BRNO UNIVERSITY OF TECHNOLOGY

FACULTY OF CIVIL ENGINEERING
institute of building testing

ilac-MRA

Z 7008

FINAL REPORT ON THE RESULTS OF PRECISION EXPERIMENT

Proficiency Testing Program
Masonry Units Testing
ZZP 2024/1

Brno University of Technology
Proficiency testing provider at the SZK FAST
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Czech Republic

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www.ptprovider.cz

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Ing. Petr Misák, Ph.D.
Coordinator of PTP results assessment

Contents

1 Introduction and Important Contacts

In the year 2024, the Proficiency Testing Provider at the SZK FAST (PT Provider) initiated the Proficiency Testing Program (PTP) designated ZZP 2024/1 whose aim was to verify and assess the conformity of test results across laboratories when testing masonry units.

The assessment of the results of the Proficiency Testing Program was carried out by a committee consisting of the following PT Provider employees:

Head of the PT Provider, PTP coordinator

Assoc. Prof. Tomáš Vymazal, Ph.D.
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Coordinator of PTP result assessment PrZZ

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The subjects of proficiency testing were the following testing procedures:

1. **EN 772-1** – Compressive strength [1].
2. **EN 772-3** – Net volume and percentage of voids of clay masonry units by hydrostatic weighing [2].
3. **EN 772-6** – Bending tensile strength of aggregate concrete masonry units [3].
4. **EN 772-7** – Water absorption of clay masonry damp proof course units by boiling in water [4].
5. **EN 772-10** – Moisture content [5].
6. **EN 772-11** – Water absorption [6].
7. **EN 772-13** – Dry density of masonry units [7].
8. **EN 15435** – part 4.9.3, Appendix B - Flexural strength of side shutters [8].
9. **EN 15435** – part 5.2 - Density [8].

Testing procedures No 3, 4, 5, 8 and 9 were not open due to low number of participants.

The specimens were taken from the same production with the same production date. The test results from individual PTP participants were compared via a method involving the statistical analysis of all their results in a manner complying with ISO 5725-2 [9] and with EN ISO/IEC 17043 [10]. The outcome is the present final report summarizing the results of the interlaboratory comparison, including statistical evaluation.

9 laboratories from Europe took part in the program. In order to maintain the anonymity of the PTP, each laboratory was given an identification number that will be used henceforth in this document. An integral part of the present final report is a Certificate of Participation in the Proficiency Testing Program. It is unique for each participant and includes the participant's ID used in this report. The following chart shows the participation of laboratories in individual parts of the PTP.

Table 1: Participation of individual laboratories in the PTP (tests designated according to part 1)

ID/Method	1	2	3	4	5	6	7	8	9
5b3698	-	-	-	-	-	X	-	-	-
6c108c	-	-	-	-	-	-	X	-	-
30a596	X	X	-	-	-	X	X	-	-
0454d5	X	X	-	-	-	X	X	-	-
c79cb6	-	X	-	-	-	X	X	-	-
d8b86c	X	X	-	-	-	-	X	-	-
8e7cfd	X	X	-	-	-	X	X	-	-
e89add	X	X	-	-	-	X	X	-	-
40f451	X	-	-	-	-	-	-	-	-

Table 2: List of participants (laboratories) – the order in the table does not correspond to the identification number in Table 1

Laboratory	Address	Accreditation number
CEMACON SA	Calea Turzii , nr. 178k, etaj 1, Cluj-Napoca, 400491, Romania	-
Höhere Technische Bundes-Lehr- und Versuchsanstalt Villach	Tschinowitscherweg 5, Villach, 9500, Austria	-
Kiwa GmbH	Gustav-Meyer-Allee 25, Gebäude 13b, Halle 10, Berlin, 13355, Germany	-
Labo Devlieger - Van Vooren	Industriepark Rosteyne 1, zelzate, 9060, Oost-Vlaanderen	296-TEST
MIRTEC S.A., THIVA BRANCH	76th km of Athens-Lamia National Road, Schimatari, Boeotia, 32009, Greece	-
SRL CIPC INCERC TEST	Bd. Dacia 38, ap. 336, Chisinau, MD 2060, Moldova	LÎ 125
TRA EOOD CTC SOFIA	Rezbarska str. № 7, SOFIA, 1000, BULGARIA	-
ÉMI Építésügyi Minőségellenőrző Innovációs Nonprofit Kft. Központi Vizsgáló Laboratórium	Dózsa György út 26., Szentendre, 2000, Magyarország	NAH-1-1110/2023/K
Ústav stavebního zkušebnictví s.r.o.	Jiřího Potůčka 115, Trnová, Pardubice, 53009, Česká republika	1115

2 Procedures used in the Statistical Analysis of Laboratory Results

The statistical analysis is based on the following steps:

1. Evaluation of intralaboratory variabilities by Cochran's C test: If 5% or 1% critical value is exceeded, the effect of the individual observations is first considered. If the results indicate that high participant variability is caused by a single observation, this value is excluded from the experiment, but the participant is not excluded as outlying. By overcoming 1% of the critical value, the participant's results can be marked as outlying and excluded from the experiment.
2. The numerical critical evaluation of the test results using Grubbs' test: By overcoming 1% critical value, the participant's results can be marked as outlying and excluded from the experiment.
3. Graphical determination of the consistency of laboratories (Mandel's statistics): The exceedance of the critical values of Mandel's statistics does not indicate that the results of the laboratories concerned are wrong; it only suggests minor inconsistencies.
4. Evaluation of descriptive statistics and, if possible, taking into account the number of observations, the repeatability and reproducibility.
5. Evaluation of the assigned value.
6. The performance evaluation: The most significant outcome of the PT Program is the so-called z-score and ζ-score (zeta-score).These characteristics assess the performance of individual participants by comparing it with the assigned value and measurement uncertainties. z-score and ζ-score are compared with limit values. The resulting ζ-score values are not taken into account during the final evaluation of the performance of participants as they are to a considerable degree dependent on the values of the measurement uncertainties of the assessed institutions.

Procedures used in the statistical analysis of proficiency testing programs can be found here: http://ptprovider.cz/?lang=en.

3 Conclusions of the Statistical Analysis

The present report summarizes the results of the Proficiency Testing Program Masonry Units Testing (PT Program) organized by the PT Provider at the SZK FAST. 9 participants (laboratories) took part in the PT Program. The program focused on ordinary standardized testing of masonry units. The test results are evaluated separately for each testing procedure examined. An evaluation of statistical characteristics is included in the Appendix, as well as test results and graphic presentations. Testing methods can be found in part 1 of this report.

Table 4: Evaluation of overall performance and outliers.
✓ – satisfactory performance; ? – questionable performance; ! – unsatisfactory performance; X – outlier;

ID / Method	1	2	3	4	5	6	7	8	9
5b3698	-	-	-	-	-	✓	-	-	-
6c108c	-	-	-	-	-	-	✓	-	-
30a596	✓	✓	-	-	-	✓	X	-	-
0454d5	✓	✓	-	-	-	✓	✓	-	-
c79cb6	-	✓	-	-	-	✓	✓	-	-
d8b86c	X	✓	-	-	-	-	✓	-	-
8e7cfd	✓	✓	-	-	-	✓	✓	-	-
e89add	✓	✓	-	-	-	✓	✓	-	-
40f451	✓	-	-	-	-	-	-	-	-

References

[1] EN 772-1+A1. *Methods of test for masonry units - Part 1: Determination of compressive strength*. 2015.

[2] EN 772-3. *Methods of test for masonry units - Part 3: Determination of net volume and percentage of voids of clay masonry units by hydrostatic weighing*. 1999.

[3] EN 772-6. *Methods of test for masonry units - Part 6: Determination of bending tensile strength of aggregate concrete masonry units*. 2002.

[4] EN 772-7. *Methods of test for masonry units - Part 7: Determination of water absorption of clay masonry damp proof course units by boiling in water*. 1999.

[5] EN 772-10. *Methods of test for masonry units - Part 10: Determination of moisture content of calcium silicate and autoclaved aerated concrete units*. 1999.

[6] EN 772-11. *Methods of test for masonry units - Part 11: Determination of water absorption of aggregate concrete, manufactured stone and natural stone masonry units due to capillary action and the initial rate of water absorption of clay masonry units*. 2011.

[7] EN 772-13. *Methods of test for masonry units - Part 13: Determination of net and gross dry density of masonry units (except for natural stone)*. 2001.

[8] EN 15435. *Precast concrete products - Normal weight and lightweight concrete shuttering blocks - Product properties and performance*. 2009.

[9] ISO 5725-2. *Accuracy (trueness and precision) of measurement methods and results - Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method*. 2019.

[10] EN ISO/IEC 17043. *Conformity assessment - General requirements for proficiency testing*. 2010.

1 Appendix – EN 772-1 (Compressive strength)

1.1 Test results

Table 4: Test results - ordered by average value. Outliers are marked by red color. u_X - extended uncertainty of measurement; $\bar{x}$ - average value; s_0 - sample standard deviation; V_X - variation coefficient

ID	Test results [N/mm^2]						u_X [N/mm^2]	$\bar{x}$ [N/mm^2]	s_0 [N/mm^2]	V_X [%]
d8b86c	8.8	9.0	10.4	7.0	9.4	10.4	1.8	9.2	1.26	13.76
0454d5	14.3	13.0	11.9	12.3	12.0	-	3.2	12.7	0.99	7.81
30a596	14.5	13.2	13.3	11.2	13.2	13.1	-	13.1	1.06	8.11
e89add	11.5	15.5	12.7	13.7	14.0	11.9	1.7	13.2	1.48	11.23
8e7cfd	13.5	14.3	15.6	12.7	11.9	12.8	1.0	13.5	1.32	9.81
40f451	15.0	14.9	13.0	12.6	14.0	12.9	0.4	13.7	1.05	7.67

1.2 The Numerical Procedure for Determining Outliers

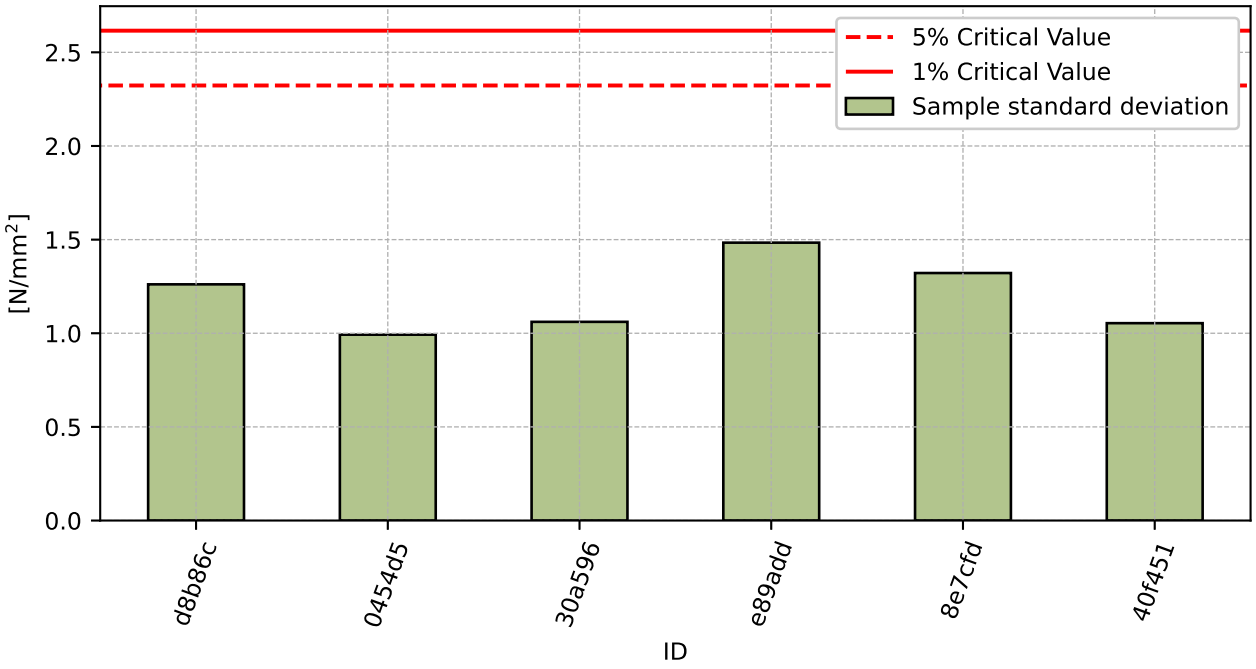

Figure 1: **Cochran's test** - sample standard deviations

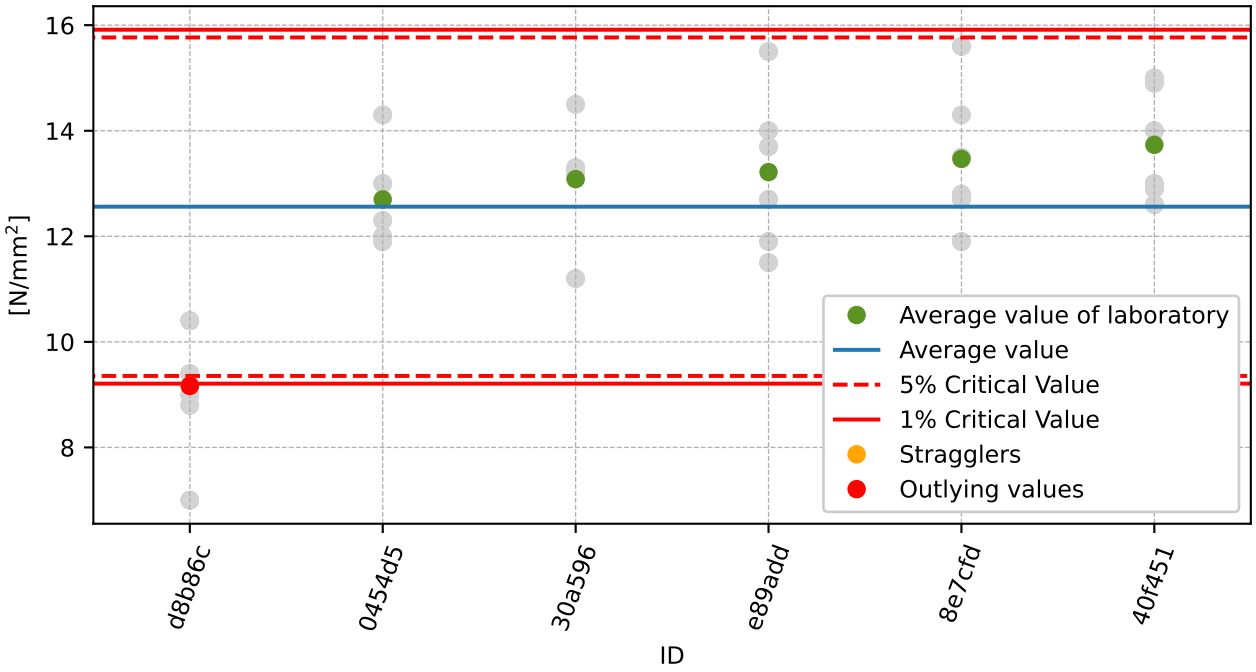

Figure 2: **Grubbs' test** - average values

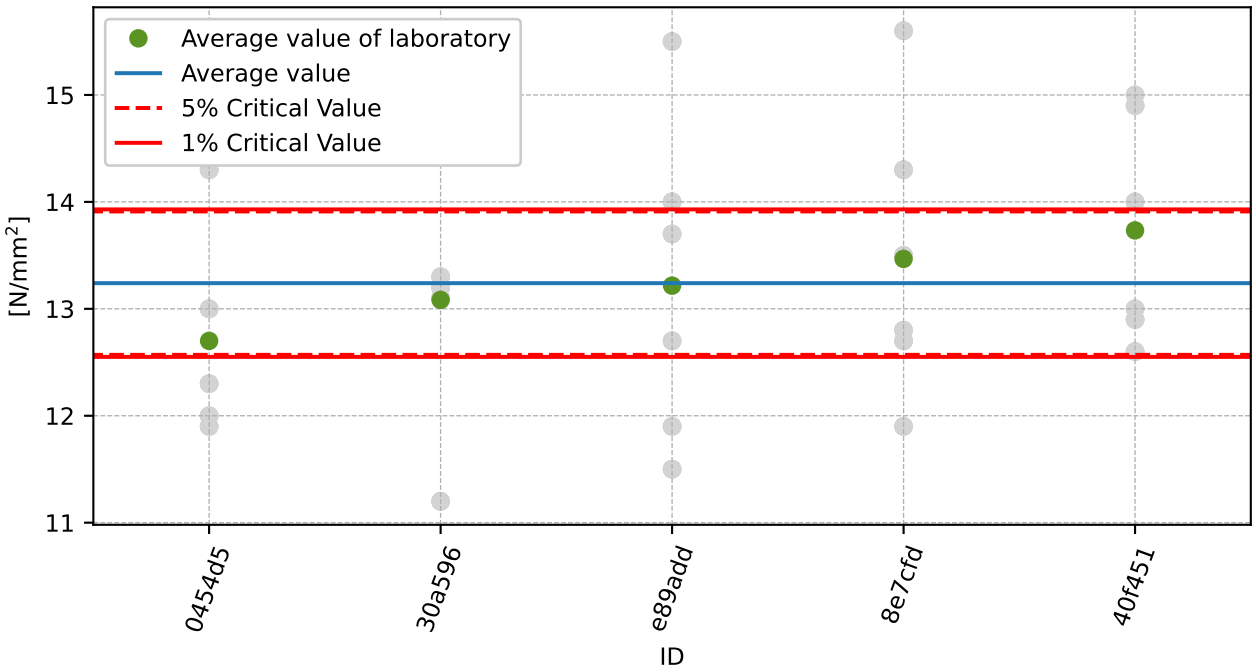

Figure 3: **Grubbs' test** - average values without outliers

1.3 Mandel's Statistics

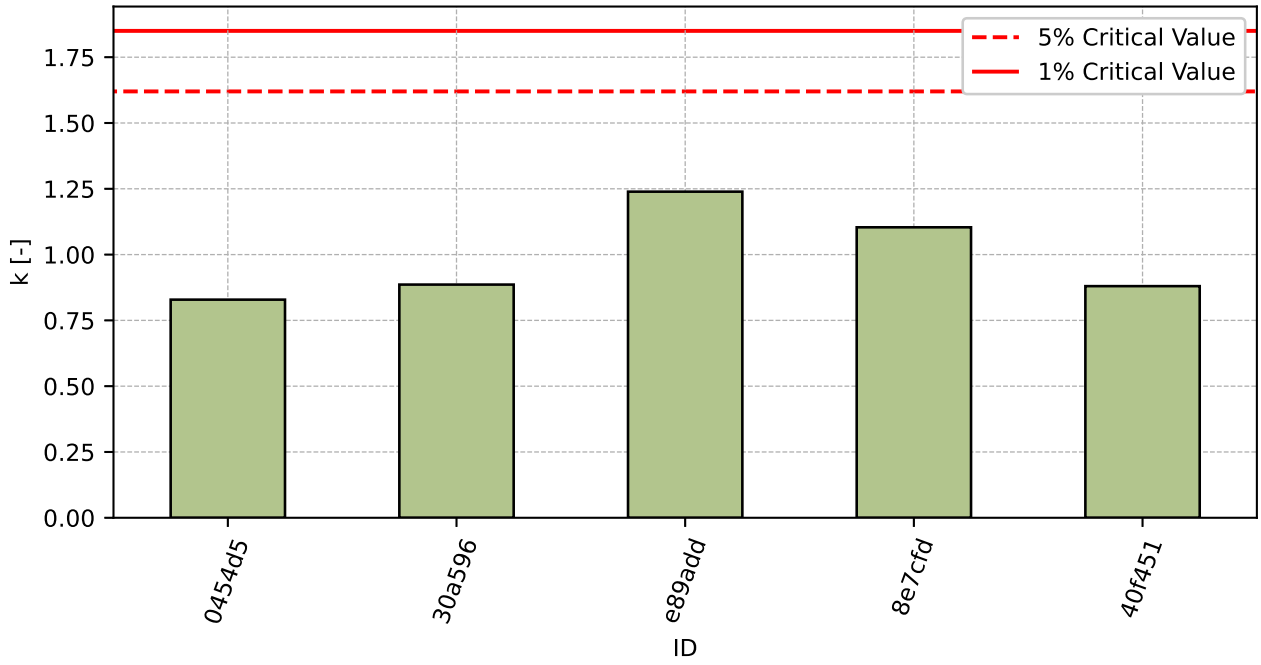

Figure 4: Intralaboratory Consistency Statistic

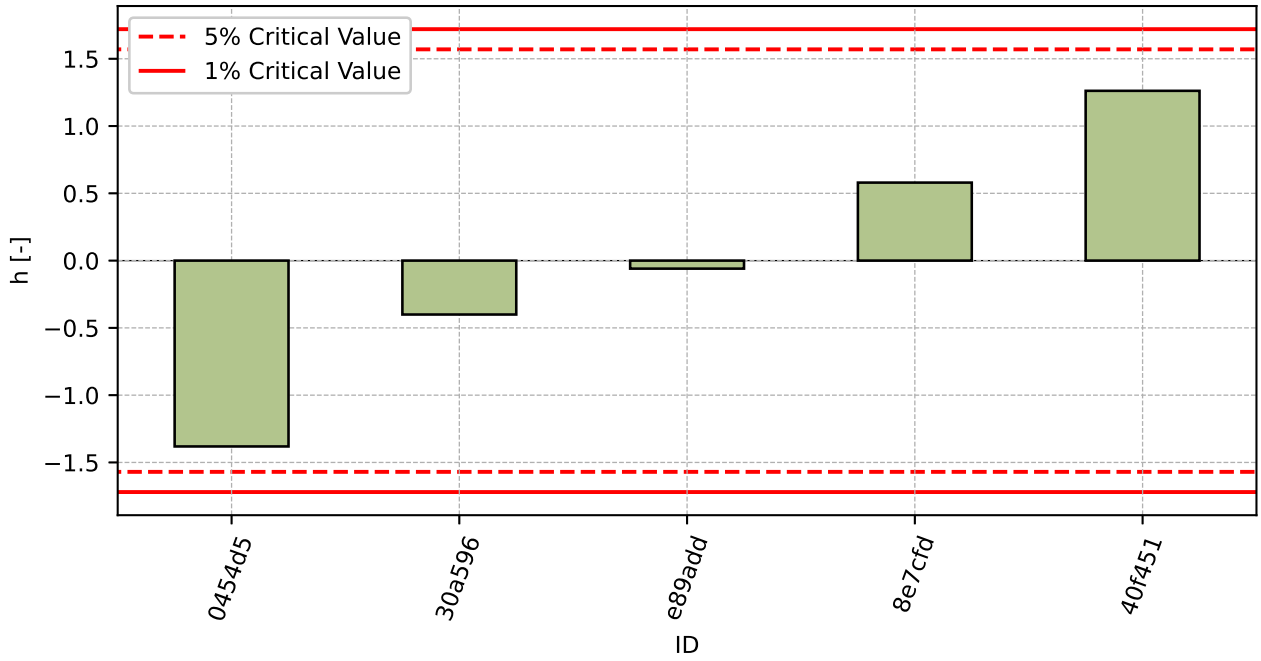

Figure 5: Interlaboratory Consistency Statistic

1.4 Descriptive statistics

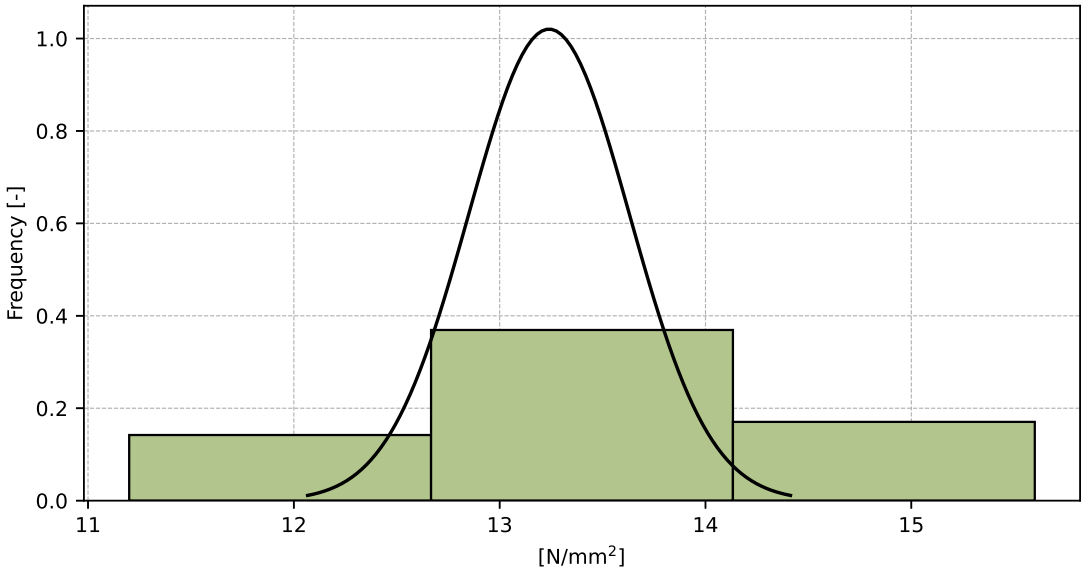

Figure 6: Histogram of all test results

Table 5: Descriptive statistics

Characteristics	[N/mm²]
Average value – $\bar{x}$	13.2
Sample standard deviation – s	0.39
Asigned value – x^*	13.2
Robust standard deviation – s^*	0.4
Measurement uncertainty of asigned value – u_X	0.22
p-value of normality test	0.745 [-]
Repeatability standard deviation – s_r	1.2
Repeatability – r	3.4

1.5 Evaluation of Performance Statistics

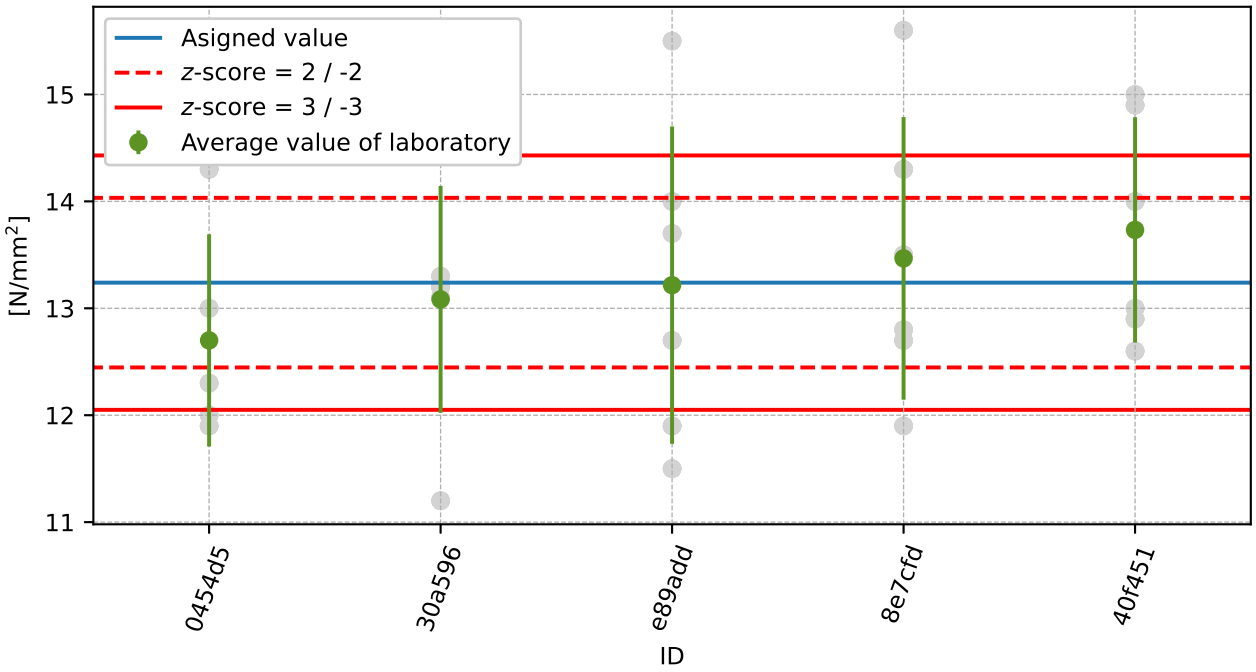

Figure 7: Average values and sample standard deviations

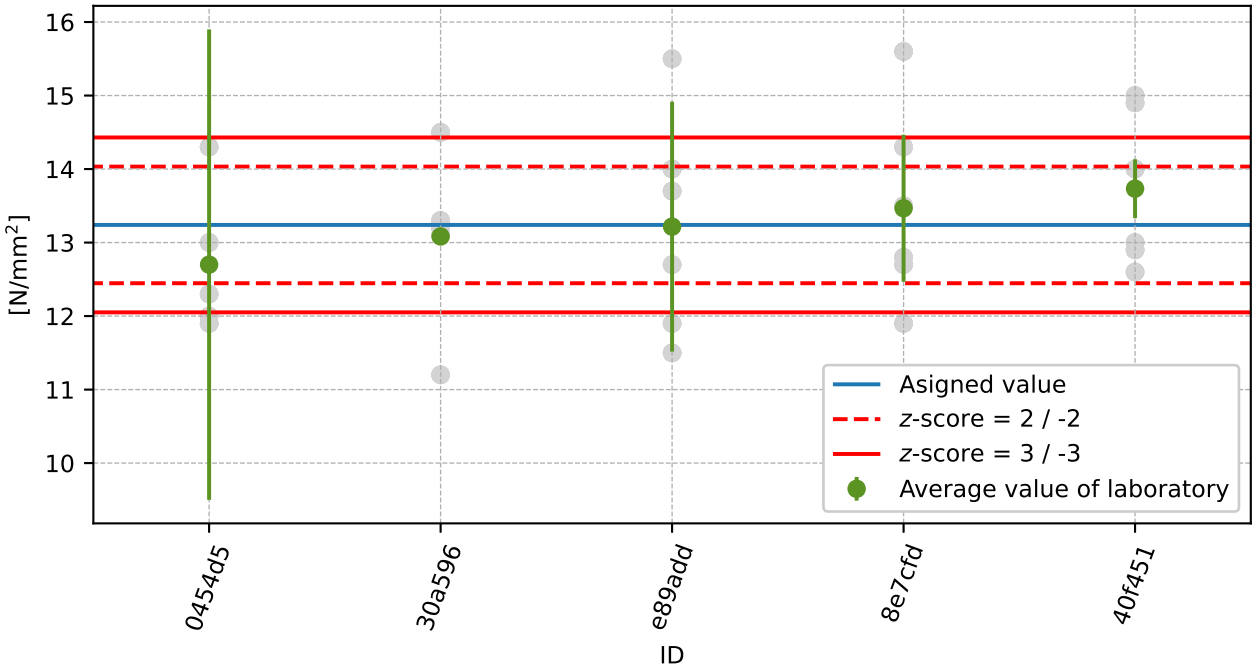

Figure 8: Average values and extended uncertainties of measurement

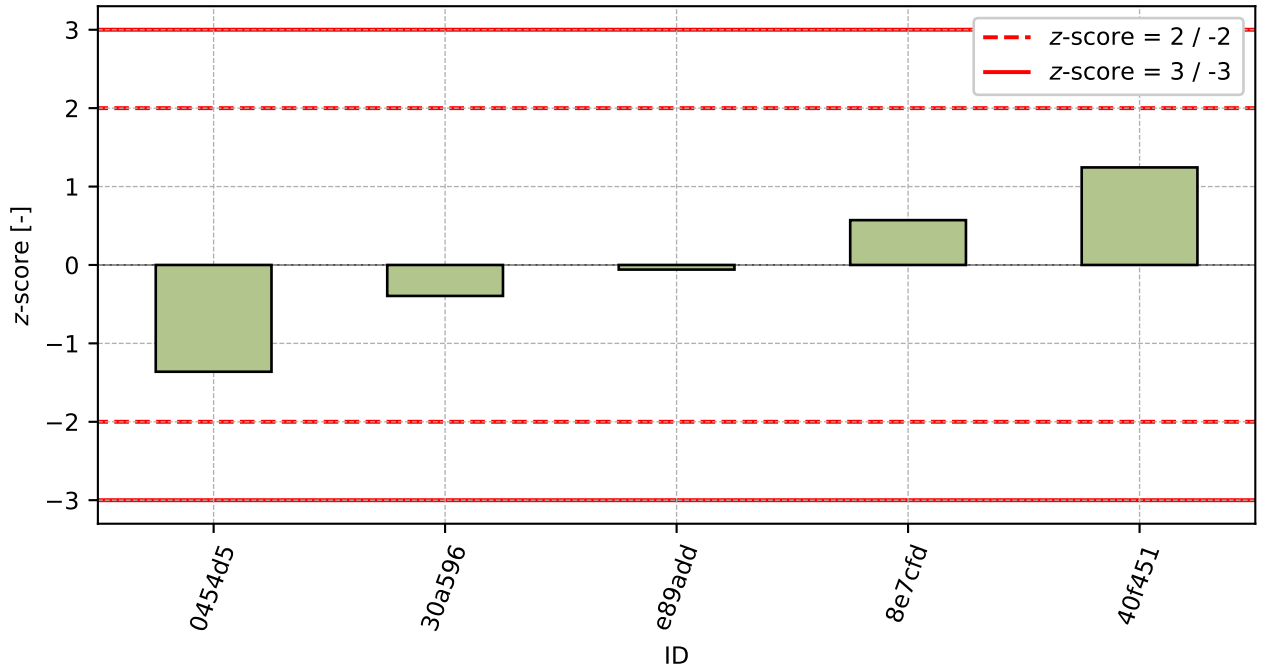

Figure 9: z-score

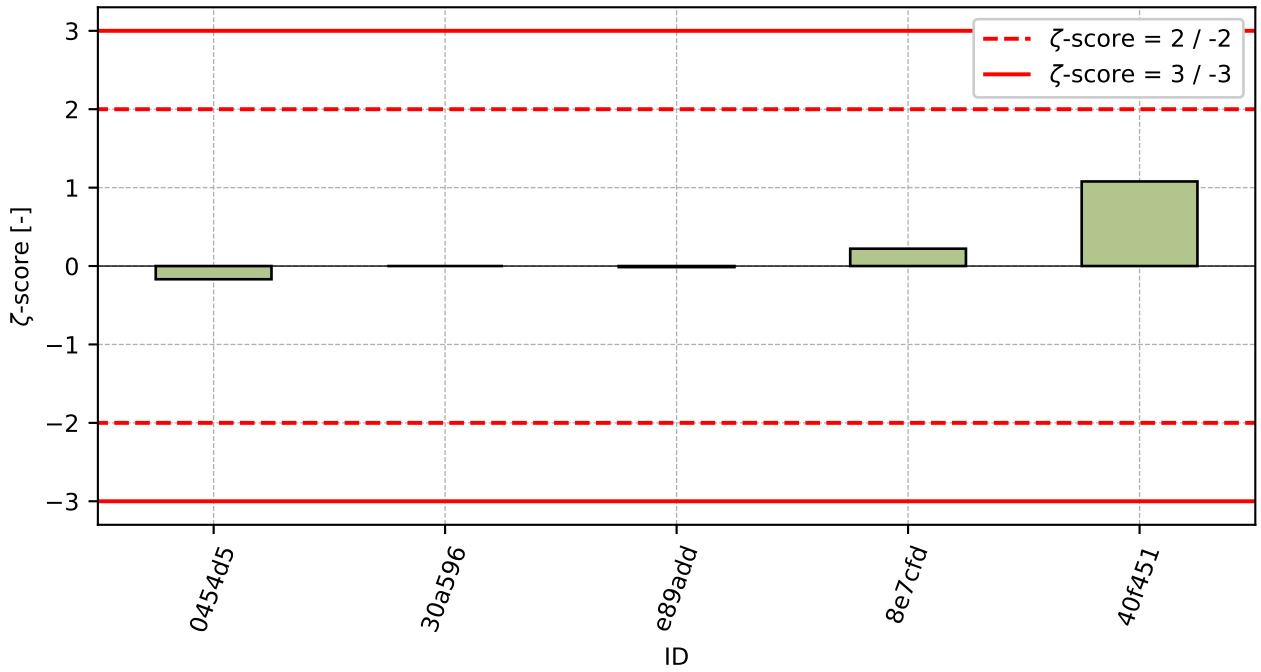

Figure 10: ζ-score

Table 6: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
0454d5	-1.36	-0.17
30a596	-0.4	-
e89add	-0.06	-0.01
8e7cfd	0.57	0.22
40f451	1.24	1.08

2 Appendix – EN 772-3 (Net volume and percentage of voids of clay masonry units by hydrostatic weighing)

2.1 Net volume

2.1.1 Test results

Table 7: Test results - ordered by average value. Outliers are marked by red color. u_X - extended uncertainty of measurement; $\bar{x}$ - average value; s_0 - sample standard deviation; V_X - variation coefficient

ID	Test results						u_X	$\bar{x}$	s_0	V_X [%]
e89add	7457900	7510600	7480900	7475800	7493500	7439000	560721	7476283	25391.3	0.34
8e7cfd	7514000	7523000	7536000	7517000	7530000	7530000	-	7525000	8485.3	0.11
0454d5	7507500	7509500	7531400	7524500	7559600	-	60200	7526500	21057.2	0.28
30a596	8034000	8078000	8055000	8096000	8049000	8063000	-	8062500	21970.4	0.27
d8b86c	9380000	9300000	9360000	9430000	9400000	9430000	77073	9383333	49261.2	0.52
c79cb6	14588316	14635702	14511687	14634839	14667601	14581644	-	14603298	55255.2	0.38

2.1.2 The Numerical Procedure for Determining Outliers

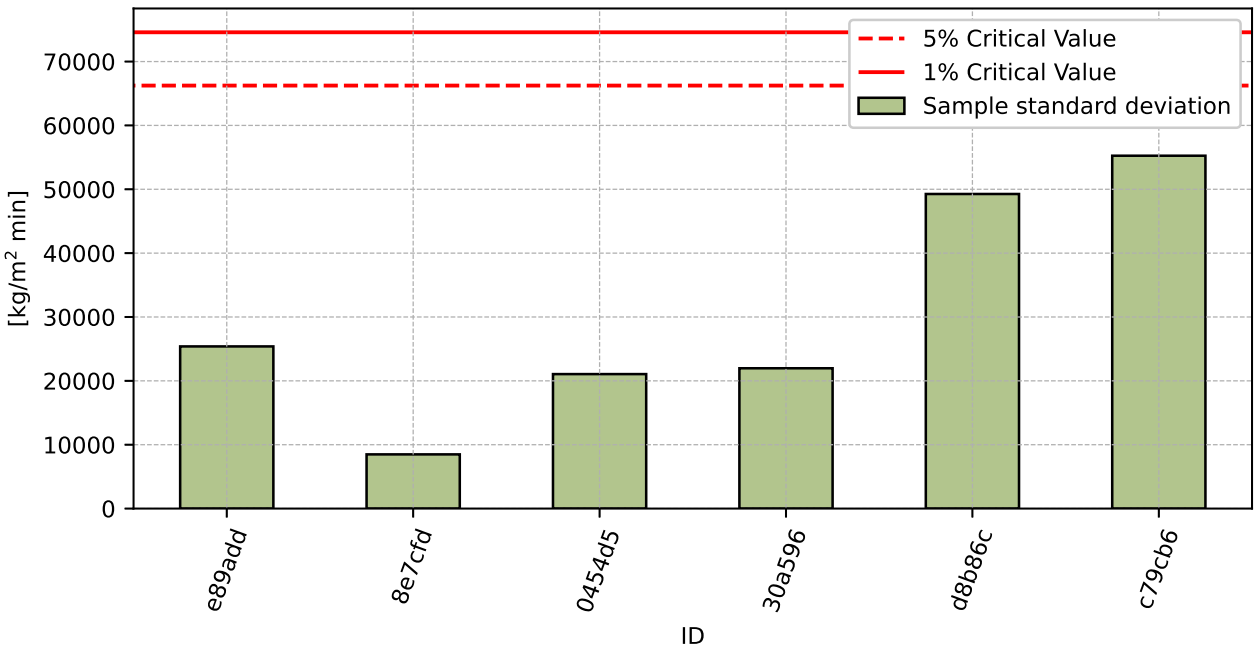

Figure 11: **Cochran's test** - sample standard deviations

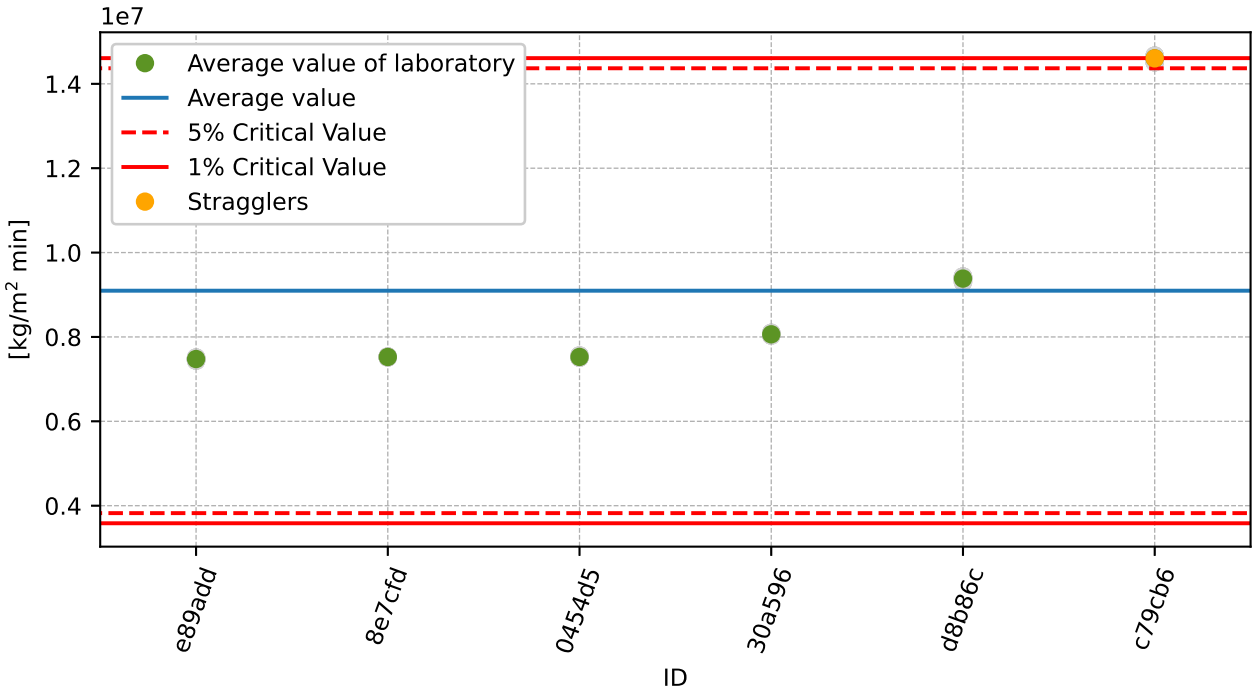

Figure 12: **Grubbs' test** - average values

2.1.3 Mandel's Statistics

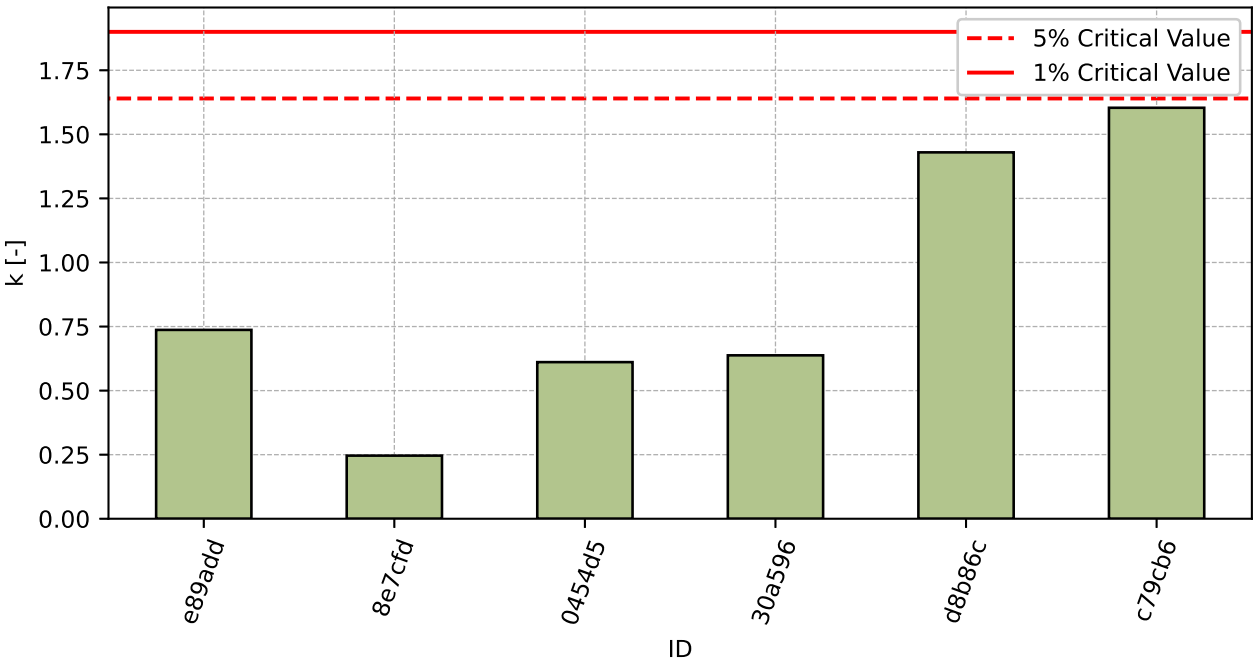

Figure 13: Intralaboratory Consistency Statistic

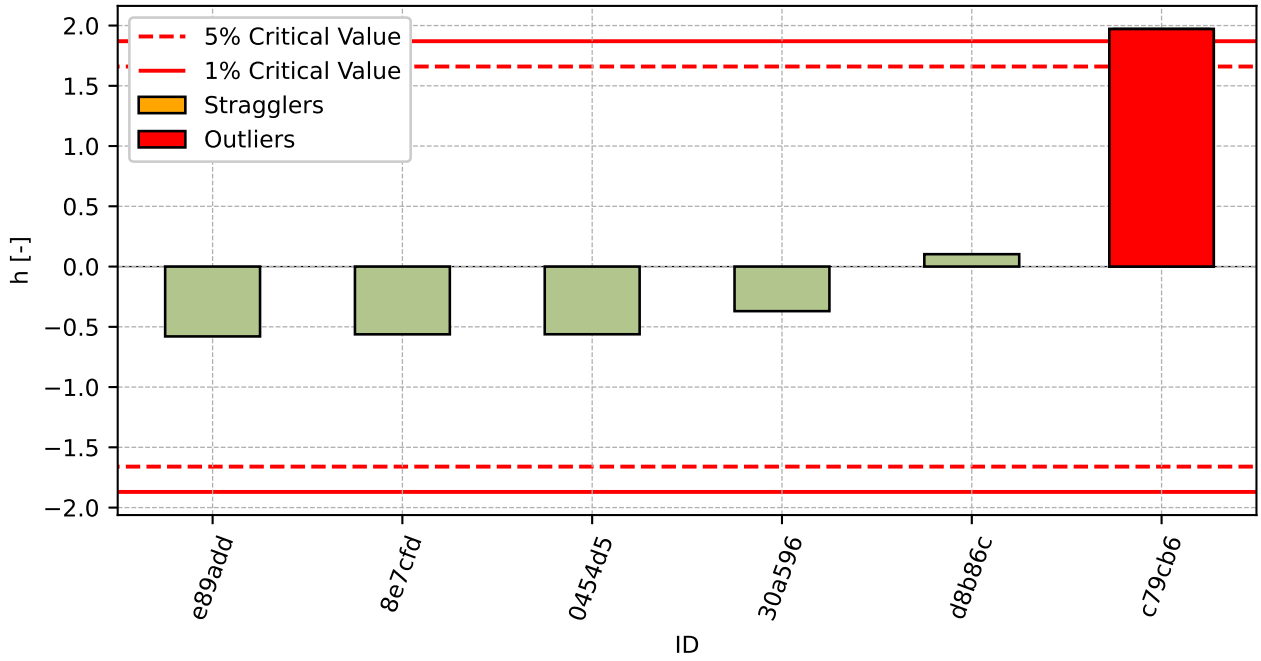

Figure 14: Interlaboratory Consistency Statistic

2.1.4 Descriptive statistics

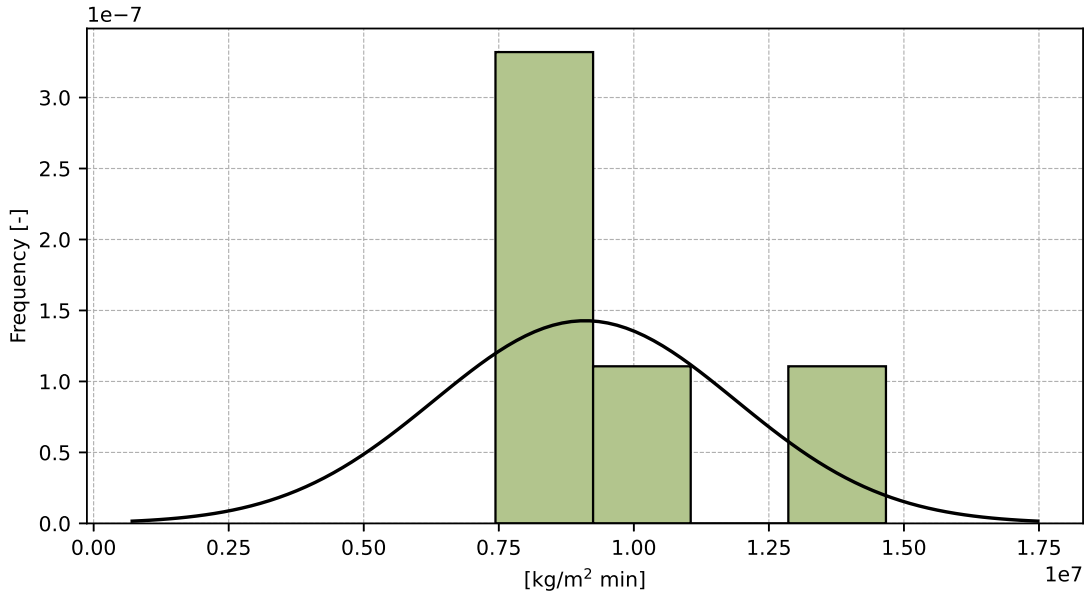

Figure 15: Histogram of all test results

Table 8: Descriptive statistics

Characteristics	[kg/m^2 min]
Average value – $\bar{x}$	9096152
Sample standard deviation – s	2794132.0
Asigned value – x^*	8940295
Robust standard deviation – s^*	2899564.5
Measurement uncertainty of asigned value – u_X	1479677.8
p-value of normality test	0.0 [-]
Interlaboratory standard deviation – s_L	2794096.6
Repeatability standard deviation – s_r	34454.4
Reproducibility standard deviation – s_R	2794309.0
Repeatability – r	96472
Reproducibility – R	7824065

2.1.5 Evaluation of Performance Statistics

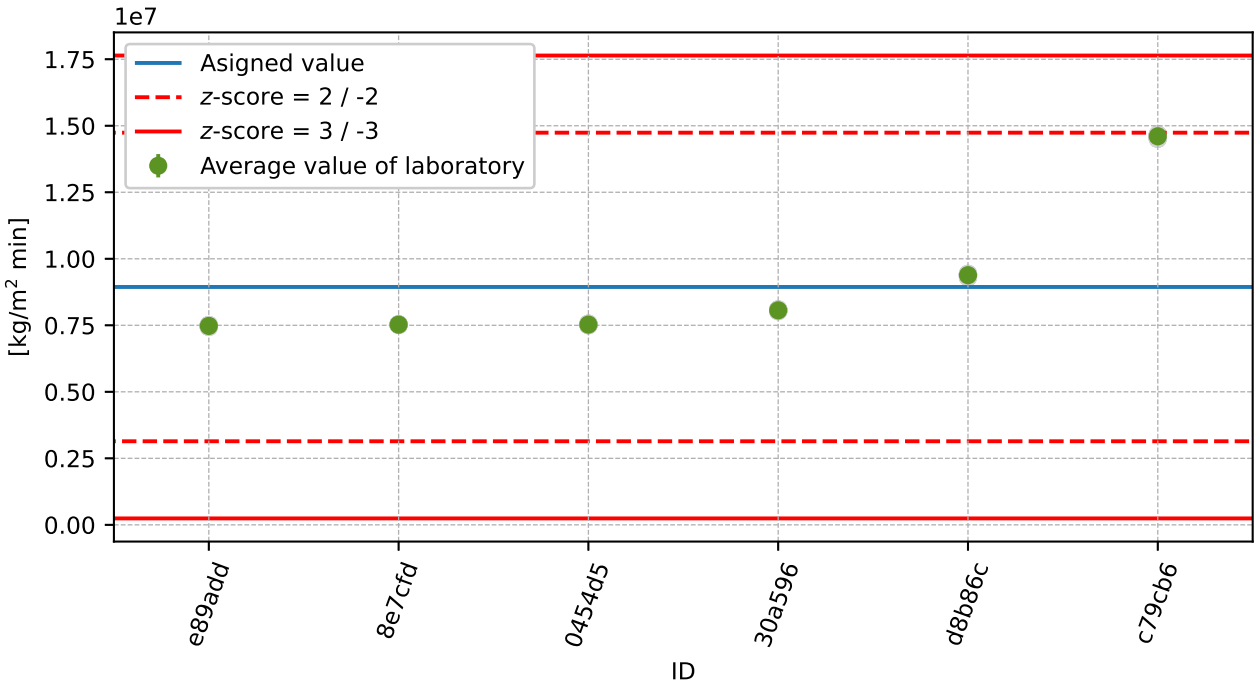

Figure 16: Average values and sample standard deviations

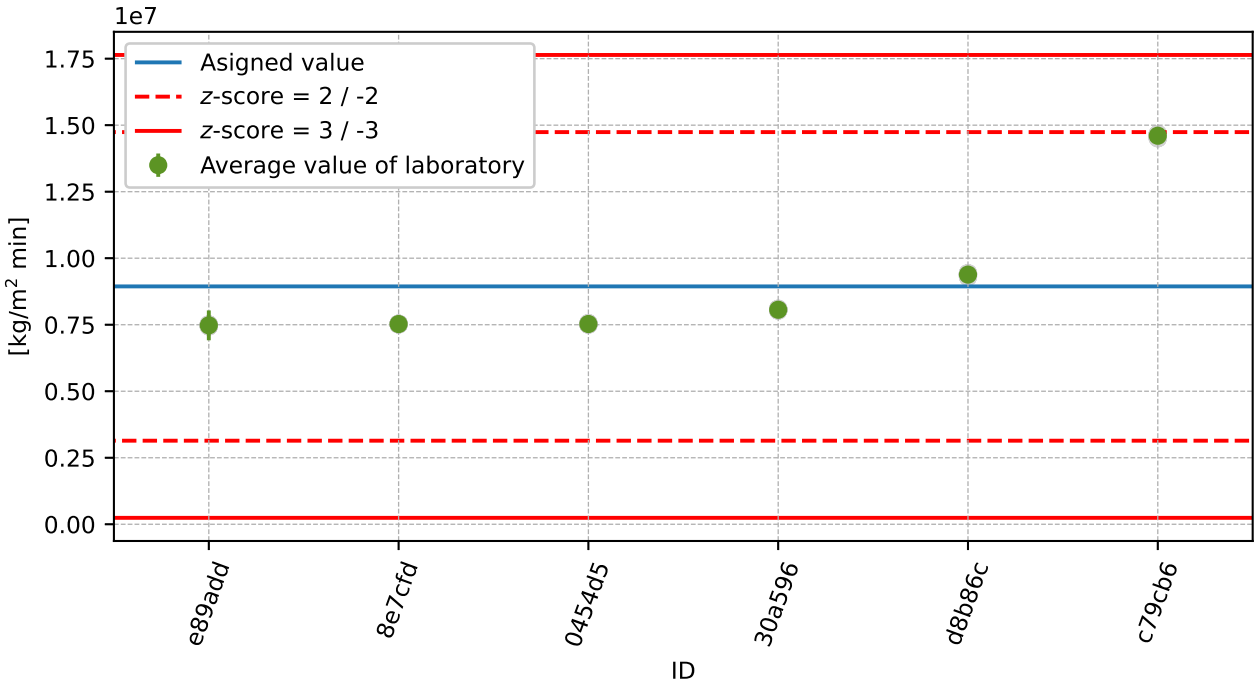

Figure 17: Average values and extended uncertainties of measurement

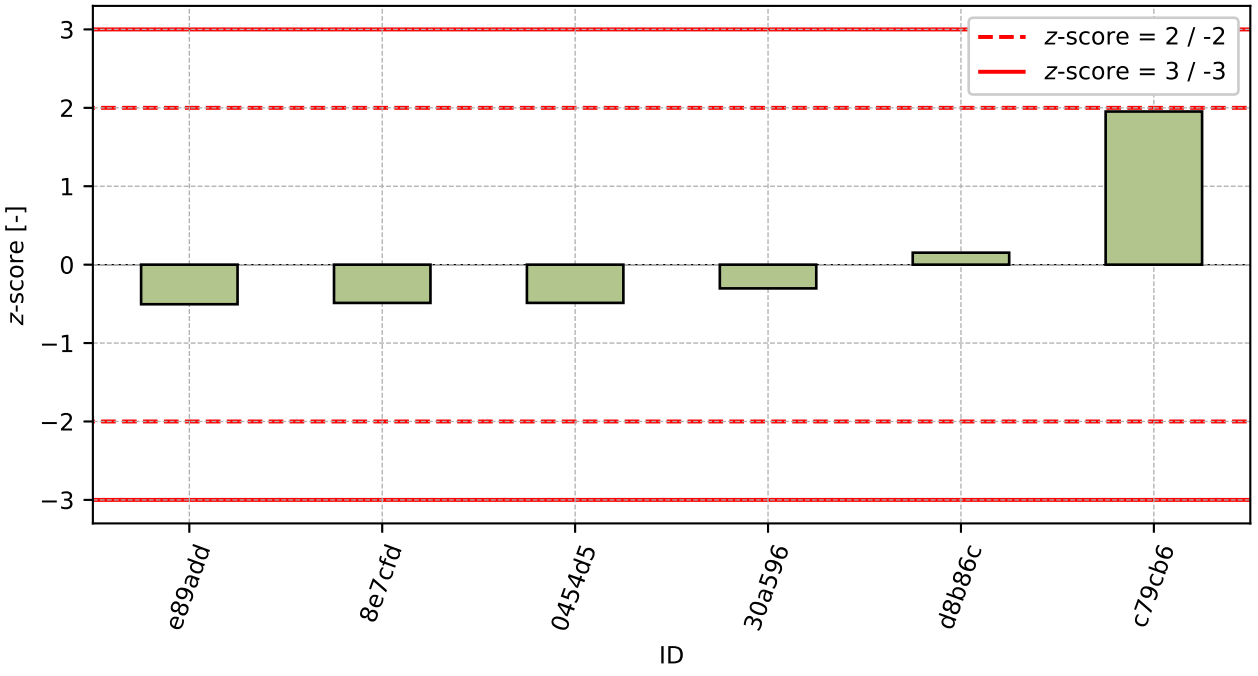

Figure 18: z-score

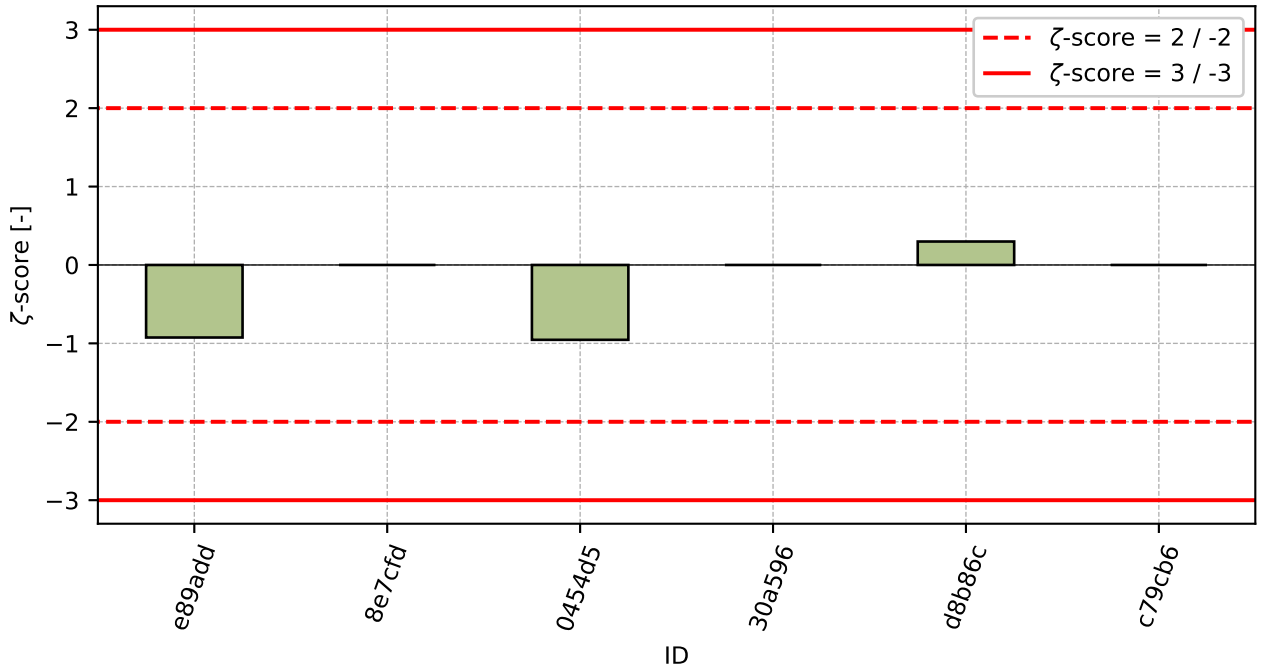

Figure 19: ζ-score

Table 9: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
e89add	-0.5	-0.93
8e7cfd	-0.49	-
0454d5	-0.49	-0.95
30a596	-0.3	-
d8b86c	0.15	0.3
c79cb6	1.95	-

2.2 Percentage of voids of clay masonry units

2.2.1 Test results

Table 10: Test results - ordered by average value. Outliers are marked by red color. u_X - extended uncertainty of measurement; $\bar{x}$ - average value; s_0 - sample standard deviation; V_X - variation coefficient

ID	Test results [%]						u_X [%]	$\bar{x}$ [%]	s_0 [%]	V_X [%]
30a596	48.5	48.7	48.5	48.4	48.6	48.6	-	48.6	0.1	0.22
0454d5	54.0	54.0	55.0	55.0	55.0	-	0.8	54.6	0.55	1.0
e89add	55.0	54.0	55.0	55.0	55.0	55.0	1.2	54.8	0.41	0.74
d8b86c	56.0	55.0	56.0	56.0	56.0	56.0	3.0	55.8	0.41	0.73
8e7cfd	56.1	55.5	55.7	56.3	56.1	56.3	-	56.0	0.33	0.59
c79cb6	85.7	85.7	85.6	85.7	85.7	85.6	-	85.7	0.05	0.06

2.2.2 The Numerical Procedure for Determining Outliers

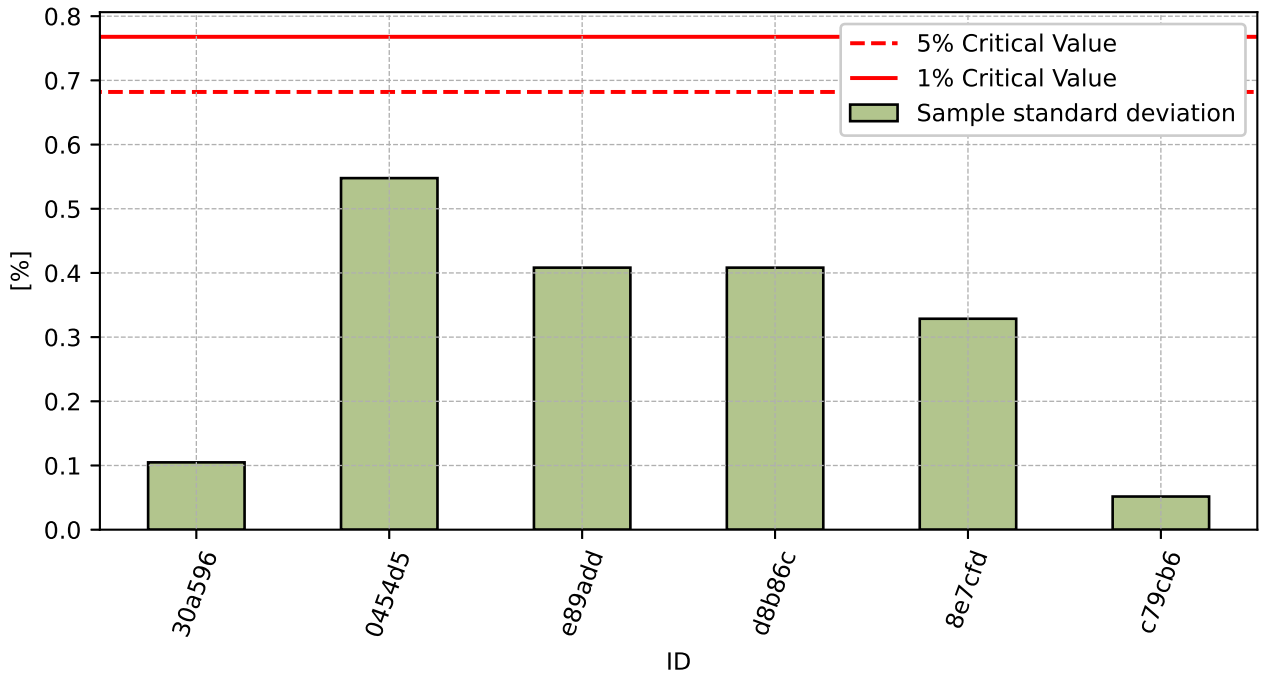

Figure 20: **Cochran's test** - sample standard deviations

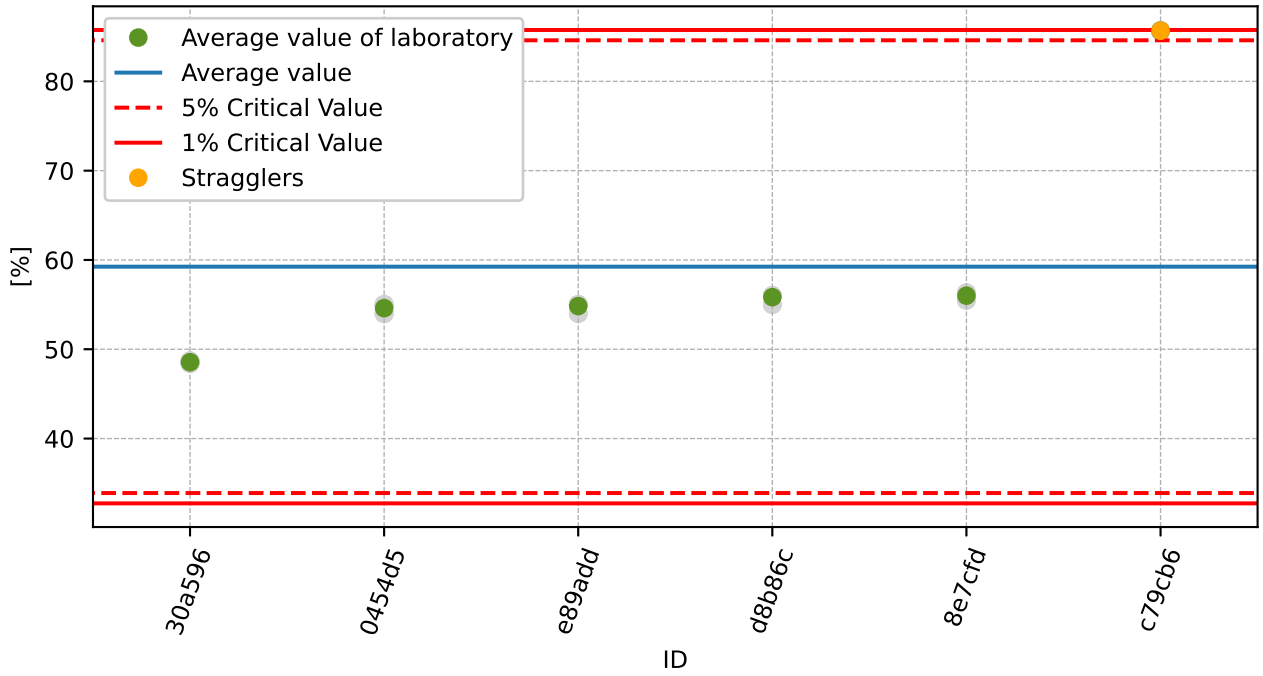

Figure 21: **Grubbs' test** - average values

2.2.3 Mandel's Statistics

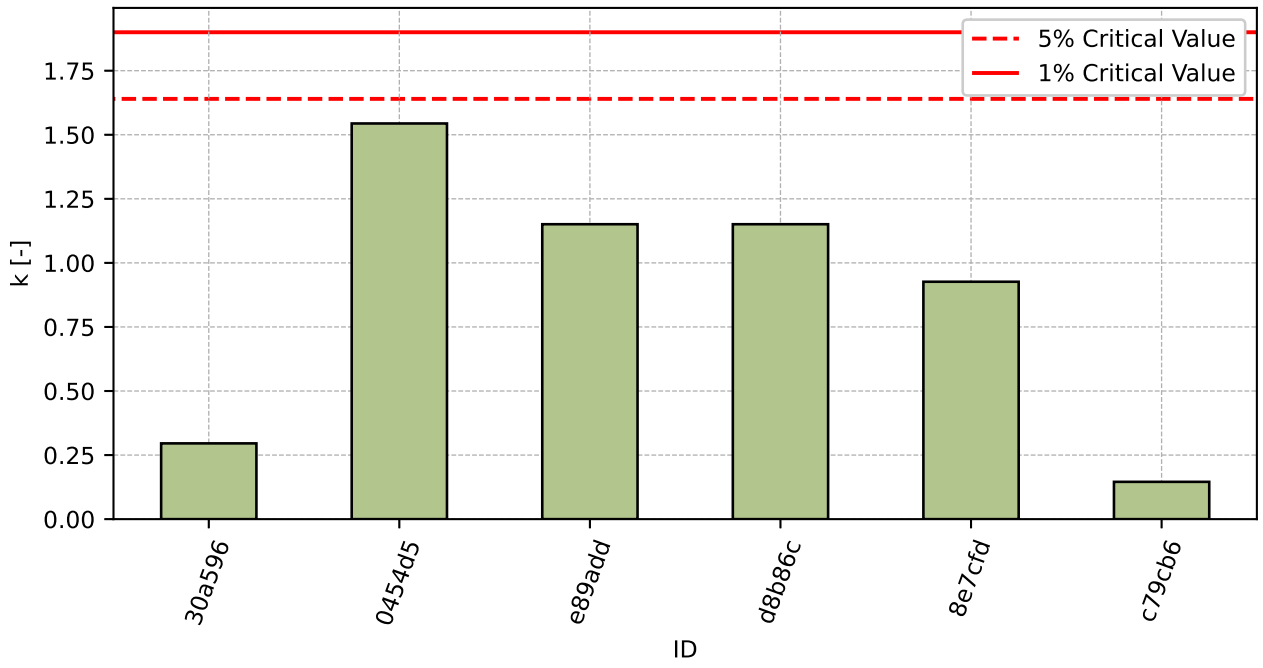

Figure 22: Intralaboratory Consistency Statistic

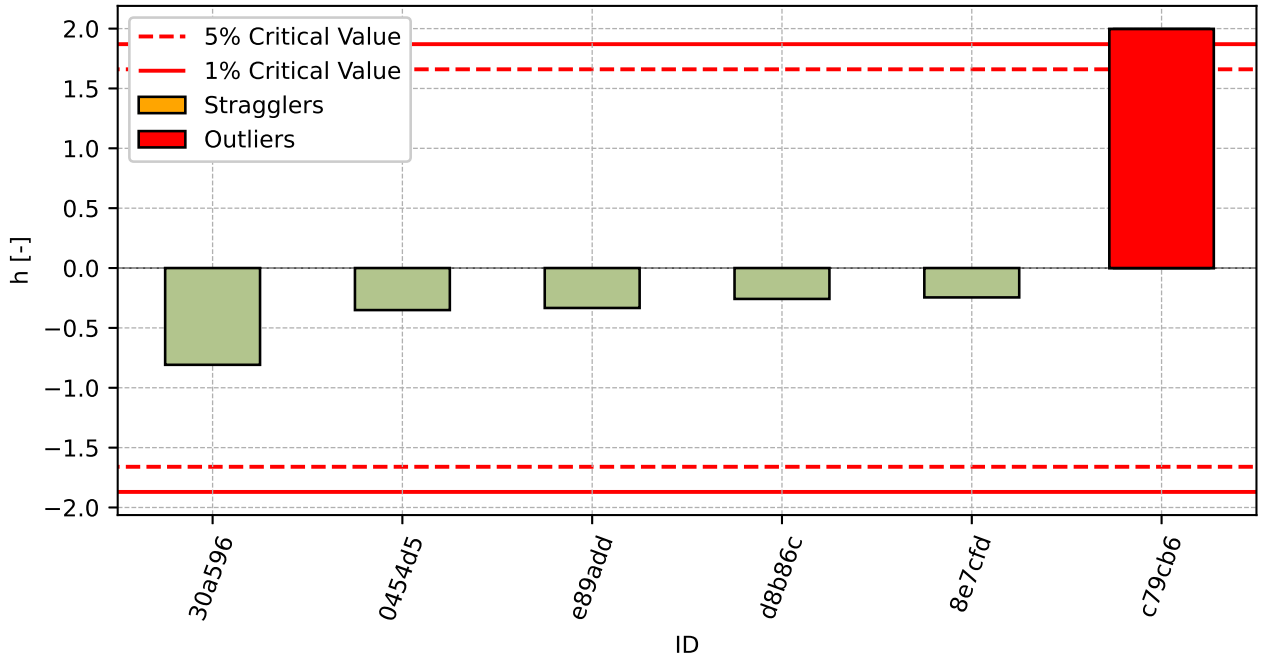

Figure 23: Interlaboratory Consistency Statistic

2.2.4 Descriptive statistics

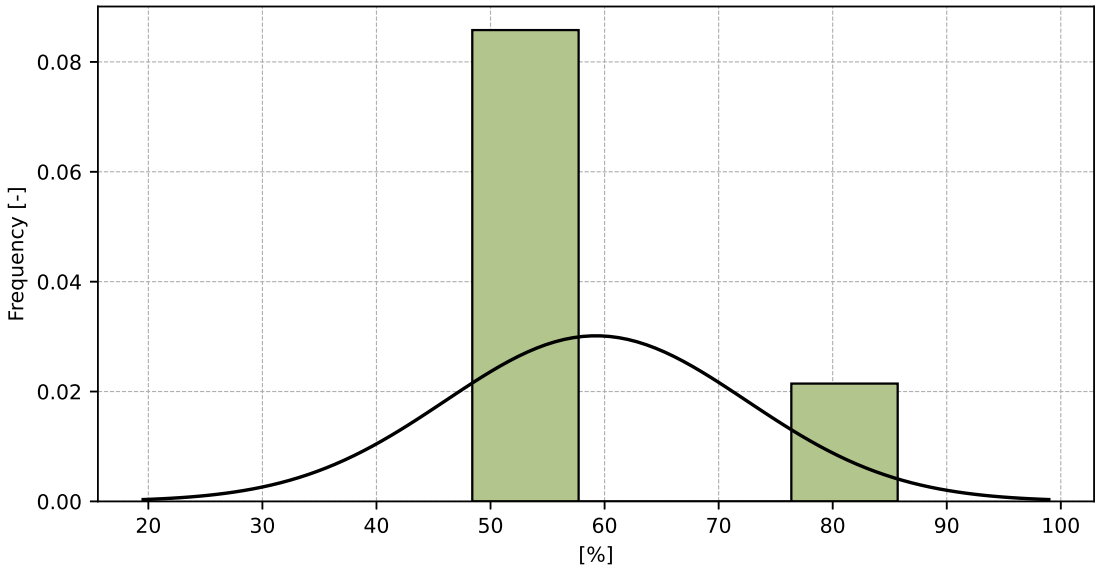

Figure 24: Histogram of all test results

Table 11: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	59.2
Sample standard deviation – s	13.23
Asigned value – x^*	60.1
Robust standard deviation – s^*	12.98
Measurement uncertainty of asigned value – u_X	6.63
p-value of normality test	0.0 [-]
Interlaboratory standard deviation – s_L	13.23
Repeatability standard deviation – s_r	0.35
Reproducibility standard deviation – s_R	13.24
Repeatability – r	1.0
Reproducibility – R	37.1

2.2.5 Evaluation of Performance Statistics

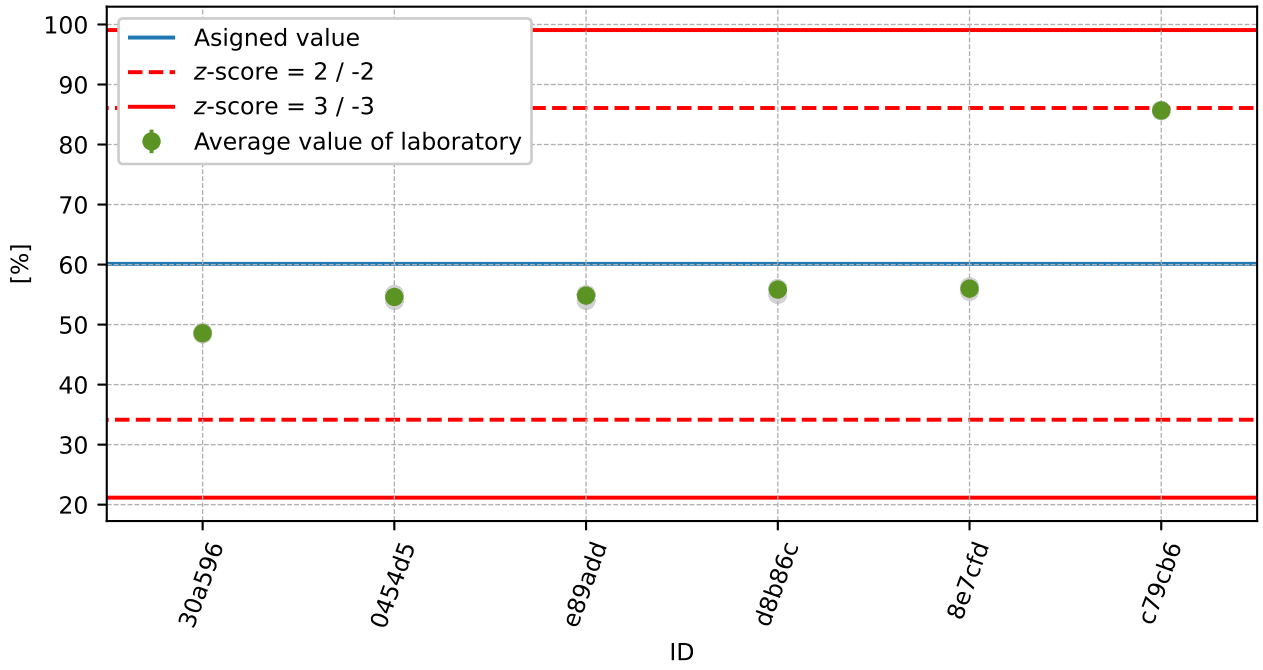

Figure 25: Average values and sample standard deviations

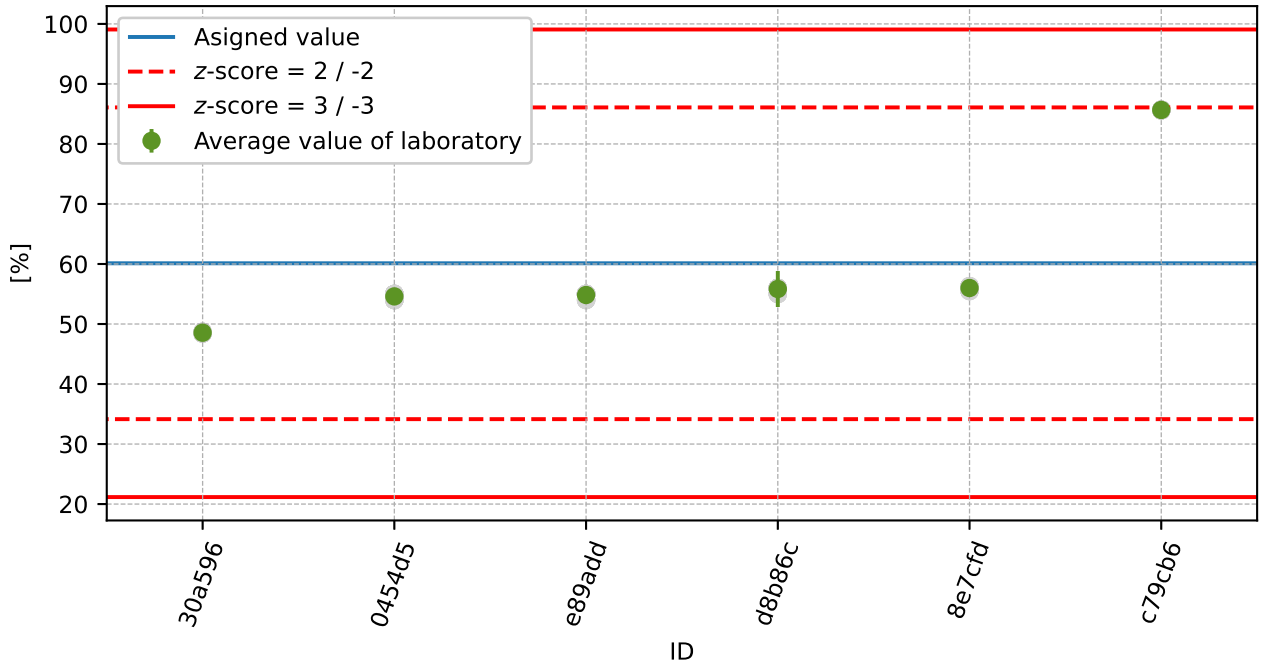

Figure 26: Average values and extended uncertainties of measurement

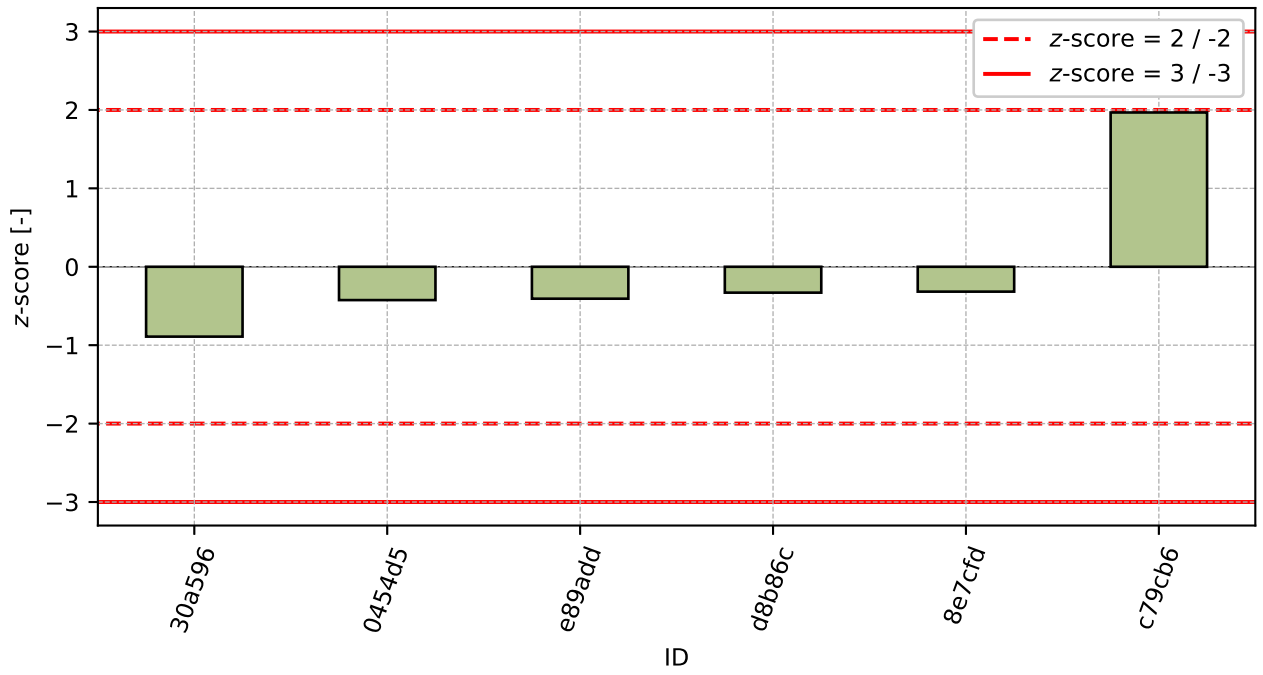

Figure 27: z-score

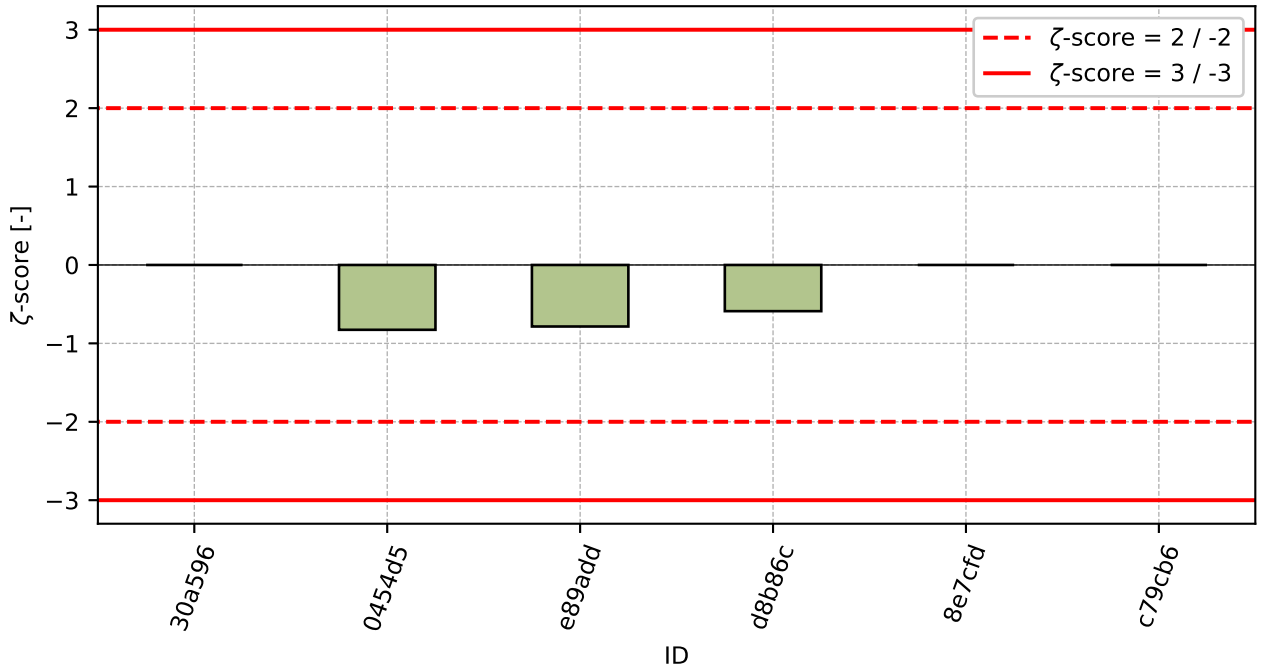

Figure 28: ζ-score

Table 12: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
30a596	-0.89	-
0454d5	-0.42	-0.83
e89add	-0.41	-0.78
d8b86c	-0.33	-0.59
8e7cfd	-0.32	-
c79cb6	1.97	-

3 Appendix – EN 772-6 (Bending tensile strength of aggregate concrete masonry units)

This part of PT program was not open due to the low number of participants.

4 Appendix – EN 772-7 (Water absorption of clay masonry damp proof course units by boiling in water)

This part of PT program was not open due to the low number of participants.

5 Appendix – EN 772-10 (Moisture content)

This part of PT program was not open due to the low number of participants.

6 Appendix – EN 772-11 (Water absorption)

6.1 Test results

Table 13: Test results - ordered by average value. Outliers are marked by red color. u_X - extended uncertainty of measurement; $\bar{x}$ - average value; s_0 - sample standard deviation; V_X - variation coefficient

ID	Test results [%]						u_X [%]	$\bar{x}$ [%]	s_0 [%]	V_X [%]
30a596	1.62	1.09	1.3	1.22	1.17	1.0	1.23	1.23	0.216	17.51
e89add	1.0	1.6	1.5	1.0	1.0	1.4	0.5	1.25	0.281	22.49
c79cb6	1.29	1.04	1.2	1.32	1.28	1.53	-	1.28	0.16	12.56
0454d5	1.3	1.3	1.3	1.4	-	-	0.13	1.33	0.05	3.77
5b3698	1.5	1.1	1.7	1.6	1.6	1.3	0.3	1.47	0.225	15.35
8e7cfd	1.79	1.62	2.16	1.32	1.86	1.62	-	1.73	0.282	16.32

6.2 The Numerical Procedure for Determining Outliers

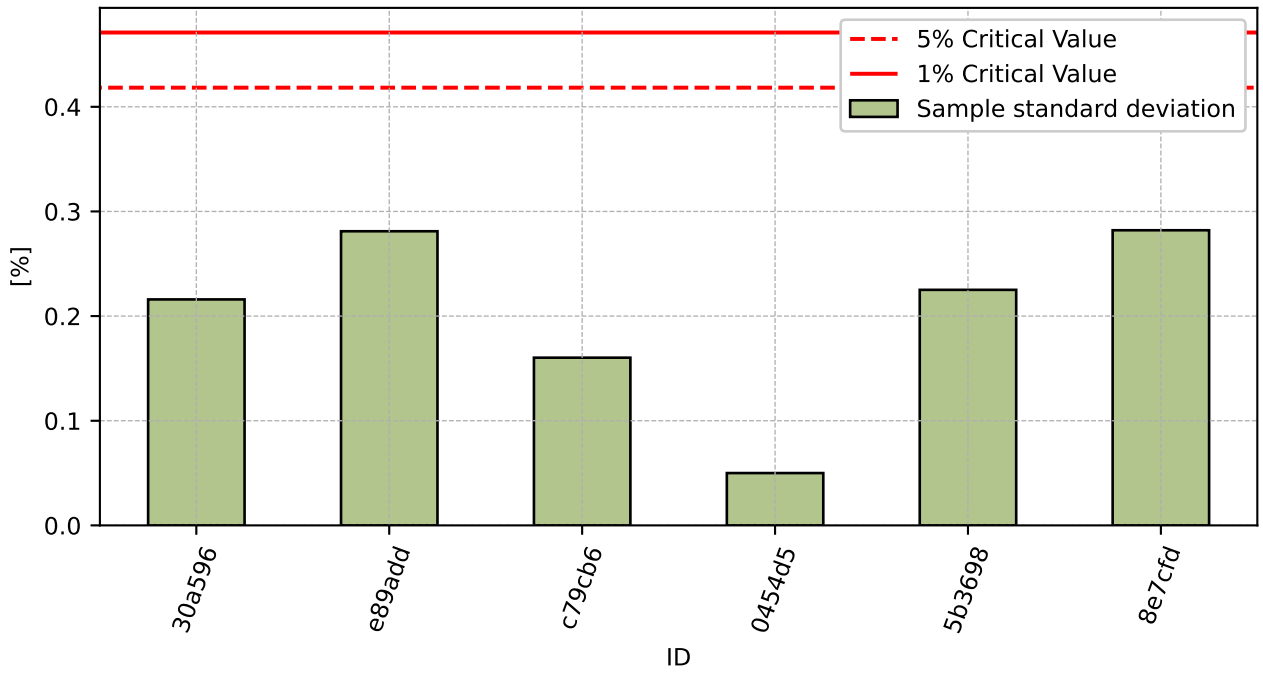

Figure 29: **Cochran's test** - sample standard deviations

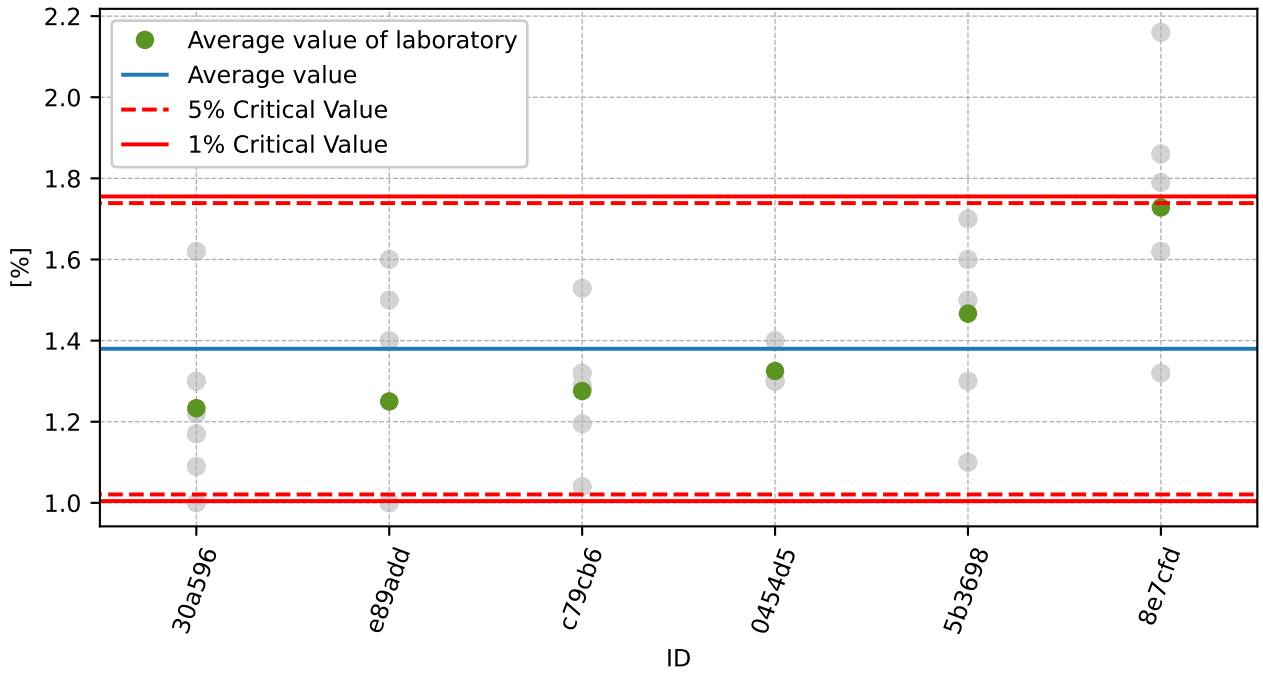

Figure 30: **Grubbs' test** - average values

6.3 Mandel's Statistics

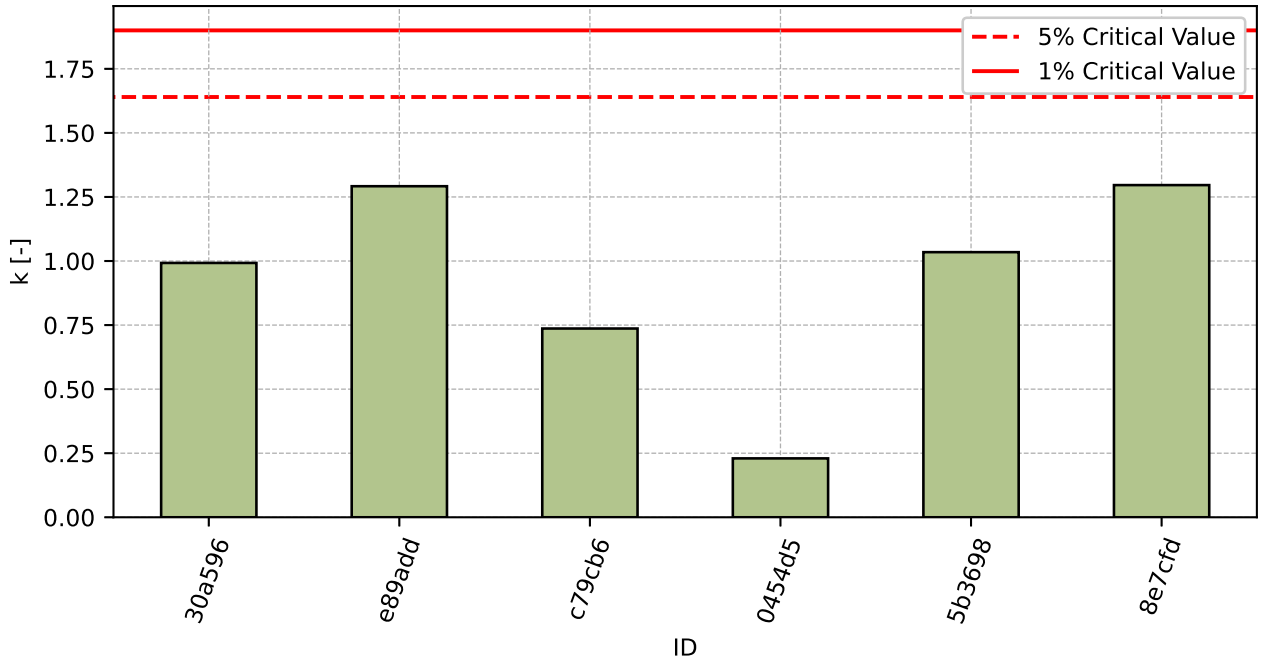

Figure 31: Intralaboratory Consistency Statistic

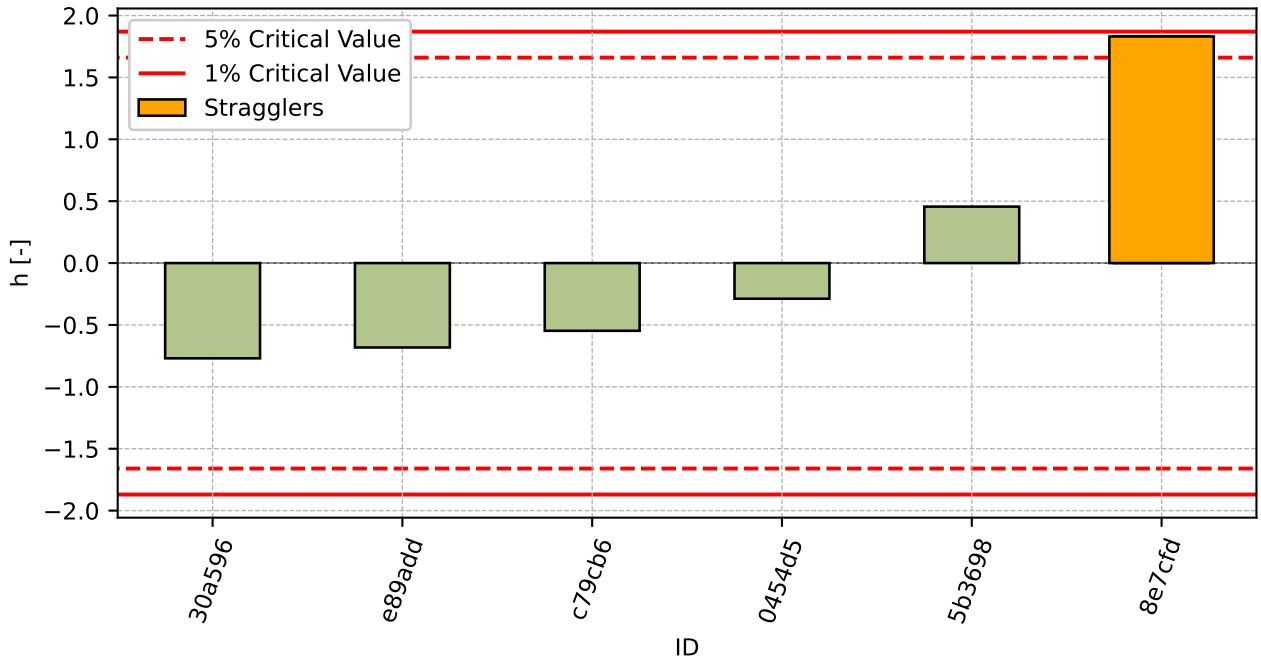

Figure 32: Interlaboratory Consistency Statistic

6.4 Descriptive statistics

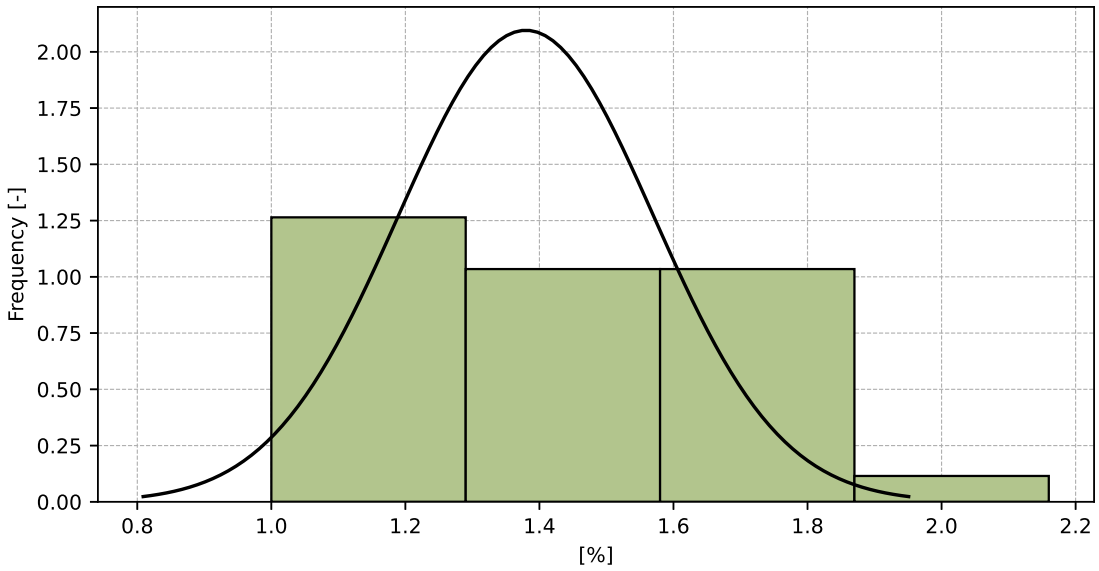

Figure 33: Histogram of all test results

Table 14: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	1.38
Sample standard deviation – s	0.19
Asigned value – x^*	1.37
Robust standard deviation – s^*	0.194
Measurement uncertainty of asigned value – u_X	0.099
p-value of normality test	0.127 [-]
Interlaboratory standard deviation – s_L	0.168
Repeatability standard deviation – s_r	0.218
Reproducibility standard deviation – s_R	0.275
Repeatability – r	0.61
Reproducibility – R	0.77

6.5 Evaluation of Performance Statistics

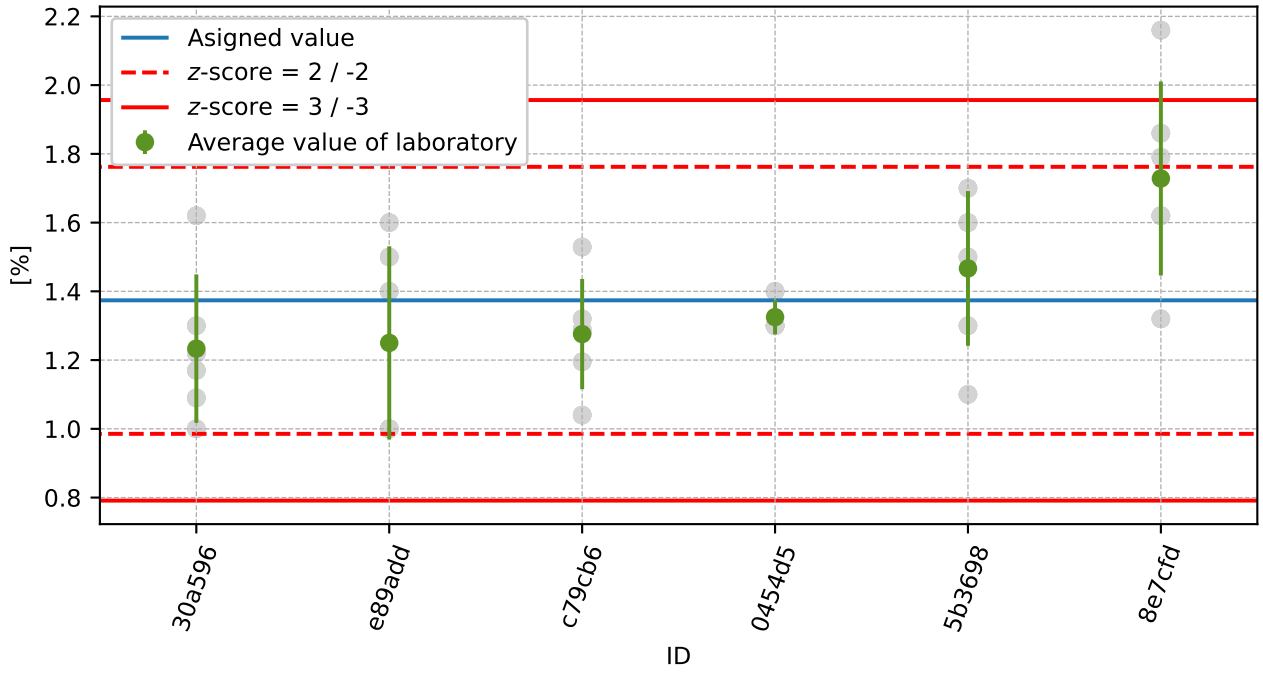

Figure 34: Average values and sample standard deviations

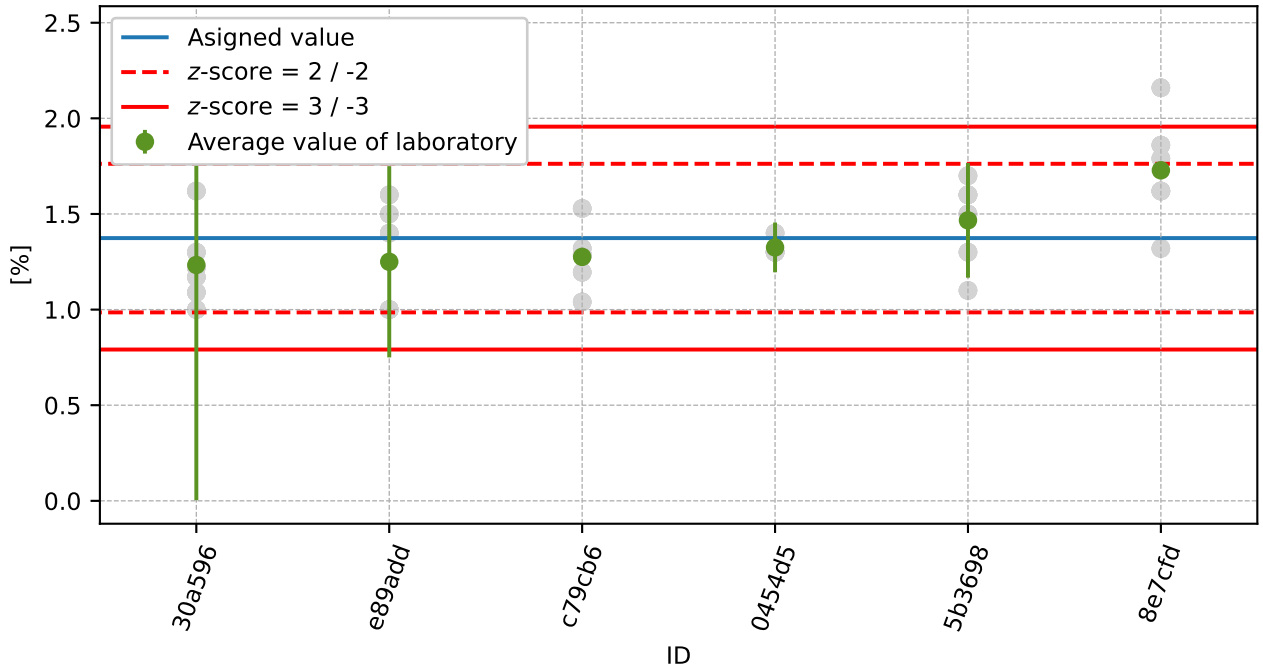

Figure 35: Average values and extended uncertainties of measurement

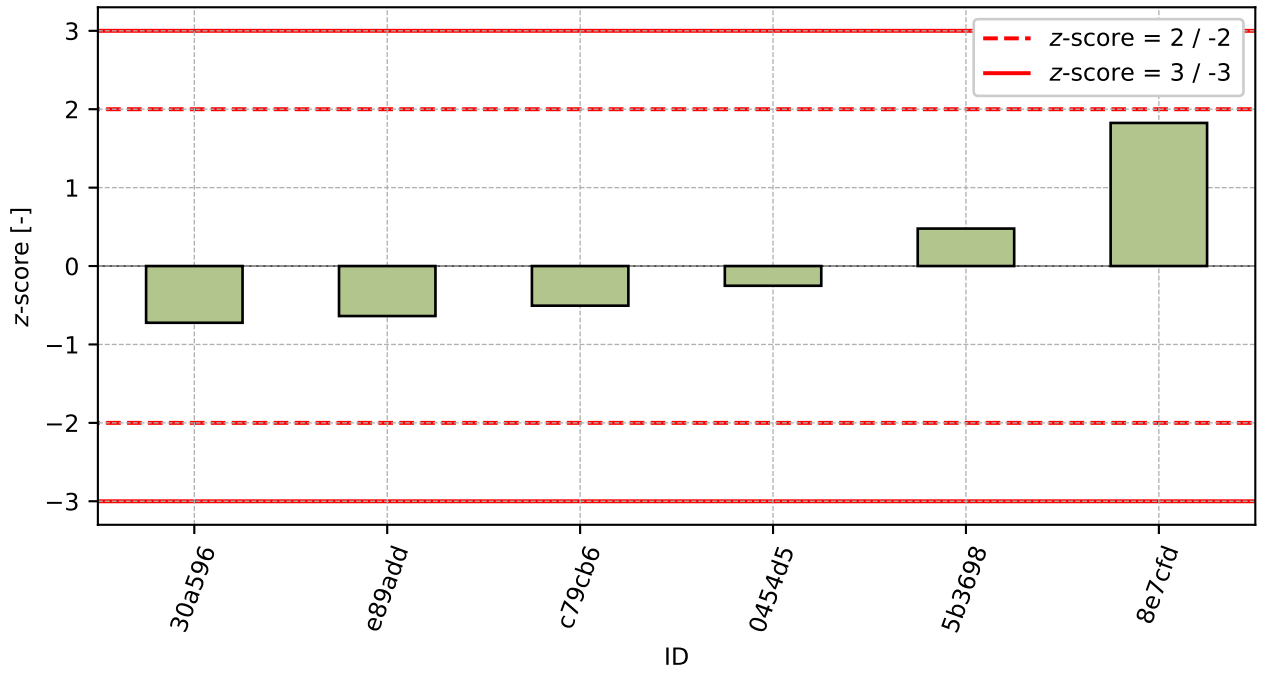

Figure 36: z-score

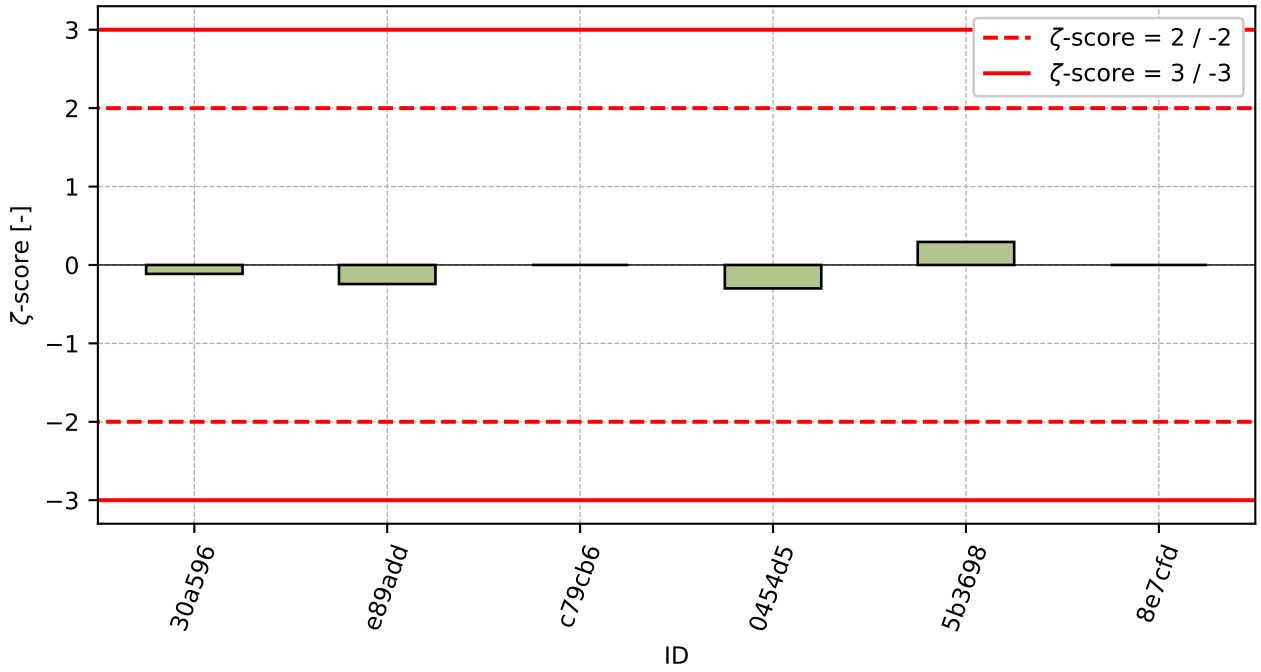

Figure 37: ζ-score

Table 15: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
30a596	-0.72	-0.11
e89add	-0.64	-0.24
c79cb6	-0.51	-
0454d5	-0.25	-0.3
5b3698	0.48	0.29
8e7cfd	1.83	-

7 Appendix – EN 772-13 (Dry density of masonry units)

7.1 Net dry density of masonry units

7.2 Test results

Table 16: Test results - ordered by average value. Outliers are marked by red color. u_X - extended uncertainty of measurement; $\bar{x}$ - average value; s_0 - sample standard deviation; V_X - variation coefficient

ID	Test results [kg/mm^3]						u_X [kg/mm^3]	$\bar{x}$ [kg/mm^3]	s_0 [kg/mm^3]	V_X [%]
30a596	1576	1571	1575	1564	1576	1572	-	1572	4.6	0.29
8e7cfd	1680	1676	1681	1680	1677	1673	-	1678	3.1	0.18
6c108c	1670	1680	1680	1680	1680	1680	20	1678	4.1	0.24
d8b86c	1680	1680	1680	1670	1680	1680	8	1678	4.1	0.24
e89add	1660	1680	1690	1690	1690	1690	185	1683	12.1	0.72
0454d5	1690	1690	1690	1690	1690	-	10	1690	0.0	0.0
c79cb6	1711	1709	1714	1705	1702	1702	-	1707	5.0	0.29

7.3 The Numerical Procedure for Determining Outliers

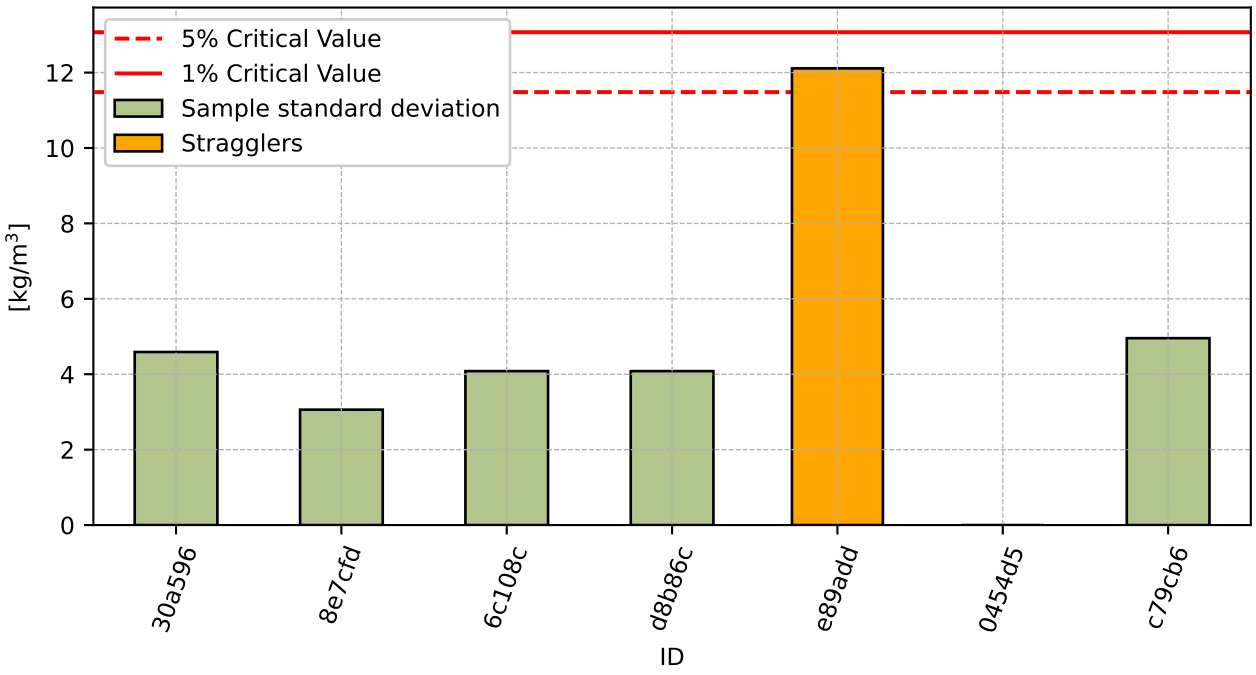

Figure 38: **Cochran's test** - sample standard deviations

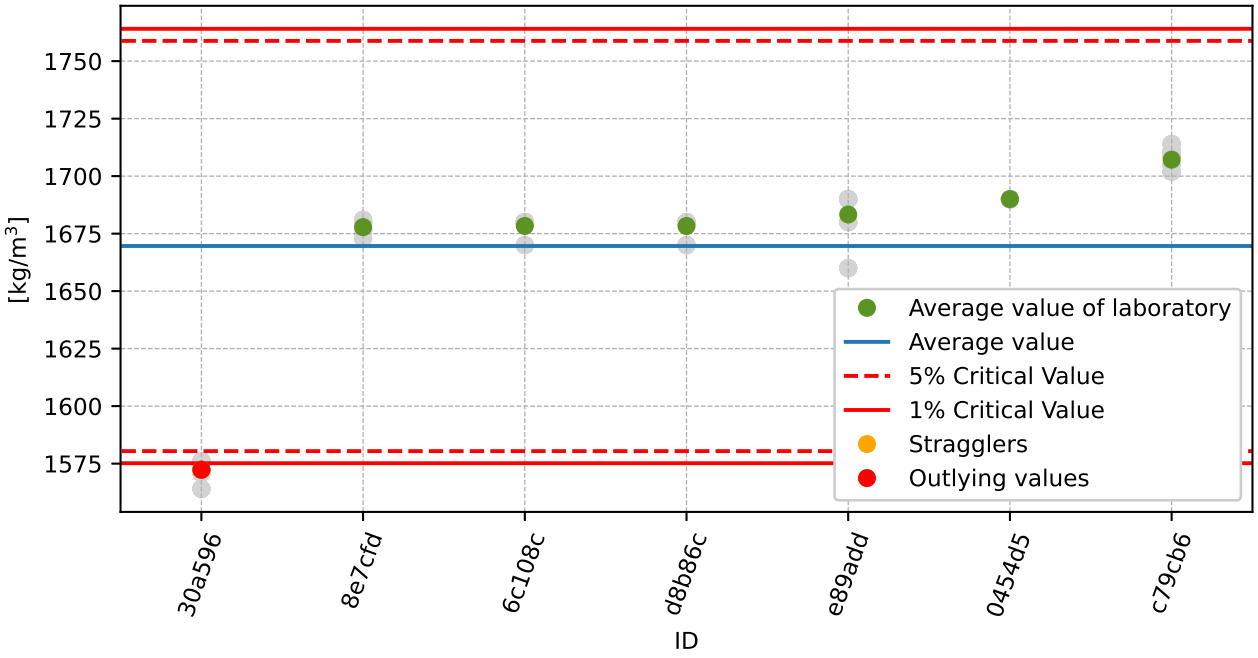

Figure 39: **Grubbs' test** - average values

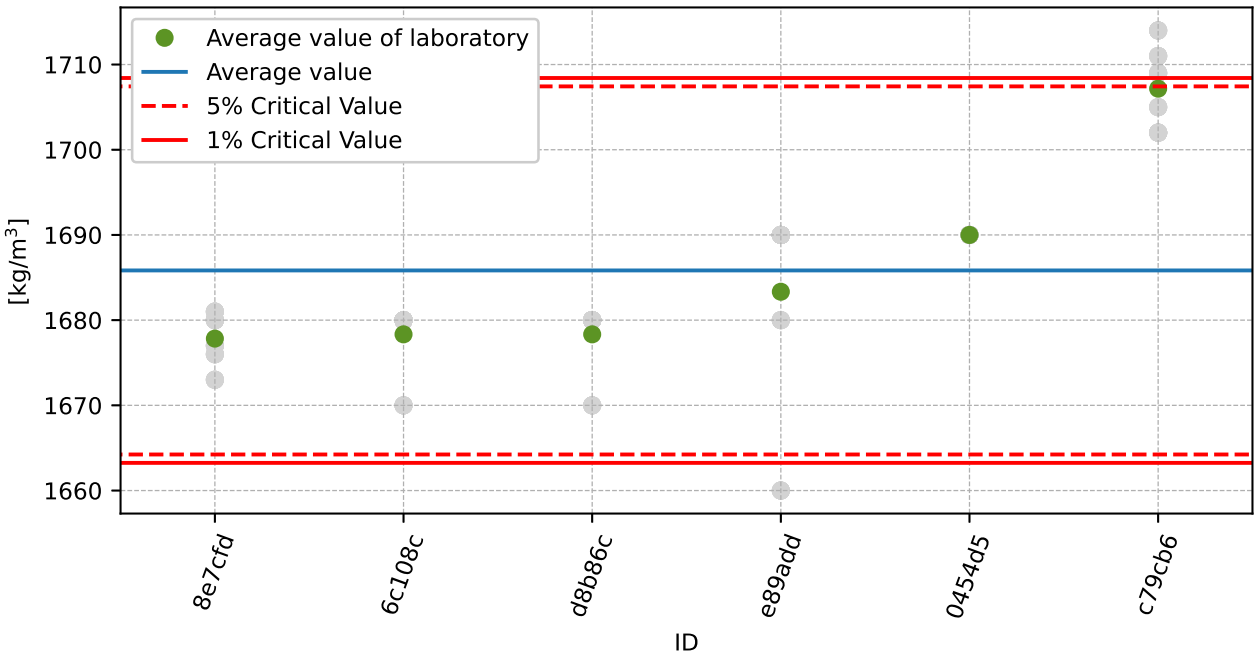

Figure 40: **Grubbs' test** - average values without outliers

7.4 Mandel's Statistics

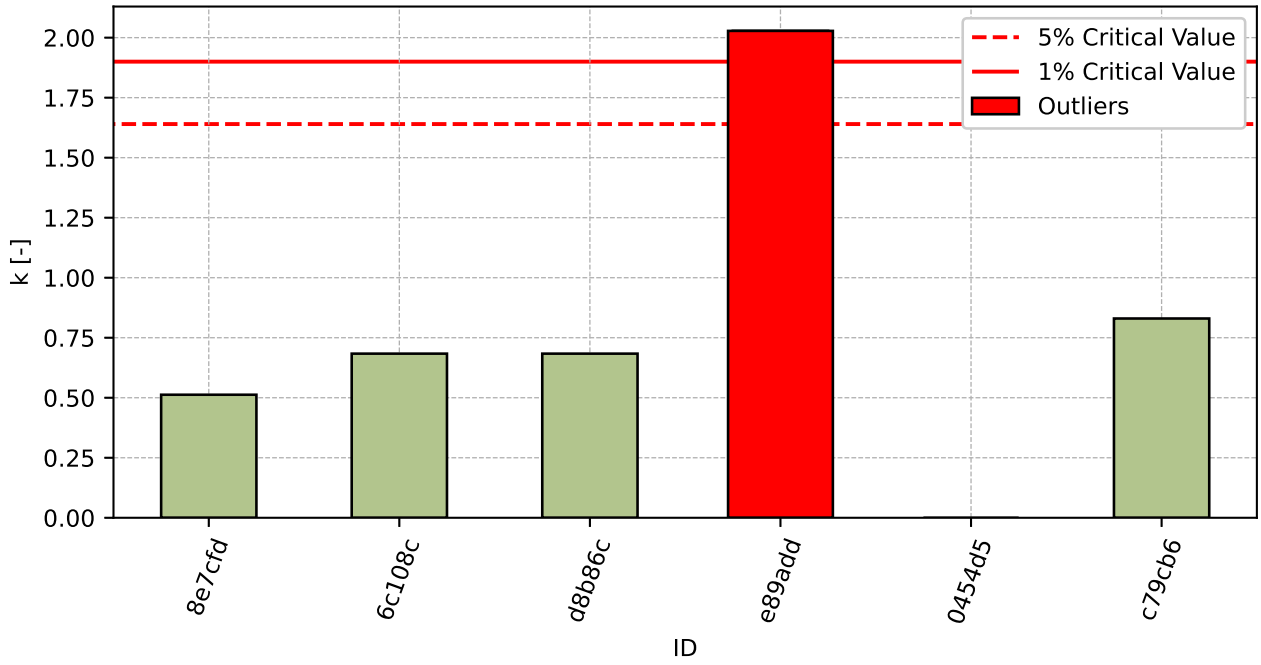

Figure 41: Intralaboratory Consistency Statistic

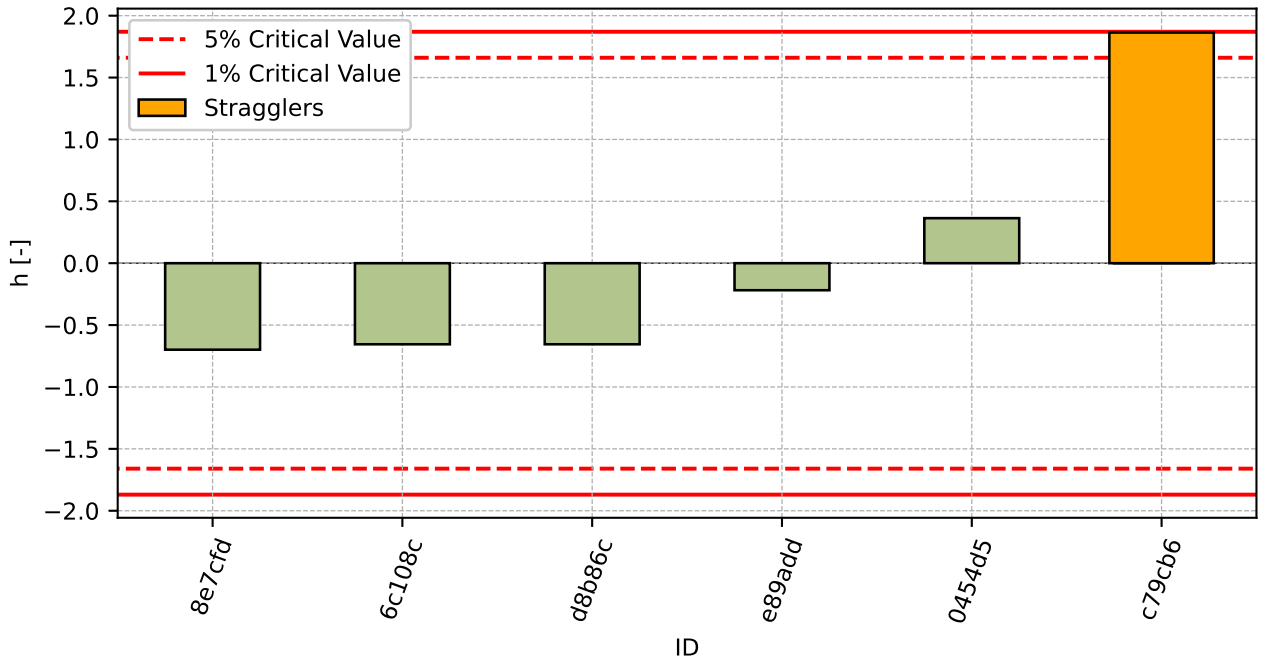

Figure 42: Interlaboratory Consistency Statistic

7.5 Descriptive statistics

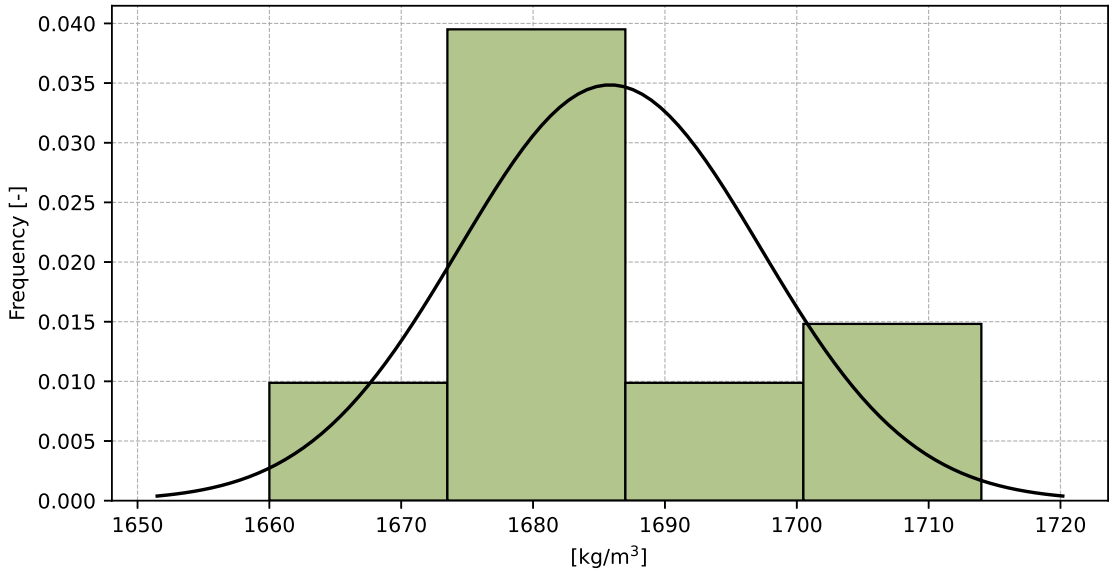

Figure 43: Histogram of all test results

Table 17: Descriptive statistics

Characteristics	[kg/mm³]
Average value – $\bar{x}$	1686
Sample standard deviation – s	11.4
Asigned value – x^*	1685
Robust standard deviation – s^*	11.7
Measurement uncertainty of asigned value – u_X	6.0
p-value of normality test	0.002 [-]
Interlaboratory standard deviation – s_L	11.2
Repeatability standard deviation – s_r	6.0
Reproducibility standard deviation – s_R	12.7
Repeatability – r	17
Reproducibility – R	36

7.6 Evaluation of Performance Statistics

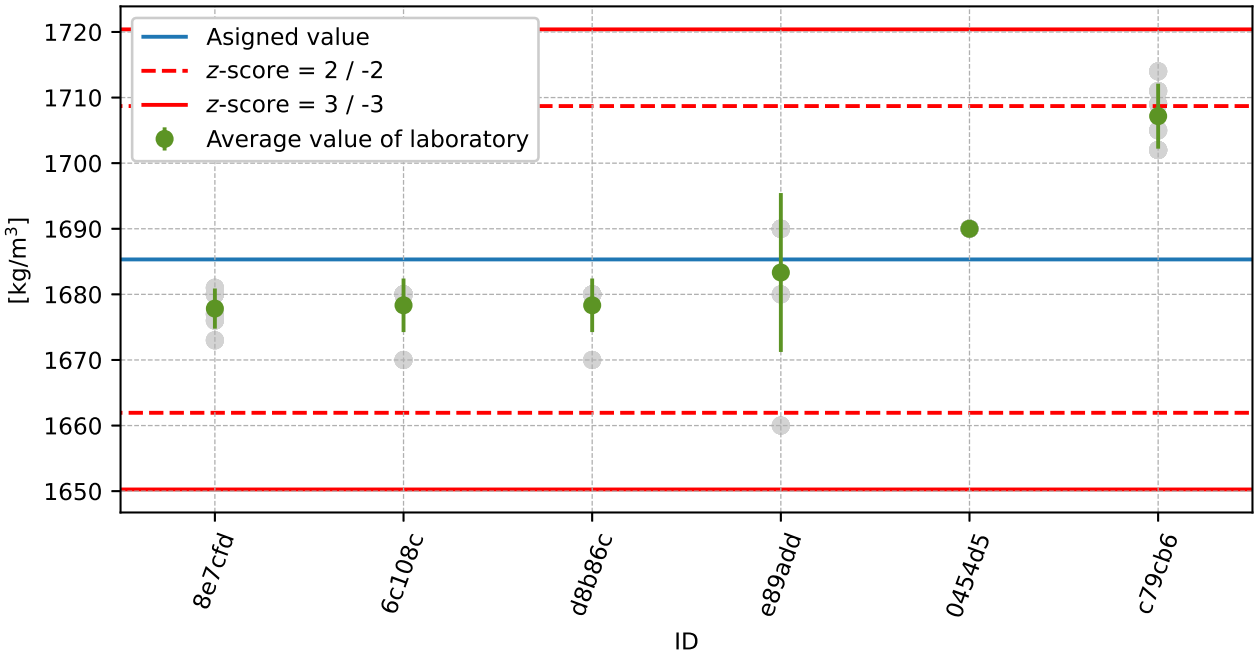

Figure 44: Average values and sample standard deviations

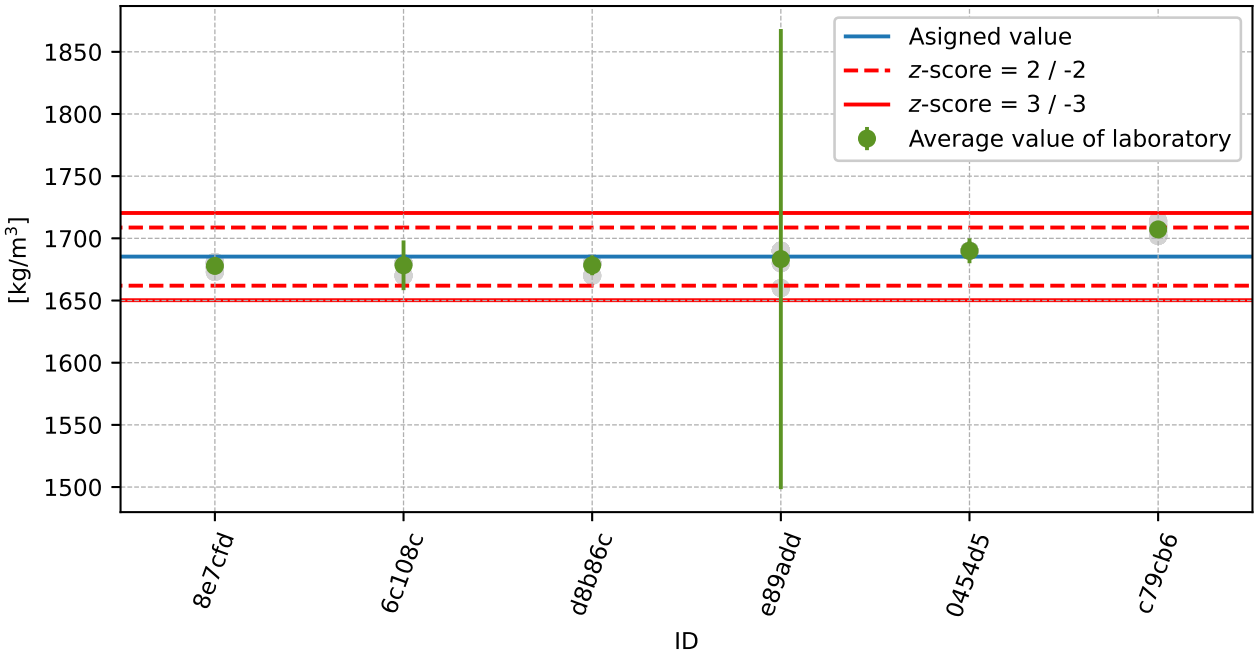

Figure 45: Average values and extended uncertainties of measurement

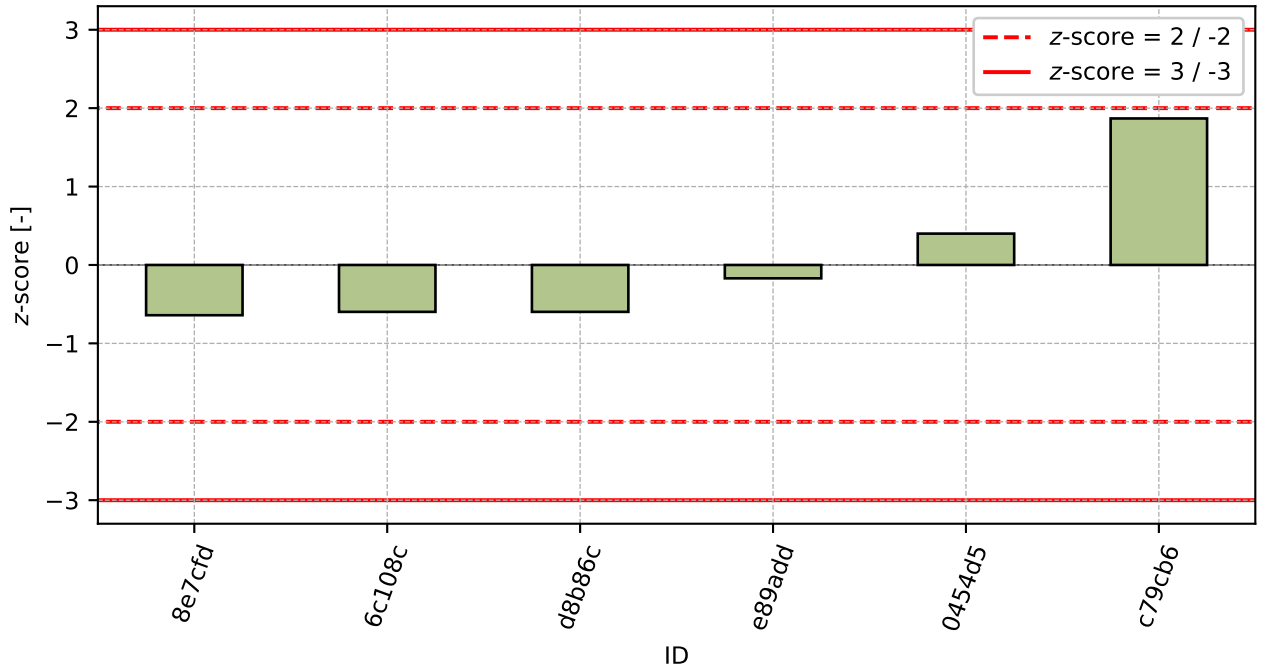

Figure 46: z-score

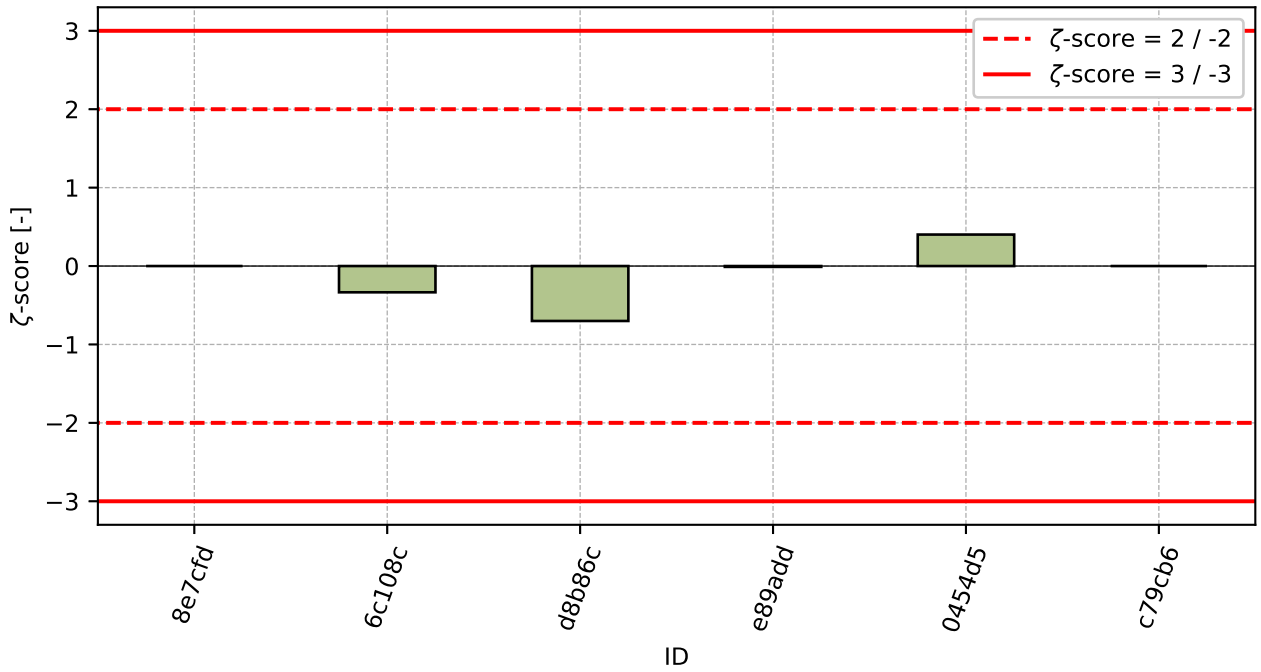

Figure 47: ζ-score

Table 18: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
8e7cfd	-0.64	-
6c108c	-0.6	-0.34
d8b86c	-0.6	-0.7
e89add	-0.17	-0.01
0454d5	0.4	0.4
c79cb6	1.87	-

7.7 Gross dry density of masonry units

7.7.1 Test results

Table 19: Test results - ordered by average value. Outliers are marked by red color. u_X - extended uncertainty of measurement; $\bar{x}$ - average value; s_0 - sample standard deviation; V_X - variation coefficient

ID	Test results [kg/mm^3]						u_X [kg/mm^3]	$\bar{x}$ [kg/mm^3]	s_0 [kg/mm^3]	V_X [%]
8e7cfd	738	745	744	735	736	731	-	738	5.4	0.73
c79cb6	746	743	750	741	740	745	-	744	3.6	0.48
d8b86c	745	750	750	745	745	745	8	747	2.6	0.35
30a596	764	765	764	758	766	763	-	763	2.8	0.37
e89add	765	765	765	765	770	760	84	765	3.2	0.41
6c108c	765	765	770	765	765	765	7	766	2.0	0.27
0454d5	770	770	770	770	770	-	5	770	0.0	0.0

7.7.2 The Numerical Procedure for Determining Outliers

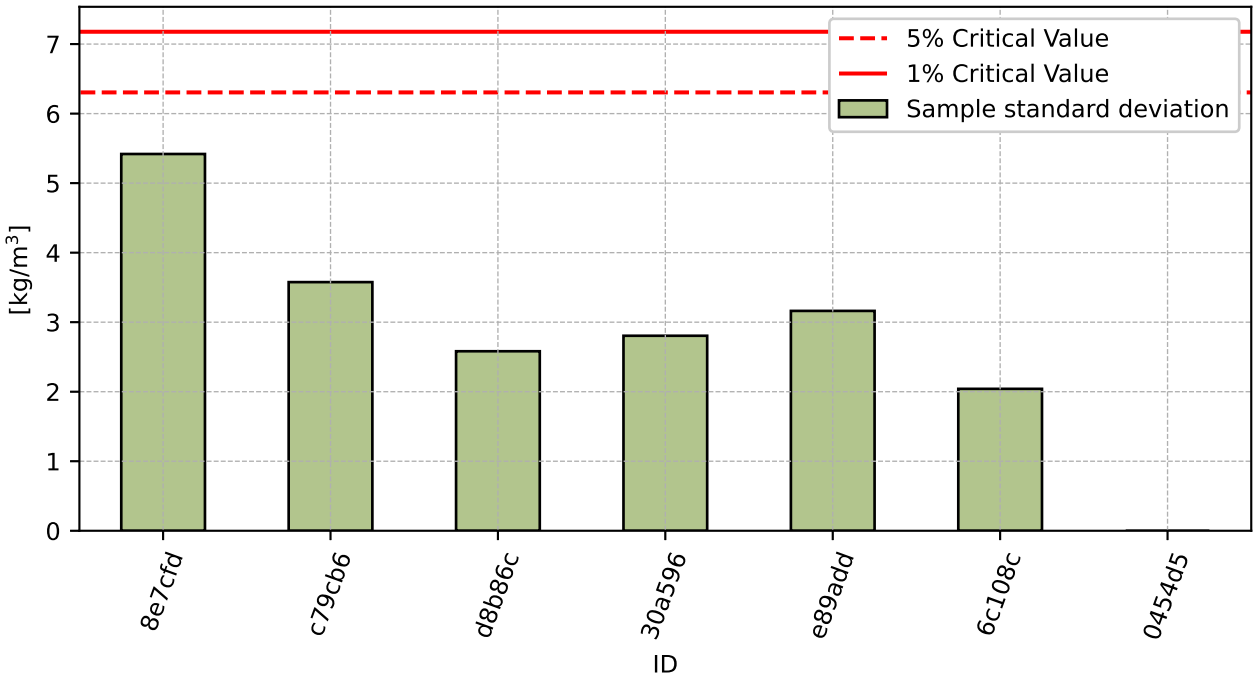

Figure 48: **Cochran's test** - sample standard deviations

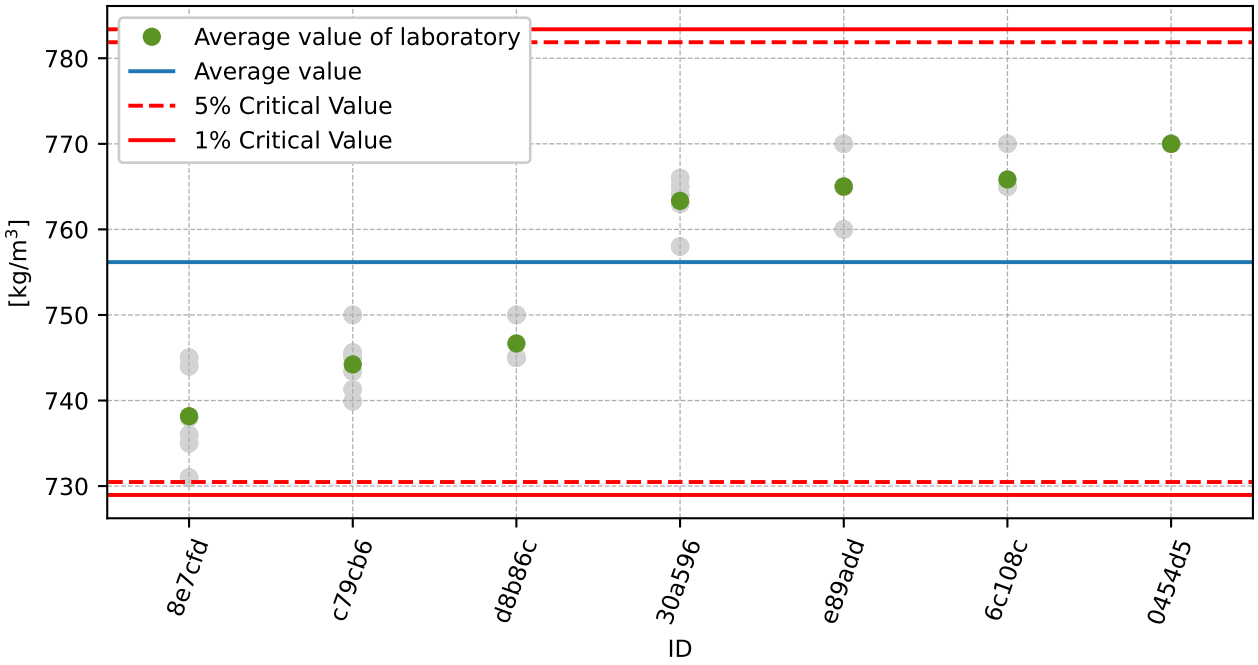

Figure 49: **Grubbs' test** - average values

7.7.3 Mandel's Statistics

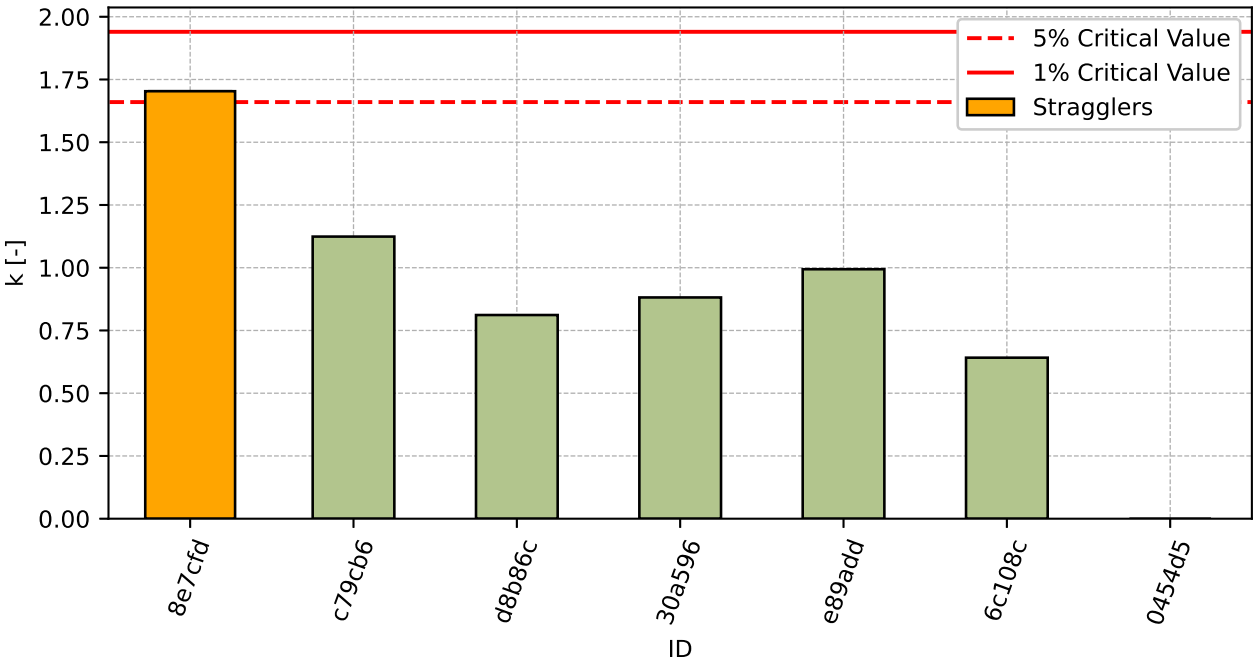

Figure 50: Intralaboratory Consistency Statistic

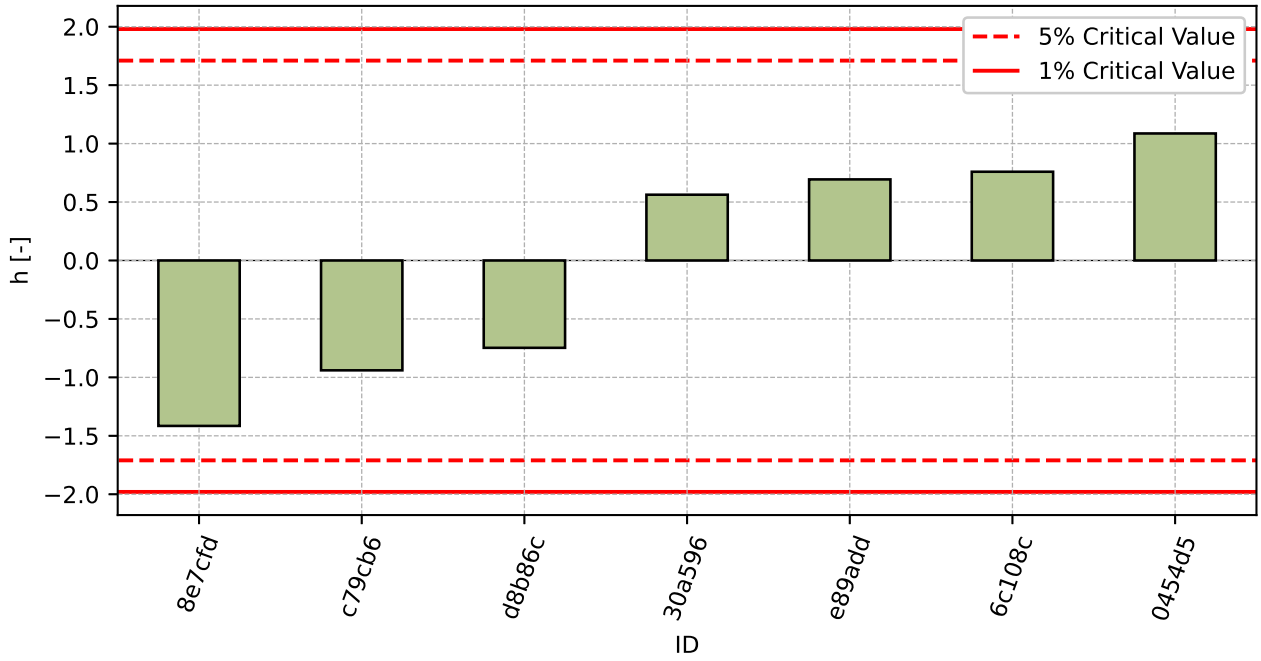

Figure 51: Interlaboratory Consistency Statistic

7.7.4 Descriptive statistics

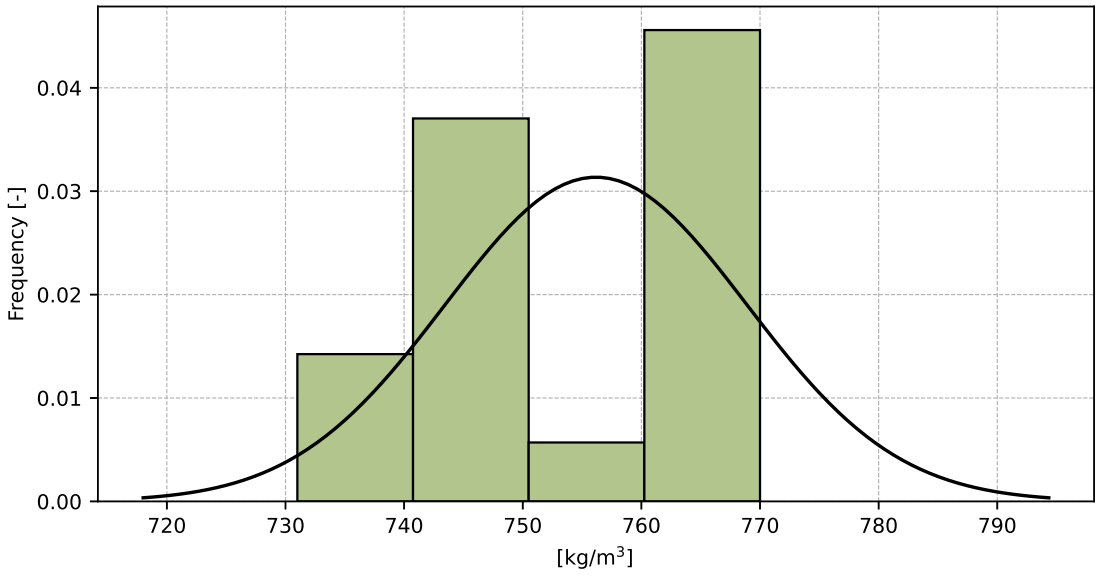

Figure 52: Histogram of all test results

Table 20: Descriptive statistics

Characteristics	[kg/mm^3]
Average value – $\bar{x}$	756
Sample standard deviation – s	12.7
Asigned value – x^*	759
Robust standard deviation – s^*	10.6
Measurement uncertainty of asigned value – u_X	4.8
p-value of normality test	0.001 [-]
Interlaboratory standard deviation – s_L	12.7
Repeatability standard deviation – s_r	3.2
Reproducibility standard deviation – s_R	13.1
Repeatability – r	9
Reproducibility – R	37

7.7.5 Evaluation of Performance Statistics

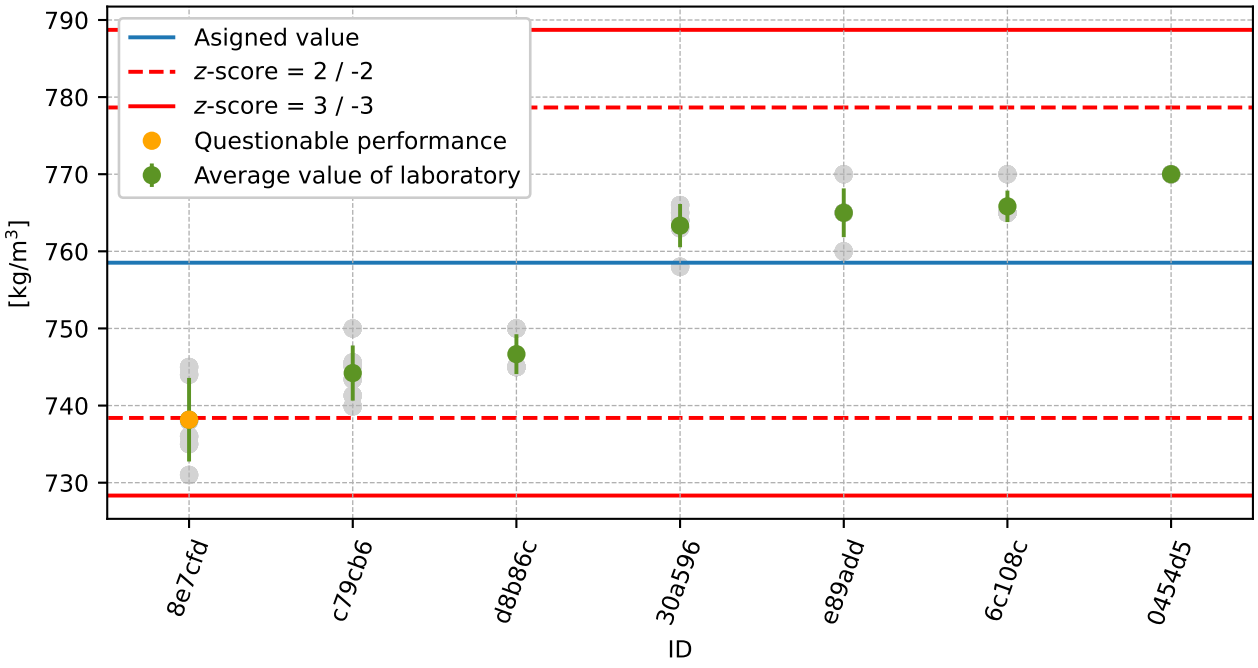

Figure 53: Average values and sample standard deviations

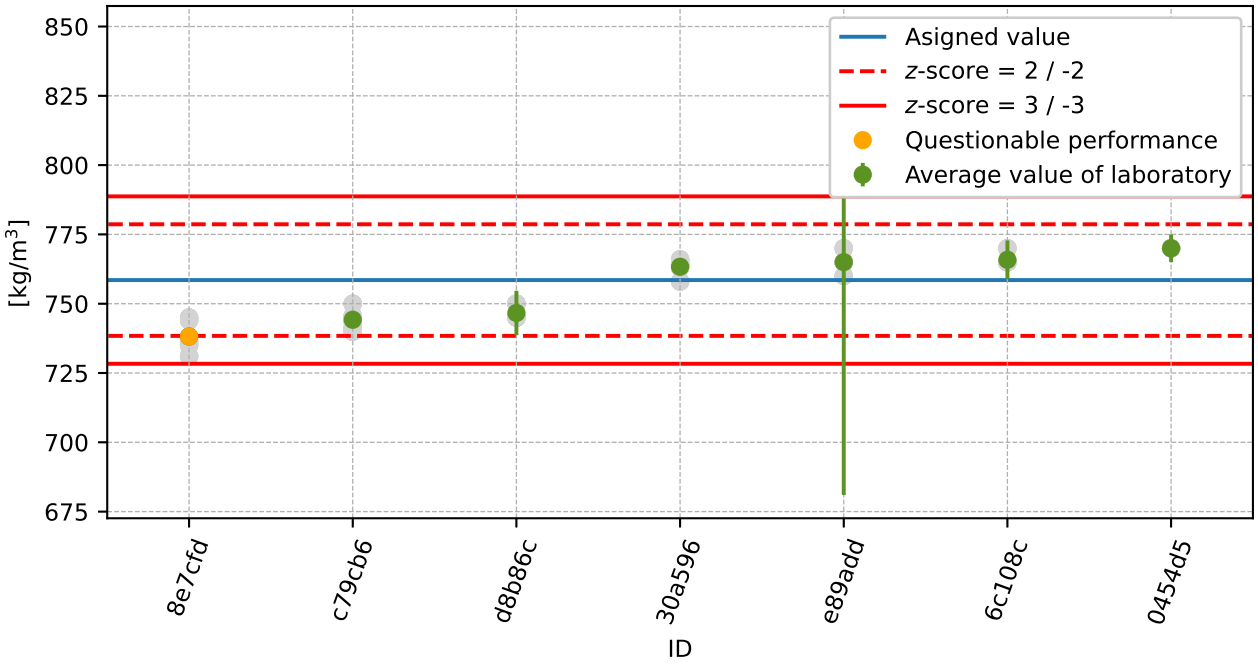

Figure 54: Average values and extended uncertainties of measurement

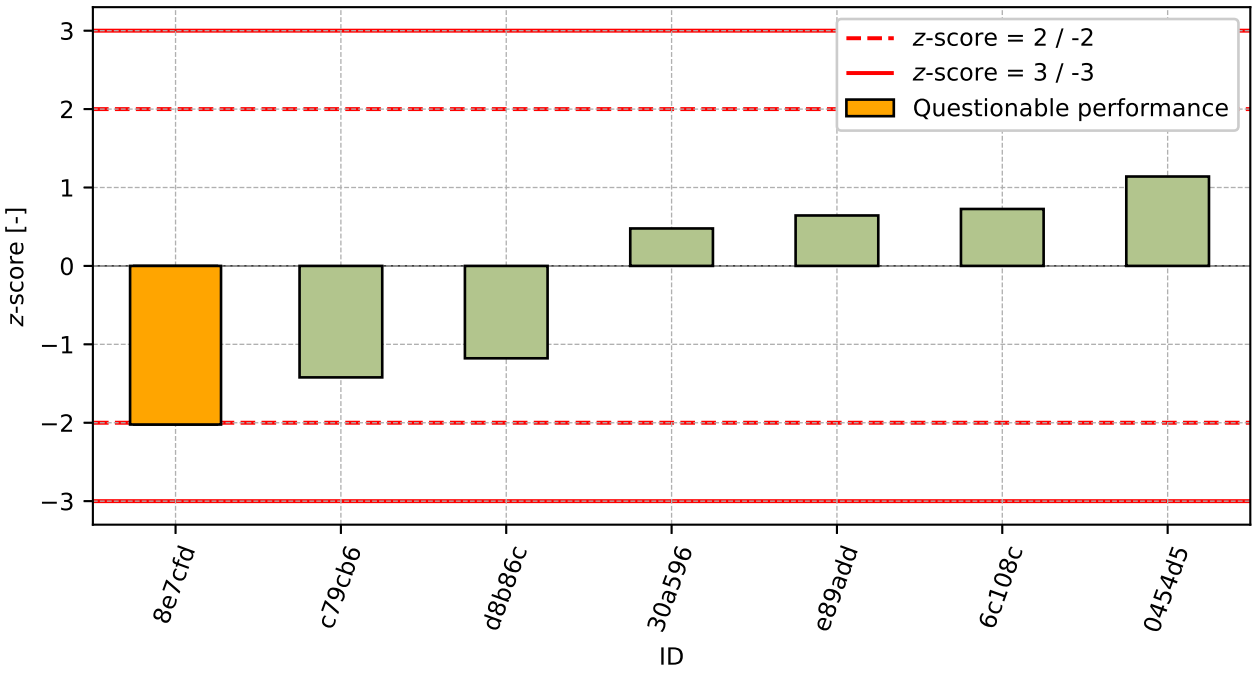

Figure 55: z-score

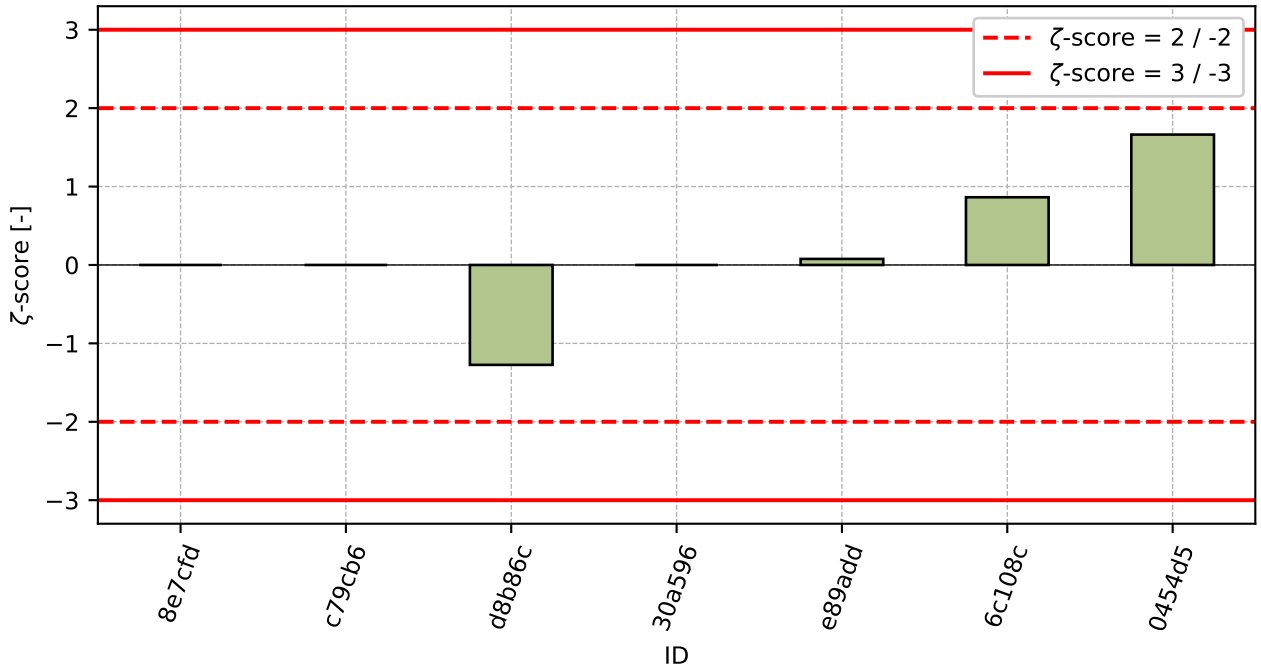

Figure 56: ζ-score

Table 21: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
8e7cfd	-2.02	-
c79cb6	-1.42	-
d8b86c	-1.18	-1.27
30a596	0.48	-
e89add	0.64	0.08
6c108c	0.73	0.86
0454d5	1.14	1.66

8 Appendix – EN 15435, part 4.9.3, Appendix B (Flexural strength of side shutters)

This part of PT program was not open due to the low number of participants.

9 Appendix – EN 15435, part 5.2 (Density)

This part of PT program was not open due to the low number of participants.