

Results of Proficiency Test
Benzene & Toluene
February 2013

Organised by: Institute for Interlaboratory Studies (iis)
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Authors: ing. L.Dijkstra
Correctors: dr. R.G. Visser & ing. L. Sweere
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1 INTRODUCTION

Since 1999, the Institute for Interlaboratory Studies organizes proficiency tests for the analysis of Benzene and Toluene. In the annual proficiency testing program of 2012/2013, it was decided to continue the proficiency test for the analysis of Benzene and Toluene. In the interlaboratory study for Benzene 46 laboratories from 20 different countries have participated and for Toluene 39 participants in 19 countries have participated. See appendix 2 for the number of participants per country.

In this report, the results of the proficiency test Benzene and Toluene 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 Spijkensisse, the Netherlands, was the organizer of this proficiency test. The analyses for fit-for-use and homogeneity determination were subcontracted to an accredited laboratory. It was decided to send one sample of Benzene (1 litre bottle, labelled # 13008) and/or one sample of Toluene (1 litre bottle, labelled # 13009) to the participants.

2.1 ACCREDITATION

The Institute for Interlaboratory Studies in Spijkensisse, the Netherlands, is accredited in agreement with ISO/IEC 17043:2010 (R007), since January 2000, by the Dutch Accreditation Council (Raad voor Accreditatie). This ensures strict adherence to protocols for sample preparation and statistical evaluation and 100% confidentiality of participant's data. Feedback from the participants on the reported data is encouraged and customer's satisfaction is measured on regular basis by sending out questionnaires.

2.2 PROTOCOL

The protocol followed in the organisation 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). This protocol can be downloaded via the FAQ page of the iis website <http://www.iisnl.com>.

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

BENZENE

The necessary bulk material of Benzene was obtained from a local chemical supplier. The approximately 60 litre was spiked with 670.7 mg 1-Methyl-2-Pyrrolidinone (for the Nitrogen determination) and 432.9 mg o-Chlorotoluene (for the Organic Chlorine determination). The bulk sample was, after homogenisation, divided over 60 amber glass bottles of 1 litre, labelled #13008. The homogeneity of the subsamples #13008 was checked by determination of Total Nitrogen in accordance with ASTM D6069:06, Density @ 20°C in accordance with ASTM D4052:11 and Toluene content according to ASTM D4492:10, on 8 stratified randomly selected samples.

Benzene	Total Nitrogen in mg/kg	Density at 20°C in kg/L	Toluene in mg/kg
sample #13008-1	2.4	0.87895	475
sample #13008-2	2.4	0.87898	475
sample #13008-3	2.4	0.87897	486
sample #13008-4	2.4	0.87898	484
sample #13008-5	2.5	0.87898	475
sample #13008-6	2.4	0.87897	464
sample #13008-7	2.4	0.87898	484
sample #13008-8	2.4	0.87898	468

table 1: homogeneity test results of Benzene sub samples #13008

From the above test results the repeatabilities were calculated and compared with 0.3 times the corresponding reproducibilities of the target methods, in agreement with the procedure of ISO 13528, Annex B2 in the next table;

	Total Nitrogen in mg/kg	Density at 20°C in kg/L	Toluene in mg/kg
r (sample #13008)	0.1	0.00003	22
target	ASTM D6069:06	ASTM D4052:02e1	ASTM D4492:10
0.3*R (target)	0.3	0.00015	67

table 2: evaluation of repeatabilities of subsamples #13008

The calculated repeatabilities for sample #13008 were in agreement with 0.3 times the corresponding target reproducibility. Therefore, homogeneity of the samples was assumed.

TOLUENE

The necessary bulk material of Toluene was purchased from a local chemical supplier. The approximately 60 litre was, after homogenisation, divided over 60 brown glass bottles of 1 litre, labelled #13009. The homogeneity of the subsamples #13009 was checked by determination of Benzene, according to ASTM D2360:11 and Density @ 20°C according to ASTM D4052:11 on 8 stratified randomly selected samples.

Toluene	Benzene in mg/kg	Density at 20°C in kg/L
sample #13009-1	7610	0.86693
sample #13009-2	7620	0.86693
sample #13009-3	7640	0.86693
sample #13009-4	7630	0.86693
sample #13009-5	7570	0.86693
sample #13009-6	7660	0.86693
sample #13009-7	7630	0.86695
sample #13009-8	7630	0.86697

table 3: homogeneity test results of Toluene sub samples #13009

From the above test results the repeatabilities were calculated and compared with 0.3 times the corresponding reproducibilities of the target methods, in agreement with the procedure of ISO 13528, Annex B2 in the next table;

	Benzene In mg/kg	Density at 20°C in kg/L
r (sample #13009)	73	0.00004
target	Horwitz	ASTM D4052:02e
0.3*R (target)	267	0.00015

table 4: evaluation of repeatabilities of subsamples #13009

The calculated repeatability on Benzene for sample #13009 was in good agreement with 0.3 times the estimated target reproducibility, calculated using the Horwitz equation. And the calculated repeatability on Density for sample #13009 was in agreement with 0.3 times the corresponding target reproducibility. Therefore, homogeneity of the samples was assumed.

Depending on their registration to each of the participating laboratories one 1 litre bottle of Benzene labelled #13008 and/or one 1 litre bottle of Toluene labelled #13009 were sent on February 13, 2013.

2.5 STABILITY OF THE SAMPLES

The stability of Benzene and Toluene, packed in an amber 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 the Benzene sample #13008: Acid Wash Color, Acidity, Appearance, Bromine Index, Color Pt-Co, Density @ 20°C, Distillation, Organic Chlorides, Total Chlorides, Total Nitrogen, Solidification Point, Methylcyclohexane, Toluene, Nonaromatics and Purity.

On Toluene sample #13009 were requested: Acid Wash Color, Appearance, Copper Corrosion, Color Pt-Co, Density @ 20°C, Distillation, Purity, Nonaromatics and Benzene.

To get comparable results a detailed report form, on which the units were prescribed as well as some of the required standards and a letter of instructions were prepared and made available for download on the iis website (www.iisnl.com).
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 received. The original reported results 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 those laboratories that had not yet reported any 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' (iis-protocol, version 3.2) of January 2010.

For 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 results of the statistical evaluation should be used with due care.

In accordance to ISO 5725 (1986 and 1994) the original results per determination were subsequently submitted 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 method is for producing a smooth density approximation to a set of data that avoids some problems associated with histograms (see appendix 3; nos.14 and 15).

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:

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

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, problems were encountered during the execution. Laboratories in Brazil, India, Oman and Saudi Arabia did receive the samples late or not at all due to courier problems and/or custom clearance. For sample #13008 (Benzene) and #13009 (Toluene), respectively five and four participants did not report any test results and four laboratories reported the test results after the final reporting date.

Finally, for sample #13008 (Benzene) and sample #13009 (Toluene) in total 686 results were submitted. Observed were in total 27 outlying results, which is 3.9%. In proficiency studies, outlier percentages of 3% - 7.5% are normal.

4.1 EVALUATION PER SAMPLE AND TEST

In this section, the results are discussed per sample and test. The methods, which are used by the various laboratories, were taken into account for explaining the observed differences when possible and applicable. These methods are also in the tables together with the original data. The abbreviations, used in these tables, are listed in appendix 3. In case no suitable test method is available, the Horwitz equation was used.

Not all original data sets proved to have a normal distribution. Not normal distributions were found for sample #13008: Bromine Index, Color Pt-Co, Density, Distillation (IBP, 50% and DP) and Toluene. For sample #13009 not normal distributions were found for: Color Pt-Co, Density and Distillation (IBP, 50% and DP). For these determinations the results of the statistical evaluation should be used with due care.

For Benzene sample #13008

Acid Wash Color: No analytical problems were observed. Twenty-four laboratories reported the Acid Wash Color as 1-. Other laboratories reported the Acid Wash Color as 0, 0+, -1. Two laboratories reported a less than test result, which is not in accordance with ASTM D848:09.

Acidity: This determination was not problematic. The way of reporting varies and should be improved in accordance with ASTM D847:08: report "no free acid" (NFA) or, when positive, "acidity as mg NaOH/100 mL". Two laboratories reported a false positive test result for this determination.

Appearance: No analytical problems were observed. All labs agreed about the appearance of the sample #13008, which was bright, clear and free of suspended matter.

Bromine Index: This determination was not problematic. One statistical outlier was observed. The calculated reproducibility after rejection of the statistical outlier is agreement with the requirements of ASTM D5776:07e1.

Color Pt-Co: This determination was not problematic. No statistical outliers were observed. The calculated reproducibility is in good agreement with the requirements of ASTM D1209:05e1.

Density @20°C: This determination was not problematic. Two statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in good agreement with the requirements of ASTM D4052:02e1. The current version of this method ASTM D4052:11 is being valid for gasolines, distillates, basestocks and lubricating oils. Therefore the reproducibility of this 2011 version may not be applicable for Benzene and Toluene.

Distillation: This determination was problematic for one laboratory. In total three statistical outliers were observed. The calculated reproducibilities for IBP 50% recovered and DP, after rejection of statistical outliers, are all in agreement with the requirements of ASTM D850:11. From the reported results of the 50% recovered, it appears that two participants obviously did not correct the results for barometric pressure and thermometer inaccuracy as described in ASTM D850-11 (paragraph 11.4).

Organic Chloride: This determination was not problematic. No statistical outliers were observed. The calculated reproducibility is in agreement with the requirements of ASTM D5808:09a.
The average recovery of Organic Chloride (theoretical increment of 1.99 mg/kg) may be good: "less than 129%" (the actual blank is unknown).

Total Chloride: This determination was not problematic. Two statistical outliers were observed. However, the calculated reproducibility after rejection of statistical outliers is in agreement with the requirements of ASTM D5194:11.

Total Nitrogen: This determination was not problematic. Two statistical outliers were observed. However, the calculated reproducibility after rejection of statistical outliers is in full agreement with the requirements of ASTM D6069:06. Two test results were excluded from statistical evaluation as the reported test method was not equivalent to ASTM D6069:06.
The average recovery of Total Nitrogen (theoretical increment of 1.55 mg/kg) may be good: "less than 132%" (the actual blank is unknown).

Solidification Point: This determination was not problematic. Three statistical outliers were observed. However, the calculated reproducibility after rejection of statistical outliers is in agreement with the requirements of ASTM D852:08. Important in this solidification point determination is addition of water, the correct benzene container and the correction by 0.09°C.

Methylcyclohexane: This determination may be very problematic. One statistical outlier was observed. However, the calculated reproducibility after rejection of statistical outlier is not at all in agreement with the strict estimated reproducibility limits calculated using the Horwitz equation. It is remarkable that nine of the twenty-two laboratories used ASTM D4492, a

method that is not applicable for the determination of methyl cyclohexane, while only three laboratories used ASTM D5713 a method that is suitable for the determination of methyl cyclohexane.

Toluene: This determination was not problematic. Only one statistical outlier was observed. The calculated reproducibility after rejection of the statistical outlier is in good agreement with the reproducibility of ASTM D4492:10.

Nonaromatics: This determination was very problematic. No statistical outliers were observed. However, the calculated reproducibility is not at all in agreement with the reproducibility of ASTM D4492:10.

Purity: This determination was not problematic. No statistical outliers were observed. The calculated reproducibility is in agreement with the estimated reproducibility of ASTM D4492:10.

For Toluene sample #13009

Acid Wash Color: No analytical problems were observed. Twenty-two laboratories reported the Acid Wash Color as 1-. Other laboratories reported the Acid Wash Color as 0, 0+, <1. Two laboratories reported a less than test result, which is not in accordance with ASTM D848:09.

Appearance: No analytical problems were observed. All labs agreed about the appearance of the sample #13009, which was bright, clear and free of suspended matter. The uniformity of reporting can be improved.

Copper Corr: No problems have been observed. All participants agreed on a result of 1 or 1A. One laboratory reported according to ISO2160, a method that is not equivalent to ASTM D849:09.

Color Pt-Co: This determination was not problematic. No statistical outliers were observed. The calculated reproducibility is in good agreement with the requirements of ASTM D1209:05e1.

Density @20°C: This determination was not problematic. Two statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in good agreement with the requirements of ASTM D4052:02e1. The current version of this method ASTM D4052:11 is being valid for gasolines, distillates, base stocks and lubricating oils. Therefore the reproducibility of this 2011 version may not be applicable for Benzene and Toluene.

Distillation: This determination was not problematic. From the reported results of the 50% recovered, it appears that four participants obviously did not correct the results for barometric pressure and thermometer inaccuracy as described in ASTM D850-11 (paragraph 11.4). In total seven statistical

outliers were observed. Six of the seven outliers are from two laboratories which did not correct for barometric pressure and thermometer inaccuracy. After applying the correction the calculated reproducibilities for IBP, 50% recovered and DP, are all in agreement with the requirements of ASTM D850:11.

Purity: This determination was not problematic. Two statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in full agreement with the requirements of ASTM D6526:12. The reproducibility of ASTM D2360:11 is a fixed value at a purity of 99.94%. Therefore the reproducibility of ASTM D5626:12 was used. In this standard reproducibilities at three different concentrations are given.

Nonaromatics: This determination was not problematic. Only one statistical outlier was observed. The calculated reproducibility after rejection of the statistical outlier is in good agreement with the requirements of ASTM D2360:11.

Benzene: This determination may be problematic at the high concentration of 7900 ppm. Two statistical outliers were observed. The calculated reproducibility after rejection of the statistical outliers is not in agreement with the strict estimated reproducibility limits calculated using the Horwitz equation.

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 per sample, calculated reproducibilities and reproducibilities derived from literature standards (in casu ASTM standards) are compared in the next table.

Parameter	unit	n	average	2.8 *sd _R	R (lit)
Acid Wash Color		31	1-	n.a.	n.a.
Acidity	mgNaOH/100ml	32	no free acid	n.a.	n.a.
Appearance		34	pass	n.a.	n.a.
Bromine Index	mg Br/100g	30	3.48	3.37	4.60
Color Pt-Co		26	3.7	2.9	7.0
Density @ 20°C	kg/l	37	0.8789	0.0002	0.0005
Distillation, IBP	°C	28	79.78	0.25	0.42
Distillation, 50%	°C	28	80.09	0.17	0.42
Distillation, DP	°C	28	80.42	0.32	0.42
Organic Chloride	mg/kg	22	2.56	1.26	1.30
Total Chloride	mg/kg	8	2.80	0.71	0.90
Total Nitrogen	mg/kg	20	2.18	0.82	0.84
Solidification Point	°C	20	5.46	0.06	0.05
Methylcyclohexane	mg/kg	21	27.6	13.9	7.5
Toluene	mg/kg	36	486.0	91.3	226.2
Nonaromatics	mg/kg	36	155.5	87.7	38.8
Purity	%M/M	37	99.93	0.02	0.03

Table 5: reproducibilities of Benzene sample #1300

Parameter	unit	n	average	2.8 *sd _R	R (lit)
Acid Wash Color		30	1-	n.a.	n.a.
Appearance		28	pass	n.a.	n.a.
Copper corrosion		27	1(1A)	n.a.	n.a.
Color Pt-Co		23	4.5	3.9	7.0
Density @ 20°C	kg/L	31	0.8669	0.0002	0.0005
Distillation, IBP	°C	27	109.84	0.69	0.58
Distillation, 50% rec.	°C	27	110.57	0.24	0.16
Distillation, DP	°C	26	110.84	0.28	0.46
Purity	%M/M	28	99.13	0.12	0.11
Nonaromatics	mg/kg	29	326.2	85.2	156.0
Benzene	mg/kg	28	7909	1156	918

Table 6: reproducibilities of Toluene sample #13009

Without further statistical calculations, it can be concluded that for most of the tests there is a compliance of the group of participating laboratories with the relevant standards. The tests that are problematic have been discussed in paragraph 4.1.

4.3 COMPARISON OF THE PROFICIENCY TEST OF FEBRUARY 2013 WITH PREVIOUS PTS

	April 2013	April 2012	April 2011	April 2010
Number of reporting labs	41	46	45	44
Number of results reported	686	718	833	684
Statistical outliers	27	27	45	28
Percentage outliers	3.9%	3.8%	5.4%	4.1%

table 7: comparison with previous proficiency tests.

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:

	April 2013	April 2012	April 2011	April 2010
Acid Wash Color	n.e.	n.e.	++	++
Acidity	n.e.	n.e.	++	n.e.
Appearance	n.e.	n.e.	++	n.e.
Bromine Index	+	++	++	++
Color Pt-Co	++	++	++	++
Density @ 20°C	++	++	++	++
Distillation, IBP	++	++	++	++
Distillation, 50%	++	++	++	++
Distillation, DP	+	+	--	++
Organic Chloride	+	++	-	+/-
Total Chloride	--	-	n.e.	n.e.
Total Nitrogen	+/-	-	--	--
Solidification Point	+/-	-	--	--
Methylcyclohexane	-- *)	n.e.	--	++
Toluene	++	++	++	++
Nonaromatics	--	--	--	+
Purity	+	++	+	++

table 8: comparison determinations on Benzene against the standards

	April 2013	March 2012	April 2011	April 2010
Acid Wash Color	n.e	n.e	++	++
Appearance	n.e	n.e	++	+
Copper Corrosion	n.e	n.e	++	++
Color Pt-Co	++	++	++	++
Density @ 20 °C	++	++	++	++
Distillation, IBP	-	++	++	++
Distillation, 50%	-	++	++	++
Distillation, DP	++	++	++	++
Purity	+/-	++	--	++
Nonaromatics	++	++	++	++
Benzene	- *)	-- *)	-- *)	- *)

table 9: comparison determinations on Toluene against the standard

*) against the strict Horwitz equation

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

APPENDIX 1

Determination of Acid Wash Color on Benzene sample #13008

lab	method	value	mark	z(targ)	remarks
52	D848	0		----	
150	D848	1-		----	
171	D848	1-		----	
174	D848	1-		----	
311	D848	0+		----	
323	D848	-1		----	
329	D848	-1		----	
333		----		----	
334		----		----	
347		----		----	
444		----		----	
497	D848	<1		----	
551		----		----	
555		----		----	
663	D848	0+		----	
823	D848	1-		----	
855	D848	1-		----	
862	D848	1-		----	
864	D848	1-		----	
865	D848	1-		----	
866	D848	1-		----	
868	D848	1-		----	
870	D848	1-		----	
902	D848	1-		----	
912	D848	1-		----	
913		----		----	
963	D848	1-		----	
1011	D848	1-		----	
1040	D848	0		----	
1041	D848	1-		----	
1067	D848	1-		----	
1081	D848	0+		----	
1117		----		----	
1264		----		----	
1419	D848	1-		----	
1429	D848	1		----	
1434	D848	1		----	
1591	D848	1-		----	
1592		----		----	
1657	D848	1-		----	
1812		----		----	
1823		----		----	
1866	D848	<5		----	false positive?
1954		----		----	
9005	D848	1-		----	
9008	D848	1-		----	
	normality	n.a			
	n	31			
	outliers	0			
	mean (n)	1-			
	st.dev. (n)	n.a			
	R(calc.)	n.a			
	R(D848:09)	n.a			

Determination of Acidity on Benzene sample #13008; results in mg NaOH per 100mL

lab	method	value	mark	z(targ)	remarks
52	D847	NIL		----	
150	D847	NFA		----	
171	D847	NFA		----	
174	D847	NFA		----	
311	D847	NFA		----	
323	D847	NFA		----	
329	D847	NFA		----	
333		----		----	
334		----		----	
347	D847	<0.4		----	
444		----		----	
497	D847	0.4		----	false positive?
551		----		----	
555		----		----	
663	D847	NFA		----	
823	D847	NFA		----	
855	D847	NFA		----	
862	D847	NFA		----	
864	D847	NFA		----	
865	D847	NFA		----	
866	D847	NFA		----	
868	D847	NFA		----	
870	D847	NFA		----	
902	D847	NFA		----	
912	D847	NFA		----	
913		----		----	
963	D847	NFA		----	
1011	D847	NIL		----	
1040		----		----	
1041		----		----	
1067	D847	NFA		----	
1081	D847	0		----	
1117	D847	0.19		----	false positive?
1264		----		----	
1419		----		----	
1429	D847	n.d.		----	
1434	D847	NIL		----	
1591	D847	NIL		----	
1592		----		----	
1657	D847	NFA		----	
1812		----		----	
1823		----		----	
1866	D847	n.d.		----	
1954		----		----	
9005	D847	NFA		----	
9008	D847	NFA		----	
	normality	not OK			
	n	32			
	outliers	0			
	mean (n)	NFA			
	st.dev. (n)	n.a			
	R(calc.)	n.a			
	R(D847:08)	n.a			

Abbreviation

NFA = No Free Acid

Determination of Appearance on Benzene sample #13008

lab	method	Value	mark	z(targ)	remarks
52	Visual	Pass		----	
150	E2680	Pass		----	
171		C&F		----	
174	E2680	Pass		----	
311	INH-402	B&C		----	
323	INH-001	Pass		----	
329	INH-001	Pass		----	
333		----		----	
334		----		----	
347	E2680	Pass		----	
444	E2680	Pass		----	
497		B&C		----	
551		----		----	
555		----		----	
663	E2680	Pass		----	
823	E2680	Pass		----	
855	E2680	B&C		----	
862		----		----	
864	E2680	Pass		----	
865	E2680	Pass		----	
866	E2680	Pass		----	
868	E2680	Pass		----	
870		B&C		----	
902	E2680	B&C		----	
912	E2680	Pass		----	
913		----		----	
963	E2680	Pass		----	
1011	Visual	B&C		----	
1040		B&C		----	
1041	Visual	CWWFFWEM		----	
1067	E2680	Pass		----	
1081	in house	B&C		----	
1117	D4176	OnSpec		----	
1264		----		----	
1419		----		----	
1429	Visual	B&C		----	
1434		Clear		----	
1591	E2680	B&C		----	
1592	Visual	CLFSH		----	
1657		----		----	
1812		----		----	
1823		----		----	
1866		Pass		----	
1954		----		----	
9005		Clear		----	
9008		Clear		----	
	normality	not OK			
	n	34			
	outliers	n.a			
	mean (n)	Pass			
	st.dev. (n)	n.a			
	R(calc.)	n.a			
	R(E2680:09e)	n.a			

Abbreviations:

B&C = bright and clear

C&F = clear and free

CLFSH = clear liquid free of sediment and haze

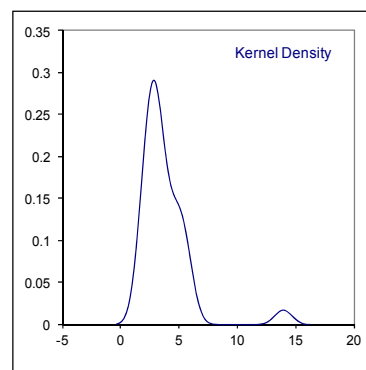
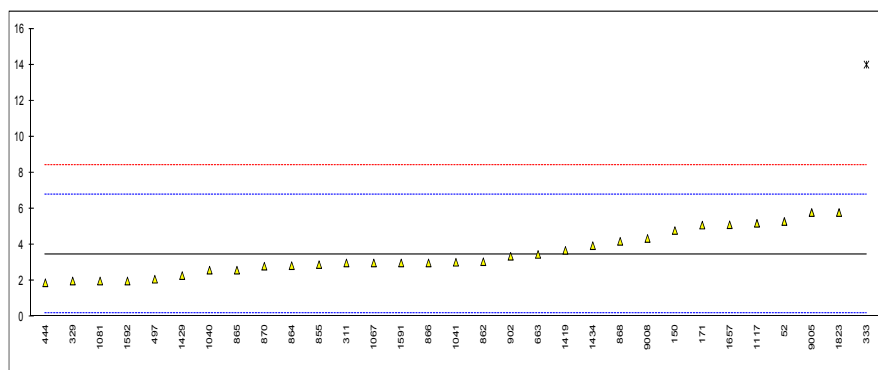
CWWFFEM = clear water white free from water and extraneous matter

Determination of Bromine Index on Benzene sample #13008; results in mg Br/100g

lab	method	value	mark	z(targ)	remarks
52	D1452	5.3		1.11	
150	D1492	4.8		0.80	
171	D5776	5.1		0.99	
174		----		----	
311	D5776	3.0		-0.29	
323		----		----	
329	D5776	2		-0.90	
333	D2710	14	G(0.01)	6.40	
334		----		----	
347		----		----	
444	D5776	1.9		-0.96	
497	D5776	2.1		-0.84	
551		----		----	
555		----		----	
663	D5776	3.475		0.00	
823		----		----	
855	D5776	2.91		-0.35	
862	D5776	3.07		-0.25	
864	D5776	2.85		-0.38	
865	D5776	2.6		-0.54	
866	D5776	3		-0.29	
868	D5776	4.2		0.44	
870	D5776	2.82		-0.40	
902	D5776	3.37		-0.07	
912		----		----	
913		----		----	
963		----		----	
1011		----		----	
1040	DIN51774	2.6		-0.54	
1041	DIN51774	3.04		-0.27	
1067	D5776	3.0		-0.29	
1081	D1492	2		-0.90	
1117	D1492	5.2		1.05	
1264		----		----	
1419	D1492	3.7		0.13	
1429	D2710	2.3		-0.72	
1434	D5776	3.96		0.29	
1591	D2710	3		-0.29	
1592	D5776	2.0		-0.90	
1657	D5776	5.12		1.00	
1812		----		----	
1823	D1492	5.80		1.41	
1866	D5776	<2		----	
1954		----		----	
9005	D1492	5.8		1.41	
9008	D1492	4.36		0.54	

normality not OK
n 30
outliers 1
mean (n) 3.48
st.dev. (n) 1.204
R(calc.) 3.37
R(D5776:07e1) 4.60

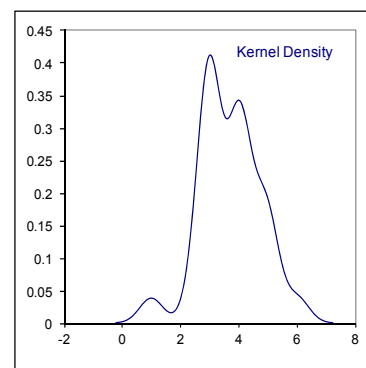
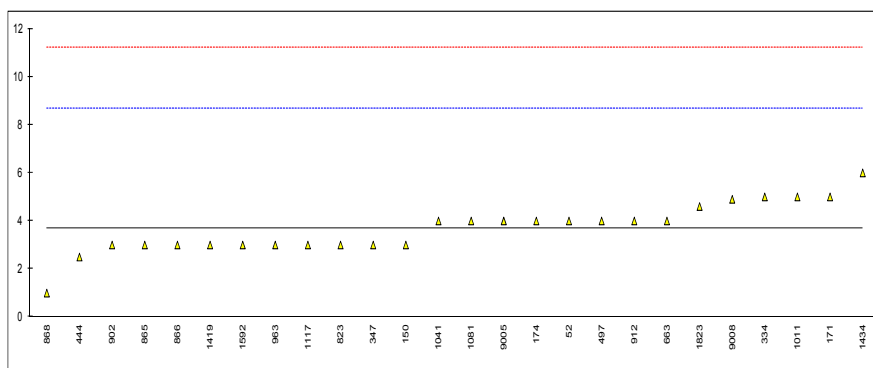
Compare R(D1492:02) = 4.10



Determination of Color Pt-Co on Benzene sample #13008

lab	method	value	mark	z(targ)	remarks
52	D5386	4		0.12	
150	D5386	3		-0.28	
171	D1209	5		0.52	
174	D1209	4		0.12	
311	D1209	<5		----	
323	D1209	<5		----	
329	D1209	<5		----	
333		----		----	
334	D1209	5		0.52	
347	D5386	3		-0.28	
444	D5386	2.5		-0.48	
497	D1209	4		0.12	
551		----		----	
555		----		----	
663	D1209	4		0.12	
823	D1209	3		-0.28	
855	D1209	<5		----	
862	D1209	<5		----	
864	D1209	<5		----	
865	D1209	3		-0.28	
866	D1209	3		-0.28	
868	D1209	1		-1.08	
870	D1209	<5		----	
902	D5386	3		-0.28	
912	D5386	4		0.12	
913		----		----	
963	D1209	3		-0.28	
1011	D1209	5		0.52	
1040	ISO6271	<5		----	
1041	ISO6271	4		0.12	
1067	D1209	<5		----	
1081	D5386	4		0.12	
1117	D1209	3		-0.28	
1264		----		----	
1419	D1209	3		-0.28	
1429	D1209	<5		----	
1434	D1209	6		0.92	
1591	D1209	<5		----	
1592	D5386	3		-0.28	
1657	D1209	<3		----	
1812		----		----	
1823	D5386	4.6		0.36	
1866	D1209	<5		----	
1954		----		----	
9005	D1209	4		0.12	
9008	D5386	4.9		0.48	

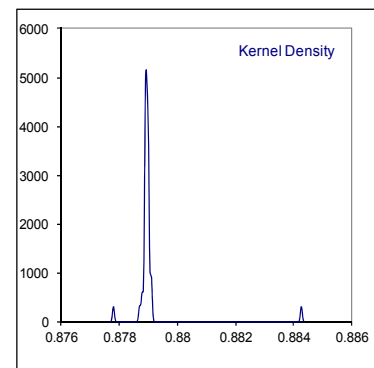
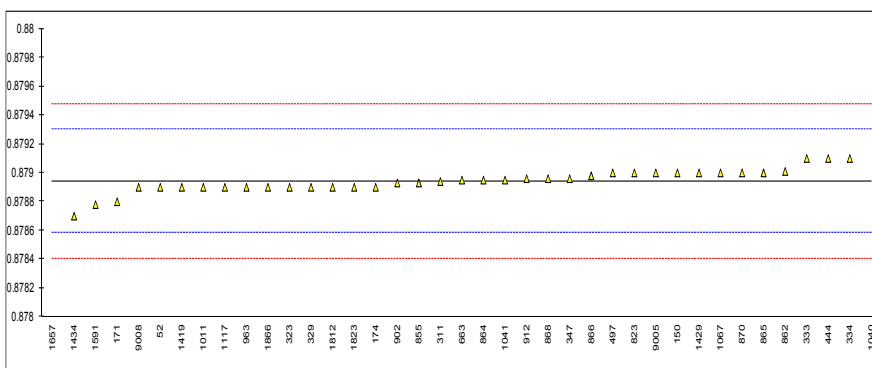
normality not OK
n 26
outliers 0
mean (n) 3.69
st.dev. (n) 1.038
R(calc.) 2.91
R(D1209:05e1) 7.00



Determination of Density @ 20°C on Benzene sample #13008; results in kg/L

lab	method	value	mark	z(targ)	remarks
52	D4052	0.8789		-0.24	
150	D4052	0.8790		0.32	
171	D4052	0.8788		-0.80	
174	D4052	0.8789		-0.24	
311	D4052	0.87894		-0.02	
323	D4052	0.8789		-0.24	
329	D4052	0.8789		-0.24	
333	D4052	0.8791		0.88	
334	D4052	0.8791		0.88	
347	D4052	0.87896		0.09	
444	D4052	0.8791		0.88	
497	D4052	0.8790		0.32	
551		----		----	
555		----		----	
663	D4052	0.87895		0.04	
823	D4052	0.8790		0.32	
855	D4052	0.87893		-0.07	
862	D4052	0.87901		0.37	
864	D4052	0.87895		0.04	
865	D4052	0.8790		0.32	
866	D4052	0.87898		0.21	
868	D4052	0.87896		0.09	
870	D4052	0.8790		0.32	
902	D4052	0.87893		-0.07	
912	D4052	0.87896		0.09	
913		----		----	
963	D4052	0.8789		-0.24	
1011	D4052	0.8789		-0.24	
1040	ISO12185	0.88426	G(0.01)	29.77	
1041	D4052	0.87895	C	0.04	first reported: 878.95
1067	D4052	0.8790		0.32	
1081		----		----	
1117	D4052	0.8789		-0.24	
1264		----		----	
1419	ISO12185	0.87890		-0.24	
1429	D4052	0.8790		0.32	
1434	D4052	0.8787		-1.36	
1591	D4052	0.87878		-0.91	
1592		----		----	
1657	D4052	0.8778	G(0.01)	-6.40	
1812	ISO12185	0.8789		-0.24	
1823	D4052	0.8789		-0.24	
1866	D4052	0.8789		-0.24	
1954		----		----	
9005	D4052	0.8790		0.32	
9008	D4052	0.8789		-0.24	

normality not OK
n 37
outliers 2
mean (n) 0.87894
st.dev. (n) 0.0000081
R(calc.) 0.00023
R(D4052:02e1) 0.00050



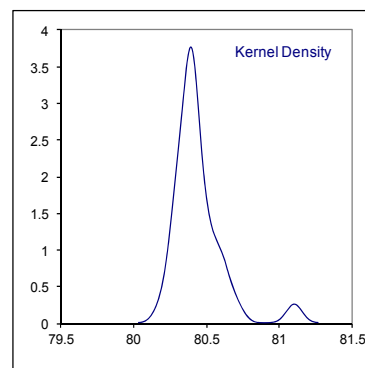
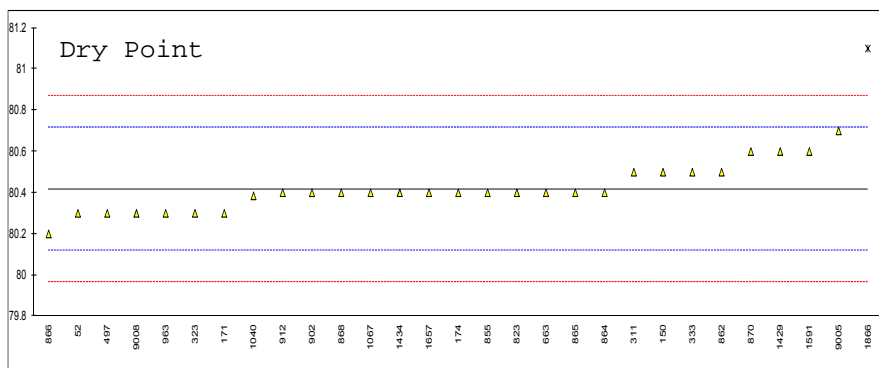
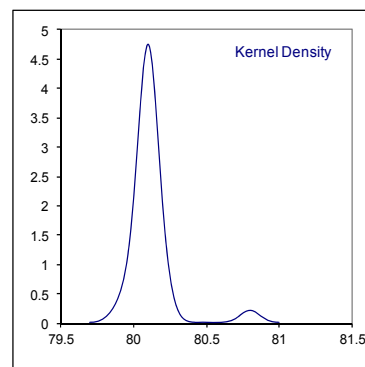
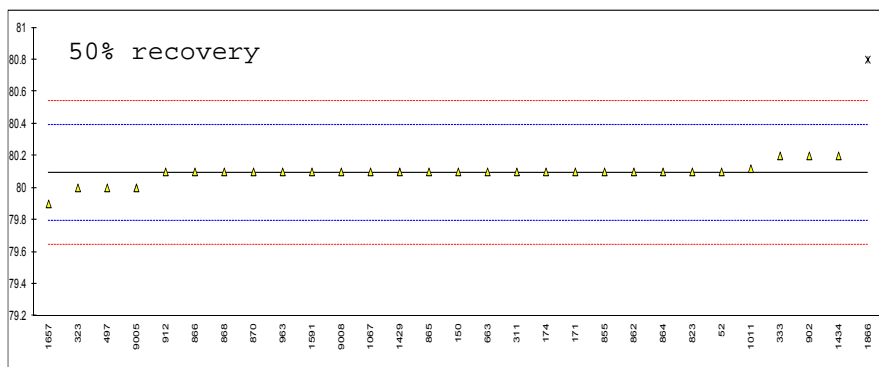
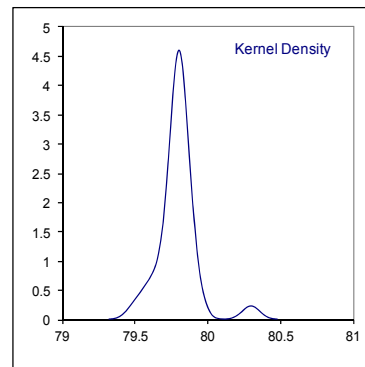
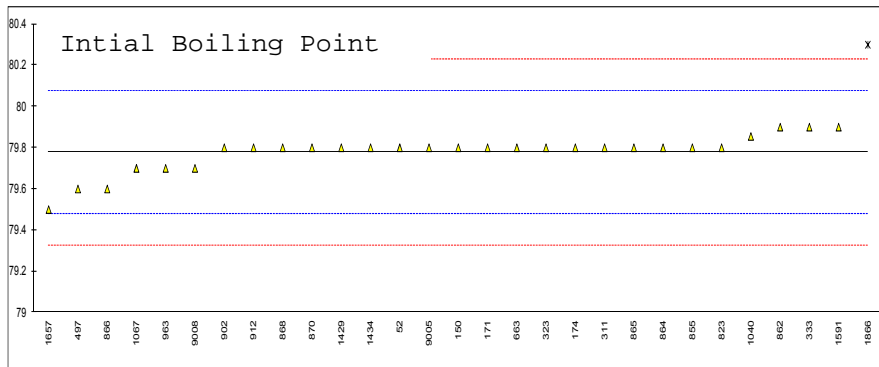
Determination of Distillation (automated + manual) on Benzene sample #13008; results in °C

Lab	method	IBP	mark	z(targ)	50%	mark	z(targ)	DP	mark	z(targ)	remarks
52	D850-A	79.8		0.15	80.1		0.04	80.3		-0.78	
150	D850-A	79.8		0.15	80.1		0.04	80.5		0.55	
171	D850-A	79.8		0.15	80.1		0.04	80.3		-0.78	
174	D850-A	79.8		0.15	80.1		0.04	80.4		-0.12	
311	D850-A	79.8		0.15	80.1		0.04	80.5		0.55	
323	D850-M	79.8		0.15	80.0		-0.62	80.3		-0.78	
329	D850	----		----	----		----	----		----	
333	D850-A	79.9		0.82	80.2		0.71	80.5		0.55	
334	D850	----		----	----		----	----		----	
347	D850	----		----	----		----	----		----	
444	D850	----		----	----		----	----		----	
497	D850-A	79.6		-1.18	80.0		-0.62	80.3		-0.78	
551	D850	----		----	----		----	----		----	
555	D850	----		----	----		----	----		----	
663	D850-A	79.8		0.15	80.1		0.04	80.4		-0.12	
823	D850-A	79.8		0.15	80.1		0.04	80.4		-0.12	
855	D850-M	79.8		0.15	80.1		0.04	80.4		-0.12	
862	D850-M	79.9		0.82	80.1		0.04	80.5		0.55	
864	D850-M	79.8		0.15	80.1		0.04	80.4		-0.12	
865	D850-A	79.8		0.15	80.1		0.04	80.4		-0.12	
866	D850-M	79.6		-1.18	80.1		0.04	80.2		-1.45	
868	D850-M	79.8		0.15	80.1		0.04	80.4		-0.12	
870	D850-M	79.8		0.15	80.1		0.04	80.6		1.22	
902	D850-M	79.8		0.15	80.2		0.71	80.4		-0.12	
912	D850-M	79.8		0.15	80.1		0.04	80.4		-0.12	
913	D850-M	----		----	----		----	----		----	
963	D850-A	79.7		-0.51	80.1		0.04	80.3		-0.78	
1011	D850	----		----	----		0.18	----		----	
1040	DIN51761-A	79.855		0.52	80.12		----	80.385		-0.22	
1041	D850	----		----	----		----	----		----	
1067	D850-M	79.7		-0.51	80.1		0.04	80.4		-0.12	
1081	D850	----		----	----		----	----		----	
1117	D850	----		----	----		----	----		----	
1264	D850	----		----	----		----	----		----	
1419	D850	----		----	----		----	----		----	
1429	D850-A	79.8		0.15	80.1		0.04	80.6		1.22	
1434	D850-A	79.8		0.15	80.2		0.71	80.4		-0.12	
1591	D850-M	79.9		0.82	80.1		0.04	80.6		1.22	
1592	D850	----		----	----		----	----		----	
1657	D850	79.5		-1.85	79.9		-1.29	80.4		-0.12	
1812	D850	----		----	----		----	----		----	
1823	D850	----		----	----		----	----		----	
1866	D850	80.3	G(0.01)	3.49	80.8	G(0.01)	4.71	81.1	G(0.01)	4.55	
1954	D850	----		----	----		----	----		----	
9005	D850-A	79.8		0.15	80.0		-0.62	80.7		1.88	
9008	D850-A	79.7		-0.51	80.1		0.04	80.3		-0.78	
	normality	not OK			not OK			not OK			
	n	28			28			28			
	outliers	1			1			1			
	mean (n)	79.78			80.09			80.42			
	st.dev. (n)	0.090			0.061			0.113			
	R(calc.)	0.25			0.17			0.32			
	R(D850:11)	0.42			0.42			0.42			

Theoretical boiling mid point = 80.1 °C

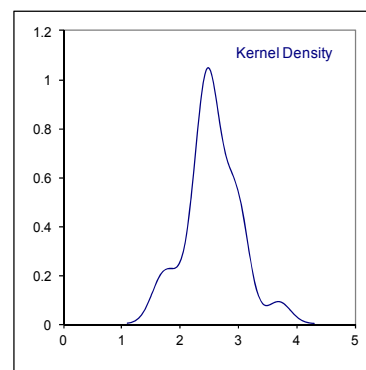
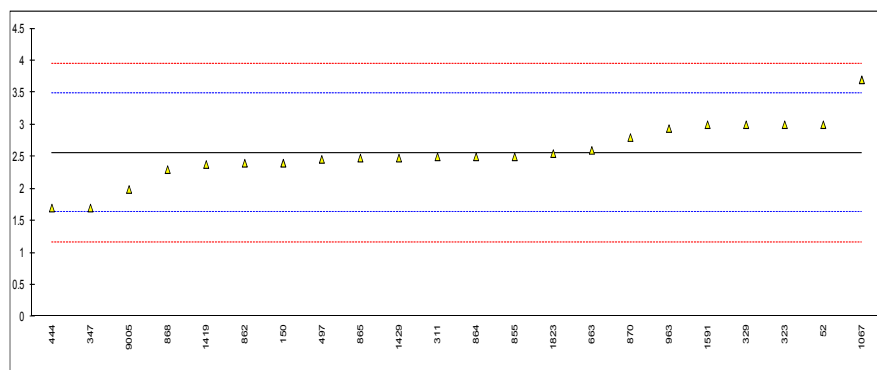
After manual correction:

1657	D850	79.7		-0.52	80.1		0.00	80.6		1.18
1866	D850	79.6		-1.19	80.1		0.00	80.4		-0.16
	normality	not OK			not OK			not OK		
	n	29			29			29		
	outliers	0			0			0		
	mean (n)	79.78			80.10			80.42		
	st.dev. (n)	0.080			0.046			0.116		
	R(calc.)	0.22			0.13			0.32		
	R(D850:11)	0.42			0.42			0.42		



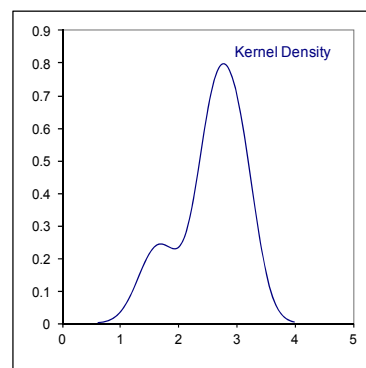
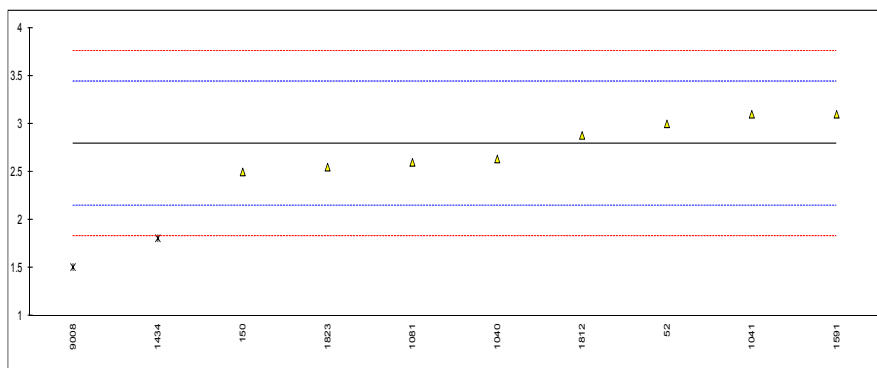
Determination of Organic Chloride on Benzene sample #13008; results in mg/kg

lab	method	value	mark	z(targ)	remarks
52	D5194	3.0		0.94	
150	D7359	2.4		-0.35	
171	D5808	<1		<-3.22	false negative result?
174		----		----	
311	D5808	2.5		-0.14	
323	D5808	3.0		0.94	
329	D5808	3.0		0.94	
333		----		----	
334		----		----	
347	INH-1095	1.7		-1.86	
444	IP510	1.7		-1.86	
497	D5808	2.46		-0.22	
551		----		----	
555		----		----	
663	D5808	2.6		0.08	
823		----		----	
855	D5808	2.5		-0.14	
862	D5808	2.4		-0.35	
864	D5808	2.5		-0.14	
865	D5808	2.48		-0.18	
866		----		----	
868	D5808	2.3		-0.57	
870	D5808	2.8		0.51	
902		----		----	
912		----		----	
913		----		----	
963	D5808	2.94		0.81	
1011		----		----	
1040		----		----	
1041		----		----	
1067	UOP779	3.7		2.45	
1081		----		----	
1117		----		----	
1264		----		----	
1419	D5808	2.38		-0.39	
1429	D5808	2.48		-0.18	
1434		----		----	
1591	D5808	3.0		0.94	
1592		----		----	
1657		----		----	
1812		----		----	
1823	INH-2296	2.55		-0.03	
1866	D5808	<5		----	
1954		----		----	
9005	D5808	1.99		-1.23	
9008		----		----	
	normality	OK			
	n	22			
	outliers	0			
	mean (n)	2.56			
	st.dev. (n)	0.451			
	R(calc.)	1.26			
	R(D5808:09a)	1.30			
			<u>Spike</u>		
			1.99		recovery: <129%



Determination of Total Chloride on Benzene sample #13008; results in mg/kg

lab	method	value	mark	z(targ)	remarks
52	D5194	3.0		0.64	
150	D7359	2.5		-0.92	
171		----		----	
174		----		----	
311		----		----	
323		----		----	
329		----		----	
333		----		----	
334		----		----	
347		----		----	
444		----		----	
497		----		----	
551		----		----	
555		----		----	
663		----		----	
823		----		----	
855		----		----	
862		----		----	
864		----		----	
865		----		----	
866		----		----	
868		----		----	
870		----		----	
902		----		----	
912		----		----	
913		----		----	
963		----		----	
1011		----		----	
1040	EN14077	2.635		-0.50	
1041	in house	3.1		0.95	
1067		----		----	
1081	D5808	2.6		-0.61	
1117		----		----	
1264		----		----	
1419		----		----	
1429		----		----	
1434	D7536	1.81	DG(0.05)	-3.07	
1591	D5194	3.1		0.95	
1592		----		----	
1657		----		----	
1812	DIN51408	2.88		0.26	
1823	INH-2296	2.55		-0.76	
1866	D5194	<5		----	
1954		----		----	
9005		----		----	
9008	D5808	1.51	DG(0.05)	-4.00	
	normality	OK			
	n	8			
	outliers	2			
	mean (n)	2.80			
	st.dev. (n)	0.252			
	R(calc.)	0.71			
	R(D5194:11)	0.90			



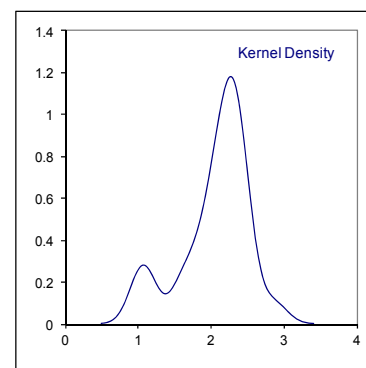
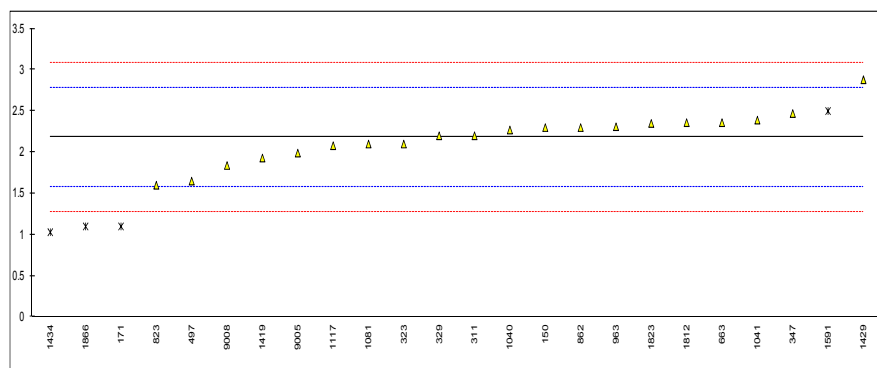
Determination of Total Nitrogen on Benzene sample #13008; results in mg/kg

lab	method	value	mark	z(targ)	remarks
52	D6069	<0.2		----	false negative result?
150	D6069	2.3		0.38	
171	D6069	1.1	DG(0.05)	-3.60	
174		----		----	
311	D6069	2.2		0.05	
323	D6069	2.1		-0.28	
329	D6069	2.2		0.05	
333		----		----	
334		----		----	
347	D4629	2.47		0.95	
444		----		----	
497	D6069	1.65		-1.77	
551		----		----	
555		----		----	
663	D6069	2.36		0.58	
823	D6069	1.6	C	-1.94	first reported: 1.2
855		----		----	
862	D6069	2.3		0.38	
864		----		----	
865		----		----	
866		----		----	
868		----		----	
870		----		----	
902		----		----	
912		----		----	
913		----		----	
963	D4629	2.31	C	0.42	first reported: 3.21
1011		----		----	
1040	D6069	2.27		0.29	
1041	D6069	2.39		0.68	
1067		----		----	
1081	D6069	2.1		-0.28	
1117	D6069	2.08		-0.35	
1264		----		----	
1419	D4629	1.93		-0.84	
1429	D4629	2.88		2.31	
1434	D7184	1.03	ex	-3.83	result excluded, see §4.1
1591	D7184	2.5	ex	1.05	result excluded, see §4.1
1592		----		----	
1657		----		----	
1812	D6069	2.36		0.58	
1823	D6069	2.35		0.55	
1866	D6069	1.1	DG(0.05)	-3.60	
1954		----		----	
9005	D6069	1.99		-0.64	
9008	D6069	1.84		-1.14	

normality OK
n 20
outliers 2
mean (n) 2.184
st.dev. (n) 0.2920
R(calc.) 0.818
R(D6069:06) 0.844

Spike
1.55 recovery: < 132%

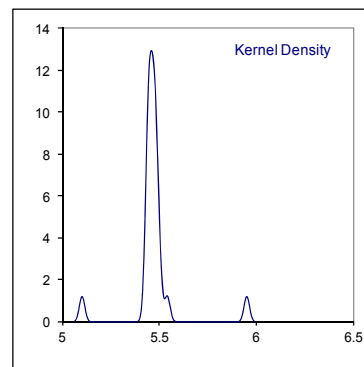
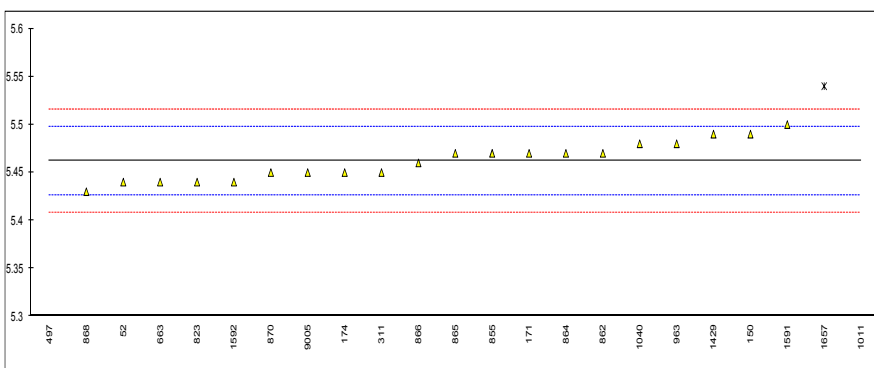
Application range D4629:12 = 0.3 -100 mg/kg
Application range D6069:06 = 0.2 – 2 mg/kg



Determination of Solidification Point (anhydrous) on Benzene sample #13008; results in °C

lab	method	value	mark	z(targ)	remarks
52	D852	5.44		-1.23	
150	D852	5.49		1.57	
171	D852	5.47		0.45	
174	D852	5.45		-0.67	
311	D852	5.45		-0.67	
323		----		----	
329		----		----	
333		----		----	
334		----		----	
347		----		----	
444		----		----	
497	D852	5.1	G(0.05)	-20.27	
551		----		----	
555		----		----	
663	D852	5.44		-1.23	
823	D852	5.44		-1.23	
855	D852	5.47		0.45	
862	D852	5.47		0.45	
864	D852	5.47		0.45	
865	D852	5.47		0.45	
866	D852	5.46		-0.11	
868	D852	5.43		-1.79	
870	D852	5.45		-0.67	
902		----		----	
912		----		----	
913		----		----	
963	D852	5.48		1.01	
1011	D852	5.95	C,G(0.01)	27.33	first reported:5.40
1040	DIN51798	5.48		1.01	
1041		----		----	
1067		----		----	
1081		----		----	
1117		----		----	
1264		----		----	
1419		----		----	
1429	D852	5.49		1.57	
1434		----		----	
1591	D852	5.50		2.13	
1592	D852	5.44		-1.23	
1657	D852	5.54	G(0.05)	4.37	
1812		----		----	
1823		----		----	
1866		----		----	
1954		----		----	
9005	D852	5.45		-0.67	
9008		----		----	

normality OK
n 20
outliers 3
mean (n) 5.462
st.dev. (n) 0.0199
R(calc.) 0.056
R(D852:08) 0.050

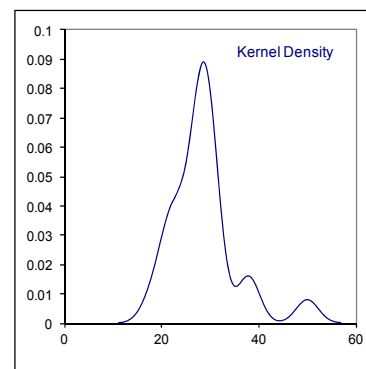
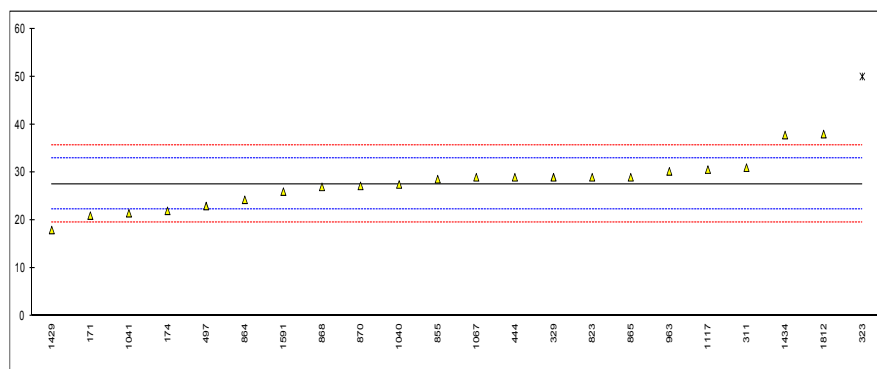


Determination of Methylcyclohexane on Benzene sample #13008 in mg/kg

lab	method	value	mark	z(targ)	Remarks
52		----		----	
150		----		----	
171	D5713	21		-2.45	
174	D4492	22		-2.08	
311	D5713	31		1.29	
323	D4492	50	G(0.01)	8.38	
329	D4492	29	C	0.54	first reported: 49
333		----		----	
334		----		----	
347		----		----	
444	D5713	29		0.54	
497		23		-1.70	
551		----		----	
555		----		----	
663		----		----	
823	D5713	29		0.54	
855		28.6		0.39	
862		----		----	
864		24.3		-1.22	
865	D4492	29		0.54	
866		----		----	
868	D4492	27		-0.21	
870		27.2		-0.13	
902		----		----	
912		----		----	
913		----		----	
963	D4492	30.22		0.99	
1011		----		----	
1040	D4492	27.5		-0.02	
1041	in house	21.5		-2.26	
1067	in house	29		0.54	
1081		----	W	----	result withdrawn, first reported: <1
1117	D4492	30.6		1.14	
1264		----		----	
1419		----		----	
1429	D4492	18	C	-3.57	first reported: 50
1434		37.8		3.83	
1591		26		-0.58	
1592		----		----	
1657		----		----	
1812	in house	38	C	3.90	first reported: 56
1823		----		----	
1866		----		----	
1954		----		----	
9005		----		----	
9008		----		----	

normality OK
n 21
outliers 1
mean (n) 27.56
st.dev. (n) 4.949
R(calc.) 13.86
R(Horwitz) 7.49

Compare R(D5713:05) < 5.4 mg/kg

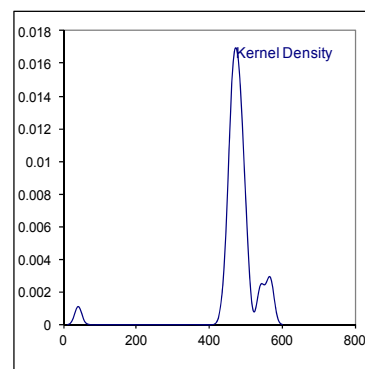
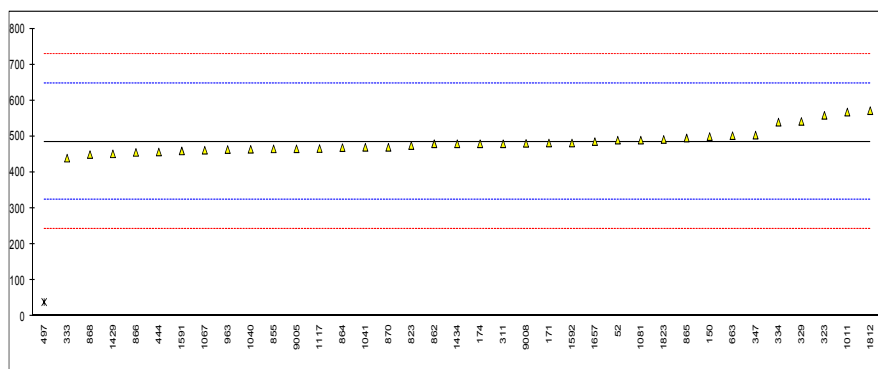


Determination of Toluene on Benzene sample #13008; results in mg/kg

lab	method	value	mark	z(targ)	Remarks
52	D4492	490		0.05	
150	D4492	500		0.17	
171	D5713	482		-0.05	
174	D4492	480		-0.07	
311	D4492	480		-0.07	
323	D4492	559		0.90	
329	D4492	542		0.69	
333	D4492	440	C	-0.57	first reported: 0.044
334	D4492	540	C	0.67	first reported: 0.054
347	D4492	504		0.22	
444	D5713	457		-0.36	
497	D4492	40	G(0.01)	-5.52	
551		----		----	
555		----		----	
663	D4492	502.4		0.20	
823	D4492	475		-0.14	
855	D4492	465.8		-0.25	
862	D4492	480		-0.07	
864	D4492	469.2		-0.21	
865	D4492	496		0.12	
866	D4492	456		-0.37	
868	D4492	450		-0.45	
870	D4492	470.2		-0.20	
902		----		----	
912		----		----	
913		----		----	
963	D4492	464		-0.27	
1011	D2360	568		1.02	
1040	D4492	464.6		-0.26	
1041	D4492	470.1		-0.20	
1067	in house	462		-0.30	
1081	D4492	490		0.05	
1117	D4492	466.7		-0.24	
1264		----		----	
1419		----		----	
1429	D4492	452		-0.42	
1434	D4492	480		-0.07	
1591	D4492	460		-0.32	
1592	D4492	482		-0.05	
1657	D4492	486		0.00	
1812	in house	572		1.06	
1823	D4492	492		0.07	
1866		----		----	
1954		----		----	
9005	D4492	466		-0.25	
9008	D4492	481	C	-0.06	first reported: 374

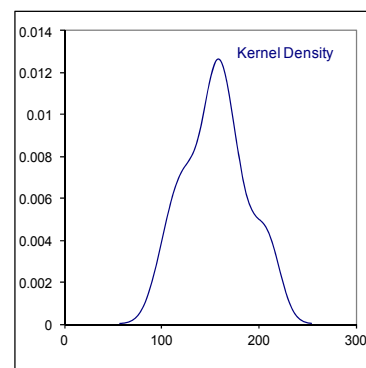
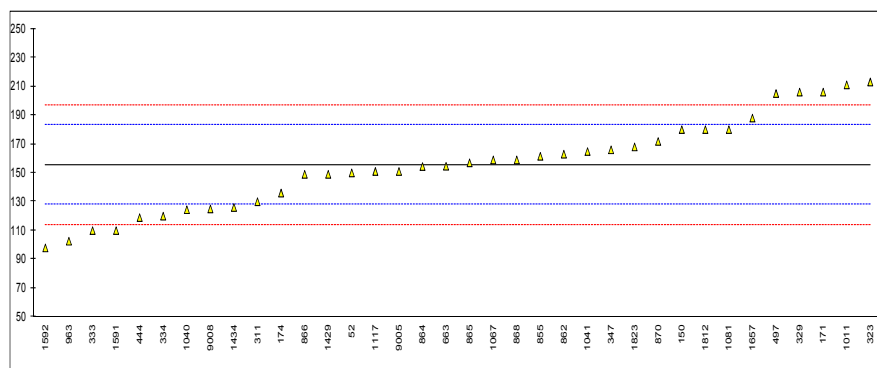
normality not OK
n 36
outliers 1
mean (n) 485.97
st.dev. (n) 32.6226
R(calc.) 91.34
R(D4492:10) 226.23

Compare R(Horwitz): 85.3



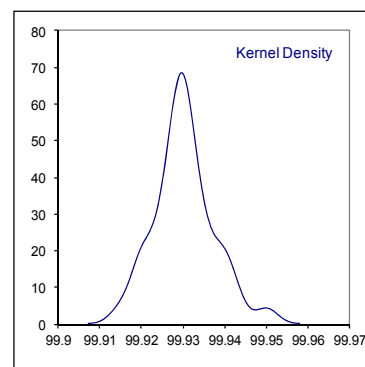
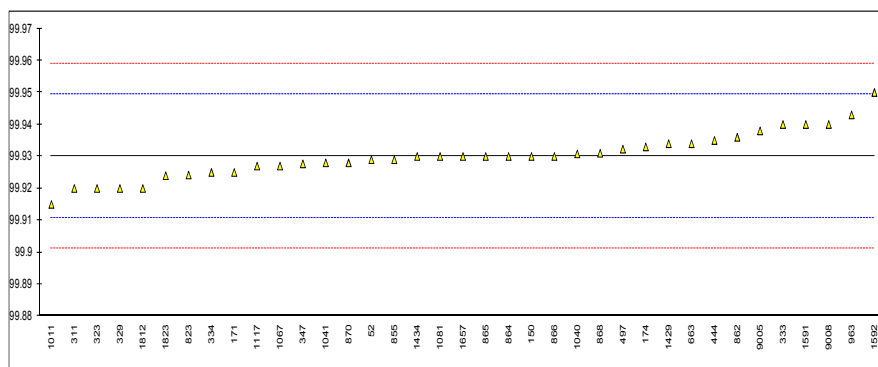
Determination of Nonaromatics on Benzene sample #13008; results in mg/kg

lab	method	value	mark	z(targ)	Remarks
52	D4492	150		-0.40	
150	D4492	180		1.76	
171	D5713	206		3.64	
174	D4492	136		-1.41	
311	D4492	130		-1.84	
323	D4492	213		4.14	
329	D4492	206		3.64	
333	D4492	110	C	-3.28	first reported: 0.011
334	D4492	120	C	-2.56	first reported: 0.012
347	D4492	166		0.75	
444	D4492	119		-2.63	
497	D4492	205		3.57	
551		----		----	
555		----		----	
663	D4492	154.6		-0.07	
823		----		----	
855	D4492	161.5		0.43	
862	D4492	163		0.54	
864	D4492	154.4		-0.08	
865	D4492	157		0.11	
866	D4492	149		-0.47	
868	D4492	159		0.25	
870	D4492	171.8		1.17	
902		----		----	
912		----		----	
913		----		----	
963	D4492	102.66		-3.81	
1011	D2360	211		4.00	
1040	D4492	124.5		-2.24	
1041	D4492	164.8		0.67	
1067	in house	159		0.25	
1081	D4492	180		1.76	
1117	D4492	151		-0.33	
1264		----		----	
1419		----		----	
1429	D4492	149		-0.47	
1434	D4492	126		-2.13	
1591	D4492	110		-3.28	
1592	D4492	98	C	-4.15	first reported: n.d
1657	D4492	188		2.34	
1812	in house	180		1.76	
1823	D4492	168		0.90	
1866		----		----	
1954		----		----	
9005	D4492	151		-0.33	
9008	D4492	125		-2.20	
normality		OK			
n		36			
outliers		0			
mean (n)		155.54			
st.dev. (n)		31.311			
R(calc.)		87.67			
R(D4492:10)		38.83			



Determination of Purity on Benzene sample #13008; results in %M/M

lab	method	value	mark	z(targ)	remarks
52	D4492	99.929		-0.12	
150	D4492	99.93		-0.02	
171	D5713	99.925		-0.54	
174	D4492	99.933		0.29	
311	D4492	99.92		-1.05	
323	D4492	99.92		-1.05	
329	D4492	99.92		-1.05	
333	D4492	99.94		1.02	
334	D4492	99.925		-0.54	
347	D4492	99.9277		-0.26	
444	D4492	99.935		0.50	
497	D4492	99.9323		0.22	
551		----		----	
555		----		----	
663	D4492	99.934		0.40	
823	D4492	99.9242		-0.62	
855	D4492	99.929		-0.12	
862	D4492	99.936		0.60	
864	D4492	99.930		-0.02	
865	D4492	99.930		-0.02	
866	D4492	99.930		-0.02	
868	D4492	99.931		0.09	
870	D4492	99.928		-0.22	
902		----		----	
912		----		----	
913		----		----	
963	D4492	99.943		1.33	
1011	D2360	99.915		-1.57	
1040	D4492	99.9308		0.07	
1041	D4492	99.928		-0.22	
1067	in house	99.927		-0.33	
1081	D4492	99.93		-0.02	
1117	D4492	99.927		-0.33	
1264		----		----	
1419		----		----	
1429	D4492	99.934		0.40	
1434	D4492	99.93		-0.02	
1591	D4492	99.94		1.02	
1592	D4492	99.95		2.06	
1657	D4492	99.93		-0.02	
1812	in house	99.92		-1.05	
1823	D4492	99.924		-0.64	
1866		----		----	
1954		----		----	
9005	D4492	99.938		0.81	
9008	D4492	99.94		1.02	
normality		OK			
n		37			
outliers		0			
mean (n)		99.930			
st.dev. (n)		0.0071			
R(calc.)		0.020			
R(D4492:10)		0.027			



Determination of Acid Wash Color on Toluene sample #13009

lab	method	value	mark	z(targ)	remarks
52	D848	0		----	
150	D848	1-		----	
171	D848	1-		----	
174	D848	1-		----	
311	D848	0+		----	
323	D848	1-		----	
333		----		----	
334		----		----	
343	D848	1		----	
396		----		----	
445	D848	1-		----	
497	D848	<1		----	
551		----		----	
555		----		----	
823	D848	1-		----	
840	D848	1-		----	
855	D848	1-		----	
862	D848	1-		----	
864	D848	1-		----	
865	D848	1-		----	
866	D848	1-		----	
868	D848	1-		----	
870	D848	1-		----	
902	D848	1-		----	
912	D848	1		----	
913		----		----	
1040	D848	0		----	
1041	D848	1-		----	
1067	D848	1-		----	
1081	D848	1-		----	
1172	D848	1-		----	
1357		----		----	
1434	D848	1		----	
1481	D848	1-		----	
1538		----		----	
1591	D848	1-		----	
1592	D848	1-		----	
1812		----		----	
1866	D848	<5		----	false positive?
	normality	n.a			
	n	30			
	outliers	n.a			
	mean (n)	1-			
	st.dev. (n)	n.a			
	R(calc.)	n.a			
	R(D848:09)	n.a			

Determination of Appearance on Toluene sample #13009

lab	method	value	mark	z(targ)	remarks
52	Visual	Pass		----	
150	E2680	Pass		----	
171	E2680	C&F		----	
174	E2680	Pass		----	
311	INH-402	B&C		----	
323	E2680	CFFMS		----	
333		----		----	
334		----		----	
343	E2680	Pass		----	
396	E2680	Pass		----	
445	E2680	Pass		----	
497	E2680	B&C		----	
551		----		----	
555		----		----	
823	E2680	Pass		----	
840	E2680	Pass		----	
855	E2680	B&C		----	
862		----		----	
864	E2680	Pass		----	
865	E2680	Pass		----	
866	E2680	Pass		----	
868	E2680	Pass		----	
870	E2680	B&C		----	
902	E2680	B&C		----	
912	E2680	Pass		----	
913		----		----	
1040	E2680	B&C		----	
1041	Visual	CWWFFWEM		----	
1067	E2680	Pass		----	
1081	E2680	B&C		----	
1172		----		----	
1357		----		----	
1434	E2680	Clear		----	
1481		Pass		----	
1538		----		----	
1591	E2680	B&C		----	
1592		----		----	
1812		----		----	
1866	E2680	Pass		----	
	normality	n.a			
	n	28			
	outliers	n.a			
	mean (n)	Pass			
	st.dev. (n)	n.a			
	R(calc.)	n.a			
	R(E2680:09e1)	n.a			

Abbreviations:

B&C = bright and clear

C&F = clear and free

CWWFFEM = clear water white free from water and extraneous matter

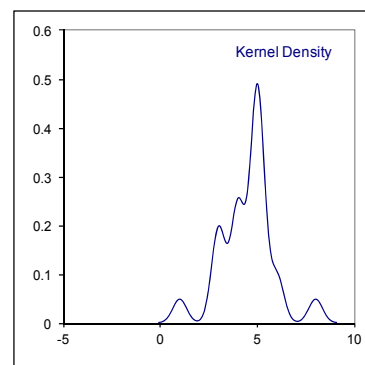
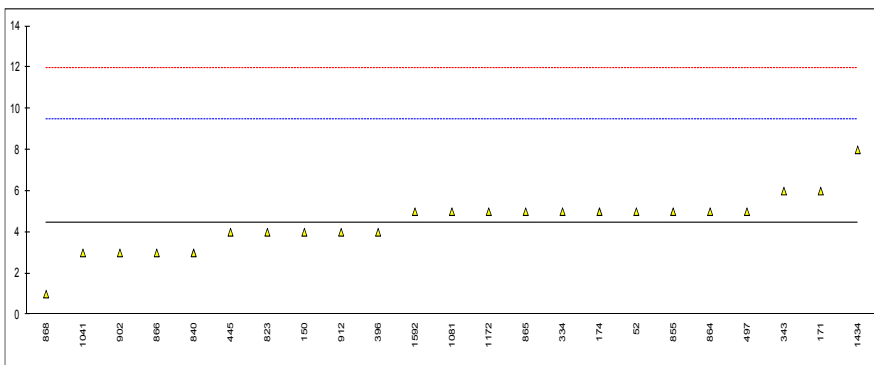
CFFSM = clear and free from suspended matter

Determination of Copper Corrosion on Toluene sample #13009

lab	method	value	mark	z(targ)	remarks
52	D849	1A		----	
150	D849	1A		----	
171	D849	1A		----	
174	D849	1A		----	
311	D849	1A		----	
323	D849	1A		----	
333		----		----	
334		----		----	
343	D849	1A		----	
396		----		----	
445	D849	1A		----	
497	D849	1A		----	
551		----		----	
555		----		----	
823	D849	1A		----	
840	D849	1A		----	
855	D849	1A		----	
862	D849	1A		----	
864	D849	1A		----	
865	D849	1A		----	
866	D849	1A		----	
868	D849	1A		----	
870	D849	1A		----	
902		----		----	
912	D849	1A		----	
913		----		----	
1040	ISO2160	1		----	ISO2160 ≠ D849, see §4.1
1041	D849	1		----	
1067		----		----	
1081	D849	1		----	
1172	D849	1A		----	
1357		----		----	
1434	D849	1A		----	
1481	D849	1A		----	
1538		----		----	
1591	D849	1A		----	
1592	D849	1A		----	
1812		----		----	
1866		----		----	
	normality	n.a			
	n	27			
	outliers	n.a			
	mean (n)	1A			
	st.dev. (n)	n.a			
	R(calc.)	n.a			
	R(D849:11)	n.a			

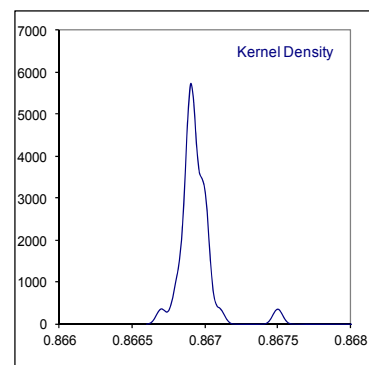
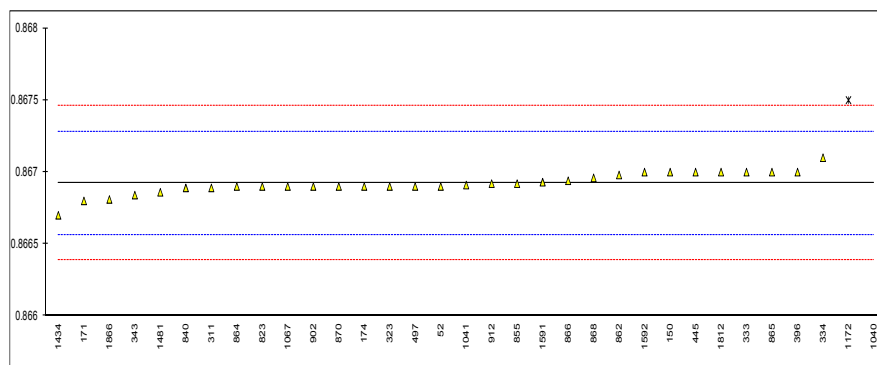
Determination of Color (Pt-Co scale) on Toluene sample #13009

lab	method	value	mark	z(targ)	remarks
52	D5386	5		0.21	
150	D5386	4		-0.19	
171	D1209	6		0.61	
174	D1209	5		0.21	
311	D1209	<5		----	
323	D1209	<5		----	
333		----		----	
334	D1209	5		0.21	
343	D5386	6		0.61	
396	D1209	4		-0.19	
445	D1209	4		-0.19	
497	D1209	5		0.21	
551		----		----	
555		----		----	
823	D1209	4		-0.19	
840	D1209	3		-0.59	
855	D1209	5		0.21	
862	D1209	<5		----	
864	D1209	5		0.21	
865	D1209	5		0.21	
866	D1209	3		-0.59	
868	D1209	1		-1.39	
870	D1209	<5		----	
902	D5386	3		-0.59	
912	D5386	4		-0.19	
913		----		----	
1040	ISO6271	<5		----	
1041	ISO6271	3		-0.59	
1067	D1209	<5		----	
1081	D5386	5		0.21	
1172	D1209	5		0.21	
1357		----		----	
1434	D1209	8		1.41	
1481	D1209	<5		----	
1538		----		----	
1591	D1209	<5		----	
1592	D1209	5		0.21	
1812		----		----	
1866	D1209	<5		----	
normality		not OK			
n		23			
outliers		0			
mean (n)		4.48			
st.dev. (n)		1.377			
R(calc.)		3.86			
R(D1209:05e1)		7.00			



Determination of Density @ 20°C on Toluene sample #13009: results in kg/L

lab	method	value	mark	z(targ)	remarks
52	D4052	0.8669		-0.12	
150	D4052	0.8670		0.44	
171	D4052	0.8668		-0.68	
174	D4052	0.8669		-0.12	
311	D4052	0.86689		-0.17	
323	D4052	0.8669		-0.12	
333	D4052	0.8670		0.44	
334	D4052	0.8671		1.00	
343	D4052	0.86684		-0.45	
396	D4052	0.8670		0.44	
445	D4052	0.8670		0.44	
497	D4052	0.8669		-0.12	
551		----		----	
555		----		----	
823	D4052	0.8669		-0.12	
840	D4052	0.86689		-0.17	
855	D4052	0.86692		-0.01	
862	D4052	0.86698		0.33	
864	D4052	0.8669		-0.12	
865	D4052	0.8670		0.44	
866	D4052	0.86694		0.11	
868	D4052	0.86696		0.22	
870	D4052	0.8669		-0.12	
902	D4052	0.86690		-0.12	
912	D4052	0.86692		-0.01	
913		----		----	
1040	ISO12185	0.87163	G(0.01)	26.37	
1041	D4052	0.86691	C	-0.06	first reported: 866.91
1067	D4052	0.8669		-0.12	
1081		----		----	
1172	D4052	0.8675	G(0.01)	3.24	
1357		----		----	
1434	D4052	0.8667		-1.24	
1481	D4052	0.86686		-0.34	
1538		----		----	
1591	D4052	0.86693		0.05	
1592	D4052	0.8670		0.44	
1812	ISO12185	0.8670		0.44	
1866	D4052	0.86681		-0.62	
normality		not OK			
n		31			
outliers		2			
mean (n)		0.86692			
st.dev. (n)		0.000076			
R(calc.)		0.00021			
R(D4052:02e)		0.00050			



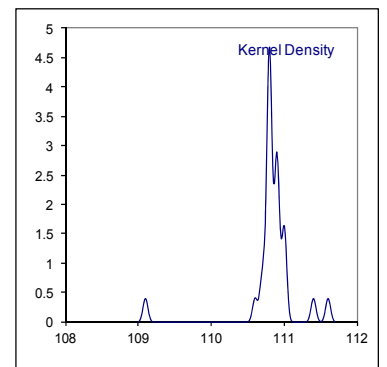
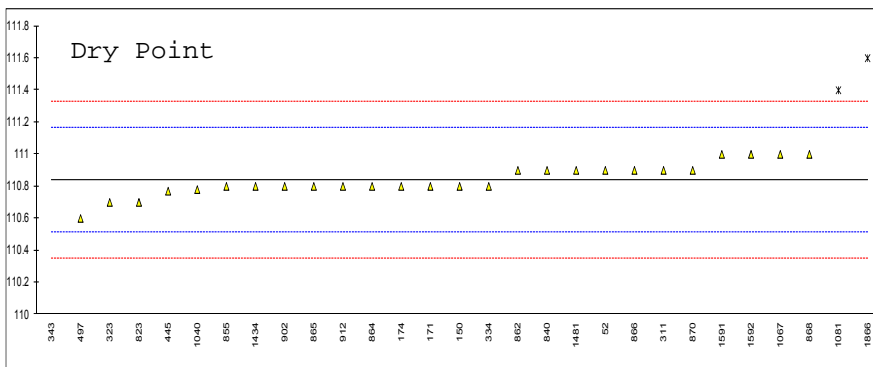
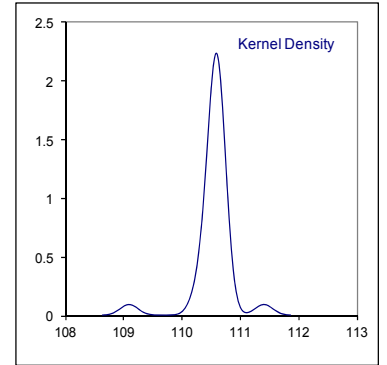
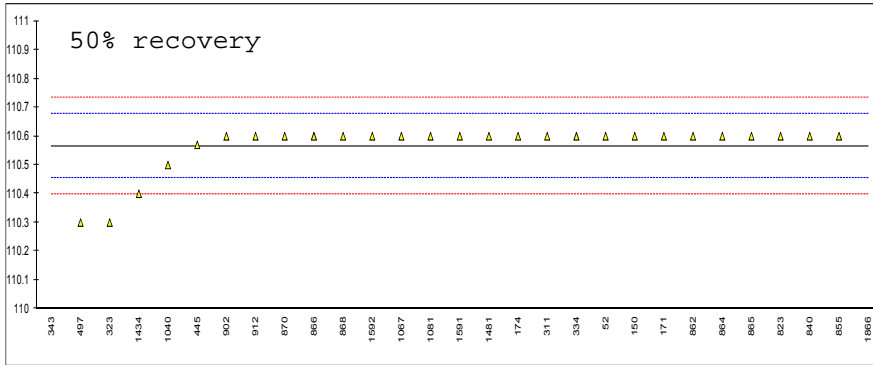
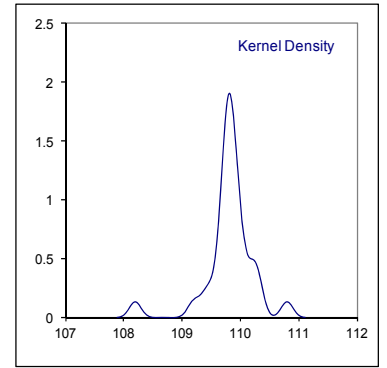
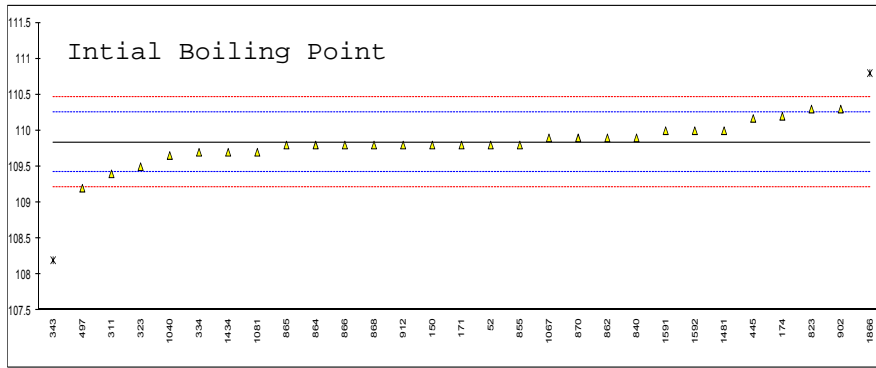
Determination of Distillation (automated and manual) on Toluene sample #13009; results in °C

lab	IBP	Mark	z(targ)	50%	mark	z(targ)	DP	mark	z(targ)	remarks
52	D850-A		-0.18	110.6		0.62	110.9		0.37	
150	D850-A		-0.18	110.6		0.62	110.8		-0.25	
171	D850-A		-0.18	110.6		0.62	110.8		-0.25	
174	D850-A		1.74	110.6		0.62	110.8		-0.25	
311	D850-A		-2.11	110.6		0.62	110.9		0.37	
323	D850-M		-1.63	110.3		-4.77	110.7		-0.86	
333			----	----		----	----		----	
334	D850-A		-0.66	110.6		0.62	110.8		-0.25	
343	D850-A	G(0.01)	-7.89	109.1	G(0.01)	-26.31	109.1	G(0.01)	-10.69	
396			----	----		----	----		----	
445	D850-M		1.60	110.57		0.08	110.77		-0.43	
497	D850-A		-3.07	110.3		-4.77	110.6		-1.48	
551			----	----		----	----		----	
555			----	----		----	----		----	
823	D850-A		2.23	110.6		0.62	110.7		-0.86	
840	D850-A		0.30	110.6		0.62	110.9		0.37	
855	D850-M		-0.18	110.6		0.62	110.8		-0.25	
862	D850-M		0.30	110.6		0.62	110.9		0.37	
864	D850-M		-0.18	110.6		0.62	110.8		-0.25	
865	D850-M		-0.18	110.6		0.62	110.8		-0.25	
866	D850-M		-0.18	110.6		0.62	110.9	fr ; 111.5	0.37	
868	D850-M		-0.18	110.6		0.62	111.0		0.98	
870	D850-M		0.30	110.6		0.62	110.9		0.37	
902	D850-M		2.23	110.6		0.62	110.8		-0.25	
912	D850-M		-0.18	110.6		0.62	110.8		-0.25	
913			----	----		----	----		----	
1040	DIN51761-M		-0.88	110.50		-1.18	110.78		-0.37	
1041			----	----		----	----		----	
1067	D850-M		0.30	110.6		0.62	111.0		0.98	
1081	D850-A		-0.66	110.6		0.62	111.4	G(0.01)	3.44	
1172			----	----		----	----		----	
1357			----	----		----	----		----	
1434	D850-A		-0.66	110.4		-2.97	110.8		-0.25	
1481	D850-M		0.78	110.6		0.62	110.9		0.37	
1538			----	----		----	----		----	
1591	D850-M		0.78	110.6		0.62	111.0		0.98	
1592	D850-M		0.78	110.6		0.62	111.0		0.98	
1812			----	----		----	----		----	
1866	D850-A	G(0.05)	4.64	111.4	G(0.01)	14.98	111.6	G(0.01)	4.66	
	normality									
	n	not OK		not OK			not OK			
	27			27			26			
	outliers			2			3			
	mean (n)			110.57			110.84			
	st.dev. (n)			0.087			0.100			
	R(calc.)			0.24			0.28			
	R(D850:11)			0.16			0.46			

Theoretical boiling mid point = 110.6 °C

After manual correction:

323	D850-M	109.8	-0.47	110.6	0.08	111.0	0.87
343	D850-A	109.7	-0.95	110.6	0.08	110.6	-1.59
1434	D850-A	109.9	0.01	110.6	0.08	111.0	0.87
1866	D850-A	110.0	0.50	110.6	0.08	110.8	-0.36
	normality						
	n	not OK		not OK		not OK	
	29			29		28	
	outliers	0		0		1	
	mean (n)	109.87		110.60		110.86	
	st.dev. (n)	0.2053		0.019		0.101	
	R(calc.)	0.57		0.05		0.28	
	R(D850:11)	0.58		0.16		0.46	

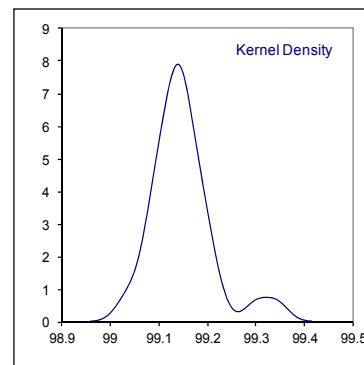
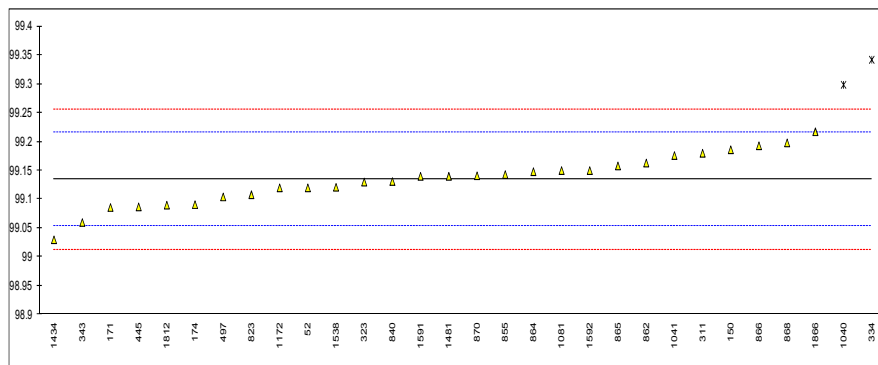


Determination of Purity on Toluene sample #13009; results in %M/M

lab	method	value	mark	z(targ)	remarks
52	D7504	99.120		-0.35	
150	D2360	99.186		1.27	
171	D2360	99.086		-1.19	
174	D2360	99.091		-1.06	
311	D2360	99.18		1.12	
323	D2360	99.130		-0.11	
333		----		----	
334	D2360	99.342	G(0.01)	5.10	
343	D2360	99.06		-1.83	
396		----		----	
445	D6526	99.087		-1.16	
497	D2360	99.1043		-0.74	
551		----		----	
555		----		----	
823	D2360	99.1081		-0.64	
840	D2360	99.131		-0.08	
855	D2360	99.143		0.21	
862	D2360	99.163		0.70	
864	D7504	99.148		0.34	
865	D7504	99.158		0.58	
866	D2360	99.193		1.44	
868	D2360	99.198		1.56	
870	D2360	99.141		0.16	
902		----		----	
912		----		----	
913		----		----	
1040	D2360	99.2986	G(0.01)	4.04	
1041	D2360	99.176		1.02	
1067		----		----	
1081	D2360	99.15		0.38	
1172	INH-2435	99.12		-0.35	
1357		----		----	
1434	D4492	99.03		-2.56	
1481	D6526	99.14		0.14	
1538	D2360	99.121		-0.33	
1591	D6526	99.14		0.14	
1592	D2360	99.15		0.38	
1812	in house	99.090		-1.09	
1866	D2360	99.2172		2.04	

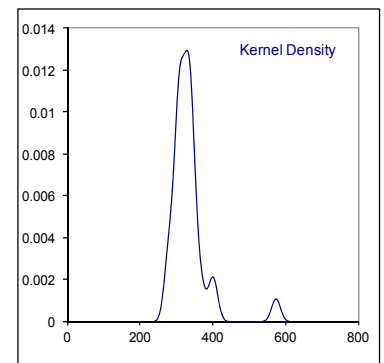
normality OK
n 28
outliers 2
mean (n) 99.1343
st.dev. (n) 0.04309
R(calc.) 0.1207
R(D6526:12) 0.1140

compare R(2360:11) = 0.0210 (see § 4.1)



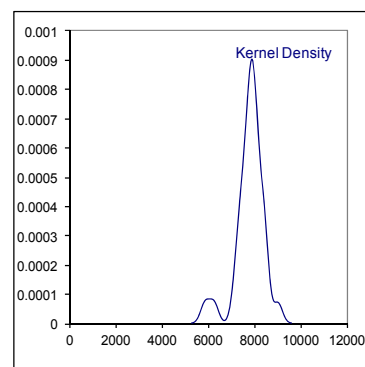
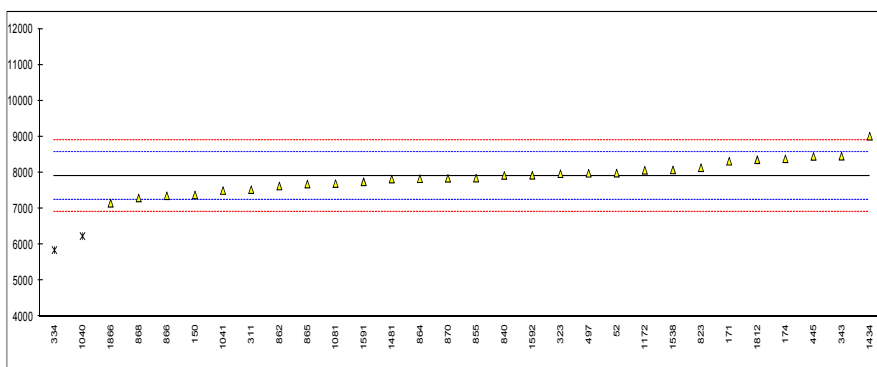
Determination of Non aromatics on Toluene sample #13009; results in mg/kg

lab	method	value	mark	z(targ)	remarks
52	D7504	340	C	0.25	first reported: 0.034
150	D2360	332		0.10	
171	D2360	404		1.40	
174	D2360	303		-0.42	
311	D2360	300		-0.47	
323	D2360	335	C	0.16	first reported: 504
333		----		----	
334	D2360	320	C	-0.11	first reported: 0.032
343	D2360	334.7		0.15	
396		----		----	
445	D6526	321		-0.09	
497	D2360	573	G(0.01)	4.43	
551		----		----	
555		----		----	
823	D2360	314		-0.22	
840	D2360	356		0.54	
855	D2360	310.8		-0.28	
862	D2360	350		0.43	
864	D7504	302		-0.43	
865	D7504	310		-0.29	
866	D2360	331		0.09	
868	D2360	340		0.25	
870	D2360	304.4		-0.39	
902		----		----	
912		----		----	
913		----		----	
1040	D2360	397.0		1.27	
1041	D2360	339.4		0.24	
1067		----		----	
1081	D2360	370		0.79	
1172	INH-2435	340		0.25	
1357		----		----	
1434	D4492	276		-0.90	
1481	D2360	310		-0.29	
1538	D2360	302		-0.43	
1591	D2360	280		-0.83	
1592	D2360	321	C	-0.09	first reported: 143
1812	in house	334		0.14	
1866	D2360	282.04		-0.79	
	normality	OK			
	n	29			
	outliers	1			
	mean (n)	326.18			
	st.dev. (n)	30.432			
	R(calc.)	85.21			
	R(D2360:11)	156.00			



Determination of Benzene on Toluene sample #13009; results in mg/kg

lab	method	value	mark	z(targ)	remarks
52	D7504	7990	C	0.25	first reported: 0.799
150	D2360	7384		-1.60	
171	D2360	8320		1.25	
174	D2360	8389		1.46	
311	D2360	7530		-1.16	
323	D2360	7973		0.19	
333		----		----	
334	D2360	5850	C,G(0.05)	-6.28	first reported: 0.585
343	D2360	8462		1.69	
396		----		----	
445	D6526	8455		1.67	
497	D2360	7987		0.24	
551		----		----	
555		----		----	
823	D2360	8140		0.70	
840	D2360	7925		0.05	
855	D2360	7851.2		-0.18	
862	D2360	7631		-0.85	
864	D7504	7835		-0.23	
865	D7504	7686		-0.68	
866	D2360	7361		-1.67	
868	D2360	7298		-1.86	
870	D2360	7846.5		-0.19	
902		----		----	
912		----		----	
913		----		----	
1040	D2360	6238.5	G(0.05)	-5.10	
1041	D2360	7506.1		-1.23	
1067		----		----	
1081	D2360	7698		-0.64	
1172	INH-2435	8070		0.49	
1357		----		----	
1434	D4492	9016.5		3.38	
1481	D6526	7825		-0.26	
1538	D2360	8080		0.52	
1591	D2360	7750		-0.49	
1592	D2360	7931		0.07	
1812	in house	8361		1.38	
1866	D2360	7153.8		-2.30	
normality		OK			
n		28			
outliers		2			
mean (n)		7909.11			
st.dev. (n)		412.860			
R(calc.)		1156.01			
R(Horwitz)		917.65			



APPENDIX 2

Number of participants in the Benzene PT

2 labs in BELGIUM
2 labs in BRAZIL
1 lab in CANADA
2 labs in FRANCE
4 labs in GERMANY
3 labs in INDIA
1 lab in ISRAEL
1 lab in KOREA
2 labs in KUWAIT
1 lab in MALAYSIA
9 labs in P.R. of CHINA
1 lab in PORTUGAL
3 labs in SAUDI ARABIA
1 lab in SLOVAKIA
1 lab in SPAIN
1 lab in THAILAND
5 labs in THE NETHERLANDS
1 lab in TURKEY
3 labs in U.S.A.
2 labs in UNITED KINGDOM

Number of participants in the Toluene PT

1 lab in BELGIUM
2 labs in BRAZIL
1 lab in CANADA
2 labs in FRANCE
4 labs in GERMANY
2 labs in INDIA
1 lab in ISRAEL
1 lab in ITALY
1 lab in KOREA
9 labs in P.R. of CHINA
1 lab in POLAND
1 lab in SAUDI ARABIA
1 lab in SPAIN
1 lab in SULTANATE of OMAN
5 labs in THE NETHERLANDS
1 lab in TURKEY
3 labs in U.S.A.
1 lab in UNITED KINGDOM
1 lab in VIETNAM

APPENDIX 3

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
fr	= first reported
E	= error in calculations
ex	= excluded from calculations
n.a.	= not applicable
fr	= first reported
U	= reported in different unit
SDS	= Safety Data Sheet

Literature:

- 1 iis Interlaboratory Studies, Protocol for the Organisation, Statistics & Evaluation, January 2010
- 2 W. Horwitz and R. Albert, J. AOAC Int., Vol. 79, 3, p. 589, (1996)
- 3 ASTM E178-02
- 4 ASTM E1301-03
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- 6 ISO 5725-86
- 7 ISO 5725, parts 1-6, 1994
- 8 M. Thompson and R. Wood, J. AOAC Int, 76, 926, (1993)
- 9 W.J. Youden and E.H. Steiner, Statistical Manual of the AOAC, (1975)
- 10 IP 367/84
- 11 DIN 38402 T41/42
- 12 P.L. Davies, Fr. Z. Anal. Chem, 331, 513, (1988)
- 13 J.N. Miller, Analyst, 118, 455, (1993)
- 14 Analytical Methods Committee Technical brief, No4 January 2001.
- 15 The Royal Society of Chemistry 2002, Analyst 2002, 127 page 1359-1364, P.J. Lowthian and M. Thompson (see <http://www.rsc.org/suppdata/an/b2/b205600n/>).