

Results of Proficiency Test
Natural Gas Analysis
March 2012

Organised by: Institute for Interlaboratory Studies
Spijkenisse, the Netherlands

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1 INTRODUCTION

A first proficiency study for natural gas (composition only) was organised by iis in 2009. Afterwards the opinion of the participating laboratories was inventorised. Most participants were very positive and therefore it was decided to repeat the PT annually.

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 36 laboratories from 23 different countries participated. See appendix 3 for the number of participants in per country.

In this report the results of the proficiency test on natural gas are presented and discussed.

2 SET UP

The Institute for Interlaboratory Studies (iis) in Spijkensisse, 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 40 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 Spijkensisse, the Netherlands, has implemented a quality system based on ISO17043:2010 and ILAC-G13:2007. 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 January 2010 (iis-protocol, version 3.2).

2.3 CONFIDENTIALITY STATEMENT

All data present 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 40 cylinders was prepared (job 11/703) starting March 1, 2012. 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	$0.3 \times R$ (abs, ISO6974-3) in %mol/mol
Ethane	0.0038	0.0607
Propane	0.0014	0.0095
n-Butane	0.0009	0.0047
iso-Butane	0.0008	0.0062
Carbon dioxide	0.0024	0.0330
Nitrogen	0.0029	0.0118

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 16, 2012.

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. Also some method details were requested to be reported.

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 January 2010 (iis-protocol, version 3.2).

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. After removal of outliers this check was repeated. In case a data set does not have a normal distribution, the results of the statistical evaluation should be used with due care.

In accordance with ISO 5725 (1986 and 1994) the original results per determination were submitted subsequently to Dixon and Grubbs outlier tests. Outliers are marked by D(0.01) for the Dixon test and by G(0.01) or DG(0.01) for the Grubbs test. Stragglers are marked by D(0.05) for the Dixon test and by G(0.05) or DG(0.05) for the Grubbs test. Both outliers and stragglers were not included in the calculations of the averages and the standard deviations.

For each assigned value, the uncertainty was determined in accordance with ISO13528. Subsequently the calculated uncertainty was evaluated against the respective requirement based on the target reproducibility in accordance with ISO13528. When the uncertainty passed the evaluation, no remarks are made in the report. However, when the uncertainty

failed the evaluation it is mentioned in the report and it will have consequences for the evaluation of the test results.

Finally the reproducibilities were calculated from the standard deviations by multiplying 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; nr.13 and 14).

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 the fit-for-useness of the reported test result.

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 eleven laboratories reported results after the final reporting date and two participants were not able to report any test results. In total 34 participants reported 475 numerical results. Observed were 23 outlying results, which is 4.8% 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 distribution. Non-Gaussian distributions were found for iso-butane. The statistical evaluation of this component should be used with due care, see also paragraph 4.4.

All test results reported by laboratory 602 were deviating, influenced by the very low ethane, n-butane and i-butane results and the very high nitrogen results. Four of the seven test results appeared to be statistical outliers. As the seven test results are not independent, it was decided not to use any of the test results of this laboratory for the statistical evaluation.

Methane: The determination of this component is very problematic. Only one statistical outlier was detected. However, the calculated reproducibility after exclusion of the statistical outlier, is not at all in agreement with the requirements of ISO6974-3:2000, nor with ASTM D1945:2003.

Ethane: The determination of this component was problematic. Only one statistical outlier was detected. The calculated reproducibility after exclusion of the statistical outlier, is not in agreement with the requirements of ISO6974-3:2000, nor with ASTM D1945:2003.

Propane: The determination of this component may be problematic for a number of participating laboratories, depending on the test method used by the laboratory. Only one statistical outlier was detected. The calculated reproducibility after exclusion of the statistical outlier, is not in agreement with the strict requirements of ISO6974-3:2000. However, the calculated reproducibility is in full agreement with the requirements of and ASTM D1945:2003.

n-Butane: The determination of this component may be problematic for a number of participating laboratories, depending on the test method used by the laboratory. Two statistical outliers were detected. The calculated reproducibility after exclusion of the statistical outliers, is not in agreement with the strict requirements of ISO6974-3:2000. However, the calculated

reproducibility is in full agreement with the requirements of and ASTM D1945:2003.

i-Butane:

The determination of this component may be problematic for a number of participating laboratories, depending on the test method used by the laboratory.

Only one statistical outlier was detected. The calculated reproducibility is not in agreement with the strict requirements of ISO6974-3:2000. However, the calculated reproducibility is in full agreement with the requirements of and ASTM D1945:2003.

Carbon Dioxide:

The determination of this component may be problematic for a number of participating laboratories, depending on the test method used by the laboratory.

Two statistical outliers were detected. The calculated reproducibility after exclusion of the statistical outliers, is not in agreement with the strict requirements of ISO6974-3:2000. However, the calculated reproducibility is in full agreement with the requirements of and ASTM D1945:2003.

Nitrogen:

The determination of this component is very problematic. Two statistical outliers were detected and the calculated reproducibility after exclusion of the statistical outliers, is not at all in agreement with the requirements of ISO6974-3:2000, nor with ASTM D1945:2003.

Calculated parameters, general remark: In this PT the calculated parameters were reported for two combustion temperatures (15 and 25°C) as well as for real and ideal gas. This because it had become clear in the previous rounds that the laboratories reported a mix of these results. The reported test results varied over a large range and the results showed bimodal distributions for caloric value, density and Wobbe index.

From the reported test results may be concluded that the majority of the laboratories prefer to report these parameters for real gas, 101.325 kPa and a combustion temperature of 25°C.

Caloric Value:

This time no bimodal distributions are visible and the spreads of the four groups of test results are all much smaller than previously observed: less than 10% of the spread in iis11S01M. However, still a number of laboratories did report results that deviate from the theoretical results, possibly due to calculation errors. These results were excluded from the statistical calculations. One laboratory did report the result for real gas under ideal gas. This was corrected before the statistical calculations.

Density:

This time no bimodal distributions are visible and the spreads of the four groups of test results are all much smaller than previously observed: less than 5% of the spread in iis11S01M.

Relative density: The spreads of the four groups of test results are only little smaller than the spread observed in the previous PT iis11S01M. However, two laboratories did report results that deviate from the theoretical results, possibly due to calculation errors, and therefore these results were not used for the statistical calculations.

Wobbe index: This time no bimodal distributions are visible and the spreads of the four groups of test results are all much smaller than previously observed: less than 5 - 10% of the spread in iis11S01M. However, still a number of laboratories did report results that deviate from the theoretical results, possibly due to calculation errors.

4.2 PERFORMANCE EVALUATION FOR THE GROUP OF LABORATORIES

The average results per component, observed reproducibilities and target reproducibilities, derived from the standard methods ISO 6974-3 and ASTM D1945 are compared in the next table.

	unit	n	cons. value	2.8 * sd	R(ISO6974-3)	R(D1945)
Methane	%mol/mol	32	86.559	0.321	0.173	0.150
Ethane	%mol/mol	33	6.814	0.265	0.204	0.100
Propane	%mol/mol	32	1.061	0.059	0.032	0.100
n-Butane	%mol/mol	32	0.261	0.020	0.016	0.070
iso-Butane	%mol/mol	33	0.349	0.029	0.021	0.070
Carbon dioxide	%mol/mol	31	1.324	0.066	0.040	0.100
Nitrogen	%mol/mol	32	3.643	0.344	0.109	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.

4.3 COMPARISON OF THE PROFICIENCY TEST OF APRIL 2012 WITH PREVIOUS PTS

	2012	2011	2010	2009
Number of reporting labs	34	33	29	39
Number of results reported	475	330	280	381
Statistical outliers	23	16	25	30
Percentage outliers	4.8%	4.8%	8.9%	7.9%

Table 3: 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:

	2012 ISO6974-3	2012 D1945	2011 ISO6974-3	2011 D1945	2010 ISO6974-3	2010 D1945
Methane	--	--	--	--	--	--
Ethane	-	-	++	++	++	++
Propane	-	++	-	+/-	-	+
n-Butane	-	++	-	++	+/-	++
iso-Butane	-	++	-	++	+/-	++
Carbon dioxide	--	++	-	++	-	-
Nitrogen	--	--	--	-	--	-

Table 4: 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 yet. 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 EfecTech in the following table.

Parameter	Average values by EfecTech in %mol/mol	Consensus values from participants results in %mol/mol	Absolute differences in %mol/mol
Methane	86.619	86.559	-0.060
Ethane	6.747	6.814	+0.067
Propane	1.051	1.061	+0.010
n-Butane	0.260	0.261	+0.001
iso-Butane	0.344	0.349	+0.005
Carbon dioxide	1.314	1.324	+0.010
Nitrogen	3.665	3.643	-0.022

Table 5: comparison of consensus values with values determined by the supplier EfecTech

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.

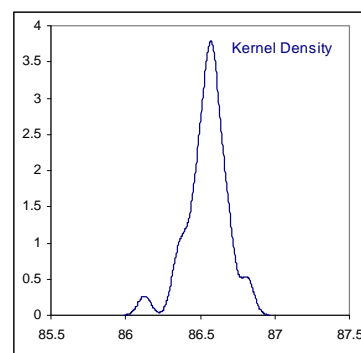
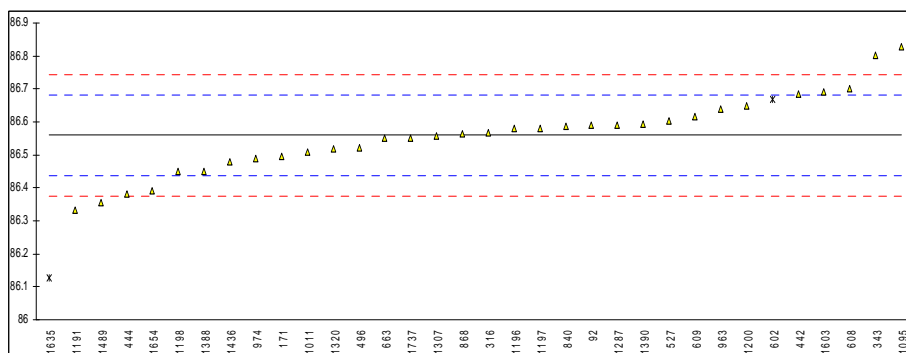
APPENDIX 1

Determination of Methane on sample #12040; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	GPA2286	86.59		0.50	
171	D1945	86.495		-1.04	
316	ISO6974	86.569		0.16	
343	CEA1624	86.802	C	3.93	first reported 86.244
442	D1945	86.6844		2.02	
444	D1945	86.381		-2.88	
496	EN15984	86.521		-0.62	
527	D1945	86.603		0.71	
602	GPA2261	86.6694	ex	1.78	see §4.1
608	GPA2286	86.702	C	2.31	first reported 86.668
609	GPA2261	86.615	C	0.90	first reported 86.796
663	D1945	86.550		-0.15	
840	D1945	86.5858		0.43	
868	GPA2261	86.563		0.06	
963	D1945	86.640		1.31	
974	ISO6974	86.490	C	-1.12	first reported 86.990
1011	UOP539	86.508		-0.83	
1081		-----		-----	
1095	UOP539	86.828		4.35	
1191	UOP539	86.334		-3.64	
1196	GPA2261	86.579		0.32	
1197	D1945	86.582		0.37	
1198	D1945	86.449		-1.78	
1200	UOP539	86.65		1.47	
1287	ISO6974	86.591		0.51	
1307	Fast RGA	86.556		-0.05	
1320	ISO6974	86.518		-0.67	
1388	GPA2261	86.449		-1.78	
1390	in house	86.593		0.54	
1436	ISO6974	86.479		-1.30	
1489	ISO6974	86.355	C	-3.30	first reported 86.391
1603	in house	86.6929		2.16	
1622		-----		-----	
1635	D1945	86.127	G(0.05)	-6.99	
1654	D1945	86.392	C	-2.71	first reported 86.430
1737	in house	86.551		-0.13	

normality OK
n 32
outliers 1
mean (n) 86.5593
st.dev. (n) 0.11465
R(calc.) 0.3210
R(ISO6974-3) 0.1731

Compare R(ASTM D1945) = 0.150

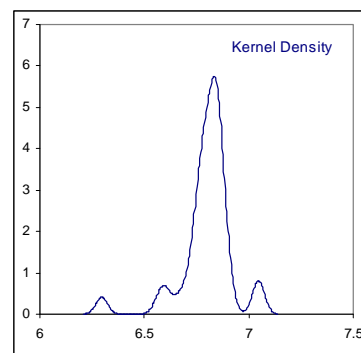
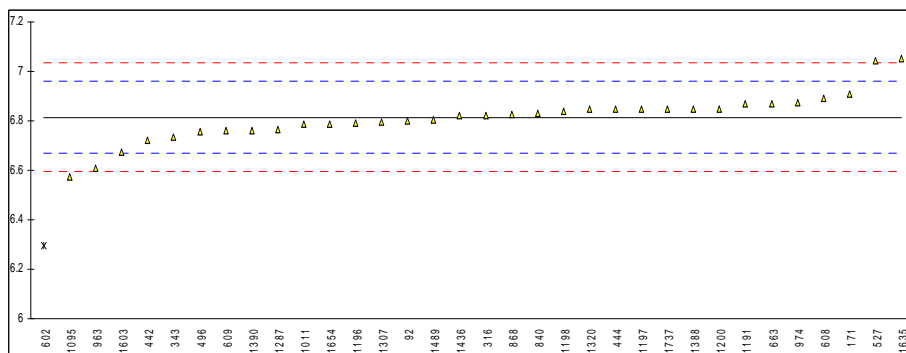


Determination of Ethane on sample #12040; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	GPA2286	6.80		-0.19	
171	D1945	6.907		1.27	
316	ISO6974	6.822		0.11	
343	CEA1624	6.736		-1.07	
442	D1945	6.7212		-1.27	
444	D1945	6.848		0.46	
496	EN15984	6.757		-0.78	
527	D1945	7.042		3.12	
602	GPA2261	6.2960	G(0.01)	-7.10	
608	GPA2286	6.892	C	1.07	first reported 6.890
609	GPA2261	6.759	C	-0.75	first reported 6.590
663	D1945	6.870		0.77	
840	D1945	6.8325		0.25	
868	GPA2261	6.827		0.18	
963	D1945	6.610		-2.80	
974	ISO6974	6.875		0.83	
1011	UOP539	6.787		-0.37	
1081		-----		-----	
1095	UOP539	6.575		-3.27	
1191	UOP539	6.868		0.74	
1196	GPA2261	6.791		-0.32	
1197	D1945	6.848		0.46	
1198	D1945	6.837		0.31	
1200	UOP539	6.85		0.49	
1287	ISO6974	6.767		-0.64	
1307	Fast RGA	6.796		-0.25	
1320	ISO6974	6.846		0.44	
1388	GPA2261	6.849		0.48	
1390	in house	6.763		-0.70	
1436	ISO6974	6.820		0.08	
1489	ISO6974	6.803	C	-0.15	first reported 6.792
1603	in house	6.6758		-1.89	
1622		-----		-----	
1635	D1945	7.052		3.26	
1654	D1945	6.789	C	-0.34	first reported 6.791
1737	in house	6.849		0.48	

normality OK
n 33
outliers 1
mean (n) 6.8141
st.dev. (n) 0.09479
R(calc.) 0.2654
R(ISO6974-3) 0.2044

Compare R(ASTM D1945) = 0.100

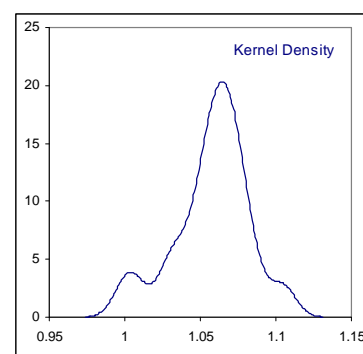
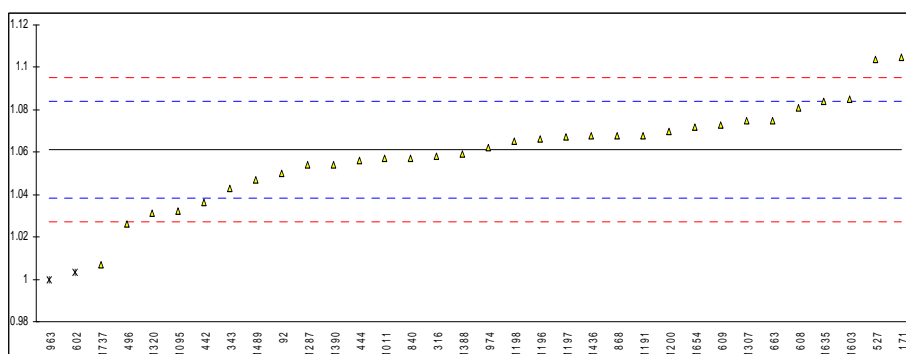


Determination of Propane on sample #12040; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	GPA2286	1.05		-0.98	
171	D1945	1.105		3.86	
316	ISO6974	1.058		-0.27	
343	CEA1624	1.043		-1.59	
442	D1945	1.0365		-2.17	
444	D1945	1.056		-0.45	
496	EN15984	1.026		-3.09	
527	D1945	1.104		3.77	
602	GPA2261	1.0031	ex	-5.10	see §4.1
608	GPA2286	1.081		1.75	
609	GPA2261	1.073	C	1.05	first reported 1.071
663	D1945	1.075		1.22	
840	D1945	1.0573		-0.34	
868	GPA2261	1.068		0.61	
963	D1945	1.000	D(0.05)	-5.38	
974	ISO6974	1.062		0.08	
1011	UOP539	1.057		-0.36	
1081		-----		-----	
1095	UOP539	1.032		-2.56	
1191	UOP539	1.068		0.61	
1196	GPA2261	1.066		0.43	
1197	D1945	1.067		0.52	
1198	D1945	1.065		0.34	
1200	UOP539	1.07		0.78	
1287	ISO6974	1.054		-0.63	
1307	Fast RGA	1.075		1.22	
1320	ISO6974	1.031		-2.65	
1388	GPA2261	1.059		-0.19	
1390	in house	1.054		-0.63	
1436	ISO6974	1.068		0.61	
1489	ISO6974	1.047	C	-1.24	first reported 1.048
1603	in house	1.0849		2.09	
1622		-----		-----	
1635	D1945	1.084		2.01	
1654	D1945	1.072	C	0.96	first reported 1.073
1737	in house	1.007		-4.76	

normality OK
n 32
outliers 1
mean (n) 1.0611
st.dev. (n) 0.020897
R(calc.) 0.0585
R(ISO6974-3) 0.0318

Compare R(ASTM D1945) = 0.100

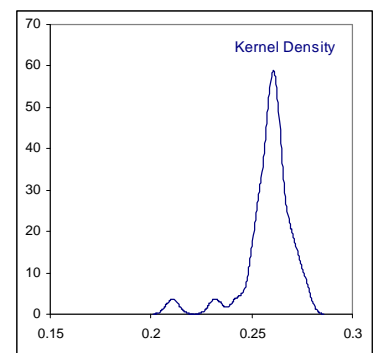
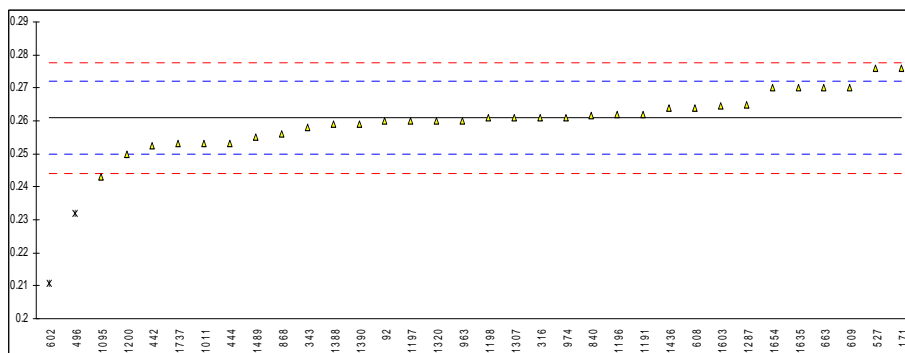


Determination of n-Butane on sample #12040; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	GPA2286	0.26		-0.17	
171	D1945	0.276		2.69	
316	ISO6974	0.261		0.01	
343	CEA1624	0.258		-0.53	
442	D1945	0.2525		-1.51	
444	D1945	0.253		-1.42	
496	EN15984	0.232	G(0.05)	-5.18	
527	D1945	0.276		2.69	
602	GPA2261	0.2107	G(0.01)	-8.99	
608	GPA2286	0.264		0.54	
609	GPA2261	0.270		1.62	
663	D1945	0.270		1.62	
840	D1945	0.2615		0.10	
868	GPA2261	0.256		-0.89	
963	D1945	0.260		-0.17	
974	ISO6974	0.261		0.01	
1011	UOP539	0.253		-1.42	
1081		-----		-----	
1095	UOP539	0.243		-3.21	
1191	UOP539	0.262		0.19	
1196	GPA2261	0.262		0.19	
1197	D1945	0.260		-0.17	
1198	D1945	0.261		0.01	
1200	UOP539	0.25		-1.96	
1287	ISO6974	0.265		0.72	
1307	Fast RGA	0.261		0.01	
1320	ISO6974	0.260		-0.17	
1388	GPA2261	0.259		-0.35	
1390	in house	0.259		-0.35	
1436	ISO6974	0.264		0.54	
1489	ISO6974	0.255	C	-1.06	first reported 0.236
1603	in house	0.2645		0.63	
1622		-----		-----	
1635	D1945	0.270		1.62	
1654	D1945	0.270	C	1.62	first reported 0.271
1737	in house	0.253		-1.42	

normality OK
n 32
outliers 2
mean (n) 0.2610
st.dev. (n) 0.00722
R(calc.) 0.0202
R(ISO6974-3) 0.0157

Compare R(ASTM D1945) = 0.070

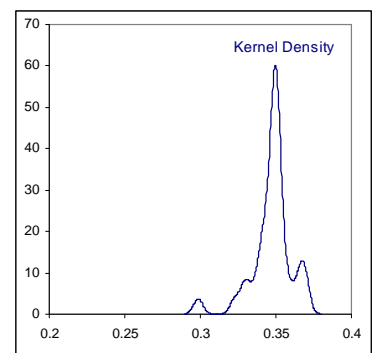
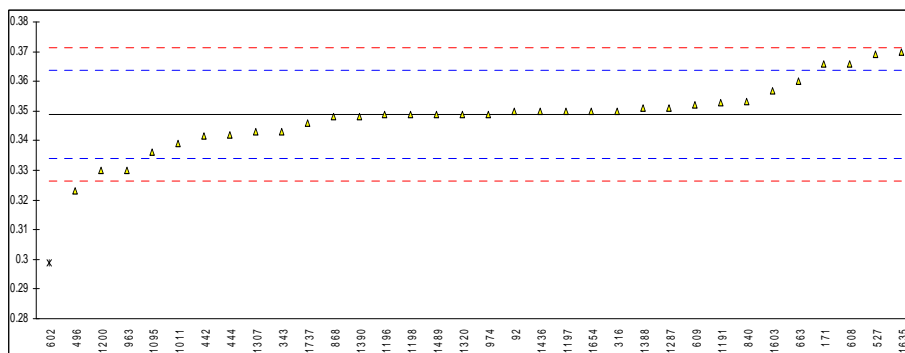


Determination of iso-Butane on sample #12040; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	GPA2286	0.35		0.15	
171	D1945	0.366		2.29	
316	ISO6974	0.350		0.15	
343	CEA1624	0.343		-0.79	
442	D1945	0.3415		-0.99	
444	D1945	0.342		-0.92	
496	EN15984	0.323		-3.46	
527	D1945	0.369		2.69	
602	GPA2261	0.2987	G(0.01)	-6.71	
608	GPA2286	0.366		2.29	
609	GPA2261	0.352		0.42	
663	D1945	0.360		1.49	
840	D1945	0.3533		0.59	
868	GPA2261	0.348		-0.12	
963	D1945	0.330		-2.52	
974	ISO6974	0.349		0.02	
1011	UOP539	0.339		-1.32	
1081		-----		-----	
1095	UOP539	0.336		-1.72	
1191	UOP539	0.353		0.55	
1196	GPA2261	0.349		0.02	
1197	D1945	0.350		0.15	
1198	D1945	0.349		0.02	
1200	UOP539	0.33		-2.52	
1287	ISO6974	0.351		0.28	
1307	Fast RGA	0.343		-0.79	
1320	ISO6974	0.349		0.02	
1388	GPA2261	0.351		0.28	
1390	in house	0.348		-0.12	
1436	ISO6974	0.350		0.15	
1489	ISO6974	0.349	C	0.02	first reported 0.326
1603	in house	0.3569		1.07	
1622		-----		-----	
1635	D1945	0.370		2.83	
1654	D1945	0.350		0.15	
1737	in house	0.346		-0.38	

normality not OK
n 33
outliers 1
mean (n) 0.3489
st.dev. (n) 0.01048
R(calc.) 0.0293
R(ISO6974-3) 0.0209

Compare R(ASTM D1945) = 0.070

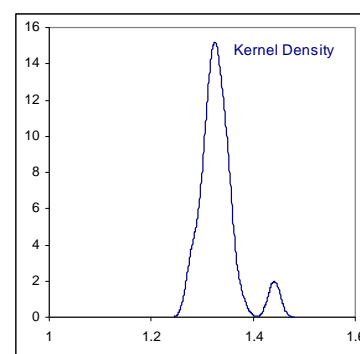
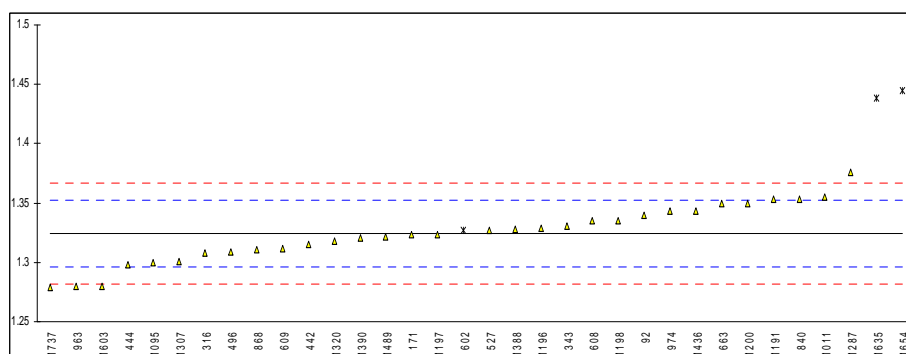


Determination of Carbon Dioxide on sample #12040; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	GPA2286	1.34		1.12	
171	D1945	1.323		-0.08	
316	ISO6974	1.308		-1.14	
343	CEA1624	1.331		0.48	
442	D1945	1.3151		-0.64	
444	D1945	1.298		-1.84	
496	EN15984	1.309		-1.07	
527	D1945	1.327		0.20	
602	GPA2261	1.3269	ex	0.19	see §4.1
608	GPA2286	1.335		0.77	
609	GPA2261	1.312	C	-0.86	first reported 1.311
663	D1945	1.350		1.82	
840	D1945	1.3534		2.06	
868	GPA2261	1.311		-0.93	
963	D1945	1.280		-3.11	
974	ISO6974	1.343		1.33	
1011	UOP539	1.355		2.17	
1081		-----		-----	
1095	UOP539	1.300		-1.70	
1191	UOP539	1.353		2.03	
1196	GPA2261	1.329		0.34	
1197	D1945	1.323		-0.08	
1198	D1945	1.335		0.77	
1200	UOP539	1.35		1.82	
1287	ISO6974	1.376		3.66	
1307	Fast RGA	1.301		-1.63	
1320	ISO6974	1.318		-0.43	
1388	GPA2261	1.328		0.27	
1390	in house	1.321		-0.22	
1436	ISO6974	1.343		1.33	
1489	ISO6974	1.322	C	-0.15	first reported 1.306
1603	in house	1.2800		-3.11	
1622		-----		-----	
1635	D1945	1.438	G(0.01)	8.03	
1654	D1945	1.445	C,G(0.05)	8.52	first reported 1.397
1737	in house	1.279		-3.18	

normality OK
n 31
outliers 2
mean (n) 1.3241
st.dev. (n) 0.02355
R(calc.) 0.0659
R(ISO6974-3) 0.0397

Compare R(ASTM D1945) = 0.100

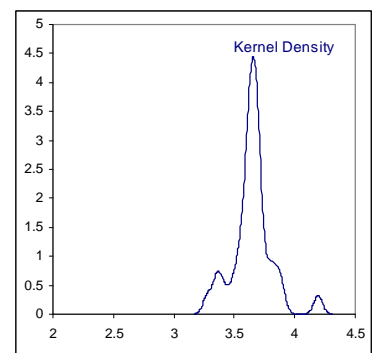
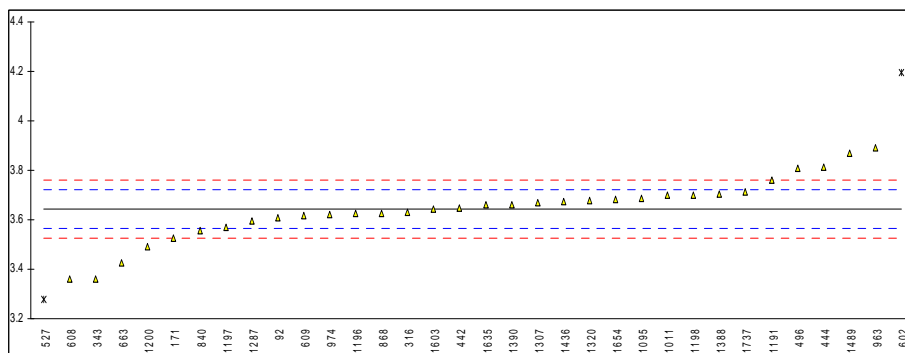


Determination of Nitrogen on sample #12040; results in %mol/mol

lab	method	value	mark	z(target)	remarks
92	GPA2286	3.61		-0.86	
171	D1945	3.528		-2.96	
316	ISO6974	3.631		-0.32	
343	CEA1624	3.363	C	-7.18	first reported 4.044
442	D1945	3.6488		0.14	
444	D1945	3.815		4.39	
496	EN15984	3.807		4.19	
527	D1945	3.279	G(0.05)	-9.34	
602	GPA2261	4.1952	G(0.01)	14.13	
608	GPA2286	3.360	C	-7.26	first reported 3.396
609	GPA2261	3.617	C	-0.68	first reported 3.610
663	D1945	3.425		-5.60	
840	D1945	3.5562		-2.23	
868	GPA2261	3.628		-0.40	
963	D1945	3.890		6.32	
974	ISO6974	3.620	C	-0.60	first reported 3.120
1011	UOP539	3.700		1.45	
1081		-----		-----	
1095	UOP539	3.686		1.09	
1191	UOP539	3.763		3.06	
1196	GPA2261	3.624		-0.50	
1197	D1945	3.568		-1.93	
1198	D1945	3.700		1.45	
1200	UOP539	3.49		-3.93	
1287	ISO6974	3.597		-1.19	
1307	Fast RGA	3.669		0.65	
1320	ISO6974	3.678		0.89	
1388	GPA2261	3.705		1.58	
1390	in house	3.662		0.48	
1436	ISO6974	3.676		0.83	
1489	ISO6974	3.869	C	5.78	first reported 3.901
1603	in house	3.6449		0.04	
1622		-----		-----	
1635	D1945	3.660		0.42	
1654	D1945	3.684	C	1.04	first reported 3.688
1737	in house	3.715		1.83	

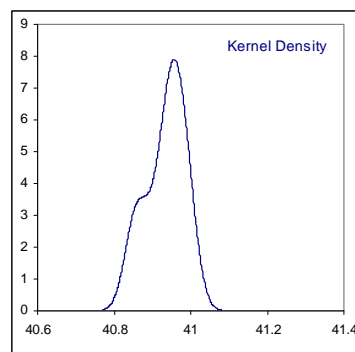
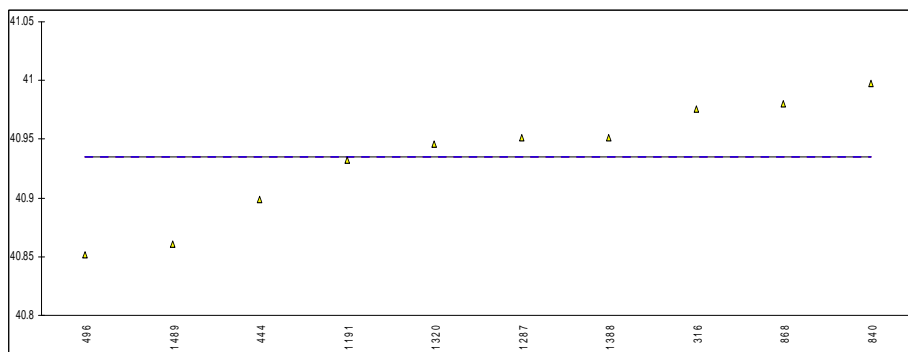
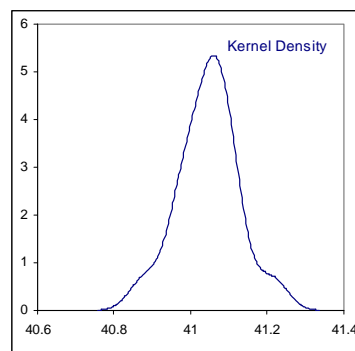
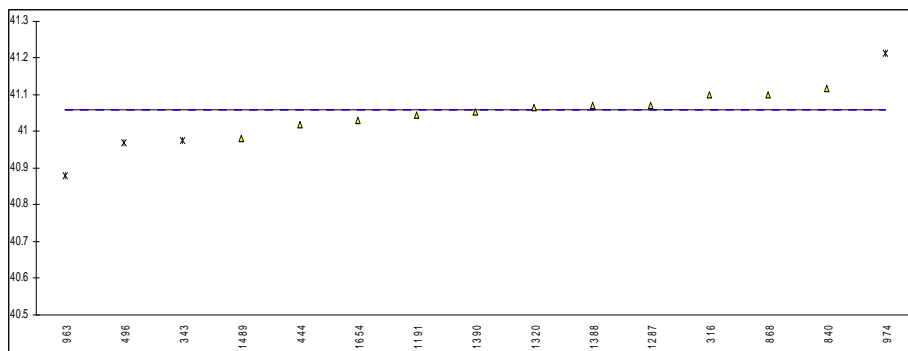
normality OK
 n 32
 outliers 2
 mean (n) 3.6434
 st.dev. (n) 0.12269
 R(calc.) 0.3435
 R(ISO6974-3) 0.1093

Compare R(ASTM D1945) = 0.100



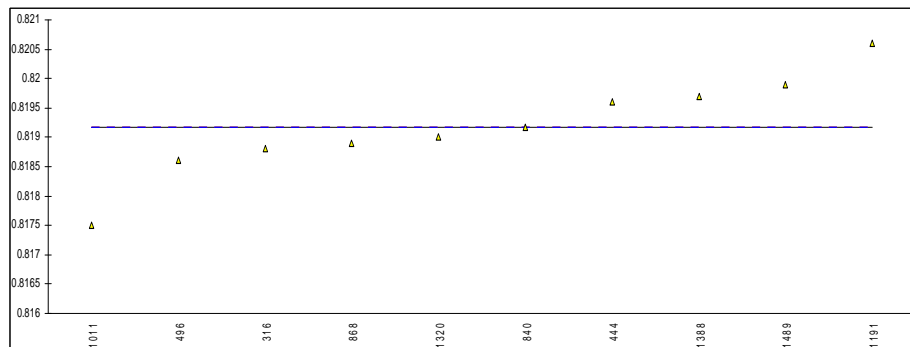
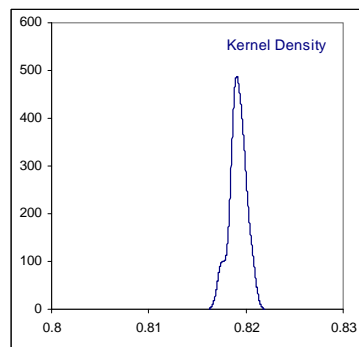
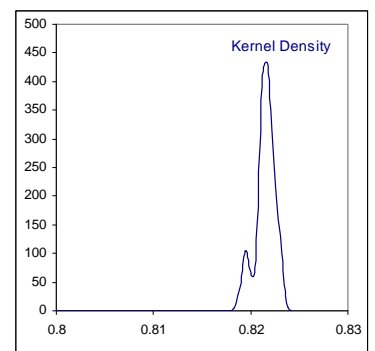
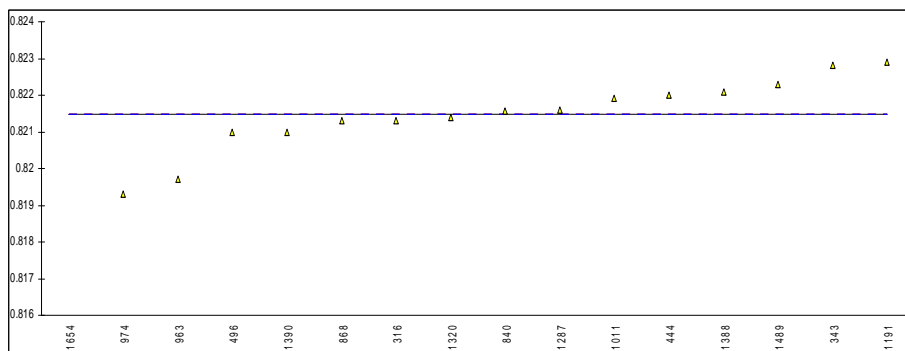
Determination of Caloric Value (sup) (101.325 kPa , comb. temp. 25°C, and metering temp 0°C) on sample #12040; results in MJ/m³

Lab	method	real gas	mark	z(targ)	ideal gas	mark	z(targ)	remarks
92		----		----	----		----	
171		----		----	----		----	
316	ISO6976	41.099		----	40.976		----	
343	CEA1624	40.9750	E,ex	----	----		----	calculation error?
442		----		----	----		----	
444	ISO6976	41.018		----	40.899		----	
496	DIN51857	40.971	E,ex	----	40.852		----	calculation error?
527		----		----	----		----	
602		----		----	----		----	
608		----		----	----		----	
609		----		----	----		----	
663		----		----	----		----	
840	ISO6976	41.1169		----	40.9972		----	
868	ISO6976	41.100		----	40.980		----	
963	ISO6976	40.880	G(0.05)	----	----		----	
974	GPA2172	41.213	C,E,ex	----	----		----	first reported 41.413; calc. error?
1011		----		----	----		----	
1081		----		----	----		----	
1095		----		----	----		----	
1191	ISO6976	41.045		----	40.932		----	
1196		----		----	----		----	
1197		----		----	----		----	
1198		----		----	----		----	
1200		----		----	----		----	
1287	ISO6976	41.071		----	40.951		----	
1307		----		----	----		----	
1320	ISO6976	41.065		----	40.946		----	
1388	ISO6976	41.070		----	40.951		----	
1390	ISO6976	41.054		----	----		----	
1436		----		----	----		----	
1489	ISO6976	40.980	C	----	40.861	C	----	first reported 40.929 / 40.810
1603		----		----	----		----	
1622		----		----	----		----	
1635		----		----	----		----	
1654	ISO6976	41.029	C	----	----		----	first reported 38.932
1737		----		----	----		----	
normality		OK			OK			
n		11			10			
outliers		1			0			
mean (n)		41.0589			40.9345			
st.dev. (n)		0.03997			0.04930			
R(calc.)		0.1119			0.1380			
R(lit.)		unknown			unknown			



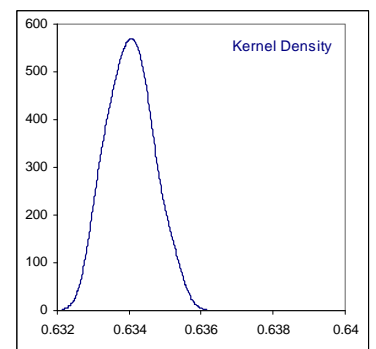
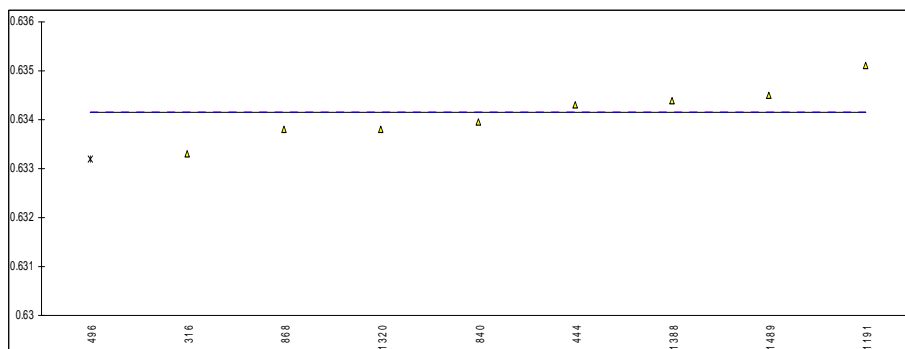
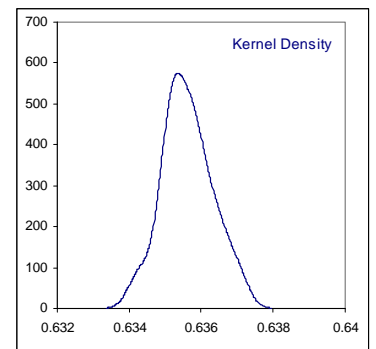
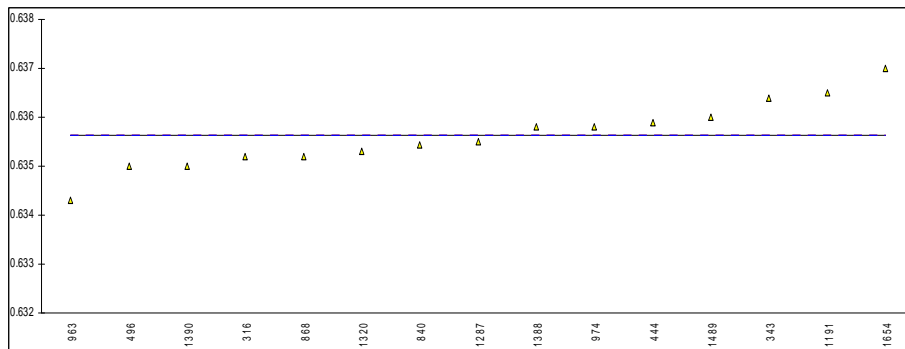
Determination of Density (101.325 kPa , combustion temp. 25°C, and metering temp. 0°C) on sample #12040; results in kg/m³

Lab	method	real gas	mark	z(targ)	ideal gas	mark	z(targ)	remarks
92		----		----	----		----	
171		----		----	----		----	
316	ISO6976	0.8213		----	0.8188		----	
343	CEA1624	0.8228		----	----		----	
442		----		----	----		----	
444	ISO6976	0.8220		----	0.8196		----	
496	DIN51857	0.8210		----	0.8186		----	
527		----		----	----		----	
602		----		----	----		----	
608		----		----	----		----	
609		----		----	----		----	
663		----		----	----		----	
840	ISO6976	0.82156		----	0.81917		----	
868	ISO6976	0.8213		----	0.8189		----	
963	ISO6976	0.8197		----	----		----	
974	GPA2172	0.8193		----	----		----	
1011	D3588	0.8219		----	0.8175		----	
1081		----		----	----		----	
1095		----		----	----		----	
1191	ISO6976	0.8229		----	0.8206		----	
1196		----		----	----		----	
1197		----		----	----		----	
1198		----		----	----		----	
1200		----		----	----		----	
1287	ISO6976	0.8216		----	----		----	
1307		----		----	----		----	
1320	ISO6976	0.8214		----	0.8190		----	
1388	ISO6976	0.8221		----	0.8197		----	
1390	ISO6976	0.8210		----	----		----	
1436		----		----	----		----	
1489	ISO6976	0.8223	C	----	0.8199	C	----	first reported 0.8214 / 0.8190
1603		----		----	----		----	
1622		----		----	----		----	
1635		----		----	----		----	
1654	ISO6976	0.7543	C,G(0.01)	----	----		----	first reported 0.7535
1737		----		----	----		----	
normality		OK			OK			
n		15			10			
outliers		1			0			
mean (n)		0.8215			0.8192			
st.dev. (n)		0.00099			0.00084			
R(calc.)		0.0028			0.0024			
R(lit.)		unknown			unknown			



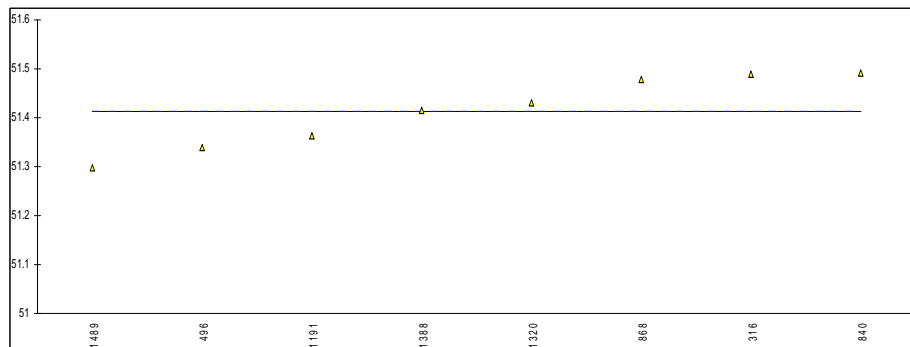
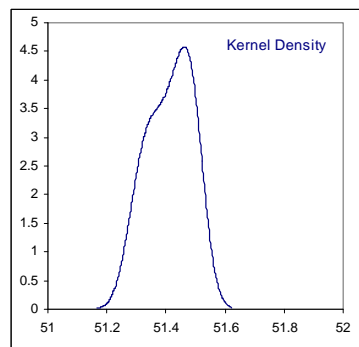
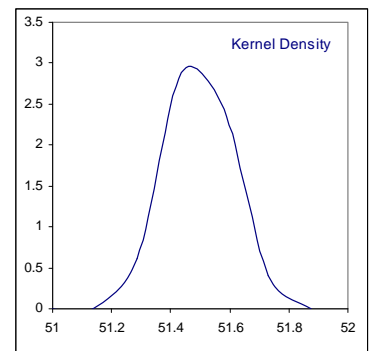
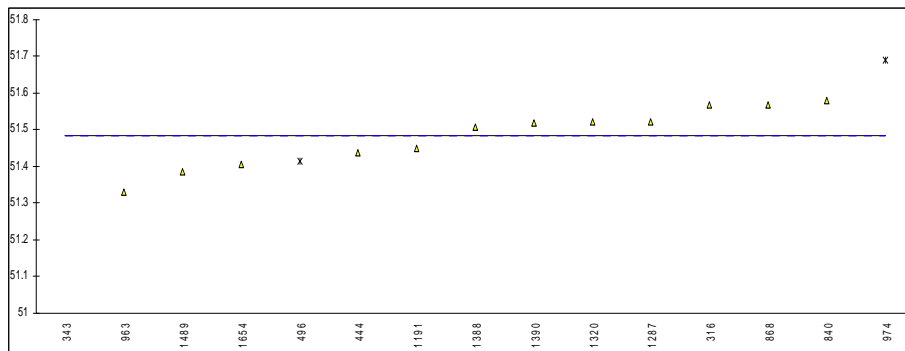
Determination of Relative Density (101.325 kPa , comb. temp. 25°C, and metering temp. 0°C) on sample #12040; unit less results

Lab	method	real gas	mark	z(targ)	ideal gas	mark	z(targ)	remarks
92		----		----	----		----	
171		----		----	----		----	
316	ISO6976	0.6352		----	0.6333		----	
343	CEA1624	0.6364		----	----		----	
442		----		----	----		----	
444	ISO6976	0.6359		----	0.6343		----	
496	DIN51857	0.6350		----	0.6332	E, ex	----	calculation error?
527		----		----	----		----	
602		----		----	----		----	
608		----		----	----		----	
609		----		----	----		----	
663		----		----	----		----	
840	ISO6976	0.63543		----	0.63395		----	
868	ISO6976	0.6352		----	0.6338		----	
963	ISO6976	0.6343		----	----		----	
974	GPA2172	0.6358	C	----	----		----	first reported 0.6337
1011		----		----	----		----	
1081		----		----	----		----	
1095		----		----	----		----	
1191	ISO6976	0.6365		----	0.6351		----	
1196		----		----	----		----	
1197		----		----	----		----	
1198		----		----	----		----	
1200		----		----	----		----	
1287	ISO6976	0.6355		----	----		----	
1307		----		----	----		----	
1320	ISO6976	0.6353		----	0.6338		----	
1388	ISO6976	0.6358		----	0.6344		----	
1390	ISO6976	0.6350		----	----		----	
1436		----		----	----		----	
1489	ISO6976	0.6360	C	----	0.6345	C	----	first reported 0.6353 / 0.6338
1603		----		----	----		----	
1622		----		----	----		----	
1635		----		----	----		----	
1654	ISO6976	0.6370	C	----	----		----	first reported 0.6363
1737		----		----	----		----	
normality		OK			OK			
n		15			8			
outliers		0			0			
mean (n)		0.6356			0.6341			
st.dev. (n)		0.00069			0.00055			
R(calc.)		0.0019			0.0015			
R(lit.)		unknown			unknown			



Determination of Wobbe Index (101.325 kPa , combustion temp. 25°C, and metering temp. 0°C) on sample #12040; results in MJ/m³

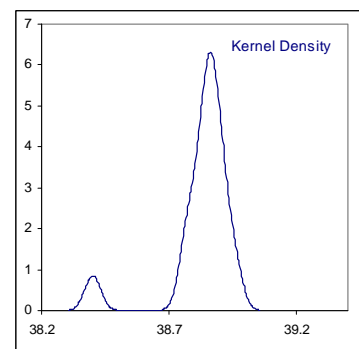
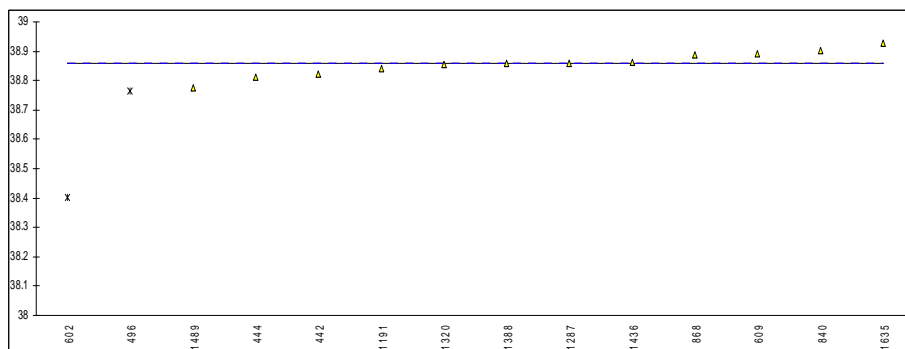
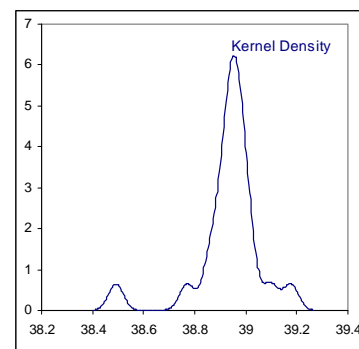
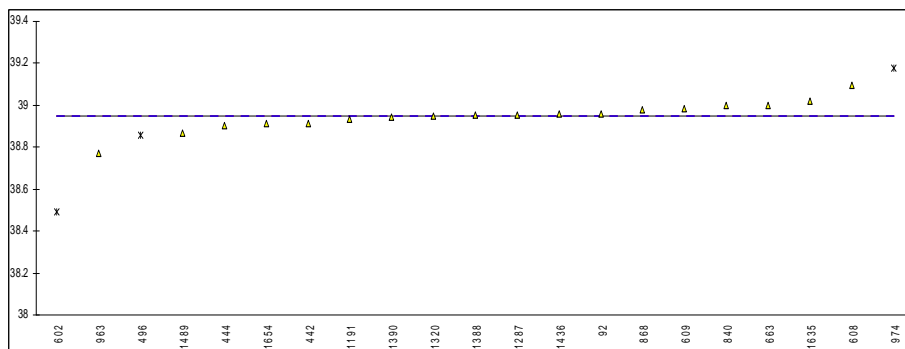
Lab	method	real gas	mark	z(targ)	ideal gas	mark	z(targ)	remarks
92		----		----	----		----	
171		----		----	----		----	
316	ISO6976	51.567		----	51.490		----	
343	CEA1624	14.38	C,G(0.01)	----	----		----	first reported 14.270
442		----		----	----		----	
444	ISO6976	51.439		----	----		----	
496	DIN51857	51.415	E,ex	----	51.340		----	calculation error?
527		----		----	----		----	
602		----		----	----		----	
608		----		----	----		----	
609		----		----	----		----	
663		----		----	----		----	
840	ISO6976	51.5806		----	51.4903		----	
868	ISO6976	51.568		----	51.478		----	
963	ISO6976	51.33		----	----		----	
974	GPA2172	51.69	C, E, ex	----	----		----	first reported 52.02, calc. error?
1011		----		----	----		----	
1081		----		----	----		----	
1095		----		----	----		----	
1191	ISO6976	51.448		----	51.363		----	
1196		----		----	----		----	
1197		----		----	----		----	
1198		----		----	----		----	
1200		----		----	----		----	
1287	ISO6976	51.521		----	----		----	
1307		----		----	----		----	
1320	ISO6976	51.521		----	51.431		----	
1388	ISO6976	51.506		----	51.416		----	
1390	ISO6976	51.519		----	----		----	
1436		----		----	----		----	
1489	ISO6976	51.386	C	----	51.297	C	----	first reported 51.351 / 51.262
1603		----		----	----		----	
1622		----		----	----		----	
1635		----		----	----		----	
1654	ISO6976	51.407	C	----	----		----	first reported 48.810
1737		----		----	----		----	
normality		OK			OK			
n		12			8			
outliers		1			0			
mean (n)		51.4827			51.4132			
st.dev. (n)		0.07993			0.07343			
R(calc.)		0.2238			0.2056			
R(lit.)		unknown			unknown			



Determination of Caloric Value (sup) (101.325 kPa , comb. temp. 15°C, and metering temp 15°C) on sample #12040; results in MJ/m³

Lab	method	real gas	mark	z(target)	ideal gas	mark	z(target)	remarks
92		38.96	C	----	----		----	reported under 'ideal'
171		----		----	----		----	
316		----		----	----		----	
343		----		----	----		----	
442	ISO6974	38.915		----	38.822		----	
444	ISO6976	38.904		----	38.810		----	
496	DIN51857	38.858	E, ex	----	38.765	E, ex	----	calculation errors?
527		----		----	----		----	
602	ISO6976	38.4914	G(0.01)	----	38.4007	G(0.01)	----	
608	ISO6976	39.097	C	----	----		----	first reported 39.104
609	ISO6976	38.984	C	----	38.890	C	----	first reported 38.937 / 38.844
663	D3588	39.00		----	----		----	
840	ISO6976	38.9970		----	38.9027		----	
868	ISO6976	38.981		----	38.887		----	
963	ISO6976	38.770		----	----		----	
974	GPA2172	39.177	E, ex	----	----		----	calculation error?
1011		----		----	----		----	
1081		----		----	----		----	
1095		----		----	----		----	
1191	ISO6976	38.935		----	38.841		----	
1196		----		----	----		----	
1197		----		----	----		----	
1198		----		----	----		----	
1200		----		----	----		----	
1287	ISO6976	38.954		----	38.860		----	
1307		----		----	----		----	
1320	ISO6976	38.948		----	38.854		----	
1388	ISO6976	38.952		----	38.858		----	
1390	ISO6976	38.941		----	----		----	
1436	ISO6976	38.957		----	38.863		----	
1489	ISO6976	38.867	C	----	38.774	C	----	first reported 38.819 / 38.726
1603		----		----	----		----	
1622		----		----	----		----	
1635	ISO6976	39.021		----	38.927		----	
1654	ISO6976	38.914	C	----	----		----	first reported 41.028
1737		----		----	----		----	

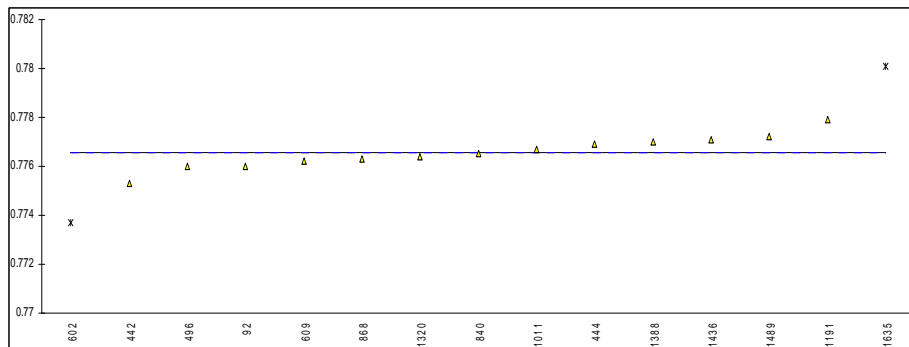
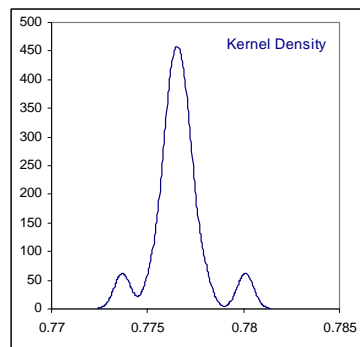
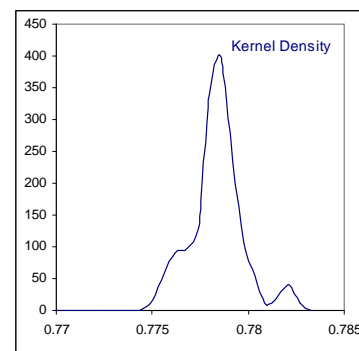
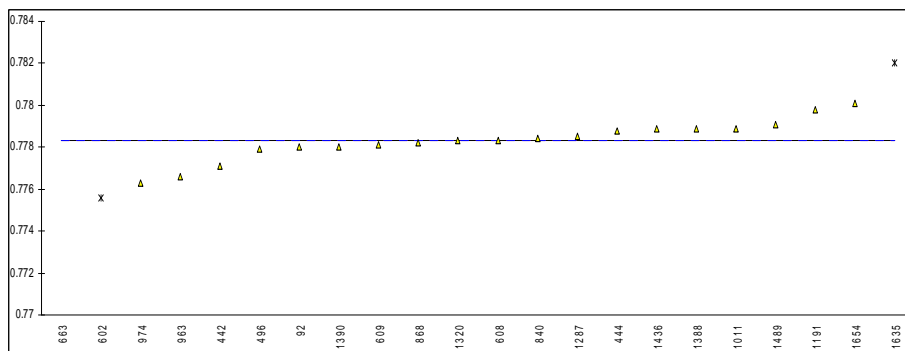
normality	OK	OK
n	18	12
outliers	1	1
mean (n)	38.9498	38.8574
st.dev. (n)	0.06768	0.04222
R(calc.)	0.1895	0.1182
R(lit.)	unknown	unknown



Determination of Density (101.325 kPa , combustion temp. 15°C, and metering temp. 15°C) on sample #12040; results in kg/m³

Lab	method	real gas	mark	z(targ)	ideal gas	mark	z(targ)	remarks
92	GPA2286	0.778	C	----	0.776	----	----	first reported 0.774
171		----		----	----			
316		----		----	----			
343		----		----	----			
442	ISO6974	0.7771		----	0.7753			
444	ISO6976	0.7788		----	0.7769			
496	DIN51857	0.7779		----	0.7760			
527		----		----	----			
602	ISO6976	0.7756	ex	----	0.7737	G(0.05)	----	see §4.1
608	ISO6976	0.7783	C	----	----			first reported 0.7782
609	ISO6976	0.7781	C	----	0.7762	C		first reported 0.7770 / 0.7551
663	D3588	0.6339	G(0.01)	----	----			
840	ISO6976	0.77841		----	0.77653			
868	ISO6976	0.7782		----	0.7763			
963	ISO6976	0.7766		----	----			
974	GPA2172	0.7763		----	----			
1011	D3588	0.7789	C	----	0.7767	C		first reported 0.7787 / 0.7765
1081		----		----	----			
1095		----		----	----			
1191	ISO6976	0.7798		----	0.7779			
1196		----		----	----			
1197		----		----	----			
1198		----		----	----			
1200		----		----	----			
1287	ISO6976	0.7785		----	----			
1307		----		----	----			
1320	ISO6976	0.7783		----	0.7764			
1388	ISO6976	0.7789		----	0.7770			
1390	ISO6976	0.7780		----	----			
1436	ISO6976	0.7789		----	0.7771			
1489	ISO6976	0.7791	C	----	0.7772	C		first reported 0.7782 / 0.7764
1603		----		----	----			
1622		----		----	----			
1635	ISO6976	0.7820	G(0.05)	----	0.7801	G(0.05)		
1654	ISO6976	0.7801	C	----	----			first reported 0.7796
1737		----		----	----			

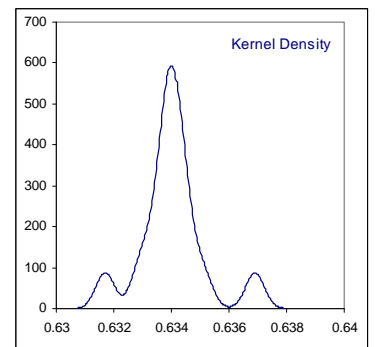
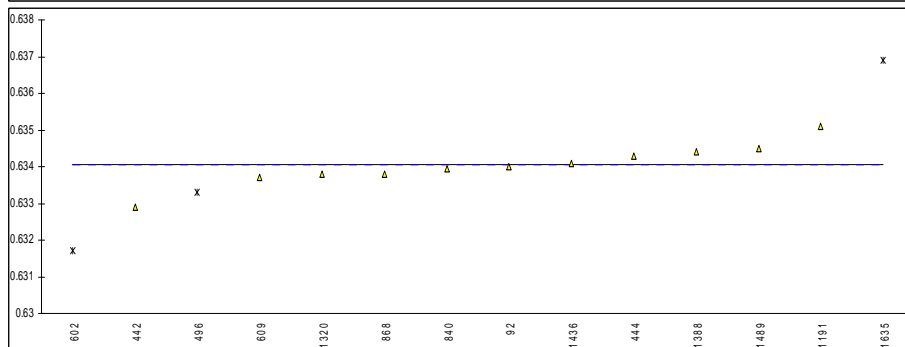
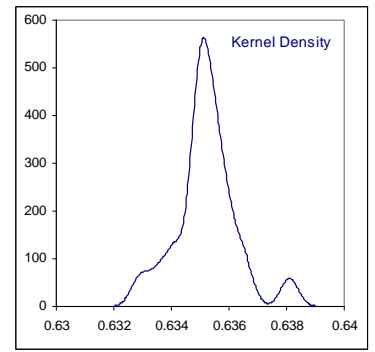
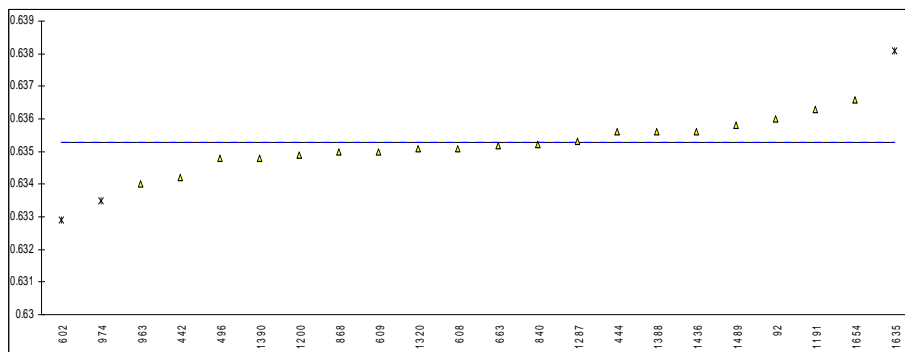
normality	OK	OK
n	19	13
outliers	2	2
mean (n)	0.7783	0.7766
st.dev. (n)	0.00095	0.00066
R(calc.)	0.0027	0.0019
R(lit.)	unknown	unknown



Determination of Relative Density (101.325 kPa , comb. temp. 15°C, and metering temp. 15°C) on sample #12040; unit less results

lab	method	real gas	mark	z(targ)	ideal gas	mark	z(targ)	remarks
92	GPA2286	0.636	C	----	0.634	----	----	first reported 0.632
171		----		----	----			
316		----		----	----			
343		----		----	----			
442	ISO6974	0.6342		----	0.6329			
444	ISO6976	0.6356		----	0.6343			
496	DIN51857	0.6348		----	0.6333	E, ex		calculation error?
527		----		----	----			
602	ISO6976	0.6329	G(0.05)	----	0.6317	G(0.05)		see §4.1
608	ISO6976	0.6351		----	----			
609	ISO6976	0.6350	C	----	0.6337	C		first reported 0.6341 / 0.6328
663	D3588	0.6352		----	----			
840	ISO6976	0.63522		----	0.63395			
868	ISO6976	0.6350		----	0.6338			
963	ISO6976	0.6340		----	----			
974	GPA2172	0.6335	E, ex	----	----			calculation error?
1011		----		----	----			
1081		----		----	----			
1095		----		----	----			
1191	ISO6976	0.6363		----	0.6351			
1196		----		----	----			
1197		----		----	----			
1198		----		----	----			
1200	D3588	0.6349		----	----			
1287	ISO6976	0.6353		----	----			
1307		----		----	----			
1320	ISO6976	0.6351		----	0.6338			
1388	ISO6976	0.6356		----	0.6344			
1390	ISO6976	0.6348		----	----			
1436	ISO6976	0.6356		----	0.6341			
1489	ISO6976	0.6358	C	----	0.6345	C		first reported 0.6350 / 0.6338
1603		----		----	----			
1622		----		----	----			
1635	ISO6976	0.6381	G(0.05)	----	0.6369	D(0.05)		
1654	ISO6976	0.6366	C	----	----			first reported 0.6362
1737		----		----	----			

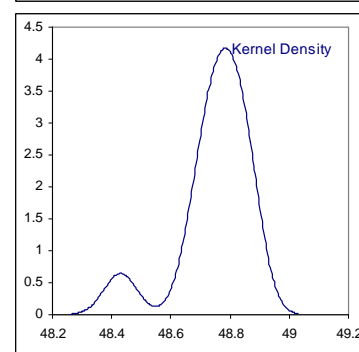
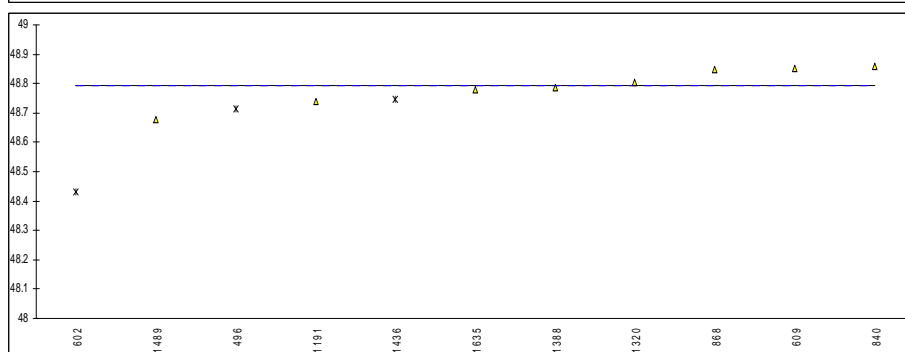
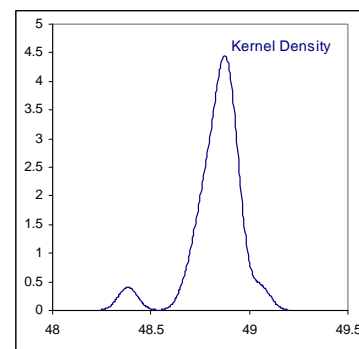
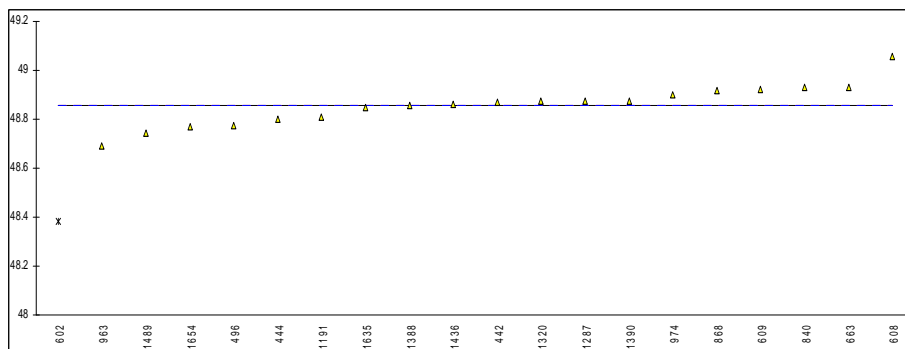
normality	OK	OK
n	19	11
outliers	2	2
mean (n)	0.6353	0.6341
st.dev. (n)	0.00064	0.00056
R(calc.)	0.0018	0.0016
R(lit.)	unknown	unknown



Determination of Wobbe Index (101.325 kPa , combustion temp. 15°C, and metering temp. 15°C) on sample #12040; results in MJ/m³

lab	method	real gas	mark	z(targ)	ideal gas	mark	z(targ)	remarks
92		----		----	----		----	
171		----		----	----		----	
316		----		----	----		----	
343		----		----	----		----	
442	ISO6974	48.87		----	----		----	
444	ISO6976	48.799		----	----		----	
496	DIN51857	48.772		----	48.713	E, ex	----	calculation error?
527		----		----	----		----	
602	ISO6976	48.3831	G(0.01)	----	48.4300	E, ex	----	calculation error? real < ideal?
608	ISO6976	49.058	C	----	----		----	first reported 49.069
609	ISO6976	48.922	C	----	48.853	C	----	first reported 48.898 / 48.829
663	D3588	48.93		----	----		----	
840	ISO6976	48.9292		----	48.8598		----	
868	ISO6976	48.917		----	48.848		----	
963	ISO6976	48.69		----	----		----	
974	GPA2172	48.90	C	----	----		----	first reported 49.22
1011		----		----	----		----	
1081		----		----	----		----	
1095		----		----	----		----	
1191	ISO6976	48.808		----	48.739		----	
1196		----		----	----		----	
1197		----		----	----		----	
1198		----		----	----		----	
1200		----		----	----		----	
1287	ISO6976	48.873		----	----		----	
1307		----		----	----		----	
1320	ISO6976	48.873		----	48.803		----	
1388	ISO6976	48.858		----	48.788		----	
1390	ISO6976	48.873		----	----		----	
1436	ISO6976	48.862		----	48.745	E, ex	----	calculation error?
1489	ISO6976	48.744	C	----	48.677	C	----	first reported 48.716 / 48.643
1603		----		----	----		----	
1622		----		----	----		----	
1635	ISO6976	48.848		----	48.778		----	
1654	ISO6976	48.771	C	----	----		----	first reported 51.437
1737		----		----	----		----	

normality	OK	OK
n	19	8
outliers	1	0
mean (n)	48.8577	48.7932
st.dev. (n)	0.082561	0.06303
R(calc.)	0.2312	0.1765
R(lit.)	unknown	unknown



APPENDIX 2**Compression factors used by participants**

lab	Compressibility factor @15°C	Compressibility factor @0°C
92	0.9976	----
171	----	----
316	----	0.997
343	----	1.0024
442	0.9976	----
444	0.9976	0.9971
496	0.998	0.997
527	----	----
602	0.997573	----
608	0.9975	----
609	0.997594402	----
663	0.9976	----
840	0.99758	0.99709
868	0.9976	0.9971
963	0.9976	0.9976
974	0.9977	0.9977
1011	1.003	----
1081	----	----
1095	----	----
1191	0.9976	----
1196	----	----
1197	----	----
1198	----	----
1200	----	----
1287	0.99759	0.99709
1307	----	----
1320	0.99759	0.99710
1388	0.997587102	0.997587102
1390	0.9976	0.9971
1436	0.9976	----
1489	0.9976	0.9971
1603	----	----
1622	----	----
1635	0.9976	----
1654	0.9976	0.9971
1737	----	----

APPENDIX 3

Number of participants per country

2 labs in BELGIUM
1 lab in CANADA
1 lab in CROATIA
1 lab in FINLAND
1 lab in FRANCE
2 labs in GERMANY
1 lab in HUNGARY
1 lab in INDONESIA
1 lab in ITALY
6 labs in MALAYSIA
1 lab in MEXICO
3 labs in P.R. of CHINA
2 labs in PORTUGAL
2 labs in SAUDI ARABIA
1 lab in SLOVAK REPUBLIC
1 lab in SPAIN
1 lab in THAILAND
2 labs in THE NETHERLANDS
1 lab in TURKEY
1 lab in U.A.E.
1 lab in U.S.A.
2 labs in UNITED KINGDOM
1 lab in VIETNAM

APPENDIX 4

Abbreviations:

C	= final result after checking of first reported suspect result
D(0.01)	= outlier in Dixon's outlier test
D(0.05)	= straggler in Dixon's outlier test
G(0.01)	= outlier in Grubbs' outlier test
G(0.05)	= straggler in Grubbs' outlier test
DG(0.01)	= outlier in Double Grubbs' outlier test
DG(0.05)	= straggler in Double Grubbs' outlier test
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 Organisation, 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. (see <http://www.rsc.org/suppdata/an/b2/b205600n/>)
- 15 ASTM D1945, Standard test method for Analysis of Natural Gas by GC