Results of Proficiency Test
Magnetics (toys)
May 2017

Organised by: Institute for Interlaboratory Studies
Spijkenisse, the Netherlands

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CONTENTS

1 INTRODUCTION

Strong magnets can cause serious injuries if swallowed. In 2009 the Consumer Product Safety Commission (CPSC) banned the sale of children's toys that included super-strong (e.g. neodymium) magnets. It had received dozens of reports of children swallowing them, resulting in serious injuries and in one case death. Further investigation by the CPSC published in 2012 found an increasing trend of magnet ingestion incidents in young children and teens since 2009. Incidents involving older children and teens were unintentional and the result of using the magnets to mimic body piercings such as tongue studs. The commission cited hidden complications if more than one magnet becomes attached across tissue inside the body. Therefore a flux index limit of 50 kG^2mm^2 was set in 2012, based on an analysis of magnets that were involved in incidents.
On request of several participants, the Institute of Interlaboratory Studies decided to organise an interlaboratory study for the determination the magnetic flux index in the annual testing program for 2016/2017.
In the 2017 interlaboratory study 13 laboratories in 8 different countries did register for participation. See appendix 4 for the number of participants per country. In this report, the test results of the 2017 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 performed by iis. It was decided to send two different types of magnets, three equal magnets of each type. Sample #17580 consisted of 3 refrigerator flat disk shaped magnets and sample #17581 consisted of 3 ball shaped neodymium magnets.
Participants were requested to report rounded and unrounded test results. The unrounded test results were preferably used for statistical evaluation. Also an inventory was made of the analytical details of the used test methods, by means of a questionnaire, which was included in the report form.

2.1 QUALITY SYSTEM

The Institute for Interlaboratory Studies in Spijkenisse, the Netherlands, has implemented a quality system based on ISO/IEC 17043:2010. 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 a regular basis by sending out questionnaires.

2.2 PROTOCOL

The protocol followed in the organisation of this proficiency test was the one as described for proficiency testing in the report 'iis Interlaboratory Studies: Protocol for the Organisation, Statistics and Evaluation' of March 2017 (iis-protocol, version 3.4). 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

The samples were purchased via the Internet. Sample #17580 consisted of 3 flat disk shaped refrigerator magnets with a diameter of approx 20 mm. Sample #17581 consisted of 3 ball shaped neodymium magnets with a diameter of approx 5 mm.
To test the homogeneity/equality of the purchased batch of magnets #17580, eighteen stratified randomly selected samples #17580 were tested in nine fold by method EN71-1 using a Lakeshore model 425 Gaussmeter. The test results are shown in table 1.

Maximum flux density in kG	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
sample #17580-1	2.180	2.104	2.162	2.135	2.060	2.066	2.024	2.061	2.064
sample #17580-2	2.253	2.336	2.329	2.381	2.291	2.042	2.435	2.169	2.206
sample #17580-3	2.015	2.142	2.158	2.315	2.167	2.151	2.229	2.165	2.080
sample #17580-4	2.378	2.204	2.168	2.144	2.214	2.190	2.230	2.103	2.132
sample #17580-5	2.094	2.173	2.185	2.064	2.180	2.185	2.245	2.143	2.151
sample #17580-6	2.047	2.056	2.157	2.107	2.114	2.219	2.189	2.228	2.267
sample #17580-7	2.219	2.231	2.211	2.195	2.196	2.157	2.241	2.196	2.203
sample #17580-8	2.113	2.172	2.103	2.133	2.192	1.988	2.124	2.066	2.178
sample #17580-9	2.212	2.223	2.159	2.164	2.182	2.215	2.204	2.116	2.069
sample #17580-10	2.298	2.147	2.105	2.202	2.154	2.205	2.298	2.220	2.267
sample #17580-11	2.151	2.255	2.111	2.167	2.109	2.234	2.070	2.213	2.033
sample #17580-12	2.166	2.225	2.119	2.238	2.175	2.273	2.310	2.264	2.134
sample #17580-13	2.462	2.269	2.497	2.191	2.312	2.265	2.144	2.210	2.158
sample #17580-14	2.200	2.183	2.119	2.125	2.073	2.242	2.228	2.204	2.205
sample #17580-15	2.215	2.272	2.110	2.158	2.191	2.218	2.245	2.154	2.430
sample #17580-16	2.173	2.221	2.336	2.422	2.279	2.451	2.256	2.320	2.338
sample #17580-17	2.136	2.255	2.145	2.297	2.207	2.274	2.127	2.138	2.110
sample #17580-18	2.279	2.254	2.225	2.164	2.270	2.265	2.251	2.158	2.180

Table 1: homogeneity test results of subsamples #17580

From the above test results the averages and the precisions were calculated. The ranges of results are given in below table.

	averages of max flux density	*RSDr%*
per magnet (min – max)	2.09 - 2.31 kG	1.1 - 4.7%
between magnets	2.19 kG	2.3%

Table 2: summary of the homogeneity of subsamples #17580

To test the homogeneity/equality of the purchased batch of magnets #17581, eighteen stratified randomly selected samples #17581 were tested in nine fold by method EN71-1 using a Lakeshore model 425 Gaussmeter. The test results are shown in table 1.

Maximum flux density in kG	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
sample #17581-1	3.708	4.145	4.034	4.626	4.474	4.546	4.098	4.395	4.237
sample #17581-2	4.565	4.370	4.059	4.525	4.514	4.233	4.467	4.404	4.620
sample #17581-3	4.069	4.331	4.501	4.350	4.658	4.356	4.146	4.063	4.304
sample #17581-4	4.431	4.588	4.628	3.790	4.646	4.489	4.538	4.593	4.650
sample #17581-5	4.103	4.303	4.128	3.699	4.325	4.449	4.491	4.522	4.253
sample #17581-6	4.653	4.547	4.510	4.377	4.511	4.649	4.507	4.418	4.220
sample #17581-7	4.490	4.406	4.104	4.629	4.313	4.585	4.422	4.456	4.216
sample #17581-8	4.562	4.567	4.600	4.436	4.439	4.644	4.460	4.679	4.752
sample #17581-9	4.821	4.482	4.542	4.648	4.271	4.683	4.728	4.477	4.465
sample #17581-10	3.973	4.558	4.591	4.550	4.420	4.181	4.723	4.245	4.553
sample #17581-11	4.717	4.369	4.293	4.407	4.335	4.184	4.429	4.194	4.351
sample #17581-12	4.487	4.348	4.298	4.554	4.710	4.421	4.217	4.266	4.624
sample #17581-13	4.670	4.236	4.356	4.540	4.397	4.153	4.230	4.675	4.396
sample #17581-14	4.138	4.464	4.351	4.329	4.241	4.285	4.066	4.434	4.419
sample #17581-15	4.159	4.197	4.027	4.549	4.042	4.415	4.490	4.346	4.496
sample #17581-16	4.179	4.393	4.280	4.531	4.426	4.086	4.472	4.182	4.264
sample #17581-17	4.287	4.447	4.495	4.139	3.966	4.050	4.574	4.430	4.499
sample #17581-18	4.475	4.370	4.073	4.043	4.566	4.351	4.249	4.293	4.376

Table 3: homogeneity test results of subsamples #17581

From the above test results the averages and the precisions were calculated. The ranges of results are given in below table.

	averages of max flux density	*RSDr%*
per magnet (min – max)	4.30 - 4.57 kG	1.7 - 5.1%
between magnets	4.40 kG	2.2%

Table 2: summary of the homogeneity of subsamples #17581

Regretfully the reference test methods EN71-1 and ASTM F963 do not contain precision statements. Therefore it was not possible to evaluate the measured precision against the precision of a reference test method.

For both samples #17580 and #17581, small differences between the maximum flux densities of the individual magnets after exclusion of several statistically deviating measurements (2 for sample #17580 and 4 for sample #17581) are visible.
ANOVA calculations revealed that the differences between the magnets of one batch are too small to be detected when only few measurements are performed. Therefore the equality of the samples was assumed.

Three magnets of sample #17580 and three magnets of sample #17581 were sent to each of the participating laboratories on May 10, 2017.

2.5 ANALYSES

The participants were requested to determine the magnetic flux index on both samples #17580 and #17581, applying the analysis procedure that is routinely used in the laboratory.
It was requested to report the test results using the indicated units on the report form and not to round the test results, but report as much significant figures as possible. It was also requested not to report 'less than' test results, which are above the detection limit, because such test results cannot be used for meaningful statistical calculations.
To get comparable test results, a detailed report form and a letter of instructions are prepared. On the report form the reporting units are given as well as the reference test methods that will be used during the evaluation. The detailed report form and the letter of instructions are both made available on the data entry portal www.kpmd.co.uk/sgs-iis-cts/. The participating laboratories are also requested to confirm the sample receipt on this data entry portal. The letter of instructions can also be downloaded from the iis website www.iisnl.com.

3 RESULTS

During five weeks after sample dispatch, the test 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 per determination in appendix 1 of this report. The laboratories are presented by their 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 (no reanalysis). Additional or corrected test results are used for data analysis and original test results are placed under 'Remarks' in the test 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 organization 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 March 2017 (iis-protocol, version 3.4).
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. If a data set does not have a normal distribution, the results of the statistical evaluation should be used with due care.

According to ISO 5725 the original test results per determination were submitted to Dixon's, Grubbs' and/or Rosner's 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 test. 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 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 test 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 reference test method. 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, e.g. EN reproducibilities, the z-scores were calculated using a target standard deviation. This results in an evaluation independent of the variation of this interlaboratory study. The target standard deviation was calculated from the literature reproducibility by division with 2.8. In case no literature reproducibility was available, other targets values were used. In some cases a reproducibility based on former iis proficiency tests could be 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 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 test result tables in appendix 1.
Absolute values for z<2 are very common and absolute values for z>3 are very rare.
The usual interpretation of z-scores is as follows:

$\lvert z \rvert < 1$	good
$1 < \lvert z \rvert < 2$	satisfactory
$2 < \lvert z \rvert < 3$	questionable
$3 < \lvert z \rvert$	unsatisfactory

4 EVALUATION

During the execution of this proficiency test no considerable problems were encountered. All 13 participants reported test results before the deadline for reporting, except one participant that did not report any test results at all. In total 12 laboratories reported 24 Magnetic flux index test results. Observed were no outlying test results, which is 0%. In proficiency studies outlier percentages of 3% - 7.5% are quite normal.

4.1 EVALUATION PER SAMPLE

In this section, the reported test results are discussed per sample. All statistical results reported on the sample are summarised in appendix 1. The abbreviations used in these tables are listed in appendix 5.

Neither test method EN71-1:2014, nor test method ASTM F963-11 have precision statements that mention a repeatability and/or a reproducibility. Therefore it was decided to use a target reproducibility based on the precision of the homogeneity testing using the requirement that the repeatability of the homogeneity testing should be less than 0.3 times the reproducibility of the target method: R(target) > 3.3 x 2.8 x RSDr%. With a (maximum) repeatability RSDr% of 4.7 - 5.1% (see tables 2 and 4), this leads to a target reproducibility of >46%, which is rounded up to 50%.

Sample #17580:

The determination of the magnetic flux index at a level of 1800 kG^2mm^2 was problematic. No statistical outliers were observed. However, the calculated reproducibility after rejection of one suspect test result, is large and not in agreement with the target reproducibility.

Sample #17581:

The determination of the magnetic flux index at a level of 340 kG^2mm^2 was problematic. No statistical outliers were observed. However, the calculated reproducibility after rejection of one suspect test result, is large and not in agreement with the target reproducibility.

4.2 PERFORMANCE EVALUATION FOR THE GROUP OF LABORATORIES

A comparison has been made between the reproducibility as found for the group of participating laboratories and the target reproducibility in the next table:

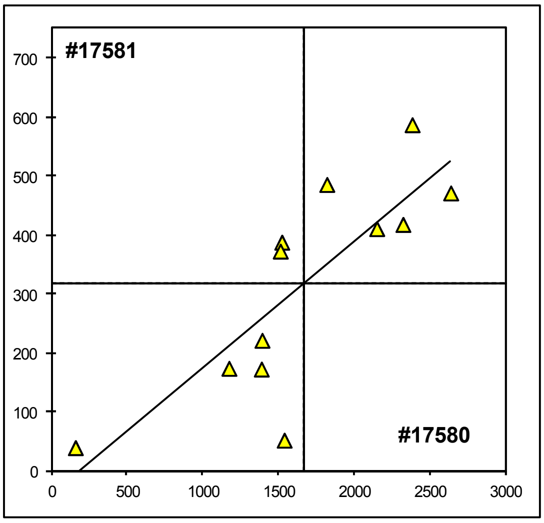
Parameter	*unit*	*n*	*average*	*2.8 * sd*	*R (target)*
Magnetic flux index #17580	kG^2mm^2	11	1802	1371	901
Magnetic flux index #17580	kG^2mm^2	11	341	457	171

Table 5: reproducibilities of test results on samples #17580 and #17581

From table 5 it can be concluded, without further statistical calculations, that the group of participating laboratories had serious problems with the determination of the magnetic flux index, when compared to the homogeneity test results.

5 DISCUSSION

When the reported test results are presented in a two-sample Youden plot, the presence of systematic errors is clearly visible, see below graph.



A laboratory that reports a low magnetic flux index on one sample, also reports a low magnetic flux index on the other sample. This large influence of the laboratory is the reason for the relatively large variations as presented in table 5.

It is tried to find the cause for the systematic errors in the reported details, like the accreditation status, the apparatus used, the pole surface area, the measured maximum flux density, the sample temperature, the probe type, the active area of the probe, the distance between the active area and the probe and the sample orientation. These reported details are summarized in appendices 2 and 3.

<u>Accreditation status:</u>
Only 2 laboratories were not accredited for the determination of magnetic flux index. One of these two reported very low test results. The other reported test results in line with the other participants.

Apparatus used:
Various different brands of apparatus were used. No correlation between the brands used and the reported magnetic flux indices was found.

Resolution of the apparatus:
The resolution varies from 0.01 G up to 1 G. No correlation with the reported test results was found.

Probe type used:
All laboratories except one used an axial probe type. Only laboratory 3214 used a transverbe probe. Both initially reported test results of this laboratory did show a negative bias. The laboratory reported to have used a wrong calculation. The revised test result for sample #17580 is in line with the consensus value. However, the revised test result for sample #17581 is still negatively biased. This may or may not be caused by the use of a deviating probe type, see also the next paragraph.

Active area diameter and distance to the probe:
All laboratories except one reported to meet the conditions set in EN71-1 and ASTM F963, being 0.76mm±0.13mm for the diameter and 0.38mm±0.13mm for the distance.
Only laboratory 3214, that used a transverse probe, reported different figures. These figures may be the consequence of the use of a different probe type.

Pole surface area:
Only one laboratory reported deviating pole surface area. When all magnetic flux in-dices were recalculated from the reported maximum flux densities and one fixed pole surface area (314.1 mm for #17580 and 19.48 mm for #17581), consensus values for the magnetic flux indices were calculated that deviate hardly from the original ones, see appendix 1.
The conclusion is that this parameter is not the cause for the large variations observed.

Number of times that sample was measured:
The samples were measured from only once to more than three times. No correlation with the reported test results was found.

Sample temperature used:
No correlation between the reported temperatures and the magnetic flux indices was found.

Underlying surface used:
No correlation between the given answers and the magnetic flux indices was found.

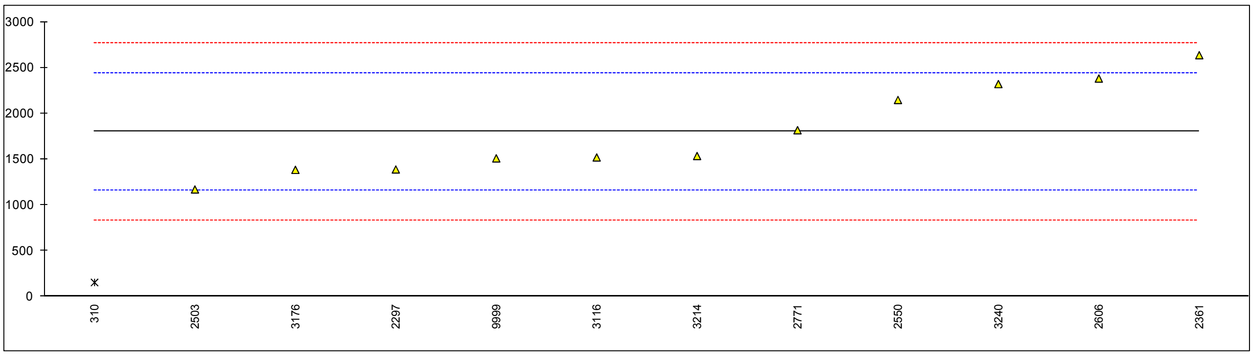
Orientation of the sample:
No correlation between the given answers and the magnetic flux indices was found.

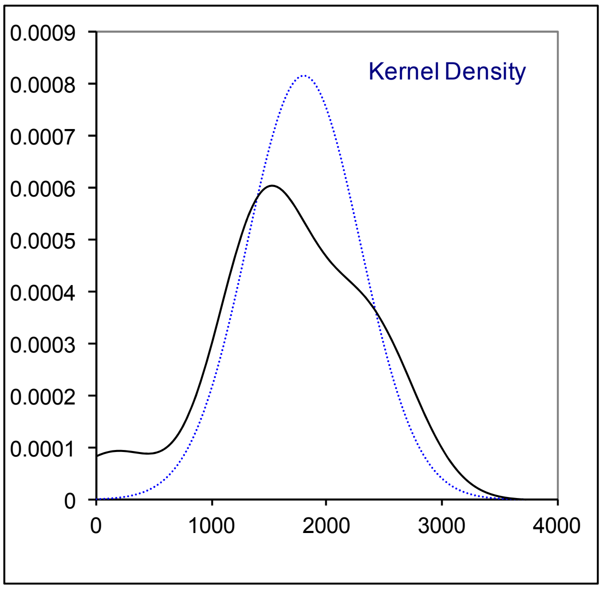
The final conclusion is that regretfully the cause for the observed systematic errors, could not be found in the reported details. Therefore each participating laboratory will have to evaluate its performance in this study and decide about corrective actions if necessary. Participation on a regular basis could be helpful to improve the performance and thus increase the quality of the test results.

APPENDIX 1

Determination of Magnetic Flux Index on sample #17580; result in kG^2mm^2

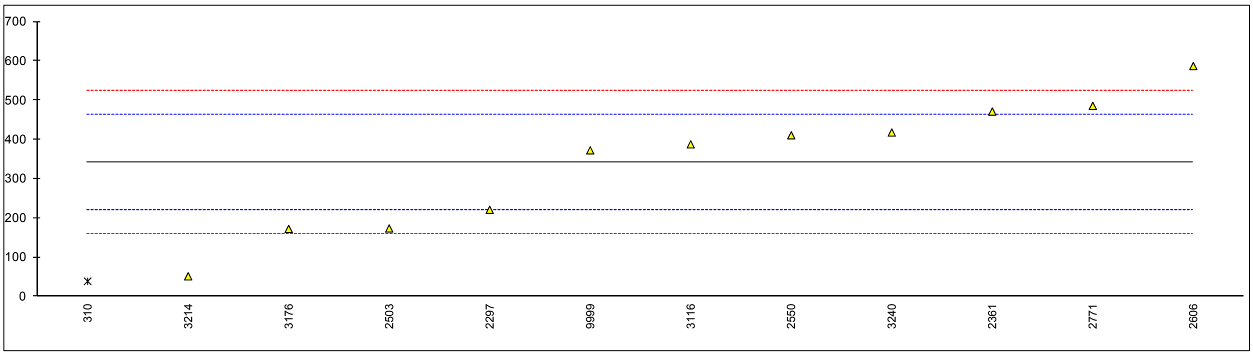
lab	method	value	mark	z(targ)	remarks
310	EN 71-1	156.36	ex, C	-5.11	first reported 60.972; excluded because of deviating pole surface
840		-----		-----	
2297	EN 71-1	1389.75597416		-1.28	
2361	EN 71-1	2636.79571		2.59	
2503	ASTM F963	1171.4	C	-1.96	first reported 234.147
2550	EN 71-1	2148		1.08	
2606	EN 71-1	2382.129		1.80	
2771	EN 71-1	1818.055351		0.05	
3116	EN 71-1	1520.5344		-0.87	
3176	EN 71-1	1385.4		-1.29	
3214	EN 71-1	1536.38	C	-0.83	first reported 977.07
3240	EN 71-1	2321.24		1.61	
9999	EN 71-1	1510.672		-0.90	
					iis calc. for fixed pole surface area 314.1 mm, see §5
	normality	OK			OK
	n	11			11
	outliers	0 + 1 ex			0 + 1 ex
	mean (n)	1801.85			1804.43
	st.dev. (n)	489.778	=27%		491.439 = 27%
	R(calc.)	1371.38			1376.03
	R(target)	900.93			902.22

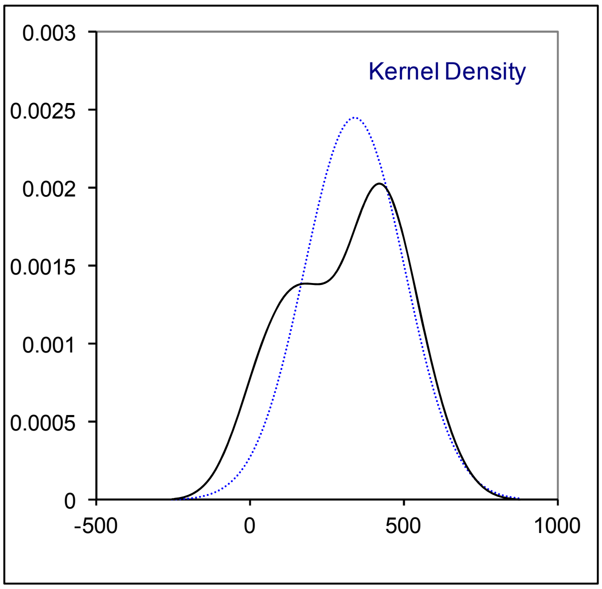




Determination of Magnetic Flux Index on sample #17581; result in kG^2mm^2

lab	method	value	mark	z(targ)	remarks
310	EN 71-1	39.24	ex, C	-4.96	first reported 19.05; excluded because of deviating pole surface
840		-----		-----	
2297	EN 71-1	221.395196321		-1.97	
2361	EN 71-1	471.4971		2.14	
2503	ASTM F963	173.90	C	-2.75	first reported 140.22
2550	EN 71-1	411		1.14	
2606	EN 71-1	587.395		4.04	
2771	EN 71-1	485.94582	C	2.37	first reported 127.636965
3116	EN 71-1	387.97812		0.77	
3176	EN 71-1	172.7		-2.77	
3214	EN 71-1	51.91	C	-4.75	first reported 33.03
3240	EN 71-1	418.158824		1.26	
9999	EN 71-1	372.844		0.52	
					<u>iis calc. for fixed pole surface area 19.48 mm, see §5</u>
	normality	OK			OK
	n	11			11
	outliers	0 + 1 ex			0 + 1 ex
	mean (n)	341.34			343.23
	st.dev. (n)	163.385	=48%		165.359 = 48%
	R(calc.)	457.48			463.01
	R(target)	170.67			171.61





APPENDIX 2

Pole surface area in mm^2 and maximum flux density in kG reported for sample #17580

lab	Pole surface area in mm2	reported maximum flux density		maximum flux density in kG
310	62.52	2.501	kG^2	1.581
840	-----	-----	-----	-----
2297	314.0000	4.42597444	kG^2	2.1038
2361	313.531	8.41	kG^2	2.90
2503	314.47	3.7249	kG^2	1.93
2550	312.7	2.621	kG	2.621
2606	313.85	2.755	kG	2.755
2771	311.03	2.4177	kG	2.4177
3116	314.16	2.200	kG	2.200
3176	314.15	4.41	kG^2	2.10
3214	314.0	4.893	kG^2	2.212
3240	314.628	2.7162	kG	2.7162
9999	314.16	2.192	kG	2.192

Pole surface area in mm^2 and maximum flux density in kG reported for sample #17581

lab	Pole surface area in mm2	reported maximum flux density		maximum flux density in kG
310	15.39	2.547	kG^2	1.596
840	-----	-----	-----	-----
2297	19.5465	11.32659025	kG^2	3.3655
2361	19.4782	24.2064	kG^2	4.92
2503	19.32	9.00	kG^2	3.00
2550	19.5	4.592	kG	4.59
2606	19.56	5.48	kG	5.48
2771	18.465162	5.130	kG	5.130
3116	19.400086	4.472	kG	4.472
3176	19.63	8.80	kG^2	2.97
3214	19.16	2.709	kG^2	1.646
3240	19.625	4.6160	kG	4.6160
9999	19.63	4.357	kG	4.357

APPENDIX 3

Reported analytical details

lab	ISO/IEC17025 accredited	Apparatus used	Resolution of the apparatus (in Gauss)
310	No	Lakeshore gauss model 410	0.1 gauss (200 gauss range)
840	---	---	---
2297	Yes	425 Gaussmeter /Lake Shore	0.1
2361	Yes	421 GAUSSMETER / LAKESHORE	0.001 kG
2503	Yes	Walker Scientific MG-4D Gauss meter	0.01
2550	Yes	G100	1
2606	Yes	GM08/HIRST Magnetic Instrument Ltd.	1
2771	Yes	Lakeshore 425 Gaussmeter	0.01 G
3116	Yes	Lakeshore	1
3176	Yes	Gaussmeter	0,1
3214	Yes	Glass Meter / F.W. BELL	0.001 (K-gauss)
3240	Yes	421/Lakeshore	0.01G
9999	No	Lakeshore Gaussmeter model 425	0.1

lab	Probe used	Distance between the active area and the probe tip (in mm)	Active area diameter of the probe (in mm)
310	axial type probe	---	---
840	---	---	---
2297	axial type probe	0.38	0.76
2361	axial type probe	0.4064 mm	0.762 mm
2503	axial type probe	0.38 mm	0.76 mm
2550	axial type probe	0.38mm±0.13mm	0.76mm±0.13mm
2606	axial type probe	---	0.2x0.2
2771	axial type probe	0.38	0.76
3116	axial type probe	0.38	0.76
3176	axial type probe	0,38	0,76
3214	Transverse probe	0.85	0.381
3240	axial type probe	0.38 mm	0.76 mm
9999	axial type probe	0.38	0.76

lab	How many times was the sample measured	Sample temp. during test (°C)	Underlying surface used during testing of the sample?	Was the sample orientated in a special direction?
310	three times	23.2	table	no
840	---	---	---	---
2297	one time	27	cross section of the ball	No
2361	three times	23	Plastic surface	---
2503	two times	23	desk & paper	No
2550	two times	24.0	wood	the surface was perpendicular to the probe
2606	more than three times	25	Wooden Table	No
2771	one time	68	desk table top	no
3116	three times	25	Acrylic sheet	flat surface for metal plate; whole surface for metal ball
3176	three times	---	Flat surface	---
3214	more than three times	25.3	Wooden surface with black painting	No
3240	more than three times	22	flat plastic surface	no
9999	more than three times	22	metalwhiteboard	yes; magnetic pole to probe

APPENDIX 4

Number of participants per country

2 labs in HONG KONG

3 labs in P.R. of CHINA

1 lab in TAIWAN R.O.C.

1 lab in THE NETHERLANDS

1 lab in TURKEY

2 labs in U.S.A.

1 lab in UNITED ARAB EMIRATES

1 lab in VIETNAM

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's outlier test
R(0.05)	= straggler in Rosner's outlier test
E	= probably an error in calculations
U	= test result probably reported in a different unit
W	= test result withdrawn on request of participant
ex	= test result excluded from the statistical evaluation
n.a.	= not applicable
n.e.	= not evaluated
n.d.	= not detected
fr.	= first reported test result

Literature:

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