

Results of Proficiency Test
Gascondensate
November 2009

Organised by: Institute for Interlaboratory Studies
Spijkenisse, the Netherlands

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1 INTRODUCTION

Since 1998, the Institute for Interlaboratory Studies organized a proficiency test for Gascondensate every year. During the annual proficiency testing program 2009/2010, it was decided to continue the round robin for the analysis of Gascondensate. In this International Interlaboratory Study of the annual program, 53 laboratories from 17 different countries have participated. See appendix 2 for a list of participants per country in alphabetical order. In this report, the results of the Gascondensate proficiency test are presented and discussed.

2 SET UP

The Institute for Interlaboratory Studies (i.i.s.) in Spijkensisse, The Netherlands, was the organiser of this proficiency test. Sample analyses for fit-for-use and homogeneity testing were subcontracted to an accredited laboratory. In this proficiency test, one sample of 0.5 litre Gascondensate, labelled #0985, was sent to the participants.

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

2.1 QUALITY SYSTEM

The Institute for Interlaboratory Studies in Spijkensisse, the Netherlands, has implemented a quality system based on ISO guide 43 and ILAC-G13:2007, (R007). This ensures 100% confidentiality of participant's data. In addition, customer's satisfaction is measured on a regular basis by sending out questionnaires.

2.2 PROTOCOL

The protocol followed in the organisation of this proficiency test was the one as described for proficiency testing in the report 'i.i.s. Interlaboratory Studies: Protocol for the Organisation, Statistics and Evaluation' of November 2008 (i.i.s.-protocol, version 3.1).

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

The necessary Gascondensate was obtained from a local refinery in the Netherlands. After homogenisation, the Gascondensate was transferred to 64 amber glass bottles of 0.5 litre and labelled #0985. The homogeneity of the subsamples #0985 was checked by determination of Density @ 15°C in accordance with ASTM D4052:02e1 on 5 stratified randomly selected

samples. The homogeneity testing was performed by a subcontracted ISO17025 accredited laboratory.

	Density @ 15 °C in kg/L
Sample #0985-1	0.76419
Sample #0985-2	0.76418
Sample #0985-3	0.76430
Sample #0985-4	0.76420
Sample #0985-5	0.76420

table 1: homogeneity test of subsamples #0985

From the above test results, the repeatability was calculated and compared with 0.3 times the corresponding target reproducibility in agreement with the procedure of ISO 13528, Annex B2 in the next table:

	Density @ 15 °C in kg/L
r sample #0985	0.00014
reference method	ASTM D4052:02e1
0.3*R(reference method)	0.00015

Table 2: Repeatability of subsamples #0985

The calculated repeatability was less than 0.3 times the reproducibility of the reference method. Therefore, homogeneity of the subsamples #0985 was assumed.

To each of the participants 1*0.5 litre of sample #0985 was sent on October 14, 2009.

2.5 STABILITY OF THE SAMPLES

The stability of Condensate, packed in the brown glass bottles, was checked. The material was found sufficiently stable for the period of the proficiency test.

2.6 ANALYSES

The participants were requested to determine on sample #0985: Colour Saybolt, Density @ 15°C, Distillation (IBP, 10 %, 50%, 90% evaporated and FBP), Mercury as Hg, Sulphur and Water by KF.

To get maximum information for the statistical calculations, the participants were requested to report unrounded results and results below the usual lower reporting limits, where possible. To get comparable results a detailed report form, on which the units were prescribed as well as some of the required standards, was sent together with each set of samples. In addition, 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 data are tabulated per determination in appendix 1 of this report. The laboratories are presented by their code numbers.

Directly after the deadline, a reminder fax was sent to the laboratories that had not reported results at that moment. Shortly 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 results are used for data analysis and original results are placed under 'Remarks' in the result tables in appendix 1.

3.1 STATISTICS

Statistical calculations were performed as described in the report 'iis Interlaboratory Studies: Protocol for the Organisation, Statistics and Evaluation' of November 2008 (iis-protocol, version 3.1).

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. Not all data sets proved to have a normal distribution, in which cases the statistical evaluation of the results should be used with due care.

In accordance to 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, by G(0.01) or DG(0.01) for the Grubbs test. Stragglers are marked by D(0.05) for the Dixon test, by G(0.05) or DG(0.05) for the Grubbs test. Both outliers and stragglers were not included in the calculations of averages and standard deviations.

Finally, the reproducibilities were calculated from the standard deviations by multiplying them with a factor of 2.8.

3.2 GRAPHICS

In order to visualize 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.12 and 13)

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. The target standard deviation was calculated from the literature reproducibility by division with 2.8. The z-scores were calculated in accordance with:

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

The $z_{(\text{target})}$ 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, some problems were encountered during the transportation of the samples to laboratories in Côte D'Ivoire, Malaysia, Nigeria, Norway, Oman, Philippines, Russia and U.S.A. The samples took an unexpected long time to reach the laboratories due to problems with custom clearance or hold up at distribution points.

Only 32 (!) participants reported results. The 32 reporting laboratories did send in 167 numerical results. Observed were 13 outlying results, which is 7.8%. In proficiency studies outlier percentages of 3% - 7.5% are quite normal.

4.1 EVALUATION PER TEST

In this section, the results are discussed per test. All data sets proved to have a normal distribution, except for the determination of Colour Saybolt, Distillation 90% evaporated and Water. In this case the statistical evaluation should be used with care.

Saybolt Colour: All laboratories agreed that the Colour Saybolt of the used condensate sample #0985 was darker than Saybolt Colour -16. For materials darker than -16, ASTM D156:07a (see note 1) is recommending ASTM D1500 to be used. Surprisingly, none of the laboratories reported the result according ASTM D1500.

Density @ 15°C: This determination is very problematic. Six statistical outliers were observed and the calculated reproducibility, after rejection of the statistical outliers, is not at all in agreement with the requirements of ASTM D4052:02e1.

The spread found may be explained by many reasons, e.g. measuring the density at a different temperature or not measuring as the first test. Light ends may easily evaporate from the sample, resulting in measurement of a too high density.

Distillation: This determination is problematic. In total only three statistical outliers were observed. However, after rejection of the statistical outliers, all calculated reproducibilities are in agreement with the requirements for automated mode of ASTM D86:07a, except for IBP, 90% evaporated and FBP. Regretfully all the calculated reproducibilities are not in agreement with the manual mode requirements of ASTM D86:07a.

Mercury: Regretfully, there are no precision requirements in UOP938 available for evaluation. Therefore, the Horwitz equation was used for evaluation. This determination is not problematic at this concentration level (134 µg/kg). Only one statistical outlier was observed and the calculated reproducibility is, after rejection of the statistical outlier, in good agreement with the strict estimated reproducibility calculated using the Horwitz equation.

Sulphur: This determination is problematic. Three statistical outliers were observed. The calculated reproducibility is, after rejection of the statistical outliers, not at all in agreement with the requirements of ASTM D5453:08b.

Water: This determination is problematic (application range of ASTM D4928 = 50 - 200 mg/kg). No statistical outliers and one false negative test result were observed. However, the calculated reproducibility is not at all in agreement with the requirements of ASTM D4928:05.

4.2 PERFORMANCE EVALUATION FOR THE GROUP OF LABORATORIES

A comparison has been made between the reproducibility as declared by the relevant standard and the reproducibility as found for the group of participating laboratories. The average results of sample #0985, calculated reproducibilities and reproducibilities, derived from literature standards (in casu ASTM standards) are compared in the next table.

Parameter	unit	n	mean	2.8 * sd	R (lit)
Colour Saybolt		12	<-16	n.a.	n.a.
Density @ 15 °C	kg/m ³	26	764.48	0.91	0.50
Initial Boiling Point	°C	17	44.71	11.47	8.50
10%-evaporated	°C	18	81.67	5.33	7.02
50%-evaporated	°C	18	120.93	5.99	10.12
90%-evaporated	°C	10	227.12	30.24	11.13
Final Boiling Point	°C	16	301.41	11.77	10.50
Mercury as Hg	µg/kg	8	134.8	43.5	81.7
Sulphur	mg/kg	15	98.80	23.75	18.17
Water	mg/kg	24	228.30	112.53	84.50

Table 3: performance evaluation sample #0985

Without further statistical calculations, it can be concluded that for several tests there is not a good compliance of the group of participants with the relevant standards. The problematic tests have been discussed in paragraph 4.1.

4.3 COMPARISON OF THE PROFICIENCY TEST OF NOVEMBER 2009 WITH THE PREVIOUS PTS

	<i>November 2009</i>	<i>November 2008</i>	<i>December 2007</i>
Number of reporting participants	32	17	21
Number of results reported	167	121	176*
Statistical outliers	13	7	15
Percentage outliers	7.8%	5.8%	8.5%

Table 4: comparison with previous proficiency test

* In this proficiency test the determination of DVPE was included

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

The performance of the determinations of the proficiency tests was compared against the requirements of the respective standards. The conclusions are given the following table:

Determination	<i>November 2009</i>	<i>November 2008</i>	<i>December 2007</i>
Colour Saybolt	n.e.	n.e.	--
Density @ 15 °C	--	-	--
Distillation (ASTM D86 automated)	-	+/-	--
Distillation (ASTM D86 manual)	--	--	--
Mercury as Hg	++	+	-/+
Sulphur	--	--	+
Water	--	+	++
Total Vapour Pressure	n.e.	n.d.	+
DVPE acc. to ASTM D5191	n.e.	n.d.	+

table 6: comparison determinations against the standard

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
- n.e.: not evaluated
- n.d.: not determined

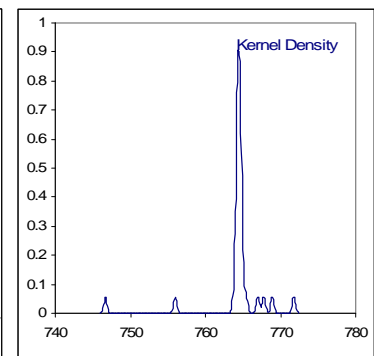
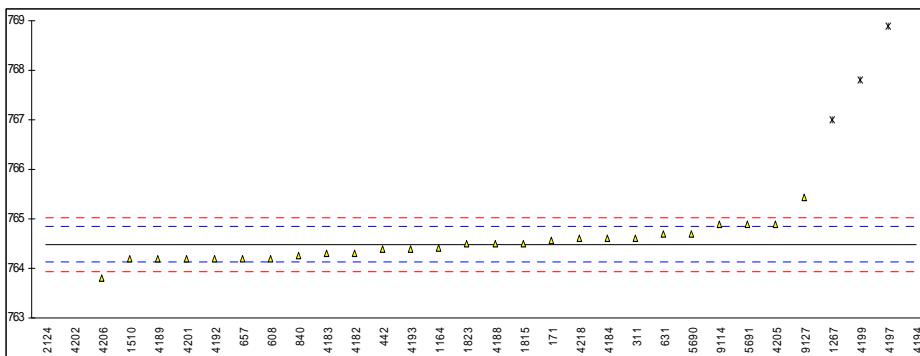
APPENDIX 1

Determination of Saybolt Colour on sample #0985;

lab	method	value	mark	z(targ)	remarks
171	D156	<-16		----	
225		----		----	
311	D156	<-16		----	
442		----		----	
608	D156	<-16		----	
609		----		----	
631	D156	<-16		----	
657	D156	<-16		----	
840	D156	<-16		----	
1106		----		----	
1164		----		----	
1214		----		----	
1267		----		----	
1301		----		----	
1510		----		----	
1815		----		----	
1823		----		----	
1842		----		----	
1855		----		----	
2124	D156	<-16		----	
4174		----		----	
4182		----		----	
4183	D156	<-16		----	
4184		----		----	
4186		----		----	
4188		----		----	
4189		----		----	
4191		----		----	
4192	D156	-16.0		----	
4193		----		----	
4194		----		----	
4197		----		----	
4198		----		----	
4199	D156	<-30		----	False negative?
4201		----		----	
4202		----		----	
4203		----		----	
4205	D156	<-16		----	
4206		----		----	
4210		----		----	
4216		----		----	
4218	D156	-16.0		----	
5690	D156	<-16		----	
5691		----		----	
9114		----		----	
9127		----		----	
	normality	n.a.			
	n	2			
	outliers	0			
	mean (n)	<-16			
	st.dev. (n)	n.a.			
	R(calc.)	n.a.			
	R(D156:07a)	unknown			

Determination of Density @ 15°C on sample #0985; results in kg/m³

lab	method	value	mark	z(targ)	remarks
171	D4052	764.56		0.45	
225		-----		-----	
311	D4052	764.6		0.67	
442	D4052	764.4		-0.45	
608	D4052	764.2		-1.57	
609		-----		-----	
631	D4052	764.7		1.23	
657	D4052	764.2		-1.57	
840	D4052	764.26		-1.23	
1106		-----		-----	
1164	D4052	764.42		-0.34	
1214		-----		-----	
1267	D4052	767	G(0.01)	14.11	
1301		-----		-----	
1510	IP365	764.2		-1.57	
1815	ISO3675	764.50		0.11	
1823	D4052	764.5		0.11	
1842		-----		-----	
1855		-----		-----	
2124	D4052	746.7	G(0.01)	-99.74	
4174		-----		-----	
4182	D4052	764.3		-1.01	
4183	D1298	764.3		-1.01	
4184	D4052	764.6		0.67	
4186		-----		-----	
4188	D4052	764.5		0.11	
4189	D4052	764.2		-1.57	
4191		-----		-----	
4192	D1298	764.2		-1.57	
4193	D4052	764.4		-0.45	
4194	D1298	771.8	G(0.05)	40.99	
4197	D4052	768.9	G(0.01)	24.75	
4198		-----		-----	
4199	D5002	767.8	G(0.01)	18.59	
4201	D4052	764.2		-1.57	
4202	D1298	756.0	G(0.01)	-47.49	
4203		-----		-----	
4205	D4052	764.9		2.35	
4206	D4052	763.8		-3.81	
4210		-----		-----	
4216		-----		-----	
4218	D4052	764.6		0.67	
5690	D4052	764.7		1.23	
5691	D4052	764.9		2.35	
9114	inhouse	764.9		2.35	
9127	D4052	765.44		5.38	
normality		OK			
n		26			
outliers		6			
mean (n)		764.48			
st.dev. (n)		0.326			
R(calc.)		0.91			
R(D4052:02e1)		0.50			

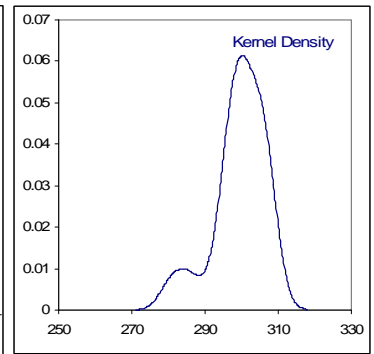
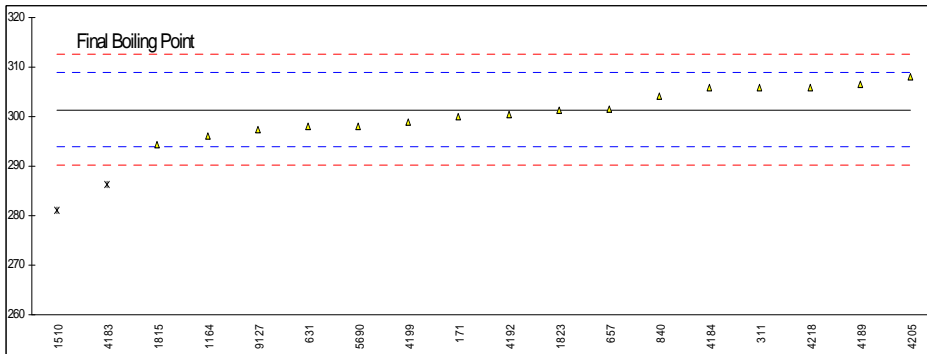
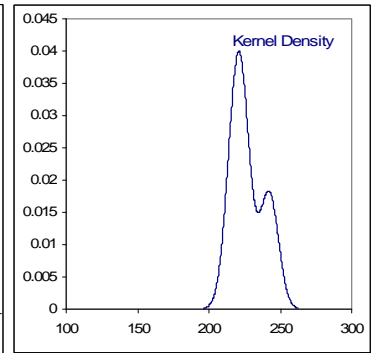
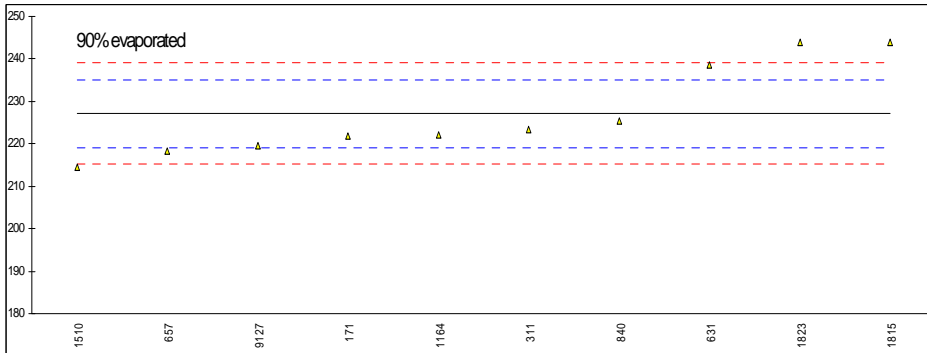
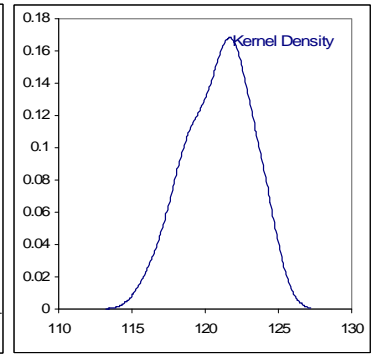
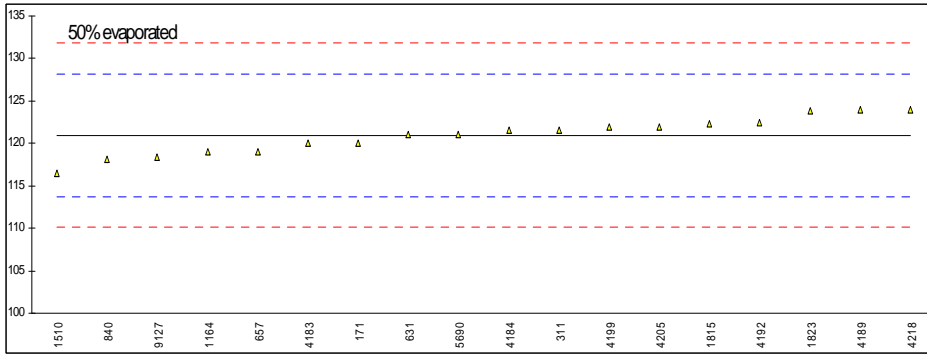
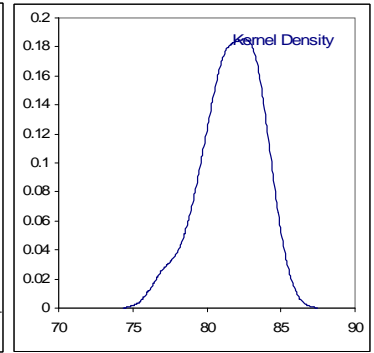
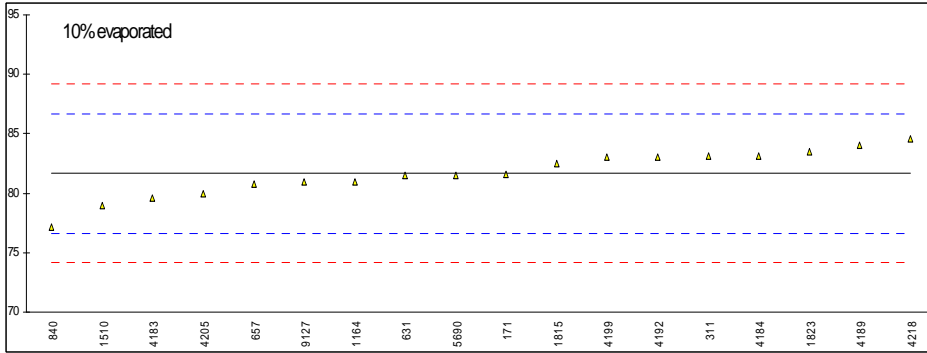
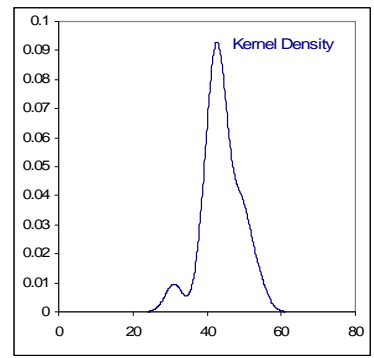
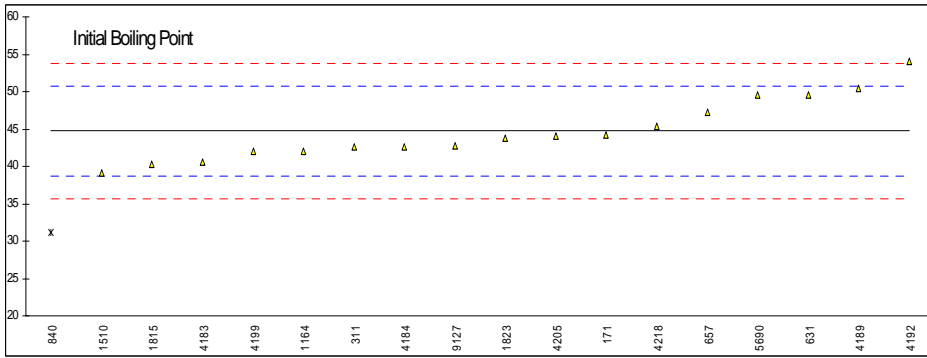


Determination of Distillation on sample #0985; results in °C, vol% evaporated

lab	method	IBP	mark	10%	mark	50%	mark	90%	mark	FBP	mark	remarks
171	D86-A	44.2		81.6		120.0		221.8		299.9		
225		----		----		----		----		----		
311	D86-A	42.6		83.1		121.6		223.4		305.9		
442		----		----		----		----		----		
608		----		----		----		----		----		
609		----		----		----		----		----		
631	D86-M	49.5		81.5		121.0		238.5		298.0		
657	D86-A	47.3		80.8		119.0		218.3		301.6		
840	D86-M	31.1	G(0.05)	77.2		118.1		225.5		304.2		
1106		----		----		----		----		----		
1164	D86-A	42.0		81.0		119.0		222.0		296.0		
1214		----		----		----		----		----		
1267		----		----		----		----		----		
1301		----		----		----		----		----		
1510	D86-A	39.2		79.0		116.5		214.6		281.1	DG(0.01)	
1815	ISO3405-A	40.3		82.5		122.3		243.8		294.3		
1823	D86-A	43.7		83.5		123.8		243.8		301.3		
1842		----		----		----		----		----		
1855		----		----		----		----		----		
2124		----		----		----		----		----		
4174		----		----		----		----		----		
4182		----		----		----		----		----		
4183	D86-	40.6		79.6		120.0		----		286.3	DG(0.01)	
4184	D86-	42.6		83.1		121.6		----		305.9		
4186		----		----		----		----		----		
4188		----		----		----		----		----		
4189	D86-	50.5		84.0		124.0		----		306.5		
4191		----		----		----		----		----		
4192	D86-	54.0		83.0		122.5		----		300.5		
4193		----		----		----		----		----		
4194		----		----		----		----		----		
4197		----		----		----		----		----		
4198		----		----		----		----		----		
4199	D86-	42.0		83.0		122.0		----		299.0		
4201		----		----		----		----		----		
4202		----		----		----		----		----		
4203		----		----		----		----		----		
4205	D86-	44.0		80.0		122.0		----		308.0		
4206		----		----		----		----		----		
4210		----		----		----		----		----		
4216		----		----		----		----		----		
4218	D86-	45.3		84.6		124.0		----		305.9		
5690	D86-	49.5		81.5		121.0		----		298.0		
5691		----		----		----		----		----		
9114		----		----		----		----		----		
9127	D86-A	42.8		81.0		118.4		219.5		297.5		
	normality	OK		OK		OK		not OK		OK		
	n	17		18		18		10		16		
	outliers	1		0		0		0		2		
	mean (n)	44.71		81.67		120.93		227.12		301.41		
	st.dev. (n)	4.096		1.903		2.140		10.799		4.203		
	R(calc.)	11.47		5.33		5.99		30.24		11.77		
	R(D86:07a) – A	8.50		7.02		10.12		11.13		10.50		
	R(D86:07a) – M	6.24		3.83		4.22		6.60		6.22		

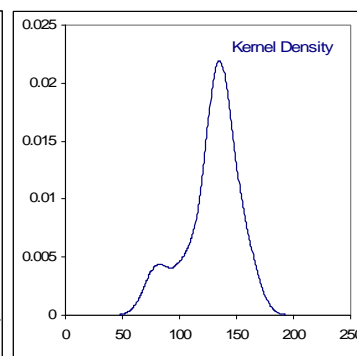
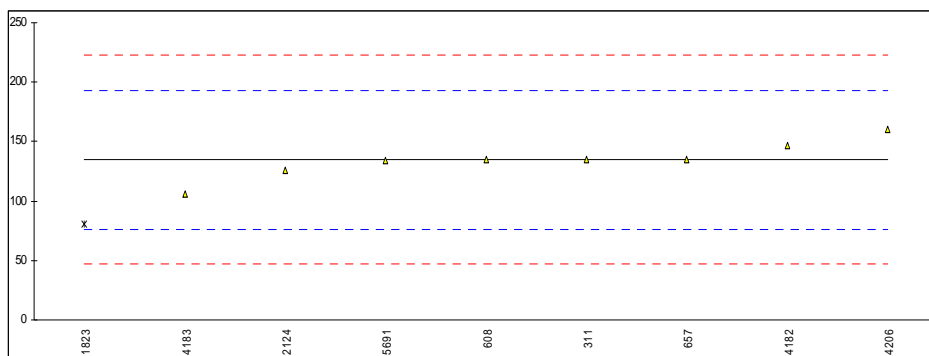
R (D86:07a) IBP: 8.50
 (table 10) 10%: 7.02 = 3.0 + 2.64 × C/%V and C/%V = 1.52
 Automated 50%: 10.12 = 2.9 + 3.97 × C/%V and C/%V = 1.82
 90%: 11.13 = 2.0 + 2.53 × C/%V and C/%V = 3.61
 FBP: 10.50

R (D86:07a) IBP: 6.24 = 2.8 + 0.93 × C/%V and C/%V = 3.70
 (table 9) 10%: 3.83 = 1.8 + 1.33 × C/%V and C/%V = 1.53
 Manual 50%: 4.22 = 1.8 + 1.33 × C/%V and C/%V = 1.82
 90%: 6.60 = 1.8 + 1.33 × C/%V and C/%V = 3.61
 FBP: 6.22 = 3.1 + 0.42 × C/%V and C/%V = 7.43



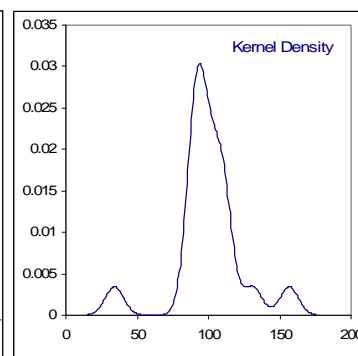
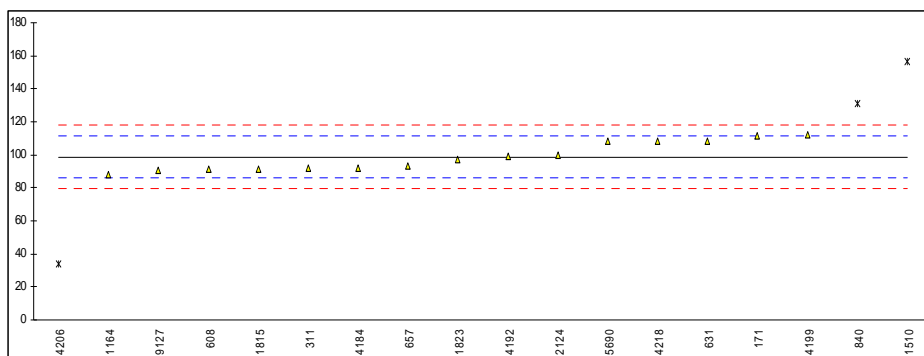
Determination of Mercury as Hg on sample #0985; results in µg/kg

lab	method	value	mark	z(targ)	remarks
171		----		----	
225		----		----	
311	UOP938	135.0		0.01	
442		----		----	
608	INH-009	134.7		0.00	
609		----		----	
631		----		----	
657	UOP938	135.4		0.02	
840		----		----	
1106		----		----	
1164		----		----	
1214		----		----	
1267		----		----	
1301		----		----	
1510		----		----	
1815		----		----	
1823	UOP938	80.2	G(0.05)	-1.87	
1842		----		----	
1855		----		----	
2124	UOP938	126.34		-0.29	
4174		----		----	
4182	UOP938	147		0.42	
4183	UOP938	106		-0.99	
4184		----		----	
4186		----		----	
4188		----		----	
4189		----		----	
4191		----		----	
4192		----		----	
4193		----		----	
4194		----		----	
4197		----		----	
4198		----		----	
4199		----		----	
4201		----		----	
4202		----		----	
4203		----		----	
4205		----		----	
4206	UOP938	160		0.86	
4210		----		----	
4216		----		----	
4218		----		----	
5690		----		----	
5691	UOP938	134		-0.03	
9114		----		----	
9127		----		----	
normality		OK			
n		8			
outliers		1			
mean (n)		134.8			
st.dev. (n)		15.52			
R(calc.)		43.5			
R(Horwitz)		81.7			



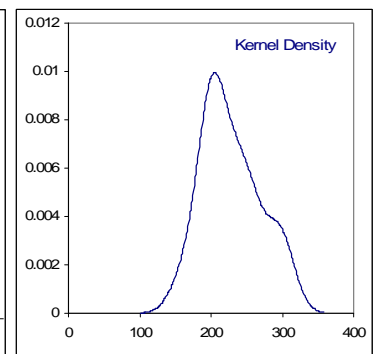
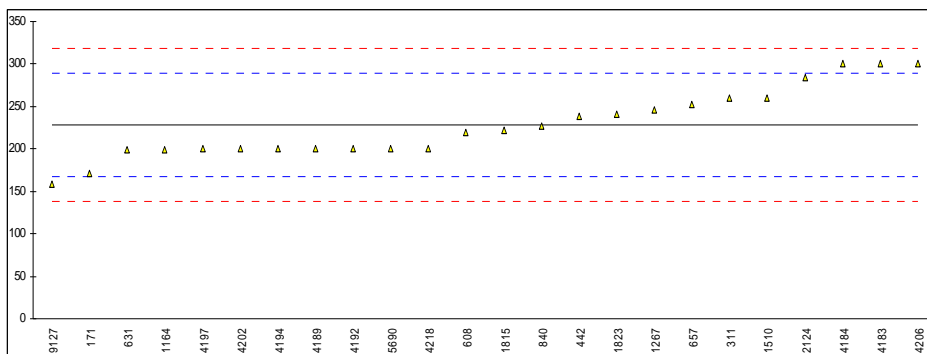
Determination of Sulphur on sample #0985; results in mg/kg

lab	method	value	mark	z(targ)	remarks
171	D5453	111.38		1.94	
225		----		----	
311	D5453	91.7		-1.09	
442		----		----	
608	D3120	91.3		-1.16	
609		----		----	
631	D5453	108		1.42	
657	D5453	93.4		-0.83	
840	D4294	131	G(0.05)	4.96	
1106		----		----	
1164	D5453	87.9		-1.68	
1214		----		----	
1267		----		----	
1301		----		----	
1510	D4294	156.7	G(0.01)	8.93	
1815	D5453	91.6		-1.11	
1823	D5453	97.4		-0.22	
1842		----		----	
1855		----		----	
2124	D5453	99.54		0.11	
4174		----		----	
4182		----		----	
4183		----		----	
4184	D5453	92		-1.05	
4186		----		----	
4188		----		----	
4189		----		----	
4191		----		----	
4192	D5453	99		0.03	
4193		----		----	
4194		----		----	
4197		----		----	
4198		----		----	
4199	D5453	112		2.04	
4201		----		----	
4202		----		----	
4203		----		----	
4205		----		----	
4206	D5453	34	G(0.05)	-9.99	
4210		----		----	
4216		----		----	
4218	D5453	108		1.42	
5690	D5453	108		1.42	
5691		----		----	
9114		----		----	
9127	D5453	90.7		-1.25	
normality	OK				
n	15				
outliers	3				
mean (n)	98.80				
st.dev. (n)	8.482				
R(calc.)	23.75				
R(D5453:08b)	18.17				



Determination of Water on sample #0985; results in mg/kg

lab	method	value	mark	z(targ)	remarks
171	D4928	171.0		-1.90	
225		----		----	
311	D4928	260		1.05	
442	D4928	238.2		0.33	
608	D4928	220		-0.28	
609		----		----	
631	D4928	199.5		-0.95	
657	D4928	252		0.79	
840	D4928	227		-0.04	
1106		----		----	
1164	D4928	199.7		-0.95	
1214		----		----	
1267	D4928	245.92		0.58	
1301		----		----	
1510	D4928	260		1.05	
1815	ISO12937	222.0		-0.21	
1823	E1064	241		0.42	
1842		----		----	
1855		----		----	
2124	D4928	284.07		1.85	
4174		----		----	
4182		----		----	
4183	D4928	300		2.38	
4184	D4928	300		2.38	
4186		----		----	
4188		----		----	
4189	D4928	200		-0.94	
4191		----		----	
4192	D4928	200		-0.94	
4193	D4928	<100		<-4.25	False negative?
4194	D4928	200		-0.94	
4197	D4928	200		-0.94	
4198		----		----	
4199		----		----	
4201		----		----	
4202	D4928	200		-0.94	
4203		----		----	
4205		----		----	
4206	D4928	300		2.38	
4210		----		----	
4216		----		----	
4218	D4928	200		-0.94	
5690	D4928	200		-0.94	
5691		----		----	
9114		----		----	
9127	D4928	158.8		-2.30	
	normality	not OK			
	n	24			
	outliers	0			
	mean (n)	228.30			
	st.dev. (n)	40.191			
	R(calc.)	112.53			
	R(D4928:05)	84.50			



APPENDIX 2:

Z-scores distillation ASTM D86 (automated and manual mode used for calculation)

lab	method	Automated mode					Manual mode				
		IBP	10%	50%	90%	FBP	IBP	10%	50%	90%	FBP
171	D86-A	-0.17	-0.03	-0.26	-1.34	-0.40	-0.23	-0.05	-0.62	-2.26	-0.68
225		----	----	----	----	----	----	----	----	----	
311	D86-A	-0.70	0.57	0.18	-0.94	1.20	-0.95	1.05	0.44	-1.58	2.02
442		----	----	----	----	----	----	----	----	----	
608		----	----	----	----	----	----	----	----	----	
609		----	----	----	----	----	----	----	----	----	
631	D86-M	1.58	-0.07	0.02	2.86	-0.91	2.15	-0.12	0.04	4.83	-1.53
657	D86-A	0.85	-0.35	-0.54	-2.22	0.05	1.16	-0.63	-1.28	-3.74	0.09
840	D86-M	-4.48	-1.78	-0.78	-0.41	0.74	-6.11	-3.27	-1.88	-0.69	1.26
1106		----	----	----	----	----	----	----	----	----	
1164	D86-A	-0.89	-0.27	-0.54	-1.29	-1.44	-1.22	-0.49	-1.28	-2.17	-2.43
1214		----	----	----	----	----	----	----	----	----	
1267		----	----	----	----	----	----	----	----	----	
1301		----	----	----	----	----	----	----	----	----	
1510	D86-A	-1.82	-1.06	-1.23	-3.15	-5.41	-2.47	-1.95	-2.94	-5.31	-9.14
1815	ISO3405-A	-1.45	0.33	0.38	4.20	-1.90	-1.98	0.61	0.91	7.08	-3.20
1823	D86-A	-0.33	0.73	0.79	4.20	-0.03	-0.45	1.34	1.90	7.08	-0.05
1842		----	----	----	----	----	----	----	----	----	
1855		----	----	----	----	----	----	----	----	----	
2124		----	----	----	----	----	----	----	----	----	
4174		----	----	----	----	----	----	----	----	----	
4182		----	----	----	----	----	----	----	----	----	
4183	D86-	-1.35	-0.82	-0.26	----	-4.03	-1.85	-1.51	-0.62	----	-6.80
4184	D86-	-0.70	0.57	0.18	----	1.20	-0.95	1.05	0.44	----	2.02
4186		----	----	----	----	----	----	----	----	----	
4188		----	----	----	----	----	----	----	----	----	
4189	D86-	1.91	0.93	0.85	----	1.36	2.60	1.71	2.03	----	2.29
4191		----	----	----	----	----	----	----	----	----	
4192	D86-	3.06	0.53	0.43	----	-0.24	4.17	0.97	1.04	----	-0.41
4193		----	----	----	----	----	----	----	----	----	
4194		----	----	----	----	----	----	----	----	----	
4197		----	----	----	----	----	----	----	----	----	
4198		----	----	----	----	----	----	----	----	----	
4199	D86-	-0.89	0.53	0.30	----	-0.64	-1.22	0.97	0.71	----	-1.08
4201		----	----	----	----	----	----	----	----	----	
4202		----	----	----	----	----	----	----	----	----	
4203		----	----	----	----	----	----	----	----	----	
4205	D86-	-0.23	-0.66	0.30	----	1.76	-0.32	-1.22	0.71	----	2.97
4206		----	----	----	----	----	----	----	----	----	
4210		----	----	----	----	----	----	----	----	----	
4216		----	----	----	----	----	----	----	----	----	
4218	D86-	0.19	1.17	0.85	----	1.20	0.26	2.14	2.03	----	2.02
5690	D86-	1.58	-0.07	0.02	----	-0.91	2.15	-0.12	0.04	----	-1.53
5691		----	----	----	----	----	----	----	----	----	
9114		----	----	----	----	----	----	----	----	----	
9127	D86-A	-0.63	-0.27	-0.70	-1.92	-1.04	-0.86	-0.49	-1.68	-3.23	-1.76

APPENDIX 3:

List of participants

1 laboratory in	AUSTRALIA
1 laboratory in	CÔTE D'IVOIRE
5 laboratories in	MALAYSIA
1 laboratory in	NEGARA BRUNEI DARUSSALAM
7 laboratories in	NIGERIA
3 laboratories in	NORWAY
4 laboratories in	OMAN
2 laboratories in	P.R. of CHINA
3 laboratories in	PHILIPPINES
1 laboratory in	POLAND
1 laboratory in	RUSSIA
1 laboratory in	SINGAPORE
4 laboratories in	THE NETHERLANDS
1 laboratory in	U.A.E.
7 laboratories in	U.S.A.
10 laboratories in	UNITED KINGDOM
1 laboratory 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
E	= error in calculations
n.a.	= not applicable
W	= withdrawn on request participant
U	= reported in deviating unit
SDS	= Safety Data Sheet

Literature:

- 1 i.i.s. Interlaboratory Studies, Protocol for the Organisation, Statistics & Evaluation, November 2008
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- 10 P.L. Davies, Fr. Z. Anal. Chem, 331, 513, (1988)
- 11 J.N. Miller, Analyst, 118, 455, (1993)
- 12 Analytical Methods Committee Technical Brief, No4 February 2001
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