



FINAL REPORT ON THE RESULTS OF PRECISION EXPERIMENT

Proficiency Testing Program Testing of Asphalt Products ZAP 2025/1

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1 Introduction and Important Contacts

At the beginning of 2025, the Proficiency Testing Provider at SZK FAST (PoZZ) launched a Proficiency Testing Programme (PrZZ), designated ZAP 2025/1, to verify and assess the consistency of asphalt products test results. The assessment of the results of the proficiency testing programme was carried out by a committee consisting of the following PT Provider employees:

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The subjects of proficiency testing were the following testing procedures:

1. EN 1426 Determination of needle penetration of bitumen and bituminous binders [1],
2. EN 1427 Determination of the softening point of bitumen and bituminous binders – Ring and Ball method [2],
3. EN 13398 Determination of elastic recovery (RE) of modified bitumen [3],
4. EN 12593 Determination of the Fraass breaking point (T) [4],
5. EN 1429 Determination of residue on sieving of bituminous emulsions and storage stability [5],
6. EN 12697-1 Determination of soluble binder content [6],
7. EN 12697-2+A1 Determination of particle size distribution [7],
8. EN 12697-5 Determination of maximum density [8],
9. EN 12697-6 Determination of bulk density of bituminous specimens [9],
10. EN 12697-8 Determination of void characteristics of bituminous mixtures [10],
11. EN 12697-12, EN 12697-23 ITSR – Resistance to water sensitivity expressed as Indirect Tensile Strength Ratio – Method A [11, 12],
12. EN 12697-18 Determination of binder drainage – Clause 5 – Beaker method [13],
13. EN 12697-20 Determination of hardness number on cube or Marshall specimens – Penetration by pin after 60 min [14],
14. EN 12697-22+A1 Wheel tracking test – Small size device, Procedure B in air [15],
15. ČSN 736161 Determination of adhesion of bituminous binders to aggregates – Dry aggregate test [16].

Test procedures 4 and 5 were not opened due to low interest of participants.

The supplier, SQZ, s. r. o., was responsible for the preparation of testing samples for the PTP. The supplier is responsible for homogeneity and stability of testing samples.

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 [17] and with EN ISO/IEC 17043 [18]. The outcome is the present final report summarizing the results of the interlaboratory comparison, including statistical evaluation.

38 laboratories took part in PTP. 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

ID/Method	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
5097f9	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-
f68f15	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
9253fc	-	-	-	-	-	X	X	X	X	X	-	-	-	-	-
e2f9b5	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-
10cca9	-	-	X	-	-	-	-	-	-	-	X	X	-	X	-
c087fe	-	-	-	-	-	X	X	X	X	X	-	-	-	-	-
10b504	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
4db578	X	X	-	-	-	X	X	X	X	X	-	-	-	-	-
4cdbad	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-
3c68f6	-	-	X	-	-	-	-	-	-	X	-	X	-	X	-
40f911	-	-	X	-	-	X	-	-	-	-	-	-	X	-	-
7ec83d	X	X	-	-	-	X	X	X	X	X	-	-	-	-	-
f08bcd	-	-	-	-	-	X	X	X	X	X	-	-	-	-	-
64ea0e	-	-	X	-	-	-	-	-	-	-	-	-	X	-	-
671d46	-	X	-	-	-	-	-	-	-	-	-	X	-	-	-
87e572	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
84a75d	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-
b0b09d	X	X	X	-	-	X	X	X	X	X	-	X	X	X	-
acb415	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-
b74330	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-
a7b1c1	-	-	-	-	-	-	-	-	-	-	X	X	-	X	X
c9849a	X	X	X	-	-	-	-	-	-	-	X	-	-	-	-
76d982	-	-	-	-	-	X	X	X	X	X	-	-	-	-	-
de0c90	-	X	X	-	-	X	X	-	-	-	-	-	-	-	X
aa6fd2	-	-	-	-	-	-	-	-	-	-	X	X	-	-	X
49e1c8	-	-	X	-	-	X	X	X	X	X	X	X	-	X	-
29c947	X	X	-	-	-	-	-	X	-	-	-	-	-	-	-
81b0e4	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
62ea7a	-	-	-	-	-	X	X	X	X	X	-	-	-	-	-
c451a4	-	-	-	-	-	X	X	-	-	-	-	-	-	-	-
de68ea	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-
cd3235	X	X	-	-	-	X	X	X	-	X	X	-	-	-	-
0789d1	X	-	-	-	-	-	X	-	-	-	-	-	-	-	-
d91cf1	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-
ed6d00	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-
c22812	-	-	-	-	-	X	X	X	X	X	-	-	-	-	-
be8406	-	-	-	-	-	-	-	-	-	-	-	-	-	-	X
3224cf	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-

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

Laboratory	Address	Accreditation number
AWV	Olympiadenlaan 10, Evere, 1140, Belgium	-
A&A MACEDONIA LAB TEST LTD	10, Moisi Street, Chlroraka, Paphos, 8220, Cyprus	-
Banat Inzenjering LBI DOO	Makedonska 15, Zrenjanin, 23000, Republic of Serbia	01-540
Bechtel ENKA UK Limited Ogranak Beograd - Kraljevo	Jasički put 52 đ, Kruševac, 37000, Serbia	-
Bechtel ENKA UK Limited Ogranak Beograd - Krusevac	Jasički put 52 đ, Kruševac, 37000, Serbia	-
C.N.A.I.R prin CESTRIN	BD. IULIU MANIU, NR.401A, SECTOR 6, BUCURESTI, 061101, ROMANIA	LI220/28.10.2024
CSS d.o.o.	Savska cesta 144a, Zagreb, 10000, Croatia	HR1106
DIGITAL SOIL FACILITY MANAGEMENT	Krommewege 31G, Maldegem, 9990, België	409-TEST
DSP a.s.	Kostěnice 111, Kostěnice, 530 02, Česká republika	1782
Gradezen Institut "Makedonija" AD Skopje	Drezdenska No.52, SKOPJE KARPOS, 1000, North Macedonia	LT-014
INISMa - Institut Interuniversitaire des Silicates, Sols et Matériaux	Avenue du Gouverneur Emile Cornez n°4, Mons, 7000, Belgique	BE0401144686
KORIDORI SRBIJE LTD.	Kralja Petra 21, Belgrade, 11000, Srbija	-
LPM Laboratorio Prove Materiali di Impresa bacchi srl	Via Don Giuseppe Dossetti 19, Carpiano (MI), 20074, Italy	-
Labo Devlieger-Van Vooren	Monnikenwerve 17-19; 8000 Bruges, Belgium	-
Laboratorium Drogowe Szczecin Sp. z o.o.	Tama Pomorzańska 13L, Szczecin, 70-030, Poland	AB1806
Laboratorium Drogowe Wojciech Bogacki	Słowicza 1, Rzgów, 95-030, Rzgów	-
Labos d.o.o.	Pavlinka ulica 5, Varazdin, 42000, Croatia	-
MTS Ltd	19 Kernanstown Ind Est, Carlow, R93 PY67, Ireland	-
Mega Infrastructure d.o.o., Beograd-Savski Venac, 11000, Belgrade, Serbia	Paje Adamova 2, Belgrade, 11000, Serbia	-
Michael Kirchweiger	Alpenstraße 157, Salzburg, 5300, Österreich	0003
NIEVELT Labor CZ s.r.o.	Za Olomouckou 4184/17, Prostějov, 79601, Česká republika	1716
Národná diaľničná spoločnosť a. s.	Dúbravská cesta 14, Bratislava, 84104, Slovensko	456/S-328

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Laboratory	Address	Accreditation number
QUALIFORM, a.s.	Mlaty 672/8, Bosonohy, Brno, 642 00, Česká republika	1008
Rita Raposo	Rua Pedro Hispano, s/n, Coimbra, 3030-289, Portugal	L0446-1
SQZ, s.r.o. - pracoviště Chvaletice	939/5 U místní dráhy, Olomouc, 779 00, Česká republika	1135.1
SQZ, s.r.o. - pracoviště Dobřany	939/5 U místní dráhy, Olomouc, 779 00, Česká republika	1135.1
Sibotec	Industriepark Oost 6, Beernem, 8730, Belgium	-
Slovenská správa ciest	Dúbravská cesta 1152/3, Bratislava - Karlova Ves, 841 04, Slovenská republika	181/S-322
TESSCONTROL - Oblastné laboratórium Žilina	Štrková 17, Žilina, Žilina, 01001, Slovenská republika	S-375
TESSCONTROL - Zkušební laboratoř Znojmo	Brněnská 3797/29, Znojmo, 669 02, Česká republika	L-1793
TESScontrol, s. r. o. Oblastné Laboratórium Bratislava, Laboratórium Bratislava	Ľubochnianska 1/A,, Bratislava, 831 04, Slovenská republika	S-375
TESTAROSA, s.r.o.	Pribylinská 12, Bratislava - mestská časť Rača, 831 04, Slovenská republika	-
TPA ČR, s.r.o.	Vrbenská 1821/31, České Budějovice, 37006, Česká republika	1181
TPA ČR, s.r.o. - pracoviště Ostrava	Vrbenská 1821/31, České Budějovice, 370 06, Česká republika	1181
TPA ČR, s.r.o. pracoviště č.4 Olomouc, Tovární 731, 783 53 Velká Bystřice	Tovární 731, Velká Bystřice, 783 53, Česká republika	1181
UAB Laboratoriniu bandymu centras	R. Kalantos street 85a, Kaunas, 45293, Lithuania	LA.01.002
Ředitelství silnic a dálnic s. p.	Čerčanská 2023/12, Praha 4 - Krč, 140 00, Česká republika	1072
Ředitelství silnic a dálnic s. p., Samostatné oddělení zkušebnictví Praha, Laboratoř Praha	Na Pankráci 546/56, Praha, 140 00, Česká republika	1734

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 (symbol **X**).
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 (symbol ).

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. The following scales are applied for the z-score values:
 - $|z\text{-score}| < 2 \Rightarrow$ shows that the laboratory performance is **satisfactory** and generates no signal – .
 - $2 \leq |z\text{-score}| < 3 \Rightarrow$ shows that the laboratory performance is **questionable** and generates an action signal – .
 - $|z\text{-score}| \geq 3 \Rightarrow$ shows that the laboratory performance is **unsatisfactory** and generates an action signal – .

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 ZAP 2025/1 (PT Program) organized by the PT Provider at the SZK FAST. 38 participants (laboratories) took part in the PT Program. The PT program focused on ordinary standardized testing of asphalt products. 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. In some cases, overcoming the critical values of the Cochran test due to incorrect rounding of test results by laboratories was not taken into account. 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	10	11	12	13	14	15
5097f9	-	-	-	-	-	-	-	-	-	-	-	-	✓	-	-
f68f15	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-
9253fc	-	-	-	-	-	✓	✓	✓	✓	✓	-	-	-	-	-
e2f9b5	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
10cca9	-	-	✓	-	-	-	-	-	-	-	✓	✓	-	✓	-
c087fe	-	-	-	-	-	✓	✓	✓	✓	✓	-	-	-	-	-
10b504	-	-	✓	-	-	-	-	-	-	-	-	-	-	-	-
4db578	✓	✓	-	-	-	✓	✓	✓	✓	✓	-	-	-	-	-
4cdbad	✓	X	✓	-	-	-	-	-	-	-	-	-	-	-	-
3c68f6	-	-	✓	-	-	-	-	-	-	✓	-	✓	-	✓	-
40f911	-	-	✓	-	-	✓	-	-	-	-	-	-	✓	-	-
7ec83d	✓	✓	-	-	-	✓	✓	✓	✓	✓	-	-	-	-	-
f08bcd	-	-	-	-	-	✓	✓	?	?	✓	-	-	-	-	-
64ea0e	-	-	✓	-	-	-	-	-	-	-	-	-	✓	-	-
671d46	-	✓	-	-	-	-	-	-	-	-	-	✓	-	-	-
87e572	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-
84a75d	-	-	-	-	-	-	-	-	-	-	✓	-	✓	-	-
b0b09d	✓	✓	✓	-	-	✓	✓	✓	✓	✓	-	✓	✓	✓	-
acb415	-	-	-	-	-	-	-	✓	-	✓	-	-	-	-	-
b74330	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
a7b1c1	-	-	-	-	-	-	-	-	-	-	✓	✓	-	✓	?
c9849a	✓	✓	✓	-	-	-	-	-	-	-	✓	-	-	-	-
76d982	-	-	-	-	-	✓	✓	✓	✓	✓	-	-	-	-	-
de0c90	-	✓	✓	-	-	✓	✓	-	-	-	-	-	-	-	✓
aa6fd2	-	-	-	-	-	-	-	-	-	-	✓	✓	-	-	✓
49e1c8	-	-	✓	-	-	✓	✓	✓	✓	✓	✓	✓	-	✓	-
29c947	?	✓	-	-	-	-	-	✓	-	-	-	-	-	-	-
81b0e4	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-

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ID / Method	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
62ea7a	-	-	-	-	-	✓	✓	✓	✓	✓	-	-	-	-	-
c451a4	-	-	-	-	-	✓	✓	-	-	-	-	-	-	-	-
de68ea	-	-	-	-	-	-	-	-	-	-	✓	✓	-	-	-
cd3235	✓	✓	-	-	-	✓	✓	!	-	✓	?	-	-	-	-
0789d1	✓	-	-	-	-	-	✓	-	-	-	-	-	-	-	-
d91cf1	-	-	-	-	-	-	-	-	-	-	-	✓	-	-	-
ed6d00	-	-	-	-	-	-	-	-	-	-	-	-	✓	-	-
c22812	-	-	-	-	-	✓	✓	✓	✓	✓	-	-	-	-	-
be8406	-	-	-	-	-	-	-	-	-	-	-	-	-	-	✓
3224cf	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-

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- [12] EN 12697-23. *Bituminous mixtures - Test methods - Part 23: Determination of the indirect tensile strength of bituminous specimens*. 2018.
- [13] EN 12697-18. *Bituminous mixtures - Test methods - Part 18: Binder drainage*. 2018.
- [14] EN 12697-20. *Bituminous Mixtures - Test Methods for Hot Mix Asphalt - Part 20: Indentation Using Cube or Cylindrical Specimens*. 2012.
- [15] EN 12697-22+A1. *Bituminous mixtures - Test methods - Part 22: Wheel tracking*. 2024.
- [16] ČSN 73 6161. *Determination for adhesion of asphaltic binders to aggregate*. 2000.
- [17] 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.
- [18] EN ISO/IEC 17043. *Conformity assessment - General requirements for proficiency testing*. 2010.

1 Appendix – EN 1426 Determination of needle penetration

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 [0.1 mm]						u_X [0.1 mm]	$\bar{x}$ [0.1 mm]	s_0 [0.1 mm]	V_X [%]
b0b09d	50.0	48.0	48.0	49.0	49.0	49.0	2.0	48.8	0.75	1.54
4db578	50.3	50.5	51.0	50.2	50.7	50.9	-	50.6	0.32	0.64
0789d1	50.0	51.0	52.0	51.0	51.0	51.0	1.1	51.0	0.63	1.24
e2f9b5	53.2	52.8	53.1	53.5	52.5	52.6	3.7	53.0	0.38	0.72
4cdbad	53.0	55.0	54.7	52.9	53.4	52.7	2.1	53.6	0.99	1.84
7ec83d	53.2	54.1	53.1	53.0	54.9	53.5	0.7	53.6	0.74	1.37
b74330	55.0	54.9	53.1	54.8	53.9	55.2	-	54.5	0.81	1.49
c9849a	56.0	55.0	55.0	55.0	54.0	55.0	1.8	55.0	0.63	1.15
cd3235	56.0	57.0	55.0	55.0	55.0	56.0	2.0	55.7	0.82	1.47
29c947	64.0	64.0	64.0	63.0	64.0	63.0	0.4	63.7	0.52	0.81

1.2 The Numerical Procedure for Determining Outliers

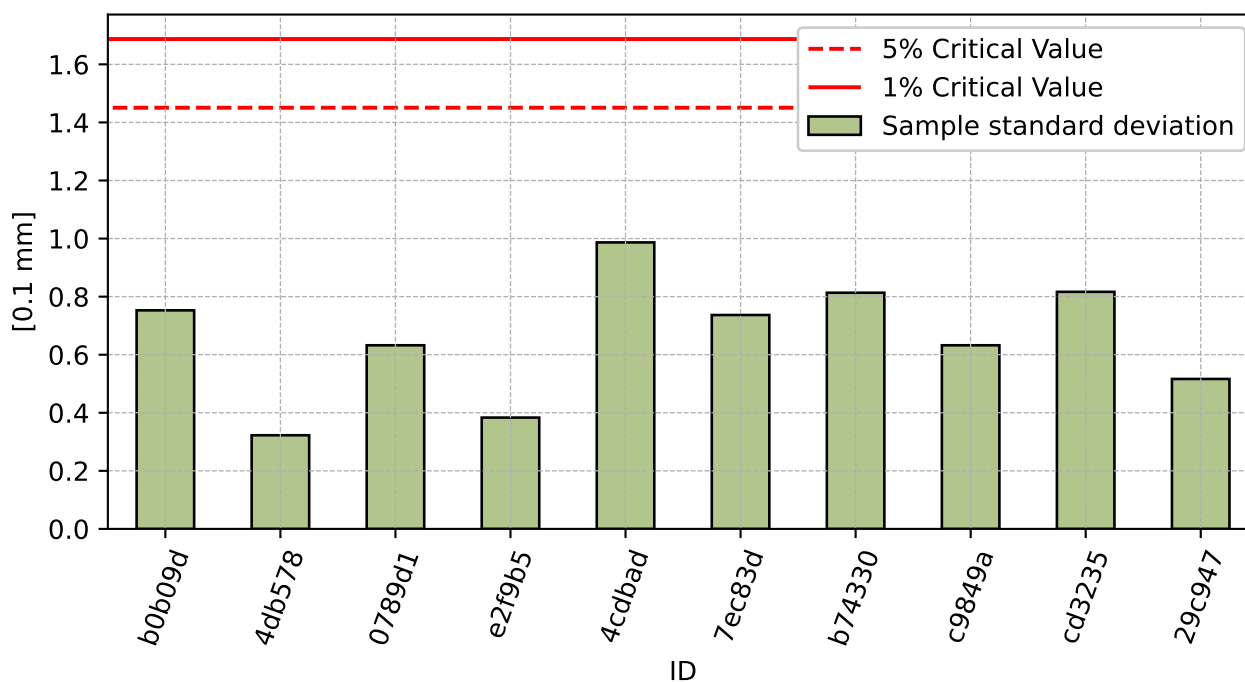
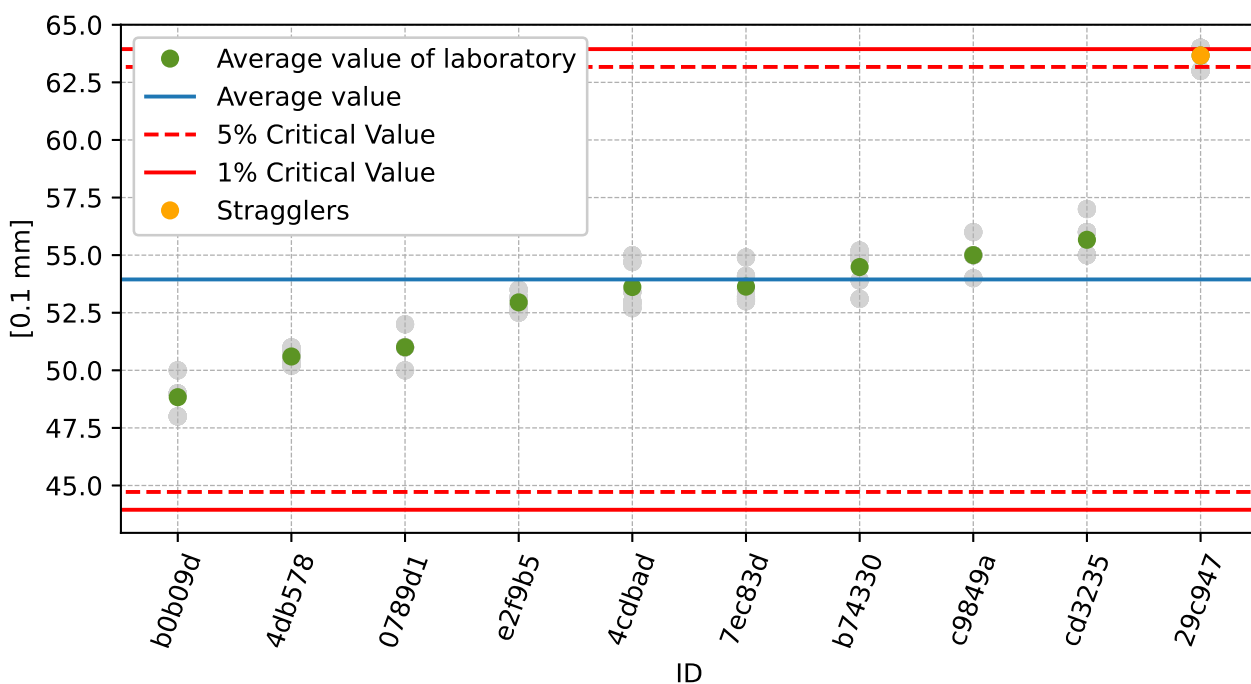


Figure 1: **Cochran's test** - sample standard deviations

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

1.3 Mandel's Statistics

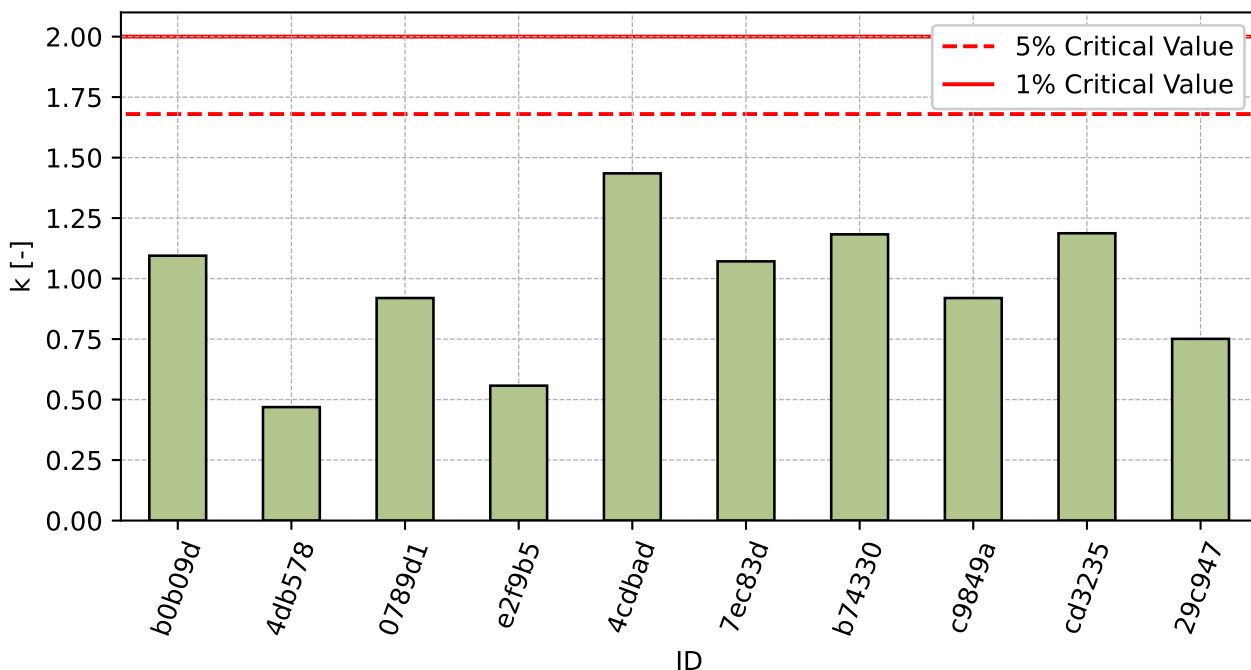


Figure 3: Intralaboratory Consistency Statistic

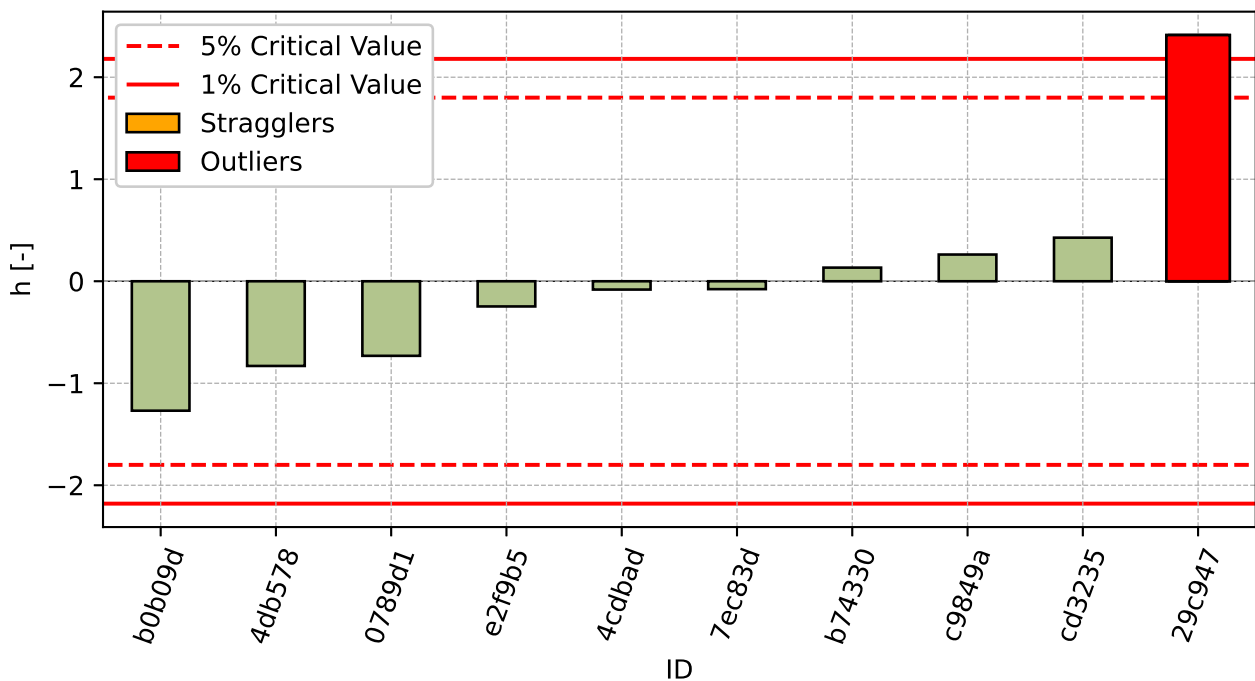


Figure 4: Interlaboratory Consistency Statistic

1.4 Descriptive statistics

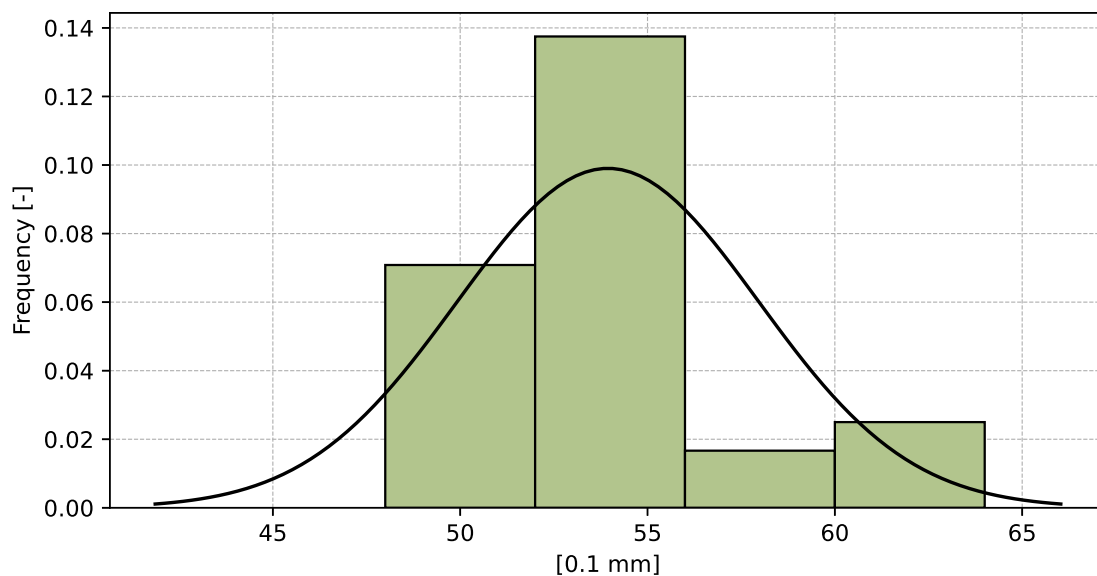


Figure 5: Histogram of all test results

Table 5: Descriptive statistics

Characteristics	[0.1 mm]
Average value – $\bar{x}$	53.9
Sample standard deviation – s	4.03
Assigned value – x^*	54.0
Robust standard deviation – s^*	4.19
Measurement uncertainty of assigned value – u_X	1.66
p -value of normality test	0.0 [-]
Interlaboratory standard deviation – s_L	4.02
Repeatability standard deviation – s_r	0.69
Reproducibility standard deviation – s_R	4.08
Repeatability – r	1.9
Reproducibility – R	11.4

1.5 Evaluation of Performance Statistics

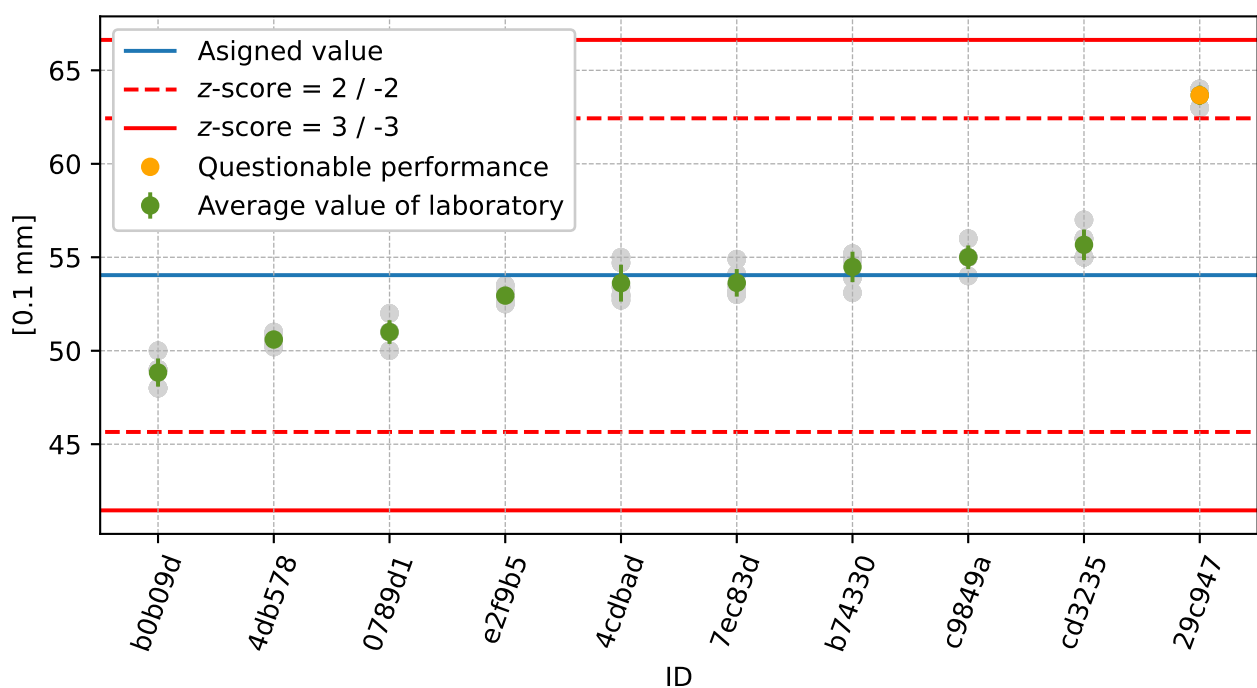


Figure 6: Average values and sample standard deviations

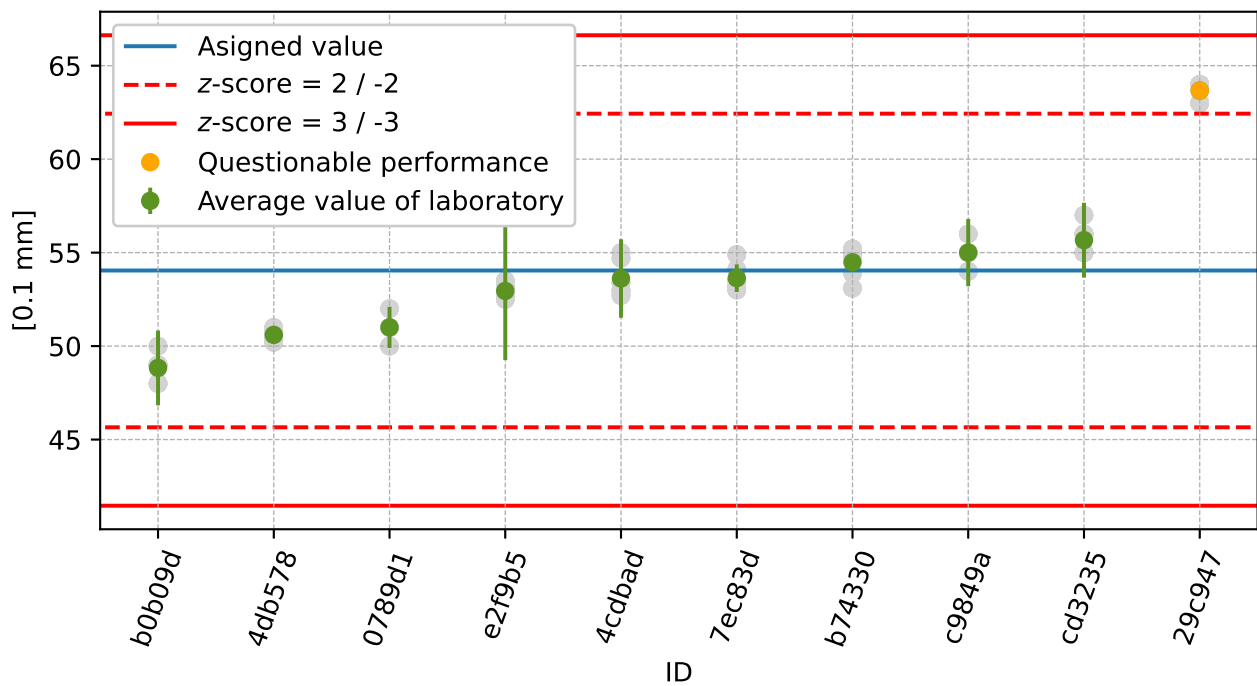


Figure 7: Average values and extended uncertainties of measurement

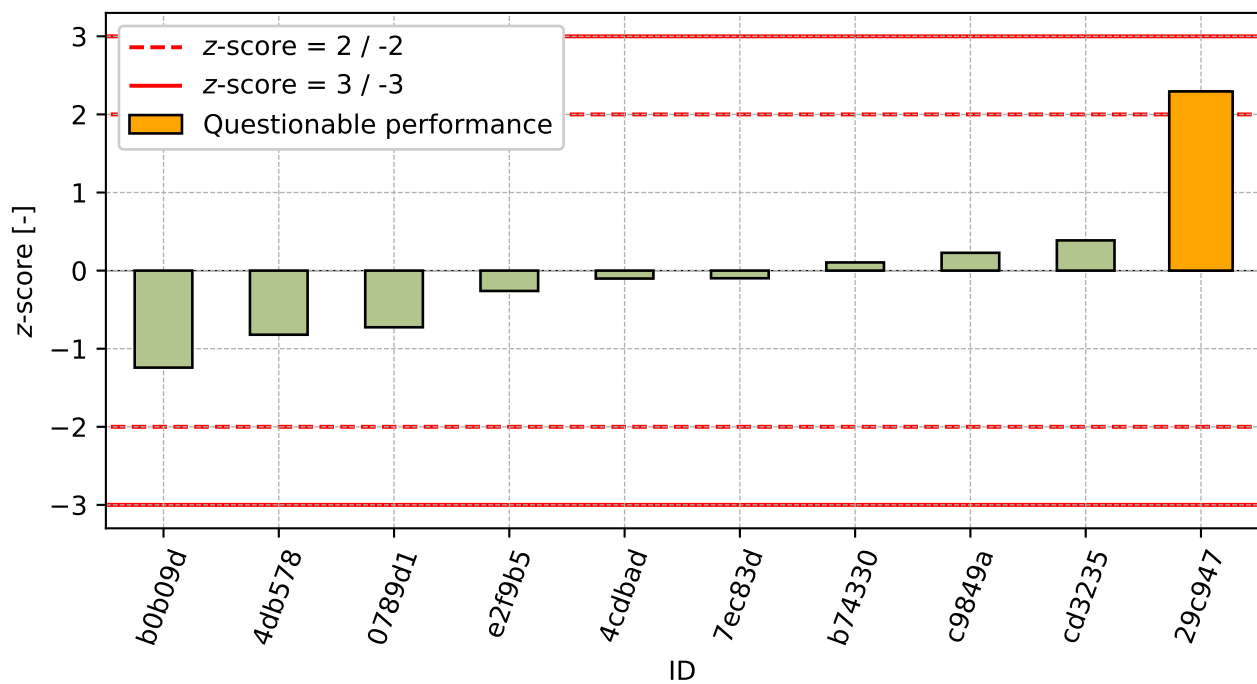


Figure 8: z-score

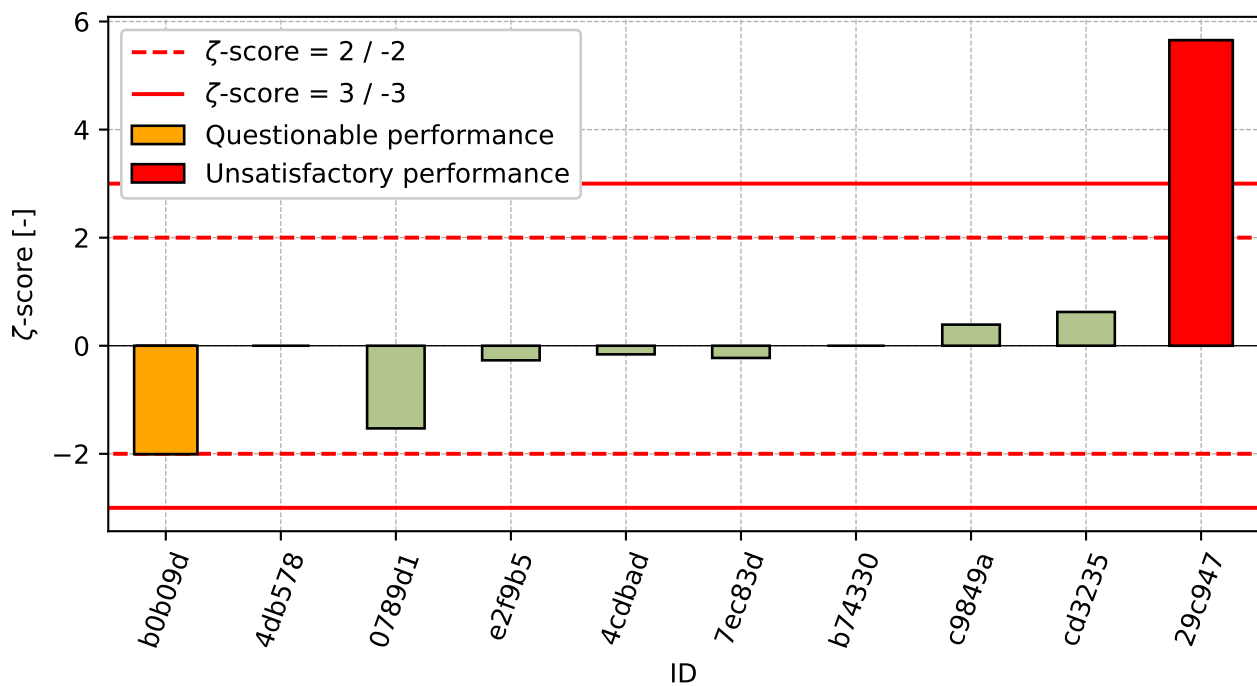


Figure 9: ζ-score

Table 6: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
b0b09d	-1.24	-2.01
4db578	-0.82	-
0789d1	-0.73	-1.53
e2f9b5	-0.26	-0.27
4cdbad	-0.10	-0.16
7ec83d	-0.10	-0.23
b74330	0.10	-
c9849a	0.23	0.39
cd3235	0.39	0.62
29c947	2.29	5.65

2 Appendix – EN 1427 Determination of the softening point – Ring and Ball method

2.1 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 [°C]		u_X [°C]	$\bar{x}$ [°C]	s_0 [°C]	V_X [%]
671d46	49.2	48.4	0.5	48.8	0.57	1.16
b74330	49.0	49.2	-	49.1	0.14	0.29
29c947	49.0	49.4	0.3	49.2	0.28	0.57
c9849a	49.5	49.9	1.4	49.7	0.28	0.57
7ec83d	50.1	49.7	0.6	49.9	0.28	0.57
b0b09d	49.8	50.1	0.3	50.0	0.21	0.42
cd3235	50.2	50.0	1.0	50.1	0.14	0.28
e2f9b5	50.2	50.6	2.0	50.4	0.28	0.56
4db578	50.7	50.2	-	50.5	0.35	0.7
de0c90	51.2	51.2	2.0	51.2	0.0	0.0
4cdbad	53.4	53.8	1.0	53.6	0.28	0.53

2.2 The Numerical Procedure for Determining Outliers

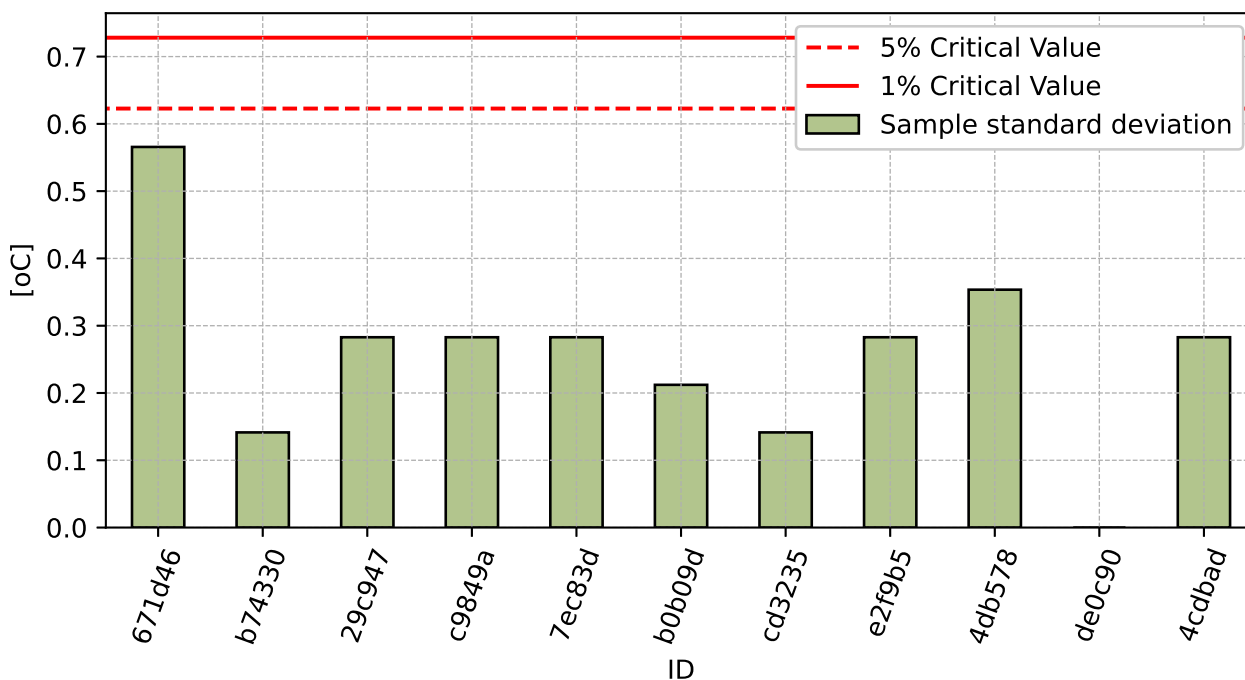


Figure 10: **Cochran's test** - sample standard deviations

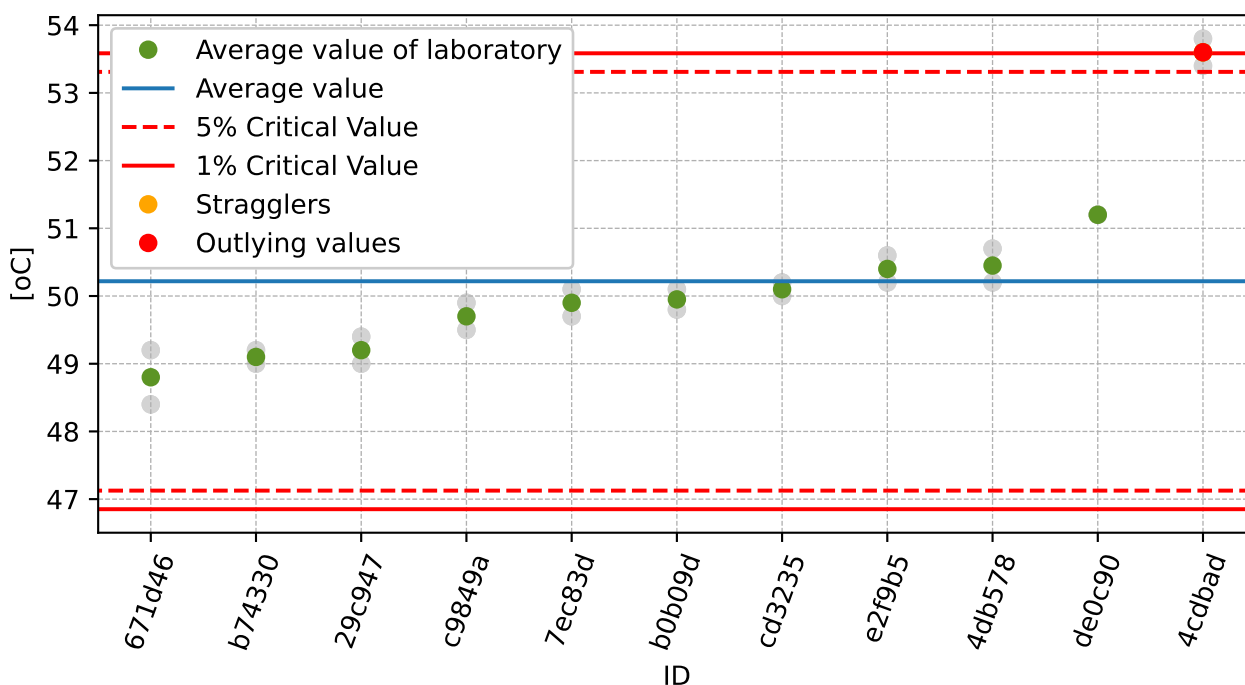
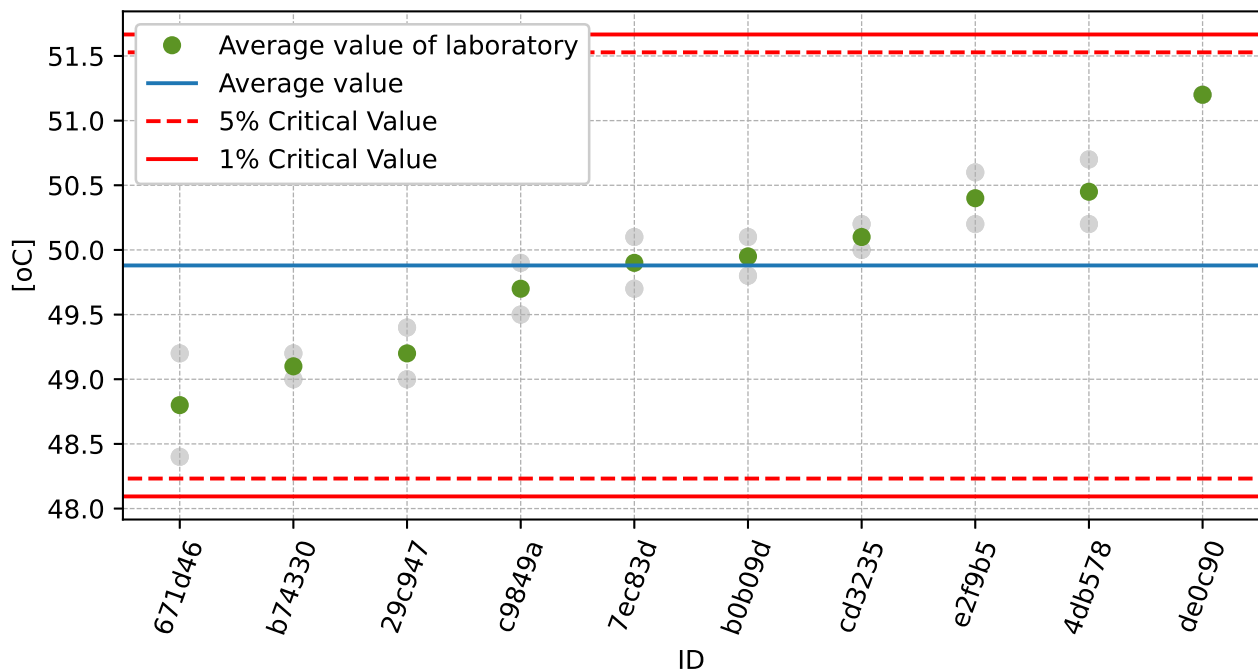


Figure 11: **Grubbs' test** - average values

Figure 12: **Grubbs' test** - average values without outliers

2.3 Mandel's Statistics

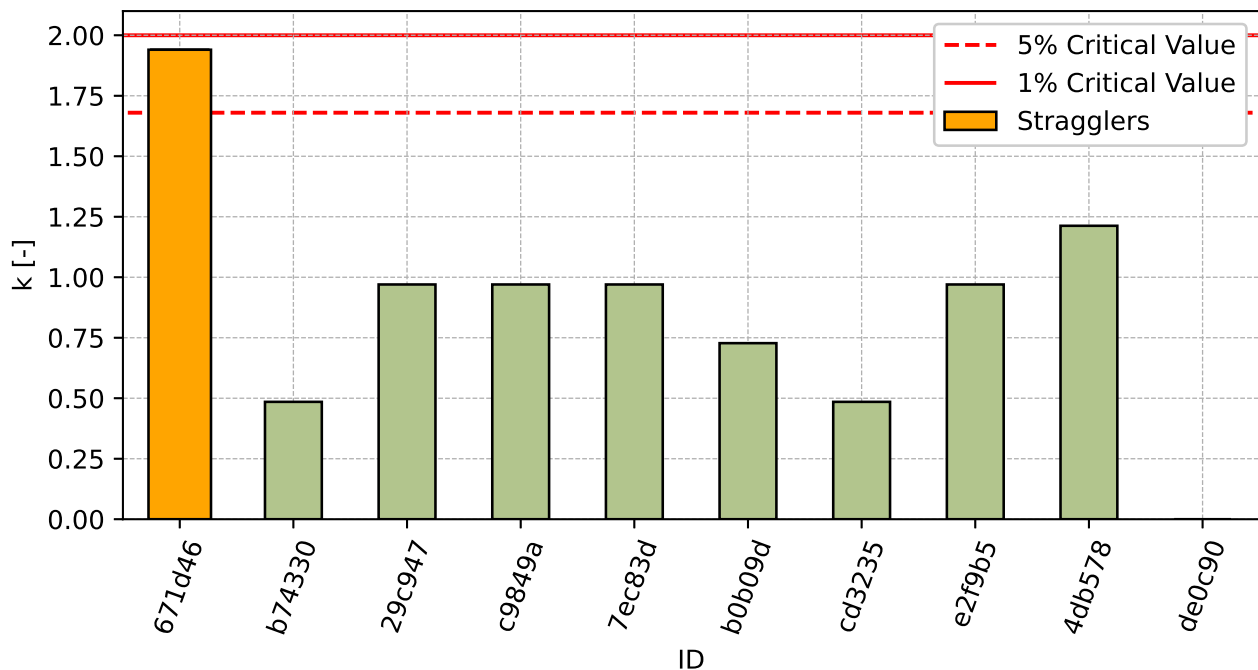


Figure 13: Intralaboratory Consistency Statistic

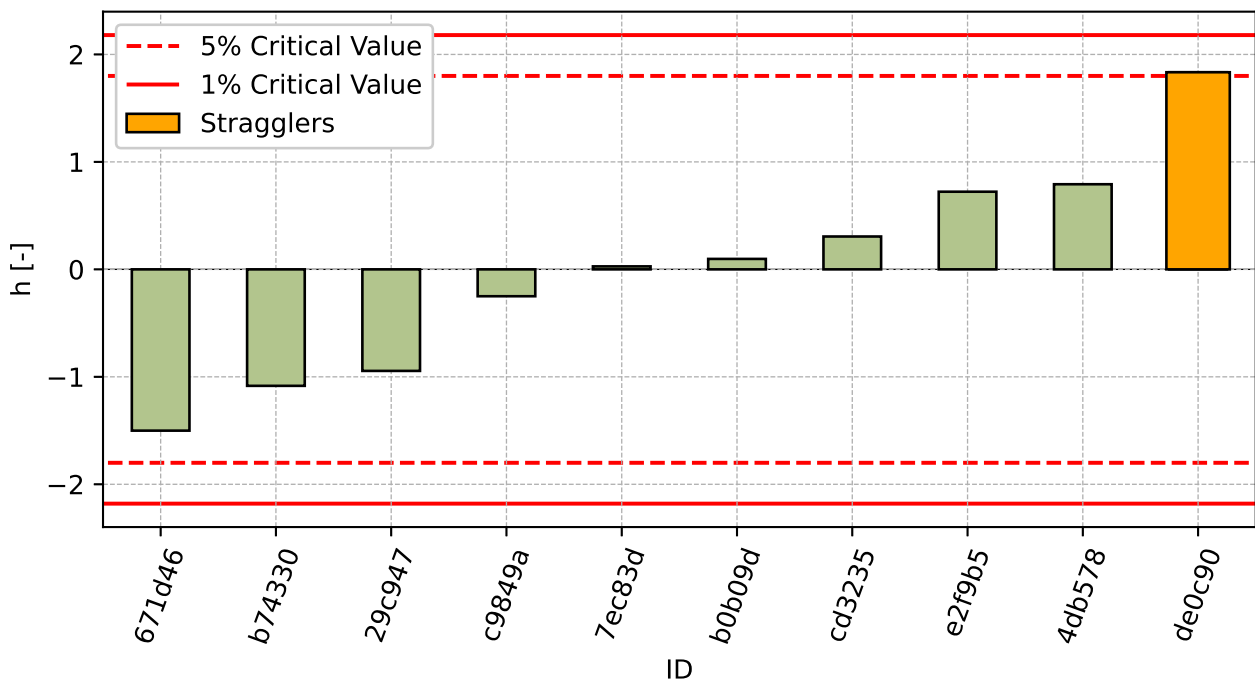


Figure 14: Interlaboratory Consistency Statistic

2.4 Descriptive statistics

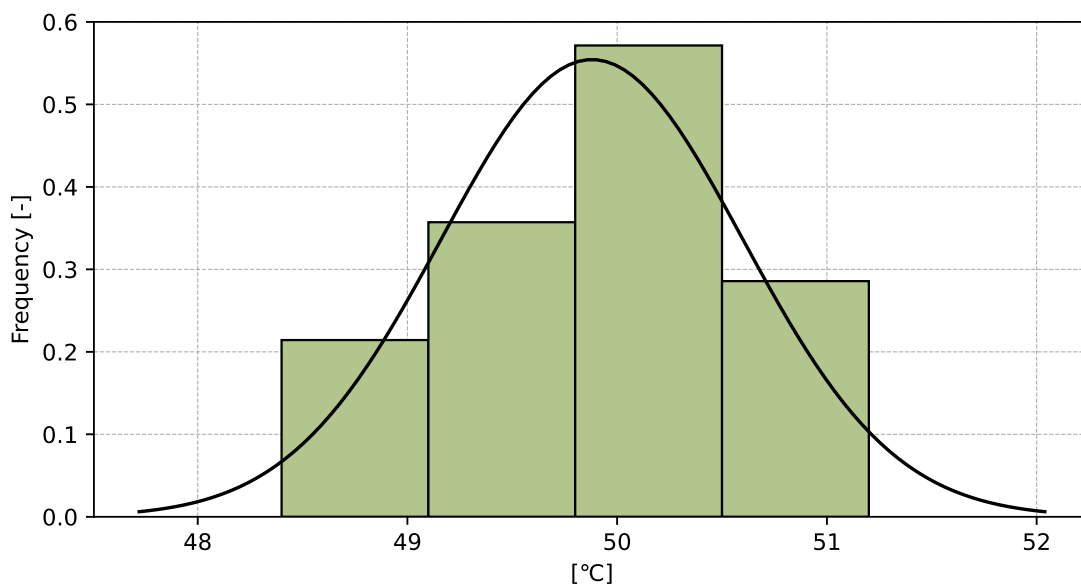


Figure 15: Histogram of all test results

Table 8: Descriptive statistics

Characteristics	[°C]
Average value – $\bar{x}$	49.9
Sample standard deviation – s	0.72
Assigned value – x^*	49.9
Robust standard deviation – s^*	0.77
Measurement uncertainty of assigned value – u_X	0.31
p -value of normality test	0.848 [-]
Interlaboratory standard deviation – s_L	0.69
Repeatability standard deviation – s_r	0.29
Reproducibility standard deviation – s_R	0.75
Repeatability – r	0.8
Reproducibility – R	2.1

2.5 Evaluation of Performance Statistics

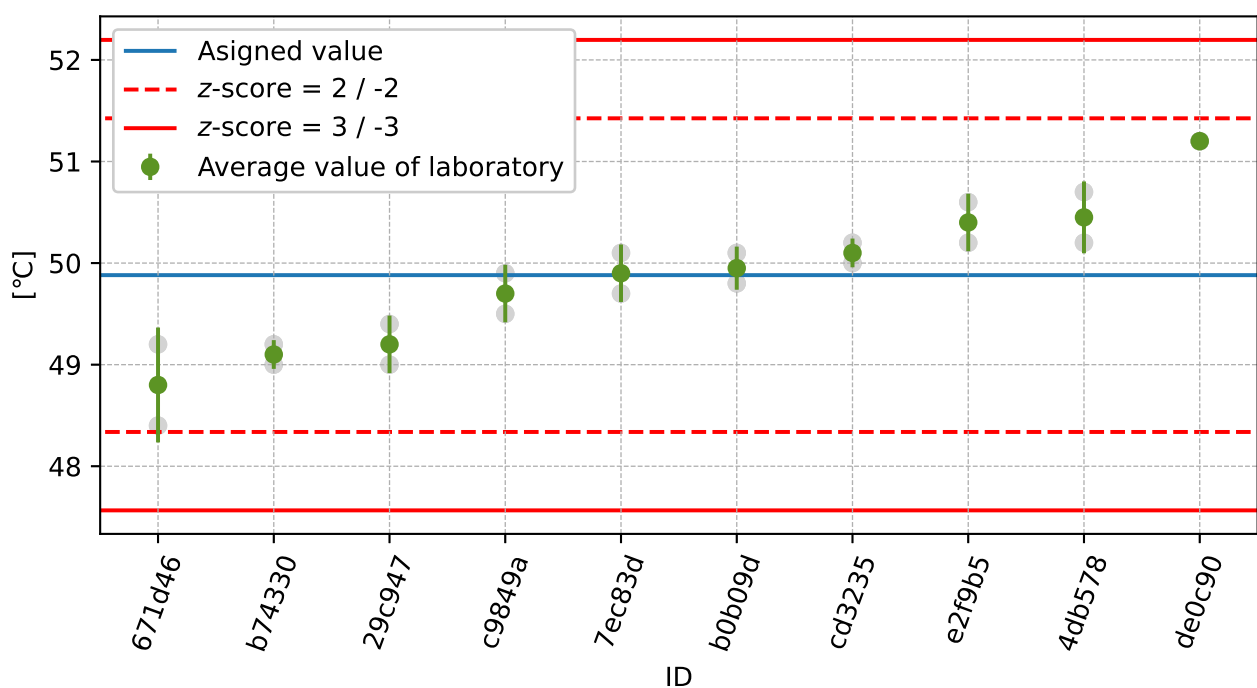


Figure 16: Average values and sample standard deviations

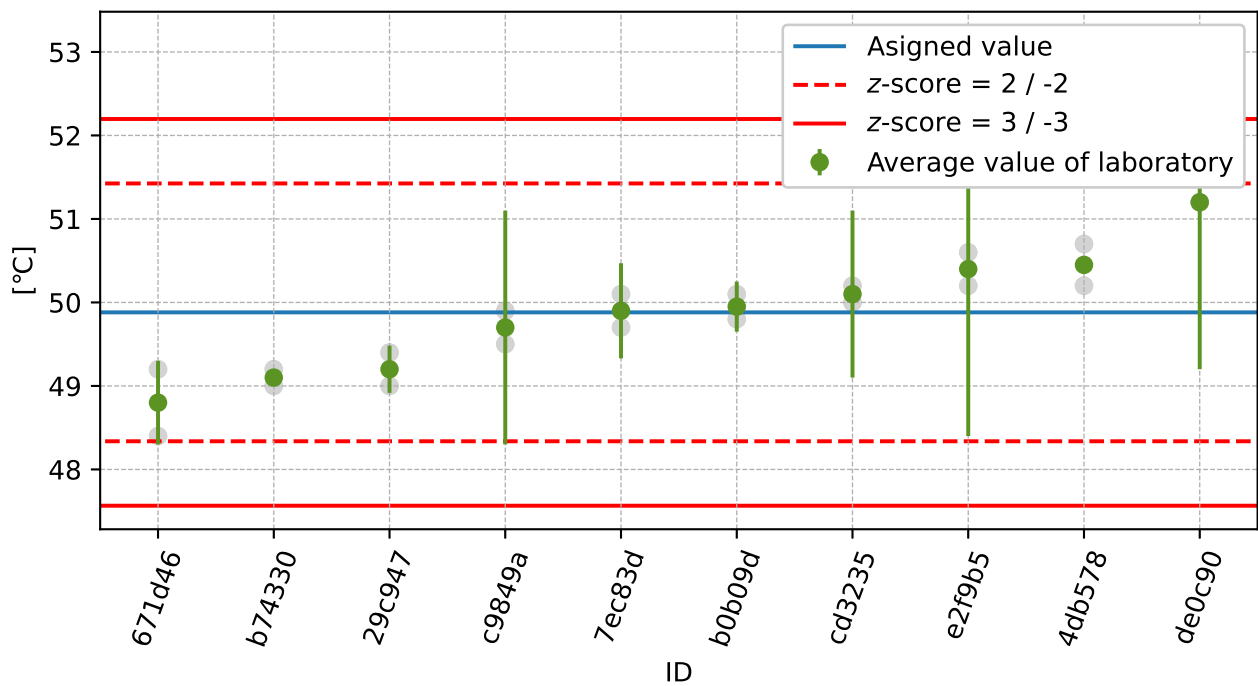


Figure 17: Average values and extended uncertainties of measurement

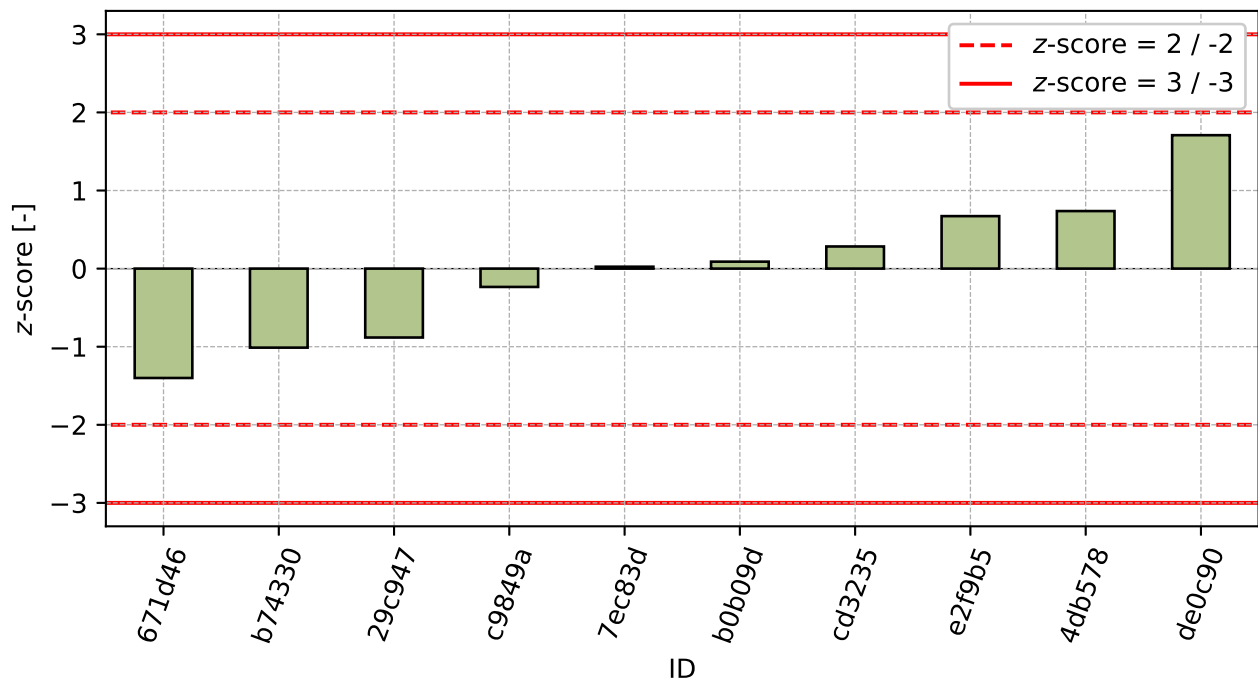
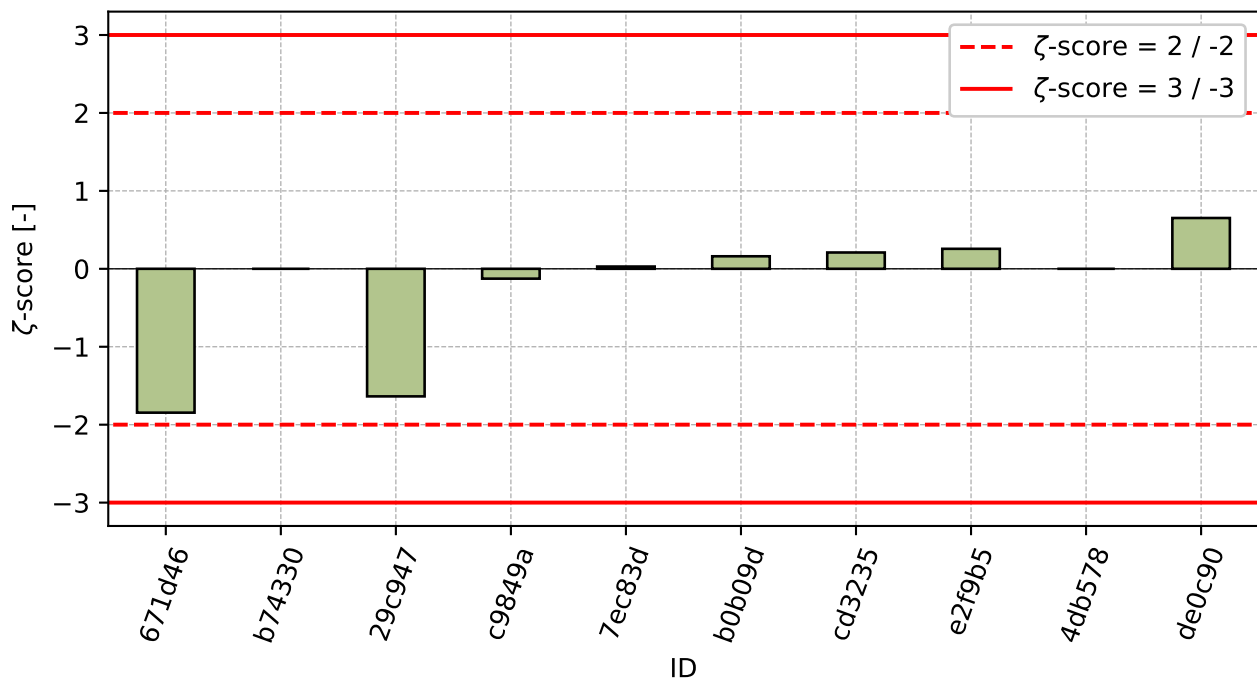


Figure 18: z-score

Figure 19: ζ -scoreTable 9: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
671d46	-1.40	-1.85
b74330	-1.01	-
29c947	-0.88	-1.64
c9849a	-0.23	-0.13
7ec83d	0.02	0.03
b0b09d	0.09	0.16
cd3235	0.28	0.21
e2f9b5	0.67	0.26
4db578	0.74	-
de0c90	1.71	0.65

3 Appendix – EN 13398 Determination of elastic recovery of modified bitumen (RE)

3.1 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
	[%]		[%]	[%]	[%]	[%]
b0b09d	94.0	94.0	1.0	94.0	0.0	0.0
c9849a	94.0	95.0	2.0	94.5	0.71	0.75
40f911	95.0	95.0	4.0	95.0	0.0	0.0
10cca9	96.0	96.0	-	96.0	0.0	0.0
10b504	96.0	96.0	-	96.0	0.0	0.0
3c68f6	96.0	96.0	3.0	96.0	0.0	0.0
64ea0e	97.0	96.0	2.0	96.5	0.71	0.73
4cdbad	96.4	96.8	4.0	96.6	0.28	0.29
de0c90	97.0	97.0	0.2	97.0	0.0	0.0
49e1c8	97.5	98.0	1.1	97.8	0.35	0.36

3.2 The Numerical Procedure for Determining Outliers

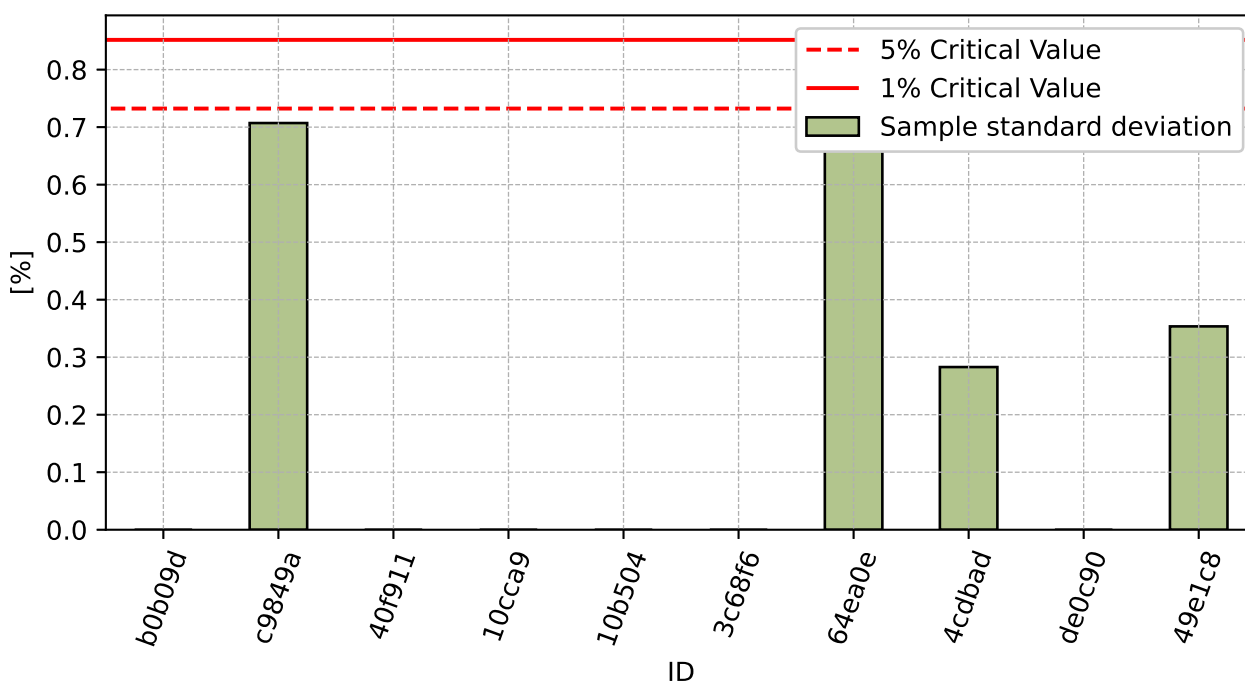
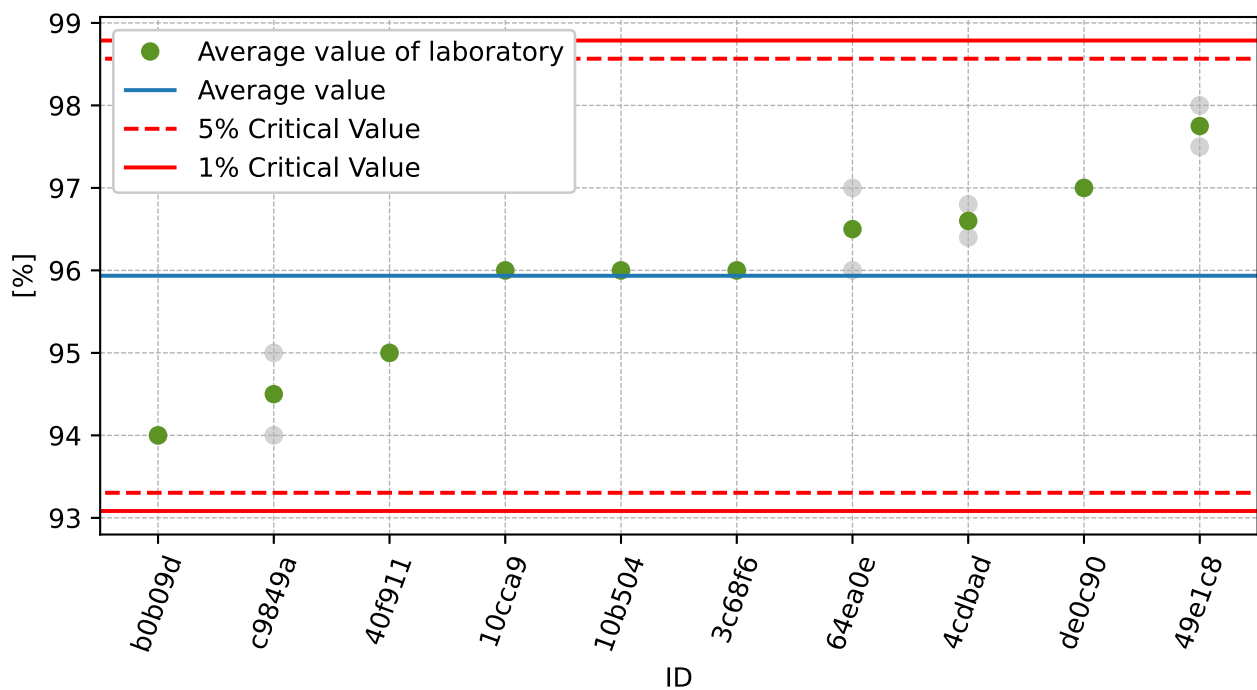


Figure 20: **Cochran's test** - sample standard deviations

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

3.3 Mandel's Statistics

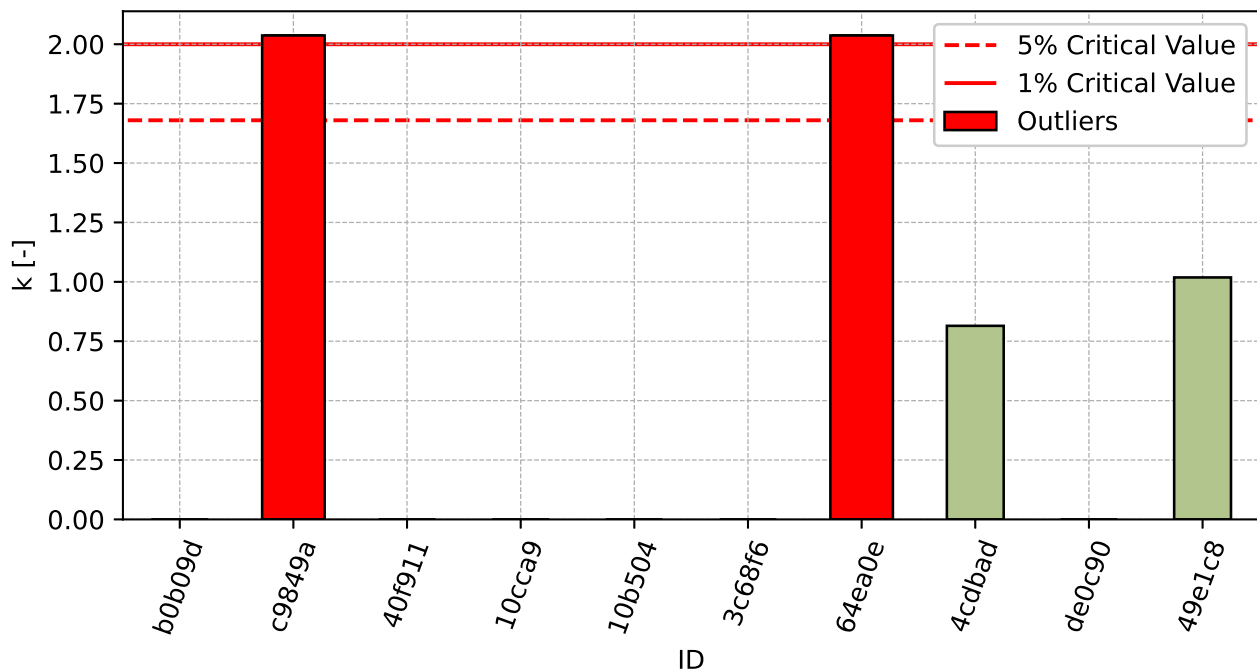


Figure 22: Intralaboratory Consistency Statistic

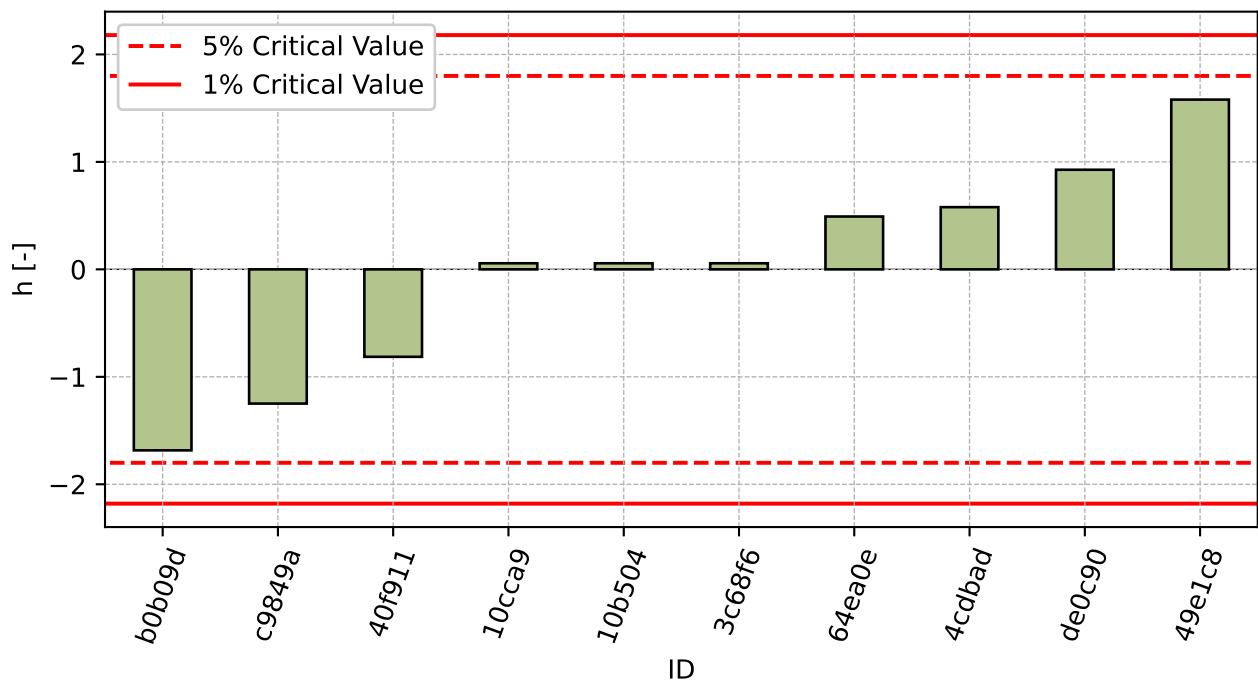


Figure 23: Interlaboratory Consistency Statistic

3.4 Descriptive statistics

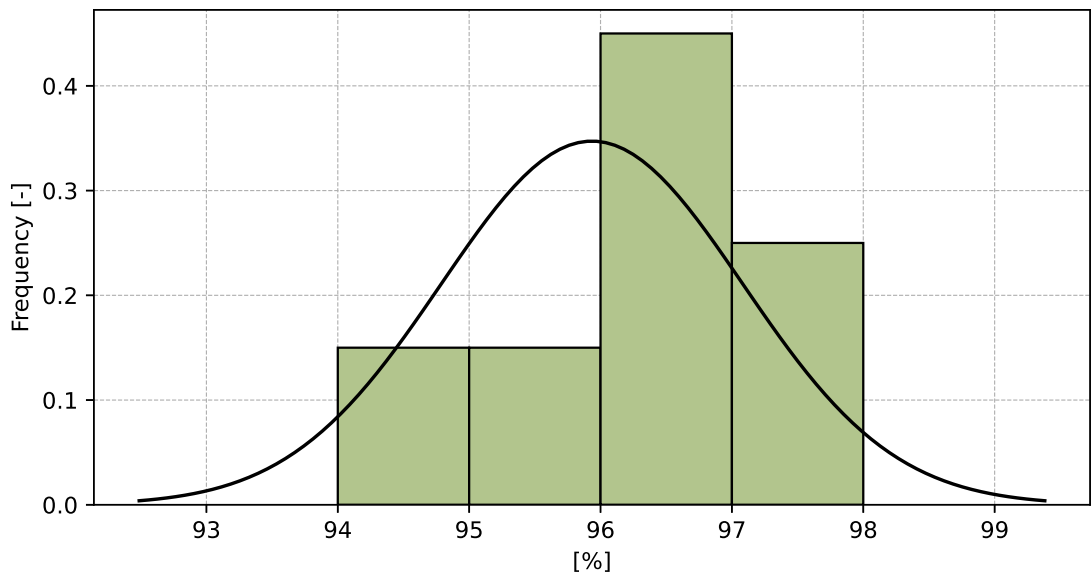


Figure 24: Histogram of all test results

Table 11: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	95.9
Sample standard deviation – s	1.15
Assigned value – x^*	96.0
Robust standard deviation – s^*	1.19
Measurement uncertainty of assigned value – u_X	0.47
p -value of normality test	0.163 [-]
Interlaboratory standard deviation – s_L	1.12
Repeatability standard deviation – s_r	0.35
Reproducibility standard deviation – s_R	1.17
Repeatability – r	1.0
Reproducibility – R	3.3

3.5 Evaluation of Performance Statistics

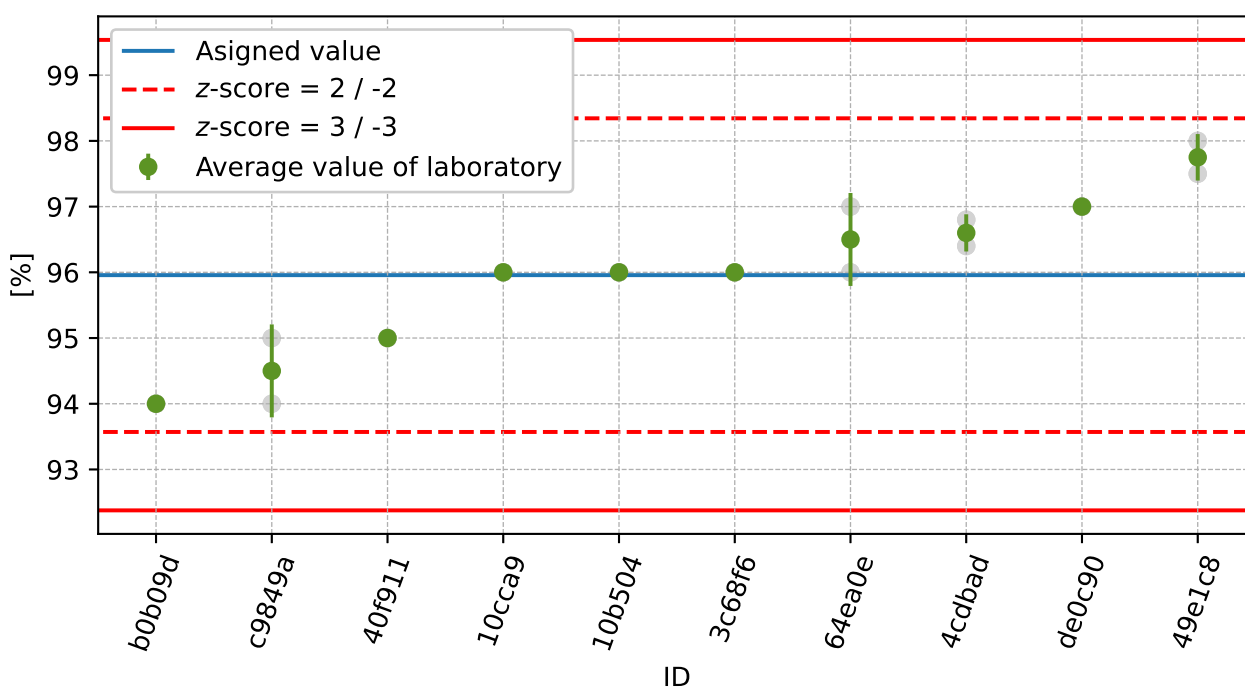


Figure 25: Average values and sample standard deviations

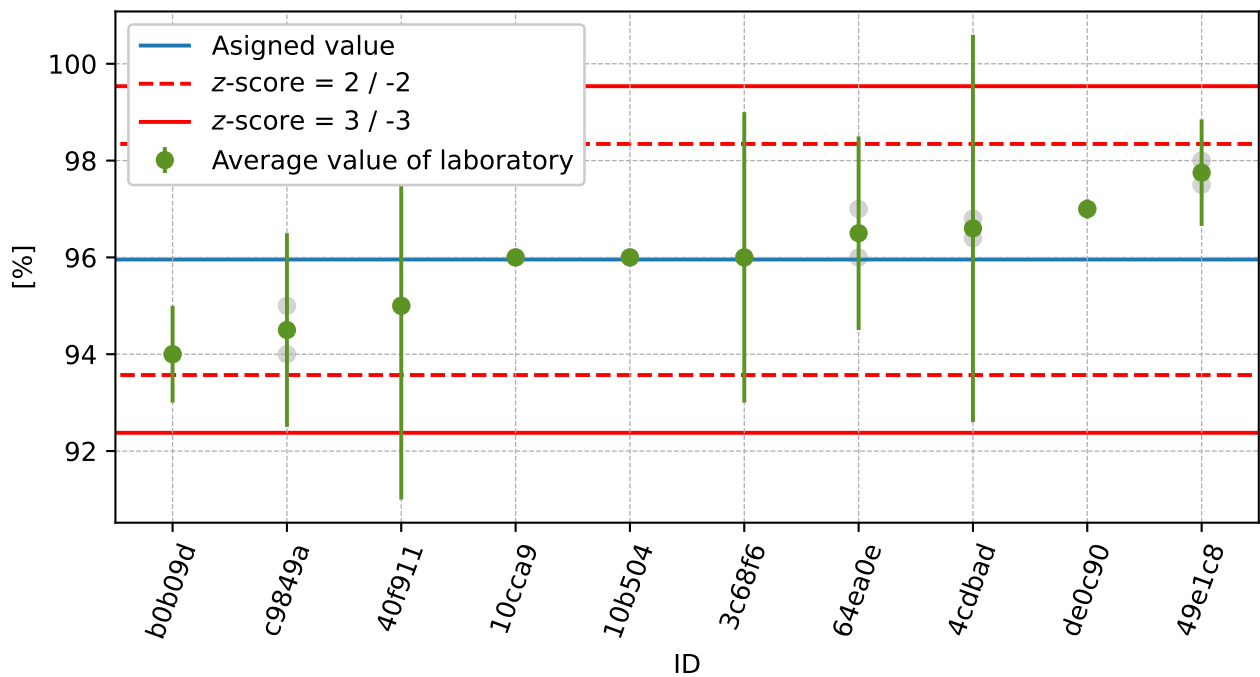


Figure 26: Average values and extended uncertainties of measurement

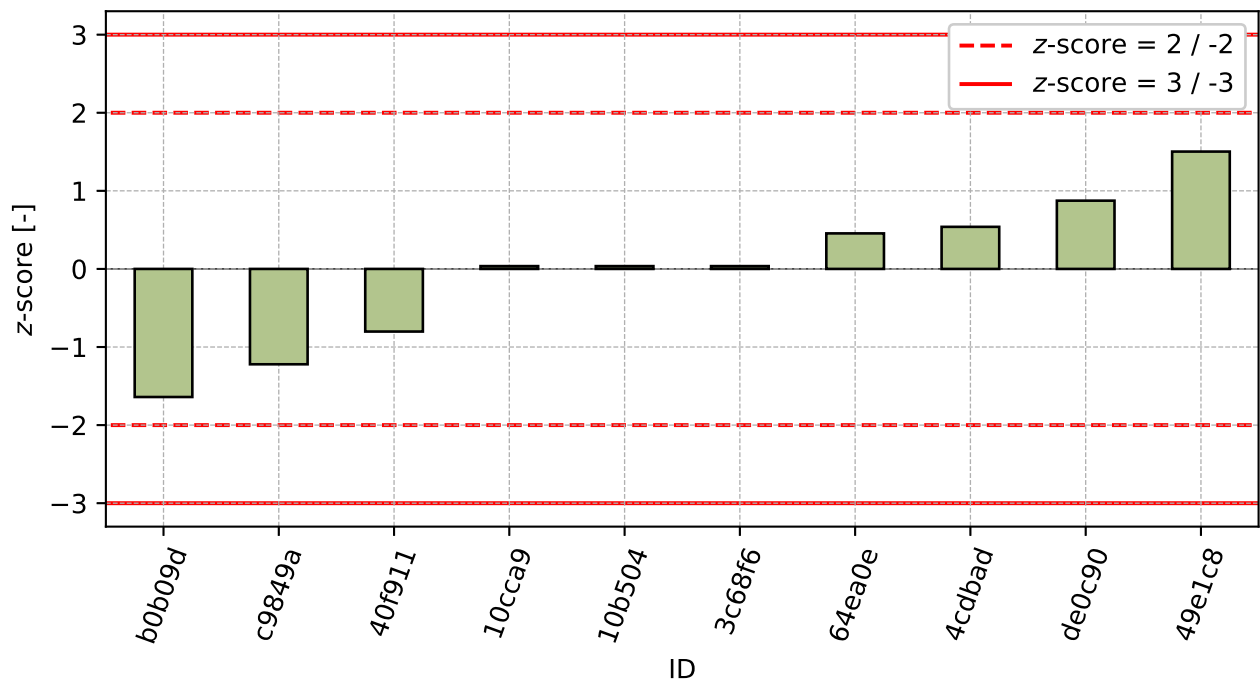


Figure 27: z-score

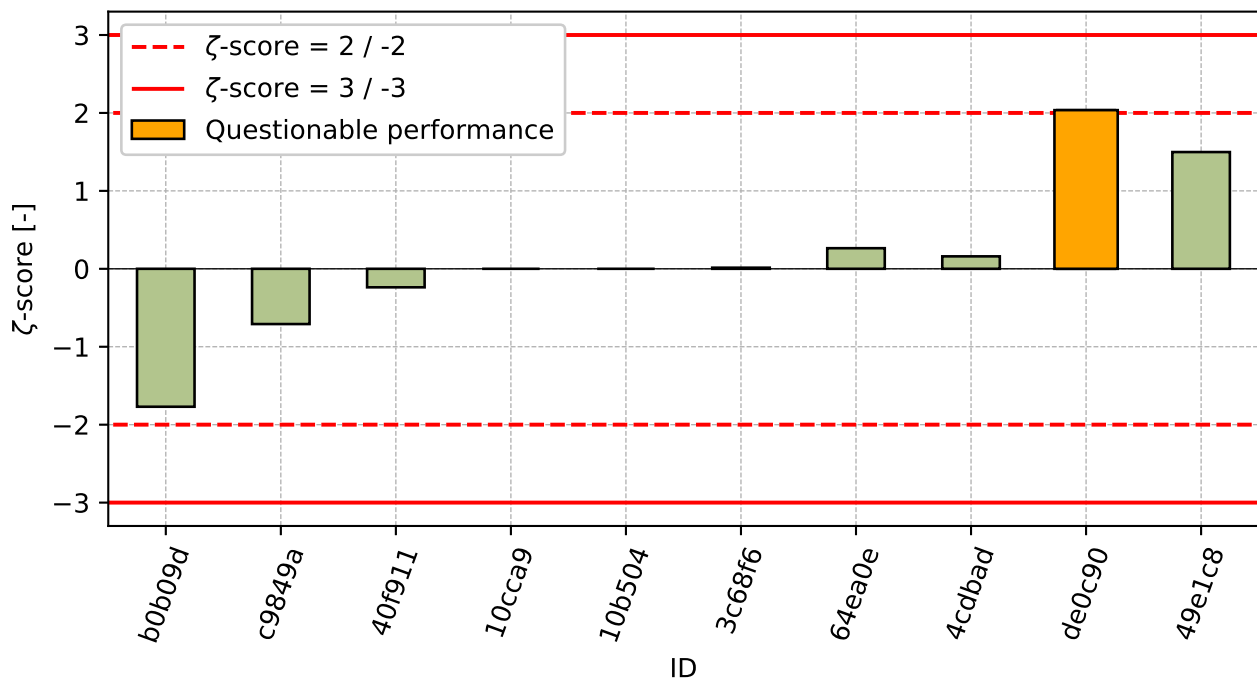


Figure 28: ζ-score

Table 12: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
b0b09d	-1.64	-1.77
c9849a	-1.22	-0.71
40f911	-0.80	-0.24
10cca9	0.04	-
10b504	0.04	-
3c68f6	0.04	0.01
64ea0e	0.46	0.26
4cdbad	0.54	0.16
de0c90	0.87	2.04
49e1c8	1.50	1.50

4 Appendix – EN 12593 Determination of the Fraass breaking point (T)

This part of the PT programme was not opened due to low interest from laboratories.

5 Appendix – EN 1429 Determination of residue on sieving of bituminous emulsions and storage stability

This part of the PT programme was not opened due to low interest from laboratories.

6 Appendix – EN 12697-1 Determination of soluble binder content

6.1 Test results

Table 13: Test results - ordered by average value. Outliers are marked by red color. u_x - extended uncertainty of measurement.

ID	Test results [%]	u_x [%]
9253fc	5.2	0.4
c22812	5.2	-
7ec83d	5.3	0.1
62ea7a	5.3	0.1
b0b09d	5.5	0.1
de0c90	5.5	0.2
c451a4	5.5	-
40f911	5.6	0.0
cd3235	5.7	0.1
f08bcd	5.7	1.0
49e1c8	5.7	0.1
76d982	5.8	-
c087fe	5.9	-
4db578	6.0	-

6.2 The Numerical Procedure for Determining Outliers

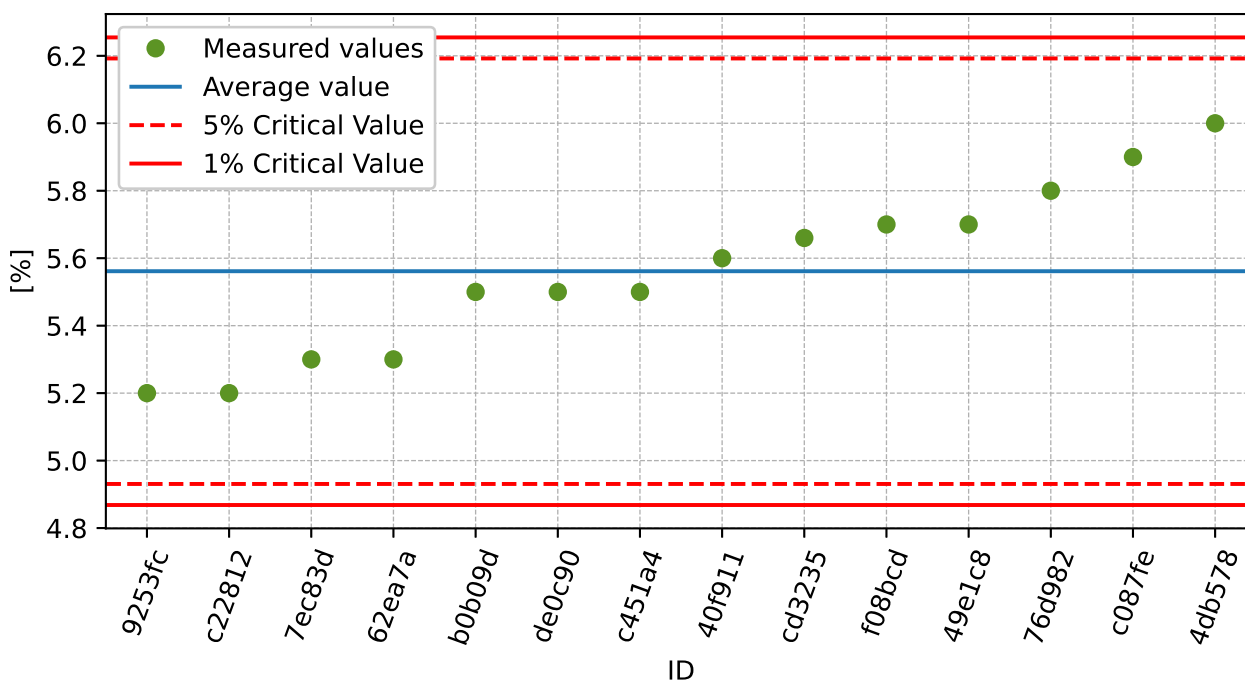


Figure 29: **Grubbs' test** - average values

6.3 Mandel's Statistics

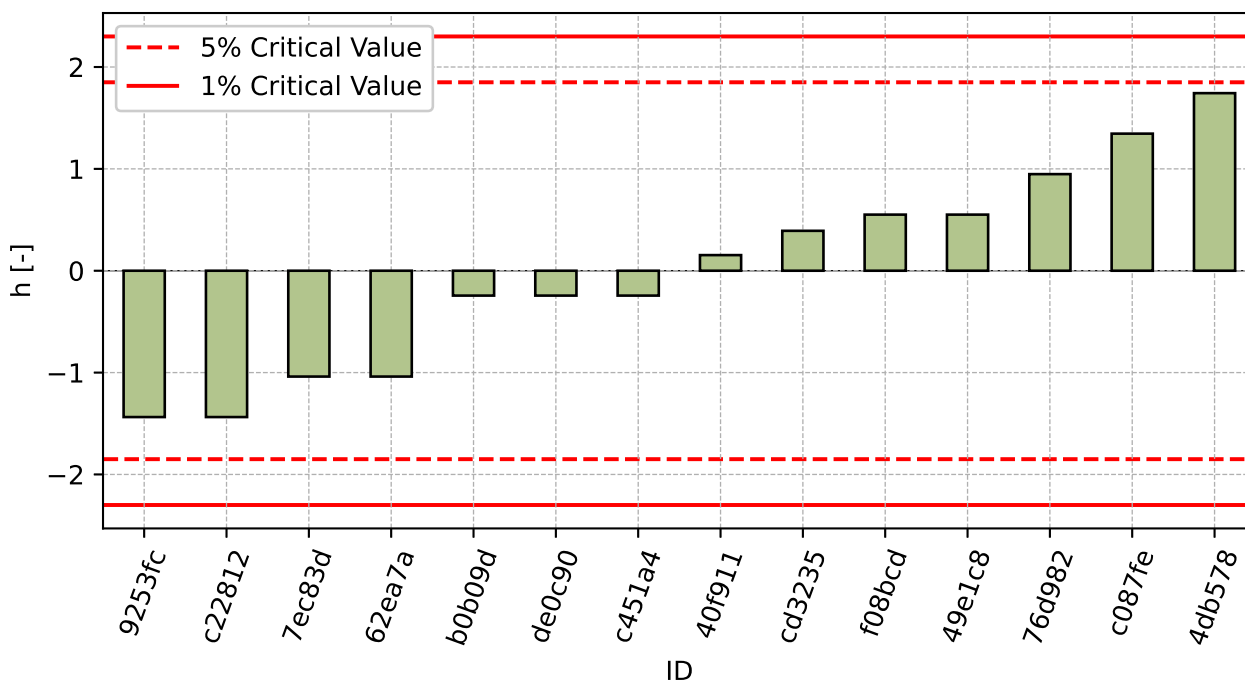


Figure 30: Interlaboratory Consistency Statistic

6.4 Descriptive statistics

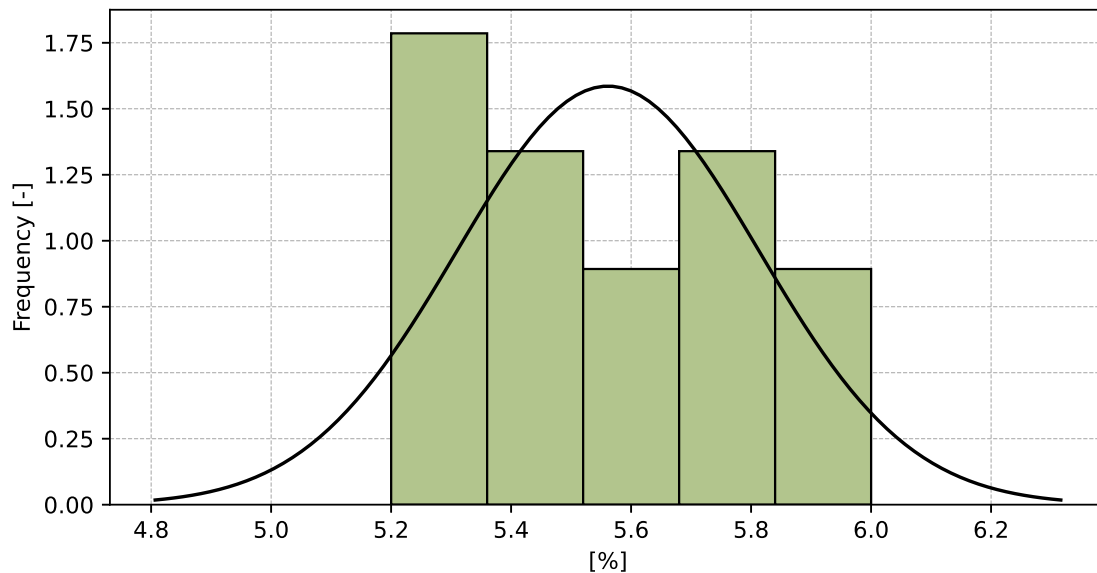


Figure 31: Histogram of all test results

Table 14: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	5.6
Sample standard deviation – s	0.25
Assigned value – x^*	5.6
Robust standard deviation – s^*	0.27
Measurement uncertainty of assigned value – u_x	0.09
p -value of normality test	0.634 [-]

6.5 Evaluation of Performance Statistics

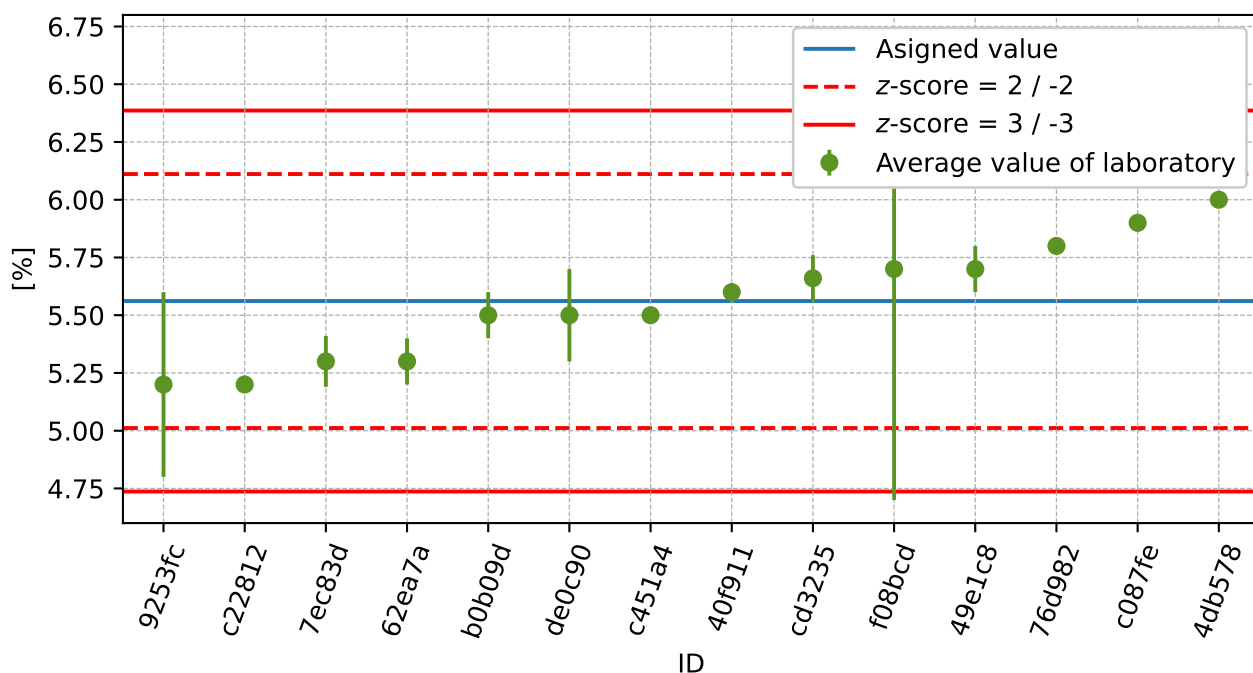


Figure 32: Average values and extended uncertainties of measurement

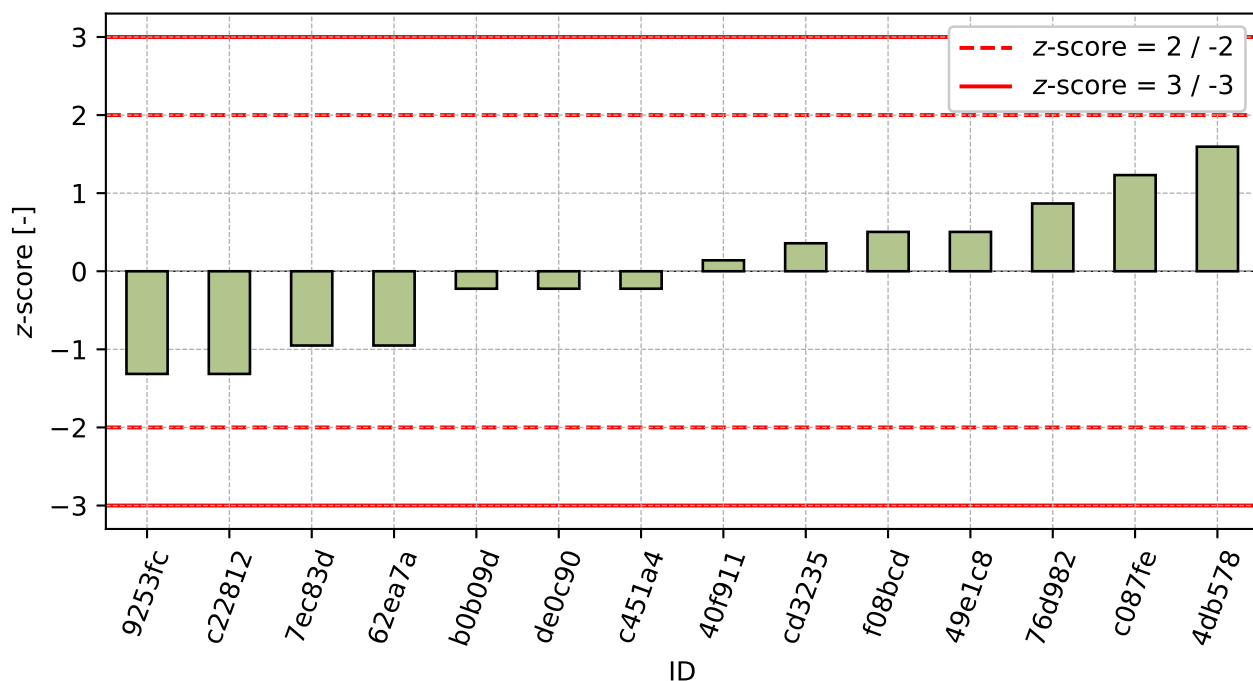
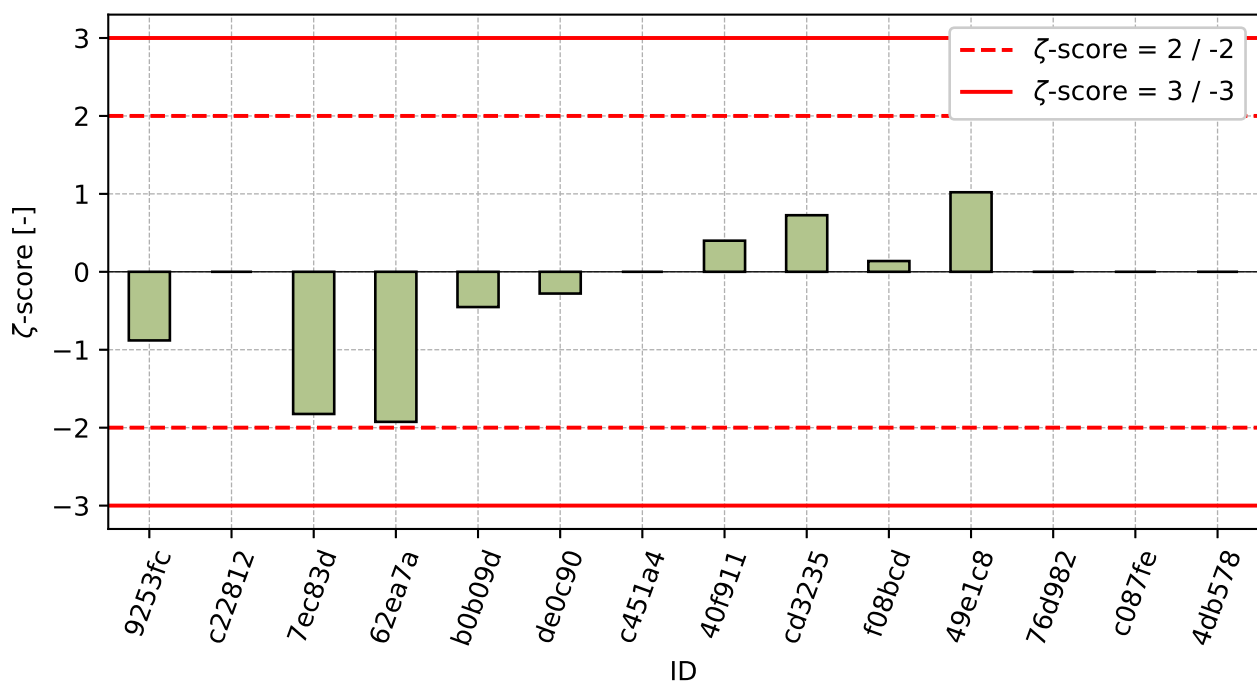


Figure 33: z-score

Figure 34: ζ -scoreTable 15: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
9253fc	-1.31	-0.88
c22812	-1.31	-
7ec83d	-0.95	-1.82
62ea7a	-0.95	-1.93
b0b09d	-0.22	-0.45
de0c90	-0.22	-0.28
c451a4	-0.22	-
40f911	0.14	0.40
cd3235	0.36	0.73
f08bcd	0.50	0.14
49e1c8	0.50	1.02
76d982	0.87	-
c087fe	1.23	-
4db578	1.60	-

7 Appendix – EN 12697-2+A1 Determination of particle size distribution

Table 16: Výsledky zkoušek – propad sítím [%]; odlehlé hodnoty jsou označeny červeně

ID účastníka	Propad sítím [%]									
	11.2 mm	8 mm	5.6 mm	4 mm	2 mm	1 mm	0.5 mm	0.25 mm	0.125 mm	0.063 mm
9253fc	99.0	82.0	52.0	39.0	25.0	17.0	12.0	9.0	7.0	6.2
c087fe	99.0	86.0	60.0	46.0	29.0	18.0	13.0	10.0	8.0	7.0
4db578	98.0	83.0	57.0	46.0	29.0	17.0	12.0	10.0	8.0	7.0
7ec83d	99.2	84.5	-	39.4	25.6	17.4	12.7	9.6	7.9	7.3
f08bcd	100.0	86.0	57.0	42.0	29.0	20.0	14.0	10.0	8.0	7.0
b0b09d	100.0	86.0	55.0	40.0	27.0	17.0	12.0	9.0	7.0	6.0
76d982	98.0	80.0	51.0	46.0	31.0	21.0	13.0	10.0	8.0	6.9
de0c90	100.0	86.0	57.0	43.0	28.0	18.0	12.0	9.0	8.0	6.6
49e1c8	100.0	81.0	57.0	40.0	27.0	18.0	12.0	9.0	7.0	5.7
62ea7a	99.5	81.8	-	39.6	25.9	16.8	11.8	8.7	6.9	5.4
c451a4	100.0	82.0	51.0	40.0	26.0	17.0	12.0	9.0	7.0	5.8
cd3235	-	84.0	-	43.0	29.0	20.0	14.0	10.0	8.0	6.9
0789d1	100.0	83.0	53.0	40.0	27.0	18.0	13.0	10.0	8.0	6.5
c22812	100.0	85.0	-	39.0	25.0	16.0	-	-	7.0	6.0

Table 17: Výsledky Grubbsova testu

Charakteristika	11.2 mm	8 mm	5.6 mm	4 mm	2 mm	1 mm	0.5 mm	0.25 mm	0.125 mm	0.063 mm
G_{min}	1.912	1.75	1.294	0.979	1.316	1.354	1.003	1.475	1.271	1.762
G_{max}	0.746	1.173	1.617	1.614	1.983	2.131	1.837	0.969	0.857	1.427
$G_{0.05}$	2.462	2.507	2.29	2.507	2.507	2.507	2.462	2.462	2.507	2.507
$G_{0.01}$	2.699	2.755	2.482	2.755	2.755	2.755	2.699	2.699	2.755	2.755

Table 18: Výsledné hodnoty z-score

ID účastníka	11.2 mm	8 mm	5.6 mm	4 mm	2 mm	1 mm	0.5 mm	0.25 mm	0.125 mm	0.063 mm
9253fc	-0.58	-0.78	-0.97	-0.98	-1.32	-0.66	-0.74	-0.91	-1.08	-0.42
c087fe	-0.58	1.17	1.62	1.61	0.88	0.04	0.55	0.97	0.86	0.92
4db578	-1.91	-0.29	0.65	1.61	0.88	-0.66	-0.74	0.97	0.86	0.92
7ec83d	-0.32	0.44	-	-0.83	-0.99	-0.38	0.16	0.22	0.66	1.43
f08bcd	0.75	1.17	0.65	0.13	0.88	1.43	1.84	0.97	0.86	0.92
b0b09d	0.75	1.17	0.0	-0.61	-0.22	-0.66	-0.74	-0.91	-1.08	-0.76
76d982	-1.91	-1.75	-1.29	1.61	1.98	2.13	0.55	0.97	0.86	0.76
de0c90	0.75	1.17	0.65	0.5	0.33	0.04	-0.74	-0.91	0.86	0.25
49e1c8	0.75	-1.26	0.65	-0.61	-0.22	0.04	-0.74	-0.91	-1.08	-1.26
62ea7a	0.08	-0.87	-	-0.76	-0.82	-0.8	-1.0	-1.47	-1.27	-1.76
c451a4	0.75	-0.78	-1.29	-0.61	-0.77	-0.66	-0.74	-0.91	-1.08	-1.09
cd3235	-	0.2	-	0.5	0.88	1.43	1.84	0.97	0.86	0.76
0789d1	0.75	-0.29	-0.65	-0.61	-0.22	0.04	0.55	0.97	0.86	0.08
c22812	0.75	0.69	-	-0.98	-1.32	-1.35	-	-	-1.08	-0.76

8 Appendix – EN 12697-5 Determination of maximum density

8.1 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 [Mg/m ³]		u_X [Mg/m ³]	$\bar{x}$ [Mg/m ³]	s_0 [Mg/m ³]	V_X [%]
cd3235	2.365	2.366	-	2.365	0.0007	0.03
c087fe	2.422	2.422	-	2.422	0.0	0.0
4db578	2.425	2.428	-	2.426	0.0021	0.09
76d982	2.439	2.435	-	2.437	0.0028	0.12
f68f15	2.441	2.439	0.231	2.44	0.0014	0.06
b0b09d	2.439	2.444	0.013	2.442	0.0035	0.14
29c947	2.445	2.455	0.007	2.45	0.0071	0.29
9253fc	2.456	2.447	0.008	2.452	0.0064	0.26
c22812	2.458	2.458	-	2.458	0.0	0.0
acb415	2.458	2.462	0.001	2.46	0.0028	0.11
7ec83d	2.46	2.463	0.003	2.462	0.0021	0.09
49e1c8	2.466	2.464	0.006	2.465	0.0014	0.06
62ea7a	2.475	2.484	0.008	2.479	0.0064	0.26
f08bcd	2.534	2.495	0.041	2.514	0.0278	1.11

8.2 The Numerical Procedure for Determining Outliers

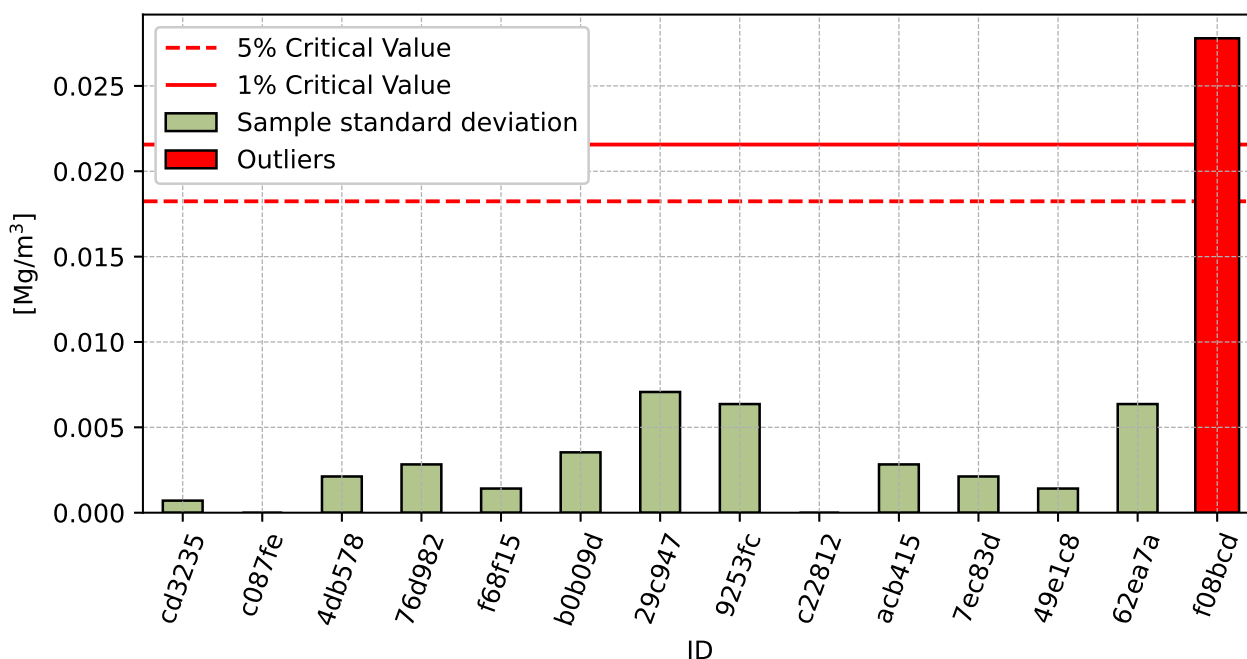


Figure 35: **Cochran's test** - sample standard deviations

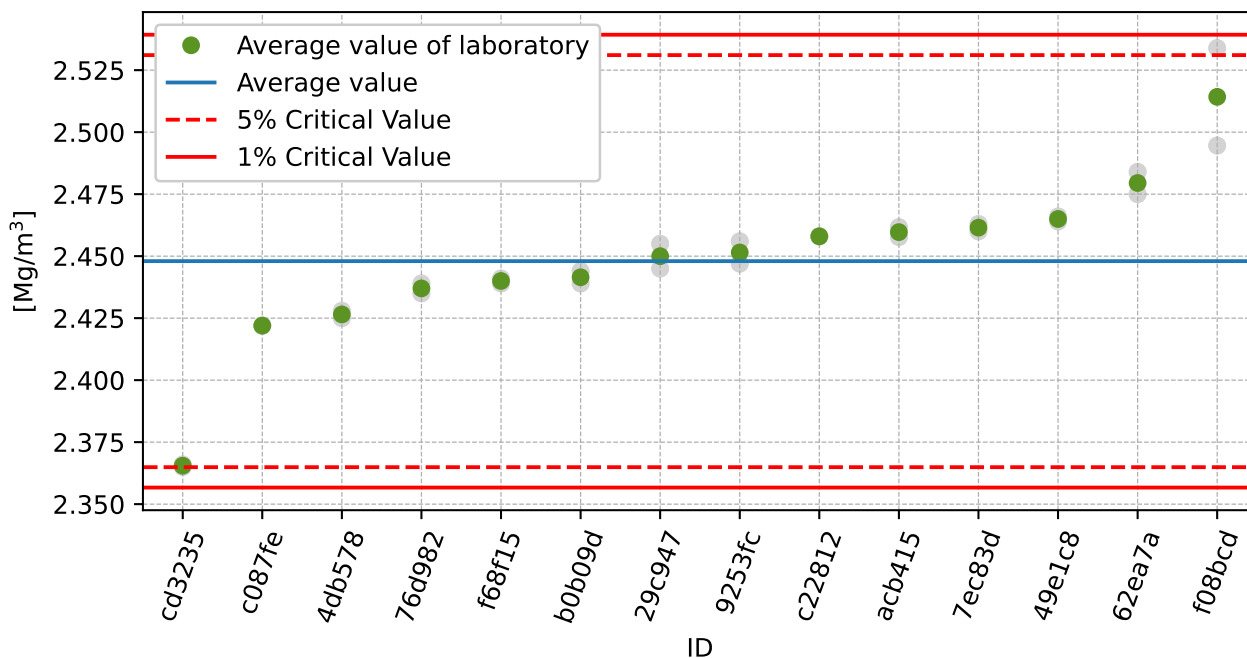


Figure 36: **Grubbs' test** - average values

8.3 Mandel's Statistics

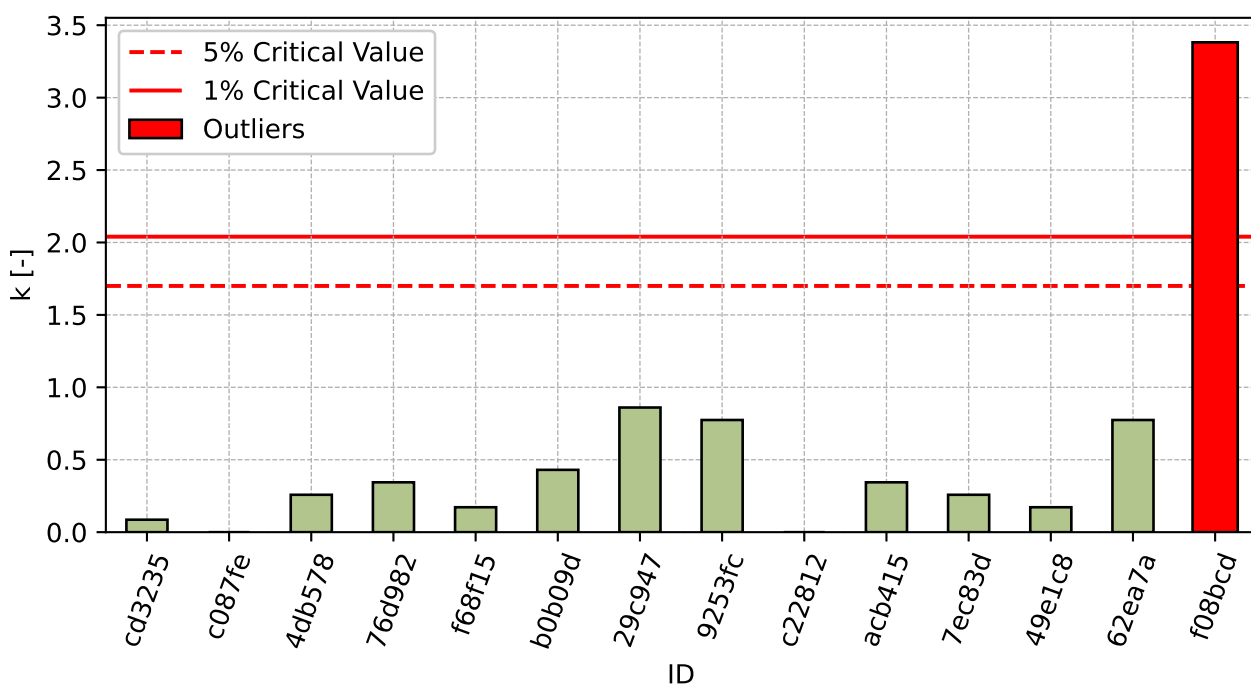


Figure 37: Intralaboratory Consistency Statistic

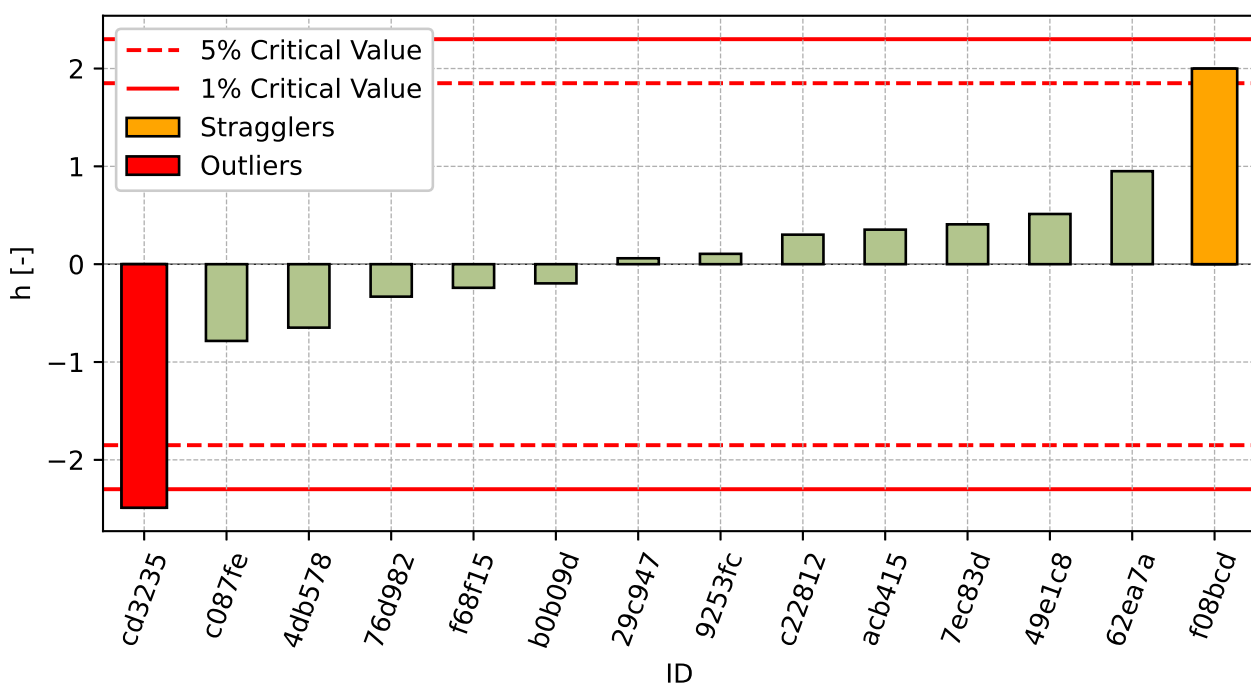


Figure 38: Interlaboratory Consistency Statistic

8.4 Descriptive statistics

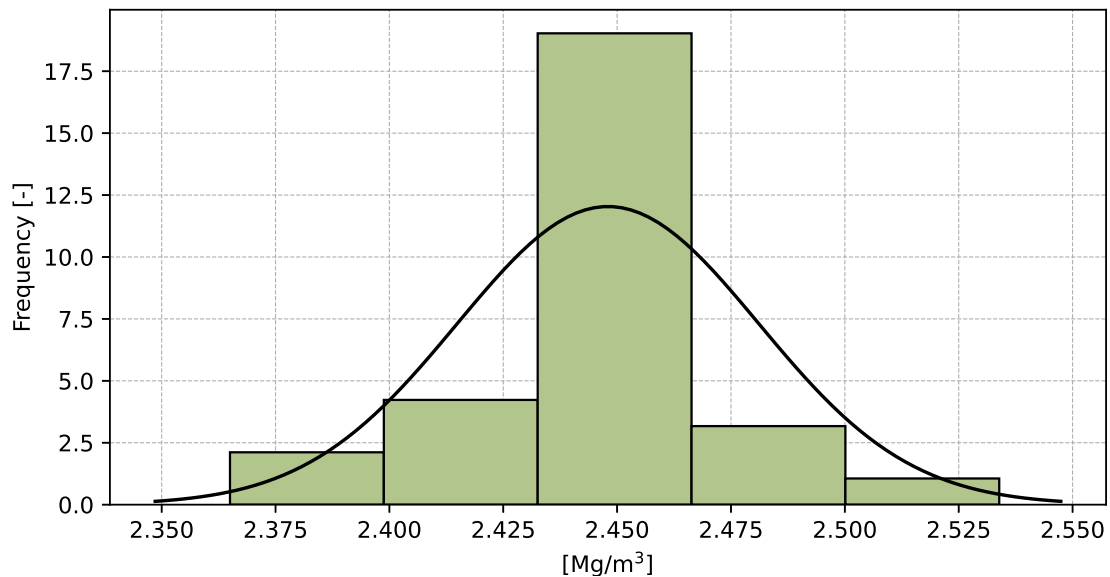


Figure 39: Histogram of all test results

Table 20: Descriptive statistics

Characteristics	[Mg/m³]
Average value – $\bar{x}$	2.448
Sample standard deviation – s	0.0331
Assigned value – x^*	2.452
Robust standard deviation – s^*	0.0265
Measurement uncertainty of assigned value – u_X	0.0089
p -value of normality test	0.018 [-]
Interlaboratory standard deviation – s_L	0.0326
Repeatability standard deviation – s_r	0.0082
Reproducibility standard deviation – s_R	0.0336
Repeatability – r	0.023
Reproducibility – R	0.094

8.5 Evaluation of Performance Statistics

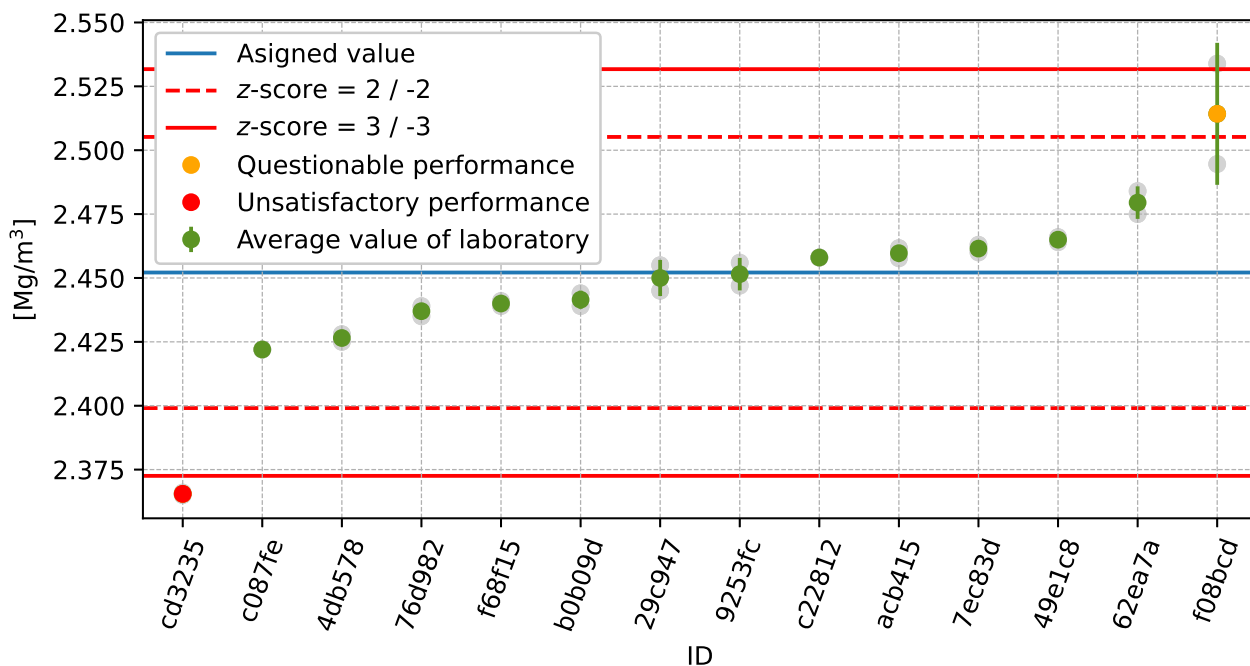


Figure 40: Average values and sample standard deviations

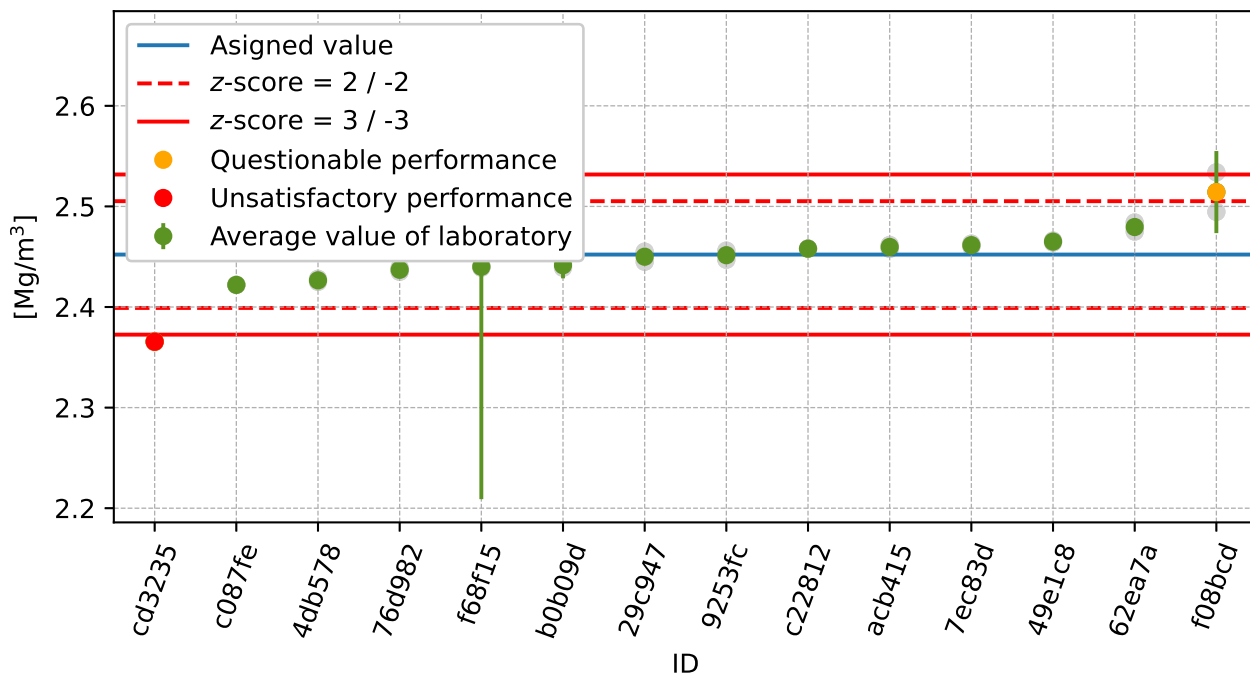


Figure 41: Average values and extended uncertainties of measurement

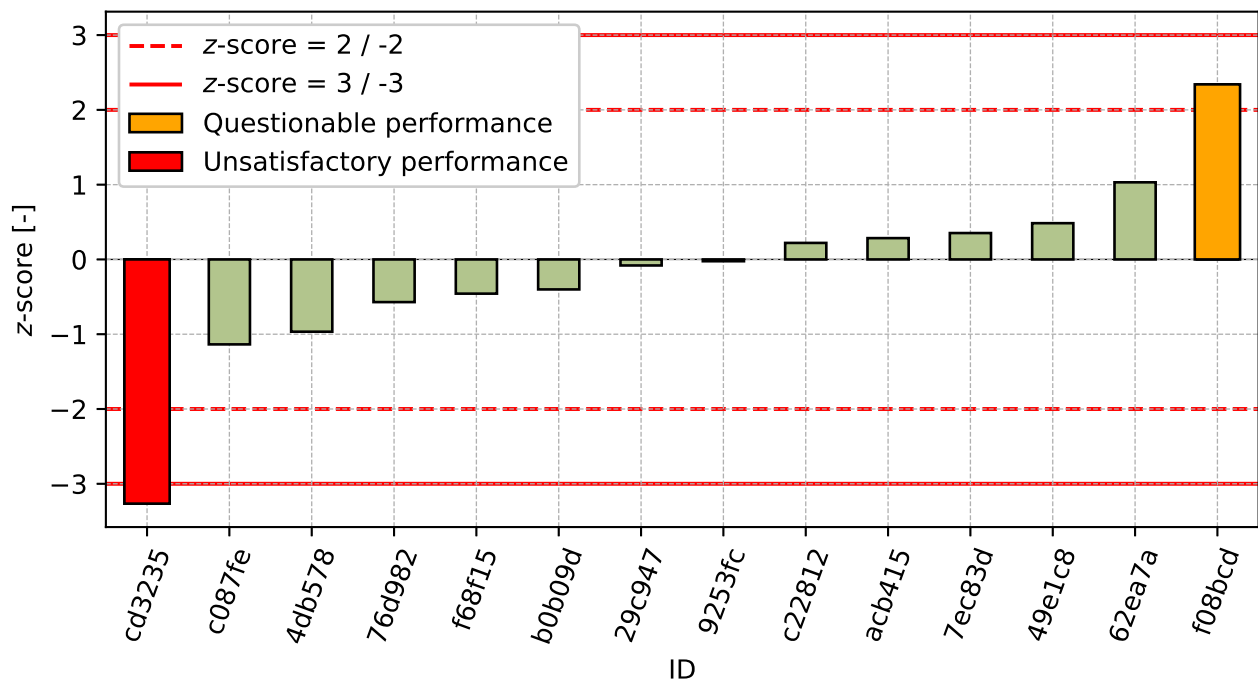


Figure 42: z-score

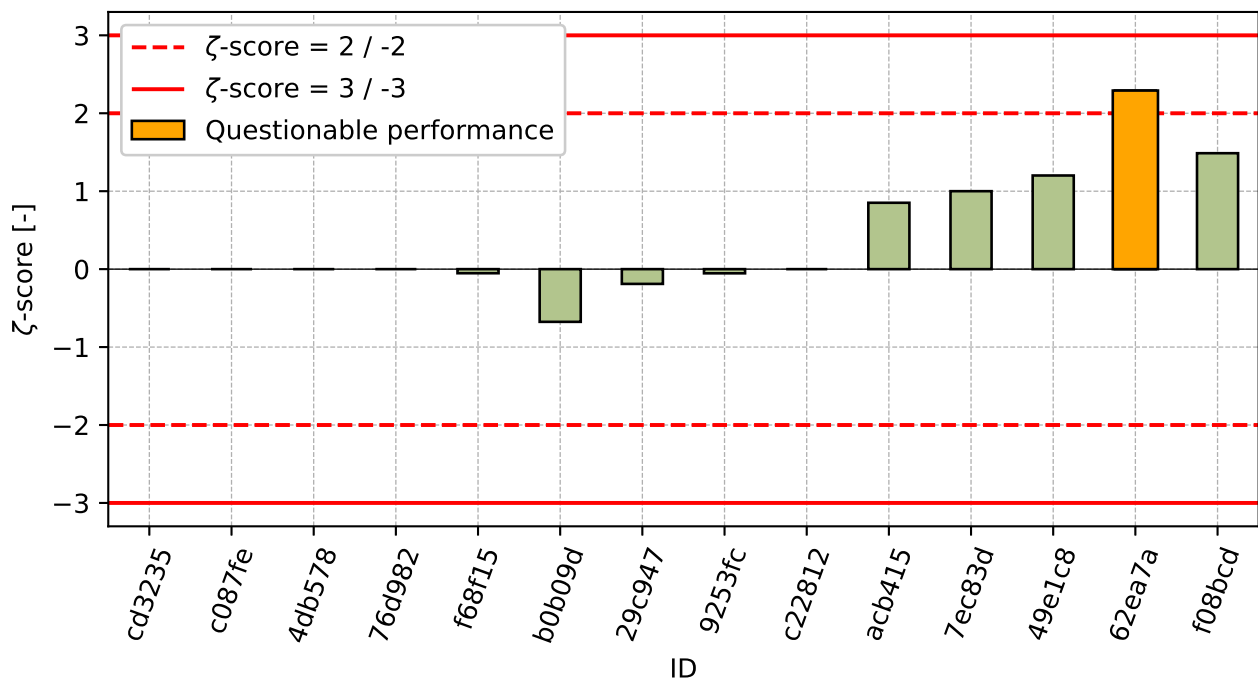


Figure 43: zeta-score

Table 21: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
cd3235	-3.27	-
c087fe	-1.14	-
4db578	-0.97	-
76d982	-0.57	-
f68f15	-0.46	-0.05
b0b09d	-0.40	-0.68
29c947	-0.08	-0.19
9253fc	-0.02	-0.05
c22812	0.22	-
acb415	0.28	0.85
7ec83d	0.35	1.00
49e1c8	0.48	1.20
62ea7a	1.03	2.29
f08bcd	2.34	1.49

9 Appendix – EN 12697-6 Determination of bulk density of bituminous specimens

9.1 Test results

Table 22: Test results - ordered by average value. Outliers are marked by red color. u_x - extended uncertainty of measurement.

ID	Test results [Mg/m ³]	u_x [Mg/m ³]
87e572	2.223	0.03
c087fe	2.232	-
4db578	2.234	-
c22812	2.245	-
62ea7a	2.249	0.006
b0b09d	2.254	0.008
9253fc	2.259	0.007
7ec83d	2.274	0.028
76d982	2.325	-
49e1c8	2.325	0.009
f08bcd	2.418	0.015

9.2 The Numerical Procedure for Determining Outliers

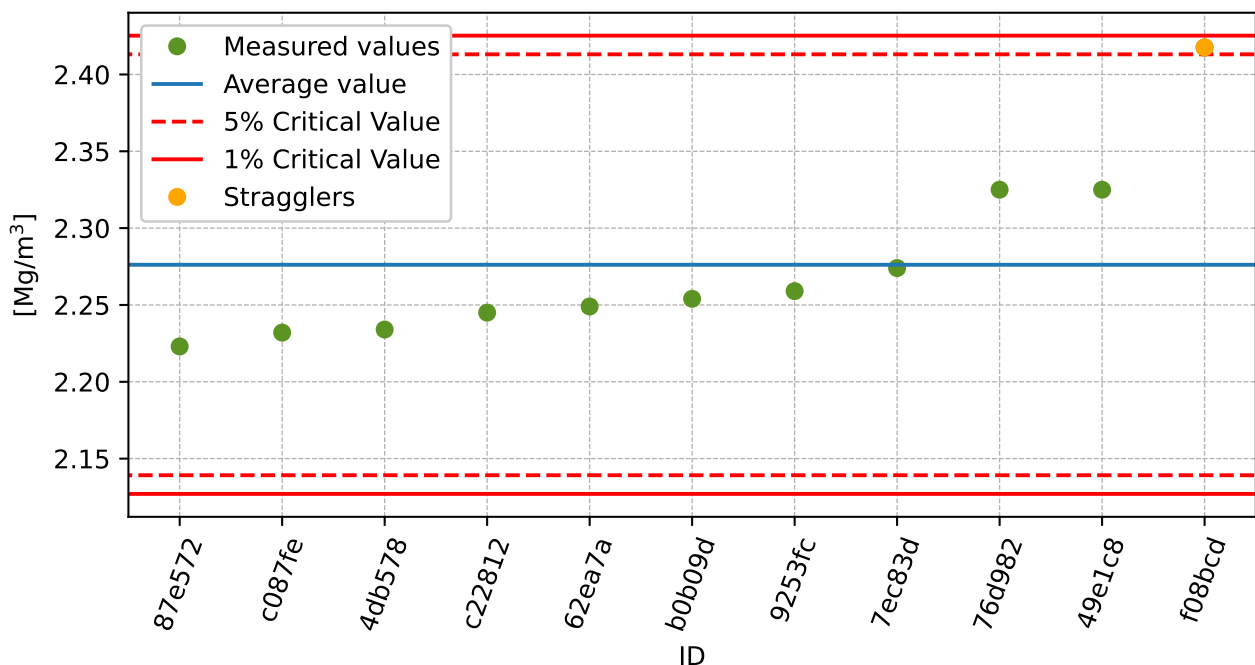


Figure 44: **Grubbs' test** - average values

9.3 Mandel's Statistics

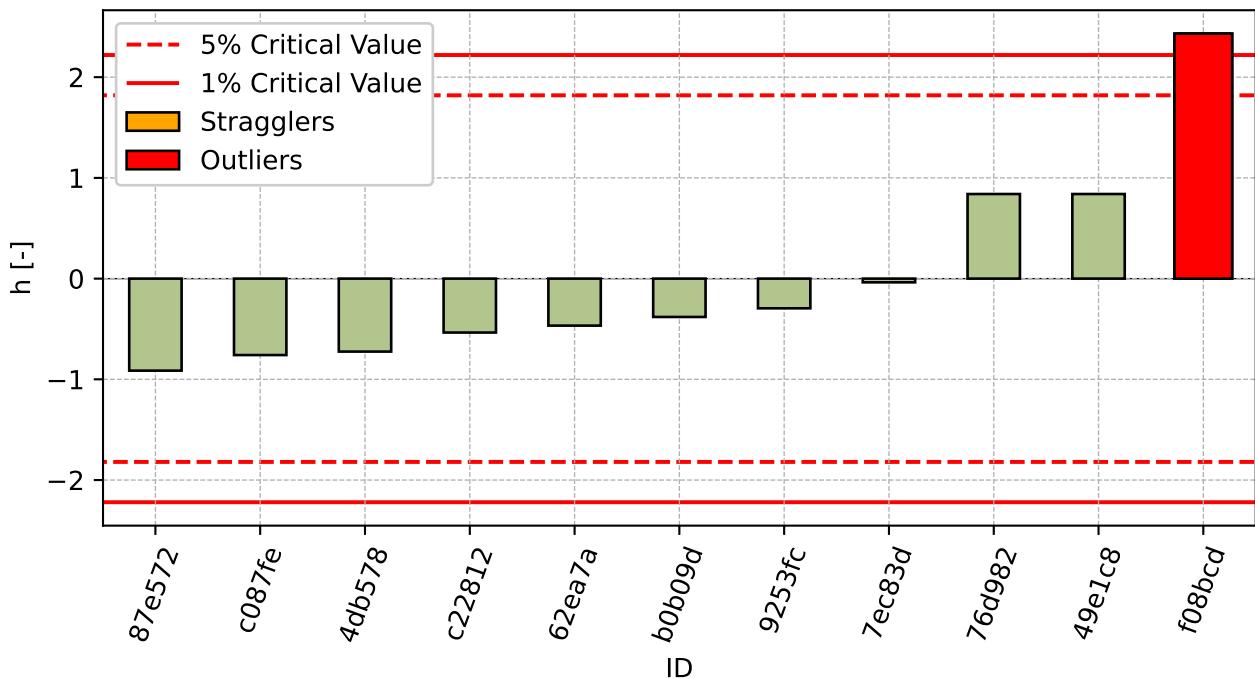


Figure 45: Interlaboratory Consistency Statistic

9.4 Descriptive statistics

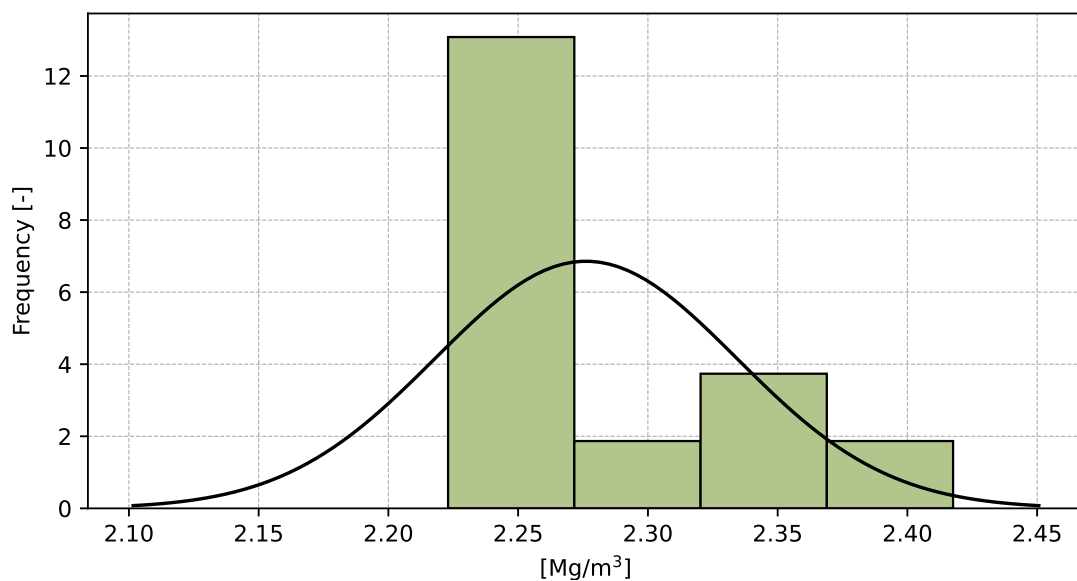


Figure 46: Histogram of all test results

Table 23: Descriptive statistics

Characteristics	[Mg/m ³]
Average value – $\bar{x}$	2.276
Sample standard deviation – s	0.0582
Assigned value – x^*	2.271
Robust standard deviation – s^*	0.059
Measurement uncertainty of assigned value – u_X	0.0222
p -value of normality test	0.012 [-]

9.5 Evaluation of Performance Statistics

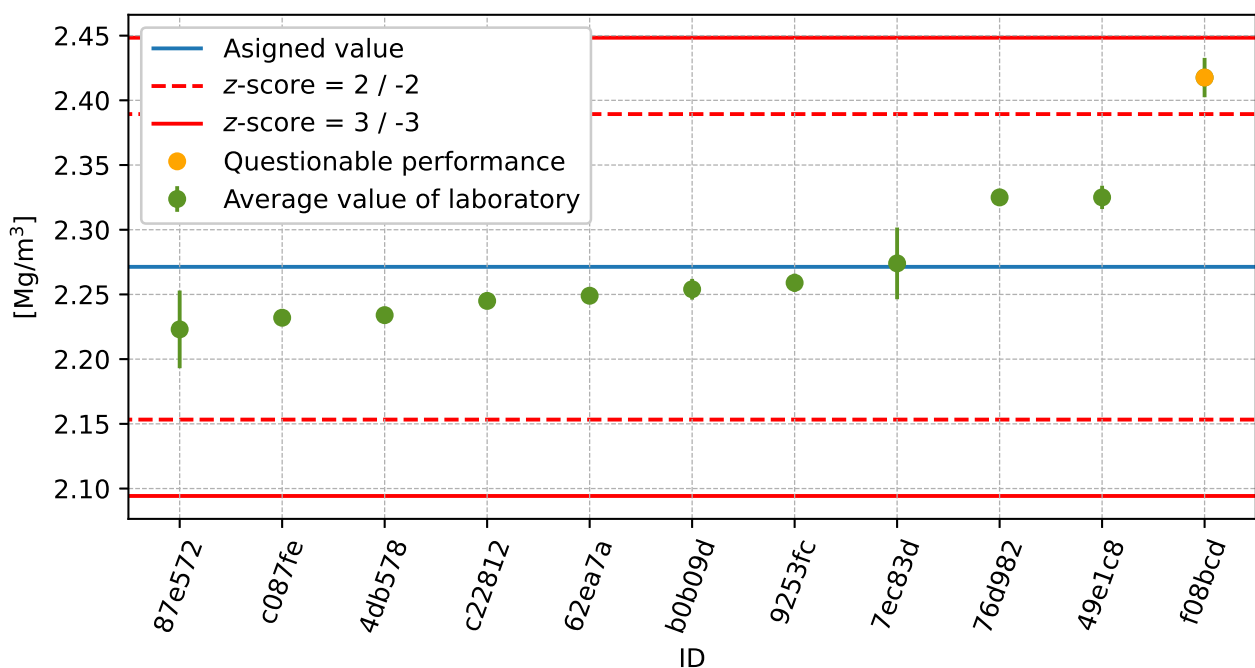


Figure 47: Average values and extended uncertainties of measurement

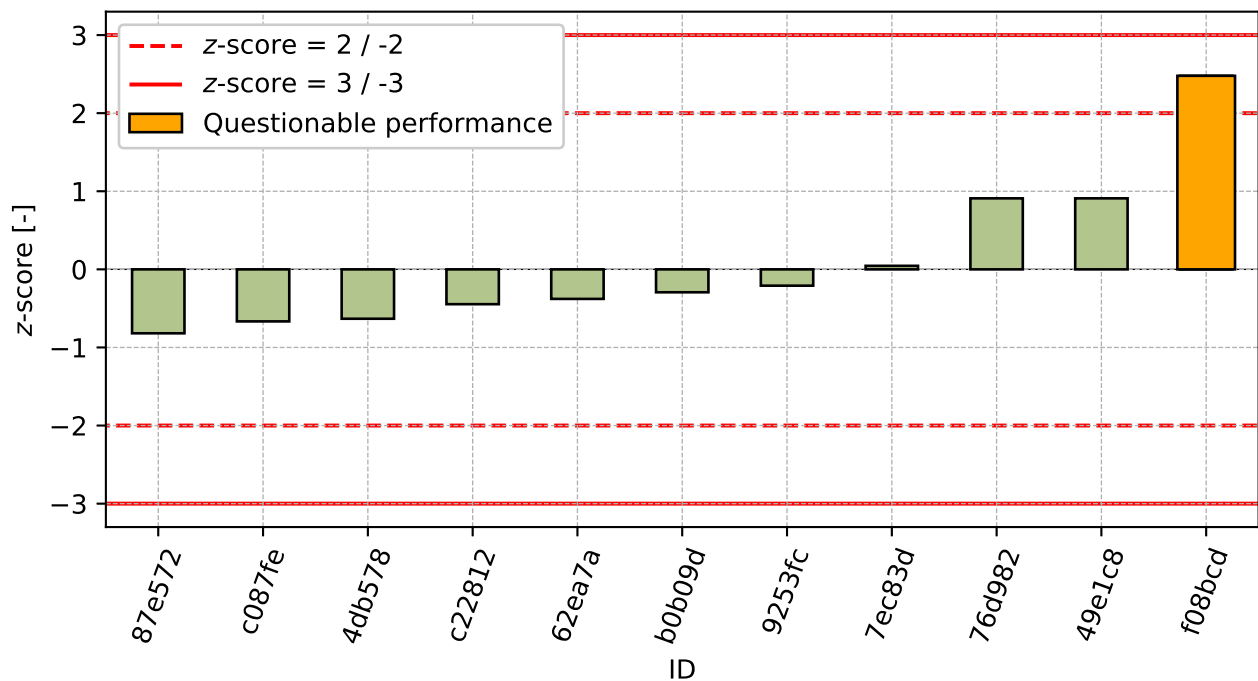


Figure 48: z-score

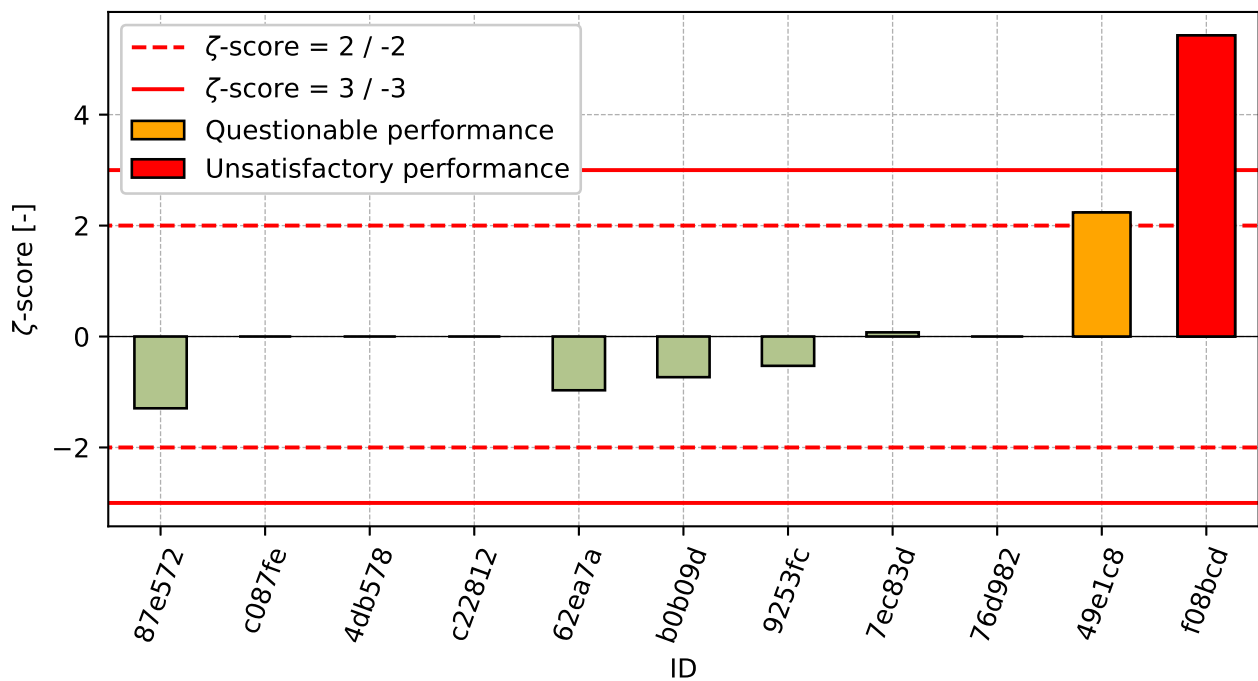


Figure 49: zeta-score

Table 24: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
87e572	-0.82	-1.29
c087fe	-0.67	-
4db578	-0.63	-
c22812	-0.45	-
62ea7a	-0.38	-0.97
b0b09d	-0.29	-0.73
9253fc	-0.21	-0.53
7ec83d	0.05	0.08
76d982	0.91	-
49e1c8	0.91	2.24
f08bcd	2.48	5.43

10 Appendix – EN 12697-8 Determination of void characteristics of bituminous mixtures

10.1 Test results

Table 25: Test results - ordered by average value. Outliers are marked by red color. u_X - extended uncertainty of measurement.

ID	Test results [%]	u_X [%]
cd3235	3.3	0.3
f08bcd	3.9	-
76d982	4.6	-
81b0e4	5.6	-
49e1c8	5.7	0.1
3c68f6	7.5	1.9
7ec83d	7.5	-
b0b09d	7.7	0.4
c087fe	7.8	-
4db578	7.8	-
9253fc	7.9	0.6
c22812	8.7	-
acb415	9.0	0.2
62ea7a	9.3	-
3224cf	17.3	1.6

10.2 The Numerical Procedure for Determining Outliers

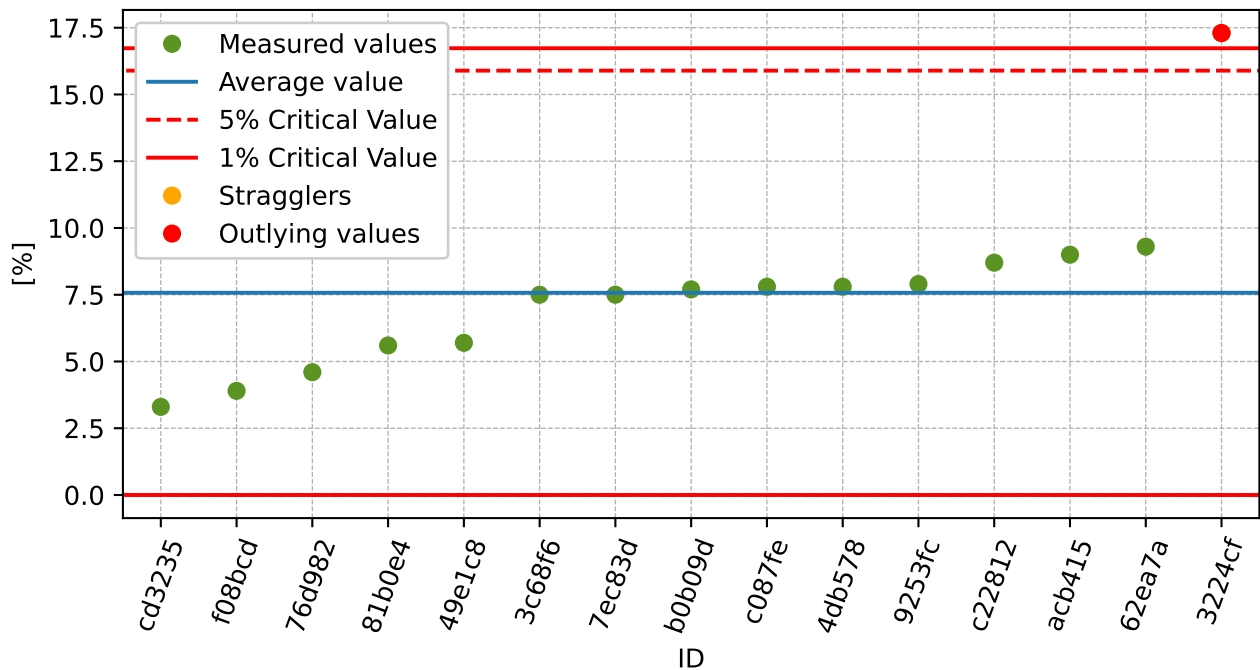


Figure 50: **Grubbs' test** - average values

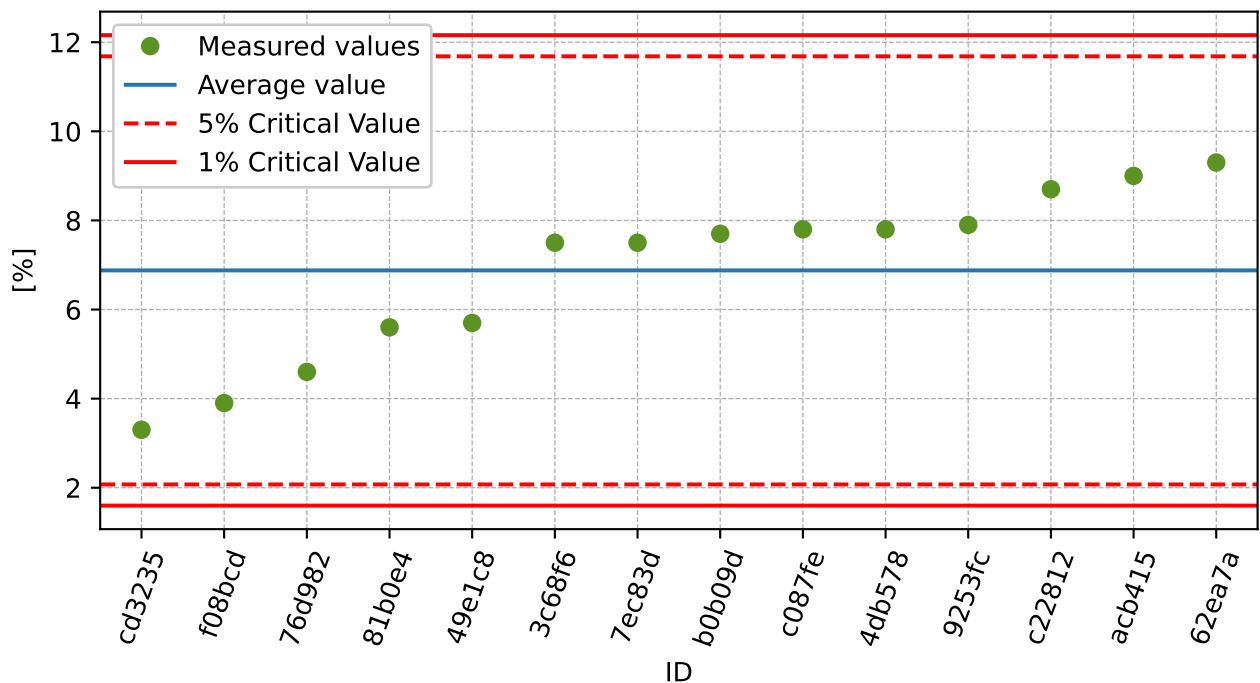


Figure 51: **Grubbs' test** - average values without outliers

10.3 Mandel's Statistics

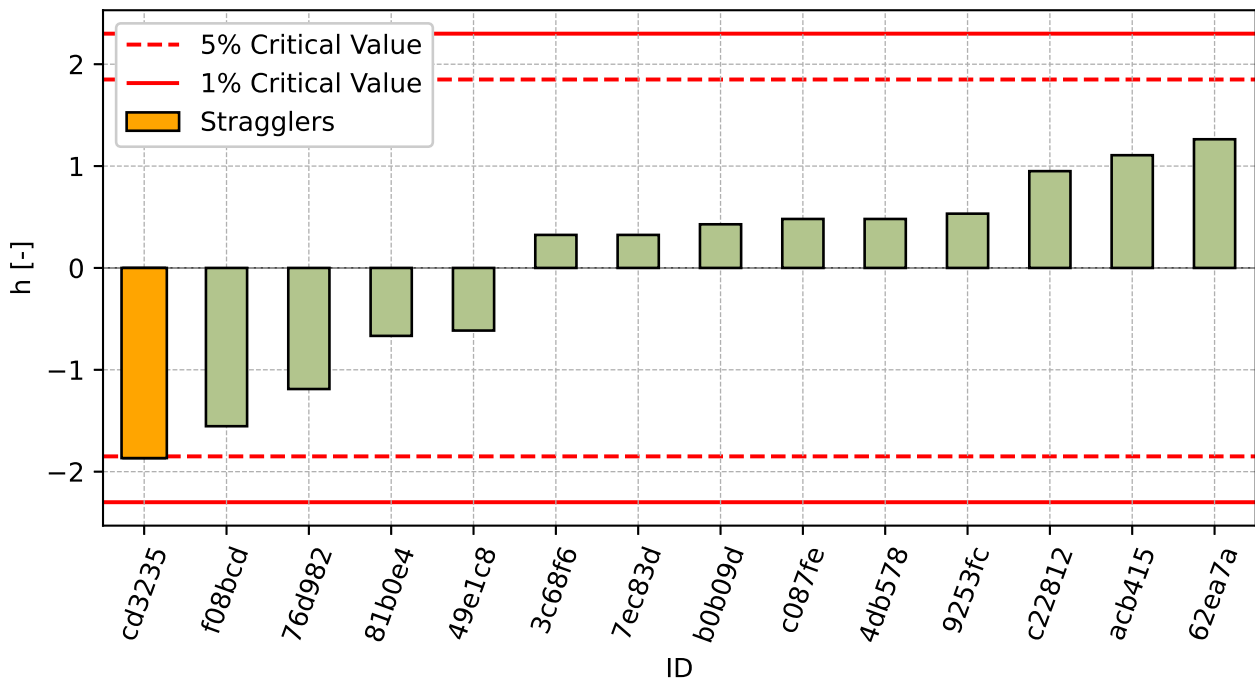


Figure 52: Interlaboratory Consistency Statistic

10.4 Descriptive statistics

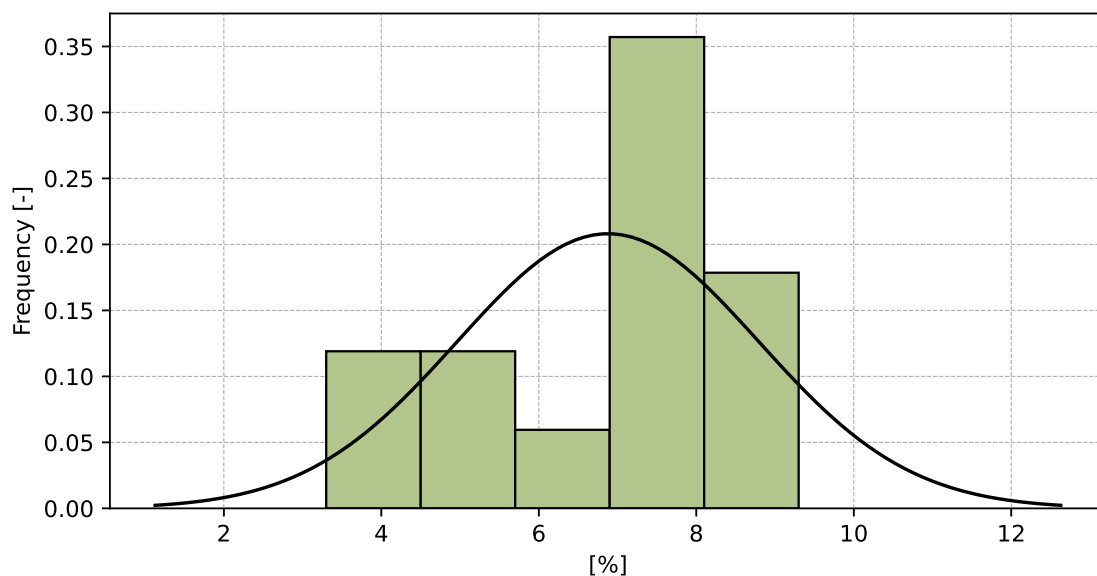


Figure 53: Histogram of all test results

Table 26: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	6.9
Sample standard deviation – s	1.92
Assigned value – x^*	7.1
Robust standard deviation – s^*	1.89
Measurement uncertainty of assigned value – u_x	0.58
p -value of normality test	0.109 [-]

10.5 Evaluation of Performance Statistics

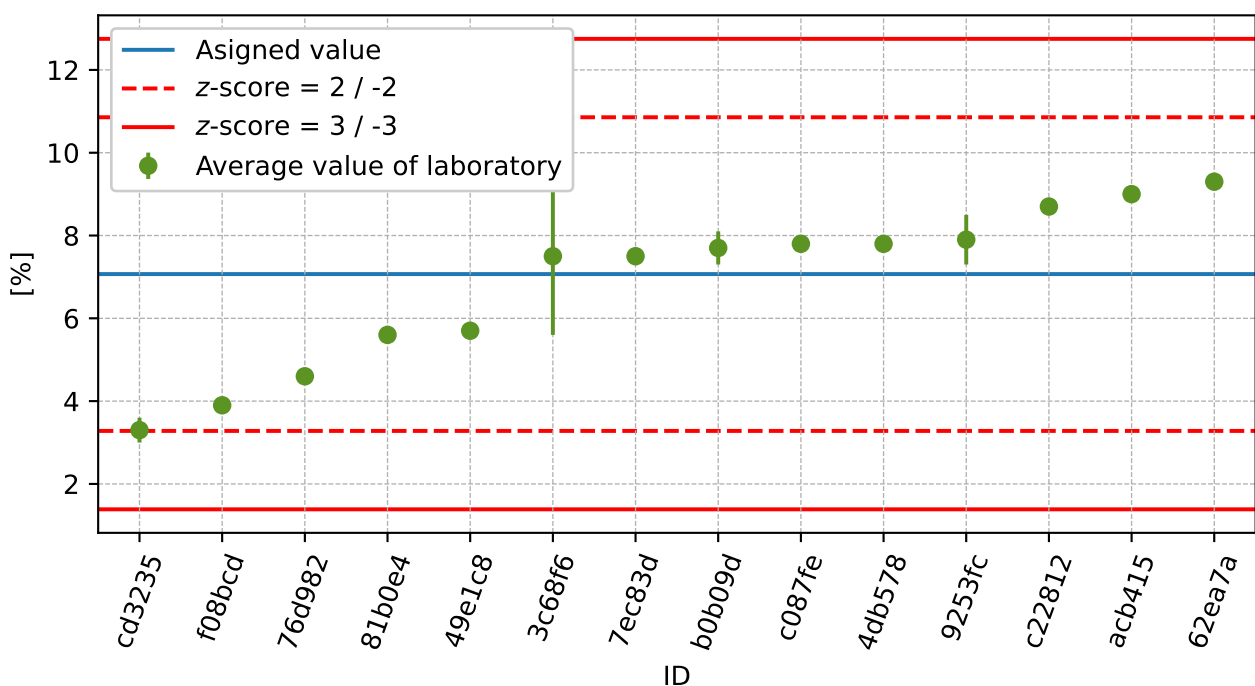


Figure 54: Average values and extended uncertainties of measurement

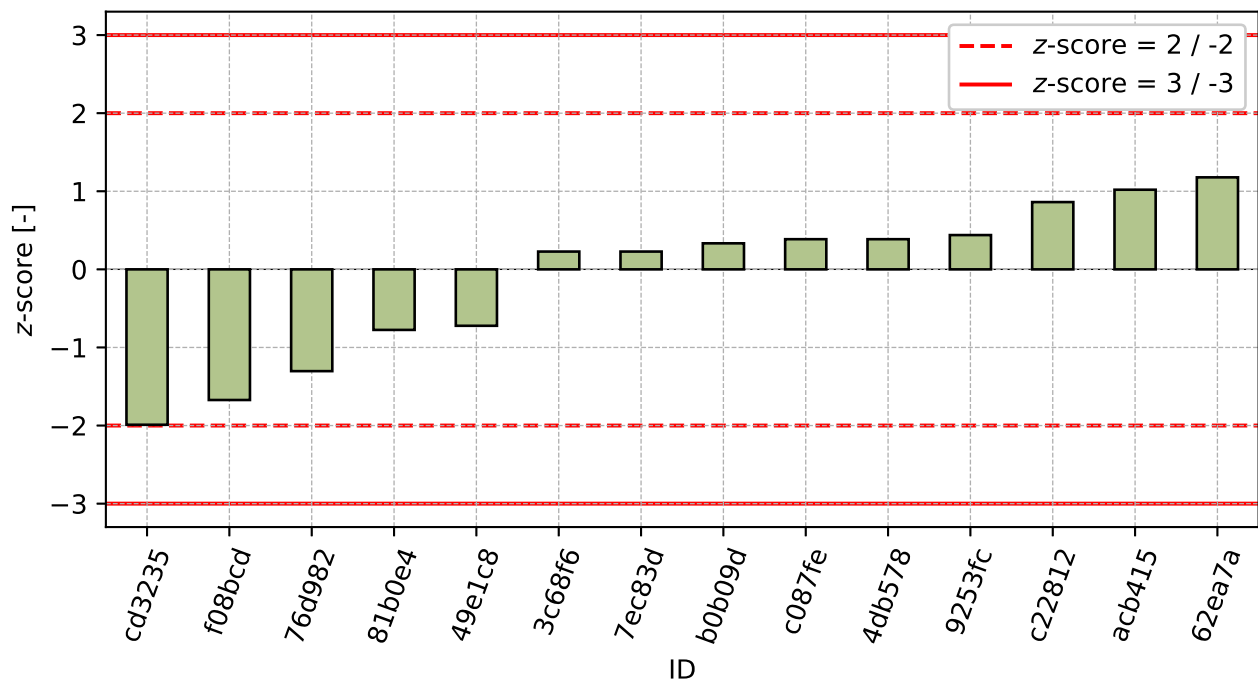


Figure 55: z-score

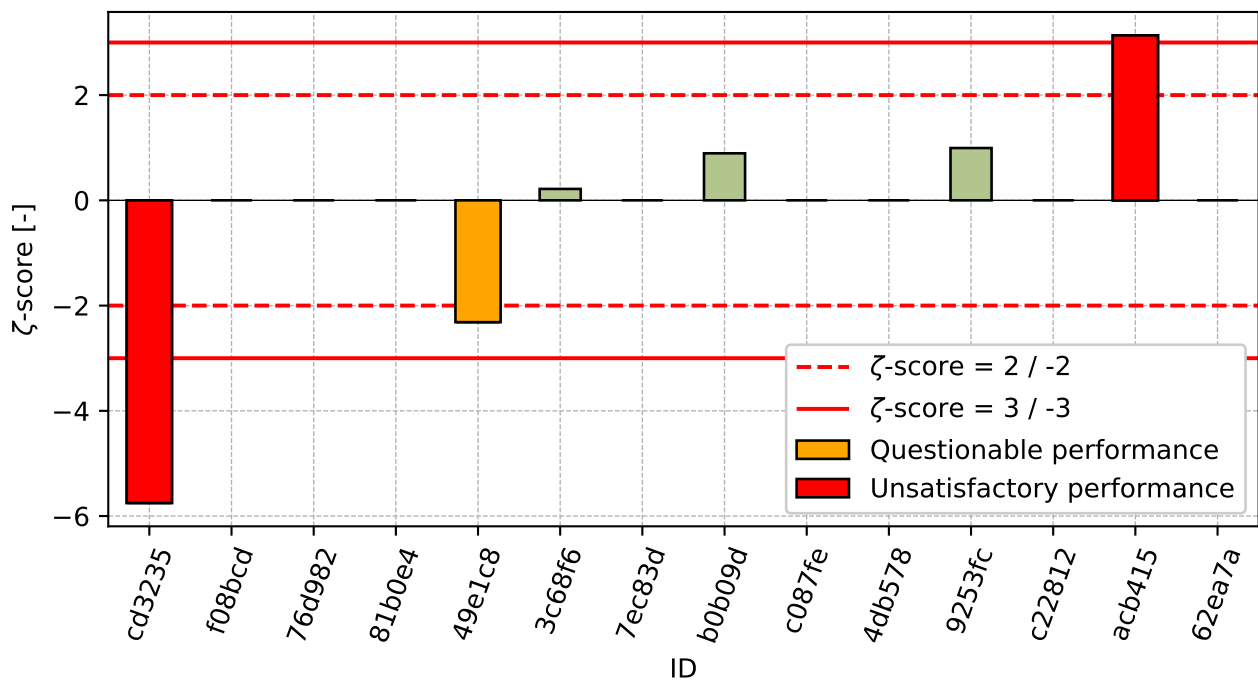


Figure 56: zeta-score

Table 27: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
cd3235	-1.99	-5.75
f08bcd	-1.67	-
76d982	-1.30	-
81b0e4	-0.78	-
49e1c8	-0.72	-2.31
3c68f6	0.23	0.22
7ec83d	0.23	-
b0b09d	0.33	0.89
c087fe	0.39	-
4db578	0.39	-
9253fc	0.44	0.99
c22812	0.86	-
acb415	1.02	3.14
62ea7a	1.18	-

11 Appendix – EN 12697-12, -23 ITSR – Resistance to water sensitivity (Method A)

11.1 Mean indirect tensile strength of dry specimens (ITSd)

11.1.1 Test results

Table 28: Test results - ordered by average value. Outliers are marked by red color. u_x - extended uncertainty of measurement.

ID	Test results [%]	u_x [%]
cd3235	677.0	80.0
49e1c8	1030.0	127.0
aa6fd2	1190.3	36.0
c9849a	1196.4	9.2
de68ea	1374.9	41.5
a7b1c1	1448.0	65.0
10cca9	1619.7	-
84a75d	1645.0	260.0

11.1.2 The Numerical Procedure for Determining Outliers

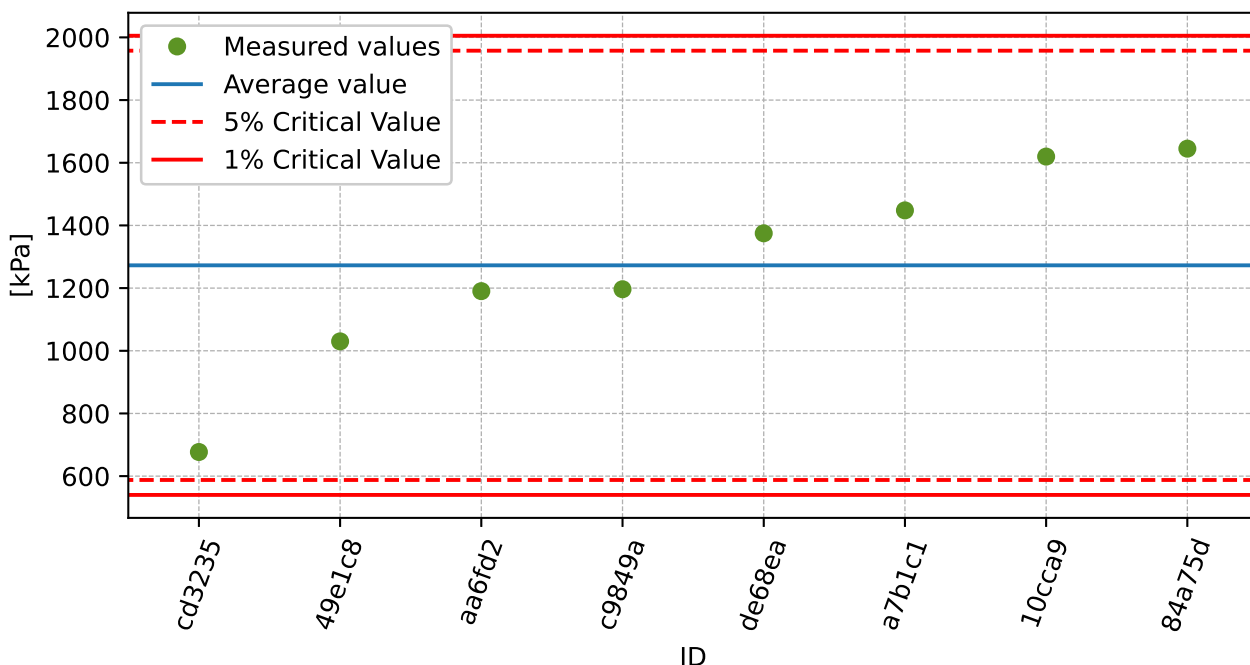


Figure 57: **Grubbs' test** - average values

11.1.3 Mandel’s Statistics

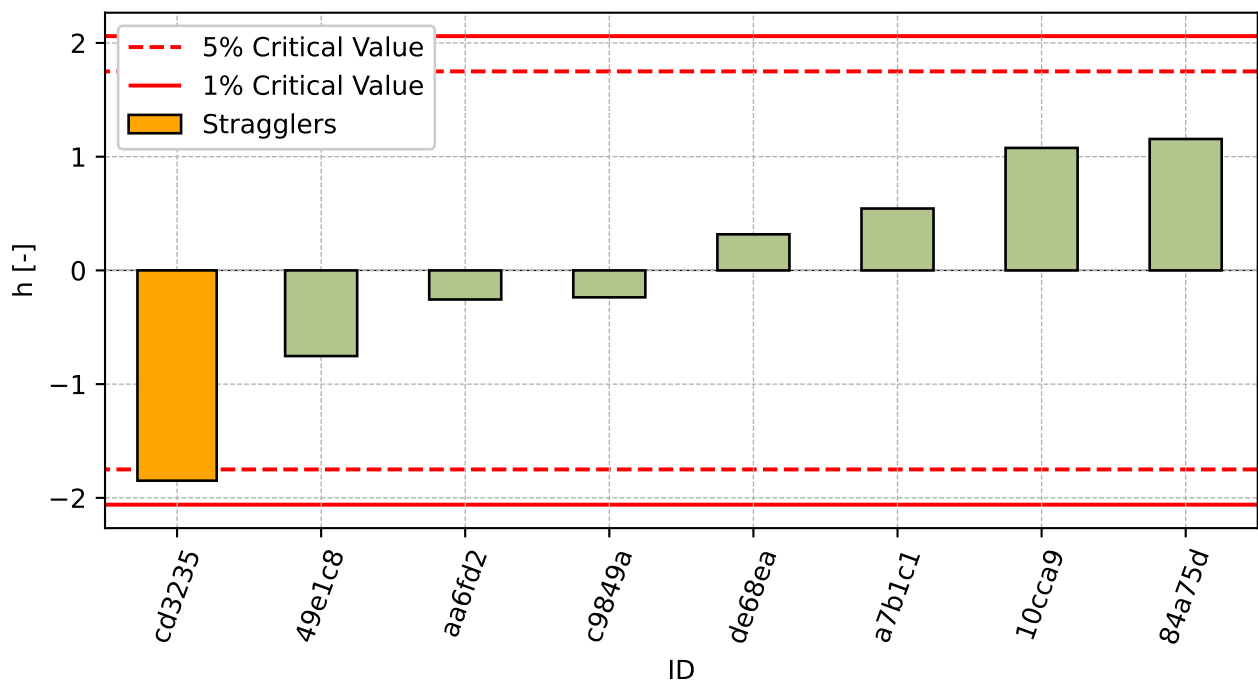


Figure 58: Interlaboratory Consistency Statistic

11.1.4 Descriptive statistics

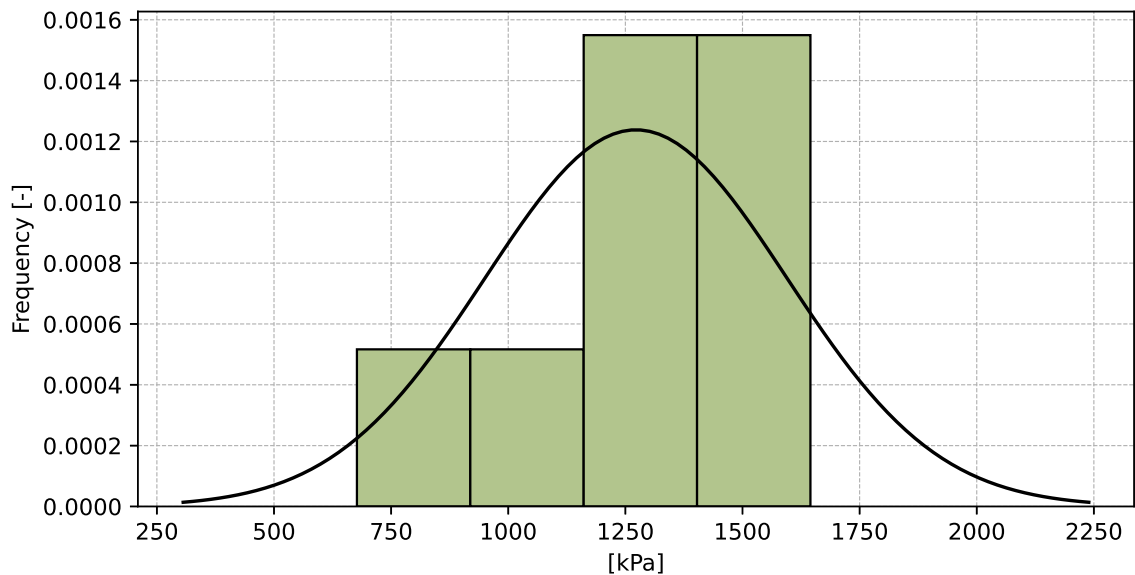


Figure 59: Histogram of all test results

Table 29: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	1272.7
Sample standard deviation – s	322.17
Assigned value – x^*	1294.2
Robust standard deviation – s^*	296.61
Measurement uncertainty of assigned value – u_x	131.08
p -value of normality test	0.634 [-]

11.1.5 Evaluation of Performance Statistics

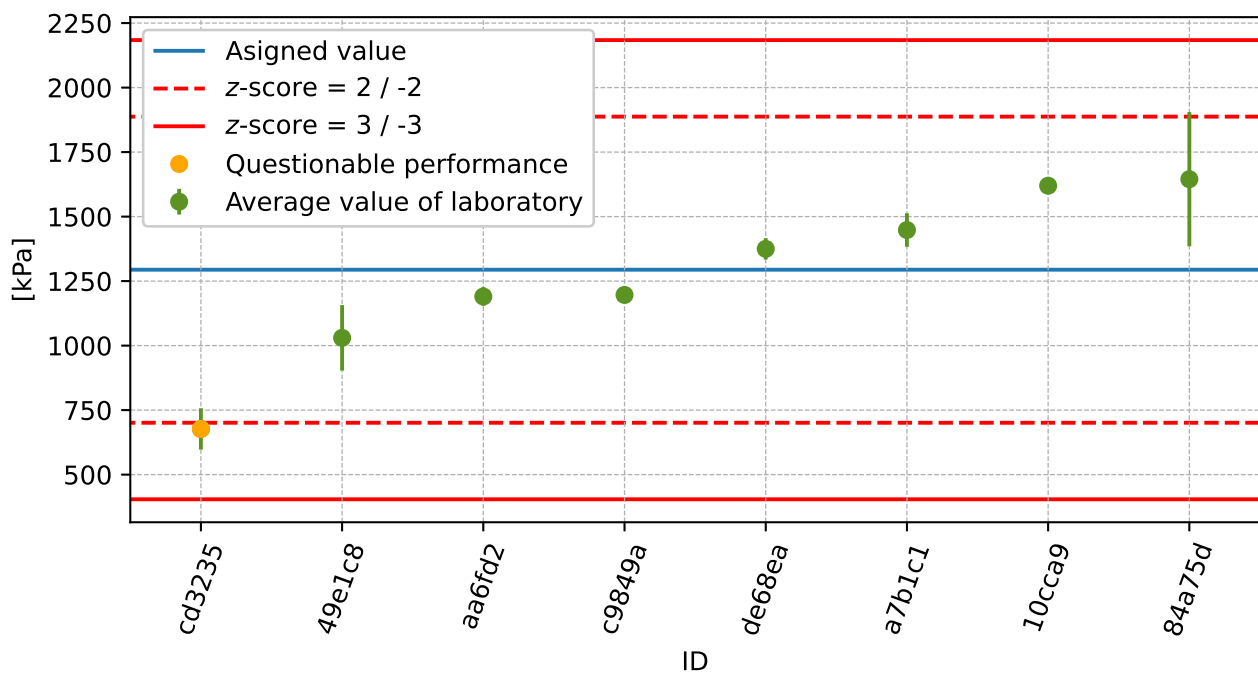


Figure 60: Average values and extended uncertainties of measurement

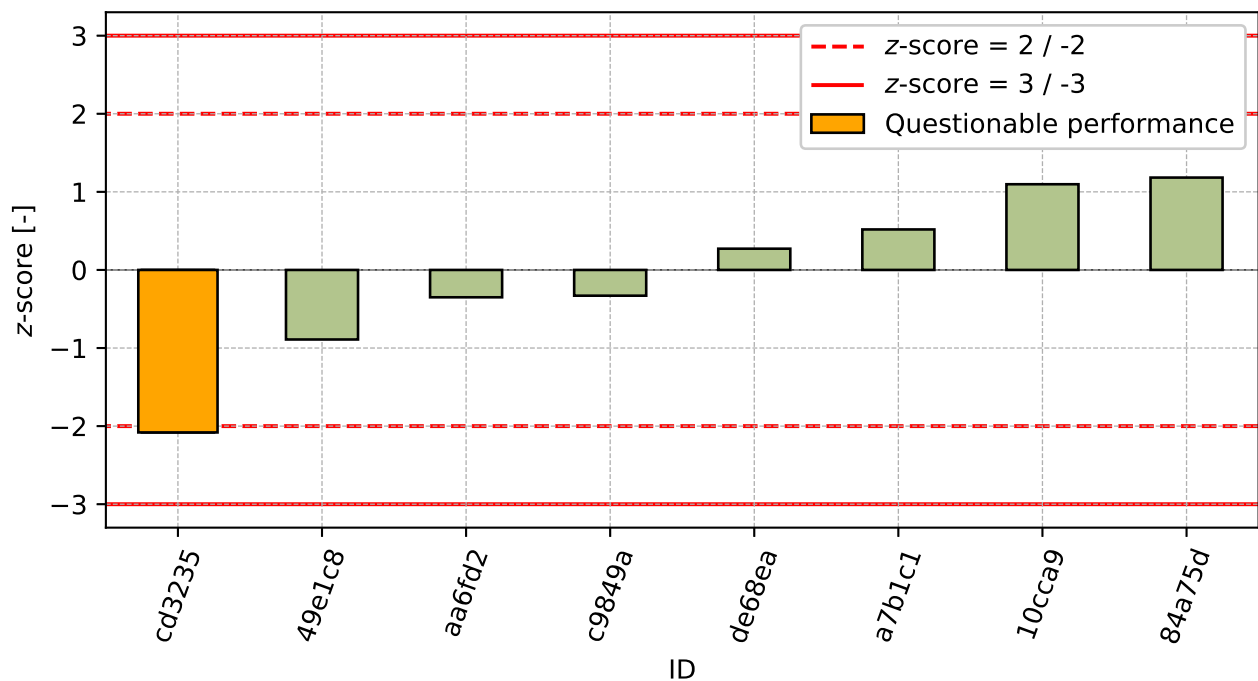


Figure 61: z-score

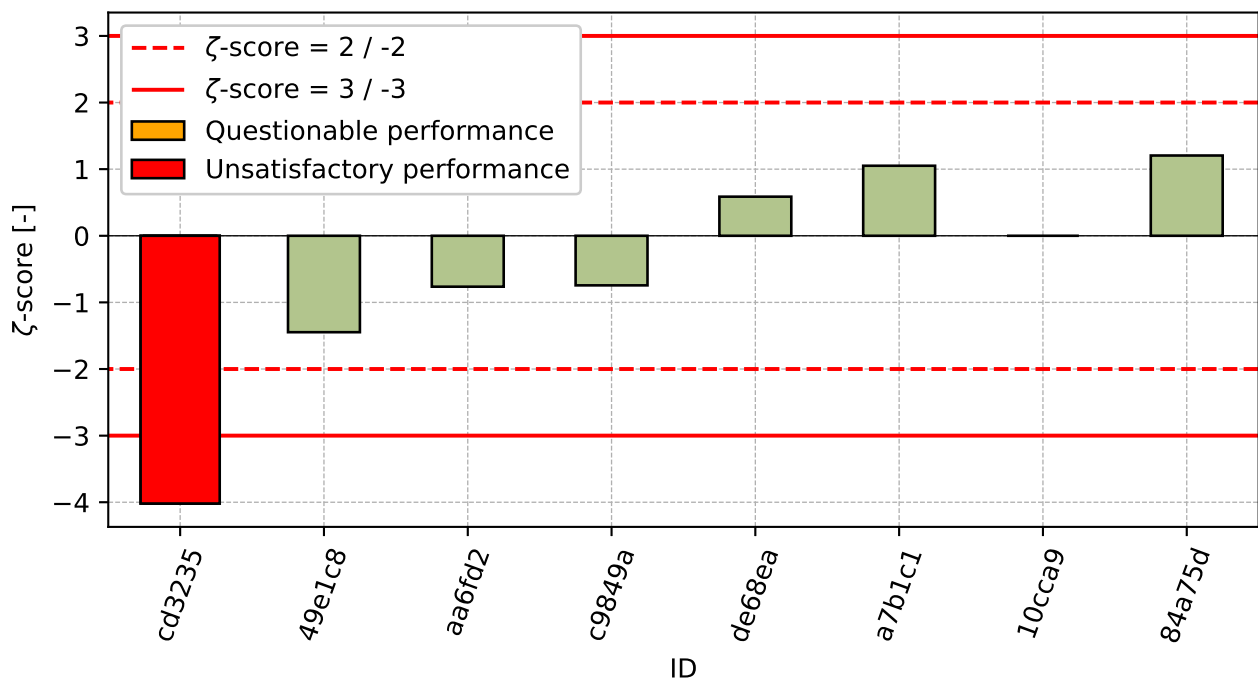


Figure 62: zeta-score

Table 30: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
cd3235	-2.08	-4.02
49e1c8	-0.89	-1.45
aa6fd2	-0.35	-0.76
c9849a	-0.33	-0.74
de68ea	0.27	0.59
a7b1c1	0.52	1.05
10cca9	1.10	-
84a75d	1.18	1.20

11.2 Mean indirect tensile strength of wet specimens (ITS_w)

11.2.1 Test results

Table 31: Test results - ordered by average value. Outliers are marked by red color. u_x - extended uncertainty of measurement.

ID	Test results [kPa]	u_x [kPa]
cd3235	633.0	80.0
49e1c8	922.0	105.0
c9849a	963.8	7.8
aa6fd2	1034.9	31.0
10cca9	1318.8	-
a7b1c1	1351.0	65.0
84a75d	1419.0	360.0
de68ea	1534.7	41.5

11.2.2 The Numerical Procedure for Determining Outliers

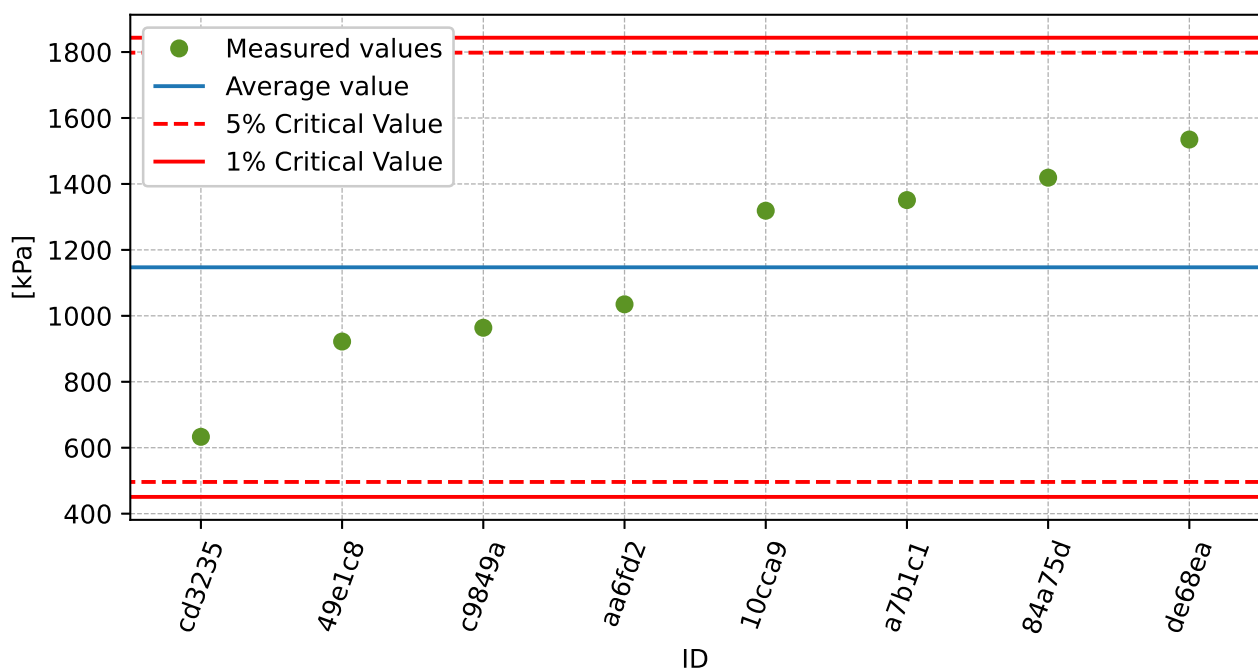


Figure 63: **Grubbs' test** - average values

11.2.3 Mandel’s Statistics

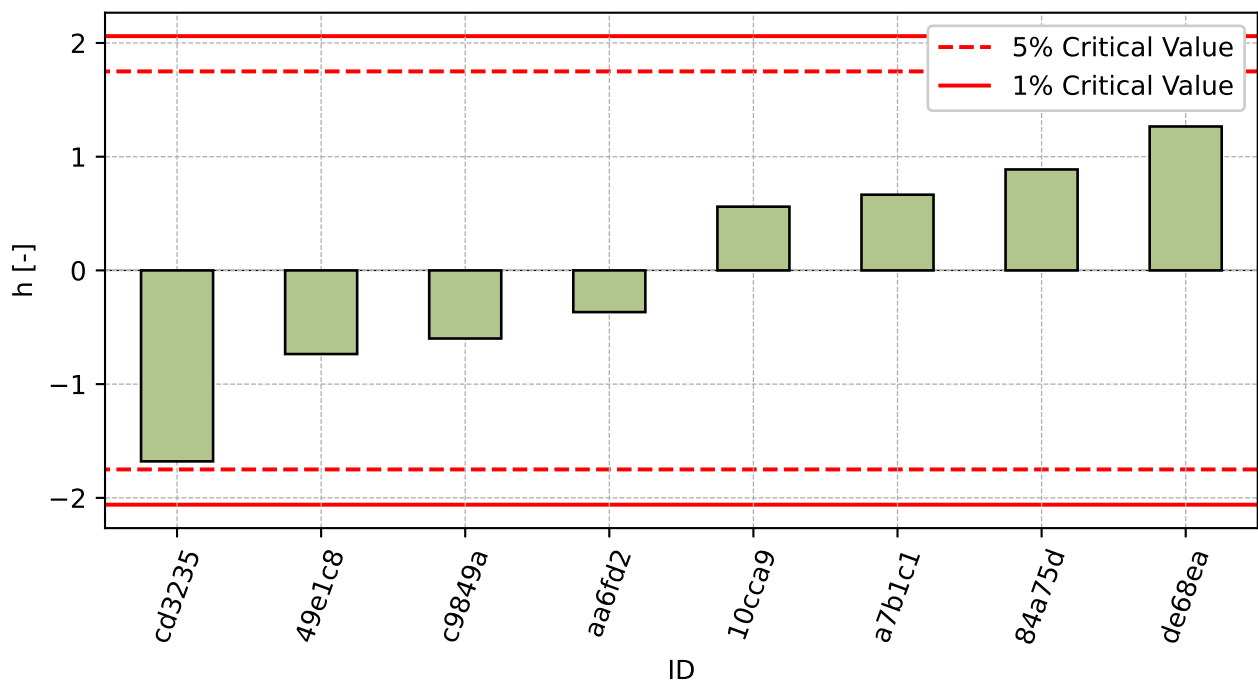


Figure 64: Interlaboratory Consistency Statistic

11.2.4 Descriptive statistics

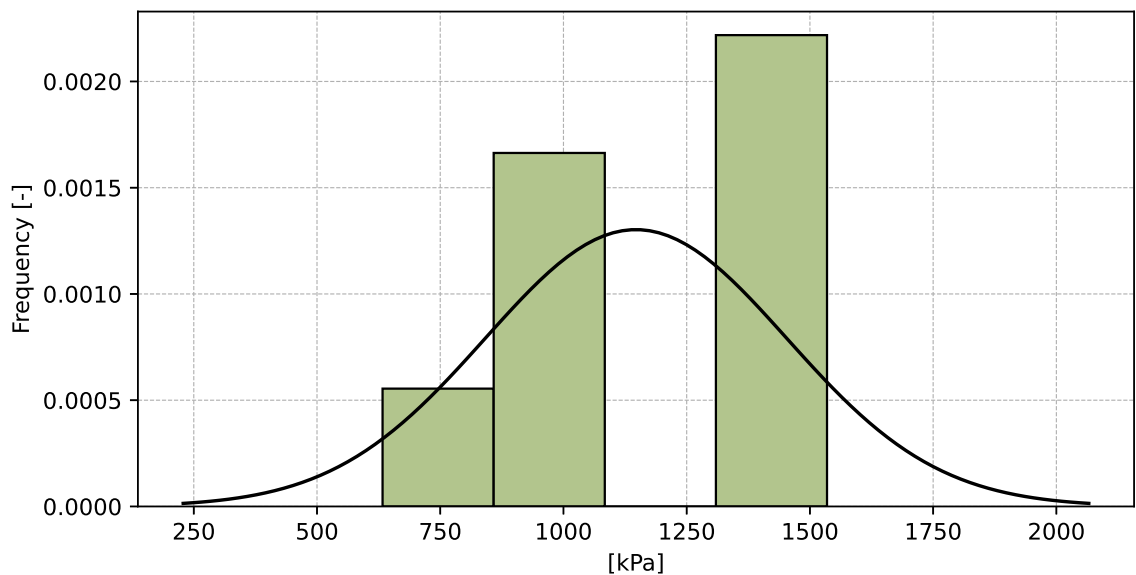


Figure 65: Histogram of all test results

Table 32: Descriptive statistics

Characteristics	[kPa]
Average value – $\bar{x}$	1147.1
Sample standard deviation – s	306.21
Assigned value – x^*	1153.8
Robust standard deviation – s^*	311.56
Measurement uncertainty of assigned value – u_x	137.69
p -value of normality test	0.638 [-]

11.2.5 Evaluation of Performance Statistics

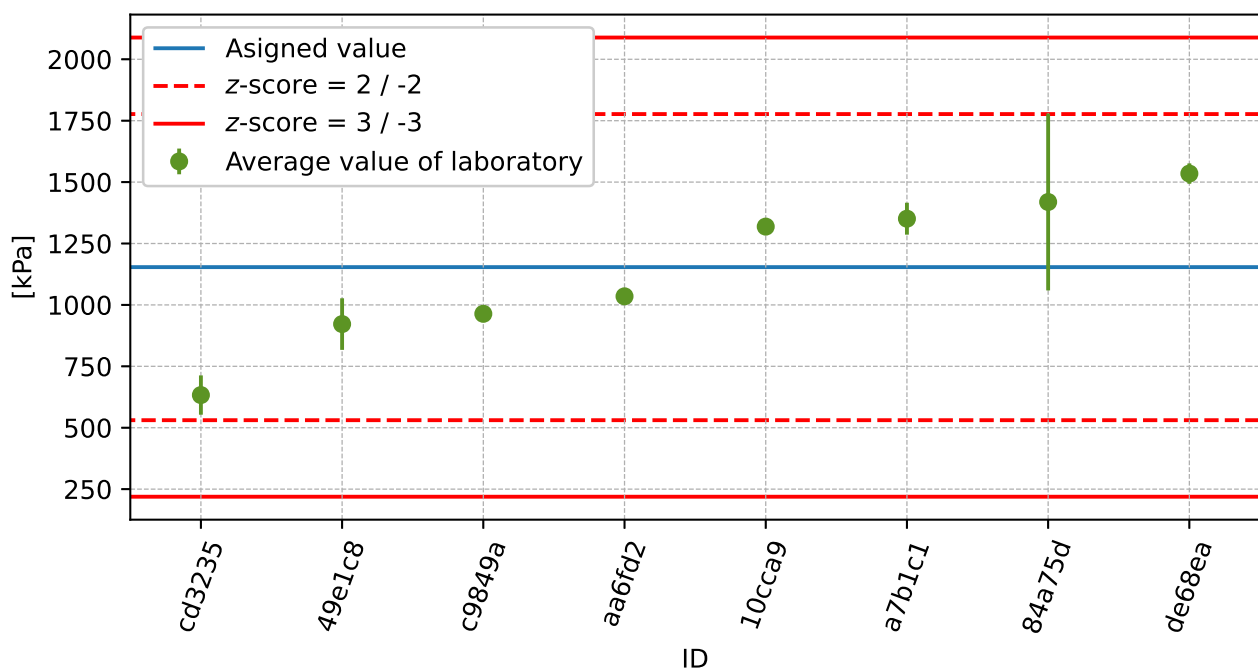


Figure 66: Average values and extended uncertainties of measurement

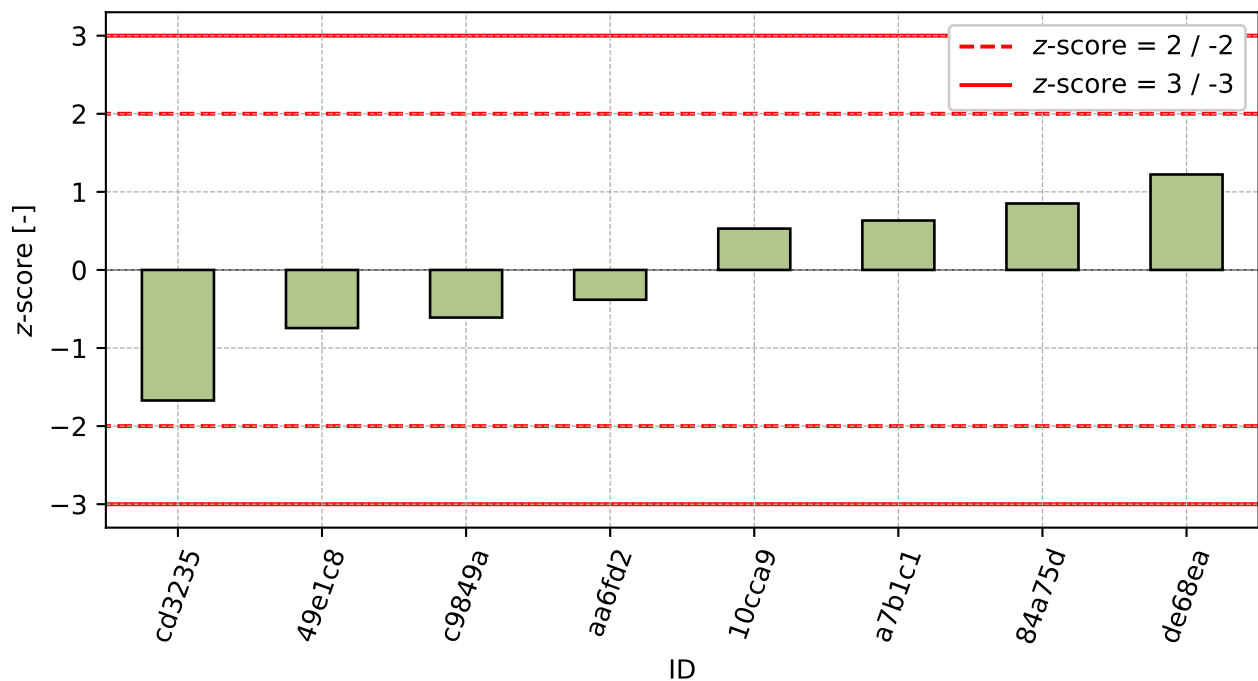


Figure 67: z-score

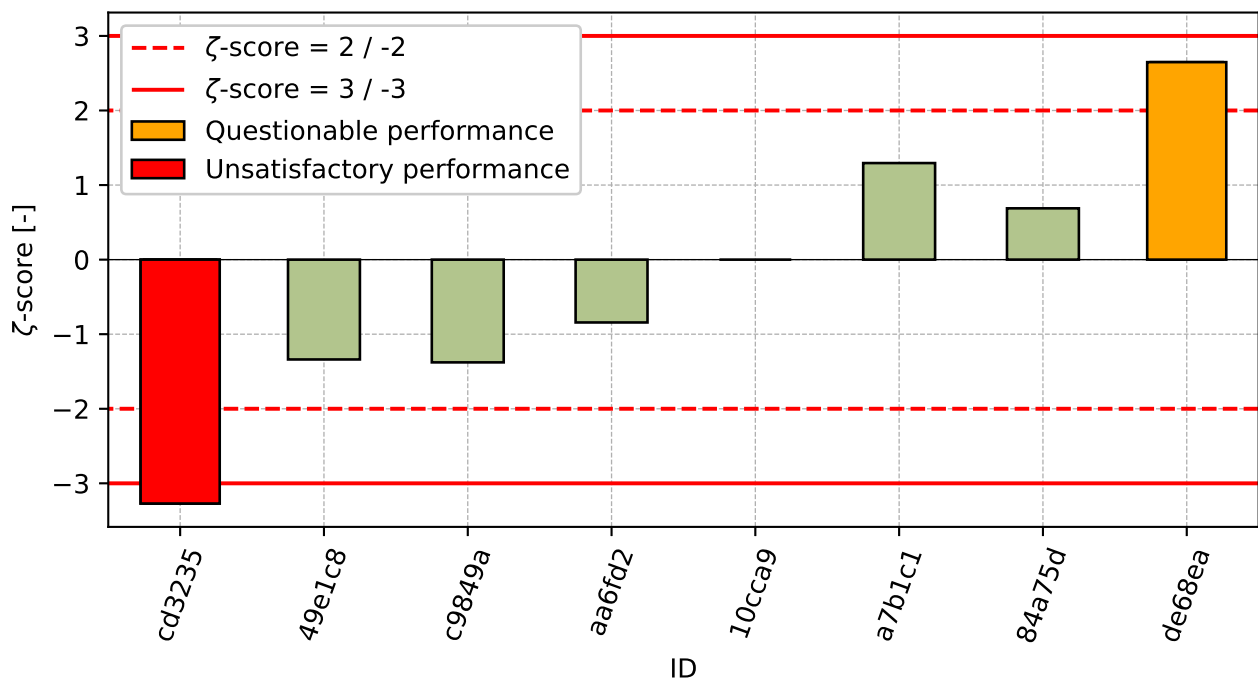


Figure 68: ζ-score

Table 33: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
cd3235	-1.67	-3.27
49e1c8	-0.74	-1.34
c9849a	-0.61	-1.38
aa6fd2	-0.38	-0.84
10cca9	0.53	-
a7b1c1	0.63	1.29
84a75d	0.85	0.69
de68ea	1.22	2.65

11.3 ITSR

11.3.1 Test results

Table 34: Test results - ordered by average value. Outliers are marked by red color. u_X - extended uncertainty of measurement.

ID	Test results [%]	u_X [%]
c9849a	80.6	1.5
10cca9	81.0	-
84a75d	86.0	6.8
aa6fd2	86.9	3.0
49e1c8	90.0	108.0
a7b1c1	93.3	4.5
cd3235	93.5	-
de68ea	111.6	34.3

11.3.2 The Numerical Procedure for Determining Outliers

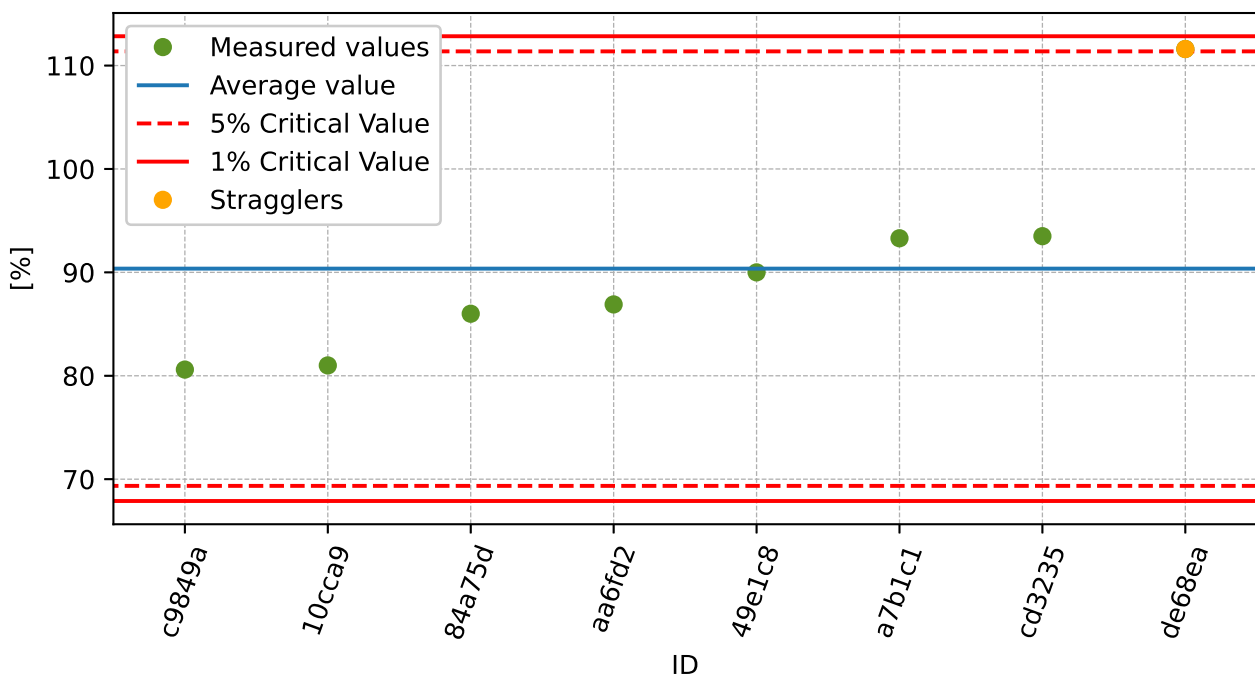


Figure 69: **Grubbs' test** - average values

11.3.3 Mandel’s Statistics

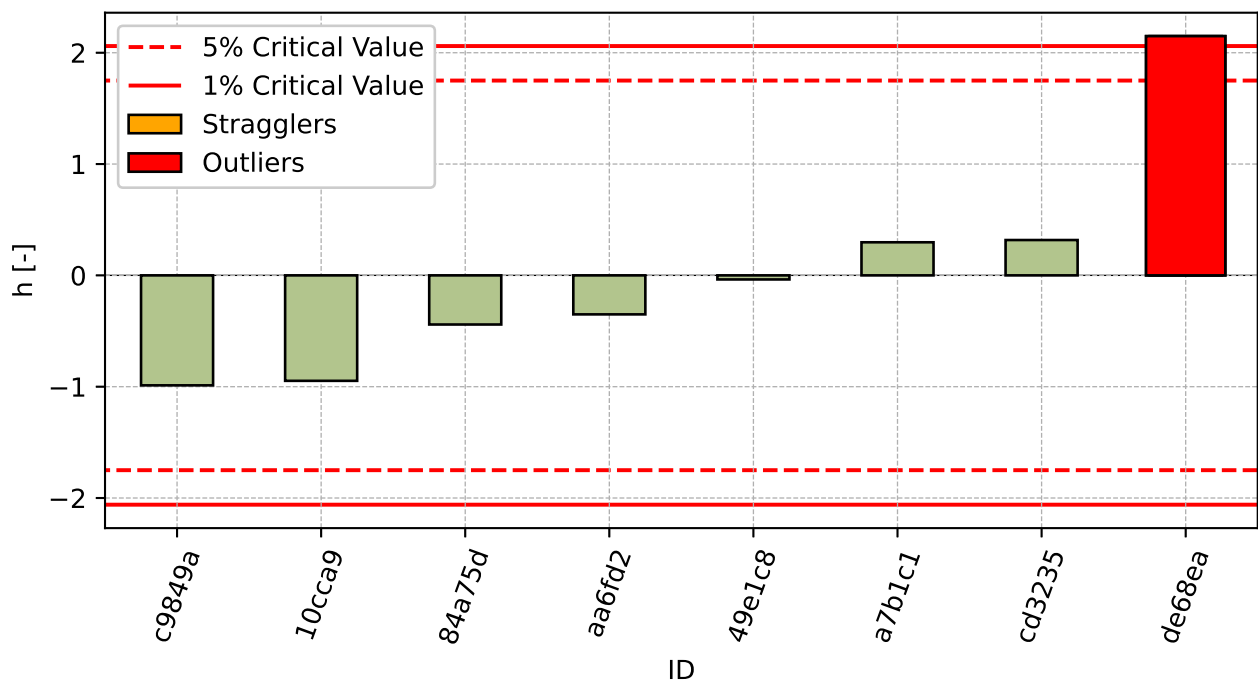


Figure 70: Interlaboratory Consistency Statistic

11.3.4 Descriptive statistics

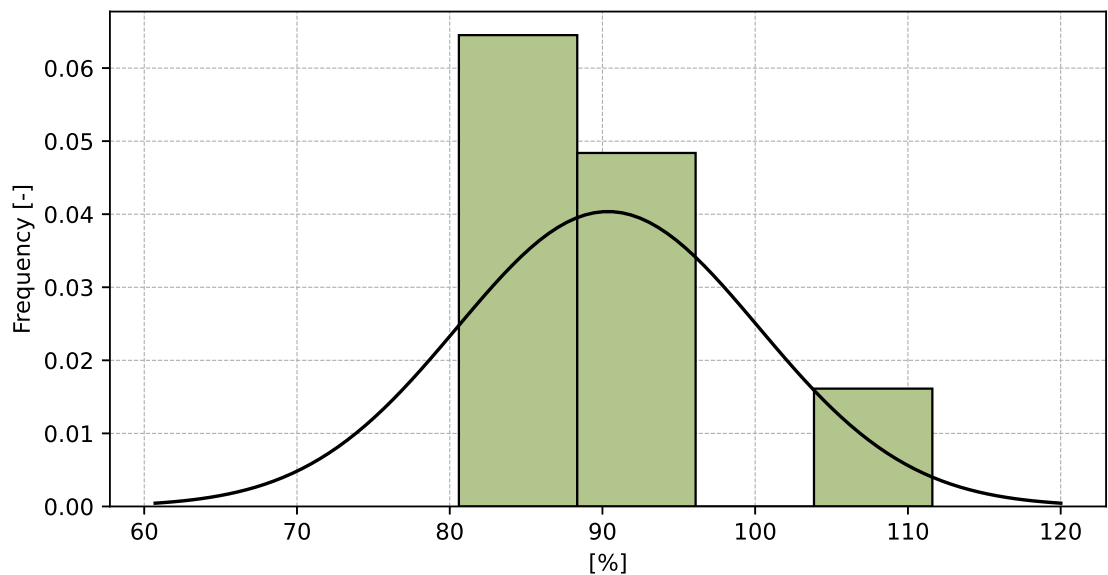


Figure 71: Histogram of all test results

Table 35: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	90.4
Sample standard deviation – s	9.88
Assigned value – x^*	90.4
Robust standard deviation – s^*	10.68
Measurement uncertainty of assigned value – u_x	4.63
p -value of normality test	0.105 [-]

11.3.5 Evaluation of Performance Statistics

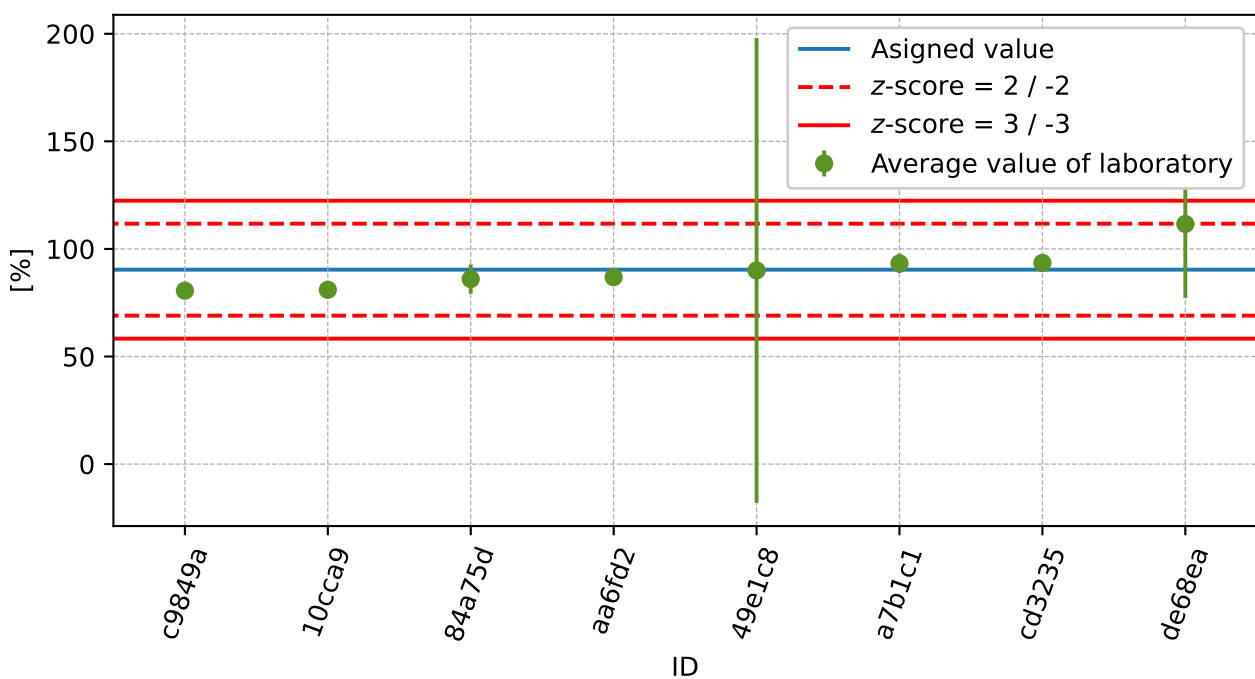


Figure 72: Average values and extended uncertainties of measurement

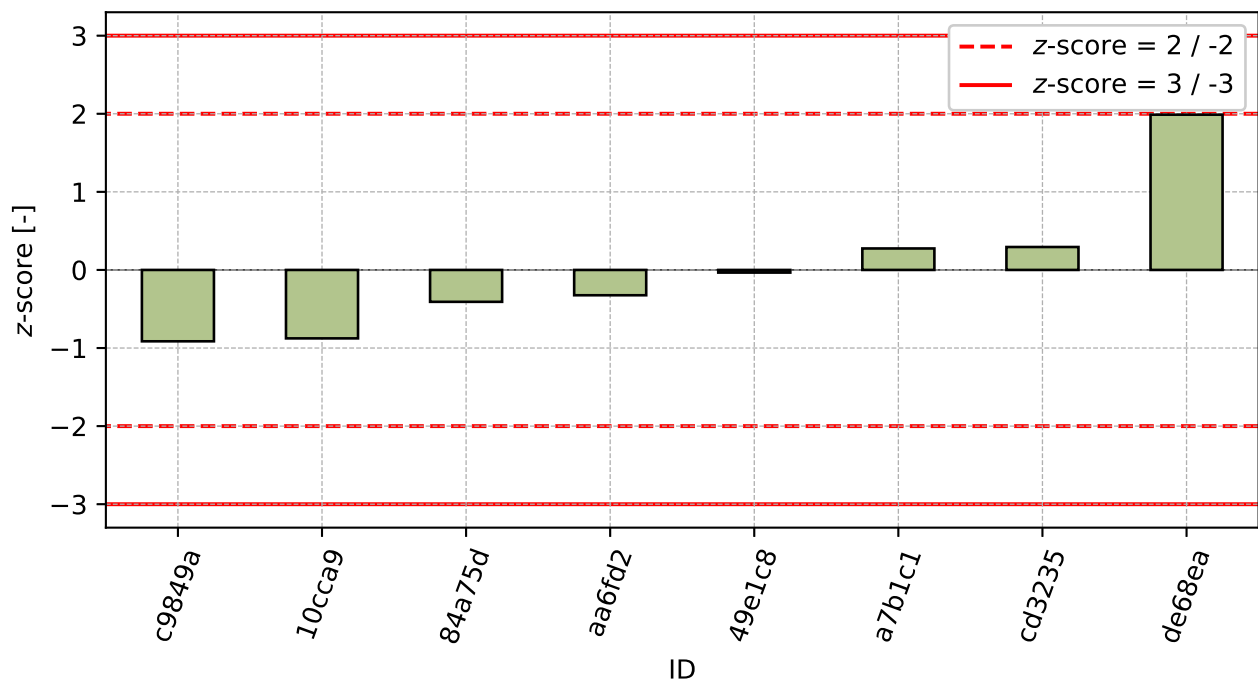


Figure 73: z-score

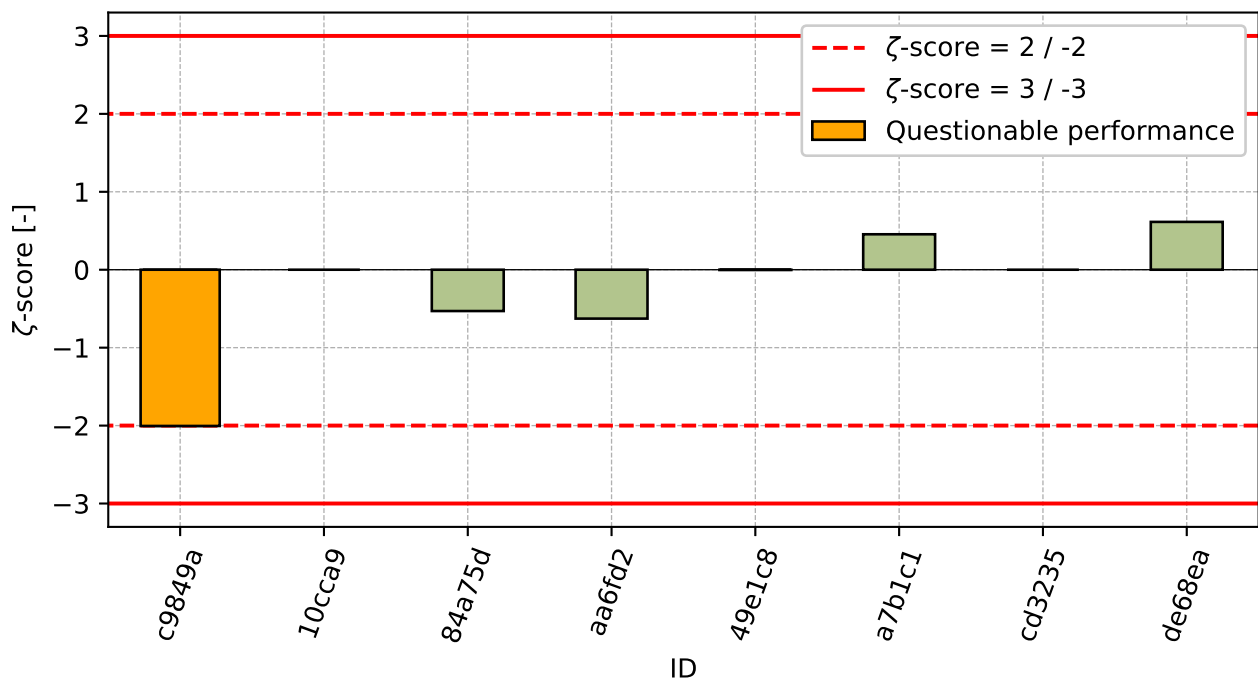


Figure 74: ζ-score

Table 36: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
c9849a	-0.91	-2.00
10cca9	-0.88	-
84a75d	-0.41	-0.53
aa6fd2	-0.32	-0.63
49e1c8	-0.03	-0.00
a7b1c1	0.27	0.45
cd3235	0.29	-
de68ea	1.99	0.61

12 Appendix – EN 12697-18 Determination of binder drainage – Beaker method

12.1 Test results

Table 37: 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 [%]
671d46	0.0	0.0	0.0	0.0	0.0	0.0
3c68f6	0.01	0.03	0.01	0.02	0.014	70.71
aa6fd2	0.06	0.02	0.01	0.04	0.028	70.71
49e1c8	0.05	0.04	0.01	0.04	0.007	15.71
10cca9	0.04	0.06	-	0.05	0.014	28.28
de68ea	0.06	0.04	0.02	0.05	0.014	28.28
d91cf1	0.1	0.03	-	0.07	0.049	76.15
b0b09d	0.1	0.1	0.1	0.1	0.0	0.0
a7b1c1	0.1	0.1	0.1	0.1	0.0	0.0

12.2 The Numerical Procedure for Determining Outliers

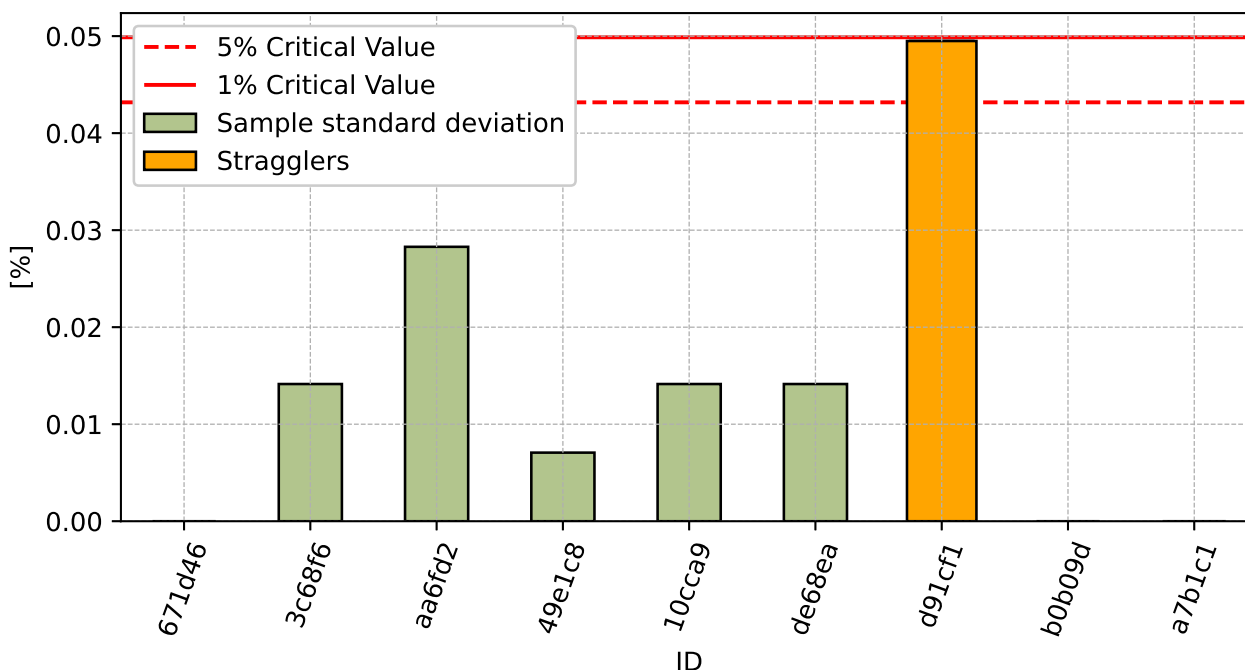
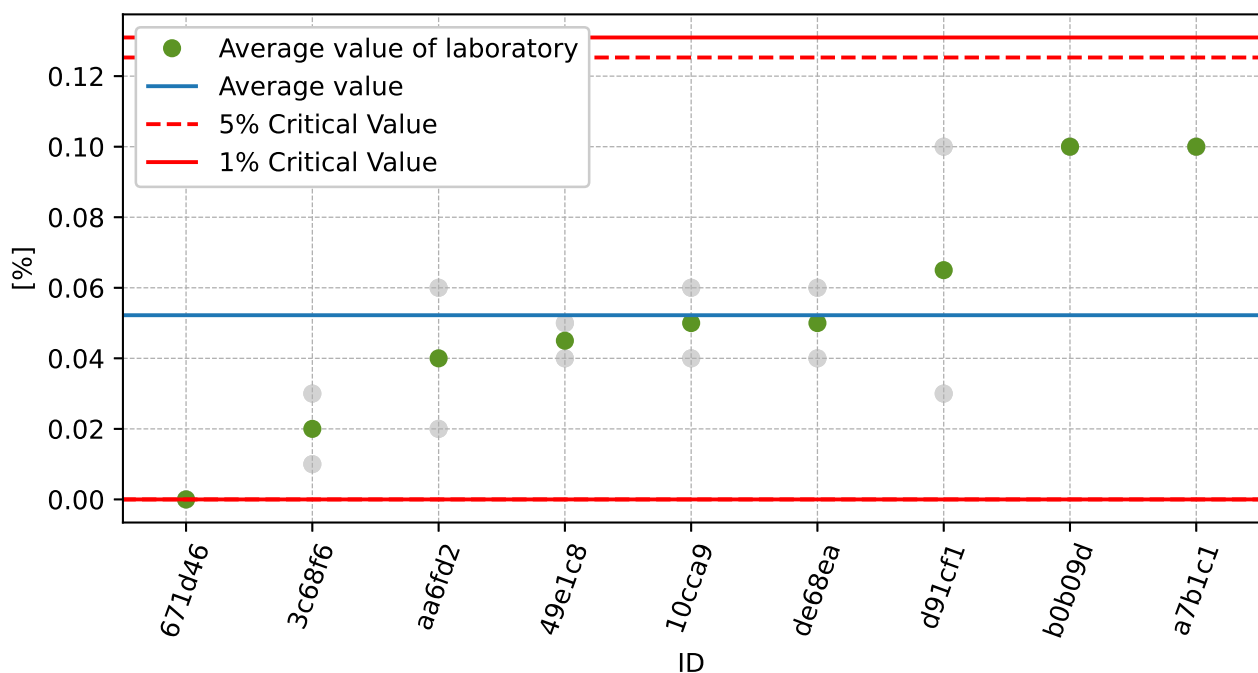


Figure 75: **Cochran's test** - sample standard deviations

Figure 76: **Grubbs' test** - average values

12.3 Mandel's Statistics

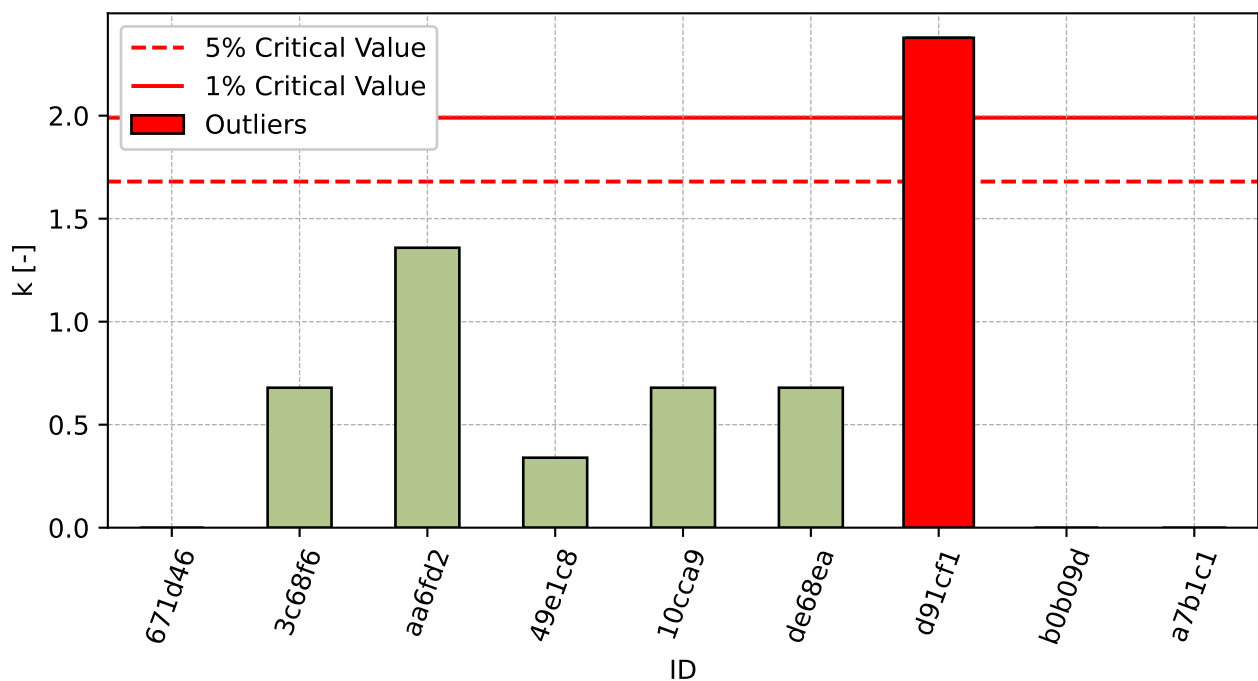


Figure 77: Intralaboratory Consistency Statistic

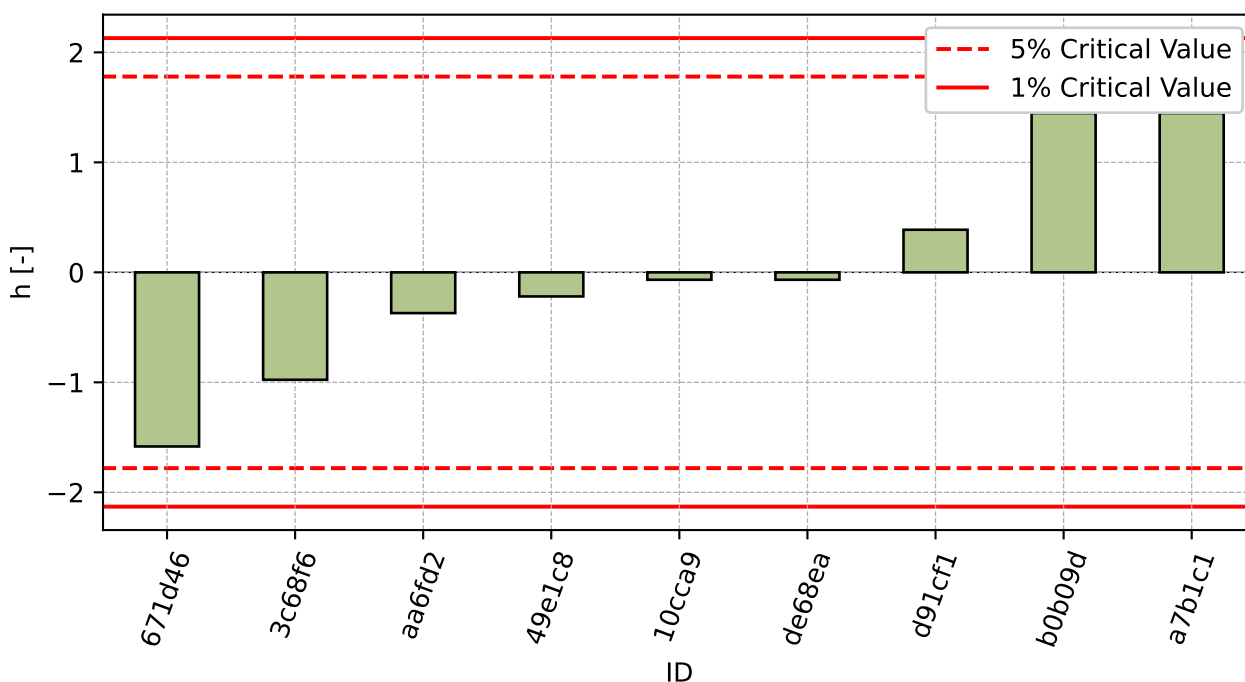


Figure 78: Interlaboratory Consistency Statistic

12.4 Descriptive statistics

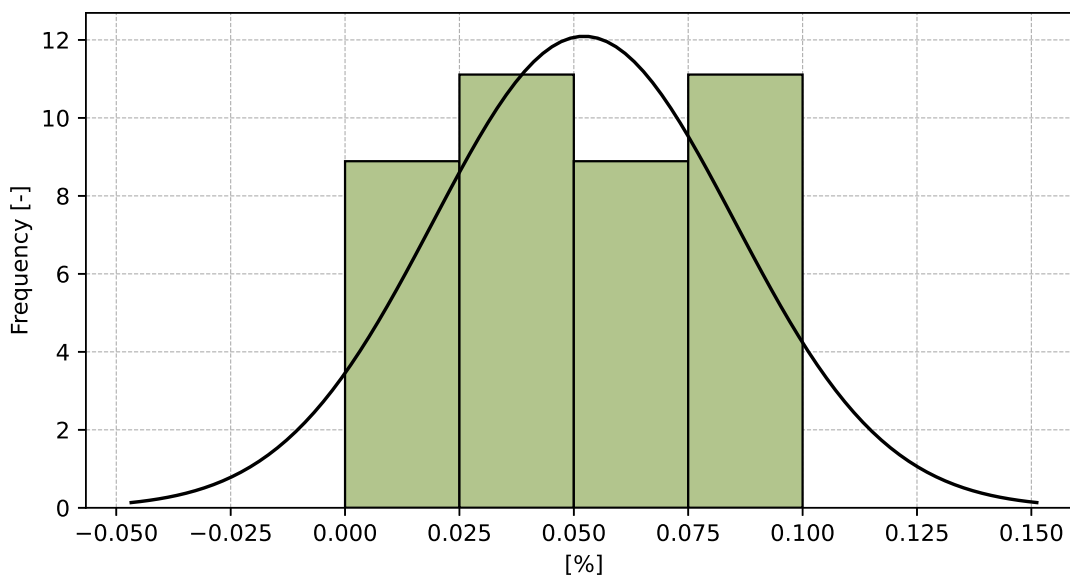


Figure 79: Histogram of all test results

Table 38: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	0.05
Sample standard deviation – s	0.033
Assigned value – x^*	0.05
Robust standard deviation – s^*	0.029
Measurement uncertainty of assigned value – u_X	0.012
p -value of normality test	0.047 [-]
Interlaboratory standard deviation – s_L	0.03
Repeatability standard deviation – s_r	0.021
Reproducibility standard deviation – s_R	0.036
Repeatability – r	0.06
Reproducibility – R	0.1

12.5 Evaluation of Performance Statistics

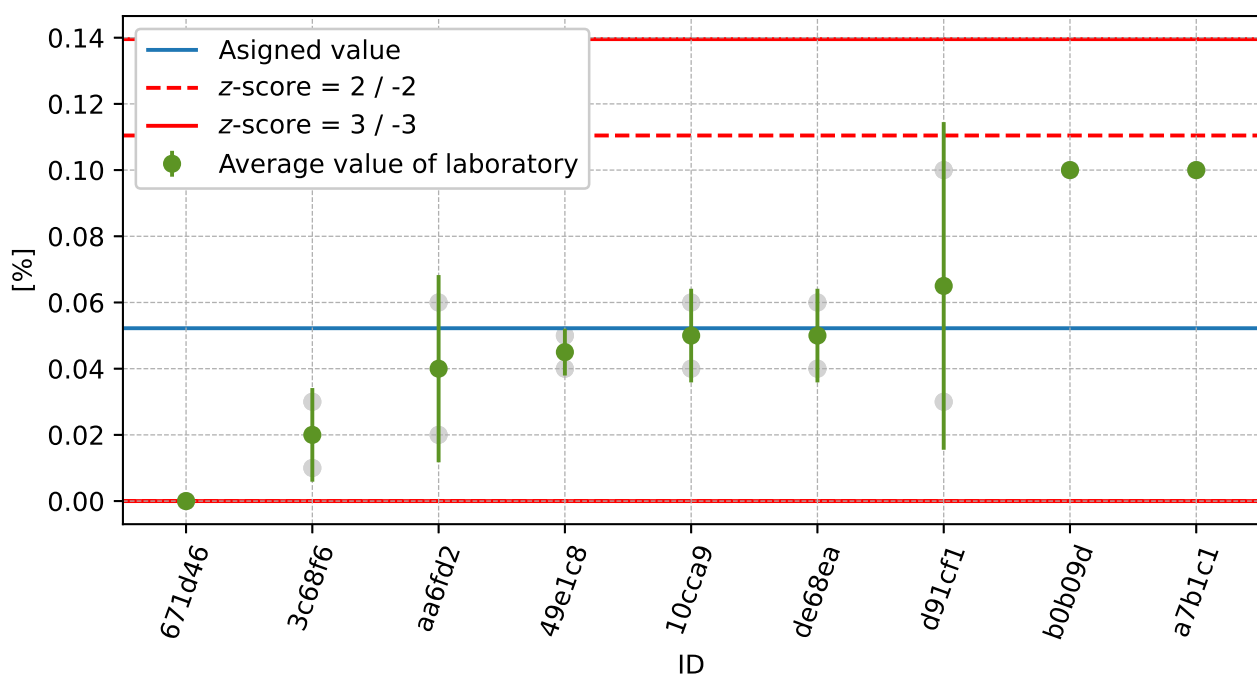


Figure 80: Average values and sample standard deviations

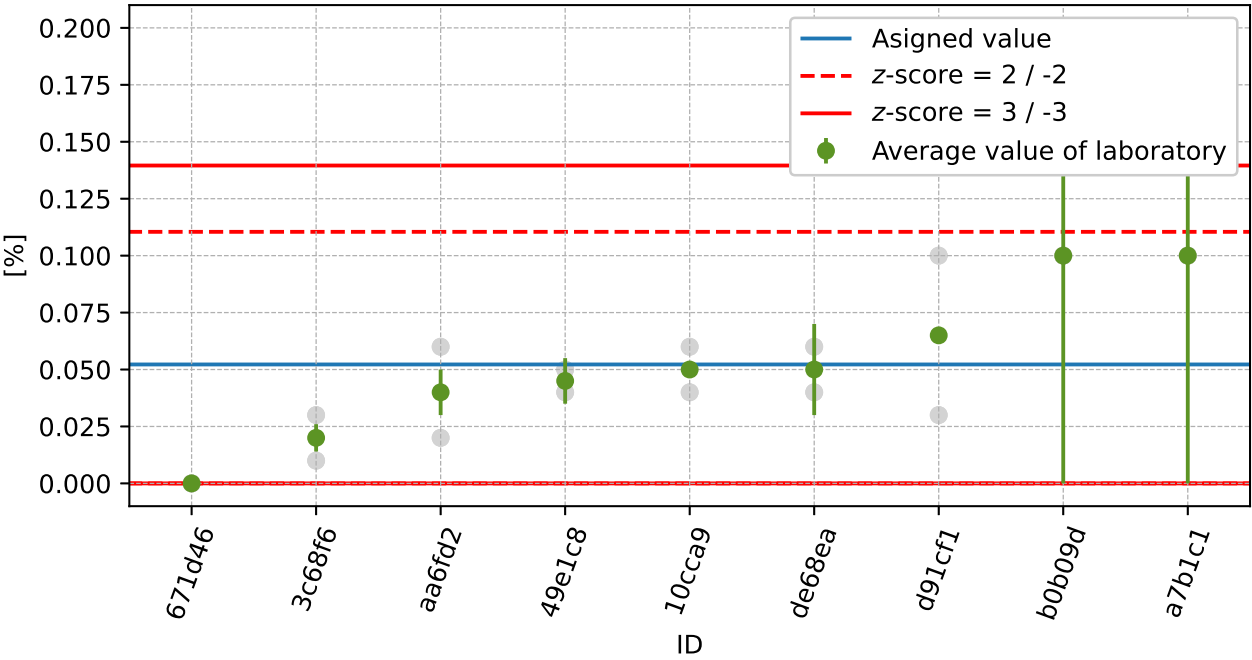


Figure 81: Average values and extended uncertainties of measurement

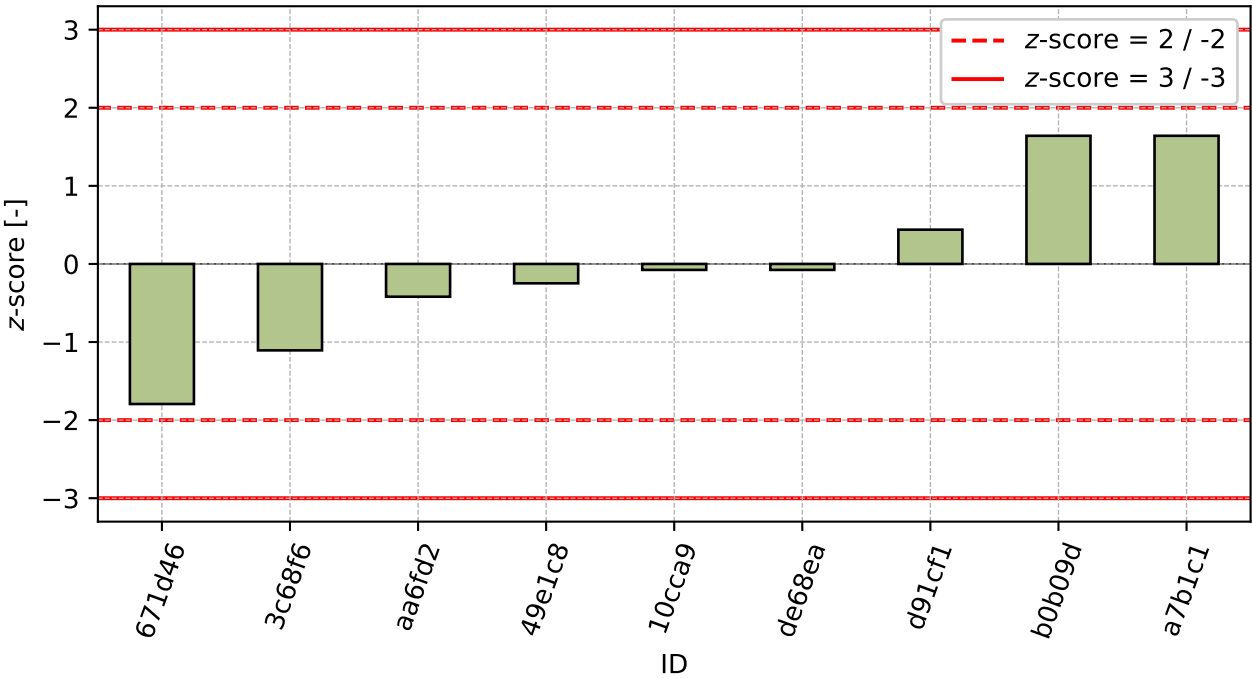
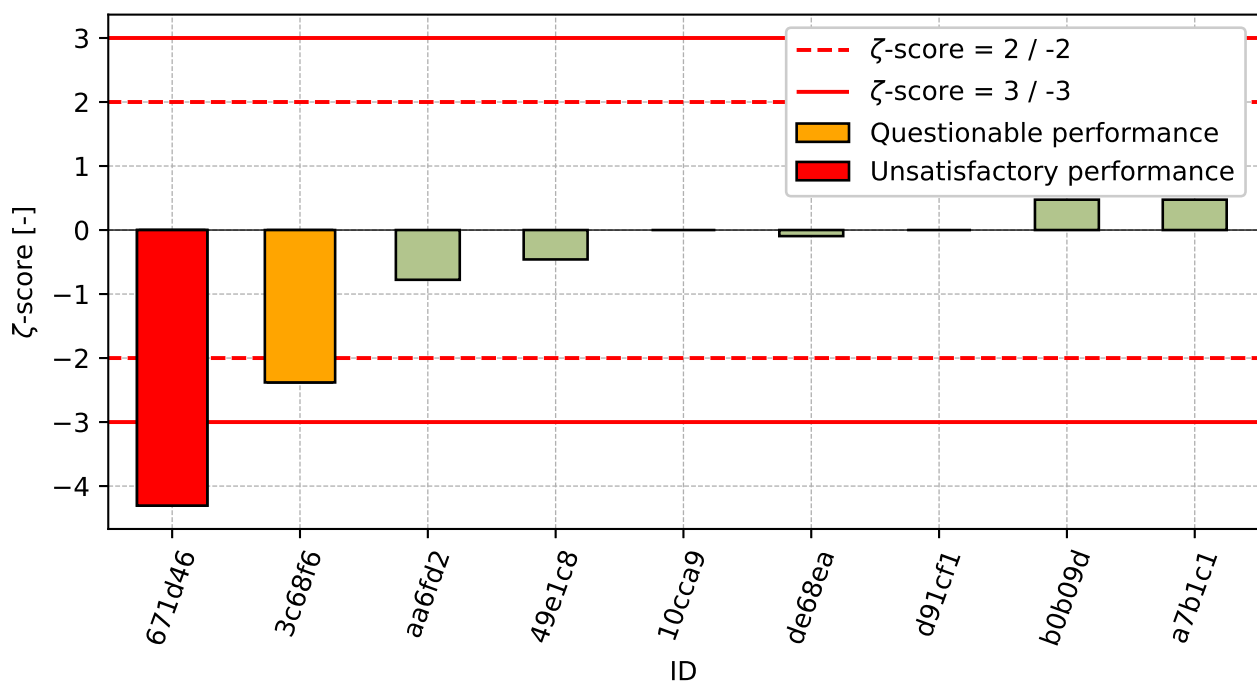


Figure 82: z-score

Figure 83: ζ -scoreTable 39: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
671d46	-1.79	-4.30
3c68f6	-1.11	-2.38
aa6fd2	-0.42	-0.78
49e1c8	-0.25	-0.46
10cca9	-0.08	-
de68ea	-0.08	-0.10
d91cf1	0.44	-
b0b09d	1.64	0.47
a7b1c1	1.64	0.47

13 Appendix – EN 12697-20 Penetration by pin after 60 min

13.1 Test results

Table 40: 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 [mm]		u_X [mm]	$\bar{x}$ [mm]	s_0 [mm]	V_X [%]
84a75d	0.5	0.6	0.7	0.6	0.04	7.71
b0b09d	0.5	0.6	0.2	0.6	0.07	12.86
40f911	0.6	0.7	0.1	0.6	0.07	10.88
64ea0e	0.7	0.8	0.1	0.8	0.07	9.43
5097f9	0.8	0.8	-	0.8	0.0	0.0
ed6d00	1.0	1.0	-	1.0	0.03	2.77

13.2 The Numerical Procedure for Determining Outliers

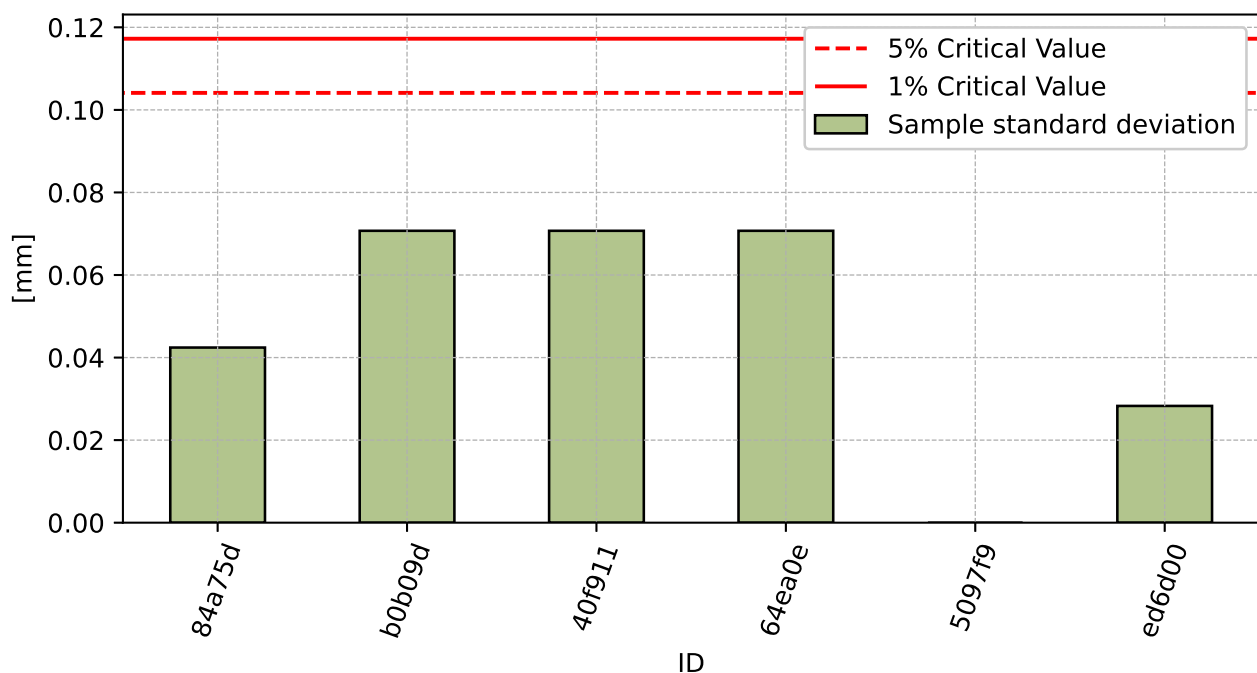


Figure 84: Cochran's test - sample standard deviations

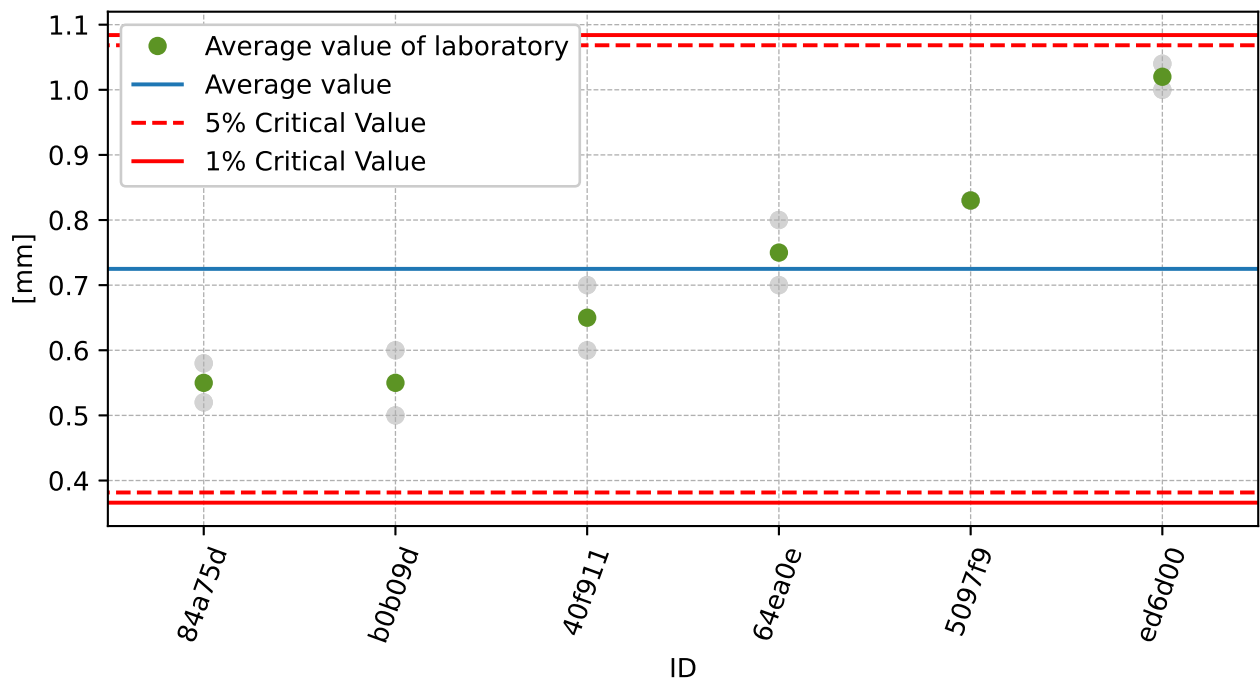


Figure 85: **Grubbs' test** - average values

13.3 Mandel's Statistics

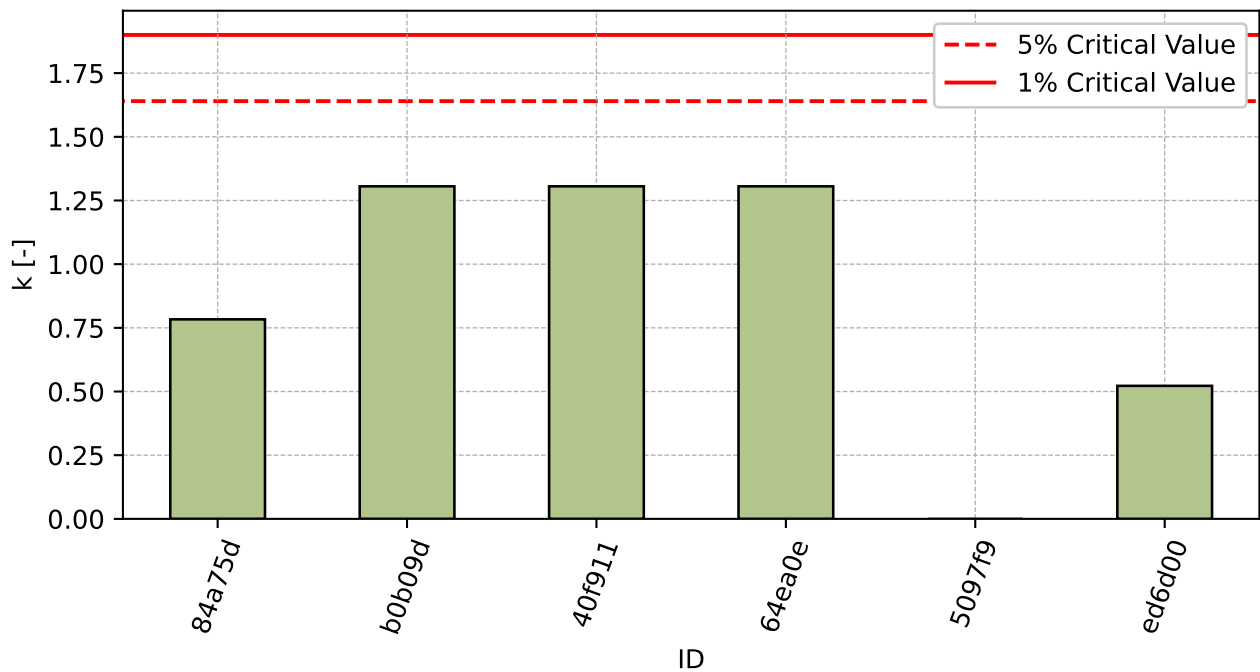


Figure 86: Intralaboratory Consistency Statistic

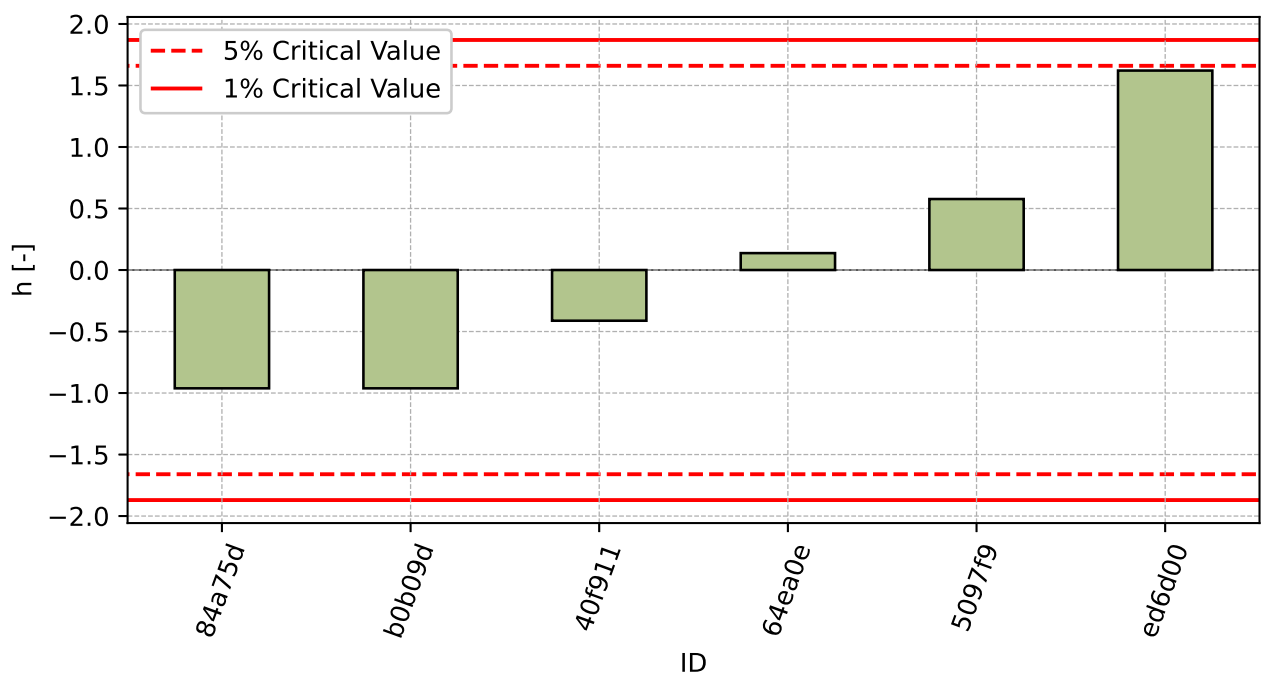


Figure 87: Interlaboratory Consistency Statistic

13.4 Descriptive statistics

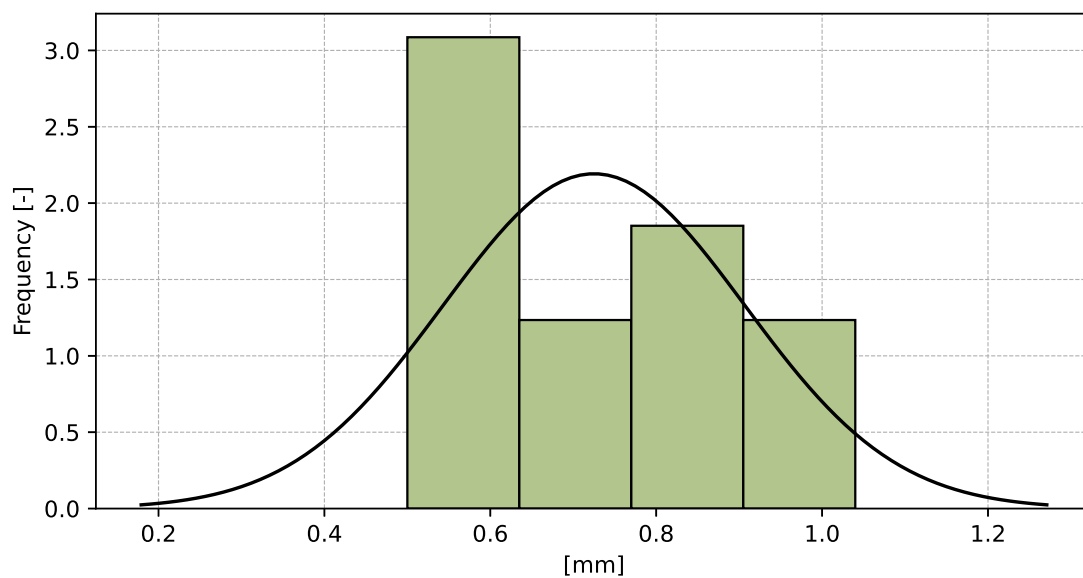


Figure 88: Histogram of all test results

Table 41: Descriptive statistics

Characteristics	[mm]
Average value – $\bar{x}$	0.72
Sample standard deviation – s	0.182
Assigned value – x^*	0.72
Robust standard deviation – s^*	0.188
Measurement uncertainty of assigned value – u_X	0.096
p -value of normality test	0.361 [-]
Interlaboratory standard deviation – s_L	0.178
Repeatability standard deviation – s_r	0.054
Reproducibility standard deviation – s_R	0.186
Repeatability – r	0.15
Reproducibility – R	0.52

13.5 Evaluation of Performance Statistics

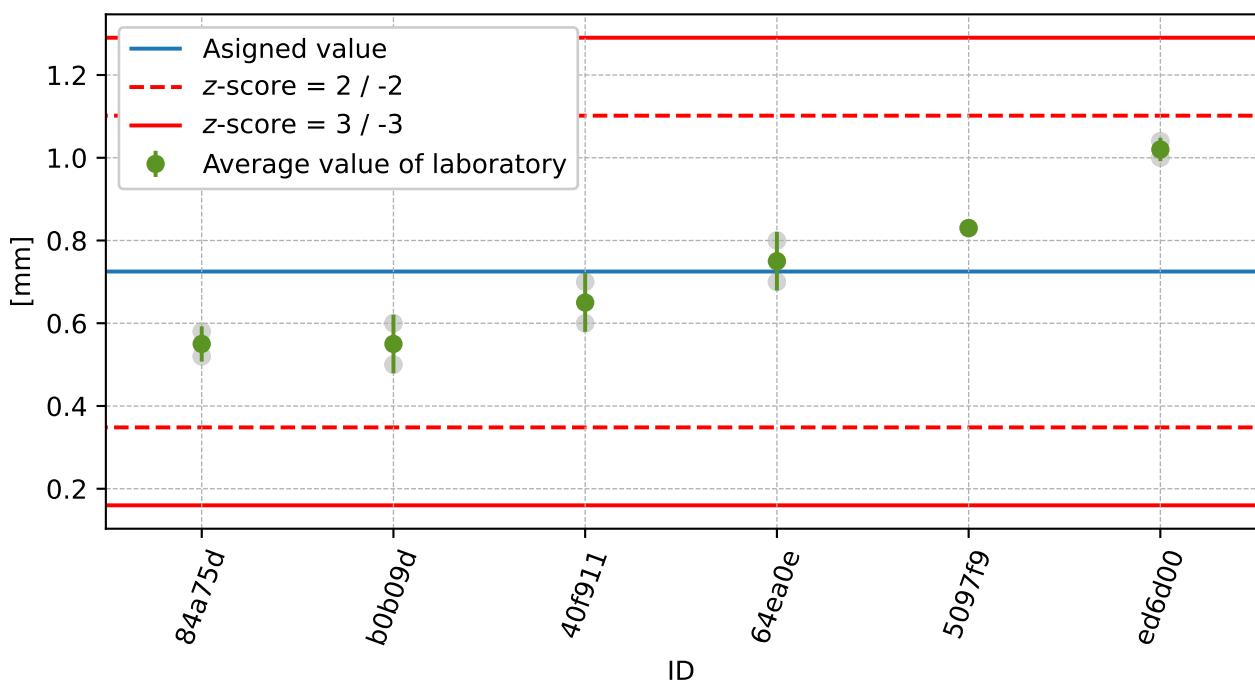


Figure 89: Average values and sample standard deviations

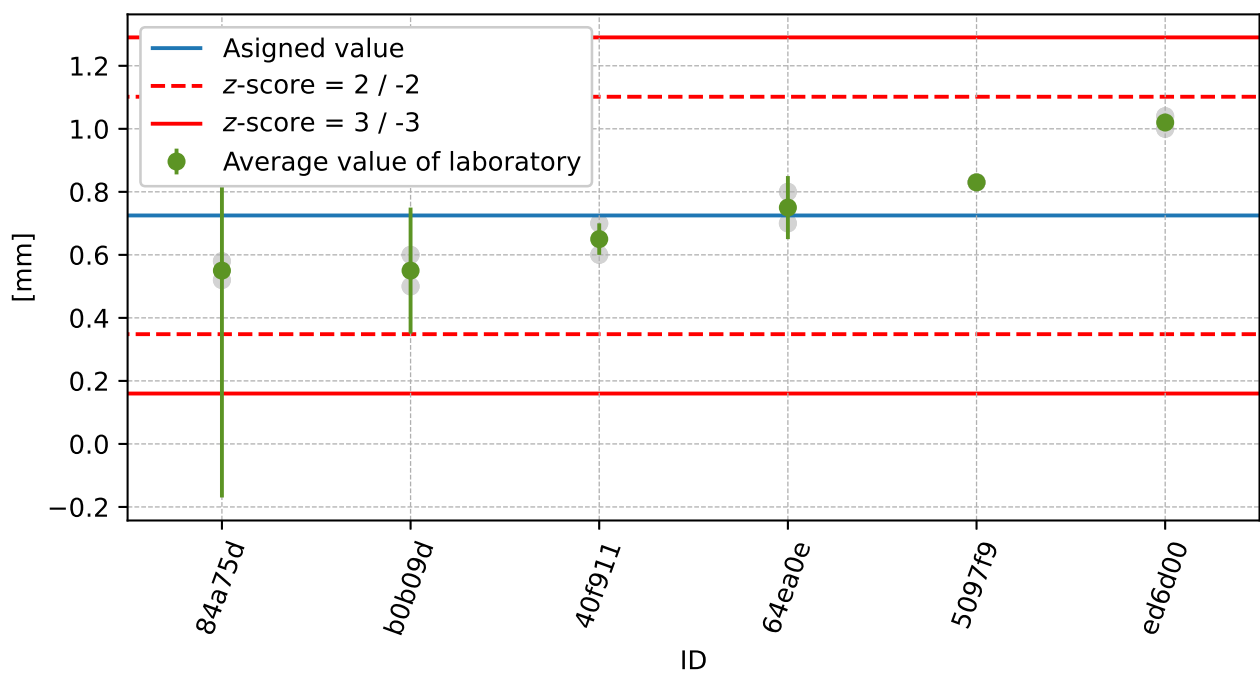


Figure 90: Average values and extended uncertainties of measurement

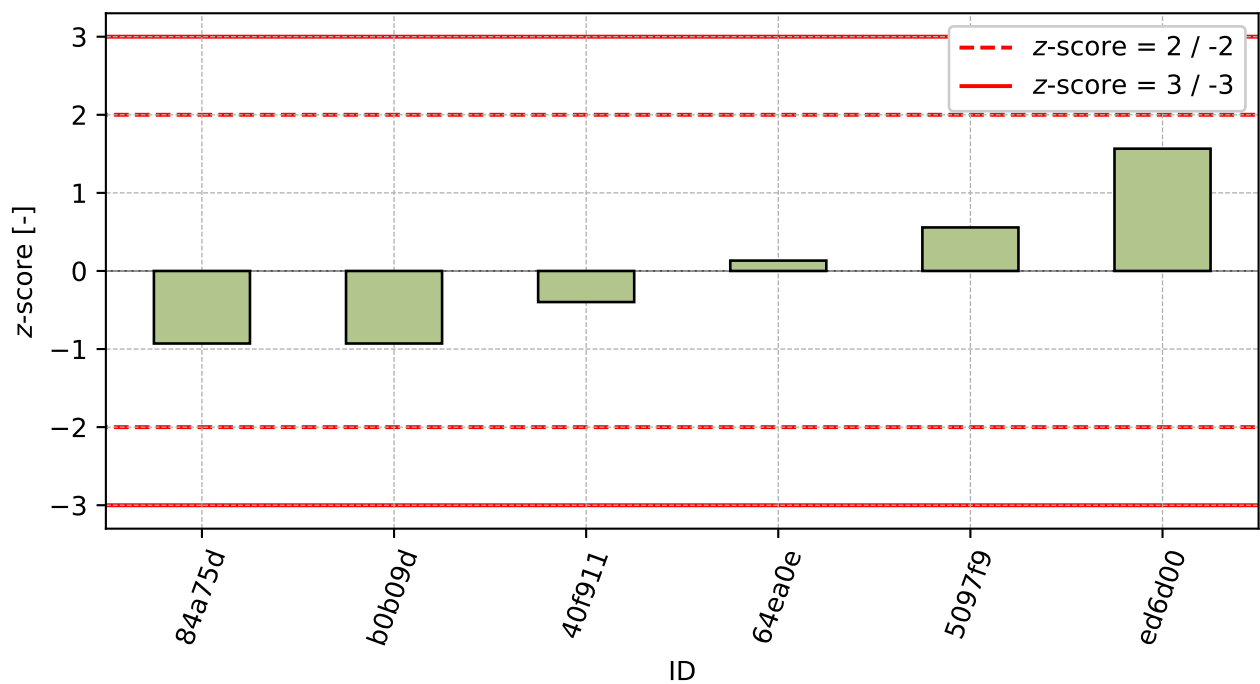


Figure 91: z-score

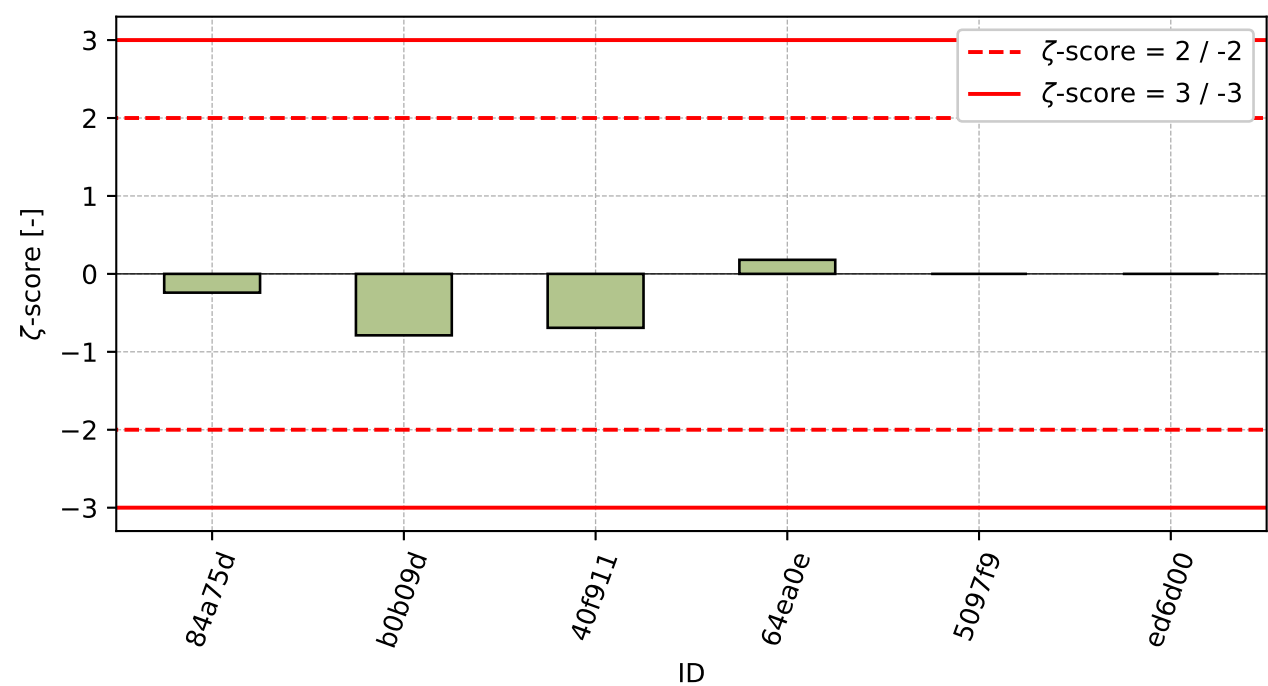


Figure 92: ζ -score

Table 42: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
84a75d	-0.93	-0.24
b0b09d	-0.93	-0.79
40f911	-0.40	-0.69
64ea0e	0.13	0.18
5097f9	0.56	-
ed6d00	1.57	-

14 Appendix – EN 12697-22+A1 Wheel tracking test – Procedure B in air

14.1 Wheel tracking

14.1.1 Test results

Table 43: 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 [mm/1000 cycles]		u_X [mm/1000 cycles]	$\bar{x}$ [mm/1000 cycles]	s_0 [mm/1000 cycles]	V_X [%]
49e1c8	0.01	0.02	0.01	0.01	0.007	47.14
10cca9	0.02	0.02	-	0.02	0.0	0.0
3c68f6	0.02	0.02	0.01	0.02	0.0	0.0
b0b09d	0.03	0.03	0.02	0.03	0.0	0.0
a7b1c1	0.04	0.05	0.01	0.04	0.007	15.71

14.1.2 The Numerical Procedure for Determining Outliers

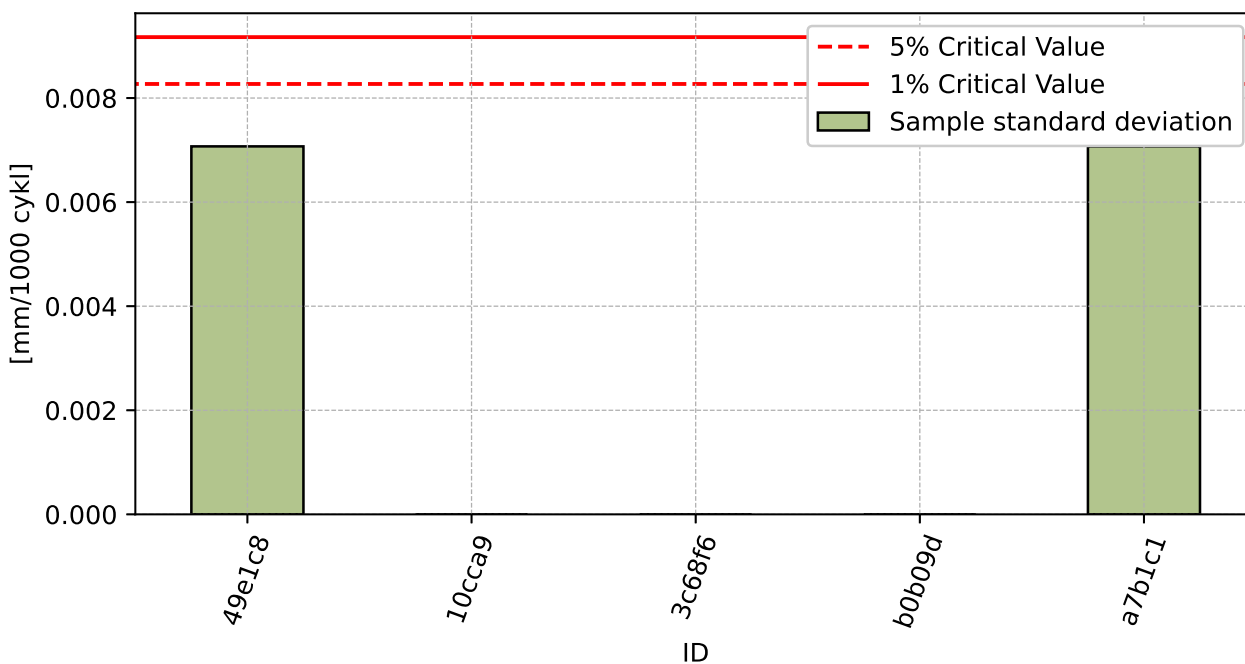


Figure 93: **Cochran's test** - sample standard deviations

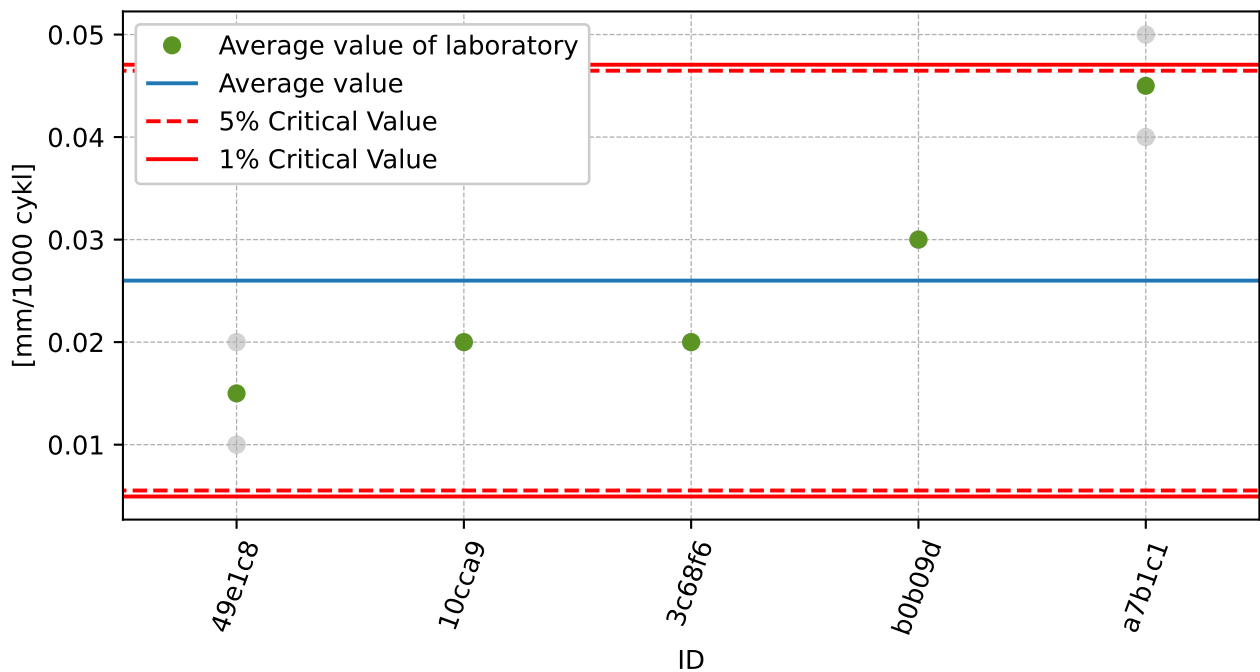


Figure 94: **Grubbs’ test** - average values

14.1.3 Mandel’s Statistics

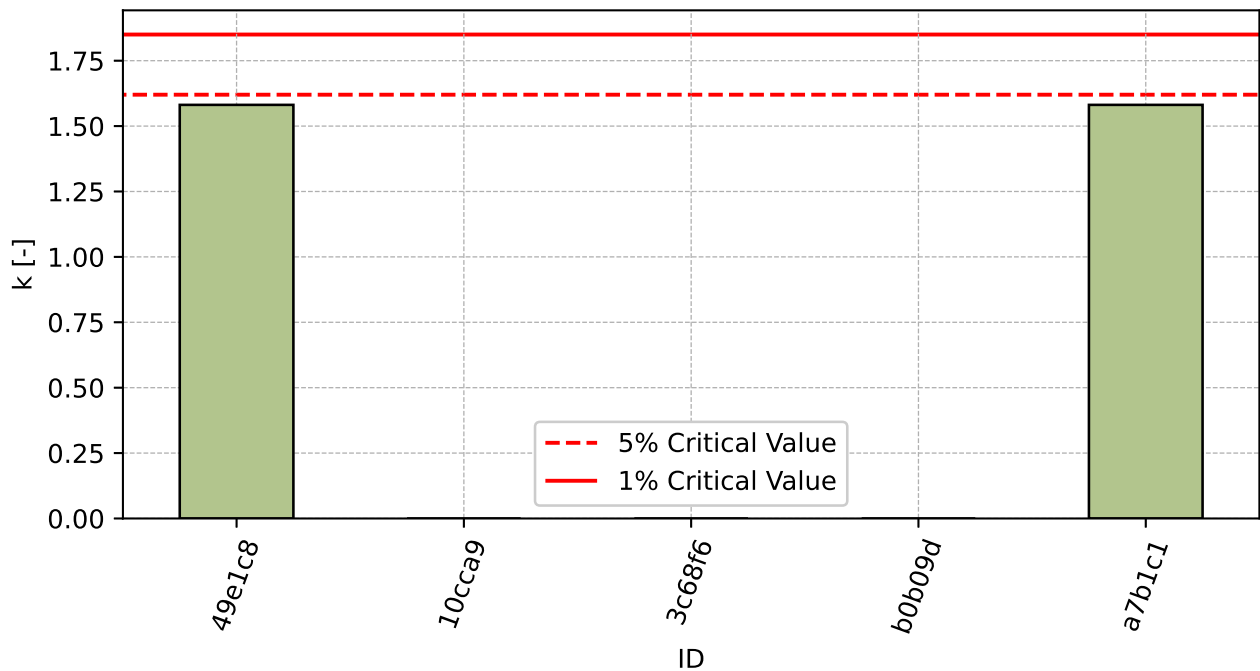


Figure 95: Intralaboratory Consistency Statistic

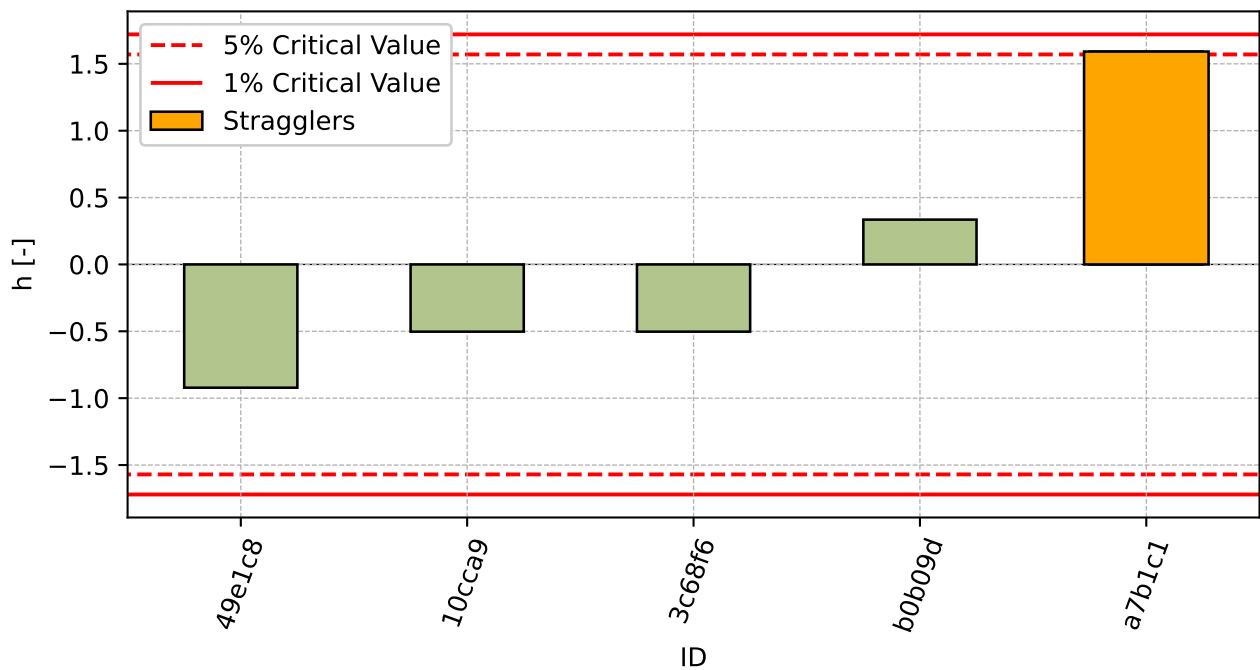


Figure 96: Interlaboratory Consistency Statistic

14.1.4 Descriptive statistics

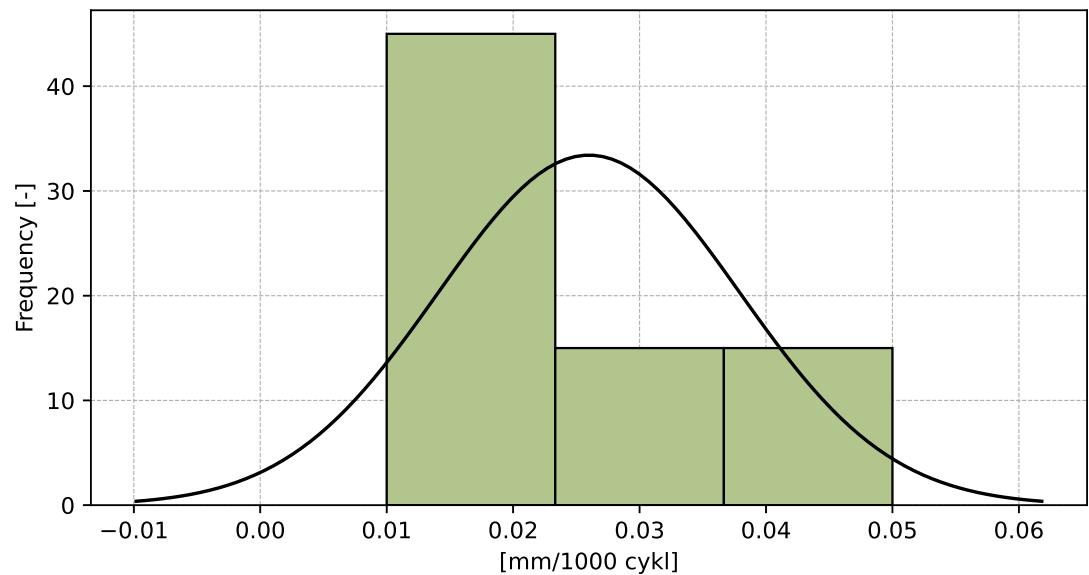


Figure 97: Histogram of all test results

Table 44: Descriptive statistics

Characteristics	[mm/1000 cycles]
Average value – $\bar{x}$	0.03
Sample standard deviation – s	0.012
Assigned value – x^*	0.03
Robust standard deviation – s^*	0.012
Measurement uncertainty of assigned value – u_X	0.007
p -value of normality test	0.108 [-]
Interlaboratory standard deviation – s_L	0.012
Repeatability standard deviation – s_r	0.004
Reproducibility standard deviation – s_R	0.012
Repeatability – r	0.01
Reproducibility – R	0.03

14.1.5 Evaluation of Performance Statistics

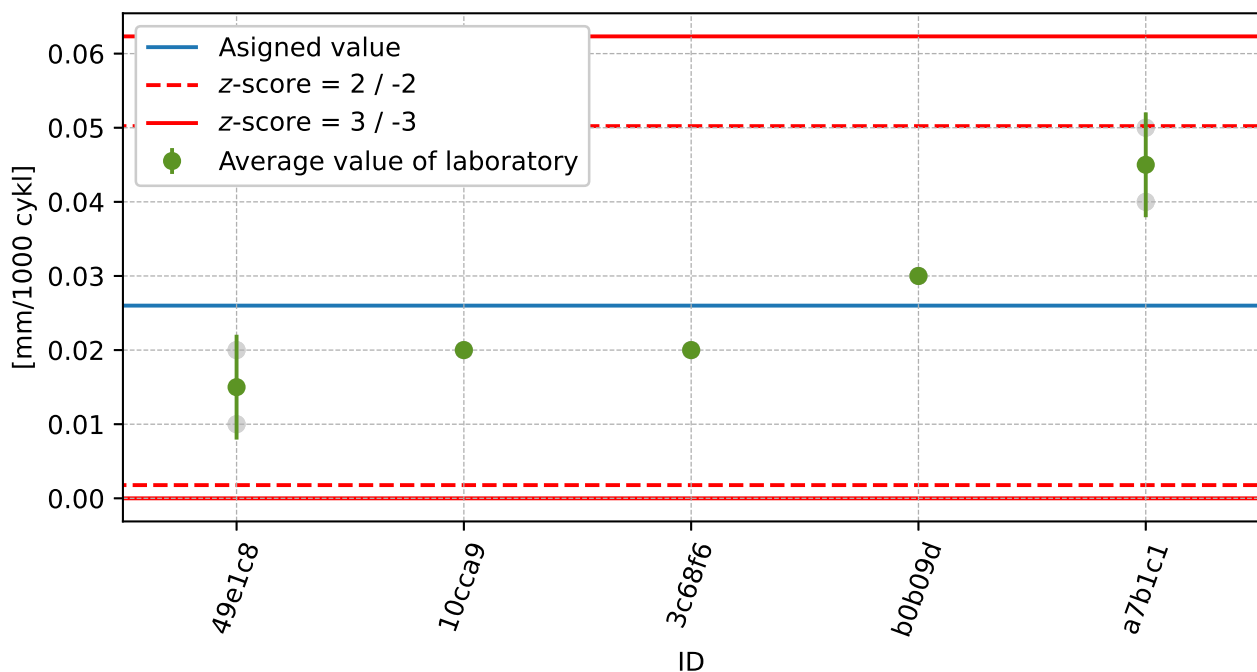


Figure 98: Average values and sample standard deviations

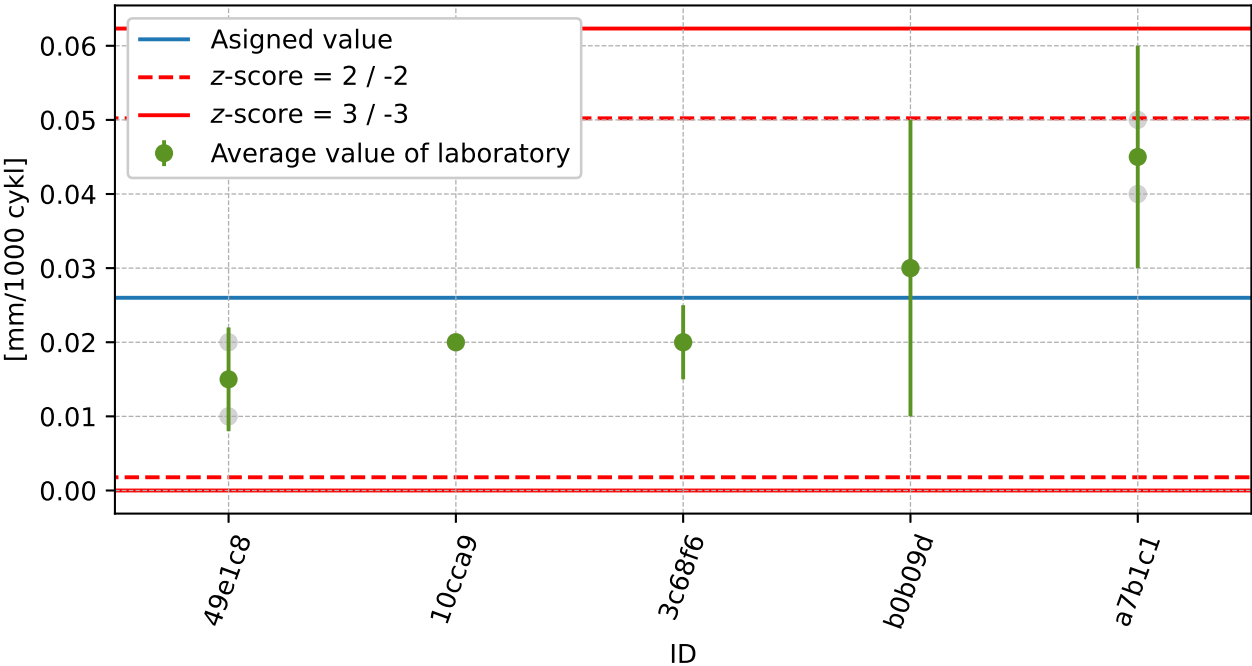


Figure 99: Average values and extended uncertainties of measurement

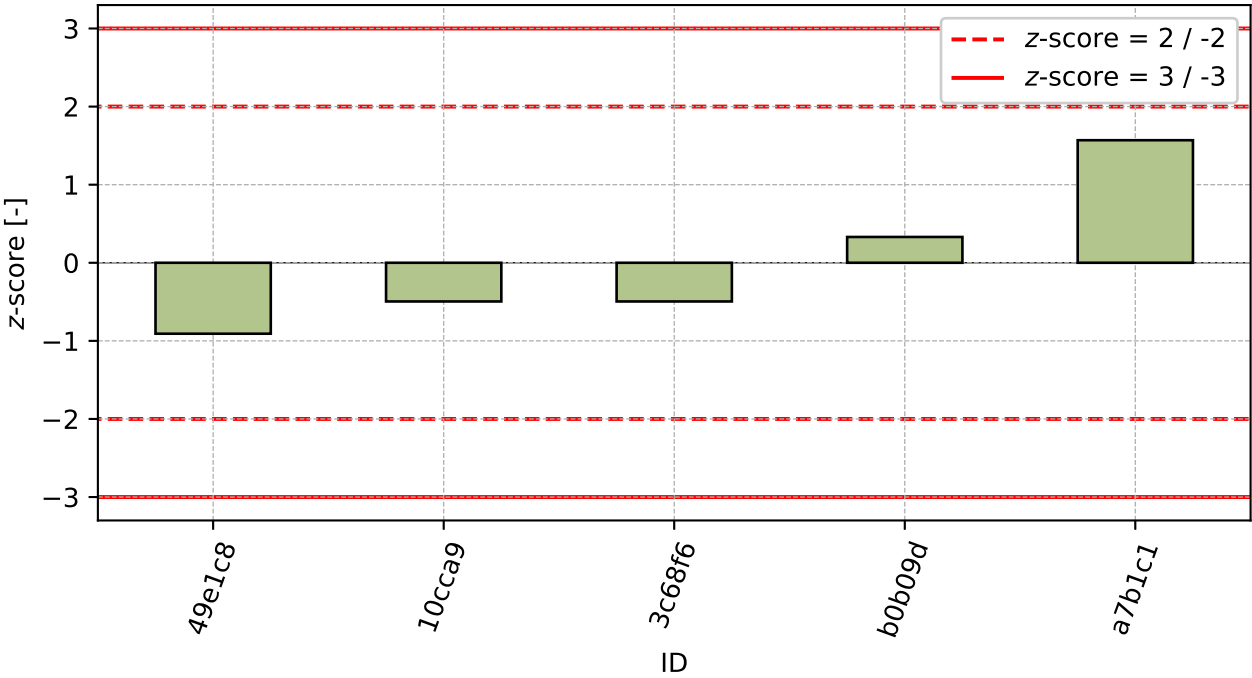


Figure 100: z-score

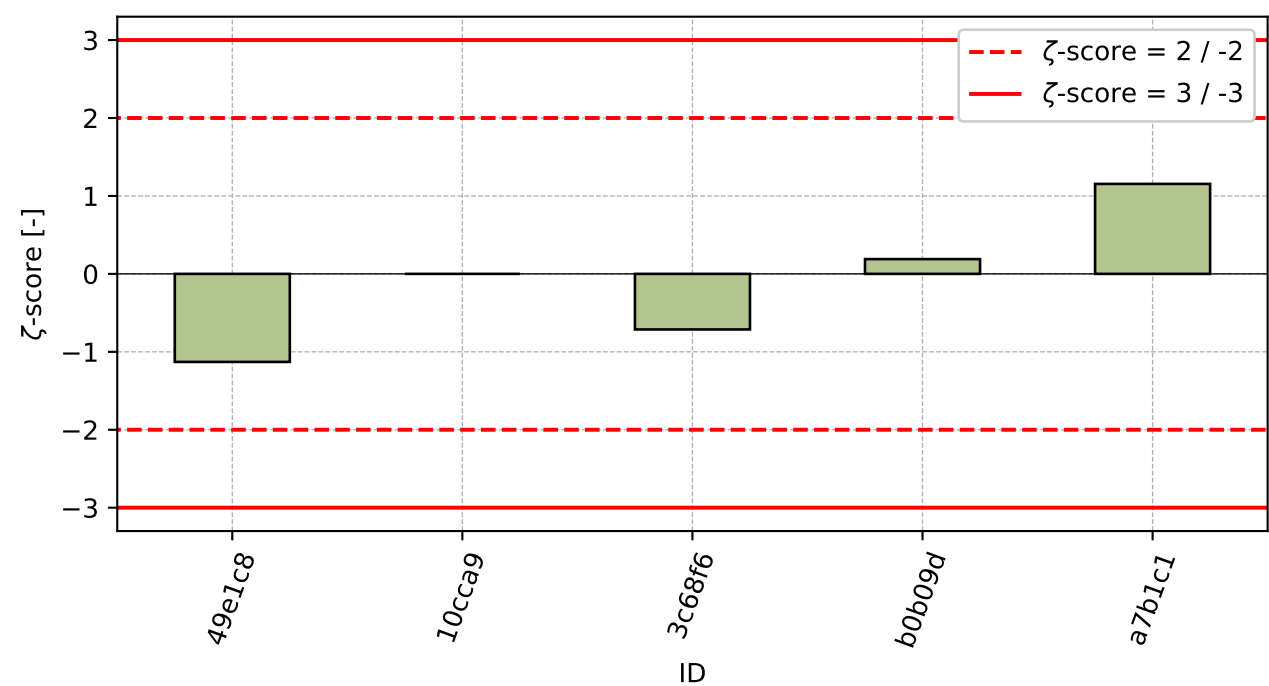


Figure 101: ζ -score

Table 45: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
49e1c8	-0.91	-1.13
10cca9	-0.50	-
3c68f6	-0.50	-0.71
b0b09d	0.33	0.19
a7b1c1	1.57	1.15

14.2 Wheel tracking test – small-size device, Procedure B in air

14.2.1 Test results

Table 46: 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 [%]
49e1c8	2.5	2.3	0.3	2.4	0.14	5.89
3c68f6	2.8	-	0.7	2.8	0.0	0.0
10cca9	3.6	2.8	-	3.2	0.57	17.68
a7b1c1	4.0	4.4	0.3	4.2	0.28	6.73
b0b09d	4.3	-	0.5	4.3	0.0	0.0

14.2.2 The Numerical Procedure for Determining Outliers

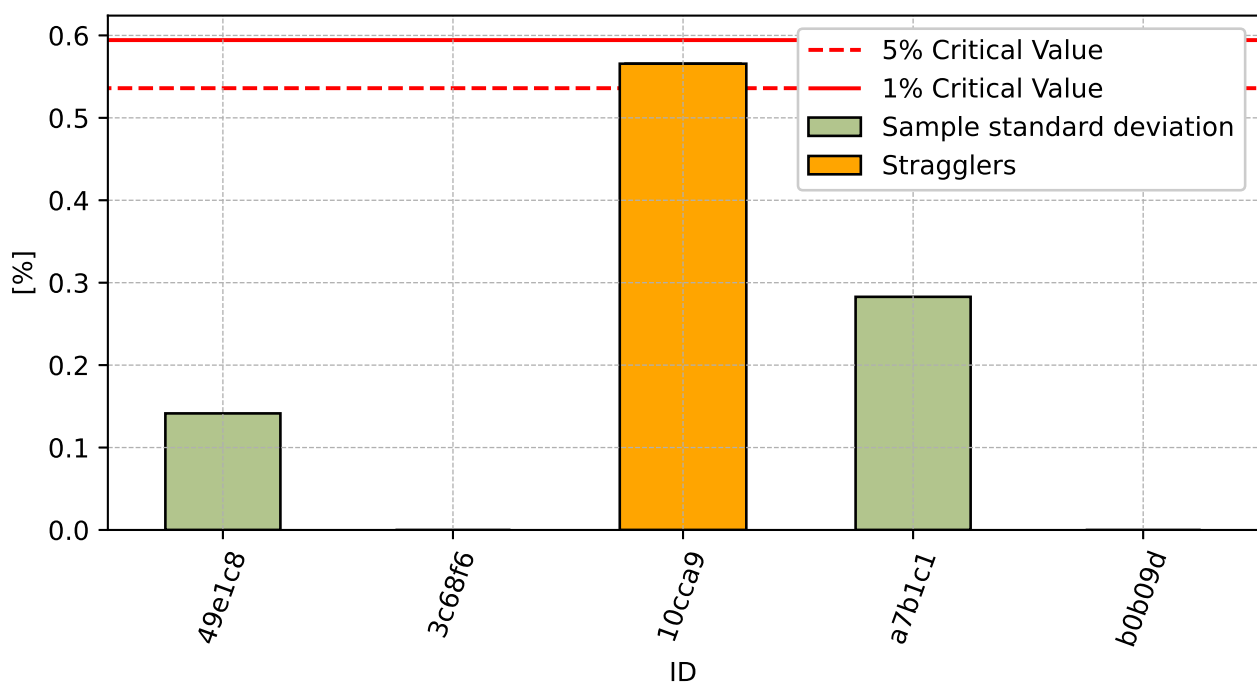
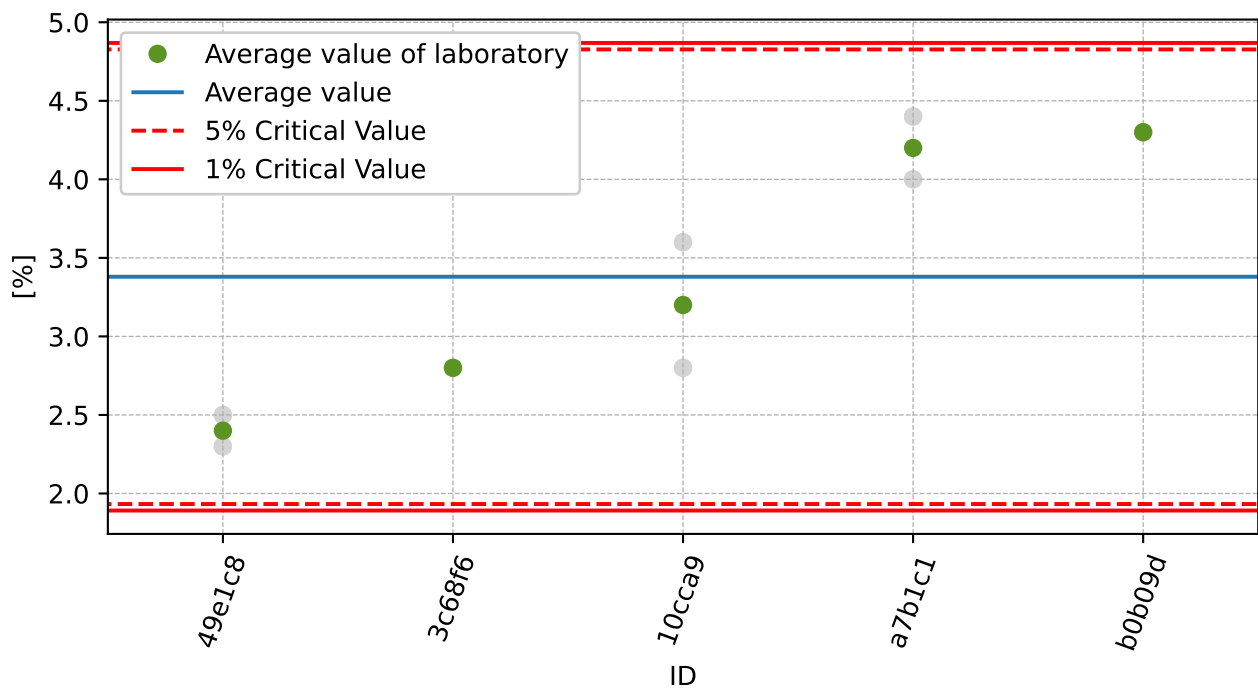


Figure 102: **Cochran's test** - sample standard deviations

Figure 103: **Grubbs' test** - average values

14.2.3 Mandel's Statistics

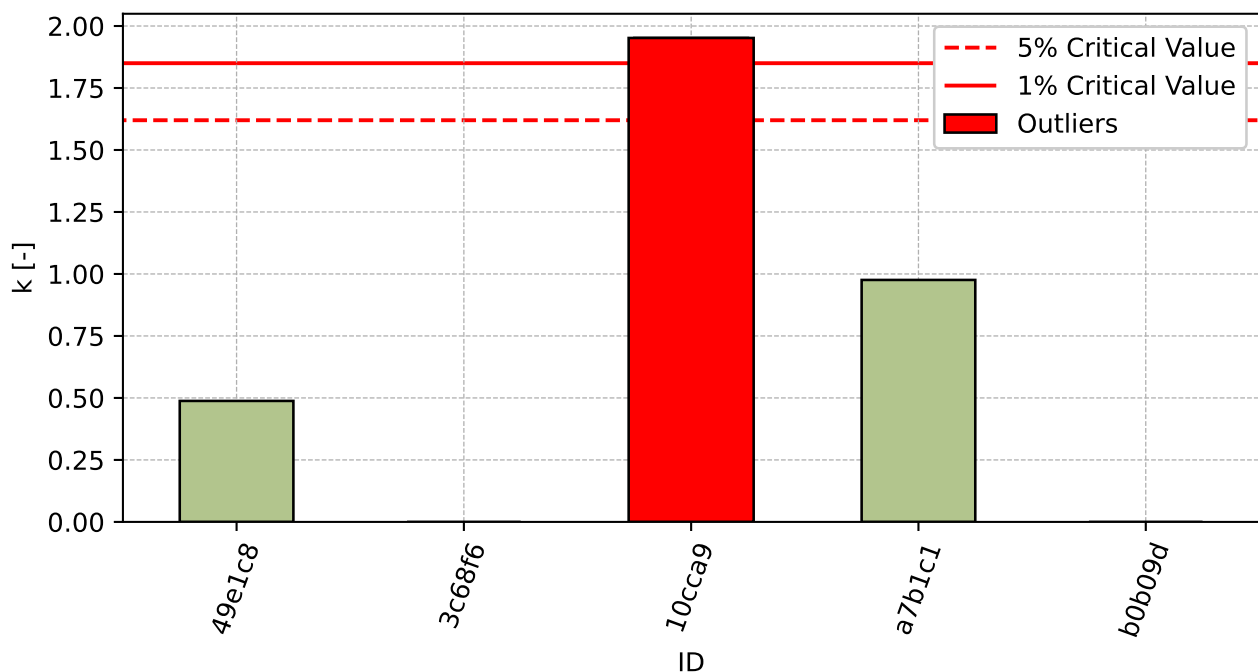


Figure 104: Intralaboratory Consistency Statistic

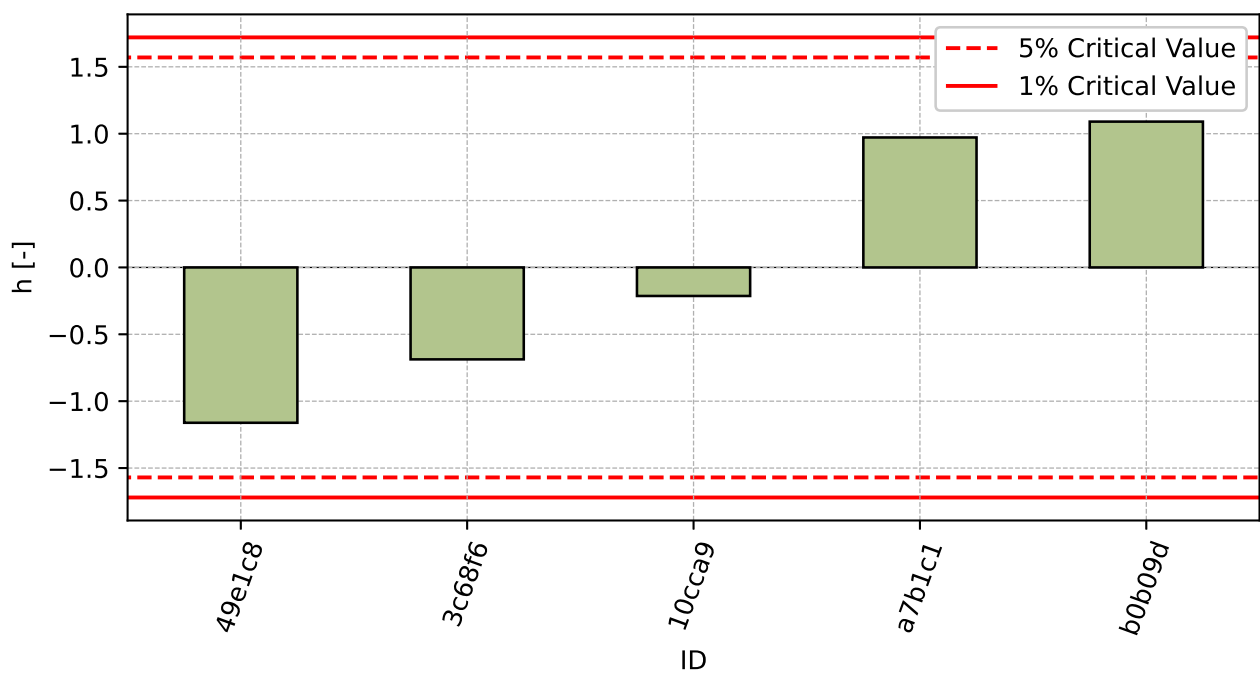


Figure 105: Interlaboratory Consistency Statistic

14.2.4 Descriptive statistics

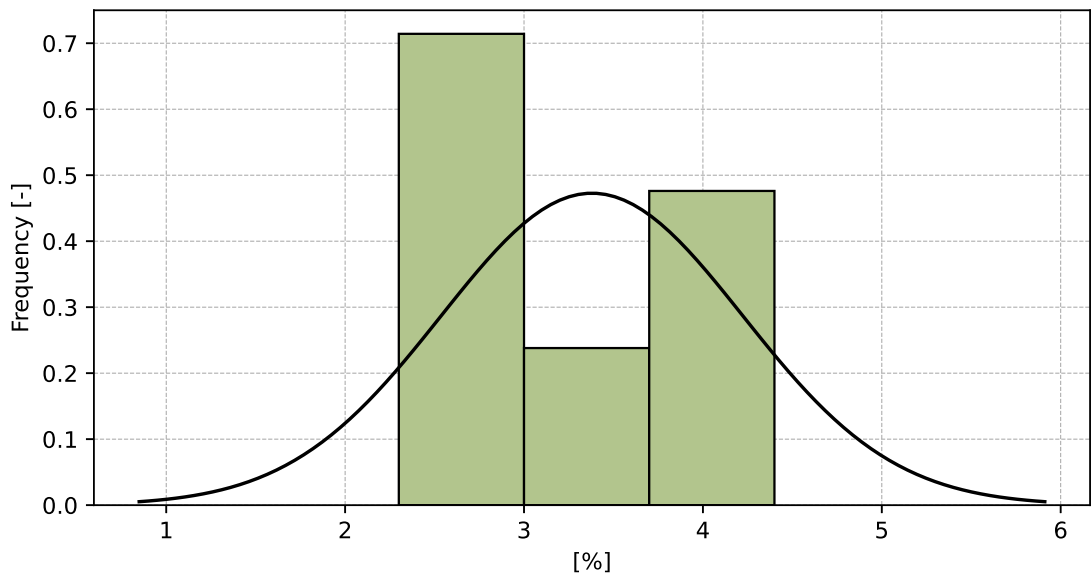


Figure 106: Histogram of all test results

Table 47: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	3.4
Sample standard deviation – s	0.84
Assigned value – x^*	3.4
Robust standard deviation – s^*	0.86
Measurement uncertainty of assigned value – u_X	0.48
p -value of normality test	0.532 [-]
Interlaboratory standard deviation – s_L	0.82
Repeatability standard deviation – s_r	0.29
Reproducibility standard deviation – s_R	0.87
Repeatability – r	0.8
Reproducibility – R	2.4

14.2.5 Evaluation of Performance Statistics

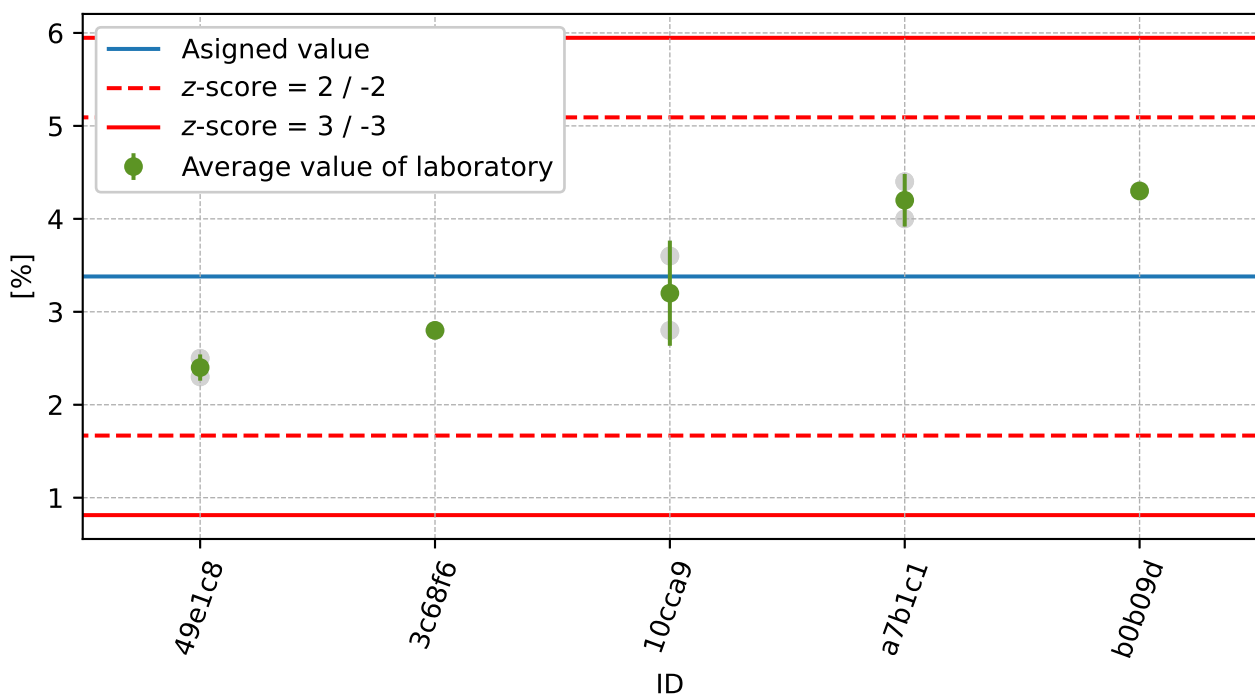


Figure 107: Average values and sample standard deviations

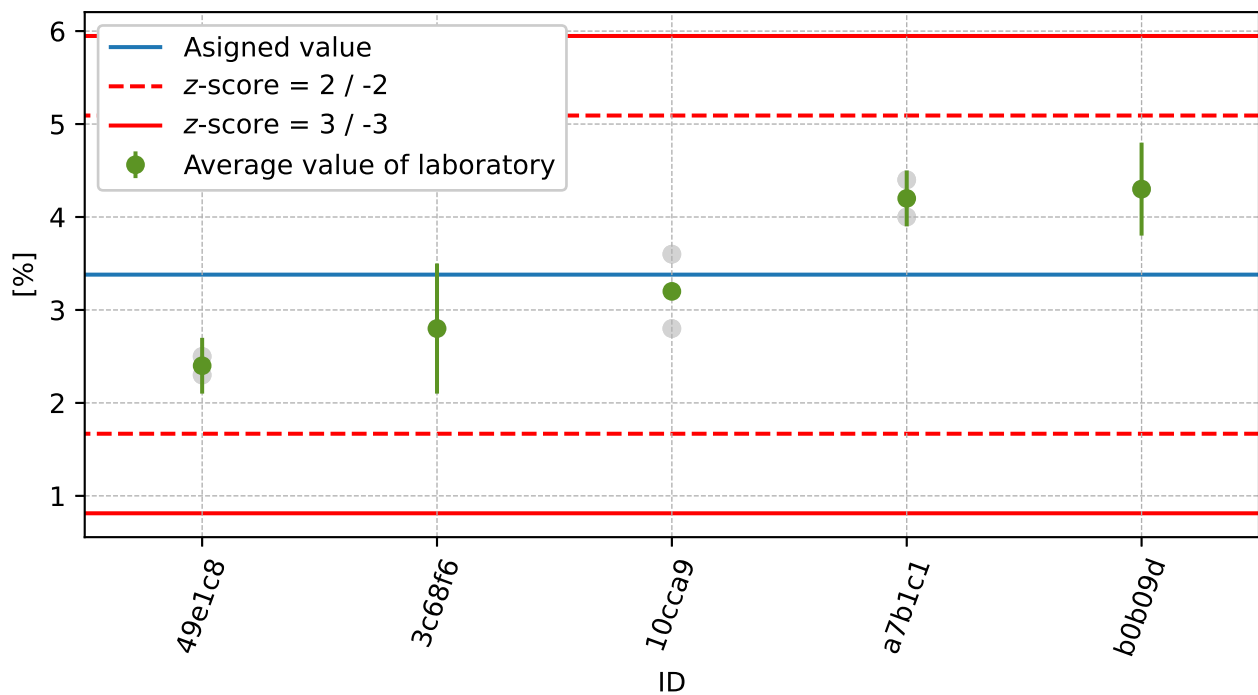


Figure 108: Average values and extended uncertainties of measurement

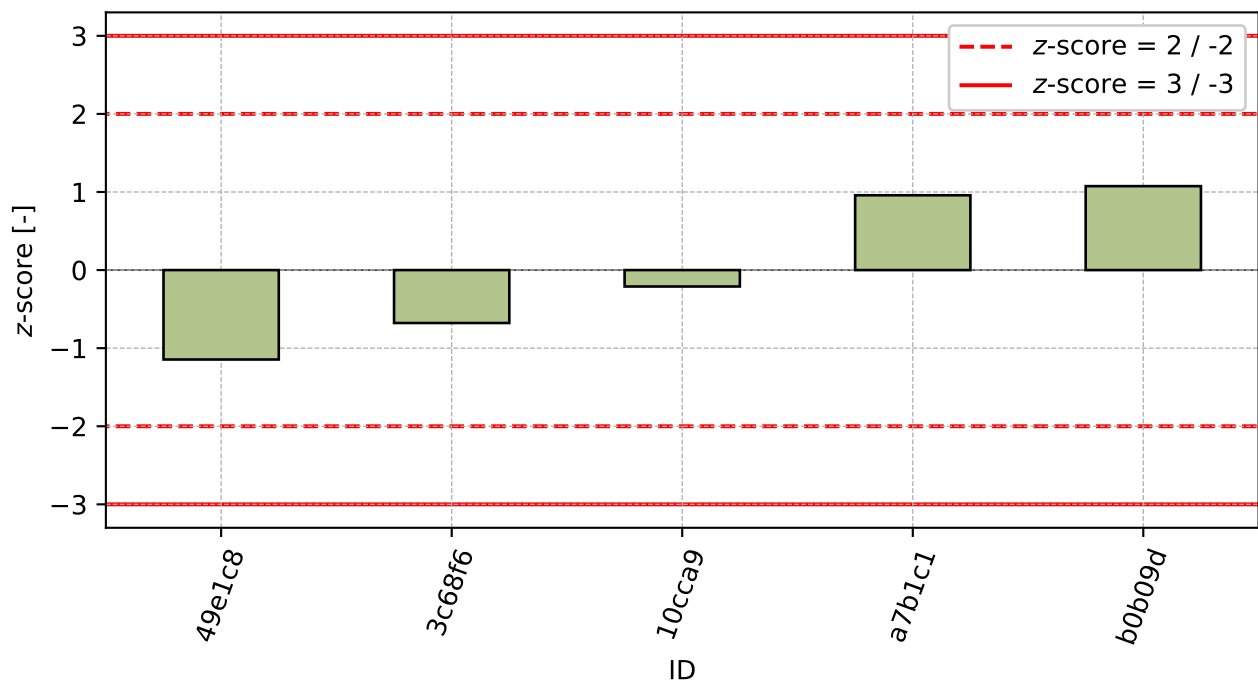


Figure 109: z-score

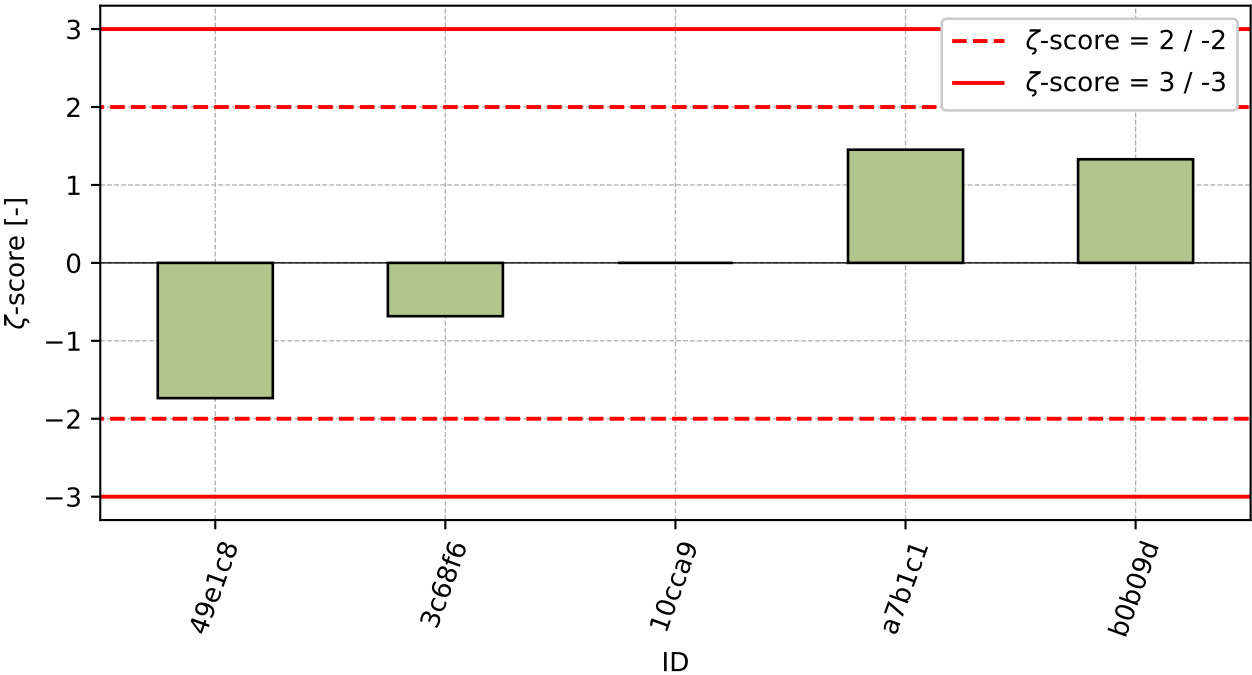


Figure 110: z-score

Table 48: z-score and z-score

ID	z-score [-]	z-score [-]
49e1c8	-1.15	-1.74
3c68f6	-0.68	-0.68
10cca9	-0.21	-
a7b1c1	0.96	1.45
b0b09d	1.07	1.33

15 Appendix – ČSN 73 6161 Adhesion of bituminous binders to aggregates

15.1 Test results

Table 49: 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 [%]
a7b1c1	85.0	80.0	10.0	82.0	3.5	4.29
de0c90	87.0	89.0	-	88.0	1.4	1.61
be8406	90.0	90.0	-	90.0	0.1	0.08
aa6fd2	91.0	92.0	-	92.0	0.7	0.77

15.2 The Numerical Procedure for Determining Outliers

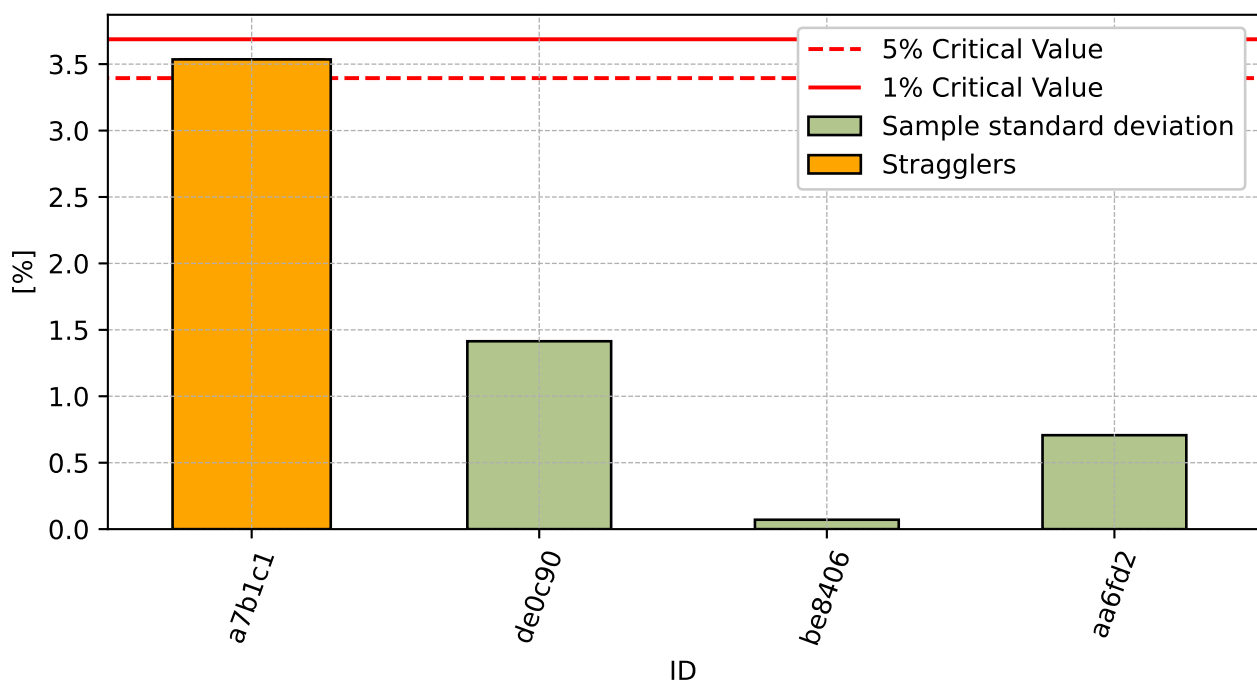
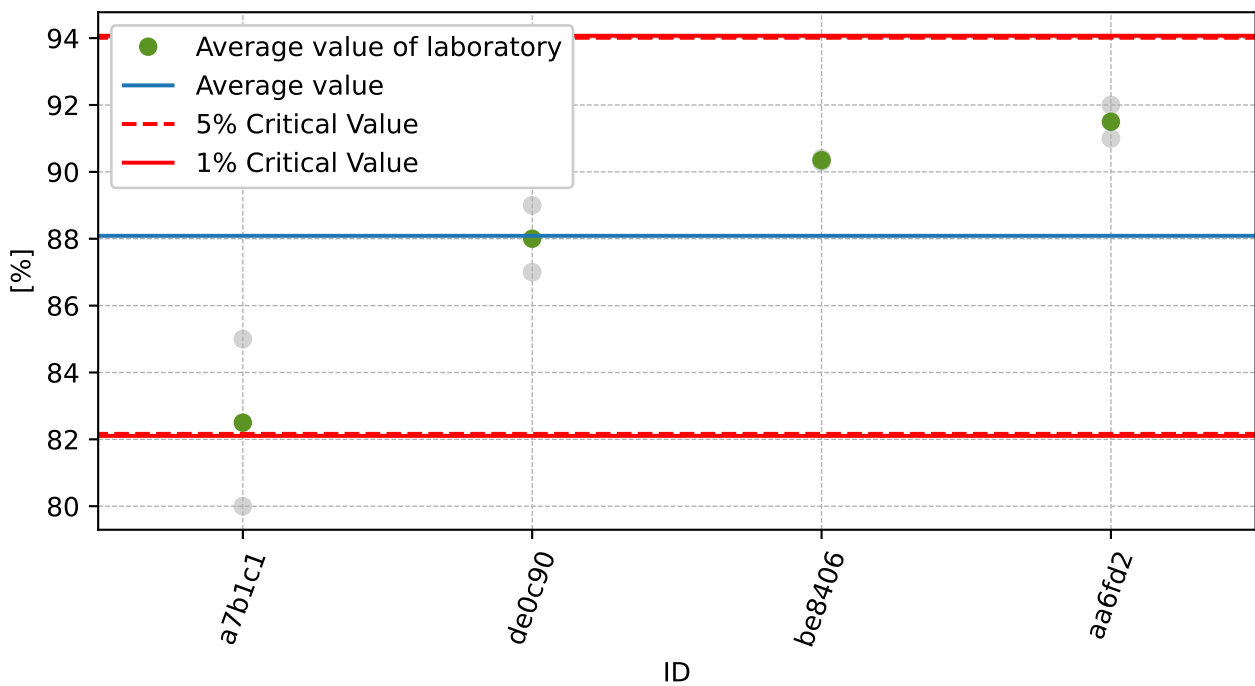


Figure 111: **Cochran's test** - sample standard deviations

Figure 112: **Grubbs' test** - average values

15.3 Mandel's Statistics

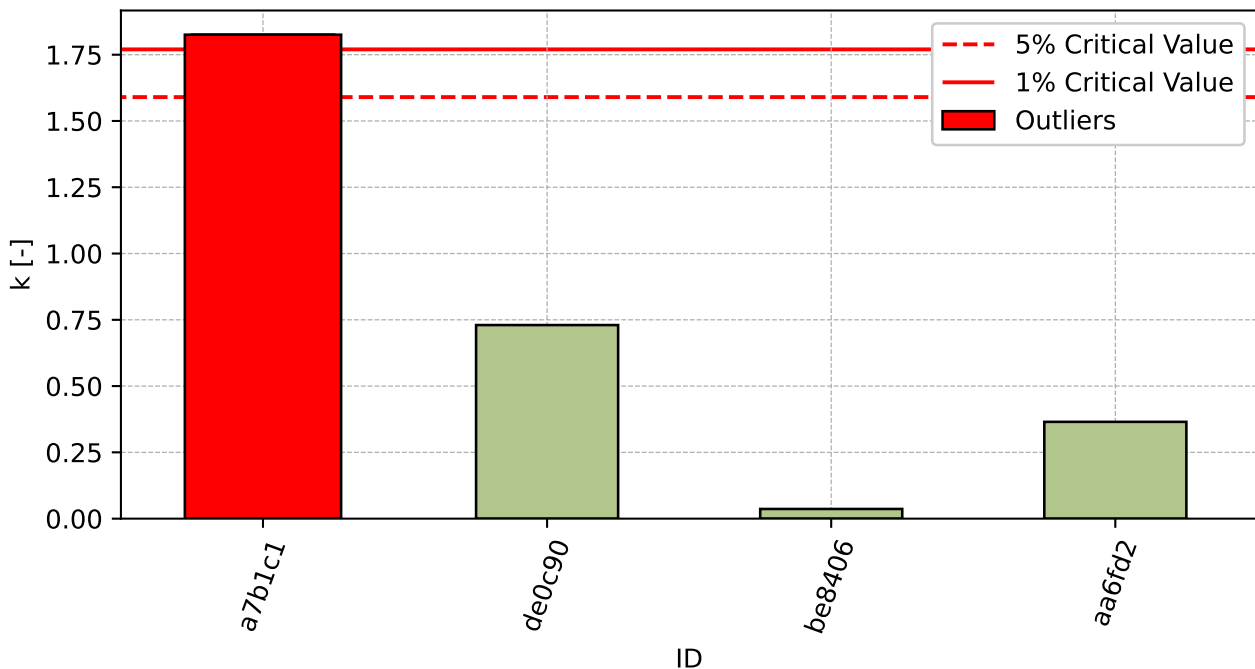


Figure 113: Intralaboratory Consistency Statistic

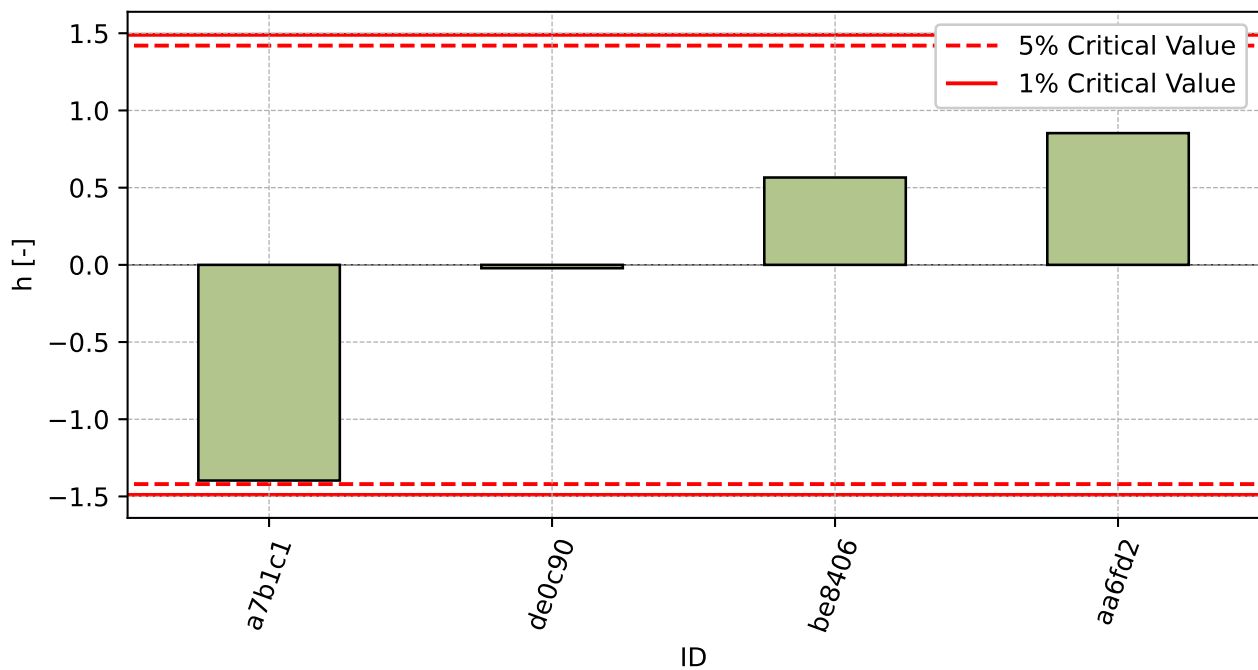


Figure 114: Interlaboratory Consistency Statistic

15.4 Descriptive statistics

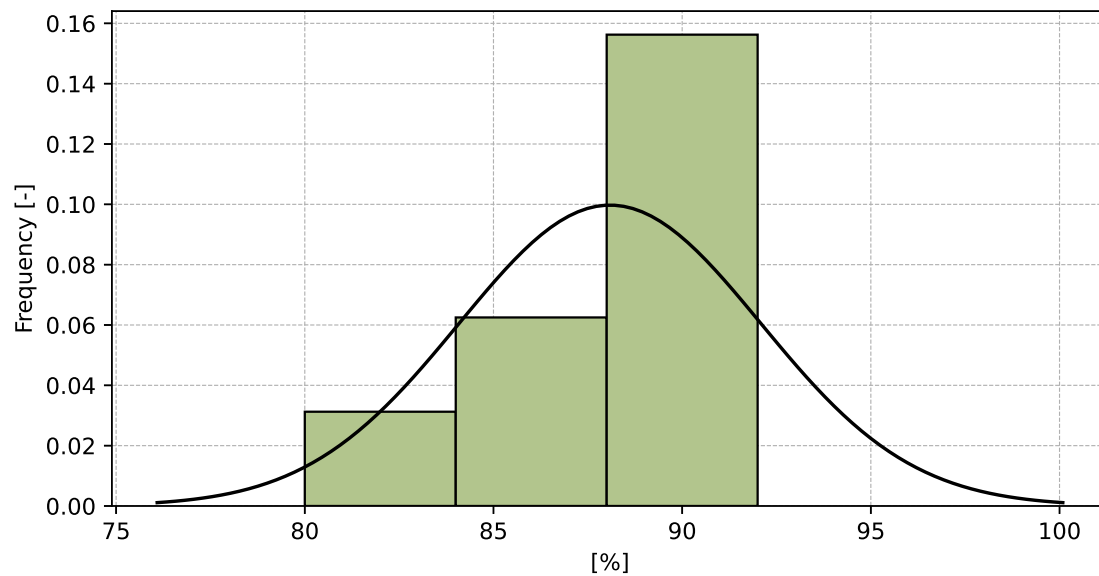


Figure 115: Histogram of all test results

Table 50: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	88
Sample standard deviation – s	4.0
Assigned value – x^*	89
Robust standard deviation – s^*	2.7
Measurement uncertainty of assigned value – u_X	1.7
p -value of normality test	0.151 [-]
Interlaboratory standard deviation – s_L	3.8
Repeatability standard deviation – s_r	1.9
Reproducibility standard deviation – s_R	4.2
Repeatability – r	5
Reproducibility – R	12

15.5 Evaluation of Performance Statistics

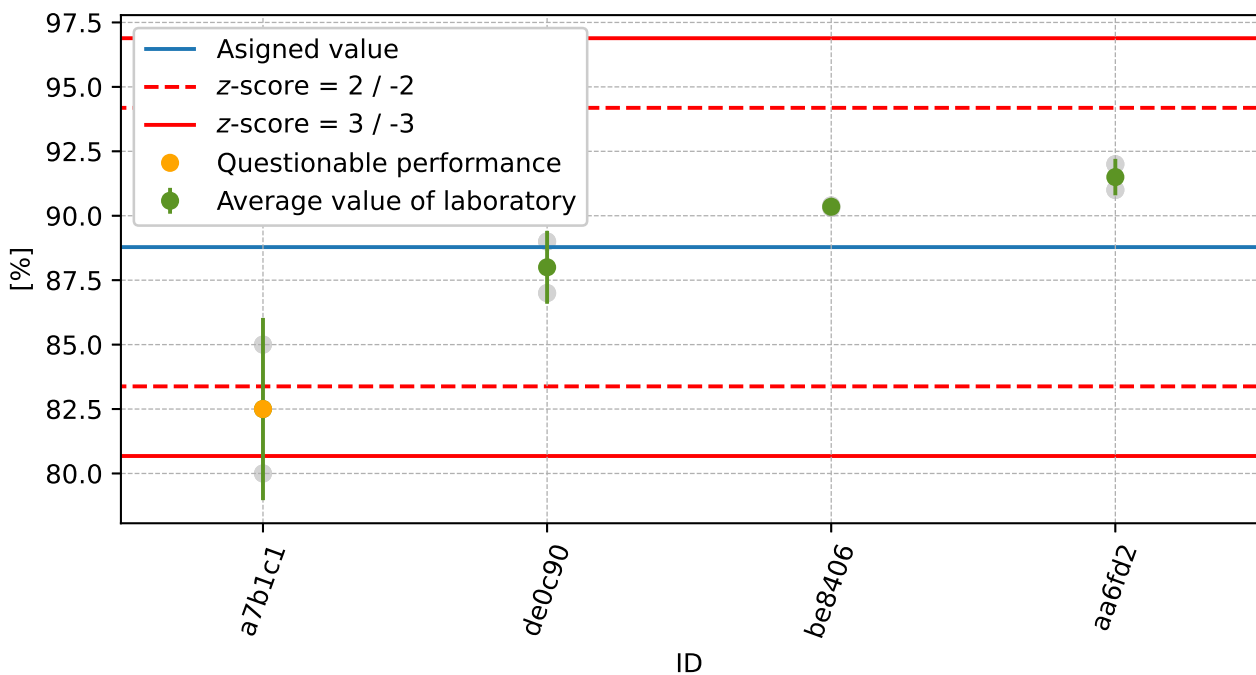


Figure 116: Average values and sample standard deviations

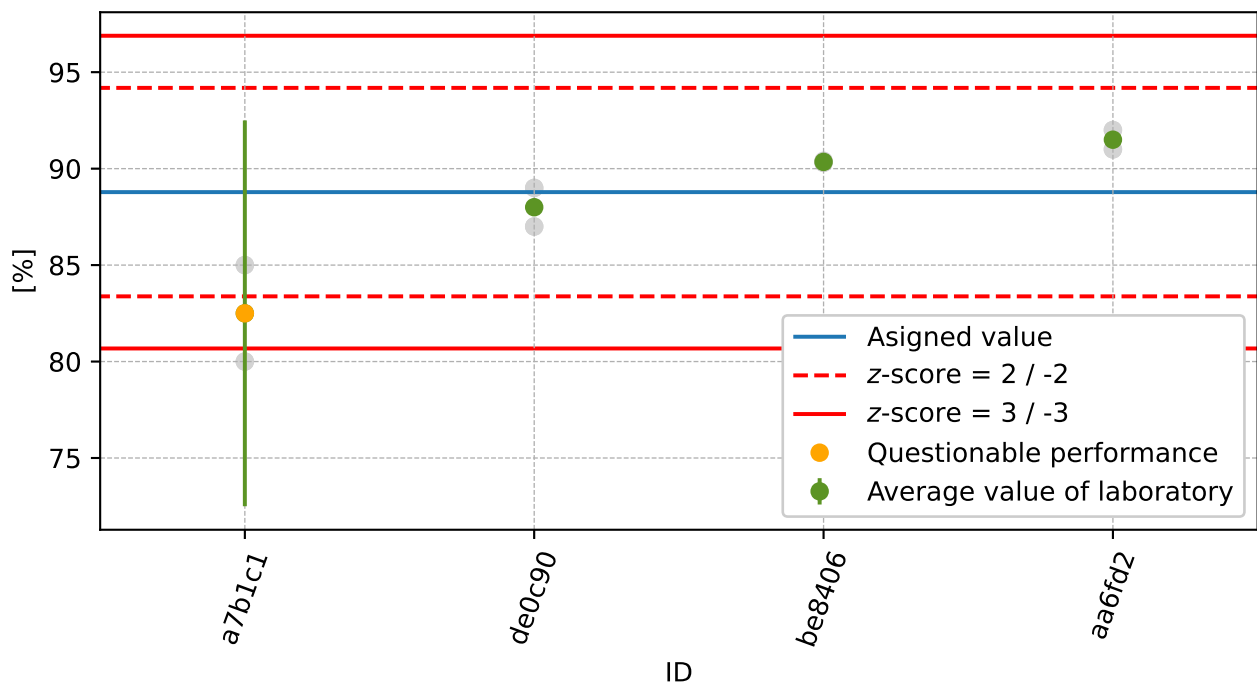


Figure 117: Average values and extended uncertainties of measurement

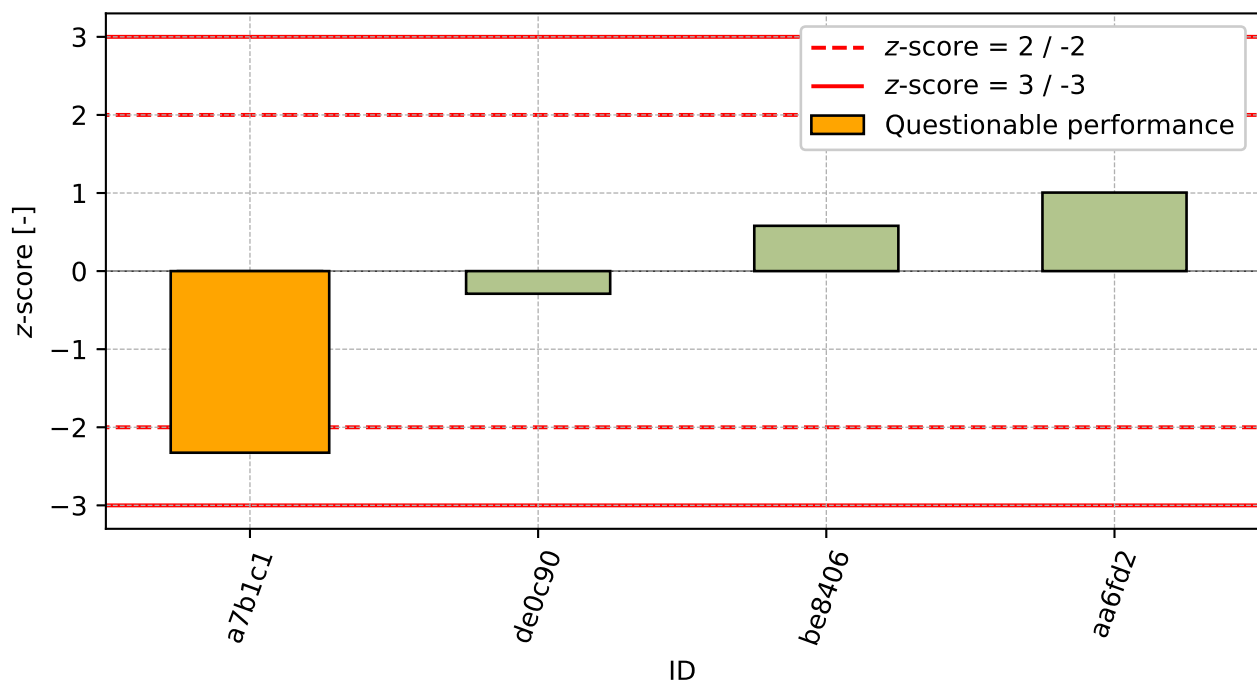


Figure 118: z-score

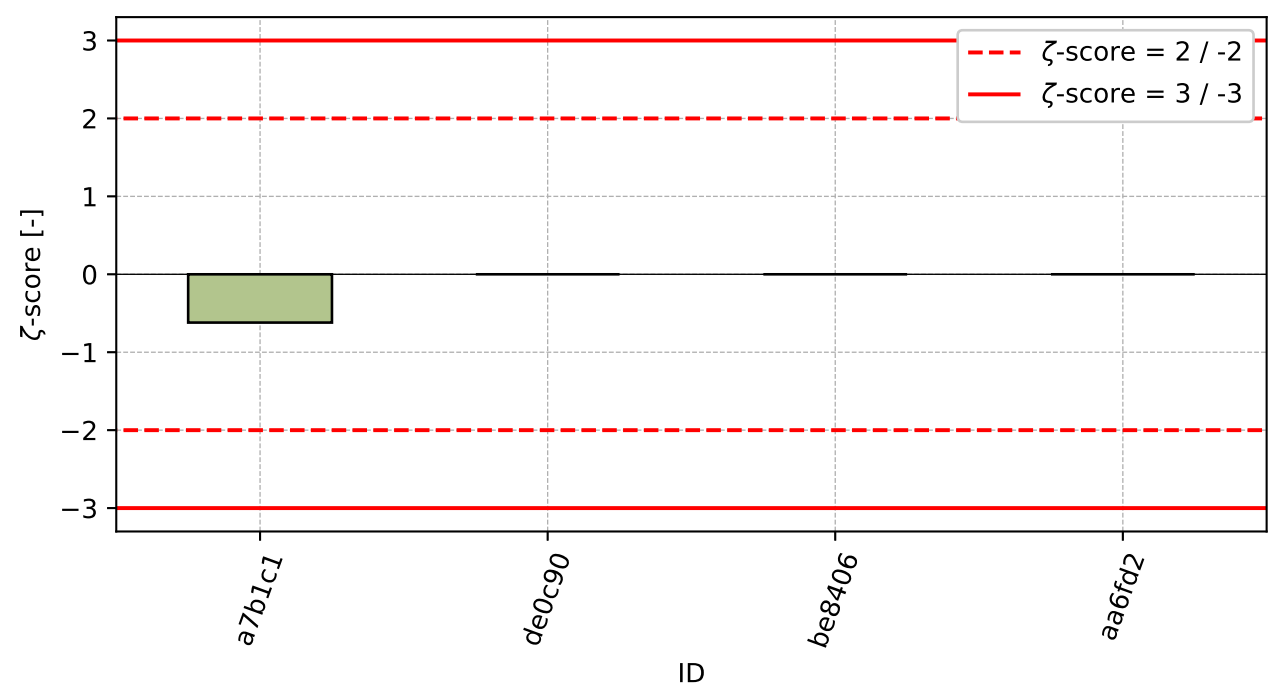


Figure 119: ζ -score

Table 51: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
a7b1c1	-2.33	-0.62
de0c90	-0.29	-
be8406	0.58	-
aa6fd2	1.01	-