BRNO UNIVERSITY OF TECHNOLOGY

FACULTY OF CIVIL ENGINEERING
institute of building testing

FINAL REPORT ON THE RESULTS OF PRECISION EXPERIMENT

Proficiency Testing Program
Strenght and Elasticity of Hardened Concrete
ZZB 2022/2

Brno University of Technology
Proficiency testing provider at the SZK FAST
Veveří 95, Brno 602 00
Czech Republic

www.szk.fce.vutbr.cz
www.ptprovider.cz

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Coordinator of PTP results assessment

Contents

1 Introduction and Important Contacts

In the year 2023, the Proficiency Testing Provider at the SZK FAST (PT Provider) initiated the Proficiency Testing Program (PTP) designated ZZB 2022/2 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

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

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The subjects of proficiency testing were the following testing procedures:

1. **EN 12390-3** – Compressive strength of test specimens [1].
2. **EN 12390-5** – Flexural strength of test specimens [2].
3. **EN 12390-6** – Tensile splitting strength of test specimens [3].
4. **EN 12390-7** – Density of hardened concrete [4].
5. **ISO 1920-10** – Determination of static modulus of elasticity in compression [5].
6. **EN 12390-13** – method A – Determination of secant modulus of elasticity in compression [6].
7. **EN 12390-13** – method B – Determination of secant modulus of elasticity in compression [6].
8. **EN 12504-4, ČSN 731371** – Non-destructive testing of concrete [7], [8].
9. **ČSN 731373, EN 12504-2** – Determination of rebound number [9], [10].
10. **EN 1542, ČSN 736242** – Appendix B – Measurement of bond strength by pull-off [11], [12],
11. **EN 1338** – Concrete paving blocks - Requirements and test methods – Appendix E (Total water absorption) [13],
12. **EN 1338** – Concrete paving blocks - Requirements and test methods – Appendix F (Tensile splitting strength) [13],
13. **EN 1338** – Concrete paving blocks - Requirements and test methods – Appendix G (Abrasion resistance) [13],
14. **EN 1338** – Concrete paving blocks - Requirements and test methods – Appendix F (Flexural strength and flexural load) [13].

Testing procedures No 6, 7, 11, 12, 13 and 14 were not open due to the low number of participants.

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 [14]. 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 [15] and with EN ISO/IEC 17043 [16]. The outcome is the present final report summarizing the results of the interlaboratory comparison, including statistical evaluation.

57 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	10	11	12	13	14
824106	X	-	-	-	-	-	-	-	-	-	-	-	-	-
694111	-	-	-	-	-	-	-	-	-	X	-	-	-	-
c406ae	-	-	-	-	-	-	-	-	X	-	-	-	-	-
7cadff	-	-	-	-	-	-	-	X	-	-	-	-	-	-
a9dfd6	X	-	-	-	X	-	-	-	-	-	-	-	-	-
96464f	-	X	-	-	-	-	-	-	-	-	-	-	-	-
35710b	-	-	-	-	-	-	-	-	X	-	-	-	-	-
6d92be	-	-	-	-	X	-	-	-	-	-	-	-	-	-
250e96	-	-	-	-	-	-	-	-	-	X	-	-	-	-
8fef74	-	X	-	-	-	-	-	-	-	X	-	-	-	-
32f753	-	-	-	-	-	-	-	-	X	-	-	-	-	-
4da533	X	-	X	-	-	-	-	X	X	-	-	-	-	-
ac860b	X	-	-	-	-	-	-	-	-	-	-	-	-	-
eeca6a	X	-	-	X	-	-	-	-	X	X	-	-	-	-
bf4403	X	X	X	X	X	-	-	X	-	-	-	-	-	-
6deff1	X	-	-	-	-	-	-	-	-	-	-	-	-	-
bcf801	X	-	-	X	-	-	-	-	-	X	-	-	-	-
b3cf46	X	-	-	X	-	-	-	-	-	-	-	-	-	-
80df78	-	-	X	-	-	-	-	-	-	-	-	-	-	-
b7c36c	-	X	-	-	-	-	-	-	-	X	-	-	-	-
4db89e	-	X	X	-	-	-	-	-	X	-	-	-	-	-
77381c	X	-	-	-	-	-	-	-	-	-	-	-	-	-
9a150c	X	-	-	-	-	-	-	-	-	-	-	-	-	-
9c1e49	X	-	-	X	-	-	-	X	X	X	-	-	-	-
919c31	-	X	-	-	-	-	-	-	-	X	-	-	-	-
c1830c	X	X	-	X	-	-	-	-	-	-	-	-	-	-
cbff4e	X	-	-	-	-	-	-	-	-	-	-	-	-	-
f31760	X	-	-	-	-	-	-	-	-	-	-	-	-	-
e25fb5	X	X	-	X	-	-	-	-	-	-	-	-	-	-
44903d	X	-	-	X	-	-	-	-	-	-	-	-	-	-
88cb82	-	-	-	-	-	-	-	-	-	X	-	-	-	-
d172ed	-	-	X	-	-	-	-	-	-	-	-	-	-	-
c45081	X	-	-	X	-	-	-	X	-	X	-	-	-	-
17160a	X	-	-	-	-	-	-	-	-	-	-	-	-	-
d13497	X	X	X	X	-	-	-	-	X	X	-	-	-	-
2051d4	-	X	-	-	X	-	-	-	X	-	-	-	-	-

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ID/Method	1	2	3	4	5	6	7	8	9	10	11	12	13	14
785226	X	-	-	X	-	-	-	-	-	-	-	-	-	-
6b9b7c	X	-	-	-	-	-	-	-	-	X	-	-	-	-
9a414c	-	-	-	-	-	-	-	X	-	-	-	-	-	-
5f03a3	X	-	-	X	-	-	-	-	X	X	-	-	-	-
76fac2	X	-	-	X	-	-	-	-	-	-	-	-	-	-
283215	-	-	-	X	-	-	-	-	-	X	-	-	-	-
d50674	-	-	-	X	-	-	-	-	-	X	-	-	-	-
b65916	-	-	-	X	-	-	-	-	-	-	-	-	-	-
7ebfcd	X	X	-	X	X	-	-	-	X	X	-	-	-	-
a3d721	-	-	-	X	-	-	-	-	-	-	-	-	-	-
6df75f	X	-	-	X	X	-	-	-	X	X	-	-	-	-
25c8f0	-	-	-	X	-	-	-	-	-	-	-	-	-	-
851362	-	-	-	X	-	-	-	-	-	-	-	-	-	-
279326	-	-	-	X	-	-	-	-	-	-	-	-	-	-
9309d9	-	-	-	-	-	-	-	-	-	X	-	-	-	-
b01a51	X	X	-	X	-	-	-	-	-	-	-	-	-	-
21c4f1	X	-	-	X	-	-	-	-	X	X	-	-	-	-
7e1549	X	-	-	X	-	-	-	-	-	-	-	-	-	-
4082c6	X	X	-	-	X	-	-	-	-	-	-	-	-	-
8fc614	X	X	-	-	X	-	-	-	-	-	-	-	-	-
96511d	-	-	-	-	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
BAU-ZERT e.V.	Raiffeisenstr. 8, Großburgwedel, 30938, Germany	-
BAUTECHNISCHE VERSUCHS- UND FORSCHUNGSANSTALT SALZBURG	Alpenstraße 157, Salzburg, 5300, Österreich	0003
BETONTEST, spol. s r. o.	Trnkova 3083/162, Brno - Líšeň, 62800, Česká republika	1116
BETOTECH, s.r.o. - Pracoviště Beroun	Beroun 660, Beroun, 26601, Česká Republika	-
BETOTECH, s.r.o. - Pracoviště Most	Beroun 660, Beroun, 26601, Česká Republika	AZL 1195
BETOTECH, s.r.o. - pracoviště Ostrava	Beroun 660, Beroun, 266 01, ČR	1195.2
BP INSTITUT d.o.o.	Veliko Blaško b.b., Laktaši, 78250, BiH	-
Bauchemia T.B., s.r.o.	Pasienkova 9, Bratislava, 821 06, Slovenská republika	-
Betosan s.r.o.	Nová cesta 40/291, Praha 4, 14000, Česká republika	1687

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Laboratory	Address	Accreditation number
CEMEX Czech Republic, s.r.o.	Semtín 102, Pardubice, 53354, Česká republika	1302
CONCRELAB S.A.S.	Calle 63D No. 71A-70, Bogotá D.C., 111061, Colombia	09-LAB-001
CSS d.o.o.	Savska cesta 144a, Zagreb, 10000, Croatia	HR1106
Central Materials Laboratory (Serian)	Canna Road, Tabuan Jaya, Kuching, 93350, Sarawak, Malaysia	-
Centrum dopravního výzkumu, v.v.i.	Líšeňská 33a, Brno, 63600, Česká republika	1506
Davide Cori	Via Anguillarese 301, Roma, 00123, Roma	-
EXAMEN lab d.o.o.	Ljudevita Gaja 26a, Samobor, 10430, Croatia	-
Faculty of Civil Engineering, University of Belgrade	Bulevar kralja Aleksandra 73, Belgrade, 11000, Serbia	-
Geo-topics	Chemin des Maréchaux, 36, Wavre, 1300, Belgium	-
Gintautas Skripkiūnas	Švepelių g. 5, Klaipėda, LT-95101, Lithuania	-
Heracles General Cement Company	1 AVRAAM KONTOPOULOU STREET, ATHENS, 18648, Greece	-
ITECONS	Rua Pedro Hispano, s/n, Pólo II da Universidade de Coimbra„ Coimbra, 3030-289, Portugal	L0446-1
Institut technologie a testování betonu, s.r.o., Zkušební laboratoř ITTB Brno	Medkova 4, Brno - Tuřany, 62700, Česká republika	1778
JKV TEST s.r.o.	Suhrady 148/4, Vřesina, 747 20, Česká republika	1294
KTU Building Materials and Structures Research Centre	Studentu st. 48, Kaunas, LT-51367, Lithuania	-
Laboratoire Central des Travaux Publics - LCTP	1. rue Kaddour RAHIM- HUSSEIN DEY, ALGER, 16005, ALGERIE	-
Laboratoire Central des Travaux Publics - Unité de BOUIRA- LCTP	1. rue Kaddour RAHIM- HUSSEIN DEY, ALGER, 16005, Algérie	-
Laboratoř Praha ŘSD ČR	Na Pankráci 546/56, Praha 4, 140 00, Česká republika	1734
Mattest (Ireland) Ltd	Unit 2, Northwest Business Park, Ballycoolin, Dublin 15., Dublin, D15 EF1H, Ireland	286T
NORD COMAT shpk	Rruga: "Muhamet Deliu", Pallati i Firmes "DODAJ" ,KATI 1, TIRANE, 1000, ALBANIA	-
PUDIS a.s.	Podbabská 1014/20, Praha 6, 160 00, Česká republika	1762
Panevezio statybos trestas, AB	P. Puzino g. 1, Panevezys, LT-36173, Lithuania	LA.01.022

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Laboratory	Address	Accreditation number
QUALIFORM, a.s. - pracoviště Brno	Mlaty 672/8, Bosonohy, Brno, 64200, Jihomoravský	1008
QUALIFORM, a.s. - pracoviště Praha	Mlaty 672/8, Bosonohy, Brno, 64200, Jihomoravský	1008
SG Geotechnika a.s.	Geologická 988/4, Praha 5 - Hlubočepy, 152 00, Česká republika	1119
STACHEMA Bratislava a.s.	Železničná 714/180, Rovinka, 900 41, Slovenská republika	S-275
TESScontrol, s.r.o., organizačná zloška, Laboratoř Znojmo, Zkušební laboratoř Znojmo	Brněnská 3797/29, Znojmo, 669 02, Česká republika	-
TPA ČR, s.r.o. - České Budějovice	Vrbenská 1831/31, České Budějovice, 370 06, Česká republika	1181
TPA ČR, s.r.o. pracoviště č.4 Velká Bystřice	Vrbenská 1821/31, České Budějovice, 370 06, Česká republika	1181
TRA EOOD CTC BURGAS	Rezbarska str. №7, SOFIA, 1510, BULGARIA	-
Technický a skúšobný ústav stavebný, n. o., Pobočka Bratislava	Studená, 967/3, Bratislava, 82104, Slovensko	S-045
Technický a skúšobný ústav stavebný, n. o., Pobočka Košice	Studená, 967/3, Bratislava, 82104, Slovensko	S-045
Technický a skúšobný ústav stavebný, n. o., Pobočka Nitra	Studená, 967/3, Bratislava, 82104, Slovensko	S-045
Technický a skúšobný ústav stavebný, n. o., Pobočka Nové Mesto nad Váhom	Studená, 967/3, Bratislava, 82104, Slovensko	S-045
Technický a skúšobný ústav stavebný, n. o., Pobočka Prešov	Studená, 967/3, Bratislava, 82104, Slovensko	S-045
Technický a skúšobný ústav stavebný, n. o., Pobočka Tatranská Štrba	Studená, 967/3, Bratislava, 82104, Slovensko	S-045
Technický a skúšobný ústav stavebný, n. o., Pobočka Zvolen	Studená, 967/3, Bratislava, 82104, Slovensko	S-045
Technický a skúšobný ústav stavebný, n. o., Pobočka Žilina	Studená, 967/3, Bratislava, 82104, Slovensko	S-045
Technische Universität Graz	Rechbauerstraße 12, Graz, 8010, Austria	-
UAB Heidelberg Materials Lietuva Cementas	Švepelių st. 5, Klaipėda, LT-95101, Lithuania	-
Universiteit Gent	Technologiepark-Zwijnaarde 60, Zwijnaarde, 9052, Belgium	220-TEST
University of Natural Resources and Life Sciences Vienna, Institute for Structural Engineering	Peter-Jordan-Str. 82, Wien, 1190, AUSTRIA	-
Vysoké učení technické v Brně, Fakulta stavební, Zkušební laboratoř při ÚTHD FAST VUT v Brně	Veveří 331/95, Brno, 60200, Česká republika	1396
ÉMI Építésügyi Minőségellenőrző Innovációs Nonprofit Kft. - Paks	Ipari Park, Vállalkozói Inkubátor Ház, Paks, 7030, Hungary	-

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Laboratory	Address	Accreditation number
ÉMI Építésügyi Minőségellenőrző Innovációs Nonprofit Kft. - Szentendre	Dózsa György út 26, Szentendre, 2000, Magyarország	NAH-1-1011/2018/K
Ústav stavebního zkušebnictví s.r.o.	Jiřího Potůčka 115, Trnová, Pardubice, 53009, Česká republika	1115
Ředitelství silnic a dálnic ČR	Rebešovická 40, Brno-Chrlice, 643 00, Česká republika	1072
Žilinská univerzita v Žiline	Univerzitná 8215/1, Žilina, 010 26, Slovenská republika	-

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 Strenght and Elasticity of Hardened Concrete (PT Program) organized by the PT Provider at the SZK FAST. 57 participants (laboratories) took part in the PT Program. The program focused on ordinary standardized testing of hardened concrete with emphasis on its strength and elasticity. The test results are evaluated separately for each testing procedure examined. An evaluation of statistical characteristics is included in the Appendix, as well as test results and graphic presentations. Testing methods can be found in part 1 of this report.

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

ID / Method	1	2	3	4	5	6	7	8	9	10	11	12	13	14
824106	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
694111	-	-	-	-	-	-	-	-	-	✓	-	-	-	-
c406ae	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
7cadff	-	-	-	-	-	-	-	✓	-	-	-	-	-	-
a9dfd6	✓	-	-	-	✓	-	-	-	-	-	-	-	-	-
96464f	-	✓	-	-	-	-	-	-	-	-	-	-	-	-
35710b	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
6d92be	-	-	-	-	✓	-	-	-	-	-	-	-	-	-
250e96	-	-	-	-	-	-	-	-	-	✓	-	-	-	-
8fef74	-	✓	-	-	-	-	-	-	-	✓	-	-	-	-
32f753	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
4da533	✓	-	✓	-	-	-	-	✓	✓	-	-	-	-	-
ac860b	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
eeca6a	✓	-	-	✓	-	-	-	-	✓	✓	-	-	-	-
bf4403	✓	✓	✓	✓	✓	-	-	✓	-	-	-	-	-	-
6deff1	!	-	-	-	-	-	-	-	-	-	-	-	-	-
bcf801	✓	-	-	✓	-	-	-	-	-	✓	-	-	-	-
b3cf46	?	-	-	✓	-	-	-	-	-	-	-	-	-	-
80df78	-	-	✓	-	-	-	-	-	-	-	-	-	-	-
b7c36c	-	✓	-	-	-	-	-	-	-	✓	-	-	-	-
4db89e	-	✓	✓	-	-	-	-	-	✓	-	-	-	-	-
77381c	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
9a150c	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
9c1e49	✓	-	-	✓	-	-	-	✓	✓	✓	-	-	-	-
919c31	-	✓	-	-	-	-	-	-	-	✓	-	-	-	-
c1830c	✓	✓	-	✓	-	-	-	-	-	-	-	-	-	-
cbff4e	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
f31760	✓	-	-	-	-	-	-	-	-	-	-	-	-	-

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ID / Method	1	2	3	4	5	6	7	8	9	10	11	12	13	14
e25fb5	✓	✓	-	✓	-	-	-	-	-	-	-	-	-	-
44903d	!	-	-	✓	-	-	-	-	-	-	-	-	-	-
88cb82	-	-	-	-	-	-	-	-	-	✓	-	-	-	-
d172ed	-	-	X	-	-	-	-	-	-	-	-	-	-	-
c45081	✓	-	-	✓	-	-	-	✓	-	✓	-	-	-	-
17160a	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
d13497	✓	✓	✓	✓	-	-	-	-	✓	✓	-	-	-	-
2051d4	-	✓	-	-	✓	-	-	-	✓	-	-	-	-	-
785226	?	-	-	✓	-	-	-	-	-	-	-	-	-	-
6b9b7c	✓	-	-	-	-	-	-	-	-	✓	-	-	-	-
9a414c	-	-	-	-	-	-	-	✓	-	-	-	-	-	-
5f03a3	✓	-	-	✓	-	-	-	-	✓	✓	-	-	-	-
76fac2	✓	-	-	✓	-	-	-	-	-	-	-	-	-	-
283215	-	-	-	✓	-	-	-	-	-	✓	-	-	-	-
d50674	-	-	-	✓	-	-	-	-	-	✓	-	-	-	-
b65916	-	-	-	✓	-	-	-	-	-	-	-	-	-	-
7ebfcd	✓	✓	-	✓	✓	-	-	-	✓	✓	-	-	-	-
a3d721	-	-	-	✓	-	-	-	-	-	-	-	-	-	-
6df75f	✓	-	-	✓	✓	-	-	-	✓	✓	-	-	-	-
25c8f0	-	-	-	✓	-	-	-	-	-	-	-	-	-	-
851362	-	-	-	✓	-	-	-	-	-	-	-	-	-	-
279326	-	-	-	✓	-	-	-	-	-	-	-	-	-	-
9309d9	-	-	-	-	-	-	-	-	-	✓	-	-	-	-
b01a51	✓	✓	-	✓	-	-	-	-	-	-	-	-	-	-
21c4f1	✓	-	-	✓	-	-	-	-	✓	✓	-	-	-	-
7e1549	✓	-	-	✓	-	-	-	-	-	-	-	-	-	-
4082c6	✓	✓	-	-	✓	-	-	-	-	-	-	-	-	-
8fc614	✓	✓	-	-	✓	-	-	-	-	-	-	-	-	-
96511d	-	-	-	-	✓	-	-	-	-	-	-	-	-	-

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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. u_X - extended uncertainty of measurement; $\bar{x}$ - average value; s_0 - sample standard deviation; V_X - variation coefficient

ID	Test results [N/mm^2]			u_X [N/mm^2]	$\bar{x}$ [N/mm^2]	s_0 [N/mm^2]	V_X [%]
44903d	50.0	51.2	52.1	-	51.1	1.05	2.06
6deff1	50.6	49.6	58.0	0.3	52.7	4.59	8.7
b3cf46	54.3	54.1	53.0	-	53.8	0.7	1.3
785226	54.1	54.6	53.0	0.4	53.9	0.82	1.53
cbff4e	51.0	59.3	58.1	3.0	56.1	4.49	7.99
17160a	57.0	53.4	58.2	1.3	56.2	2.5	4.44
77381c	55.1	54.6	59.3	1.6	56.3	2.58	4.58
5f03a3	57.6	55.0	57.0	-	56.5	1.36	2.41
6df75f	57.2	56.2	56.3	-	56.6	0.55	0.97
7ebfcd	56.1	56.1	59.1	-	57.1	1.73	3.03
e25fb5	57.0	57.4	58.1	2.8	57.5	0.56	0.97
bcf801	56.7	58.6	58.1	1.2	57.8	0.98	1.7
9c1e49	56.2	58.7	58.9	0.4	57.9	1.5	2.6
f31760	59.3	59.7	55.1	5.6	58.0	2.55	4.39
c1830c	59.2	58.3	57.5	-	58.3	0.85	1.46
eeca6a	59.4	58.0	57.7	2.4	58.4	0.91	1.55
7e1549	58.3	58.1	59.6	2.2	58.7	0.81	1.39
9a150c	57.2	59.4	59.9	0.4	58.8	1.42	2.41
76fac2	58.4	59.5	59.0	-	59.0	0.55	0.93
b01a51	59.4	58.4	59.1	0.6	59.0	0.55	0.94
4da533	60.2	58.0	58.9	1.4	59.0	1.11	1.87
c45081	61.7	58.2	57.9	2.0	59.3	2.11	3.56
d13497	58.9	59.3	59.7	3.3	59.3	0.4	0.67
ac860b	61.1	60.0	57.1	2.0	59.4	2.07	3.48
6b9b7c	57.3	59.9	61.0	0.8	59.4	1.9	3.2
a9dfd6	60.6	61.3	56.8	1.7	59.6	2.42	4.07
824106	59.0	61.8	59.3	0.9	60.0	1.54	2.56
4082c6	60.1	57.7	62.4	4.2	60.1	2.35	3.91
8fc614	61.7	58.5	60.3	3.6	60.2	1.6	2.67
bf4403	60.7	61.1	59.4	4.0	60.4	0.89	1.47
21c4f1	60.1	60.8	61.6	-	60.8	0.75	1.23

1.2 The Numerical Procedure for Determining Outliers

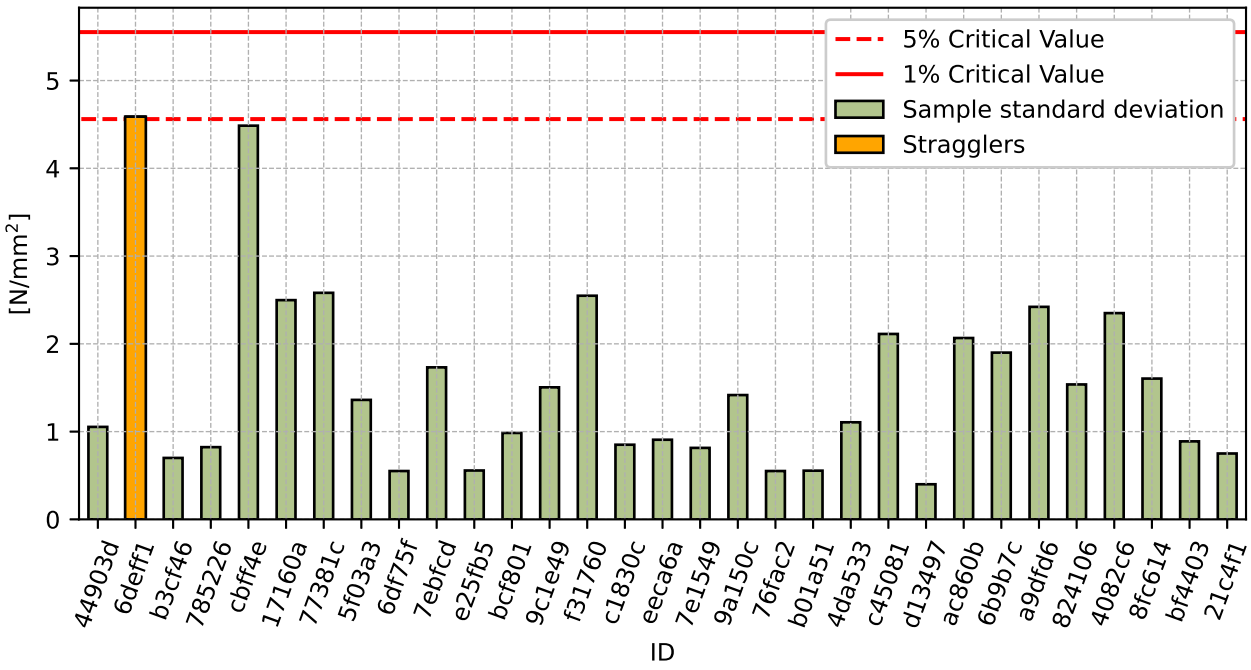

Figure 1: **Cochran's test** - sample standard deviations

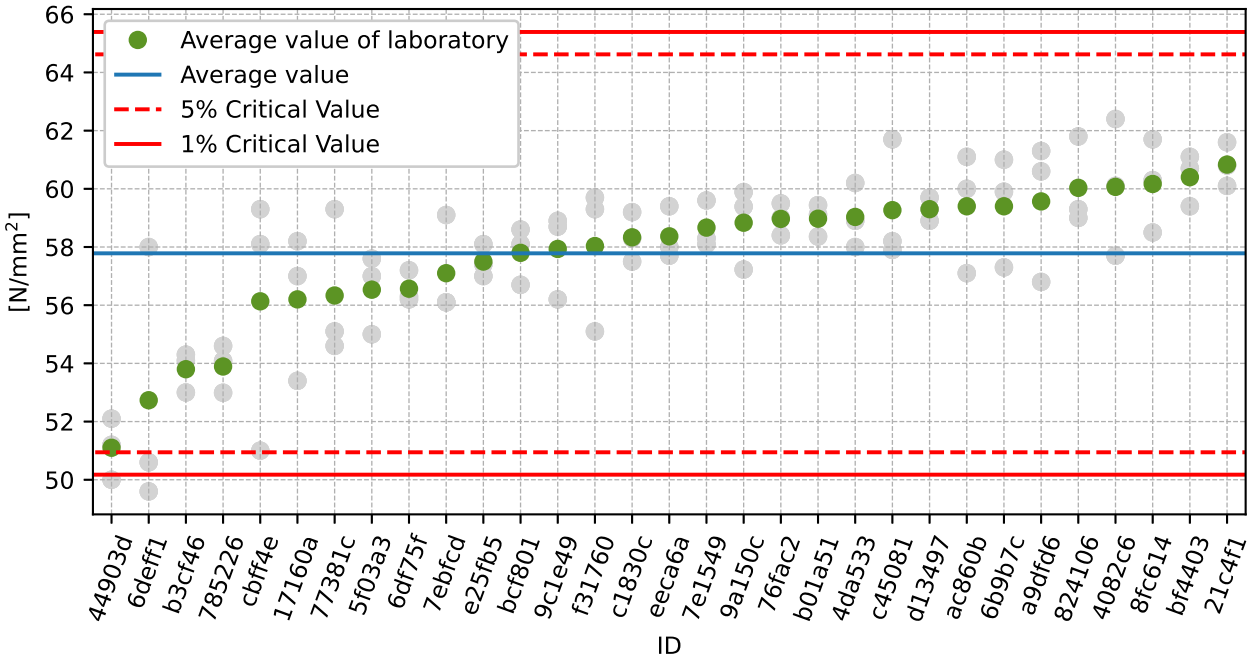

Figure 2: **Grubbs' test** - average values

1.3 Mandel's Statistics

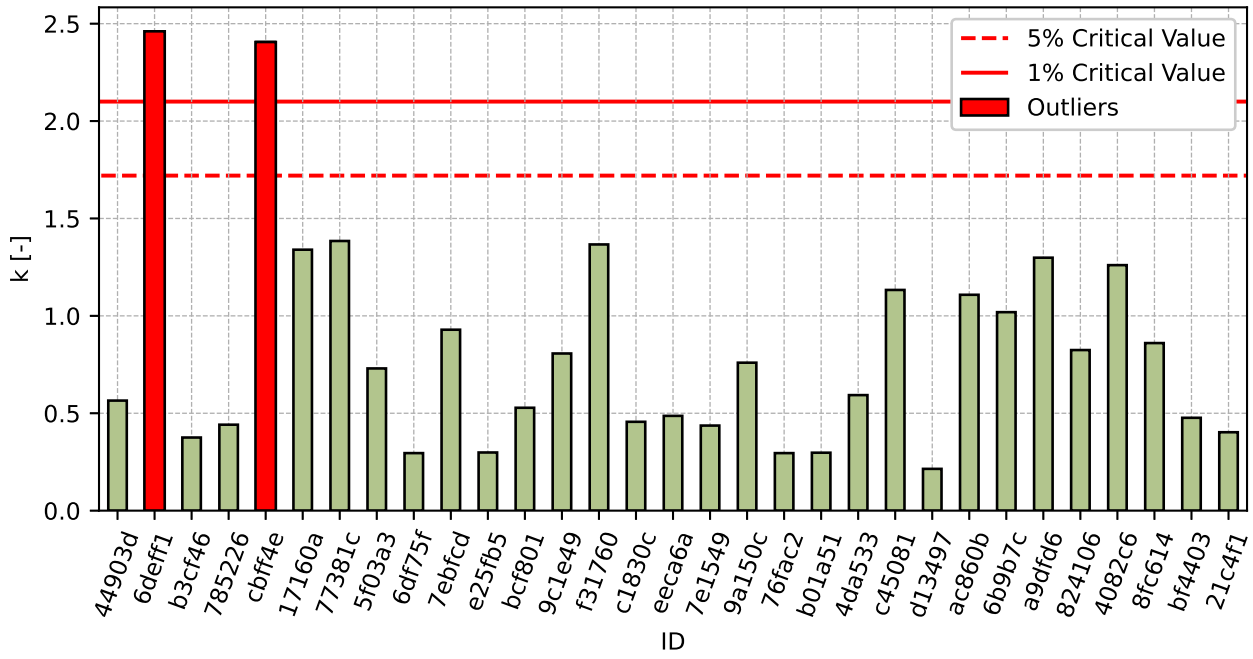

Figure 3: Intralaboratory Consistency Statistic

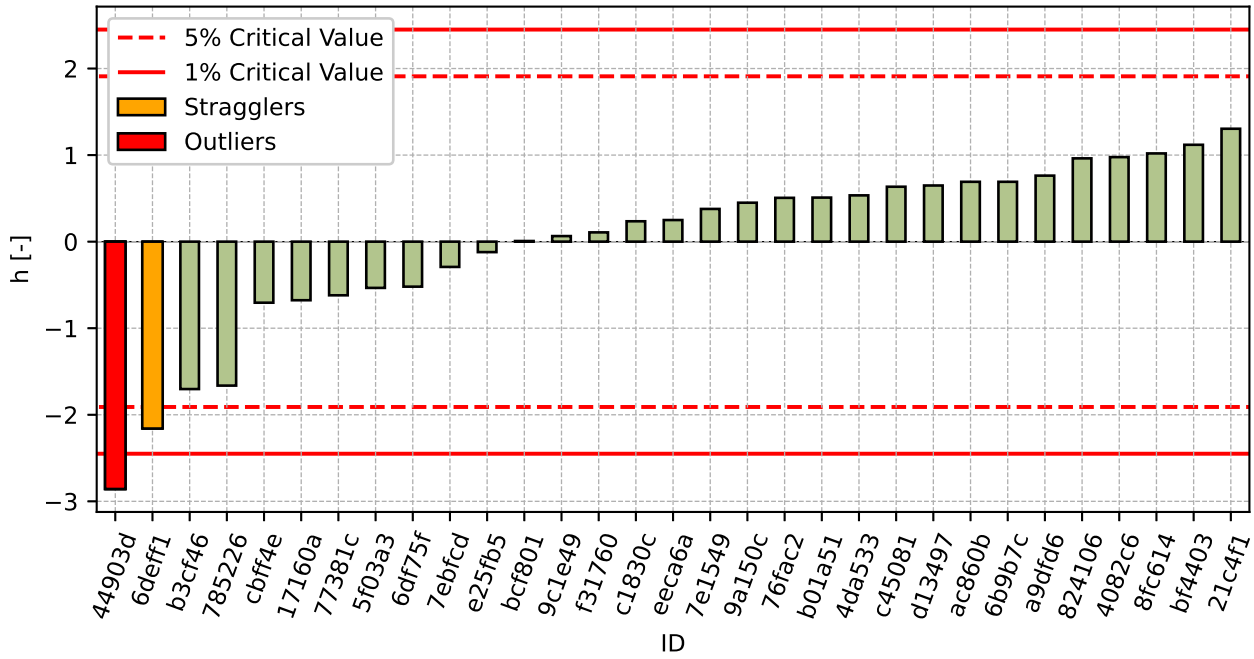

Figure 4: Interlaboratory Consistency Statistic

1.4 Descriptive statistics

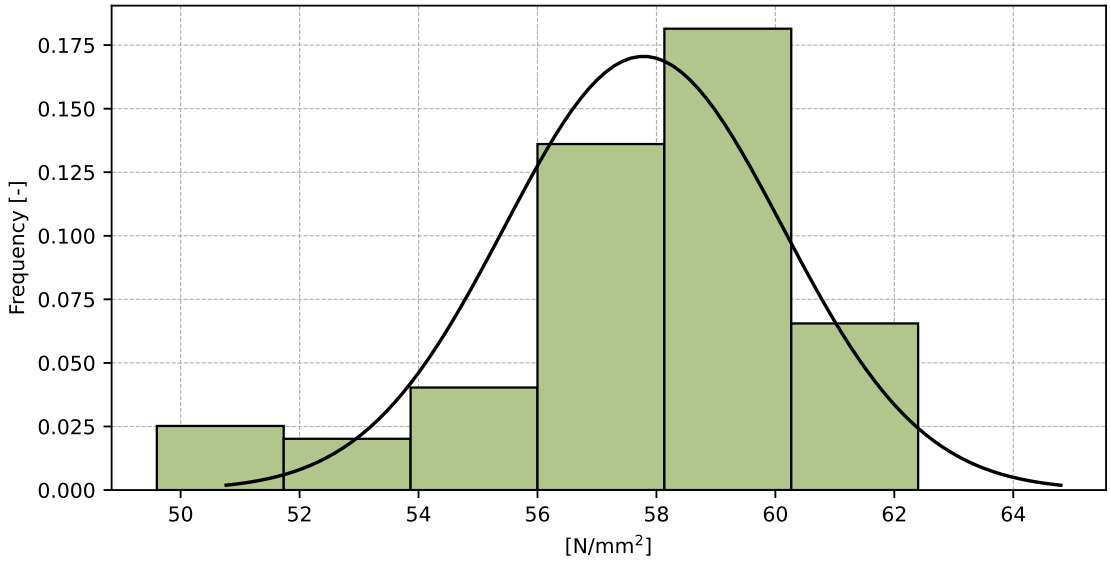

Figure 5: Histogram of all test results

Table 5: Descriptive statistics

Characteristics	**[N/mm²]**
Average value – $\bar{x}$	57.8
Sample standard deviation – s	2.34
Asigned value – x^*	58.1
Robust standard deviation – s^*	1.78
Measurement uncertainty of asigned value – u_X	0.4
p-value of normality test	0.0 [-]
Interlaboratory standard deviation – s_L	2.08
Repeatability standard deviation – s_r	1.86
Reproducibility standard deviation – s_R	2.79
Repeatability – r	5.2
Reproducibility – R	7.8

1.5 Evaluation of Performance Statistics

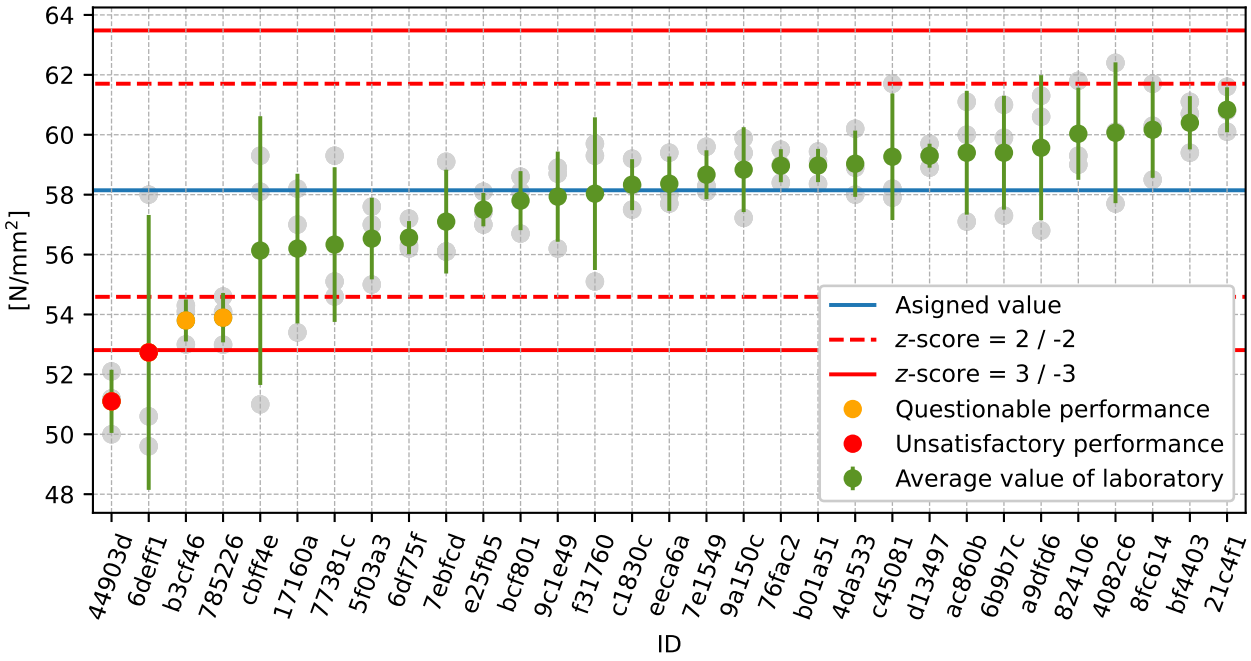

Figure 6: Average values and sample standard deviations

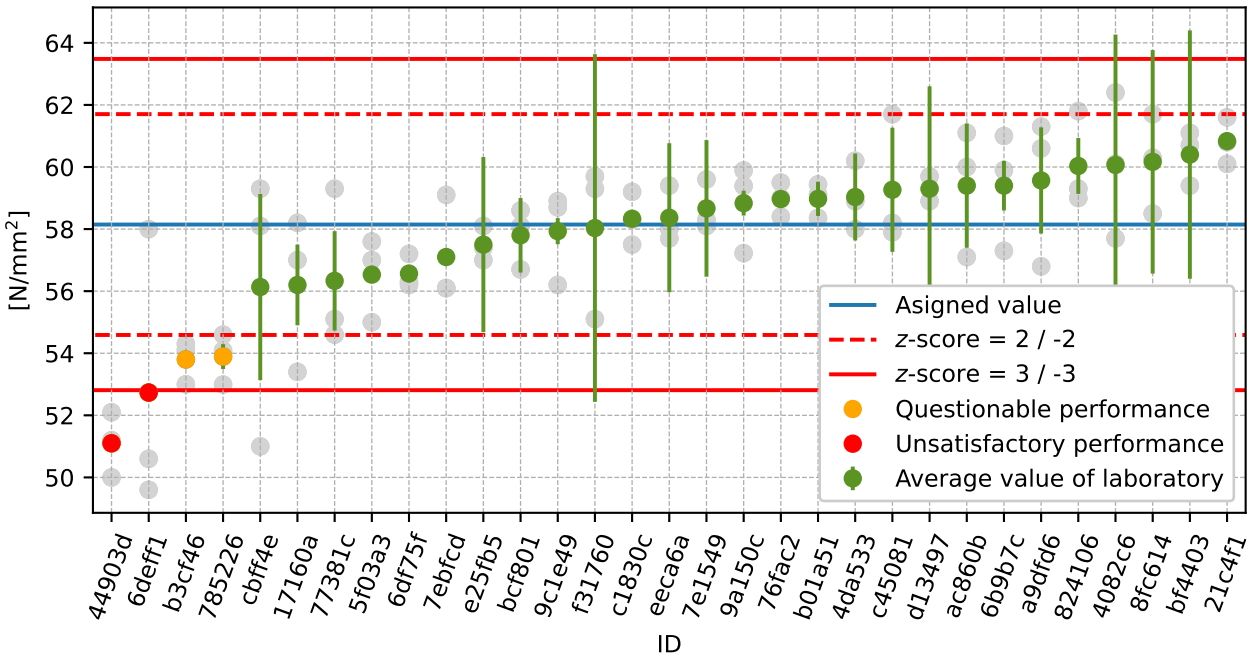

Figure 7: Average values and extended uncertainties of measurement

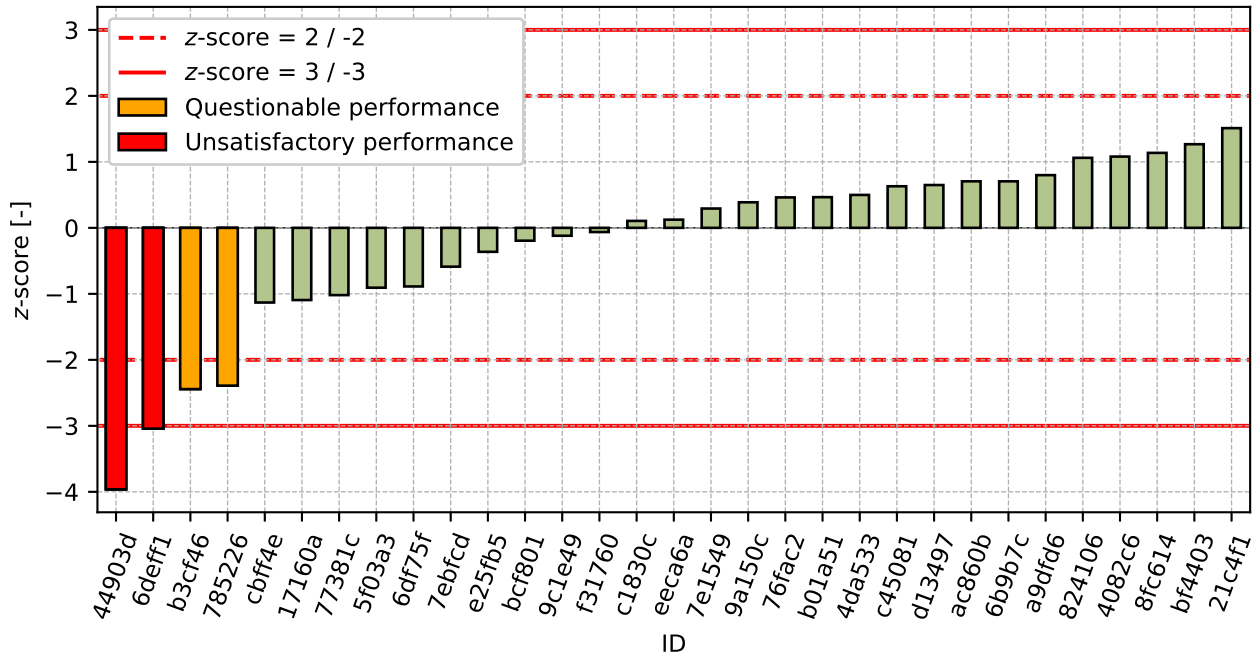

Figure 8: z-score

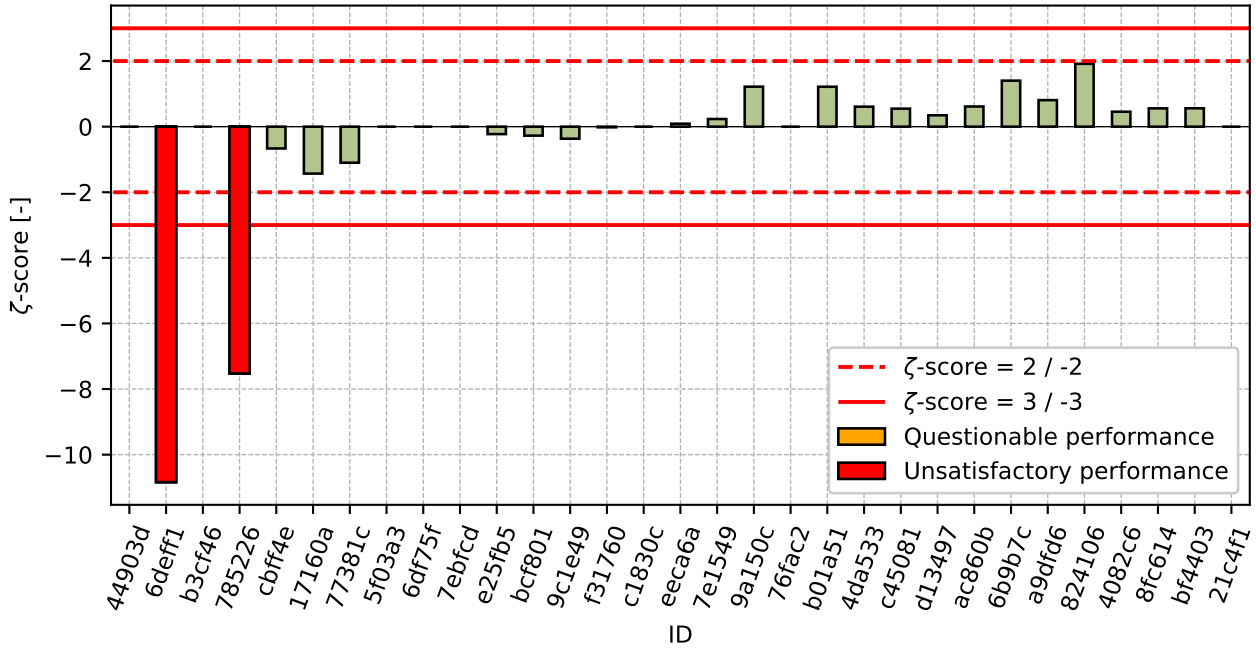

Figure 9: ζ-score

Table 6: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
44903d	-3.96	-
6deff1	-3.04	-10.84
b3cf46	-2.44	-
785226	-2.39	-7.52
cbff4e	-1.13	-0.67
17160a	-1.09	-1.43
77381c	-1.02	-1.1
5f03a3	-0.91	-
6df75f	-0.89	-
7ebfcd	-0.59	-
e25fb5	-0.36	-0.23
bcf801	-0.19	-0.27
9c1e49	-0.12	-0.37
f31760	-0.06	-0.02
c1830c	0.11	-
eeca6a	0.12	0.09
7e1549	0.29	0.23
9a150c	0.39	1.22
76fac2	0.46	-
b01a51	0.47	1.22
4da533	0.5	0.61
c45081	0.63	0.55
d13497	0.65	0.35
ac860b	0.7	0.61
6b9b7c	0.7	1.4
a9dfd6	0.8	0.81
824106	1.06	1.92
4082c6	1.08	0.46
8fc614	1.14	0.56
bf4403	1.27	0.56
21c4f1	1.51	-

2 Appendix – EN 12390-5 – Flexural strength of test specimens

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 [N/mm^2]			u_X [N/mm^2]	$\bar{x}$ [N/mm^2]	s_0 [N/mm^2]	V_X [%]
e25fb5	4.0	4.0	4.0	0.2	4.0	0.0	0.0
4db89e	4.6	3.8	4.5	-	4.3	0.44	10.14
919c31	4.4	4.2	4.4	0.1	4.3	0.07	1.6
b01a51	4.4	4.3	4.3	0.0	4.3	0.04	0.93
2051d4	4.2	4.5	4.3	-	4.3	0.15	3.53
8fc614	4.8	4.3	4.5	0.6	4.5	0.25	5.55
c1830c	5.3	4.3	4.2	-	4.6	0.61	13.22
96464f	4.7	4.6	4.6	0.2	4.6	0.06	1.25
bf4403	4.2	4.9	4.8	1.2	4.6	0.38	8.17
7ebfcd	4.6	4.9	5.1	-	4.9	0.25	5.17
d13497	5.0	4.7	5.0	0.3	4.9	0.17	3.53
4082c6	4.4	5.3	5.0	0.8	4.9	0.46	9.35
8fef74	4.5	5.1	5.3	0.1	5.0	0.42	8.38
b7c36c	5.4	5.0	4.6	1.4	5.0	0.4	8.0

2.2 The Numerical Procedure for Determining Outliers

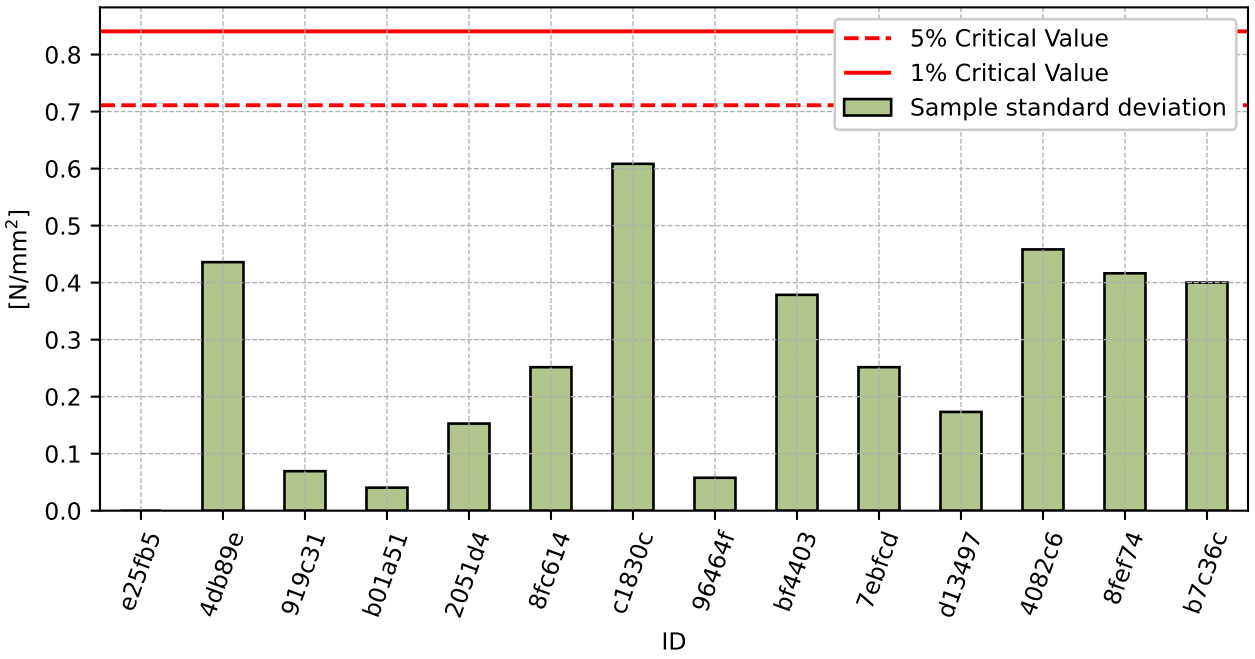

Figure 10: **Cochran's test** - sample standard deviations

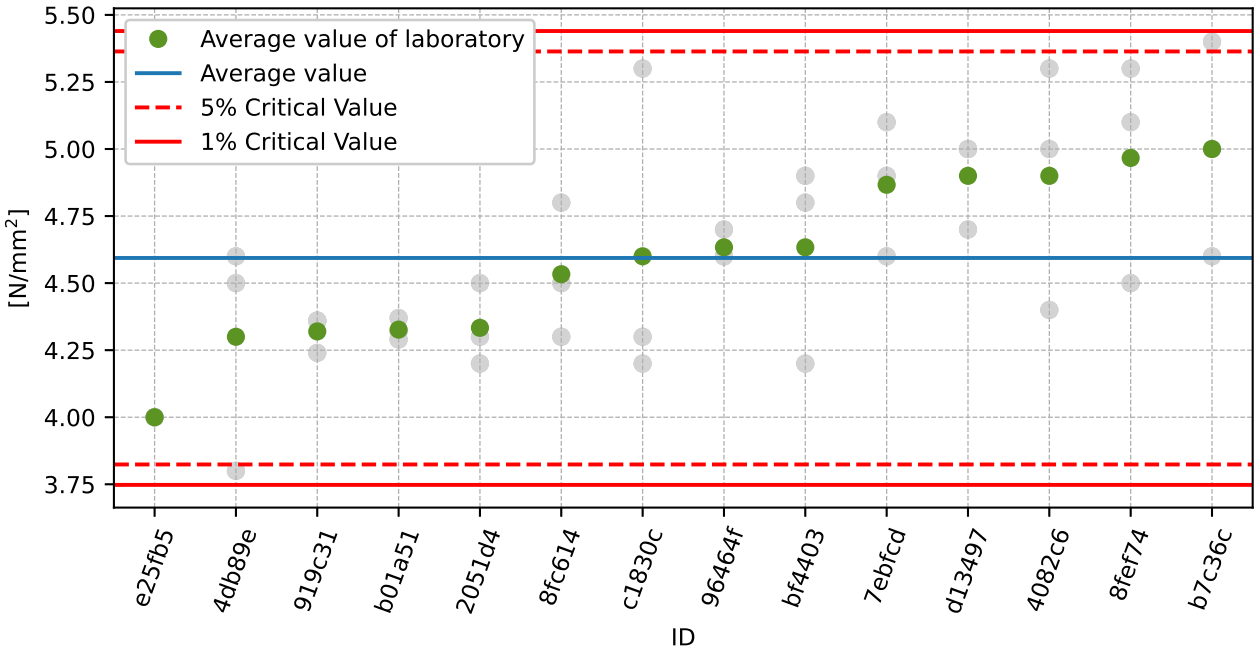

Figure 11: **Grubbs' test** - average values

2.3 Mandel's Statistics

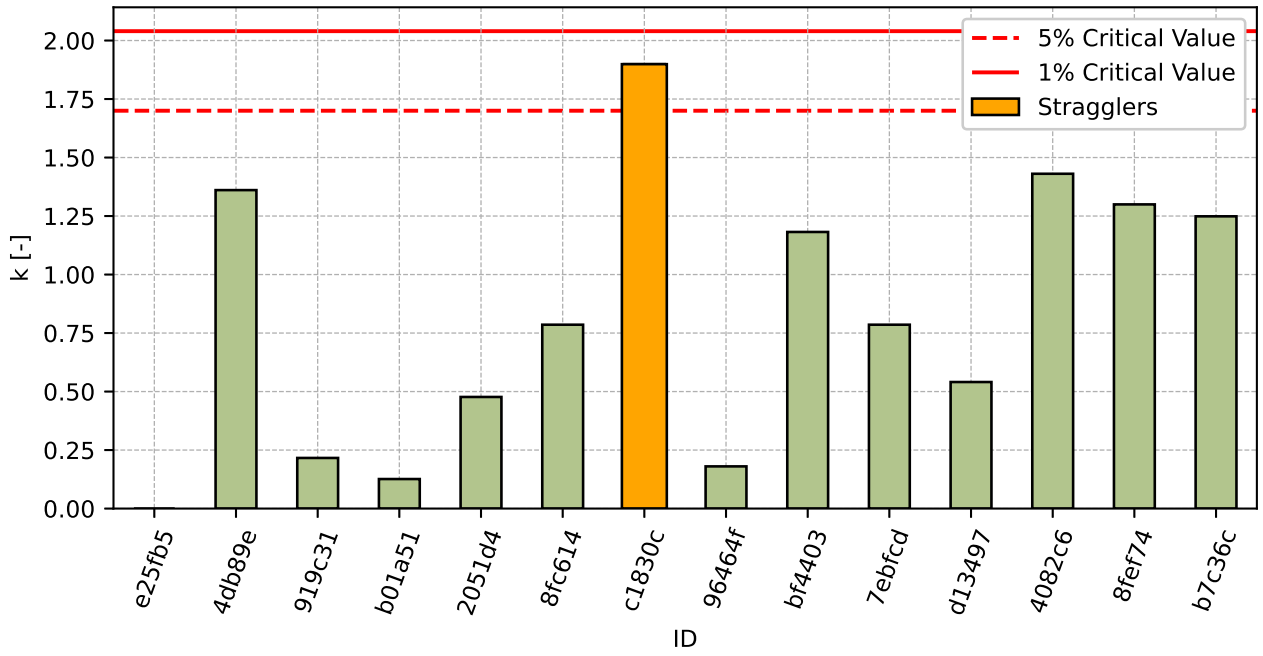

Figure 12: Intralaboratory Consistency Statistic

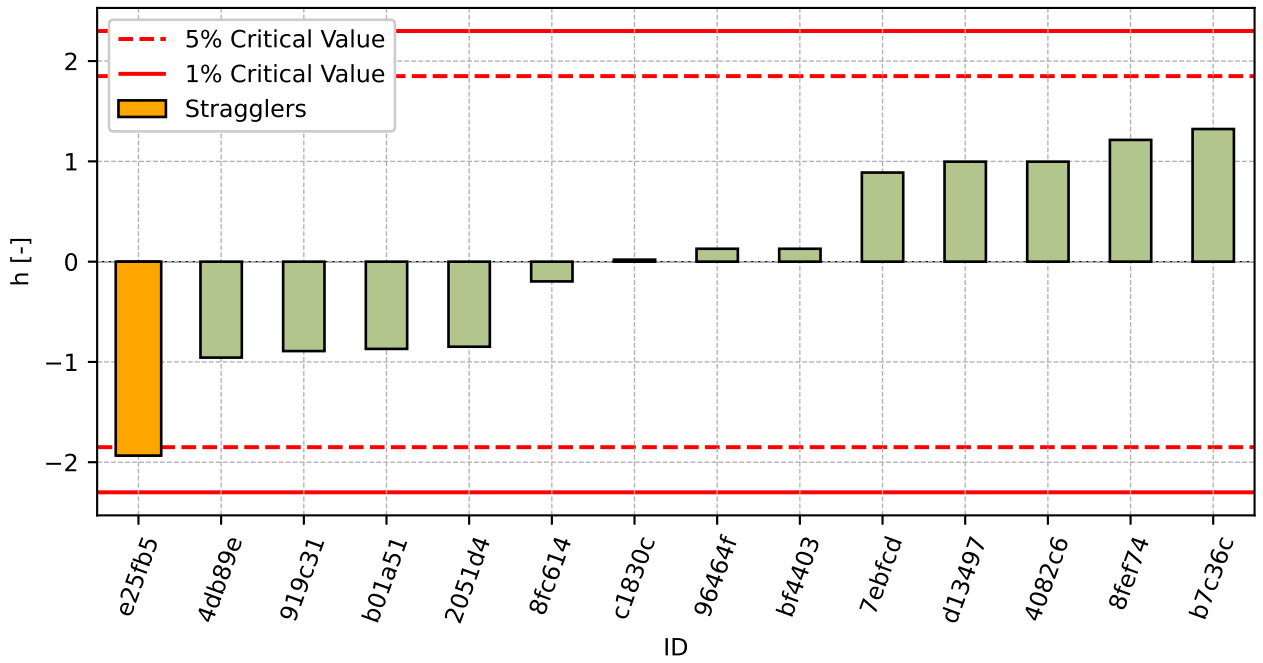

Figure 13: Interlaboratory Consistency Statistic

2.4 Descriptive statistics

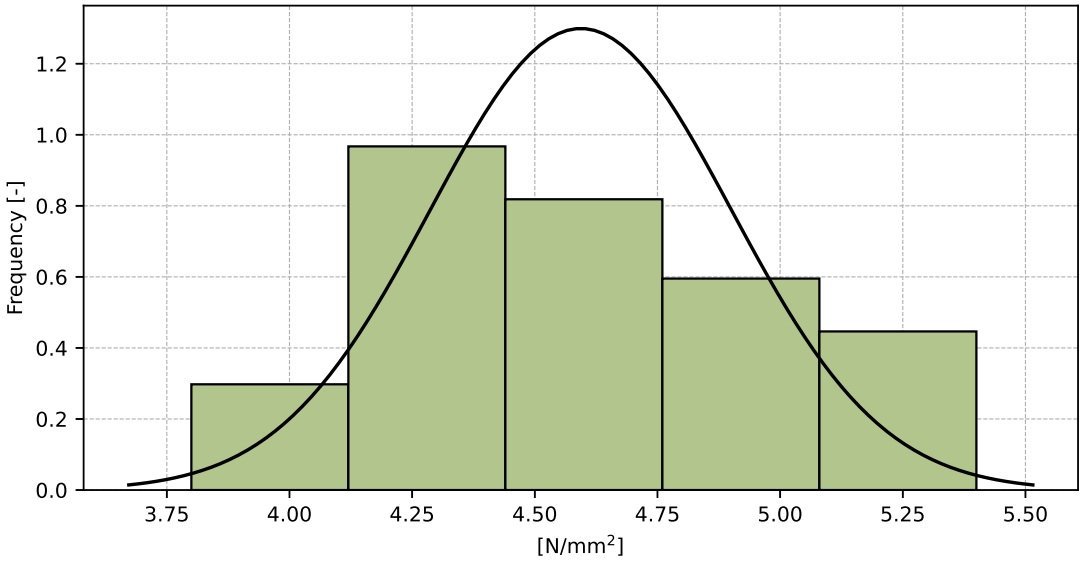

Figure 14: Histogram of all test results

Table 8: Descriptive statistics

Characteristics	**[N/mm²]**
Average value – $\bar{x}$	4.6
Sample standard deviation – s	0.31
Asigned value – x^*	4.6
Robust standard deviation – s^*	0.32
Measurement uncertainty of asigned value – u_X	0.11
p-value of normality test	0.287 [-]
Interlaboratory standard deviation – s_L	0.25
Repeatability standard deviation – s_r	0.32
Reproducibility standard deviation – s_R	0.4
Repeatability – r	0.9
Reproducibility – R	1.1

2.5 Evaluation of Performance Statistics

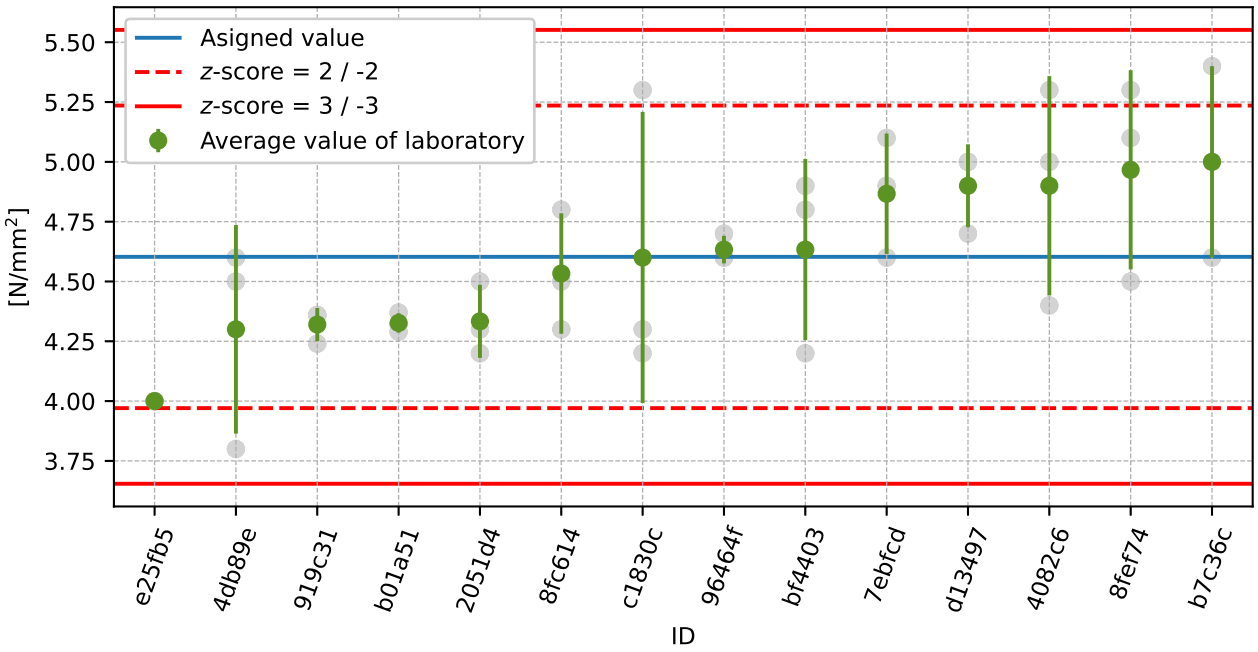

Figure 15: Average values and sample standard deviations

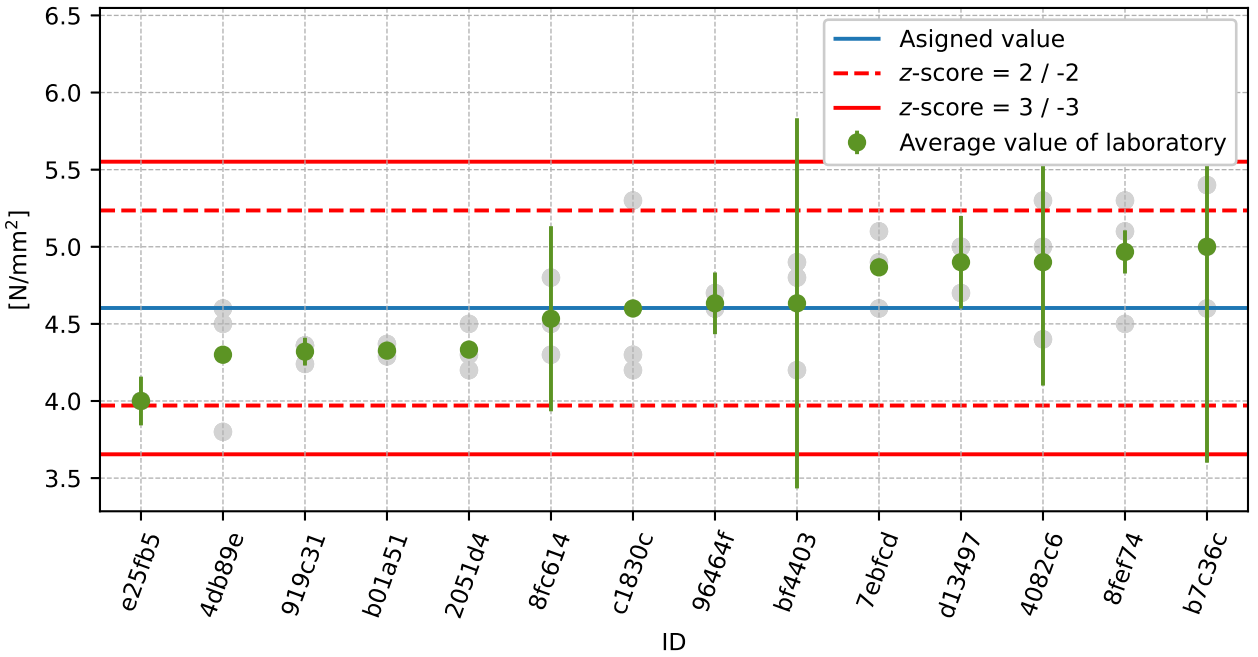

Figure 16: Average values and extended uncertainties of measurement

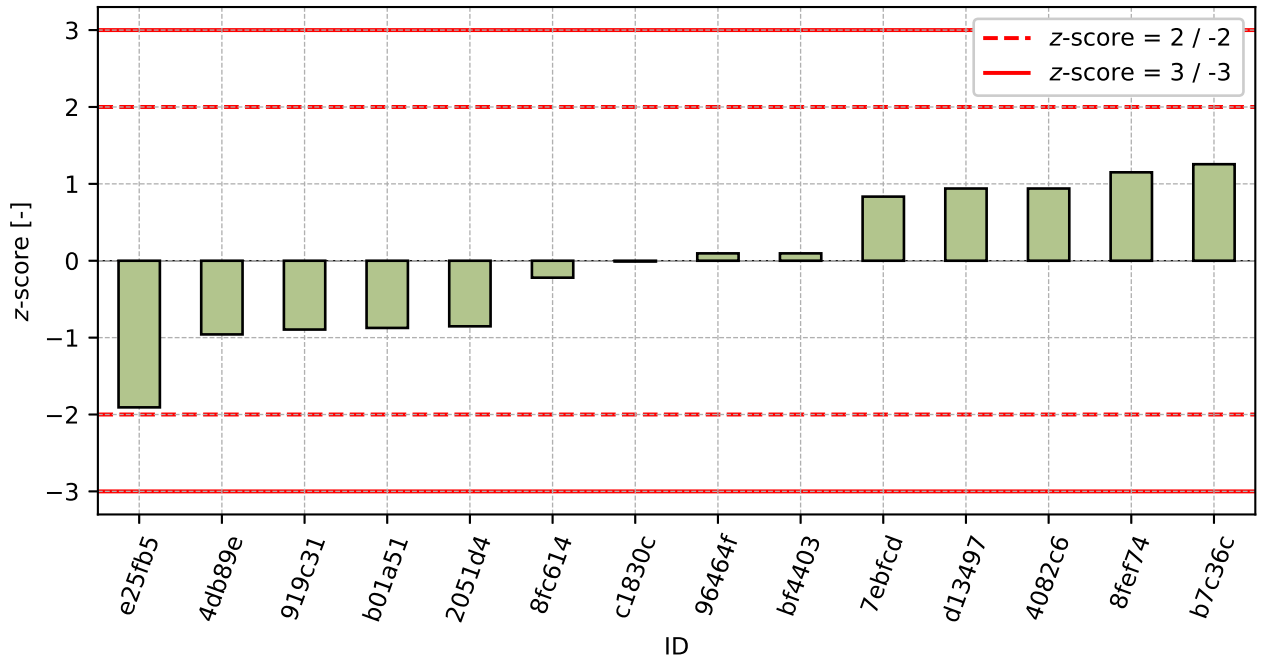

Figure 17: z-score

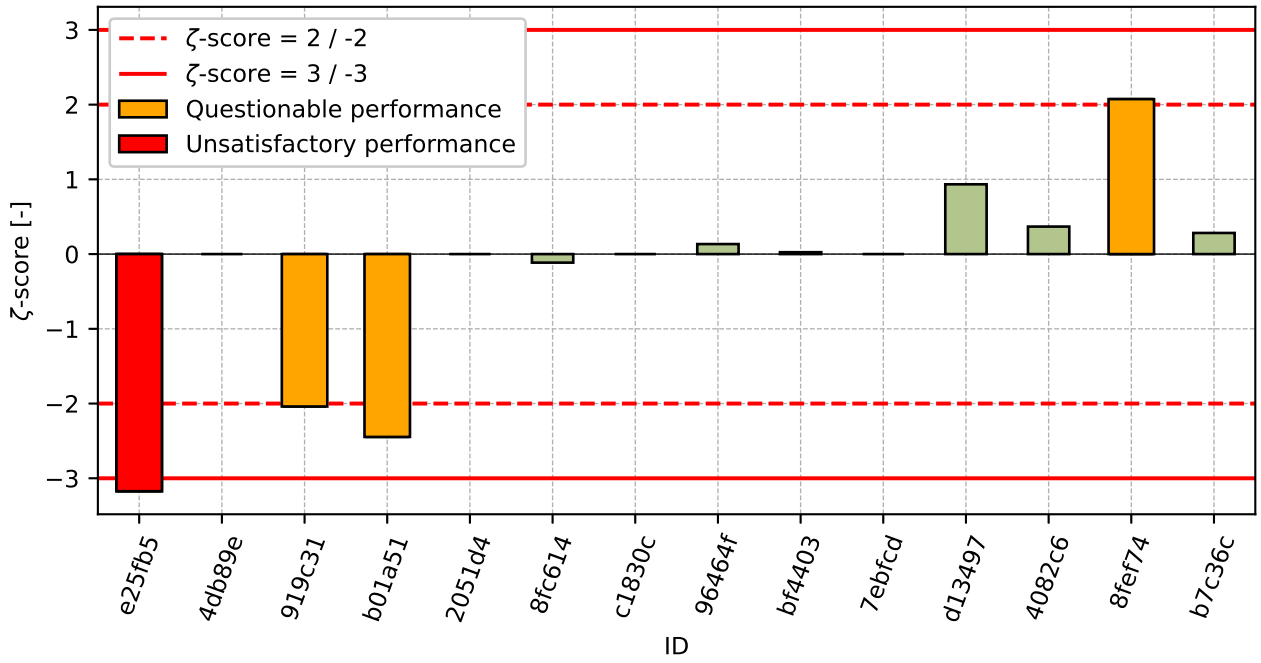

Figure 18: ζ-score

Table 9: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
e25fb5	-1.91	-3.17
4db89e	-0.96	-
919c31	-0.9	-2.04
b01a51	-0.87	-2.45
2051d4	-0.85	-
8fc614	-0.22	-0.11
c1830c	-0.01	-
96464f	0.1	0.13
bf4403	0.1	0.03
7ebfcd	0.83	-
d13497	0.94	0.93
4082c6	0.94	0.37
8fef74	1.15	2.07
b7c36c	1.26	0.28

3 Appendix – EN 12390-6 – Tensile splitting strength of test specimens

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 [N/mm^2]			u_X [N/mm^2]	$\bar{x}$ [N/mm^2]	s_0 [N/mm^2]	V_X [%]
4db89e	4.5	4.1	4.45	-	4.35	0.218	5.01
d13497	3.95	4.95	4.8	0.25	4.57	0.539	11.81
80df78	4.31	5.32	4.25	0.1	4.63	0.601	12.99
bf4403	4.75	4.68	5.01	0.5	4.81	0.174	3.61
4da533	5.4	4.9	5.15	0.12	5.15	0.25	4.85
d172ed	7.35	8.05	7.2	0.69	7.53	0.454	6.02

3.2 The Numerical Procedure for Determining Outliers

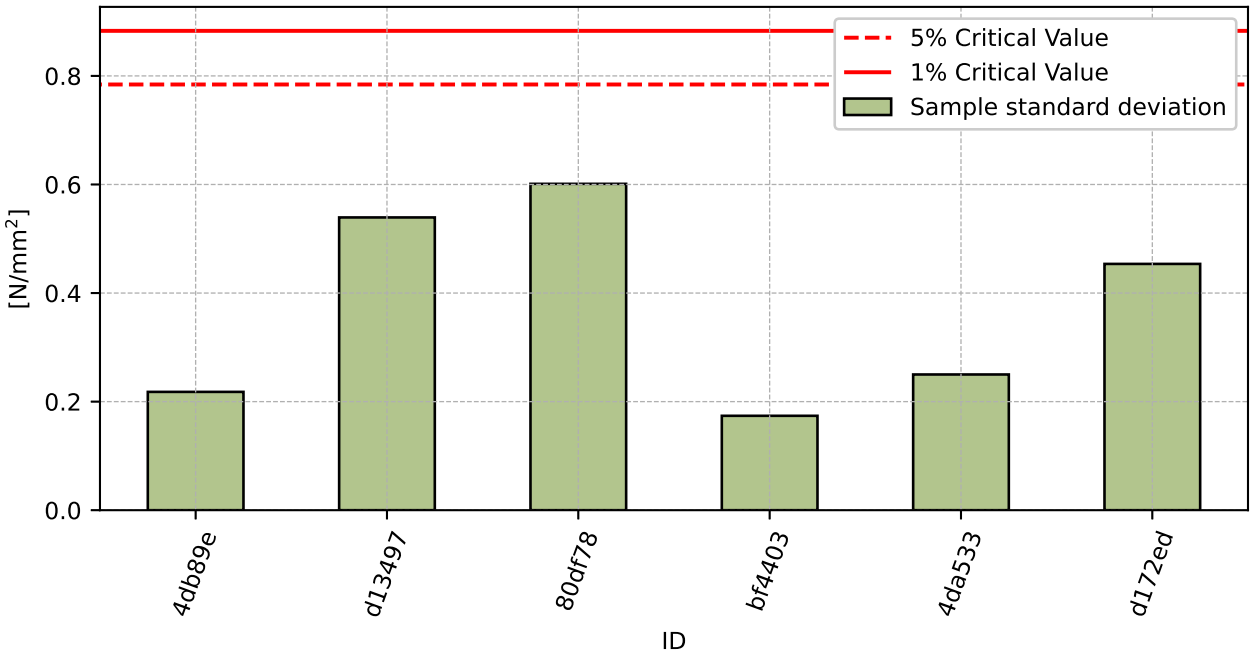

Figure 19: **Cochran's test** - sample standard deviations

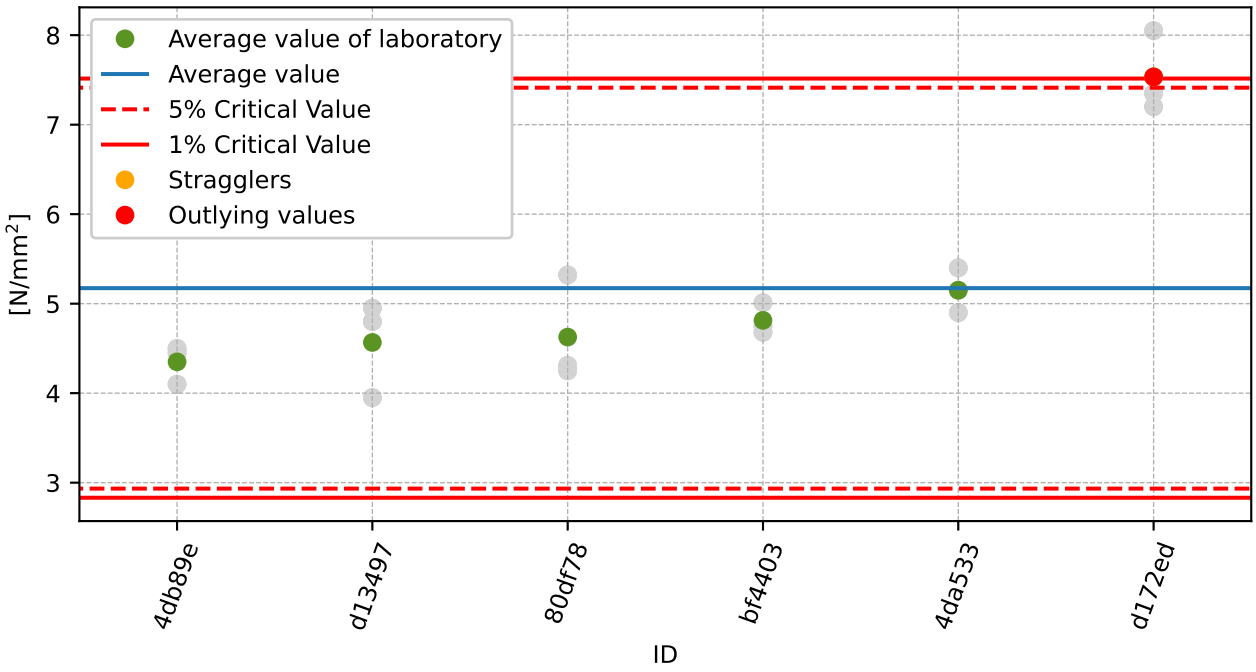

Figure 20: **Grubbs' test** - average values

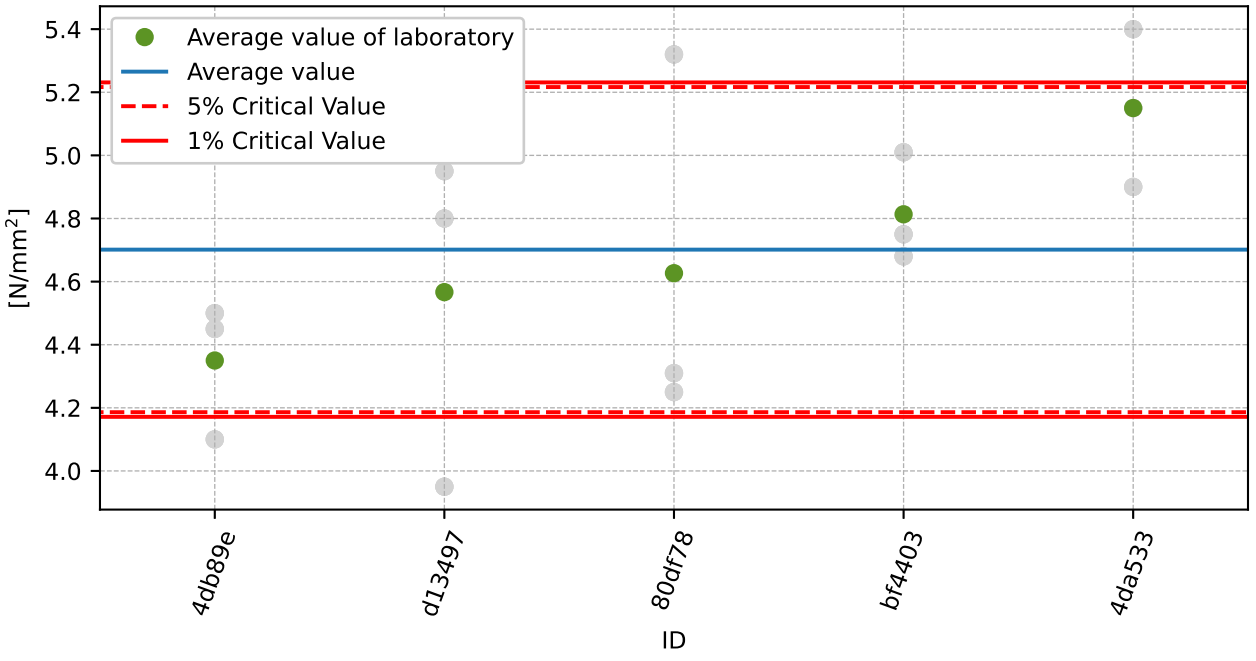

Figure 21: **Grubbs' test** - average values without outliers

3.3 Mandel's Statistics

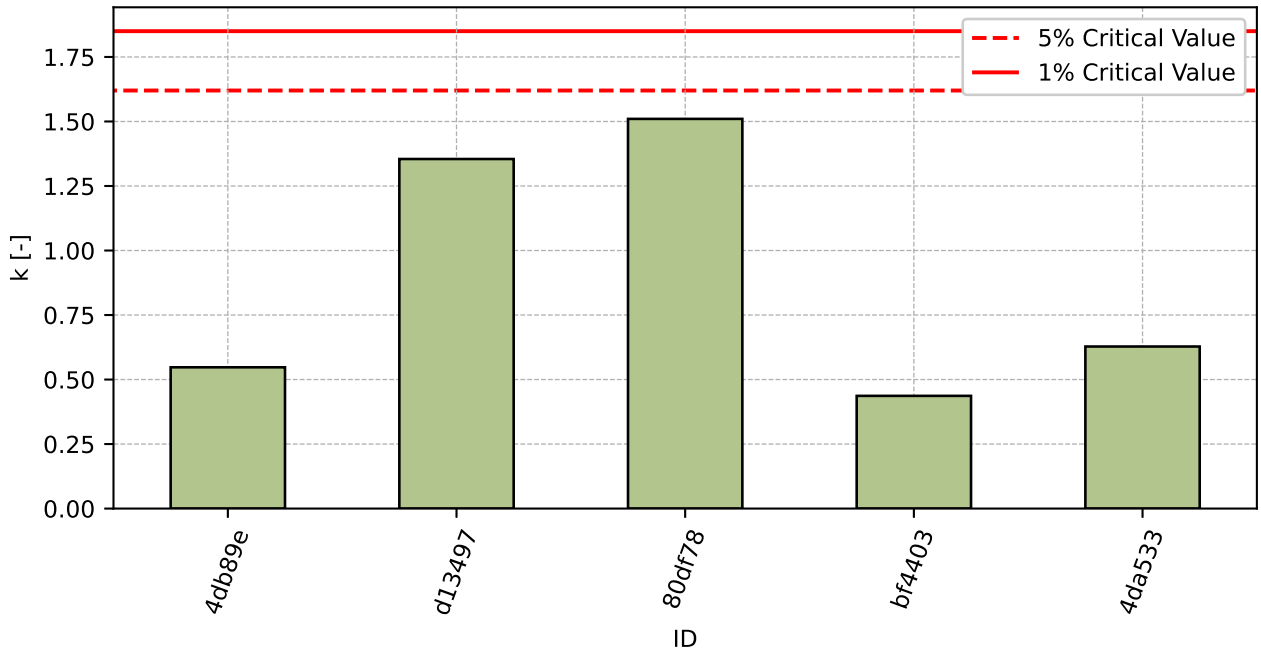

Figure 22: Intralaboratory Consistency Statistic

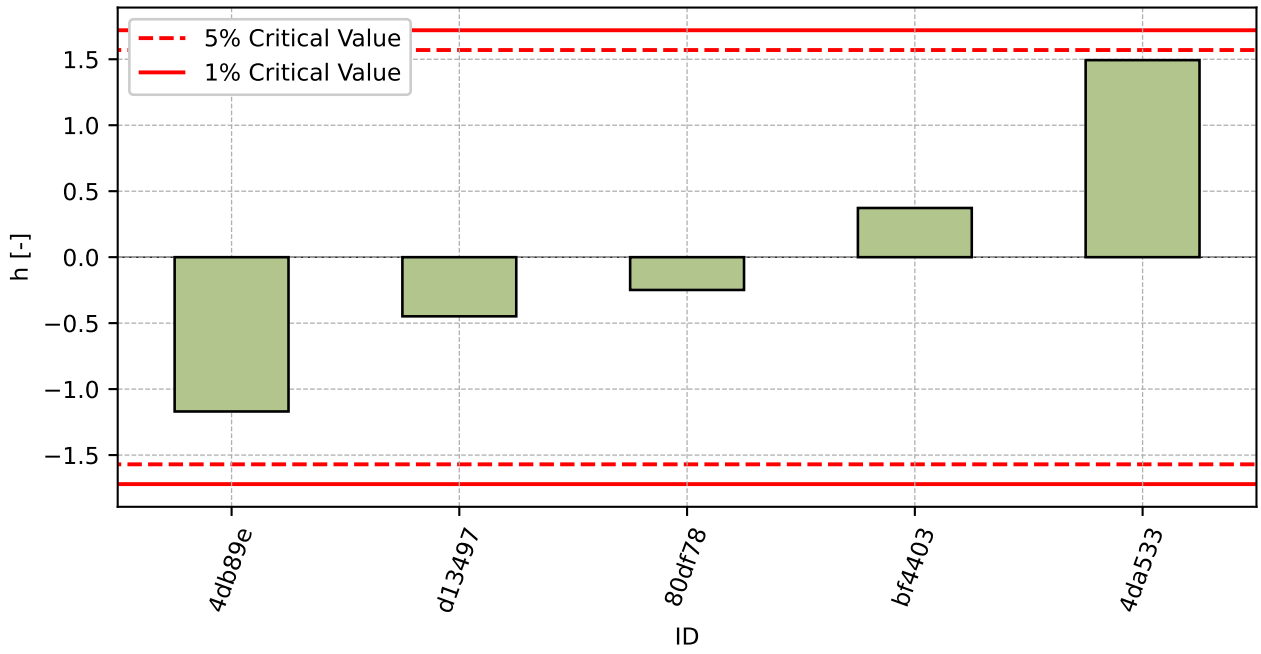

Figure 23: Interlaboratory Consistency Statistic

3.4 Descriptive statistics

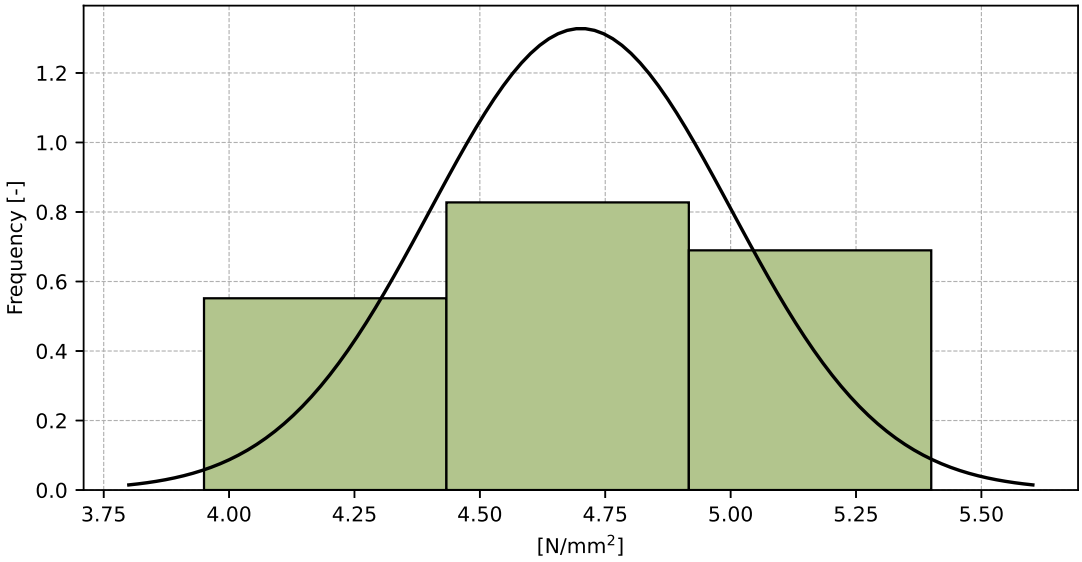

Figure 24: Histogram of all test results

Table 11: Descriptive statistics

Characteristics	[N/mm²]
Average value – $\bar{x}$	4.7
Sample standard deviation – s	0.3
Asigned value – x^*	4.7
Robust standard deviation – s^*	0.305
Measurement uncertainty of asigned value – u_X	0.17
p-value of normality test	0.942 [-]
Interlaboratory standard deviation – s_L	0.193
Repeatability standard deviation – s_r	0.398
Reproducibility standard deviation – s_R	0.443
Repeatability – r	1.11
Reproducibility – R	1.24

3.5 Evaluation of Performance Statistics

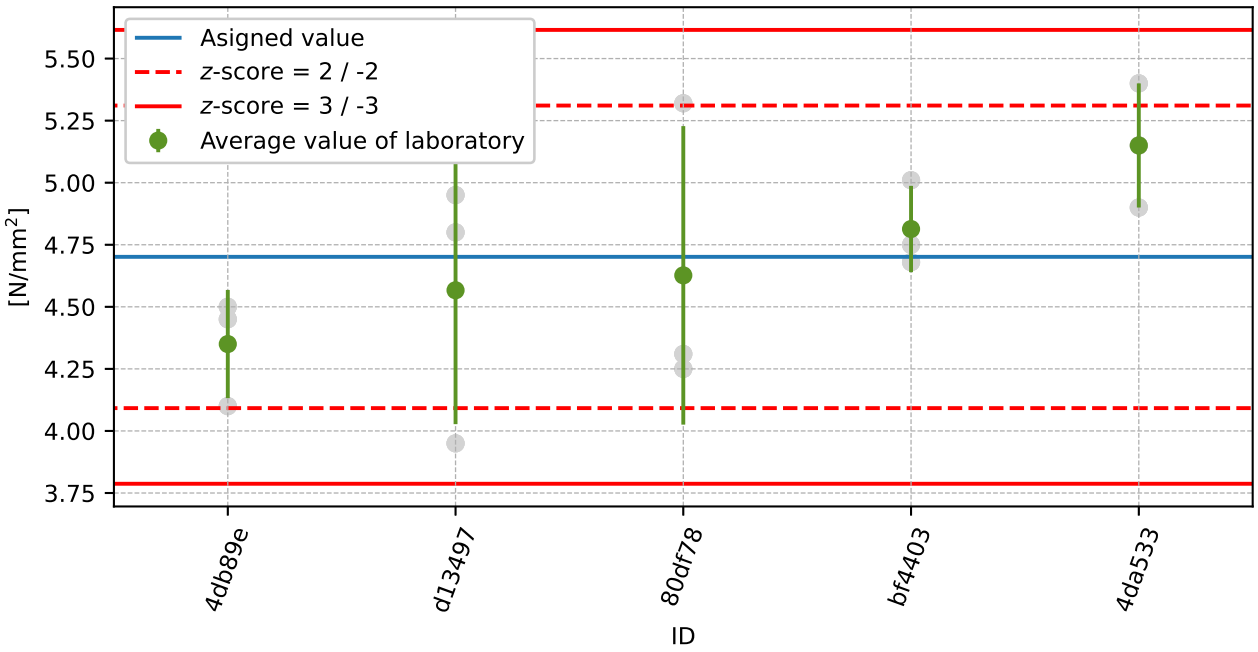

Figure 25: Average values and sample standard deviations

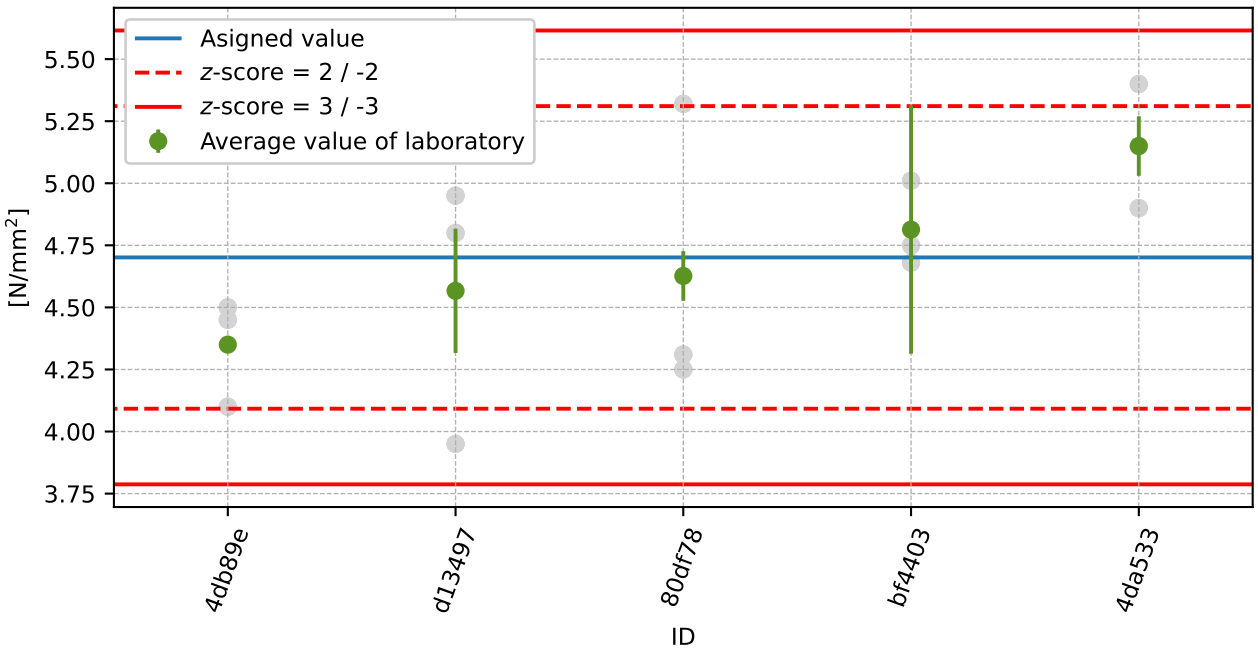

Figure 26: Average values and extended uncertainties of measurement

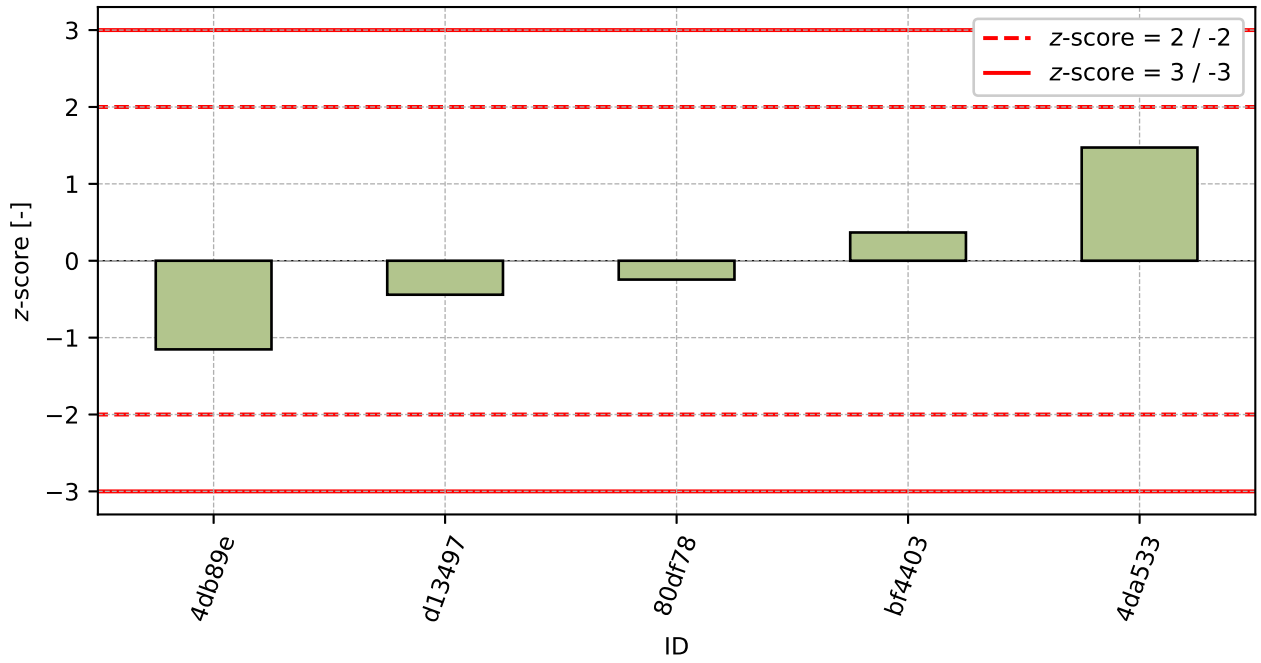

Figure 27: z-score

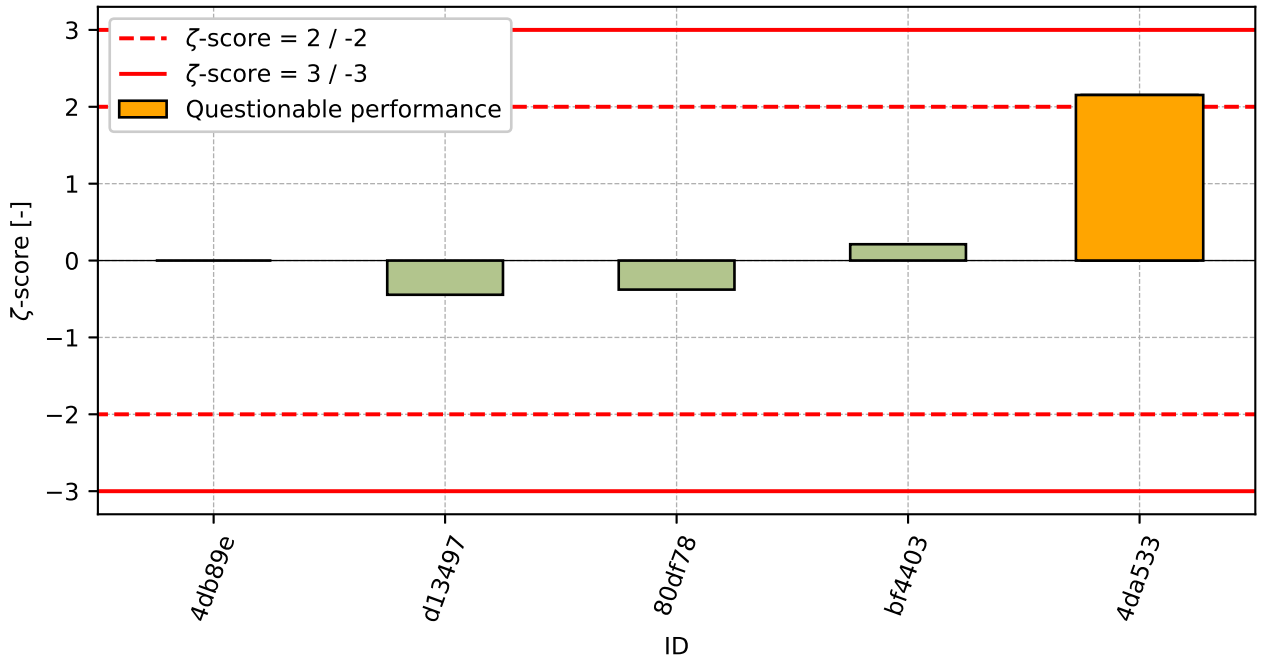

Figure 28: ζ-score

Table 12: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
4db89e	-1.15	-
d13497	-0.44	-0.45
80df78	-0.25	-0.38
bf4403	0.37	0.21
4da533	1.47	2.15

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

4.1 Test results

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

ID	Test results [kg/m³]			u_X [kg/m³]	$\bar{x}$ [kg/m³]	s_0 [kg/m³]	V_X [%]
21c4f1	2270	2270	2260	-	2267	5.8	0.25
bf4403	2270	2270	2270	50	2270	0.0	0.0
a3d721	2270	2270	2270	10	2270	0.0	0.0
851362	2280	2250	2290	30	2273	20.8	0.92
e25fb5	2260	2290	2270	24	2273	15.3	0.67
7e1549	2284	2294	2255	41	2278	20.3	0.89
44903d	2277	2278	2279	-	2278	1.0	0.04
bcf801	2280	2280	2280	10	2280	0.0	0.0
279326	2280	2280	2280	10	2280	0.0	0.0
d13497	2280	2270	2290	20	2280	10.0	0.44
283215	2280	2270	2300	20	2283	15.3	0.67
5f03a3	2290	2280	2280	-	2283	5.8	0.25
eeca6a	2276	2297	2286	26	2286	10.5	0.46
d50674	2280	2290	2290	10	2287	5.8	0.25
7ebfcd	2290	2280	2290	-	2287	5.8	0.25
25c8f0	2280	2290	2290	10	2287	5.8	0.25
b65916	2290	2280	2300	20	2290	10.0	0.44
c1830c	2280	2320	2290	-	2297	20.8	0.91
6df75f	2300	2300	2290	-	2297	5.8	0.25
9c1e49	2311	2302	2281	11	2298	15.4	0.67
76fac2	2300	2300	2300	-	2300	0.0	0.0
c45081	2300	2320	2300	10	2307	11.5	0.5
b01a51	2299	2317	2317	11	2311	10.4	0.45
b3cf46	2320	2310	2310	-	2313	5.8	0.25
785226	2367	2321	2284	5	2324	41.6	1.79

4.2 The Numerical Procedure for Determining Outliers

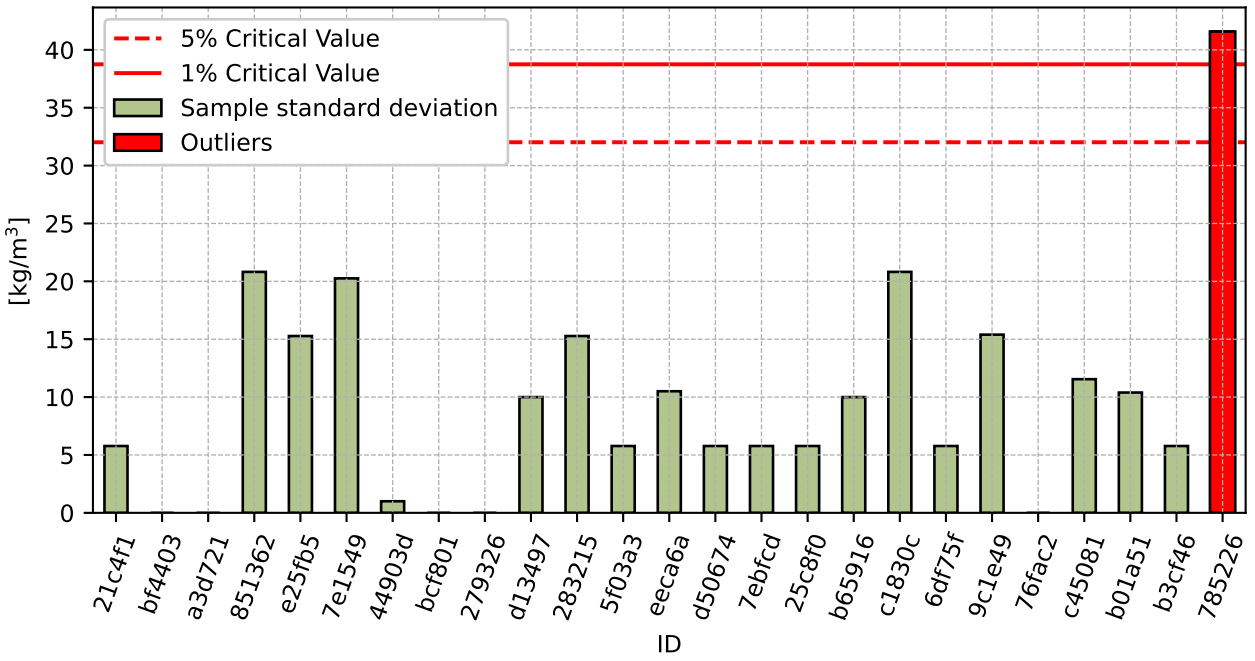

Figure 29: **Cochran's test** - sample standard deviations

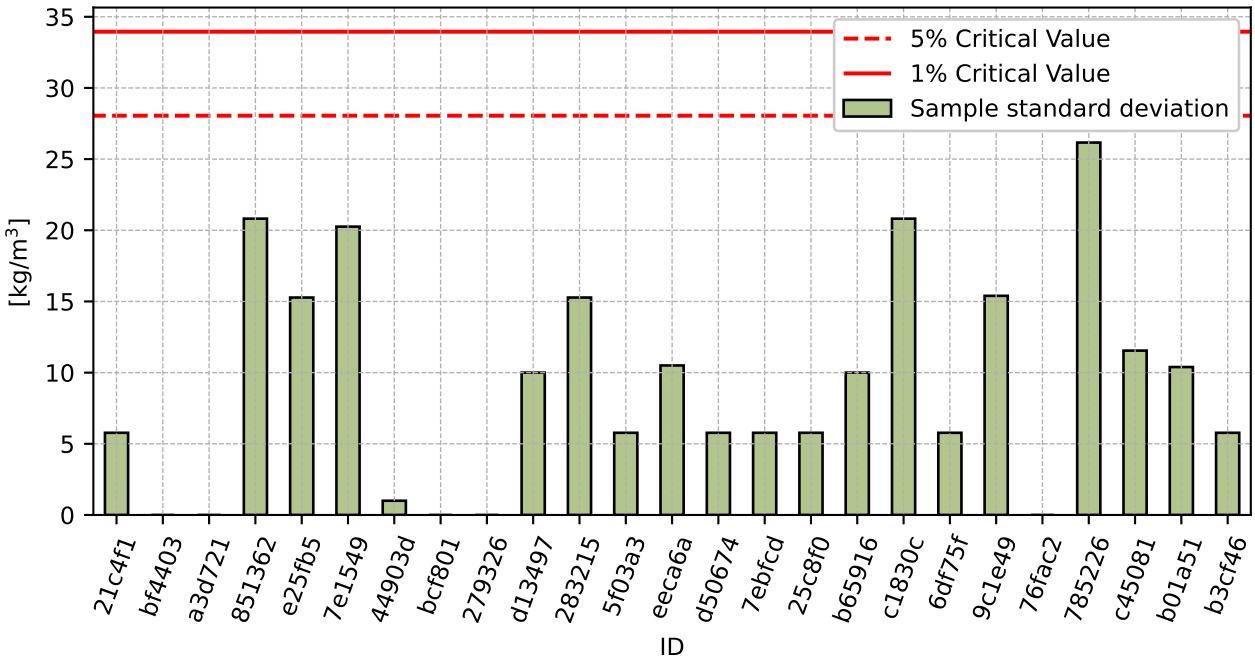

Figure 30: **Cochran's test** - sample standard deviations without outliers

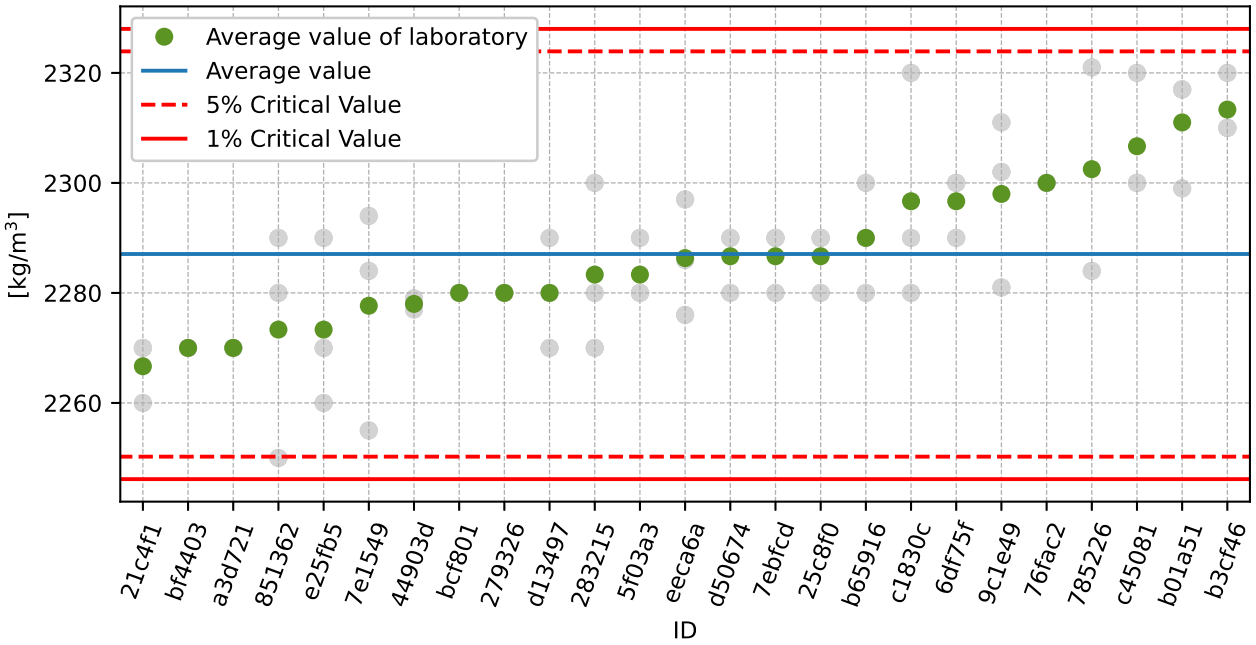

Figure 31: **Grubbs' test** - average values

4.3 Mandel's Statistics

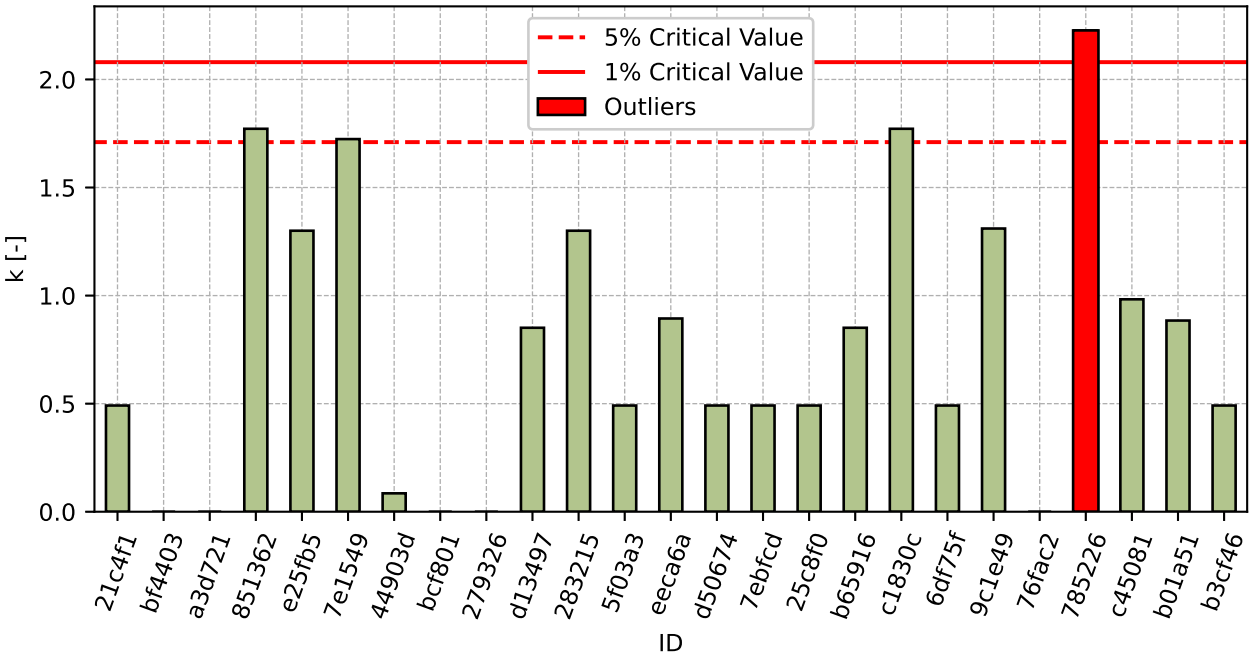

Figure 32: Intralaboratory Consistency Statistic

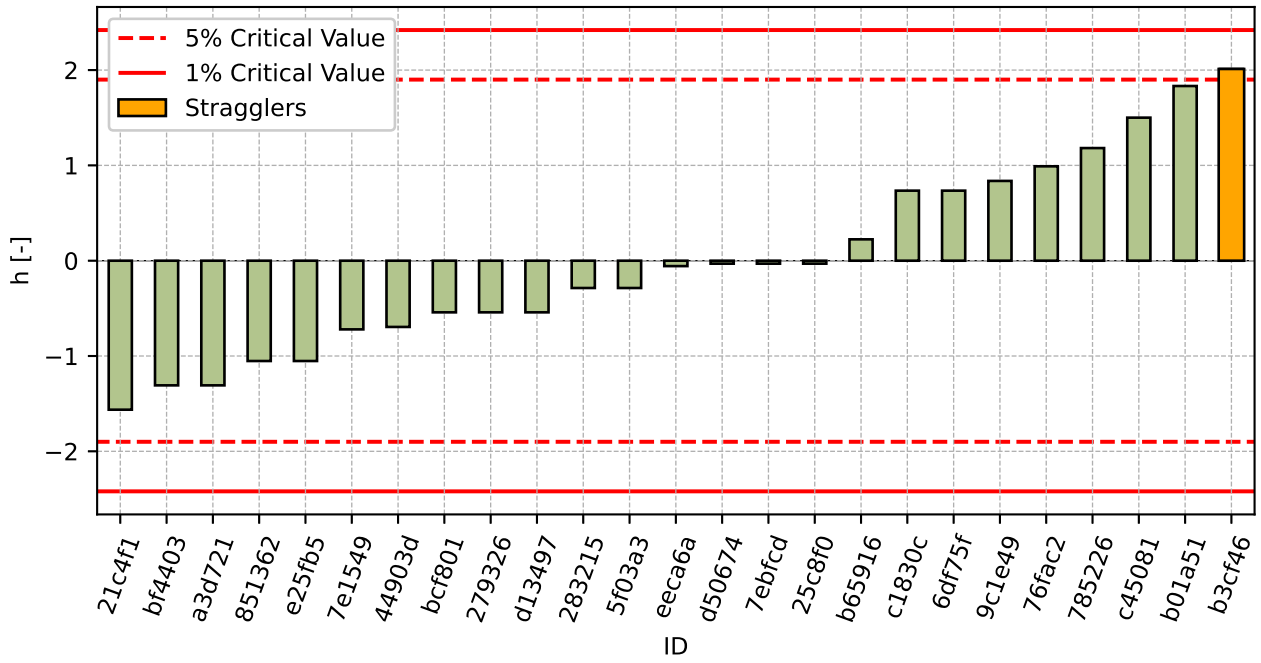

Figure 33: Interlaboratory Consistency Statistic

4.4 Descriptive statistics

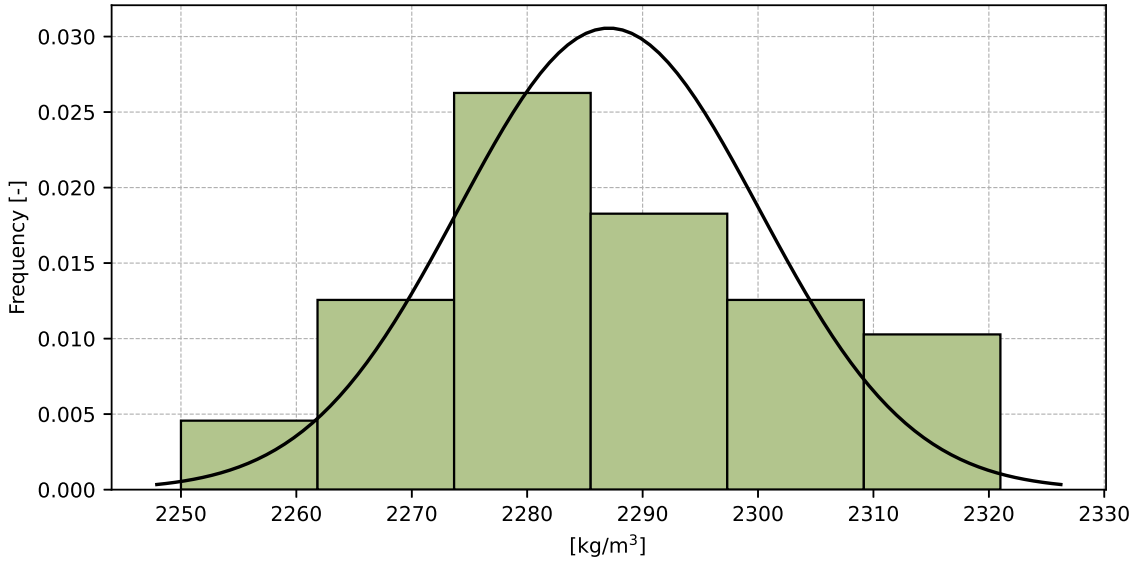

Figure 34: Histogram of all test results

Table 14: Descriptive statistics

Characteristics	[kg/m³]
Average value – $\bar{x}$	2287
Sample standard deviation – s	13.1
Asigned value – x^*	2287
Robust standard deviation – s^*	14.3
Measurement uncertainty of asigned value – u_X	3.6
p-value of normality test	1.0 [-]
Interlaboratory standard deviation – s_L	11.2
Repeatability standard deviation – s_r	11.7
Reproducibility standard deviation – s_R	16.2
Repeatability – r	33
Reproducibility – R	45

4.5 Evaluation of Performance Statistics

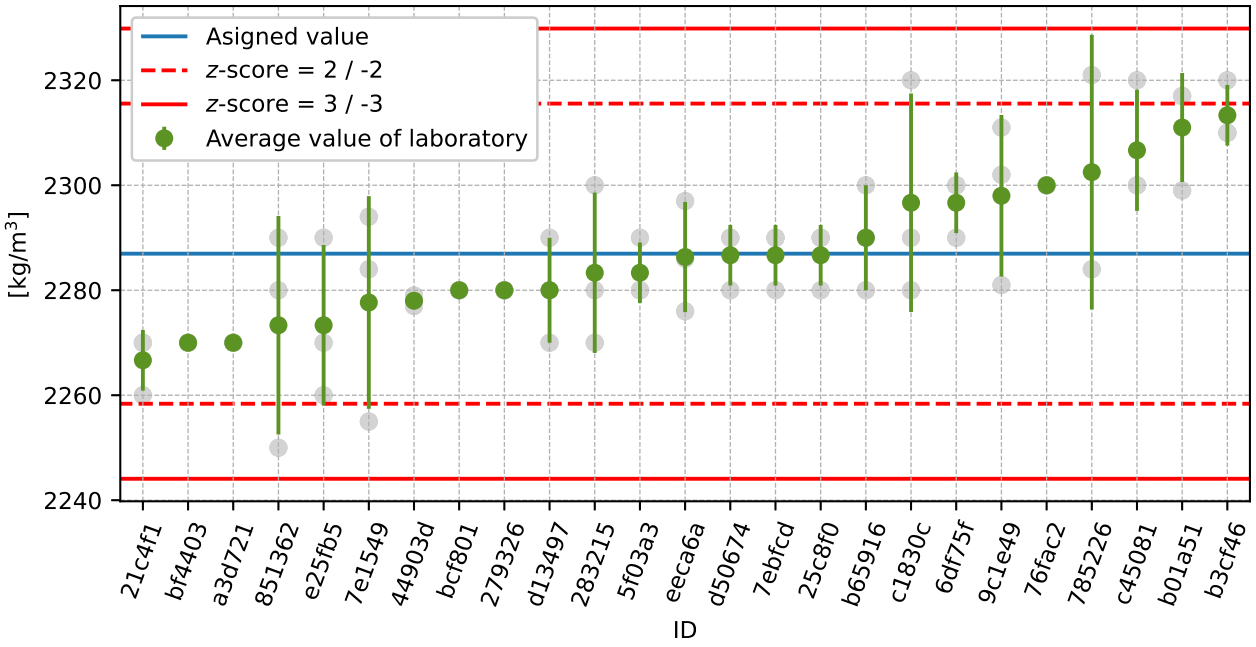

Figure 35: Average values and sample standard deviations

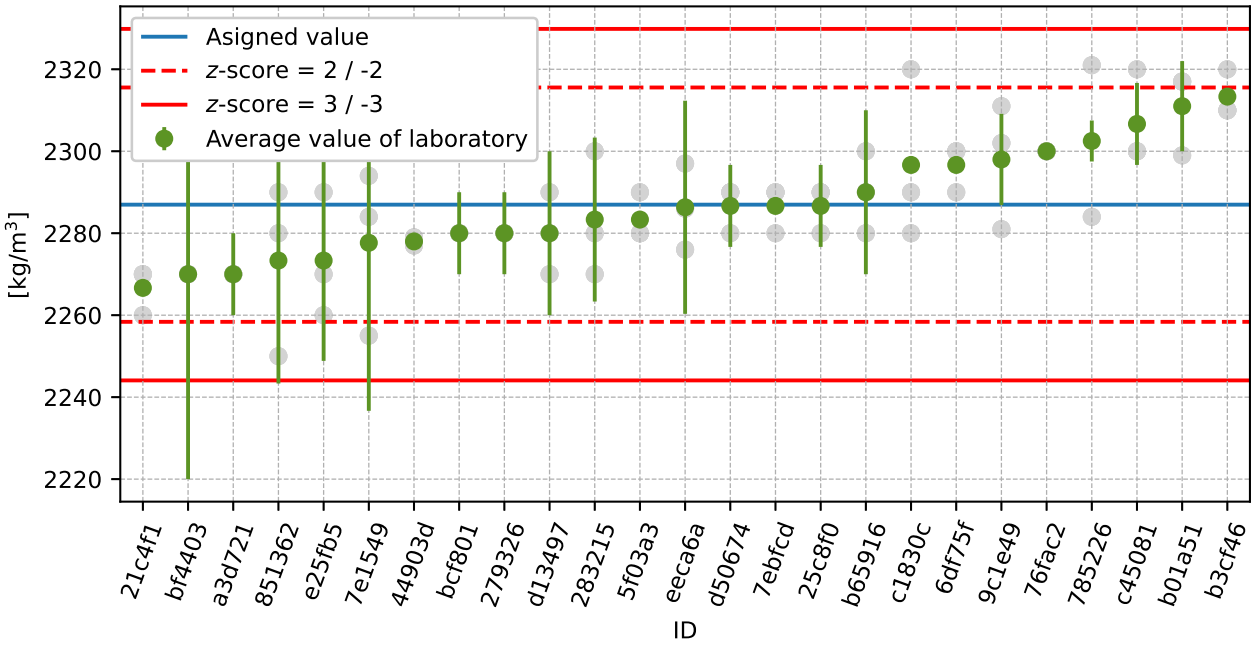

Figure 36: Average values and extended uncertainties of measurement

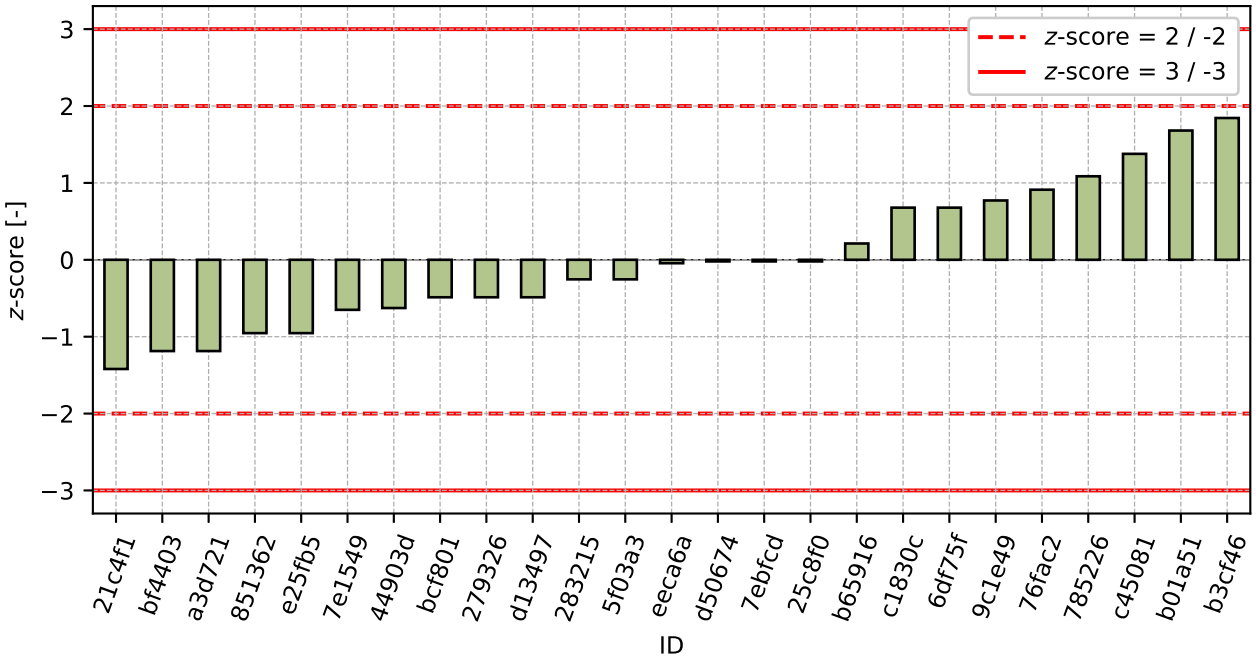

Figure 37: z-score

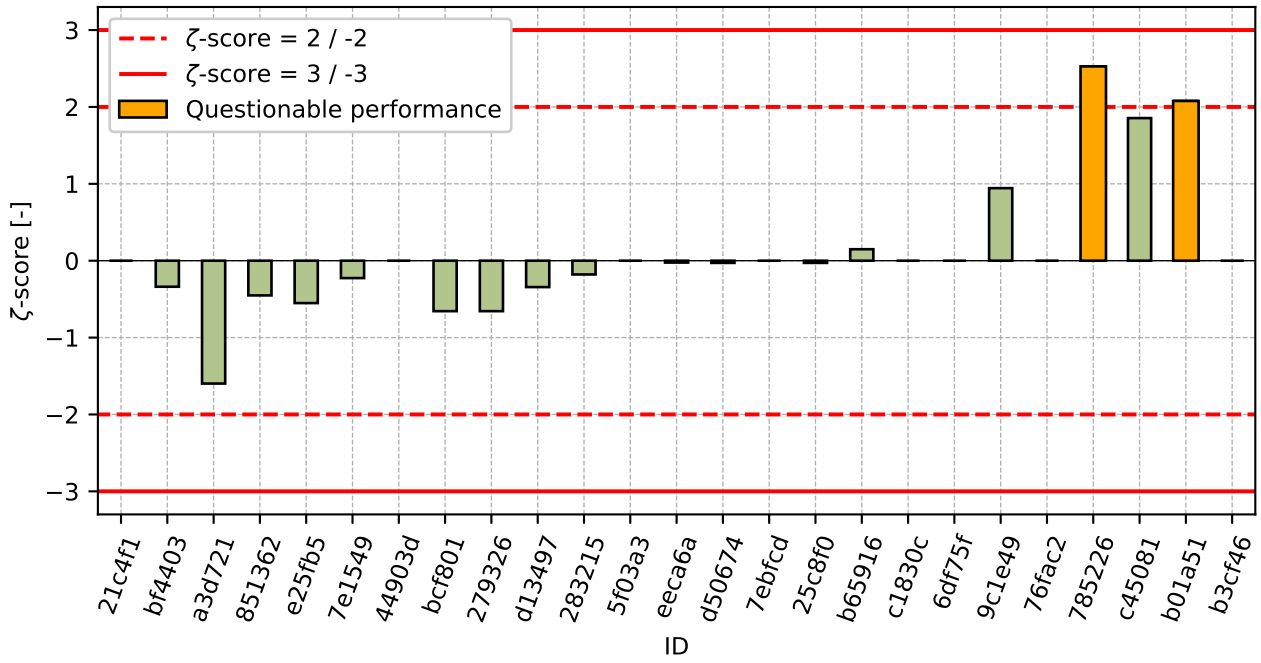

Figure 38: ζ-score

Table 15: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
21c4f1	-1.42	-
bf4403	-1.19	-0.34
a3d721	-1.19	-1.6
851362	-0.95	-0.45
e25fb5	-0.95	-0.55
7e1549	-0.65	-0.23
44903d	-0.63	-
bcf801	-0.49	-0.66
279326	-0.49	-0.66
d13497	-0.49	-0.34
283215	-0.25	-0.18
5f03a3	-0.25	-
eeca6a	-0.04	-0.02
d50674	-0.02	-0.03
7ebfcd	-0.02	-
25c8f0	-0.02	-0.03
b65916	0.21	0.15
c1830c	0.68	-
6df75f	0.68	-
9c1e49	0.77	0.94
76fac2	0.91	-
785226	1.09	2.53

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ID	z-score [-]	ζ-score [-]
c45081	1.38	1.85
b01a51	1.68	2.08
b3cf46	1.84	-

5 Appendix – ISO 1920-10 – Determination of static modulus of elasticity in compression

5.1 Test results

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

ID	Test results [N/mm²]		u_X [N/mm²]	$\bar{x}$ [N/mm²]	s_0 [N/mm²]	V_X [%]
bf4403	38800	38400	100	38600	282.8	0.73
4082c6	38500	38800	900	38650	212.1	0.55
7ebfcd	38900	38600	-	38750	212.1	0.55
96511d	38700	39200	2500	38950	353.6	0.91
2051d4	41900	38000	-	39950	2757.7	6.9
8fc614	39600	40300	1100	39950	495.0	1.24
a9dfd6	39500	41100	750	40300	1131.4	2.81
6d92be	40225	40487	2220	40356	185.3	0.46
6df75f	42300	41800	-	42050	353.6	0.84

5.2 The Numerical Procedure for Determining Outliers

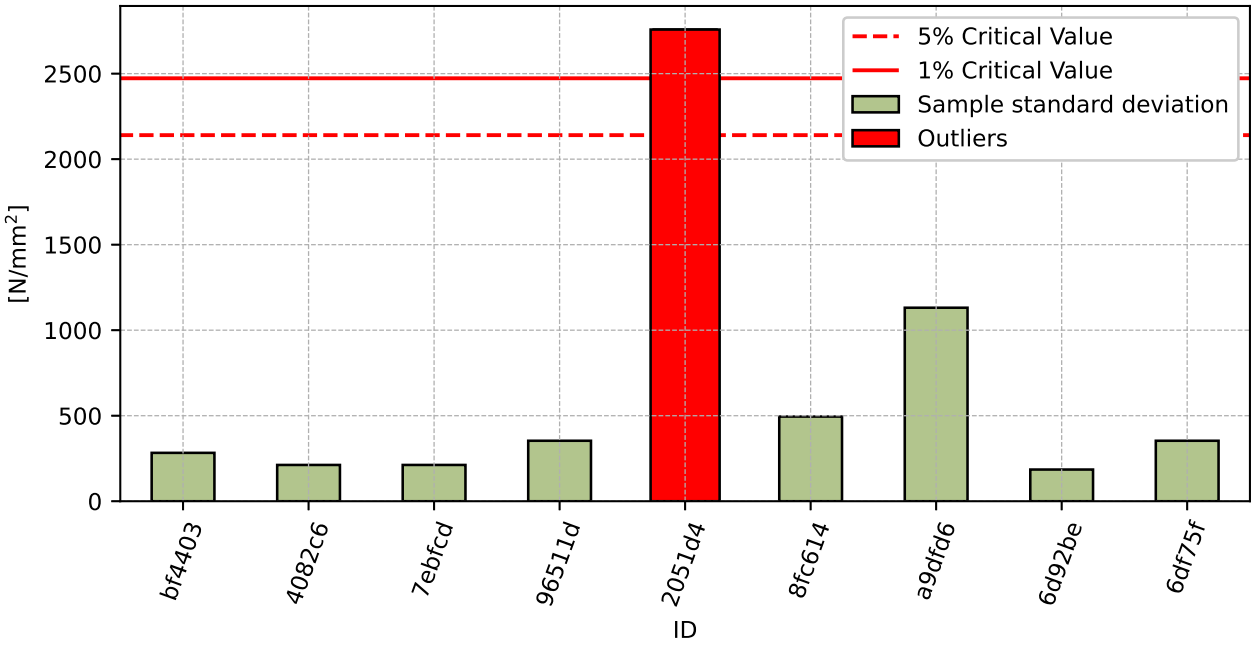

Figure 39: **Cochran's test** - sample standard deviations

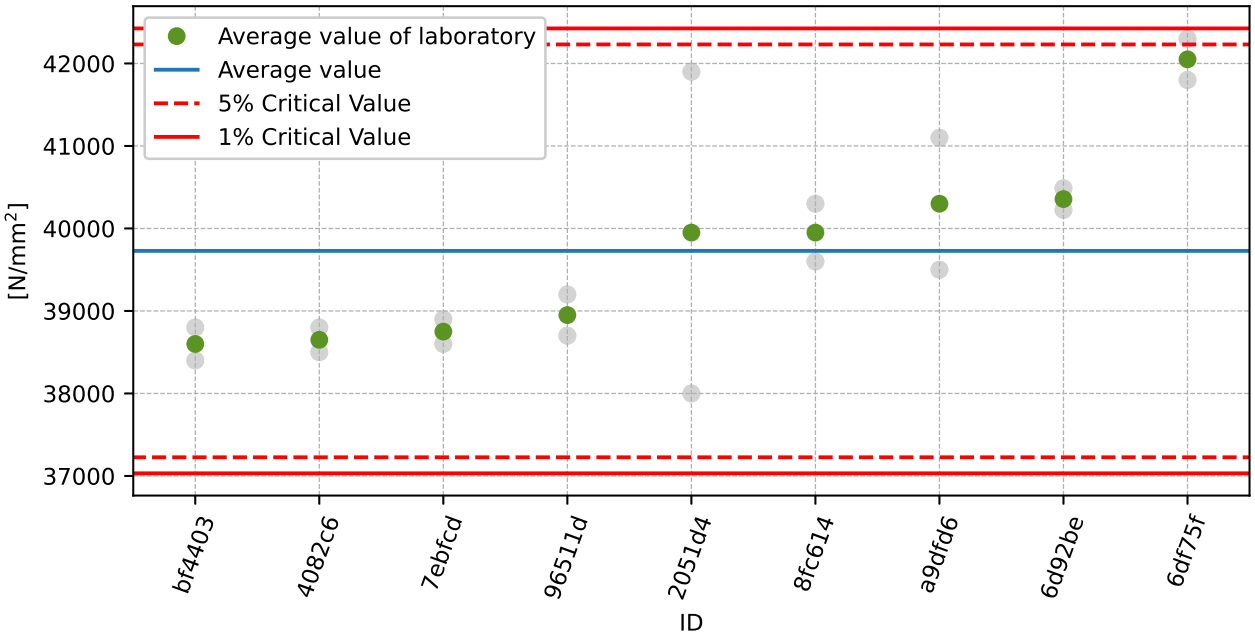

Figure 40: **Grubbs' test** - average values

5.3 Mandel's Statistics

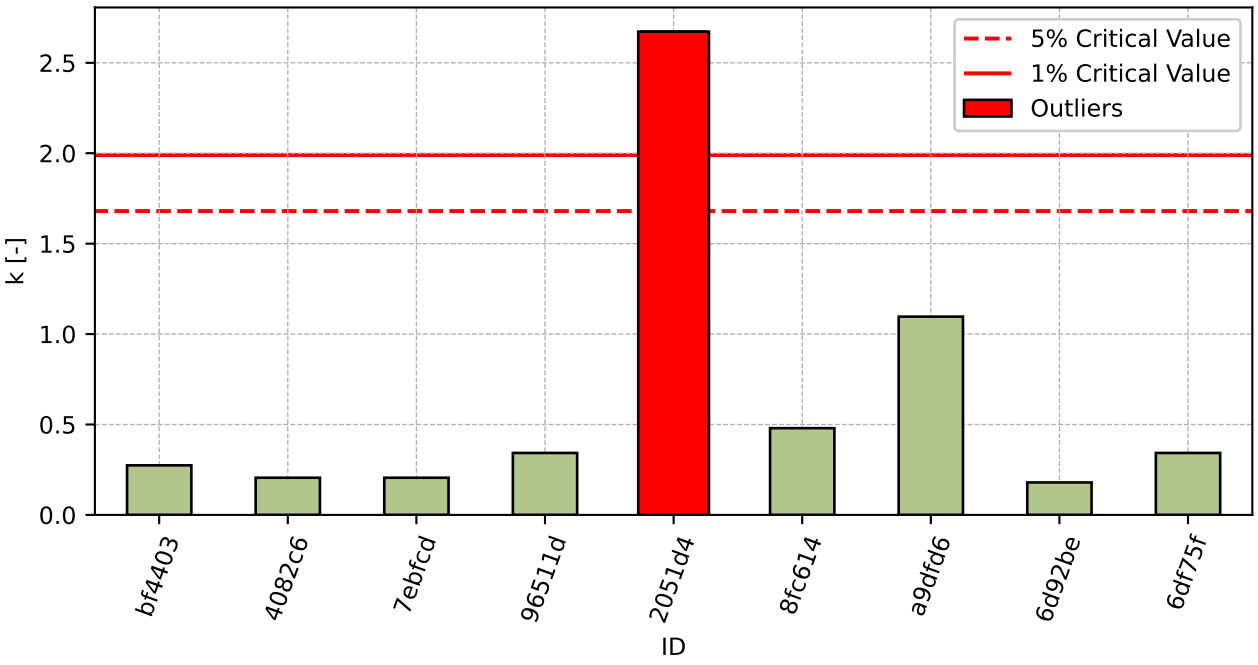

Figure 41: Intralaboratory Consistency Statistic

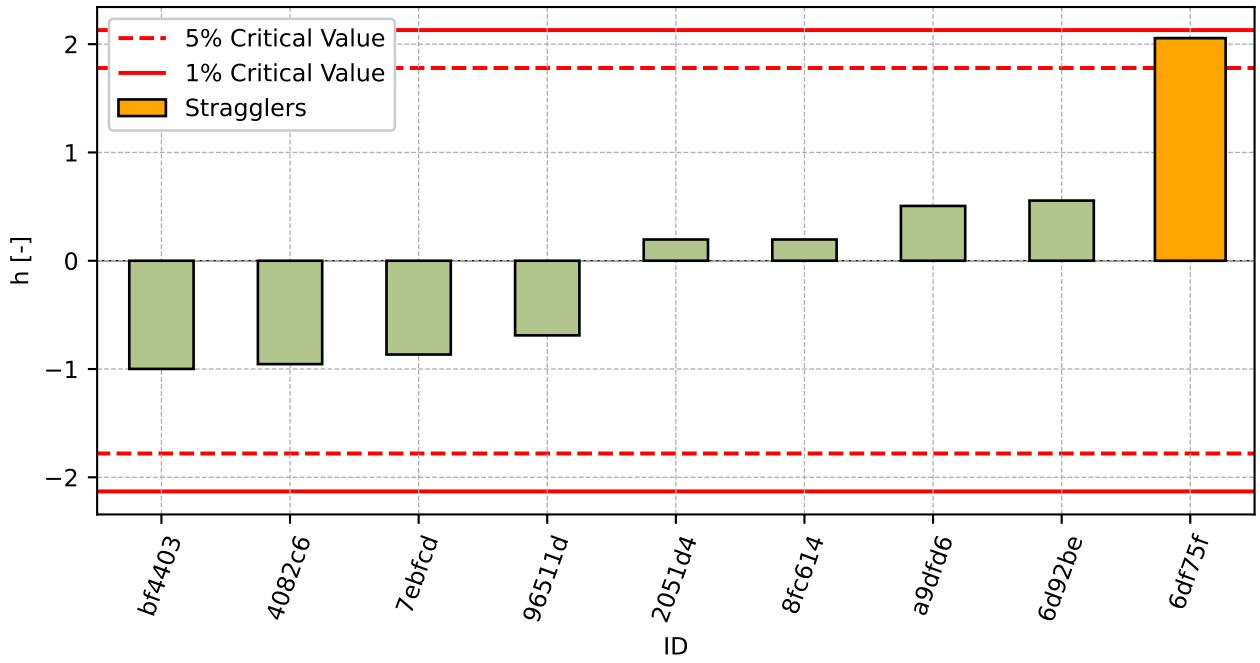

Figure 42: Interlaboratory Consistency Statistic

5.4 Descriptive statistics

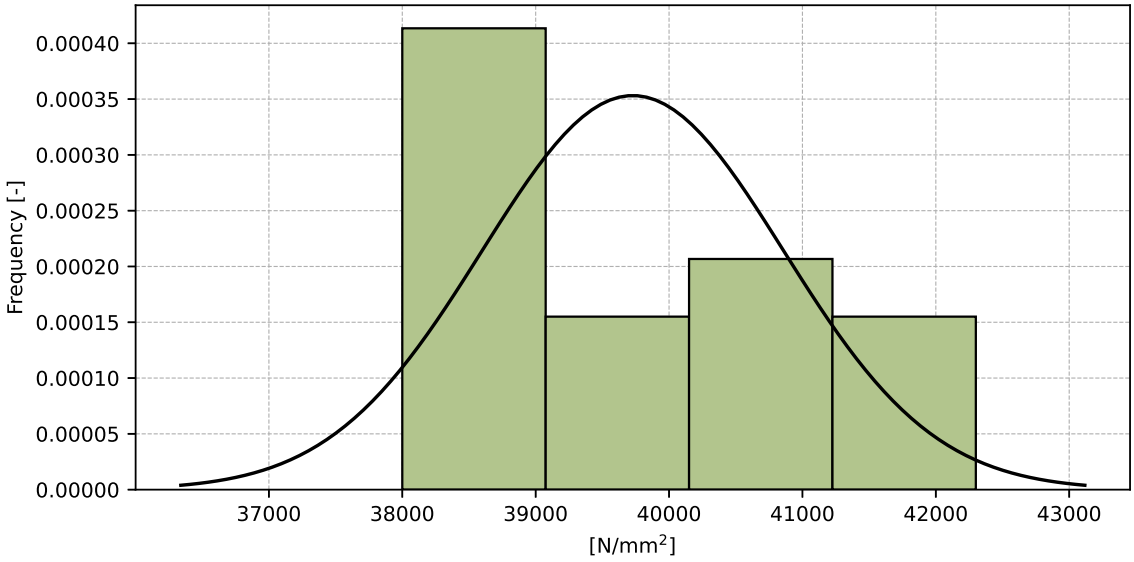

Figure 43: Histogram of all test results

Table 17: Descriptive statistics

Characteristics	[N/mm^2]
Average value – $\bar{x}$	39728
Sample standard deviation – s	1129.6
Asigned value – x^*	39728
Robust standard deviation – s^*	1207.7
Measurement uncertainty of asigned value – u_X	503.2
p-value of normality test	0.07 [-]
Interlaboratory standard deviation – s_L	862.3
Repeatability standard deviation – s_r	1032.0
Reproducibility standard deviation – s_R	1344.8
Repeatability – r	2889
Reproducibility – R	3765

5.5 Evaluation of Performance Statistics

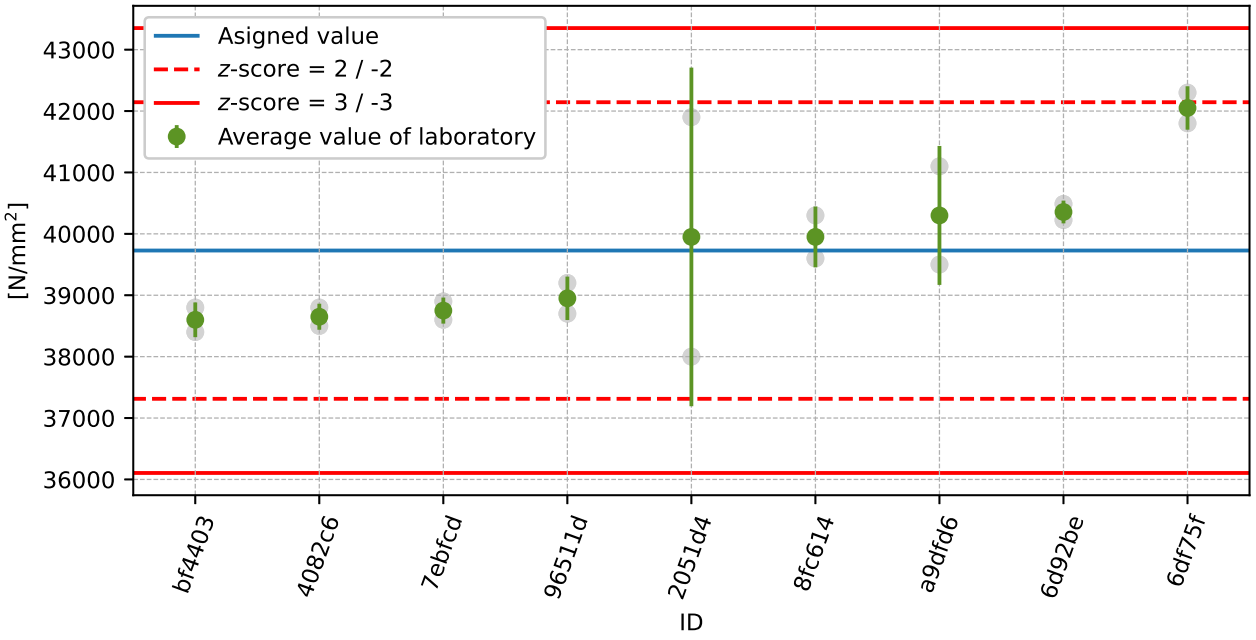

Figure 44: Average values and sample standard deviations

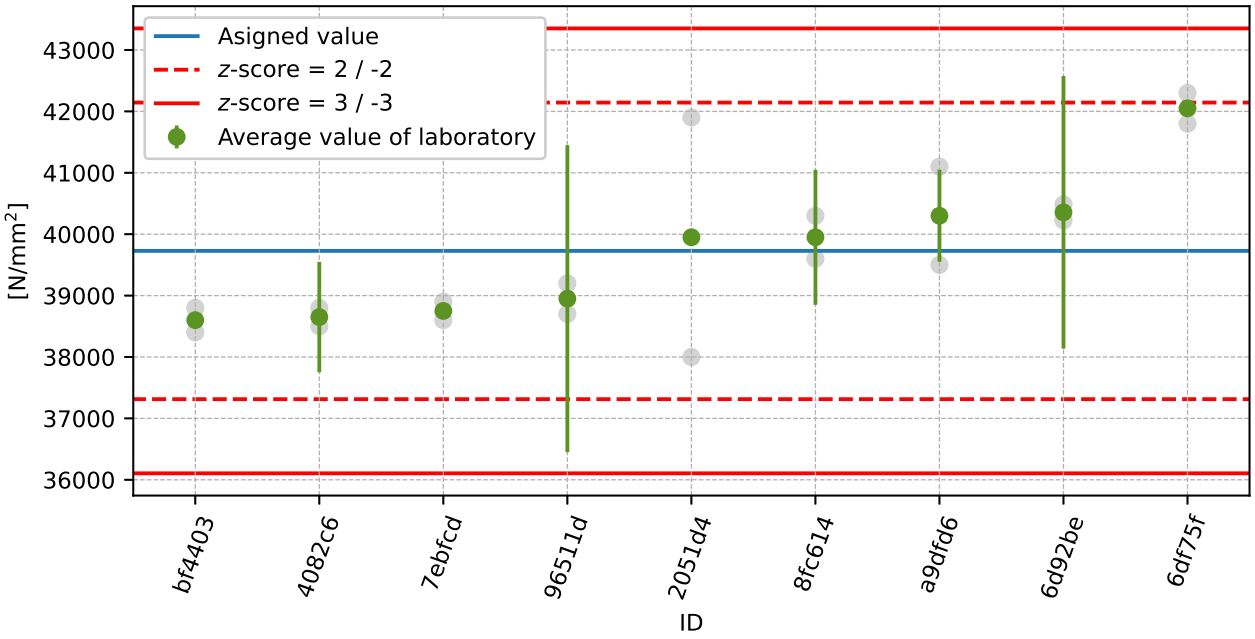

Figure 45: Average values and extended uncertainties of measurement

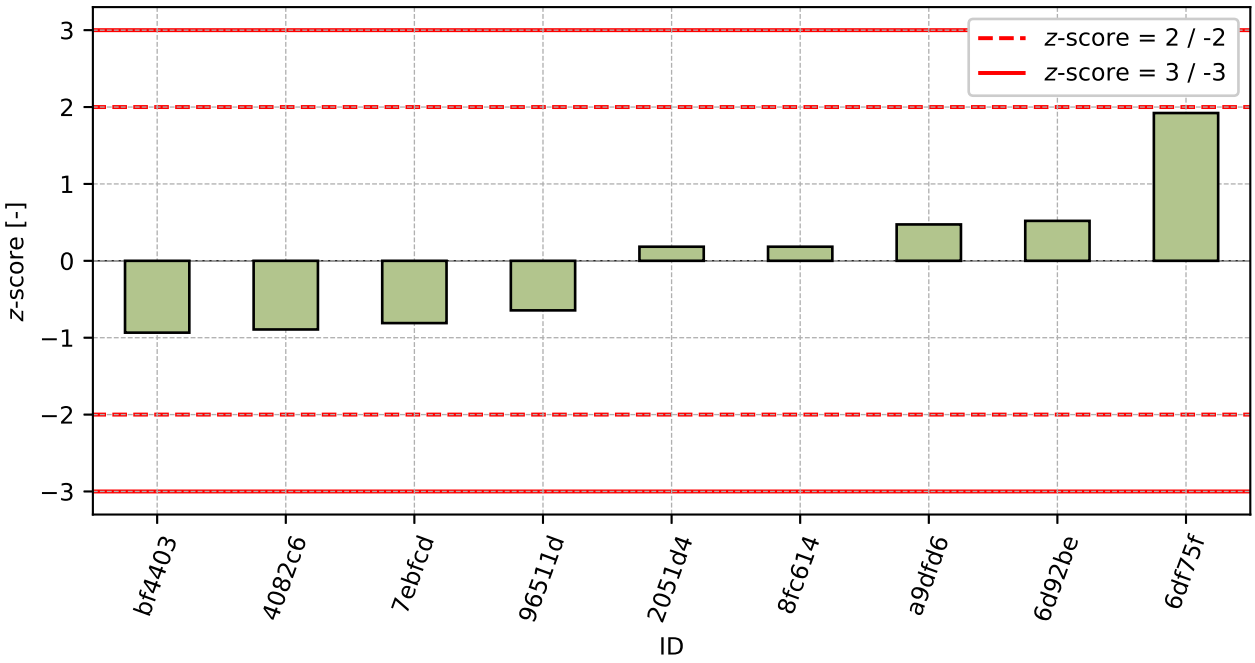

Figure 46: z-score

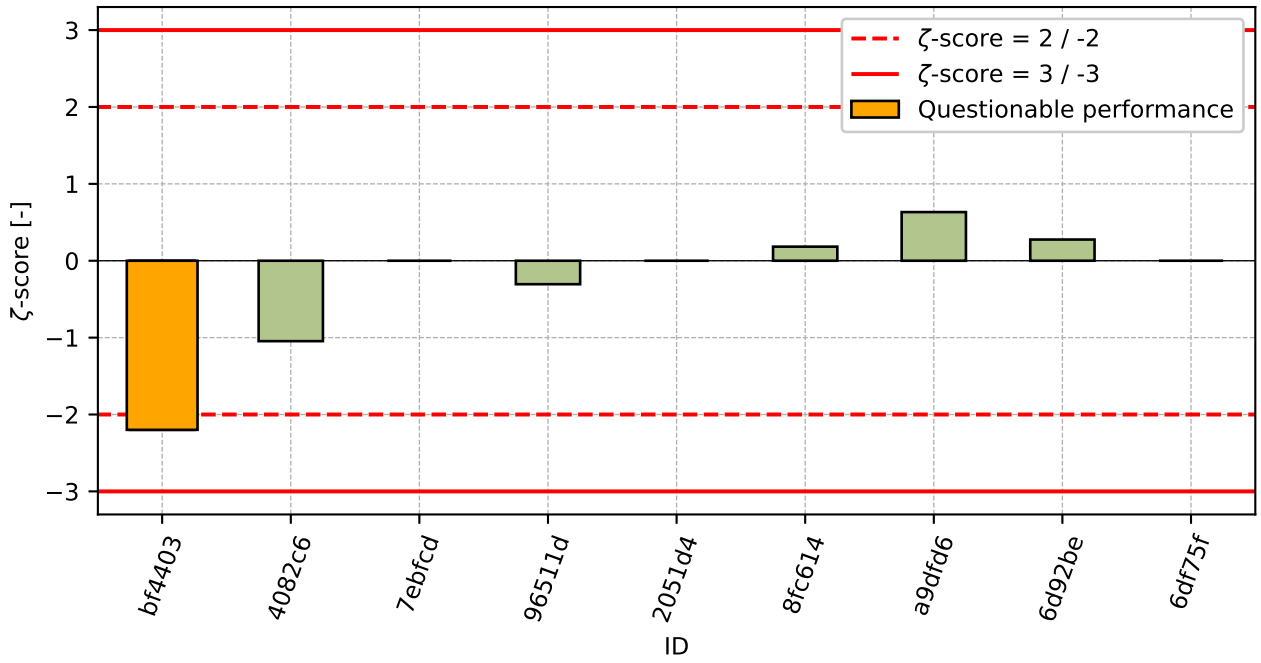

Figure 47: ζ-score

Table 18: *z*-score and ζ-score

ID	*z*-score [-]	ζ-score [-]
bf4403	-0.93	-2.2
4082c6	-0.89	-1.05
7ebfcd	-0.81	-
96511d	-0.64	-0.31
2051d4	0.18	-
8fc614	0.18	0.18
a9dfd6	0.47	0.63
6d92be	0.52	0.28
6df75f	1.92	-

6 Appendix – EN 12390-13, method A – Determination of secant modulus of elasticity in compression

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

7 Appendix – EN 12390-13, method B – Determination of secant modulus of elasticity in compression

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

8 Appendix – EN 12504-4, ČSN 731371 – Non-destructive testing of concrete

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 [km/s]			u_X [km/s]	$\bar{x}$ [km/s]	s_0 [km/s]	V_X [%]
7cadff	4.324	4.284	4.305	0.023	4.304	0.02	0.46
c45081	4.37	4.4	4.39	0.01	4.387	0.0153	0.35
9a414c	4.59	4.55	4.53	0.029	4.557	0.0306	0.67
9c1e49	4.598	4.603	4.577	0.052	4.593	0.0138	0.3
4da533	4.71	4.71	4.7	0.024	4.707	0.0058	0.12
bf4403	4.825	4.933	4.944	-	4.901	0.0658	1.34

8.2 The Numerical Procedure for Determining Outliers

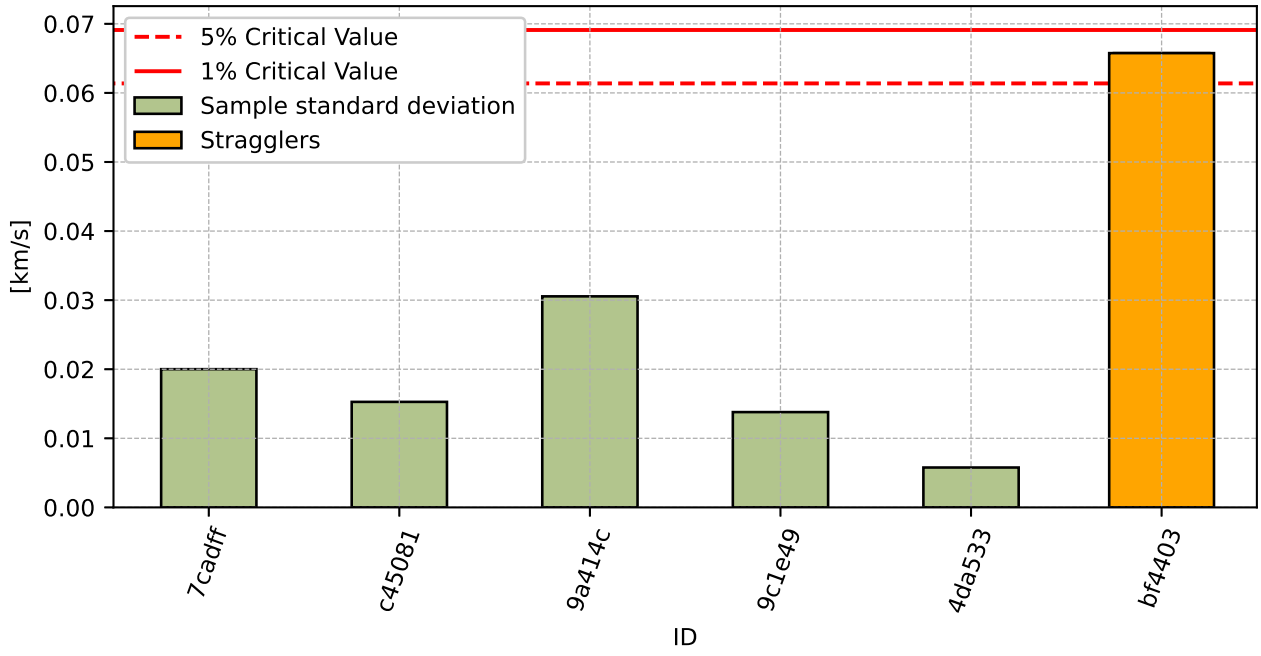

Figure 48: **Cochran's test** - sample standard deviations

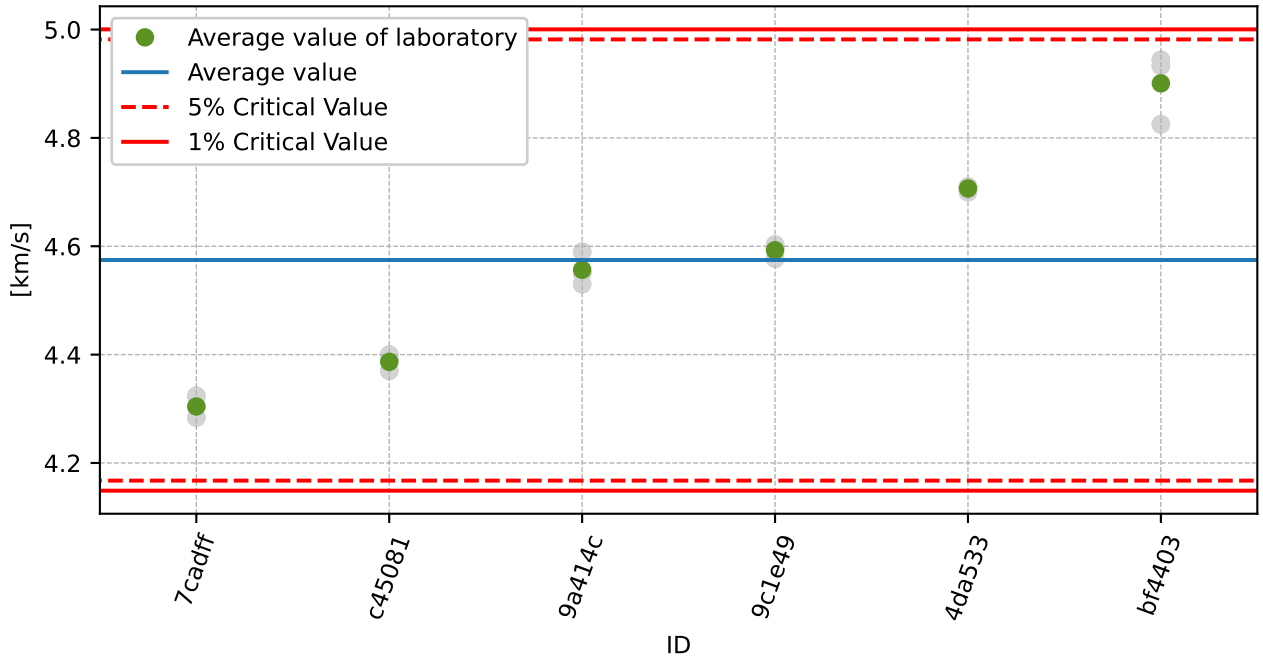

Figure 49: **Grubbs' test** - average values

8.3 Mandel's Statistics

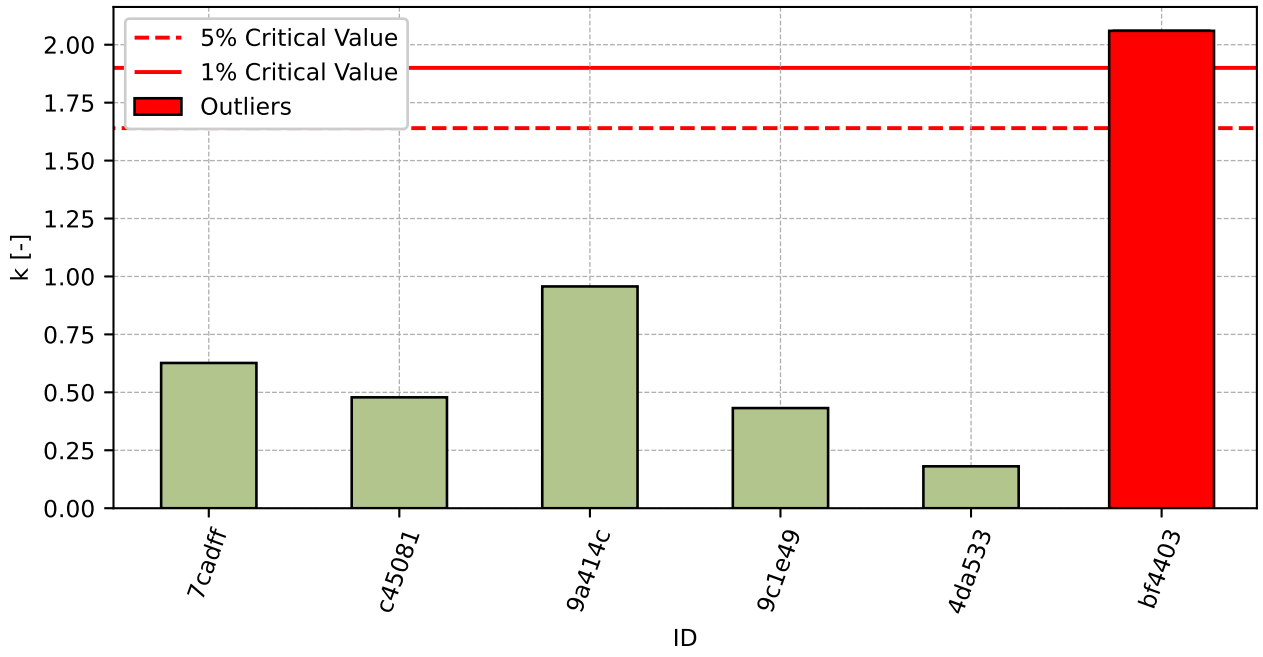

Figure 50: Intralaboratory Consistency Statistic

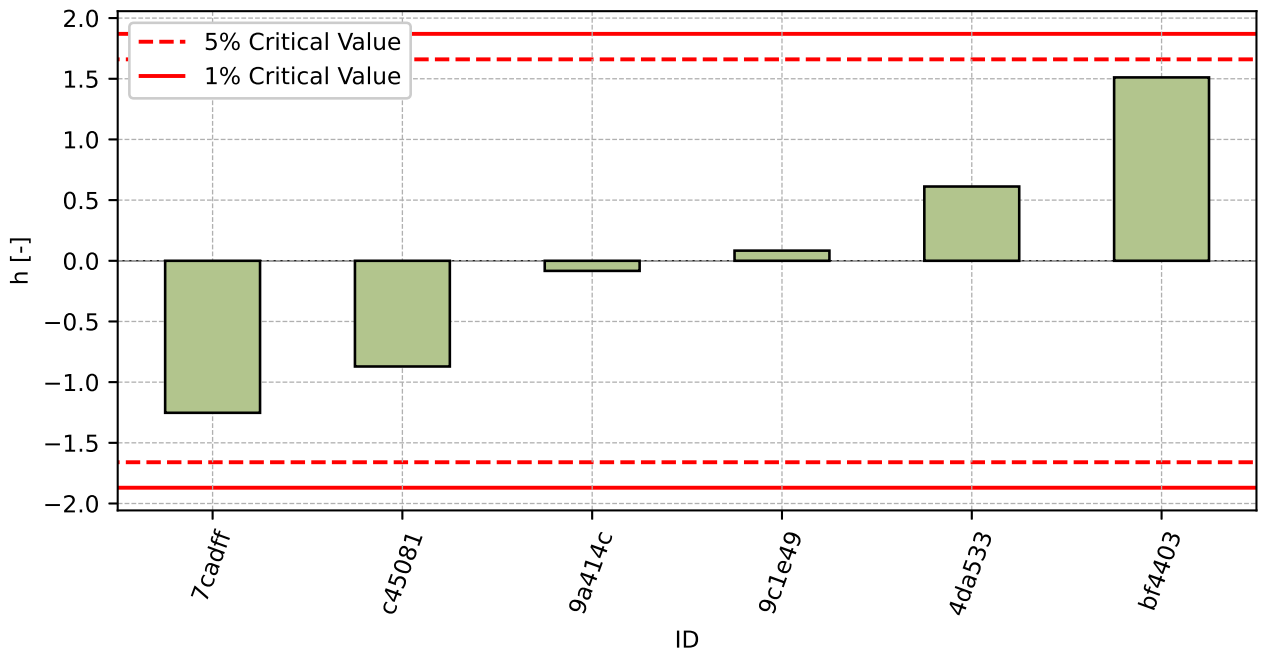

Figure 51: Interlaboratory Consistency Statistic

8.4 Descriptive statistics

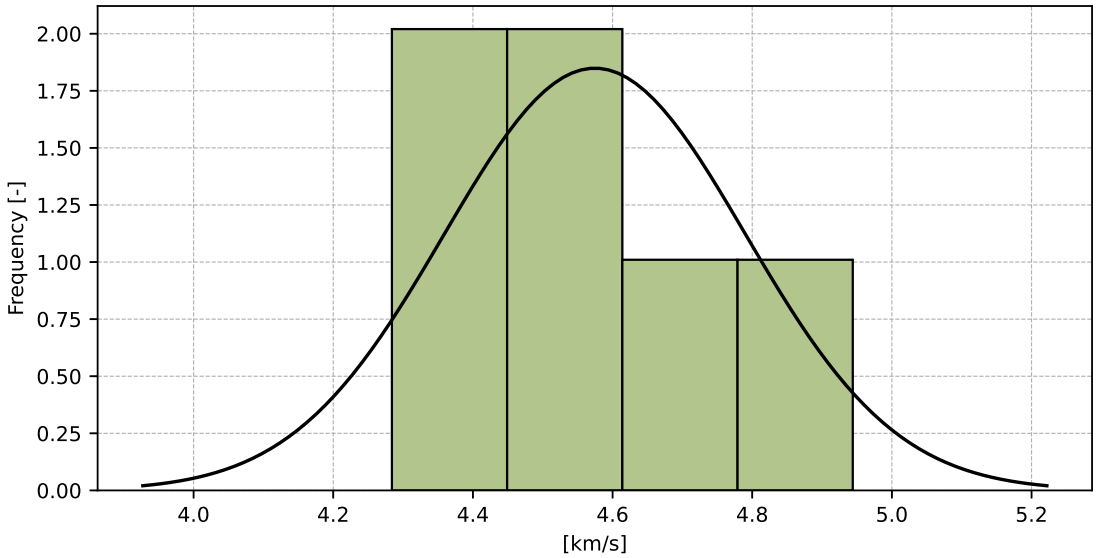

Figure 52: Histogram of all test results

Table 20: Descriptive statistics

Characteristics	[km/s]
Average value – $\bar{x}$	4.575
Sample standard deviation – s	0.2158
Asigned value – x^*	4.575
Robust standard deviation – s^*	0.2234
Measurement uncertainty of asigned value – u_X	0.114
p-value of normality test	0.337 [-]
Interlaboratory standard deviation – s_L	0.215
Repeatability standard deviation – s_r	0.0319
Reproducibility standard deviation – s_R	0.2173
Repeatability – r	0.089
Reproducibility – R	0.609

8.5 Evaluation of Performance Statistics

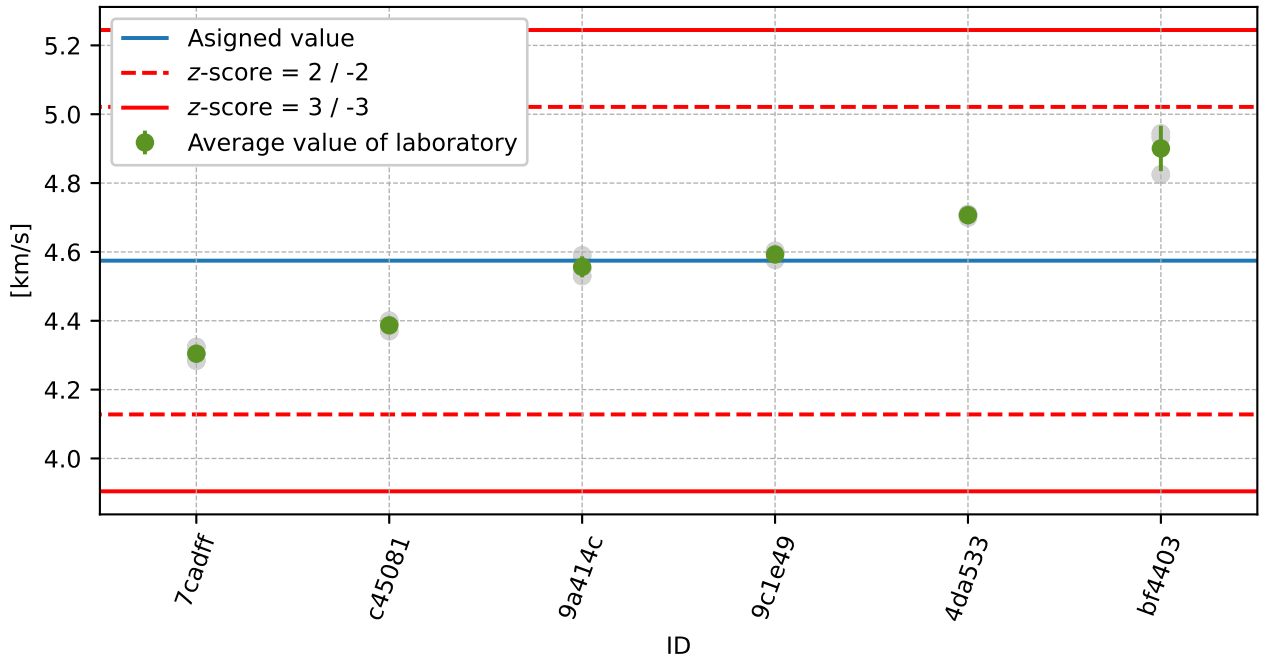

Figure 53: Average values and sample standard deviations

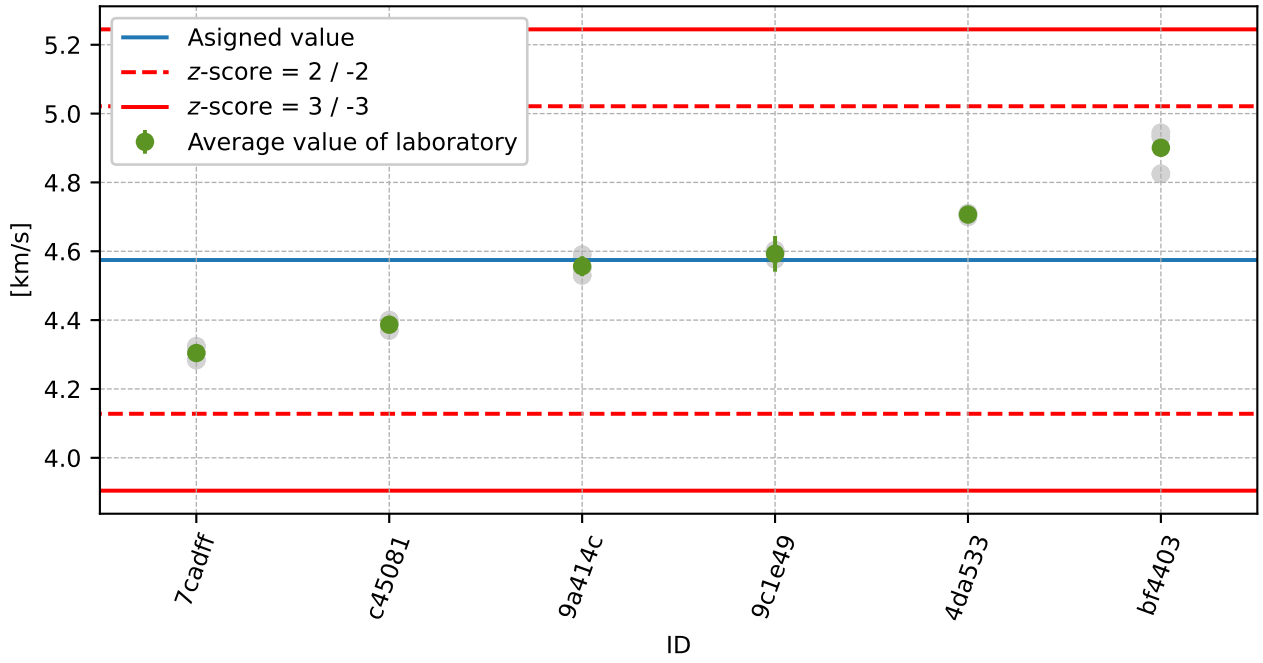

Figure 54: Average values and extended uncertainties of measurement

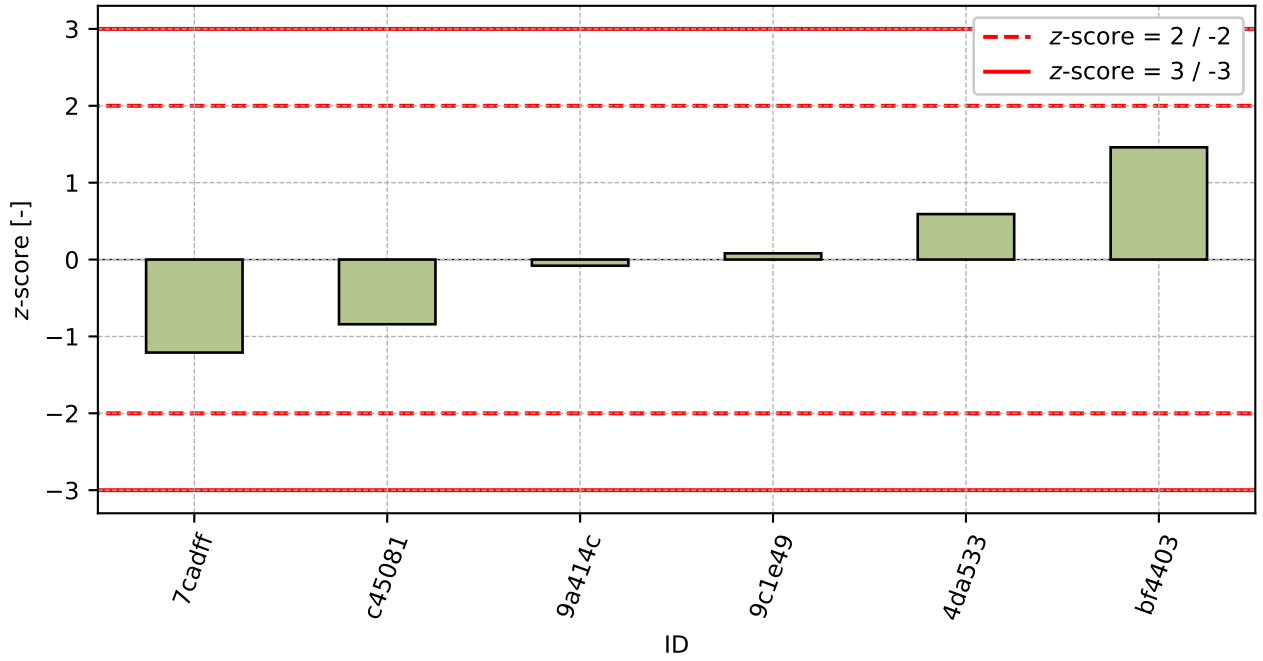

Figure 55: z-score

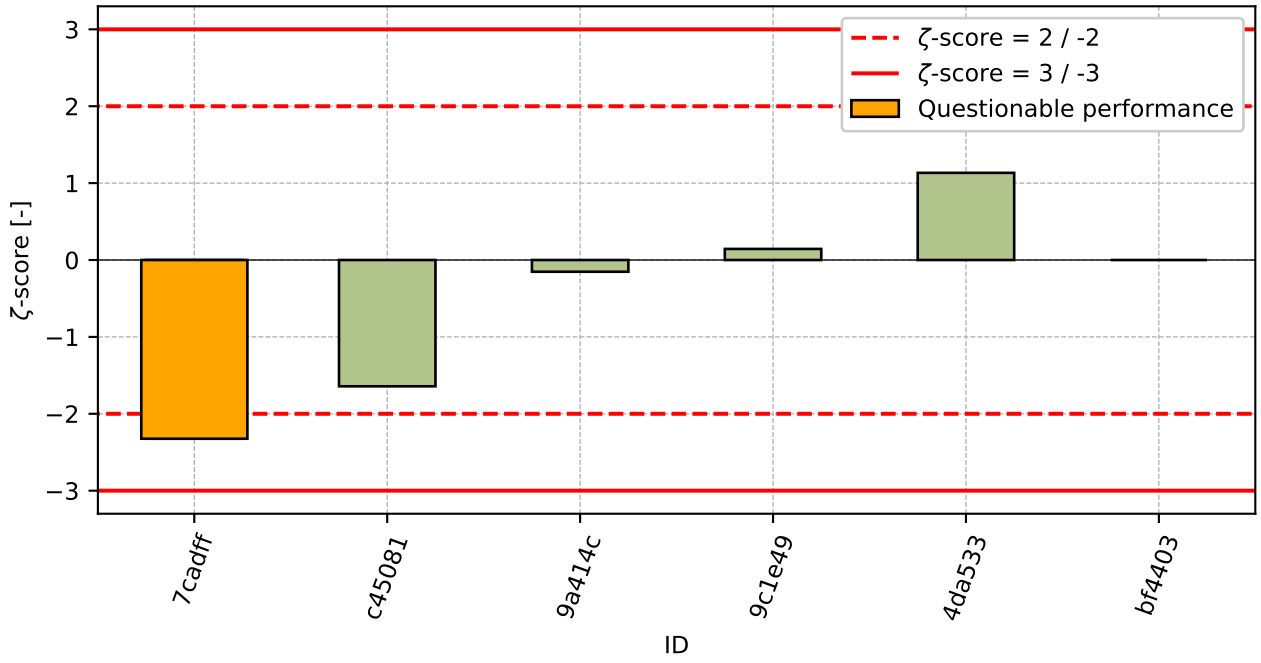

Figure 56: ζ-score

Table 21: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
7cadff	-1.21	-2.32
c45081	-0.84	-1.64
9a414c	-0.08	-0.15
9c1e49	0.08	0.14
4da533	0.59	1.13
bf4403	1.46	-

9 Appendix – ČSN 731373, EN 12504-2 – Determination of rebound number

9.1 Test results

Table 22: 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 [%]
21c4f1	31	31	27	-	30	2.3	7.78
6df75f	35	37	37	-	36	1.2	3.18
32f753	37	38	38	2	37	0.4	1.08
5f03a3	38	37	38	-	38	0.6	1.53
7ebfcd	37	37	39	-	38	1.2	3.07
4da533	36	40	40	3	39	2.3	5.97
4db89e	40	39	41	-	40	1.0	2.5
d13497	40	40	40	3	40	0.0	0.0
9c1e49	40	40	40	6	40	0.3	0.72
2051d4	45	46	45	-	45	0.6	1.27
eeca6a	50	46	45	7	47	3.0	6.33
35710b	49	47	48	2	48	0.8	1.69

9.2 The Numerical Procedure for Determining Outliers

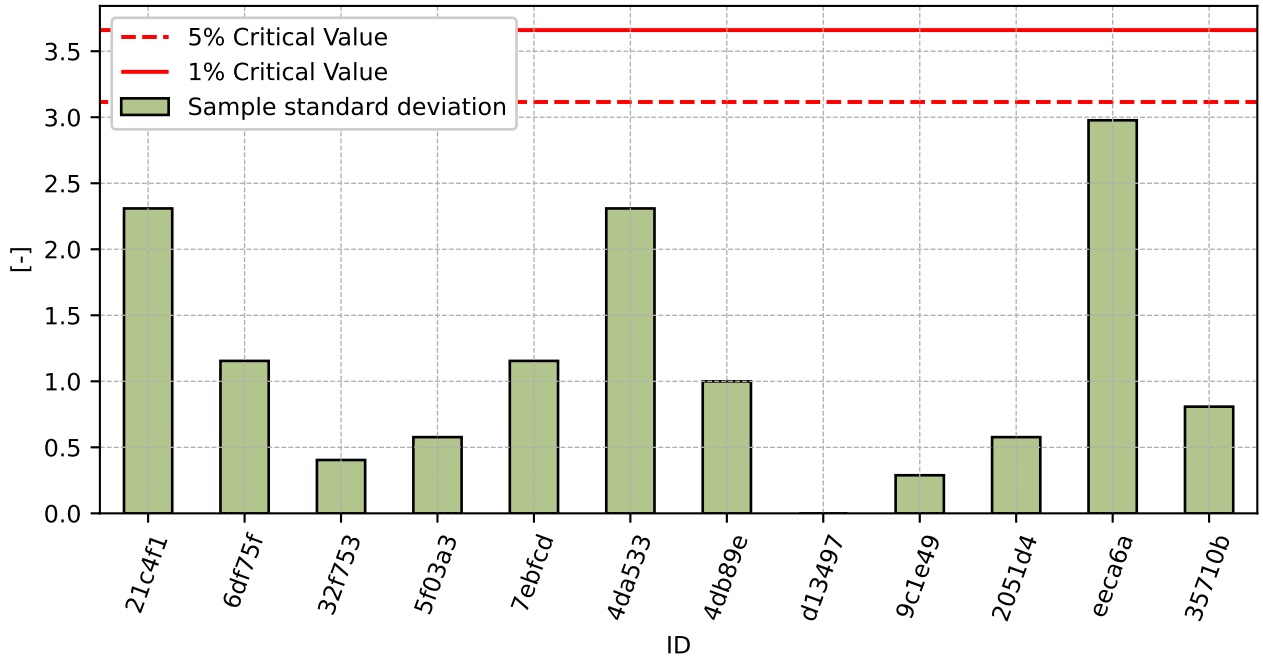

Figure 57: **Cochran's test** - sample standard deviations

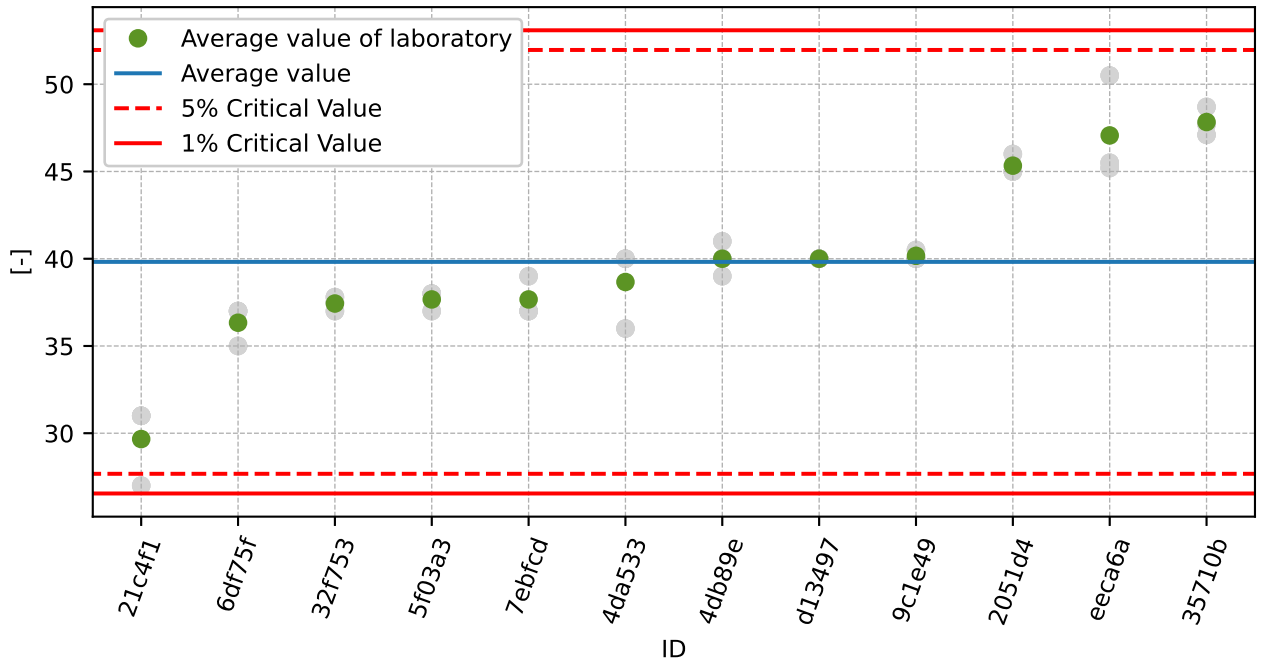

Figure 58: **Grubbs' test** - average values

9.3 Mandel's Statistics

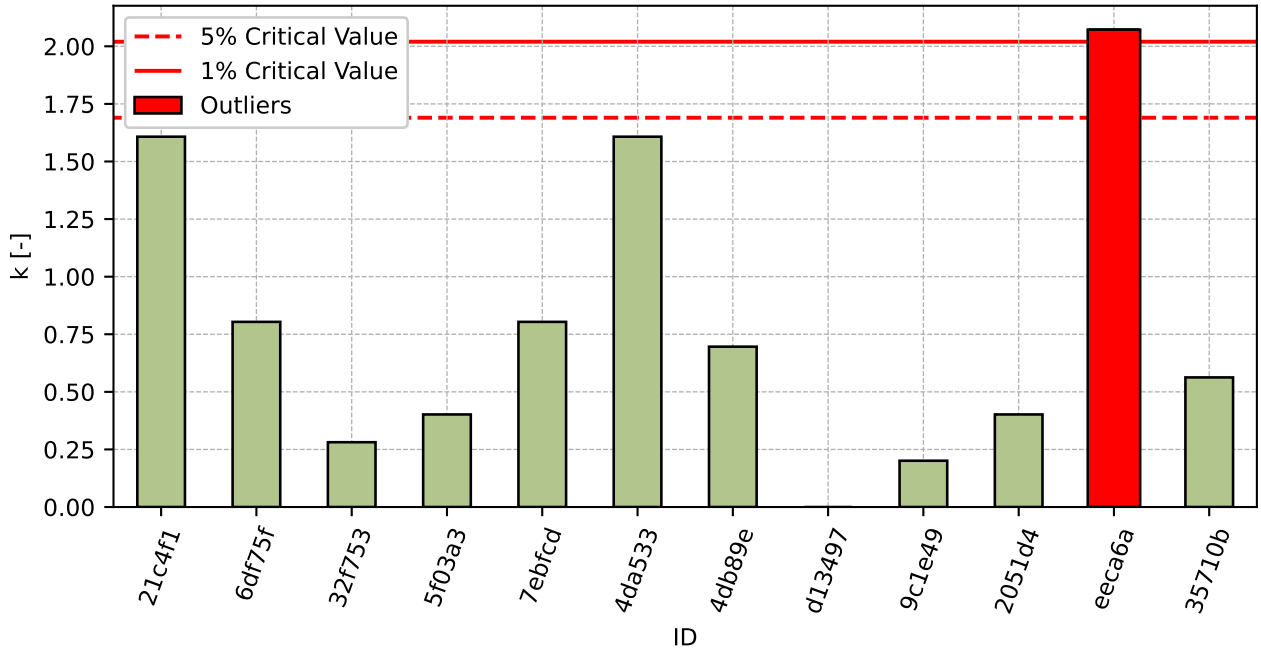

Figure 59: Intralaboratory Consistency Statistic

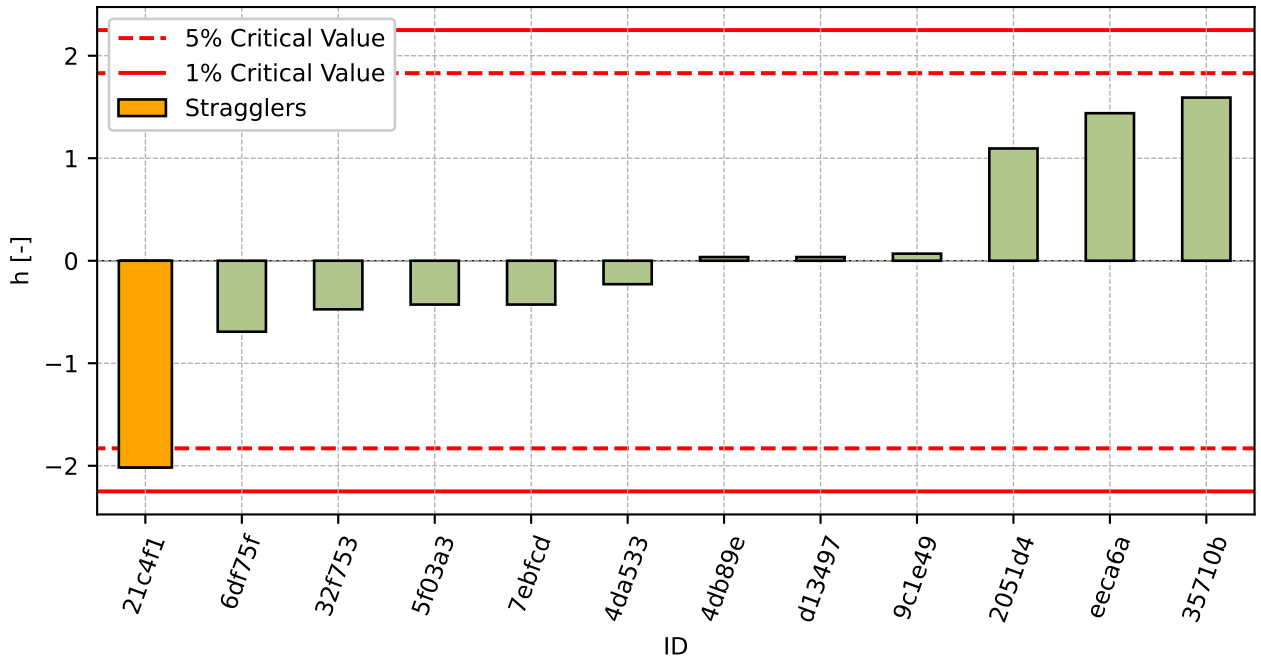

Figure 60: Interlaboratory Consistency Statistic

9.4 Descriptive statistics

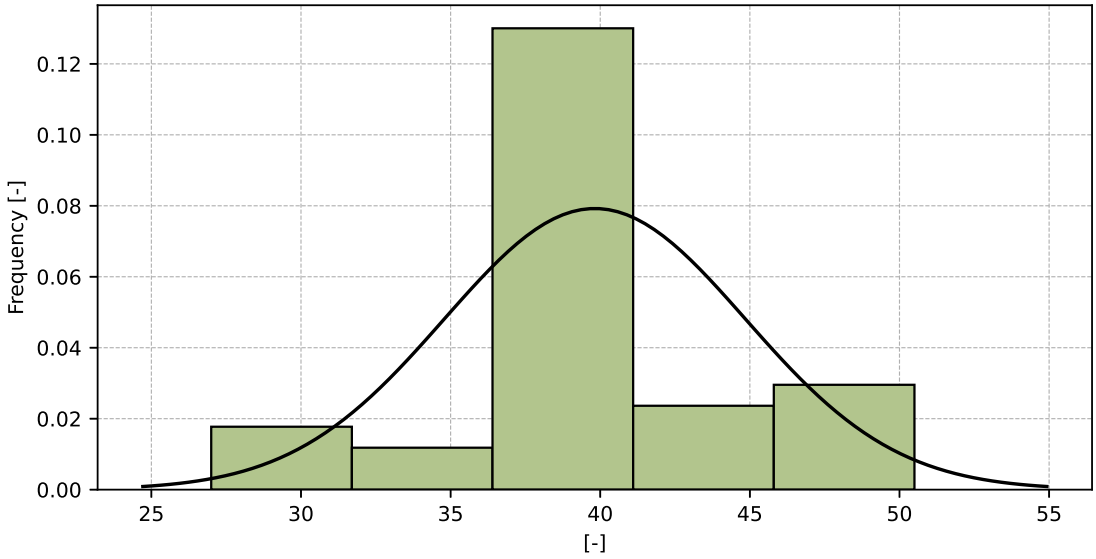

Figure 61: Histogram of all test results

Table 23: Descriptive statistics

Characteristics	[-]
Average value – $\bar{x}$	40
Sample standard deviation – s	5.0
Asigned value – x^*	40
Robust standard deviation – s^*	5.1
Measurement uncertainty of asigned value – u_X	1.5
p-value of normality test	0.087 [-]
Interlaboratory standard deviation – s_L	5.0
Repeatability standard deviation – s_r	1.4
Reproducibility standard deviation – s_R	5.2
Repeatability – r	4
Reproducibility – R	14

9.5 Evaluation of Performance Statistics

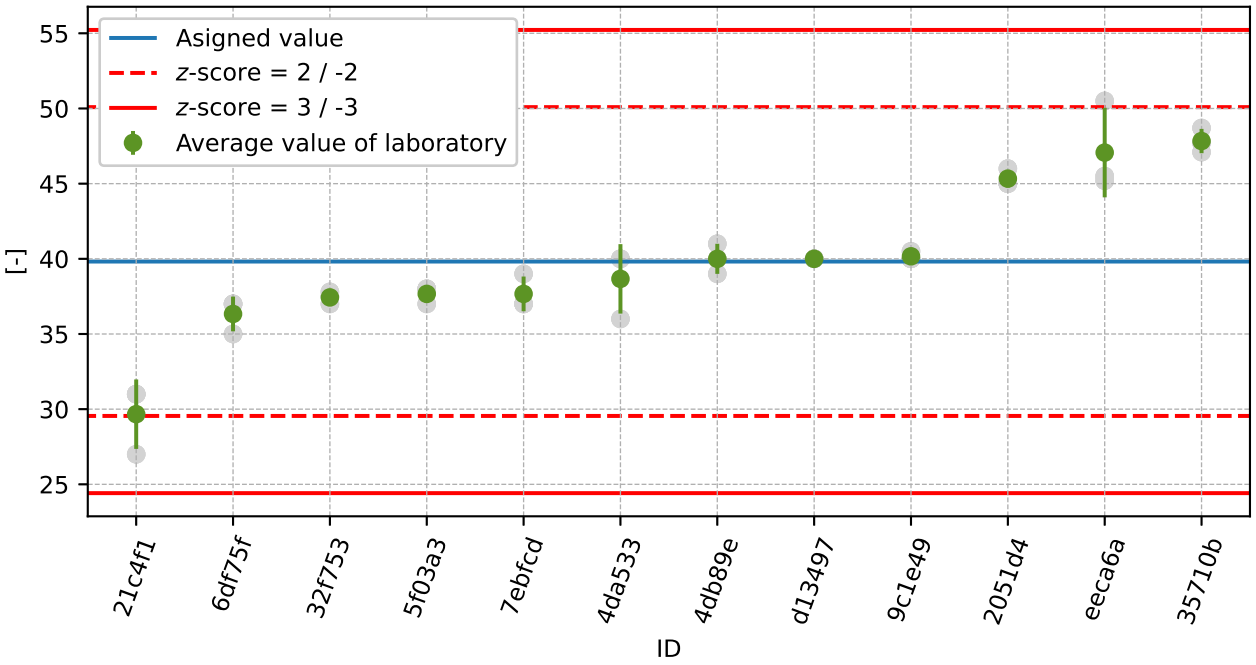

Figure 62: Average values and sample standard deviations

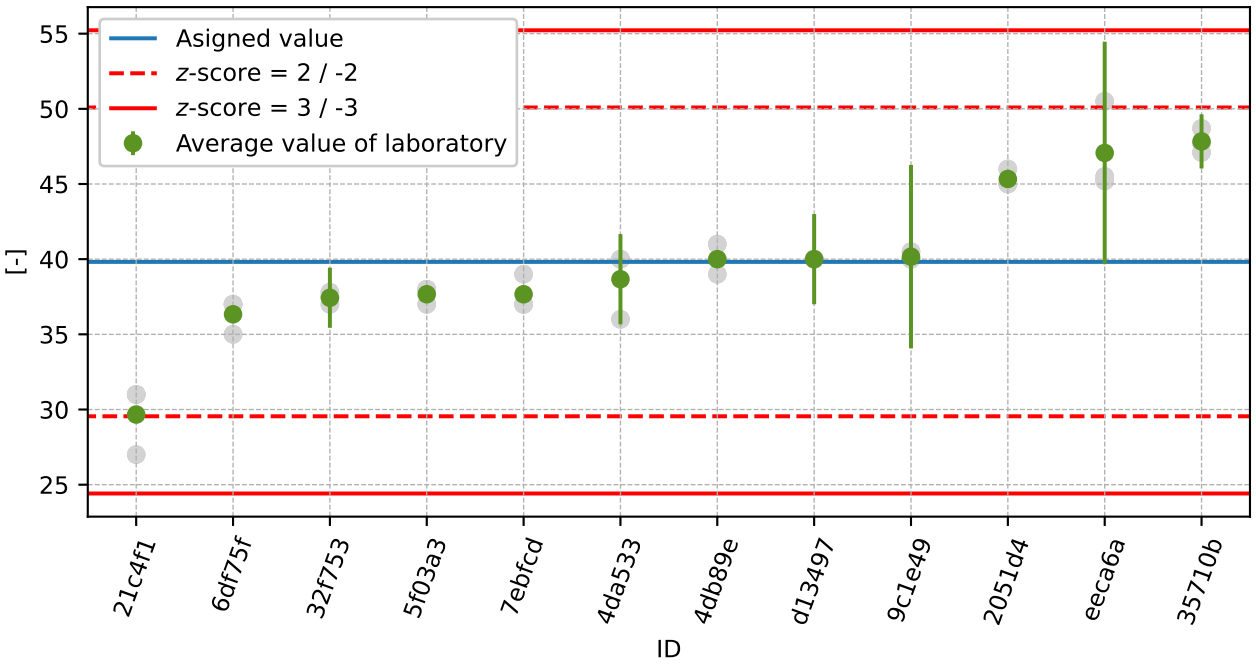

Figure 63: Average values and extended uncertainties of measurement

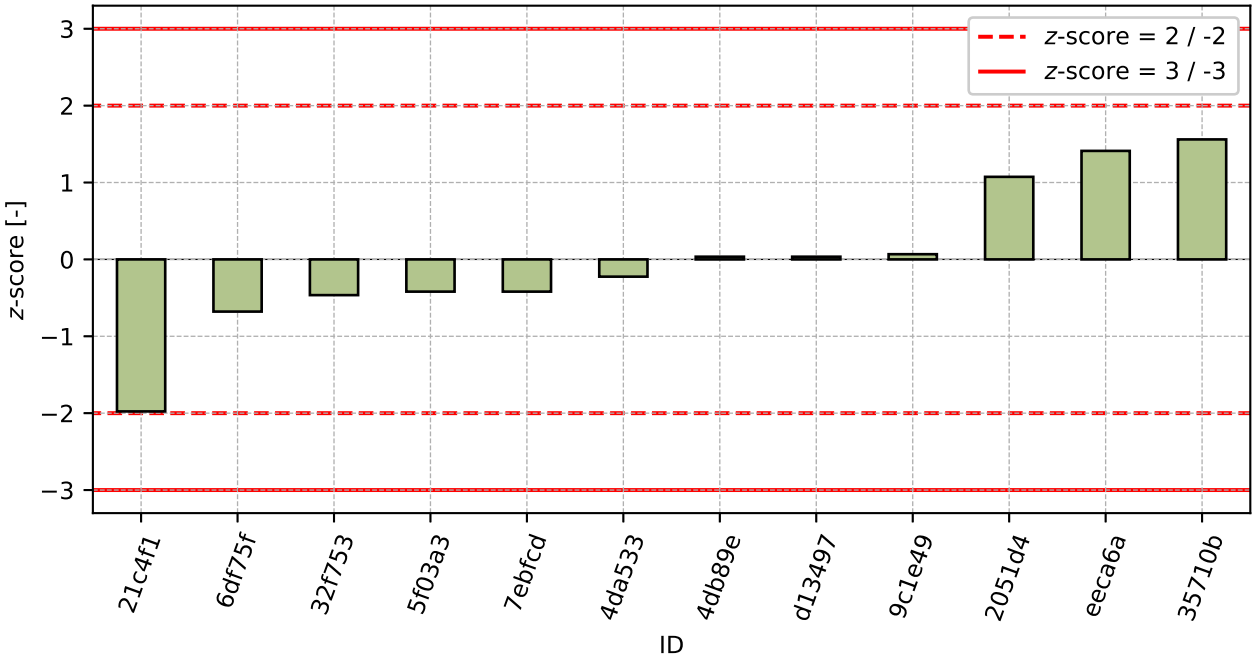

Figure 64: z-score

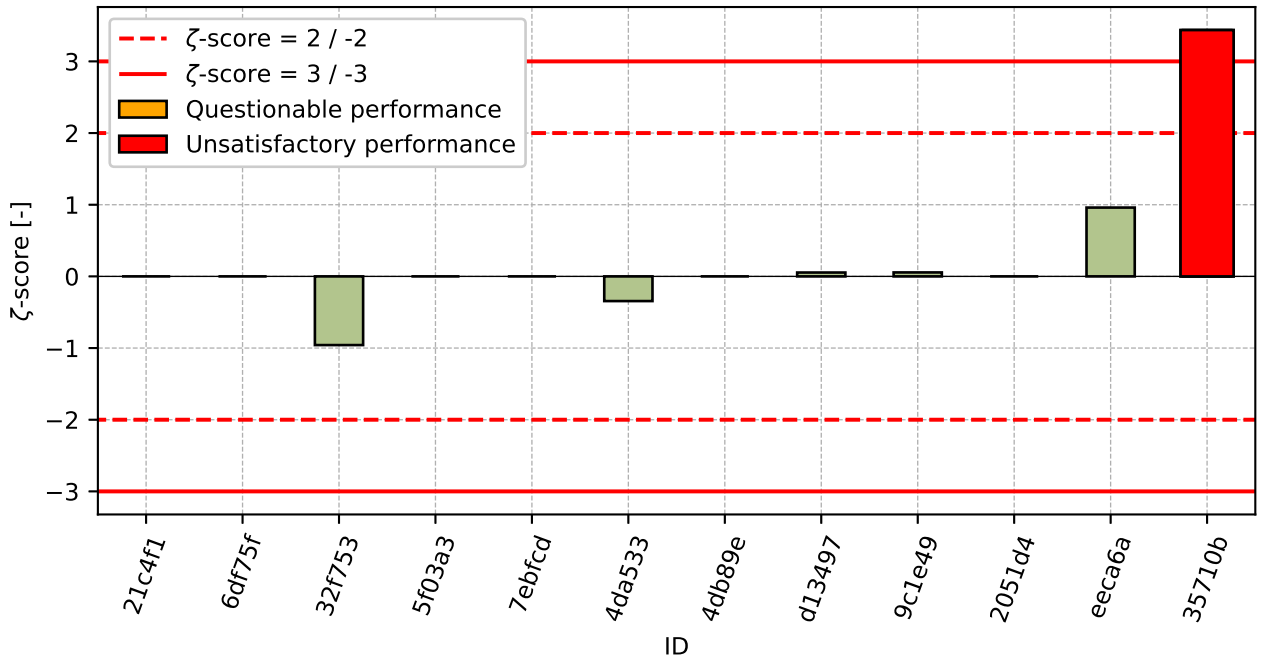

Figure 65: ζ-score

Table 24: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
21c4f1	-1.98	-
6df75f	-0.68	-
32f753	-0.46	-0.96
5f03a3	-0.42	-
7ebfcd	-0.42	-
4da533	-0.22	-0.34
4db89e	0.04	-
d13497	0.04	0.05
9c1e49	0.07	0.06
2051d4	1.07	-
eeca6a	1.41	0.96
35710b	1.56	3.44

10 Appendix – EN 1542, ČSN 736242, Appendix B – Measurement of bond strength by pull-off

10.1 Test results

Table 25: 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 [MPa]					u_X [MPa]	$\bar{x}$ [MPa]	s_0 [MPa]	V_X [%]
21c4f1	2.18	2.09	2.5	2.01	2.86	-	2.33	0.351	15.07
c45081	2.4	2.4	2.3	2.5	2.5	0.1	2.42	0.084	3.46
88cb82	3.0	2.5	2.4	3.0	2.5	-	2.68	0.295	11.01
eeca6a	2.9	2.7	3.2	3.1	3.1	0.3	3.0	0.2	6.67
919c31	2.8	3.2	3.0	3.1	3.3	0.37	3.08	0.192	6.25
5f03a3	3.23	3.47	3.17	2.88	2.73	-	3.1	0.294	9.5
8fef74	3.5	2.3	3.1	3.6	3.0	0.09	3.1	0.515	16.61
6b9b7c	2.82	3.05	3.15	3.03	3.74	0.07	3.16	0.347	10.98
9309d9	3.5	3.0	2.9	3.2	3.2	0.2	3.16	0.23	7.29
9c1e49	3.23	3.74	3.18	2.83	3.06	0.19	3.21	0.335	10.44
694111	3.5	3.5	3.6	2.9	2.8	0.5	3.26	0.378	11.6
bcf801	3.7	3.3	3.2	3.2	3.5	0.3	3.38	0.217	6.41
d50674	3.6	3.8	3.5	3.1	3.4	0.3	3.48	0.259	7.44
d13497	3.31	3.67	3.72	3.36	3.77	0.53	3.57	0.215	6.02
283215	3.6	3.8	3.5	3.4	3.6	0.2	3.58	0.148	4.14
7ebfcd	4.3	3.6	3.5	3.5	3.2	-	3.62	0.409	11.29
6df75f	3.64	4.19	3.58	3.52	3.62	-	3.71	0.272	7.34
b7c36c	4.3	4.1	3.9	3.3	3.6	0.1	3.84	0.397	10.35
250e96	3.9	4.1	4.2	4.0	3.8	0.1	4.0	0.158	3.95

10.2 The Numerical Procedure for Determining Outliers

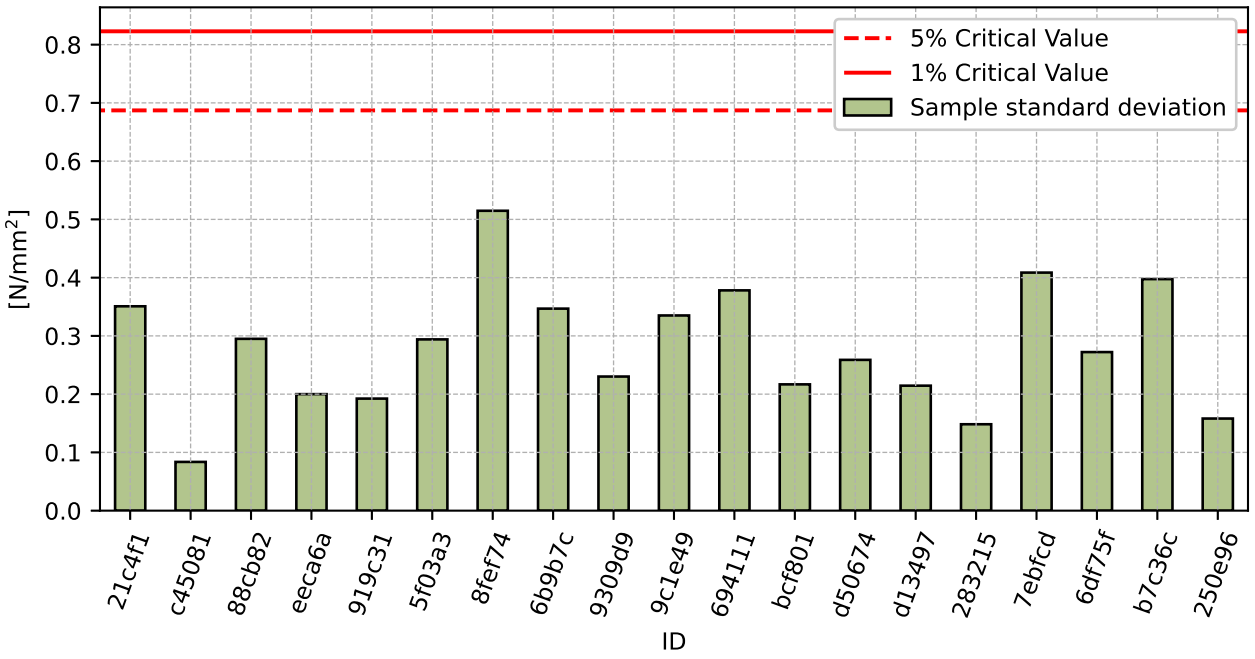

Figure 66: **Cochran's test** - sample standard deviations

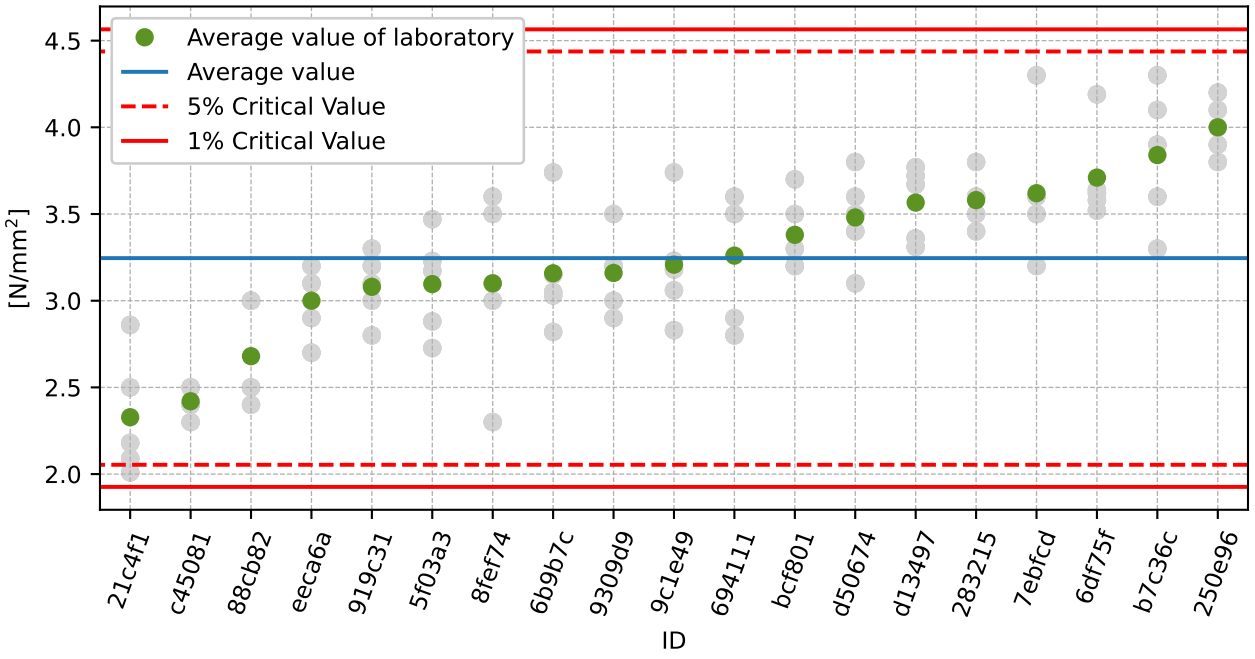

Figure 67: **Grubbs' test** - average values

10.3 Mandel's Statistics

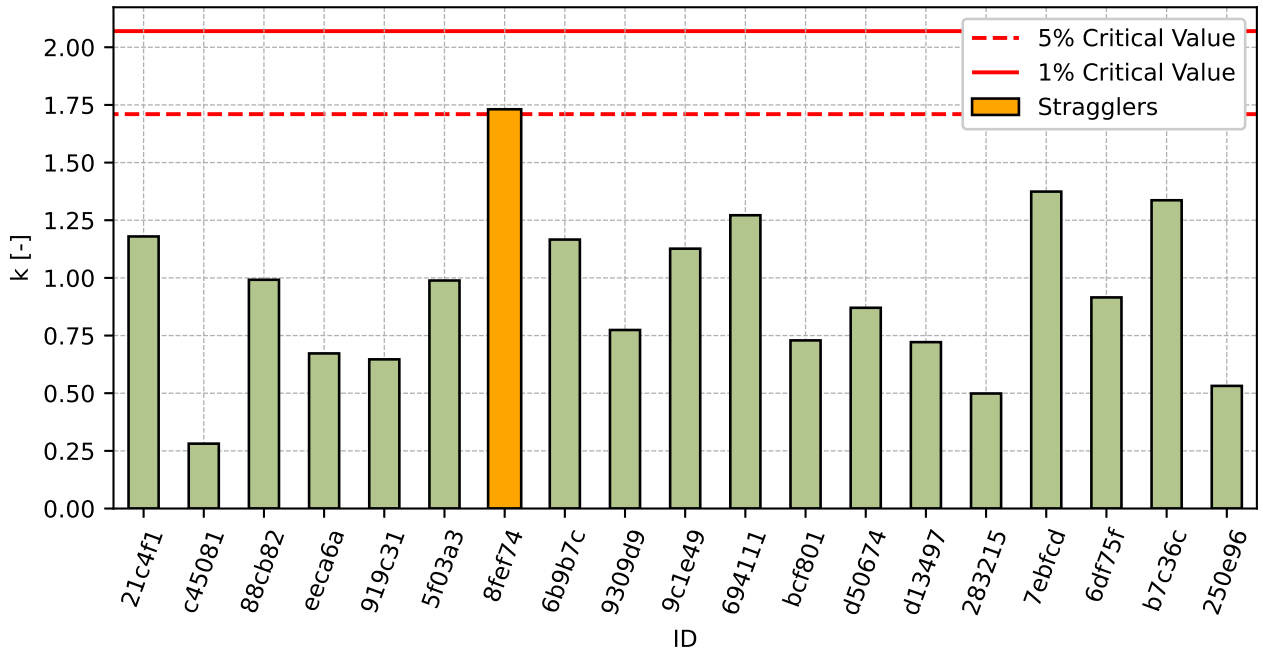

Figure 68: Intralaboratory Consistency Statistic

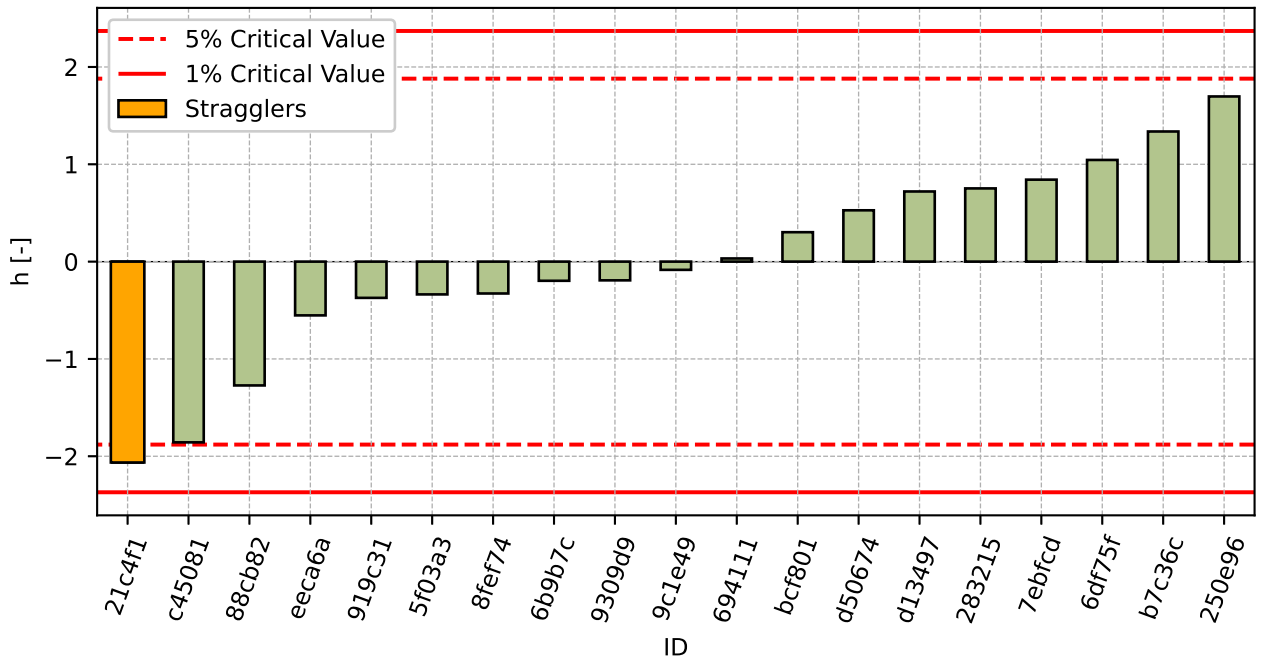

Figure 69: Interlaboratory Consistency Statistic

10.4 Descriptive statistics

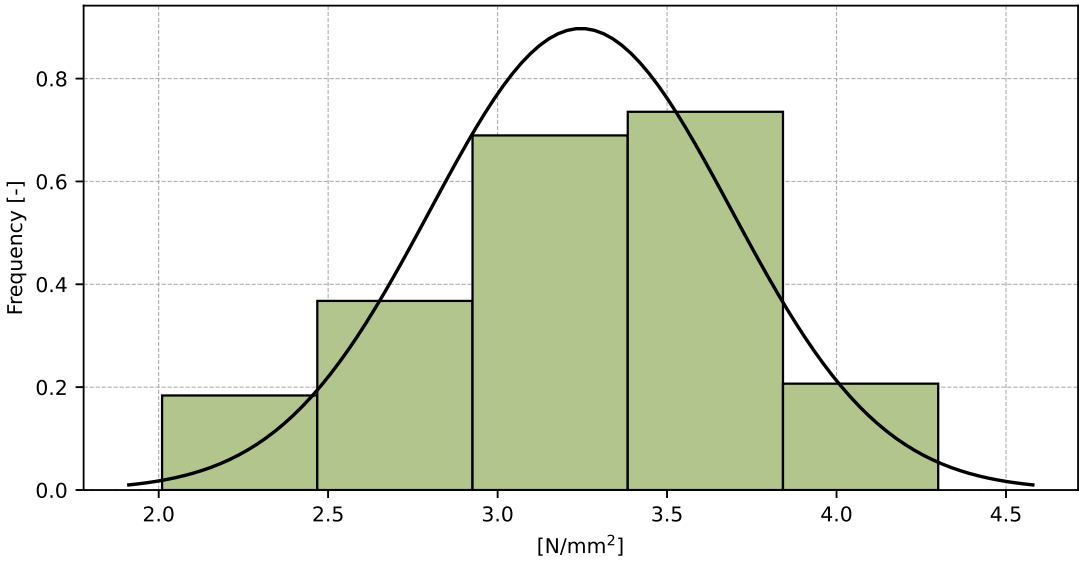

Figure 70: Histogram of all test results

Table 26: Descriptive statistics

Characteristics	[MPa]
Average value – $\bar{x}$	3.25
Sample standard deviation – s	0.445
Asigned value – x^*	3.27
Robust standard deviation – s^*	0.483
Measurement uncertainty of asigned value – u_X	0.124
p-value of normality test	0.25 [-]
Interlaboratory standard deviation – s_L	0.424
Repeatability standard deviation – s_r	0.297
Reproducibility standard deviation – s_R	0.518
Repeatability – r	0.83
Reproducibility – R	1.45

10.5 Evaluation of Performance Statistics

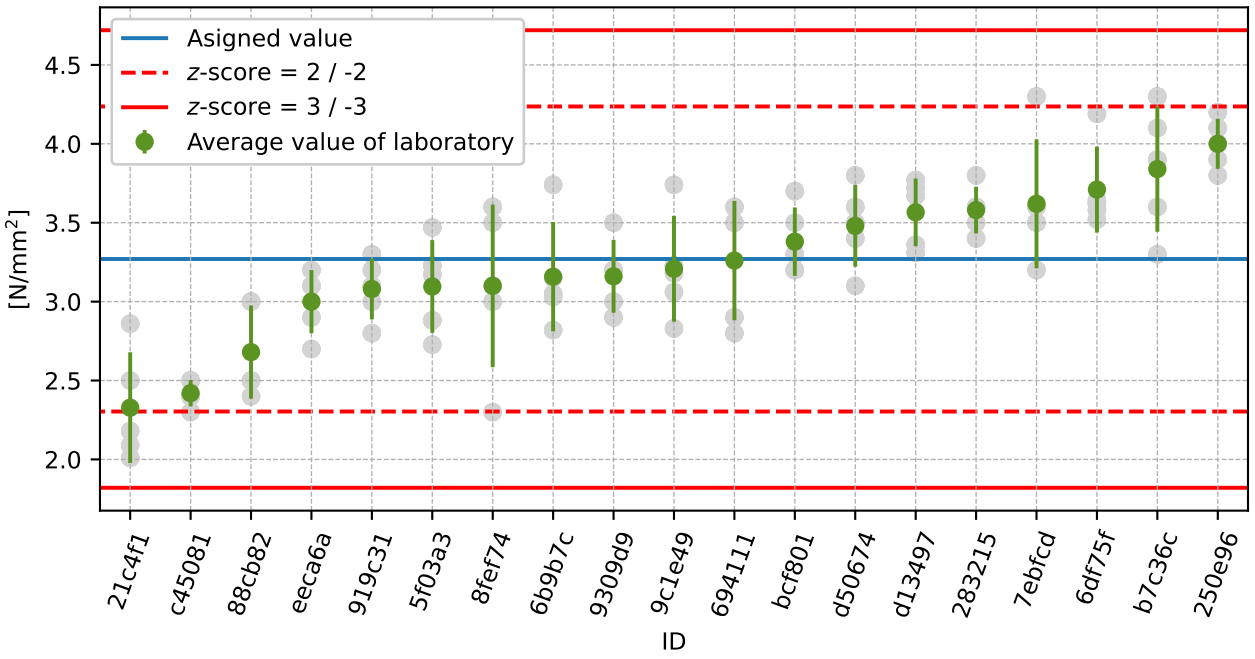

Figure 71: Average values and sample standard deviations

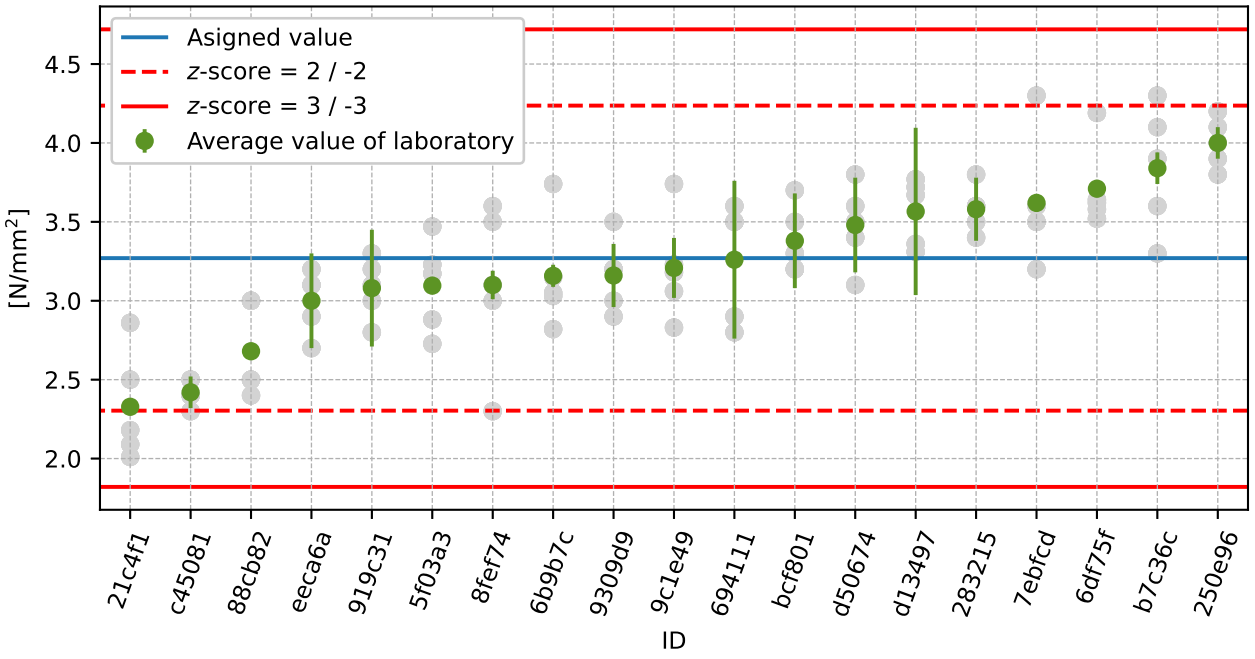

Figure 72: Average values and extended uncertainties of measurement

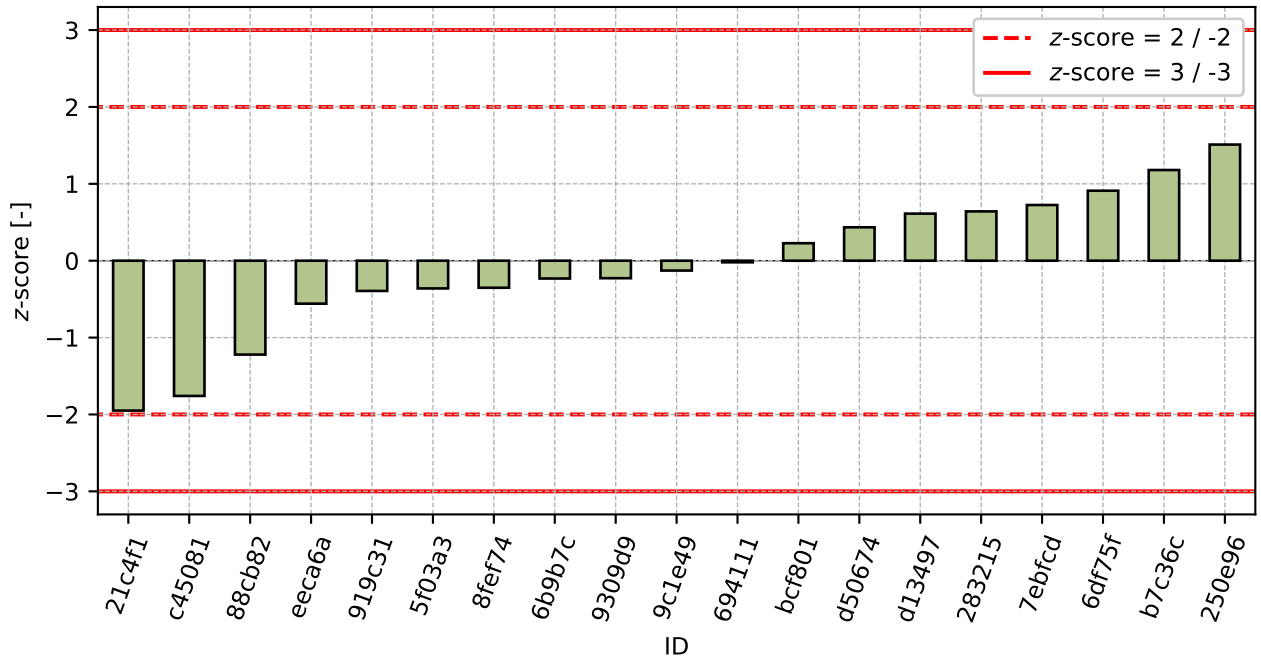

Figure 73: z-score

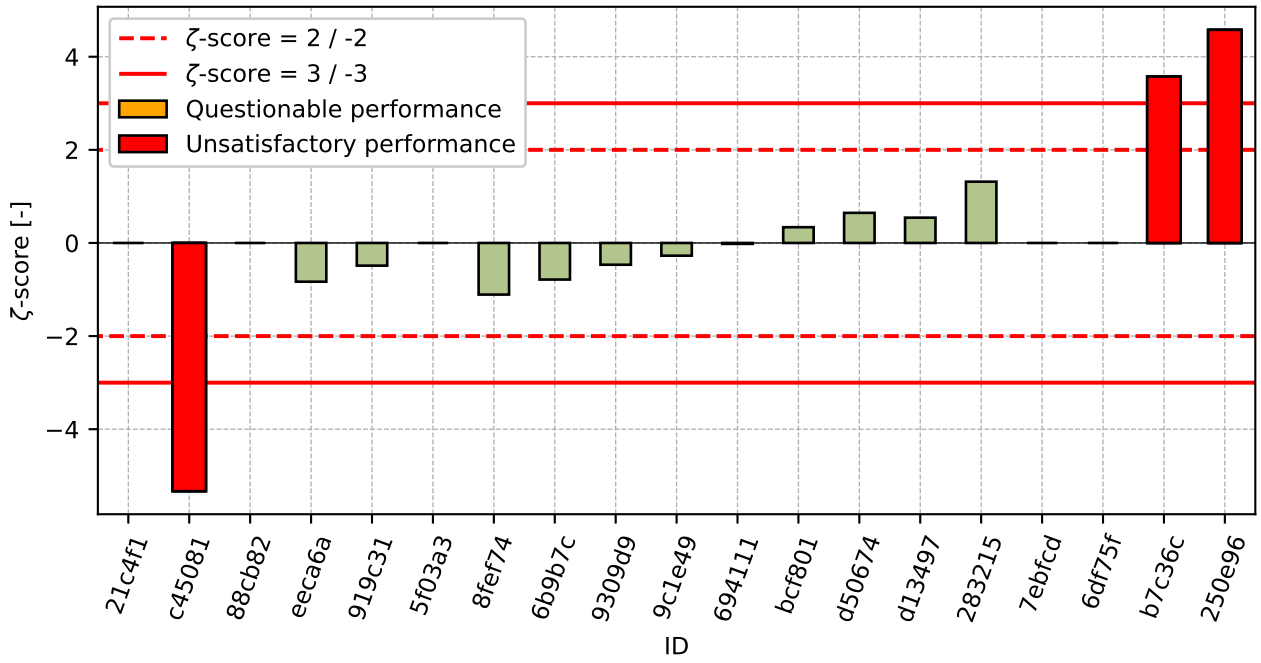

Figure 74: ζ-score

Table 27: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
21c4f1	-1.95	-
c45081	-1.76	-5.33
88cb82	-1.22	-
eeca6a	-0.56	-0.83
919c31	-0.39	-0.49
5f03a3	-0.36	-
8fef74	-0.35	-1.11
6b9b7c	-0.23	-0.79
9309d9	-0.23	-0.47
9c1e49	-0.13	-0.27
694111	-0.02	-0.02
bcf801	0.23	0.34
d50674	0.43	0.65
d13497	0.61	0.54
283215	0.64	1.32
7ebfcd	0.72	-
6df75f	0.91	-
b7c36c	1.18	3.57
250e96	1.51	4.58

11 Appendix – EN 1338 – Appendix E (Total water absorption)

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

12 Appendix – EN 1338 – Appendix F (Tensile splitting strength)

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

13 Appendix – EN 1338 – Appendix G (Abrasion resistance)

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

14 Appendix – EN 1338 – Appendix F (Flexural strength and flexural load)

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