

Results of Proficiency Test
Natural Gas Analysis
March 2013

Organised by: Institute for Interlaboratory Studies
Spijkenisse, the Netherlands

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1 INTRODUCTION

Since 2009, the Institute organizes a proficiency scheme for Natural Gas (composition only). During the annual proficiency testing program 2012/2013, it was decided to continue the round robin 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 37 laboratories in 23 different countries have participated. See appendix 3 for the number of participants per country. In this report, the results of the 2013 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 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 Spijkennisse, the Netherlands, has implemented a quality system based on ISO/IEC17043:2010 and ILAC-G13:2007, (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 January 2010 (iis-protocol, version 3.2).

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 40 cylinders was prepared (job 13/042) starting February 4, 2013. 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	0.0026	0.0447
Propane	0.0016	0.0136
n-Butane	0.0008	0.0036
iso-Butane	0.0007	0.0054
Carbon dioxide	0.0016	0.0181
Nitrogen	0.0018	0.0223

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 6, 2013.

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 4; nos.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 three laboratories reported results after the final reporting date and three participants were not able to report any test results. In total 33 participants reported 466 numerical results. Observed were 29 outlying results, which is 6.2% of the numerical results. In proficiency studies outlier percentages of 3% - 7.5% are quite normal.

4.1 EVALUATION PER TEST/COMPONENT

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

Not all original data sets proved to have a normal distribution. Non-Gaussian distributions were found for n-Butane, iso-Butane, Density (ideal gas, 101kPa, combustion 25°C, metering 0°C) and Relative Density (real gas, combustion 25°C, metering 0°C). The statistical evaluation of these data sets should be used with due care, see also paragraph 4.4.

All test results reported by laboratory 1095 were deviating, influenced by the very low ethane, propane and carbon dioxide results and the very high nitrogen result. 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.

All laboratories reported normalized test results as requested.

Methane: The determination of this component was problematic. Five statistical outliers were detected. The calculated reproducibility after exclusion of the statistical outliers is not in agreement with the requirements of ISO6974-3:2000, nor with ASTM D1945:2010.

Ethane: 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 in agreement with the requirements of ISO6974-3:2000. However, the calculated reproducibility is not in agreement with the requirements of ASTM D1945:2010.

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 ASTM D1945:2010.

- 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.
No statistical outliers were detected. However, the calculated reproducibility is not in agreement with the strict requirements of ISO6974-3:2000. But, the calculated reproducibility is in full agreement with the requirements of ASTM D1945:2010.
- 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.
No statistical outliers were detected. However, the calculated reproducibility is not in agreement with the strict requirements of ISO6974-3:2000. But, the calculated reproducibility is in full agreement with the requirements of ASTM D1945:2010.
- 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.
Three statistical outliers were detected. The calculated reproducibility after exclusion of the statistical outliers is not at all in agreement with the strict requirements of ISO6974-3:2000. However, the calculated reproducibility is almost in agreement with the requirements of ASTM D1945:2010.
- Nitrogen: The determination of this component was 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 D1945:2010.
- 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, as it became 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 15°C.
- Caloric Value: This time bimodal distributions are visible and the spreads of the four groups of test results are all, except for ideal gas (combustion 25°C/0°C), much larger than previously observed spread in iis12S01M. However, still a number of laboratories did report results that deviate from the theoretical results, possibly due to calculation errors.

Density: This time no bimodal distributions are visible and the spreads of the four groups of test results are all smaller than previously observed spread in iis12S01M. However, four laboratories did report results that deviate from the theoretical results, possibly due to calculation errors and one laboratory reported a value for real gas that is smaller than for ideal gas, which is not possible.

Relative density: This time no bimodal distributions are visible and the spreads of the four groups of test results are all smaller than previously observed spread in iis12S01M. However, three laboratories did report results that deviate from the theoretical results, possibly due to calculation errors and two laboratories reported a value for real gas that is smaller than for ideal gas, which is not possible.

Wobbe index: This time no bimodal distributions are visible and the spreads of two of the four groups of test results are larger than previously observed spread in iis12S01M. However, one laboratory did report a result that deviate from the theoretical result, possibly due to calculation errors and one laboratory reported a value for real gas that is smaller than for ideal gas, which is not possible.

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	28	88.493	0.227	0.177	0.150
Ethane	%mol/mol	31	4.997	0.138	0.150	0.100
Propane	%mol/mol	32	1.522	0.071	0.046	0.100
n-Butane	%mol/mol	32	0.203	0.020	0.012	0.070
iso-Butane	%mol/mol	32	0.303	0.025	0.018	0.070
Carbon dioxide	%mol/mol	30	2.021	0.110	0.061	0.100
Nitrogen	%mol/mol	32	2.478	0.243	0.074	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 MARCH 2013 WITH PREVIOUS PTS

	2013	2012	2011	2010
Number of reporting labs	33	34	33	29
Number of results reported	466	475	330	280
Statistical outliers	29	23	16	25
Percentage outliers	6.2%	4.8%	4.8%	8.9%

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:

	2013 ISO6974-3	2013 D1945	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 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	88.519	88.493	+0.026
Ethane	4.970	4.997	-0.027
Propane	1.513	1.522	-0.009
n-Butane	0.203	0.203	0.000
iso-Butane	0.302	0.303	-0.001
Carbon dioxide	2.012	2.021	-0.009
Nitrogen	2.481	2.478	+0.003

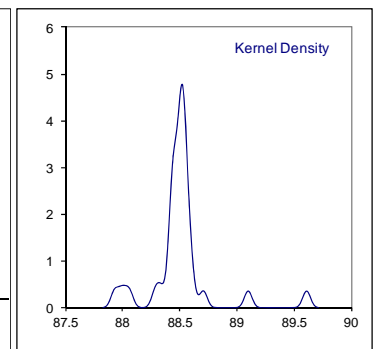
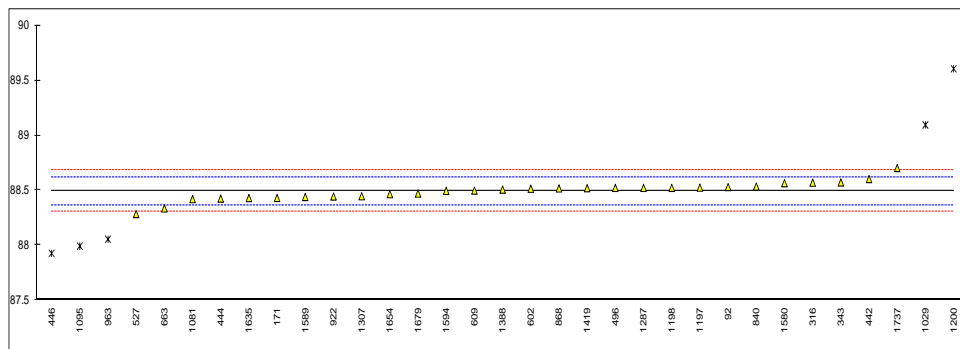
Table 5: comparison of consensus values with values determined by the supplier EffecTech

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

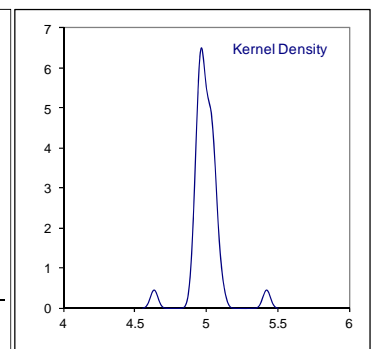
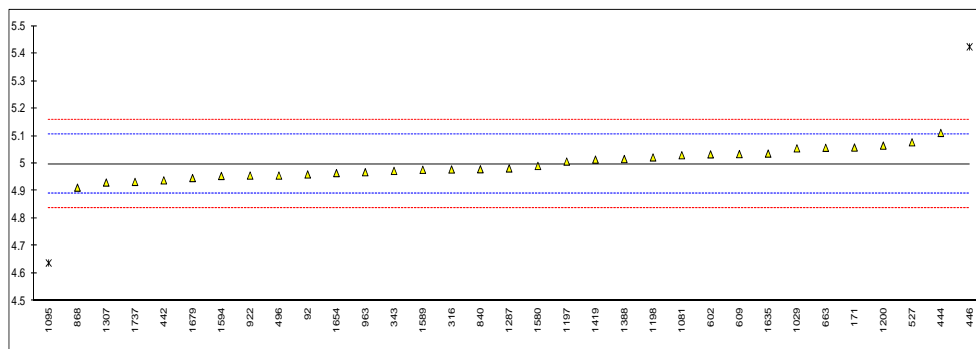
Determination of Methane on sample #13030; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	GPA2286	88.53		0.58	
171	D1945	88.431		-0.99	
316	ISO6974	88.570		1.21	
343	CEA1624	88.572		1.24	
442	D1945/ISO6974	88.6028		1.73	
444	D1945	88.425		-1.08	
446	DIN51666	87.927	G(0.05)	-8.96	
496	DIN15984	88.522		0.45	
527	D1945	88.284		-3.31	
602	GPA2261	88.515		0.34	
608		----		----	
609	GPA2261	88.498		0.07	
663	D1945	88.336		-2.49	
840	D1945	88.535		0.66	
868	GPA2261	88.518		0.39	
922	D1945	88.444		-0.78	
963	D1945	88.0553	G(0.01)	-6.93	
974		----		----	
1011		----		----	
1029	INH-11	89.095	C,G(0.05)	9.52	First reported 90.806
1081	in house	88.42		-1.16	
1095	UOP539	87.993	G(0.01)	-7.92	
1197	D1945	88.525		0.50	
1198	D1945	88.523		0.47	
1200	UOP539	89.606	C,G(0.01)	17.60	First reported 85.376
1287	ISO6974	88.522		0.45	
1307	INH-RGA	88.4464		-0.74	
1388	GPA2261	88.507		0.21	
1419	D1945	88.520		0.42	
1580	GB/T13610	88.565		1.13	
1589	D1945	88.440		-0.85	
1594	GPA2261	88.4958	C	0.04	First reported 88.3626
1622		----		----	
1635	D1945	88.430		-1.00	
1654	D1945	88.465		-0.45	
1679	ISO6974	88.471		-0.35	
1737	in house	88.703		3.32	
normality		OK			
n		28			
outliers		5			
mean (n)		88.4934			
st.dev. (n)		0.08098			
R(calc.)		0.2267			
R(ISO6974-3)		0.1770	Compare R(ASTM D1945) = 0.1500		



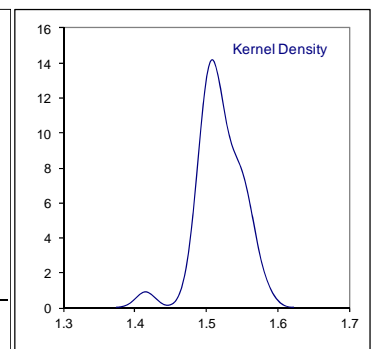
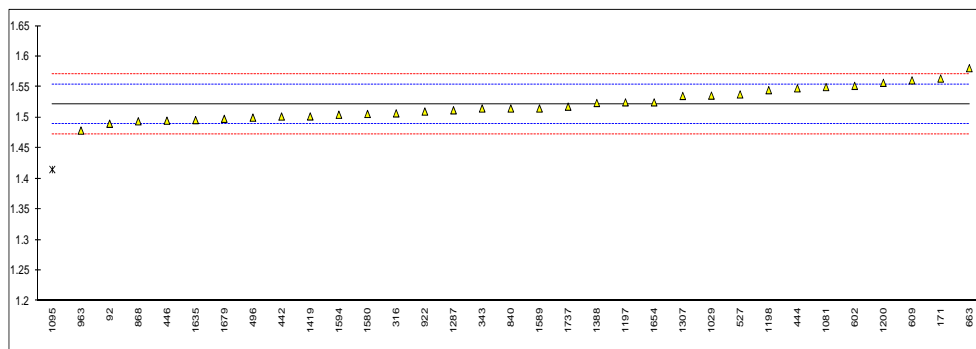
Determination of Ethane on sample #13030; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	GPA2286	4.96		-0.70	
171	D1945	5.058		1.13	
316	ISO6974	4.978		-0.36	
343	CEA1624	4.973		-0.45	
442	D1945/ISO6974	4.9386		-1.10	
444	D1945	5.111		2.12	
446	DIN51666	5.424	G(0.01)	7.97	
496	DIN15984	4.956		-0.77	
527	D1945	5.077		1.49	
602	GPA2261	5.033		0.67	
608		-----		-----	
609	GPA2261	5.034		0.69	
663	D1945	5.057		1.12	
840	D1945	4.979		-0.34	
868	GPA2261	4.912		-1.59	
922	D1945	4.956		-0.77	
963	D1945	4.9681		-0.55	
974		-----		-----	
1011		-----		-----	
1029	INH-11	5.055		1.08	
1081	in house	5.03		0.61	
1095	UOP539	4.638	G(0.05)	-6.71	
1197	D1945	5.007		0.18	
1198	D1945	5.022		0.46	
1200	UOP539	5.065	C	1.26	First reported 4.824
1287	ISO6974	4.982		-0.29	
1307	INH-RGA	4.9307		-1.24	
1388	GPA2261	5.016		0.35	
1419	D1945	5.014		0.31	
1580	GB/T13610	4.991		-0.12	
1589	D1945	4.977		-0.38	
1594	GPA2261	4.9546	C	-0.80	First reported 4.9471
1622		-----		-----	
1635	D1945	5.036		0.72	
1654	D1945	4.965		-0.60	
1679	ISO6974	4.947		-0.94	
1737	in house	4.933		-1.20	
	normality	OK			
	n	31			
	outliers	2			
	mean (n)	4.9973			
	st.dev. (n)	0.04943			
	R(calc.)	0.1384			
	R(ISO6974-3)	0.1499			Compare R(ASTM D1945) = 0.1000



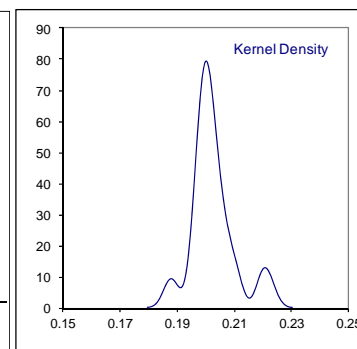
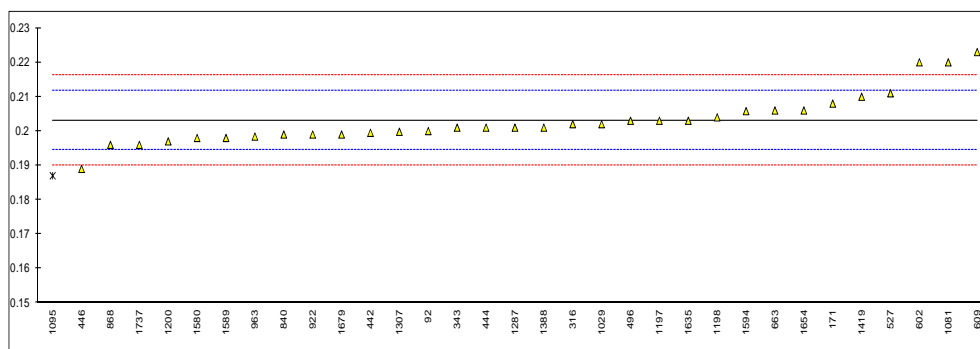
Determination of Propane on sample #13030; results in %mol/mol

lab	method	value	mark	z(targ)	Remarks
92	GPA2286	1.49		-1.95	
171	D1945	1.564		2.58	
316	ISO6974	1.507		-0.91	
343	CEA1624	1.515		-0.42	
442	D1945/ISO6974	1.5018		-1.23	
444	D1945	1.548		1.60	
446	DIN51666	1.495		-1.65	
496	DIN15984	1.500		-1.34	
527	D1945	1.538		0.99	
602	GPA2261	1.552		1.85	
608		-----		-----	
609	GPA2261	1.561		2.40	
663	D1945	1.581		3.63	
840	D1945	1.515		-0.42	
868	GPA2261	1.494		-1.71	
922	D1945	1.510		-0.73	
963	D1945	1.4788		-2.64	
974		-----		-----	
1011		-----		-----	
1029	INH-11	1.536		0.87	
1081	in house	1.55		1.73	
1095	UOP539	1.415	G(0.01)	-6.55	
1197	D1945	1.525		0.19	
1198	D1945	1.545		1.42	
1200	UOP539	1.278	C	2.15	First reported 1.096
1287	ISO6974	1.512		-0.61	
1307	INH-RGA	1.5355		0.84	
1388	GPA2261	1.524		0.13	
1419	D1945	1.502		-1.22	
1580	GB/T13610	1.506		-0.97	
1589	D1945	1.515		-0.42	
1594	GPA2261	1.5048	C	-1.05	First reported 1.5026
1622		-----		-----	
1635	D1945	1.496		-1.59	
1654	D1945	1.525		0.19	
1679	ISO6974	1.498		-1.46	
1737	in house	1.518		-0.24	
	normality	OK			
	n	32			
	outliers	1			
	mean (n)	1.5219			
	st.dev. (n)	0.02519			
	R(calc.)	0.0705			
	R(ISO6974-3)	0.0457			Compare R(ASTM D1945) = 0.1000



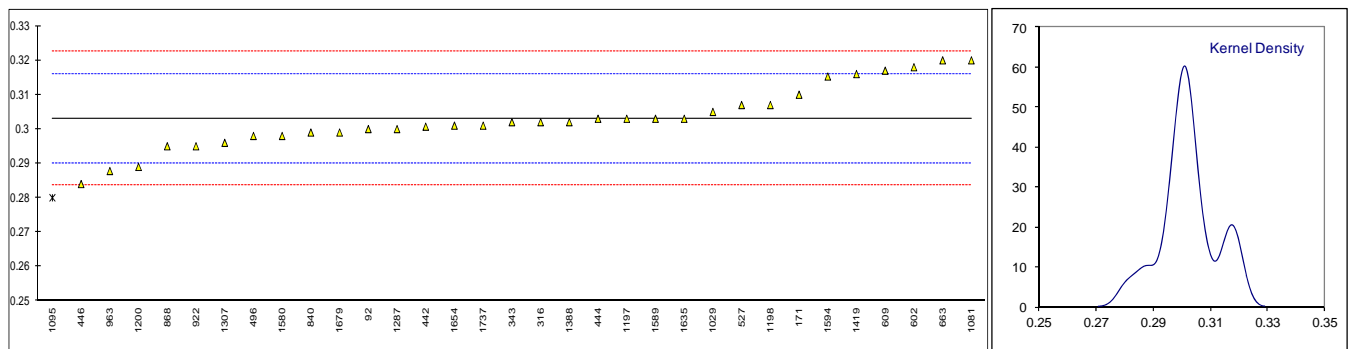
Determination of n-Butane on sample #13030; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	GPA2286	0.20		-0.71	
171	D1945	0.208		1.12	
316	ISO6974	0.202		-0.25	
343	CEA1624	0.201		-0.48	
442	D1945/ISO6974	0.1995		-0.83	
444	D1945	0.201		-0.48	
446	DIN51666	0.189		-3.24	
496	DIN15984	0.203	C	-0.03	First reported 0.171
527	D1945	0.211		1.81	
602	GPA2261	0.220		3.88	
608		----		----	
609	GPA2261	0.223		4.57	
663	D1945	0.206		0.66	
840	D1945	0.199		-0.94	
868	GPA2261	0.196		-1.63	
922	D1945	0.199		-0.94	
963	D1945	0.1984		-1.08	
974		----		----	
1011		----		----	
1029	INH-11	0.202		-0.25	
1081	in house	0.22	C	3.88	First reported 0.32
1095	UOP539	0.187	ex	-3.70	Excluded, see §4.1
1197	D1945	0.203		-0.03	
1198	D1945	0.204		0.20	
1200	UOP539	0.197	C	-1.40	First reported 0.181
1287	ISO6974	0.201		-0.48	
1307	INH-RGA	0.1998		-0.76	
1388	GPA2261	0.201		-0.48	
1419	D1945	0.210		1.58	
1580	GB/T13610	0.198		-1.17	
1589	D1945	0.198		-1.17	
1594	GPA2261	0.2058		0.62	
1622		----		----	
1635	D1945	0.203		-0.03	
1654	D1945	0.206		0.66	
1679	ISO6974	0.199		-0.94	
1737	in house	0.196		-1.63	
	normality	not OK			
	n	32			
	outliers	0			
	mean (n)	0.2031			
	st.dev. (n)	0.00728			
	R(calc.)	0.0204			
	R(ISO6974-3)	0.0122			Compare R(ASTM D1945) = 0.0700



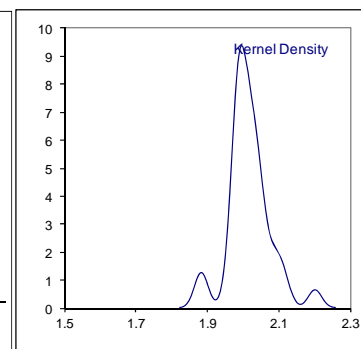
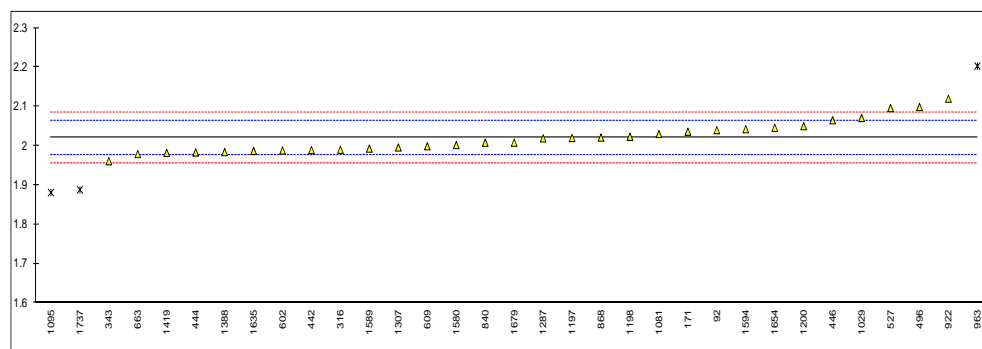
Determination of iso-Butane on sample #13030; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	GPA2286	0.30		-0.47	
171	D1945	0.310		1.07	
316	ISO6974	0.302		-0.16	
343	CEA1624	0.302		-0.16	
442	D1945/ISO6974	0.3007		-0.36	
444	D1945	0.303		0.00	
446	DIN51666	0.284		-2.93	
496	DIN15984	0.298		-0.77	
527	D1945	0.307		0.61	
602	GPA2261	0.318		2.31	
608		----		----	
609	GPA2261	0.317		2.15	
663	D1945	0.320		2.61	
840	D1945	0.299		-0.62	
868	GPA2261	0.295		-1.24	
922	D1945	0.295		-1.24	
963	D1945	0.2878		-2.34	
974		----		----	
1011		----		----	
1029	INH-11	0.305		0.30	
1081	in house	0.32	C	2.61	First reported 0.22
1095	UOP539	0.280	ex	-3.55	Excluded, see §4.1
1197	D1945	0.303		0.00	
1198	D1945	0.307		0.61	
1200	UOP539	0.289		-2.16	
1287	ISO6974	0.300		-0.47	
1307	INH-RGA	0.2960		-1.08	
1388	GPA2261	0.302		-0.16	
1419	D1945	0.316		2.00	
1580	GB/T13610	0.298		-0.77	
1589	D1945	0.303		0.00	
1594	GPA2261	0.3153		1.89	
1622		----		----	
1635	D1945	0.303		0.00	
1654	D1945	0.301		-0.31	
1679	ISO6974	0.299		-0.62	
1737	in house	0.301		-0.31	
	normality	not OK			
	n	32			
	outliers	0			
	mean (n)	0.3030			
	st.dev. (n)	0.00895			
	R(calc.)	0.0251			
	R(ISO6974-3)	0.0182			
					Compare R(ASTM D1945) = 0.0700



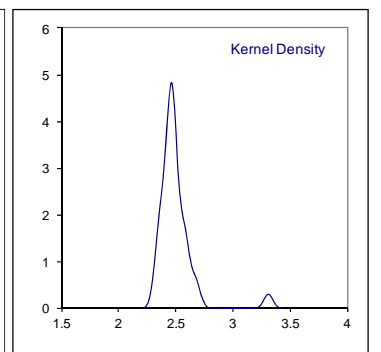
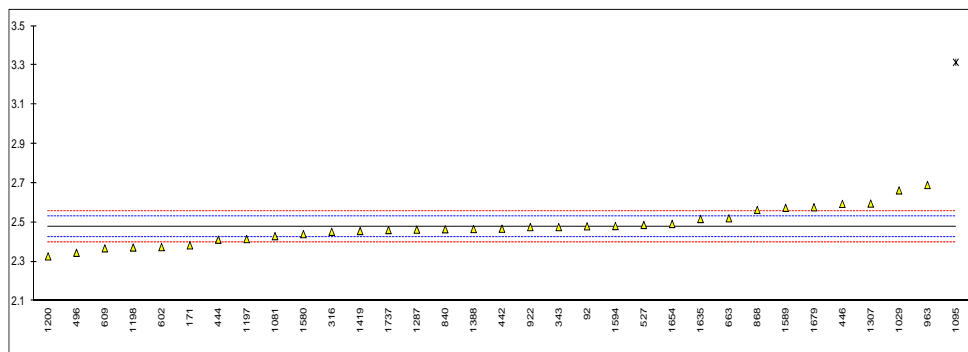
Determination of Carbon Dioxide on sample #13030; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	GPA2286	2.04		0.88	
171	D1945	2.036		0.70	
316	ISO6974	1.990		-1.43	
343	CEA1624	1.961		-2.77	
442	D1945/ISO6974	1.9890		-1.47	
444	D1945	1.983		-1.75	
446	DIN51666	2.065		2.04	
496	DIN15984	2.099	C	3.61	First reported 2.208
527	D1945	2.096		3.47	
602	GPA2261	1.988		-1.52	
608		----		----	
609	GPA2261	1.999		-1.01	
663	D1945	1.979		-1.94	
840	D1945	2.008		-0.60	
868	GPA2261	2.021		0.00	
922	D1945	2.120		4.58	
963	D1945	2.2029	G(0.05)	8.41	
974		----		----	
1011		----		----	
1029	INH-11	2.071		2.31	
1081	in house	2.03		0.42	
1095	UOP539	1.881	DG(0.05)	-6.46	
1197	D1945	2.020		-0.04	
1198	D1945	2.023		0.10	
1200	UOP539	2.050	C	1.34	First reported 2.037
1287	ISO6974	2.019		-0.09	
1307	INH-RGA	1.9959		-1.15	
1388	GPA2261	1.984		-1.70	
1419	D1945	1.982		-1.80	
1580	GB/T13610	2.002		-0.87	
1589	D1945	1.993		-1.29	
1594	GPA2261	2.0423	C	0.99	First reported 2.1898
1622		----		----	
1635	D1945	1.987		-1.57	
1654	D1945	2.046		1.16	
1679	ISO6974	2.008		-0.60	
1737	in house	1.888	DG(0.05)	-6.14	
	normality	OK			
	n	30			
	outliers	3			
	mean (n)	2.0209			
	st.dev. (n)	0.03942			
	R(calc.)	0.1104			
	R(ISO6974-3)	0.0606			Compare R(ASTM D1945) = 0.1000



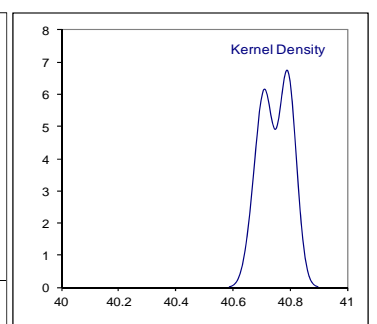
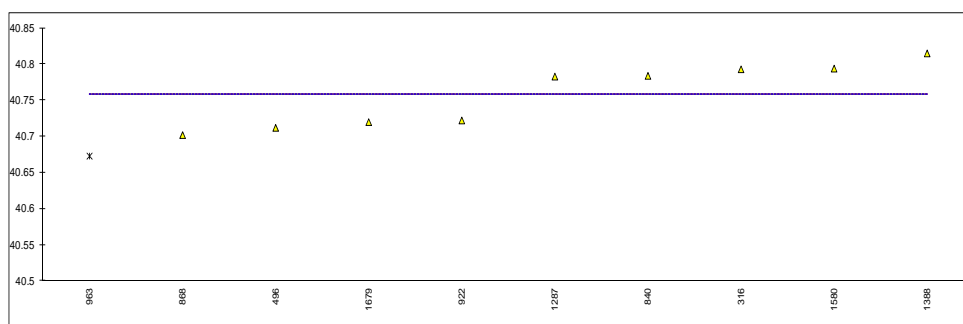
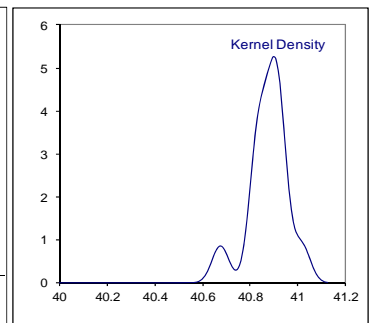
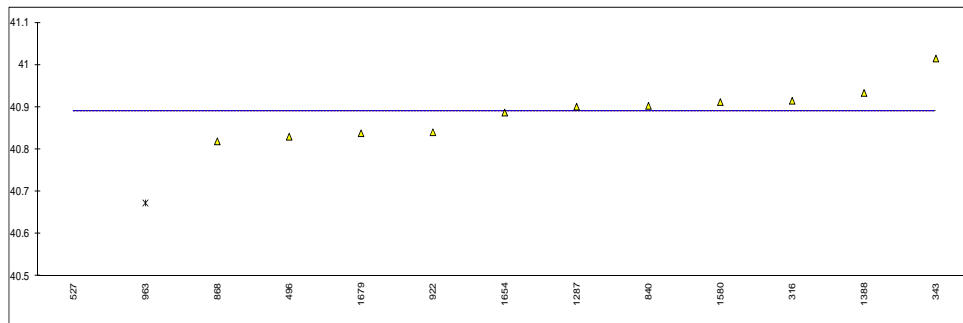
Determination of Nitrogen on sample #13030; results in %mol/mol

lab	method	value	mark	z(targ)	remarks
92	GPA2286	2.48		0.09	
171	D1945	2.383		-3.56	
316	ISO6974	2.452		-0.97	
343	CEA1624	2.476		-0.06	
442	D1945/ISO6974	2.4677		-0.37	
444	D1945	2.412		-2.47	
446	DIN51666	2.594		4.38	
496	DIN15984	2.345		-5.00	
527	D1945	2.487		0.35	
602	GPA2261	2.374		-3.90	
608		-----		-----	
609	GPA2261	2.368		-4.13	
663	D1945	2.521		1.63	
840	D1945	2.465		-0.48	
868	GPA2261	2.563		3.22	
922	D1945	2.476		-0.06	
963	D1945	2.6903		8.01	
974		-----		-----	
1011		-----		-----	
1029	INH-11	2.663		6.98	
1081	in house	2.43		-1.79	
1095	UOP539	3.315	G(0.01)	31.54	
1197	D1945	2.415		-2.36	
1198	D1945	2.372		-3.98	
1200	UOP539	2.327	C	-5.67	First reported 2.444
1287	ISO6974	2.463		-0.55	
1307	INH-RGA	2.5957		4.45	
1388	GPA2261	2.466		-0.44	
1419	D1945	2.456		-0.81	
1580	GB/T13610	2.440		-1.42	
1589	D1945	2.574		3.63	
1594	GPA2261	2.4814		0.14	
1622		-----		-----	
1635	D1945	2.517		1.48	
1654	D1945	2.492		0.54	
1679	ISO6974	2.577		3.74	
1737	in house	2.461		-0.63	
normality		OK			
n		32			
outliers		1			
mean (n)		2.4776			
st.dev. (n)		0.08695			
R(calc.)		0.2434			
R(ISO6974-3)		0.0743			Compare R(ASTM D1945) = 0.1000



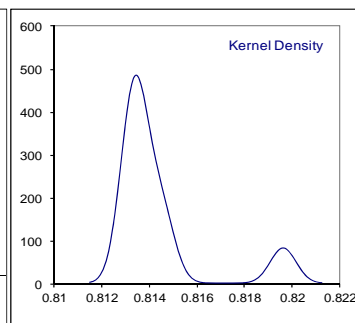
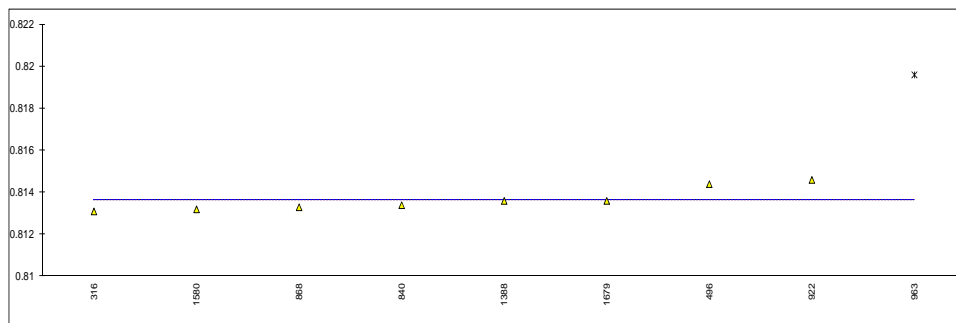
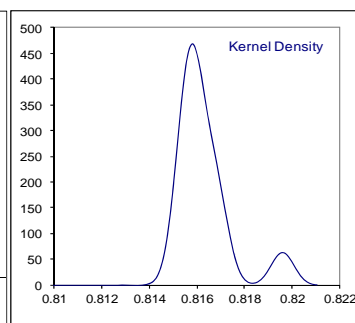
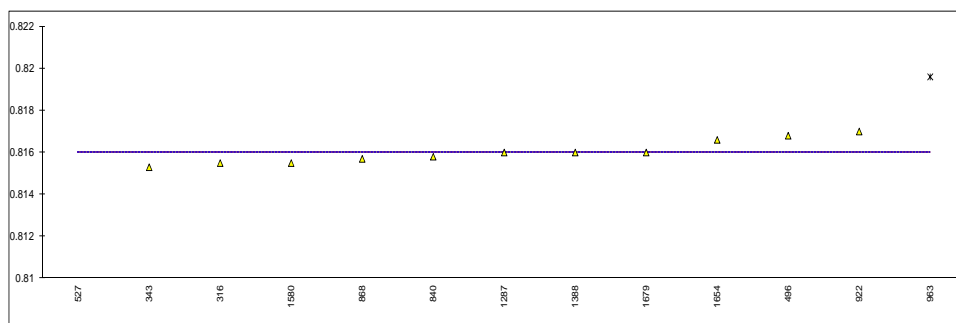
Determination of Caloric Value (sup) (101.325 kPa , comb. temp. 25°C, and metering temp 0°C) on sample #13030; results in MJ/m³

Lab	method	real gas	mark	z(targ)	ideal gas	mark	z(targ)	remarks
92		----		----	----		----	
171		----		----	----		----	
316	ISO6976	40.915		----	40.793		----	
343	CEA1624	41.015	E	----	----		----	iis calculated 40.920
442		----		----	----		----	
444		----		----	----		----	
446		----		----	----		----	
496	DIN51857	40.830		----	40.712		----	
527	D1945	38.708	E,G(0.01)	----	----		----	iis calculated 40.921
602		----		----	----		----	
608		----		----	----		----	
609		----		----	----		----	
663		----		----	----		----	
840	ISO6976	40.903		----	40.784		----	
868	ISO6976	40.819		----	40.702		----	
922	ISO6976	40.8405	C	----	40.7223	C	----	First reported 37.454 vs 37.346
963	ISO6976	40.673	G(0.05)	----	40.673	E,ex	----	Excluded see §4.1, iis calc 40.561
974		----		----	----		----	
1011		----		----	----		----	
1029		----		----	----		----	
1081		----		----	----		----	
1095		----		----	----		----	
1197		----		----	----		----	
1198		----		----	----		----	
1200		----		----	----		----	
1287	ISO6976	40.901		----	40.783		----	
1307		----		----	----		----	
1388	ISO6976	40.9335		----	40.8150		----	
1419		----		----	----		----	
1580	GB/T11062	40.912		----	40.794		----	
1589		----		----	----		----	
1594		----		----	----		----	
1622		----		----	----		----	
1635		----		----	----		----	
1654	ISO6976	40.887		----	----		----	
1679	ISO6976	40.838		----	40.720		----	
1737		----		----	----		----	
	normality	OK			OK			
	n	11			9			
	outliers	2			0			
	mean (n)	40.8904			40.7584			
	st.dev. (n)	0.05720			0.04336			
	R(calc.)	0.1602			0.1214			
	R(lit)	unknown			unknown			
Comp.	R(iis12S01M)	0.1119			0.1380			



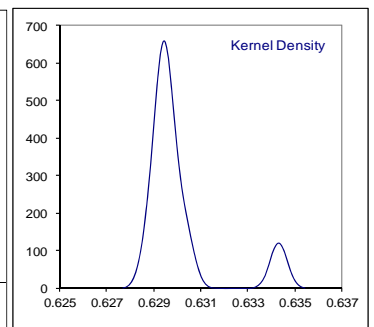
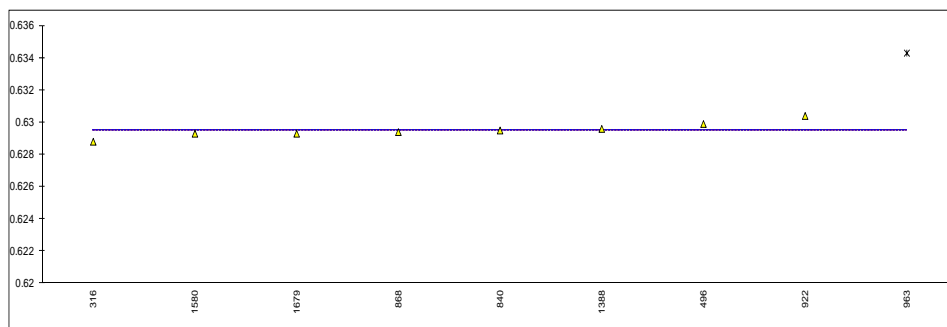
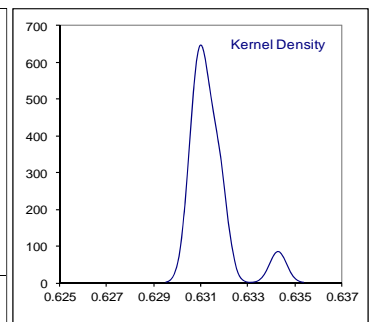
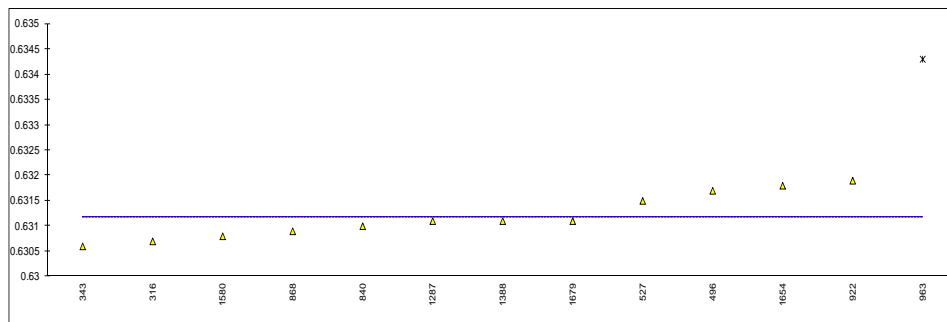
Determination of Density (101.325 kPa , combustion temp. 25°C, and metering temp. 0°C)
on sample #13030; results in kg/m³

Lab	method	real gas	mark	z(targ)	ideal gas	mark	z(targ)	remarks
92		----		----	----		----	
171		----		----	----		----	
316	ISO6976	0.8155		----	0.8131		----	
343	CEA1624	0.8153		----	----		----	
442		----		----	----		----	
444		----		----	----		----	
446		----		----	----		----	
496	DIN51857	0.8168	E	----	0.8144	E	----	iis calculated. 0.8150, 0.8131
527	D1945	0.7844	E,G(0.01)	----	----		----	iis calculated. 0.8178
602		----		----	----		----	
608		----		----	----		----	
609		----		----	----		----	
663		----		----	----		----	
840	ISO6976	0.8158		----	0.8134		----	
868	ISO6976	0.8157		----	0.8133		----	
922	ISO6976	0.8170	C	----	0.8146	C	----	First reported 0.7485 vs 0.7463
963	ISO6976	0.8196	E,G(0.01)	----	0.8196	E,G(0.01)	----	iis calculated. 0.8174, 0.8155
974		----		----	----		----	
1011		----		----	----		----	
1029		----		----	----		----	
1081		----		----	----		----	
1095		----		----	----		----	
1197		----		----	----		----	
1198		----		----	----		----	
1200		----		----	----		----	
1287	ISO6976	0.8160		----	----		----	
1307		----		----	----		----	
1388	ISO6976	0.8160		----	0.8136		----	
1419		----		----	----		----	
1580	GB/T11062	0.8155		----	0.8132		----	
1589		----		----	----		----	
1594		----		----	----		----	
1622		----		----	----		----	
1635		----		----	----		----	
1654	ISO6976	0.8166		----	----		----	
1679	ISO6976	0.8160		----	0.8136		----	
1737		----		----	----		----	
normality		OK			not OK			
n		11			8			
outliers		2			1			
mean (n)		0.8160			0.8137			
st.dev. (n)		0.00056			0.00056			
R(calc.)		0.0016			0.0016			
R(lit)		unknown			unknown			
Comp. R(iis12S01M)		0.0028			0.0024			



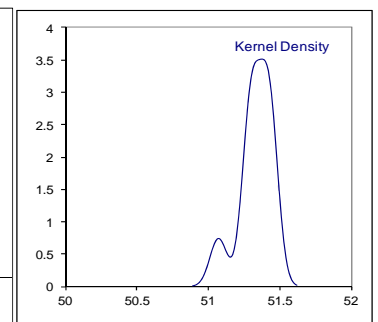
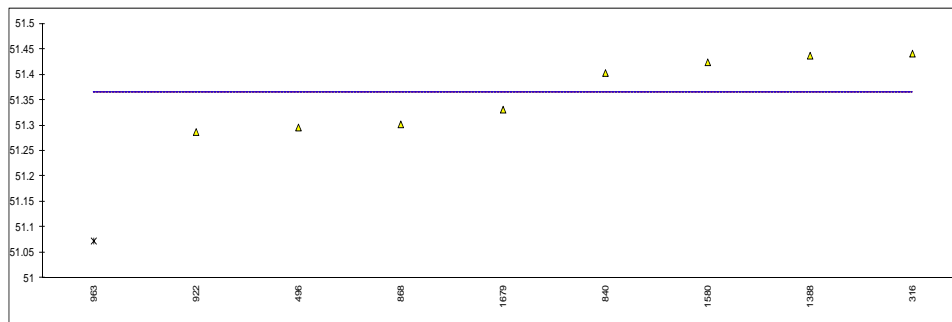
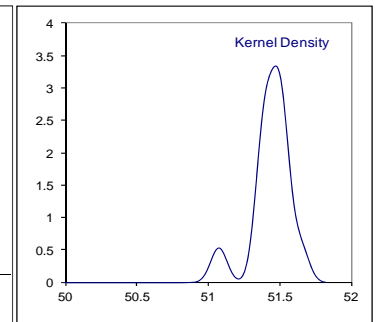
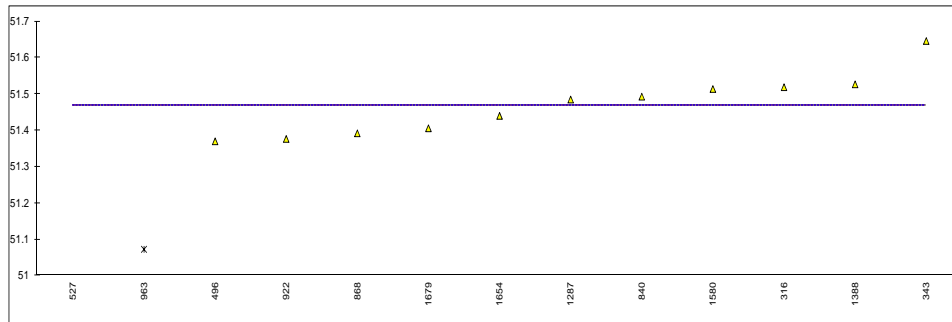
Determination of Relative Density (101.325 kPa , comb. Temp. 25°C, and metering temp. 0°C)
on sample #13030; unitless results

Lab	method	real gas	mark	z(targ)	ideal gas	mark	z(targ)	remarks
92		----		----	----		----	
171		----		----	----		----	
316	ISO6976	0.6307		----	0.6288		----	
343	CEA1624	0.6306		----	----		----	
442		----		----	----		----	
444		----		----	----		----	
446		----		----	----		----	
496	DIN51857	0.6317	E	----	0.6299		----	iis calculated. 0.6340
527	D1945	0.6315	E	----	----		----	iis calculated. 0.6326
602		----		----	----		----	
608		----		----	----		----	
609		----		----	----		----	
663		----		----	----		----	
840	ISO6976	0.6310		----	0.6295		----	
868	ISO6976	0.6309		----	0.6294		----	
922	ISO6976	0.6319		----	0.6304		----	
963	ISO6976	0.6343	E,G(0.01)	----	0.6343	E,G(0.01)	----	iis calculated. 0.6323, 0.6311
974		----		----	----		----	
1011		----		----	----		----	
1029		----		----	----		----	
1081		----		----	----		----	
1095		----		----	----		----	
1197		----		----	----		----	
1198		----		----	----		----	
1200		----		----	----		----	
1287	ISO6976	0.6311		----	----		----	
1307		----		----	----		----	
1388	ISO6976	0.6311		----	0.6296		----	
1419		----		----	----		----	
1580	GB/T11062	0.6308		----	0.6293		----	
1589		----		----	----		----	
1594		----		----	----		----	
1622		----		----	----		----	
1635		----		----	----		----	
1654	ISO6976	0.6318		----	----		----	
1679	ISO6976	0.6311		----	0.6293		----	
1737		----		----	----		----	
	normality	not OK			OK			
	n	12			8			
	outliers	1			1			
	mean (n)	0.6312			0.6295			
	st.dev. (n)	0.00044			0.00047			
	R(calc.)	0.0012			0.0013			
	R(lit)	unknown			Unknown			
Comp.	R(iis12S01M)	0.0019			0.0015			



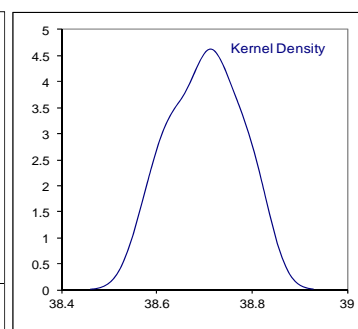
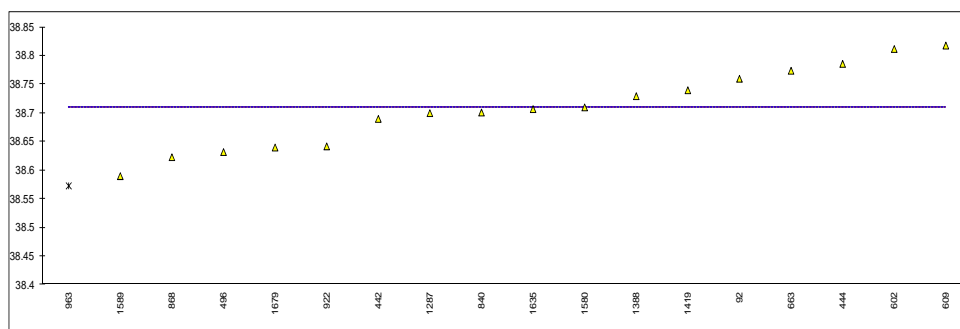
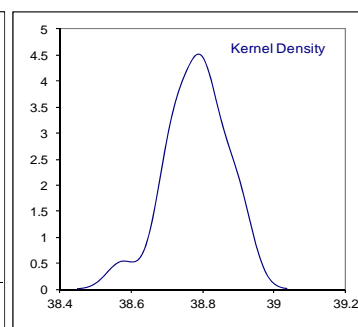
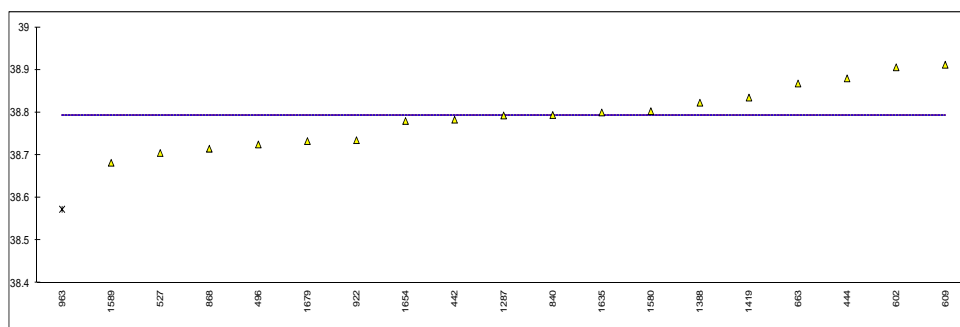
Determination of Wobbe Index (101.325 kPa , combustion temp. 25°C, and metering temp. 0°C) on sample #13030; results in MJ/m³

Lab	method	real gas	mark	z(targ)	ideal gas	mark	z(targ)	remarks
92		----		----	----		----	
171		----		----	----		----	
316	ISO6976	51.519		----	51.441		----	
343	CEA1624	51.646		----	----		----	
442		----		----	----		----	
444		----		----	----		----	
446		----		----	----		----	
496	DIN51857	51.370		----	51.296		----	
527	D1945	48.728	E,G(0.01)	----	----		----	iis calculated. 51.378
602		----		----	----		----	
608		----		----	----		----	
609		----		----	----		----	
663		----		----	----		----	
840	ISO6976	51.493		----	51.403		----	
868	ISO6976	51.392		----	51.302		----	
922	ISO6976	51.3766	C	----	51.2871	C	----	First reported 47.117 vs 47.035
963	ISO6976	51.073	G(0.05)	----	51.073	G(0.05)	----	
974		----		----	----		----	
1011		----		----	----		----	
1029		----		----	----		----	
1081		----		----	----		----	
1095		----		----	----		----	
1197		----		----	----		----	
1198		----		----	----		----	
1200		----		----	----		----	
1287	ISO6976	51.485		----	----		----	
1307		----		----	----		----	
1388	ISO6976	51.5268		----	51.4370		----	
1419		----		----	----		----	
1580	GB/T11062	51.514		----	51.424		----	
1589		----		----	----		----	
1594		----		----	----		----	
1622		----		----	----		----	
1635		----		----	----		----	
1654	ISO6976	51.440		----	----		----	
1679	ISO6976	51.406		----	51.331		----	
1737		----		----	----		----	
normality		OK			OK			
n		11			8			
outliers		2			1			
mean (n)		51.4699			51.3651			
st.dev. (n)		0.08312			0.06744			
R(calc.)		0.2327			0.1888			
R(lit)		unknown			unknown			
Comp. R(iis12S01M)		0.2312			0.1765			



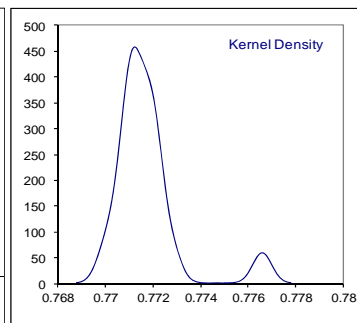
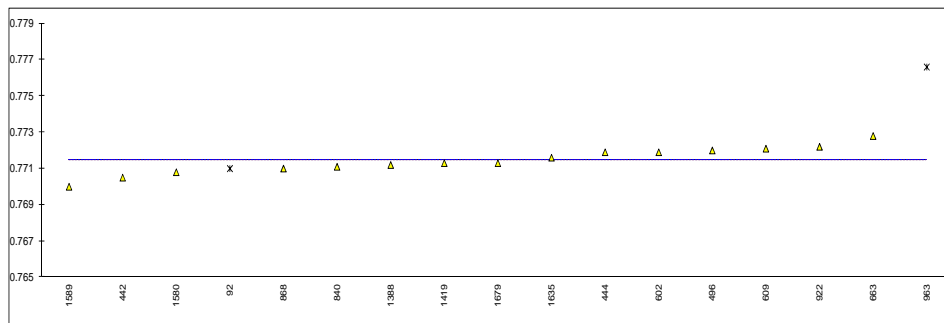
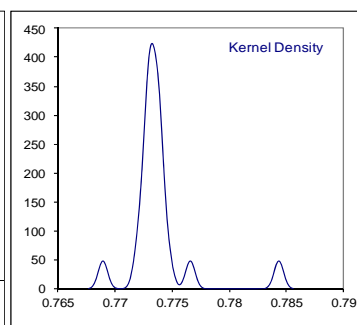
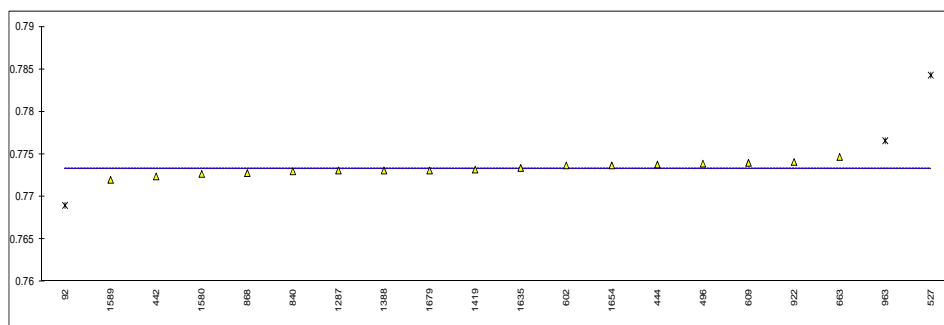
Determination of Caloric Value (sup) (101.325 kPa , comb. Temp. 15°C, and metering temp 15°C) on sample #13030; results in MJ/m³

Lab	method	real gas	mark	z(targ)	ideal gas	mark	z(targ)	remarks
92		----		----	38.76		----	
171		----		----			----	
316		----		----			----	
343		----		----			----	
442	D1945/ISO6974	38.783		----	38.690		----	
444	ISO6976	38.880		----	38.786		----	
446		----		----			----	
496	DIN51857	38.725		----	38.632		----	
527	D1945	38.705	E	----			----	iis calculated. 38.806
602	ISO6976	38.906		----	38.812		----	
608		----		----			----	
609	ISO6976	38.912		----	38.818		----	
663	ISO6976	38.868		----	38.774		----	
840	ISO6976	38.794		----	38.701		----	
868	ISO6976	38.715		----	38.623		----	
922	ISO6976	38.735		----	38.642		----	
963	ISO6976	38.573	G(0.05)	----	38.573	E,ex	----	excluded, see §4.1, iis calc 38.465
974		----		----			----	
1011		----		----			----	
1029		----		----			----	
1081		----		----			----	
1095		----		----			----	
1197		----		----			----	
1198		----		----			----	
1200		----		----			----	
1287	ISO6976	38.793		----	38.700		----	
1307		----		----			----	
1388	ISO6976	38.8230		----	38.7296		----	
1419	ISO6976	38.835		----	38.740		----	
1580	GB/T11062	38.803		----	38.710		----	
1589	D3588	38.682	E	----	38.590	E	----	iis calculated. 38.756, 38.668
1594		----		----			----	
1622		----		----			----	
1635	ISO6976	38.800		----	38.707		----	
1654	ISO6976	38.780		----			----	
1679	ISO6976	38.733		----	38.640		----	
1737		----		----			----	
normality		OK			OK			
n		18			17			
outliers		1			0			
mean (n)		38.7929			38.7091			
st.dev. (n)		0.06900			0.06795			
R(calc.)		0.1932			0.1903			
R(lit)		unknown			unknown			
Comp.. R(iis12S01M)		0.1895			0.1182			



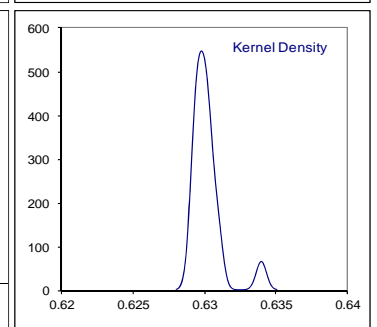
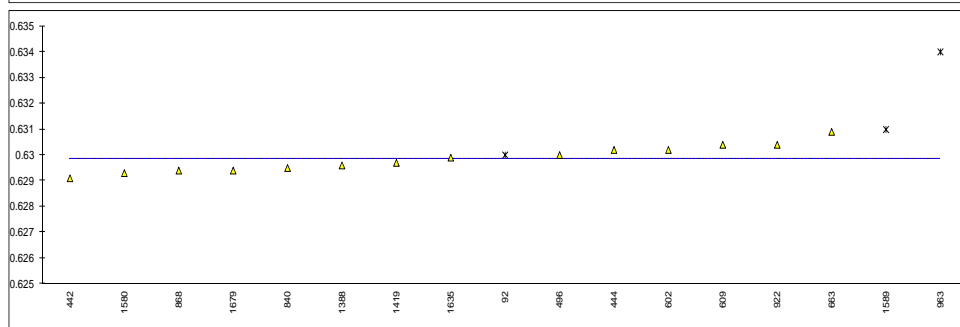
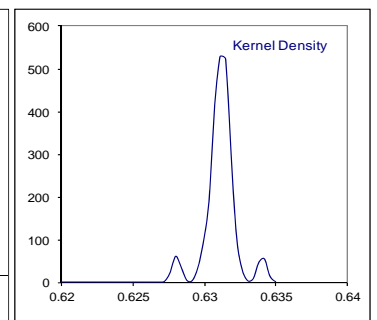
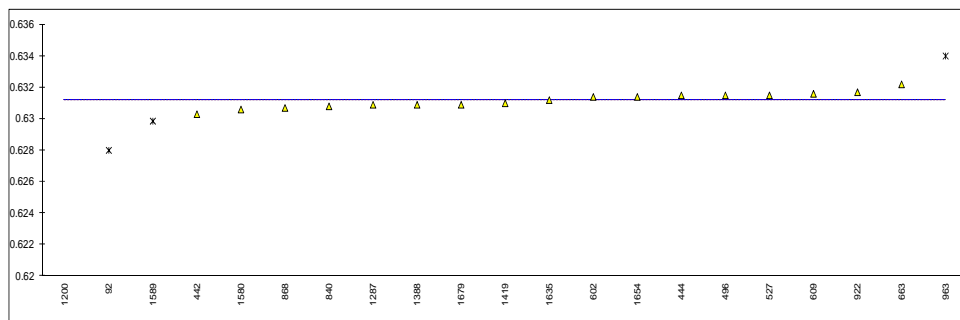
Determination of Density (101.325 kPa , combustion temp. 15°C, and metering temp. 15°C)
on sample #13030; results in kg/m³

Lab	method	real gas	mark	z(targ)	ideal gas	mark	z(targ)	remarks
92	AGA#5	0.769	ex	----	0.771	ex	----	real < ideal= impossible
171		----		----	----		----	
316		----		----	----		----	
343		----		----	----		----	
442	D1945/ISO6974	0.7724		----	0.7705		----	
444	ISO6976	0.7738		----	0.7719		----	
446		----		----	----		----	
496	DIN51857	0.7739	E	----	0.7720	E	----	iis calculated. 0.7726, 0.7708
527	D1945	0.7843	E,G(0.01)	----	----		----	iis calculated. 0.7752
602	ISO6976	0.7737		----	0.7719		----	
608		----		----	----		----	
609	ISO6976	0.7740		----	0.7721		----	
663	ISO6976	0.7747		----	0.7728		----	
840	ISO6976	0.7730		----	0.7711		----	
868	ISO6976	0.7728		----	0.7710		----	
922	ISO6976	0.7741		----	0.7722		----	
963	ISO6976	0.7766	E,ex	----	0.7766	E,G(0.01)	----	excl, see §4.1, iis calc 0.7748,0.7730
974		----		----	----		----	
1011		----		----	----		----	
1029		----		----	----		----	
1081		----		----	----		----	
1095		----		----	----		----	
1197		----		----	----		----	
1198		----		----	----		----	
1200		----		----	----		----	
1287	ISO6976	0.7731		----	----		----	
1307		----		----	----		----	
1388	ISO6976	0.7731		----	0.7712		----	
1419	ISO6976	0.7732		----	0.7713		----	
1580	GB/T11062	0.7727		----	0.7708		----	
1589	D3588	0.772	E	----	0.770	E	----	iis calculated. 0.7733, 0.7715
1594		----		----	----		----	
1622		----		----	----		----	
1635	ISO6976	0.7734		----	0.7716		----	
1654	ISO6976	0.7737		----	----		----	
1679	ISO6976	0.7731		----	0.7713		----	
1737		----		----	----		----	
	normality	OK			OK			
	n	17			15			
	outliers	1			1			
	mean (n)	0.7733			0.7714			
	st.dev. (n)	0.00068			0.00073			
	R(calc.)	0.0019			0.0020			
	R(lit)	unknown			unknown			
Comp.	R(iis12S01M)	0.0027			0.0019			



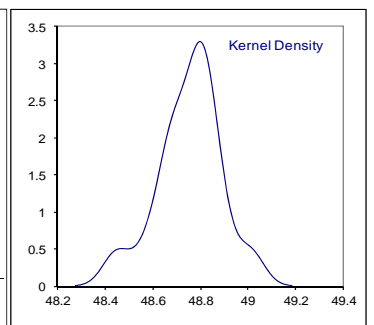
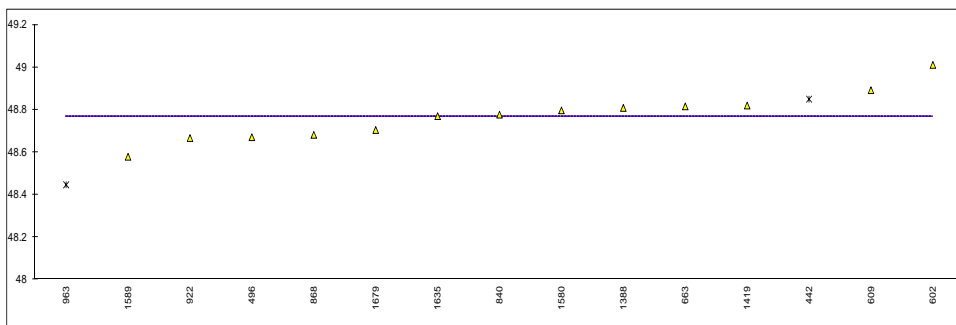
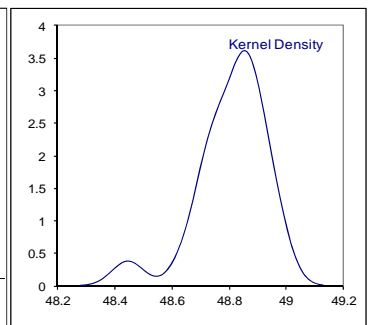
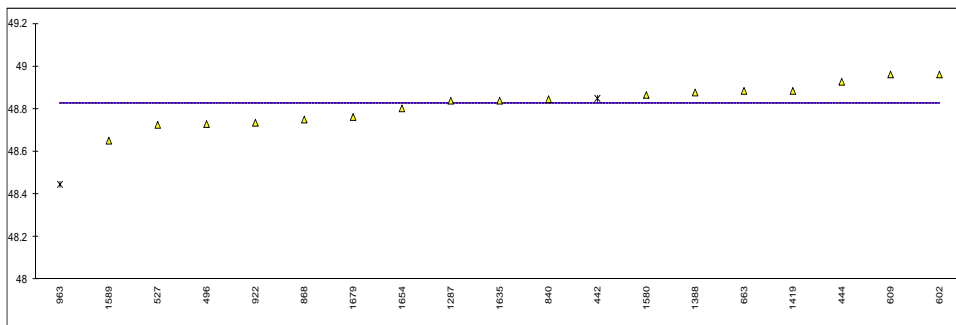
Determination of Relative Density (101.325 kPa , comb. temp. 15°C, and metering temp. 15°C) on sample #13030; unitless results

lab	method	real gas	mark	z(targ)	ideal gas	mark	z(targ)	remarks
92	AGA#5	0.628	ex	----	0.630	ex	----	real < ideal= impossible
171		----		----	----		----	
316		----		----	----		----	
343		----		----	----		----	
442	D1945/ISO6974	0.6303		----	0.6291		----	
444	ISO6976	0.6315		----	0.6302		----	
446		----		----	----		----	
496	DIN51857	0.6315		----	0.6300		----	
527	D1945	0.6315		----	----		----	
602	ISO6976	0.6314		----	0.6302		----	
608		----		----	----		----	
609	ISO6976	0.6316		----	0.6304		----	
663	ISO6976	0.6322		----	0.6309		----	
840	ISO6976	0.6308		----	0.6295		----	
868	ISO6976	0.6307		----	0.6294		----	
922	ISO6976	0.6317		----	0.6304		----	
963	ISO6976	0.6340	ex	----	0.6340	G(0.01)	----	Excluded, see §4.1
974		----		----	----		----	
1011		----		----	----		----	
1029		----		----	----		----	
1081		----		----	----		----	
1095		----		----	----		----	
1197		----		----	----		----	
1198		----		----	----		----	
1200	D3588	0.5369	G(0.01)	----	----		----	
1287	ISO6976	0.6309		----	----		----	
1307		----		----	----		----	
1388	ISO6976	0.6309		----	0.6296		----	
1419	ISO6976	0.6310		----	0.6297		----	
1580	GB/T11062	0.6306		----	0.6293		----	
1589	D3588	0.62986	C,ex	----	0.63099	C,ex	----	First reported 0.6311vs0.6322 real < ideal= impossible
1594		----		----	----		----	
1622		----		----	----		----	
1635	ISO6976	0.6312		----	0.6299		----	
1654	ISO6976	0.6314		----	----		----	
1679	ISO6976	0.6309		----	0.6294		----	
1737		----		----	----		----	
	normality	OK			OK			
	n	17			14			
	outliers	1			1			
	mean (n)	0.6312			0.6299			
	st.dev. (n)	0.00048			0.00052			
	R(calc.)	0.0013			0.0014			
	R(lit)	unknown			unknown			
Comp.	R(iis12S01M)	0.0018			0.0016			



Determination of Wobbe Index (101.325 kPa , combustion temp. 15°C, and metering temp. 15°C) on sample #13030; results in MJ/m³

lab	method	real gas	mark	z(targ)	ideal gas	mark	z(targ)	remarks
92		----		----	----		----	
171		----		----	----		----	
316		----		----	----		----	
343		----		----	----		----	
442	D1945/ISO6974	48.85	ex	----	48.85	ex	----	real < ideal= impossible
444	ISO6976	48.928		----	----		----	
446		----		----	----		----	
496	DIN51857	48.730		----	48.671		----	
527	D1945	48.726		----	----		----	
602	ISO6976	48.962		----	49.011		----	
608		----		----	----		----	
609	ISO6976	48.962		----	48.892		----	
663	ISO6976	48.885		----	48.816		----	
840	ISO6976	48.846		----	48.777		----	
868	ISO6976	48.751		----	48.682		----	
922	ISO6976	48.736		----	48.667		----	
963	ISO6976	48.447	G(0.01)	----	48.447	ex	----	Excluded, see §4.1
974		----		----	----		----	
1011		----		----	----		----	
1029		----		----	----		----	
1081		----		----	----		----	
1095		----		----	----		----	
1197		----		----	----		----	
1198		----		----	----		----	
1200		----		----	----		----	
1287	ISO6976	48.839		----	----		----	
1307		----		----	----		----	
1388	ISO6976	48.8779		----	48.8088		----	
1419	ISO6976	48.885		----	48.820		----	
1580	GB/T11062	48.866		----	48.797		----	
1589	D3588	48.652		----	48.579		----	
1594		----		----	----		----	
1622		----		----	----		----	
1635	ISO6976	48.839		----	48.770		----	
1654	ISO6976	48.803		----	----		----	
1679	ISO6976	48.763		----	48.705		----	
1737		----		----	----		----	
	normality	OK			OK			
	n	17			13			
	outliers	1			0			
	mean (n)	48.8265			48.7689			
	st.dev. (n)	0.08913			0.11132			
	R(calc.)	0.2496			0.3117			
	R(lit)	unknown			unknown			
	Comp. R(iis12S01M)	0.2238			0.2056			



APPENDIX 2**Compression factors used by participants**

lab	Compressibility factor @15°C	Compressibility factor @0°C
92	0.9976	----
171	----	----
316	----	0.9970
343	----	1.0024
442	0.9976	----
444	0.997586	----
446	----	----
496	0.9976	0.9971
527	0.9290	0.9290
602	0.997584	----
608	----	----
609	0.997582	----
663	0.9976	----
840	0.99760	0.99711
868	0.9976	0.9971
922	0.9976	0.9971
963	0.9976	0.9976
974	----	----
1011	----	----
1029	----	----
1081	----	----
1095	----	----
1197	----	----
1198	----	----
1200	----	----
1287	0.99760	0.99711
1307	----	----
1388	0.9976	0.9971
1419	----	----
1580	0.9976	----
1589	0.9976	----
1594	----	----
1622	----	----
1635	0.99759	----
1654	0.9976	0.9971
1679	0.9976	0.9971
1737	----	----

APPENDIX 3

Number of participants per country

1 lab in BELGIUM
1 lab in CANADA
1 lab in CROATIA
1 lab in FRANCE
1 lab in GERMANY
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 PAKISTAN
1 lab in PERU
2 labs in PORTUGAL
2 labs in SAUDI ARABIA
2 lab in SLOVAKIA
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.
3 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 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