Results of Proficiency Test Natural Gas Analysis April 2010

Organised by:Institute for Interlaboratory Studies
Spijkenisse, the NetherlandsAuthor:dr. R.G. Visser
Corrector:Corrector:mr. I. Kooren & ing. R. Starink
iis10S01M-X

June 2010

CONTENTS

1	INTRODUCTION	3
2	SET UP	3
2.1	QUALITY SYSTEM	3
2.2	PROTOCOL	3
2.3	CONFIDENTIALITY STATEMENT	4
2.4	SAMPLES	4
2.5	STABILITY OF THE SAMPLES	4
2.6	ANALYSES	5
3	RESULTS	5
3.1	STATISTICS	5
3.2	GRAPHICS	6
3.3	Z-SCORES	6
4	EVALUATION	7
4.1	EVALUATION PER TEST/COMPONENT	7
4.2	PERFORMANCE EVALUATION FOR THE GROUP OF LABORATORIES	9
4.3	COMPARISON OF THE PROFICIENCY TEST OF MAY 2010 WITH PREVIOUS PT	9
4.4	DISCUSSION	10

Appendices:

1.	Data and statistical results	12
2.	Details of the GC configurations used	23
3.	List of participants	24
4.	Abbreviations and literature	25

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 inventarised. Most participants were very positive and therefore it was decided to repeat the PT in 2010.

Because iis has limited gas-handling facilities in place to prepare gas samples, a cooperation with Scott Specialty Gases (Breda, the Netherlands) was set up. This company is fully equipped and has a broad experience in the preparation of synthetic natural gas samples for PT purposes. Scott Specialty Gases maintains an ISO17025 accreditation for the preparation of PT samples in homogeneous and stable batches and the analytical testing of these samples.

In this second Interlaboratory study 30 laboratories from 22 different countries participated. See appendix 3 for a list of participants in alphabetical country order. 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 Spijkenisse, the Netherlands, was the organizer of this proficiency test.

To optimise the costs for the participating laboratories, it was decided to prepare one natural gas mixture. Samples were divided over a batch of 35 cylinders. The cylinder size is a cost-effective one-litre cylinder. Each cylinder was uniquely numbered. The limited cylinder size is chosen to optimise transport and handling costs.

Participants were requested to report rounded and unrounded results. The unrounded results were preferably used for statistical evaluation.

2.1 QUALITY SYSTEM

The Institute for Interlaboratory Studies in Spijkenisse, the Netherlands, has implemented a quality system based on ISO guide 43 and ILAC-G13:2007. This ensures 100% confidentially of participant's data. Also customer's satisfaction is measured on regular basis by the distribution of questionnaires.

Scott Specialty Gases Netherlands B.V is accredited for the preparation and testing of Natural Gas mixtures in accordance with ISO/IEC 17025, (K064) by the Dutch Accreditation Council RvA (Raad voor Accreditatie).

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 Scott Specialty Gases (Breda, the Netherlands) in conformance with ISO 6143 and ISO Guide 35. In total one batch of 35 cylinders was prepared (lot 78131) on March 5, 2010. Each cylinder was uniquely numbered. The cylinders were all tested in fivefold to check the homogeneity of the batch. From ANOVA analysis on the test results in accordance with ISO 6143 the in-between bottle standard deviation was calculated. The repeatability values (r) were calculated per component by multiplication of the respective standard deviation by 2.8. Subsequently, the calculated repeatabilities were compared with 0.3 times the reproducibility of the reference method in agreement with the procedure of ISO 13528, Annex B2 in the next table:

Parameter	r (abs, observed) in %mol/mol	0.3xR (abs, ISO6974-3) in %mol/Imol	r (abs, ISO6974-3) in %mol/Imol
Ethane	0.006	0.039	0.043
Propane	0.017	0.023	0.023
n-Butane	0.0036	0.0019	0.0032
iso-Butane	0.0023	0.0020	0.0033
Carbon dioxide	0.033	0.034	0.037
Nitrogen	0.009	0.020	0.022

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

From the above table it is clear that allmost all repeatability values are less than 0.3 times the reproducibility of the reference method ISO6974-3 as well as less than the respective repeatability 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 30, 2010.

2.5 STABILITY OF THE SAMPLES

Scott Specialty Gases (Breda, the Netherlands) 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, was sent together with each set of samples. Also a letter of instructions and a SDS were added to the 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.

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; 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. The z-scores were calculated according to:

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

The z(target) scores are listed in the result tables in appendix 1. Absolute values for z<2 are very common and absolute values for z>3 are very rare. Therefore the usual interpretation of z-scores is as follows:

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

4 EVALUATION

In this proficiency test several problems were encountered with sample transport. Also several laboratories reported after receipt of the gas cylinder that they could not sample the gas cylinder due to the lack of a proper connection.

In total eleven laboratories reported results after the final reporting date and one participant was not able to report any test results. One laboratory was not able to test and report carbon dioxide. Because this laboratory reported normalized results, all original results of this laboratory were relatively high. Therefore these results were corrected manually with the average PT carbon dioxide concentration before use in the statistical evaluation. In total 29 participants reported 280 numerical results.

Observed were 25 outlying results, which is 8.9% 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 the following parameters: caloric value, density and Wobbe index. In these cases the statistical evaluation should be used with due care.

- <u>Methane</u>: The determination of this component is very problematic. Three 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.
- Ethane: The determination of this component may only be problematic for a number of participating laboratories. Four statistical outliers were detected. However, the calculated reproducibility after exclusion of the statistical outliers, is in good agreement with the requirements of ISO6974-3:2000 and of ASTM D1945:2003.
- Propane:The determination of this component may only 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 requirements of ISO6974-3:2000. However,
the calculated reproducibility is in full agreement with the requirements
of and ASTM D1945:2003.
- <u>n-Butane</u>: The determination of this component was not problematic. Two statistical outliers were detected, after exclusion of one test result that

was rounded to one significant figure. The calculated reproducibility after exclusion of the suspect test results, is in good agreement with the requirements of ISO6974-3:2000 and of ASTM D1945:2003.

<u>i-Butane</u>: The determination of this component was not problematic. Two statistical outliers were detected, after exclusion of one test result that was rounded to one significant figure. One other test result was excluded from the calculations because all other test results of this laboratory proofed to be statistical outliers. The calculated reproducibility after exclusion of the suspect test results is in good agreement with the requirements of ISO6974-3:2000 and of ASTM D1945:2003.

- <u>Carbon Dioxide</u>: The determination of this component is problematic. Three statistical outliers were detected and the calculated reproducibility after exclusion of the statistical outliers, is not in agreement with the requirements of ISO6974-3:2000, nor with ASTM D1945:2003.
- <u>Nitrogen</u>: The determination of this component is problematic. Four statistical outliers were detected and the calculated reproducibility after exclusion of the statistical outliers, is not in agreement with the requirements of ISO6974-3:2000, nor with ASTM D1945:2003.
- <u>Caloric Value</u>: This calculated parameter is problematic. The reported results vary over a large range from 37.0 up to 40.57 MJ/m³ and can be divided in several groups. No correlation with the methane concentration can be found. Possibly not all results were reported using the requested conditions, being 25°C and 101.325 KPa. See also the discussion in 4.3.
- <u>Density</u>: This calculated parameter is problematic. The reported results vary over a large range from 0.7407 up to 0.8395 kg/m³ and can be divided in several groups. No correlation can be seen with the methane concentration. Possibly not all results were reported using the requested conditions, being 25°C and 101.325 KPa. See also the discussion in 4.3.
- <u>Rel. density</u>: This calculated parameter is problematic. The results vary over a large range from 0.6150 up to 0.6493. Possibly not all results were reported using the requested conditions, being 25°C and 101.325 KPa. See also the discussion in 4.3.
- Wobbe index:This calculated parameter is problematic. The reported results vary over
a large range from 46.0 up to 51.2 MJ/m³ and can be divided in several
groups. No correlation can be seen with the methane concentration.
Obviously not all results were reported using the requested conditions,
being 25°C and 101.325 KPa. See also the discussion in 4.3.

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.

Component	unit	n	cons. value	2.8 * sd	R(ISO6974-3)	R(D1945)
Methane	%mol/mol	26	86.990	0.356	0.174	0.150
Ethane	%mol/mol	25	4.319	0.067	0.130	0.100
Propane	%mol/mol	27	2.506	0.094	0.075	0.100
n-Butane	%mol/mol	26	0.108	0.007	0.006	0.070
iso-Butane	%mol/mol	25	0.108	0.007	0.006	0.070
Carbon dioxide	%mol/mol	25	3.718	0.136	0.112	0.100
Nitrogen	%mol/mol	25	2.237	0.133	0.067	0.100

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

Without further statistical calculations it can be concluded that for many 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 MAY 2010 WITH PREVIOUS PT

	2010	2009
Number of reporting labs	29	39
Number of results reported	280	381
Statistical outliers	25	30
Percentage outliers	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 in the following table:

Component	2010 ISO6974-3	2010 ASTM D1945	2009 ISO6974-3	2009 ASTM D1945
Methane				
Ethane	++	++	-	+
Propane	-	+		-
n-Butane	+/-	++		++
iso-Butane	+/-	++		++
Carbon dioxide	-	-		-
Nitrogen		-		

table 4: comparison of observed precision with precision of ISO6974-3 / ASTM D1945

The performance of the determinations against the requirements of the respective standards is listed in the above table. 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 the test methods used and therefore it had to be concluded that, although a clear improvement was observed since the 2009 PT for NG, the determination of the composition of Natural Gas was problematic for a significant number of participating laboratories.

However, it is to be expected that the performance of many laboratories will further improve during the next PTs for Natural Gas.

The consensus values as determined in this PT are compared with the average values from the homogeneity testing by Scott Specialty Gases in the following table.

Parameter	Average values by Scott Specialty Gases in %mol/mol	Consensus values from participants results in %mol/mol	Absolute differences in %mol/mol
Methane	87.010	86.990	-0.014
Ethane	4.302	4.319	+0.017
Propane	2.502	2.506	+0.004
n-Butane	0.109	0.108	-0.001
iso-Butane	0.108	0.108	+0.000
Carbon dioxide	3.723	3.718	-0.010
Nitrogen	2.246	2.237	-0.011

Table 5: comparison of consensus values with values determined by Scott Specialty Gases

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

From the results of the calculated parameters it is clear that not all results were calculated for the requested conditions, resulting in trimodal distributions of the reported results. Probably many results calculated for different temperatures were reported.

It was the intention to request to report the ideal-gas superior caloric value on a volumetric basis in accordance with equation 8 of ISO 6976:1995 @ $\underline{25}^{\circ}$ C and 101.325 kPa (using table 4 of ISO6976:1995), and using the metering reference condition $\underline{0}^{\circ}$ C and 101.325 kPa (see table 5 of ISO6976:1995).

From the reported results it was clear that not all laboratories used the intended conditions (25° C and 101.325 kPa) to calculate the caloric value results. Several laboratories did remark that the metering reference conditions 15° C and 101.325 kPa were used.

Also for the other calculated parameters results were reported calculated using various conditions, at least 15°C and 25 °C.

The fact that no correlation can be seen between Caloric Value results and the methane concentration, but 3 groups of results in stead is in agreement with above conclusion.



z(targ) value mark remarks lab method 78 GPA2286 86.887 -1.66 92 GPA2286 86.970 -0.32 171 D1945mod 86.696 -4.73 225 316 ISO6974-3 87.046 0.90 CEA1624 343 86.98 -0.16 442 D1945 87.035 0.72 444 D1945 87.059 1.11 496 DIN51666 87.524 G(0.05) 8.59 529 D1945 87.317 5.26 602 GPA2261 87.025 0.56 608 GPA2261 87.035 0.72 609 GPA2261 86.962 -0.45 GPA2261 618 86.720 -4.35 87.089 622 D1945 1.59 662 D1945 86.822 -2.70 GPA2261 868 87.031 0.66 974 ISO6974 87.0526 1.01 1011 UOP539 86.99 0.00 1066 ISO6974 86.981 -0.14 1081 86.51 G(0.05) -7.73 in house UOP539 1082 87.064 1.19 1197 D1945 86.918 -1.16 1198 D1945 86.916 -1.19 ISO6974-3 86.986 -0.06 1287 1307 RGA 86.989 -0.02 1654 D1945 91.017 C,G(0.01) 64.81 first reported 80.490 1730 **UOP539** 87.206 3.48 -0.97 1737 in house 86.93 ISO6974-3 87.03368 1943 0.70 reported normalized result 90.395 ОK normality 26 n outliers 3 mean (n) 86.9900 0.12702 st.dev. (n) R(calc.) 0.3557 R(ISO6974-3) 0.1740 Compare R(D1945) = 0.1500 88 87.8

APPENDIX 1

Determination of Methane on sample #10ME; results in %mol/mol





Determination of Ethane on sample #10ME; results in %mol/mol

lab	method	value	mark	z(targ)	ren	narks	5													
78	GPA2286	4.326		0.15																
92	GPA2286	4.320		0.02																
171	D1945mod	4.335		0.34																
225	10000740																			
316	ISO6974-3	4.314		-0.11																
343	D1045	4.283		-0.78																
442	D1945	4.300		-0.29																
444	DIN51666	4 350		0.25																
529	D1945	4.176	G(0.05)	-3.10																
602	GPA2261	4.297	-()	-0.48																
608	GPA2261	4.338		0.40																
609	GPA2261	4.340		0.45																
618	GPA2261	4.297		-0.48																
622	D1945	4.286		-0.72																
662	D1945	4.351		0.69																
868	GPA2261	4.297		-0.48																
974 1011	1300974	4.3100		-0.07																
1066	ISO6974	4.344		0.23																
1081	in house	4.59	G(0.01)	5.85																
1082	UOP539	4.319	-()	-0.01																
1197	D1945	4.307		-0.27																
1198	D1945	4.325		0.12																
1287	ISO6974-3	4.275	0 (0 0 1)	-0.96																
1307	RGA	4.191	G(0.01)	-2.77	6		ام م اس	2 05	~											
1654	D1945	4.462	C,G(0.05)	3.08	TIPS	repo	ortea	3.95	2											
1730	in house	4.292		-0.59																
1943	ISO6974-3	4.33		1 16	ren	orted	norr	nalizi	ed re	tlue	4 54	2								
1010		1.070101		1.10	TOP	01100	mon	nanz	oun	Joun		-								
	normality	OK																		
	n	25																		
	outliers	4																		
	mean (n)	4.3193																		
	St.dev. (n)	0.02408																		
	R(ISO6974-3)	0.1296			Co	mnar	e R(ľ	0194	5) =	0 10	00									
							(-		-,											
4.7 _T																				
4.6 -																				*
4.5 —																			~	
4.4																			x_	
									^	^	Δ	Δ	Δ	۵	Δ	Δ	Δ	۵		
4.3 -	<u>م</u> ۵ ۵	<u> </u>	Δ Δ		4	4	-	-												
4.2													;						!	
4.1 -																				
4 -																				
3.9																				
529	1307 1287 343 343	1730 602 868	618 442	316 316 974	1082	92	1198	78	1011	1737	444	171	608	609	1066	496	662	1943	1654	1081
14																				
		Kernel Densit	v 🗌																	
12 -	n	. temor bonon	'																	
	/\																			
10 -	(]																			

4.4

4.6

4.8

4.2

8 -6 -4 -2 -0 -4

Determination of Propane on sample #10ME; results in %mol/mol

lab	method	value	ma	rk		z(ta	rg)	rer	nark	S													
78	GPA2286	2.520				0	.53																
92	GPA2286	2.490				-0	.59																
225	D1945m00	2.585				2	.95																
316	ISO6974-3	2.507				0	.04																
343	CEA1624	2.561				2	.05																
442	D1945	2.496				-0	.37																
444	D1945 DIN51666	2.515				-0	.34																
490 529	D1945	2.468				-1	.41																
602	GPA2261	2.510				0	.15																
608	GPA2261	2.496				-0	.37																
609	GPA2261	2.540				1	.27																
618 622	GPA2261	2.536				-2	.12																
662	D1945	2.539				1	.24																
868	GPA2261	2.509				0	.12																
974	ISO6974	2.5077				0	.07																
1011	UOP539	2.49				-0	.59																
1000	in house	2.475				-1	.15 33																
1082	UOP539	2.547				1	.53																
1197	D1945	2.541				1	.31																
1198	D1945	2.521				0	.56																
1287	ISO6974-3	2.480				-0	.96																
1654	RGA D1945	2.440	G(C	05)		-2	.15	firs	t ren	orte	d 2 3	345											
1730	UOP539	2.472	0(0	,		-1	.26			0.10													
1737	in house	2.50				-0	.22																
1943	ISO6974-3	2.413778	G(0).05)		-3	.43	rep	orte	d no	rmali	ized	resu	lt 2.5	507								
	normality	OK																					
	n	27																					
	outliers	2																					
	mean (n)	2.5058																					
	st.dev. (n)	0.03355																					
	R(Calc.) R(ISO6974-3)	0.0939						Co	mpa	re R	(D19	945) :	= 0.1	000									
		0.01.02									(2.0	,	0										
2.7 T																							
2.65 -																							
																							*
2.6																						- & -	-
2.55																	Δ	Δ	Δ	Δ			-
2.5				•	A	Δ	Δ	Δ				A	Δ	Δ	Δ								-
2.45	<u>^</u> _ <u>^</u>	<u> </u>																					_
×																							-
2.4 -																							
2.35 -																							
2.3	~ ~ ~ ~ ~	0 % >		0	-	~	<i></i>	~		*	<i>m</i>	0	*			<i>"</i>	0		~	N	~	-	
194;	130 52! 108'	173 106(128]	49	3	101	44,	60	173.	31	26	86	60	44	ř.	119	61	66.	60	119	108;	34:	17	165
10 -																							
9	\wedge	Kernel Density																					
	/ \																						
1	(\																						
6 -																							
5 -																							
4	/ \																						
3	/ \																						
2	/ \																						
	/ \																						
_1		\sim																					
I U +	- , ,	·																					

2.5

2.6

2.7

2.8

2.3

2.4

Determination of n-Butane on sample #10ME; results in %mol/mol

lah	mothod	value	mark	z(tora)	rom	arke														
			mark	Z(targ)	rem	diks														
/8	GPAZZ80	0.108		0.05																
92	GPAZZ00 D1045mod	0.110		0.91																
225	D194511100	0.110		0.91																
316	1506074-3	0.100		0.48																
343	CFA1624	0.109		0.40																
442	D1945	0.109		0.40																
444	D1945	0.107		-0.38																
496	DIN51666	0.103		-2.11																
529	D1945	0.109		0.48																
602	GPA2261	0.108		0.05																
608	GPA2261	0.111		1.35																
609	GPA2261	0.111		1.35																
618	GPA2261	0.107		-0.38																
622	D1945	0.102		-2.55																
662	D1945	0.111		1.35																
868	GPA2261	0.110		0.91																
974	ISO6974	0.1032		-2.03																
1011	UOP539	0.10	DG(0.05)	-3.41																
1066	ISO6974	0.106		-0.82																
1081	in house	0.1	ex	-3.41	excl	uded	resu	ult ro	und	ed to	one	sign	ifica	nt fig	ure					
1082	UOP539	0.104		-1.68																
1197	D1945	0.107		-0.38																
1198	D1945	0.108		0.05																
1287	ISO6974-3	0.111		1.35																
1307	RGA	0.110		0.91	final		ا م م	~ 4 ^	~											
1054	D1945	0.119	C,D(0.05)	4.81	first	repoi	tea	0.10	6											
1730	UUP539	0.105		-1.25																
1042		0.11		0.91	rond	rtad	norn	ooliz	od r	ooult	0 1 1	4								
1943	1506974-3	0.106672		-0.44	repo	nea	nom	naliz	eare	esuit	0.11	I								
	normality	OK																		
	normality	26																		
	outliers	20																		
	mean (n)	0 1079																		
	st dev (n)	0.00266																		
	R(calc.)	0.0075																		
	R(ISO6974-3)	0.0065			Con	npare	R(D	0194	5) =	0.07	00									
	()						``	-	-,											
0.125																				
0.125																				
0.12 -																				
																				*
0.115																				
																	Δ	Δ	Δ	
0.11 -				\		<u>^</u>	Δ	Δ	Δ	Δ	Δ		Δ	Δ	Δ					_
0.105 -		. 4 4		Δ Δ																
	<u>\</u> <u>\</u> \																			
0.1 - *	к ж																			
0.095 -																				
0.09																				
110	1081 622 496 974	1082 1730	1943	444 618 198	78	602	316	529	442	343	1307	171	92	868	1737	609	608	662	1287	1654
L	.			-							-				-				-	-
140 -																				
		Kernel Density	/																	
120 -	\wedge																			
	()																			
1 100	1 1																			



Determination of iso-Butane on sample #10ME; results in %mol/mol

lab	method		value		mar	k	z(t	arg)	r	emar	ks														
78	GPA2286		0.107				-	0.40																	
92	GPA2286		0.110					0.89																	
171	D1945mod		0.111					1.33																	
225	1000																								
316	ISO6974-3		0.108		D (a	05)		0.03																	
343	CEA1624		0.100		D(0.	.05)	-	3.43																	
442	D1945		0.109					0.40																	
444	DIN51666		0.100					1 27																	
529	D1945		0.105				_	0.84																	
602	GPA2261		0.108					0.03																	
608	GPA2261		0.115					3.06																	
609	GPA2261		0.111					1.33																	
618	GPA2261		0.108					0.03																	
622	D1945		0.105				-	1.27																	
662	D1945		0.109					0.46																	
868	GPA2261		0.109					0.46																	
974	1506974		0.105	4		05)	-	1.09																	
1011	1SO6974		0.10		D(0.	.05)	-	3.43 1 27																	
1081	in house		0.100		ex		_	3.43	e	xcluc	led r	esult	rou	nder	t to c	ne s	ianif	icant	figu	re					
1082	UOP539		0.105		U.		-	1.27	Ŭ	Norac	1001	ooun		naoc				loain	ngu						
1197	D1945		0.107				-	0.40																	
1198	D1945		0.108					0.03																	
1287	ISO6974-3		0.110					0.89																	
1307	RGA		0.109			~		0.46																	
1654	D1945		0.114		ex,	C		2.62	ti	rst re	eporte	ed 0.	101												
1730	UOP539		0.106				-	0.84																	
1043	ISO6974-3		0.11				_	0.09	ra	anort	od ni	orms	lizor	d roc	ult O	110									
1040	1000074-0		0.100					0.07		spon	cum	onne	11200	1103	oun o										
	normality		OK																						
	n		25																						
	outliers		2																						
	mean (n)		0.107	9																					
	st.dev. (n)		0.002	45																					
	R(Calc.)	2)	0.006	9					C	`omn	oro E	1 ח/כ	045	\ _ 0	070	^									
	K(1300974-	-3)	0.000	5					C	Joint	aler	(01	945)) = 0	.070	0									
0.12																									
0.12																									
0.115 -																									_ - ∆
0.11 -															_	▲	۵	۵	۵	4	۵	Δ	Δ		
0.405					Δ	Δ	Δ	Δ	۵	Δ	<u> </u>		<u>A</u>	∆											
0.105 -		▲ 		<u> </u>	·																				
0.1 + *																									
0.095 -																									
0.09	<u>5</u> 5 8	8 8	8	4 62	4	.00	4	53	78	97	5	16	18	88	20	4	62	89	37	32	87	60	4	5	80
	0 0 0 4	t ú	9	0 6	19.	17:	4	ŝ		Ę	ý	e	9	1	13	4	Ō	ō	17.		12	ē	-	16	ē
140 -																									



Determination of Carbon Dioxide on sample #10ME; results in %mol/mol

lab	method			valu	e	r	nark		Z	(targ)) r	emai	rks														
78	GPA2286			3.78	7					1.72	2																
92	GPA2286			3.75	0					0.79)																
171	D1945mo	d		3.70	3					-0.39)																
225											-																
316	ISO6974-3	3		3.70	9					-0.24	Ļ																
343	CEA1624			3.72	7					0.21																	
442	D1945			3.70	5					-0.34	ŀ																
444	D1945			3.70	6					-0.31																	
496	DIN51666	6		3.22	5	(G(0.0)1)	-	12.39)																
529	D1945			3.63	6					-2.07	,																
602	GPA2261			3.72	7					0.21																	
608	GPA2261			3.67	6					-1.07	,																
609	GPA2261			3.74	3					0.62	2																
618	GPA2261			3.90	9	(G(0.0)5)		4.78	3																
622	D1945			3.74	3					0.62	2																
662	D1945			3.69	4					-0.61																	
868	GPA2261			3.69	8					-0.51																	
974	ISO6974			3.70	09					-0.44	ŀ																
1011	UOP539			3.78						1.54	ŀ																
1066	ISO6974			3.74	6					0.69)																
1081	in house			3.65						-1.72	2																
1082	UOP539			3.68	6					-0.82	2																
1197	D1945			3.68	1					-0.94	ŀ																
1198	D1945			3.71	2					-0.16	5																
1287	ISO6974-3	3		3.81	2					2.35	5																
1307	RGA			3.83	7					2.97	· .																
1654	D1945			0.49	1	C	J,G((J.01)	-	81.01	T	irst re	eport	ed 1	1.158	5											
1730	UOP539			3.65	3					-1.64	ł																
1/3/	in nouse			3.70						-0.40)																
1943											-																
	n o rm olity (ov																							
	normality			25 25																							
	outliors			20																							
	mean (n)			371	85																						
	st day (n)			0.04	865																						
	R(calc.)			0.04	62																						
	R(ISO697	(4-3)		0.11	16						(Comp	are	R(D1	945)	= 0.	1000										
				••••											,												
2.05																											_
5.55 T																											
3.9 -																										ж	
3.85 -																									^-		
3.8																								۵			
																						Δ	Δ				
3.75 -																Δ	_	۵	Δ	Δ	Δ						
3.7 -						^	۵	۵	Δ	Δ	Δ	Δ	Δ	۵	Δ												
3.65		4	Δ	Δ	Δ	-																					
-	<u>-</u>																'										
3.6																											
3.55 -																											
3.5	0 m	-		~	~	0	0	m	~	4		0	**		<i>"</i>	<i>m</i>	~	0			0	-	~	~	~	~	
165/	525 525	108	173(60	119	108	66	86	173,	726	17	44	44	316	1196	34:	602	62	60	106	36	101	24	1287	1307	616	
							_																				
191							1																				



Determination of Nitrogen on sample #10ME; results in %mol/mol

lab	method	value	mark	z(targ)	r	emark	S													
78	GPA2286	2.265		1.16																
92	GPA2286	2.250		0.53																
171	D1945mod	2.459	DG(0.05)	9.25																
225																				
316	ISO6974-3	2.208	_	-1.22																
343	CEA1624	2.240	С	0.11	fi	rst rep	ortec	2.07	70											
442	D1945	2.239		0.07																
444	D1945	2.162		-3.14																
490	D1045	2.205		-1.35																
529 602	CPA2261	2.107		-2.10																
608	GPA2261	2.224		-0.33																
609	GPA2261	2 1 9 4		-1.80																
618	GPA2261	2.282		1.87																
622	D1945	2.227		-0.43																
662	D1945	2.382	DG(0.05)	6.04																
868	GPA2261	2.246	,	0.36																
974	ISO6974	2.2142		-0.96																
1011	UOP539	2.21		-1.14																
1066	ISO6974	2.249		0.49																
1081	in house	2.38	D(0.05)	5.95																
1082	UOP539	2.177		-2.51																
1197	D1945	2.339		4.24																
1097	D1940 ISO6074 2	2.311		5.00 0.47																
1307	RGA	2.220		3 24																
1654	D1945	1 152	CG(0.01)	-45 27	fi	irst rep	orted	1 1 84	48											
1730	UOP539	2.166	00(0.01)	-2.97		liot iop	01100													
1737	in house	2.32		3.45																
1943	ISO6974-3	2.247211		0.42	r	eporte	d nor	maliz	zed ı	resul	t 2.3	34								
	a a nas a lite e																			
	normality	0K 25																		
	outliere	25																		
	mean (n)	2 2373																		
	st.dev. (n)	0.04760																		
	R(calc.)	0.1333																		
	R(ISO6974-3)	0.0671			C	Compa	re R(D194	45) =	= 0.1	000									
	, , , , , , , , , , , , , , , , , , ,					•	``		,											
^{2.5} T																				
2.45 -																				ж
24																				
2																		*	ж	
2.35 +																۵	۵			
2.3																				
2.25					<u> </u>	Δ	∆	۵	۵	۵	۵	Δ								
2.2 -	<u>-</u> <u>*</u> <u>*</u>	<u>A</u>	▲ ▲ 																	
2.15 -	<u>∧</u> <u>∧</u> <u>→</u>																			
2.1	4 0 0 m	თ. დ. ") 4	~ 4 5	4	80 Ci	en	60	en .	9	8	80	80	80	2	2	~	-	2	-
654	52 08: 73 44	49(60	61/10	60 28 60	3	8 4	¥	861	8	06(6	12	611	191	30	23	19.	8	.99	17.



Determination of Caloric Value (sup) (@ 25°C and 101.325 kPa) on smpl #10ME; results in MJ/m³

				/ (_	/							
lab	method	value	mark	z(1	arg)	remark	5									
78	AGA#5	38.340				calculat	ed @15°	°C and	101.32	5 as p	er AGA	#5				
92	AGA#5	38.75				calculat	ed @15°	°C and	101.32	5 as p	er AGA	#5				
171	ISO6976	40.31														
225																
316	ISO6976	40.4730														
343		40.57199														
442	D1945	38.369														
444	ISO6976	40.50														
496	DIN51857	37.220														
529	ISO6976	37.03														
602	1506976	38 27431				calculat	nd @159	C and	101 32	5						
608	1906976	38 30854				calculat	nd @159	C and	101.02	5						
600	1506976	38 40727				calculat	50 ⊛15 sd @159	C and	101.32	5						
619	1500370	20.40727				calculat	5u @15	C anu	101.52	5						
622	1506076	40 2084														
662	1300970	40.3904														
002	1806076	40.45														
000	1506976	40.45														
974																
1011																
1066																
1081																
1082	ISO6976	37.0051														
1197	ISO6976	38.35														
1198	ISO6976	38.35														
1287	ISO6976	38.316														
1307																
1654	ISO6976	40.132	ex,C			first repo	orted 29.	882								
1730	ISO6976	40.478				•										
1737																
1943	ISO6976	39.132				Group 1			Group	2 .		G	7 AUD 3	۱.		
	normality	not OK				n/a	-		not Ok	<u> </u>			K	Ŀ		
	normanty	21				3			11	`		7	`			
	outliors	21				0			0			6				
		20 01 45				0 27 005			0 100			40	1515			
	mean (n)	30.9143				37.000			30.433	94 150		40	00040			
	st.dev. (n)	1.22551				0.1175			0.2794	53		0.0	08248			
	R(calc.)	~~ / ~~ 1 / /							/ . / /			<i>(</i>) ·				
	DUID	5.4514				0.3291			0.7825)		0.,	2309			
	R(lit)	n/a				0.3291 n/a			0.7825 n/a)		n/a	2309 a			
	R(lit)	n/a				0.3291 n/a			0.7825 n/a	,		n/a	2309 a			
41 T	R(lit)	n/a				0.3291 n/a			0.7825 n/a)		n/a	2309 a			
41 40 5	R(lit)	n/a				0.3291 n/a			0.7825 n/a			n/a	2309 a			
41 T 40.5 -	R(lit)	n/a				0.3291 n/a			0.7825 n/a	Δ	Δ	n/a	2309 a	۵	۵	۵
41 - 40.5 - 40 -	R(lit)	n/a				0.3291 n/a			0.7825 n/a	Δ	Δ	0 n/a	2309 a	۵	۵	۵
41 - 40.5 - 40 - 39.5 -	R(lit)	n/a				0.3291 n/a			0.7825 n/a	۰ ۵	Δ	0 n/a	2309 a	۵	۵	۵
41 - 40.5 - 40 - 39.5 - 39 -	R(lit)	n/a				0.3291 n/a			0.782€ n/a ∗	, 	۵	0 n/a	2309 a	۵	۵	۵
41 - 40.5 - 40 - 39.5 - 39	R(lit)	n/a				0.3291 n/a		 	0.7825 n/a ∗	Δ	۵	0 n/: ▲	2309 a	Δ	۵	۵
41 40.5 40 39.5 39 38.5	R(lit)	n/a	Δ	Δ	Δ 4	0.3291 n/a	Δ	 A	0.7825 n/a ∗	۶ ۵	۵	0 n/: 	2309 a 	۵	۵	Δ
41 - 40.5 - 40 - 39.5 - 39 38.5 - 38 -	R(lit)	n/a		۵	Δ 4	0.3291 n/a	Δ	 A	0.7825 n/a ∗	۰ ۵	۵	0 n/: 	2309 a 	۵	۵	Δ
41 - 40.5 - 40 - 39.5 - 39 - 38.5 - 38 - 37.5 -	R(lit)	n/a	Δ	Δ	<u> </u>	0.3291 n/a	۵		0.782c n/a ∗	•	۵		2309 a 	۵	۵	Δ
41 40.5 - 39.5 - 38.5 - 38.5 - 38.5 - 38.5 - 37.5 - 37.5 -	R(lit)	n/a	Δ	<u>۸</u>	<u> </u>	0.3291 n/a	Δ		0.782c n/a *	Δ	۵		2309 a 	Δ	۵	Δ
41 40.5 - 40 - 39.5 - 39 - 38.5 - 38 - 37.5 - 37 - A	R(lit)	n/a	Δ	۵	<u> </u>	0.3291 n/a	۵		0.7825 n/a ∗	<u>،</u>	۵		2309 a	Δ	۵	Δ
41 40.5 - 40 - 39.5 - 38 - 38.5 - 38 - 37.5 - 37.5 - 36.5 -	R(lit)	۵.4014 n/a	۵	۵	A A	0.3291 n/a	Δ		0.7825 n/a ∗	<u>،</u>	Δ	0 n/i	2309 a	۵	۵	Δ
41 - 40.5 - 40 - 39.5 - 38 - 37.5 - 36.5 - 36.5 - 36.5 - 36 -	R(lit)	0.4014 n/a	۵	۵	<u>م</u>	0.3291 n/a	۵	A	0.782c n/a *	<u>۵</u>	۵	۰ n/a	2309 a •	۵.	4	۵
$\begin{bmatrix} 41 & - \\ 40.5 & - \\ 40 & - \\ 39.5 & - \\ 38.5 & - \\ 38.5 & - \\ 37.5 & - \\ 36.5 & - \\ 36.5 & - \\ 36 $	R(lit)	n/a	۵.	₹		0.3291 n/a	۵.	4	*		622	0 n/a ▲	2309 a <u>م</u>	1730	444	343
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	R(lit)	n/a	۵	138	A A	0.3291 n/a	۵۵ و۵۵	A 8	×	A 12	622	0 n/a	2309 a 	1730	444	343
$ \begin{array}{c} 41 \\ 40.5 \\ 40 \\ -39.5 \\ 39 \\ -38.5 \\ 38 \\ -37.5 \\ 37 \\ -36.5 \\ 36 \\ \underline{36} \\ \underline{5} \\ \underline$	R(lit)	n/a	۸۵ ۲۵ ۲۵	1188	13611 6447	0.3291 n/a	A	A	0.782c n/a *	۵ ۲۲	622	0 n/: ▲	2309 a <u>•</u>	41330	444	343
$ \begin{array}{c} 41 \\ 40.5 \\ 40 \\ -39.5 \\ 39 \\ -38.5 \\ 38 \\ -37.5 \\ 36 \\ -36 \\ -36 \\ -36 \\ -36 \\ 0.35 \\ -36 \\ -$	R(lit)	n/a	۸ ۶2	۵ ۵ ۲.2	7911 646 7	0.3291 n/a	A 88	▲	0.782c n/a ∗	<u>م</u>	622	0 n/: ▲	2309 a	1730	444	2
$ \begin{array}{c} 41 \\ 40.5 \\ 40 \\ -39.5 \\ 39 \\ -38.5 \\ 38 \\ -37.5 \\ 36.5 \\ -36 \\ \underline{36} \\ \underline{80} $	R(lit)	0.4014 n/a	۸ ۲۵ ۲۵	▲ 88 1.2	۸ ۷۵ اور ۱۹۹۲ ۱۹۹۲ - ۲۰۰۵ - ۲۰۰۵ - ۲۰۰۵ - ۲۰۰۵ - ۲۰۰۵ - ۲۰۰۵ - ۲۰۰۵ - ۲۰۰۵ - ۲۰۰۵ - ۲۰۰۵ - ۲۰۰۵ - ۲۰۰۵ - ۲۰۰۵ - ۲۰۰۵ - ۲۰۰۵	0.3291 n/a	۵ 8 8	م ع الك الك الك الك الك الك الك الك الك الك	0.782c n/a *	<u>م</u>	622	0n/i	2309 a	۵ (120)	444	343
$ \begin{array}{c} 41 \\ 40.5 \\ 40 \\ -39.5 \\ 39 \\ -38.5 \\ 38 \\ -37.5 \\ 36.5 \\ -36 \\ \underline{8} \\ \underline{8} \\ \underline{8} \\ 0.35 \\ 0.3 \\ \underline{8} \\ 0.35 \\ 0.3 \\ \underline{8} \\ 0.3 \\ 0.3 \\ \underline{8} \\ 0.3 \\ 0.3 \\ \underline{8} \\ $	R(lit)	0.4014 n/a	<u>م</u>	▲ 1.2	A A	0.3291 n/a	≜ 8 Kerne	A B B B B Dens	0.782c n/a ∗	2 171	623	0n/i	2309 a	۵	646 •	343
$\begin{bmatrix} 41 & - \\ 40.5 & - \\ 40 & - \\ 39.5 & - \\ 38.5 & - \\ 38.5 & - \\ 37.5 & - \\ 36.5 & - \\ 36.5 & - \\ 36 & - \\ 0.35 & - \\ 0.3 & - \\ 0 & - \\$	R(lit)	a a a a a a a a a a a a a a a a a a a	۸ 28	▲ 1.2 1 -	2 2 CFV	0.3291 n/a	ু জু Kerne	a a a a a a a a a a a a a a a a a a a	0.782c n/a ∗	23 23	622	0n/n	2309 a	۵	444	343
$ \begin{array}{c} 41 \\ 40.5 \\ 40 \\ -39.5 \\ 39 \\ -38.5 \\ 38 \\ -37.5 \\ 37.5 \\ 36 \\ -36 \\ 0.3 \\ 0.25 \\ 0.25 \\ -37 \\ 0.25 \\ 0.3 \\ 0.25 \\ 0.25 \\ 0.3 \\ 0.3 $	R(lit)	A A A	۵ ۶۷	۵ ٤ ٤ ١.2 1 -		0.3291 n/a	۵ ۵ ۶	A A S S S S S S S S S S S S S S S S S S	0.782c n/a ∗ ▲	121	€ 623	0n/a	2309 a	4	444 	▲ 943 848
$\begin{bmatrix} 41 & - \\ 40.5 & - \\ 40 & - \\ 39.5 & - \\ 38.5 & - \\ 38.5 & - \\ 37.5 & - \\ 36.5 & - \\ 36.5 & - \\ 0.35 & - \\ 0.35 & - \\ 0.25 & - \\ 0.25 & - \\ \end{bmatrix}$	R(lit)	s. 4 14 n/a	۸ 22	A 88 1.2 1 - 0.8 -	/6tt	0.3291 n/a	۵ ۲ ۲ ۲ ۲ ۲ ۲ ۲ ۲	a a a a b b b a b b a b b a b a b a b a	0.782c n/a *	171	23 623	0n/a	2309 a	A	444	₽
$ \begin{array}{c} 41 & - \\ 40.5 & - \\ 40 & - \\ 39.5 & - \\ 38.5 & - \\ 38.5 & - \\ 38.5 & - \\ 37.5 & - \\ 36.5 & - \\ 36.5 & - \\ 36.5 & - \\ 0.35 & - \\ 0.25 & - \\ 0.2 & - \\ 0.2 & - \\ 0.2 & - \\ \end{array} $	R(lit)	s. 4 14 n/a	۸ ۶2	▲ ⁸ : 1.2 1 - 0.8 -	4	0.3291 n/a	۵ ۲ ۲	a B B B B B B B B B B B B B B B B B B B	0.782c n/a ∗	23	622	0n/a	2309 a	A 05/1	444	4 343 343
$ \begin{array}{c} 41 \\ 40.5 \\ -40 \\ -39.5 \\ 39.5 \\ -38.5 \\ -38.5 \\ 38. \\ -37.5 \\ -37 \\ -36.5 \\ -36 \\ 0.35 \\ 0.3 \\ -0.25 \\ 0.2 \\ -0.$	R(lit)	A A A	۸ ۲	▲ ⁸⁸ 1.2 1 - 0.8 - 0.6 -	۸ ۲۲ (ATT)	0.3291 n/a	۵ 8 Kerne	a B B B B B B B B B B B B B B B B B B B	0.7825 n/a ∗	4	622	0n/a	2309 a	۵	444	343
$ \begin{array}{c} 41 \\ 40.5 \\ 40 \\ -39.5 \\ 39 \\ -38.5 \\ 38 \\ -37.5 \\ 37 \\ 36.5 \\ -36 \\ \underline{8} \\ \underline{8} \\ 0.35 \\ 0.3 \\ 0.25 \\ 0.2 \\ 0.2 \\ 0.15 \\ \end{array} $	R(lit)	A A A	۸ ۶۷ ۶۷ ۶۷ ۶۷ ۶۷ ۶۷ ۶۷ ۶۷ ۶۷ ۶۷	▲ 1.2 1 - 0.8 - 0.6 -	A A	0.3291 n/a	¢ 8 Kerne	a B B B Dens	0.782c n/a ∗	<u>۲</u>	622	0n/i	2309 a	۵ (۲۲۹)	444	343
$\begin{bmatrix} 41 & - \\ 40.5 & - \\ 40 & - \\ 39.5 & - \\ 38.5 & - \\ 38.5 & - \\ 37.5 & - \\ 36.5 & - \\ 36.5 & - \\ 36.5 & - \\ 0.35 & - \\ 0.25 & - \\ 0.25 & - \\ 0.25 & - \\ 0.25 & - \\ 0.15 & - \\ 0.15 & - \\ \end{bmatrix}$	R(lit)	A A A	۸ <u>ور</u>	▲ 1.2 1 - 0.8 - 0.6 -		0.3291 n/a	د ع Kerne	a a a a b b a b a b a b a b a b a b a b	0.782c n/a *	م ۱۲	622	0n/a 	2309 a	۵	644 	343
$ \begin{bmatrix} 41 & - \\ 40.5 & - \\ 40 & - \\ 39.5 & - \\ 38.5 & - \\ 38. & - \\ 37.5 & - \\ 36.5 & - \\ 36.5 & - \\ 36.5 & - \\ 36.5 & - \\ 36.5 & - \\ 36.5 & - \\ 0.2 & - \\ 0.25 & - \\ 0.2 & - \\ 0.15 & - \\ 0.1 & - \\ 0$	R(lit)	A A A	۵۷ ۱۹۷۶ ۱۹۷۶	▲ 1.2 1 - 0.8 - 0.6 - 0.4 -		0.3291 n/a	۵ گ Kerne	a a a b b Dens	0.782c n/a ∗	121	۵	8 8	2309 a	A 00211	44-5	▲ 949 8
$\begin{bmatrix} 41 & - \\ 40.5 & - \\ 40 & - \\ 39.5 & - \\ 38.5 & - \\ 38.5 & - \\ 37.5 & - \\ 36.5 & - \\ 36.5 & - \\ 0.35 & - \\ 0.35 & - \\ 0.25 & - \\ 0.25 & - \\ 0.25 & - \\ 0.25 & - \\ 0.15 & - \\ 0.1 & - \\ $	R(lit)	s. 4 14 n/a	<u>م</u> 22	۵	۸ ۲ (۲۳) ۱۶۱۱ - ۲۰۰۲ - ۲۰۰۲ - ۲۰۰۲ - ۲۰۰۲ - ۲۰۰۲ - ۲۰۰۲ - ۲۰۰۲ - ۲۰۰۲ - ۲۰۰۲ - ۲۰۰۲ - ۲۰۰۲ - ۲۰۰۲ - ۲۰۰۲ - ۲۰۰۲ - ۲۰۰۲ -	0.3291 n/a	۵ ۲ ۲ ۲ ۲ ۲ ۲ ۲ ۲	a a a a b b b b a b b a b b a b a b a b	0.782c n/a ∗	171	23 625	8 8	2309 a	A 1230	444	₽
$ \begin{array}{c} 41 \\ 40.5 \\ 40 \\ -39.5 \\ 39 \\ -38.5 \\ 38 \\ -37.5 \\ 37 \\ -36.5 \\ -36 \\ 0.35 \\ 0.35 \\ 0.25 \\ 0.25 \\ 0.25 \\ 0.2 \\ 0.15 \\ 0.15 \\ 0.25 \\ 0.2 \\ 0.15 \\ 0.2 \\ 0.2 \\ 0.15 \\ 0.2 \\ 0.2 \\ 0.15 \\ 0.2 \\ 0$	R(lit)	s. 4014 n/a	۸ ۶2	▲ ⁸ 1.2 1 - 0.8 - 0.6 - 0.4 - 0.2 -	7	0.3291 n/a	۵ ۲ Кети	a B B B B Dens	0.782c n/a ∗	2	622	0n/a	2309 a	A 0211	444	343
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	R(lit)	N/a	۸ ۲	▲ 1.2 1 - 0.8 - 0.6 - 0.4 - 0.2 -	۸ ۵ ۵ ۱۹۱۱	0.3291 n/a	۵ ۲ Кеги	a B B B B B B B B B B B B B B B B B B B	0.782c n/a ∗	4	622	0n/i	2309 a	۵ د ا	444	۵
$ \begin{array}{c} 41 \\ 40 \\ -39.5 \\ -39 \\ -39 \\ -38.5 \\ -37 \\ -37 \\ -36.5 \\ -36 \\ -36 \\ -37 \\ -36.5 \\ -37 \\ -36.5 \\ -37 \\ -36.5 \\ -37 \\ -37 \\ -36.5 \\ -37 $	R(lit)	A A A	۸ ۶2	▲ 1.2 1 - 0.8 - 0.6 - 0.4 - 0.2 - 0		0.3291 n/a	¢ 8 Kerne	A B B B Densi	0.782c n/a *	<u>م</u>	622	88 88	2309 a	۵ (1230)	644 644	343
$\begin{bmatrix} 41 & - \\ 40.5 & - \\ 40 & - \\ 39.5 & - \\ 39 & - \\ 38.5 & - \\ 37.5 & - \\ 36$	R(lit)	S. 4014 n/a		▲ 1.2 1 - 0.8 - 0.6 - 0.4 - 0.2 - 0 - 34		0.3291 n/a	8 8 Kerne	a B B B Dens	0.782c n/a ∗	<u>۲</u>	622	0n/i	2309 a	۵ (1230)	444 •	343

Determination of Density (@ 25°C and 101.325 kPa) on sample #10ME; results in kg/m³

lab method value mark Z(arg) remarks 22 GPA2286 0.793		innation of	Den	Sity (@	20 0	anu	101.	5251		511 54	mpic	#101	vic, i	Count	5 III K	<i>y</i> /111		
78 GPA2145 0.7941	lab	method	v	alue	mark		z(targ) re	marks									
92 GPA2286 0.793	78	GPA2145	C	.7941														
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	92	GPA2286	0	.793														
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	171																	
316 ISOB976 0.8388	225																	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	316	ISO6976	0	8388														
444 50847	3/3	1000010	0	8305														
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	440	D1045		7047														
444 ISDB976 0.3385 reported result for Real gas 522 ISDB976 0.75716 calculated B15°C and 101.325 663 ISDB976 0.736662 calculated B15°C and 101.325 663 ISDB976 0.736662 calculated B15°C and 101.325 664 ISDB976 0.736662	442	D1945	0	0.7947														
1940 D/R018:7 0.76212	444	1506976	0	0.8388				re	ported	result to	or Real	gas						
529 ISOB976 0.7657	496	DIN51857	0	0.76212														
602 ISOB976 0.794945	529	ISO6976	C	.7657														
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	602	ISO6976	C	.794945				ca	lculated	d @15°	C and	101.32	5					
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	608	ISO6976	C	.794606				ca	lculated	d @15°	C and	101.32	5					
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	609	ISO6976	C	.795662				ca	lculated	d @15°	C and	101.32	5					
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	618																	
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	622	ISO6976	0	8382														
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	662		-															
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	868	1906076	0	8386														
	000	1300970	U	.0300														
$1011 \qquad \qquad \\ 1081 \qquad \qquad \\ 1082 \qquad ISO6976 \qquad 0.7963 \qquad \\ 1197 \qquad ISO6976 \qquad 0.7965 \qquad \\ 1287 \qquad ISO6976 \qquad 0.7965 \qquad \\ 1730 \qquad ISO6976 \qquad 0.78763 \qquad \\ 1730 \qquad ISO6976 \qquad 0.7407 \qquad \\ 1730 \qquad SO50976 \qquad 0.7407 \qquad \\ 1943 \qquad ISO6976 \qquad 0.7407 \qquad \\ 1943 \qquad ISO6976 \qquad 0.7407 \qquad \\ 1954 \qquad \qquad \\ 1964 \qquad \qquad \\ 1964 \qquad \qquad \\ 1964 \qquad \qquad \\ 197 \qquad \qquad \\ 1964 \qquad \qquad \\ 1964 \qquad \qquad \\ 197 \qquad \qquad \\ 1964 \qquad \qquad \\ 1964 \qquad \qquad \\ 1964 \qquad \qquad \\ 197 \qquad \qquad \\ 1964 \qquad \qquad \\ 1964 \qquad \qquad \\ 197 \qquad \qquad \\ 1964 \qquad \qquad \\ 1964 \qquad \qquad \\ 1964 \qquad \qquad \\ 1964 \qquad$	974		-															
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	1011																	
1081 SC6976 0.7661	1066		-															
1082 SO6976 0.7661	1081		-															
$1197 SO6976 0.7853 1287 SO6976 0.7865 1307 1730 SO6976 0.83763 1731 SO6976 0.7407 normality not OK \frac{\text{Group 1:}}{n^{A}} \frac{\text{Group 2:}}{n \text{ot 0K}} \frac{\text{Group 3:}}{OK} OK & OK \\ n \text{outliers 0 } 0 & 0 & 0 & 0 \\ \text{outliers 0 } 0 & 0 & 0 & 0 \\ \text{st.dev. (n) 0.030218 } 0.03218 & 0.012103 & 0.000914 & 0.000631 \\ \text{R(lit) } n/a & n/a & n/a & n/a \\ \text{R(lit) } n/a & n/a & n/a & n/a \\ \frac{n}{2} & \frac{n}{2$	1082	ISO6976	0	.7661														
1198 SO6976 0.796 0.796 ISO6976 0.796 0.796 ISO6976 0.83763 ISO6976 0.7407 ISO6976 0.79487 ISO6976 0.79487 ISO6976 0.000631 ISO6976 0.000631 ISO6976 0.000631 ISO6976 0.000631 ISO6976 0.000177 ISO6976 0.000541 ISO6976 0.000631 ISO6976 0.000541 ISO6976 0.000631 ISO6976 0.000631 ISO6976 0.000541 ISO6976 0.000631 ISO6976 0.00077 ISO6976 0.000631 ISO6976 0.000177 ISO6976 0.000631 ISO6976 0.000177 ISO6976 0.000631 ISO6976 0.000177 ISO6976 0.0000177 ISO6976 0.0000177 ISO6976 0.000177 ISO6976 0.000177 ISO6976 0.000177 ISO7976 0.0000177 ISO7976 0.00001	1197	ISO6976	C	.7953														
$1287 SO6976 \\ 1307 \\ \\ 1654 \\ 1730 SO6976 \\ 0.33763 \\ \\ 1943 SO6976 \\ 0.7407 \\ \\ 1943 SO6976 \\ 0.7407 \\ \\ \\ 1943 SO6976 \\ 0.7407 \\$	1198	ISO6976	C	.7955														
$130 \\ 1730 \\ 1730 \\ 1730 \\ 1730 \\ 1737 \\ 1731 \\ 1730 \\ 1737 \\ 1$	1287	ISO6976	0	796														
$1954 \\ 1737 \\ 1737 \\ 1943 \\ 1SO6976 \\ 0.7407 \\ 0.7 \\ 0.001675 \\ 0.030218 \\ 0.030218 \\ 0.030218 \\ 0.030218 \\ 0.030218 \\ 0.03389 \\ 0.0256 \\ 0.00256 \\ 0.000914 \\ 0.03026 \\ 0.000631 \\ 0.03026 \\ 0.000631 \\ 0.0006$	1307		-															
$1037 150 1506976 0.83763 \dots 1000 11 1000 11 1000 11 1000 11 1000 11 1000 11 1000 11 1000 11 10000 1000 1000 10000 1000 1000 1000 1000 1$	165/		_															
1737 1943 ISO6976 0.7407	1720	1906076	0	92762														
$1/33 SO6976 \\ 0.7407 \\ n \\ n \\ outliers \\ 0 \\ mean (n) \\ 0.80105 \\ st.dev. (n) \\ 0.03218 \\ 0.0389 \\ 0.00256 \\ 0.00256 \\ 0.00014 \\ 0.000631 \\ 0.00256 \\ 0.000631 \\ 0.00056 \\ 0.000177 \\ n/a $	4707	1300970	U	.03703														
$193 \ 1505976 \ 0.7407 \ normality not OK n 19 outliers 0 19 4 9 6 0 0 0 79487 0.83859 0.03218 0.012103 0.000914 0.000631 0.03389 0.00256 0.00177 R(it) n/a n/a n/a n/a n/a n/a 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0$	1/3/	1000070	-															
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	1943	1506976	U	0.7407								_	_		-			
normality not OK 0K								Gr	oup 1:			Group	<u> 2:</u>		G	roup 3)	<u>.</u>	
$n = 19 \\ outliers \\ nean (n) \\ 0.80105 \\ st.dev. (n) \\ 0.030218 \\ 0.00256 \\ 0.00328 \\ 0.00256 \\ 0.00177 \\ n/a \\ $		normality	n	iot OK				n/a	a			not O	K		0	K		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		n	1	9				4				9			6			
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		outliers	C)				0				0			0			
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		mean (n)	0	.80105				0.7	75866			0.794	87		0.	83859		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		st dev (n)	Ő	030218				0.0	12103			0.000	914		0	000631	1	
$\begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} $		P(calc.)		08/61				0.0	13380			0.000	56		0.	00177		
$\mathbf{R}(\mathbf{n}) \mathbf{n}/\mathbf{a} \qquad \mathbf{n}/\mathbf{n}/\mathbf{a} \qquad \mathbf{n}/\mathbf{a} $			5	.00401				0.0	5505			0.002	50		0. n/	00177		
$\begin{bmatrix} 1 & 2 & 2 & 2 & 2 \\ 0 & 3 & 4 & 4 & 4 & 4 & 4 & 4 & 4 & 4 & 4$				/a				11/0	a			n/a			11/	a		
$\begin{bmatrix} 286 \\ 0.84 \\ 0.82 \\ 0.84 \\ 0.82 \\ 0.74 \\ 0.74 \\ 0.72 \\ 0.7 \\ 0$																		
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	0.86 T																	
$\begin{bmatrix} 0.24 \\ 0.8 \\ 0.76 \\$																		
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	0.84 +												Δ	Δ	Δ	Δ	Δ	▲
$\begin{array}{c} 0.8 \\ 0.8 \\ 0.78 \\ 0.78 \\ 0.76$	0.82																	
$\begin{array}{cccccccccccccccccccccccccccccccccccc$																		
$\begin{bmatrix} 0,78\\ 0,76\\ 0,74\\ 0,72\\ 0,7\\ 0,7\\ 0,7\\ 0,7\\ 0,7\\ 0,7\\ 0,7\\ 0,7$	0.8 +				•	^		A	Δ.	Δ	Δ	Δ						
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	0.70			Δ	-	-	-	_	_									
$\begin{bmatrix} 0.76 \\ 0.74 \\ 0.72 \\ 0.7 \\$	0.78 -																	
$\begin{bmatrix} 0.74 & 4 \\ 0.72 & \\ 0.7 & $	0.76 -	۵ ۵	Δ															
$ \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c}$																		
$\begin{bmatrix} 0.72\\ 0.7\\ \hline 0.7\\ \hline$	0.74 -	Δ																
$\begin{bmatrix} 1 & 2 & 2 & 2 & 2 & 2 & 2 & 2 & 2 & 2 &$	0.72																	
$\begin{bmatrix} 0.7 \\ \hline 9 \\ \hline $	0.72																	
98 98 <td< td=""><td>0.7</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>-</td><td></td></td<>	0.7																-	
$\begin{bmatrix} 14\\12\\0\\10\\8\\-6\\-4\\-4\\-4\\-4\\-6\\-10\\-10\\-10\\-10\\-10\\-10\\-10\\-10\\-10\\-10$		943 496 529	082	92	78	608	442	602	197	198	609	287	730	622	868	316	444	343
14 12 Kernel Density 10 35 8 25 20 15 10 10		-	-						-	-		-	-					
14 Kernel Density 10 Kernel Density 8 25 20 15 10 10																		
14 Kernel Density 10 Kernel Density 8 25 6 15 10 10						40												
12 Kernel Density 35 10 30 8 25 6 15 10 10	14					40 T												
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$		{	\ Ke	rnel Density	'	35				Kernel I	Density							
10 30 8 25 20 20 15 10	12 -		\mathbf{i}			00			٨									
						30 -				٨								
	10 -	/																
		/	\ .	\sim		25 -			11	1								
	8 -	/		1														
		/	\checkmark	\		20 -												
	6 -	/						٨										
		/				15 -		-1										
	4 -					10			1									

0.8

0.85

0.75

5

0

0.7

0.75

0.8

0.85

0.9

0.9

2

0 -

0.7

Determination of Relative Density (@ 25°C and 101.325 kPa) on sample #10ME; results

lah	method	value	mark	z(targ)	remarks
79	CDA2145	0.6492	mark	2(targ)	Temarks
70	GFAZ145	0.0403			
92	GPAZZ00	0.040			
171	D3588	0.6491			
225					
316	ISO6976	0.6488			
343		0.6493			
442	D1945	0.6485			
444	ISO6976	0.6489			reported result for Real gas
496	DIN51857	0.64379	G(0.01)		
529	ISO6976	0.6466	DG(0.05)		
602	ISO6976	0.648717	· · · ·		
608	ISO6976	0.648441			
609	ISO6976	0.649303			
618					
622	1906076	0.6483			
662	1500370	0.0403			
002	1806076	0 6 4 9 6			
000	1300970	0.0400			
974					
1011					
1066					
1081					
1082	ISO6976	0.6471	DG(0.05)		
1197	ISO6976	0.6490			
1198	ISO6976	0.6491			
1287	ISO6976	0.649			
1307					
1654					
1730	ISO6976	0.64761			
1737					
1943	ISO6976	0.6150	G(0.01)		
			-()		
	normality	OK			
	nonnanty	16			
	outliere	10			
		4			
		0.04009			
	st.dev. (n)	0.000475			
	R(calc.)	0.00133			
	R(lit)	n/a			
0.65 T					
0.649 -					
0.648 -			<u>م</u>	Δ Δ	× -
		۵			
0.647 -		*			
0.646	*				
0.646					
0.645					
0.644 +	*				



0.643

Determination of Wobbe Index (@ 25°C and 101.325 kPa) on sample #10ME; results in MJ/m³

lah	method					7/101	(n)	rema	rks					-, 10			
78	memou	v			ain	2(เล	<u>y)</u>	Tenna	142								
92																	
171																	
225																	
316	ISO6976	5	0.2490														
343		5	0.34959)													
442	D1945	4	7.65														
444	ISO6976	5	0.28														
496 520	DIN51857	4	6.388 6.05														
602	ISO6976	4	7 638					calcu	lated (⊉15°C a	nd 101	325					
608	ISO6976	4	7.68475	5				calcu	lated @	2,15°C a	nd 101	.325					
609	ISO6976	4	7.664					calcu	lated @	⊉15°C a	nd 101	.325					
618		4	6.5														
622	ISO6976	5	0.1741														
662																	
868	ISO6976	5	0.23														
974																	
1011																	
1081																	
1082	ISO6976	4	6.0002														
1197																	
1198																	
1287	ISO6976	4	7.555														
1307	1000070				•			e		105 040							
1654	1506976	006976 51.163 ex		D6976 51.163 eX,C				TIFST F	eporte	35.318							
1730	1300970		0.299														
1943	ISO6976	4	9.900														
		-						Grou	o 1:		Gr	oup 2:			Group 3):		
	normality	n	ot OK					n/a			n/a	a/			OK		
	n	1	6					4			5				7		
	outliers	0						0	_		0				0		
	mean (n)	4	8.413					46.23	15		47	.638			50.212		
	St.dev. (n)	1	.731Z 947					0.247	0		0.0	1497			0.1481		
	R(lit)	4 n	.047 /a					0.091 n/a			0.1 n/s	109			0.415 n/a		
	(iii)		, u					n/a			17.0	•			n/a		
50																	
⁵²																	
51 -																	ж
50											Δ	Δ	۵	Δ	۵	Δ	
50 T										Δ							
49 -																	
- 10																	
48 -				۵	Δ	۵		Δ	۵								
47 -																	
		Δ	Δ														
46 - 🔺	Δ																
45																	
1082	529	496	618	1287	602	442		609	608	1943	622	868	316	444	1730	343	1654
0.05						0											
0.25		IZ -	mal Dara	:6.	0.	°				Kornel D.	noite						
		Ke	mei Dens	ity	0.	7 -			ſ	Kernel De	nsity						
0.2 -		~							/\								
	~	/ \			0.	ю -											
0.15	/	$\langle \rangle$			0.	5 -											
0.13	/ \							A									
	/ `	\checkmark			0.	4 -											
0.1 -	}	1			0.	3 -											
	}	}															
0.05 -	/	```	\		0.	2 -		IH	h	`							

47

52

0 -

42

0.1

57

0 -

42

47

52

57

APPENDIX 2

Details of the GC-configurations used

- 78 3 columns with switching/backflush (Mol Sieve/TCD + Hayesep N/TCD + capillary/FID)
- 92 3 columns with switching/backflush (ISO 6974-5)
- 171 2 packed columns with switching/backflush
- 225 ---
- 316 2 packed columns with switching/backflush
- 343 2 packed columns with switching/backflush
- 442 2 packed columns
- 444 2 packed columns with switching/backflush (D1945)
- 496 4 micropacked columns+2 capillary columns (1xFID & 2xTCD) with switching/backflush
- 529 3 columns with switching/backflush (Mol Sieve 13X + Hayesep + capillary CP-Sil 5CB)
- 602 3 columns with switching/backflush (ISO 6974-5)
- 608 3 packed columns with switching/backflush to TCD1 & 2 packed columns to TCD2
- 609 3 columns with switching/backflush (ISO 6974-5)
- 618 2 packed columns
- 622 3 packed columns (Mol Sieve 13X + Hayesep T + Hayesep Q) and one capillary column (CP-Sil 5CB)
- 662 ---
- 868 4 packed columns with switching/backflush
- 974 4 columns (13X, 5A, Hayesep Q, CP Sil 5CB) with dual TCD & FID
- 1011 ---
- 1066 2 packed columns
- 1081 ---
- 1082 6 columns with switching/backflush (2xTCD + 1xFID)
- 1197 4 columns with switching/backflush (DC200, UCW 982, Hayesep Q, Mol Sieve)
- 1198 4 columns with switching/backflush (DC200, UCW 982, Hayesep Q, Mol Sieve)
- 1287 2 packed columns
- 1307 Agilent RGA with 5 packed columns and 2 capillary colums
- 1654 2 packed columns
- 1730 ----
- 1737 2 packed columns (Mol Sieve 13X & Charcoal) and one capillary column (Elite Alumina)
- 1943 2 packed columns

APPENDIX 3

List of participants

1 lab in AUSTRALIA 1 lab in BELGIUM 2 labs in CANADA 1 lab in CÔTE D'IVOIRE 1 lab in FINLAND 1 lab in FRANCE 1 lab in GERMANY 1 lab in GREECE 1 lab in INDONESIA 1 lab in ITALY 1 lab in LATVIA 5 labs in MALAYSIA 1 lab in MEXICO 1 lab in P.R. of CHINA 1 lab in PORTUGAL 1 lab in SPAIN 1 lab in THAILAND 3 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

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, <u>76</u>, 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, <u>331</u>, 513, (1988)
- 12 J.N. Miller, Analyst, <u>118</u>, 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