Results of Proficiency Test
Natural Gas Analysis
March 2015

Organised by: Institute for Interlaboratory Studies
Spijkenisse, the Netherlands

Author: ing. R.J. Starink
Corrector: dr. R.G. Visser & ing. C. Nijssen-Wester

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Appendices:

1 INTRODUCTION

Since 2009, the Institute organizes a proficiency scheme for Natural Gas (composition only). During the annual proficiency testing program 2014/2015, it was decided to continue the proficiency test for the analysis of Natural Gas.
Because iis has limited gas-handling facilities in place to prepare gas samples, a co-operation with EffecTech (Uttoxeter, United Kingdom) was set up. This company is fully equipped and has experience in the preparation of synthetic natural gas samples for PT purposes. EffecTech maintains an ISO17043 accreditation for the preparation of PT samples in homogeneous and stable batches and an ISO17025 accreditation for the calibration and assignment of reference values for these samples.
In this interlaboratory study 50 laboratories in 30 different countries have participated. See appendix 3 for the number of participants per country. In this report, the results of the 2015 Natural Gas proficiency test 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 natural gas mixture. Samples were divided over a batch of 53 cylinders. The cylinder size is a cost-effective one-litre cylinder. Each cylinder was uniquely numbered. The limited cylinder size is chosen to optimise transport and handling costs. Participants were requested to report rounded and unrounded results. The unrounded results were preferably used for statistical evaluation.

2.1 QUALITY SYSTEM

The Institute for Interlaboratory Studies in Spijkenisse, the Netherlands, has implemented a quality system based on ISO/IEC17043:2010 (R007). This ensures strict adherence to protocols for sample preparation and statistical evaluation and 100% confidentially of participant's data. Also customer's satisfaction is measured on regular basis by the distribution of questionnaires.
EffecTech is an accredited provider of proficiency testing schemes under the requirements of ISO/IEC17043:2010 by UKAS (no. 4719).

2.2 PROTOCOL

The protocol followed in the organisation of this proficiency test was the one as described for proficiency testing in the report 'iis Interlaboratory Studies: Protocol for the Organisation, Statistics and Evaluation' of April 2014 (iis-protocol, version 3.3). This protocol is also electronically available through the iis internet site www.iisnl.com .

2.3 CONFIDENTIALITY STATEMENT

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

2.4 SAMPLES

In this proficiency test one gas sample was used. The necessary one litre cylinders with artificial natural gas mixture was prepared and tested for homogeneity by EffecTech (Uttoxeter, United Kingdom) in conformance with ISO Guide 35: 2006 and ISO/IEC17043:2010.
One batch of 53 cylinders was prepared (job 15/0057) starting in January, 2015. Each cylinder was uniquely numbered. Every cylinder in the batch was analysed using eight 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 (abs, observed) in %mol/mol	0.3xR (abs, ISO6974-3) in %mol/lmol
Methane	0.0046	0.0553
Ethane	0.0031	0.0271
Propane	0.0012	0.0136
iso-Butane	0.0003	0.0027
n-Butane	0.0004	0.0036
Carbon dioxide	0.0008	0.0072
Nitrogen	0.0012	0.0226

Table 1: evaluation of homogeneity test results against ISO6974-3 requirements

From the above table it is clear that all observed repeatability values are far less than 0.3 times the respective reproducibility of the reference method ISO6974-3.
Therefore, the homogeneity of the prepared cylinders was assumed.

To each of the participating laboratories one 1L gas cylinder was sent on March 11, 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: Methane, Ethane, Propane, n-Butane, iso-Butane, Carbon dioxide, Nitrogen, Caloric Value (sup), Density, Relative Density and Wobbe index. To get comparable results a detailed report form, on which the units were prescribed as well as the required standards and a letter of instructions were prepared and made available on the data entry portal www.kpmd.co.uk/sgs-iis/. The detailed report form and the letter of instructions were also made available for download on the iis website www.iisnl.com.
A SDS and a form to confirm receipt of the sample was added to the sample package.

3 RESULTS

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

Directly after the deadline, the available results were screened for suspect data. A result was called suspect in case the Huber Elimination Rule (a robust outlier test) found it to be an outlier. The laboratories that produced these suspect data were asked to check the results. Additional or corrected data are put under 'Remarks' in the result tables in appendix 1. Results that came in after deadline were not taken into account in the screening for suspect data and thus these participants were not requested for checks.

3.1 STATISTICS

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

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

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

According to ISO 5725 (1986 and 1994, lit.5 and 6) the original results per determination were submitted to Dixon's and/or 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 (ref. 16). 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 these with a factor of 2.8.

3.2 GRAPHICS

In order to visualise the data against the reproducibilities from literature, Gauss plots were made, using the sorted data for one determination (see appendix 1). On the Y-axis the reported analysis results are plotted. The corresponding laboratory numbers are under the X-axis.
The straight horizontal line presents the consensus value (a trimmed mean). The four striped lines, parallel to the consensus value line, are the +3s, +2s, -2s and -3s target reproducibility limits of the selected standard. Outliers and other data, which were excluded from the calculations, are represented as a cross. Accepted data are represented as a triangle.
Furthermore, Kernel Density Graphs were made. This is a method for producing a smooth density approximation to a set of data that avoids some problems associated with histograms. (see appendix 3; nos.13 and 14). 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. ISO reproducibilities, the z-scores were calculated using a target standard deviation. This target standard deviation was calculated from the literature reproducibility by division with 2.8.
When a laboratory did use a test method with a reproducibility that is significantly different from the reproducibility of the reference test method used in this report, it is strongly advised to recalculate the z-score, while using the reproducibility of the actual test method used, this in order to evaluate whether the reported test result is fit-for-use.

The z-scores were calculated according to:

z(target) = (result - average of PT) / target standard deviation

The z(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 is as follows:

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

4 EVALUATION

In this proficiency test several problems were encountered with customs clearance.
In total sixteen laboratories reported results after the final reporting date and four participants were not able to report any test results. In total 47 participants reported 532 numerical results. Observed were 33 outlying results, which is 6.2% of the numerical results. In proficiency studies outlier percentages of 3% - 7.5% are quite normal.

4.1 EVALUATION PER TEST/COMPONENT

In this section the results are discussed per component. The methods that were used by the participating laboratories were 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 (see Appendix 1, normality). When the normality is “not OK” or “suspect”, the statistical evaluation of these data sets should be used with due care.

Three laboratories reported deviating results on the gas composition values. At least four of the seven test results were statistical outliers for each of the laboratories 1069, 1106 and 1580. As the seven test results are not independent, it was decided not to use any of the reported results of these laboratories for the statistical evaluation. Also the reported results of these three laboratories were excluded for the statistical evaluation of the Caloric Value (sup), Density, Relative Density and Wobbe index, since these values were calculated from the measured gas composition.

All laboratories reported normalized test results as requested.

Methane: The determination of this component was very problematic. Two statistical outliers were detected and two test results were excluded. The calculated reproducibility after rejection of the suspect data is not at all in agreement with the requirements of ISO6974-3:2000, nor at all in agreement with ASTM D1945:2014.

Ethane: The determination of this component was problematic for a number of laboratories. Four statistical outliers were detected. However, the calculated reproducibility after rejection of statistical outliers is in agreement with the requirements of ISO6974-3:2000 and ASTM D1945:2014.

Propane: The determination of this component may be problematic for a number of laboratories, depending on the test method used by the laboratory. Four statistical outliers were detected. The calculated reproducibility after rejection of the statistical outliers is not in agreement with the strict requirements of ISO6974-3:2000. However the calculated reproducibility is in agreement with the requirements of ASTM D1945:2014.

i-Butane: The determination of this component was problematic for a number of laboratories. Four statistical outliers were detected. However, the calculated reproducibility after rejection of the statistical outliers is in agreement with the requirements of both ISO6974-3:2000 and ASTM D1945:2014.

n-Butane: The determination of this component may be problematic for a number of laboratories, depending on the test method used by the laboratory. Five statistical outliers were detected and one test result was excluded. The calculated reproducibility after rejection of the suspect data is not in agreement with the requirements of ISO6974-3:2000, but in good agreement with the requirements of ASTM D1945:2014.

Carbon Dioxide: The determination of this component may be problematic for a number of laboratories, depending on the test method used by the laboratory. Three statistical outliers were detected and two test results were excluded. The calculated reproducibility after rejection of the suspect data is not at all in agreement with the requirements of ISO6974-3:2000, but in agreement with the requirements of ASTM D1945:2014.

Nitrogen: The determination of this component was very problematic. Five statistical outliers were detected and two test results were excluded. The calculated reproducibility after rejection of the suspect data is not at all in agreement with the requirements of ISO6974-3:2000 and also not at all in agreement with the requirements of ASTM D1945:2014.

Calculated parameters, general remark:

In this PT, the calculated parameters were reported for two combustion temperatures (15 and 25°C) for real gas. The number of participants with results for 15°C and 25°C varied between 22 and 29.

Caloric Value: The calculation at combustion temperature 25°C/metering temperature 0°C may be problematic for a number of laboratories. Two statistical outliers were found and two results were excluded. Eight results were marked as calculation errors. The spread for real gas was exactly the same to the previously observed spread in iis14S01M.

The calculation at combustion temperature 15°C/metering temperature 15°C may be problematic for a number of laboratories. Three statistical outliers were found and two results were excluded. Nine results were marked as calculation errors. However, the spread for real gas was smaller than the previously observed spread in iis14S01M.

Density: The calculation at combustion temperature 25°C/metering temperature 0°C may be problematic for a number of laboratories. One statistical outlier was found and two results were excluded. Four results were marked as calculation errors. However, the spread for real gas was smaller than the previously observed spread in iis14S01M.

The calculation at combustion temperature 15°C/metering temperature 15°C may be problematic for a number of laboratories. Two statistical outliers were found and two results were excluded. Four results were marked as calculation errors. However, the spread for real gas was smaller than the previously observed spread in iis14S01M.

Relative density: The calculation at combustion temperature 25°C/metering temperature 0°C appeared not to be problematic. No statistical outliers were found, but two results were excluded. Two calculation errors were observed. The spread for real gas was somewhat larger than the previously observed spread in iis14S01M.

The calculation at combustion temperature 15°C/metering temperature 15°C appeared not to be problematic. No statistical outliers were found, but two results were excluded. Three calculation errors were observed. The spread for real gas is the somewhat larger than the previously observed spread in iis14S01M.

Wobbe index: The calculation at combustion temperature 25°C/metering temperature 0°C may be problematic for a number of laboratories. Two statistical outliers were found and two results were excluded. Seven results were marked as calculation errors. However, the spread for real gas was smaller than the previously observed spread in iis14S01M.

The calculation at combustion temperature 15°C/metering temperature 15°C may be problematic for a number of laboratories. One statistical outlier was found and two results were excluded. Two results were marked as calculation errors. However, the spread for real gas smaller than the previously observed spread in iis14S01M.

4.2 PERFORMANCE EVALUATION FOR THE GROUP OF LABORATORIES

The average results per component, observed reproducibilities and target reproducibilities, derived from the standard methods ISO6974-3 and ASTM D1945 are compared in the next table.

	unit	n	cons. value	2.8 * sd	R(ISO6974-3)	R(D1945)
Methane	%mol/mol	42	92.224	0.404	0.184	0.150
Ethane	%mol/mol	43	3.026	0.093	0.091	0.100
Propane	%mol/mol	43	1.513	0.055	0.045	0.100
iso-Butane	%mol/mol	43	0.151	0.010	0.009	0.070
n-Butane	%mol/mol	41	0.202	0.014	0.012	0.070
Carbon dioxide	%mol/mol	41	0.399	0.038	0.024	0.070
Nitrogen	%mol/mol	40	2.506	0.194	0.075	0.100

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

Without further statistical calculations it can be concluded that for several components there is not a good compliance of the group of participating laboratories with the relevant standard. The problematic components have been discussed in paragraph 4.1.

The average results per calculation for the real gas, observed reproducibilities are compared in table 3 and 4.

Combustion temperature 25°C, metering temperature 0°C, real gas				
Property	unit	n	cons. value	2.8 * sd
Caloric Value	MJ/m^3	18	40.826	0.186
Density	kg/m^3	20	0.781	0.005
Relative Density		20	0.604	0.004
Wobbe Index	MJ/m^3	18	52.527	0.218

Table 3: Performance of the group for combustion temperature of 25°C, real gas

Combustion temperature 15°C, metering temperature 15°C, real gas				
Property	unit	n	cons. value	2.8 * sd
Caloric Value	MJ/m^3	24	38.709	0.102
Density	kg/m^3	25	0.740	0.003
Relative Density		28	0.604	0.003
Wobbe Index	MJ/m^3	25	49.838	0.216

Table 4: Performance of the group for combustion temperature of 15°C, real gas

4.3 COMPARISON OF THE PROFICIENCY TEST OF MARCH 2015 WITH PREVIOUS PTS

	2015	2014	2013	2012
Number of reporting labs	47	38	33	34
Number of results reported	532	600	466	475
Statistical outliers	33	38	29	23
Percentage outliers	6.2%	6.5%	6.2%	4.8%

Table 5: Comparison with previous proficiency tests

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

The performances of the determinations in the proficiency tests for Natural Gas were compared against the requirements of the two often used standard test methods. See the overview in the following table:

	2015 ISO6974-3	2015 D1945	2014 ISO6974-3	2014 D1945	2013 ISO6974-3	2013 D1945	2012 ISO6974-3	2012 D1945
Methane	--	--	--	--	--	--	--	--
Ethane	+/-	+	++	+	+	-	-	-
Propane	-	++	-	++	-	++	-	++
iso-Butane	+/-	++	++	++	-	++	-	++
n-Butane	+/-	++	+/-	++	--	++	-	++
Carbon dioxide	--	++	--	--	--	+/-	--	++
Nitrogen	--	--	--	--	--	--	--	--

Table 6: comparison of observed precision with precision of ISO6974-3 / ASTM D1945

From the above table it is clear that the performance of the group of participating laboratories did not improve.

The following performance categories were used:

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

4.4 DISCUSSION

Many of the observed reproducibilities are larger than the reproducibility requirements of ISO6974-3 and therefore it had to be concluded that no improvement was observed since the 2010 PT for Natural Gas and that the determination of the composition of Natural Gas was still problematic for a significant number of participating laboratories.

The consensus values as determined in this PT are compared with the average values from the homogeneity testing by the supplier EffecTech 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
Methane	92.2166	92.2239	0.0073
Ethane	3.0134	3.0256	0.0122
Propane	1.5118	1.5130	0.0012
iso-Butane	0.1503	0.1512	0.0009
n-Butane	0.2005	0.2024	0.0019
Carbon dioxide	0.4006	0.3992	0.0014
Nitrogen	2.5068	2.5057	0.0011

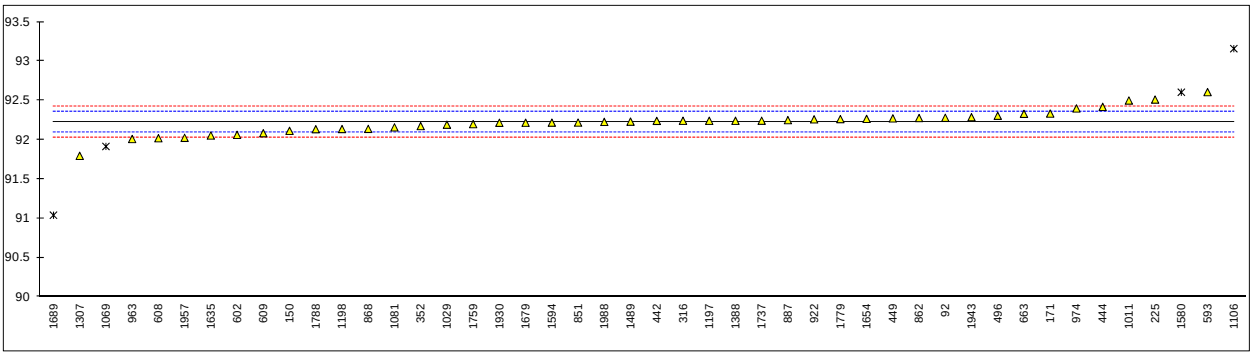
Table 7: comparison of consensus values with values determined by the supplier EffecTech

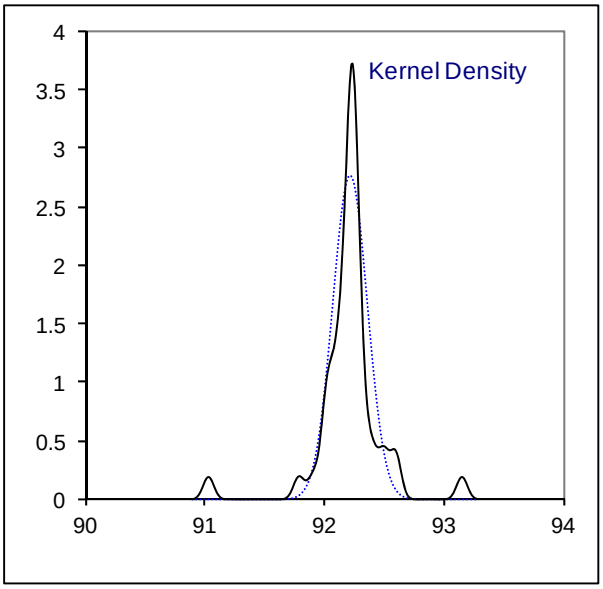
From the comparison in table 7 it is clear that the consensus values as determined in this PT are all very well in line with the values as determined during the preparation of the gas cylinders.

APPENDIX 1

Determination of Methane on sample #15030; results in %mol/mol

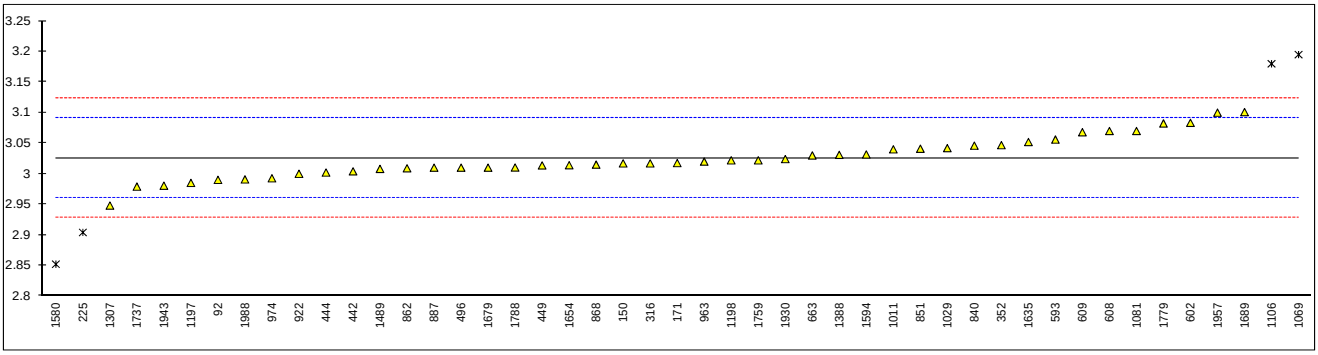
lab	method	value	mark	z(targ)	remarks
92	GPA2286	92.28		0.85	
150	D1945	92.114		-1.67	
171	D1945	92.33398		1.67	
225	D1945	92.512		4.37	
316	ISO6974-3	92.242		0.28	
352	ISO6974-3	92.1745		-0.75	
442	D1945	92.2404		0.25	
444	D1945	92.419	C	2.96	First reported 92.380
449	D1945	92.2722		0.73	
496	DIN15984	92.306		1.25	
593	D1945	92.607		5.82	
602	GPA2261	92.0625		-2.45	
608	GPA2261	92.02		-3.09	
609	GPA2261	92.0835		-2.13	
663	D1945	92.330		1.61	
840		-----		-----	
851	GPA2261	92.219		-0.07	
862	GPA2261	92.277		0.81	
868	GPA2261	92.139		-1.29	
887	D1945	92.25		0.40	
922	D1945	92.26		0.55	
963	D1945	92.010		-3.25	
974	ISO6974-3	92.3992		2.66	
1011	UOP539	92.50		4.19	
1029	D1945	92.192		-0.48	
1069	UOP539	91.915	ex	-4.69	See §4.1
1081		92.158		-1.00	
1095		-----		-----	
1106	ISO6976	93.160	R(0.01)	14.21	
1197	D1945	92.242		0.28	
1198	D1945	92.137		-1.32	
1200		-----		-----	
1307	in house	91.796		-6.50	
1388	GPA2261	92.2421		0.28	
1489	ISO6974-3	92.231		0.11	
1580	GB/T13610	92.605	ex	5.79	See §4.1
1594	GPA2261	92.2182		-0.09	
1635	D1945	92.054		-2.58	
1654	D1945	92.266		0.64	
1679	ISO6974-3	92.217		-0.10	
1689	GB/T13610	91.040	C,R(0.01)	-17.97	First reported 90.907
1737	in house	92.243		0.29	
1759	ISO6974-5	92.199		-0.38	
1779	GPA2261	92.2635		0.60	
1788	D7833	92.1349		-1.35	
1892		-----		-----	
1930	ISO6974-6	92.2167		-0.11	
1943	ISO6974-3	92.2876		0.97	
1957	GPA2261	92.0250		-3.02	
1960		-----		-----	
1988	ISO6974-6	92.2276		0.06	
	normality	suspect			
	n	42			
	outliers	2 (+ 2excl)			
	mean (n)	92.2239			
	st.dev. (n)	0.14417			
	R(calc.)	0.4037			
	R(ISO6974-3:00)	0.1844			Compare R(ASTM D1945:14) = 0.1500

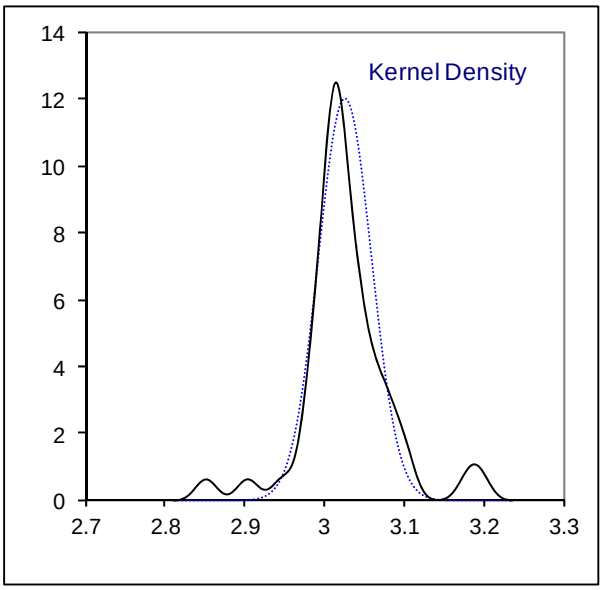

93.5
93
92.5
92
91.5
91
90.5
90
1689 1307 1069 963 608 1957 1635 602 609 150 1788 1198 868 1081 352 1029 1759 1930 1679 1594 851 1988 1489 442 316 1197 1388 1737 887 922 1779 1654 449 862 92 1943 496 663 171 974 444 1011 225 1580 593 1106


Kernel Density
4
3.5
3
2.5
2
1.5
1
0.5
0
90
91
92
93
94

Determination of Ethane on sample #15030; results in %mol/mol

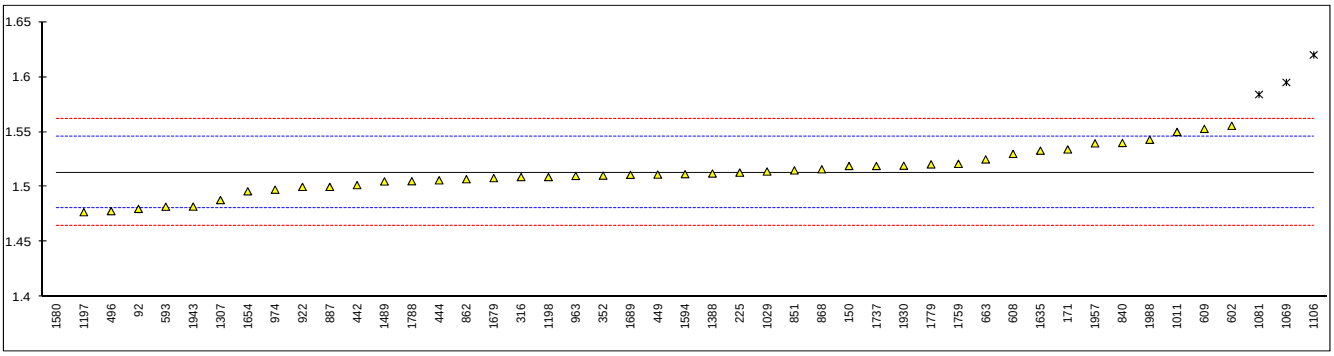
lab	method	value	mark	z(targ)	remarks
92	GPA2286	2.99		-1.10	
150	D1945	3.017		-0.27	
171	D1945	3.017515		-0.25	
225	D1945	2.904	C,R(0.05)	-3.75	First reported 2.915
316	ISO6974-3	3.017		-0.27	
352	ISO6974-3	3.0468		0.65	
442	D1945	3.0040		-0.67	
444	D1945	3.002	C	-0.73	First reported 3.017
449	D1945	3.0137		-0.37	
496	DIN15984	3.010		-0.48	
593	D1945	3.056		0.94	
602	GPA2261	3.0834		1.78	
608	GPA2261	3.07		1.37	
609	GPA2261	3.0680		1.31	
663	D1945	3.030		0.13	
840	D1945	3.046		0.63	
851	GPA2261	3.041		0.47	
862	GPA2261	3.009		-0.51	
868	GPA2261	3.015		-0.33	
887	D1945	3.01		-0.48	
922	D1945	3.00		-0.79	
963	D1945	3.020		-0.17	
974	ISO6974-3	2.9926		-1.02	
1011	UOP539	3.04		0.44	
1029	D1945	3.042		0.50	
1069	UOP539	3.195	R(0.01)	5.22	
1081		3.070		1.37	
1095		-----		-----	
1106	ISO6976	3.180	R(0.01)	4.76	
1197	D1945	2.985		-1.25	
1198	D1945	3.022		-0.11	
1200		-----		-----	
1307	in house	2.948		-2.40	
1388	GPA2261	3.0310		0.17	
1489	ISO6974-3	3.008		-0.54	
1580	GB/T13610	2.852	R(0.01)	-5.36	
1594	GPA2261	3.0316		0.18	
1635	D1945	3.052		0.81	
1654	D1945	3.014		-0.36	
1679	ISO6974-3	3.010		-0.48	
1689	GB/T13610	3.101		2.32	
1737	in house	2.979		-1.44	
1759	ISO6974-5	3.022		-0.11	
1779	GPA2261	3.0824		1.75	
1788	D7833	3.0103		-0.47	
1892		-----		-----	
1930	ISO6974-6	3.0240		-0.05	
1943	ISO6974-3	2.9805		-1.39	
1957	GPA2261	3.1000		2.29	
1960		-----		-----	
1988	ISO6974-6	2.9908		-1.07	
	normality	OK			
	n	43			
	outliers	4			
	mean (n)	3.0256			
	st.dev. (n)	0.03315			
	R(calc.)	0.0928			
	R(ISO6974-3:00)	0.0908			Compare R(ASTM D1945:14) = 0.1000

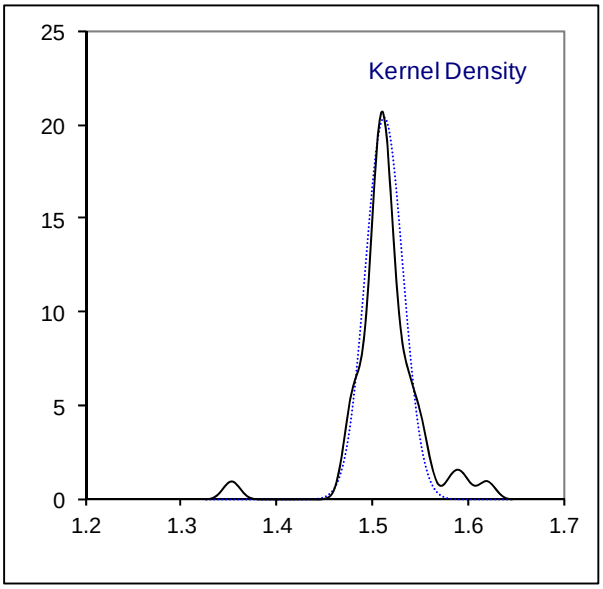

3.25
3.2
3.15
3.1
3.05
3
2.95
2.9
2.85
2.8
1580 225 1307 1737 1943 1197 92 1988 974 922 444 442 1489 862 887 496 1679 1788 449 1654 868 150 316 171 963 1198 1759 1930 663 1388 1594 1011 851 1029 840 352 1635 593 609 608 1081 1779 602 1957 1689 1106 1069


Kernel Density
14
12
10
8
6
4
2
0
2.7 2.8 2.9 3 3.1 3.2 3.3

Determination of Propane on sample #15030; results in %mol/mol

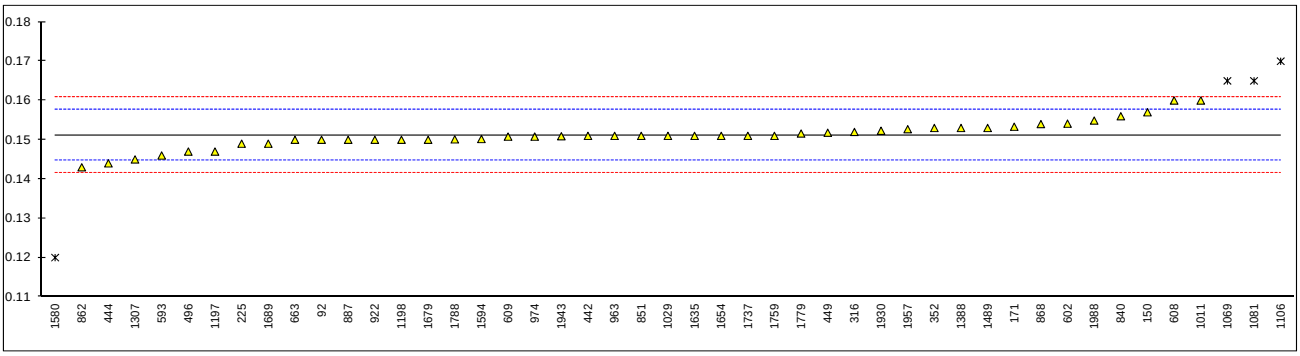
lab	method	value	mark	z(targ)	remarks
92	GPA2286	1.48		-2.03	
150	D1945	1.519	C	0.37	First reported 1.589
171	D1945	1.53406		1.30	
225	D1945	1.513		0.00	
316	ISO6974-3	1.509		-0.24	
352	ISO6974-3	1.5103		-0.16	
442	D1945	1.5016		-0.70	
444	D1945	1.506		-0.43	
449	D1945	1.5112		-0.11	
496	DIN15984	1.478		-2.16	
593	D1945	1.482		-1.91	
602	GPA2261	1.5556		2.63	
608	GPA2261	1.53		1.05	
609	GPA2261	1.5528		2.46	
663	D1945	1.525		0.74	
840	D1945	1.540		1.67	
851	GPA2261	1.515		0.13	
862	GPA2261	1.507		-0.37	
868	GPA2261	1.516		0.19	
887	D1945	1.50		-0.80	
922	D1945	1.50		-0.80	
963	D1945	1.510		-0.18	
974	ISO6974-3	1.4975		-0.95	
1011	UOP539	1.55		2.28	
1029	D1945	1.514		0.06	
1069	UOP539	1.595	R(0.05)	5.06	
1081		1.584	R(0.05)	4.38	
1095		-----		-----	
1106	ISO6976	1.620	R(0.01)	6.60	
1197	D1945	1.477		-2.22	
1198	D1945	1.509		-0.24	
1200		-----		-----	
1307	in house	1.488		-1.54	
1388	GPA2261	1.5122		-0.05	
1489	ISO6974-3	1.505		-0.49	
1580	GB/T13610	1.354	R(0.01)	-9.81	
1594	GPA2261	1.5116		-0.08	
1635	D1945	1.533		1.24	
1654	D1945	1.496		-1.05	
1679	ISO6974-3	1.508		-0.31	
1689	GB/T13610	1.511		-0.12	
1737	in house	1.519		0.37	
1759	ISO6974-5	1.521		0.50	
1779	GPA2261	1.5205		0.46	
1788	D7833	1.5052		-0.48	
1892		-----		-----	
1930	ISO6974-6	1.5193		0.39	
1943	ISO6974-3	1.4821		-1.90	
1957	GPA2261	1.5396		1.64	
1960		-----		-----	
1988	ISO6974-6	1.5429		1.85	
	normality	OK			
	n	43			
	outliers	4			
	mean (n)	1.5130			
	st.dev. (n)	0.01956			
	R(calc.)	0.0548			
	R(ISO6974-3:00)	0.0454			Compare R(ASTM D1945:14) = 0.1000

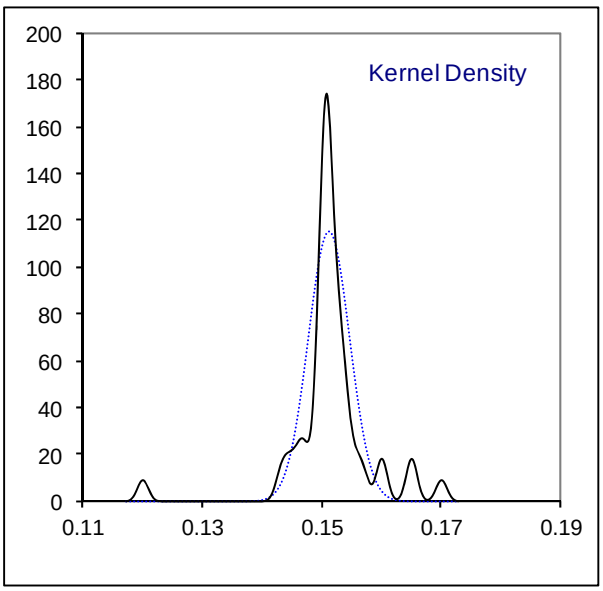

1.65
1.6
1.55
1.5
1.45
1.4
1580 1197 496 92 593 1943 1307 1654 974 922 887 442 1489 1788 444 862 1679 316 1198 963 352 1689 449 1594 1388 225 1029 851 868 150 1737 1930 1779 1759 663 608 1635 171 1957 840 1988 1011 609 602 1081 1069 1106


Kernel Density
25
20
15
10
5
0
1.2
1.3
1.4
1.5
1.6
1.7

Determination of iso-Butane on sample #15030; results in %mol/mol

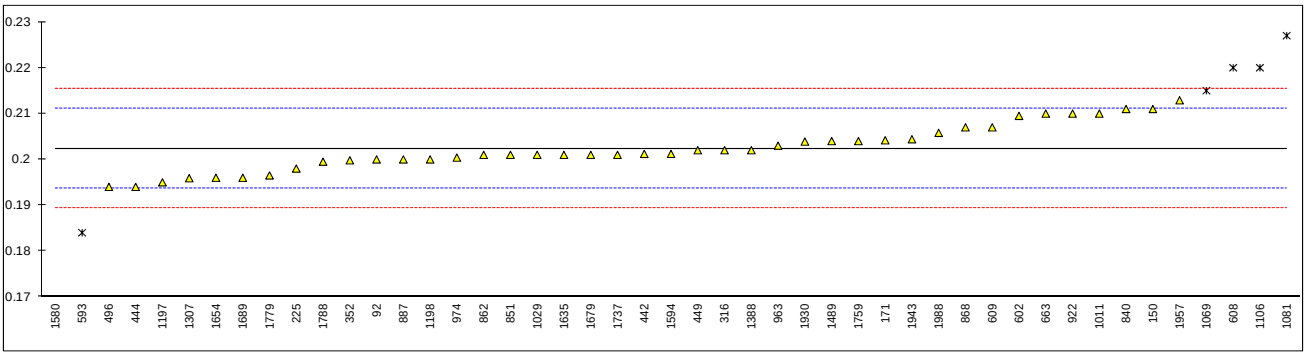
lab	method	value	mark	z(targ)	remarks
92	GPA2286	0.15		-0.36	
150	D1945	0.157		1.81	
171	D1945	0.153321		0.67	
225	D1945	0.149		-0.66	
316	ISO6974-3	0.1520		0.26	
352	ISO6974-3	0.1530		0.57	
442	D1945	0.1510		-0.05	
444	D1945	0.144		-2.21	
449	D1945	0.1518		0.20	
496	DIN15984	0.147		-1.28	
593	D1945	0.146		-1.59	
602	GPA2261	0.1541		0.91	
608	GPA2261	0.16		2.73	
609	GPA2261	0.1508		-0.11	
663	D1945	0.150		-0.36	
840	D1945	0.156		1.50	
851	GPA2261	0.151		-0.05	
862	GPA2261	0.143		-2.52	
868	GPA2261	0.154		0.88	
887	D1945	0.15		-0.36	
922	D1945	0.15		-0.36	
963	D1945	0.151		-0.05	
974	ISO6974-3	0.1508		-0.11	
1011	UOP539	0.16		2.73	
1029	D1945	0.151		-0.05	
1069	UOP539	0.165	R(0.05)	4.28	
1081		0.165	R(0.05)	4.28	
1095		-----		-----	
1106	ISO6976	0.170	R(0.05)	5.82	
1197	D1945	0.147		-1.28	
1198	D1945	0.150		-0.36	
1200		-----		-----	
1307	in house	0.145		-1.90	
1388	GPA2261	0.1530		0.57	
1489	ISO6974-3	0.153		0.57	
1580	GB/T13610	0.120	R(0.01)	-9.62	
1594	GPA2261	0.1502	C	-0.29	Result first reported as n-butane. Result was mixed-up
1635	D1945	0.151		-0.05	
1654	D1945	0.151		-0.05	
1679	ISO6974-3	0.150		-0.36	
1689	GB/T13610	0.149		-0.66	
1737	in house	0.151		-0.05	
1759	ISO6974-5	0.151		-0.05	
1779	GPA2261	0.1516		0.14	
1788	D7833	0.1501		-0.32	
1892		-----		-----	
1930	ISO6974-6	0.1523		0.35	
1943	ISO6974-3	0.1509		-0.08	
1957	GPA2261	0.1527	C	0.48	First reported 0.1671
1960		-----		-----	
1988	ISO6974-6	0.1549		1.16	
	normality	suspect			
	n	43			
	outliers	4			
	mean (n)	0.1512			
	st.dev. (n)	0.00345			
	R(calc.)	0.0097			
	R(ISO6974-3:00)	0.0091			Compare R(ASTM D1945:14) = 0.0700

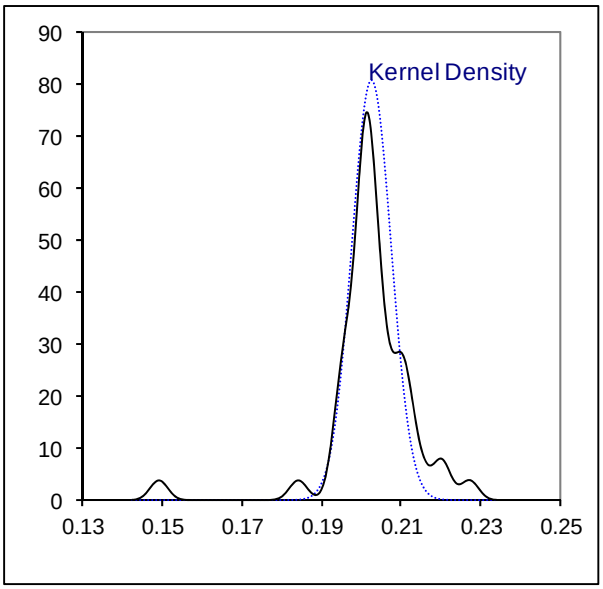

0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
1580 862 444 1307 593 496 1197 225 1689 663 92 887 922 1198 1679 1788 1594 609 974 1943 442 963 851 1029 1635 1654 1737 1759 1779 449 316 1930 1957 352 1388 1489 171 868 602 1988 840 150 608 1011 1069 1081 1106


Kernel Density
200
180
160
140
120
100
80
60
40
20
0
0.11
0.13
0.15
0.17
0.19

Determination of n-Butane on sample #15030; results in %mol/mol

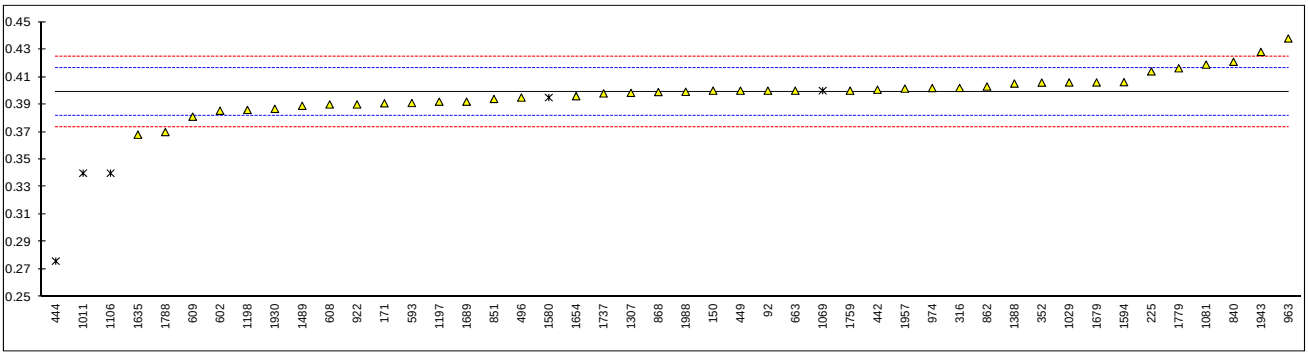
lab	method	value	mark	z(targ)	remarks
92	GPA2286	0.20		-0.55	
150	D1945	0.211		1.99	
171	D1945	0.204166		0.41	
225	D1945	0.198		-1.01	
316	ISO6974-3	0.2020		-0.09	
352	ISO6974-3	0.1998		-0.59	
442	D1945	0.2012		-0.27	
444	D1945	0.194		-1.93	
449	D1945	0.2020		-0.09	
496	DIN15984	0.194		-1.93	
593	D1945	0.184	R(0.05)	-4.24	
602	GPA2261	0.2095		1.64	
608	GPA2261	0.22	R(0.05)	4.07	
609	GPA2261	0.2070		1.07	
663	D1945	0.210		1.76	
840	D1945	0.211		1.99	
851	GPA2261	0.201		-0.32	
862	GPA2261	0.201	C	-0.32	First reported 0.172
868	GPA2261	0.207		1.07	
887	D1945	0.20		-0.55	
922	D1945	0.21		1.76	
963	D1945	0.203		0.15	
974	ISO6974-3	0.2004		-0.45	
1011	UOP539	0.21		1.76	
1029	D1945	0.201		-0.32	
1069	UOP539	0.215	R(0.05)	2.91	
1081		0.227	R(0.05)	5.68	
1095		-----		-----	
1106	ISO6976	0.220	ex	4.07	See §4.1
1197	D1945	0.195		-1.70	
1198	D1945	0.200		-0.55	
1200		-----		-----	
1307	in house	0.1959		-1.49	
1388	GPA2261	0.2020		-0.09	
1489	ISO6974-3	0.204		0.38	
1580	GB/T13610	0.149	R(0.01)	-12.31	
1594	GPA2261	0.2012	C	-0.27	Result first reported as iso-butane. Result was mixed-up
1635	D1945	0.201		-0.32	
1654	D1945	0.196		-1.47	
1679	ISO6974-3	0.201		-0.32	
1689	GB/T13610	0.196		-1.47	
1737	in house	0.201		-0.32	
1759	ISO6974-5	0.204		0.38	
1779	GPA2261	0.1965		-1.35	
1788	D7833	0.1995		-0.66	
1892		-----		-----	
1930	ISO6974-6	0.2039		0.35	
1943	ISO6974-3	0.2044		0.47	
1957	GPA2261	0.2129		2.43	
1960		-----		-----	
1988	ISO6974-6	0.2058		0.79	
	normality	OK			
	n	41			
	outliers	5 (+ 1 excl)			
	mean (n)	0.2024			
	st.dev. (n)	0.00494			
	R(calc.)	0.0138			
	R(ISO6974-3:00)	0.0121			Compare R(ASTM D1945:14) = 0.0700

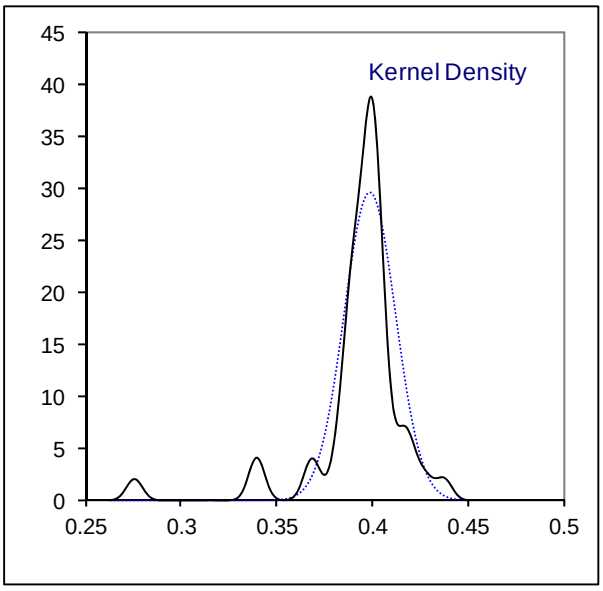

0.23
0.22
0.21
0.2
0.19
0.18
0.17
1580 593 496 444 1197 1307 1654 1689 1779 225 1788 352 92 887 1198 974 862 851 1029 1635 1679 1737 442 1594 449 316 1388 963 1930 1489 1759 171 1943 1988 868 609 602 663 922 1011 840 150 1957 1069 608 1106 1081


Kernel Density
90
80
70
60
50
40
30
20
10
0
0.13 0.15 0.17 0.19 0.21 0.23 0.25

Determination of Carbon Dioxide on sample #15030; results in %mol/mol

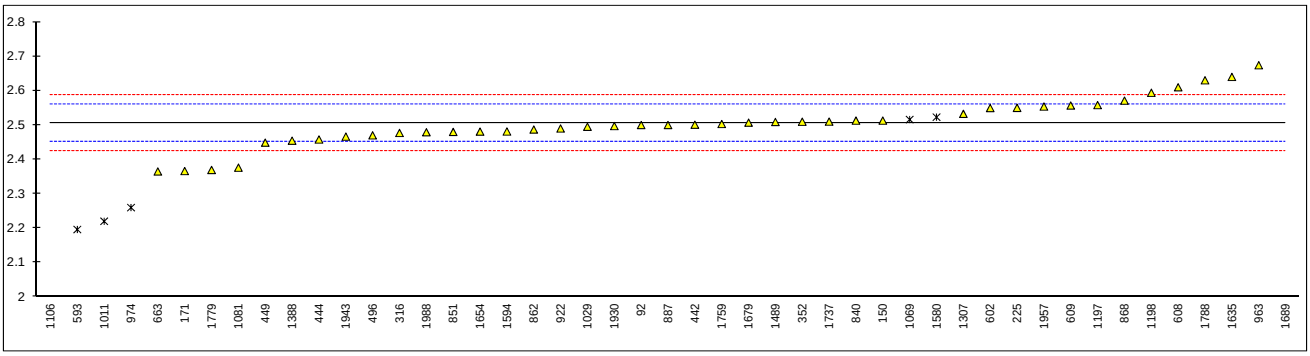
lab	method	value	mark	z(targ)	remarks
92	GPA2286	0.40		0.10	
150	D1945	0.400		0.10	
171	D1945	0.390838		-0.98	
225	D1945	0.414		1.73	
316	ISO6974-3	0.402		0.33	
352	ISO6974-3	0.4059		0.79	
442	D1945	0.4007		0.18	
444	D1945	0.276	C,R(0.01)	-14.40	First reported 0.300
449	D1945	0.4000		0.10	
496	DIN15984	0.395		-0.49	
593	D1945	0.391		-0.96	
602	GPA2261	0.3854		-1.61	
608	GPA2261	0.39		-1.07	
609	GPA2261	0.3811		-2.11	
663	D1945	0.400		0.10	
840	D1945	0.421		2.55	
851	GPA2261	0.394		-0.61	
862	GPA2261	0.403		0.45	
868	GPA2261	0.399		-0.02	
887		-----		-----	
922	D1945	0.39		-1.07	
963	D1945	0.438		4.54	
974	ISO6974-3	0.4019		0.32	
1011	UOP539	0.34	R(0.01)	-6.92	
1029	D1945	0.406		0.80	
1069	UOP539	0.4	ex	0.10	See §4.1
1081		0.419		2.32	
1095		-----		-----	
1106	ISO6976	0.340	R(0.01)	-6.92	
1197	D1945	0.392		-0.84	
1198	D1945	0.386		-1.54	
1200		-----		-----	
1307	in house	0.3984		-0.09	
1388	GPA2261	0.4052		0.70	
1489	ISO6974-3	0.389		-1.19	
1580	GB/T13610	0.395	ex	-0.49	See §4.1
1594	GPA2261	0.4062		0.82	
1635	D1945	0.368		-3.65	
1654	D1945	0.396		-0.37	
1679	ISO6974-3	0.406		0.80	
1689	GB/T13610	0.392		-0.84	
1737	in house	0.398		-0.14	
1759	ISO6974-5	0.400		0.10	
1779	GPA2261	0.4163		2.00	
1788	D7833	0.3699		-3.42	
1892		-----		-----	
1930	ISO6974-6	0.3868		-1.45	
1943	ISO6974-3	0.4282		3.39	
1957	GPA2261	0.4015		0.27	
1960		-----		-----	
1988	ISO6974-6	0.3992		0.00	
	normality	suspect			
	n	41			
	outliers	3 (+2 excl)			
	mean (n)	0.3992			
	st.dev. (n)	0.01345			
	R(calc.)	0.0377			
	R(ISO6974-3:00)	0.0240			Compare R(ASTM D1945:14) = 0.0700

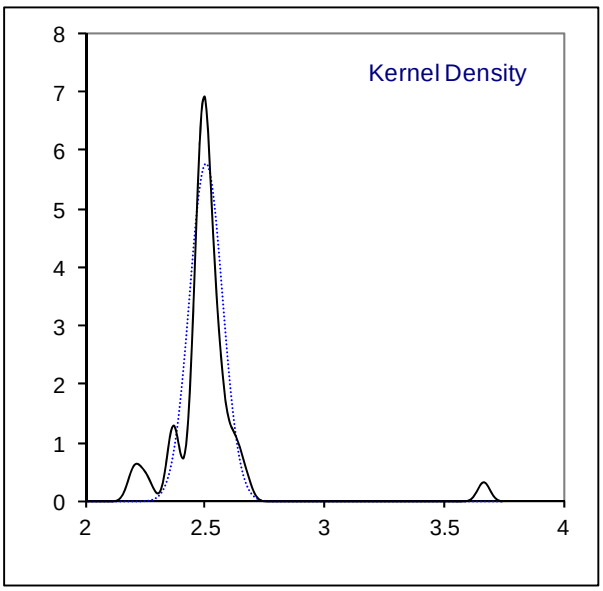

0.45
0.43
0.41
0.39
0.37
0.35
0.33
0.31
0.29
0.27
0.25
444 1011 1106 1635 1788 609 602 1198 1930 1489 608 922 171 593 1197 1689 851 496 1580 1654 1737 1307 868 1988 150 449 92 663 1069 1759 442 1957 974 316 862 1388 352 1029 1679 1594 225 1779 1081 840 1943 963


Kernel Density
45
40
35
30
25
20
15
10
5
0
0.25
0.3
0.35
0.4
0.45
0.5

Determination of Nitrogen on sample #15030; results in %mol/mol

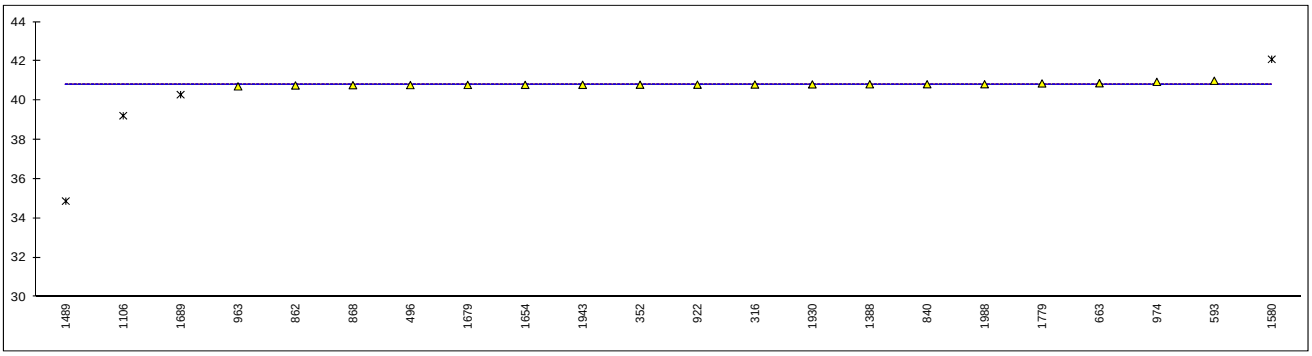
lab	method	value	mark	z(targ)	remarks
92	GPA2286	2.50		-0.21	
150	D1945	2.513		0.27	
171	D1945	2.366125		-5.20	
225	D1945	2.550	C	1.65	First reported 2.295
316	ISO6974-3	2.477		-1.07	
352	ISO6974-3	2.5097		0.15	
442	D1945	2.5010		-0.17	
444	D1945	2.458		-1.78	
449	D1945	2.4488		-2.12	
496	DIN15984	2.470		-1.33	
593	D1945	2.196	R(0.05)	-11.54	
602	GPA2261	2.5495		1.63	
608	GPA2261	2.61		3.89	
609	GPA2261	2.5569		1.91	
663	D1945	2.365		-5.24	
840	D1945	2.513		0.27	
851	GPA2261	2.480		-0.96	
862	GPA2261	2.487		-0.70	
868	GPA2261	2.571		2.43	
887	D1945	2.50		-0.21	
922	D1945	2.49		-0.58	
963	D1945	2.674		6.27	
974	ISO6974-3	2.2599	C,R(0.05)	-9.16	First reported 2.3576
1011	UOP539	2.22	R(0.05)	-10.64	
1029	D1945	2.495		-0.40	
1069	UOP539	2.516	ex	0.38	See §4.1
1081		2.376		-4.83	
1095		-----		-----	
1106	ISO6976	1.300	R(0.01)	-44.91	
1197	D1945	2.558		1.95	
1198	D1945	2.594		3.29	
1200		-----		-----	
1307	in house	2.5327		1.01	
1388	GPA2261	2.4545		-1.91	
1489	ISO6974-3	2.509		0.12	
1580	GB/T13610	2.523	ex	0.65	See §4.1
1594	GPA2261	2.4812		-0.91	
1635	D1945	2.640		5.00	
1654	D1945	2.481		-0.92	
1679	ISO6974-3	2.507		0.05	
1689	GB/T13610	3.671	C,R(0.01)	43.41	First reported 3.371
1737	in house	2.510		0.16	
1759	ISO6974-5	2.503		-0.10	
1779	GPA2261	2.3693		-5.08	
1788	D7833	2.6302		4.64	
1892		-----		-----	
1930	ISO6974-6	2.4970		-0.32	
1943	ISO6974-3	2.4663		-1.47	
1957	GPA2261	2.5539		1.80	
1960		-----		-----	
1988	ISO6974-6	2.4791		-0.99	
	normality	OK			
	n	40			
	outliers	5 (+2 excl)			
	mean (n)	2.5057			
	st.dev. (n)	0.06928			
	R(calc.)	0.1940			
	R(ISO6974-3:00)	0.0752			Compare R(ASTM D1945:14) = 0.1000

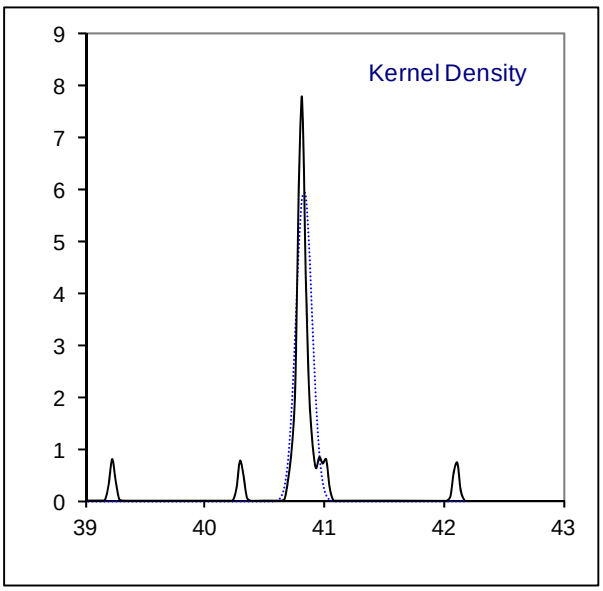

2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2
1106 593 1011 974 663 171 1779 1081 449 1388 444 1943 496 316 1988 851 1654 1594 862 922 1029 1930 92 887 442 1759 1679 1489 352 1737 840 150 1069 1580 1307 602 225 1957 609 1197 868 1198 608 1788 1635 963 1689


Kernel Density
8
7
6
5
4
3
2
1
0
2
2.5
3
3.5
4

Determination of Caloric Value Superior (101.325 kPa, comb. temp. 25°C, metering temp 0°C) on sample #15030; results in MJ/m^3 (real gas)

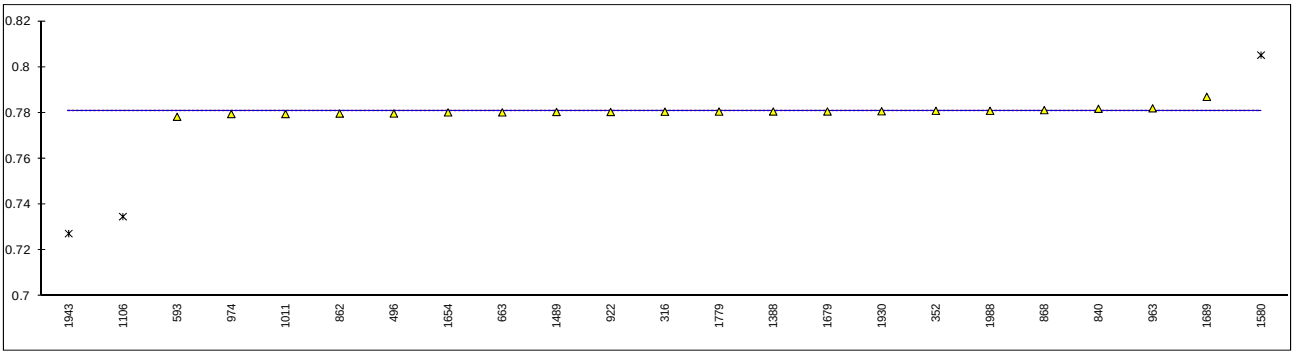
lab	method	value	mark	z(targ)	remarks
92		-----		-----	
150		-----		-----	
171		-----		-----	
225		-----		-----	
316	ISO6976	40.812		-----	
352	ISO6976	40.805		-----	
442		-----		-----	
444		-----		-----	
449		-----		-----	
496	DIN51857	40.7847		-----	
593	ISO6976	41.006	E	-----	Iis calculated 40.927
602		-----		-----	
608		-----		-----	
609		-----		-----	
663	ISO6976	40.880		-----	
840	ISO6976	40.828		-----	
851		-----		-----	
862	ISO6976	40.766	E	-----	Iis calculated 40.805
868	ISO6976	40.78		-----	
887		-----		-----	
922	ISO6976	40.806		-----	
963	ISO6976	40.72		-----	
974	GPA2172	40.948	E	-----	iis calculated 40.842
1011		-----		-----	
1029		-----		-----	
1069		-----		-----	
1081		-----		-----	
1095		-----		-----	
1106	GPA2286	39.22402	ex, E	-----	See §4.1, iis calculated 41.450
1197		-----		-----	
1198		-----		-----	
1200		-----		-----	
1307		-----		-----	
1388	ISO6976	40.827		-----	
1489	ISO6976	34.875	R(0.01),E	-----	iis calculated 40.801
1580	GB/T11062	42.098	ex, E	-----	See §4.1, iis calculated 40.576
1594		-----		-----	
1635		-----		-----	
1654	ISO6976	40.797		-----	
1679	ISO6976	40.792		-----	
1689	GB/T11062	40.297	C,R(0.01),E	-----	First reported 38.250, iis calculated 40.380
1737		-----		-----	
1759		-----		-----	
1779	ISO6976	40.8703		-----	
1788		-----		-----	
1892		-----		-----	
1930	DIN51857	40.8197		-----	
1943	ISO6976	40.7988	E	-----	Iis calculated 40.779
1957		-----		-----	
1960		-----		-----	
1988	ISO6976	40.8284		-----	
	normality	not OK			
	n	18			
	outliers	2 (+2 excl)			
	mean (n)	40.8260			
	st.dev. (n)	0.06626			
	R(calc.)	0.1855			
	R(lit)	unknown			Compare R(iis14S01M) = 0.1855

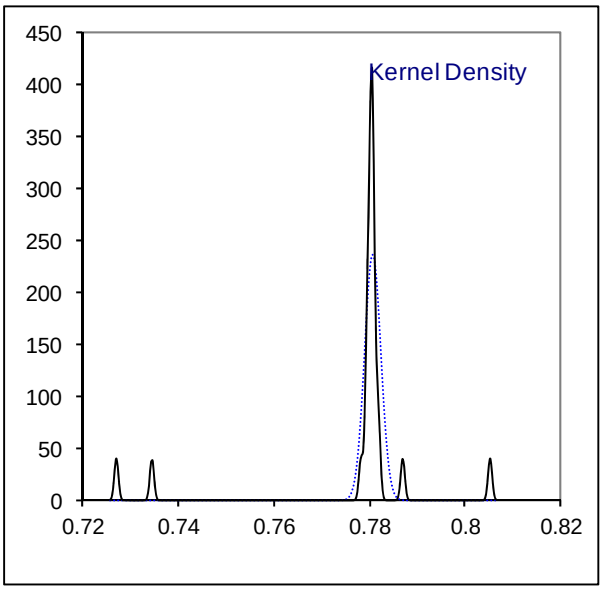

44
42
40
38
36
34
32
30
1489
1106
1689
963
862
868
496
1679
1654
1943
352
922
316
1930
1388
840
1988
1779
663
974
593
1580


Kernel Density
9
8
7
6
5
4
3
2
1
0
39
40
41
42
43

Determination of Density (101.325 kPa, comb. 25°C, metering temp. 0°C) on sample #15030; results in kg/m^3 (real gas)

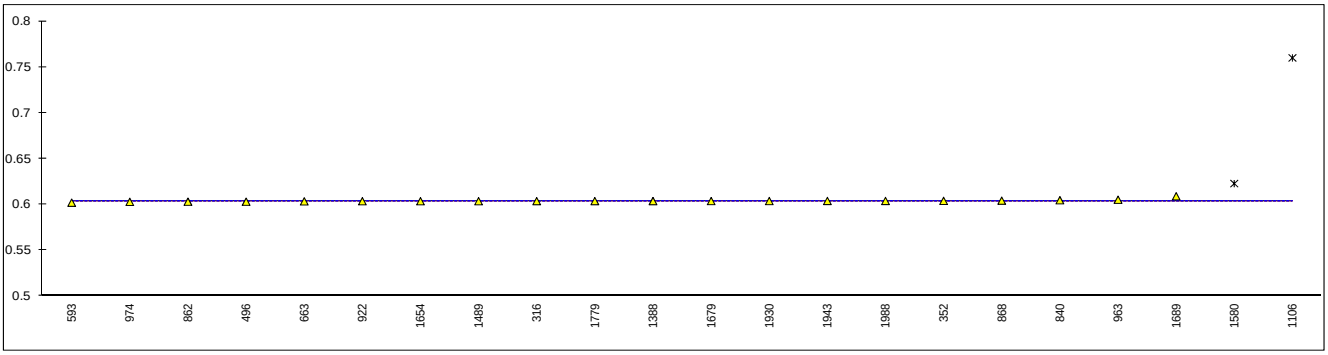
lab	method	value	mark	z(targ)	remarks
92		-----		-----	
150		-----		-----	
171		-----		-----	
225		-----		-----	
316	ISO6976	0.7805		-----	
352	ISO6976	0.7809		-----	
442		-----		-----	
444		-----		-----	
449		-----		-----	
496	DIN51857	0.779720		-----	
593	ISO6976	0.7783		-----	
602		-----		-----	
608		-----		-----	
609		-----		-----	
663	ISO6976	0.78021	C	-----	First reported 0.60347
840	ISO6976	0.78178		-----	
851		-----		-----	
862	ISO6976	0.77970		-----	
868	ISO6976	0.7812		-----	
887		-----		-----	
922	ISO6976	0.7804		-----	
963	ISO6976	0.7820		-----	
974	GPA2172	0.7795	E	-----	Iis calculated 0.7783
1011	D3588	0.7795		-----	
1029		-----		-----	
1069		-----		-----	
1081		-----		-----	
1095		-----		-----	
1106	GPA2286	0.734713	ex, E	-----	See §4.1, iis calculated 0.77651
1197		-----		-----	
1198		-----		-----	
1200		-----		-----	
1307		-----		-----	
1388	ISO6976	0.78059		-----	
1489	ISO6976	0.78039		-----	
1580	GB/T11062	0.8052	ex, E	-----	See §4.1, iis calculated 0.77606
1594		-----		-----	
1635		-----		-----	
1654	ISO6976	0.7802		-----	
1679	ISO6976	0.78061		-----	
1689	GB/T11062	0.787	C	-----	First reported 0.639
1737		-----		-----	
1759		-----		-----	
1779	ISO6976	0.78058		-----	
1788		-----		-----	
1892		-----		-----	
1930	DIN51857	0.7807		-----	
1943	ISO6976	0.7273	R(0.01),E	-----	iis calculated 0.78025
1957		-----		-----	
1960		-----		-----	
1988	ISO6976	0.7809		-----	
	normality	not OK			
	n	20			
	outliers	1 (+2 excl)			
	mean (n)	0.7807			
	st.dev. (n)	0.00169			
	R(calc.)	0.0047			
	R(lit)	unknown			Compare R(iis14S01M) = 0.0058

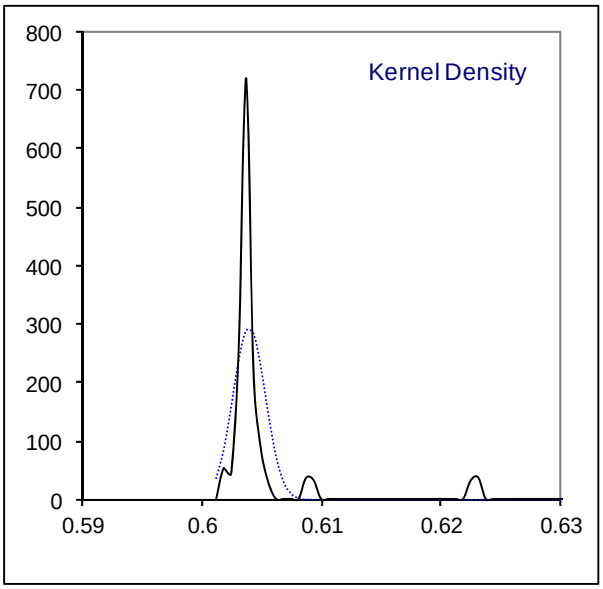

0.82
0.8
0.78
0.76
0.74
0.72
0.7
1943
1106
593
974
1011
862
496
1654
663
1489
922
316
1779
1388
1679
1930
352
1988
868
840
963
1689
1580


Kernel Density
450
400
350
300
250
200
150
100
50
0
0.72
0.74
0.76
0.78
0.8
0.82

Determination of Relative Density (101.325 kPa, comb. temp. 25°C, metering temp. 0°C) on sample #15030; results have no unit (real gas)

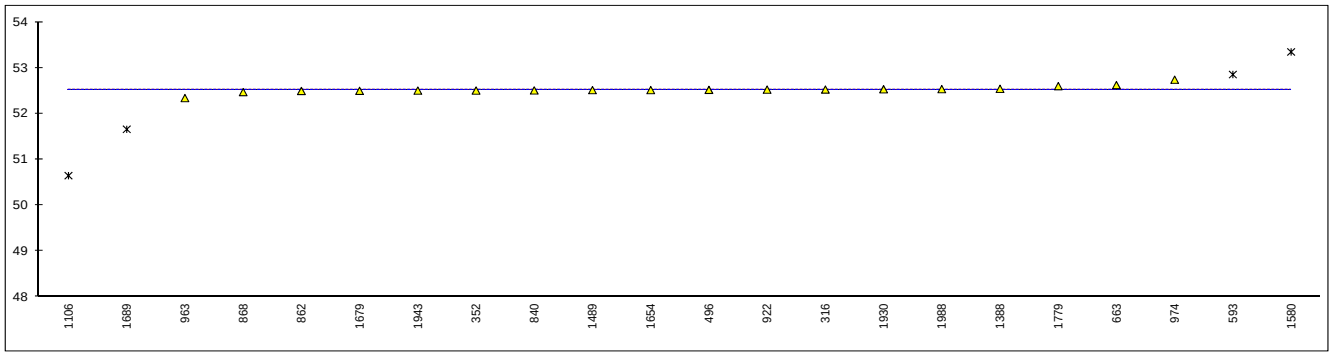
lab	method	value	mark	z(targ)	remarks
92		-----		-----	
150		-----		-----	
171		-----		-----	
225		-----		-----	
316	ISO6976	0.6037		-----	
352	ISO6976	0.6040		-----	
442		-----		-----	
444		-----		-----	
449		-----		-----	
496	DIN51857	0.603068		-----	
593	ISO6976	0.6020		-----	
602		-----		-----	
608		-----		-----	
609		-----		-----	
663	ISO6976	0.60347	C	-----	First reported 0.60219
840	ISO6976	0.60466		-----	
851		-----		-----	
862	ISO6976	0.60306		-----	
868	ISO6976	0.6042		-----	
887		-----		-----	
922	ISO6976	0.6036		-----	
963	ISO6976	0.6052		-----	
974	GPA2172	0.6029		-----	
1011		-----		-----	
1029		-----		-----	
1069		-----		-----	
1081		-----		-----	
1095		-----		-----	
1106	GPA2286	0.759981	ex, E	-----	See §4.1, iis calculated 0.60059
1197		-----		-----	
1198		-----		-----	
1200		-----		-----	
1307		-----		-----	
1388	ISO6976	0.60374		-----	
1489	ISO6976	0.60362		-----	
1580	GB/T11062	0.6228	ex, E	-----	See §4.1, iis calculated 0.60024
1594		-----		-----	
1635		-----		-----	
1654	ISO6976	0.6036		-----	
1679	ISO6976	0.60376		-----	
1689	GB/T11062	0.609	C	-----	First reported 0.742
1737		-----		-----	
1759		-----		-----	
1779	ISO6976	0.60373		-----	
1788		-----		-----	
1892		-----		-----	
1930	DIN51857	0.6038		-----	
1943	ISO6976	0.6039		-----	
1957		-----		-----	
1960		-----		-----	
1988	ISO6976	0.6039		-----	
	normality	not OK			
	n	20			
	outliers	0 (+2 excl)			
	mean (n)	0.6039			
	st.dev. (n)	0.00136			
	R(calc.)	0.0038			
	R(lit)	unknown			Compare R(iis14S01M) = 0.0025

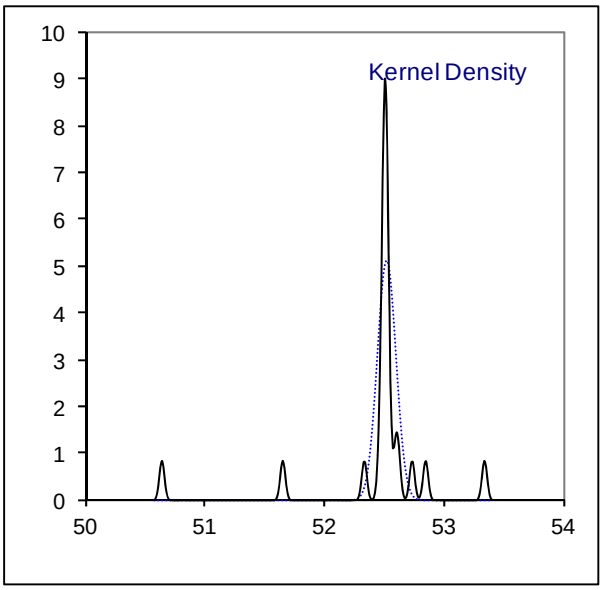

0.8
0.75
0.7
0.65
0.6
0.55
0.5
593
974
862
496
663
922
1654
1489
316
1779
1388
1679
1930
1943
1988
352
868
840
963
1689
1580
1106


Kernel Density
800
700
600
500
400
300
200
100
0
0.59
0.6
0.61
0.62
0.63

Determination of Wobbe Index (101.325 kPa , combustion temp. 25°C, metering temp. 0°C) on sample #15030; results in MJ/m^3 (real gas)

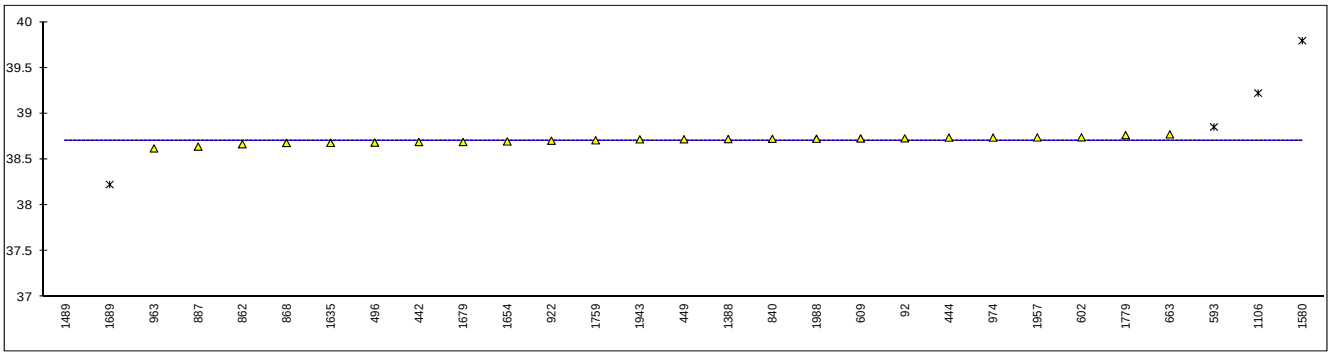
lab	method	value	mark	z(targ)	remarks
92		-----		-----	
150		-----		-----	
171		-----		-----	
225		-----		-----	
316	ISO6976	52.526		-----	
352	ISO6976	52.504		-----	
442		-----		-----	
444		-----		-----	
449		-----		-----	
496	DIN51857	52.5187		-----	
593	ISO6976	52.853	R(0.05), E	-----	iis calculated 52.733
602		-----		-----	
608		-----		-----	
609		-----		-----	
663	ISO6976	52.624		-----	
840	ISO6976	52.506		-----	
851		-----		-----	
862	ISO6976	52.494	E	-----	iis calculated 52.518
868	ISO6976	52.47		-----	
887		-----		-----	
922	ISO6976	52.524		-----	
963	ISO6976	52.34	E	-----	iis calculated 52.358
974	GPA2172	52.74	E	-----	iis calculated 52.640
1011		-----		-----	
1029		-----		-----	
1069		-----		-----	
1081		-----		-----	
1095		-----		-----	
1106	GPA2286	50.6464	ex, E	-----	See §4.1, iis calculated 53.485
1197		-----		-----	
1198		-----		-----	
1200		-----		-----	
1307		-----		-----	
1388	ISO6976	52.542		-----	
1489	ISO6976	52.513		-----	
1580	GB/T11062	53.346	ex, E	-----	See §4.1, iis calculated 52.373
1594		-----		-----	
1635		-----		-----	
1654	ISO6976	52.514		-----	
1679	ISO6976	52.498		-----	
1689	GB/T11062	51.658	C,R(0.01),E	-----	First reported 51.821, iis calculated 51.738
1737		-----		-----	
1759		-----		-----	
1779	ISO6976	52.6000		-----	
1788		-----		-----	
1892		-----		-----	
1930	DIN51857	52.5320		-----	
1943	ISO6976	52.5027		-----	
1957		-----		-----	
1960		-----		-----	
1988	ISO6976	52.5352		-----	
	normality	not OK			
	n	18			
	outliers	2 (+2 excl)			
	mean (n)	52.5269			
	st.dev. (n)	0.07768			
	R(calc.)	0.2175			
	R(lit)	unknown			Compare R(iis14S01M) = 0.2496

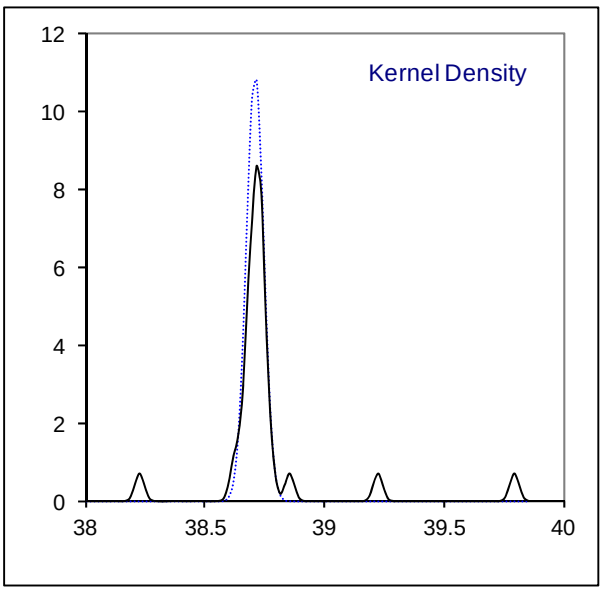

54
53
52
51
50
49
48
1106
1689
963
868
862
1679
1943
352
840
1489
1654
496
922
316
1930
1988
1388
1779
663
974
593
1580


Kernel Density
10
9
8
7
6
5
4
3
2
1
0
50
51
52
53
54

Determination of Caloric Value Superior (101.325 kPa, comb. temp. 15°C, metering temp 15°C) on sample #15030; results in MJ/m^3 (real gas)

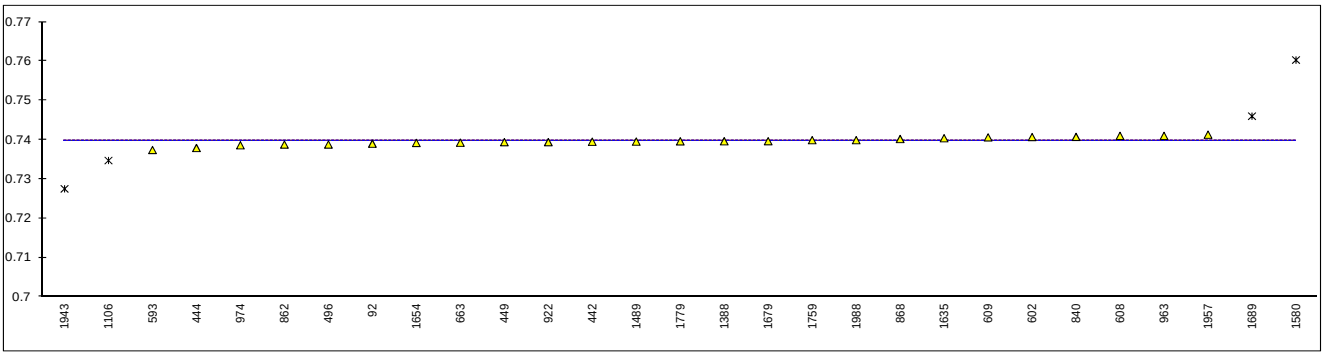
lab	method	value	mark	z(targ)	remarks
92		38.73	E	-----	iis calculated 38.673
150		-----		-----	
171		-----		-----	
225		-----		-----	
316		-----		-----	
352		-----		-----	
442	ISO6974	38.69		-----	
444	ISO6976	38.738		-----	
449	ISO6976	38.720		-----	
496	DIN51857	38.6836		-----	
593	ISO6976	38.854	R(0.05),E	-----	iis calculated 38.818
602	ISO6976	38.7411		-----	
608		-----		-----	
609	ISO6976	38.7290		-----	
663	ISO6976	38.773		-----	
840	ISO6976	38.725		-----	
851		-----		-----	
862	ISO6976	38.666	E	-----	iis calculated 38.703
868	ISO6976	38.68		-----	
887	D3588	38.63997	C	-----	First reported at 25ºC/ 0ºC
922	ISO6976	38.704		-----	
963	ISO6976	38.62		-----	
974	GPA2172	38.738		-----	
1011		-----		-----	
1029		-----		-----	
1069		-----		-----	
1081		-----		-----	
1095		-----		-----	
1106	GPA2286	39.22402	ex, E	-----	See §4.1, iis calculated 39.314
1197		-----		-----	
1198		-----		-----	
1200		-----		-----	
1307		-----		-----	
1388	ISO6976	38.722		-----	
1489	ISO6976	34.912	R(0.01), E	-----	iis calculated 38.699
1580	GB/T11062	39.795	ex, E	-----	See §4.1, iis calculated 38.486
1594		-----		-----	
1635	ISO6976	38.681		-----	
1654	ISO6976	38.696		-----	
1679	ISO6976	38.690		-----	
1689	GB/T11062	38.226	C,R(0.01),E	-----	First reported 38.165, iis calculated 38.300
1737		-----		-----	
1759	ISO6976	38.7088		-----	
1779	ISO6976	38.7651		-----	
1788		-----		-----	
1892		-----		-----	
1930		-----		-----	
1943	ISO6976	38.7187	E	-----	iis calculated 38.678
1957	ISO6976	38.74	E	-----	iis calculated 38.725
1960		-----		-----	
1988	ISO6976	38.7258		-----	
	normality	OK			
	n	24			
	outliers	3 (+2 excl)			
	mean (n)	38.7094			
	st.dev. (n)	0.03635			
	R(calc.)	0.1018			
	R(lit)	unknown			Compare R(iis14S01M) = 0.1510

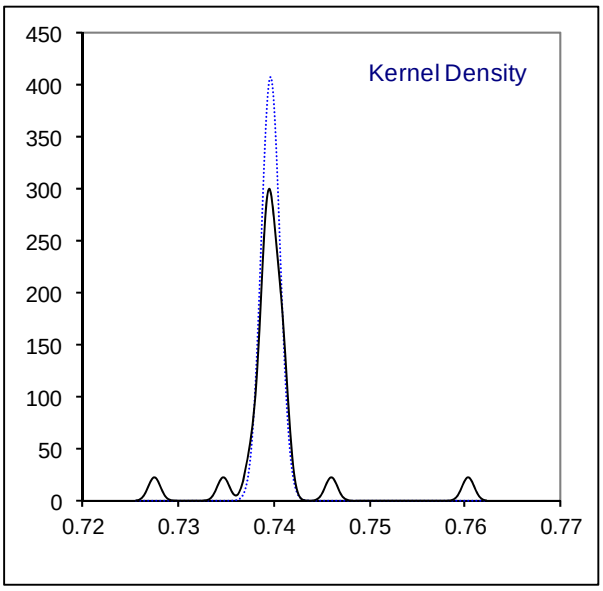

40
39.5
39
38.5
38
37.5
37
1489
1689
963
887
862
868
1635
496
442
1679
1654
922
1759
1943
449
1388
840
1988
609
92
444
974
1957
602
1779
663
593
1106
1580


Kernel Density
12
10
8
6
4
2
0
38
38.5
39
39.5
40

Determination of Density (101.325 kPa, combustion temp. 15°C, metering temp. 15°C) on sample #15030; results in kg/m^3 (real gas)

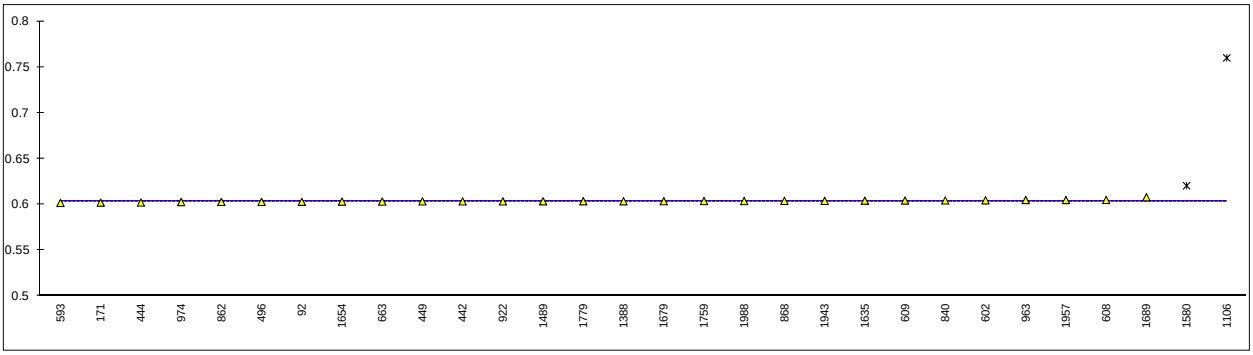
lab	method	value	mark	z(targ)	remarks
92	GPA2286	0.739		-----	
150		-----		-----	
171		-----		-----	
225		-----		-----	
316		-----		-----	
352		-----		-----	
442	ISO6974	0.7395		-----	
444	ISO6976	0.7379		-----	
449	ISO6976	0.7394		-----	
496	DIN51857	0.738792		-----	
593	ISO6976	0.7374		-----	
602	ISO6976	0.7407		-----	
608	ISO6976	0.741		-----	
609	ISO6976	0.74061		-----	
663	ISO6976	0.73926		-----	
840	ISO6976	0.74074		-----	
851		-----		-----	
862	ISO6976	0.73878		-----	
868	ISO6976	0.7402		-----	
887		-----		-----	
922	ISO6976	0.7394		-----	
963	ISO6976	0.7410		-----	
974	GPA2172	0.7386	E	-----	iis calculated 0.73745
1011		-----		-----	
1029		-----		-----	
1069		-----		-----	
1081		-----		-----	
1095		-----		-----	
1106	GPA2286	0.734713	ex, E	-----	See §4.1, iis calculated 0.73575
1197		-----		-----	
1198		-----		-----	
1200		-----		-----	
1307		-----		-----	
1388	ISO6976	0.73962		-----	
1489	ISO6976	0.73954		-----	
1580	GB/T11062	0.7603	ex, E	-----	See §4.1, iis calculated 0.73533
1594		-----		-----	
1635	ISO6976	0.7404		-----	
1654	ISO6976	0.7392		-----	
1679	ISO6976	0.73964		-----	
1689	GB/T11062	0.746	C,R(0.01)	-----	First reported 0.605
1737		-----		-----	
1759	ISO6976	0.7399		-----	
1779	ISO6976	0.73961		-----	
1788		-----		-----	
1892		-----		-----	
1930		-----		-----	
1943	ISO6976	0.7275	R(0.01), E	-----	iis calculated 0.73929
1957	ISO6976	0.7413		-----	
1960		-----		-----	
1988	ISO6976	0.7399		-----	
	normality	OK			
	n	25			
	outliers	2 (+2 excl)			
	mean (n)	0.7397			
	st.dev. (n)	0.00096			
	R(calc.)	0.0027			
	R(lit)	unknown			Compare R(iis14S01M) = 0.0043

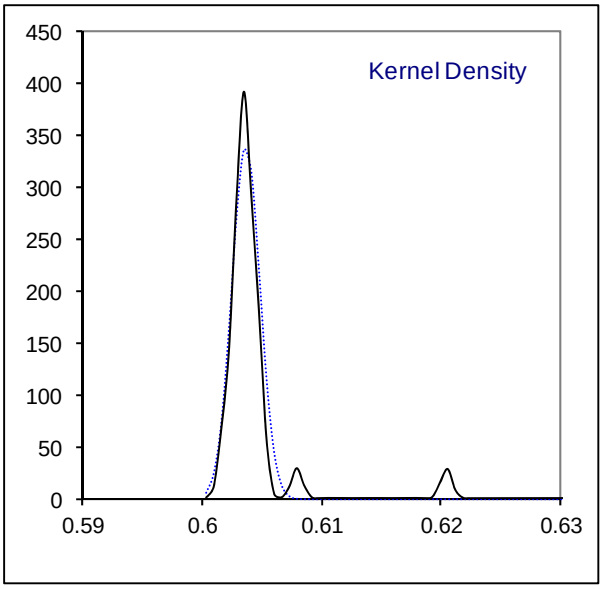

0.77
0.76
0.75
0.74
0.73
0.72
0.71
0.7
1943
1106
593
444
974
862
496
92
1654
663
449
922
442
1489
1779
1388
1679
1759
1988
868
1635
609
602
840
608
963
1957
1689
1580


Kernel Density
450
400
350
300
250
200
150
100
50
0
0.72
0.73
0.74
0.75
0.76
0.77

Determination of Relative Density (101.325 kPa, comb. temp. 15°C, metering temp. 15°C) on sample #15030; results have no unit (real gas)

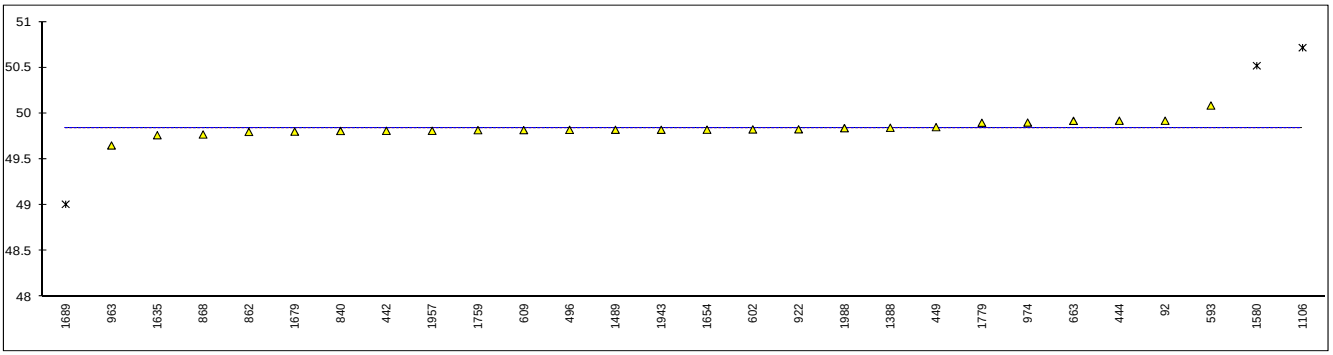
lab	method	value	mark	z(targ)	remarks
92	GPA2286	0.603		-----	
150		-----		-----	
171	D3588	0.6021	E	-----	Iis calculated 0.60325
225		-----		-----	
316		-----		-----	
352		-----		-----	
442	ISO6974	0.6034		-----	
444	ISO6976	0.6022		-----	
449	ISO6976	0.6034		-----	
496	DIN51857	0.602894		-----	
593	ISO6976	0.6018		-----	
602	ISO6976	0.6046		-----	
608	ISO6976	0.605		-----	
609	ISO6976	0.60437		-----	
663	ISO6976	0.60329		-----	
840	ISO6976	0.60448		-----	
851		-----		-----	
862	ISO6976	0.60288		-----	
868	ISO6976	0.6040		-----	
887		-----		-----	
922	ISO6976	0.6034		-----	
963	ISO6976	0.6049		-----	
974	GPA2172	0.6027		-----	
1011		-----		-----	
1029		-----		-----	
1069		-----		-----	
1081		-----		-----	
1095		-----		-----	
1106	GPA2286	0.759981	ex, E	-----	See §4.1, iis calculated 0.60041
1197		-----		-----	
1198		-----		-----	
1200		-----		-----	
1307		-----		-----	
1388	ISO6976	0.60357		-----	
1489	ISO6976	0.60352		-----	
1580	GB/T11062	0.6205	ex, E	-----	See §4.1, iis calculated 0.60007
1594		-----		-----	
1635	ISO6976	0.6042		-----	
1654	ISO6976	0.6032		-----	
1679	ISO6976	0.60359		-----	
1689	GB/T11062	0.608	C	-----	First reported 0.742
1737		-----		-----	
1759	ISO6976	0.6038		-----	
1779	ISO6976	0.60356		-----	
1788		-----		-----	
1892		-----		-----	
1930		-----		-----	
1943	ISO6976	0.6040		-----	
1957	ISO6976	0.6049		-----	
1960		-----		-----	
1988	ISO6976	0.6038		-----	
	normality	not OK			
	n	28			
	outliers	0 (+2 excl)			
	mean (n)	0.6037			
	st.dev. (n)	0.00118			
	R(calc.)	0.0033			
	R(lit)	unknown			Comprae R(iis14S01M) = 0.0029

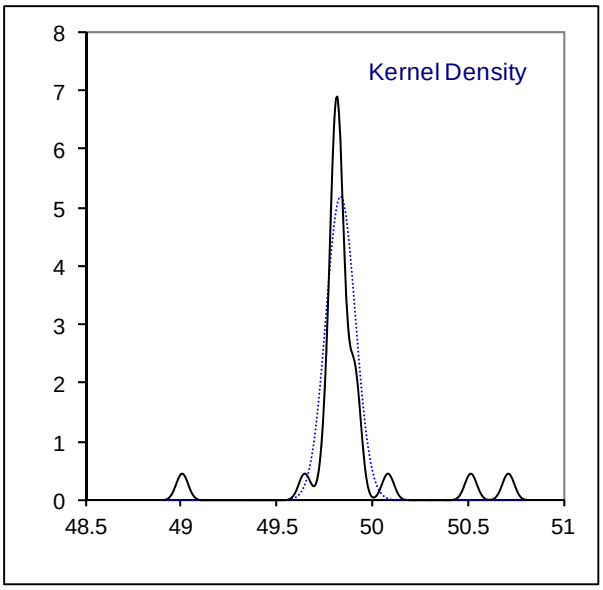

0.8
0.75
0.7
0.65
0.6
0.55
0.5
593
171
444
974
862
496
92
1654
663
449
442
922
1489
1779
1388
1679
1759
1988
868
1943
1635
609
840
602
963
1957
608
1689
1580
1106


Kernel Density
450
400
350
300
250
200
150
100
50
0
0.59
0.6
0.61
0.62
0.63

Determination of Wobbe Index (101.325 kPa, combustion temp. 15°C, metering temp. 15°C) on sample #15030; results in MJ/m^3

lab	method	value	mark	z(targ)	remarks
92	ISO6976	49.92	E	-----	Iis calculated 49.80
150		-----		-----	
171		-----		-----	
225		-----		-----	
316		-----		-----	
352		-----		-----	
442	ISO6974	49.8100		-----	
444	ISO6976	49.920		-----	
449	ISO6976	49.8500		-----	
496	DIN51857	49.8203		-----	
593	ISO6976	50.086		-----	
602	ISO6976	49.8250		-----	
608		-----		-----	
609	ISO6976	49.8177		-----	
663	ISO6976	49.919		-----	
840	ISO6976	49.808		-----	
851		-----		-----	
862	ISO6976	49.798		-----	
868	ISO6976	49.77		-----	
887		-----		-----	
922	ISO6976	49.826		-----	
963	ISO6976	49.65		-----	
974	GPA2172	49.90		-----	
1011		-----		-----	
1029		-----		-----	
1069		-----		-----	
1081		-----		-----	
1095		-----		-----	
1106	GPA2286	50.7166	ex	-----	See §4.1
1197		-----		-----	
1198		-----		-----	
1200		-----		-----	
1307		-----		-----	
1388	ISO6976	49.843		-----	
1489	ISO6976	49.821		-----	
1580	GB/T11062	50.520	ex, E	-----	See §4.1, iis calculated 49.683
1594		-----		-----	
1635	ISO6976	49.762		-----	
1654	ISO6976	49.822		-----	
1679	ISO6976	49.801		-----	
1689	GB/T11062	49.008	C,R(0.01)	-----	First reported 49.162
1737		-----		-----	
1759	ISO6976	49.8170		-----	
1779	ISO6976	49.8978		-----	
1788		-----		-----	
1892		-----		-----	
1930		-----		-----	
1943	ISO6976	49.8210		-----	
1957	ISO6976	49.81		-----	
1960		-----		-----	
1988	ISO6976	49.8390		-----	
	normality	not OK			
	n	25			
	outliers	1 (+2 excl)			
	mean (n)	49.8382			
	st.dev. (n)	0.07708			
	R(calc.)	0.2158			
	R(lit)	unknown			Compare R(iis14S01M) = 0.2417


51
50.5
50
49.5
49
48.5
48
1689
963
1635
868
862
1679
840
442
1957
1759
609
496
1489
1943
1654
602
922
1988
1388
449
1779
974
663
444
92
583
1580
1106


Kernel Density
8
7
6
5
4
3
2
1
0
48.5
49
49.5
50
50.5
51

APPENDIX 2

Number of participants per country

1 lab in AUSTRALIA
1 lab in BELGIUM
1 lab in BRUNEI
1 lab in CANADA
7 labs in CHINA, People's Republic
1 lab in COTE D'IVOIRE
1 lab in CROATIA
1 lab in ECUADOR
1 lab in FINLAND
1 lab in FRANCE
2 labs in GERMANY
1 lab in HONG KONG
1 lab in IRAQ
1 lab in LATVIA
1 lab in LITHUANIA
7 labs in MALAYSIA
2 labs in NETHERLANDS
1 lab in PAKISTAN
1 lab in PERU
4 labs in PORTUGAL
2 labs in SAUDI ARABIA
1 lab in SERBIA
1 lab in SLOVAKIA
1 lab in TAIWAN
1 lab in THAILAND
1 lab in TURKEY
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 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 ISO 6974, Natural Gas – Determination of composition with defined uncertainty by GC

3 ASTM E178-89

4 ASTM E1301-89

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.

15 ASTM D1945, Standard test method for Analysis of Natural Gas by GC

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