

Results of Proficiency Test  
Liquefied Butane Analysis  
June 2014

Organised by: Institute for Interlaboratory Studies  
Spijkenisse, the Netherlands

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## SUMMARY OF CHANGES

The staff of the institute for Interlaboratory Studies has changed several chapters and tables since the last issue of this report, which may have impact on the use of this report.

The following chapters and tables in this report have been revised:

- Contents, page 3
- Chapter 4.1, page 11
- Table 2 on page 11
- Chapter 4.4, page 14
- In appendix 1, the table on page 27
- In appendix 1, the table on page 28

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## 1 INTRODUCTION

Since 2009, the Institute for Interlaboratory Studies organizes a proficiency test for Liquefied Butane (composition only) every year.

Because iis has limited gas-handling facilities in place to prepare gas samples, a co-operation with EffecTech (Uttoxeter, United Kingdom) was set up. This company is fully equipped and has experience in the preparation of synthetic natural gas samples for PT purposes. EffecTech 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 41 laboratories in 25 different countries have participated. See appendix 3 for the number of participants per country. In this report the results of the 2014 proficiency test on Liquefied Butane are presented and discussed. This report is also electronically available through the iis internet site <http://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 Butane mixture. The mixture was divided over a batch of 44 cylinders.

The cylinder size is a cost-effective one-litre cylinder with dip tube device. Each cylinder, filled with approx 200 grams of liquefied butane mixture, was uniquely numbered. The limited cylinder size is chosen to optimise sample stability, cylinder costs, transport and handling costs.

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/IEC17043:2010 (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.

EffecTech 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).

## 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 44 one litre cylinders with artificial Liquefied Butane mixture was prepared and tested for homogeneity by EffectTech (Uttoxeter, United Kingdom) in conformance with ISO Guide 35: 2006 and ISO/IEC17043:2010 (job 14/0390) starting May 1, 2014. Each cylinder was uniquely numbered. Every cylinder in the batch was analysed using 5 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) in %mol/mol
iso-Butane	0.024	0.280
Propane	0.013	0.077
Propylene	0.006	0.065
n-Butane	0.008	0.076
1,3-Butadiene	0.006	0.041
iso-Butylene	0.003	0.067
1-Butene	0.004	0.084
trans-2-Butene	0.006	0.062
cis-2-Butene	0.012	0.085
iso-Pentane	0.011	0.017

Table 1: homogeneity test results of samples #14086

Each calculated repeatability is far less than 0.3 times the corresponding reproducibility of the reference method ASTM D2163:14e1.

Therefore, homogeneity of the subsamples #14086 was assumed.

To each of the participating laboratories one 1L cylinder was sent on May 28, 2014.

## 2.5 STABILITY OF THE SAMPLES

EffecTech (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: Propane, Propylene, n-Butane, 1,3-Butadiene, iso-Butylene, 1-Butene, trans-2-Butene, cis-2-Butene, iso-Pentane, iso-Butane, Molar Mass, Relative Density and Absolute and Relative Vapour pressure. Also some method details were requested to be reported.

To get comparable results a detailed report form, on which the units were prescribed as well as some of the required standards and a letter of instructions were prepared and made available for download on the iis website ([www.iisnl.com](http://www.iisnl.com)).

A SDS and a form to confirm receipt of the samples were added to the sample package. Participants are also requested to send a remark if other components were found e.g. Helium or/and Pentane.

## 3 RESULTS

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

Directly after deadline, a reminder fax was sent to those laboratories that had not yet reported.

Shortly 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 (raw data of the) reported results. Additional or corrected results have been used for data analysis and the original results are placed under 'Remarks' in the result tables in appendix 1.

### 3.1 STATISTICS

Statistical calculations were performed as described in the report 'iis Interlaboratory Studies: Protocol for the Organisation, Statistics and Evaluation' (iis-protocol, April 2014 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 to ISO 5725 (1986 and 1994) the original results per determination were submitted subsequently to Dixon, Grubbs and Rosner outlier tests. Outliers are marked by D(0.01) for the Dixon test, by G(0.01) or DG(0.01) for the Grubbs test and by R(0.01) for the Rosner General ESD test (see appendix 4, no.19). 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). Both outliers and stragglers were not included in the calculations of the averages and the standard deviations.

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

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

## 3.2 GRAPHICS

In order to 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 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 "x". 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 (see appendix 4; nos.13 and 14). Also a normal Gauss curve was projected over the Kernel Density Graph.

## 3.3 Z-SCORES

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



this interlaboratory study. The target standard deviation was calculated from the literature reproducibility by division with 2.8.

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

The z-scores were calculated in accordance with:

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

The  $Z_{(\text{target})}$  scores are listed in the result tables in appendix 1.

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

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

## 4 EVALUATION

In this proficiency test several problems were encountered with sample transport. Due to customs problems one cylinder did not reach the laboratory in time to test the cylinder and to report results to be included in the final report. In total thirteen laboratories reported test results after the final reporting date and three laboratories did not report any test results at all. Not all laboratories were able to report all test results requested.

In total 38 participants reported 467 numerical results. Observed were 33 outlying results, which is 7.1% of the 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 test methods that are used by the various laboratories are 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 listed in appendix 4.

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

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 IP 405 and ISO 7941) for reference only.

Two laboratories appeared to have some problems. Respectively six and five test results reported by laboratory 1065 and 1776 appeared to be statistical outliers and because all test results of one laboratory are correlated, the remaining test results of laboratory 1065 and 1776 were excluded manually prior to the statistical analysis.

iso-Butane: The determination of this main component may be problematic, depending on the test method used by the laboratory. Three statistical outliers were detected. The calculated reproducibility after rejection of the suspect data is not in agreement with the requirements of ASTM D2163:14e1. However, the calculated reproducibility is in good agreement with the less strict reproducibility of EN27941 (identical to IP 405 and ISO 7941).

Propane: The determination of this component may be problematic, depending on the test method used by the laboratory. Four statistical outliers were detected. The calculated reproducibility after rejection of the statistical outliers is not in agreement with the requirements of ASTM D2163:14e1. However, the calculated reproducibility is in good agreement with the less strict reproducibility of EN27941 (identical to IP 405 and ISO 7941).

Propylene: The determination of this component is not problematic. Three statistical outliers were detected. The calculated reproducibility after rejection of the suspect data is in good agreement with the requirements of ASTM D2163:14e1 and also with the reproducibility of EN27941 (identical to IP 405 and ISO 7941).

n-Butane: The determination of this component may be problematic, depending on the test method used by the laboratory. Two statistical outliers were detected. The calculated reproducibility after rejection of the suspect data is not in agreement with the requirements of ASTM D2163:14e1. However, the calculated reproducibility is in good agreement with the less strict reproducibility of EN27941 (identical to IP 405 and ISO 7941).

1,3-Butadiene: The determination of this component is not problematic. Two statistical outliers were detected. However, the calculated reproducibility after rejection of the suspect data is in good agreement with the requirements of ASTM D2163:14e1 and also with the reproducibility of EN27941 (identical to IP 405 and ISO 7941). Two false negative test results were observed.

- iso-Butylene: The determination was not problematic. Only one statistical outlier was detected and the calculated reproducibility after exclusion of the suspect data is in good agreement with the requirements of ASTM D2163:14e1 and also with the reproducibility of EN27941 (identical to IP 405 and ISO 7941).
- 1-Butene: The determination of this component may be problematic, depending on the test method used by the laboratory. Three statistical outliers were detected. The calculated reproducibility after exclusion of the suspect data is not in agreement with the requirements of ASTM D2163:14e1. However, the calculated reproducibility is in good agreement with the less strict reproducibility of EN27941 (identical to IP 405 and ISO 7941).
- trans-2-Butene: The determination was not problematic. Two statistical outliers were detected. However, the calculated reproducibility after rejection of the statistical outliers is in full agreement with the requirements of ASTM D2163:14e1 and also with the reproducibility of EN27941 (identical to IP 405 and ISO 7941).
- cis-2-Butene: The determination of this component may be problematic, depending on the test method used by the laboratory. Five statistical outliers were detected. The calculated reproducibility after rejection of the statistical outlier is not in agreement with the requirements of ASTM D2163:14e1. However, the calculated reproducibility is in good agreement with the less strict reproducibility of EN27941 (identical to IP 405 and ISO 7941). One false negative test result was observed.
- iso-Pentane: The determination of this component may be problematic, depending on the test method used by the laboratory. Two statistical outliers were detected. The calculated reproducibility after exclusion of the suspect data is not in agreement with the requirements of ASTM D2163:14e1. However, the calculated reproducibility is in good agreement with the less strict reproducibility of EN27941 (identical to IP 405 and ISO 7941).
- Molar Mass: This calculated parameter may be problematic. The results vary over a range from 57.48 - 57.802 g/mol. The calculated reproducibility is large in comparison with the theoretical reproducibility (0.18 vs 0.11). See also the discussion in 4.4. Two laboratories probably made a calculation error in the reported test result.
- Relative Density: This calculated parameter may be problematic. The results vary over a range from 0.5637 - 0.6043. Two statistical outliers were observed (in 27 test results). The calculated reproducibility after rejection of the statistical outliers is not in agreement with the theoretical reproducibility

(0.0042 vs 0.0010). See also the discussion in 4.4. One laboratory probably made a calculation error in the reported test result.

Abs. Vapour Press.: As test results calculated via ASTM D2598 and ISO8973 are not equivalent, it was decided to calculate the absolute vapour pressure for each laboratory according to both test methods by using the reported compositions. It is noticed that the absolute vapour pressure calculated in accordance with ASTM D2598 is lower than the absolute vapour pressure calculated using ISO8973. See also the discussion in 4.4.

Rel. Vapour Press.: As test results calculated via ASTM D2598 and ISO8973 are not equivalent, it was decided to calculate the relative vapour pressure for each laboratory according to both test methods by using the reported compositions. It is noticed that the relative vapour pressure calculated in accordance with ASTM D2598 is lower than the relative vapour pressure calculated using ISO8973. See also the discussion in 4.4.

#### 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 and EN27941/ISO7941/IP405) are compared in the next table.

Parameter	unit	n	cons. value	2.8 * sd	R(D2163) in %mol	R(EN27941) liq.-inj. in %mol	R(EN27941) liq.-inj. in %M/M
iso-Butane	%mol/mol	34	76.075	1.141	0.933	1.488	1.5
Propane	%mol/mol	34	1.718	0.298	0.254	1.307	1
Propylene	%mol/mol	34	0.649	0.152	0.214	1.370	1
n-Butane	%mol/mol	35	3.968	0.352	0.256	0.992	1
1,3-Butadiene	%mol/mol	33	0.960	0.120	0.135	1.066	1
iso-Butylene	%mol/mol	36	2.962	0.228	0.224	1.027	1
1-Butene	%mol/mol	34	4.895	0.356	0.281	1.027	1
trans-2-Butene	%mol/mol	36	2.464	0.202	0.206	1.027	1
cis-2-Butene	%mol/mol	32	4.928	0.342	0.282	1.027	1
iso-Pentane	%mol/mol	34	1.412	0.230	0.058	0.799	1
Molar Mass	g/mol	21	57.65	0.18	n/a	n/a	n/a
Rel. Density @60F		25	0.571	0.004	n/a	n/a	n/a
Abs. Vapour pres.	psi	20	see §4.4		n/a	n/a	n/a
Rel. Vapour pres.	psi	19	see §4.4		n/a	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 many components 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 COMPARISON OF THE PROFICIENCY TEST OF JUNE 2014 WITH PREVIOUS PTS

	June 2014	June 2013	June 2012	May 2011	May 2010
Number of reporting labs	38	30	30	27	22
Number of results reported	467	358	373	333	263
Statistical outliers	33	15	39	29	20
Percentage outliers	7.1%	4.2%	10.5%	8.7%	7.6%

table 3: comparison with previous proficiency tests

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

The performance of the determinations of the proficiency tests was compared against the requirements of ASTM D2163. For 2010 – 2013 against D2163:96 and for 2014 against D2163:14e1. The conclusions are given the following table:

	June 2014	June 2013	June 2012	May 2011	May 2010
iso-Butane	-	-	--	--	--
Propane	-	--	-	--	--
Propylene	++	--	-	--	--
n-Butane	--	+/-	++	++	+
1,3-Butadiene	+	--	+/-	-	--
iso-Butylene	+/-	++	++	++	++
1-Butene	-	++	++	++	-
trans-2-Butene	+/-	++	+	+	-
cis-2-Butene	-	++	+	++	-
iso-Pentane	--	--	+	-	-

table 4: comparison determinations against the requirements of ASTM D2163

The following performance categories were used in the above table:

- ++: group performed much better than the standard
- + : group performed better than the standard
- +/-: group performance equals the standard
- : group performed worse than the standard
- : group performed much worse than the standard

#### 4.4 DISCUSSION

Because the majority of the reproducibility requirements of ASTM D2163 differ significantly from the reproducibility requirements of EN27941 (for liquid injection), the outcome of the evaluations 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 (Uttoxeter, United Kingdom) in the following table. From this comparison it is clear that most consensus values as determined in this PT are very well in line with the values as determined during the preparation of the gas cylinders.

Parameter	Average values by EffecTech in %mol/mol	Consensus values from participants results in %mol/mol	Absolute differences in %mol/mol	z-score
iso-Butane	76.0721	76.0751	-0.0030	-0.01
Propane	1.7314	1.7182	+0.0133	+0.15
Propylene	0.6678	0.6486	+0.0192	+0.25
n-Butane	3.8994	3.9677	-0.0684	-0.75
1,3-Butadiene	0.9652	0.9602	-0.0050	-0.10
iso-Butylene	2.9701	2.9621	+0.0080	+0.10
1-Butene	4.9073	4.8952	+0.0121	+0.12
trans-2-Butene	2.4338	2.4643	-0.0213	-0.41
cis-2-Butene	4.9509	4.9275	+0.0234	+0.23
iso-Pentane	1.4019	1.4119	-0.0099	-0.48

Table 5: comparison of consensus values with values determined by EffecTech (Uttoxeter, United Kingdom)

In total three laboratories reported the presence of some impurities (n-Pentane), a component probably present as impurity in one or more of the pure components that were used to prepare the iso-Butane mixture.

In principle no additional spread should be introduced when applying a calculation on the reported component concentrations. However, in practice a significant additional uncertainty is added in most cases. See the differences between the values from the results as reported by the participating laboratories (each using its own calculation procedure) and the values as calculated by iis using one calculation procedure for each set of laboratory test results.

For the calculation of the Molar Mass and Relative Density several standardized methods are available, e.g. ASTM D2421 for the interconversion of the units to gas-volume, liquid-volume or mass basis.

Also different methods for the calculation of the Vapour Pressure do exist. And the selection of the tables to be used for the calculations may cause additional uncertainty.

For the calculation of the absolute and relative Vapour Pressure (VP), thirteen participants used ISO8973 / IP432 / EN589 and ten participants used ASTM D2598.

In ISO 8973 (identical to IP432 and EN589) 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.

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 2012 version of D2598 no factors are given for 1,3-Butadiene. And it is uncertain how the laboratories treated the partial VP caused by 1,3-Butadiene in the calculations.

As one would expect to find equivalent values when using each of the two calculation methods, it is remarkable to see that the VP results from the ASTM D2598 calculation are significantly lower than the VP results from the ISO8973/IP432 calculation, both for Absolute VP and for relative VP.

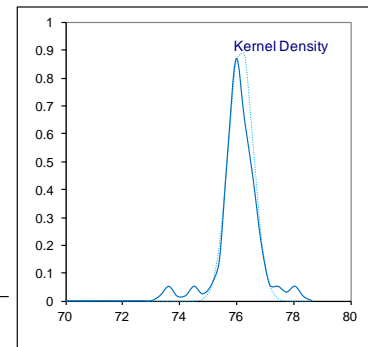
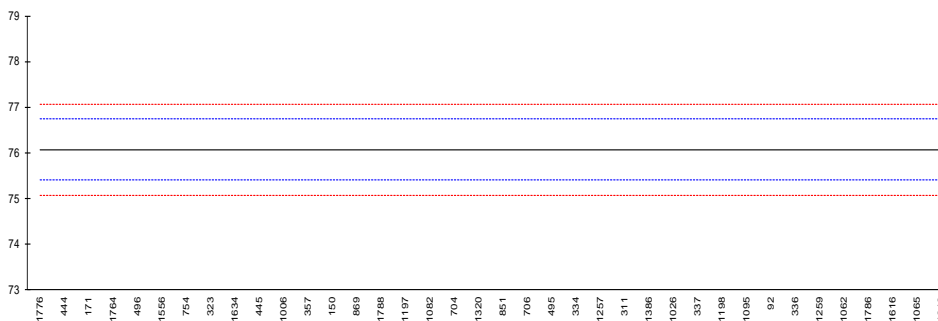
**APPENDIX 1**

**Determination of iso-Butane on sample #14086; results in %mol/mol**

lab	method	value	mark	z(targ)	remarks
92	D2163	76.510		1.30	
150	D2163	75.844		-0.69	
171	D2163	75.090	C	-2.96	Result probably mixed up with n-Butane; reported 3.959
311	INH-407	76.198		0.37	
323	D2163	75.76		-0.95	
334		76.1		0.07	
336	EN27941	76.6		1.57	
337	ISO7941	76.354		0.84	
357	D2163	75.844		-0.69	
444	IP432	74.50	C,R(0.05)	-4.73	First reported 75.45
445	D2163	75.80		-0.83	
495		76.09		0.04	
496	EN27941	75.505		-1.71	
704	D2163	76.037		-0.11	
706	D2163	76.080		0.01	
754	D2163	75.753		-0.97	
851	D2163	76.060		-0.05	
869	D2163	75.904		-0.51	
912		-----		-----	
1006	D2163	75.822		-0.76	
1026	ISO7941	76.3370		0.79	
1062	D2163	76.654		1.74	
1065	D2163	77.402	ex	3.98	Result excluded, see §4.1
1082	IP473	76.008		-0.20	
1095	EN27941	76.464		1.17	
1197	D2163	75.993		-0.25	
1198	D2163	76.403		0.98	
1213	D2163	78.03	C,R(0.05)	5.87	First reported 71.48, did not quantify iso-pentane
1229		-----		-----	
1257		76.1038		0.09	
1259	EN27941	76.6101		1.61	
1320	EN27941	76.055		-0.06	
1386	D2163	76.320		0.73	
1556	EN27941	75.713		-1.09	
1616	D2163	76.870	C	2.39	First reported 77.722
1634	ISO7941	75.79		-0.86	
1720		-----		-----	
1764	D2163	75.195		-2.64	
1776	EN27941	73.6	R(0.01)	-7.43	
1786	D2163	76.768		2.08	
1788	ISO7941	75.918		-0.47	

normality OK  
n 34  
outliers 3 + 1 excl.  
mean (n) 76.0751  
st.dev. (n) 0.40747  
R(calc.) 1.1409  
R(D2163:14e1) 0.9332

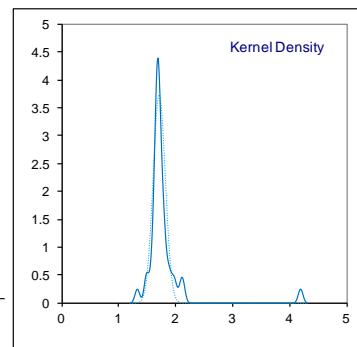
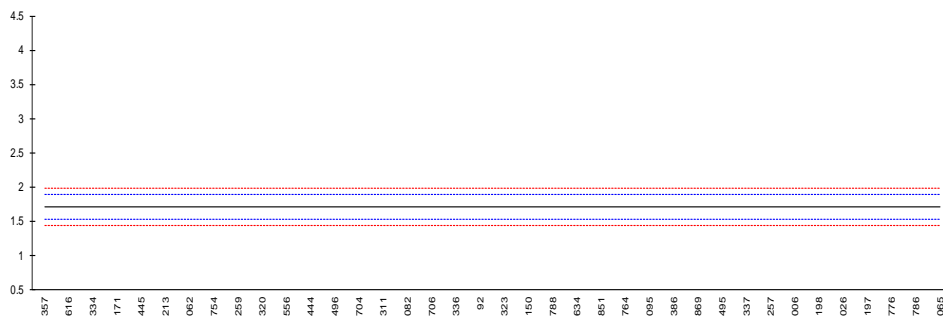
Compare R(EN27941 (liq)) = 1.4877





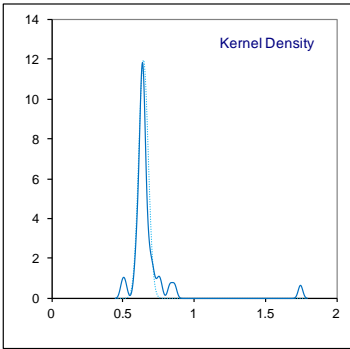
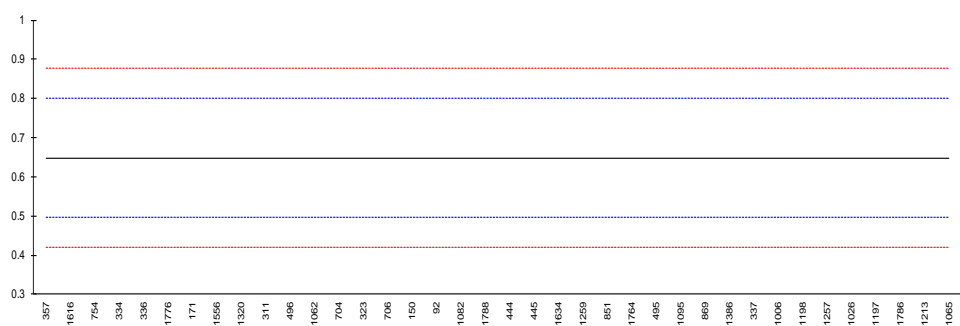
Determination of Propane on sample #14086; results in %mol/mol

lab	method	value	mark	z(targ)	Remarks
92	D2163	1.701		-0.19	
150	D2163	1.712		-0.07	
171	D2163	1.586		-1.45	
311	INH-407	1.693		-0.28	
323	D2163	1.71		-0.09	
334		1.5		-2.40	
336	EN27941	1.7		-0.20	
337	ISO7941	1.801		0.91	
357	D2163	1.337	R(0.05)	-4.20	
444	IP432	1.67	C	-0.53	First reported 1.28
445	D2163	1.61		-1.19	
495		1.79		0.79	
496	EN27941	1.688		-0.33	
704	D2163	1.689		-0.32	
706	D2163	1.699		-0.21	
754	D2163	1.658		-0.66	
851	D2163	1.722		0.04	
869	D2163	1.789		0.78	
912		-----		-----	
1006	D2163	1.878		1.76	
1026	ISO7941	1.9542		2.60	
1062	D2163	1.649		-0.76	
1065	D2163	4.185	R(0.01)	27.15	
1082	IP473	1.697		-0.23	
1095	EN27941	1.748		0.33	
1197	D2163	1.997		3.07	
1198	D2163	1.887		1.86	
1213	D2163	1.63	C	-0.97	First reported 2.48
1229		-----		-----	
1257		1.8110		1.02	
1259	EN27941	1.6626		-0.61	
1320	EN27941	1.664		-0.60	
1386	D2163	1.776		0.64	
1556	EN27941	1.669		-0.54	
1616	D2163	1.497	C	-2.43	First reported 1.769
1634	ISO7941	1.72		0.02	
1720		-----		-----	
1764	D2163	1.742		0.26	
1776	EN27941	2.1	R(0.05)	4.20	
1786	D2163	2.135	R(0.05)	4.59	
1788	ISO7941	1.718		0.00	
	normality	suspect			
	n	34			
	outliers	4			
	mean (n)	1.7182			
	st.dev. (n)	0.10654			
	R(calc.)	0.2983			
	R(D2163:14e1)	0.2544			Compare R(EN27941 (liq)) = 1.3073



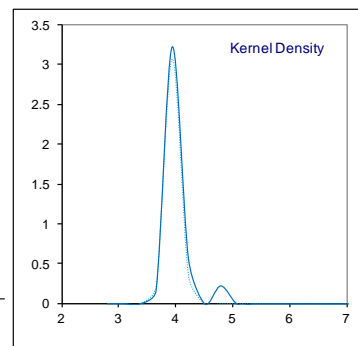
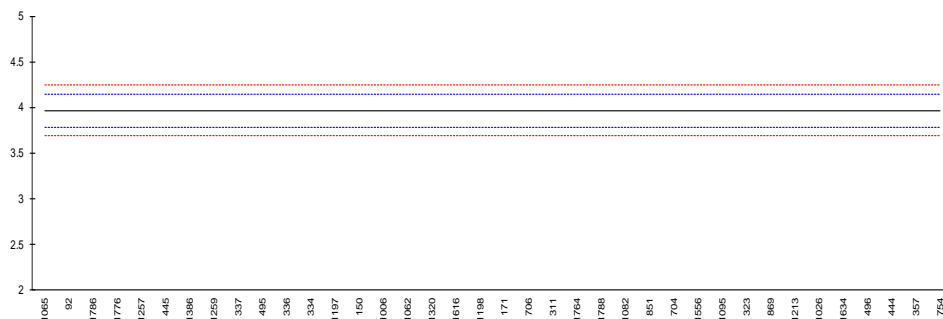
Determination of Propylene on sample #14086; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	D2163	0.634		-0.19	
150	D2163	0.633		-0.20	
171	D2163	0.613		-0.47	
311	INH-407	0.623		-0.34	
323	D2163	0.63		-0.24	
334		0.6		-0.64	
336	EN27941	0.6		-0.64	
337	ISO7941	0.679		0.40	
357	D2163	0.493	R(0.05)	-2.03	
444	IP432	0.64	C	-0.11	First reported 0.47
445	D2163	0.64		-0.11	
495		0.65		0.02	
496	EN27941	0.627		-0.28	
704	D2163	0.630		-0.24	
706	D2163	0.630		-0.24	
754	D2163	0.582		-0.87	
851	D2163	0.648		-0.01	
869	D2163	0.658		0.12	
912		-----		-----	
1006	D2163	0.681		0.42	
1026	ISO7941	0.7424		1.23	
1062	D2163	0.629		-0.26	
1065	D2163	1.743	R(0.01)	14.31	
1082	IP473	0.637		-0.15	
1095	EN27941	0.653		0.06	
1197	D2163	0.762		1.48	
1198	D2163	0.704		0.72	
1213	D2163	0.86	R(0.05)	2.76	
1229		-----		-----	
1257		0.7077		0.77	
1259	EN27941	0.6464		-0.03	
1320	EN27941	0.620		-0.37	
1386	D2163	0.669		0.27	
1556	EN27941	0.618		-0.40	
1616	D2163	0.514	C	-1.76	First reported 0.588
1634	ISO7941	0.64		-0.11	
1720		-----		-----	
1764	D2163	0.648		-0.01	
1776	EN27941	0.6	ex	-0.64	Result excluded, see §4.1
1786	D2163	0.828		2.34	
1788	ISO7941	0.637		-0.15	
normality		not OK			
n		34			
outliers		3 + 1 excl.			
mean (n)		0.6486			
st.dev. (n)		0.05413			
R(calc.)		0.1516			
R(D2163:14e1)		0.2142			
				Compare R(EN27941 (liq)) = 1.3699	



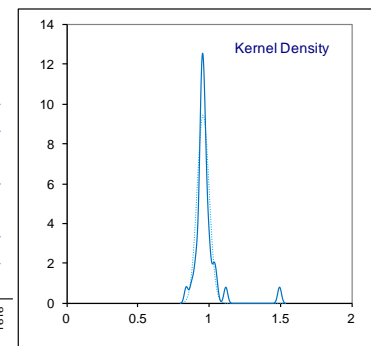
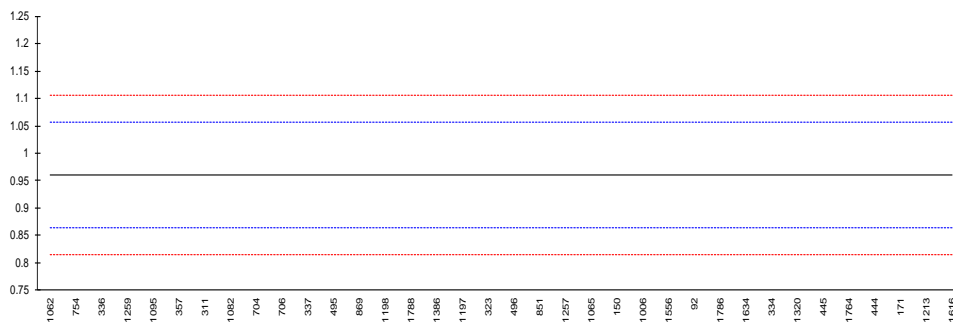
Determination of n-Butane on sample #14086; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	D2163	3.614		-3.87	
150	D2163	3.908		-0.65	
171	D2163	3.959	C	-0.10	Result probably mixed up with iso-Butane; reported 75.090
311	INH-407	3.970		0.02	
323	D2163	4.03		0.68	
334		3.9		-0.74	
336	EN27941	3.9		-0.74	
337	ISO7941	3.889		-0.86	
357	D2163	4.262		3.22	
444	IP432	4.19	C	2.43	First reported 4.23
445	D2163	3.84		-1.40	
495		3.89		-0.85	
496	EN27941	4.182		2.34	
704	D2163	4.011		0.47	
706	D2163	3.959		-0.10	
754	D2163	4.792	R(0.01)	9.02	
851	D2163	4.008		0.44	
869	D2163	4.036		0.75	
912		-----		-----	
1006	D2163	3.913		-0.60	
1026	ISO7941	4.1447		1.94	
1062	D2163	3.920		-0.52	
1065	D2163	2.950	R(0.01)	-11.14	
1082	IP473	4.004		0.40	
1095	EN27941	4.027		0.65	
1197	D2163	3.906		-0.68	
1198	D2163	3.953		-0.16	
1213	D2163	4.07	C	1.12	First reported 4.58
1229		-----		-----	
1257		3.8292		-1.52	
1259	EN27941	3.8879		-0.87	
1320	EN27941	3.936		-0.35	
1386	D2163	3.879		-0.97	
1556	EN27941	4.016		0.53	
1616	D2163	3.936		-0.35	
1634	ISO7941	4.16		2.10	
1720		-----		-----	
1764	D2163	3.991		0.25	
1776	EN27941	3.8	ex	-1.84	Result excluded, see §4.1
1786	D2163	3.753		-2.35	
1788	ISO7941	3.997		0.32	
normality		suspect			
n		35			
outliers		2 + 1 excl.			
mean (n)		3.9677			
st.dev. (n)		0.12587			
R(calc.)		0.3524			
R(D2163:14e1)		0.2558			Compare R(EN27941 (liq)) = 0.9918



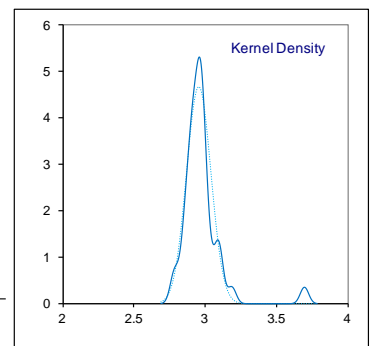
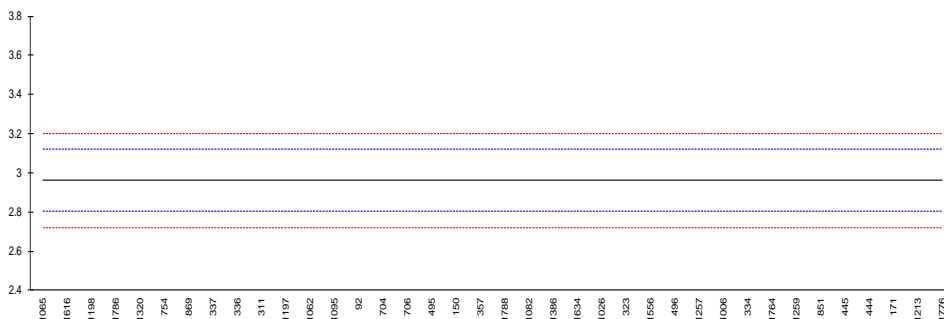
Determination of 1,3-Butadiene on sample #14086; results in %mol/mol

lab	method	Value	mark	z(targ)	remarks
92	D2163	0.977		0.35	
150	D2163	0.973		0.27	
171	D2163	1.055		1.97	
311	INH-407	0.940		-0.42	
323	D2163	0.96		0.00	
334		1.0		0.83	
336	EN27941	0.9		-1.25	
337	ISO7941	0.948		-0.25	
357	D2163	0.934		-0.54	
444	IP432	1.04	C	1.65	First reported 0.98
445	D2163	1.01		1.03	
495		0.95		-0.21	
496	EN27941	0.963		0.06	
704	D2163	0.946		-0.29	
706	D2163	0.948		-0.25	
754	D2163	0.878		-1.70	
851	D2163	0.965		0.10	
869	D2163	0.950		-0.21	
912		-----		-----	
1006	D2163	0.973		0.27	
1026	ISO7941	<0.1		<-17.37	False negative test result?
1062	D2163	0.842		-2.45	
1065	D2163	0.971	ex	0.22	Result excluded, see §4.1
1082	IP473	0.941		-0.40	
1095	EN27941	0.917		-0.89	
1197	D2163	0.957		-0.07	
1198	D2163	0.952		-0.17	
1213	D2163	1.12	R(0.05)	3.31	
1229		-----		-----	
1257		0.9654		0.11	
1259	EN27941	0.9153		-0.93	
1320	EN27941	1.000		0.83	
1386	D2163	0.956		-0.09	
1556	EN27941	0.973		0.27	
1616	D2163	1.498	C,R(0.01)	11.15	First reported 1.459
1634	ISO7941	0.99		0.62	
1720		-----		-----	
1764	D2163	1.033		1.51	
1776	EN27941	<0.01		<-19.69	False negative test result?
1786	D2163	0.982		0.45	
1788	ISO7941	0.952		-0.17	
normality		suspect			
n		33			
outliers		2 + 1 excl.			
mean (n)		0.9602			
st.dev. (n)		0.04296			
R(calc.)		0.1203			
R(D2163:14e1)		0.1351			Compare R(EN27941 (liq)) = 1.0657



Determination of iso-Butylene on sample #14086; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	D2163	2.927		-0.44	
150	D2163	2.953		-0.11	
171	D2163	3.105		1.78	
311	INH-407	2.910		-0.65	
323	D2163	2.98		0.22	
334		3.0		0.47	
336	EN27941	2.9		-0.78	
337	ISO7941	2.899		-0.79	
357	D2163	2.955		-0.09	
444	IP432	3.10	C	1.72	First reported 3.01
445	D2163	3.10		1.72	
495		2.95		-0.15	
496	EN27941	2.985		0.29	
704	D2163	2.928		-0.43	
706	D2163	2.943		-0.24	
754	D2163	2.872		-1.12	
851	D2163	3.073		1.38	
869	D2163	2.889		-0.91	
912		-----		-----	
1006	D2163	2.999		0.46	
1026	ISO7941	2.9738		0.15	
1062	D2163	2.917		-0.56	
1065	D2163	2.781	ex	-2.26	Result excluded, see §4.1
1082	IP473	2.970		0.10	
1095	EN27941	2.917		-0.56	
1197	D2163	2.91		-0.65	
1198	D2163	2.851		-1.39	
1213	D2163	3.19		2.85	
1229		-----		-----	
1257		2.9857		0.29	
1259	EN27941	3.0296		0.84	
1320	EN27941	2.864		-1.22	
1386	D2163	2.970		0.10	
1556	EN27941	2.984		0.27	
1616	D2163	2.795	C	-2.09	First reported 2.757
1634	ISO7941	2.97		0.10	
1720		-----		-----	
1764	D2163	3.026		0.80	
1776	EN27941	3.7	R(0.01)	9.21	
1786	D2163	2.854		-1.35	
1788	ISO7941	2.960		-0.03	
	normality	OK			
	n	36			
	outliers	1 + 1 excl.			
	mean (n)	2.9621			
	st.dev. (n)	0.08137			
	R(calc.)	0.2278			
	R(D2163:14e1)	0.2243			Compare R(EN27941 (liq)) = 1.0275

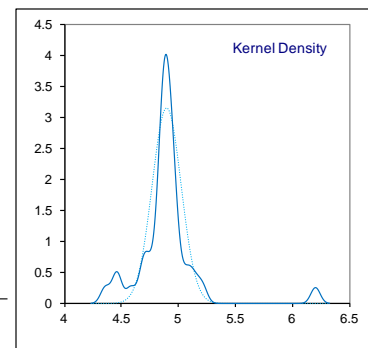
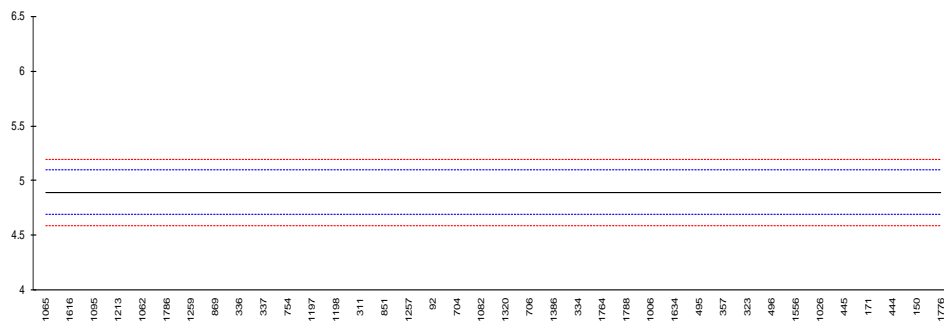


Determination of 1-Butene on sample #14086; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	D2163	4.880		-0.15	
150	D2163	5.212		3.15	
171	D2163	5.101		2.05	
311	INH-407	4.860		-0.35	
323	D2163	4.96		0.65	
334		4.9		0.05	
336	EN27941	4.8		-0.95	
337	ISO7941	4.834		-0.61	
357	D2163	4.950		0.55	
444	IP432	5.15	C	2.54	First reported 5.02
445	D2163	5.07		1.74	
495		4.94		0.45	
496	EN27941	4.962		0.67	
704	D2163	4.883		-0.12	
706	D2163	4.893		-0.02	
754	D2163	4.840		-0.55	
851	D2163	4.862		-0.33	
869	D2163	4.764		-1.31	
912		----		----	
1006	D2163	4.929		0.34	
1026	ISO7941	5.0122		1.17	
1062	D2163	4.678		-2.16	
1065	D2163	4.357	ex	-5.36	Result excluded, see §4.1
1082	IP473	4.884		-0.11	
1095	EN27941	4.469	DG(0.05)	-4.24	
1197	D2163	4.846		-0.49	
1198	D2163	4.846		-0.49	
1213	D2163	4.58		-3.14	
1229		----		----	
1257		4.8650		-0.30	
1259	EN27941	4.7169		-1.78	
1320	EN27941	4.888		-0.07	
1386	D2163	4.897		0.02	
1556	EN27941	4.976		0.80	
1616	D2163	4.450	C,DG(0.05)	-4.43	First reported 4.514
1634	ISO7941	4.93		0.35	
1720		----		----	
1764	D2163	4.900		0.05	
1776	EN27941	6.2	G(0.01)	12.99	
1786	D2163	4.703		-1.91	
1788	ISO7941	4.924		0.29	

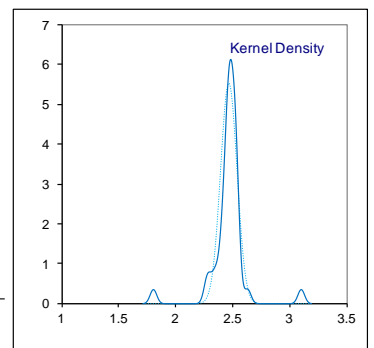
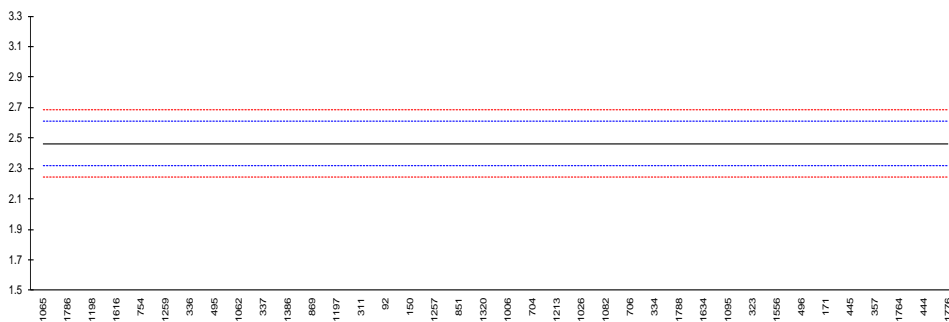
normality suspect  
n 34  
outliers 3 + 1 excl.  
mean (n) 4.8952  
st.dev. (n) 0.12701  
R(calc.) 0.3556  
R(D2163:96) 0.2812

Compare R(EN27941 (liq)) = 1.0275



Determination of trans-2-Butene on sample #14086; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	D2163	2.462		-0.03	
150	D2163	2.464		0.00	
171	D2163	2.528		0.86	
311	INH-407	2.457		-0.10	
323	D2163	2.52		0.76	
334		2.5		0.48	
336	EN27941	2.4		-0.87	
337	ISO7941	2.430		-0.47	
357	D2163	2.537		0.99	
444	IP432	2.63	C	2.25	First reported 2.56
445	D2163	2.53		0.89	
495		2.42		-0.60	
496	EN27941	2.527		0.85	
704	D2163	2.476		0.16	
706	D2163	2.496		0.43	
754	D2163	2.352		-1.52	
851	D2163	2.467		0.04	
869	D2163	2.450		-0.19	
912		-----		-----	
1006	D2163	2.472		0.10	
1026	ISO7941	2.4878		0.32	
1062	D2163	2.421		-0.59	
1065	D2163	1.803	R(0.01)	-8.97	
1082	IP473	2.489		0.33	
1095	EN27941	2.519		0.74	
1197	D2163	2.455		-0.13	
1198	D2163	2.287		-2.40	
1213	D2163	2.48	C	0.21	First reported 3.40
1229		-----		-----	
1257		2.4645		0.00	
1259	EN27941	2.3939		-0.95	
1320	EN27941	2.469		0.06	
1386	D2163	2.437		-0.37	
1556	EN27941	2.526		0.84	
1616	D2163	2.335	C	-1.75	First reported 2.345
1634	ISO7941	2.51		0.62	
1720		-----		-----	
1764	D2163	2.546		1.11	
1776	EN27941	3.1	R(0.01)	8.62	
1786	D2163	2.271		-2.62	
1788	ISO7941	2.506		0.57	
	normality	suspect			
	n	36			
	outliers	2			
	mean (n)	2.4643			
	st.dev. (n)	0.07225			
	R(calc.)	0.2023			
	R(D2163:14e1)	0.2065			Compare R(EN27941 (liq)) = 1.0275

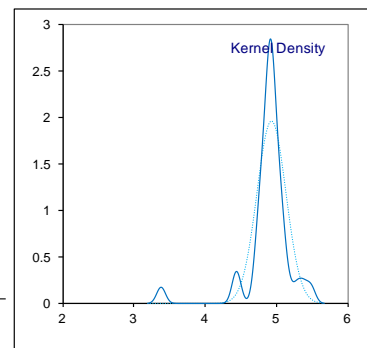
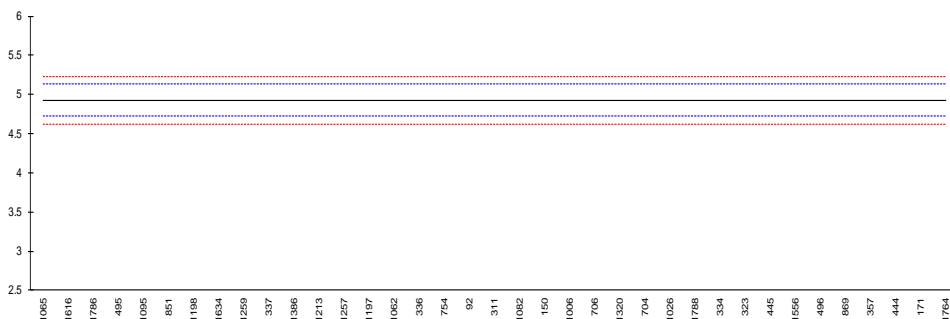


Determination of cis-2-Butene on sample #14086; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	D2163	4.913		-0.14	
150	D2163	4.918		-0.09	
171	D2163	5.374	G(0.05)	4.43	
311	INH-407	4.914		-0.13	
323	D2163	5.02		0.92	
334		5.0		0.72	
336	EN27941	4.9		-0.27	
337	ISO7941	4.822		-1.05	
357	D2163	5.150		2.21	
444	IP432	5.28	C	3.50	First reported 5.14
445	D2163	5.04		1.12	
495		4.72		-2.06	
496	EN27941	5.067		1.38	
704	D2163	4.962		0.34	
706	D2163	4.936		0.08	
754	D2163	4.903		-0.24	
851	D2163	4.742		-1.84	
869	D2163	5.085		1.56	
912		-----		-----	
1006	D2163	4.923		-0.04	
1026	ISO7941	4.9769		0.49	
1062	D2163	4.898		-0.29	
1065	D2163	3.381	R(0.01)	-15.35	
1082	IP473	4.915		-0.12	
1095	EN27941	4.740		-1.86	
1197	D2163	4.897		-0.30	
1198	D2163	4.785		-1.41	
1213	D2163	4.85	C	-0.77	First reported 6.54
1229		-----		-----	
1257		4.8855		-0.42	
1259	EN27941	4.8182		-1.09	
1320	EN27941	4.945		0.17	
1386	D2163	4.823		-1.04	
1556	EN27941	5.065		1.36	
1616	D2163	4.429	C,DG(0.05)	-4.95	First reported 3.743
1634	ISO7941	4.81		-1.17	
1720		-----		-----	
1764	D2163	5.483	G(0.05)	5.51	
1776	EN27941	<0.1		<-47.93	False negative test result?
1786	D2163	4.448	DG(0.05)	-4.76	
1788	ISO7941	4.977		0.49	

normality suspect  
n 32  
outliers 5  
mean (n) 4.9275  
st.dev. (n) 0.12210  
R(calc.) 0.3419  
R(D2163:14e1) 0.2820

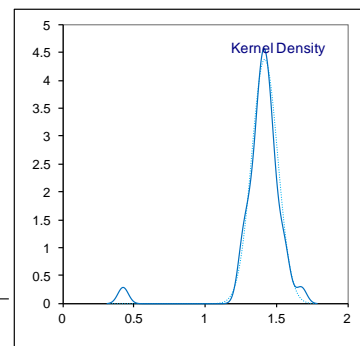
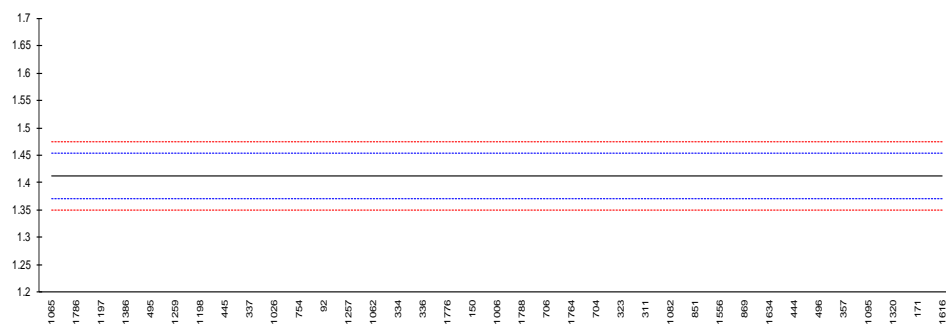
Compare R(EN27941 (liq)) = 1.0275





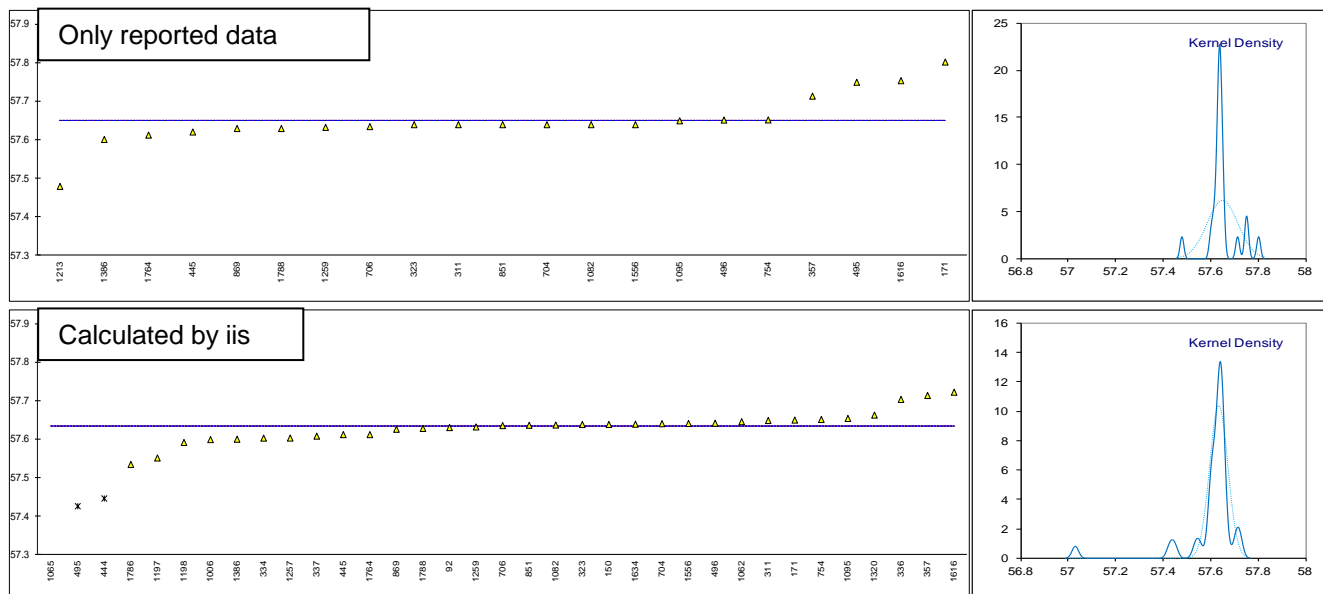
Determination of iso-Pentane on sample #14086; results in %mol/mol

lab	method	value	mark	z(targ)	Remarks
92	D2163	1.382		-1.45	
150	D2163	1.406		-0.29	
171	D2163	1.579		8.10	
311	INH-407	1.443		1.51	
323	D2163	1.44		1.36	
334		1.4		-0.58	
336	EN27941	1.4		-0.58	
337	ISO7941	1.343		-3.34	
357	D2163	1.530		5.72	
444	IP432	1.49	C	3.79	First reported 1.87
445	D2163	1.34		-3.48	
495		1.29		-5.91	
496	EN27941	1.493		3.93	
704	D2163	1.438		1.27	
706	D2163	1.416		0.20	
754	D2163	1.370		-2.03	
851	D2163	1.453		1.99	
869	D2163	1.472		2.91	
912		----		----	
1006	D2163	1.410		-0.09	
1026	ISO7941	1.3626		-2.39	
1062	D2163	1.385		-1.30	
1065	D2163	0.427	R(0.01)	-47.73	
1082	IP473	1.450		1.85	
1095	EN27941	1.542		6.31	
1197	D2163	1.271		-6.83	
1198	D2163	1.327		-4.11	
1213		----		----	
1229		----		----	
1257		1.3822		-1.44	
1259	EN27941	1.3192		-4.49	
1320	EN27941	1.560		7.18	
1386	D2163	1.272		-6.78	
1556	EN27941	1.460		2.33	
1616	D2163	1.676	C,G(0.05)	12.80	First reported 1.168
1634	ISO7941	1.48		3.30	
1720		----		----	
1764	D2163	1.436		1.17	
1776	EN27941	1.4	ex	-0.58	Result excluded, see §4.1
1786	D2163	1.252		-7.75	
1788	ISO7941	1.410		-0.09	
normality		OK			
n		34			
outliers		2 + 1 excl.			
mean (n)		1.4119			
st.dev. (n)		0.08215			
R(calc.)		0.2300			
R(D2163:14e1)		0.0578			Compare R(EN27941 (liq)) = 0.7990



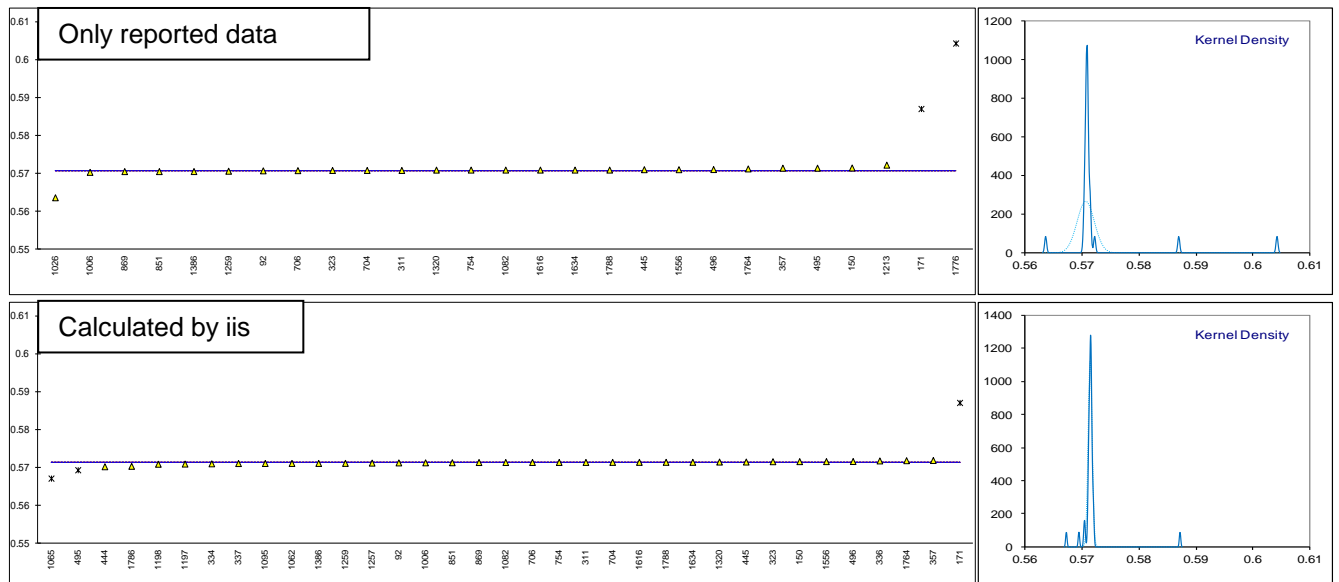
Determination of Molar Mass on sample #14086; results in g/mol

lab	method	value	mark	z(targ)	remarks
92		----		----	
150		----		----	
171	D2421	57.8023503	E	----	Calculated by iis from the reported test results: 57.6506
311	in house	57.64		----	
323	D3588	57.64		----	
334		----		----	
336		----		----	
337		----		----	
357	ISO8973	57.714		----	
444		----		----	
445	IP432	57.621		----	
495	ISO8973	57.75	E	----	Calculated by iis from the reported test results: 57.4272
496	D2421	57.652		----	
704	D2163/D2421	57.6400		----	
706	D2163/D2421	57.6350		----	
754	D2421	57.6523		----	
851	D2598	57.64		----	
869	Calc.	57.63		----	
912		----		----	
1006		----		----	
1026		----		----	
1062		----		----	
1065		----		----	
1082	ISO6976	57.64		----	
1095	D2421	57.65		----	
1197		----		----	
1198		----		----	
1213	D2598	57.48		----	
1229		----		----	
1257		----		----	
1259	ISO8973	57.633		----	
1320		----		----	
1386	D2598	57.60171		----	
1556		57.64		----	
1616	D2421	57.754	C	----	First reported 57.646
1634		----		----	
1720		----		----	
1764		57.613		----	
1776		----		----	
1786		----		----	
1788	ISO8973	57.63		----	
					<u>Calculated by iis from all reported test results</u>
	normality	not OK			suspect
	n	21			32
	outliers	0			3
	mean (n)	57.650			57.633
	st.dev. (n)	0.0646			0.0384
	R(calc.)	0.181			0.107



Determination of Relative Density @ 60F on sample #14086; unitless results

lab	method	value	mark	z(targ)	remarks
92	D2598	0.5708		----	
150	D2598	0.57155		----	
171	D2421	0.58706591	R(0.01),E	----	Calculated by iis from the reported test results: 0.5721
311	in house	0.5709		----	
323	D2598	0.5709		----	
334		----		----	
336		----		----	
337		----		----	
357	D2598	0.5715		----	
444		----		----	
445	IP432	0.5711		----	Reported 571.1 kg/m3
495	D2598	0.5715		----	Reported 571.5 kg/m3
496	D2598	0.57114		----	
704	D2598	0.5709		----	
706	D2598	0.57085		----	
754	ISO8973	0.571		----	
851	D2598	0.5706		----	
869	D2598	0.5706		----	
912		----		----	
1006	D2598	0.5704		----	
1026	ISO8973	0.56371203		----	Reported 563.7 kg/m3
1062		----		----	
1065		----		----	
1082	D2598	0.5710		----	
1095		----		----	
1197		----		----	
1198		----		----	
1213	D2598	0.5723		----	
1229		----		----	
1257		----		----	
1259	ISO8973	0.5707		----	
1320	ISO8973	0.57099		----	
1386	D2598	0.570612		----	
1556	ISO8973	0.5711		----	Reported 571.1 kg/m3
1616	D2421	0.5710	C	----	First reported 0.5701
1634	ISO8973	0.571		----	Reported 571 kg/m3
1720		----		----	
1764	D2598	0.5713		----	
1776	ISO8973	0.6043	R(0.01)	----	Reported 604.3 kg/m3
1786		----		----	
1788	ISO8973	0.571		----	
					<u>Calculated by iis from all reported test results</u>
normality		not OK			not OK
n		25			32
outliers		2			3
mean (n)		0.57074			0.57138
st.dev. (n)		0.001514			0.000355
R(calc.)		0.00424			0.00099

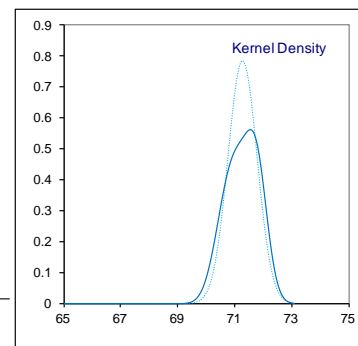
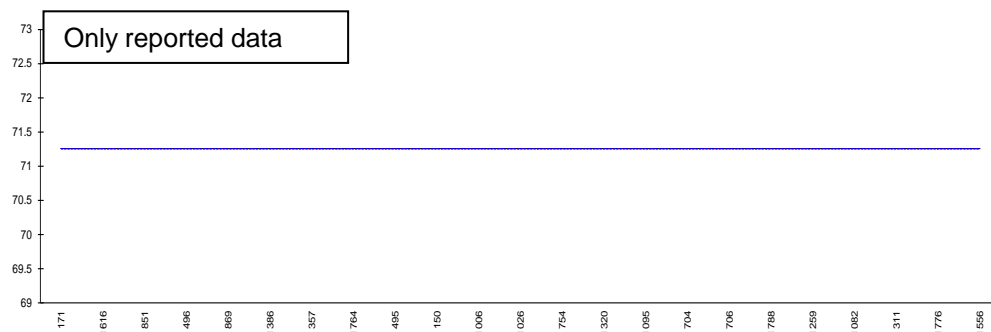


Determination of Abs. Vapour Pressure on sample #14086; results in psi

lab	method	value	mark	z(targ)	remarks
92		----		----	
150	D2598	71.0957		----	
171	D2598	55.376235	R(0.01)	----	Reported test result probably a test result for relative vapour pressure
311	ISO8973	72		----	
323		----		----	
334		----		----	
336		----		----	
337		----		----	
357	ISO8973	70.91		----	
444		----		----	
445		----		----	
495	D2598	71.02		----	
496	D2598	70.6		----	
704	ISO8973	71.72		----	
706	ISO8973	71.75		----	
754	ISO8973	71.504		----	
851	D2598	70.6		----	
869	D2598	70.6	C	----	First reported 55.9
912		----		----	
1006	D2598	71.22		----	
1026	ISO8973	71.3686		----	
1062		----		----	
1065		----		----	
1082	ISO8973	71.83		----	
1095	ISO8973	71.649		----	
1197		----		----	
1198		----		----	
1213		----		----	
1229		----		----	
1257		----		----	
1259		71.794		----	
1320	ISO8973	71.63		----	
1386	D2598	70.90		----	
1556	ISO8973	519	C,R(0.01)	----	First reported 418, reported test result probably in a deviating unit
1616	in house	70.27	C	----	First reported 71.10
1634		----		----	
1720		----		----	
1764	D2598	71.014		----	
1776	ISO8973	402	R(0.01)	----	Reported test result probably in a deviating unit
1786		----		----	
1788	ISO8973	71.79		----	

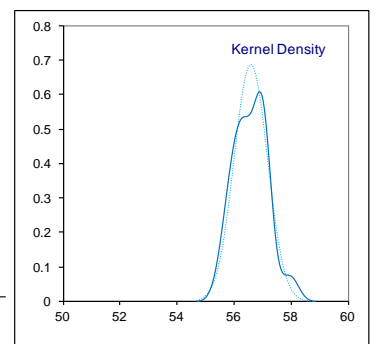
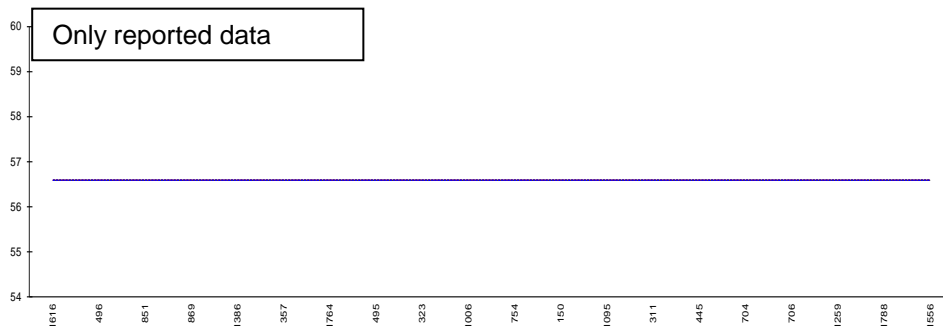
  

	Calculated by iis from reported test results see §4.3	
	<u>ASTM D2598</u>	<u>ISO8972/IP432</u>
normality	OK	OK
n	32	32
outliers	3	3
mean (n)	71.313	71.766
st.dev. (n)	0.2463	0.2554
R(calc.)	0.690	0.715



Determination of Rel. Vapour Pressure on sample #14086; results in psi

lab	method	value	mark	z(targ)	remarks
92		----		----	
150	D2598	56.8365		----	
171		----		----	
311	ISO8973	57		----	
323	D2598	56.46		----	
334		----		----	
336		----		----	
337		----		----	
357	ISO8973	56.21		----	
444		----		----	
445	IP432	57		----	
495	D2598	56.32		----	
496	D2598	55.9		----	
704	ISO8793	57.02		----	
706	ISO8793	57.06		----	
754	ISO8973	56.811		----	
851	D2598	55.9		----	
869	D2598	55.9	C	----	First reported 70.6
912		----		----	
1006	D2598	56.52		----	
1026		----		----	
1062		----		----	
1065		----		----	
1082		----		----	
1095	ISO8793	56.956		----	
1197		----		----	
1198		----		----	
1213		----		----	
1229		----		----	
1257		----		----	
1259		57.145		----	
1320		----		----	
1386	D2598	56.20044		----	
1556	ISO8973	418	R(0.01)	----	
1616	in house	55.58	C	----	First reported 56.41
1634		----		----	
1720		----		----	
1764	D2598	56.318		----	
1776		----		----	
1786		----		----	
1788	ISO8973	57.96	E	----	Calculated by iis from the reported test results: 57.06 Calculated by iis from reported test results see §4.3
					<u>ASTM D2598</u>
					<u>ISO8972/IP432</u>
	normality				OK
	n				32
	outliers				3
	mean (n)				56.617
	st.dev. (n)				0.2463
	R(calc.)				0.690
					OK
					32
					3
					57.070
					0.2554
					0.715



**APPENDIX 2****Additional details**

	Sample Volume (mL)	Type of vaporizer	Remarks
92	-----	-----	
150	-----	-----	
171	-----	-----	
311	112 gram	LSV	
323	59 gram	LSV	
334	-----	-----	
336	-----	-----	
337	-----	-----	
357	-----	-----	
444	-----	-----	
445	-----	HGST60CO/L	
495	70	in house	
496	-----	-----	
704	0.0005	SPL	
706	0.0005	SPL	
754	-----	-----	
851	20	-----	
869	70	-----	
912	-----	-----	
1006	-----	-----	
1026	-----	-----	
1062	-----	-----	
1065	-----	-----	
1082	0.06 µl	NO	
1095	0.00025	-----	
1197	-----	-----	
1198	-----	-----	
1213	-----	-----	
1229	-----	-----	
1257	-----	-----	
1259	-----	-----	
1320	0.0002	-----	
1386	-----	-----	
1556	-----	-----	
1616	-----	-----	
1634	-----	-----	
1720	-----	-----	
1764	95	ON-LINE ELEC. HEATED	
1776	-----	-----	
1786	-----	-----	
1788	-----	-----	

## **APPENDIX 3**

### **Number of participants per country**

2 labs in BELGIUM  
1 lab in CANADA  
1 lab in CROATIA  
3 labs in FINLAND  
3 labs in FRANCE  
2 labs in GERMANY  
1 lab in HONG KONG  
1 lab in INDIA  
1 lab in ISRAEL  
1 lab in ITALY  
3 labs in MALAYSIA  
2 labs in P.R. of CHINA  
3 labs in PORTUGAL  
1 lab in QATAR  
1 lab in RUSSIA  
1 lab in SLOVAKIA  
1 lab in SUDAN  
2 labs in SWEDEN  
1 lab in TAIWAN R.O.C.  
2 labs in THE NETHERLANDS  
1 lab in U.A.E.  
2 labs in U.S.A.  
2 labs in UKRAINE  
2 labs in UNITED KINGDOM  
1 lab in VIETNAM

**APPENDIX 4****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 Organization, Statistics and Evaluation, April 2014
- 2 prNEN 12766-2:2000.
- 3 ASTM E178-02
- 4 ASTM E1301-03
- 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 ISO17043
- 16 EN27941
- 17 ASTM D2163
- 18 ASTM D2421
- 19 Bernard Rosner, Percentage Points for a Generalized ESD Many-Outlier Procedure, *Technometrics*, 25(2), pp. 165-172, (1983)