		-0.83	
707	D2163	0.200		-0.08	
754	D2163	0.185		-0.70	
868		-----		-----	
994	D2163	0.2194		0.74	
1006	D2163	0.198		-0.16	
1011	ISO7941	0.09	C,R(0.01)	-4.68	first reported: 0.1
1012		-----		-----	
1016	ISO7941	0.204		0.09	
1026	ISO7941	0.2023		0.02	
1095	ISO7941	0.20		-0.08	
1109	IP405	0.20		-0.08	
1191	IP473	0.201		-0.03	
1197		-----		-----	
1198		-----		-----	
1259	EN27941	0.191		-0.45	
1275	EN27941	0.20155		-0.01	
1528	EN27941	0.16	ex	-1.75	test result excluded, see paragraph 4.1
1603	In house	0.1917		-0.42	
1634	ISO7941	0.20		-0.08	
1720		-----		-----	
1746	D2163	0.19		-0.49	
1786		-----		-----	
1852	DIN51619	0.20		-0.08	
1941	DIN51619	0.199		-0.12	
1978	D2163	0.1979		-0.16	
1990	IP473	0.206		0.17	
2124	D2163	0.193		-0.37	
6018	ISO7941	0.224		0.93	
6019	ISO7941	0.185		-0.70	
6052	D2163	0.1855		-0.68	
6065	D2163	0.2153		0.56	
6193	D2163	0.21		0.34	
6201		-----		-----	
6215		-----		-----	
6285	EN27941	0.19		-0.49	
	normality	OK			
	n	43			
	outliers	2 (+1ex)			
	mean (n)	0.2018			
	st.dev. (n)	0.01260			
	R(calc.)	0.0353			
	st.dev.(D2163:14e1)	0.02392			
	R(D2163:14e1)	0.0667			Compare R(EN27941:93(liq)) = 0.1600

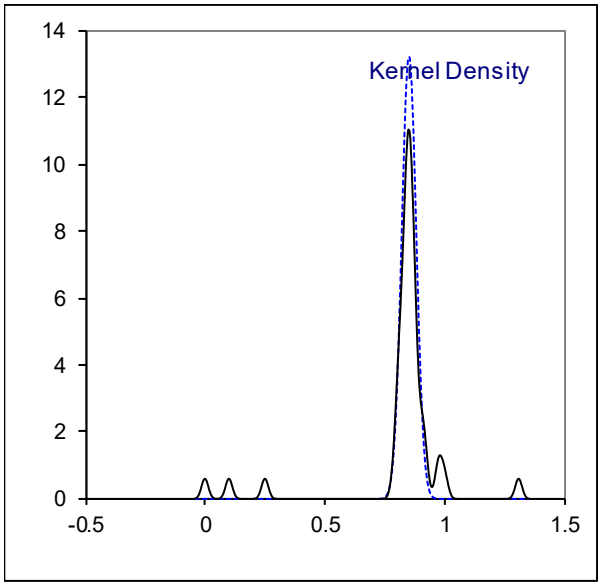

0.3
0.25
0.2
0.15
0.1
0.05
1011 1528 317 704 754 6019 6052 386 1746 6285 1259 1603 2124 352 1978 1006 1941 311 707 445 381 335 511 1095 1109 1634 1852 150 347 1191 1275 444 1026 1016 1990 496 6193 6065 994 334 360 6018 323 337 333 508


Kernel Density
45
40
35
30
25
20
15
10
5
0
0.05
0.1
0.15
0.2
0.25
0.3

Determination of n-Pentane on sample #19215; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
150	D2163	0.860		0.31	
171		-----		-----	
311	D2163	0.87		0.63	
317	D2163	0.84		-0.33	
323	D2163	0.92		2.24	
333	D2163	1.00	R(0.05)	4.81	
334	D2163	0.97	R(0.05)	3.84	
335	D2163	0.85		-0.01	
336	EN27941	0.81		-1.30	
337	D2163	0.98	R(0.05)	4.17	
347	D2163	0.847		-0.11	
352	EN27941	0.9112		1.96	
360	EN27941	0.90		1.60	
381	EN27941	0.847		-0.11	
444	IP405	0.874		0.76	
445	D2163	0.86		0.31	
496	D2163	0.882		1.02	
508	D2163	0.0000	R(0.01)	-27.32	
511	D2163	0.82		-0.97	
529		-----		-----	
704	D2163	0.832		-0.59	
707	D2163	0.816		-1.10	
754	D2163	0.84		-0.33	
868		-----		-----	
994	D2163	0.8569		0.21	
1006	D2163	0.874		0.76	
1011	ISO7941	0.10	C,R(0.01)	-24.10	first reported: 0.1
1012		-----		-----	
1016	ISO7941	0.847		-0.11	
1026	ISO7941	0.9044		1.74	
1095	ISO7941	0.85		-0.01	
1109	IP405	0.85		-0.01	
1191	IP473	0.831		-0.62	
1197		-----		-----	
1198		-----		-----	
1259	EN27941	0.828		-0.72	
1275	EN27941	0.82745		-0.73	
1528	EN27941	0.25	R(0.01)	-19.29	
1603	In house	0.8654		0.48	
1634	ISO7941	0.87		0.63	
1720		-----		-----	
1746	D2163	0.85		-0.01	
1786		-----		-----	
1852	DIN51619	0.85		-0.01	
1941	DIN51619	0.853		0.09	
1978	D2163	0.8069		-1.40	
1990	IP473	0.868		0.57	
2124	D2163	0.809		-1.33	
6018	ISO7941	0.789		-1.97	
6019	ISO7941	1.307	R(0.01)	14.67	
6052	D2163	0.8016		-1.57	
6065	D2163	0.8318		-0.60	
6193	D2163	0.88		0.95	
6201		-----		-----	
6215		-----		-----	
6285	EN27941	0.84		-0.33	
	normality	OK			
	n	39			
	outliers	7			
	mean (n)	0.8503			
	st.dev. (n)	0.03008			
	R(calc.)	0.0842			
	st.dev.(D2163:14e1)	0.03113			
	R(D2163:14e1)	0.0872			Compare R(EN27941:93(liq)) = 0.3111

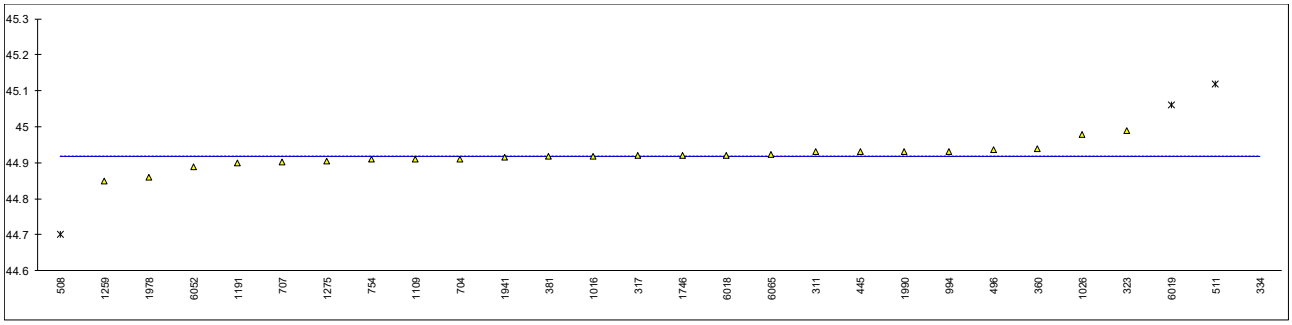

1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
508 1011 1528 6018 6052 1978 2124 336 707 511 1275 1259 1191 6065 704 754 317 6285 381 347 1016 335 1095 1109 1746 1852 1941 994 445 150 1603 1990 311 1634 1006 444 6193 496 360 1026 352 323 334 337 333 6019

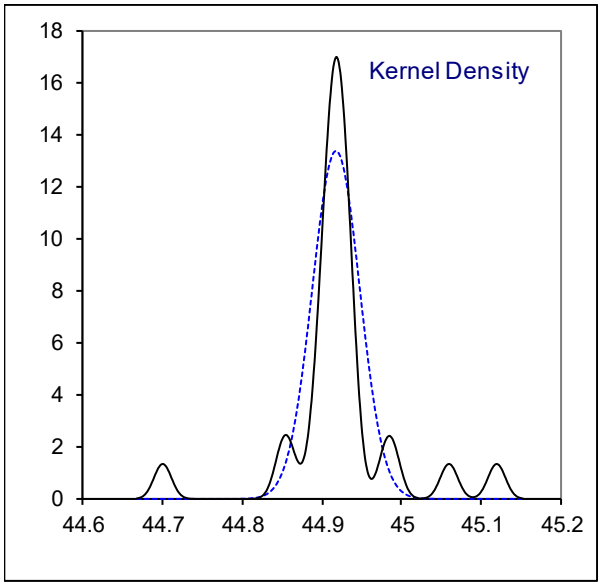

Kernel Density
14
12
10
8
6
4
2
0
-0.5
0
0.5
1
1.5

Determination of Molar Mass on sample #19215; results in g/mol

lab	method	value	mark	z(targ)	remarks
150		-----		-----	
171		-----		-----	
311	INH-407	44.93		-----	
317	inh-001	44.92		-----	
323	D2598	44.99		-----	
333		-----		-----	
334	ISO8973	512.8	ex,E	-----	test result excluded, see paragr. 4.1, calc. error, iis calc.: 45.05
335		-----		-----	
336		-----		-----	
337		-----		-----	
347		-----		-----	
352		-----		-----	
360	ISO8973	44.94		-----	
381	ISO8973	44.9167		-----	
444		-----		-----	
445	D2163	44.930		-----	
496	D2163	44.937		-----	
508	D2598	44.70	ex	-----	test result excluded, see paragraph 4.1
511	D2598	45.12	C,R(0.01)	-----	first reported: 44.55
529		-----		-----	
704	D2421	44.9106		-----	
707	D2421	44.9016		-----	
754	D2421	44.909		-----	
868		-----		-----	
994	D2163	44.9304		-----	
1006		-----		-----	
1011		-----		-----	
1012		-----		-----	
1016	EN27941	44.9167		-----	
1026	ISO8973	44.98		-----	
1095		-----		-----	
1109	ISO8973	44.909		-----	
1191	ISO6976	44.899		-----	
1197		-----		-----	
1198		-----		-----	
1259	ISO8973	44.85		-----	
1275	EN589	44.904		-----	
1528		-----		-----	
1603		-----		-----	
1634		-----		-----	
1720		-----		-----	
1746	D3588	44.92		-----	
1786		-----		-----	
1852		-----		-----	
1941	D2421	44.9153		-----	
1978	D2598	44.8594		-----	
1990	D2598	44.93		-----	
2124		-----		-----	
6018	ISO8973	44.92		-----	
6019	ISO8973	45.06	R(0.01)	-----	
6052	D3588	44.89	C	-----	first reported: 44.38
6065	D2598	44.922		-----	
6193		-----		-----	
6201		-----		-----	
6215		-----		-----	
6285		-----		-----	

			Calc. by iis from ALL rep. comp. results (acc. to D2421:18):
	normality	not OK	suspect
	n	24	38
	outliers	2 (+2ex)	2 (+6ex)
	mean (n)	44.918	44.914
	st.dev. (n)	0.0298	0.0257
	R(calc.)	0.083	0.072
	compare		
	R(iis18S03P)	0.098	0.173

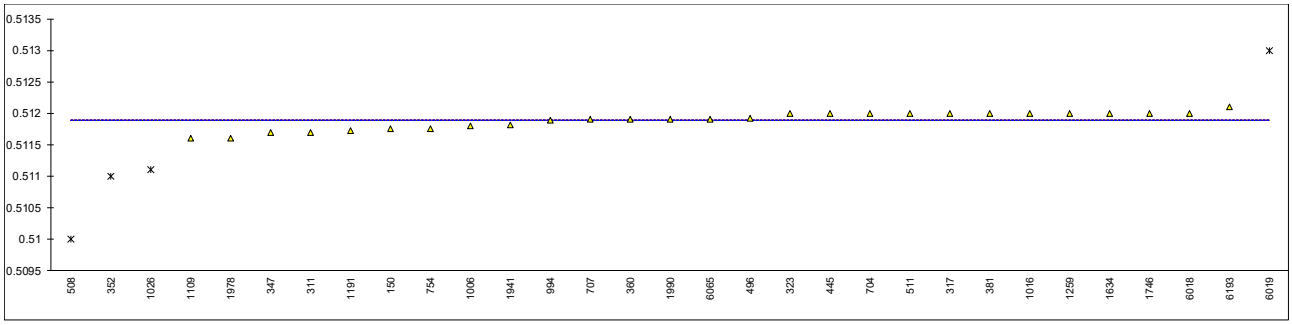

45.3
45.2
45.1
45
44.9
44.8
44.7
44.6
508
1259
1978
6052
1191
707
1275
754
1109
704
1941
381
1016
317
1746
6018
6065
311
445
1990
994
496
360
1026
323
6019
511
334

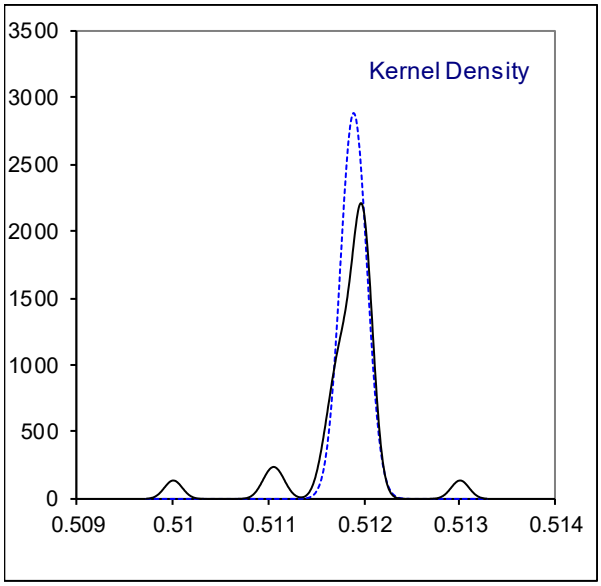

Kernel Density
18
16
14
12
10
8
6
4
2
0
44.6
44.7
44.8
44.9
45
45.1
45.2

Determination of Relative Density at 60/60°F on sample #19215; unitless results

lab	method	value	mark	z(targ)	remarks
150	D2598	0.51175		-----	
171		-----		-----	
311	INH-407	0.5117		-----	
317	D2598	0.512		-----	
323	D2598	0.512		-----	
333		-----		-----	
334		-----		-----	
335		-----		-----	
336		-----		-----	
337		-----		-----	
347	D2598	0.5117		-----	
352	ISO8973	0.511	R(0.01),E	-----	calculation error, iis calculated: 0.5120
360	D2598	0.5119		-----	
381	D2598	0.512		-----	
444		-----		-----	
445	IP432	0.5120		-----	
496	D2598	0.51192		-----	
508	D2598	0.510	ex, E	-----	test result excluded, see paragr. 4.1, calc. error, iis calc.: 0.5111
511	D2598	0.5120	C	-----	first reported: 0.5092
529		-----		-----	
704	D2598	0.5120		-----	
707	D2598	0.5119		-----	
754	D2598	0.51175		-----	
868		-----		-----	
994	D2598	0.51189		-----	
1006	D2598	0.5118		-----	
1011		-----	W	-----	first reported: 507.7
1012		-----		-----	
1016	ISO8973	0.5120		-----	
1026	ISO8973	0.5111	R(0.01),E	-----	calculation error, iis calculated: 0.5121
1095		-----		-----	
1109	D2598	0.5116		-----	
1191	D2598	0.511723	C	-----	first reported: 511.9
1197		-----		-----	
1198		-----		-----	
1259	ISO8973	0.512		-----	
1275		-----		-----	
1528		-----		-----	
1603		-----		-----	
1634	ISO8973	0.512	C	-----	first reported: 512
1720		-----		-----	
1746	D2598	0.512		-----	
1786		-----		-----	
1852		-----		-----	
1941	D2598	0.51181		-----	
1978	D2598	0.5116		-----	
1990	D2598	0.5119		-----	
2124		-----		-----	
6018	ISO8973	0.512		-----	
6019	ISO8973	0.513	R(0.01)	-----	
6052		-----		-----	
6065	D2598	0.5119		-----	
6193	ISO8973	0.5121		-----	
6201		-----		-----	
6215		-----		-----	
6285		-----		-----	

			Calc. by iis from ALL rep. composition results (acc. to D2598:16)
	normality	OK	not OK
	n	27	39
	outliers	3 (+1ex)	1 (+6ex)
	mean (n)	0.51189	0.51180
	st.dev. (n)	0.000139	0.000150
	R(calc.)	0.00039	0.00042
	compare		
	R(iis18S03P)	0.00129	0.00081

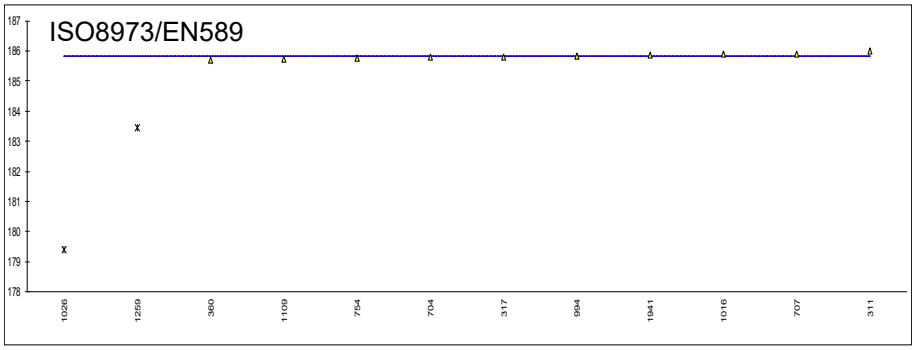

0.5135
0.513
0.5125
0.512
0.5115
0.511
0.5105
0.51
0.5095
508
352
1026
1109
1978
347
311
1191
150
754
1006
1941
994
707
360
1990
6065
496
323
445
704
511
317
381
1016
1259
1634
1746
6018
6193
6019

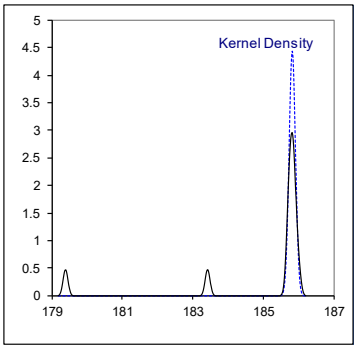

Kernel Density
3500
3000
2500
2000
1500
1000
500
0
0.509
0.51
0.511
0.512
0.513
0.514

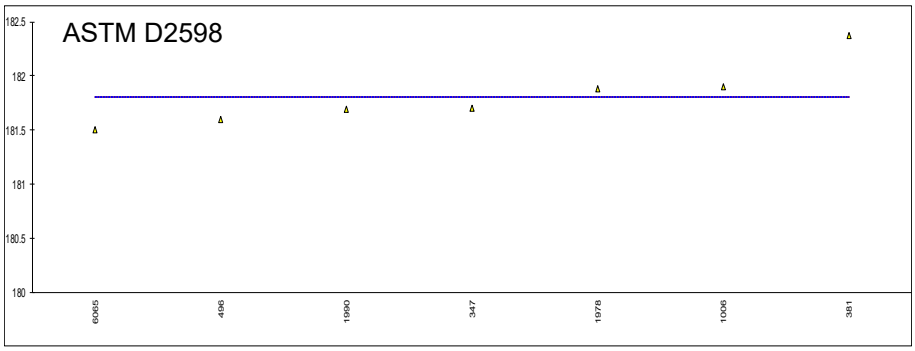
Determination of Absolute Vapor Pressure at 100°F on sample #19215; results in psi

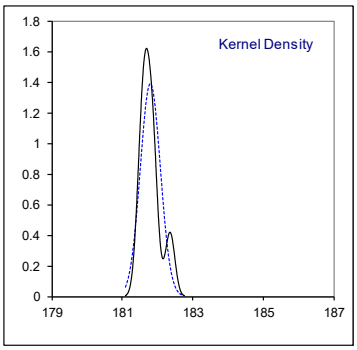
lab	method	ISO8973	mark	z(targ)	D2598	mark	z(targ)	remarks
150		-----		-----	-----		-----	
171		-----		-----	-----		-----	
311	ISO8973	186		-----	-----		-----	
317	ISO8973	185.8		-----	-----		-----	
323		-----		-----	-----		-----	
333		-----		-----	-----		-----	
334		-----		-----	-----		-----	
335		-----		-----	-----		-----	
336		-----		-----	-----		-----	
337		-----		-----	-----		-----	
347	D2598	-----		-----	181.7		-----	
352		-----		-----	-----		-----	
360	ISO8973	185.7		-----	-----		-----	
381	D2598	-----		-----	182.37		-----	
444		-----		-----	-----		-----	
445		-----		-----	-----		-----	
496	D2598	-----		-----	181.60		-----	
508		-----		-----	-----		-----	
511		-----		-----	-----		-----	
529		-----		-----	-----		-----	
704	ISO8973	185.8		-----	-----		-----	
707	ISO8973	185.9		-----	-----		-----	
754	ISO8973	185.75		-----	-----		-----	
868		-----		-----	-----		-----	
994	ISO8973	185.84		-----	-----		-----	
1006	D2598	-----		-----	181.9		-----	
1011		-----		-----	-----		-----	
1012		-----		-----	-----		-----	
1016	EN589	185.8852		-----	-----		-----	
1026	ISO8973	179.41	G(0.01),E	-----	-----		-----	calculation error, iis calc.: 185.31
1095		-----		-----	-----		-----	
1109	ISO8973	185.73		-----	-----		-----	
1191		-----		-----	-----		-----	
1197		-----		-----	-----		-----	
1198		-----		-----	-----		-----	
1259	ISO8973	183.43	G(0.01),E	-----	-----		-----	calculation error, iis calc.: 186.65
1275		-----		-----	-----		-----	
1528		-----		-----	-----		-----	
1603		-----		-----	-----		-----	
1634		-----		-----	-----		-----	
1720		-----		-----	-----		-----	
1746		-----		-----	-----		-----	
1786		-----		-----	-----		-----	
1852		-----		-----	-----		-----	
1941	ISO8973	185.859		-----	-----		-----	
1978	D2598	-----		-----	181.8773		-----	
1990	D2598	-----		-----	181.696		-----	
2124		-----		-----	-----		-----	
6018		-----		-----	-----		-----	
6019		-----		-----	-----		-----	
6052		-----		-----	-----		-----	
6065	D2598	-----		-----	181.5		-----	
6193		-----		-----	-----		-----	
6201		-----		-----	-----		-----	
6215		-----		-----	-----		-----	
6285		-----		-----	-----		-----	

	ISO8973/IP432:	D2598:
normality	OK	unknown
n	10	7
outliers	2	0
mean (n)	185.826	181.806
st.dev. (n)	0.0899	0.2862
R(calc.)	0.252	0.801
compare		
R(iis18S03P)	2.785	2.239
	iis calc. based on ALL reported composition results	**iis calc. based on ALL reported composition results**
normality	not OK	not OK
n	40	40
outliers	0 (+6ex)	0 (+6ex)
mean (n)	185.823	181.748
st.dev. (n)	0.3454	0.3444
R(calc.)	0.967	0.964
compare		
R(iis18S03P)	0.872	1.007





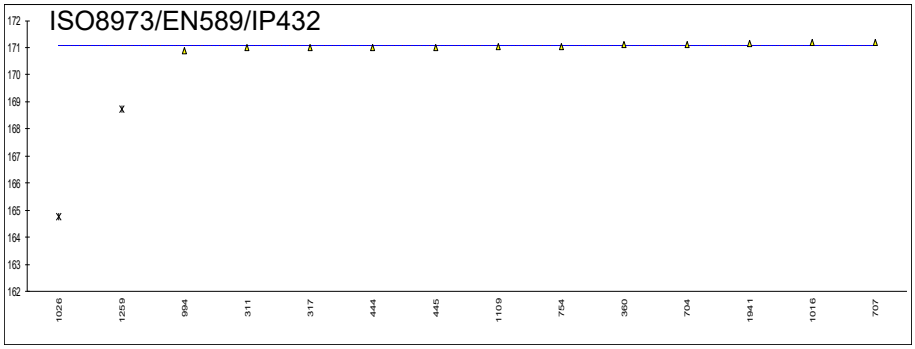


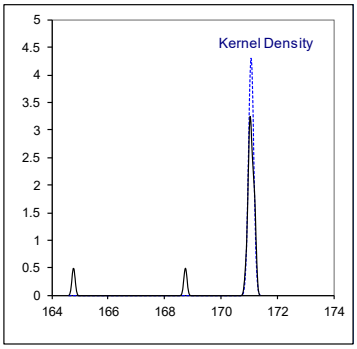


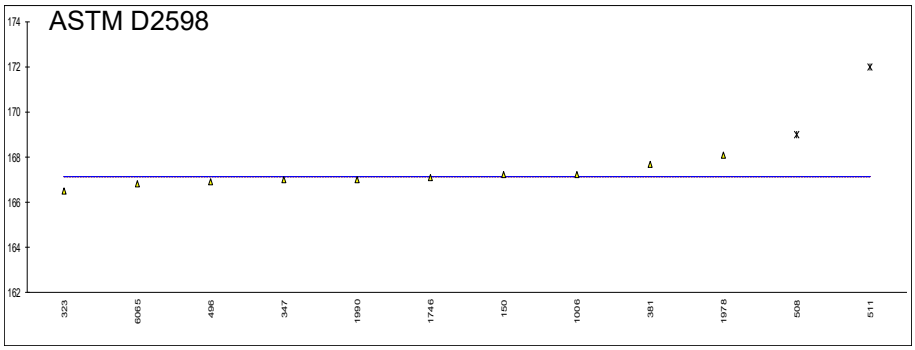
Determination of Relative Vapor Pressure at 100°F on sample #19215; results in psi

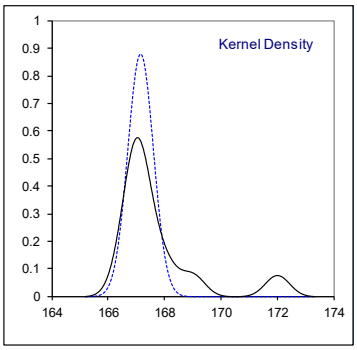
lab	method	ISO8973	mark	z(targ)	D2598	mark	z(targ)	remarks
150	D2598	-----		-----	167.2		-----	
171		-----		-----	-----		-----	
311	ISO8973	171		-----	-----		-----	
317	ISO8973	171		-----	-----		-----	
323	D2598	-----		-----	166.48		-----	
333		-----		-----	-----		-----	
334		-----		-----	-----		-----	
335		-----		-----	-----		-----	
336		-----		-----	-----		-----	
337		-----		-----	-----		-----	
347	D2598	-----		-----	167		-----	
352		-----		-----	-----		-----	
360	ISO8973	171.1		-----	-----		-----	
381	D2598	-----		-----	167.67		-----	
444	ISO8973	171		-----	-----		-----	
445	IP432	171		-----	-----		-----	
496	D2598	-----		-----	166.91		-----	
508	D2598	-----		-----	169	ex, E	-----	excl., see paragr. 4.1, iis calc. 167.72
511	D2598	-----		-----	172	G(0.01), E	-----	calculation error, iis calc. 166.93
529		-----		-----	-----		-----	
704	ISO8973	171.1		-----	-----		-----	
707	ISO8973	171.2		-----	-----		-----	
754	ISO8973	171.05		-----	-----		-----	
868		-----		-----	-----		-----	
994	ISO8973	170.89		-----	-----		-----	
1006	D2598	-----		-----	167.2		-----	
1011		-----		-----	-----		-----	
1012		-----		-----	-----		-----	
1016	EN589	171.1892		-----	-----		-----	
1026	ISO8973	164.76	G(0.01),E	-----	-----		-----	calculation error, iis calc. 170.62
1095		-----		-----	-----		-----	
1109	ISO8973	171.04		-----	-----		-----	
1191		-----		-----	-----		-----	
1197		-----		-----	-----		-----	
1198		-----		-----	-----		-----	
1259	ISO8973	168.73	G(0.01),E	-----	-----		-----	calculation error, iis calc. 171.95
1275		-----		-----	-----		-----	
1528		-----		-----	-----		-----	
1603		-----		-----	-----		-----	
1634		-----		-----	-----		-----	
1720		-----		-----	-----		-----	
1746	D2598	-----		-----	167.1		-----	
1786		-----		-----	-----		-----	
1852		-----		-----	-----		-----	
1941	ISO8973	171.163		-----	-----		-----	
1978	D2598	-----		-----	168.0987		-----	
1990	D2598	-----		-----	167		-----	
2124		-----		-----	-----		-----	
6018		-----		-----	-----		-----	
6019		-----		-----	-----		-----	
6052		-----		-----	-----		-----	
6065	D2598	-----		-----	166.8		-----	
6193		-----		-----	-----		-----	
6201		-----		-----	-----		-----	
6215		-----		-----	-----		-----	
6285		-----		-----	-----		-----	

	ISO8973/IP432:	D2598:
normality	OK	suspect
n	12	10
outliers	2	1 (+1ex)
mean (n)	171.061	167.146
st.dev. (n)	0.0924	0.4536
R(calc.)	0.259	1.270
compare		
R(iis18S03P)	2.086	2.040
	iis calc. based on ALL reported composition results	**iis calc. based on ALL reported composition results**
normality	not OK	not OK
n	40	40
outliers	0 (+6ex)	0 (+6ex)
mean (n)	171.127	167.052
st.dev. (n)	0.3454	0.3444
R(calc.)	0.967	0.964
compare		
R(iis18S03P)	1.470	1.593



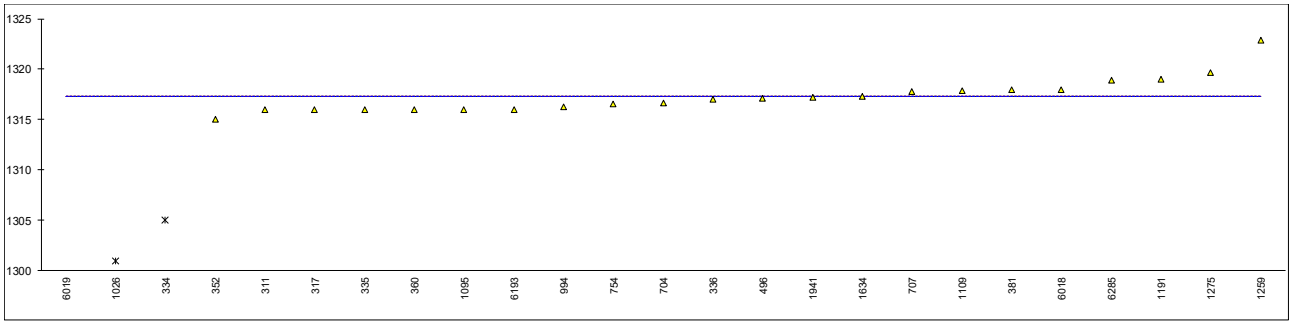


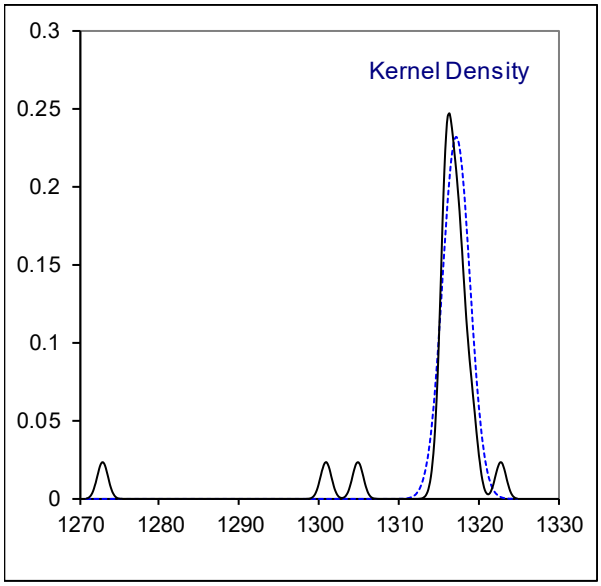




Determination of Absolute Vapor Pressure at 40°C on sample #19215; results in kPa

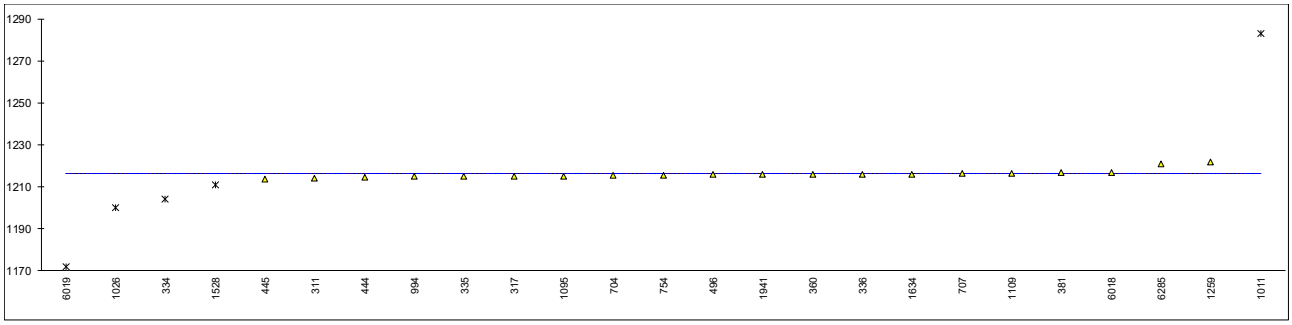
lab	method	value	mark	z(targ)	remarks
150		-----		-----	
171		-----		-----	
311	ISO8973	1316		-----	
317	ISO8973	1316		-----	
323		-----		-----	
333		-----		-----	
334	ISO8973	1305	ex	-----	test result excluded, see paragraph 4.1
335	ISO8973	1316		-----	
336	ISO8973	1317		-----	
337		-----		-----	
347		-----		-----	
352	ISO8973	1315		-----	
360	ISO8973	1316		-----	
381	ISO8973	1318		-----	
444		-----		-----	
445		-----		-----	
496	ISO8973	1317.16		-----	
508		-----		-----	
511		-----		-----	
529		-----		-----	
704	ISO8973	1316.6		-----	
707	ISO8973	1317.8		-----	
754	ISO8973	1316.5		-----	
868		-----		-----	
994	ISO8973	1316.25		-----	
1006		-----		-----	
1011		-----		-----	
1012		-----		-----	
1016		-----		-----	
1026	ISO8973	1301	R(0.01),E	-----	calculation error, iis calculated: 1313
1095	ISO8973	1316		-----	
1109	ISO8973	1317.84		-----	
1191	ISO8973	1319		-----	
1197		-----		-----	
1198		-----		-----	
1259	ISO8973	1322.91	C	-----	first reported: 1299.20
1275	EN589	1319.7		-----	
1528		-----		-----	
1603		-----		-----	
1634	ISO8973	1317.3		-----	
1720		-----		-----	
1746		-----		-----	
1786		-----		-----	
1852		-----		-----	
1941	ISO8973	1317.25		-----	
1978		-----		-----	
1990		-----		-----	
2124		-----		-----	
6018	ISO8973	1318		-----	
6019	ISO8973	1273	R(0.01),E	-----	calculation error, iis calculated: 1309
6052		-----		-----	
6065		-----		-----	
6193	ISO8973	1316		-----	
6201		-----		-----	
6215		-----		-----	
6285	ISO8973	1318.9		-----	
					Calc. by iis from ALL rep. composition results:
	normality	not OK			not OK
	n	22			40
	outliers	2 (+1ex)			0 (+6ex)
	mean (n)	1317.33			1316.98
	st.dev. (n)	1.718			2.462
	R(calc.)	4.81			6.89
	compare				
	R(iis18S03P)	8.61			10.39

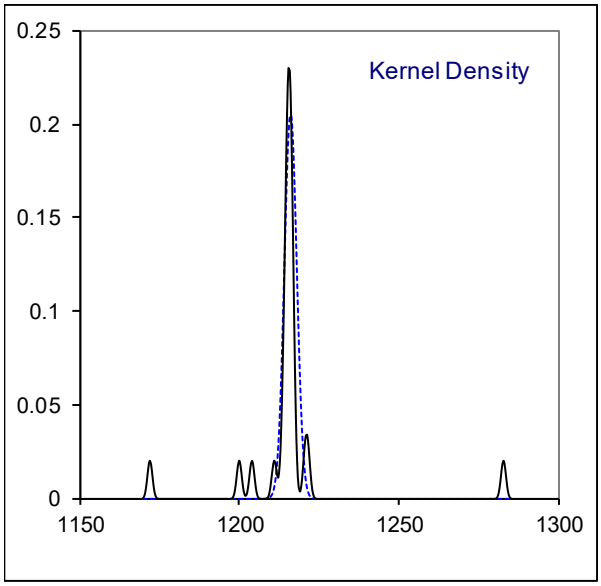

1325
1320
1315
1310
1305
1300
6019
1026
334
352
311
317
335
360
1095
6193
994
754
704
336
496
1941
1634
707
1109
381
6018
6285
1191
1275
1259


Kernel Density
0.3
0.25
0.2
0.15
0.1
0.05
0
1270
1280
1290
1300
1310
1320
1330

Determination of Relative Vapor Pressure at 40°C on sample #19215; results in kPa

lab	method	value	mark	z(targ)	remarks
150		-----		-----	
171		-----		-----	
311	ISO8973	1214		-----	
317	ISO8973	1215		-----	
323		-----		-----	
333		-----		-----	
334	ISO8973	1204	ex	-----	test result excluded, see paragraph 4.1
335	ISO8973	1215		-----	
336	ISO8973	1216		-----	
337		-----		-----	
347		-----		-----	
352		-----		-----	
360	ISO8973	1216		-----	
381	ISO8973	1217		-----	
444	ISO8973	1214.6		-----	
445	IP432	1213.7		-----	
496	ISO8973	1215.84		-----	
508		-----		-----	
511		-----		-----	
529		-----		-----	
704	ISO8973	1215.3		-----	
707	ISO8973	1216.5		-----	
754	ISO8973	1215.5		-----	
868		-----		-----	
994	ISO8973	1214.95		-----	
1006		-----		-----	
1011	ISO8973	1282.9	ex	-----	test result excluded, see paragraph 4.1
1012		-----		-----	
1016		-----		-----	
1026	ISO8973	1200	R(0.01),E	-----	calculation error, iis calculated: 1212.03
1095	ISO8973	1215		-----	
1109	ISO8973	1216.54		-----	
1191		-----		-----	
1197		-----		-----	
1198		-----		-----	
1259	ISO8973	1221.58	C	-----	first reported: 1197.88
1275		-----		-----	
1528	ISO8973	1211	ex, E	-----	test result excluded, see paragr. 4.1, calc. error, iis calc.: 1232
1603		-----		-----	
1634	ISO8973	1216		-----	
1720		-----		-----	
1746		-----		-----	
1786		-----		-----	
1852		-----		-----	
1941	ISO8973	1215.92		-----	
1978		-----		-----	
1990		-----		-----	
2124		-----		-----	
6018	ISO8973	1217		-----	
6019	ISO8973	1172	R(0.01),E	-----	calculation error, iis calc.: 1207
6052		-----		-----	
6065		-----		-----	
6193		-----		-----	
6201		-----		-----	
6215		-----		-----	
6285	ISO8973	1220.7		-----	
					Calc. bij iis from ALL rep. composition results:
	normality	not OK			not OK
	n	20			40
	outliers	2 (+3ex)			0 (+6ex)
	mean (n)	1216.11			1215.66
	st.dev. (n)	1.942			2.462
	R(calc.)	5.44			6.89
	compare				
	R(iis18S03P)	10.79			10.39

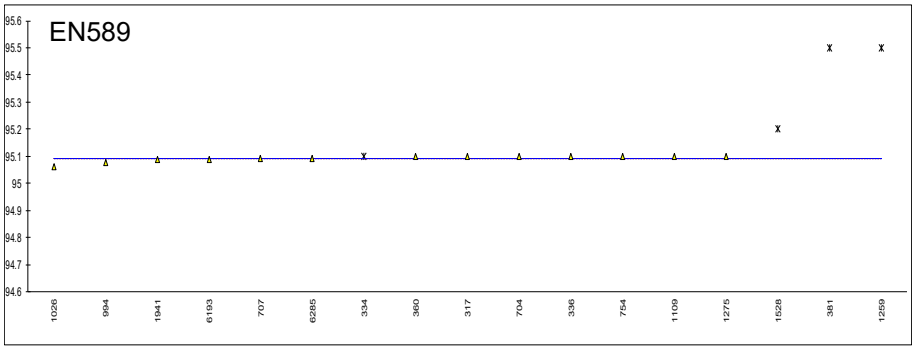

1290
1270
1250
1230
1210
1190
1170
6019
1026
334
1528
445
311
444
994
335
317
1095
704
754
496
1941
360
336
1634
707
1109
381
6018
6285
1259
1011

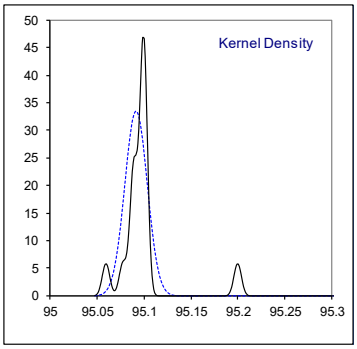

Kernel Density
0.25
0.2
0.15
0.1
0.05
0
1150
1200
1250
1300

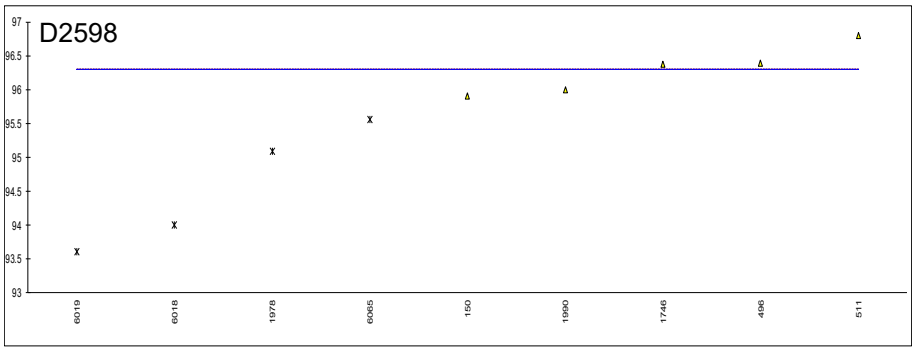
Determination of Motor Octane Number, MON on sample #19215;

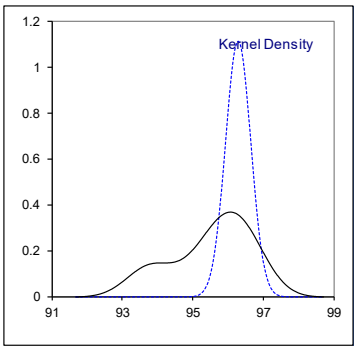
lab	method	EN589	mark	z(targ)	D2598	mark	z(targ)	remarks
150	D2598	-----		-----	95.9		-----	
171		-----		-----	-----		-----	
311		-----		-----	-----		-----	
317	EN589	95.1		-----	-----		-----	
323		-----		-----	-----		-----	
333		-----		-----	-----		-----	
334	EN589	95.1	ex	-----	-----		-----	test result excluded, see paragr.4.1
335		-----		-----	-----		-----	
336	EN589	95.1		-----	-----		-----	
337		-----		-----	-----		-----	
347		-----		-----	-----		-----	
352		-----		-----	-----		-----	
360	EN589	95.1		-----	-----		-----	
381	EN589	95.5	DG(0.01)	-----	-----		-----	
444		-----		-----	-----		-----	
445	EN589	-----		-----	-----		-----	
496	D2598	-----		-----	96.391		-----	
508		-----		-----	-----		-----	
511	D2598	-----		-----	96.8		-----	
529		-----		-----	-----		-----	
704	EN589	95.10		-----	-----		-----	
707	EN589	95.09		-----	-----		-----	
754	EN589	95.1		-----	-----		-----	
868		-----		-----	-----		-----	
994	EN589	95.078		-----	-----		-----	
1006		-----		-----	-----		-----	
1011		-----		-----	-----		-----	
1012		-----		-----	-----		-----	
1016		-----		-----	-----		-----	
1026	EN589	95.06		-----	-----		-----	
1095		-----		-----	-----		-----	
1109	EN589	95.1		-----	-----		-----	
1191		-----		-----	-----		-----	
1197		-----		-----	-----		-----	
1198		-----		-----	-----		-----	
1259	EN589	95.5	DG(0.01)	-----	-----		-----	
1275	EN589	95.1		-----	-----		-----	
1528	EN589	95.2	ex	-----	-----		-----	test result excluded, see paragr.4.1
1603		-----		-----	-----		-----	
1634		-----		-----	-----		-----	
1720		-----		-----	-----		-----	
1746	D2598	-----		-----	96.37		-----	
1786		-----		-----	-----		-----	
1852		-----		-----	-----		-----	
1941	EN589	95.089		-----	-----		-----	
1978	D2598	-----		-----	95.0959	ex,E	-----	calculation error, iis calc.: 96.45
1990	Calculation	-----		-----	96		-----	
2124		-----		-----	-----		-----	
6018	D2598	-----		-----	94.0	ex,E	-----	calculation error, iis calc.: 96.44
6019	D2598	-----		-----	93.6	ex,E	-----	calculation error, iis calc.: 96.21
6052		-----		-----	-----		-----	
6065	D2598	-----		-----	95.55	ex,E	-----	calculation error, iis calc.: 96.42
6193	EN589	95.089		-----	-----		-----	
6201		-----		-----	-----		-----	
6215		-----		-----	-----		-----	
6285	EN589	95.09		-----	-----		-----	

	EN589:	D2598:
normality	not OK	Unknown
n	13	5
outliers	2 (+2ex)	0 (+4ex)
mean (n)	95.092	96.292
st.dev. (n)	0.0119	(0.3581)
R(calc.)	0.033	(1.003)
compare		
R(iis18S03P)	0.445	(1.229)
	iis calc. based on ALL reported composition results	**iis calc. based on ALL reported composition results**
normality	not OK	suspect
n	39	39
outliers	1 (+6ex)	1 (+6ex)
mean (n)	95.085	96.419
st.dev. (n)	0.0178	0.0203
R(calc.)	0.050	0.057
compare		
R(iis18S03P)	0.049	0.064





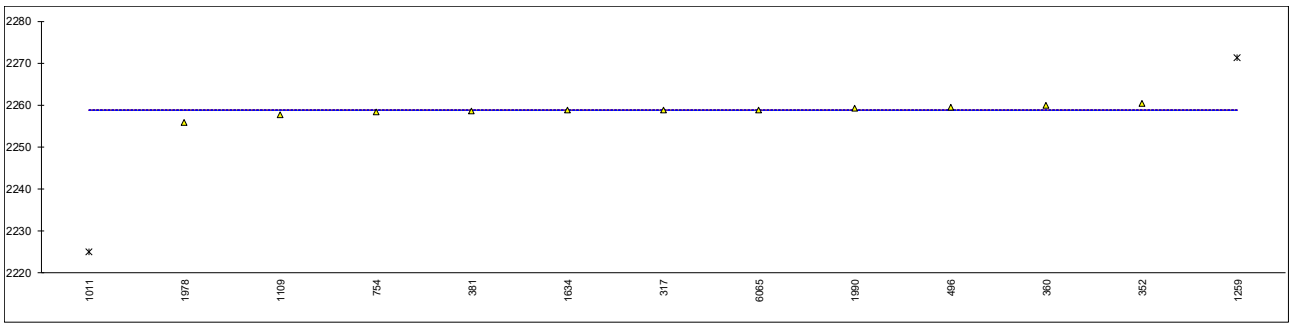


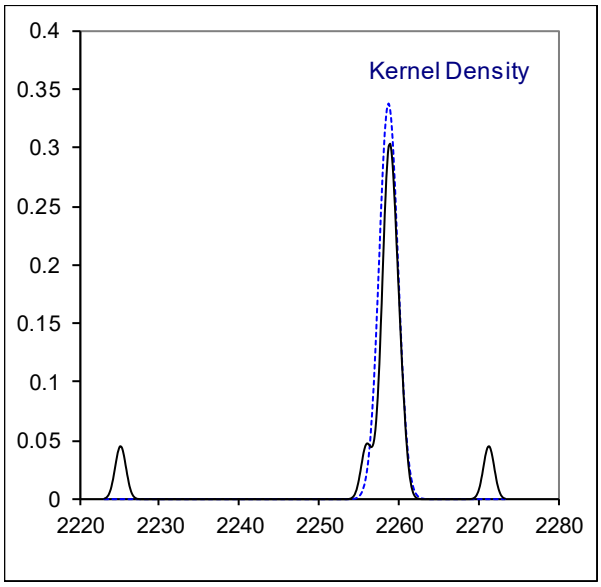


Determination of Ideal Gross Heating Value at 14.696 psia and 60°F on sample #19215; results in kJ/mol

lab	method	value	mark	z(targ)	remarks
150		-----		-----	
171		-----		-----	
311		-----		-----	
317	D3588	2258.8		-----	
323		-----		-----	
333		-----		-----	
334		-----		-----	
335		-----		-----	
336		-----		-----	
337		-----		-----	
347		-----		-----	
352	D3588	2260.364		-----	
360	D3588	2259.85		-----	
381	D3588	2258.53		-----	
444		-----		-----	
445		-----		-----	
496	D3588	2259.53		-----	
508		-----		-----	
511		-----		-----	
529		-----		-----	
704		-----		-----	
707		-----		-----	
754	D3588	2258.35	C	-----	first reported: 2195.45
868		-----		-----	
994		-----		-----	
1006		-----		-----	
1011	D3588	2225.06	ex,C	-----	test result excluded, see paragraph 4.1, first reported: 12031
1012		-----		-----	
1016		-----		-----	
1026		-----		-----	
1095		-----		-----	
1109	D3588	2257.67		-----	
1191		-----		-----	
1197		-----		-----	
1198		-----		-----	
1259	D3588	2271.31	C,G(0.01),E	-----	first reported: 5029, calculation error, iis calculated: 2256
1275		-----		-----	
1528		-----		-----	
1603		-----		-----	
1634	D3588	2258.74		-----	
1720		-----		-----	
1746		-----		-----	
1786		-----		-----	
1852		-----		-----	
1941		-----		-----	
1978		2255.9489		-----	
1990	Calculation	2259.25		-----	
2124		-----		-----	
6018		-----		-----	
6019		-----		-----	
6052		-----		-----	
6065	D3588	2258.8		-----	
6193		-----		-----	
6201		-----		-----	
6215		-----		-----	
6285		-----		-----	

			Calc. by iis from ALL reported composition results:
	normality	not OK	suspect
	n	11	38
	outliers	1 (+1ex)	2 (+6ex)
	mean (n)	2258.71	2258.45
	st.dev. (n)	1.178	1.196
	R(calc.)	3.30	3.35
	comp R(iis18S03P)	11.72	8.13

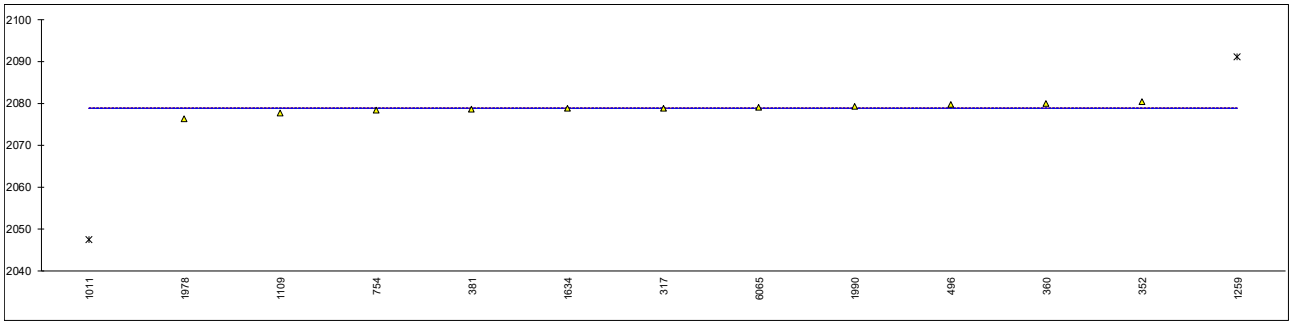

2280
2270
2260
2250
2240
2230
2220
1011
1978
1109
754
381
1634
317
6085
1990
496
360
352
1259

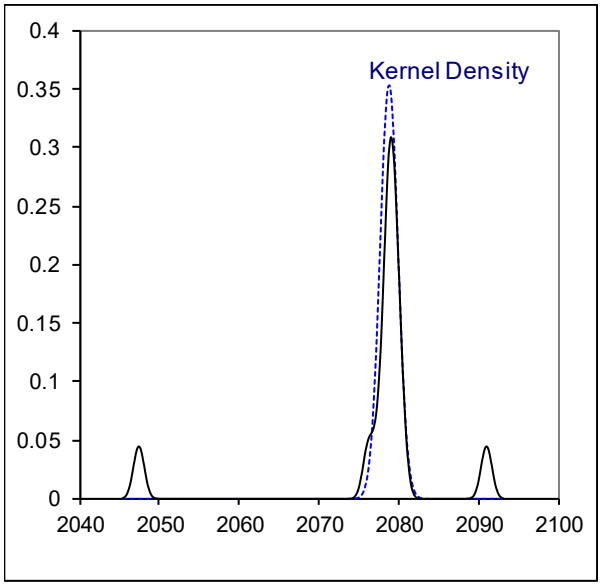

Kernel Density
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
2220
2230
2240
2250
2260
2270
2280

Determination of Ideal Net Heating Value at 14.696 psia and 60°F on sample #19215; results in kJ/mol

lab	method	value	mark	z(targ)	remarks
150		-----		-----	
171		-----		-----	
311		-----		-----	
317	D3588	2078.9		-----	
323		-----		-----	
333		-----		-----	
334		-----		-----	
335		-----		-----	
336		-----		-----	
337		-----		-----	
347		-----		-----	
352	D3588	2080.340		-----	
360	D3588	2079.86		-----	
381	D3588	2078.65		-----	
444		-----		-----	
445		-----		-----	
496	D3588	2079.60		-----	
508		-----		-----	
511		-----		-----	
529		-----		-----	
704		-----		-----	
707		-----		-----	
754	D3588	2078.45	C	-----	first reported: 2020.4
868		-----		-----	
994		-----		-----	
1006		-----		-----	
1011	D3588	2047.46	ex,C	-----	test result excluded, see paragraph 4.1, first reported: 11065
1012		-----		-----	
1016		-----		-----	
1026		-----		-----	
1095		-----		-----	
1109	D3588	2077.60		-----	
1191		-----		-----	
1197		-----		-----	
1198		-----		-----	
1259	D3588	2091.02	C,G(0.01),E	-----	first reported: 46.28, calculation error, iis calculated: 2076
1275		-----		-----	
1528		-----		-----	
1603		-----		-----	
1634	D3588	2078.85		-----	
1720		-----		-----	
1746		-----		-----	
1786		-----		-----	
1852		-----		-----	
1941		-----		-----	
1978		2076.2238		-----	
1990	Calculation	2079.30		-----	
2124		-----		-----	
6018		-----		-----	
6019		-----		-----	
6052		-----		-----	
6065	D3588	2079.1		-----	
6193		-----		-----	
6201		-----		-----	
6215		-----		-----	
6285		-----		-----	

			Calc. by iis from ALL reported composition results:
	normality	suspect	suspect
	n	11	38
	outliers	1 (+1ex)	2 (+2ex)
	mean (n)	2078.81	2078.58
	st.dev. (n)	1.127	1.120
	R(calc.)	3.16	3.14
	compare		
	R(iis18S03P)	11.04	7.59

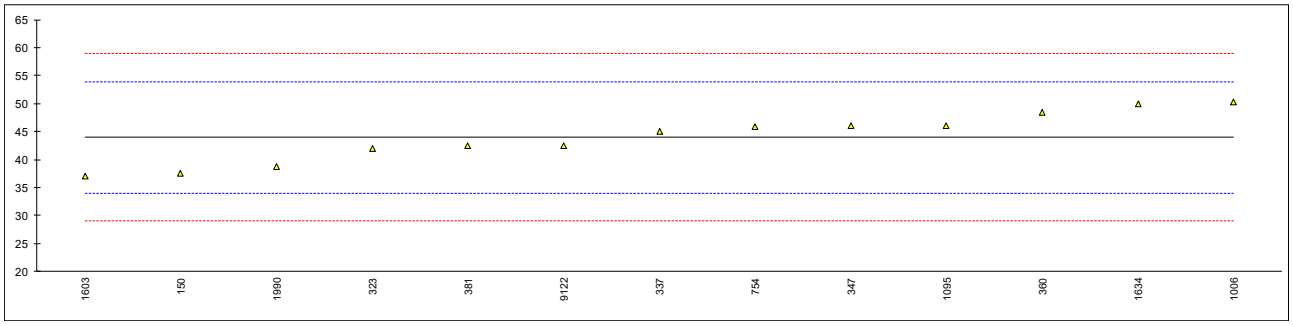

2100
2090
2080
2070
2060
2050
2040
1011
1978
1109
754
381
1634
317
6065
1990
496
360
352
1259

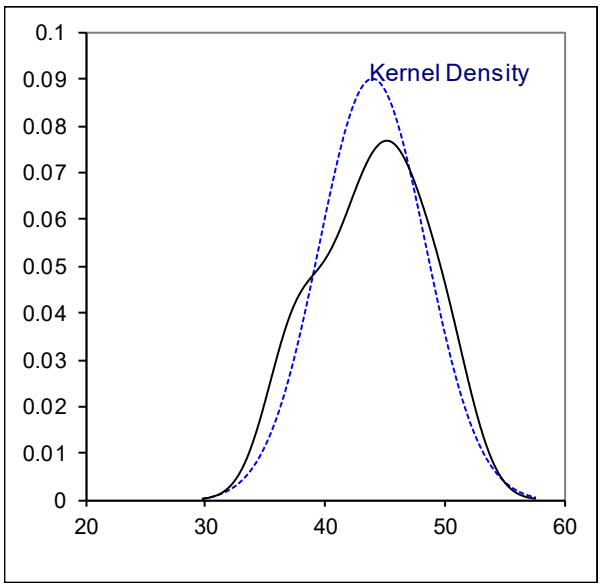

Kernel Density
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
2040
2050
2060
2070
2080
2090
2100

Determination of Sulfur, total on sample #19216; results in mg/kg

lab	method	value	mark	z(targ)	remarks
150	D6667	37.5	C	-1.30	first reported: 9.2
171		-----		-----	
311		-----		-----	
323	D6667	42.0		-0.40	
337	D6667	45		0.21	
347	D6667	46		0.41	
360	D6667	48.4	C	0.89	first reported: 20.8
381	D6667	42.5		-0.30	
445		-----		-----	
754	D6667	45.79		0.36	
1006	D6667	50.35		1.28	
1011		-----		-----	
1095	D6667	46		0.41	
1603	in house	37.0		-1.40	
1634	D6667	50	C	1.21	first reported: 60
1990	D6667	38.67		-1.07	
6018		-----		-----	
6019		-----		-----	
6201		-----		-----	
9122	D6667	42.5		-0.30	

normality	OK
n	13
outliers	0
mean (n)	43.9777
st.dev. (n)	4.43508
R(calc.)	12.4182
st.dev.(D6667:14)	4.97642
R(D6667:14)	13.9340





APPENDIX 2

Number of participants per country

2 labs in AUSTRALIA
1 lab in AZERBAIJAN
1 lab in BELGIUM
1 lab in BULGARIA
1 lab in CHILE
1 lab in CHINA, People's Republic
1 lab in COLOMBIA
1 lab in CROATIA
1 lab in DENMARK
1 lab in FINLAND
5 labs in FRANCE
3 labs in GERMANY
4 labs in MALAYSIA
2 labs in MEXICO
5 labs in NETHERLANDS
1 lab in NIGER
1 lab in NIGERIA
1 lab in PANAMA
1 lab in PERU
1 lab in POLAND
6 labs in PORTUGAL
1 lab in ROMANIA
1 lab in RUSSIAN FEDERATION
2 labs in SERBIA
1 lab in SPAIN
1 lab in SUDAN
1 lab in TAIWAN
2 labs in UKRAINE
1 lab in UNITED ARAB EMIRATES
3 labs in UNITED KINGDOM
3 labs in UNITED STATES OF AMERICA

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
E	= possibly an error in calculations
ex	= test result excluded from the statistical evaluation
n.a.	= not applicable
n.e.	= not evaluated
fr.	= first reported
SDS	= safety data sheet

Literature

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