ISSS Round Robin 2014

Evaluation and interpretation
of the general results

INTERNATIONAL ASSOCIATION FOR SPORTS SURFACE SCIENCES

ISSS Task Group

AGENDA

ISP

ISSS Round Robin so far

Organisation of the ISSS Round Robin 2014

Selected test methods

Selected test samples

INTERNATIONAL ASSOCIATION FOR SPORTS SURFACE SCIENCES

Interpretation of the general results

Evaluation of the general results

Discussion

ISSS Task Group

HISTORY

ISP

2009 – ISSS decided to organise Round Robin (RR) on a new level

2010 – the first total independent ISSS RR 2010 was conducted on artificial turf as a trail

2011 – ISSS decided to proceed with the scheme

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2012 – the ISSS RR 2012 was conducted on synthetic surfaces

2013 – the ISSS RR 2013 was conducted on indoor and playground surfaces

2014 – the ISSS RR 2014 was conducted on artificial turf

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ORGANISATION

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- In autumn 2013, a questionnaire was prepaired and sent out to:
    - members of ISSS
    - other test institutes
    - equipment manufacturers
    - consultants
    - installers

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- Six methods were selected

- Samples were chosen and requested by individual manufacturers

- Samples and instruction were sent out by ofi

- The testing was completed within 8 weeks

ORGANISATION

ISP

The interlaboratory comparison testing was conducted by:

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Arsenal Objekt 213
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TEST METHODS

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The following six test methods were compaired in 2014:

Determination of

- particle size – sieving method (EN 933-1)
- rotational resistance (EN 15301-1)
- vertical ball behaviour (EN 12235)
- tuft withdrawal force (ISO 4919)
- resistance to abrasion of non-filled turf (EN 13672)
- differential scanning calorimetry (DSC) (ISO 11357-3)

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SAMPLES

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The following five different products were chosen for 2014:

- non-filled synthetic turf for football use
- non-filled synthetic turf for hockey use
- shockpad
- elastic infill (SBR)
- mineral infill (silica sand)

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SAMPLES

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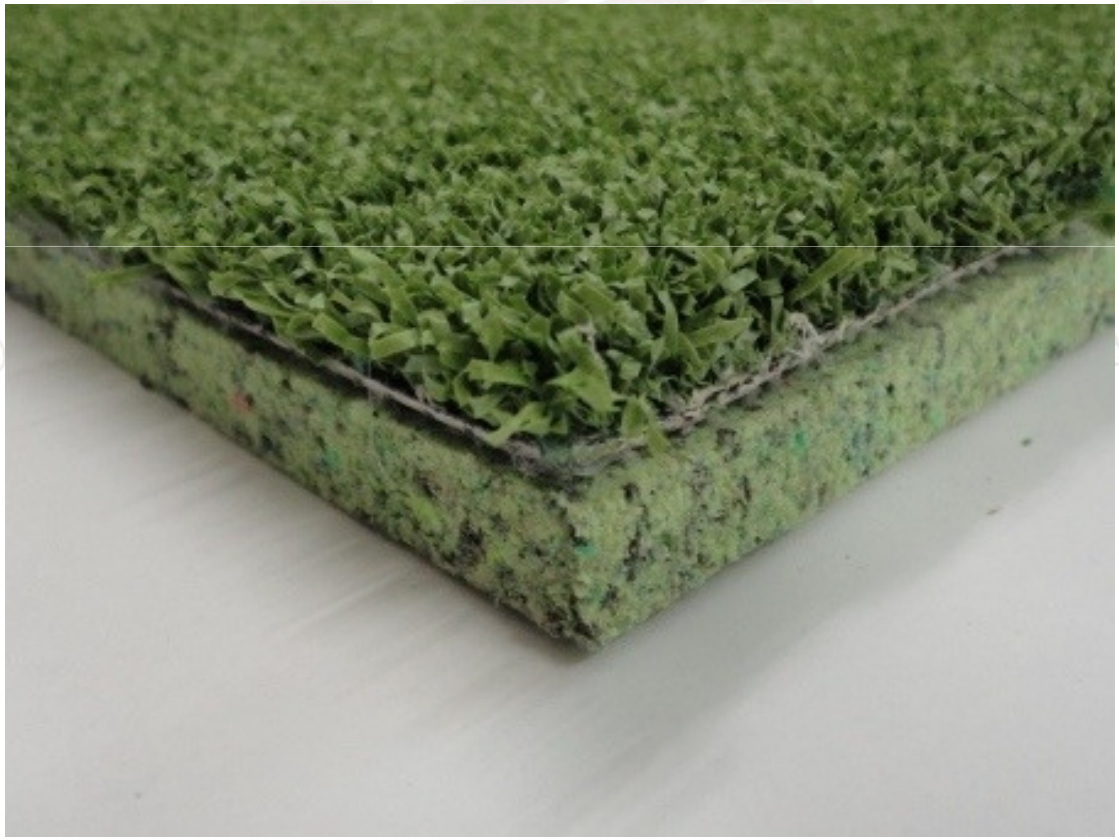
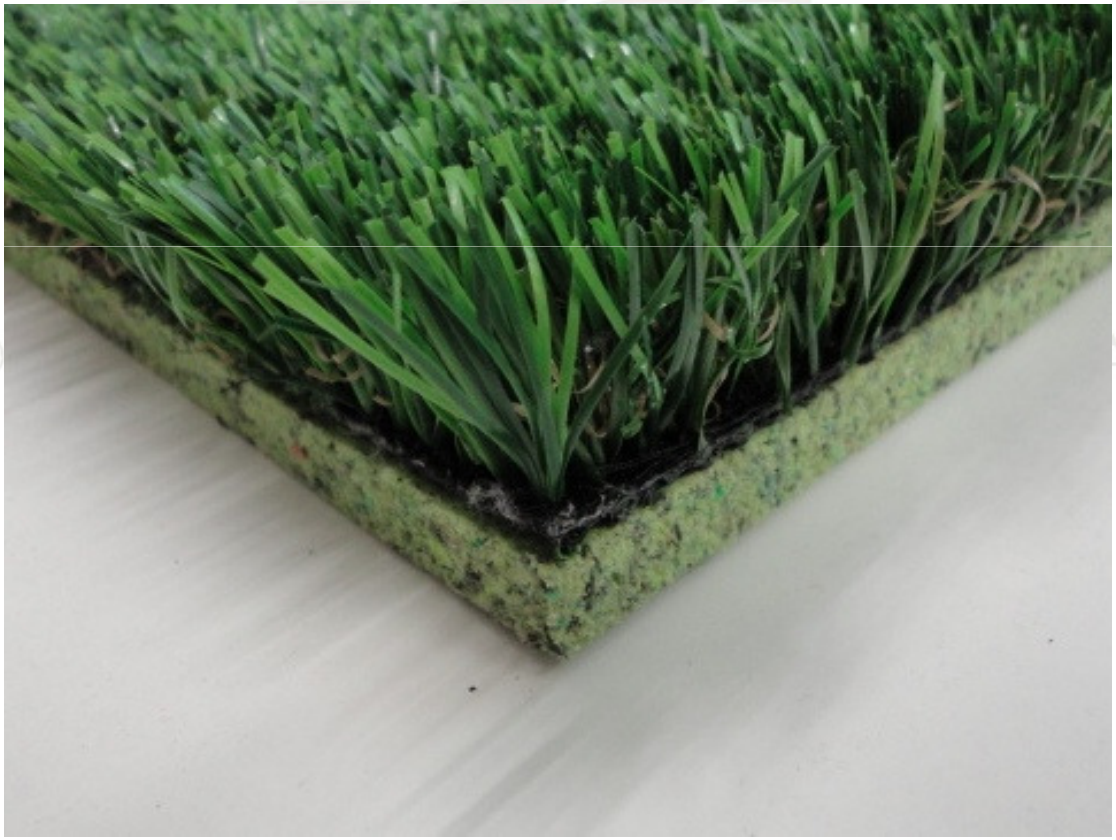
Non-filled Synthetic turf, laid loose on a shockpad



SAMPLES

ISP

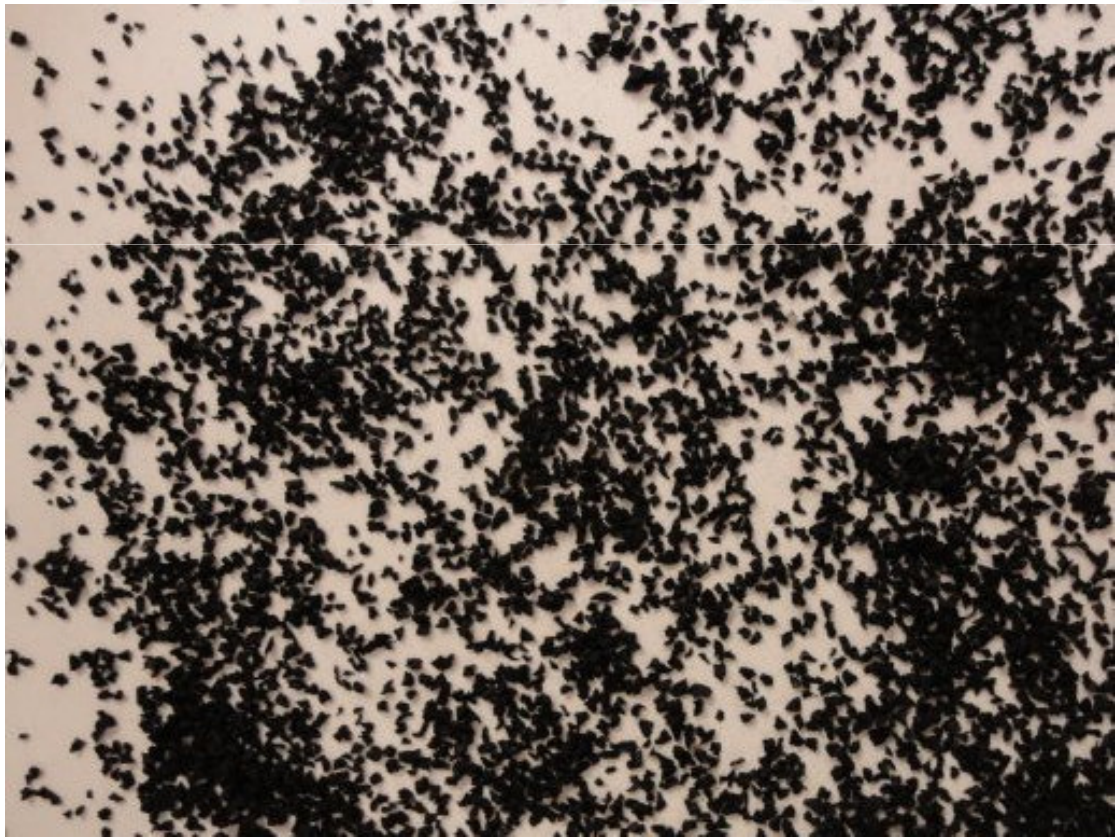
Non-filled Synthetic turf, laid loose on a shockpad



SAMPLES

ISP

Elastic infill - SBR



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SAMPLES

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Mineral-infill (silica sand)

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INTERPRETATION

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Shock absorption - 3rd impact

R

Synthetic surface

EN 14808

Results submitted by participants

i.e., individual results x_{ik}

+ number of the test repetitions made by each lab (n_i)

+ within laboratory means (x_i) and standard deviations (s_i)

+ results of tests for outliers

Number of reporting laboratories p *: 21

Number of reported test results Σn_i: 42

Lab Code No.	Test results in % — Test replication No. (k)						Statistical evaluation of the submitted test results x_{ik}			Outliers		
	1	2	3	4	5	6	n_i	x_i	s_i	Cochran	Grubbs	$z_i > 2$
18	36,6	36,3					2	36,43	0,2475			
786	36,3	37,2					2	36,76	0,6187			
900	37,3	36,4					2	36,84	0,5834			
915	37,3	36,4					2	36,85	0,6364			
864	38,1	37,0					2	37,56	0,7955			
472	38,0	37,8					2	37,89	0,0884			
481	37,5	38,3					2	37,90	0,5657			
318	37,7	38,4					2	38,07	0,4844			
569	38,3	38,0					2	38,13	0,1768			
875	38,5	38,5					2	38,51	0,0283			
1	38,9	39,5					2	39,18	0,3889			
627	39,2	39,4					2	39,29	0,1591			
793	39,6	39,5					2	39,54	0,0884			
889	39,6	39,7					2	39,64	0,0530			
772	39,8	39,8					2	39,80	0,0000			
701	40,1	40,0					2	40,06	0,0884			
~~905~~	~~42,4~~	~~37,8~~					~~2~~	~~40,11~~	~~3,2350~~	**		
562	40,0	40,4					2	40,18	0,3182			
162	40,0	40,4					2	40,20	0,2828			
803	41,7	41,6					2	41,63	0,0707			
515	42,2	42,7					2	42,41	0,3359			x

INTERPRETATION

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Results of robust statistics			
Robust average: x^* = **38,9**	assigned value for the proficiency assessment		
Robust standard deviation for the proficiency assessment: s^* = **1,64**			
Number of repeate measurements necessary due to s_r/s^*-ratio: n' = 1	**OK**	see page 4 for the meaning of **NOT OK**	
Standard uncertainty of the assigned value: u_x = 0,44861	**OK**		

Additional check of the test method accuracy			
Do the input data come from a normal distribution ? (The results listed below shall be considered as really justified only if the input data come from a normal distribution)		**YES**	
General mean $\Sigma n_i x_{ik} / \Sigma n_i$	m	38,8	%
Repeatability variance	s_r^2	0,1455363	
Repeatability standard deviation	s_r	0,38149	%
Repeatability coefficient of variation	$CV\%_r$	0,982	%
Between-laboratory variance	s_L^2	2,5983125	
Between-laboratory standard deviation	s_L	1,61193	%
Between-laboratory coefficient of variation	$CV\%_L$	4,150	%
Reproducibility variance s_R^2	$s_r^2 + s_L^2$	2,7438487	
Reproducibility standard deviation	s_R	1,6565	%
Reproducibility coefficient of variation	$CV\%_R$	4,265	%
Repeatability limit	r	**1,07**	%
Relative repeatability limit	r_{rel}	**2,8**	%
Reproducibility limit	R	**4,64**	%
Relative reproducibility limit	R_{rel}	**11,9**	%
Number of participants included in the accuracy evaluation	p	20	
Number of tests included in the accuracy evaluation	Σn	40	

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Repeatability limit (*r*):

A value less than or equal to what the absolute difference between two test results obtained under repeatability conditions may be expected to be with a probability of 95%.

within the same test institute

LAB 318 **LAB 318**

INTERPRETATION

ISP

Reproducibility limit (*R*):

A value less than or equal to what the absolute difference between two test results obtained under reproducibility conditions may be expected to be with a probability of 95%

between two test institutes

LAB 318 **LAB 875**

INTERPRETATION

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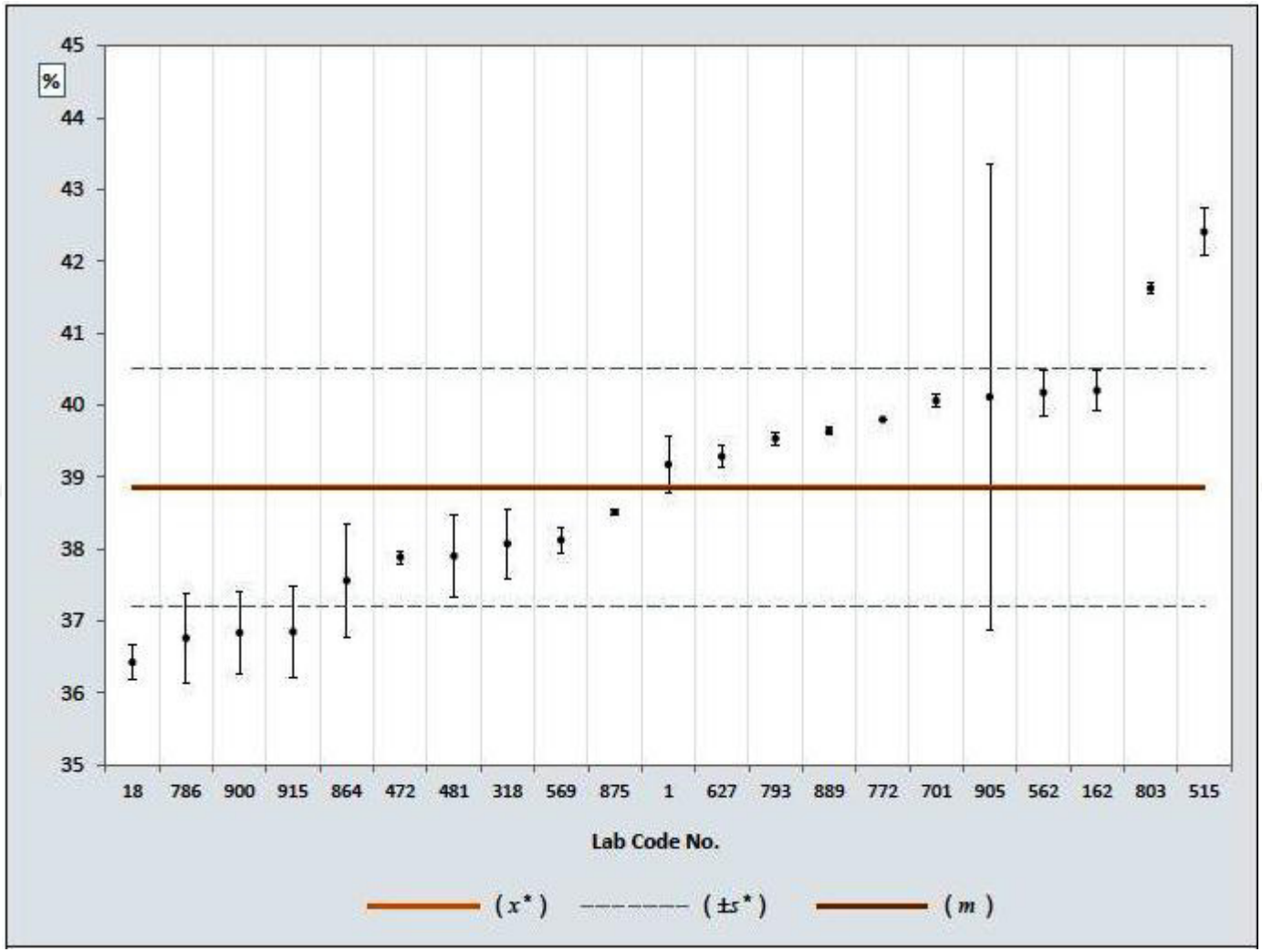

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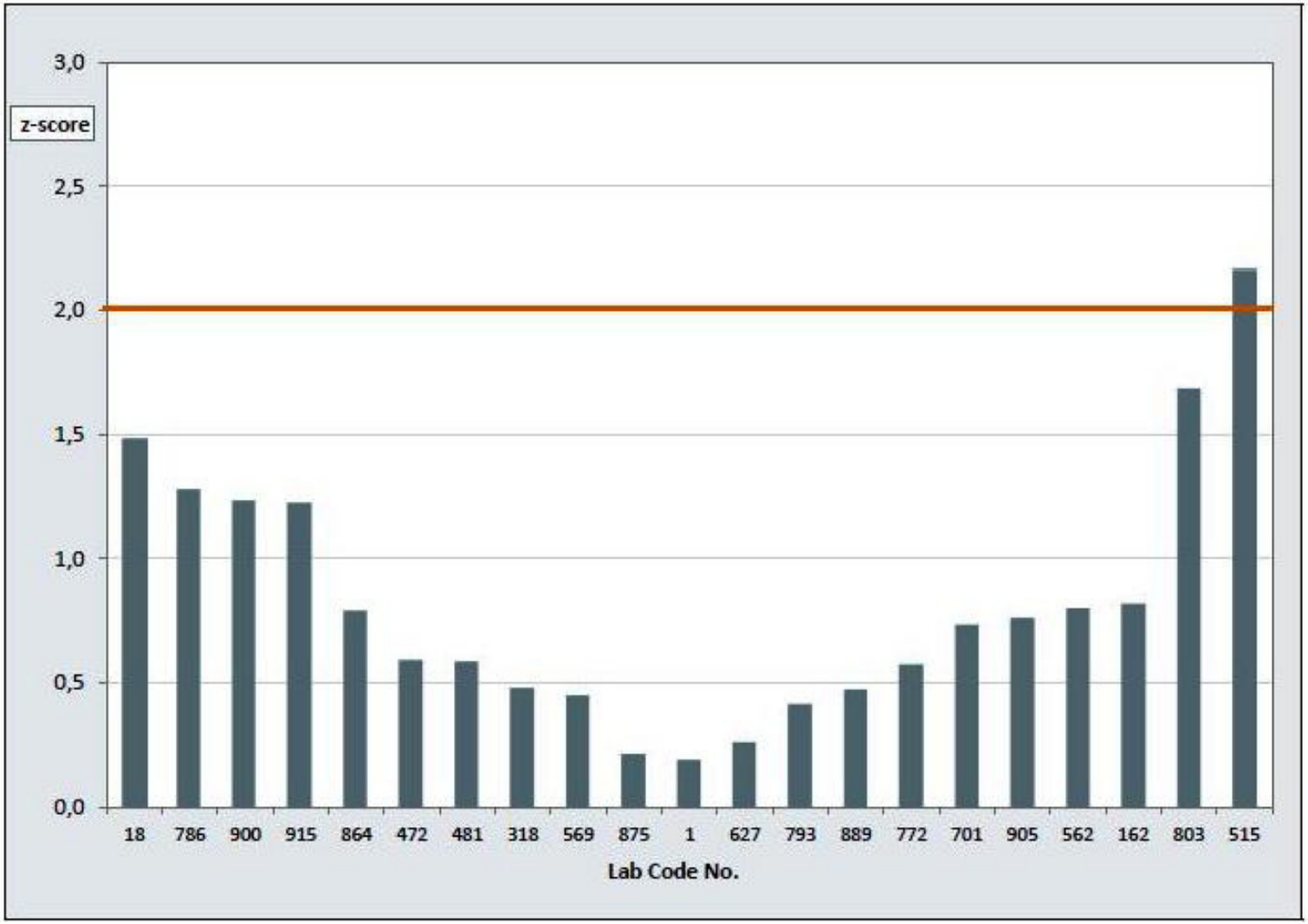

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z-score:

The z-score is a measure of the distance of an individual result from the mean; the scale unit is the standard deviation.

The resulting data is assessed as follows:

z = ≤ 1 *the performance of the laboratory is **very good***
z = 1 – 2 *the performance of the laboratory is **satisfactory***
z = 2 – 3 *the performance of the laboratory is **questionable***
z = ≥ 3 *the performance of the laboratory is **unsatisfactory***

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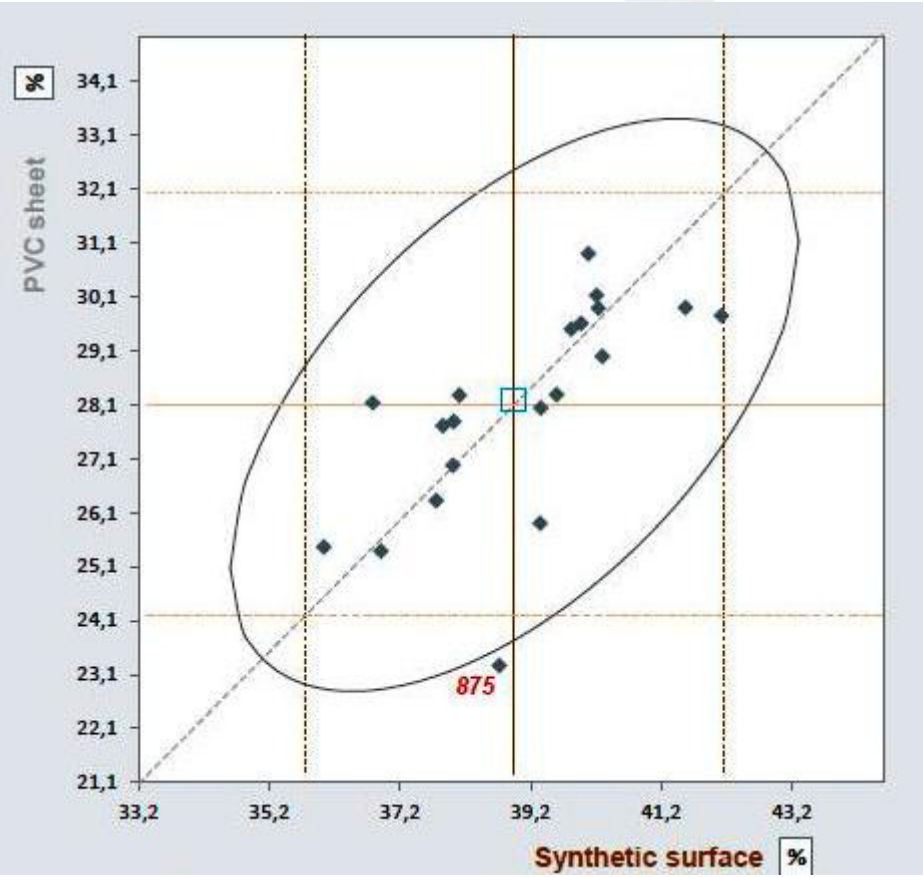

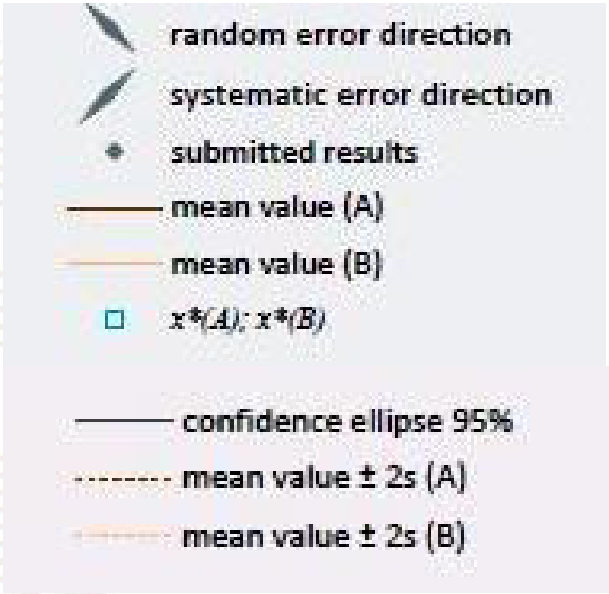

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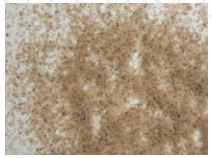
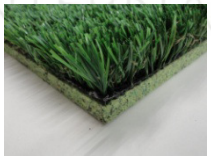
Determination of particle size

Number of test laboratories: 7

Sample	Size *(mm)*	General mean *(%)*	Repeatability limit *(r)*		Reproducibility limit *(R)*	
	0.63	25.1%	5.6%	(22.2%)	7.3%	(28.9%)
	0.50	30.2%	1.3%	(4.2%)	10.9%	(36.3%)
	1.25	42.3%	4.6%	(11.0%)	16.4%	(38.9%)
	1.00	34.5%	1.9%	(5.4%)	10.6%	(30.7%)

Determination of vertical ball behaviour

Number of test laboratories: 15

Sample	General mean (%)	Repeatability limit (r)		Reproducibility limit (R)	
	62.2%	2.0%	(3.2%)	12.9%	(20.7%)
	73.0%	2.6%	(3.6%)	10.3%	(14.1%)

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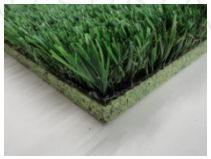
Determination of rotational resistance

Number of test laboratories: 14

Sample	General mean (*Nm*)	Repeatability limit *(r)*	Reproducibility limit *(R)*
	25.0 Nm	2 Nm (7.0%)	9 Nm (34.0%)
	39.6 Nm	2 Nm (4.9%)	20 Nm (49.6%)

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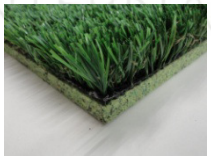
Determination of tuft withdrawal force

Number of test laboratories: 12

Sample	General mean (*N*)	Repeatability limit *(r)*	Reproducibility limit *(R)*
	54.4 N	2.3 N (4.3%)	27.2 N (49.9%)
	24.3 N	4.5 N (18.7%)	10.0 N (41.2%)

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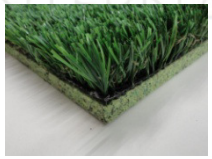
Determination of resistance to abrasion of non-filled synthetic turf

Number of test laboratories: 5

Sample	Cycles	General mean (*g*)	Repeatability limit *(r)*	Reproducibility limit *(R)*
	2,000	0.2 g	0.1 g (27.2%)	0.2 g (96.5%)
	5,000	0.4 g	0.1 g (19.1%)	0.3 g (83.7%)
	2,000	0.1 g	0.0 g (10.2%)	0.1 g (81.1%)
	5,000	0.2 g	0.1 g (30.8%)	0.2 g (88.1%)

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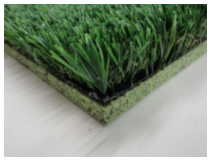
Determination of differential scanning calorimetry (DSC)

Number of test laboratories: 5

Sample	General mean Peak temperature (°C)	Repeatability limit (r)		Reproducibility limit (R)	
	122.7 °C	0.7 °C	(0.6%)	3.0 °C	(2.5%)
	125.6 °C	0.2 °C	(0.2%)	1.0 °C	(0.8%)

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The variations in the results could rely on the following reasons:

- misunderstanding of the instructions
- undetailed instructions
- undetailed information of the standard
- calibration of the used test equipment
- unsuitable test equipment
- inappropriate test method
- ISO 17025 accreditation of the test institutes

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- formed in December 2012
- looking into each test method (RR 2012 & 2013)
- preparing a questionnaire for more information
- evaluating the information
- recommendation to the CEN TC
- new laboratory comparison testing are ongoing

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Thank you for your attention

ISP

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