

**Results of Proficiency Test
Liquefied Butane Analysis
June 2016**

Organised by: Institute for Interlaboratory Studies
Spijkenisse, the Netherlands

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Report: iis16S02B

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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 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 2016 proficiency test 50 laboratories in 29 different countries have registered for participation. See appendix 3 for the number of participants per country. In this report the test results of the 2016 proficiency test on Liquefied Butane are presented and discussed. This report is also electronically available through the iis website www.iisnl.com.

2 SET UP

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

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 56 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 test results. The unrounded test results were preferably used for statistical evaluation.

2.1 QUALITY SYSTEM

The Institute for Interlaboratory Studies in Spijkenisse, the Netherlands, has implemented a quality system based on ISO/IEC17043:2010 (R007). This ensures strict adherence to protocols for sample preparation and statistical evaluation and 100% confidentiality of participant's data. Feedback from the participants on the reported data is encouraged and customer's satisfaction is measured on regular basis by sending out questionnaires.

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). This protocol is electronically available through the iis website www.iisnl.com, from the FAQ page.

2.3 CONFIDENTIALITY STATEMENT

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

2.4 SAMPLES

In this proficiency test only one sample was used. One batch of 56 cylinders of one litre with artificial Liquefied Butane mixture was prepared and tested for homogeneity by EffecTech (Uttoxeter, United Kingdom) in conformance with ISO Guide 35: 2006 and ISO/IEC17043:2010 (job 16/0432) starting May 11, 2016. 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 test 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(ref. test method) in %mol/mol
Propane	0.003	0.052
Propylene	0.004	0.100
iso-Butane	0.073	0.280
n-Butane	0.013	0.078
1-Butene	0.021	0.093
iso-Butene	0.008	0.076
trans-2-Butene	0.007	0.051
cis-2-Butene	0.014	0.076
1,3-Butadiene	0.008	0.042
iso-Pentane	0.004	0.015

Table 1: homogeneity test results of samples #16111 compared to reference test method ASTM D2163:14e1

Each of the calculated repeatabilities is far less than 0.3 times the corresponding reproducibility of the reference test method ASTM D2163:14e1. Therefore, homogeneity of the subsamples #16111 was assumed.

To each of the participating laboratories one 1L cylinder labelled #16111 was sent on June 1, 2016.

2.5 STABILITY OF THE SAMPLES

EffecTech (Uttometer, 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 requested to determine on sample #16111: Propane, Propylene, iso-Butane, n-Butane, 1-Butene, iso-Butene, trans-2-Butene, cis-2-Butene, 1,3-Butadiene, iso-Pentane, Molar Mass, Relative Density at 60/60F(15.6/15.6°C), Absolute and Relative Vapour pressure at 100F(37.8°C) and at 40°C and Motor Octane Number (MON).

To get comparable test results a detailed report form, on which the units were prescribed as well as the reference test method and a letter of instructions were prepared and made available on the data entry portal www.kpmd.co.uk/sgs-iis/.

A SDS and a form to confirm receipt of the samples were added to the sample package

3 RESULTS

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

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

3.1 STATISTICS

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

For the statistical evaluation the *unrounded* (when available) figures were used instead of the rounded test results. Test results reported as '<...' or '>...' were not used in the statistical evaluation.

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

According to ISO 5725 the original test results per determination were submitted to Dixon's, Grubbs' and/or Rosner's outlier tests. Outliers are marked by D(0.01) for the Dixon's test, by G(0.01) or DG(0.01) for the Grubbs' test and by R(0.01) for the Rosner's test. Stragglers are marked by D(0.05) for the Dixon's test, by G(0.05) or DG(0.05) for the Grubbs' test and by R(0.05) for the Rosner's test. Both outliers and stragglers were not included in the calculations of averages and standard deviations.

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

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

3.2 GRAPHICS

In order to visualise the data against the reproducibilities from literature, Gauss plots were made, using the sorted data for one determination (see appendix 1). On the Y-axis the reported test results are plotted. The corresponding laboratory numbers are on the X-axis.

The straight horizontal line presents the consensus value (a trimmed mean). The four striped lines, parallel to the consensus value line, are the +3s, +2s, -2s and -3s target reproducibility limits of the selected reference test method. Outliers and other data, which were excluded from the calculations, are represented as a cross. Accepted data are represented as a triangle. Furthermore, Kernel Density Graphs were made. This is a method for producing a smooth density approximation to a set of data that avoids some problems associated with histograms. Also a normal Gauss curve was projected over the Kernel Density Graph for reference.

3.3 Z-SCORES

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

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

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

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

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

4 EVALUATION

In this interlaboratory study, some problems with sample dispatch were encountered by two laboratories. Two participants reported after the final reporting date and one participant did not report any test result at all. In total 49 participants reported 627 test results. Observed were 63 outlying test results, which is 10.0%. In proficiency studies, outlier percentages of 3% - 7.5% are quite normal.

4.1 EVALUATION PER COMPONENT AND PER TEST

In this section the reported test results are discussed per component and per test. 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 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, 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.

Propane: The determination of this component may be problematic for a number of laboratories. Five statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in good agreement with the requirements of ASTM D2163:14e1 and in good agreement with the less strict reproducibility of EN27941:93 (identical to IP 405 and ISO 7941).

Propylene: The determination of this component may be problematic for a number of laboratories. Five statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in good agreement with the requirements of ASTM D2163:14e1 and with the less strict reproducibility of EN27941:93 (identical to IP 405 and ISO 7941).

iso-Butane: The determination of this component was problematic for a number of laboratories. Three statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in agreement with the requirements of ASTM D2163:14e1 and with the less strict reproducibility of EN27941:93 (identical to IP 405 and ISO 7941).

- n-Butane: The determination of this component may be (not) problematic depending on the test method used. Six statistical outliers were observed. The calculated reproducibility after rejection of the statistical outliers is not in agreement with the requirements of ASTM D2163:14e1 but it is in agreement with the less strict reproducibility of EN27941:93 (identical to IP 405 and ISO 7941).
- 1-Butene: The determination of this component was problematic for a number of laboratories. Five statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in full agreement with the requirements of ASTM D2163:14e1 and in good agreement with the less strict reproducibility of EN27941:93 (identical to IP 405 and ISO 7941).
- Iso-Butene: The determination of this component may be problematic for a number of laboratories. Four statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in full agreement with the requirements of ASTM D2163:14e1 and with the less strict reproducibility of EN27941:93 (identical to IP 405 and ISO 7941).
- trans-2-Butene: The determination of this component may be problematic for a number of laboratories. Five statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in good agreement with the requirements of ASTM D2163:14e1 and with the less strict reproducibility of EN27941:93 (identical to IP 405 and ISO 7941).
- cis-2-Butene: The determination of this component was problematic for a number of laboratories. Eight statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in full agreement with the requirements of ASTM D2163:14e1 and with the less strict reproducibility of EN27941:93 (identical to IP 405 and ISO 7941).
- 1,3-Butadiene The determination of this component may be problematic for a number of laboratories. Four statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in good agreement with the requirements of ASTM D2163:14e1 and with the less strict reproducibility of EN27941:93 (identical to IP 405 and ISO 7941).
- iso-Pentane: The determination of this component may be (not) problematic depending on the test method used. Five statistical outliers were observed. The calculated reproducibility after rejection of the statistical outliers is not in agreement with the requirements of ASTM D2163:14e1 but in agreement with the less strict reproducibility of EN27941:93 (identical to IP 405 and ISO 7941).

Molar Mass: This calculated parameter may be problematic for a number of laboratories. The reported test results vary over a range from 56.81 - 57.753 g/mol. Three statistical outliers were observed. The calculated reproducibility after rejection of the statistical outliers is not in agreement with the calculated reproducibility using the published relative molecular masses obtained from one test method (IP432:99/ISO8973:97) over all reported component concentrations (0.115 vs 0.063). See also the discussion in paragraph 5.

Relative Density at 60/60F: This calculated parameter may be problematic for a number of laboratories. The reported test results vary over a range from 0.5602 - 0.578. Three statistical outliers were observed. The calculated reproducibility after rejection of the statistical outliers is not in agreement with the calculated reproducibility using the published relative density at 60/60F obtained from one test method (ASTM D2598:12) over all reported component concentrations (0.0013 vs 0.0007). See also the discussion in paragraph 5.
ASTM D2598:12 does not mention a relative density for 1,3 –Butadiene. For this component the relative density at 60/60F of 0.627 was taken from Data Book of J.B. Maxwell.

Abs. Vapour Pres. at 100F: This calculated parameter may be problematic for a number of laboratories. The reported test results vary from 70.49 – 72.31 psi. However, when the absolute vapour pressure values were calculated from the reported test results according to the factors mentioned in either ASTM D2598 or in ISO8973/IP432 it appeared that after rejection of the statistical outliers both test methods give significant different mean values and different calculated reproducibilities (0.395 vs 0.505 respectively). See also the discussion in paragraph 5.

Rel. Vapour Pres. at 100F: This calculated parameter may be problematic for a number of laboratories. The reported test results vary over a range from 55 – 59.12 psi. The same differences between ASTM D2598 and ISO8973/IP432 are observed as with the Absolute Vapour Pressure.

Abs. Vapour Pres. at 40°C: This calculated parameter may be problematic for a number of laboratories. The reported test results vary from 514.2 – 556 kPa. The calculated reproducibility after rejection of the statistical outliers is in agreement with the calculated reproducibility using the published vapour pressure factors obtained from one test method (IP432:99/ISO8973:97) over all reported component concentrations (2.82 vs 3.49). See also the discussion in paragraph 5.

Rel. Vapour Pres. at 40°C: This calculated parameter may be problematic for a number of laboratories. The reported test results vary over a range from 411.2 – 454 kPa. Four statistical outliers were observed. The calculated reproducibility after rejection of the statistical outliers is in agreement with the calculated reproducibility using the published vapour pressure factors obtained from one test method (IP432:99/ISO8973:97) over all reported component concentrations (2.82 vs 3.49). See also the discussion in paragraph 5.

MON: This calculated parameter may be problematic for a number of laboratories. The reported test results vary from 86.023 – 94.7. However when the MON values were calculated over all reported component concentrations according to the MON factors mentioned in either EN589 or in ASTM D2598 it appeared that after rejection of the statistical outliers both test methods give significant different mean values and different calculated reproducibilities (0.239 vs 0.121). See also the discussion in paragraph 5. EN589:08_A1:12 does not mention a MON factor for 1,3 –Butadiene. For this component an estimated value of 70 is used in calculations in this report in analogy of the MON factors of the other components. ASTM D2598:12 does not mention MON factors for iso-Butene, trans-2-Butene or 1,3 –Butadiene. For iso-Butene and trans-2-Butene the value of 83.5 of cis-2-Butene are used in analogy of EN589 and for 1,3 –Butadiene an estimated value of 70 is used in the calculations in this report in analogy of the MON factors of the other components.

4.2 PERFORMANCE EVALUATION FOR THE GROUP OF LABORATORIES

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

Component	unit	n	average	2.8 * sd	R(D2163) in %mol	R(EN27941) liq.-inj.n %mol	R(EN27941) liq.-inj.in %M/M
Propane	%mol/mol	44	0.970	0.114	0.171	1.305	1
Propylene	%mol/mol	44	1.187	0.129	0.319	1.367	1
iso-Butane	%mol/mol	46	76.025	0.948	0.933	1.485	1.5
n-Butane	%mol/mol	43	4.214	0.379	0.263	0.990	1
1-Butene	%mol/mol	43	6.069	0.309	0.310	1.026	1
iso-Butene	%mol/mol	44	3.873	0.252	0.253	1.026	1
trans-2-Butene	%mol/mol	44	1.619	0.130	0.171	1.026	1
cis-2-Butene	%mol/mol	41	4.145	0.272	0.261	1.026	1
1,3-Butadiene	%mol/mol	44	1.055	0.120	0.141	1.064	1
iso-Pentane	%mol/mol	44	0.813	0.093	0.050	0.798	1

Table 2: performance of the group in comparison with the reference test method 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 reference test method. The problematic components/tests have been discussed in paragraph 4.1.

Parameter	unit	n	average	2.8 * sd over reported test results	2.8 * sd calc. over all results using one set of factors	2.8 * sd calc. over all results using one set of factors June 2015
Molar Mass	g/mol	22	57.57	0.115	0.063	0.084
Rel. Density at 60/60F		27	0.5707	0.0013	0.0007	0.0010
Abs. VP at 100F D2598	psi	43	71.45	n.a.	0.40	0.47
Abs. VP at 100F ISO/IP	psi	43	72.17	n.a.	0.50	0.57
Rel. VP at 100F D2598	psi	43	56.75	n.a.	0.40	0.47
Rel. VP at 100F ISO/IP	psi	43	57.48	n.a.	0.50	0.57
Abs. VP at 40°C	kPa	15	523.5	2.8	3.5	n.e.
Rel. VP at 40°C	kPa	14	422.1	3.6	3.5	n.e.
MON		43	92.95	n.a.	0.24	n.e.
MON D2598		43	94.65	n.a.	0.12	n.e.

Table 3: performance of the group in comparison with the calculated reproducibilities using one set of factors.

Without further statistical calculations it can be concluded that for many parameters there is a good compliance of the group of participating laboratories with the method reproducibilities calculated over all reported test results of this PT compared to 2015 PT. See also the discussion in paragraph 5.

4.3 COMPARISON OF THE PROFICIENCY TEST OF JUNE 2016 WITH PREVIOUS PTS

	June 2016	June 2015	June 2014	June 2013	June 2012
Number of reporting labs	49	46	38	30	30
Number of test results reported	627	538	467	358	373
Statistical outliers	63	45	33	15	39
Percentage outliers	10.0%	8.4%	7.1%	4.2%	10.5%

Table 4: comparison with previous proficiency tests

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

The performance of the determinations of the proficiency tests was compared against the requirements of ASTM D2163. For 2012 – 2013 against D2163:96 and for 2014 – 2016 against D2163:14e1. The conclusions are given the following table:

Component	June 2016	June 2015	June 2014	June 2013	June 2012
Propane	+	+	-	--	-
Propylene	++	++	++	--	-
iso-Butane	+/-	-	-	-	--
n-Butane	-	-	--	+/-	++
1-Butene	+/-	+	-	++	++
iso-Butene	+/-	+/-	+/-	++	++
trans-2-Butene	+	+	+/-	++	+
cis-2-Butene	+/-	+/-	-	++	+
1,3-Butadiene	+	+	+	--	+/-
iso-Pentane	-	-	--	--	+

Table 5: comparison determinations against the requirements of ASTM D2163

The following performance categories were used in the above table:

- ++: group performed much better than the reference test method
- + : group performed better than the reference test method
- +/-: group performance equals the reference test method
- : group performed worse than the reference test method
- : group performed much worse than the reference test method

5 DISCUSSION

Because 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 reference 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 EffectTech (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, except for cis-2-Butene. No explanation could be given for this remarkable deviation.

Component	Average values by EffectTech in %mol/mol	Consensus values from participants test results in %mol/mol	Absolute differences in %mol/mol	z-score
Propane	0.9932	0.9703	-0.0229	-0.38
Propylene	1.259	1.1871	-0.0719	-0.63
iso-Butane	76.3228	76.0249	-0.2979	-0.89
n-Butane	4.0915	4.2144	0.1229	1.31
1-Butene	6.0958	6.0690	-0.0268	-0.24
iso-Butene	3.9066	3.8728	-0.0338	-0.37
trans-2-Butene	1.6143	1.6188	0.0045	0.07
cis-2-Butene	3.8477	4.1451	0.2974	3.19
1,3-Butadiene	1.0613	1.0554	-0.0059	-0.12
iso-Pentane	0.8077	0.8125	0.0048	0.27

Table 6: comparison of consensus values with values determined by EffectTech (Uttoxeter, United Kingdom)

Two laboratories reported traces of some impurities. One laboratory reported the presence n-Pentane and neo Pentane (2,2-dimethylpropane) and another laboratory reported the presence of n-Pentane. These components are 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 variation 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 test 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.

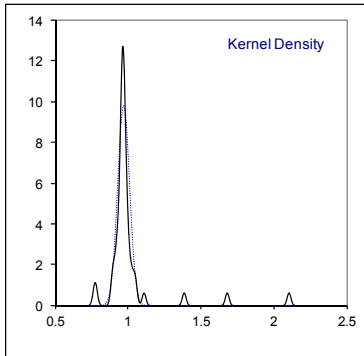
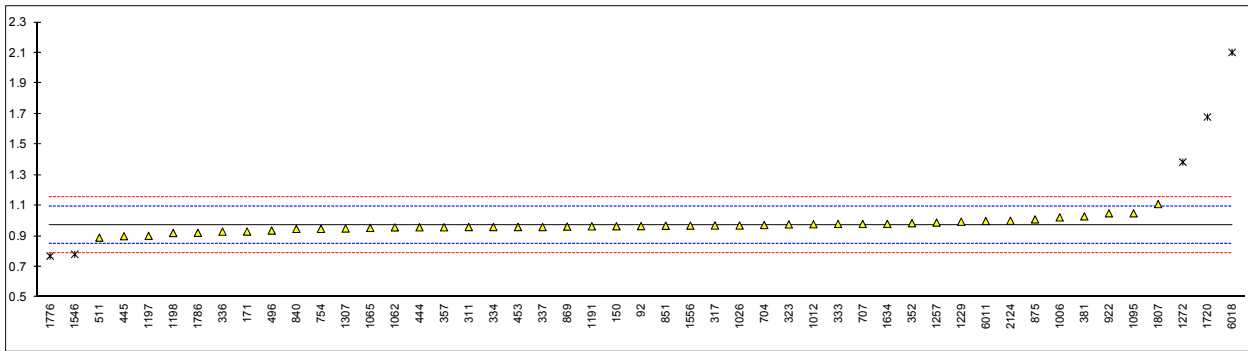
For the calculation of the Molar Mass, Relative Density and Vapour Pressure and Motor Octane Number several standardized test methods are available, e.g. ASTM D2421 for the interconversion of the units to gas-volume, liquid-volume or mass basis. Also different test methods for the calculation of the Vapour Pressure do exist. In ISO 8973 (identical to IP432) the Vapour Pressure is calculated from the mole fraction per component and a Vapour Pressure factor of that component (given for all components). In ASTM D2598 the Vapour Pressure is calculated from the liquid volume percentage per component and a Vapour Pressure factor of that component (given for only several components). Also the selection of the tables to be used

for the calculations may cause additional uncertainty. This has been at least observed for Vapour pressure at 100F and Motor Octane Number.

APPENDIX 1

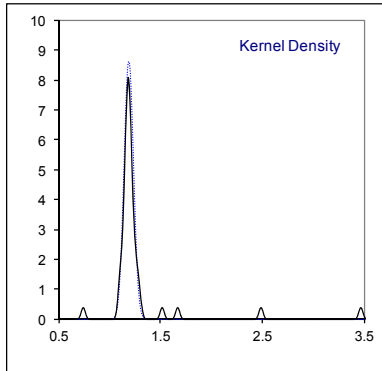
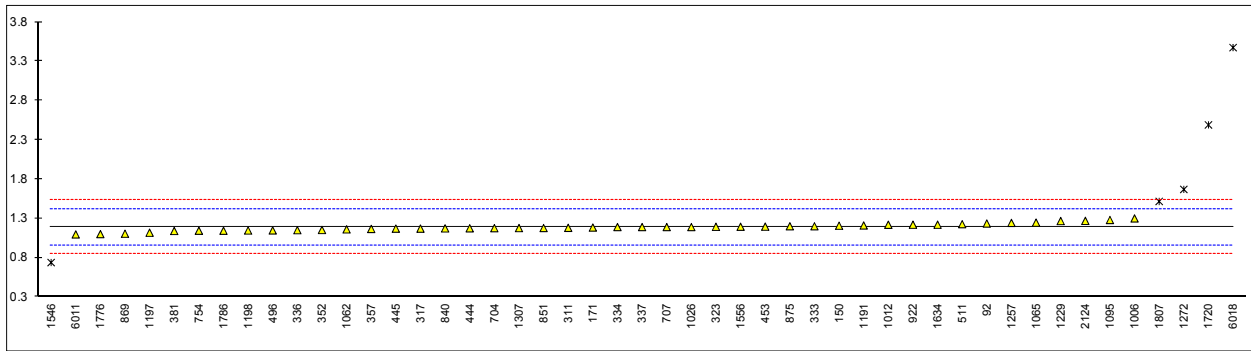
Determination of Propane on sample #16111; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	D2163	0.966		-0.07	
150	D2163	0.965		-0.09	
171	D2163	0.9306		-0.65	
311	D2163	0.96		-0.17	
317	D2163	0.97		-0.01	
323	D2163	0.977		0.11	
333	D2163	0.98		0.16	
334	D2163	0.96		-0.17	
336	EN27941	0.93		-0.66	
337	D2163	0.96		-0.17	
352	EN27941	0.9852		0.24	
357	D2163	0.958		-0.20	
381	EN27941	1.03	C	0.98	first reported: 0.78
444	IP405	0.958		-0.20	
445	D2163	0.90		-1.15	
453	D2163	0.960		-0.17	
496	D2163	0.937		-0.55	
511	D2163	0.8907		-1.31	
704	D2163	0.973		0.04	
707	D2163	0.980		0.16	
754	D2163	0.948		-0.37	
840	D2163	0.948		-0.37	
851	D2163	0.9684		-0.03	
869	D2163	0.963		-0.12	
875	D2163	1.01		0.65	
912		----		----	
922	D2163	1.05		1.31	
1006	D2163	1.023		0.87	
1012	D2163	0.9781		0.13	
1026	ISO7941	0.97		-0.01	
1062	D2163	0.9575		-0.21	
1065	D2163	0.954		-0.27	
1095	ISO7941	1.05		1.31	
1191	IP473	0.9645		-0.10	
1197	D2163	0.902		-1.12	
1198	D2163	0.921		-0.81	
1229	IP473	0.995		0.41	
1257	D2163	0.9891		0.31	
1272	EN27941	1.385	C,R(0.01)	6.81	first reported: 1.461
1307	INH-450	0.9505		-0.33	
1546	EN27941	0.781	R(0.01)	-3.11	
1556	EN27941	0.969		-0.02	
1634	ISO7941	0.98		0.16	
1720	D2163	1.68	R(0.01)	11.65	
1776	EN27941	0.77	R(0.01)	-3.29	
1786	D2163	0.922		-0.79	
1807	D2163	1.110		2.29	
2124	D2163	1.0012		0.51	
6011	D2163	0.9992		0.47	
6018	EN27941	2.103	R(0.01)	18.60	
	normality	not OK			
	n	44			
	outliers	5			
	mean (n)	0.9703			
	st.dev. (n)	0.04069			
	R(calc.)	0.1139			
	R(D2163:14e1)	0.1705			compare EN27941(liq)=1.3048



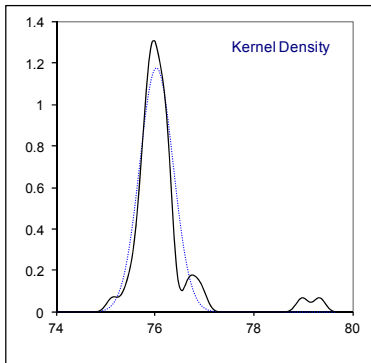
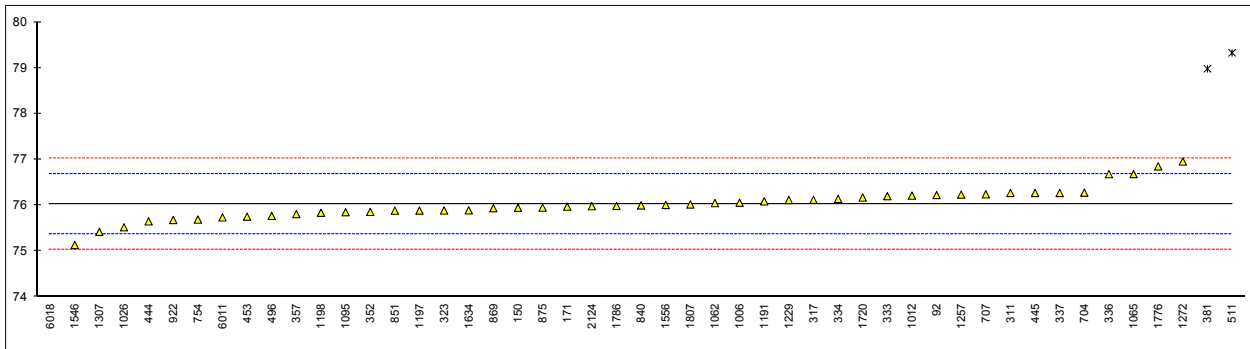
Determination of Propylene on sample #16111; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	D2163	1.235		0.42	
150	D2163	1.207		0.17	
171	D2163	1.1837		-0.03	
311	D2163	1.18		-0.06	
317	D2163	1.17		-0.15	
323	D2163	1.193		0.05	
333	D2163	1.20		0.11	
334	D2163	1.19		0.03	
336	EN27941	1.15		-0.33	
337	D2163	1.19		0.03	
352	EN27941	1.1528		-0.30	
357	D2163	1.166		-0.18	
381	EN27941	1.14	C	-0.41	first reported: 1.01
444	IP405	1.174		-0.11	
445	D2163	1.17		-0.15	
453	D2163	1.195		0.07	
496	D2163	1.147		-0.35	
511	D2163	1.2264		0.35	
704	D2163	1.176		-0.10	
707	D2163	1.190		0.03	
754	D2163	1.143		-0.39	
840	D2163	1.173		-0.12	
851	D2163	1.1774		-0.08	
869	D2163	1.105		-0.72	
875	D2163	1.20		0.11	
912		----		----	
922	D2163	1.22		0.29	
1006	D2163	1.300		0.99	
1012	D2163	1.2190		0.28	
1026	ISO7941	1.19		0.03	
1062	D2163	1.1603		-0.23	
1065	D2163	1.246		0.52	
1095	ISO7941	1.28		0.82	
1191	IP473	1.2105		0.21	
1197	D2163	1.118		-0.61	
1198	D2163	1.146		-0.36	
1229	IP473	1.2665		0.70	
1257	D2163	1.2425		0.49	
1272	EN27941	1.669	C,R(0.01)	4.23	first reported: 1.682
1307	INH-450	1.1766		-0.09	
1546	EN27941	0.738	R(0.01)	-3.94	
1556	EN27941	1.194		0.06	
1634	ISO7941	1.22		0.29	
1720	D2163	2.49	R(0.01)	11.43	
1776	EN27941	1.10		-0.76	
1786	D2163	1.143		-0.39	
1807	D2163	1.516	R(0.01)	2.89	
2124	D2163	1.2686		0.72	
6011	D2163	1.0959		-0.80	
6018	EN27941	3.474	R(0.01)	20.06	
	normality	OK			
	n	44			
	outliers	5			
	mean (n)	1.1871			
	st.dev. (n)	0.04606			
	R(calc.)	0.1290			
	R(D2163:14e1)	0.3192			compare EN27941(liq)=1.3673



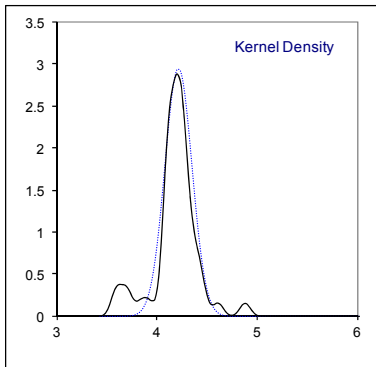
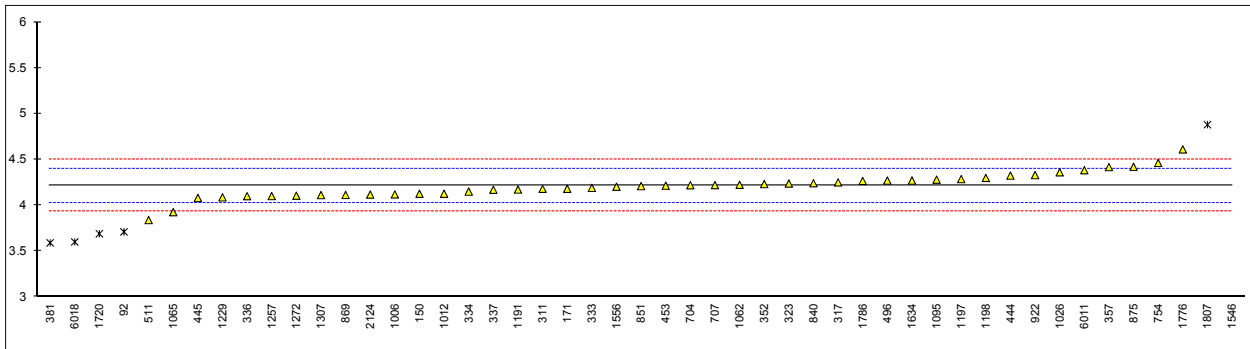
Determination of iso-Butane on sample #16111; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	D2163	76.224		0.60	
150	D2163	75.946	C	-0.24	first reported: 75.405
171	D2163	75.9714		-0.16	
311	D2163	76.27		0.74	
317	D2163	76.12		0.29	
323	D2163	75.888		-0.41	
333	D2163	76.20		0.53	
334	D2163	76.14		0.35	
336	EN27941	76.68		1.97	
337	D2163	76.27		0.74	
352	EN27941	75.856		-0.51	
357	D2163	75.809		-0.65	
381	EN27941	78.98	C,R(0.01)	8.87	first reported: 79.86
444	IP405	75.650		-1.13	
445	D2163	76.27		0.74	
453	D2163	75.752		-0.82	
496	D2163	75.769		-0.77	
511	D2163	79.3270	R(0.01)	9.91	
704	D2163	76.277		0.76	
707	D2163	76.240		0.65	
754	D2163	75.689		-1.01	
840	D2163	75.998		-0.08	
851	D2163	75.8832		-0.43	
869	D2163	75.938		-0.26	
875	D2163	75.95		-0.22	
912		-----		-----	
922	D2163	75.68		-1.04	
1006	D2163	76.056		0.09	
1012	D2163	76.2114		0.56	
1026	ISO7941	75.52		-1.52	
1062	D2163	76.0479		0.07	
1065	D2163	76.682		1.97	
1095	ISO7941	75.85		-0.52	
1191	IP473	76.0869		0.19	
1197	D2163	75.885		-0.42	
1198	D2163	75.836		-0.57	
1229	IP473	76.1145		0.27	
1257	D2163	76.2342		0.63	
1272	EN27941	76.956		2.79	
1307	INH-450	75.4203		-1.81	
1546	EN27941	75.134		-2.67	
1556	EN27941	76.008		-0.05	
1634	ISO7941	75.89		-0.40	
1720	D2163	76.17		0.44	
1776	EN27941	76.85		2.48	
1786	D2163	75.986		-0.12	
1807	D2163	76.019		-0.02	
2124	D2163	75.9811		-0.13	
6011	D2163	75.73705		-0.86	
6018	EN27941	65.990	R(0.01)	-30.12	
	normality	suspect			
	n	46			
	outliers	3			
	mean (n)	76.0249			
	st.dev. (n)	0.33857			
	R(calc.)	0.9480			
	R(D2163:14e1)	0.9330			compare EN27941(liq)=1.4849



Determination of n-Butane on sample #16111; results in %mol/mol

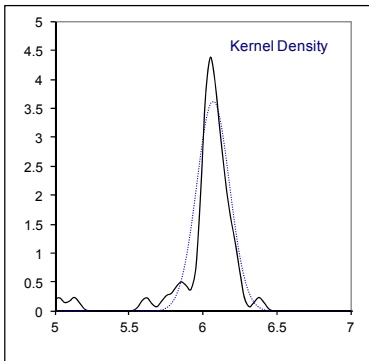
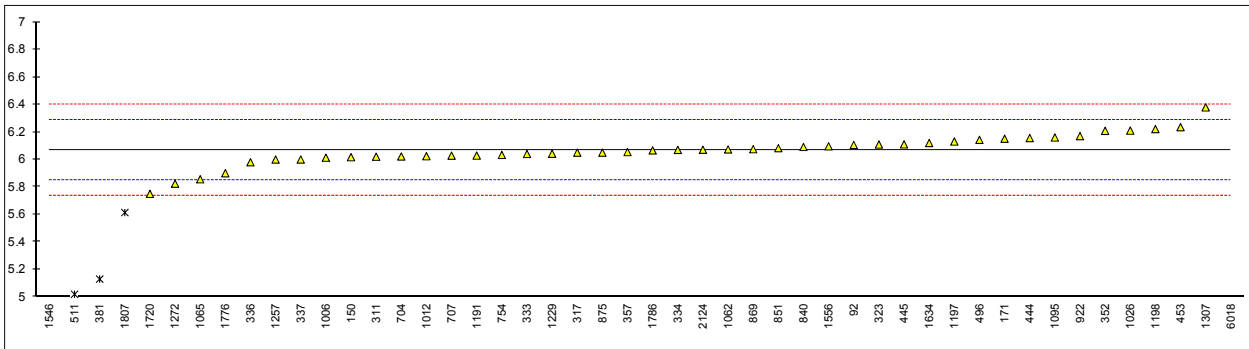
lab	method	value	mark	z(targ)	remarks
92	D2163	3.710	R(0.05)	-5.37	
150	D2163	4.126		-0.94	
171	D2163	4.1806		-0.36	
311	D2163	4.18		-0.37	
317	D2163	4.25		0.38	
323	D2163	4.238		0.25	
333	D2163	4.19		-0.26	
334	D2163	4.15		-0.69	
336	EN27941	4.10		-1.22	
337	D2163	4.17		-0.47	
352	EN27941	4.2317		0.18	
357	D2163	4.417		2.16	
381	EN27941	3.59	C,R(0.05)	-6.65	first reported: 3.27
444	IP405	4.324		1.17	
445	D2163	4.08		-1.43	
453	D2163	4.214		0.00	
496	D2163	4.270		0.59	
511	D2163	3.8391		-4.00	
704	D2163	4.219		0.05	
707	D2163	4.220		0.06	
754	D2163	4.462	C	2.64	first reported: 4.862
840	D2163	4.241		0.28	
851	D2163	4.2095		-0.05	
869	D2163	4.113		-1.08	
875	D2163	4.42		2.19	
912		----		----	
922	D2163	4.33		1.23	
1006	D2163	4.119		-1.02	
1012	D2163	4.1265		-0.94	
1026	ISO7941	4.36		1.55	
1062	D2163	4.2239		0.10	
1065	D2163	3.925		-3.08	
1095	ISO7941	4.28		0.70	
1191	IP473	4.1723		-0.45	
1197	D2163	4.286		0.76	
1198	D2163	4.299		0.90	
1229	IP473	4.087		-1.36	
1257	D2163	4.1010		-1.21	
1272	EN27941	4.105		-1.17	
1307	INH-450	4.1109		-1.10	
1546	EN27941	12.585	R(0.01)	89.16	
1556	EN27941	4.203		-0.12	
1634	ISO7941	4.27		0.59	
1720	D2163	3.69	R(0.05)	-5.59	
1776	EN27941	4.61		4.21	
1786	D2163	4.266		0.55	
1807	D2163	4.880	R(0.05)	7.09	
2124	D2163	4.1171		-1.04	
6011	D2163	4.38305		1.80	
6018	EN27941	3.600	R(0.05)	-6.54	
	normality	suspect			
	n	43			
	outliers	6			
	mean (n)	4.2144			
	st.dev. (n)	0.13517			
	R(calc.)	0.3785			
	R(D2163:14e1)	0.2629			compare EN27941(liq)=0.9899



Determination of 1-Butene on sample #16111; results in %mol/mol

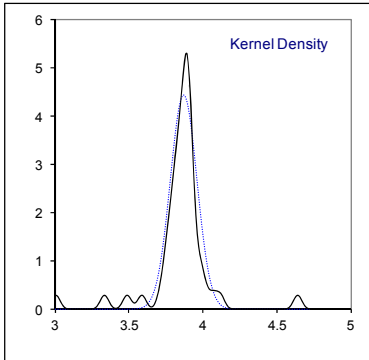
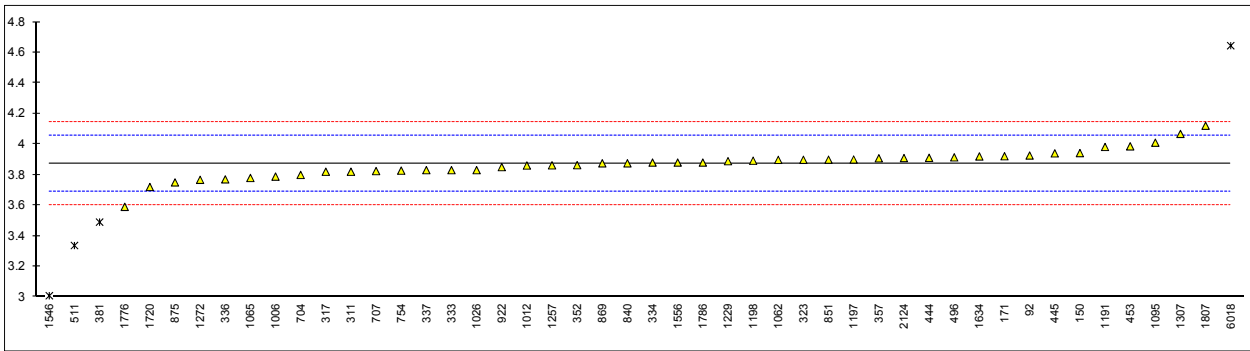
lab	method	value	mark	z(targ)	remarks
92	D2163	6.106		0.33	
150	D2163	6.017		-0.47	
171	D2163	6.1513		0.74	
311	D2163	6.02		-0.44	
317	D2163	6.05		-0.17	
323	D2163	6.109		0.36	
333	D2163	6.04		-0.26	
334	D2163	6.07		0.01	
336	EN27941	5.98		-0.80	
337	D2163	6.00		-0.62	
352	EN27941	6.2085		1.26	
357	D2163	6.054		-0.14	
381	EN27941	5.13	C,R(0.01)	-8.49	first reported: 4.85
444	IP405	6.156		0.79	
445	D2163	6.11		0.37	
453	D2163	6.235		1.50	
496	D2163	6.143		0.67	
511	D2163	5.0198	R(0.01)	-9.48	
704	D2163	6.022		-0.42	
707	D2163	6.028		-0.37	
754	D2163	6.033		-0.33	
840	D2163	6.091		0.20	
851	D2163	6.0824		0.12	
869	D2163	6.075		0.05	
875	D2163	6.05		-0.17	
912		----		----	
922	D2163	6.17		0.91	
1006	D2163	6.013		-0.51	
1012	D2163	6.0240		-0.41	
1026	ISO7941	6.21		1.27	
1062	D2163	6.0731		0.04	
1065	D2163	5.856		-1.93	
1095	ISO7941	6.16		0.82	
1191	IP473	6.0285		-0.37	
1197	D2163	6.131		0.56	
1198	D2163	6.221		1.37	
1229	IP473	6.042		-0.24	
1257	D2163	5.9998		-0.63	
1272	EN27941	5.824		-2.21	
1307	INH-450	6.3791		2.80	
1546	EN27941	4.347	R(0.01)	-15.57	
1556	EN27941	6.096		0.24	
1634	ISO7941	6.12		0.46	
1720	D2163	5.75		-2.88	
1776	EN27941	5.90		-1.53	
1786	D2163	6.066		-0.03	
1807	D2163	5.614	R(0.01)	-4.11	
2124	D2163	6.0711		0.02	
6011		----		----	
6018	EN27941	12.523	R(0.01)	58.34	
	normality	not OK			
	n	43			
	outliers	5			
	mean (n)	6.0690			
	st.dev. (n)	0.11017			
	R(calc.)	0.3085			
	R(D2163:14e1)	0.3098			compare EN27941(liq)=1.0255

Lab 6011 reported: We can't separate isobutene, 1-butene and 1,3-butadiene (about 11.0602 %mol) because our product and raw material don't have alkene component. So, we don't have the standard material to calibrate our gas chromatograph and we can't report normalized composition.



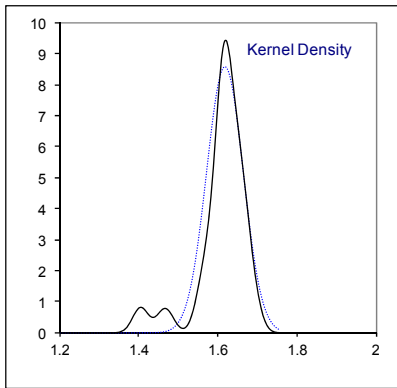
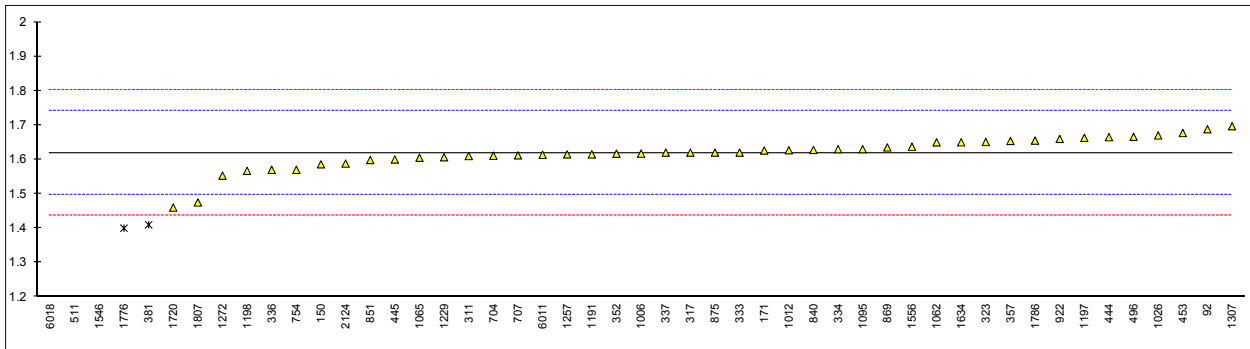
Determination of iso-Butene on sample #16111; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	D2163	3.926		0.59	
150	D2163	3.942		0.77	
171	D2163	3.9212		0.54	
311	D2163	3.82		-0.58	
317	D2163	3.82		-0.58	
323	D2163	3.898		0.28	
333	D2163	3.83		-0.47	
334	D2163	3.88		0.08	
336	EN27941	3.77		-1.14	
337	D2163	3.83		-0.47	
352	EN27941	3.8629		-0.11	
357	D2163	3.908		0.39	
381	EN27941	3.49	C,R(0.01)	-4.24	first reported: 3.30
444	IP405	3.911		0.42	
445	D2163	3.94		0.74	
453	D2163	3.986		1.25	
496	D2163	3.914		0.46	
511	D2163	3.3368	R(0.01)	-5.93	
704	D2163	3.799		-0.82	
707	D2163	3.824		-0.54	
754	D2163	3.827		-0.51	
840	D2163	3.875		0.02	
851	D2163	3.8989		0.29	
869	D2163	3.875		0.02	
875	D2163	3.75		-1.36	
912		----		----	
922	D2163	3.85		-0.25	
1006	D2163	3.788		-0.94	
1012	D2163	3.8605		-0.14	
1026	ISO7941	3.83		-0.47	
1062	D2163	3.8975		0.27	
1065	D2163	3.779		-1.04	
1095	ISO7941	4.01		1.52	
1191	IP473	3.9820		1.21	
1197	D2163	3.900		0.30	
1198	D2163	3.892		0.21	
1229	IP473	3.889		0.18	
1257	D2163	3.8618		-0.12	
1272	EN27941	3.767		-1.17	
1307	INH-450	4.0675		2.15	
1546	EN27941	3.008	R(0.01)	-9.57	
1556	EN27941	3.880		0.08	
1634	ISO7941	3.92		0.52	
1720	D2163	3.72		-1.69	
1776	EN27941	3.59		-3.13	
1786	D2163	3.880		0.08	
1807	D2163	4.121		2.75	
2124	D2163	3.9095		0.41	
6011		----		----	
6018	EN27941	4.645	R(0.01)	8.54	
	normality	not OK			
	n	44			
	outliers	4			
	mean (n)	3.8728			
	st.dev. (n)	0.08984			
	R(calc.)	0.2515			
	R(D2163:14e1)	0.2531			compare EN27941(liq)=1.0255



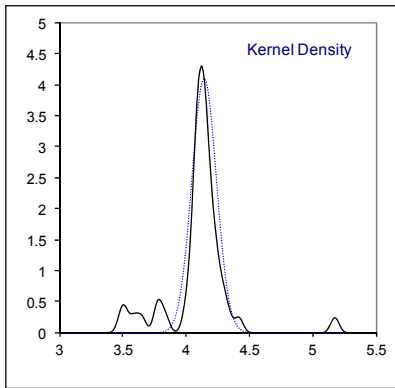
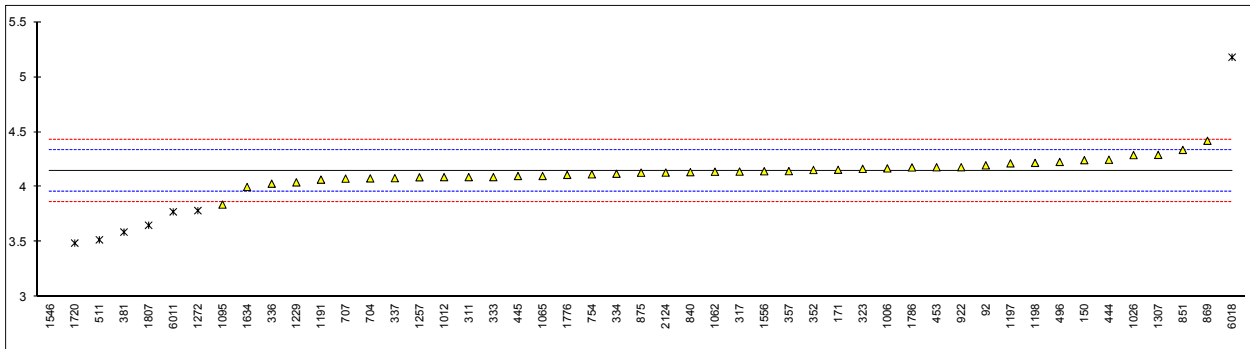
Determination of trans-2-Butene on sample #16111; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	D2163	1.688		1.13	
150	D2163	1.586		-0.54	
171	D2163	1.6261		0.12	
311	D2163	1.61		-0.14	
317	D2163	1.62		0.02	
323	D2163	1.651		0.53	
333	D2163	1.62		0.02	
334	D2163	1.63		0.18	
336	EN27941	1.57		-0.80	
337	D2163	1.62		0.02	
352	EN27941	1.6168		-0.03	
357	D2163	1.654		0.58	
381	EN27941	1.41	C,R(0.01)	-3.42	first reported: 1.63
444	IP405	1.665		0.76	
445	D2163	1.60		-0.31	
453	D2163	1.677		0.95	
496	D2163	1.666		0.77	
511	D2163	0.9570	R(0.01)	-10.84	
704	D2163	1.611		-0.13	
707	D2163	1.612		-0.11	
754	D2163	1.570		-0.80	
840	D2163	1.628		0.15	
851	D2163	1.5986		-0.33	
869	D2163	1.635		0.27	
875	D2163	1.62		0.02	
912		----		----	
922	D2163	1.66		0.67	
1006	D2163	1.617		-0.03	
1012	D2163	1.6269		0.13	
1026	ISO7941	1.67		0.84	
1062	D2163	1.6499		0.51	
1065	D2163	1.605		-0.23	
1095	ISO7941	1.63		0.18	
1191	IP473	1.6149		-0.06	
1197	D2163	1.663		0.72	
1198	D2163	1.567		-0.85	
1229	IP473	1.6065		-0.20	
1257	D2163	1.6148		-0.07	
1272	EN27941	1.553		-1.08	
1307	INH-450	1.6968		1.28	
1546	EN27941	0.957	R(0.01)	-10.84	
1556	EN27941	1.637		0.30	
1634	ISO7941	1.65		0.51	
1720	D2163	1.46		-2.60	
1776	EN27941	1.40	R(0.01)	-3.59	
1786	D2163	1.655		0.59	
1807	D2163	1.475		-2.36	
2124	D2163	1.5882		-0.50	
6011	D2163	1.61365		-0.08	
6018	EN27941	0.688	R(0.01)	-15.25	
	normality	not OK			
	n	44			
	outliers	5			
	mean (n)	1.6188			
	st.dev. (n)	0.04638			
	R(calc.)	0.1299			
	R(D2163:14e1)	0.1709			compare EN27941(liq)=1.0255



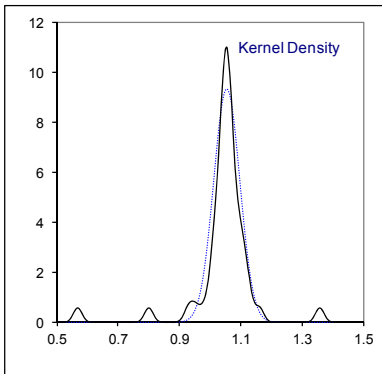
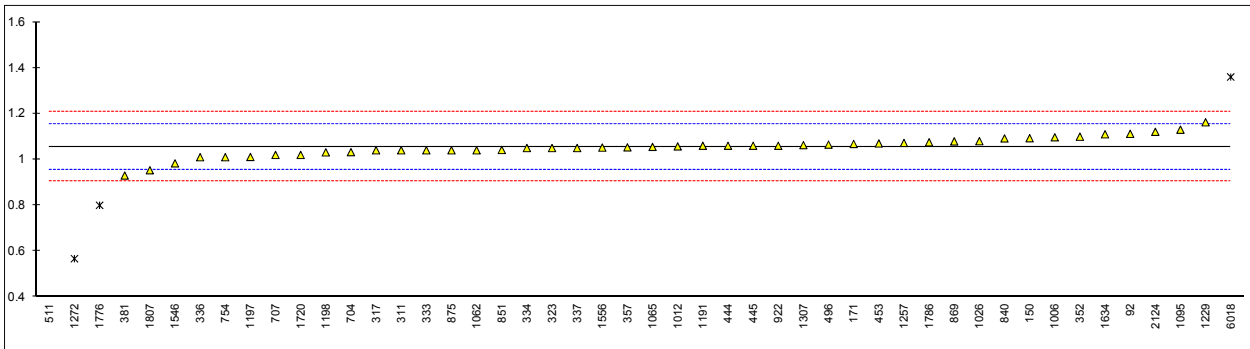
Determination of cis-2-Butene on sample #16111; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	D2163	4.197		0.56	
150	D2163	4.244	C	1.06	first reported: 4.621
171	D2163	4.1564		0.12	
311	D2163	4.09		-0.59	
317	D2163	4.14		-0.05	
323	D2163	4.165		0.21	
333	D2163	4.09		-0.59	
334	D2163	4.12		-0.27	
336	EN27941	4.03		-1.24	
337	D2163	4.08		-0.70	
352	EN27941	4.1545		0.10	
357	D2163	4.144		-0.01	
381	EN27941	3.59	R(0.05)	-5.96	
444	IP405	4.248		1.10	
445	D2163	4.10		-0.48	
453	D2163	4.179		0.36	
496	D2163	4.228		0.89	
511	D2163	3.5194	R(0.05)	-6.71	
704	D2163	4.078		-0.72	
707	D2163	4.076		-0.74	
754	D2163	4.115		-0.32	
840	D2163	4.135		-0.11	
851	D2163	4.3371		2.06	
869	D2163	4.420		2.95	
875	D2163	4.13		-0.16	
912		----		----	
922	D2163	4.18		0.37	
1006	D2163	4.169		0.26	
1012	D2163	4.0896		-0.60	
1026	ISO7941	4.29		1.55	
1062	D2163	4.1387		-0.07	
1065	D2163	4.10		-0.48	
1095	ISO7941	3.84		-3.27	
1191	IP473	4.0668		-0.84	
1197	D2163	4.215		0.75	
1198	D2163	4.219		0.79	
1229	IP473	4.042		-1.11	
1257	D2163	4.0882		-0.61	
1272	EN27941	3.785	C,R(0.05)	-3.86	first reported: 3.712
1307	INH-450	4.2919		1.58	
1546	EN27941	0.714	R(0.01)	-36.82	
1556	EN27941	4.143		-0.02	
1634	ISO7941	4.00		-1.56	
1720	D2163	3.49	R(0.05)	-7.03	
1776	EN27941	4.11		-0.38	
1786	D2163	4.178		0.35	
1807	D2163	3.652	R(0.05)	-5.29	
2124	D2163	4.1310		-0.15	
6011	D2163	3.7743	R(0.05)	-3.98	
6018	EN27941	5.180	R(0.01)	11.11	
	normality	not OK			
	n	41			
	outliers	8			
	mean (n)	4.1451			
	st.dev. (n)	0.09713			
	R(calc.)	0.2720			
	R(D2163:14e1)	0.2609			compare EN27941(liq)=1.0255



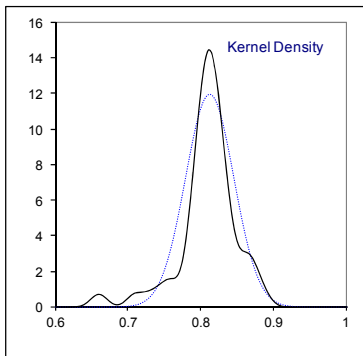
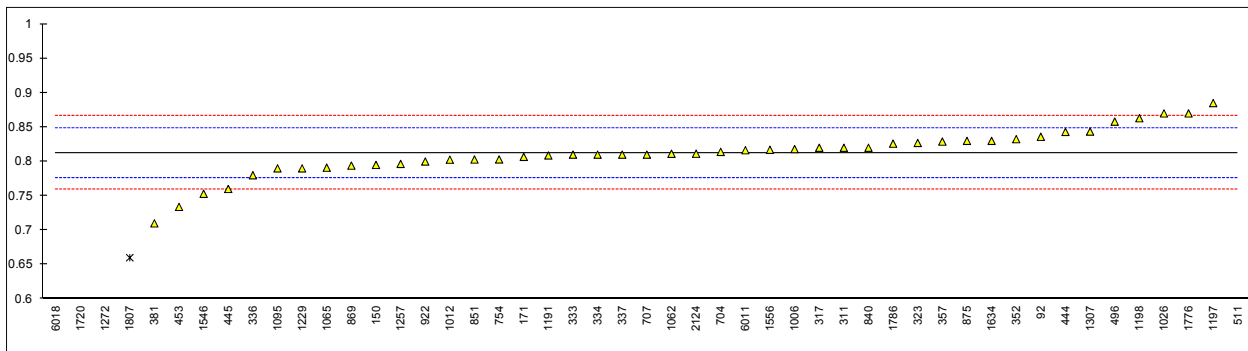
Determination of 1,3-Butadiene on sample #16111; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	D2163	1.112		1.12	
150	D2163	1.093	C	0.75	first reported: 1.257
171	D2163	1.0678		0.25	
311	D2163	1.04		-0.31	
317	D2163	1.04		-0.31	
323	D2163	1.050		-0.11	
333	D2163	1.04		-0.31	
334	D2163	1.05		-0.11	
336	EN27941	1.01		-0.90	
337	D2163	1.05		-0.11	
352	EN27941	1.0996		0.88	
357	D2163	1.053		-0.05	
381	EN27941	0.93	C	-2.49	first reported: 0.97
444	IP405	1.060		0.09	
445	D2163	1.06		0.09	
453	D2163	1.070		0.29	
496	D2163	1.065		0.19	
511	D2163	0.3381	R(0.01)	-14.25	
704	D2163	1.032		-0.46	
707	D2163	1.020		-0.70	
754	D2163	1.010		-0.90	
840	D2163	1.092		0.73	
851	D2163	1.0416		-0.27	
869	D2163	1.079		0.47	
875	D2163	1.04		-0.31	
912		----		----	
922	D2163	1.06		0.09	
1006	D2163	1.097		0.83	
1012	D2163	1.0572		0.04	
1026	ISO7941	1.08		0.49	
1062	D2163	1.0400		-0.31	
1065	D2163	1.055		-0.01	
1095	ISO7941	1.13		1.48	
1191	IP473	1.0599		0.09	
1197	D2163	1.011		-0.88	
1198	D2163	1.031		-0.48	
1229	IP473	1.1625		2.13	
1257	D2163	1.0721		0.33	
1272	EN27941	0.567	C,R(0.01)	-9.70	first reported: 0.541
1307	INH-450	1.0628		0.15	
1546	EN27941	0.983		-1.44	
1556	EN27941	1.052		-0.07	
1634	ISO7941	1.11		1.08	
1720	D2163	1.02		-0.70	
1776	EN27941	0.80	R(0.01)	-5.07	
1786	D2163	1.075		0.39	
1807	D2163	0.953		-2.03	
2124	D2163	1.1208		1.30	
6011		----		----	
6018	EN27941	1.360	R(0.01)	6.05	
	normality	suspect			
	n	44			
	outliers	4			
	mean (n)	1.0554			
	st.dev. (n)	0.04287			
	R(calc.)	0.1200			
	R(D2163:14e1)	0.1410			compare EN27941(liq)=1.0637



Determination of iso-Pentane on sample #16111; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	D2163	0.836		1.31	
150	D2163	0.795		-0.97	
171	D2163	0.8067		-0.32	
311	D2163	0.82		0.42	
317	D2163	0.82		0.42	
323	D2163	0.827		0.81	
333	D2163	0.81		-0.14	
334	D2163	0.81		-0.14	
336	EN27941	0.78		-1.81	
337	D2163	0.81		-0.14	
352	EN27941	0.8325		1.11	
357	D2163	0.829		0.92	
381	EN27941	0.71	C	-5.70	first reported: 0.74
444	IP405	0.843		1.70	
445	D2163	0.76		-2.92	
453	D2163	0.734		-4.37	
496	D2163	0.858		2.53	
511	D2163	1.5375	R(0.01)	40.35	
704	D2163	0.814		0.09	
707	D2163	0.810		-0.14	
754	D2163	0.803		-0.53	
840	D2163	0.820		0.42	
851	D2163	0.8029		-0.53	
869	D2163	0.794		-1.03	
875	D2163	0.83		0.98	
912		----		----	
922	D2163	0.80		-0.69	
1006	D2163	0.818		0.31	
1012	D2163	0.8026		-0.55	
1026	ISO7941	0.87		3.20	
1062	D2163	0.8112		-0.07	
1065	D2163	0.791		-1.19	
1095	ISO7941	0.79		-1.25	
1191	IP473	0.8088		-0.20	
1197	D2163	0.885		4.04	
1198	D2163	0.863		2.81	
1229	IP473	0.79		-1.25	
1257	D2163	0.7965		-0.89	
1272	EN27941	0.545	C,R(0.01)	-14.88	first reported: 0.556
1307	INH-450	0.8435		1.73	
1546	EN27941	0.753		-3.31	
1556	EN27941	0.817		0.25	
1634	ISO7941	0.83		0.98	
1720	D2163	0.53	R(0.01)	-15.72	
1776	EN27941	0.87		3.20	
1786	D2163	0.826		0.75	
1807	D2163	0.660	R(0.01)	-8.48	
2124	D2163	0.8113		-0.06	
6011	D2163	0.8164		0.22	
6018	EN27941	0.437	R(0.01)	-20.89	
	normality	suspect			
	n	44			
	outliers	5			
	mean (n)	0.8125			
	st.dev. (n)	0.03333			
	R(calc.)	0.0933			
	R(D2163:14e1)	0.0503			compare EN27941(liq)=0.7975



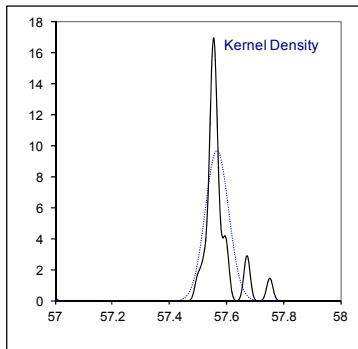
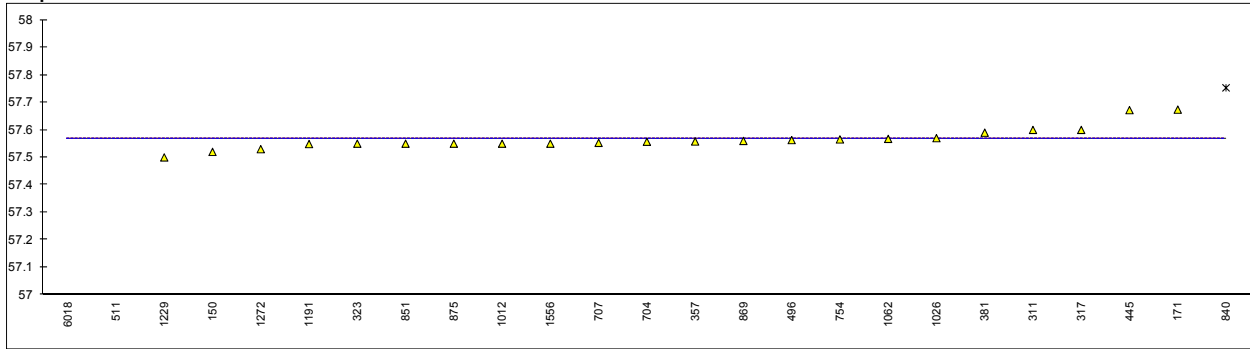
Determination of Molar Mass on sample #16111; results in g/mol

lab	method	value	mark	z(targ)	remarks
92		----		----	
150	D2163	57.52		----	
171	D2421	57.6738	E	----	calculated by iis from the reported test results: 57.5507
311	INH-ASTM databook	57.6		----	
317	INH-001	57.6		----	
323	INH-305	57.55		----	
333		----		----	
334		----		----	
336		----		----	
337		----		----	
352		----		----	
357	ISO8973	57.558		----	
381	ISO8973	57.59	C	----	first reported: 57.65
444		----		----	
445	D2163	57.672	E	----	calculated by iis from the reported test results: 57.5496
453		----		----	
496	D2163	57.563		----	
511	D2598	56.98	E,R(0.01)	----	calculated by iis from the reported test results: 57.7399
704	D2421	57.5570		----	
707	D2421	57.5530		----	
754	D2421	57.5655		----	see remark below
840	D2598	57.753	E,R(0.01)	----	calculated by iis from the reported test results: 57.5564
851	D2598	57.55		----	
869	D2598	57.56		----	
875	D2163	57.55		----	
912		----		----	
922		----		----	
1006		----		----	
1012	D2163	57.55		----	
1026	ISO8973	57.57		----	
1062	D2163	57.5675		----	
1065		----		----	
1095		----		----	
1191	ISO6976	57.5486		----	
1197		----		----	
1198		----		----	
1229	ISO8973	57.5		----	
1257		----		----	
1272	ISO8973	57.53		----	
1307		----		----	
1546		----		----	
1556	ISO8973	57.55		----	
1634		----		----	
1720		----		----	
1776		----		----	
1786		----		----	
1807		----		----	
2124		----		----	
6011		----		----	
6018	ISO8973	56.81	R(0.01)	----	
					<u>calculated by iis from all reported test results</u>
	normality	not OK			not OK
	n	22			43
	outliers	3			5
	mean (n)	57.567			57.547
	st.dev. (n)	0.0411	RSD=0.07%		0.0225 RSD=0.04%
	R(calc.)	0.115			0.063

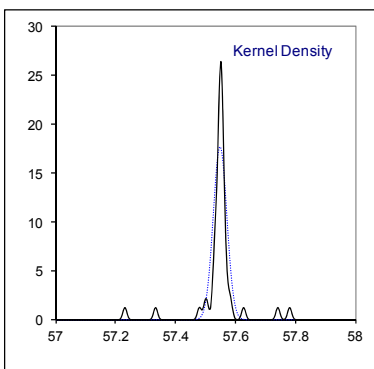
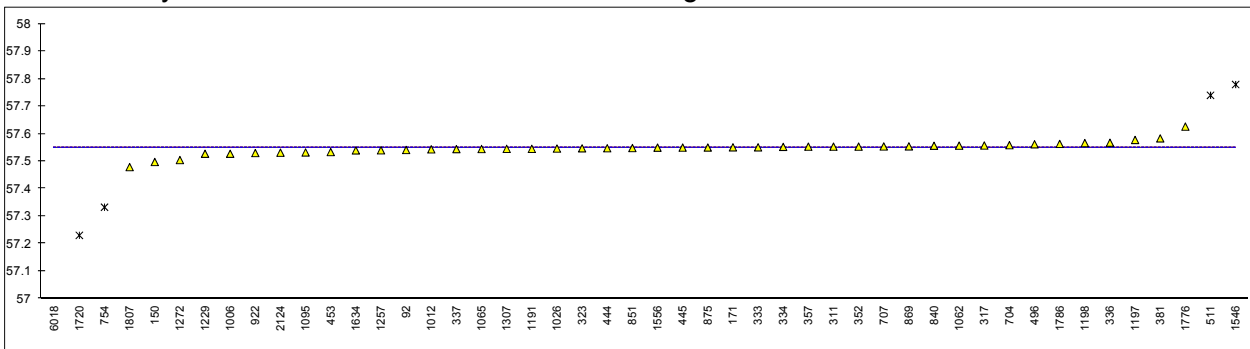
Note: iis calculations based on relative molecular masses given in Table A.1 of IP432:99/ISO8973:97

Lab 754: iis calculated a different Molar Mass from the reported test results (57.3327) due to correction in composition test results by participant without correction of their calculation test result.

Reported test results



Calculated by iis based on relative molecular masses given in Table A.1 of IP432:99 / ISO8973:97



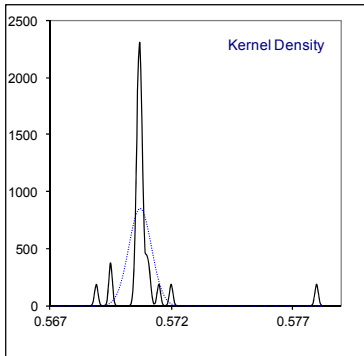
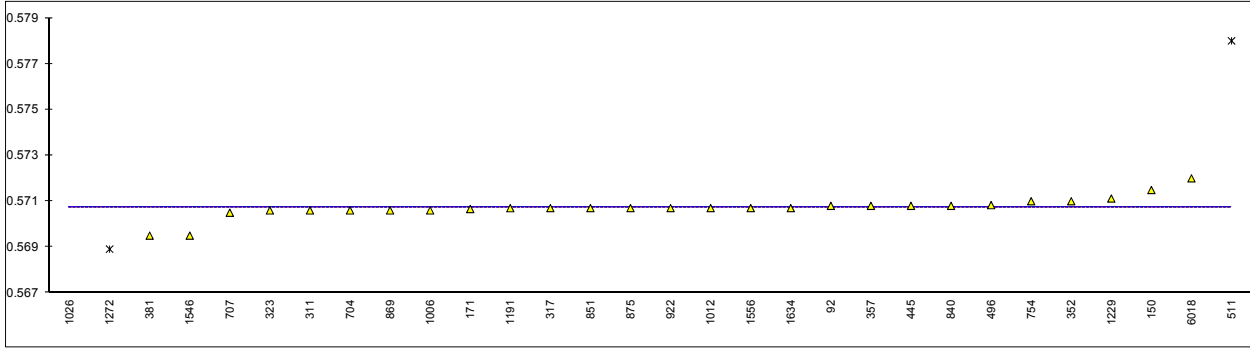
Determination of Relative Density at 60/60F on sample #16111; unitless results

lab	method	value	mark	z(targ)	remarks
92	D2598	0.5708		----	
150	D2598	0.57149		----	
171	D2598	0.57066		----	
311	INH-ASTM databook	0.5706		----	
317	INH-001	0.5707		----	
323	D2598	0.5706		----	
333		----		----	
334		----		----	
336		----		----	
337		----		----	
352	ISO8973	0.571		----	
357	D2598	0.5708		----	
381	ISO8973	0.5695		----	
444		----		----	
445	IP432	0.5708	C	----	first reported: 570.8
453		----		----	
496	D2598	0.57083		----	
511	D2598	0.578	E,R(0.01)	----	calc. by iis from the reported test results: 0.5695 to D2598
704	D2598	0.5706		----	
707	D2598	0.5705		----	
754	ISO8973	0.571		----	
840	D2598	0.5708		----	
851	D2598	0.5707		----	
869	D2598	0.5706		----	
875	D2598	0.5707		----	
912		----		----	
922	D2598	0.5707		----	
1006	D2598	0.5706		----	
1012	D2598	0.5707		----	
1026	ISO8973	0.5602	E,R(0.01)	----	calc. by iis from the reported test results: 0.5709 to ISO8973
1062		----		----	
1065		----		----	
1095		----		----	
1191	D2598	0.570696		----	
1197		----		----	
1198		----		----	
1229	ISO8973	0.57112	C	----	reported: 571.12
1257		----		----	
1272	ISO8973	0.56891	R(0.05)	----	
1307		----		----	
1546	ISO8973	0.5695	C	----	first reported: 569.5
1556	ISO8973	0.5707		----	
1634	ISO8973	0.5707	C	----	first reported:570.7
1720		----		----	
1776		----		----	
1786		----		----	
1807		----		----	
2124		----		----	
6011		----		----	
6018	ISO8973	0.572		----	
					<u>calculated by iis from all reported test results</u>
	normality	not OK			OK
	n	27			43
	outliers	3			5
	mean (n)	0.5707			0.5706
	st.dev. (n)	0.00047	RSD=0.08%		0.00023 RSD=0.04%
	R(calc.)	0.0013			0.0007

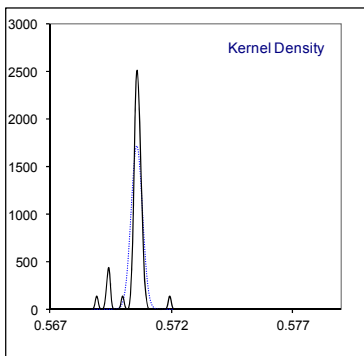
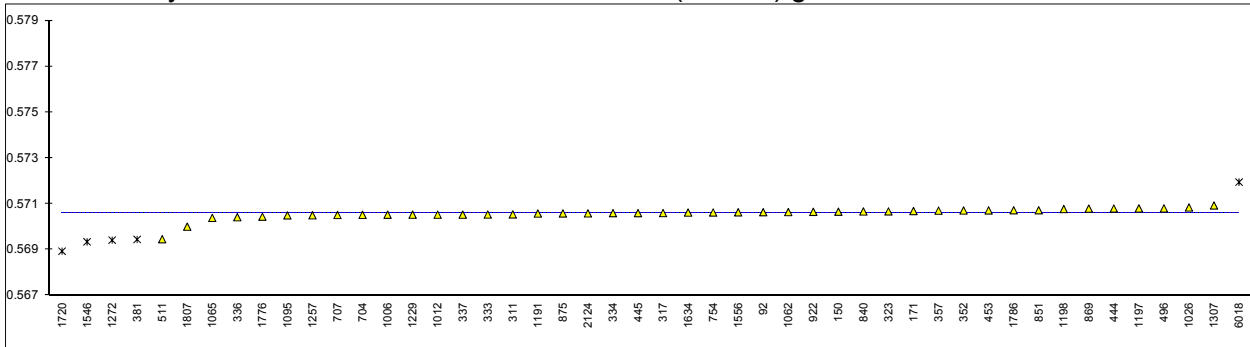
Note: iis calculations based on relative densities at 60F (15.6°C) given in ASTM D2598:12; Table 1

ASTM D2598:12 does not mention a relative density at 60F (15.6°C) for 1,3 –Butadiene. For this component the value of 0.627 is taken from Data Book of J.B. Maxwell

Reported test results



Calculated by iis based on relative densities at 60F (15.6°C) given in ASTM D2598:12; Table 1

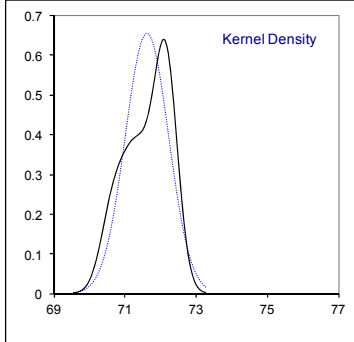
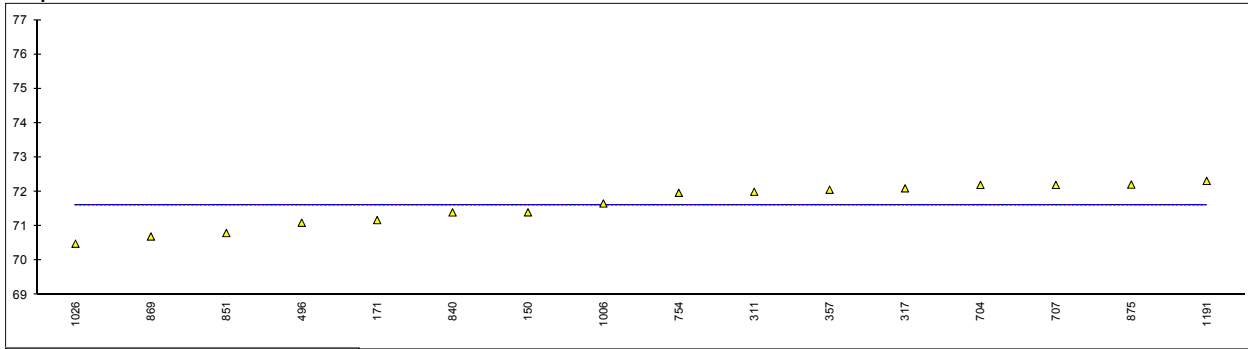


Determination of Abs. Vapour Pressure at 100F on sample #16111; results in psi

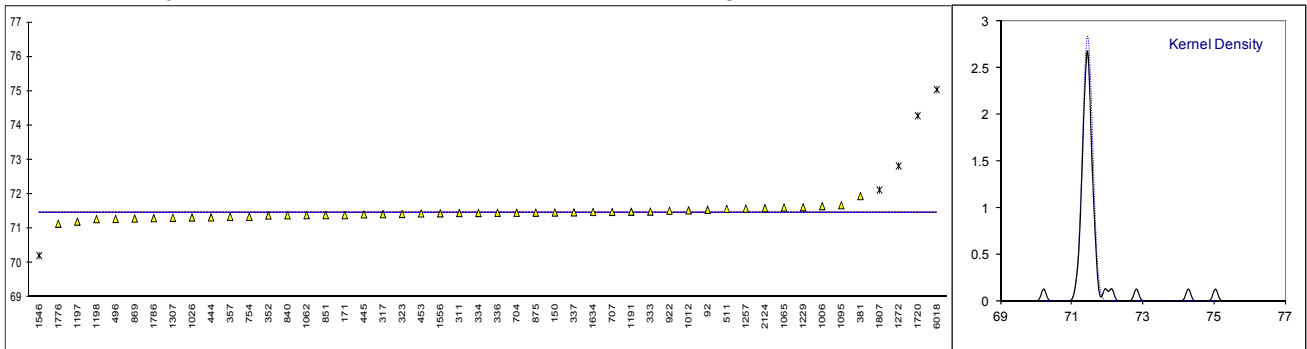
lab	method	value	mark	z(targ)	remarks
92		----		----	
150	D2598	71.402		----	
171	D2598	71.17576		----	
311	ISO8973	72		----	
317	ISO8973	72.1		----	
323		----		----	
333		----		----	
334		----		----	
336		----		----	
337		----		----	
352		----		----	
357	ISO8973	72.06		----	
381		----		----	
444		----		----	
445		----		----	
453		----		----	
496	D2598	71.1		----	
511		----		----	
704	ISO8973	72.2		----	
707	ISO8973	72.2		----	
754	ISO8973	71.97		----	
840	D2598	71.4		----	
851	D2598	70.8	E	----	calculated by iis from the reported test results: 71.39 acc. to D2598
869	D2598	70.7	E	----	calculated by iis from the reported test results: 71.29 acc. to D2598
875	ISO8973	72.21		----	
912		----		----	
922		----		----	
1006	D2598	71.66		----	
1012		----		----	
1026	ISO8973	70.49	E	----	calculated by iis from the reported test results: 72.04 acc. to ISO8973
1062		----		----	
1065		----		----	
1095		----		----	
1191	ISO8973	72.31706		----	
1197		----		----	
1198		----		----	
1229		----		----	
1257		----		----	
1272		----		----	
1307		----		----	
1546		----		----	
1556		----		----	
1634		----		----	
1720		----		----	
1776		----		----	
1786		----		----	
1807		----		----	
2124		----		----	
6011		----		----	
6018		----		----	<u>calculated by iis from all reported test results</u>
					ASTM D2598
					ISO8973/IP432
	normality				not OK
	n				43
	outliers				43
	mean (n)				5
	st.dev. (n)				71.448
	R(calc.)				72.173
					0.1409 RSD=0.20%
					0.1804 RSD=0.25%
					0.395
					0.505

Note: iis calculations either based on Vapor Pressure factors at 100F (37.8°C) given in ASTM D2598:12; Table 1 or based on IP432:99/ISO8973:97; Table A.1.

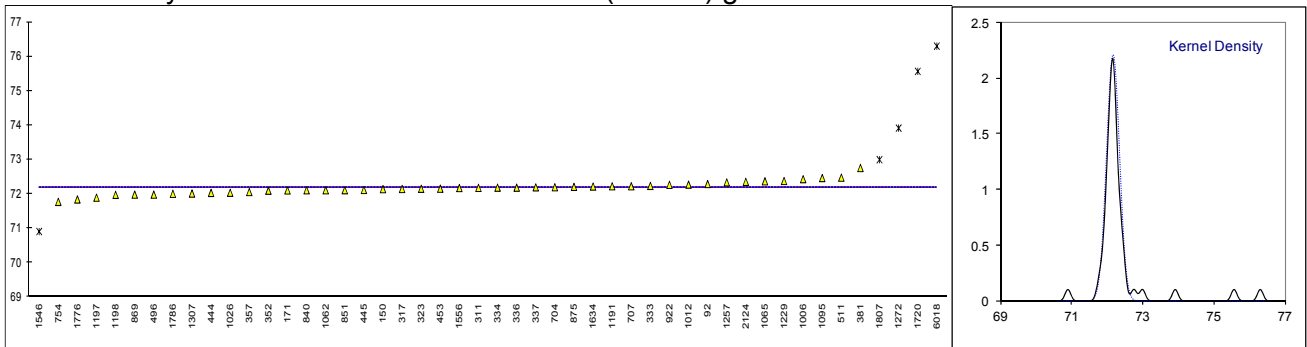
Reported test results



Calculated by iis based on VP factors at 100F (37.8°C) given in ASTM D2598:12; Table 1



Calculated by iis based on VP factors at 100F (37.8°C) given in Table A.1 of IP432:99 / ISO8973:97

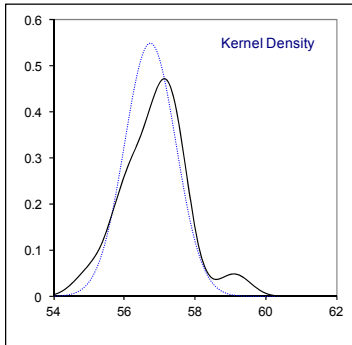
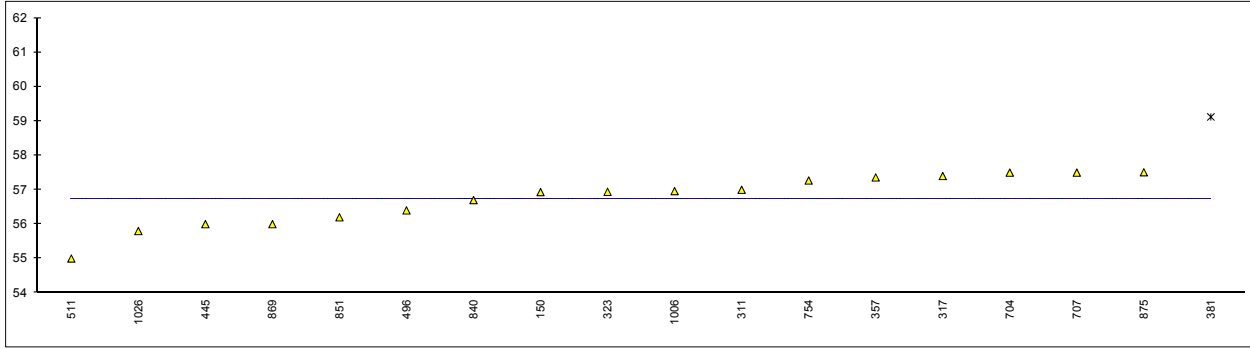


Determination of Rel. Vapour Pressure at 100F on sample #16111; results in psi

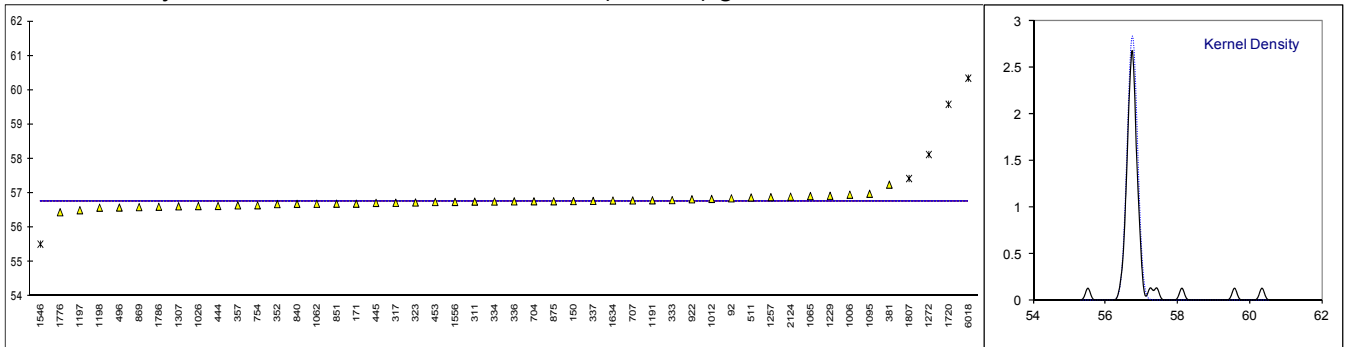
lab	method	value	mark	z(targ)	remarks
92		----		----	
150	D2598	56.932		----	
171		----		----	
311	ISO8973	57		----	
317	ISO8973	57.4		----	
323	D2598	56.94		----	
333		----		----	
334		----		----	
336		----		----	
337		----		----	
352		----		----	
357	ISO8973	57.36		----	
381	D2598	59.12	E, C,D(0.05)	----	first reported: 58.7; iis calc. from rep.test results: 57.25 acc. D2598
444		----		----	
445	IP432	56.0	E, C	----	first reported: 385.4; iis calc. from rep.test results: 57.42 acc.IP432
453		----		----	
496	D2598	56.4		----	
511	D2598	55	E, C	----	reported as abs. VP; iis calc. from rep.test results: 56.88 acc.D2598
704	ISO8973	57.5		----	
707	ISO8973	57.5		----	
754	ISO8973	57.27		----	
840	D2598	56.7		----	
851	D2598	56.2		----	
869	D2598	56.0		----	
875	ISO8973	57.51		----	
912		----		----	
922		----		----	
1006	D2598	56.96		----	
1012		----		----	
1026	ISO8973	55.8	E	----	iis calc. from rep.test results: 57.34 acc.to ISO8973
1062		----		----	
1065		----		----	
1095		----		----	
1191		----		----	
1197		----		----	
1198		----		----	
1229		----		----	
1257		----		----	
1272		----		----	
1307		----		----	
1546		----		----	
1556		----		----	
1634		----		----	
1720		----		----	
1776		----		----	
1786		----		----	
1807		----		----	
2124		----		----	
6011		----		----	
6018		----		----	
					<u>calculated by iis from all reported test results</u>
					ASTM D2598 ISO8973/IP432
	normality				not OK suspect
	n				43 43
	outliers				5 5
	mean (n)				56.752 57.477
	st.dev. (n)				0.1409 RSD=0.25% 0.1804 RSD=0.31%
	R(calc.)				0.395 0.505

Note: iis calculations either based on Vapor Pressure factors at 100F (37.8°C) given in ASTM D2598:12; Table 1 or based on IP432:99/ISO8973:97; Table A.1.

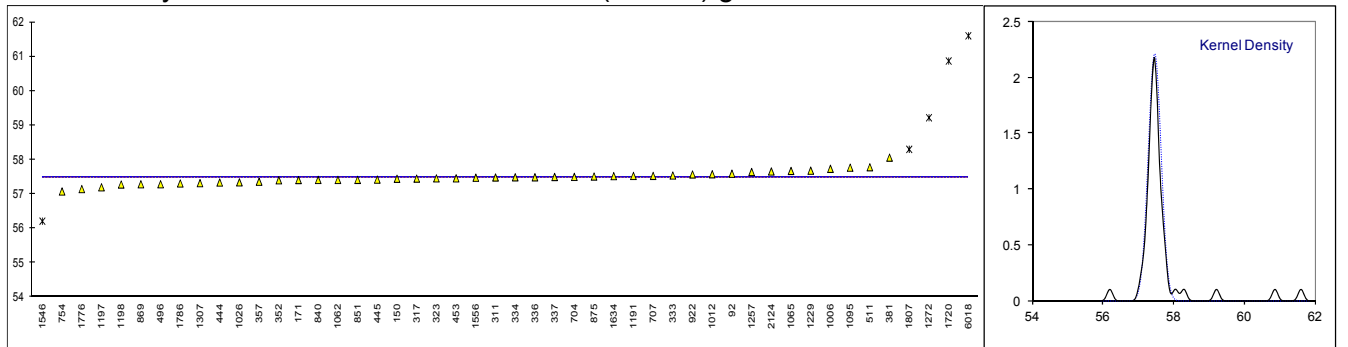
Reported test results



Calculated by iis based on VP factors at 100F (37.8°C) given in ASTM D2598:12; Table 1



Calculated by iis based on VP factors at 100F (37.8°C) given in Table A.1 of IP432:99/ISO8973:97



Determination of Abs. Vapour Pressure at 40°C on sample #16111; results in kPa

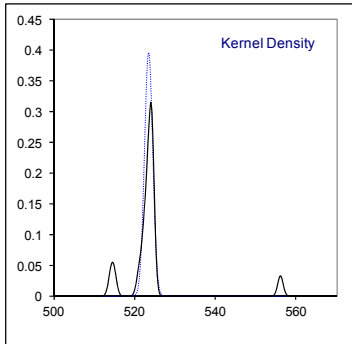
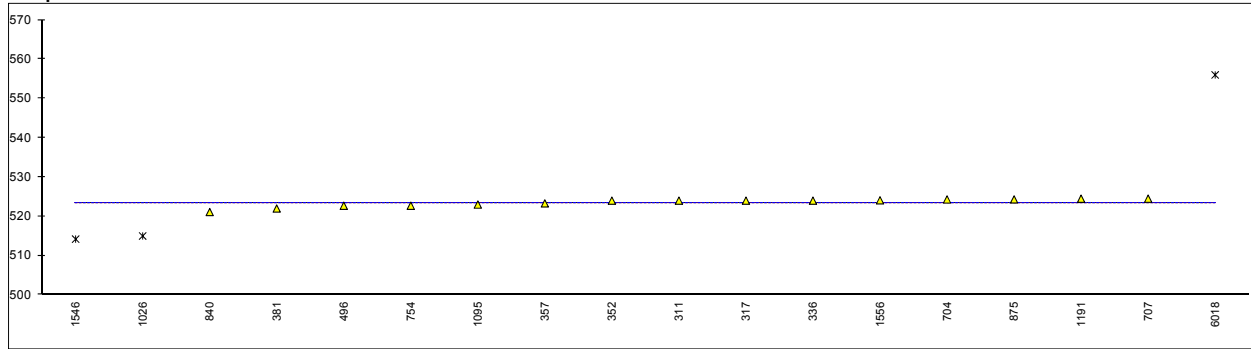
lab	method	value	mark	z(targ)	remarks
92		----		----	
150		----		----	
171		----		----	
311	ISO8973	524		----	
317	ISO8973	524		----	
323		----		----	
333		----		----	
334		----		----	
336	ISO8973	524		----	
337		----		----	
352	ISO8973	524		----	
357	ISO8973	523.3		----	
381	ISO8973	522.0	E, C	----	first reported: 524.6 calc.by iis from the rep.test results: 527.89
444		----		----	
445		----		----	
453		----		----	
496	ISO8973	522.7		----	
511		----		----	
704	ISO8973	524.3		----	
707	ISO8973	524.5		----	
754	ISO8973	522.7		----	see remark below
840	ISO8973	521.1	E	----	calculated by iis from the reported test results: 523.65
851		----		----	
869		----		----	
875	ISO8973	524.32		----	
912		----		----	
922		----		----	
1006		----		----	
1012		----		----	
1026	ISO8973	515	E,G(0.01)	----	calculated by iis from the reported test results: 523.17
1062		----		----	
1065		----		----	
1095	ISO8973	523	E	----	calculated by iis from the reported test results: 526.24
1191	ISO8973	524.49		----	
1197		----		----	
1198		----		----	
1229		----		----	
1257		----		----	
1272		----		----	
1307		----		----	
1546	ISO8973	514.2	G(0.05)	----	
1556	ISO8973	524.08		----	
1634		----		----	
1720		----		----	
1776		----		----	
1786		----		----	
1807		----		----	
2124		----		----	
6011		----		----	
6018	ISO8973	556	G(0.01)	----	
					<u>calculated by iis from all reported test results:</u>
	normality	OK			suspect
	n	15			43
	outliers	3			5
	mean (n)	523.499			524.092
	st.dev. (n)	1.0074	RSD=0.19%		1.2447 RSD=0.24%
	R(calc.)	2.821			3.485

Note: iis calculations based on Vapour Pressure factors at 40°C given in IP432:99/ISO8973:97; Table A.1.

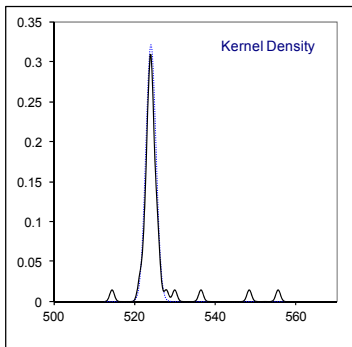
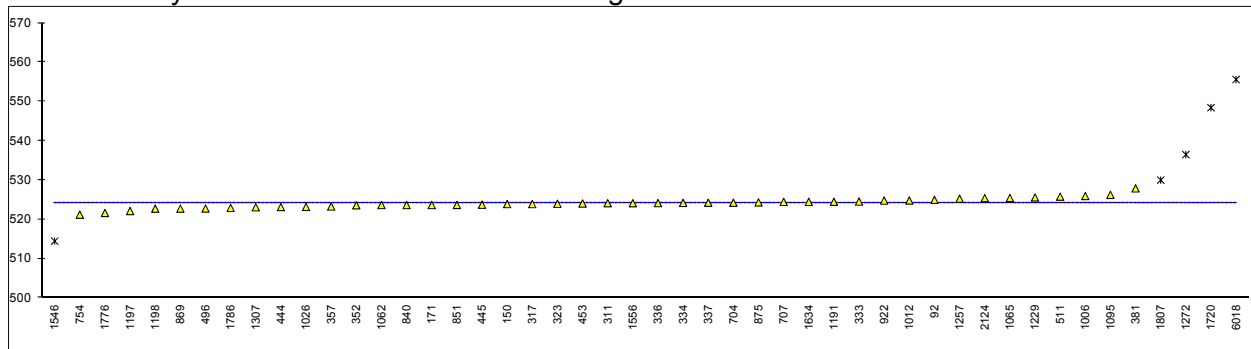
Lab 381 reported test result as relative Vapour Pressure

Lab 754: iis calculated a different Absolute Vapour Pressure from the reported test results (521.19) due to correction in composition test results by participant without correction of their calculation test result.

Reported test results



Calculated by iis based on VP factors at 40°C given in Table A.1 of IP432:99/ISO8973:97



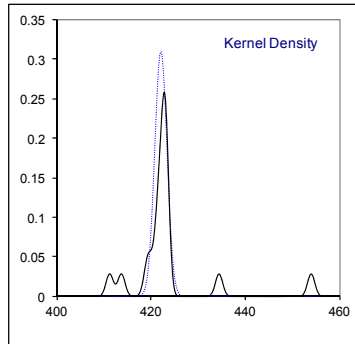
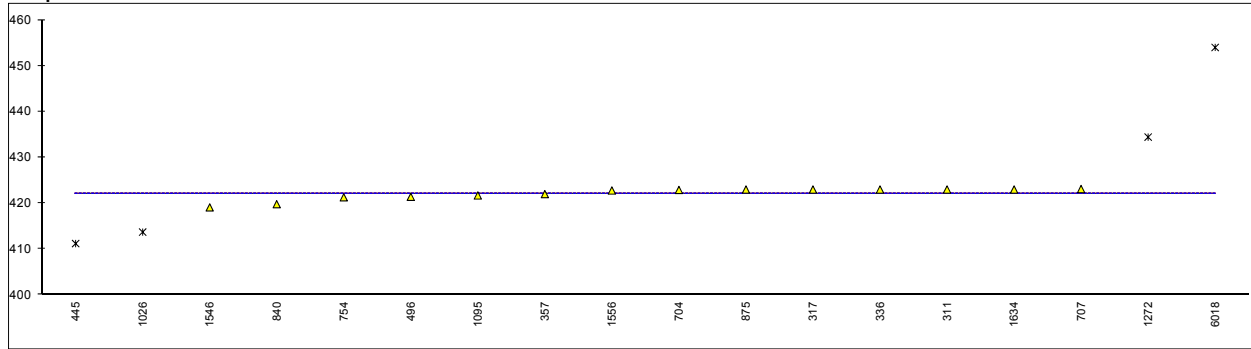
Determination of Rel. Vapour Pressure at 40°C on sample #161111; results in kPa

lab	method	value	mark	z(targ)	remarks
92		----		----	
150		----		----	
171		----		----	
311	ISO8973	423		----	
317	ISO8973	423		----	
323		----		----	
333		----		----	
334		----		----	
336	ISO8973	423		----	
337		----		----	
352		----		----	
357	ISO8973	422.0		----	
381		----		----	
444		----		----	
445	IP432	411.2	E,G(0.05)	----	calculated by iis from the reported test results: 422.40
453		----		----	
496	ISO8973	421.4		----	
511		----		----	
704	ISO8973	422.9		----	
707	ISO8973	423.1		----	
754	ISO8973	421.3		----	see remark below
840	ISO8973	419.8	E	----	calculated by iis from the reported test results: 422.32
851		----		----	
869		----		----	
875	ISO8973	422.99		----	
912		----		----	
922		----		----	
1006		----		----	
1012		----		----	
1026	ISO8973	413.7	E,G(0.01)	----	calculated by iis from the reported test results: 421.84
1062		----		----	
1065		----		----	
1095	ISO8973	421.7	E	----	calculated by iis from the reported test results: 424.92
1191		----		----	
1197		----		----	
1198		----		----	
1229		----		----	
1257		----		----	
1272	ISO8973	434.43	C,G(0.05)	----	reported test result as Absolute Vapour Pressure
1307		----		----	
1546	ISO8973	419.1	E	----	calculated by iis from the reported test results: 413.13
1556	ISO8973	422.78		----	
1634	ISO8973	423	C	----	reported test result as Absolute Vapour Pressure
1720		----		----	
1776		----		----	
1786		----		----	
1807		----		----	
2124		----		----	
6011		----		----	
6018	ISO8973	454	G(0.01)	----	
					<u>calculated by iis from all reported test results:</u>
	normality	suspect			suspect
	n	14			43
	outliers	4			5
	mean (n)	422.076			422.767
	st.dev. (n)	1.2925	RSD=0.31%		1.2447 RSD=0.29%
	R(calc.)	3.619			3.485

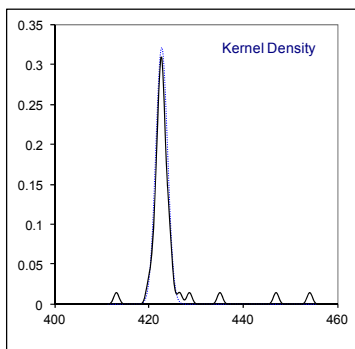
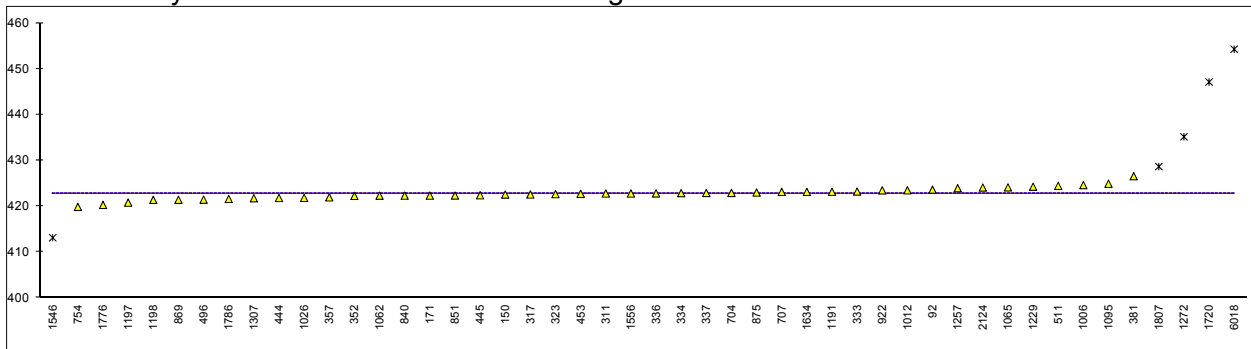
Note: iis calculations based on Vapour Pressure factors at 40°C given in IP432:99/ISO8973:97; Table A.1.

Lab 754: iis calculated a different Relative Vapour Pressure from the reported test results (419.86) due to correction in composition test results by participant without correction of their calculation test result.

Reported test results



Calculated by iis based on VP factors at 40°C given in Table A.1 of IP432:99/ISO8973:97



Determination of Motor Octane Number, MON on sample #16111;

lab	method	value	mark	z(targ)	remarks
92		----		----	
150		----		----	
171	D2598	86.023	E,D(0.01)	----	see remark below
311	EN589	92.3		----	
317	EN589	92.3		----	
323		----		----	
333		----		----	
334		----		----	
336		----		----	
337		----		----	
352		----		----	
357		----		----	
381	EN589	93.56	C	----	first reported: 93.65
444	D2598	89.7	D(0.05)	----	see remark below
445		----		----	
453		----		----	
496	EN589	92.5		----	
511		----		----	
704	EN589	93.07		----	
707	EN589	93.07		----	
754	EN589	93		----	
840		----		----	
851	D2598	94.7		----	
869	D2598	94.7		----	
875	EN589	93		----	
912		----		----	
922		----		----	
1006		----		----	
1012		----		----	
1026	EN589	92.2		----	
1062		----		----	
1065		----		----	
1095		----		----	
1191		----		----	
1197		----		----	
1198		----		----	
1229		----		----	
1257		----		----	
1272	EN589	93.41		----	
1307		----		----	
1546	EN589	93.8		----	
1556		----		----	
1634		----		----	
1720		----		----	
1776		----		----	
1786		----		----	
1807		----		----	
2124		----		----	
6011		----		----	
6018		----		----	calculated by iis from all reported test results
					EN589 ASTM D2598
	normality				not OK suspect
	n				43 43
	outliers				5 5
	mean (n)				92.954 94.649
	st.dev. (n)				0.0854 0.0433 RSD=0.05
	R(calc.)				0.239 0.121

Note: iis calculations either based on MON factors given in EN589:08_A1:12; Table B.1 or based on ASTM D2598:12; Table 1

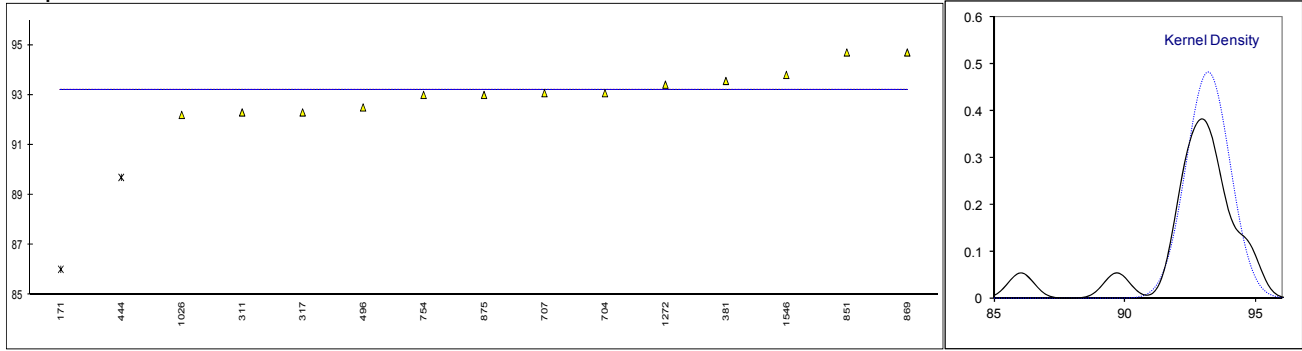
EN589:08_A1:12 does not mention a MON factor for 1,3 –Butadiene. For this component an estimated value of 70 is used in calculations in analogy of the MON factors of the other components.

ASTM D2598:12 does not mention MON factors for iso-Butene, trans-2-Butene or 1,3 –Butadiene. For iso-Butene and trans-2-Butene the value of 83.5 of cis-2-Butene are used in analogy of EN589 and for 1,3 –Butadiene an estimated value of 70 is used in calculations in analogy of the MON factors of the other components.

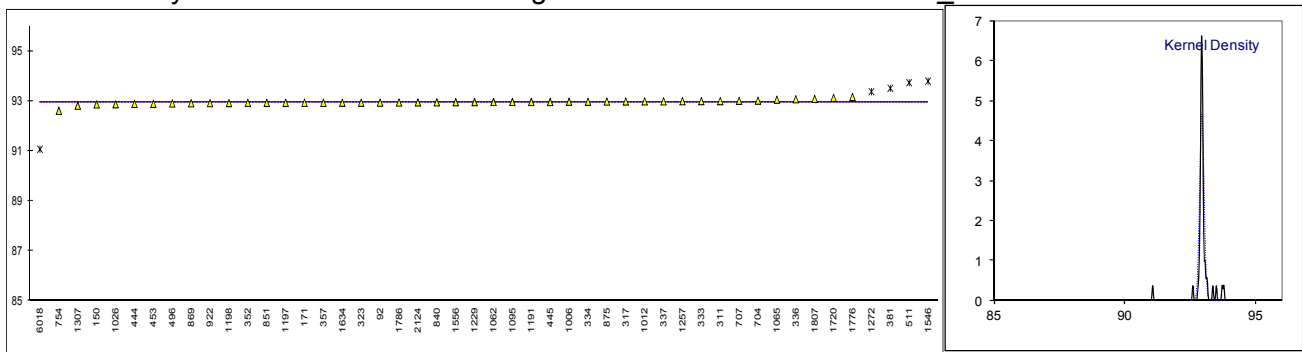
Lab 171: the reported MON value was presumably calculated without iso-Butene, trans-2-Butene and 1,3 –Butadiene. If these three components are omitted iis calculated a MON value of 89.7. This means that iis could not reproduce the reported MON test value of lab 171.

Lab 444 mentioned that method D2598 does not have MON factors for iso-butene or trans-butene and estimated that their test result may be 4-5% lower than expected; iis indeed calculated a MON value of 89.7 without these components which is the reported MON test value of lab 444

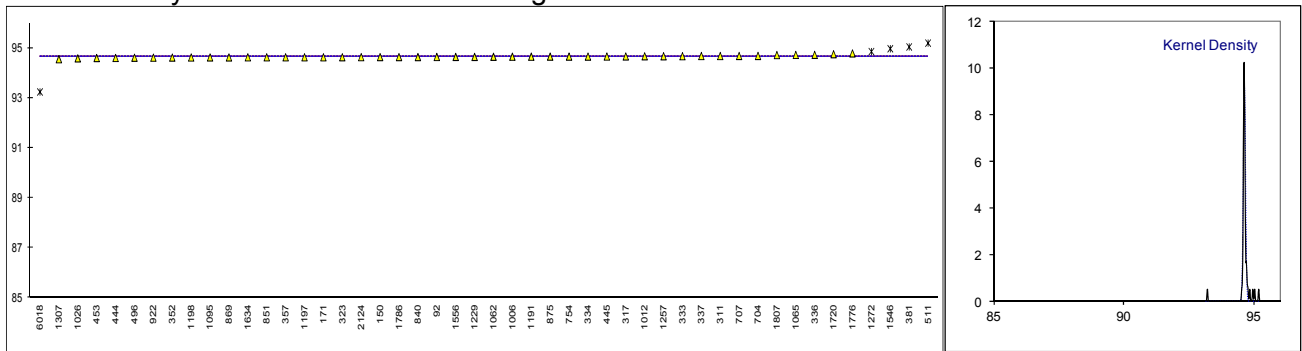
Reported test results



Calculated by iis based on MON factors given in Table B.1 of EN589:08 A1:12



Calculated by iis based on MON factors given in Table 1 of ASTM D2598:12



APPENDIX 2**Number of participants per country**

1 lab in AUSTRALIA
3 labs in BELGIUM
1 lab in BULGARIA
1 lab in CANADA
1 lab in CHINA, People's Republic
3 labs in FINLAND
4 labs in FRANCE
1 lab in GERMANY
1 lab in HONG KONG
1 lab in INDIA
1 lab in ISRAEL
3 labs in MALAYSIA
3 labs in NETHERLANDS
1 lab in NIGERIA
1 lab in PAKISTAN
1 lab in PERU
4 labs in PORTUGAL
2 labs in RUSSIAN FEDERATION
2 labs in SERBIA
1 lab in SPAIN
1 lab in SUDAN
2 labs in SWEDEN
1 lab in TAIWAN
1 lab in THAILAND
2 labs in UKRAINE
1 lab in UNITED ARAB EMIRATES
3 labs in UNITED KINGDOM
2 labs in UNITED STATES OF AMERICA
1 lab in VIETNAM

APPENDIX 3

Abbreviations:

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

Literature:

- 1 iis Interlaboratory Studies, Protocol for the Organization, Statistics and Evaluation, April 2014
- 2 prNEN 12766-2:00
- 3 ASTM E178:16
- 4 ASTM E130:95(2003)
- 5 ISO 5725:86(1994)
- 6 ISO 5725, parts 1-6:94
- 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, Fr. Z. Anal. Chem, 331, 513, (1988)
- 12 J.N. Miller, Analyst, 118, 455, (1993)
- 13 Analytical Methods Committee Technical Brief, No 4 January 2001
- 14 The Royal Society of Chemistry 2002, Analyst 2002, 127, 1359-1364, P.J. Lowthian and M. Thompson
- 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)
- 20 J.B. Maxwell, Data book on Hydrocarbons, 5th edition, 3 (1958)