

Results of Proficiency Test
Natural Gas Analysis
March 2014

Organised by: Institute for Interlaboratory Studies
Spijkenisse, the Netherlands

Author: ing. C. Nijssen-Wester
Corrector: dr. R.G. Visser & ing. R.J. Starink
Report: iis14S01M

June 2014

CONTENTS

1	INTRODUCTION.....	3
2	SET UP.....	3
2.1	QUALITY SYSTEM.....	3
2.2	PROTOCOL.....	3
2.3	CONFIDENTIALITY STATEMENT.....	4
2.4	SAMPLES.....	4
2.5	STABILITY OF THE SAMPLES.....	5
2.6	ANALYSES.....	5
3	RESULTS.....	5
3.1	STATISTICS.....	5
3.2	GRAPHICS.....	6
3.3	Z-SCORES.....	6
4	EVALUATION.....	7
4.1	EVALUATION PER TEST/COMPONENT.....	7
4.2	PERFORMANCE EVALUATION FOR THE GROUP OF LABORATORIES.....	11
4.3	COMPARISON OF THE PROFICIENCY TEST OF MARCH 2014 WITH PREVIOUS PTS.....	12
4.4	DISCUSSION.....	13

Appendices:

1.	Data and statistical results.....	14
2.	Compression factors used by the participants.....	33
3.	Number of participants per country.....	34
4.	Abbreviations and literature.....	35

1 INTRODUCTION

Since 2009, the Institute organizes a proficiency scheme for Natural Gas (composition only). During the annual proficiency testing program 2013/2014, 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 43 laboratories in 27 different countries have participated. See appendix 3 for the number of participants per country. In this report, the results of the 2014 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 Spijkennisse, 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 44 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 Spijkennisse, the Netherlands, has implemented a quality system based on ISO/IEC17043:2010 (R007). This ensures strict adherence to protocols for sample preparation and statistical evaluation and 100% confidentiality of participant's data. Also customer's satisfaction is measured on regular basis by the distribution of questionnaires.

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

2.2 PROTOCOL

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

2.3 CONFIDENTIALITY STATEMENT

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

2.4 SAMPLES

In this proficiency test only one sample was used. A batch of 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 44 cylinders was prepared (job 14-077) starting in January, 2014. Each cylinder was uniquely numbered. Every cylinder in the batch was analysed using ten 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/mol
Methane	0.0024	0.0532
Ethane	0.0011	0.0359
Propane	0.0005	0.0179
n-Butane	0.0002	0.0045
iso-Butane	0.0002	0.0027
Carbon dioxide	0.0007	0.0180
Nitrogen	0.0012	0.0271

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 February 25, 2014.

2.5 STABILITY OF THE SAMPLES

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

2.6 ANALYSES

The participants were asked to determine: 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 and a letter of instructions were prepared and made available for download on the iis website. A SDS and a form to confirm receipt of the samples were 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.8 and 9) 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. 15). 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 4; 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. ASTM 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:

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

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

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 six laboratories reported results after the final reporting date and five participants were not able to report any test results. In total 38 participants reported 600 numerical results. Observed were 38 outlying results, which is 6.5% of the numerical results. It should be noted that three laboratories were responsible for 15 of these outliers. 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.

In the iis PT reports, ASTM methods are referred to with a number (e.g. D1945) and an added designation for the year that the method was adopted or revised (e.g. D1945:03). If applicable, a designation in parentheses is added to designate the year of reapproval (e.g. D1945:03(2010)). In the results tables of Appendix 1 only the method number and year of adoption or revision e.g. D1945:03 will be used.

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 527, 593 and 1864. 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. Five statistical outliers were detected. The calculated reproducibility after rejection of the statistical outliers is not at all in agreement with the requirements of ISO6974-3:2000, nor at all in agreement with ASTM D1945:2003(2010).
- Ethane: The determination of this component was not problematic. Two statistical outliers were detected and one test result was excluded. The calculated reproducibility after rejection of suspect data is in agreement with the requirements of ISO6974-3:2000 and ASTM D1945:2003(2010).
- Propane: The determination of this component may be problematic for a number of laboratories, depending on the test method used by the laboratory. Two statistical outliers were detected and two test results were excluded. The calculated reproducibility after rejection of the suspect data is not in agreement with the strict requirements of ISO6974-3:2000. However the calculated reproducibility is in agreement with the requirements of ASTM D1945:2003(2010).
- n-Butane: The determination of this component was not problematic. Four statistical outliers were detected and two test results were excluded. The calculated reproducibility after rejection of the suspect data is in agreement with the requirements of both ISO6974-3:2000 and ASTM D1945:2003(2010).
- i-Butane: The determination of this component was not problematic. Four statistical outliers were detected and one test result was excluded. The calculated reproducibility after rejection of the suspect data is in agreement with the requirements of both ISO6974-3:2000 and ASTM D1945:2003(2010).
- Carbon Dioxide: 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 in agreement with the requirements of ASTM D1945:2003(2010).
- Nitrogen: The determination of this component was problematic. Six statistical outliers were detected. The calculated reproducibility after rejection of the statistical outliers is not at all in agreement with the requirements of ISO6974-3:2000 and not in agreement with the requirements of ASTM D1945:2003(2010).

Calculated parameters, general remark:

In this PT, the calculated parameters were reported for three combustion temperatures (15, 25°C and 60°F) for real gas as well as for ideal gas. A very small number of labs (maximum of 4) reported results for 60°F. The number of participants with results for 15°C and 25°C varied between 11 and 21.

iis (re-)calculated all results for Caloric Value, Density, Relative Density and Wobbe Index according to ISO6976:1995. The calculations are based on the gas composition values, reported by the participating laboratories. These calculated results for real gas were also statistically evaluated and can be found in Appendix 1, in the tables for Caloric Value, Density, Relative Density and Wobbe Index.

Caloric Value:

The calculation at combustion temperature 25°C/metering temperature 0°C may be problematic. One statistical outlier was found in both real gas and ideal gas, however five results were marked as calculation errors. The spread for real gas was similar to the previously observed spread in iis13S01M. The spread for ideal gas was lower than that of iis13S01M.

The calculation at combustion temperature 15°C/metering temperature 15°C may be problematic. One statistical outlier was found in real gas, in ideal gas no outliers were found. Two results were marked as calculation errors. The spread for both real gas and ideal gas was lower than the previously observed spread in iis13S01M.

The calculation at combustion temperature 60°F/metering temperature 60°F was only done by four laboratories. No statistical conclusion can be made from this small number of results. However the average value was nearly the same as iis calculated from the gas composition results of all participants.

Density:

The calculation at combustion temperature 25°C/metering temperature 0°C may be problematic. Two statistical outliers were found in both real gas and ideal gas and four results were marked as calculation errors. The spread for real gas and ideal gas was higher than the previously observed spread in iis13S01M, but similar to the spread calculated by iis from the gas composition results of all participants.

The calculation at combustion temperature 15°C/metering temperature 15°C may be problematic. Two statistical outliers were found in real gas and one in ideal gas. Two results were marked as calculation errors. The spread for both real gas and ideal gas was somewhat higher than the previously observed spread in iis13S01M, but similar to the spread calculated by iis from the gas composition results of all participants.

The calculation at combustion temperature 60°F/metering temperature 60°F was only done by two or three laboratories. No statistical conclusion can be made from this small number of results. However the average value was nearly the same as iis calculated from all laboratories with gas composition results.

Relative density:

The calculation at combustion temperature 25°C/metering temperature 0°C did not seem to be problematic. No statistical outliers were found in both real gas and ideal gas and no calculation errors were observed. The spread for real gas and ideal gas was somewhat higher than the previously observed spread in iis13S01M, but similar to the spread calculated by iis from the gas composition results of all participants.

The calculation at combustion temperature 15°C/metering temperature 15°C may be problematic. One statistical outlier was found in real gas, this also was the only calculation error. The spread for both real gas and ideal gas was somewhat higher than the previously observed spread in iis13S01M, but similar to the spread calculated by iis from the gas composition results of all participants.

The calculation at combustion temperature 60°F/metering temperature 60°F was only done by two or three laboratories. No statistical conclusion can be made from this small number of results. However the average value was nearly the same as iis calculated from all laboratories with gas composition results.

Wobbe index:

The calculation at combustion temperature 25°C/metering temperature 0°C may be problematic. One statistical outlier was found in both real gas and ideal gas and 4 results were marked as calculation errors. The spread for real gas and ideal gas was similar to the previously observed spread in iis13S01M.

The calculation at combustion temperature 15°C/metering temperature 15°C may be problematic. No statistical outliers were found, however 4 results were marked as calculation errors. The spread for real gas and ideal gas was similar to the previously observed spread in iis13S01M.

The calculation at combustion temperature 60°F/metering temperature 60°F was only done by two or three laboratories. No statistical conclusion can be made from this small number of results. However the average value was nearly the same as iis calculated from all laboratories with gas composition results.

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	33	88.625	0.405	0.177	0.150
Ethane	%mol/mol	35	4.004	0.093	0.120	0.100
Propane	%mol/mol	34	1.991	0.072	0.060	0.100
n-Butane	%mol/mol	31	0.150	0.008	0.009	0.070
iso-Butane	%mol/mol	33	0.248	0.011	0.015	0.070
Carbon dioxide	%mol/mol	33	3.023	0.276	0.091	0.100
Nitrogen	%mol/mol	32	1.984	0.147	0.060	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 and values calculated by iis are compared in table 3, 4 and 5.

Combustion temperature 25°C, metering temperature 0°C, real gas								
Property	unit	n	cons. value	2.8 * sd		n	cons. Value	2.8 * sd
Caloric Value	MJ/m ³	15	40.6226	0.1855	iis calc.	32	40.6069	0.1480
Density	kg/m ³	15	0.8243	0.0058	iis calc.	32	0.8238	0.0042
Relative Dens.		16	0.6369	0.0025	iis calc.	32	0.6372	0.0033
Wobbe Index	MJ/m ³	15	50.8940	0.2496	iis calc.	32	50.8711	0.2351

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		n	cons. Value	2.8 * sd
Caloric Value	MJ/m ³	20	38.5178	0.1510	iis calc.	32	38.5135	0.1403
Density	kg/m ³	21	0.7801	0.0043	iis calc.	32	0.7806	0.0040
Relative Dens.		20	0.6367	0.0029	iis calc.	32	0.6370	0.0033
Wobbe Index	MJ/m ³	20	48.2705	0.2417	iis calc.	32	48.2563	0.2231

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

Combustion temperature 60°F, metering temperature 60°F, real gas								
Property	unit	n	cons. value	2.8 * sd		n	cons. Value	2.8 * sd
Caloric Value	MJ/m ³	4	38.4460	n.a.	iis calc.	32	38.4425	0.1400
Density	kg/m ³	3	0.7787	n.a.	iis calc.	32	0.7792	0.0040
Relative Dens.		3	0.6367	n.a.	iis calc.	32	0.6370	0.0033
Wobbe Index	MJ/m ³	3	48.2140	n.a.	iis calc.	32	48.1674	0.2227

Table 5: Performance of the group for combustion temperature of 60°F, real gas

4.3 COMPARISON OF THE PROFICIENCY TEST OF MARCH 2014 WITH PREVIOUS PTS

	2014	2013	2012	2011
Number of reporting labs	38	33	34	33
Number of results reported	600	466	475	330
Statistical outliers	38	29	23	16
Percentage outliers	6.5%	6.2%	4.8%	4.8%

Table 6: 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 NG were compared against the requirements of the two often used standard test methods. See the overview in the following table:

	2014 ISO6974-3	2014 D1945	2013 ISO6974-3	2013 D1945	2012 ISO6974-3	2012 D1945	2011 ISO6974-3	2011 D1945
Methane	--	--	--	--	--	--	--	--
Ethane	++	+	+	-	-	-	++	++
Propane	-	++	-	++	-	++	-	+/-
n-Butane	+/-	++	--	++	-	++	-	++
iso-Butane	++	++	-	++	-	++	-	++
Carbon dioxide	--	--	--	+/-	--	++	-	++
Nitrogen	--	--	--	--	--	--	--	-

Table 7: 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 improve on the determination of ethane, n-butane and i-butane.

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	88.616	88.625	0.009
Ethane	3.993	4.004	0.011
Propane	1.988	1.991	0.003
n-Butane	0.148	0.145	0.003
iso-Butane	0.247	0.248	0.001
Carbon dioxide	3.012	3.023	0.011
Nitrogen	1.995	1.984	0.011

Table 8: comparison of consensus values with values determined by the supplier EffecTech

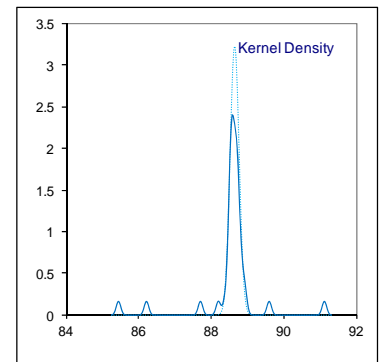
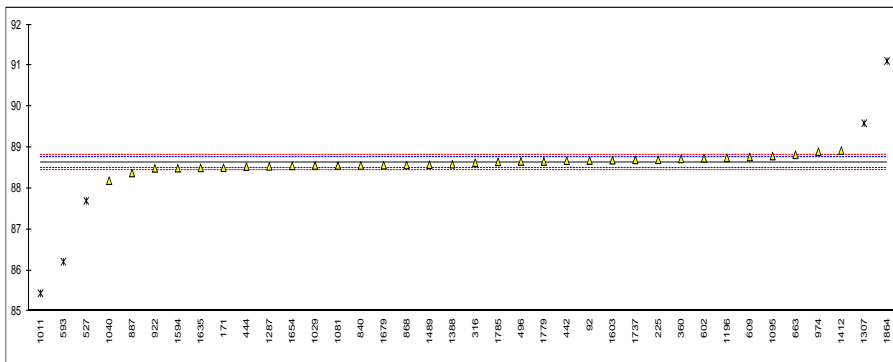
From the comparison in table 5 it is clear that the consensus values as determined in this PT are all very well in line with the values as determined during the preparation of the gas cylinders.

APPENDIX 1

Determination of Methane on sample #14030; results in %mol/mol

lab	method	value	mark	z(targ)	Remarks
92	GPA2286	88.68		0.87	
171	D1945	88.504		-1.91	
225	ISO6974	88.701		1.20	
316	ISO6974-3	88.628		0.05	
360	ISO6974	88.719	C	1.49	First reported: 87.771
442	D1945/ISO6974	88.6783		0.84	
444	D1945	88.534		-1.44	
449		-----		-----	
496	EN15984	88.659		0.54	
527	D1945	87.697	R(0.01)	-14.66	
593	D1945	86.21	C,R(0.01)	-38.15	First reported: 94.173
602	GPA2261	88.735		1.74	
608		-----		-----	
609	GPA2261	88.767	C	2.25	First reported: 88.756
663	D1945	88.823		3.13	
840	D1945-03	88.5616		-1.00	
868	GPA2261	88.573		-0.82	
887	D1945	88.376	C	-3.93	First reported: 88.207
922	D1945	88.49		-2.13	
963		-----		-----	
974	ISO6974	88.897	C	4.30	First reported: 88.916
1011	UOP539	85.44	R(0.01)	-50.31	
1029	D1945-03Mod.	88.560	C	-1.02	First reported: 88.407
1040	EN15984	88.19	C	-6.87	First reported: 88.12
1081	in house	88.56		-1.02	
1095	UOP539	88.79		2.61	
1196	GPA2261	88.749		1.96	
1200		-----		-----	
1287	ISO6974-3	88.539		-1.36	
1307	INH-RGA	89.590	R(0.01)	15.25	
1388	GPA2261	88.591		-0.54	
1412	D1945	88.925	C	4.74	First reported: 88.957
1489	ISO6974-3	88.580		-0.71	
1594	GPA2261	88.4937		-2.07	
1603	in house	88.690		1.03	
1635	D1945	88.501		-1.96	
1654	D1945	88.552		-1.15	
1679	ISO6974-3	88.567		-0.91	
1696		-----		-----	
1737	in house	88.698		1.16	
1779	GPA2261	88.659		0.54	
1785	GPA2261	88.650		0.40	
1864	D1945	91.110	R(0.01)	39.26	
	normality	suspect			
	n	33			
	outliers	5			
	mean (n)	88.6249			
	st.dev. (n)	0.14475			
	R(calc.)	0.4053			
	R(ISO6974-3:00)	0.1771			

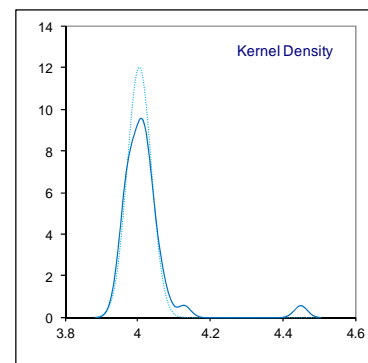
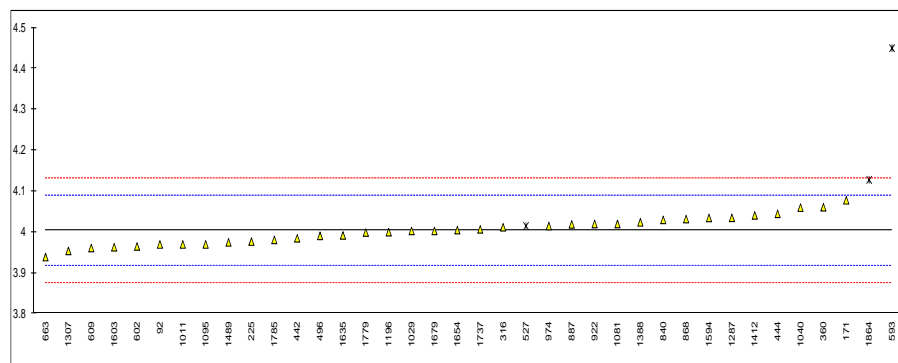
Compare R(ASTM D1945:03) = 0.1500



Determination of Ethane on sample #14030; results in %mol/mol

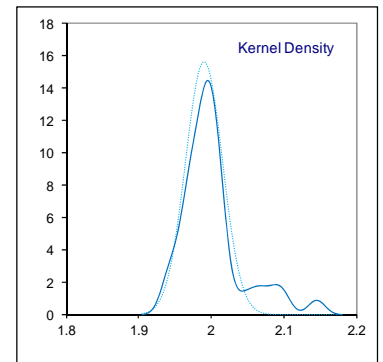
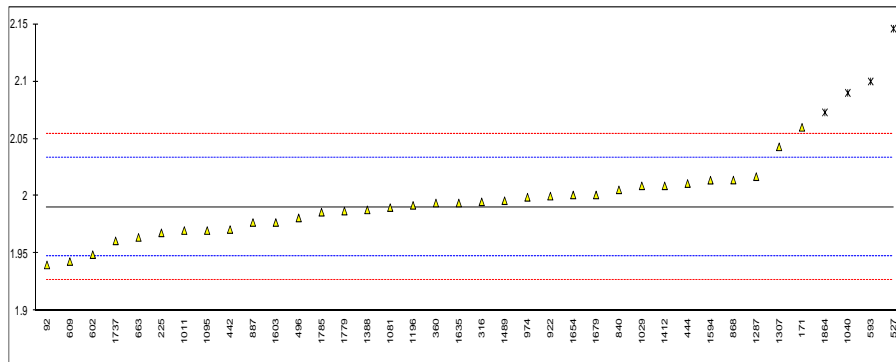
lab	method	value	mark	z(targ)	remarks
92	GPA2286	3.97		-0.79	
171	D1945	4.078		1.73	
225	ISO6974	3.977		-0.63	
316	ISO6974-3	4.012		0.19	
360	ISO6974	4.061		1.33	
442	D1945/ISO6974	3.9850		-0.44	
444	D1945	4.045		0.96	
449		----		----	
496	EN15984	3.991		-0.30	
527	D1945	4.015	ex	0.26	See §4.1
593	D1945	4.45	C,R(0.01)	10.40	First reported: 1.668
602	GPA2261	3.965		-0.91	
608		----		----	
609	GPA2261	3.961	C	-1.00	First reported: 3.960
663	D1945	3.939		-1.51	
840	D1945-03	4.0300		0.61	
868	GPA2261	4.032		0.65	
887	D1945	4.019	C	0.35	First reported: 4.010
922	D1945	4.02		0.38	
963		----		----	
974	ISO6974	4.015		0.26	
1011	UOP539	3.97		-0.79	
1029	D1945-03Mod.	4.003	C	-0.02	First reported: 4.053
1040	EN15984	4.06	C	1.31	First reported: 4.04
1081	in house	4.02		0.38	
1095	UOP539	3.97		-0.79	
1196	GPA2261	4.000		-0.09	
1200		----		----	
1287	ISO6974-3	4.035		0.72	
1307	INH-RGA	3.954		-1.16	
1388	GPA2261	4.024		0.47	
1412	D1945	4.041	C	0.86	First reported: 4.042
1489	ISO6974-3	3.975		-0.67	
1594	GPA2261	4.0348		0.72	
1603	in house	3.963		-0.95	
1635	D1945	3.992		-0.28	
1654	D1945	4.005		0.03	
1679	ISO6974-3	4.003		-0.02	
1696		----		----	
1737	in house	4.007		0.07	
1779	GPA2261	3.999		-0.11	
1785	GPA2261	3.981		-0.53	
1864	D1945	4.128	R(0.05)	2.89	
	normality	OK			
	n	35			
	outliers	2 (+1 ex)			
	mean (n)	4.0039			
	st.dev. (n)	0.03329			
	R(calc.)	0.0932			
	R(ISO6974-3:00)	0.1201			

Compare R(ASTM D1945:03) = 0.1000



Determination of Propane on sample #14030; results in %mol/mol

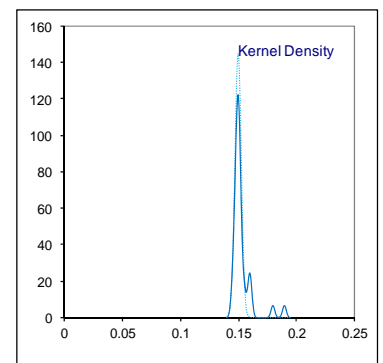
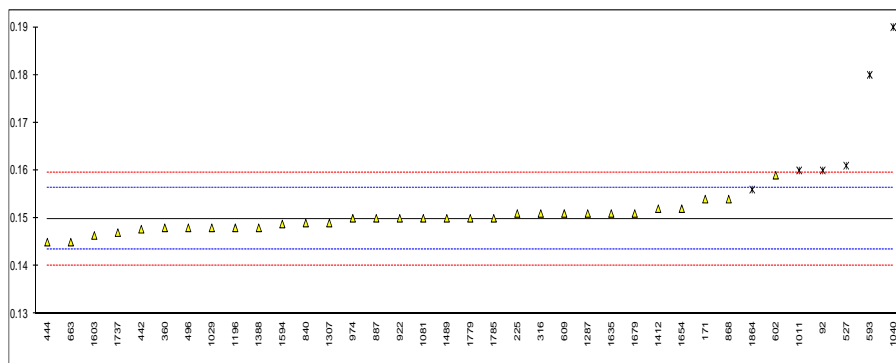
lab	method	value	mark	z(targ)	remarks
92	GPA2286	1.94		-2.37	
171	D1945	2.060		3.26	
225	ISO6974	1.968		-1.05	
316	ISO6974-3	1.995		0.21	
360	ISO6974	1.994	C	0.17	First reported: 2.258
442	D1945/ISO6974	1.9709		-0.92	
444	D1945	2.011		0.96	
449		-----		-----	
496	EN15984	1.981		-0.44	
527	D1945	2.146	R(0.01)	7.29	
593	D1945	2.10	ex,C	5.14	First reported: 1.669; see §4.1
602	GPA2261	1.949		-1.94	
608		-----		-----	
609	GPA2261	1.943		-2.23	
663	D1945	1.964		-1.24	
840	D1945-03	2.0055		0.70	
868	GPA2261	2.014		1.10	
887	D1945	1.977	C	-0.63	First reported: 1.974
922	D1945	2.00		0.45	
963		-----		-----	
974	ISO6974	1.999		0.40	
1011	UOP539	1.97		-0.96	
1029	D1945-03Mod.	2.009	C	0.87	First reported: 1.997
1040	EN15984	2.09	C,R(0.05)	4.67	First reported: 1.98
1081	in house	1.99		-0.02	
1095	UOP539	1.97		-0.96	
1196	GPA2261	1.992		0.07	
1200		-----		-----	
1287	ISO6974-3	2.017		1.24	
1307	INH-RGA	2.043		2.46	
1388	GPA2261	1.988		-0.12	
1412	D1945	2.009	C	0.87	First reported: 2.010
1489	ISO6974-3	1.996		0.26	
1594	GPA2261	2.0139		1.10	
1603	in house	1.977		-0.63	
1635	D1945	1.994		0.17	
1654	D1945	2.001		0.49	
1679	ISO6974-3	2.001		0.49	
1696		-----		-----	
1737	in house	1.961		-1.38	
1779	GPA2261	1.987		-0.16	
1785	GPA2261	1.986		-0.21	
1864	D1945	2.073	ex,C	3.87	See §4.1
normality		OK			
n		34			
outliers		2 (+2 ex)			
mean (n)		1.9905			
st.dev. (n)		0.02552			
R(calc.)		0.0715			
R(ISO6974-3:00)		0.0600			Compare R(ASTM D1945:03) = 0.1000



Determination of n-Butane on sample #14030; results in %mol/mol

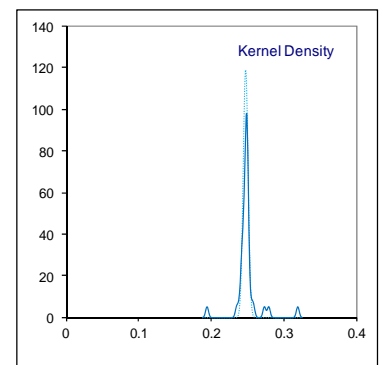
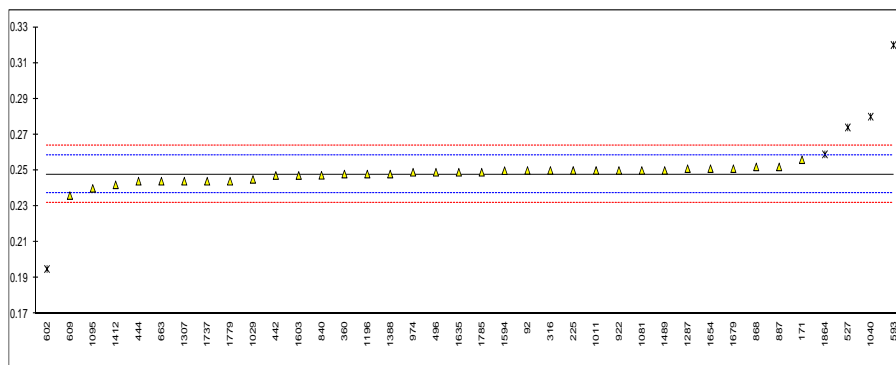
lab	method	value	mark	z(targ)	remarks
92	GPA2286	0.16	R(0.05)	3.17	
171	D1945	0.154		1.30	
225	ISO6974	0.151		0.36	
316	ISO6974-3	0.151		0.36	
360	ISO6974	0.148	C	-0.57	First reported: 0.233
442	D1945/ISO6974	0.1477		-0.67	
444	D1945	0.145		-1.51	
449		----		----	
496	EN15984	0.148		-0.57	
527	D1945	0.161	ex	3.48	See §4.1
593	D1945	0.18	C,R(0.01)	9.39	First reported: 0.033
602	GPA2261	0.159		2.85	
608		----		----	
609	GPA2261	0.151	C	0.36	First reported: 0.165
663	D1945	0.145	C	-1.51	First reported: 0.244
840	D1945-03	0.1490		-0.26	
868	GPA2261	0.154		1.30	
887	D1945	0.150		0.05	
922	D1945	0.15		0.05	
963		----		----	
974	ISO6974	0.150		0.05	
1011	UOP539	0.16	R(0.05)	3.17	
1029	D1945-03Mod.	0.148	C	-0.57	First reported: 0.147
1040	EN15984	0.19	C,R(0.01)	12.51	First reported: 0.15
1081	in house	0.15		0.05	
1095		----	W	----	First reported: 0.13
1196	GPA2261	0.148		-0.57	
1200		----		----	
1287	ISO6974-3	0.151		0.36	
1307	INH-RGA	0.149		-0.26	
1388	GPA2261	0.148		-0.57	
1412	D1945	0.152	C	0.67	First reported: 0.242
1489	ISO6974-3	0.150		0.05	
1594	GPA2261	0.1488		-0.32	
1603	in house	0.1464		-1.07	
1635	D1945	0.151		0.36	
1654	D1945	0.152		0.67	
1679	ISO6974-3	0.151		0.36	
1696		----		----	
1737	in house	0.147		-0.88	
1779	GPA2261	0.150		0.05	
1785	GPA2261	0.150		0.05	
1864	D1945	0.156	ex	1.92	See §4.1
normality		not OK			
n		31			
outliers		4 (+ 2 ex)			
mean (n)		0.1498			
st.dev. (n)		0.00275			
R(calc.)		0.0077			
R(ISO6974-3:00)		0.0091			

Compare R(ASTM D1945:03) = 0.0700



Determination of iso-Butane on sample #14030; results in %mol/mol

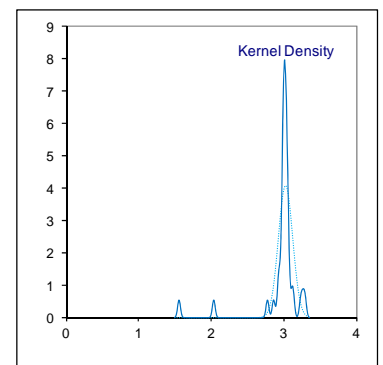
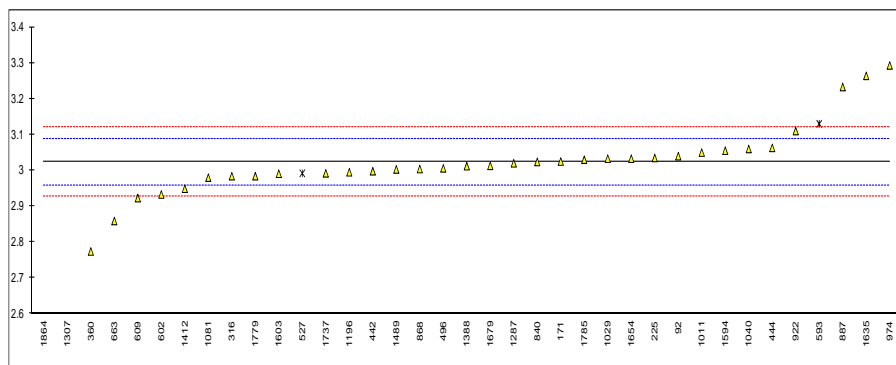
lab	method	value	mark	z(targ)	remarks
92	GPA2286	0.25		0.41	
171	D1945	0.256		1.54	
225	ISO6974	0.250		0.41	
316	ISO6974-3	0.250		0.41	
360	ISO6974	0.248	C	0.04	First reported: 0.310
442	D1945/ISO6974	0.2472		-0.11	
444	D1945	0.244		-0.72	
449		-----		-----	
496	EN15984	0.249		0.22	
527	D1945	0.274	R(0.01)	4.93	
593	D1945	0.32	C,R(0.01)	13.58	First reported: 0.207
602	GPA2261	0.195	R(0.01)	-9.93	
608		-----		-----	
609	GPA2261	0.236	C	-2.22	First reported: 0.235
663	D1945	0.244	C	-0.72	First reported: 0.145
840	D1945-03	0.2473		-0.10	
868	GPA2261	0.252		0.79	
887	D1945	0.252	C	0.79	First reported: 0.251
922	D1945	0.25		0.41	
963		-----		-----	
974	ISO6974	0.249		0.22	
1011	UOP539	0.25		0.41	
1029	D1945-03Mod.	0.245	C	-0.53	First reported: 0.248
1040	EN15984	0.28	C,R(0.01)	6.05	First reported: 0.25
1081	in house	0.25		0.41	
1095	UOP539	0.24		-1.47	
1196	GPA2261	0.248		0.04	
1200		-----		-----	
1287	ISO6974-3	0.251		0.60	
1307	INH-RGA	0.244		-0.72	
1388	GPA2261	0.248		0.04	
1412	D1945	0.242	C	-1.09	First reported: 0.152
1489	ISO6974-3	0.250		0.41	
1594	GPA2261	0.2499		0.39	
1603	in house	0.2472		-0.11	
1635	D1945	0.249		0.22	
1654	D1945	0.251		0.60	
1679	ISO6974-3	0.251		0.60	
1696		-----		-----	
1737	in house	0.244		-0.72	
1779	GPA2261	0.244		-0.72	
1785	GPA2261	0.249		0.22	
1864	D1945	0.259	ex	2.11	See §4.1
normality		suspect			
n		33			
outliers		4 (+ 1ex)			
mean (n)		0.2478			
st.dev. (n)		0.00392			
R(calc.)		0.0110			
R(ISO6974-3:00)		0.0149			Compare R(ASTM D1945:03) = 0.0700



Determination of Carbon Dioxide on sample #14030; results in %mol/mol

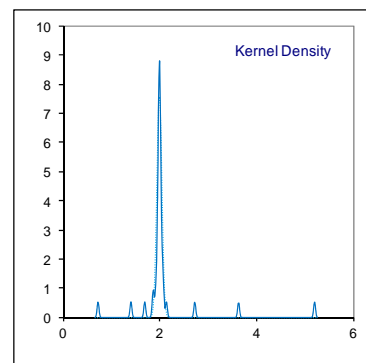
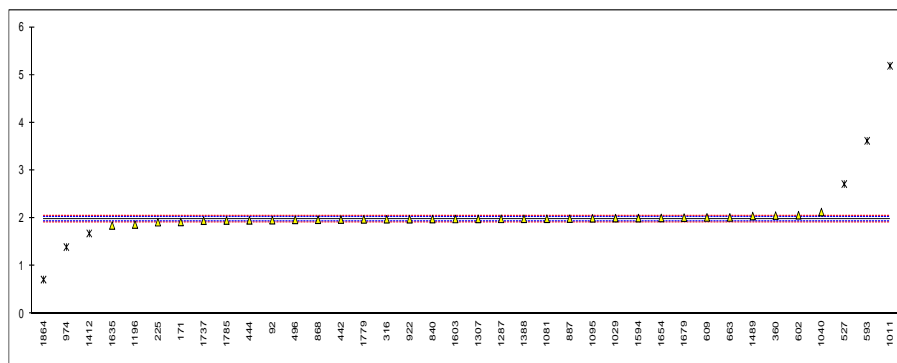
lab	method	value	mark	z(targ)	remarks
92	GPA2286	3.04		0.52	
171	D1945	3.025		0.05	
225	ISO6974	3.035		0.36	
316	ISO6974-3	2.984		-1.21	
360	ISO6974	2.774	C	-7.69	First reported: 3.311
442	D1945/ISO6974	2.9979		-0.78	
444	D1945	3.063		1.23	
449		----		----	
496	EN15984	3.006		-0.53	
527	D1945	2.992	ex	-0.96	See §4.1
593	D1945	3.13	ex,C	3.29	First reported: 0.303; see §4.1
602	GPA2261	2.933		-2.79	
608		----		----	
609	GPA2261	2.923	C	-3.09	First reported: 2.922
663	D1945	2.859		-5.07	
840	D1945-03	3.0240		0.02	
868	GPA2261	3.004		-0.59	
887	D1945	3.233	C	6.47	First reported: 3.418
922	D1945	3.11		2.68	
963		----		----	
974	ISO6974	3.293	C	8.32	First reported: 3.231
1011	UOP539	3.05		0.82	
1029	D1945-03Mod.	3.033	C	0.30	First reported: 3.034
1040	EN15984	3.06	C	1.13	First reported: 2.97
1081	in house	2.98		-1.34	
1095		----	W	----	First reported: 2.89
1196	GPA2261	2.995		-0.87	
1200		----		----	
1287	ISO6974-3	3.020		-0.10	
1307	INH-RGA	2.035	R(0.01)	-30.49	
1388	GPA2261	3.012		-0.35	
1412	D1945	2.949		-2.29	
1489	ISO6974-3	3.003		-0.63	
1594	GPA2261	3.0553		0.99	
1603	in house	2.991		-1.00	
1635	D1945	3.264		7.43	
1654	D1945	3.033		0.30	
1679	ISO6974-3	3.013		-0.32	
1696		----		----	
1737	in house	2.992		-0.96	
1779	GPA2261	2.984		-1.21	
1785	GPA2261	3.030		0.21	
1864	D1945	1.557	R(0.01)	-45.23	
normality		not OK			
n		33			
outliers		2 (+2 ex)			
mean (n)		3.0233			
st.dev. (n)		0.09844			
R(calc.)		0.2756			
R(ISO6974-3:00)		0.0908			

Compare R(ASTM D1945:03) = 0.1000



Determination of Nitrogen on sample #14030; results in %mol/mol

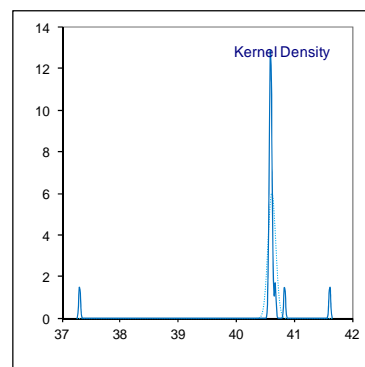
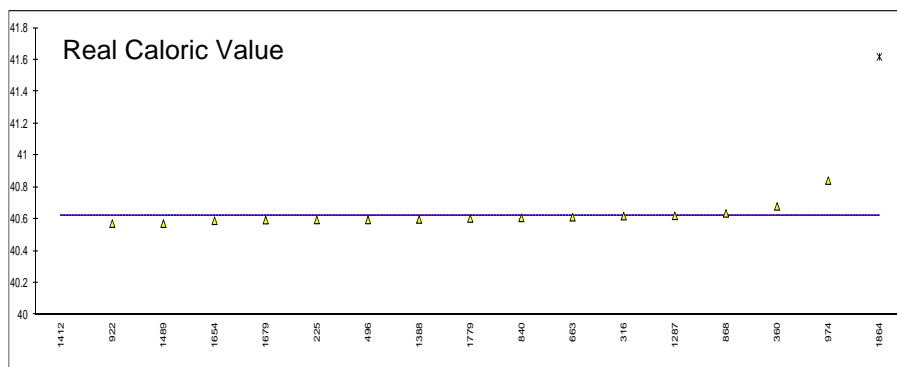
lab	method	value	mark	z(targ)	remarks
92	GPA2286	1.96		-1.14	
171	D1945	1.923		-2.88	
225	ISO6974	1.918		-3.12	
316	ISO6974-3	1.979		-0.25	
360	ISO6974	2.056		3.37	
442	D1945/ISO6974	1.9731		-0.53	
444	D1945	1.955		-1.38	
449		----		----	
496	EN15984	1.967		-0.81	
527	D1945	2.716	R(0.01)	34.42	
593	D1945	3.62	C,R(0.01)	76.94	First reported: 1.947
602	GPA2261	2.064		3.75	
608		----		----	
609	GPA2261	2.018		1.59	
663	D1945	2.018		1.59	
840	D1945-03	1.9826		-0.08	
868	GPA2261	1.970		-0.67	
887	D1945	1.993	C	0.41	First reported: 1.990
922	D1945	1.98		-0.20	
963		----		----	
974	ISO6974	1.397	C,R(0.01)	-27.62	First reported: 1.440
1011	UOP539	5.19	R(0.01)	150.79	
1029	D1945-03Mod.	2.002	C	0.83	First reported: 2.115
1040	EN15984	2.13	C	6.85	First reported: 2.30
1081	in house	1.99		0.27	
1095	UOP539	2.00		0.74	
1196	GPA2261	1.868		-5.47	
1200		----		----	
1287	ISO6974-3	1.988		0.18	
1307	INH-RGA	1.987		0.13	
1388	GPA2261	1.989		0.22	
1412	D1945	1.682	C,R(0.01)	-14.22	First reported: 1.648
1489	ISO6974-3	2.046		2.90	
1594	GPA2261	2.0038		0.92	
1603	in house	1.985		0.03	
1635	D1945	1.849		-6.36	
1654	D1945	2.007		1.07	
1679	ISO6974-3	2.014		1.40	
1696		----		----	
1737	in house	1.950		-1.61	
1779	GPA2261	1.977		-0.34	
1785	GPA2261	1.954		-1.42	
1864	D1945	0.717	R(0.01)	-59.61	
	normality	not OK			
	n	32			
	outliers	6			
	mean (n)	1.9843			
	st.dev. (n)	0.05253			
	R(calc.)	0.1471			
	R(ISO6974-3:00)	0.0595			Compare R(ASTM D1945:03) = 0.1000



Determination of Caloric Value (sup) (101.325 kPa, comb. temp. 25°C, metering temp 0°C) on sample #14030; results in MJ/m³

Lab	method	real gas	mark	iis calc.	mark	ideal gas	mark	Remarks
92		----		40.5659		----		
171		----		40.6911		----		
225	ISO6976	40.595		40.5955		40.477		
316	ISO6976	40.619		40.6177		40.497		
360	ISO6976	40.680	C	40.6805		40.562	C	First reported 40.757 vs 40.635
442		----		40.5870		----		
444		----		40.6040		----		
449		----		----		----		
496	DIN51857	40.595		40.5963		40.477		
527		----		40.4425	ex	----		See §4.1
593		----		40.1919	ex	----		See §4.1
602		----		40.5208		----		
608		----		----		----		
609		----		40.5674		----		
663	ISO6976	40.612	E	40.5976		40.494	E	iis calc. ideal: 40.480
840	ISO6976	40.6083		40.6083		40.4896		
868	ISO6976	40.636		40.6353		40.517		
887		----		40.5059		----		
922	ISO6976	40.572		40.5722		40.453		
963		----		----		----		
974	GPA2172	40.842	E	40.7296		----		
1011		----		39.3011	G(0.01)	----		
1029		----		40.5880		----		
1040		----		40.6607		----		
1081		----		40.5898		----		
1095		----		----		----		
1196		----		40.6482		----		
1200		----		----		----		
1287	ISO6976	40.621		40.6217		40.502		
1307		----		40.9966	G(0.01)	----		
1388	ISO6976	40.598		40.5980		40.480		
1412	ISO6976	37.313	C,E,G(0.01)	40.7617		37.234	C,E,G(0.01)	iis calc. ideal: 40.642
1489	ISO6976	40.572		40.5723		40.454		first reported 37.326 vs 37.248
1594		----		40.5961		----		
1603		----		40.5806		----		
1635		----		40.5514		----		
1654	ISO6976	40.590		40.5912		----		
1679	ISO6976	40.594		40.5944		40.476		
1696		----		----		----		
1737		----		40.5954		----		
1779	ISO6976	40.604		40.6040		40.485		
1785		----		40.5933		----		
1864	ISO6976	41.619	ex	41.7834	ex	41.519	ex	See §4.1
normality		not OK		not OK		not OK		
n		15		32		13		
outliers		1 (+1 ex)		2 (+3ex)		1 (+1ex)		
mean (n)		40.6226		40.6069		40.4895		
st.dev. (n)		0.06623		0.0528		0.02805		
R(calc.)		0.1855		0.1480		0.0786		
R(lit)		Unknown		Unknown		Unknown		
Comp.	R(iis13S01M)	0.1602		----		0.1214		

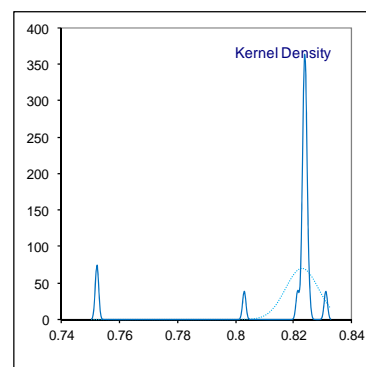
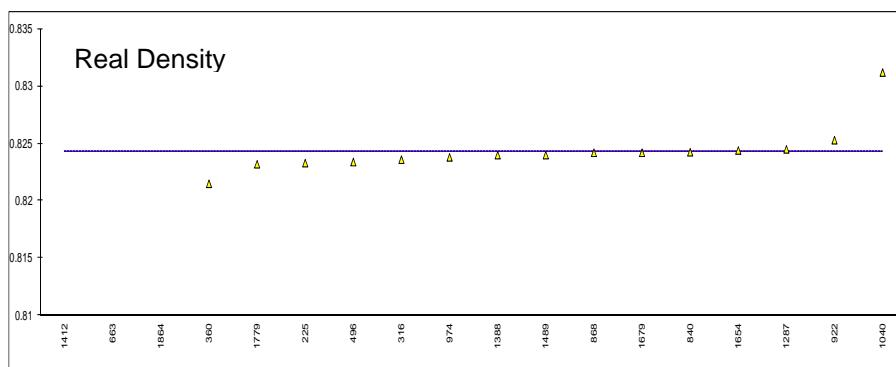
Since the R(lit) is unknown, no Z-scores could be calculated.



Determination of Density (101.325 kPa, combustion temp. 25°C, metering temp. 0°C) on sample #14030; results in kg/m³

Lab	method	real gas	mark	iis calc.	mark	ideal gas	mark	remarks
92		----		0.8234		----		
171		----		0.8252		----		
225	ISO6976	0.8233		0.8233		0.8209		
316	ISO6976	0.8236		0.8236		0.8211		
360	ISO6976	0.8215	C	0.8215		0.8192	C	First reported 0.8344 vs 0.8319
442		----		0.8231		----		
444		----		0.8246		----		
449		----		----		----		
496	DIN51857	0.82339		0.8234		0.82098		
527		----		0.8302	ex	----		See §4.1
593		----		0.8402	ex	----		See §4.1
602		----		0.8216		----		
608		----		----		----		
609		----		0.8218		----		
663	ISO6976	0.7525	E,G(0.01)	0.8211		0.7503	E,DG(0.01)	iis calc. ideal: 0.8187
840	ISO6976	0.82425		0.8242		0.82184		
868	ISO6976	0.8242		0.8242		0.8218		
887		----		0.8266		----		
922	ISO6976	0.8253		0.8252		0.8228		
963		----		----		----		
974	GPA2172	0.8238		0.8244		----		
1011		----		0.8413	G(0.01)	----		
1029		----		0.8243		----		
1040	EN15984	0.8312		0.8281		----		
1081		----		0.8231		----		
1095		----		----		----		
1196		----		0.8229		----		
1200		----		----		----		
1287	ISO6976	0.8245		0.8245		----		
1307		----		0.8118	G(0.05)	----		
1388	ISO6976	0.824		0.8239		0.822		
1412	ISO6976	0.7522	E,C,G(0.05)	0.8218		0.7506	E,C,DG(0.01)	iis calc. ideal: 0.8194
1489	ISO6976	0.8240		0.8239		0.8216		first reported 0.7528 vs 0.7512
1594		----		0.8249		----		
1603		----		0.8230		----		
1635		----		0.8262		----		
1654	ISO6976	0.8244		0.8244		----		
1679	ISO6976	0.8242		0.8242		0.8217		
1696		----		----		----		
1737		----		0.8229		----		
1779	ISO6976	0.8232		0.8232		0.8208		
1785		----		0.8237		----		
1864	ISO6976	0.8031	ex	0.8009	ex	0.8007	ex	See §4.1
normality		not OK		suspect		not OK		
n		15		32		11		
outliers		2 (+ 1ex)		2 (+3ex)		2 (+1ex)		
mean (n)		0.8243		0.8238		0.8213		
st.dev. (n)		0.00208		0.00151		0.00092		
R(calc.)		0.0058		0.0042		0.0026		
R(lit)		Unknown		Unknown		Unknown		
Comp. R(iis13S01M)		0.0016		----		0.0016		

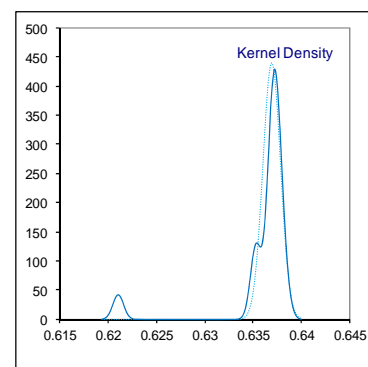
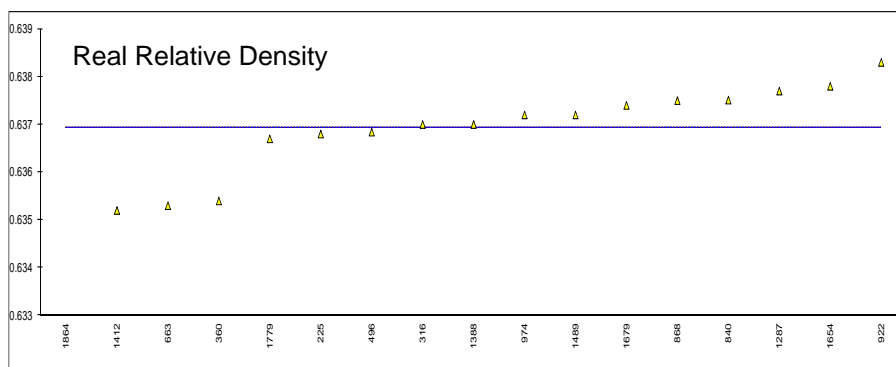
Since the R(lit) is unknown, no Z-scores could be calculated.



Determination of Relative Density (101.325 kPa, comb. temp. 25°C, metering temp. 0°C) on sample #14030; results have no unit

Lab	method	real gas	mark	iis calc.	mark	ideal gas	mark	Remarks
92		----		0.6368		----		
171		----		0.6382		----		
225	ISO6976	0.6368		0.6368		0.6353		
316	ISO6976	0.6370		0.6370		0.6351		
360	ISO6976	0.6354	C	0.6354		0.6339	C	First reported: 0.6457 vs 0.6438
442		----		0.6366		----		
444		----		0.6378		----		
449		----		----		----		
496	DIN51857	0.63684		0.6369		0.63498		
527		----		0.6421	ex	----		See §4.1
593		----		0.6498	ex	----		See §4.1
602		----		0.6355		----		
608		----		----		----		
609		----		0.6356		----		
663	ISO6976	0.6353		0.6350		0.6338		
840	ISO6976	0.63751		0.6375		0.63602		
868	ISO6976	0.6375		0.6375		0.6360		
887		----		0.6393		----		
922	ISO6976	0.6383		0.6383		0.6368		
963		----		----		----		
974	GPA2172	0.6372		0.6376		----		
1011		----		0.6507	G(0.01)	----		
1029		----		0.6375		----		
1040		----		0.6405		----		
1081		----		0.6366		----		
1095		----		----		----		
1196		----		0.6365		----		
1200		----		----		----		
1287	ISO6976	0.6377		0.6377		----		
1307		----		0.6279	G(0.05)	----		
1388	ISO6976	0.637		0.6372		0.636		
1412	ISO6976	0.6352	C	0.6356		0.6340	C	First reported: 0.6357 vs 0.6345
1489	ISO6976	0.6372		0.6373		0.6358		
1594		----		0.6380		----		
1603		----		0.6365		----		
1635		----		0.6390		----		
1654	ISO6976	0.6378		0.6376		----		
1679	ISO6976	0.6374		0.6374		0.6356		
1696		----		----		----		
1737		----		0.6364		----		
1779	ISO6976	0.6367		0.6367		0.6352		
1785		----		0.6371		----		
1864	ISO6976	0.6211	ex	0.6195	ex	0.6197	ex	See §4.1
normality		OK		suspect		OK		
n		16		32		13		
outliers		0 (+1ex)		2 (+3ex)		0 (+1ex)		
mean (n)		0.6369		0.6372		0.6353		
st.dev. (n)		0.00091		0.00116		0.00092		
R(calc.)		0.0025		0.0033		0.0026		
R(lit)		Unknown		Unknown		Unknown		
Comp. R(iis13S01M)		0.0012		----		0.0013		

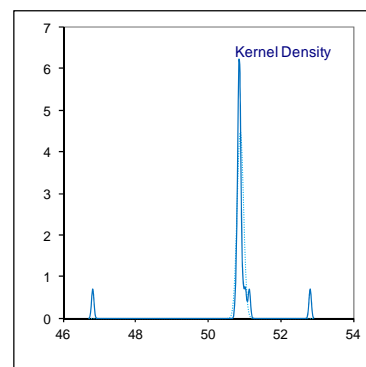
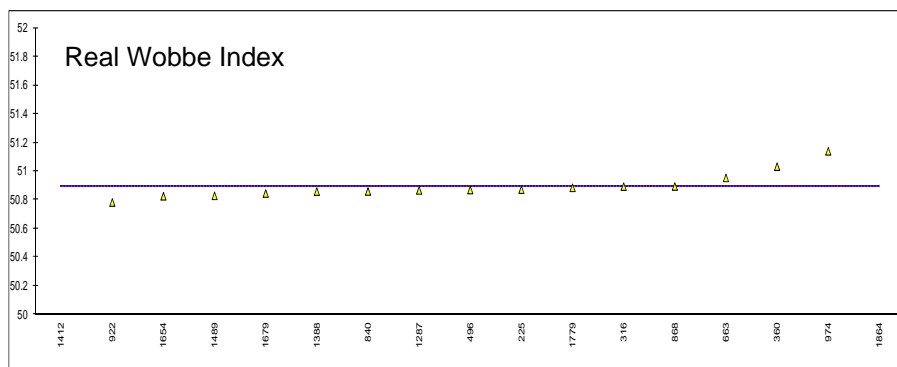
Since the R(lit) is unknown, no Z-scores could be calculated.



Determination of Wobbe Index (101.325 kPa , combustion temp. 25°C, metering temp. 0°C) on sample #14030; results in MJ/m³

Lab	method	real gas	mark	iis calc.	mark	ideal gas	mark	Remarks
92		----		50.8332		----		
171		----		50.9340		----		
225	ISO6976	50.872		50.8722		50.783		
316	ISO6976	50.893		50.8925		50.816		
360	ISO6976	51.033	C	51.0336		50.944	C	First reported: 50.720 vs 50.644
442		----		50.8676		----		
444		----		50.8435		----		
449		----		----		----		
496	DIN51857	50.870		50.8706		50.796		
527		----		50.4706	ex	----		See §4.1
593		----		49.8579	ex	----		See §4.1
602		----		50.8313		----		
608		----		----		----		
609		----		50.8851		----		
663	ISO6976	50.954		50.9445		50.864		
840	ISO6976	50.8596		50.8596		50.7702		
868	ISO6976	50.894		50.8940		50.804		
887		----		50.6590		----		
922	ISO6976	50.783		50.7835		50.693		
963		----		----		----		
974	GPA2172	51.14	E,C	51.0076		----		First reported: 51.17
1011		----		48.7203	G(0.01)	----		
1029		----		50.8333		----		
1040		----		50.8053		----		
1081		----		50.8714		----		
1095		----		----		----		
1196		----		50.9510		----		
1200		----		----		----		
1287	ISO6976	50.867		50.8679		----		
1307		----		51.7377	G(0.01)	----		
1388	ISO6976	50.859		50.8584		50.770		
1412	ISO6976	46.818	E,C,G(0.01)	51.1284		46.762	E,C,G(0.01)	iis calc. ideal 51.038
1489	ISO6976	50.829		50.8245		50.734		first reported: 46.8416 vs 46.760
1594		----		50.8231		----		
1603		----		50.8631		----		
1635		----		50.7273		----		
1654	ISO6976	50.826		50.8331		----		
1679	ISO6976	50.845		50.8449		50.771	E	iis calc. ideal: 50.756
1696		----		----		----		
1737		----		50.8863		----		
1779	ISO6976	50.885		50.8852		50.796		
1785		----		50.8588		----		
1864	ISO6976	52.822	ex	53.0878	ex	52.742	ex	See §4.1
normality		not OK		not OK		not OK		
n		15		32		12		
outliers		1 (+1ex)		2 (+3ex)		1 (+1ex)		
mean (n)		50.8940		50.8711		50.7951		
st.dev. (n)		0.08916		0.08340		0.06294		
R(calc.)		0.2496		0.2351		0.1762		
R(lit)		Unknown		Unknown		Unknown		
Comp.	R(iis13S01M	0.2312		----		0.1765		

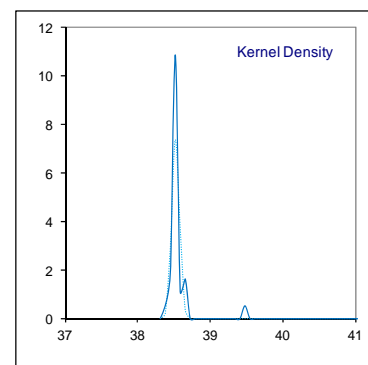
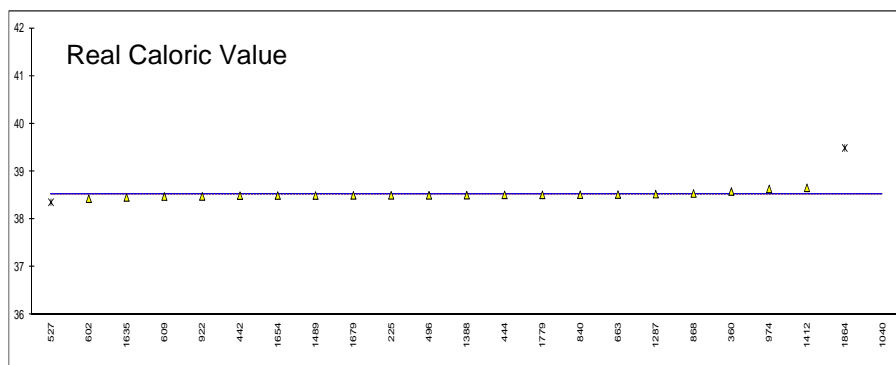
Since the R(lit) is unknown, no Z-scores could be calculated.



Determination of Caloric Value (sup) (101.325 kPa, comb. Temp. 15°C, metering temp 15°C) on sample #14030; results in MJ/m³

Lab	method	real gas	mark	iis calc.	mark	ideal gas	mark	remarks
92		----		38.4747		38.47	E	iis calc. ideal: 38.381
171		----		38.5933		----		
225	ISO6976	38.503		38.5027		38.408		
316		----		38.5238		----		
360	ISO6976	38.583	C	38.5833		38.490	C	First reported 38.657 vs 38.560
442		38.4946		38.4947		38.4013		
444	ISO6976	38.511		38.5107		38.418		
449		----		----		----		
496	DIN51857	38.503		38.5035		38.409		
527	D1945	38.357	ex	38.3574	ex	----		See §4.1
593		----		38.1195	ex	----		See §4.1
602	ISO6976	38.433		38.4320		38.340		
608		----		----		----		
609	ISO6976	38.477	C	38.4761		38.384	C	First reported 38.489 vs 38.395
663	ISO6976	38.518		38.5048		38.425		
840	ISO6976	38.5149		38.5149		38.4212		
868	ISO6976	38.541		38.5404		38.447		
887		----		38.4177		----		
922	ISO6976	38.480		38.4806		38.386		
963		----		----		----		
974	GPA2172	38.637		38.6298		----		
1011		----		37.2752	G(0.01)	----		
1029		----		38.4956		----		
1040	EN15984	55.756	E,G(0.01)	38.5643		----		
1081		----		38.4973		----		
1095		----		----		----		
1196		----		38.5527		----		
1200		----		----		----		
1287	ISO6976	38.527		38.5275		38.434		
1307		----		38.8834	G(0.01)	----		
1388	ISO6976	38.505		38.5051		38.412		
1412	ISO6976	38.660	C	38.6603		38.566	C	First reported: 38.674 vs 38.580
1489	ISO6976	38.499		38.4807		38.387		
1594		----		38.5033		----		
1603		----		38.4886		----		
1635	ISO6976	38.459		38.4608		38.366		
1654	ISO6976	38.498		38.4986		----		
1679	ISO6976	38.502		38.5016		38.408		
1696		----		----		----		
1737		----		38.5026		----		
1779	ISO6976	38.511		38.5108		38.417		
1785		----		38.5006		----		
1864	ISO6976	39.493	ex	39.6295	ex	39.398	ex	See §4.1
	normality	not OK		not OK		not OK		
	n	20		32		19		
	outliers	1 (+2ex)		2 (+3ex)		0 (+1ex)		
	mean (n)	38.5178		38.5135		38.4205		
	st.dev. (n)	0.05394		0.05010		0.04908		
	R(calc.)	0.1510		0.1403		0.1374		
	R(lit)	Unknown		Unknown		Unknown		
Comp.	R(iis13S01M)	0.1932		----		0.1903		

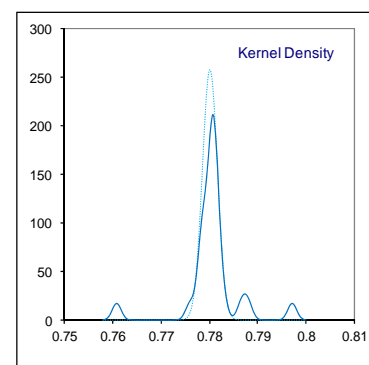
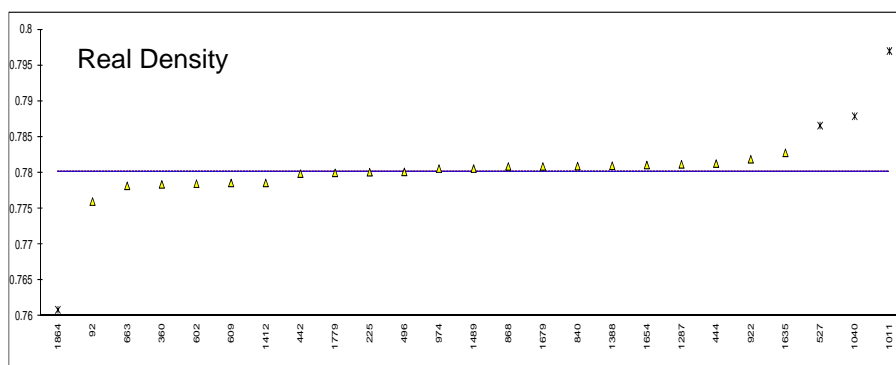
Since the R(lit) is unknown, no Z-scores could be calculated.



Determination of Density (101.325 kPa, combustion temp. 15°C, metering temp. 15°C) on sample #14030; results in kg/m³

Lab	method	real gas	mark	iis calc.	mark	ideal gas	mark	remarks
92	GPA2286	0.776	E	0.7801		0.778		
171		----		0.7818		----		
225	ISO6976	0.7801		0.7801		0.7782		
316		----		0.7803		----		
360	ISO6976	0.7784	C	0.7784		0.7765	C	First reported: 0.7906 vs 0.7886
442		0.7799		0.7799		0.7780		
444	ISO6976	0.7813		0.7813		0.7794		
449		----		----		----		
496	DIN51857	0.78014		0.7802		0.77824		
527	D1945	0.7866	ex	0.7866	ex	----		See §4.1
593		----		0.7961	ex	----		See §4.1
602	ISO6976	0.7785		0.7785		0.7766		
608		----		----		----		
609	ISO6976	0.7786	C	0.7786		0.7767	C	First reported: 0.7788 vs 0.7770
663	ISO6976	0.7782		0.7779		0.7763		
840	ISO6976	0.78095		0.7810		0.77905		
868	ISO6976	0.7809		0.7809		0.7790		
887		----		0.7832		----		
922	ISO6976	0.7819		0.7819		0.7800		
963		----		----		----		
974	GPA2172	0.7806		0.7811		----		
1011	D3588	0.7970	G(0.01)	0.7971	G(0.01)	0.7948	G(0.01)	
1029		----		0.7810		----		
1040	EN15984	0.7879	E,G(0.01)	0.7846		----		
1081		----		0.7799		----		
1095		----		----		----		
1196		----		0.7797		----		
1200		----		----		----		
1287	ISO6976	0.7812		0.7812		----		
1307		----		0.7692	G(0.05)	----		
1388	ISO6976	0.781		0.7806		0.779		
1412	ISO6976	0.7786	C	0.7786		0.7767	C	First reported: 0.7784 vs 0.7765
1489	ISO6976	0.7806		0.7806		0.7788		
1594		----		0.7816		----		
1603		----		0.7798		----		
1635	ISO6976	0.7828		0.7828		0.7809		
1654	ISO6976	0.7811		0.7811		----		
1679	ISO6976	0.7809		0.7809		0.7790		
1696		----		----		----		
1737		----		0.7796		----		
1779	ISO6976	0.7800		0.7800		0.7781		
1785		----		0.7804		----		
1864	ISO6976	0.7609	ex	0.7589	ex	0.7591	ex	See §4.1
	normality	suspect		suspect		OK		
	n	21		32		18		
	outliers	2 (+2ex)		2 (+3ex)		1 (+1ex)		
	mean (n)	0.7801		0.7806		0.7782		
	st.dev. (n)	0.00155		0.00143		0.00130		
	R(calc.)	0.0043		0.0040		0.0036		
	R(lit)	Unknown		Unknown		Unknown		
Comp.	R(iis13S01M	0.0019		----		0.0020		

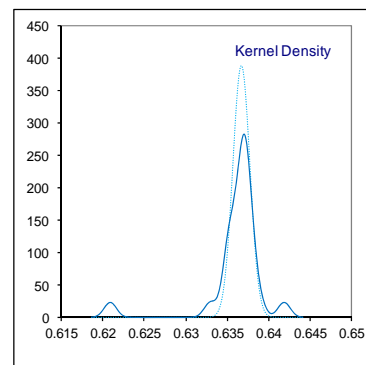
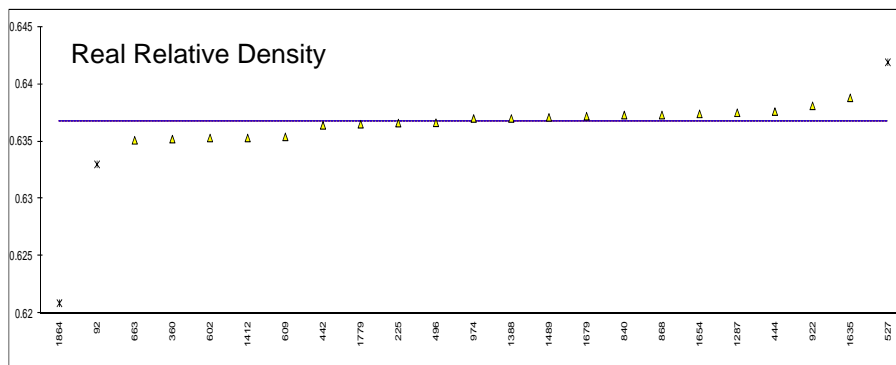
Since the R(lit) is unknown, no Z-scores could be calculated.



Determination of Relative Density (101.325 kPa, comb. temp. 15°C, metering temp. 15°C) on sample #14030; results have no unit

lab	method	real gas	mark	iis calc.	mark	ideal gas	mark	remarks
92	GPA2286	0.633	E,G(0.05)	0.6366		0.635		
171		----		0.6380		----		
225	ISO6976	0.6366		0.6366		0.6353		
316		----		0.6368		----		
360	ISO6976	0.6352	C	0.6352		0.6339	C	First reported: 0.6454 vs 0.6438
442		0.6364		0.6364		0.6352		
444	ISO6976	0.6376		0.6376		0.6363		
449		----		----		----		
496	DIN51857	0.63663		0.6366		0.63509		
527	D1945	0.6419	ex	0.6419	ex	----		See 4.1
593		----		0.6496	ex	----		
602	ISO6976	0.6353		0.6353		0.6340		
608		----		----		----		
609	ISO6976	0.6354	C	0.6354		0.6341	C	First reported: 0.6356 vs 0.6343
663	ISO6976	0.6351		0.6348		0.6338		
840	ISO6976	0.63730		0.6373		0.63602		
868	ISO6976	0.6373		0.6373		0.6360		
887		----		0.6391		----		
922	ISO6976	0.6381		0.6381		0.6368		
963		----		----		----		
974	GPA2172	0.6370		0.6374		----		
1011		----		0.6505	G(0.01)	----		
1029		----		0.6373		----		
1040		----		0.6403		----		
1081		----		0.6364		----		
1095		----		----		----		
1196		----		0.6363		----		
1200		----		----		----		
1287	ISO6976	0.6375		0.6375		----		
1307		----		0.6277	G(0.05)	----		
1388	ISO6976	0.637		0.6370		0.636		
1412	ISO6976	0.6353	C	0.6354		0.6341	C	First reported: 0.6352 vs 0.6339
1489	ISO6976	0.6371		0.6371		0.6358		
1594		----		0.6378		----		
1603		----		0.6363		----		
1635	ISO6976	0.6388		0.6388		0.6375		
1654	ISO6976	0.6374		0.6374		----		
1679	ISO6976	0.6372		0.6372		0.6357		
1696		----		----		----		
1737		----		0.6362		----		
1779	ISO6976	0.6365		0.6365		0.6352		
1785		----		0.6369		----		
1864	ISO6976	0.6209	ex	0.6193	ex	0.6197	ex	See §4.1
	normality	OK		suspect		OK		
	n	20		32		18		
	outliers	1 (+2ex)		2 (+3ex)		0 (+1ex)		
	mean (n)	0.6367		0.6370		0.6353		
	st.dev. (n)	0.00103		0.00106		0.00106		
	R(calc.)	0.0029		0.0033		0.0030		
	R(lit)	Unknown		Unknown		Unknown		
Comp.	R(iis13S01M)	0.0013		----		0.0014		

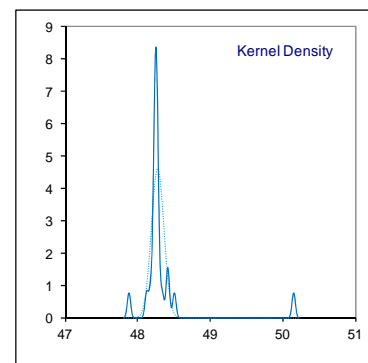
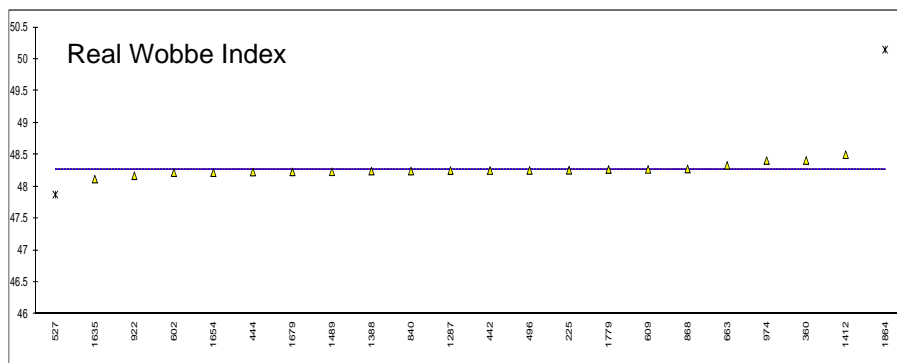
Since the R(lit) is unknown, no Z-scores could be calculated.



Determination of Wobbe Index (101.325 kPa, combustion temp. 15°C, metering temp. 15°C) on sample #14030; results in MJ/m³

lab	method	real gas	mark	iis calc.	mark	ideal gas	mark	Remarks
92		----		48.2205		----		
171		----		48.3160		----		
225	ISO6976	48.258		48.2574		48.189		
316		----		48.2767		----		
360	ISO6976	48.411	C	48.4105		48.342	C	First reported 48.113 vs 48.058
442		48.2531		48.2531		48.1844		
444	ISO6976	48.230		48.2301		----		
449		----		----		----		
496	DIN51857	48.255		48.2559		48.197		
527	D1945	47.875	ex	47.8763	ex	----		See §4.1
593		----		47.2950	ex	----		See §4.1
602	ISO6976	48.219		48.2187		48.151		
608		----		----		----		
609	ISO6976	48.271	C	48.2697		48.202	C	First reported 48.278 vs 48.209
663	ISO6976	48.334	E	48.3260		48.266		
840	ISO6976	48.2454		48.2454		48.1766		
868	ISO6976	48.278		48.2781		48.209		
887		----		48.0551		----		
922	ISO6976	48.172		48.1732		48.104		
963		----		----		----		
974	GPA2172	48.41	E	48.3857		----		
1011		----		46.2162	G(0.01)	----		
1029		----		48.2205		----		
1040		----		48.1938		----		
1081		----		48.2567		----		
1095		----		----		----		
1196		----		48.3322		----		
1200		----		----		----		
1287	ISO6976	48.253		48.2533		----		
1307		----		49.0786	G(0.01)	----		
1388	ISO6976	48.244		48.2443		48.176		
1412	ISO6976	48.502	C	48.5004		48.433	C	First reported 48.526 vs 48.457
1489	ISO6976	48.233	E	48.2121		48.142		
1594		----		48.2108		----		
1603		----		48.2488		----		
1635	ISO6976	48.119		48.1199		48.050		
1654	ISO6976	48.220	C	48.2203		----		First reported 48.827
1679	ISO6976	48.232		48.2315		48.173	E	iis calc. ideal: 48.1628
1696		----		----		----		
1737		----		48.2708		----		
1779	ISO6976	48.270		48.2697		48.201		
1785		----		48.2447		----		
1864	ISO6976	50.149	ex	50.3592	ex	50.048	ex	See §4.1
normality		not OK		not OK		not OK		
n		20		32		16		
outliers		0 (+2ex)		2 (+3ex)		0 (+1ex)		
mean (n)		48.2705		48.2563		48.1997		
st.dev. (n)		0.08633		0.07966		0.08892		
R(calc.)		0.2417		0.2231		0.2490		
R(lit)		Unknown		Unknow		Unknow		
Comp.	R(iis13S01M)	0.2496		----		0.3117		

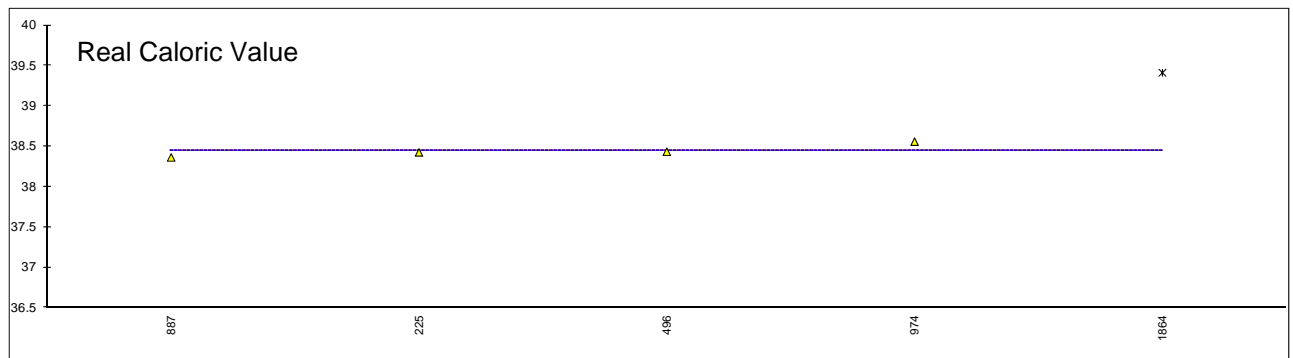
Since the R(lit) is unknown, no Z-scores could be calculated.



Determination of Caloric Value (sup) (14.696 psia, comb. Temp. 60°F, metering temp 60°F) on sample #14030; results in MJ/m³

Lab	method	real gas	mark	iis calc.	mark	ideal gas	mark	remarks
92		----		38.4038		----		
171		----		38.5221		----		
225	ISO6976	38.426		38.4318		38.333		
316		----		38.4528		----		
360		----		38.5122		----		
442		----		38.4237		----		
444		----		38.4397		----		
449		----		----		----		
496	D3588	38.435		38.4325		38.342		
527		----		38.2867	ex	----		See §4.1
593		----		38.0492	ex	----		See §4.1
602		----		38.3612		----		
608		----		----		----		
609		----		38.4052		----		
663		----		38.4339		----		
840		----		38.4439		----		
868		----		38.4693		----		
887	D3588	38.364	C	38.3468		----		First reported: 38.292
922		----		38.4096		----		
963		----		----		----		
974	GPA2172	38.559		38.5585		----		
1011		----		37.2065	G(0.01)	----		
1029		----		38.4246		----		
1040		----		38.4932		----		
1081		----		38.4264		----		
1095		----		----		----		
1196		----		38.4817		----		
1200		----		----		----		
1287		----		38.4564		----		
1307		----		38.8117	G(0.01)	----		
1388		----		38.4341		----		
1412		----		38.5890		----		
1489		----		38.4098		----		
1594		----		38.4323		----		
1603		----		38.4177		----		
1635		----		38.3899		----		
1654		----		38.4276		----		
1679		----		38.4307		----		
1696		----		----		----		
1737		----		38.4316		----		
1779		----		38.4398		----		
1785		----		38.4297		----		
1864	ISO6976	39.413	ex	39.5564	ex	39.319	ex	See §4.1
normality	Unknown			not OK		Unknown		
n	4			32		2		
outliers	0 (+1ex)			2 (+3ex)		0 (+1ex)		
mean (n)	38.4460			38.4425		38.3375		
st.dev. (n)	n.a.			0.05000		n.a.		
R(calc.)	n.a.			0.1400		n.a.		
R(lit)	Unknown			Unknown		Unknown		

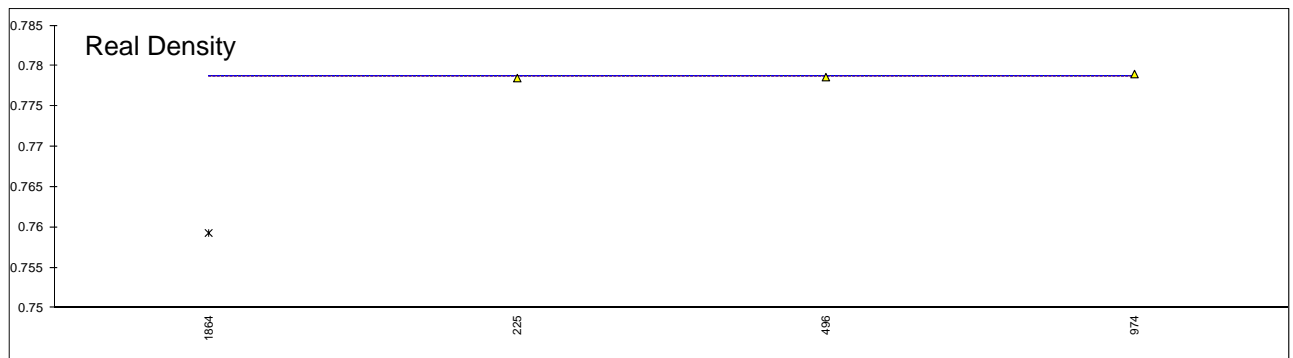
Since the R(lit) is unknown, no Z-scores could be calculated.



Determination of Density (14.696 psia, comb. Temp. 60°F, metering temp 60°F) on sample #14030; results in kg/m³

Lab	method	real gas	mark	iis calc.	mark	ideal gas	mark	Remarks
92		----		0.7788		----		
171		----		0.7805		----		
225	ISO6976	0.7785		0.7787		0.7767		
316		----		0.7790		----		
360		----		0.7770		----		
442		----		0.7785		----		
444		----		0.7799		----		
449		----		----		----		
496	D3588	0.77862		0.7788		0.77675		
527		----		0.7852	ex	----		See §4.1
593		----		0.7947	ex	----		See §4.1
602		----		0.7771		----		
608		----		----		----		
609		----		0.7773		----		
663		----		0.7766		----		
840		----		0.7796		----		
868		----		0.7796		----		
887		----		0.7818		----		
922		----		0.7805		----		
963		----		----		----		
974	GPA2172	0.7790		0.7797		----		
1011		----		0.7958	G(0.01)	----		
1029		----		0.7796		----		
1040		----		0.7833		----		
1081		----		0.7785		----		
1095		----		----		----		
1196		----		0.7783		----		
1200		----		----		----		
1287		----		0.7799		----		
1307		----		0.7678	G(0.05)	----		
1388		----		0.7792		----		
1412		----		0.7773		----		
1489		----		0.7793		----		
1594		----		0.7803		----		
1603		----		0.7784		----		
1635		----		0.7815		----		
1654		----		0.7798		----		
1679		----		0.7795		----		
1696		----		----		----		
1737		----		0.7783		----		
1779		----		0.7787		----		
1785		----		0.7791		----		
1864	ISO6976	0.7593	ex	0.7575	ex	0.7575	ex	See §4.1
	normality	Unknown		suspect		Unknown		
	n	3		32		2		
	outliers	0 (+1ex)		2 (+3ex)		0 (+1ex)		
	mean (n)	0.7787		0.7792		0.7767		
	st.dev. (n)	n.a.		0.00142		n.a.		
	R(calc.)	n.a.		0.0040		n.a.		
	R(lit)	Unknown		Unknown		Unknown		

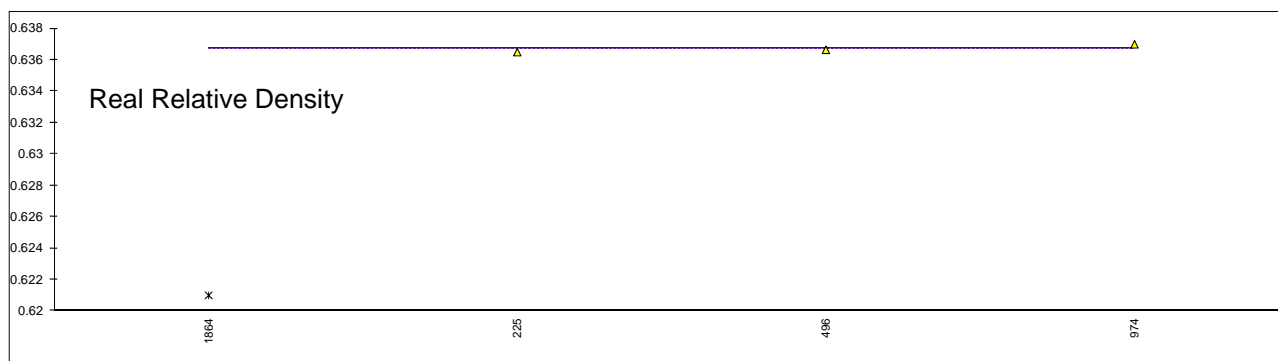
Since the R(lit) is unknown, no Z-scores could be calculated.



Determination of Relative Density (14.696 psia, comb. Temp. 60°F, metering temp 60°F) on sample #14030; results have no unit

lab	method	real gas	mark	iis calc.	mark	ideal gas	mark	remarks
92		----		0.6366		----		
171		----		0.6380		----		
225	ISO6976	0.6365		0.6366		0.6353		
316		----		0.6368		----		
360		----		0.6352		----		
442		----		0.6364		----		
444		----		0.6376		----		
449		----		----		----		
496	D3588	0.63665		0.6366		0.63563		
527		----		0.6419	ex	----		See §4.1
593		----		0.6496	ex	----		See §4.1
602		----		0.6353		----		
608		----		----		----		
609		----		0.6354		----		
663		----		0.6348		----		
840		----		0.6373		----		
868		----		0.6373		----		
887		----		0.6391		----		
922		----		0.6381		----		
963		----		----		----		
974	GPA2172	0.6370		0.6374		----		
1011		----		0.6505	G(0.01)	----		
1029		----		0.6373		----		
1040		----		0.6403		----		
1081		----		0.6364		----		
1095		----		----		----		
1196		----		0.6363		----		
1200		----		----		----		
1287		----		0.6375		----		
1307		----		0.6277	G(0.05)	----		
1388		----		0.6370		----		
1412		----		0.6354		----		
1489		----		0.6371		----		
1594		----		0.6378		----		
1603		----		0.6363		----		
1635		----		0.6388		----		
1654		----		0.6374		----		
1679		----		0.6372		----		
1696		----		----		----		
1737		----		0.6362		----		
1779		----		0.6365		----		
1785		----		0.6369		----		
1864	ISO6976	0.6210	ex	0.6193	ex	0.6197	ex	See §4.1
normality	Unknown			suspect		Unknown		
n	3			32		2		
outliers	0 (+1ex)			2 (+3ex)		0 (+1ex)		
mean (n)	0.6367			0.6370		0.6355		
st.dev. (n)	n.a.			0.00116		n.a.		
R(calc.)	n.a.			0.0033		n.a.		
R(lit)	Unknown			Unknown		Unknown		

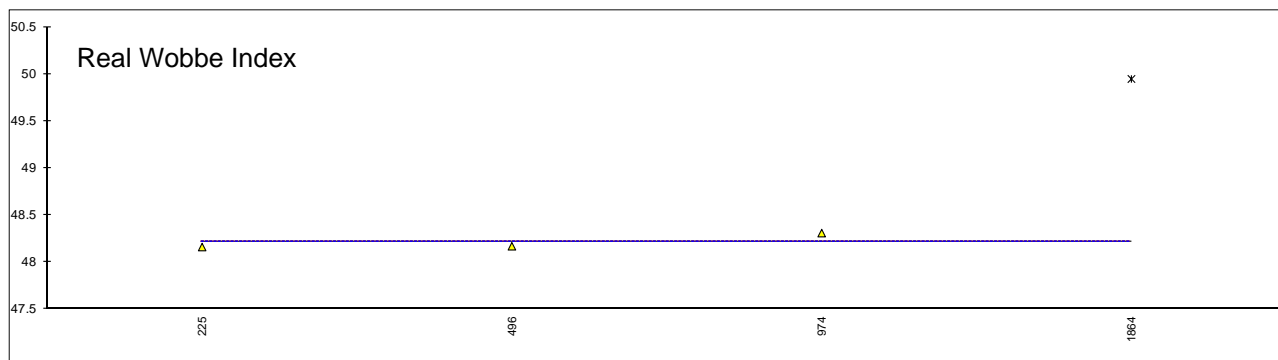
Since the R(lit) is unknown, no Z-scores could be calculated.



Determination of Wobbe Index (14.696 psia, comb. Temp. 60°F, metering temp 60°F) on sample #14030; results in MJ/m³

lab	method	real gas	mark	iis calc.	mark	ideal gas	mark	remarks
92		----		48.1316		----		
171		----		48.2269		----		
225	ISO6976	48.162		48.1684		48.094		
316		----		48.1877		----		
360		----		48.3213		----		
442		----		48.1641		----		
444		----		48.1412		----		
449		----		----		----		
496	D3588	48.170		48.1669		48.103		
527		----		47.7880	ex	----		See §4.1
593		----		47.2077	ex	----		See §4.1
602		----		48.1298		----		
608		----		----		----		
609		----		48.1808		----		
663		----		48.2370		----		
840		----		48.1565		----		
868		----		48.1891		----		
887		----		47.9665		----		
922		----		48.0844		----		
963		----		----		----		
974	GPA2172	48.31		48.2965		----		
1011		----		46.1310	G(0.01)	----		
1029		----		48.1316		----		
1040		----		48.1049		----		
1081		----		48.1677		----		
1095		----		----		----		
1196		----		48.2431		----		
1200		----		----		----		
1287		----		48.1644		----		
1307		----		48.9881	G(0.01)	----		
1388		----		48.1554		----		
1412		----		48.4110		----		
1489		----		48.1233		----		
1594		----		48.1219		----		
1603		----		48.1599		----		
1635		----		48.0312		----		
1654		----		48.1314		----		
1679		----		48.1426		----		
1696		----		----		----		
1737		----		48.1818		----		
1779		----		48.1807		----		
1785		----		48.1557		----		
1864	ISO6976	49.947	ex	50.2663	ex	49.823	ex	See §4.1
normality		Unknown		not OK		unknown		
n		3		32		2		
outliers		0 (+1ex)		2 (+3ex)		0 (+1ex)		
mean (n)		48.2140		48.1674		48.0985		
st.dev. (n)		n.a.		0.07952		n.a.		
R(calc.)		n.a.		0.2227		n.a.		
R(lit)		Unknown		Unknown		Unknown		

Since the R(lit) is unknown, no Z-scores could be calculated.



APPENDIX 2**Compression factors used by participants**

lab	Compressibility factor @15°C	Compressibility factor @0°C	Compressibility factor @60°F
92	0.9976	----	----
171	----	----	----
225	----	----	----
316	----	0.9970	----
360	0.9975	0.9970	----
442	0.9976	----	----
444	0.997566	----	----
449	----	----	----
496	0.998	0.997	0.998
527	0.9976	----	----
593	----	----	----
602	0.997587	----	----
608	----	----	----
609	0.9975825	----	----
663	0.99758	0.99709	----
840	0.99757	0.99708	----
868	0.997566	0.997074	----
887	----	----	----
922	0.9976	0.9971	----
963	----	----	----
974	0.9977	0.9977	0.9977
1011	1.003	----	----
1029	----	----	----
1040	----	----	----
1081	----	----	----
1095	----	----	----
1196	----	----	----
1200	----	----	----
1287	0.99757	0.99707	----
1307	----	----	----
1388	0.9976	0.9971	----
1412	0.9976	0.9979	----
1489	0.9976	0.9971	----
1594	----	----	----
1603	----	----	----
1635	0.99756	----	----
1654	----	----	----
1679	0.9976	0.9971	----
1696	----	----	----
1737	----	----	----
1779	0.997573	0.997081	----
1785	----	----	----
1864	0.9976	0.9976	0.9976

APPENDIX 3

Number of participants per country

1 lab in AZERBAIJAN
1 lab in BELGIUM
1 lab in BULGARIA
1 lab in CANADA
5 labs in CHINA, People's Republic
1 lab in COTE D'IVOIRE
1 lab in CROATIA
1 lab in ECUADOR
1 lab in FRANCE
3 labs in GERMANY
1 lab in INDONESIA
1 lab in ITALY
5 labs in MALAYSIA
1 lab in MEXICO
2 labs in NETHERLANDS
1 lab in PAKISTAN
1 lab in PERU
2 labs in PORTUGAL
2 labs in SAUDI ARABIA
1 lab in SLOVAKIA
1 lab in TAIWAN
1 lab in THAILAND
2 labs in TURKEY
1 lab in UNITED ARAB EMIRATES
3 labs in UNITED KINGDOM
1 lab in UNITED STATES OF AMERICA
1 lab in VIETNAM

APPENDIX 4

Abbreviations:

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

Literature:

- 1 iis Interlaboratory Studies, Protocol for the Organization, Statistics and Evaluation, January 2010
- 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
- 16 Bernard Rosner, Percentage Points for a Generalized ESD Many-Outlier Procedure, *Technometrics*, 25(2), pp. 165-172, (1983)