

Results of Proficiency Test
Liquefied Propane
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Organised by: Institute for Interlaboratory Studies
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1 INTRODUCTION

Since 2009, the Institute for Interlaboratory Studies organized a proficiency test for the analysis of Liquefied Propane (composition only) every year. It was decided to continue this interlaboratory study during the annual program 2014/2015.

Because iis has limited gas-handling facilities in place to prepare gas samples, a co-operation with EffectTech (Uttometer, United Kingdom) was set up. This company is fully equipped and has experience in the preparation of synthetic natural gas samples for PT purposes. EffectTech maintains an ISO17043 accreditation for the preparation of PT samples in homogeneous and stable batches and an ISO17025 accreditation for the calibration and assignment of reference values for these samples.

In the 2014 proficiency test 44 laboratories in 24 different countries have participated. See appendix 2 for the number of participants per country. In this report the results of the 2014 proficiency test on Liquefied Propane are presented and discussed. This report is also electronically available through the iis internet site www.iisnl.com.

2 SET UP

The Institute for Interlaboratory Studies (iis) in Spijkenisse, the Netherlands, was the organizer of this proficiency test.

To optimise the costs for the participating laboratories, it was decided to prepare one Liquefied Propane mixture. The mixture was divided over a batch of 48 cylinders.

The cylinder size is a cost-effective one-litre cylinder with dip tube device. Each cylinder, filled with approx 200 grams of liquefied propane mixture, was uniquely numbered. The limited cylinder size is chosen to optimise sample stability, cylinder costs, transport and handling costs. The preparation and testing of the sample cylinders was subcontracted. Participants were requested to report rounded and unrounded results. The unrounded 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/IEC 17043:2010 (R007). This ensures strict adherence to protocols for sample preparation and statistical evaluation and 100% confidentiality of participant's data. Also customer's satisfaction is measured on regular basis by the distribution of questionnaires.

EffectTech is an accredited provider of proficiency testing schemes under the requirements of ISO/IEC17043:2010 by UKAS (no. 4719).

2.2 PROTOCOL

The protocol followed in the organisation of this proficiency test was the one as described for proficiency testing in the report 'iis Interlaboratory Studies: Protocol for the Organisation, Statistics and Evaluation' of April 2014 (iis-protocol, version 3.3), that can be downloaded from the iis web site <http://www.iisnl.com>.

2.3 CONFIDENTIALITY STATEMENT

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

2.4 SAMPLES

In this proficiency test only one sample was used. One batch of 48 one litre cylinders with artificial Liquefied Propane mixture was prepared and tested for homogeneity by EffectTech (Uttoxeter, United Kingdom) in conformance with ISO Guide 35: 2006 and ISO/IEC17043:2010 (job 14/0842) starting September 1, 2014. Each cylinder was uniquely numbered. Every cylinder in the batch was analysed using 6 replicate measurements. The within bottle and between bottle variations were then assessed in accordance with ISO Guide 35:2006 (Annex A.1). This procedure showed that the between bottle variations were all 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 reproducibility of the reference method in agreement with the procedure of ISO 13528, Annex B2 in the next table:

Parameter	r (observed) in %mol/mol	0.3 X R(D2163:96) in %mol/mol	0.3 X R(D2163:14) in %mol/mol
Ethane	0.013	0.028	0.093
Propane	0.035	0.282	1.259
Propylene	0.006	0.026	0.071
Iso-Butane	0.013	0.058	0.059
n-Butane	0.014	0.057	0.050
1-Butene	0.001	0.006	0.018
iso-Butylene	0.001	0.006	0.018
n-Pentane	0.008	0.023	0.023

Table 1: homogeneity test results of samples #14202

Each calculated repeatability is equal or less than 0.3 times the corresponding reproducibility of the reference method ASTM D2163:96 and also of the latest version D2163:14.

Therefore, homogeneity of the subsamples #14202 was assumed.

To each of the participating laboratories one 1L cylinder was sent on October 8, 2014.

2.5 STABILITY OF THE SAMPLES

EffectTech (Uttoxeter, United Kingdom) declares that the prepared gas cylinders have a shelf life of at least 6 months. This is sufficient for the proficiency testing purposes.

2.6 ANALYSES

The participants were asked to determine the composition: Ethane, Propane, Propylene, n-Butane, iso-Butane, n-Pentane, 1-Butene, iso-Butene and some physical parameters calculated from the composition: Molar Mass, Relative Density @60F, Absolute and Relative Vapour pressure @100F and Absolute and Relative Vapour pressure @40°C.

To get comparable results a detailed report form, on which the units were prescribed as well as the required standards and a letter of instructions were prepared and made available on the data entry portal www.kpmd.co.uk/sgs-iis/. The detailed report form and the letter of instructions were also made available for download on the iis website www.iisnl.com. A SDS and a form to confirm receipt of the sample was added to the sample package.

3 RESULTS

During four weeks after sample despatch, the results of the individual laboratories were gathered. The original results are tabulated per determination in the appendix 1 of this report. The laboratories are presented by their code numbers.

Directly after the deadline the available results were screened for suspect data. A 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 results. Additional or corrected data are put under 'Remarks' in the result tables in appendix 1. Results that came in after deadline were not taken into account in the screening for suspect data and thus these participants were not requested for checks.

3.1 STATISTICS

The protocol followed in the organisation of this proficiency test was the one as described for proficiency testing in the report 'iis Interlaboratory Studies: Protocol for the Organisation, Statistics and Evaluation' of April 2014 (iis-protocol, version 3.3).

For the statistical evaluation the *unrounded* (when available) figures were used instead of the rounded results. 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. Not all data sets proved to have a normal distribution, in which cases the statistical evaluation of the results should be used with due care.

In accordance with ISO 5725 (1986 and 1994) the original results per determination were submitted subsequently to Dixon and Grubbs outlier tests. Outliers are marked by D(0.01) for the Dixon test and by G(0.01) or DG(0.01) for the Grubbs test. Stragglers are marked by

D(0.05) for the Dixon test, by G(0.05) or DG(0.05) for the Grubbs test and by R(0.05) for the Rosner General ESD test (ref. 21). Both outliers and stragglers were not included in the calculations of the averages and the standard deviations.

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

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

3.2 GRAPHICS

In order to visualise the data against the reproducibilities from literature, Gauss plots were made, using the sorted data for one determination (see appendix 1). On the Y-axis the reported analysis results are plotted. The corresponding laboratory numbers are under the X-axis. The straight horizontal line presents the consensus value (a trimmed mean). The four striped lines, parallel to the consensus value line, are the +3s, +2s, -2s and -3s target reproducibility limits of the selected standard. Outliers and other data, which were excluded from the calculations, are represented as a cross. Accepted data are represented as a triangle. Furthermore, Kernel Density Graphs were made. This method is producing a smooth density approximation to a set of data that avoids some problems associated with histograms (see appendix 3; nos.14 and 15). 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, EN-, ISO-, IP reproducibilities, the z-scores were calculated using a target standard deviation. This target standard deviation was calculated from the literature reproducibility by division with 2.8. The z-scores were calculated according to:

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

The z(target) scores are listed in the result tables in appendix 1.

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.

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

In this proficiency test several problems were encountered with sample transport. Due to these problems five cylinders did reach the laboratory near or after the final reporting date and were unable to test the cylinder and to report results before the deadline of reporting. In total seven laboratories reported the test results after the final reporting date and another seven laboratories did not report any test results due to several circumstances. Not all laboratories did report all test results requested.

In total 44 participating laboratories reported 395 numerical test results. Observed were 27 outlying test results, which is 6.8% of all numerical results. In proficiency studies outlier percentages of 3% - 7.5% are quite normal.

4.1 EVALUATION PER TEST/COMPONENT

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

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

Because the majority of the participating laboratories used ASTM D2163 as test method, 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. Regretfully in the last version ASTM D2163:07 only repeatabilities, but no reproducibilities are mentioned. Therefore the precision data from the previous version ASTM D2163:96 (estimated from figure 3) were used.

All test results reported by laboratories 92, 1491 and 1776 were deviating and many of the eight test results appeared to be statistical outliers. As the eight test results are not independent, it was decided to reject all of the test results of this laboratory for the statistical evaluation.

Also the test results of laboratory 1026 were not used in the calculations because this laboratory did report only 5 of the 8 components present and therefore proper normalisation of the test results was not possible.

Ethane: The determination of this component may be problematic, depending on the test method used by the laboratory. Four statistical outliers were observed. The calculated reproducibility, after exclusion of the suspect data, is not at all in agreement with the requirements of ASTM D2163:96. However, the calculated reproducibility is in good agreement with the less strict reproducibility requirements of EN27941 (identical to IP405 and ISO7941).

- Propane: The determination of this component was problematic for a number of laboratories. Two statistical outliers were observed. However, the calculated reproducibility after exclusion of the suspect data is in good agreement with the requirements of ASTM D2163:96 and also with the reproducibility requirements of EN27941 (identical to IP405 and ISO7941).
- Propylene: The determination of this component may be problematic, depending on the test method used by the laboratory. Four statistical outliers were observed. The calculated reproducibility after exclusion of the suspect data is not in agreement with the requirements of ASTM D2163:96. However, the calculated reproducibility is in good agreement with the less strict reproducibility requirements of EN27941 (identical to IP405 and ISO7941).
- iso-Butane: The determination of this component was problematic for a number of laboratories. Five (!) statistical outliers were observed. The calculated reproducibility after exclusion of the suspect data is in good agreement with the requirements of ASTM D2163:96 and also with the reproducibility requirements of EN27941 (identical to IP405 and ISO7941).
- n-Butane: The determination of this component was problematic. Four statistical outliers were observed. The calculated reproducibility after exclusion of the suspect data is not in agreement with the requirements of ASTM D2163:96, nor with the less strict reproducibility requirements of EN27941 (identical to IP405 and ISO7941).
- 1-Butene: The determination of this component may be problematic, depending on the test method used by the laboratory. Two statistical outliers were observed. The calculated reproducibility after exclusion of the suspect data is not in agreement with the requirements of ASTM D2163:96. However, the calculated reproducibility is in good agreement with the less strict reproducibility requirements of EN27941 (identical to IP405 and ISO7941).
- Iso-Butene: The determination of this component may be problematic, depending on the test method used by the laboratory. Two statistical outliers were observed. The calculated reproducibility after exclusion of the suspect data is not in agreement with the requirements of ASTM D2163:96. However, the calculated reproducibility is in good agreement with the less strict reproducibility requirements of EN27941 (identical to IP405 and ISO7941).

- n-Pentane: The determination of this component may be problematic, depending on the test method used by the laboratory. Two statistical outliers were observed. The calculated reproducibility after exclusion of the suspect data is not in agreement with the requirements of ASTM D2163:96. However, the calculated reproducibility is in good agreement with the less strict reproducibility requirements of EN27941 (identical to IP405 and ISO7941).
- Molar Mass: This calculated parameter may not be problematic. The results vary over a range from 44.58 – 44.7346. No statistical outliers were present. The calculated reproducibility is small in comparison with the calculated reproducibility of iis13S03P (0.12 vs. 0.27). See also the discussion in 4.3.
- Rel. Density @60F: This calculated parameter may be problematic. The results vary over a range from 0.5095 – 0.511. No statistical outliers were present. Possibly seven laboratories reported the relative density @15°C, as IP432 or ISO8973 were used, both methods use 15°C instead of 60F. However, the difference in relative density between 15°C and 60F is less than 0.0001 and therefore this cannot fully explain for the observed spread.
- Abs. VP @100F: As the reported results calculated via ASTM D2598 and ISO8973 are not identical, it was decided to calculate the absolute vapour pressure for each laboratory according to both test methods by using the reported contents of the components. When the result of the calculation method of ASTM D2598 is comparison with the result of the calculation method of ISO8973, it is noticed that the difference in the means is significant, while the difference in the spreads is not significant. See also the discussion in 4.3. The quality of the test results has improved significantly since the previous PT as the dispersion of the results decreased (1.534 vs 2.698 for ISO8973 and 1.575 vs 2.485 for D2598).
- Rel. VP @100F: As the reported results calculated via ASTM D2598 and ISO8973 are not identical, it was decided to calculate the absolute vapour pressure for each laboratory according to both test methods by using the reported contents of the components. When the result of the calculation method of ASTM D2598 is comparison with the result of the calculation method of ISO8973, it is noticed that the difference in the means is significant, while the difference in the spreads is not significant. See also the discussion in 4.3. The quality of the test results has improved significantly since the previous PT as the dispersion of the results decreased (1.534 vs 2.698 for ISO8973 and 1.575 vs 2.485 for D2598).
- Abs. VP @40°C: This determination may be problematic. The range of the reported test results is large: from 1236 - 1386 kPa. One calculation error was observed and possibly two Relative VPs results were reported under

Absolute VP. After exclusion of the suspect data one more statistical outlier was observed.

Rel. VP @40°C: This determination may be problematic. The range of the reported test results is large: from 1138.7 – 1285 kPa. After exclusion of the suspect data one more statistical outlier was observed.

4.2 PERFORMANCE EVALUATION FOR THE GROUP OF LABORATORIES

A comparison has been made between the reproducibility as declared by the relevant standard and the reproducibility as found for the group of participating laboratories. The average results per sample, calculated reproducibilities and reproducibilities, derived from literature standards (in casu ASTM D2163:96 and EN27941/ISO7941/IP405) are compared in the next table.

Parameter	unit	n	cons. value	2.8 * sd	R(D2163:96) in %mol	R(EN27941) liq.-inj. in %mol
Ethane	%mol/mol	31	0.807	0.167	0.093	0.297
Propane	%mol/mol	32	94.103	0.778	0.941	1.013
Propylene	%mol/mol	31	0.743	0.096	0.086	0.212
iso-Butane	%mol/mol	31	1.670	0.187	0.192	0.384
n-Butane	%mol/mol	32	1.658	0.237	0.191	0.212
1-Butene	%mol/mol	32	0.168	0.041	0.019	0.159
Iso-Butene	%mol/mol	32	0.168	0.041	0.019	0.159
n-Pentane	%mol/mol	30	0.669	0.139	0.077	0.310
Molar Mass	g/mol	18	44.662	0.122	n.a.	n.a.
Rel. Density @60F		20	0.5102	0.0013	n.a.	n.a.
Abs. VP @100F	psi		see §4.3		n.a.	n.a.
Rel. VP @100F	psi		see §4.3		n.a.	n.a.
Abs. VP @40°C	kPa	13	1350	32	n.a.	n.a.
Rel. VP @40°C	kPa	13	1246	12	n.a.	n.a.

Table 2: Performance of the group in comparison with the target reproducibilities

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

4.3 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 values by EffectTech in %mol/mol	Consensus values from participants results in %mol/mol	Absolute differences in %mol/mol	z-score
Ethane	0.950	0.807	+0.143	+4.31
Propane	94.231	94.103	+0.128	+0.38
Propylene	0.757	0.743	+0.014	+0.46
iso-Butane	1.578	1.670	-0.092	-1.34
n-Butane	1.551	1.658	-0.107	-1.57
1-Butene	0.159	0.168	-0.009	-1.31
Iso-Butene	0.156	0.169	-0.013	-1.88
n-Pentane	0.618	0.669	+0.051	+1.85

Table 3: comparison of consensus values with values determined by EffectTech

From this comparison it is clear that all consensus values as determined in this PT are in line with the values as determined by EffectTech during the preparation of the cylinders, except for Ethane. Ethane, being the most volatile component, ethane will occupy the headspace in the sample to a greater extent. With each handling (injection, rinsing), the amount of liquid will decrease and the amount of vapour will increase and consequently the ethane concentration in the liquid will decrease. The higher the initial ethane concentration, the more visible the decrease will be.

For the calculation of the Vapour Pressure (VP) @100F, ten participants used ISO8973/IP432/EN589 and seven participants used ASTM D2598. In ISO 8973 (identical to IP432) the Absolute VP is calculated from the mole fraction per component and a VP factor of that component (given for all components). From the Absolute VP, the Relative VP is calculated. The participants that reported a test result for Vapour Pressure @40° all used ISO8973 or IP 432, except one laboratory.

In ASTM D2598 the Gage pressure (identical to the Relative VP) is calculated from the liquid volume percentage per component and a VP factor of that component. Regretfully in the 2002 (2007) version of D2598 no factors are given for n-butene, 1-butene and n-pentane. However, in the draft 2012 version, factors are mentioned for these and other components. As one would expect to find identical values from both calculation methods, it is remarkable to see that the results 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: 20):

"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".

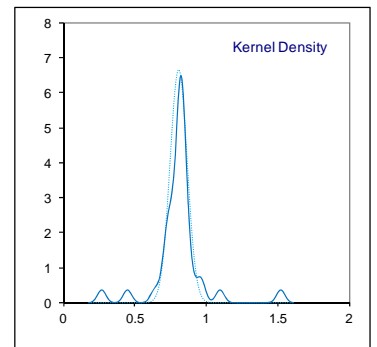
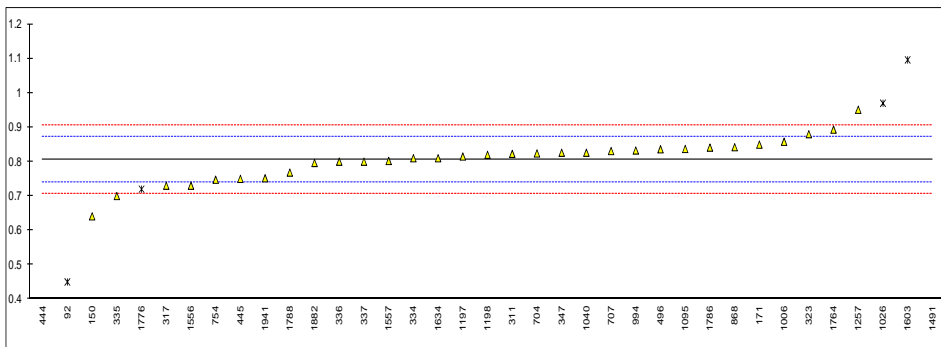
APPENDIX 1

Determination of Ethane on sample #14202; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	D2163	0.45	R(0.01)	-10.76	
150	D2163	0.641		-5.01	
171	D2163	0.8496		1.28	
311	D2163	0.8227		0.47	
317	D2163	0.73		-2.32	
323	D2163	0.88		2.19	
334	EN27941	0.81		0.09	
335	D2163	0.7		-3.23	
336	EN27941	0.8	C	-0.22	first reported 0.44
337	EN27941	0.8		-0.22	
347	D2163	0.826		0.57	
444	IP405	0.27	C,R(0.01)	-16.19	first reported .21
445	D2163	0.75		-1.72	
496	EN27941	0.836		0.87	
511		----		----	
704	D2163	0.824		0.51	
707	D2163	0.831		0.72	
754	D2163	0.7475		-1.80	
868	D2163	0.842		1.05	
912		----		----	
994	D2163	0.8325		0.76	
1006	D2163	0.858		1.53	
1026	ISO7941	0.97	ex	4.91	result excluded, laboratory did report only 5 components
1040	DIN51619	0.826		0.57	
1095	EN27941	0.837		0.90	
1109		----		----	
1197	D2163	0.815		0.24	
1198	D2163	0.820		0.39	
1200		----		----	
1257	D2163	0.9511		4.34	
1259		----		----	
1491	ISO7941	1.520	R(0.01)	21.48	
1556	EN27941	0.73		-2.32	
1557	EN27941	0.802	C	-0.16	first reported .5372
1603	in house	1.0961	R(0.01)	8.71	
1634	ISO7941	0.81		0.09	
1764	D2163	0.8933		2.60	
1776	EN27941	0.72	ex	-2.63	see §4.1
1786	D2163	0.841		1.02	
1788	EN27941	0.7682		-1.17	
1882	EN27941	0.7963		-0.33	
1941	EN27941	0.7517		-1.67	
1960		----		----	
2124		----		----	

normality suspect
n 31
outliers 4 + 2 excl.
mean (n) 0.8072
st.dev. (n) 0.05980
R(calc.) 0.1674
R(D2163:96) 0.0929

Compare R(EN27941(liq)) = 0.2970

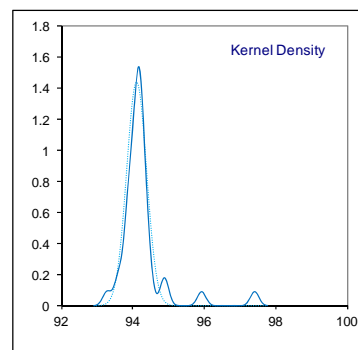
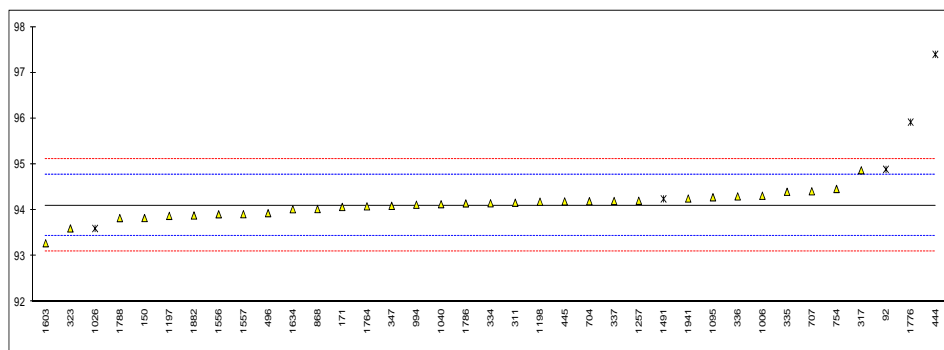


Determination of Propane on sample #14202; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	D2163	94.89	ex	2.34	see §4.1
150	D2163	93.827		-0.82	
171	D2163	94.0695		-0.10	
311	D2163	94.1617		0.17	
317	D2163	94.87		2.28	
323	D2163	93.60		-1.50	
334	EN27941	94.15		0.14	
335	D2163	94.4		0.88	
336	EN27941	94.3	C	0.59	first reported 93.91
337	EN27941	94.2		0.29	
347	D2163	94.094		-0.03	
444	IP405	97.40	C,R(0.01)	9.81	first reported 99.03
445	D2163	94.19		0.26	
496	EN27941	93.934		-0.50	
511		----		----	
704	D2163	94.194		0.27	
707	D2163	94.412		0.92	
754	D2163	94.4625		1.07	
868	D2163	94.023		-0.24	
912		----		----	
994	D2163	94.1181		0.04	
1006	D2163	94.313		0.62	
1026	ISO7941	93.6	ex	-1.50	result excluded, laboratory did report only 5 components
1040	DIN51619	94.130		0.08	
1095	EN27941	94.281		0.53	
1109		----		----	
1197	D2163	93.875		-0.68	
1198	D2163	94.184		0.24	
1200		----		----	
1257	D2163	94.2040		0.30	
1259		----		----	
1491	ISO7941	94.246	ex	0.42	see §4.1
1556	EN27941	93.91		-0.58	
1557	EN27941	93.911	C	-0.57	first reported 92.5901
1603	in house	93.2776		-2.46	
1634	ISO7941	94.02		-0.25	
1764	D2163	94.083		-0.06	
1776	EN27941	95.92	R(0.01)	5.41	
1786	D2163	94.147		0.13	
1788	EN27941	93.8268		-0.82	
1882	EN27941	93.8833		-0.65	
1941	EN27941	94.2532		0.45	
1960		----		----	
2124		----		----	

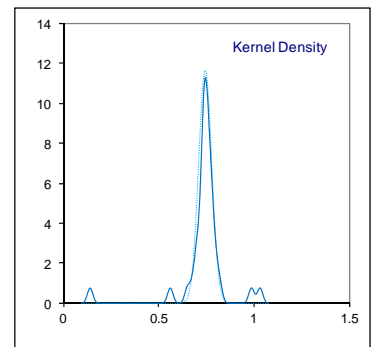
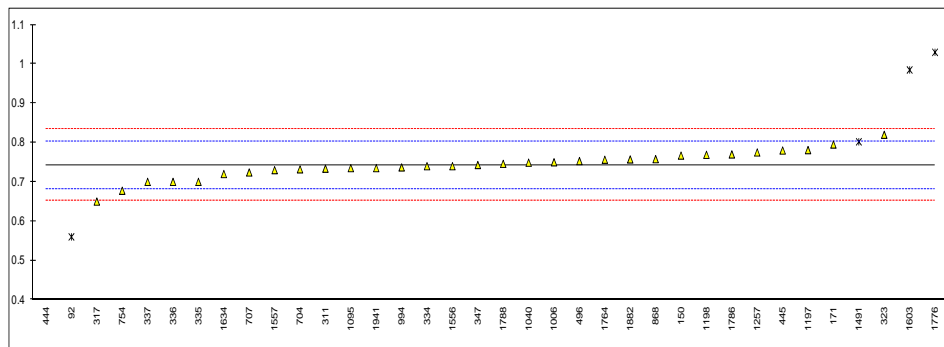
normality not OK
n 32
outliers 2 +3 excl.
mean (n) 94.103
st.dev. (n) 0.2779
R(calc.) 0.778
R(D2163:96) 0.941

Compare R(EN27941(liq)) = 1.013



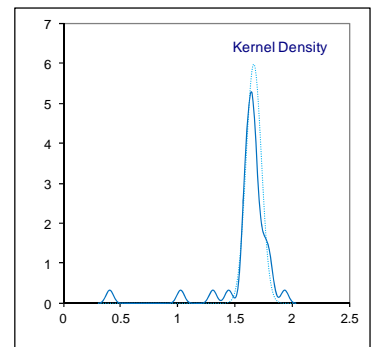
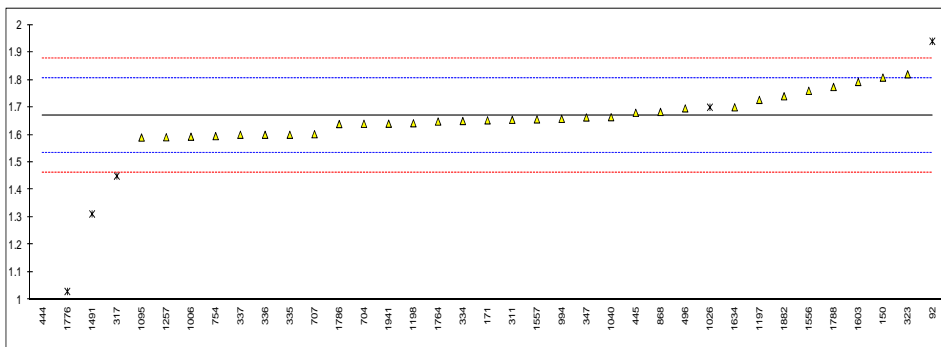
Determination of Propylene on sample #14202; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	D2163	0.56	R(0.01)	-5.98	
150	D2163	0.767		0.80	
171	D2163	0.7952		1.72	
311	D2163	0.7337		-0.30	
317	D2163	0.65		-3.04	
323	D2163	0.82		2.53	
334	EN27941	0.74		-0.09	
335	D2163	0.7		-1.40	
336	EN27941	0.7	C	-1.40	first reported 0.65
337	EN27941	0.7		-1.40	
347	D2163	0.743		0.01	
444	IP405	0.14	C,R(0.01)	-19.74	first reported 0.17
445	D2163	0.78		1.22	
496	EN27941	0.753		0.34	
511		-----		-----	
704	D2163	0.732		-0.35	
707	D2163	0.724		-0.61	
754	D2163	0.6775		-2.14	
868	D2163	0.758		0.50	
912		-----		-----	
994	D2163	0.7369		-0.19	
1006	D2163	0.750		0.24	
1026		-----		-----	
1040	DIN51619	0.749		0.21	
1095	EN27941	0.735		-0.25	
1109		-----		-----	
1197	D2163	0.781		1.25	
1198	D2163	0.769		0.86	
1200		-----		-----	
1257	D2163	0.7750		1.06	
1259		-----		-----	
1491	ISO7941	0.802	ex	1.94	see §4.1
1556	EN27941	0.74		-0.09	
1557	EN27941	0.730	C	-0.42	first reported 0.6908
1603	in house	0.9850	C,R(0.01)	7.93	first reported 0.9970
1634	ISO7941	0.72		-0.74	
1764	D2163	0.7564		0.45	
1776	EN27941	1.03	R(0.01)	9.41	
1786	D2163	0.770		0.89	
1788	EN27941	0.7460		0.11	
1882	EN27941	0.7573		0.48	
1941	EN27941	0.7351		-0.25	
1960		-----		-----	
2124		-----		-----	
normality		suspect			
n		31			
outliers		4	+1 excl.		
mean (n)		0.7427			
st.dev. (n)		0.03426			
R(calc.)		0.0959			
R(D2163:96)		0.0855			
				Compare R(EN27941(liq)) = 0.2122	



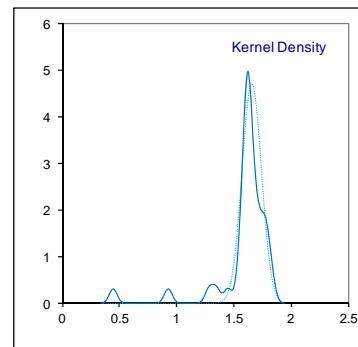
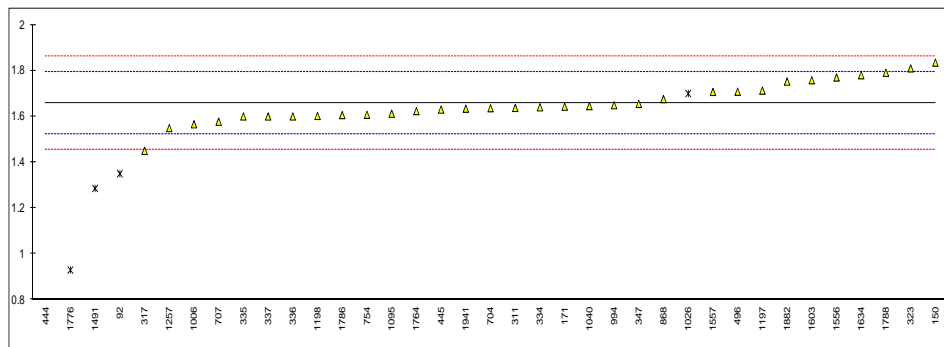
Determination of iso-Butane on sample #14202; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	D2163	1.94	R(0.01)	3.94	
150	D2163	1.808		2.02	
171	D2163	1.6525		-0.25	
311	D2163	1.6545		-0.22	
317	D2163	1.45	D(0.05)	-3.20	
323	D2163	1.82		2.19	
334	EN27941	1.65		-0.29	
335	D2163	1.6		-1.01	
336	EN27941	1.6	C	-1.01	first reported 1.85
337	EN27941	1.6		-1.01	
347	D2163	1.663		-0.10	
444	IP405	0.41	C,R(0.01)	-18.35	first reported 0.34
445	D2163	1.68		0.15	
496	EN27941	1.696		0.38	
511		----		----	
704	D2163	1.640		-0.43	
707	D2163	1.602		-0.99	
754	D2163	1.5950		-1.09	
868	D2163	1.683		0.19	
912		----		----	
994	D2163	1.6581		-0.17	
1006	D2163	1.593		-1.12	
1026	ISO7941	1.7	ex	0.44	result excluded, laboratory did report only 5 components
1040	DIN51619	1.664		-0.08	
1095	EN27941	1.590		-1.16	
1109		----		----	
1197	D2163	1.727		0.84	
1198	D2163	1.642		-0.40	
1200		----		----	
1257	D2163	1.5910		-1.15	
1259		----		----	
1491	ISO7941	1.312	R(0.01)	-5.21	
1556	EN27941	1.76		1.32	
1557	EN27941	1.656	C	-0.20	first reported 2.1558
1603	in house	1.7923		1.79	
1634	ISO7941	1.70		0.44	
1764	D2163	1.6482		-0.31	
1776	EN27941	1.03	R(0.01)	-9.32	
1786	D2163	1.639		-0.45	
1788	EN27941	1.7738		1.52	
1882	EN27941	1.7402		1.03	
1941	EN27941	1.6403		-0.43	
1960		----		----	
2124		----		----	
normality		OK			
n		31			
outliers		5	+1 excl.		
mean (n)		1.6696			
st.dev. (n)		0.06690			
R(calc.)		0.1873			
R(D2163:96)		0.1922			
				Compare R(EN27941(liq)) = 0.3842	



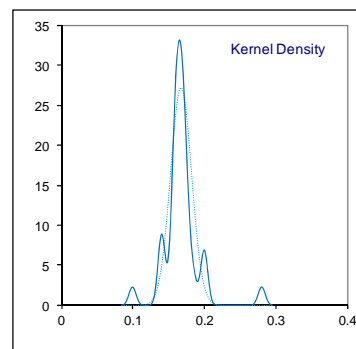
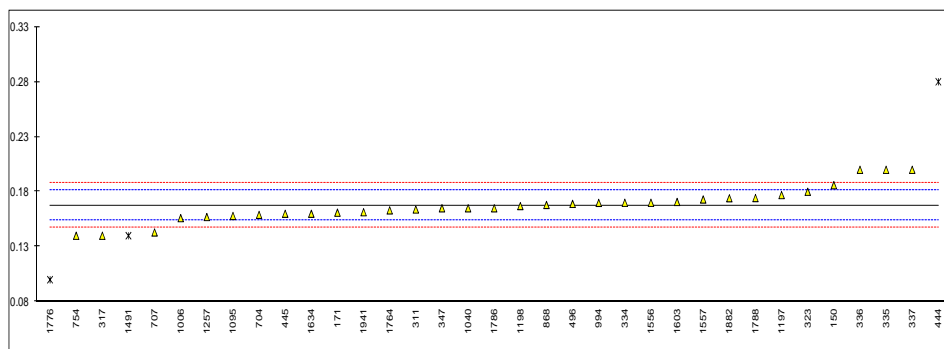
Determination of n-Butane on sample #14202; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	D2163	1.35	R(0.05)	-4.52	
150	D2163	1.835		2.59	
171	D2163	1.6428		-0.23	
311	D2163	1.6370		-0.31	
317	D2163	1.45		-3.05	
323	D2163	1.81		2.23	
334	EN27941	1.64		-0.27	
335	D2163	1.6		-0.85	
336	EN27941	1.6	C	-0.85	first reported 1.93
337	EN27941	1.6		-0.85	
347	D2163	1.655		-0.05	
444	IP405	0.45	C,R(0.01)	-17.72	first reported 0.20
445	D2163	1.63		-0.41	
496	EN27941	1.708		0.73	
511		----		----	
704	D2163	1.636		-0.33	
707	D2163	1.577		-1.19	
754	D2163	1.6075		-0.74	
868	D2163	1.676		0.26	
912		----		----	
994	D2163	1.6489		-0.14	
1006	D2163	1.566		-1.35	
1026	ISO7941	1.7	ex	0.61	result excluded, laboratory did report only 5 components
1040	DIN51619	1.645		-0.19	
1095	EN27941	1.612		-0.68	
1109		----		----	
1197	D2163	1.713		0.80	
1198	D2163	1.602		-0.82	
1200		----		----	
1257	D2163	1.5490		-1.60	
1259		----		----	
1491	ISO7941	1.286	R(0.05)	-5.46	
1556	EN27941	1.77		1.64	
1557	EN27941	1.707	C	0.72	first reported 2.2217
1603	in house	1.7582		1.47	
1634	ISO7941	1.78		1.79	
1764	D2163	1.6235		-0.51	
1776	EN27941	0.93	R(0.01)	-10.68	
1786	D2163	1.606		-0.77	
1788	EN27941	1.7907		1.94	
1882	EN27941	1.7524		1.38	
1941	EN27941	1.6340		-0.35	
1960		----		----	
2124		----		----	
normality		OK			
n		32			
outliers		4	+1 excl.		
mean (n)		1.6582			
st.dev. (n)		0.08457			
R(calc.)		0.2368			
R(D2163:96)		0.1909			
				Compare R(EN27941(liq)) = 0.2122	



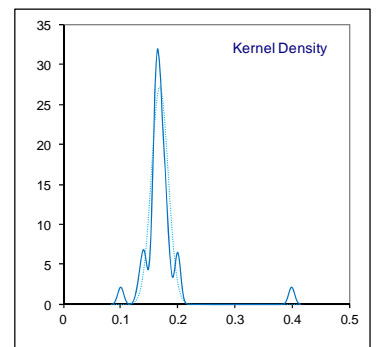
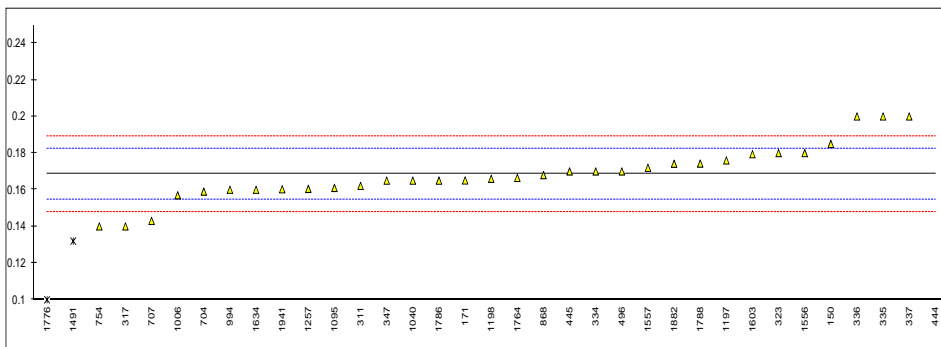
Determination of 1-Butene on sample #14202; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92		----		----	
150	D2163	0.186		2.65	
171	D2163	0.1610		-0.97	
311	D2163	0.1639		-0.55	
317	D2163	0.14		-4.02	
323	D2163	0.18		1.78	
334	EN27941	0.17		0.33	
335	D2163	0.2		4.68	
336	EN27941	0.2	C	4.68	first reported 0.19
337	EN27941	0.2		4.68	
347	D2163	0.165		-0.39	
444	IP405	0.28	C,R(0.01)	16.29	first reported 0.01
445	D2163	0.16		-1.12	
496	EN27941	0.169		0.19	
511		----		----	
704	D2163	0.159		-1.26	
707	D2163	0.143		-3.58	
754	D2163	0.1400		-4.02	
868	D2163	0.168		0.04	
912		----		----	
994	D2163	0.1699		0.32	
1006	D2163	0.156		-1.70	
1026		----		----	
1040	DIN51619	0.165		-0.39	
1095	EN27941	0.158		-1.41	
1109		----		----	
1197	D2163	0.177		1.35	
1198	D2163	0.167		-0.10	
1200		----		----	
1257	D2163	0.1570		-1.55	
1259		----		----	
1491	ISO7941	0.140	ex	-4.02	see §4.1
1556	EN27941	0.17		0.33	
1557	EN27941	0.173	C	0.77	first reported 0.2179
1603	in house	0.1707		0.44	
1634	ISO7941	0.16		-1.12	
1764	D2163	0.1631		-0.67	
1776	EN27941	0.10	R(0.01)	-9.82	
1786	D2163	0.165		-0.39	
1788	EN27941	0.1743		0.96	
1882	EN27941	0.1741		0.93	
1941	EN27941	0.1614		-0.91	
1960		----		----	
2124		----		----	
normality		OK			
n		32			
outliers		2	+1 excl.		
mean (n)		0.1677			
st.dev. (n)		0.01467			
R(calc.)		0.0411			
R(D2163:96)		0.0193			
				Compare R(EN27941(liq)) = 0.1592	



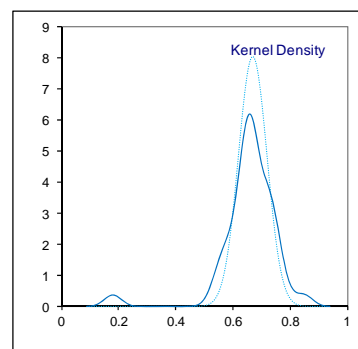
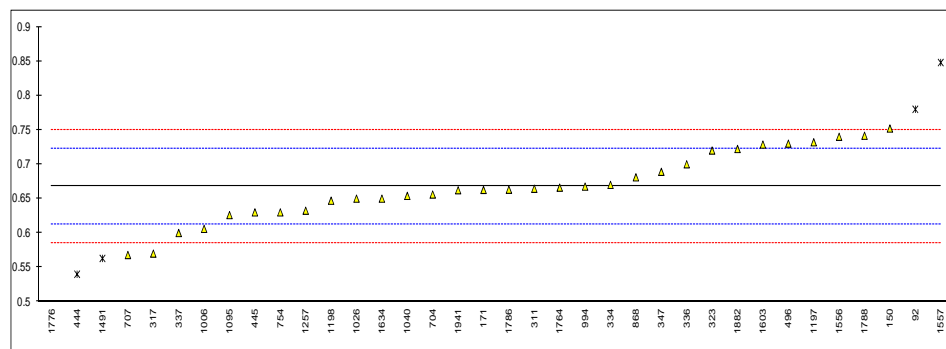
Determination of iso-Butene on sample #14202; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92		----		----	
150	D2163	0.185		2.37	
171	D2163	0.1651		-0.50	
311	D2163	0.1621		-0.93	
317	D2163	0.14		-4.12	
323	D2163	0.18		1.65	
334	EN27941	0.17		0.21	
335	D2163	0.2		4.53	
336	EN27941	0.2	C	4.53	first reported 0.19
337	EN27941	0.2		4.53	
347	D2163	0.165		-0.52	
444	IP405	0.40	C,R(0.01)	33.39	first reported 0.02
445	D2163	0.17		0.21	
496	EN27941	0.170		0.21	
511		----		----	
704	D2163	0.159		-1.38	
707	D2163	0.143		-3.69	
754	D2163	0.1400		-4.12	
868	D2163	0.168		-0.08	
912		----		----	
994	D2163	0.1600		-1.24	
1006	D2163	0.157		-1.67	
1026		----		----	
1040	DIN51619	0.165		-0.52	
1095	EN27941	0.161		-1.09	
1109		----		----	
1197	D2163	0.176		1.07	
1198	D2163	0.166		-0.37	
1200		----		----	
1257	D2163	0.1605		-1.17	
1259		----		----	
1491	ISO7941	0.132	ex	-5.28	see §4.1
1556	EN27941	0.18		1.65	
1557	EN27941	0.172	C	0.49	first reported 2.166
1603	in house	0.1794		1.56	
1634	ISO7941	0.16		-1.24	
1764	D2163	0.1665		-0.30	
1776	EN27941	0.10	R(0.01)	-9.89	
1786	D2163	0.165		-0.52	
1788	EN27941	0.1743		0.83	
1882	EN27941	0.1742		0.81	
1941	EN27941	0.1603		-1.19	
1960		----		----	
2124		----		----	
normality		OK			
n		32			
outliers		2	+1 excl.		
mean (n)		0.1686			
st.dev. (n)		0.01470			
R(calc.)		0.0412			
R(D2163:96)		0.0194			
				Compare R(EN27941(liq)) = 0.1592	



Determination of n-Pentane on sample #14202; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	D2163	0.78	ex	4.05	see §4.1
150	D2163	0.752		3.03	
171	D2163	0.6627		-0.22	
311	D2163	0.6644		-0.16	
317	D2163	0.57		-3.59	
323	D2163	0.72		1.87	
334	EN27941	0.67		0.05	
335		-----		-----	
336	EN27941	0.7	C	1.14	first reported 0.85
337	EN27941	0.6		-2.50	
347	D2163	0.689		0.74	
444	IP405	0.54	C,ex	-4.68	see §4.1, first reported 0.02
445	D2163	0.63		-1.41	
496	EN27941	0.730		2.23	
511		-----		-----	
704	D2163	0.656		-0.46	
707	D2163	0.568		-3.66	
754	D2163	0.6300		-1.41	
868	D2163	0.681		0.45	
912		-----		-----	
994	D2163	0.6675		-0.04	
1006	D2163	0.606		-2.28	
1026	ISO7941	0.65	ex	-0.68	result excluded, laboratory did report only 5 components
1040	DIN51619	0.654		-0.54	
1095	EN27941	0.626		-1.55	
1109		-----		-----	
1197	D2163	0.732		2.30	
1198	D2163	0.647		-0.79	
1200		-----		-----	
1257	D2163	0.6324		-1.32	
1259		-----		-----	
1491	ISO7941	0.563	ex	-3.84	see §4.1
1556	EN27941	0.74		2.59	
1557	EN27941	0.848	C,G(0.05)	6.52	first reported 1.3664
1603	in house	0.7287		2.18	
1634	ISO7941	0.65		-0.68	
1764	D2163	0.6660		-0.10	
1776	EN27941	0.18	R(0.01)	-17.77	
1786	D2163	0.663		-0.21	
1788	EN27941	0.7415		2.65	
1882	EN27941	0.7222		1.95	
1941	EN27941	0.6622		-0.24	
1960		-----		-----	
2124		-----		-----	
normality		OK			
n		30			
outliers		2	+4 excl.		
mean (n)		0.6687			
st.dev. (n)		0.04973			
R(calc.)		0.1393			
R(D2163:96)		0.0770			
				Compare R(EN27941(liq)) = 0.3095	

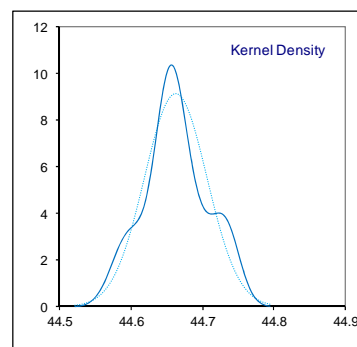
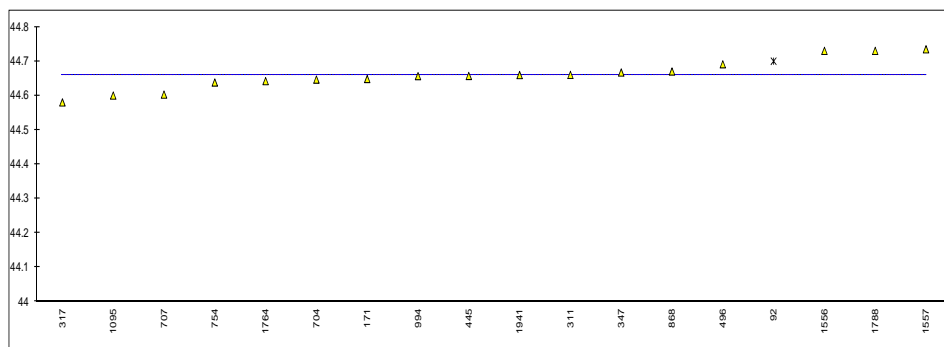


Determination of Molar Mass on sample #14202; results in g/mol

lab	method	value	mark	z(targ)	remarks
92	D2163	44.7	ex	----	see §4.1
150		----		----	
171	D2421	44.64814322		----	
311	in house	44.66		----	
317	INH-001	44.58		----	
323		----		----	
334		----		----	
335		----		----	
336		----		----	
337		----		----	
347	D2421	44.667		----	
444		----		----	
445	IP432	44.657		----	
496	D2421	44.691		----	
511		----		----	
704	D2163/D2421	44.6464		----	
707	D2163/D2421	44.6028		----	
754	D2421	44.63798		----	
868	D2598	44.67		----	
912		----		----	
994	calc	44.6565		----	
1006		----		----	
1026		----		----	
1040		----		----	
1095	D2421	44.6		----	
1109		----		----	
1197		----		----	
1198		----		----	
1200		----		----	
1257		----		----	
1259		----		----	
1491		----		----	
1556		44.73		----	
1557	INH-1200	44.7346		----	
1603		----		----	
1634		----		----	
1764	D2598	44.642		----	
1776		----		----	
1786		----		----	
1788	ISO8973	44.73		----	
1882		----		----	
1941	in house	44.65954		----	
1960		----		----	
2124		----		----	

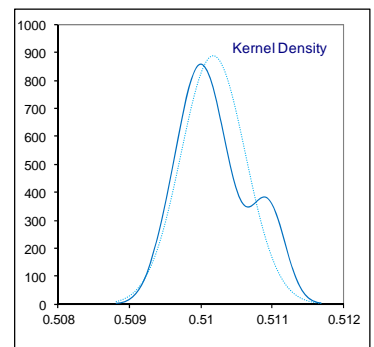
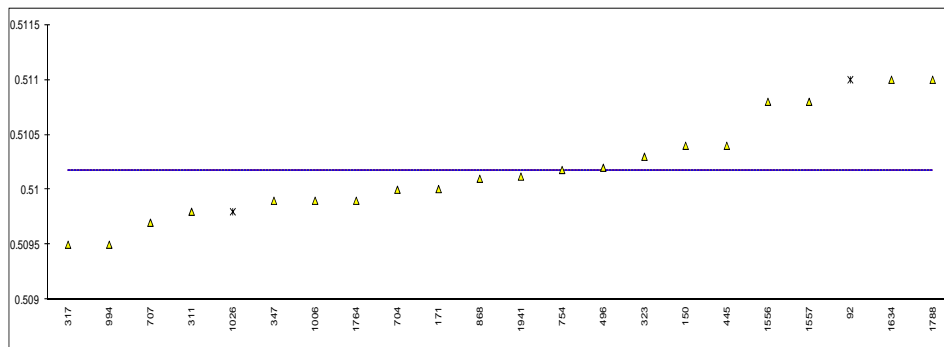
Calculated by iis from all reported results

normality	OK	OK
n	17	30
outliers	0 + 1 excl.	1 + 3 excl.
mean (n)	44.662	44.663
st.dev. (n)	0.0437	0.0423
R(calc.)	0.122	0.119
R(iis13S03P)	0.272	0.224



Determination of Relative Density @60F on sample #14202; unitless results

lab	method	value	mark	z(targ)	remarks
92	D2598	0.511	ex	----	see §4.1
150	D2598	0.5104		----	
171	D2421	0.510006		----	
311	in house	0.5098		----	
317	INH-001	0.5095		----	
323	D2598	0.5103		----	
334		----		----	
335		----		----	
336		----		----	
337		----		----	
347	D2598	0.5099		----	
444		----		----	
445	IP432	0.5104		----	
496	D2598	0.5102		----	
511		----		----	
704	D2598	0.5100		----	
707	D2598	0.5097		----	
754	ISO8973	0.51018		----	
868	D2598	0.5101		----	
912		----		----	
994	D2598	0.5095	E	----	Result calculated by iis 0.5102
1006	D2598	0.5099		----	
1026	ISO8973	0.5098	C, ex	----	reported 509.8 probably in a different unit result excluded, laboratory did report only 5 components
1040		----		----	
1095		----		----	
1109		----		----	
1197		----		----	
1198		----		----	
1200		----		----	
1257		----		----	
1259		----		----	
1491		----		----	
1556	ISO8973	0.5108	C	----	reported 510.8 probably in a different unit
1557	ISO8973	0.5108		----	
1603		----		----	
1634	ISO8973	0.511		----	
1764	D2598	0.5099		----	
1776		----		----	
1786		----		----	
1788	ISO8973	0.511		----	
1882		----		----	
1941	D2598	0.51012		----	
1960		----		----	
2124		----		----	
					<u>Calculated by iis from all reported results</u>
normality	OK				suspect
n	20				31
outliers	0		+2 excl.		2 + 4 excl.
mean (n)	0.51018				0.51024
st.dev. (n)	0.000449				0.0002496
R(calc.)	0.00126				0.00069
R(iis13S03P)	0.00156				0.00134

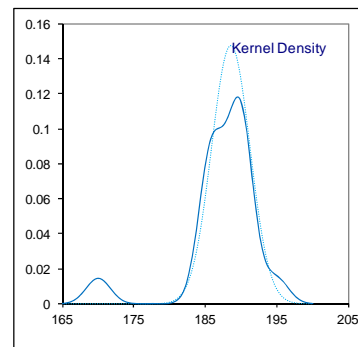
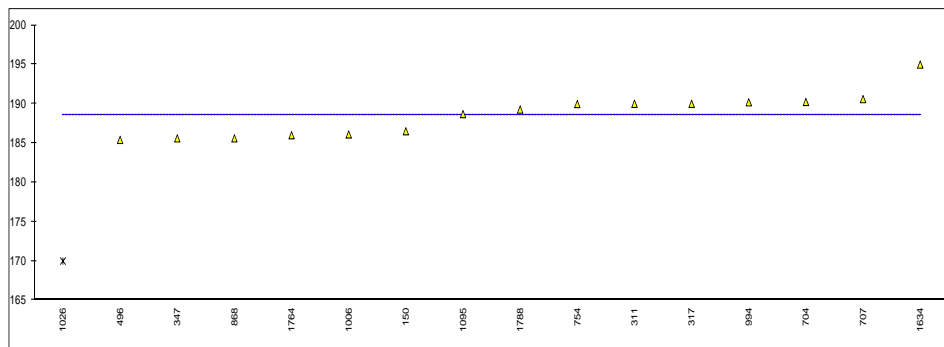


Determination of Absolute Vapour Pressure @100F on sample #14202; results in psi

lab	method	value	mark	z(targ)	remarks
92		----		----	
150	D2598	186.51	E	----	iis calculated 184.34
171		----		----	
311	ISO8973	190		----	
317	ISO8973	190		----	
323		----		----	
334		----		----	
335		----		----	
336		----		----	
337		----		----	
347	D2598	185.6	C	----	first reported 172.7
444		----		----	
445		----		----	
496	D2598	185.4		----	
511		----		----	
704	ISO8973	190.24		----	
707	ISO8973	190.60		----	
754	ISO8973	189.975		----	
868	D2598	185.6		----	
912		----		----	
994	IP432	190.194		----	
1006	D2598	186.1		----	
1026	ISO8973	169.98	ex	----	result excluded, laboratory did report only 5 components
1040		----		----	
1095	ISO8973	188.69		----	
1109		----		----	
1197		----		----	
1198		----		----	
1200		----		----	
1257		----		----	
1259		----		----	
1491		----		----	
1556		----		----	
1557		----		----	
1603		----		----	
1634	ISO8973	195	C, E	----	first reported 181; iis calculated 189.88
1764	D2598	186.000		----	
1776		----		----	
1786		----		----	
1788	ISO8973	189.27		----	
1882		----		----	
1941		----		----	
1960		----		----	
2124		----		----	

Calculated by iis from all reported results

	ISO8973/IP432	ASTM D2598
normality	not OK	suspect
n	32	33
outliers	0 + 2 excl.	0 + 4 excl.
mean (n)	190.081	185.813
st.dev. (n)	0.5477	0.5172
R(calc.)	1.534	1.448
R(iis13S03P)	2.698	2.485

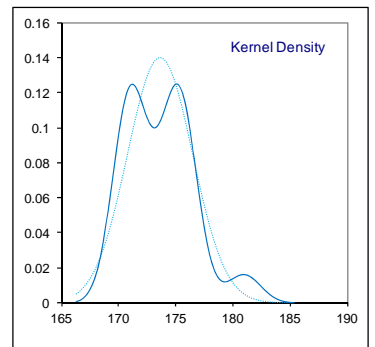
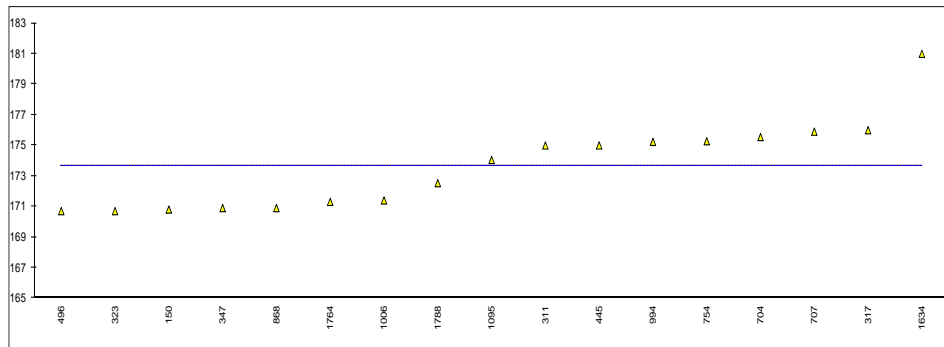


Determination of Relative Vapour Pressure @100F on sample #14202; results in psi

lab	method	value	mark	z(targ)	remarks
92		----		----	
150	D2598	170.802	E	----	iis calculated 169.64
171		----		----	
311	ISO8973	175		----	
317	ISO8973	176		----	
323	D2598	170.7		----	
334		----		----	
335		----		----	
336		----		----	
337		----		----	
347	D2598	170.9	C	----	first reported 158.0
444		----		----	
445	IP432	175		----	
496	D2598	170.7		----	
511		----		----	
704	ISO8973	175.55		----	
707	ISO8973	175.90		----	
754	ISO8973	175.275		----	
868	D2598	170.9		----	
912		----		----	
994	IP432	175.236		----	
1006	D2598	171.4		----	
1026		----		----	
1040		----		----	
1095	ISO8973	174.05		----	
1109		----		----	
1197		----		----	
1198		----		----	
1200		----		----	
1257		----		----	
1259		----		----	
1491		----		----	
1556		----		----	
1557		----		----	
1603		----		----	
1634	ISO8973	181	C,E	----	first reported 166; iis calculated 175.19
1764	D2598	171.304		----	
1776		----		----	
1786		----		----	
1788	ISO8973	172.53	E	----	iis calculated 174.65
1882		----		----	
1941		----		----	
1960		----		----	
2124		----		----	

Calculated by iis from all reported results

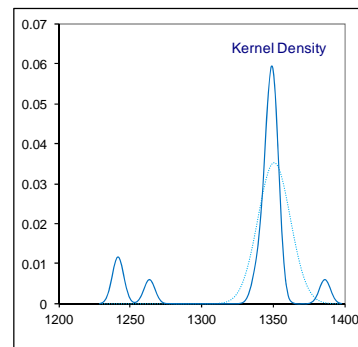
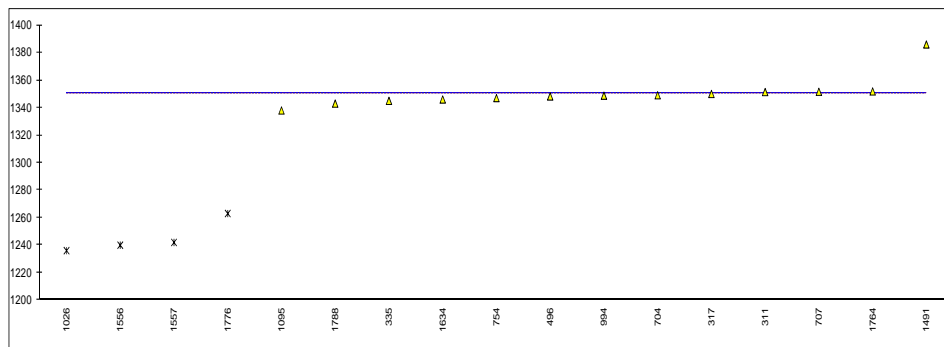
	ISO8973/IP432	ASTM D2598
normality	not OK	suspect
n	32	33
outliers	0 + 2 excl.	0 + 4 excl.
mean (n)	175.382	171.117
st.dev. (n)	0.5477	0.5172
R(calc.)	1.534	1.448
R(iis13S03P)	2.698	2.485



Determination of Absolute Vapour Pressure @40°C on sample #14202; results in kPa

lab	method	value	mark	z(targ)	remarks
92		----		----	
150		----		----	
171		----		----	
311	ISO8973	1351.4	E	----	iis calculated 1348.6
317	ISO8973	1350	C	----	first reported 196, probably in a different unit
323		----		----	
334		----		----	
335	ISO8973	1345		----	
336		----		----	
337		----		----	
347		----		----	
444		----		----	
445		----		----	
496	ISO8973	1348.2		----	
511		----		----	
704	ISO8973	1349.05		----	
707	ISO8973	1351.60		----	
754	ISO8973	1347.0		----	
868		----		----	
912		----		----	
994	IP432	1348.75		----	
1006		----		----	
1026	ISO8973	1236	ex	----	result excluded, laboratory did report only 5 components
1040		----		----	
1095	ISO8973	1338		----	
1109		----		----	
1197		----		----	
1198		----		----	
1200		----		----	
1257		----		----	
1259		----		----	
1491	ISO8973	1386	ex	----	see §4.1
1556	ISO8973	1240.0	G(0.01)	----	
1557	ISO8973	1242	ex	----	result excluded, probably reported Relative Vapour Pressure instead
1603		----		----	
1634	ISO8973	1346	C	----	first reported 1245
1764	ISO8973	1351.849		----	
1776	ISO8973	1263.03	ex	----	see §4.1
1786		----		----	
1788	ISO8973	1343		----	
1882		----		----	
1941		----		----	
1960		----		----	
2124		----		----	

normality	not OK	Calculated by iis from all reported results
n	13	<u>ISO8973/IP432</u>
outliers	1 + 4 excl.	suspect
mean (n)	1350.45	0 + 2 excl.
st.dev. (n)	11.365	1347.87
R(calc.)	31.823	4.062
R(iis13S03P)	n.a.	11.374
		n.a.

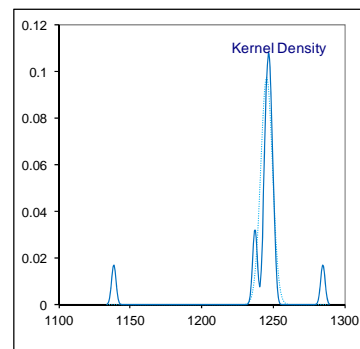
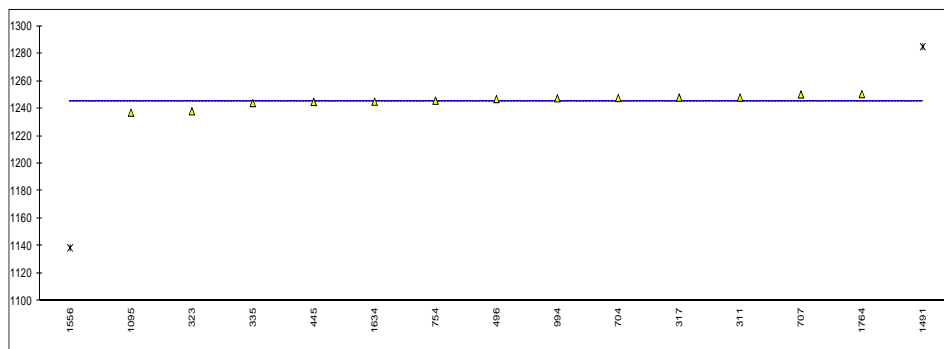


Determination of Relative Vapour Pressure @40°C on sample #14202; results in kPa

lab	method	value	mark	z(targ)	remarks
92		----		----	
150		----		----	
171		----		----	
311	ISO8973	1248.0		----	
317	ISO8973	1248	C	----	first reported 181, probably in a different unit
323	D2598	1238		----	
334		----		----	
335	ISO8973	1244		----	
336		----		----	
337		----		----	
347		----		----	
444		----		----	
445	IP432	1244.8		----	
496	ISO8973	1246.9		----	
511		----		----	
704	ISO8973	1247.73		----	
707	ISO8973	1250.28		----	
754	ISO8973	1245.7		----	
868		----		----	
912		----		----	
994	IP432	1247.45		----	
1006		----		----	
1026		----		----	
1040		----		----	
1095	ISO8973	1237		----	
1109		----		----	
1197		----		----	
1198		----		----	
1200		----		----	
1257		----		----	
1259		----		----	
1491	ISO8973	1285	ex	----	see §4.1
1556	ISO8973	1138.7	G(0.01)	----	
1557		----		----	
1603		----		----	
1634	ISO8973	1245	C	----	first reported 1144
1764	ISO8973	1250.524		----	
1776		----		----	
1786		----		----	
1788		----		----	
1882		----		----	
1941		----		----	
1960		----		----	
2124		----		----	

Calculated by iis from all reported results
ISO8973/IP432

normality	OK	suspect
n	13	32
outliers	1 + 1 excl.	0 + 2 excl.
mean (n)	1245.65	1246.55
st.dev. (n)	4.109	4.062
R(calc.)	11.50	11.37
R(iis13S03P)	n.a.	n.a.



APPENDIX 2

Number of participants per country

3 labs in AUSTRALIA
1 lab in AZERBAIJAN
1 lab in BELGIUM
1 lab in CANADA
1 lab in CHINA, People's Republic
1 lab in CROATIA
4 labs in FRANCE
3 labs in GERMANY
1 lab in INDIA
1 lab in ITALY
3 labs in MALAYSIA
3 labs in NETHERLANDS
1 lab in PERU
4 labs in PORTUGAL
1 lab in RUSSIAN FEDERATION
1 lab in SAUDI ARABIA
3 labs in SERBIA
1 lab in SPAIN
2 labs in SWEDEN
1 lab in TAIWAN
2 labs in UKRAINE
1 lab in UNITED ARAB EMIRATES
2 labs in UNITED KINGDOM
2 labs in UNITED STATES OF AMERICA

APPENDIX 3

Abbreviations:

C	= final result after checking of first reported suspect 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 outlier test
R(0.05)	= straggler in Rosner outlier test
ex	= excluded from calculations
n/a	= not applicable
W	= withdrawn on request participant
U	= reported in wrong unit
E	= error in calculations
SDS	= Safety Data Sheet

Literature:

- 1 iis Interlaboratory Studies, Protocol for the Organisation, Statistics and Evaluation, April 2014
- 2 ASTM D2163-96
- 3 ASTM D2163-07
- 4 ASTM D2421-07
- 5 ISO 5725-86
- 6 ISO 5725, parts 1-6, 1994
- 7 M. Thompson and R. Wood, J. AOAC Int, 76, 926, (1993)
- 8 W.J. Youden and E.H. Steiner, Statistical Manual of the AOAC, (1975)
- 9 IP 367/84
- 10 DIN 38402 T41/42
- 11 P.L. Davies, First reported Z. Anal. Chem, 331, 513, (1988)
- 12 J.N. Miller, Analyst, 118, 455, (1993)
- 13 Analytical Methods Committee Technical Brief, No4 January 2001
- 14 The Royal Society of Chemistry 2002, Analyst 2002, 127 page1359-1364, P.J. Lowthian and M. Thompson. (see <http://www.rsc.org/suppdata/an/b2/b205600n/>)
- 15 ISO 17043:2010
- 16 EN 27941:1993
- 17 ASTM D2598-02 (reapproved 2007)
- 18 IP 432-2000 = ISO8973-1997
- 19 Work Item WK36318, proposal to revise ASTM D2598-02 (07)
- 20 Private communication ASTM Subcommittee D02.H
- 21 Bernard Rosner, Percentage Points for a Generalized ESD Many-Outlier Procedure, Technometrics, 25(2), pp. 165-172, (1983)