



FINAL REPORT ON THE RESULTS OF PRECISION EXPERIMENT

Proficiency Testing Program Strength and Durability of Hardened Concrete ZZB 2026/1

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Proficiency testing provider at the SZK FAST
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www.ptprovider.cz

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1 Introduction and Important Contacts

In the year 2026, the Proficiency Testing Provider at the SZK FAST (PT Provider) initiated the Proficiency Testing Program (PTP) designated ZZB 2026/1 whose aim was to verify and assess the conformity of test results across laboratories when testing hardened concrete.

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

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The subjects of proficiency testing were the following testing procedures:

1. **EN 12390-3** – Compressive strength of test specimens [1].
2. **EN 12390-7** – Density of hardened concrete [2].
3. **EN 12390-8** – Depth of penetration of water under pressure [3].
4. **EN 480-11** – Determination of air void characteristics in hardened concrete [4].
5. **ČSN 73 1322** – Determination of frost resistance of concrete [5].
6. **ČSN 73 1324** – Determination of grindability of concrete [6].
7. **ČSN 73 1326** – Resistance of cement concrete surface to water and defrosting chemicals – Method A [7].
8. **ČSN 73 1326** – Resistance of cement concrete surface to water and defrosting chemicals – Method C [7].
9. **CEN/TS 12390-9** – Freeze-thaw resistance – Scaling [8].

Testing procedure 6 was not open due to low interest from laboratories.

The supplier, BETOTECH s. r. o., was responsible for the preparation of hardened concrete for the PTP. Fresh concrete for the preparation of test samples was taken from one production batch prepared in accordance with methods stipulated in EN 206 [9]. Fresh concrete was poured into test molds, which were always of the same type, and after removal from the molds the test specimens were placed under identical conditions in storage rooms complying with the requirements for individual specifications.

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 [10] and with EN ISO/IEC 17043 [11]. The outcome is the present final report summarizing the results of the interlaboratory comparison, including statistical evaluation.

66 laboratories 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

ID/Method	1	2	3	4	5	6	7	8	9
1b5b6f	-	X	X	-	-	-	-	-	X
c0f9d3	-	-	X	-	-	-	-	-	-
8302e7	X	X	X	-	-	-	X	X	-
1b0879	X	X	-	-	-	-	-	-	-
1a3903	X	X	-	-	-	-	-	-	-
5a7133	X	X	X	-	-	-	-	-	X
d85200	X	X	-	-	-	-	-	-	-
7c0f45	X	X	X	-	-	-	-	-	X
2085f6	-	-	X	-	-	-	-	-	-
9068a9	-	-	-	-	-	-	X	-	-
7a413d	X	X	-	-	-	-	-	-	-
816a9c	X	X	-	-	-	-	-	-	-
b61aa5	X	-	X	-	-	-	-	-	X
2c5b91	X	-	-	-	-	-	-	-	-
b5198d	-	-	-	-	-	-	X	-	-
d1d5e3	X	X	X	X	-	-	-	X	-
e6a816	X	X	-	-	-	-	-	-	-
d29ff7	-	-	-	-	-	-	X	X	-
0e9e26	X	X	-	-	-	-	-	-	-
3a6254	X	X	X	-	-	-	X	-	-
1c0489	-	-	-	-	-	-	X	-	-
0cc119	X	X	-	-	-	-	-	-	-
907694	X	-	X	-	-	-	-	-	-
3084f9	X	-	-	-	-	-	-	-	-
5222e7	-	-	-	X	-	-	X	-	-
896852	-	-	-	X	-	-	-	-	-
db5ed0	X	X	X	-	-	-	X	-	-
89e2dd	X	X	X	-	-	-	X	-	-
d7328e	-	-	X	-	-	-	-	-	X
a6af84	-	-	-	-	-	-	-	-	X
7d4927	X	X	X	-	-	-	X	-	-
dcc466	X	-	-	-	-	-	-	-	-
571843	X	X	X	-	-	-	-	-	X
a4c504	X	-	-	-	-	-	-	-	-
a9f454	X	X	X	-	X	-	-	X	-
2e0f6c	-	-	X	-	-	-	-	-	-
420c1c	-	-	X	-	-	-	-	-	-
8ef05a	X	X	X	-	-	-	-	X	-
0928bf	X	X	-	-	X	-	X	-	-
14b514	-	-	X	-	-	-	-	-	X
113dff	X	X	X	-	-	-	-	-	-
754435	X	-	X	-	X	-	-	-	-
c2d631	-	-	-	-	-	-	-	-	X
22a7b7	X	-	-	-	-	-	-	-	-

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ID/Method	1	2	3	4	5	6	7	8	9
b001e1	-	-	-	-	X	-	-	-	-
11467d	X	-	-	-	-	-	-	-	-
d27d88	X	X	-	-	-	-	-	-	-
dd65a7	X	X	X	-	-	-	-	-	-
6b8ef9	X	X	X	-	-	-	-	X	-
2a406f	X	X	X	X	-	-	-	X	-
dc2389	X	X	X	-	-	-	-	-	-
0b8373	X	X	X	-	-	-	-	-	-
b7ccd2	X	X	X	-	-	-	-	-	X
c86e46	X	-	-	-	-	-	X	X	-
2c0b46	-	-	-	X	-	-	-	-	-
fe6f4d	X	-	-	-	-	-	-	-	-
e08293	X	X	X	-	-	-	-	-	X
92cb03	-	X	-	-	-	-	X	-	-
ff601a	X	X	-	-	-	-	-	-	-
5a9139	X	X	X	-	X	-	X	-	-
fbf08a	X	-	X	-	-	-	X	-	-
c427f0	X	X	-	-	X	-	X	-	-
d8e44d	-	-	-	-	X	-	-	-	-
817af7	X	-	X	-	-	-	-	-	-
192705	X	X	X	-	-	-	X	-	-
1a28a8	-	X	-	-	X	-	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
Asphalt Pavement Institute - APIAN doo Beograd	Vranjska 29/65, Beograd, 11050, Serbia	01-565
BEST, a.s.	Rybnice 148, Kaznějov, 33151, Česká republika	1739
BETONTEST, spol. s r. o.	Trnkova 3083/162 628 00 Brno, Brno-Líšeň, 62800, Jihomoravský kraj	1116
BETOTECH, s.r.o. - Pracoviště Jindřichův Hradec	Beroun 660, Beroun, 266 01, Česká republika	1195
BETOTECH, s.r.o. - Pracoviště Trutnov	Beroun 660, Beroun, 26601, Česká republika	1195
BETOTECH, s.r.o. - Pracoviště Cheb	Beroun 660, Beroun, 266 01, Česká republika	1195
BETOTECH, s.r.o. - Pracoviště Klatovy	Beroun 660, Beroun, 266 01, Česká republika	1195
BETOTECH, s.r.o. - Pracoviště Most	Beroun 660, Beroun, 266 01, Česká republika	1195

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Laboratory	Address	Accreditation number
BOKU Wien, Institut fuer Konstruktiven Ingenieurbau	Peter-Jordan-Str. 82, Wien, 1190, AUSTRIA	-
Bauzert e.V. Geschäftsstelle Großburgwedel MPI Nord	Raiffeisenstraße 8, Großburgwedel, 30938, Germany	D-PL-17407-01
Bechtel ENKA UK Limited Ogranak Beograd	Jasički put 52đ, Krusevac, 37000, Serbia	-
Betotech, s.r.o. - pracoviště Beroun	Beroun 660, Beroun, 26601, Česká republika	1195
BetónRacio, s.r.o., Skúšobné laboratórium, Pracovisko Trnava.	Skladová 2, Trnava, 917 01, Slovensko	-
Bouwkundig Labo BL	Langendonkstraat 2, Sint-Joris, 8730, Belgium	BELAC (Belgium)
Budimex S.A., odštěpný závod Česko	č. 4 vedle pekárny Nopek, Hrušova, 565 55, Česká republika	L1814
CDDI s.r.o.	Vraclavská 163, Vysoké Mýto, 56601, Česká republika	-
CONTROL-VHS-SK, s.r.o.	Kamenná 14, Žilina, 010 01, Slovenská republika	437/S-317
Cement Hranice, akciová společnost	Bělotínská 288, Hranice I - Město, Hranice, 75301, Česká republika	1284
Cemex Czech Republic s.r.o.	Plzeňská 3217/16, Praha 5, 15500, Česká republika	1302
Center for Innovation and Materials Testing CIRM Ltd.	Stevana Markovica 8, floor 1, Belgrade, 11080, Serbia	-
Center for Testing and European Certification	Industrialna No 2, Stara Zagora, 6006, Bulgaria	252 ЛИ
Centrum dopravního výzkumu, v.v.i.	Líšeňská 33a, Brno, 63600, Česká republika	1506
Concrefy B.V.	Olivier van Noortweg 10, Venlo, 5928 LX, Limburg	L216
DISOMA	Krommewege 31G, Maldegem, 9990, België	409-TEST
Danucem Slovensko a.s., Skúšobné laboratórium Bratislava	Pestovateľská 2, Bratislava, 821 04, Slovenská republika	426/S-313
EDAFOMICHIKANI S.A.	19 EMM. PAPADAKI, Neo Iraklio, 14121, Greece	-
Examen lab d.o.o.	Ljudevita Gaja 26A, Samobor, 10430, Croatia	-
Geokontrol DOOEL, Strumica	Kiril Trencev br.10, Strumica, 2400, North Macedonia	-
Gradezen Institut "Makedonija" AD Skopje	Drezdenska No.52, SKOPJE KARPOS, 1000, North Macedonia	LT-014
Holcim (Hrvatska) d.o.o.	Koromačno 7b, Koromačno, 52222, Croatia	-
Holcim (Česko), a.s.	Čížkovice č.p. 27, Čížkovice, 41112, Česká republika	1426
INSTITUTI NDERTIMIT (IN)	Myslym Keta, Brare Tufine, Albania, Tirana, 1001, Albania	-

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Laboratory	Address	Accreditation number
Institut technologie a testování betonu, s.r.o., Zkušební laboratoř ITTB Brno	Medkova 974/4, Brno - Tuřany, 62700, Česká republika	L1778
Institut za beton doo	Prizrenska 28, Beograd, 11070, Srbija	-
Instytut Podstawowych Problemow Techniki Polskiej Akademii Nauk	Pawińskiego 5B, Warszawa, Warszawa, mazowieckie	-
KORIDORI SRBIJE DOO BEOGRAD	Kralja Petra 21, Beograd, 11000, Republika Srbija	-
Kilsaran Concrete Unlimited Company	Piercetown, Dunboyne, Co.Meath, A86 W820, Ireland	241T
KŠ PREFA s.r.o.	Jinonická 805/57, Praha 5, 15000, Česká republika	—
LEPL Levan Samkharauli National Forensic Bureau (NFB)	84 Chavchavadze Avenue, Tbilisi, 0162, Georgia	2 225 84 84
Primekss SIA	Gustava Zemgala gatve 76, Riga, LV-1039, Latvia	-
QCONTROL s.r.o., odštěpný závod - pracoviště Děčín	Lesní 693, Bílovice nad Svitavou, 66401, Česká republika	1737
QUALIFORM SLOVAKIA s.r.o. - pracovisko Bratislava	Pasienková 9 D, Bratislava, 821 06, Slovenská republika	S-301
Radis d.o.o. PJ Radis Institut	Jovana Dučića, Istočno Sarajevo, 71123, Bosna i Hercegovina	-
SRL CIPC INCERC TEST	Bd. Dacia 38, ap. 336, Chisinau, MD 2060, Moldova	LÎ 125
STACHEMA Kolín s.r.o. - Zkušební laboratoř - pracoviště 1	Hasičská 1, Zibohlavy, Kolín, 28002, Česká republika	1433
STACHEMA Kolín s.r.o. - Zkušební laboratoř - pracoviště 2	Hasičská 1, Zibohlavy, Kolín, 28002, Česká republika	1433
Sibotec BV	Industriepark Oost 6, Beernem, 8730, Belgium	637
Skanska Transbeton, s.r.o. - Zkušební laboratoř Letňany	Skanska a.s., Křižíkova 682/34a, Praha 8 - Karlín, 186 00, Česká republika	1122
Skanska Transbeton, s.r.o. - Zkušební laboratoř Olomouc	Skanska a.s., Křižíkova 682/34a, Praha 8 - Karlín, 186 00, Česká republika	1122
Skanska a.s.	Křižíkova 682/34a, Praha 8- Karlín, 186 00, Česká republika	1355
Smart Minerals GmbH	Franz-Grill-Strasse 9, Vienna, 1030, Austria	-
TESScontrol, s. r. o. Oblastné laboratórium Zvolen Laboratórium Zvolen Hronská 1, 960 93 Zvolen	efaktury@tesscontrol.sk (alebo Hronská 3211/1), Zvolen, 960 93, Slovenská republika	S-375
TESTAV-LAB s.r.o.	Chodská 7, Liberec 3, 466 02, Česká republika	1180
TITAN CEMENT COMPANY S.A.	22A Halkidos street,, Athens, Greece, 111 43, Greece	-
TPA ČR, s.r.o.	Vrbenská 1821/31, České Budějovice, 370 06, Česká republika	1181

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Laboratory	Address	Accreditation number
TPA ČR, s.r.o. pracoviště č.4 Olomouc	Vrbenská 1821/31, České Budějovice, 370 06, Česká republika	1181
TRA EOOD CTC SOFIA	Rezbarska str. №7, SOFIA, 1510, BULGARIA	-
Technický a zkušební ústav stavební Praha, s. p., Centrální laboratoř - zkušebna Brno	Hněvkovského 77, Brno, 617 00, Česká republika	1018.3
UAB "Testlita"	Jankiskiu str. 39, Vilnius, LT-02300, Lithuania	LA.01.013
University of Zagreb Faculty of Civil Engineering	Fra Andrije Kačića Miošića 26, Zagreb, 10000, Croatia	-
VIALAB CZ s.r.o. - CL01 Krč	U Michelského lesa 1581/2, Praha 4, 140 00, Česká republika	L 1112
VIALAB CZ s.r.o. - CL12 Liberec	Piletická 498, Hradec Králové, 503 41, Česká republika	L 1112
Vysoké učení technické v Brně, Fakulta stavební, Zkušební laboratoř při ÚTHD FAST VUT v Brně	Veveří 331/95, Brno, 60200, Česká republika	L1396
Výzkumný ústav pozemních staveb - Certifikační společnost, s.r.o.	Pražská 16/810, Praha - Hostivař, 10200, Česká republika	AZL 1234
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	Čerčanská 2023/12, 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 **X**).
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 Strength and Durability of Hardened Concrete (PT Program) organized by the PT Provider at the SZK FAST. 66 participants (laboratories) took part in the PT Program. The program focused on ordinary standardized testing of hardened concrete with emphasis on its strength and durability. 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 3 shows the evaluation of the laboratory performance according to EN ISO/IEC 17043 [11].

Test procedures 7 and 8 were evaluated as a multilevel experiment. The level of the experiment was always composed of the number of freeze-thaw cycles. Laboratory performance was marked other than satisfactory only when critical z-score values were exceeded at two or more experiment levels.

Table 3: Evaluation of overall performance and outliers.

✓ – satisfactory performance; ? – questionable performance; ! – unsatisfactory performance;

X – outlier;

Table 3: Evaluation of participants performance

ID / Method	1	2	3	4	5	7	8	9
0928bf	✓	✓	-	-	✓	✓	-	-
0b8373	✓	✓	✓	-	-	-	-	-
0cc119	!	✓	-	-	-	-	-	-
0e9e26	✓	✓	-	-	-	-	-	-
113dff	✓	✓	✓	-	-	-	-	-
11467d	✓	-	-	-	-	-	-	-
14b514	-	-	X	-	-	-	-	✓
192705	✓	✓	✓	-	-	✓	-	-
1a28a8	-	✓	-	-	✓	✓	-	-
1a3903	✓	✓	-	-	-	-	-	-
1b0879	!	✓	-	-	-	-	-	-
1b5b6f	-	X	✓	-	-	-	-	✓
1c0489	-	-	-	-	-	✓	-	-
2085f6	-	-	?	-	-	-	-	-
22a7b7	✓	-	-	-	-	-	-	-
2a406f	✓	✓	✓	✓	-	-	✓	-
2c0b46	-	-	-	✓	-	-	-	-
2c5b91	✓	-	-	-	-	-	-	-
2e0f6c	-	-	✓	-	-	-	-	-
3084f9	✓	-	-	-	-	-	-	-
3a6254	✓	✓	✓	-	-	✓	-	-
420c1c	-	-	✓	-	-	-	-	-
5222e7	-	-	-	✓	-	✓	-	-
571843	✓	✓	✓	-	-	-	-	✓

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ID / Method	1	2	3	4	5	7	8	9
5a7133	✓	✓	✓	-	-	-	-	✓
5a9139	✓	✓	✓	-	✓	✓	-	-
6b8ef9	✓	✓	✓	-	-	-	✓	-
754435	✓	-	✓	-	✓	-	-	-
7a413d	✓	✓	-	-	-	-	-	-
7c0f45	✓	✓	✓	-	-	-	-	✓
7d4927	✓	✓	✓	-	-	✓	-	-
816a9c	✓	✓	-	-	-	-	-	-
817af7	✓	-	✓	-	-	-	-	-
8302e7	✓	✓	✓	-	-	✓	✓	-
896852	-	-	-	✓	-	-	-	-
89e2dd	✓	✓	✓	-	-	✓	-	-
8ef05a	✓	✓	✓	-	-	-	✓	-
9068a9	-	-	-	-	-	✓	-	-
907694	✓	-	?	-	-	-	-	-
92cb03	-	✓	-	-	-	✓	-	-
a4c504	✓	-	-	-	-	-	-	-
a6af84	-	-	-	-	-	-	-	✓
a9f454	✓	✓	✓	-	✓	-	✓	-
b001e1	-	-	-	-	✓	-	-	-
b5198d	-	-	-	-	-	✓	-	-
b61aa5	✓	-	✓	-	-	-	-	✓
b7ccd2	✓	✓	✓	-	-	-	-	✓
c0f9d3	-	-	✓	-	-	-	-	-
c2d631	-	-	-	-	-	-	-	✓
c427f0	✓	✓	-	-	✓	✓	-	-
c86e46	✓	-	-	-	-	✓	✓	-
d1d5e3	✓	✓	✓	✓	-	-	✓	-
d27d88	✓	✓	-	-	-	-	-	-
d29ff7	-	-	-	-	-	✓	✓	-
d7328e	-	-	✓	-	-	-	-	✓
d85200	✓	✓	-	-	-	-	-	-
d8e44d	-	-	-	-	✓	-	-	-
db5ed0	✓	✓	✓	-	-	✓	-	-
dc2389	✓	✓	✓	-	-	-	-	-
dcc466	✓	-	-	-	-	-	-	-
dd65a7	✓	✓	✓	-	-	-	-	-

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ID / Method	1	2	3	4	5	7	8	9
e08293	✓	✓	✓	-	-	-	-	✓
e6a816	✓	✓	-	-	-	-	-	-
fbf08a	✓	-	✓	-	-	✓	-	-
fe6f4d	?	-	-	-	-	-	-	-
ff601a	✓	✓	-	-	-	-	-	-

References

- [1] EN 12390-3. *Testing hardened concrete - Part 3: Compressive strength of test specimens*. 2020.
- [2] EN 12390-7. *Testing hardened concrete - Part 7: Density of hardened concrete*. 2020.
- [3] EN 12390-8. *Testing hardened concrete - Part 8: Depth of penetration of water under pressure*. 2020.
- [4] EN 480-11. *Admixtures for concrete, mortar and grout - Test methods - Part 11: Determination of air void characteristics in hardened concrete*. 2006.
- [5] ČSN 73 1322. *Determination of frost resistance of concrete*. 2003.
- [6] ČSN 73 1324. *Determination of grindability of concrete*. 2003.
- [7] ČSN 73 1326. *Resistance of cement concrete surface to water and defrosting chemicals*. 2003.
- [8] CEN/TS 12390-9. *Testing hardened concrete - Part 9: Freeze-thaw resistance - Scaling*. 2007.
- [9] EN 206:2013+A2:2021. *Concrete - Specification, performance, production and conformity*. 2021.
- [10] 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.
- [11] EN ISO/IEC 17043. *Conformity assessment - General requirements for proficiency testing*. 2010.

1 Appendix – EN 12390-3 – Compressive strength of test specimens

1.1 Test results

Table 4: Test results – ordered by average value. Outliers are marked by red color. Columns 1–3 are individual determinations; u_X – extended uncertainty of measurement; $\bar{x}$ – average value; s_0 – sample standard deviation; V_X – variation coefficient

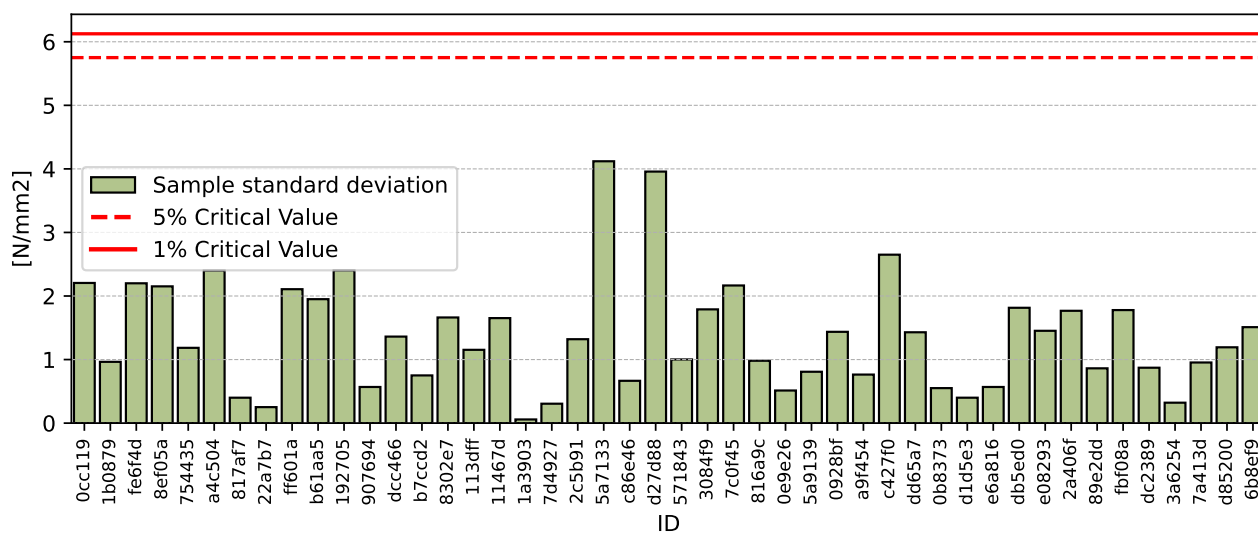
ID	1 [N/mm ²]	2 [N/mm ²]	3 [N/mm ²]	u_X [N/mm ²]	$\bar{x}$ [N/mm ²]	s_0 [N/mm ²]	V_X [%]
0cc119	50.1	48.8	53.1	4.70	50.7	2.21	4.35
1b0879	50.0	51.5	51.8	0.35	51.1	0.96	1.89
fe6f4d	52.1	56.5	54.3	1.00	54.3	2.20	4.05
8ef05a	60.5	58.5	56.2	5.70	58.4	2.15	3.68
754435	58.5	60.5	60.6	-	59.9	1.18	1.98
a4c504	61.8	59.4	64.2	-	61.8	2.40	3.88
817af7	62.2	61.8	62.6	0.20	62.2	0.40	0.64
22a7b7	62.9	63.4	63.1	0.40	63.1	0.25	0.40
ff601a	65.4	61.2	63.0	2.30	63.2	2.11	3.33
b61aa5	61.6	63.5	65.5	-	63.5	1.95	3.07
192705	64.1	61.9	66.7	-	64.2	2.40	3.74
907694	64.2	65.0	63.9	1.20	64.4	0.57	0.88
dcc466	63.0	65.0	65.6	1.30	64.5	1.36	2.11
b7ccd2	64.2	64.2	65.5	-	64.6	0.75	1.16
8302e7	66.6	63.3	64.6	1.60	64.8	1.66	2.56
113dff	64.2	64.7	66.4	2.80	65.1	1.15	1.77
11467d	63.5	66.5	66.2	3.40	65.4	1.65	2.53
1a3903	65.5	65.6	65.6	4.81	65.6	0.06	0.09
7d4927	65.3	65.7	65.9	3.00	65.6	0.31	0.47
2c5b91	67.1	66.2	64.5	1.10	65.9	1.32	2.00
5a7133	62.3	65.7	70.5	4.82	66.2	4.12	6.23
c86e46	65.8	66.7	67.1	3.30	66.5	0.67	1.00
d27d88	62.6	69.9	68.9	1.90	67.1	3.96	5.90
571843	66.7	68.2	68.6	-	67.8	1.00	1.48
3084f9	67.6	70.0	66.5	6.80	68.0	1.79	2.63
7c0f45	70.1	68.4	65.8	2.74	68.1	2.17	3.18
816a9c	68.7	67.0	68.7	0.60	68.1	0.98	1.44
0e9e26	68.8	67.8	68.1	3.20	68.2	0.51	0.75
5a9139	68.2	69.2	67.6	-	68.3	0.81	1.18
0928bf	69.5	66.8	69.0	3.80	68.4	1.44	2.10
a9f454	69.3	68.3	67.8	2.70	68.5	0.76	1.12
c427f0	70.7	65.6	69.4	6.50	68.6	2.65	3.87
dd65a7	68.3	70.2	67.4	2.50	68.6	1.43	2.08
0b8373	68.6	69.5	68.5	1.80	68.9	0.55	0.80
d1d5e3	69.0	68.6	69.4	2.40	69.0	0.40	0.58
e6a816	68.7	69.8	69.0	2.40	69.2	0.57	0.82
db5ed0	71.2	67.6	69.0	2.20	69.3	1.81	2.62
e08293	70.9	69.6	68.0	-	69.5	1.45	2.09
2a406f	68.9	68.6	71.8	4.80	69.8	1.77	2.53

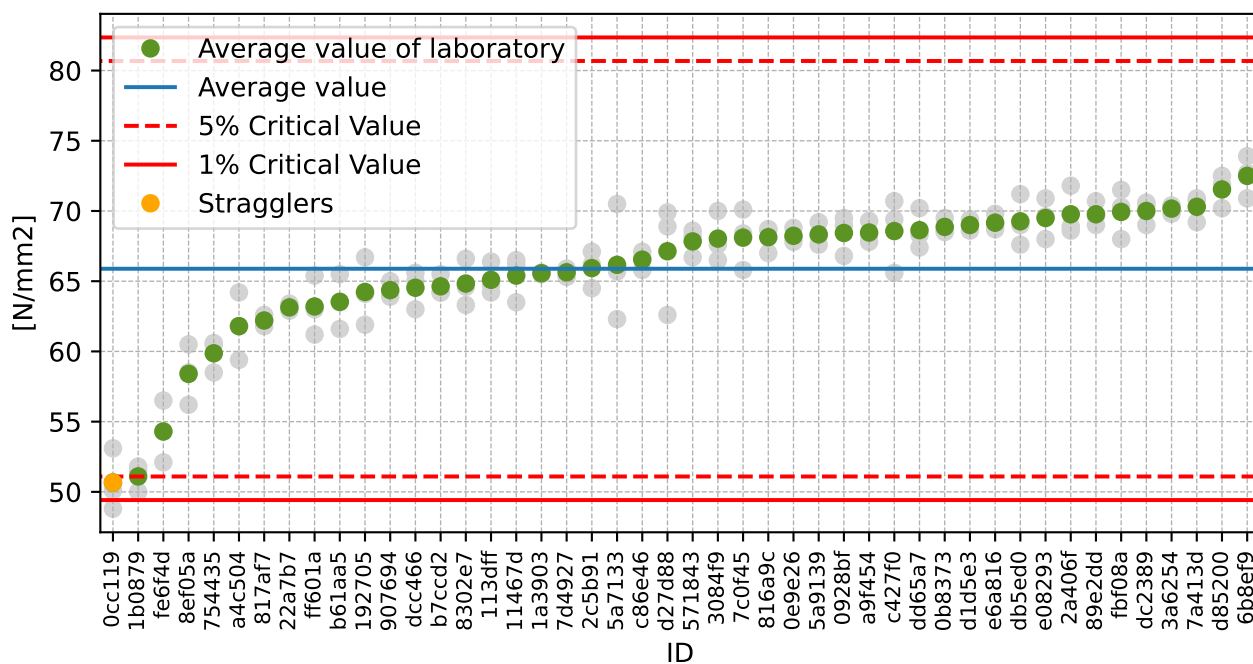
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ID	1 [N/mm ²]	2 [N/mm ²]	3 [N/mm ²]	u_x [N/mm ²]	$\bar{x}$ [N/mm ²]	s_0 [N/mm ²]	V_x [%]
89e2dd	69.0	69.6	70.7	2.20	69.8	0.86	1.24
fbf08a	71.5	70.3	68.0	5.60	69.9	1.78	2.54
dc2389	70.4	69.0	70.6	1.80	70.0	0.87	1.25
3a6254	70.3	69.8	70.4	3.90	70.2	0.32	0.46
7a413d	69.2	70.8	70.9	3.20	70.3	0.95	1.36
d85200	70.2	72.5	71.9	0.50	71.5	1.19	1.67
6b8ef9	72.7	70.9	73.9	2.00	72.5	1.51	2.08

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

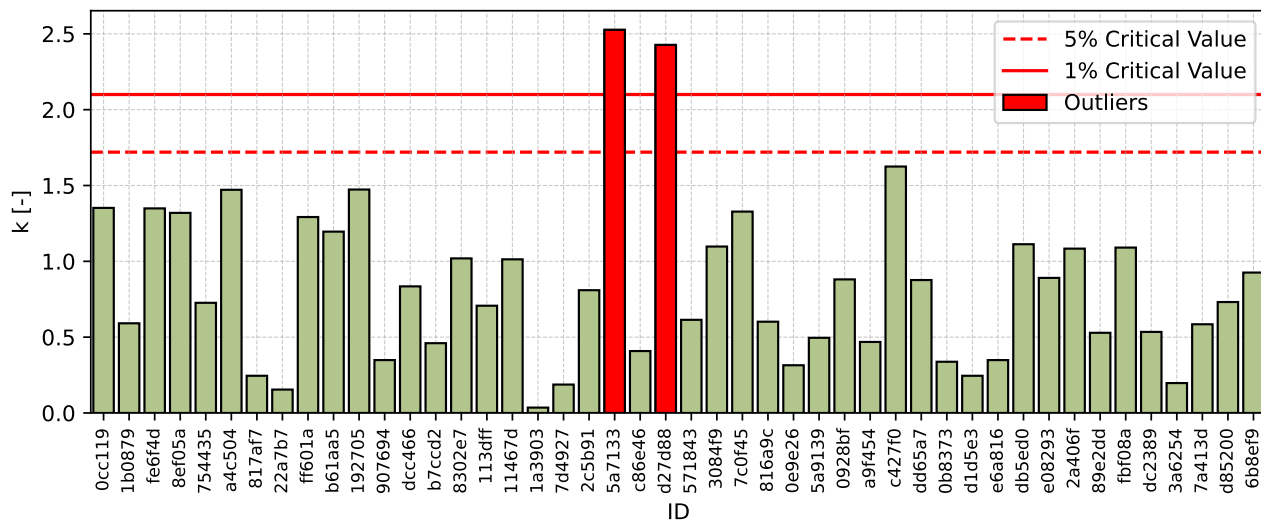


Figure 3: Intralaboratory Consistency Statistic

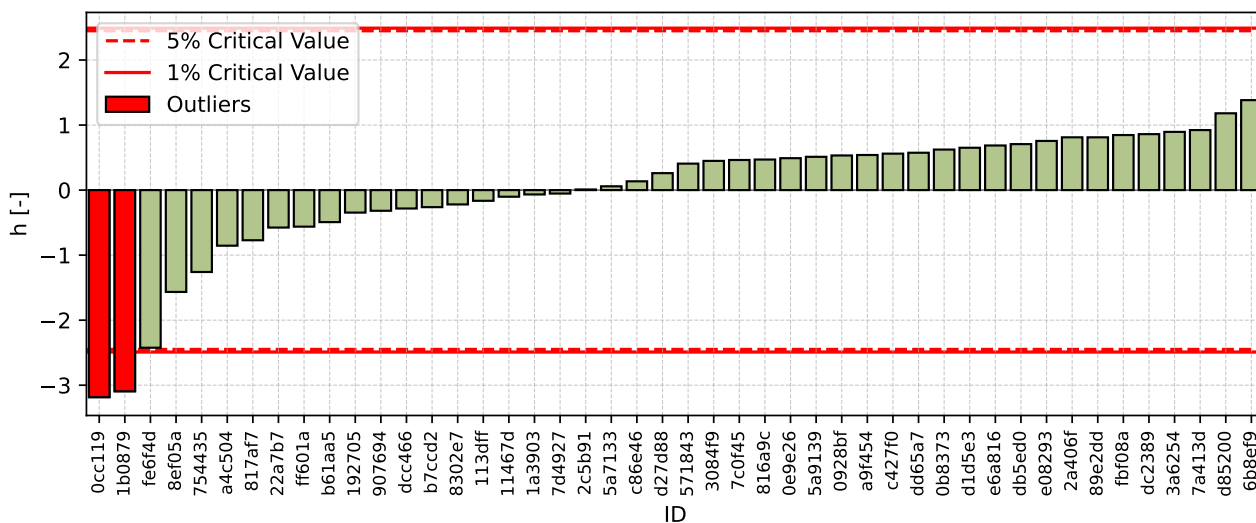


Figure 4: Interlaboratory Consistency Statistic

1.4 Descriptive statistics

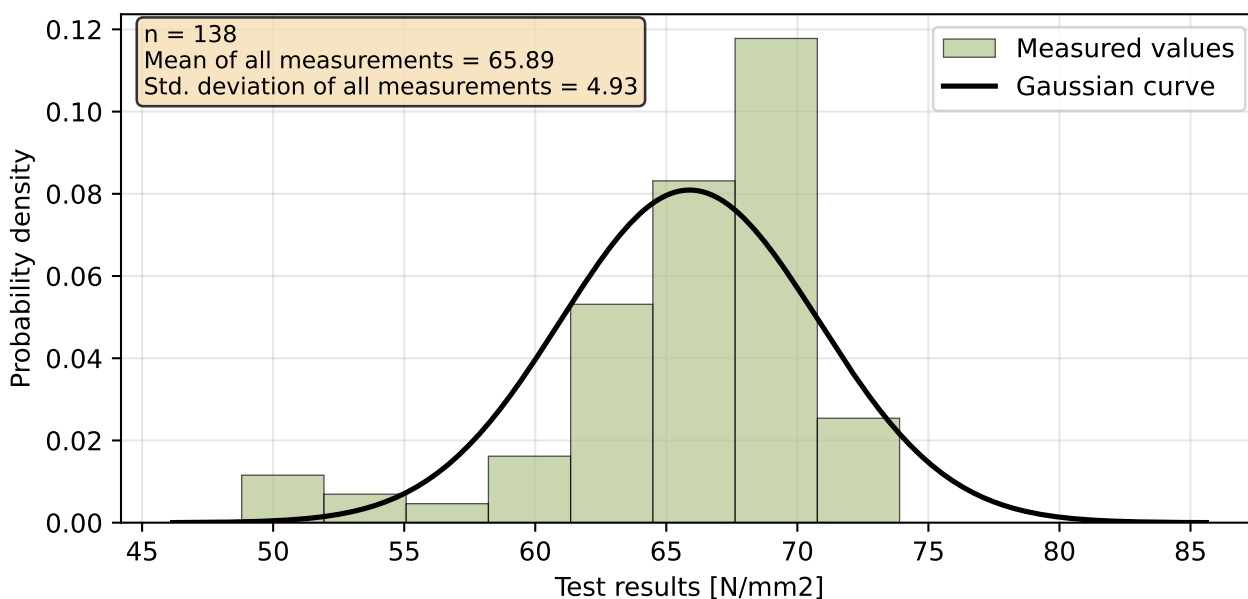


Figure 5: Histogram of all test results

Table 5: Descriptive statistics

Characteristics	[N/mm ²]
Average value – $\bar{x}$	65.89
Sample standard deviation – s	4.78
Assigned value – x^*	65.89
Robust standard deviation – s^*	4.78
Measurement uncertainty of assigned value – u_X	0.70
p -value of normality test [-]	< 0.001
Interlaboratory standard deviation – s_L	4.69
Repeatability standard deviation – s_r	1.63
Reproducibility standard deviation – s_R	4.96
Repeatability – r	4.57
Reproducibility – R	13.90

1.5 Evaluation of Performance Statistics

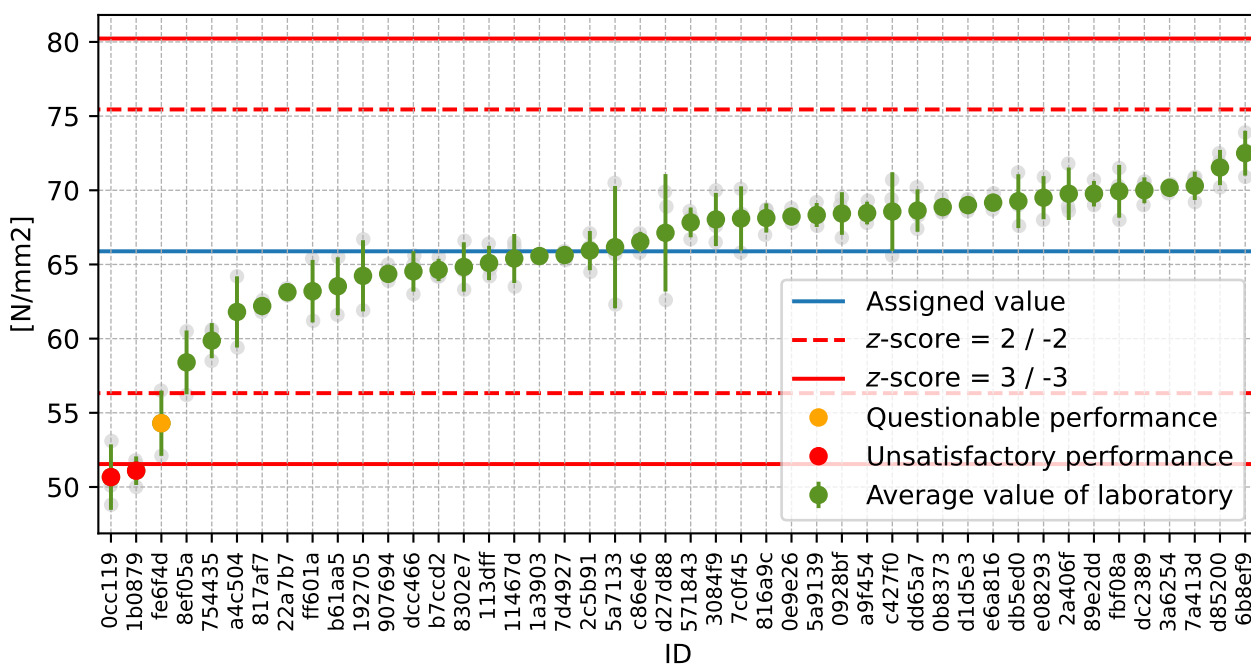


Figure 6: Average values and sample standard deviations

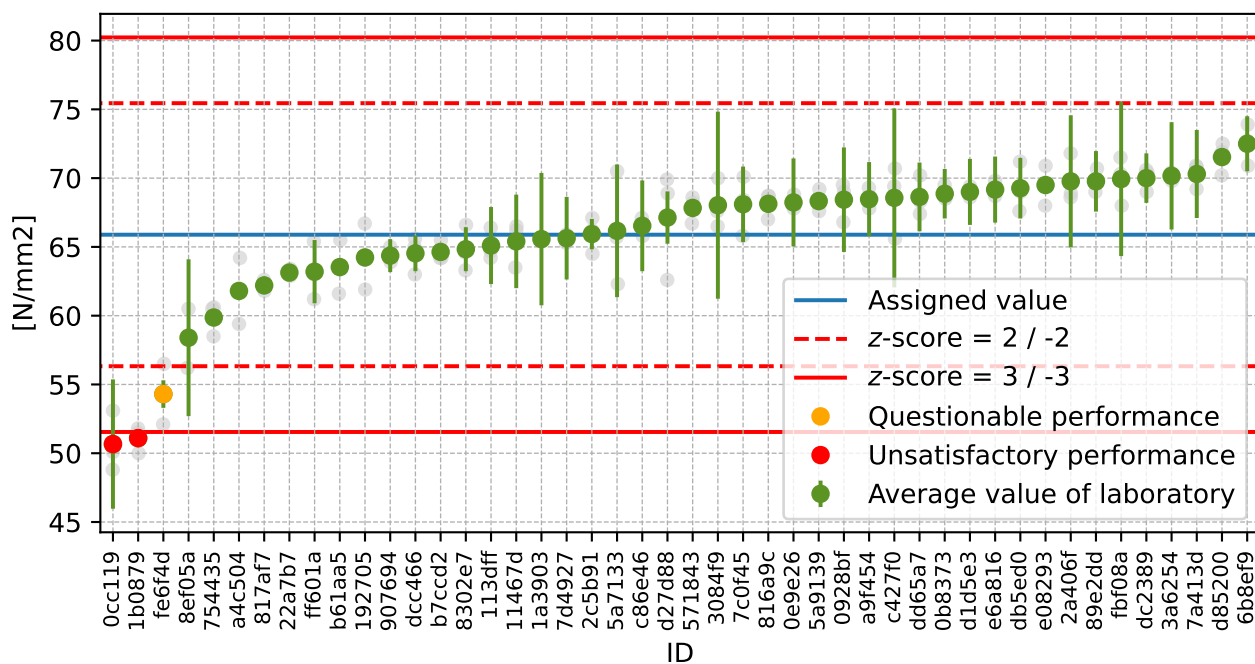


Figure 7: Average values and extended uncertainties of measurement

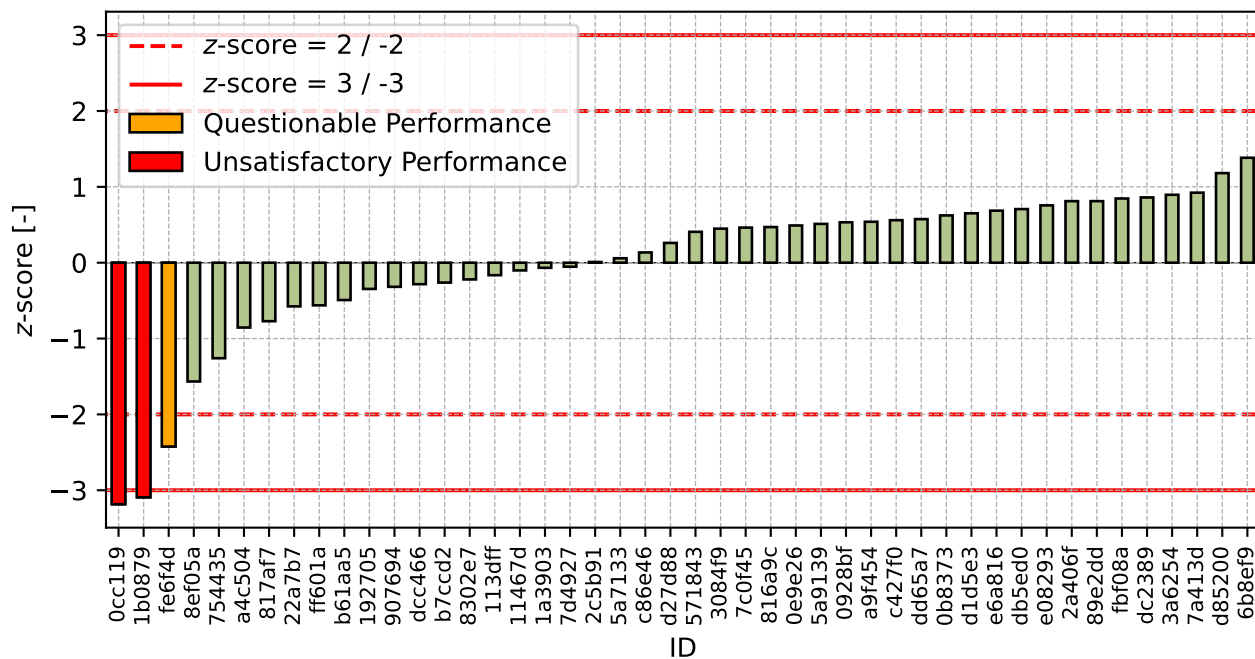
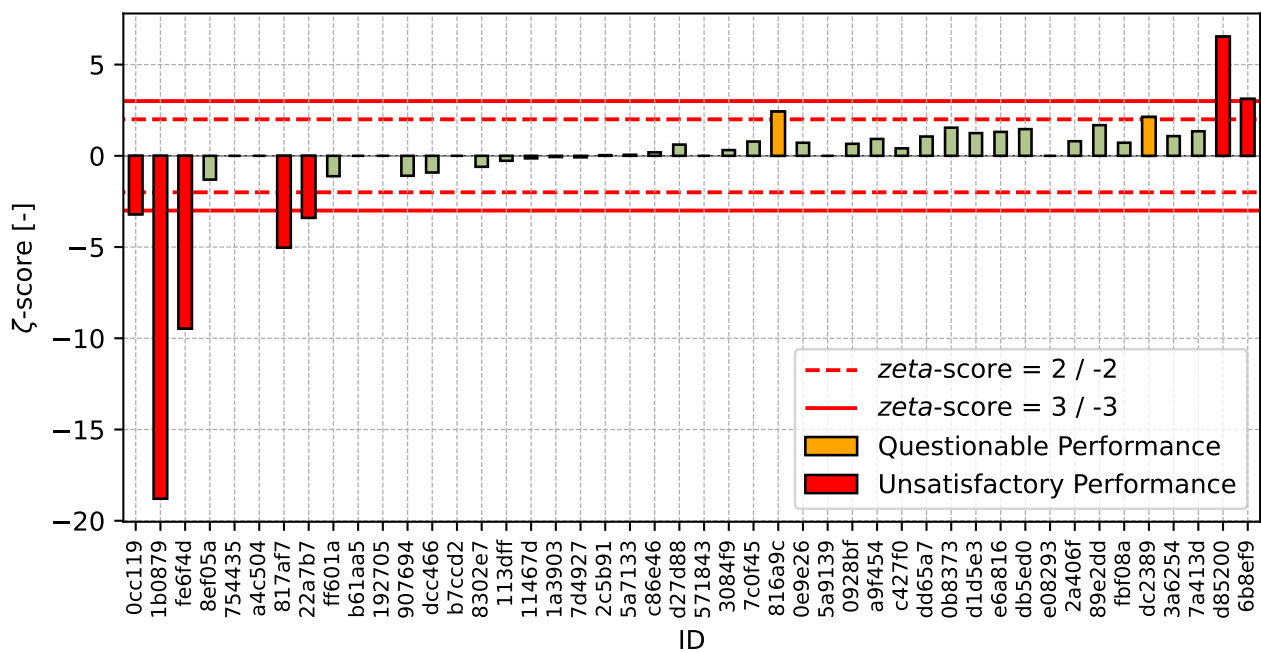


Figure 8: z-score

Figure 9: ζ -scoreTable 6: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
0cc119	-3.18	-3.20
1b0879	-3.09	-18.79
fe6f4d	-2.42	-9.47
8ef05a	-1.57	-1.30
754435	-1.26	-
a4c504	-0.85	-
817af7	-0.77	-5.03
22a7b7	-0.58	-3.40
ff601a	-0.56	-1.12
b61aa5	-0.49	-
192705	-0.35	-
907694	-0.32	-1.09
dcc466	-0.28	-0.92
b7ccd2	-0.26	-
8302e7	-0.22	-0.60
113dff	-0.16	-0.27
11467d	-0.10	-0.14
1a3903	-0.07	-0.07
7d4927	-0.05	-0.08
2c5b91	0.01	0.04
5a7133	0.06	0.06
c86e46	0.14	0.19
d27d88	0.26	0.62
571843	0.41	-
3084f9	0.45	0.31

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ID	z-score [-]	ζ-score [-]
7c0f45	0.46	0.78
816a9c	0.47	2.43
0e9e26	0.49	0.72
5a9139	0.51	-
0928bf	0.53	0.66
a9f454	0.54	0.92
c427f0	0.56	0.41
dd65a7	0.57	1.06
0b8373	0.62	1.54
d1d5e3	0.65	1.24
e6a816	0.69	1.31
db5ed0	0.71	1.46
e08293	0.76	-
2a406f	0.81	0.80
89e2dd	0.81	1.68
fbf08a	0.85	0.72
dc2389	0.86	2.13
3a6254	0.90	1.08
7a413d	0.92	1.35
d85200	1.18	6.53
6b8ef9	1.38	3.12

2 Appendix – EN 12390-7 – Density of hardened concrete

2.1 Test results

Table 7: Test results – ordered by average value. Outliers are marked by red color. Columns 1–3 are individual determinations; u_X – extended uncertainty of measurement; $\bar{x}$ – average value; s_0 – sample standard deviation; V_X – variation coefficient

ID	1 [kg/m ³]	2 [kg/m ³]	3 [kg/m ³]	u_X [kg/m ³]	$\bar{x}$ [kg/m ³]	s_0 [kg/m ³]	V_X [%]
1b5b6f	2190	2220	2220	-	2210	17.3	0.78
92cb03	2330	2340	2320	-	2330	10.0	0.43
5a7133	2350	2330	2330	60.0	2337	11.5	0.49
6b8ef9	2350	2330	2330	20.0	2337	11.5	0.49
3a6254	2330	2330	2350	20.0	2337	11.5	0.49
5a9139	2333	2339	2345	-	2339	6.0	0.26
ff601a	2360	2340	2330	20.0	2343	15.3	0.65
0928bf	2340	2360	2330	47.0	2343	15.3	0.65
1a28a8	2340	2340	2350	40.0	2343	5.8	0.25
816a9c	2350	2348	2340	3.1	2346	5.3	0.23
dc2389	2340	2350	2350	20.0	2347	5.8	0.25
dd65a7	2340	2350	2350	12.0	2347	5.8	0.25
7d4927	2340	2360	2340	40.0	2347	11.5	0.49
192705	2340	2360	2340	-	2347	11.5	0.49
571843	2340	2350	2360	-	2350	10.0	0.43
c427f0	2350	2360	2340	30.0	2350	10.0	0.43
8302e7	2340	2350	2360	60.0	2350	10.0	0.43
0cc119	2341	2351	2364	21.2	2352	11.5	0.49
2a406f	2350	2370	2350	32.0	2357	11.5	0.49
d1d5e3	2350	2360	2360	20.0	2357	5.8	0.24
e6a816	2350	2360	2360	20.0	2357	5.8	0.24
1b0879	2344	2355	2373	24.0	2357	14.6	0.62
a9f454	2360	2360	2360	10.0	2360	0.0	0.00
0b8373	2360	2350	2370	28.0	2360	10.0	0.42
113dff	2350	2380	2360	25.0	2363	15.3	0.65
0e9e26	2366	2362	2365	21.0	2364	2.1	0.09
7c0f45	2365	2372	2358	147.0	2365	7.0	0.30
d27d88	2365	2361	2370	32.0	2365	4.5	0.19
1a3903	2360	2370	2370	35.8	2367	5.8	0.24
8ef05a	2346	2384	2370	21.0	2367	19.2	0.81
db5ed0	2380	2370	2360	20.0	2370	10.0	0.42
7a413d	2388	2361	2371	21.0	2373	13.7	0.58
b7ccd2	2368	2379	2382	-	2376	7.4	0.31
89e2dd	2370	2380	2380	20.0	2377	5.8	0.24
d85200	2380	2370	2380	5.0	2377	5.8	0.24
e08293	2370	2380	2380	-	2377	5.8	0.24

2.2 The Numerical Procedure for Determining Outliers

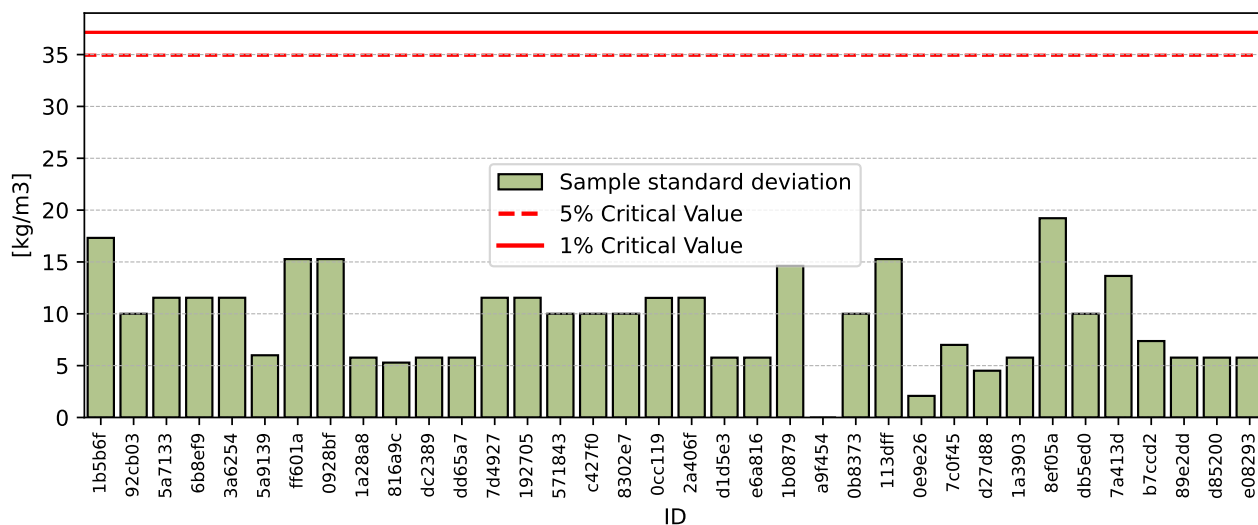


Figure 10: **Cochran's test** - sample standard deviations

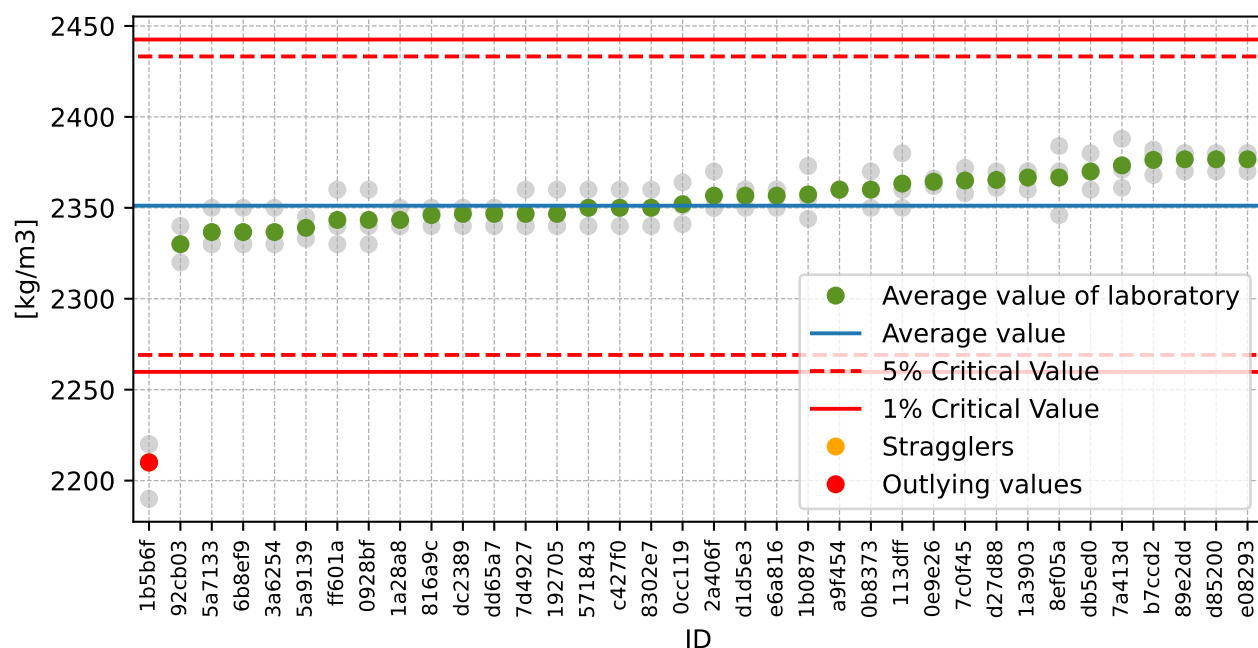
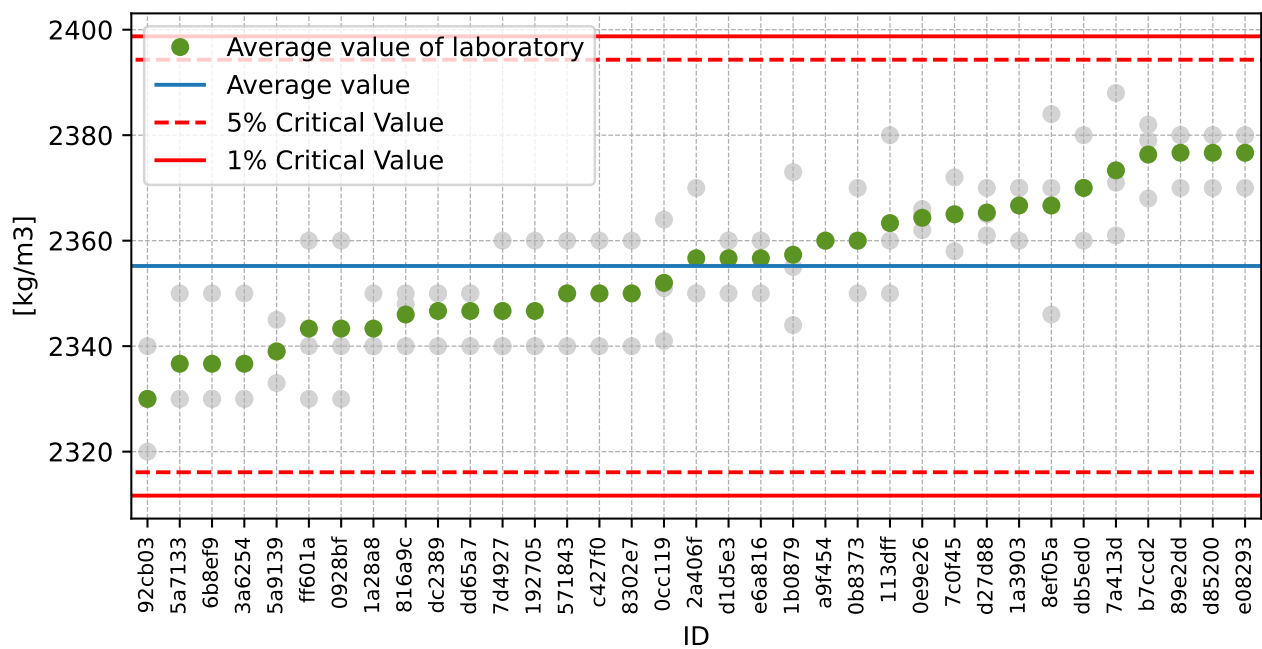


Figure 11: **Grubbs' test** - average values

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

2.3 Mandel's Statistics

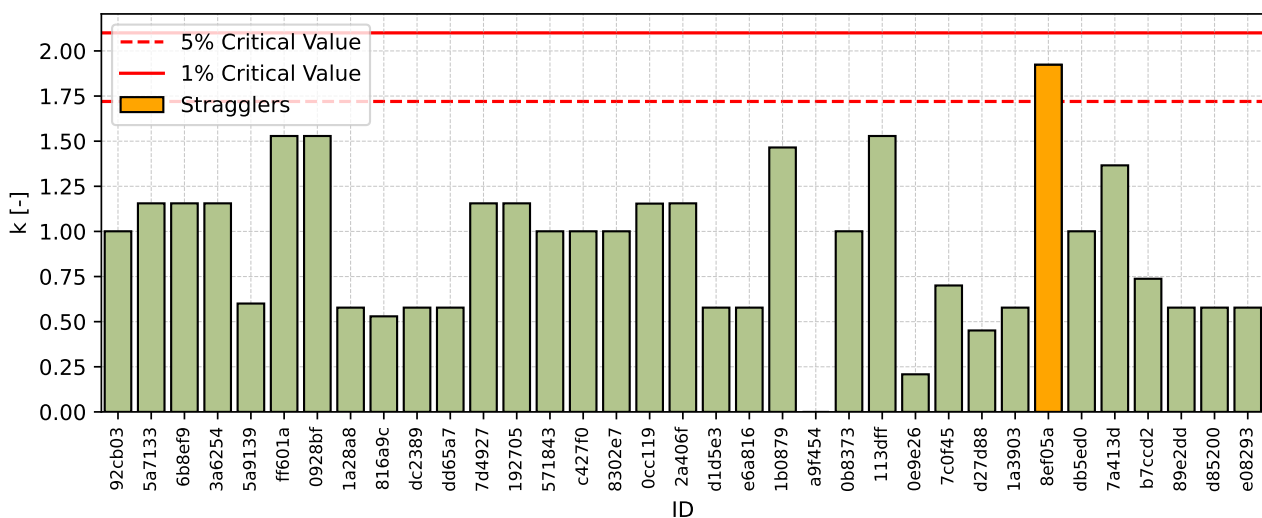


Figure 13: Intralaboratory Consistency Statistic

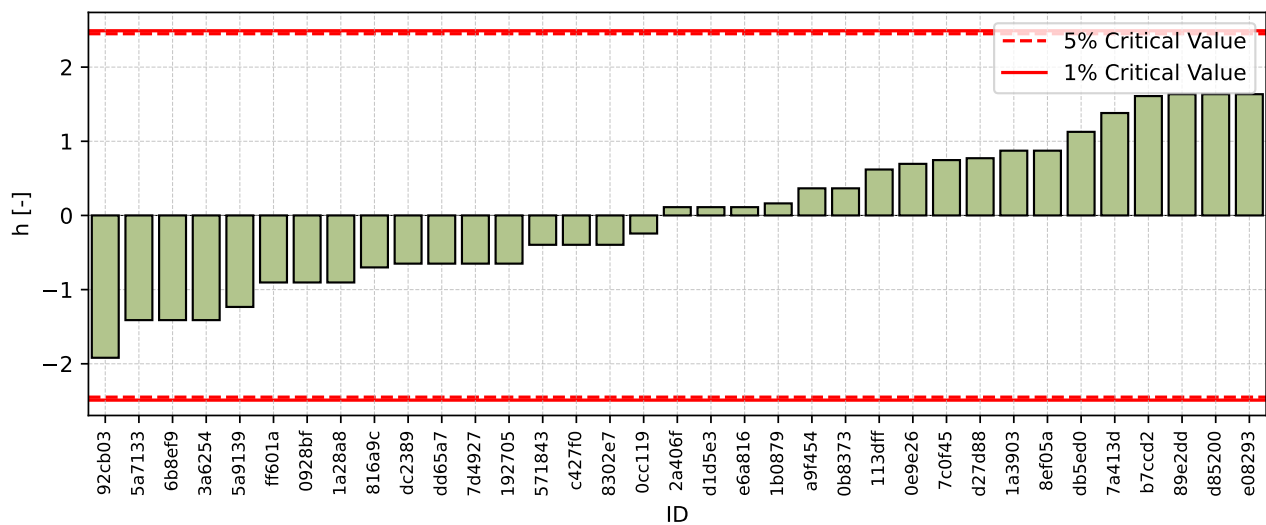


Figure 14: Interlaboratory Consistency Statistic

2.4 Descriptive statistics

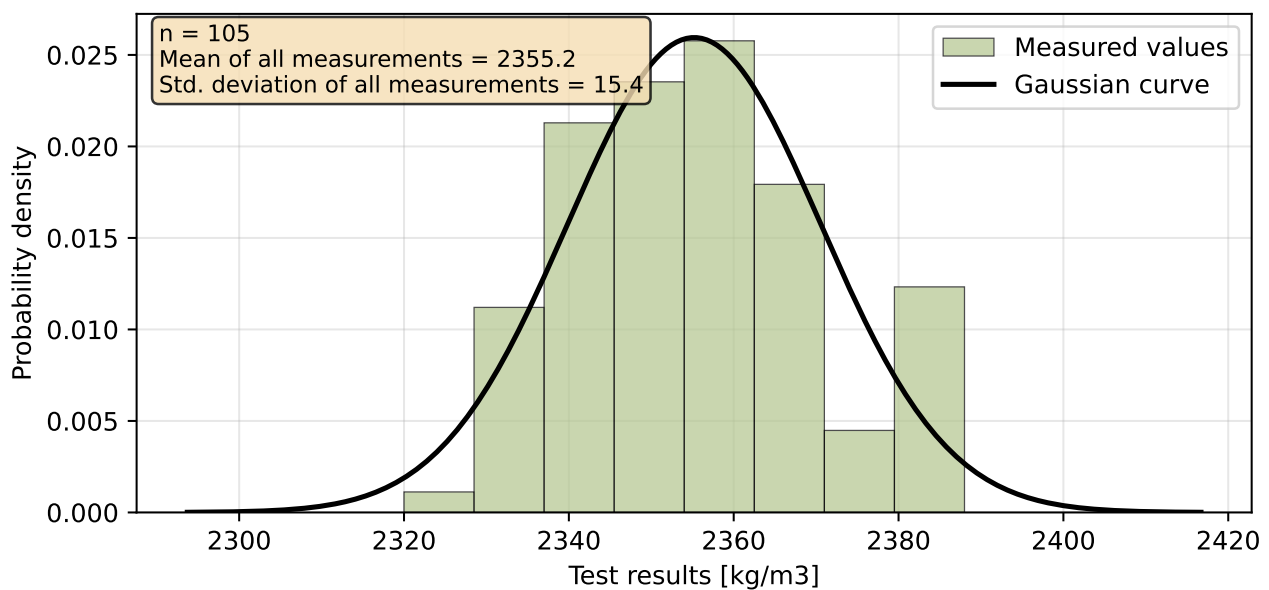


Figure 15: Histogram of all test results

Table 8: Descriptive statistics

Characteristics	[kg/m ³]
Average value – $\bar{x}$	2355.2
Sample standard deviation – s	13.1
Assigned value – x^*	2355.2
Robust standard deviation – s^*	13.1
Measurement uncertainty of assigned value – u_x	2.2
p -value of normality test [-]	0.009

2.5 Evaluation of Performance Statistics

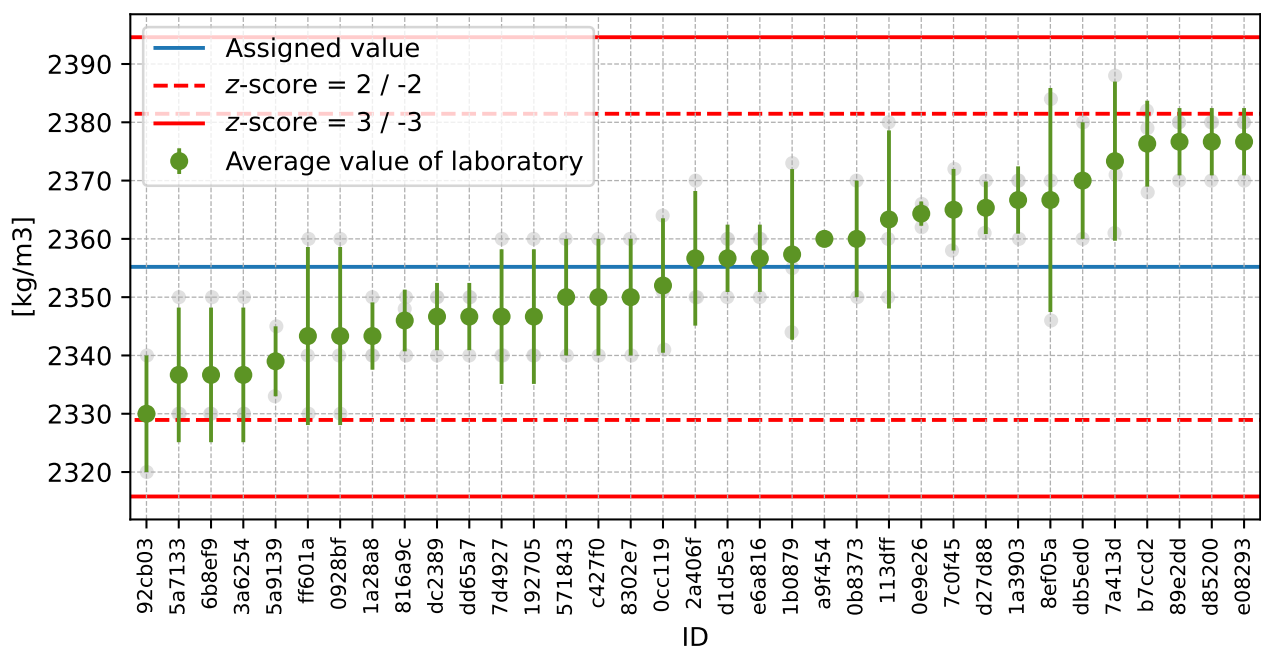


Figure 16: Average values and sample standard deviations

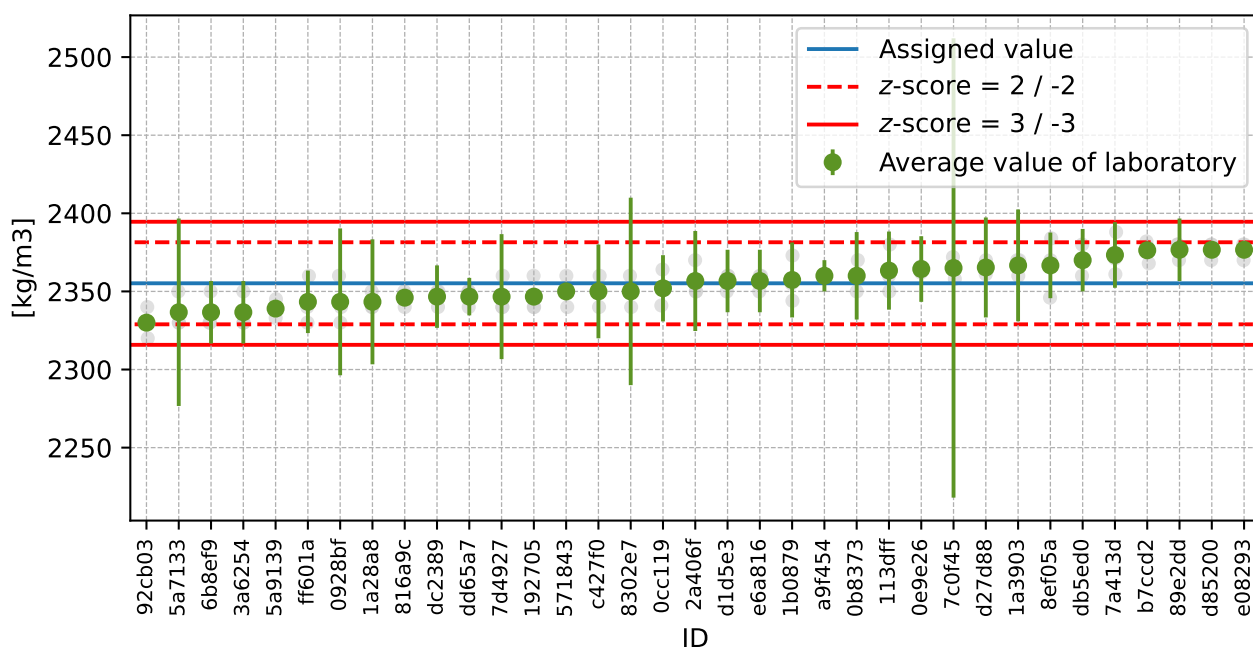


Figure 17: Average values and extended uncertainties of measurement

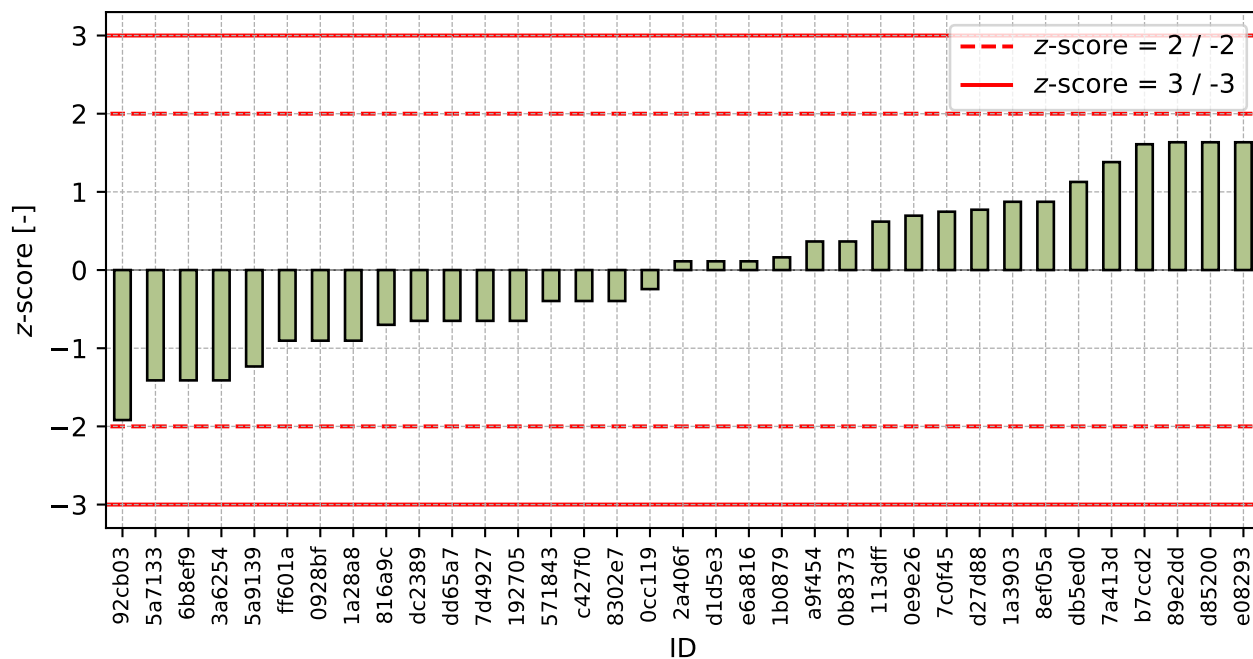
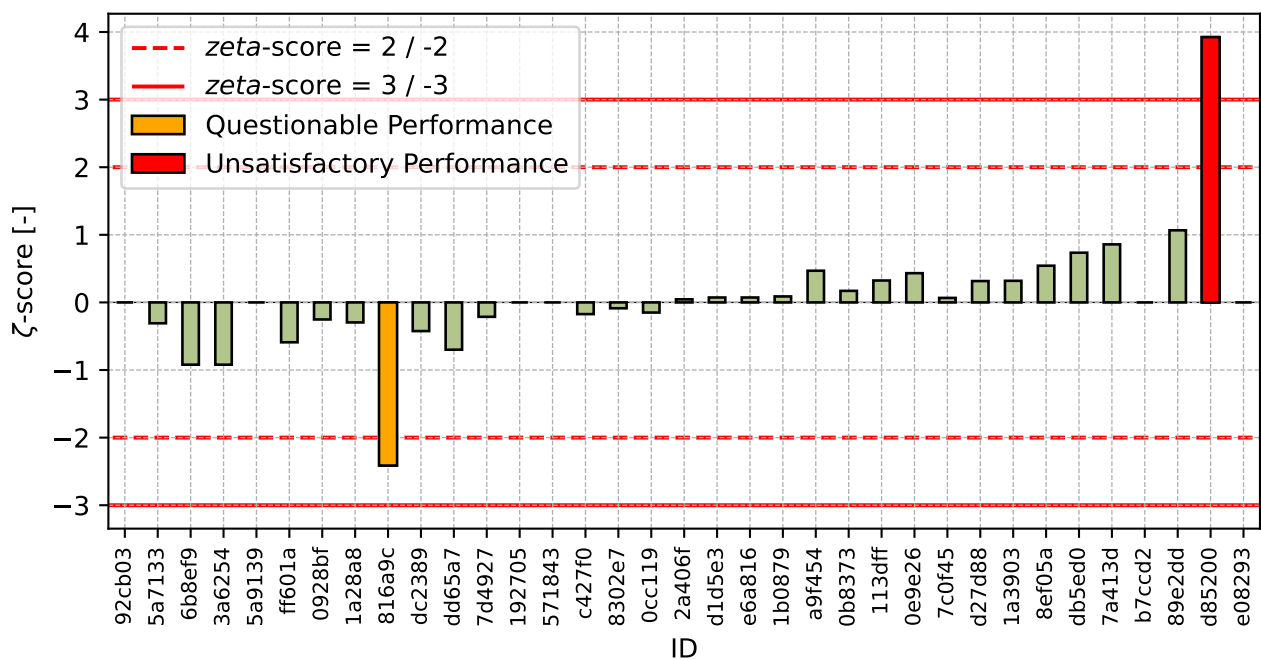


Figure 18: z-score

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

ID	z-score [-]	ζ -score [-]
92cb03	-1.92	-
5a7133	-1.41	-0.31
6b8ef9	-1.41	-0.92
3a6254	-1.41	-0.92
5a9139	-1.23	-
ff601a	-0.90	-0.59
0928bf	-0.90	-0.25
1a28a8	-0.90	-0.30
816a9c	-0.70	-2.41
dc2389	-0.65	-0.42
dd65a7	-0.65	-0.70
7d4927	-0.65	-0.21
192705	-0.65	-
571843	-0.40	-
c427f0	-0.40	-0.17
8302e7	-0.40	-0.09
0cc119	-0.24	-0.15
2a406f	0.11	0.05
d1d5e3	0.11	0.07
e6a816	0.11	0.07
1b0879	0.16	0.09
a9f454	0.37	0.47
0b8373	0.37	0.17
113dff	0.62	0.32
0e9e26	0.70	0.43
7c0f45	0.75	0.07
d27d88	0.77	0.32

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ID	z-score [-]	ζ-score [-]
1a3903	0.87	0.32
8ef05a	0.87	0.54
db5ed0	1.13	0.74
7a413d	1.38	0.86
b7ccd2	1.61	-
89e2dd	1.63	1.07
d85200	1.63	3.92
e08293	1.63	-

3 Appendix – EN 12390-8 – Depth of penetration of water under pressure

3.1 Test results

Table 10: Test results – ordered by average value. Outliers are marked by red color. Columns 1–3 are individual determinations; u_X – extended uncertainty of measurement; $\bar{x}$ – average value; s_0 – sample standard deviation; V_X – variation coefficient

ID	1 [mm]	2 [mm]	3 [mm]	u_X [mm]	$\bar{x}$ [mm]	s_0 [mm]	V_X [%]
2085f6	0	0	0	2.0	0	0.0	0.00
fbf08a	4	4	4	1.0	4	0.0	0.00
7c0f45	3	4	7	1.0	5	2.1	44.61
5a7133	7	5	7	1.3	6	1.2	18.23
3a6254	5	7	7	2.0	6	1.2	18.23
754435	6	8	6	-	7	1.2	17.32
0b8373	7	6	7	2.4	7	0.6	8.66
2a406f	8	7	8	2.4	8	0.6	7.53
e08293	8	10	9	-	9	1.0	11.11
7d4927	7	9	11	6.0	9	2.0	22.22
db5ed0	9	8	11	3.0	9	1.5	16.37
a9f454	8	12	10	2.0	10	2.0	20.00
192705	8	13	9	-	10	2.6	26.46
dc2389	9	11	12	0.5	11	1.5	14.32
d1d5e3	10	12	11	0.8	11	1.0	9.09
dd65a7	11	12	10	1.0	11	1.0	9.09
5a9139	13	10	12	-	12	1.5	13.09
6b8ef9	12	13	11	0.5	12	1.0	8.33
817af7	18	12	9	2.6	13	4.6	35.25
8302e7	11	15	13	1.0	13	2.0	15.38
420c1c	14	13	13	0.7	13	0.6	4.33
8ef05a	12	16	12	0.1	13	2.3	17.32
89e2dd	12	16	13	3.0	14	2.1	15.23
571843	17	15	12	-	15	2.5	17.16
d7328e	14	13	17	2.0	15	2.1	14.19
2e0f6c	15	15	18	5.0	16	1.7	10.83
b61aa5	12	14	23	16.3	16	5.9	35.87
c0f9d3	19	14	16	1.0	16	2.5	15.41
113dff	14	19	17	2.6	17	2.5	15.10
b7ccd2	16	19	20	-	18	2.1	11.35
1b5b6f	23	18	17	-	19	3.2	16.63
907694	22	19	28	3.0	23	4.6	19.92
14b514	48	54	56	-	53	4.2	7.91

3.2 The Numerical Procedure for Determining Outliers

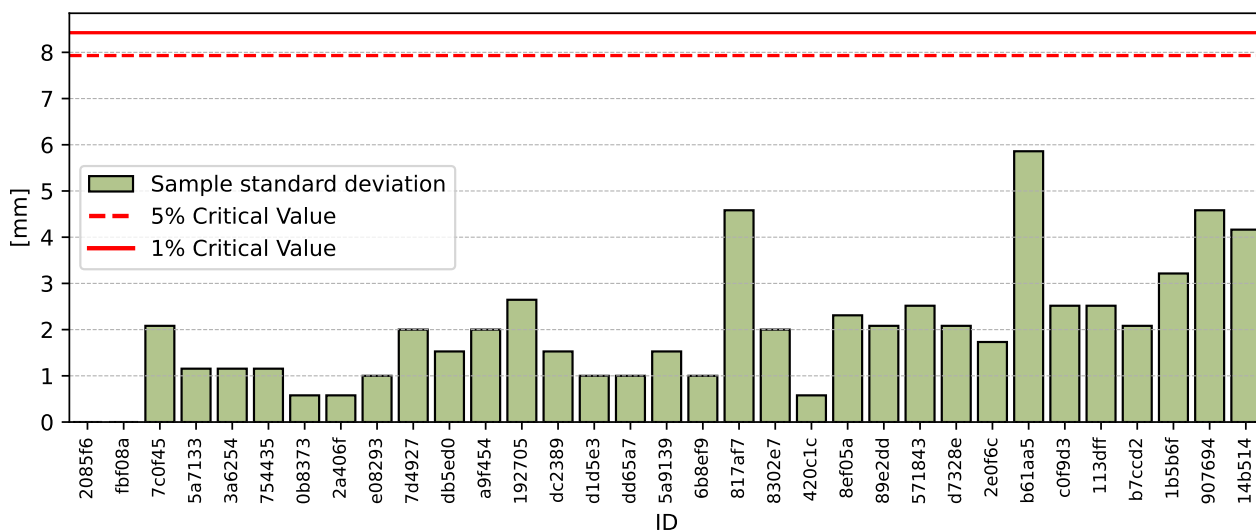


Figure 20: **Cochran's test** - sample standard deviations

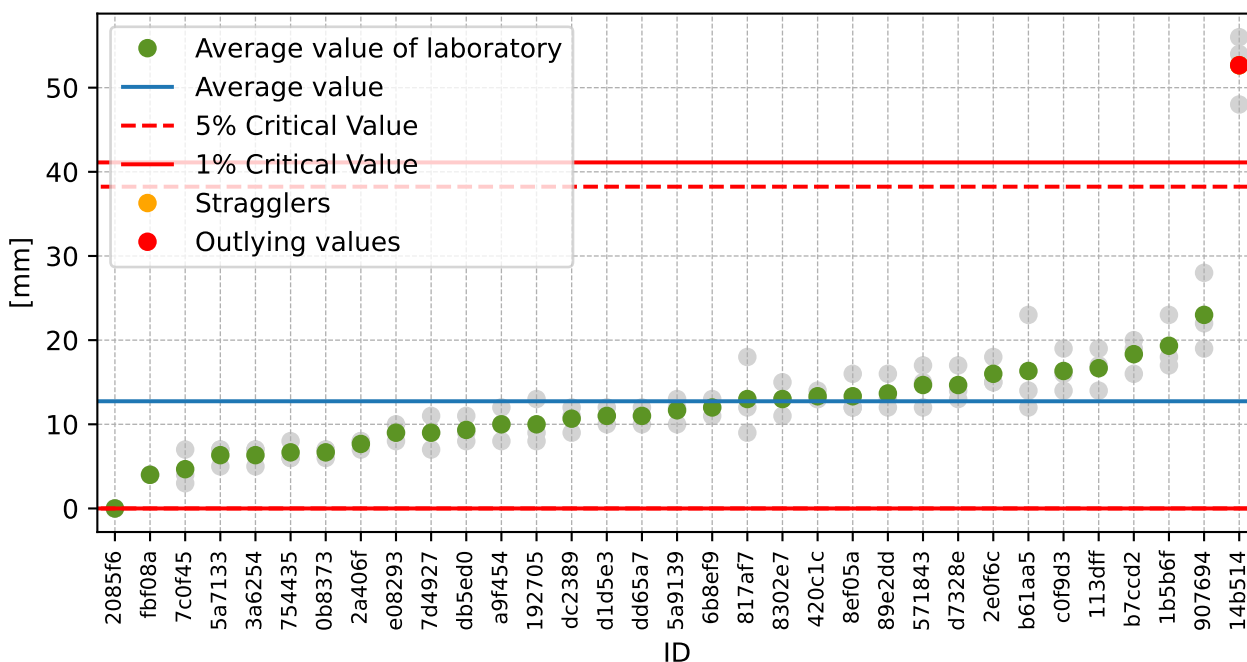
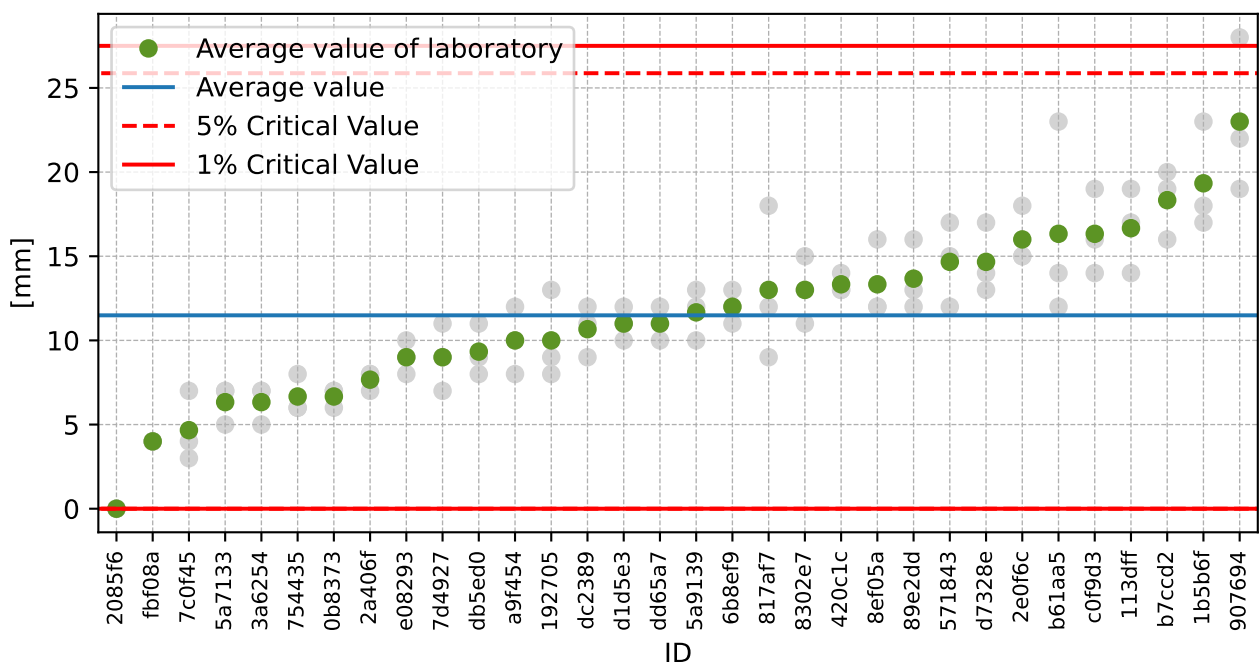


Figure 21: **Grubbs' test** - average values

Figure 22: **Grubbs' test** - average values without outliers

3.3 Mandel's Statistics

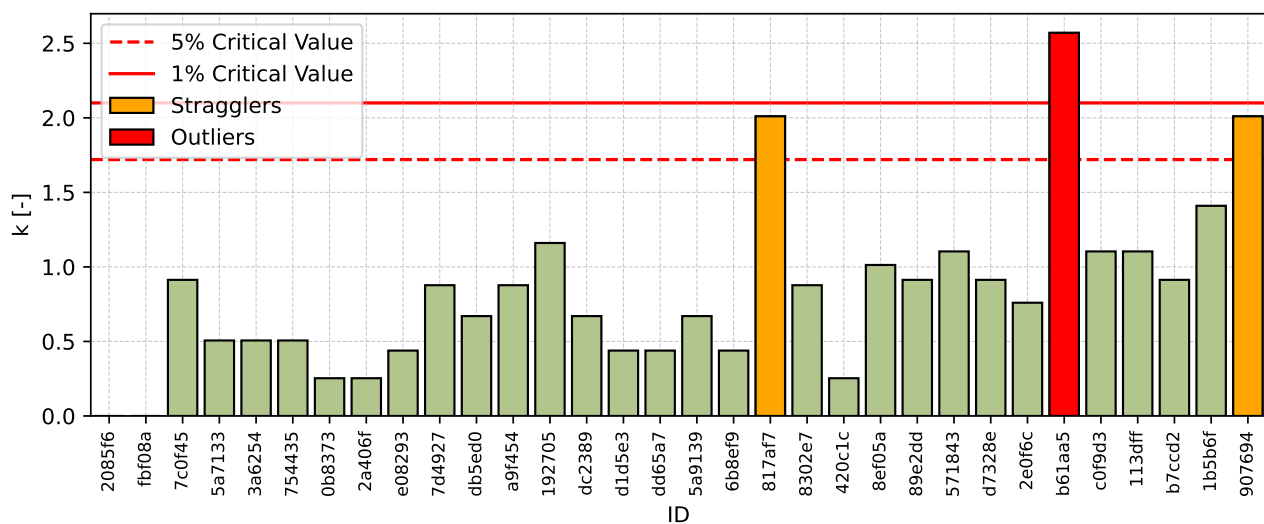


Figure 23: Intralaboratory Consistency Statistic

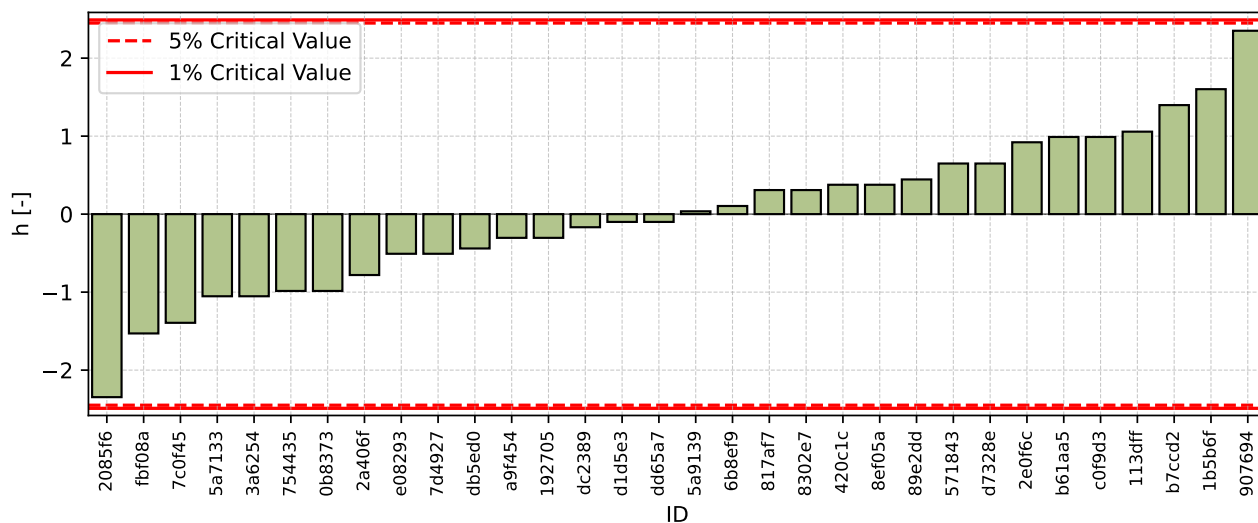


Figure 24: Interlaboratory Consistency Statistic

3.4 Descriptive statistics

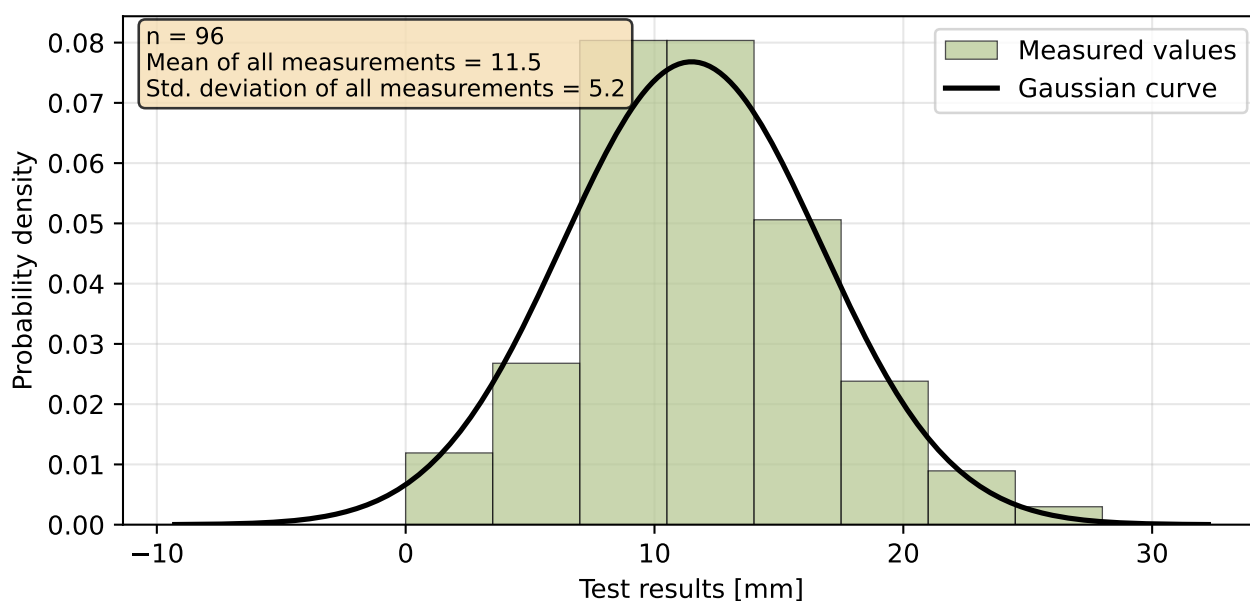


Figure 25: Histogram of all test results

Table 11: Descriptive statistics

Characteristics	[mm]
Average value – $\bar{x}$	11.5
Sample standard deviation – s	4.9
Assigned value – x^*	11.5
Robust standard deviation – s^*	4.9
Measurement uncertainty of assigned value – u_X	0.9
p -value of normality test [-]	0.333

3.5 Evaluation of Performance Statistics

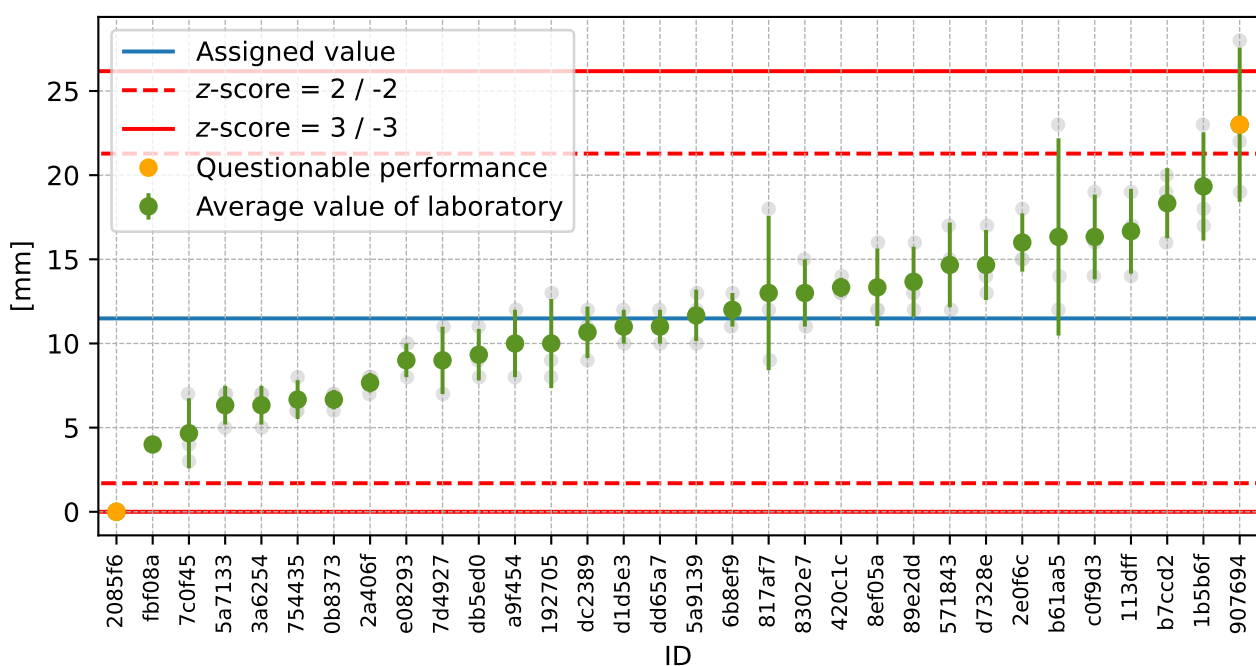


Figure 26: Average values and sample standard deviations

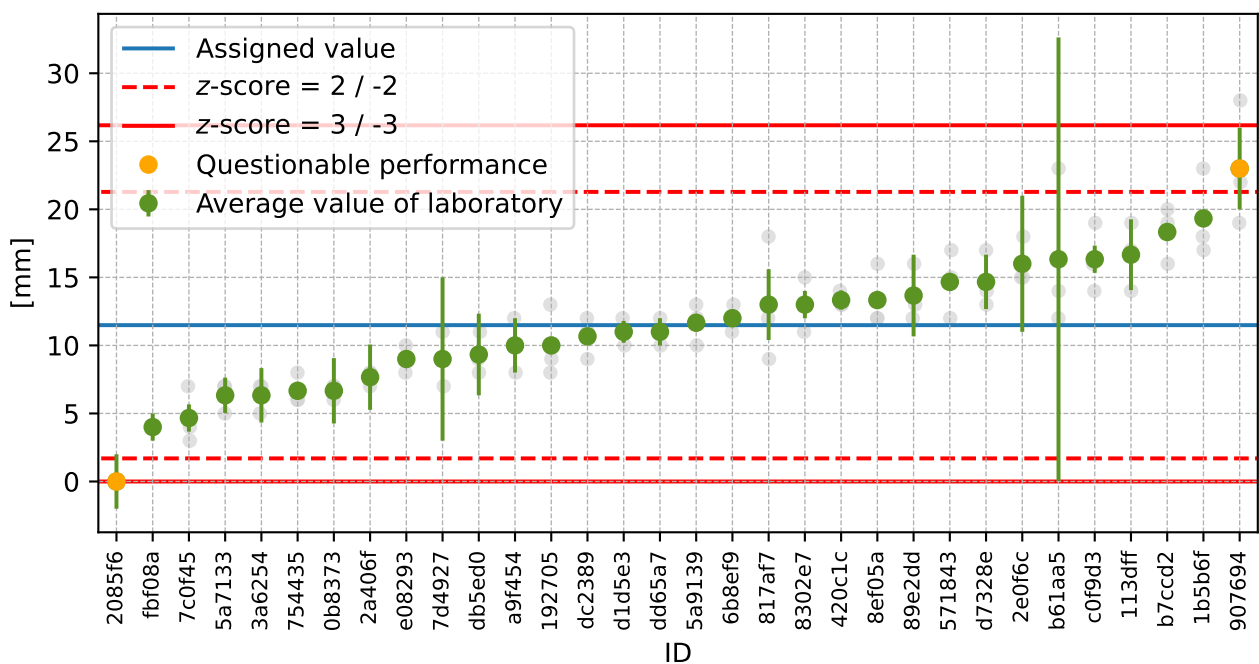


Figure 27: Average values and extended uncertainties of measurement

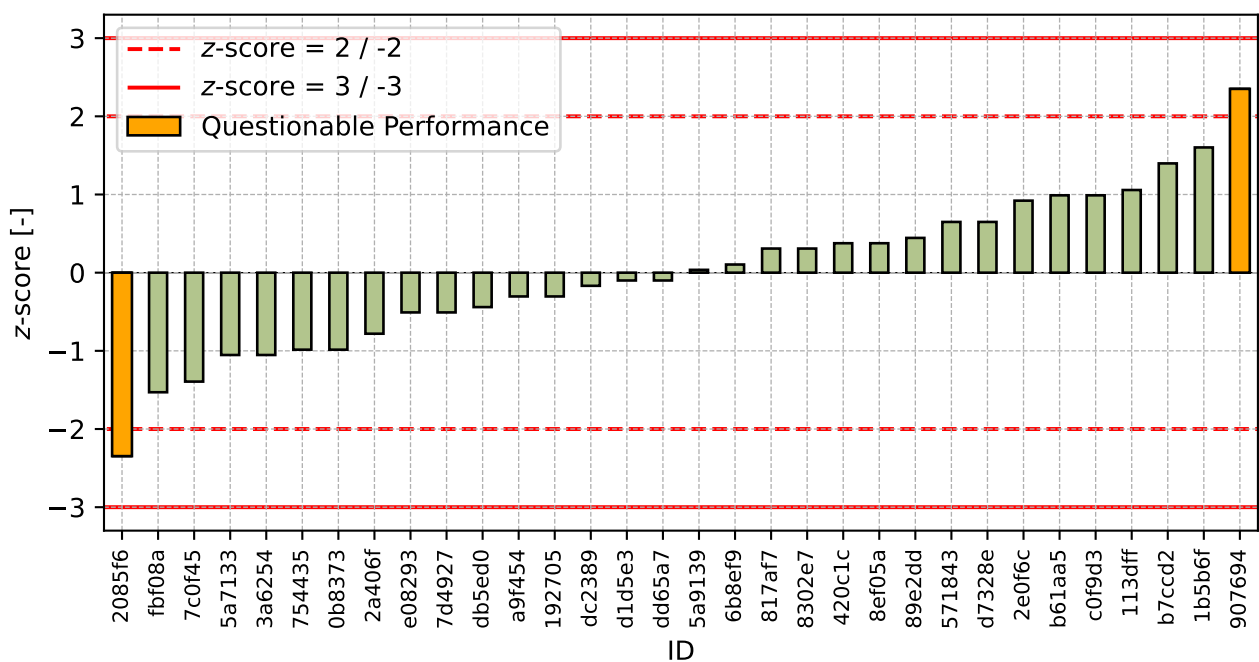
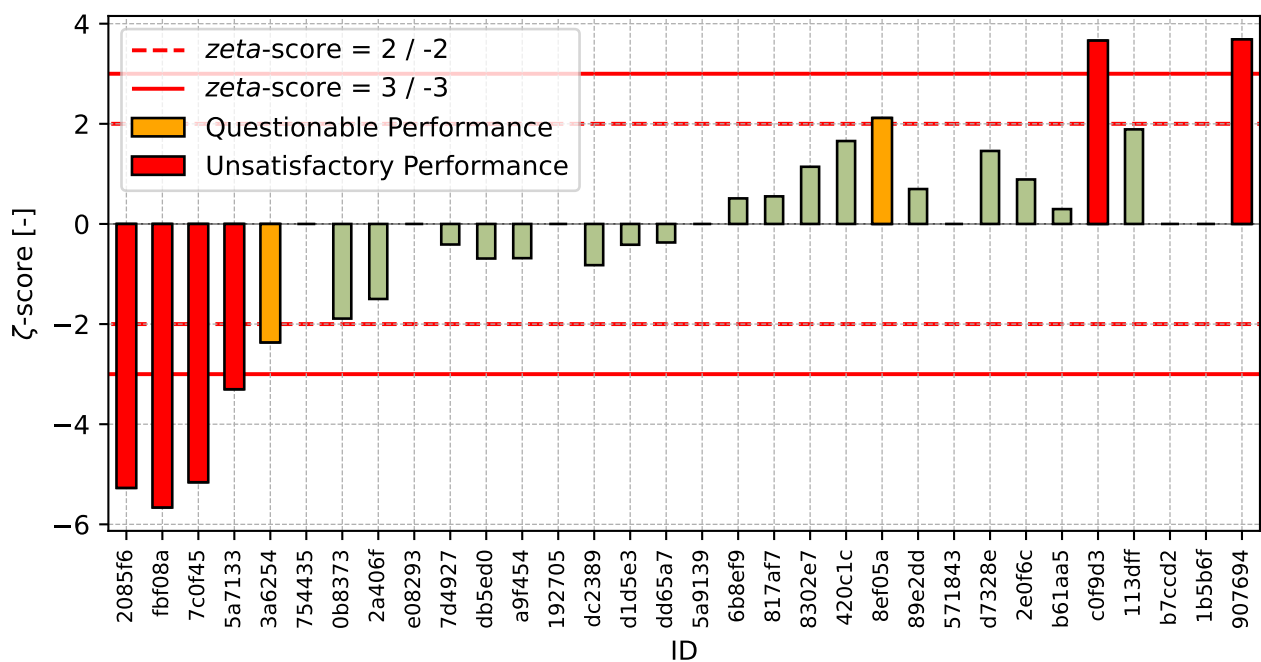


Figure 28: z-score

Figure 29: ζ -scoreTable 12: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
2085f6	-2.35	-5.27
fbf08a	-1.53	-5.66
7c0f45	-1.39	-5.16
5a7133	-1.05	-3.30
3a6254	-1.05	-2.37
754435	-0.99	-
0b8373	-0.99	-1.89
2a406f	-0.78	-1.50
e08293	-0.51	-
7d4927	-0.51	-0.41
db5ed0	-0.44	-0.69
a9f454	-0.30	-0.68
192705	-0.30	-
dc2389	-0.17	-0.82
d1d5e3	-0.10	-0.42
dd65a7	-0.10	-0.37
5a9139	0.04	-
6b8ef9	0.10	0.51
817af7	0.31	0.55
8302e7	0.31	1.14
420c1c	0.38	1.66
8ef05a	0.38	2.12
89e2dd	0.44	0.70
571843	0.65	-
d7328e	0.65	1.46
2e0f6c	0.92	0.89
b61aa5	0.99	0.30

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ID	z-score [-]	ζ-score [-]
c0f9d3	0.99	3.66
113dff	1.06	1.89
b7ccd2	1.40	-
1b5b6f	1.60	-
907694	2.35	3.69

4 Appendix – EN 480-11 – Determination of air void characteristics in hardened concrete

4.1 Total air content

4.1.1 Test results

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

ID	Result [%]	u_x [%]
2c0b46	3.29	0.620
896852	4.10	-
5222e7	4.55	-
d1d5e3	4.58	0.260
2a406f	4.97	0.430

4.1.2 The Numerical Procedure for Determining Outliers

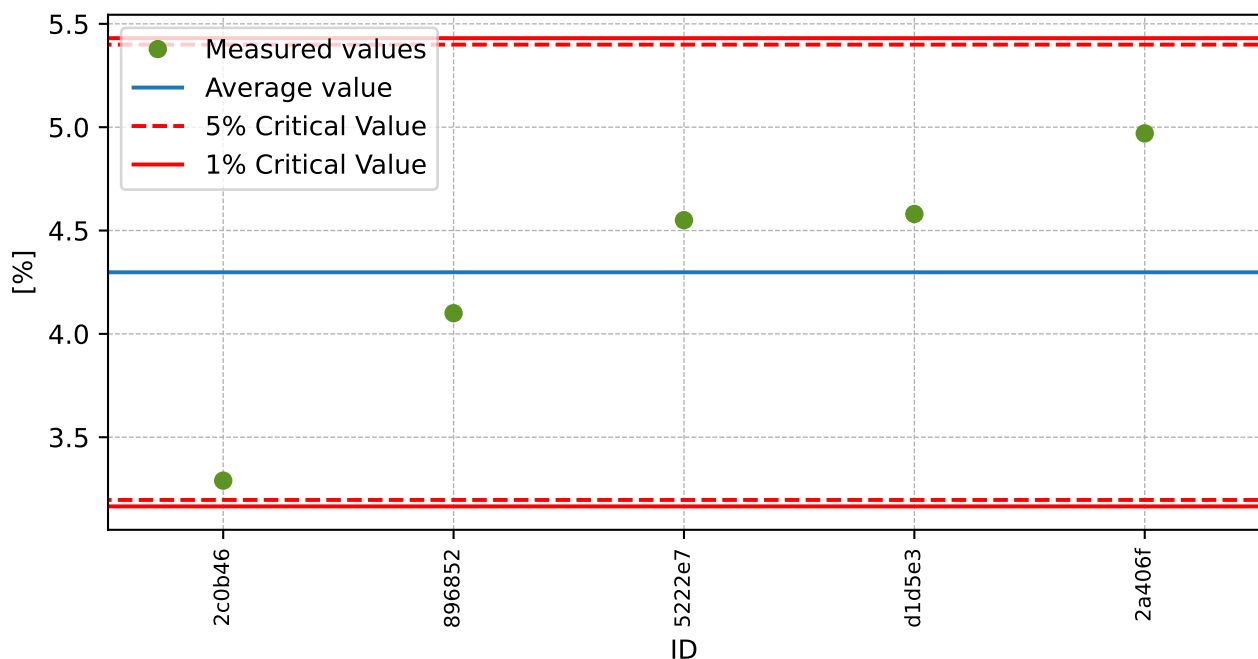


Figure 30: **Grubbs' test** - average values

4.1.3 Mandel's Statistics

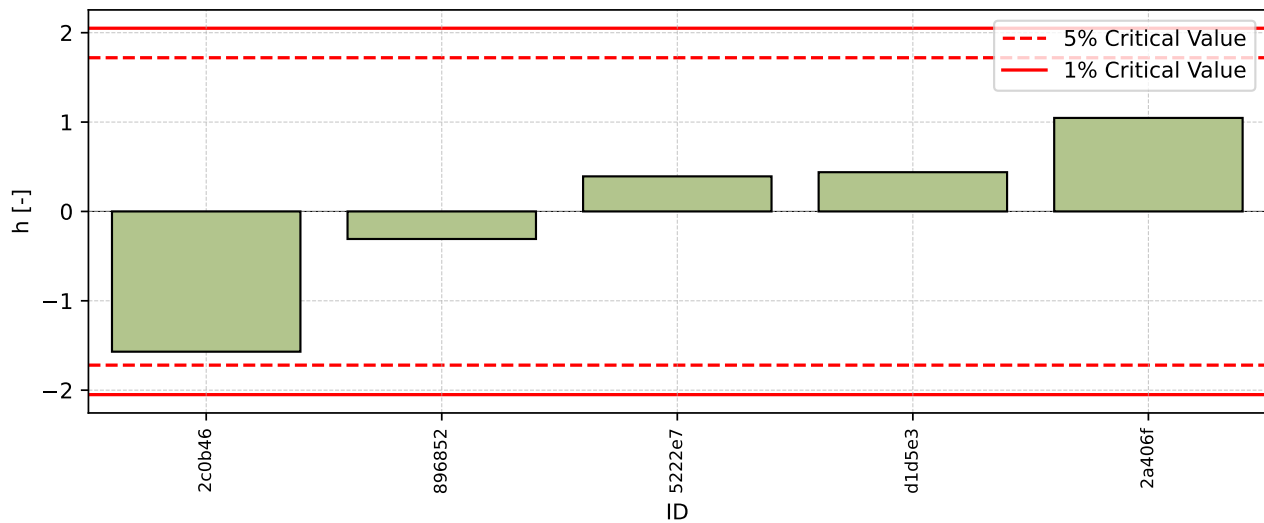


Figure 31: Interlaboratory Consistency Statistic

4.1.4 Descriptive statistics

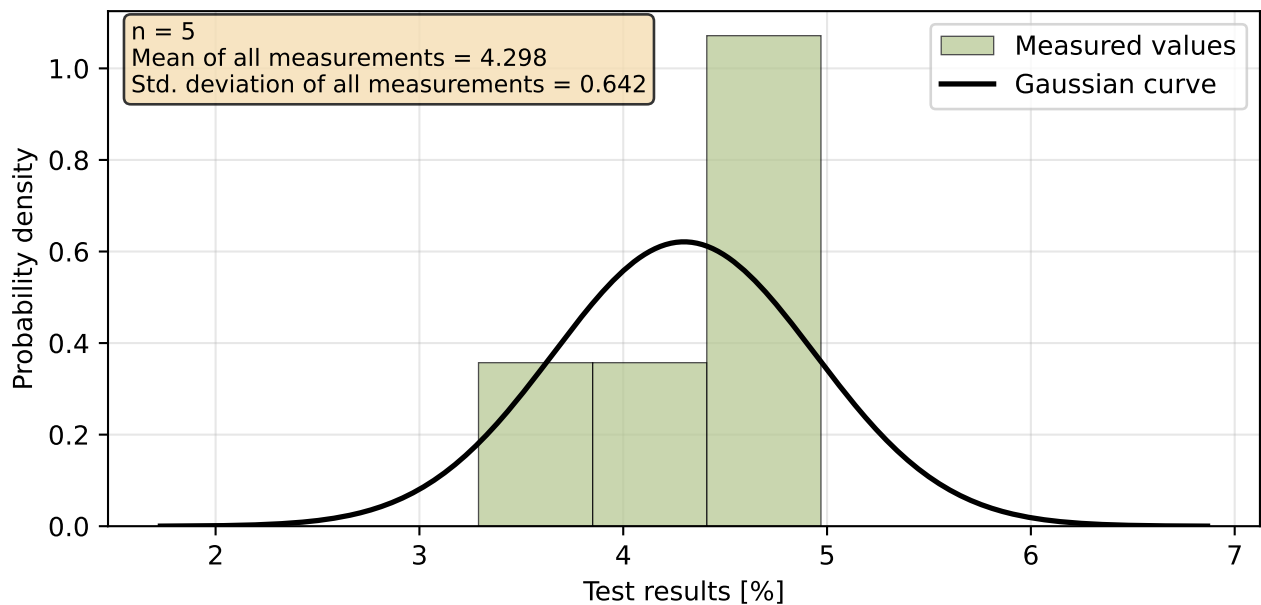


Figure 32: Histogram of all test results

Table 14: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	4.298
Sample standard deviation – s	0.642
Assigned value – x^*	4.298
Robust standard deviation – s^*	0.642
Measurement uncertainty of assigned value – u_X	0.287
p -value of normality test [-]	0.534

4.1.5 Evaluation of Performance Statistics

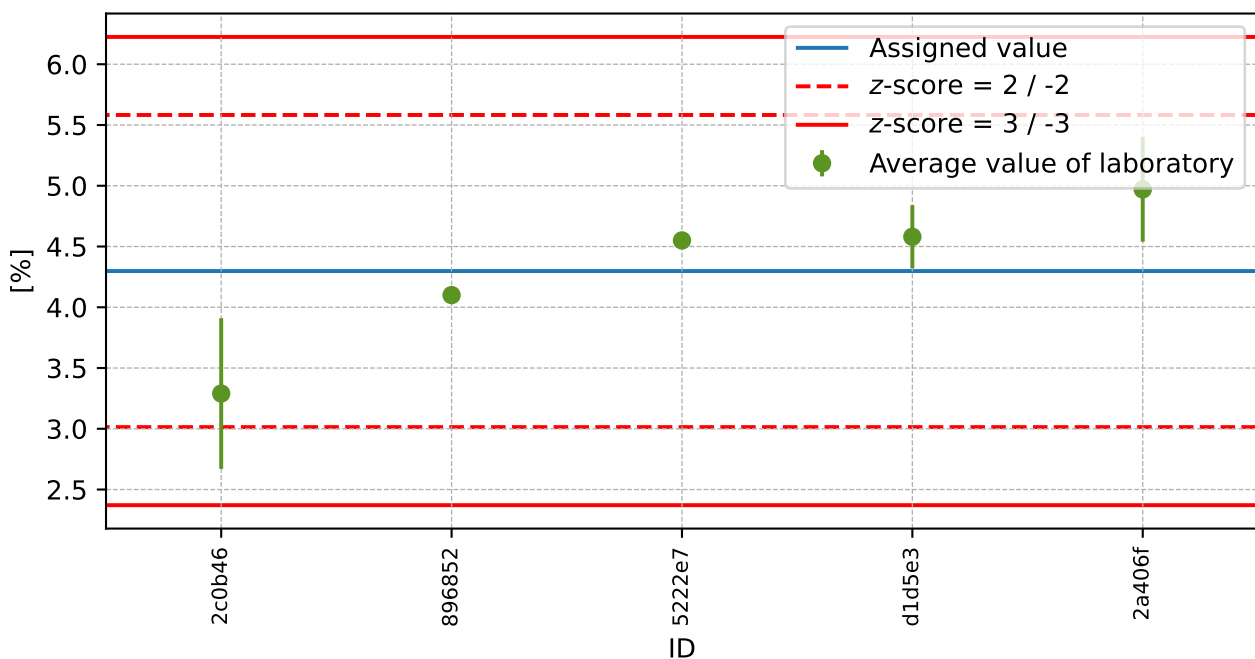


Figure 33: Average values and extended uncertainties of measurement

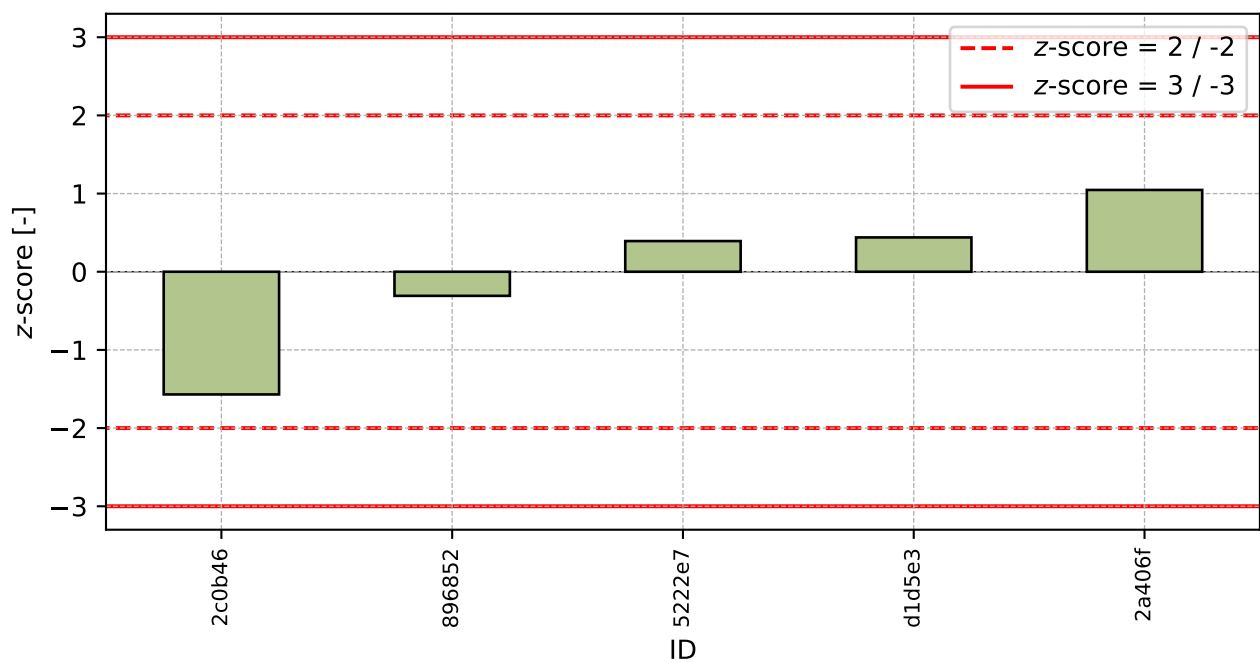


Figure 34: z-score

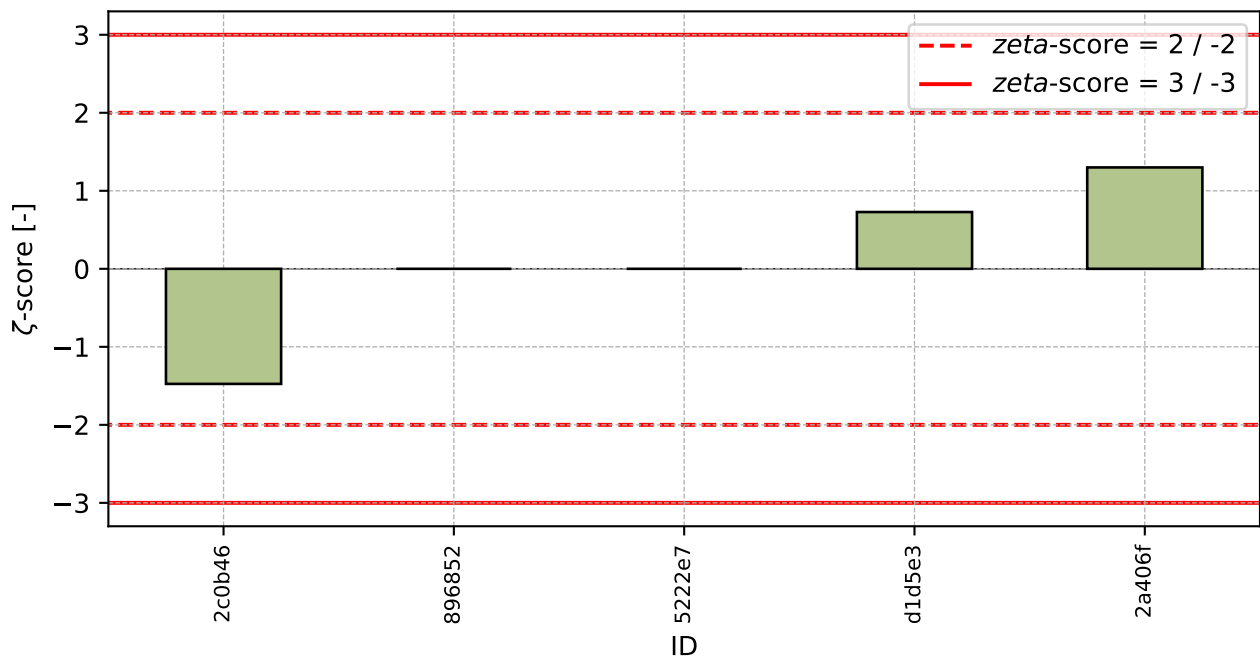


Figure 35: ζ-score

Table 15: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
2c0b46	-1.57	-1.48
896852	-0.31	-
5222e7	0.39	-
d1d5e3	0.44	0.73
2a406f	1.05	1.30

4.2 Micro air content A_{300}

4.2.1 Test results

Table 16: Test results – ordered by average value. Outliers are marked by red color. u_x – extended uncertainty of measurement.

ID	Result [%]	u_x [%]
896852	0.36	-
5222e7	0.38	-
2c0b46	0.39	0.070
d1d5e3	0.80	0.080
2a406f	1.45	0.150

4.2.2 The Numerical Procedure for Determining Outliers

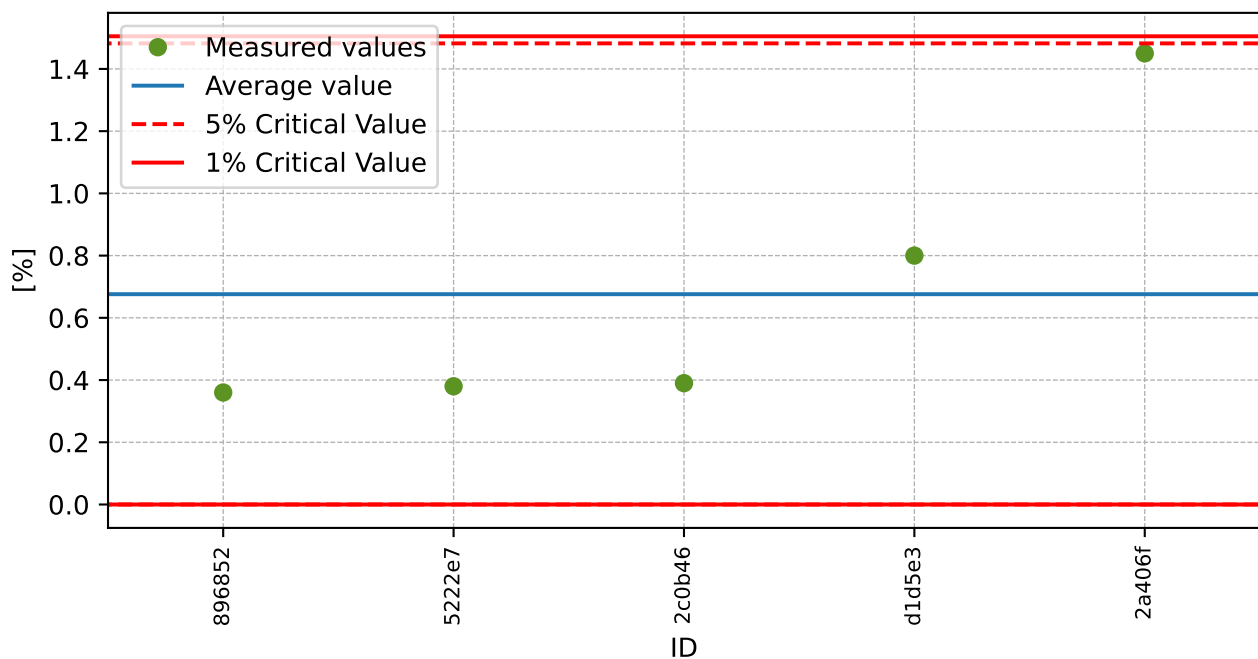


Figure 36: **Grubbs' test** - average values

4.2.3 Mandel's Statistics

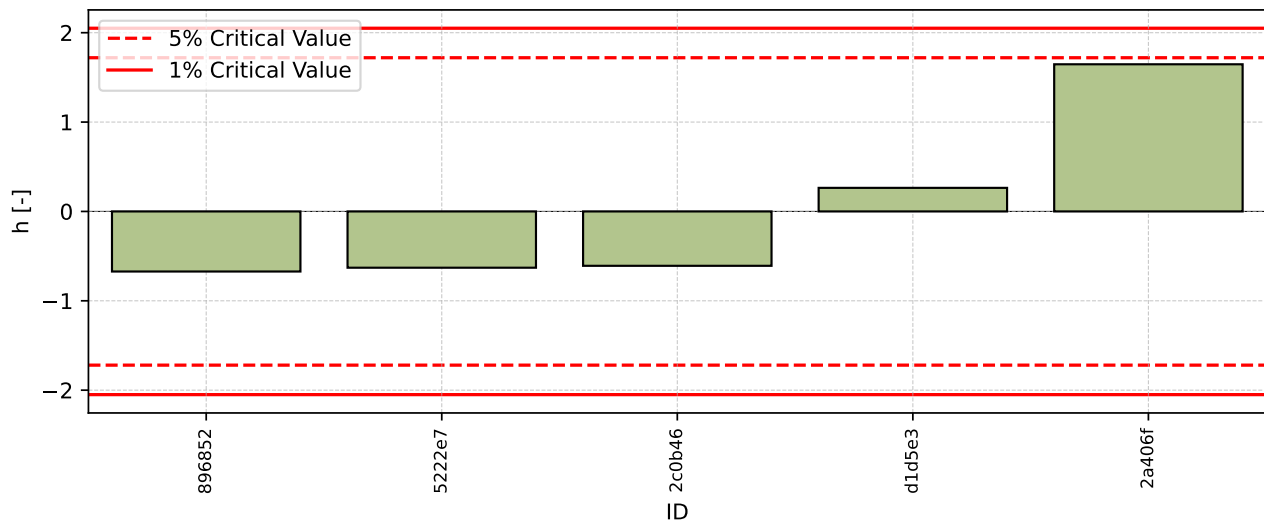


Figure 37: Interlaboratory Consistency Statistic

4.2.4 Descriptive statistics

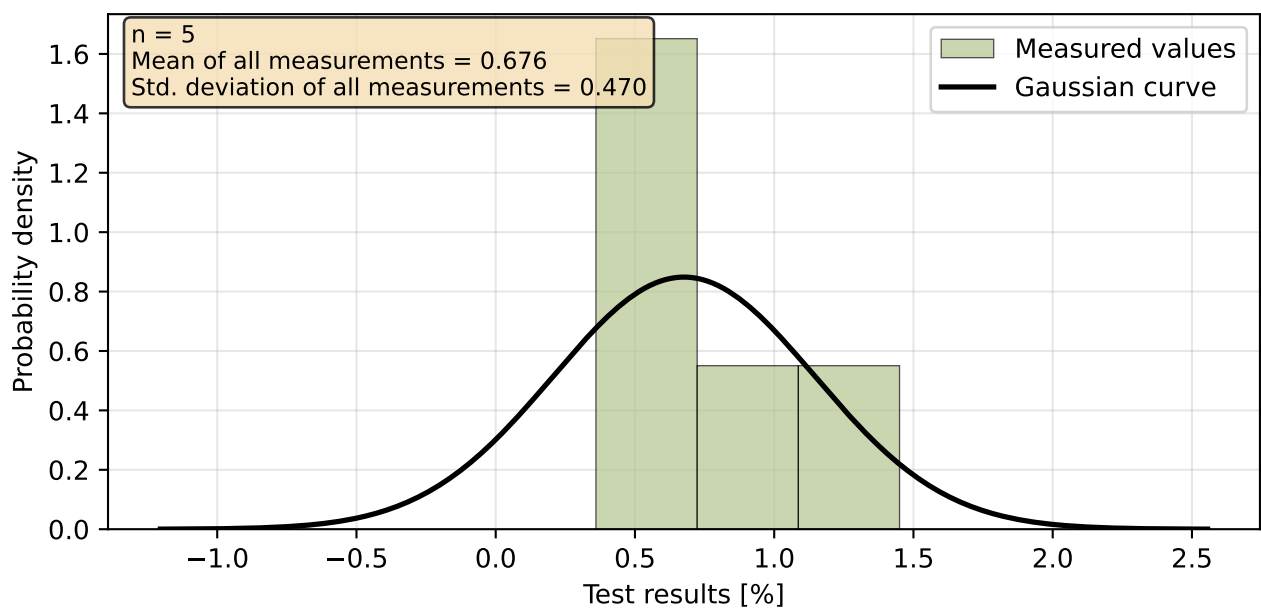


Figure 38: Histogram of all test results

Table 17: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	0.676
Sample standard deviation – s	0.470
Assigned value – x^*	0.676
Robust standard deviation – s^*	0.470
Measurement uncertainty of assigned value – u_x	0.210
p -value of normality test [-]	0.047

4.2.5 Evaluation of Performance Statistics

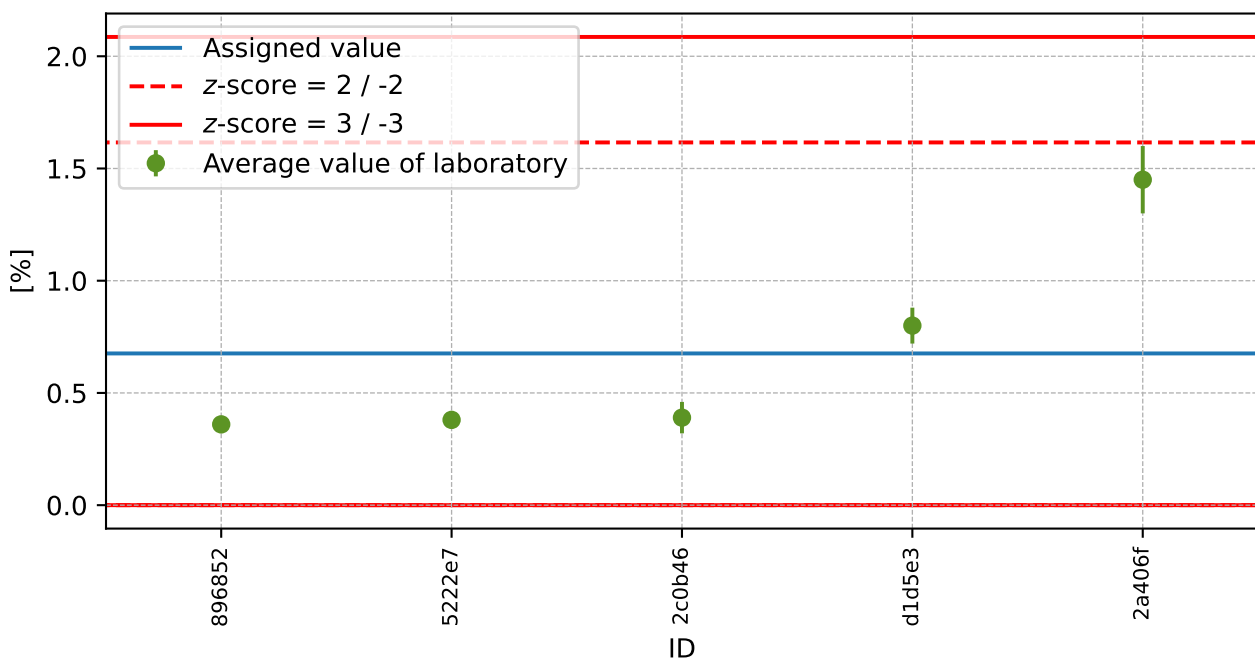


Figure 39: Average values and extended uncertainties of measurement

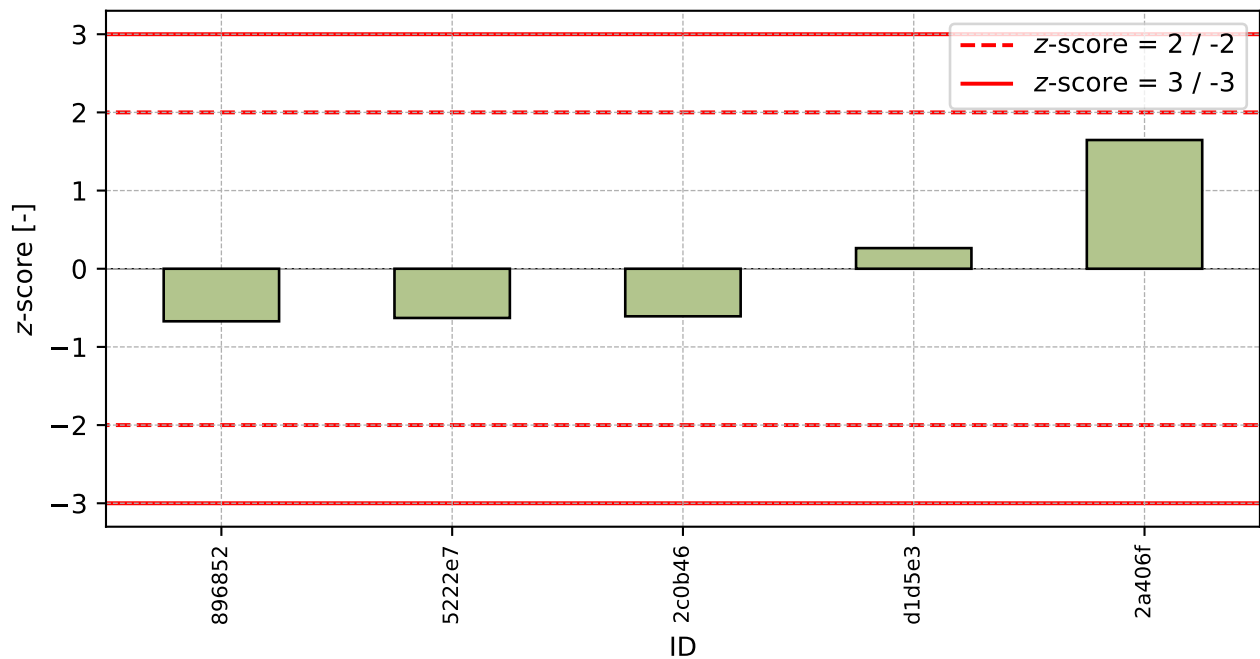


Figure 40: z-score

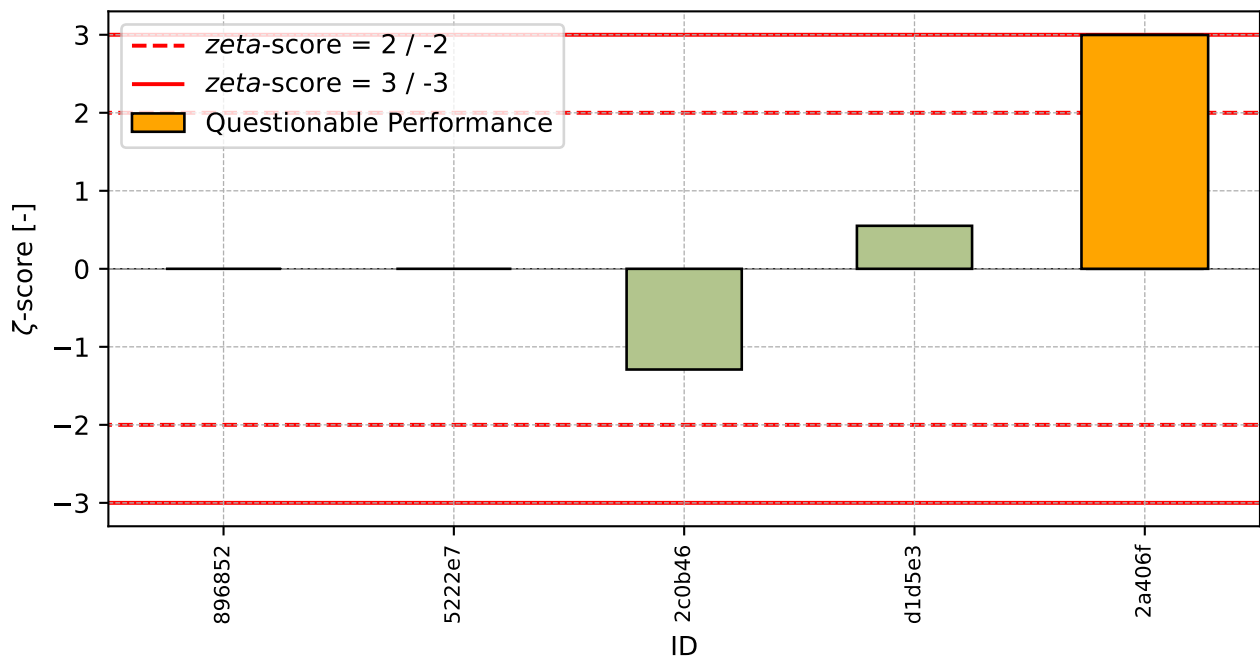


Figure 41: ζ-score

Table 18: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
896852	-0.67	-
5222e7	-0.63	-
2c0b46	-0.61	-1.29
d1d5e3	0.26	0.55
2a406f	1.65	3.00

4.3 Spacing factor L

4.3.1 Test results

Table 19: Test results – ordered by average value. Outliers are marked by red color. u_X – extended uncertainty of measurement.

ID	Result [mm]	u_X [mm]
2c0b46	0.240	0.0200
2a406f	0.257	0.0250
d1d5e3	0.274	0.0274
5222e7	0.377	-
896852	0.391	-

4.3.2 The Numerical Procedure for Determining Outliers

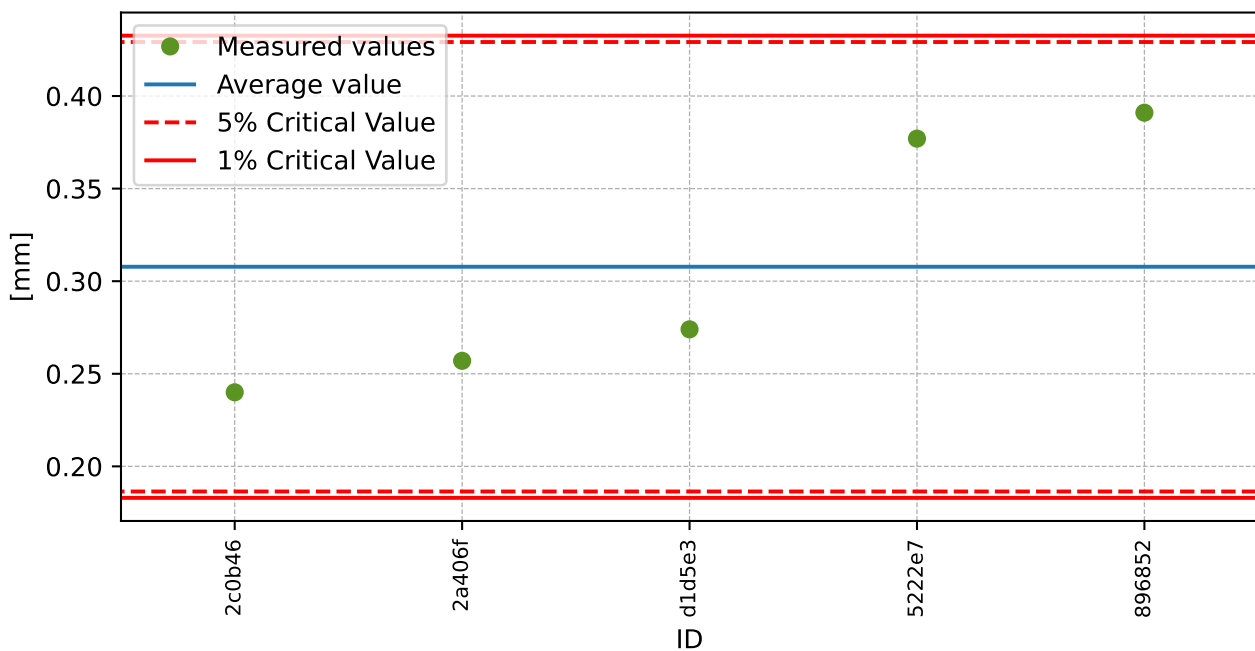


Figure 42: **Grubbs' test** - average values

4.3.3 Mandel’s Statistics

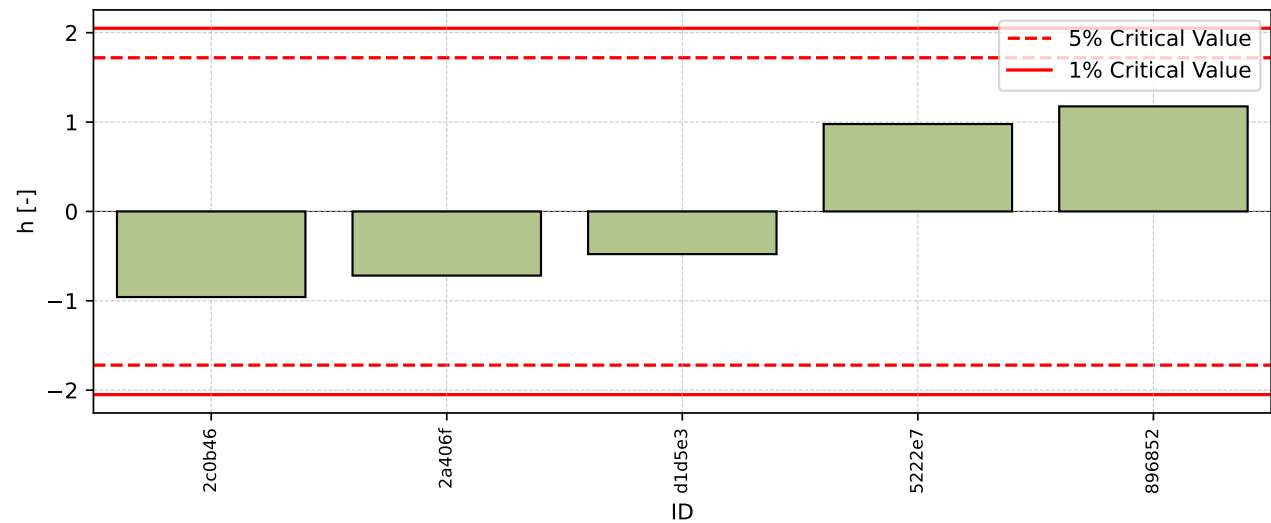


Figure 43: Interlaboratory Consistency Statistic

4.3.4 Descriptive statistics

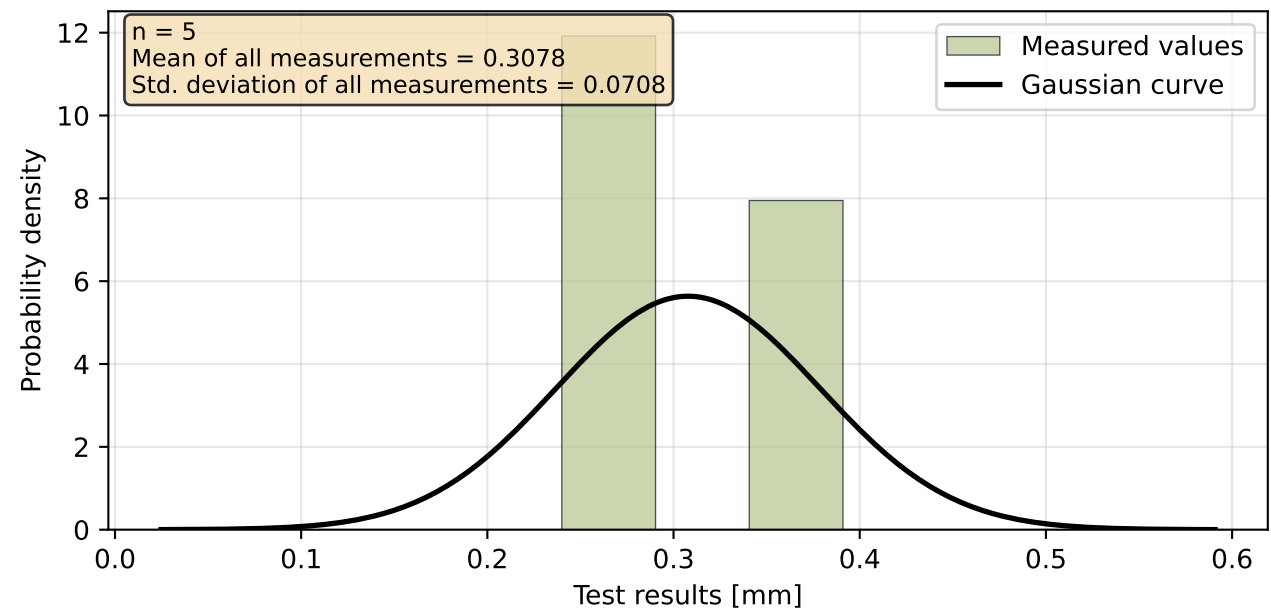


Figure 44: Histogram of all test results

Table 20: Descriptive statistics

Characteristics	[mm]
Average value – $\bar{x}$	0.3078
Sample standard deviation – s	0.0708
Assigned value – x^*	0.3078
Robust standard deviation – s^*	0.0708
Measurement uncertainty of assigned value – u_X	0.0316
p -value of normality test [-]	0.151

4.3.5 Evaluation of Performance Statistics

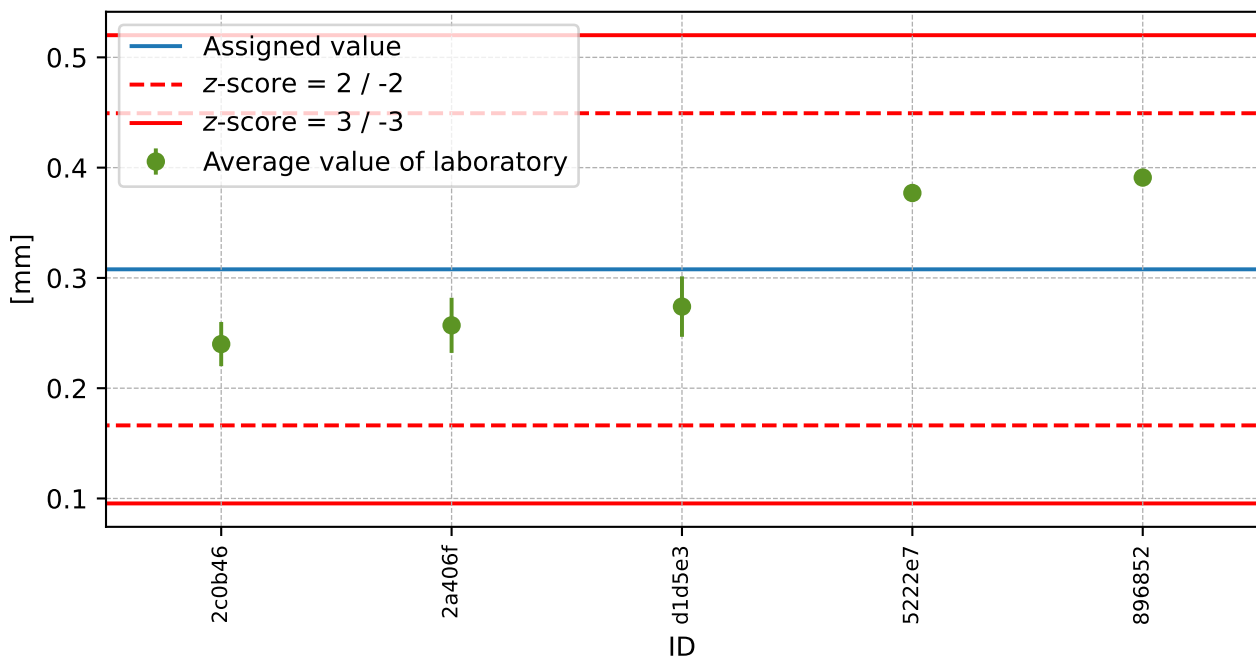


Figure 45: Average values and extended uncertainties of measurement

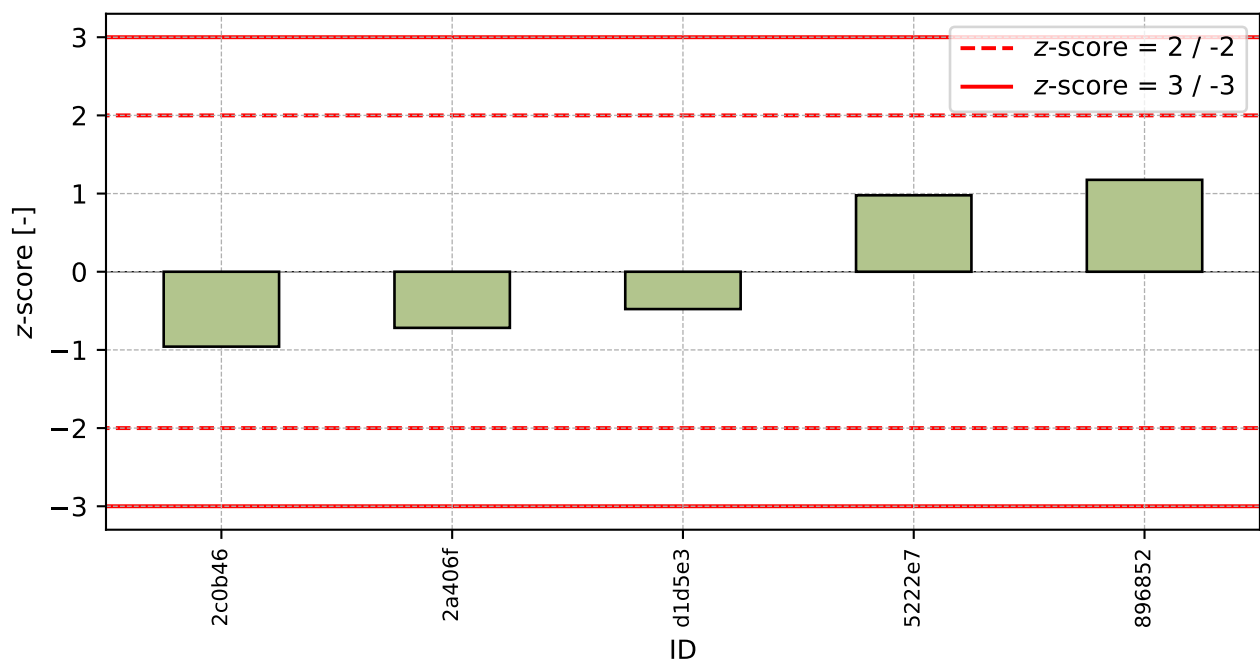


Figure 46: z-score

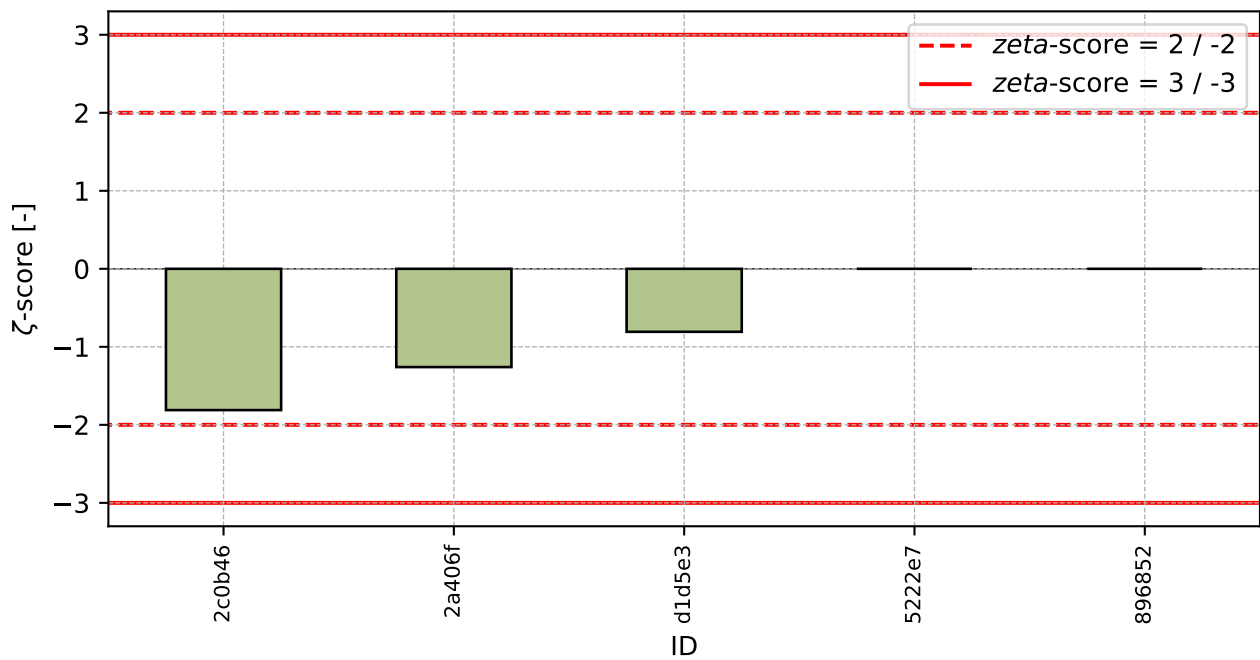


Figure 47: ζ-score

Table 21: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
2c0b46	-0.96	-1.81
2a406f	-0.72	-1.26
d1d5e3	-0.48	-0.81
5222e7	0.98	-
896852	1.18	-

5 Appendix – ČSN 73 1322 – Determination of frost resistance of concrete

5.1 Test results

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

ID	Result [-]	u_x [-]
5a9139	0.22	-
0928bf	0.26	12.200
754435	0.37	-
1a28a8	0.88	0.045
b001e1	0.90	-
d8e44d	0.90	-
c427f0	0.91	0.030
a9f454	1.00	0.060

5.2 The Numerical Procedure for Determining Outliers

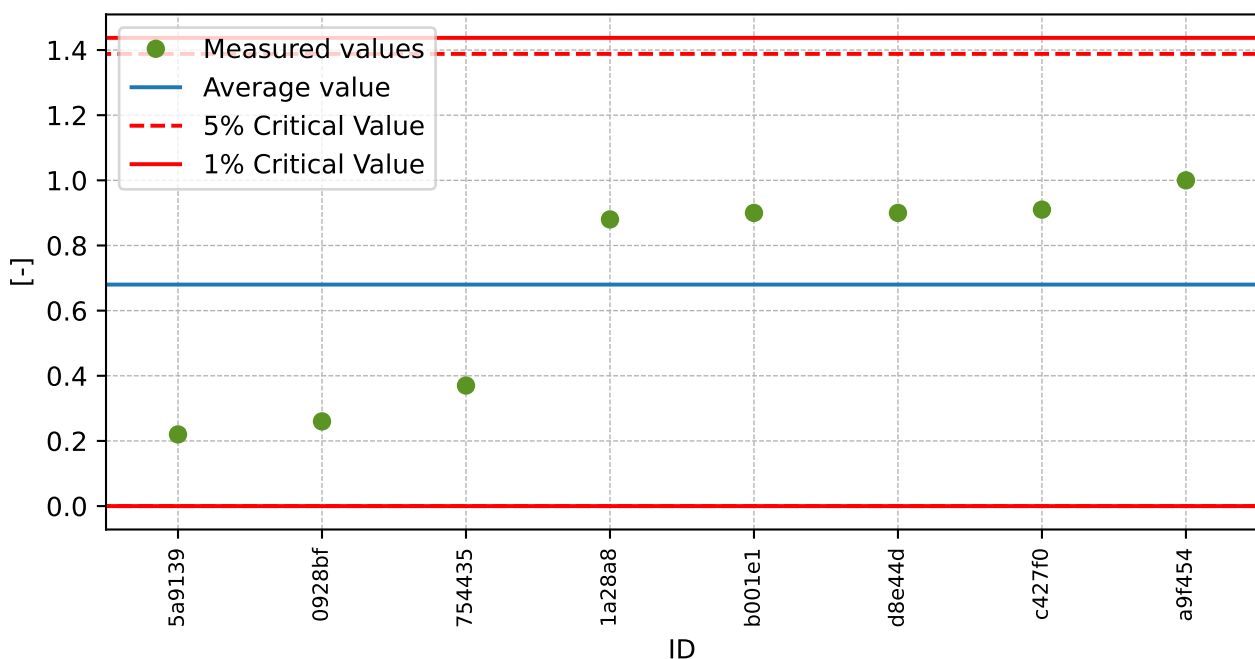


Figure 48: **Grubbs' test** - average values

5.3 Mandel's Statistics

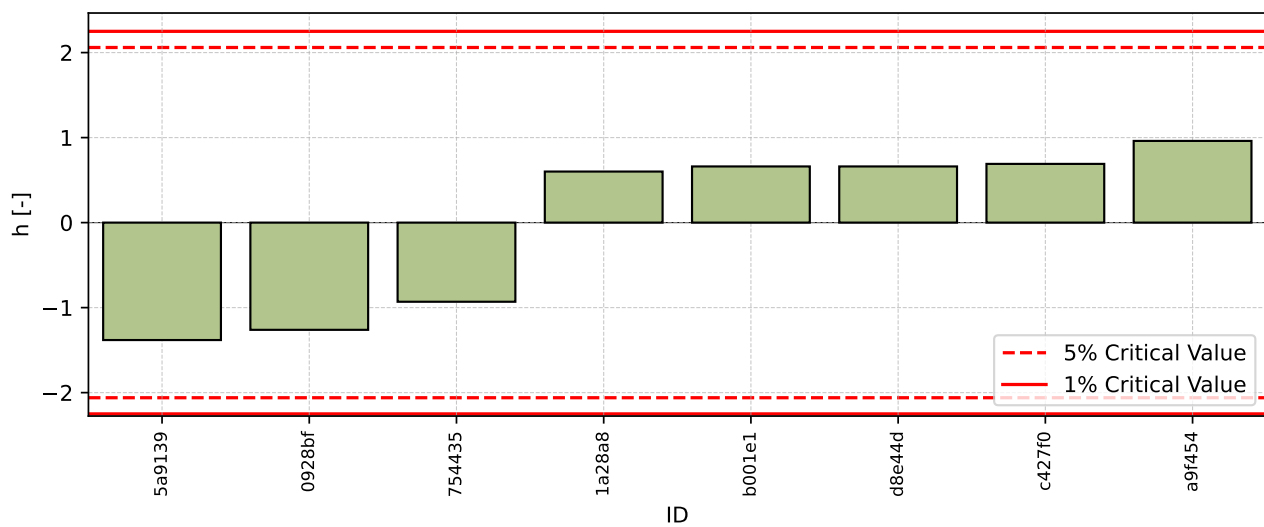


Figure 49: Interlaboratory Consistency Statistic

5.4 Descriptive statistics

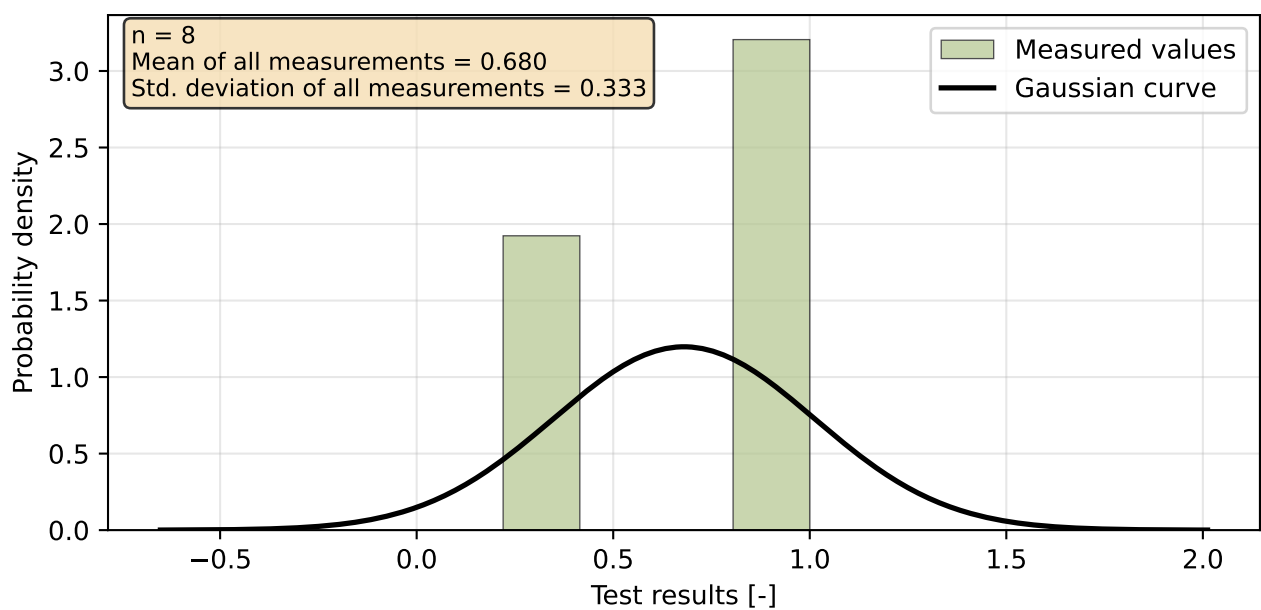


Figure 50: Histogram of all test results

Table 23: Descriptive statistics

Characteristics	[-]
Average value – $\bar{x}$	0.680
Sample standard deviation – s	0.333
Assigned value – x^*	0.680
Robust standard deviation – s^*	0.333
Measurement uncertainty of assigned value – u_X	0.118
p -value of normality test [-]	0.013

5.5 Evaluation of Performance Statistics

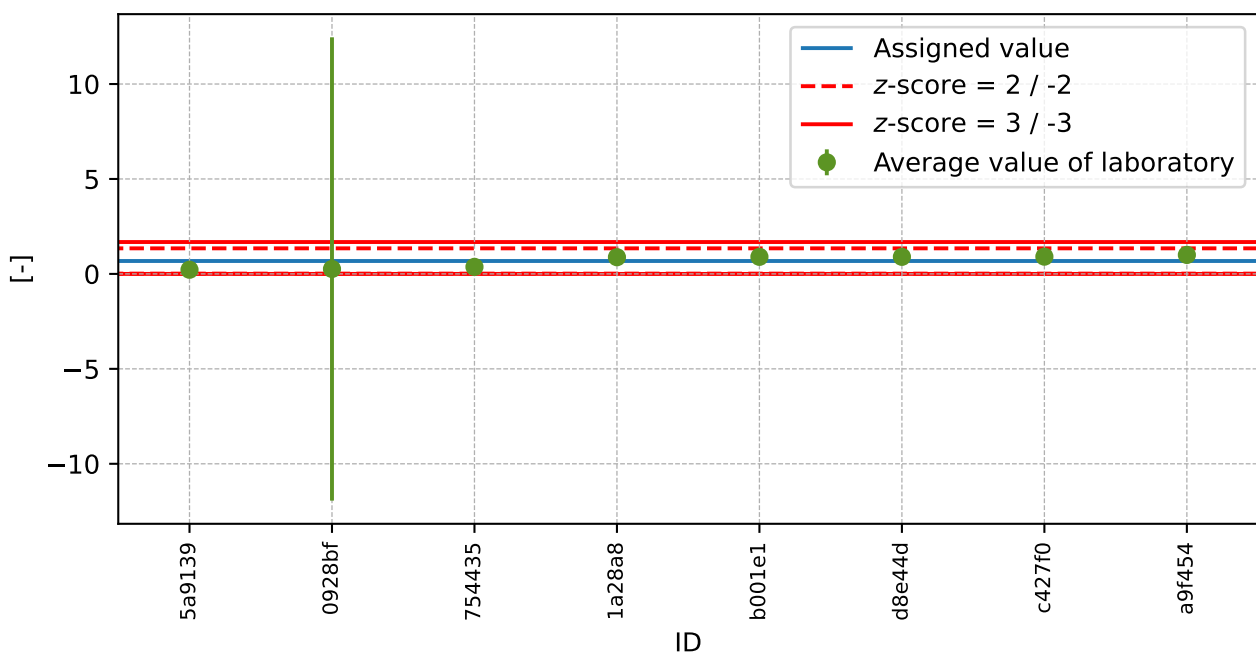


Figure 51: Average values and extended uncertainties of measurement

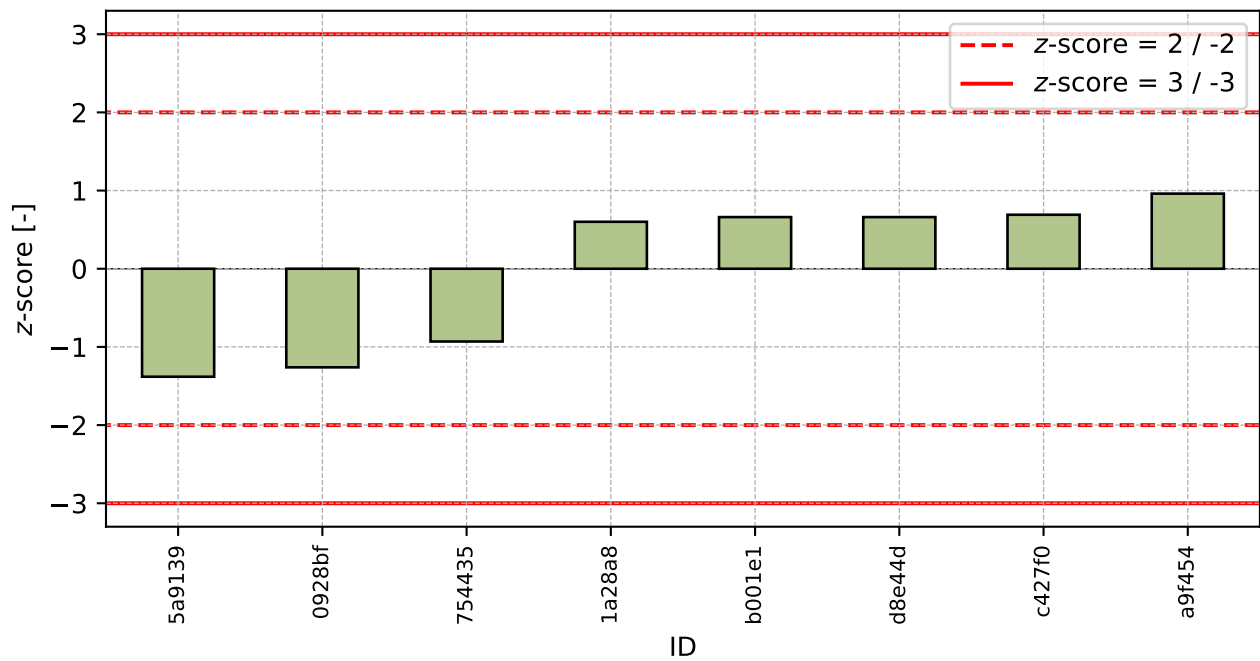


Figure 52: z-score

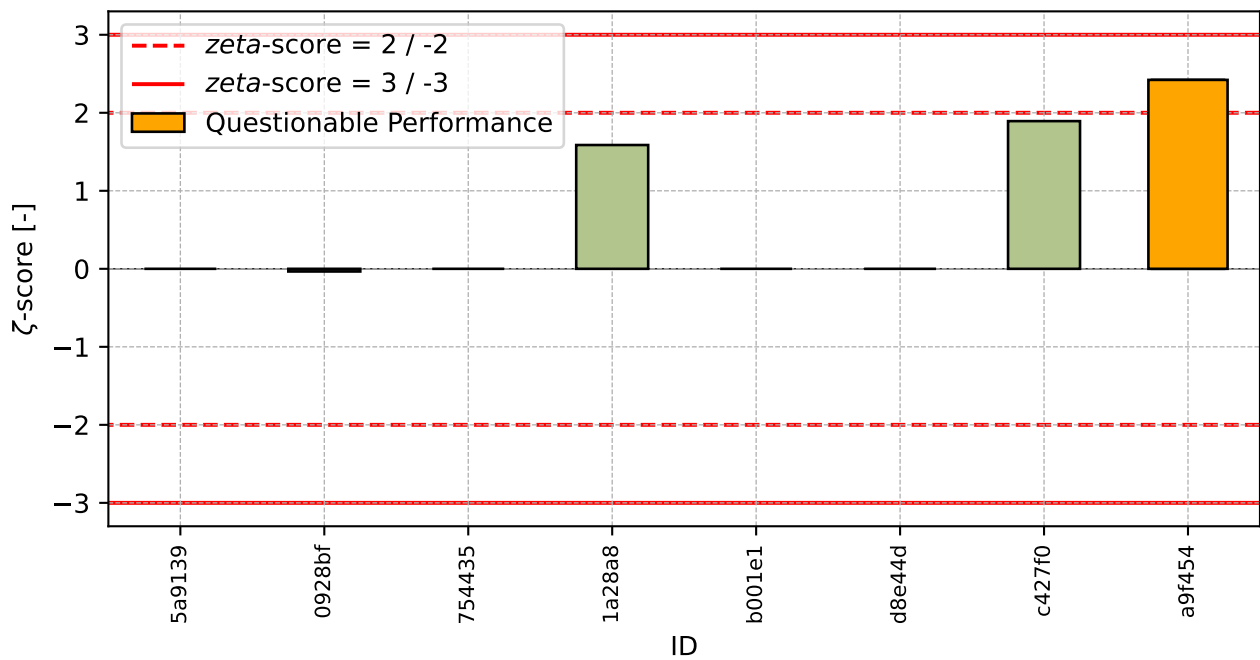


Figure 53: ζ-score

Table 24: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
5a9139	-1.38	-
0928bf	-1.26	-0.03
754435	-0.93	-
1a28a8	0.60	1.59
b001e1	0.66	-
d8e44d	0.66	-
c427f0	0.69	1.89
a9f454	0.96	2.42

6 Appendix – ČSN 73 1324 – Determination of grindability of concrete

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

7 Appendix – ČSN 73 1326 – Resistance of cement concrete surface to water and defrosting chemicals – Method A

7.1 25 cycles

7.1.1 Test results

Table 25: Test results – ordered by average value. Outliers are marked by red color. Columns 1–3 are individual determinations; u_X – extended uncertainty of measurement; $\bar{x}$ – average value; s_0 – sample standard deviation; V_X – variation coefficient

ID	1 [g/m ²]	2 [g/m ²]	3 [g/m ²]	u_X [g/m ²]	$\bar{x}$ [g/m ²]	s_0 [g/m ²]	V_X [%]
8302e7	0.8	0.0	1.2	0.02	0.7	0.61	91.65
9068a9	40.0	35.6	26.8	-	34.1	6.72	19.69
1a28a8	46.8	77.9	42.9	22.00	55.9	19.18	34.33
3a6254	42.8	70.0	66.7	2.80	59.8	14.84	24.81
db5ed0	40.0	70.0	70.0	10.00	60.0	17.32	28.87
fbf08a	89.0	72.2	55.5	27.00	72.2	16.75	23.19
d29ff7	43.0	102.0	74.0	80.00	73.0	29.51	40.43
1c0489	77.6	64.7	115.7	81.00	86.0	26.52	30.83
192705	139.9	133.2	155.9	-	143.0	11.66	8.16
5a9139	210.7	211.4	136.5	-	186.2	43.04	23.12
c427f0	228.4	164.6	195.8	45.00	196.3	31.90	16.25
89e2dd	180.0	160.0	250.0	30.00	196.7	47.26	24.03
5222e7	233.1	195.1	236.8	62.00	221.7	23.08	10.41
b5198d	278.4	239.2	278.4	15.90	265.3	22.63	8.53
c86e46	345.9	235.3	303.9	64.40	295.0	55.83	18.92
7d4927	266.7	301.0	321.6	74.00	296.4	27.73	9.36
92cb03	290.0	322.0	289.0	-	300.3	18.77	6.25
0928bf	341.2	333.3	258.8	121.00	311.1	45.47	14.61

7.1.2 The Numerical Procedure for Determining Outliers

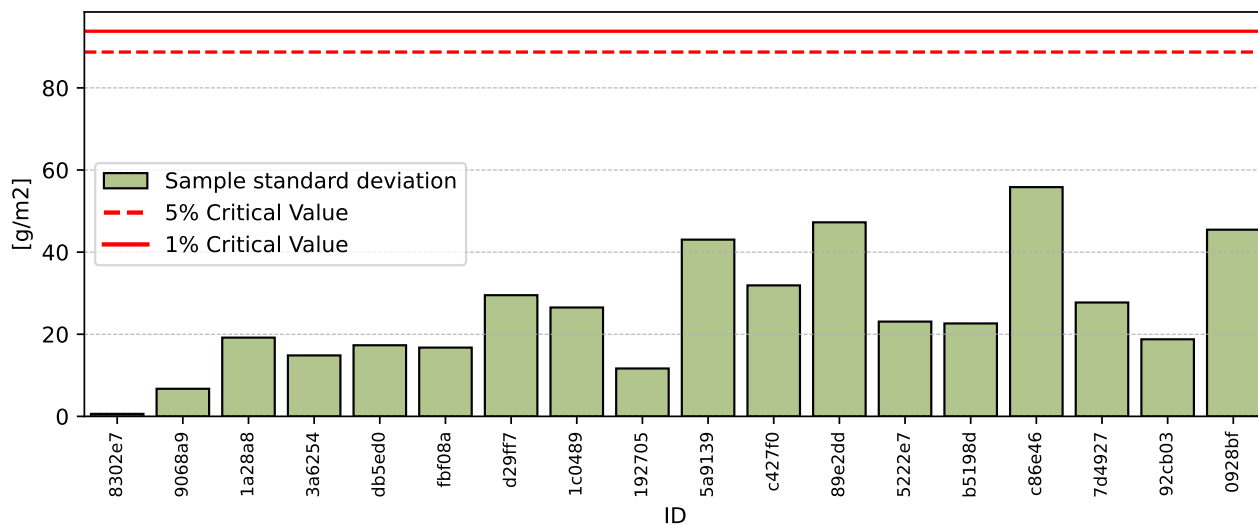


Figure 54: **Cochran's test** - sample standard deviations

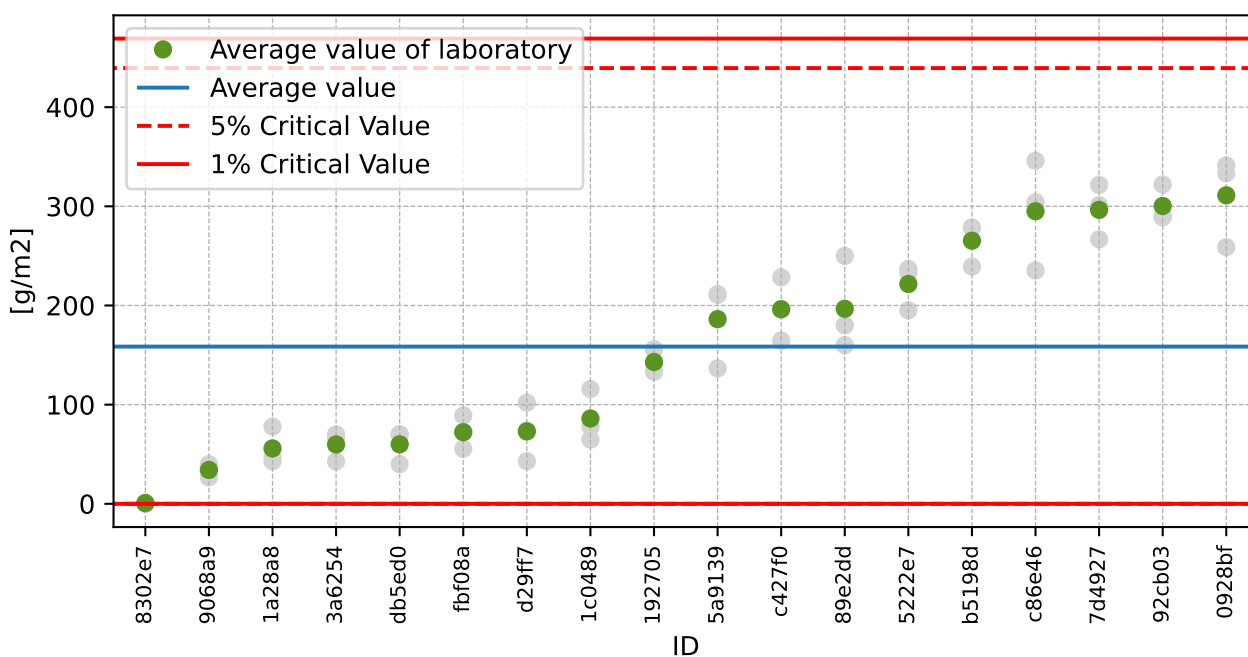


Figure 55: **Grubbs' test** - average values

7.1.3 Mandel’s Statistics

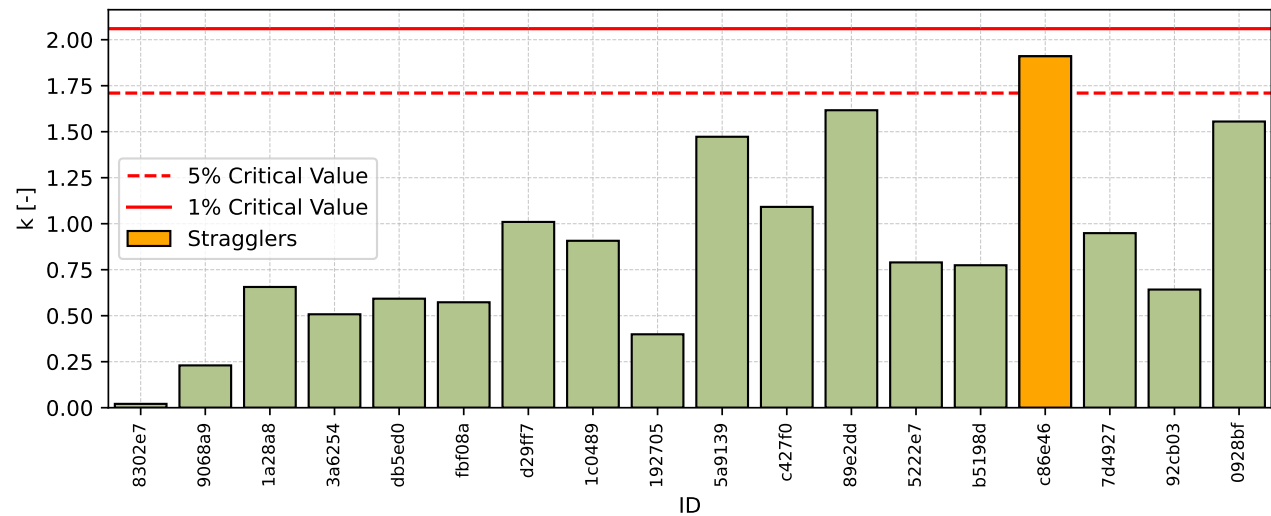


Figure 56: Intralaboratory Consistency Statistic

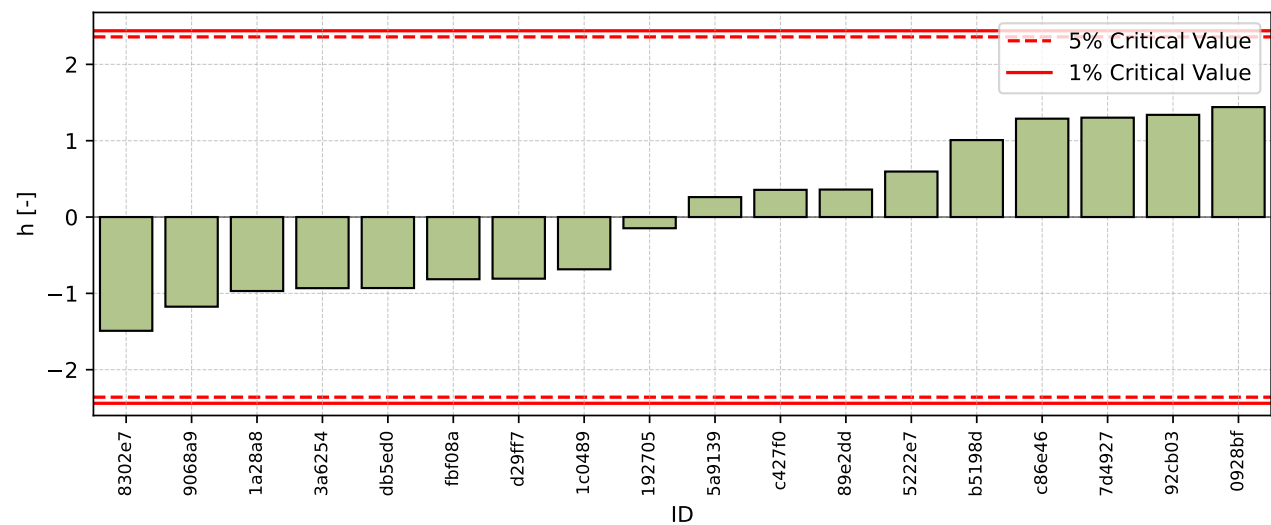


Figure 57: Interlaboratory Consistency Statistic

7.1.4 Descriptive statistics

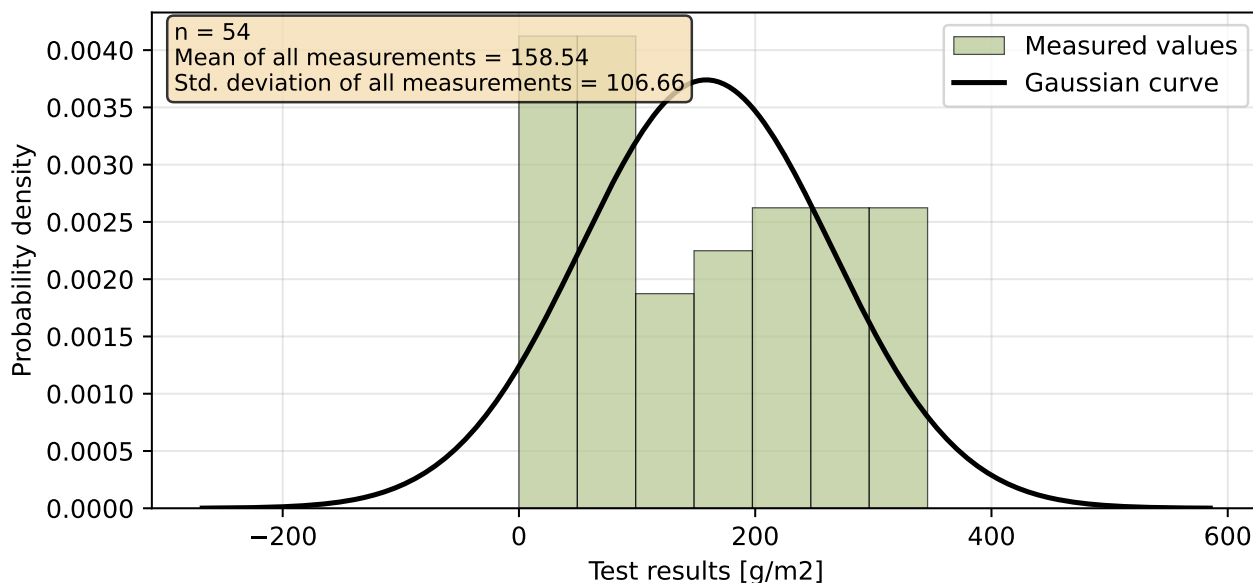


Figure 58: Histogram of all test results

Table 26: Descriptive statistics

Characteristics	[g/m²]
Average value – $\bar{x}$	158.54
Sample standard deviation – s	105.92
Assigned value – x^*	158.54
Robust standard deviation – s^*	105.92
Measurement uncertainty of assigned value – u_X	24.97
p -value of normality test [-]	0.002
Interlaboratory standard deviation – s_L	104.57
Repeatability standard deviation – s_r	29.23
Reproducibility standard deviation – s_R	108.58
Repeatability – r	81.84
Reproducibility – R	304.01

7.1.5 Evaluation of Performance Statistics

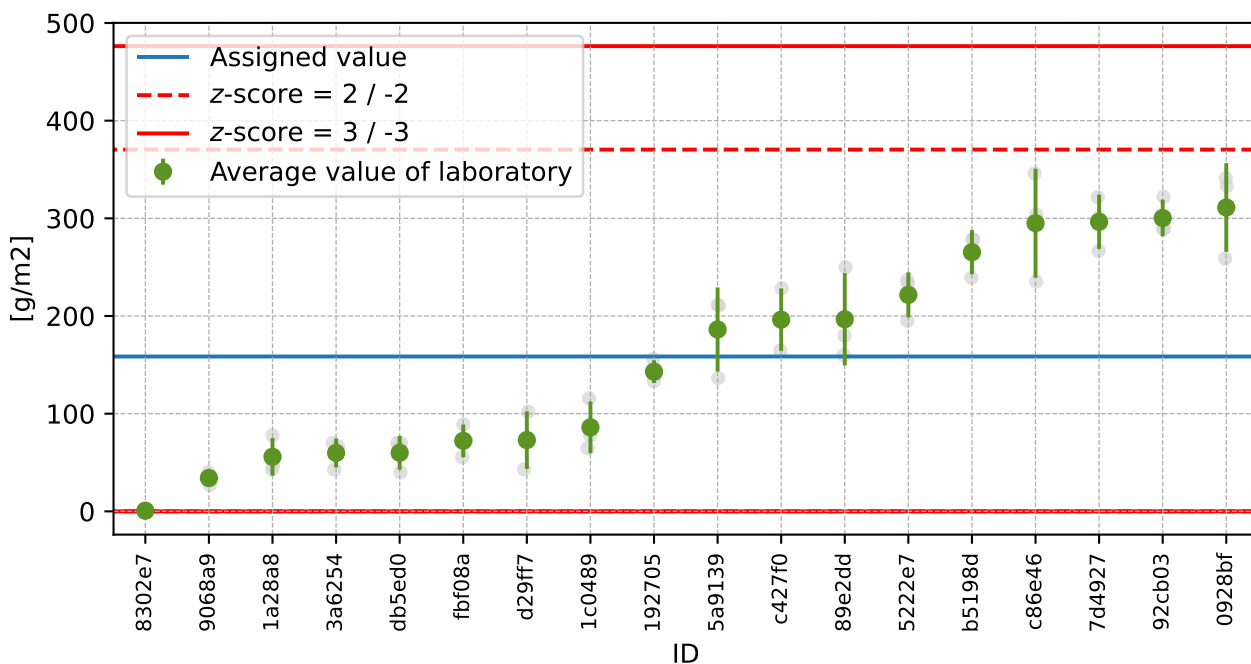


Figure 59: Average values and sample standard deviations

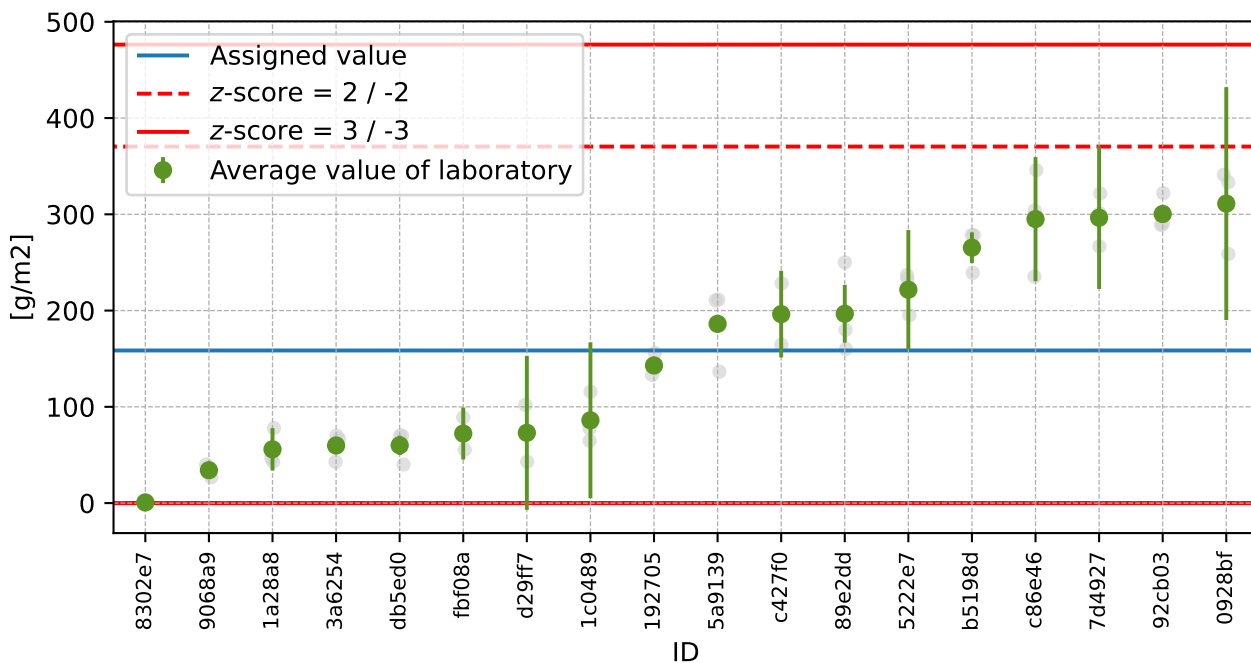


Figure 60: Average values and extended uncertainties of measurement

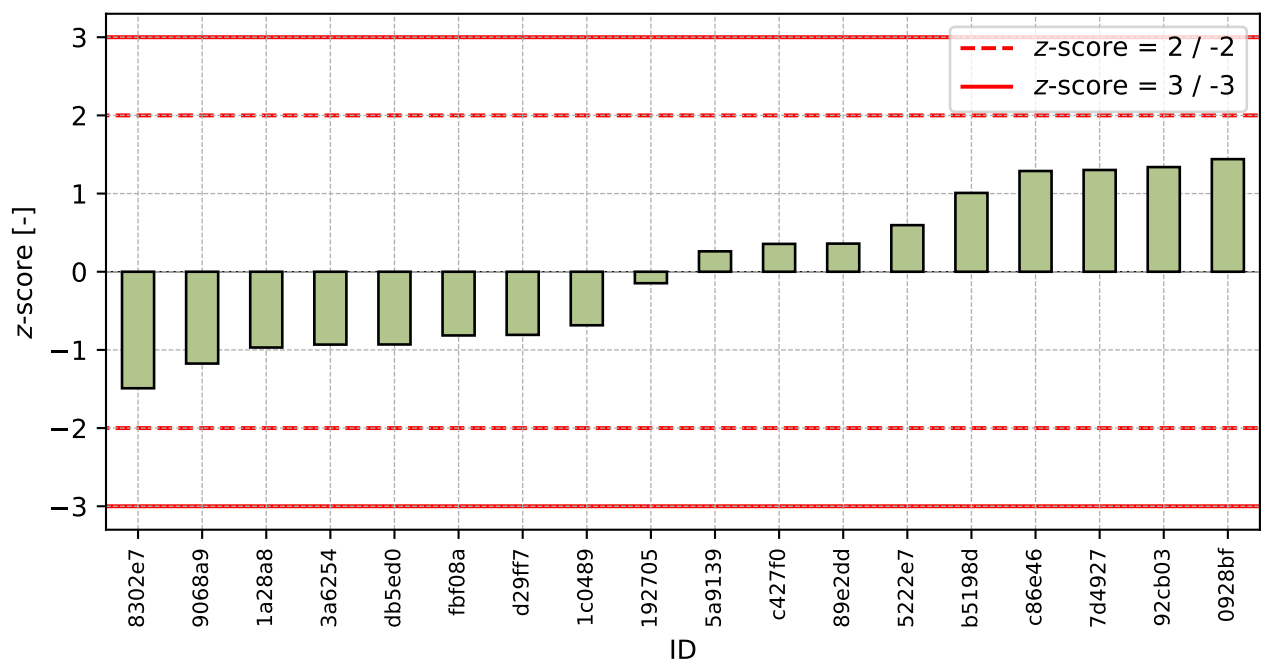


Figure 61: z-score

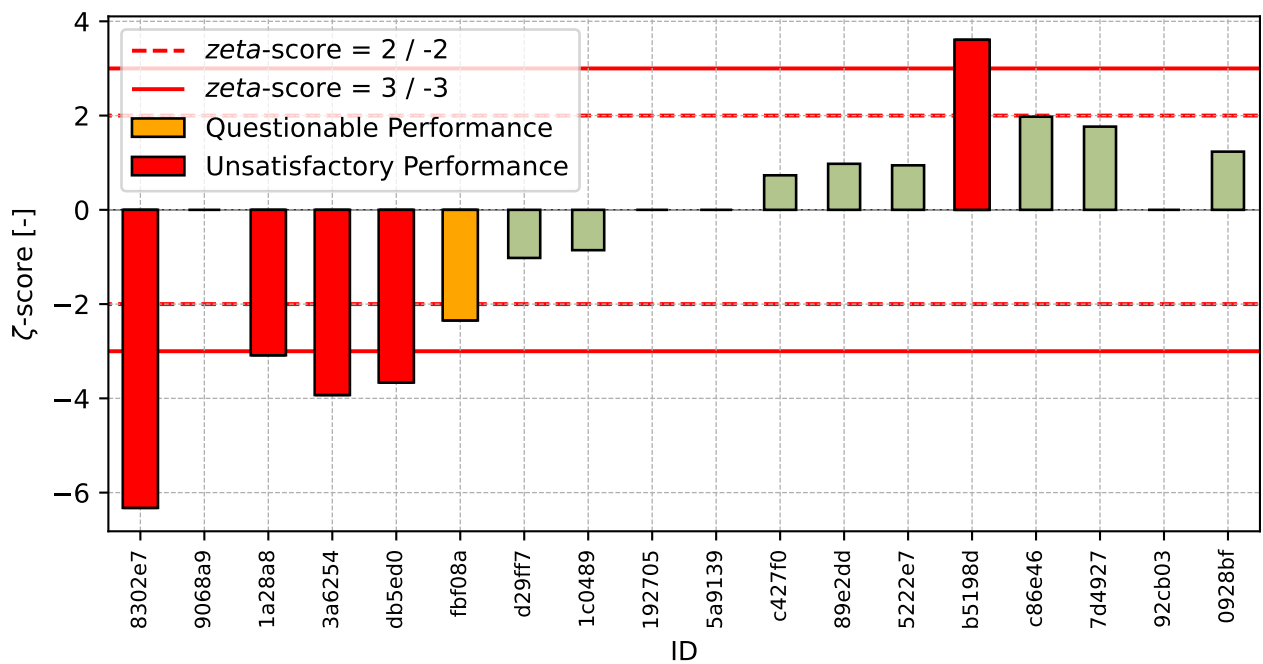


Figure 62: ζ-score

Table 27: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
8302e7	-1.49	-6.32
9068a9	-1.17	-
1a28a8	-0.97	-3.09
3a6254	-0.93	-3.93
db5ed0	-0.93	-3.66
fbf08a	-0.81	-2.35
d29ff7	-0.81	-1.02
1c0489	-0.68	-0.86
192705	-0.15	-
5a9139	0.26	-
c427f0	0.36	0.73
89e2dd	0.36	0.98
5222e7	0.60	0.94
b5198d	1.01	3.61
c86e46	1.29	1.98
7d4927	1.30	1.77
92cb03	1.34	-
0928bf	1.44	1.23

7.2 50 cycles

7.2.1 Test results

Table 28: Test results – ordered by average value. Outliers are marked by red color. Columns 1–3 are individual determinations; u_X – extended uncertainty of measurement; $\bar{x}$ – average value; s_0 – sample standard deviation; V_X – variation coefficient

ID	1 [g/m ²]	2 [g/m ²]	3 [g/m ²]	u_X [g/m ²]	$\bar{x}$ [g/m ²]	s_0 [g/m ²]	V_X [%]
8302e7	1.2	0.4	1.6	0.03	1.1	0.61	57.28
9068a9	80.0	71.1	58.0	-	69.7	11.07	15.88
3a6254	85.6	124.5	109.8	5.00	106.6	19.64	18.42
1c0489	167.1	89.4	229.0	208.00	161.8	69.95	43.22
1a28a8	140.3	249.4	148.1	22.00	179.3	60.86	33.95
db5ed0	140.0	210.0	190.0	30.00	180.0	36.06	20.03
d29ff7	101.0	293.0	198.0	254.00	197.3	96.00	48.65
fbf08a	240.9	236.9	155.5	75.50	211.1	48.19	22.83
192705	233.1	215.6	280.6	-	243.1	33.63	13.84
5a9139	386.2	378.7	251.0	-	338.6	75.99	22.44
c427f0	404.5	339.7	412.2	65.50	385.5	39.82	10.33
89e2dd	360.0	330.0	480.0	50.00	390.0	79.37	20.35
5222e7	427.3	386.3	462.0	101.00	425.2	37.89	8.91
b5198d	545.1	517.6	502.0	31.30	521.6	21.82	4.18
0928bf	576.5	560.8	517.6	82.00	551.6	30.50	5.53
92cb03	565.0	593.0	536.0	-	564.7	28.50	5.05
7d4927	529.4	582.5	603.9	103.00	571.9	38.36	6.71
c86e46	713.3	592.1	634.4	71.10	646.6	61.51	9.51

7.2.2 The Numerical Procedure for Determining Outliers

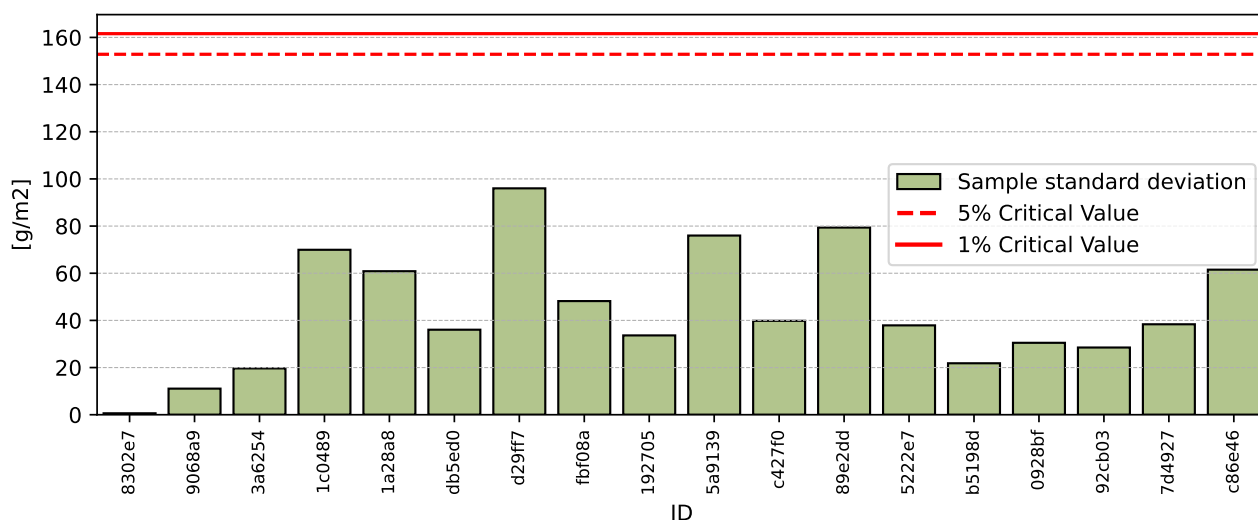


Figure 63: **Cochran's test** - sample standard deviations

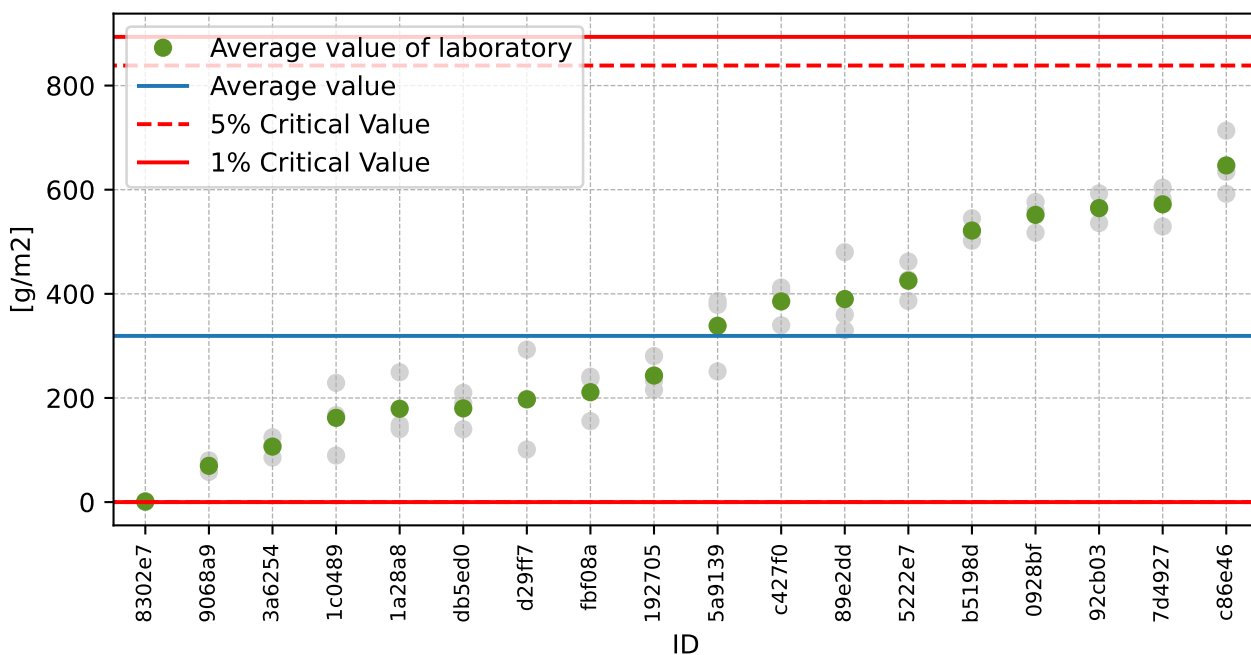


Figure 64: **Grubbs' test** - average values

7.2.3 Mandel's Statistics

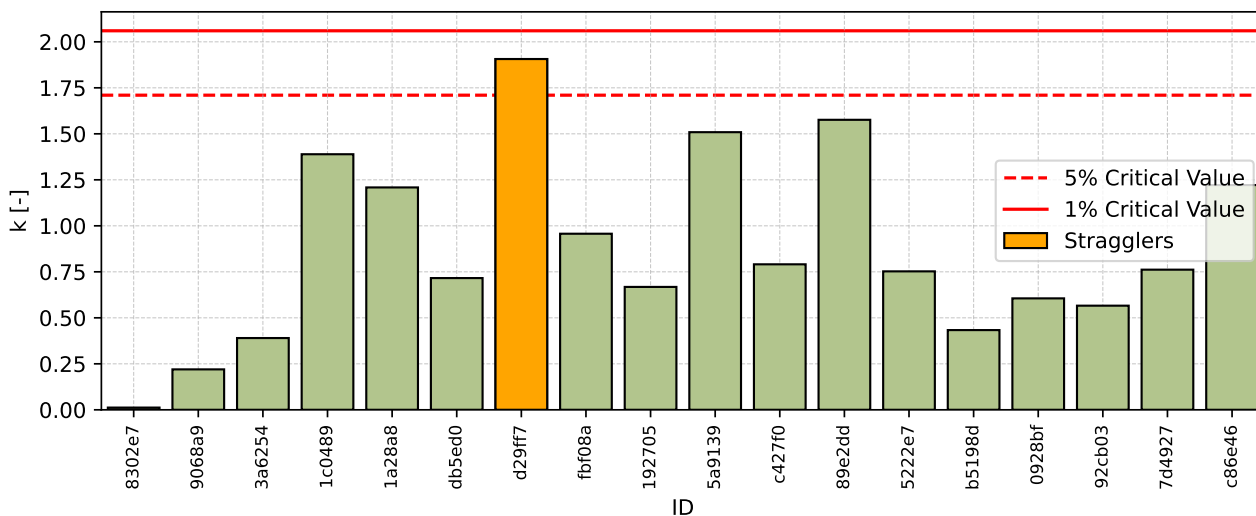


Figure 65: Intralaboratory Consistency Statistic

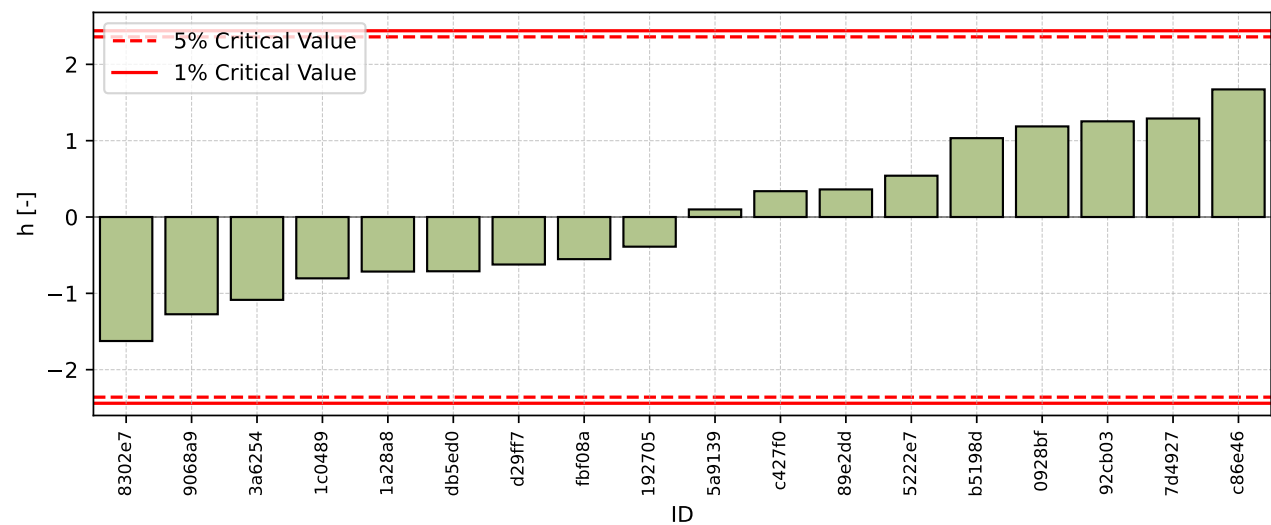


Figure 66: Interlaboratory Consistency Statistic

7.2.4 Descriptive statistics

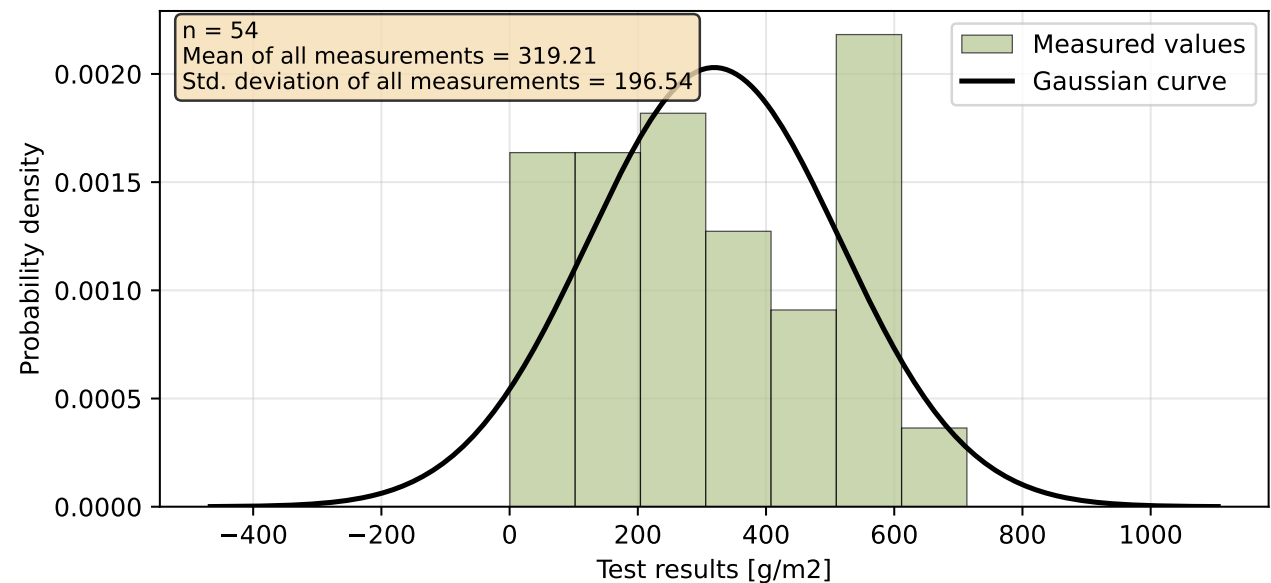


Figure 67: Histogram of all test results

Table 29: Descriptive statistics

Characteristics	[g/m ²]
Average value – $\bar{x}$	319.21
Sample standard deviation – s	195.84
Assigned value – x^*	319.21
Robust standard deviation – s^*	195.84
Measurement uncertainty of assigned value – u_X	46.16
p -value of normality test [-]	0.024
Interlaboratory standard deviation – s_L	193.67
Repeatability standard deviation – s_r	50.36
Reproducibility standard deviation – s_R	200.11
Repeatability – r	141.00
Reproducibility – R	560.31

7.2.5 Evaluation of Performance Statistics

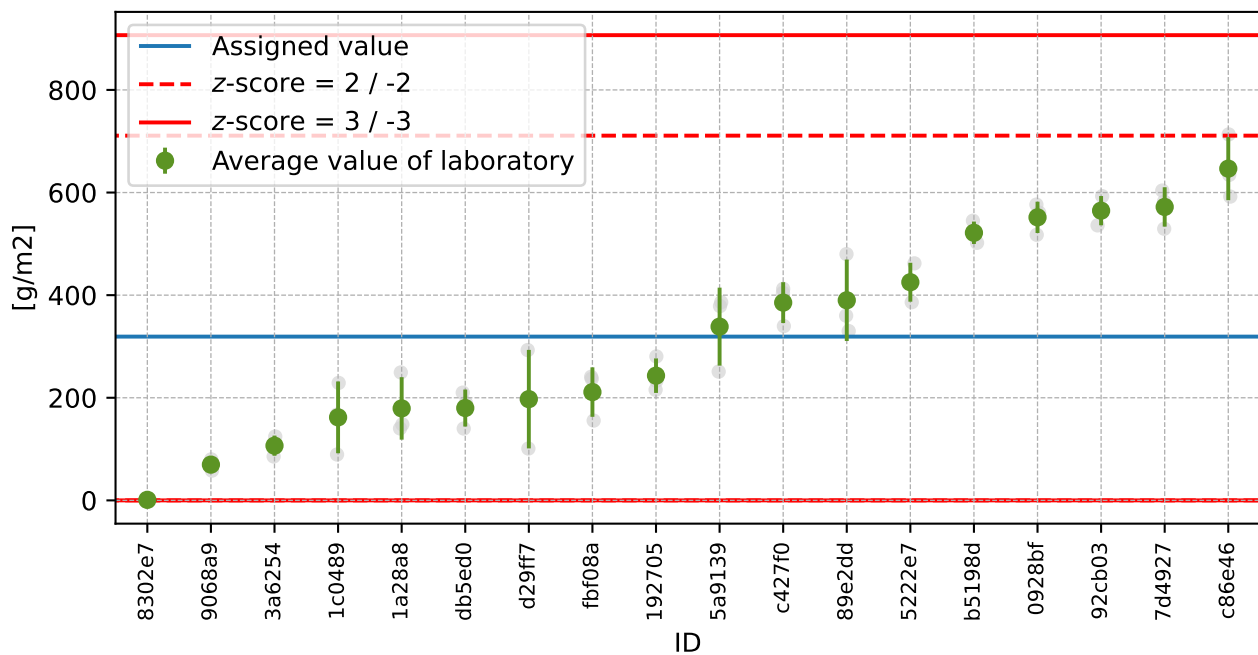


Figure 68: Average values and sample standard deviations

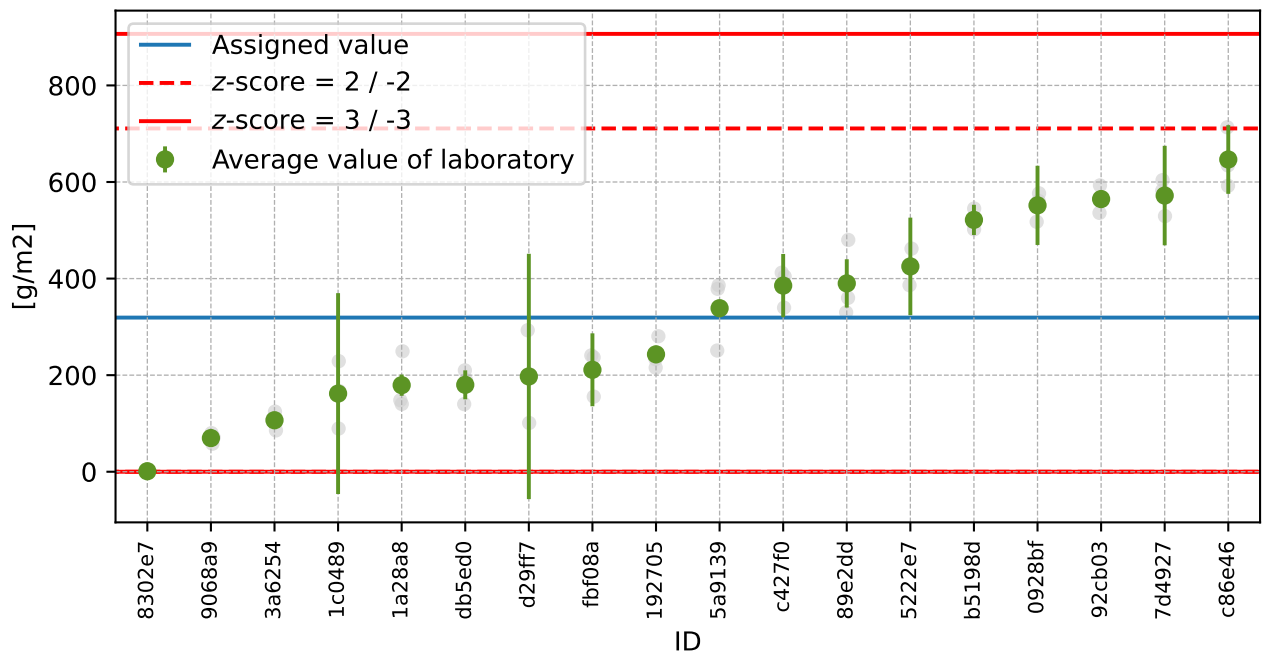


Figure 69: Average values and extended uncertainties of measurement

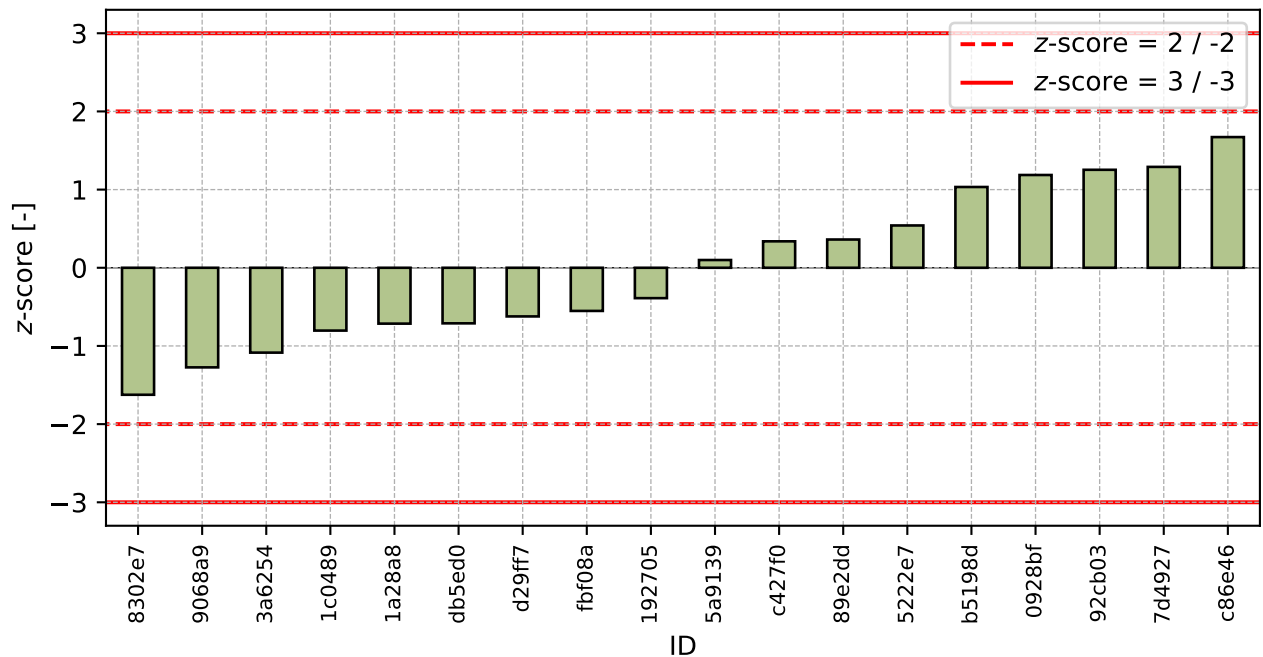


Figure 70: z-score

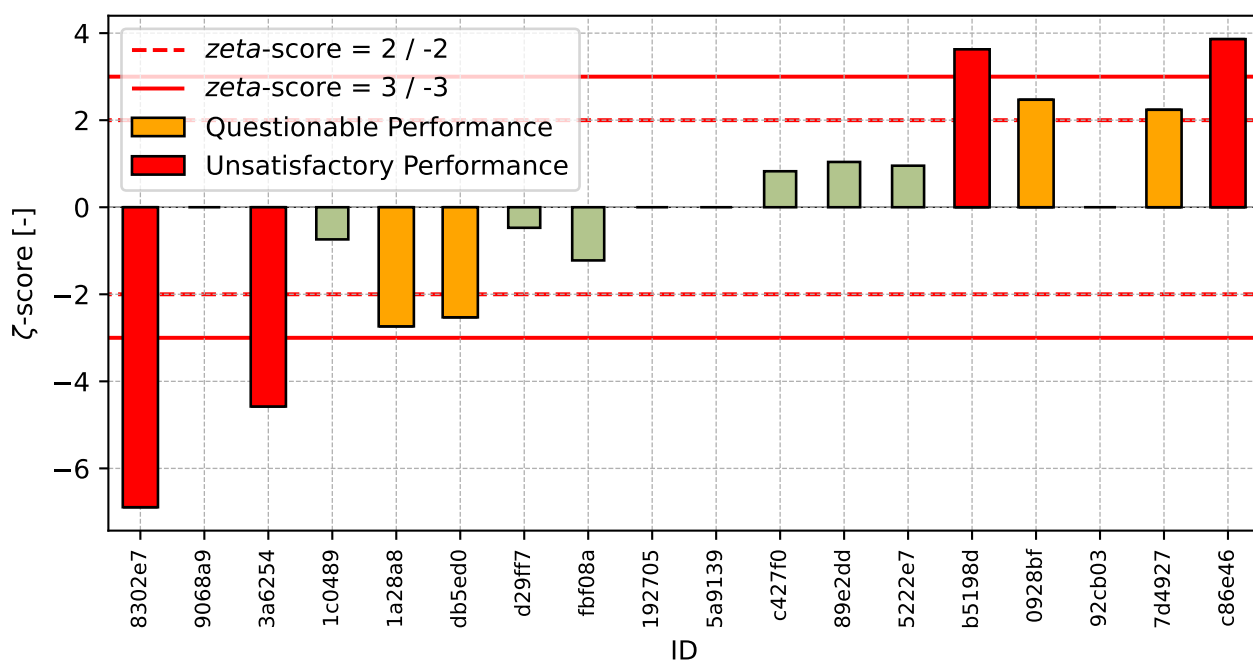


Figure 71: ζ-score

Table 30: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
8302e7	-1.62	-6.89
9068a9	-1.27	-
3a6254	-1.09	-4.58
1c0489	-0.80	-0.74
1a28a8	-0.71	-2.74
db5ed0	-0.71	-2.53
d29ff7	-0.62	-0.47
fbf08a	-0.55	-1.22
192705	-0.39	-
5a9139	0.10	-
c427f0	0.34	0.83
89e2dd	0.36	1.04
5222e7	0.54	0.95
b5198d	1.03	3.63
0928bf	1.19	2.47
92cb03	1.25	-
7d4927	1.29	2.24
c86e46	1.67	3.86

7.3 75 cycles

7.3.1 Test results

Table 31: Test results – ordered by average value. Outliers are marked by red color. Columns 1–3 are individual determinations; u_X – extended uncertainty of measurement; $\bar{x}$ – average value; s_0 – sample standard deviation; V_X – variation coefficient

ID	1 [g/m ²]	2 [g/m ²]	3 [g/m ²]	u_X [g/m ²]	$\bar{x}$ [g/m ²]	s_0 [g/m ²]	V_X [%]
8302e7	1.6	0.8	2.3	0.04	1.6	0.75	47.91
9068a9	128.9	124.4	124.7	-	126.0	2.52	2.00
3a6254	136.2	190.6	164.7	7.70	163.8	27.21	16.61
1c0489	200.4	114.1	272.5	243.00	195.7	79.31	40.53
1a28a8	218.2	350.7	233.8	22.00	267.6	72.42	27.06
192705	303.0	297.9	366.3	-	322.4	38.10	11.82
db5ed0	280.0	360.0	340.0	40.00	326.7	41.63	12.74
fbf08a	369.7	458.0	272.7	142.50	366.8	92.68	25.27
d29ff7	186.0	543.0	381.0	472.00	370.0	178.75	48.31
5a9139	535.4	572.4	361.1	-	489.6	112.84	23.05
89e2dd	520.0	520.0	680.0	70.00	573.3	92.38	16.11
c427f0	646.2	487.1	608.8	135.50	580.7	83.19	14.33
5222e7	672.1	616.5	733.8	156.00	674.1	58.68	8.70
0928bf	784.3	756.9	713.7	95.00	751.6	35.59	4.74
b5198d	792.2	800.0	702.0	45.90	764.7	54.47	7.12
92cb03	800.0	876.0	790.0	-	822.0	47.03	5.72
7d4927	784.3	860.0	862.7	121.00	835.7	44.51	5.33
c86e46	1055.3	856.6	911.3	118.50	941.1	102.64	10.91

7.3.2 The Numerical Procedure for Determining Outliers

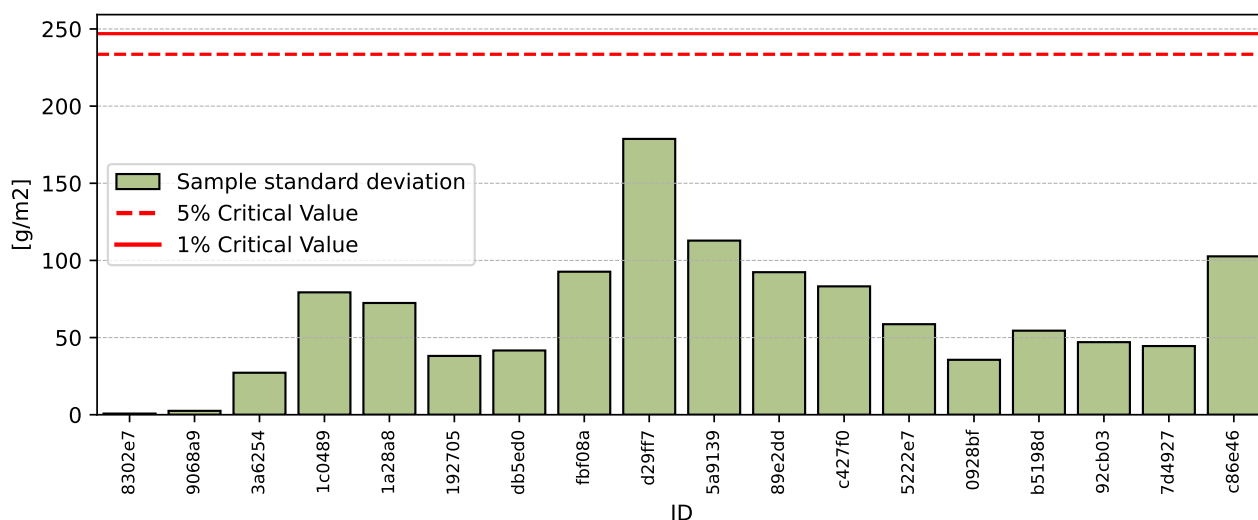
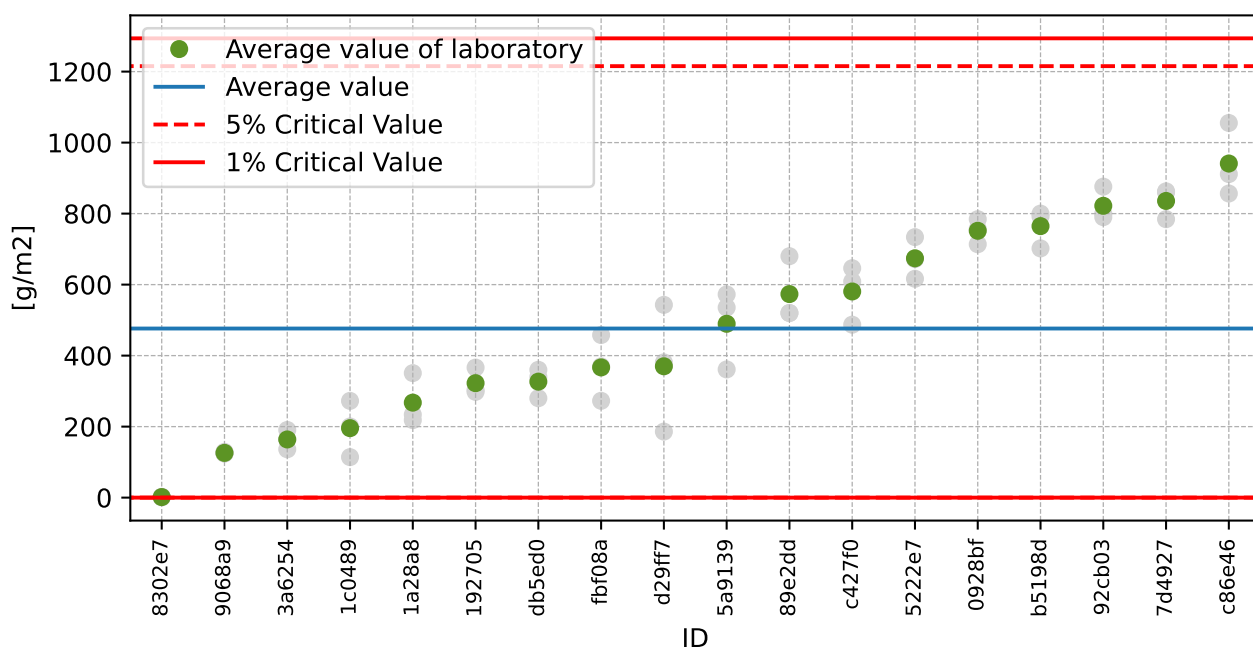


Figure 72: Cochran's test - sample standard deviations


Figure 73: **Grubbs' test** - average values

7.3.3 Mandel's Statistics

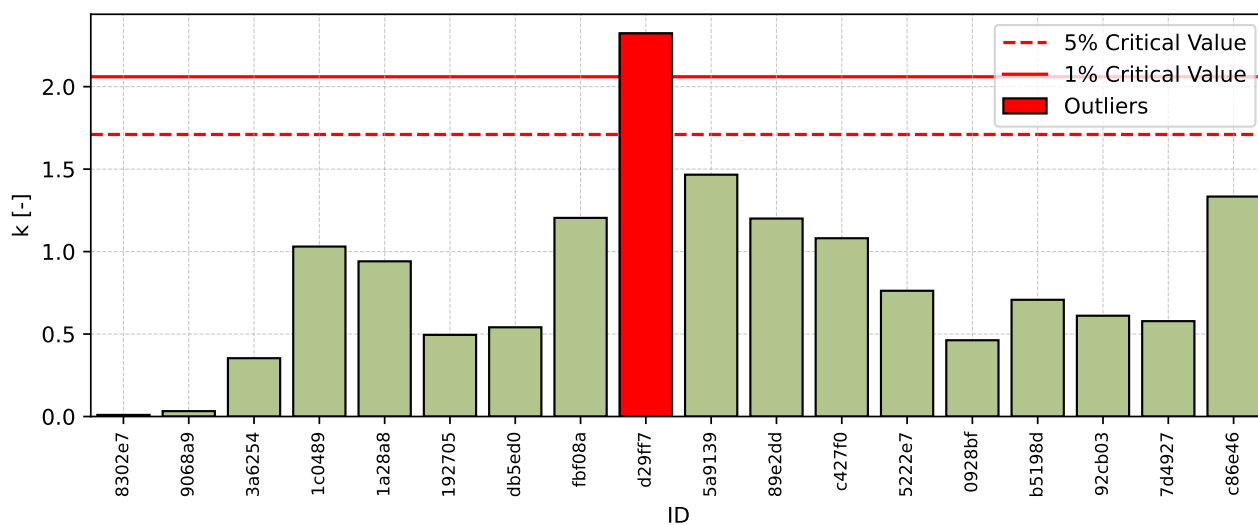


Figure 74: Intralaboratory Consistency Statistic

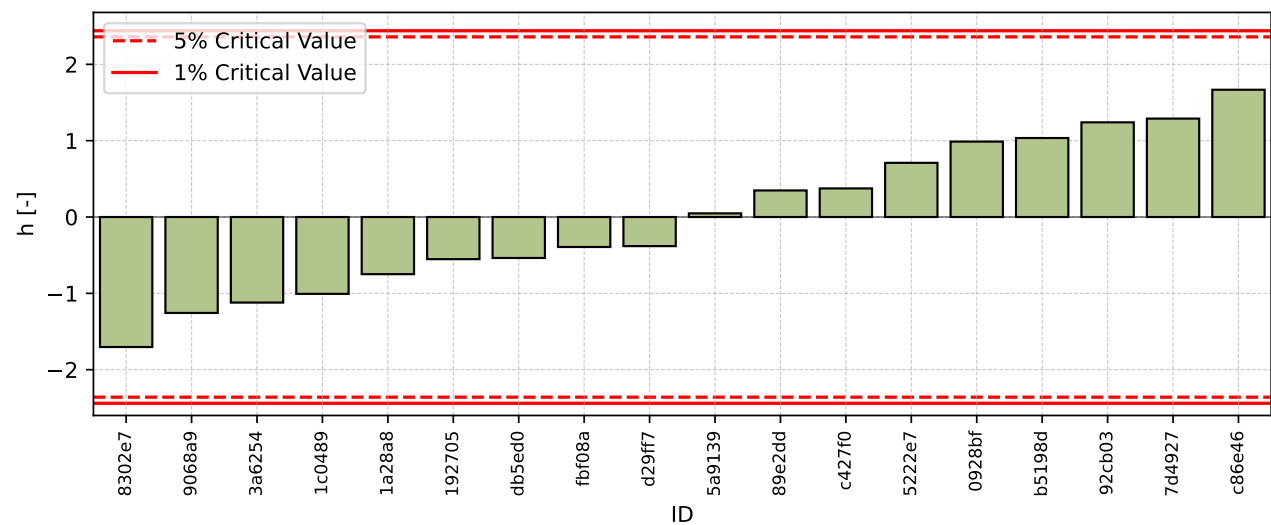


Figure 75: Interlaboratory Consistency Statistic

7.3.4 Descriptive statistics

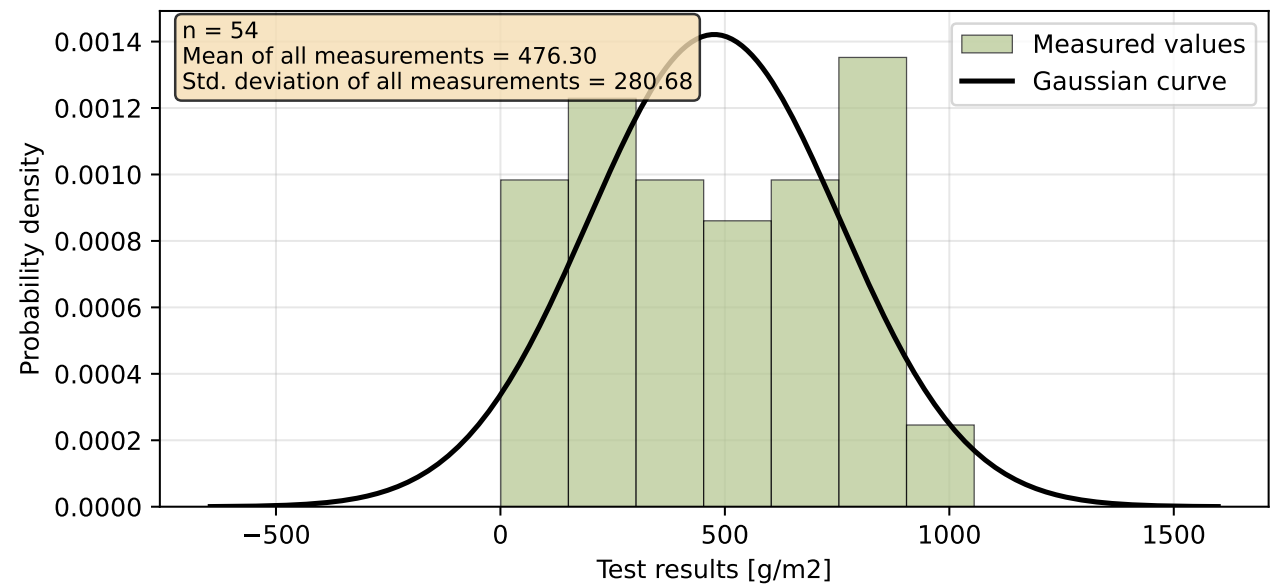


Figure 76: Histogram of all test results

Table 32: Descriptive statistics

Characteristics	[g/m ²]
Average value – $\bar{x}$	476.30
Sample standard deviation – s	278.73
Assigned value – x^*	476.30
Robust standard deviation – s^*	278.73
Measurement uncertainty of assigned value – u_X	65.70
p -value of normality test [-]	0.039
Interlaboratory standard deviation – s_L	275.16
Repeatability standard deviation – s_r	76.96
Reproducibility standard deviation – s_R	285.72
Repeatability – r	215.48
Reproducibility – R	800.02

7.3.5 Evaluation of Performance Statistics

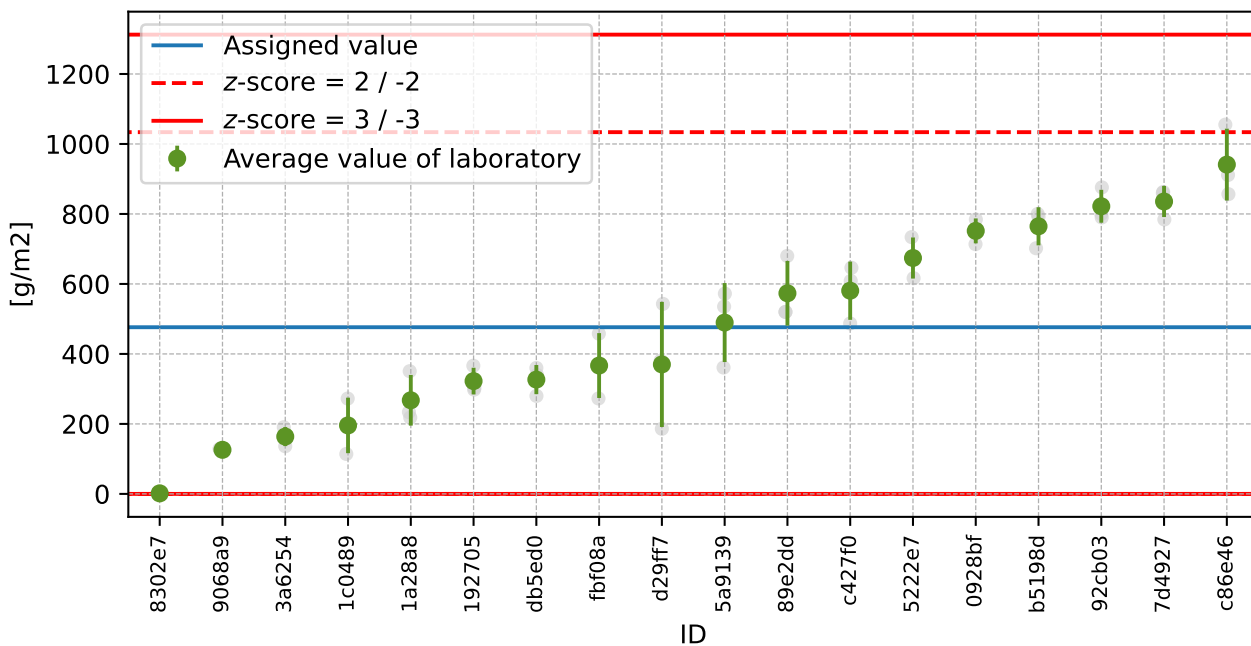


Figure 77: Average values and sample standard deviations

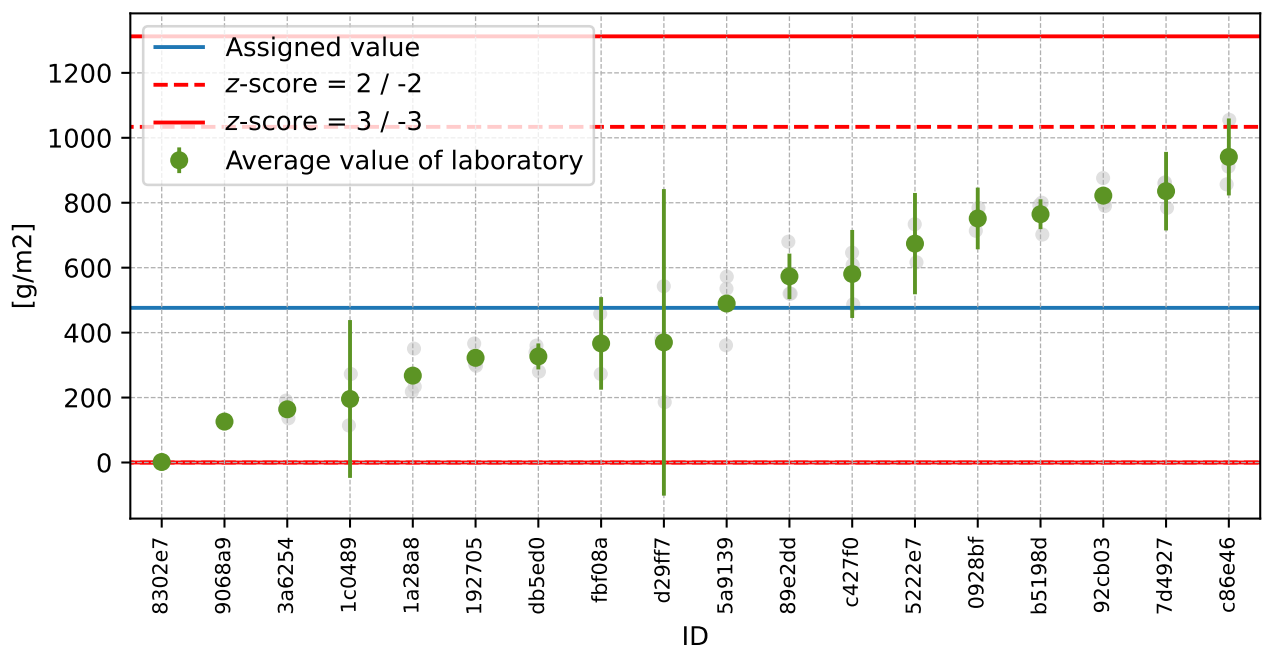


Figure 78: Average values and extended uncertainties of measurement

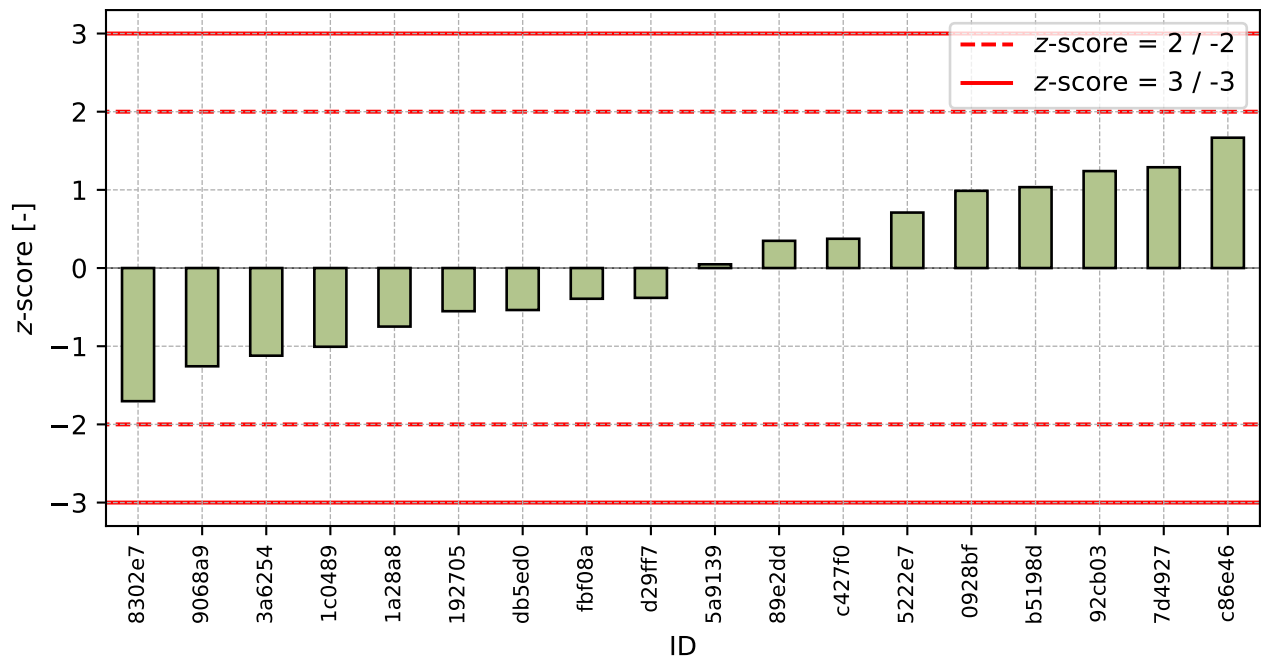
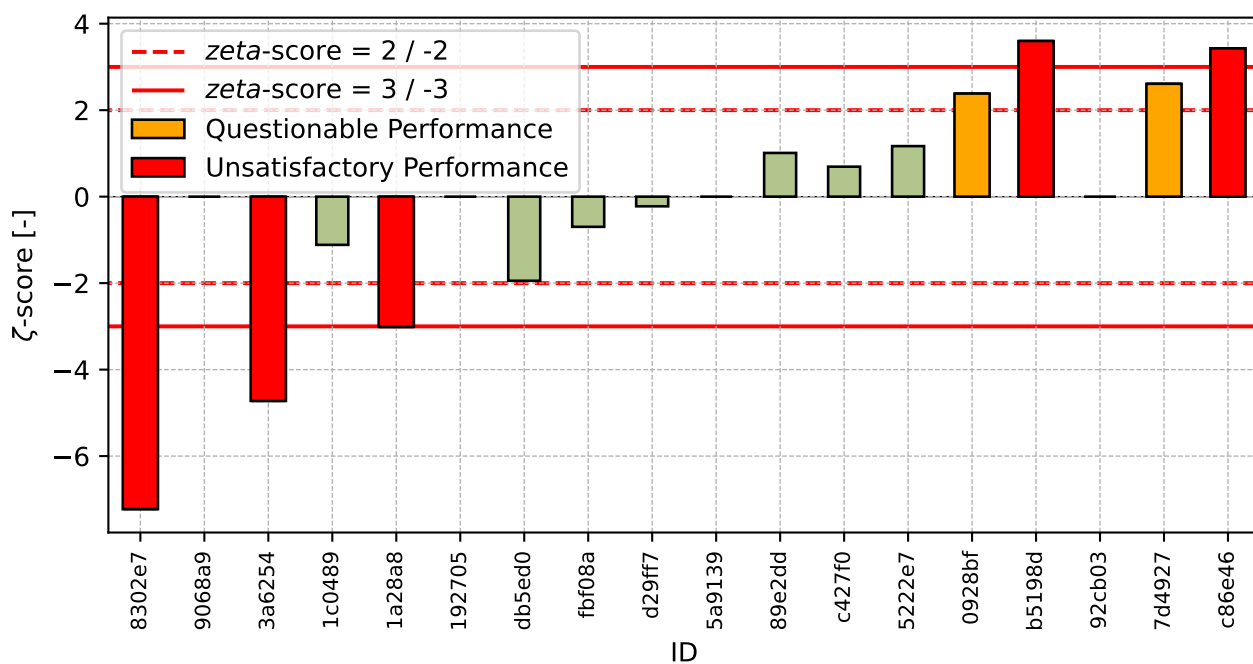


Figure 79: z-score

Figure 80: ζ -scoreTable 33: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
8302e7	-1.70	-7.23
9068a9	-1.26	-
3a6254	-1.12	-4.72
1c0489	-1.01	-1.11
1a28a8	-0.75	-3.01
192705	-0.55	-
db5ed0	-0.54	-1.95
fbf08a	-0.39	-0.70
d29ff7	-0.38	-0.22
5a9139	0.05	-
89e2dd	0.35	1.01
c427f0	0.37	0.69
5222e7	0.71	1.17
0928bf	0.99	2.38
b5198d	1.03	3.60
92cb03	1.24	-
7d4927	1.29	2.61
c86e46	1.67	3.43

7.4 100 cycles

7.4.1 Test results

Table 34: Test results – ordered by average value. Outliers are marked by red color. Columns 1–3 are individual determinations; u_X – extended uncertainty of measurement; $\bar{x}$ – average value; s_0 – sample standard deviation; V_X – variation coefficient

ID	1 [g/m ²]	2 [g/m ²]	3 [g/m ²]	u_X [g/m ²]	$\bar{x}$ [g/m ²]	s_0 [g/m ²]	V_X [%]
8302e7	2.0	1.2	3.5	0.06	2.2	1.17	52.28
9068a9	186.7	191.1	169.5	-	182.4	11.41	6.26
1c0489	243.5	126.3	267.5	229.00	212.4	75.55	35.57
3a6254	221.8	272.3	251.0	10.90	248.4	25.35	10.21
192705	373.0	356.6	444.3	-	391.3	46.63	11.92
1a28a8	366.3	549.5	432.6	22.00	449.5	92.76	20.64
fbf08a	535.4	674.5	415.6	230.20	541.8	129.57	23.91
d29ff7	326.0	793.0	583.0	617.00	567.3	233.89	41.23
db5ed0	530.0	650.0	570.0	70.00	583.3	61.10	10.47
5a9139	689.0	814.6	532.8	-	678.8	141.18	20.80
89e2dd	710.0	700.0	900.0	100.00	770.0	112.69	14.64
c427f0	859.8	656.8	806.5	212.50	774.4	105.25	13.59
5222e7	944.0	932.6	978.4	71.00	951.7	23.84	2.51
0928bf	988.2	1003.9	937.3	94.00	976.5	34.82	3.57
b5198d	1027.5	1090.2	902.0	60.40	1006.6	95.83	9.52
92cb03	1102.0	1162.0	1017.0	-	1093.7	72.86	6.66
7d4927	1074.5	1125.9	1117.6	77.00	1106.0	27.59	2.49
c86e46	1412.5	1103.2	1217.4	180.60	1244.4	156.40	12.57

7.4.2 The Numerical Procedure for Determining Outliers

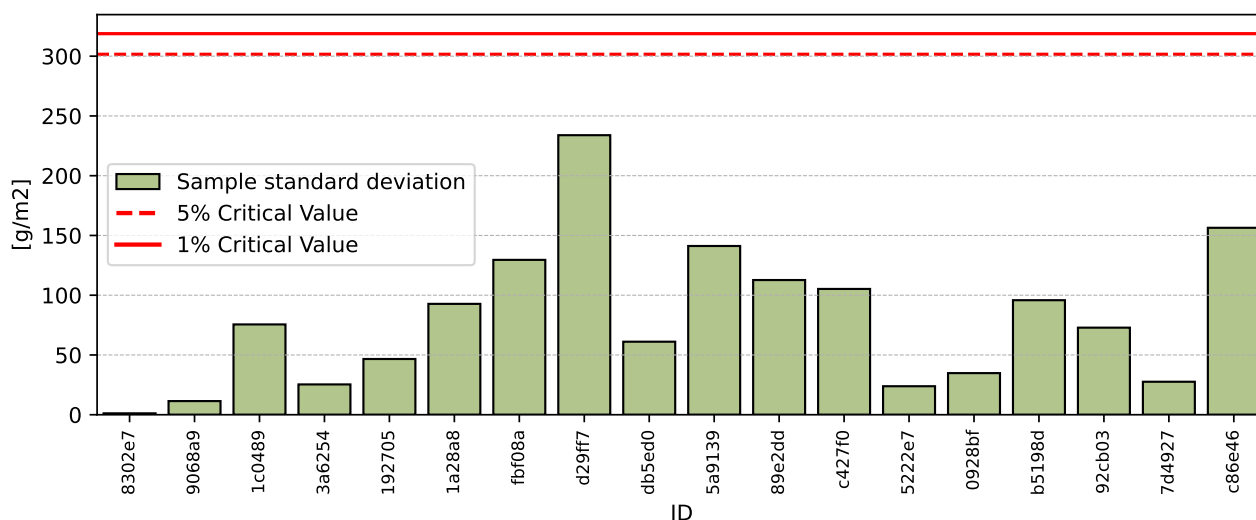


Figure 81: Cochran's test - sample standard deviations

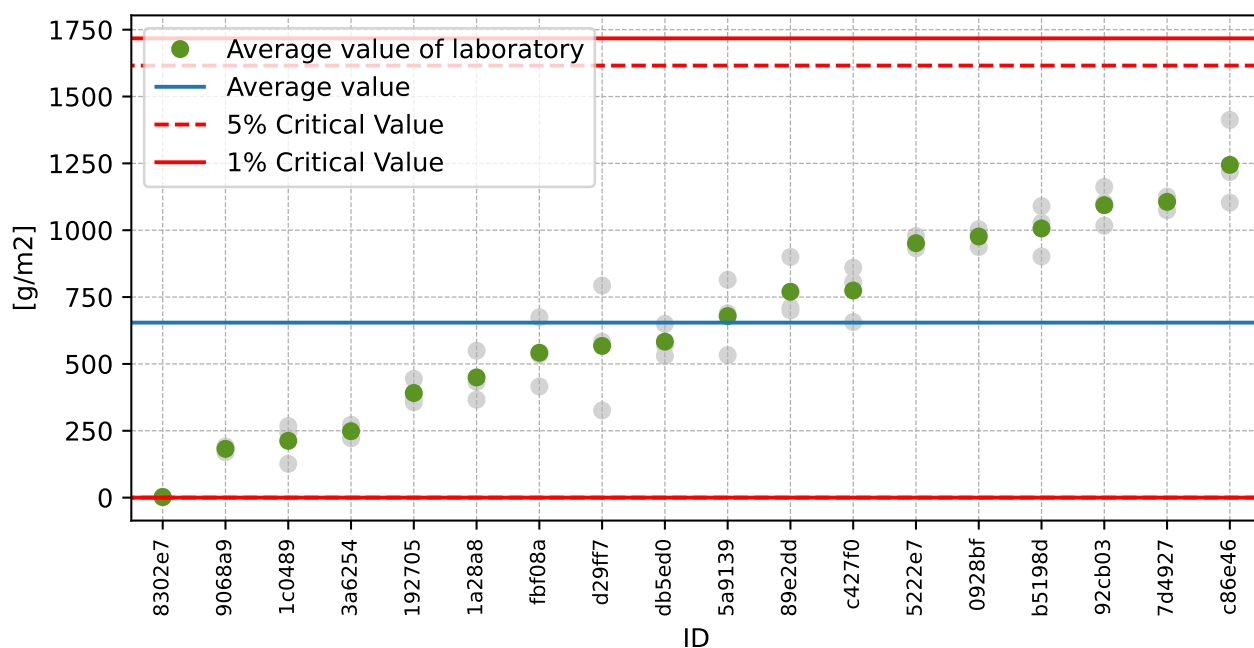


Figure 82: **Grubbs' test** - average values

7.4.3 Mandel's Statistics

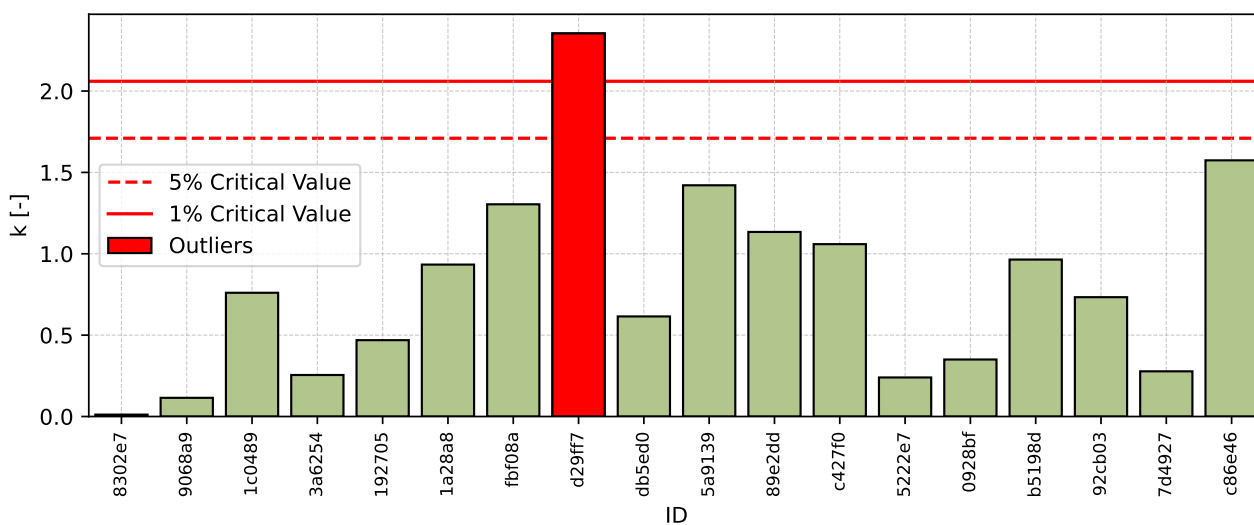


Figure 83: Intralaboratory Consistency Statistic

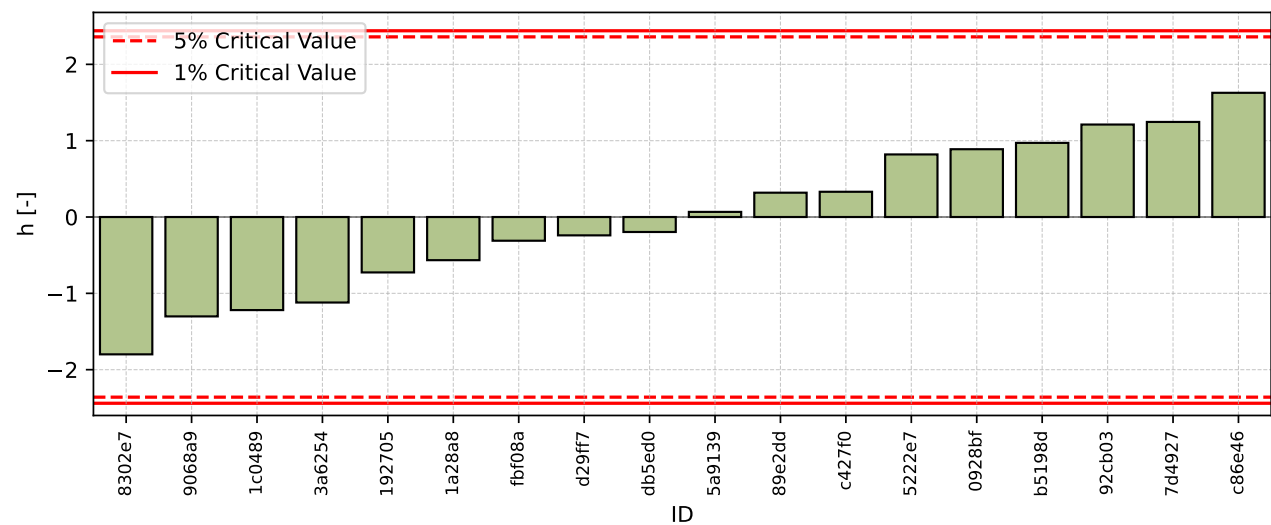


Figure 84: Interlaboratory Consistency Statistic

7.4.4 Descriptive statistics

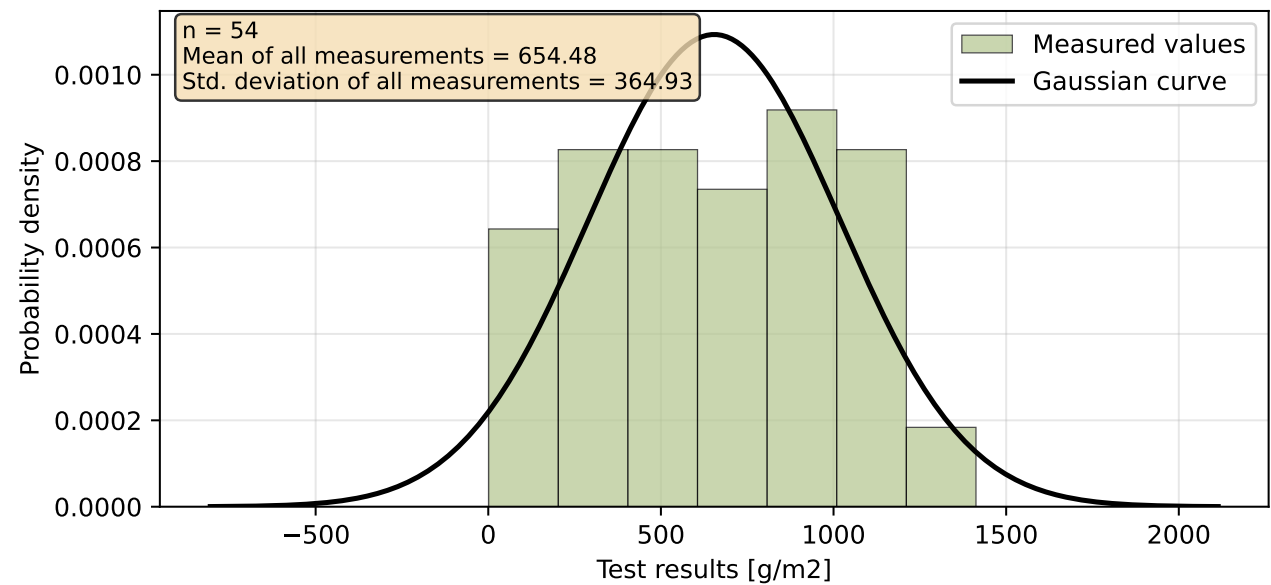


Figure 85: Histogram of all test results

Table 35: Descriptive statistics

Characteristics	[g/m ²]
Average value – $\bar{x}$	654.48
Sample standard deviation – s	362.53
Assigned value – x^*	654.48
Robust standard deviation – s^*	362.53
Measurement uncertainty of assigned value – u_X	85.45
p -value of normality test [-]	0.104
Interlaboratory standard deviation – s_L	357.96
Repeatability standard deviation – s_r	99.36
Reproducibility standard deviation – s_R	371.49
Repeatability – r	278.20
Reproducibility – R	1040.18

7.4.5 Evaluation of Performance Statistics

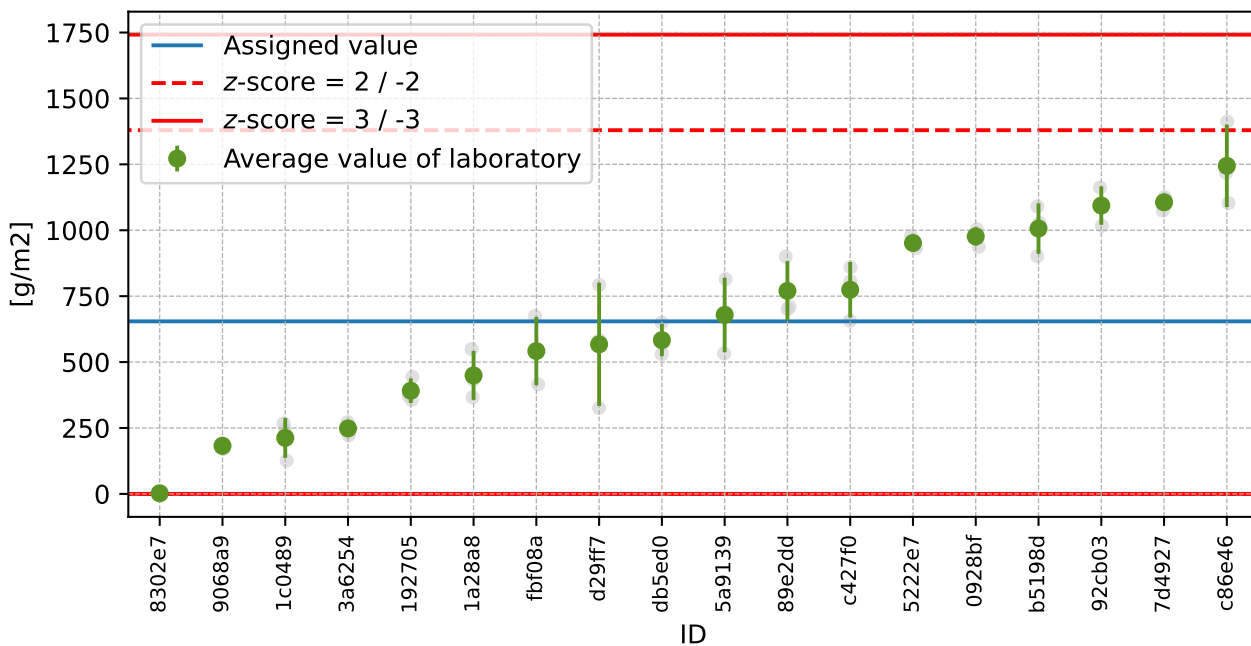


Figure 86: Average values and sample standard deviations

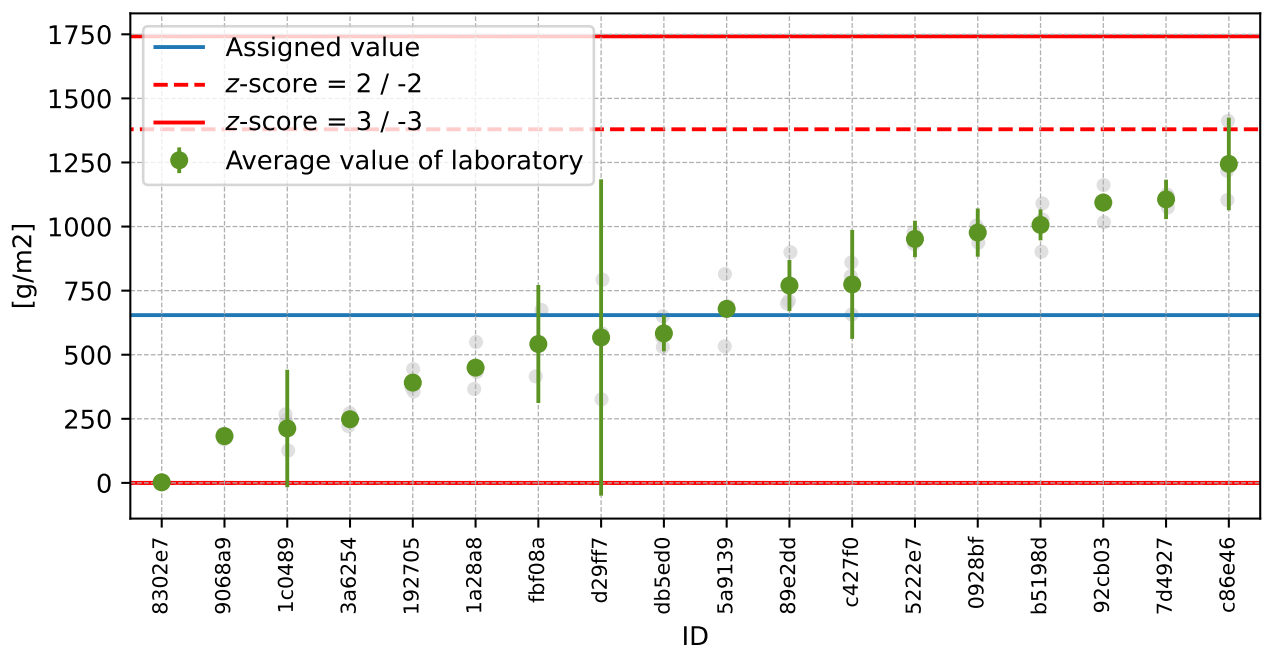


Figure 87: Average values and extended uncertainties of measurement

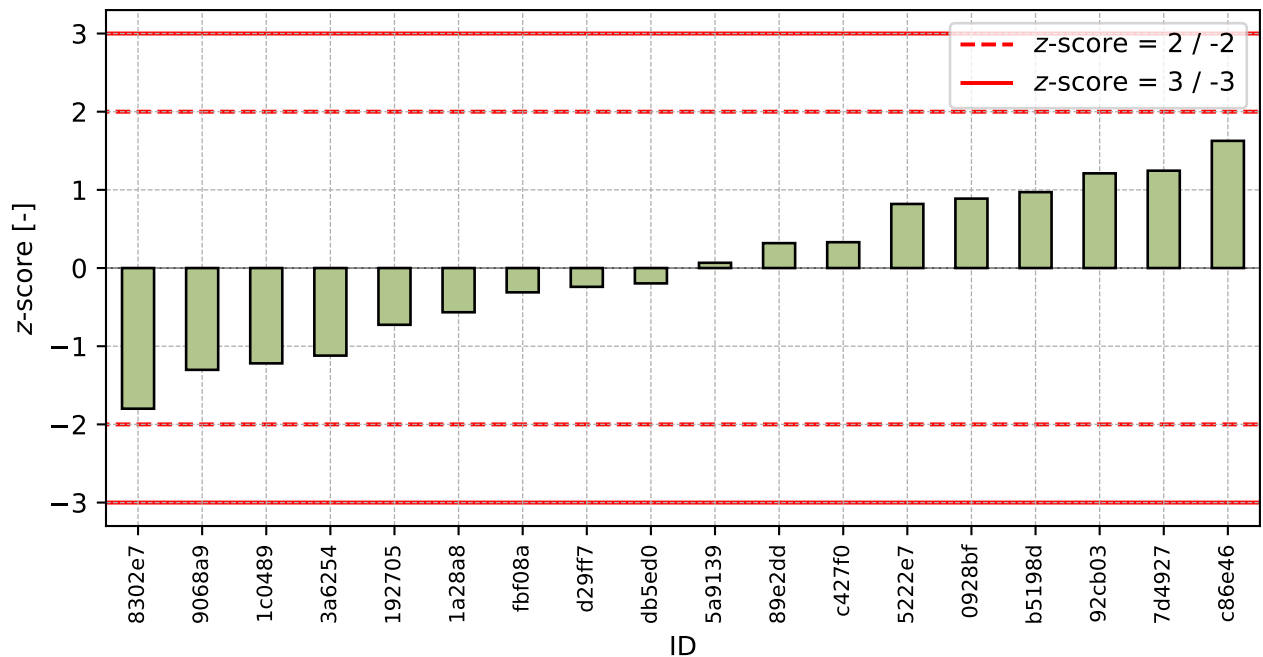


Figure 88: z-score

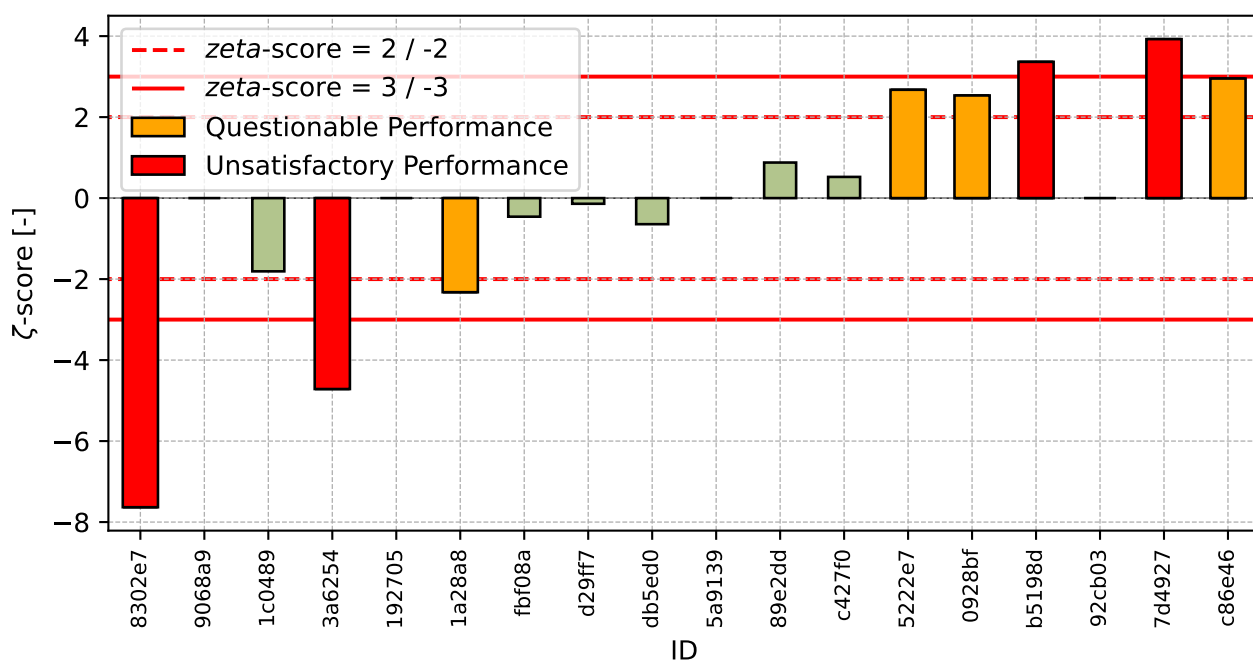


Figure 89: ζ-score

Table 36: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
8302e7	-1.80	-7.63
9068a9	-1.30	-
1c0489	-1.22	-1.81
3a6254	-1.12	-4.71
192705	-0.73	-
1a28a8	-0.57	-2.32
fbf08a	-0.31	-0.46
d29ff7	-0.24	-0.14
db5ed0	-0.20	-0.64
5a9139	0.07	-
89e2dd	0.32	0.88
c427f0	0.33	0.52
5222e7	0.82	2.68
0928bf	0.89	2.53
b5198d	0.97	3.36
92cb03	1.21	-
7d4927	1.25	3.93
c86e46	1.63	2.95

8 Appendix – ČSN 73 1326 – Resistance of cement concrete surface to water and defrosting chemicals – Method C

8.1 25 cycles

8.1.1 Test results

Table 37: Test results – ordered by average value. Outliers are marked by red color. Columns 1–3 are individual determinations; u_X – extended uncertainty of measurement; $\bar{x}$ – average value; s_0 – sample standard deviation; V_X – variation coefficient

ID	1 [g/m ²]	2 [g/m ²]	3 [g/m ²]	u_X [g/m ²]	$\bar{x}$ [g/m ²]	s_0 [g/m ²]	V_X [%]
a9f454	12.4	7.6	5.3	0.50	8.4	3.62	42.96
8302e7	10.5	8.4	12.1	0.30	10.3	1.86	17.96
2a406f	5.5	22.2	5.5	14.00	11.1	9.64	87.12
d29ff7	17.0	28.0	6.0	40.00	17.0	11.00	64.71
c86e46	20.7	16.8	16.2	10.10	17.9	2.44	13.65
8ef05a	22.0	17.0	23.0	4.55	20.7	3.21	15.55
6b8ef9	25.7	27.3	20.0	2.00	24.3	3.84	15.77
d1d5e3	22.4	33.5	27.9	6.00	27.9	5.55	19.87

8.1.2 The Numerical Procedure for Determining Outliers

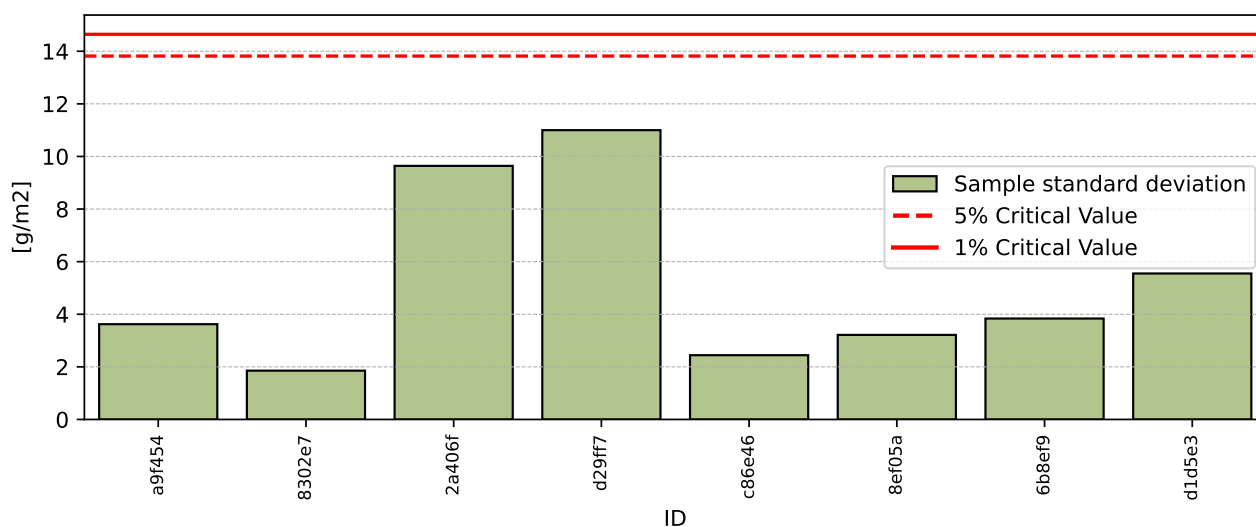


Figure 90: **Cochran's test** - sample standard deviations

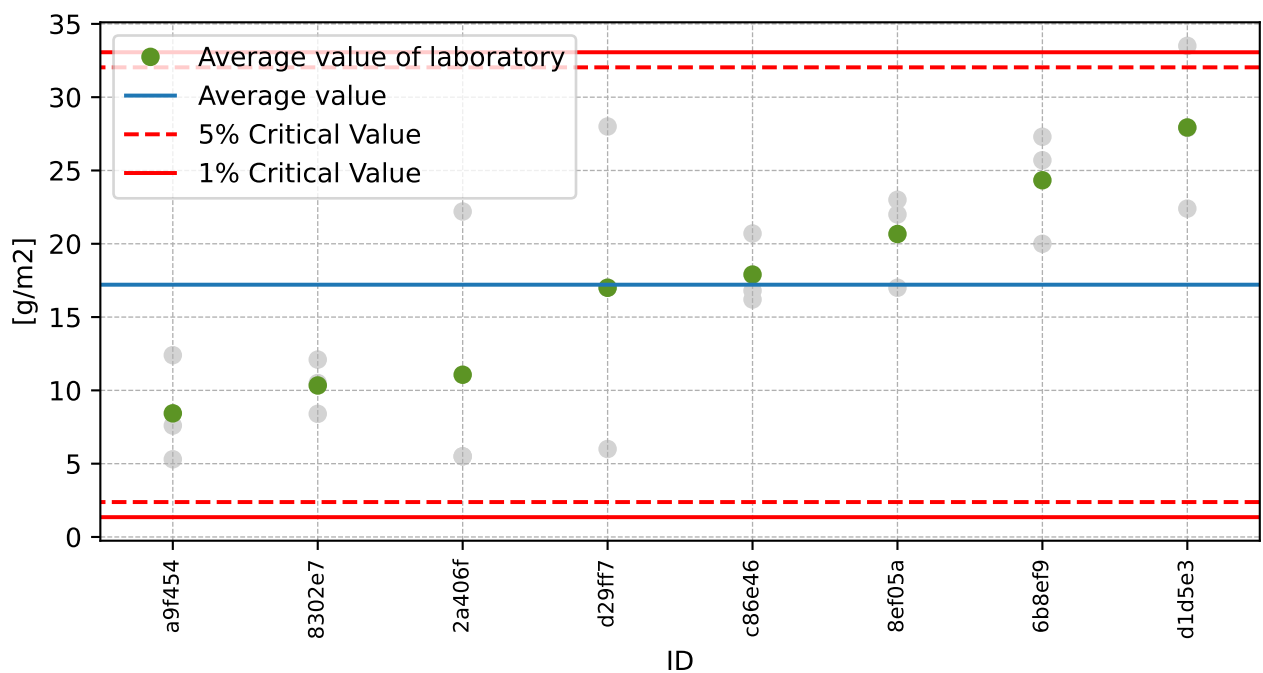


Figure 91: **Grubbs' test** - average values

8.1.3 Mandel's Statistics

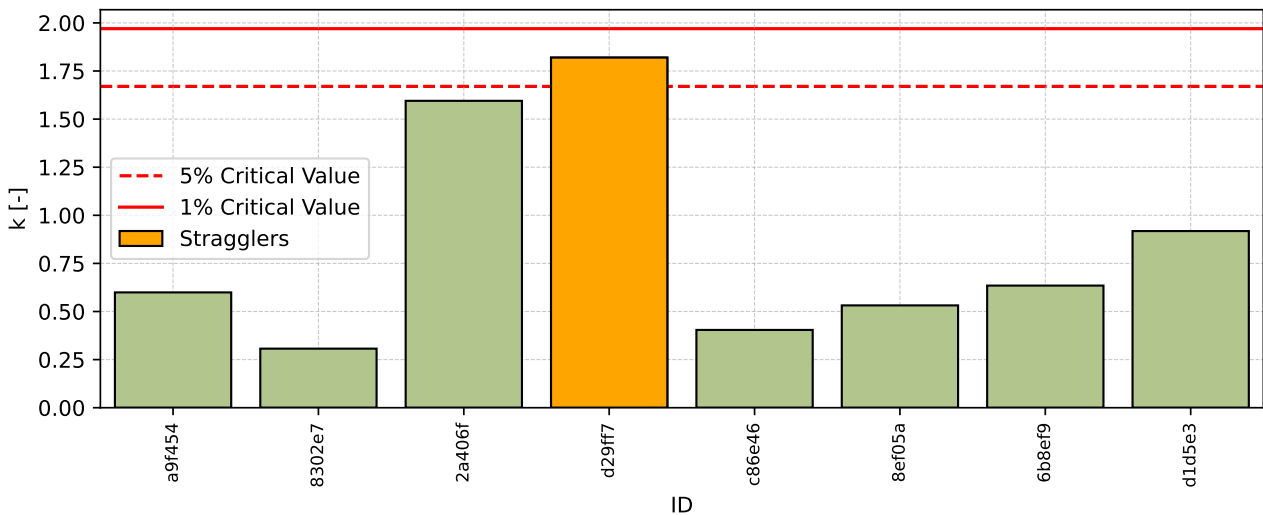


Figure 92: Intralaboratory Consistency Statistic

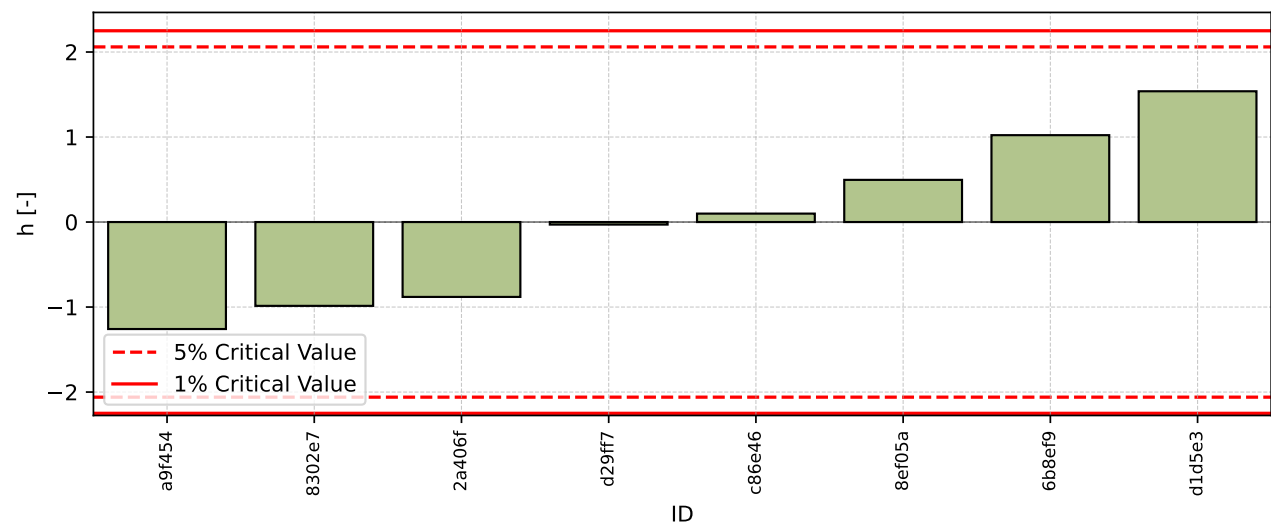


Figure 93: Interlaboratory Consistency Statistic

8.1.4 Descriptive statistics

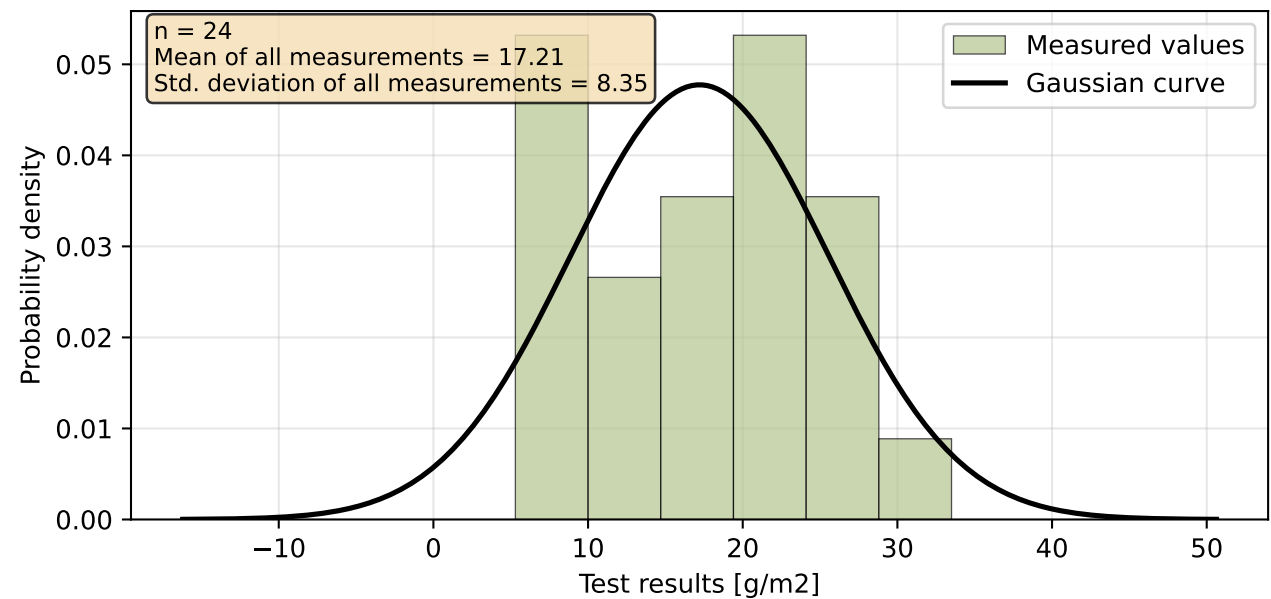


Figure 94: Histogram of all test results

Table 38: Descriptive statistics

Characteristics	[g/m ²]
Average value – $\bar{x}$	17.21
Sample standard deviation – s	6.97
Assigned value – x^*	17.21
Robust standard deviation – s^*	6.97
Measurement uncertainty of assigned value – u_X	2.46
p -value of normality test [-]	0.228
Interlaboratory standard deviation – s_L	6.04
Repeatability standard deviation – s_r	6.05
Reproducibility standard deviation – s_R	8.54
Repeatability – r	16.93
Reproducibility – R	23.92

8.1.5 Evaluation of Performance Statistics

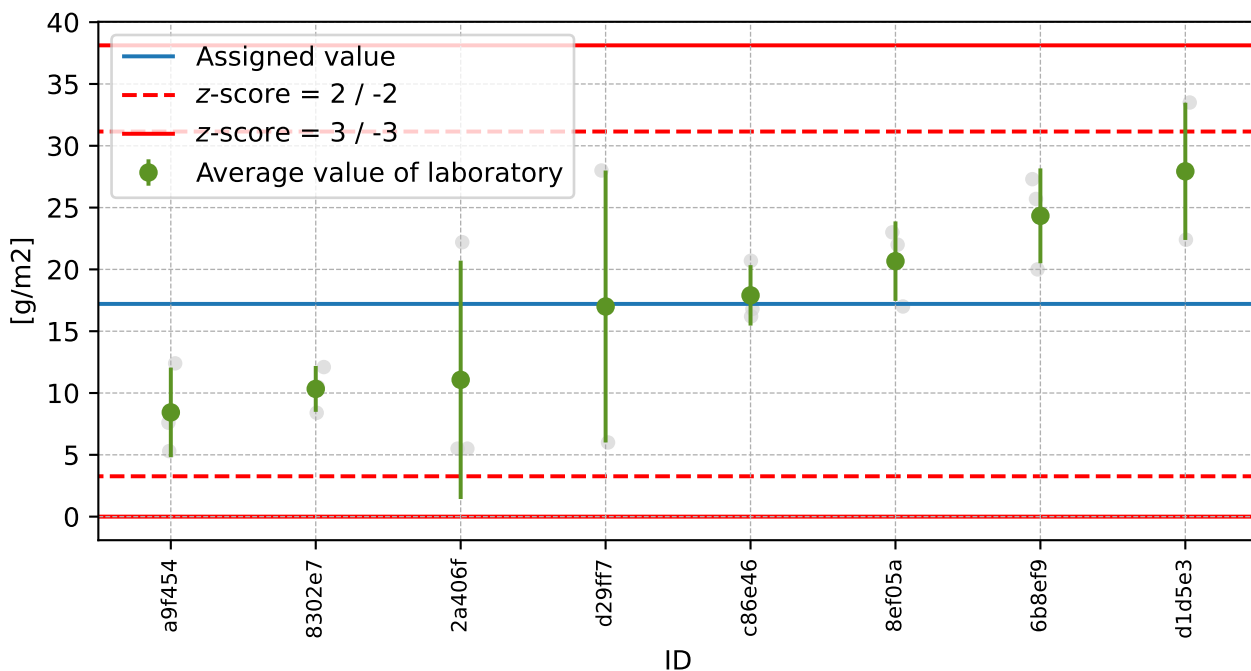


Figure 95: Average values and sample standard deviations

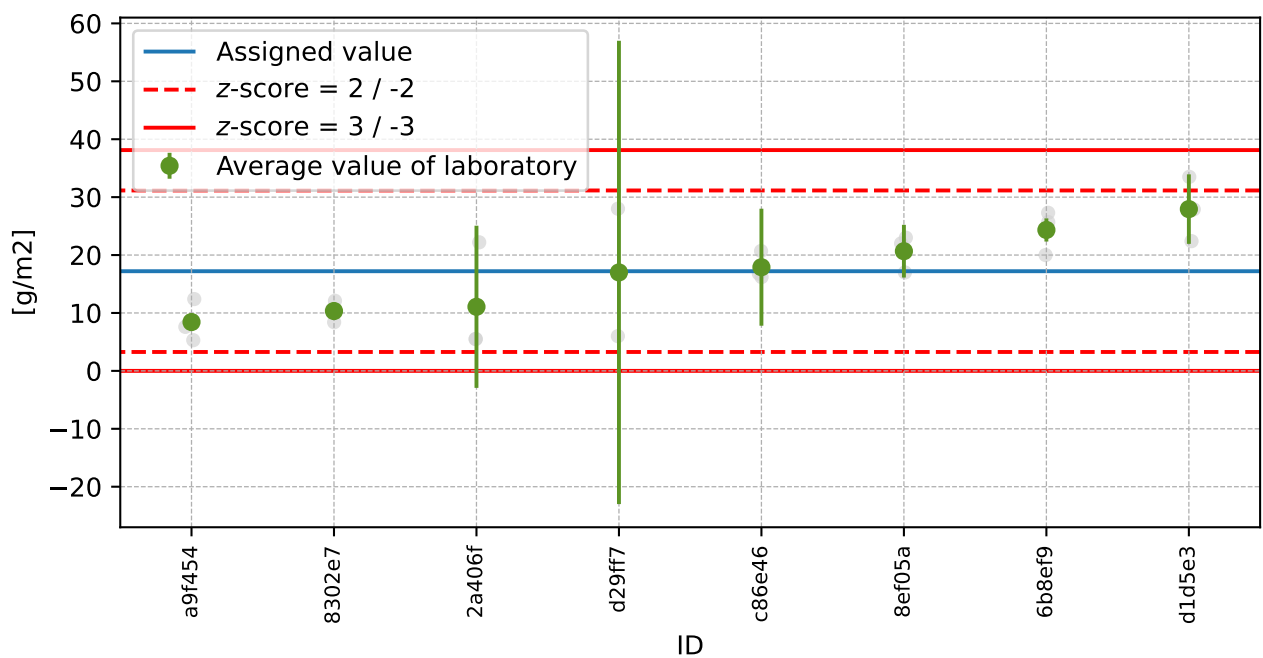


Figure 96: Average values and extended uncertainties of measurement

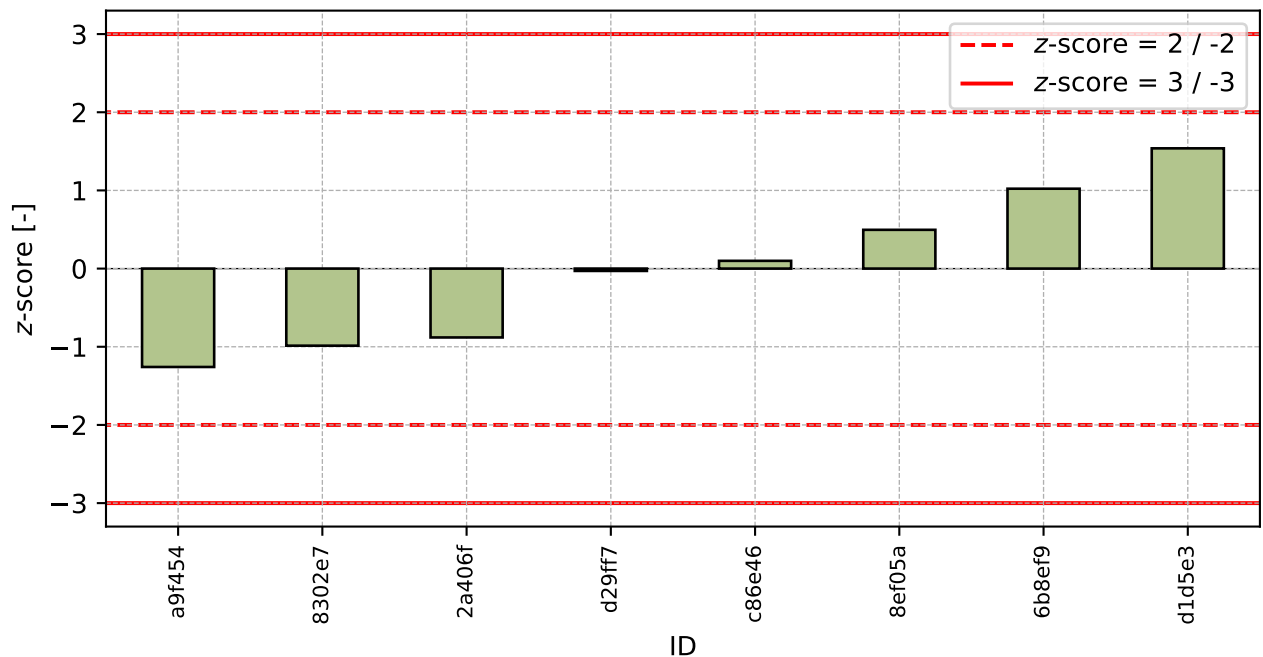
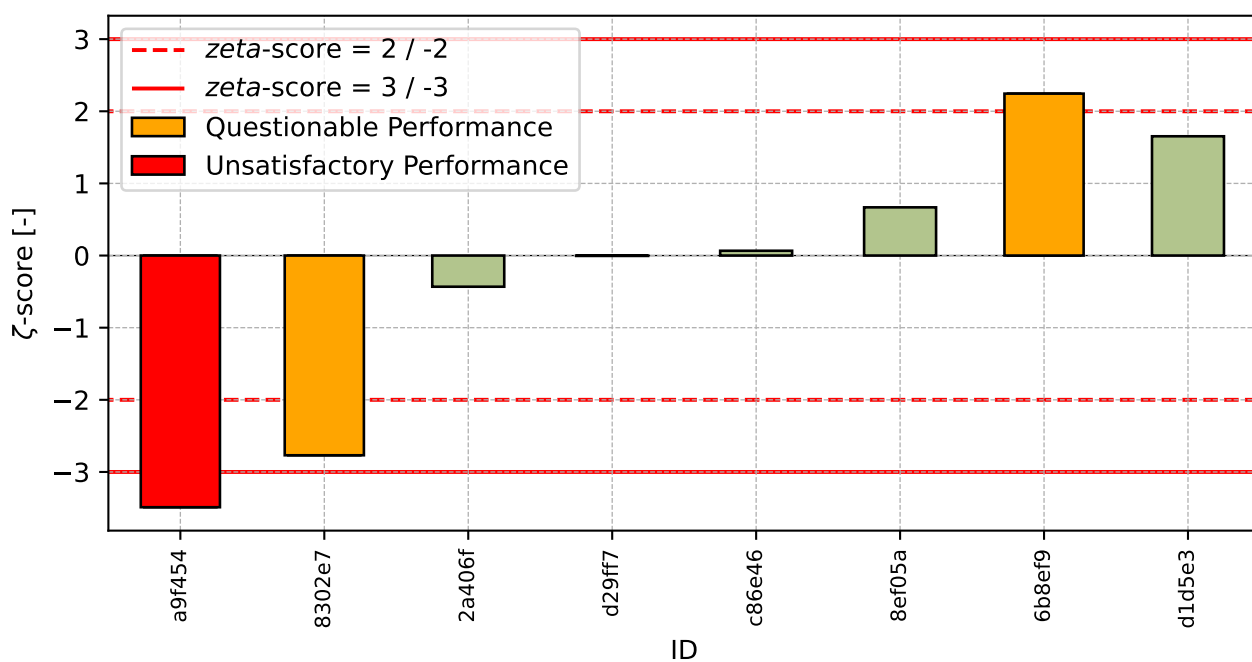


Figure 97: z-score

Figure 98: ζ -scoreTable 39: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
a9f454	-1.26	-3.49
8302e7	-0.99	-2.77
2a406f	-0.88	-0.43
d29ff7	-0.03	-0.01
c86e46	0.10	0.07
8ef05a	0.50	0.67
6b8ef9	1.02	2.24
d1d5e3	1.54	1.65

8.2 50 cycles

8.2.1 Test results

Table 40: Test results – ordered by average value. Outliers are marked by red color. Columns 1–3 are individual determinations; u_X – extended uncertainty of measurement; $\bar{x}$ – average value; s_0 – sample standard deviation; V_X – variation coefficient

ID	1 [g/m ²]	2 [g/m ²]	3 [g/m ²]	u_X [g/m ²]	$\bar{x}$ [g/m ²]	s_0 [g/m ²]	V_X [%]
a9f454	20.0	12.4	12.4	1.00	14.9	4.39	29.38
8302e7	16.1	12.2	18.7	0.45	15.7	3.27	20.88
2a406f	22.2	-	11.1	16.10	16.6	7.85	47.14
8ef05a	22.0	17.0	23.0	4.13	20.7	3.21	15.55
d29ff7	22.0	34.0	11.0	40.00	22.3	11.50	51.51
c86e46	26.9	34.7	26.3	14.90	29.3	4.69	15.99
6b8ef9	42.4	39.6	34.5	3.10	38.8	4.01	10.31
d1d5e3	39.1	44.7	33.5	8.00	39.1	5.60	14.32

8.2.2 The Numerical Procedure for Determining Outliers

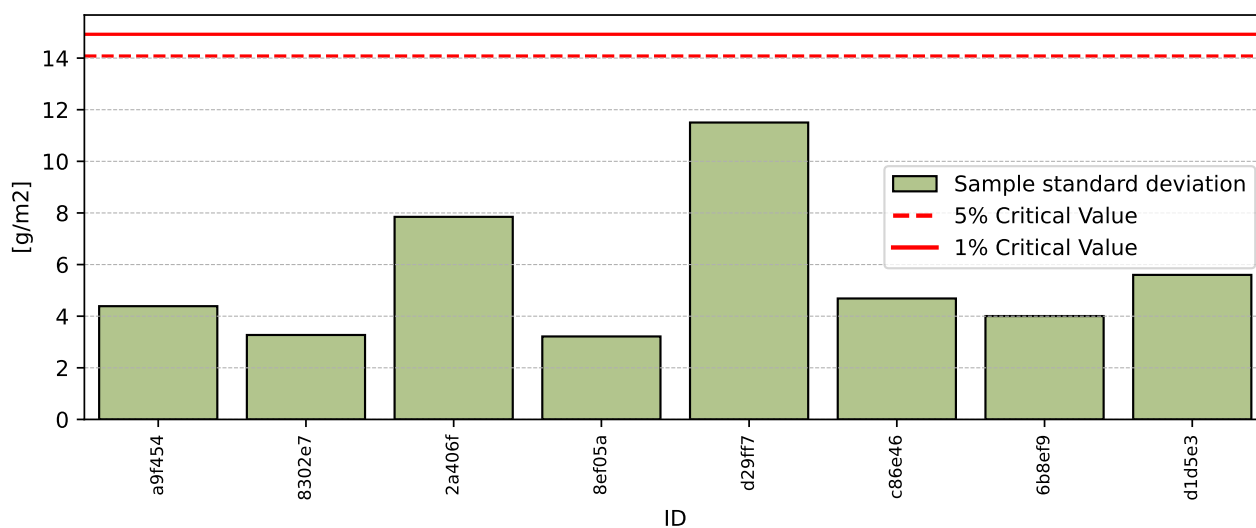


Figure 99: **Cochran's test** - sample standard deviations

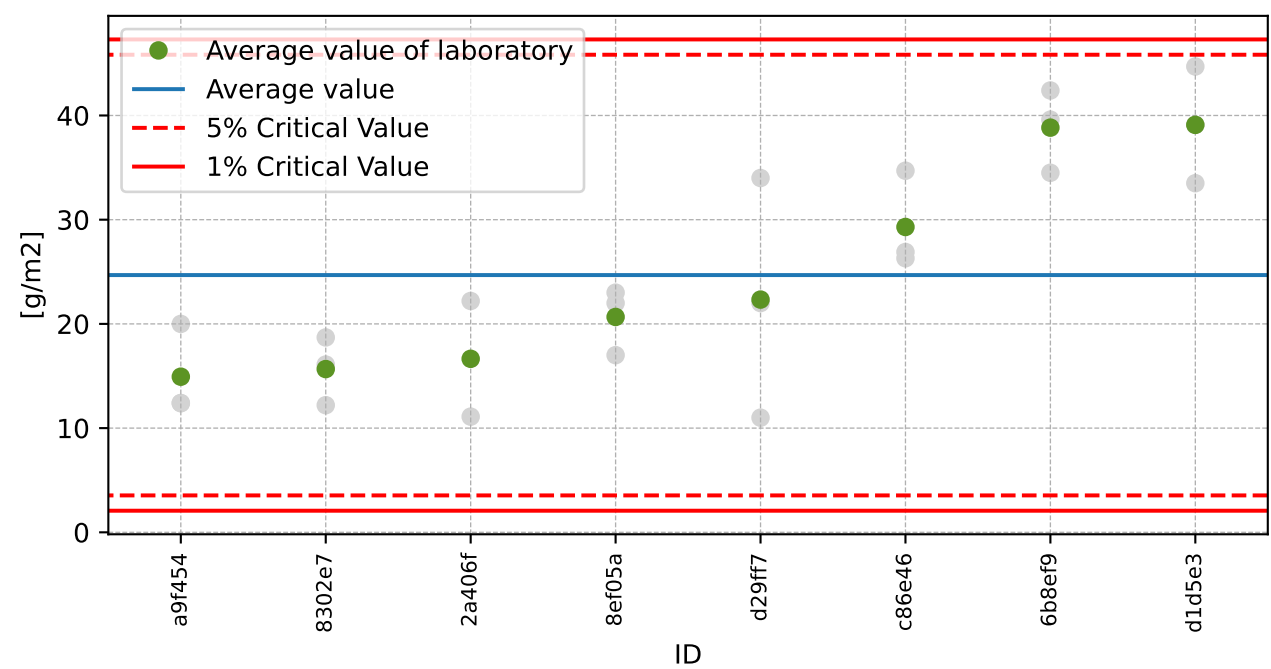


Figure 100: **Grubbs' test** - average values

8.2.3 Mandel's Statistics



Figure 101: Intralaboratory Consistency Statistic

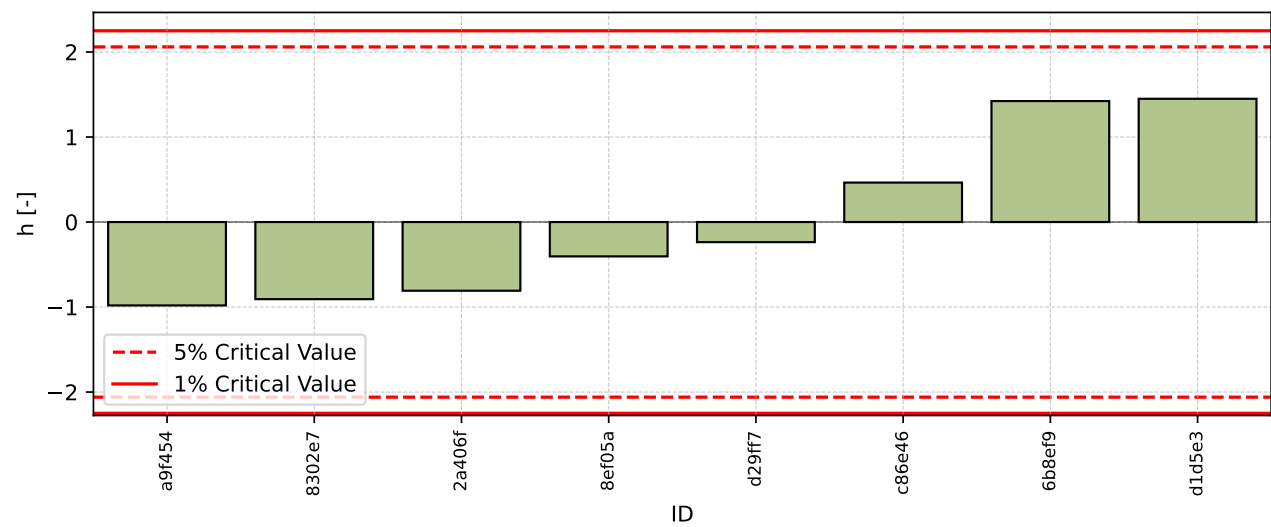


Figure 102: Interlaboratory Consistency Statistic

8.2.4 Descriptive statistics

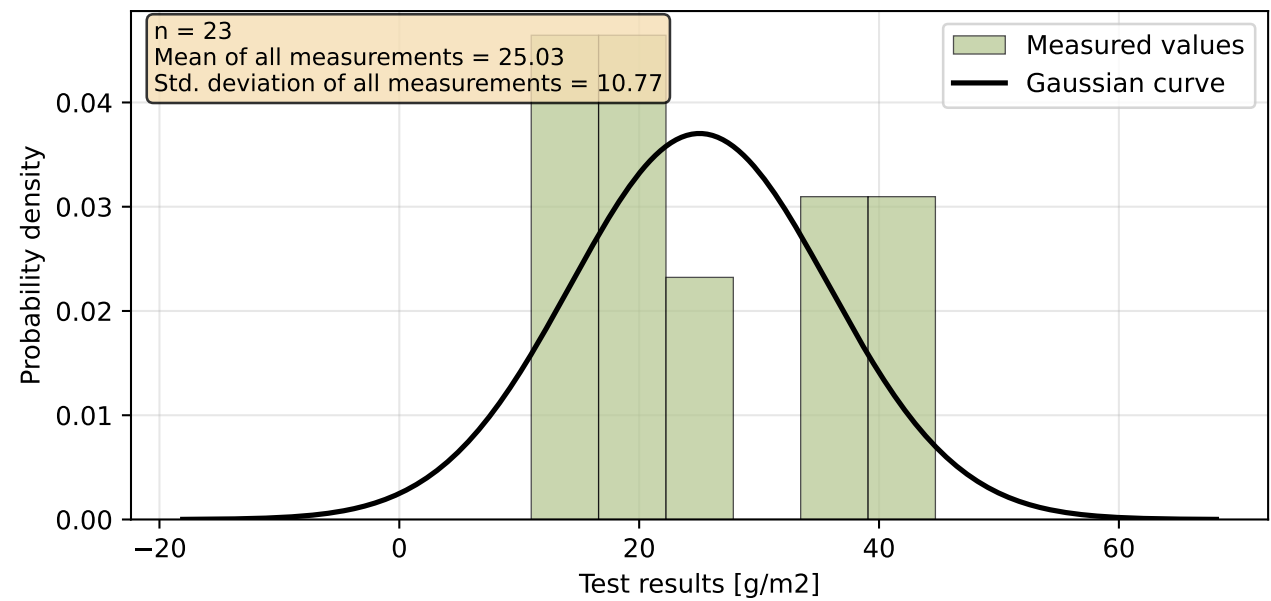


Figure 103: Histogram of all test results

Table 41: Descriptive statistics

Characteristics	[g/m ²]
Average value – $\bar{x}$	24.69
Sample standard deviation – s	9.94
Assigned value – x^*	24.69
Robust standard deviation – s^*	9.94
Measurement uncertainty of assigned value – u_X	3.52
p -value of normality test [-]	0.095
Interlaboratory standard deviation – s_L	9.28
Repeatability standard deviation – s_r	6.16
Reproducibility standard deviation – s_R	11.14
Repeatability – r	17.25
Reproducibility – R	31.20

8.2.5 Evaluation of Performance Statistics

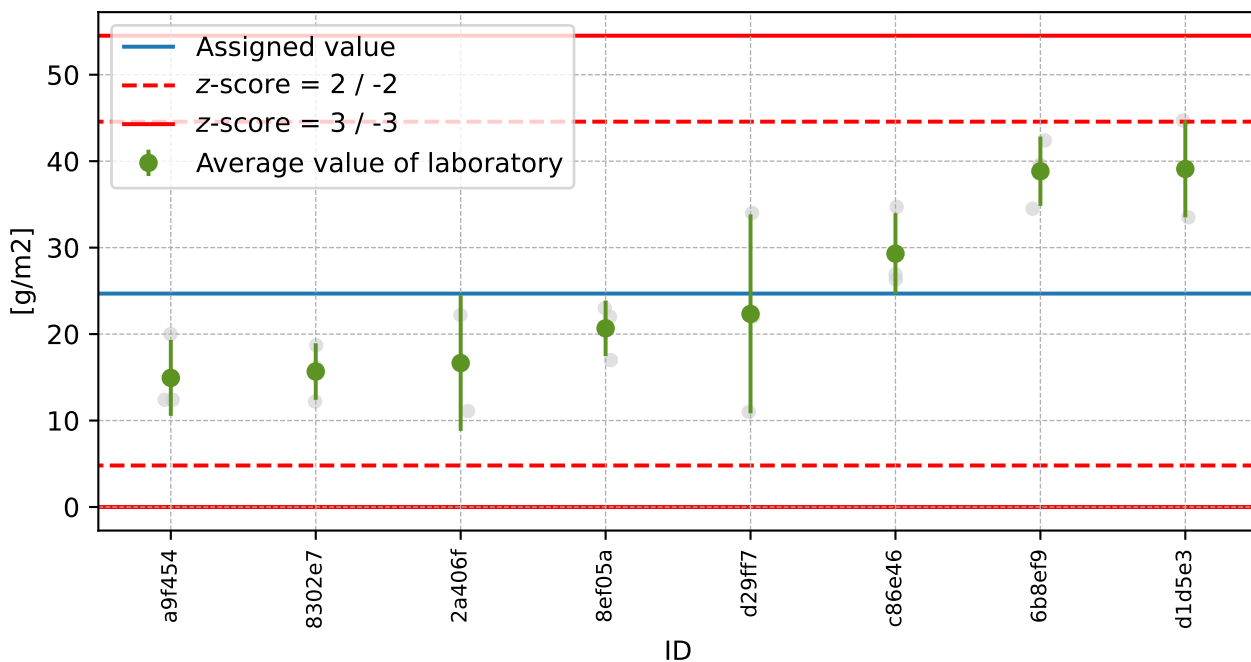


Figure 104: Average values and sample standard deviations

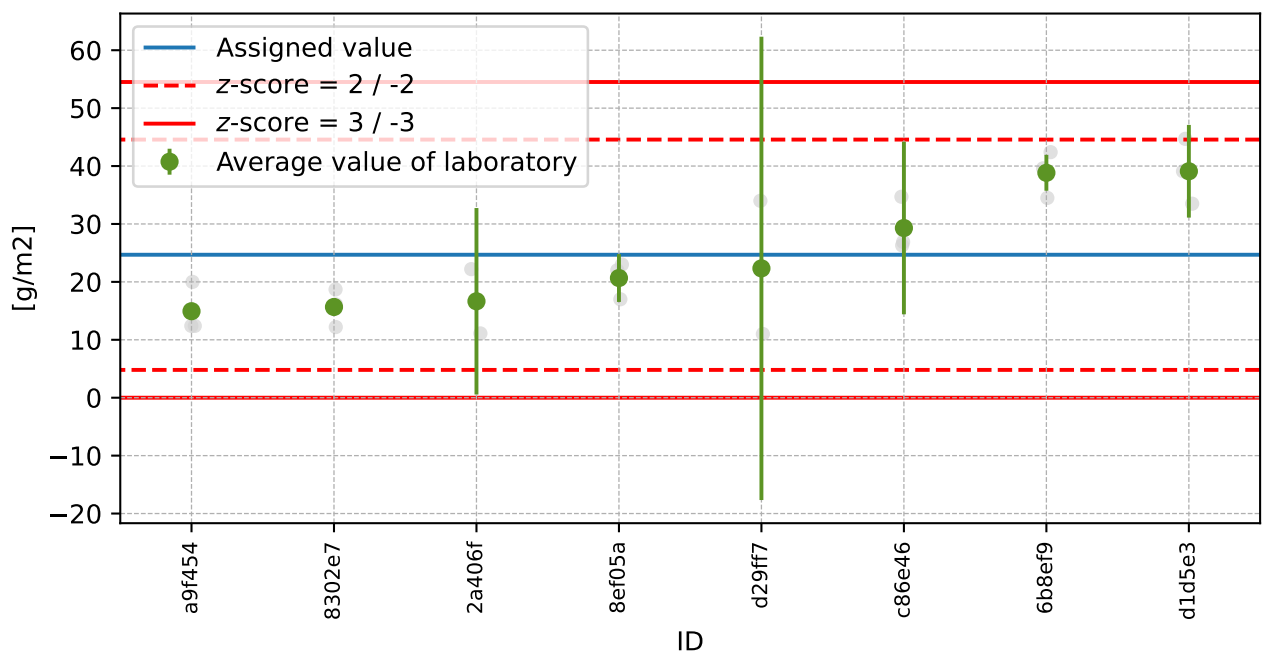


Figure 105: Average values and extended uncertainties of measurement

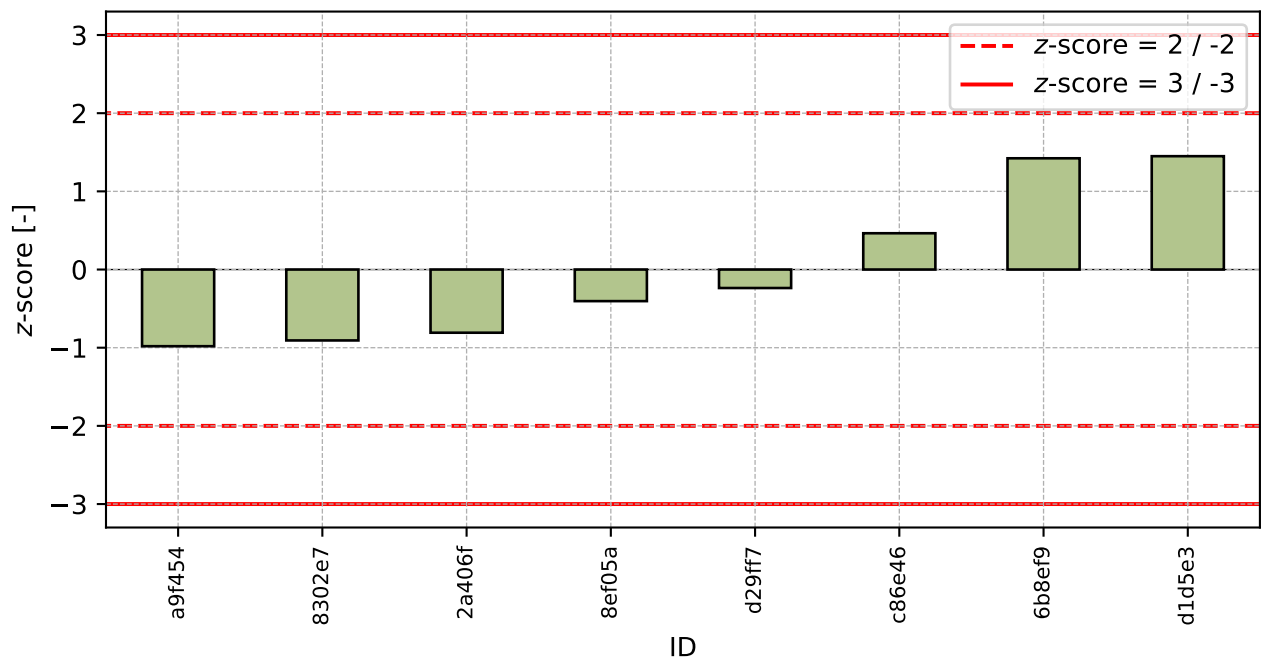


Figure 106: z-score

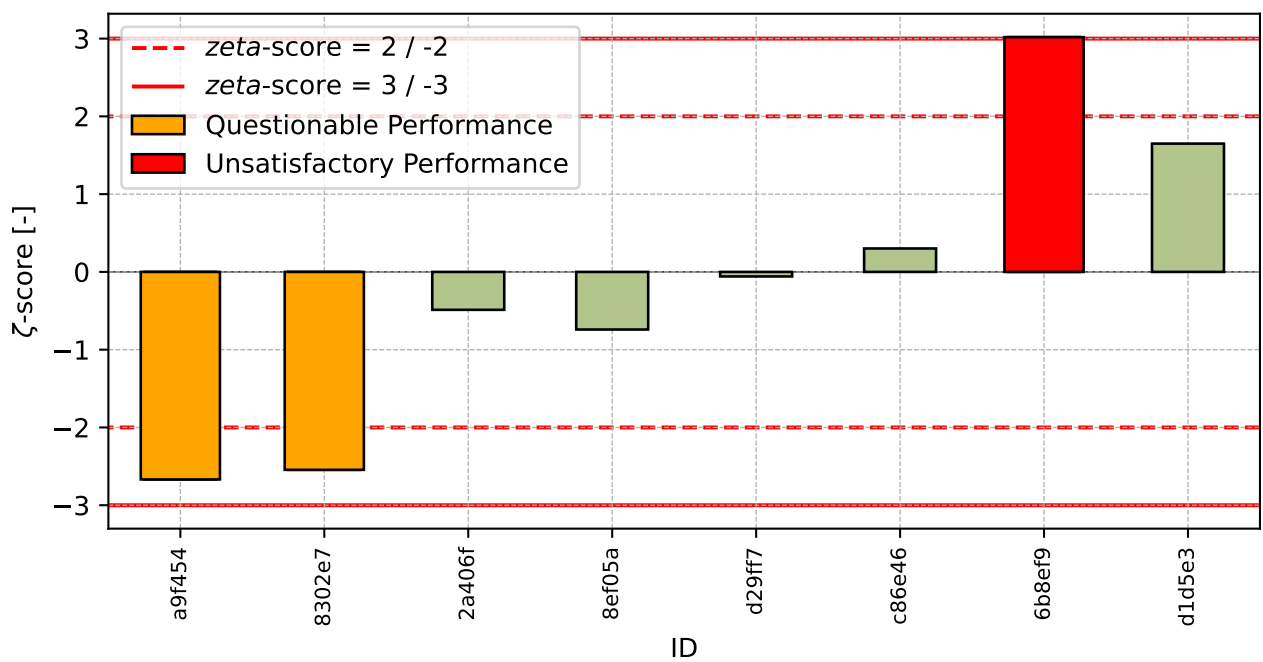


Figure 107: ζ -score

Table 42: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
a9f454	-0.98	-2.67
8302e7	-0.91	-2.54
2a406f	-0.81	-0.49
8ef05a	-0.40	-0.74
d29ff7	-0.24	-0.06
c86e46	0.46	0.30
6b8ef9	1.42	3.02
d1d5e3	1.45	1.65

8.3 75 cycles

8.3.1 Test results

Table 43: Test results – ordered by average value. Outliers are marked by red color. Columns 1–3 are individual determinations; u_X – extended uncertainty of measurement; $\bar{x}$ – average value; s_0 – sample standard deviation; V_X – variation coefficient

ID	1 [g/m ²]	2 [g/m ²]	3 [g/m ²]	u_X [g/m ²]	$\bar{x}$ [g/m ²]	s_0 [g/m ²]	V_X [%]
8ef05a	22.0	17.0	28.0	4.47	22.3	5.51	24.66
a9f454	29.3	18.2	25.3	1.50	24.3	5.62	23.17
8302e7	24.4	25.2	30.8	0.77	26.8	3.49	13.01
d29ff7	28.0	39.0	17.0	40.00	28.0	11.00	39.29
2a406f	27.7	49.9	16.5	24.70	31.4	17.00	54.20
c86e46	42.6	54.3	43.1	18.80	46.7	6.62	14.18
d1d5e3	61.5	67.0	55.8	12.00	61.4	5.60	9.12
6b8ef9	83.7	70.3	64.0	5.80	72.7	10.06	13.85

8.3.2 The Numerical Procedure for Determining Outliers

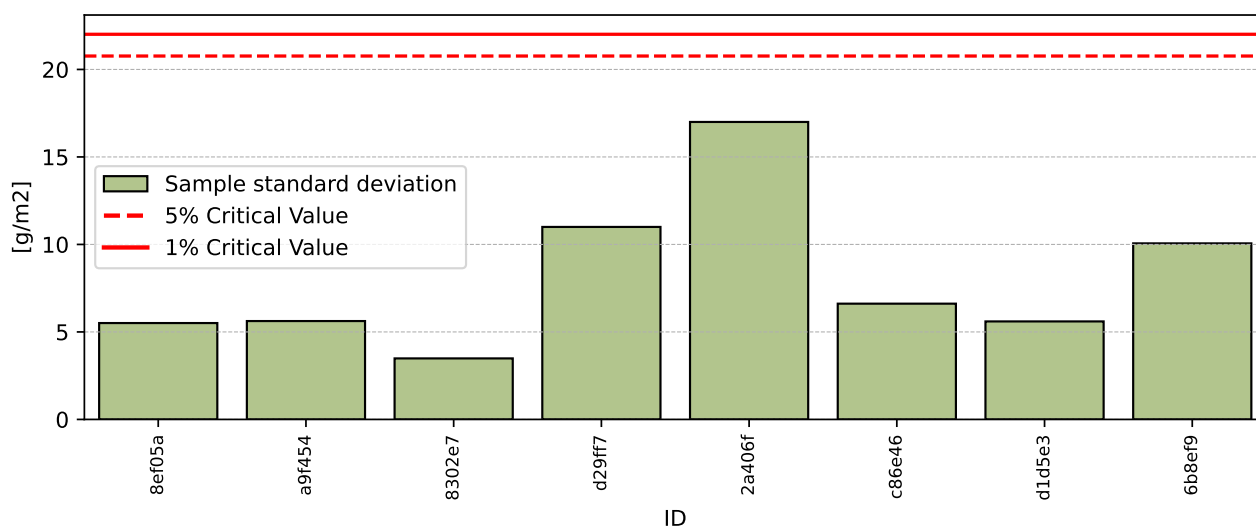


Figure 108: **Cochran's test** - sample standard deviations

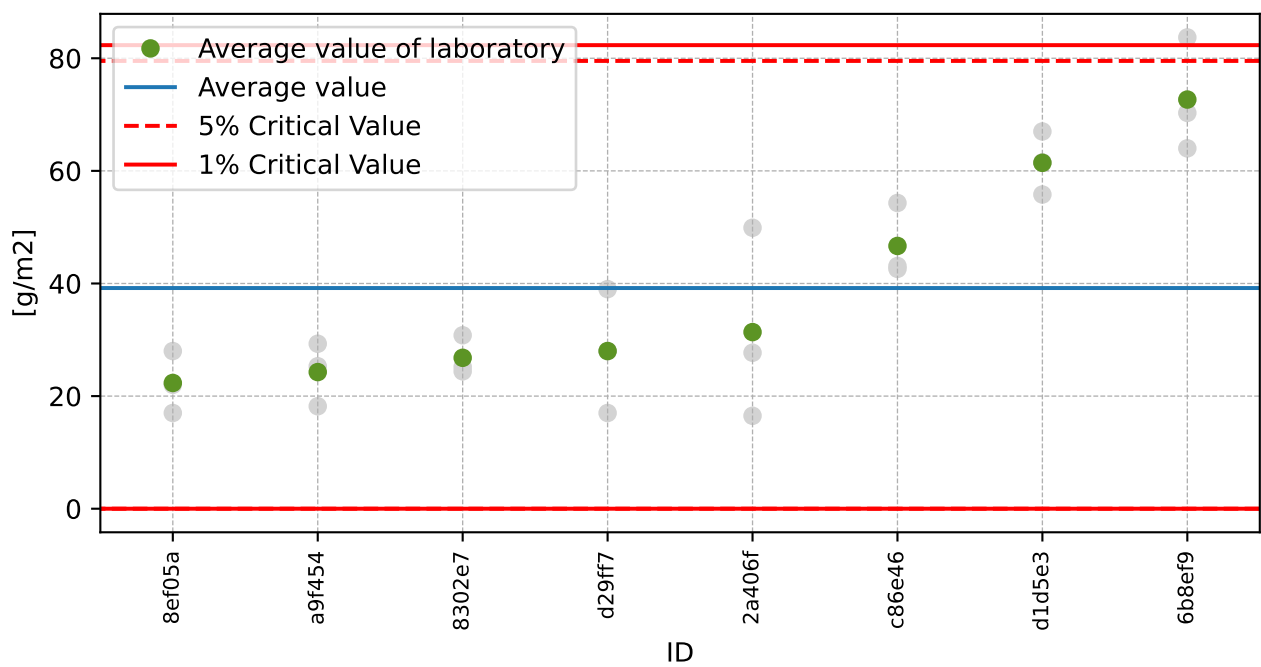


Figure 109: **Grubbs' test** - average values

8.3.3 Mandel's Statistics

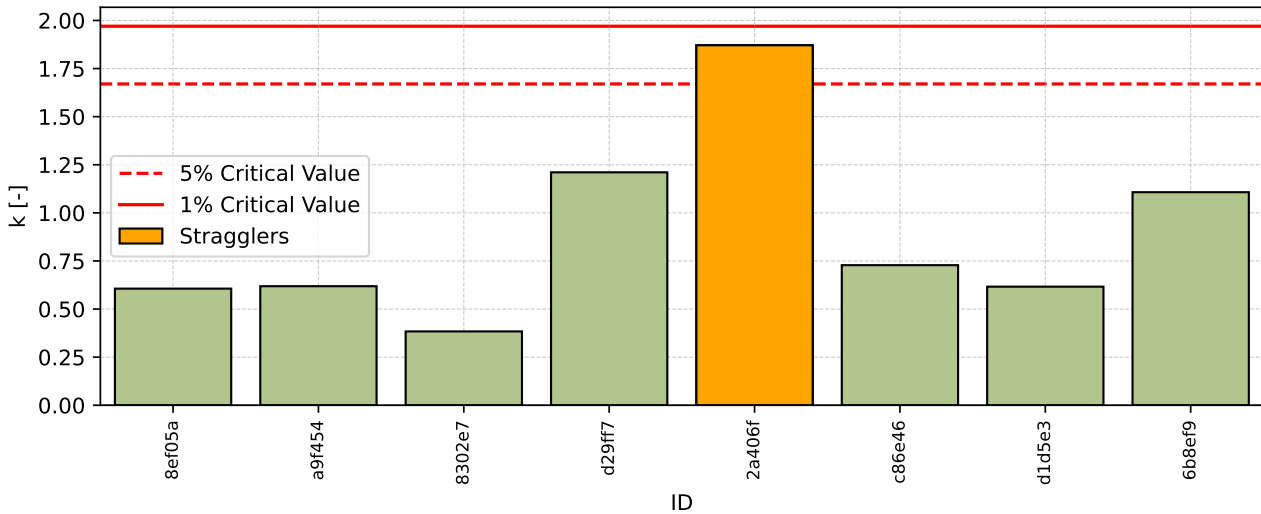


Figure 110: Intralaboratory Consistency Statistic

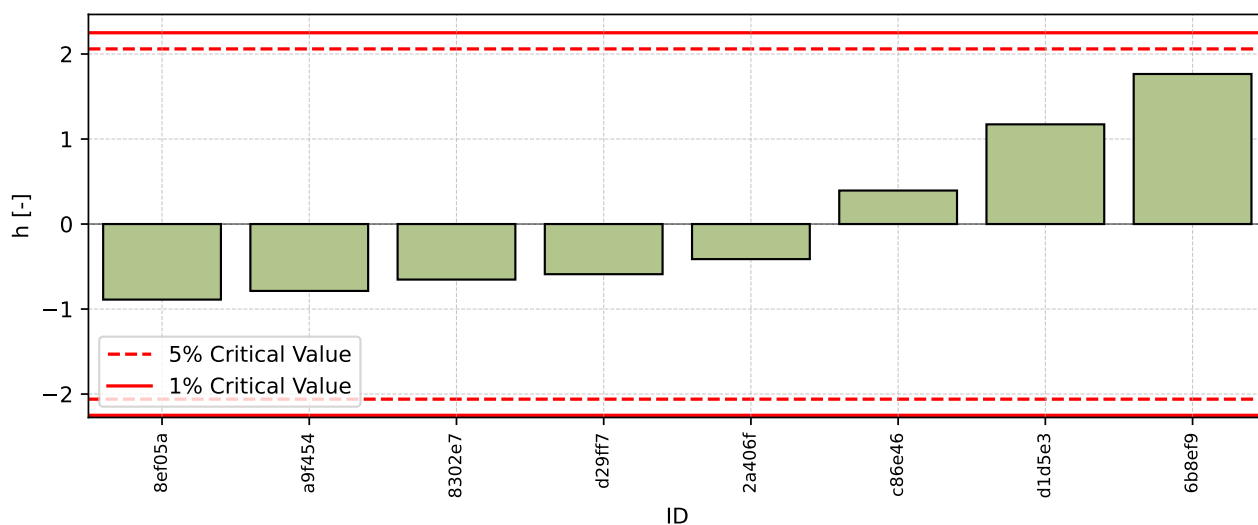


Figure 111: Interlaboratory Consistency Statistic

8.3.4 Descriptive statistics

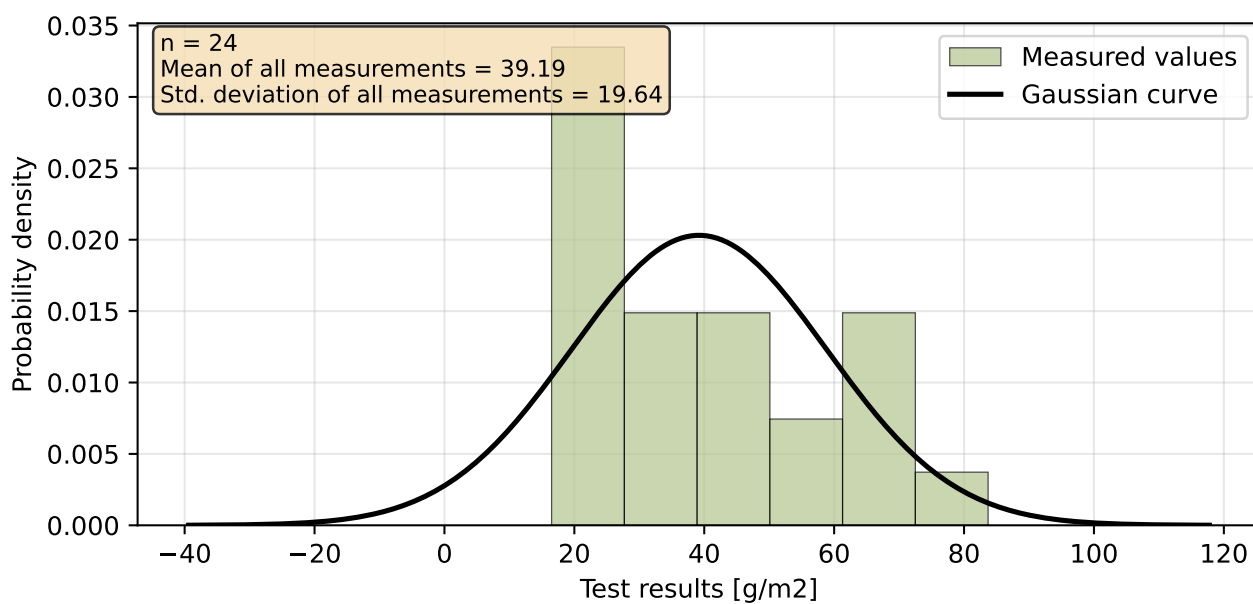


Figure 112: Histogram of all test results

Table 44: Descriptive statistics

Characteristics	[g/m ²]
Average value – $\bar{x}$	39.19
Sample standard deviation – s	18.97
Assigned value – x^*	39.19
Robust standard deviation – s^*	18.97
Measurement uncertainty of assigned value – u_X	6.71
p -value of normality test [-]	0.027
Interlaboratory standard deviation – s_L	18.23
Repeatability standard deviation – s_r	9.09
Reproducibility standard deviation – s_R	20.37
Repeatability – r	25.44
Reproducibility – R	57.02

8.3.5 Evaluation of Performance Statistics

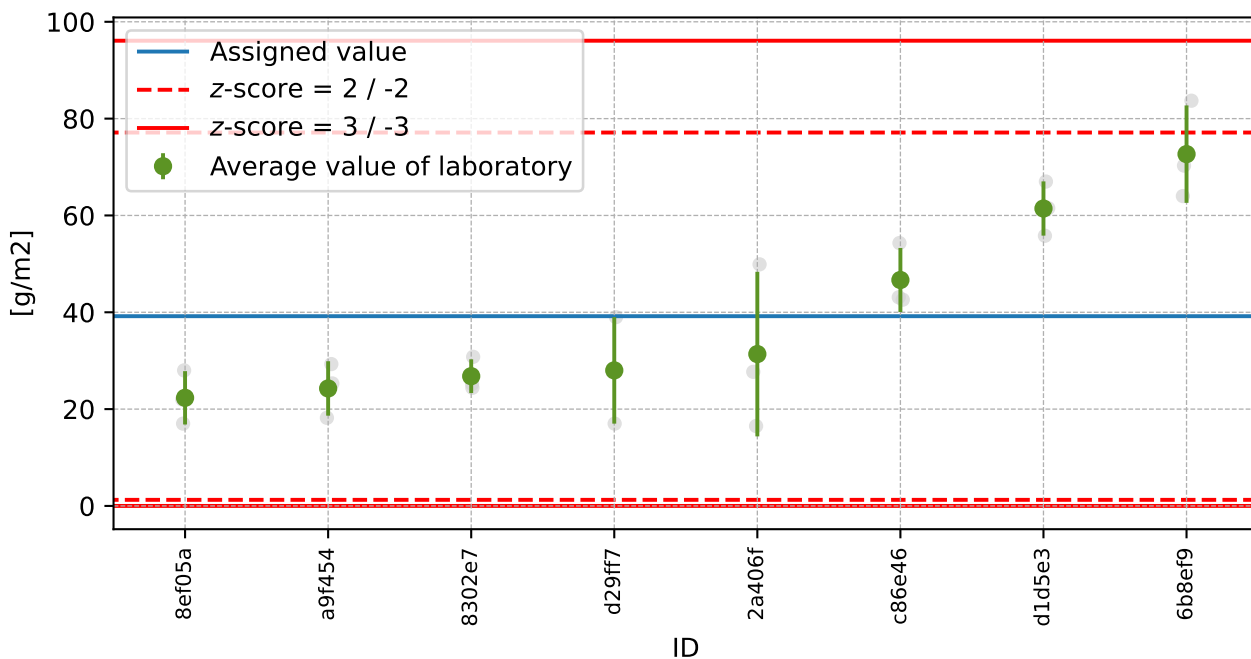


Figure 113: Average values and sample standard deviations

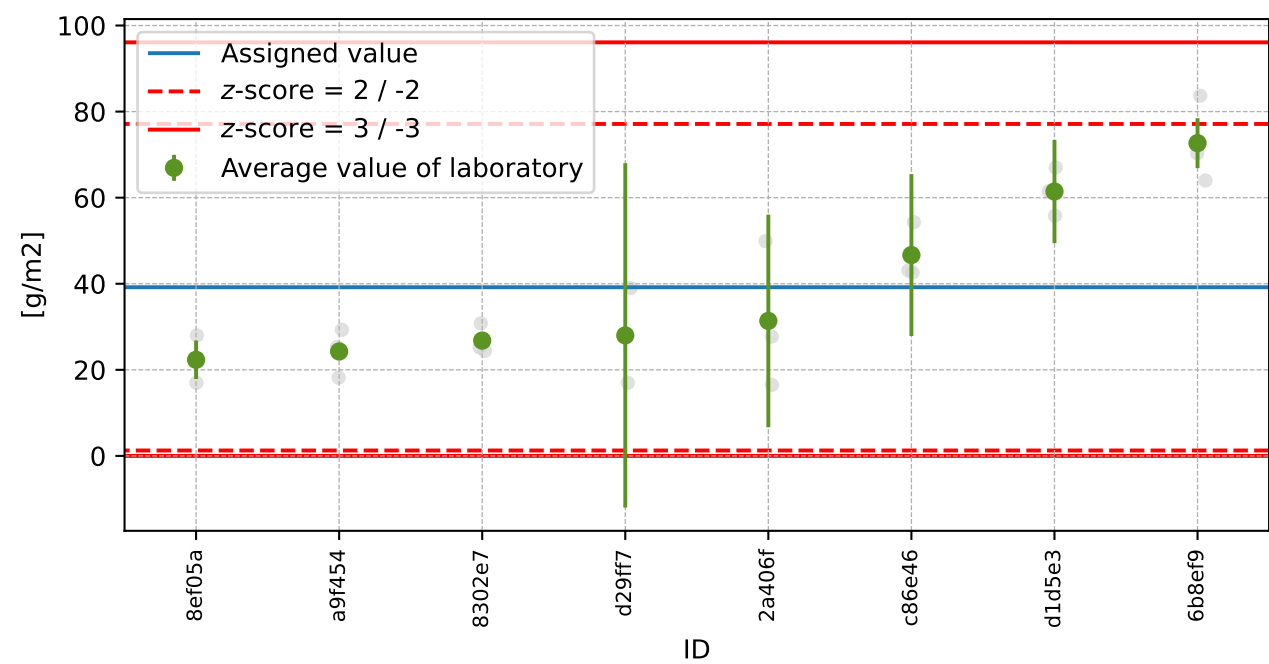


Figure 114: Average values and extended uncertainties of measurement

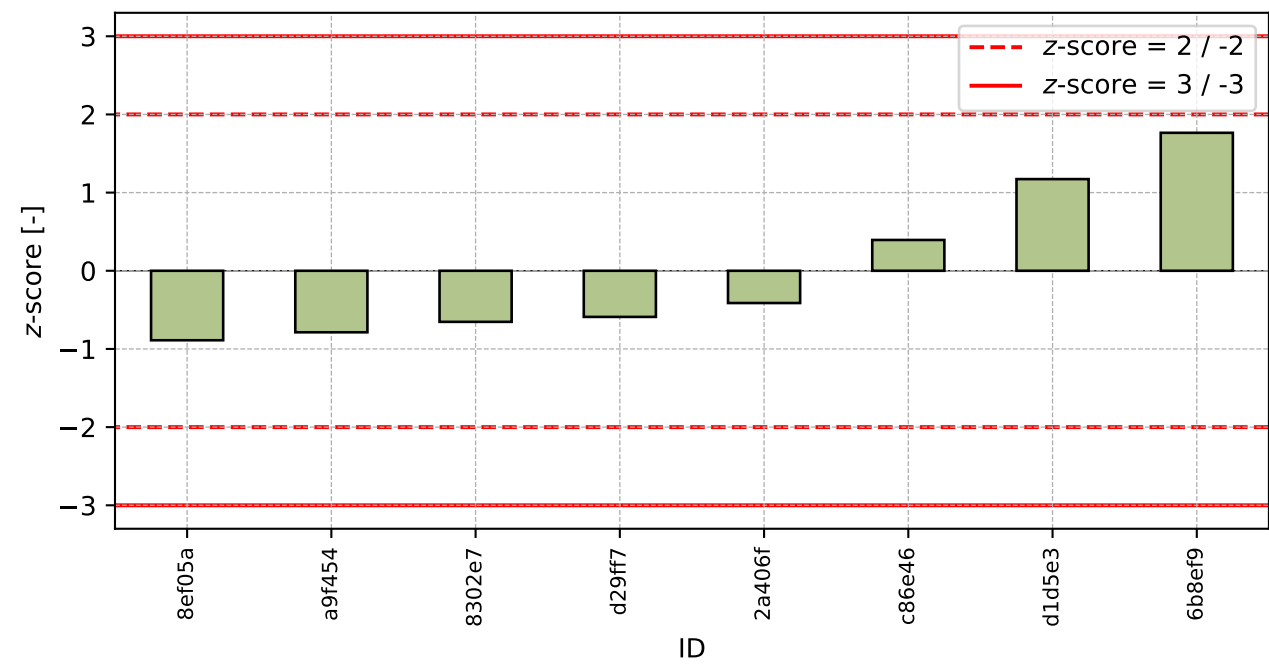


Figure 115: z-score

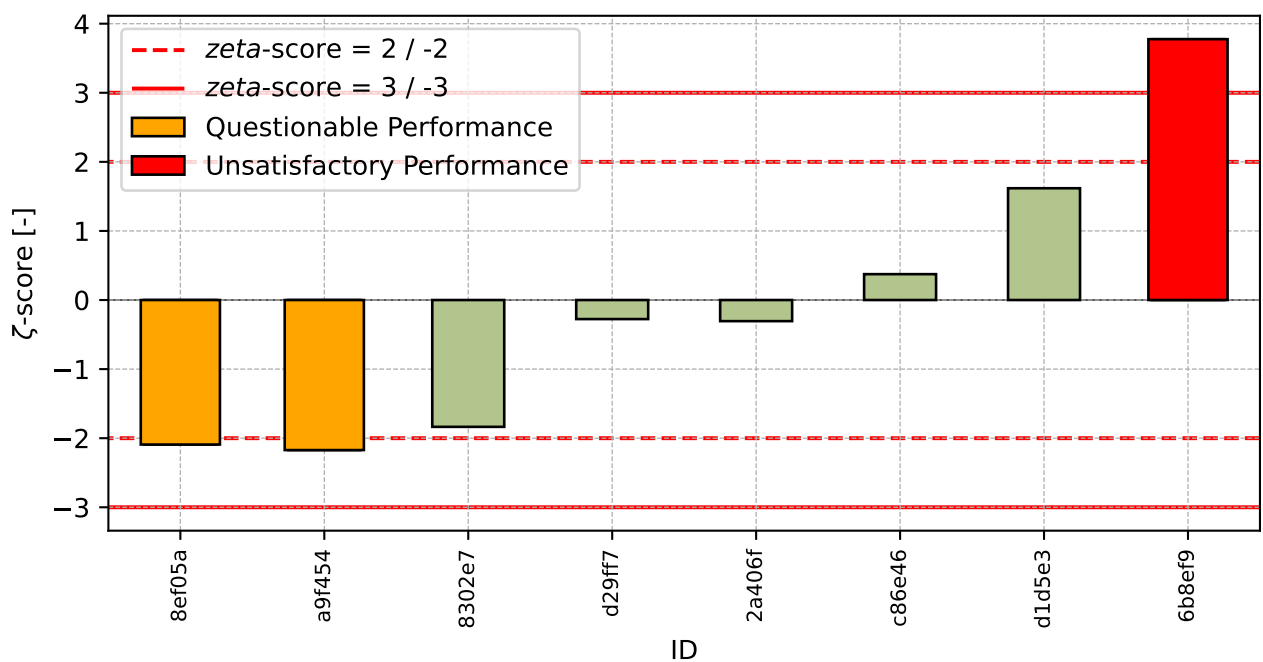


Figure 116: ζ -score

Table 45: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
8ef05a	-0.89	-2.09
a9f454	-0.79	-2.17
8302e7	-0.65	-1.84
d29ff7	-0.59	-0.28
2a406f	-0.41	-0.31
c86e46	0.39	0.37
d1d5e3	1.17	1.62
6b8ef9	1.76	3.78

9 Appendix – CEN/TS 12390-9 – Freeze-thaw resistance – Scaling

9.1 Test results

Table 46: Test results – ordered by average value. Outliers are marked by red color. Columns 1–4 are individual determinations; u_X – extended uncertainty of measurement; $\bar{x}$ – average value; s_0 – sample standard deviation; V_X – variation coefficient

ID	1 [g/m ²]	2 [g/m ²]	3 [g/m ²]	4 [g/m ²]	u_X [g/m ²]	$\bar{x}$ [g/m ²]	s_0 [g/m ²]	V_X [%]
571843	0.3	0.3	0.2	0.2	-	0.2	0.06	23.09
d7328e	7.1	15.6	8.7	7.8	0.20	9.8	3.92	40.02
b61aa5	17.2	19.9	18.1	16.1	17.81	17.8	1.61	9.02
a6af84	17.2	19.2	16.6	19.1	5.10	18.0	1.32	7.34
b7ccd2	24.0	16.0	19.0	20.0	-	19.8	3.30	16.73
5a7133	27.8	15.7	25.6	13.9	6.96	20.8	6.97	33.58
14b514	60.2	40.8	19.7	18.9	-	34.9	19.68	56.39
1b5b6f	59.0	55.0	32.0	29.0	-	43.8	15.44	35.28
e08293	86.7	54.3	36.1	34.6	-	52.9	24.23	45.79
c2d631	260.0	180.0	220.0	140.0	70.00	200.0	51.64	25.82
7c0f45	180.0	300.0	130.0	250.0	15.00	215.0	75.06	34.91

9.2 The Numerical Procedure for Determining Outliers

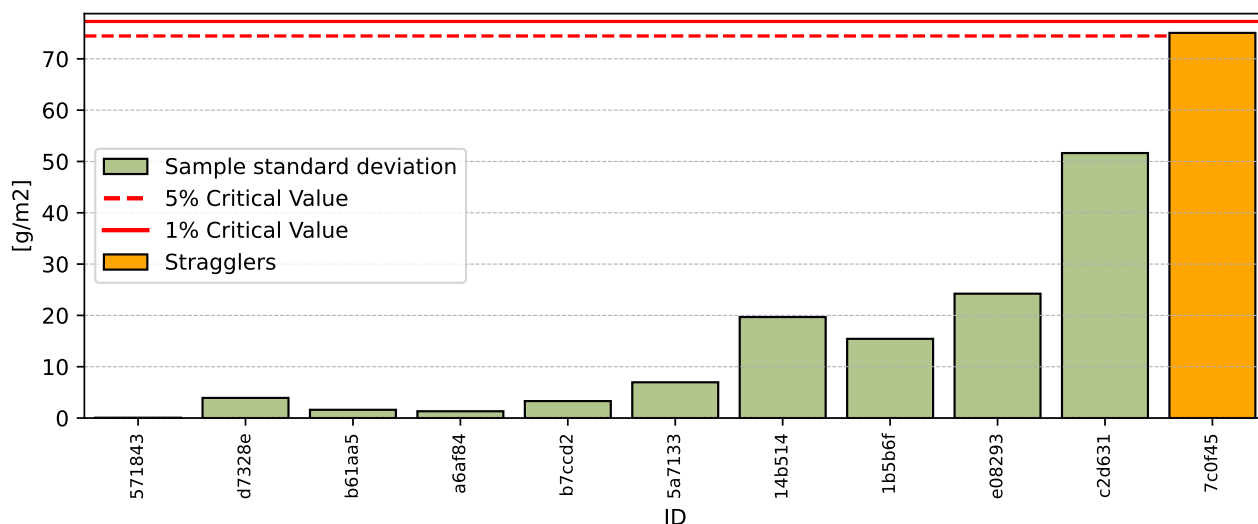
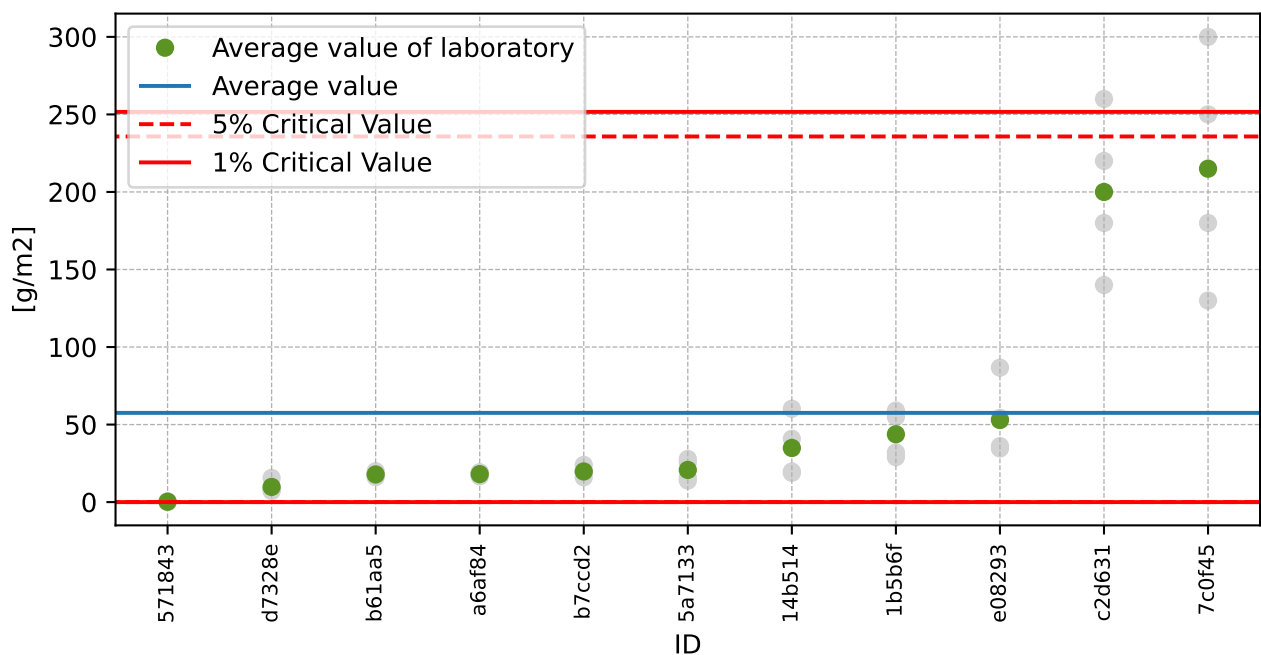


Figure 117: Cochran's test - sample standard deviations

Figure 118: **Grubbs' test** - average values

9.3 Mandel's Statistics

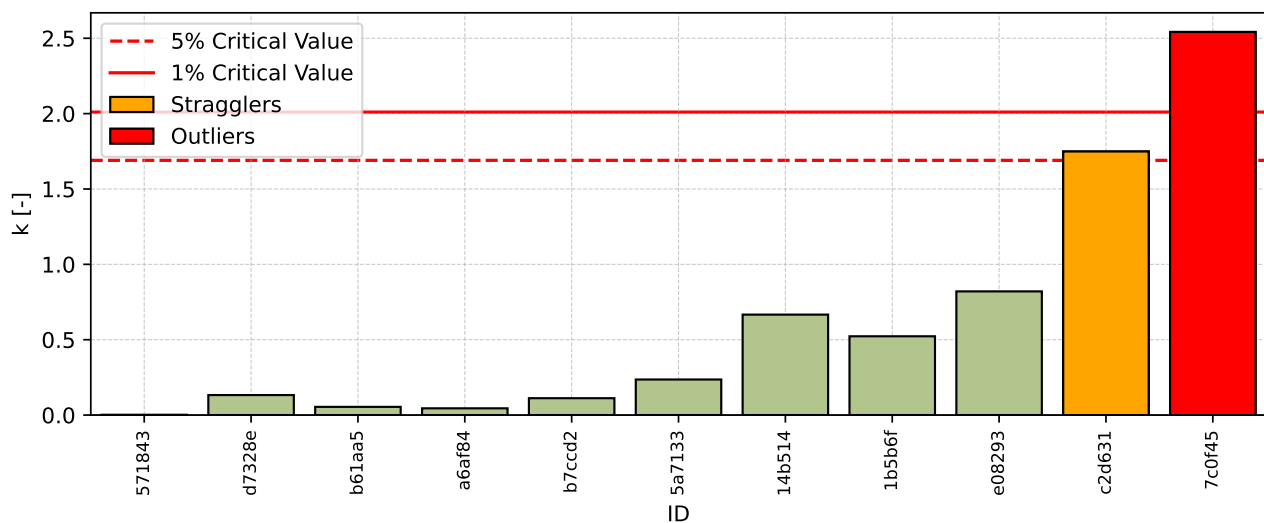


Figure 119: Intralaboratory Consistency Statistic

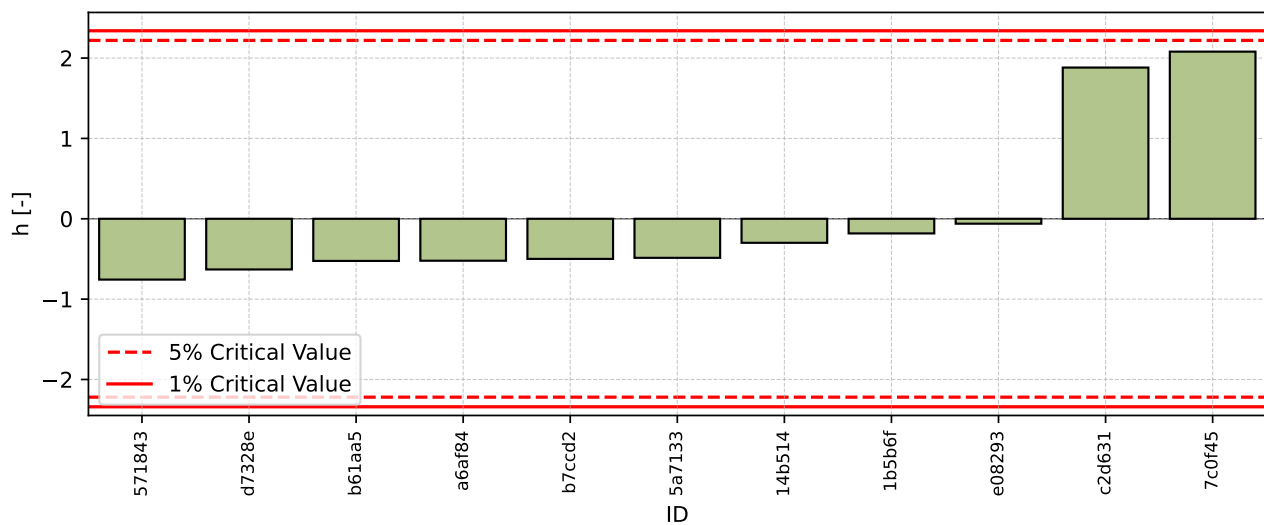


Figure 120: Interlaboratory Consistency Statistic

9.4 Descriptive statistics

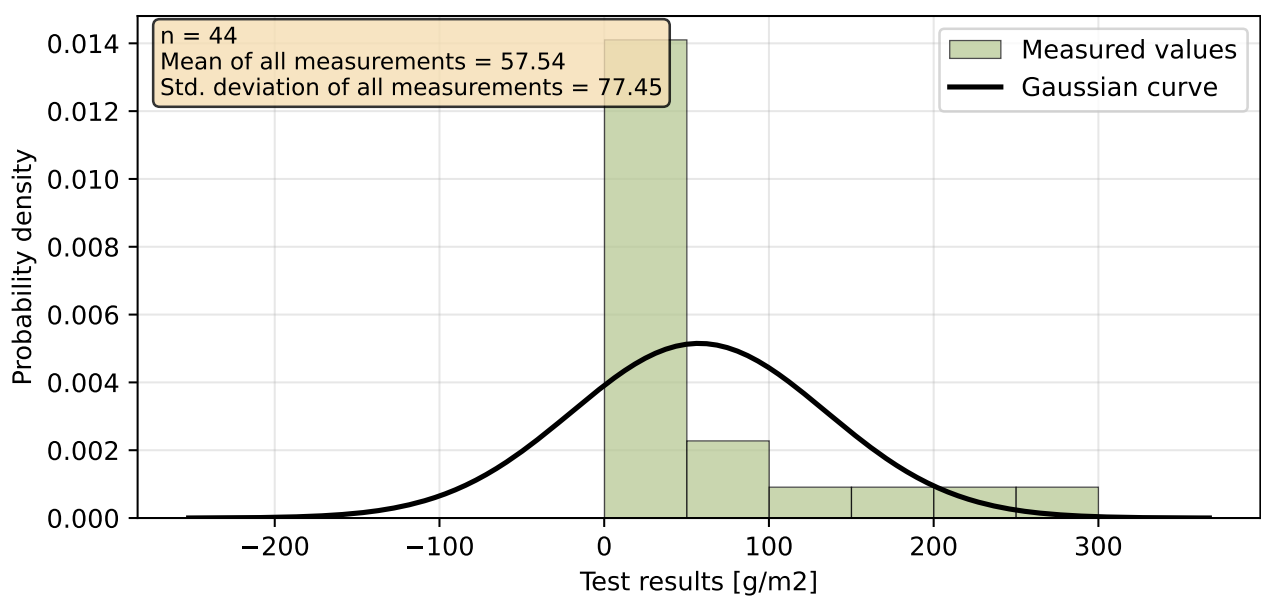


Figure 121: Histogram of all test results

Table 47: Descriptive statistics

Characteristics	[g/m ²]
Average value – $\bar{x}$	57.54
Sample standard deviation – s	75.69
Assigned value – x^*	57.54
Robust standard deviation – s^*	80.69
Measurement uncertainty of assigned value – u_X	24.33
p -value of normality test [-]	< 0.001
Interlaboratory standard deviation – s_L	74.24
Repeatability standard deviation – s_r	29.53
Reproducibility standard deviation – s_R	79.90
Repeatability – r	82.68
Reproducibility – R	223.71

9.5 Evaluation of Performance Statistics

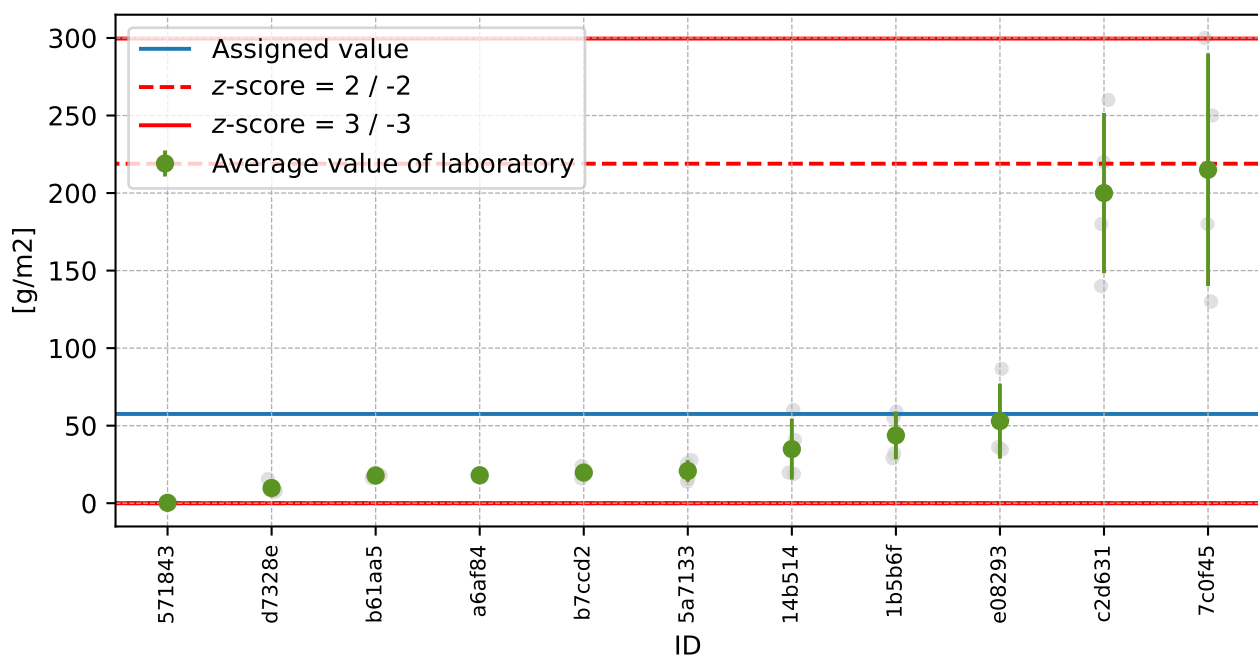


Figure 122: Average values and sample standard deviations

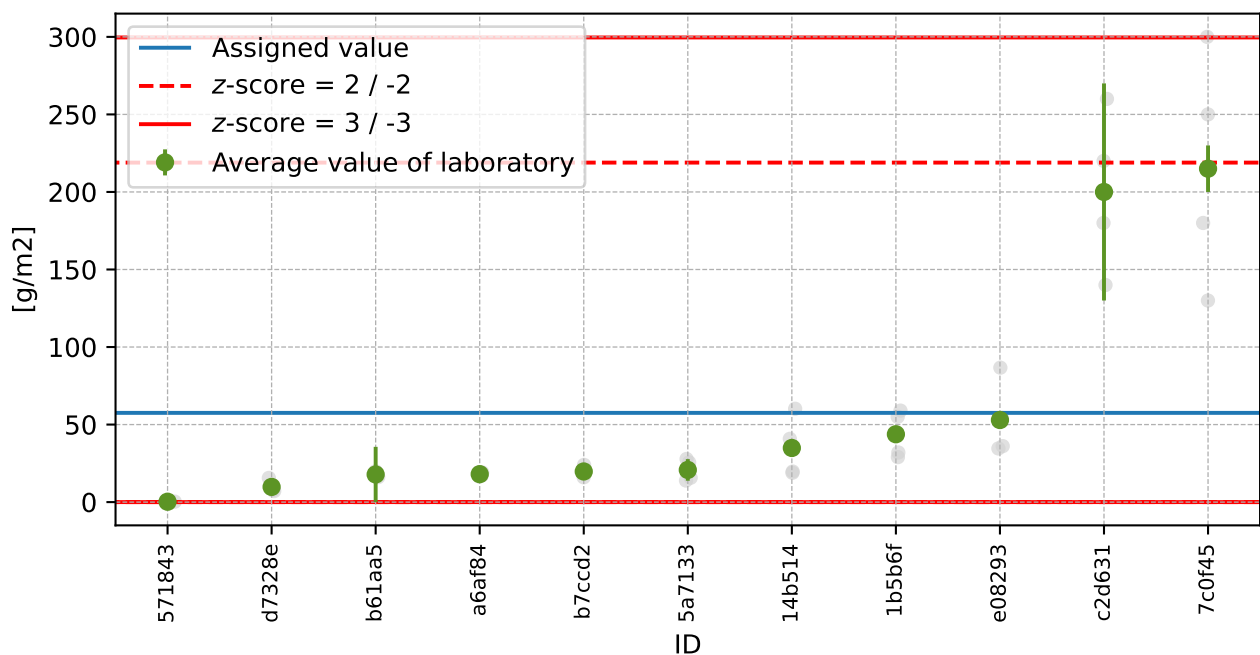


Figure 123: Average values and extended uncertainties of measurement

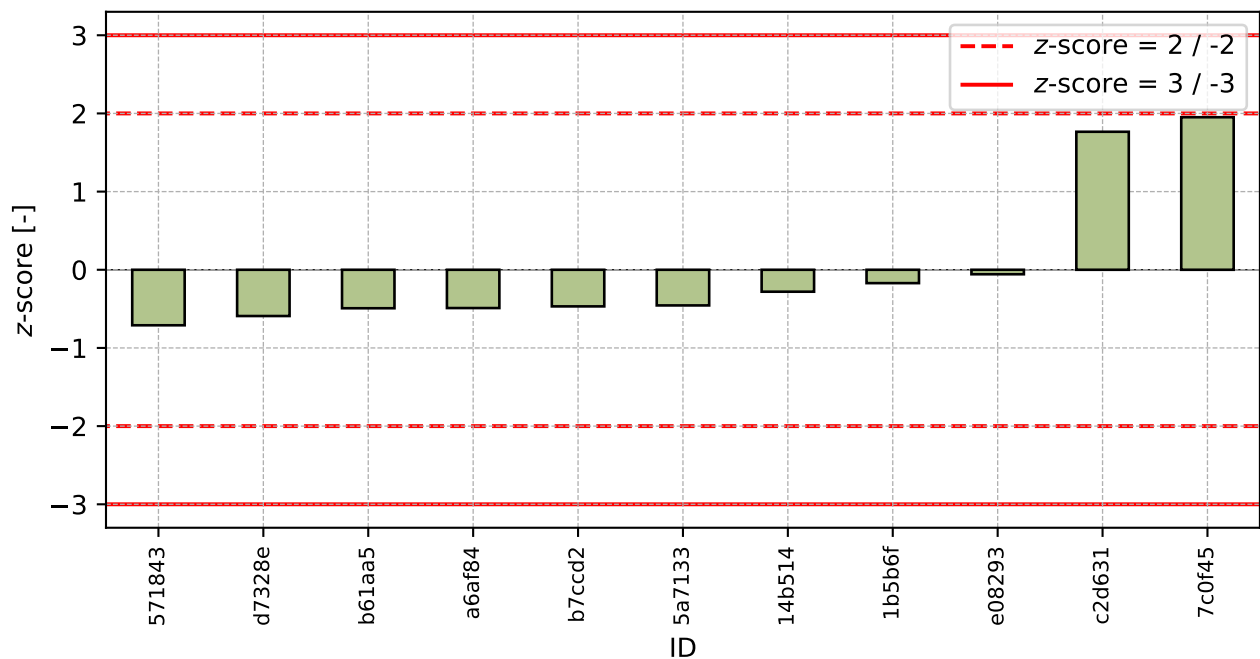


Figure 124: z-score

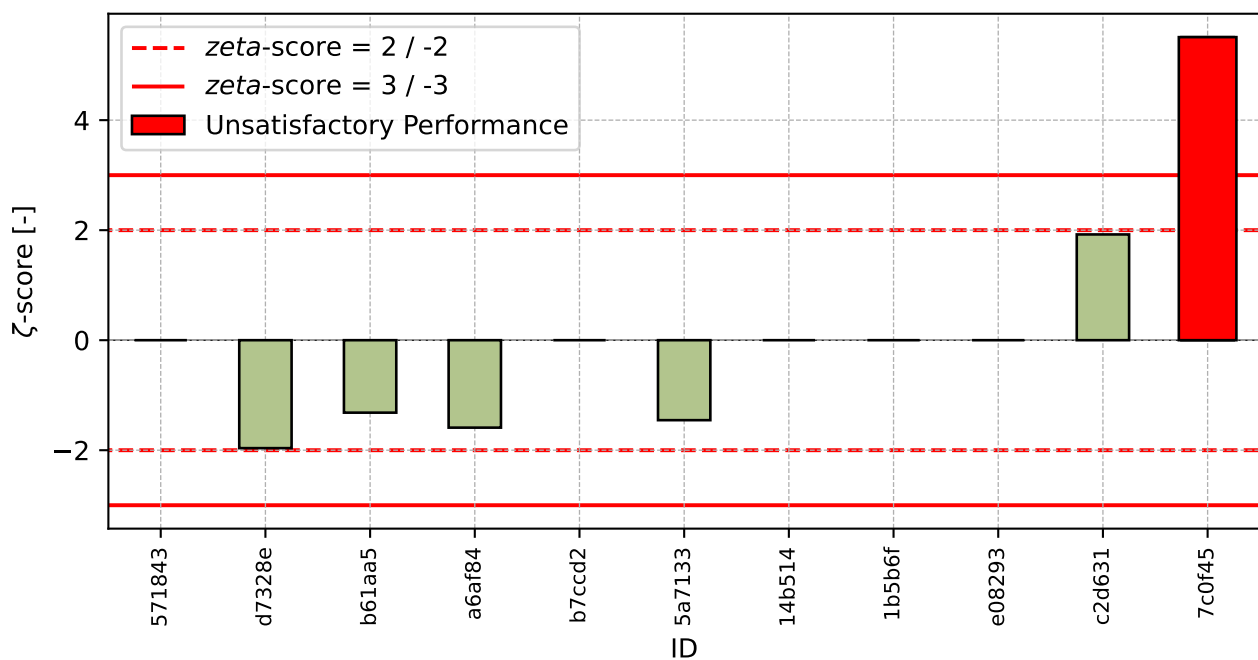


Figure 125: ζ-score

Table 48: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
571843	-0.71	-
d7328e	-0.59	-1.96
b61aa5	-0.49	-1.32
a6af84	-0.49	-1.59
b7ccd2	-0.47	-
5a7133	-0.46	-1.45
14b514	-0.28	-
1b5b6f	-0.17	-
e08293	-0.06	-
c2d631	1.77	1.92
7c0f45	1.95	5.51