[#109]

DETERMINATION OF VERTICAL BALL BEHAVIOUR

EN 12235:2004

LabCodeNo. 66 remarked: “On samples ST3A and ST3B the test has been made only on point 5, because the samples were slightly raised in two sides. We find that the samples are too small to do the tests”.

LabCodeNo. 99 remarked: “Football measured without K-value”.

LabCodeNo. 178 remarked: “Mikasa digital pressure gauge used Hockey Ball Not possible with required hockey ball to get required concrete rebound result per table 1 of cited EN. We got 0,637 to 0,640. The data entered reflects testing with the concrete values we got”.

LabCodeNo. 438 remarked: “Measured with naked eye Rebound height on concrete (first day/second day): Hockeyball 59,5cm/59 cm Football 136 cm/135 cm Basketball 130 cm/130 cm”.

LabCodeNo. 464 remarked: “ The Kookaburra-ball had a very high „concrete-value“. The pressure of the basketball is much more lower than the recommended normal-pressure of the ball. Samples 4a and 4b seem to be not comparable”.

LabCodeNo. 872 remarked: “ The underlayments for samples ST4a and ST4b were too small. The distance between the border of the underlayment and two of five measure-points was in places 6 cm”.

Determination of vertical ball behaviour - SS1 - hockeyball - R

EN 12235

Results submitted by participants and Results of robust statistics

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

(bottom part of the table)

Number of reporting laboratories p *: 16
Number of reported test results Σn_i: 32

Lab Code No.	Test results in % — Test replication No. (k) 1	2	3	4	5	6	Statistical evaluation of the submitted test results x_{ik}: n_i	x_i	s_i	Outliers: Cochran	Grubbs	z>2
627	39,18	38,70					2	38,940	0,3394			X
520	39,38	39,46					2	39,420	0,0566		**	X
439	112,54	108,94					2	110,740	2,5456			
136	116,40	115,20					2	115,800	0,8485			
938	117,00	116,20					2	116,600	0,5657			
238	116,42	117,54					2	116,980	0,7920			
565	118,32	120,70					2	119,510	1,6829			
872	121,00	121,20					2	121,100	0,1414			
812	122,68	121,36					2	122,020	0,9334			
99	121,20	126,62					2	123,910	3,8325	*		
362	128,24	127,92					2	128,080	0,2263			
464	129,08	130,26					2	129,670	0,8344			
747	131,50	131,50					2	131,500	0,0000			
279	135,60	136,58					2	136,090	0,6930			
438	135,98	137,62					2	136,800	1,1597			
250	164,22	163,34					2	163,780	0,6223		**	X
178			no results reported									X
66			no results reported									X

Robust average:	x^* =	122,33	← assigned value for the proficiency assessment
Robust standard deviation for the proficiency assessment:	s^* =	11,863	
Number of repeate measurements necessary due to s_r/s^*-ratio:	n' =	1	OK
Standard uncertainty of the assigned value:	u_x =	3,70704	NOT OK

see page 4 for the meaning of **NOT OK**

** ... **statistical outlier (99%)** * ... **straggler (95%)**

X ... z **> 2; in this case,** x_i **is considered to be an outlier and is not taken into account in the test method accuracy check**

Additional check of the test method accuracy

Do the input data come from a normal distribution (when outliers found were eliminated) ? (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	123,75	%
Repeatability variance	s_r^2	2,2408615	
Repeatability standard deviation	s_r	1,49695	%
Repeatability coefficient of variation	$CV\%_r$	1,210	%
Between-laboratory variance	s_L^2	65,0355949	
Between-laboratory standard deviation	s_L	8,06446	%
Between-laboratory coefficient of variation	$CV\%_L$	6,517	%
Reproducibility variance s_R^2	$s_r^2 + s_L^2$	67,2764564	
Reproducibility standard deviation	s_R	8,20222	%
Reproducibility coefficient of variation	$CV\%_R$	6,628	%
Repeatability limit	r	**4,19**	%
Relative repeatability limit	r_{rel}	**3,4**	%
Reproducibility limit	R	**22,97**	%
Relative reproducibility limit	R_{rel}	**18,6**	%
Number of participants included in the accuracy evaluation	p	13	
Number of tests included in the accuracy evaluation	Σn	26	

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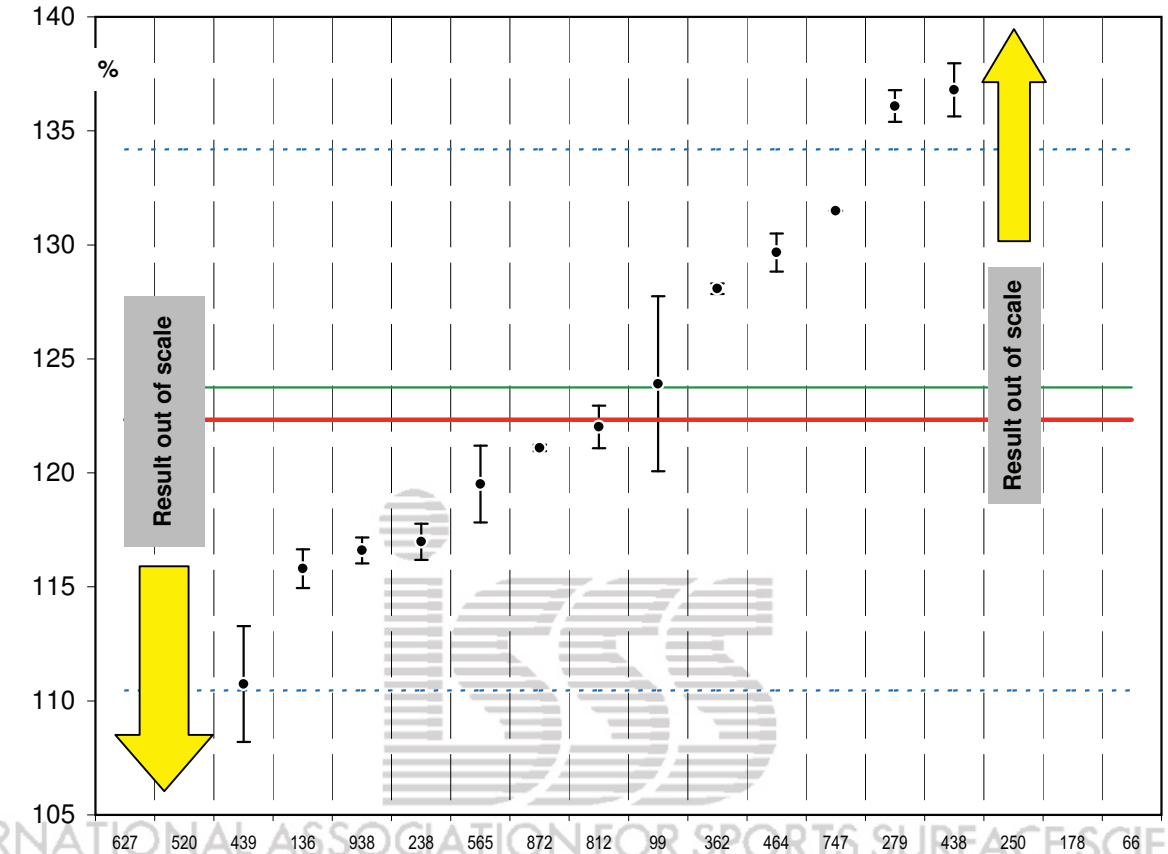
Determination of vertical ball behaviour - SS1 - hockeyball - R



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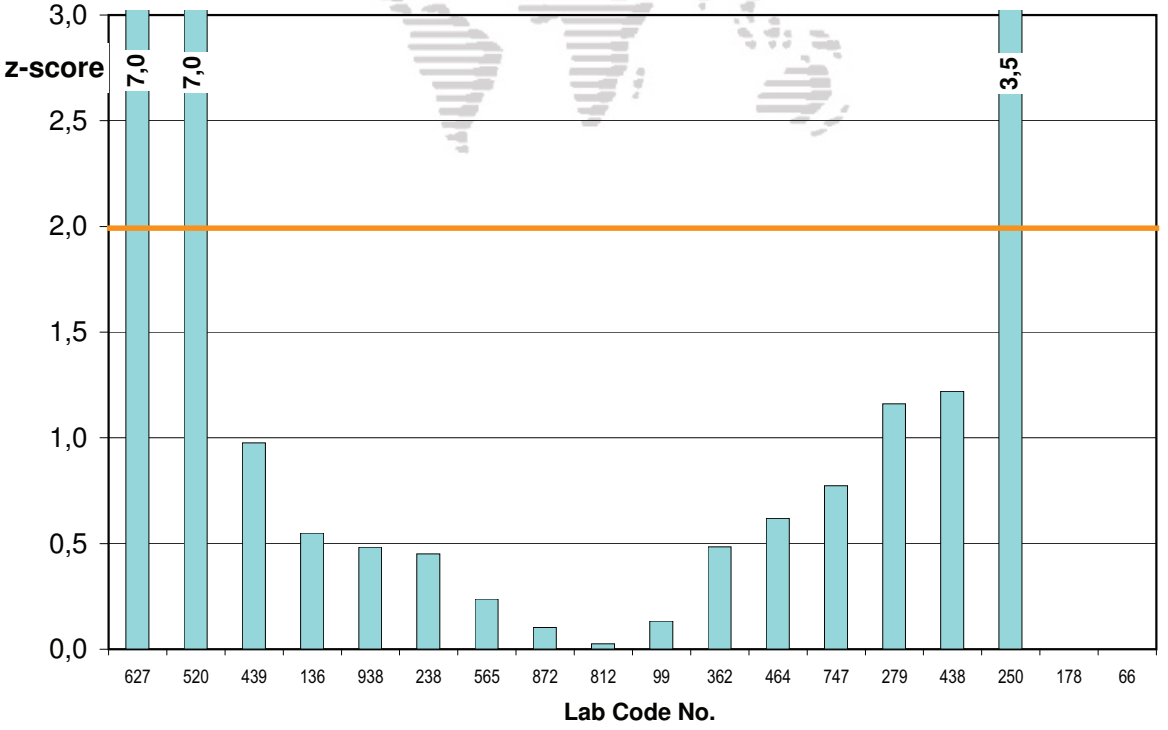

Determination of vertical ball behaviour - SS2 - hockeyball - R

EN 12235

Results submitted by participants and Results of robust statistics

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

(bottom part of the table)

Number of reporting laboratories p *: 16
Number of reported test results $\sum n_i$: 32

Lab Code No.	Test results in % — Test replication No. (k) 1	2	3	4	5	6	Statistical evaluation of the submitted test results x_{ik}: n_i	x_i	s_i	Outliers: Cochran	Grubbs	z>2
627	35,80	35,94					2	35,870	0,0990			X
520	37,30	37,30					2	37,300	0,0000		**	X
439	104,72	103,74					2	104,230	0,6930			
238	107,74	106,38					2	107,060	0,9617			
872	108,34	108,66					2	108,500	0,2263			
938	110,32	107,80					2	109,060	1,7819			
136	110,60	107,60					2	109,100	2,1213			
565	112,68	115,08					2	113,880	1,6971			
812	117,08	117,12					2	117,100	0,0283			
747	113,34	123,98					2	118,660	7,5236	**		
464	120,52	118,02					2	119,270	1,7678			
99	119,16	119,50					2	119,330	0,2404			
362	120,12	120,86					2	120,490	0,5233			
438	127,06	128,98					2	128,020	1,3576			
279	131,94	129,22					2	130,580	1,9233			
250	157,62	158,10					2	157,860	0,3394		**	X
178			no results reported									X
66			no results reported									X

Robust average:	x^* =	114,79	← assigned value for the proficiency assessment
Robust standard deviation for the proficiency assessment:	s^* =	11,105	
Number of repeate measurements necessary due to s_r/s^*-ratio:	n' =	1	OK
Standard uncertainty of the assigned value:	u_x =	3,47038	NOT OK

see page 4 for the meaning of **NOT OK**

** ... **statistical outlier (99%)** * ... **straggler (95%)**

X ... z **> 2; in this case,** x_i **is considered to be an outlier and is not taken into account in the test method accuracy check**

Additional check of the test method accuracy

Do the input data come from a normal distribution (when outliers found were eliminated) **?**
(The results listed below shall be considered as really justified only if the input data come from a normal distribution)

YES

General mean $\sum n_i x_{ik} / \sum n_i$	m	115,79	%
Repeatability variance	s_r^2	5,9704615	
Repeatability standard deviation	s_r	2,44345	%
Repeatability coefficient of variation	$CV\%_r$	2,110	%
Between-laboratory variance	s_L^2	62,1555769	
Between-laboratory standard deviation	s_L	7,88388	%
Between-laboratory coefficient of variation	$CV\%_L$	6,809	%
Reproducibility variance s_R^2	$s_r^2 + s_L^2$	68,1260385	
Reproducibility standard deviation	s_R	8,25385	%
Reproducibility coefficient of variation	$CV\%_R$	7,128	%
Repeatability limit	r	**6,84**	%
Relative repeatability limit	r_{rel}	**5,9**	%
Reproducibility limit	R	**23,11**	%
Relative reproducibility limit	R_{rel}	**20,0**	%
Number of participants included in the accuracy evaluation	p	13	
Number of tests included in the accuracy evaluation	$\sum n$	26	

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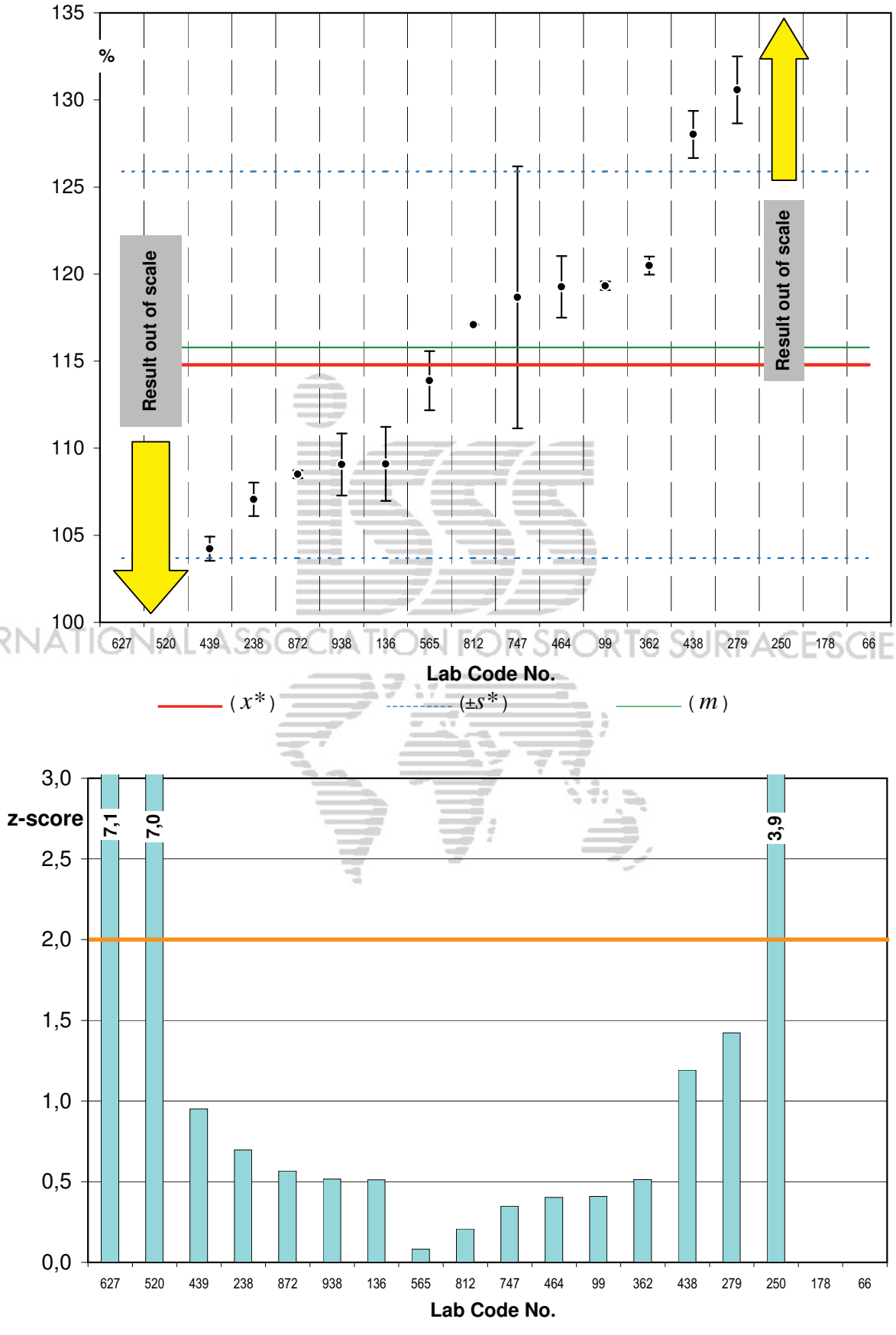
Determination of vertical ball behaviour - SS2 - hockeyball - R



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Determination of vertical ball behaviour - SS1 - football - R

EN 12235

Results submitted by participants and Results of robust statistics

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

(bottom part of the table)

Number of reporting laboratories p *: 17
Number of reported test results $\sum n_i$: 34

Lab Code No.	Test results in % — Test replication No. (k) 1	2	3	4	5	6	Statistical evaluation of the submitted test results x_{ik}: n_i	x_i	s_i	Outliers: Cochran	Grubbs	$z>2$
~~627~~	~~66,10~~	~~66,14~~					~~2~~	~~66,120~~	~~0,0283~~		*	X
~~520~~	~~71,64~~	~~69,66~~					~~2~~	~~70,650~~	~~1,4001~~			X
747	95,06	94,22					2	94,640	0,5940		*	X
438	97,36	98,02					2	97,690	0,4667			
99	96,88	98,96					2	97,920	1,4708			
279	98,70	98,62					2	98,660	0,0566			
872	98,82	98,64					2	98,730	0,1273			
812	99,02	99,10					2	99,060	0,0566			
136	99,40	98,80					2	99,100	0,4243			
250	100,42	99,40					2	99,910	0,7212			
464	100,30	100,26					2	100,280	0,0283			
362	100,14	100,90					2	100,520	0,5374			
66	100,58	100,54					2	100,560	0,0283			
938	100,20	101,40					2	100,800	0,8485			
439	100,60	101,40					2	101,000	0,5657			
238	99,86	102,68					2	101,270	1,9940			
565	102,30	103,10					2	102,700	0,5657			
178	no results reported											X

Robust average: x^* =	99,67	← assigned value for the proficiency assessment	
Robust standard deviation for the proficiency assessment: s^* =	1,593		
Number of repeate measurements necessary due to s_r/s^*-ratio: n' =	3	NOT OK	see page 4 for the meaning of **NOT OK**
Standard uncertainty of the assigned value: u_x =	0,51399	NOT OK	

** ... **statistical outlier (99%)** * ... **straggler (95%)**
X ... z **> 2; in this case, x_i is considered to be an outlier and is not taken into account in the test method accuracy check**

Additional check of the test method accuracy

Do the input data come from a normal distribution (when outliers found were eliminated) ? (The results listed below shall be considered as really justified only if the input data come from a normal distribution)		YES
General mean $\sum n_i x_{ik} / \sum n_i$	m	99,87 %
Repeatability variance	s_r^2	0,6236000
Repeatability standard deviation	s_r	0,78968 %
Repeatability coefficient of variation	$CV\%_r$	0,791 %
Between-laboratory variance	s_L^2	1,6687055
Between-laboratory standard deviation	s_L	1,29178 %
Between-laboratory coefficient of variation	$CV\%_L$	1,293 %
Reproducibility variance s_R^2	$s_r^2 + s_L^2$	2,2923055
Reproducibility standard deviation	s_R	1,51404 %
Reproducibility coefficient of variation	$CV\%_R$	1,516 %
Repeatability limit	r	**2,21** %
Relative repeatability limit	r_{rel}	**2,2** %
Reproducibility limit	R	**4,24** %
Relative reproducibility limit	R_{rel}	**4,2** %
Number of participants included in the accuracy evaluation	p	14
Number of tests included in the accuracy evaluation	$\sum n$	28

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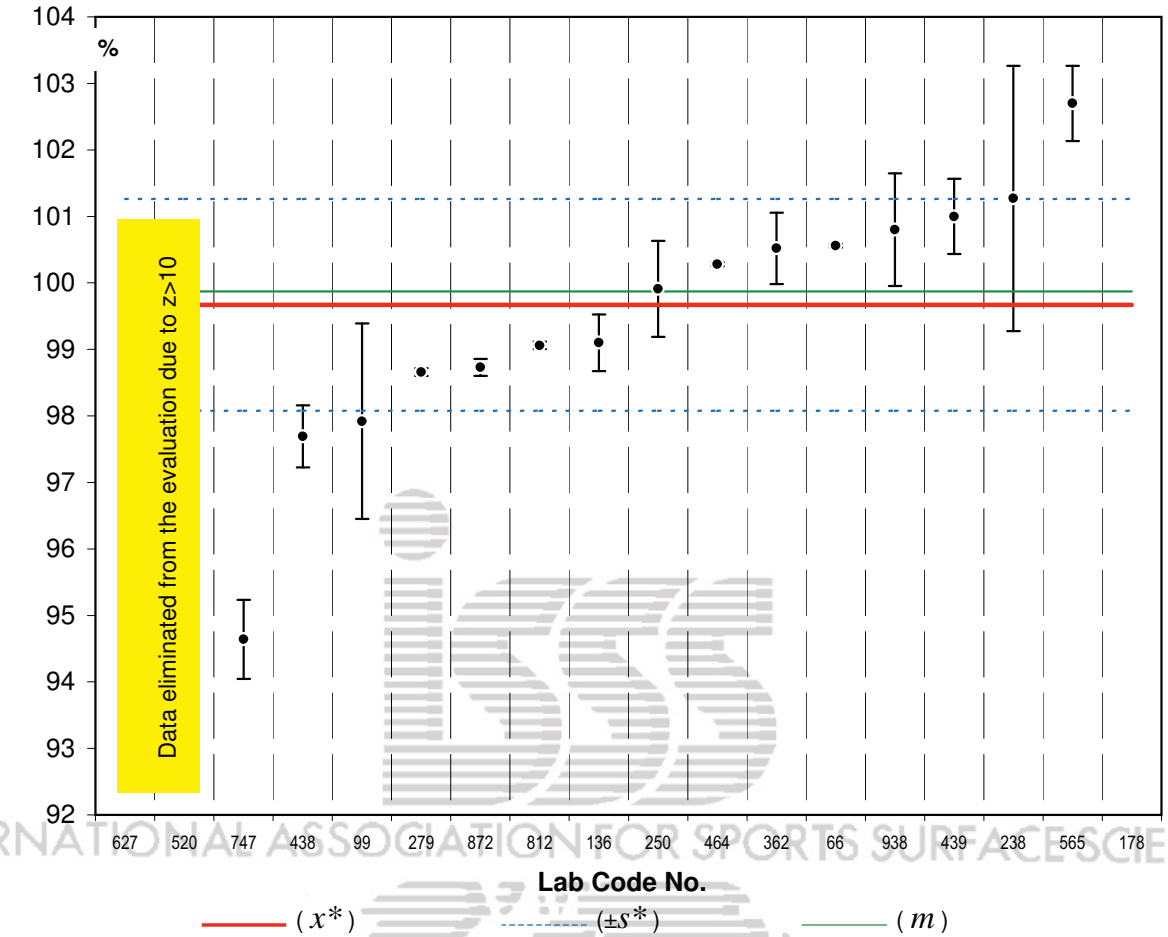
Determination of vertical ball behaviour - SS1 - football - R



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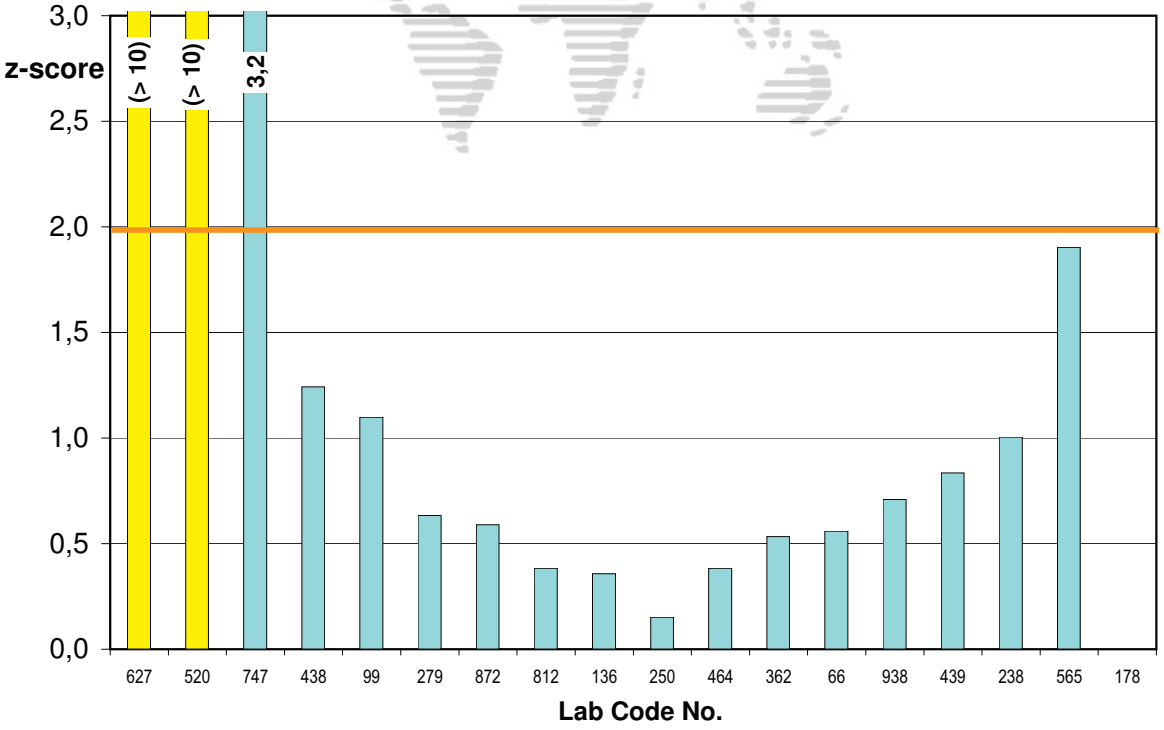

Determination of vertical ball behaviour - SS2 - football - R

EN 12235

Results submitted by participants and Results of robust statistics

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

(bottom part of the table)

Number of reporting laboratories p *: 17
Number of reported test results $\sum n_i$: 34

Lab Code No.	Test results in % — Test replication No. (k) 1	2	3	4	5	6	Statistical evaluation of the submitted test results x_{ik}: n_i	x_i	s_i	Outliers: Cochran	Grubbs	$z>2$
~~627~~	~~69,22~~	~~68,94~~					~~2~~	~~69,080~~	~~0,1980~~		*	X
~~520~~	~~72,88~~	~~71,56~~					~~2~~	~~72,220~~	~~0,9334~~			X
747	97,24	96,38					2	96,810	0,6081		*	X
872	99,30	99,18					2	99,240	0,0849			
66	99,98	99,20					2	99,590	0,5515			
136	100,00	100,40					2	100,200	0,2828			
238	99,40	101,18					2	100,290	1,2587			
439	101,08	99,80					2	100,440	0,9051			
99	99,86	101,32					2	100,590	1,0324			
812	100,90	100,49					2	100,693	0,2927			
438	100,70	101,10					2	100,900	0,2828			
938	101,00	101,00					2	101,000	0,0000			
464	101,06	101,14					2	101,100	0,0566			
279	102,30	100,84					2	101,570	1,0324			
250	103,48	100,28					2	101,880	2,2627			
362	102,62	102,64					2	102,630	0,0141			X
565	102,30	103,64					2	102,970	0,9475			X
178	no results reported											X

Robust average: x^* =	100,73	← assigned value for the proficiency assessment	
Robust standard deviation for the proficiency assessment: s^* =	0,896		
Number of repeate measurements necessary due to s_r/s^*-ratio: n' =	>5	NOT OK	see page 4 for the meaning of **NOT OK**
Standard uncertainty of the assigned value: u_x =	0,28932	NOT OK	

** ... **statistical outlier (99%)** * ... **straggler (95%)**
X ... z **> 2; in this case, x_i is considered to be an outlier and is not taken into account in the test method accuracy check**

Additional check of the test method accuracy

Do the input data come from a normal distribution (when outliers found were eliminated) ? (The results listed below shall be considered as really justified only if the input data come from a normal distribution)		YES
General mean $\sum n_i x_{ik} / \sum n_i$	m	100,62 %
Repeatability variance	s_r^2	0,8512748
Repeatability standard deviation	s_r	0,92265 %
Repeatability coefficient of variation	$CV\%_r$	0,917 %
Between-laboratory variance	s_L^2	0,1409348
Between-laboratory standard deviation	s_L	0,37541 %
Between-laboratory coefficient of variation	$CV\%_L$	0,373 %
Reproducibility variance s_R^2	$s_r^2 + s_L^2$	0,9922097
Reproducibility standard deviation	s_R	0,99610 %
Reproducibility coefficient of variation	$CV\%_R$	0,990 %
Repeatability limit	r	**2,58** %
Relative repeatability limit	r_{rel}	**2,6** %
Reproducibility limit	R	**2,79** %
Relative reproducibility limit	R_{rel}	**2,8** %
Number of participants included in the accuracy evaluation	p	12
Number of tests included in the accuracy evaluation	$\sum n$	24

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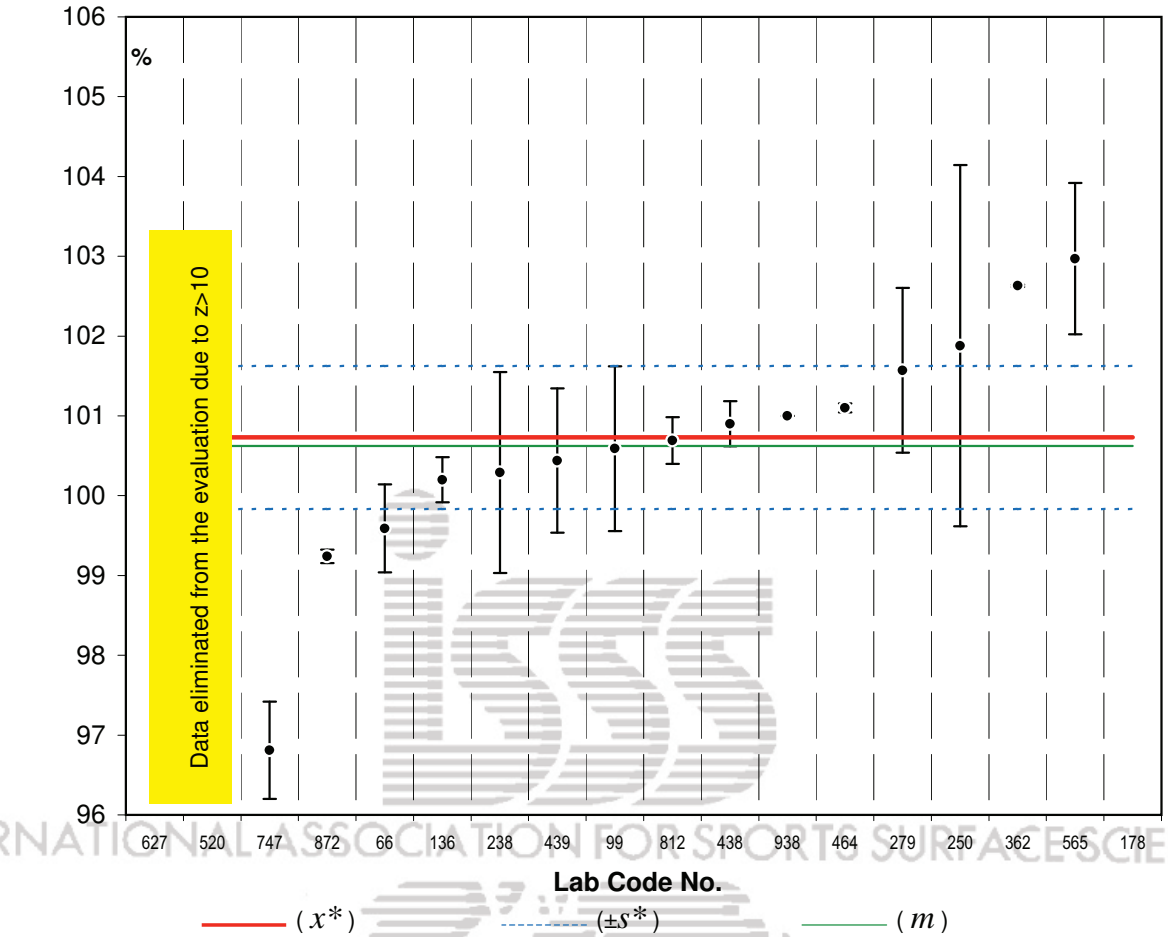
Determination of vertical ball behaviour - SS2 - football - R



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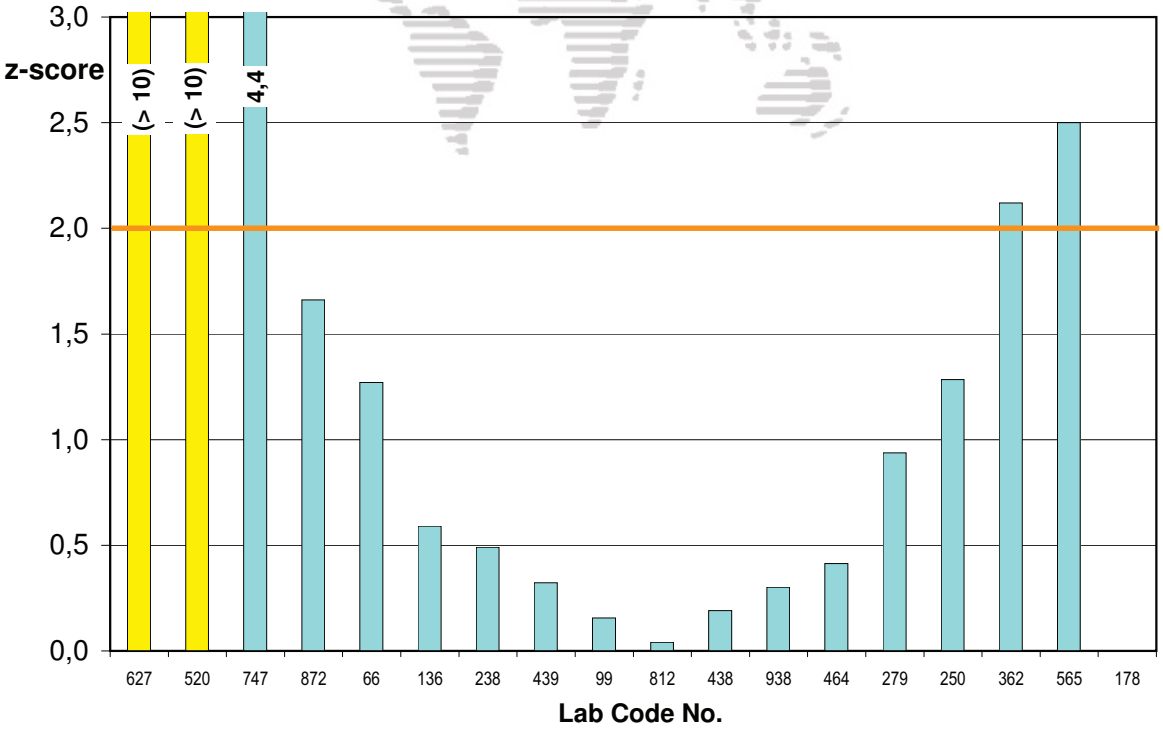

Determination of vertical ball behaviour - SS1 - basketball - R

EN 12235

Results submitted by participants and Results of robust statistics

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

(bottom part of the table)

Number of reporting laboratories p *: 18
Number of reported test results $\sum n_i$: 36

Lab Code No.	Test results in % — Test replication No. (k) 1	2	3	4	5	6	Statistical evaluation of the submitted test results x_{ik}: n_i	x_i	s_i	Outliers: Cochran	Grubbs	z>2
~~627~~	~~61,70~~	~~61,24~~					~~2~~	~~61,470~~	~~0,3253~~		*	X
~~520~~	~~63,60~~	~~62,30~~					~~2~~	~~62,950~~	~~0,9192~~			X
747	98,10	95,72					2	96,910	1,6829			X
565	100,18	98,52					2	99,350	1,1738			
438	99,68	99,68					2	99,680	0,0000			
279	100,28	100,60					2	100,440	0,2263			
464	101,08	100,82					2	100,950	0,1838			
362	100,86	101,34					2	101,100	0,3394			
250	103,58	101,32					2	102,450	1,5981			
812	102,76	102,24					2	102,500	0,3677			
938	103,60	101,40					2	102,500	1,5556			
99	102,52	103,26					2	102,890	0,5233			
136	103,00	102,80					2	102,900	0,1414			
872	103,32	104,06					2	103,690	0,5233			
439	103,48	104,36					2	103,920	0,6223			
178	103,82	105,86					2	104,840	1,4425			
238	105,68	104,96					2	105,320	0,5091			
66	107,68	107,44					2	107,560	0,1697			X

Robust average: x^* =	102,35	← assigned value for the proficiency assessment	
Robust standard deviation for the proficiency assessment: s^* =	2,362		
Number of repeate measurements necessary due to s_r/s^*-ratio: n' =	2	OK	see page 4 for the meaning of **NOT OK**
Standard uncertainty of the assigned value: u_x =	0,73825	NOT OK	

** ... **statistical outlier (99%)** * ... **straggler (95%)**
X ... z **> 2; in this case,** x_i **is considered to be an outlier and is not taken into account in the test method accuracy check**

Additional check of the test method accuracy

Do the input data come from a normal distribution (when outliers found were eliminated) ? (The results listed below shall be considered as really justified only if the input data come from a normal distribution)		YES
General mean $\sum n_i x_{ik} / \sum n_i$	m	102,32 %
Repeatability variance	s_r^2	0,7129857
Repeatability standard deviation	s_r	0,84438 %
Repeatability coefficient of variation	$CV\%_r$	0,825 %
Between-laboratory variance	s_L^2	2,9681473
Between-laboratory standard deviation	s_L	1,72283 %
Between-laboratory coefficient of variation	$CV\%_L$	1,684 %
Reproducibility variance s_R^2	$s_r^2 + s_L^2$	3,6811330
Reproducibility standard deviation	s_R	1,91863 %
Reproducibility coefficient of variation	$CV\%_R$	1,875 %
Repeatability limit	r	**2,36** %
Relative repeatability limit	r_{rel}	**2,3** %
Reproducibility limit	R	**5,37** %
Relative reproducibility limit	R_{rel}	**5,3** %
Number of participants included in the accuracy evaluation	p	14
Number of tests included in the accuracy evaluation	$\sum n$	28

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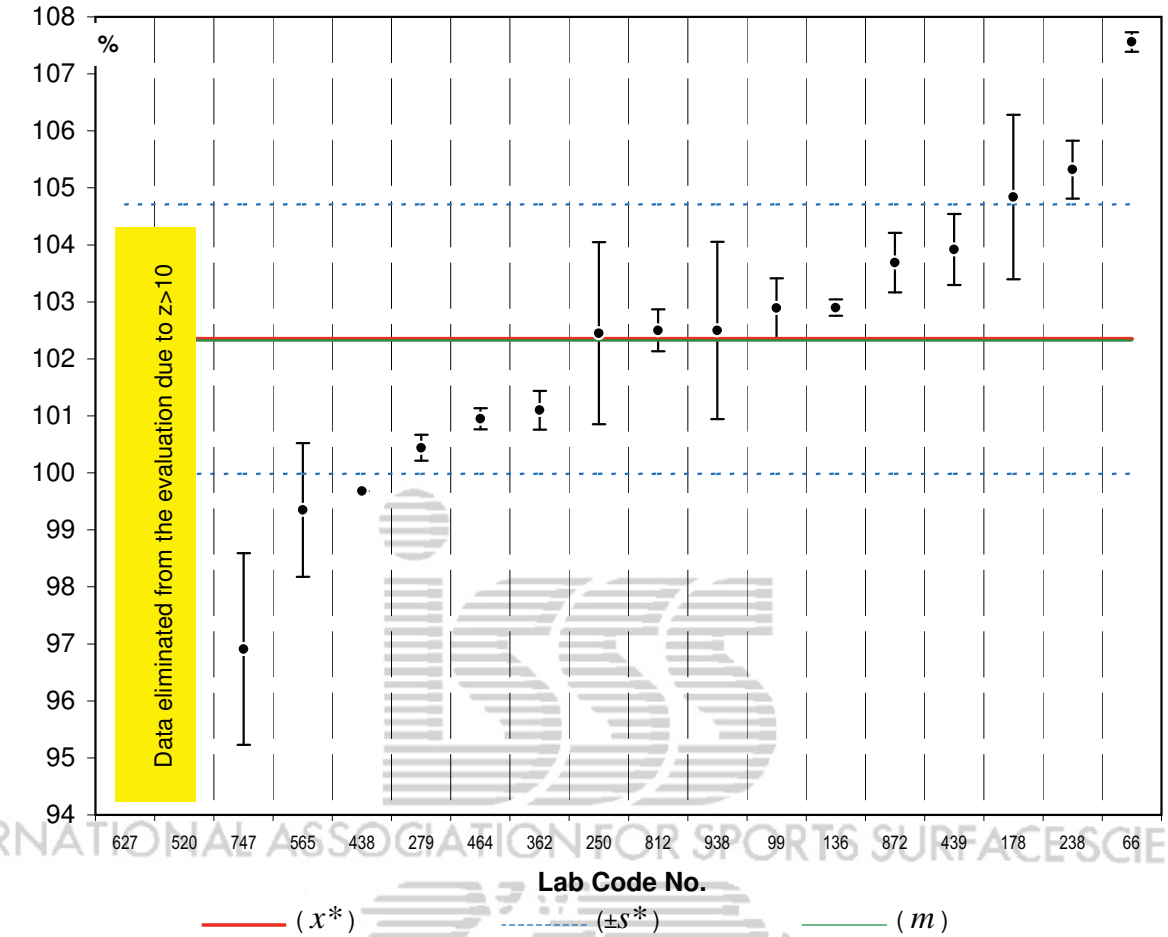
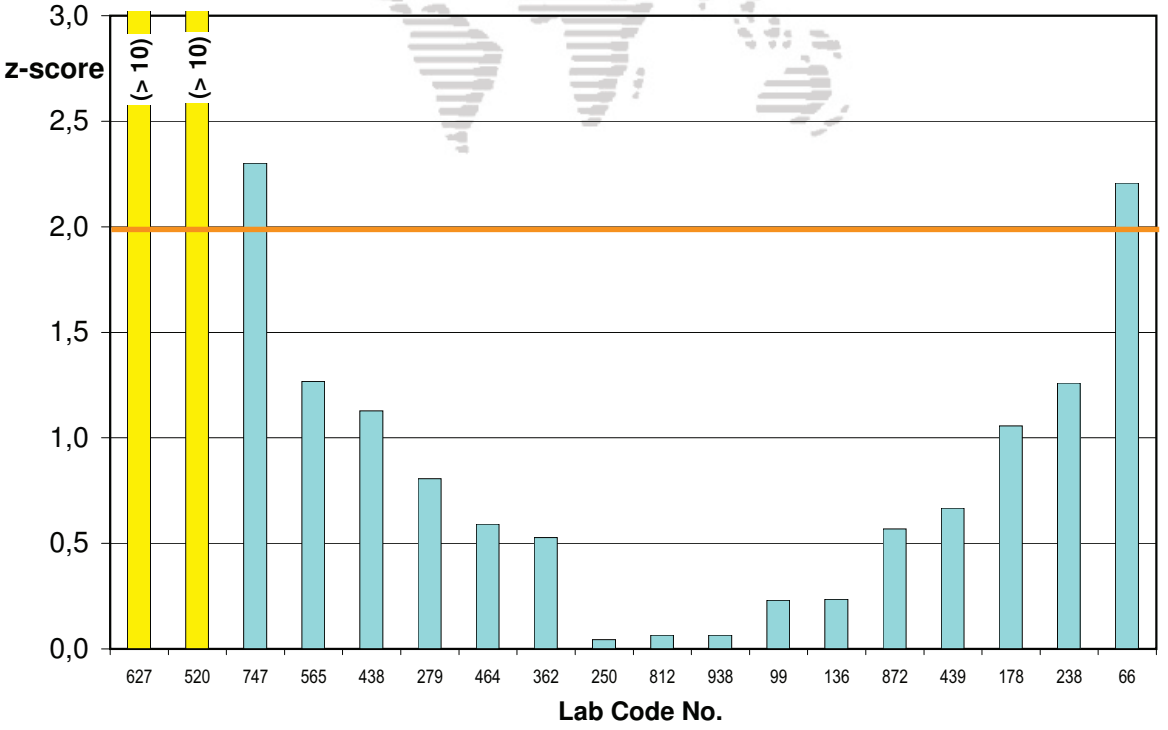
Determination of vertical ball behaviour - SS1 - basketball - R





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Determination of vertical ball behaviour - SS2 - basketball - R

EN 12235

Results submitted by participants and Results of robust statistics

i.e., individual results x_{ik}
+ number of the test repetitions made by each lab (n_i)
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+ results of tests for outliers

(bottom part of the table)

Number of reporting laboratories p *: 18
Number of reported test results Σn_i: 36

Lab Code No.	Test results in % — Test replication No. (k) 1	2	3	4	5	6	Statistical evaluation of the submitted test results x_{ik}: n_i	x_i	s_i	Outliers: Cochran	Grubbs	$z>2$
~~627~~	~~62,58~~	~~61,96~~					~~2~~	~~62,270~~	~~0,4384~~		*	X
~~520~~	~~64,48~~	~~64,10~~					~~2~~	~~64,290~~	~~0,2687~~			X
747	88,94	97,52					2	93,230	6,0670	**	*	X
565	97,58	95,98					2	96,780	1,1314			X
464	100,08	99,30					2	99,690	0,5515			
438	101,60	100,46					2	101,030	0,8061			
362	102,14	102,40					2	102,270	0,1838			
136	101,60	103,40					2	102,500	1,2728			
279	102,48	102,76					2	102,620	0,1980			
99	102,90	104,20					2	103,550	0,9192			
250	101,90	105,28					2	103,590	2,3900			
938	105,00	102,80					2	103,900	1,5556			
872	104,82	103,98					2	104,400	0,5940			
238	106,24	103,62					2	104,930	1,8526			
812	104,82	105,40					2	105,110	0,4101			
439	105,16	105,10					2	105,130	0,0424			
178	104,98	106,22					2	105,600	0,8768			
66	107,86	107,00					2	107,430	0,6081			

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Robust average: x^* =	103,27	← assigned value for the proficiency assessment
Robust standard deviation for the proficiency assessment: s^* =	2,296	
Number of repeate measurements necessary due to s_r/s^*-ratio: n' =	3	NOT OK
Standard uncertainty of the assigned value: u_x =	0,71743	NOT OK

see page 4 for the meaning of **NOT OK**

** ... **statistical outlier (99%)** * ... **straggler (95%)**

X ... z **> 2; in this case,** x_i **is considered to be an outlier and is not taken into account in the test method accuracy check**

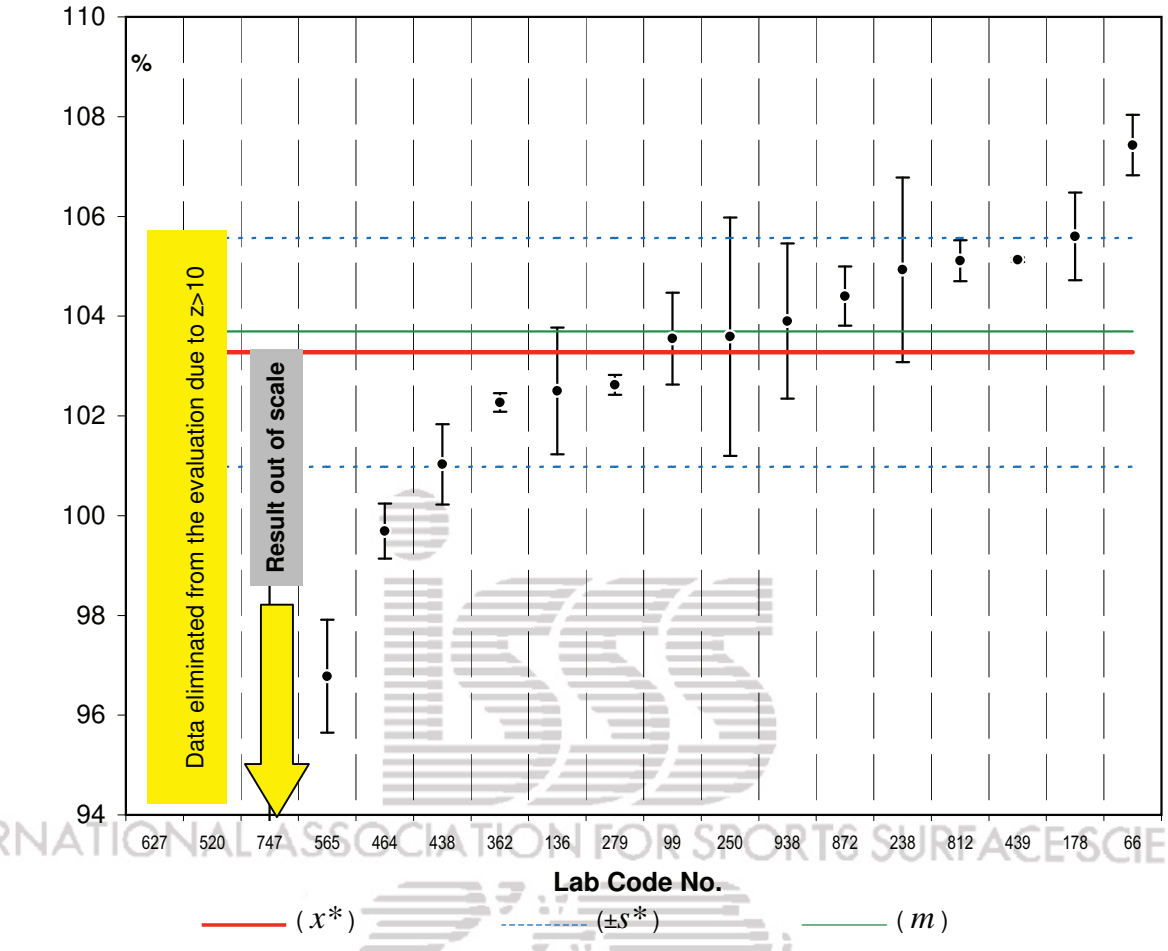
Additional check of the test method accuracy

Do the input data come from a normal distribution (when outliers found were eliminated) **?**
(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	103,70	%
Repeatability variance	s_r^2	1,1941286	
Repeatability standard deviation	s_r	1,09276	%
Repeatability coefficient of variation	$CV\%_r$	1,054	%
Between-laboratory variance	s_L^2	3,3639758	
Between-laboratory standard deviation	s_L	1,83411	%
Between-laboratory coefficient of variation	$CV\%_L$	1,769	%
Reproducibility variance s_R^2	$s_r^2 + s_L^2$	4,5581044	
Reproducibility standard deviation	s_R	2,13497	%
Reproducibility coefficient of variation	$CV\%_R$	2,059	%
Repeatability limit	r	**3,06**	%
Relative repeatability limit	r_{rel}	**3,0**	%
Reproducibility limit	R	**5,98**	%
Relative reproducibility limit	R_{rel}	**5,8**	%
Number of participants included in the accuracy evaluation	p	14	
Number of tests included in the accuracy evaluation	Σn	28	

Determination of vertical ball behaviour - SS2 - basketball - R



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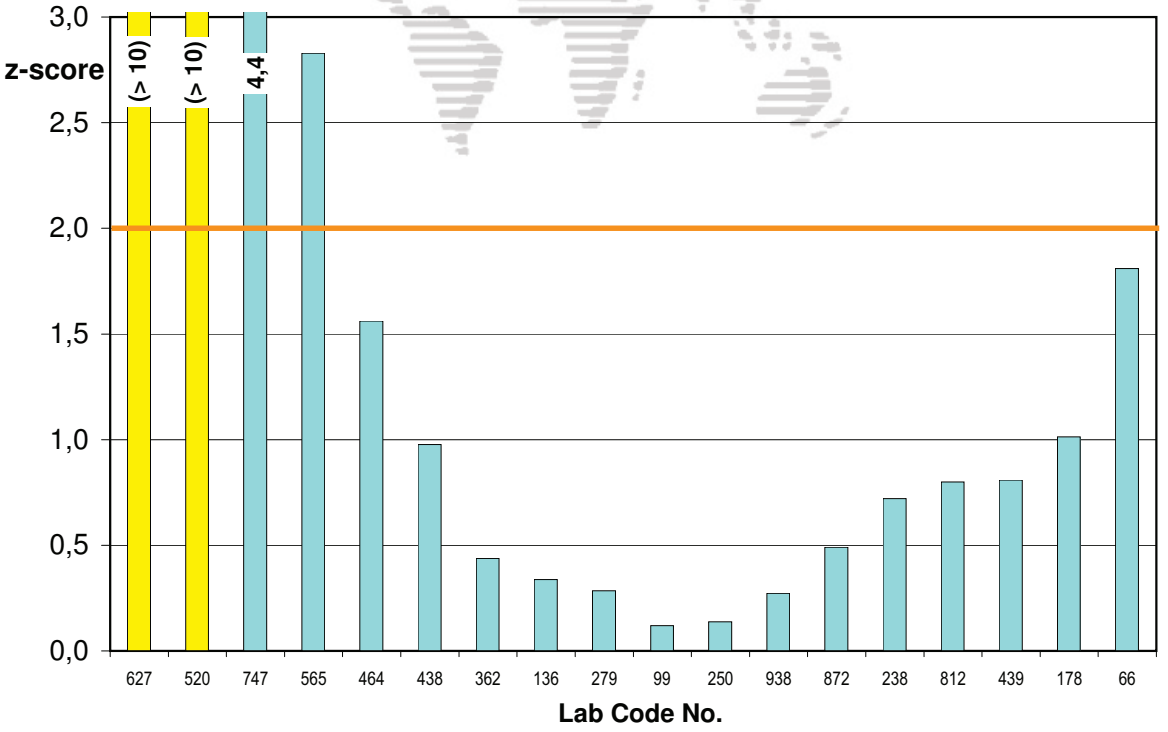

Determination of vertical ball behaviour - ST3 - hockeyball - R

EN 12235

Results submitted by participants and Results of robust statistics

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

(bottom part of the table)

Number of reporting laboratories p *: 17
Number of reported test results $\sum n_i$: 34

Lab Code No.	Test results in % — Test replication No. (k) 1	2	3	4	5	6	Statistical evaluation of the submitted test results x_{ik}: n_i	x_i	s_i	Outliers: Cochran	Grubbs	$z>2$
627	23,82	23,60					2	23,710	0,1556			X
520	24,84	24,26					2	24,550	0,4101		**	X
872	71,20	67,86					2	69,530	2,3617			
439	71,58	68,76					2	70,170	1,9940			
136	73,20	72,20					2	72,700	0,7071			
238	71,64	73,88					2	72,760	1,5839			
938	74,60	74,80					2	74,700	0,1414			
362	76,24	77,84					2	77,040	1,1314			
565	78,10	77,24					2	77,670	0,6081			
178	76,28	79,10					2	77,690	1,9940			
279	85,00	77,52					2	81,260	5,2892			
99	81,14	82,84					2	81,990	1,2021			
747	78,32	86,84					2	82,580	6,0245			
438	84,52	83,74					2	84,130	0,5515			
812	83,50	85,66					2	84,580	1,5274			
464	90,90	90,76					2	90,830	0,0990			
250	137,24	137,60					2	137,420	0,2546			X
66	no results reported											X

Robust average: x^* =	77,50	← assigned value for the proficiency assessment	
Robust standard deviation for the proficiency assessment: s^* =	8,089		
Number of repeate measurements necessary due to s_r/s^*-ratio: n' =	2	OK	see page 4 for the meaning of **NOT OK**
Standard uncertainty of the assigned value: u_x =	2,45232	NOT OK	

** ... statistical outlier (99%) * ... straggler (95%)

X ... z > 2; in this case, x_i is considered to be an outlier and is not taken into account in the test method accuracy check

Additional check of the test method accuracy

Do the input data come from a normal distribution (when outliers found were eliminated) ?
(The results listed below shall be considered as really justified only if the input data come from a normal distribution)

YES

General mean $\sum n_i x_{ik} / \sum n_i$	m	78,40	%
Repeatability variance	s_r^2	6,1836429	
Repeatability standard deviation	s_r	2,48669	%
Repeatability coefficient of variation	$CV\%_r$	3,172	%
Between-laboratory variance	s_L^2	34,7048121	
Between-laboratory standard deviation	s_L	5,89108	%
Between-laboratory coefficient of variation	$CV\%_L$	7,514	%
Reproducibility variance s_R^2	$s_r^2 + s_L^2$	40,8884549	
Reproducibility standard deviation	s_R	6,39441	%
Reproducibility coefficient of variation	$CV\%_R$	8,156	%
Repeatability limit	r	**6,96**	%
Relative repeatability limit	r_{rel}	**8,9**	%
Reproducibility limit	R	**17,90**	%
Relative reproducibility limit	R_{rel}	**22,8**	%
Number of participants included in the accuracy evaluation	p	14	
Number of tests included in the accuracy evaluation	$\sum n$	28	

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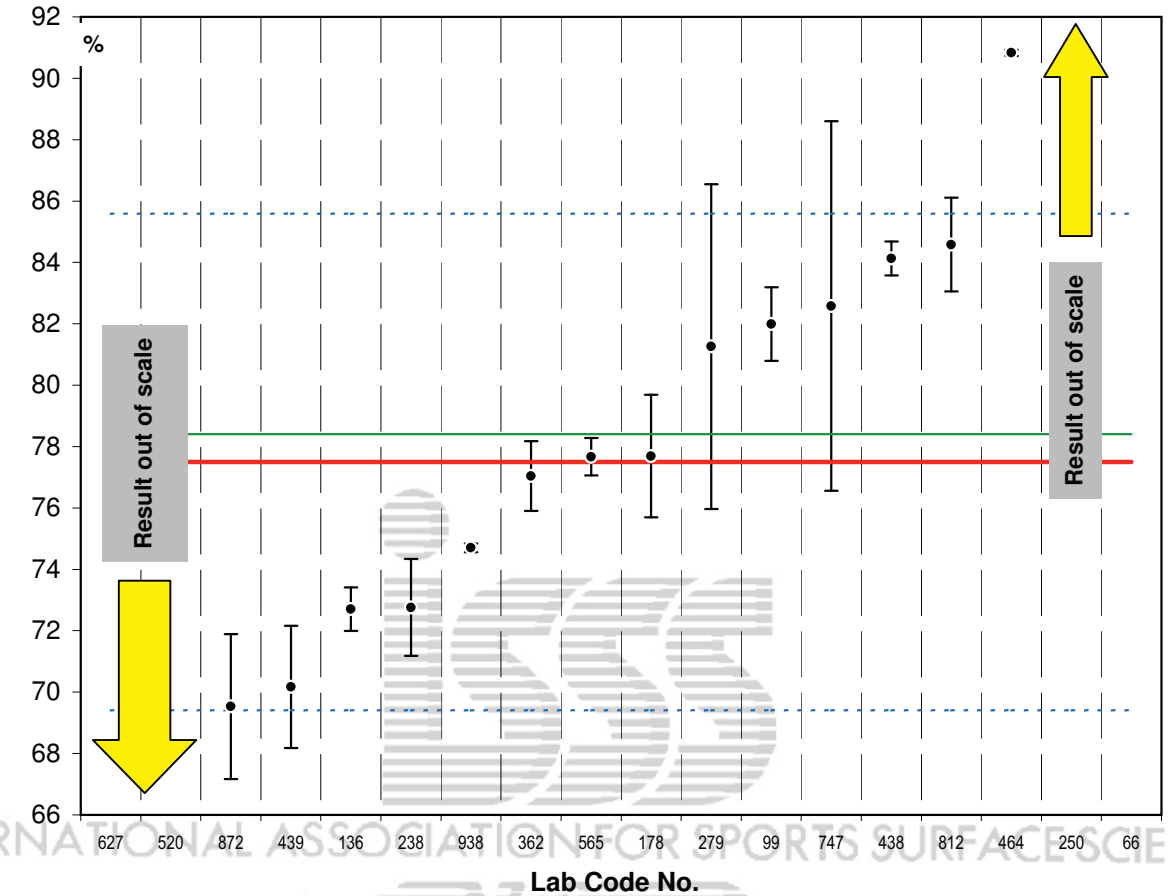
Determination of vertical ball behaviour - ST3 - hockeyball - R



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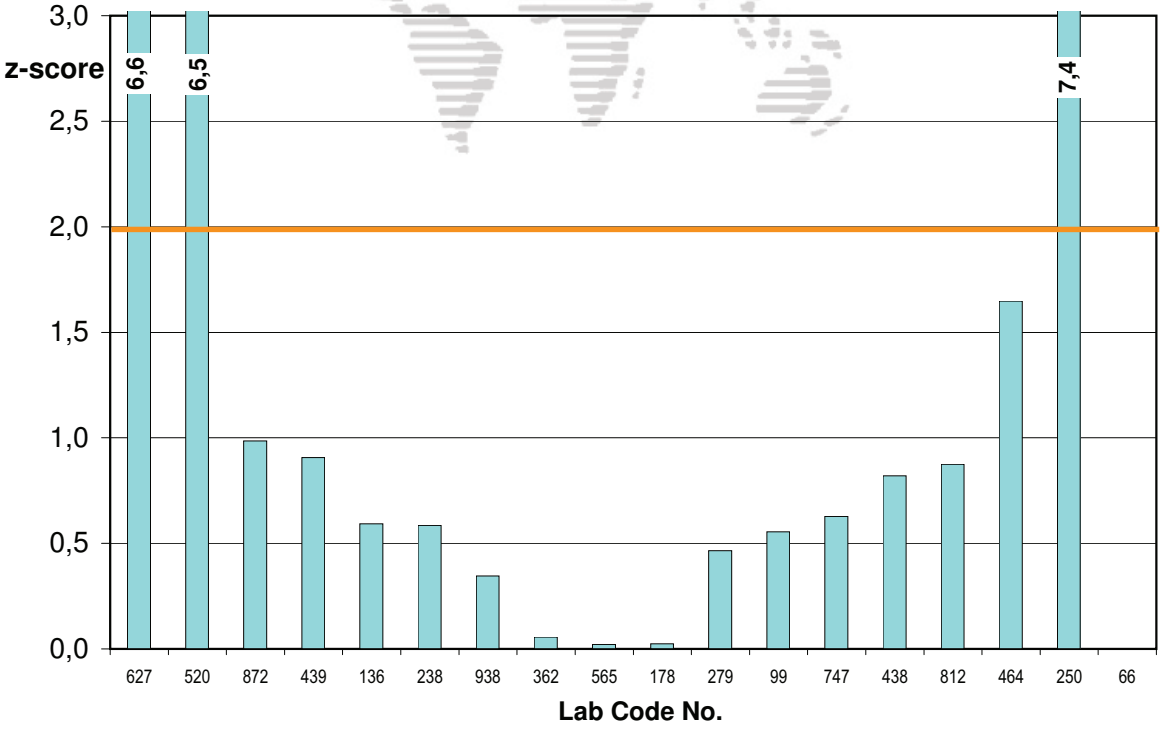

Determination of vertical ball behaviour - ST4 - hockeyball - R

EN 12235

Results submitted by participants and Results of robust statistics

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

(bottom part of the table)

Number of reporting laboratories p *: 17
Number of reported test results $\sum n_i$: 34

Lab Code No.	Test results in % — Test replication No. (k) 1	2	3	4	5	6	Statistical evaluation of the submitted test results x_{ik}: n_i	x_i	s_i	Outliers: Cochran	Grubbs	z>2
520	18,60	19,88					2	19,240	0,9051			X
627	21,32	21,48					2	21,400	0,1131		*	X
938	49,02	49,22					2	49,120	0,1414			
99	49,82	52,20					2	51,010	1,6829			
238	53,08	52,80					2	52,940	0,1980			
136	53,60	52,40					2	53,000	0,8485			
178	52,98	53,58					2	53,280	0,4243			
747	51,94	55,82					2	53,880	2,7436			
464	66,32	42,66					2	54,490	16,7301	**		
872	53,96	56,18					2	55,070	1,5698			
565	56,66	55,68					2	56,170	0,6930			
279	60,78	62,80					2	61,790	1,4284			
438	68,72	66,94					2	67,830	1,2587			
362	71,36	71,60					2	71,480	0,1697			
812	72,92	70,50					2	71,710	1,7112			
250	73,32	83,32					2	78,320	7,0711			X
439	91,96	91,04					2	91,500	0,6505			X
66	no results reported											X

Robust average: x^* =	56,37	← assigned value for the proficiency assessment	
Robust standard deviation for the proficiency assessment: s^* =	9,125		
Number of repeate measurements necessary due to s_r/s^*-ratio: n' =	4	NOT OK	see page 4 for the meaning of **NOT OK**
Standard uncertainty of the assigned value: u_x =	2,76657	NOT OK	

** ... **statistical outlier (99%)** * ... **straggler (95%)**
X ... z **> 2; in this case,** x_i **is considered to be an outlier and is not taken into account in the test method accuracy check**

Additional check of the test method accuracy

Do the input data come from a normal distribution (when outliers found were eliminated) **?** NO
(The results listed below shall be considered as really justified only if the input data come from a normal distribution)

General mean $\sum n_i x_{ik} / \sum n_i$	m	57,83	%
Repeatability variance	s_r^2	23,1340154	
Repeatability standard deviation	s_r	4,80978	%
Repeatability coefficient of variation	$CV\%_r$	8,317	%
Between-laboratory variance	s_L^2	48,6088064	
Between-laboratory standard deviation	s_L	6,97200	%
Between-laboratory coefficient of variation	$CV\%_L$	12,056	%
Reproducibility variance s_R^2	$s_r^2 + s_L^2$	71,7428218	
Reproducibility standard deviation	s_R	8,47011	%
Reproducibility coefficient of variation	$CV\%_R$	14,647	%
Repeatability limit	r	**13,47**	%
Relative repeatability limit	r_{rel}	**23,3**	%
Reproducibility limit	R	**23,72**	%
Relative reproducibility limit	R_{rel}	**41,0**	%
Number of participants included in the accuracy evaluation	p	13	
Number of tests included in the accuracy evaluation	$\sum n$	26	

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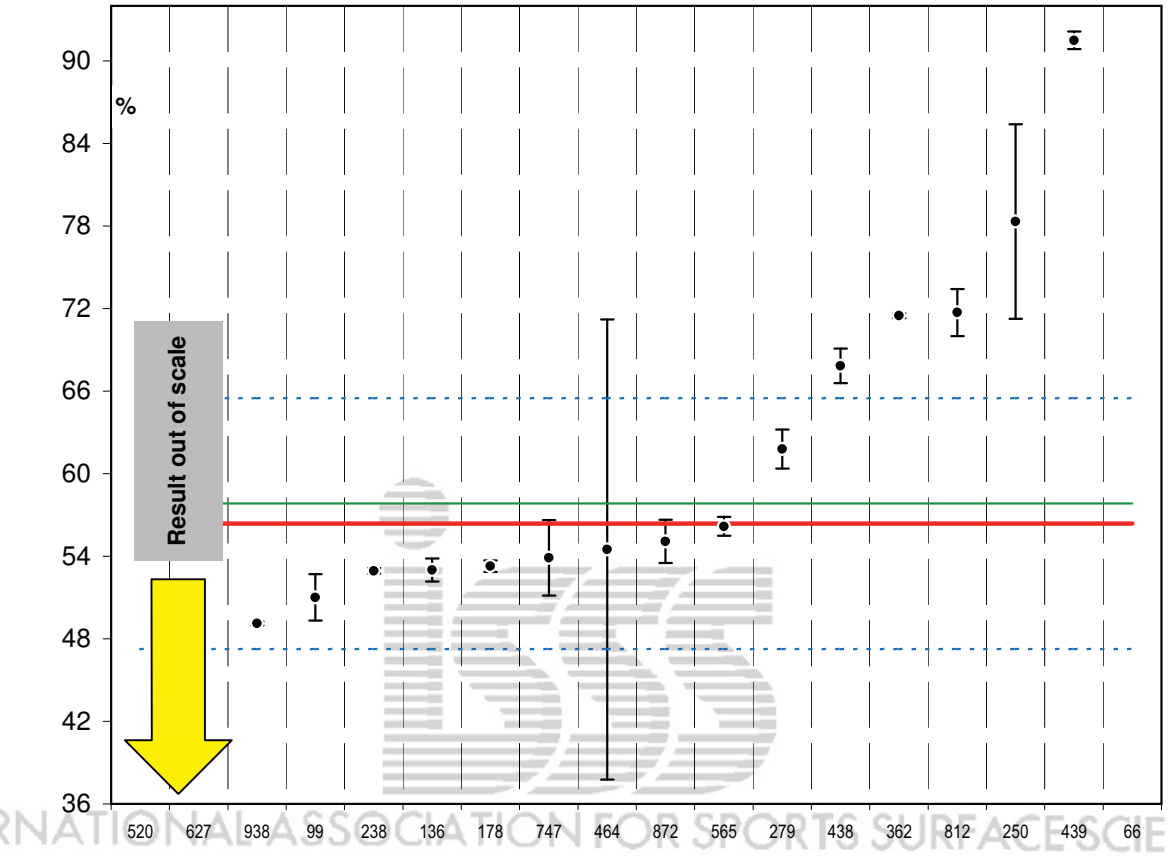
Determination of vertical ball behaviour - ST4 - hockeyball - R



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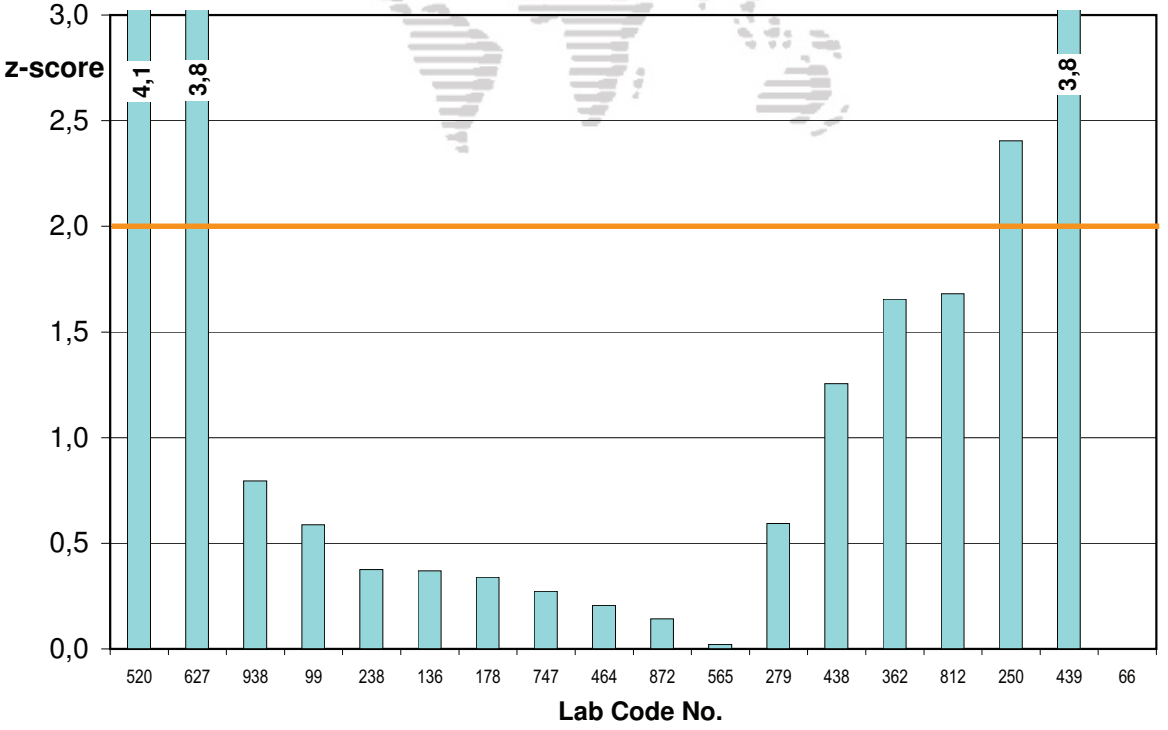

Determination of vertical ball behaviour - ST3 - football - R

EN 12235

Results submitted by participants and Results of robust statistics

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

(bottom part of the table)

Number of reporting laboratories p *: 17
Number of reported test results $\sum n_i$: 34

Lab Code No.	Test results in % — Test replication No. (k) 1	2	3	4	5	6	Statistical evaluation of the submitted test results x_{ik}: n_i	x_i	s_i	Outliers: Cochran	Grubbs	$z>2$
627	65,28	65,28					2	65,280	0,0000			X
520	67,56	66,72					2	67,140	0,5940		**	X
747	79,76	83,42					2	81,590	2,5880			X
279	87,80	89,48					2	88,640	1,1879			
136	88,60	89,20					2	88,900	0,4243			
438	91,48	92,96					2	92,220	1,0465			
872	93,34	94,20					2	93,770	0,6081			
938	95,00	95,00					2	95,000	0,0000			
250	94,12	96,98					2	95,550	2,0223			
238	94,32	97,02					2	95,670	1,9092			
362	97,08	97,02					2	97,050	0,0424			
99	97,34	97,48					2	97,410	0,0990			
178	98,16	98,30					2	98,230	0,0990			
439	97,94	99,66					2	98,800	1,2162			
812	98,96	98,72					2	98,840	0,1697			
565	99,20	102,60					2	100,900	2,4042			
464	100,66	101,32					2	100,990	0,4667			
66	no results reported											X

Robust average: x^* = 94,51 ← assigned value for the proficiency assessment

Robust standard deviation for the proficiency assessment: s^* = 5,238

Number of repeate measurements necessary due to s_r/s^*-ratio: n' = 1 — OK

Standard uncertainty of the assigned value: u_x = 1,58790 — NOT OK

see page 4 for the meaning of **NOT OK**

** ... **statistical outlier (99%)** * ... **straggler (95%)**

X ... z **> 2; in this case, x_i is considered to be an outlier and is not taken into account in the test method accuracy check**

Additional check of the test method accuracy

Do the input data come from a normal distribution (when outliers found were eliminated) **?**
(The results listed below shall be considered as really justified only if the input data come from a normal distribution)

YES

General mean $\sum n_i x_{ik} / \sum n_i$	m	95,86	%
Repeatability variance	s_r^2	1,3084429	
Repeatability standard deviation	s_r	1,14387	%
Repeatability coefficient of variation	$CV\%_r$	1,193	%
Between-laboratory variance	s_L^2	14,5563286	
Between-laboratory standard deviation	s_L	3,81528	%
Between-laboratory coefficient of variation	$CV\%_L$	3,980	%
Reproducibility variance s_R^2	$s_r^2 + s_L^2$	15,8647714	
Reproducibility standard deviation	s_R	3,98306	%
Reproducibility coefficient of variation	$CV\%_R$	4,155	%
Repeatability limit	r	**3,20**	%
Relative repeatability limit	r_{rel}	**3,3**	%
Reproducibility limit	R	**11,15**	%
Relative reproducibility limit	R_{rel}	**11,6**	%
Number of participants included in the accuracy evaluation	p	14	
Number of tests included in the accuracy evaluation	$\sum n$	28	

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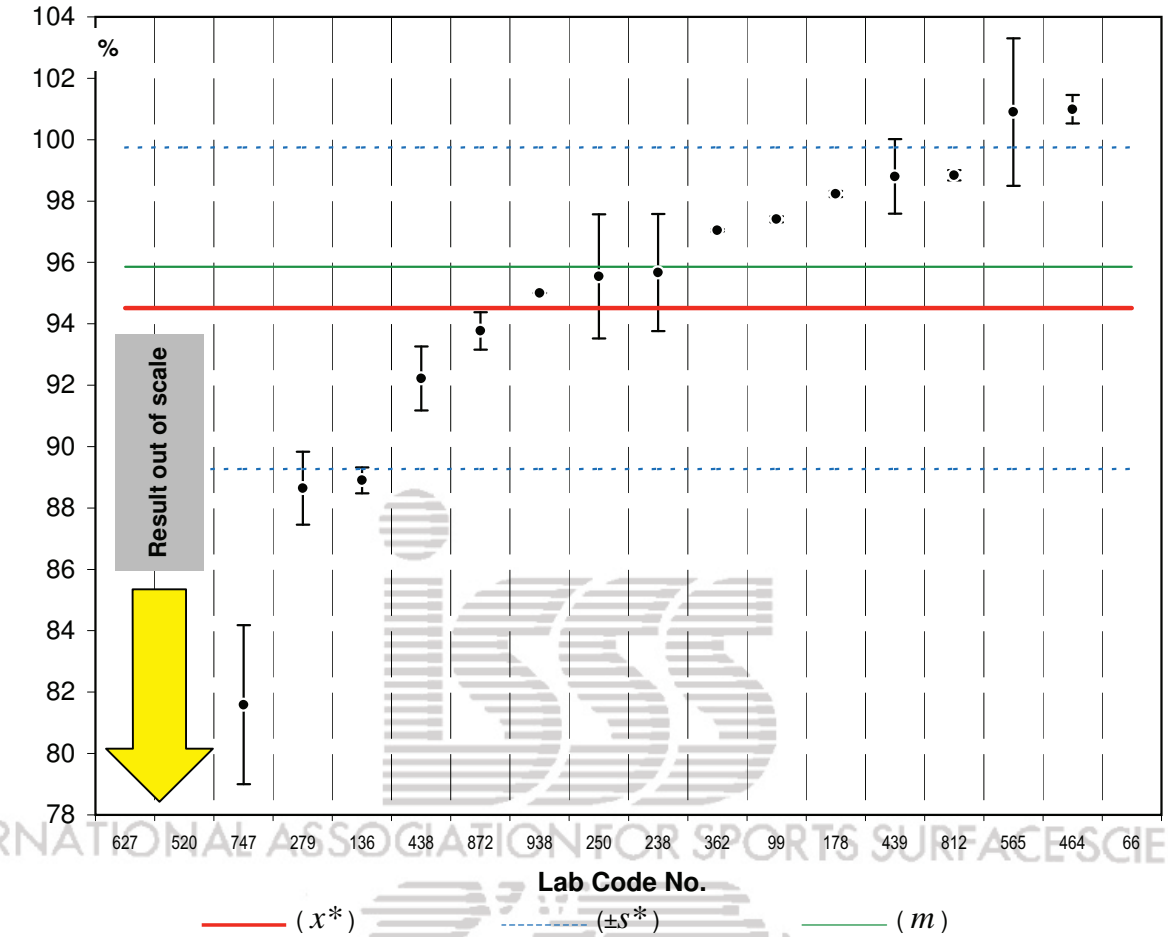
Determination of vertical ball behaviour - ST3 - football - R



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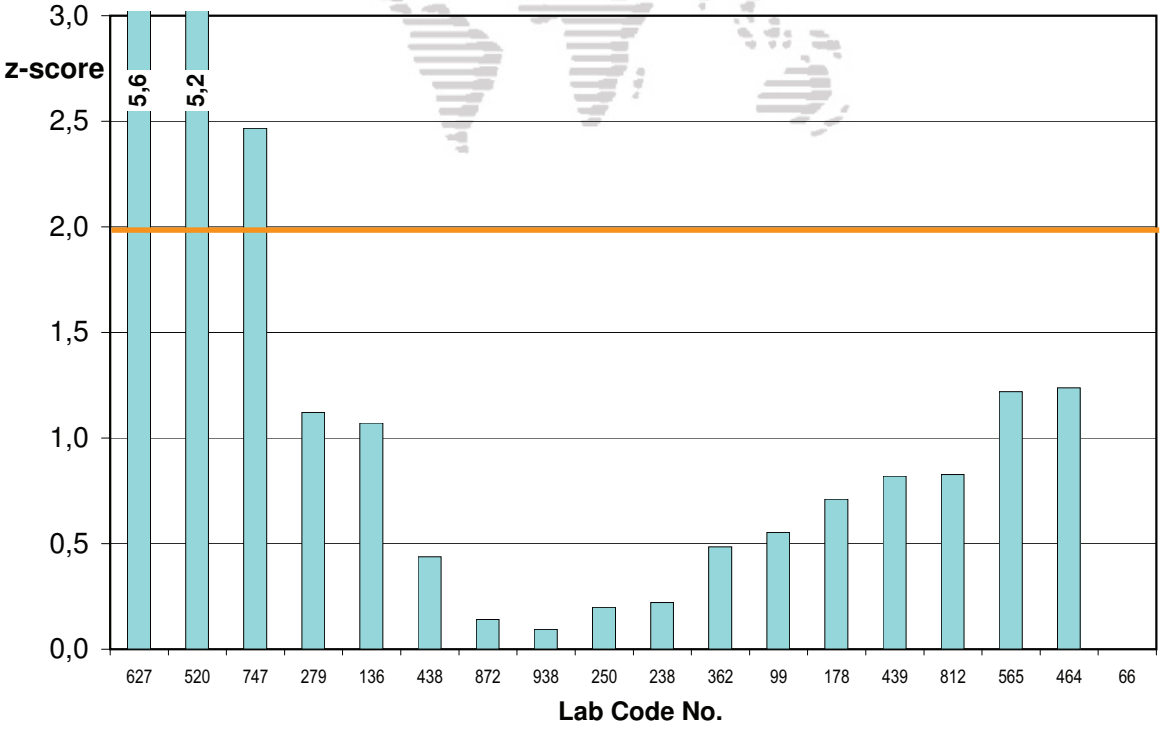

Determination of vertical ball behaviour - ST4 - football - R

EN 12235

Results submitted by participants and Results of robust statistics

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

(bottom part of the table)

Number of reporting laboratories p *: 18
Number of reported test results Σn_i: 36

Lab Code No.	Test results in % — Test replication No. (k) 1	2	3	4	5	6	Statistical evaluation of the submitted test results x_{ik}: n_i	x_i	s_i	Outliers: Cochran	Grubbs	$z>2$
627	48,24	48,08					2	48,160	0,1131			X
520	47,84	49,88					2	48,860	1,4425			X
747	49,78	50,64					2	50,210	0,6081		**	X
136	55,40	64,60					2	60,000	6,5054	*		
938	64,00	64,60					2	64,300	0,4243			
438	66,32	63,42					2	64,870	2,0506			
250	65,14	65,72					2	65,430	0,4101			
238	67,78	63,14					2	65,460	3,2810			
66	67,86	65,48					2	66,670	1,6829			
99	67,84	66,66					2	67,250	0,8344			
464	70,54	67,32					2	68,930	2,2769			
362	70,08	70,76					2	70,420	0,4808			
565	71,36	70,60					2	70,980	0,5374			
812	73,06	69,72					2	71,390	2,3617			
872	74,48	68,40					2	71,440	4,2992			
178	71,20	72,78					2	71,990	1,1172			
439	100,72	100,50					2	100,610	0,1556		**	X
279	180,92	65,38					2	123,150	81,6991	**	**	X

Robust average: x^* =	66,92	← assigned value for the proficiency assessment	
Robust standard deviation for the proficiency assessment: s^* =	6,755		
Number of repeate measurements necessary due to s_r/s^*-ratio: n' =	2	OK	see page 4 for the meaning of **NOT OK**
Standard uncertainty of the assigned value: u_x =	1,99032	OK	

** ... **statistical outlier (99%)** * ... **straggler (95%)**
X ... z **> 2; in this case,** x_i **is considered to be an outlier and is not taken into account in the test method accuracy check**

Additional check of the test method accuracy

Do the input data come from a normal distribution (when outliers found were eliminated) ? (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	67,63	%
Repeatability variance	s_r^2	7,0907538	
Repeatability standard deviation	s_r	2,66285	%
Repeatability coefficient of variation	$CV\%_r$	3,938	%
Between-laboratory variance	s_L^2	9,4461167	
Between-laboratory standard deviation	s_L	3,07345	%
Between-laboratory coefficient of variation	$CV\%_L$	4,545	%
Reproducibility variance s_R^2	$s_r^2 + s_L^2$	16,5368705	
Reproducibility standard deviation	s_R	4,06656	%
Reproducibility coefficient of variation	$CV\%_R$	6,013	%
Repeatability limit	r	**7,46**	%
Relative repeatability limit	r_{rel}	**11,0**	%
Reproducibility limit	R	**11,39**	%
Relative reproducibility limit	R_{rel}	**16,8**	%
Number of participants included in the accuracy evaluation	p	13	
Number of tests included in the accuracy evaluation	Σn	26	

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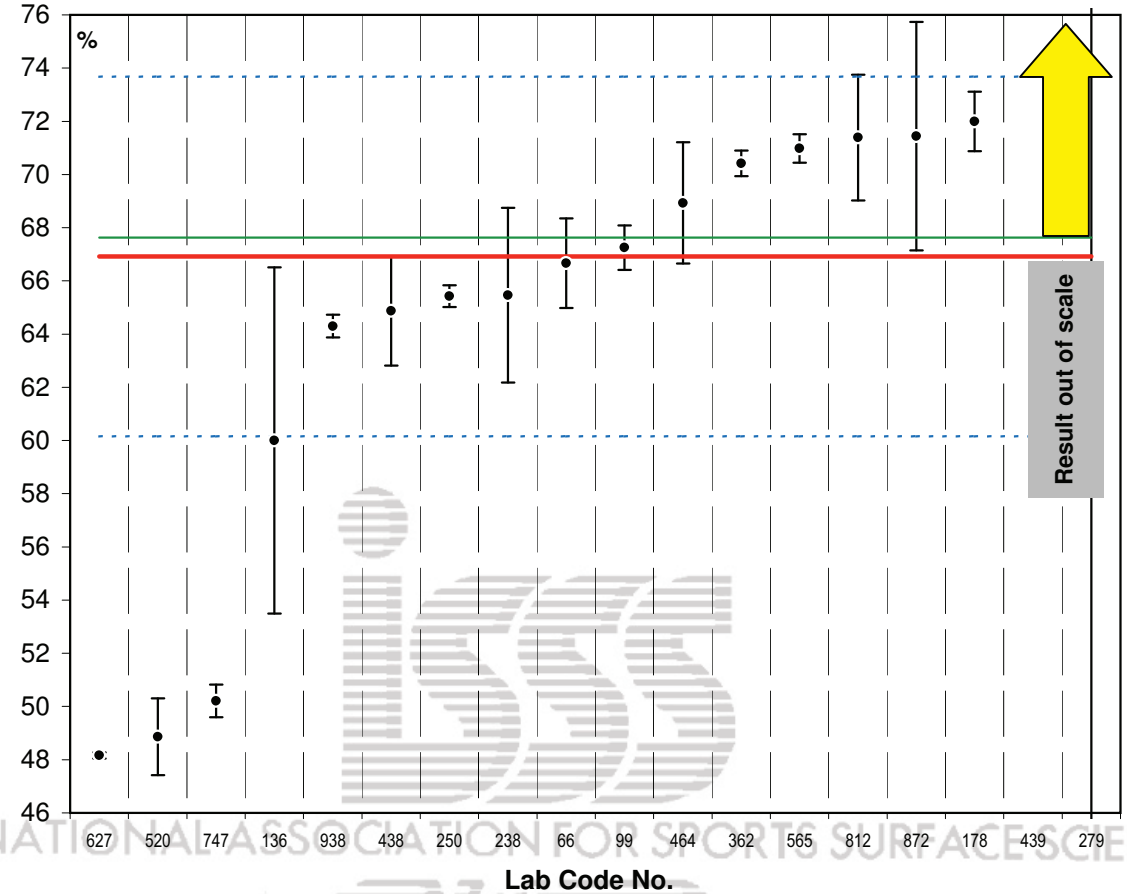
Determination of vertical ball behaviour - ST4 - football - R



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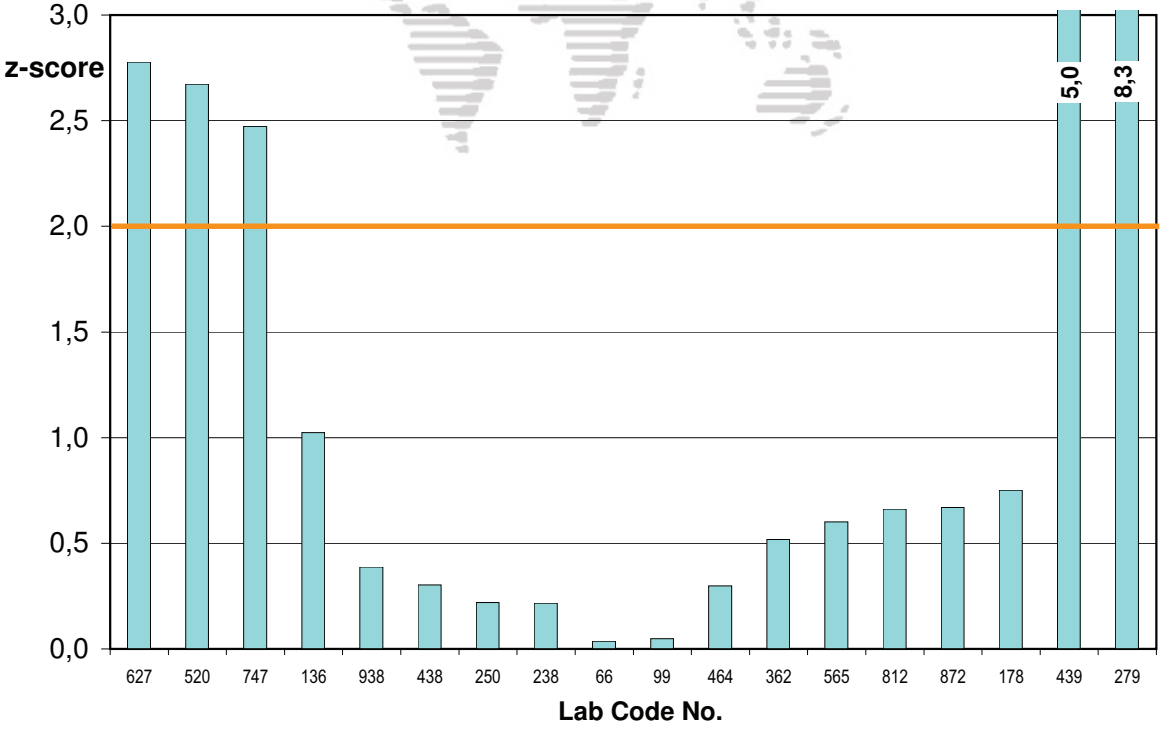

Determination of vertical ball behaviour - ST3 - basketball - R

EN 12235

Results submitted by participants and Results of robust statistics

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

(bottom part of the table)

Number of reporting laboratories p *: 16
Number of reported test results $\sum n_i$: 32

Lab Code No.	Test results in % — Test replication No. (k) 1	2	3	4	5	6	Statistical evaluation of the submitted test results x_{ik}: n_i	x_i	s_i	Outliers: Cochran	Grubbs	$z>2$
627	60,93	59,80					2	60,363	0,7955			X
520	61,68	60,13					2	60,900	1,0960		**	X
279	84,58	84,80					2	84,688	0,1591			
747	89,28	89,18					2	89,225	0,0707			
438	91,08	90,58					2	90,825	0,3536			
565	91,78	95,98					2	93,875	2,9698	*		
136	97,75	96,25					2	97,000	1,0607			
938	99,00	99,00					2	99,000	0,0000			
872	99,80	100,23					2	100,013	0,3005			
250	101,20	101,63					2	101,413	0,3005			
99	101,68	101,90					2	101,788	0,1591			
362	101,90	101,73					2	101,813	0,1237			
439	101,80	102,35					2	102,075	0,3889			
238	103,78	101,00					2	102,388	1,9622			
812	104,65	105,08					2	104,863	0,3005			
464	106,38	108,20					2	107,288	1,2905			
66	no results reported											X
178	no results reported											X

Robust average:	x^* =	97,73	← assigned value for the proficiency assessment
Robust standard deviation for the proficiency assessment:	s^* =	6,661	
Number of repeate measurements necessary due to s_r/s^*-ratio:	n' =	1	OK
Standard uncertainty of the assigned value:	u_x =	2,08165	NOT OK

see page 4 for the meaning of **NOT OK**

** ... **statistical outlier (99%)** * ... **straggler (95%)**

X ... z **> 2; in this case,** x_i **is considered to be an outlier and is not taken into account in the test method accuracy check**

Additional check of the test method accuracy

Do the input data come from a normal distribution (when outliers found were eliminated) **?** NO

(The results listed below shall be considered as really justified only if the input data come from a normal distribution)

General mean $\sum n_i x_{ik} / \sum n_i$	m	98,30	%
Repeatability variance	s_r^2	1,1484821	
Repeatability standard deviation	s_r	1,07167	%
Repeatability coefficient of variation	$CV\%_r$	1,090	%
Between-laboratory variance	s_L^2	40,7497837	
Between-laboratory standard deviation	s_L	6,38356	%
Between-laboratory coefficient of variation	$CV\%_L$	6,494	%
Reproducibility variance s_R^2	$s_r^2 + s_L^2$	41,8982658	
Reproducibility standard deviation	s_R	6,47289	%
Reproducibility coefficient of variation	$CV\%_R$	6,585	%
Repeatability limit	r	**3,00**	%
Relative repeatability limit	r_{rel}	**3,1**	%
Reproducibility limit	R	**18,12**	%
Relative reproducibility limit	R_{rel}	**18,4**	%
Number of participants included in the accuracy evaluation	p	14	
Number of tests included in the accuracy evaluation	$\sum n$	28	

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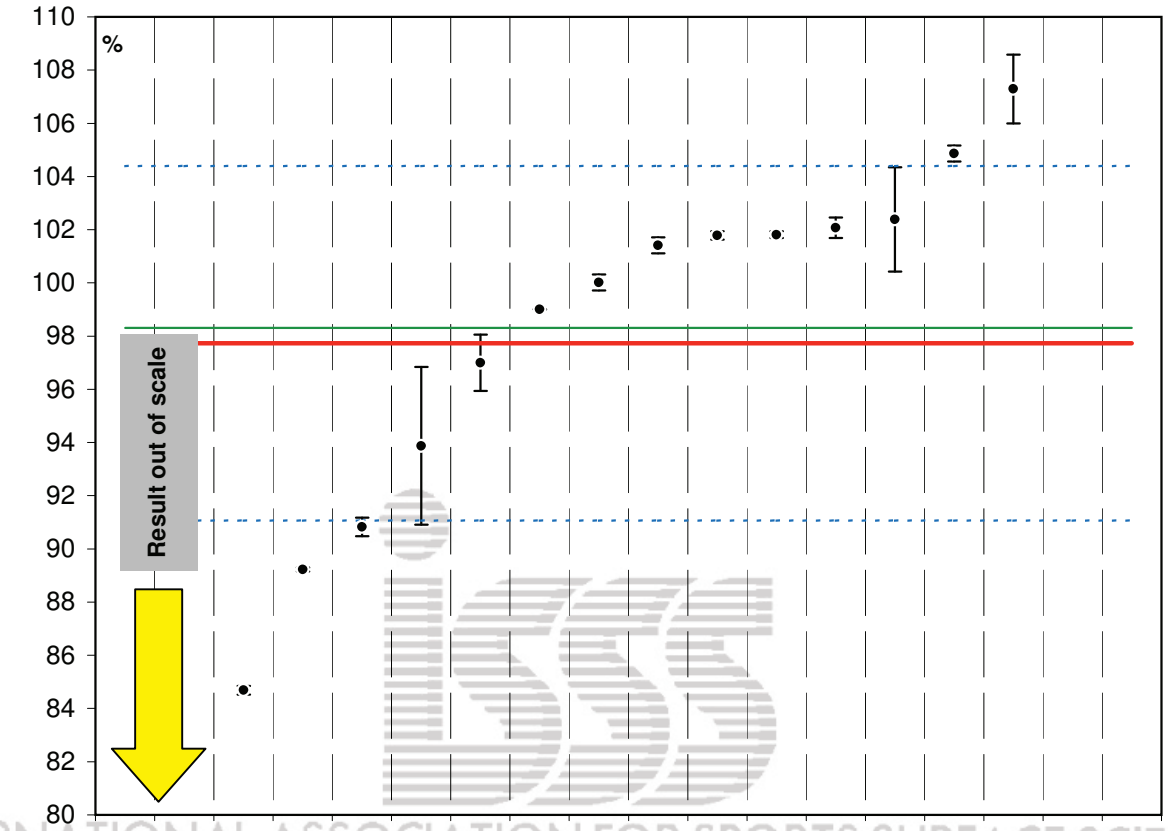
Determination of vertical ball behaviour - ST3 - basketball - R



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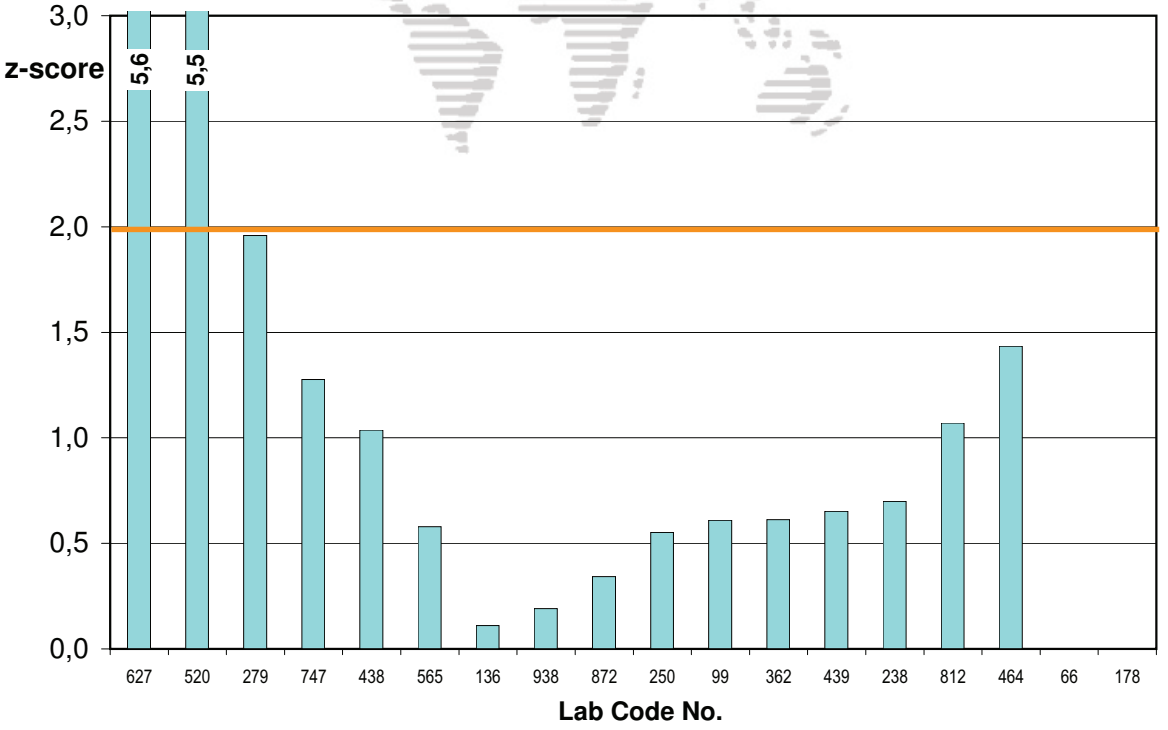

Determination of vertical ball behaviour - ST4 - basketball - R

EN 12235

Results submitted by participants and Results of robust statistics

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

(bottom part of the table)

Number of reporting laboratories p *: 17
Number of reported test results $\sum n_i$: 34

Lab Code No.	Test results in % — Test replication No. (k) 1	2	3	4	5	6	Statistical evaluation of the submitted test results x_{ik}: n_i	x_i	s_i	Outliers: Cochran	Grubbs	z>2
627	44,50	44,32					2	44,410	0,1273			X
520	44,66	45,04					2	44,850	0,2687			X
279	46,10	45,40					2	45,750	0,4950			X
747	57,52	55,70					2	56,610	1,2869			
438	62,12	59,24					2	60,680	2,0365			
238	66,02	61,54					2	63,780	3,1678			
99	67,06	64,22					2	65,640	2,0082			
938	65,60	66,60					2	66,100	0,7071			
250	67,00	71,32					2	69,160	3,0547			
66	70,88	68,22					2	69,550	1,8809			
812	73,56	68,02					2	70,790	3,9174			
565	71,72	71,72					2	71,720	0,0000			
464	72,44	73,76					2	73,100	0,9334			
362	74,26	75,06					2	74,660	0,5657			
872	78,20	73,76					2	75,980	3,1396			
136	103,00	70,80					2	86,900	22,7688	**		X
439	102,52	101,44					2	101,980	0,7637			X
178	no results reported											X

Robust average: x^* =	67,74	← assigned value for the proficiency assessment	
Robust standard deviation for the proficiency assessment: s^* =	9,353		
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 =	2,83541	NOT OK	

** ... **statistical outlier (99%)** * ... **straggler (95%)**
X ... z **> 2; in this case,** x_i **is considered to be an outlier and is not taken into account in the test method accuracy check**

Additional check of the test method accuracy

Do the input data come from a normal distribution (when outliers found were eliminated) ? (The results listed below shall be considered as really justified only if the input data come from a normal distribution)		YES
General mean $\sum n_i x_{ik} / \sum n_i$	m	**68,15** %
Repeatability variance	s_r^2	4,9695167
Repeatability standard deviation	s_r	2,22924 %
Repeatability coefficient of variation	$CV\%_r$	3,271 %
Between-laboratory variance	s_L^2	31,1023348
Between-laboratory standard deviation	s_L	5,57695 %
Between-laboratory coefficient of variation	$CV\%_L$	8,184 %
Reproducibility variance s_R^2	$s_r^2 + s_L^2$	36,0718515
Reproducibility standard deviation	s_R	6,00598 %
Reproducibility coefficient of variation	$CV\%_R$	8,813 %
Repeatability limit	r	**6,24** %
Relative repeatability limit	r_{rel}	**9,2** %
Reproducibility limit	R	**16,82** %
Relative reproducibility limit	R_{rel}	**24,7** %
Number of participants included in the accuracy evaluation	p	12
Number of tests included in the accuracy evaluation	$\sum n$	24

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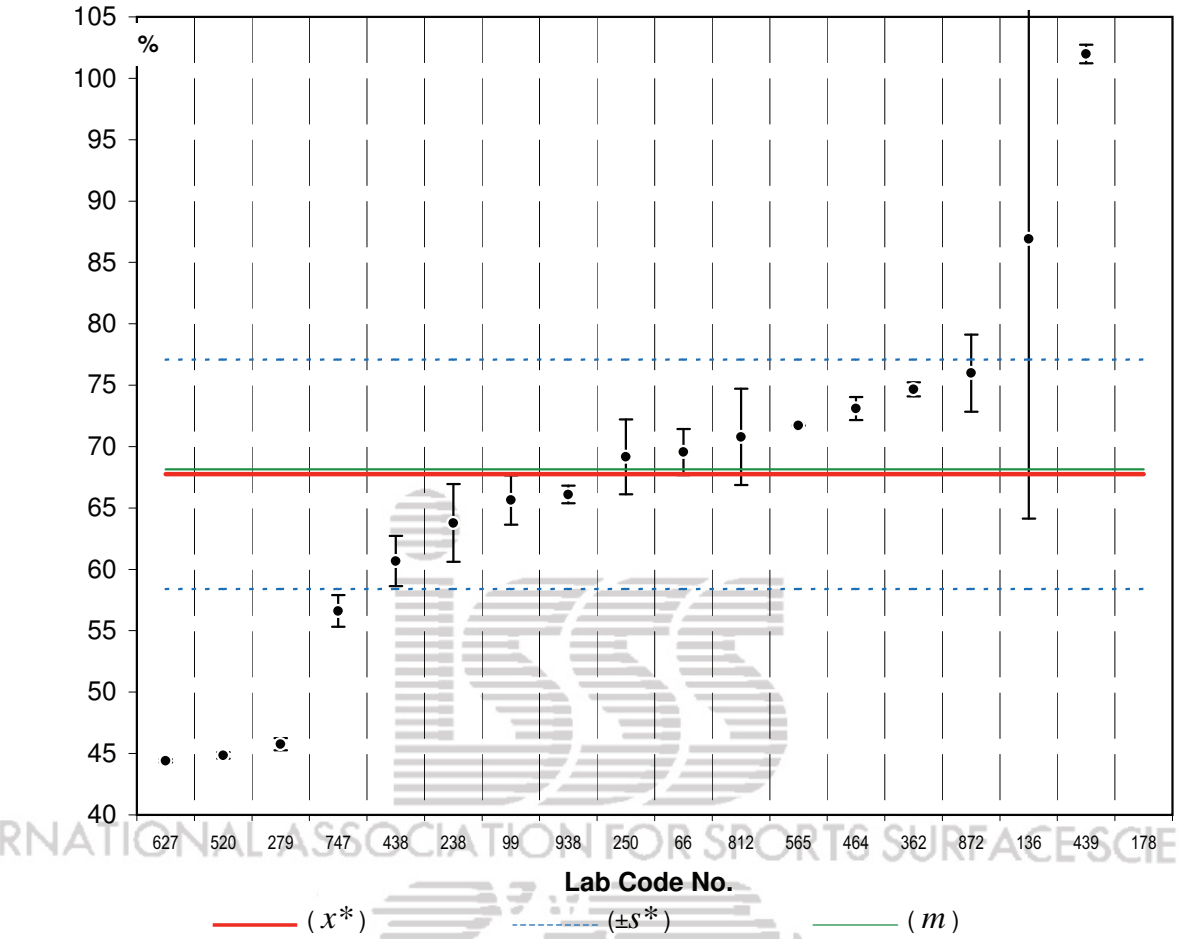
Determination of vertical ball behaviour - ST4 - basketball - R



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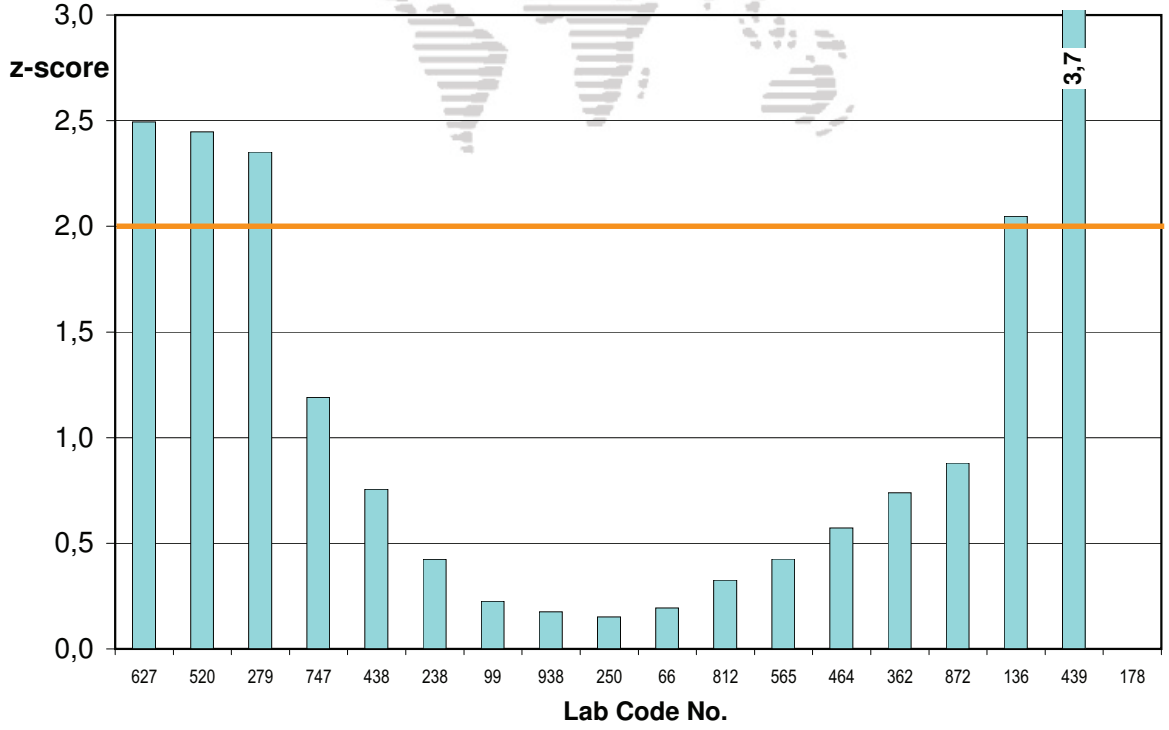
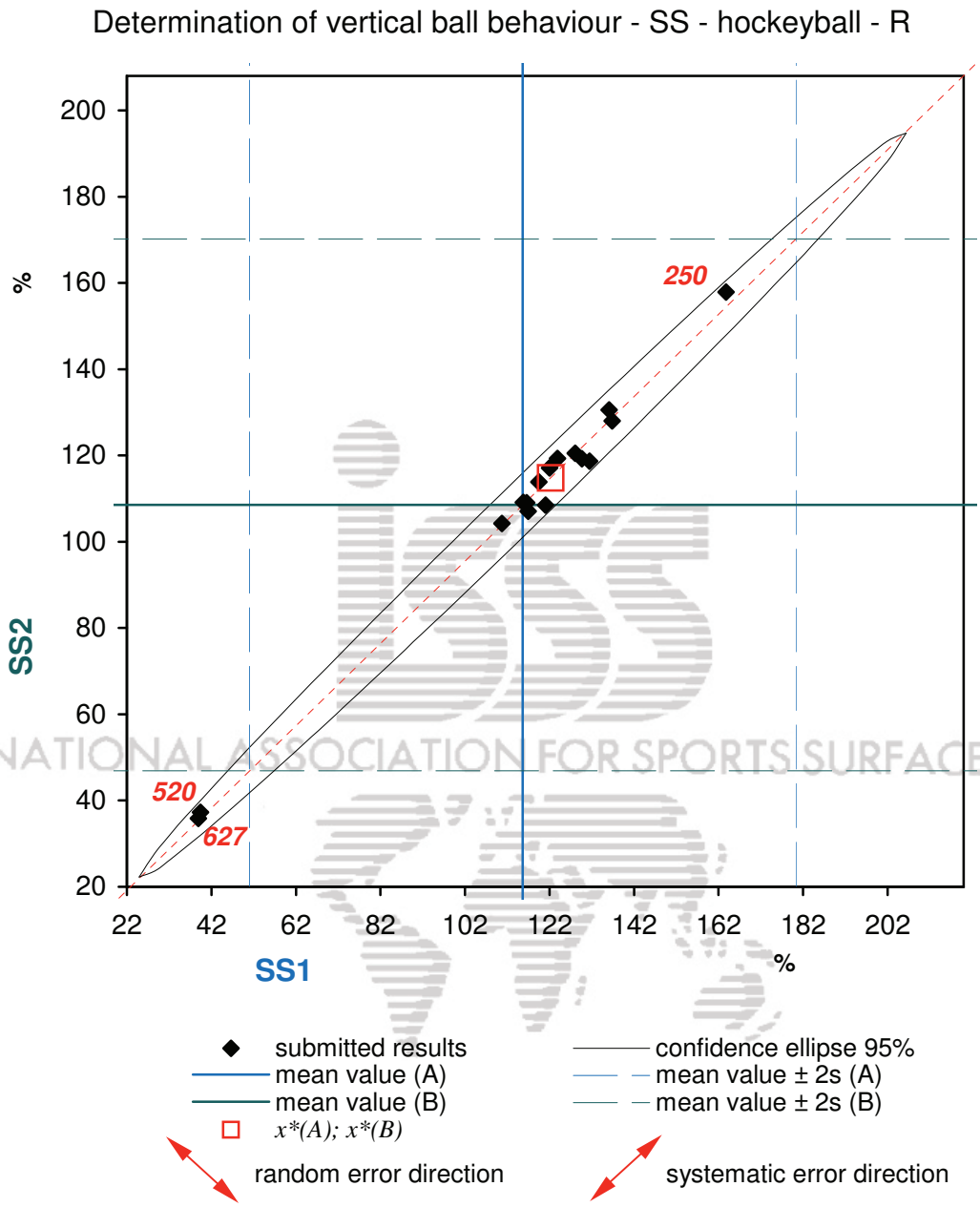


Youden Plot & Confidence Ellipse



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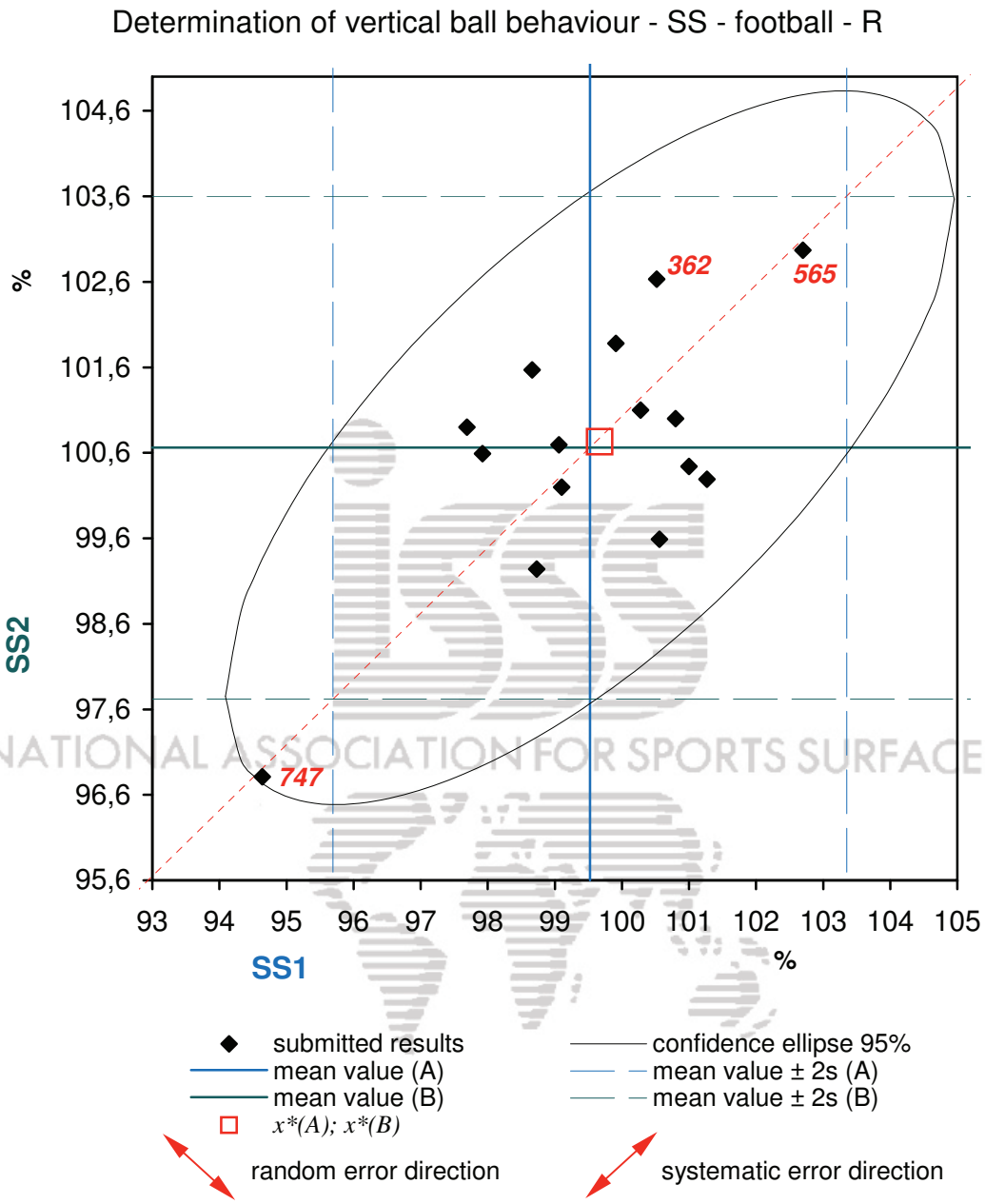
Youden Plot & Confidence Ellipse



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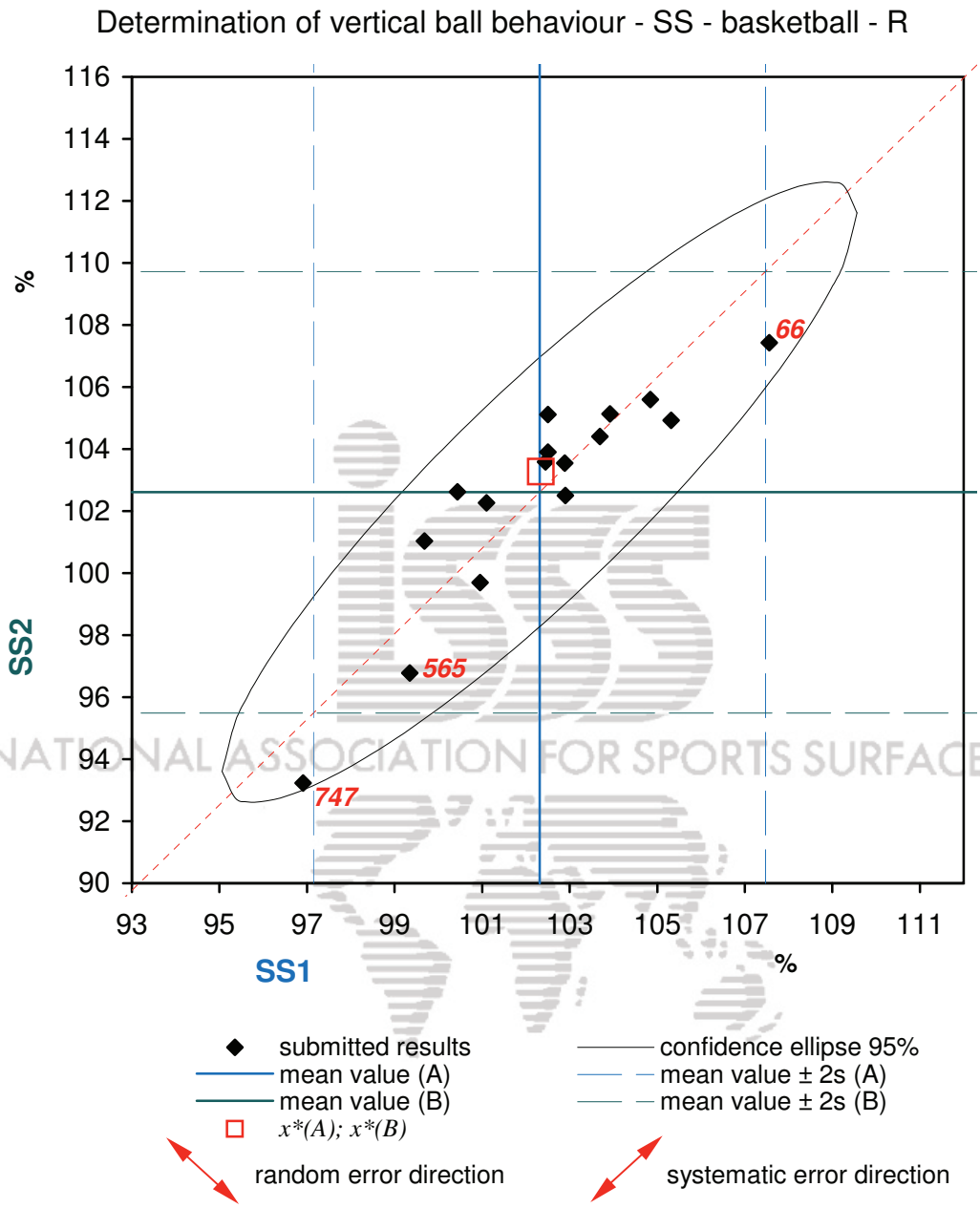

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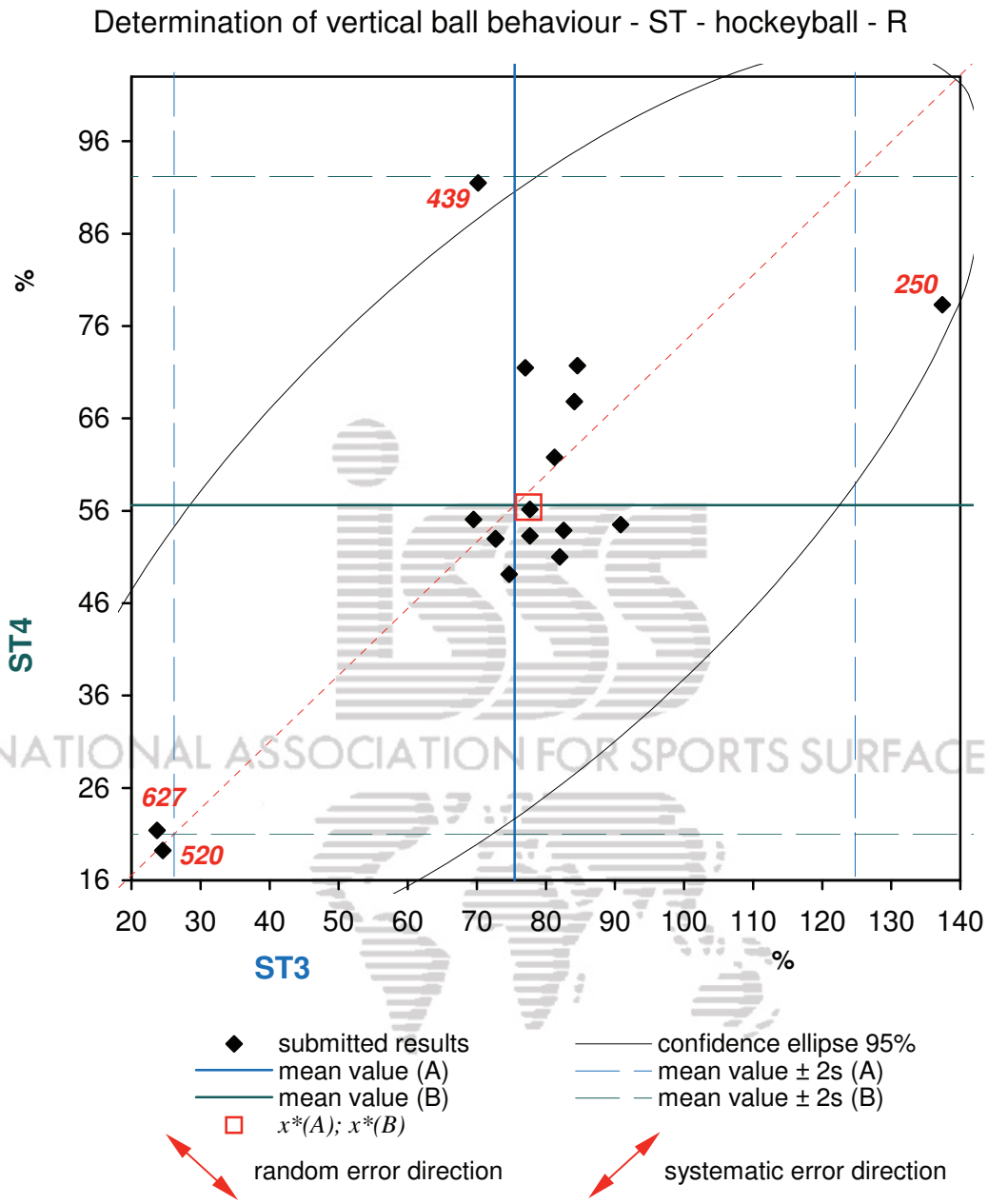

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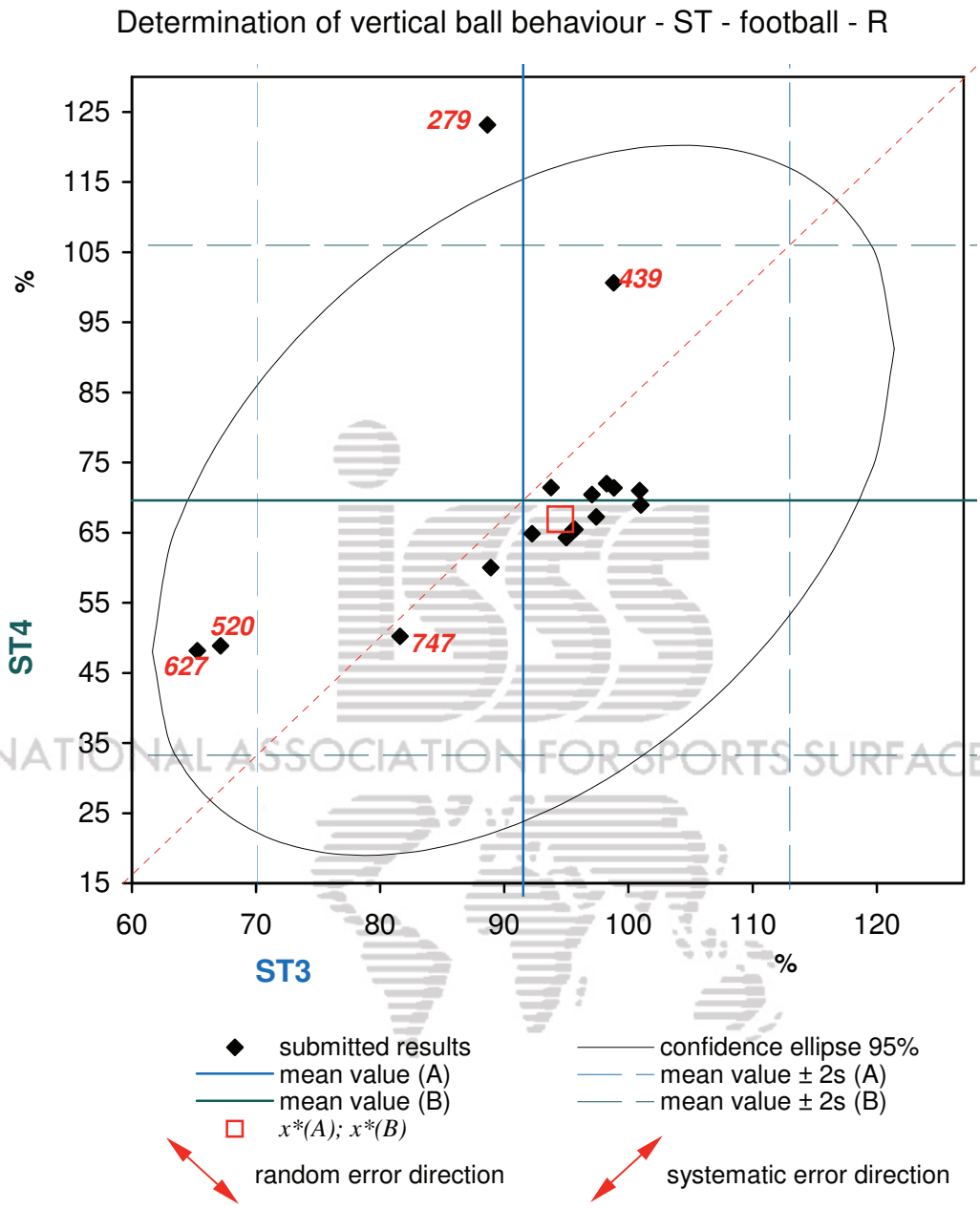

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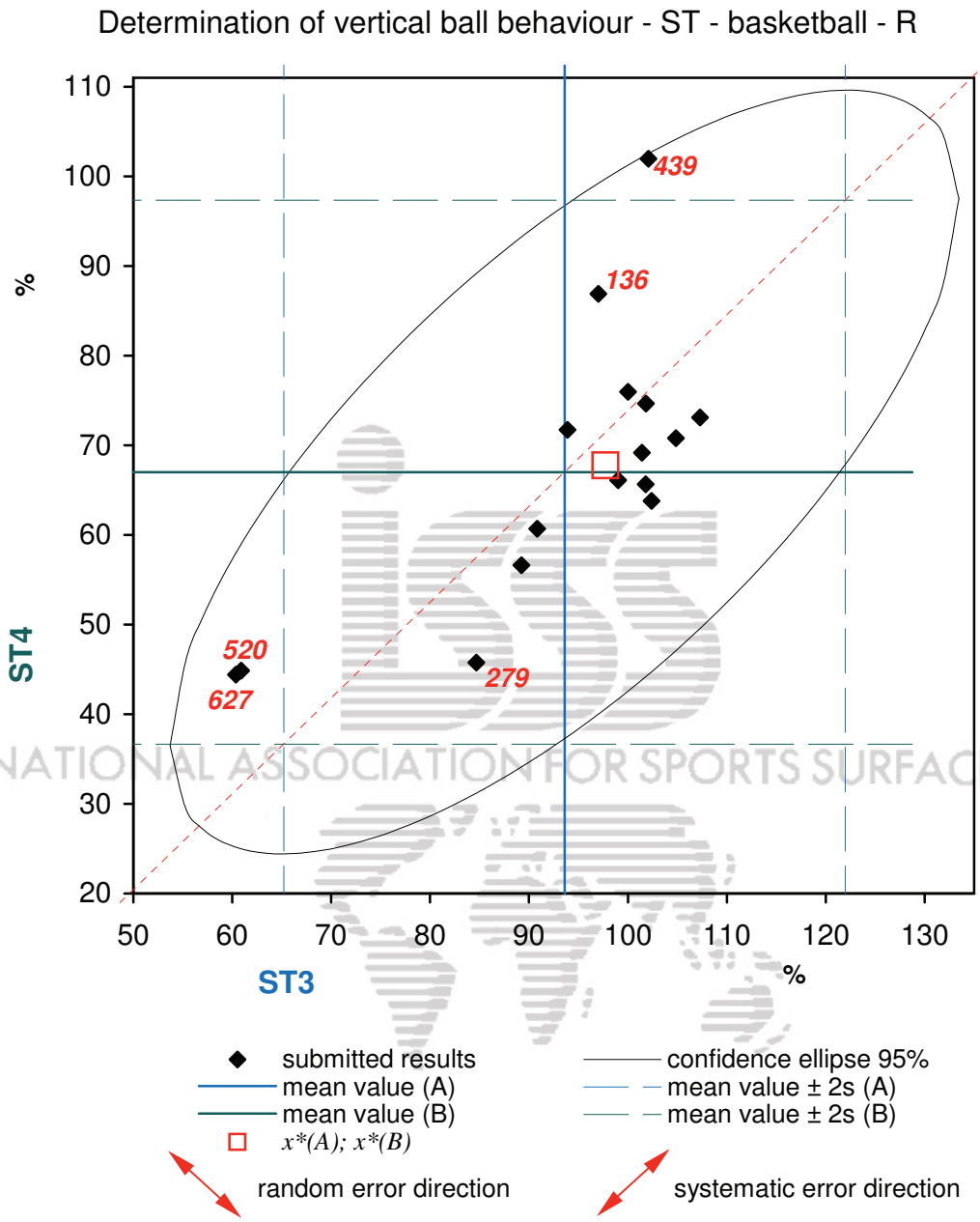

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