# Results of Proficiency Test
# Specific migration (fcm)
# October 2016


Organised by: Institute for Interlaboratory Studies
Spijkenisse, the Netherlands

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## 1 INTRODUCTION

Since 2012, the Institute of Interlaboratory Studies (iis) organizes a proficiency test scheme for food contact materials. During the annual proficiency testing program 2016/2017, it was decided to continue the proficiency test for the determination of Specific Migration.
During the contact of food with materials like kitchenware, molecules can migrate from the material to the food. Because of this, in many countries regulations are made to ensure food safety.
The framework Regulation (EU) No. 10/2011 (lit. 3) applies to all food contact materials and describes a large number of requirements, e.g. limits for overall migration and specific limits for certain constituents. Article 11 (and Annex II) of this regulation describes the specific migration limit, expressed in mg/kg food or food simulant. It has been recently amended with regulation 1416/2016/EU in which a limit for Aluminium and a lower limit for Zinc is published (implementation date is September 2018, see lit. 19).

For metals, the following specific migration limit applies:

| Metal | Specific Migration Limit (mg/kg food simulant) 10/2011/EU | Specific Migration Limit (mg/kg food simulant) amendment 1416/2016/EU |
|---|---|---|
| Aluminium | not restricted | 1 |
| Barium | 1 | 1 |
| Cobalt | 0.05 | 0.05 |
| Copper | 5 | 5 |
| Iron | 48 | 48 |
| Lithium | 0.6 | 0.6 |
| Manganese | 0.6 | 0.6 |
| Zinc | 25 | 5 |

Table 1: specific migration maximum limits

The determination of specific migration requires additional analytical testing following the migration step, while the determination of the overall (also called global, or total) migration requires weighing as only quantitative analytical technique. This makes the specific migration of metals from food contact materials more difficult than determination of the overall migration.
In the interlaboratory study of September 2016, 35 laboratories from 16 different countries participated (see appendix 4). In this report, the results of the 2016 proficiency test are presented and discussed. This report is also electronically available through the iis website www.iisnl.com.

## 2 SET-UP

The Institute for Interlaboratory Studies (iis) in Spijkenisse, the Netherlands, was the organiser of this proficiency test (PT). Sample analyses for fit-for-use and homogeneity testing were subcontracted to an ISO/IEC 17025 accredited laboratory. It was decided to send one sample, that was artificially fortified with different metals, and to prescribe a number of test conditions (migration method, type of simulant, exposure time and temperature) to be used. Participants were also requested to report some intermediate test results and to report rounded and unrounded test results. The unrounded test results were preferably used for statistical evaluation.

## 2.1 ACCREDITATION

The Institute for Interlaboratory Studies in Spijkenisse, the Netherlands, is accredited in agreement with ISO/IEC 17043:2010 (R007), since January 2000, by the Dutch Accreditation Council (Raad voor Accreditatie). This PT falls in the accredited scope. 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 of this proficiency test was the one as described for proficiency testing in the report 'iis Interlaboratory Studies: Protocol for the Organisation, Statistics and Evaluation' of April 2014 (iis-protocol, version 3.3). This protocol is electronically available through 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

A batch of polypropylene plates of 15 x 15 cm containing a relevant concentration of the metals Barium, Cobalt, Copper and Zinc was prepared. The homogeneity of the batch #16620 was checked by determination of the specific migration of Cobalt on 8 stratified randomly selected plates.

| | migration of Cobalt in mg/kg food simulant (3% acetic acid, 60 min at 100°C) |
|---|---|
| Sample #16620-1 | 0.19 |
| Sample #16620-2 | 0.22 |
| Sample #16620-3 | 0.22 |
| Sample #16620-4 | 0.23 |
| Sample #16620-5 | 0.21 |
| Sample #16620-6 | 0.19 |
| Sample #16620-7 | 0.20 |
| Sample #16620-8 | 0.19 |

Table 2: results of the homogeneity test on the subsamples #16620

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

| | migration of Cobalt in mg/kg food simulant (3% acetic acid, 60 min at 100°C) |
|---|---|
| r(observed) | 0.04 |
| reference | Horwitz |
| 0.3 x R (reference) | 0.04 |

Table 3: evaluation of the repeatability of subsamples #16620

The calculated repeatability was in good agreement with 0.3 times the corresponding target reproducibility, estimated from the Horwitz equation. Therefore, homogeneity of the sub samples was assumed.

To each of the participating laboratories one sample #16620 was sent on September 7, 2016.

## 2.5 ANALYSES

The participants were requested to determine the metals Barium, Cobalt, Copper, Iron, Lithium, Manganese and Zinc on sample #16620 using the prescribed test conditions (total immersion, 2.0 hrs at 100°C and 3% Acetic acid as simulant). It was explicitly requested to treat the samples as if they were routine samples and to report the test results using the indicated units on the report form and not to round the results, but report as much significant figures as possible. 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 evaluations. The laboratories were also requested to report some details of the test methods used.

To get comparable results a detailed report form, on which the units were prescribed as well as the reference test methods and a letter of instructions were prepared and made available on the data entry portal www.kpmd.co.uk/sgs-iis-cts/. The laboratories were requested to confirm the sample receipt on the same data entry portal.

# 3 RESULTS

During five weeks after sample dispatch, the results of the individual laboratories were gathered via the data entry portal www.kpmd.co.uk/sgs-iis-cts/. The reported test results are tabulated 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 had not reported test results at that moment. Shortly after the deadline, the available test results were screened for suspect data. A test 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 reported test results.

Additional or corrected test results are used for the data analysis and the original results are placed under 'Remarks' in the result tables in appendix 1. Test results that came in after the deadline were not taken into account in this screening for suspect data and thus these participants were not requested for checks.

### 3.1 STATISTICS

The protocol followed in the organisation of this proficiency test was the one as described in the report ‘iis Interlaboratory Studies, Protocol for the Organisation, Statistics and Evaluation’ of April 2014 (iis-protocol, version 3.3).

For the statistical evaluation the *unrounded* (when available) figures were used instead of the rounded test results. Test 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, 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 the original test 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’s test, by G(0.01) or DG(0.01) for the Grubbs’ test and by R(0.01) for the Rosner’s test. Stragglers are marked by D(0.05) for the Dixon’s test, by G(0.05) or DG(0.05) for the Grubbs’ test and by R(0.05) for the Rosner’s. Both outliers and stragglers were not included in the calculations of averages and 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 significant consequences for the evaluation of the test results.

Finally, the reproducibilities were calculated from the standard deviations by multiplying them 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 on 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. 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. In case no literature reproducibility was available, other target values were used.

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 result is fit-for-use.

The z-scores were calculated according to:

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

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

Absolute values for z<2 are very common and absolute values for z>3 are very rare. Therefore the usual interpretation of z-scores is as follows:

| | |
|---|---|
| $\mid z \mid < 1$ | good |
| $1 < \mid z \mid < 2$ | satisfactory |
| $2 < \mid z \mid < 3$ | questionable |
| $3 < \mid z \mid$ | unsatisfactory |

## 4 EVALUATION

In this interlaboratory study, no problems were encountered with the dispatch of the samples.
No participants reported test results after the final reporting date, but three participants did not report any test results at all. Thus, 32 of the 35 participants submitted test results.
In total over 400 (intermediate) results were reported, of which 227 test results in both $mg/dm^2$ and mg/kg food simulant. From this, fifteen participants reported test results in both $mg/dm^2$ contact surface and mg/kg food simulant, a further nine participants only a test result in $mg/dm^2$ and seven only a test result in mg/kg. In total five statistical outliers were observed, which is 2.2% of the combined migration results in $mg/dm^2$ contact surface and mg/kg food simulant. In proficiency studies, outlier percentages of 3% - 7.5% are quite normal. It should be noted that twenty test results were excluded from the statistical evaluations (= 8.8%!).

For the determination of Specific Migration, several standardised test methods exist. The most relevant literature is test method EN13130 part 1. Method EN13130-1 describes how the specific migration test should be performed. Regretfully no reference test method is available with precision requirements for the migration of metals from food contact materials. Therefore, it was decided to estimate the target reproducibilities from the Horwitz equation.

Method EN13130-1 describes that the volume to surface ratio that should be used for this test (see paragraph 10.2 of EN13130-1:2004) is 100 ml for 0.6 $dm^2$. This is a volume to surface ratio of 167 ml/ $dm^2$. Surprisingly, only 48% of the reporting laboratories used a volume to surface ratio of 167 ml/$dm^2$. This is less than the 60% that used the correct ratio in last year's PT.
Only when using the volume to surface ratio of 100 ml for 0.6 $dm^2$, automatically the calculated result in mg/kg food simulant will be the same as the result obtained by the multiplication of the result in mg/$dm^2$ with the conventional conversion factor 6.

Five laboratories (2115, 2129, 2384, 2495 and 2760) were excluded from the evaluation in mg/kg food simulant, because the conventional conversion factor 6 obviously was not used to calculate the results from mg/$dm^2$ to mg/kg food simulant.

## 4.1 EVALUATION PER TEST

Concentration metals in simulant in mg/l final solution of simulant:

These intermediate results were not evaluated as they are in principle dependent on the amount of simulant used.

Specific migration of Barium in mg/$dm^2$ contact surface:

This determination may be problematic. One statistical outlier was observed. The calculated reproducibility after rejection of the statistical outlier is not in agreement with the estimated reproducibility using the Horwitz equation.

Specific migration of Barium in mg/kg food simulant:

This migration result is obtained from the specific migration in mg/$dm^2$ by multiplication with the conventional conversion factor 6.
This determination may be problematic. No statistical outliers were observed, but five test results were excluded for not using the conventional conversion factor 6. The calculated reproducibility after rejection of the suspect data is not in agreement with the estimated reproducibility using the Horwitz equation.

Specific migration of Cobalt in mg/$dm^2$ contact surface:

This determination may not be problematic. Two statistical outliers were observed. However, the calculated reproducibility after rejection of the statistical outliers is in agreement with the estimated reproducibility using the Horwitz equation.

Specific migration of Cobalt in mg/kg food simulant:

This migration result is obtained from the specific migration in mg/$dm^2$ by multiplication with the conventional conversion factor 6.
This determination may be problematic. No statistical outliers were observed, but five test

results were excluded for not using the conventional conversion factor 6. The calculated reproducibility after rejection of the suspect data is not in agreement with the estimated reproducibility using the Horwitz equation.

Specific migration of Copper in mg/dm$^2$ contact surface:

This determination may be problematic. One statistical outlier was observed. The calculated reproducibility after rejection of the statistical outlier is not in agreement with the estimated reproducibility using the Horwitz equation.

Specific migration of Copper in mg/kg food simulant:

This migration result is obtained from the specific migration in mg/dm$^2$ by multiplication with the conventional conversion factor 6.
This determination may be problematic. No statistical outliers were observed, but five test results were excluded for not using the conventional conversion factor 6. The calculated reproducibility after rejection of the suspect data is not in agreement with the estimated reproducibility using the Horwitz equation.

Specific migration of Zinc in mg/dm$^2$ contact surface:

This determination may be problematic. One statistical outlier was observed. The calculated reproducibility after rejection of the statistical outlier is not in agreement with the estimated reproducibility using the Horwitz equation.

Specific migration of Copper in mg/kg food simulant:

This migration result is obtained from the specific migration in mg/dm$^2$ by multiplication with the conventional conversion factor 6.
This determination may be problematic. No statistical outliers were observed, but five test results were excluded for not using the conventional conversion factor 6. The calculated reproducibility after rejection of the suspect data is not in agreement with the estimated reproducibility using the Horwitz equation.

Specific migration of Iron, Lithium and Manganes in mg/dm$^2$ and mg/kg food simulant:

The majority of the participants did not detect these metals in the simulant solution and reported a ‘smaller than’ value or “not detected”.

Specific migration of metals in mg/L food:

The majority of the participants reported the same test result in mg/L food as the result in mg/kg food, as is described in method EN13130-1 (see appendix 3).

## 4.2 EVALUATION OF THE TEST METHODS USED

Most participants reported to have used EN13130 (part 1). Eight laboratories reported to have used an in house method and one other laboratory used EN1186. EN1186 is a method to determine Overall Migration. Two laboratories reported to have used EU 10/2011. The reported details that were used by the participants (volume of simulant and contact surface) are listed in appendix 2 and 3. The actual concentrations measured in the simulant for each metal are listed in appendix 3.

### 4.3 PERFORMANCE EVALUATION FOR THE GROUP OF LABORATORIES

A comparison has been made between the reproducibility as declared by the relevant test method and the reproducibility as found for the group of participating laboratories. The target reproducibilities derived from literature standards are compared in the next tables.

| Specific Migration | unit | n | Average | 2.8 * sd | R (target) |
|---|---|---|---|---|---|
| Barium | $mg/dm^2$ | 24 | 0.29 | 0.29 | 0.16 |
| Cobalt | $mg/dm^2$ | 23 | 0.05 | 0.03 | 0.03 |
| Copper | $mg/dm^2$ | 24 | 0.33 | 0.26 | 0.17 |
| Iron | $mg/dm^2$ | 23 | <8 | n.a. | n.a. |
| Lithium | $mg/dm^2$ | 22 | <0.1 | n.a. | n.a. |
| Manganese | $mg/dm^2$ | 22 | <0.1 | n.a. | n.a. |
| Zinc | $mg/dm^2$ | 24 | 0.58 | 0.48 | 0.28 |

Table 4: Reproducibilities of tests on sample #16620 in $mg/dm^2$

| Specific Migration | unit | n | Average | 2.8 * sd | R (target) |
|---|---|---|---|---|---|
| Barium | mg/kg food | 18 | 1.77 | 1.62 | 0.73 |
| Cobalt | mg/kg food | 18 | 0.30 | 0.23 | 0.16 |
| Copper | mg/kg food | 18 | 2.05 | 1.62 | 0.82 |
| Iron | mg/kg food | 22 | <48 | n.a. | n.a. |
| Lithium | mg/kg food | 21 | <0.6 | n.a. | n.a. |
| Manganese | mg/kg food | 21 | <0.6 | n.a. | n.a. |
| Zinc | mg/kg food | 18 | 3.70 | 2.88 | 1.36 |

Table 5: Reproducibilities of tests on sample #16620 in mg/kg food simulant

Without further statistical calculations, it can be concluded that there is not a good compliance of the group of laboratories with the relevant target reproducibility (see for discussion paragraph 4.1).

### 4.4 COMPARISON WITH PREVIOUS PROFICIENCY TESTS

The evolution of the uncertainty for Specific Migration in $mg/dm^2$ and/or mg/kg as observed in this proficiency scheme and the comparison with the findings in previous rounds is visualized in table 6.

| | Metals via total immersion iis16P11SM | DEHP via total immersion iis15P10SM | BPA via total immersion iis14P09SM | formaldehyde via article filling | Target (Horwitz) |
|---|---|---|---|---|---|
| 2012 | ---- | ---- | ---- | 41 - 47% | 14-20% |
| 2013 | ---- | ---- | ---- | 41 – 61% | 14-20% |
| 2014 | ---- | ---- | 44 – 52% | ---- | 14-20% |
| 2015 | ---- | 34-40% | ---- | ---- | 14-20% |
| 2016 | 29-30% | ---- | ---- | ---- | 14-20% |

Table 6: comparison of the uncertainties in % for Specific Migration in $mg/dm^2$ and/or mg/kg in the previous and present round

From the above table it is clear that the performance of this PT shows improvement over the PTs of the last years, but is not yet meeting the strict requirements, estimated from the Horwitz equation.

When looking at the group of laboratories that used the volume to surface ratio of 167 ml/dm$^2$ as per test method EN13130-1, the uncertainties for the metals in mg/dm$^2$ vary from 15 to 24%, which meet the target requirements (see Discussion paragraph 5).

## 5 DISCUSSION

Before the start of this PT, it was assumed that a wide range of test results would be reported when the choice of the test conditions would have been left to the participating laboratories. Therefore, a set of predetermined test conditions was given together with the instructions to all participants. These preset conditions were:

| | |
|---|---|
| Simulant | 3% acetic acid |
| Exposure time | 2.0 hr (120 min) |
| Exposure temperature | 100.0 °C |
| Migration method | Total immersion |
| Article use | Single use |

Table 7: preset test conditions used in this PT

Not only a migration result was to be reported, but the participants were requested to report also the intermediate metal concentration in the simulant. The reported metal concentrations are listed in appendix 3. Using these intermediate test results, it was possible to check the calculations done by the laboratories. This revealed that in the initially reported test results of a number of laboratories, calculation errors were present. These test results were either corrected by the participant or excluded from the statistical calculations by iis.

The majority of laboratories performed a double surface immersion test. This is the test that should be used for this symmetrical sample according to EN13130-1. Two laboratories (2375 and 2495) used a single surface test. When performing total immersion on both sides, but using only the single surface area in the calculation the test result could be twice as high. The results of both laboratories do not appear to be twice as high for all detected metals. Therefore, it is assumed that the laboratories sufficiently corrected their results for the single surface use.

Test method EN13130-1 uses for the total immersion test an area of 0.6 dm$^2$ and 100 ml simulant. This means that the volume to surface area ratio is 167 ml/dm$^2$. About 47% of the laboratories used this ratio. Surprisingly still, 34% used a ratio around 100 (1 dm$^2$ and 100 ml), as is described in the **Overall** Migration method for total immersion EN1186-3. One laboratory used a lower ratio of 50 and four laboratories used a ratio higher than 200 ml/dm$^2$.

Evaluating the test results in mg/dm$^2$ for the laboratories that used the ratio of 167 ml/dm$^2$, the uncertainties significantly decrease (from a RSD of 29-30% for all laboratories to a RSD of 15-24% for only the laboratories using a ratio of 167 ml/dm$^2$). Unfortunately, when the same evaluation is done for the results in mg/kg food simulant, performed with a ratio of 167 ml/dm$^2$, the uncertainties do not increase (RSD 23-31%). Please note that only sixteen laboratories reported results in both mg/dm$^2$ and mg/kg food simulant, while the others reported either mg/dm$^2$ or mg/kg food simulant. Only seven reported results in both units and used a ratio of 167 ml/dm$^2$. Therefore, the difference in RSD between the results in mg/dm$^2$ and mg/kg food simulant may be a result of the fact that the participants of each group are not the same. Still, using a different volume to surface ratio than described in method EN13130-1 may have a negative influence on the reproducibility of the group. So the precision of this test method may be improved by following the method regarding the volume to surface ratio used

Details for cleaning the sample before testing were also requested. Twenty-one participants did not clean the sample and eight participants cleaned the sample with a cloth or by purged air. Surprisingly, four participants cleaned the sample before testing with (warm) water and/or detergent/surfactant, while paragraph 15.5 of EN13130-1 explicitly states that under no circumstances the sample to be tested should be cleaned with water.

Comparing the determinations of the different metals, it can be seen that only the performance of the determination of Cobalt is close to the estimated requirements of the Horwitz equation. This determination is done in two steps, a migration step (which is the same for all metals) and a quantification step. The quantification of Cobalt appears to be less difficult than the quantification of Barium, Copper and Zinc.

From the reported details, it became clear that not all participants followed the test method that was reported to have been used. Several deviating conditions (like surface to volume ratio, calculations, preparation) were used. These deviations may be one of the main reasons for the large variation in the test results as observed.

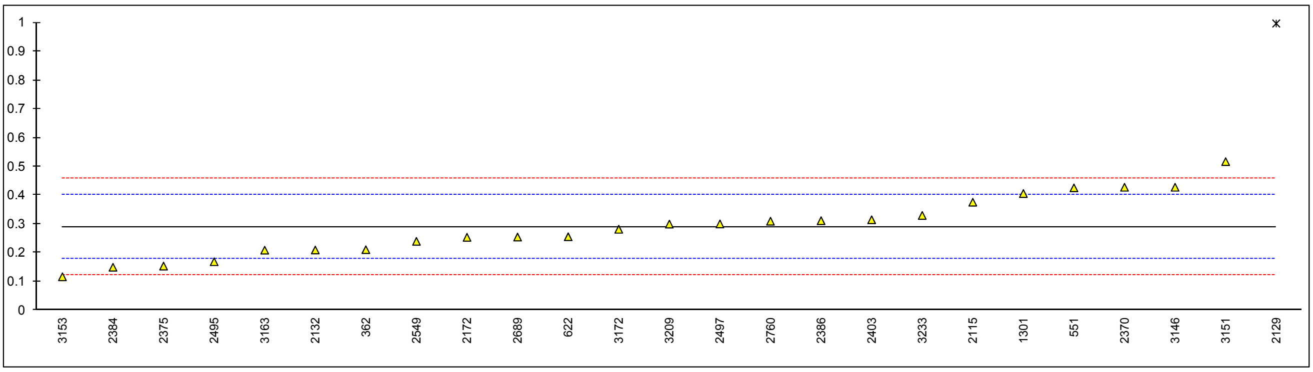
Each laboratory has to evaluate its performance in this study and make decisions about necessary corrective actions. Therefore, participation on a regular basis in this scheme could be helpful to improve the performance and the quality of the analytical results.

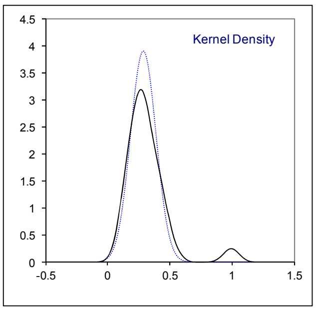
## APPENDIX 1

Specific Migration of Barium as Ba per contact surface on sample #16620; results in mg/dm$^2$

| lab | method | value | mark | z(targ) | remarks |
|---|---|---|---|---|---|
| 310 | | ----- | | ----- | |
| 330 | | ----- | | ----- | |
| 362 | | 0.211 | | -1.41 | |
| 551 | EN13130-1 | 0.426 | | 2.44 | |
| 622 | In house | 0.256 | | -0.61 | |
| 1179 | | ----- | | ----- | |
| 1301 | INH-95-1003 | 0.4063 | | 2.08 | |
| 2115 | In house | 0.376 | | 1.54 | |
| 2129 | DIN EN 13130-1 | 0.9971 | R(0.01) | 12.66 | |
| 2132 | In house | 0.21 | | -1.43 | |
| 2172 | EU 10 2011 | 0.254 | | -0.64 | |
| 2215 | | ----- | | ----- | |
| 2284 | | ----- | | ----- | |
| 2353 | | ----- | | ----- | |
| 2370 | INH-602 | 0.428 | | 2.47 | |
| 2375 | In house | 0.154 | | -2.43 | |
| 2384 | BS EN13130-1 | 0.15 | C | -2.50 | first reported: 15.41 |
| 2386 | DIN 13130-1 | 0.3117 | | 0.39 | |
| 2403 | BS/EN 13130-1 | 0.315 | | 0.45 | |
| 2495 | In house | 0.1692 | | -2.16 | |
| 2497 | In house | 0.30078 | | 0.20 | |
| 2549 | EN13130 | 0.24 | | -0.89 | |
| 2689 | EN13130 | 0.255 | | -0.62 | |
| 2747 | | ----- | | ----- | |
| 2753 | | ----- | | ----- | |
| 2760 | INH-13130 | 0.31 | C | 0.36 | first reported: 0.61 |
| 3146 | DIN EN 13130-1 | 0.428 | | 2.47 | |
| 3151 | EN 13130 | 0.517 | | 4.07 | |
| 3153 | EN 13130-1 | 0.117 | | -3.09 | |
| 3163 | EN-1186 | 0.209333 | C | -1.44 | first reported: 3.15 |
| 3172 | EN 13130-1 | 0.282 | | -0.14 | |
| 3209 | EN13130 | 0.300 | | 0.18 | |
| 3225 | | ----- | | ----- | |
| 3233 | INH-13130 | 0.33 | | 0.72 | |
| 3237 | | ----- | | ----- | |

| | | | | |
|---|---|---|---|---|
| | | | Only volume to surface ratio of 167 ml/dm$^2$ | |
| normality | OK | | OK | |
| n | 24 | | 10 | |
| outliers | 1 | | 0 | |
| mean (n) | 0.2898 | | 0.3142 | |
| st.dev. (n) | 0.10223 | RSD = 35% | 0.06631 | RSD = 21% |
| R(calc.) | 0.2862 | | 0.1857 | |
| R(Horwitz) | 0.1565 | | 0.1675 | |

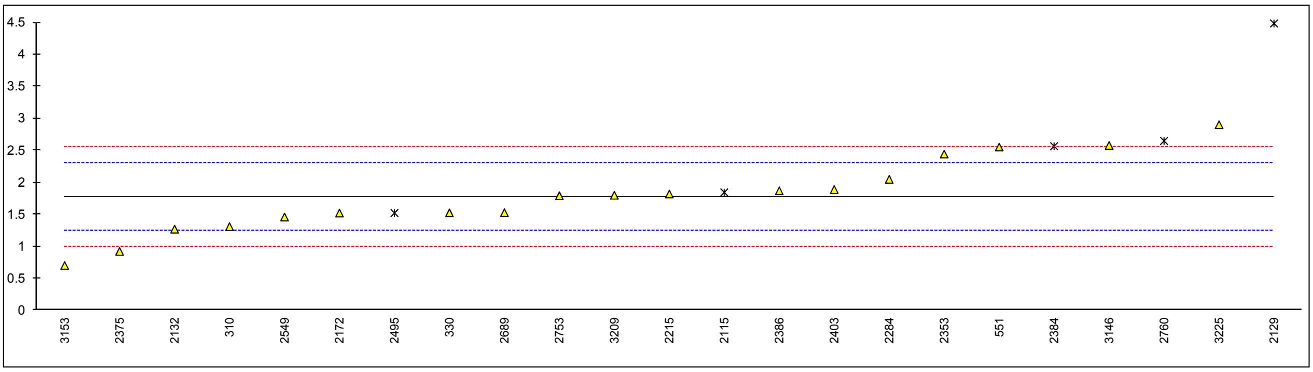


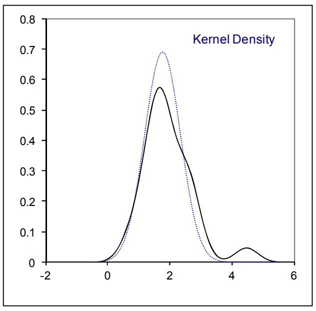



## Specific Migration of Barium as Ba on sample #16620; results in mg/kg food simulant

| lab | method | value | mark | z(targ) | remarks |
|---|---|---|---|---|---|
| 310 | EN 13130 | 1.31 | | -1.78 | |
| 330 | NF EN 13130-1 | 1.526 | | -0.96 | |
| 362 | | ----- | | ----- | |
| 551 | EN13130-1 | 2.554 | | 2.99 | |
| 622 | | ----- | | ----- | |
| 1179 | | ----- | | ----- | |
| 1301 | | ----- | | ----- | |
| 2115 | In house | 1.845 | ex | 0.27 | excluded for not using conventional conversion factor 6 (see §4 and 5) |
| 2129 | DIN EN 13130-1 | 4.487 | ex | 10.41 | excluded for not using conventional conversion factor 6 (see §4 and 5) |
| 2132 | In house | 1.27 | | -1.94 | |
| 2172 | EU 10 2011 | 1.523 | | -0.97 | |
| 2215 | (EU)NO.10/2011 | 1.82 | | 0.17 | |
| 2284 | EN 13130-1 | 2.05 | | 1.06 | |
| 2353 | EN13130-1 | 2.444 | | 2.57 | |
| 2370 | | ----- | | ----- | |
| 2375 | In house | 0.924 | | -3.27 | |
| 2384 | BS EN13130-1 | 2.568 | ex | 3.04 | excluded for not using conventional conversion factor 6 (see §4 and 5) |
| 2386 | DIN 13130-1 | 1.87 | | 0.36 | |
| 2403 | BS/EN 13130-1 | 1.89 | | 0.44 | |
| 2495 | In house | 1.523 | ex | -0.97 | excluded for not using conventional conversion factor 6 (see §4 and 5) |
| 2497 | | ----- | | ----- | |
| 2549 | EN13130 | 1.46 | | -1.21 | |
| 2689 | EN13130 | 1.528 | | -0.95 | |
| 2747 | | ----- | | ----- | |
| 2753 | EN 13130-1 | 1.793 | | 0.07 | |
| 2760 | INH-13130 | 2.65 | ex | 3.36 | excluded for not using conventional conversion factor 6 (see §4 and 5) |
| 3146 | DIN EN 13130-1 | 2.58 | | 3.09 | |
| 3151 | | ----- | | ----- | |
| 3153 | EN 13130-1 | 0.702 | | -4.12 | |
| 3163 | | ----- | | ----- | |
| 3172 | | ----- | | ----- | |
| 3209 | EN13130 | 1.801 | | 0.10 | |
| 3225 | EN13130 | 2.9040 | | 4.33 | |
| 3233 | | ----- | | ----- | |
| 3237 | | ----- | | ----- | |

| | | | | Only volume to surface ratio of 167 ml/dm$^2$ | |
|---|---|---|---|---|---|
| normality | OK | | | not OK | |
| n | 18 | | | 12 | |
| outliers | 0 (+5ex) | | | 0 | |
| mean (n) | 1.7749 | | | 1.8932 | |
| st.dev. (n) | 0.57958 | RSD = 33% | | 0.43697 | RSD = 23% |
| R(calc.) | 1.6228 | | | 1.2235 | |
| R(Horwitz) | 0.7294 | | | 0.7705 | |

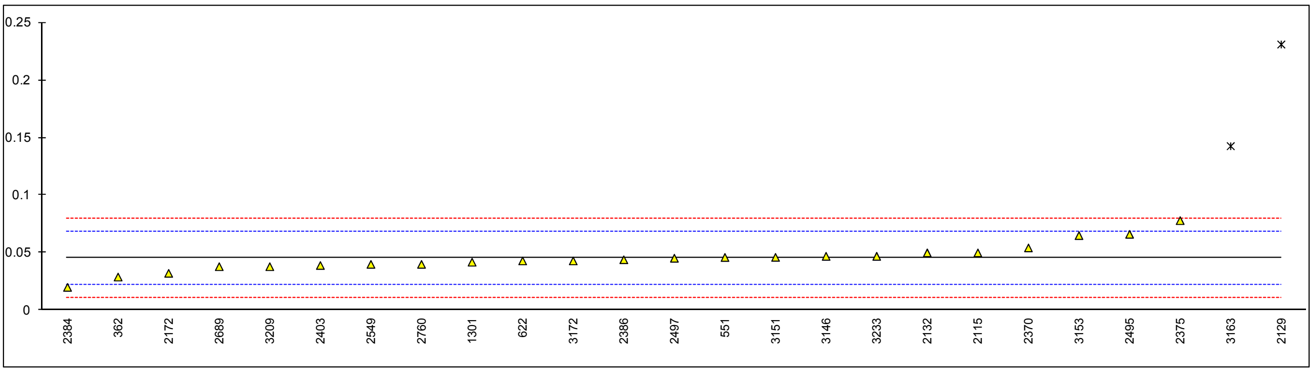


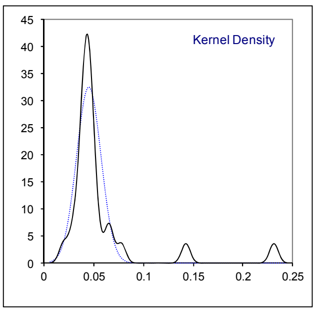



## Specific Migration Cobalt as Co per contact surface on sample #16620; results in mg/dm$^2$

| lab | method | value | mark | z(targ) | remarks |
|---|---|---|---|---|---|
| 310 | | ----- | | ----- | |
| 330 | | ----- | | ----- | |
| 362 | | 0.029 | | -1.41 | |
| 551 | EN13130-1 | 0.046 | | 0.06 | |
| 622 | In house | 0.043 | | -0.20 | |
| 1179 | | ----- | | ----- | |
| 1301 | INH-95-1003 | 0.0419 | | -0.30 | |
| 2115 | In house | 0.05 | | 0.40 | |
| 2129 | DIN EN 13130-1 | 0.231 | R(0.01) | 16.06 | |
| 2132 | In house | 0.05 | | 0.40 | |
| 2172 | EU 10 2011 | 0.0322 | | -1.14 | |
| 2215 | | ----- | | ----- | |
| 2284 | | ----- | | ----- | |
| 2353 | | ----- | | ----- | |
| 2370 | INH-602 | 0.0543 | | 0.77 | |
| 2375 | In house | 0.078 | | 2.83 | |
| 2384 | BS EN13130-1 | 0.02 | C | -2.19 | first reported: 2.07 |
| 2386 | DIN 13130-1 | 0.0440 | | -0.12 | |
| 2403 | BS/EN 13130-1 | 0.039 | | -0.55 | |
| 2495 | In house | 0.0661 | | 1.80 | |
| 2497 | In house | 0.04531 | | 0.00 | |
| 2549 | EN13130 | 0.04 | | -0.46 | |
| 2689 | EN13130 | 0.038 | | -0.64 | |
| 2747 | | ----- | | ----- | |
| 2753 | | ----- | | ----- | |
| 2760 | INH-13130 | 0.04 | C | -0.46 | first reported: 0.08 |
| 3146 | DIN EN 13130-1 | 0.047 | | 0.14 | |
| 3151 | EN 13130 | 0.0461 | | 0.07 | |
| 3153 | EN 13130-1 | 0.065 | | 1.70 | |
| 3163 | EN-1186 | 0.142667 | C,R(0.01) | 8.42 | first reported: 2.06 |
| 3172 | EN 13130-1 | 0.043 | | -0.20 | |
| 3209 | EN13130 | 0.038 | | -0.64 | |
| 3225 | | ----- | | ----- | |
| 3233 | INH-13130 | 0.047 | | 0.14 | |
| 3237 | | ----- | | ----- | |

| | | | | |
|---|---|---|---|---|
| | | | Only volume to surface ratio of 167 ml/dm$^2$ | |
| normality | suspect | | OK | |
| n | 23 | | 10 | |
| outliers | 2 | | 0 | |
| mean (n) | 0.0453 | | 0.0422 | |
| st.dev. (n) | 0.01230 | RSD = 27% | 0.00613 | RSD = 15% |
| R(calc.) | 0.0344 | | 0.0172 | |
| R(Horwitz) | 0.0324 | | 0.0304 | |

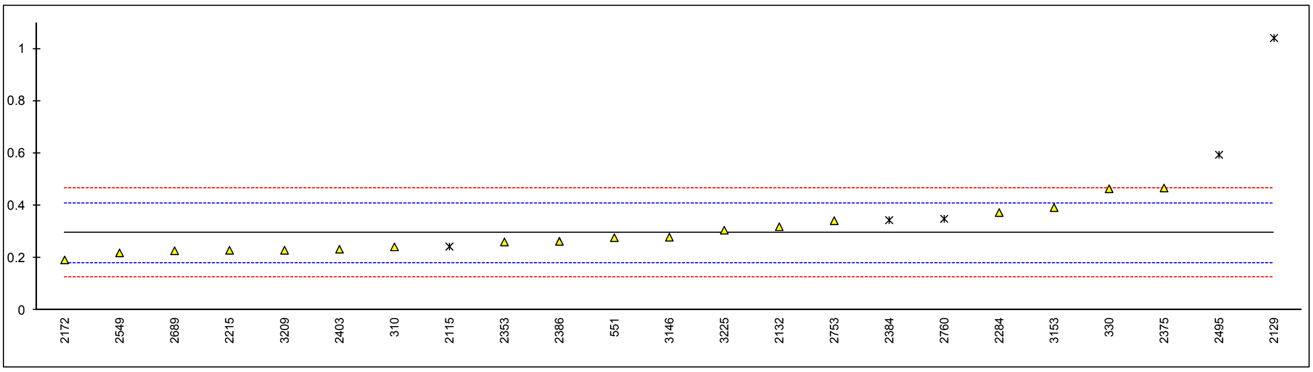


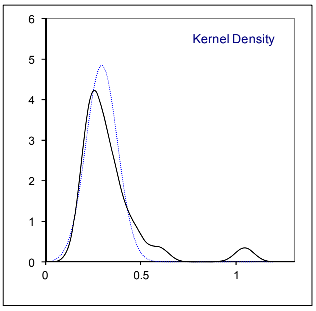



## Specific Migration Cobalt as Co on sample #16620; results in mg/kg food simulant

| lab | method | value | mark | z(targ) | remarks |
|---|---|---|---|---|---|
| 310 | EN 13130 | 0.243 | | -0.93 | |
| 330 | NF EN 13130-1 | 0.465 | | 2.97 | |
| 362 | | ----- | | ----- | |
| 551 | EN13130-1 | 0.278 | | -0.32 | |
| 622 | | ----- | | ----- | |
| 1179 | | ----- | | ----- | |
| 1301 | | ----- | | ----- | |
| 2115 | In house | 0.244 | ex | -0.92 | excluded for not using conventional conversion factor 6 (see §4 and 5) |
| 2129 | DIN EN 13130-1 | 1.041 | ex | 13.09 | excluded for not using conventional conversion factor 6 (see §4 and 5) |
| 2132 | In house | 0.32 | | 0.42 | |
| 2172 | EU 10 2011 | 0.193 | | -1.81 | |
| 2215 | (EU)NO.10/2011 | 0.23 | | -1.16 | |
| 2284 | EN 13130-1 | 0.374 | | 1.37 | |
| 2353 | EN13130-1 | 0.2617 | | -0.61 | |
| 2370 | | ----- | | ----- | |
| 2375 | In house | 0.468 | | 3.02 | |
| 2384 | BS EN13130-1 | 0.345 | ex | 0.86 | excluded for not using conventional conversion factor 6 (see §4 and 5) |
| 2386 | DIN 13130-1 | 0.264 | | -0.57 | |
| 2403 | BS/EN 13130-1 | 0.234 | | -1.09 | |
| 2495 | In house | 0.595 | ex | 5.25 | excluded for not using conventional conversion factor 6 (see §4 and 5) |
| 2497 | | ----- | | ----- | |
| 2549 | EN13130 | 0.22 | | -1.34 | |
| 2689 | EN13130 | 0.228 | | -1.20 | |
| 2747 | | ----- | | ----- | |
| 2753 | EN 13130-1 | 0.343 | | 0.82 | |
| 2760 | INH-13130 | 0.35 | ex | 0.95 | excluded for not using conventional conversion factor 6 (see §4 and 5) |
| 3146 | DIN EN 13130-1 | 0.280 | | -0.28 | |
| 3151 | | ----- | | ----- | |
| 3153 | EN 13130-1 | 0.393 | | 1.70 | |
| 3163 | | ----- | | ----- | |
| 3172 | | ----- | | ----- | |
| 3209 | EN13130 | 0.230 | | -1.16 | |
| 3225 | EN13130 | 0.3067 | | 0.18 | |
| 3233 | | ----- | | ----- | |
| 3237 | | ----- | | ----- | |

| | | | | Only volume to surface ratio of 167 ml/dm² | |
|---|---|---|---|---|---|
| normality | OK | | not OK | |
| n | 18 | | 12 | |
| outliers | 0 (+5ex) | | 0 | |
| mean (n) | 0.2962 | | 0.2805 | |
| st.dev. (n) | 0.08249 | RSD = 28% | 0.07919 | RSD = 28% |
| R(calc.) | 0.2310 | | 0.2217 | |
| R(Horwitz) | 0.1594 | | 0.1521 | |

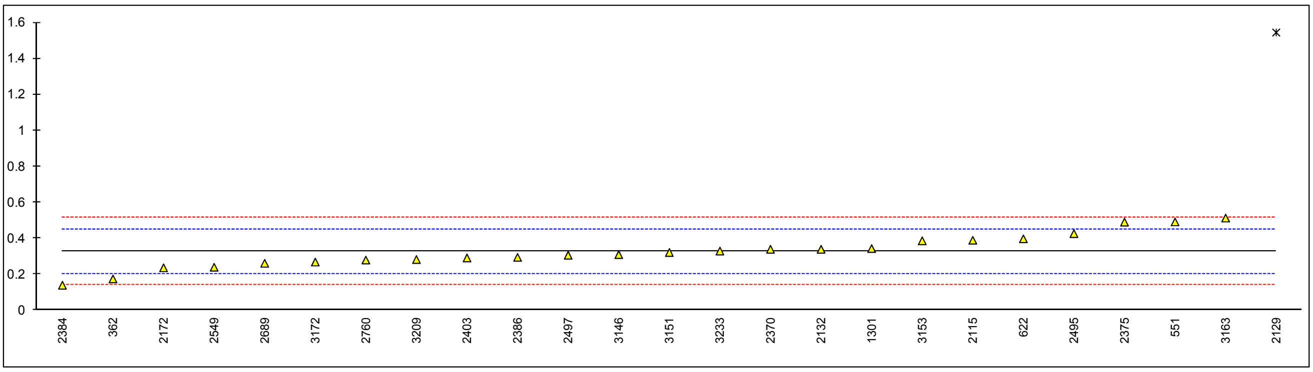


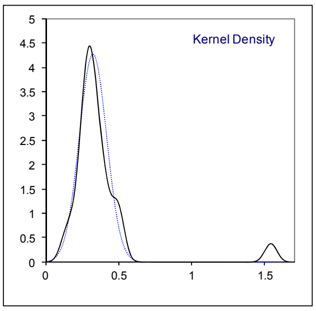



## Specific Migration Copper as Cu per contact surface on sample #16620; results in mg/dm$^2$

| lab | method | value | mark | z(targ) | remarks |
|---|---|---|---|---|---|
| 310 | | ----- | | ----- | |
| 330 | | ----- | | ----- | |
| 362 | | 0.175 | | -2.46 | |
| 551 | EN13130-1 | 0.492 | | 2.65 | |
| 622 | In house | 0.398 | | 1.13 | |
| 1179 | | ----- | | ----- | |
| 1301 | INH-95-1003 | 0.3438 | | 0.26 | |
| 2115 | In house | 0.390 | | 1.01 | |
| 2129 | DIN EN 13130-1 | 1.545 | R(0.01) | 19.63 | |
| 2132 | In house | 0.34 | | 0.20 | |
| 2172 | EU 10 2011 | 0.237 | | -1.46 | |
| 2215 | | ----- | | ----- | |
| 2284 | | ----- | | ----- | |
| 2353 | | ----- | | ----- | |
| 2370 | INH-602 | 0.340 | | 0.20 | |
| 2375 | In house | 0.491 | | 2.63 | |
| 2384 | BS EN13130-1 | 0.14 | C | -3.03 | first reported: 14.32 |
| 2386 | DIN 13130-1 | 0.2950 | | -0.53 | |
| 2403 | BS/EN 13130-1 | 0.292 | | -0.58 | |
| 2495 | In house | 0.4270 | | 1.60 | |
| 2497 | In house | 0.30688 | | -0.34 | |
| 2549 | EN13130 | 0.24 | | -1.41 | |
| 2689 | EN13130 | 0.262 | | -1.06 | |
| 2747 | | ----- | | ----- | |
| 2753 | | ----- | | ----- | |
| 2760 | INH-13130 | 0.28 | C | -0.77 | first reported: 0.56 |
| 3146 | DIN EN 13130-1 | 0.310 | | -0.28 | |
| 3151 | EN 13130 | 0.322 | | -0.09 | |
| 3153 | EN 13130-1 | 0.387 | | 0.96 | |
| 3163 | EN-1186 | 0.513333 | C | 2.99 | first reported: 8.01 |
| 3172 | EN 13130-1 | 0.269 | | -0.95 | |
| 3209 | EN13130 | 0.283 | | -0.72 | |
| 3225 | | ----- | | ----- | |
| 3233 | INH-13130 | 0.33 | | 0.04 | |
| 3237 | | ----- | | ----- | |

| | | | | |
|---|---|---|---|---|
| | | | Only volume to surface ratio of 167 ml/dm$^2$ | |
| normality | OK | | not OK | |
| n | 24 | | 10 | |
| outliers | 1 | | 0 | |
| mean (n) | 0.3277 | | 0.3040 | |
| st.dev. (n) | 0.09337 | RSD = 28% | 0.07420 | RSD = 24% |
| R(calc.) | 0.2614 | | 0.2078 | |
| R(Horwitz) | 0.1736 | | 0.1629 | |

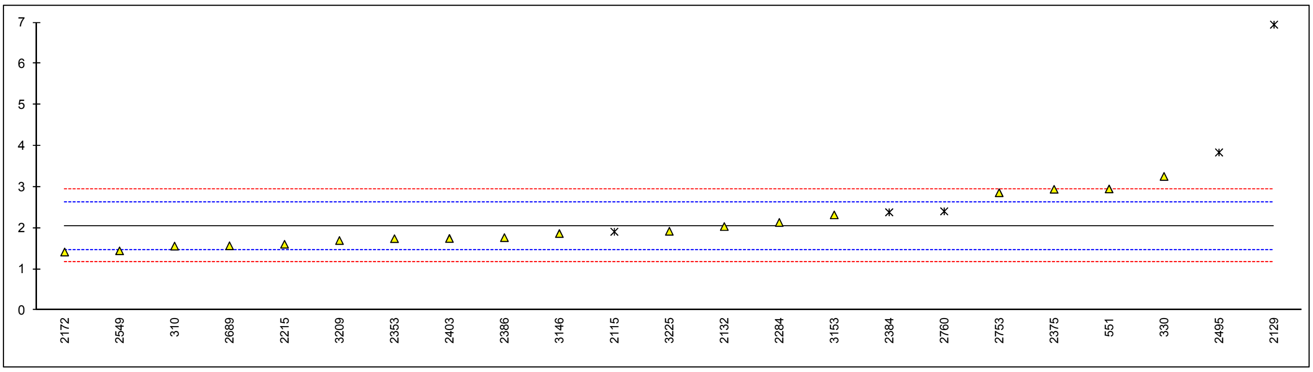


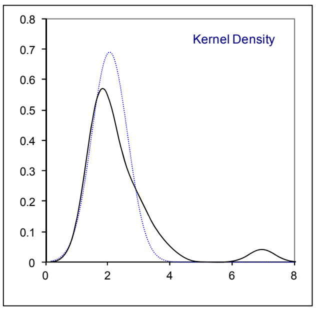



## Specific Migration Copper as Cu on sample #16620; results in mg/kg food simulant

| lab | method | value | mark | z(targ) | remarks |
|---|---|---|---|---|---|
| 310 | EN 13130 | 1.565 | | -1.65 | |
| 330 | NF EN 13130-1 | 3.26 | | 4.11 | |
| 362 | | ----- | | ----- | |
| 551 | EN13130-1 | 2.955 | | 3.07 | |
| 622 | | ----- | | ----- | |
| 1179 | | ----- | | ----- | |
| 1301 | | ----- | | ----- | |
| 2115 | In house | 1.913 | ex | -0.47 | excluded for not using conventional conversion factor 6 (see §4 and 5) |
| 2129 | DIN EN 13130-1 | 6.951 | ex | 16.64 | excluded for not using conventional conversion factor 6 (see §4 and 5) |
| 2132 | In house | 2.04 | | -0.04 | |
| 2172 | EU 10 2011 | 1.421 | | -2.14 | |
| 2215 | (EU)NO.10/2011 | 1.61 | | -1.50 | |
| 2284 | EN 13130-1 | 2.14 | | 0.30 | |
| 2353 | EN13130-1 | 1.745 | | -1.04 | |
| 2370 | | ----- | | ----- | |
| 2375 | In house | 2.946 | | 3.04 | |
| 2384 | BS EN13130-1 | 2.387 | ex | 1.14 | excluded for not using conventional conversion factor 6 (see §4 and 5) |
| 2386 | DIN 13130-1 | 1.77 | | -0.95 | |
| 2403 | BS/EN 13130-1 | 1.75 | | -1.02 | |
| 2495 | In house | 3.843 | ex | 6.09 | excluded for not using conventional conversion factor 6 (see §4 and 5) |
| 2497 | | ----- | | ----- | |
| 2549 | EN13130 | 1.45 | | -2.04 | |
| 2689 | EN13130 | 1.573 | | -1.62 | |
| 2747 | | ----- | | ----- | |
| 2753 | EN 13130-1 | 2.862 | | 2.76 | |
| 2760 | INH-13130 | 2.41 | ex | 1.22 | excluded for not using conventional conversion factor 6 (see §4 and 5) |
| 3146 | DIN EN 13130-1 | 1.87 | | -0.61 | |
| 3151 | | ----- | | ----- | |
| 3153 | EN 13130-1 | 2.324 | | 0.93 | |
| 3163 | | ----- | | ----- | |
| 3172 | | ----- | | ----- | |
| 3209 | EN13130 | 1.700 | | -1.19 | |
| 3225 | EN13130 | 1.9260 | | -0.42 | |
| 3233 | | ----- | | ----- | |
| 3237 | | ----- | | ----- | |

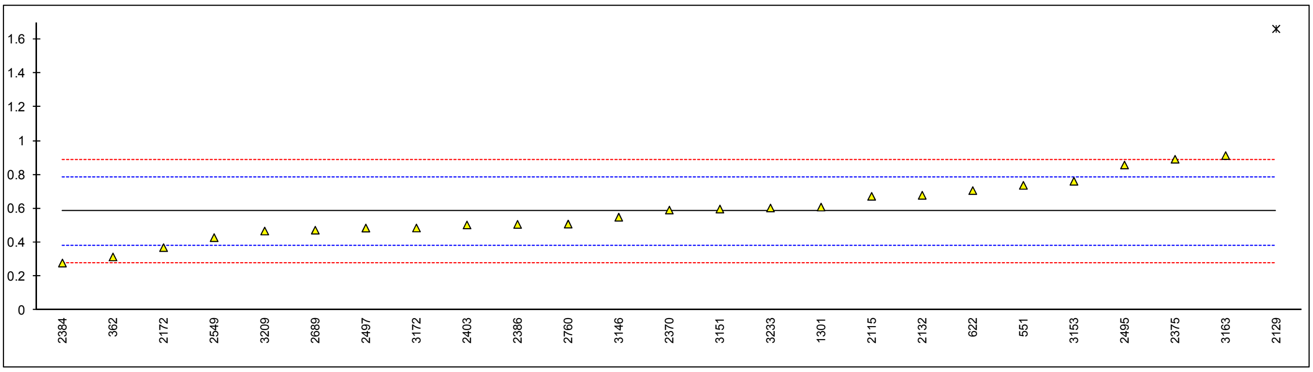
| | | | | Only volume to surface ratio of 167 ml/dm$^2$ | |
|---|---|---|---|---|---|
| normality | OK | | | suspect | |
| n | 18 | | | 12 | |
| outliers | 0 (+5ex) | | | 0 | |
| mean (n) | 2.0504 | | | 2.0347 | |
| st.dev. (n) | 0.57763 | RSD = 28% | | 0.63467 | RSD = 31% |
| R(calc.) | 1.6174 | | | 1.7771 | |
| R(Horwitz) | 0.8245 | | | 0.8197 | |

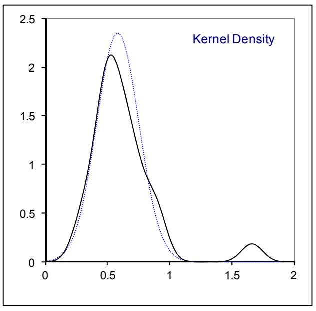


## Specific Migration Zinc as Zn per contact surface on sample #16620; results in mg/dm$^2$

| lab | method | value | mark | z(targ) | remarks | |
|---|---|---|---|---|---|---|
| 310 | | ----- | | ----- | | |
| 330 | | ----- | | ----- | | |
| 362 | | 0.316 | | -2.65 | | |
| 551 | EN13130-1 | 0.739 | | 1.52 | | |
| 622 | In house | 0.708 | | 1.22 | | |
| 1179 | | ----- | | ----- | | |
| 1301 | INH-95-1003 | 0.6105 | | 0.26 | | |
| 2115 | In house | 0.674 | | 0.88 | | |
| 2129 | DIN EN 13130-1 | 1.663 | R(0.01) | 10.64 | | |
| 2132 | In house | 0.68 | | 0.94 | | |
| 2172 | EU 10 2011 | 0.371 | | -2.11 | | |
| 2215 | | ----- | | ----- | | |
| 2284 | | ----- | | ----- | | |
| 2353 | | ----- | | ----- | | |
| 2370 | INH-602 | 0.593 | | 0.08 | | |
| 2375 | In house | 0.893 | | 3.04 | | |
| 2384 | BS EN13130-1 | 0.28 | C | -3.00 | first reported: 27.84 | |
| 2386 | DIN 13130-1 | 0.5083 | | -0.75 | | |
| 2403 | BS/EN 13130-1 | 0.505 | | -0.78 | | |
| 2495 | In house | 0.8590 | | 2.71 | | |
| 2497 | In house | 0.48673 | | -0.96 | | |
| 2549 | EN13130 | 0.43 | | -1.52 | | |
| 2689 | EN13130 | 0.474 | | -1.09 | | |
| 2747 | | ----- | | ----- | | |
| 2753 | | ----- | | ----- | | |
| 2760 | INH-13130 | 0.51 | C | -0.73 | first reported: 1.03 | |
| 3146 | DIN EN 13130-1 | 0.551 | | -0.33 | | |
| 3151 | EN 13130 | 0.599 | | 0.14 | | |
| 3153 | EN 13130-1 | 0.763 | | 1.76 | | |
| 3163 | EN-1186 | 0.914667 | C | 3.26 | first reported: 14.21 | |
| 3172 | EN 13130-1 | 0.487 | | -0.96 | | |
| 3209 | EN13130 | 0.469 | | -1.14 | | |
| 3225 | | ----- | | ----- | | |
| 3233 | INH-13130 | 0.605 | | 0.20 | | |
| 3237 | | ----- | | ----- | | |
| | | | | | Only volume to surface ratio of 167 ml/dm$^2$ | |
| | normality | OK | | | suspect | |
| | n | 24 | | | 10 | |
| | outliers | 1 | | | 0 | |
| | mean (n) | 0.5844 | | | 0.5181 | |
| | st.dev. (n) | 0.17026 | RSD = 29% | | 0.10379 | RSD = 20% |
| | R(calc.) | 0.4767 | | | 0.2906 | |
| | R(Horwitz) | 0.2839 | | | 0.2563 | |

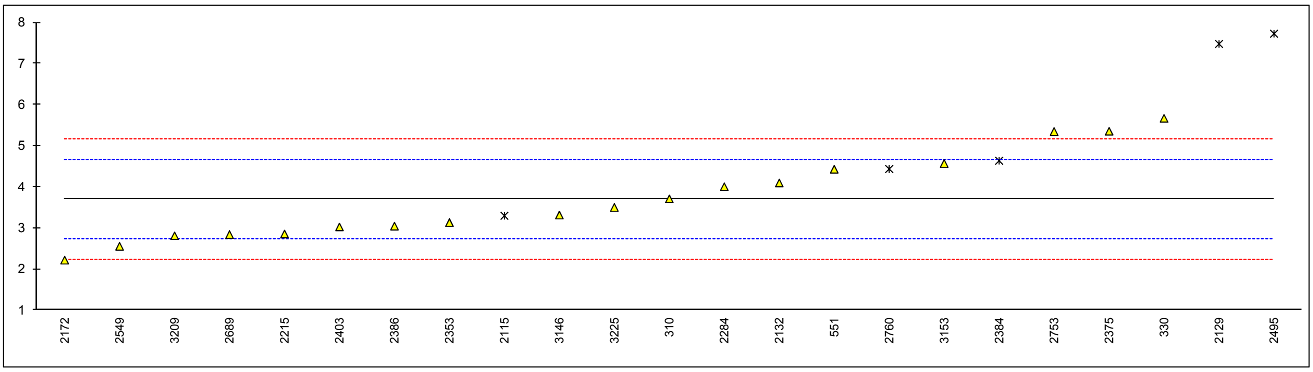


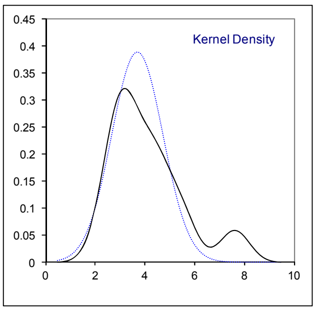



## Specific Migration Zinc as Zn on sample #16620; results in mg/kg food simulant

| lab | method | value | mark | z(targ) | remarks |
|---|---|---|---|---|---|
| 310 | EN 13130 | 3.714 | | 0.03 | |
| 330 | NF EN 13130-1 | 5.672 | | 4.06 | |
| 362 | | ----- | | ----- | |
| 551 | EN13130-1 | 4.433 | | 1.51 | |
| 622 | | ----- | | ----- | |
| 1179 | | ----- | | ----- | |
| 1301 | | ----- | | ----- | |
| 2115 | In house | 3.303 | ex | -0.81 | excluded for not using conventional conversion factor 6 (see §4 and 5) |
| 2129 | DIN EN 13130-1 | 7.482 | ex | 7.79 | excluded for not using conventional conversion factor 6 (see §4 and 5) |
| 2132 | In house | 4.10 | | 0.83 | |
| 2172 | EU 10 2011 | 2.224 | | -3.03 | |
| 2215 | (EU)NO.10/2011 | 2.86 | | -1.72 | |
| 2284 | EN 13130-1 | 4.009 | | 0.64 | |
| 2353 | EN13130-1 | 3.137 | | -1.15 | |
| 2370 | | ----- | | ----- | |
| 2375 | In house | 5.358 | | 3.42 | |
| 2384 | BS EN13130-1 | 4.640 | ex | 1.94 | excluded for not using conventional conversion factor 6 (see §4 and 5) |
| 2386 | DIN 13130-1 | 3.05 | | -1.33 | |
| 2403 | BS/EN 13130-1 | 3.03 | | -1.37 | |
| 2495 | In house | 7.731 | ex | 8.30 | excluded for not using conventional conversion factor 6 (see §4 and 5) |
| 2497 | | ----- | | ----- | |
| 2549 | EN13130 | 2.56 | | -2.34 | |
| 2689 | EN13130 | 2.844 | | -1.76 | |
| 2747 | | ----- | | ----- | |
| 2753 | EN 13130-1 | 5.352 | | 3.40 | |
| 2760 | INH-13130 | 4.44 | ex | 1.53 | excluded for not using conventional conversion factor 6 (see §4 and 5) |
| 3146 | DIN EN 13130-1 | 3.32 | | -0.78 | |
| 3151 | | ----- | | ----- | |
| 3153 | EN 13130-1 | 4.575 | | 1.81 | |
| 3163 | | ----- | | ----- | |
| 3172 | | ----- | | ----- | |
| 3209 | EN13130 | 2.815 | | -1.82 | |
| 3225 | EN13130 | 3.5060 | | -0.39 | |
| 3233 | | ----- | | ----- | |
| 3237 | | ----- | | ----- | |

| | | | | Only volume to surface ratio of 167 ml/dm$^2$ | |
|---|---|---|---|---|---|
| normality | OK | | | OK | |
| n | 18 | | | 12 | |
| outliers | 0 (+5ex) | | | 0 | |
| mean (n) | 3.6977 | | | 3.5296 | |
| st.dev. (n) | 1.02886 | RSD = 28% | | 1.10827 | RSD = 31% |
| R(calc.) | 2.8808 | | | 3.1032 | |
| R(Horwitz) | 1.3606 | | | 1.3079 | |



## Specific Migration Fe, Li and Mn per contact surface on sample #16620; results in mg/dm$^2$

| lab | method | Fe | | Li | | Mn | | Remarks |
|---|---|---|---|---|---|---|---|---|
| 310 | | ----- | | ----- | | ----- | | |
| 330 | | ----- | | ----- | | ----- | | |
| 362 | | ----- | | ----- | | ----- | | |
| 551 | EN13130-1 | <0.05 | | <0.05 | | <0.05 | | |
| 622 | In house | 0.006 | | 0.000 | | 0.000 | | |
| 1179 | | ----- | | ----- | | ----- | | |
| 1301 | INH-95-1003 | 0.0152 | | <0.001 | | <0.001 | | |
| 2115 | In house | 0.005 | | ----- | | ----- | | |
| 2129 | DIN EN 13130-1 | 0.00987 | | <0,001 | | <0,001 | | |
| 2132 | In house | <0.01 | | <0.01 | | <0.01 | | |
| 2172 | EU 10 2011 | <0.83 | | <0.017 | | <0.017 | | |
| 2215 | | ----- | | ----- | | ----- | | |
| 2284 | | ----- | | ----- | | ----- | | |
| 2353 | | ----- | | ----- | | ----- | | |
| 2370 | INH-602 | 0.00433 | | <0.004 | | <0.004 | | |
| 2375 | In house | ----- | | ----- | | ----- | | |
| 2384 | BS EN13130-1 | <0.1 | | <0.1 | | <0.1 | | |
| 2386 | DIN 13130-1 | 0.0022 | | <0.005 | | 0.0012 | | |
| 2403 | BS/EN 13130-1 | ND | | ND | | ND | | |
| 2495 | In house | <0.004 | | <0.004 | | <0.004 | | |
| 2497 | In house | 0.00715 | | 0.00001 | | 0.00009 | | |
| 2549 | EN13130 | <0.005 | | <0.005 | | <0.005 | | |
| 2689 | EN13130 | ND | | ND | | ND | | |
| 2747 | | ----- | | ----- | | ----- | | |
| 2753 | | ----- | | ----- | | ----- | | |
| 2760 | INH-13130 | 0.0009 | C | 0.0008 | C | 0.0001 | C | fr. resp. 0.0018, 0.0016 and 0.0002 |
| 3146 | DIN EN 13130-1 | <0.002 | | <0.005 | | <0.002 | | |
| 3151 | EN 13130 | 0.00413 | | nd | | nd | | |
| 3153 | EN 13130-1 | <0.5 | | <0.01 | | <0.01 | | |
| 3163 | EN-1186 | 0.018 | C | 0.000524 | C | 0.000041 | C | fr.resp. 0.224, 0.032 and 0.005 |
| 3172 | EN 13130-1 | n.d. | | n.d. | | n.d. | | |
| 3209 | EN13130 | ND | | ND | | ND | | |
| 3225 | | ----- | | ----- | | ----- | | |
| 3233 | INH-13130 | < 0.1 | | < 0.01 | | < 0.01 | | |
| 3237 | | ----- | | ----- | | ----- | | |
| | n | 23 | | 22 | | 22 | | |
| | mean (n) | <8 | | <0.1 | | <0.1 | | |

## Specific Migration Fe, Li and Mn on sample #16620; results in mg/kg food simulant

| lab | method | Fe | Li | Mn | Remarks |
|---|---|---|---|---|---|
| 310 | EN 13130 | 0.004 | 0 | 0 | |
| 330 | NF EN 13130-1 | 0 | 0 | 0 | |
| 362 | | ----- | ----- | ----- | |
| 551 | EN13130-1 | <0.05 | <0.05 | <0.05 | |
| 622 | | ----- | ----- | ----- | |
| 1179 | | ----- | ----- | ----- | |
| 1301 | | ----- | ----- | ----- | |
| 2115 | In house | 0.022 | ----- | ----- | |
| 2129 | DIN EN 13130-1 | 0.04442 | <0,001 | 0.00268 | |
| 2132 | In house | <0.03 | <0.03 | <0.03 | |
| 2172 | EU 10 2011 | ＜5 | ＜0.1 | ＜0.1 | |
| 2215 | (EU)NO.10/2011 | <0.03 | <0.03 | <0.03 | |
| 2284 | EN 13130-1 | nd | nd | nd | |
| 2353 | EN13130-1 | < 0.25 | < 0.5 | < 0.25 | |
| 2370 | | ----- | ----- | ----- | |
| 2375 | In house | ----- | ----- | ----- | |
| 2384 | BS EN13130-1 | <0.25 | <0.5 | <0.25 | |
| 2386 | DIN 13130-1 | 0.013 | <0.005 | 0.007 | |
| 2403 | BS/EN 13130-1 | ND | ND | ND | |
| 2495 | In house | <0.04 | <0.04 | <0.04 | |
| 2497 | | ----- | ----- | ----- | |
| 2549 | EN13130 | <0.03 | <0.03 | <0.03 | |
| 2689 | EN13130 | ND | ND | ND | |
| 2747 | | ----- | ----- | ----- | |
| 2753 | EN 13130-1 | 0.013 | <0.001 | 0.001 | |
| 2760 | INH-13130 | 0.008 | 0.007 | 0.001 | |
| 3146 | DIN EN 13130-1 | <0.014 | <0.089 | <0.014 | |
| 3151 | | ----- | ----- | ----- | |
| 3153 | EN 13130-1 | <5 | <0.1 | <0.1 | |
| 3163 | | ----- | ----- | ----- | |
| 3172 | | ----- | ----- | ----- | |
| 3209 | EN13130 | ND | ND | ND | |
| 3225 | EN13130 | <1.0 | <0.10 | <0.05 | |
| 3233 | | ----- | ----- | ----- | |
| 3237 | | ----- | ----- | ----- | |
| | | | | | |
| | n | 22 | 21 | 21 | |
| | mean (n) | <48 | <0.6 | <0.6 | |

## APPENDIX 2

### Details reported by the participating laboratories

| lab | sample cleaned during preparation | exposed contact surface area in $dm^2$ | used as single or double surface | volume of simulant used in mL | simulant preheated before use | thickness of sample used for area |
|---|---|---|---|---|---|---|
| 310 | No | 4.50 | Double surface | 450 | Yes | Yes |
| 330 | No | 0.60 | Double surface | 100 | Yes | Yes |
| 362 | No | 4.56 | --- | 2000 | No | --- |
| 551 | Yes, with a lint free cloth | 0.60 | Double surface | 100 | Yes | Yes |
| 622 | No | 1 | Double surface | 100 | No | No |
| 1179 | --- | | --- | | --- | --- |
| 1301 | No | 1.28 | Double surface | 500 | --- | No |
| 2115 | No | 0.49 | Double surface | 100 | Yes | No |
| 2129 | No | 4.50 | Double surface | 500 | Yes | No |
| 2132 | Yes, with lint-free cloth | 1.039 | Double surface | 100 | Yes | Yes |
| 2172 | No | 0.60 | Double surface | 100 | Yes | No |
| 2215 | No | 4.53 | Double surface | 755 | Yes | Yes |
| 2284 | No | 0.60 | Double surface | 100 | Yes | Yes |
| 2353 | Yes, with brush to remove dust | 4.1909 | Double surface | 419 | Yes | Yes |
| 2370 | Yes, purged air to remove dust. | 4.52 | Double surface | 753 | Yes | Yes |
| 2375 | No | 2.19 | Single surface | 200 | Yes | No |
| 2384 | No | 0.55 | Double surface | 55 | Yes | Yes |
| 2386 | Yes, with H2O | 1.20 | Double surface | 200 | Yes | Yes |
| 2403 | No | 0.78 | Double surface | 130 | Yes | Yes |
| 2495 | Yes, with dry paper to remove dust | 2.25 | Single surface | 250 | Yes | No |
| 2497 | Yes, with non -ionic surfactant | 4.3210 | --- | 220 | Yes | --- |
| 2549 | No | 4.54 | Double surface | 750 | Yes | Yes |
| 2689 | No | 4.56 | Double surface | 760 | Yes | No |
| 2747 | --- | | --- | | --- | --- |
| 2753 | No | 4.54 | Double surface | 757 | Yes | Yes |
| 2760 | No | 4.32 | Double surface | 500 | Yes | No |
| 3146 | No | 4.53 | Double surface | 2150 | Yes | Yes |
| 3151 | Yes, with *) | 0.269 | Double surface | 30 | No | Yes |
| 3153 | Yes, with a lint-free cloth | 1.00 | Double surface | 100 | Yes | Yes |
| 3163 | No | 0.375 | Double surface | 50 | Yes | No |
| 3172 | No | 4.55 | Double surface | 760 | Yes | Yes |
| 3209 | Yes, with Distilled water | 4.54 | Double surface | 757 | Yes | Yes |
| 3225 | Yes, with a Kimwipe | 4.54 | Double surface | 750 | Yes | Yes |
| 3233 | Yes, with a lint-free cloth | 0.60 | Double surface | 100 | Yes | No |
| 3237 | No | 4.50 | --- | | --- | --- |

*) Washed with household liquid detergent in water about 40°C, rinsed with tap water and then deionized

**APPENDIX 3:**

**Other results reported by participating laboratories on Specific Migration on sample #16620**

| lab | actual surface area used ($dm^2$) | actual volume simulant used (ml) | actual volume to surface ratio ($ml/dm^2$) | final conc. in food simulant (mg/L) Ba | final conc. in food simulant (mg/L) Co | final conc. in food simulant (mg/L) Cu | final conc. in food simulant (mg/L) Zn | factor 6 used to calc. spec. migration in mg/kg food simulant? | result in mg/L the same as mg/kg food simulant? |
|---|---|---|---|---|---|---|---|---|---|
| 310 | 4.50 | 450 | 100.00 | 2.181 | 0.404 | 2.608 | 6.190 | Yes | ----- |
| 330 | 0.60 | 100 | **166.67** | 1.526 | 0.465 | 3.26 | 5.672 | Yes | ----- |
| 362 | 4.56 | 2000 | 438.60 | 0.48 | 0.065 | 0.40 | 0.72 | ----- | ----- |
| 551 | 0.60 | 100 | **166.67** | 2.554 | 0.278 | 2.955 | 4.433 | Yes | Yes |
| 622 | 1 | 100 | 100.00 | 2.555 | 0.429 | 3.983 | 7.079 | ----- | ----- |
| 1179 | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| 1301 | 1.28 | 500 | 390.63 | 1.040 | 0.107 | 0.880 | 1.563 | ----- | ----- |
| 2115 | 0.49 | 100 | 204.08 | 1.845 | 0.244 | 1.91 | 3.303 | No | Yes |
| 2129 | 4.50 | 500 | 111.11 | ----- | ----- | ----- | ----- | No | ----- |
| 2132 | 1.039 | 100 | 96.25 | 2.20 | 0.56 | 3.54 | 7.10 | Yes | Yes |
| 2172 | 0.60 | 100 | **166.67** | 1.523 | 0.193 | 1.421 | 2.224 | Yes | Yes |
| 2215 | 4.53 | 755 | **166.67** | ----- | ----- | ----- | ----- | Yes | ----- |
| 2284 | 0.60 | 100 | **166.67** | 2.05 | 0.374 | 2.14 | 4.009 | Yes | ----- |
| 2353 | 4.1909 | 419 | 99.98 | 4.073 | 0.4361 | 2.908 | 5.229 | Yes | Yes |
| 2370 | 4.52 | 753 | **166.59** | 2.57 | 0.326 | 2.04 | 3.56 | ----- | ----- |
| 2375 | 2.19 | 200 | 91.32 | 1.68 | 0.85 | 5.37 | 9.77 | Yes | Yes |
| 2384 | 0.55 | 55 | 100.00 | 1.541 | 0.207 | 1.432 | 2.784 | No | Yes |
| 2386 | 1.20 | 200 | **166.67** | 1.87 | 0.264 | 1.77 | 3.05 | Yes | ----- |
| 2403 | 0.78 | 130 | **166.67** | 1.89 | 0.234 | 1.75 | 3.03 | Yes | Yes |
| 2495 | 2.25 | 250 | 111.11 | 1.523 | 0.595 | 3.843 | 7.731 | No | Yes |
| 2497 | 4.3210 | 220 | 50.91 | 5.908 | 0.890 | 6.028 | 9.560 | ----- | ----- |
| 2549 | 4.54 | 750 | **165.20** | 1.47 | 0.23 | 1.46 | 2.58 | Yes | ----- |
| 2689 | 4.56 | 760 | **166.67** | 1.528 | 0.228 | 1.573 | 2.844 | Yes | Yes |
| 2747 | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| 2753 | 4.54 | 757 | **166.74** | ----- | ----- | ----- | ----- | Yes | ----- |
| 2760 | 4.32 | 500 | 115.74 | 2.65 | 0.35 | 2.41 | 4.44 | No | Yes |
| 3146 | 4.53 | 2150 | 474.61 | 0.902 | 0.098 | 0.654 | 1.16 | Yes | ----- |
| 3151 | 0.269 | 30 | 111.52 | 4.637 | 0.0124 | 0.0866 | 0.161 | ----- | ----- |
| 3153 | 1.00 | 100 | 100.00 | 1.173 | 0.656 | 3.884 | 7.644 | Yes | No |
| 3163 | 0.375 | 50 | 133.33 | 1.57 | 1.07 | 3.85 | 6.86 | ----- | ----- |
| 3172 | 4.55 | 760 | **167.03** | ----- | ----- | ----- | ----- | ----- | ----- |
| 3209 | 4.54 | 757 | **166.74** | 1.801 | 0.230 | 1.700 | 2.815 | Yes | Yes |
| 3225 | 4.54 | 750 | **165.20** | 2.9040 | 0.3067 | 1.9260 | 3.5060 | Yes | ----- |
| 3233 | 0.60 | 100 | **166.67** | 1.99 | 0.28 | 1.98 | 3.63 | ----- | ----- |
| 3237 | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- | ----- |

## APPENDIX 4

## Number of participating laboratories per country

1 lab in BRAZIL

1 lab in BULGARIA

2 labs in FRANCE

4 labs in GERMANY

4 labs in HONG KONG

1 lab in INDIA

1 lab in INDONESIA

4 labs in ITALY

1 lab in MALAYSIA

7 labs in P.R. of CHINA

1 lab in QATAR

1 lab in SERBIA

1 lab in TAIWAN R.O.C.

3 labs in THE NETHERLANDS

2 labs in TURKEY

1 lab in UNITED ARAB EMIRATES

## APPENDIX 5

**Abbreviations**:

| | |
|---|---|
| C | = final test result after checking of first reported suspect test 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 |
| E | = probably an error in calculation |
| W | = test result withdrawn on request of the participant |

**Literature**:


1 iis Interlaboratory Studies, Protocol for the Organisation, Statistics & Evaluation, April 2014

2 EN13130-1 Materials and articles in contact with foodstuffs – Plastics substances subject to limitation - Part 1: Guide to test methods for the specific migration of substances from plastics to foods and food simulants and the determination of substances in plastics and the selection of conditions of exposure to food simulants

3 Commission regulation (EU) No 10/2011 of January 2011 on plastic materials and articles intended to come into contact with food, published in the official journal of the EU on the 15$^{th}$ of January 2011

4 ASTM E178-02

5 ASTM E1301-03

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 367/96

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 P.J. Lowthian and M. Thompson, The Royal Society of Chemistry 2002, Analyst 2002, 127 page1359-1364.

16 R.G. Visser, Reliability of proficiency test results for metals and phthalates in plastics, Accred Qual Assur, 14:29-34 (2009)

17 EUR 24815 EN 2011 - Technical guidelines on testing the migration of primary aromatic amines from polyamide kitchenware and of formaldehyde from melamine kitchenware, JRC (2011)

18 Bernard Rosner, Percentage Points for a Generalized ESD Many-Outlier Procedure, Technometrics, 25(2), pp. 165-172, (1983)

19 Commission regulation (EU) No 1416/2016 of 24 August 2016, amending and correcting Regulation (EU) No 10/2011 on plastic materials and articles intended to come into contact with food