BRNO UNIVERSITY OF TECHNOLOGY

FACULTY OF CIVIL ENGINEERING
institute of building testing

ilac-MRA

Z 7008

FINAL REPORT ON THE RESULTS OF PRECISION EXPERIMENT

Proficiency Testing Program
Soil Testing
ZZ 2023/1

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

Date: February 27, 2024

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

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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 ZZ 2023/1 whose aim was to verify and assess the conformity of test results across laboratories when testing soils.

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

doc. Ing. Tomáš Vymazal, Ph.D.
Brno University of Technology
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Veveří 95, Brno 602 00
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Coordinator of PTP result assessment PrZZ

Ing. Petr Misák, Ph.D.
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Veveří 95, Brno 602 00
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The subjects of proficiency testing were the following testing procedures:

1. EN ISO 17892-1 Geotechnical investigation and testing - Laboratory testing of soil - Part 1: Determination of water content [1],
2. EN ISO 17892-3 Geotechnical investigation and testing - Laboratory testing of soil - Part 3: Determination of particle density [2],
3. EN ISO 17892-4 Geotechnical investigation and testing - Laboratory testing of soil - Part 4: Determination of particle size distribution, art. 5.2 (Sieving) [3],
4. EN ISO 17892-4 Geotechnical investigation and testing - Laboratory testing of soil - Part 4: Determination of particle size distribution, art. 5.3 (Densimetric analysis),
5. EN ISO 17892-5 Geotechnical investigation and testing - Laboratory testing of soil - Part 5: Incremental loading oedometer test [4],
6. EN ISO 17892-7 Geotechnical investigation and testing - Laboratory testing of soil - Part 7: Unconfined compression test [5],
7. CEN ISO/TS 17892-10 Geotechnical investigation and testing - Laboratory testing of soil - Part 10: Direct shear tests [6],
8. EN ISO 17892-12 Geotechnical investigation and testing - Laboratory testing of soil - Part 12: Determination of liquid and plastic limits [7],
9. EN 13286-2 Unbound and hydraulically bound mixtures - Part 2: Test methods for laboratory reference density and water content -Proctor compaction [8],
10. EN 13286-47 Unbound and hydraulically bound mixtures - Part 47: Test method for the determination of California Bearing ratio, immediate bearing index and linear swelling [9].

The test results from individual PTP participants were compared via a method involving the statistical analysis of all their results in a manner complying with ISO 5725-2 [10] and with EN ISO/IEC 17043 [11]. The outcome is the present final report summarizing the results of the interlaboratory comparison, including statistical evaluation.

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

Table 1: Participation of individual laboratories in the PTP

ID/Method	1	2	3	4	5	6	7	8	9	10
d52881	X	-	-	-	-	-	-	-	-	-
d23d72	-	-	-	-	-	-	X	-	-	-
7974e3	-	-	-	-	-	-	-	-	-	X
526ece	X	X	X	X	X	-	X	X	-	-
432f9d	X	X	-	X	-	X	-	-	X	-
7b482a	-	-	-	-	-	-	-	X	-	-
269ec5	X	-	-	X	-	-	-	X	-	-
344dbc	X	-	X	-	-	-	-	-	-	-
a68573	-	-	-	-	-	-	-	-	X	-
d4bcaf	-	-	-	-	-	-	-	-	X	-
d36137	X	-	-	-	-	-	-	-	X	-
6cbdf1	-	-	X	X	-	-	-	-	-	X
44e007	-	-	-	-	-	-	-	-	-	X
a40228	X	X	X	-	-	-	-	X	X	X
d42de8	X	-	-	-	X	-	-	-	-	-
676031	-	-	-	-	-	-	-	X	-	-
7faa64	-	-	-	-	X	-	X	-	-	-
85ab0e	-	-	-	X	-	-	-	-	-	-
7e62f8	X	X	X	X	X	X	X	X	X	-
3c62de	-	-	-	X	-	-	X	-	-	-
c4e6ee	-	-	-	-	-	X	-	-	-	-
4e6829	-	-	-	-	-	-	-	X	X	X
8e30a8	X	X	X	X	X	X	X	X	X	X
03da8b	X	X	X	-	X	-	X	X	X	-
de09c5	X	-	-	-	-	-	-	-	-	X
47a0ff	-	-	-	-	X	-	X	-	-	-
1f159f	-	-	X	-	-	-	-	-	-	X
02bd37	X	-	X	X	-	-	-	X	-	-
05f4ea	X	-	-	-	-	-	-	-	-	-
550e05	X	X	X	X	-	-	-	X	-	-
13c4f0	X	X	X	X	X	X	X	X	X	X
a70ec5	X	X	X	X	X	X	X	X	-	-
1e5f15	-	-	X	X	-	-	-	-	X	-
baa022	-	-	-	X	-	-	-	-	-	-
3614c8	X	-	X	-	-	-	-	-	-	-
e7a7c0	X	-	-	-	-	-	-	-	-	-
62d725	X	-	-	-	-	-	-	-	-	-
ba7e11	-	-	-	-	X	-	-	-	X	X
18d74c	X	-	X	-	-	-	-	-	-	-
f7d66c	-	-	-	-	-	-	-	X	-	-
c09547	X	-	-	-	X	-	-	-	-	-
0828e7	-	-	-	-	-	-	-	-	X	X
7b88c9	-	-	X	X	-	-	-	-	-	-
94cb0b	-	-	-	X	-	-	-	-	-	-

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ID/Method	1	2	3	4	5	6	7	8	9	10
f26f63	X	-	X	-	-	-	-	-	X	-
52cc32	X	-	-	-	X	X	X	-	-	-
c30acd	-	-	-	-	X	X	-	-	-	-
d88cb5	X	-	-	-	-	-	X	-	-	-
c5596c	-	-	-	-	-	-	-	X	-	-
ed020a	-	X	-	-	-	-	X	X	X	X
6727eb	-	-	-	-	-	-	-	X	-	-
333f9d	-	-	X	-	-	-	-	-	-	-
7a9a8e	-	-	-	-	X	-	-	-	X	X
e75250	-	-	-	-	-	-	X	-	-	-
eb0501	-	-	-	-	-	-	-	-	X	X
d3096f	X	X	X	X	-	-	-	X	-	-
06b0ef	-	X	X	-	-	-	X	X	-	-
5e7bb2	X	-	X	-	-	-	X	X	-	-
d60213	-	-	-	-	-	-	-	-	X	-
9a4772	-	-	-	-	X	-	X	-	-	-
afe61e	X	-	X	X	-	X	X	-	X	X
644b53	X	-	-	-	-	-	-	-	X	-
4032d8	-	-	-	-	-	-	X	-	-	X
e40afd	X	X	X	X	X	X	X	X	X	X
77a1d8	X	-	X	-	-	-	-	X	-	-
7126ed	-	-	-	-	X	-	X	-	-	-
671841	X	X	X	X	X	X	X	X	X	-
b8b262	-	-	-	-	-	-	-	-	X	-
5f2d09	X	X	X	-	-	-	-	X	X	-
769514	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
4G consite s.r.o.	Šlikova 406/29, Praha 6, 16900, Česká republika	1518
AZ Consult, spol. s r.o.	Klíšská 1334/12, Ústí nad Labem, 400 01, 44567430	L1740
AZ GEO, s.r.o.	Chittussiho 1186/14, Ostrava – Slezská Ostrava, 71000, Česká republika	1768
B-PROJEKTY Teplice s.r.o.	Kollárova 1879/11, Teplice, 415 01, Česká republika	L 1428
BANAT INŽENJERING 223 DOO	Makedanska 15, Zrenjanin, 23000, Serbia	-
Bechtel ENKA UK Limited Ogranak Beograd	Jasički put 52đ, Kruševac, 37000, Serbia	-

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Laboratory	Address	Accreditation number
Bechtel ENKA UK Limited Ogranak Beograd	Jasički put 52đ, Kruševac, 37000, Serbia	-
CEMEX Czech Republic, s.r.o.	Laurinova 2800/4, Praha 5, 15500, Česká republika	1302
CSS d.o.o.	Savska cesta 144a, Zagreb, 10000, Croatia	HR1106
DSP a.s.	Kostěnice 111, Kostěnice, 53002, Česká republika	1782
EDAFOMICHANIKI S.A.	19 EMMANUEL PAPADAKI, NEO IRAKLEIO, 14121, GREECE	-
Eurofins Umwelt Österreich GmbH & Co. KG	Palmersstrasse 2, Wiener Neudorf, 2351, Austria	PSID0071
Fugro	Mindaugo g. 42, Vilnius, 01311, Lithuania	-
GEMATEST s.r.o.	Dr. Janského 954, Černošice, 25228, Česká republika	1291
GEOTECHNICAL LABORATORY OF OFFSHORE GEOTECHNICS DEPARTMENT IN MARITIME INSTITUTE (GDYNIA MARITIME UNIVERSITY)	al. Grunwaldzka 311A, Gdańsk, 80-577, Poland	-
GEOTECHNICAL LABORATORY OF OFFSHORE GEOTECHNICS DEPARTMENT IN MARITIME INSTITUTE (GDYNIA MARITIME UNIVERSITY)	Grunwaldzka 311A, Gdańsk, 80-309, Polska	AB 1770
GEOtest a.s.	Šmahova 112, Brno 27, 627 00, Česká Republika	1271
Gdynia Maritime University, Maritime Institute (GMU IM)	Trzy Lipy 3, building A, Maritime Institute, Gdańsk, 80-172, Poland	-
Geolab d.o.o,Sarajevo	Mustafe Bajića 19, Sarajevo, 71 000, Bosna i Hercegovina	-
Geotest shpk	Autostada Tirane -Durres, km2,Mezez,Kashar,Tirane, Tirane, 1051, Albania	-
IBIS-Inženjering d.o.o.	Omladinska 28, Banja Luka, 78 000, Bosna i Hercegovina	LI-169-01
IGH d.o.o.	Bišće polje bb, Mostar, 88000, Bosna i Hercegovina	LI-31-01
IGSL	IGSL M7 Business Park Newhall, NAAS, W91 DY93, Ireland	-
INŻ-GEO Badania i Roboty Geotechniczne Sp. z o.o. Sp. komandytowa	Wolności 20, Psary, 51-180, Dolnośląskie	AB 1750
Impresa Bacchi Srl	VIA DON DOSSETTI 19, carpiano (MI), 20080, 9BIE	1554L
Innovation Hub/PPC S.A.	Leontariou 9, Kantza-Pallini, Athens, 15351, Athens Greece	ed56ac

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Laboratory	Address	Accreditation number
Institut technologie a testování betonu, s.r.o., Zkušební laboratoř ITTB Brno	K Babě 609/9, Brno, 62100, Česká republika	L1778
Klaipeda University Marine Research Institute	Universiteto al. 17, Klaipeda, 92295, Lithuania	-
LI Zemna Mehanika	3. Tsarevo selo Str., Sofia, 1612, Bulgaria	LI255
LabTech d.o.o. Osijek	Ulica borova 3, OSIJEK, 31000, CROATIA	-
Labgeo cz s.r.o.	Plzeňská 466/359, Ostrava, 724 00, Česká republika	1789
Laboratoire Central des Travaux Publics - LCTP	1. rue Kaddour RAHIM- HUSSEIN DEY, ALGER, 16005, ALGERIE	-
Laboratoire Central des Travaux Publics- Laboratoire Mécanique des sols Hussein dey -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
M.I.S. a.s., pracoviště Chrudim	Resslova 956/13, Hradec Králové, 500 02, Česká republika	1197
M.I.S. a.s., pracoviště Hradec Králové	Resslova 956/13, Hradec Králové, 500 02, Česká republika	1197
MATTEST, Unit 2	Northwest Business Park, Ballycoolin. Dublin 15., Dublin, D15 EF1H, Ireland	286T
Mansoura University	El Gomhouria, MANSOURA, 35511, Dakahlia, Egypt	-
Mining and Metallurgy Institute Bor	Zeleni bulevar 35, Bor, 19210, Serbia	01-308, ATS Serbia
Ministeries van de Vlaamse Gemeenschap – Departement mobiliteit en openbare werken - Geotechniek	Technologiepark-Zwijnaarde 68, Zwijnaarde, 9052, België	-
PUDIS a.s.	Podbabská 1014/20, Praha 6, 160 00, Česká republika	1762
Przedsiebiorstwo Realizacyjne INORA Inorganic Activities sp. z o.o.	Prymasa Stefana Wyszyńskiego 11, Gliwice, 44-100, Polska	-
QCONTROL s.r.o., odštěpný závod - pracoviště Rousínov	Lesní 693, Bílovice nad Svitavou, 66401, Česká republika	1737
Rina-Consulting GET Srl	Via cecchi 6, GE, 16129, Italy	-
Rina-Consulting GET Srl	Via albisola 64-66, GENOVA, 16162, ITALY	-
Rudarski institut d.d. Tuzla	Rudarska 72, Tuzla, 75000, Bosnia & Herzegovina	-
Rudarski institut d.o.o. Beograd-Zemun	Batajnicki put br.2, Beograd, 11080, Serbia	01-309
S.C. GEOSTUD S.R.L.	Str. Sîngerului, nr. 11, sector 1, Bucharest, 014617, Romania	LI 974
SG Geotechnika a.s.	Geologická 988/4, Praha 5 - Hlubočepy, 152 00, Česká republika	1119

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Laboratory	Address	Accreditation number
SOILAB S.A.S	Calle 66 No 28-41, Bogotá D.C, 111221, Colombia	-
STATS ASIA PACIFIC PTE LTD	71 TOH GUAN ROAD EAST 02-01/02, TCH TECHCENTRE, SINGAPORE, 608598, SINGAPORE, 608598, SINGAPORE	-
Sibotec	Industriepark Oost 6, Beernem, 8730, West - Vlaanderen	-
Slovenská správa ciest	M. Rázusa 104/A, Žilina, 010 01, Slovenská republika	181/S-322
Sweco Lietuva UAB	A. Strazdo g 22, Kaunas, LT-48488, Lithuania	-
TEPVERAM, s.r.o.	Třibřichy 13, Třibřichy, 53701, Česká republika	1759
TESS control, Zkušební laboratoř Znojmo	Brněnská 3797/29, Znojmo, 182 00, Česká republika	-
TESTSTAV, spol. s r.o.	Orlovská 347/160, Ostrava-Heřmanice, 71300, Česká republika	1290
TPA EOOD CTC SOFIA	Rezbarska str. №7, SOFIA, 1015, BULGARIA	-
TPA ČR, s.r.o.	Ustřední 62, Praha 10, 102 00, Česká republika	1181
TRA EOOD CTC KREPOST	Rezbarska str. №7, SOFIA, 1510, BULGARIA	-
TRANSLAB LABORATORIUM	Oeverstraat 21, Lokeren, 9160, Belgium	-
UAB „Geoanalizė“	Lauko str. 2, Karmėlava, LT-54448, Lithuania	-
UNIGEO a.s.	Místecká 329/258, Ostrava, 70200, Česká republika	1412
Výzkumný ústav pro hnědé uhlí a.s.	tř. Budovatelů 2830/3, Most, 434 01, Česká republika	1078
VšĮ Energetikų mokymo centras	Raudondvario pl. 168, Kaunas, 47172, Kauno Apskritis	-
i2 Analytical Ltd. Sp. z o.o. Oddzial w Polsce	Pionierów 39, Ruda Śląska, 41-711, Polska	-
ÉMI Építésügyi Minőségellenőrző Innovációs Nonprofit Kft.	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
České vysoké učení technické v Praze	Thákurova 7/2077, Praha, 166 29, Česká republika	675/2022
Ředitelství silnic a dálnic ČR	Rebešovická 40, Brno-Chrlice, 643 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 Soil Testing (PT Program) organized by the PT Provider at the SZK FAST. 71 participants (laboratories) took part in the PT Program. The program focused on ordinary standardized testing of soil. 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.

The testing methods 3 and 4 were evaluated as a multilevel experiment. Laboratory performance was classified as problematic or unsatisfactory if critical values were exceeded on at least three levels of the experiment.

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
d52881	✓	-	-	-	-	-	-	-	-	-
d23d72	-	-	-	-	-	-	?	-	-	-
7974e3	-	-	-	-	-	-	-	-	-	✓
526ece	✓	✓	✓	✓	✓	-	✓	✓	-	-
432f9d	✓	✓	-	✓	-	✓	-	-	?	-
7b482a	-	-	-	-	-	-	-	!	-	-
269ec5	✓	-	-	✓	-	-	-	✓	-	-
344dbc	✓	-	✓	-	-	-	-	-	-	-
a68573	-	-	-	-	-	-	-	-	✓	-
d4bcaf	-	-	-	-	-	-	-	-	✓	-
d36137	✓	-	-	-	-	-	-	-	✓	-
6cbdf1	-	-	✓	✓	-	-	-	-	-	✓
44e007	-	-	-	-	-	-	-	-	-	✓
a40228	✓	✓	✓	-	-	-	-	✓	✓	✓
d42de8	✓	-	-	-	✓	-	-	-	-	-
676031	-	-	-	-	-	-	-	✓	-	-
7faa64	-	-	-	-	?	-	✓	-	-	-
85ab0e	-	-	-	✓	-	-	-	-	-	-
7e62f8	✓	✓	✓	✓	✓	✓	✓	✓	✓	-
3c62de	-	-	-	✓	-	-	✓	-	-	-
c4e6ee	-	-	-	-	-	X	-	-	-	-
4e6829	-	-	-	-	-	-	-	✓	✓	✓
8e30a8	✓	✓	✓	✓	?	✓	✓	✓	✓	✓
03da8b	✓	✓	✓	-	✓	-	✓	✓	✓	-
de09c5	✓	-	-	-	-	-	-	-	-	✓
47a0ff	-	-	-	-	✓	-	✓	-	-	-
1f159f	-	-	?	-	-	-	-	-	-	✓

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ID / Method	1	2	3	4	5	6	7	8	9	10
02bd37	✓	-	✓	✓	-	-	-	✓	-	-
05f4ea	✓	-	-	-	-	-	-	-	-	-
550e05	✓	✓	✓	✓	-	-	-	✓	-	-
13c4f0	✓	✓	✓	✓	✓	✓	X	!	✓	✓
a70ec5	✓	✓	✓	✓	✓	✓	✓	✓	-	-
1e5f15	-	-	✓	?	-	-	-	-	✓	-
baa022	-	-	-	✓	-	-	-	-	-	-
3614c8	✓	-	✓	-	-	-	-	-	-	-
e7a7c0	✓	-	-	-	-	-	-	-	-	-
62d725	X	-	-	-	-	-	-	-	-	-
ba7e11	-	-	-	-	✓	-	-	-	✓	✓
18d74c	✓	-	✓	-	-	-	-	-	-	-
f7d66c	-	-	-	-	-	-	-	✓	-	-
c09547	X	-	-	-	✓	-	-	-	-	-
0828e7	-	-	-	-	-	-	-	-	X	X
7b88c9	-	-	X	?	-	-	-	-	-	-
94cb0b	-	-	-	✓	-	-	-	-	-	-
f26f63	✓	-	✓	-	-	-	-	-	✓	-
52cc32	✓	-	-	-	✓	✓	✓	-	-	-
c30acd	-	-	-	-	✓	✓	-	-	-	-
d88cb5	X	-	-	-	-	-	✓	-	-	-
c5596c	-	-	-	-	-	-	-	✓	-	-
ed020a	-	✓	-	-	-	-	✓	✓	✓	✓
6727eb	-	-	-	-	-	-	-	✓	-	-
333f9d	-	-	✓	-	-	-	-	-	-	-
7a9a8e	-	-	-	-	✓	-	-	-	✓	✓
e75250	-	-	-	-	-	-	X	-	-	-
eb0501	-	-	-	-	-	-	-	-	X	✓
d3096f	✓	✓	✓	✓	-	-	-	✓	-	-
06b0ef	-	✓	✓	-	-	-	✓	?	-	-
5e7bb2	✓	-	✓	-	-	-	✓	✓	-	-
d60213	-	-	-	-	-	-	-	-	✓	-
9a4772	-	-	-	-	✓	-	✓	-	-	-
afe61e	X	-	✓	✓	-	✓	✓	-	?	✓
644b53	✓	-	-	-	-	-	-	-	✓	-
4032d8	-	-	-	-	-	-	✓	-	-	✓
e40afd	✓	✓	✓	✓	✓	✓	?	✓	✓	✓

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ID / Method	1	2	3	4	5	6	7	8	9	10
77a1d8	✓	-	✓	-	-	-	-	✓	-	-
7126ed	-	-	-	-	✓	-	✓	-	-	-
671841	✓	✓	✓	✓	✓	✓	✓	✓	✓	-
b8b262	-	-	-	-	-	-	-	-	✓	-
5f2d09	✓	✓	✓	-	-	-	-	✓	✓	-
769514	✓	✓	✓	-	-	-	-	-	-	-

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[2] EN ISO 17892-3. *Geotechnical investigation and testing - Laboratory testing of soil - Part 3: Determination of particle density*. 2016.

[3] EN ISO 17892-4. *Geotechnical investigation and testing - Laboratory testing of soil - Part 4: Determination of particle size distribution*. 2017.

[4] EN ISO 17892-5. *Geotechnical investigation and testing - Laboratory testing of soil - Part 5: Incremental loading oedometer test*. 2017.

[5] EN ISO 17892-7. *Geotechnical investigation and testing - Laboratory testing of soil - Part 7: Unconfined compression test*. 2018.

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[8] EN 13286-2. *Unbound and hydraulically bound mixtures - Part 2: Test methods for laboratory reference density and water content - Proctor compaction*. 2011.

[9] EN 13286-47. *Unbound and hydraulically bound mixtures - Part 47: Test method for the determination of California Bearing ratio, immediate bearing index and linear swelling*. 2021.

[10] ISO 5725-2. *Accuracy (trueness and precision) of measurement methods and results - Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method*. 1997.

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

1 Appendix – EN ISO 17892-1 – Water content

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 [%]			u_X [%]	$\bar{x}$ [%]	s_0 [%]	V_X [%]
02bd37	5.1	5.1	5.1	2.0	5.1	0.03	0.52
05f4ea	5.2	5.1	5.1	0.2	5.1	0.06	1.12
644b53	5.1	5.3	5.3	0.2	5.2	0.12	2.21
7e62f8	5.5	5.3	5.7	6.8	5.5	0.2	3.64
344dbc	5.5	5.5	5.6	0.2	5.5	0.04	0.75
8e30a8	5.6	5.5	5.5	0.2	5.5	0.06	1.04
d36137	5.6	5.4	5.7	0.2	5.6	0.15	2.74
18d74c	5.6	5.5	5.7	0.6	5.6	0.1	1.79
03da8b	5.6	5.5	5.8	0.4	5.6	0.14	2.43
52cc32	5.6	5.6	5.6	-	5.6	0.04	0.72
13c4f0	5.6	5.6	5.7	-	5.6	0.06	1.02
f26f63	5.7	5.7	5.7	0.2	5.7	0.0	0.0
e7a7c0	5.7	5.7	5.8	-	5.7	0.06	1.01
e40afd	5.7	5.6	5.9	0.2	5.7	0.15	2.66
de09c5	5.8	5.8	5.7	1.0	5.8	0.06	1.0
432f9d	5.8	5.8	5.7	-	5.8	0.06	1.0
526ece	5.8	5.9	5.7	0.3	5.8	0.1	1.72
5e7bb2	5.8	5.8	5.8	-	5.8	0.0	0.0
769514	5.8	5.9	5.9	0.3	5.9	0.06	1.04
d42de8	5.9	5.6	6.1	-	5.9	0.22	3.75
a70ec5	6.0	5.9	6.0	-	6.0	0.06	0.97
5f2d09	6.0	6.0	6.0	0.1	6.0	0.05	0.87
550e05	6.0	6.0	6.0	2.0	6.0	0.0	0.0
77a1d8	5.9	6.0	6.1	-	6.0	0.1	1.67
671841	5.8	5.9	6.3	-	6.0	0.26	4.41
d3096f	6.1	6.3	6.1	-	6.2	0.14	2.21
3614c8	6.3	6.2	6.3	-	6.3	0.06	0.92
269ec5	6.4	-	-	0.8	6.4	0.0	0.0
a40228	6.5	6.5	6.4	-	6.5	0.06	0.89
d52881	6.6	6.5	6.7	1.4	6.6	0.1	1.52
c09547	16.3	16.6	16.6	0.4	16.5	0.17	1.05
d88cb5	16.8	16.6	16.8	0.2	16.7	0.14	0.84
62d725	17.8	17.5	17.7	0.5	17.7	0.15	0.86
afe61e	18.5	18.4	18.5	0.6	18.5	0.06	0.31

1.2 The Numerical Procedure for Determining Outliers

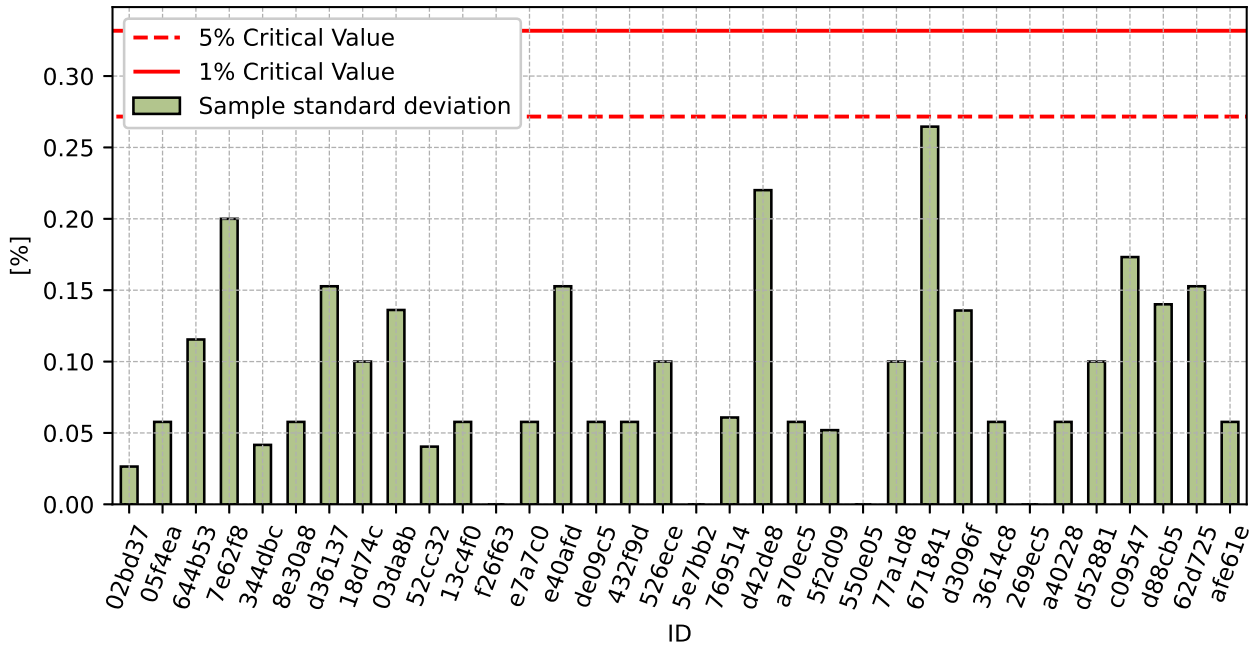

Figure 1: **Cochran's test** - sample standard deviations

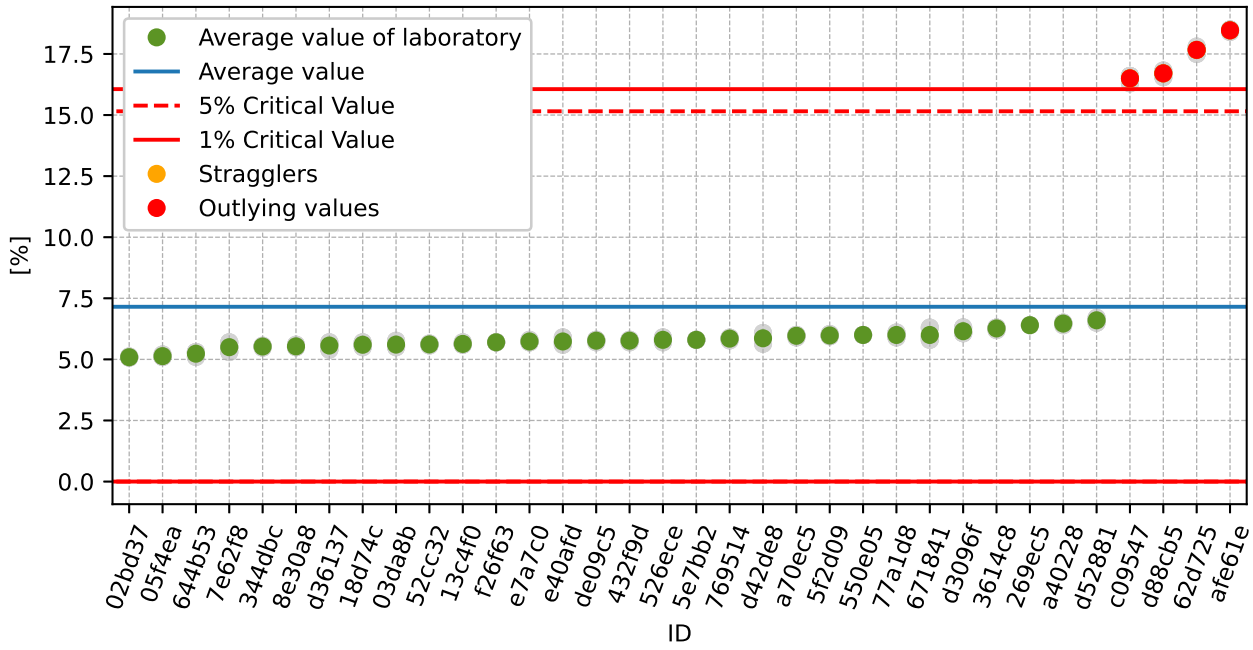

Figure 2: **Grubbs' test** - average values

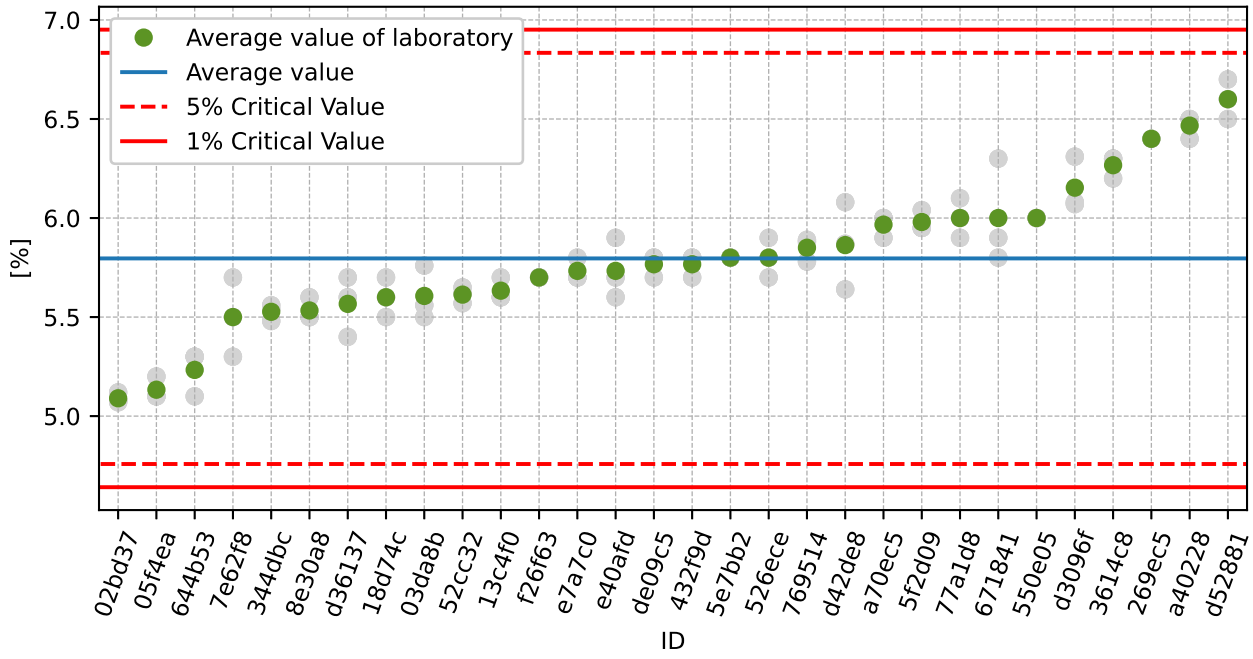

Figure 3: **Grubbs' test** - average values without outliers

1.3 Mandel's Statistics

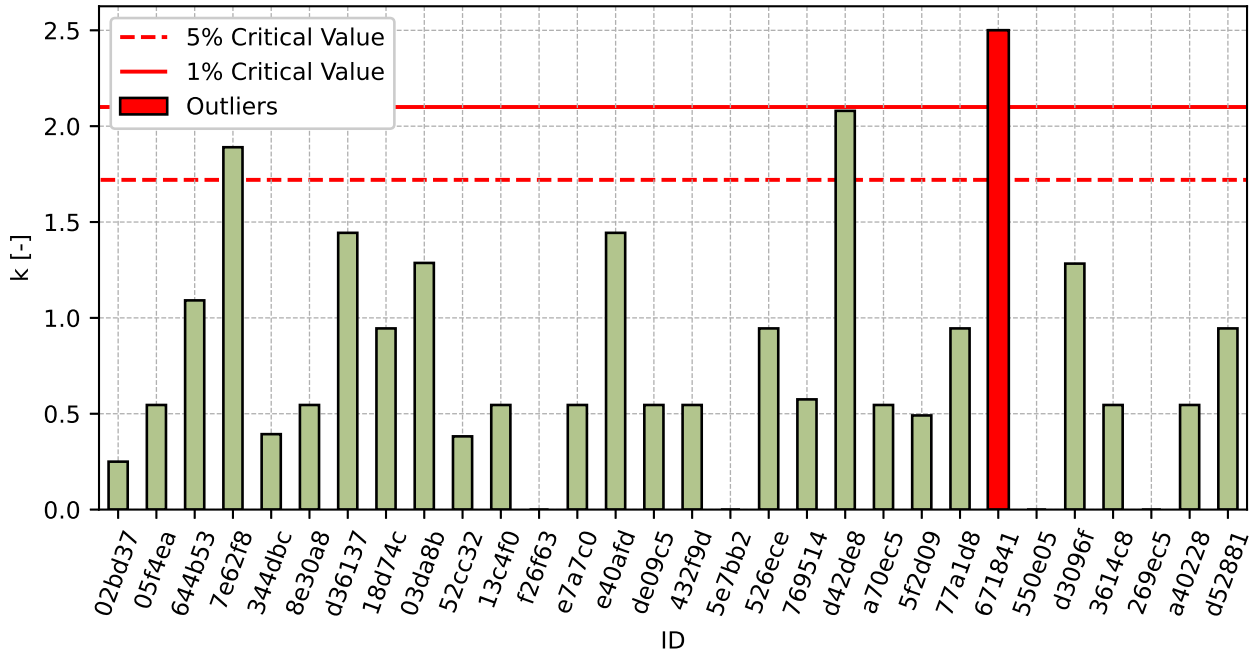

Figure 4: Intralaboratory Consistency Statistic

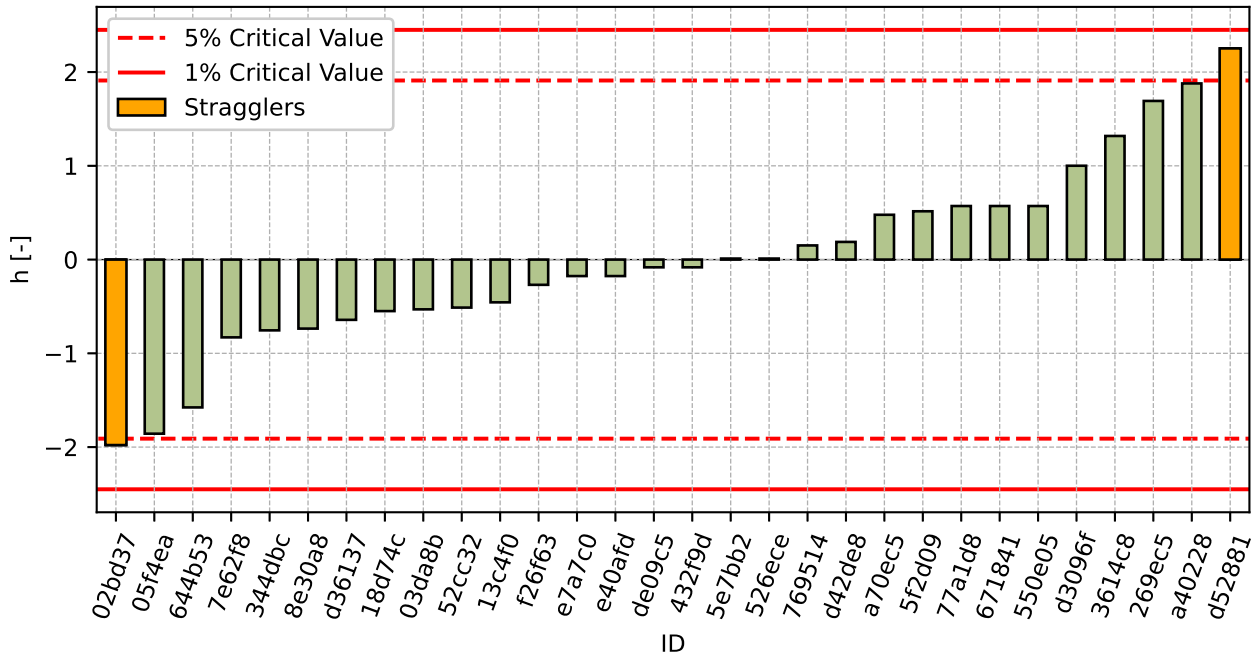

Figure 5: Interlaboratory Consistency Statistic

1.4 Descriptive statistics

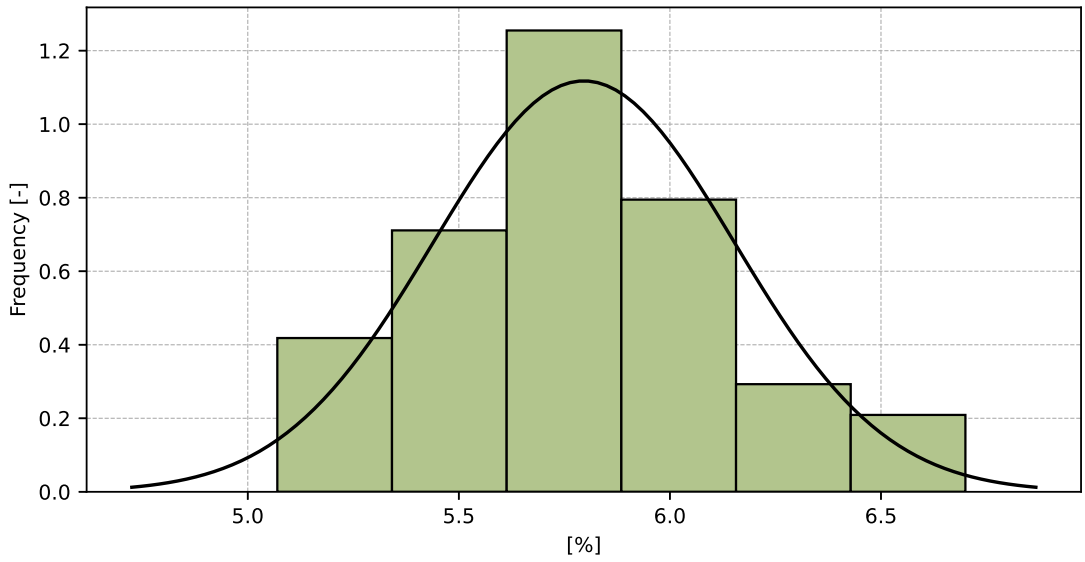

Figure 6: Histogram of all test results

Table 5: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	5.8
Sample standard deviation – s	0.36
Asigned value – x^*	5.8
Robust standard deviation – s^*	0.41
Measurement uncertainty of asigned value – u_X	0.08
p-value of normality test	1.0 [-]
Interlaboratory standard deviation – s_L	0.35
Repeatability standard deviation – s_r	0.11
Reproducibility standard deviation – s_R	0.37
Repeatability – r	0.3
Reproducibility – R	1.0

1.5 Evaluation of Performance Statistics

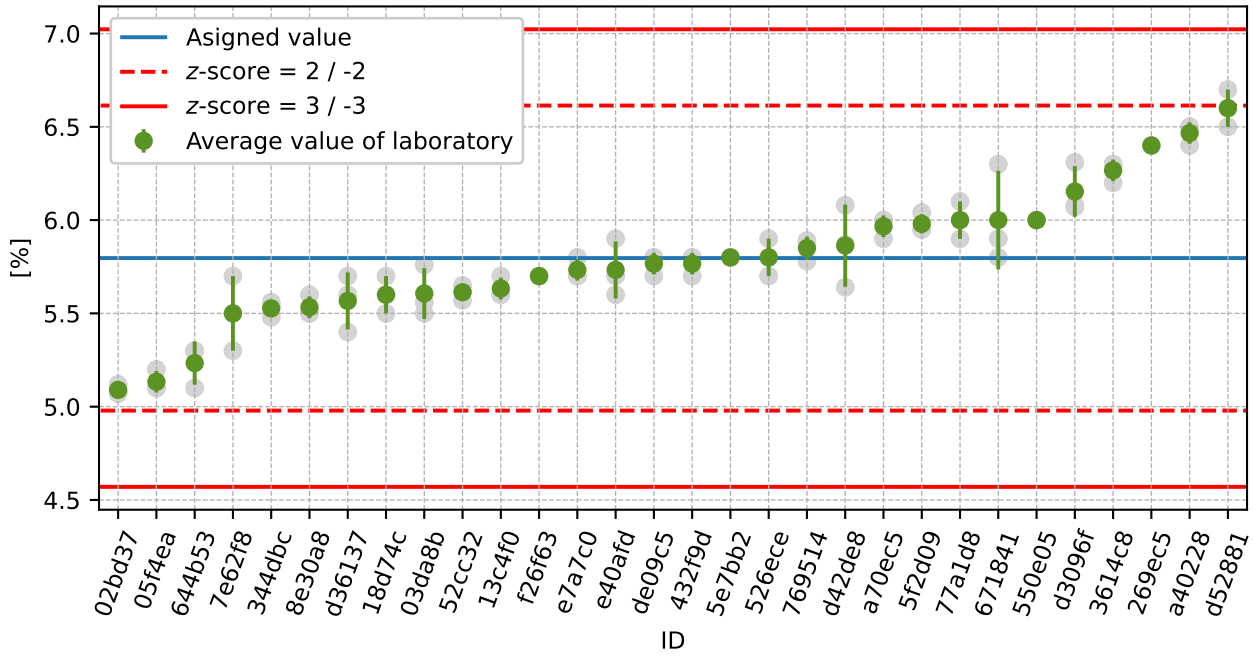

Figure 7: Average values and sample standard deviations

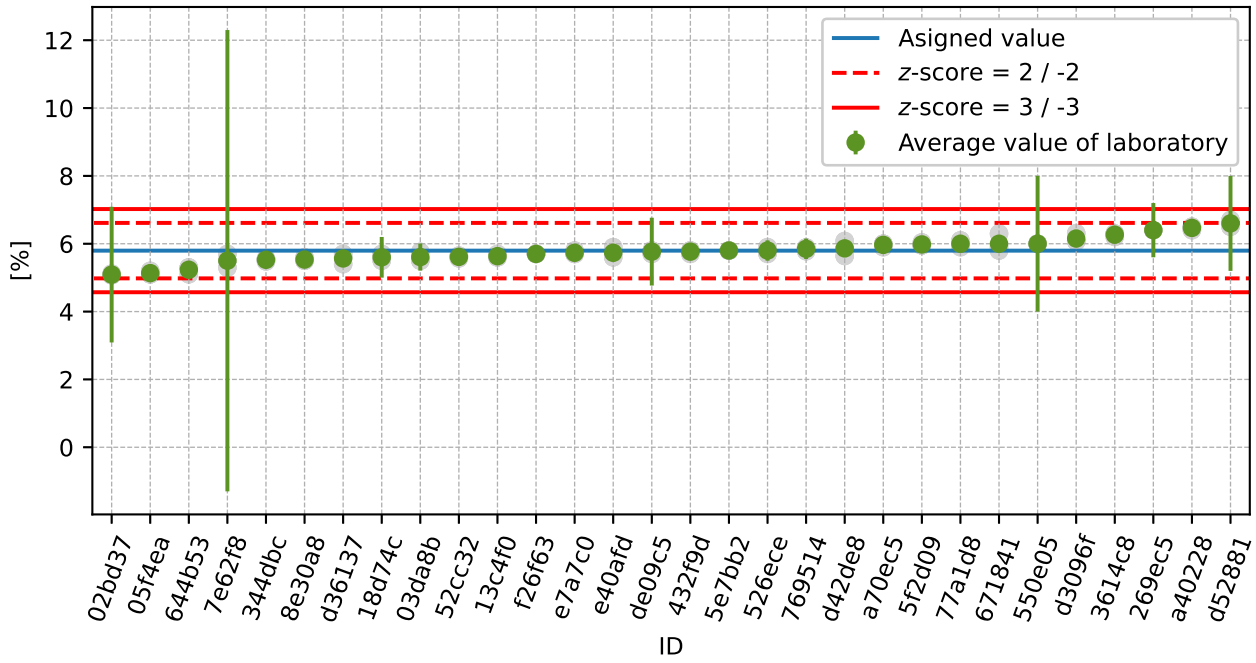

Figure 8: Average values and extended uncertainties of measurement

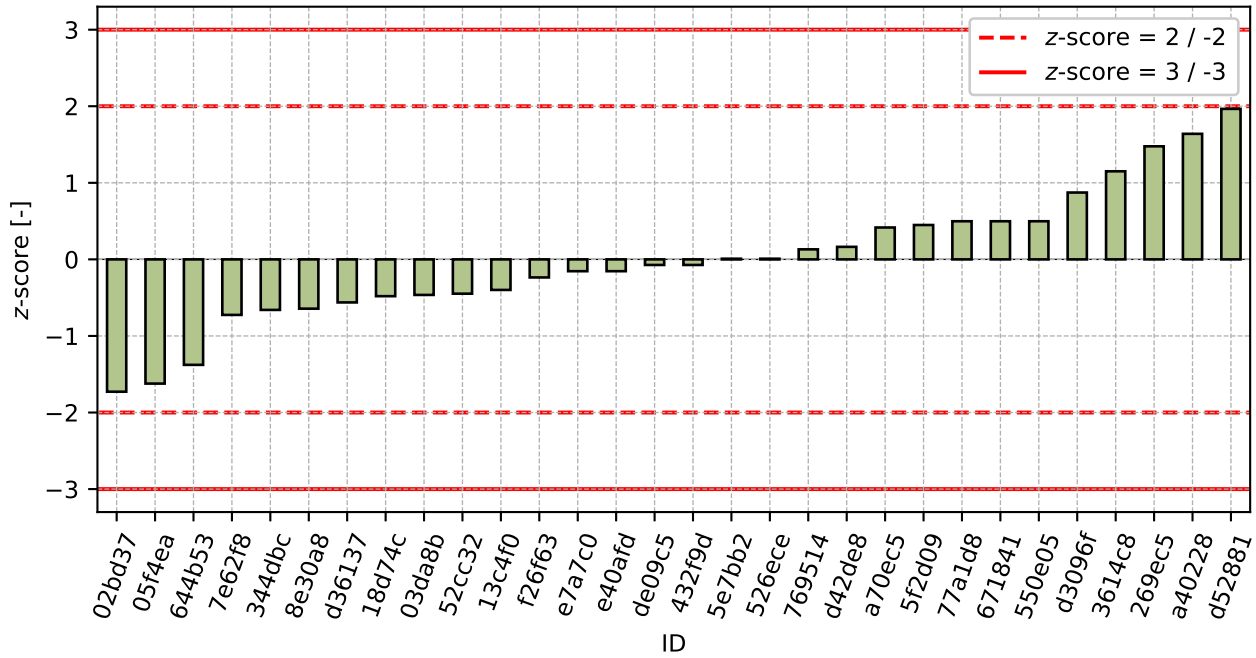

Figure 9: z-score

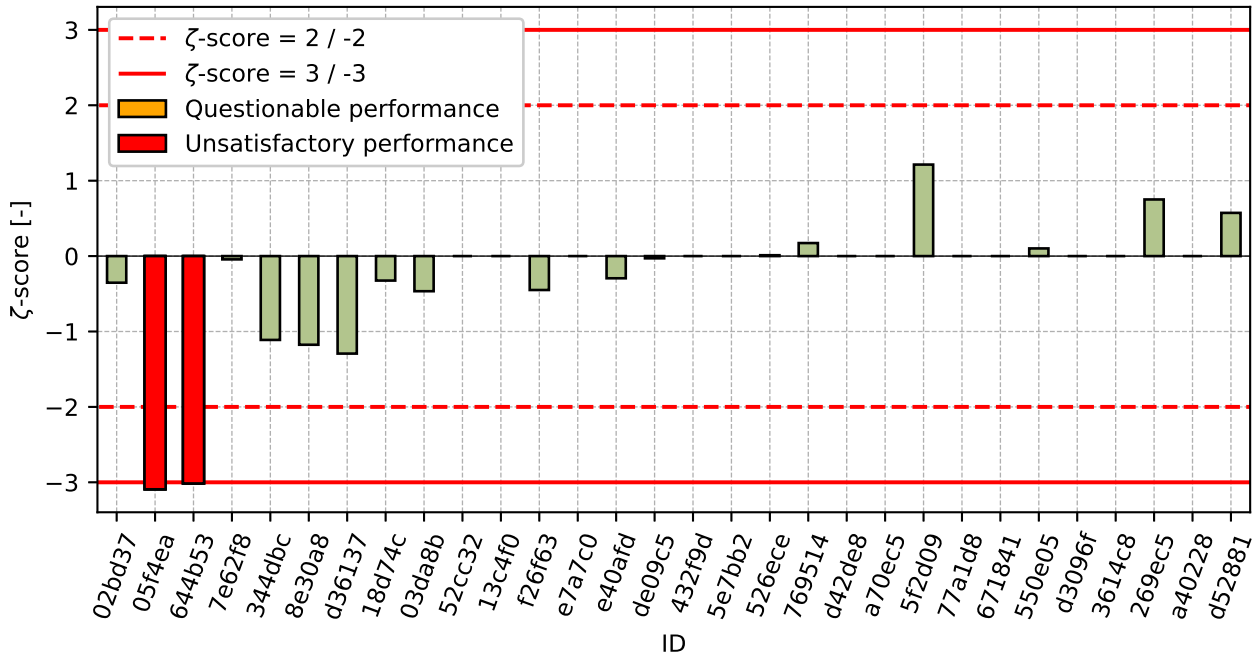

Figure 10: ζ-score

Table 6: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
02bd37	-1.73	-0.35
05f4ea	-1.62	-3.09
644b53	-1.38	-3.02
7e62f8	-0.73	-0.04
344dbc	-0.66	-1.11
8e30a8	-0.64	-1.18
d36137	-0.56	-1.29
18d74c	-0.48	-0.32
03da8b	-0.46	-0.47
52cc32	-0.45	-
13c4f0	-0.4	-
f26f63	-0.24	-0.45
e7a7c0	-0.15	-
e40afd	-0.15	-0.29
de09c5	-0.07	-0.03
432f9d	-0.07	-
5e7bb2	0.01	-
526ece	0.01	0.01
769514	0.13	0.17
d42de8	0.16	-
a70ec5	0.42	-
5f2d09	0.45	1.21

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ID	z-score [-]	ζ-score [-]
77a1d8	0.5	-
671841	0.5	-
550e05	0.5	0.1
d3096f	0.87	-
3614c8	1.15	-
269ec5	1.48	0.75
a40228	1.64	-
d52881	1.97	0.57

2 Appendix – EN ISO 17892-3 – Particle density

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 [Mg/m^3]			u_X [Mg/m^3]	$\bar{x}$ [Mg/m^3]	s_0 [Mg/m^3]	V_X [%]
06b0ef	2.62	2.6	2.63	0.03	2.62	0.015	0.58
a40228	2.63	2.63	2.64	-	2.63	0.006	0.22
e40afd	2.62	2.65	2.63	0.04	2.63	0.015	0.58
5f2d09	2.66	2.63	2.65	0.11	2.65	0.015	0.58
550e05	2.65	2.68	2.64	-	2.66	0.021	0.78
03da8b	2.67	2.65	2.67	0.05	2.66	0.012	0.43
7e62f8	2.67	2.67	2.68	0.04	2.67	0.006	0.22
526ece	2.67	2.7	2.66	0.06	2.68	0.021	0.78
a70ec5	2.69	2.68	2.68	-	2.68	0.006	0.22
432f9d	2.68	2.69	2.69	-	2.69	0.006	0.21
671841	2.68	2.7	2.69	-	2.69	0.01	0.37
13c4f0	2.69	2.68	2.71	-	2.69	0.015	0.57
d3096f	2.7	2.7	2.69	-	2.7	0.006	0.21
769514	2.71	2.7	2.71	0.02	2.71	0.006	0.21
8e30a8	2.71	2.71	2.71	0.02	2.71	0.0	0.0
ed020a	2.73	2.73	2.72	0.01	2.73	0.006	0.21

2.2 The Numerical Procedure for Determining Outliers

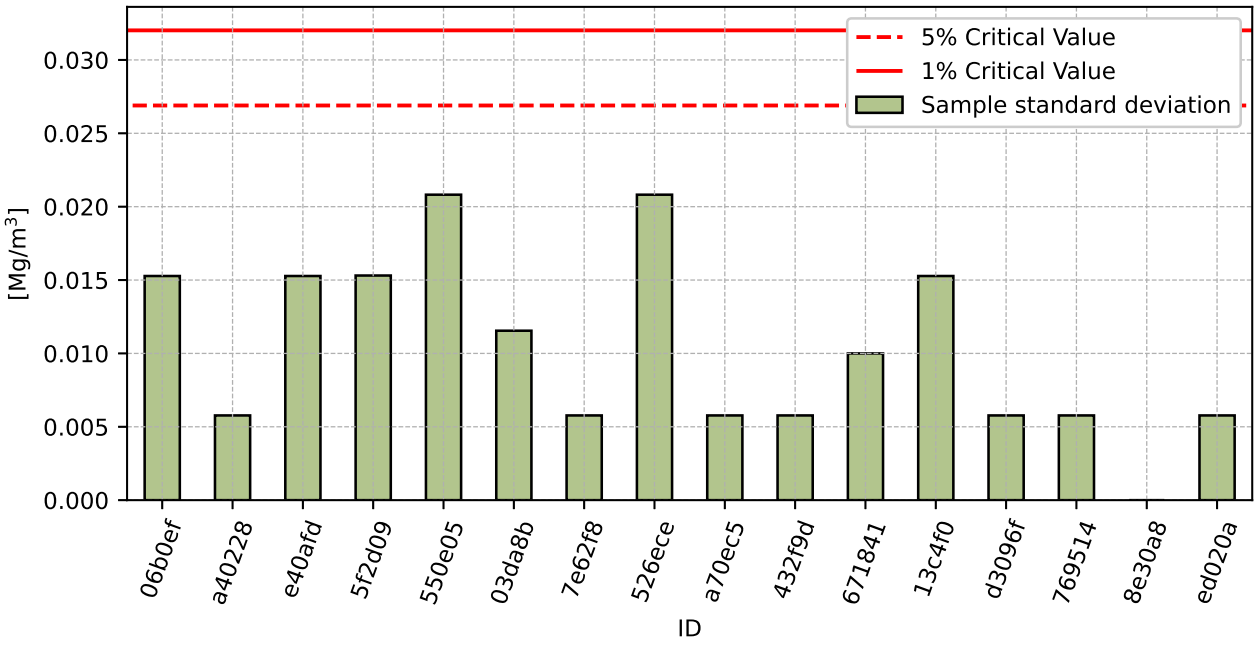

Figure 11: **Cochran's test** - sample standard deviations

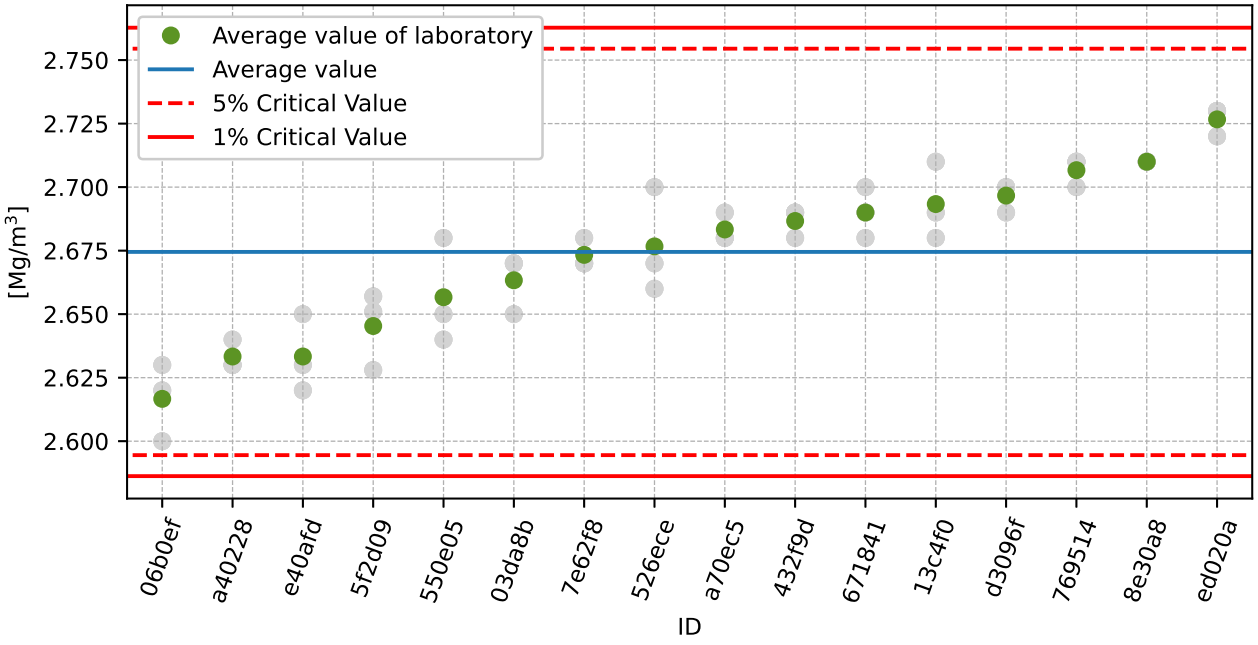

Figure 12: **Grubbs' test** - average values

2.3 Mandel's Statistics

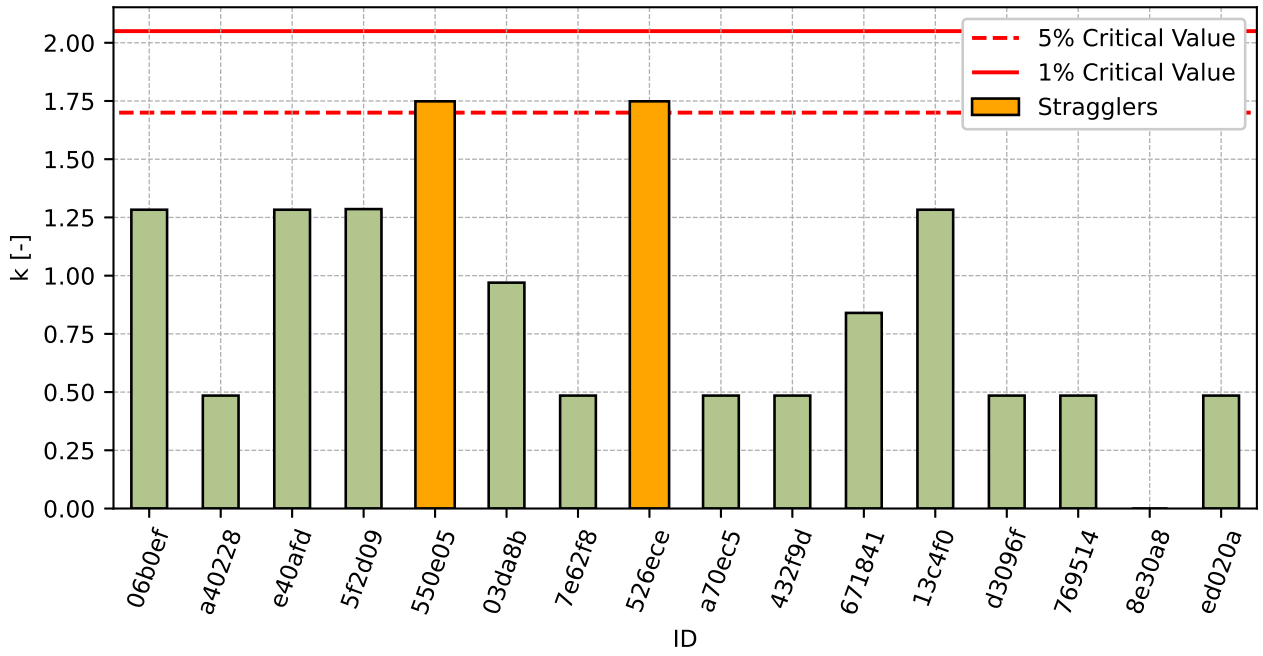

Figure 13: Intralaboratory Consistency Statistic

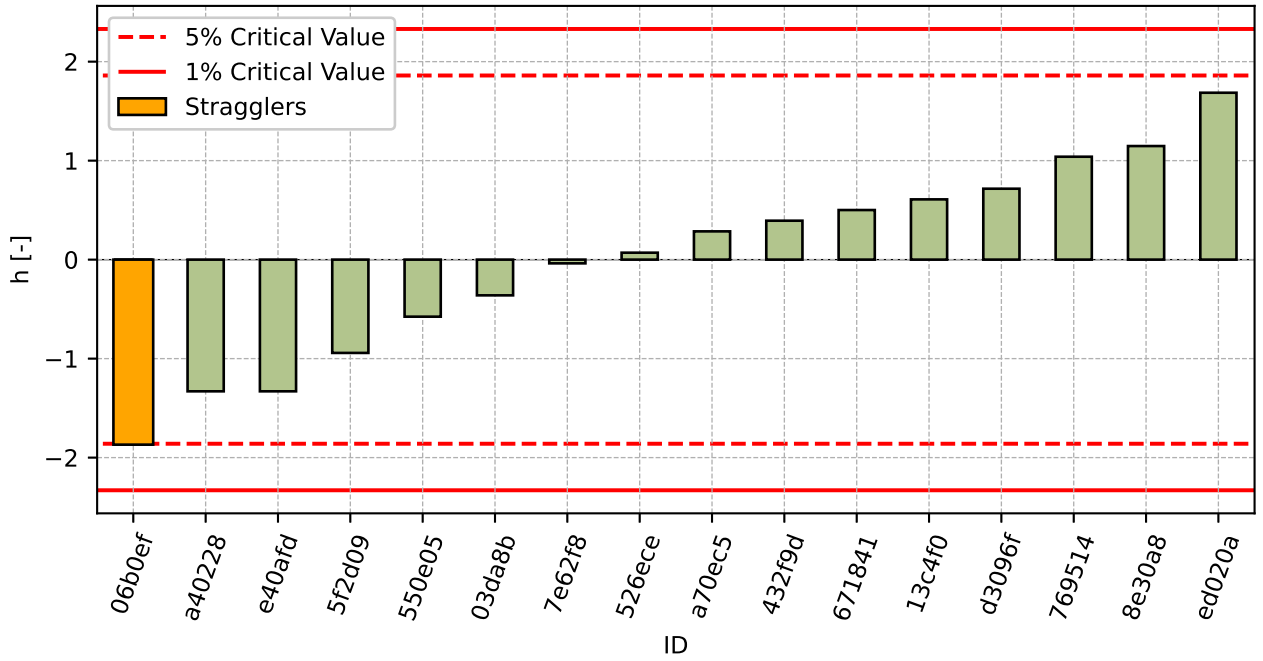

Figure 14: Interlaboratory Consistency Statistic

2.4 Descriptive statistics

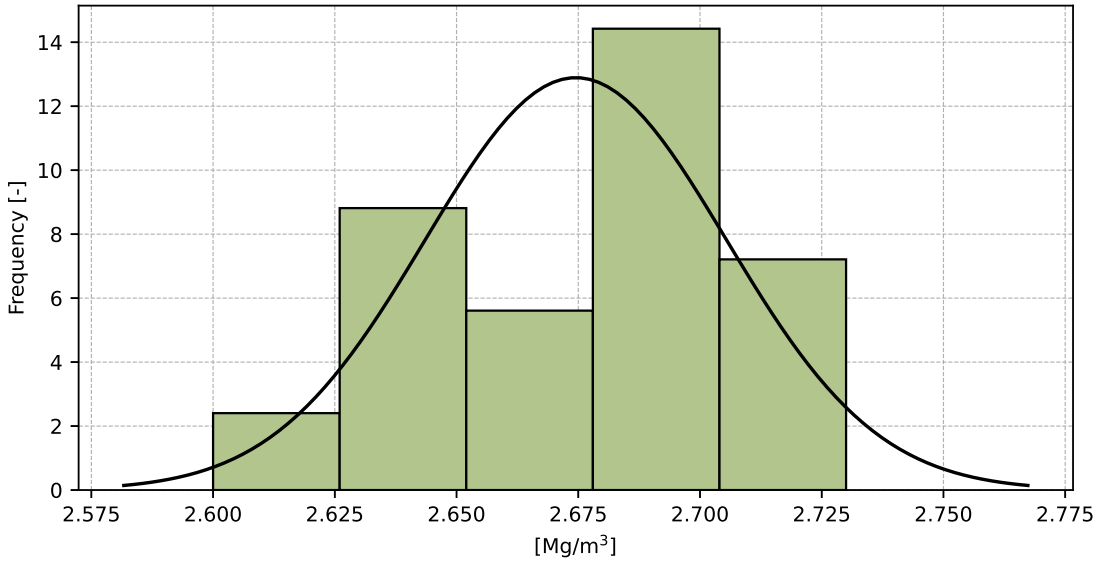

Figure 15: Histogram of all test results

Table 8: Descriptive statistics

Characteristics	**[Mg/m³]**
Average value – $\bar{x}$	2.67
Sample standard deviation – s	0.031
Asigned value – x^*	2.68
Robust standard deviation – s^*	0.031
Measurement uncertainty of asigned value – u_X	0.01
p-value of normality test	0.123 [-]
Interlaboratory standard deviation – s_L	0.03
Repeatability standard deviation – s_r	0.012
Reproducibility standard deviation – s_R	0.032
Repeatability – r	0.03
Reproducibility – R	0.09

2.5 Evaluation of Performance Statistics

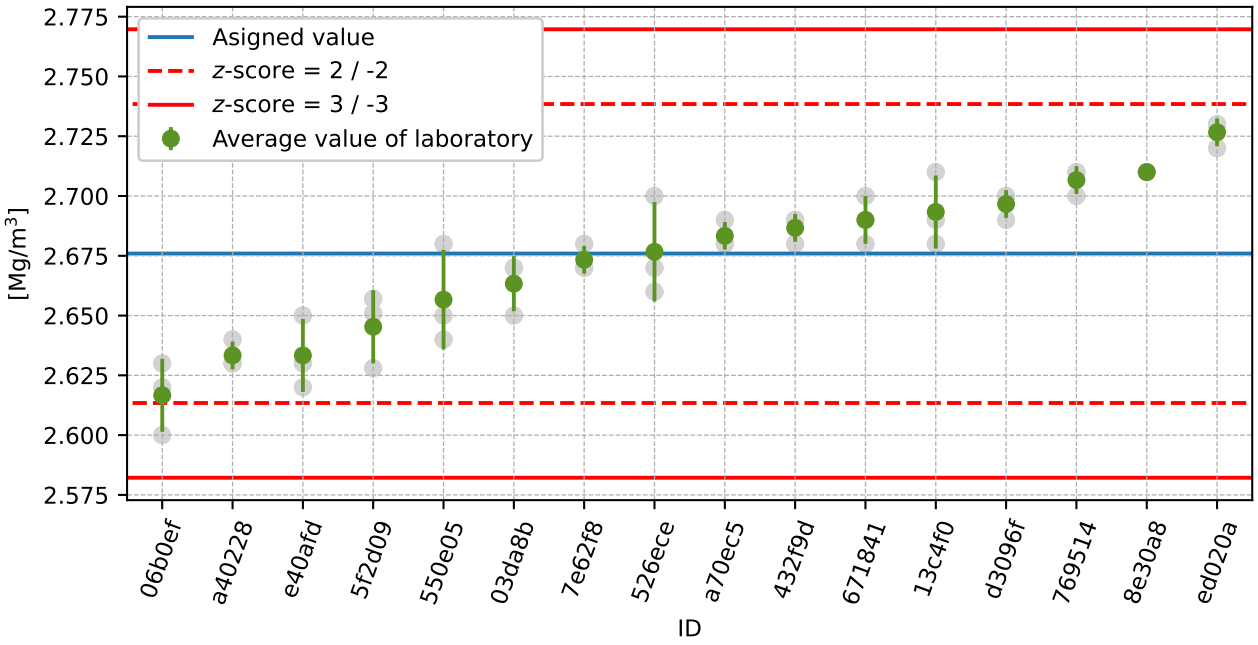

Figure 16: Average values and sample standard deviations

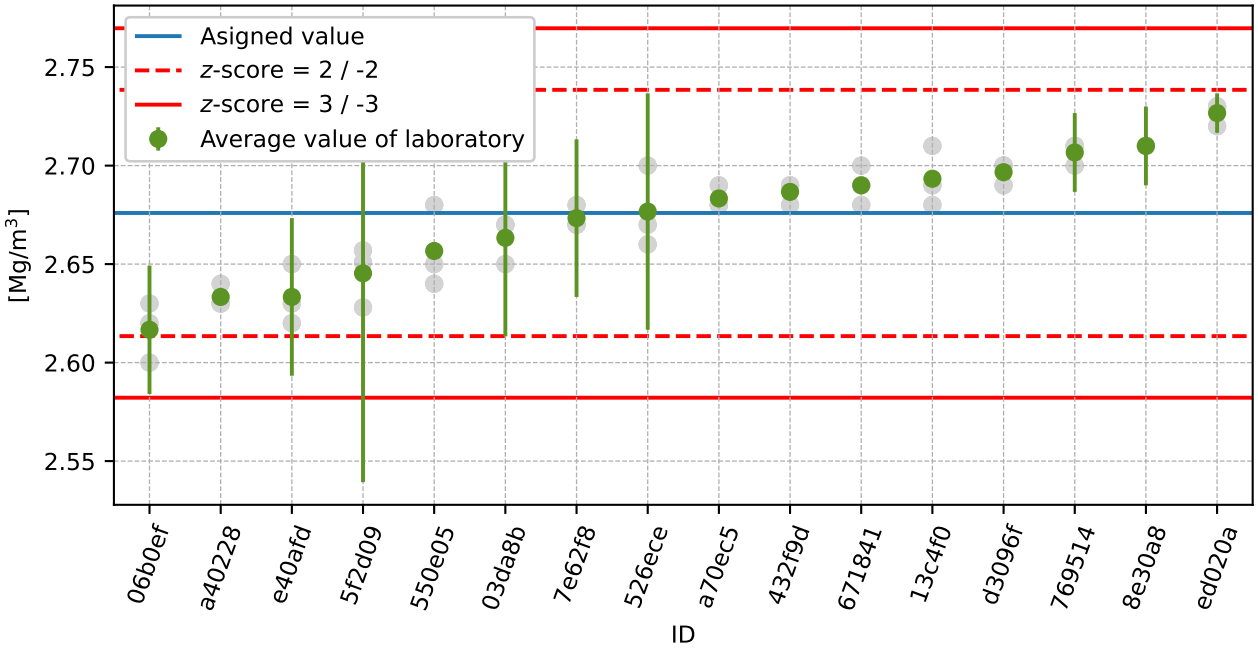

Figure 17: Average values and extended uncertainties of measurement

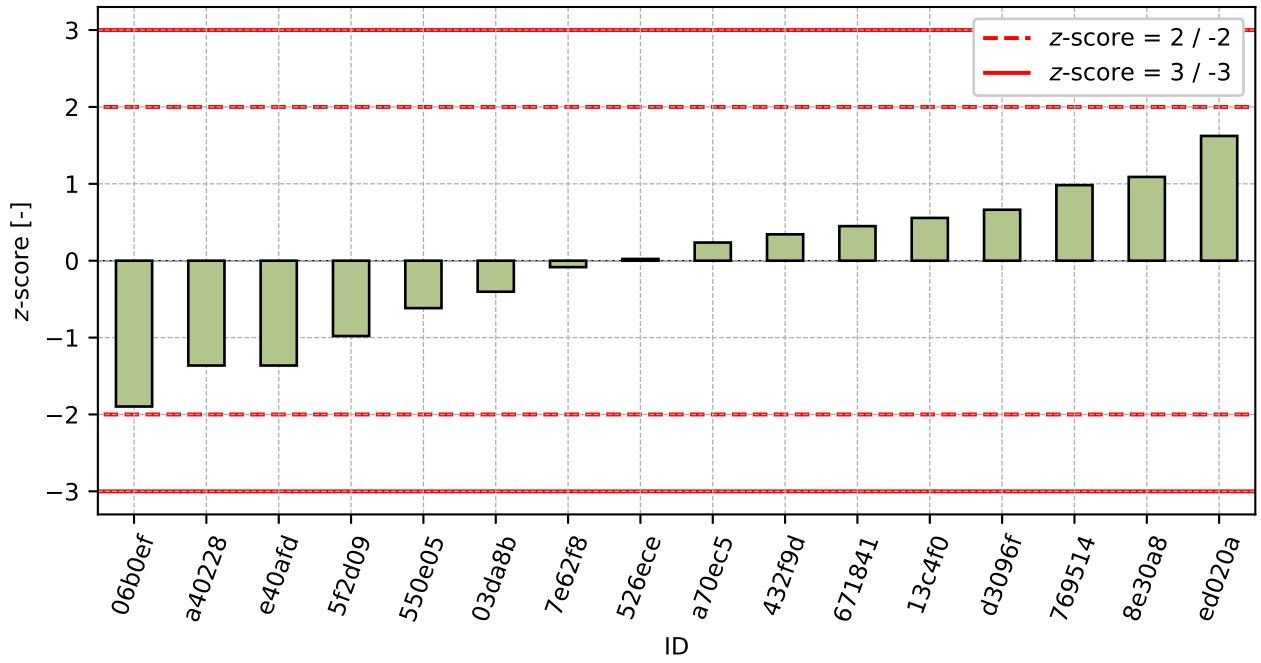

Figure 18: z-score

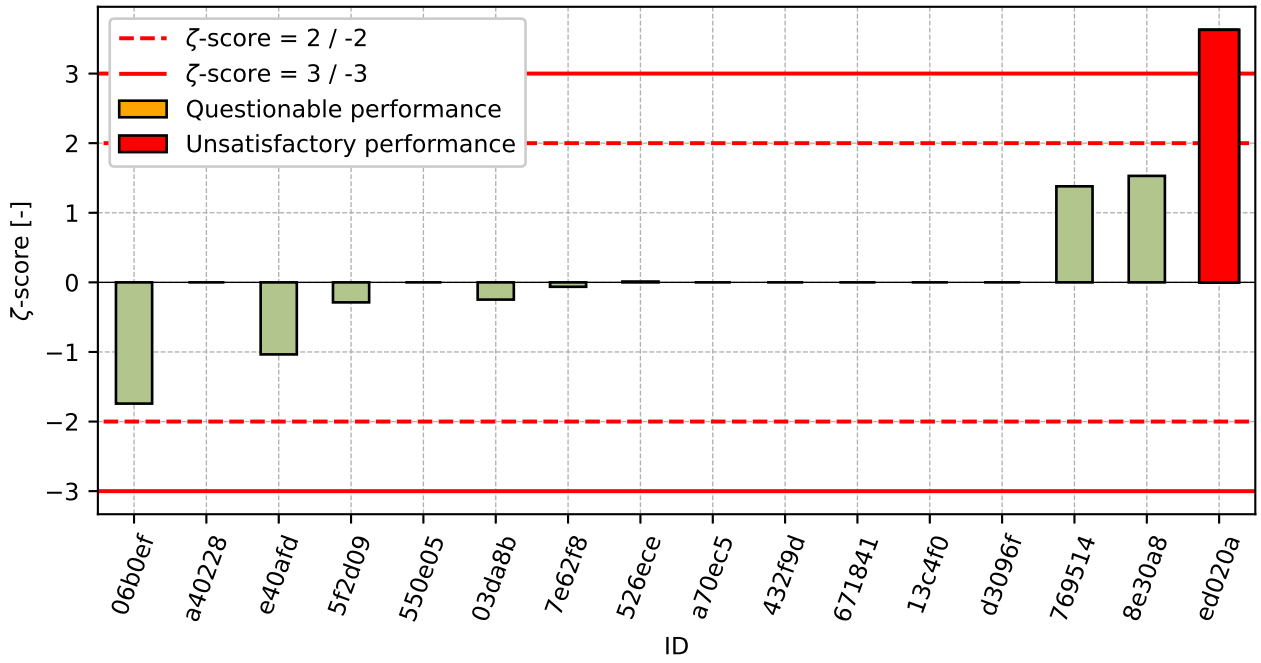

Figure 19: ζ-score

Table 9: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
06b0ef	-1.9	-1.74
a40228	-1.36	-
e40afd	-1.36	-1.04
5f2d09	-0.98	-0.29
550e05	-0.62	-
03da8b	-0.4	-0.25
7e62f8	-0.08	-0.06
526ece	0.02	0.01
a70ec5	0.24	-
432f9d	0.34	-
671841	0.45	-
13c4f0	0.56	-
d3096f	0.66	-
769514	0.98	1.38
8e30a8	1.09	1.53
ed020a	1.62	3.63

3 Appendix – EN ISO 17892-4 – Particle size distribution, art. 5.2 (Sieving)

Table 10: Test results - Sieve through [%]

ID of participant	Sieve through [%]						
	4 mm	2 mm	1 mm	0.5 mm	0.25 mm	0.125 mm	0.063 mm
526ece	100.0	88.1	63.7	34.5	12.1	2.1	1.0
344dbc	99.0	87.1	63.8	34.9	11.9	2.6	1.2
6cbdf1	99.3	87.6	64.3	34.8	11.5	3.2	2.1
a40228	98.8	86.3	61.3	32.2	9.9	1.7	0.9
7e62f8	99.1	86.1	61.6	31.5	11.8	2.2	1.0
8e30a8	100.0	87.0	62.0	33.0	10.0	1.0	0.0
03da8b	99.1	87.2	62.0	32.6	9.9	1.4	0.6
1f159f	99.0	86.0	68.2	41.4	14.5	3.6	1.9
02bd37	99.0	86.1	62.5	33.3	10.6	2.1	1.2
550e05	99.2	85.5	60.3	30.9	8.8	1.6	0.5
13c4f0	99.1	87.1	63.5	35.7	13.9	3.8	0.7
a70ec5	98.9	86.4	61.9	33.0	10.2	1.7	0.5
1e5f15	98.9	87.3	62.8	30.0	8.3	1.1	0.2
3614c8	98.8	86.2	62.2	32.0	10.2	2.3	1.3
18d74c	-	87.6	63.2	34.5	10.1	2.1	0.9
7b88c9	99.6	88.5	66.0	38.3	17.1	6.2	5.0
f26f63	99.4	87.1	64.3	34.8	10.8	1.8	0.6
333f9d	99.1	87.4	62.8	32.9	9.1	1.5	0.4
d3096f	99.0	86.0	59.7	30.3	9.3	2.0	0.9
06b0ef	99.0	86.0	61.0	31.0	9.0	2.0	1.0
5e7bb2	99.0	85.0	61.0	-	-	-	1.0
afe61e	99.1	86.7	61.4	33.4	10.2	1.1	0.0
e40afd	99.2	86.9	62.6	33.5	10.3	2.2	1.0
77a1d8	99.5	89.9	67.5	37.4	11.9	2.6	1.3
671841	99.3	88.4	65.2	35.1	11.5	2.1	0.8
5f2d09	99.2	87.3	62.4	33.5	10.0	1.6	0.5
769514	99.0	86.9	63.1	34.7	10.6	1.7	0.5

Table 11: Grubbs' test [%]

Value	4 mm	2 mm	1 mm	0.5 mm	0.25 mm	0.125 mm	0.063 mm
G_{min}	1.215	1.902	1.635	1.511	1.356	1.126	1.069
G_{max}	2.653	2.874	2.61	3.004	3.226	3.737	4.275
$G_{0.05}$	2.841	2.859	2.859	2.841	2.841	2.841	2.859
$G_{0.01}$	3.157	3.178	3.178	3.157	3.157	3.157	3.178

Table 12: Grubbs' test - without outliers [%]

Value	4 mm	2 mm	1 mm	0.5 mm	0.25 mm	0.125 mm	0.063 mm
G_{min}	1.215	1.902	1.635	1.511	1.596	1.478	1.707
G_{max}	2.653	2.874	2.61	3.004	2.604	2.485	2.529
$G_{0.05}$	2.841	2.859	2.859	2.841	2.822	2.822	2.841
$G_{0.01}$	3.157	3.178	3.178	3.157	3.135	3.135	3.157

Table 13: *z*-score

ID of participant	*z*-score [-] / sieve 4 mm	2 mm	1 mm	0.5 mm	0.25 mm	0.125 mm	0.063 mm
526ece	2.65	1.12	0.36	0.27	0.98	0.08	0.31
344dbc	-0.57	0.14	0.41	0.43	0.84	0.79	0.71
6cbdf1	0.4	0.63	0.66	0.39	0.57	1.64	2.53
a40228	-1.21	-0.64	-0.84	-0.64	-0.51	-0.49	0.11
7e62f8	-0.25	-0.83	-0.69	-0.92	0.77	0.22	0.31
8e30a8	2.65	0.05	-0.49	-0.32	-0.44	-1.48	-1.71
03da8b	-0.25	0.24	-0.49	-0.48	-0.51	-0.91	-0.5
1f159f	-0.57	-0.93	2.61	3.0	2.6	2.2	2.13
02bd37	-0.57	-0.83	-0.24	-0.2	-0.04	0.08	0.71
550e05	0.07	-1.42	-1.34	-1.15	-1.26	-0.63	-0.7
13c4f0	-0.25	0.14	0.26	0.75	2.2	2.49	-0.29
a70ec5	-0.89	-0.54	-0.54	-0.32	-0.31	-0.49	-0.7
1e5f15	-0.89	0.34	-0.09	-1.51	-1.6	-1.34	-1.3
3614c8	-1.21	-0.73	-0.39	-0.72	-0.31	0.36	0.92
18d74c	-	0.63	0.11	0.27	-0.38	0.08	0.11
7b88c9	1.36	1.51	1.51	1.78	-	-	-
f26f63	0.72	0.14	0.66	0.39	0.1	-0.35	-0.5
333f9d	-0.25	0.44	-0.09	-0.36	-1.05	-0.77	-0.9
d3096f	-0.57	-0.93	-1.64	-1.39	-0.92	-0.06	0.11
06b0ef	-0.57	-0.93	-0.99	-1.11	-1.12	-0.06	0.31
5e7bb2	-0.57	-1.9	-0.99	-	-	-	0.31
afe61e	-0.25	-0.25	-0.79	-0.16	-0.31	-1.34	-1.71
e40afd	0.07	-0.05	-0.19	-0.12	-0.24	0.22	0.31
77a1d8	1.04	2.87	2.26	1.42	0.84	0.79	0.92
671841	0.4	1.41	1.11	0.51	0.57	0.08	-0.09
5f2d09	0.07	0.34	-0.29	-0.12	-0.44	-0.63	-0.7
769514	-0.57	-0.05	0.06	0.35	-0.04	-0.49	-0.7

4 Appendix – EN ISO 17892-4 – Particle size distributionn, art. 5.3 (Densimetric analysis)

Table 14: Test results – outliers are marked in red

ID of participant	[%] 0.02 mm	0.01 mm	0.002 mm	0.05 mm	0.005 mm
526ece	46.4	37.3	17.7	75.2	27.6
432f9d	46.4	32.8	16.4	68.2	21.8
269ec5	59.8	33.4	12.1	90.8	19.2
6cbdf1	42.5	32.3	19.2	63.8	25.0
85ab0e	46.4	29.6	18.0	60.2	23.2
7e62f8	53.4	35.5	20.9	82.1	29.0
3c62de	50.8	31.9	18.6	81.7	24.8
8e30a8	46.0	30.0	17.0	75.0	21.0
02bd37	56.9	38.0	21.8	79.9	27.9
550e05	49.2	36.7	21.6	81.5	26.7
13c4f0	60.3	45.8	25.7	88.9	34.3
a70ec5	46.9	34.1	16.2	87.7	27.6
1e5f15	27.1	14.0	5.9	74.9	9.3
baa022	57.6	40.2	20.8	88.1	29.4
7b88c9	65.0	52.0	31.0	79.0	41.0
94cb0b	56.7	40.2	22.3	84.0	30.7
d3096f	60.0	44.0	27.3	87.5	33.9
afe61e	50.8	29.2	6.5	89.2	17.3
e40afd	50.5	42.1	16.8	86.9	-
671841	52.5	35.3	18.0	84.5	25.5

Table 15: Grubbs' test [%]

Value	0.02 mm	0.01 mm	0.002 mm	0.05 mm	0.005 mm
G_{min}	2.909	2.789	2.121	2.343	2.422
G_{max}	1.654	2.091	2.041	1.197	2.158
$G_{0.05}$	2.709	2.709	2.709	2.709	2.681
$G_{0.01}$	3.001	3.001	3.001	3.001	2.968

Table 16: *z*-score

ID of participant	*z*-score [-] 0.02 mm	0.01 mm	0.002 mm	0.05 mm	0.005 mm
526ece	-0.59	0.2	-0.16	-0.61	0.22
432f9d	-0.59	-0.37	-0.38	-1.42	-0.62
269ec5	1.03	-0.3	-1.09	1.2	-0.99
6cbdf1	-1.05	-0.44	0.08	-1.93	-0.15
85ab0e	-0.59	-0.79	-0.11	-2.34	-0.41
7e62f8	0.26	-0.03	0.37	0.19	0.42
3c62de	-0.06	-0.49	-0.01	0.14	-0.18
8e30a8	-0.63	-0.73	-0.28	-0.63	-0.73
02bd37	0.68	0.29	0.52	-0.06	0.27
550e05	-0.25	0.13	0.48	0.12	0.09
13c4f0	1.09	1.29	1.16	0.98	1.19
a70ec5	-0.52	-0.21	-0.41	0.84	0.22
1e5f15	-2.91	-2.79	-2.12	-0.64	-2.42
baa022	0.76	0.58	0.35	0.88	0.48
7b88c9	1.65	2.09	2.04	-0.17	2.16
94cb0b	0.65	0.58	0.6	0.41	0.67
d3096f	1.05	1.06	1.43	0.82	1.13
afe61e	-0.06	-0.84	-2.02	1.01	-1.27
e40afd	-0.09	0.82	-0.31	0.75	-
671841	0.15	-0.05	-0.11	0.47	-0.08

5 Appendix – EN ISO 17892-5 – Incremental loading oedometer test

5.1 50 – 100 kPa

5.1.1 Test results

Table 17: Test results - ordered by average value. Outliers are marked by red color. u_X - extended uncertainty of measurement.

ID	Test results [MPa]	u_X [MPa]
d42de8	5.12	-
7a9a8e	5.5	-
a70ec5	5.68	-
ba7e11	5.7	-
c09547	5.8	0.1
526ece	5.89	0.62
e40afd	6.4	0.2
c30acd	6.76	0.81
671841	7.4	-
52cc32	7.57	-
7126ed	7.58	-
03da8b	7.94	0.6
47a0ff	8.85	2.06
8e30a8	9.23	0.12
13c4f0	9.7	-
9a4772	10.24	-
7e62f8	12.4	-
7faa64	14.14	0.23

5.1.2 The Numerical Procedure for Determining Outliers

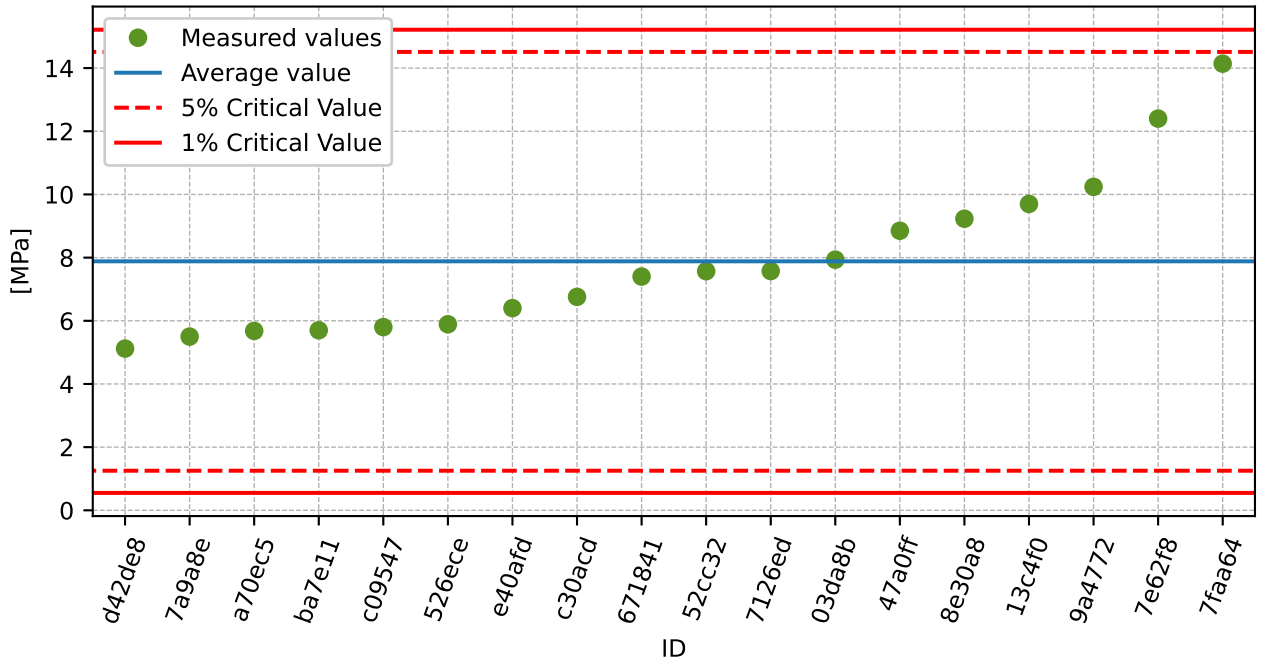

Figure 20: **Grubbs' test** - average values

5.1.3 Mandel's Statistics

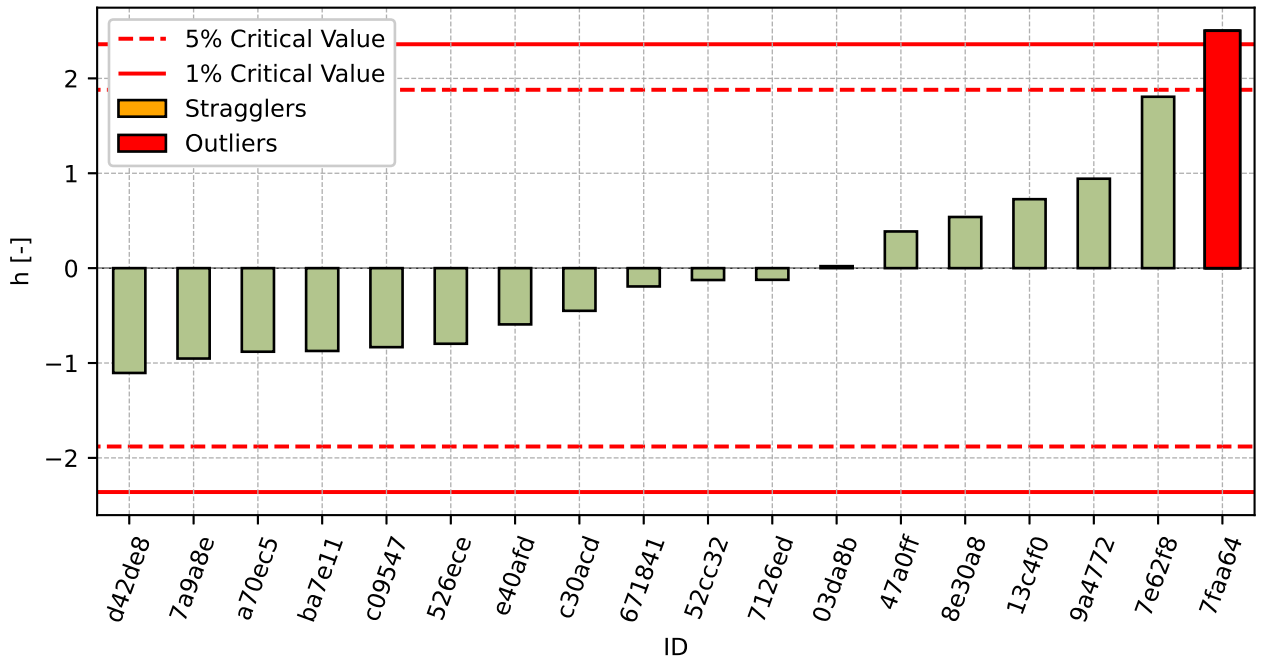

Figure 21: Interlaboratory Consistency Statistic

5.1.4 Descriptive statistics

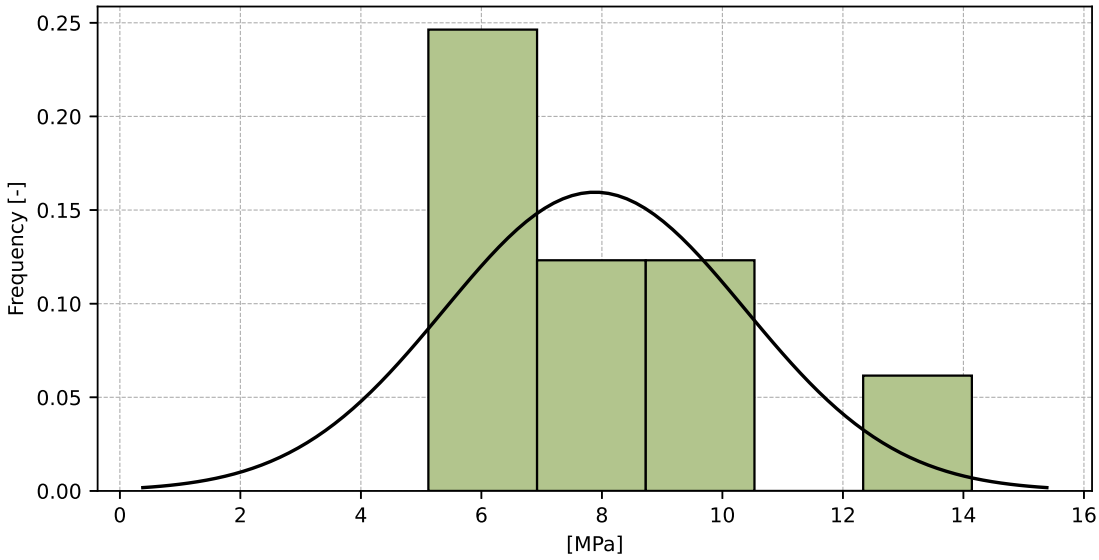

Figure 22: Histogram of all test results

Table 18: Descriptive statistics

Characteristics	**[MPa]**
Average value – $\bar{x}$	7.88
Sample standard deviation – s	2.501
Asigned value – x^*	7.82
Robust standard deviation – s^*	2.639
Measurement uncertainty of asigned value – u_X	0.778
p-value of normality test	0.031 [-]

5.1.5 Evaluation of Performance Statistics

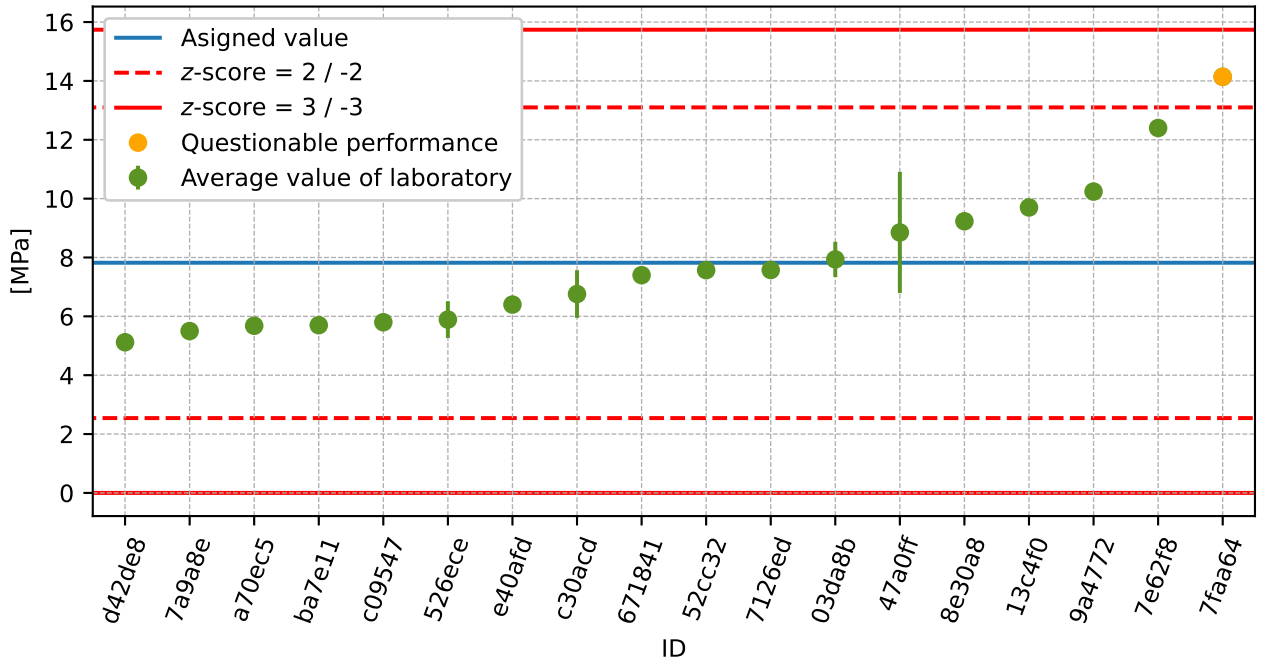

Figure 23: Average values and extended uncertainties of measurement

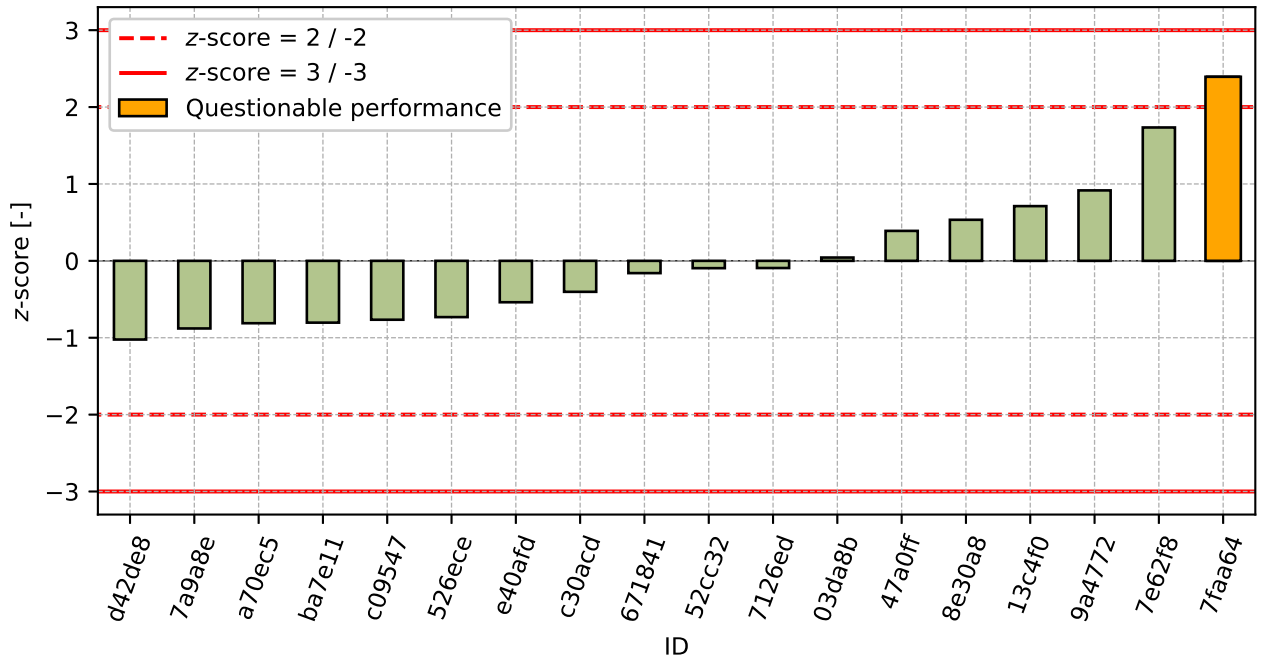

Figure 24: z-score

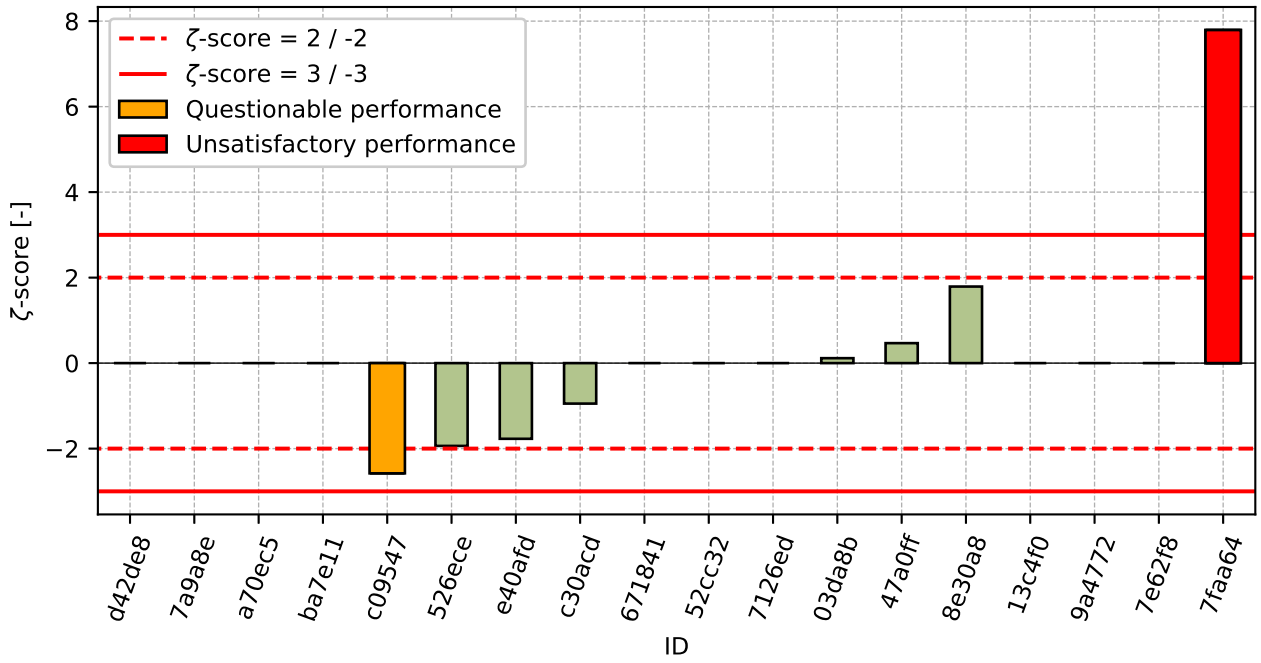

Figure 25: ζ-score

Table 19: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
d42de8	-1.02	-
7a9a8e	-0.88	-
a70ec5	-0.81	-
ba7e11	-0.8	-
c09547	-0.77	-2.58
526ece	-0.73	-1.94
e40afd	-0.54	-1.77
c30acd	-0.4	-0.95
671841	-0.16	-
52cc32	-0.1	-
7126ed	-0.09	-
03da8b	0.04	0.12
47a0ff	0.39	0.47
8e30a8	0.53	1.79
13c4f0	0.71	-
9a4772	0.92	-
7e62f8	1.73	-
7faa64	2.39	7.79

5.2 100 – 200 kPa

5.2.1 Test results

Table 20: Test results - ordered by average value. Outliers are marked by red color. u_X - extended uncertainty of measurement.

ID	Test results [MPa]	u_X [MPa]
e40afd	5.6	0.2
d42de8	6.4	-
ba7e11	7.0	-
7126ed	7.08	-
7a9a8e	7.1	-
a70ec5	7.14	-
526ece	7.59	0.8
c30acd	7.6	0.32
c09547	7.7	0.1
03da8b	9.11	0.7
671841	9.3	-
52cc32	9.56	-
47a0ff	10.81	2.18
9a4772	11.1	-
7e62f8	12.7	-
7faa64	14.06	0.23
8e30a8	14.66	0.08
13c4f0	15.2	-

5.2.2 The Numerical Procedure for Determining Outliers

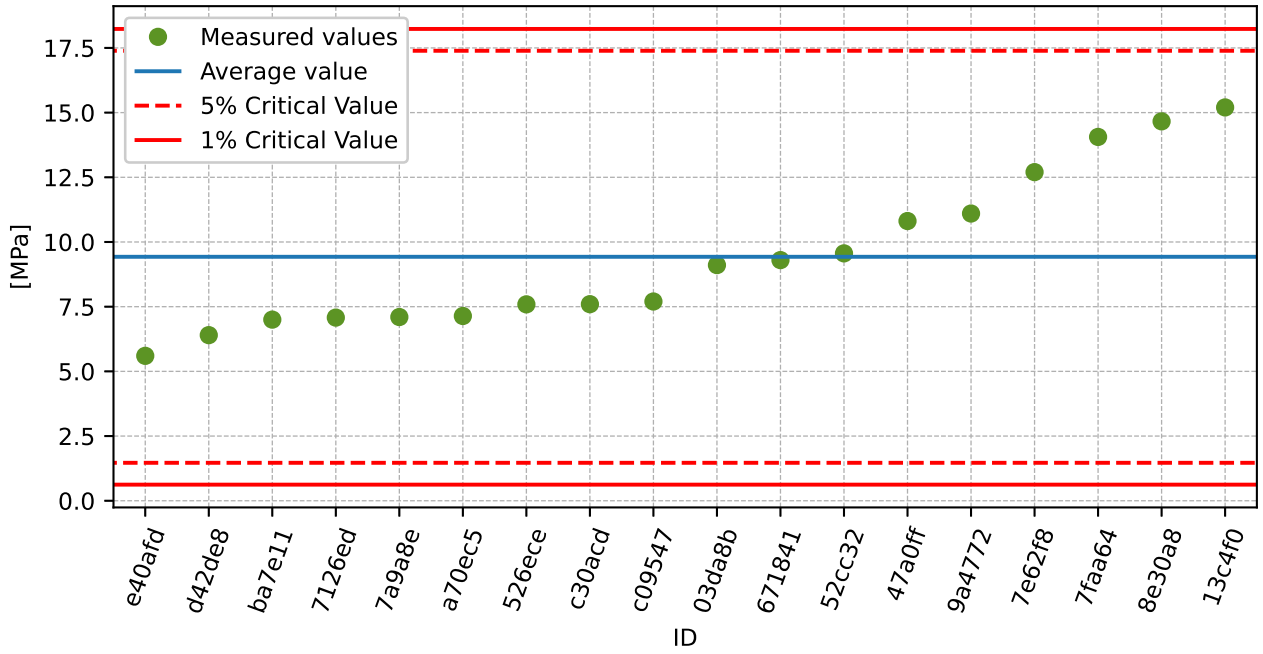

Figure 26: **Grubbs' test** - average values

5.2.3 Mandel's Statistics

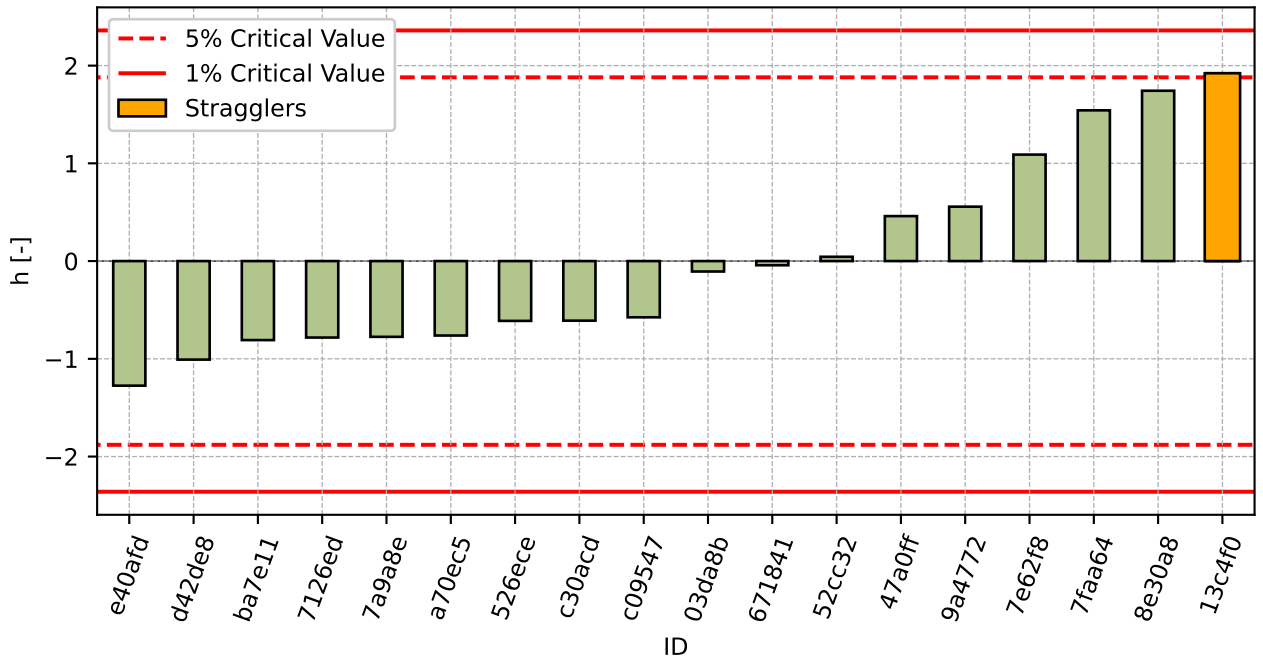

Figure 27: Interlaboratory Consistency Statistic

5.2.4 Descriptive statistics

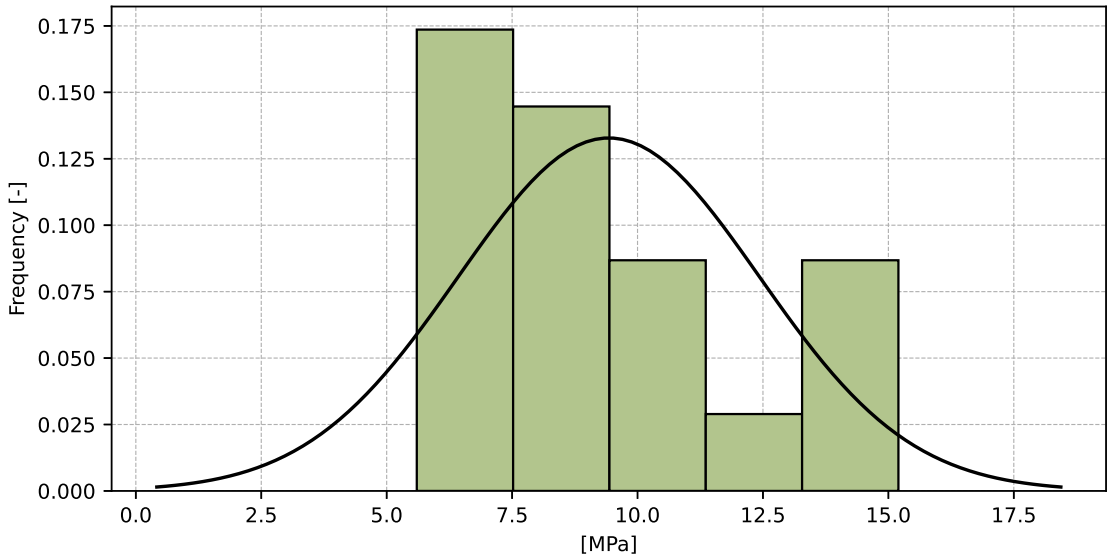

Figure 28: Histogram of all test results

Table 21: Descriptive statistics

Characteristics	[MPa]
Average value – $\bar{x}$	9.43
Sample standard deviation – s	3.003
Asigned value – x^*	9.43
Robust standard deviation – s^*	3.003
Measurement uncertainty of asigned value – u_X	0.708
p-value of normality test	0.035 [-]

5.2.5 Evaluation of Performance Statistics

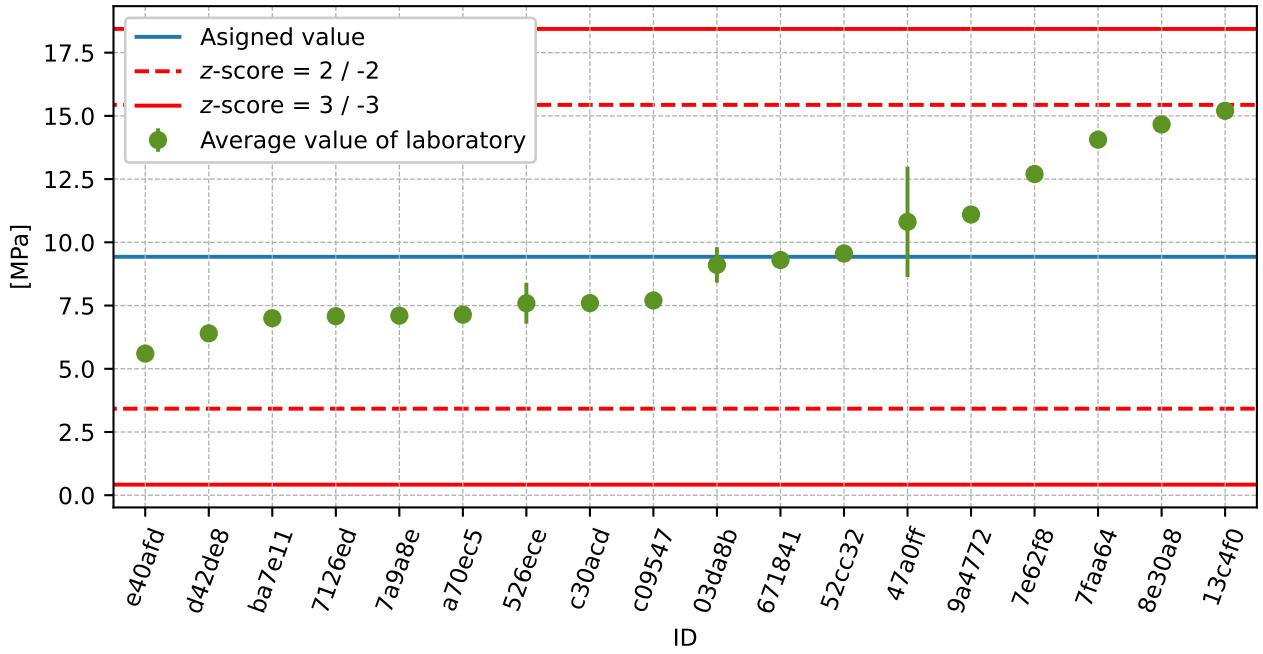

Figure 29: Average values and extended uncertainties of measurement

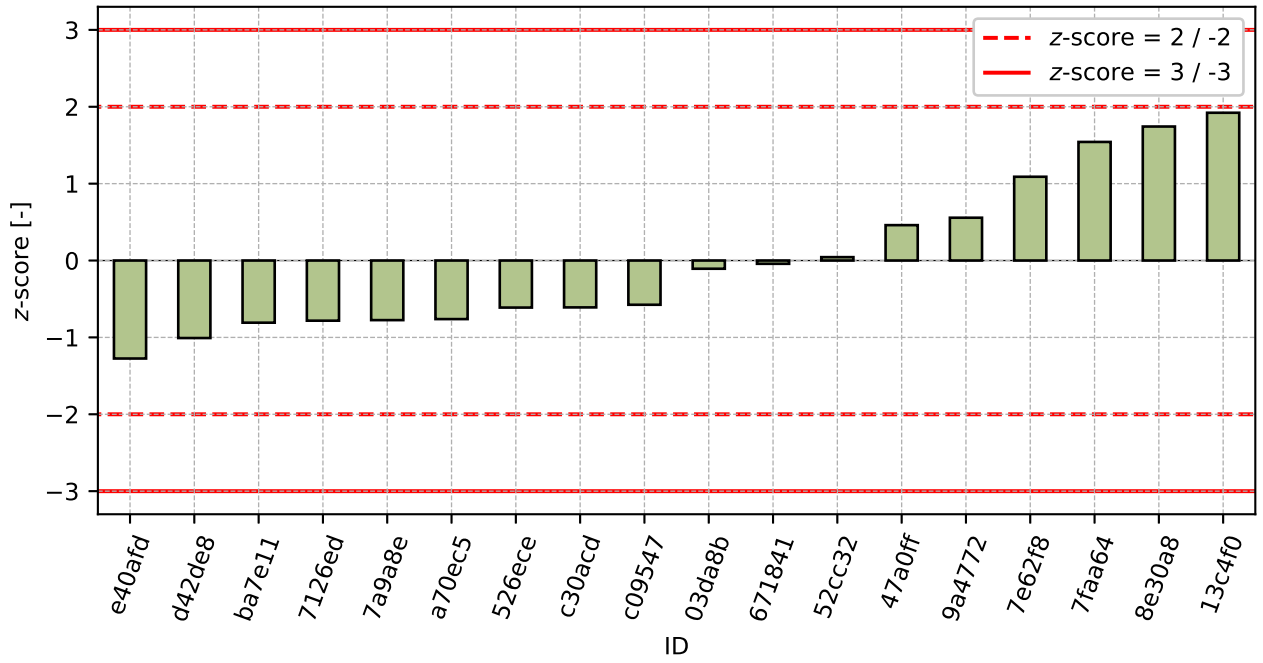

Figure 30: z-score

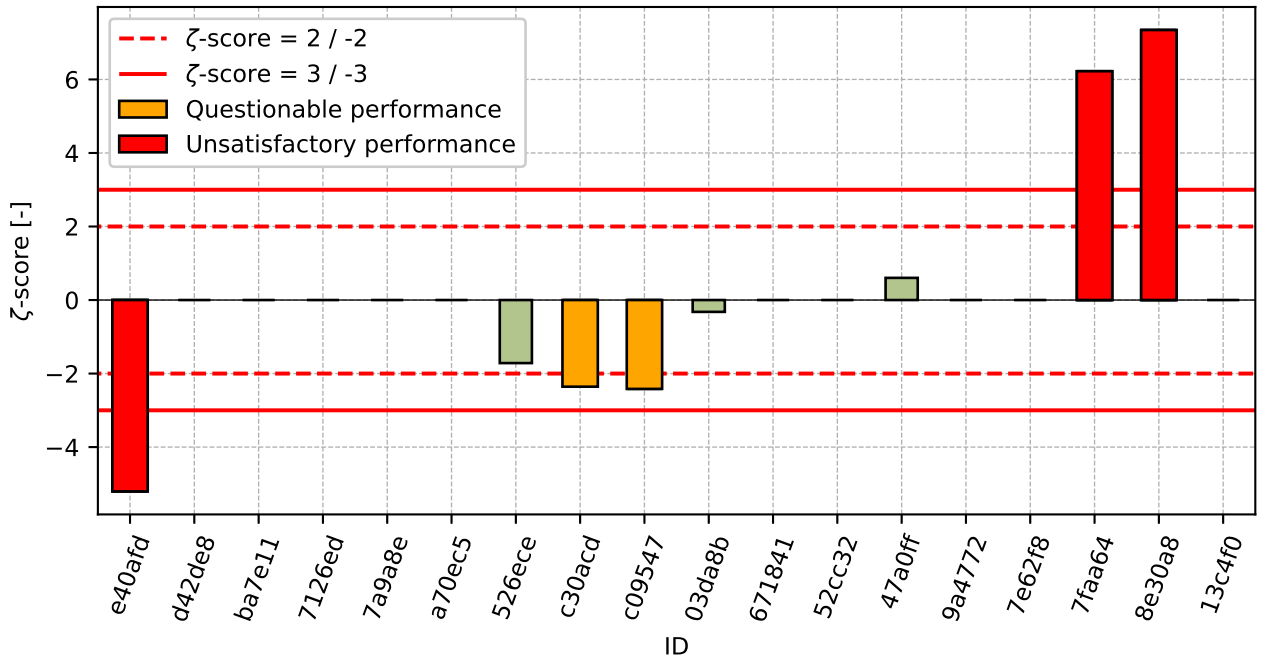

Figure 31: ζ-score

Table 22: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
e40afd	-1.27	-5.2
d42de8	-1.01	-
ba7e11	-0.81	-
7126ed	-0.78	-
7a9a8e	-0.78	-
a70ec5	-0.76	-
526ece	-0.61	-1.72
c30acd	-0.61	-2.36
c09547	-0.58	-2.42
03da8b	-0.11	-0.32
671841	-0.04	-
52cc32	0.04	-
47a0ff	0.46	0.6
9a4772	0.56	-
7e62f8	1.09	-
7faa64	1.54	6.22
8e30a8	1.74	7.34
13c4f0	1.92	-

5.3 200 – 400 kPa

5.3.1 Test results

Table 23: Test results - ordered by average value. Outliers are marked by red color. u_X - extended uncertainty of measurement.

ID	Test results [MPa]	u_X [MPa]
c09547	3.4	0.1
7126ed	6.64	-
e40afd	7.5	0.2
ba7e11	9.5	-
7a9a8e	10.0	-
d42de8	10.19	-
a70ec5	10.28	-
526ece	10.3	1.09
03da8b	13.6	0.8
47a0ff	13.7	2.33
671841	13.9	-
c30acd	14.09	0.95
7faa64	14.61	0.24
9a4772	15.83	-
52cc32	16.64	-
7e62f8	17.4	-
13c4f0	20.6	-
8e30a8	23.88	0.06

5.3.2 The Numerical Procedure for Determining Outliers

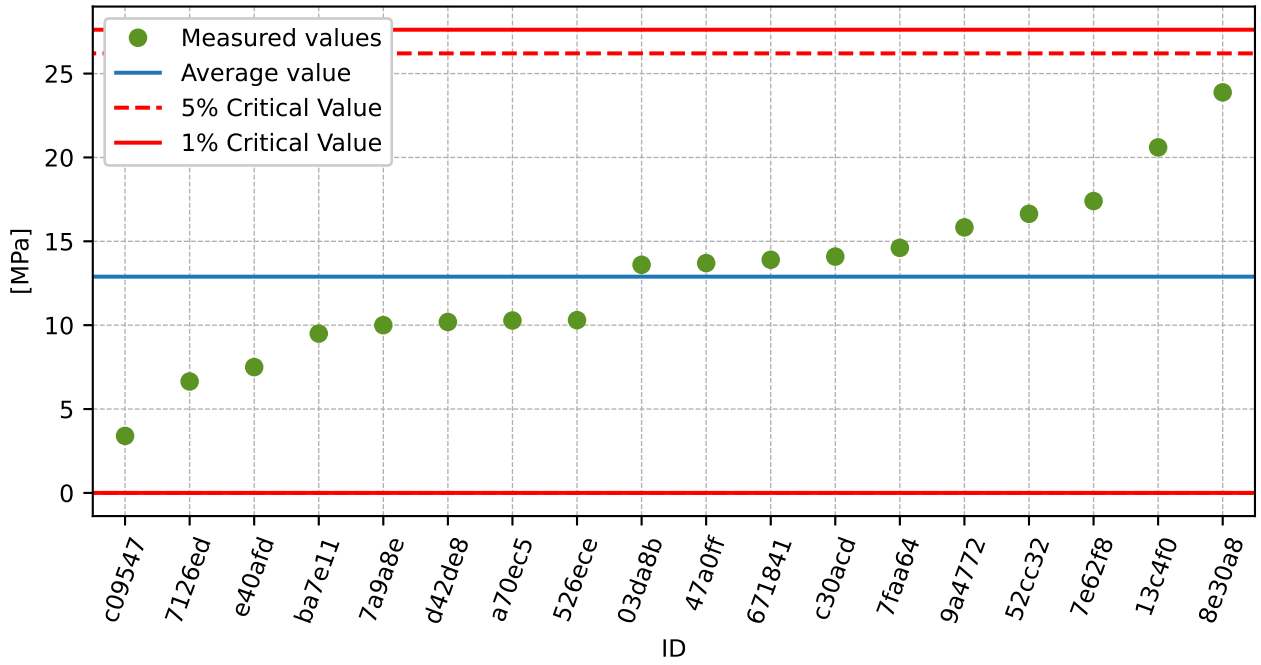

Figure 32: **Grubbs' test** - average values

5.3.3 Mandel's Statistics

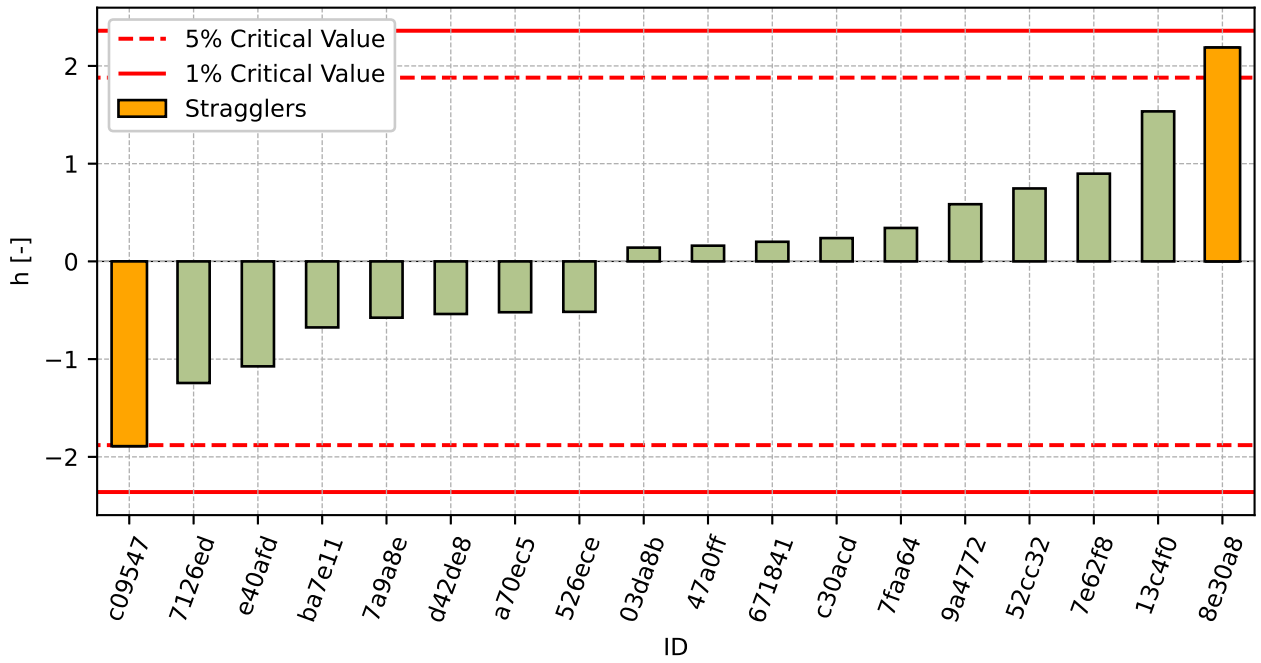

Figure 33: Interlaboratory Consistency Statistic

5.3.4 Descriptive statistics

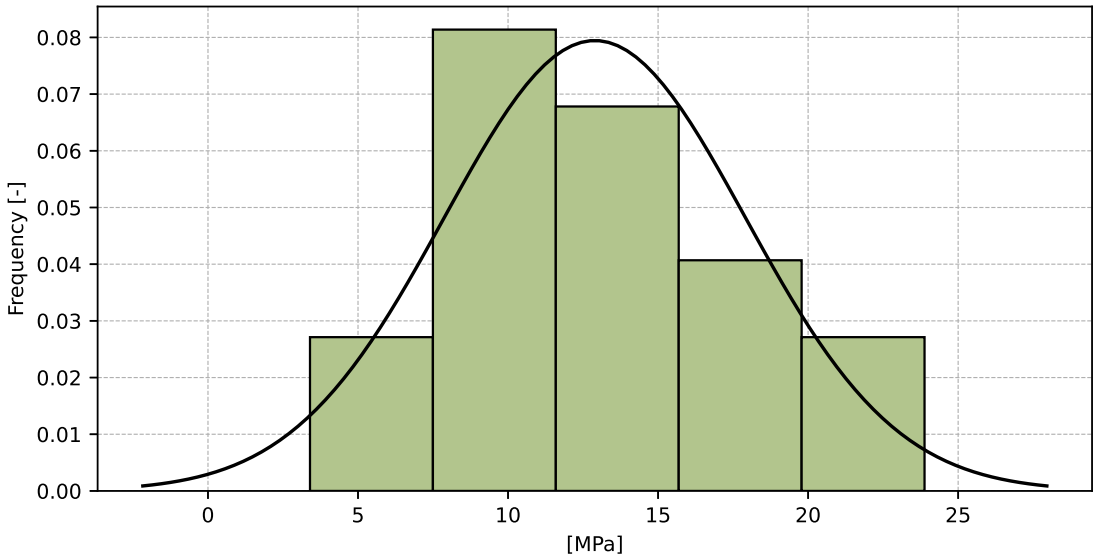

Figure 34: Histogram of all test results

Table 24: Descriptive statistics

Characteristics	**[MPa]**
Average value – $\bar{x}$	12.89
Sample standard deviation – s	5.021
Asigned value – x^*	12.89
Robust standard deviation – s^*	5.021
Measurement uncertainty of asigned value – u_X	1.184
p-value of normality test	0.927 [-]

5.3.5 Evaluation of Performance Statistics

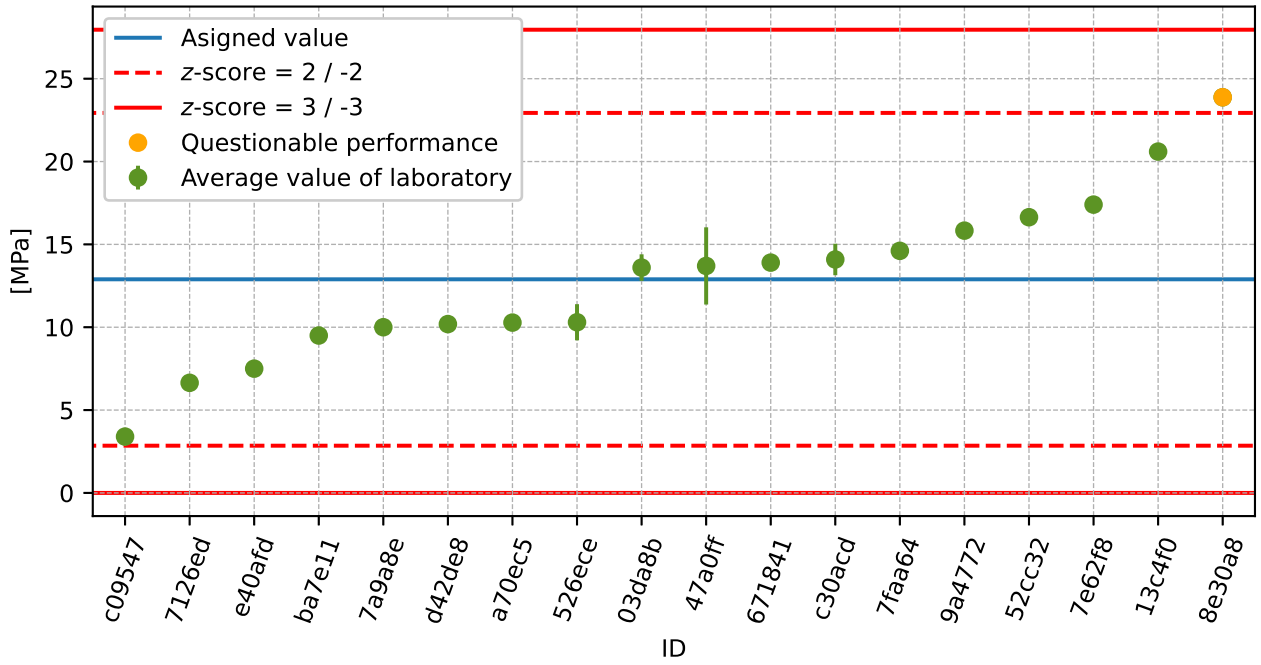

Figure 35: Average values and extended uncertainties of measurement

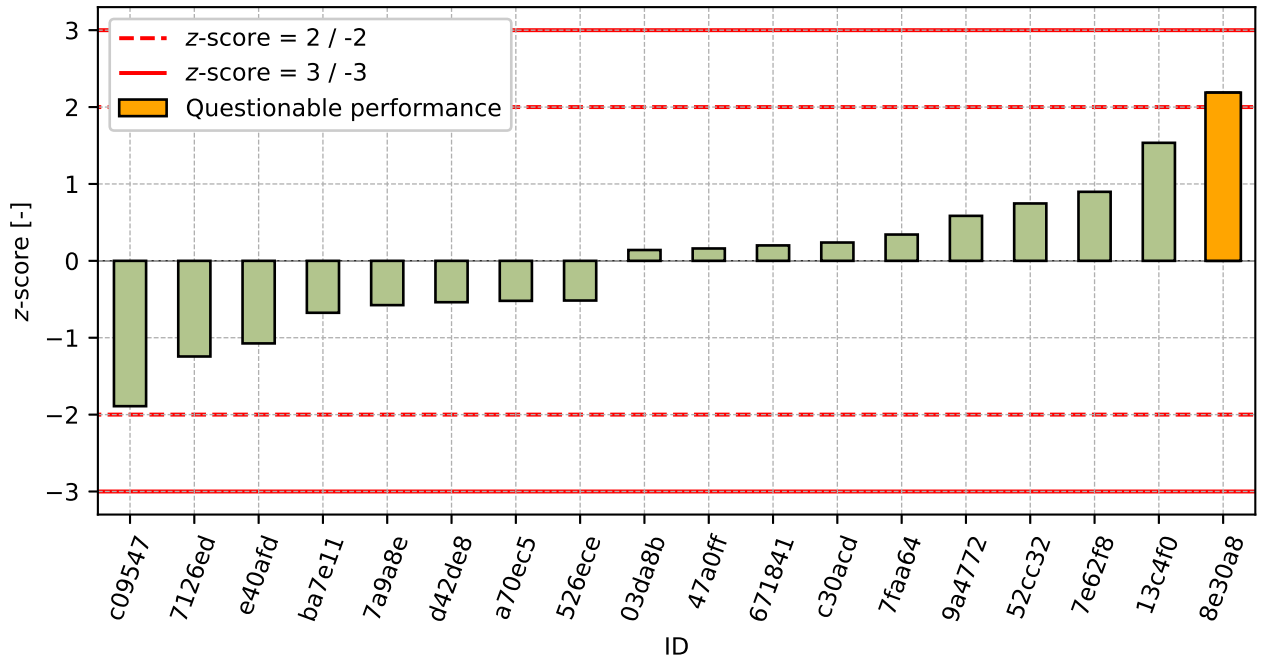

Figure 36: z-score

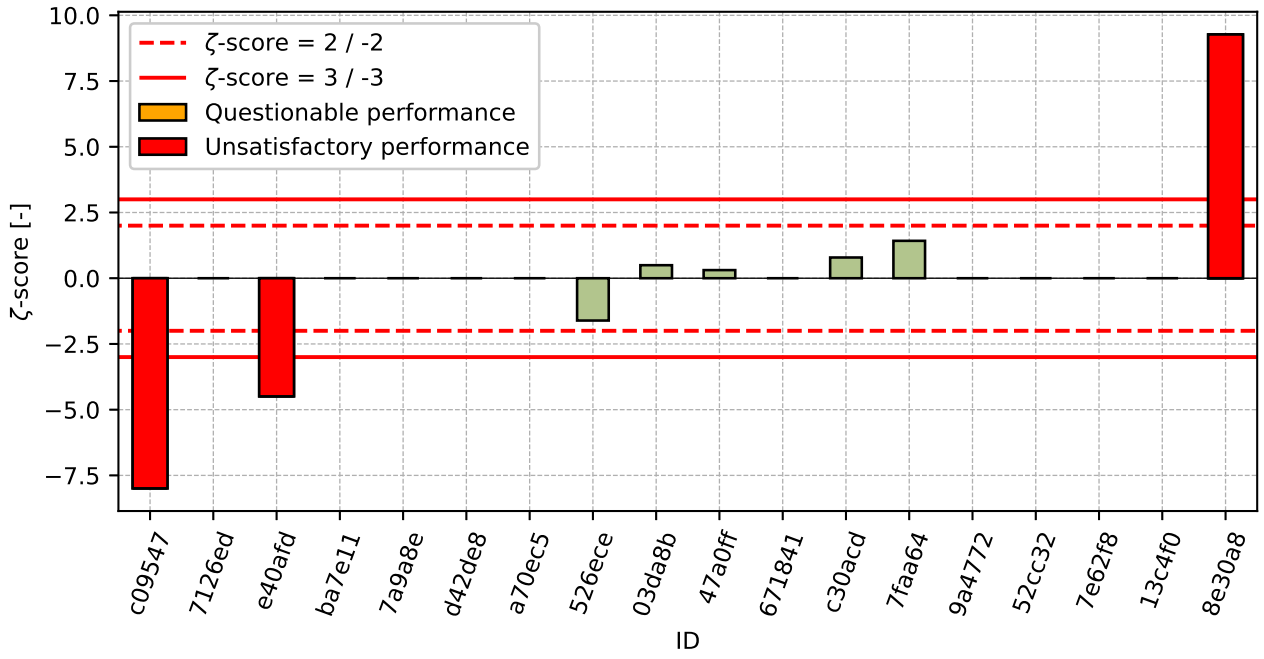

Figure 37: ζ-score

Table 25: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
c09547	-1.89	-7.99
7126ed	-1.24	-
e40afd	-1.07	-4.49
ba7e11	-0.68	-
7a9a8e	-0.58	-
d42de8	-0.54	-
a70ec5	-0.52	-
526ece	-0.52	-1.61
03da8b	0.14	0.5
47a0ff	0.16	0.31
671841	0.2	-
c30acd	0.24	0.79
7faa64	0.34	1.42
9a4772	0.59	-
52cc32	0.75	-
7e62f8	0.9	-
13c4f0	1.53	-
8e30a8	2.19	9.27

6 Appendix – EN ISO 17892-7 – Unconfined compressive strength, Strain at failure

6.1 Unconfined compressive strength

6.1.1 Test results

Table 26: 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 [%]
a70ec5	0.137	0.116	0.118	0.114	-	0.121	0.0106	8.76
e40afd	0.174	0.178	0.186	0.18	0.06	0.18	0.005	2.79
52cc32	0.216	0.212	0.216	0.212	-	0.214	0.0023	1.08
13c4f0	0.232	0.222	0.21	0.229	-	0.223	0.0098	4.4
7e62f8	0.233	0.215	0.246	0.243	0.018	0.234	0.014	5.97
432f9d	0.271	0.252	0.2	0.225	-	0.237	0.0311	13.11
671841	0.267	0.267	0.235	0.245	-	0.254	0.0161	6.36
afe61e	0.237	0.317	0.276	0.331	0.002	0.29	0.0425	14.64
c30acd	0.336	0.354	0.329	0.323	0.02	0.336	0.0135	4.03
8e30a8	0.38	0.402	0.407	0.395	0.027	0.396	0.0117	2.97
c4e6ee	0.86	0.92	0.91	0.88	0.095	0.892	0.0275	3.09

6.1.2 The Numerical Procedure for Determining Outliers

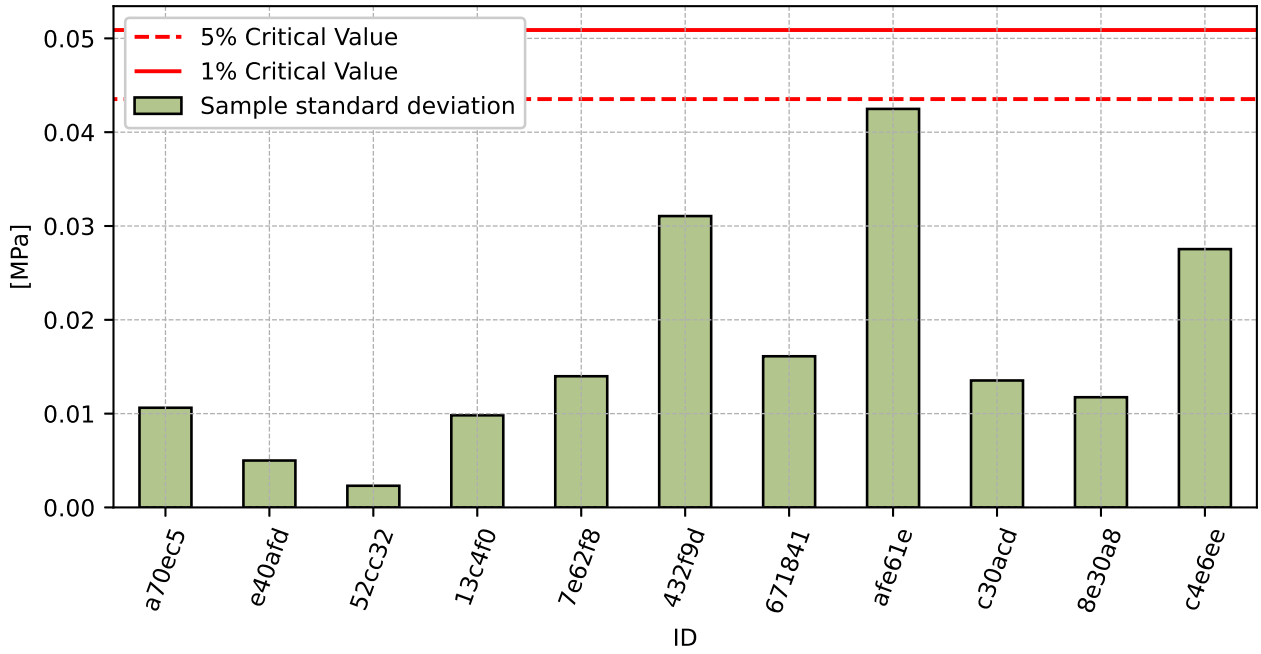

Figure 38: **Cochran's test** - sample standard deviations

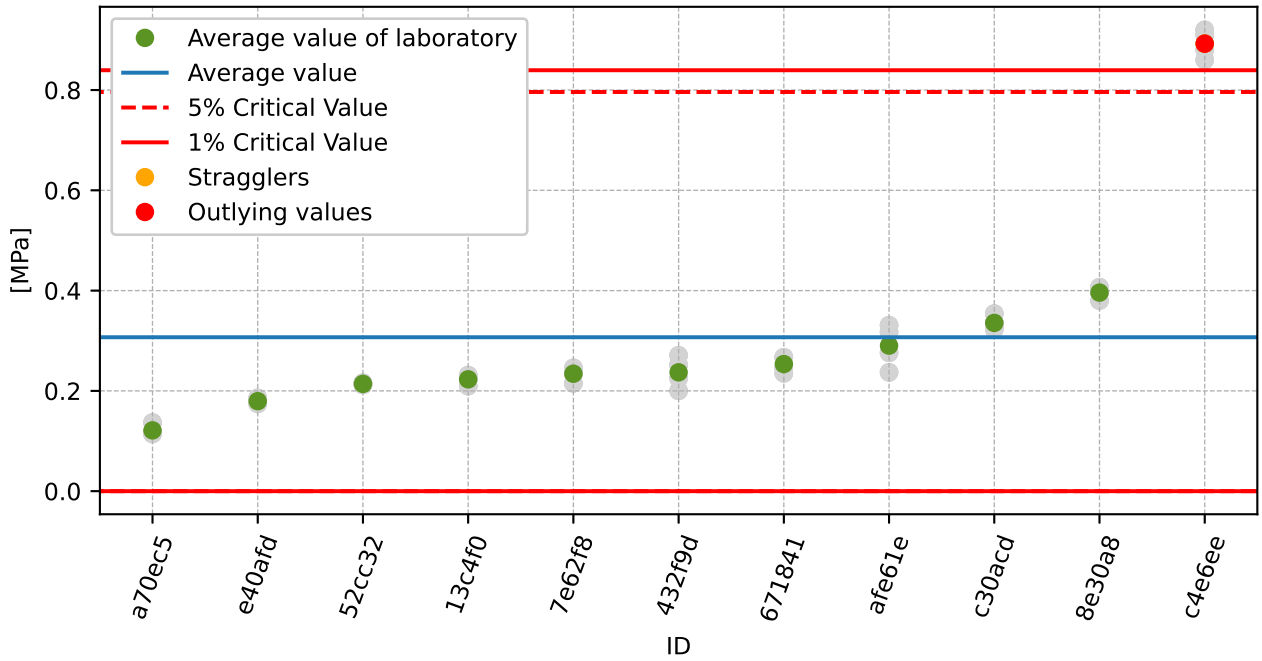

Figure 39: **Grubbs' test** - average values

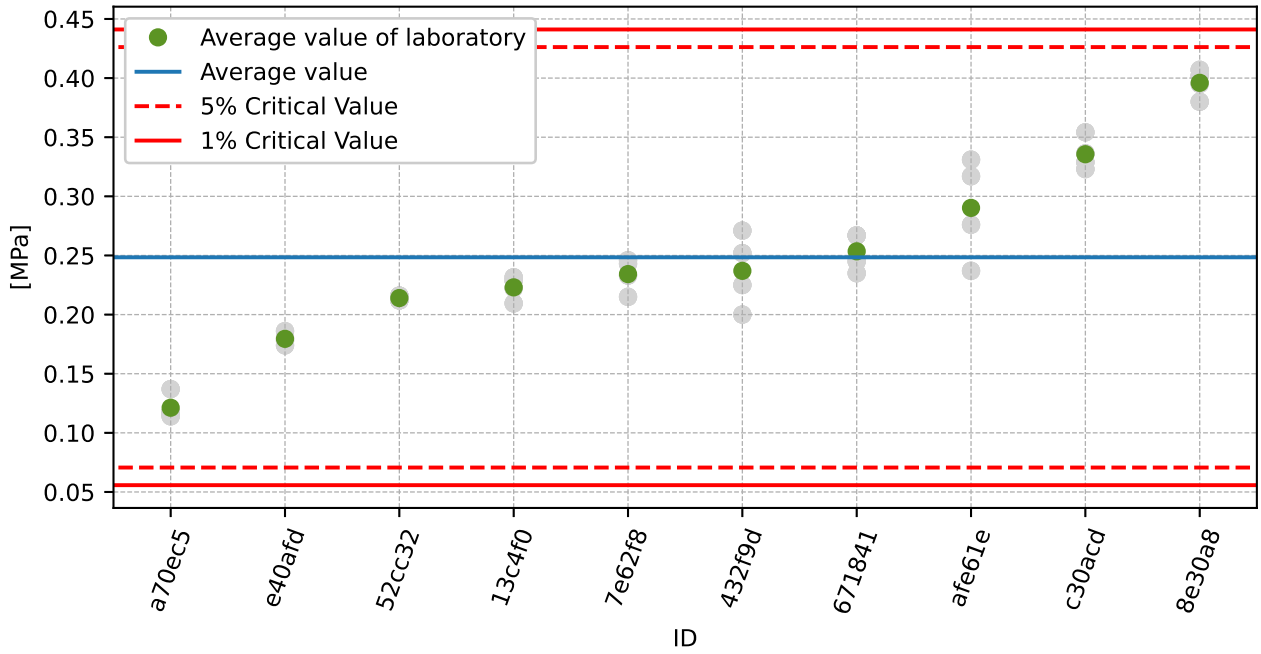

Figure 40: **Grubbs' test** - average values without outliers

6.1.3 Mandel's Statistics

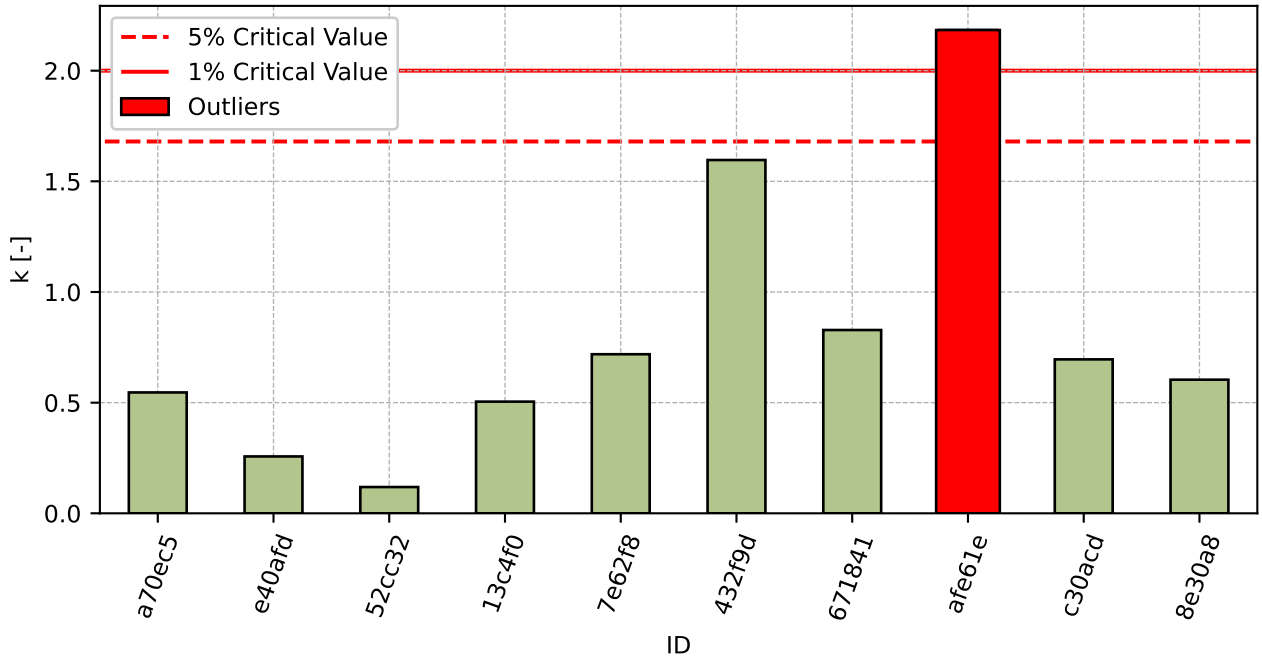

Figure 41: Intralaboratory Consistency Statistic

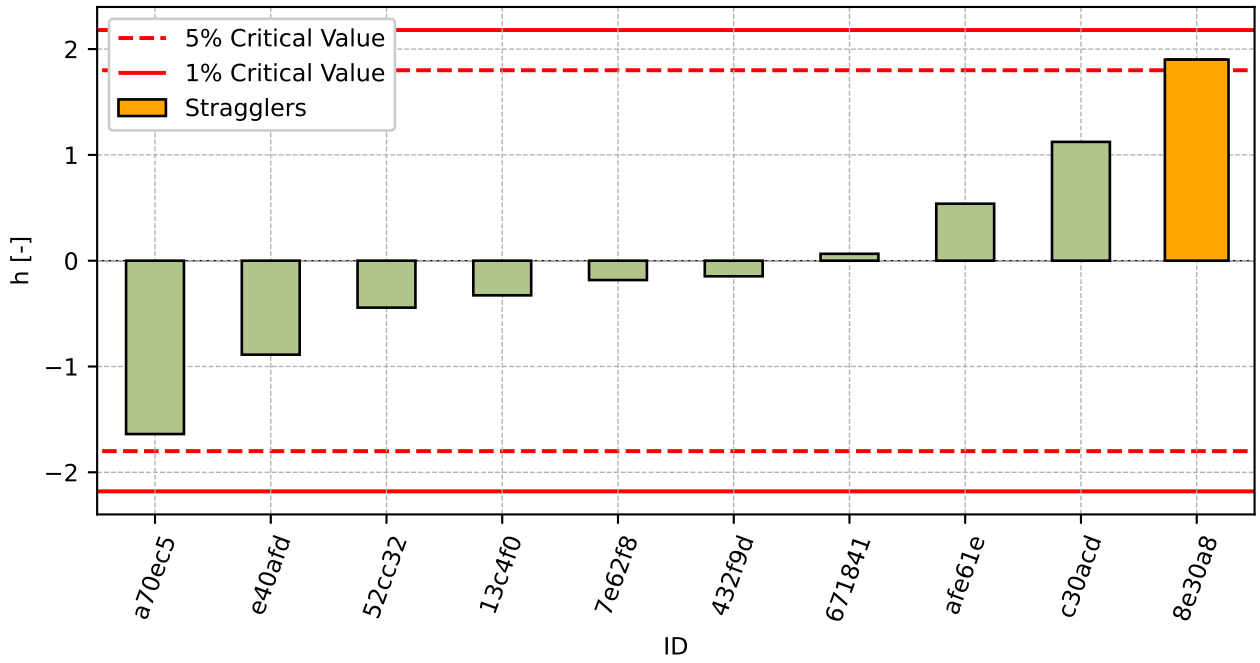

Figure 42: Interlaboratory Consistency Statistic

6.1.4 Descriptive statistics

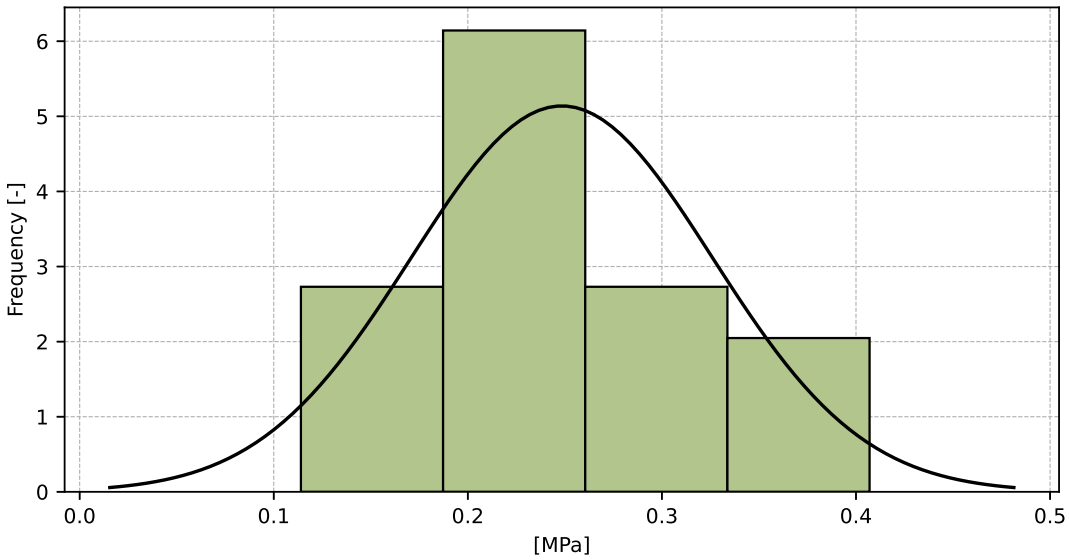

Figure 43: Histogram of all test results

Table 27: Descriptive statistics

Characteristics	[MPa]
Average value – $\bar{x}$	0.248
Sample standard deviation – s	0.0776
Asigned value – x^*	0.248
Robust standard deviation – s^*	0.0776
Measurement uncertainty of asigned value – u_X	0.0245
p-value of normality test	0.082 [-]
Interlaboratory standard deviation – s_L	0.077
Repeatability standard deviation – s_r	0.0195
Reproducibility standard deviation – s_R	0.0794
Repeatability – r	0.054
Reproducibility – R	0.222

6.1.5 Evaluation of Performance Statistics

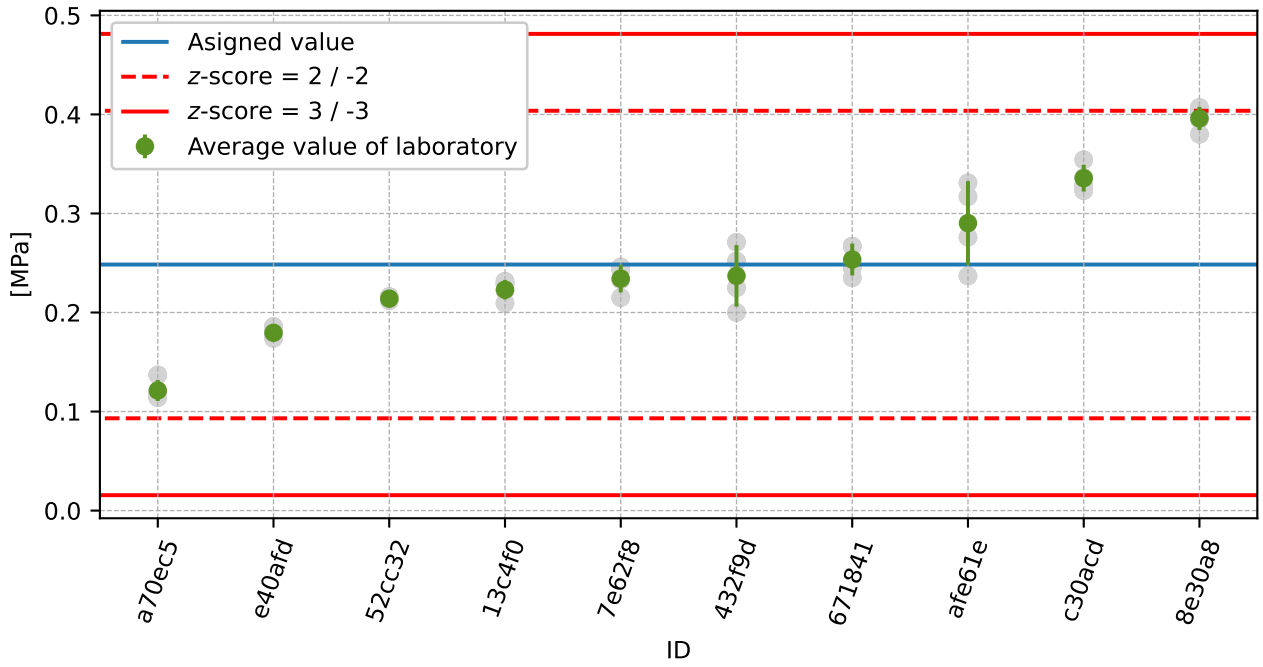

Figure 44: Average values and sample standard deviations

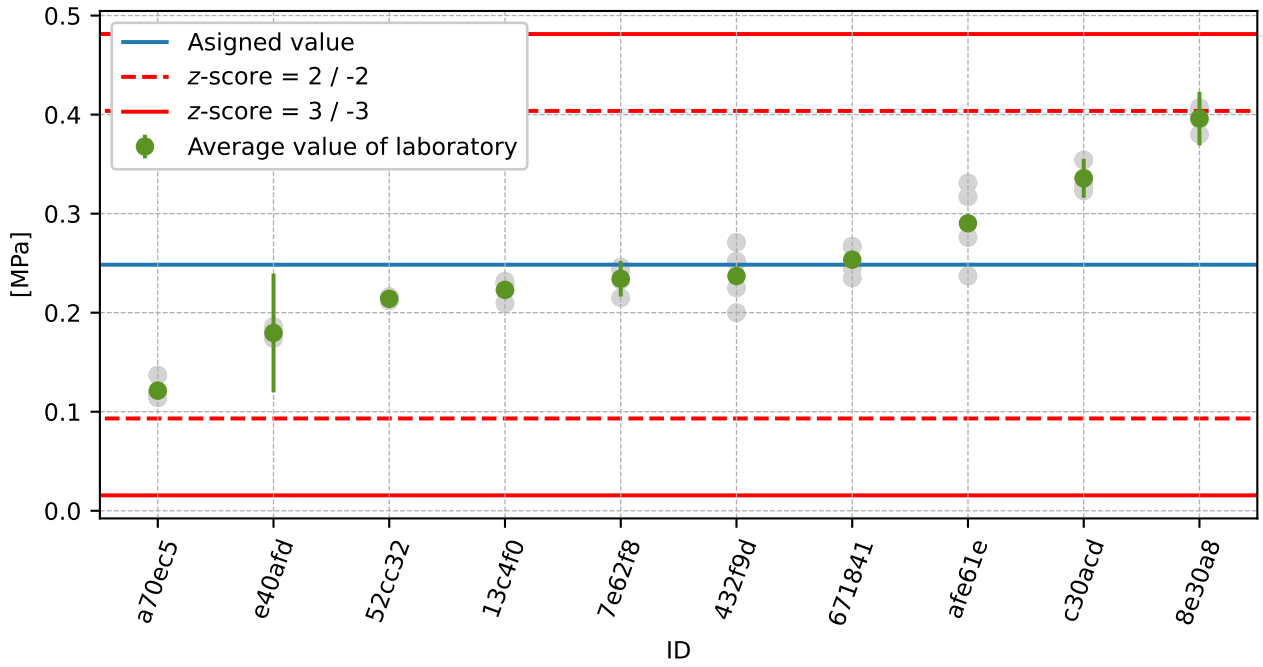

Figure 45: Average values and extended uncertainties of measurement

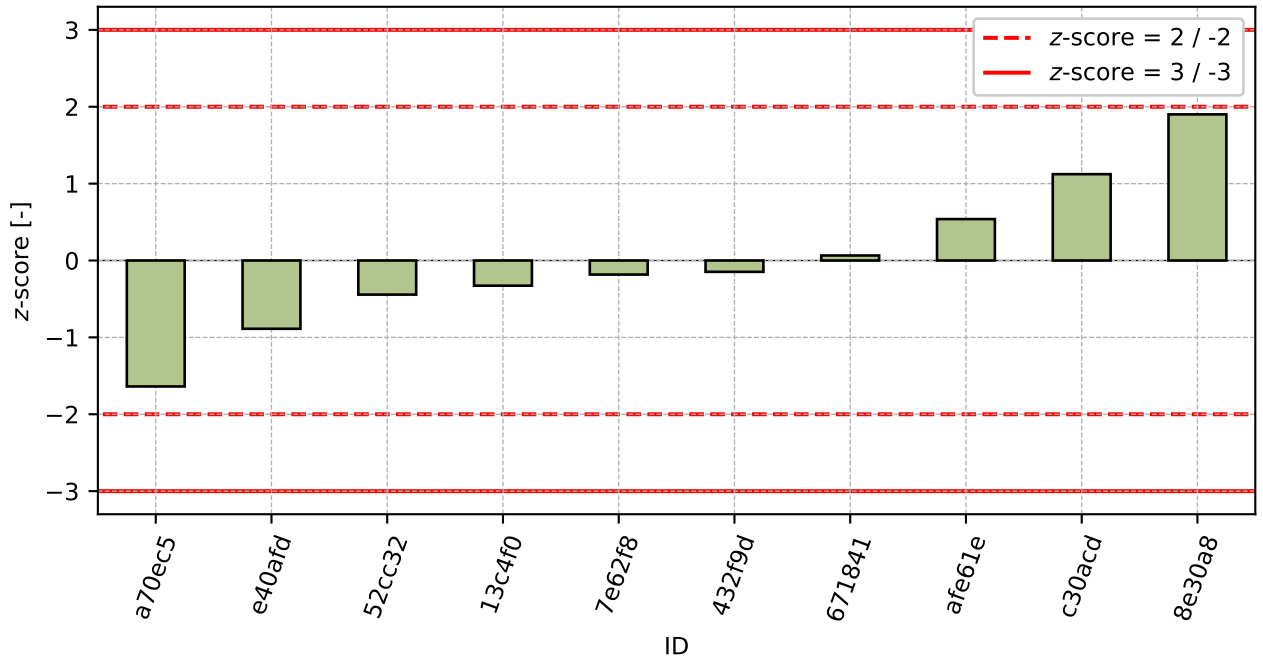

Figure 46: z-score

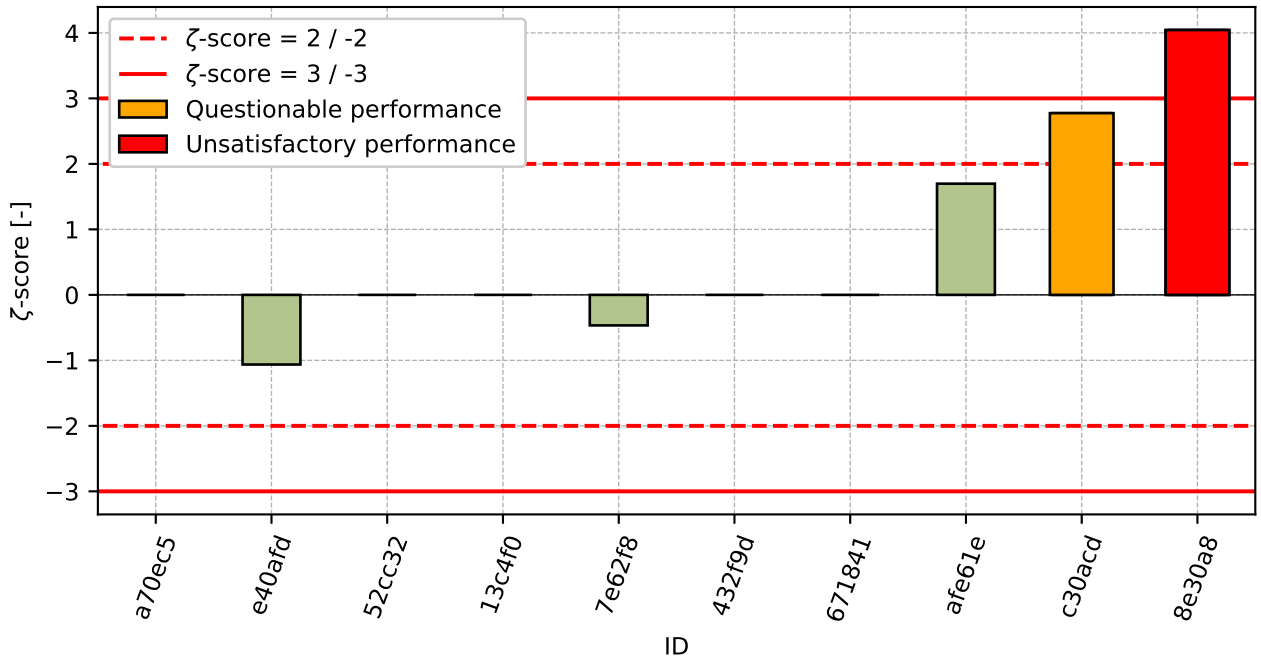

Figure 47: ζ-score

Table 28: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
a70ec5	-1.64	-
e40afd	-0.89	-1.06
52cc32	-0.44	-
13c4f0	-0.33	-
7e62f8	-0.18	-0.47
432f9d	-0.15	-
671841	0.07	-
afe61e	0.54	1.7
c30acd	1.12	2.77
8e30a8	1.9	4.04

6.2 Strain at failure

6.2.1 Test results

Table 29: 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 [%]
e40afd	3.0	3.1	2.9	3.4	0.2	3.1	0.216	6.97
c4e6ee	2.9	2.8	3.7	3.6	0.344	3.25	0.4655	14.32
afe61e	3.0	3.2	3.8	4.0	0.07	3.5	0.4761	13.6
8e30a8	4.0	3.4	3.5	3.8	1.4	3.675	0.2754	7.49
7e62f8	4.3	3.7	3.7	3.1	-	3.7	0.4899	13.24
671841	5.5	6.0	4.9	5.5	-	5.475	0.45	8.22
52cc32	6.13	7.04	6.13	7.04	-	6.585	0.5254	7.98
13c4f0	7.0	7.3	7.1	6.8	-	7.05	0.2082	2.95
432f9d	6.05	8.08	9.13	7.83	-	7.772	1.279	16.46
c30acd	8.67	9.35	9.62	8.62	0.49	9.065	0.4978	5.49
a70ec5	10.92	9.56	10.15	9.85	-	10.12	0.5852	5.78

6.2.2 The Numerical Procedure for Determining Outliers

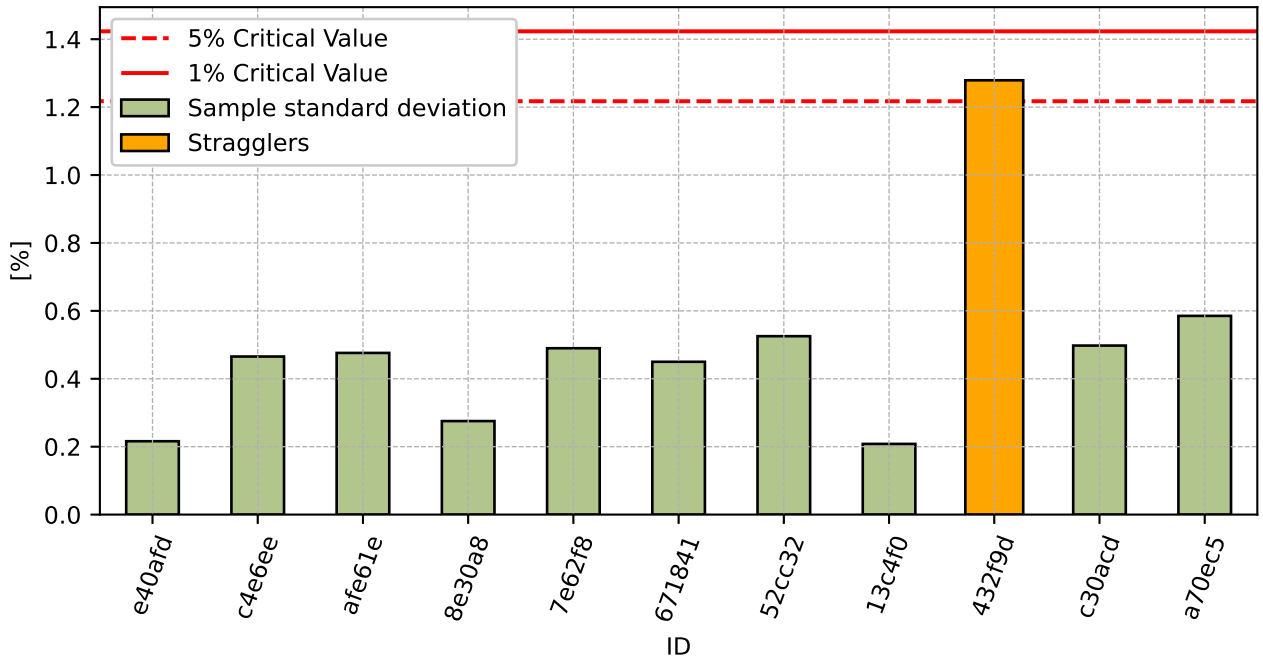

Figure 48: **Cochran's test** - sample standard deviations

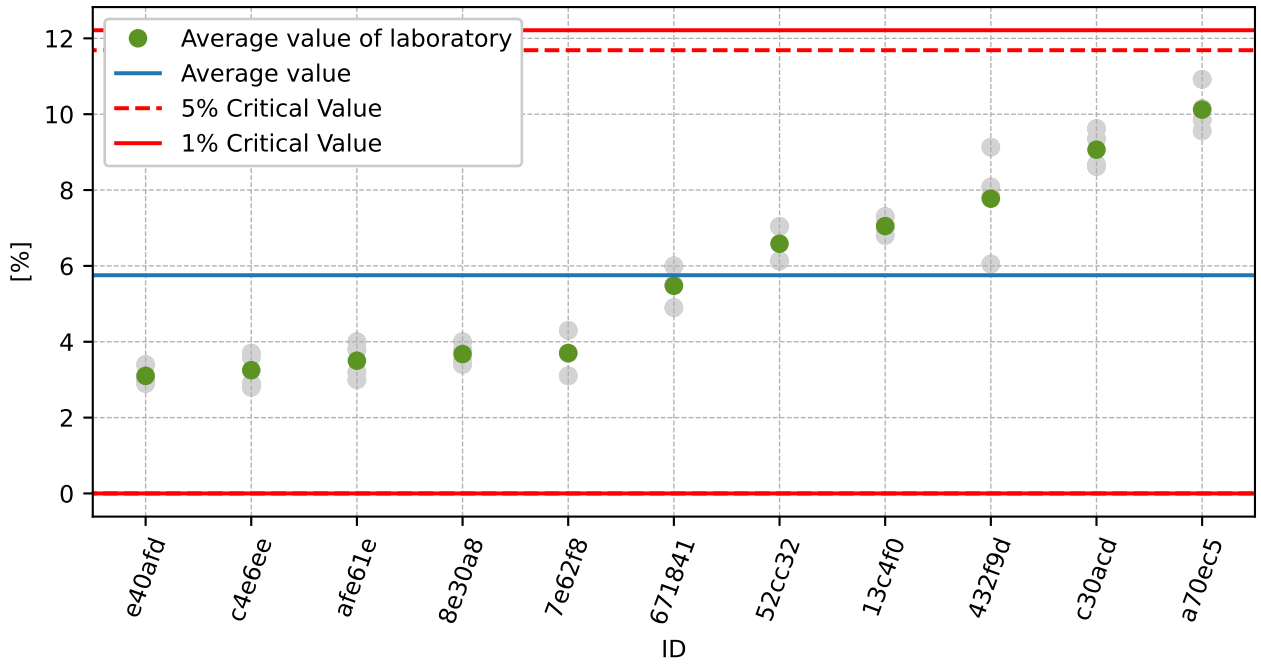

Figure 49: **Grubbs' test** - average values

6.2.3 Mandel's Statistics

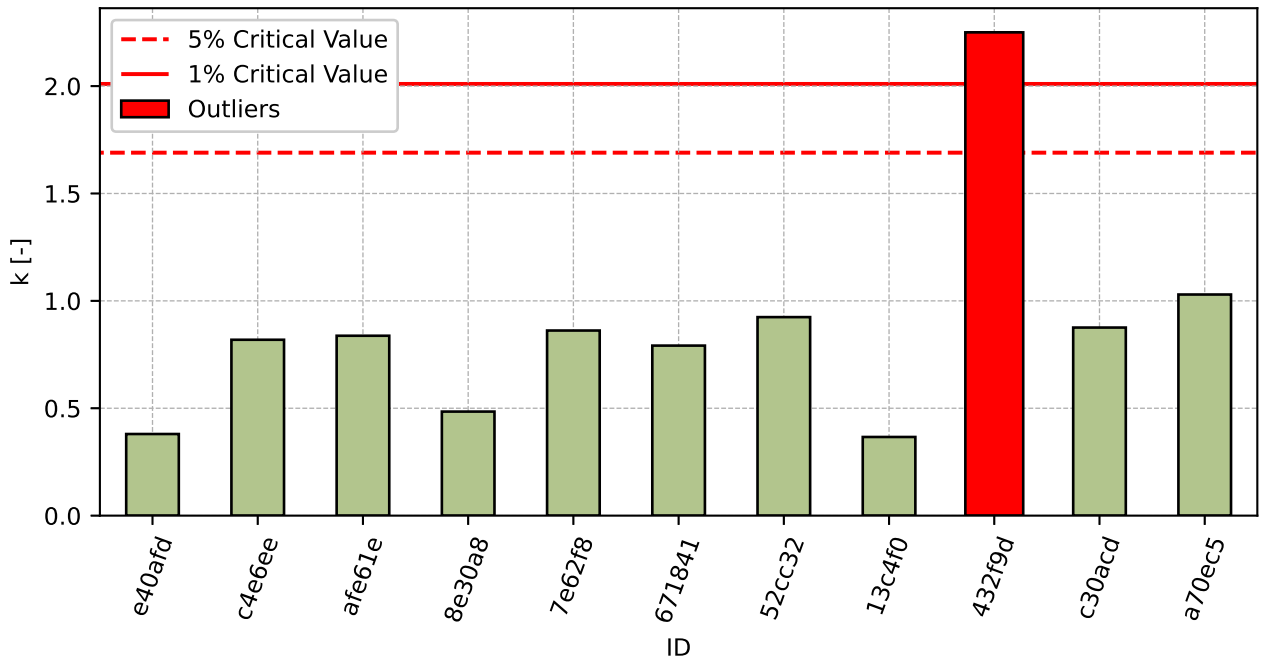

Figure 50: Intralaboratory Consistency Statistic

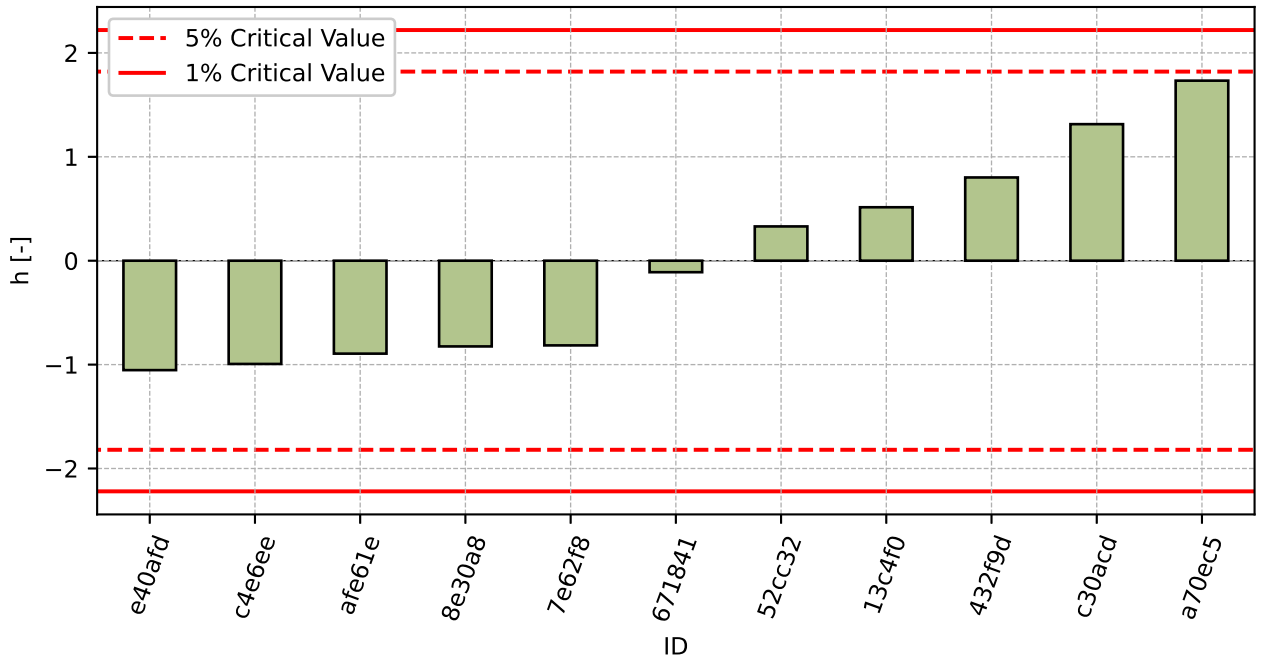

Figure 51: Interlaboratory Consistency Statistic

6.2.4 Descriptive statistics

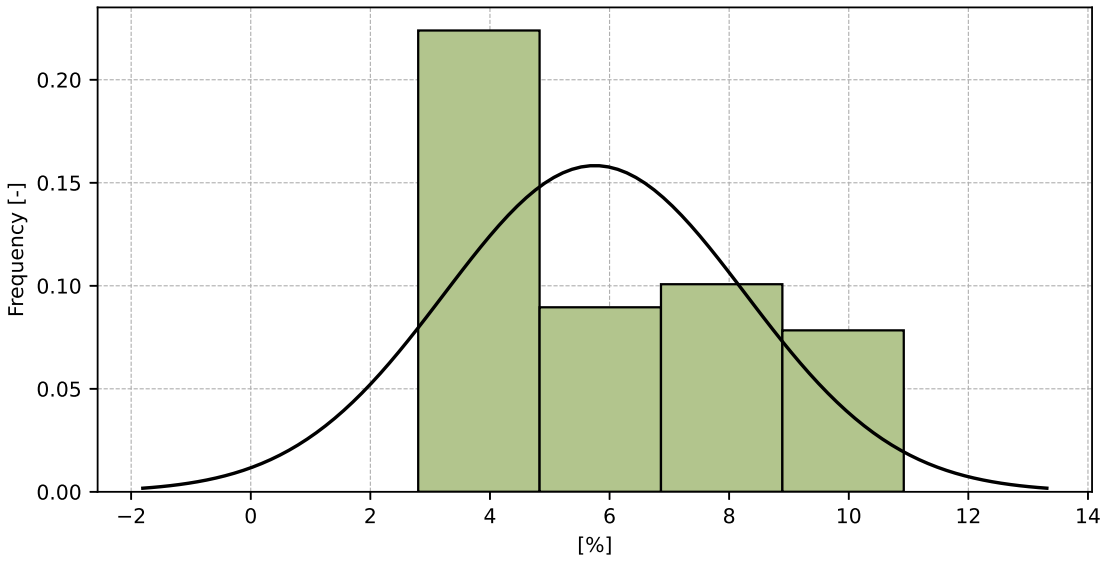

Figure 52: Histogram of all test results

Table 30: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	5.754
Sample standard deviation – s	2.5196
Asigned value – x^*	5.754
Robust standard deviation – s^*	2.7242
Measurement uncertainty of asigned value – u_X	1.0267
p-value of normality test	0.001 [-]
Interlaboratory standard deviation – s_L	2.5035
Repeatability standard deviation – s_r	0.5684
Reproducibility standard deviation – s_R	2.5672
Repeatability – r	1.592
Reproducibility – R	7.188

6.2.5 Evaluation of Performance Statistics

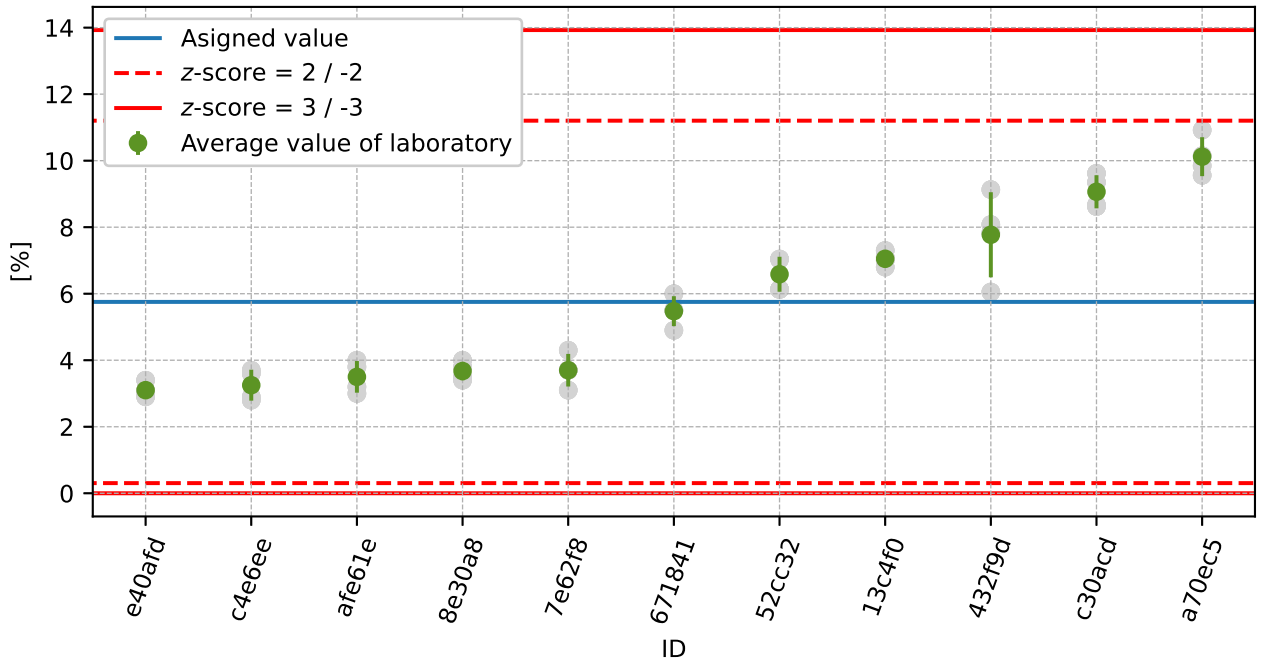

Figure 53: Average values and sample standard deviations

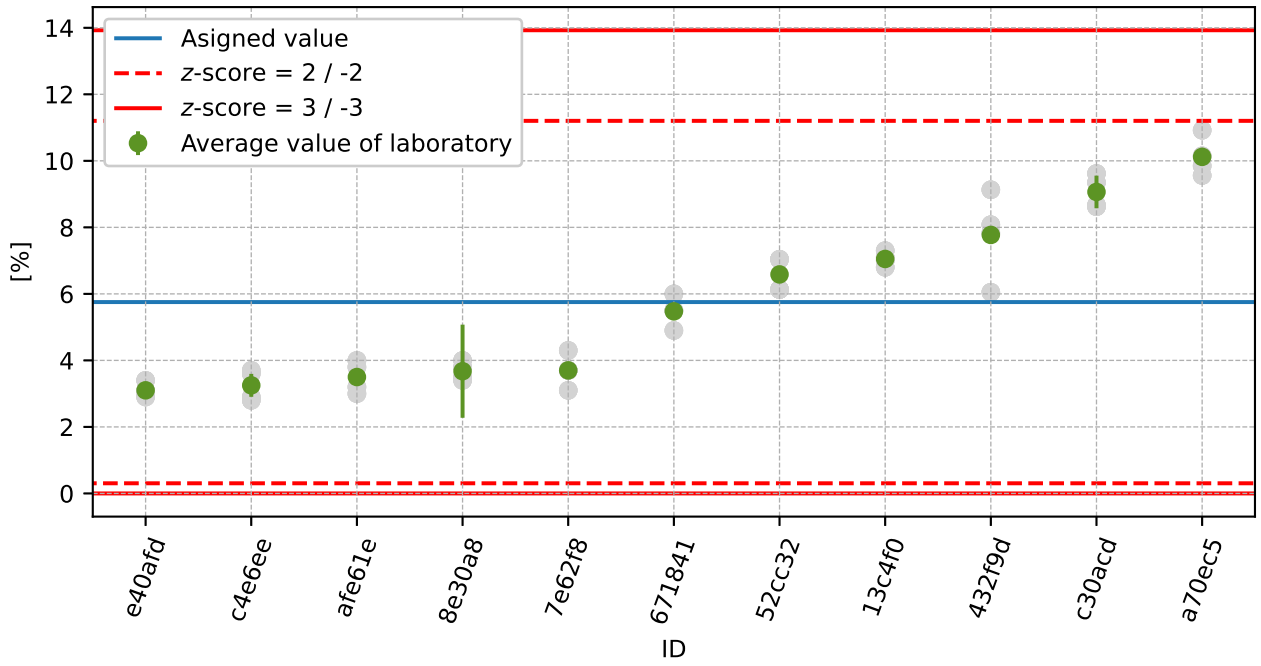

Figure 54: Average values and extended uncertainties of measurement

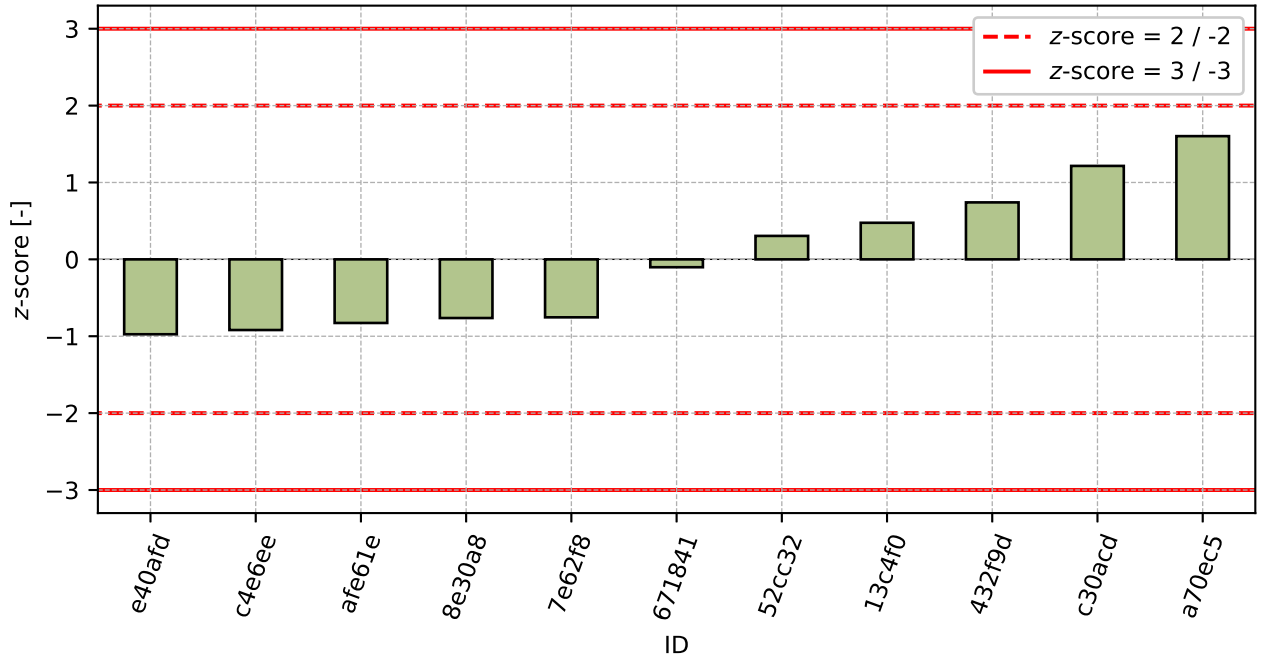

Figure 55: z-score

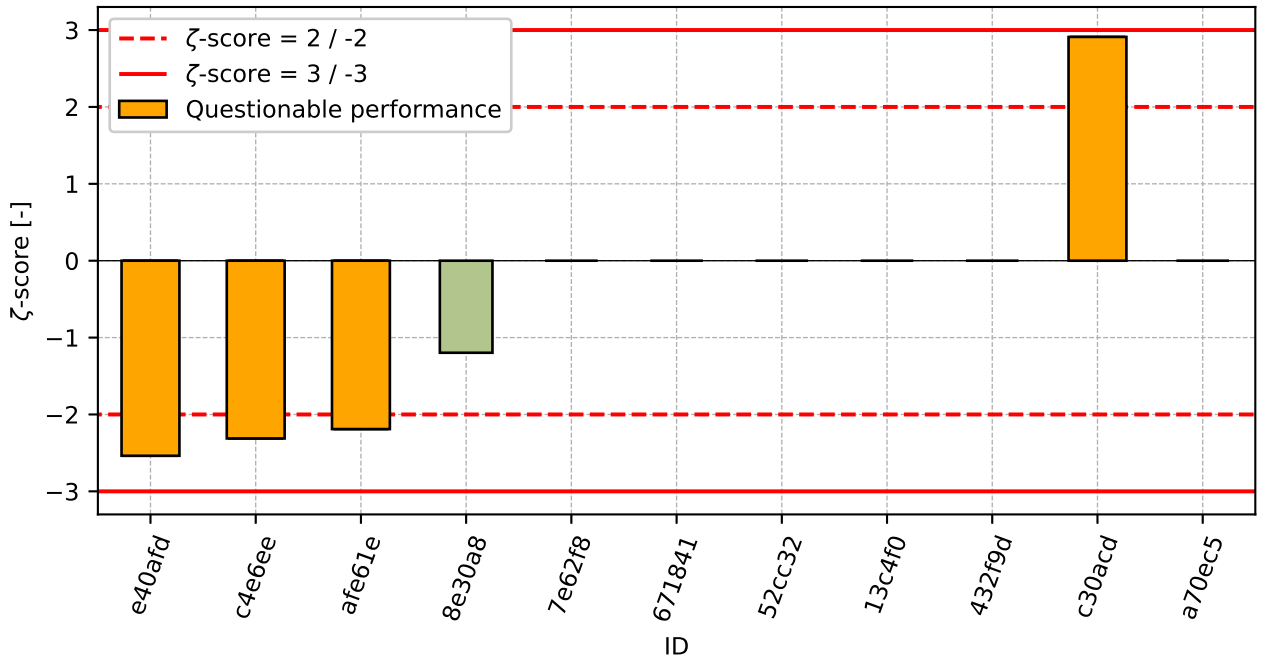

Figure 56: ζ-score

Table 31: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
e40afd	-0.97	-2.54
c4e6ee	-0.92	-2.31
afe61e	-0.83	-2.19
8e30a8	-0.76	-1.2
7e62f8	-0.75	-
671841	-0.1	-
52cc32	0.31	-
13c4f0	0.48	-
432f9d	0.74	-
c30acd	1.22	2.91
a70ec5	1.6	-

7 Appendix – CEN ISO/TS 17892-10 – Effective shear parameters

7.1 50 kPa

7.1.1 Test results

Table 32: Test results - ordered by average value. Outliers are marked by red color. u_X - extended uncertainty of measurement.

ID	Test results [kPa]	u_X [kPa]
e40afd	26.7	0.3
7126ed	31.0	-
06b0ef	35.2	0.2
03da8b	36.1	0.8
52cc32	37.5	-
d23d72	39.4	11.5
8e30a8	41.0	1.0
7faa64	42.0	0.0
a70ec5	42.7	-
ed020a	43.0	2.0
3c62de	44.0	-
d88cb5	45.1	2.5
47a0ff	45.3	3.1
9a4772	47.0	1.0
671841	47.2	-
afe61e	49.0	1.0
4032d8	50.0	2.3
7e62f8	51.9	5.0
526ece	52.6	7.1
e75250	55.0	0.6
5e7bb2	60.4	-
13c4f0	92.0	-

7.1.2 The Numerical Procedure for Determining Outliers

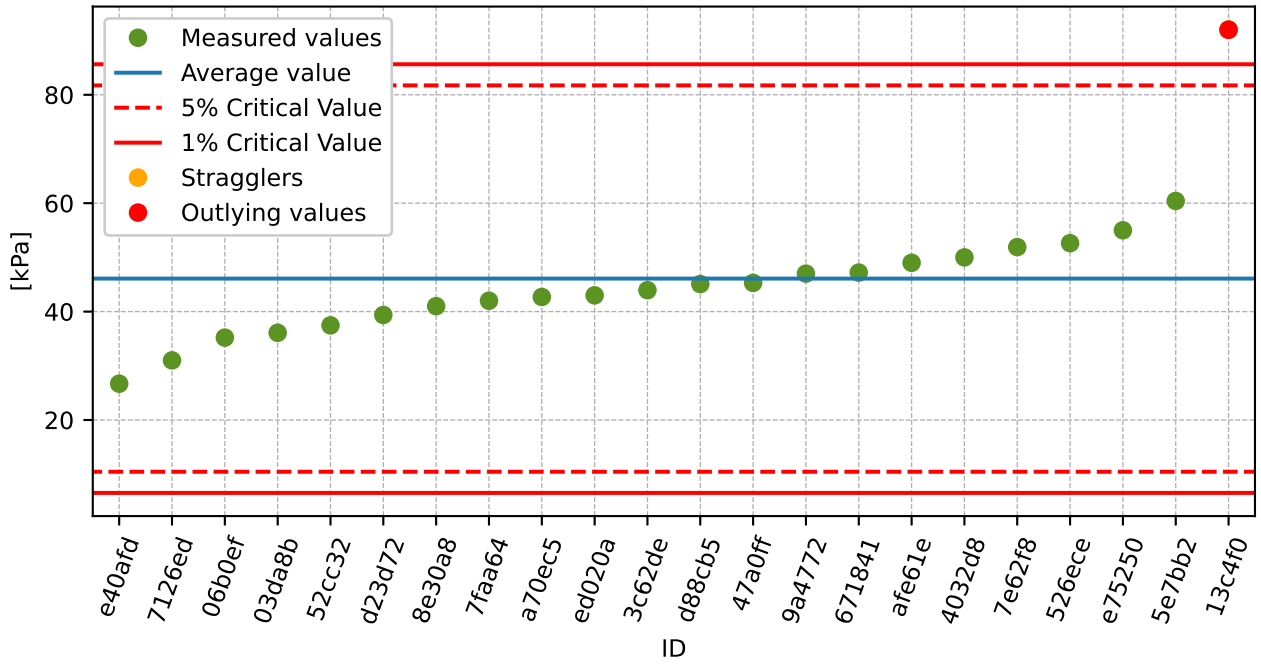

Figure 57: **Grubbs' test** - average values

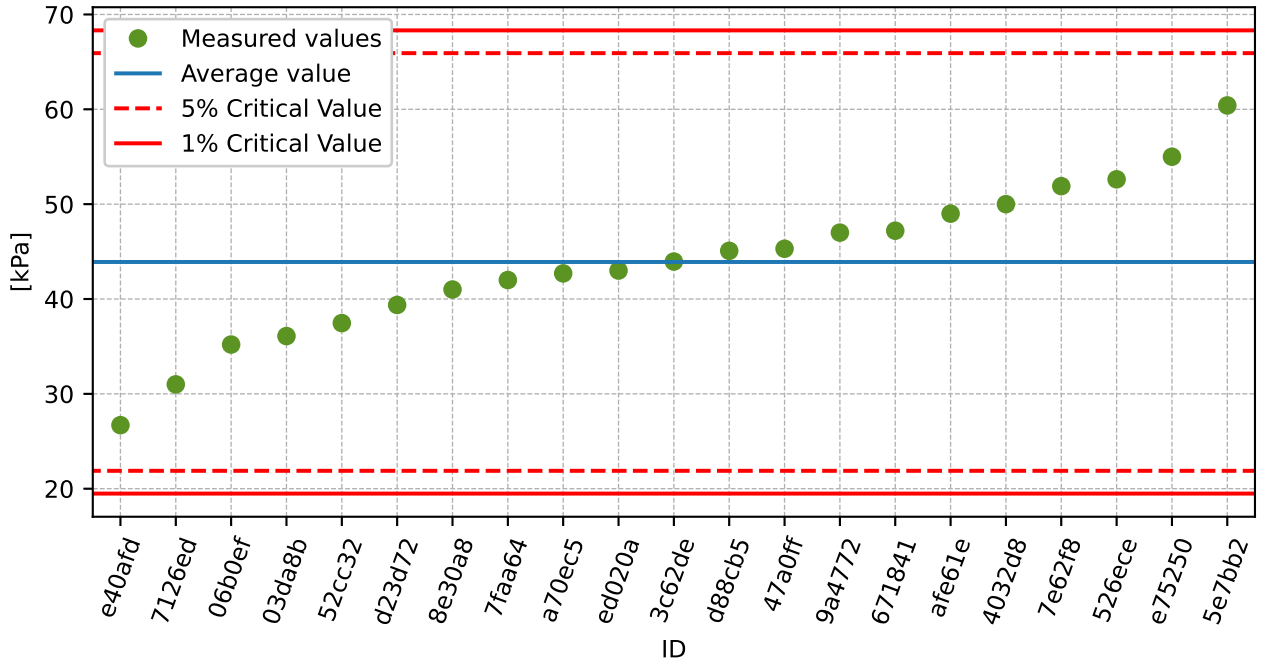

Figure 58: **Grubbs' test** - average values without outliers

7.1.3 Mandel's Statistics

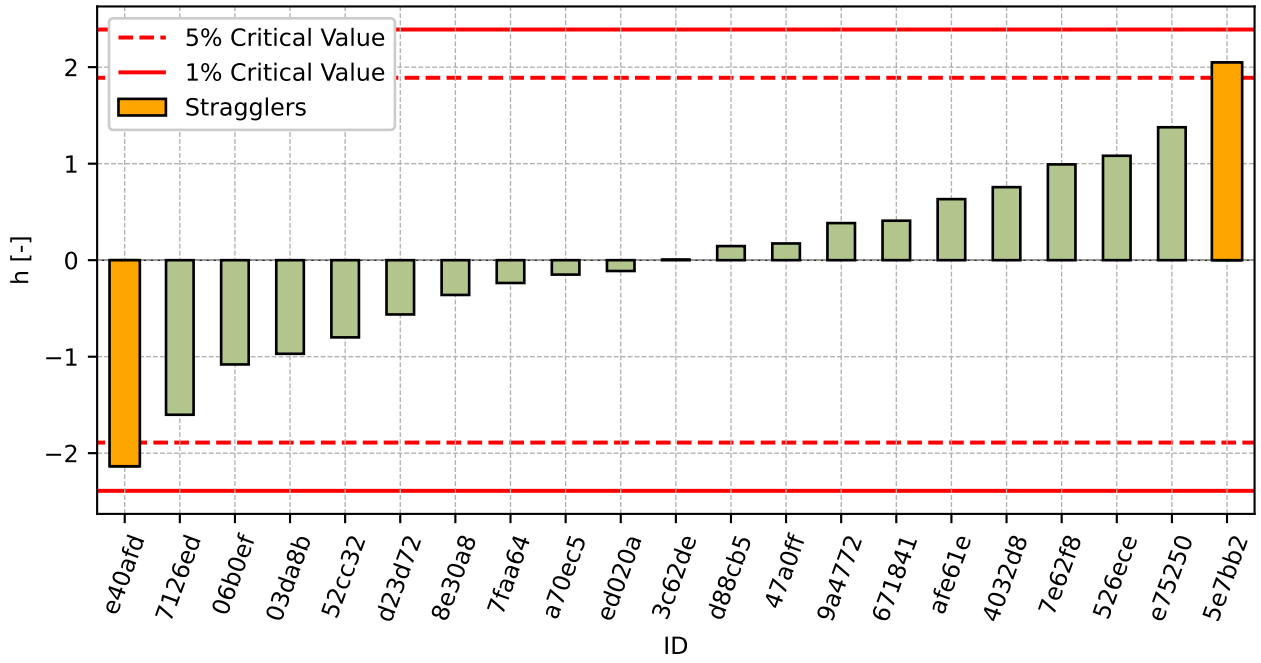

Figure 59: Interlaboratory Consistency Statistic

7.1.4 Descriptive statistics

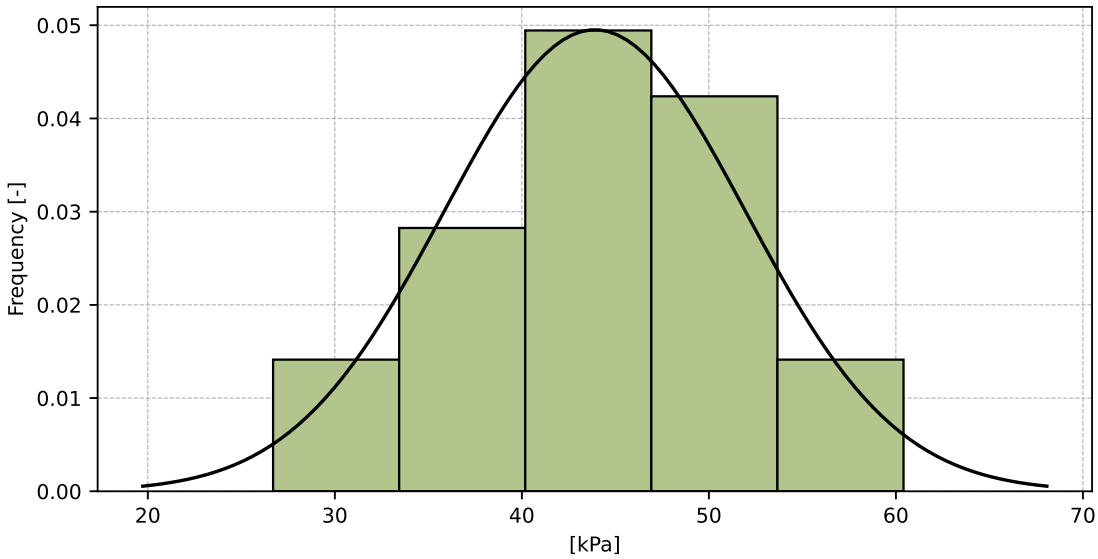

Figure 60: Histogram of all test results

Table 33: Descriptive statistics

Characteristics	[kPa]
Average value – $\bar{x}$	43.9
Sample standard deviation – s	8.06
Asigned value – x^*	44.3
Robust standard deviation – s^*	8.14
Measurement uncertainty of asigned value – u_X	2.22
p-value of normality test	1.0 [-]

7.1.5 Evaluation of Performance Statistics

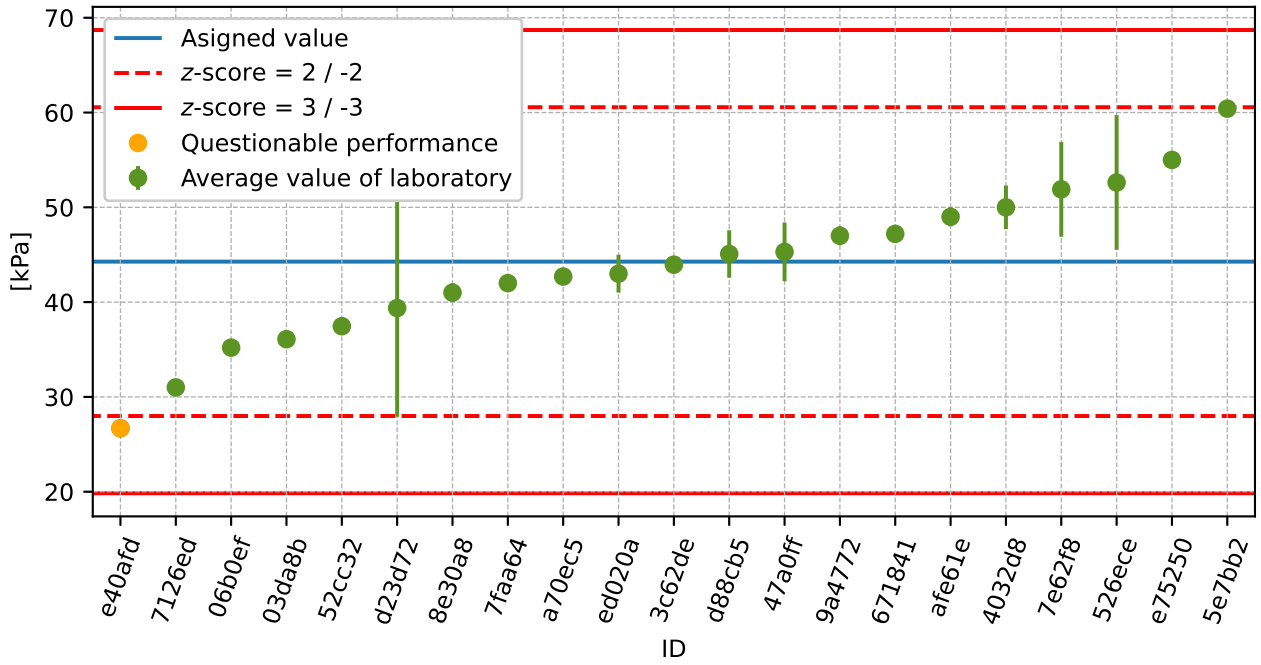

Figure 61: Average values and extended uncertainties of measurement

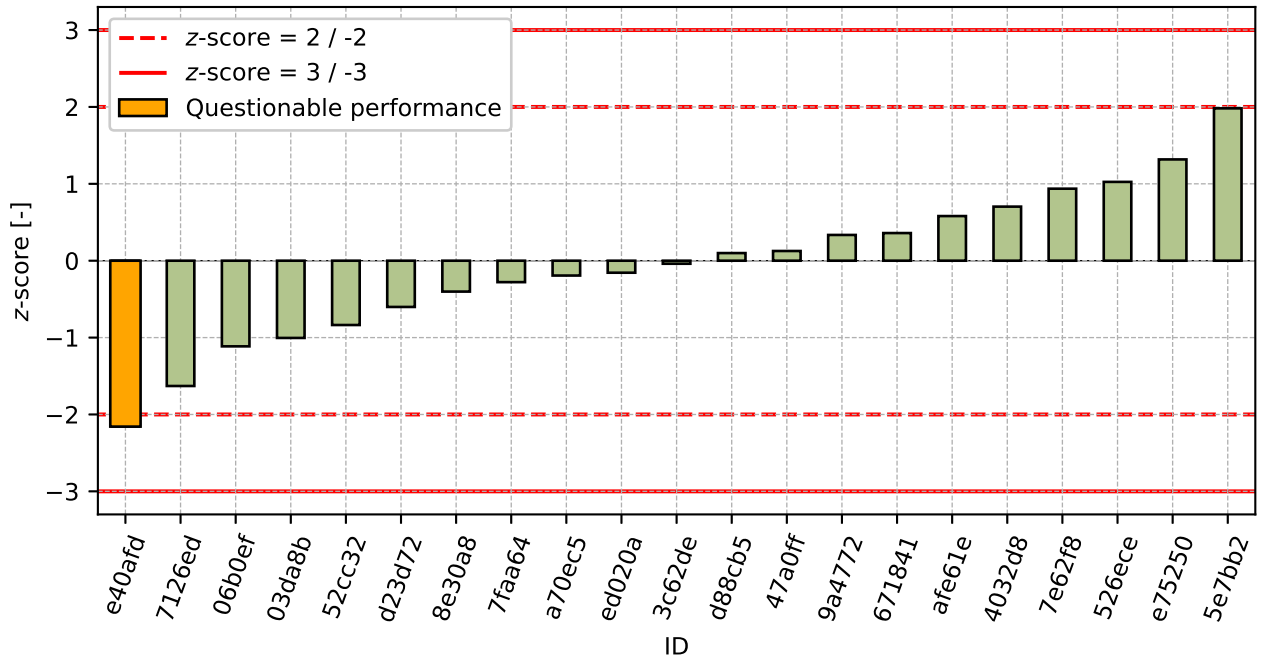

Figure 62: z-score

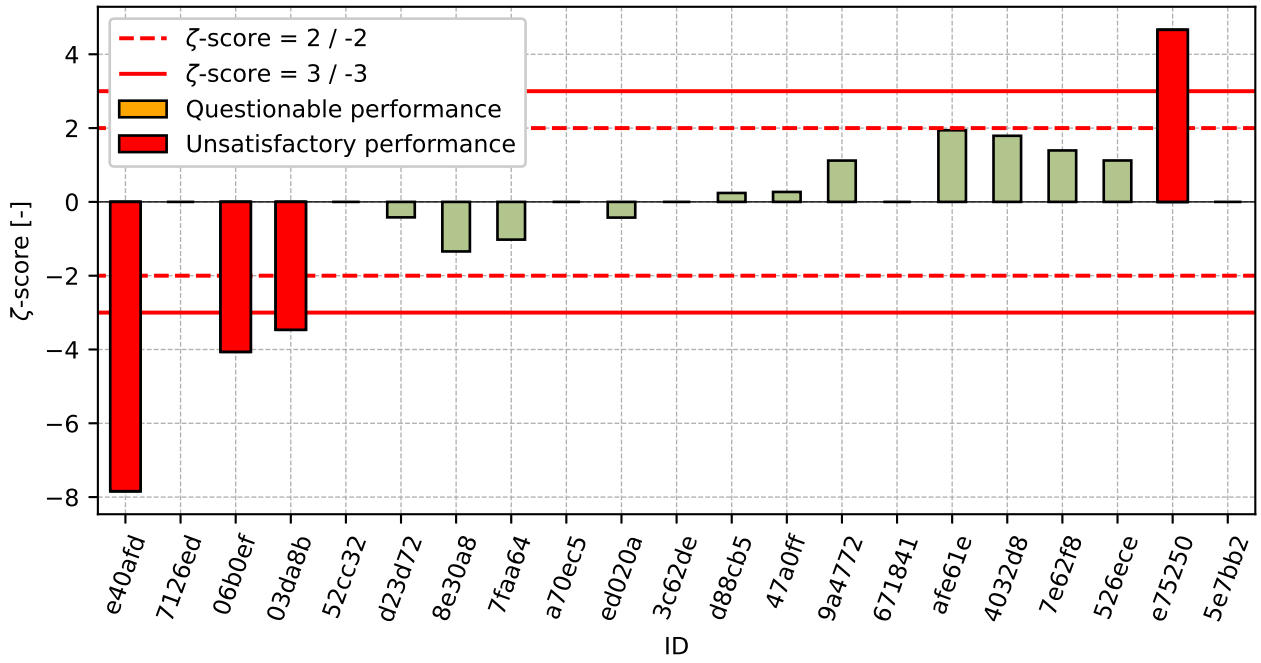

Figure 63: ζ-score

Table 34: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
e40afd	-2.16	-7.84
7126ed	-1.63	-
06b0ef	-1.11	-4.06
03da8b	-1.0	-3.47
52cc32	-0.84	-
d23d72	-0.6	-0.42
8e30a8	-0.4	-1.34
7faa64	-0.28	-1.02
a70ec5	-0.19	-
ed020a	-0.16	-0.43
3c62de	-0.04	-
d88cb5	0.1	0.24
47a0ff	0.13	0.27
9a4772	0.33	1.12
671841	0.36	-
afe61e	0.58	1.94
4032d8	0.7	1.79
7e62f8	0.94	1.39
526ece	1.03	1.12
e75250	1.32	4.66
5e7bb2	1.98	-

7.2 100 kPa

7.2.1 Test results

Table 35: Test results - ordered by average value. Outliers are marked by red color. u_X - extended uncertainty of measurement.

ID	Test results [kPa]	u_X [kPa]
7126ed	58.0	-
d23d72	58.6	17.1
e40afd	59.7	0.5
03da8b	61.8	1.1
52cc32	64.8	-
7e62f8	68.0	5.0
06b0ef	69.8	0.2
d88cb5	72.5	3.5
47a0ff	75.3	2.7
3c62de	76.4	-
a70ec5	78.4	-
ed020a	80.0	2.0
9a4772	80.0	2.0
4032d8	82.0	2.2
7faa64	82.0	0.1
8e30a8	84.0	1.0
afe61e	86.0	2.0
5e7bb2	90.9	-
671841	91.1	-
526ece	95.8	7.1
13c4f0	132.0	-
e75250	156.0	0.6

7.2.2 The Numerical Procedure for Determining Outliers

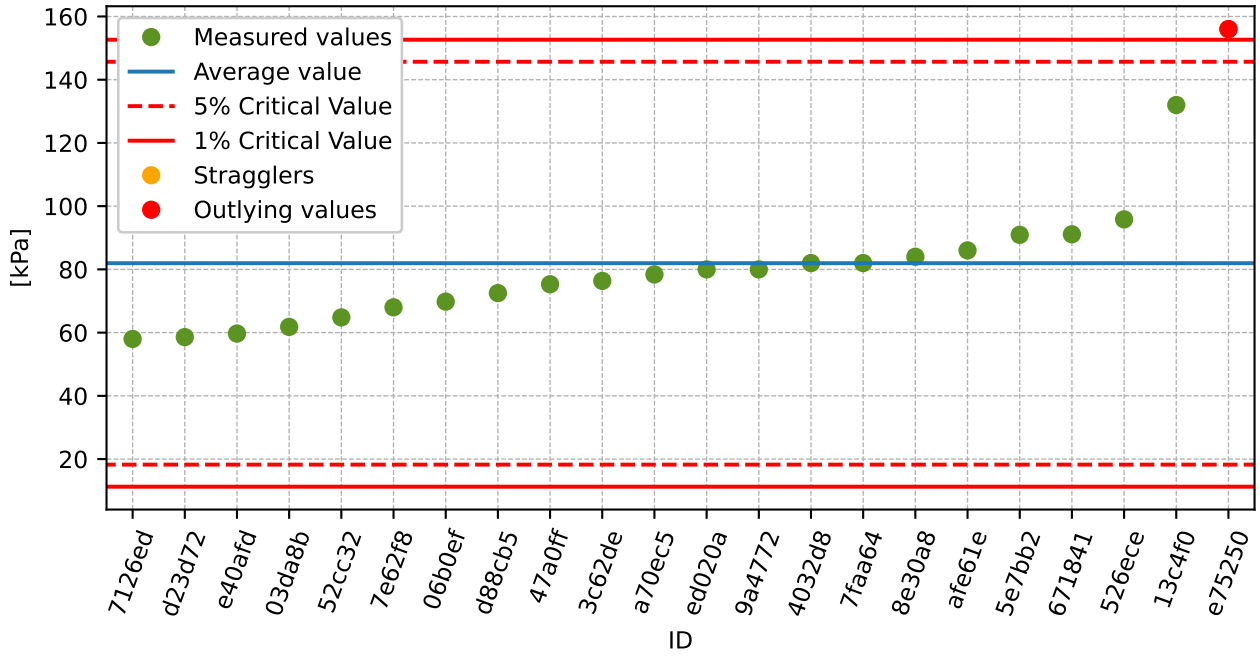

Figure 64: **Grubbs' test** - average values

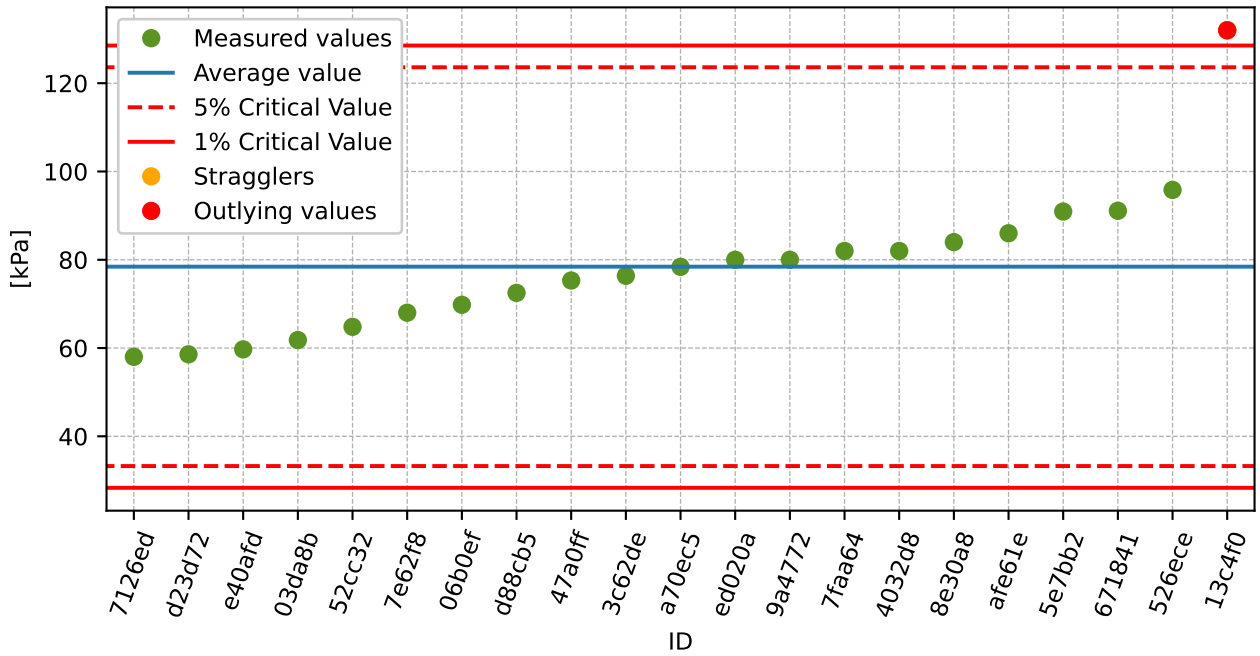

Figure 65: **Grubbs' test** - average values without outliers

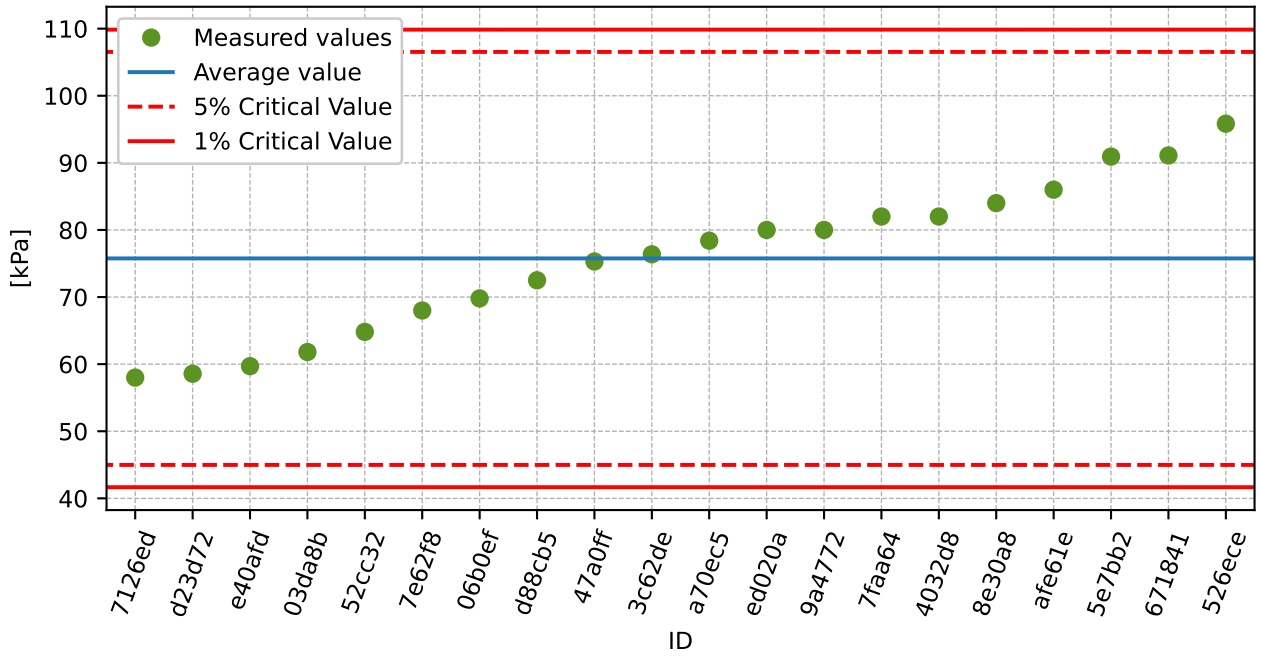

Figure 66: **Grubbs' test** - average values without outliers

7.2.3 Mandel's Statistics

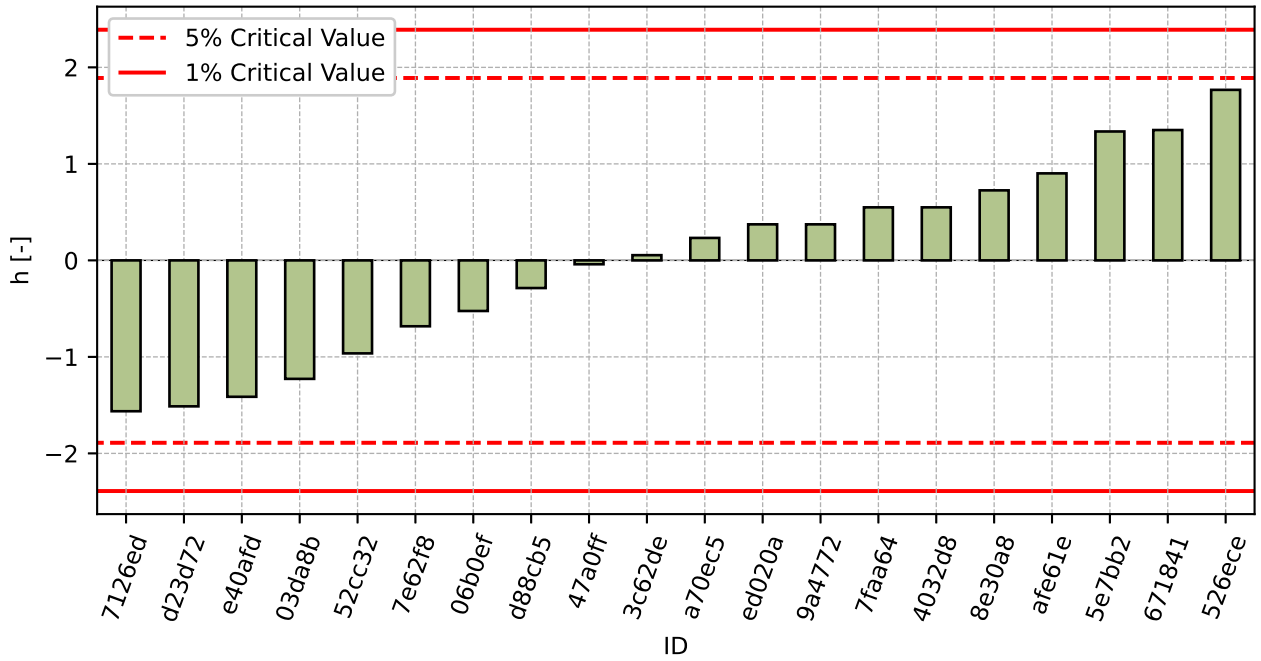

Figure 67: Interlaboratory Consistency Statistic

7.2.4 Descriptive statistics

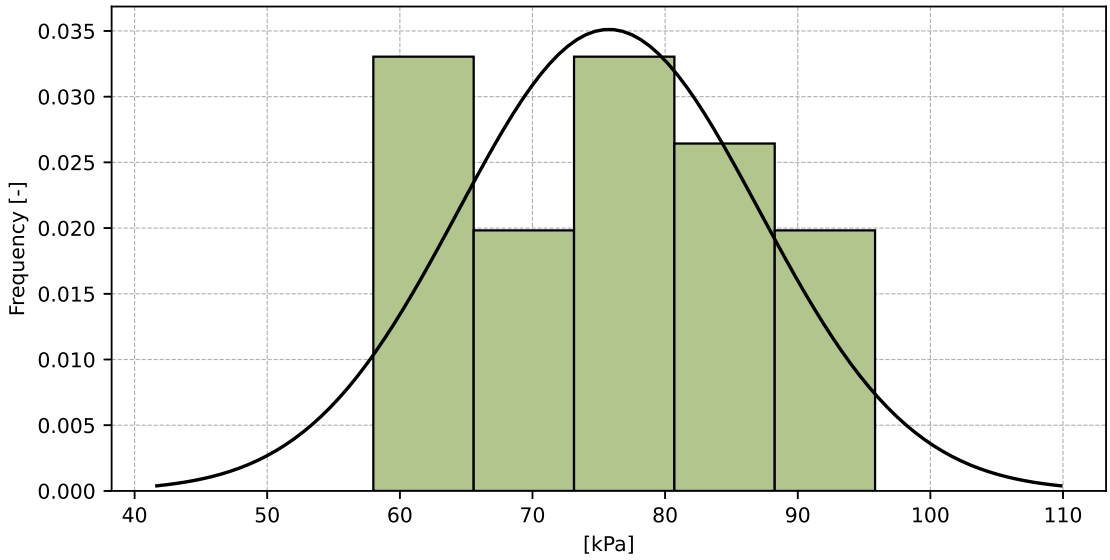

Figure 68: Histogram of all test results

Table 36: Descriptive statistics

Characteristics	**[kPa]**
Average value – $\bar{x}$	75.8
Sample standard deviation – s	11.36
Asigned value – x^*	75.9
Robust standard deviation – s^*	12.37
Measurement uncertainty of asigned value – u_X	3.46
p-value of normality test	0.532 [-]

7.2.5 Evaluation of Performance Statistics

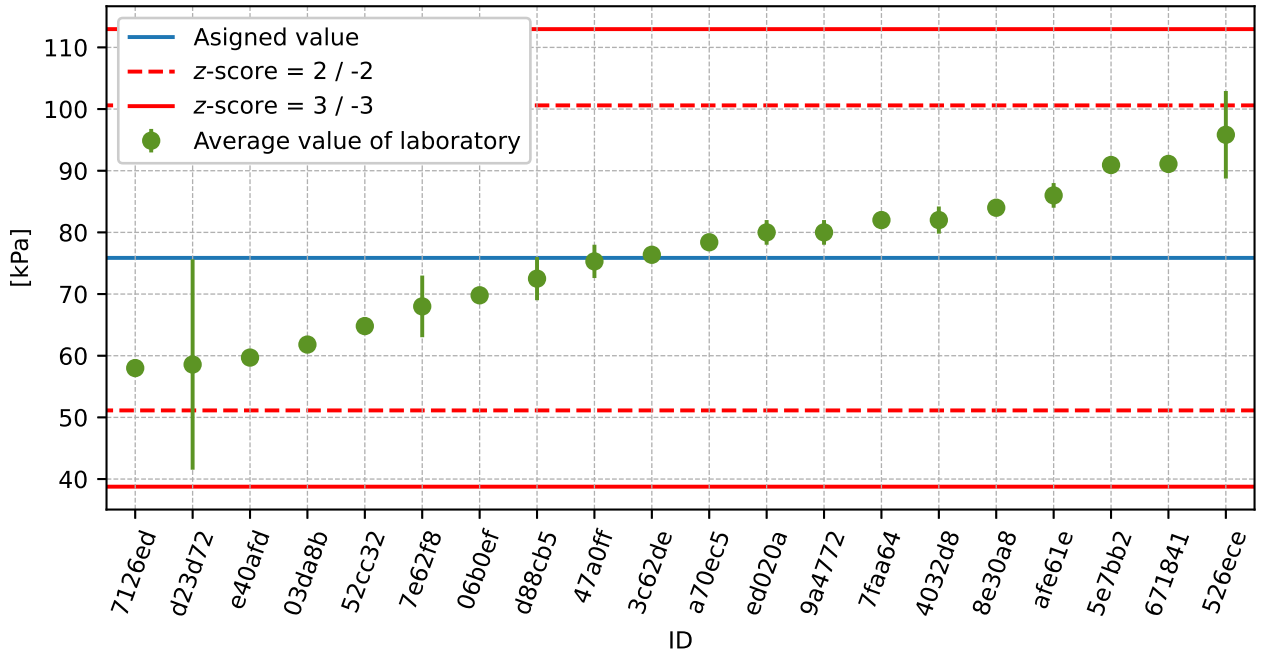

Figure 69: Average values and extended uncertainties of measurement

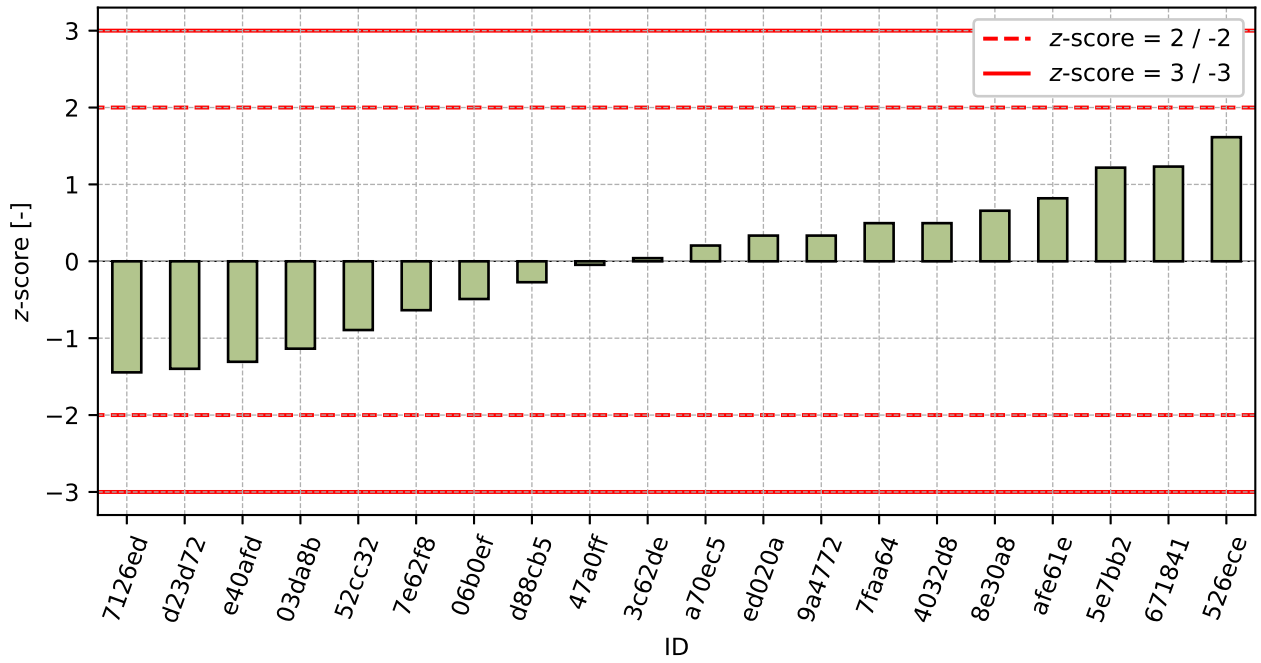

Figure 70: z-score

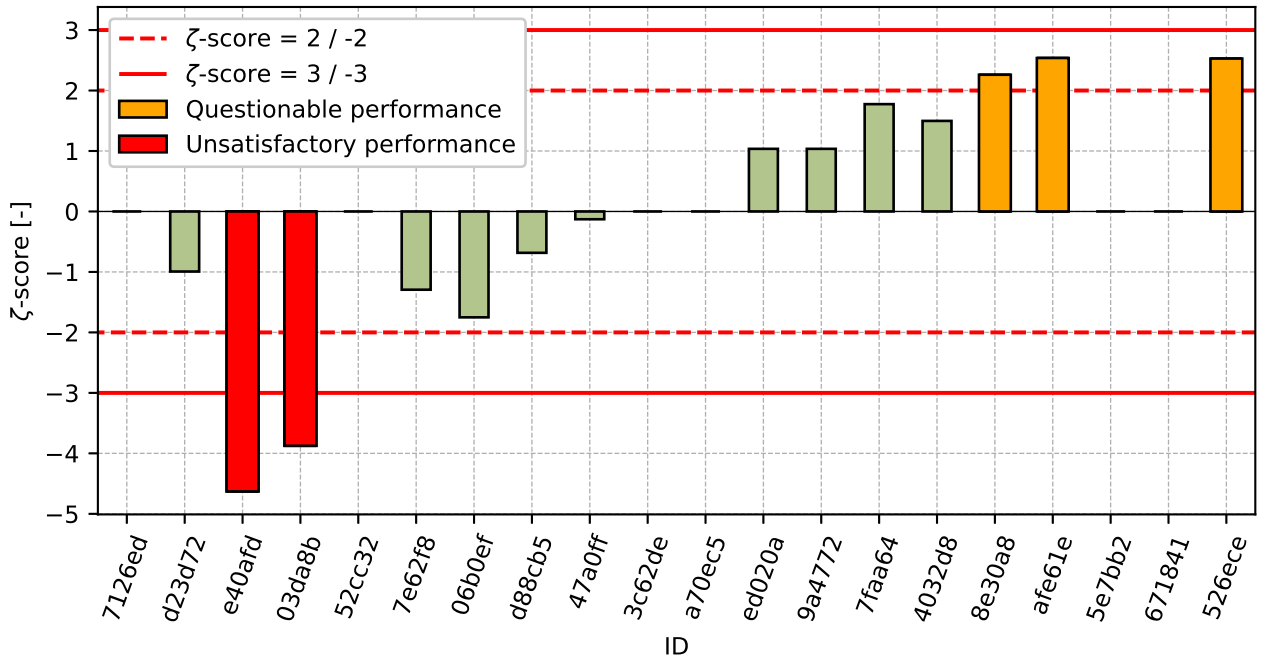

Figure 71: ζ-score

Table 37: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
7126ed	-1.44	-
d23d72	-1.4	-0.99
e40afd	-1.31	-4.63
03da8b	-1.14	-3.87
52cc32	-0.89	-
7e62f8	-0.64	-1.29
06b0ef	-0.49	-1.75
d88cb5	-0.27	-0.68
47a0ff	-0.05	-0.13
3c62de	0.04	-
a70ec5	0.21	-
ed020a	0.33	1.04
9a4772	0.33	1.04
7faa64	0.5	1.77
4032d8	0.5	1.5
8e30a8	0.66	2.26
afe61e	0.82	2.54
5e7bb2	1.22	-
671841	1.23	-
526ece	1.61	2.53

7.3 200 kPa

7.3.1 Test results

Table 38: Test results - ordered by average value. Outliers are marked by red color. u_X - extended uncertainty of measurement.

ID	Test results [kPa]	u_X [kPa]
7126ed	100.0	-
d23d72	101.9	29.7
d88cb5	121.2	6.0
e40afd	121.8	1.1
03da8b	123.1	1.9
8e30a8	127.0	1.0
3c62de	131.0	-
9a4772	136.0	3.0
7faa64	138.0	0.1
a70ec5	139.2	-
ed020a	142.0	2.0
06b0ef	142.1	0.2
47a0ff	143.9	2.6
7e62f8	147.2	5.0
52cc32	148.0	-
4032d8	157.0	3.2
5e7bb2	159.2	-
671841	159.4	-
afe61e	163.0	3.0
13c4f0	176.0	-
526ece	196.2	7.1
e75250	209.0	0.6

7.3.2 The Numerical Procedure for Determining Outliers

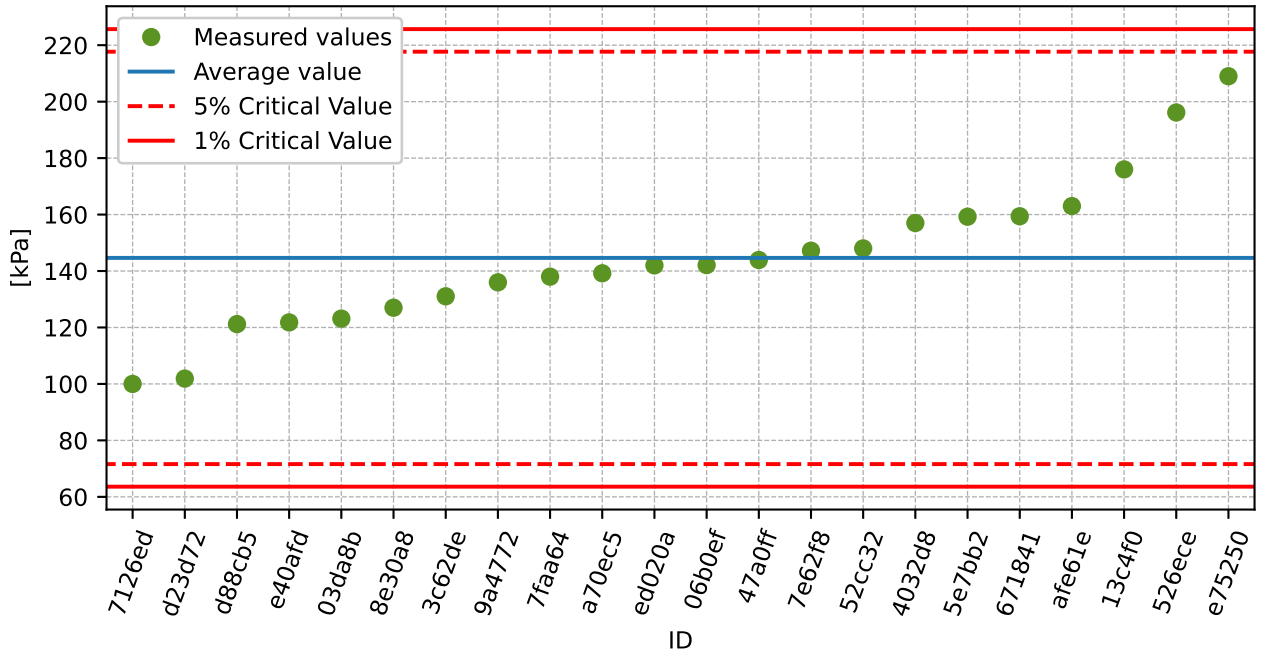

Figure 72: **Grubbs' test** - average values

7.3.3 Mandel's Statistics

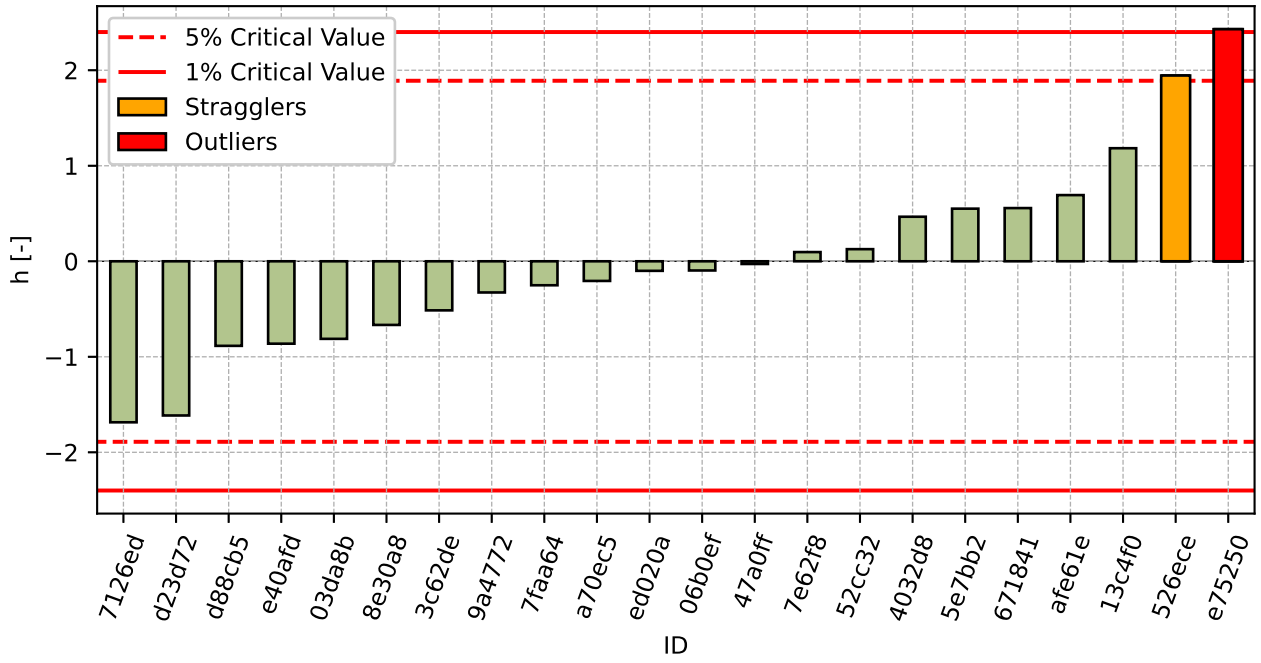

Figure 73: Interlaboratory Consistency Statistic

7.3.4 Descriptive statistics

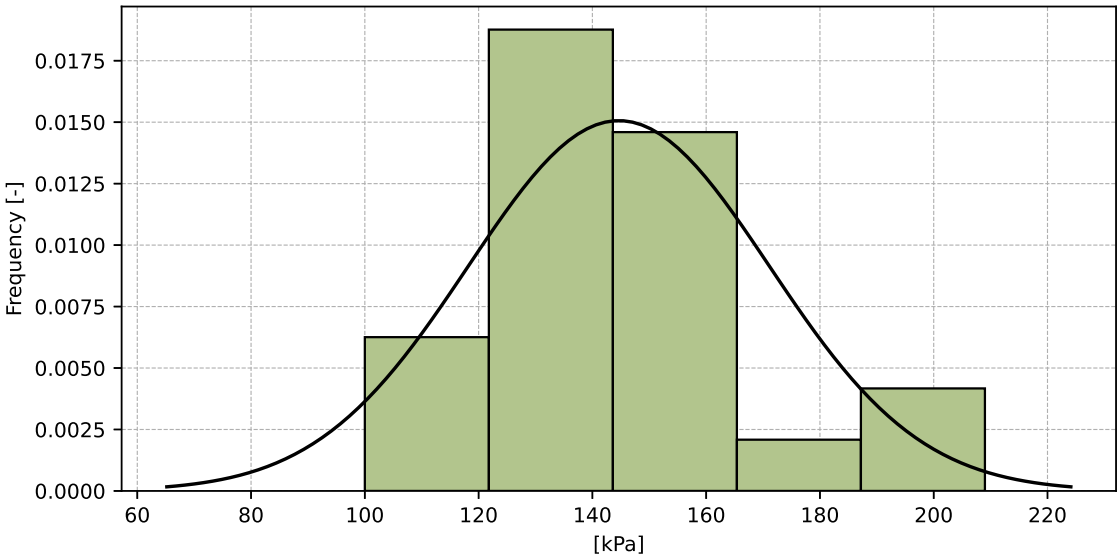

Figure 74: Histogram of all test results

Table 39: Descriptive statistics

Characteristics	**[kPa]**
Average value – $\bar{x}$	144.6
Sample standard deviation – s	26.49
Asigned value – x^*	144.3
Robust standard deviation – s^*	26.83
Measurement uncertainty of asigned value – u_X	7.15
p-value of normality test	0.379 [-]

7.3.5 Evaluation of Performance Statistics

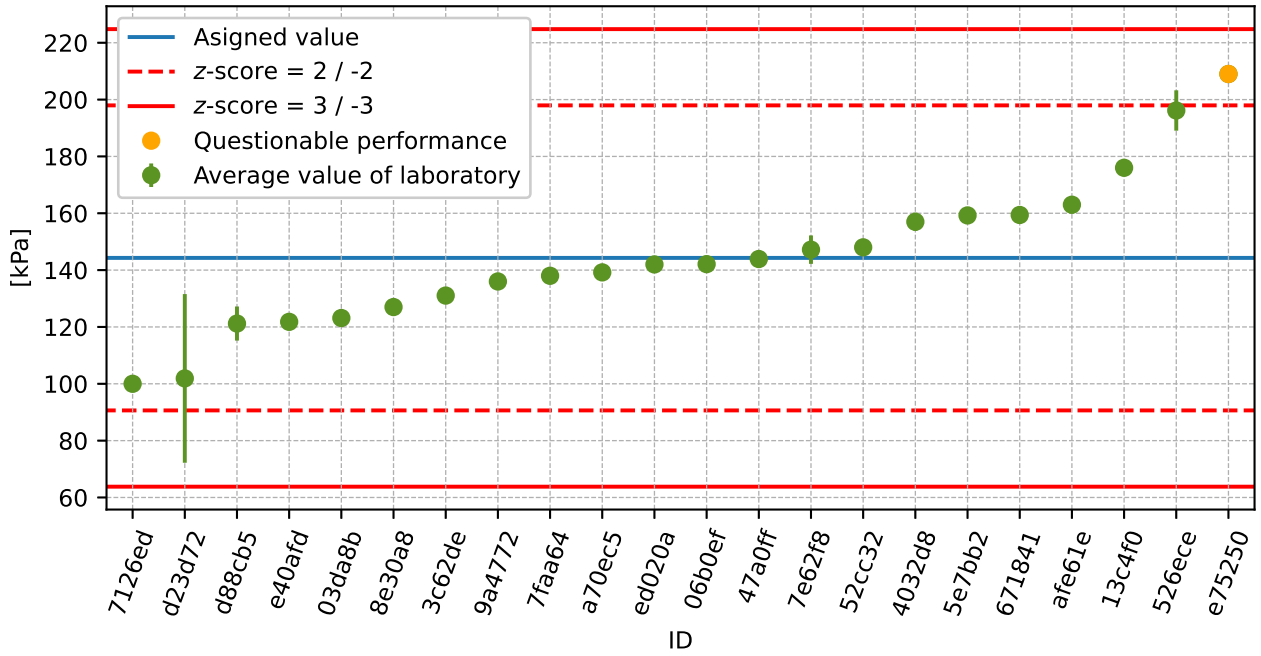

Figure 75: Average values and extended uncertainties of measurement

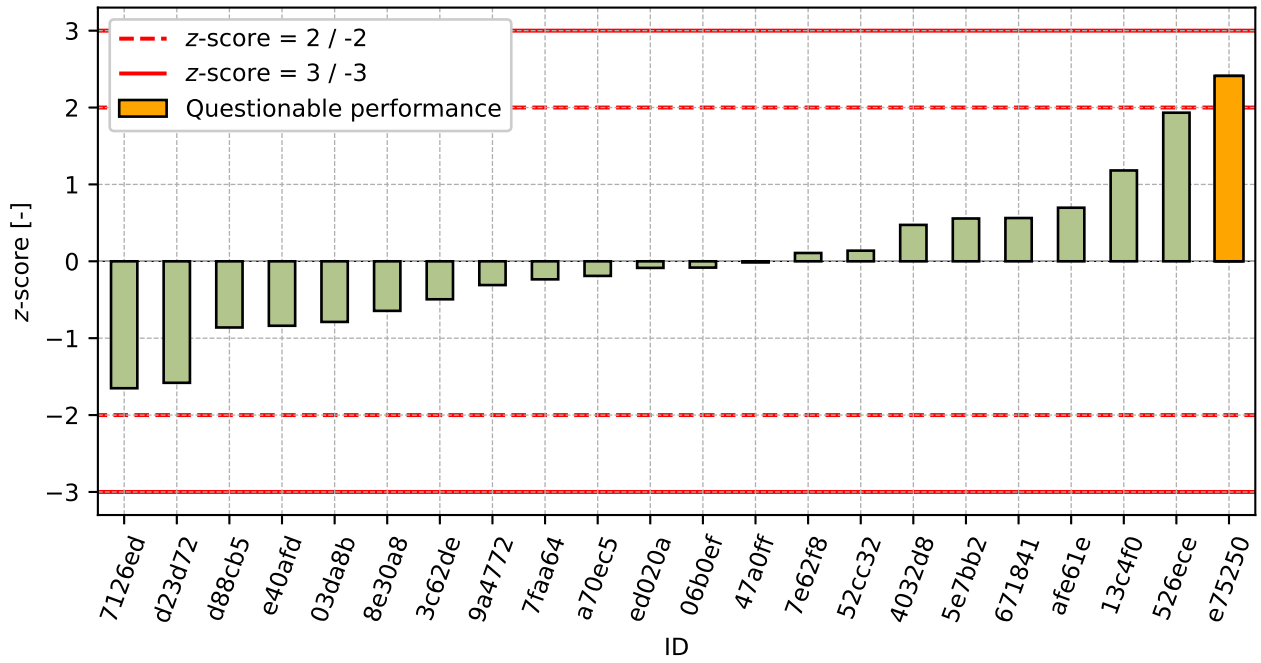

Figure 76: z-score

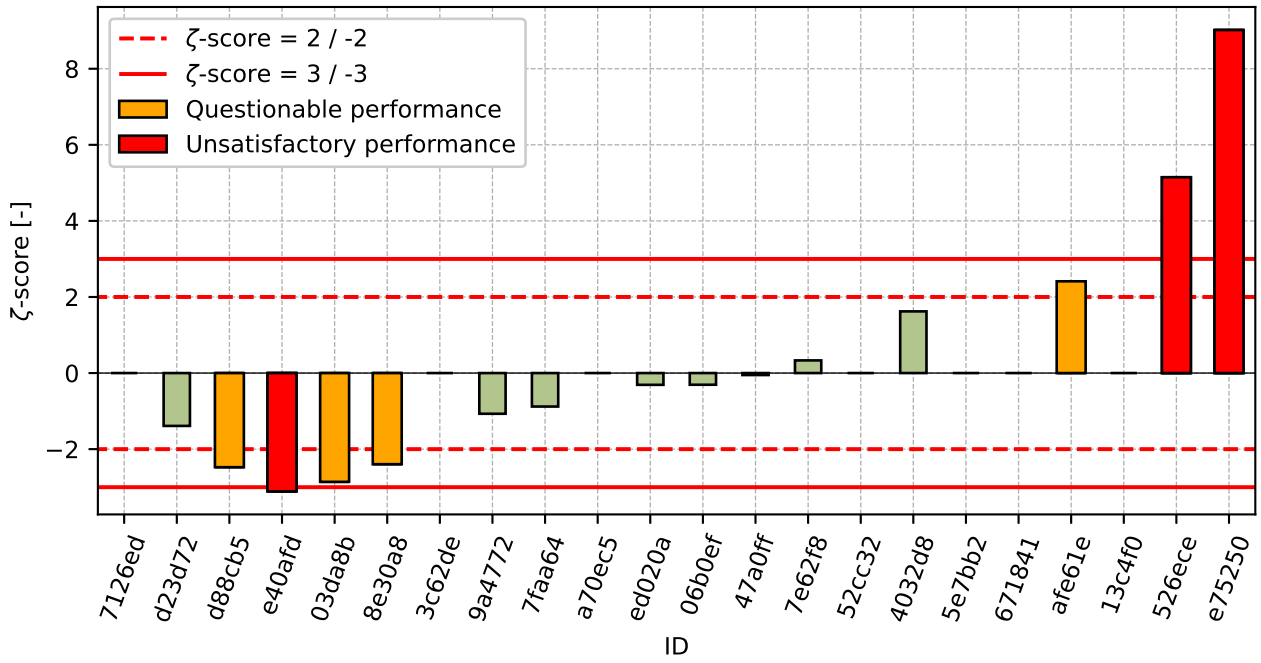

Figure 77: ζ-score

Table 40: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
7126ed	-1.65	-
d23d72	-1.58	-1.39
d88cb5	-0.86	-2.47
e40afd	-0.84	-3.11
03da8b	-0.79	-2.86
8e30a8	-0.64	-2.4
3c62de	-0.49	-
9a4772	-0.31	-1.07
7faa64	-0.23	-0.88
a70ec5	-0.19	-
ed020a	-0.09	-0.31
06b0ef	-0.08	-0.31
47a0ff	-0.01	-0.05
7e62f8	0.11	0.33
52cc32	0.14	-
4032d8	0.47	1.62
5e7bb2	0.56	-
671841	0.56	-
afe61e	0.7	2.41
13c4f0	1.18	-
526ece	1.93	5.15
e75250	2.41	9.02

7.4 400 kPa

7.4.1 Test results

Table 41: Test results - ordered by average value. Outliers are marked by red color. u_X - extended uncertainty of measurement.

ID	Test results [kPa]	u_X [kPa]
d23d72	179.0	52.1
13c4f0	222.0	-
06b0ef	223.0	0.2
7126ed	225.0	-
d88cb5	233.4	11.0
3c62de	239.2	-
03da8b	241.7	2.1
e40afd	247.9	2.0
a70ec5	248.5	-
9a4772	249.0	5.0
afe61e	251.0	5.0
7faa64	260.0	0.2
47a0ff	261.7	2.3
8e30a8	264.0	2.0
52cc32	268.8	-
ed020a	271.0	2.0
671841	271.6	-
7e62f8	275.6	8.3
4032d8	286.0	4.7
e75250	290.0	0.6
526ece	293.9	7.1
5e7bb2	295.4	-

7.4.2 The Numerical Procedure for Determining Outliers

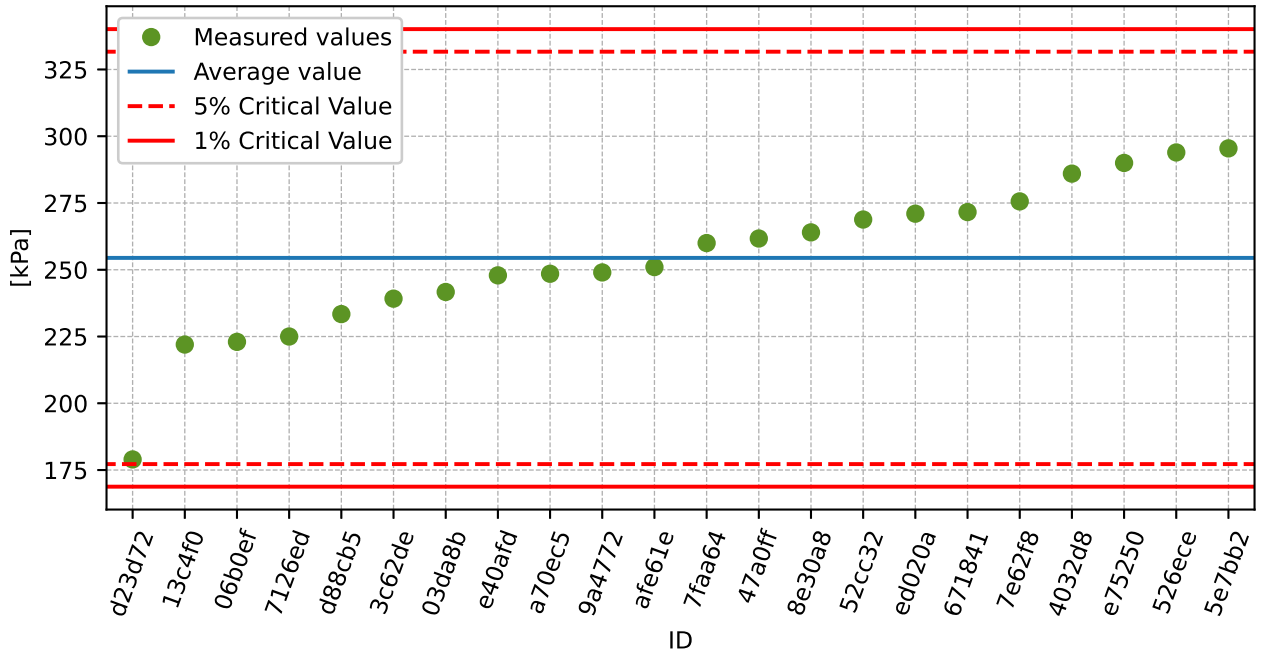

Figure 78: **Grubbs' test** - average values

7.4.3 Mandel's Statistics

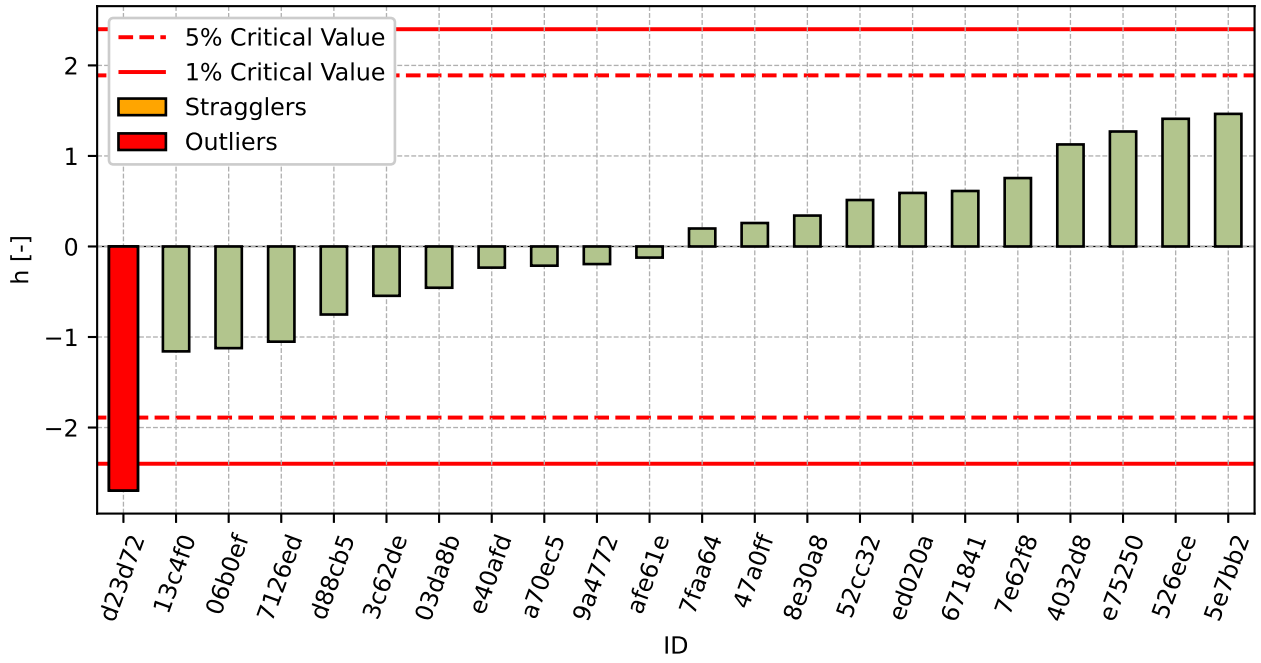

Figure 79: Interlaboratory Consistency Statistic

7.4.4 Descriptive statistics

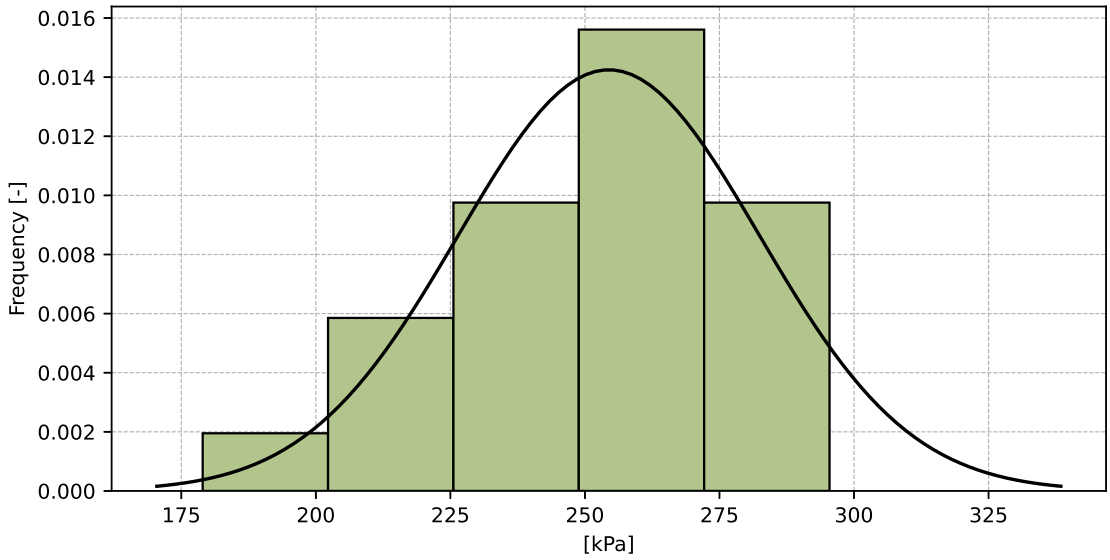

Figure 80: Histogram of all test results

Table 42: Descriptive statistics

Characteristics	**[kPa]**
Average value – $\bar{x}$	254.4
Sample standard deviation – s	28.0
Asigned value – x^*	256.2
Robust standard deviation – s^*	26.2
Measurement uncertainty of asigned value – u_X	6.98
p-value of normality test	0.358 [-]

7.4.5 Evaluation of Performance Statistics

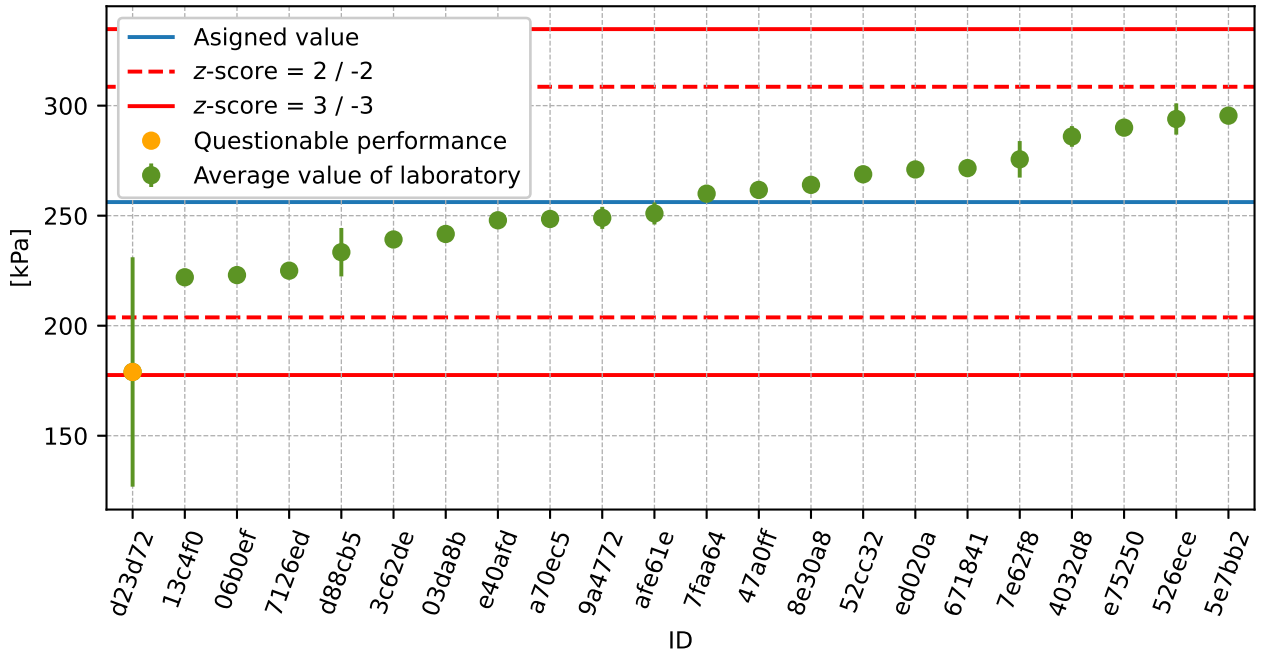

Figure 81: Average values and extended uncertainties of measurement

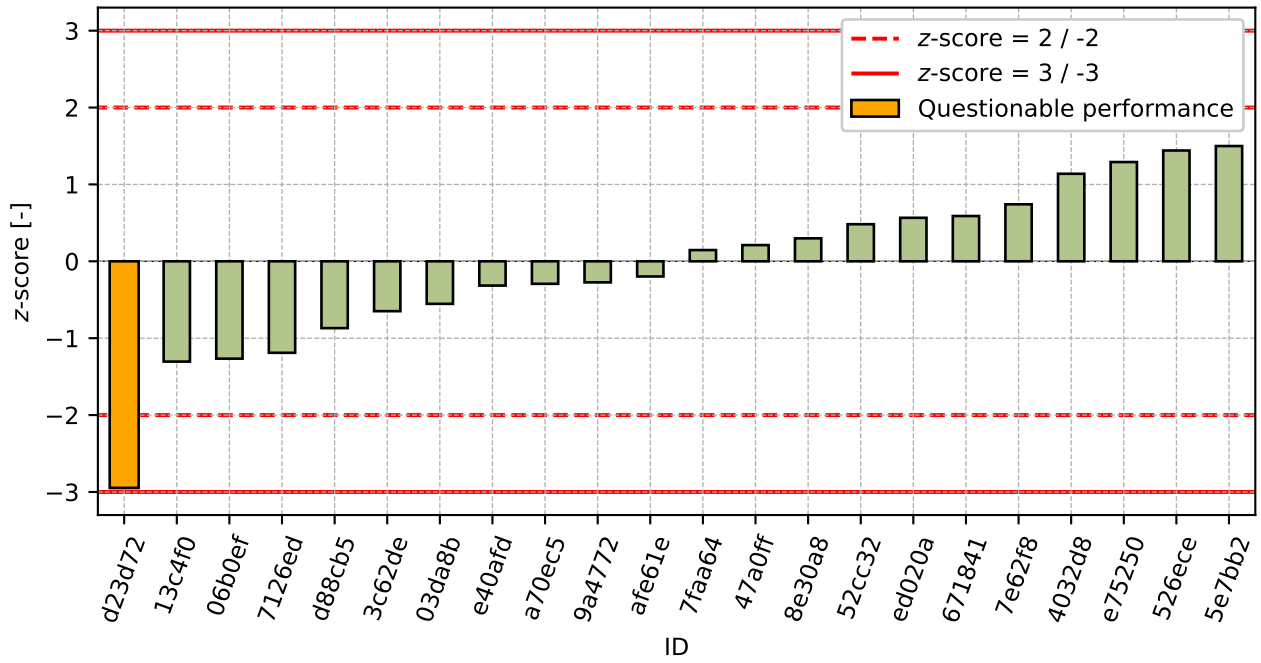

Figure 82: z-score

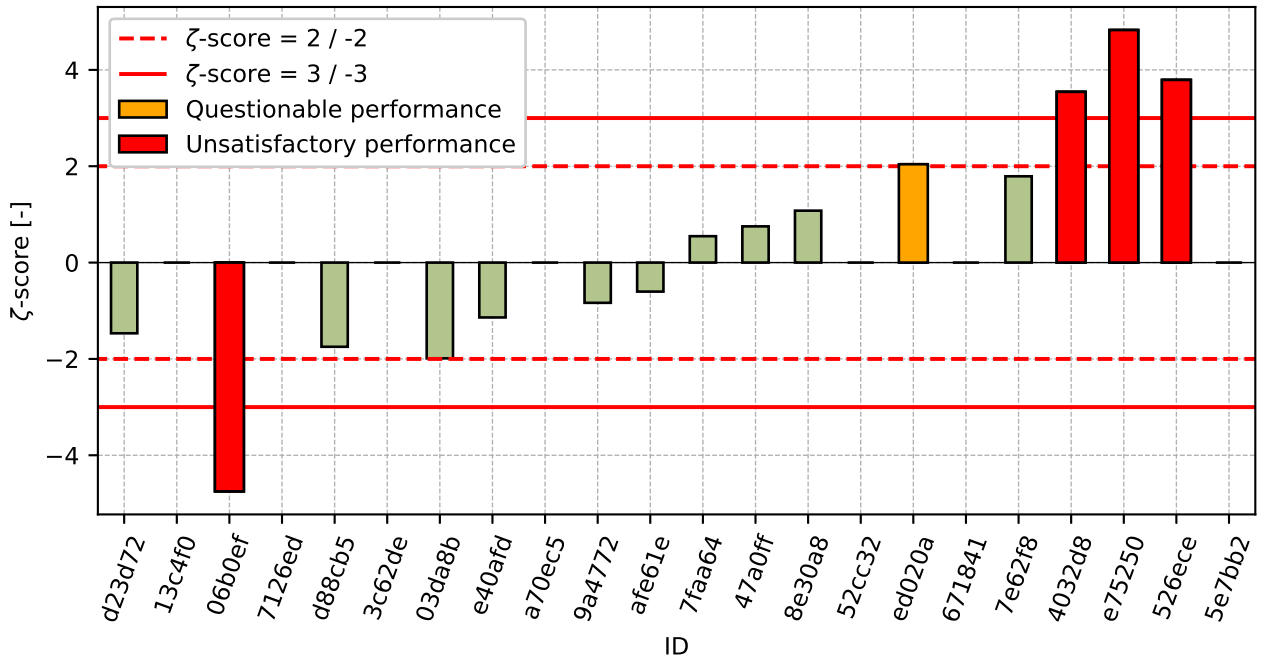

Figure 83: ζ-score

Table 43: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
d23d72	-2.95	-1.47
13c4f0	-1.3	-
06b0ef	-1.27	-4.75
7126ed	-1.19	-
d88cb5	-0.87	-1.75
3c62de	-0.65	-
03da8b	-0.55	-1.99
e40afd	-0.32	-1.14
a70ec5	-0.29	-
9a4772	-0.27	-0.84
afe61e	-0.2	-0.6
7faa64	0.15	0.55
47a0ff	0.21	0.75
8e30a8	0.3	1.08
52cc32	0.48	-
ed020a	0.57	2.04
671841	0.59	-
7e62f8	0.74	1.79
4032d8	1.14	3.54
e75250	1.29	4.83
526ece	1.44	3.79
5e7bb2	1.5	-

8 Appendix – EN ISO 17892-12 – Atterberg limits

8.1 Liquit limit

8.1.1 Test results

Table 44: 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 [%]
a70ec5	29.4	29.8	29.3	-	29.5	0.26	0.9
03da8b	29.7	31.0	30.3	0.3	30.4	0.64	2.11
8e30a8	30.9	30.2	31.1	2.6	30.7	0.47	1.54
269ec5	32.6	-	-	1.5	32.6	0.0	0.0
4e6829	32.8	32.8	32.6	1.0	32.7	0.12	0.35
7b482a	34.2	33.6	34.1	0.5	34.0	0.32	0.95
5e7bb2	34.0	-	-	-	34.0	0.0	0.0
526ece	34.0	35.0	34.0	3.1	34.3	0.58	1.68
77a1d8	34.5	34.6	34.3	-	34.5	0.15	0.44
6727eb	35.4	35.0	34.5	4.8	35.0	0.45	1.29
a40228	35.0	35.0	35.0	-	35.0	0.0	0.0
13c4f0	35.7	34.3	35.4	-	35.1	0.74	2.1
d3096f	35.7	35.2	34.7	-	35.2	0.5	1.42
676031	35.6	35.2	35.5	2.4	35.4	0.22	0.62
c5596c	36.0	35.0	-	2.9	35.5	0.71	1.99
f7d66c	35.8	35.6	35.8	1.8	35.7	0.12	0.32
e40afd	35.0	36.0	37.0	1.4	36.0	1.0	2.78
5f2d09	36.1	35.7	36.2	1.1	36.0	0.26	0.73
671841	36.2	36.3	36.0	-	36.2	0.15	0.42
02bd37	39.5	34.8	34.7	2.5	36.3	2.75	7.58
7e62f8	36.8	-	-	-	36.8	0.0	0.0
550e05	38.0	38.9	38.1	-	38.3	0.49	1.29
ed020a	38.9	41.2	39.3	1.6	39.8	1.23	3.09
06b0ef	39.0	42.0	44.0	0.4	41.7	2.52	6.04

8.1.2 The Numerical Procedure for Determining Outliers

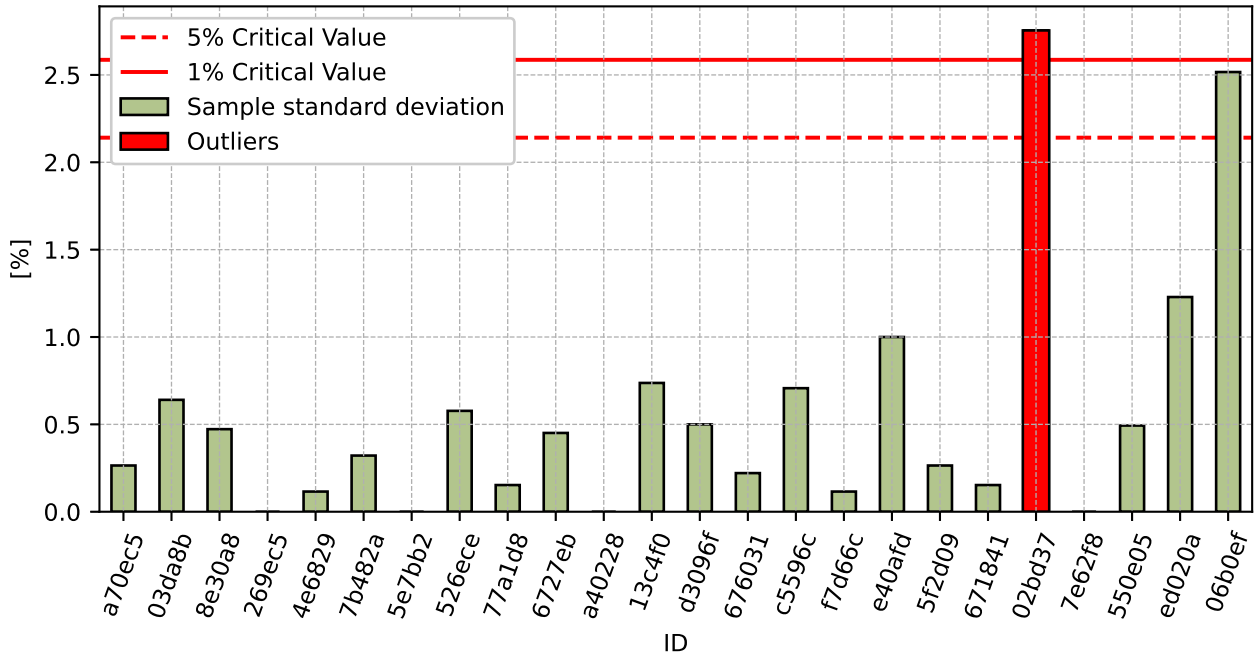

Figure 84: **Cochran's test** - sample standard deviations

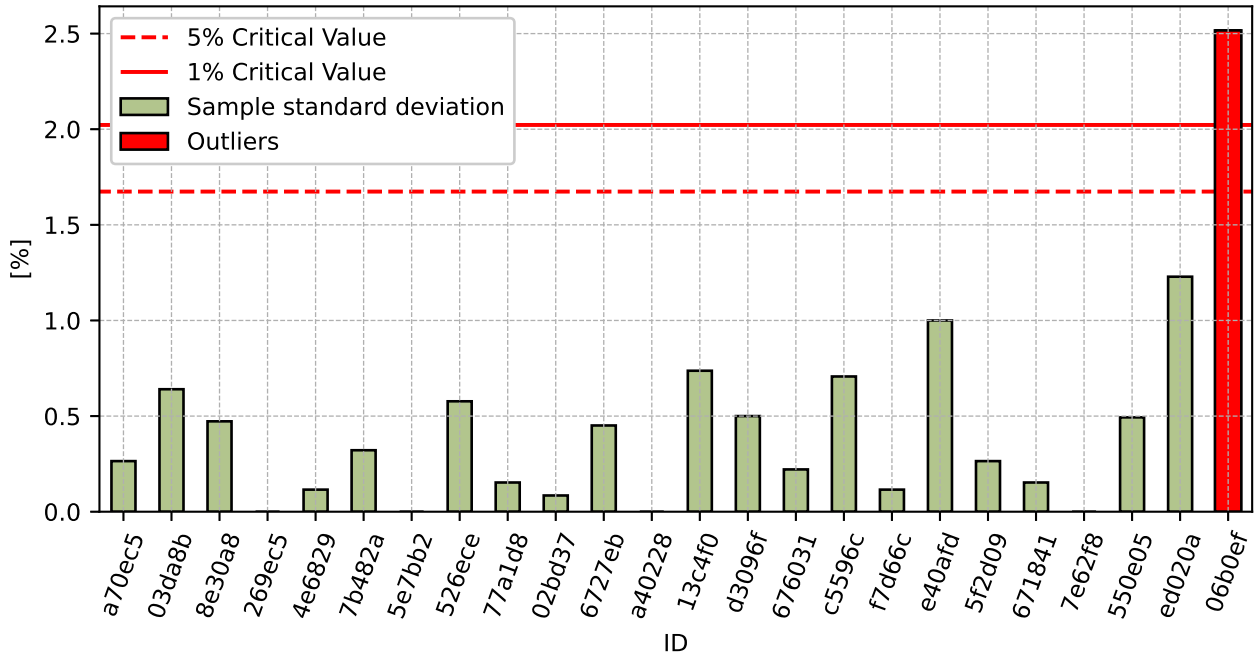

Figure 85: **Cochran's test** - sample standard deviations without outliers

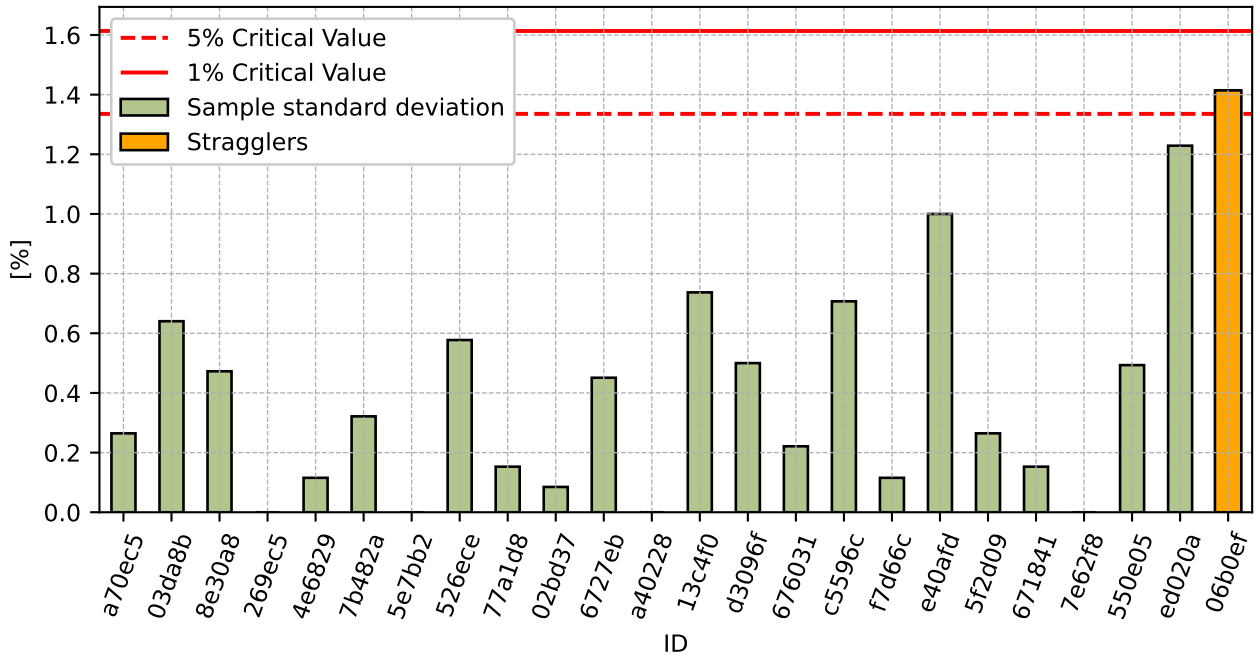

Figure 86: **Cochran's test** - sample standard deviations without outliers

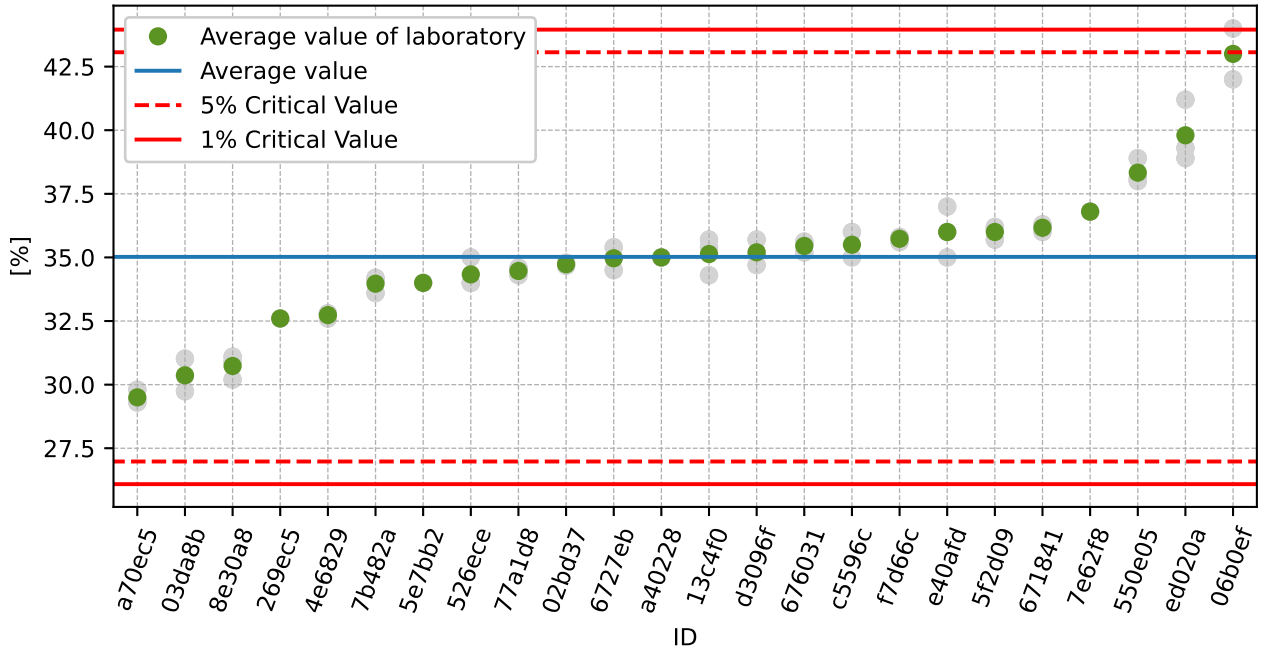

Figure 87: **Grubbs' test** - average values

8.1.3 Mandel's Statistics

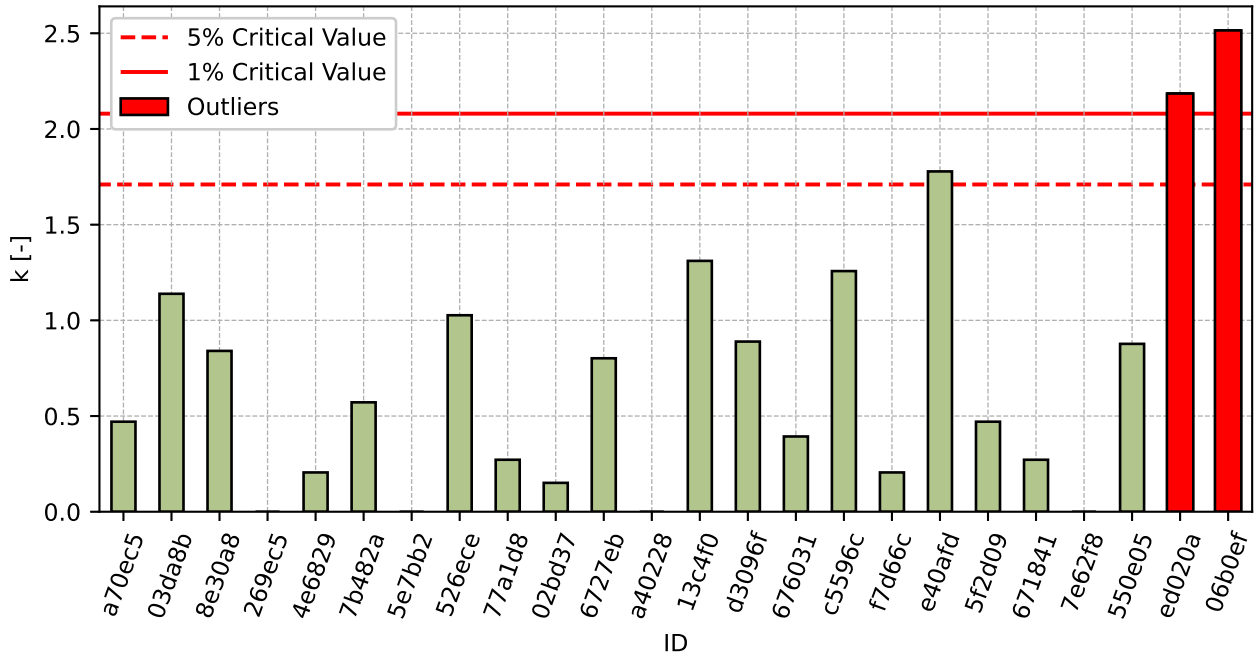

Figure 88: Intralaboratory Consistency Statistic

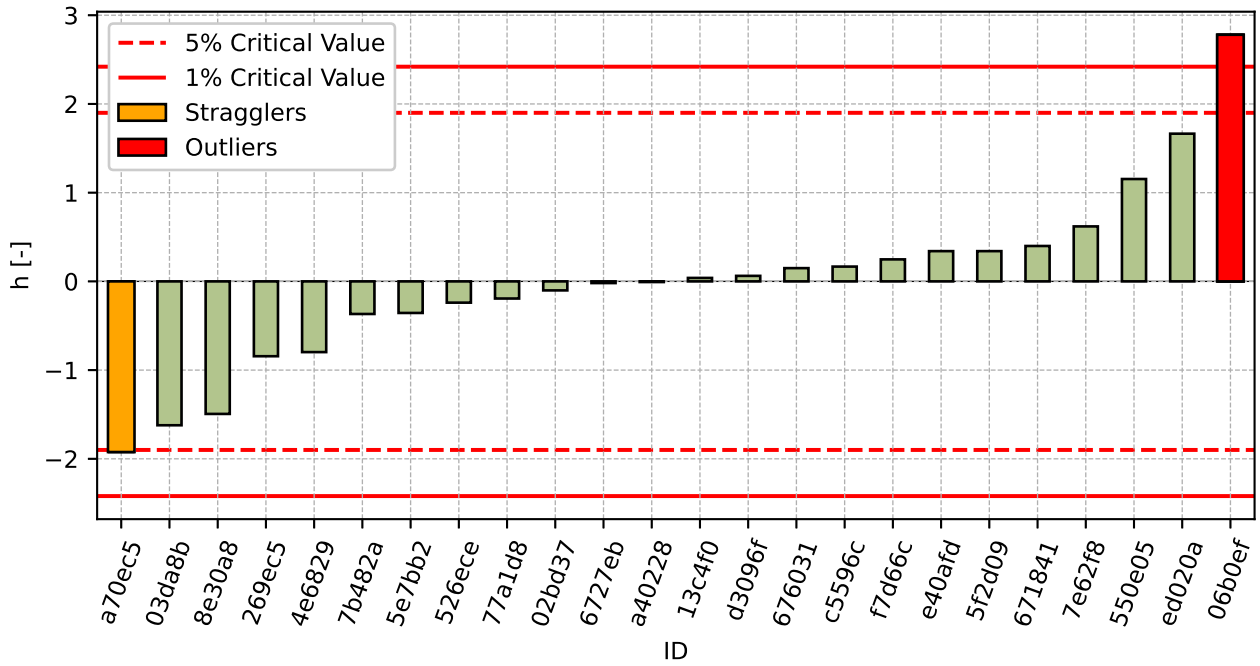

Figure 89: Interlaboratory Consistency Statistic

8.1.4 Descriptive statistics

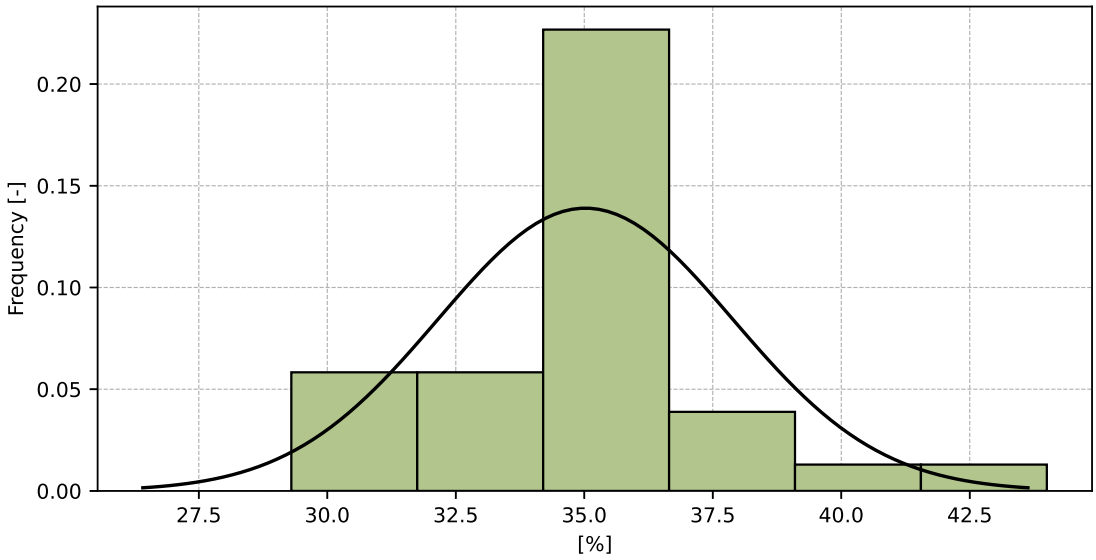

Figure 90: Histogram of all test results

Table 45: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	35.0
Sample standard deviation – s	2.87
Asigned value – x^*	35.0
Robust standard deviation – s^*	2.87
Measurement uncertainty of asigned value – u_X	0.59
p-value of normality test	1.0 [-]
Interlaboratory standard deviation – s_L	2.85
Repeatability standard deviation – s_r	0.56
Reproducibility standard deviation – s_R	2.91
Repeatability – r	1.6
Reproducibility – R	8.1

8.1.5 Evaluation of Performance Statistics

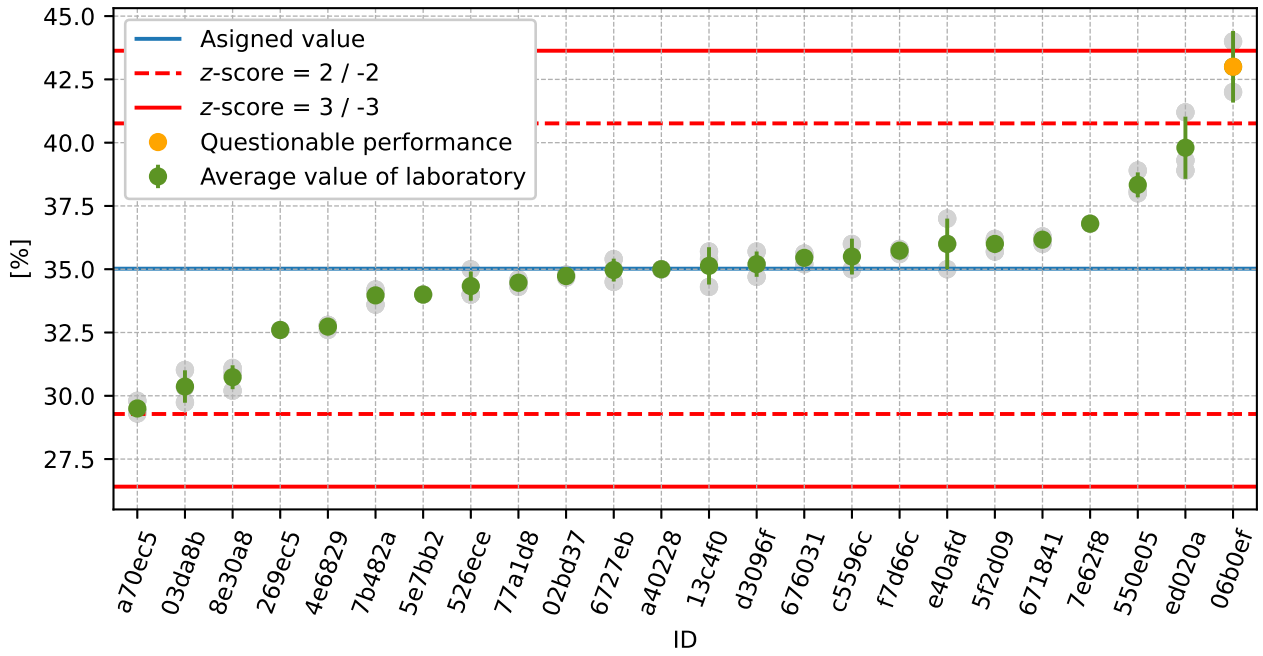

Figure 91: Average values and sample standard deviations

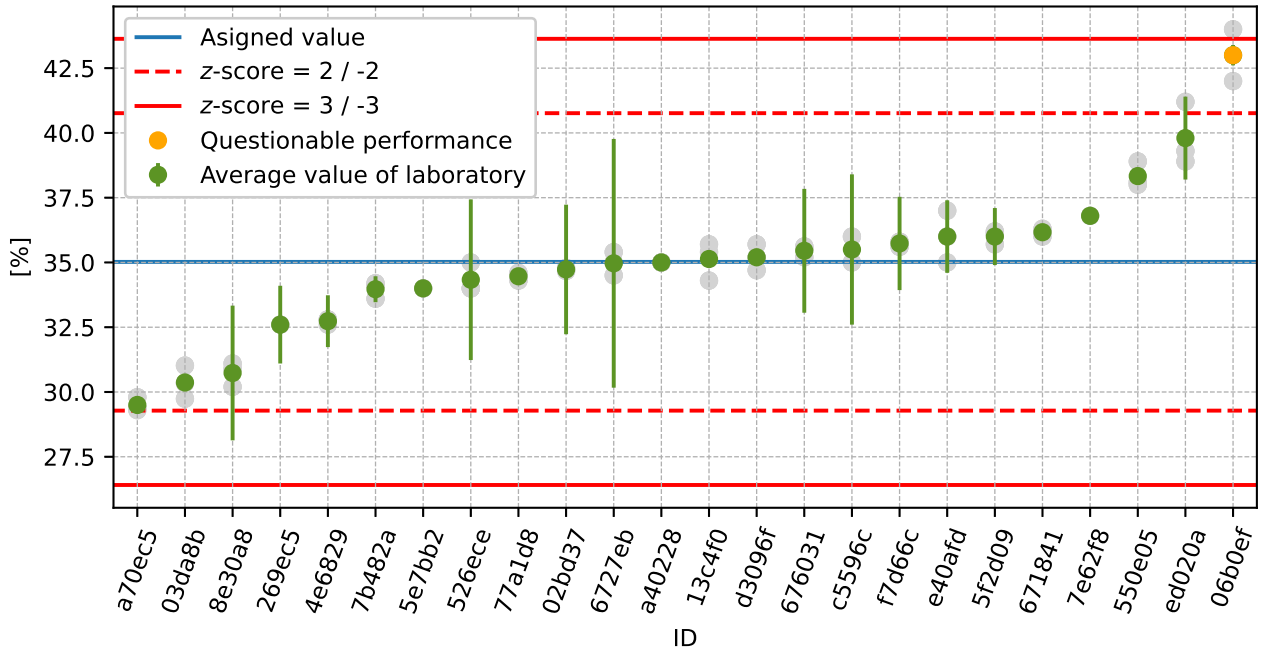

Figure 92: Average values and extended uncertainties of measurement

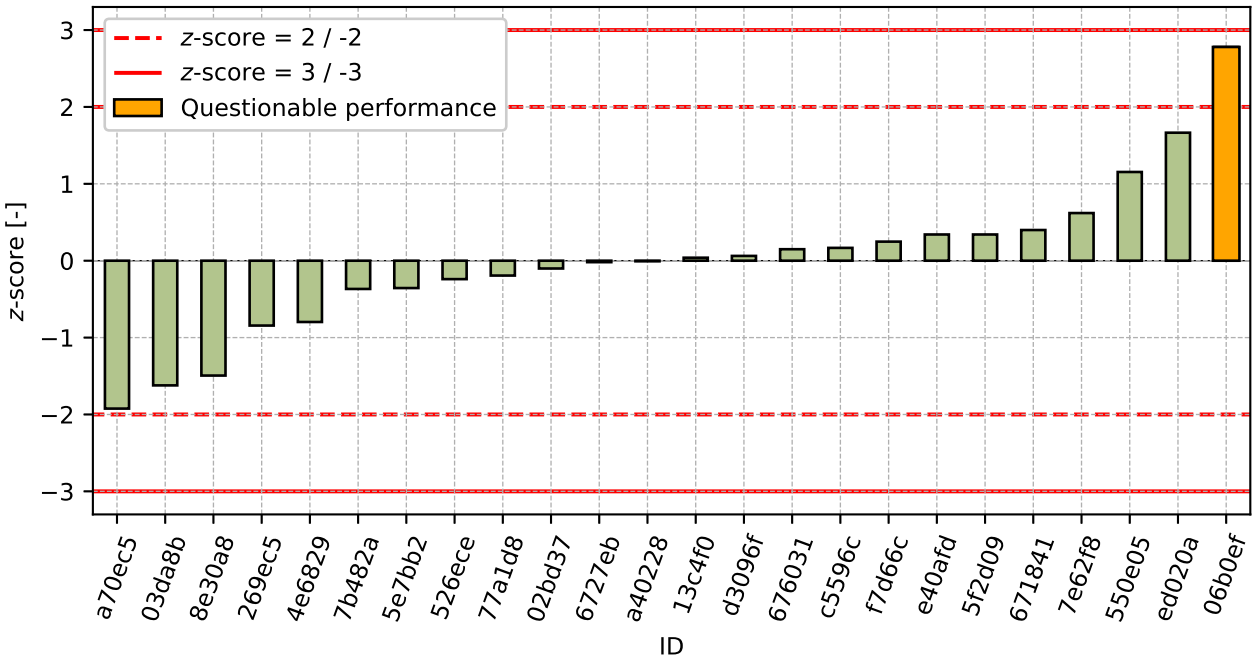

Figure 93: z-score

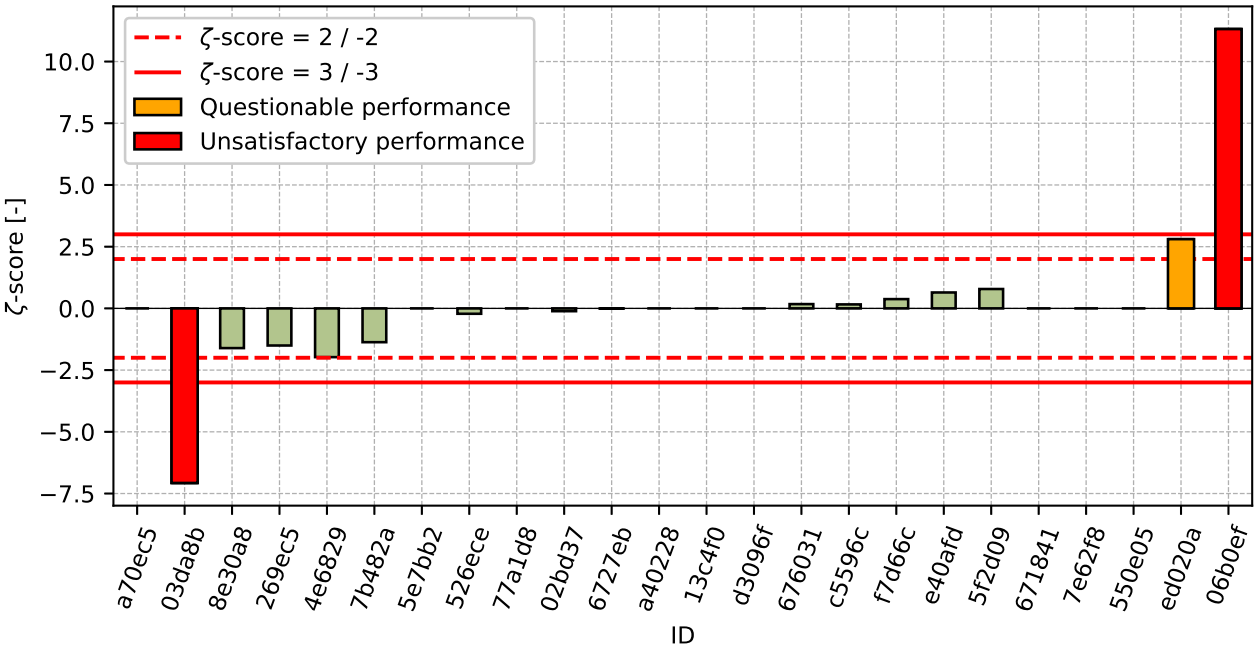

Figure 94: ζ-score

Table 46: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
a70ec5	-1.92	-
03da8b	-1.62	-7.07
8e30a8	-1.49	-1.61
269ec5	-0.84	-1.5
4e6829	-0.8	-1.97
7b482a	-0.37	-1.37
5e7bb2	-0.36	-
526ece	-0.24	-0.22
77a1d8	-0.19	-
02bd37	-0.1	-0.11
6727eb	-0.02	-0.01
a40228	-0.01	-
13c4f0	0.04	-
d3096f	0.06	-
676031	0.15	0.17
c5596c	0.17	0.16
f7d66c	0.25	0.38
e40afd	0.34	0.64
5f2d09	0.34	0.79
671841	0.4	-
7e62f8	0.62	-
550e05	1.15	-
ed020a	1.66	2.8
06b0ef	2.78	11.31

8.2 Plastic limit

8.2.1 Test results

Table 47: 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 [%]
13c4f0	14.2	13.9	14.0	-	14.0	0.15	1.09
4e6829	17.2	17.2	17.1	0.5	17.2	0.06	0.34
526ece	19.0	18.0	19.0	3.6	18.7	0.58	3.09
a70ec5	18.8	18.9	19.2	-	19.0	0.21	1.1
a40228	19.0	19.0	19.0	-	19.0	0.0	0.0
5e7bb2	19.0	-	-	-	19.0	0.0	0.0
7e62f8	19.2	-	-	-	19.2	0.0	0.0
ed020a	19.2	19.2	19.3	1.5	19.2	0.06	0.3
676031	19.5	19.4	19.5	4.9	19.5	0.06	0.3
5f2d09	19.2	20.4	19.8	1.6	19.8	0.6	3.03
03da8b	19.6	20.2	20.4	0.4	20.0	0.38	1.87
550e05	20.1	20.4	19.8	-	20.1	0.3	1.49
6727eb	20.2	20.5	20.0	0.6	20.2	0.25	1.24
02bd37	20.7	20.5	20.6	1.3	20.6	0.11	0.51
e40afd	21.0	21.0	20.0	1.4	20.7	0.58	2.79
f7d66c	20.7	20.6	20.8	2.0	20.7	0.1	0.48
269ec5	20.8	-	-	1.5	20.8	0.0	0.0
8e30a8	21.1	20.6	20.8	4.0	20.8	0.25	1.21
77a1d8	20.6	21.0	21.4	-	21.0	0.4	1.9
d3096f	21.8	21.2	21.1	-	21.4	0.38	1.77
671841	22.2	22.1	22.2	-	22.2	0.06	0.26
c5596c	24.0	24.0	-	1.9	24.0	0.0	0.0
06b0ef	22.0	26.0	26.0	0.8	24.7	2.31	9.36
7b482a	27.7	25.8	26.9	0.5	26.8	0.95	3.56

8.2.2 The Numerical Procedure for Determining Outliers

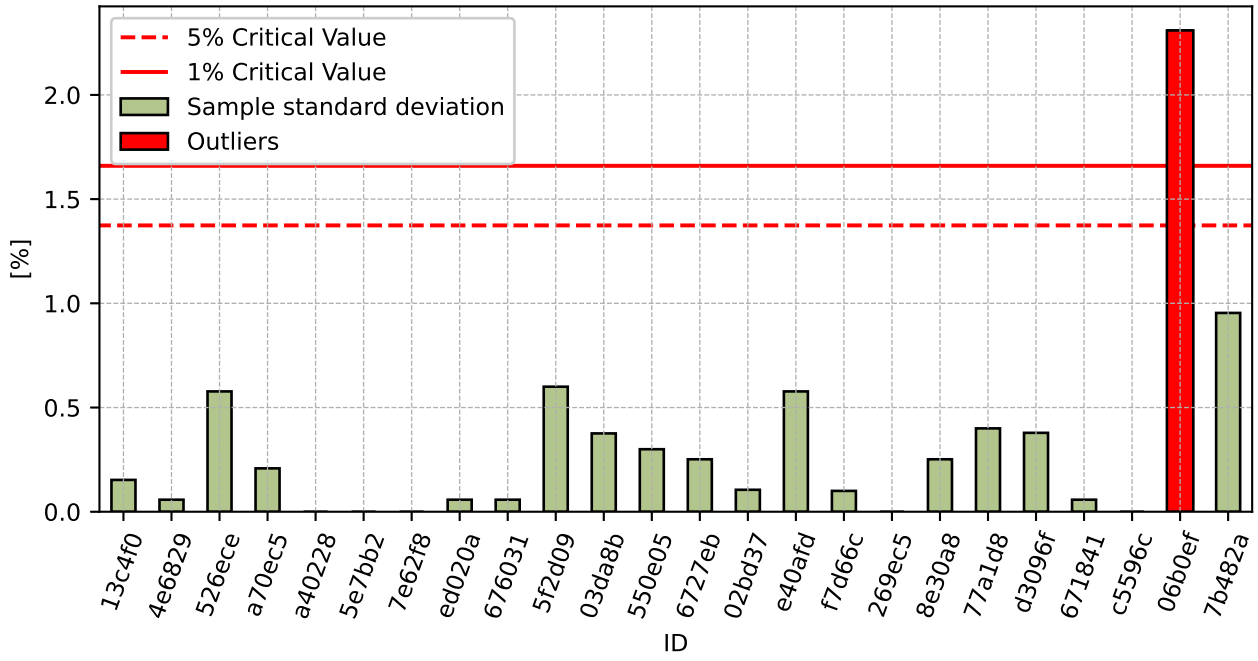

Figure 95: **Cochran's test** - sample standard deviations

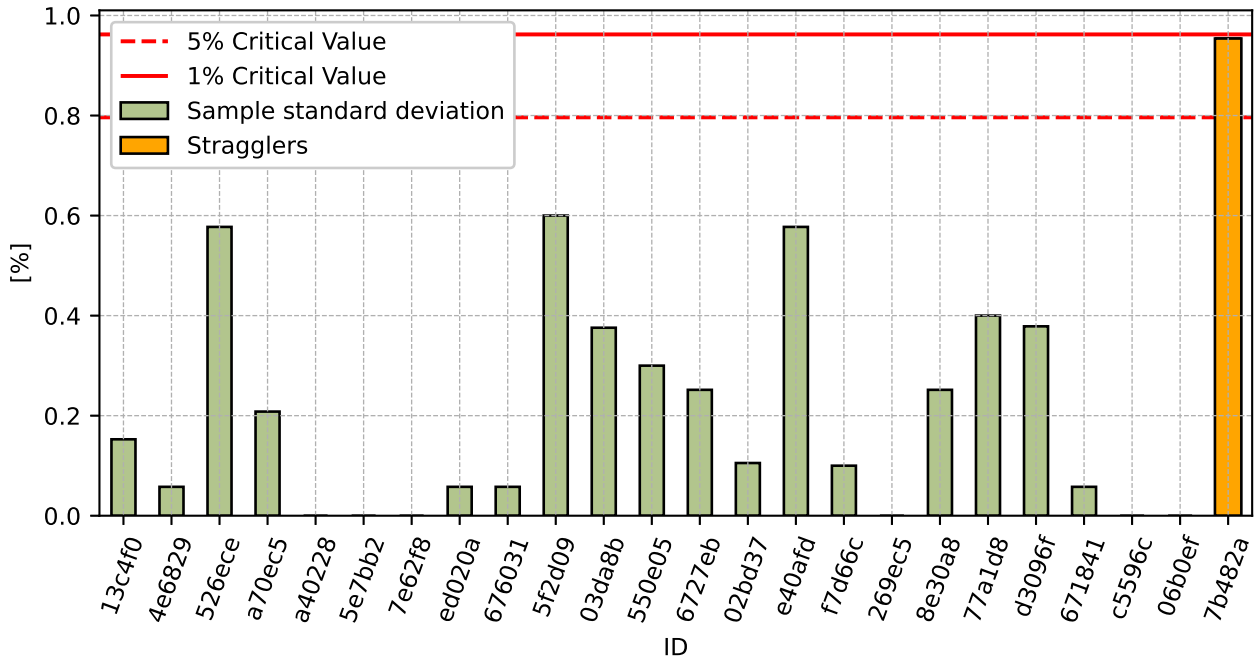

Figure 96: **Cochran's test** - sample standard deviations without outliers

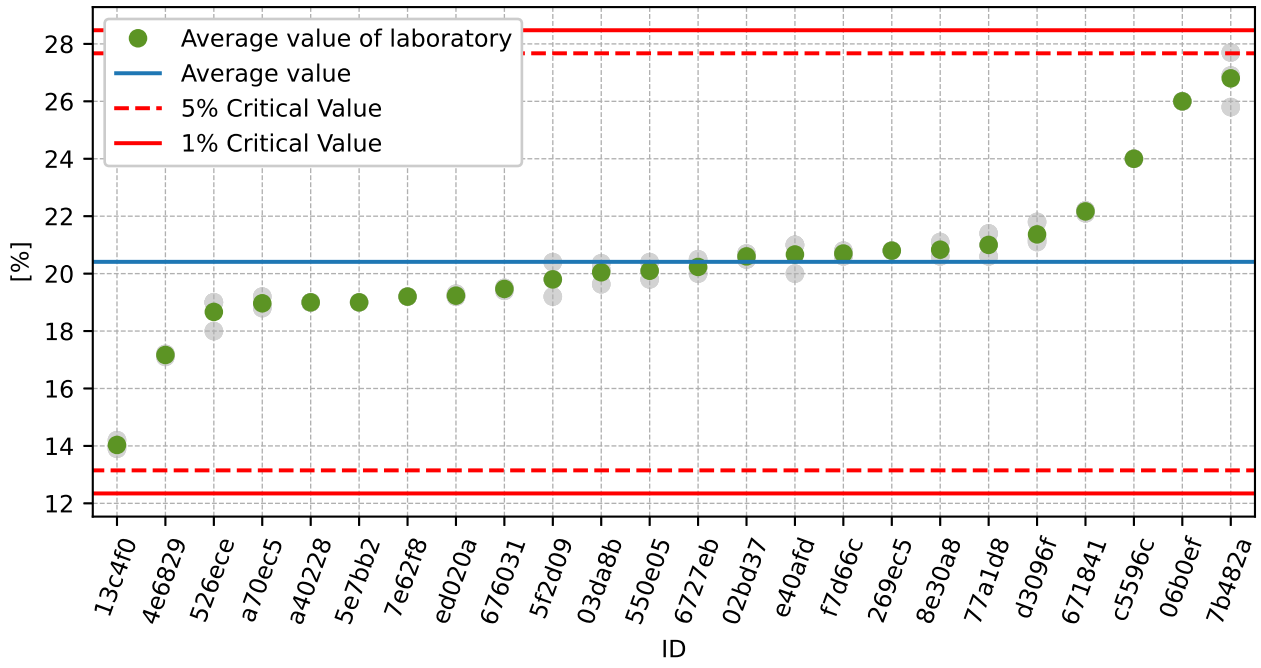

Figure 97: **Grubbs' test** - average values

8.2.3 Mandel's Statistics

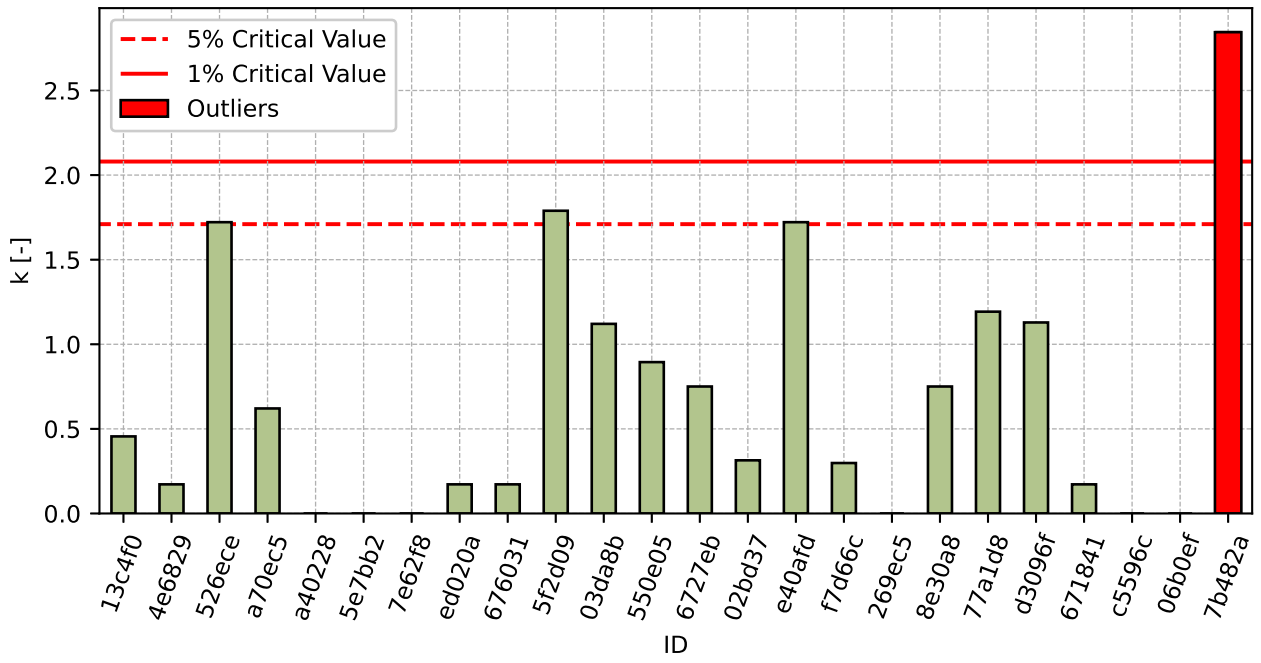

Figure 98: Intralaboratory Consistency Statistic

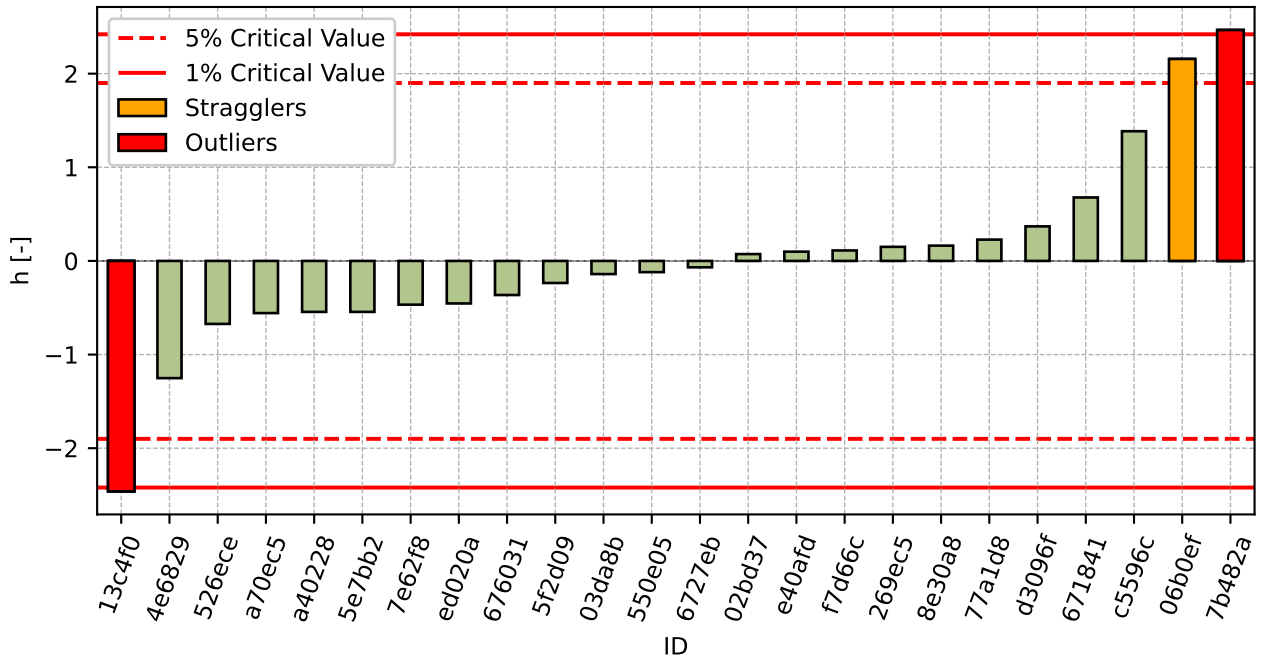

Figure 99: Interlaboratory Consistency Statistic

8.2.4 Descriptive statistics

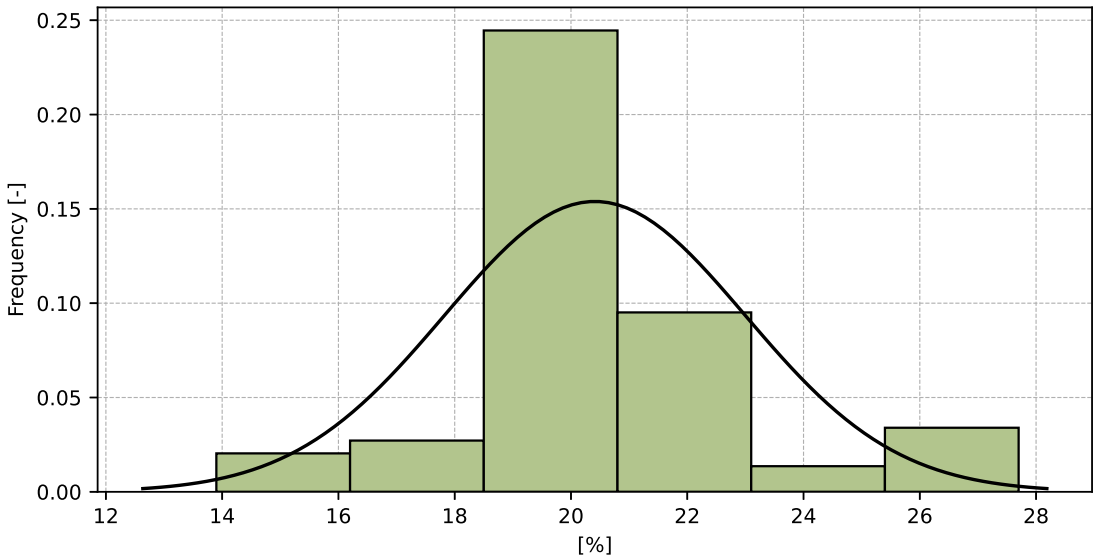

Figure 100: Histogram of all test results

Table 48: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	20.4
Sample standard deviation – s	2.59
Asigned value – x^*	20.4
Robust standard deviation – s^*	2.03
Measurement uncertainty of asigned value – u_X	0.52
p-value of normality test	1.0 [-]
Interlaboratory standard deviation – s_L	2.58
Repeatability standard deviation – s_r	0.34
Reproducibility standard deviation – s_R	2.61
Repeatability – r	0.9
Reproducibility – R	7.3

8.2.5 Evaluation of Performance Statistics

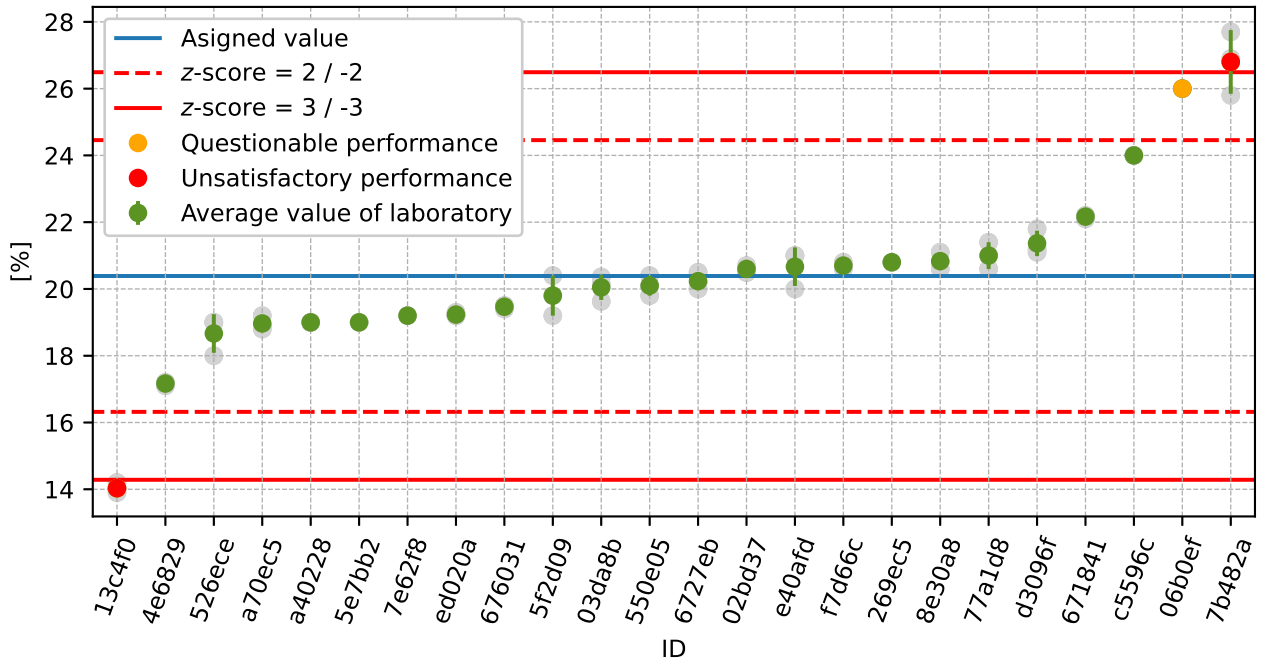

Figure 101: Average values and sample standard deviations

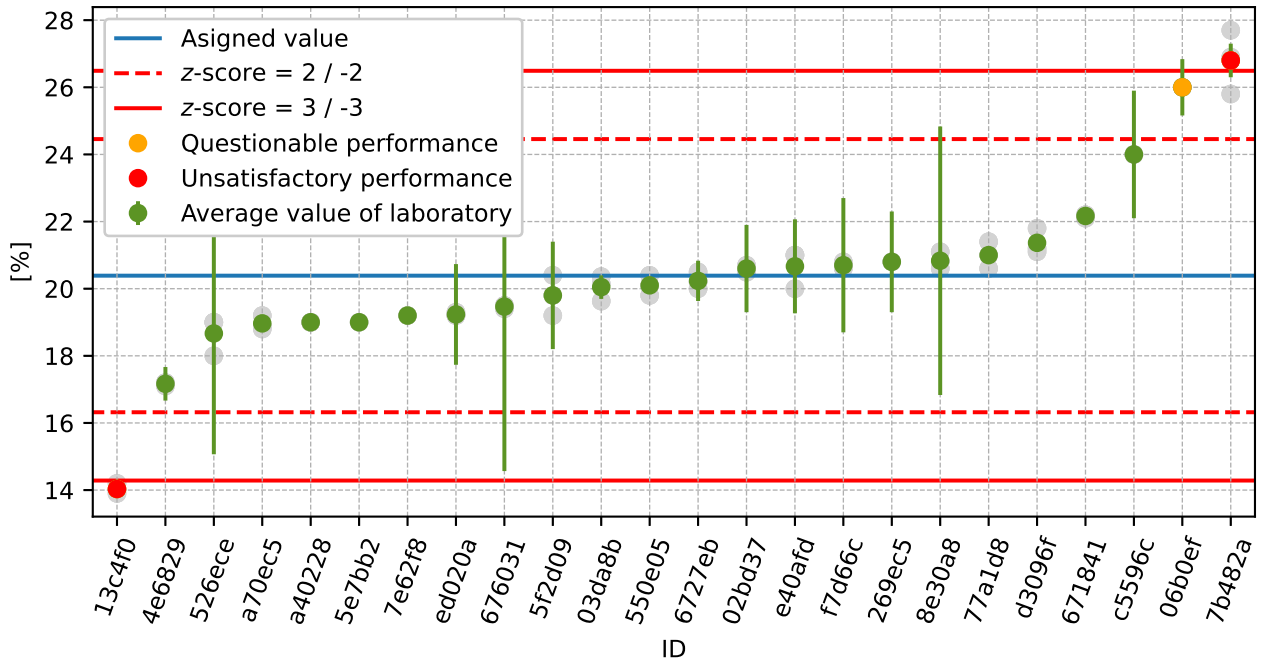

Figure 102: Average values and extended uncertainties of measurement

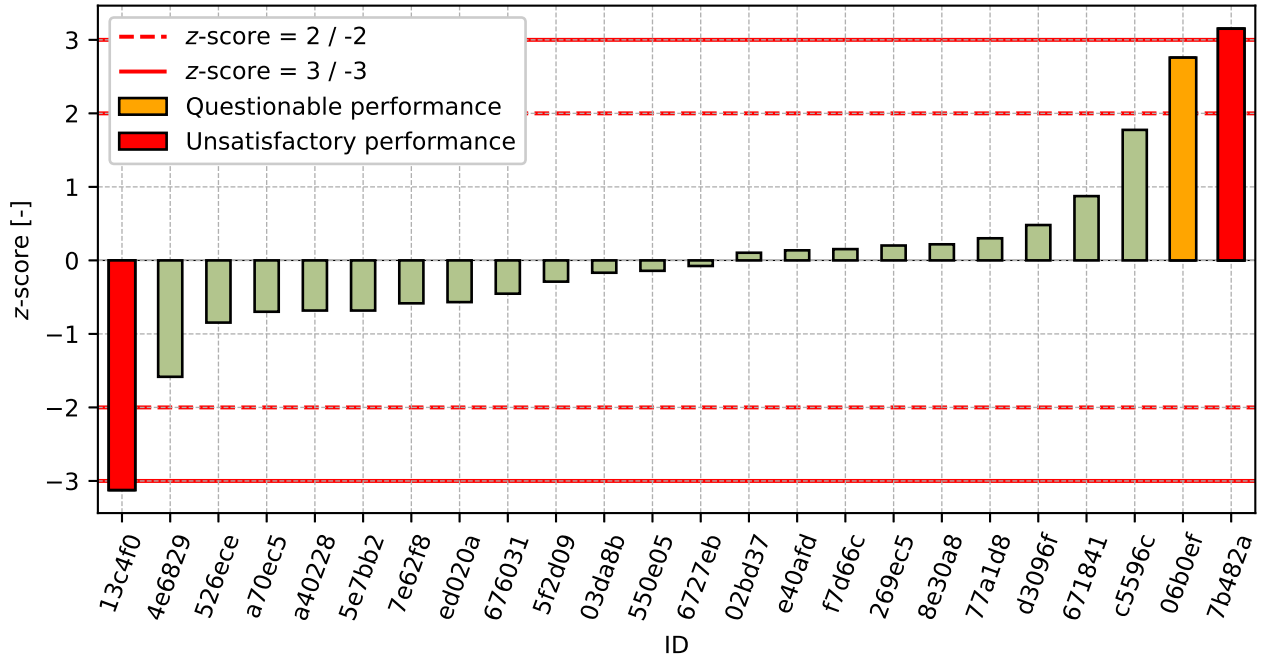

Figure 103: z-score

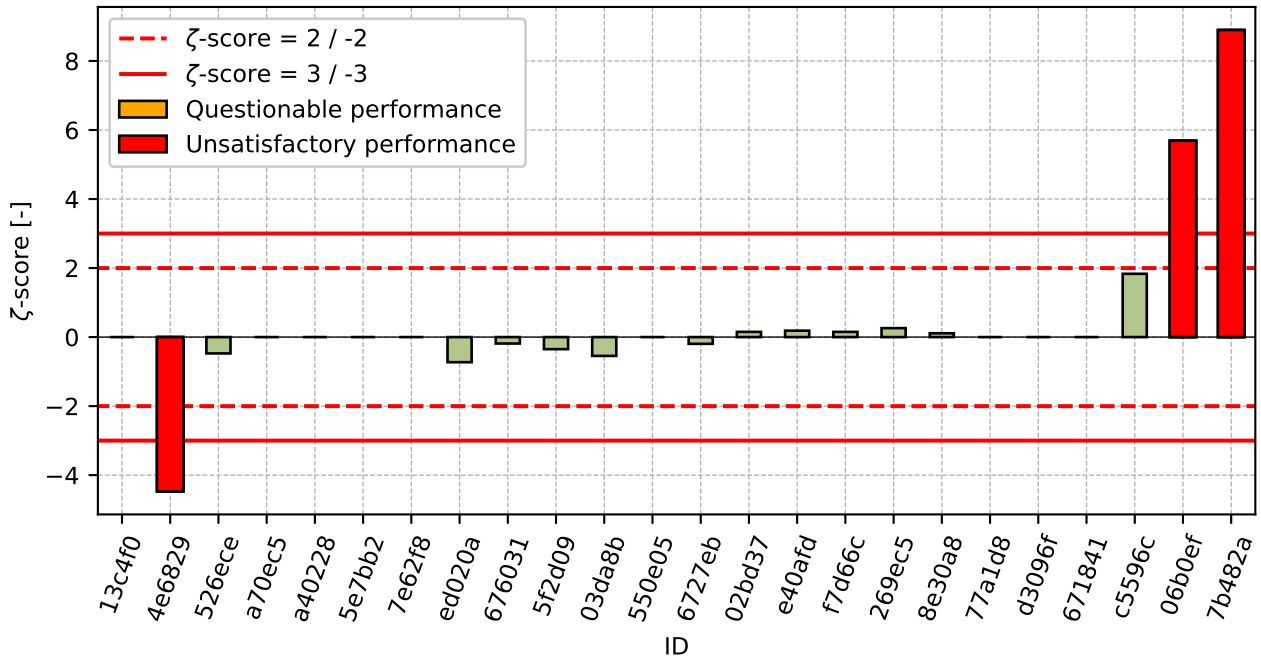

Figure 104: ζ-score

Table 49: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
13c4f0	-3.12	-
4e6829	-1.58	-4.47
526ece	-0.85	-0.47
a70ec5	-0.7	-
a40228	-0.68	-
5e7bb2	-0.68	-
7e62f8	-0.58	-
ed020a	-0.57	-0.73
676031	-0.45	-0.19
5f2d09	-0.29	-0.35
03da8b	-0.17	-0.55
550e05	-0.14	-
6727eb	-0.08	-0.2
02bd37	0.1	0.15
e40afd	0.14	0.19
f7d66c	0.15	0.15
269ec5	0.2	0.26
8e30a8	0.22	0.11
77a1d8	0.3	-
d3096f	0.48	-
671841	0.87	-
c5596c	1.78	1.83

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ID	z-score [-]	ζ-score [-]
06b0ef	2.76	5.69
7b482a	3.15	8.9

9 Appendix – EN 13286-2 – Proctor

9.1 Proctor density

9.1.1 Test results

Table 50: Test results - ordered by average value. Outliers are marked by red color. u_X - extended uncertainty of measurement.

ID	Test results [kg/m^3]	u_X [kg/m^3]
eb0501	1570	-
4e6829	1750	35
afe61e	1750	9
ed020a	1758	25
a68573	1760	43
8e30a8	1760	0
d36137	1770	53
7a9a8e	1770	-
d4bcaf	1780	20
13c4f0	1780	-
671841	1783	-
ba7e11	1785	-
e40afd	1790	14
5f2d09	1798	54
b8b262	1800	30
1e5f15	1800	-
f26f63	1808	33
d60213	1810	-
644b53	1810	101
7e62f8	1820	50
03da8b	1833	7
a40228	1836	-
432f9d	1836	-
0828e7	1862	40

9.1.2 The Numerical Procedure for Determining Outliers

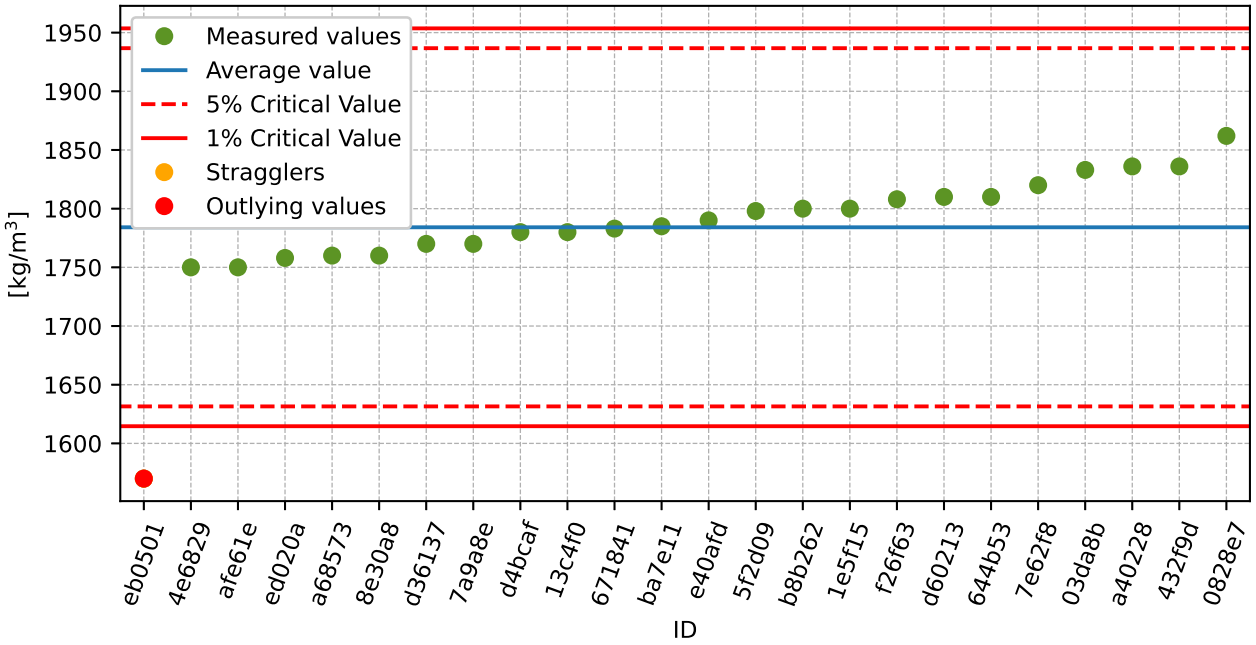

Figure 105: **Grubbs' test** - average values

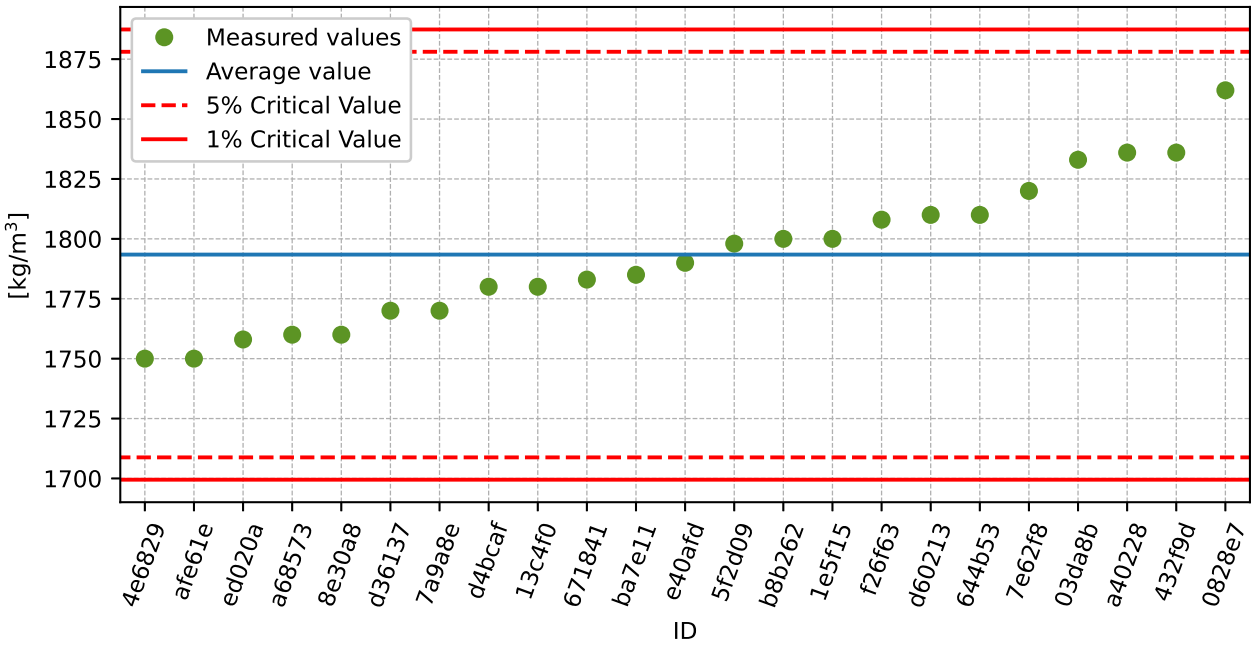

Figure 106: **Grubbs' test** - average values without outliers

9.1.3 Mandel's Statistics

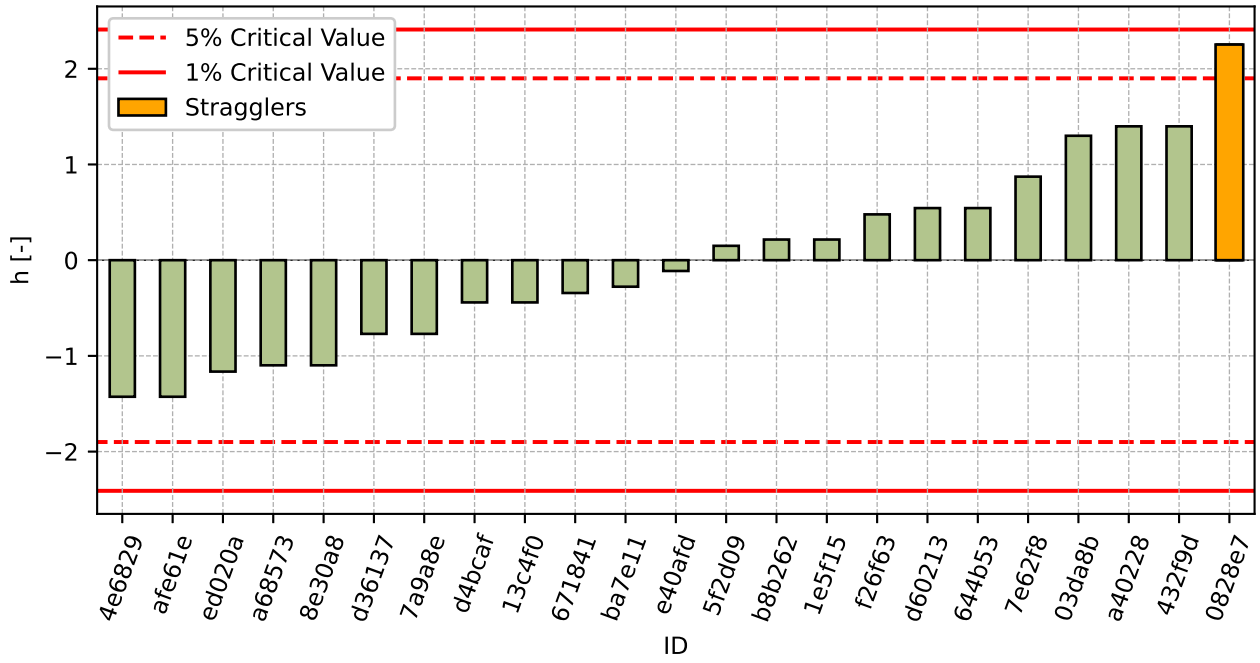

Figure 107: Interlaboratory Consistency Statistic

9.1.4 Descriptive statistics

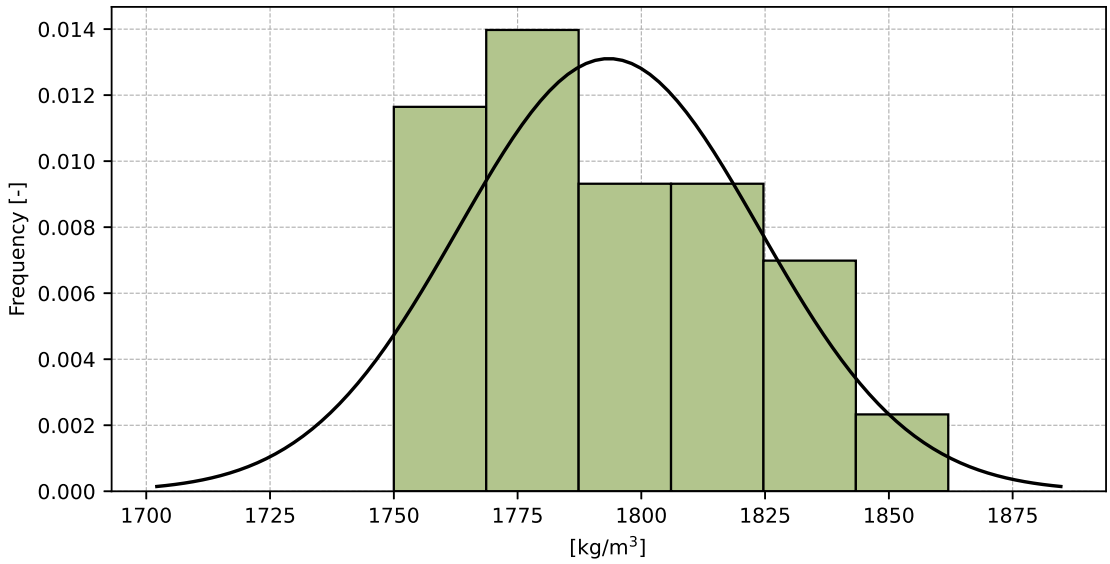

Figure 108: Histogram of all test results

Table 51: Descriptive statistics

Characteristics	[kg/m³]
Average value – $\bar{x}$	1793
Sample standard deviation – s	30.4
Asigned value – x^*	1793
Robust standard deviation – s^*	34.5
Measurement uncertainty of asigned value – u_X	8.7
p-value of normality test	0.468 [-]

9.1.5 Evaluation of Performance Statistics

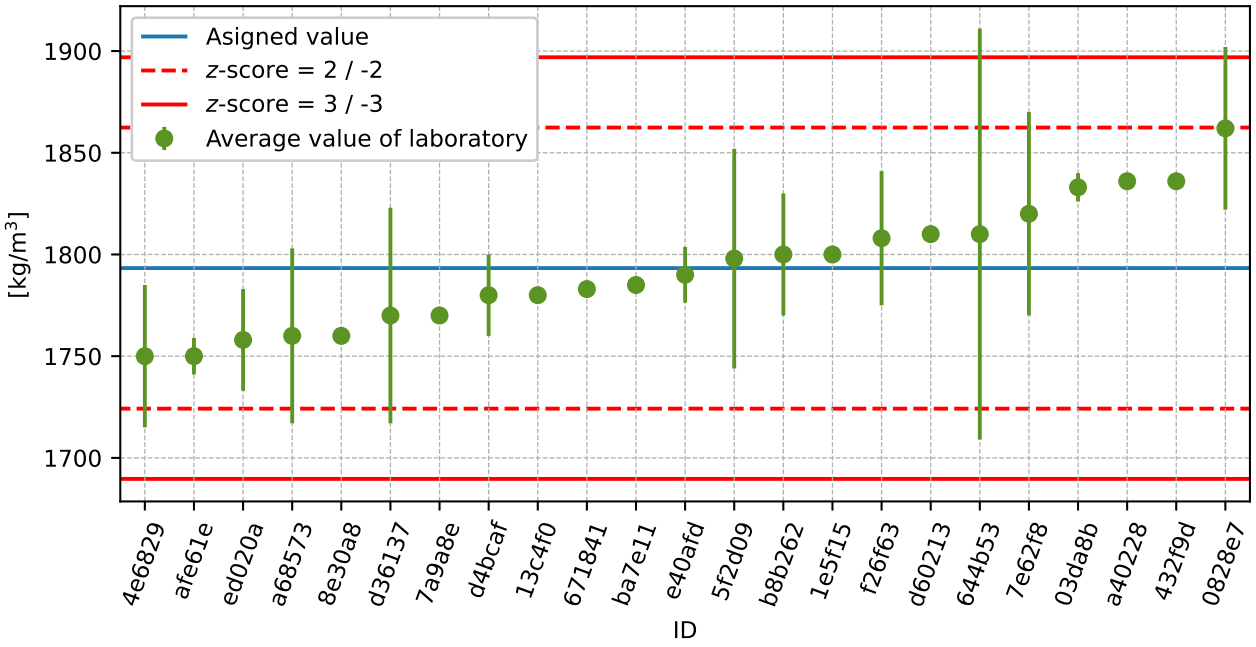

Figure 109: Average values and extended uncertainties of measurement

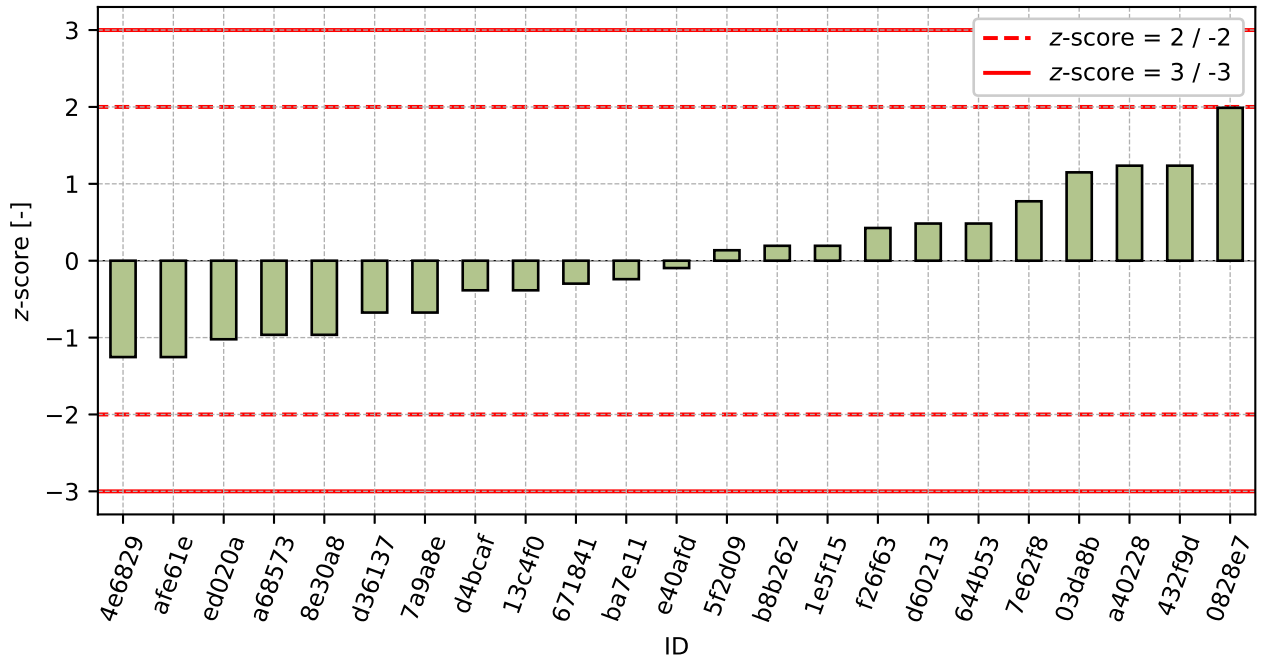

Figure 110: z-score

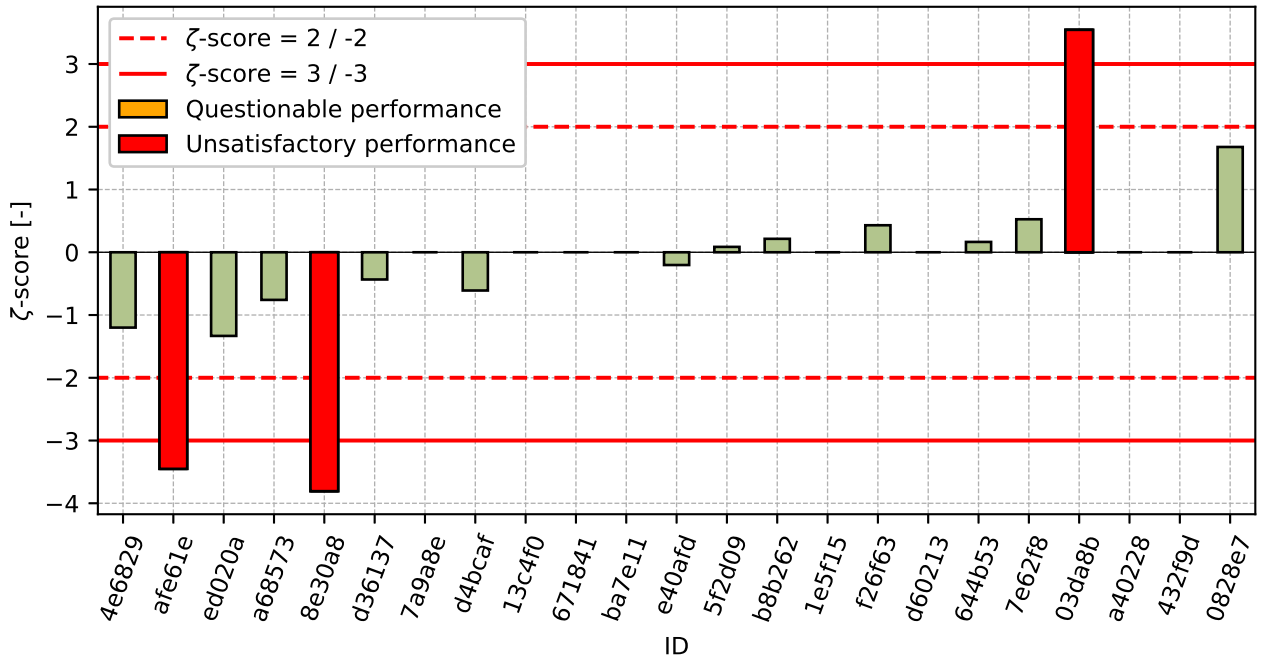

Figure 111: ζ-score

Table 52: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
4e6829	-1.25	-1.2
afe61e	-1.25	-3.45
ed020a	-1.02	-1.33
a68573	-0.96	-0.76
8e30a8	-0.96	-3.81
d36137	-0.67	-0.43
7a9a8e	-0.67	-
d4bcaf	-0.39	-0.61
13c4f0	-0.39	-
671841	-0.3	-
ba7e11	-0.24	-
e40afd	-0.1	-0.2
5f2d09	0.14	0.09
b8b262	0.19	0.21
1e5f15	0.19	-
f26f63	0.43	0.43
d60213	0.48	-
644b53	0.48	0.16
7e62f8	0.77	0.53
03da8b	1.15	3.54
a40228	1.24	-
432f9d	1.24	-
0828e7	1.99	1.68

9.2 Optimum water content

9.2.1 Test results

Table 53: Test results - ordered by average value. Outliers are marked by red color. u_X - extended uncertainty of measurement.

ID	Test results [%]	u_X [%]
0828e7	11.4	0.3
432f9d	14.0	-
a40228	14.7	-
644b53	15.0	0.5
d60213	15.0	-
ba7e11	15.2	-
03da8b	15.4	0.3
d4bcaf	15.6	0.2
7a9a8e	15.7	-
7e62f8	15.8	1.8
4e6829	16.0	0.8
8e30a8	16.0	1.0
e40afd	16.0	0.1
a68573	16.0	0.1
671841	16.1	-
ed020a	16.1	1.0
b8b262	16.1	0.7
f26f63	16.2	0.5
d36137	16.3	0.5
1e5f15	16.5	-
13c4f0	16.5	-
5f2d09	16.7	2.2
eb0501	17.0	-
afe61e	17.5	0.6

9.2.2 The Numerical Procedure for Determining Outliers

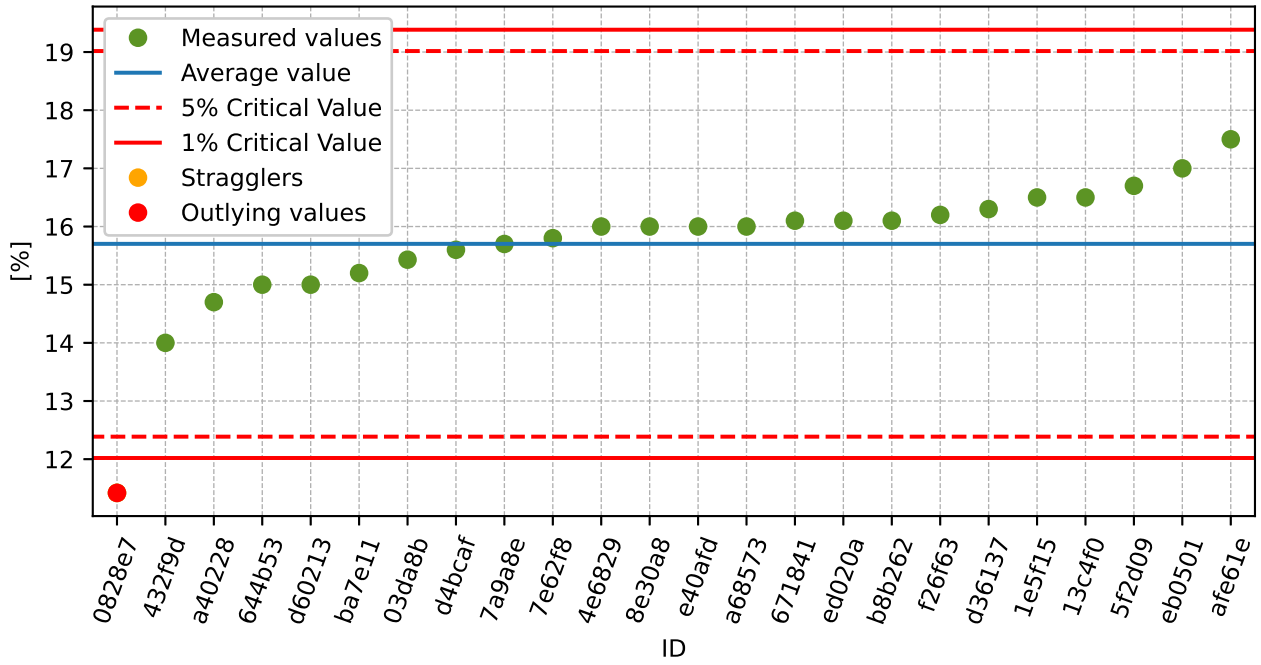

Figure 112: **Grubbs' test** - average values

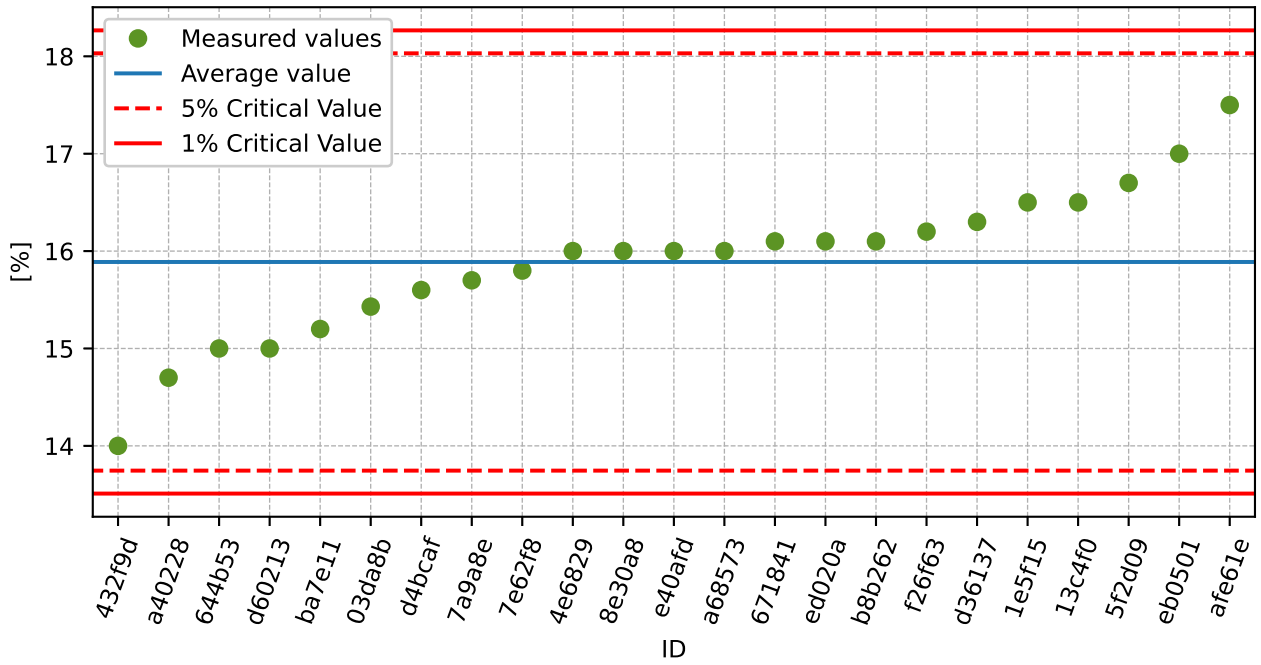

Figure 113: **Grubbs' test** - average values without outliers

9.2.3 Mandel's Statistics

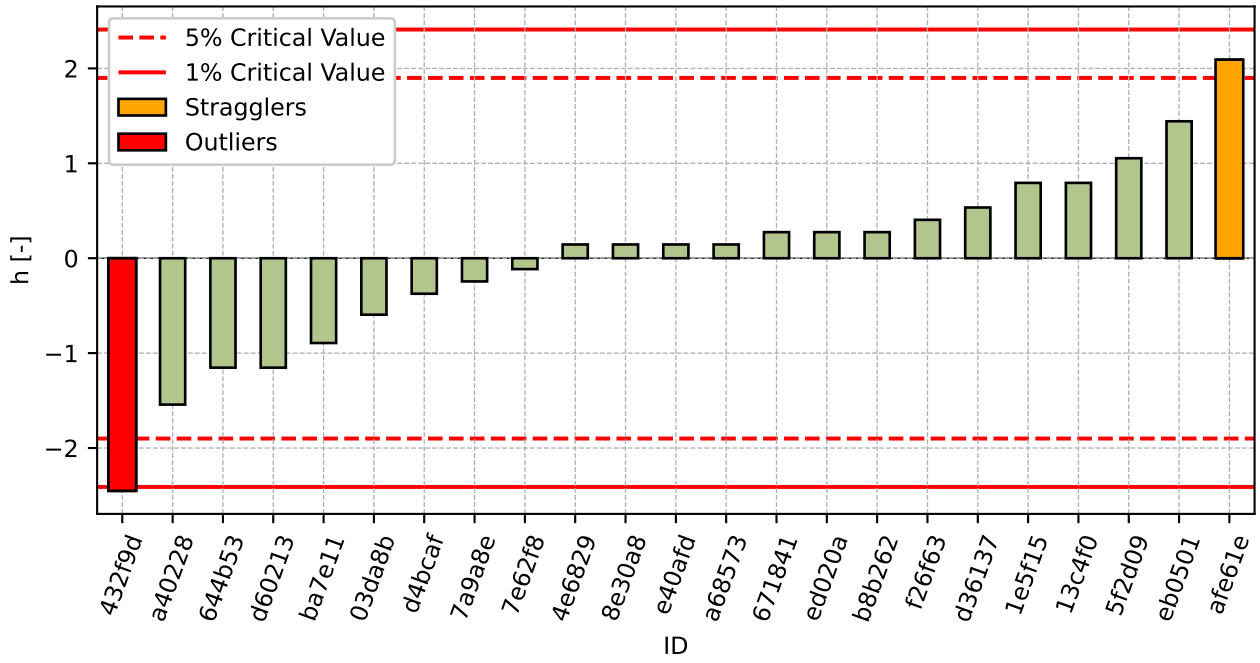

Figure 114: Interlaboratory Consistency Statistic

9.2.4 Descriptive statistics

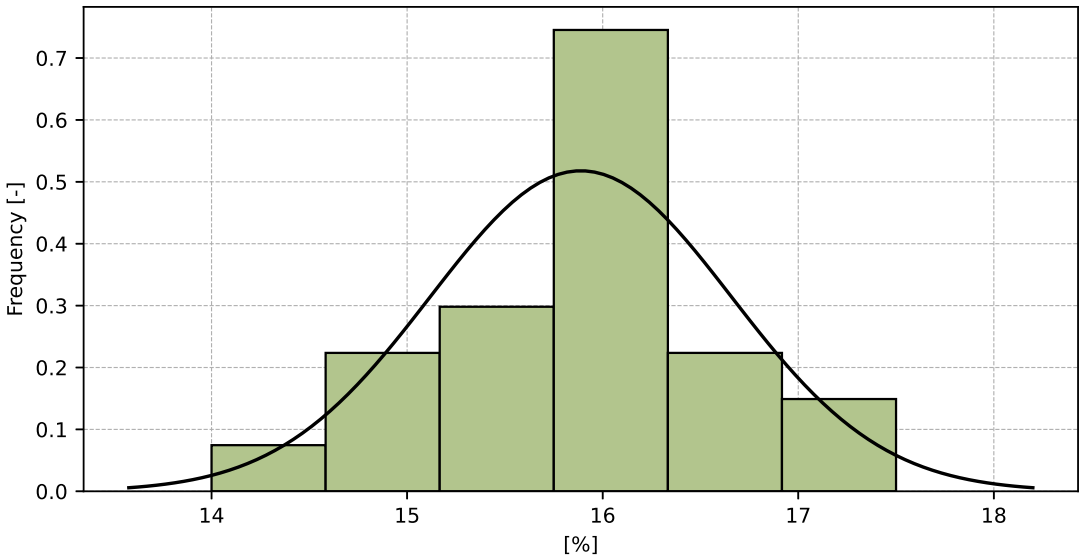

Figure 115: Histogram of all test results

Table 54: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	15.9
Sample standard deviation – s	0.77
Asigned value – x^*	16.0
Robust standard deviation – s^*	0.69
Measurement uncertainty of asigned value – u_X	0.18
p-value of normality test	0.724 [-]

9.2.5 Evaluation of Performance Statistics

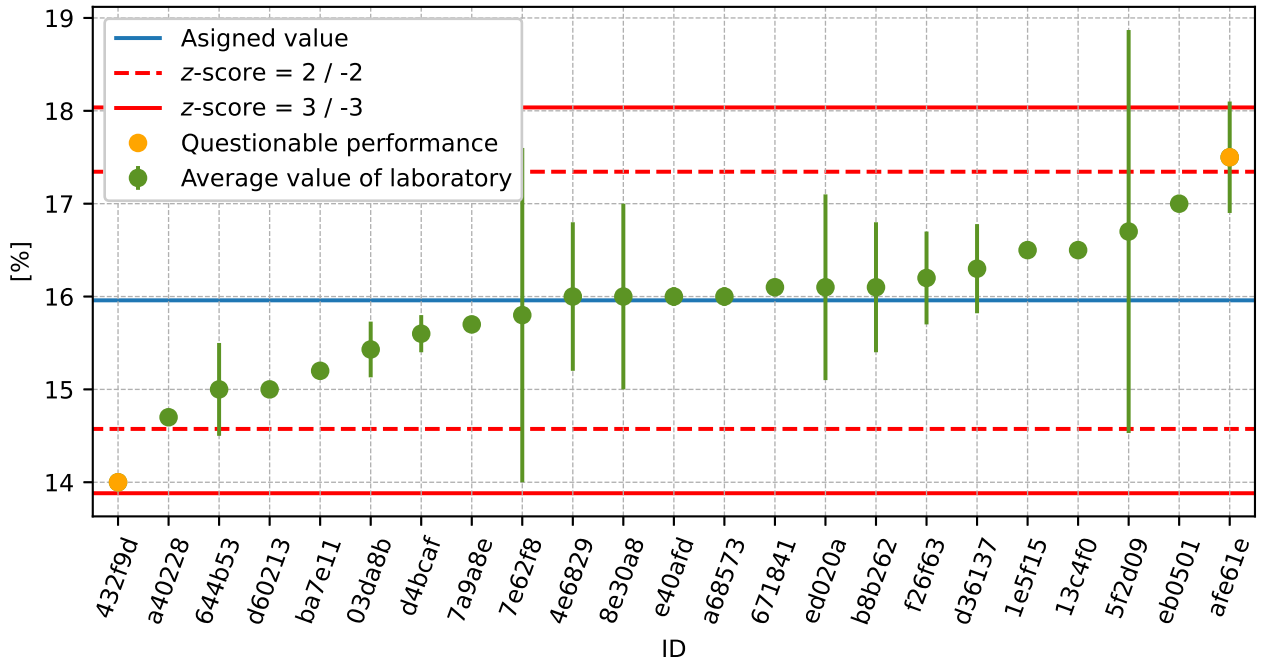

Figure 116: Average values and extended uncertainties of measurement

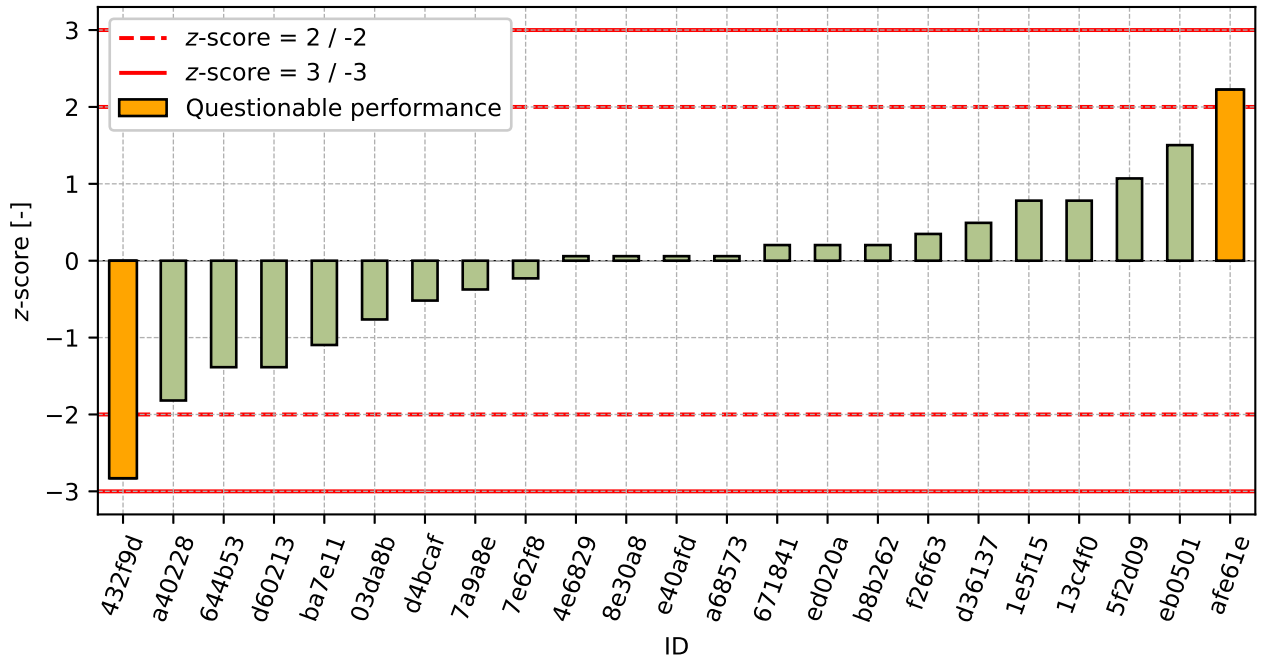

Figure 117: z-score

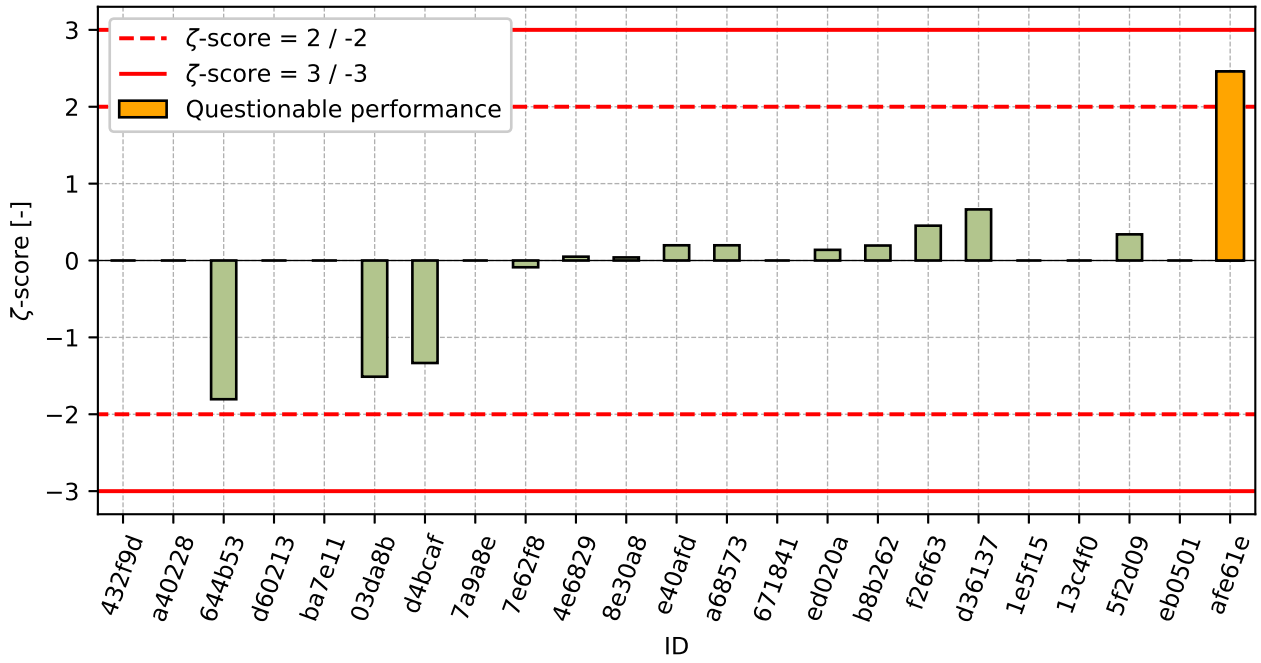

Figure 118: ζ-score

Table 55: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
432f9d	-2.83	-
a40228	-1.82	-
644b53	-1.39	-1.8
d60213	-1.39	-
ba7e11	-1.1	-
03da8b	-0.76	-1.51
d4bcaf	-0.52	-1.33
7a9a8e	-0.37	-
7e62f8	-0.23	-0.09
4e6829	0.06	0.05
8e30a8	0.06	0.04
e40afd	0.06	0.2
a68573	0.06	0.2
671841	0.2	-
ed020a	0.2	0.14
b8b262	0.2	0.19
f26f63	0.35	0.45
d36137	0.49	0.66
1e5f15	0.78	-
13c4f0	0.78	-
5f2d09	1.07	0.34
eb0501	1.5	-
afe61e	2.23	2.46

10 Appendix – EN 13286-47 – IBI

10.1 Test results

Table 56: Test results - ordered by average value. Outliers are marked by red color. u_X - extended uncertainty of measurement.

ID	Test results [%]	u_X [%]
4032d8	5	1
eb0501	6	-
de09c5	8	10
4e6829	8	0
7a9a8e	9	-
ba7e11	9	-
13c4f0	9	-
44e007	10	1
ed020a	12	2
7974e3	12	0
a40228	12	-
e40afd	12	1
8e30a8	15	2
1f159f	16	-
6cbdf1	20	3
afe61e	20	0
0828e7	60	1

10.2 The Numerical Procedure for Determining Outliers

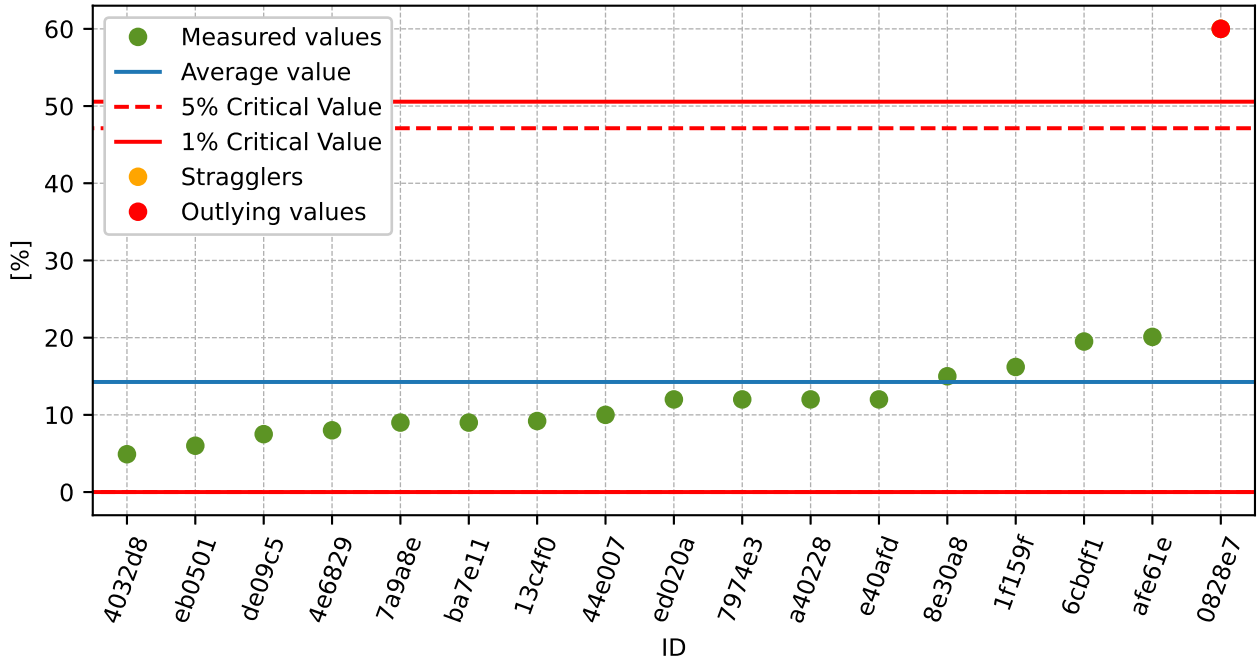

Figure 119: **Grubbs' test** - average values

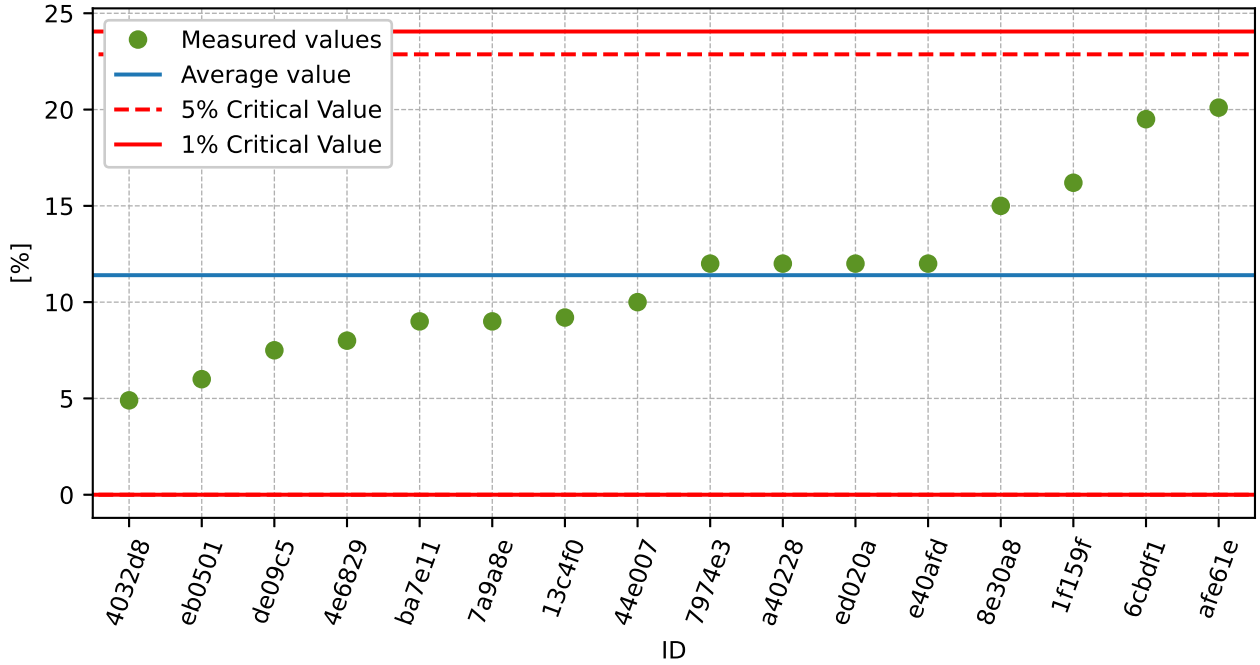

Figure 120: **Grubbs' test** - average values without outliers

10.3 Mandel's Statistics

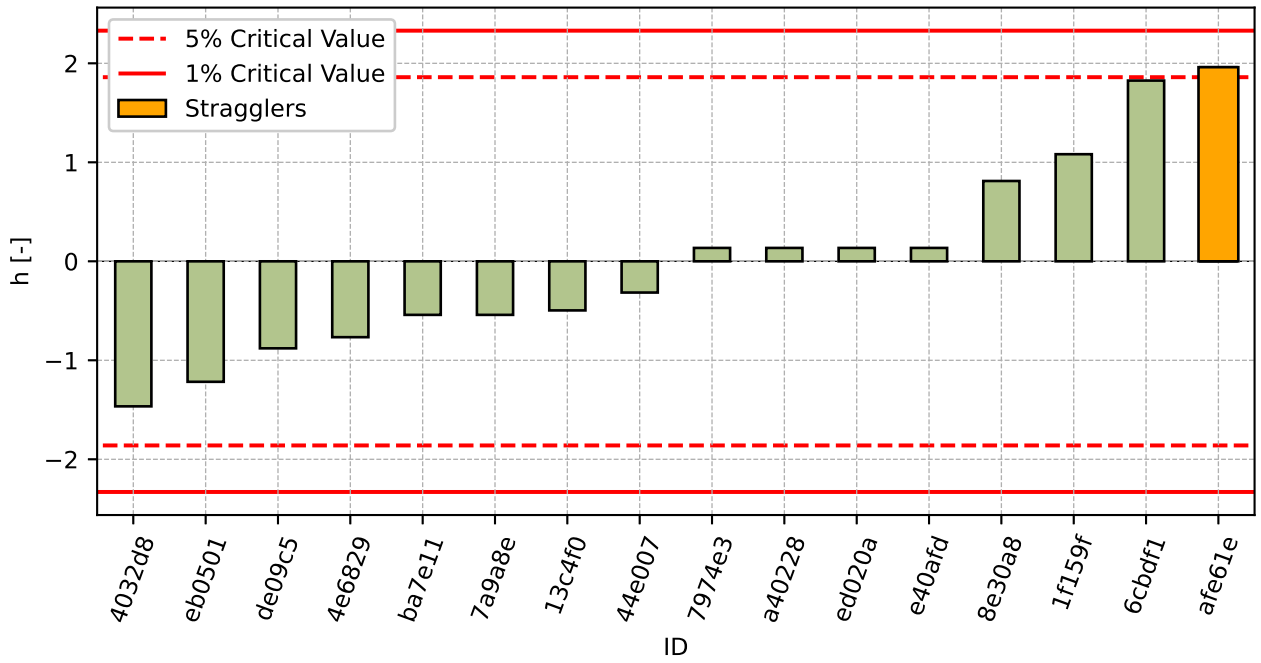

Figure 121: Interlaboratory Consistency Statistic

10.4 Descriptive statistics

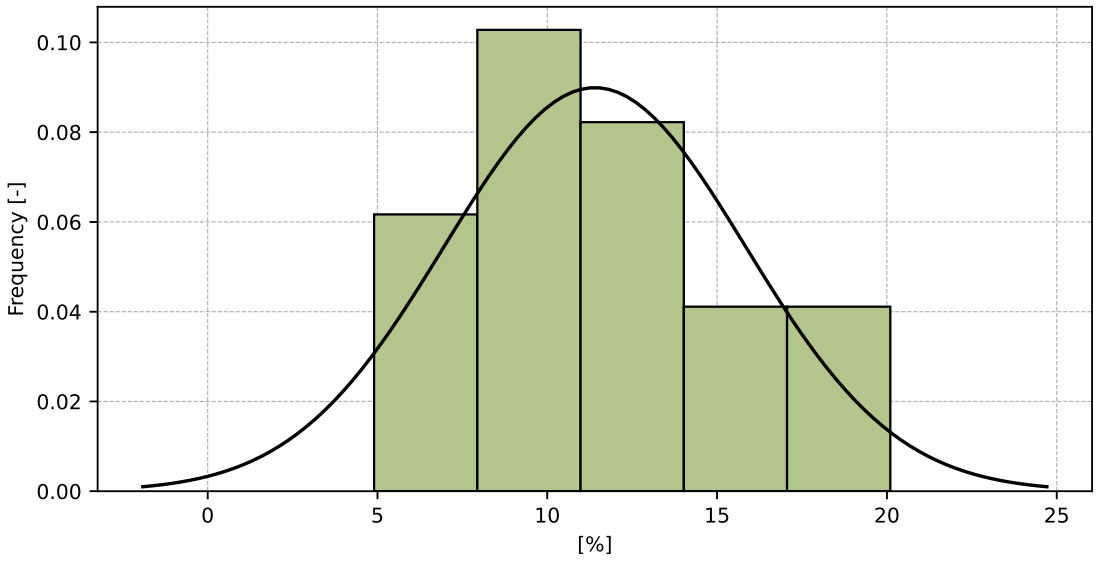

Figure 122: Histogram of all test results

Table 57: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	11
Sample standard deviation – s	4.4
Asigned value – x^*	11
Robust standard deviation – s^*	4.5
Measurement uncertainty of asigned value – u_X	1.4
p-value of normality test	0.298 [-]

10.5 Evaluation of Performance Statistics

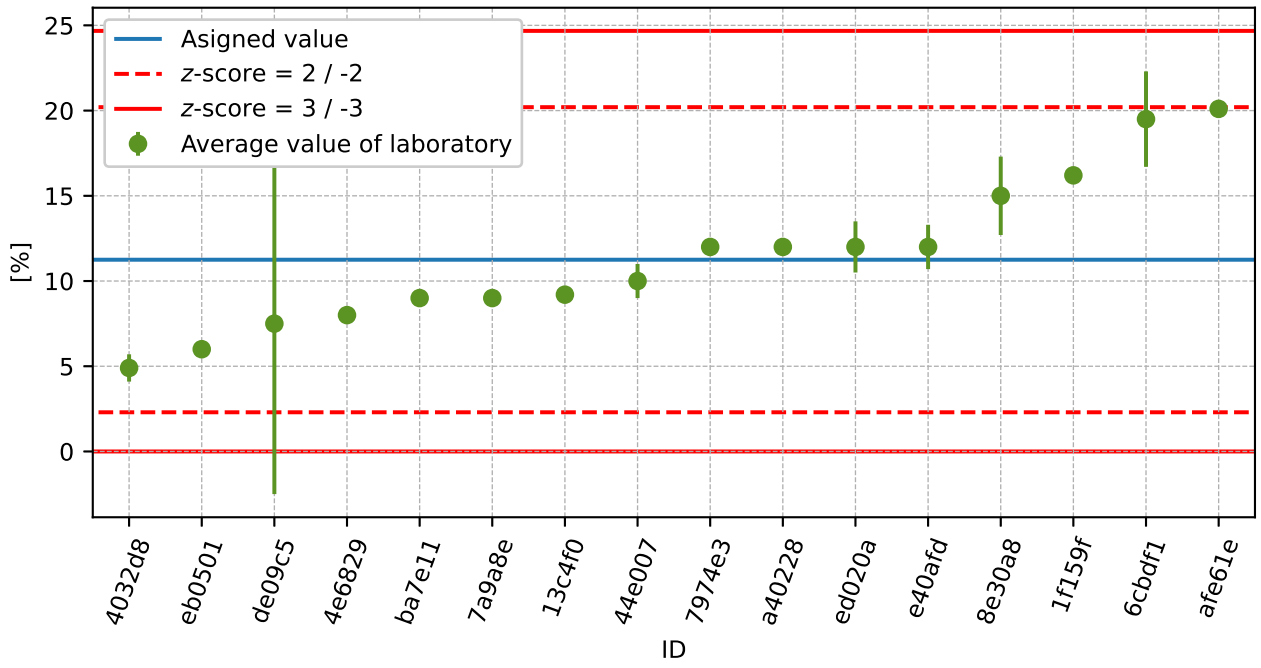

Figure 123: Average values and extended uncertainties of measurement

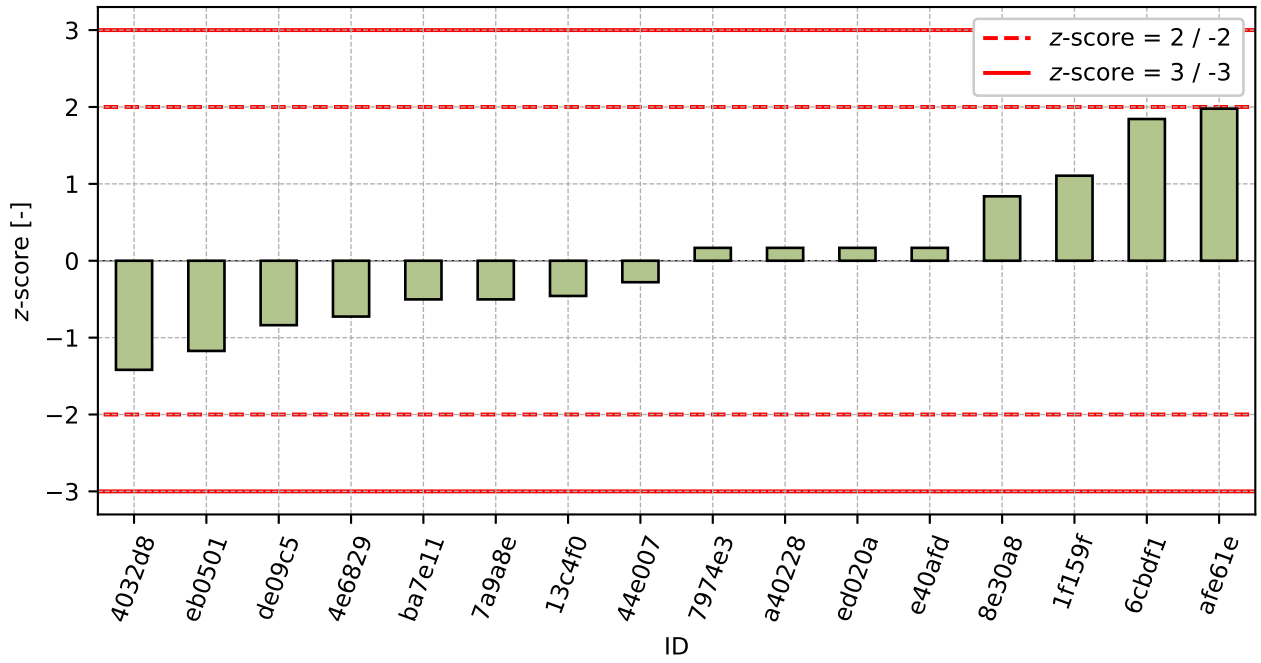

Figure 124: z-score

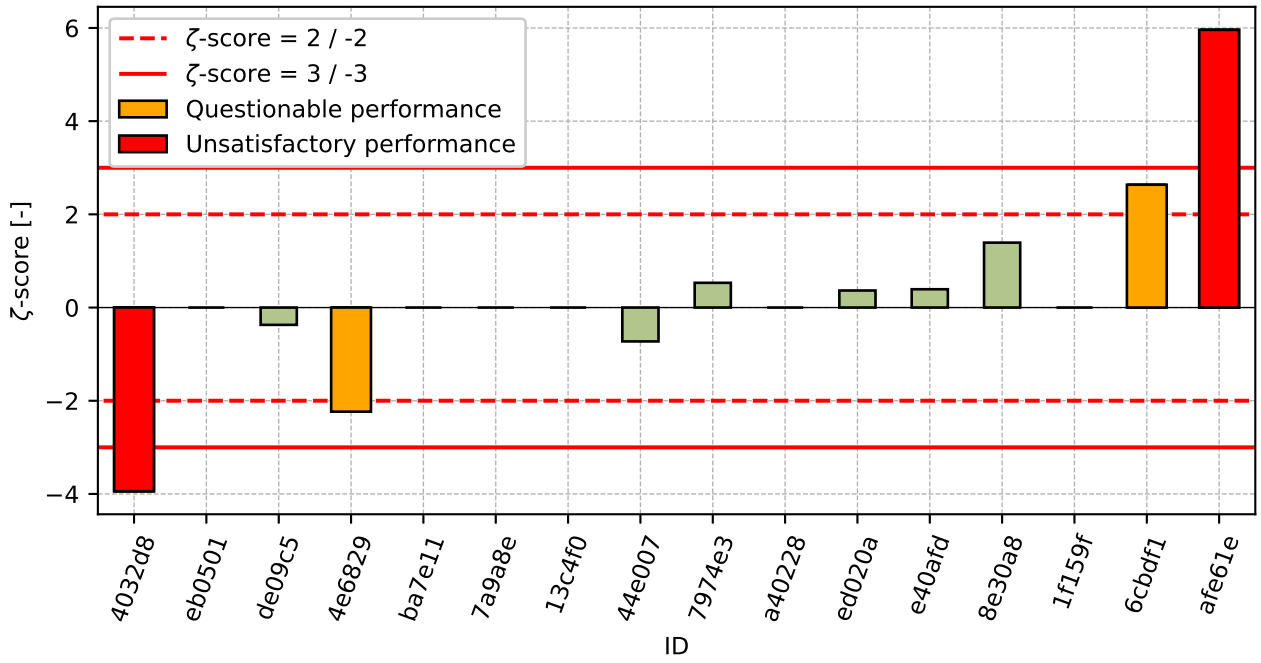

Figure 125: ζ-score

Table 58: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
4032d8	-1.42	-3.94
eb0501	-1.17	-
de09c5	-0.84	-0.37
4e6829	-0.73	-2.23
ba7e11	-0.5	-
7a9a8e	-0.5	-
13c4f0	-0.46	-
44e007	-0.28	-0.73
7974e3	0.17	0.53
a40228	0.17	-
ed020a	0.17	0.37
e40afd	0.17	0.39
8e30a8	0.84	1.39
1f159f	1.11	-
6cbdf1	1.84	2.64
afe61e	1.98	5.96