RESULT PRESENTATION REPORT

N° 11.1.18

About the tests

Determination of strength and modulus of a hydraulically bound fine soil (silt A2)

According to standards
NF EN 13286-41
NF EN 13286-42
NF EN 13286-43

April 21st, 2020 by G. PIOT – EAPIC Executive Cell
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*P*reamble

In the history of EAPIC, the majority of achieved series of tests concern test methods on asphalt concretes. This is because important issues about their results are often encountered in daily use in laboratories, as well as other agencies carry out some on other road materials : aggregates and bituminous binders in particular.

However, co-called « white » granular mixtures are not absent, whether they are hydraulically bound or unbound : Proctor compaction test had been subject of series EAPIC 9.1.13 in 2013-2014. It was therefore logical to complete it by proposing that laboratories compare their results of mechanical test methods : strengths and stiffness modulus.

The original idea was to work with a hydraulically bound gravel. Its feasibility did not resist to economic constraints, because of a too small number of applicant laboratories. The proposal to use a bound silt addressed this obstacle, by making possible the participation of laboratories involved in both fields of pavements and earthworks.

The number of registered participants (33) is good news, sign of your interest in these inter-laboratories tests. We thank you for this. Unfortunately, some of you were not able to answer within the given deadline, or only partially. EAPIC members then decided to accept answers until one month of delay, compromise between a moderate time lag of the synthesis report and a big enough population of results. The histograms of this report reflect this situation.

Furthermore, they show a high scattering in the results, that it is not up to EAPIC to analyse.
However, the elements given in the chapter « Making statistics » may help to do it.
Finally, as in last series, EAPIC makes available to concerned standard commissions the complete database of information anonymously collected on this occasion. Doing so, it gives them a matter to analyse in the perspective of further revisions of test method standards.

Kind regards,

For EAPIC,

Michel SAUBOT

Summary

Session organisation and data collection

Homogenised batches are supplied to participating laboratories. They must determine :

- The compression strength (Rc) for moulded specimens with dimensions 50x100 mm, for curing at 7 days, 28 days, 28 days on air + 32 days in immersion and 60 days ;

- The indirect traction strength (Rit) and modulus (Eit) for moulded specimens with dimensions 50x50 mm and/or 100x100 mm, for curing at 28 days, 60 days and 90 days.

And according to standard:

- Determination of the compression strength (Rc) of hydraulically bound mixtures according to NF EN 13286-41 (July 2003) ;

- Determination of the indirect tensile strength (Rit) of hydraulically bound mixtures according to NF EN 13286-42 (September 2003) ;

- Determination of the modulus of elasticity (Eit) of hydraulically bound mixtures according to NF EN 13286-43 (September 2003).

The selected formula is describe as follows:

Silt A2	93.0 %
Quicklime	1.0 %
Hydraulic road binder	6.0 %

The moulded specimens must meet the following conditions:

- The water content must be equal to the water content at the Optimum Proctor Normal ;

- 98.5% of OPN density for compressive strength Rc (specimens 50x100 mm);

- 96.0% of OPN density for indirect tensile strength Rit and modulus Eit (specimens 50x50 mm and/or 100x100 mm).

OPN dry density values and OPN water content were determined by the EAPIC Specialised Group and transmitted to all laboratories.

- OPN Dry density: 1.74 Mg/m^3 (according to NF P 94-093) ;

- OPN Water content: 17.5%.

The campaign unfolded as follows :

- Shipping of samples in April 2019.

- Result delivery from participating laboratories no later than September 30,2019.
  The number of participants to this session is 33 laboratories.
  67 determination results forms were received, distributed as follows :
    - 29 results forms Rc for specimens 50x100 mm ;
    - 23 results forms Rit – Eit for specimens 50x50 mm ;
    - 15 results forms Rit – Eit for specimens 100x100 mm.
  The request for additional delays transmitted to the EAPIC Executive Cell have all been accepted until October 31, 2019.

- Publication of result report in January 2020.

Preparation and shipping of samples

Support Laboratory : Cerema Ouest – 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 materials:

- 2, 4 or 5 bags of 25 kg of silt A2 ;
- 1 bucket of 2 kg of quicklime ;
- 1 bucket of 10 kg of hydraulic road binder.

The silt A2 comes from a reference stock. The bags have been checked for homogeneity by the Support Laboratory Cerema Ouest – Department Laboratory of Angers (see next page).

The quicklime and hydraulic road binder come each of them from a unique manufacturing batch. The buckets were subject to performance checks : reactivity test for lime, and mechanical performance measurements on standard mortar for the binder. The dispersion of the mechanical strengths is in accordance with known fidelity values.

Preparation

To carry out this session, the Cerema Ouest – Department Laboratory of Angers has prepared and bagged:

- 125 bags of silt A2 ;
- 41 buckets of quicklime ;
- 34 buckets of hydraulic road binder.

Shipping of materials

The materials were sent by the Cerema Ouest – 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 silt A2 homogeneity

Support Laboratory : Cerema Ouest – Department laboratory of Angers

In order to check that all samples of silt are homogeneous, it was chosen to check the VBS results on 10 bags taken at randomly from the received stock.

The usual homogeneity criteria according to standard NF ISO 13528 isn't applicable here in absence of precision values r and R. The homogeneity criteria used by the EAPIC Group are therefore:

- The relative range e_r of VBS values (range divided by average) defined in French Technical Guide « Traitement des sols à la chaux et/ou aux liants hydrauliques » for sub-base layers (September 2007), specially in Table 5. This table requires that $e_r < 40$ %.

|	VBS (Relative Extensible)
Number of values	20
Mini	2.47
Max	2.94
Extensive	0.47
Relative Extensible er	17%
Validation er < 40%	condition verified

- The scattering of these VBS values is defined in French Technical Guide « Traitement des sols à la chaux et/ou aux liants hydrauliques » for backfills and capping layers (January 2000), in Table C1-1, as $2\sigma/m$. This table requires that $2\sigma/m < 18$ %.

	VBS (Dispersion)
Number of values	20
Average m	2.70
Standard deviation σ	0.152
Dispersion 2 σ/m	11%
Validation Dispersion <18%	condition verified

The criteria is fulfilled for each test.
Therefore, it can be concluded that the samples of silt A2 are homogeneous.

Making statistics
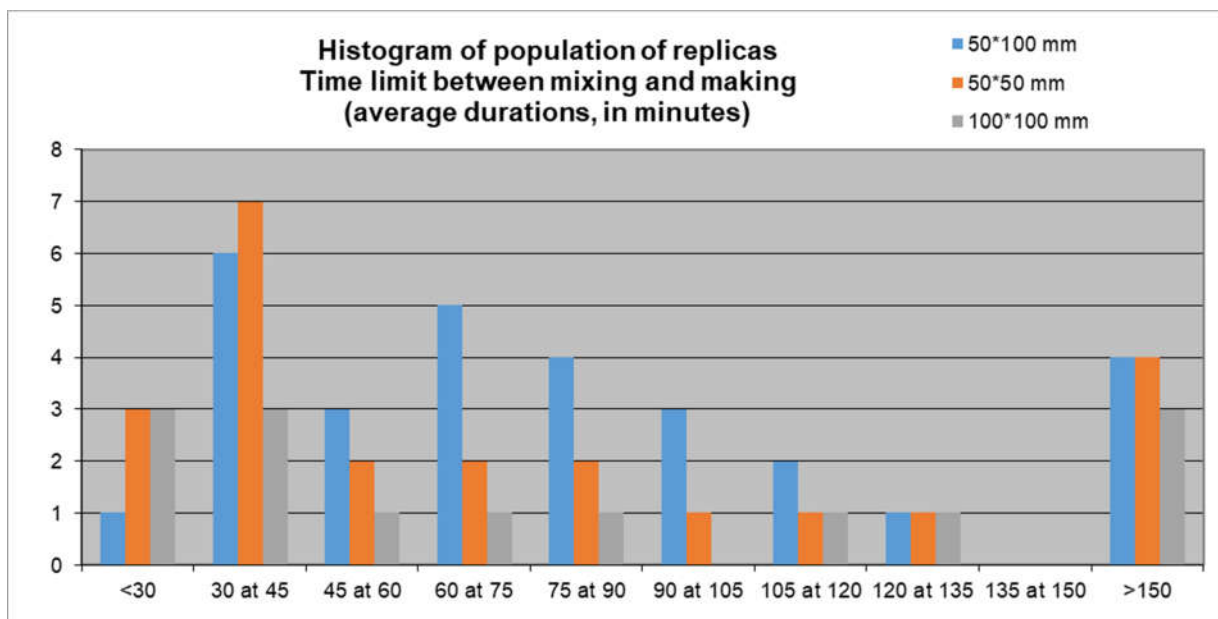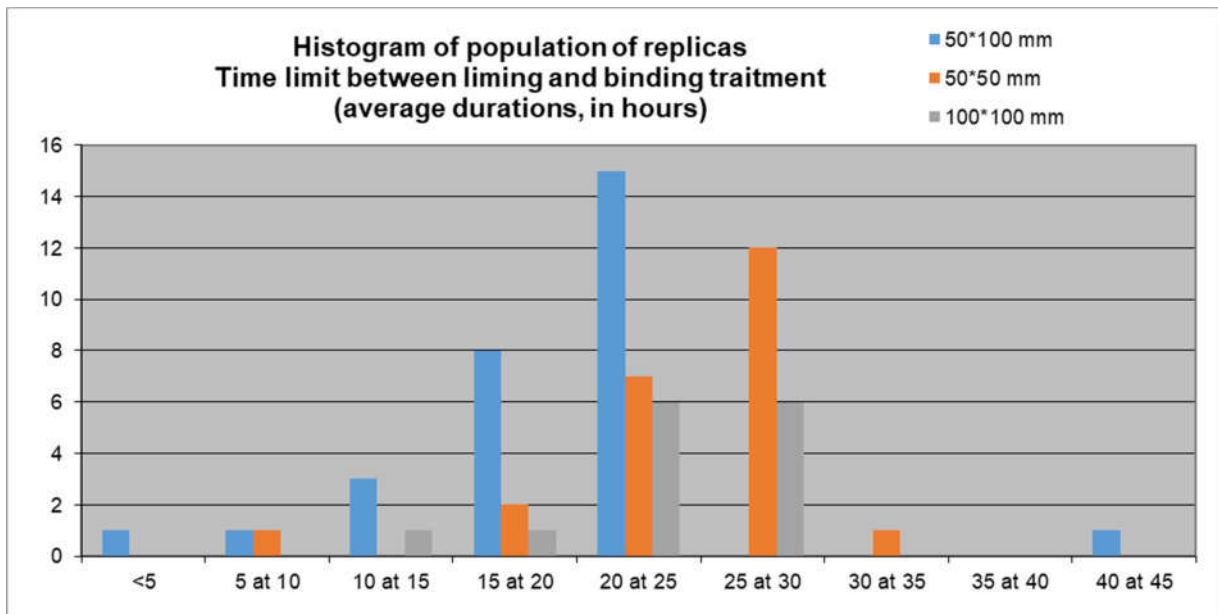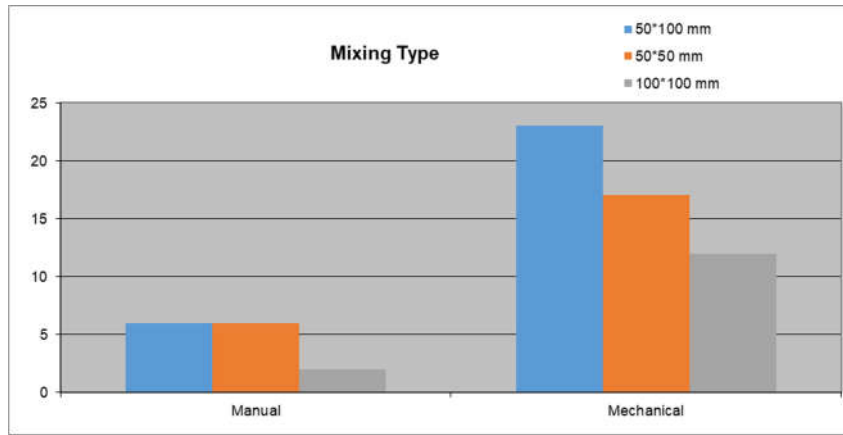
Data processing

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 table. 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.

The graphic legend is the following :
M : laboratories that manufactured the mixtures manually ;
*   : results presented in the graphs but not included in the statistical treatments.

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.

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 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.

Specimens 50x100 mm

Determination of water content (*)

(*) free choice of method

Determination of water content

Target value : 17.5%

Graphical representation

		Raw data	Results rejected by statistical tests	Standard (NF EN 1097-5)
In %	Number of results taken in account	29	None	
	Average m	17.423		
	Standard deviation repeatability	0.493		
	repeatability r	1.382		r = 1.488
	Standard deviation Reproducitibility	0.828		
	Reproducitibility R	2.319		R = /
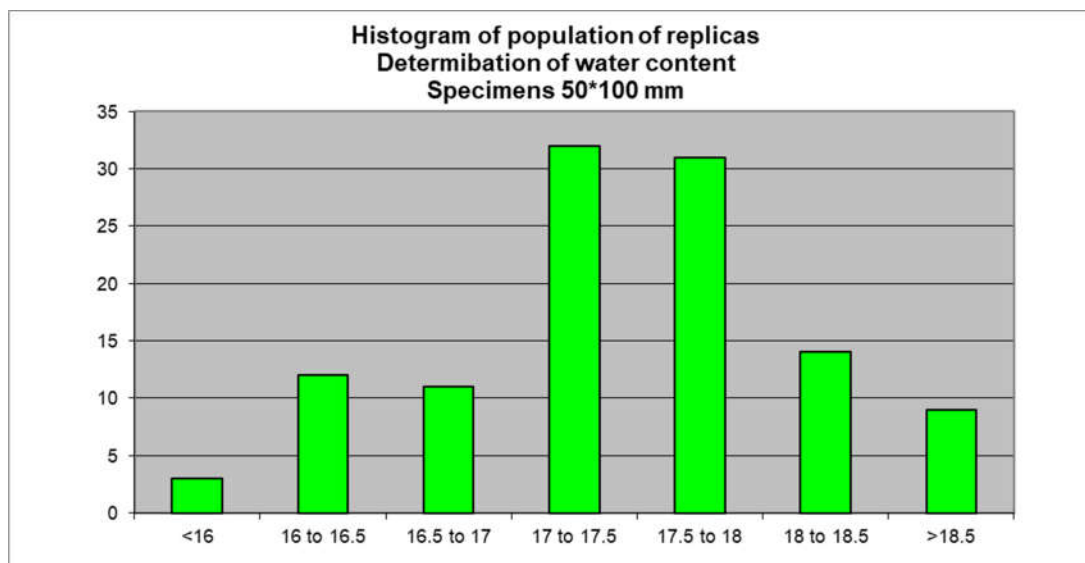
Raw date

Histogram of population of replicas
Determibation of water content
Specimens 50*100 mm

Campaign EAPIC N°11 - Session 1 - Serie 18
Determination of water contrent
Specimens 50*100 mm
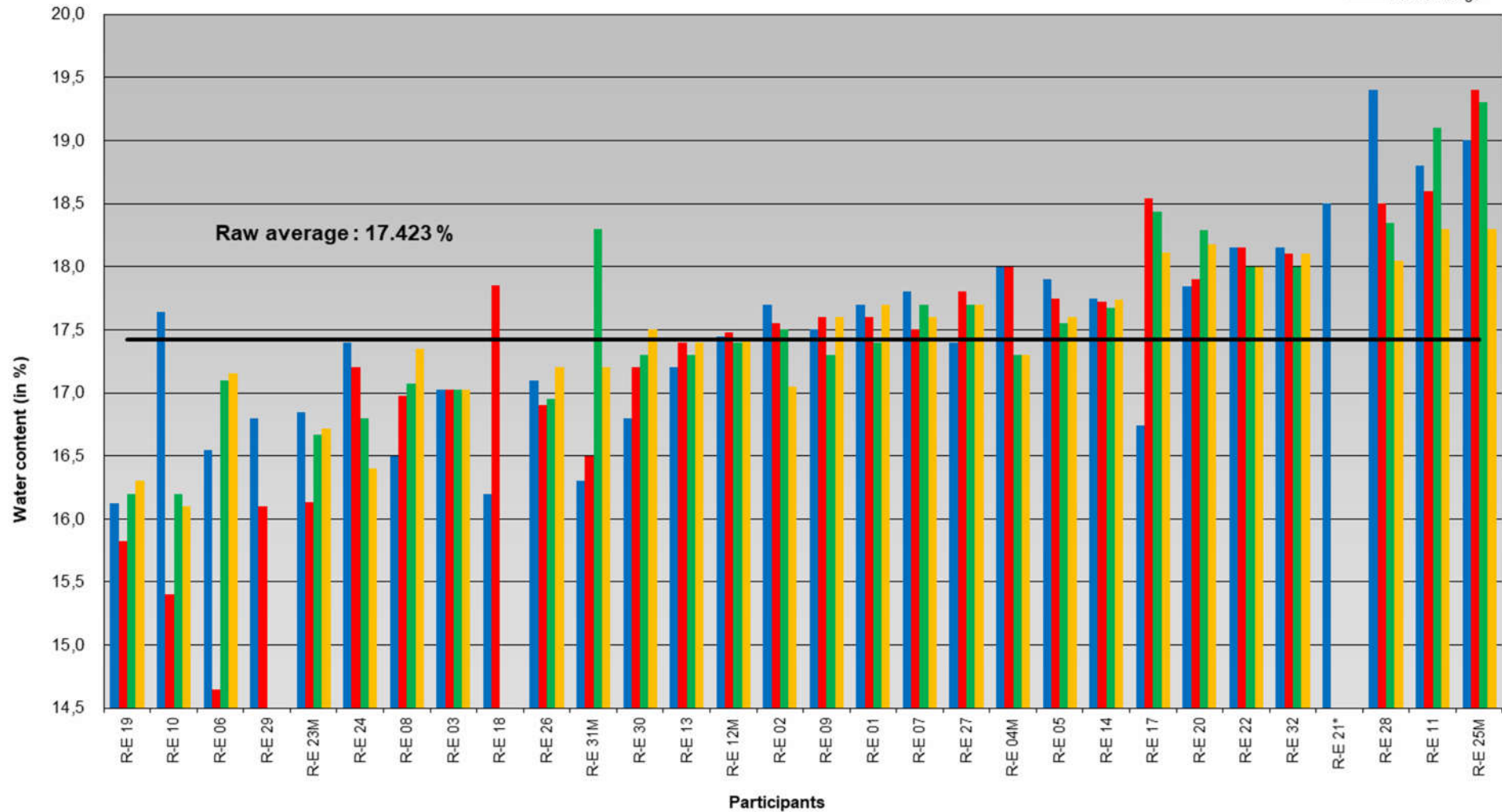
Average difference and Z-score value on raw data

Difference less than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 02	0.00	0.00
R-E 12M	0.01	0.01
R-E 09	0.05	0.06
R-E 13	0.12	0.15
R-E 01	0.15	0.18
R-E 07	0.20	0.24
R-E 27	0.20	0.24
R-E 04M	0.20	0.24
R-E 30	0.25	0.30
R-E 05	0.25	0.30
R-E 14	0.27	0.33
R-E 31M	0.37	0.45
R-E 26	0.41	0.50
R-E 18	0.42	0.51
R-E 03	0.42	0.51
R-E 08	0.47	0.57
R-E 24	0.50	0.60
R-E 17	0.51	0.62
R-E 20	0.61	0.73
R-E 22	0.63	0.76
R-E 32	0.64	0.77

Differnce more than 1 standard deviation

| Code results	Average deviation	Z-Score
R-E 23M	0.86	1.03
R-E 29	1.00	1.20
R-E 06	1.08	1.31
R-E 10	1.11	1.34
R-E 28	1.13	1.36
R-E 11	1.25	1.51
R-E 19	1.34	1.61
R-E 25M	1.55	1.87

Determination of compactness

Determination of compactness

Target value : 98.5%

Graphicals representation

		Raw date	Results rejected by statistical tests	Corrected data
In %	**Number of results taken in account**	29		26
	Average m	97.354	Cochran R-E06 R-E17 R-E18	97.415
	Standard deviation repeatability	0.486		0.345
	repeatability r	1.361		0.967
	Standard deviation Reproducitibility	1.419		1.419
	Reproducitibility R	3.974		3.974

Raw data
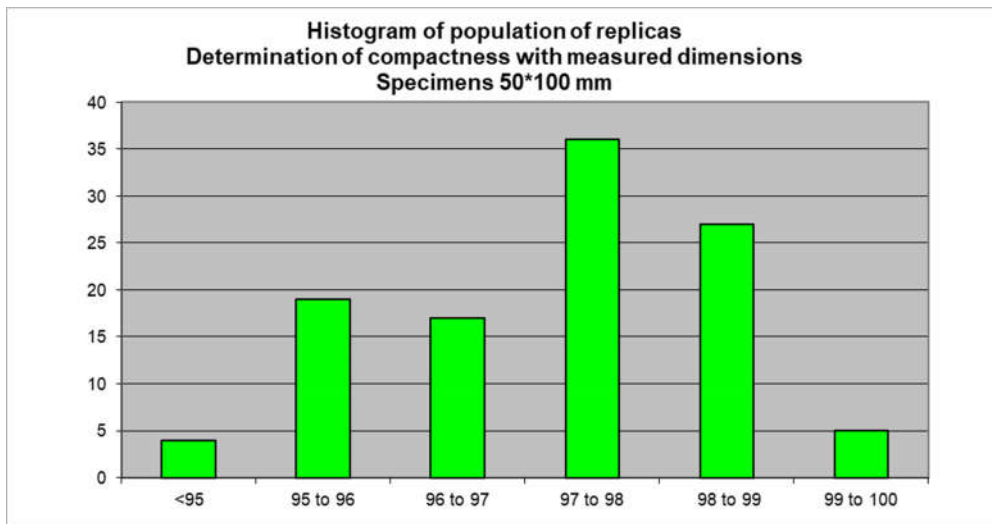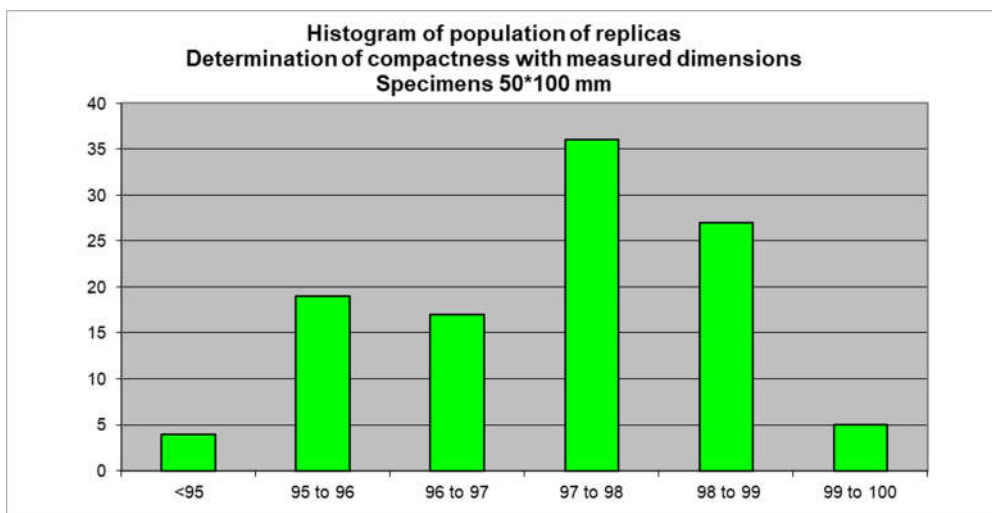
Histogram of population of replicas
Determination of compactness with measured dimensions
Specimens 50*100 mm

Corrected data

Histogram of population of replicas
Determination of compactness with measured dimensions
Specimens 50*100 mm
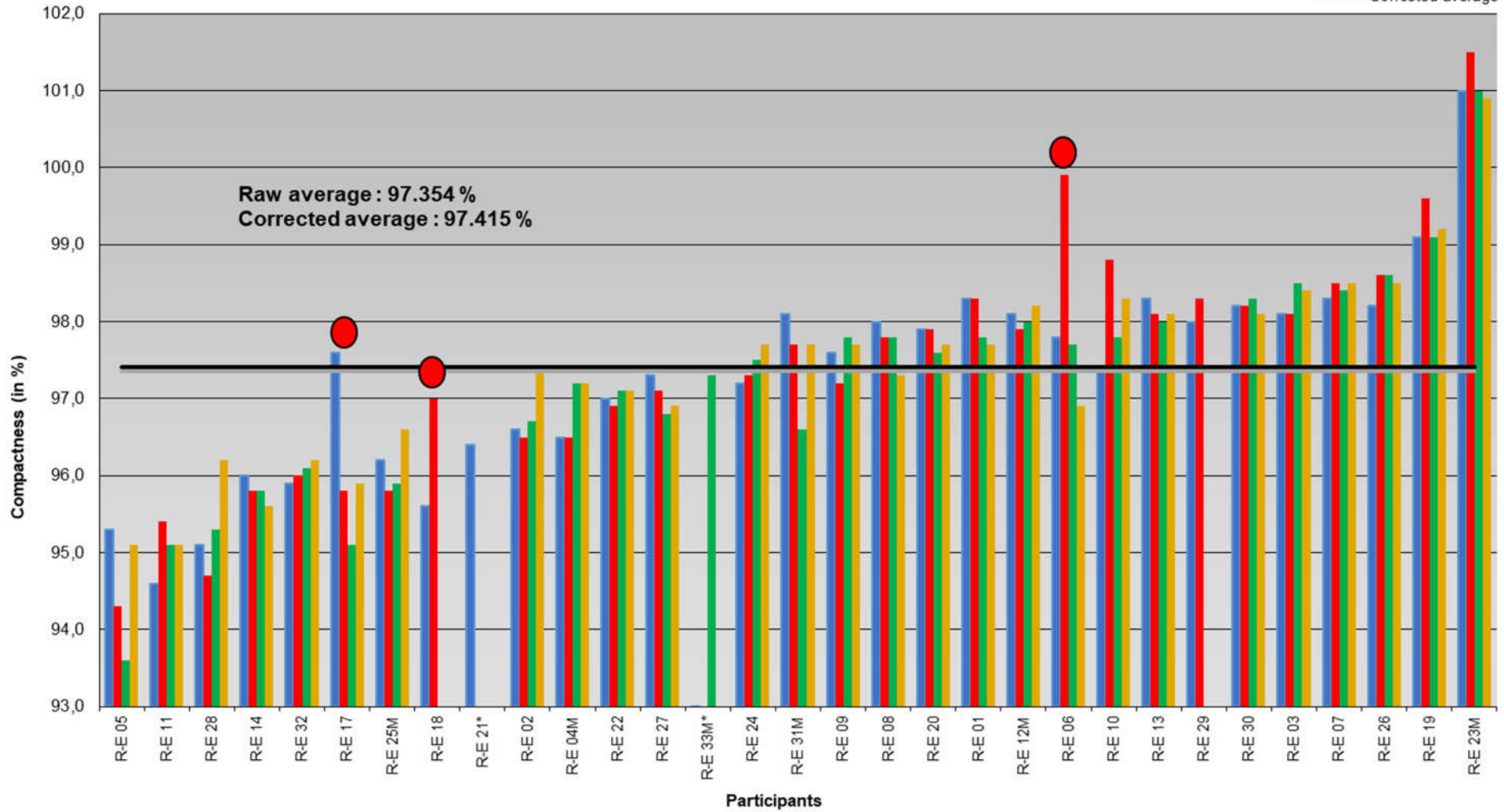
Campaign EAPIC N°11 - Session 1 - Serie 18
Determination of compactness with measured dimensions
Specimens 50*100 mm

Average difference and Z-score value on raw data

Difference less than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 24	0.07	0.05
R-E 31M	0.17	0.12
R-E 09	0.22	0.15
R-E 22	0.33	0.24
R-E 27	0.33	0.24
R-E 08	0.37	0.26
R-E 20	0.42	0.29
R-E 04M	0.51	0.36
R-E 02	0.56	0.39
R-E 01	0.67	0.47
R-E 12M	0.69	0.49
R-E 06	0.72	0.50
R-E 10	0.72	0.50
R-E 13	0.77	0.54
R-E 29	0.79	0.56
R-E 30	0.84	0.59
R-E 03	0.92	0.65
R-E 18	1.06	0.75
R-E 07	1.07	0.75
R-E 26	1.12	0.79
R-E 25M	1.23	0.87
R-E 17	1.26	0.89
R-E 32	1.31	0.92

Difference more than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 14	1.56	1.10
R-E 19	1.89	1.33
R-E 28	2.03	1.43
R-E 11	2.31	1.63
R-E 05	2.78	1.96
R-E 23M	3.74	2.64

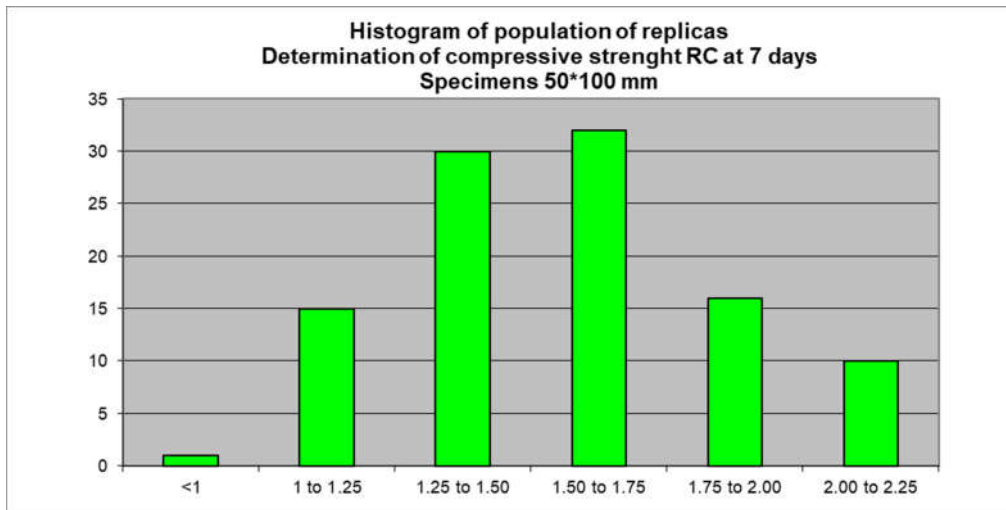# *Determination of compressive strength Rc (*)*

(*) according to standard NF EN 13286-41 july 2003

Rc at 7 days

Graphical representations

|		Raw date	Results rejected by statistical tests	Corrected data
In MPa	**Number of results taken in account**	29		28
	Average m	1.640		1.650
	Standard deviation repeatability	0.113	Cochran R-E28	0.100
	repeatability r	0.317		0.281
	Standard deviation Reproducitibility	0.429		0.430
	Reproducitibility R	1.200		1.205

Raw data

Corrected data
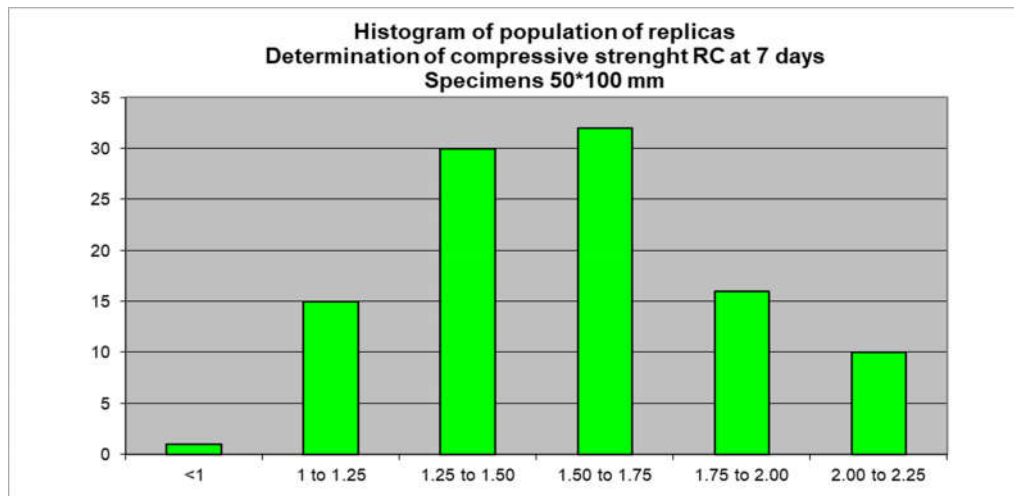
Campaign EAPIC N°11 - Session 1 - Serie 18
Determination of compressive strength RC at 7 days
Specimens 50*100 mm
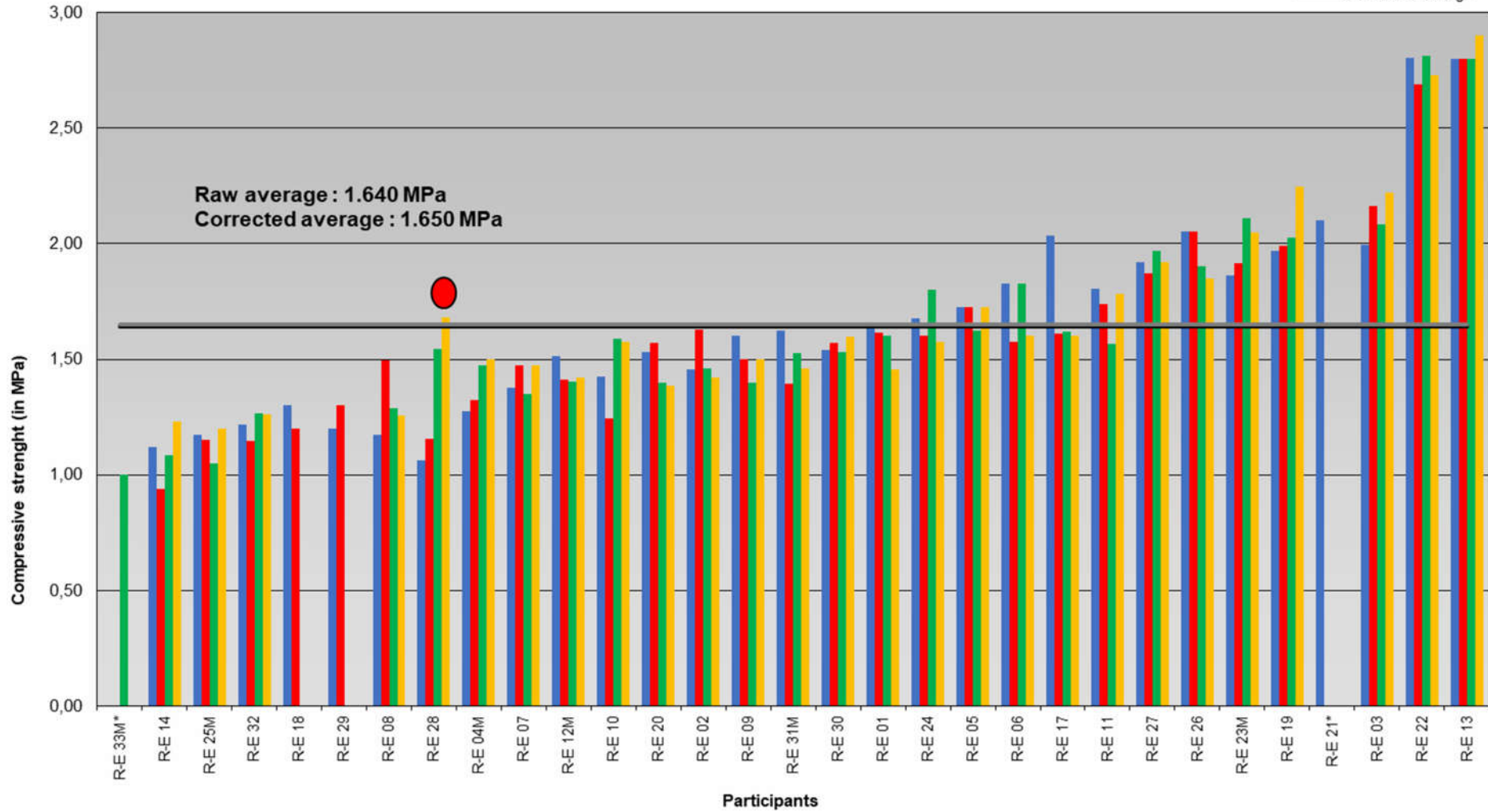
Average difference and Z-score value on raw data

Difference less than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 24	0.01	0.02
R-E 05	0.05	0.11
R-E 06	0.05	0.12
R-E 17	0.06	0.15
R-E 11	0.07	0.16
R-E 01	0.07	0.17
R-E 30	0.09	0.22
R-E 31M	0.15	0.36
R-E 09	0.15	0.36
R-E 02	0.16	0.38
R-E 20	0.18	0.43
R-E 10	0.20	0.46
R-E 12M	0.22	0.51
R-E 07	0.24	0.55
R-E 04M	0.26	0.61
R-E 27	0.27	0.62
R-E 28	0.29	0.68
R-E 26	0.31	0.72
R-E 23M	0.33	0.77
R-E 08	0.35	0.82
R-E 19	0.40	0.94
R-E 18	0.40	0.94
R-E 29	0.40	0.94

Difference more than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 32	0.43	1.00
R-E 03	0.46	1.08
R-E 25M	0.51	1.19

Difference more than 2 standard deviation

Code results	Average deviation	Z-Score
R-E 22	1.10	2.57
R-E 13	1.17	2.73

Rc at 28 days

Graphical representations

		Raw date	Results rejected by statistical tests	Corrected data
In MPa	**Number of results taken in account**	29		28
	Average m	2.815		2.705
	Standard deviation repeatability	0.200	Grubbs R-E22	0.202
	repeatability r	0.560		0.567
	Standard deviation Reproducitibility	0.901		0.679
	Reproducitibility R	2.522		1.901

Raw data
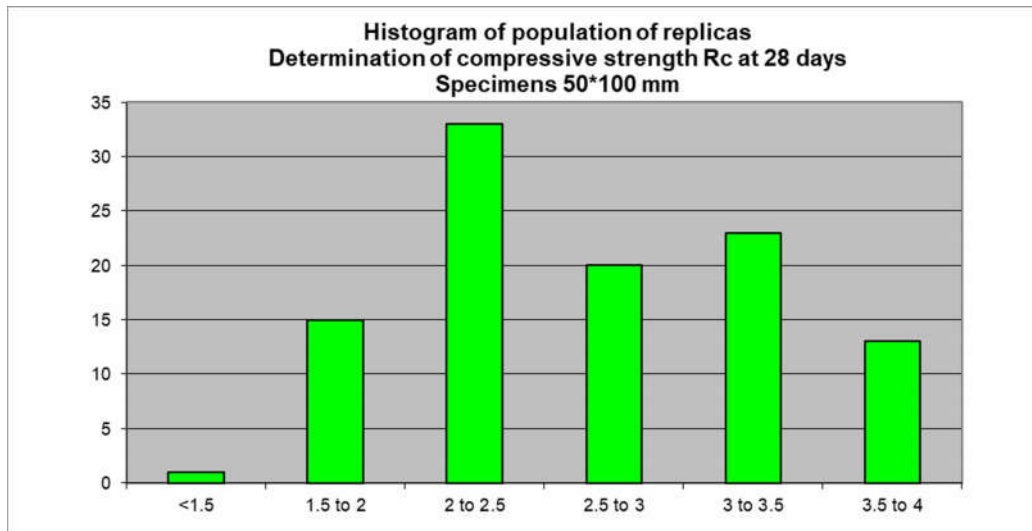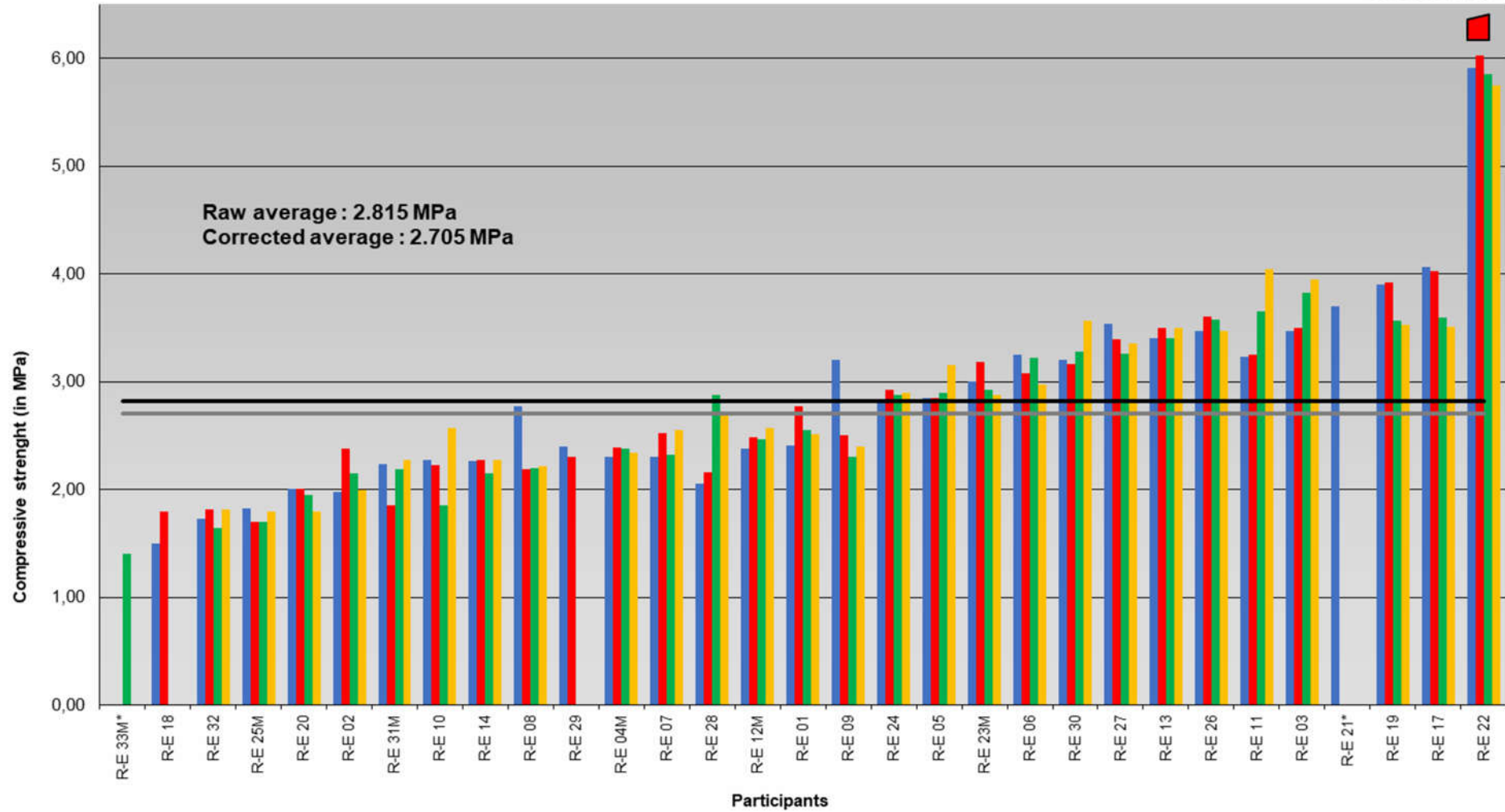

Corrected data
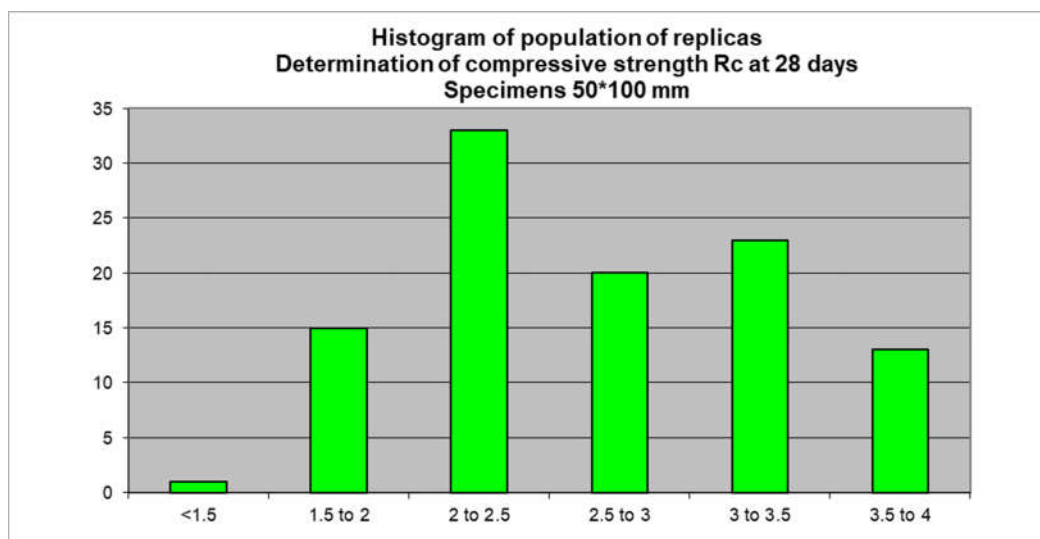
Campaign EAPIC N°11 - Session 1 - Serie 18
Determination of compressive strength Rc at 28 days
Specimens 50*100 mm

Raw average : 2.815 MPa
Corrected average : 2.705 MPa

Average difference and Z-score value on raw data

Difference less than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 24	0.03	0.03
R-E 05	0.09	0.10
R-E 23M	0.15	0.17
R-E 09	0.24	0.27
R-E 01	0.29	0.32
R-E 06	0.29	0.32
R-E 12M	0.37	0.41
R-E 28	0.39	0.43
R-E 07	0.42	0.47
R-E 30	0.46	0.51
R-E 04M	0.49	0.55
R-E 29	0.49	0.55
R-E 08	0.50	0.55
R-E 27	0.54	0.60
R-E 14	0.60	0.67
R-E 13	0.61	0.67
R-E 10	0.61	0.68
R-E 26	0.69	0.76
R-E 11	0.70	0.78
R-E 31M	0.71	0.78
R-E 02	0.72	0.80
R-E 03	0.84	0.94
R-E 19	0.88	0.98

Difference more than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 20	0.90	1.00
R-E 17	0.95	1.06
R-E 25M	1.09	1.21
R-E 32	1.09	1.22
R-E 18	1.19	1.33

Difference more than 2 standard deviation

Code results	Average deviation	Z-Score
R-E 22	3.04	3.37

Rci at 28 days in air and 32 days in immersion

Graphical representations

In MPa		Raw date	Results rejected by statistical tests	Corrected data
	Number of results taken in account	29		28
	Average m	3.399		3.360
	Standard deviation repeatability	0.497	Cochran R-E29	0.270
	repeatability r	1.391		0.755
	Standard deviation Reproducitibility	1.026		0.953
	Reproducitibility R	2.874		2.669

Raw data
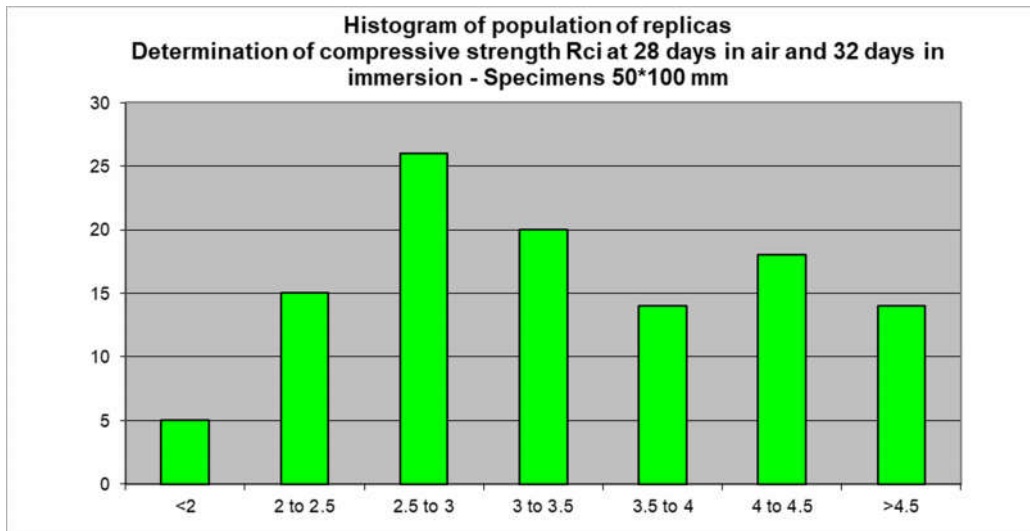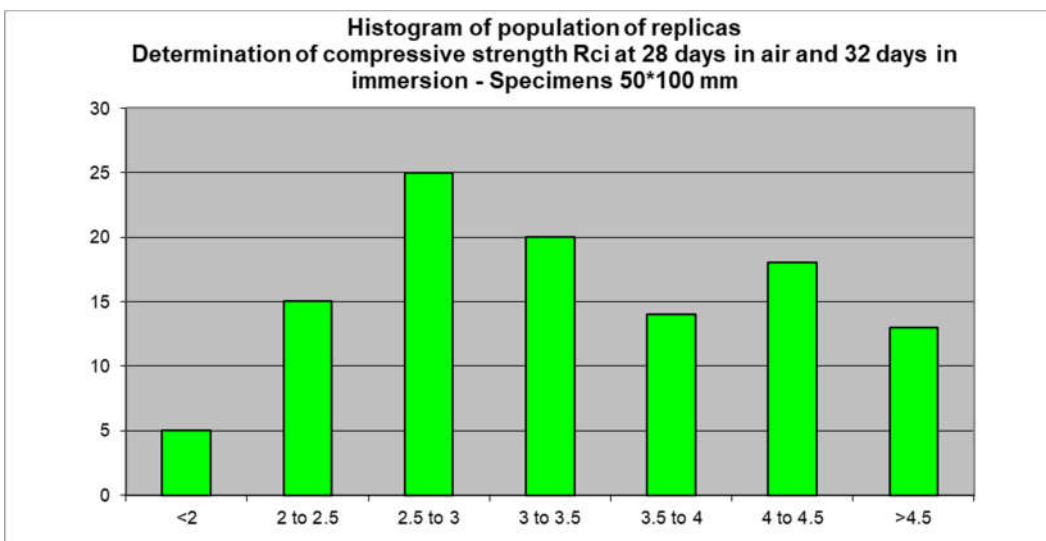
Histogram of population of replicas
Determination of compressive strength Rci at 28 days in air and 32 days in immersion - Specimens 50*100 mm

Corrected data

Histogram of population of replicas
Determination of compressive strength Rci at 28 days in air and 32 days in immersion - Specimens 50*100 mm
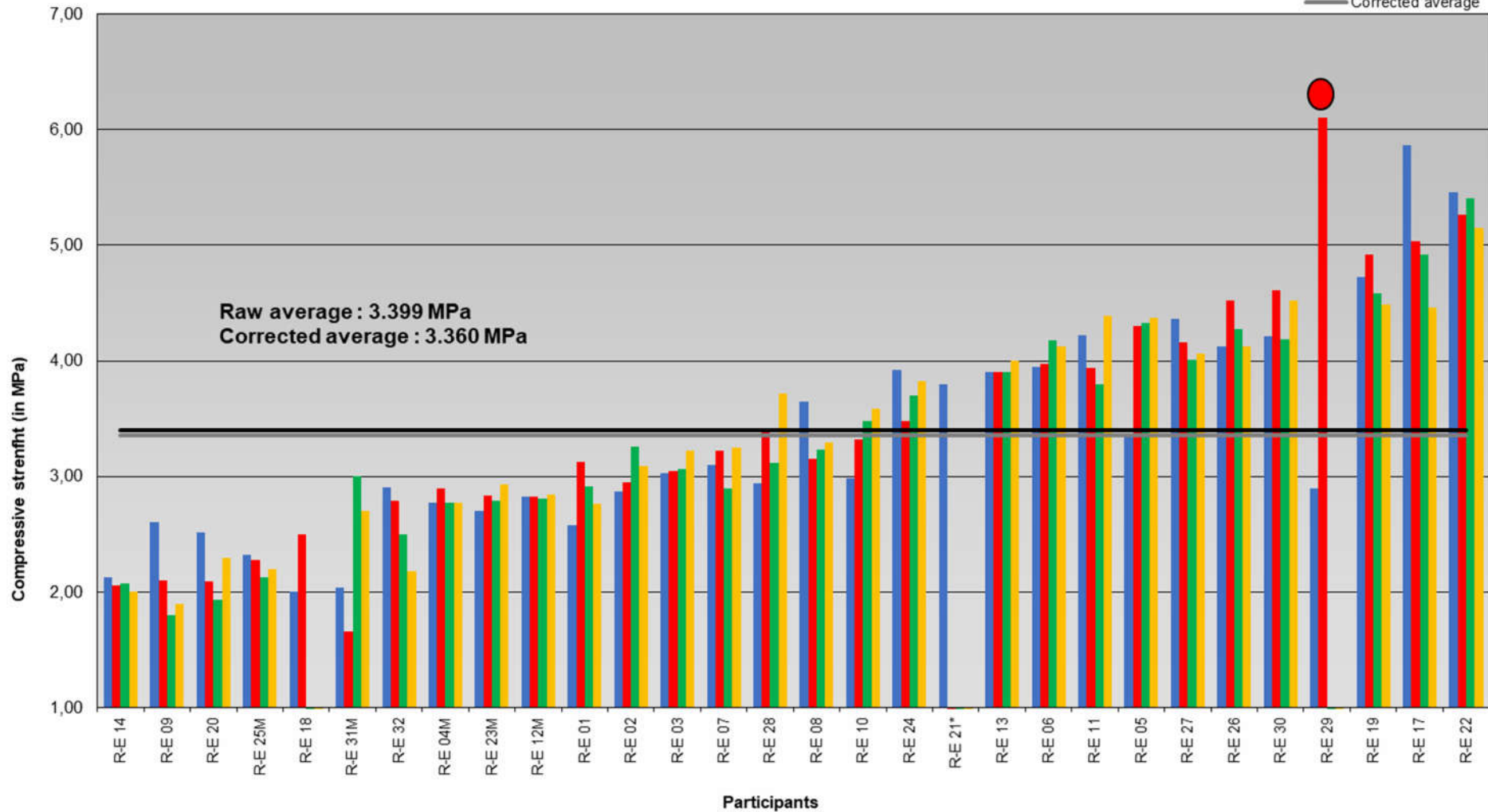
Campagne EAPIC N°11- Session 1 - Série 18
Determination of compressive strength Rci at 28 days in air
and 32 days in immersion
Specimens 50*100 mm

Average difference and Z-score value on raw data

Difference less than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 10	0.08	0.08
R-E 08	0.09	0.09
R-E 28	0.12	0.12
R-E 07	0.30	0.29
R-E 24	0.31	0.30
R-E 03	0.33	0.32
R-E 02	0.38	0.37
R-E 13	0.50	0.49
R-E 01	0.58	0.56
R-E 12M	0.59	0.58
R-E 23M	0.61	0.59
R-E 04M	0.61	0.60
R-E 06	0.64	0.62
R-E 11	0.67	0.65
R-E 05	0.67	0.65
R-E 27	0.73	0.71
R-E 32	0.83	0.80
R-E 26	0.84	0.82
R-E 30	0.96	0.94

Difference more than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 31M	1.07	1.04
R-E 29	1.08	1.05
R-E 18	1.17	1.14
R-E 25M	1.19	1.16
R-E 20	1.21	1.18
R-E 19	1.26	1.23
R-E 09	1.32	1.29
R-E 14	1.35	1.32
R-E 17	1.65	1.61
R-E 22	1.90	1.85

Rc at 60 days

Graphical representations

		Raw data	Results rejected by statistical tests
In MPa	**Number of results taken in account**	29	None
	Average m	3.772	
	Standard deviation repeatability	0.265	
	repeatability r	0.742	
	Standard deviation Reproducitibility	0.957	
	Reproducitibility R	2.680	

Raw data
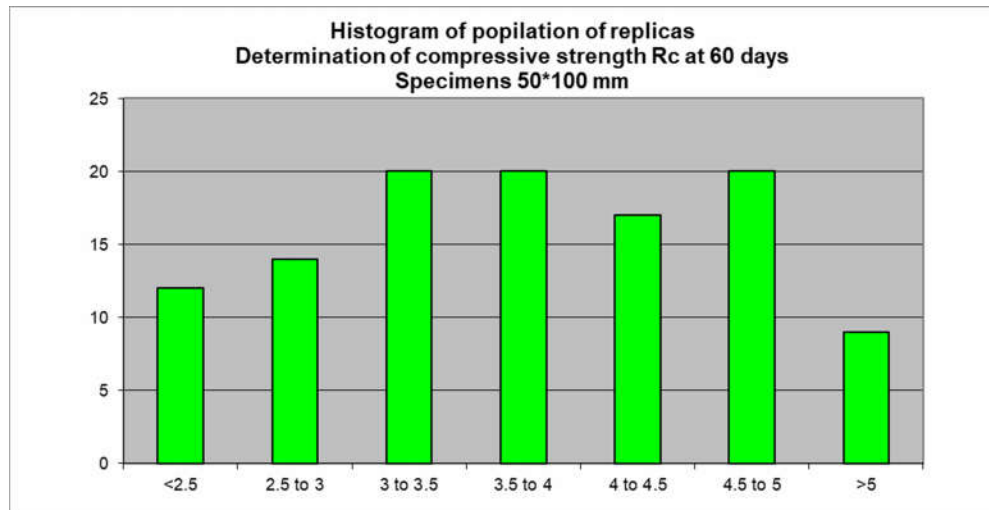
Campaign EAPIC N°11- Session 1 - Serie 18
Determination of compressive strength Rc at 60 days
Specimens 50*100 mm
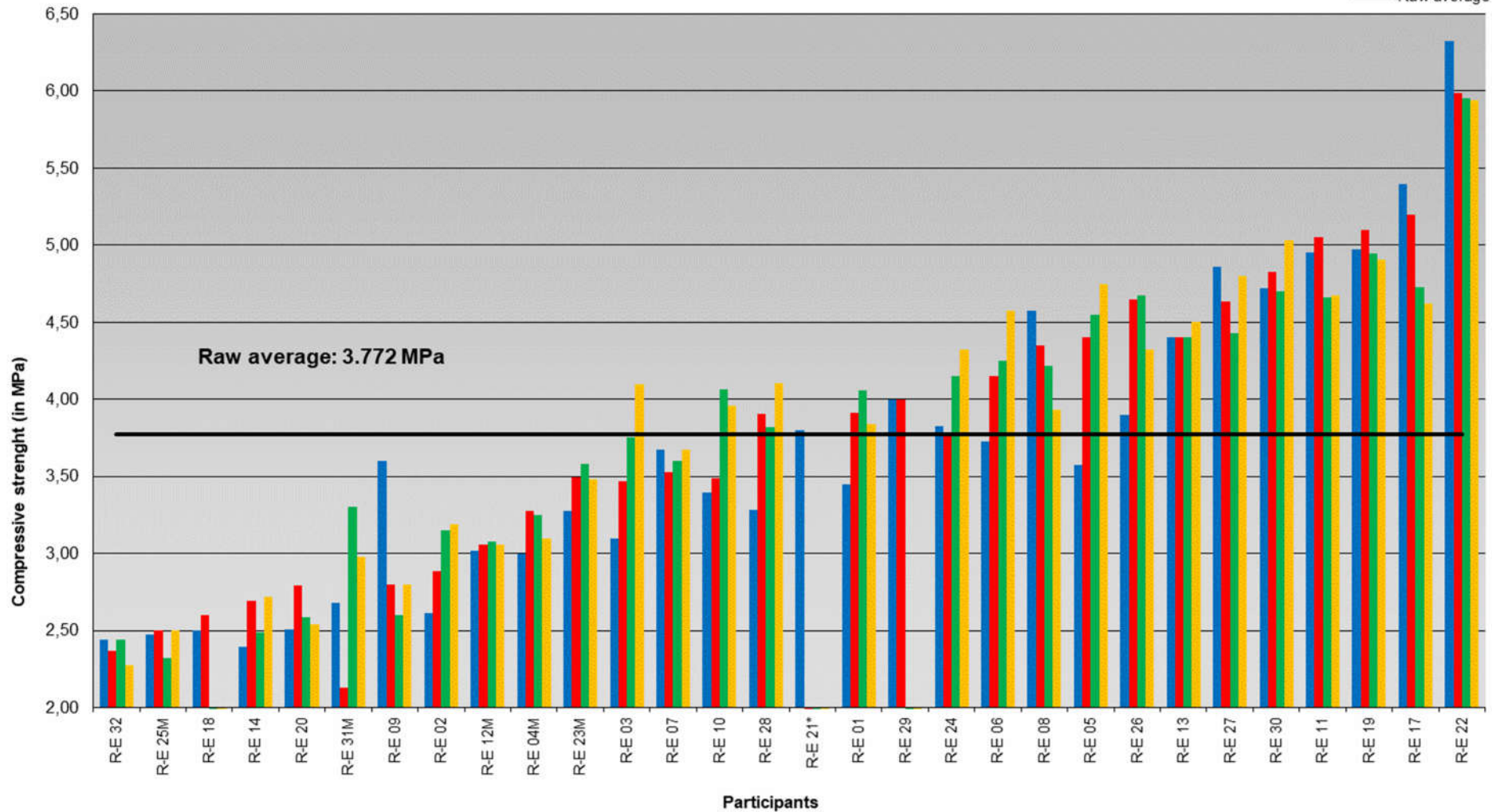
Average difference and Z-score value on raw data

Difference less than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 28	0.01	0.01
R-E 01	0.02	0.02
R-E 10	0.06	0.07
R-E 07	0.17	0.18
R-E 03	0.19	0.19
R-E 29	0.21	0.22
R-E 24	0.23	0.24
R-E 23M	0.33	0.35
R-E 06	0.38	0.40
R-E 08	0.48	0.50
R-E 05	0.53	0.55
R-E 26	0.60	0.62
R-E 04M	0.63	0.66
R-E 13	0.63	0.66
R-E 12M	0.74	0.77
R-E 02	0.83	0.87
R-E 09	0.84	0.88
R-E 27	0.89	0.93

Difference more than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 31M	1.02	1.06
R-E 30	1.03	1.08
R-E 11	1.04	1.09
R-E 20	1.18	1.23
R-E 19	1.19	1.24
R-E 17	1.19	1.25
R-E 14	1.22	1.27
R-E 18	1.24	1.30
R-E 25M	1.34	1.40
R-E 32	1.41	1.47

Difference more than 2 standard deviation

Code results	Average deviation	Z-Score
R-E 22	2.26	2.36

Determination of strength in immersion at early age (*) ratio R_{ci}/R_{c60}

(*) According to French Technical Guide « Traitement des sols à la chaux et/ou aux liants hydrauliques » for backfills and capping layers (January 2000).

# **D**etermination of strength in immersion at early age

Graphical representations

|		Raw data	Results rejected by statistical tests	Corrected data
No unityy	**Number of results taken in account**	29		28
	Average m	0,901		0.893
	Standard deviation repeatability	0.122	Cochran R-E29	0.058
	repeatability r	0.341		0.163
	Standard deviation Reproducitibility	0.139		0.096
	Reproducitibility R	0.389		0.268

Raw data
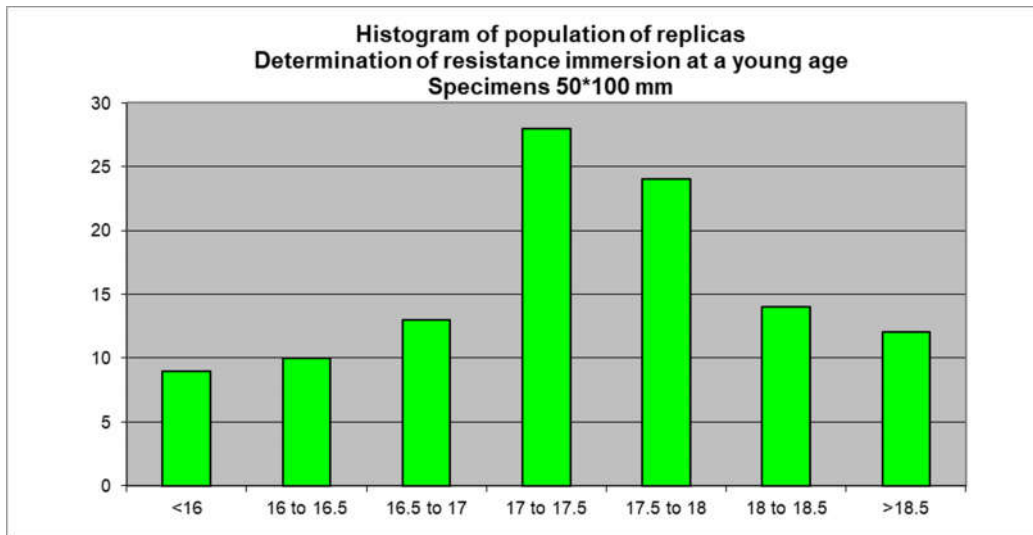
Corrected data
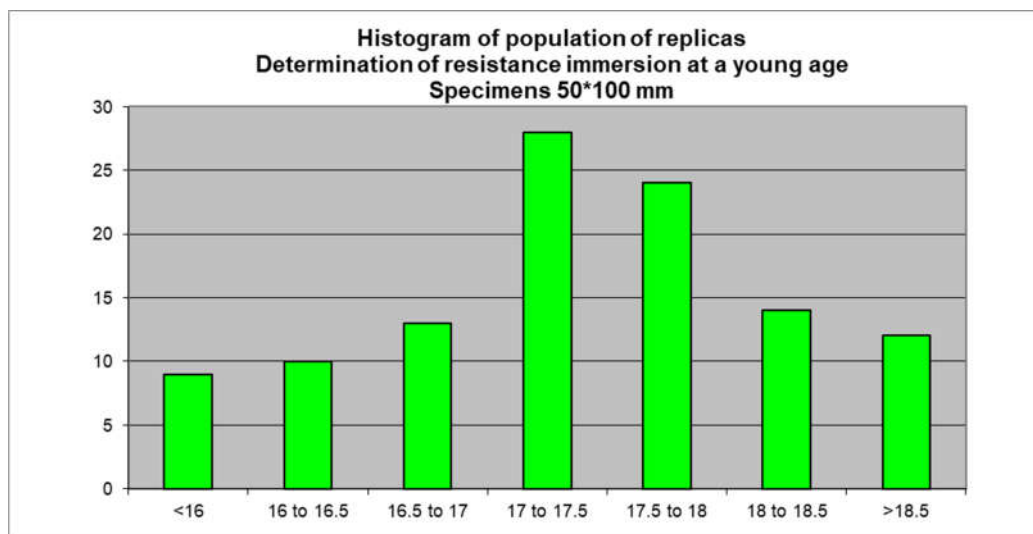
Campaign EAPIC N°11 - Session 1 - Serie 18
Determination of resistance immersion at a young age
Specimens 50*100 mm
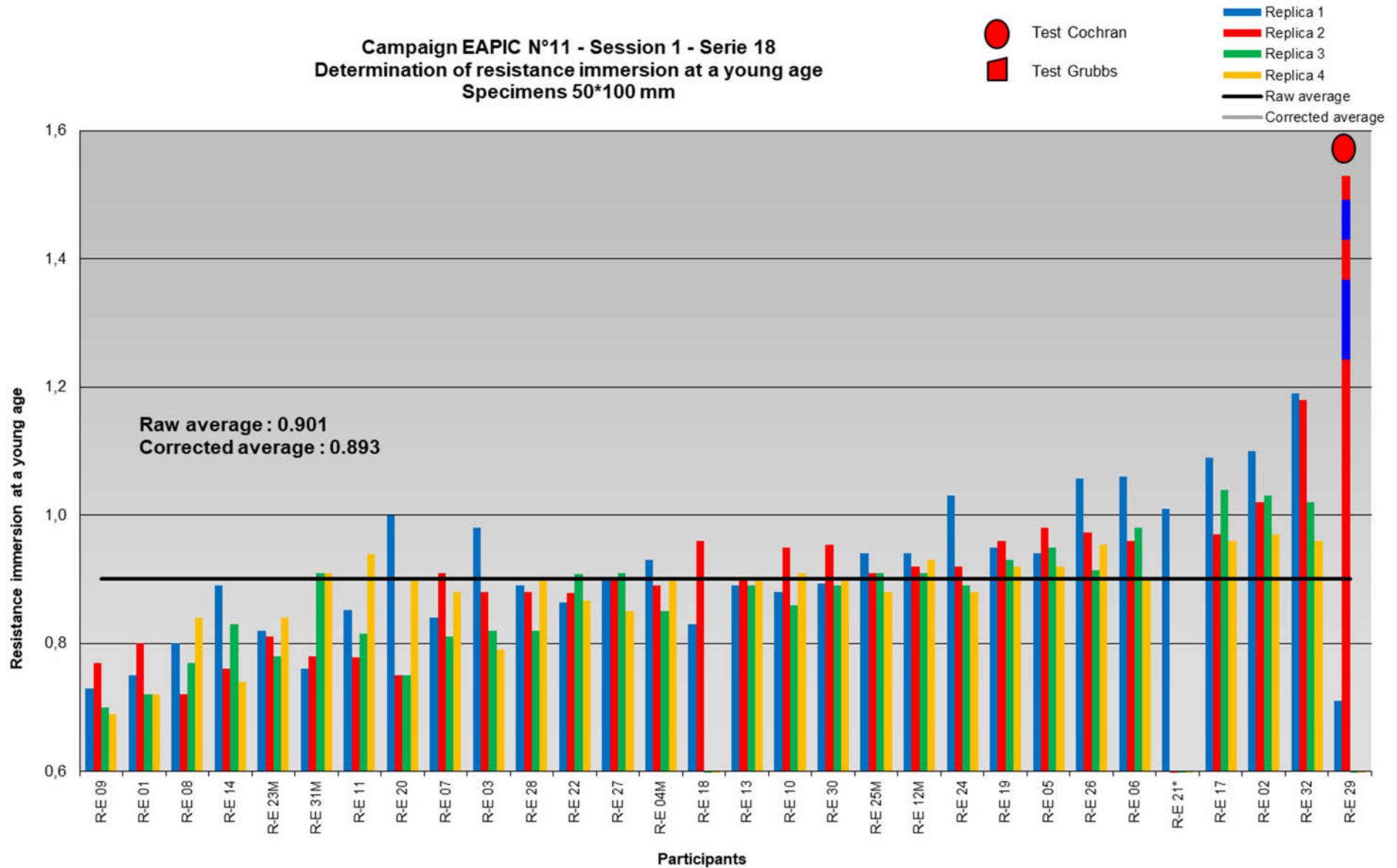
Raw average : 0.901
Corrected average : 0.893

Average difference and Z-score value on raw data

Difference less than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 13	0.00	0.01
R-E 10	0.00	0.02
R-E 04M	0.00	0.02
R-E 27	0.01	0.03
R-E 30	0.01	0.06
R-E 25M	0.01	0.06
R-E 22	0.02	0.09
R-E 28	0.02	0.12
R-E 12M	0.03	0.14
R-E 03	0.03	0.15
R-E 24	0.03	0.16
R-E 07	0.04	0.18
R-E 19	0.04	0.21
R-E 20	0.05	0.23
R-E 11	0.05	0.25
R-E 05	0.05	0.25
R-E 31M	0.06	0.28
R-E 26	0.08	0.39
R-E 06	0.08	0.39
R-E 23M	0.08	0.42
R-E 14	0.09	0.46
R-E 08	0.11	0.57
R-E 17	0.12	0.59
R-E 02	0.13	0.66
R-E 01	0.15	0.74
R-E 09	0.17	0.87
R-E 32	0.19	0.95

Difference more than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 29	0.34	1.67
R-E 18	0.45	2.23

Specimens 50x50 mm

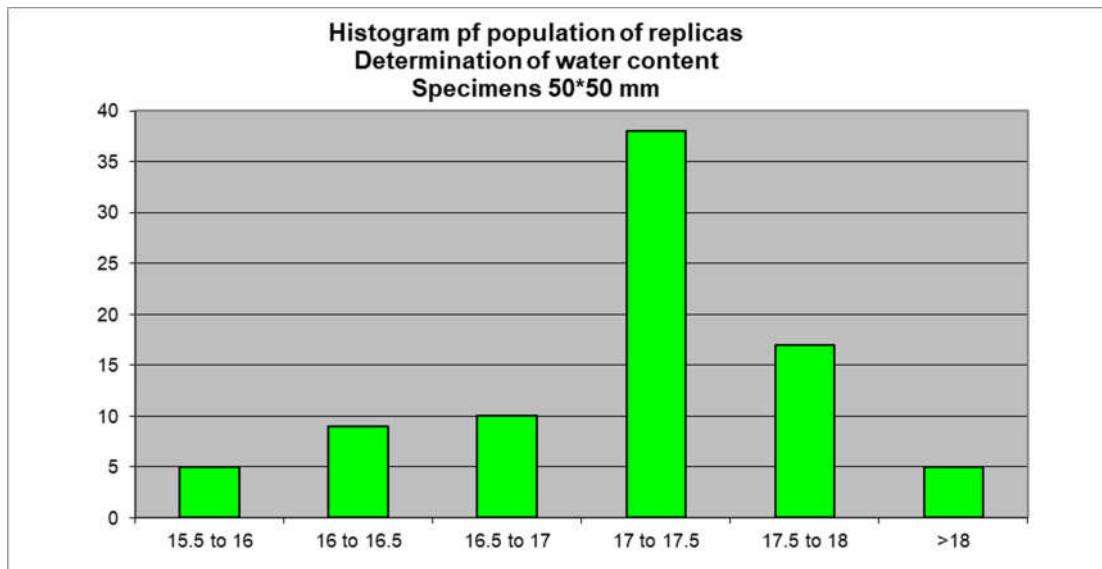# *Determination of water content (*)*

(*) free choice of method

Determination of water content

*Target value : 17.5%*

Graphical representations

		Raw data	Results rejected by statistical tests	Standard (NF EN 1097-5)
In %	**Number of results taken in account**	23	None	
	Average m	17.063		
	Standard deviation repeatability	0.413		
	repeatability r	1.156		r = 1.460
	Standard deviation Reproducitibility	0.801		
	Reproducitibility R	2.243		R = /

Raw data

Campaign EAPIC N°11- Session 1 - Serie 18
Determination of water content
Specimens 50*50 mm

![EAPIC - ESSAIS D'APTITUDE PAR ESSAI DE COMPARAISON]
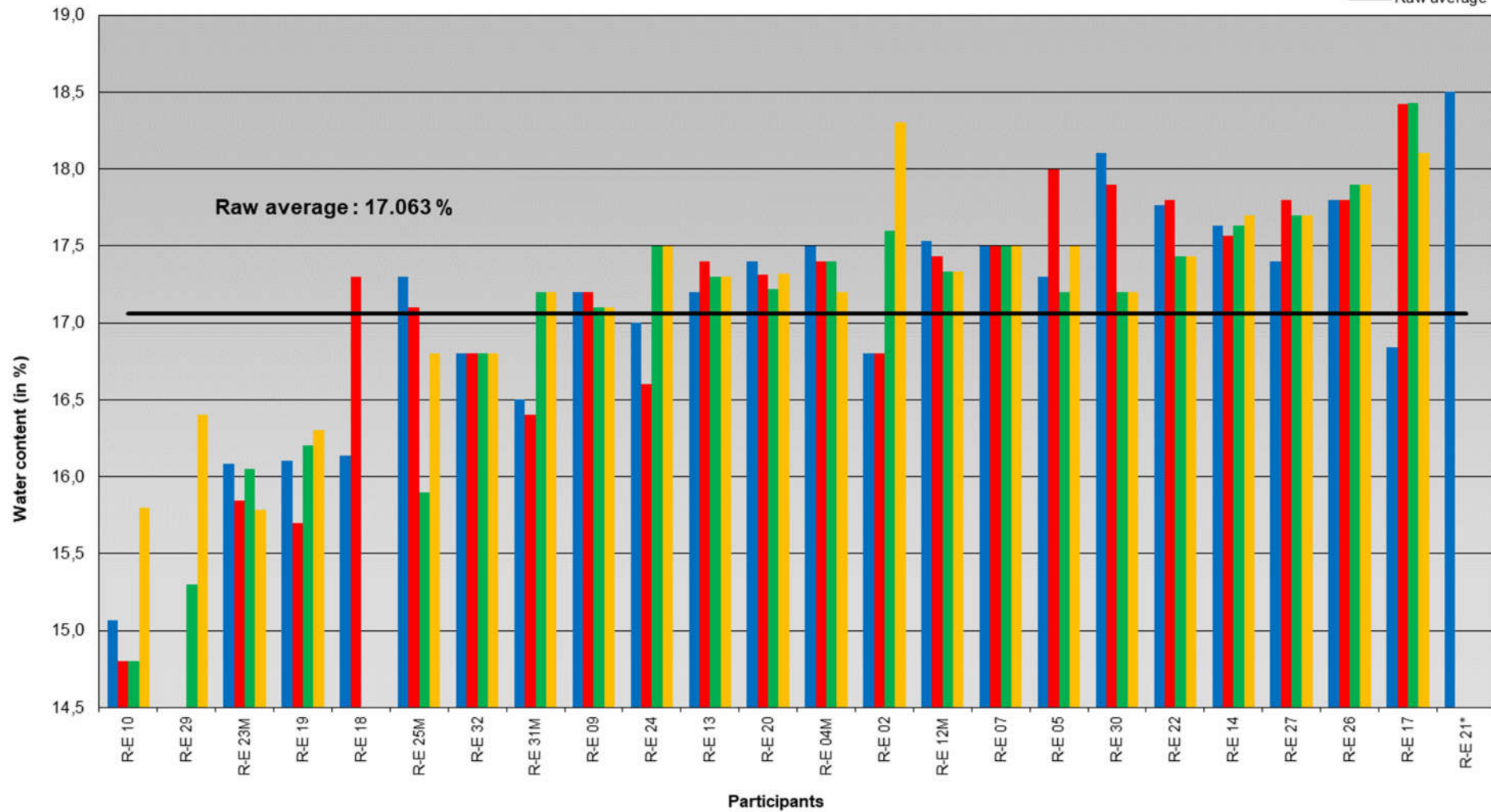
Average difference and Z-score value on raw data

Difference less than more 1 standard deviation

Code results	Average deviation	Z-Score
R-E 09	0.05	0.06
R-E 24	0.05	0.06
R-E 13	0.20	0.25
R-E 20	0.21	0.27
R-E 31M	0.27	0.34
R-E 04M	0.28	0.34
R-E 02	0.28	0.34
R-E 32	0.30	0.37
R-E 12M	0.31	0.39
R-E 25M	0.32	0.40
R-E 18	0.38	0.48
R-E 07	0.40	0.50
R-E 05	0.40	0.50
R-E 30	0.50	0.62
R-E 22	0.51	0.64
R-E 14	0.53	0.67
R-E 27	0.55	0.69
R-E 26	0.75	0.94

Difference more than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 17	0.85	1.06
R-E 19	1.02	1.28
R-E 23M	1.16	1.44
R-E 29	1.25	1.56

Difference more than 2 standard deviation

| Code results	Average deviation	Z-Score
R-E 10	1.98	2.47

Determination of compactness

Determination of compactness

Trget value : 96.0%

Graphical representations

		Raw data	Results rejected by statistical tests	Correcetd data
In %	Number of results taken in account	22		21
	Average m	95.616		95.417
	Standard deviation repeatability	0.314	Grubbs R-E23M	0.321
	repeatability r	0.880		0.899
	Standard deviation Reproducitibility	1.253		0.855
	Reproducitibility R	3.508		2.394

Raw data
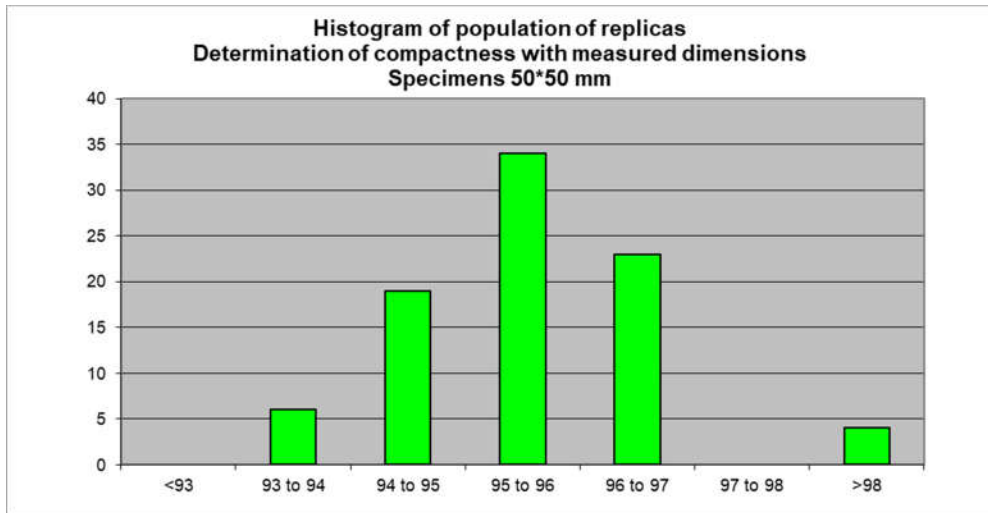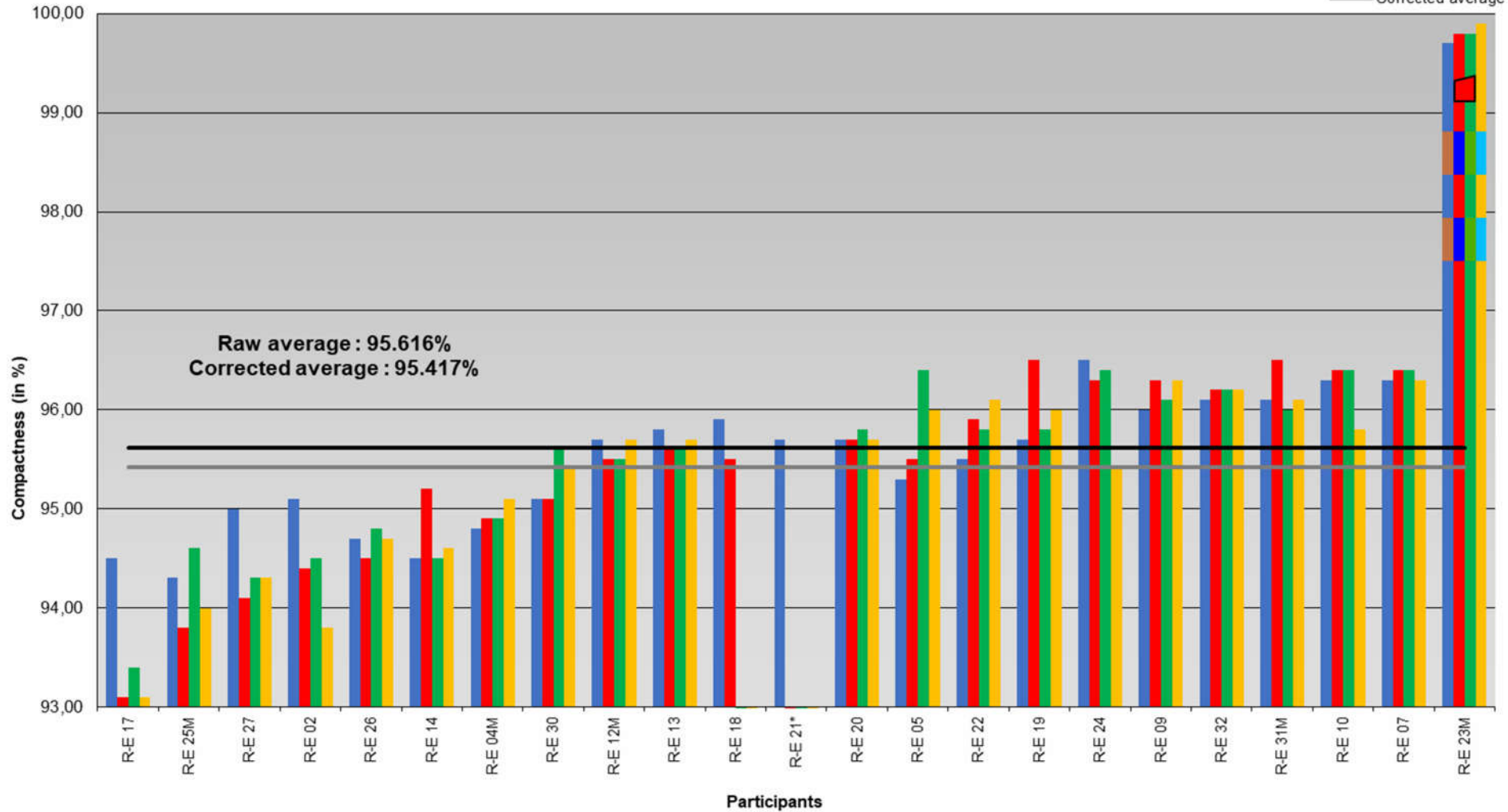

Corrected data
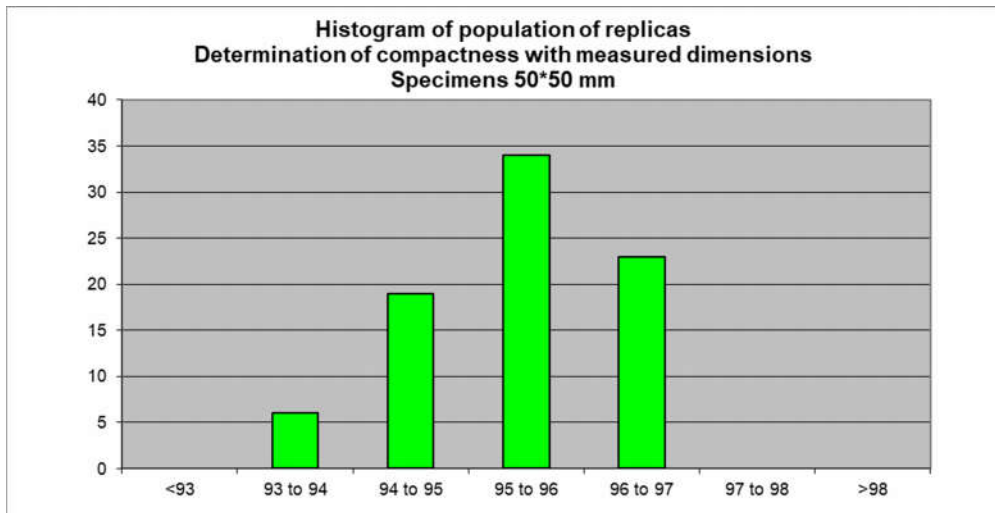
Campaign EAPIC N°11- Session 1 - Serie 18
Determination of compactness with measured dimensions
Specimens 50*50 mm

Average difference and Z-score value on raw data

Difference less than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 12M	0.01	0.01
R-E 13	0.06	0.05
R-E 18	0.09	0.07
R-E 20	0.11	0.09
R-E 05	0.19	0.15
R-E 22	0.21	0.17
R-E 30	0.31	0.25
R-E 19	0.39	0.31
R-E 24	0.54	0.43
R-E 09	0.56	0.45
R-E 32	0.56	0.45
R-E 31M	0.56	0.45
R-E 10	0.61	0.49
R-E 04M	0.69	0.55
R-E 07	0.74	0.59
R-E 14	0.91	0.73
R-E 26	0.94	0.75
R-E 02	1.16	0.93
R-E 27	1.19	0.95

Difference more than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 25M	1.44	1.15
R-E 17	2.09	1.67

Difference more than 2 standard eviation

Code results	Average deviation	Z-Score
R-E 23M	4.19	3.34

Determination of strength Rit
# *and modulus Eit (*)*

(*) According to standards NF EN 13286-42 (September 2003) and NF EN 13286-43 (July 2003).

Rit at 28 days

Graphical representations

		Raw data	Results rejected by statistical tests
	Number of results taken in account	23	
In MPa	Average m	0.305	None
	Standard deviation repeatability	0.028	
	repeatability r	0.079	
	Standard deviation Reproducitibility	0.081	
	Reproducitibility R	0.228	

Raw data
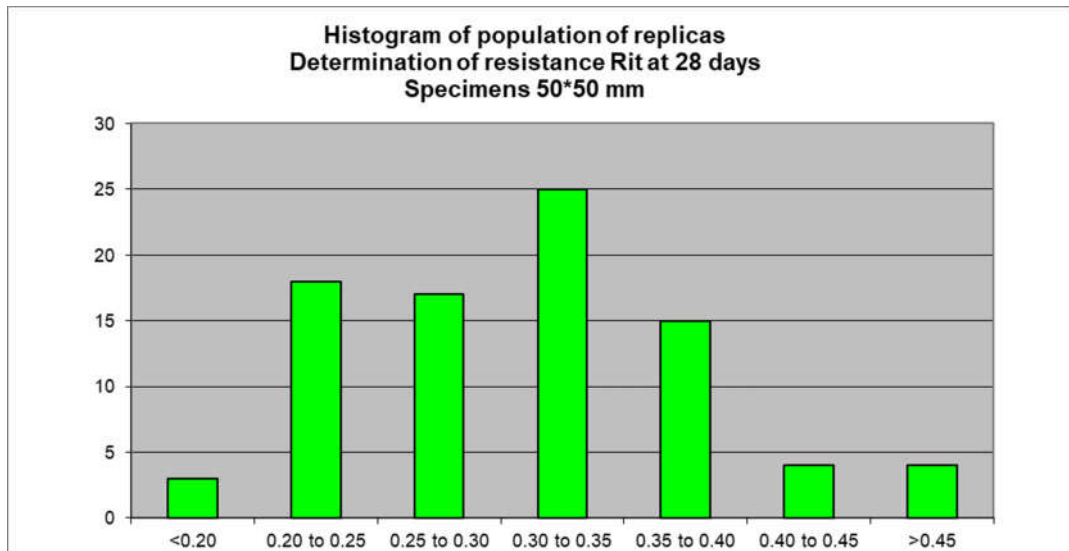
Histogram of population of replicas
Determination of resistance Rit at 28 days
Specimens 50*50 mm

Campaign EAPIC N°11- Session 1 - Serie 18
Determination of resistance Rit at 28 days
Specimens 50*50 mm
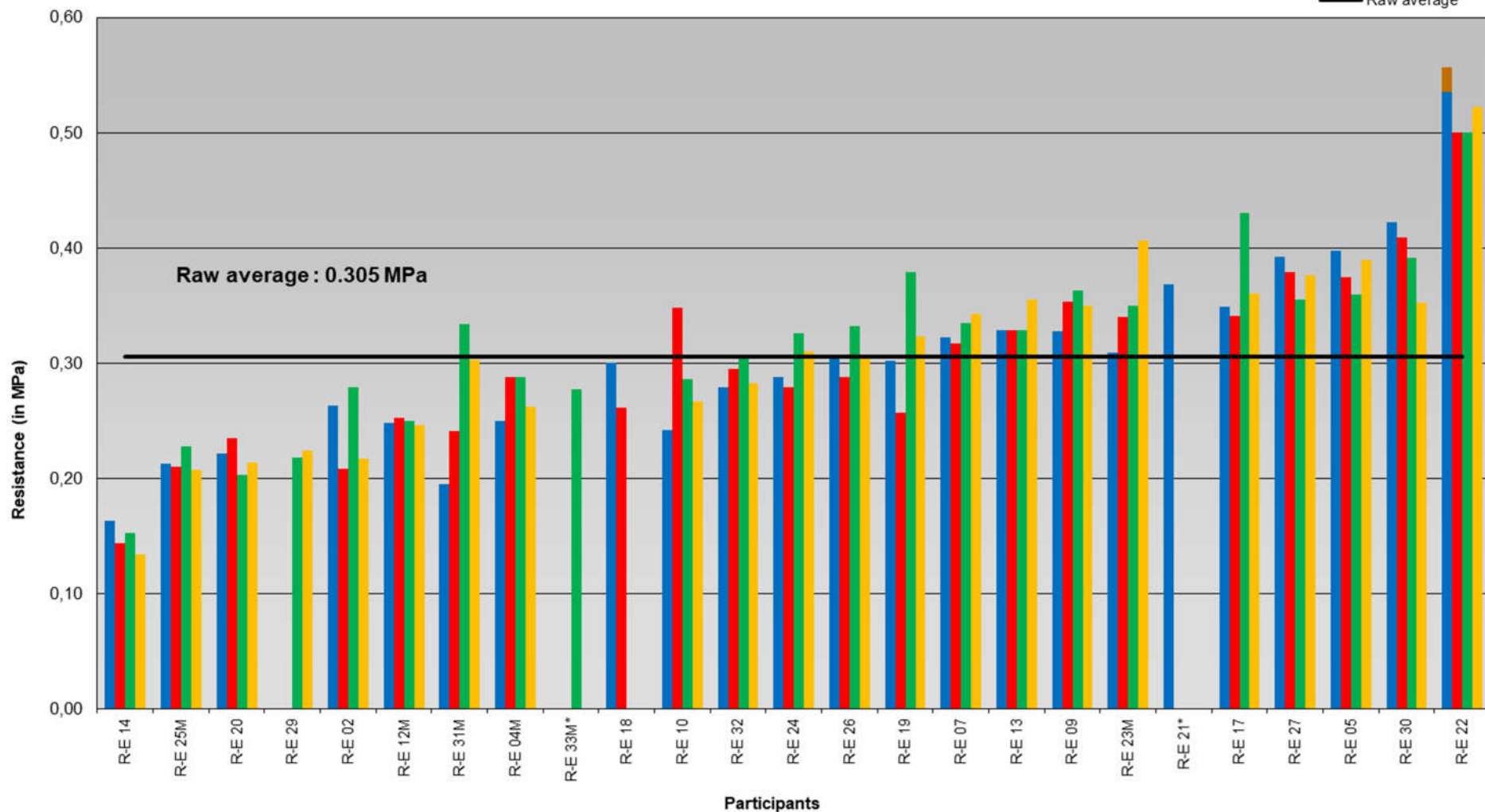
Average difference and Z-score value on raw data

Difference less than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 26	0.00	0.01
R-E 24	0.01	0.08
R-E 19	0.01	0.09
R-E 32	0.02	0.20
R-E 07	0.02	0.27
R-E 10	0.02	0.27
R-E 18	0.03	0.33
R-E 13	0.03	0.34
R-E 04M	0.04	0.44
R-E 31M	0.04	0.49
R-E 09	0.04	0.50
R-E 23M	0.04	0.54
R-E 12M	0.06	0.72
R-E 17	0.06	0.77
R-E 02	0.07	0.81
R-E 27	0.07	0.84
R-E 05	0.07	0.90

Difference more than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 30	0.09	1.05
R-E 29	0.09	1.06
R-E 20	0.09	1.10
R-E 25M	0.09	1.15
R-E 14	0.16	1.96

Difference more than 2 standard deviation

Code results	Average deviation	Z-Score
R-E 22	0.21	2.60

Eit at 28 days

Graphical representations

|		Raw data	Results rejected by statistical tests	Corrected data
In MPa	**Number of results taken in account**	22		21
	Average m	3529		3041
	Standard deviation repeatability	907	Cochran : R-E23M	294
	repeatability r	2540		823
	Standard deviation Reproducitibility	2613		1034
	Reproducitibility R	7315		2894

Raw data
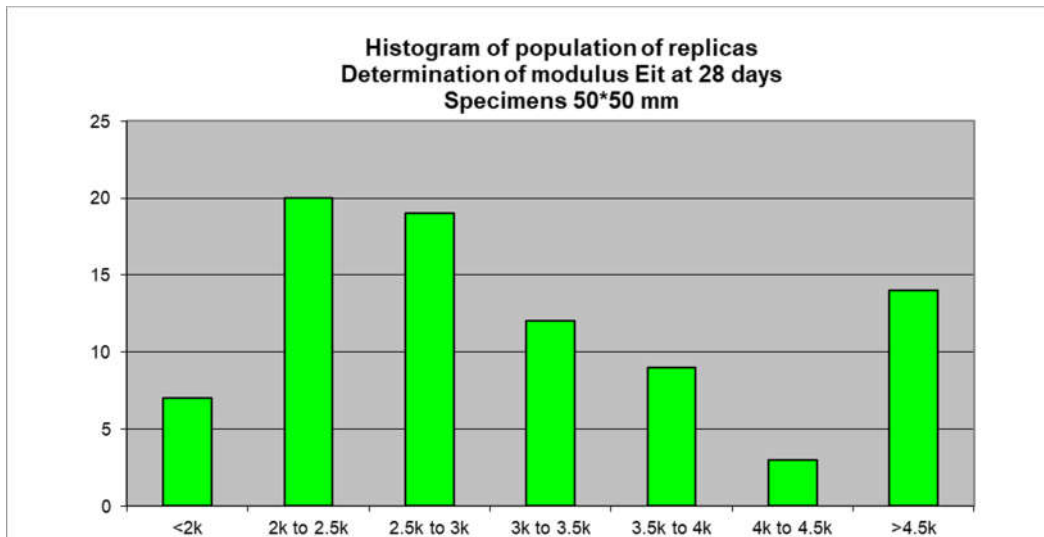
Corrected data
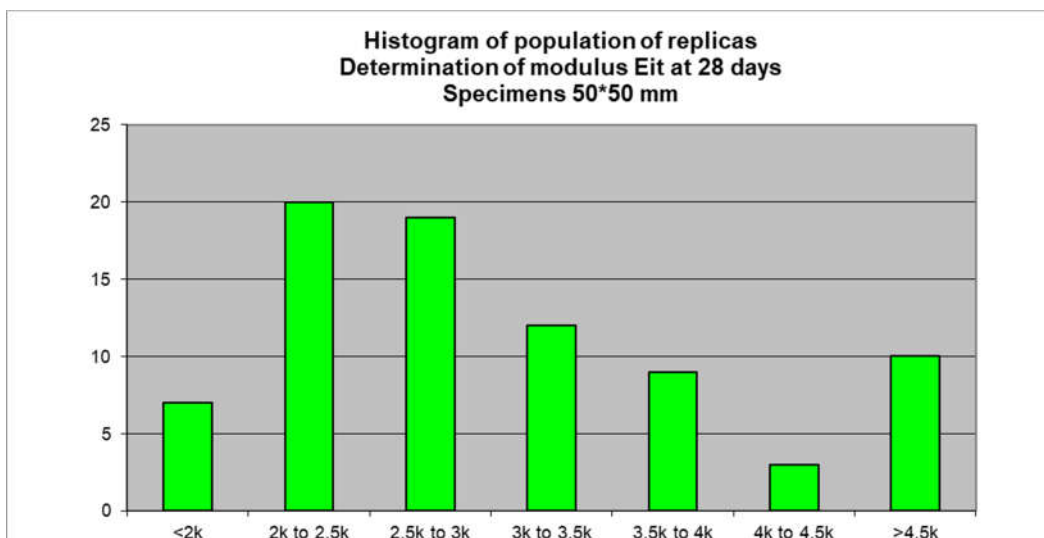
Campaign EAPIC N°11- Session 1 - Serie 18
Determination of modulus Eit at 28 days
Specimens 50*50 mm

Raw average: 3 529 MPa
Correcetd average : 3 041 MPa
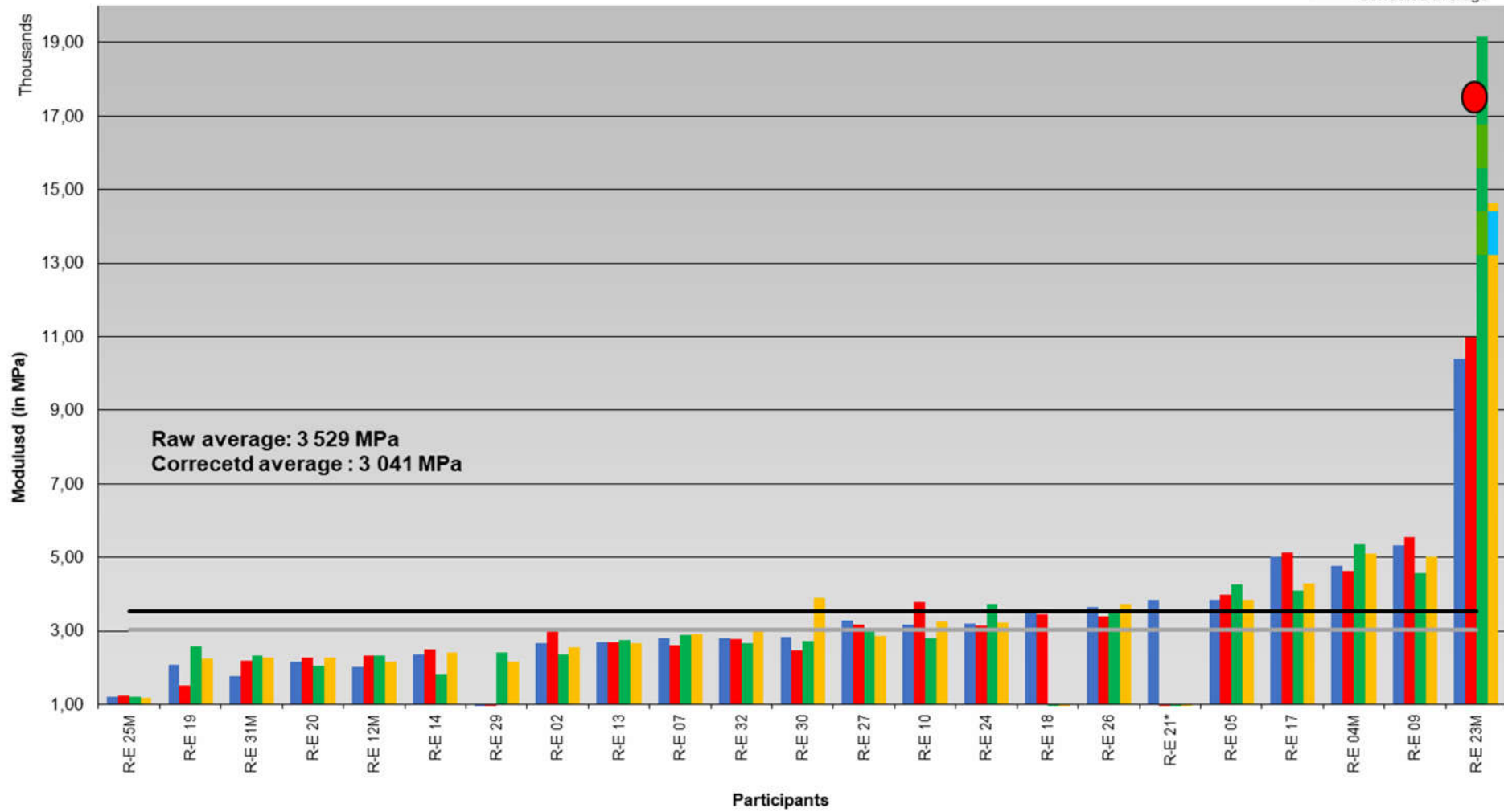
Average difference and Z-score value on raw data

Difference less than 1 standard deviation		
Code results	**Average deviation**	**Z-Score**
R-E 26	19.93	0.01
R-E 24	225.70	0.09
R-E 10	292.04	0.11
R-E 05	436.61	0.17
R-E 27	450.32	0.17
R-E 18	523.70	0.20
R-E 30	562.26	0.21
R-E 32	726.18	0.28
R-E 07	738.51	0.28
R-E 13	840.70	0.32
R-E 02	913.91	0.35
R-E 17	1090.43	0.42
R-E 29	1256.70	0.48
R-E 14	1271.16	0.49
R-E 12M	1337.70	0.51
R-E 20	1351.07	0.52
R-E 31M	1407.61	0.54
R-E 04M	1413.14	0.54
R-E 19	1439.80	0.55
R-E 09	1578.51	0.60
R-E 25M	2334.64	0.89

Difference more than 2 standard deviation		
Code results	**Average deviation**	**Z-Score**
R-E 23M	10243.18	3.91

Rit at 60 days

Graphical representations

		Raw data	Results rejected by statistical tests	Corrected data
In MPa	**Number of results taken in account**	23		21
	Average m	0.410	Cochran : R-E10 R-E31M	0.405
	Standard deviation repeatability	0.035		0.026
	repeatability r	0.098		0.073
	Standard deviation Reproducitibility	0.089		0.087
	Reproducitibility R	0.249		0.243

Raw data
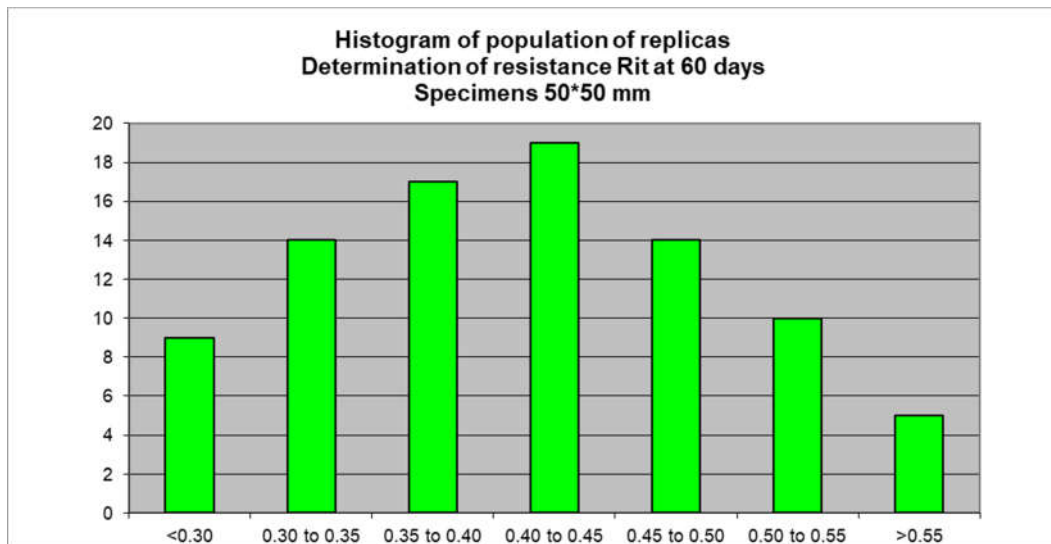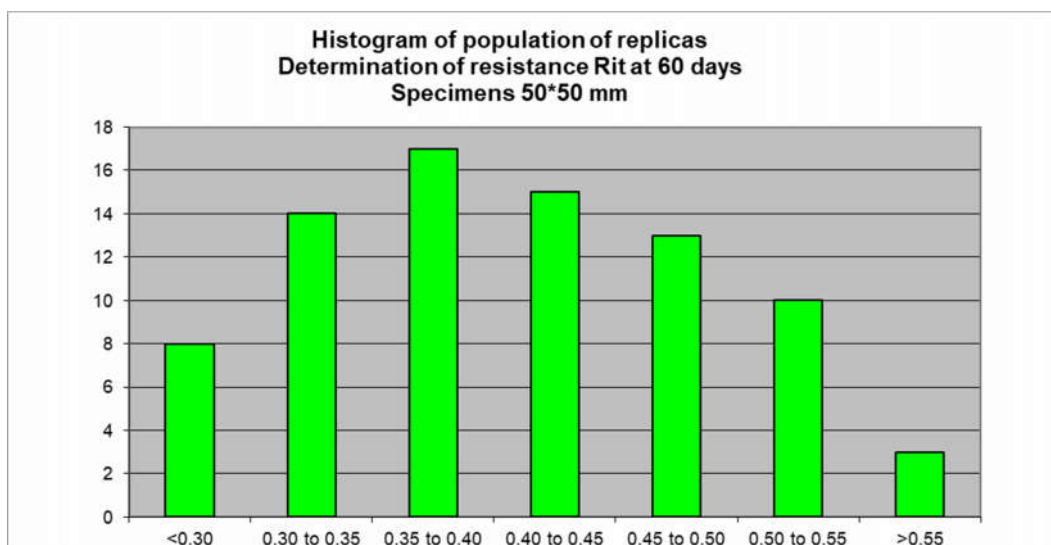
Histogram of population of replicas
Determination of resistance Rit at 60 days
Specimens 50*50 mm

Corrected data

Histogram of population of replicas
Determination of resistance Rit at 60 days
Specimens 50*50 mm

Campaign EAPIC N°11 - Session 1 - Serie 18
Determination of resistance Rit at 60 days
Specimens 50*50 mm

Raw average : 0.410 MPa
Corrected average : 0.405 MPa
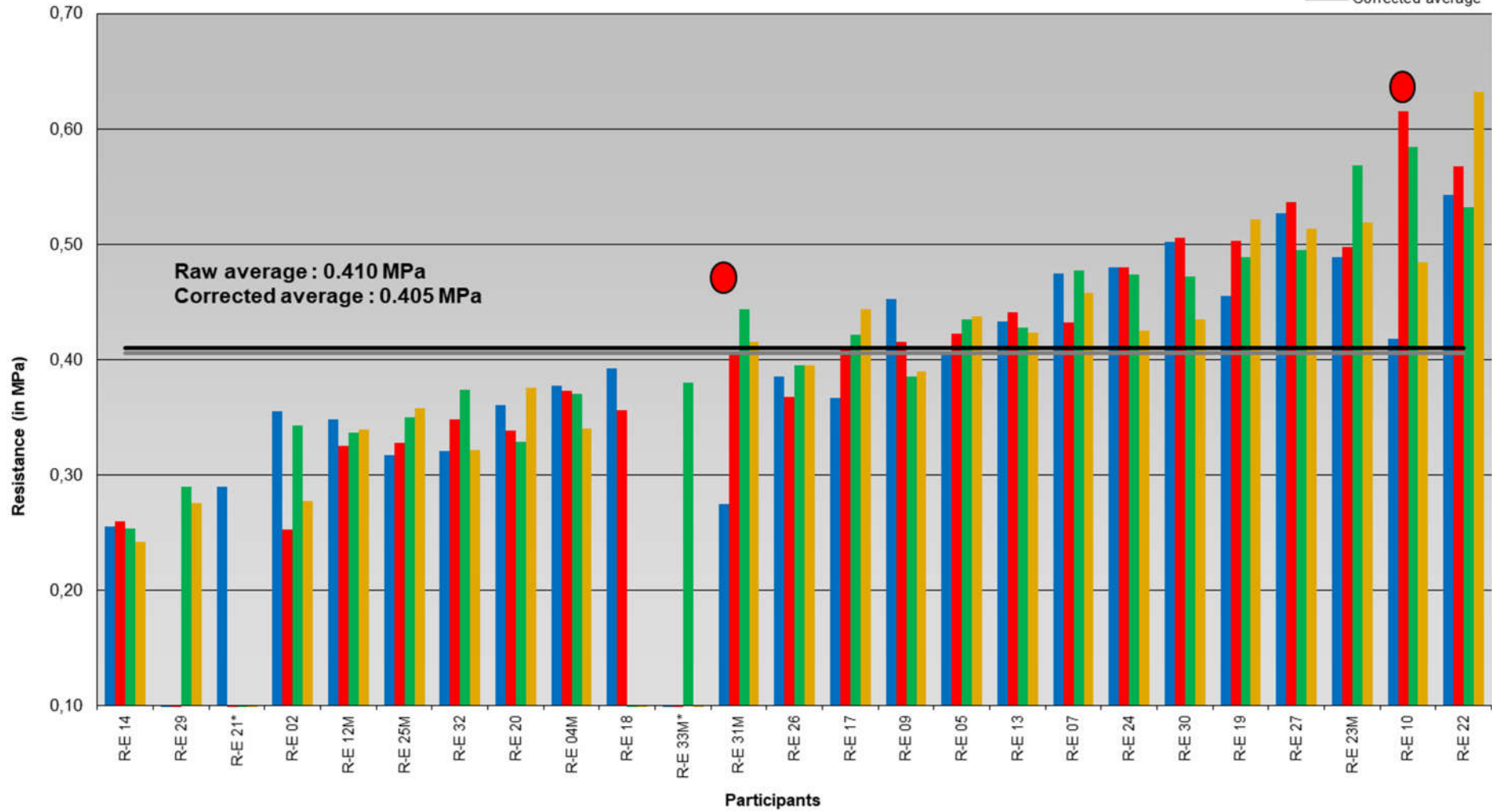
Average difference and Z-score value on raw data

Difference less than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 09	0.00	0.03
R-E 17	0.00	0.04
R-E 05	0.01	0.13
R-E 13	0.02	0.20
R-E 26	0.03	0.31
R-E 31M	0.03	0.32
R-E 18	0.04	0.44
R-E 07	0.05	0.53
R-E 04M	0.05	0.54
R-E 24	0.05	0.57
R-E 20	0.06	0.70
R-E 30	0.07	0.73
R-E 32	0.07	0.81
R-E 25M	0.08	0.84
R-E 12M	0.08	0.86
R-E 19	0.08	0.88

Difference more than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 27	0.10	1.17
R-E 23M	0.11	1.18
R-E 02	0.11	1.19
R-E 10	0.11	1.26
R-E 29	0.13	1.46
R-E 22	0.16	1.74
R-E 14	0.16	1.80

Eit at 60 days

Graphical reprensentations

		Raw data	Results rejected by statistical tests	Corrected data
In MPa	Number of results taken in account	22		19
	Average m	4850	Cochran : R-E23M R-E18 R-E17	3995
	Standard deviation repeatability	731		355
	repeatability r	2046		995
	Standard deviation Reproducitibility	2915		1129
	Reproducitibility R	8162		3162

Raw data
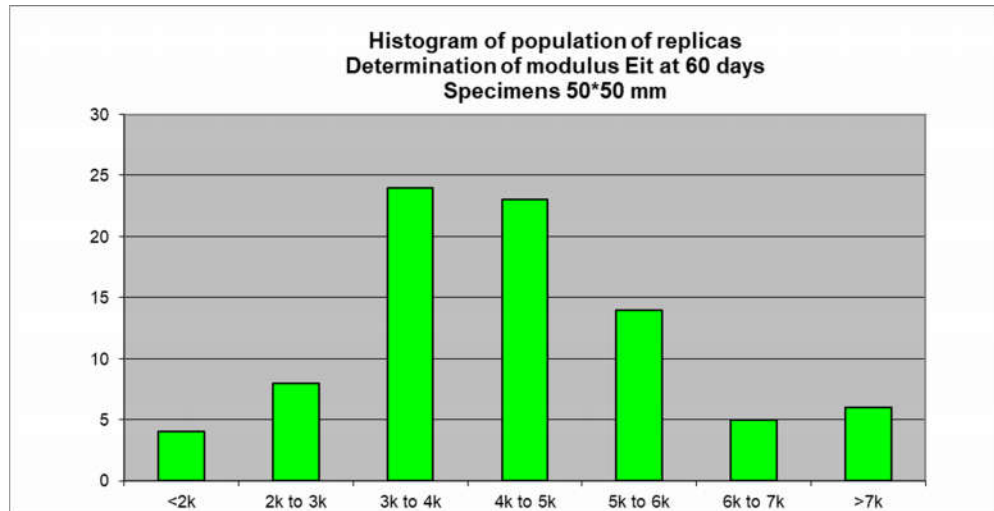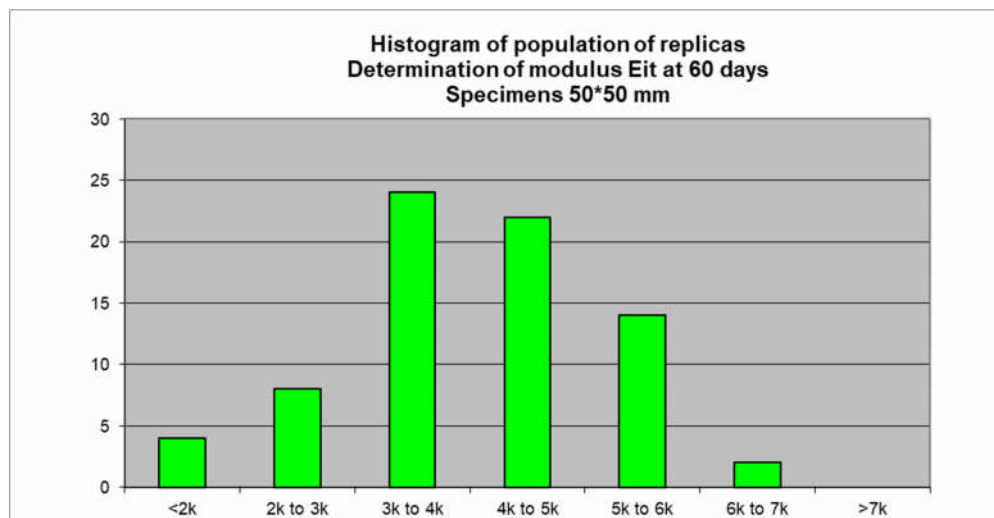
Histogram of population of replicas
Determination of modulus Eit at 60 days
Specimens 50*50 mm

Corrected data

Histogram of population of replicas
Determination of modulus Eit at 60 days
Specimens 50*50 mm

Campaign EAPIC N°11- Session 1 - Serie 18
Determination of modulus Eit at 60 days
Specimens 50*50 mm
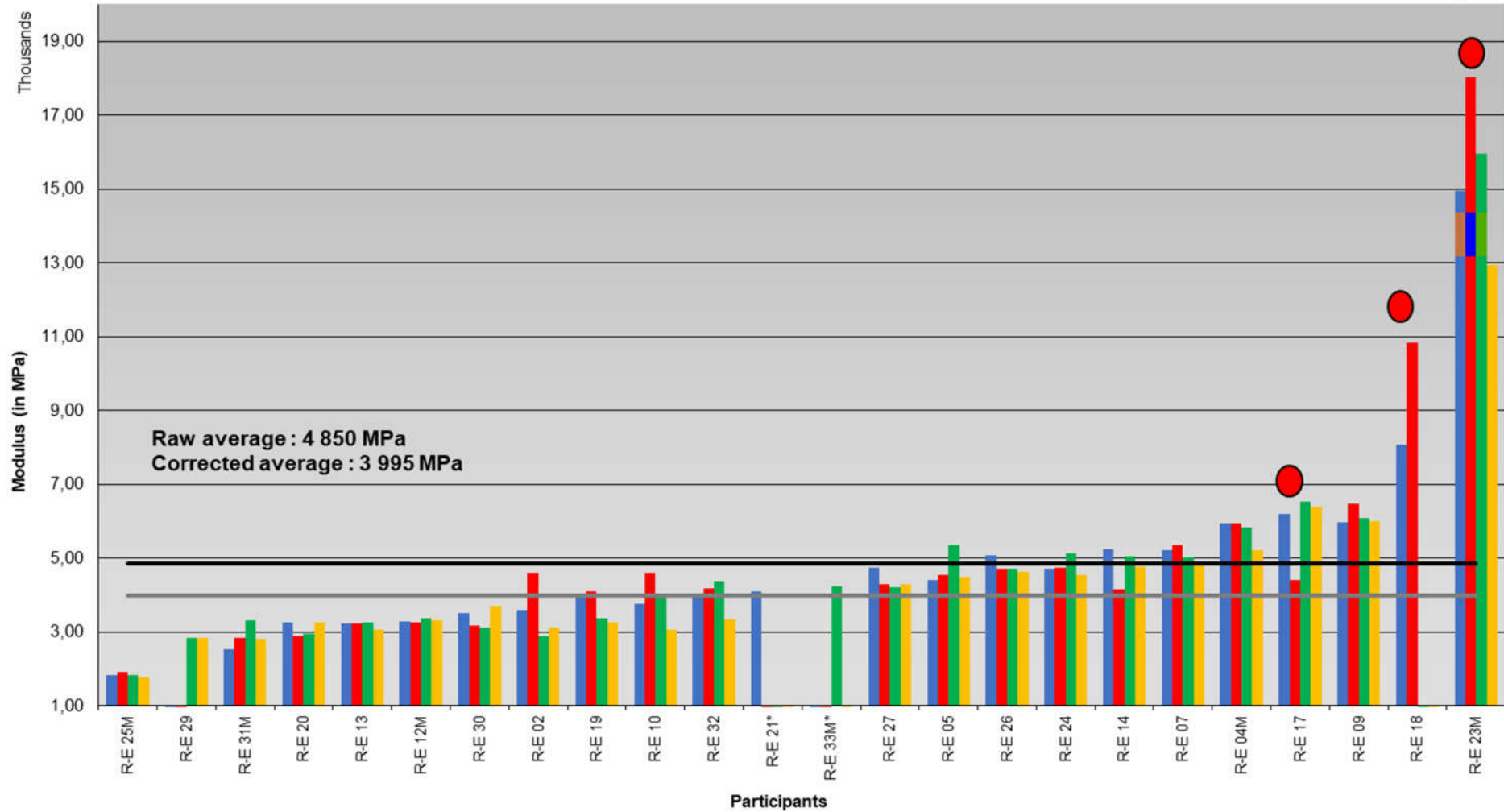
Average difference and Z-score value on raw data

Difference less than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 24	10.27	0.00
R-E 14	11.23	0.00
R-E 26	12.68	0.00
R-E 05	95.35	0.03
R-E 07	312.61	0.11
R-E 27	409.99	0.14
R-E 32	834.68	0.29
R-E 10	928.35	0.32
R-E 04M	941.86	0.32
R-E 17	1088.69	0.37
R-E 19	1112.74	0.38
R-E 02	1235.95	0.42
R-E 09	1338.92	0.46
R-E 30	1411.24	0.48
R-E 12M	1494.43	0.51
R-E 13	1598.74	0.55
R-E 20	1703.49	0.58
R-E 31M	1921.58	0.66
R-E 29	1949.74	0.67

Difference more than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 25M	2957.37	1.01
R-E 18	4663.76	1.60

Difference more than 2 standard deviation

Code results	Average deviation	Z-Score
R-E 23M	10676.57	3.66

Rit at 90 days

Graphical representations

|		Raw data	Results rejected by statistical tests	Corrected data
	Number of results taken in account	23		21
In MPa	Average m	0.473	Cochran : R-E22 R-E31M	0.468
	Standard deviation repeatability	0.034		0.025
	repeatability r	0.096		0.070
	Standard deviation Reproducitibility	0.096		0.091
	Reproducitibility R	0.268		0.253

Raw data
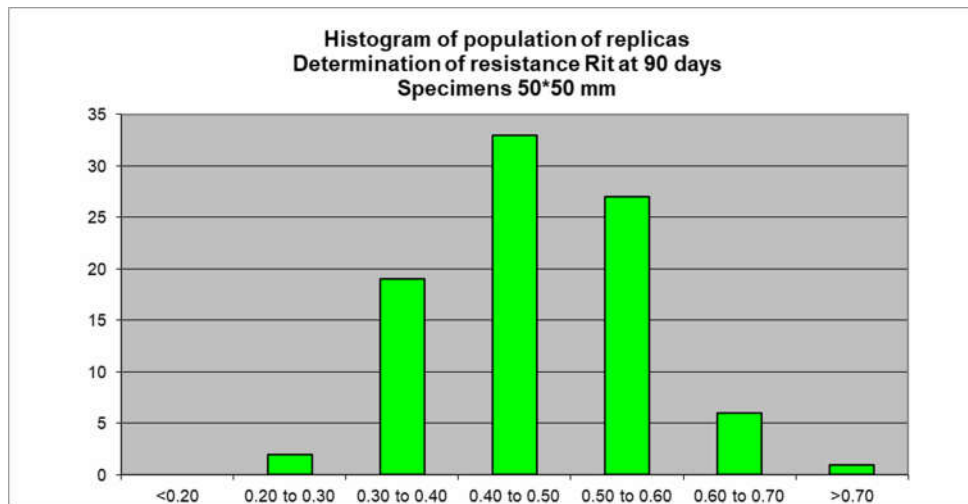
Corrected data
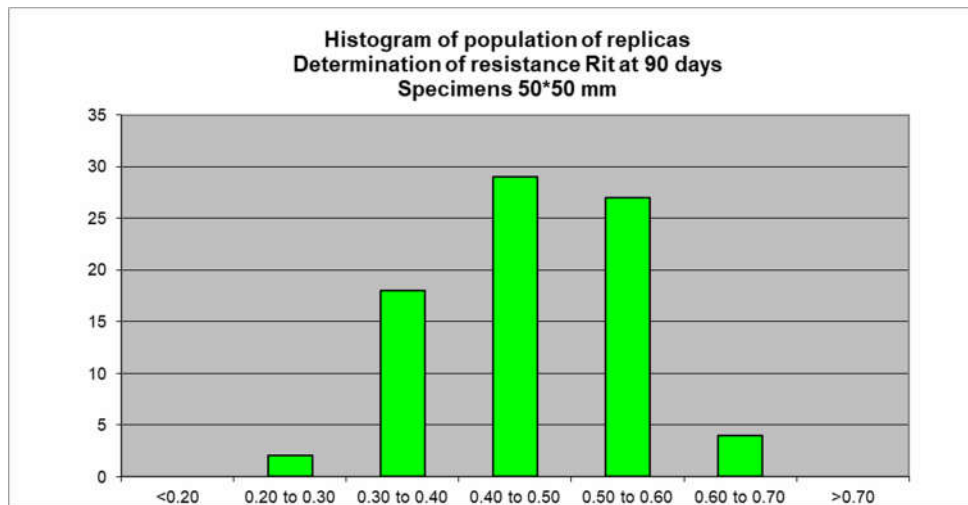
Campaign EAPIC N°11- Session 1 - Serie 18
Determination of resistance Rit at 90 days
Specimens 50*50 mm
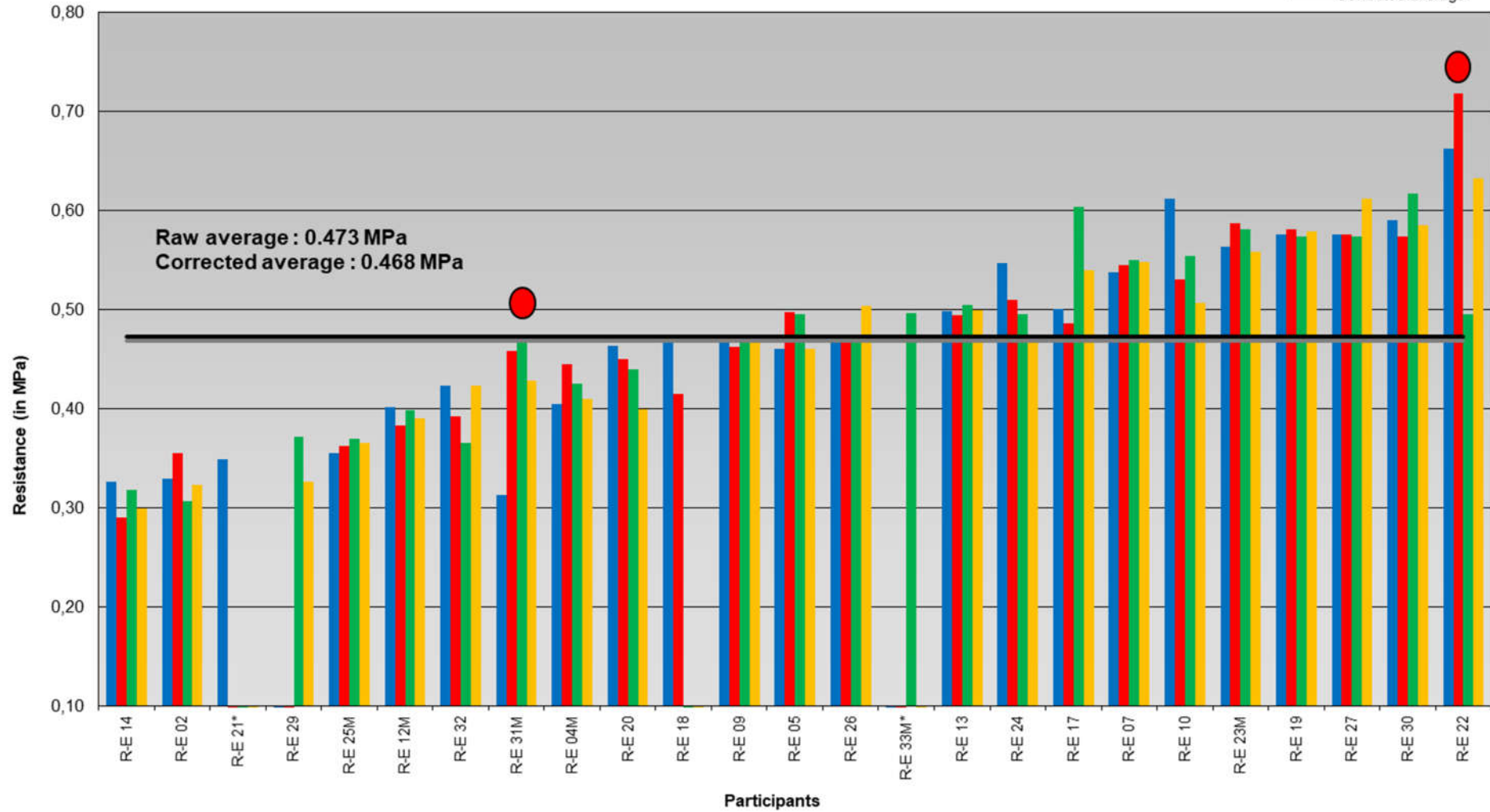
Average difference and Z-score value on raw data

Difference less than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 05	0.00	0.02
R-E 26	0.00	0.02
R-E 09	0.01	0.07
R-E 13	0.02	0.24
R-E 24	0.03	0.31
R-E 18	0.03	0.33
R-E 20	0.04	0.40
R-E 04M	0.06	0.58
R-E 17	0.06	0.58
R-E 31M	0.06	0.61
R-E 07	0.07	0.72
R-E 10	0.07	0.78
R-E 32	0.08	0.79
R-E 12M	0.08	0.87

Difference more than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 23M	0.10	1.00
R-E 19	0.10	1.05
R-E 27	0.11	1.13
R-E 25M	0.11	1.18
R-E 30	0.12	1.20
R-E 29	0.13	1.33
R-E 02	0.15	1.54
R-E 22	0.15	1.57
R-E 14	0.17	1.75

Eit at 90 days

Graphical representations

|		Raw data	Results rejected by statistical tests	Corrected data
In MPa	**Number of results taken in account**	22		18
	Average m	5200	Cochran : R-E23 R-E18 R-E17 R-E24	4657
	Standard deviation repeatability	700		313
	repeatability r	1960		878
	Standard deviation Reproducitibility	2264		1421
	Reproducitibility R	6339		3978

Raw data
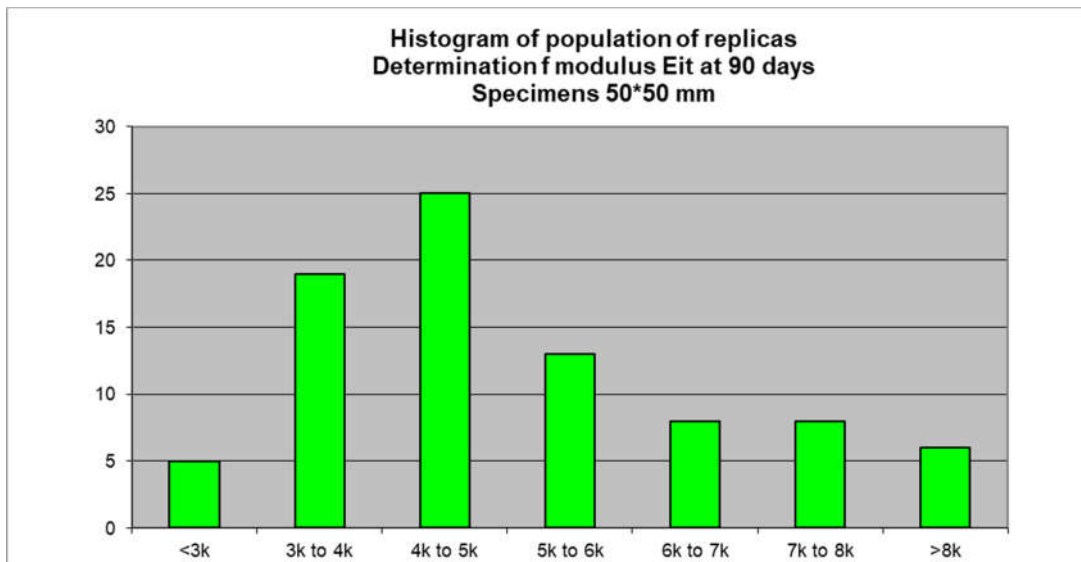
Corrected data
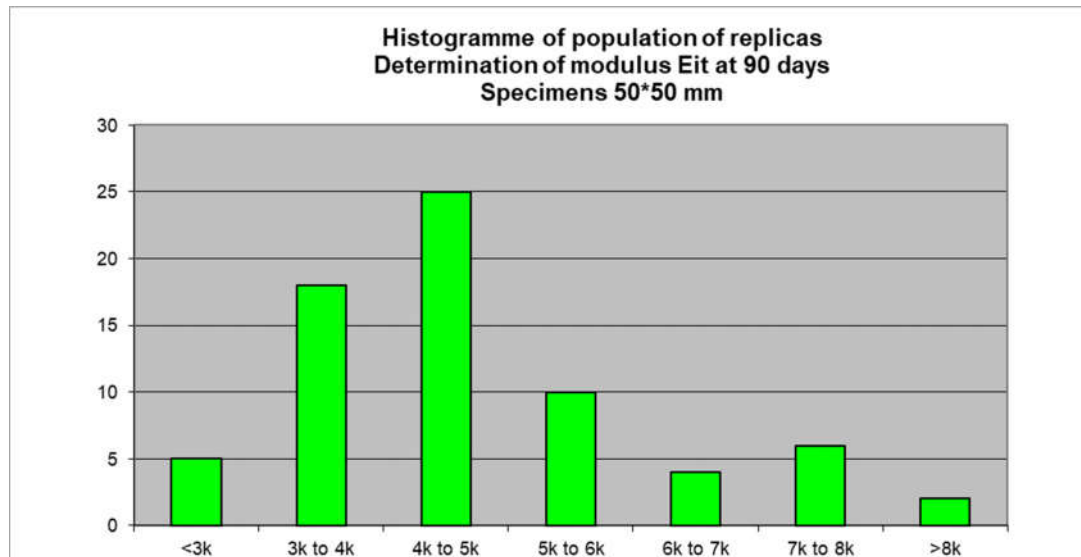
Campaign EAPIC N°11- Session 1 - Serie 18
Determination of modulus Eit at 90 days
Specimens 50*50 mm
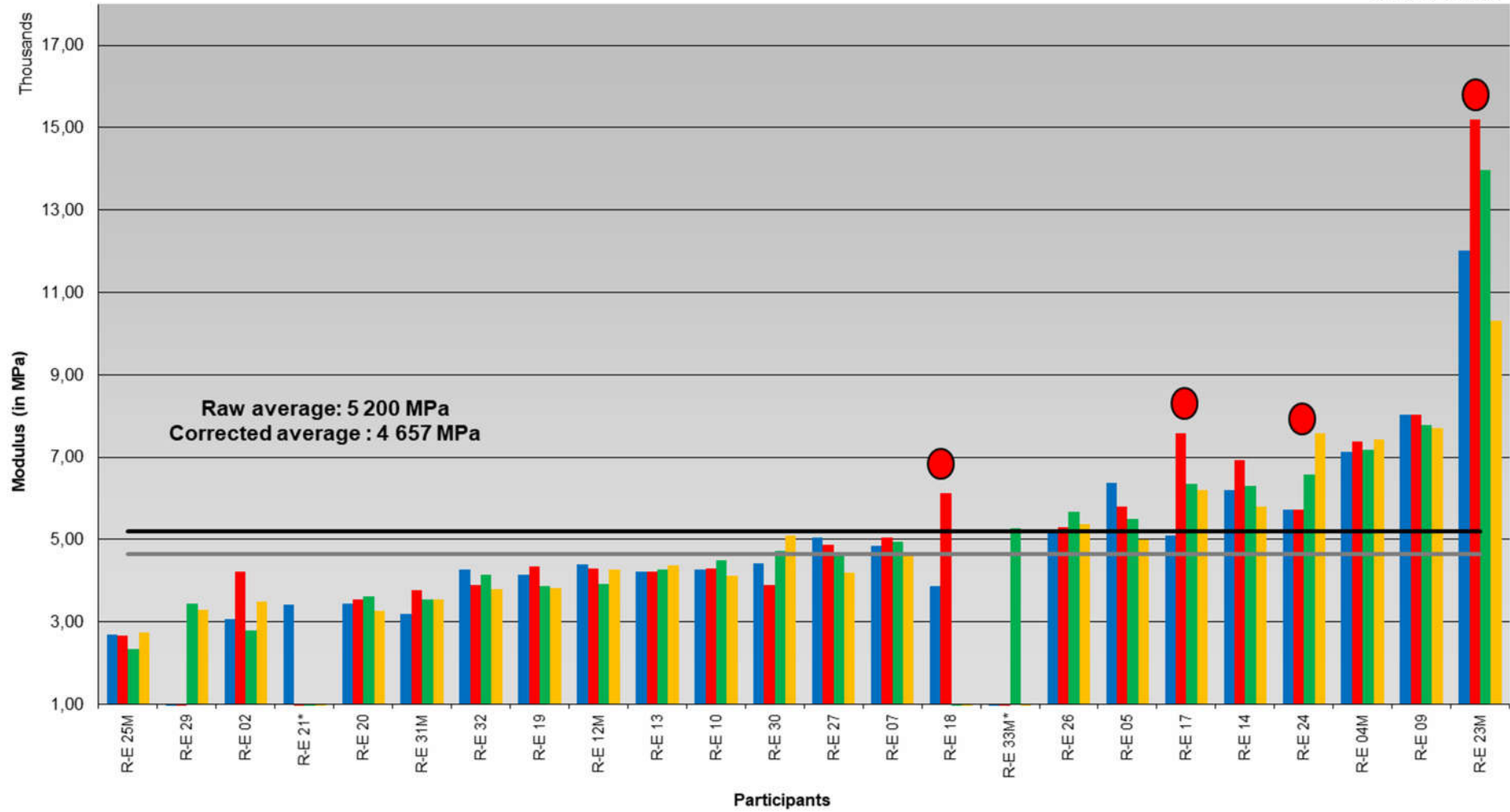
Average difference and Z-score value on raw data

Difference less than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 26	151.27	0.07
R-E 18	258.21	0.11
R-E 07	396.09	0.17
R-E 05	415.66	0.18
R-E 27	556.52	0.25
R-E 30	716.29	0.32
R-E 10	947.67	0.42
R-E 13	974.09	0.43
R-E 12M	1026.46	0.45
R-E 17	1058.96	0.47
R-E 14	1059.39	0.47
R-E 24	1153.73	0.51
R-E 19	1204.25	0.53
R-E 32	1228.36	0.54
R-E 31M	1737.34	0.77
R-E 20	1775.77	0.78
R-E 02	1860.52	0.82
R-E 29	1870.59	0.83
R-E 04	2031.39	0.90

Difference more than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 09	2637.10	1.16
R-E 25M	2642.59	1.17

Difference more than 2 standard deviation

Code results	Average deviation	Z-Score
R-E 23M	7622.83	3.37

Specimens 100x100 mm

Determination of water content (*)

(*) free choice of method

Determination of water content

Target value : 17.5%

Graphical representations

|		Raw data	Results rejected by statistical tests	Corrected data	standard NF EN 1097-5
In %	Number of results taken in account	14	Cochran R-E17	13	
	Average m	17.702		17.683	
	Standard deviation repeatability	0.381		0.312	
	repeatability r	1.066		0.873	r = 1.507
	Standard deviation Reproducitibility	0.656		0.646	
	Reproducitibility R	1.838		1.808	R = /

Raw data
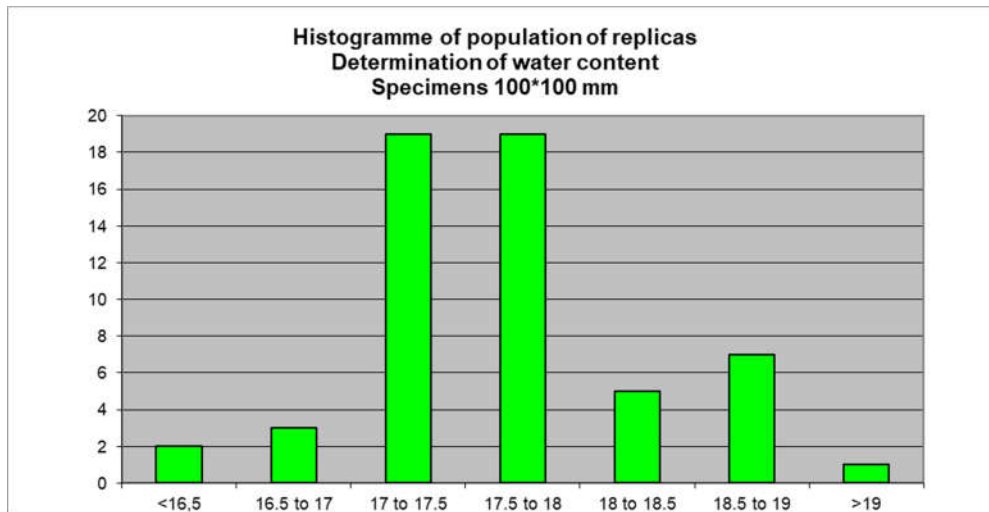
Corrected data
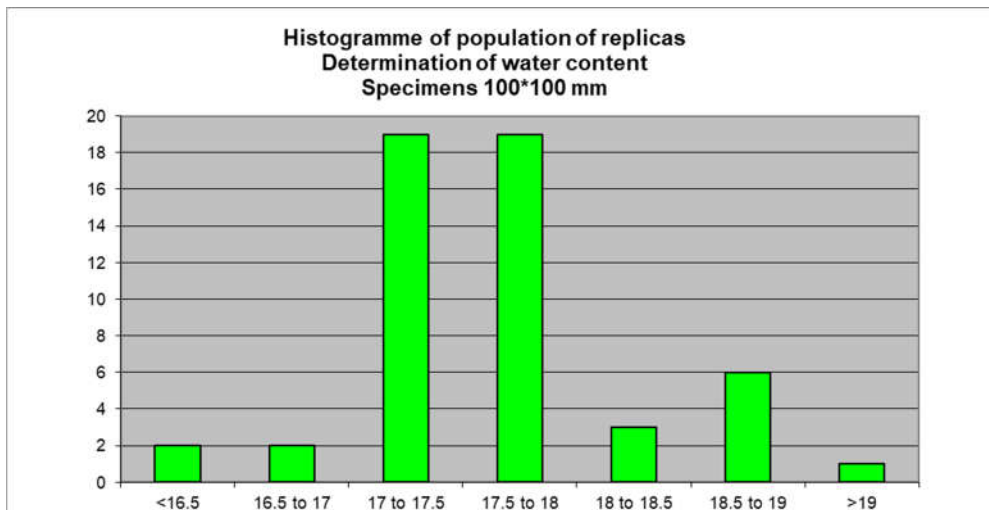
Campagne EAPIC N°11- Session 1 - Série 18
Determination of water content
specimens 100*100 mm

Raw average : 17.702 %
Corrected average : 17.683 %
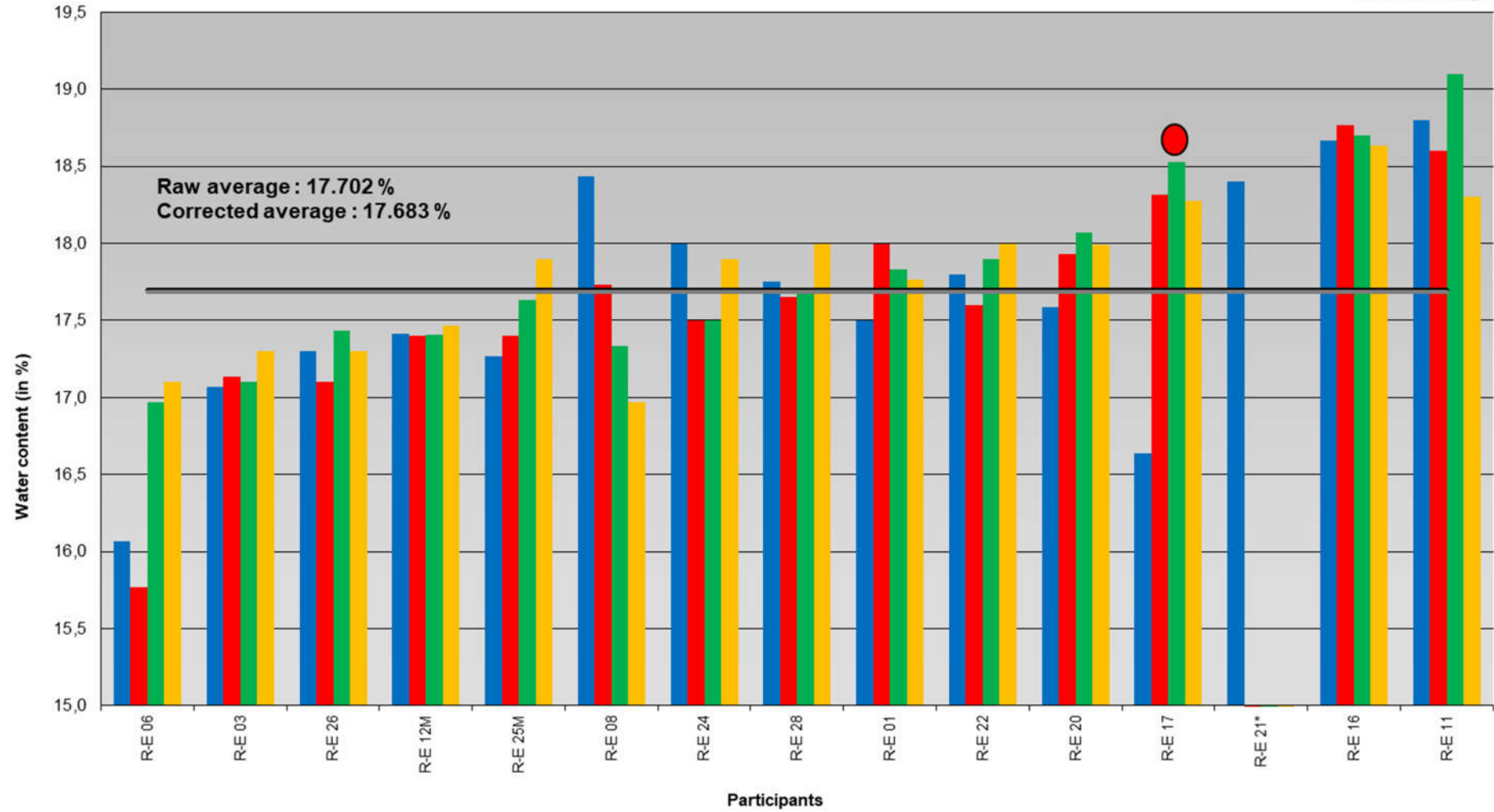
Average difference and Z-score value on raw data

Difference less than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 24	0.02	0.04
R-E 28	0.07	0.11
R-E 01	0.07	0.11
R-E 08	0.08	0.13
R-E 22	0.12	0.19
R-E 25M	0.15	0.23
R-E 20	0.19	0.29
R-E 17	0.24	0.36
R-E 12M	0.28	0.42
R-E 26	0.42	0.64
R-E 03	0.55	0.84

Difference more than 1 standard deviation

| Code results	Average deviation	Z-Score
R-E 16	0.99	1.51
R-E 11	1.00	1.52
R-E 06	1.23	1.87

Determination of compactness

Determination of compactness

Target value : 96.0%

Graphical representations

		Raw data	Results rejected by statistical tests
	Number of results taken in account	14	
In %	**Average m**	94.949	None
	Standard deviation repeatability	0.338	
	repeatability r	0.946	
	Standard deviation Reproducitibility	0.809	
	Reproducitibility R	2.264	

Raw data
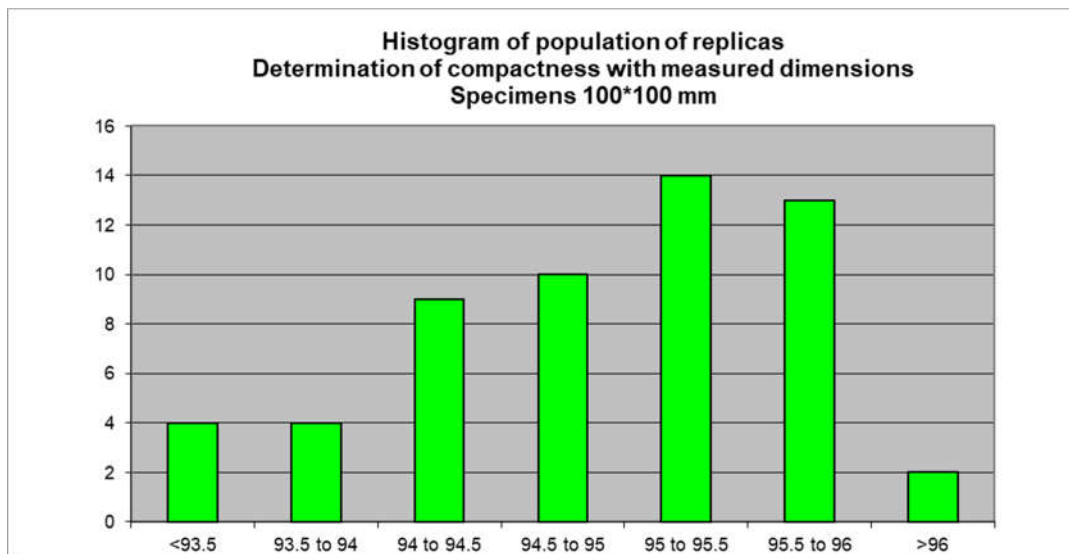
Histogram of population of replicas
Determination of compactness with measured dimensions
Specimens 100*100 mm

Campaign EAPIC N°11- Session 1 - Serie 18
Determination of compactness with measured dimensions
Specimens 100*100 mm
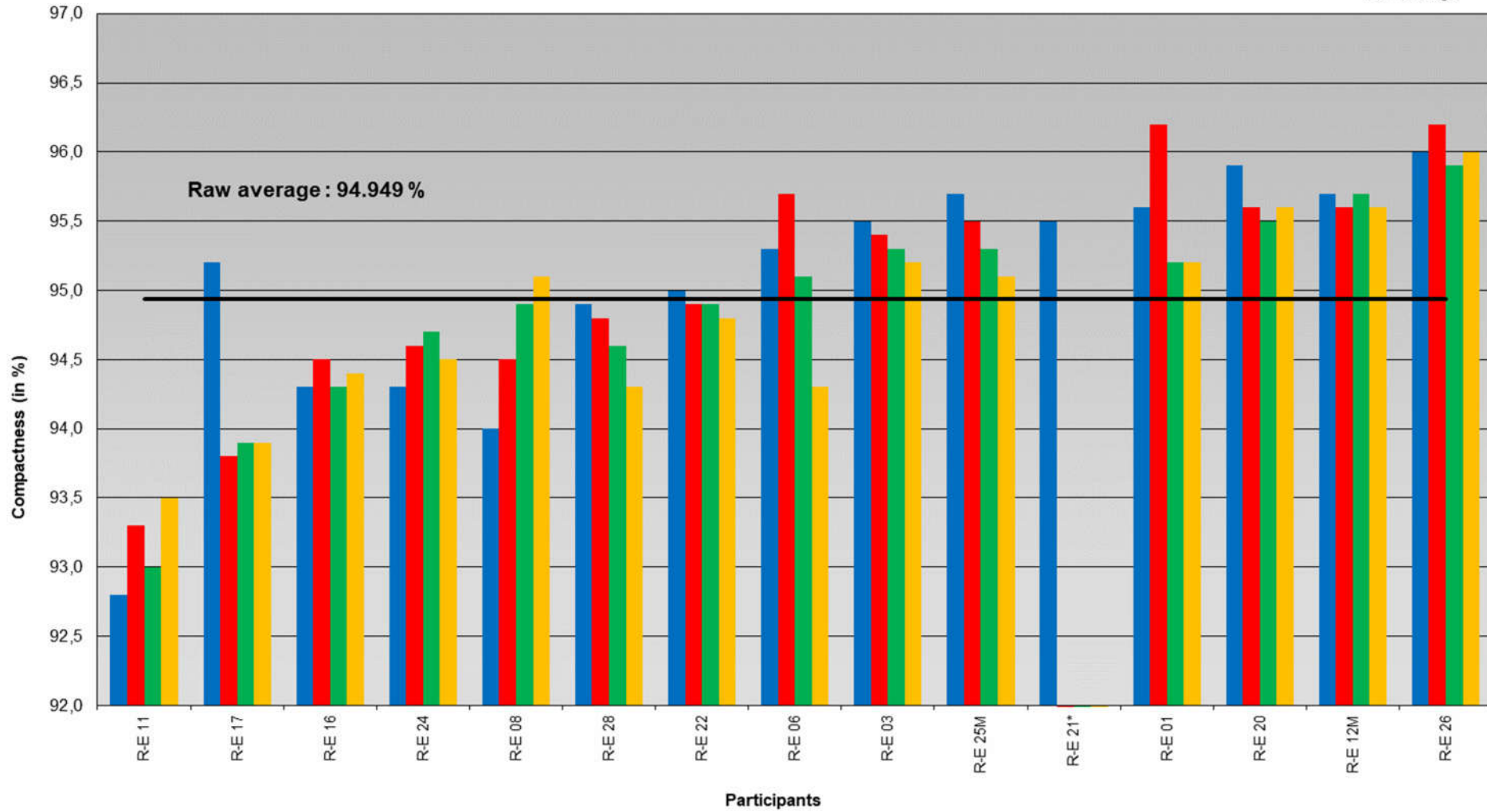
Average difference and Z-score value on raw data

Difference less than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 22	0.04	0.05
R-E 06	0.16	0.20
R-E 28	0.29	0.36
R-E 08	0.31	0.39
R-E 03	0.41	0.51
R-E 24	0.41	0.51
R-E 25M	0.46	0.57
R-E 16	0.56	0.70
R-E 01	0.61	0.76
R-E 20	0.71	0.88
R-E 12M	0.71	0.88
R-E 17	0.74	0.91

Difference more than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 26	1.09	1.34
R-E 11	1.79	2.21

Determination of strength Rit
# and modulus Eit (*)

(*) According to standards NF EN 13286-42 of Septembre 2003 and NF EN 13286-43 of July 2003

Rit at 28 days

Graphical representations

		Raw data	Results rejected by statistical tests
	Number of results taken in account	13	
In MPa	Average m	0.270	None
	Standard deviation repeatability	0.021	
	repeatability r	0.058	
	Standard deviation Reproducitibility	0.053	
	Reproducitibility R	0.147	

Raw data
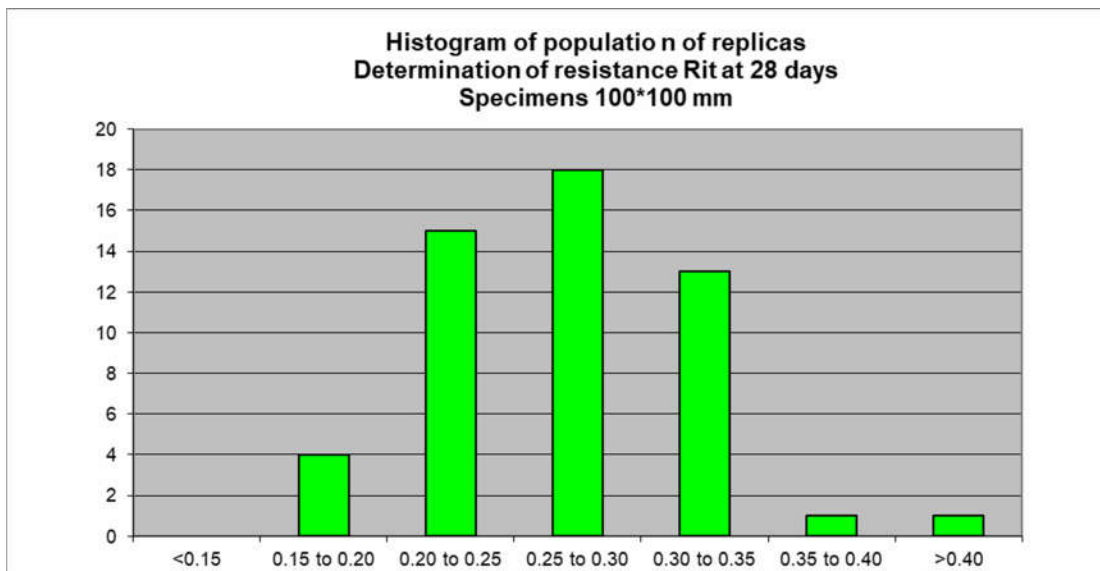
Histogram of population of replicas
Determination of resistance Rit at 28 days
Specimens 100*100 mm

Campaign EAPIC N°11- Session 1 - Serie 18
Determination of resistance Rit at 28 days
Specimens 100*100 mm
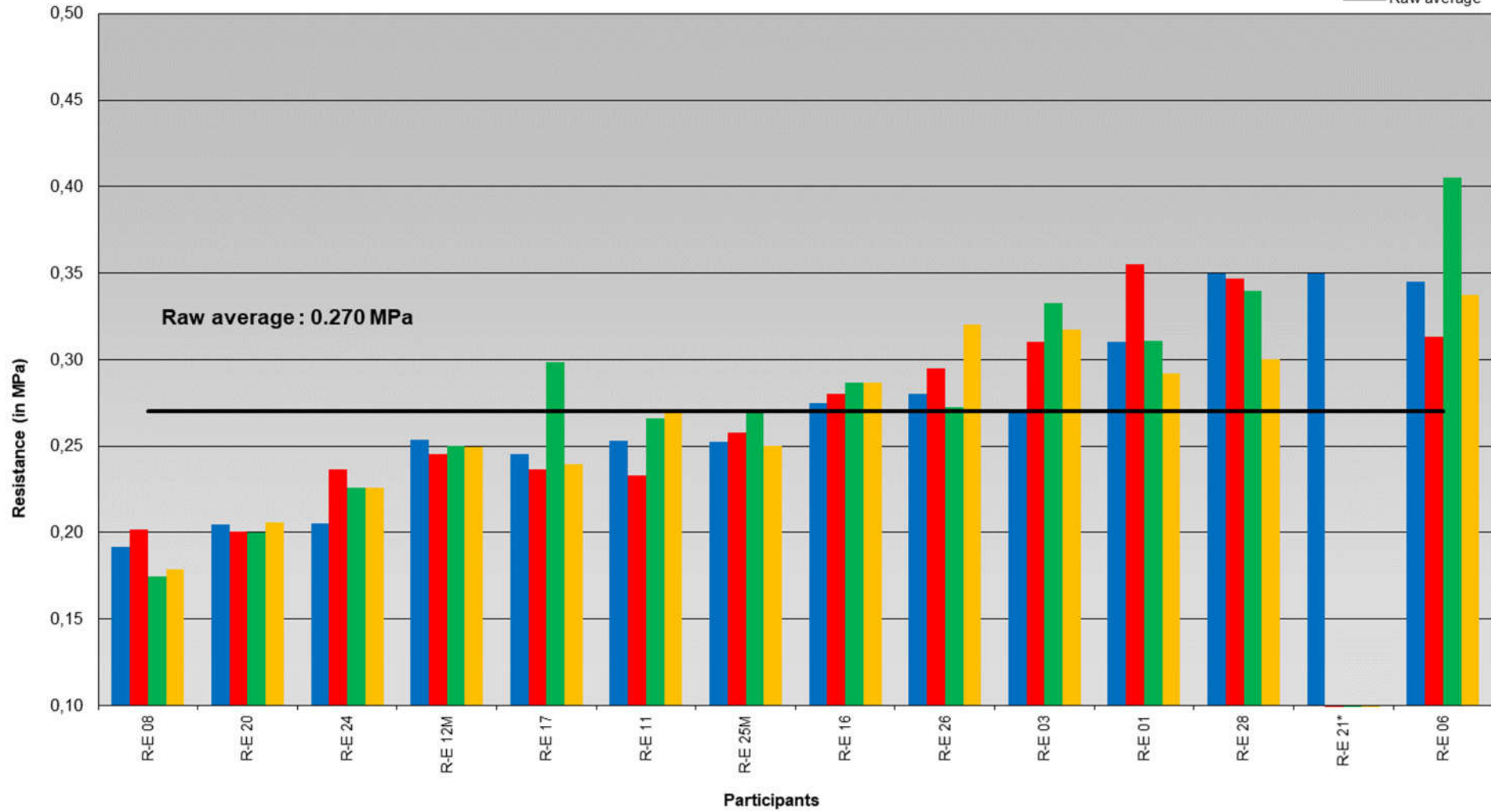
Average difference and Z-score value on raw data

Difference less than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 16	0.01	0.23
R-E 25M	0.01	0.24
R-E 11	0.02	0.28
R-E 17	0.02	0.29
R-E 12M	0.02	0.39
R-E 26	0.02	0.41
R-E 03	0.04	0.71
R-E 01	0.05	0.89
R-E 24	0.05	0.89

Difference more than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 28	0.06	1.21
R-E 20	0.07	1.28
R-E 06	0.08	1.52
R-E 08	0.08	1.59

Eit at 28 days

Graphical representations

		Raw data	Results rejected by statistical tests
	Number of results taken in account	13	
In MPa	Average m	3548	None
	Standard deviation repeatability	474	
	repeatability r	1328	
	Standard deviation Reproducitibility	938	
	Reproducitibility R	2626	

Raw data
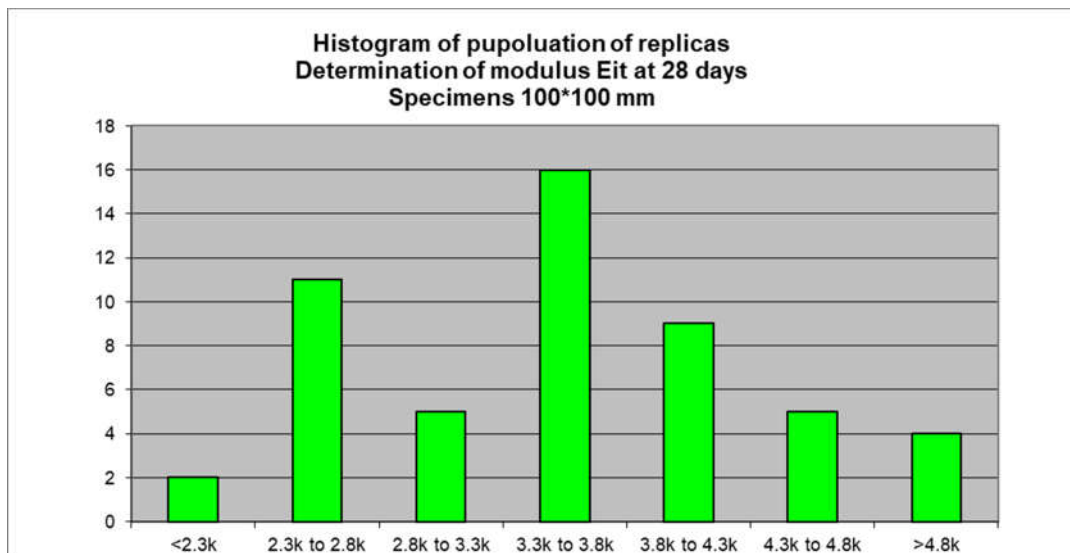
Histogram of pupoluation of replicas
Determination of modulus Eit at 28 days
Specimens 100*100 mm

Campaign EAPIC N°11- Session 1 - Serie 18
Determination of modulus Eit at 28 days
Specimens 100*100 mm
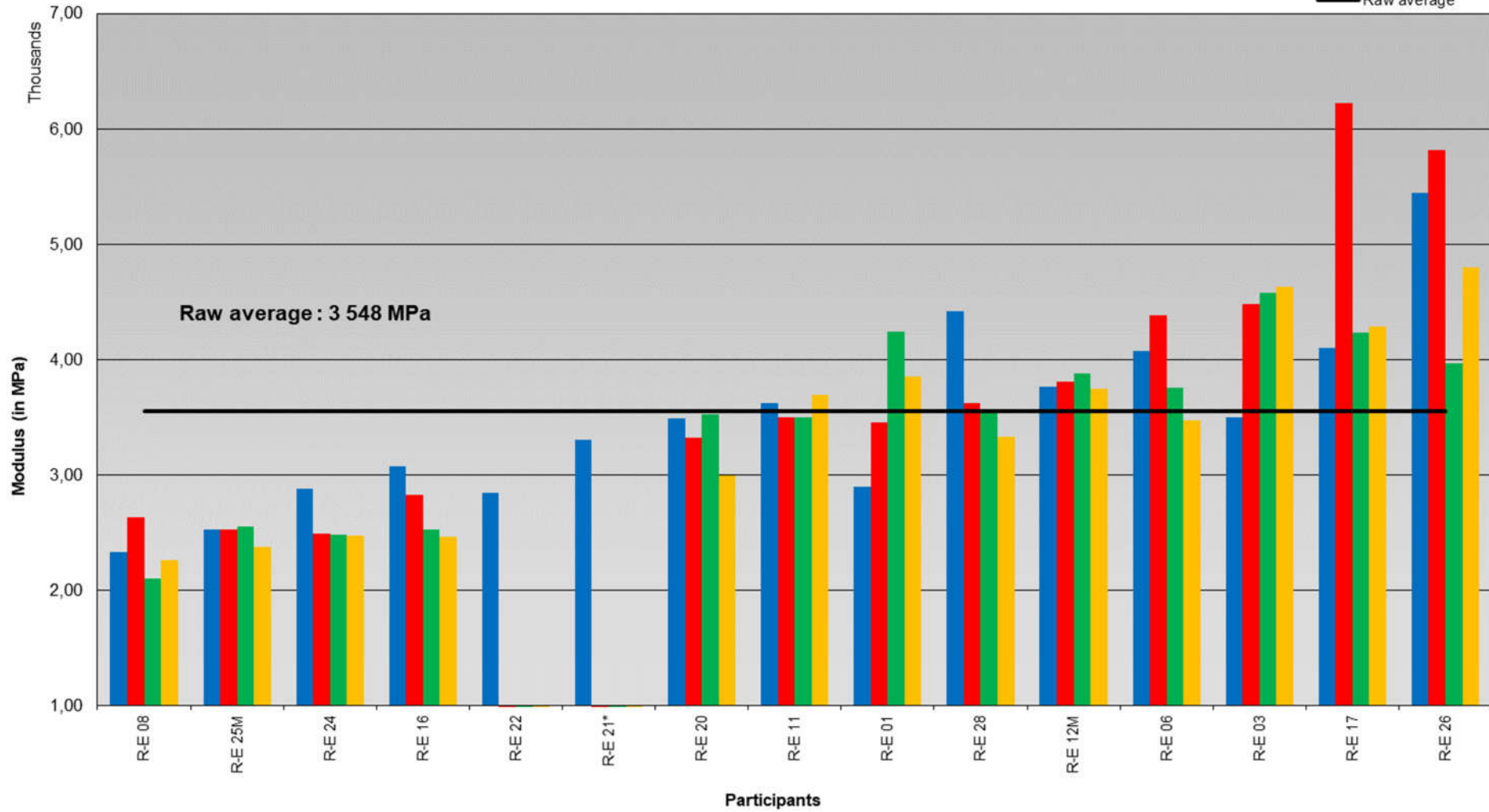
Average difference and Z-score value on raw data

Difference less than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 11	31.10	0.03
R-E 01	64.58	0.07
R-E 28	182.33	0.19
R-E 20	213.27	0.23
R-E 12M	250.73	0.27
R-E 06	372.41	0.40
R-E 03	749.10	0.80
R-E 16	824.94	0.88

Difference more than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 24	967.59	1.03
R-E 25M	1050.77	1.12
R-E 17	1162.71	1.24
R-E 08	1216.52	1.30
R-E 26	1460.14	1.56

Rit at 60 days

Graphical representations

	Raw data	Results rejected by statistical tests
Number of results taken in account	13	
Average m	0.384	None
Standard deviation repeatability	0.023	
repeatability r	0.065	
Standard deviation Reproducitibility	0.084	
Reproducitibility R	0.235	
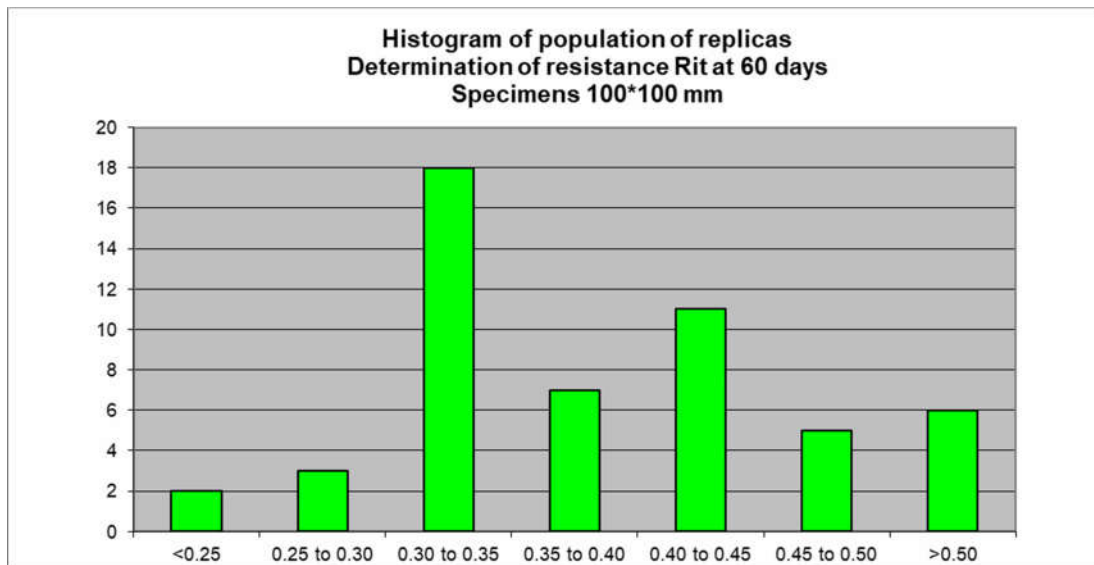
(In MPa)

Raw data

Histogram of population of replicas
Determination of resistance Rit at 60 days
Specimens 100*100 mm

Campaign EAPIC N°11- Session 1 - Serie 18
Determination of resistance Rit at 60 days
Specimens 100*100 mm

Raw average : 0.384 MPa
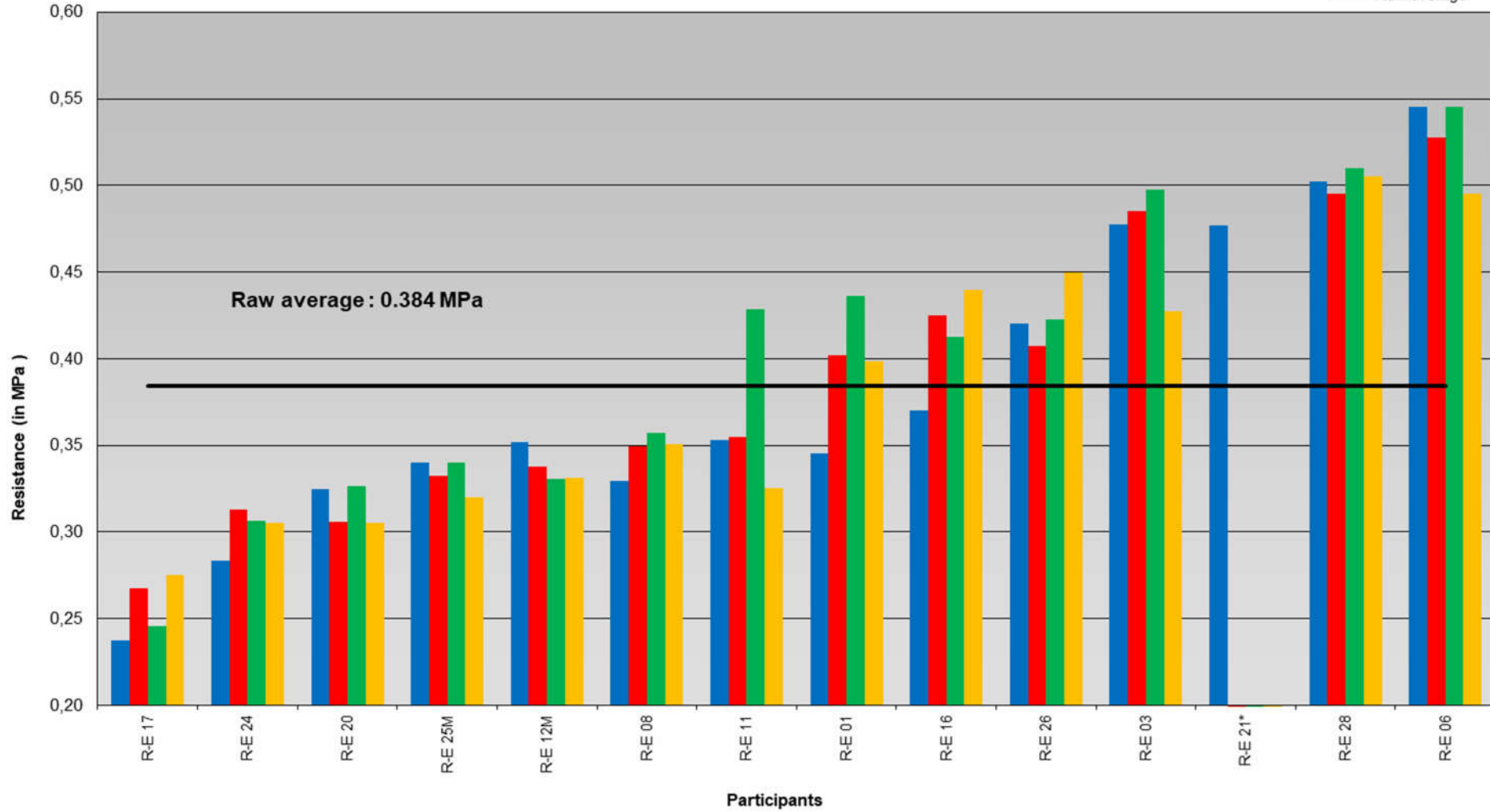
Average difference and Z-score value on raw data

Difference less than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 01	0.012	0.138
R-E 11	0.019	0.221
R-E 16	0.028	0.332
R-E 08	0.037	0.447
R-E 26	0.041	0.489
R-E 12M	0.046	0.553
R-E 25M	0.051	0.608
R-E 20	0.068	0.815
R-E 24	0.082	0.980

Difference more than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 03	0.088	1.048
R-E 28	0.119	1.421
R-E 17	0.128	1.522
R-E 06	0.144	1.719

Eit at 60 days

Graphical representations

		Raw data	Results rejected by statistical tests
In MPa	Number of results taken in account	14	None
	Average m	4577	
	Standard deviation repeatability	398	
	repeatability r	1113	
	Standard deviation Reproducitibility	1263	
	Reproducitibility R	3537	

Raw data
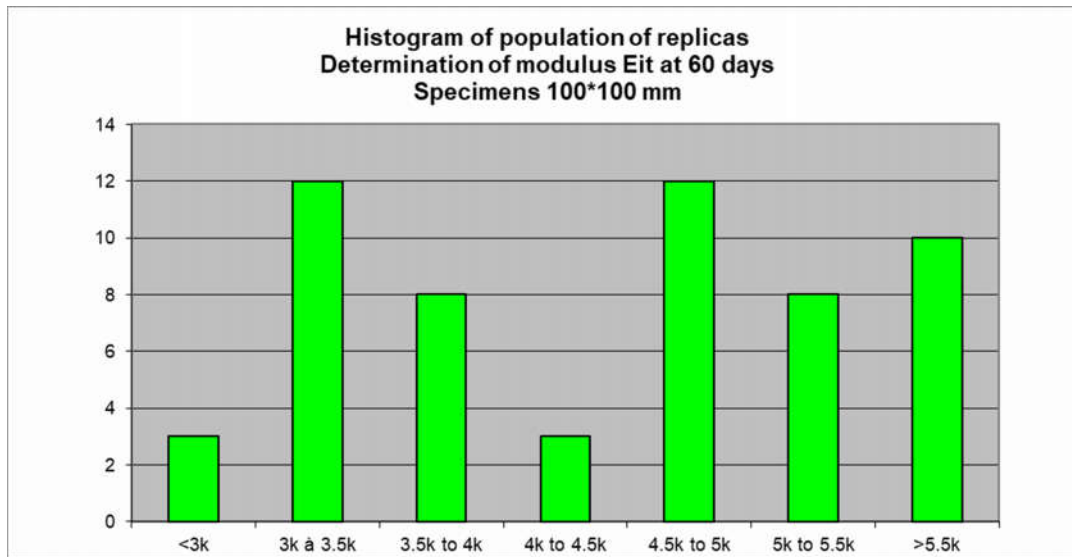
Campaign EAPIC N°11- Session 1 - Serie 18
Determination of modulus Eit at 60 days
Specimens 100*100 mm
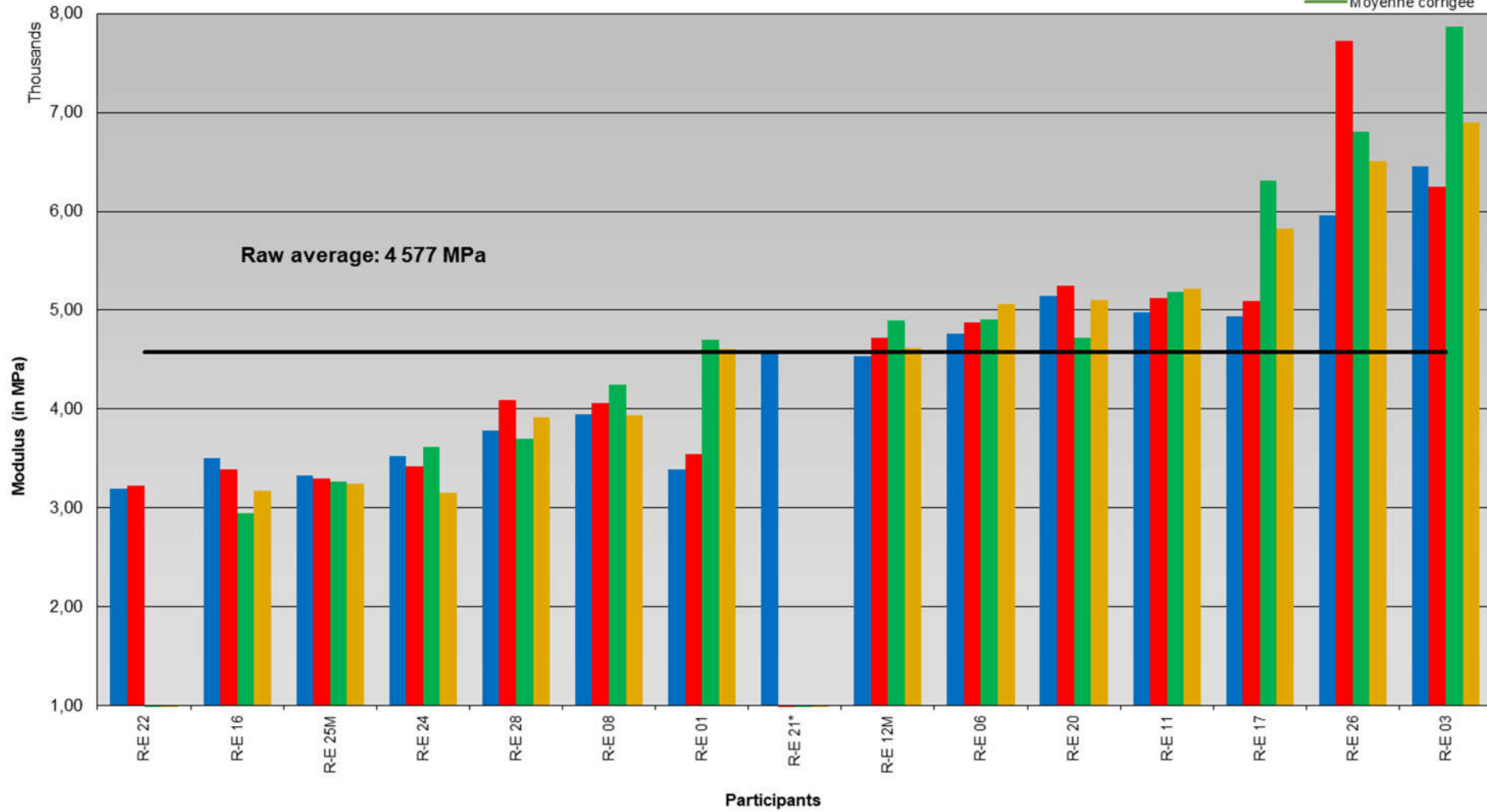
Average difference and Z-score value on raw data

Difference less than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 12M	65.86	0.05
R-E 06	276.74	0.22
R-E 20	427.07	0.34
R-E 11	498.17	0.39
R-E 01	570.84	0.45
R-E 08	583.33	0.46
R-E 28	758.70	0.60
R-E 17	913.84	0.72
R-E 24	1199.31	0.95

Difference more than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 25M	1344.76	1.06
R-E 16	1375.45	1.09
R-E 22	1417.89	1.12
R-E 26	2119.38	1.68
R-E 03	2240.27	1.77

Rit at 90 days

Graphical representations

		Raw data	Results rejected by statistical tests
In MPa	Number of results taken in account	13	None
	Average m	0.461	
	Standard deviation repeatability	0.040	
	repeatability r	0.111	
	Standard deviation Reproducitibility	0.098	
	Reproducitibility R	0.273	

Raw data
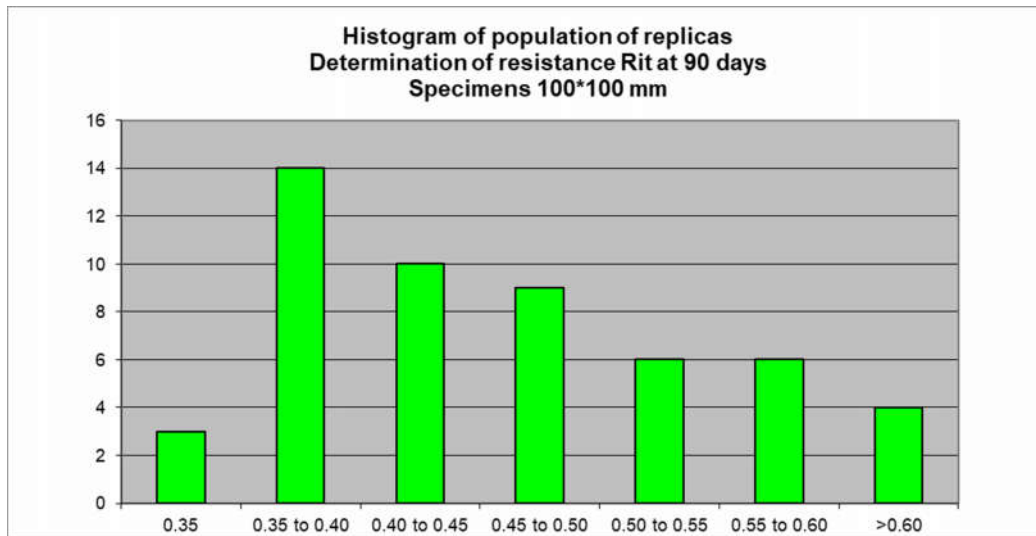
Campaign EAPIC N°11- Session 1 - Serie 18
Determination of resistance Rit at 90 days
Specimens 100*100 mm
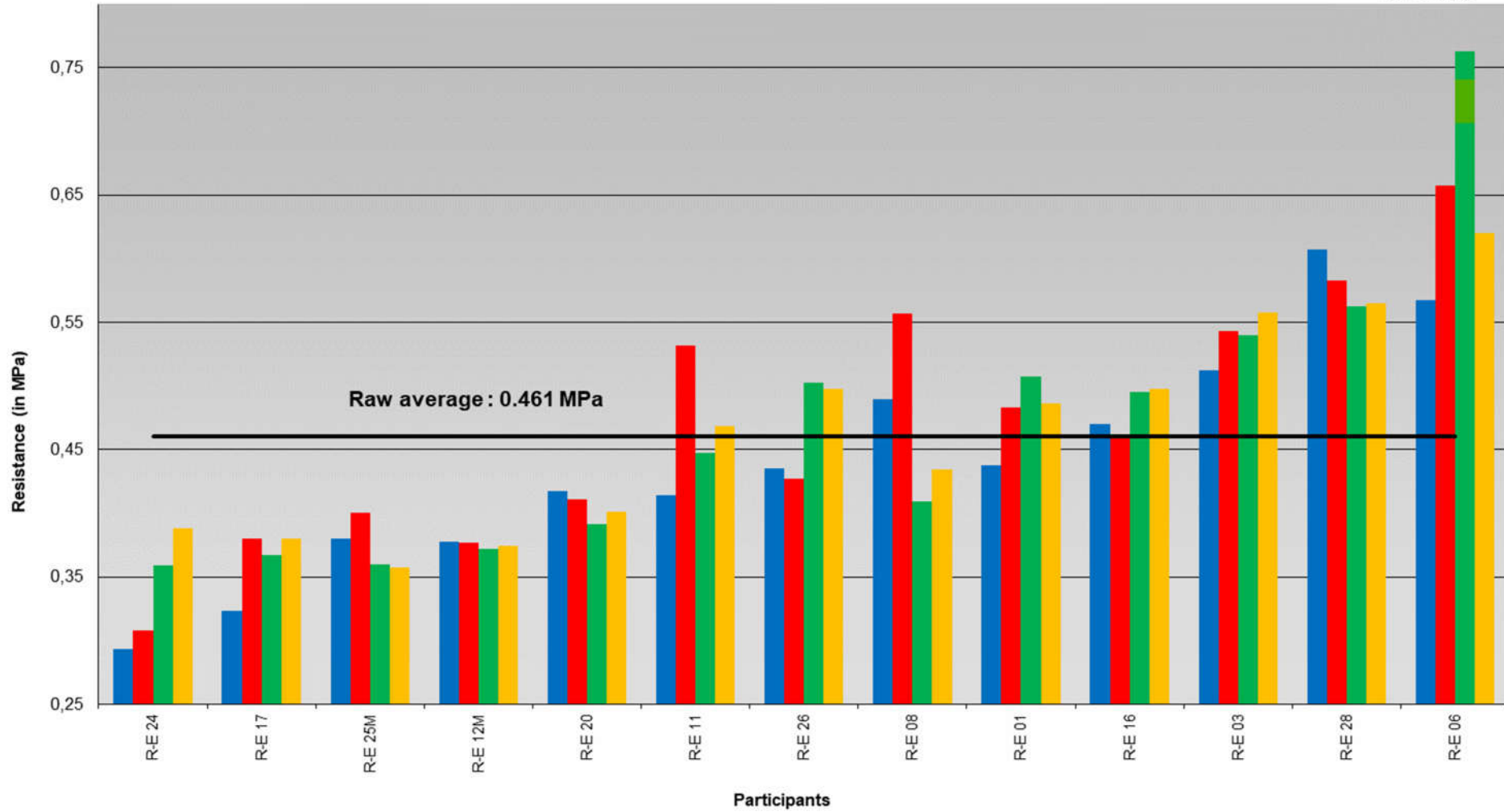
Average difference and Z-score value on raw data

Difference less than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 11	0.005	0.05
R-E 26	0.005	0.05
R-E 08	0.012	0.12
R-E 01	0.018	0.19
R-E 16	0.020	0.21
R-E 20	0.055	0.57
R-E 03	0.078	0.80
R-E 12M	0.085	0.87
R-E 25M	0.086	0.88

Difference more than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 17	0,098	1.00
R-E 28	0.119	1.22
R-E 24	0.124	1.27
R-E 06	0.191	1.96

Eit at 90 days

Graphical representations

| In MPa		Raw data	Results rejected by statistical tests	Corrected data
	Number of results taken in account	14		12
	Average m	5259		4857
	Standard deviation repeatability	617	Cochran R-E03 R-E17	297
	repeatability r	1728		830
	Standard deviation Reproducitibility	1619		1170
	Reproducitibility R	4532		3275

Raw data
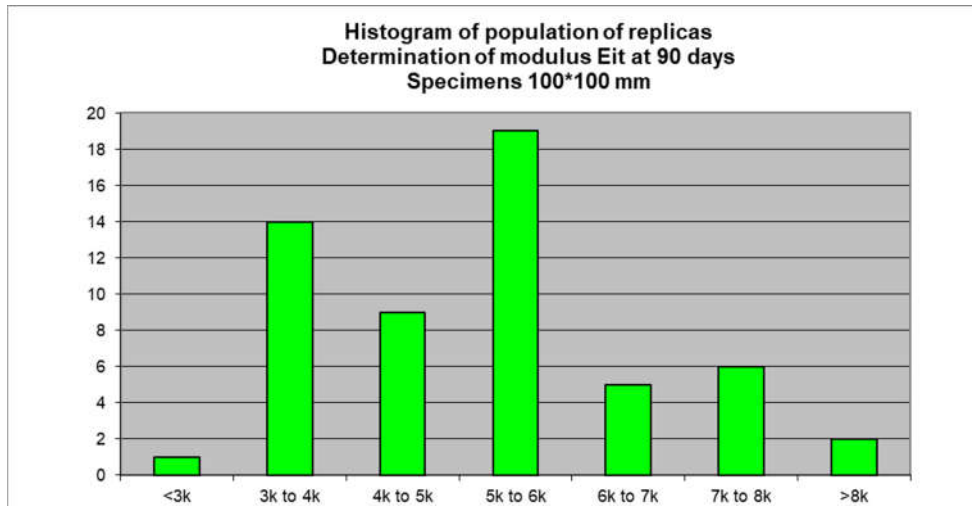
Corrected data
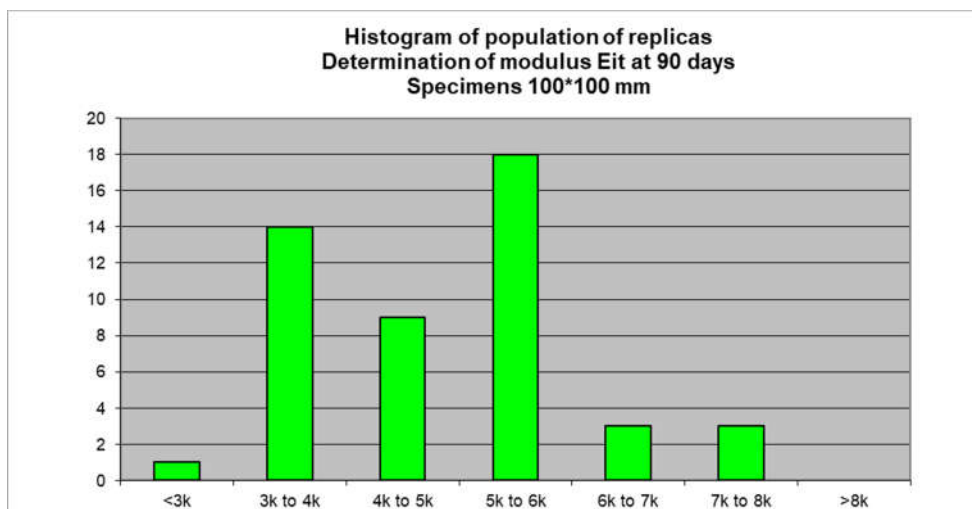
Campaign EAPIC N°11- Session 1 - Serie 18
Determination of modulus Eit at 90 days
Specimens 100*100 mm
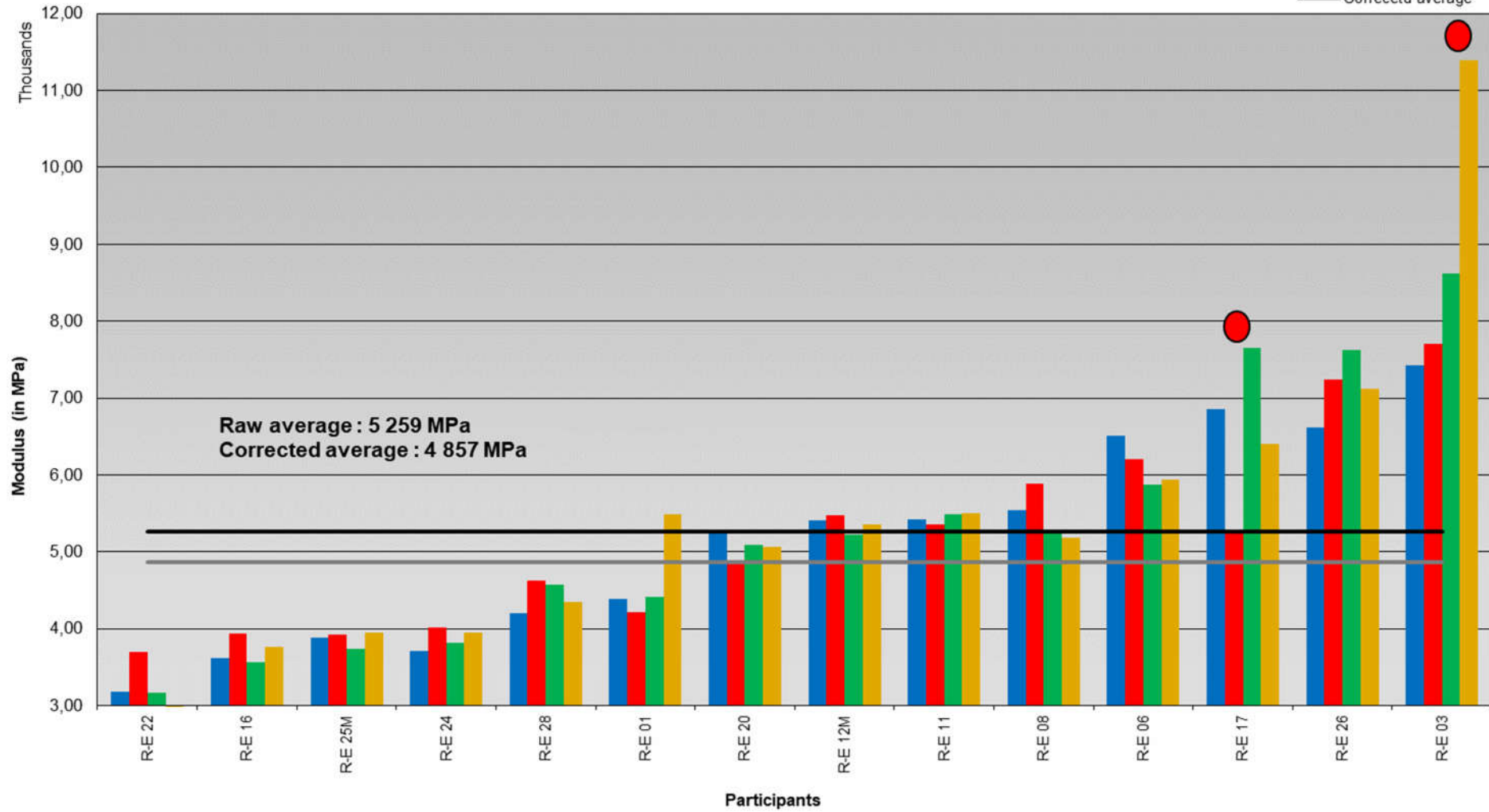
Average difference and Z-score value on raw data

Difference less than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 12M	104.79	0.06
R-E 20	179.90	0.11
R-E 11	181.67	0.11
R-E 08	206.79	0.13
R-E 01	633.64	0.39
R-E 28	819.46	0.51
R-E 06	870.67	0.54
R-E 17	1286.93	0.80
R-E 24	1386.83	0.86
R-E 25M	1390.46	0.86
R-E 16	1544.23	0.95

Difference more than 1 standard deviation

Code results	Average deviation	Z-Score
R-E 26	1892.73	1.17
R-E 22	2116.33	1.31
R-E 03	3527.28	2.18

Average difference and Z-score value on raw data

Organisation of EAPIC

The Specialised Group « Inter Camparison 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 LE GUERN (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

Members :

BADROUILLET Christophe
DANIEL Vincent
DELFOSSE Frédéric
PERIGOIS Stéphanie
PIOT Géraldine
PRIEZ Christophe
SOME Ciryle

EAPIC Executive Cell

Cerema IDF- Sourdun site : PIOT Géraldine & SOME Ciryle
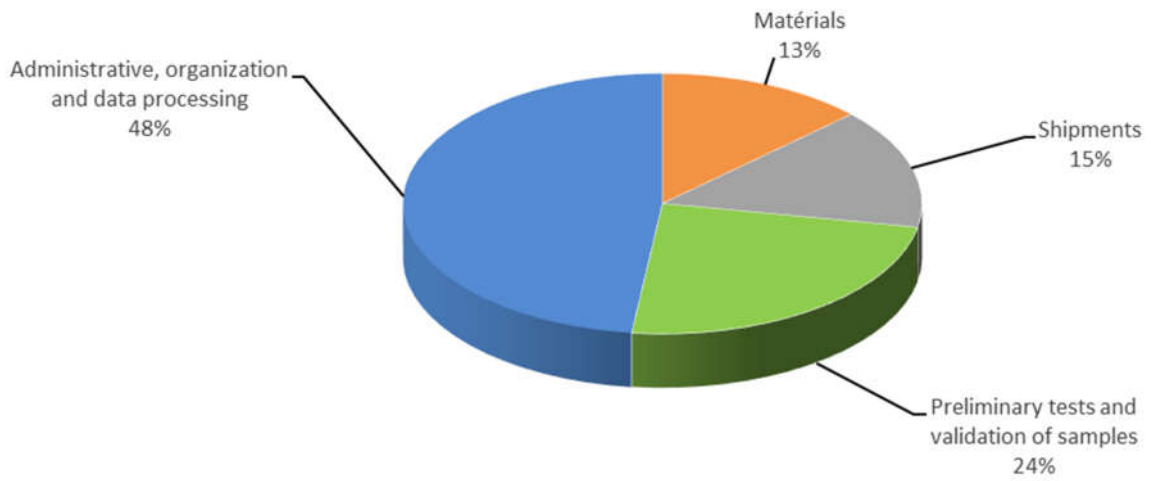
EAPIC Support Laboratories

Cerema Ouest Département Laboratoire d'Angers : PERIGOIS Stéphanie & DANIEL Vincent

Cerema Ouest Département Laboratoire d'Autun : BADROUILLET Christophe

*A*nnexes

- o Financial balance sheet
- o Grading curves of silt

*F*inancial balance sheet

Matérials 13%

Shipments 15%

Administrative, organization and data processing 48%

Preliminary tests and validation of samples 24%

Grading curves of silt

The silt samples were verified by particle size analysis.
10 bags were aleatory selected from the stock.
On each bag, 2 tests were carried out.

	Passing 63µm	Passing 80µm
Nomber of values	20	20
Average	89 %	93%
Intra-sample average	89%	93%
Mini	86%	93%
Max	91%	94%
Deviation	1.348	0.489

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