Results of Proficiency Test
Free and Released
Formaldehyde in textile
November 2015

Organised by: Institute for Interlaboratory Studies
Spijkenisse, the Netherlands

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Report: iis15A05T

December 2015

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1 INTRODUCTION

Since the 1990's, many countries have adopted environmental standards and requirements restricting the use of harmful chemicals in the production of textiles and clothing. Laws and regulations impose some of these standards and requirements. In addition to mandatory environmental standards and requirements for textiles, there are some Ecolabelling schemes imposing environmental requirements for textile products on a voluntary basis. Well known programs are for instance Milieukeur (the Netherlands), Öko-Tex Standard 100 (Germany) and Thai Green Label (Thailand).
Since 2008, the Institute for Interlaboratory Studies (iis) organises a proficiency scheme for Free Formaldehyde in textile, which was extended in 2013/2014 with a scheme for Released Formaldehyde. In the 2015/2016 program it was decided to organize both schemes again.
In the 2015/2016 interlaboratory study 194 laboratories in 42 different countries participated. See appendix 2 for the number of participating laboratories per country.
In this report, the results of the 2015 proficiency test are presented and discussed. This report is also electronically available through the iis internet site www.iisnl.com.

2 SET UP

The Institute for Interlaboratory Studies in Spijkenisse was the organiser of this proficiency test. Sample preparation and analyses of fit for use and homogeneity were subcontracted. The analyses for fit-for-use testing were subcontracted to an ISO17025 accredited laboratory. It was decided to use in this Proficiency Test two positive samples. Sample #15207 is approx. 3 grams and sample #15208 is approx. 2 gram. The participants were requested to report rounded and unrounded results. These unrounded results were preferably used for the statistical evaluations.

2.1 QUALITY SYSTEM

The Institute for Interlaboratory Studies in Spijkenisse, the Netherlands, is accredited in accordance with ISO/IEC 17043:2010, (R007), since January 2000, by the Dutch Accreditation Council (Raad voor Accreditatie, see also www.RVA.nl). This ensures strict adherence to protocols for sample preparation and statistical evaluation and 100% confidentially 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 April 2014 (iis-protocol, version 3.3). This protocol can be downloaded from the iis website www.iisnl.com, from the FAQ page.

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

Two batches each positive on (Free) Formaldehyde were selected. From the first batch, an uncoloured cotton, 200 subsamples of approx. 3 gram were prepared and labelled #15207. Each sample was packed in aluminium foil.
The homogeneity of the subsamples was checked on 7 stratified randomly selected samples. The homogeneity testing was performed by a subcontracted ISO17027 accredited laboratory. See the following tables for the test results.

	Free Formaldehyde in mg/kg
Sample #15207-1	28.5
Sample #15207-2	28.9
Sample #15207-3	30.0
Sample #15207-4	29.4
Sample #15207-5	30.0
Sample #15207-6	30.5
Sample #15207-7	30.8

Table 1: homogeneity test results of subsamples #15207

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

	Free Formaldehyde in mg/kg
r(observed)	2.3
reference	Horwitz
0.3 x R (reference)	2.4

Table 2: evaluation of the repeatability of the homogeneity test results

The calculated repeatability of subsamples #15207 is in good agreement with the target, estimated from the Horwitz equation. Therefore, homogeneity of the subsamples #15207 was assumed.

From the second batch, a blue coloured cotton, 200 subsamples of approx. 2 gram were prepared and labelled #15208. Each sample was packed in aluminium foil.
This sample was used in a previous proficiency test (iis12A04). The statistical evaluation of the group performance in the previous proficiency test proved the homogeneity of the sample. Therefore the homogeneity of the subsamples #15208 was assumed.

To the participants, a set of samples (1 sample labelled #15207 containing approx. 3 grams textile and 1 sample labelled #15208 containing approx. 2 grams textile) was sent on October 14, 2015.

2.5 ANALYSIS

The participants were asked to determine on both samples (#15207 and #15208) the Free Formaldehyde content and the Released Formaldehyde content with the analytical procedures that are routinely used in the laboratory.
It was requested to report the analytical results using the indicated units on the report form and to use a minimum number of digits and not to round the results more. It was also requested not to report ‘less than’ results, which are above the detection limit, because such results cannot be used for meaningful statistical calculations.
To get comparable results a detailed report form, on which the units were prescribed as well as the required standards and a letter of instructions were prepared and made available on the data entry portal www.kpmd.co.uk/sgs-iis-cts/. A form to confirm receipt of the samples and a letter of instructions were added to the samples.

3 RESULTS

During four weeks after sample despatch, the results of the individual laboratories were gathered via the data entry portal www.kpmd.co.uk/sgs-iis-cts/. The original data are tabulated per sample in the appendix 1 of this report. The laboratories are represented by the code numbers.
Directly after the deadline, a reminder was sent to those laboratories that did not report 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 the data analysis and the original results are placed under 'Remarks' in the result tables in appendix 1.

3.1 STATISTICS

The statistical calculations were performed as described in the procedures in the report ‘iis Interlaboratory Studies, Protocol for the Organisation, Statistics and Evaluation’ of April 2014 (iis-protocol, version 3.3).

First, the normality of the distribution of the various data sets per determination was checked by means of the Lilliefors-test a variant of the Kolmogorov-Smirnov test and by the calculation of skewness and kurtosis. Evaluation of the three normality indicators in combination with the visual evaluation of the graphic Kernel density plot, lead to judgement of the normality being either ‘unknown’, ‘OK’, ‘suspect’ or ‘not OK’.
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, Grubbs and or Rosner General ESD 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 and by R(0.01) for the Rosner General ESD test. Stragglers are marked by D(0.05) for the Dixon test, by G(0.05) or DG(0.05) for the Grubbs test and by R(0.05) for the Rosner General ESD test (ref. 17). 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.

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 significant consequences for the evaluation of the test results.

3.2 GRAPHICS

In order to visualise the data against the reproducibilities from literature, Gauss plots were made, using the sorted data for one determination (see appendix 1). On the Y-axis the reported analysis results are plotted. The corresponding laboratory numbers are under the X-axis.
The straight horizontal line presents the consensus value (a trimmed mean). The four striped lines, parallel to the consensus value line, are the +3s, +2s, -2s and -3s target reproducibility limits of the selected standard. Outliers and other data, which were excluded from the calculations, are represented as a cross. Accepted data are represented as a triangle. Furthermore, Kernel Density Graphs were made. This is a method for producing a smooth density approximation to a set of data that avoids some problems associated with histograms (see appendix 5; nr.14 and 15). Also a normal Gauss curve was projected over the Kernel Density Graph for reference.

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, the z-scores were calculated using a target standard deviation. This results in an evaluation independent of the spread of this interlaboratory study.

The target standard deviation was calculated from the target reproducibility (preferably taken from a standardized test method) by division with 2.8.
The z-scores were calculated in accordance with:

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

The $z_{(target)}$ scores are listed in the result tables in appendix 1.

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 should be done in order to evaluate whether the reported test results are fit-for-purpose.

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

During the execution of this proficiency test no problems occurred with the delivery of the samples. Two laboratories did not report any test results and five laboratories reported results after the final reporting date.
Finally, the 192 reporting laboratories sent in total 415 numerical results. Observed were 14 statistical outlying results, which is 3.4% of the numerical results. In proficiency studies, outlier percentages of 3% - 7.5% are quite normal.

In ISO14184-1:11 some information on precision data is given. In table B.1 of this method “approximate accuracy” values are mentioned. These values are probably the calculated repeatability standard deviations. Note also that under table B.1 is mentioned “that the method in this part of ISO14184 uses a different calibration graph from that used in the determination of the above-mentioned results”. Therefore it was concluded that reliable reproducibility data cannot be estimated and therefore target reproducibilities estimated from the Horwitz equation were used for evaluation.

Also in ISO14184-2:11 some information on precision data is given. In tables C.1 and C.2 of this method critical differences are given for zero-formaldehyde fabrics and for low-level-formaldehyde fabrics (100 – 400 mg/kg). The given reproducibilities are divided between ‘single fabric’ and ‘multiple fabric’. ”. Therefore it was concluded that reliable reproducibility data cannot be estimated and therefore target reproducibilities estimated from the Horwitz equation were used for evaluation.

4.1 EVALUATION PER SAMPLE

In this section, the reported results are discussed per test and per sample. All statistical results reported on the textile samples are summarised in appendix 1.

Not all original data sets proved to have a normal Gaussian distribution. These are referred to as “not OK” or “suspect”. The statistical evaluation of these data sets should be used with due care.

#15207:

Free Formaldehyde content: This determination was problematic for a number of laboratories. Eight statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in full agreement with the estimated reproducibility calculated using the Horwitz equation.

Released Formaldehyde: This determination was very problematic. No statistical outliers were observed. Three results were excluded from statistical evaluation, as the reported test method is for the determination of Free Formaldehyde. The calculated reproducibility after rejection of the suspect data is not at all in agreement with the estimated reproducibility calculated using the Horwitz equation.

#15208:

Free Formaldehyde content: This determination may be problematic. Four statistical outliers were observed. The calculated reproducibility after rejection of the statistical outliers is not in agreement with the estimated reproducibility calculated using the Horwitz equation.

Released Formaldehyde: This determination was very problematic. Two statistical outliers were observed and two results were excluded from statistical evaluation, as the reported test method is for the determination of Free Formaldehyde. The calculated reproducibility after rejection of the suspect data is not at all in agreement with the estimated reproducibility calculated using the Horwitz equation.

4.2 PERFORMANCE EVALUATION FOR THE GROUP OF LABORATORIES

A comparison has been made between the calculated reproducibilities using the Horwitz equation and the reproducibilities as found for the group of participating laboratories. The number of significant results, the average results, the calculated reproducibilities (standard deviation*2.8) and the target reproducibilities (Horwitz equation), are compared in the next table.

Parameter	unit	n	average	2.8 * sd	R (target)
Free Formaldehyde	mg/kg	182	46.1	11.0	11.6
Released Formaldehyde	mg/kg	19	73.9	45.2	17.3

Table 3: reproducibilities of textile sample #15207

Parameter	unit	n	average	2.8 * sd	R (target)
Free Formaldehyde	mg/kg	181	109.3	29.8	24.2
Released Formaldehyde	mg/kg	14	319	151	60

Table 4: reproducibilities of textile sample #15208

From the above tables it can be concluded that, without further statistical calculations, the group of participating laboratories do not have much difficulties with the analysis of Free Formaldehyde but with the analysis of released formaldehyde the laboratories do have large difficulties when the calculated target results are compared with the Horwitz equation. See also the discussions in paragraphs 4.1 and 6.

5 COMPARISON WITH THE PREVIOUS PROFICIENCY TESTS

The spreads, present in the results for the two samples with Free Formaldehyde during the present PT, are fully in line with the spreads as observed in previous iis PTs (see below table).

Parameter	October 2015	October 2014	October 2013	October 2012	October 2009 - 2011
Free Formaldehyde	9-10%	8%	10-13%	8-9%	7-15%
Released Formaldehyde	17-22%	10%	9-10%	n.e.	n.e.

Table 5: Development of relative uncertainties over the years

6 DISCUSSION

When the results of this interlaboratory study were compared to the Ecolabelling Standards and Requirements for Textiles in EU (table 6), it was noticed that not all participants would make identical decisions about the acceptability of the textiles for the determined parameters.

Ecolabel	baby clothes	Öko-Tex 103 no direct skin contact	Öko-Tex 103 in direct skin contact	Decoration material
Free Formaldehyde extractable (mg/kg)	<16	300	75	300
Released Formaldehyde (mg/m^3)	0.1	0.1	0.1	0.1

Table 6: Ecolabelling Standards and Requirements for Textiles in EU

The method for determination of the Free Formaldehyde is specified in the Standards of the Ecolabelling Institutes.
It should be noticed that ISO14184-1 corresponds to the Japanese method specified in the Japanese Law 112 and is described in the Japanese Standard JIS L1096.

Extractable free formaldehyde:
For sample #15207, all reporting laboratories would accept the sample for the categories “Öko-Tex 103 no direct skin contact” and “Decoration material” (<300 mg/kg). All reporting laboratories, except three, would accept the sample for the category “Öko-Tex 103 direct skin contact” (<75 mg/kg). All reporting laboratories, except one, would reject the sample for the category “Baby clothes” (<16 mg/kg).

For sample #15208, all reporting laboratories, except one, would accept the sample for the categories “Öko-Tex 103 no direct skin contact” and “Decoration material” (<300 mg/kg). All reporting laboratories, except two, would reject the sample for the categories “Baby clothes” (<16 mg/kg) and “Öko-Tex 103 direct skin contact” (<75 mg/kg).

Released Formaldehyde:
No conclusions can be drawn, as the limits mentioned in the Ecolabel Standard have a different unit compared with test method ISO14184-2:11 (mg/m^3 vs mg/kg).

6.1 GENERAL CONCLUSION

In this proficiency test the Free Formaldehyde content and the Released Formaldehyde were determined. The spread observed for the Free Formaldehyde content and the Released Formaldehyde in this interlaboratory study are in line with the previous proficiency tests. The spread observed in this interlaboratory study can be caused by the preparation or the conditioning of the sample and/or by the performance of the analysis. Consequently, the reproducibility cannot be improved by only one change in the analysis. Each laboratory has to evaluate its performance in this study and make decisions about necessary corrective actions. Therefore, participation on a regular basis in this scheme could be helpful to improve the performance and thus increase of the quality of the analytical results.

APPENDIX 1

Determination of Free Formaldehyde content on sample #15207; results in mg/kg

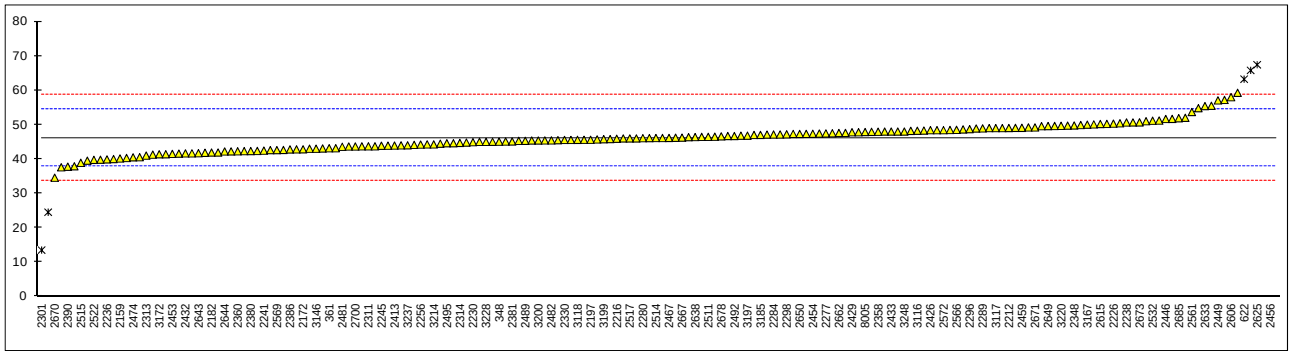
lab	Method	value	mark	z(targ)	lab	method	value	mark	z(targ)
110	JIS L1041B	44.117		-0.48	2368	ISO14184-1	46.37		0.06
213	ISO14184-1	99.1	R(0.01)	12.78	2373	ISO14184-1	48.89		0.67
230	ISO14184-1	46.7		0.14	2379	ISO14184-1	44.47		-0.40
348	In house	45.06		-0.26	2380	ISO14184-1	42.33		-0.91
361	ISO14184-1	43.15		-0.72	2381	ISO14184-1	45.12		-0.24
551	ISO14184-1	42.81		-0.80	2386	ISO14184-1	42.8	C	-0.80
622	ISO14184-1	63.24	R(0.01)	4.13	2389	ISO14184-1	45.6		-0.13
632	ISO14184-1	167.8958	R(0.01)	29.38	2390	ISO14184-1	37.77		-2.01
826	ISO14184-1	47.3		0.28	2401	ISO14184-1	50.9995		1.18
1051	GB/T2912	47.92		0.43	2403	ISO14184-1	51.6820		1.34
2102		-----		-----	2404	ISO14184-1	48.29		0.52
2115	ISO14184-1	43.08		-0.73	2410	ISO14184-1	45.02		-0.27
2129	ISO14184-1	40.30		-1.40	2413	ISO14184-1	43.92		-0.53
2132	ISO14184-1	47.32		0.29	2415	ISO14184-1	45.4		-0.17
2137	ISO14184-1	43.64		-0.60	2426	ISO14184-1	48.4		0.55
2138	ISO14184-1	41.66		-1.08	2429	ISO14184-1	47.8		0.41
2139	ISO14184-1	50.66		1.10	2432	ISO14184-1	41.64		-1.08
2146	ISO14184-1	43.98		-0.52	2433	ISO14184-1	48.00		0.45
2156	ISO14184-1	47.12		0.24	2442	ISO14184-1	47.15		0.25
2159	ISO14184-1	40.17		-1.44	2446	In house	51.65		1.33
2165	ISO14184-1	45.0		-0.27	2449	ISO14184-1	57.06		2.64
2170	ISO14184-1	55.5		2.26	2453	ISO14184-1	41.50		-1.11
2172	ISO14184-1	42.83		-0.79	2454	ISO14184-1	47.36		0.30
2182	ISO14184-1	41.9		-1.02	2456	ISO14184-1	133.4	C,R(0.01)	21.05
2184	ISO14184-1	47.6		0.36	2459	ISO14184-1	49.085		0.72
2186		-----		-----	2460	ISO14184-1	40.54	C	-1.35
2190	ISO14184-1	51.2		1.23	2467	ISO14184-1	46.14		0.00
2197	ISO14184-1	45.6		-0.13	2474	ISO14184-1	40.50		-1.36
2201	ISO14184-1	46.44		0.08	2475	ISO14184-1	43.15		-0.72
2212	JIS L1041B	49.02		0.70	2476	ISO14184-1	46.12		0.00
2216	JIS L1041B	45.91		-0.05	2481	ISO14184-1	43.56	C	-0.62
2217	ISO14184-1	45.41		-0.17	2482	ISO14184-1	45.43		-0.17
2225	ISO14184-1	48.0		0.45	2483	ISO14184-1	49		0.69
2226	ISO14184-1	50.30		1.01	2489	ISO14184-1	45.3		-0.20
2229	ISO14184-1	45.48		-0.15	2492	In house	46.7		0.14
2230	ISO14184-1	44.9		-0.29	2495	ISO14184-1	44.6		-0.37
2236	ISO14184-1	39.90		-1.50	2497	ISO14184-1	59.27		3.17
2238	ISO14184-1	50.64		1.09	2500	ISO14184-1	48.4		0.55
2241	ISO14184-1	42.45		-0.89	2506	ISO14184-1	41.82		-1.04
2245	ISO14184-1	43.87		-0.54	2511	GB/T2912	46.45		0.08
2246	ISO14184-1	46		-0.03	2514	ISO14184-1	46.11		0.00
2255	ISO14184-1	47.8		0.41	2515	ISO14184-1	38.896		-1.74
2256	ISO14184-1	44.2		-0.46	2517	ISO14184-1	46.0		-0.03
2264	GB/T2912	41.9		-1.02	2519	ISO14184-1	43.7		-0.58
2269	ISO14184-1	49.076		0.71	2522	ISO14184-1	39.77		-1.53
2272	ISO14184-1	40.0		-1.48	2532	ISO14184-1	51.15		1.21
2275	ISO14184-1	48.2		0.50	2534	ISO14184-1	49.2		0.74
2277	ISO14184-1	47.45		0.32	2535	ISO14184-1	52		1.42
2279	ISO14184-1	48		0.45	2540	ISO14184-1	49.62		0.84
2280	ISO14184-1	46.07		-0.01	2559	ISO14184-1	65.8	C,R(0.01)	4.75
2282	ISO14184-1	46.1		0.00	2561	ISO14184-1	53.68		1.82
2284	ISO14184-1	47.14		0.25	2563		-----		-----
2289	ISO14184-1	48.92		0.68	2566	JIS B	48.5	C	0.57
2290	ISO14184-1	49.73		0.87	2567		-----		-----
2292	ISO14184-1	45.8075		-0.08	2569	ISO14184-1	42.6		-0.85
2293	ISO14184-1	49.564		0.83	2572	ISO14184-1	48.4		0.55
2294	ISO14184-1	37.9		-1.98	2582	ISO14184-1	39.80		-1.52
2295	ISO14184-1	46.5	C	0.09	2589	ISO14184-1	47.01		0.21
2296	ISO14184-1	48.70		0.62	2590	ISO14184-1	45.1		-0.25
2298	JIS L1041B	47.2		0.26	2591	In house	39.53		-1.59
2301	ISO14184-1	13.51	R(0.01)	-7.87	2602	LFGB B 82.02-1	44.8		-0.32
2310	ISO14184-1	42.3		-0.92	2606	ISO14184-1	58	C	2.87
2311	ISO14184-1	43.7		-0.58	2615	ISO14184-1	50.20		0.98
2313	ISO14184-1	41.0		-1.24	2625	ISO14184-1	67.43	R(0.01)	5.14
2314	ISO14184-1	44.69		-0.35	2629	ISO14184-1	50.40		1.03
2330	ISO14184-1	45.55		-0.14	2633	GB/T2912	55.4		2.24
2348	ISO14184-1	49.77		0.88	2638	ISO14184-1	46.391		0.07
2351	ISO14184-1	45.28		-0.20	2643	ISO14184-1	41.7		-1.07
2356	ISO14184-1	42.6		-0.85	2644	ISO14184-1	42.2	C	-0.95
2358	ISO14184-1	47.94		0.44	2649	ISO14184-1	49.60		0.84
2360	ISO14184-1	42.25		-0.93	2650	ISO14184-1	47.3		0.28
2361	Japan ST2012	46.8		0.16	2654	ISO14184-1	41.28		-1.17
2363	ISO14184-1	43		-0.75	2662	ISO14184-1	47.58		0.35
2364	ISO14184-1	43.89		-0.54	2667	ISO14184-1	46.23		0.03
2366	ISO14184-1	49.9		0.91	2670	ISO14184-1	34.56		-2.79
2367	ISO14184-1	42.64		-0.84	2671	ISO14184-1	49.2	C	0.74

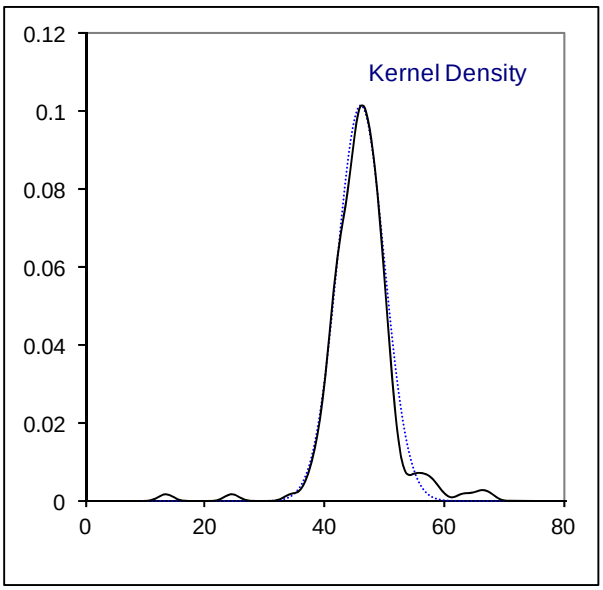
2672	ISO14184-1	45.70	-0.10	3176	ISO14184-1	42.23		-0.94
2673	ISO14184-1	50.67	1.10	3182	ISO14184-1	49.0		0.69
2678	ISO14184-1	46.6	0.12	3185	ISO14184-1	47.02		0.22
2685	ISO14184-1	51.88	1.39	3186	ISO14184-1	41.4		-1.14
2700	ISO14184-1	43.65	-0.60	3190	ISO14184-1	50.08		0.96
2702	ISO14184-1	48.45	0.56	3191	ISO14184-1	45.55		-0.14
2703	ISO14184-1	54.8	2.09	3195	ISO14184-1	46		-0.03
2712	ISO14184-1	44.6	-0.37	3197	ISO14184-1	46.8		0.16
3110	ISO14184-1	43.69	-0.59	3199	ISO14184-1	45.78		-0.08
3116	ISO14184-1	48.24	0.51	3200	ISO14184-1	45.4		-0.17
3117	ISO14184-1	49.0	0.69	3207	JIS L1041B	46.2		0.02
3118	ISO14184-1	45.59	-0.13	3210	ISO14184-1	47.5		0.33
3145	LFGB B 82.02-1	50.22	0.99	3214	ISO14184-1	44.26		-0.45
3146	ISO14184-1	43.0	-0.75	3216	ISO14184-1	24.53	R(0.01)	-5.21
3149	ISO14184-1	57.2	2.67	3218	ISO14184-1	48.62		0.60
3150	ISO14184-1	37.6	-2.06	3220	ISO14184-1	49.66		0.85
3153	ISO14184-1	44.26	-0.45	3225	ISO14184-1	47.41		0.31
3154	ISO14184-1	41.5735	-1.10	3228	ISO14184-1	45		-0.27
3166	ISO14184-1	42.35	-0.91	3237	ISO14184-1	43.99	C	-0.51
3167	ISO14184-1	50	0.94	3248	GB/T2912	48		0.45
3172	ISO14184-1	41.39	-1.14	8005	JIS L1041B	47.86		0.42

normality	suspect
n	182
outliers	8
mean (n)	46.120
st.dev. (n)	3.9372
R(calc.)	11.024
R(Horwitz)	11.607

Lab 2295: first reported 33.3
Lab 2386: first reported 42.8
Lab 2456: first reported 66.7
Lab 2460: first reported 32.59
Lab 2481: first reported 42.17
Lab 2559: first reported 60.2

Lab 2566: first reported 105.6
Lab 2606: first reported 85
Lab 2644: first reported 21.1
Lab 2671: first reported 104.5
Lab 3237: first reported 37.05





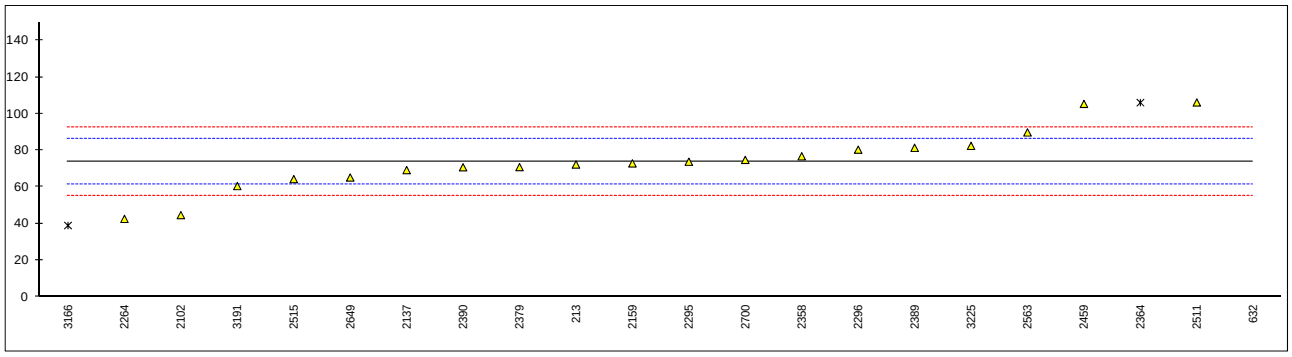
Determination of Released Formaldehyde content on sample #15207; results in mg/kg

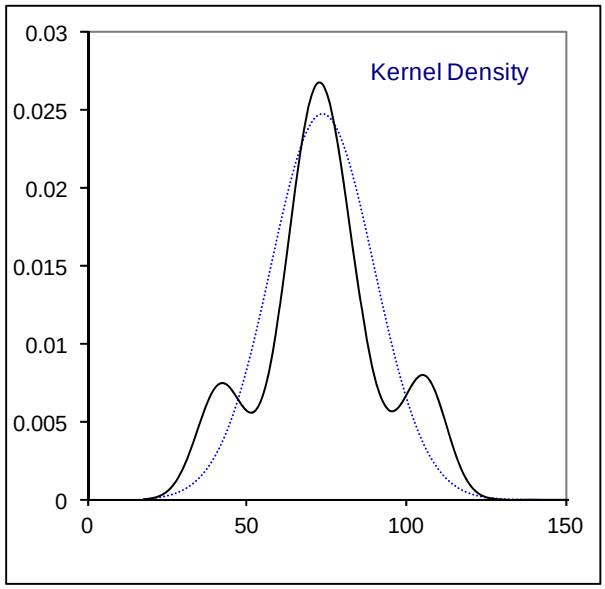
lab	method	value	mark	z(targ)	lab	method	value	mark	z(targ)
110		-----		-----	2368		-----		-----
213	ISO14184-2	72.3		-0.26	2373		-----		-----
230		-----		-----	2379	ISO14184-2	70.87		-0.49
348		-----		-----	2380		-----		-----
361		-----		-----	2381		-----		-----
551		-----		-----	2386		-----		-----
622		-----		-----	2389	ISO14184-2	81.4		1.21
632	ISO14184-1	443.0532	ex	59.64	2390	ISO14184-2	70.8		-0.50
826		-----		-----	2401		-----		-----
1051		-----		-----	2403		-----		-----
2102	In house	44.68		-4.72	2404		-----		-----
2115		-----		-----	2410		-----		-----
2129		-----		-----	2413		-----		-----
2132		-----		-----	2415		-----		-----
2137	ISO14184-2	69.25		-0.75	2426		-----		-----
2138		-----		-----	2429		-----		-----
2139		-----		-----	2432		-----		-----
2146		-----		-----	2433		-----		-----
2156		-----		-----	2442		-----		-----
2159	ISO14184-2	72.91		-0.16	2446		-----		-----
2165		-----		-----	2449		-----		-----
2170		-----		-----	2453		-----		-----
2172		-----		-----	2454		-----	W	-----
2182		-----		-----	2456		-----		-----
2184		-----		-----	2459	ISO14184-2	105.37		5.08
2186		-----		-----	2460		-----		-----
2190		-----		-----	2467		-----		-----
2197		-----		-----	2474		-----		-----
2201		-----		-----	2475		-----		-----
2212		-----		-----	2476		-----		-----
2216		-----		-----	2481		-----		-----
2217		-----		-----	2482		-----		-----
2225		-----		-----	2483		-----		-----
2226		-----		-----	2489		-----		-----
2229		-----	W	-----	2492		-----		-----
2230		-----		-----	2495		-----		-----
2236		-----		-----	2497		-----		-----
2238		-----		-----	2500		-----		-----
2241		-----		-----	2506		-----		-----
2245		-----		-----	2511	GB/T2912	106.15		5.21
2246		-----		-----	2514		-----		-----
2255		-----		-----	2515	AATCC112	64.335		-1.55
2256		-----		-----	2517		-----		-----
2264	JIS L1041	42.64		-5.05	2519		-----		-----
2269		-----		-----	2522		-----		-----
2272		-----		-----	2532		-----		-----
2275		-----		-----	2534		-----		-----
2277		-----		-----	2535		-----		-----
2279		-----		-----	2540		-----		-----
2280		-----		-----	2559		-----		-----
2282		-----		-----	2561		-----		-----
2284		-----		-----	2563	ISO14184-1	89.8	C,ex	2.57
2289		-----		-----	2566		-----		-----
2290		-----		-----	2567		-----		-----
2292		-----		-----	2569		-----		-----
2293		-----		-----	2572		-----		-----
2294		-----		-----	2582		-----		-----
2295	ISO14184-2	73.8		-0.02	2589		-----		-----
2296	ISO14184-2	80.41		1.05	2590		-----		-----
2298		-----		-----	2591		-----		-----
2301		-----		-----	2602		-----		-----
2310		-----		-----	2606		-----		-----
2311		-----		-----	2615		-----		-----
2313		-----		-----	2625		-----		-----
2314		-----		-----	2629		-----		-----
2330		-----		-----	2633		-----		-----
2348		-----		-----	2638		-----		-----
2351		-----		-----	2643		-----		-----
2356		-----		-----	2644		-----		-----
2358	ISO14184-2	76.80		0.47	2649	ISO14184-2	65.2		-1.41
2360		-----		-----	2650		-----	W	-----
2361		-----		-----	2654		-----		-----
2363		-----		-----	2662		-----		-----
2364	ISO14184-1	106.03	ex	5.19	2667		-----		-----
2366		-----		-----	2670		-----		-----
2367		-----		-----	2671		-----		-----
2672		-----		-----	3176		-----		-----

2673		-----		-----	3182		-----	-----
2678		-----		-----	3185		-----	-----
2685		-----		-----	3186		-----	-----
2700	AATCC112	74.80		0.14	3190		-----	-----
2702		-----		-----	3191	ISO14184-2	60.54	-2.16
2703		-----		-----	3195		-----	-----
2712		-----		-----	3197		-----	-----
3110		-----		-----	3199		-----	-----
3116		-----		-----	3200		-----	-----
3117		-----		-----	3207		-----	-----
3118		-----		-----	3210		-----	-----
3145		-----		-----	3214		-----	-----
3146		-----		-----	3216		-----	-----
3149		-----		-----	3218		-----	-----
3150		-----		-----	3220		-----	-----
3153		-----		-----	3225	ISO14184-2	82.45	1.38
3154		-----		-----	3228		-----	-----
3166	ISO14184-1	39	ex	-5.64	3237		-----	-----
3167		-----		-----	3248		-----	-----
3172		-----		-----	8005		-----	-----

normality	OK
n	19
outliers	0 (+3 excl)
mean (n)	73.921
st.dev. (n)	16.1328
R(calc.)	45.172
R(Horwitz)	17.329

Lab 2229: results withdrawn: reported 45.48
Lab 2454: results withdrawn: reported 47.73
Lab 2563: first reported 43.4, result excluded as test method is for free formaldehyde
Lab 2650: results withdrawn: reported 45.8
Lab 632: result excluded as test method is for free formaldehyde
Lab 3166: result excluded as test method is for free formaldehyde





Determination of Free Formaldehyde content on sample #15208; results in mg/kg

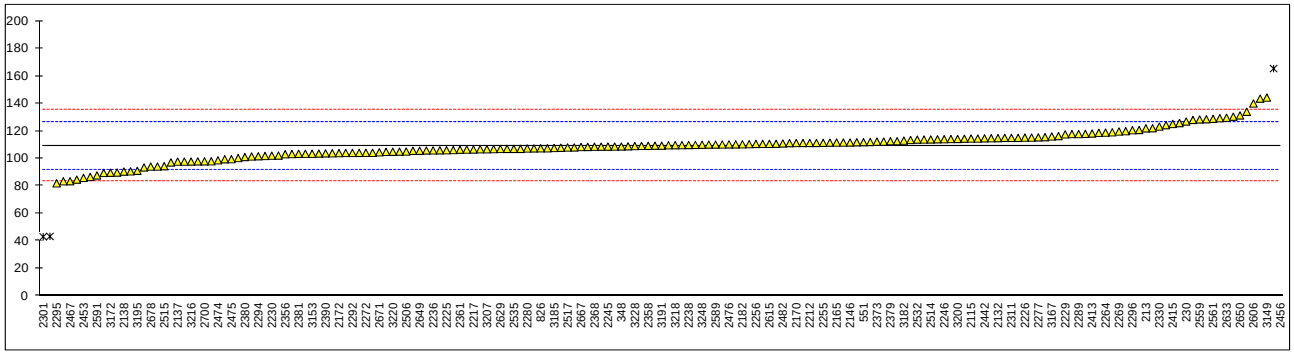
lab	method	value	mark	z(targ)	lab	method	value	mark	z(targ)
110	JIS L1041B	103.196		-0.71	2368	ISO14184-1	108.54		-0.09
213	ISO14184-1	121.9		1.46	2373	ISO14184-1	112.26		0.34
230	ISO14184-1	126.9		2.04	2379	ISO14184-1	112.56		0.38
348	In house	108.72		-0.07	2380	ISO14184-1	101.01		-0.96
361	ISO14184-1	105.93		-0.39	2381	ISO14184-1	103.39		-0.69
551	ISO14184-1	111.87		0.30	2386	ISO14184-1	83.4		-3.00
622	ISO14184-1	43.31	R(0.01)	-7.65	2389	ISO14184-1	111.5		0.25
632		-----		-----	2390	ISO14184-1	103.69		-0.65
826	ISO14184-1	107.4		-0.22	2401	ISO14184-1	104.9990		-0.50
1051	GB/T2912	119.02		1.12	2403	ISO14184-1	112.5620		0.38
2102		-----		-----	2404	ISO14184-1	109.10		-0.03
2115	ISO14184-1	114.49		0.60	2410	ISO14184-1	103.45		-0.68
2129	ISO14184-1	128.05		2.17	2413	ISO14184-1	118.15		1.02
2132	ISO14184-1	114.79		0.63	2415	ISO14184-1	125.1		1.83
2137	ISO14184-1	97.70		-1.35	2426	ISO14184-1	108.0		-0.15
2138	ISO14184-1	90.47		-2.18	2429	ISO14184-1	115.0		0.66
2139	ISO14184-1	108.83		-0.06	2432	ISO14184-1	97.87		-1.33
2146	ISO14184-1	111.62		0.27	2433	ISO14184-1	110.40		0.13
2156	ISO14184-1	119.84		1.22	2442	ISO14184-1	114.66		0.62
2159	ISO14184-1	94.13		-1.76	2446	In house	115.0		0.66
2165	ISO14184-1	111.6		0.26	2449	ISO14184-1	113.78		0.52
2170	ISO14184-1	111.2		0.22	2453	ISO14184-1	85.84		-2.72
2172	ISO14184-1	103.9		-0.63	2454	ISO14184-1	106.80		-0.29
2182	Japan ST2012	110.3		0.11	2456	ISO14184-1	308.4	C,R(0.01)	23.07
2184	ISO14184-1	112.0		0.31	2459		-----		-----
2186		-----		-----	2460	ISO14184-1	97.73		-1.34
2190	ISO14184-1	130.4		2.44	2467	ISO14184-1	83.43		-3.00
2197	ISO14184-1	122.0		1.47	2474	ISO14184-1	98.63		-1.24
2201	ISO14184-2	109.69		0.04	2475	ISO14184-1	99.49		-1.14
2212	JIS L1041B	111.30		0.23	2476	ISO14184-1	110.25		0.11
2216	JIS L1041B	117.73		0.97	2481	ISO14184-1	109.29	C	0.00
2217	ISO14184-1	106.52		-0.32	2482	ISO14184-1	110.94		0.19
2225	ISO14184-1	106.0		-0.38	2483	ISO14184-1	115.5		0.72
2226	ISO14184-1	115.17		0.68	2489	ISO14184-1	114.4		0.59
2229	ISO14184-1	117.52		0.95	2492	In house	114.7		0.62
2230	ISO14184-1	102.0		-0.85	2495	ISO14184-1	102.1		-0.84
2236	ISO14184-1	105.84		-0.40	2497	ISO14184-1	143.55	C	3.97
2238	ISO14184-1	109.79		0.05	2500	ISO14184-1	111.3		0.23
2241	ISO14184-1	107.30		-0.23	2506	ISO14184-1	105.03		-0.50
2245	ISO14184-1	108.63		-0.08	2511		-----		-----
2246	ISO14184-1	114		0.54	2514	ISO14184-1	113.83		0.52
2255	ISO14184-1	111.4		0.24	2515	ISO14184-1	94.398		-1.73
2256	ISO14184-1	110.6		0.15	2517	ISO14184-1	107.97		-0.16
2264	GB/T2912	118.8		1.10	2519	ISO14184-1	120.7		1.32
2269	ISO14184-1	119.609		1.19	2522	ISO14184-1	106.47		-0.33
2272	ISO14184-1	104.1		-0.60	2532	ISO14184-1	113.7		0.51
2275	ISO14184-1	110.1		0.09	2534	ISO14184-1	114.5		0.60
2277	ISO14184-1	115.36		0.70	2535	ISO14184-1	107		-0.27
2279	ISO14184-1	107		-0.27	2540	ISO14184-1	111.77		0.28
2280	ISO14184-1	107.28		-0.24	2559	ISO14184-1	128.4		2.21
2282	ISO14184-1	107.8		-0.18	2561	ISO14184-1	128.87		2.27
2284	ISO14184-1	108.65		-0.08	2563		-----		-----
2289	ISO14184-1	117.75		0.98	2566	JIS B	105.6	C	-0.43
2290	ISO14184-1	113.41		0.47	2567		-----		-----
2292	ISO14184-1	104.029		-0.61	2569	ISO14184-1	106.7		-0.30
2293	ISO14184-1	116.273		0.81	2572	ISO14184-1	112.3		0.35
2294	ISO14184-1	101.6		-0.89	2582	ISO14184-1	89.76	C	-2.27
2295	ISO14184-1	81.9		-3.18	2589	ISO14184-1	110.11		0.09
2296	ISO14184-1	120.52		1.30	2590	ISO14184-1	97.1		-1.42
2298	JIS L1041B	110.7		0.16	2591	In house	87.65		-2.51
2301	ISO14184-1	43.05	R(0.01)	-7.68	2602	LFGB B 82.02-1	104.1		-0.60
2310	ISO14184-1	111.6		0.26	2606	ISO14184-1	140		3.56
2311	ISO14184-1	115		0.66	2615	ISO14184-1	110.64		0.15
2313	ISO14184-1	108.4		-0.11	2625	ISO14184-1	165.37	R(0.01)	6.50
2314	ISO14184-1	111.27		0.23	2629	ISO14184-1	106.90		-0.28
2330	ISO14184-1	123.19		1.61	2633	GB/T2912	129.6		2.35
2348	ISO14184-1	124.23		1.73	2638	ISO14184-1	97.969		-1.32
2351	ISO14184-1	125.74		1.90	2643	ISO14184-1	90.6		-2.17
2356	ISO14184-1	103.1		-0.72	2644	GB/T2912	107.4	C	-0.22
2358	ISO14184-1	109.21		-0.01	2649	ISO14184-1	105.60		-0.43
2360	ISO14184-1	101.47		-0.91	2650	ISO14184-1	131.3		2.55
2361	Japan ST2012	106.4		-0.34	2654	ISO14184-1	93.46		-1.84
2363	ISO14184-1	110.2		0.10	2662	ISO14184-1	118.66		1.08
2364		-----		-----	2667	ISO14184-1	108.32		-0.12
2366	ISO14184-1	104.8		-0.52	2670	ISO14184-1	89.46		-2.30
2367	ISO14184-1	115.21		0.68	2671	ISO14184-1	104.5	C	-0.56
2672	ISO14184-1	106.1		-0.37	3176	ISO14184-1	110.63		0.15

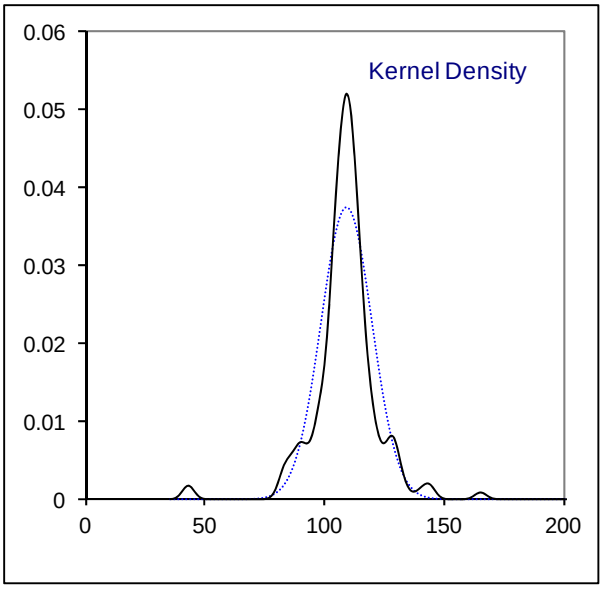
2673	ISO14184-1	117.90		0.99	3182	ISO14184-1	113.0		0.43
2678	ISO14184-1	94.1		-1.76	3185	ISO14184-1	107.59		-0.20
2685	ISO14184-1	103.79		-0.64	3186	ISO14184-1	105.8		-0.41
2700	ISO14184-1	97.91		-1.32	3190	ISO14184-1	114.12		0.56
2702	ISO14184-1	110.26		0.11	3191	ISO14184-1	109.29		0.00
2703	ISO14184-1	134.0		2.86	3195	ISO14184-1	91		-2.12
2712		-----		-----	3197	ISO14184-1	103.6		-0.66
3110	ISO14184-1	99.42		-1.15	3199	ISO14184-1	108.6		-0.08
3116	ISO14184-1	111.17		0.21	3200	ISO14184-1	114.2		0.57
3117	ISO14184-1	109.9		0.07	3207	JIS L1041B	106.7		-0.30
3118	ISO14184-1	100.27		-1.05	3210	ISO14184-1	107		-0.27
3145	LFGB B 82.02-1	129.28		2.31	3214	ISO14184-1	104.01		-0.62
3146	ISO14184-1	101.8		-0.87	3216	ISO14184-1	97.77		-1.34
3149	ISO14184-1	144.3	C	4.05	3218	ISO14184-1	109.68		0.04
3150	ISO14184-1	84.6		-2.86	3220	ISO14184-1	104.89		-0.51
3153	ISO14184-1	103.45		-0.68	3225	ISO14184-1	104.08		-0.61
3154	ISO14184-1	113.9375		0.54	3228	ISO14184-1	109		-0.04
3166	ISO14184-1	128.5		2.22	3237	ISO14184-1	86.57		-2.64
3167	ISO14184-1	116		0.77	3248	GB/T2912	110		0.08
3172	ISO14184-1	89.63		-2.28	8005	JIS L1041B	109.61		0.03

normality	suspect
n	181
outliers	4
mean (n)	109.318
st.dev. (n)	10.6475
R(calc.)	29.813
R(Horwitz)	24.161

Lab 2456: first reported 154.2
Lab 2481: first reported 101.56
Lab 2497: first reported 173.31
Lab 2566: first reported 48.5

Lab 2582: first reported 37.63
Lab 2644: first reported 53.7
Lab 2671: first reported 49.2
Lab 3149: first reported 157.7





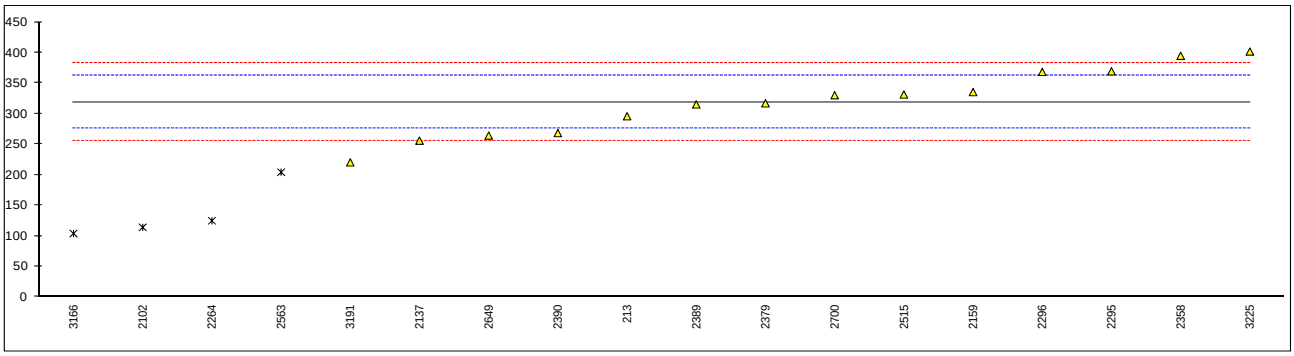
Determination of Released Formaldehyde content on sample #15208; results in mg/kg

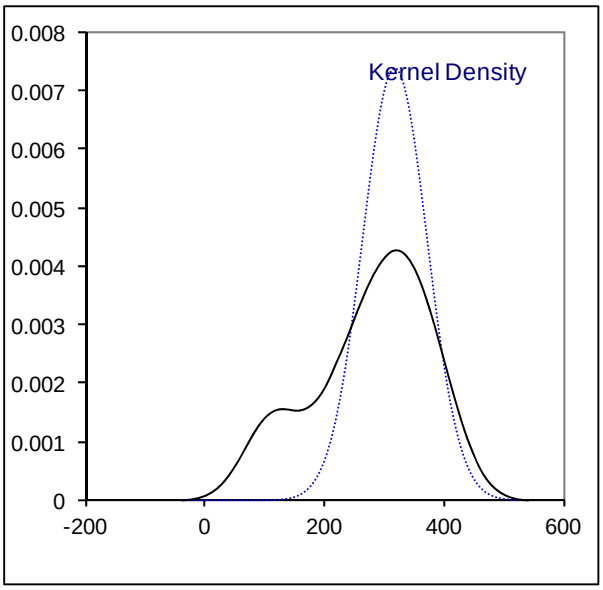
lab	method	value	mark	z(targ)	lab	method	value	mark	z(targ)
110		-----		-----	2368		-----		-----
213	ISO14184-2	295.8		-1.09	2373		-----		-----
230		-----		-----	2379	ISO14184-2	317.07		-0.10
348		-----		-----	2380		-----		-----
361		-----		-----	2381		-----		-----
551		-----		-----	2386		-----		-----
622		-----		-----	2389	ISO14184-2	315.2		-0.19
632		-----		-----	2390	ISO14184-2	268.30		-2.37
826		-----		-----	2401		-----		-----
1051		-----		-----	2403		-----		-----
2102	In house	114.06	DG(0.05)	-9.57	2404		-----		-----
2115		-----		-----	2410		-----		-----
2129		-----		-----	2413		-----		-----
2132		-----		-----	2415		-----		-----
2137	ISO14184-2	255.95		-2.95	2426		-----		-----
2138		-----		-----	2429		-----		-----
2139		-----		-----	2432		-----		-----
2146		-----		-----	2433		-----		-----
2156		-----		-----	2442		-----		-----
2159	ISO14184-2	335.42		0.76	2446		-----		-----
2165		-----		-----	2449		-----		-----
2170		-----		-----	2453		-----		-----
2172		-----		-----	2454		-----	W	-----
2182		-----		-----	2456		-----		-----
2184		-----		-----	2459		-----		-----
2186		-----		-----	2460		-----		-----
2190		-----		-----	2467		-----		-----
2197		-----		-----	2474		-----		-----
2201		-----		-----	2475		-----		-----
2212		-----		-----	2476		-----		-----
2216		-----		-----	2481		-----		-----
2217		-----		-----	2482		-----		-----
2225		-----		-----	2483		-----		-----
2226		-----		-----	2489		-----		-----
2229		-----	W	-----	2492		-----		-----
2230		-----		-----	2495		-----		-----
2236		-----		-----	2497		-----		-----
2238		-----		-----	2500		-----		-----
2241		-----		-----	2506		-----		-----
2245		-----		-----	2511		-----		-----
2246		-----		-----	2514		-----		-----
2255		-----		-----	2515	AATCC112	331.47		0.57
2256		-----		-----	2517		-----		-----
2264	JIS L1041B	124.78	DG(0.05)	-9.07	2519		-----		-----
2269		-----		-----	2522		-----		-----
2272		-----		-----	2532		-----		-----
2275		-----		-----	2534		-----		-----
2277		-----		-----	2535		-----		-----
2279		-----		-----	2540		-----		-----
2280		-----		-----	2559		-----		-----
2282		-----		-----	2561		-----		-----
2284		-----		-----	2563	ISO14184-1	204.3	C,ex	-5.36
2289		-----		-----	2566		-----		-----
2290		-----		-----	2567		-----		-----
2292		-----		-----	2569		-----		-----
2293		-----		-----	2572		-----		-----
2294		-----		-----	2582		-----		-----
2295	ISO14184-2	369.5		2.35	2589		-----		-----
2296	ISO14181-2	368.37		2.29	2590		-----		-----
2298		-----		-----	2591		-----		-----
2301		-----		-----	2602		-----		-----
2310		-----		-----	2606		-----		-----
2311		-----		-----	2615		-----		-----
2313		-----		-----	2625		-----		-----
2314		-----		-----	2629		-----		-----
2330		-----		-----	2633		-----		-----
2348		-----		-----	2638		-----		-----
2351		-----		-----	2643		-----		-----
2356		-----		-----	2644		-----		-----
2358	ISO14184-2	394.78		3.53	2649	ISO14184-2	264.3		-2.56
2360		-----		-----	2650		-----	W	-----
2361		-----		-----	2654		-----		-----
2363		-----		-----	2662		-----		-----
2364		-----		-----	2667		-----		-----
2366		-----		-----	2670		-----		-----
2367		-----		-----	2671		-----		-----

2672		-----		-----	3176		-----	-----
2673		-----		-----	3182		-----	-----
2678		-----		-----	3185		-----	-----
2685		-----		-----	3186		-----	-----
2700	AATCC112	330.32		0.52	3190		-----	-----
2702		-----		-----	3191	ISO14184-2	220.40	-4.61
2703		-----		-----	3195		-----	-----
2712		-----		-----	3197		-----	-----
3110		-----		-----	3199		-----	-----
3116		-----		-----	3200		-----	-----
3117		-----		-----	3207		-----	-----
3118		-----		-----	3210		-----	-----
3145		-----		-----	3214		-----	-----
3146		-----		-----	3216		-----	-----
3149		-----		-----	3218		-----	-----
3150		-----		-----	3220		-----	-----
3153		-----		-----	3225	ISO14184-2	401.80	3.85
3154		-----		-----	3228		-----	-----
3166	ISO14184-1	104	ex	-10.04	3237		-----	-----
3167		-----		-----	3248		-----	-----
3172		-----		-----	8005		-----	-----

normality	OK
n	14
outliers	2 (+2 excl)
mean (n)	319.191
st.dev. (n)	54.0335
R(calc.)	151.294
R(Horwitz)	60.039

Lab 2229: results withdrawn: reported 117.52
Lab 2454: results withdrawn: reported 106.87
Lab 2563: first reported 103.9, result excluded as test method is for free formaldehyde
Lab 2650: results withdrawn: reported 121.1
Lab 3166: result excluded as test method is for free formaldehyde





APPENDIX 2

Number of participants per country

7 labs in	BANGLADESH
1 lab in	BRAZIL
1 lab in	BULGARIA
2 labs in	CAMBODIA, Kingdom of
1 lab in	CROATIA
1 lab in	EGYPT
1 lab in	FINLAND
4 labs in	FRANCE
14 labs in	GERMANY
1 lab in	GREECE
1 lab in	GUATEMALA
16 labs in	HONG KONG
1 lab in	HUNGARY
12 labs in	INDIA
4 labs in	INDONESIA
9 labs in	ITALY
7 labs in	KOREA
1 lab in	MALAYSIA
2 labs in	MAURITIUS
4 labs in	MEXICO
2 labs in	MOROCCO
1 lab in	NICARAGUA
49 labs in	P.R. of CHINA
6 labs in	PAKISTAN
1 lab in	PERU
2 labs in	PHILIPPINES
1 lab in	PORTUGAL
1 lab in	ROMANIA
1 lab in	SERBIA
1 lab in	SINGAPORE
1 lab in	SLOVENIA
5 labs in	SPAIN
1 lab in	SRI LANKA
4 labs in	TAIWAN R.O.C.
3 labs in	THAILAND
1 lab in	THE NETHERLANDS
2 labs in	TUNISIA
5 labs in	TURKEY
1 lab in	U.A.E.
7 labs in	U.S.A.
3 labs in	UNITED KINGDOM
6 labs 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
R(0.01) = outlier in Rosner outlier test
R(0.05) = straggler in Rosner outlier test
n.a. = not applicable
n.d. = not detected
W = withdrawn

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