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 2024/2

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

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1 Introduction and Important Contacts

In the year 2024, the Proficiency Testing Provider at the SZK FAST (PT Provider) initiated the Proficiency Testing Program (PTP) designated ZZB 2024/2 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 1339** – Concrete paving flags – Requirements and test methods – Appendix F (Flexural strength and flexural load) [14].

Testing procedures No 6, 7, 8 and 13 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 [15]. 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 [16] and with EN ISO/IEC 17043 [17]. The outcome is the present final report summarizing the results of the interlaboratory comparison, including statistical evaluation.

59 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
ef0e3a	-	-	-	-	-	-	-	-	-	-	-	-	-	X
0d23d4	-	-	-	-	-	-	-	-	-	X	-	-	-	-
7742a2	-	-	-	-	-	-	-	-	X	-	-	-	-	-
928a3b	X	-	-	-	-	-	-	-	-	-	-	-	-	-
e63b22	-	X	-	-	X	-	-	-	-	-	-	X	-	-
243942	-	-	-	-	-	-	-	-	-	X	-	-	-	-
56ac15	X	X	X	X	-	-	-	-	X	-	-	-	-	-
33a6e7	-	-	-	-	-	-	-	-	-	-	X	X	-	X
9078d7	X	-	-	-	-	-	-	-	-	-	-	-	-	-
52b50d	X	-	-	-	X	-	-	-	-	-	-	-	-	-
780924	-	X	-	-	-	-	-	-	-	-	-	-	-	-
de0879	-	-	-	-	-	-	-	-	X	-	-	-	-	-
a5dd62	X	-	-	-	-	-	-	-	-	-	-	X	-	X
d1ea1e	X	-	-	-	-	-	-	-	-	-	-	-	-	-
b98482	X	-	-	X	-	-	-	-	-	X	X	-	-	-
58a64a	X	X	-	-	-	-	-	-	X	-	-	-	-	-
089bc2	-	X	-	-	-	-	-	-	-	-	-	-	-	-
225960	-	-	-	-	-	-	-	-	-	-	X	-	-	-
42f004	-	-	-	-	X	-	-	-	-	-	-	-	-	-
43f135	X	-	-	-	-	-	-	-	-	-	-	-	-	-
16c362	-	X	-	-	-	-	-	-	X	-	-	-	-	-
f3cd50	X	-	-	X	-	-	-	-	-	-	-	-	-	-
9d97d6	X	-	-	X	-	-	-	-	-	-	-	-	-	-
db66de	X	X	-	X	-	-	-	-	-	-	X	-	-	X
9826a1	X	-	-	X	-	-	-	-	-	-	-	-	-	-
1d314d	X	X	X	X	-	-	-	-	X	X	-	-	-	-
f5fbcd	-	-	-	X	-	-	-	-	-	-	-	-	-	-
9891d4	-	X	X	-	-	-	-	-	-	-	-	-	-	-
2cdd75	X	X	-	-	X	-	-	-	-	-	-	-	-	-
5d59c8	-	-	X	-	-	-	-	-	-	-	-	-	-	-
b67ca8	X	-	-	X	-	-	-	-	X	X	-	X	-	-
537007	X	-	-	X	X	-	-	-	-	-	-	-	-	-
ebf42a	-	-	X	-	-	-	-	-	-	-	-	-	-	-
500203	-	-	-	-	-	-	-	-	-	X	-	-	-	-
c2de2c	X	X	X	-	-	-	-	-	-	-	-	-	-	-
ff7004	X	-	-	-	-	-	-	-	-	X	-	-	-	-

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ID/Method	1	2	3	4	5	6	7	8	9	10	11	12	13	14
c77935	-	-	-	-	-	-	-	-	-	-	-	X	-	-
725f2f	X	-	-	-	-	-	-	-	-	-	-	X	-	-
0a3040	X	X	X	X	-	-	-	-	-	-	-	-	-	-
b3df0e	-	X	-	-	-	-	-	-	X	X	X	X	-	X
b31adf	X	-	-	X	-	-	-	-	X	-	-	-	-	-
5c8f54	-	-	-	-	-	-	-	-	X	X	-	-	-	-
0d23f7	-	-	-	-	-	-	-	-	-	X	-	-	-	-
31fb26	-	-	-	-	-	-	-	-	X	X	-	-	-	-
b562b2	-	-	-	-	-	-	-	-	X	X	-	-	-	-
8fad93	X	-	-	-	-	-	-	-	-	-	-	-	-	-
fa4e31	X	-	-	X	-	-	-	-	-	-	-	-	-	-
d29aaa	X	-	-	-	-	-	-	-	-	-	-	-	-	-
0ec7ce	-	-	-	-	-	-	-	-	-	X	-	-	-	-
d9c995	X	-	-	-	-	-	-	-	-	-	-	-	-	-
434e59	X	-	X	X	-	-	-	-	-	-	-	-	-	-
397173	X	-	-	X	-	-	-	-	-	-	-	-	-	-
7a198f	X	-	-	X	-	-	-	-	-	-	-	-	-	-
81a6d6	X	-	-	-	-	-	-	-	-	-	-	-	-	-
6fa28a	-	-	-	-	-	-	-	-	X	-	-	-	-	-
6ea5eb	-	X	-	-	-	-	-	-	-	X	-	-	-	-
6658ac	X	-	-	X	-	-	-	-	X	-	-	-	-	-
df1c46	X	-	-	-	-	-	-	-	-	-	-	-	-	-
3dc7ad	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
A&A MACEDONIA LAB TEST LTD	10, Moisi Street, Chlroraka, Paphos, 8220, Cyprus	-
BEST, a.s.	Rybnice 148, Kaznějov, 33151, Česká republika	1739
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	1195
BETOTECH, s.r.o. - pracoviště Brno	Beroun 660, B, 66484, Česká republika	1195.3
BETOTECH, s.r.o. - pracoviště Most	Beroun 660, Beroun, 26601, Česká republika	1195
BOKU University Vienna	Peter-Jordan-Str. 82, Vienna, 1190, AUSTRIA	P0252
BTI Bautechnisches Institut GmbH	Karl-Leitl-Straße 2, Puchenau bei Linz, A 4048, Austria	0037

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Laboratory	Address	Accreditation number
BetónRacio, s.r.o., Skúšobné laboratórium, Pracovisko Lietavská Lúčka	Žilinská cesta 49/25, Lietavská Lúčka, 013 11, Slovenská republika	S-320
BetónRacio, s.r.o., Skúšobné laboratórium, Pracovisko Trnava	Skladová 2, Trnava, 917 01, Slovenská republika	S-320
BetónRacio, s.r.o., Skúšobné laboratórium, Pracovisko Veľký Šariš	Železničná 9, Veľký Šariš, 082 21, Slovenská republika	S-320
CS-BETON s.r.o.	Velké Žernoseky 184, Litoměřice, 412 01, ČR	1500
CSS d.o.o.	Savska cesta 144a, Zagreb, 10000, c	HR1106
Cement Hranice akciová společnost	Bělotínská 288, Hranice I-Město, 753 01, ČR	1284
Cemex Czech Republic s.r.o.	Plzeňská 3217/16, Praha 5, 15000, Česká republika	1302
Danucem Slovensko a.s., Skúšobné laboratórium Bratislava	Pestovateľská 2, Bratislava, 821 04, Slovenská republika	426/S-313
EDAFOMICHANIKI S.A.	19 EMMANUEL PAPADAKI, NEO IRAKLEIO, 14121, GREECE	1269
ELKE APTH - LABORATORY OF BUILDING MATERIALS	Laboratory of Building Materials, School of Engineering, Aristotle University Campus, Thessaloniki, GR 54124, Greece	-
Grean consult BV	winkelomseheide 229, Geel, 2440, Belgium	-
INSTITUTI I NDERTIMIT	Myslym Keta Street, Tirana, 1001, Albania	-
ITECONS	Rua Pedro Hispano, s/n, Pólo II da Universidade de Coimbra„ Coimbra, 3030-289, Portugal	L0446-1
Innovation Hub/PPC S.A.	Leontariou 9, Kantza Pallini, Athens, 15351, Greece	-
Institut technologie a testování betonu, s.r.o., Zkušební laboratoř ITTB Brno	Medkova 974/4, Brno, 62700, Česká republika	L1778
Kilsaran	Kilsaran Paving , Piercetown , Dunboyne, Dunboyne, A86 W820, Co Meath , Ireland	-
Kloknerův ústav, ČVUT v Praze	Šolínova 1903/7, Praha 6, 166 08, Česká republika	1061
LABORATOIRE DES TRAVAUX PUBLICS DU SUD	Zone des activités Bouhraoua- PB 332 GHARDAIA, GHARDAIA, 47000, ALGERIA	-
Labo Devlieger - Van Vooren	Industriepark Rosteyne 1, zelzate, 6090, Oost-Vlaanderen	296-TEST
Laboratoire des Travaux Publics de l'Ouest (LTP-Ouest)	Rond-point des CASTORS, Oran, 31000, ALGERIA	-
Laborator Central Constructii SRL	242, sector 6 Calea Giulesti, nr. 242, Bucuresti, 060286, ROMANIA	-

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Laboratory	Address	Accreditation number
Laboratorium Drogowe Szczecin Sp. z o.o.	Tama Pomorzańska 13L, Szczecin, 70-030, Poland	AB1806
Magnel-Vandepitte Laboratory	Technologiepark 60, Ghent, 9052, Belgium	220-TEST
NIEVELT Labor CZ s.r.o.	Za Olomouckou 4184/17, Prostějov, 79601, Česká republika	1716
Nucleco S.p.A.	Via Anguillarese 301, Rome, 00123, Italy	-
PUDIS a.s.	Podbabská 1014/20, Praha 6, 160 00, Česká republika	1762
QUALIFORM SLOVAKIA s.r.o.	Pasienková 9D, Bratislava, 82106, Slovenská republika	154/S-301
SG Geotechnika a.s.	Geologická 4, Praha 5, 15200, Česká republika	1119
SQZ, s.r.o. - pracoviště Srch	939/5 U místní dráhy, Olomouc, 779 00, Česká republika	1135.1
STACHEMA Bratislava a.s.	Železničná 714/180, Rovinka, 90041, Slovensko	S-275
Sibotec bv	Industriepark Oost 6, Beernem, 8730, West - Vlaanderen	-
Stachema CZ s.r.o. - Zkušební laboratoř - pracoviště 1	Hasičská 1, Zibohlavy, Kolín, 28002, Česká republika	1433
Stachema CZ s.r.o. - Zkušební laboratoř - pracoviště 2	Hasičská 1, Zibohlavy, Kolín, 28002, Česká republika	1433
Structural Soils Ltd	Unit 1A, Princess Street, Bedminster, Bristol, BS3 4AG, Bristol	-
TESScontrol, s. r. o. Oblastné Laboratórium Bratislava, Laboratórium Bratislava	efaktury@tesscontrol.sk, Ľubochnianska 1/A, Bratislava, 831 04, Slovenská republika	S-375
TESScontrol, s. r. o. Oblastné Laboratórium Zvolen, Laboratórium Zvolen	efaktury@tesscontrol.sk; Hronská 3211/1, Zvolen, 960 93, Slovenská republika	S-375
TESScontrol, s. r. o. Oblastné Laboratórium Žilina, Laboratórium Žilina	efaktury@tesscontrol.sk; Štrková 17„ Žilina, 010 01, Slovenská republika	S-375
TESScontrol, s.r.o. Oblastné Laboratórium Bratislava, Laboratórium Prešov	efaktury@tesscontrol.sk; Petrovianska 4„ Pešov, 080 05, Slovenská republika	S-375
TPA ČR, s.r.o.	Vrbenská 1821/31, České Budějovice, 370 06, Česká republika	1181
Technický a zkušební ústav stavební Praha, s. p., Centrální laboratoř - zkušebna Brno	Hněvkovského 77, Brno, 617 00, Česká republika	1018.3
Technický a zkušební ústav stavební Praha, s.p.	Prosecká 811/76a, Praha 9, 19000, Česká republika	1018.3
UAB Laboratoriniu bandymu centras	R.Kalantos st. 85a., Kaunas, LT-52308, Lithuania	LA.01.002
University of Natural Resources and Life Sciences Vienna	Peter-Jordan-Str. 82, Vienna, 1190, AUSTRIA	-

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Laboratory	Address	Accreditation number
VIALAB CZ s.r.o.	U Michelského lesa 1581/2, Praha 4, 14000, Česká republika	1112
VUIS – CESTY, spol. s r. o.	Vlčie hrdlo 1, Bratislava-mestská časť Ružinov, 82107, Slovensko	-
Vilnius Tech	Saulėtekio ave. 11, Vilnius, LT-10223, Lithuania	LA.01.063
ÉMI Építésügyi Minőségellenőrző Innovációs Nonprofit Kft. Központi Vizsgáló Laboratórium	Dózsa György út 26., Szentendre, 2000, Magyarország	NAH-1-1110/2023/K
ÉMI Építésügyi Minőségellenőrző Innovációs Nonprofit Kft. Közép-magyarországi Anyagvizsgáló Kirendeltség	Dózsa György út 26., Szentendre, 2000, Magyarország	NAH-1-1110/2023/K
Ústav stavebního zkušebnictví s.r.o.	Jiřího Potůčka 115, Trnová, Pardubice, 53009, Česká republika	1115
ČVUT v Praze - Stavební fakulta	Thákurova 7, Praha, 16629, Česká republika	1048
Ředitelství silnic a dálnic s. p.	Na Pankráci 546/56, Praha 4, 145 00, Česká republika	1072

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. 59 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
ef0e3a	-	-	-	-	-	-	-	-	-	-	-	-	-	✓
0d23d4	-	-	-	-	-	-	-	-	-	✓	-	-	-	-
7742a2	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
928a3b	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
e63b22	-	✓	-	-	✓	-	-	-	-	-	-	✓	-	-
243942	-	-	-	-	-	-	-	-	-	✓	-	-	-	-
56ac15	✓	✓	✓	✓	-	-	-	-	✓	-	-	-	-	-
33a6e7	-	-	-	-	-	-	-	-	-	-	✓	✓	-	✓
9078d7	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
52b50d	✓	-	-	-	✓	-	-	-	-	-	-	-	-	-
780924	-	✓	-	-	-	-	-	-	-	-	-	-	-	-
de0879	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
a5dd62	✓	-	-	-	-	-	-	-	-	-	-	✓	-	✓
d1ea1e	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
b98482	✓	-	-	✓	-	-	-	-	-	✓	✓	-	-	-
58a64a	✓	✓	-	-	-	-	-	-	✓	-	-	-	-	-
089bc2	-	✓	-	-	-	-	-	-	-	-	-	-	-	-
225960	-	-	-	-	-	-	-	-	-	-	✓	-	-	-
42f004	-	-	-	-	✓	-	-	-	-	-	-	-	-	-
43f135	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
16c362	-	✓	-	-	-	-	-	-	✓	-	-	-	-	-
f3cd50	✓	-	-	✓	-	-	-	-	-	-	-	-	-	-
9d97d6	✓	-	-	✓	-	-	-	-	-	-	-	-	-	-
db66de	✓	✓	-	✓	-	-	-	-	-	-	✓	-	-	✓
9826a1	✓	-	-	✓	-	-	-	-	-	-	-	-	-	-
1d314d	✓	✓	✓	✓	-	-	-	-	✓	✓	-	-	-	-
f5fbcd	-	-	-	✓	-	-	-	-	-	-	-	-	-	-
9891d4	-	✓	✓	-	-	-	-	-	-	-	-	-	-	-

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ID / Method	1	2	3	4	5	6	7	8	9	10	11	12	13	14
2cdd75	✓	✓	-	-	✓	-	-	-	-	-	-	-	-	-
5d59c8	-	-	✓	-	-	-	-	-	-	-	-	-	-	-
b67ca8	✓	-	-	✓	-	-	-	-	✓	✓	-	✓	-	-
537007	✓	-	-	✓	✓	-	-	-	-	-	-	-	-	-
ebf42a	-	-	✓	-	-	-	-	-	-	-	-	-	-	-
500203	-	-	-	-	-	-	-	-	-	✓	-	-	-	-
c2de2c	✓	✓	✓	-	-	-	-	-	-	-	-	-	-	-
ff7004	✓	-	-	-	-	-	-	-	-	✓	-	-	-	-
c77935	-	-	-	-	-	-	-	-	-	-	-	✓	-	-
725f2f	✓	-	-	-	-	-	-	-	-	-	-	✓	-	-
0a3040	✓	✓	✓	✓	-	-	-	-	-	-	-	-	-	-
b3df0e	-	✓	-	-	-	-	-	-	✓	✓	✓	!	-	✓
b31adf	✓	-	-	✓	-	-	-	-	✓	-	-	-	-	-
5c8f54	-	-	-	-	-	-	-	-	✓	✓	-	-	-	-
0d23f7	-	-	-	-	-	-	-	-	-	✓	-	-	-	-
31fb26	-	-	-	-	-	-	-	-	✓	✓	-	-	-	-
b562b2	-	-	-	-	-	-	-	-	✓	✓	-	-	-	-
8fad93	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
fa4e31	✓	-	-	✓	-	-	-	-	-	-	-	-	-	-
d29aaa	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
0ec7ce	-	-	-	-	-	-	-	-	-	✓	-	-	-	-
d9c995	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
434e59	✓	-	✓	✓	-	-	-	-	-	-	-	-	-	-
397173	✓	-	-	✓	-	-	-	-	-	-	-	-	-	-
7a198f	✓	-	-	✓	-	-	-	-	-	-	-	-	-	-
81a6d6	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
6fa28a	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
6ea5eb	-	✓	-	-	-	-	-	-	-	✓	-	-	-	-
6658ac	✓	-	-	✓	-	-	-	-	✓	-	-	-	-	-
df1c46	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
3dc7ad	✓	-	-	✓	-	-	-	-	-	-	-	-	-	✓

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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 [%]
ff7004	63.1	63.4	59.5	0.8	62.0	2.14	3.45
d1ea1e	67.1	60.2	65.3	-	64.2	3.58	5.57
db66de	64.0	65.7	67.0	4.5	65.6	1.5	2.29
0a3040	70.1	66.8	62.4	-	66.4	3.86	5.81
fa4e31	61.7	67.2	72.3	-	67.1	5.3	7.9
8fad93	67.6	65.9	68.2	0.3	67.2	1.19	1.77
df1c46	65.3	69.1	67.6	1.0	67.3	1.91	2.84
9826a1	69.3	66.5	68.0	4.0	67.9	1.4	2.06
56ac15	69.3	65.9	68.9	2.2	68.0	1.86	2.73
b31adf	68.5	62.9	73.7	8.2	68.4	5.4	7.9
43f135	67.8	69.4	68.0	-	68.4	0.87	1.27
d9c995	68.5	68.6	68.7	2.1	68.6	0.1	0.15
3dc7ad	71.1	69.2	66.6	1.1	69.0	2.26	3.28
7a198f	70.4	69.6	69.9	-	70.0	0.4	0.58
b67ca8	66.4	72.3	72.5	4.8	70.4	3.47	4.92
9078d7	69.2	74.8	68.9	1.9	71.0	3.32	4.68
f3cd50	72.4	68.9	72.0	0.6	71.1	1.92	2.69
b98482	76.7	74.0	64.6	3.6	71.8	6.35	8.85
6658ac	71.1	74.7	72.0	1.9	72.6	1.87	2.58
a5dd62	69.0	75.6	73.4	4.1	72.7	3.36	4.62
434e59	70.6	73.0	75.6	-	73.1	2.5	3.42
81a6d6	70.6	73.6	75.5	8.2	73.2	2.47	3.37
725f2f	74.9	72.7	74.3	2.0	74.0	1.14	1.54
397173	73.1	71.3	77.9	-	74.1	3.41	4.6
d29aaa	81.1	69.7	73.6	3.3	74.8	5.79	7.75
2cdd75	77.6	74.3	75.7	1.1	75.9	1.66	2.18
9d97d6	69.9	79.8	78.0	-	75.9	5.27	6.95
52b50d	76.2	74.9	77.2	1.0	76.1	1.15	1.52
537007	78.4	76.4	75.8	3.4	76.9	1.36	1.77
58a64a	77.8	76.3	78.2	4.7	77.4	1.0	1.29
c2de2c	77.3	80.9	76.2	6.6	78.1	2.46	3.15
1d314d	76.2	79.8	78.8	4.4	78.3	1.86	2.37
928a3b	78.2	81.1	79.3	-	79.5	1.46	1.84

1.2 The Numerical Procedure for Determining Outliers

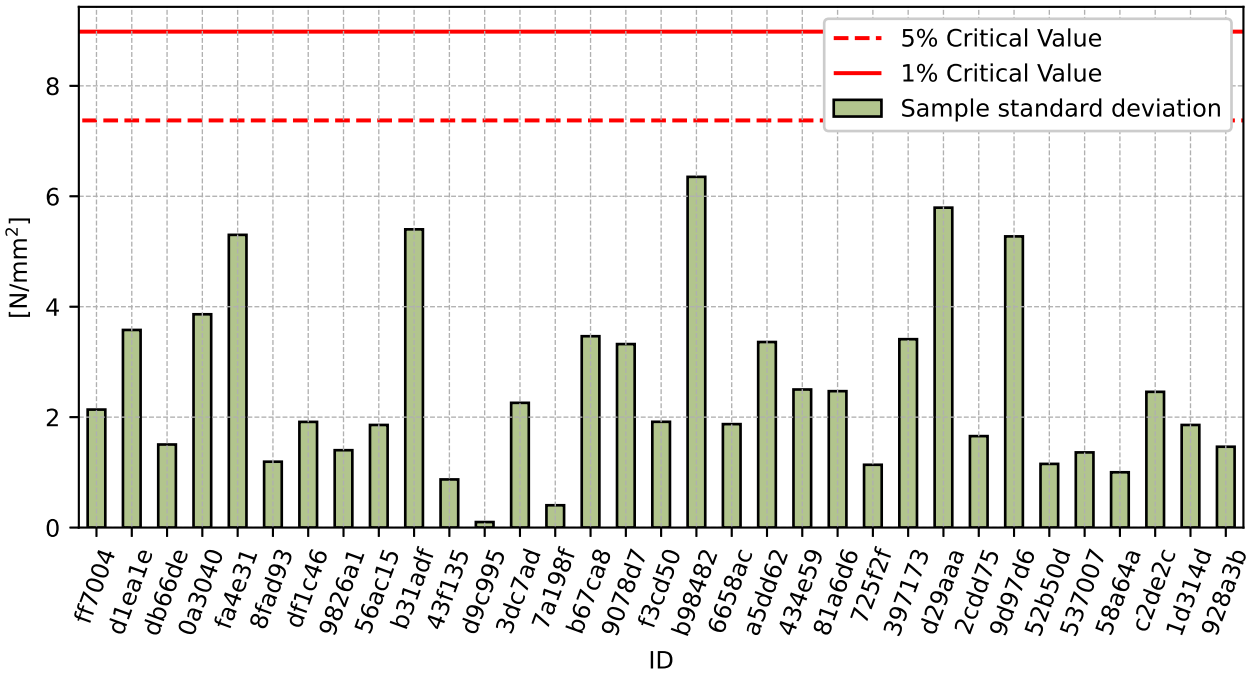

Figure 1: **Cochran's test** - sample standard deviations

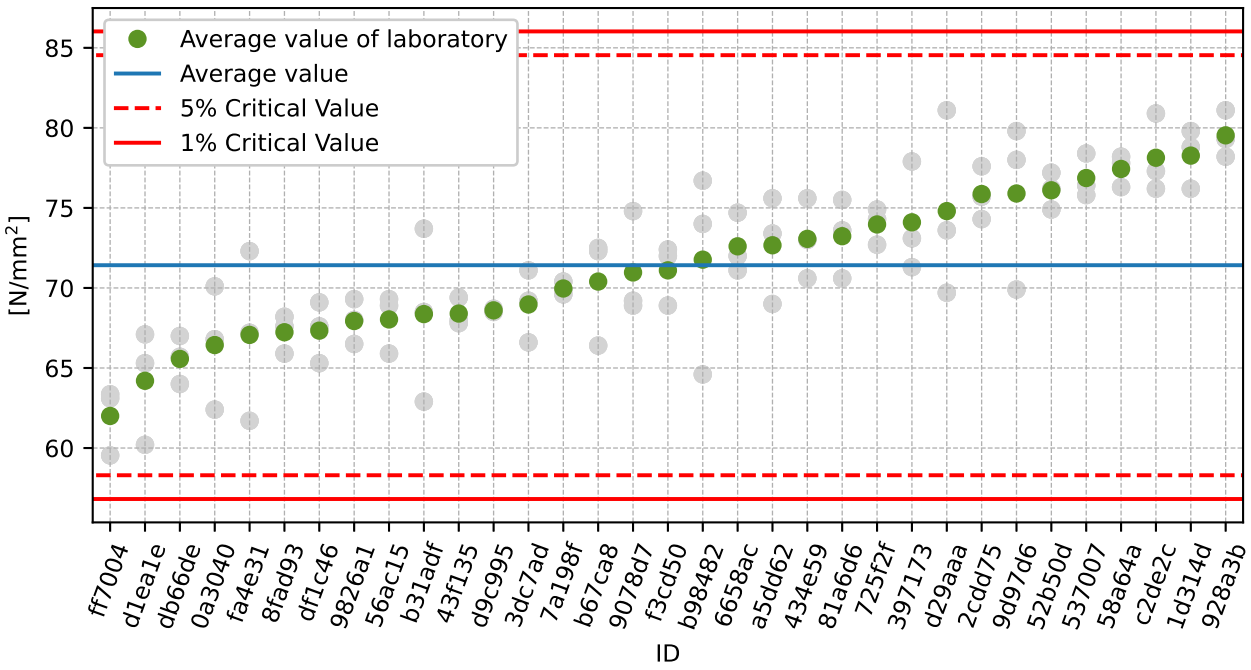

Figure 2: **Grubbs' test** - average values

1.3 Mandel's Statistics

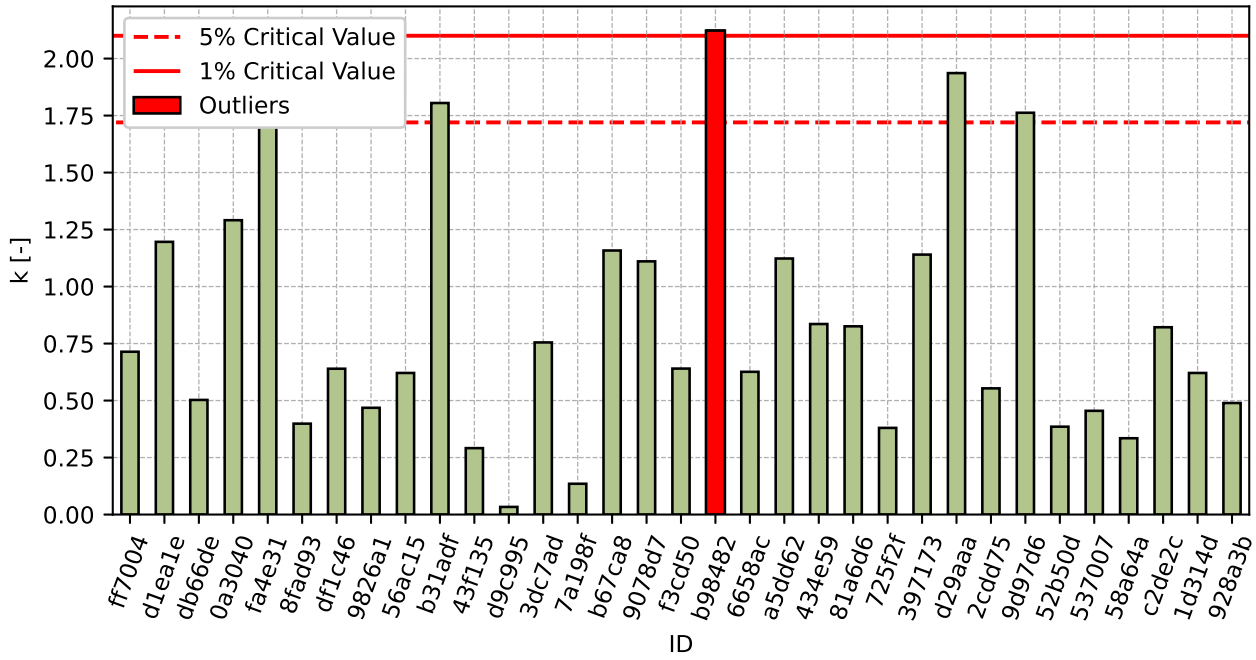

Figure 3: Intralaboratory Consistency Statistic

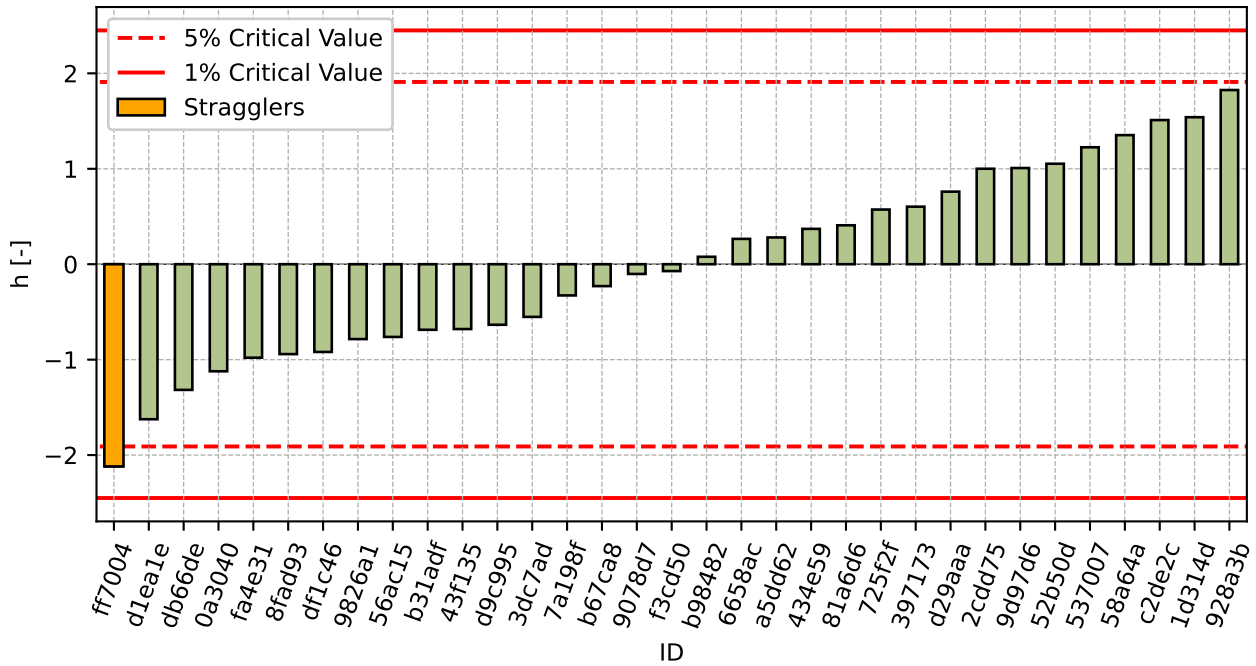

Figure 4: Interlaboratory Consistency Statistic

1.4 Descriptive statistics

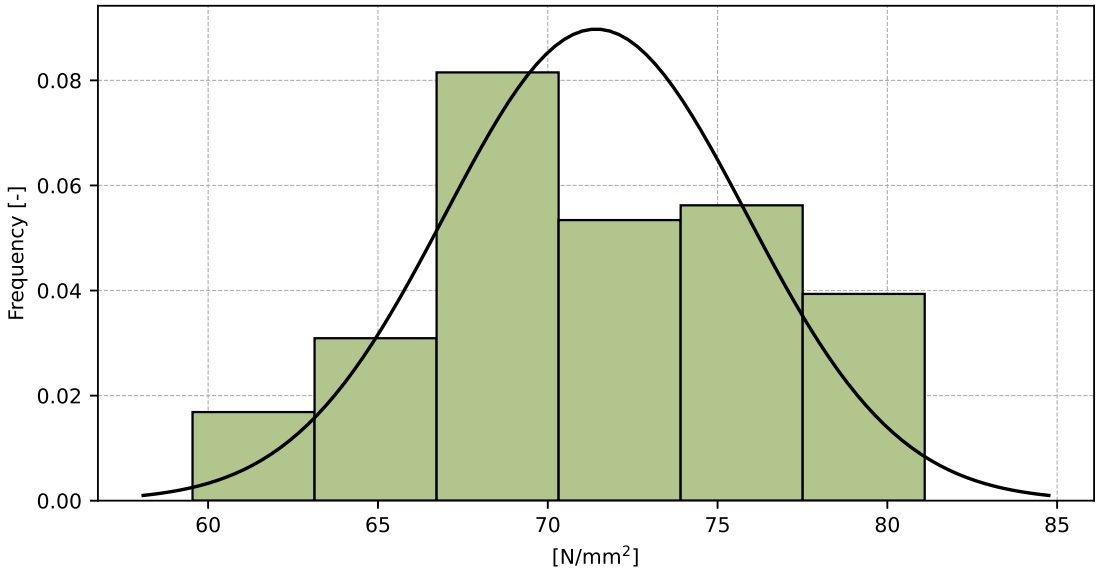

Figure 5: Histogram of all test results

Table 5: Descriptive statistics

Characteristics	**[N/mm²]**
Average value – $\bar{x}$	71.4
Sample standard deviation – s	4.44
Asigned value – x^*	71.5
Robust standard deviation – s^*	4.8
Measurement uncertainty of asigned value – u_X	1.04
p-value of normality test	0.195 [-]
Interlaboratory standard deviation – s_L	4.09
Repeatability standard deviation – s_r	2.99
Reproducibility standard deviation – s_R	5.07
Repeatability – r	8.4
Reproducibility – R	14.2

1.5 Evaluation of Performance Statistics

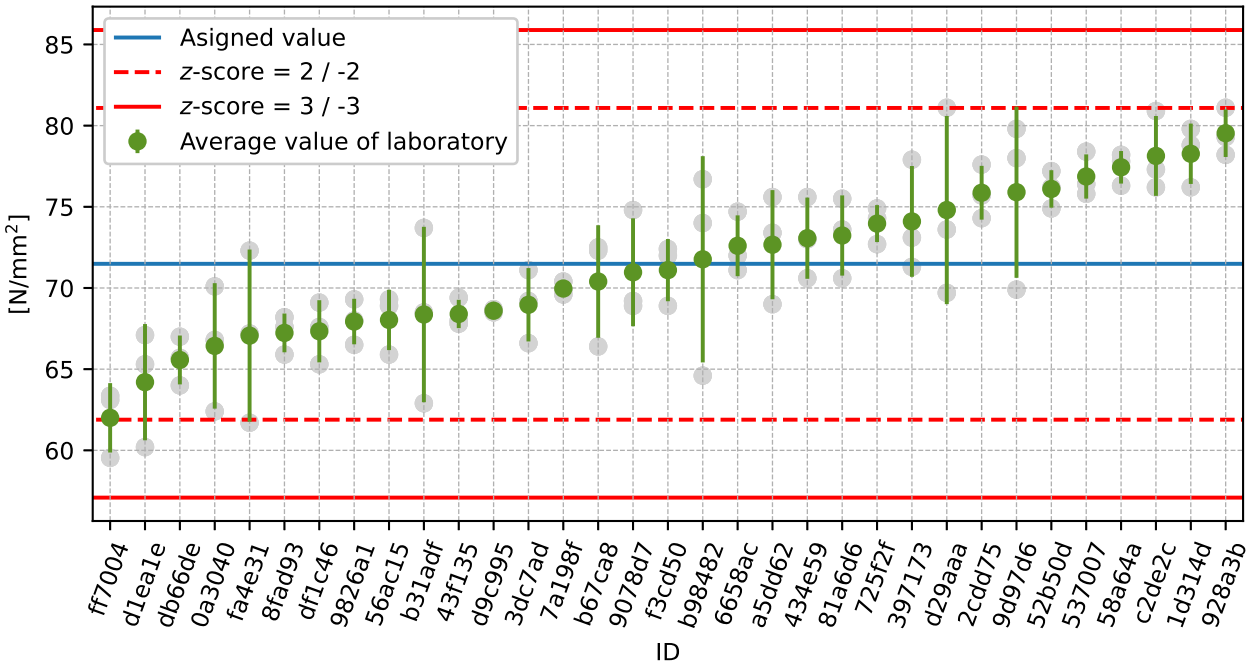

Figure 6: Average values and sample standard deviations

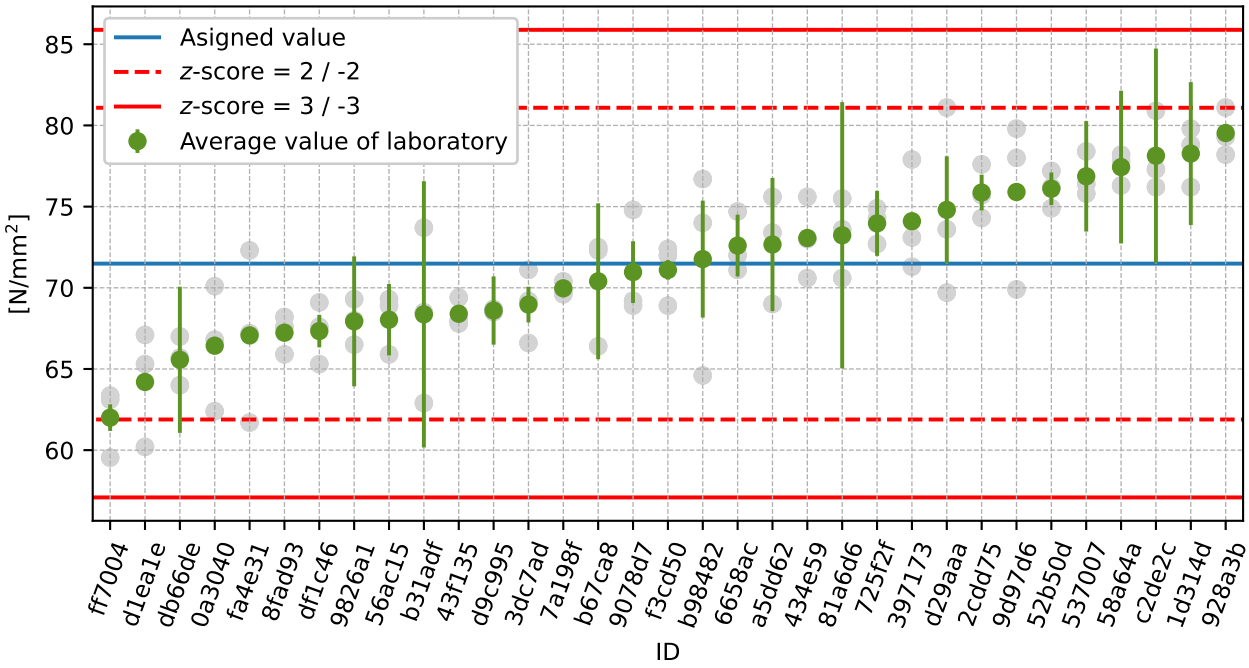

Figure 7: Average values and extended uncertainties of measurement

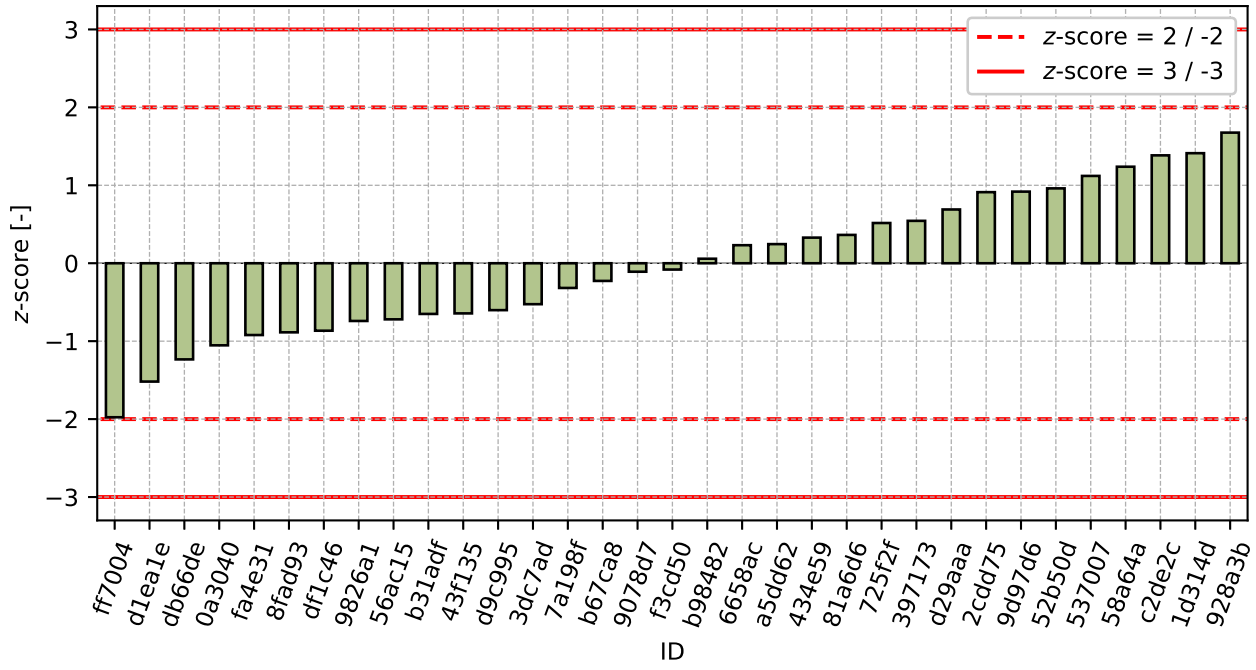

Figure 8: z-score

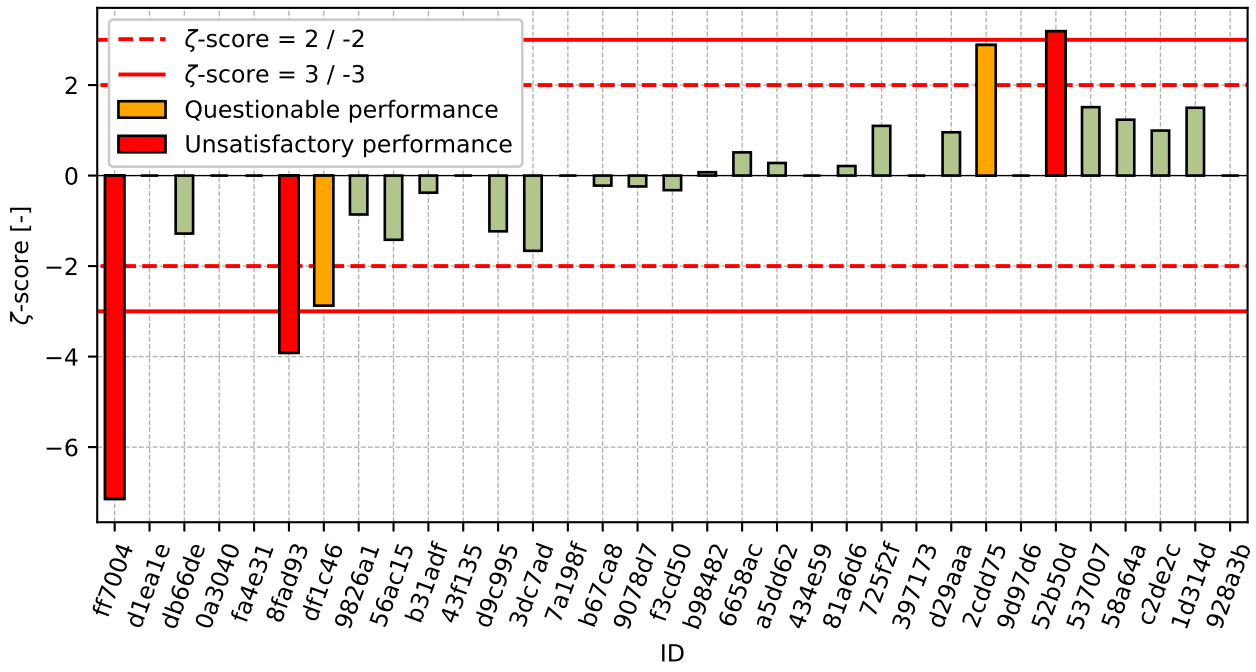

Figure 9: ζ-score

Table 6: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
ff7004	-1.98	-7.14
d1ea1e	-1.52	-
db66de	-1.23	-1.28
0a3040	-1.05	-
fa4e31	-0.92	-
8fad93	-0.89	-3.92
df1c46	-0.87	-2.87
9826a1	-0.74	-0.86
56ac15	-0.72	-1.42
b31adf	-0.65	-0.38
43f135	-0.64	-
d9c995	-0.6	-1.23
3dc7ad	-0.53	-1.66
7a198f	-0.32	-
b67ca8	-0.23	-0.22
9078d7	-0.11	-0.24
f3cd50	-0.08	-0.32
b98482	0.06	0.07
6658ac	0.23	0.51
a5dd62	0.25	0.28
434e59	0.33	-
81a6d6	0.36	0.21
725f2f	0.52	1.1
397173	0.54	-
d29aaa	0.69	0.96
2cdd75	0.91	2.89
9d97d6	0.92	-
52b50d	0.96	3.19
537007	1.12	1.51
58a64a	1.24	1.23
c2de2c	1.38	0.99
1d314d	1.41	1.5
928a3b	1.68	-

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 [%]
0a3040	5.6	5.2	5.2	-	5.3	0.23	4.33
2cdd75	5.5	5.0	5.7	0.3	5.4	0.36	6.68
780924	5.8	5.5	5.2	0.2	5.5	0.3	5.45
58a64a	5.6	5.9	5.7	0.3	5.7	0.15	2.66
b3df0e	5.8	5.8	5.7	0.2	5.8	0.06	1.0
6ea5eb	5.7	5.8	5.8	1.6	5.8	0.06	1.0
56ac15	6.0	5.4	6.0	0.3	5.8	0.33	5.6
e63b22	6.1	5.9	5.5	0.4	5.8	0.31	5.24
16c362	6.1	5.7	6.4	0.5	6.1	0.35	5.79
9891d4	5.8	6.2	6.4	-	6.1	0.31	4.98
1d314d	6.6	6.3	6.0	0.4	6.3	0.3	4.76
c2de2c	6.1	6.6	6.6	0.9	6.4	0.29	4.49
db66de	6.2	6.6	6.6	0.4	6.5	0.23	3.57
089bc2	6.9	6.8	6.7	-	6.8	0.11	1.55

2.2 The Numerical Procedure for Determining Outliers

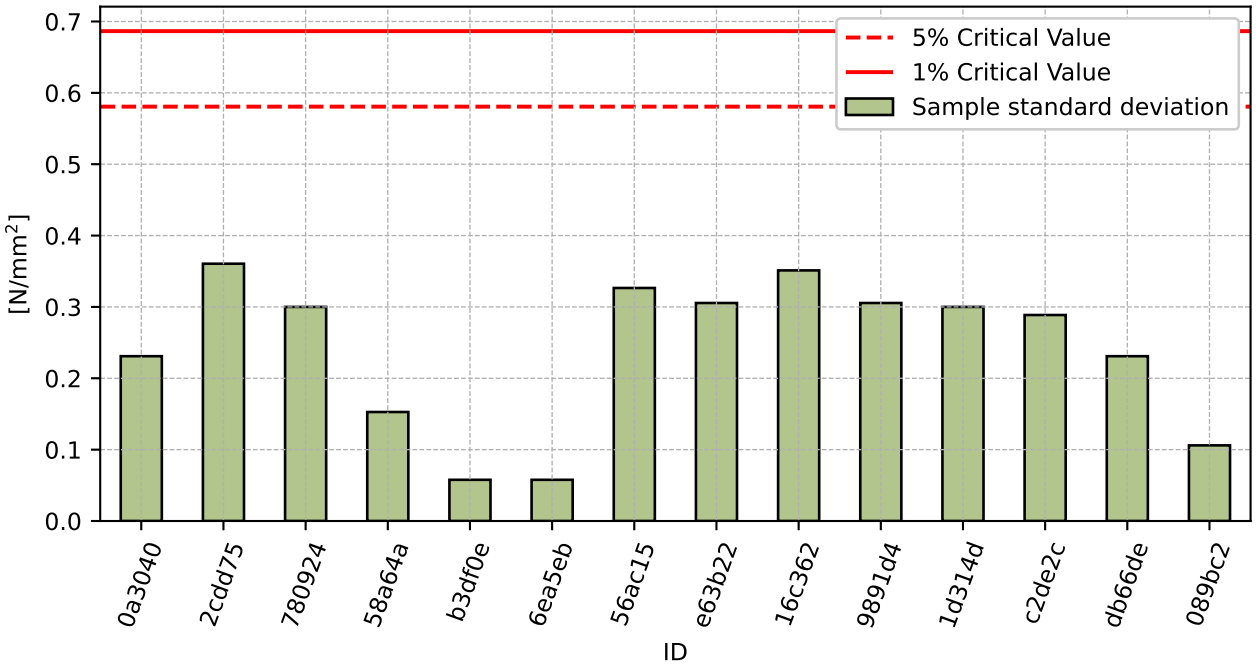

Figure 10: **Cochran's test** - sample standard deviations

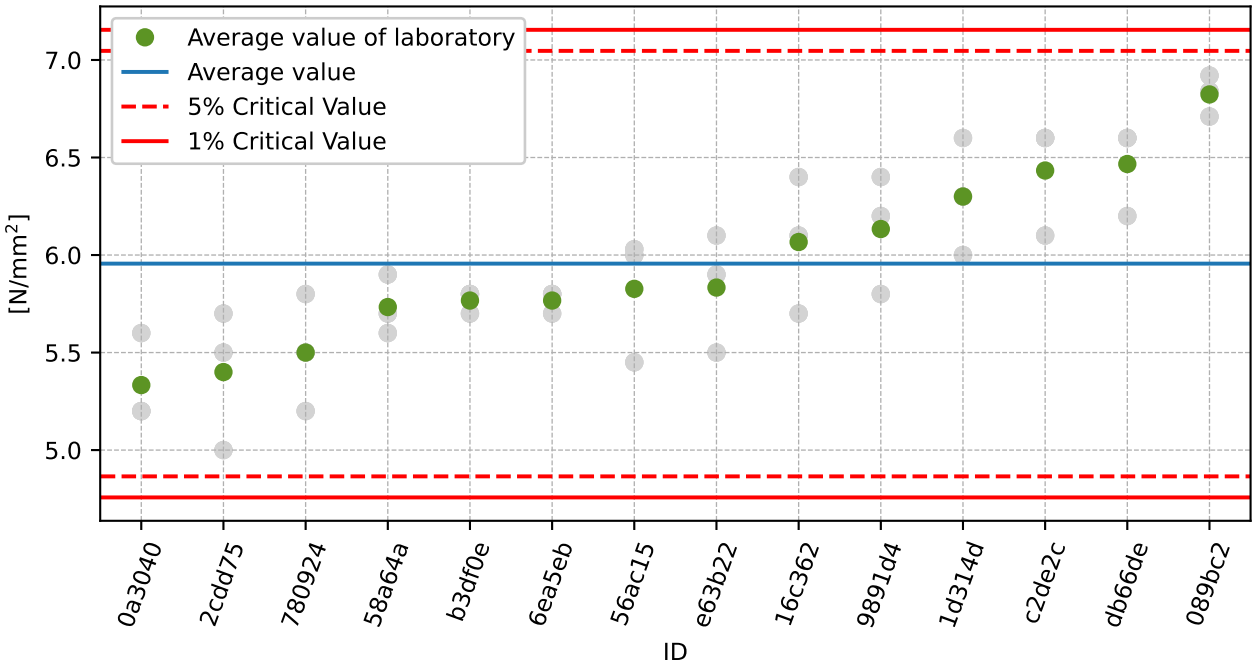

Figure 11: **Grubbs' test** - average values

2.3 Mandel's Statistics

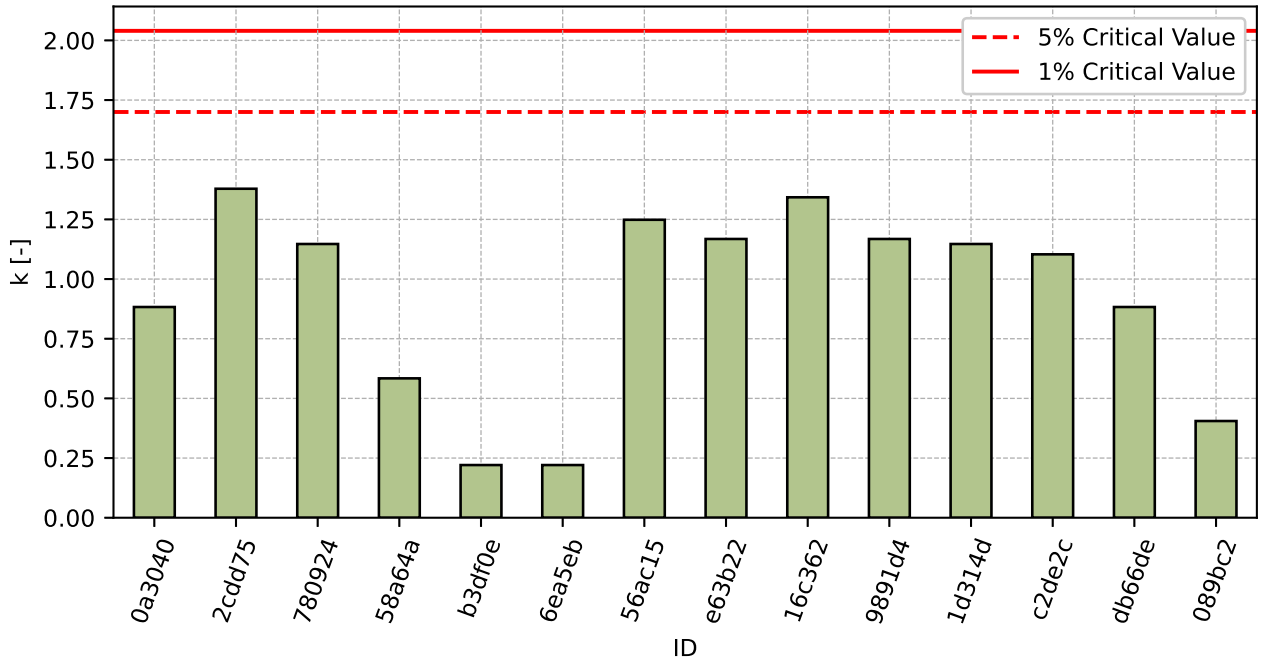

Figure 12: Intralaboratory Consistency Statistic

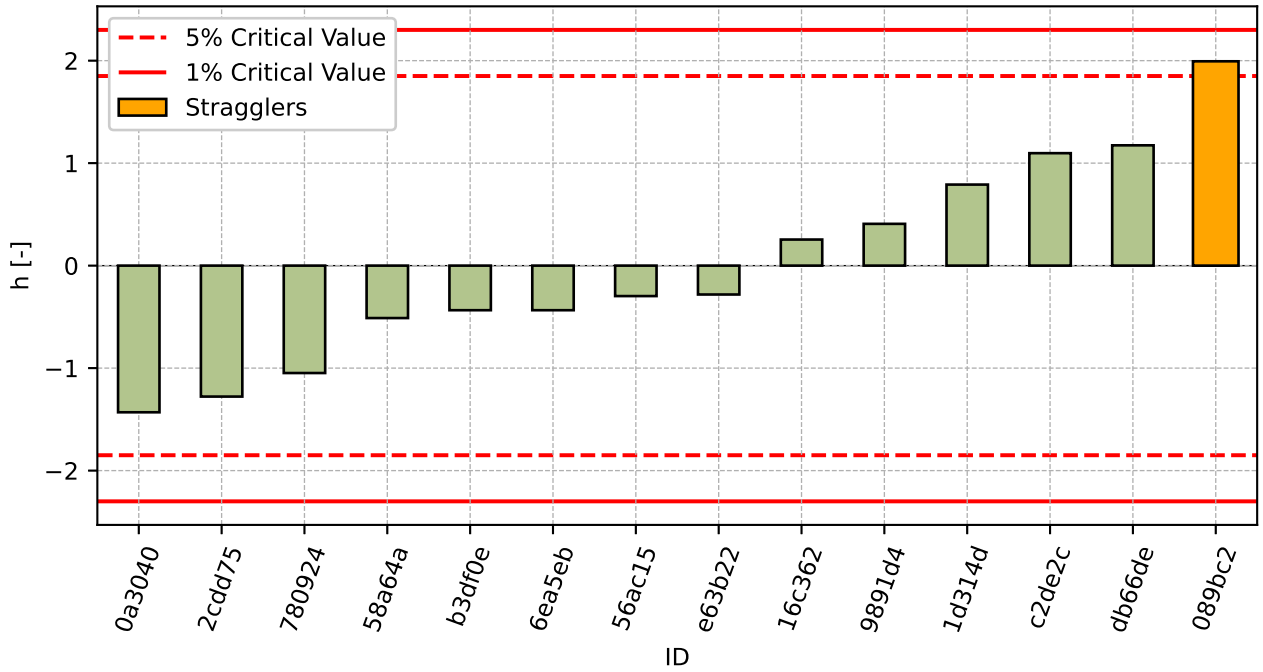

Figure 13: Interlaboratory Consistency Statistic

2.4 Descriptive statistics

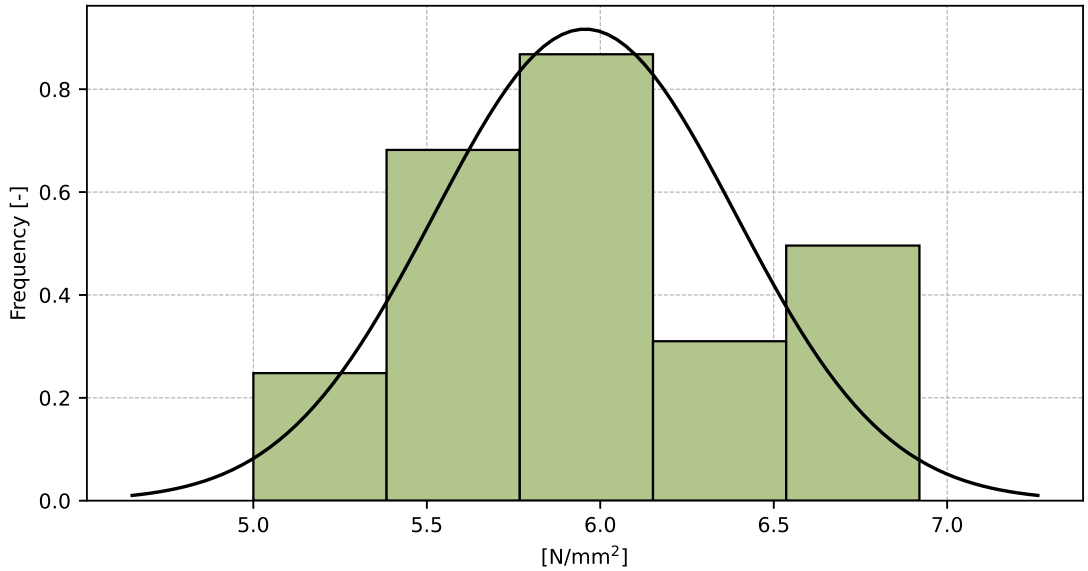

Figure 14: Histogram of all test results

Table 8: Descriptive statistics

Characteristics	**[N/mm²]**
Average value – $\bar{x}$	6.0
Sample standard deviation – s	0.44
Asigned value – x^*	6.0
Robust standard deviation – s^*	0.48
Measurement uncertainty of asigned value – u_X	0.16
p-value of normality test	0.581 [-]
Interlaboratory standard deviation – s_L	0.41
Repeatability standard deviation – s_r	0.26
Reproducibility standard deviation – s_R	0.48
Repeatability – r	0.7
Reproducibility – R	1.4

2.5 Evaluation of Performance Statistics

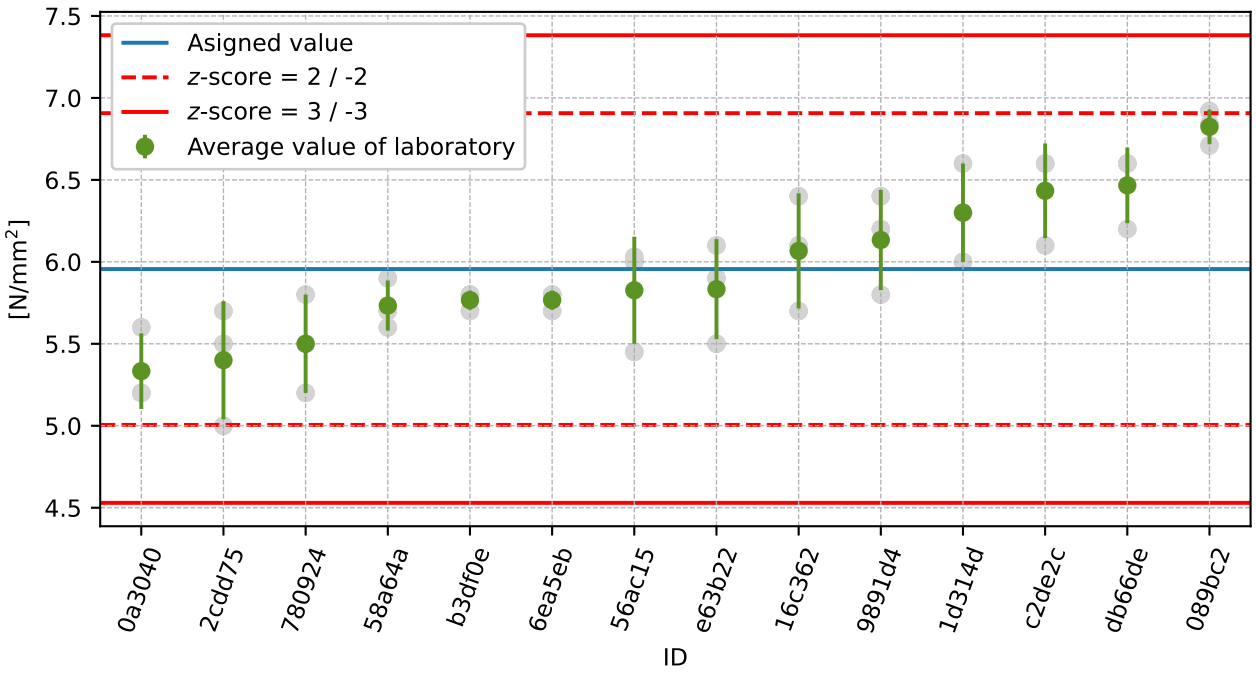

Figure 15: Average values and sample standard deviations

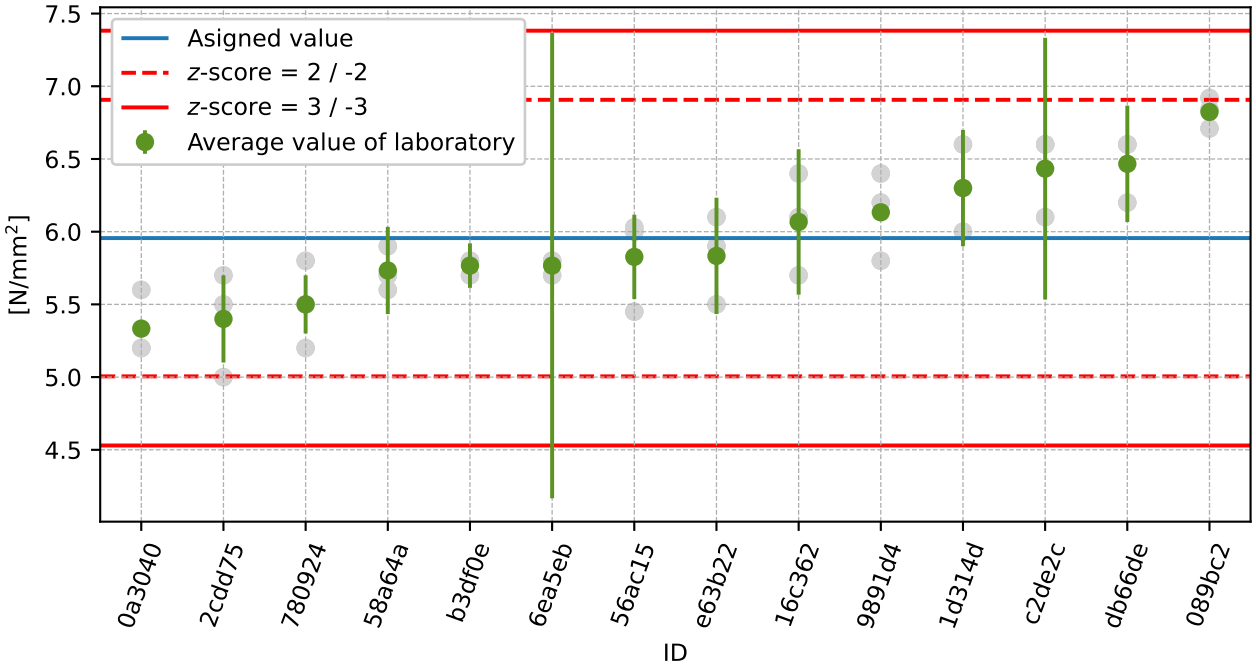

Figure 16: Average values and extended uncertainties of measurement

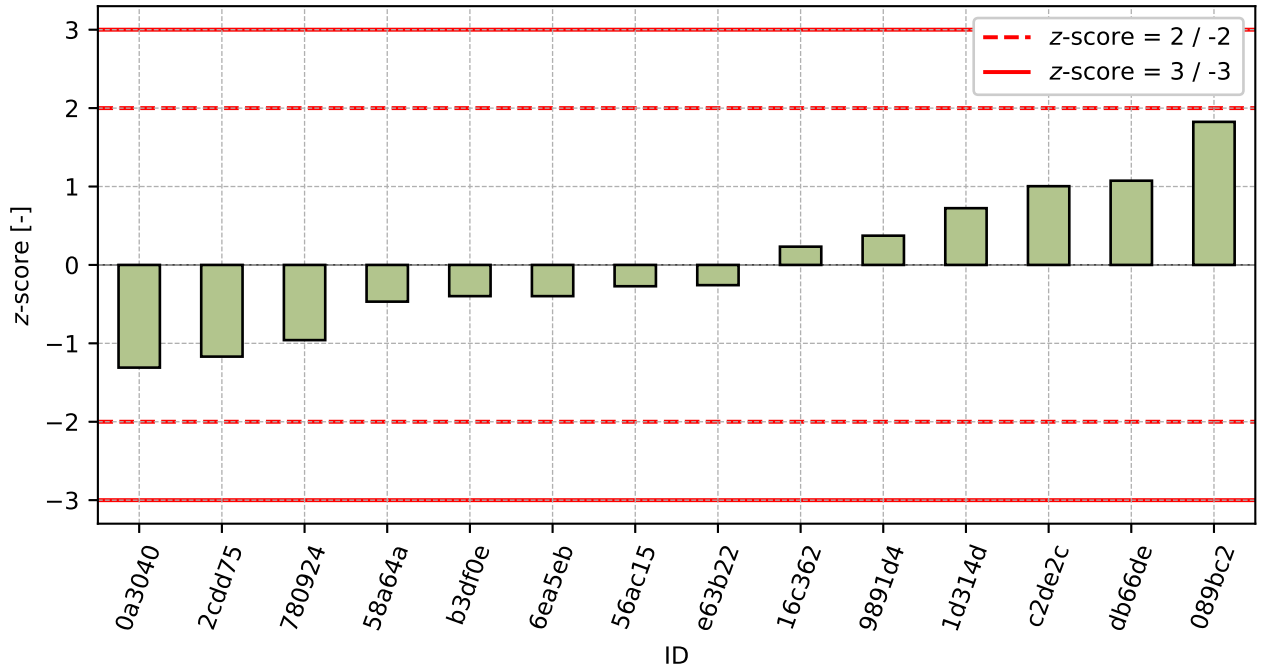

Figure 17: z-score

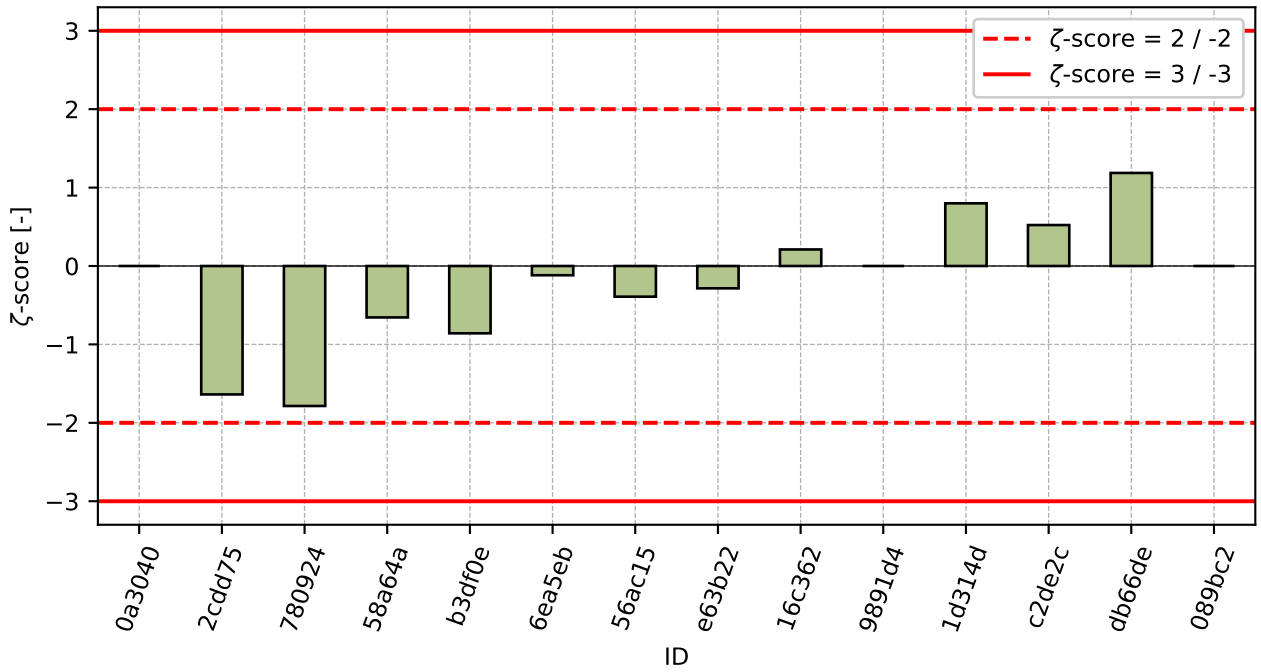

Figure 18: ζ-score

Table 9: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
0a3040	-1.31	-
2cdd75	-1.17	-1.64
780924	-0.96	-1.79
58a64a	-0.47	-0.66
b3df0e	-0.4	-0.86
6ea5eb	-0.4	-0.12
56ac15	-0.27	-0.39
e63b22	-0.26	-0.28
16c362	0.23	0.21
9891d4	0.37	-
1d314d	0.72	0.8
c2de2c	1.0	0.52
db66de	1.07	1.19
089bc2	1.82	-

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 [%]
ebf42a	3.6	3.6	3.5	-	3.6	0.05	1.41
0a3040	3.8	3.7	3.6	-	3.7	0.08	2.07
56ac15	4.2	4.0	3.8	0.2	4.0	0.17	4.31
434e59	4.1	4.0	3.8	-	4.0	0.13	3.31
5d59c8	4.0	4.1	3.9	2.0	4.0	0.1	2.5
c2de2c	4.2	3.6	4.4	1.0	4.0	0.36	8.9
1d314d	3.9	4.2	4.4	0.2	4.1	0.23	5.45
9891d4	4.0	4.3	4.3	-	4.2	0.17	4.12

3.2 The Numerical Procedure for Determining Outliers

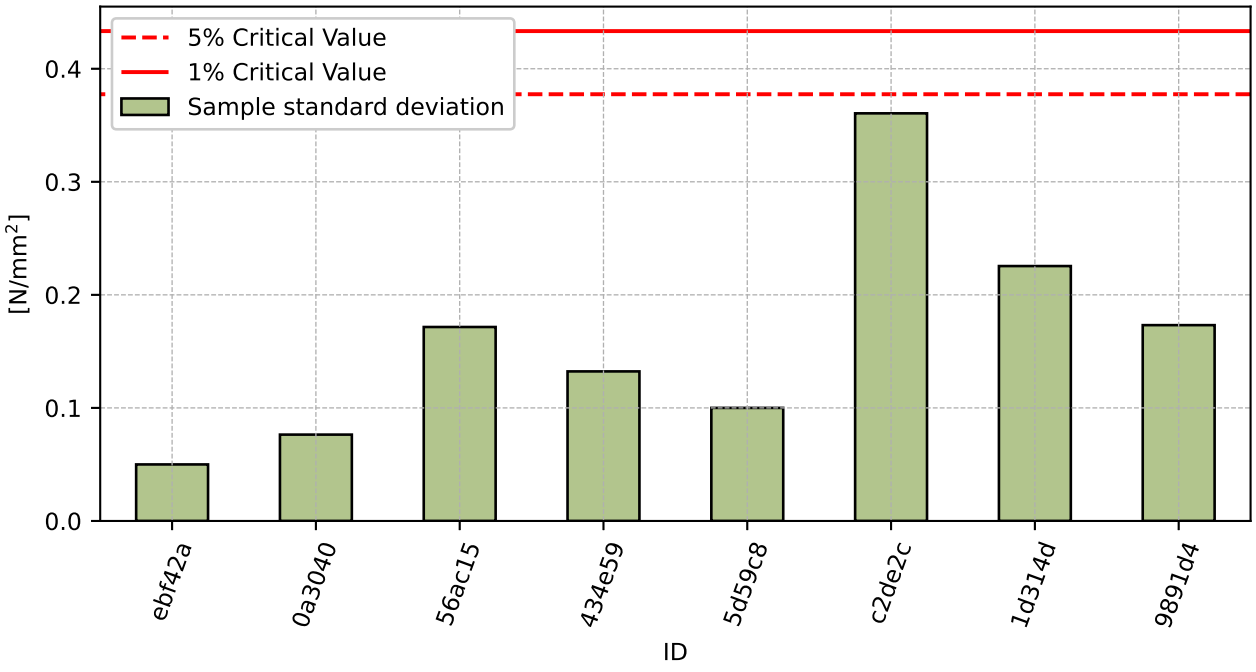

Figure 19: **Cochran's test** - sample standard deviations

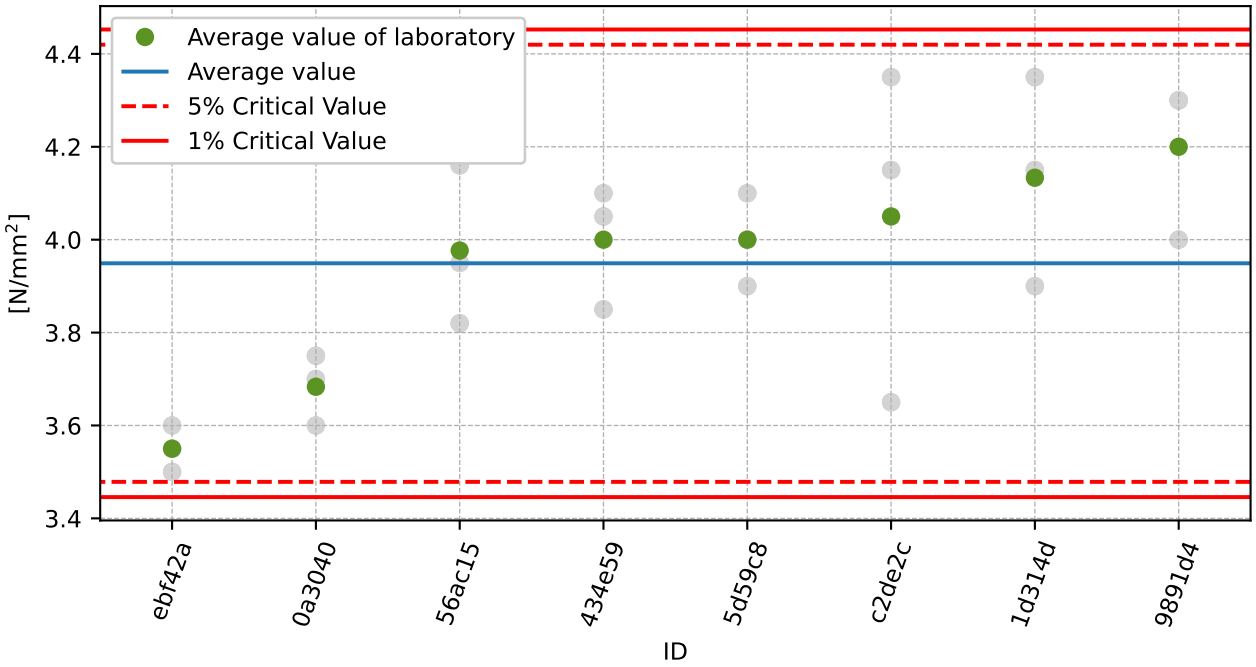

Figure 20: **Grubbs' test** - average values

3.3 Mandel's Statistics

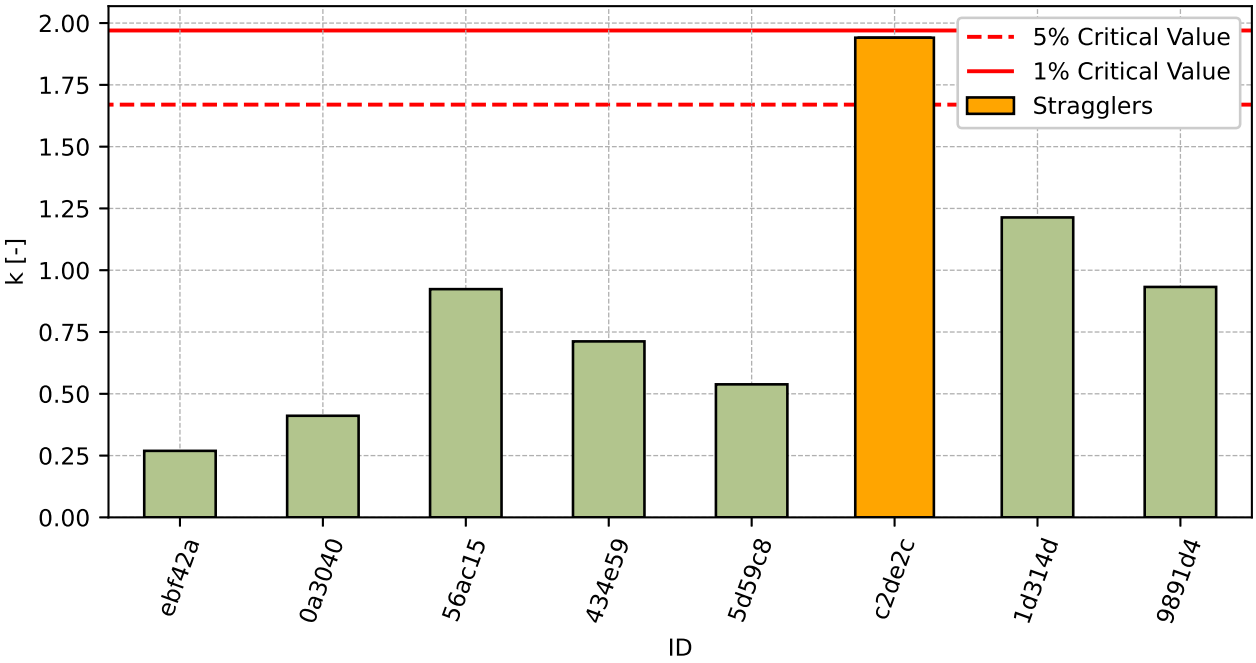

Figure 21: Intralaboratory Consistency Statistic

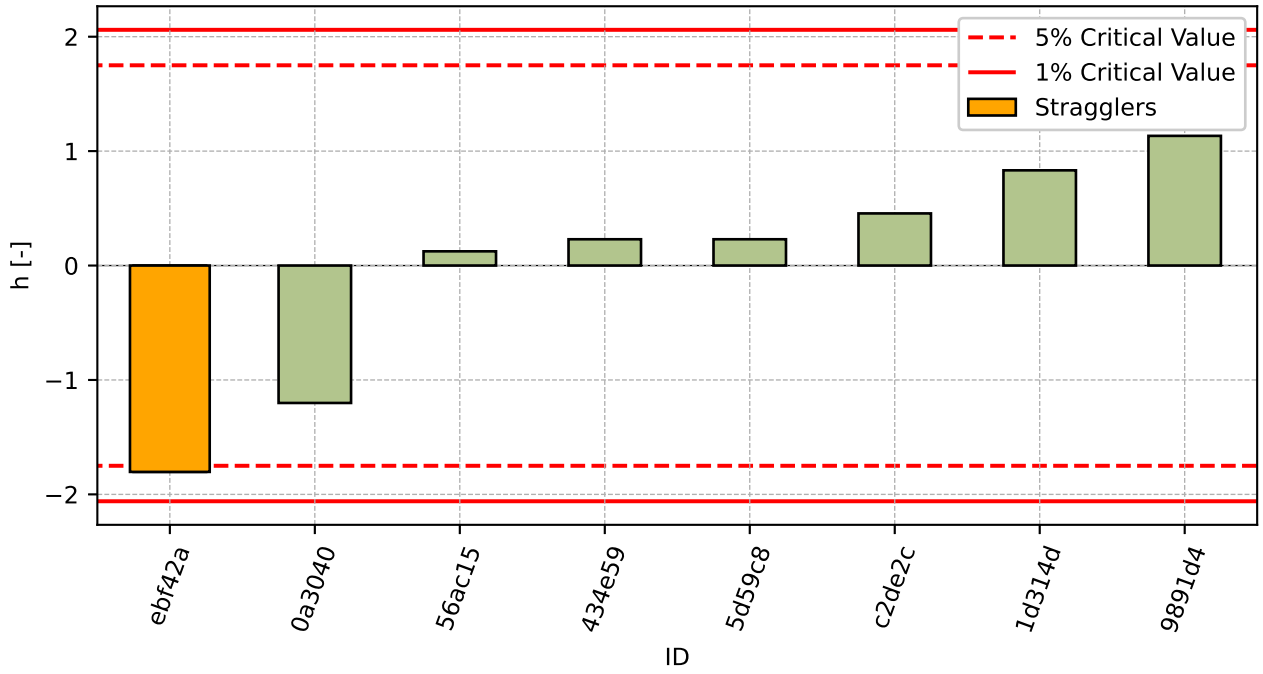

Figure 22: Interlaboratory Consistency Statistic

3.4 Descriptive statistics

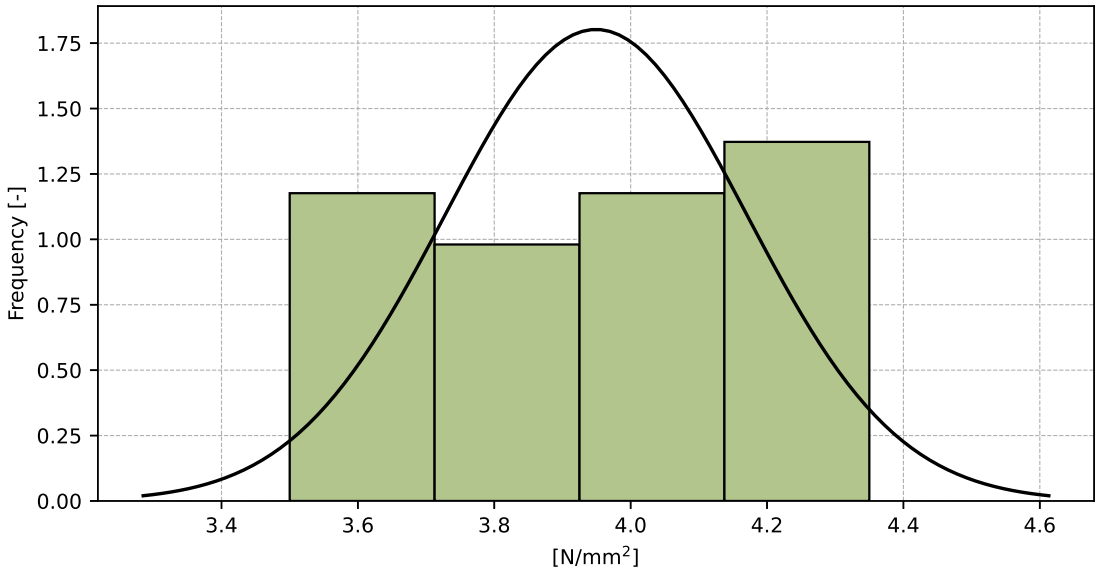

Figure 23: Histogram of all test results

Table 11: Descriptive statistics

Characteristics	[N/mm^2]
Average value – $\bar{x}$	3.9
Sample standard deviation – s	0.22
Asigned value – x^*	3.9
Robust standard deviation – s^*	0.22
Measurement uncertainty of asigned value – u_X	0.08
p-value of normality test	0.266 [-]
Interlaboratory standard deviation – s_L	0.19
Repeatability standard deviation – s_r	0.19
Reproducibility standard deviation – s_R	0.27
Repeatability – r	0.5
Reproducibility – R	0.8

3.5 Evaluation of Performance Statistics

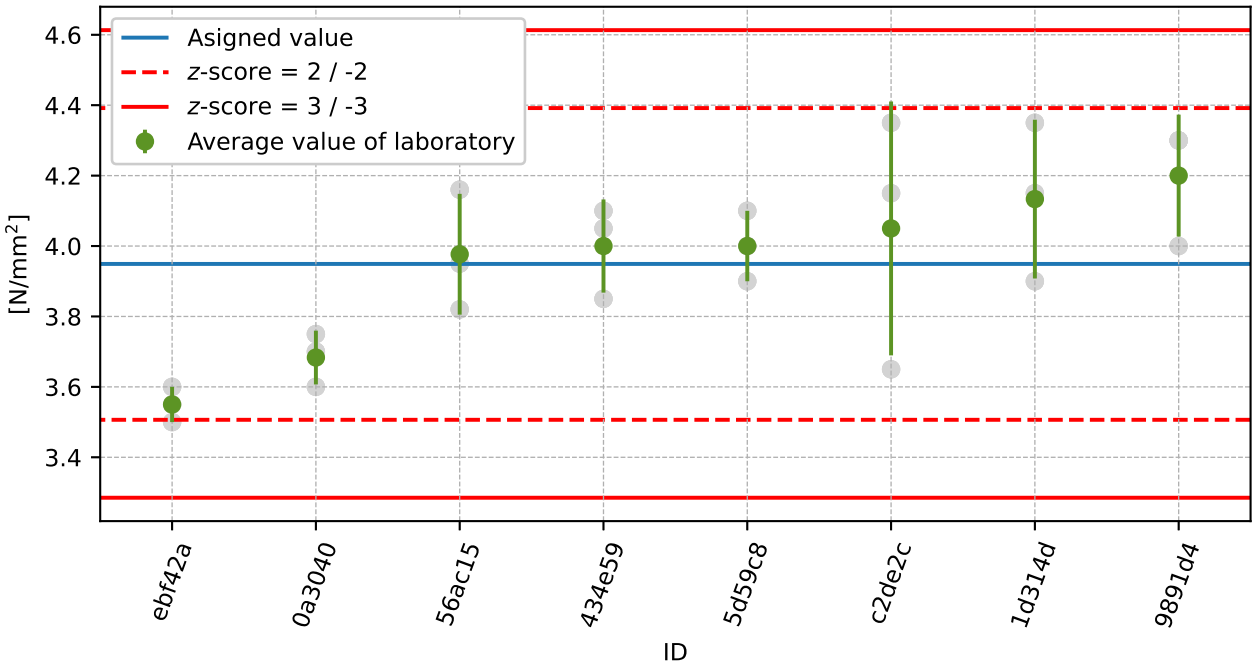

Figure 24: Average values and sample standard deviations

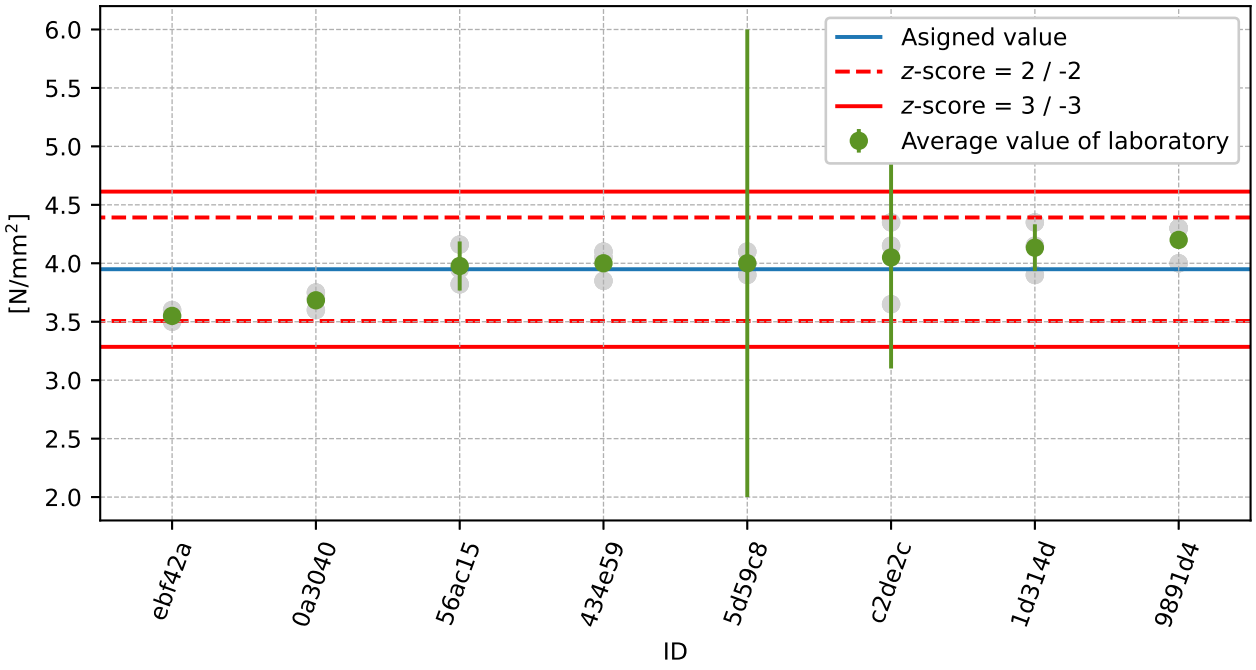

Figure 25: Average values and extended uncertainties of measurement

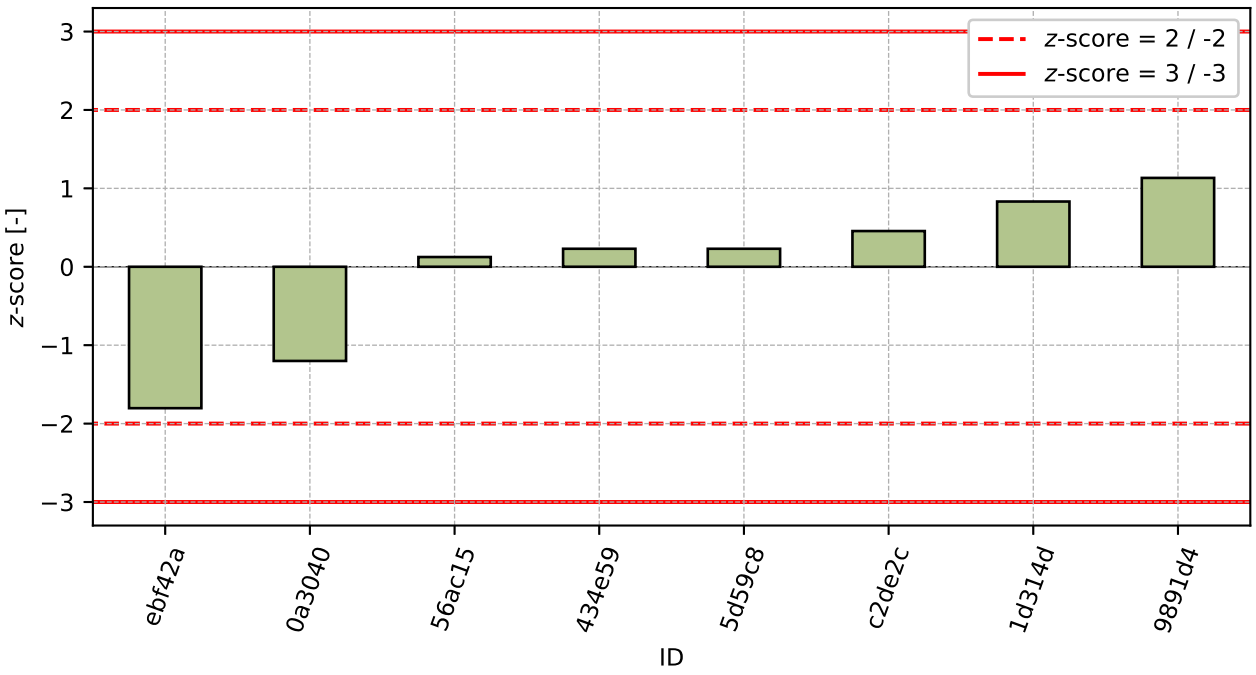

Figure 26: z-score

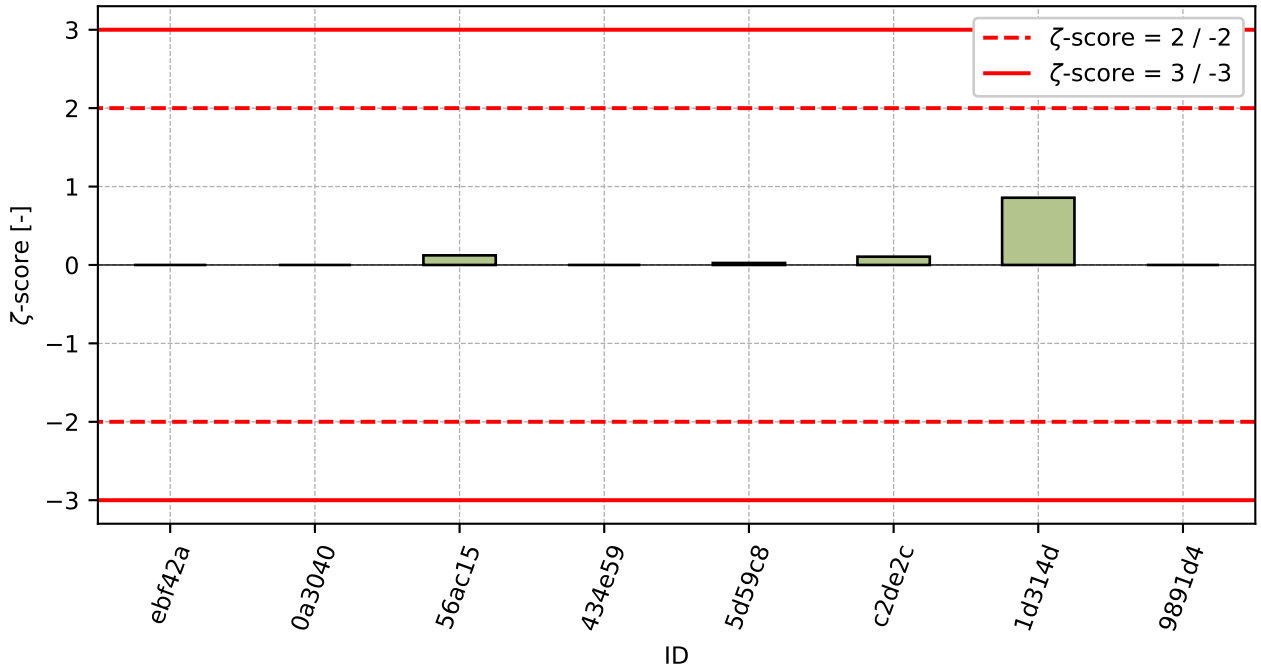

Figure 27: ζ-score

Table 12: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
ebf42a	-1.8	-
0a3040	-1.2	-
56ac15	0.12	0.12
434e59	0.23	-
5d59c8	0.23	0.03
c2de2c	0.46	0.11
1d314d	0.83	0.86
9891d4	1.13	-

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 [%]
0a3040	2300	2310	2280	-	2297	15.3	0.67
9826a1	2303	2313	2322	3	2313	9.5	0.41
fa4e31	2285	2303	2353	-	2314	35.2	1.52
f5fbcd	2286	2328	2329	1	2314	24.5	1.06
56ac15	2326	2296	2331	19	2318	18.9	0.82
7a198f	2320	2320	2320	-	2320	0.0	0.0
b31adf	2320	2300	2350	38	2323	25.2	1.08
db66de	2312	2346	2331	56	2330	17.0	0.73
397173	2340	2310	2340	-	2330	17.3	0.74
434e59	2320	2330	2340	-	2330	10.0	0.43
3dc7ad	2360	2320	2310	0	2330	26.5	1.14
6658ac	2330	2340	2350	60	2340	10.0	0.43
b98482	2360	2350	2310	10	2340	26.5	1.13
1d314d	2340	2350	2340	20	2343	5.8	0.25
f3cd50	2350	2340	2350	1	2347	5.8	0.25
537007	2371	2344	2353	7	2356	13.7	0.58
9d97d6	2370	2360	2340	-	2357	15.3	0.65
b67ca8	2360	2400	2380	53	2380	20.0	0.84

4.2 The Numerical Procedure for Determining Outliers

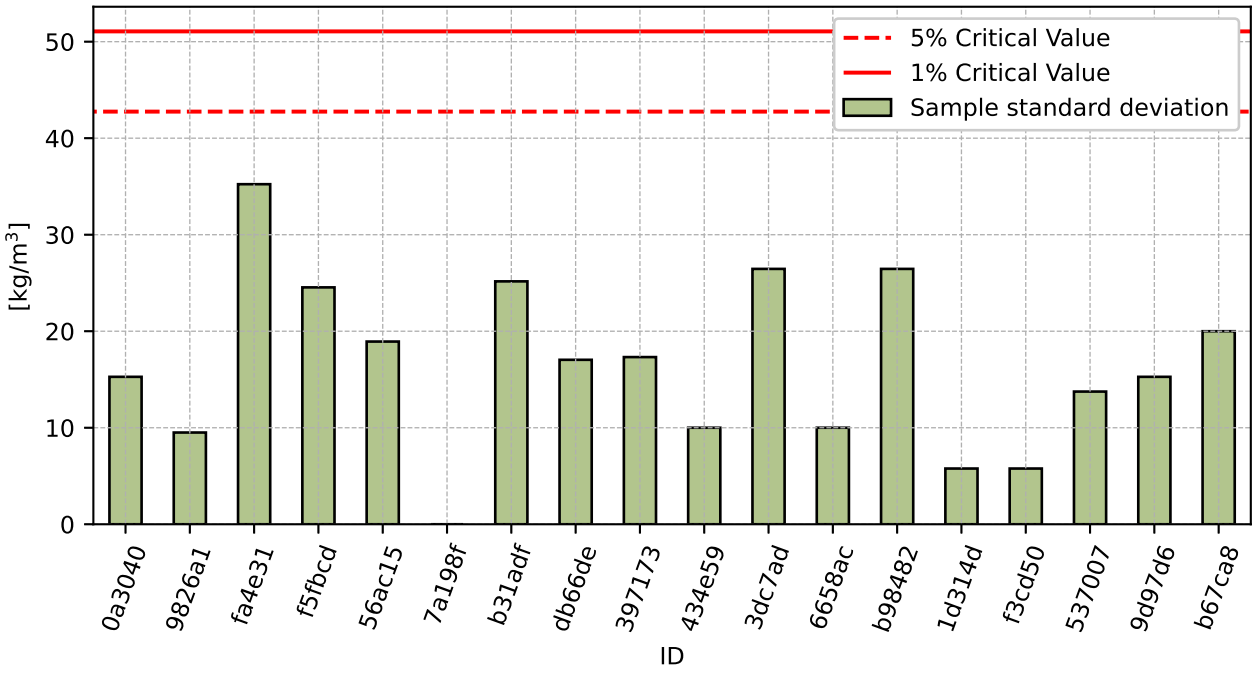

Figure 28: **Cochran's test** - sample standard deviations

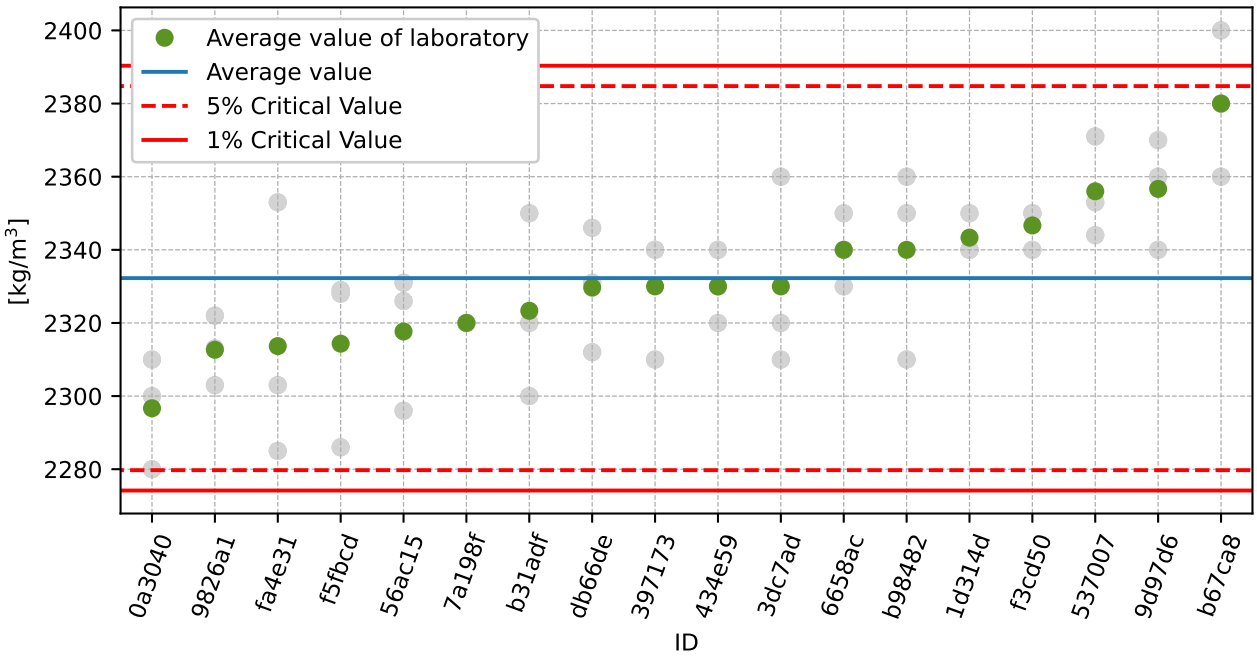

Figure 29: **Grubbs' test** - average values

4.3 Mandel's Statistics

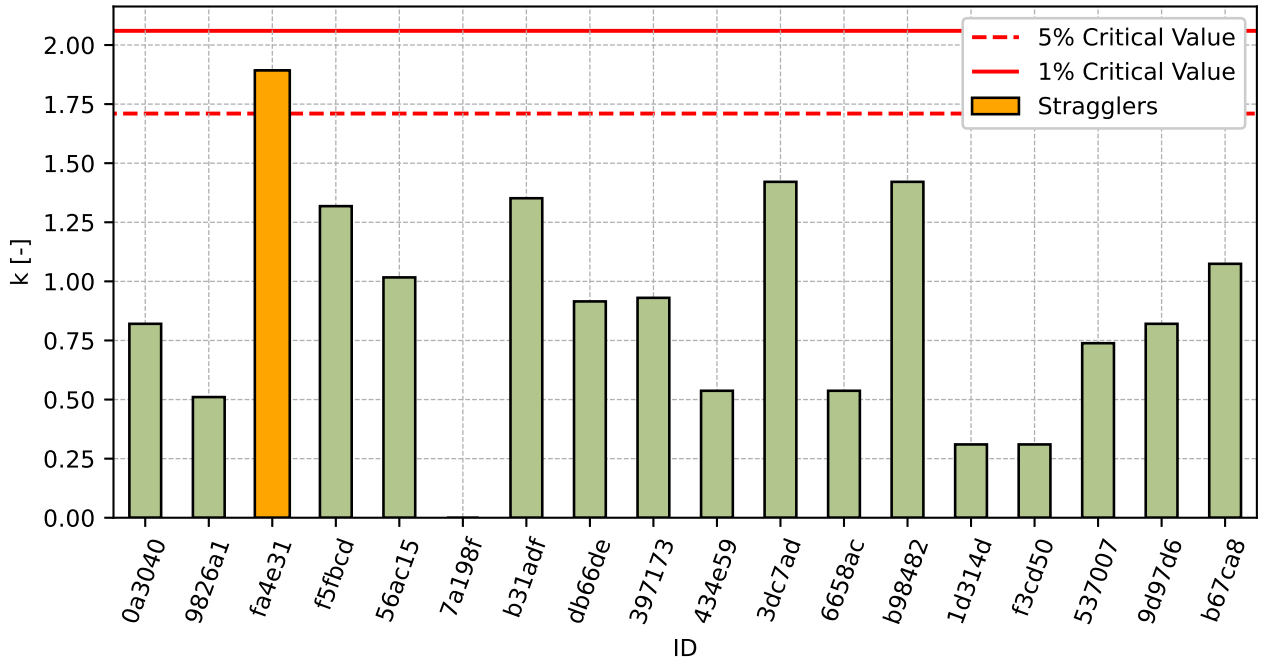

Figure 30: Intralaboratory Consistency Statistic

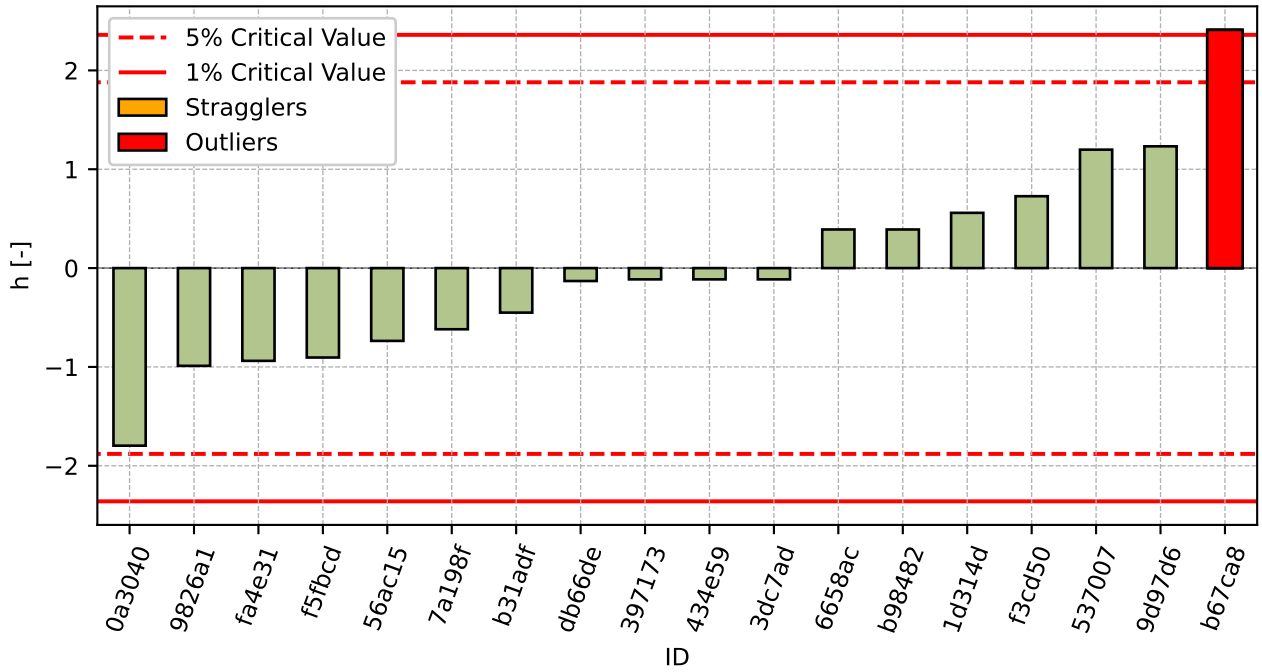

Figure 31: Interlaboratory Consistency Statistic

4.4 Descriptive statistics

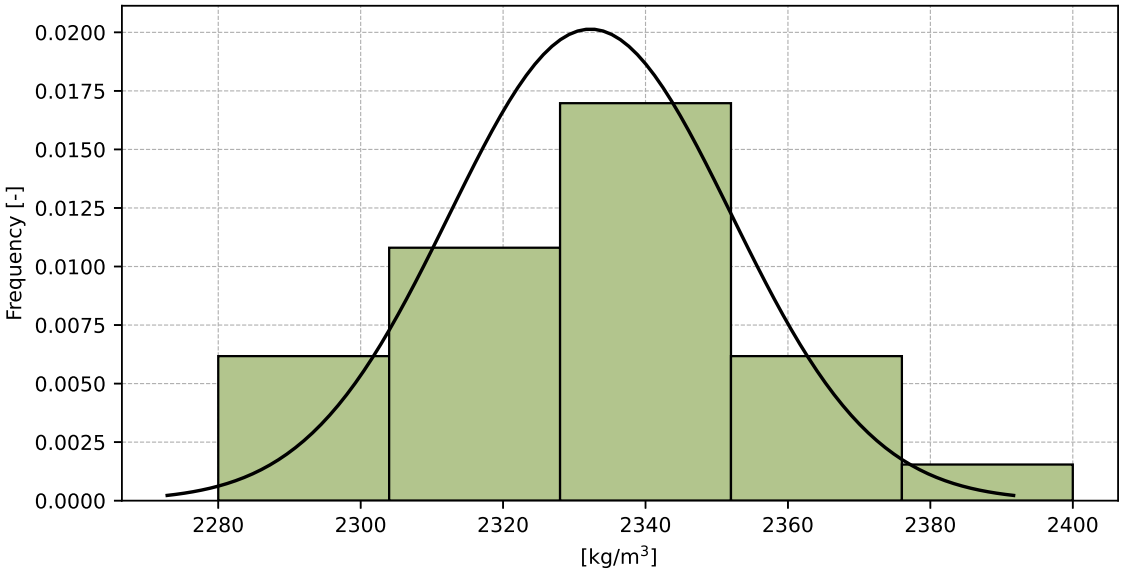

Figure 32: Histogram of all test results

Table 14: Descriptive statistics

Characteristics	**[kg/m³]**
Average value – $\bar{x}$	2332
Sample standard deviation – s	19.8
Asigned value – x^*	2333
Robust standard deviation – s^*	24.3
Measurement uncertainty of asigned value – u_X	6.3
p-value of normality test	0.88 [-]
Interlaboratory standard deviation – s_L	16.6
Repeatability standard deviation – s_r	18.6
Reproducibility standard deviation – s_R	25.0
Repeatability – r	52
Reproducibility – R	70

4.5 Evaluation of Performance Statistics

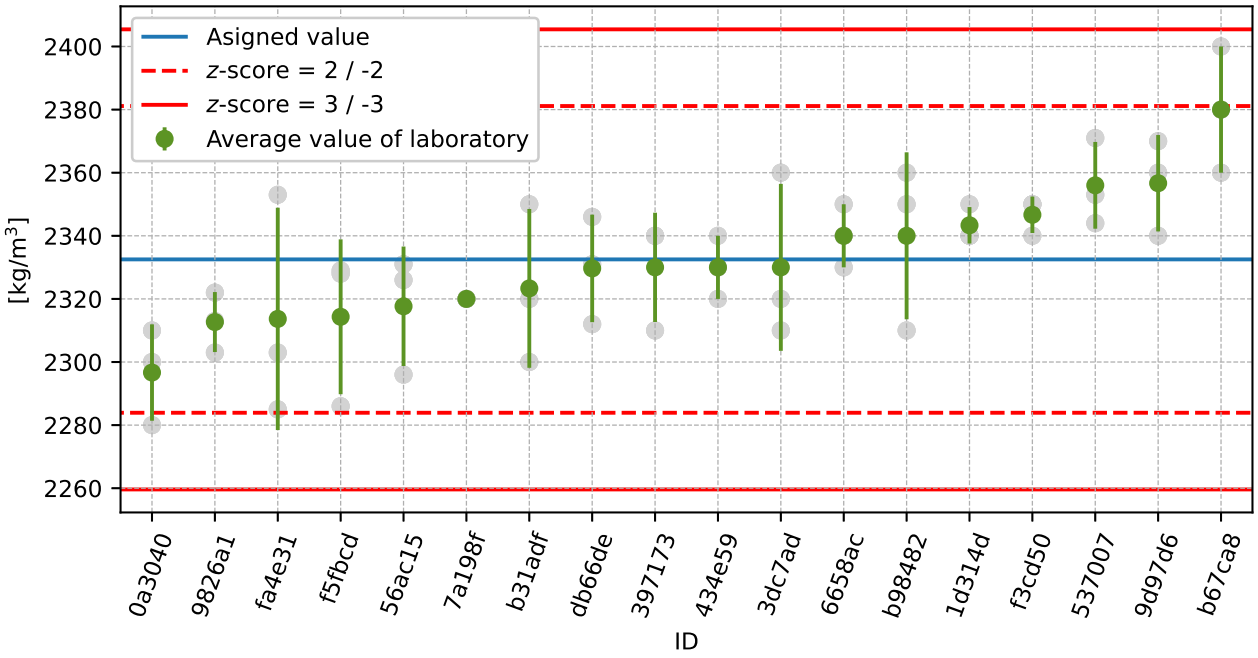

Figure 33: Average values and sample standard deviations

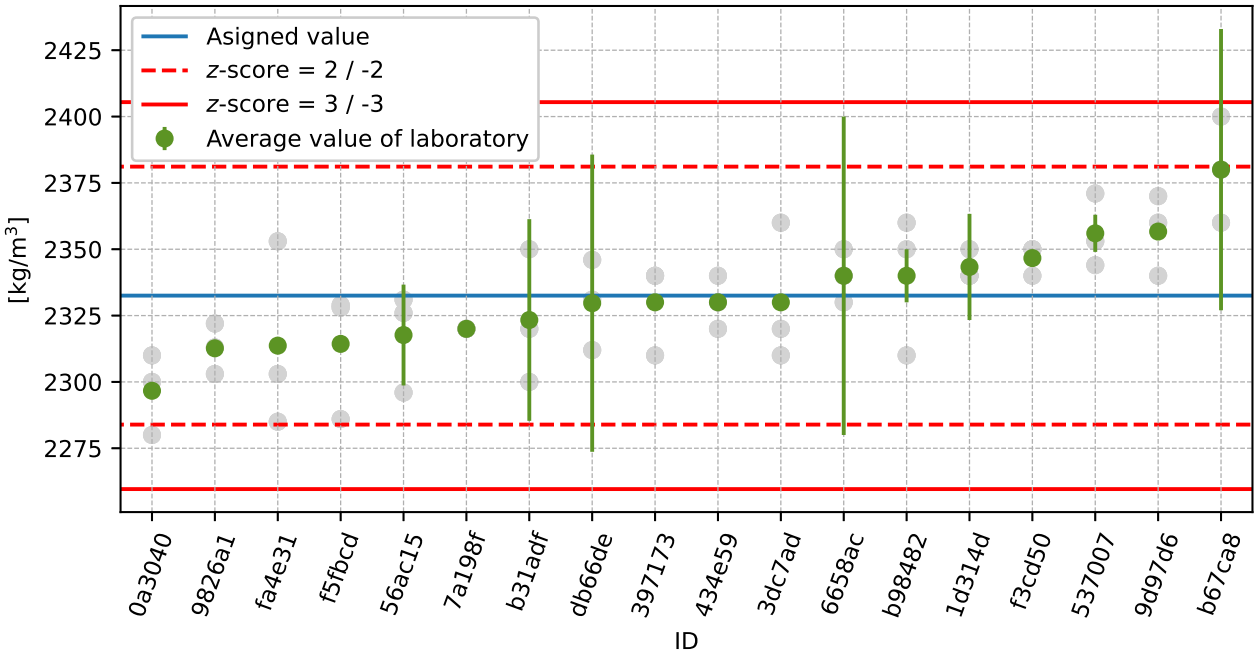

Figure 34: Average values and extended uncertainties of measurement

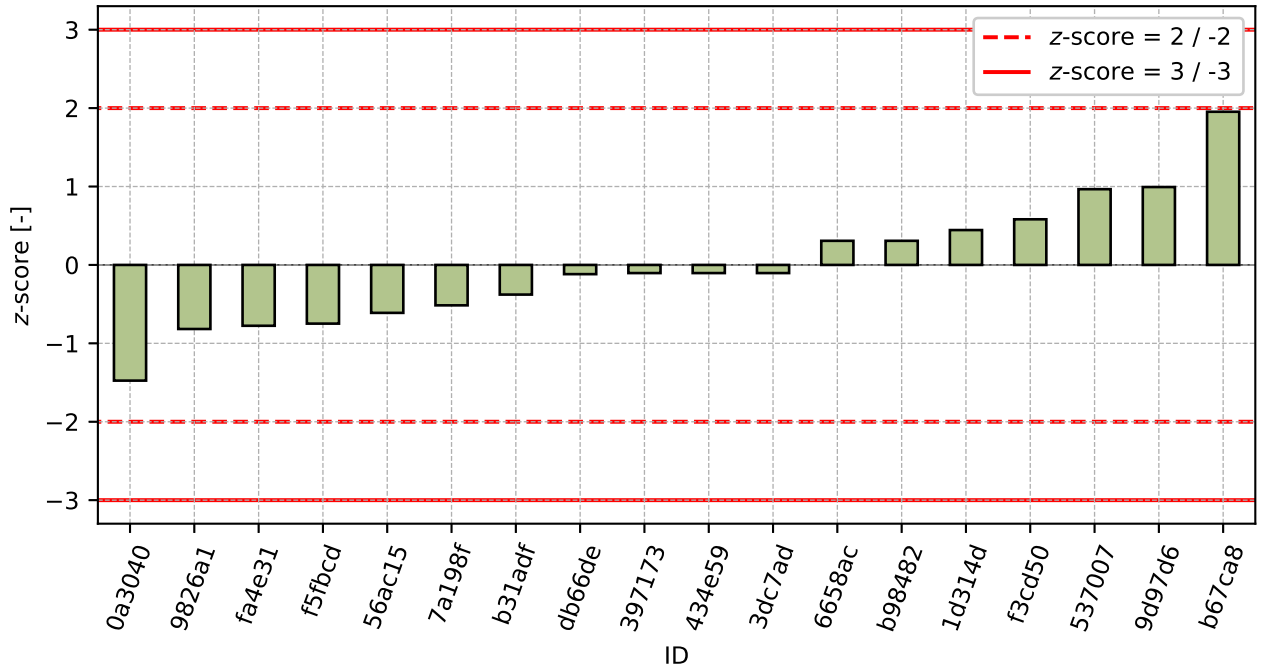

Figure 35: z-score

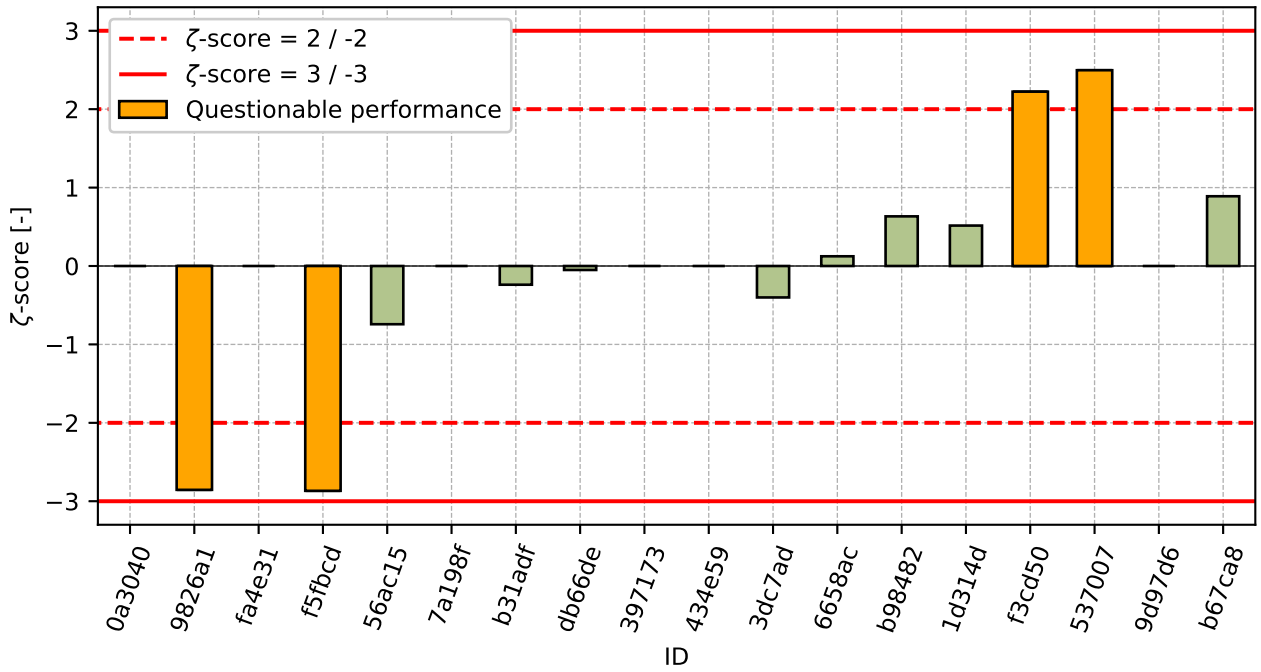

Figure 36: ζ-score

Table 15: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
0a3040	-1.48	-
9826a1	-0.82	-2.85
fa4e31	-0.78	-
f5fbcd	-0.75	-2.87
56ac15	-0.61	-0.74
7a198f	-0.52	-
b31adf	-0.38	-0.24
db66de	-0.12	-0.05
397173	-0.1	-
434e59	-0.1	-
3dc7ad	-0.1	-0.4
6658ac	0.31	0.12
b98482	0.31	0.63
1d314d	0.44	0.52
f3cd50	0.58	2.22
537007	0.97	2.5
9d97d6	0.99	-
b67ca8	1.95	0.89

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 [%]
42f004	31020	33180	1100	32100	1527.4	4.76
537007	33700	32700	670	33200	707.1	2.13
2cdd75	35100	33600	700	34350	1060.7	3.09
e63b22	35300	36000	2000	35650	495.0	1.39
52b50d	37700	38600	750	38150	636.4	1.67

5.2 The Numerical Procedure for Determining Outliers

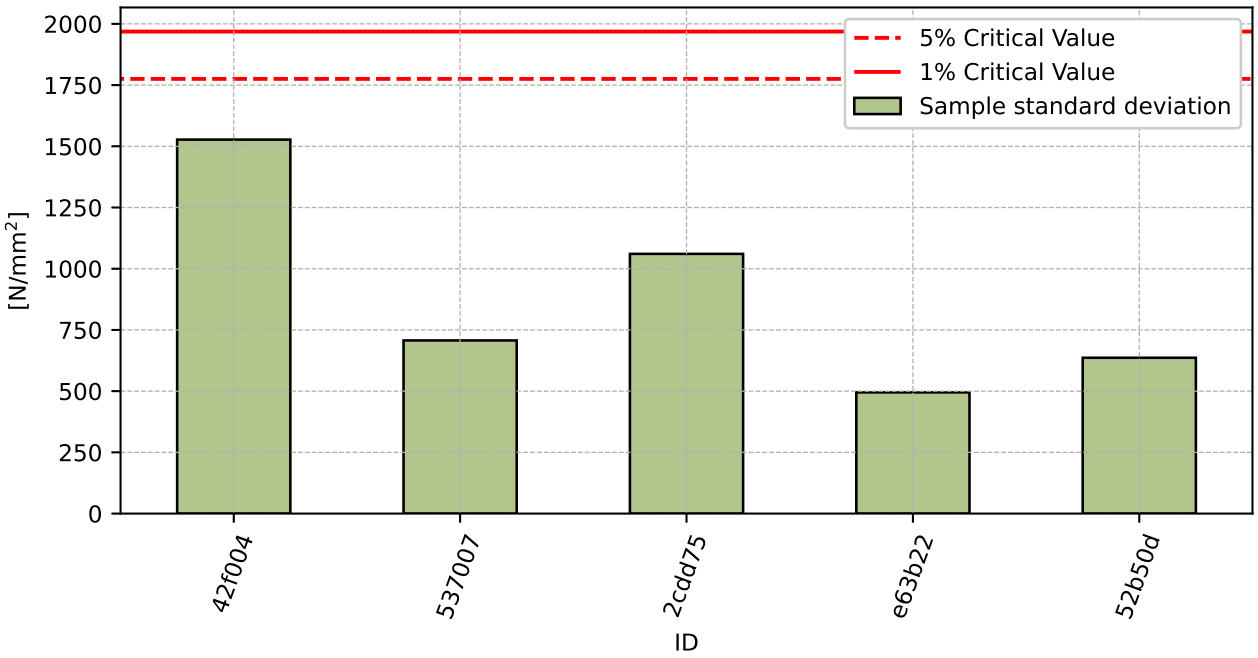

Figure 37: **Cochran's test** - sample standard deviations

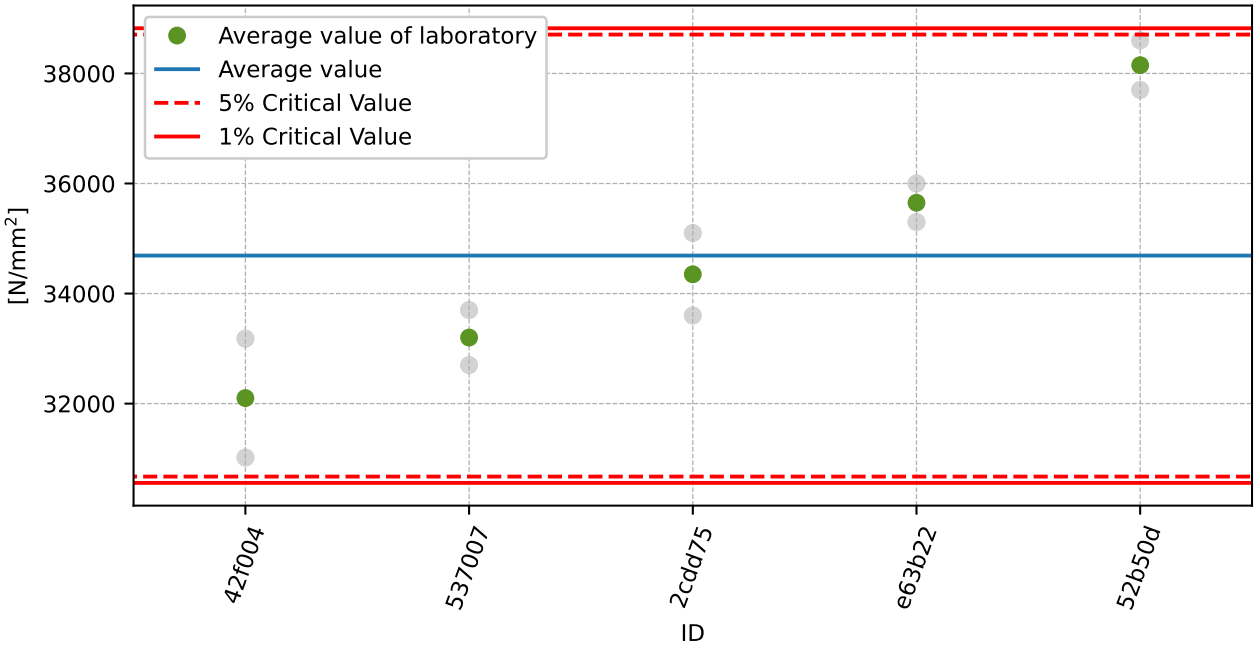

Figure 38: **Grubbs' test** - average values

5.3 Mandel's Statistics

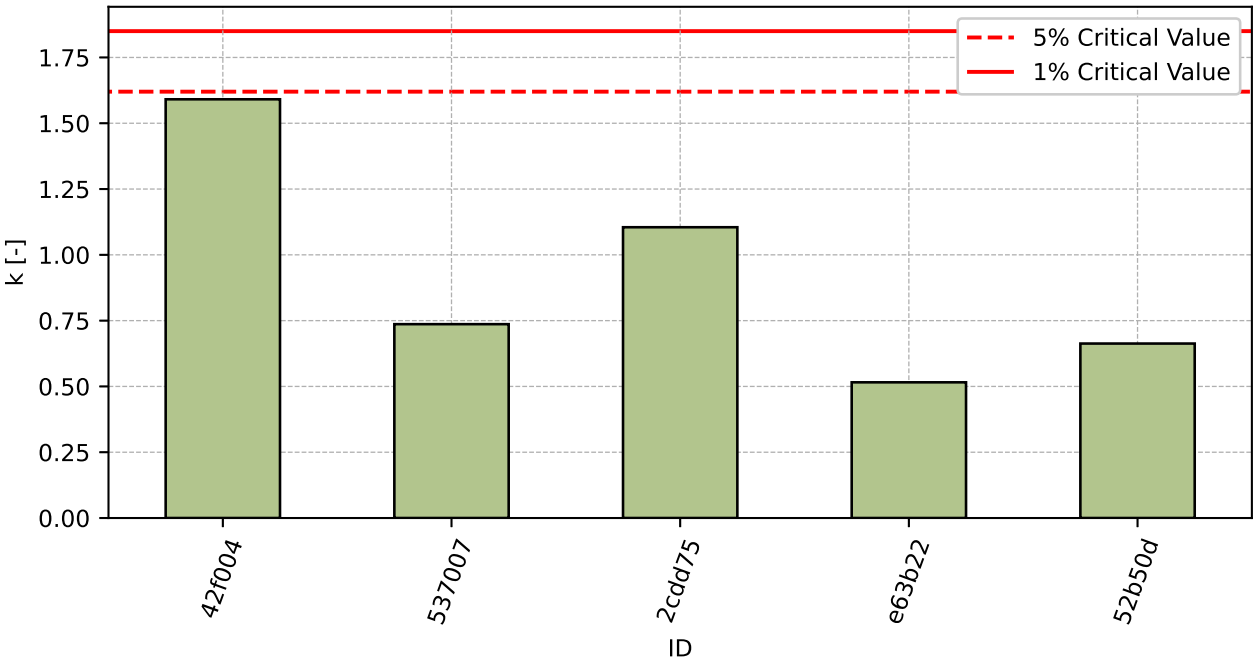

Figure 39: Intralaboratory Consistency Statistic

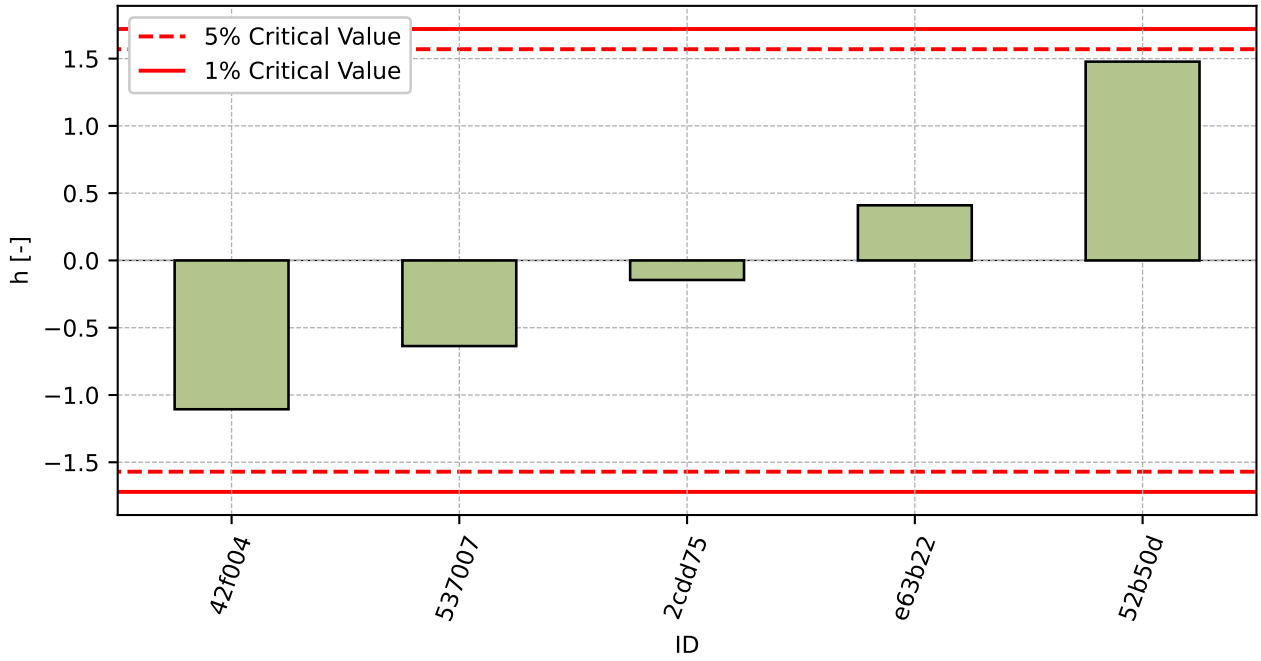

Figure 40: Interlaboratory Consistency Statistic

5.4 Descriptive statistics

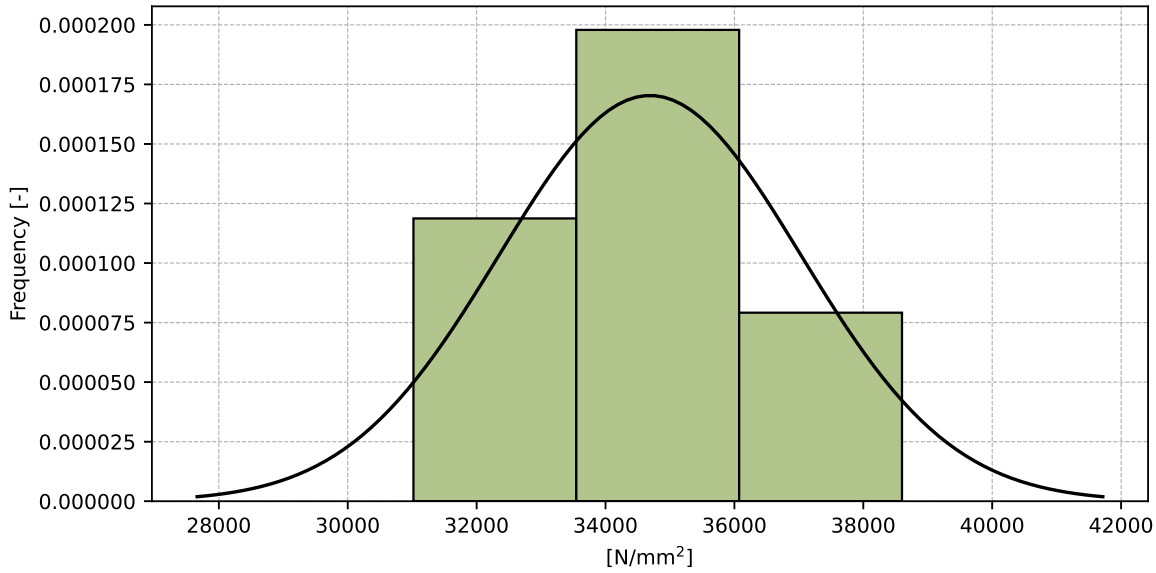

Figure 41: Histogram of all test results

Table 17: Descriptive statistics

Characteristics	[N/mm^2]
Average value – $\bar{x}$	34690
Sample standard deviation – s	2341.8
Asigned value – x^*	34690
Robust standard deviation – s^*	2378.3
Measurement uncertainty of asigned value – u_X	1327.8
p-value of normality test	0.897 [-]
Interlaboratory standard deviation – s_L	2241.3
Repeatability standard deviation – s_r	960.0
Reproducibility standard deviation – s_R	2438.2
Repeatability – r	2688
Reproducibility – R	6827

5.5 Evaluation of Performance Statistics

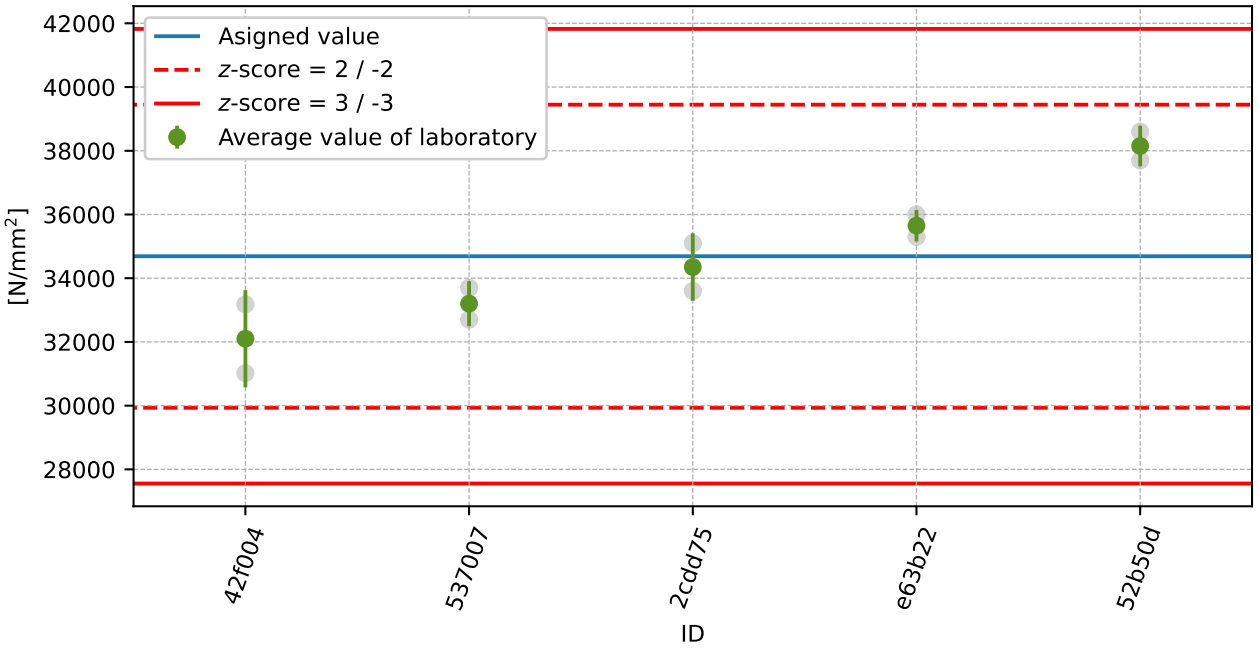

Figure 42: Average values and sample standard deviations

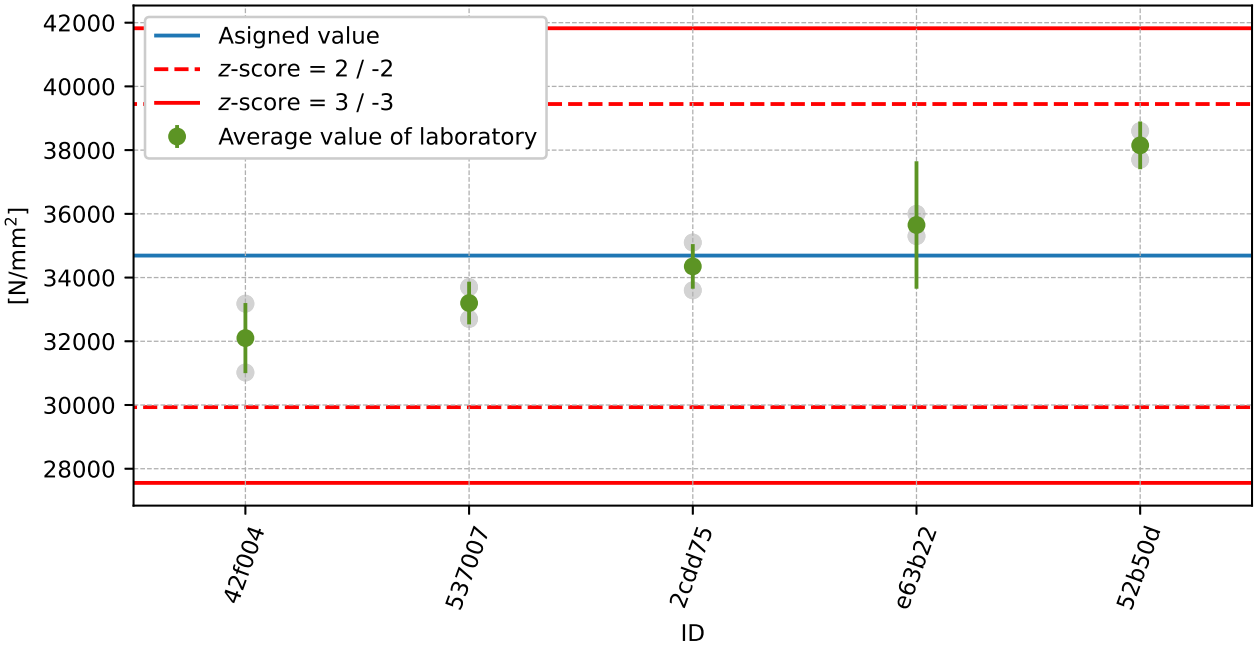

Figure 43: Average values and extended uncertainties of measurement

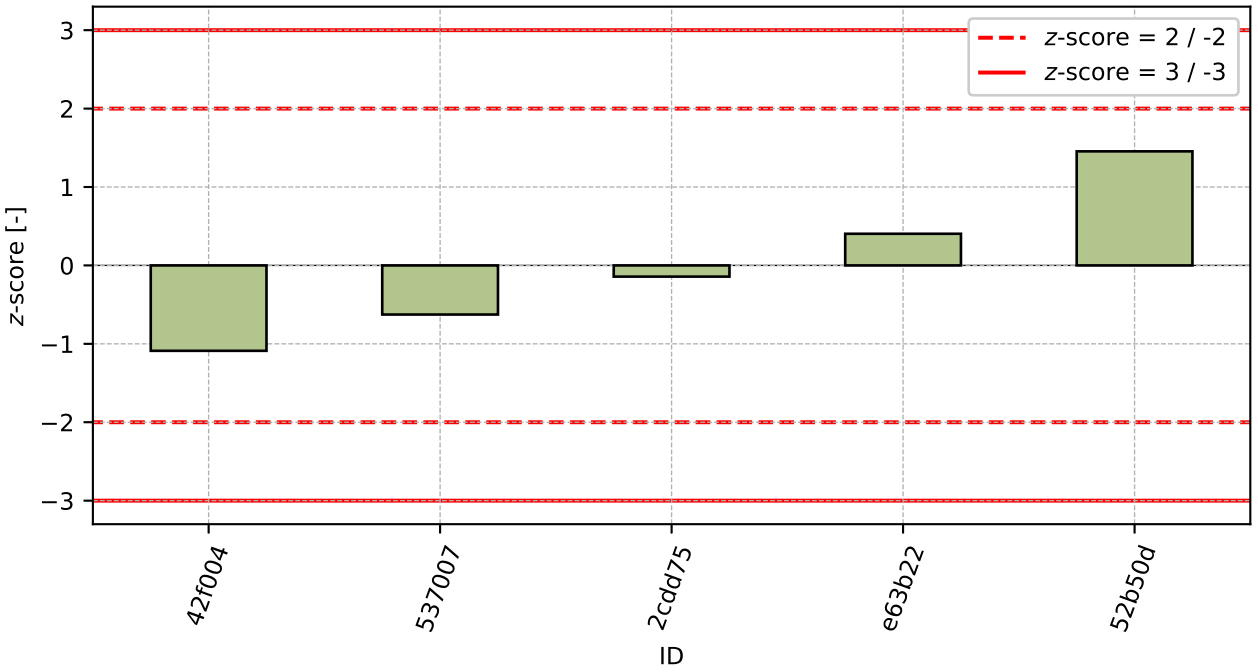

Figure 44: z-score

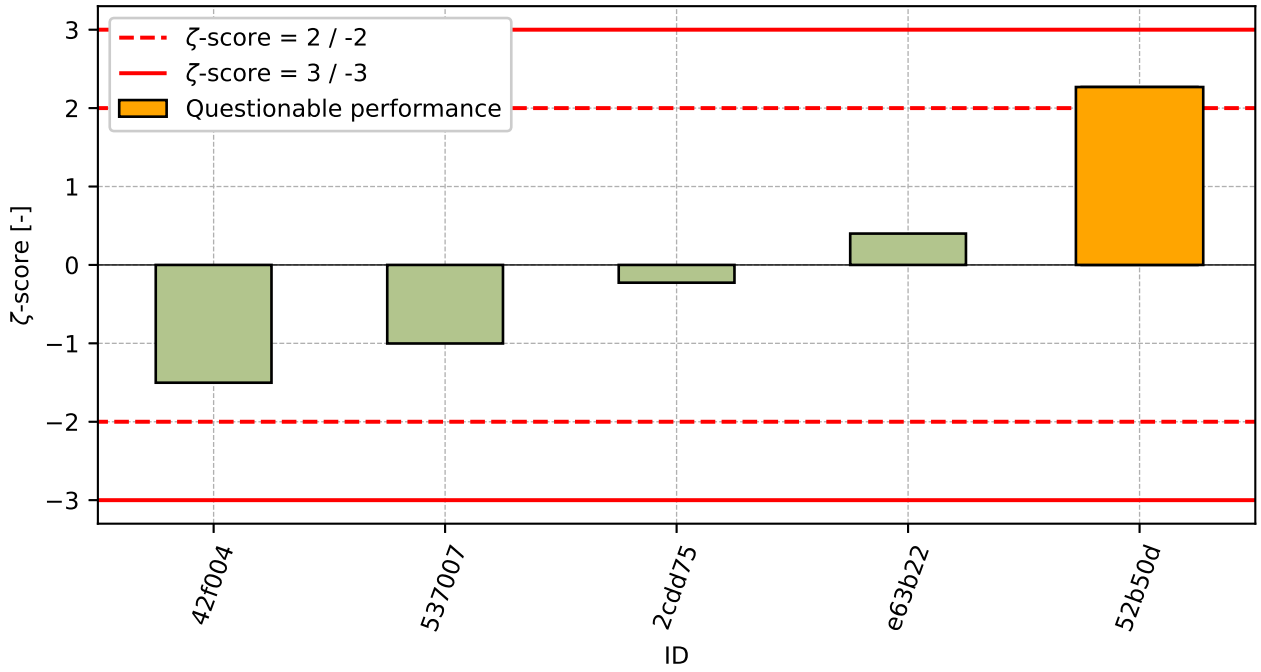

Figure 45: ζ-score

Table 18: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
42f004	-1.09	-1.5
537007	-0.63	-1.0
2cdd75	-0.14	-0.23
e63b22	0.4	0.4
52b50d	1.45	2.27

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

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

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

9.1 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 [-]			u_X [-]	$\bar{x}$ [-]	s_0 [-]	V_X [%]
b31adf	36	32	35	1	34	1.6	4.68
7742a2	35	35	35	2	35	0.0	0.0
b3df0e	40	37	34	1	37	3.0	8.11
6fa28a	38	38	37	3	38	0.6	1.53
56ac15	37	37	41	2	38	2.3	6.02
de0879	38	40	42	10	40	1.8	4.41
b562b2	43	46	44	2	44	1.5	3.45
b67ca8	44	46	45	3	45	1.0	2.22
5c8f54	45	44	47	3	45	1.5	3.37
6658ac	46	45	48	1	46	1.5	3.3
58a64a	48	47	49	-	48	1.0	2.08
16c362	48	50	52	2	50	2.0	4.0
31fb26	51	52	51	3	51	0.6	1.12
1d314d	54	53	55	4	54	1.0	1.85

9.2 The Numerical Procedure for Determining Outliers

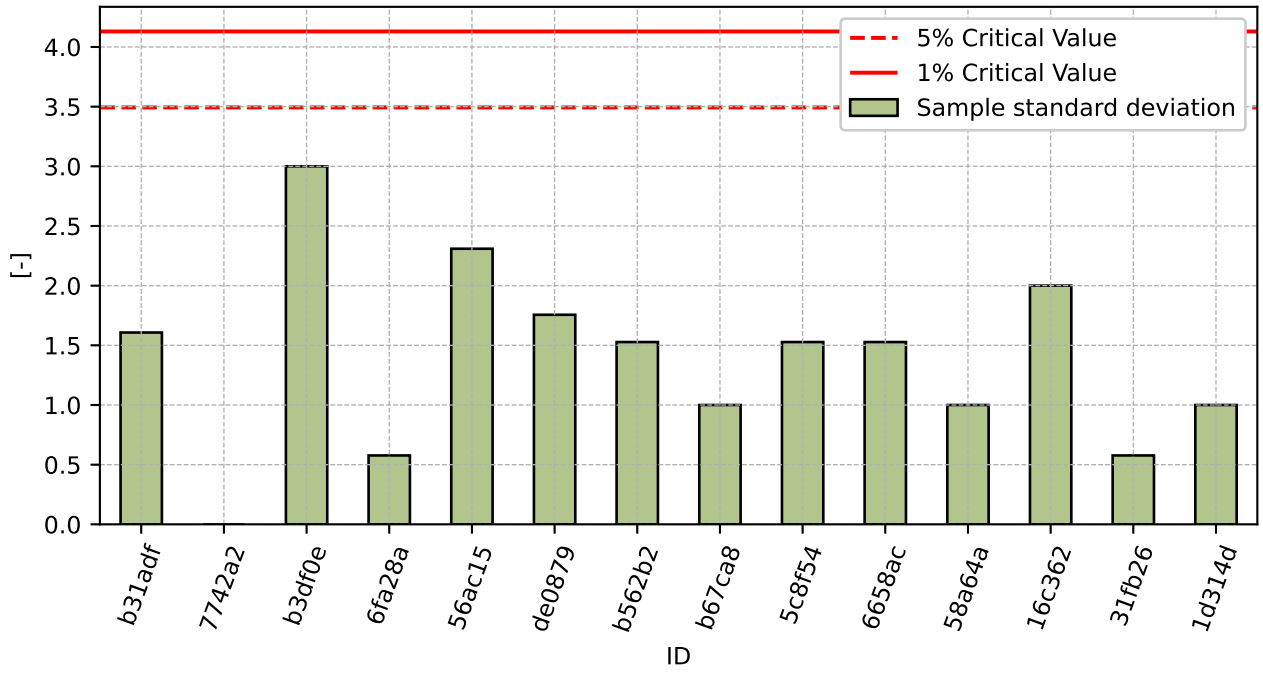

Figure 46: **Cochran's test** - sample standard deviations

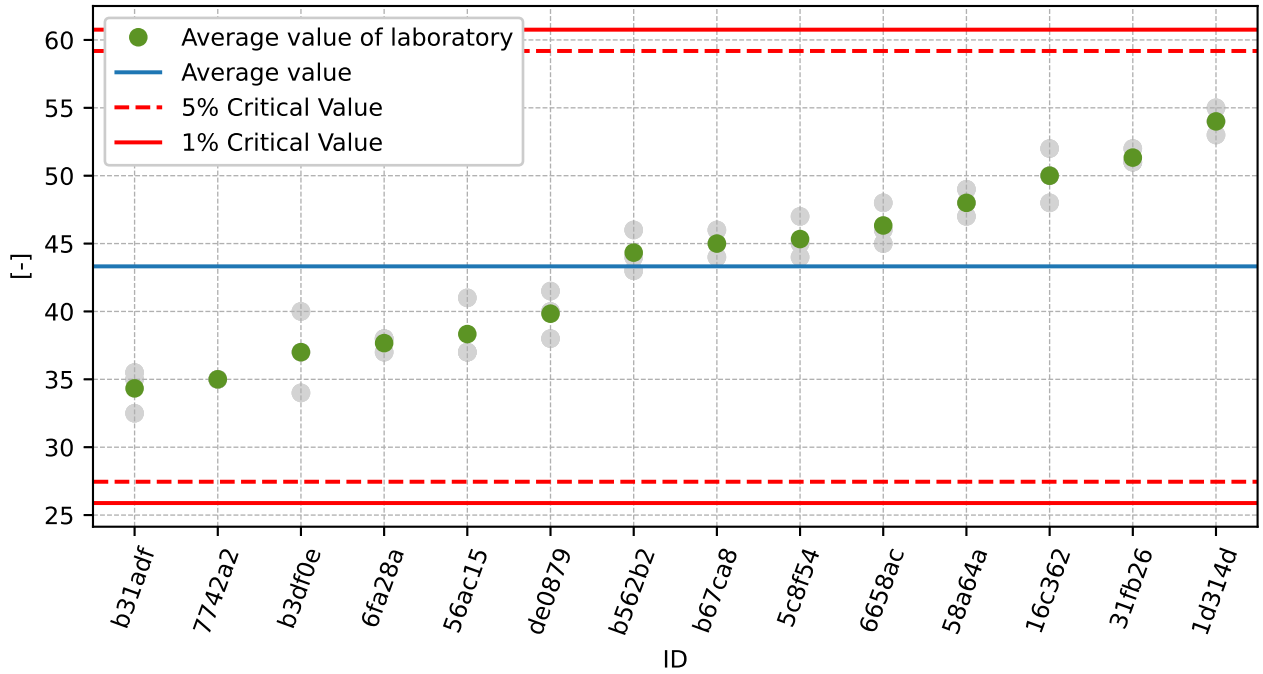

Figure 47: **Grubbs' test** - average values

9.3 Mandel's Statistics

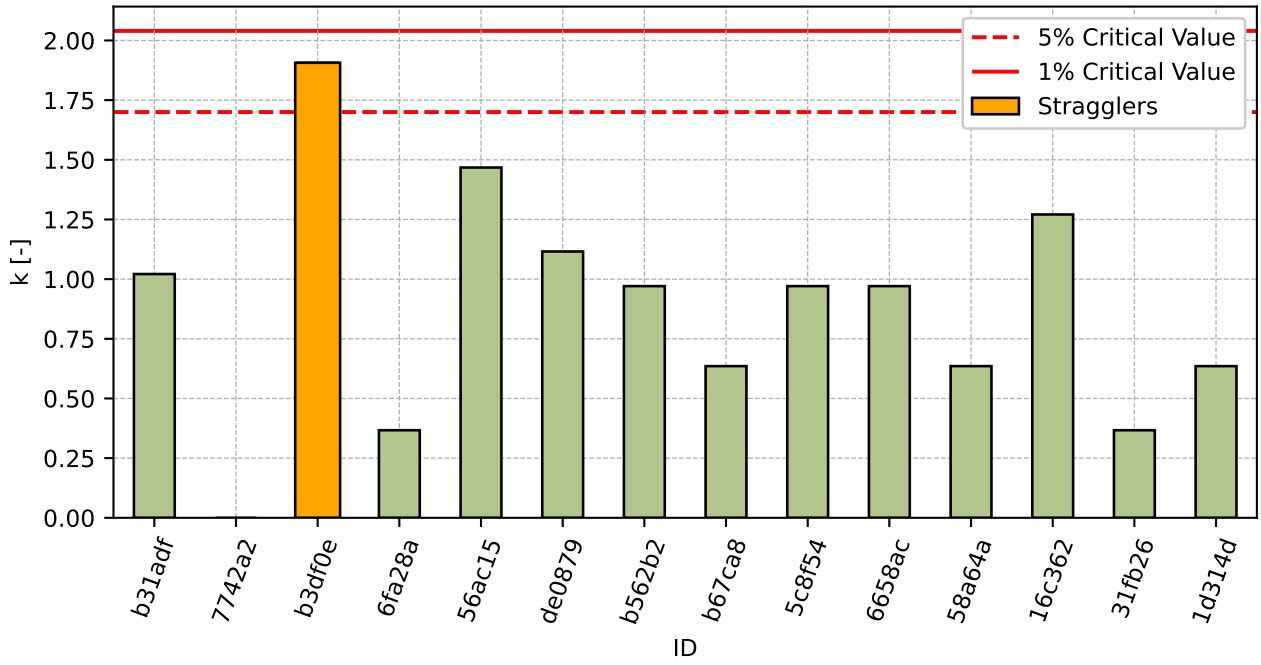

Figure 48: Intralaboratory Consistency Statistic

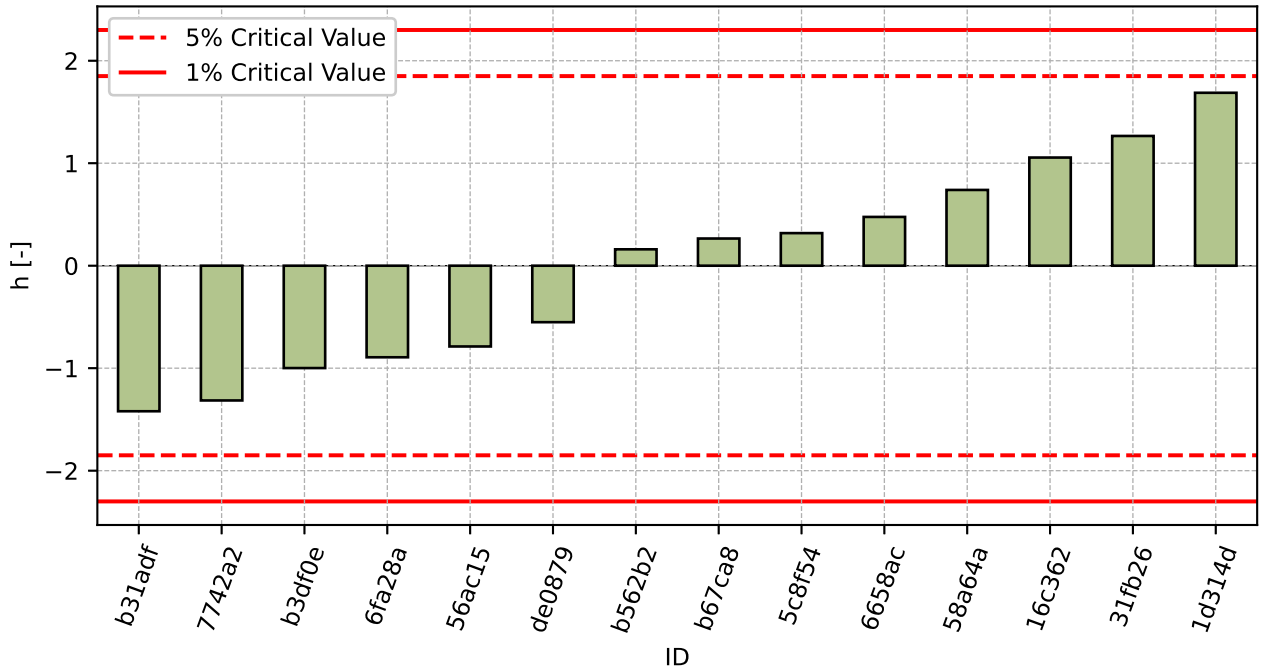

Figure 49: Interlaboratory Consistency Statistic

9.4 Descriptive statistics

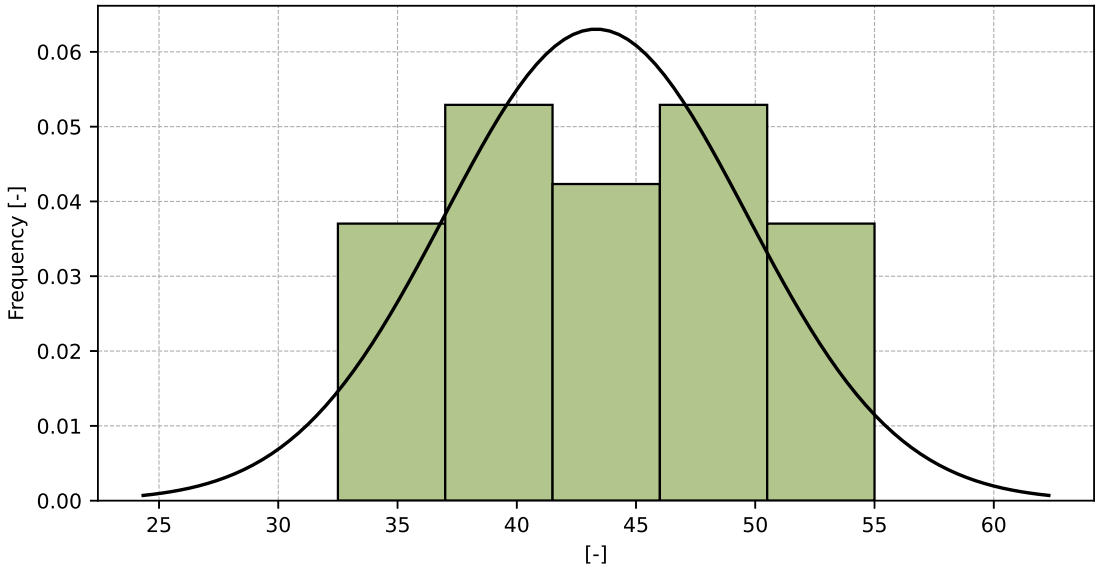

Figure 50: Histogram of all test results

Table 20: Descriptive statistics

Characteristics	[-]
Average value – $\bar{x}$	43
Sample standard deviation – s	6.3
Asigned value – x^*	43
Robust standard deviation – s^*	6.9
Measurement uncertainty of asigned value – u_X	2.3
p-value of normality test	0.023 [-]
Interlaboratory standard deviation – s_L	6.3
Repeatability standard deviation – s_r	1.6
Reproducibility standard deviation – s_R	6.5
Repeatability – r	4
Reproducibility – R	18

9.5 Evaluation of Performance Statistics

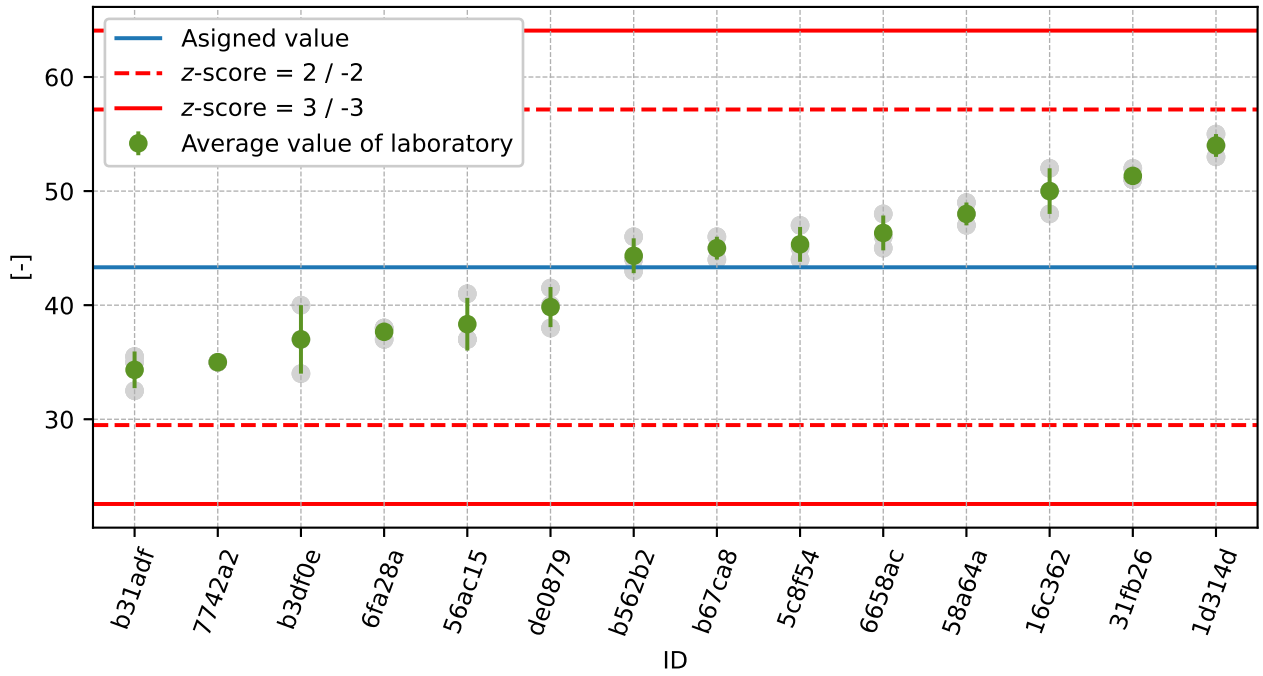

Figure 51: Average values and sample standard deviations

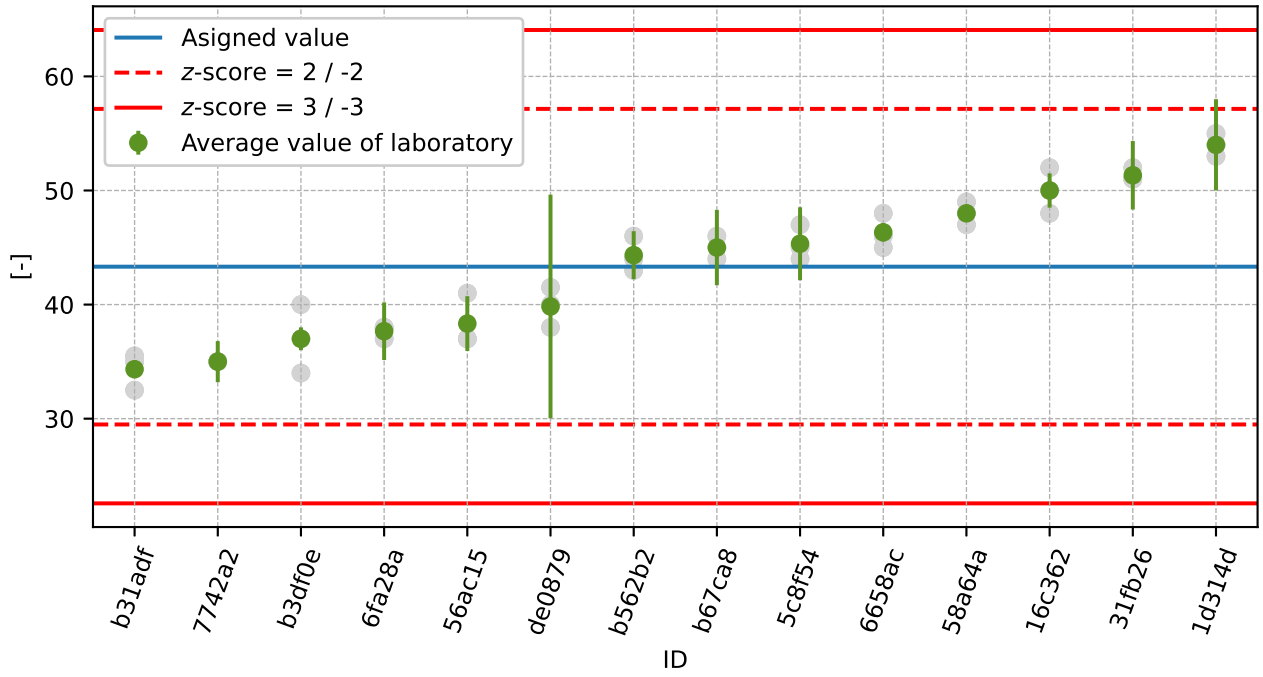

Figure 52: Average values and extended uncertainties of measurement

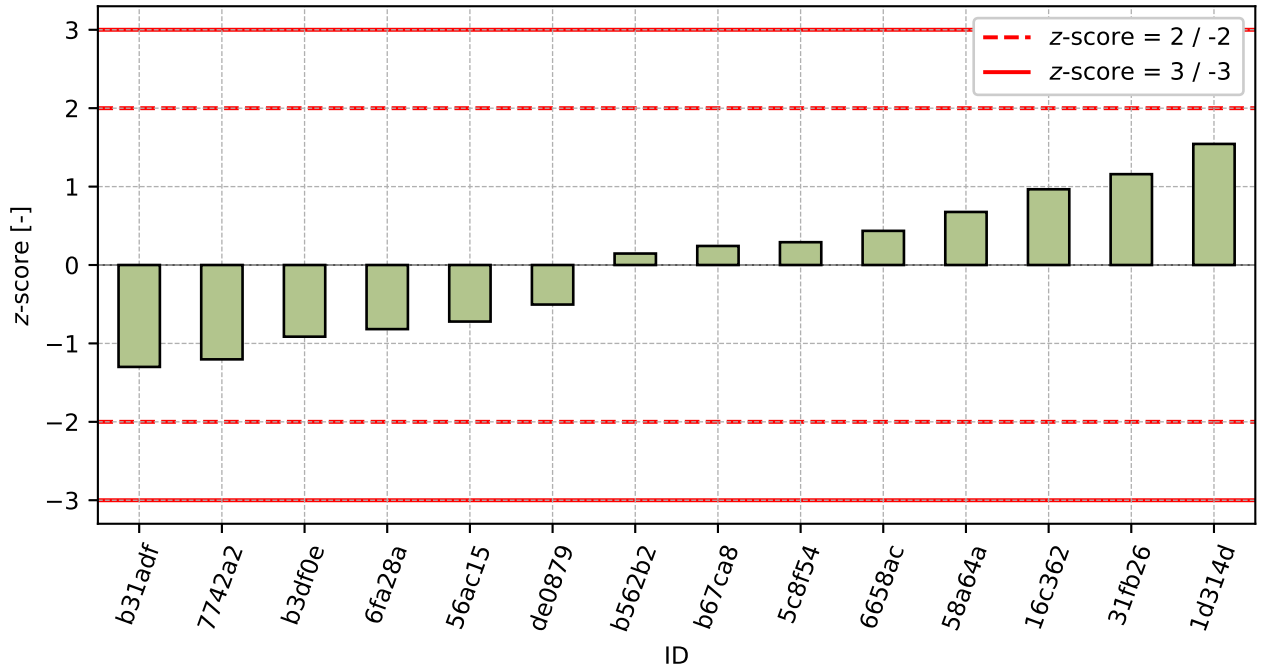

Figure 53: z-score

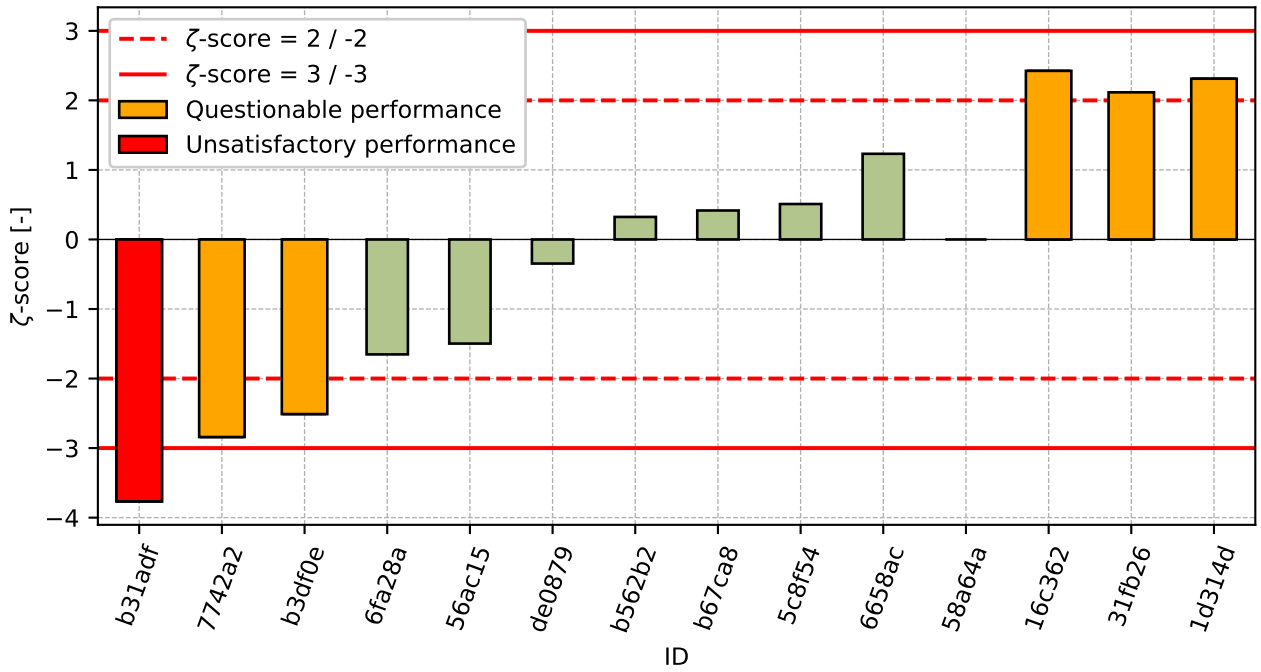

Figure 54: ζ-score

Table 21: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
b31adf	-1.3	-3.77
7742a2	-1.2	-2.84
b3df0e	-0.91	-2.51
6fa28a	-0.82	-1.65
56ac15	-0.72	-1.5
de0879	-0.5	-0.35
b562b2	0.15	0.32
b67ca8	0.24	0.42
5c8f54	0.29	0.51
6658ac	0.44	1.23
58a64a	0.68	-
16c362	0.97	2.42
31fb26	1.16	2.12
1d314d	1.54	2.31

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

10.1 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 [MPa]					u_X [MPa]	$\bar{x}$ [MPa]	s_0 [MPa]	V_X [%]
1d314d	2.0	1.8	2.4	2.3	2.2	0.4	2.2	0.24	10.93
0d23d4	2.0	1.9	2.3	3.1	2.3	0.0	2.3	0.47	20.4
5c8f54	2.4	2.1	2.2	2.7	2.5	0.1	2.4	0.22	9.07
31fb26	2.1	2.5	2.8	2.2	2.7	0.1	2.5	0.31	12.58
0ec7ce	2.1	2.5	2.4	2.6	2.9	0.4	2.5	0.29	11.66
ff7004	2.6	2.3	2.6	2.5	2.7	0.0	2.5	0.14	5.37
b98482	2.5	3.2	2.1	2.5	2.5	0.3	2.6	0.4	15.53
0d23f7	2.5	2.7	2.4	2.7	2.8	0.1	2.6	0.15	5.73
b3df0e	3.0	3.0	2.4	2.3	2.4	0.2	2.6	0.35	13.33
6ea5eb	2.5	3.1	2.5	2.8	2.4	0.4	2.7	0.29	10.83
b562b2	2.6	2.8	2.8	3.0	2.8	0.1	2.8	0.15	5.44
243942	2.6	2.7	2.8	2.8	3.1	0.4	2.8	0.19	6.68
500203	2.8	2.7	2.8	3.0	3.2	0.3	2.9	0.22	7.71
b67ca8	3.0	3.0	2.9	3.3	3.3	0.4	3.1	0.17	5.61

10.2 The Numerical Procedure for Determining Outliers

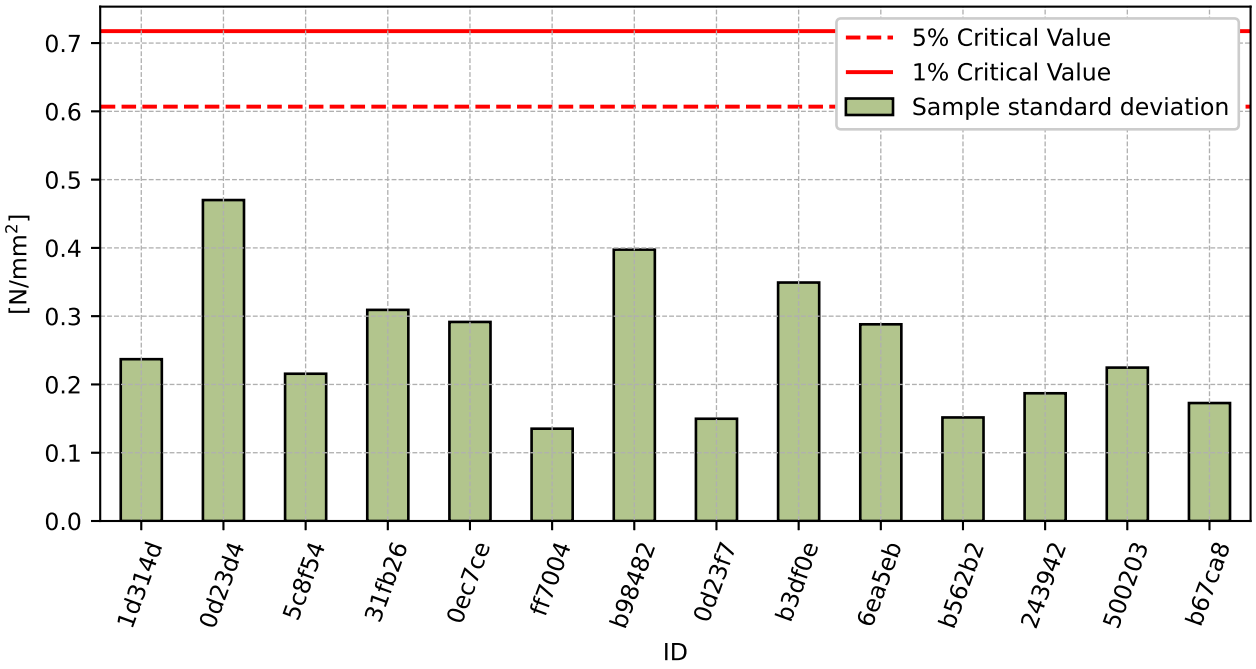

Figure 55: **Cochran's test** - sample standard deviations

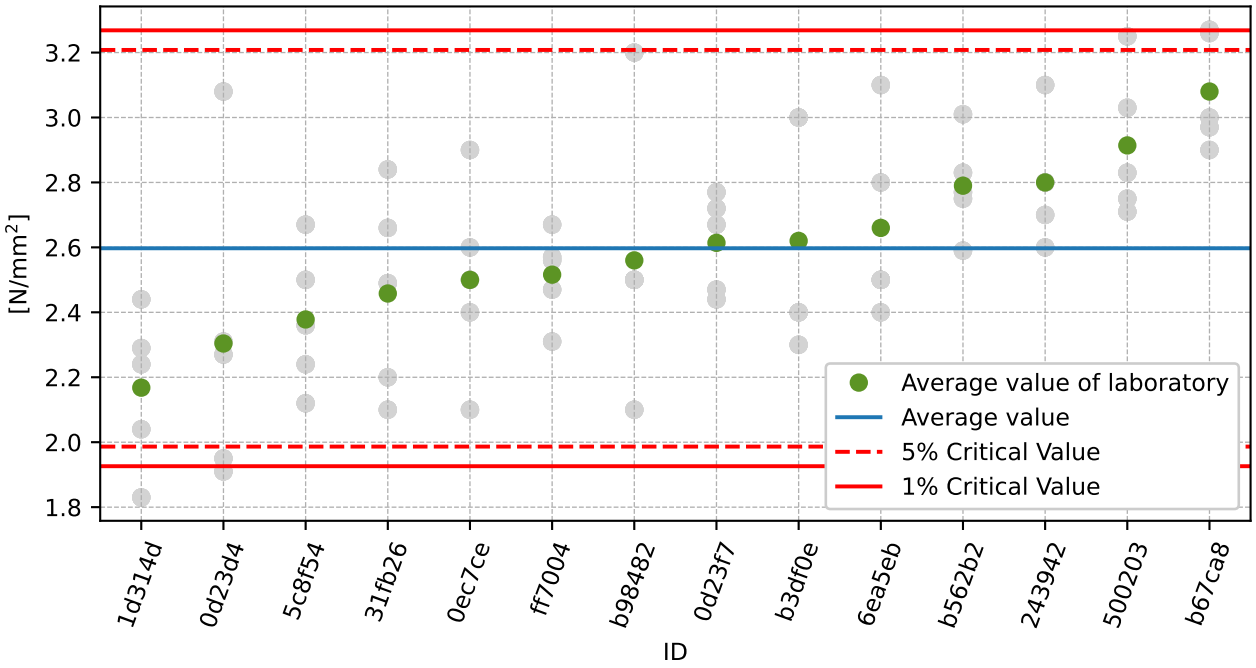

Figure 56: **Grubbs' test** - average values

10.3 Mandel's Statistics

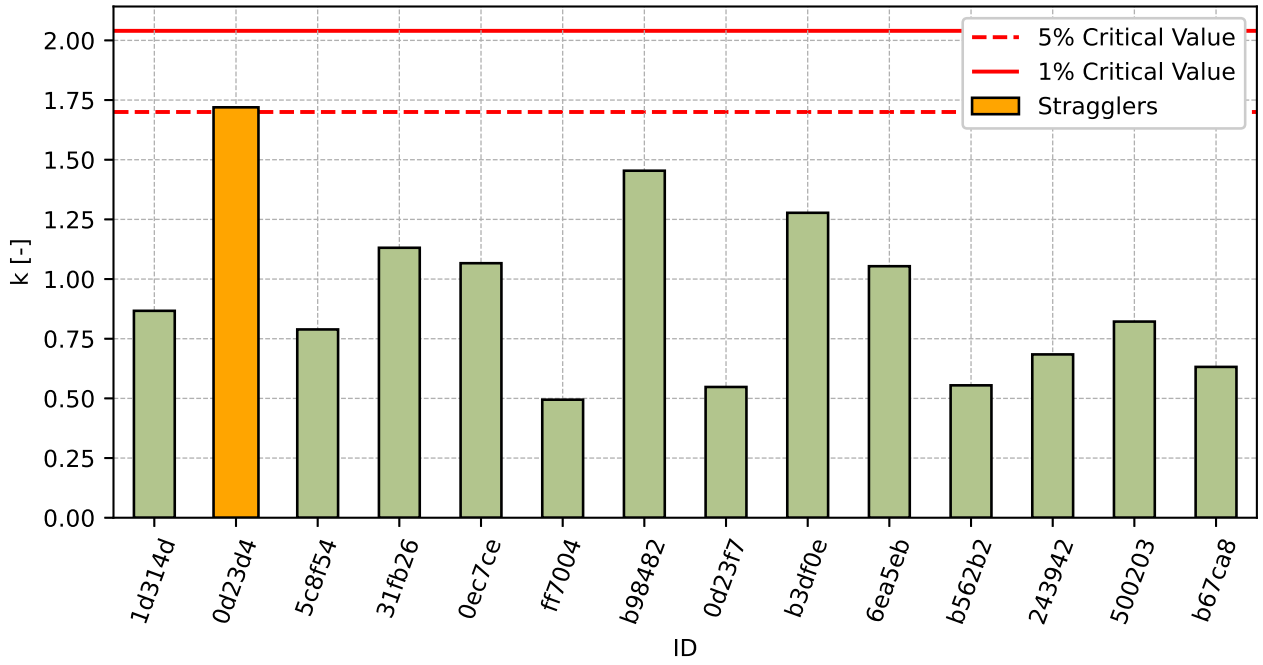

Figure 57: Intralaboratory Consistency Statistic

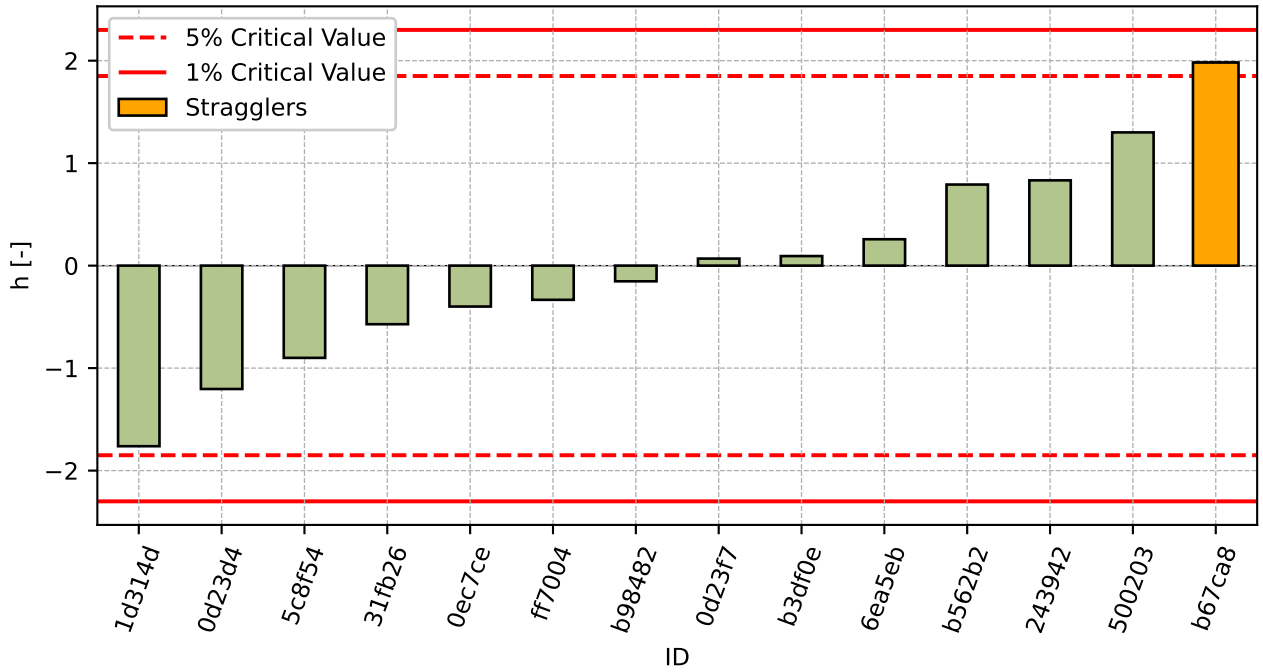

Figure 58: Interlaboratory Consistency Statistic

10.4 Descriptive statistics

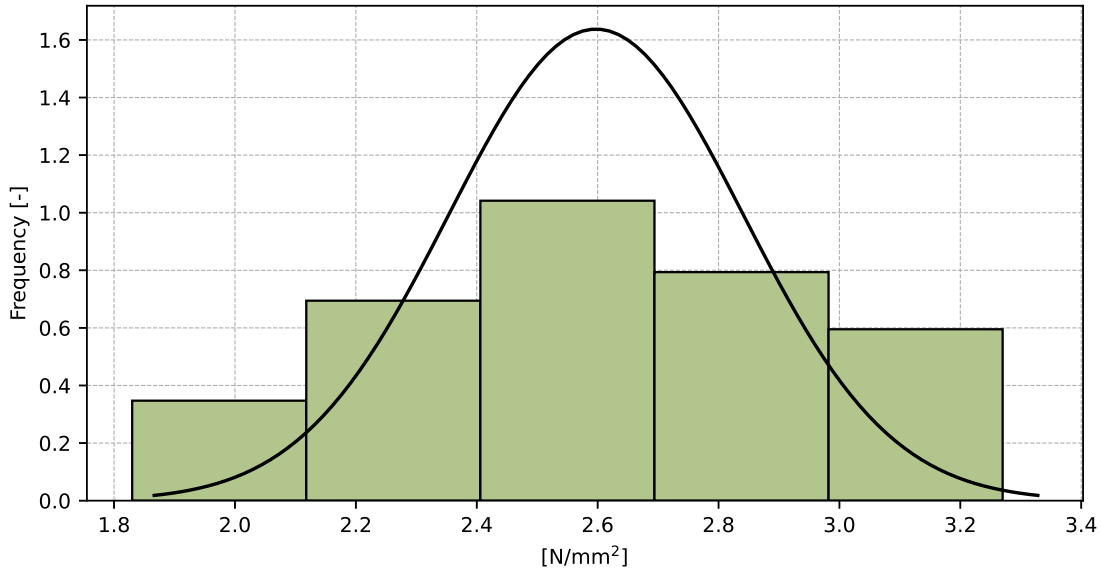

Figure 59: Histogram of all test results

Table 23: Descriptive statistics

Characteristics	[MPa]
Average value – $\bar{x}$	2.6
Sample standard deviation – s	0.24
Asigned value – x^*	2.6
Robust standard deviation – s^*	0.26
Measurement uncertainty of asigned value – u_X	0.09
p-value of normality test	0.652 [-]
Interlaboratory standard deviation – s_L	0.21
Repeatability standard deviation – s_r	0.27
Reproducibility standard deviation – s_R	0.35
Repeatability – r	0.8
Reproducibility – R	1.0

10.5 Evaluation of Performance Statistics

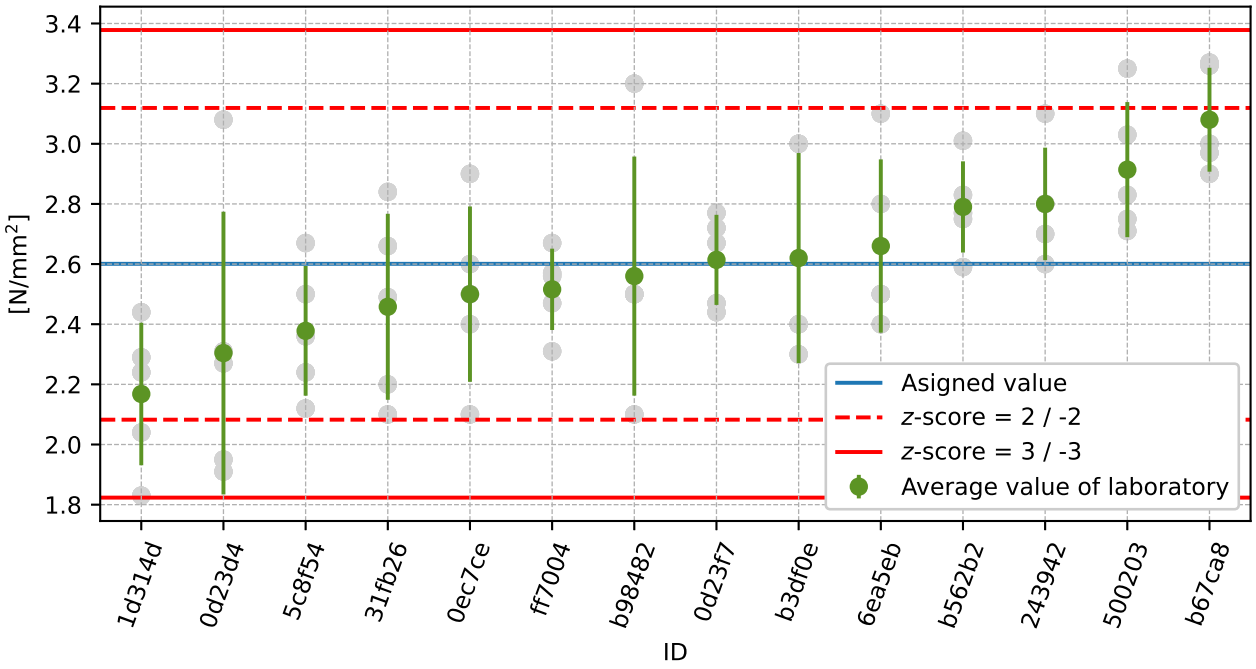

Figure 60: Average values and sample standard deviations

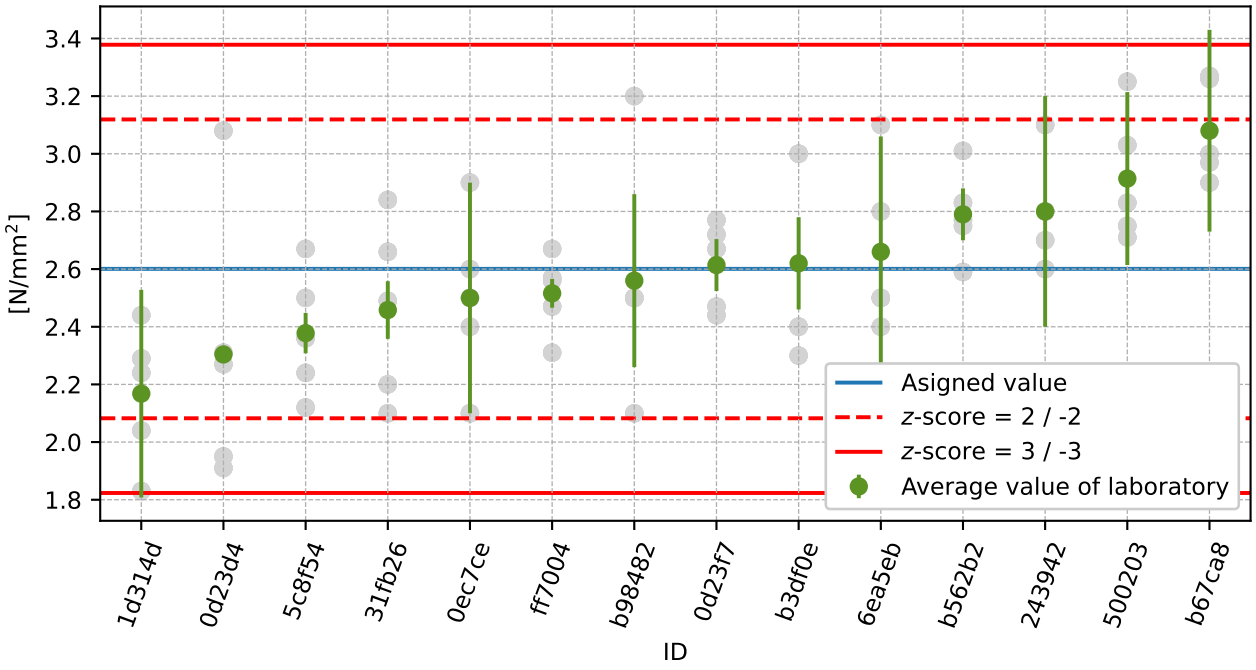

Figure 61: Average values and extended uncertainties of measurement

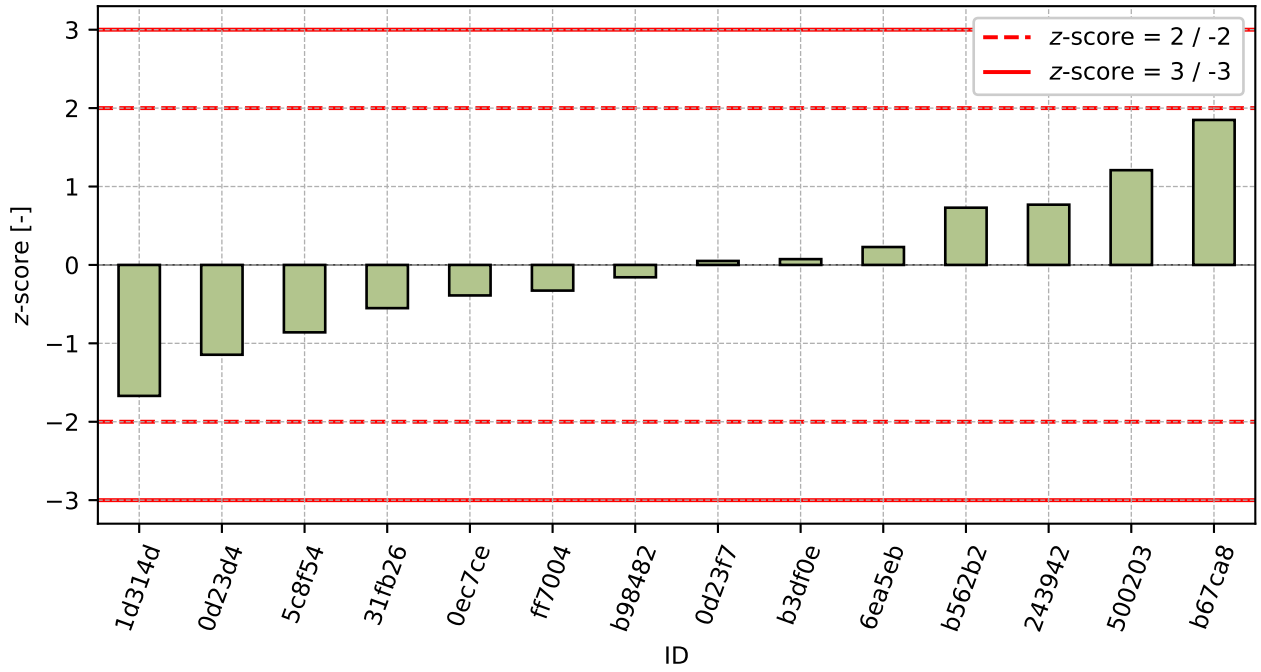

Figure 62: z-score

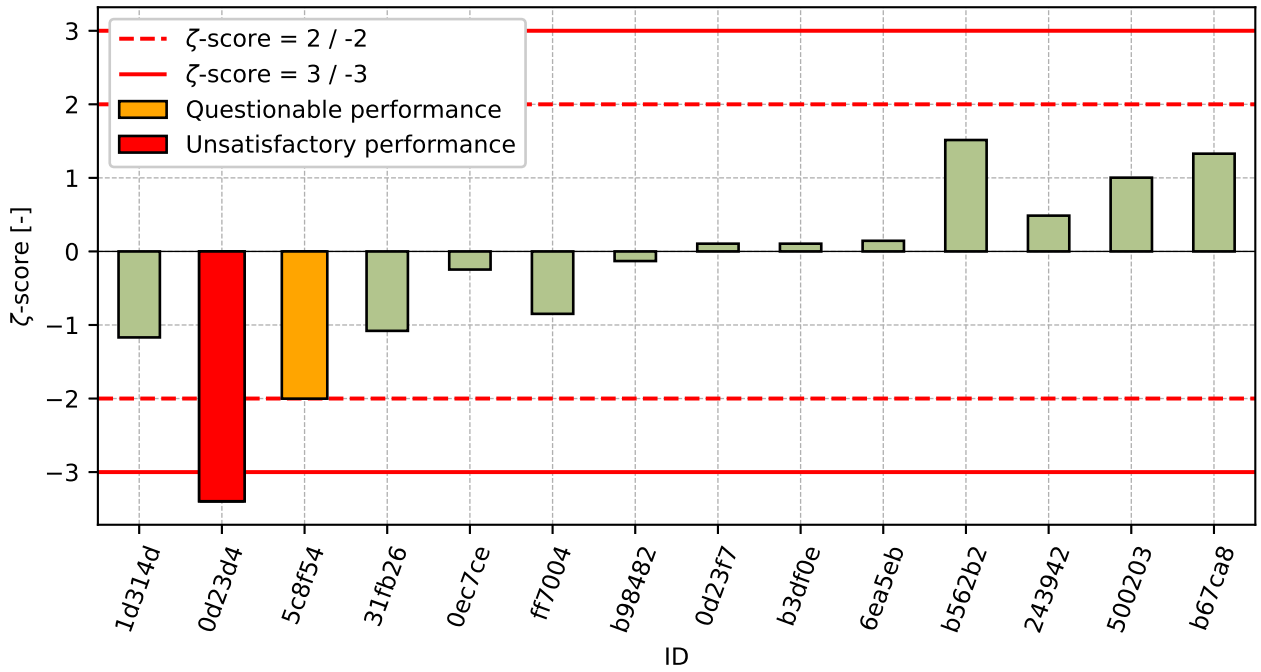

Figure 63: ζ-score

Table 24: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
1d314d	-1.67	-1.17
0d23d4	-1.15	-3.4
5c8f54	-0.86	-2.0
31fb26	-0.55	-1.08
0ec7ce	-0.39	-0.25
ff7004	-0.33	-0.85
b98482	-0.16	-0.13
0d23f7	0.05	0.11
b3df0e	0.07	0.11
6ea5eb	0.23	0.14
b562b2	0.73	1.51
243942	0.77	0.49
500203	1.21	1.0
b67ca8	1.85	1.33

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

11.1 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 [%]			u_X [%]	$\bar{x}$ [%]	s_0 [%]	V_X [%]
33a6e7	3.9	2.8	3.3	2.5	3.3	0.55	16.52
b3df0e	3.4	3.4	3.6	0.1	3.5	0.12	3.33
db66de	3.4	3.5	3.6	0.2	3.5	0.1	2.86
225960	3.9	3.8	3.7	-	3.8	0.09	2.45
b98482	3.9	3.9	4.2	0.2	4.0	0.17	4.33

11.2 The Numerical Procedure for Determining Outliers

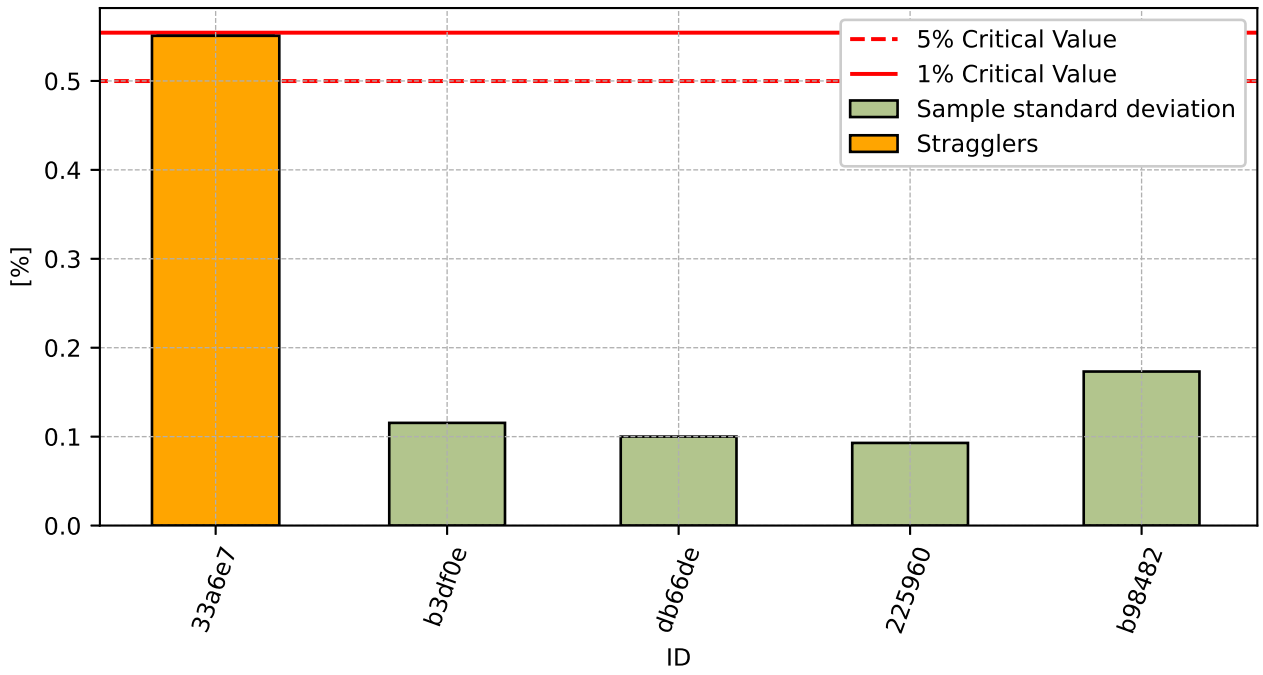

Figure 64: **Cochran's test** - sample standard deviations

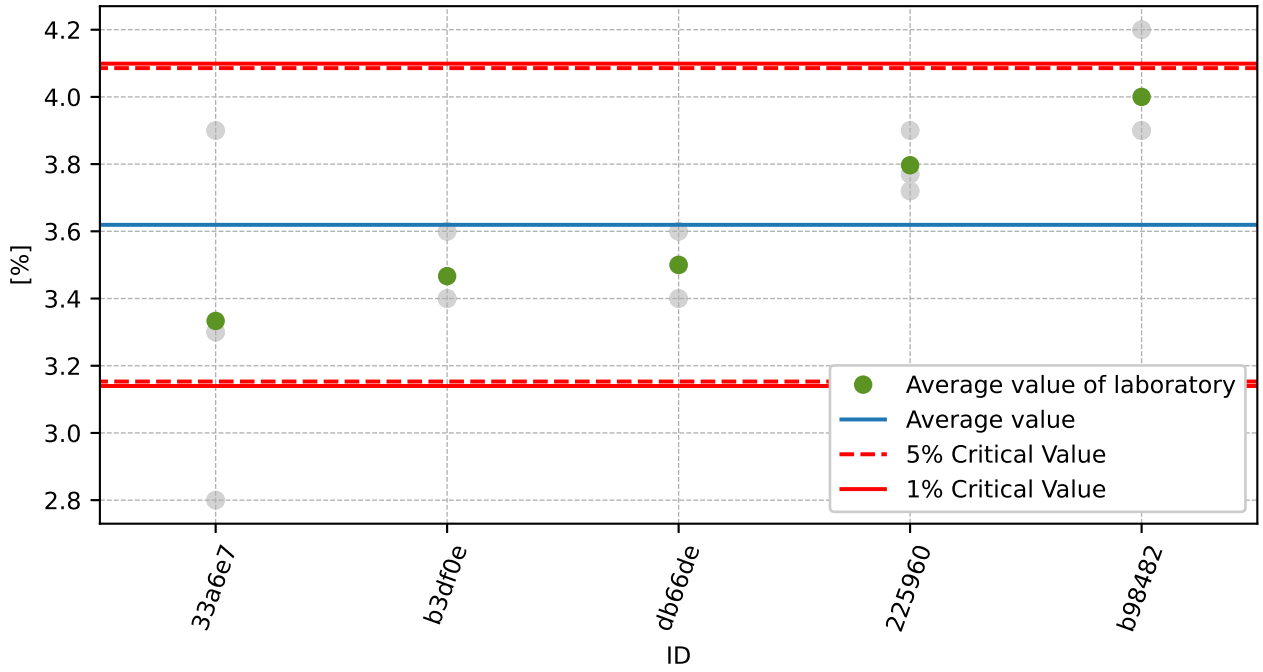

Figure 65: **Grubbs' test** - average values

11.3 Mandel's Statistics

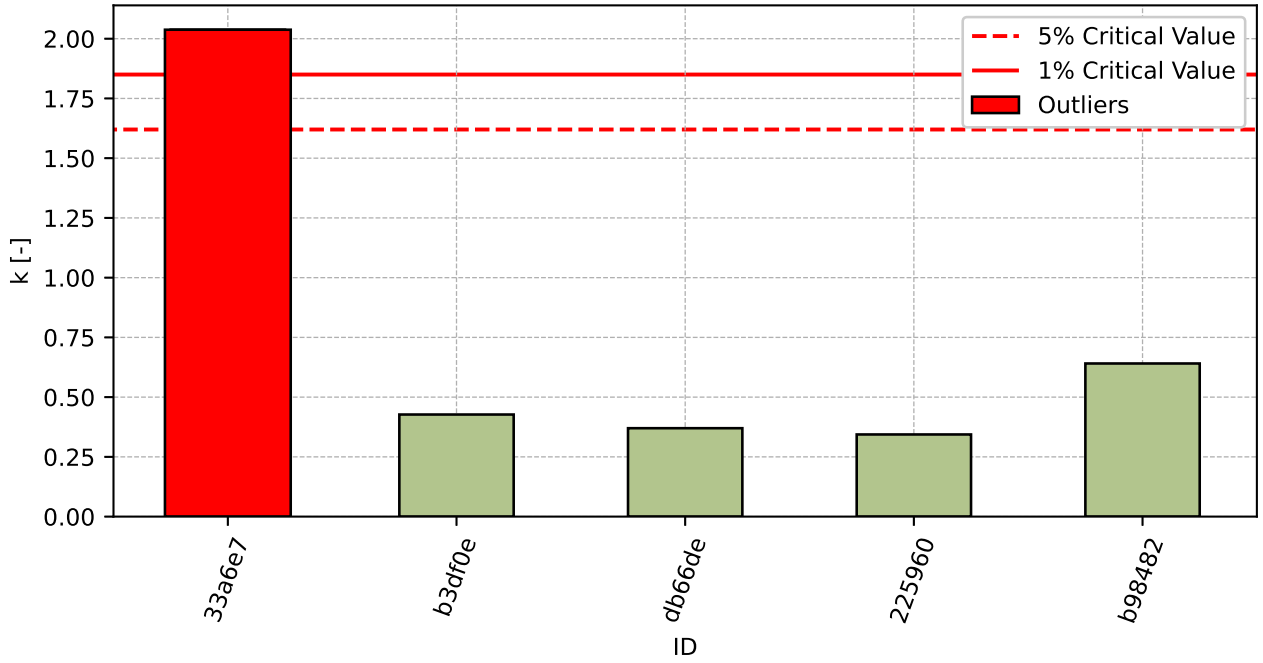

Figure 66: Intralaboratory Consistency Statistic

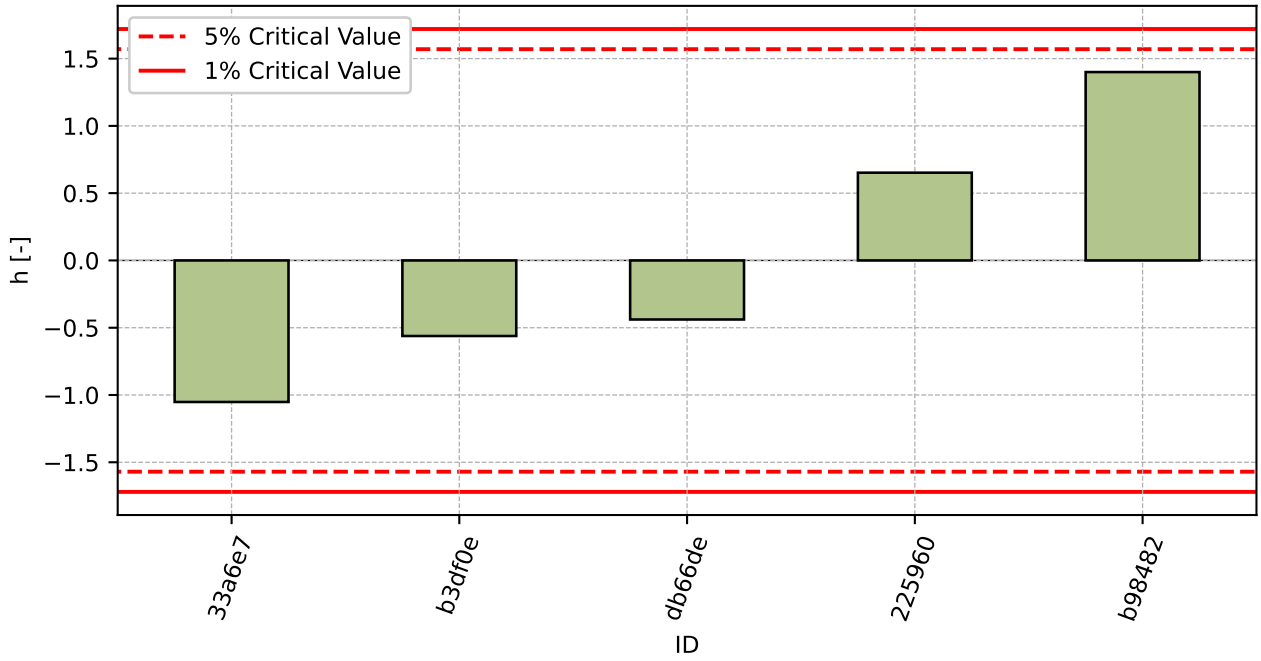

Figure 67: Interlaboratory Consistency Statistic

11.4 Descriptive statistics

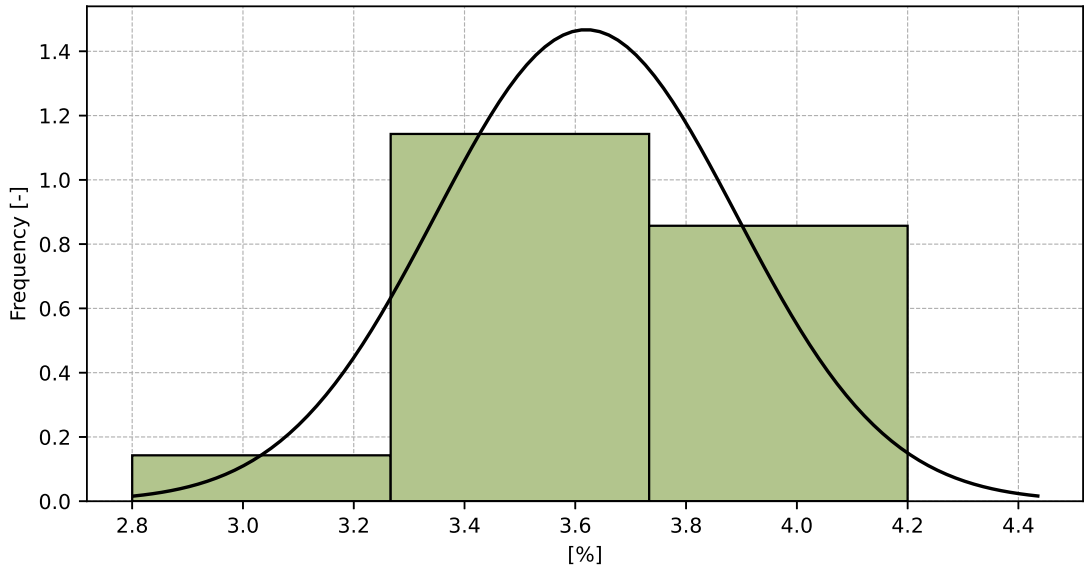

Figure 68: Histogram of all test results

Table 26: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	3.6
Sample standard deviation – s	0.27
Asigned value – x^*	3.6
Robust standard deviation – s^*	0.28
Measurement uncertainty of asigned value – u_X	0.15
p-value of normality test	0.239 [-]
Interlaboratory standard deviation – s_L	0.22
Repeatability standard deviation – s_r	0.27
Reproducibility standard deviation – s_R	0.35
Repeatability – r	0.8
Reproducibility – R	1.0

11.5 Evaluation of Performance Statistics

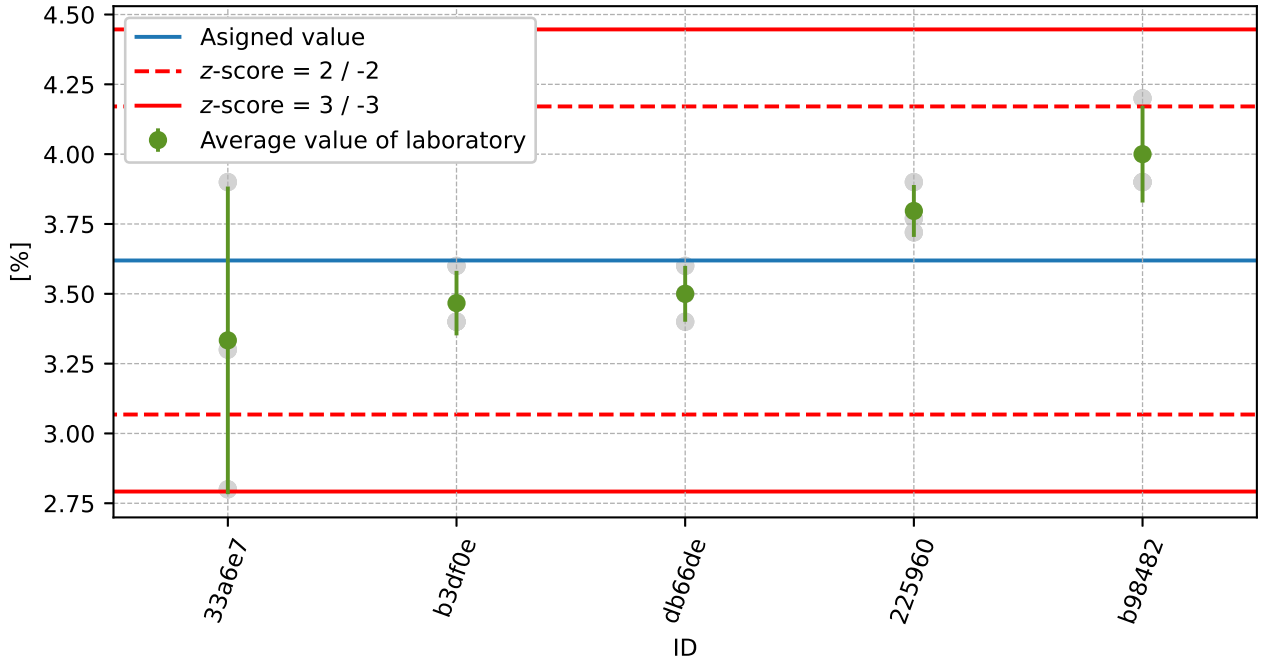

Figure 69: Average values and sample standard deviations

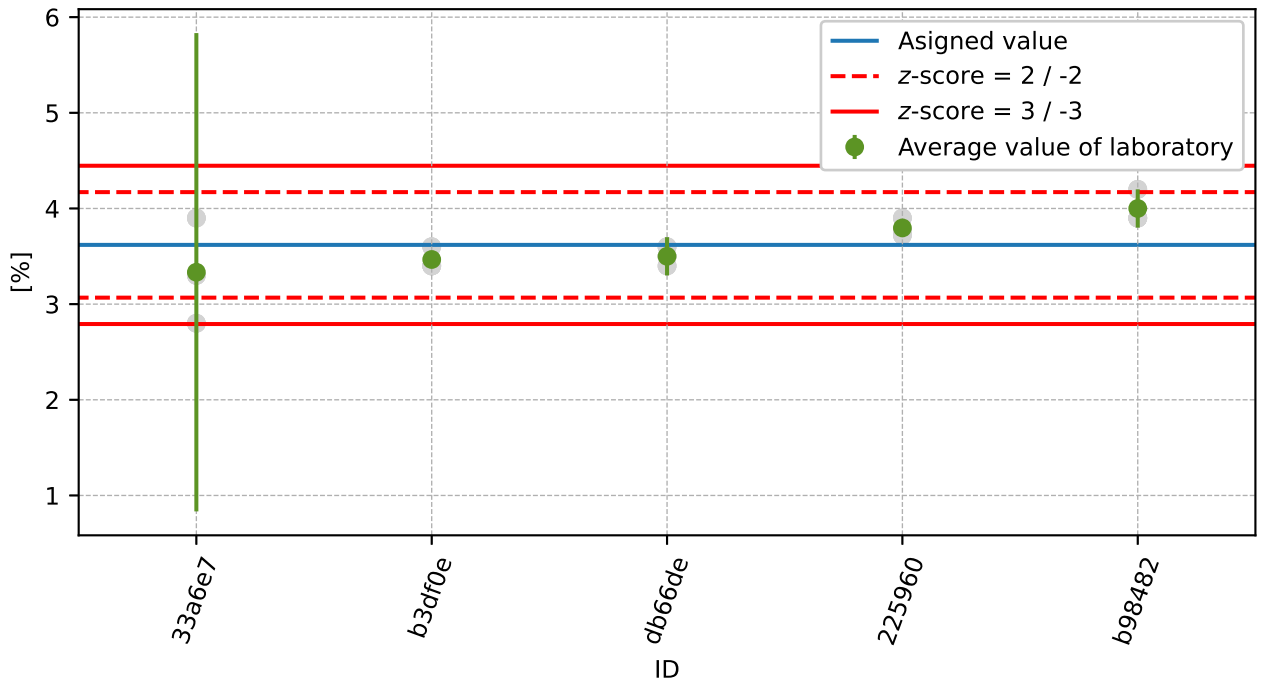

Figure 70: Average values and extended uncertainties of measurement

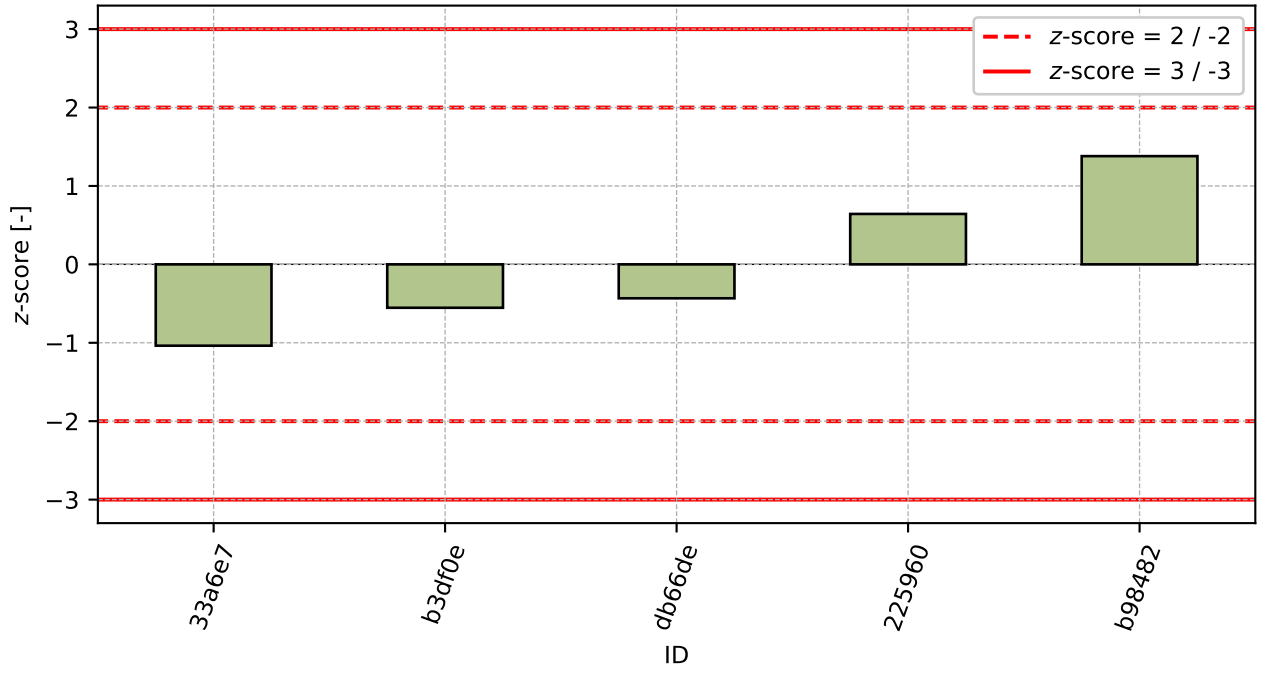

Figure 71: z-score

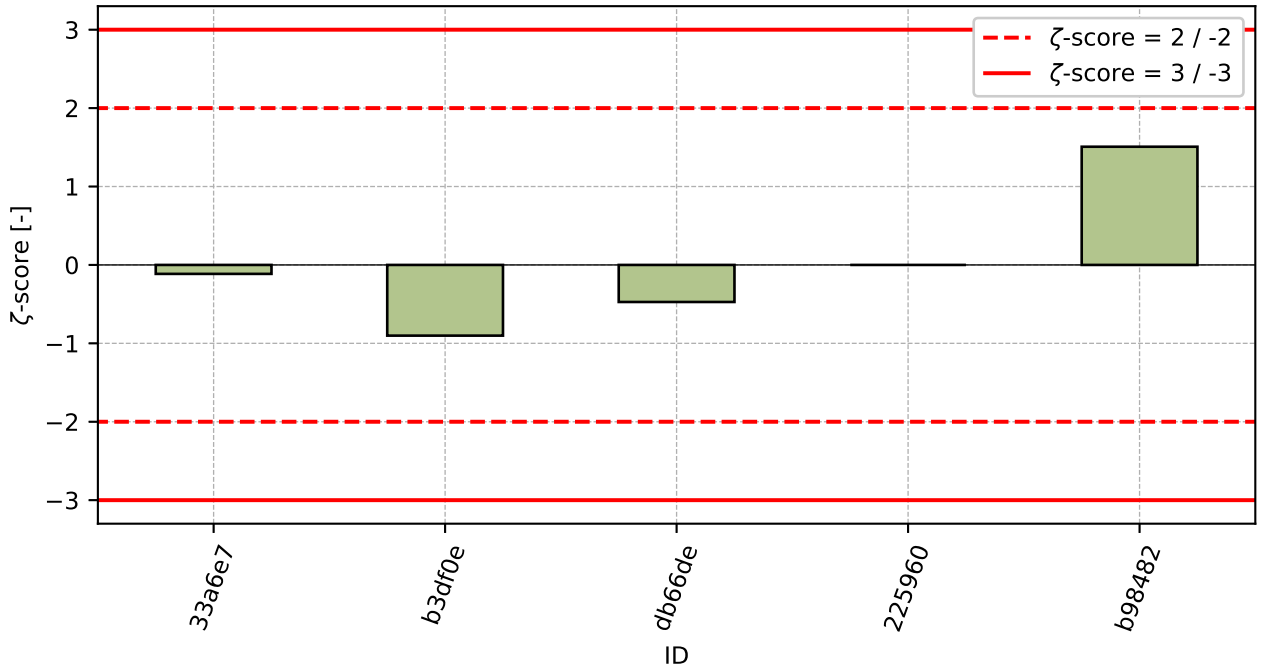

Figure 72: ζ-score

Table 27: *z*-score and ζ-score

ID	*z*-score [-]	ζ-score [-]
33a6e7	-1.04	-0.11
b3df0e	-0.55	-0.9
db66de	-0.43	-0.47
225960	0.64	-
b98482	1.38	1.51

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

12.1 Test results

Table 28: 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 [%]
b3df0e	3.5	3.7	3.2	3.0	3.4	3.2	3.3	2.8	0.0	3.3	0.28	8.66
a5dd62	7.0	5.2	6.3	6.2	7.5	6.2	5.7	5.7	-	6.2	0.74	11.89
c77935	6.3	5.2	7.9	6.3	6.7	7.0	5.9	7.2	0.6	6.6	0.83	12.67
33a6e7	6.7	6.2	7.0	6.3	6.6	7.4	5.7	7.1	1.4	6.6	0.55	8.3
b67ca8	7.1	6.5	6.6	5.7	6.1	7.6	6.3	8.1	1.6	6.8	0.81	11.92
e63b22	7.5	6.9	6.3	7.0	7.1	6.6	6.1	6.8	0.3	6.8	0.45	6.61
725f2f	7.9	8.6	8.5	8.2	8.3	8.6	8.2	7.9	0.3	8.3	0.27	3.25

12.2 The Numerical Procedure for Determining Outliers

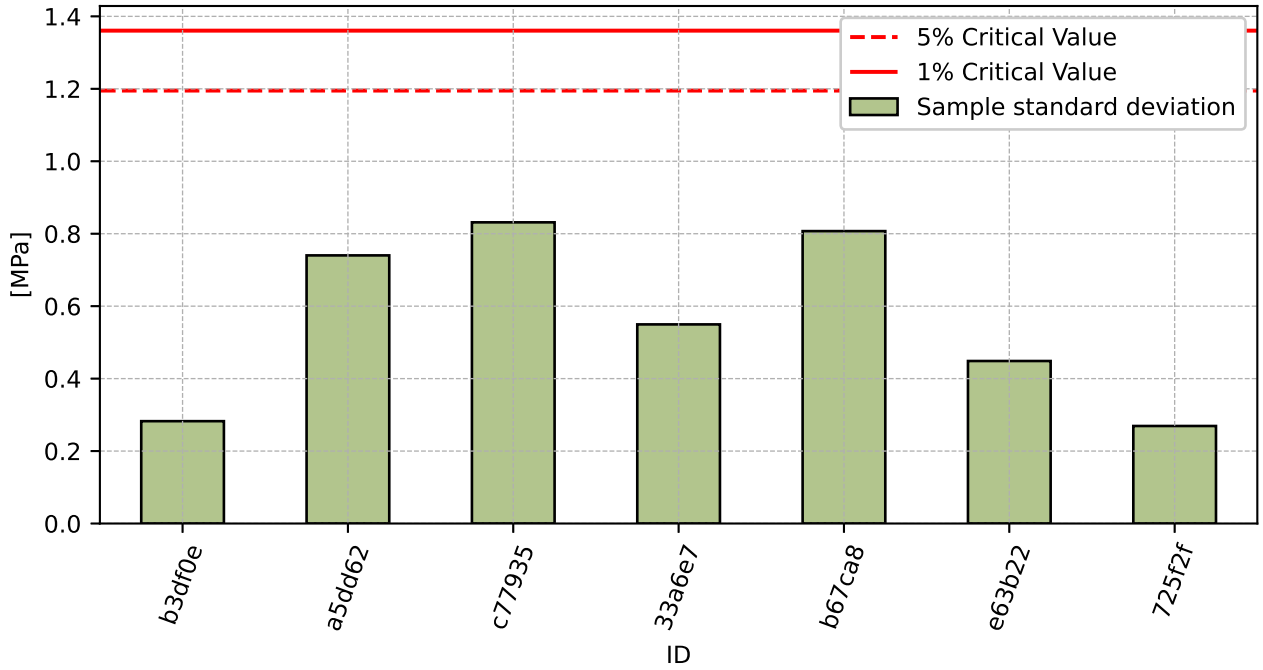

Figure 73: **Cochran's test** - sample standard deviations

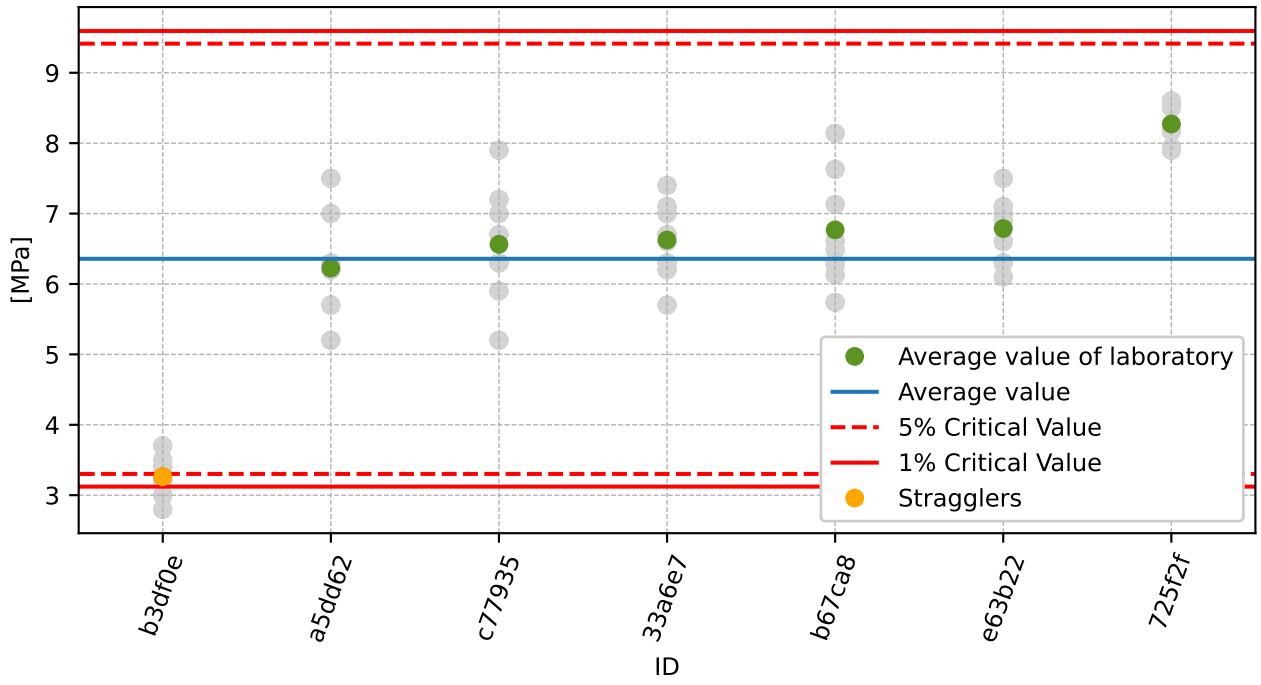

Figure 74: **Grubbs' test** - average values

12.3 Mandel's Statistics

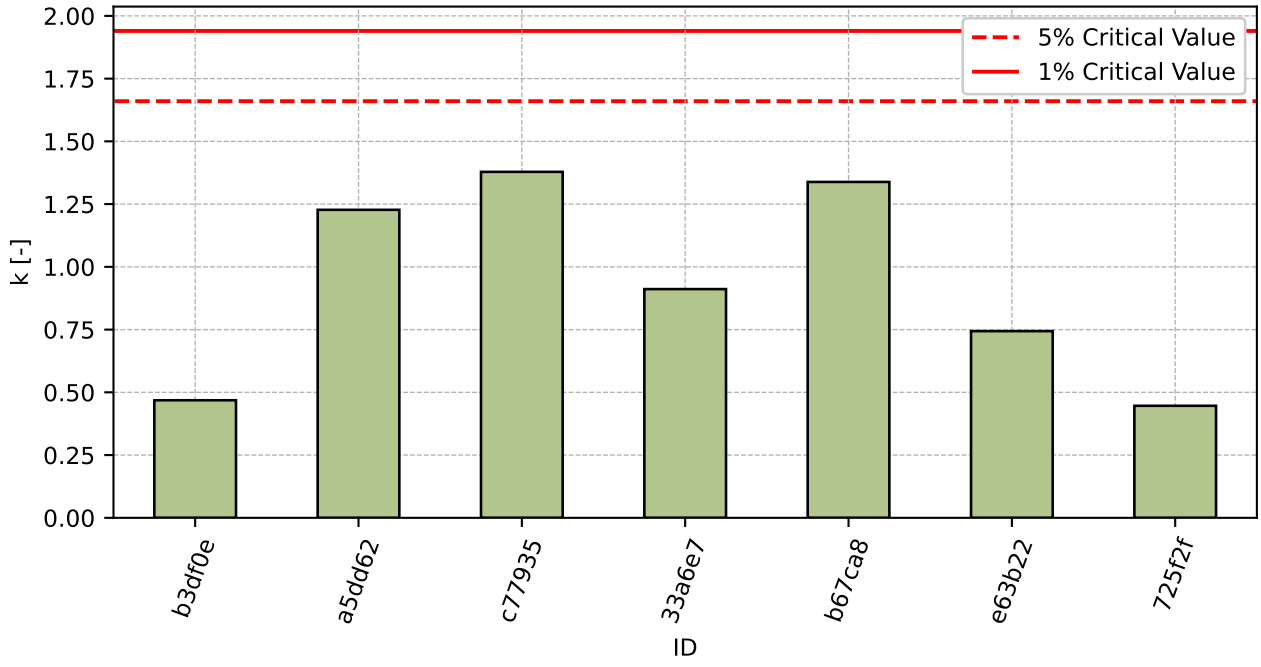

Figure 75: Intralaboratory Consistency Statistic

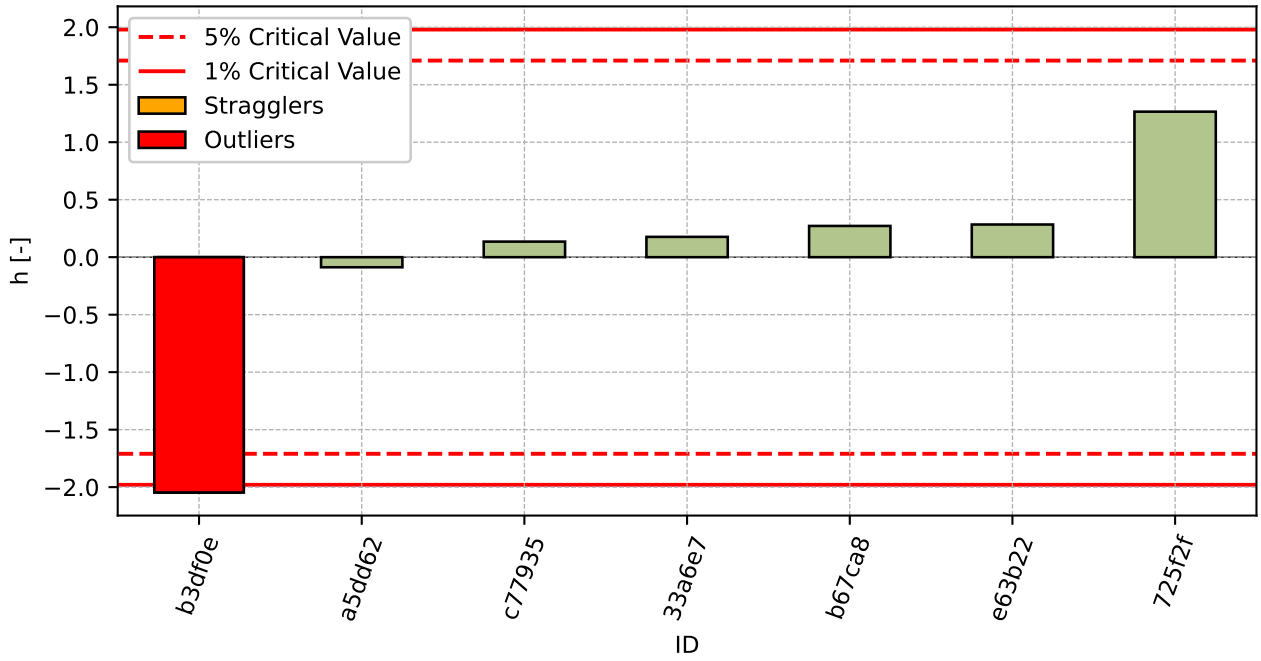

Figure 76: Interlaboratory Consistency Statistic

12.4 Descriptive statistics

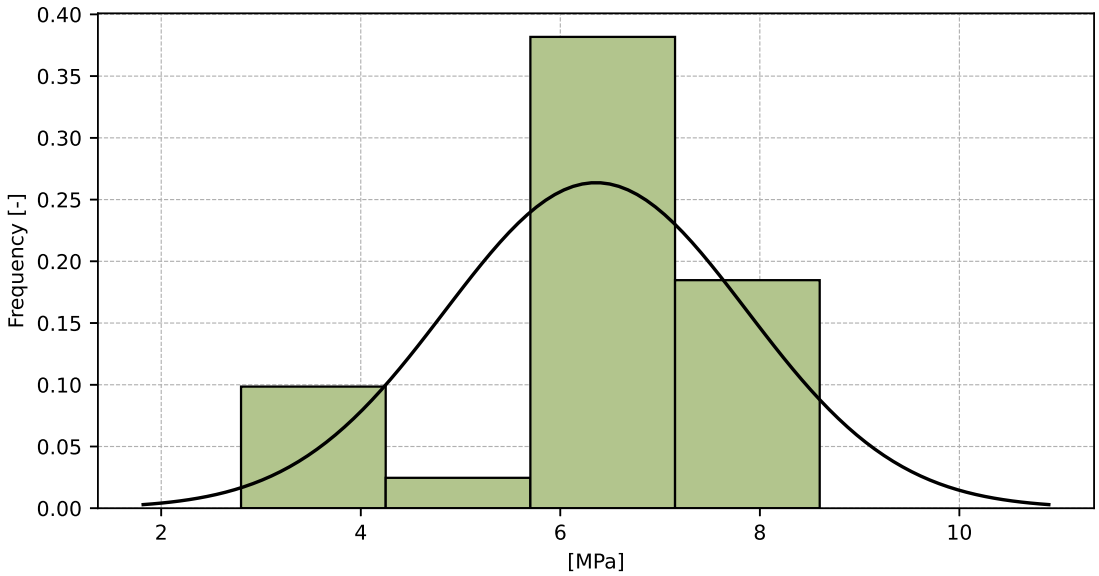

Figure 77: Histogram of all test results

Table 29: Descriptive statistics

Characteristics	[MPa]
Average value – $\bar{x}$	6.4
Sample standard deviation – s	1.51
Asigned value – x^*	6.8
Robust standard deviation – s^*	0.82
Measurement uncertainty of asigned value – u_X	0.34
p-value of normality test	0.024 [-]
Interlaboratory standard deviation – s_L	1.5
Repeatability standard deviation – s_r	0.6
Reproducibility standard deviation – s_R	1.61
Repeatability – r	1.7
Reproducibility – R	4.5

12.5 Evaluation of Performance Statistics

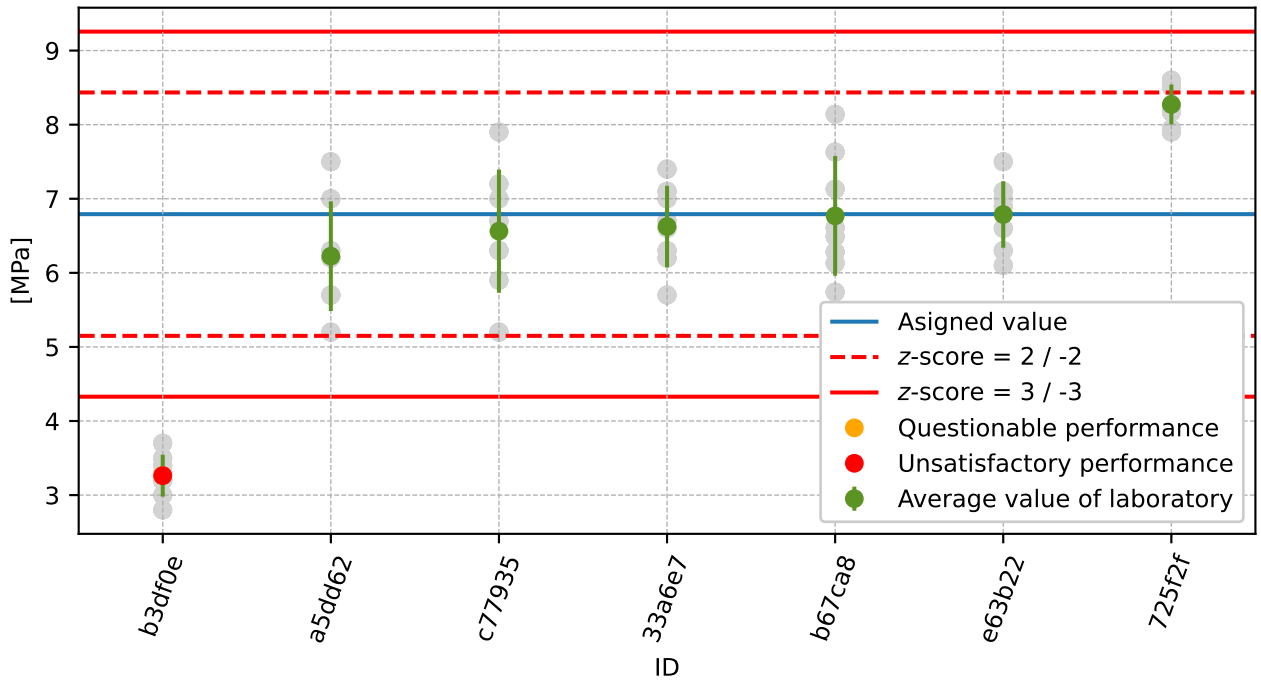

Figure 78: Average values and sample standard deviations

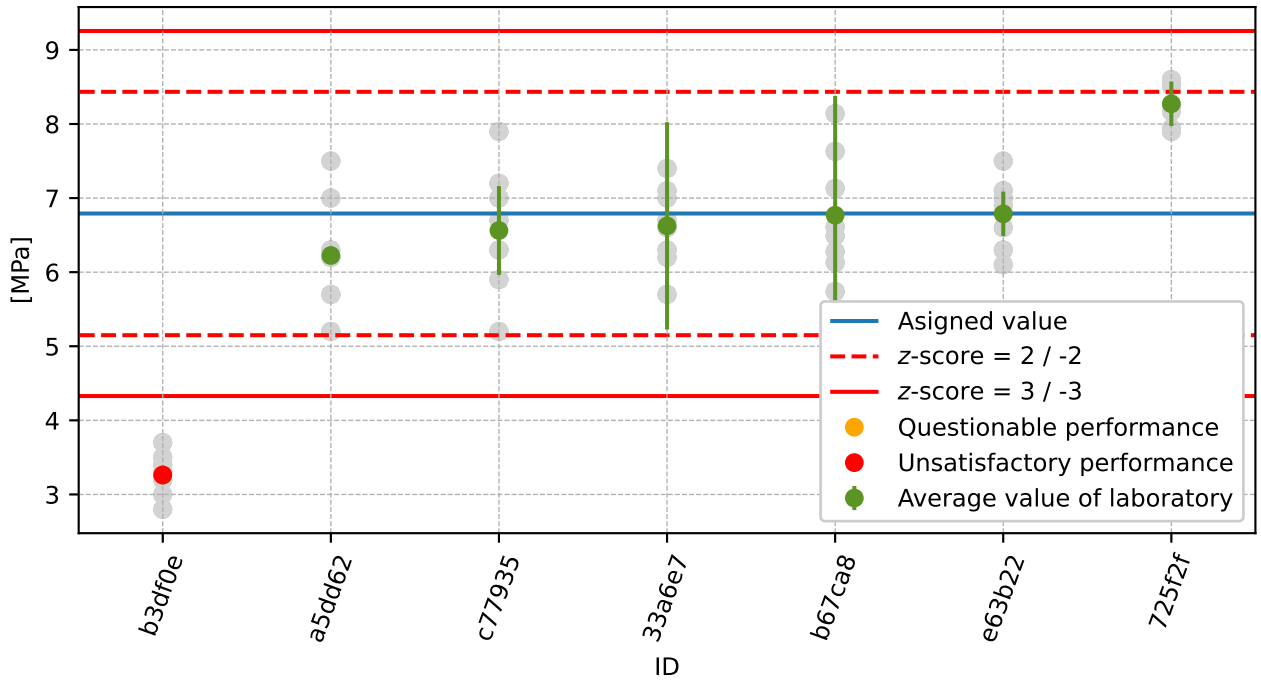

Figure 79: Average values and extended uncertainties of measurement

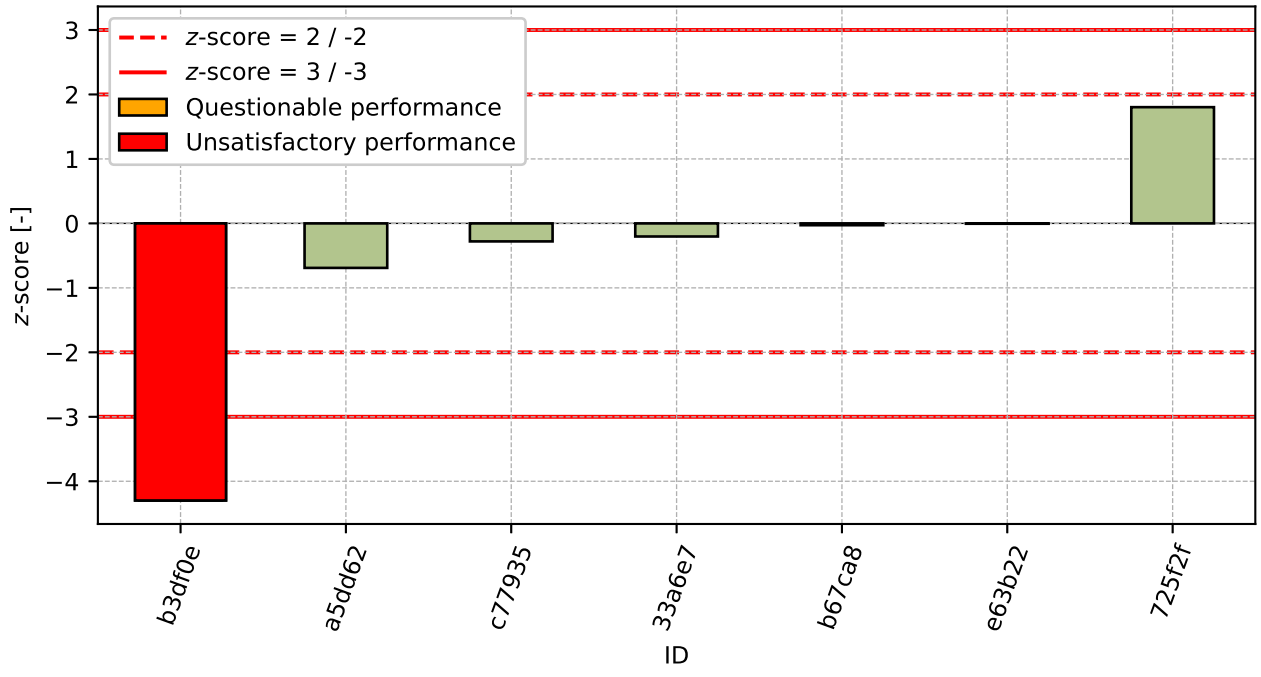

Figure 80: z-score

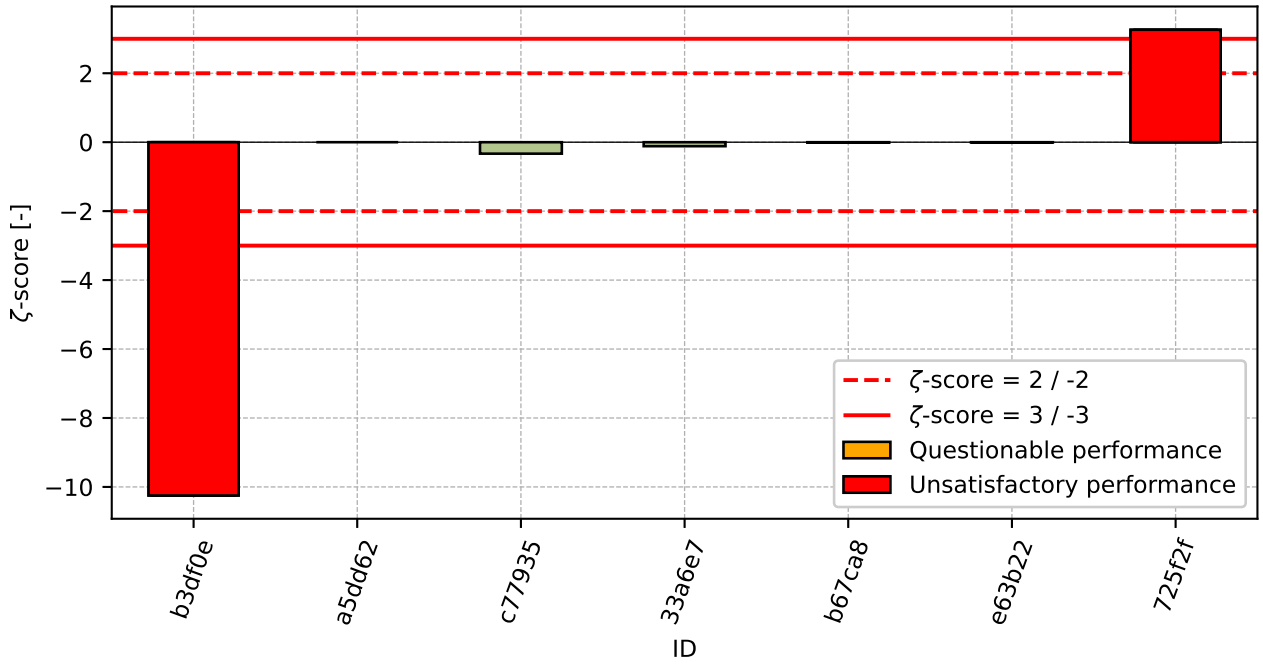

Figure 81: ζ-score

Table 30: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
b3df0e	-4.3	-10.25
a5dd62	-0.69	-
c77935	-0.28	-0.33
33a6e7	-0.2	-0.12
b67ca8	-0.03	-0.01
e63b22	-0.01	-0.01
725f2f	1.8	3.26

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 1339 – Appendix F (Flexural strength and flexural load)

14.1 Test results

Table 31: 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 [%]
33a6e7	9.5	10.2	9.3	9.7	10.4	9.7	0.6	9.8	0.42	4.28
ef0e3a	10.3	11.7	10.2	10.5	10.0	10.4	0.4	10.5	0.6	5.75
db66de	10.7	11.5	11.1	10.7	10.5	10.9	1.0	10.9	0.36	3.28
a5dd62	11.1	11.6	12.1	11.5	11.5	12.5	1.3	11.7	0.5	4.26
3dc7ad	12.7	14.8	11.9	12.7	11.7	12.8	0.5	12.8	1.1	8.6
b3df0e	17.2	16.3	16.3	14.5	15.1	14.1	0.7	15.6	1.2	7.73

14.2 The Numerical Procedure for Determining Outliers

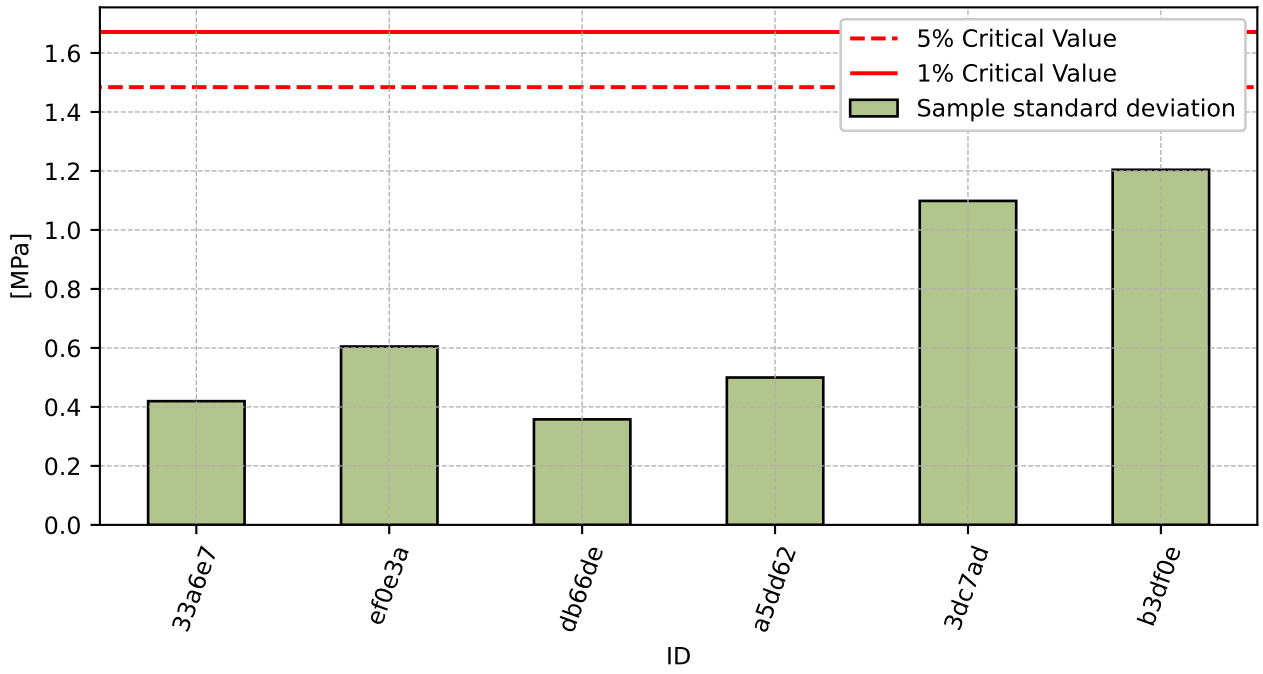

Figure 82: **Cochran's test** - sample standard deviations

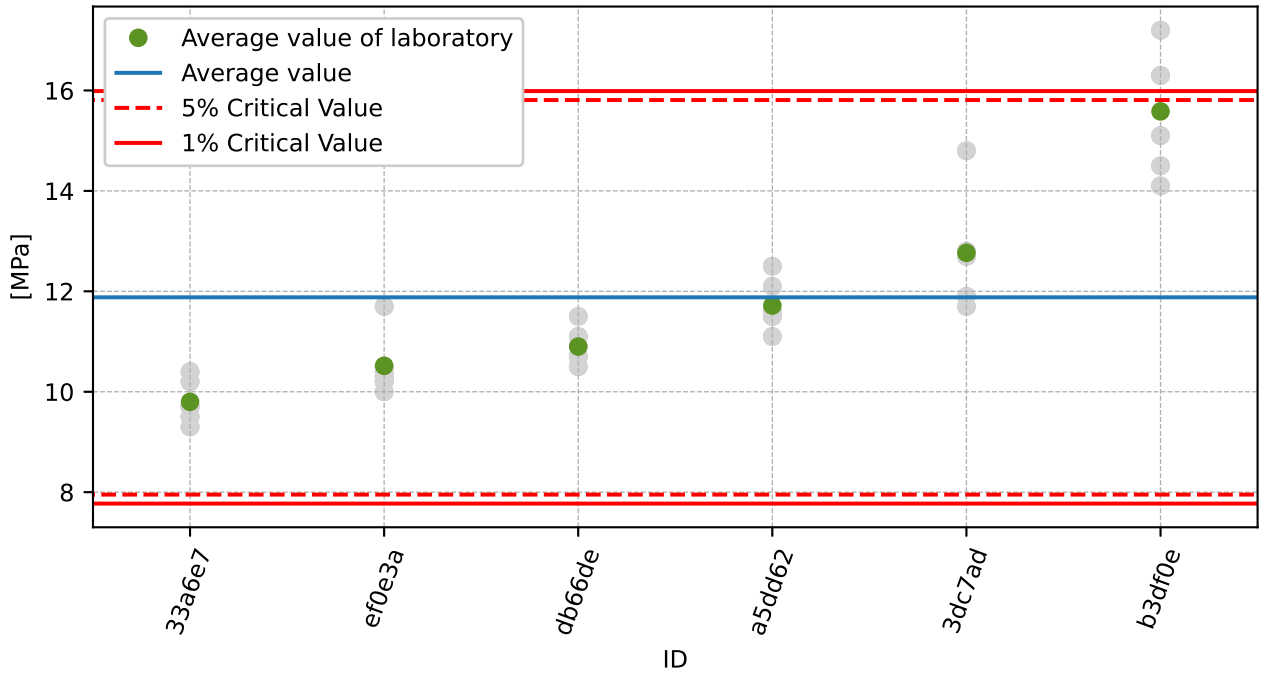

Figure 83: **Grubbs' test** - average values

14.3 Mandel's Statistics

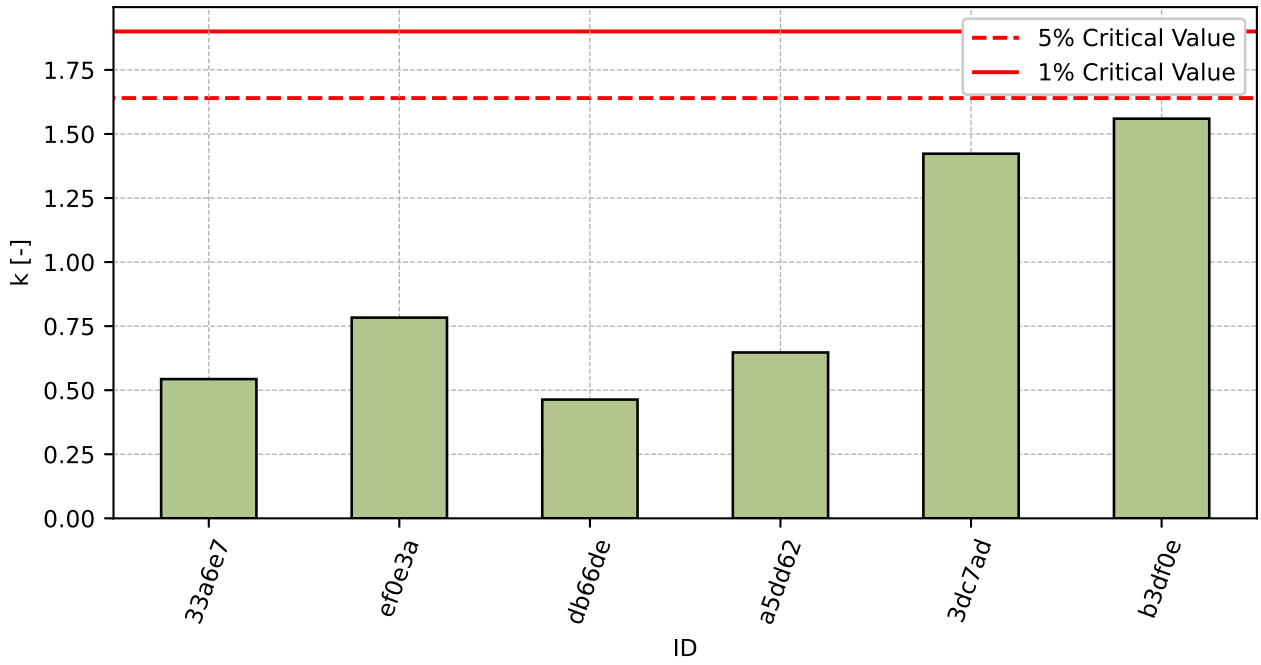

Figure 84: Intralaboratory Consistency Statistic

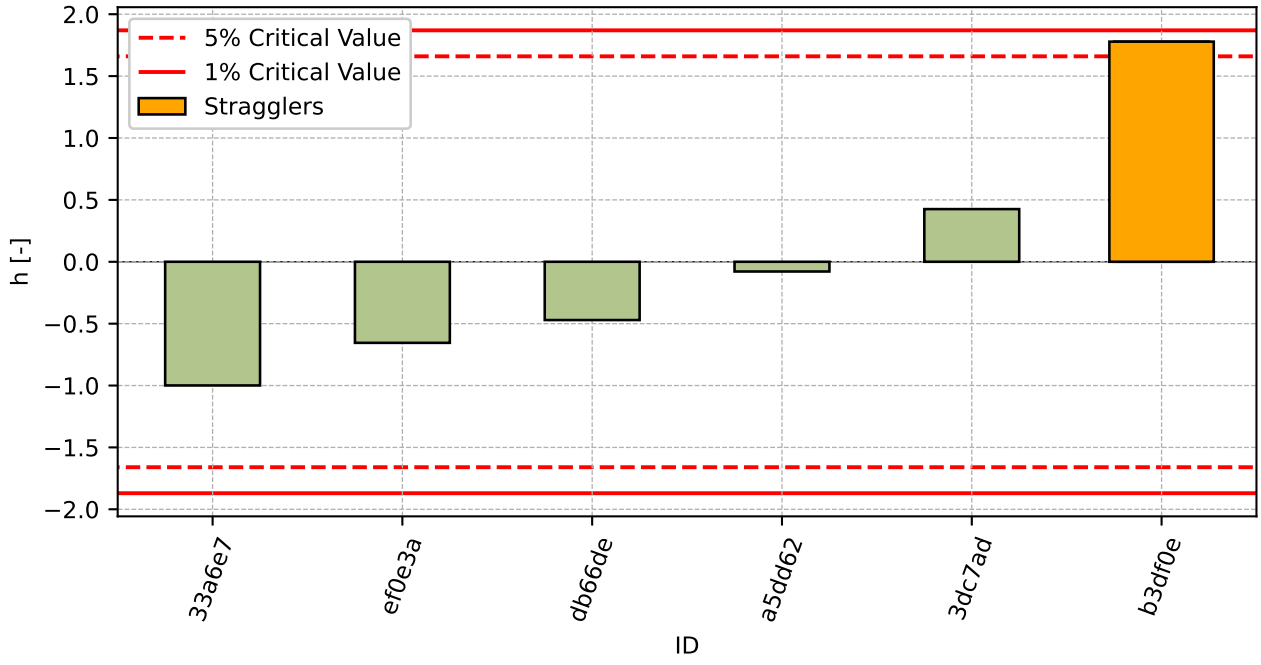

Figure 85: Interlaboratory Consistency Statistic

14.4 Descriptive statistics

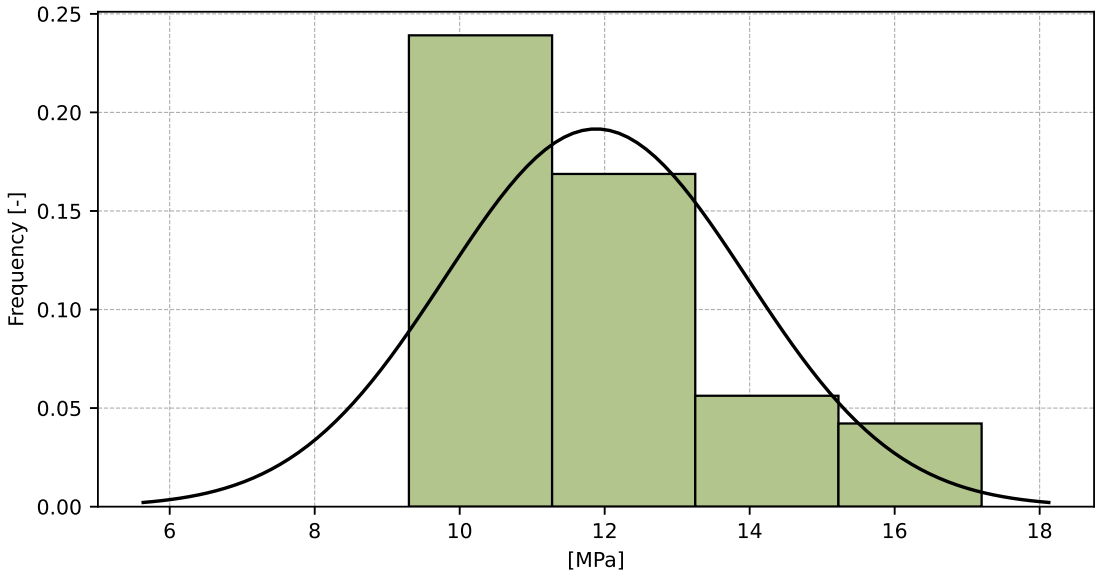

Figure 86: Histogram of all test results

Table 32: Descriptive statistics

Characteristics	[MPa]
Average value – $\bar{x}$	11.9
Sample standard deviation – s	2.08
Asigned value – x^*	11.9
Robust standard deviation – s^*	2.16
Measurement uncertainty of asigned value – u_X	1.1
p-value of normality test	0.02 [-]
Interlaboratory standard deviation – s_L	2.06
Repeatability standard deviation – s_r	0.77
Reproducibility standard deviation – s_R	2.2
Repeatability – r	2.2
Reproducibility – R	6.2

14.5 Evaluation of Performance Statistics

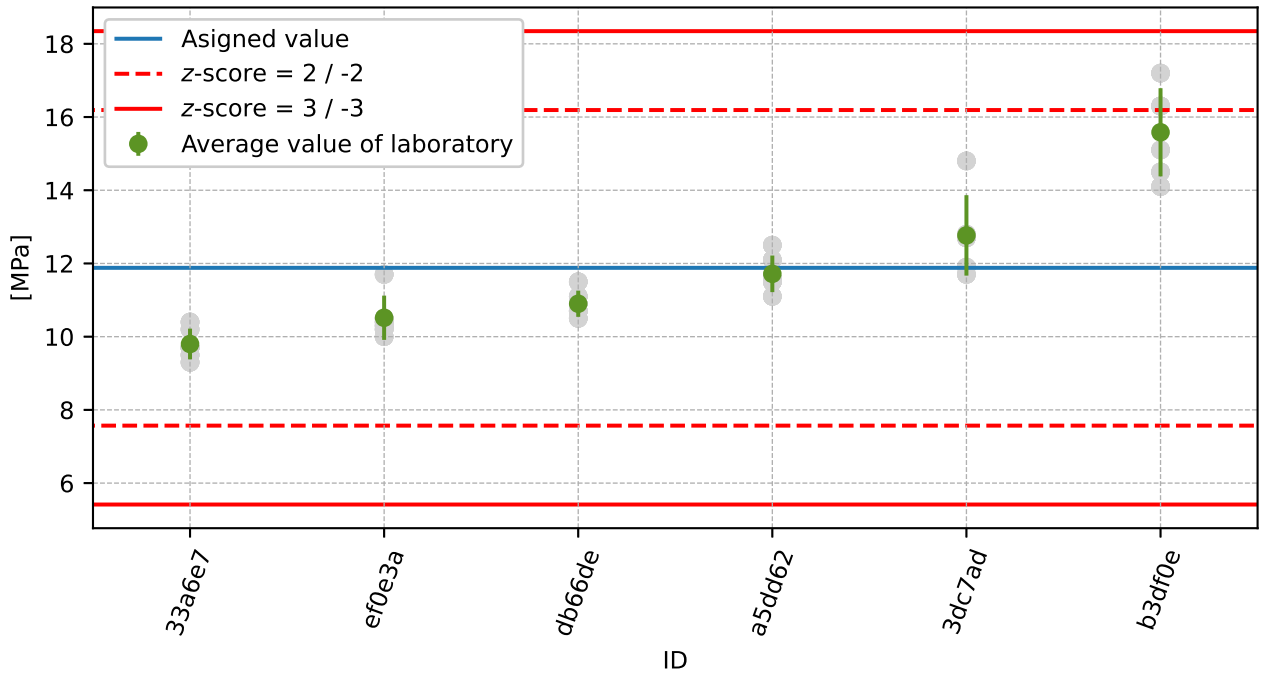

Figure 87: Average values and sample standard deviations

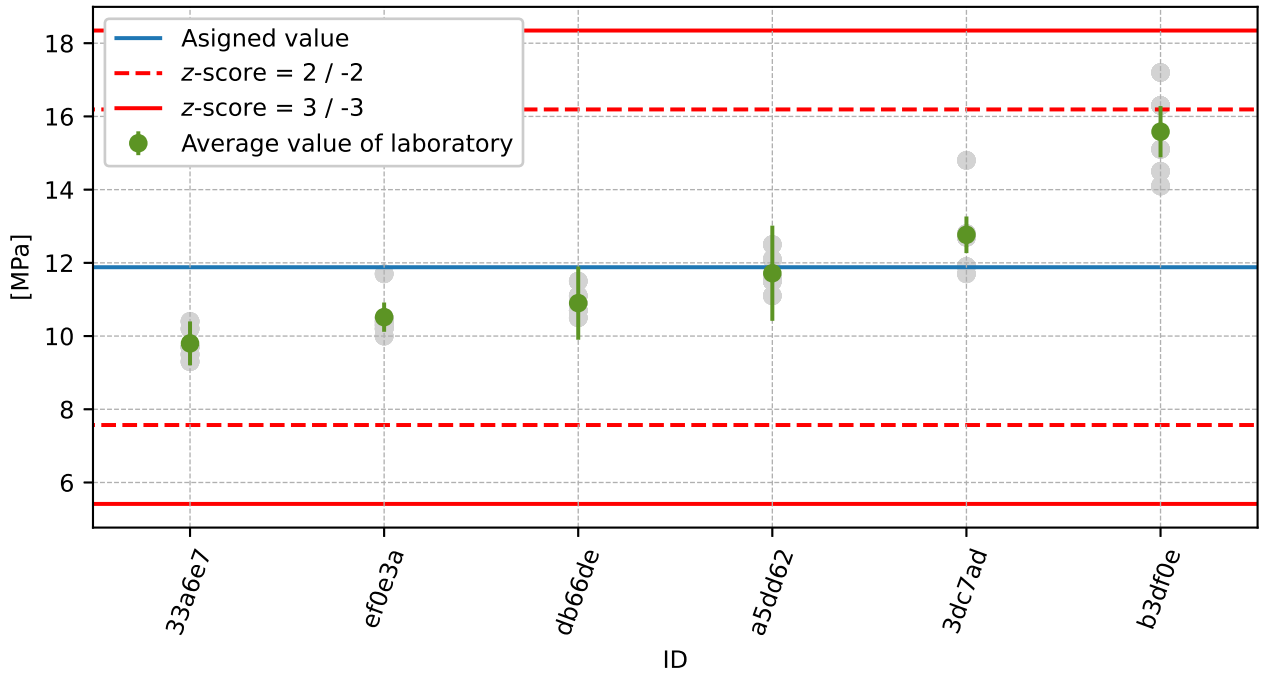

Figure 88: Average values and extended uncertainties of measurement

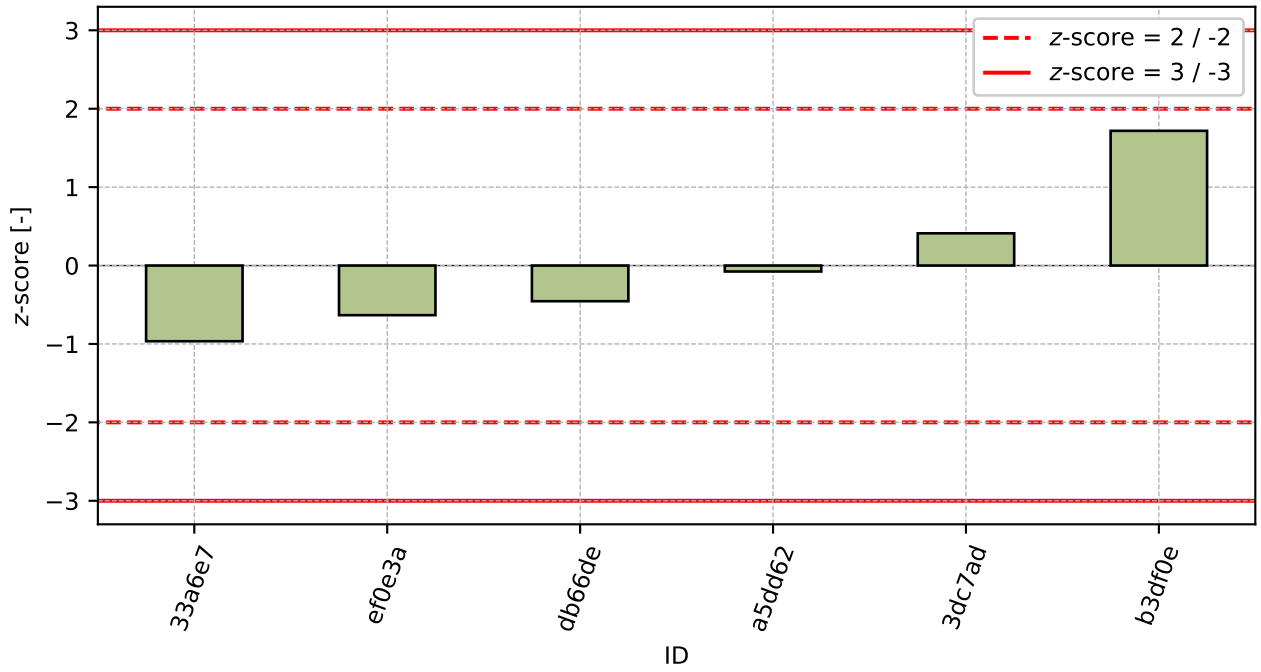

Figure 89: z-score

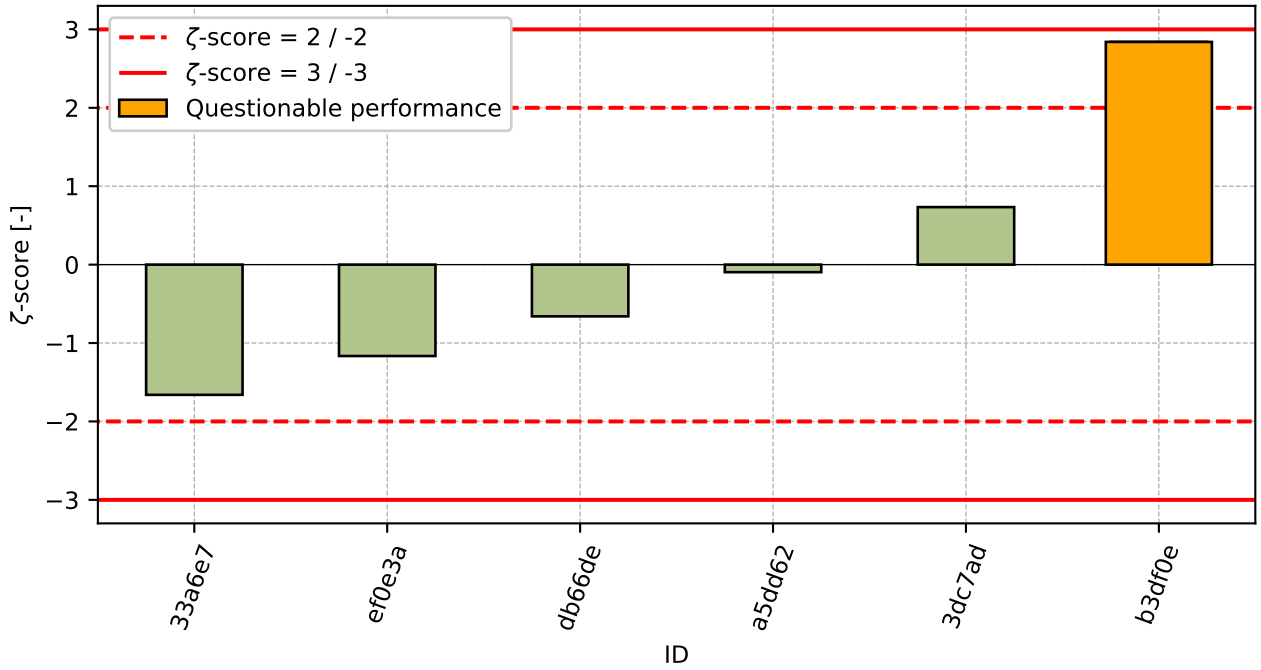

Figure 90: ζ-score

Table 33: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
33a6e7	-0.97	-1.66
ef0e3a	-0.63	-1.17
db66de	-0.45	-0.66
a5dd62	-0.08	-0.1
3dc7ad	0.41	0.73
b3df0e	1.72	2.84