EAPIC

ESSAIS D'APTITUDE PAR ESSAI DE COMPARAISON

RESULT PRESENTATION REPORT

N° 6.2.19

About the test

Wheel tracking on large-size devices

According to the standard
NF EN 12697-22 February 2020

May 25th, 2021 by G. PIOT – EAPIC Executive Cell
Cerema IDF – Département Infrastructures Risques et Matériaux
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EAPIC
ESSAIS D'APTITUDE PAR ESSAI DE COMPARAISON

Preamble

After the EAPIC 18 series dedicated to stabilized fine soils, it was important to return to asphalt mixes to complete this kind of second round for mix design tests: Giratory Compactor, rutting, modulus. As Giratory Compactor and modulus have both recently been the subject of a second EAPIC series, the rutting test - one of the most critical for the mixes to be formulated - was a natural choice, after a first series carried out in 2009-2010. Your participation remained strong: 32 laboratories for this series, compared to 33 in 2010. And even if the consequences of the recent pandemic have postponed this series by a few months in 2020, the most of you have answered on time and the publication of this report is finally only a few months behind the initial schedule.

This series provided an opportunity to evaluate the practice of this test by the laboratories in a technical context marked over the last ten years by both a diversification of the materials used and the increasingly frequent use of asphalt aggregates. Both these elements have guided EAPIC's choices in the organization of the series proposed to you.

First, the proposed mix design is close to that of the first series, but with a 20% reclaimed asphalt and a slightly higher total binder content. It leads to a slightly lower range of results than those sent in 2010. The precision values obtained, which are better than in 2010, must be read taking into account this level of value, as well as a maximum density value common to all laboratories.

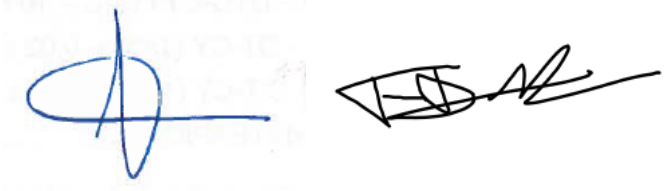
Moreover, such as in the last series, the question sheet that comes with the results enabled the constitution of an anonymous database, which will be proposed to the "Pavement Testing" Standardisation Committee. We will thus provide it with material to be analysed - which is not the role of EAPIC – for future revisions of the relevant testing standards.

Finally, it is almost a tradition, the forthcoming English translation of this report will allow its contents to be disseminated and used in international exchanges on rutting testing.

Best regards,

For EAPIC,

Michel SAUBOT & Frédéric DELFOSSE



Michel SAUBOT & Frédéric DELFOSSE

EAPIC
ESSAIS D'APTITUDE PAR ESSAI DE COMPARAISON

Summary

Session organization and data collection

Homogenized lots of constituents are supplied to participating laboratories. They must determine:

- The geometric bulk density;
- The percentages of wheel tracking resulting from the average of the 2 values obtained from each test specimen at 300 cycles (optional), 1 000 cycles, 3 000 cycles, 10 000 cycles and 30 000 cycles.

And according to the standards:

- Determination of the void content from the geometric bulk density according to the standard NF EN 12697-6 – procedure D of February 2020;
- Determination of whell tracking on large-size devices according to the standard NF EN 12697-22 of February 2020.

The formula to be manufactured is adapted by each laboratory according to its value of the binder content measured on the batch of asphalt aggregates transmitted:

6.3/10	Value refined according to the measured AE binder content
2/6.3	20.00%
0/2	25.00%
RAP	20.00%
Bitumen	Value refined according to the measured RAP binder content

The total binder content must be 5.50%.

For example:
For an RAP binder content of 4.86%, the formula to be manufacture is as follow:

6.3/10	30.47%
2/6.3	20.00%
0/2	25.00%
RAP	20.00%
Bitumen	4.53%

The compacted specimens must comply with the following conditions: the void content must be (6.5 ± 1.5) % in geometric measurement.

The value of MVRe was determined by the Specialized Group EAPIC and was sent to all the laboratories.

MVRe: 2.594g/cm^3

The campaign unfolded as follows:

- Registration of laboratories from mid November 2019 to mid January 2020;
- Pandemie context: shutdown of the session between March and June 2020;
- Confirmation of registration of laboratories and start of the session in June 2020;
- Shipping of samples at the beginning November 2020;
- Results delivery from participating laboratories no later than January 15, 2021.
  The number of participants to this session is 32 laboratories.
  90% results were transmitted on time.
  The requests for additional delays transmitted to the EAPIC Executive Cell have all been accepted until February 28, 2021.
  31 participating laboratories have transmitted their results.
- Publication of the results report in May 2021.

Preparation and shipping of samples

Support Laboratory: Cerema West - Department Laboratory of Angers

Materials

Each laboratory received one pallet with the quantities of materials needed to carry out their tests.

Each pallet is composed of the following fractions:

- 2 bags of 25kg of 6.3/10 ;
- 2 bags of 25kg of 2/6.3 ;
- 2 bags of 25kg of 0/2 ;
- 2 bags of 25kg AE (3 bags for laboratories having registered 2-wheel tracking);
- 1 pot of 10kg of bitumen.

The aggregates come from a single stock. Each granular fraction has been checked for homogeneity by the Support Laboratory Cerema East Central - Department Laboratory Autun (see page 8 and in the appendix)

Bitumen comes from a single manufacturing batch. The pots were checked for the following characteristics: penetration, TBA (carried out by the Support Laboratory Cerema West - Department Laboratory Angers) and G* (produced by Cerema Med - Department Laboratory Aix-en-Provence) (see page 9).

RAP come from a reference stock. They have been checked for homogeneity of the binder content by the Support Laboratory Cerema West - Department Laboratory Angers (see page 10).

Preparation

To carry out this session, Cerema West – Department Laboratory of Angers has received and alloted:

- 96 bags of 25 kg of 6.3/10;
- 96 bags of 25 kg of 2/6.3;
- 96 bags of 25 kg of 0/2;
- 72 bags of 25 kg of RAP;
- 60 pots of 10 kg of bitumen.

Materials Shipping

The materials were sent by the Cerema West – Department Laboratory of Angers.
The set of bags and buckets required for the campaign was set on pallets before shipment.
Only shipments for participants outside Metropolitan France were made in wooden crate (due to shipping).

Verification of aggregates samples homogeneity

Support Laboratory: Cerema East Central - Department laboratory of Autun

In order to check that all the samples are homogeneous, the indication of Annex B of the ISO 13528 standard of October 2015 (French corrected version of December 2016) which gives a statistical method used in inter-laboratory comparison aptitude tests, are applied. This appendix is based on the comparison of the standard deviation inter-samples S_s to the standard deviation for the assessment of aptitude σ_{PT}. Samples are considered to be homogeneous if $S_s \leq 0.3 \times \sigma_{PT}$.

The homogeneity criteria considered by the EAPIC Executive Cell is the pre-dried aggregates density determined according to the standard NF EN 1097-6 annex A, of January 2014.

For each bag or pot, the values of the inter-sample standard deviation are compared to the estimate of the homogeneity criterion 0,3 × $\boldsymbol{\sigma_{PT}}$.

	MVR 0/2	**MVR 2/6.3**	**MVR 6.3/10**
Average	2.818	2.850	2.859
Origin of r and R	EAPIC 5th Campaign	NF EN 1097-6	NF EN 1097-6
r	0.022	0.019	0.019
R	0.074	0.042	0.042
0,3 × $\boldsymbol{\sigma_{PT}}$	0.008	0.004	0.004
Standard deviation between samples S_s	0.001	0.003	0.003
Validation $S_s \leq 0.3 \times \sigma_{PT}$	condition fulfilled	condition fulfilled	condition fulfilled

Criteria is fulfilled for each test.

Therefore, it can be concluded that samples are sufficiently homogeneous.

Complementary tests for the characterization of bitumen samples

Support Laboratory: Cerema West - Department laboratory of Angers

Additional tests were carried out on bitumen samples in order to verify their characteristics and homogeneity:

- The needle penetration, determined according to the standard NF EN 1426 of June 2007;
- The softening point, determined according to the standard NF EN 1427 of June 2007;
- The dynamic complex modulus G*, at 15 °C and 10 Hz, determined according to NF EN 14770.

The results of these tests of 5 pots randomly selected are shown in the following table:

	1	2	3	4	5	Average	Maxi - Mini	r (Standard)
Penetration on new binder (0.1mm)	57	57	58	57	57	57.2	1	2
Softening point of the new binder (°C)	47.8	48.2	47.4	48.4	48.4	48.04	1	1
G* (MPa) on new binder	22.6	25.6	25.3	27.1	25.5	25.2	4.5	/ *(*)*

(*) For dynamic complex modulus G there is no repeatability data on 15°C – 10 Hz.*

It is noted that the repeatability calculated for the penetration and TBA Tests is lower than the repeatability criteria of the standard.

Verification of RAP samples homogeneity

Support Laboratory: Cerema West - Department laboratory of Angers

In order to check that all the samples are homogeneous, the indication of Appendix B of the ISO 13528 standard dated October 2015 (French corrected version of December 2016) which gives a statistical method used in inter-laboratory comparison aptitude tests, are applied. This appendix is based on the comparison of the standard deviation inter-samples S_s to the standard deviation for the assessment of aptitude σ_{PT}. Samples are considered to be homogeneous if $S_s \leq 0.3 \times \sigma_{PT}$.
There is also a relaxed criteria with σ'_{pt} which is calculated from σ_{pt} and s_s.

The homogeneity criteria considered by the EAPIC Executive Cell is the binder context of RAP.

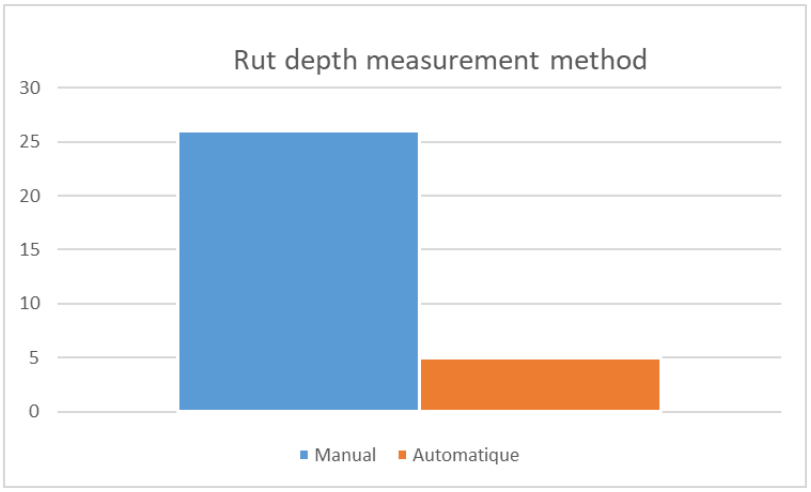
	Criteria ISO 13528 (2015)	Relaxed criteria ISO 13528 (2015) with σ'_{pt}
Average	4.856	
Origin of r and R	EAPIC 1.4.10	
r	0.500	
R	0.300	
$0.3 \times \sigma_{pt}$	0.0046	0.120
Standard deviation between samples s_s	0.368	0.368
Validation $s_s \leq 0.3 \times \sigma_{pt}$	condition not fulfilled	condition not fulfilled

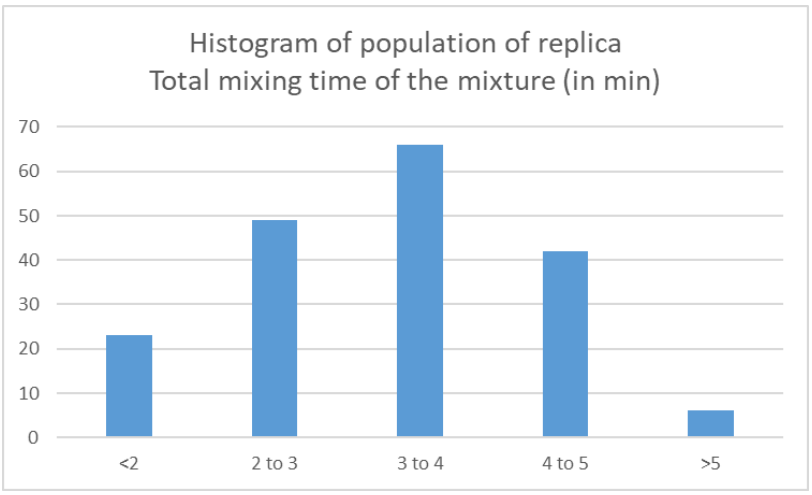
In both cases, the homogeneity is not verified.
Consequently, an instruction will be given to the participants in order to homogenize their batches of aggregates, and to determine the binder content thereof in order to adapt the given formula with respect to the total binder content of the asphalt.

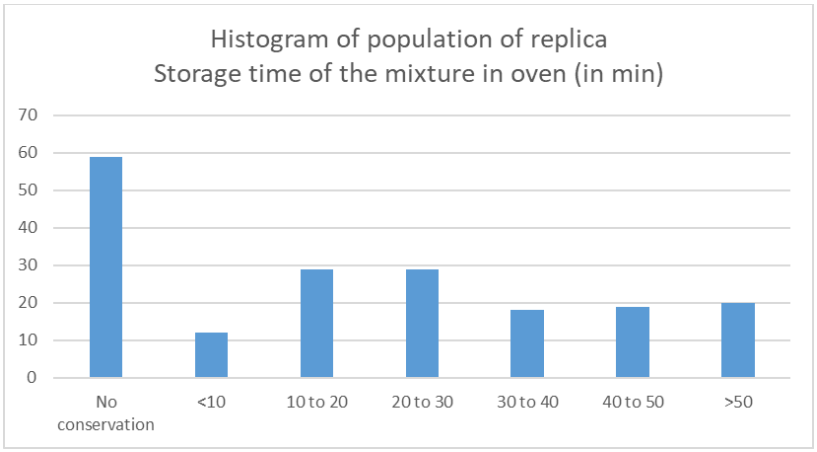
For information, penetrability, softening point and G* tests were carried out on the reclaimed asphalt. Below are the obtained values:

	1	2	3	4	5	Average
Penetration on binder contents of RAP (0.1mm)	10	9	7	8	7	8.2
softening point on binder contents of RAP (°C)	74.4	74.4	74.4	73.8	74.6	74.32
G* (MPa) on binder contents of RAP	153	141	142	170	122	146

Making statistics







Data processing

Data processing is based on series of standards ISO 5725 « Application of statistics – Accuracy (trueness and precision) of measurement methods and results ».
The traitment is performed using an Excel sheet. Results are then checked using the XLSTAT software.

Graphic representation

The raw data are represented in histogram diagrams that express the results obtained by participating laboratories. The raw average and corrected average (after removal of outliers) are placed in the graph.

Statistical tests

The following statistical tests are applied to raw results :

- intra-laboratory variability (Cochran test): detection of variance outliers, in the statistical sense of the results in a laboratory ;
- inter-laboratory variability (simple Grubbs test or possibly double): detection of averages outliers, among the population of laboratories.
- Mandel h and k tests (representation in appendices) : identification of differences at sample levels, the h statistic at the mean level and the k statistic at the variance level.

Results exceeding the critical value of 1% are reported as outliers and removed from the statistical treatment that only deals with corrected data.

Z-Score

Z-Score, calculated according to the standard NF ISO 13528 of October 2015, is the number of standard deviations that are above or below the population average.

Le Z-Score is calculated from the following formula :
$z = (|X - \mu| / \sigma)$
where :

z is z-score ;
X is the laboratory average ;
μ is the average of population ;
σ is the standard deviation of the population.

Determination of air void contents from the geometric bulk density (ρ_{bdim}) (*)

(*) according to the standard NF EN 12697-6 – procedure D

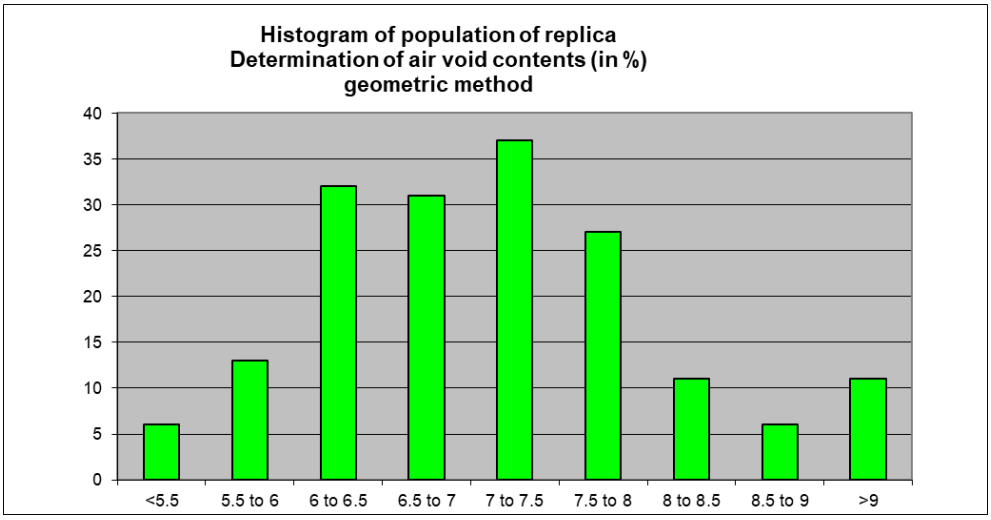
Determination of the void air contents

Target value: between 5 and 8%

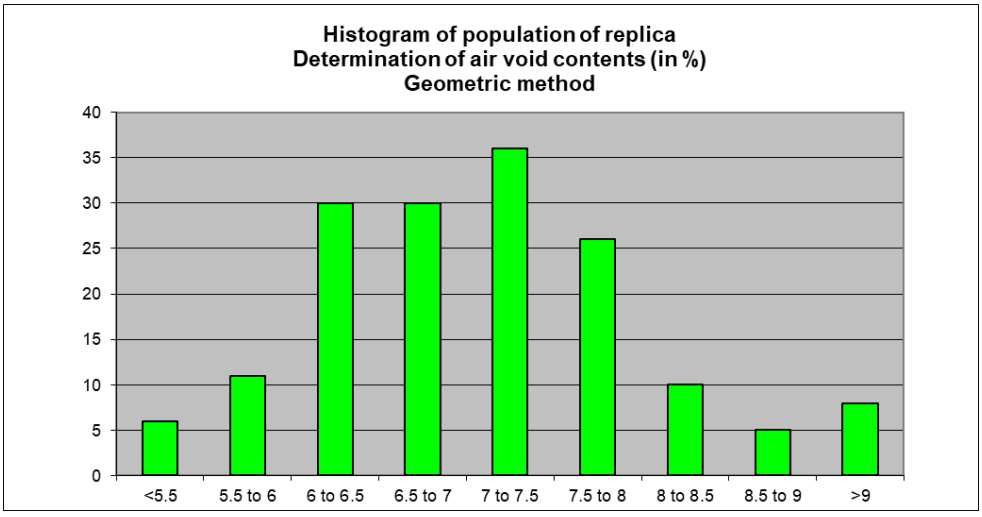
Graphical representations

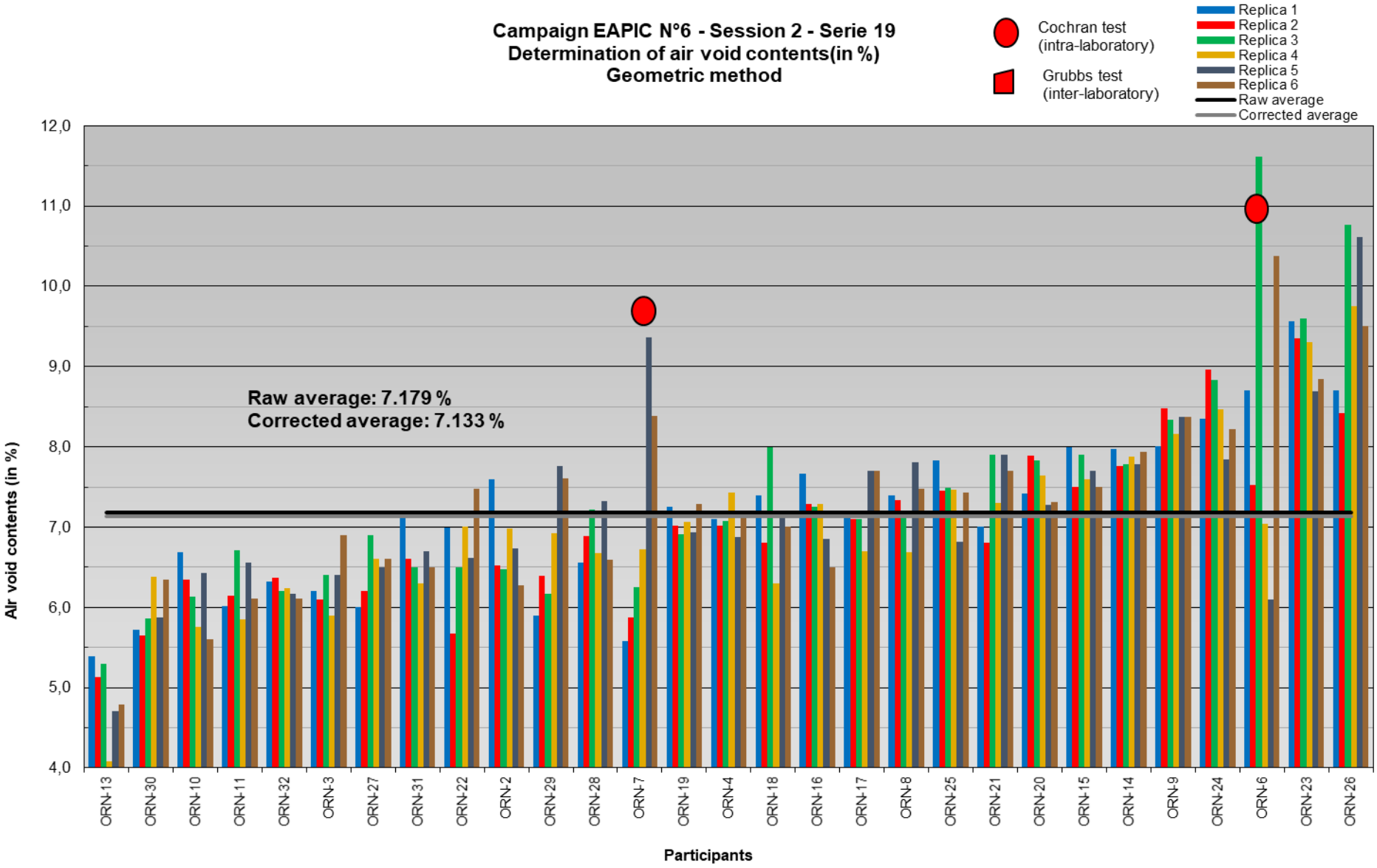
		Raw data	Results rejected by statistical tests	Corrected data	Standard (NF EN 12697-6, according to procedure B)
In %	Number of results taken in account	29	Cochran : ORN-6 ORN-7	27	
	Average m	7.179		7.133	
	Standard deviation repeatability	0.630		0.422	
	repeatability r	1.764		1.181	r = 1.1
	Standard deviation Reproducibility	1.148		1.065	
	Reproducibility R	3.214		2.983	R = 2.2

Raw data



Corrected data




Campaign EAPIC N°6 - Session 2 - Serie 19
Determination of air void contents(in %)
Geometric method
Cochran test
(intra-laboratory)
Grubbs test
(inter-laboratory)
Replica 1
Replica 2
Replica 3
Replica 4
Replica 5
Replica 6
Raw average
Corrected average
Raw average: 7.179 %
Corrected average: 7.133 %
Air void contents (in %)
12,0
11,0
10,0
9,0
8,0
7,0
6,0
5,0
4,0
ORN-13
ORN-30
ORN-10
ORN-11
ORN-32
ORN-3
ORN-27
ORN-31
ORN-22
ORN-2
ORN-29
ORN-28
ORN-7
ORN-19
ORN-4
ORN-18
ORN-16
ORN-17
ORN-8
ORN-25
ORN-21
ORN-20
ORN-15
ORN-14
ORN-9
ORN-24
ORN-6
ORN-23
ORN-26
Participants

Average difference and Z-score value on raw data

Difference less than 1 standard deviation

Code results	Average deviation	Z-Score
ORN-16	0.04	0.03
ORN-18	0.06	0.05
ORN-4	0.07	0.06
ORN-17	0.07	0.06
ORN-19	0.10	0.09
ORN-8	0.13	0.12
ORN-7	0.15	0.13
ORN-25	0.23	0.20
ORN-21	0.25	0.22
ORN-28	0.31	0.27
ORN-20	0.38	0.33
ORN-29	0.39	0.34
ORN-2	0.41	0.36
ORN-22	0.47	0.41
ORN-15	0.52	0.45
ORN-31	0.55	0.48
ORN-14	0.67	0.59
ORN-27	0.71	0.62
ORN-3	0.86	0.75
ORN-32	0.94	0.82
ORN-11	0.95	0.82
ORN-10	1.02	0.89
ORN-9	1.11	0.97

Difference more than 1 standard deviation

Code results	Average deviation	Z-Score
ORN-30	1.21	1.05
ORN-24	1.26	1.10
ORN-6	1.38	1.20
ORN-23	2.05	1.78
ORN-13	2.28	1.99

Difference more than 2 standard deviation

Code results	Average deviation	Z-Score
ORN-26	2.45	2.13

Determination of mean rut depth, on large-size devices (*)

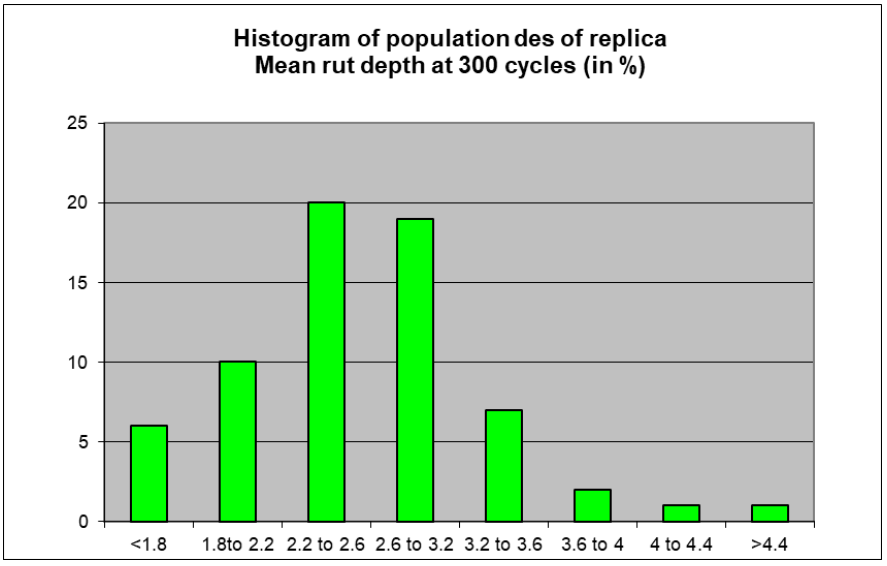
(*) according to standard NF EN 12697-22 of February 2020

Mean rut depth at 300 cycles

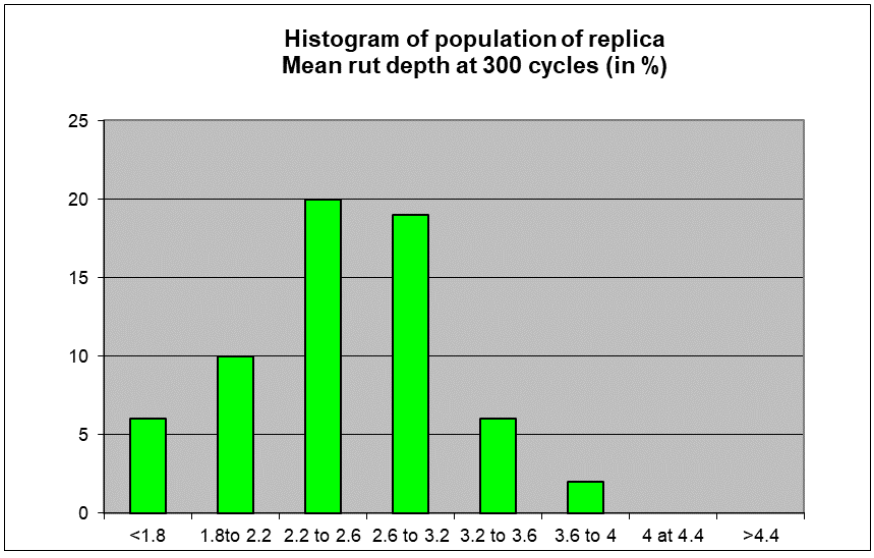
Graphical representations

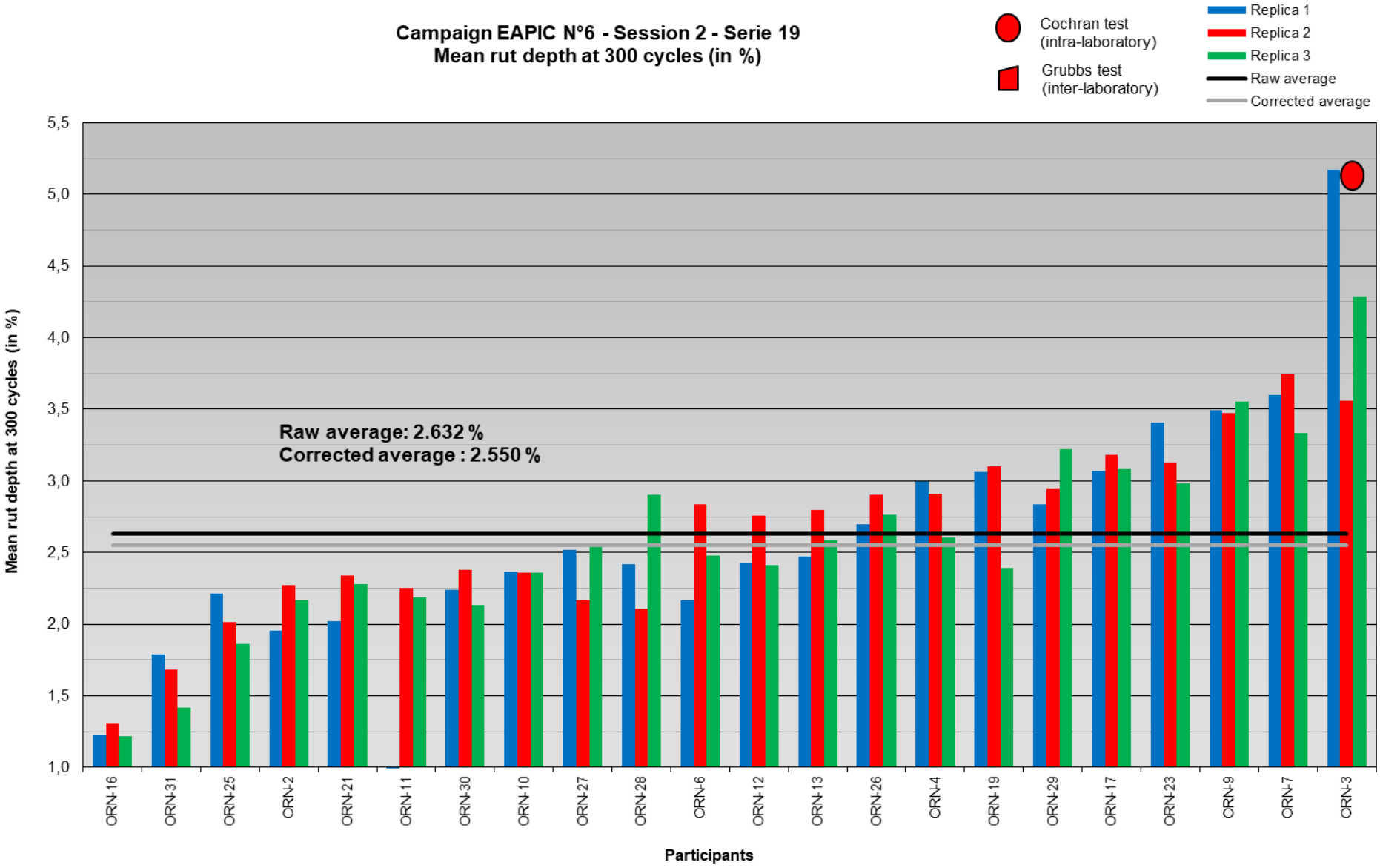
		Raw data	Results rejected by statistical tests	Corrected data
In %	Number of results taken in account	22	Cochran : ORN-3	21
	Average m	2.632		2.550
	Standard deviation repeatability	0.263		0.203
	Repetability r	0.736		0.569
	Standard deviation Reproducibility	0.706		0.591
	Reproducibility R	1.976		1.654

Raw data



Corrected data




Campaign EAPIC N°6 - Session 2 - Serie 19
Mean rut depth at 300 cycles (in %)
Cochran test (intra-laboratory)
Grubbs test (inter-laboratory)
Replica 1
Replica 2
Replica 3
Raw average
Corrected average
Raw average: 2.632 %
Corrected average : 2.550 %
Mean rut depth at 300 cycles (in %)
5,5
5,0
4,5
4,0
3,5
3,0
2,5
2,0
1,5
1,0
ORN-16
ORN-31
ORN-25
ORN-2
ORN-21
ORN-11
ORN-30
ORN-10
ORN-27
ORN-28
ORN-6
ORN-12
ORN-13
ORN-26
ORN-4
ORN-19
ORN-29
ORN-17
ORN-23
ORN-9
ORN-7
ORN-3
Participants

Average difference and Z-score value on raw data

Difference less than 1 standard deviation

Code results	Average deviation	Z-Score
ORN-13	0.01	0.02
ORN-12	0.10	0.14
ORN-6	0.14	0.19
ORN-26	0.15	0.22
ORN-28	0.16	0.22
ORN-4	0.20	0.29
ORN-19	0.22	0.31
ORN-27	0.22	0.32
ORN-10	0.27	0.38
ORN-29	0.37	0.52
ORN-30	0.38	0.54
ORN-11	0.41	0.58
ORN-21	0.42	0.59
ORN-17	0.48	0.67
ORN-2	0.50	0.71
ORN-23	0.54	0.76
ORN-25	0.60	0.85

Difference more than 1 standard deviation

Code results	Average deviation	Z-Score
ORN-9	0.87	1.23
ORN-7	0.93	1.31
ORN-31	1.00	1.41
ORN-16	1.38	1.95

Difference more than 2 standard deviation

Code results	Average deviation	Z-Score
ORN-3	1,70	2.40

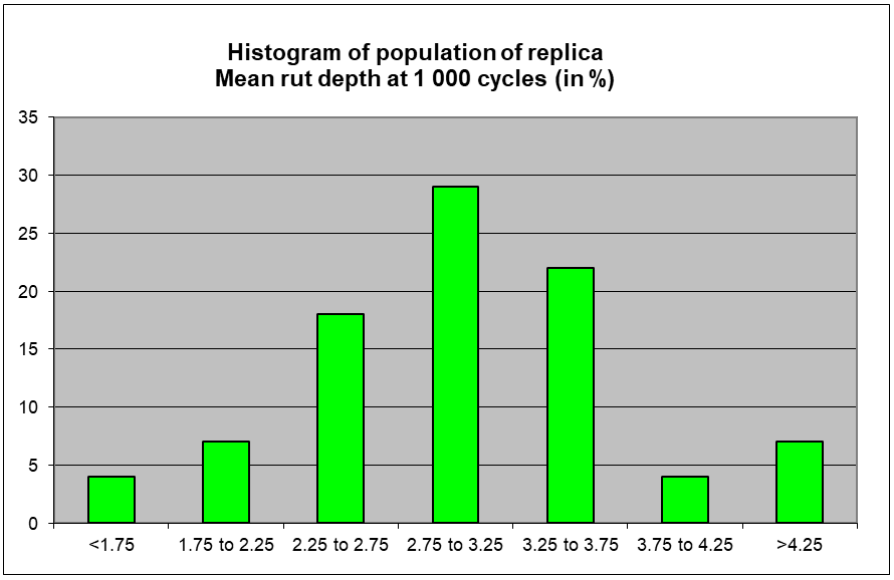
Mean rut depth at 1 000 cycles

Graphical representations

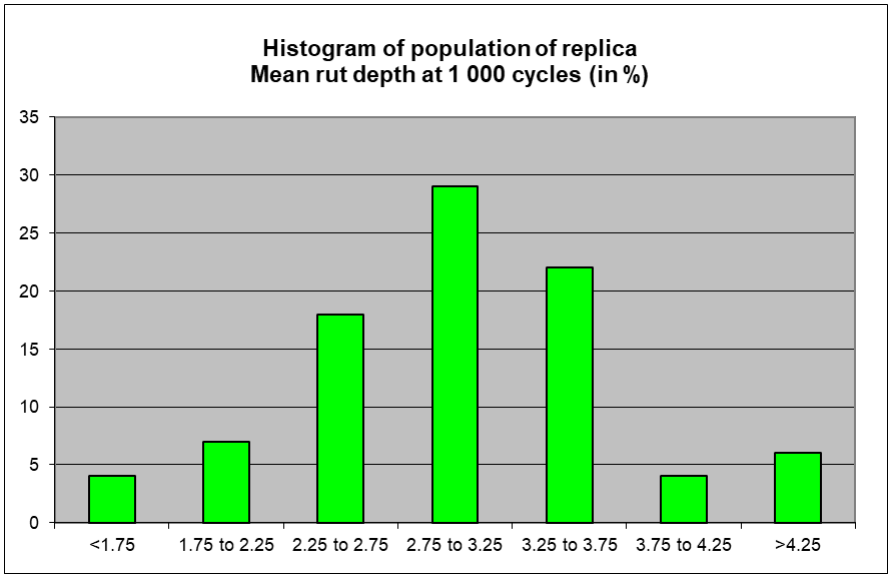
		Raw data	Results rejected by statistical tests	Corrected data	standard NF EN 12697-22 (*)
In %	Number of results taken in account	31	Cochran : ORN-3	30	
	Average m	3.090		3.017	
	Standard deviation repeatability	0.309		0.258	
	Repeatability r	0.864		0.721	r = 1.05
	Standard deviation Reproducibility	0.803		0.689	
	Reproducibility R	2.248		1.930	R = 1.32

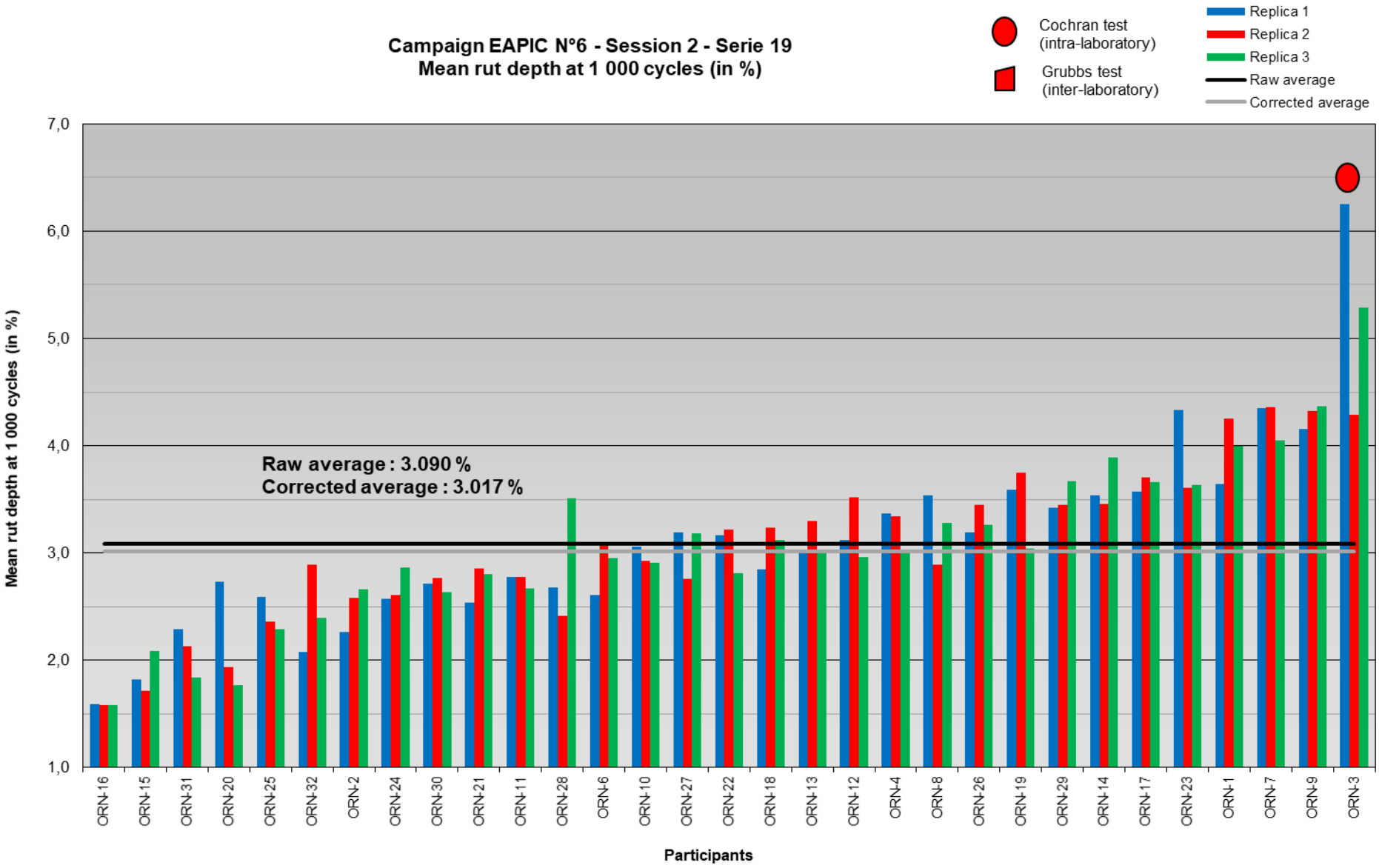
(*) Precision value obtained on test specimen provided by the organizing laboratory

Raw data



Corrected data




Campaign EAPIC N°6 - Session 2 - Serie 19
Mean rut depth at 1 000 cycles (in %)
Cochran test
(intra-laboratory)
Grubbs test
(inter-laboratory)
Replica 1
Replica 2
Replica 3
Raw average
Corrected average
Raw average : 3.090 %
Corrected average : 3.017 %
Mean rut depth at 1 000 cycles (in %)
7,0
6,0
5,0
4,0
3,0
2,0
1,0
ORN-16
ORN-15
ORN-31
ORN-20
ORN-25
ORN-32
ORN-2
ORN-24
ORN-30
ORN-21
ORN-11
ORN-28
ORN-6
ORN-10
ORN-27
ORN-22
ORN-18
ORN-13
ORN-12
ORN-4
ORN-8
ORN-26
ORN-19
ORN-29
ORN-14
ORN-17
ORN-23
ORN-1
ORN-7
ORN-9
ORN-3
Participants

Average difference and Z-score value on raw data

Difference less than 1 standard deviation

Code results	Average deviation	Z-Score
ORN-18	0.02	0.03
ORN-22	0.03	0.03
ORN-13	0.03	0.03
ORN-27	0.05	0.06
ORN-12	0.11	0.14
ORN-10	0.13	0.16
ORN-4	0.15	0.18
ORN-8	0.15	0.18
ORN-6	0.21	0.26
ORN-26	0.21	0.26
ORN-28	0.22	0.28
ORN-11	0.35	0.43
ORN-21	0.36	0.44
ORN-19	0.37	0.46
ORN-30	0.39	0.48
ORN-24	0.41	0.51
ORN-29	0.42	0.53
ORN-14	0.54	0.67
ORN-17	0.55	0.69
ORN-2	0.59	0.73
ORN-32	0.64	0.79
ORN-25	0.68	0.84
ORN-23	0.77	0.95

Difference more than 1 standard deviations

Code results	Average deviation	Z-Score
ORN-1	0.87	1.09
ORN-20	0.94	1.18
ORN-31	1.00	1.25
ORN-7	1.17	1.45
ORN-9	1.19	1.49
ORN-15	1.21	1.51
ORN-16	1.50	1.87

Difference more than 2 standard deviations

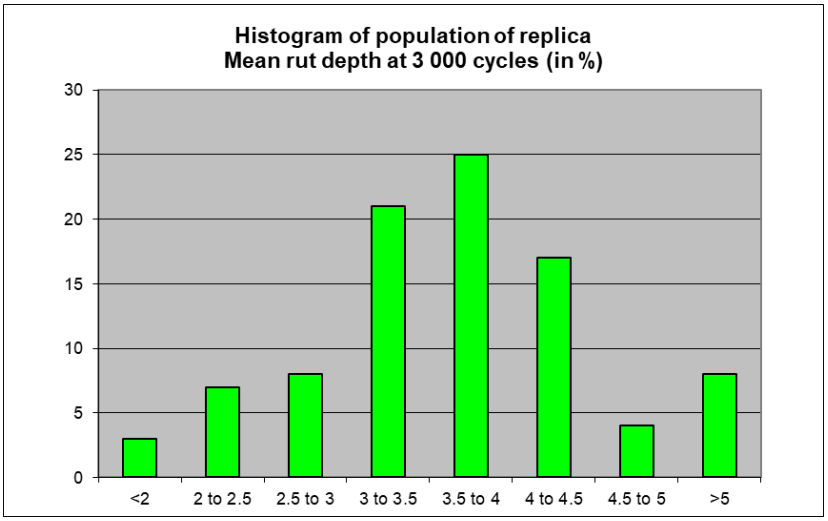
Code results	Average deviation	Z-Score
ORN-3	2.18	2.72

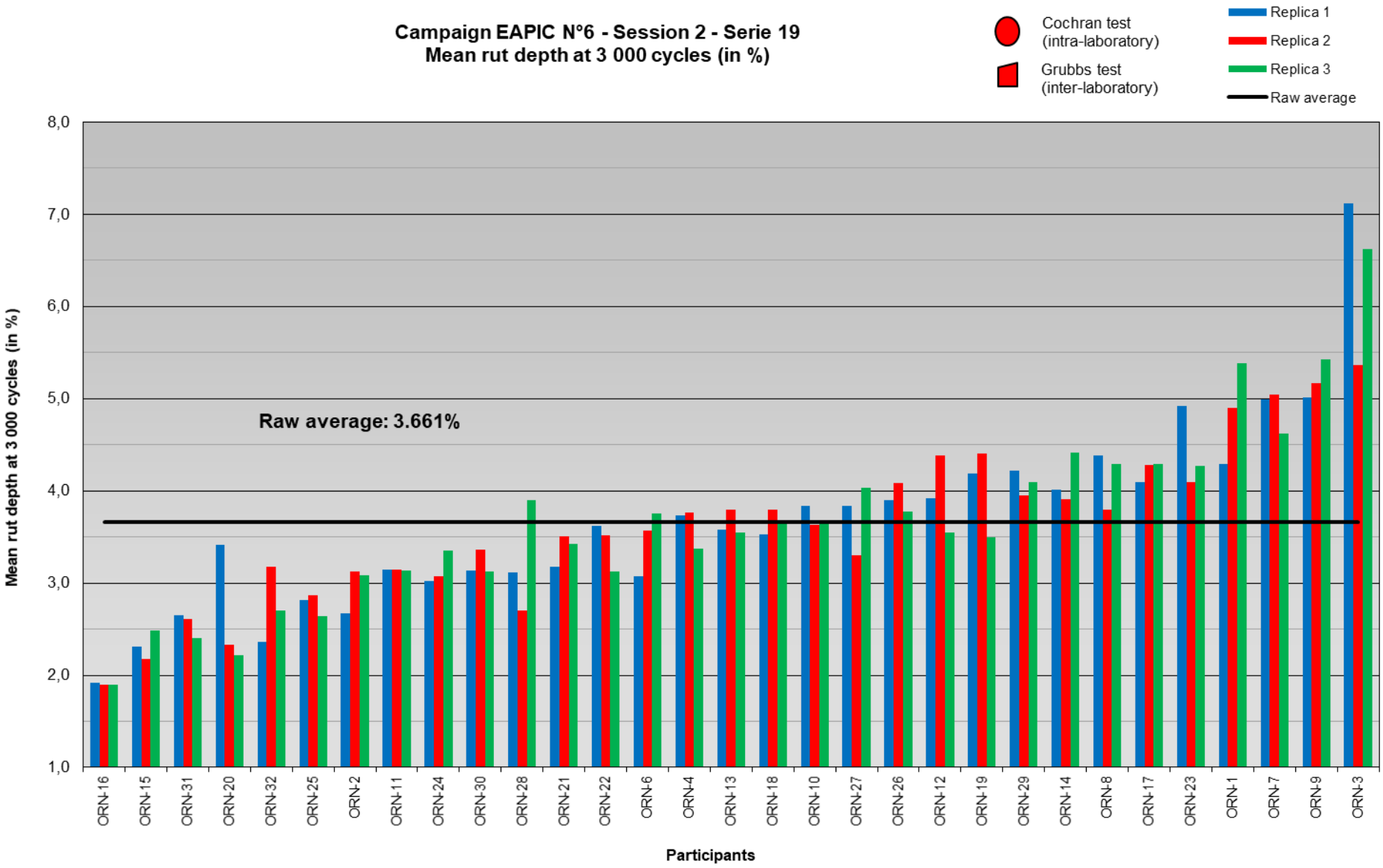
Mean rut depth at 3 000 cycles

Graphical Representations

		Raw data	Results rejected by statistical tests
	Number of results taken in account	31	No one
In %	Average m	3.661	
	Standard deviation repeatability	0.342	
	Repeatability r	0.959	
	Standard deviation Reproducibility	0.951	
	Reproducibility R	2.662	

Raw data




Campaign EAPIC N°6 - Session 2 - Serie 19
Mean rut depth at 3 000 cycles (in %)
Cochran test
(intra-laboratory)
Grubbs test
(inter-laboratory)
Replica 1
Replica 2
Replica 3
Raw average
Raw average: 3.661%
Mean rut depth at 3 000 cycles (in %)
8,0
7,0
6,0
5,0
4,0
3,0
2,0
1,0
ORN-16
ORN-15
ORN-31
ORN-20
ORN-32
ORN-25
ORN-2
ORN-11
ORN-24
ORN-30
ORN-28
ORN-21
ORN-22
ORN-6
ORN-4
ORN-13
ORN-18
ORN-10
ORN-27
ORN-26
ORN-12
ORN-19
ORN-29
ORN-14
ORN-8
ORN-17
ORN-23
ORN-1
ORN-7
ORN-9
ORN-3
Participants

Average difference and Z-score value on raw data

Difference less than 1 standard deviation

Code résults	Average deviation	Z-Score
ORN-18	0.01	0.01
ORN-13	0.02	0.02
ORN-4	0.04	0.04
ORN-10	0.05	0.06
ORN-27	0.06	0.06
ORN-6	0.20	0.21
ORN-22	0.24	0.25
ORN-26	0.26	0.28
ORN-12	0.29	0.30
ORN-21	0.29	0.31
ORN-19	0.37	0.39
ORN-28	0.42	0.45
ORN-29	0.43	0.45
ORN-14	0.45	0.47
ORN-30	0.45	0.48
ORN-8	0.49	0.52
ORN-24	0.51	0.54
ORN-11	0.52	0.54
ORN-17	0.56	0.59
ORN-2	0.70	0.74
ORN-23	0.77	0.81
ORN-25	0.89	0.93
ORN-32	0.91	0.96

Difference more 1 standard deviations

Code résults	Average deviation	Z-Score
ORN-20	1.01	1.06
ORN-31	1.11	1.16
ORN-1	1.20	1.26
ORN-7	1.22	1.29
ORN-15	1.34	1.40
ORN-9	1.54	1.62
ORN-16	1.76	1.85

Difference more than 2 standard deviations

Code résults	Average deviation	Z-Score
ORN-3	2,71	2.85

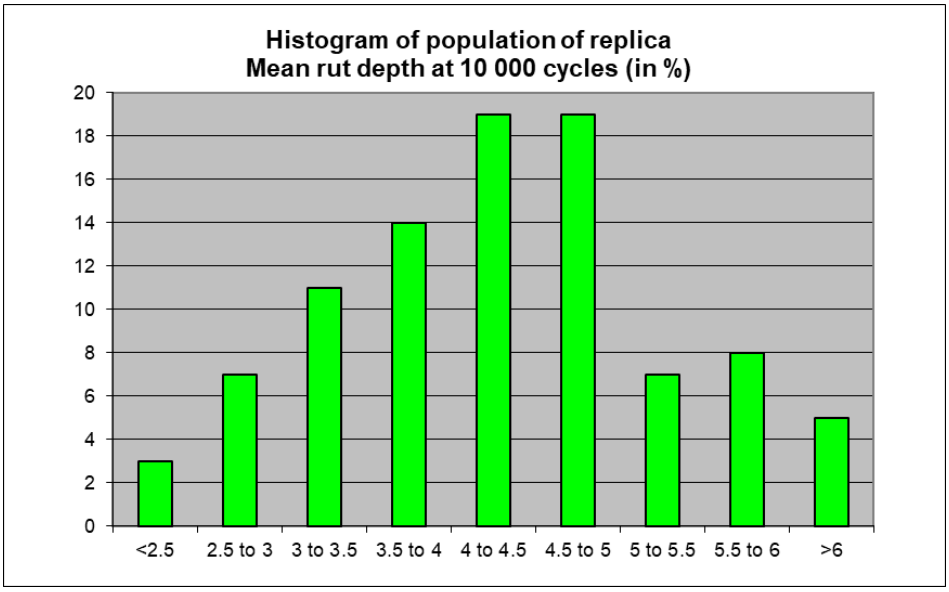
Mean rut depth at 10 000 cycles

Graphicals representations

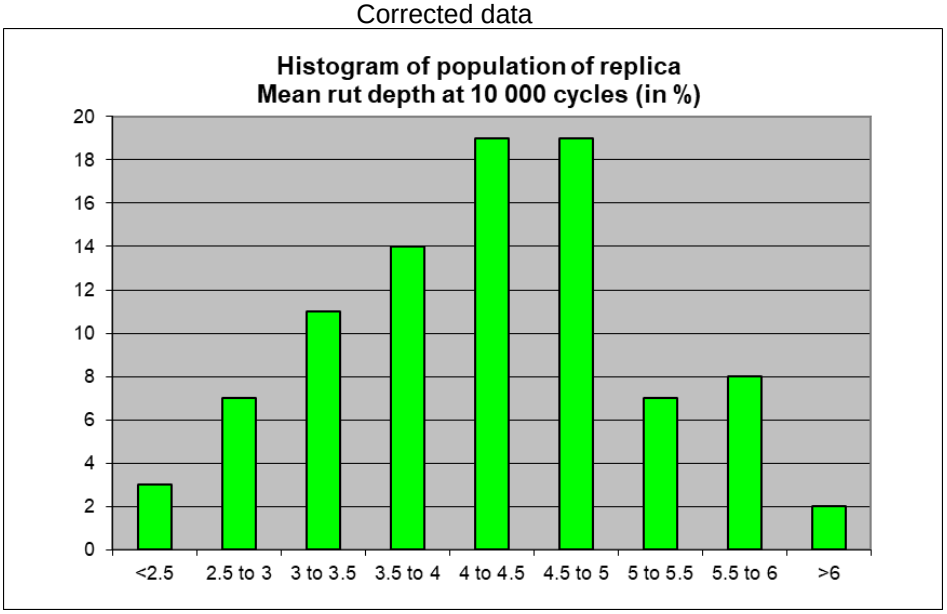
		Raw date	Results rejected by statistical tests	Corrected data	Standard NF EN12697-22 (*)	Previous experiences EAPIC 6.1.9 (Corrected data)
	Number of results taken in account	31	Grubbs : ORN-3	30		32
In %	Average m	4,.86		4.221		
	Standard deviation repeatability	0.374		0.354		
	repeatability r	1.047		0.990	r = 1.08	r = 1.48
	Standard deviation Reproducibility	1.312		0.946		
	Reproducibility R	3.673		2.650	R = 1.20	R = 3.72

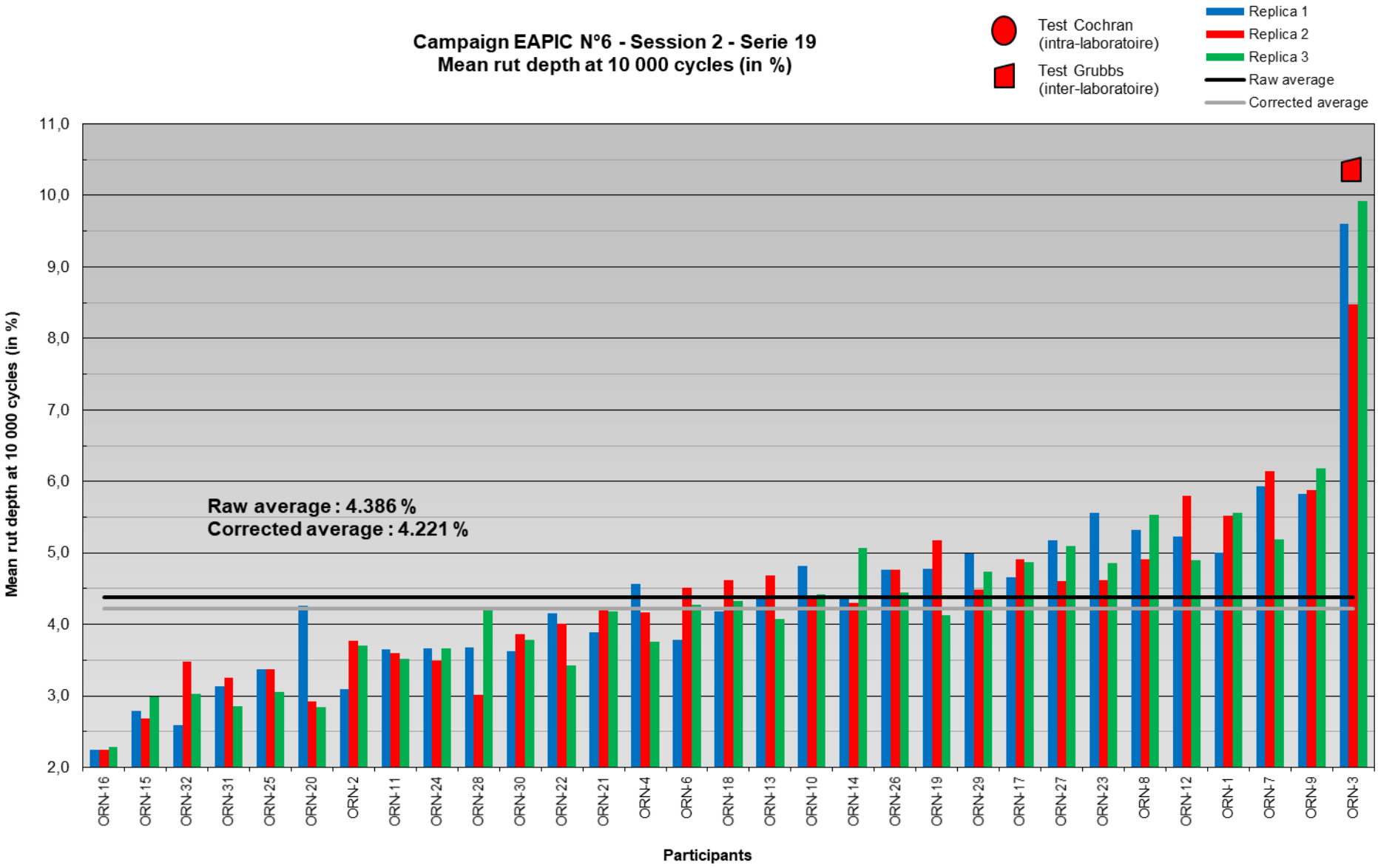
(*) Precision value obtained on test specimen provided by the organizing laboratory

Raw data



Corrected data




Campaign EAPIC N°6 - Session 2 - Serie 19
Mean rut depth at 10 000 cycles (in %)
Test Cochran (intra-laboratoire)
Test Grubbs (inter-laboratoire)
Replica 1
Replica 2
Replica 3
Raw average
Corrected average
Raw average : 4.386 %
Corrected average : 4.221 %
Mean rut depth at 10 000 cycles (in %)
11,0
10,0
9,0
8,0
7,0
6,0
5,0
4,0
3,0
2,0
ORN-16
ORN-15
ORN-32
ORN-31
ORN-25
ORN-20
ORN-2
ORN-11
ORN-24
ORN-28
ORN-30
ORN-22
ORN-21
ORN-4
ORN-6
ORN-18
ORN-13
ORN-10
ORN-14
ORN-26
ORN-19
ORN-29
ORN-17
ORN-27
ORN-23
ORN-8
ORN-12
ORN-1
ORN-7
ORN-9
ORN-3
Participants

Average difference and Z-score value on raw data

Difference less than 1 standard deviation

Code results	Average deviation	Z-Score
ORN-13	0.00	0.00
ORN-18	0.01	0.01
ORN-10	0.16	0.12
ORN-6	0.19	0.15
ORN-14	0.20	0.16
ORN-4	0.22	0.17
ORN-26	0.27	0.21
ORN-21	0.29	0.22
ORN-19	0.31	0.23
ORN-29	0.35	0.26
ORN-17	0.43	0.33
ORN-22	0.52	0.40
ORN-27	0.57	0.44
ORN-23	0.63	0.48
ORN-30	0.63	0.48
ORN-28	0.74	0.56
ORN-24	0.78	0.59
ORN-11	0.80	0.61
ORN-8	0.87	0.66
ORN-2	0.87	0.66
ORN-12	0.92	0.70
ORN-1	0.97	0.74
ORN-20	1.04	0.79
ORN-25	1.12	0.85

Difference more than 1 standard deviation

Code results	Average deviation	Z-Score
ORN-31	1.31	1.00
ORN-32	1.36	1.03
ORN-7	1.37	1.04
ORN-15	1.56	1.19
ORN-9	1.57	1.20
ORN-16	2.12	1.62

Difference more than 2 standard deviation

Code results	Average deviation	Z-Score
ORN-3	4.95	3.77

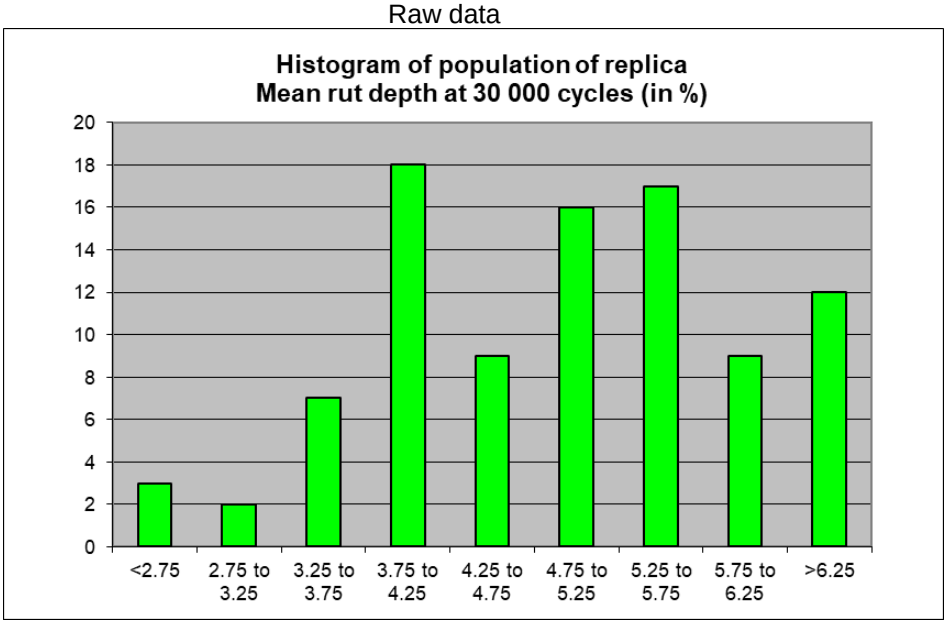
Mean rut depth at 30 000 cycles

Graphical representations

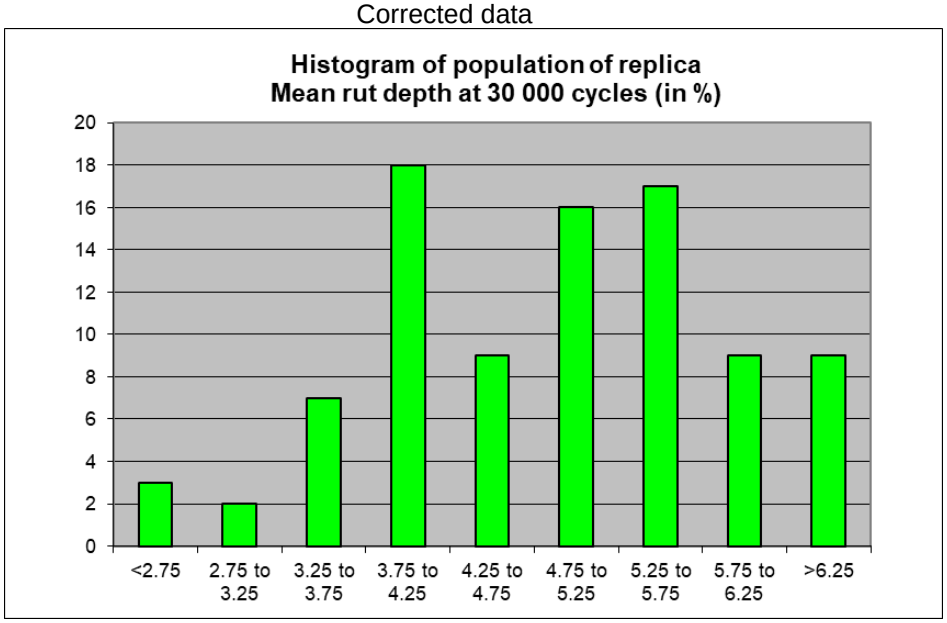
		Raw date	Results rejected by statistical tests	Corrected data	Standard NF EN 12697-22 (*)	Previous experiences EAPIC 6.1.9
	Number of results taken in account	31	Grubbs : ORN-3	30		33
In %	Average m	5.079		4.880		
	Standard deviation repeatability	0.390		0.395		
	repeatability r	1.092		1.106	r = 1.11	r = 1.64
	Standard deviation Reproducibility	1.565		1.127		
	Reproducibility R	4.381		3.155	R = 1.16	R = 4.59

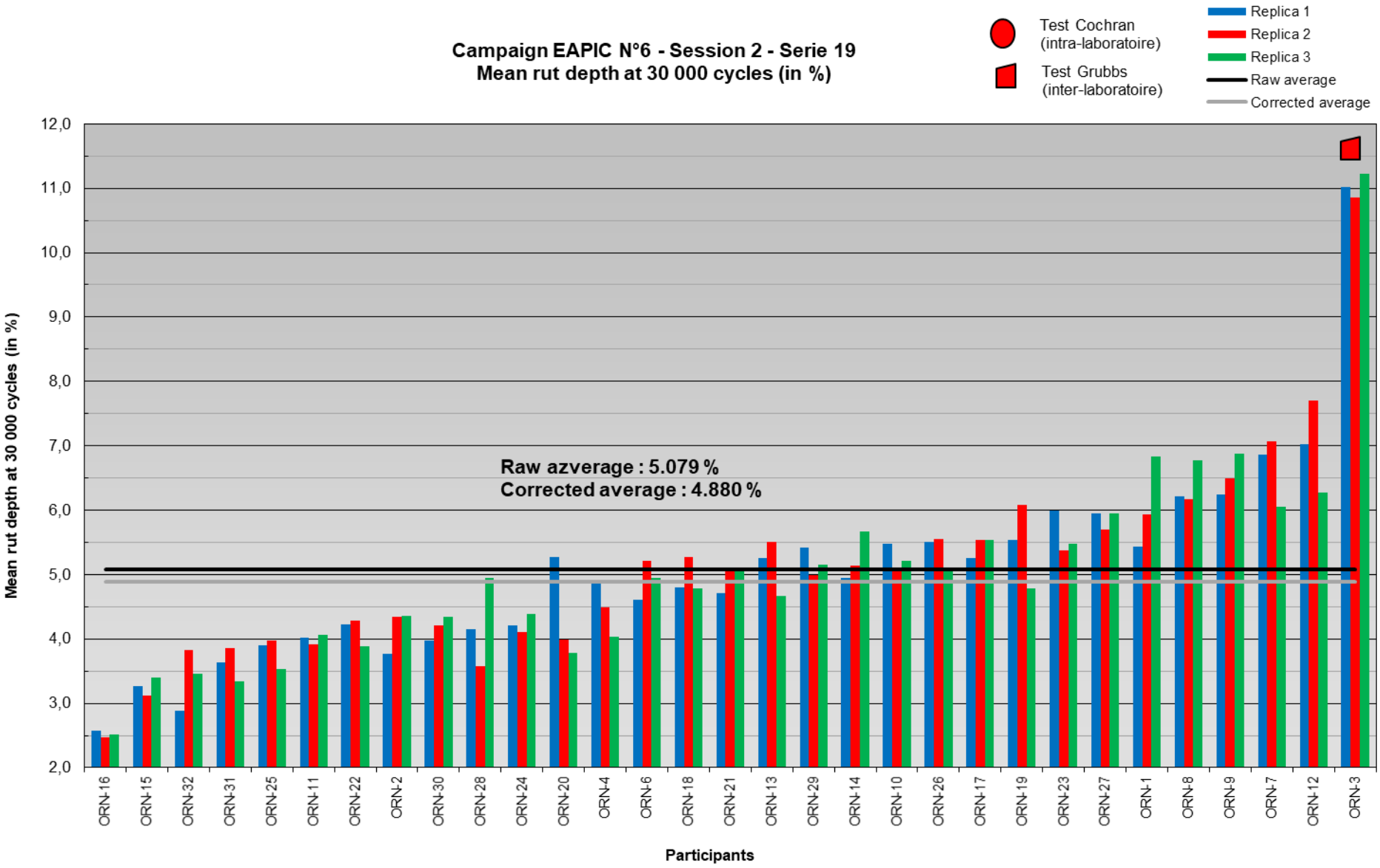
(*) Precision value obtained on test specimen provided by the organizing laboratory

Raw data



Corrected data




Campaign EAPIC N°6 - Session 2 - Serie 19
Mean rut depth at 30 000 cycles (in %)
Test Cochran (intra-laboratoire)
Test Grubbs (inter-laboratoire)
Replica 1
Replica 2
Replica 3
Raw average
Corrected average
Raw azverage : 5.079 %
Corrected average : 4.880 %
Mean rut depth at 30 000 cycles (in %)
12,0
11,0
10,0
9,0
8,0
7,0
6,0
5,0
4,0
3,0
2,0
ORN-16
ORN-15
ORN-32
ORN-31
ORN-25
ORN-11
ORN-22
ORN-2
ORN-30
ORN-28
ORN-24
ORN-20
ORN-4
ORN-6
ORN-18
ORN-21
ORN-13
ORN-29
ORN-14
ORN-10
ORN-26
ORN-17
ORN-19
ORN-23
ORN-27
ORN-1
ORN-8
ORN-9
ORN-7
ORN-12
ORN-3
Participants

Average difference and Z-score value on raw data

Difference less than 1 standard deviation

Code results	Average deviation	Z-Score
ORN-13	0.07	0.04
ORN-29	0.11	0.07
ORN-21	0.12	0.08
ORN-18	0.13	0.08
ORN-6	0.15	0.10
ORN-14	0.17	0.11
ORN-10	0.19	0.12
ORN-26	0.29	0.18
ORN-17	0.36	0.23
ORN-19	0.39	0.25
ORN-23	0.54	0.34
ORN-4	0.61	0.39
ORN-20	0.73	0.47
ORN-27	0.79	0.50
ORN-24	0.85	0.54
ORN-28	0.85	0.54
ORN-30	0.90	0.58
ORN-2	0.92	0.59
ORN-22	0.95	0.60
ORN-1	0.99	0.63
ORN-11	1.08	0.69
ORN-25	1.28	0.82
ORN-8	1.30	0.83
ORN-9	1.46	0.93
ORN-31	147	0.94

Difference more than 1 standard deviation

Code results	Average deviation	Z-Score
ORN-7	1.58	1.01
ORN-32	1.69	1.08
ORN-15	1.82	1.16
ORN-12	1.92	1.23
ORN-16	2.55	1.63

Difference more than 2 standard deviation

Code results	Average deviation	Z-Score
ORN-3	5.95	3,.0

Organisation of EAPIC

The Specialised Group « Inter Comparison Aptitude Tests (EAPIC) » is placed under the aegis of the Operational Committee for Qualification and inter-laboratory Comparison (COQC) of the Institute of Roads, Streets and Infrastructures for Mobility (IDRRIM) chaired by Eric OLLINGER (assistant: Anaïs FERMINE).

The ***Specialised Group*** relies on the ***Executive Cell*** to organise the test campaign. The logistic for the preparation of samples is provided by the ***Support Laboratories.***

EAPIC Specialised Group

General Secretary: Michel SAUBOT & Frédéric DELFOSSE

Members:

BADROUILLET Christophe
DANIEL Vincent
DUPRIET Stéphane
DELFOSSE Frédéric
ESPIEUX Baudouin
PIOT Géraldine
PRIEZ Christophe
SOME Cyril

EAPIC Executive Cell

Cerema IDF- Sourdun site: PIOT Géraldine & SOME Ciryle

EAPIC Support Laboratories

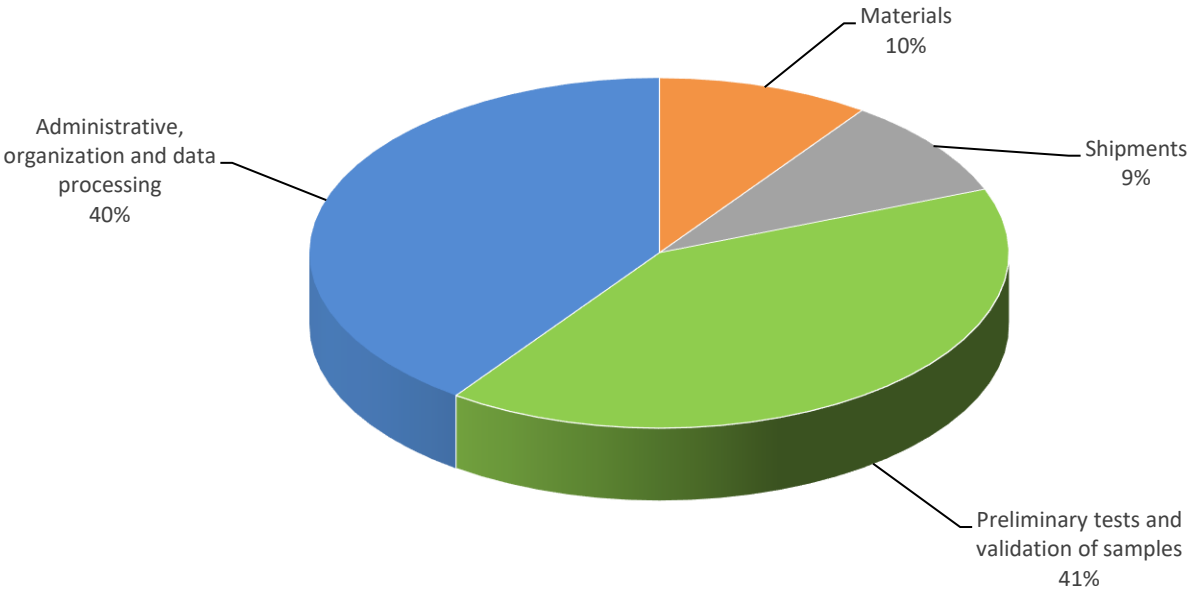
Cerema West Department Laboratory of Angers: DANIEL Vincent

Cerema East Central Department Laboratory of Autun: BADROUILLET Christophe & ESPIEUX Baudouin

Appendix

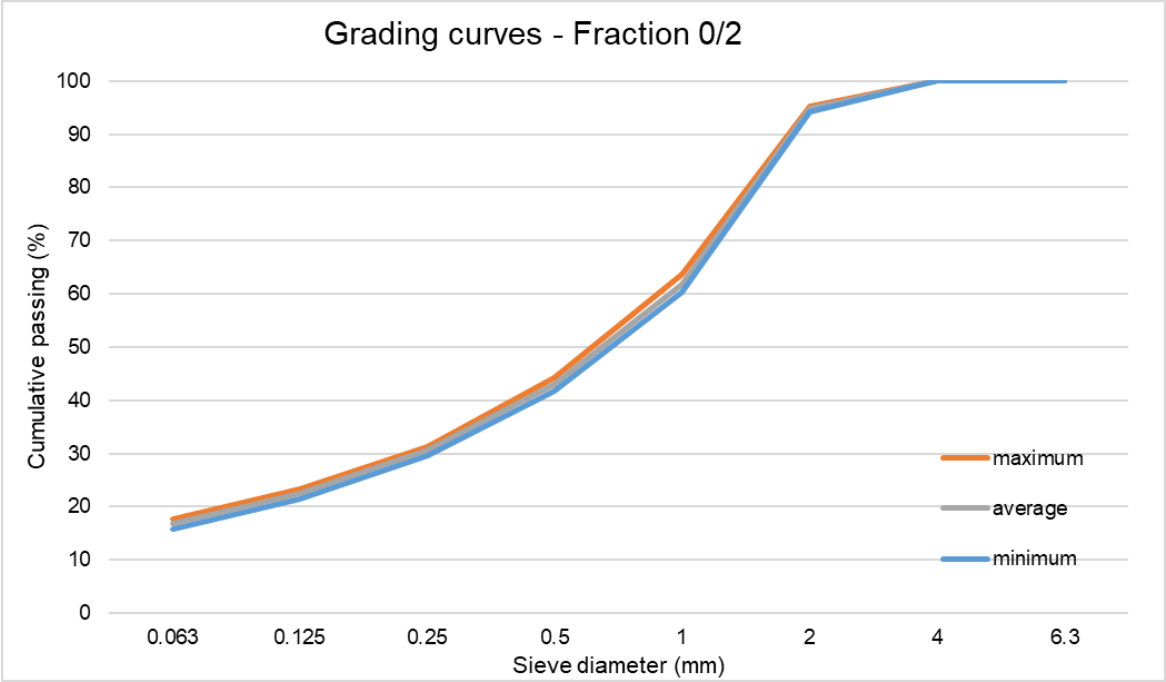
- Financial balance sheet
- Grading curves of aggregates
- Determination of air void contents by gamma rays
- Average change of mean rut depth per laboratory
- Results at 30 000 cycles with geometric air void contents between 5 and 8%
- Value of the RAP binder contents
- Mandel h and k tests

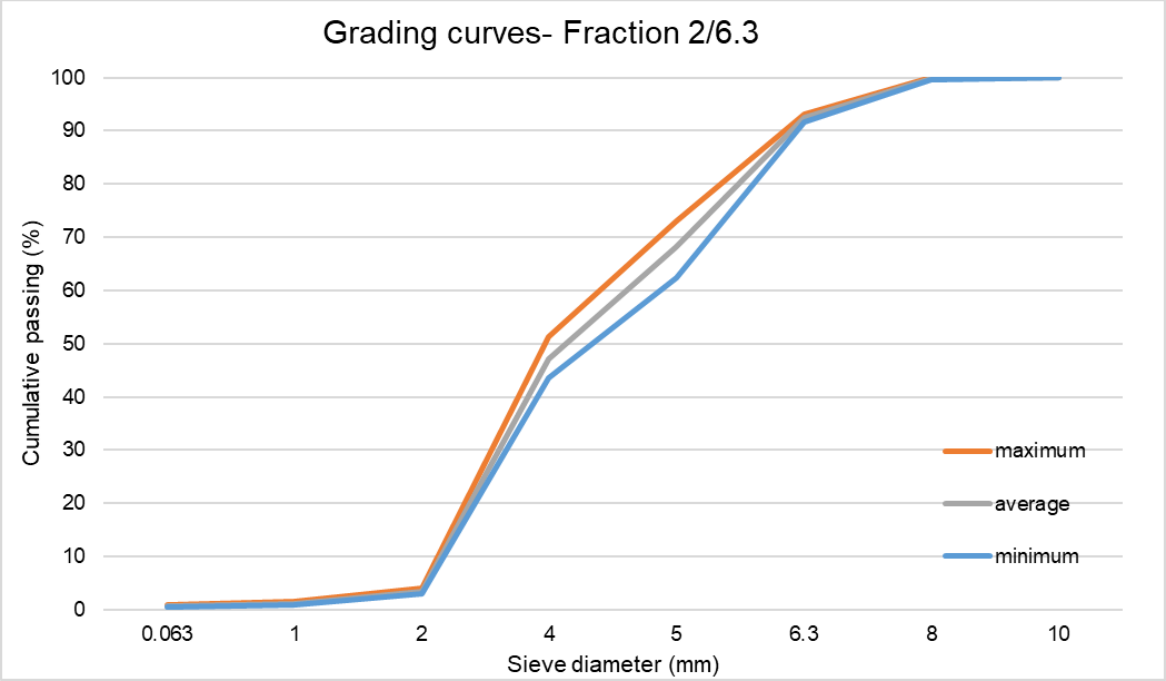
Financial balance sheet

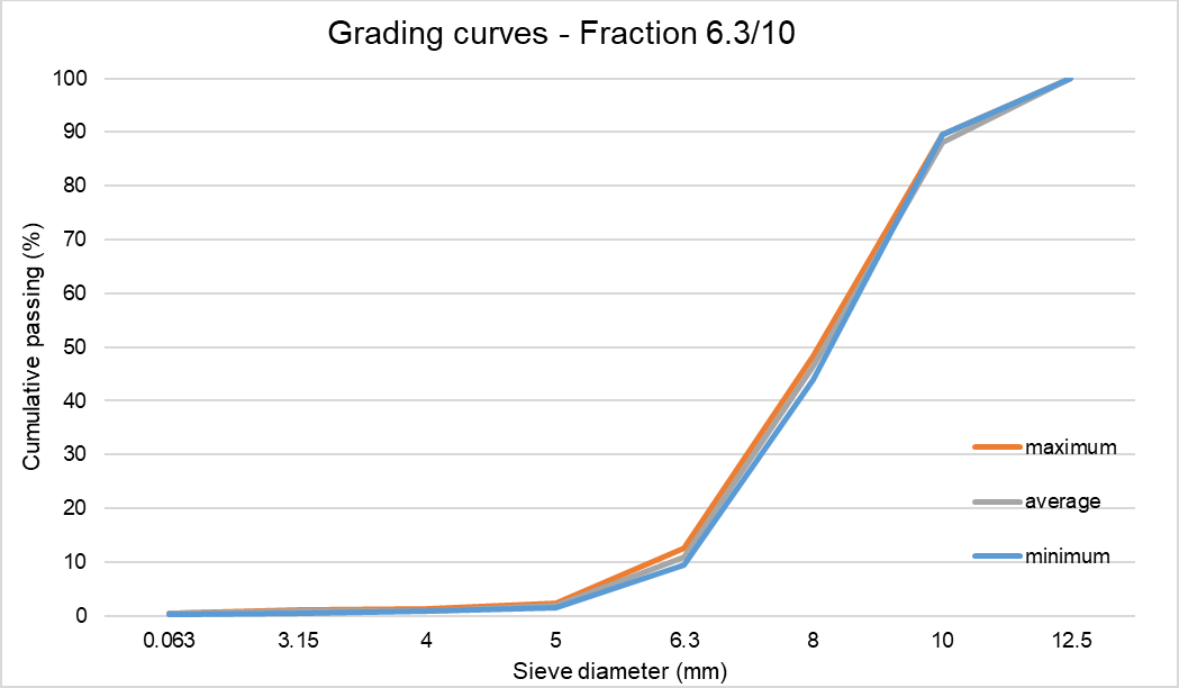


Grading curves of aggregates

Grading curves are carried out on fractions 0/2, 2/6.3 and 6.3/10, according to standard NF EN 933-1.
10 bags were randomly selected from the stock. On each bag, 2 tests were carried out.





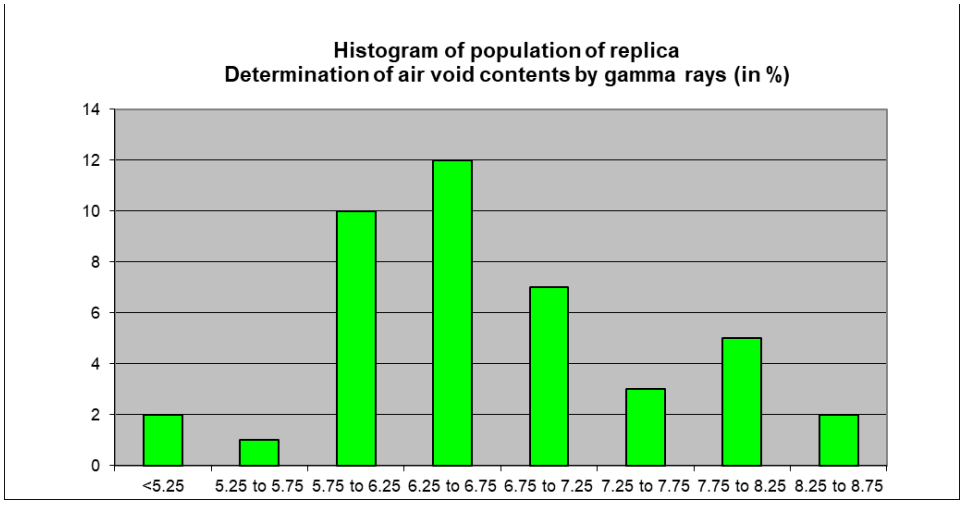

Grading curves - Fraction 6.3/10
Cumulative passing (%)
100
90
80
70
60
50
40
30
20
10
0
0.063
3.15
4
5
6.3
8
10
12.5
Sieve diameter (mm)
maximum
average
minimum

Determination of air void contents by gamma rays, according to NF EN 12697-7

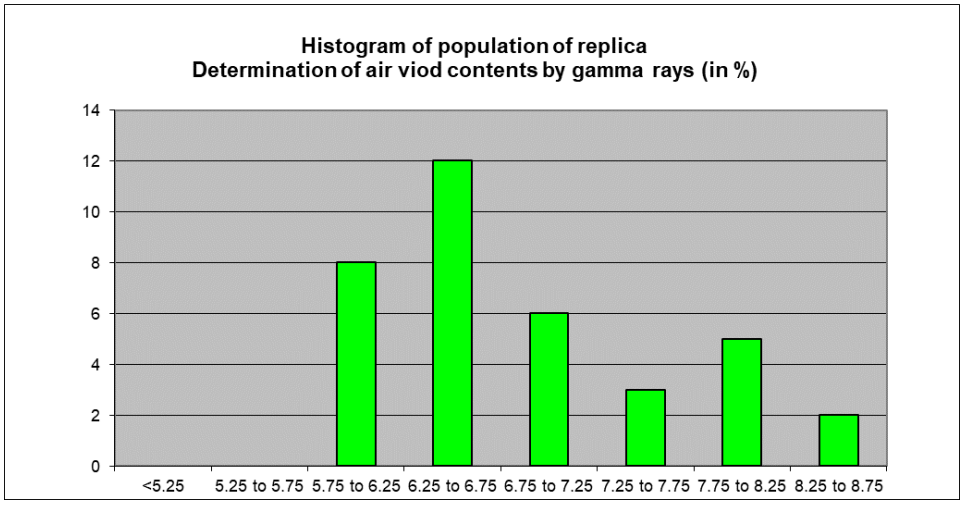
Graphical representations

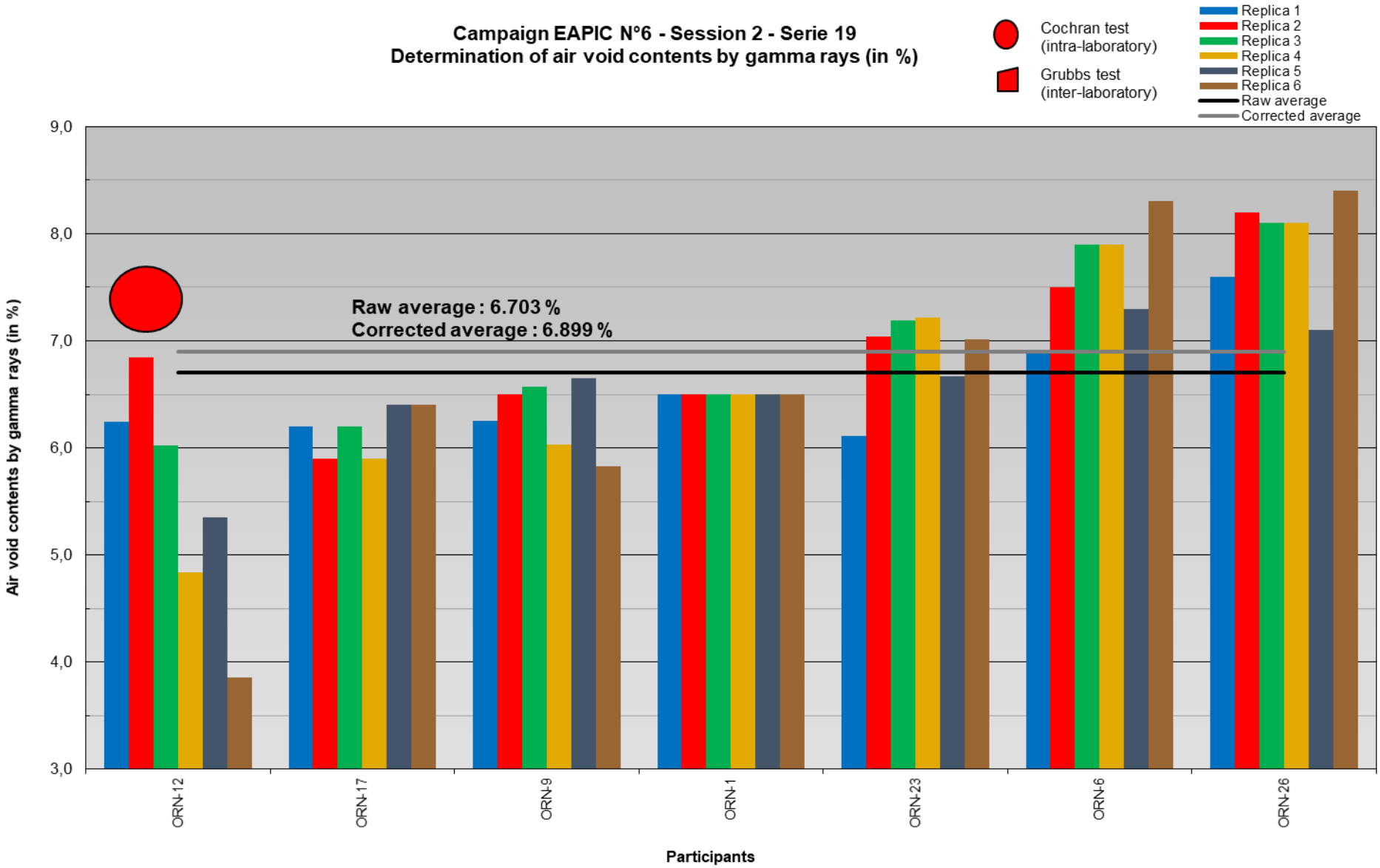
		Raw data	Results rejected by statistical tests	Corrected data
	Number of results taken in account	7	Cochran : ORN-12	6
In %	Average m	6.703		6.899
	Standard deviation repeatability	0.531		0.369
	repeatability r	1.486		1.032
	Standard deviation Reproducibility	0.970		0.799
	Reproducibility R	2.716		2.237

Raw data



Corrected data




Campaign EAPIC N°6 - Session 2 - Serie 19
Determination of air void contents by gamma rays (in %)
Cochran test
(intra-laboratory)
Grubbs test
(inter-laboratory)
Replica 1
Replica 2
Replica 3
Replica 4
Replica 5
Replica 6
Raw average
Corrected average
Raw average : 6.703 %
Corrected average : 6.899 %
Air void contents by gamma rays (in %)
9,0
8,0
7,0
6,0
5,0
4,0
3,0
ORN-12
ORN-17
ORN-9
ORN-1
ORN-23
ORN-6
ORN-26
Participants

Average difference and Z-score value on raw data

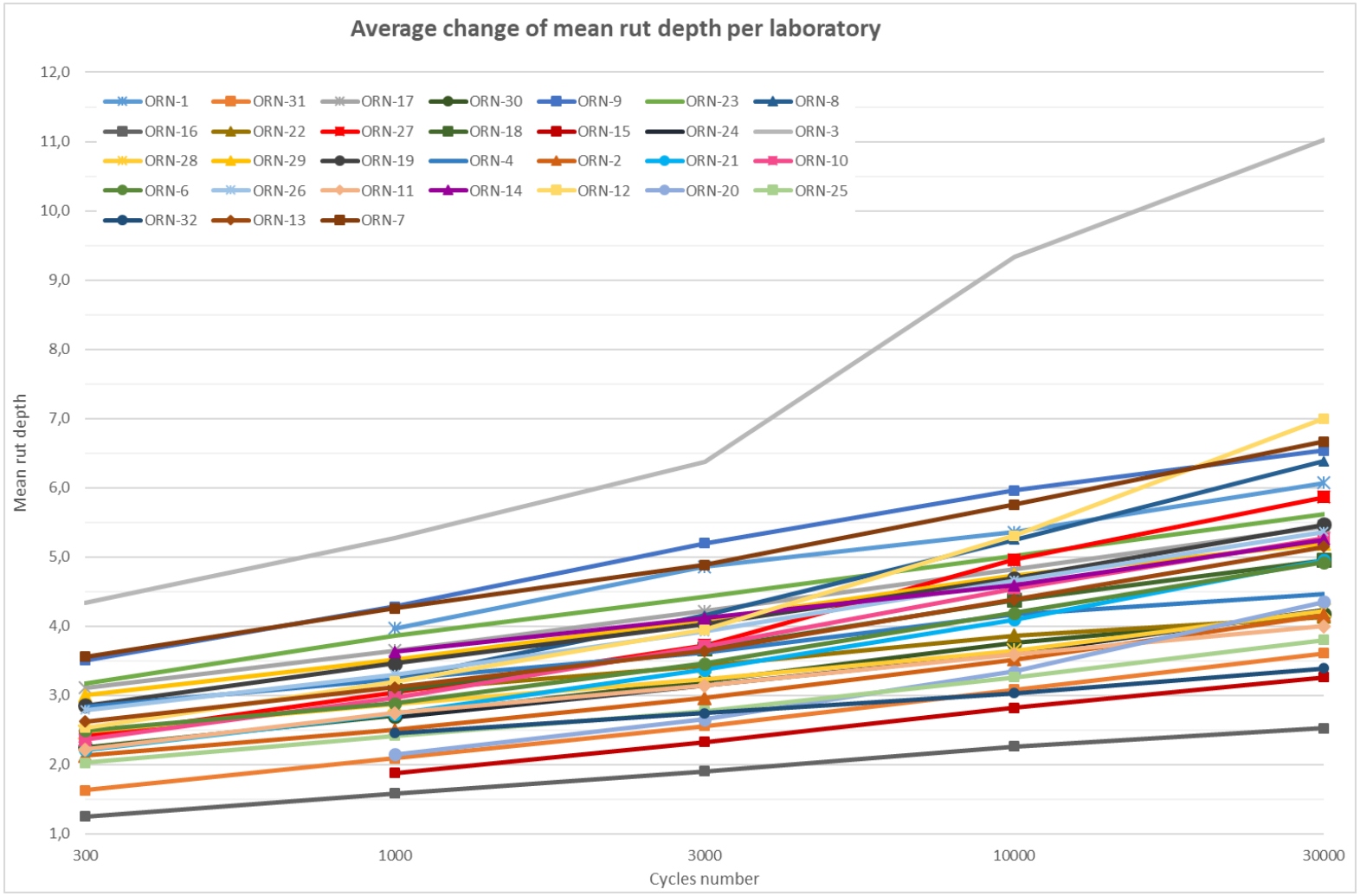
Difference less than 1 standard deviation

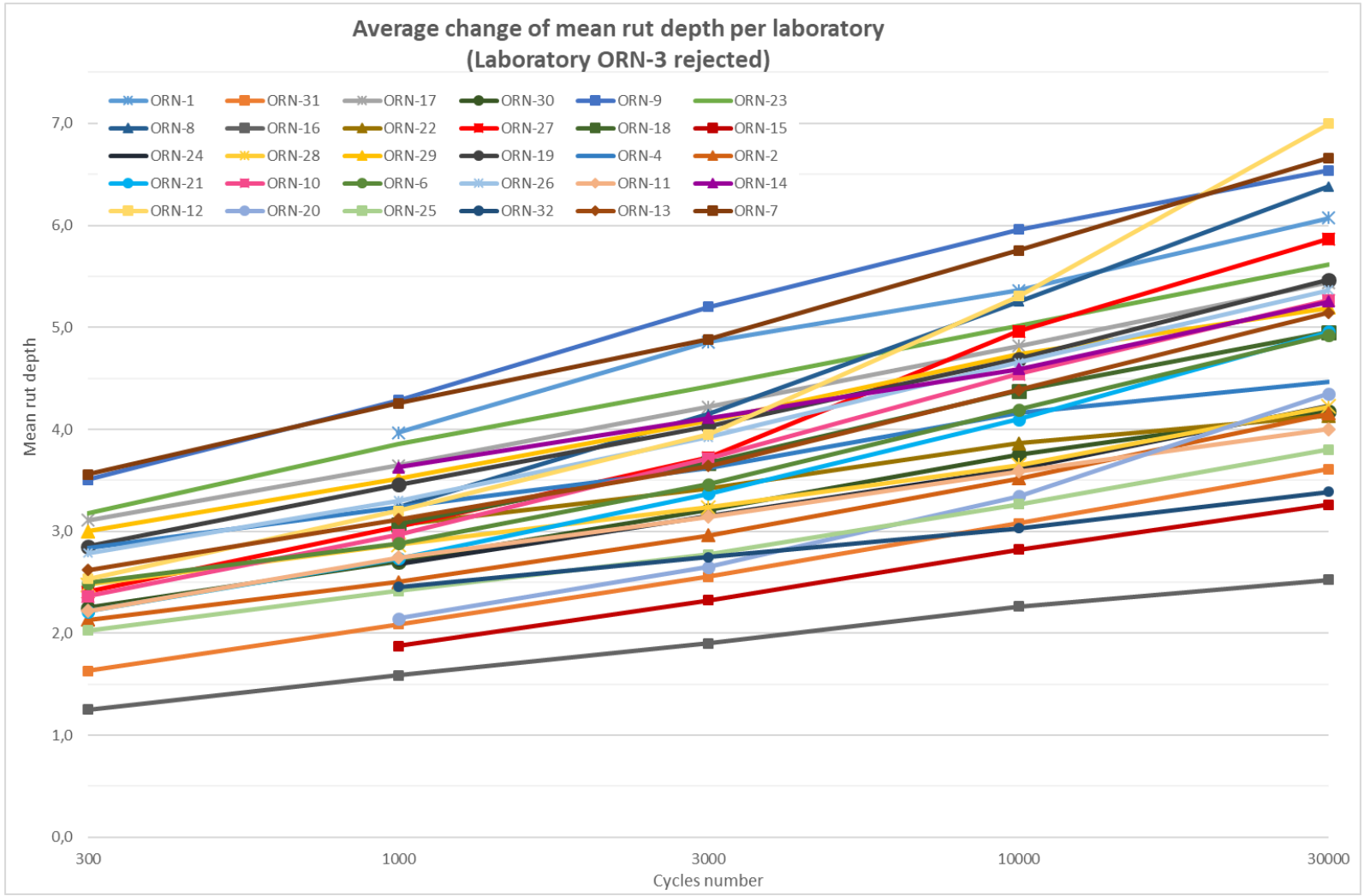
Code results	Average deviation	Z-Score
ORN-23	0.17	0.18
ORN-1	0.20	0.21
ORN-9	0.40	0.41
ORN-17	0.54	0.55
ORN-6	0.93	0.96

Difference more than 1 standard deviation

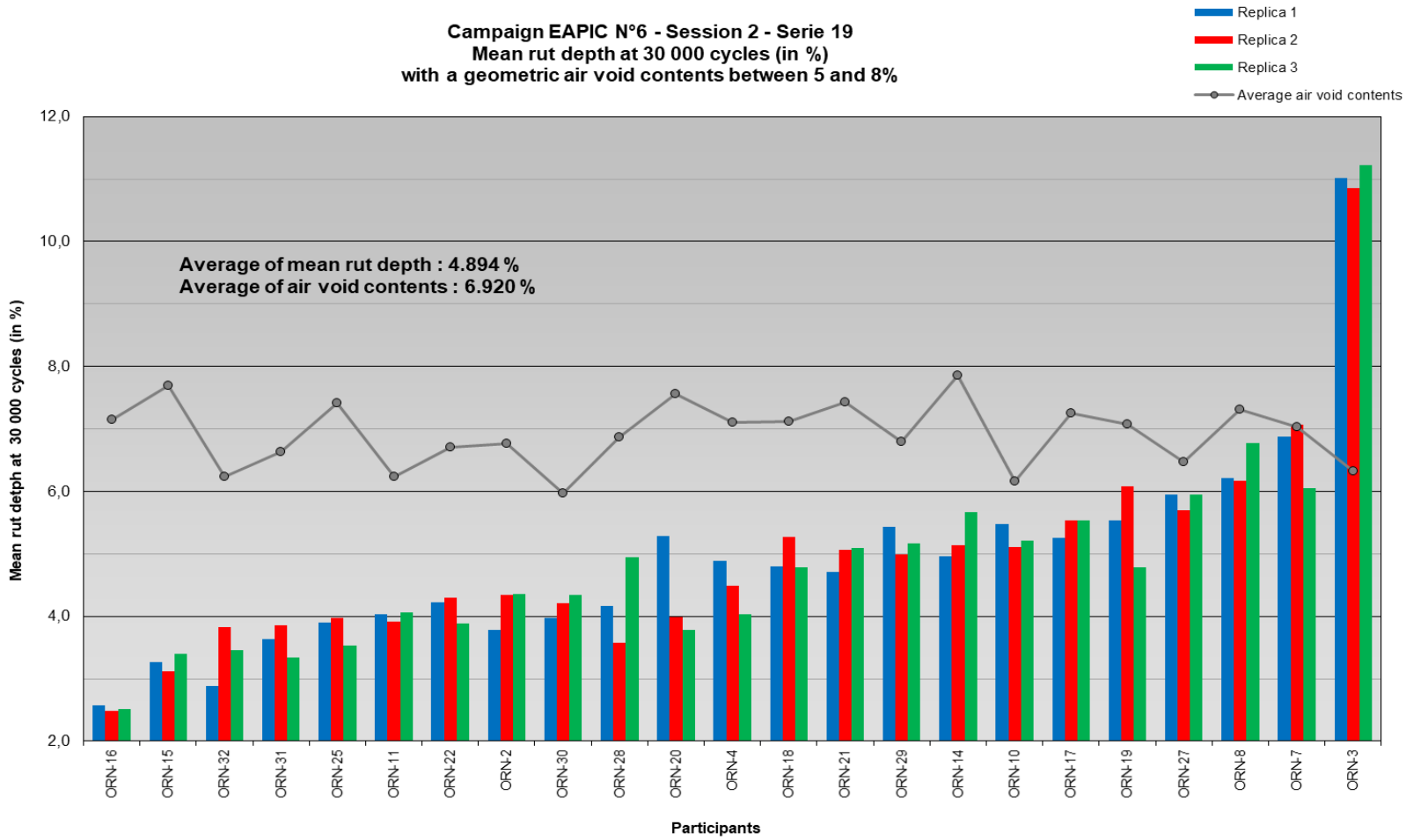
Code results	Average deviation	Z-Score
ORN-12	1.18	1.21
ORN-26	1.21	1.25

Average change of mean rut depth per laboratory

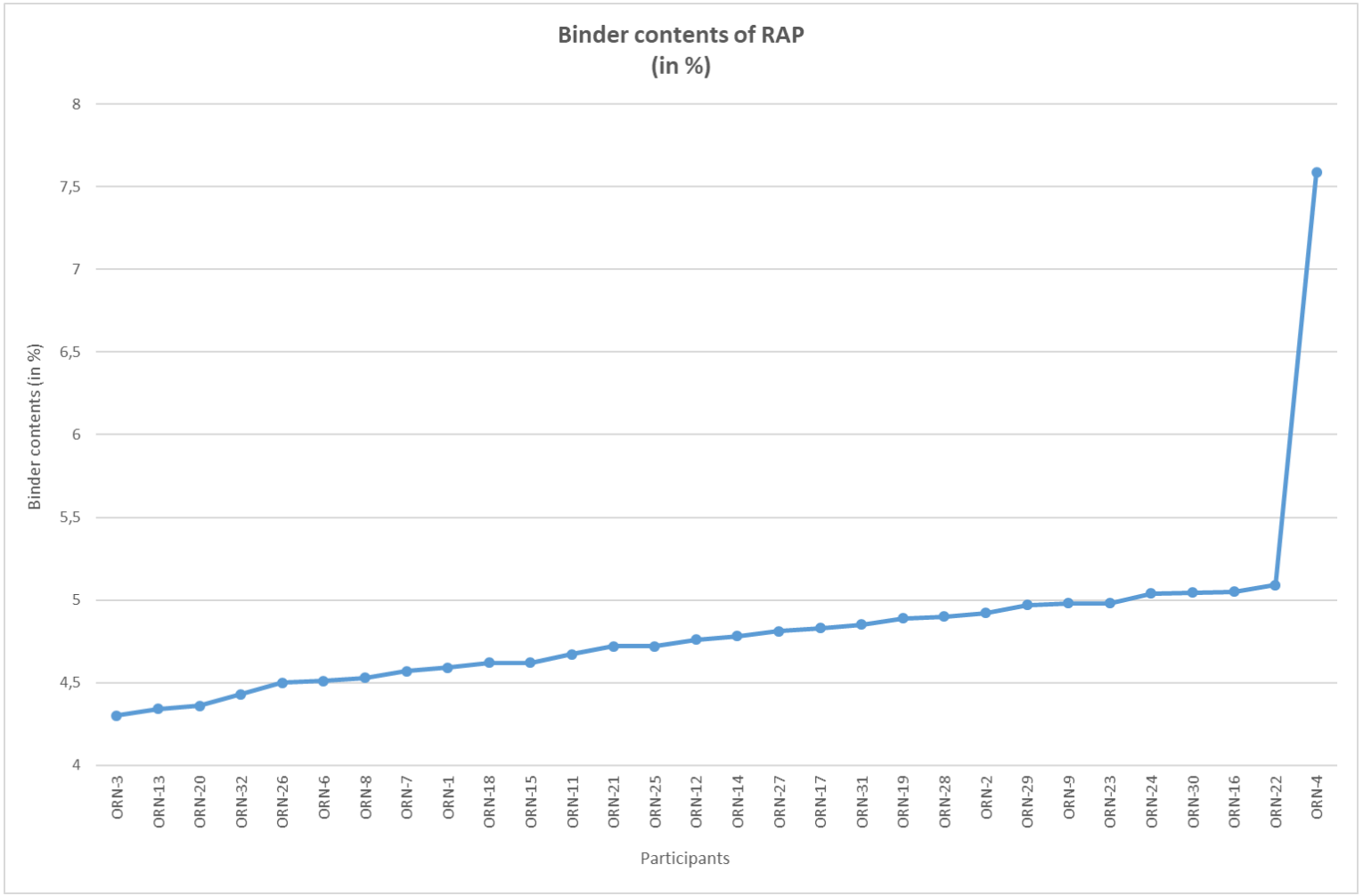



Average change of mean rut depth per laboratory
(Laboratory ORN-3 rejected)
ORN-1
ORN-31
ORN-17
ORN-30
ORN-9
ORN-23
ORN-8
ORN-16
ORN-22
ORN-27
ORN-18
ORN-15
ORN-24
ORN-28
ORN-29
ORN-19
ORN-4
ORN-2
ORN-21
ORN-10
ORN-6
ORN-26
ORN-11
ORN-14
ORN-12
ORN-20
ORN-25
ORN-32
ORN-13
ORN-7
Mean rut depth
7,0
6,0
5,0
4,0
3,0
2,0
1,0
0,0
300
1000
3000
10000
30000
Cycles number

Results of mean rut depth at 30 000 cycles with geometric air void contents between 5 and 8%



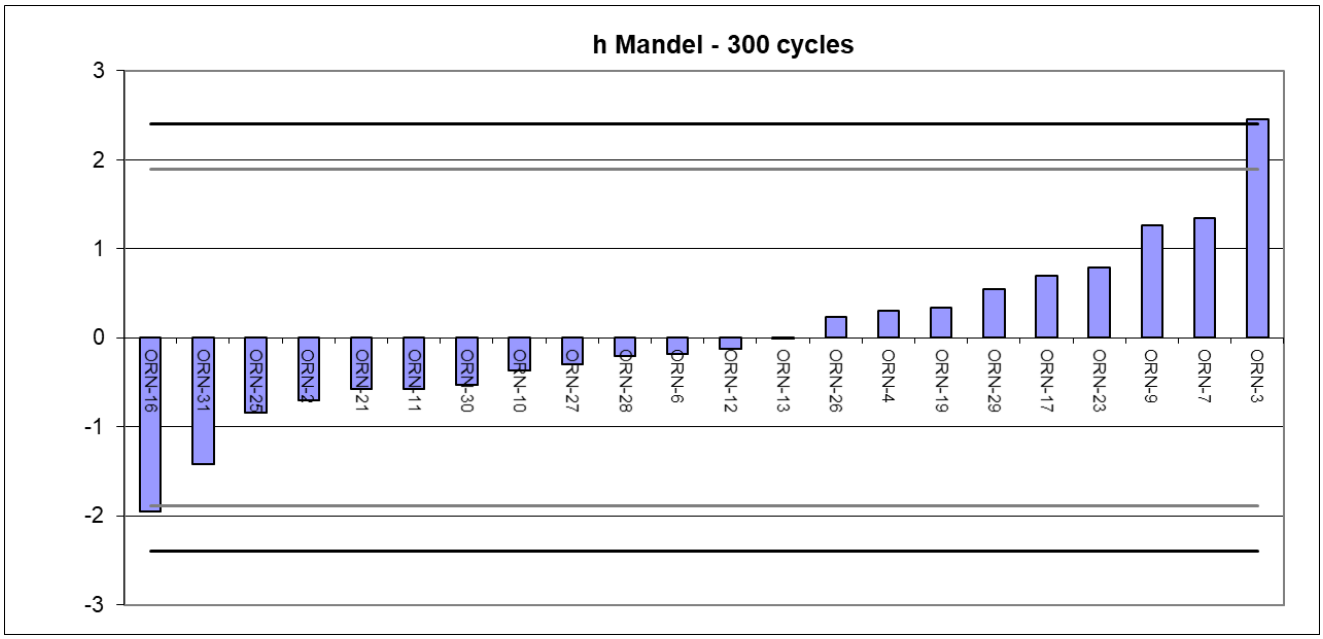
Value of RAP binder contents



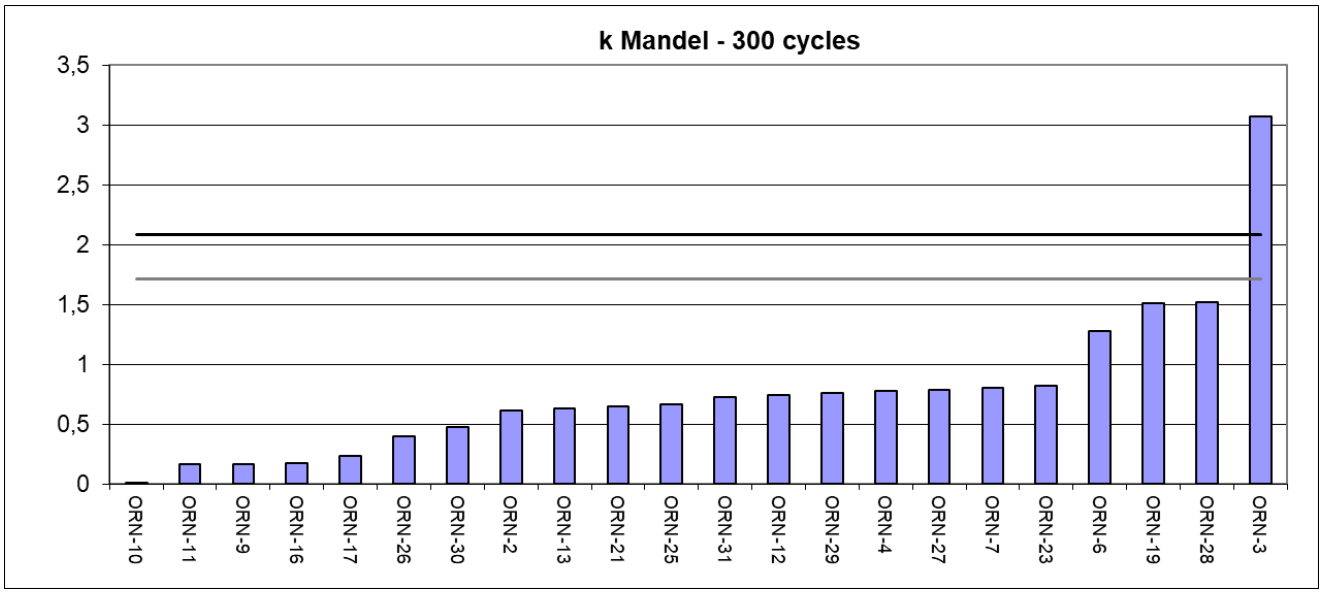
Mandel h and k tests on the raw data

Mean rut depth at 300 cycles

h Mandel: suspect value: 1.89 / critical value: 2.40

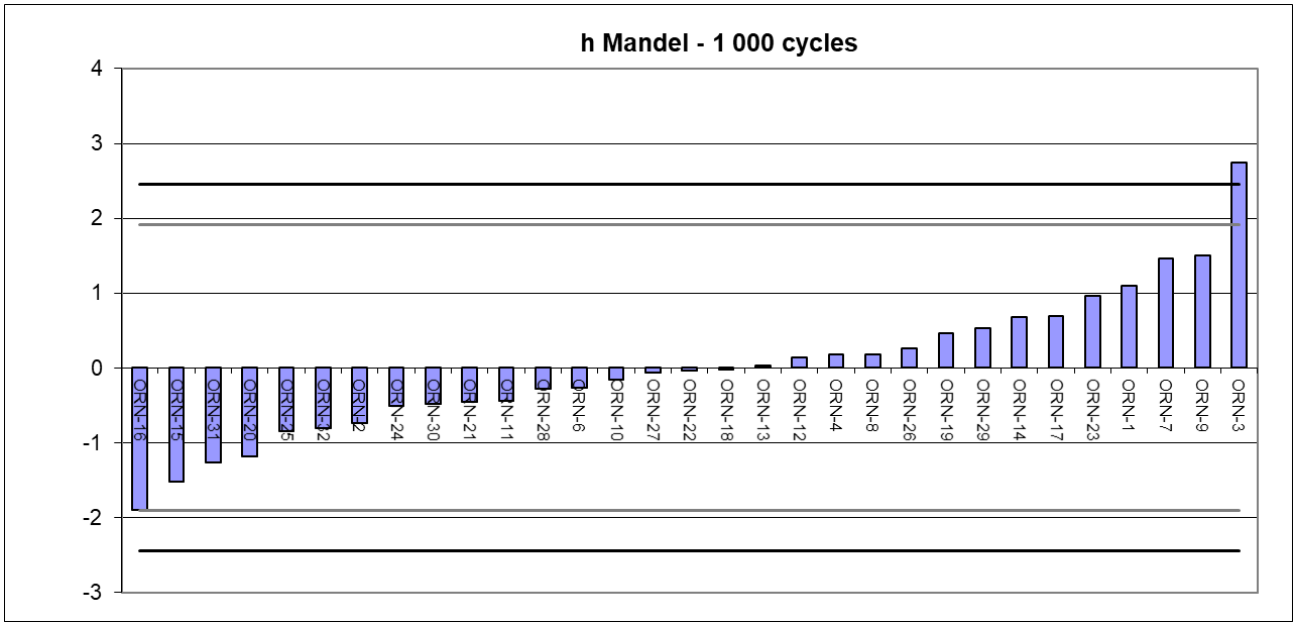


k Mandel: suspect value: 1.71 / critical value: 2.08

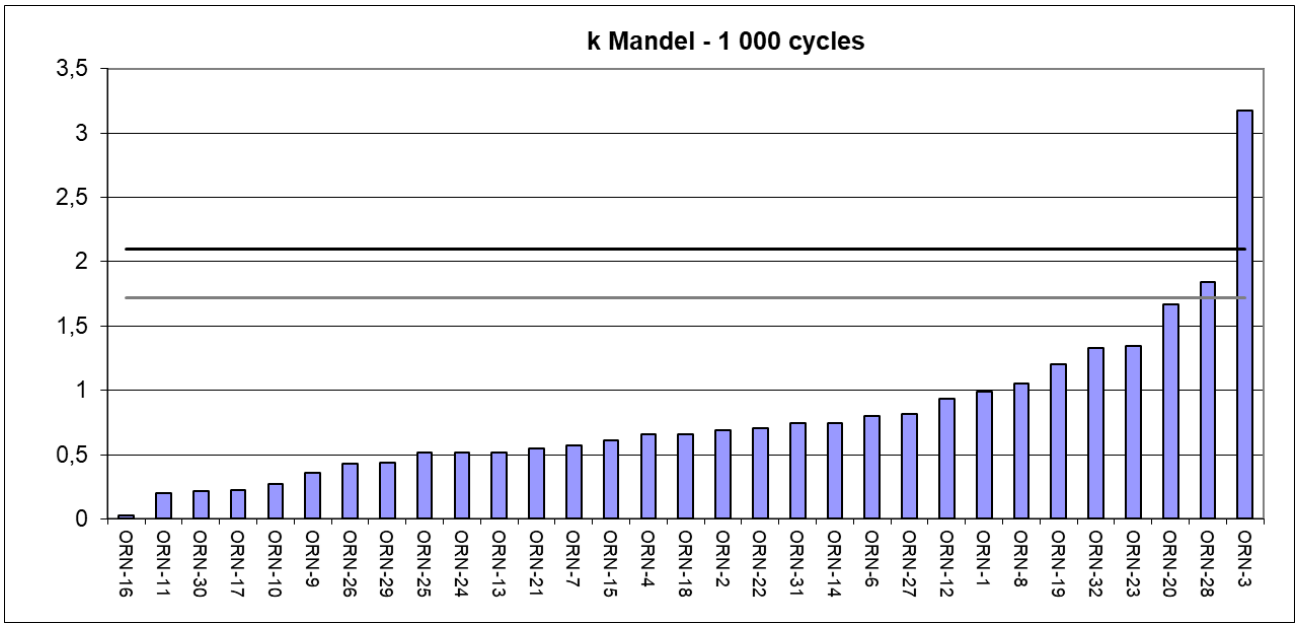


Mean rut depth at 1 000 cycles

h Mandel: suspect value: 1.91 / critical value: 2.45

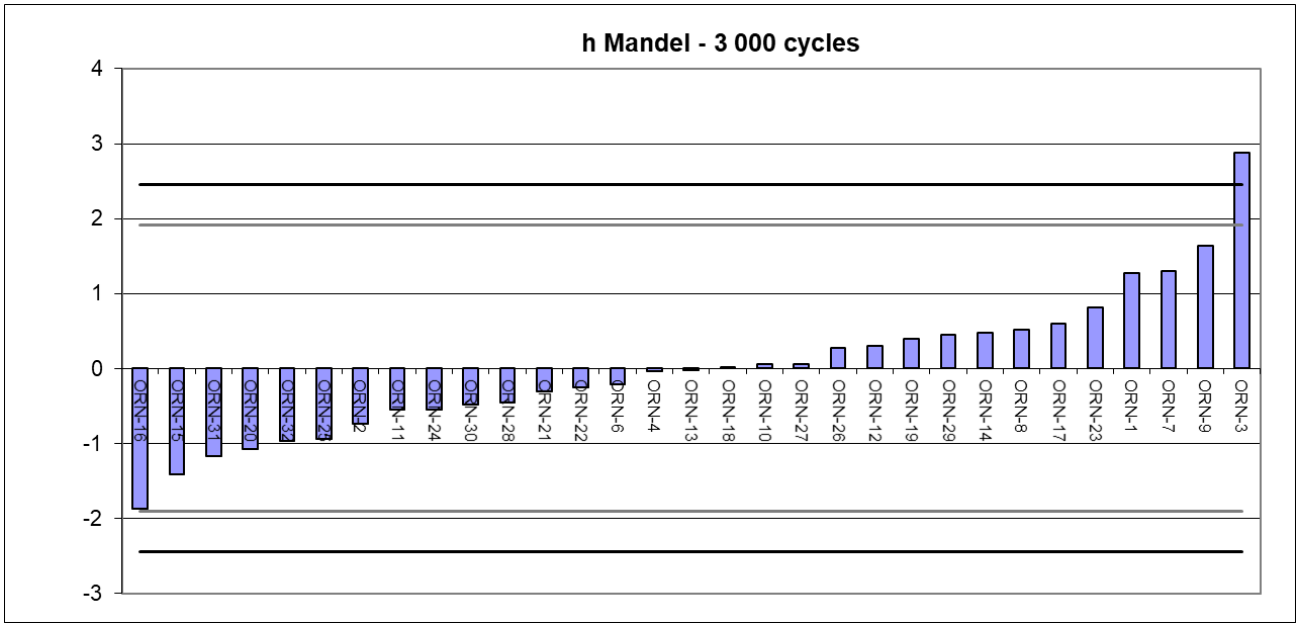


k Mandel: suspect value: 1.72 / critical value: 2.10

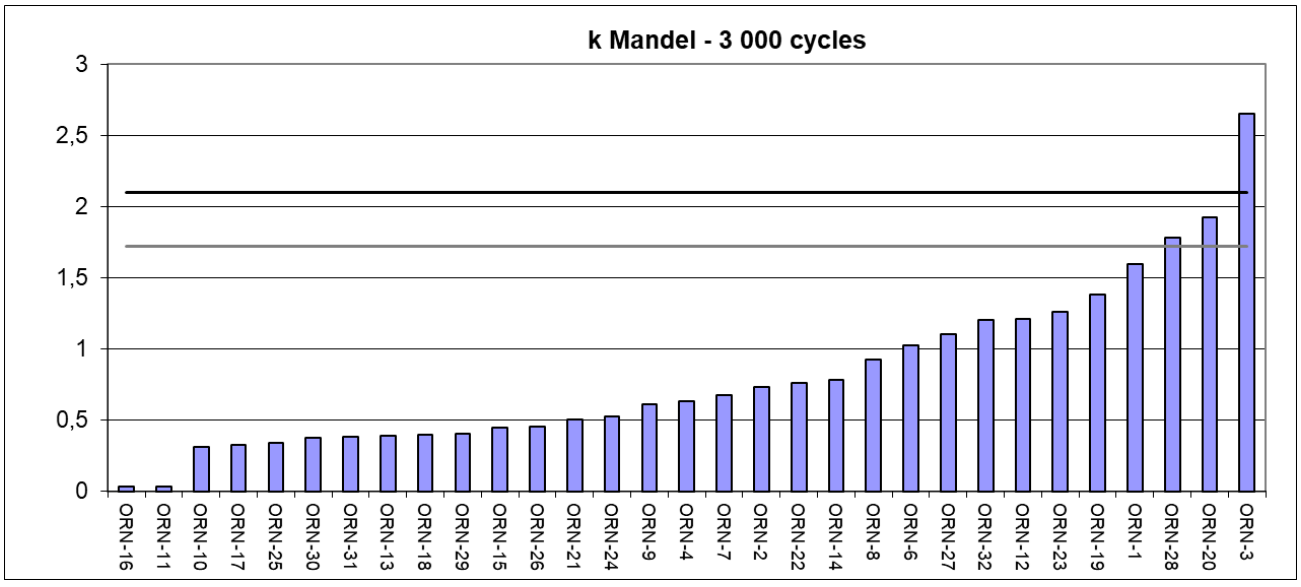


Mean rut depth at 3 000 cycles

h Mandel: suspect value: 1.91 / critical value: 2.45

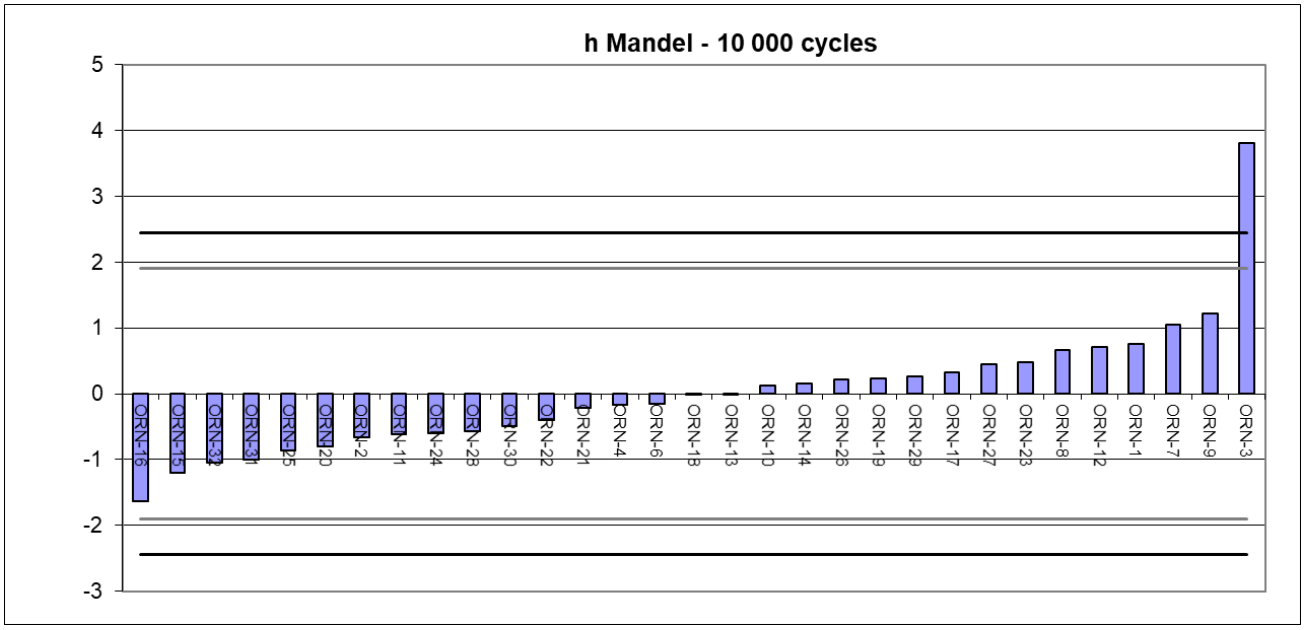


k Mandel: suspect value: 1,72 / critical value: 2.10

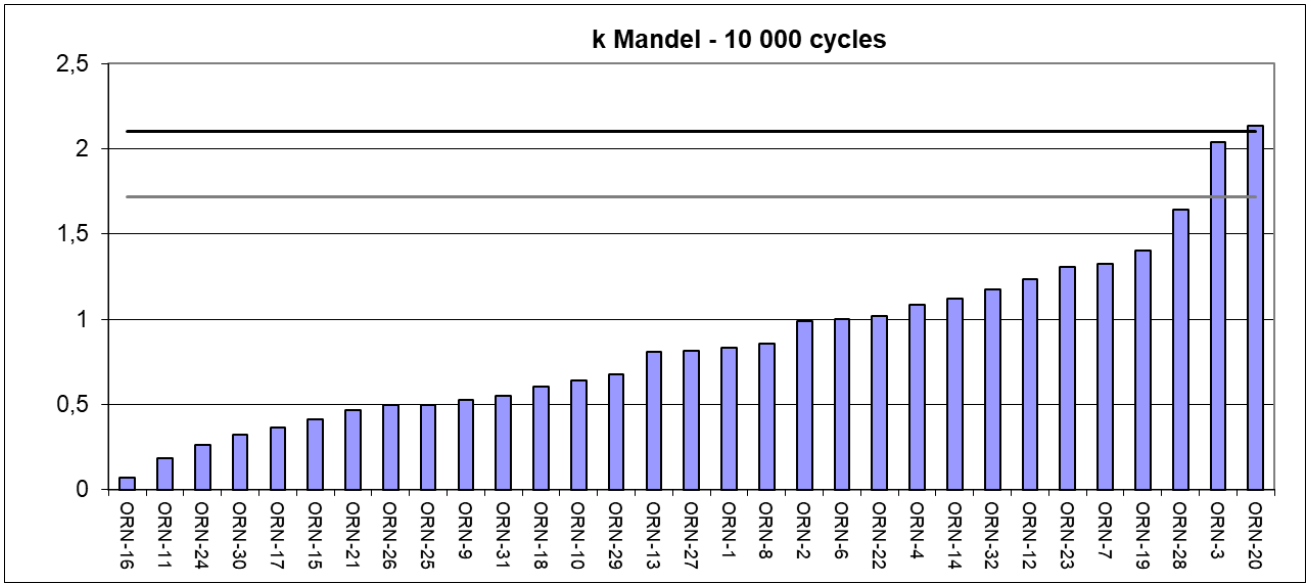


Mean rut depth at 10 000 cycles

h Mandel: suspect value: 1.91 / critical value: 2.45

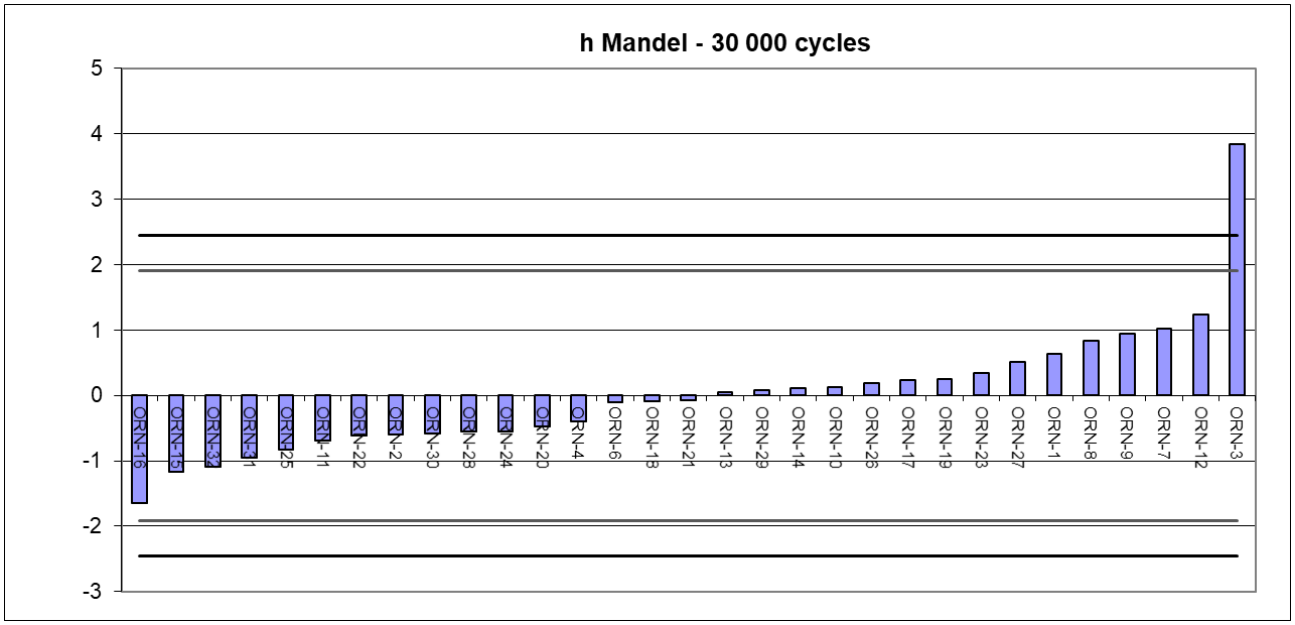


k Mandel: suspect value: 1,72 / critical value: 2.10

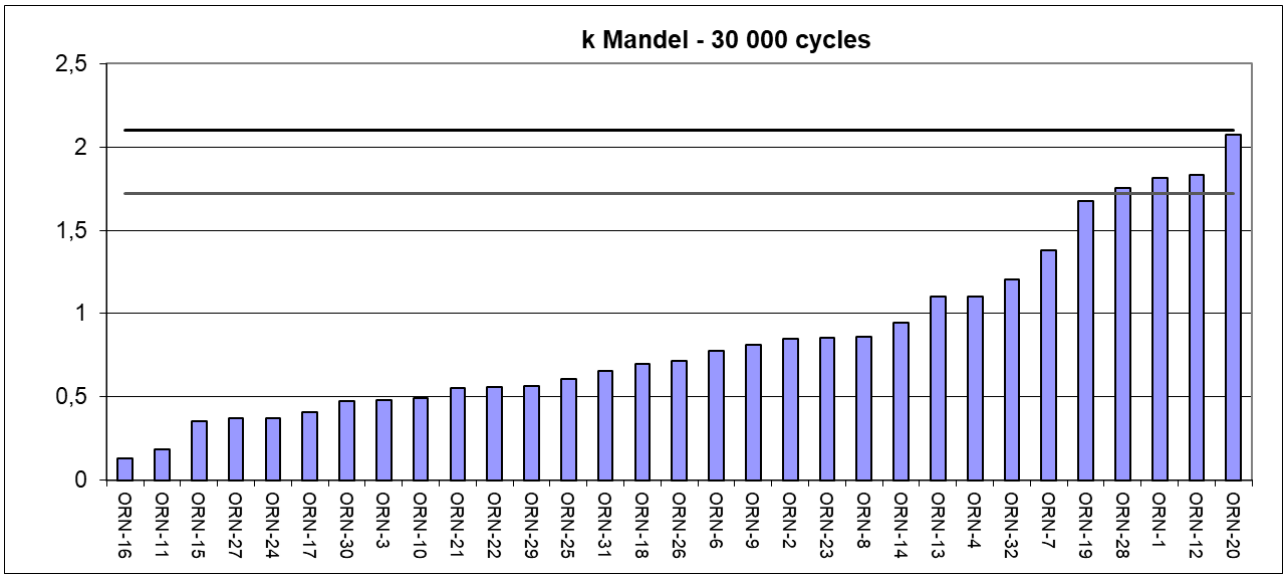


Mean rut depth at 30 000 cycles

h Mandel: suspect value: 1.91 / critical value: 2.45



k Mande: suspect value: 1.72 / critical value: 2.10



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