

Results of Proficiency Test
Liquefied Propane
October 2015

Organised by: Institute for Interlaboratory Studies
Spijkenisse, the Netherlands

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1 INTRODUCTION

Since 2009, the Institute for Interlaboratory Studies organized a proficiency test for the analysis of Liquefied Propane (composition only) every year. It was decided to continue this interlaboratory study during the annual program 2015/2016.

Because iis has limited gas-handling facilities in place to prepare gas samples, a co-operation with EffectTech (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. EffectTech maintains an ISO17043 accreditation for the preparation of PT samples in homogeneous and stable batches and an ISO17025 accreditation for the calibration and assignment of reference values for these samples.

In the 2015 proficiency test 47 laboratories in 27 different countries have participated. See appendix 2 for the number of participants per country. In this report the results of the 2015 proficiency test on Liquefied Propane are presented and discussed. This report is also electronically available through the iis internet site www.iisnl.com.

2 SET UP

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

To optimise the costs for the participating laboratories, it was decided to prepare one Liquefied Propane mixture. The mixture was divided over a batch of 50 cylinders.

The cylinder size is a cost-effective one-litre cylinder with dip tube device. Each cylinder, filled with approx 200 grams of liquefied propane mixture, was uniquely numbered. The limited cylinder size is chosen to optimise sample stability, cylinder costs, transport and handling costs. The preparation and testing of the sample cylinders was subcontracted. Participants were requested to report rounded and unrounded results. The unrounded results were preferably used for statistical evaluation.

2.1 QUALITY SYSTEM

The Institute for Interlaboratory Studies in Spijkenisse, the Netherlands, has implemented a quality system based on ISO/IEC 17043:2010 (R007). This ensures strict adherence to protocols for sample preparation and statistical evaluation and 100% confidentiality of participant's data. Also customer's satisfaction is measured on regular basis by the distribution of questionnaires.

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

2.2 PROTOCOL

The protocol followed in the organisation of this proficiency test was the one as described for proficiency testing in the report 'iis Interlaboratory Studies: Protocol for the Organisation, Statistics and Evaluation' of April 2014 (iis-protocol, version 3.3). This protocol is electronically available through the iis internet site 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 50 one litre cylinders with artificial Liquefied Propane mixture was prepared and tested for homogeneity by EffectTech (Uttoxeter, United Kingdom) in conformance with ISO Guide 35: 2006 and ISO/IEC17043:2010 (job 15/0843) starting September 1, 2015. Each cylinder was uniquely numbered. Every cylinder in the batch was analysed using 6 replicate measurements. The within bottle and between bottle variations were then assessed in accordance with ISO Guide 35:2006 (Annex A.1). This procedure showed that the between bottle variations were all small compared to the uncertainties on the reference values on each component. Hence, a single reference value could be safely assigned to the entire batch of samples.

The repeatability values (r) were calculated per component by multiplication of the respective standard deviation by 2.8. Subsequently, the calculated repeatabilities were compared with 0.3 times the reproducibility of the reference method in agreement with the procedure of ISO 13528, Annex B2 in the next table:

Parameter	r (observed) in %mol/mol	0.3 X R(D2163:14e1) in %mol/mol
Ethane	0.002	0.021
Propane	0.059	1.268
Propylene	0.009	0.074
Iso-Butane	0.014	0.051
n-Butane	0.028	0.057
1-Butene	0.001	0.015
iso-Butylene	0.001	0.014
n-Pentane	0.007	0.021

Table 1: homogeneity test results of samples #15203

Each calculated repeatability is equal or less than 0.3 times the corresponding reproducibility of the reference method ASTM D2163:14e1. Therefore, homogeneity of the subsamples #15203 was assumed.

To each of the participating laboratories one 1L cylinder was sent on October 7, 2015.

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

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

3 RESULTS

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

Directly after deadline, a reminder was sent to those laboratories that had not yet reported results. 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 were used for data analysis and original results were 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 (ref. 15). Stragglers are marked by D(0.05) for the Dixon test, by G(0.05) or DG(0.05) for the Grubbs test and by R(0.05) for the Rosner's test. 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 visualise the data against the reproducibilities from literature, Gauss plots were made, using the sorted data for one determination (see appendix 1). On the Y-axis the reported analysis results are plotted. The corresponding laboratory numbers are under the X-axis.

The straight horizontal line presents the consensus value (a trimmed mean). The four striped lines, parallel to the consensus value line, are the +3s, +2s, -2s and -3s target reproducibility limits of the selected standard. Outliers and other data, which were excluded from the calculations, are represented as a cross. Accepted data are represented as a triangle.

Furthermore, Kernel Density Graphs were made. This 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. In order to be able to have an objective evaluation of the performance of each participant, it was decided to evaluate this performance against the literature requirements, e.g. ASTM reproducibilities. Therefore the z-scores were calculated using a target standard deviation. This target standard deviation was calculated from the literature reproducibility (R) by division with 2.8.

When a laboratory 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 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 these problems three cylinders did not reach the laboratory near or after the final reporting date and were unable to test the cylinder and to report results before the deadline of reporting. In total six laboratories did not report any test results due to several reasons. Not all laboratories did report all test results requested.

In total 41 participating laboratories reported 468 numerical test results. Observed were 24 outlying test results, which is 5.1% of all numerical results. In proficiency studies outlier percentages of 3% - 7.5% are quite normal.

4.1 EVALUATION PER TEST/COMPONENT

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

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

Most test results reported by laboratories 92, 1788 and 6018 were deviating and many of the eight test results appeared to be statistical outliers. As the eight test results are not independent, it was decided to reject all of the test results of this laboratory for the statistical evaluation. Also the corresponding calculated physical values were excluded for statistical evaluation.

Three of the eight test results of laboratory 381 were an outlier on composition, therefore the results of the calculated properties for this laboratory were excluded.

Ethane: The determination of this component was not problematic. One statistical outlier was observed and two test results were excluded. However, 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 requirements of EN27941 (identical to IP405 and ISO7941).

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

Propene: The determination of this component was not problematic. No statistical outliers were observed, but two test results were excluded. However, the calculated reproducibility after exclusion of the suspect data is in agreement with the requirements of ASTM D2163:14e1 and also with the reproducibility requirements of EN27941 (identical to IP405 and ISO7941).

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

- n-Butane: The determination of this component may be problematic, depending on the test method used by the laboratory. Four statistical outliers were observed. The calculated reproducibility after exclusion of the 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 requirements of EN27941 (identical to IP405 and ISO7941).
- 1-Butene: The determination of this component was not problematic. Two statistical outliers were observed. However, the calculated reproducibility after exclusion of the statistical outliers is in agreement with the requirements of ASTM D2163:14e1 and also with the reproducibility requirements of EN27941 (identical to IP405 and ISO7941).
- Iso-Butene: The determination of this component was not problematic. One statistical outlier was observed. However, the calculated reproducibility after exclusion of the statistical outlier is in agreement with the requirements of ASTM D2163:14e1 and also with the reproducibility requirements of EN27941 (identical to IP405 and ISO7941).
- n-Pentane: The determination of this component may be problematic, depending on the test method used by the laboratory. Four statistical outliers were observed. The calculated reproducibility after exclusion 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 requirements of EN27941 (identical to IP405 and ISO7941).
- Molar Mass: This calculated parameter may not be problematic. The results vary over a range from 44.28 – 45.15. No statistical outliers were present, but six test results were excluded. The calculated reproducibility after excluding of the six suspect test results is small in comparison with the calculated reproducibility of iis14S03P (0.087 vs. 0.122). See also the discussion in 4.3.
- Rel. Density @60F: This calculated parameter may not be problematic. The results vary over a range from 0.5085 – 0.514. No statistical outliers were present, but five test results were excluded. The calculated reproducibility after excluding the suspect test results is small in comparison with the calculated reproducibility of iis14S03P (0.00070 vs. 0.00126). See also the discussion in 4.3.

Abs. VP @100F: As the reported results calculated via ASTM D2598 and ISO8973 are not identical, it was decided to calculate the absolute vapour pressure for each laboratory according to both test methods by using the reported contents of the components. When the result of the calculation method of ASTM D2598 is compared with the result of the calculation method of ISO8973, it is noticed that the difference in the means is significant, while the difference in the spreads is not significant. See also the discussion in 4.3. The quality of the test results has improved significantly since the previous PT (iis14S03P) as the dispersion of the results decreased (0.749 vs 1.534 for ISO8973 and 0.798 vs 1.448 for D2598).

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Abs. VP @40°C: This determination may be problematic for a number of laboratories. The range of the reported test results is large: from 1293 - 1346 kPa. Four calculation errors were observed and possibly one Relative VP result was reported under Absolute VP. After exclusion of the suspect data no statistical outliers were observed. The quality of the test results has improved significantly since the previous PT (iis14S03P) as the dispersion of the results decreased significantly (4.67 vs 31.82).

Rel. VP @40°C: This determination may be problematic for a number of laboratories. The range of the reported test results is large: from 1205 – 1245 kPa. Four calculation errors were observed and possibly one Absolute VP result was reported under Relative VP. After exclusion of the suspect data no statistical outliers were observed. The quality of the test results has improved significantly since the previous PT (iis14S03P) as the dispersion of the results decreased significantly (4.66 vs 11.50).

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 D2163:14e1 and EN27941/ISO7941/IP405) are compared in the next table.

Parameter	unit	n	cons. value	2.8 * sd	R(D2163:14 ^e 1) in %mol	R(EN27941) liq.-inj. in %mol
Ethane	%mol/mol	38	0.088	0.027	0.066	0.297
Propane	%mol/mol	37	95.053	0.541	4.222	1.014
Propene	%mol/mol	39	0.791	0.169	0.244	0.212
iso-Butane	%mol/mol	38	1.150	0.144	0.175	0.385
n-Butane	%mol/mol	37	2.172	0.257	0.195	0.385
1-Butene	%mol/mol	38	0.102	0.019	0.049	0.159
Iso-Butene	%mol/mol	37	0.099	0.016	0.049	0.159
n-Pentane	%mol/mol	37	0.523	0.085	0.072	0.310
Molar Mass	g/mol	20	44.71	0.09	n.a.	n.a.
Rel. Density @60F		24	0.5109	0.0007	n.a.	n.a.
Abs. VP @100F	psi	22	see §4.3		n.a.	n.a.
Rel. VP @100F	psi	22	see §4.3		n.a.	n.a.
Abs. VP @40°C	kPa	17	1319.3	4.7	n.a.	n.a.
Rel. VP @40°C	kPa	17	1218.1	4.7	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 a number of components/tests there is a good compliance of the group of participating laboratories with the relevant standard. The problematic components/tests have been discussed in paragraph 4.1.

4.3 DISCUSSION

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

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

Parameter	Average values by EffecTech in %mol/mol	Consensus values from participants results in %mol/mol	Absolute differences in %mol/mol	z-score
Ethane	0.099	0.088	+0.011	+0.46
Propane	95.259	95.053	+0.206	+0.14
Propene	0.805	0.791	+0.014	+0.16
iso-Butane	1.080	1.150	-0.070	-1.12
n-Butane	2.066	2.172	-0.106	-1.52
1-Butene	0.099	0.102	-0.003	-0.17
Iso-Butene	0.098	0.099	+0.001	+0.06
n-Pentane	0.494	0.523	-0.029	-1.13

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

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

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

In ASTM D2598 the Gage pressure (identical to the Relative VP) is calculated from the liquid volume percentage per component and a VP factor of that component. Regretfully in the 2002 (2007) version of D2598 no factors are given for n-butene, 1-butene and n-pentane. However, in the 2012 version, factors are mentioned for these and other components. As one would expect to find identical values from both calculation methods, it is remarkable to see that the results from the ASTM D2598 calculation are significantly lower than the results from the ISO8973/IP432 calculation. The observed difference is caused by a difference in the VP factor of Ethane. ASTM (Subcommittee D02.H) commented (see also Appendix 3, literature: 20):

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

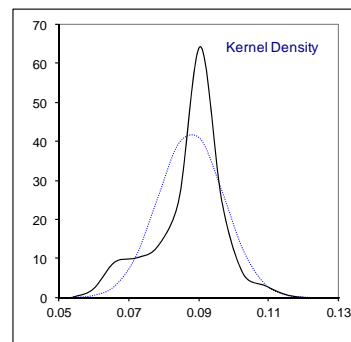
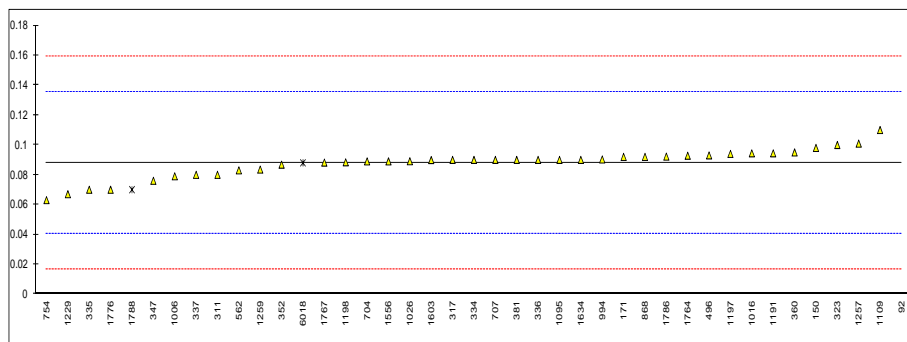
APPENDIX 1

Determination of Ethane on sample #15203; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	D2163	1.61	R(0.01)	64.28	
150	D2163	0.098		0.43	
171	D2163	0.092		0.17	
311	D2163	0.08		-0.33	
317	D2163	0.09		0.09	
323	D2163	0.10		0.51	
334	D2163	0.09		0.09	
335	D2163	0.07		-0.76	
336	EN27941	0.09		0.09	
337	D2163	0.08		-0.33	
347	D2163	0.076		-0.50	
352	ISO7941	0.0868		-0.05	
360	EN27941	0.095		0.30	
381	EN27941	0.09	C	0.09	first reported:0.07
444		----		----	
445		----		----	
496	D2163	0.093		0.21	
511		----		----	
562	D2163	0.083		-0.21	
704	D2163	0.089		0.05	
707	D2163	0.090		0.09	
754	D2163	0.063		-1.05	
868	D2163	0.092		0.17	
912		----		----	
994	D2163	0.0903		0.10	
1006	D2163	0.079		-0.38	
1016	ISO7941	0.0944		0.27	
1026	ISO7941	0.0891		0.05	
1095	EN27941	0.09		0.09	
1109	IP405	0.11		0.93	
1191	IP473	0.0944		0.27	
1197	D2163	0.0940		0.26	
1198	D2163	0.0884		0.02	
1200		----		----	
1229	IP473	0.067		-0.88	
1257	D2163	0.1009		0.55	
1259	EN27941	0.0835		-0.19	
1556	EN27941	0.089		0.05	
1603		0.0899		0.08	
1634	ISO7941	0.09		0.09	
1764	D2163	0.0928		0.21	
1767	D2163	0.0882		0.01	
1776	EN27941	0.07		-0.76	
1786	D2163	0.0922		0.18	
1788	ISO7941	0.07	ex	-0.76	excluded, see §4.1
1960		----		----	
6018	EN27941	0.088	ex	0.00	excluded, see §4.1

normality suspect
n 38
outliers 1 (+2ex)
mean (n) 0.0879
st.dev. (n) 0.00946
R(calc.) 0.0265
R(D2163:14e1) 0.0663

Compare R(EN27941(liq)) = 0.2973

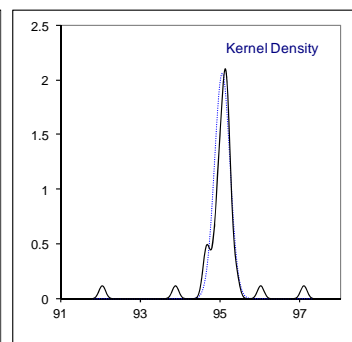
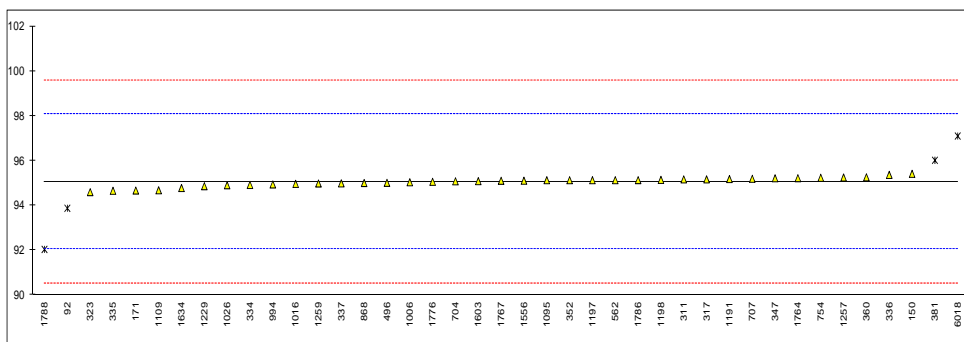


Determination of Propane on sample #15203; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	D2163	93.88	R(0.01)	-0.78	
150	D2163	95.416		0.24	
171	D2163	94.6709		-0.25	
311	D2163	95.17		0.08	
317	D2163	95.17		0.08	
323	D2163	94.60		-0.30	
334	D2163	94.92		-0.09	
335	D2163	94.66		-0.26	
336	EN27941	95.37		0.21	
337	D2163	94.99		-0.04	
347	D2163	95.216		0.11	
352	ISO7941	95.1305		0.05	
360	EN27941	95.262		0.14	
381	EN27941	96.02	C,R(0.01)	0.64	first reported: 96.21
444		----		----	
445		----		----	
496	D2163	95.013		-0.03	
511		----		----	
562	D2163	95.134		0.05	
704	D2163	95.082		0.02	
707	D2163	95.194		0.09	
754	D2163	95.239		0.12	
868	D2163	95.006		-0.03	
912		----		----	
994	D2163	94.9425		-0.07	
1006	D2163	95.041		-0.01	
1016	ISO7941	94.9674		-0.06	
1026	ISO7941	94.9062		-0.10	
1095	EN27941	95.13		0.05	
1109	IP405	94.68		-0.25	
1191	IP473	95.1837		0.09	
1197	D2163	95.1325		0.05	
1198	D2163	95.1478		0.06	
1200		----		----	
1229	IP473	94.865		-0.13	
1257	D2163	95.2514		0.13	
1259	EN27941	94.9845		-0.05	
1556	EN27941	95.109		0.04	
1603		95.0906		0.02	
1634	ISO7941	94.78		-0.18	
1764	D2163	95.222		0.11	
1767	D2163	95.1066		0.04	
1776	EN27941	95.06		0.00	
1786	D2163	95.1350		0.05	
1788	ISO7941	92.043	R(0.01)	-2.00	
1960		----		----	
6018	EN27941	97.102	R(0.01)	1.36	

normality OK
n 37
outliers 4
mean (n) 95.053
st.dev. (n) 0.1932
R(calc.) 0.541
R(D2163:14e1) 4.222

Compare R(EN27941(liq)) = 1.0136

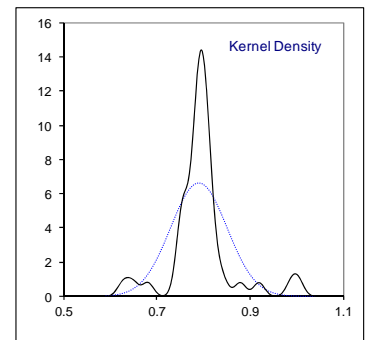
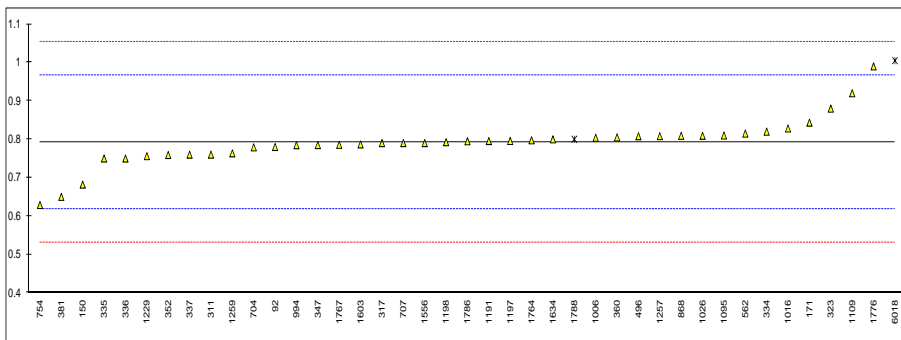


Determination of Propene on sample #15203; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	D2163	0.78		-0.13	
150	D2163	0.682		-1.25	
171	D2163	0.8434		0.60	
311	D2163	0.76		-0.36	
317	D2163	0.79		-0.01	
323	D2163	0.88		1.02	
334	D2163	0.82		0.33	
335	D2163	0.75		-0.47	
336	EN27941	0.75		-0.47	
337	D2163	0.76		-0.36	
347	D2163	0.785		-0.07	
352	ISO7941	0.7592		-0.37	
360	EN27941	0.805		0.16	
381	EN27941	0.65	C	-1.62	first reported: 0.59
444		----		----	
445		----		----	
496	D2163	0.808		0.19	
511		----		----	
562	D2163	0.815		0.27	
704	D2163	0.779		-0.14	
707	D2163	0.790		-0.01	
754	D2163	0.629		-1.86	
868	D2163	0.809		0.20	
912		----		----	
994	D2163	0.7847		-0.07	
1006	D2163	0.804		0.15	
1016	ISO7941	0.8282		0.42	
1026	ISO7941	0.8092		0.21	
1095	EN27941	0.81		0.22	
1109	IP405	0.92		1.48	
1191	IP473	0.7955		0.05	
1197	D2163	0.7957		0.05	
1198	D2163	0.7926		0.02	
1200		----		----	
1229	IP473	0.756		-0.40	
1257	D2163	0.8081		0.19	
1259	EN27941	0.7634		-0.32	
1556	EN27941	0.790		-0.01	
1603		0.7867		-0.05	
1634	ISO7941	0.80		0.10	
1764	D2163	0.7973		0.07	
1767	D2163	0.7856		-0.06	
1776	EN27941	0.99		2.28	
1786	D2163	0.7950		0.04	
1788	ISO7941	0.800	ex	0.10	excluded, see §4.1
1960		----		----	
6018	EN27941	1.005	ex	2.45	excluded, see §4.1

normality not OK
n 39
outliers 0 (+2ex)
mean (n) 0.7912
st.dev. (n) 0.06038
R(calc.) 0.1691
R(D2163:14e1) 0.2442

Compare R(EN27941(liq)) = 0.2124

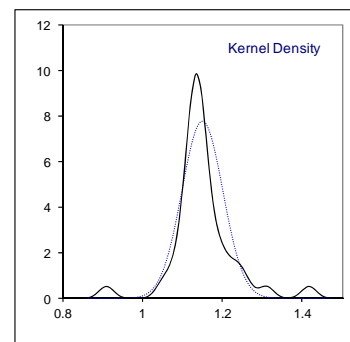
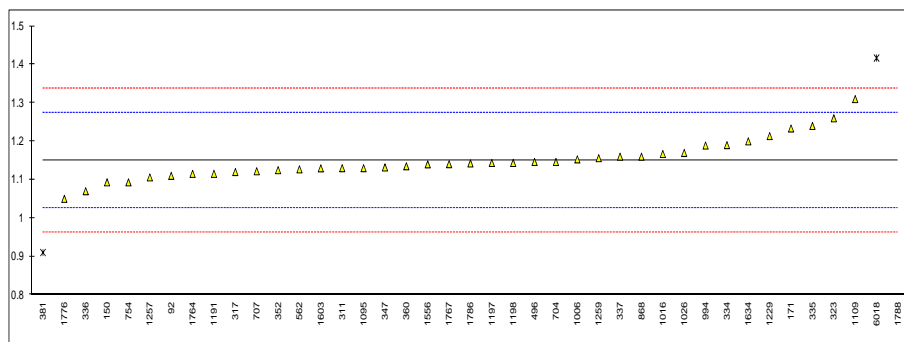


Determination of iso-Butane on sample #15203; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	D2163	1.11		-0.64	
150	D2163	1.093		-0.92	
171	D2163	1.2335		1.34	
311	D2163	1.13		-0.32	
317	D2163	1.12		-0.48	
323	D2163	1.26		1.76	
334	D2163	1.19		0.64	
335	D2163	1.24		1.44	
336	EN27941	1.07		-1.29	
337	D2163	1.16		0.16	
347	D2163	1.132		-0.29	
352	ISO7941	1.1248		-0.41	
360	EN27941	1.135		-0.24	
381	EN27941	0.91	C,R(0.01)	-3.85	first reported:0.89
444		----		----	
445		----		----	
496	D2163	1.146		-0.07	
511		----		----	
562	D2163	1.127		-0.37	
704	D2163	1.146		-0.07	
707	D2163	1.122		-0.45	
754	D2163	1.093		-0.92	
868	D2163	1.160		0.16	
912		----		----	
994	D2163	1.1890		0.62	
1006	D2163	1.153		0.05	
1016	ISO7941	1.1669		0.27	
1026	ISO7941	1.1697		0.31	
1095	EN27941	1.13		-0.32	
1109	IP405	1.31		2.56	
1191	IP473	1.1152		-0.56	
1197	D2163	1.1435		-0.11	
1198	D2163	1.1437		-0.10	
1200		----		----	
1229	IP473	1.2135		1.02	
1257	D2163	1.1059		-0.71	
1259	EN27941	1.1560		0.09	
1556	EN27941	1.140		-0.16	
1603		1.1296		-0.33	
1634	ISO7941	1.20		0.80	
1764	D2163	1.1151		-0.56	
1767	D2163	1.1405		-0.16	
1776	EN27941	1.05		-1.61	
1786	D2163	1.1424		-0.12	
1788	ISO7941	3.659	R(0.01)	40.26	
1960		----		----	
6018	EN27941	1.417	R(0.01)	4.28	

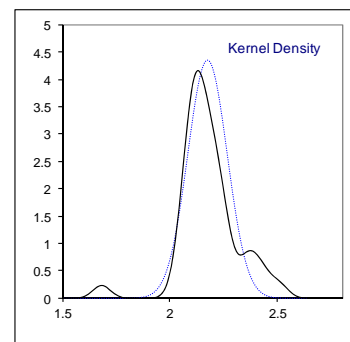
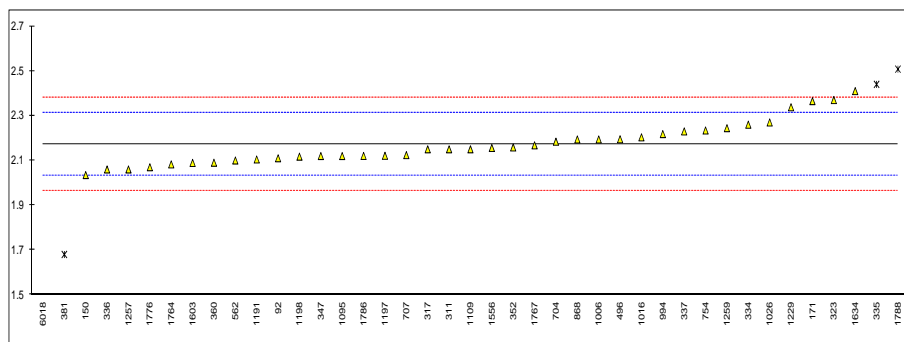
normality not OK
n 38
outliers 3
mean (n) 1.1502
st.dev. (n) 0.05125
R(calc.) 0.1435
R(D2163:14e1) 0.1745

Compare R(EN27941(liq)) = 0.3845



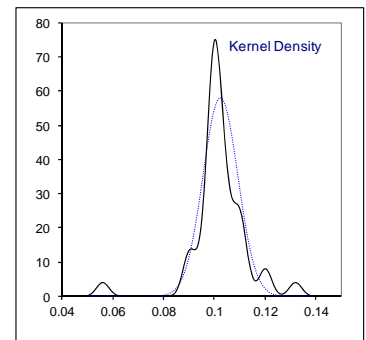
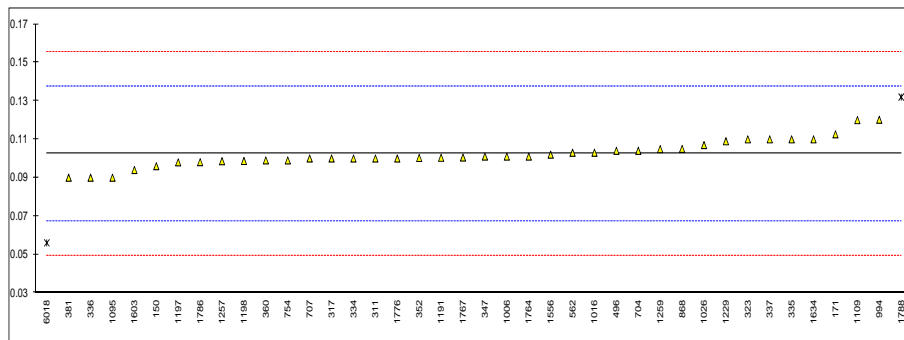
Determination of n-Butane on sample #15203; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	D2163	2.11		-0.89	
150	D2163	2.035		-1.97	
171	D2163	2.3653		2.77	
311	D2163	2.15		-0.32	
317	D2163	2.15		-0.32	
323	D2163	2.37		2.84	
334	D2163	2.26		1.26	
335	D2163	2.44	R(0.05)	3.85	
336	EN27941	2.06		-1.61	
337	D2163	2.23		0.83	
347	D2163	2.120		-0.75	
352	ISO7941	2.1582		-0.20	
360	EN27941	2.090		-1.18	
381	EN27941	1.68	C,R(0.01)	-7.06	first reported:1.67
444		----		----	
445		----		----	
496	D2163	2.195		0.33	
511		----		----	
562	D2163	2.1		-1.03	
704	D2163	2.184		0.17	
707	D2163	2.124		-0.69	
754	D2163	2.234		0.89	
868	D2163	2.194		0.31	
912		----		----	
994	D2163	2.2181		0.66	
1006	D2163	2.194		0.31	
1016	ISO7941	2.2035		0.45	
1026	ISO7941	2.2699		1.40	
1095	EN27941	2.12		-0.75	
1109	IP405	2.15		-0.32	
1191	IP473	2.1045		-0.97	
1197	D2163	2.1211		-0.73	
1198	D2163	2.1172		-0.79	
1200		----		----	
1229	IP473	2.338		2.38	
1257	D2163	2.0600		-1.61	
1259	EN27941	2.2445		1.04	
1556	EN27941	2.156		-0.23	
1603		2.0892		-1.19	
1634	ISO7941	2.41		3.42	
1764	D2163	2.0826		-1.28	
1767	D2163	2.1677		-0.06	
1776	EN27941	2.07		-1.46	
1786	D2163	2.1204		-0.74	
1788	ISO7941	2.508	R(0.05)	4.82	
1960		----		----	
6018	EN27941	0.181	R(0.01)	-28.58	
	normality	OK			
	n	37			
	outliers	4			
	mean (n)	2.1721			
	st.dev. (n)	0.09169			
	R(calc.)	0.2567			
	R(D2163:14e1)	0.1951			
					Compare R(EN27941(liq)) = 0.3845



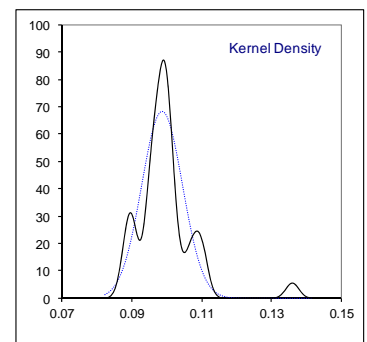
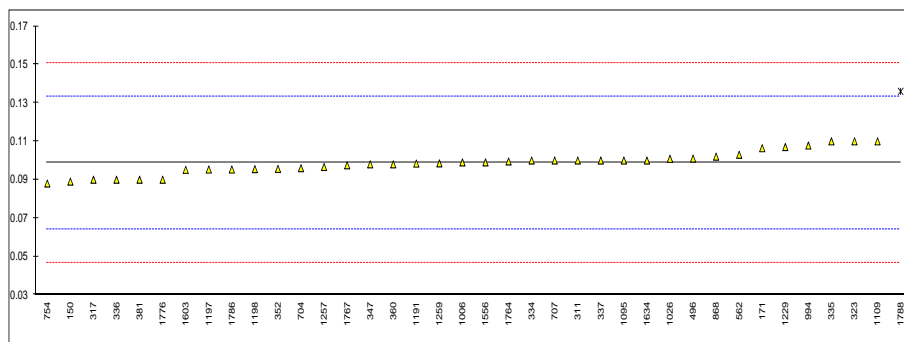
Determination of 1-Butene on sample #15203; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92		----		----	
150	D2163	0.096		-0.36	
171	D2163	0.1126		0.58	
311	D2163	0.10		-0.13	
317	D2163	0.10		-0.13	
323	D2163	0.11		0.43	
334	D2163	0.10		-0.13	
335	D2163	0.11		0.43	
336	EN27941	0.09		-0.70	
337	D2163	0.11		0.43	
347	D2163	0.101		-0.08	
352	ISO7941	0.1003		-0.12	
360	EN27941	0.099		-0.19	
381	EN27941	0.09	C	-0.70	first reported: 0.08
444		----		----	
445		----		----	
496	D2163	0.104		0.09	
511		----		----	
562	D2163	0.103		0.04	
704	D2163	0.104		0.09	
707	D2163	0.100		-0.13	
754	D2163	0.099		-0.19	
868	D2163	0.105		0.15	
912		----		----	
994	D2163	0.1202		1.01	
1006	D2163	0.101		-0.08	
1016	ISO7941	0.103		0.04	
1026	ISO7941	0.1070		0.26	
1095	EN27941	0.09		-0.70	
1109	IP405	0.12		1.00	
1191	IP473	0.1004		-0.11	
1197	D2163	0.0980		-0.25	
1198	D2163	0.0987		-0.21	
1200		----		----	
1229	IP473	0.109		0.38	
1257	D2163	0.0986		-0.21	
1259	EN27941	0.1049		0.14	
1556	EN27941	0.102		-0.02	
1603		0.0940		-0.48	
1634	ISO7941	0.11		0.43	
1764	D2163	0.1010		-0.08	
1767	D2163	0.1005		-0.11	
1776	EN27941	0.10		-0.13	
1786	D2163	0.0981		-0.24	
1788	ISO7941	0.132	R(0.01)	1.68	
1960		----		----	
6018	EN27941	0.056	R(0.01)	-2.63	
	normality	suspect			
	n	38			
	outliers	2			
	mean (n)	0.1024			
	st.dev. (n)	0.00689			
	R(calc.)	0.0193			
	R(D2163:14e1)	0.0493			
					Compare R(EN27941(liq)) = 0.1593



Determination of iso-Butene on sample #15203; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92		----		----	
150	D2163	0.089		-0.56	
171	D2163	0.1064		0.44	
311	D2163	0.10		0.07	
317	D2163	0.09		-0.50	
323	D2163	0.11		0.65	
334	D2163	0.10		0.07	
335	D2163	0.11		0.65	
336	EN27941	0.09		-0.50	
337	D2163	0.10		0.07	
347	D2163	0.098		-0.04	
352	ISO7941	0.0956		-0.18	
360	EN27941	0.098		-0.04	
381	EN27941	0.09	C	-0.50	first reported: 0.08
444		----		----	
445		----		----	
496	D2163	0.101		0.13	
511		----		----	
562	D2163	0.103		0.25	
704	D2163	0.096		-0.16	
707	D2163	0.100		0.07	
754	D2163	0.088		-0.62	
868	D2163	0.102		0.19	
912		----		----	
994	D2163	0.1078		0.52	
1006	D2163	0.099		0.02	
1016	ISO7941	<0.1		----	
1026	ISO7941	0.1009		0.13	
1095	EN27941	0.10		0.07	
1109	IP405	0.11		0.65	
1191	IP473	0.0984		-0.02	
1197	D2163	0.0953		-0.20	
1198	D2163	0.0955		-0.19	
1200		----		----	
1229	IP473	0.107		0.48	
1257	D2163	0.0966		-0.12	
1259	EN27941	0.0985		-0.01	
1556	EN27941	0.099		0.02	
1603		0.0951		-0.21	
1634	ISO7941	0.10		0.07	
1764	D2163	0.0995		0.05	
1767	D2163	0.0975		-0.07	
1776	EN27941	0.09		-0.50	
1786	D2163	0.0953		-0.20	
1788	ISO7941	0.136	R(0.01)	2.15	
1960		----		----	
6018	EN27941	<0,1		----	
normality		OK			
n		37			
outliers		1			
mean (n)		0.0987			
st.dev. (n)		0.00584			
R(calc.)		0.0163			
R(D2163:14e1)		0.0485			
					Compare R(EN27941(liq)) = 0.1593

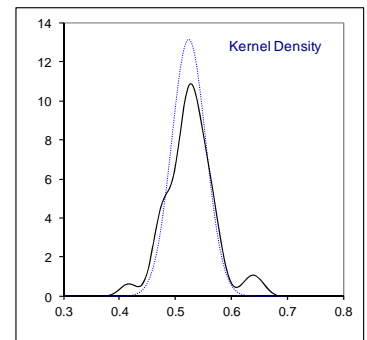
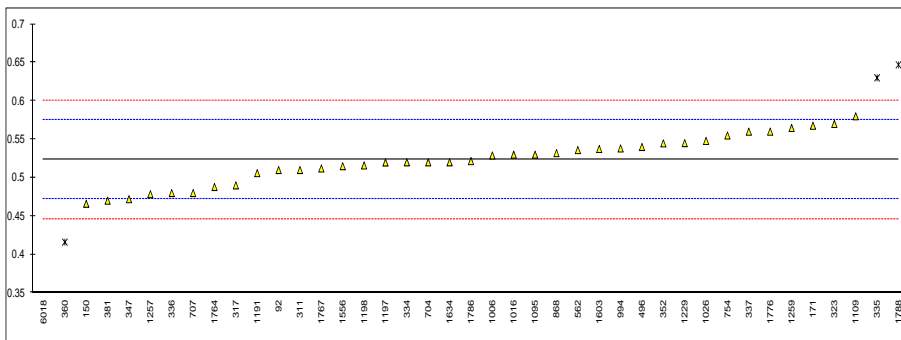


Determination of n-Pentane on sample #15203; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	D2163	0.51		-0.52	
150	D2163	0.466		-2.24	
171	D2163	0.5677		1.73	
311	D2163	0.51		-0.52	
317	D2163	0.49		-1.30	
323	D2163	0.57		1.82	
334	D2163	0.52		-0.13	
335	D2163	0.63	R(0.05)	4.16	
336	EN27941	0.48		-1.69	
337	D2163	0.56		1.43	
347	D2163	0.472		-2.00	
352	ISO7941	0.5447		0.83	
360	EN27941	0.416	R(0.05)	-4.19	
381	EN27941	0.47	C	-2.08	first reported: 0.41
444		----		----	
445		----		----	
496	D2163	0.540		0.65	
511		----		----	
562	D2163	0.536		0.50	
704	D2163	0.520		-0.13	
707	D2163	0.480		-1.69	
754	D2163	0.555		1.24	
868	D2163	0.532		0.34	
912		----		----	
994	D2163	0.5381		0.58	
1006	D2163	0.529		0.22	
1016	ISO7941	0.530	C	0.26	first reported: <0.1
1026	ISO7941	0.5479		0.96	
1095	EN27941	0.53		0.26	
1109	IP405	0.58		2.21	
1191	IP473	0.5059		-0.68	
1197	D2163	0.5198		-0.14	
1198	D2163	0.5160		-0.28	
1200		----		----	
1229	IP473	0.545		0.85	
1257	D2163	0.4785		-1.75	
1259	EN27941	0.5647		1.61	
1556	EN27941	0.515		-0.32	
1603		0.5374		0.55	
1634	ISO7941	0.52		-0.13	
1764	D2163	0.4879		-1.38	
1767	D2163	0.5120		-0.44	
1776	EN27941	0.56		1.43	
1786	D2163	0.5216		-0.07	
1788	ISO7941	0.647	R(0.05)	4.83	
1960		----		----	
6018	EN27941	0.090	R(0.01)	-16.90	

normality OK
n 37
outliers 4
mean (n) 0.5233
st.dev. (n) 0.03037
R(calc.) 0.0850
R(D2163:14e1) 0.0718

Compare R(EN27941(liq)) = 0.3097

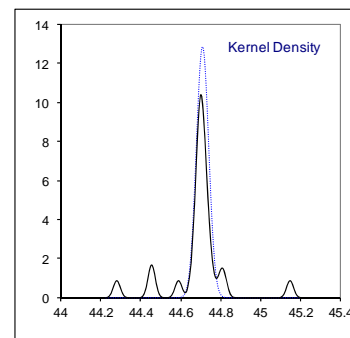
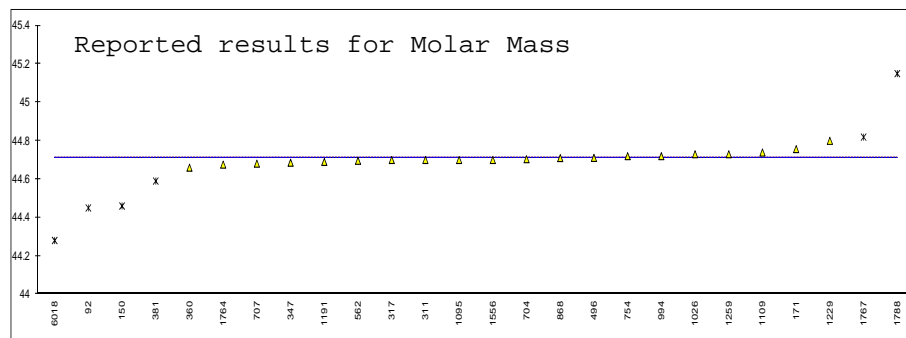


Determination of Molar Mass on sample #15203; results in g/mol

lab	method	value	mark	z(targ)	remarks
92	D2163	44.45	ex	----	excluded, see §4.1
150	D2598	44.46	ex,E	----	excluded for calculation error, iis calc. 44.65
171	D2421	44.75680026		----	
311	INH-407	44.70		----	
317	INH-001	44.70		----	
323		----		----	
334		----		----	
335		----		----	
336		----		----	
337		----		----	
347	D2421	44.6858		----	
352		----		----	
360	ISO8973	44.66		----	
381	D3588	44.59	ex,C	----	first reported: 44.567, excluded, see §4.1
444		----		----	
445		----		----	
496	D2421	44.711		----	
511		----		----	
562	D2163	44.696		----	
704	D2421	44.7042		----	
707	D2421	44.6810		----	
754	D2421	44.720		----	
868	D2598	44.71		----	
912		----		----	
994	D2598	44.72		----	
1006		----		----	
1016		----		----	
1026	ISO8973	44.73		----	
1095	D2598	44.7		----	
1109	ISO8973	44.739		----	
1191	ISO6976	44.69		----	
1197		----		----	
1198		----		----	
1200		----		----	
1229	ISO8973	44.8		----	
1257		----		----	
1259	ISO8973	44.730		----	
1556	ISO8973	44.7		----	
1603		----		----	
1634		----		----	
1764	D2598	44.676		----	
1767	D2421	44.819	ex,E	----	excluded for calculation error, iis calc. 44.698
1776		----		----	
1786		----		----	
1788	ISO8973	45.15	ex	----	excluded, see §4.1
1960		----		----	
6018	ISO8973	44.28	ex	----	excluded, see §4.1

Calc. by iis from ALL rep. composition results (acc. to ASTM D2421):

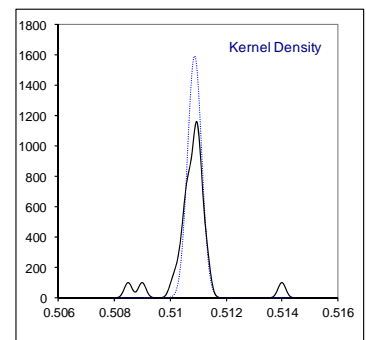
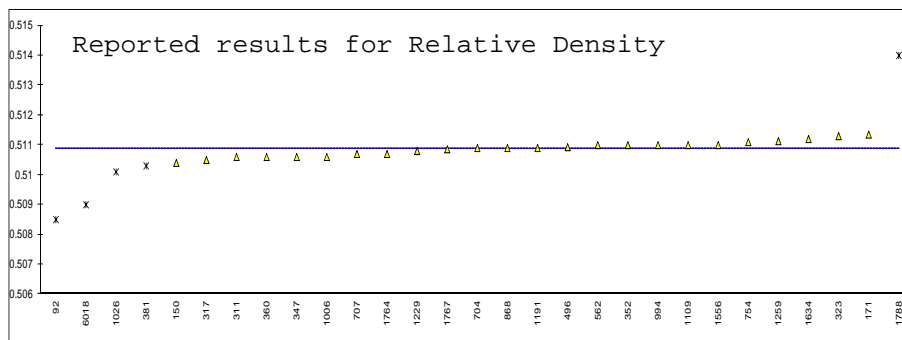
normality	not OK	OK
n	20	37
outliers	0 (+6ex)	0 (+4ex)
mean (n)	44.710	44.703
st.dev. (n)	0.0310	0.0323
R(calc.)	0.087	0.091
R(iis14S03P)	0.122	0.119



Determination of Relative Density at 60/60F on sample #15203; unitless results

lab	method	value	mark	z(targ)	remarks
92	D2598	0.5085	ex	----	excluded, see §4.1
150	D2598	0.5104		----	
171	D2598	0.51135		----	
311	INH-407	0.5106		----	
317	INH-001	0.5105		----	
323	D2598	0.5113		----	
334		----		----	
335		----		----	
336		----		----	
337		----		----	
347	D2598	0.5106		----	
352	ISO8973	0.5110		----	
360	D2598	0.5106		----	
381	D2598	0.5103	ex,C	----	first reported: 0.5102, excluded, see §4.1
444		----		----	
445		----		----	
496	D2598	0.51093		----	
511		----		----	
562	D2598	0.511		----	
704	D2598	0.5109		----	
707	D2598	0.5107		----	
754	ISO8973	0.5111		----	
868	D2598	0.5109		----	
912		----		----	
994	D2598	0.5110		----	
1006	D2598	0.5106		----	
1016		----		----	
1026	ISO8973	0.5101	ex,E,C	----	first reported: 510.11 kg/m ³ , excl. for calc. error, iis calc:0.5111
1095		----		----	
1109	ISO8973	0.511		----	
1191	D2598	0.5109		----	
1197		----		----	
1198		----		----	
1200		----		----	
1229	ISO8973	0.5108	C	----	first reported: 510.8
1257		----		----	
1259	ISO8973	0.51113		----	
1556	ISO8973	0.511		----	
1603		----		----	
1634	ISO8973	0.5112		----	
1764	D2598	0.5107		----	
1767	D2598	0.51086		----	
1776		----		----	
1786		----		----	
1788	ISO8973	0.514	ex	----	excluded, see §4.1
1960		----		----	
6018	ISO8973	0.509	ex	----	excluded, see §4.1

		<u>Calc. by iis from ALL rep. composition results (acc. to ASTM D2598):</u>
normality	OK	OK
n	24	37
outliers	0 (+5ex)	0 (+4ex)
mean (n)	0.51088	0.51090
st.dev. (n)	0.000251	0.000174
R(calc.)	0.00070	0.00049
R(iis14S03P)	0.00126	0.00069

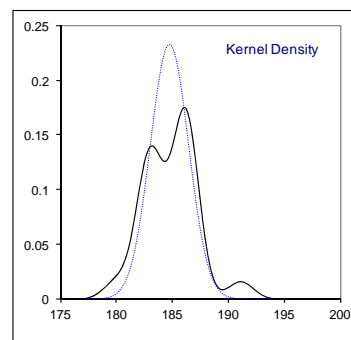
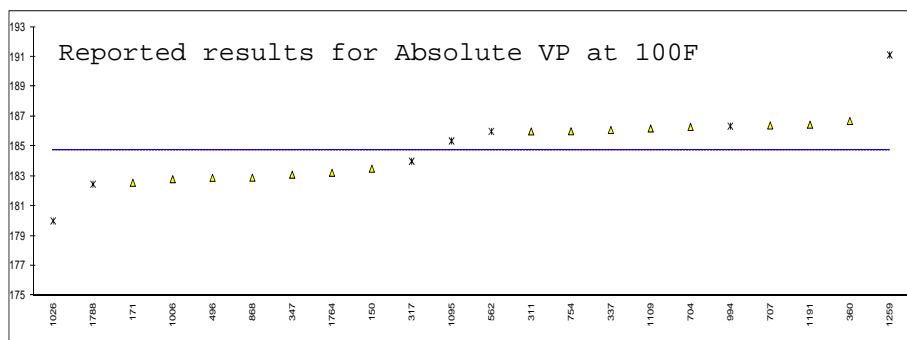


Determination of Absolute Vapour Pressure at 100F on sample #15203; results in psi

lab	method	value	mark	z(targ)	remarks
92		----		----	
150	D2598	183.5		----	
171	D2598	182.55592		----	
311	ISO8973	186		----	
317	INH-001	184	ex, E	----	excluded for calculation error, iis calc. 186.27 (ISO) or 183.30 (ASTM)
323		----		----	
334		----		----	
335		----		----	
336		----		----	
337	ISO8973	186.1		----	
347	D2598	183.1		----	
352		----		----	
360	ISO8973	186.7		----	
381		----		----	reported 169.66, result evaluated as Relative Vapour Pressure
444		----		----	
445		----		----	
496	D2598	182.89		----	
511		----		----	
562	D2598	186	ex,E	----	excluded for calculation error, iis calc. 183.25
704	ISO8973	186.3		----	
707	ISO8973	186.4		----	
754	ISO8973	186.01		----	
868	D2598	182.9		----	
912		----		----	
994	ISO8973	186.35	ex,E	----	excluded for calculation error, iis calc. 185.92
1006	D2598	182.8		----	
1016		----		----	
1026	ISO8973	180	ex,E	----	excluded for calculation error, iis calc.185.90
1095	D2598	185.36	ex,E,C	----	first reported: 1278, excluded for calc. error, iis calc. 183.27
1109	ISO8973	186.2		----	
1191	ISO8973	186.4504		----	
1197		----		----	
1198		----		----	
1200		----		----	
1229		----		----	
1257		----		----	
1259	ISO8973	191.122	ex,E,C	----	first reported: 176.4, excluded for calc. error, iis calc. 185.88
1556		----		----	
1603		----		----	
1634		----		----	
1764	D2598	183.228		----	
1767		----		----	
1776		----		----	
1786		----		----	
1788	ISO8973	182.46	ex	----	excluded, see §4.1
1960		----		----	
6018		----		----	

Calculated by iis from ALL reported composition results

	ISO8973/IP432	ASTM D2598
normality	OK	OK
n	37	37
outliers	0 (+4ex)	0 (+4ex)
mean (n)	186.080	183.130
st.dev. (n)	0.2675	0.2851
R(calc.)	0.749	0.798
R(iis14S03P)	1.534	1.448

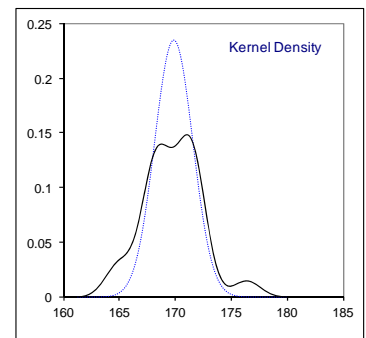
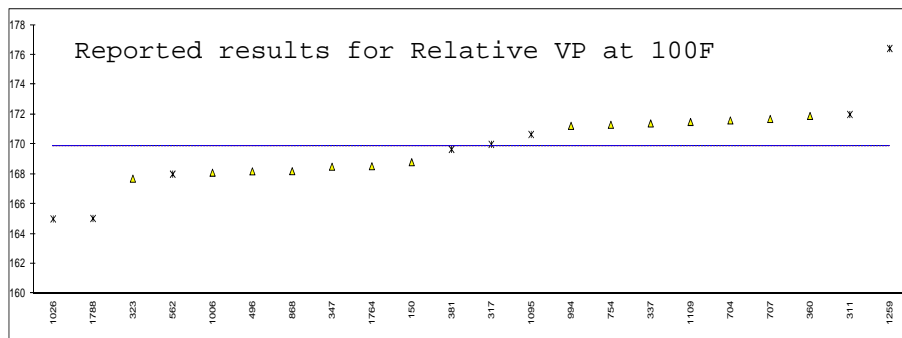


Determination of Relative Vapour Pressure at 100F on sample #15203; results in psi

lab	method	value	mark	z(targ)	remarks
92		----		----	
150	D2598	168.8		----	
171		----		----	
311	ISO8973	172	ex,E	----	excluded for calculation error, iis calc. 171.43
317	INH-001	170	ex,E	----	excluded for calculation error, iis calc. 171.57 (ISO) or 168.61 (ASTM)
323	D2598	167.7		----	
334		----		----	
335		----		----	
336		----		----	
337	ISO8973	171.4		----	
347	D2598	168.5		----	
352		----		----	
360	ISO8973	171.9		----	
381	D2598	169.66	ex,C	----	reported result as Abs. VP, first reported: 169.74, excluded, see §4.1
444		----		----	
445		----		----	
496	D2598	168.19		----	
511		----		----	
562	D2598	168	ex,E	----	excluded for calculation error, iis calc. 168.55
704	ISO8973	171.6		----	
707	ISO8973	171.7		----	
754	ISO8973	171.31		----	
868	D2598	168.2		----	
912		----		----	
994	ISO8973	171.24		----	
1006	D2598	168.1		----	
1016		----		----	
1026	ISO8973	165	ex,E	----	excluded for calculation error, iis calc. 171.21
1095	D2598	170.66	ex,E,C	----	first reported: 1263, excluded for calc. error, iis calc. 168.57
1109	ISO8973	171.5		----	
1191		----		----	
1197		----		----	
1198		----		----	
1200		----		----	
1229		----		----	
1257		----		----	
1259	ISO8973	176.422	ex,E,C	----	first reported: 161.7, excluded for calc. error, iis calc. 171.18
1556		----		----	
1603		----		----	
1634		----		----	
1764	D2598	168.532		----	
1767		----		----	
1776		----		----	
1786		----		----	
1788	ISO8973	165.03	ex, E	----	excluded, see §4.1, iis calc. 167.54
1960		----		----	
6018		----		----	

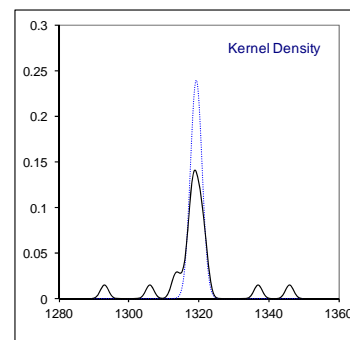
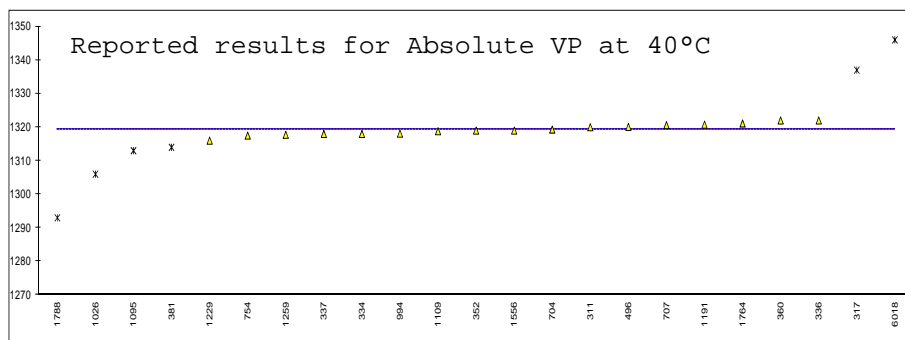
Calculated by iis from ALL reported composition results

	ISO8973/IP432	ASTM D2598
normality	OK	OK
n	37	37
outliers	0 (+4ex)	0 (+4ex)
mean (n)	171.384	168.434
st.dev. (n)	0.2675	0.2851
R(calc.)	0.749	0.798
R(iis14S03P)	1.534	1.448



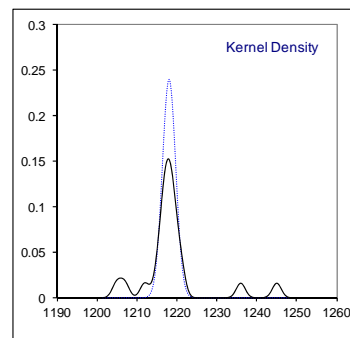
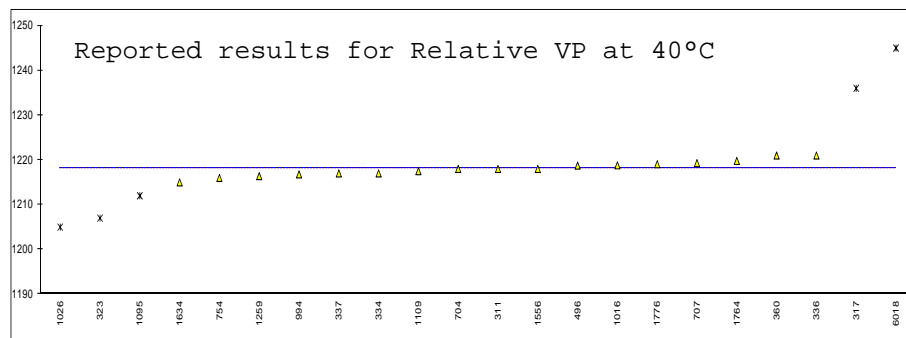
Determination of Absolute Vapour Pressure at 40°C on sample #15203; results in kPa

lab	method	value	mark	z(targ)	remarks
92		----		----	
150		----		----	
171		----		----	
311	ISO8973	1320		----	
317	INH-001	1337	ex,E	----	excluded for calculation error, iis calc. 1319.38
323		----		----	
334	ISO8973	1318		----	
335		----		----	
336	ISO8973	1322	C	----	first reported: 13.2
337	ISO8973	1318		----	
347		----		----	
352	ISO8973	1319		----	
360	ISO8973	1322		----	
381	ISO8973	1314	ex, E	----	excluded, see §4.1, iis calc. 1325.61
444		----		----	
445		----		----	
496	ISO8973	1320.08		----	
511		----		----	
562		----		----	
704	ISO8973	1319.3		----	
707	ISO8973	1320.6		----	
754	ISO8973	1317.5		----	
868		----		----	
912		----		----	
994	ISO8973	1318.08		----	
1006		----		----	
1016		----		----	
1026	ISO8973	1306	ex,E	----	excluded for calculation error, iis calc. 1316.83
1095	D2598	1313	ex,E	----	excluded for calculation error, iis calc. 1319.07
1109	ISO8973	1318.8		----	
1191	ISO8973	1320.751		----	
1197		----		----	
1198		----		----	
1200		----		----	
1229	ISO8973	1316		----	
1257		----		----	
1259	ISO8973	1317.74	C	----	first reported: 1216.42
1556	ISO8973	1319		----	
1603		----		----	
1634		----		----	
1764	ISO8973	1321.106		----	
1767		----		----	
1776		----		----	reported: 1219.05, result evaluated as Relative Vapour Pressure
1786		----		----	
1788	ISO8973	1293	ex	----	excluded, see §4.1
1960		----		----	
6018	ISO8973	1346	ex	----	excluded, see §4.1
	normality	OK			<u>Calc. by iis from ALL rep. composition results acc. to ISO8973/IP432:</u>
	n	17			OK
	outliers	0 +(6ex)			0 (+4ex)
	mean (n)	1319.29			1318.07
	st.dev. (n)	1.670			1.884
	R(calc.)	4.67			5.28
	R(iis14S03P)	31.82			11.37



Determination of Relative Vapour Pressure at 40°C on sample #15203; results in kPa

lab	method	value	mark	z(targ)	remarks
92		----		----	
150		----		----	
171		----		----	
311	ISO8973	1218		----	
317	INH-001	1236	ex,E	----	excluded for calculation error, iis calc. 1218.05
323	D2598	1207	ex,E	----	excluded for calculation error, iis calc. 1214.02 (D2598 not applicable)
334	ISO8973	1217		----	
335		----		----	
336	ISO8973	1221	C	----	first reported: 12.2
337	ISO8973	1217		----	
347		----		----	
352		----		----	
360	ISO8973	1221		----	
381		----		----	
444		----		----	
445		----		----	
496	ISO8973	1218.75		----	
511		----		----	
562		----		----	
704	ISO8973	1218.0		----	
707	ISO8973	1219.3		----	
754	ISO8973	1216.0		----	
868		----		----	
912		----		----	
994	ISO8973	1216.78		----	
1006		----		----	
1016	ISO8973	1218.7974		----	
1026	ISO8973	1205	ex,E	----	excluded for calculation error, iis calc. 1215.50
1095	D2598	1212	ex,E	----	excluded for calculation error, iis calc. 1217.74 (D2598 not applicable)
1109	ISO8973	1217.5		----	
1191		----		----	
1197		----		----	
1198		----		----	
1200		----		----	
1229		----		----	
1257		----		----	
1259	ISO8973	1216.39	C	----	first reported: 1115.07
1556	ISO8973	1218		----	
1603		----		----	
1634	ISO8973	1215		----	
1764	ISO8973	1219.781		----	
1767		----		----	
1776	ISO8973	1219.05	C	----	reported result as Absolute Vapour Pressure
1786		----		----	
1788		----		----	
1960		----		----	
6018	ISO8973	1245	ex	----	excluded, see §4.1
normality	OK				Calc. by iis from ALL rep. composition results acc. to ISO8973/IP432:
n	17				OK
outliers	0 (+5ex)				0 (+4ex)
mean (n)	1218.08				1216.74
st.dev. (n)	1.666				1.884
R(calc.)	4.66				5.28
R(iis14S03P)	11.50				11.37



APPENDIX 2

Number of participants per country

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

APPENDIX 3

Abbreviations:

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

Literature:

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