BRNO UNIVERSITY OF TECHNOLOGY

FACULTY OF CIVIL ENGINEERING
institute of building testing

FINAL REPORT ON THE RESULTS OF PRECISION EXPERIMENT

Proficiency Testing Program
Soil Testing
ZZ 2021/1

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: 1/5/2022

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Coordinator of PTP results assessment

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1 Introduction and Important Contacts

In the year 2021, the Proficiency Testing Provider at the SZK FAST (PT Provider) initiated the Proficiency Testing Program (PTP) designated ZZ 2021/1 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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Institute of Building Testing
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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 [3],
4. EN ISO 17892-5 Geotechnical investigation and testing - Laboratory testing of soil - Part 5: Incremental loading oedometer test [4],
5. EN ISO 17892-7 Geotechnical investigation and testing - Laboratory testing of soil - Part 7: Unconfined compression test [5],
6. CEN ISO/TS 17892-10 Geotechnical investigation and testing - Laboratory testing of soil - Part 10: Direct shear tests [6],
7. EN ISO 17892-12 Geotechnical investigation and testing - Laboratory testing of soil - Part 12: Determination of liquid and plastic limits [7],
8. EN 13286-2 Unbound and hydraulically bound mixtures - Part 2: Test methods for laboratory reference density and water content -Proctor compaction [8],
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 [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.

73 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
037ad0	-	-	-	-	-	-	-	X	X
414107	X	X	X	-	-	-	X	X	-
768b7b	X	X	X	X	X	X	X	X	X
26e50d	X	X	X	-	-	-	X	X	X
b3eb69	X	X	X	-	-	-	X	-	-
57fb23	-	-	-	-	-	-	X	-	-
ab69c5	X	X	X	-	-	-	X	X	X
e86bc6	X	X	X	-	-	-	X	-	-
5c1c2a	-	-	-	-	-	-	-	X	-
603f12	X	-	X	-	-	-	X	X	-
b07558	X	-	-	-	-	-	X	-	-
c4cf19	-	-	-	-	-	-	X	-	-
ca5af0	X	-	-	-	-	-	-	X	X
bcb27b	X	-	-	X	-	-	-	-	-
8bbd4f	X	-	X	-	-	-	-	X	X
adaf6b	-	X	X	-	-	-	-	X	X
559fc9	-	-	-	X	X	X	-	-	X
d1733b	-	-	-	-	-	X	-	-	-
717a59	-	X	-	X	-	X	-	-	-
344cdc	-	-	-	-	-	-	-	X	-
70635a	-	-	-	-	-	-	X	X	X
710e68	X	-	-	-	-	-	-	X	X
132004	X	-	-	-	-	-	-	X	X
cab52a	X	-	-	-	-	-	-	X	X
07e005	X	-	-	-	-	-	-	-	-
9ca4b3	X	X	X	X	X	X	X	X	X
959272	X	-	X	-	-	-	X	-	-
3e27db	X	X	X	-	-	-	-	-	-
6b9708	X	-	X	-	-	X	X	-	-
f90493	-	-	-	-	-	-	-	X	-
407176	X	-	-	-	-	-	-	-	-
a17694	-	-	X	-	-	-	-	X	X
3d56aa	-	-	-	-	-	X	-	-	-
890859	X	-	-	-	-	X	-	-	-
154ca0	-	-	X	-	-	-	X	-	-
1520a4	-	-	X	-	-	-	X	-	-
2630e9	X	-	X	-	-	-	X	-	-
060b31	X	-	-	-	-	-	-	-	-
521442	-	-	-	-	-	X	-	-	-
9aa5b6	-	-	X	-	-	-	-	-	-
da3822	-	X	-	-	-	-	-	-	-
6c9b10	X	X	X	X	X	X	X	X	X
7bd050	-	-	-	-	-	-	-	X	-
e532e3	X	X	X	X	-	X	X	X	-

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ID/Method	1	2	3	4	5	6	7	8	9
36908c	X	X	X	X	-	X	X	X	X
3d334f	X	X	X	X	X	X	X	X	-
19cf6e	-	-	-	-	-	-	-	X	X
f6afb9	-	-	-	-	-	-	-	X	X
7c2812	X	-	-	-	-	-	-	X	-
05817a	X	X	X	-	-	-	X	X	X
cbfb53	-	-	-	-	-	-	-	X	-
7c68c6	-	-	-	-	X	X	-	X	X
614399	X	-	-	-	-	-	-	-	-
3a40f8	X	X	-	-	-	-	X	-	-
58fcba	X	X	X	X	X	X	X	X	X
6f2e40	X	-	X	-	-	-	-	X	X
d614a2	-	-	-	-	-	-	-	X	-
3a16d4	-	-	-	-	-	-	-	X	-
5a7c66	X	-	X	-	-	-	-	X	-
e56609	-	-	-	X	-	-	X	-	X
c87776	X	-	-	X	-	-	-	X	X
254382	X	-	X	-	-	-	X	-	-
307a20	-	-	-	X	-	X	-	-	-
f0f0a7	X	X	X	-	-	X	X	X	-
a7b1ba	-	X	X	X	X	X	X	-	-
44c83c	X	-	-	-	-	-	-	X	X
0e7dcd	X	-	-	-	-	-	-	X	X
6da029	X	-	-	-	-	-	-	X	X
899e89	X	-	-	-	-	-	-	X	X
c76279	-	-	-	-	-	-	-	X	-
39fda6	-	-	-	-	-	-	-	X	-
9972ed	X	-	-	X	-	-	X	X	X
0c52ed	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
ALS Czech Republic, s.r.o.	Na Harfě, 336/9, Praha 9, 190 00, Česká republika	1163
AZ Consult, spol. s r.o.	Klíšská 1334/12, Ústí nad Labem, 400 01, Česká republika	L1740
AZ GEO, s.r.o.	Chittussiho 1186/14, Ostrava – Slezská Ostrava, 71000, Česká republika	-
BP INSTITUT	Turjanica 31, Veliko Blaško, Laktaši, 78250, Bosnia and Herzegovi	-
Bechtel ENKA UK Limited Ogranak Beograd	Jasicki put 52 đ, Kruševac, 37000, Serbia	-
CSS d.o.o.	Savska cesta 144a, Zagreb, 10000, CROATIA	HR1106
Cemex CR s.r.o.	Semtín 102, Pardubice, 53354, Česká republika	1302
Centar za projektovanje i konsalting d.o.o.	bulevar Desanke Maksimović 2, Banja Luka, 78000, Bosnia and Herzegovi	-
Centrum dopravního výzkumu, v. v. i.	Líšeňská 33a, Brno, 636 00, Česká republika	1506
DTQ d.o.o. Sarajevo	Stjepana Tomića 3, Sarajevo, 71000, BIH	LI-64-01
EDAFOMICHANIKI S.A.	19 EMMANUEL PAPADAKI, NEO IRAKLEIO, 14121, GREECE	-
EIE ECHEVERRY INGENIERIA Y ENSAYOS SAS	CARRERA 29C N° 71A-30, Bogota D.C, 111211, Colombia	09-LAB-017
Energetikų mokymo centras	Raudondvario pl. 168, Kaunas, LT-47172, Kaunas	-
Eurofins Umwelt Österreich GmbH & Co. KG	Palmersstrasse 2, Wiener Neudorf, 2351, Austria	-
GEMATEST s.r.o.	Dr.janského 954, Černošice, 25228, Česká republika	1291
GEO-TEST d.o.o.	Vojina Đurašinovića 11, Belgrade, 11160, Serbia	01-466
GEODRILL s.r.o.	K Bukovinám 169/45, Brno, 63500, ČR	1596
GEOINVEST	Aglantzias Light Industrial Area, No 10, Nicosia, 2103, Cyprus	L001
GEOMEHANIKA d.o.o.	Dobropoljska 21, Beograd/Belgrade, 011, Srbija/Serbia	01-198
GEOSTAND AND ASSOCIATES S.A.	KALIMNOU 16, ATHENS, 11251, ATTICA, GREECE	357-4
GEOSTAR, spol. s r.o. - pracoviště Brno	Tuřanka 111, Brno, 627 00, Česká republika	1373

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Laboratory	Address	Accreditation number
GEOSTAR, spol. s r.o. - pracoviště Hranice	Tuřanka 111, Brno, 627 00, Česká republika	1373
GEOTEST S.A.	6th km Ioanninon - Athinon, IOANNINA, 45500, EPIRUS	-
GEOTEST SHPK	Autostrada Tirane-Durres, KM 2,Mezez-Kashar, Tirane, 1051, Albania	LT 090
GEOtest, a.s.	Šmahova 1244/112, Brno, 62700, Česká republika	1271.2
GIM-TEST D.O.O. BANJA LUKA	Palih boraca 55, local No. 2, Banja Luka, 78000, RS, BiH	LI-152-01
GUBT	Gewerbeparkstrasse 5, Markgrafneusiedl, 2282, Austria	-
Geolab d.o.o. Sarajevo	Mustafe Bajića 19, Sarajevo, 71000, Bosna i Hercegovina	-
Gradjevinsko-arhitektonski fakultet Univerziteta u Nišu	Aleksandra Medvedeva 14, Niš, 18000, Serbia	-
INSTITUT 1.MAJ DOO NIŠ	Bulevar 12. Februar 83, Niš, 18000, Srbija	01-288
Institut pro testování a certifikaci, a.s.	třída Tomáše Bati 299, Louky, Zlín, 763 02, Česká republika	1004
Institute IMS AD Belgrade - Laboratory for Roads and Geotechnics	Bulevar vojvode Mišića 43, Belgrade, 11000, Serbia	ATS 01-138
LABIS Ltd. Independent cinstruction laboratory LABIS	Doiran 9A str., Sofia, 1680, Bulgaria	6 LI
LABO DEVLIEGER - VAN VOOREN	Industriepark Rosteyne 1, zelzate, 9060, België	296-TEST
Laboratoire Central des Travaux Publics-LCTP	1. rue Kaddour RAHIM- HUSSEIN DEY, ALGER, 16005, ALGERIE	-
Laboratoire des Travaux Publics de l'Ouest LTP-Ouest	Rond point des Castors, Oran, 31000, 99B0103524	-
Materialversuchsanstalt Strass GmbH	Oberdorf, 103, Strass im Zillertal, 6261, Österreich	0455
Mattest (Ireland)Ltd.	Unit 2, Northwest Business Park, Ballycoolin, Dublin 15., Dublin, D15 EF1H, Ireland	286T
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, Gent, 9052, België	-
PUDIS a.s.	Podbabská 1014/20, Praha 6, 160 00, Česká republika	L1762
Przedsiębiorstwo Realizacyjne INORA Inorganic Activities sp. z o.o.	Prym. S. Wyszyńskiego 11, Gliwice, 44-100, woj. śląskie	-
QCONTROL s.r.o., odštěpný závod	Lesní 693, Bílovice nad Svitavou, 66401, Česká republika	1737

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Laboratory	Address	Accreditation number
QUALIFORM, a.s.	Mlaty 672/8, BRNO, 642 00, Česká republika	1008
Rudarski institut d.o.o Beograd	Batajnički put br.2, Beograd, 11080, Srbija	01-309
S.C. GEOSTUD S.R.L.	Str. Sîngerului, nr. 11, sector 1, Bucharest, 014617, Romania	LI 974
SIBOTEC CVBA	Industriepark Oost 6 8730 Beernem, Beernem, 8730, West - Vlaanderen	BELAC 637-TEST
Structum, Inštitut za gradbeništvo, d.o.o.	Tovarniška cesta 26, Ajdovščina, 5270, Slovenia	LP-108
Structural Soils Ltd - Cheshire	Spring Lodge, 172 Chester Road, Helsby, Cheshire, WA6 0AR, UK	1774
Structural Soils Ltd - Hemel Hempstead	Spring Lodge, 172 Chester Road, Helsby, Cheshire, WA6 0AR, UK	1774
Structural Soils Ltd - Tonbridge	Spring Lodge, 172 Chester Road, Heslby, WA6 0AR, Cheshire, UK	1774
T.E.C. Translab Environmental Consult nv	OEVERSTRAAT 21, LOKEREN, 9160, BELGIUM	-
TEPVERAM s.r.o.	Třibřichy 13, Třibřichy, 53701, Česká republika	1759
UAB LABORATORINIU BANDYMU CENTRAS	R. KALANTOS ST. 85A, Kaunas, LT-52308, LITHUANIA	LA.01.002
UNIGEO a.s.	Místecká 329/258, Ostrava - Hrabová, 720 00, Česká republika	1412
VIALAB CZ s.r.o. - CL01	U Michelského lesa 1581/2, Praha 4, 140 00, Česká republika	1112
VIALAB CZ s.r.o. - CL07	U Michelského lesa 1581/2, Praha 4, 140 00, Česká republika	1112
VIALAB CZ s.r.o., Laboratoř Čechy západ, pracoviště Chlumec	VIALAB CZ s.r.o., Laboratoř Čechy západ, Sedlecká 169, Karlovy Vary, 360 02, Česká republika	1524
VIALAB CZ s.r.o., Laboratoř Čechy západ, pracoviště Plzeň Letkov	VIALAB CZ s.r.o., Laboratoř Čechy západ, Sedlecká 169, Karlovy Vary, 360 02, Česká republika	1524
VIALAB CZ s.r.o., Laboratoř Čechy západ, pracoviště Sedlec	VIALAB CZ s.r.o., Laboratoř Čechy západ, Sedlecká 169, Karlovy Vary, 360 02, Česká republika	1524
VIALAB CZ s.r.o., Laboratoř Čechy západ, pracoviště České Budějovice	VIALAB CZ s.r.o., Laboratoř Čechy západ, Sedlecká 169, Karlovy Vary, 360 02, Česká republika	1524
VIALAB s.r.o. - CL12	U Michelského lesa 1581/2, Praha 4, 140 00, Česká republika	1112
VUIS - CESTY, spol. s r. o.	Lamačská cesta, , 8, Bratislava, 811 04, Česká republika	20
Vilnius Gediminas technical University	Saulėtekio al. 11, Vilnius, LT-10223, Lithuania	LA.01.063
Vysoké učení Technické v Brně, Fakulta stavební, Zkušební laboratoř při ÚTHD FAST VUT v Brně - č. 1396	Veveří 331/95, Brno, 60200, Česká republika	L1396

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Laboratory	Address	Accreditation number
ZONAS COSTERAS S.A.S	Calle 68 # 44 - 95, Barranquilla, 080002, Atlántico - Colombia	-
i2 Analytical LTD Sp. z o.o. Oddział w Polsce	ul. Pionierów 39, Ruda Śląska, 41-711, Poland	-
Ústav stavebního zkušebnictví s.r.o.	Jiřího Potůčka 115, Pardubice, 53009, Česká republika	1115
ČVUT Kloknerův ústav	Šolínova 7, Praha (okr. Hlavní město Praha), 16608, Česká republika	1061
ČVUT v Praze, Fakulta stavební	Thákurova 7, Praha 6, 16629, Česká republika	1048 (OL182)
Ředitelství silnic a dálnic ČR	Rebešovická 40, Brno-Chrlice, 643 00, Česká republika	1072
Ředitelství silnic a dálnic ČR, laboratoř Praha	Na Pankráci 546/56, Praha 4, Praha, 140 00, ČR	1734

2 Procedures used in the Statistical Analysis of Laboratory Results

The statistical analysis is based on the following steps:

1. Evaluation of intralaboratory variabilities by Cochran's C test: If 5% or 1% critical value is exceeded, the effect of the individual observations is first considered. If the results indicate that high participant variability is caused by a single observation, this value is excluded from the experiment, but the participant is not excluded as outlying. By overcoming 1% of the critical value, the participant's results can be marked as outlying and excluded from the experiment (symbol **X**).
2. The numerical critical evaluation of the test results using Grubbs' test: By overcoming 1% critical value, the participant's results can be marked as outlying and excluded from the experiment (symbol **X**).
3. Graphical determination of the consistency of laboratories (Mandel's statistics): The exceedance of the critical values of Mandel's statistics does not indicate that the results of the laboratories concerned are wrong; it only suggests minor inconsistencies.
4. Evaluation of descriptive statistics and, if possible, taking into account the number of observations, the repeatability and reproducibility.
5. Evaluation of the assigned value.
6. The performance evaluation: The most significant outcome of the PT Program is the so-called z-score and ζ-score (zeta-score). These characteristics assess the performance of individual participants by comparing it with the assigned value and measurement uncertainties. z-score and ζ-score are compared with limit values. The resulting ζ-score values are not taken into account during the final evaluation of the performance of participants as they are to a considerable degree dependent on the values of the measurement uncertainties of the assessed institutions. The following scales are applied for the z-score values:
   - $|z\text{-score}| < 2 \Rightarrow$ shows that the laboratory performance is **satisfactory** and generates no signal – ✓.
   - $2 \leq |z\text{-score}| < 3 \Rightarrow$ shows that the laboratory performance is **questionable** and generates an action signal – **?**.
   - $|z\text{-score}| \geq 3 \Rightarrow$ shows that the laboratory performance is **unsatisfactory** and generates an action signal – **!**.

Procedures used in the statistical analysis of proficiency testing programs can be found here: http://ptprovider.cz/?lang=en.

3 Conclusions of the Statistical Analysis

The present report summarizes the results of the Proficiency Testing Program Soil Testing (PT Program) organized by the PT Provider at the SZK FAST. 73 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.

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
037ad0	-	-	-	-	-	-	-	✓	✓
414107	✓	✓	✓	-	-	-	✓	✓	-
768b7b	✓	✓	✓	✓	✓	✓	✓	✓	✓
26e50d	✓	✓	?	-	-	-	✓	✓	✓
b3eb69	✓	✓	✓	-	-	-	✓	-	-
57fb23	-	-	-	-	-	-	✓	-	-
ab69c5	✓	✓	✓	-	-	-	✓	✓	✓
e86bc6	✓	✓	X	-	-	-	✓	-	-
5c1c2a	-	-	-	-	-	-	-	✓	-
603f12	✓	-	✓	-	-	-	✓	✓	-
b07558	✓	-	-	-	-	-	?	-	-
c4cf19	-	-	-	-	-	-	X	-	-
ca5af0	✓	-	-	-	-	-	-	✓	?
bcb27b	✓	-	-	✓	-	-	-	-	-
8bbd4f	✓	-	✓	-	-	-	-	✓	✓
adaf6b	-	✓	✓	-	-	-	-	✓	✓
559fc9	-	-	-	✓	✓	✓	-	-	✓
d1733b	-	-	-	-	-	✓	-	-	-
717a59	-	✓	-	✓	-	✓	-	-	-
344cdc	-	-	-	-	-	-	-	✓	-
70635a	-	-	-	-	-	-	✓	✓	✓
710e68	✓	-	-	-	-	-	-	✓	✓
132004	✓	-	-	-	-	-	-	✓	✓
cab52a	✓	-	-	-	-	-	-	✓	✓
07e005	✓	-	-	-	-	-	-	-	-
9ca4b3	✓	✓	✓	✓	✓	?	✓	?	✓
959272	✓	-	✓	-	-	-	✓	-	-
3e27db	?	-	✓	-	-	-	-	-	-
6b9708	✓	-	X	-	-	!	✓	-	-

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ID / Method	1	2	3	4	5	6	7	8	9
f90493	-	-	-	-	-	-	-	✓	-
407176	✓	-	-	-	-	-	-	-	-
a17694	-	-	✓	-	-	-	-	✓	✓
3d56aa	-	-	-	-	-	✓	-	-	-
890859	✓	-	-	-	-	✓	-	-	-
154ca0	-	-	✓	-	-	-	✓	-	-
1520a4	-	-	✓	-	-	-	✓	-	-
2630e9	✓	-	✓	-	-	-	✓	-	-
060b31	✓	-	-	-	-	-	-	-	-
521442	-	-	-	-	-	✓	-	-	-
9aa5b6	-	-	✓	-	-	-	-	-	-
da3822	-	✓	-	-	-	-	-	-	-
6c9b10	✓	✓	✓	✓	✓	✓	✓	✓	✓
7bd050	-	-	-	-	-	-	-	✓	-
e532e3	✓	✓	✓	✓	-	!	?	✓	-
36908c	✓	✓	✓	✓	-	✓	✓	✓	✓
3d334f	✓	✓	✓	✓	✓	✓	✓	✓	-
19cf6e	-	-	-	-	-	-	-	✓	✓
f6afb9	-	-	-	-	-	-	-	✓	✓
7c2812	✓	-	-	-	-	-	-	✓	-
05817a	✓	✓	✓	-	-	-	✓	✓	✓
cbfb53	-	-	-	-	-	-	-	✓	-
7c68c6	-	-	-	-	✓	✓	-	✓	✓
614399	✓	-	-	-	-	-	-	-	-
3a40f8	✓	✓	-	-	-	-	✓	-	-
58fcba	✓	✓	✓	✓	✓	✓	✓	✓	✓
6f2e40	✓	-	✓	-	-	-	-	✓	?
d614a2	-	-	-	-	-	-	-	✓	-
3a16d4	-	-	-	-	-	-	-	✓	-
5a7c66	✓	-	✓	-	-	-	-	✓	-
e56609	-	-	-	✓	-	-	✓	-	✓
c87776	✓	-	-	✓	-	-	-	✓	✓
254382	!	-	✓	-	-	-	✓	-	-
307a20	-	-	-	✓	-	✓	-	-	-
f0f0a7	✓	✓	✓	-	-	✓	✓	✓	-
a7b1ba	-	✓	✓	✓	✓	✓	✓	-	-
44c83c	✓	-	-	-	-	-	-	✓	-

Continued on next page

Continued from previous page

ID / Method	1	2	3	4	5	6	7	8	9
0e7dcd	✓	-	-	-	-	-	-	✓	✓
6da029	✓	-	-	-	-	-	-	✓	✓
899e89	✓	-	-	-	-	-	-	✓	✓
c76279	-	-	-	-	-	-	-	?	-
39fda6	-	-	-	-	-	-	-	✓	-
9972ed	✓	-	-	✓	-	-	✓	✓	?
0c52ed	✓	-	-	-	-	-	-	-	-

References

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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.

[6] EN ISO 17892-10. *Geotechnical investigation and testing - Laboratory testing of soil - Part 10: Direct shear tests*. 2018.

[7] EN ISO 17892-12. *Geotechnical investigation and testing - Laboratory testing of soil - Part 12: Determination of liquid and plastic limits*. 2018.

[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*. 2012.

[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 [%]
254382	3.4	3.5	3.5	0.1	3.5	0.05	1.51
3e27db	3.7	3.6	3.6	0.0	3.6	0.04	1.12
3d334f	3.7	3.7	3.7	0.4	3.7	0.04	0.95
407176	3.7	3.7	3.7	0.0	3.7	0.0	0.0
05817a	3.8	3.8	3.6	0.4	3.7	0.12	3.09
e86bc6	3.8	3.7	3.7	2.0	3.7	0.06	1.55
b07558	3.8	3.8	3.7	0.3	3.7	0.07	1.93
b3eb69	3.7	3.7	3.9	0.5	3.8	0.12	3.07
614399	3.8	3.8	3.7	0.1	3.8	0.05	1.4
e532e3	3.7	3.8	3.9	0.1	3.8	0.08	1.98
9ca4b3	3.8	3.8	3.8	-	3.8	0.0	0.0
ca5af0	3.8	3.7	3.9	0.5	3.8	0.1	2.63
060b31	3.8	3.8	3.9	0.1	3.8	0.06	1.51
bcb27b	3.8	3.9	3.8	-	3.8	0.04	1.05
3a40f8	3.8	3.9	3.9	0.0	3.9	0.06	1.56
959272	3.9	3.9	3.8	0.2	3.9	0.03	0.79
890859	3.9	3.9	3.9	0.4	3.9	0.02	0.39
6f2e40	3.9	3.9	3.9	0.1	3.9	0.0	0.0
7c2812	3.8	3.9	4.0	0.1	3.9	0.1	2.56
8bbd4f	3.8	3.9	4.0	0.8	3.9	0.1	2.56
2630e9	3.9	4.0	3.8	-	3.9	0.1	2.56
c87776	3.9	3.9	3.9	0.1	3.9	0.01	0.15
132004	3.9	3.9	4.0	0.2	3.9	0.06	1.47
44c83c	3.9	3.9	4.0	2.7	3.9	0.06	1.47
5a7c66	3.9	4.0	3.9	0.2	3.9	0.06	1.47
6da029	4.0	3.9	3.9	2.6	3.9	0.06	1.47
899e89	3.9	3.9	4.0	2.8	3.9	0.06	1.47
07e005	3.9	3.9	4.0	0.4	3.9	0.06	1.47
0c52ed	3.9	3.9	4.0	0.0	3.9	0.07	1.7
58fcba	3.9	4.0	4.0	-	4.0	0.06	1.46
0e7dcd	4.0	4.0	4.0	2.7	4.0	0.0	0.0
f0f0a7	4.0	3.9	4.1	0.3	4.0	0.1	2.5
6b9708	3.9	4.1	-	-	4.0	0.14	3.54
710e68	4.0	4.0	4.0	0.2	4.0	0.0	0.0
ab69c5	4.0	4.0	4.0	0.7	4.0	0.0	0.0
cab52a	4.0	4.0	4.1	0.2	4.0	0.06	1.43
26e50d	3.9	4.3	3.9	0.5	4.0	0.23	5.73
768b7b	4.0	4.0	4.1	-	4.0	0.06	1.43
36908c	4.0	4.0	4.2	-	4.0	0.11	2.76
9972ed	4.0	4.1	4.0	-	4.0	0.04	0.89
603f12	4.1	4.1	4.1	0.1	4.1	0.02	0.38
6c9b10	4.2	4.2	4.0	-	4.1	0.09	2.11
414107	4.1	4.2	4.2	0.1	4.1	0.05	1.14

1.2 The Numerical Procedure for Determining Outliers

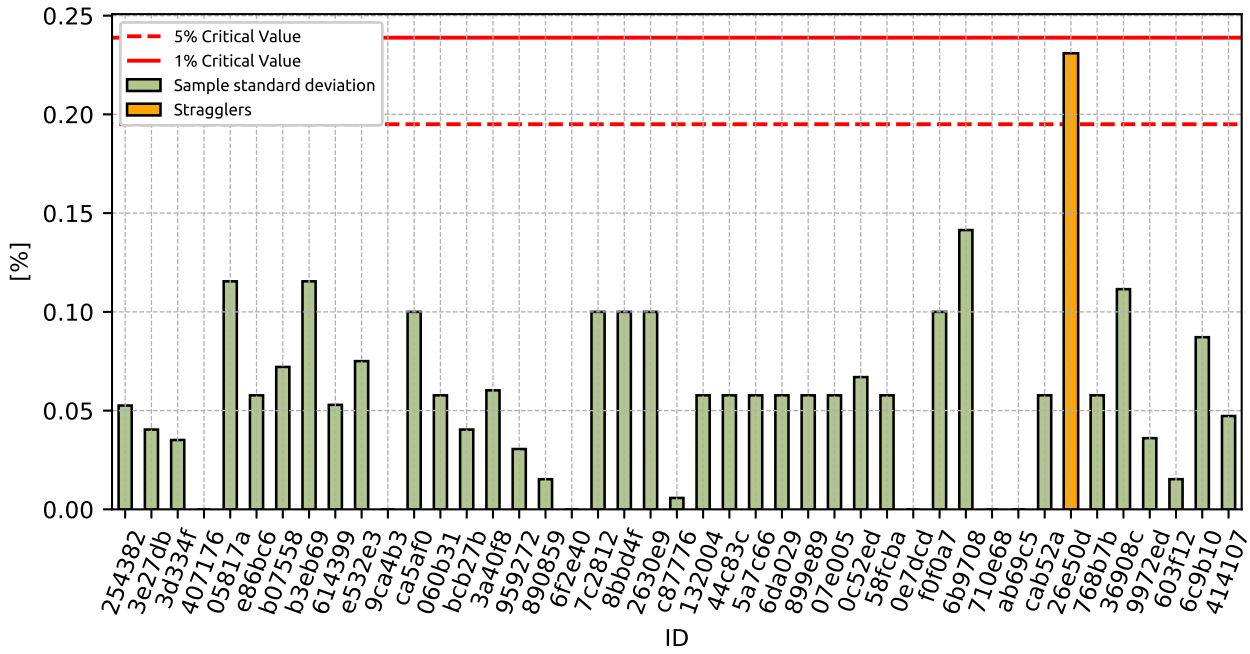

Figure 1: **Cochran's test** - sample standard deviations

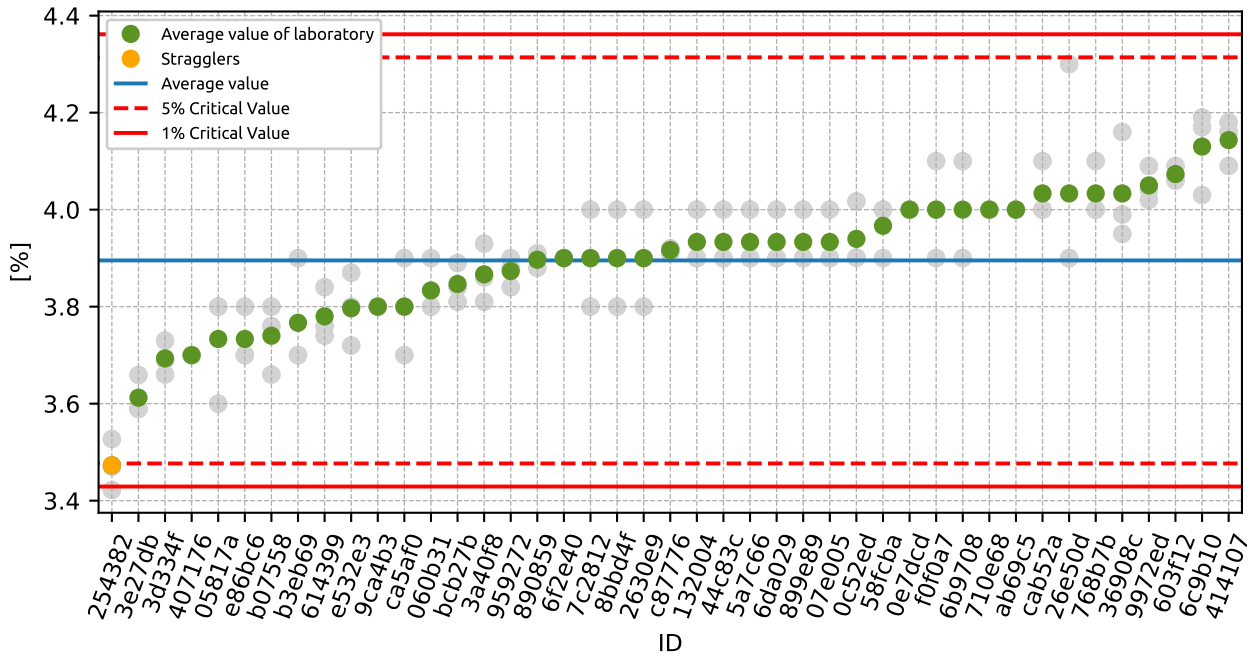

Figure 2: **Grubbs' test** - average values

1.3 Mandel's Statistics

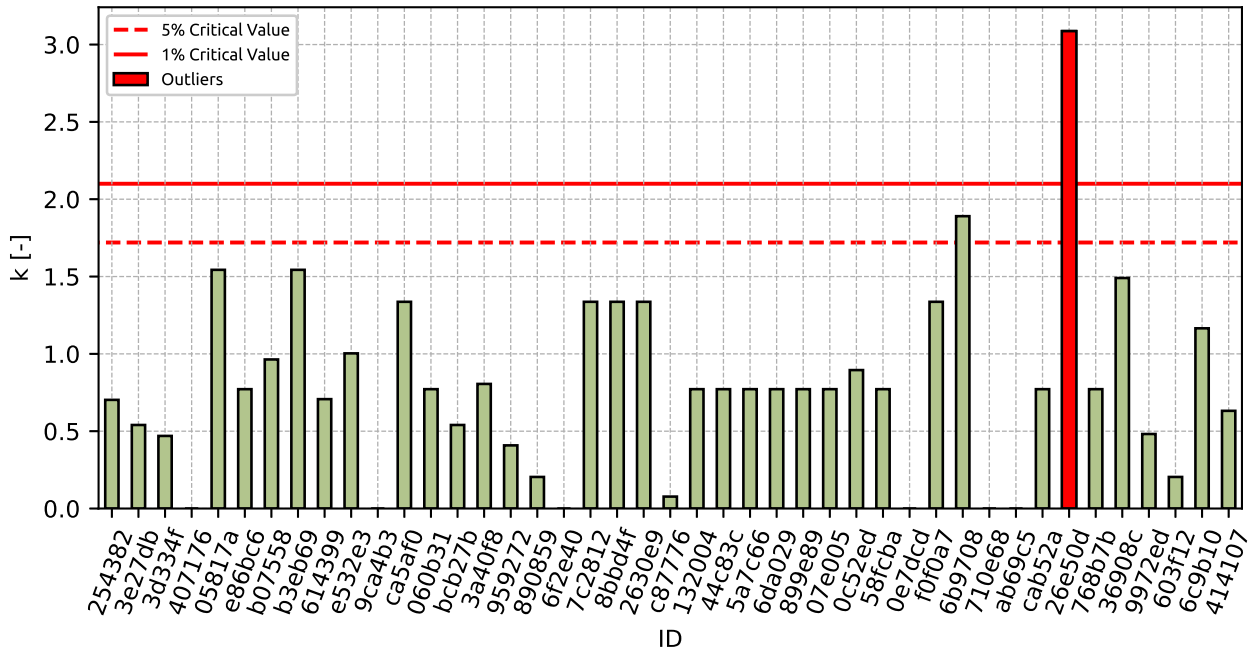

Figure 3: Intralaboratory Consistency Statistic

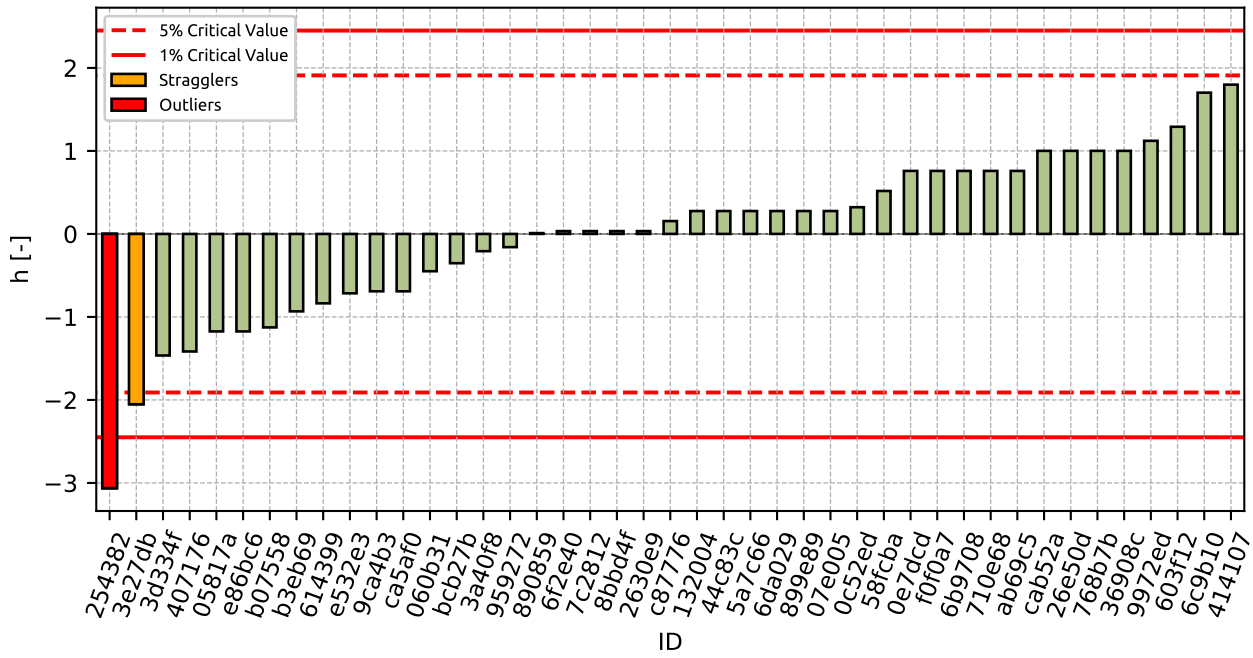

Figure 4: Interlaboratory Consistency Statistic

1.4 Descriptive statistics

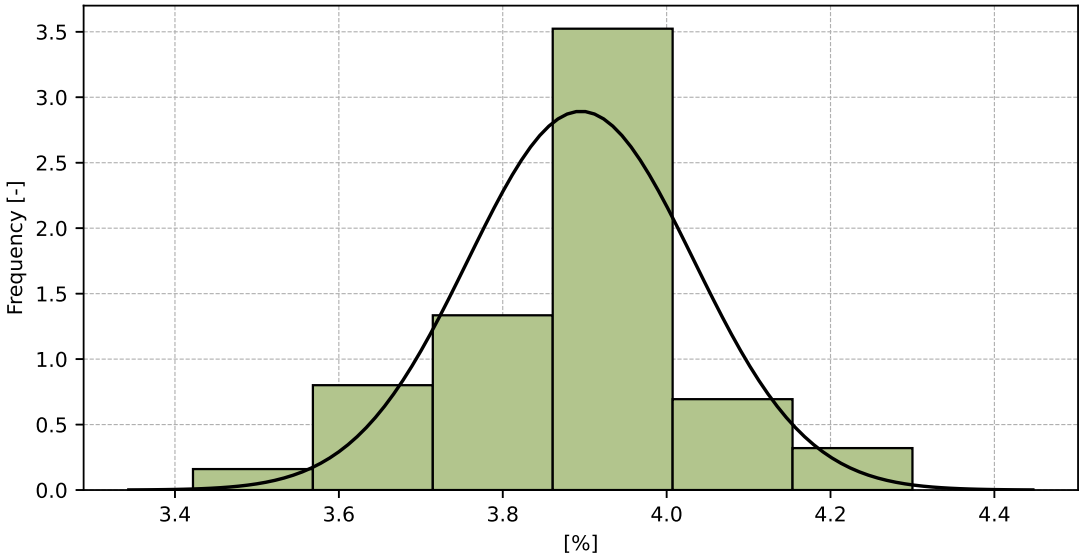

Figure 5: Histogram of all test results

Table 5: Descriptive statistics

Characteristics	**[%]**
Average value – $\bar{x}$	3.9
Sample standard deviation – s	0.14
Asigned value – x^*	3.9
Robust standard deviation – s^*	0.13
Measurement uncertainty of asigned value – u_X	0.02
p-value of normality test	1.0 [-]
Interlaboratory standard deviation – s_L	0.13
Repeatability standard deviation – s_r	0.07
Reproducibility standard deviation – s_R	0.15
Repeatability – r	0.2
Reproducibility – R	0.4

1.5 Evaluation of Performance Statistics

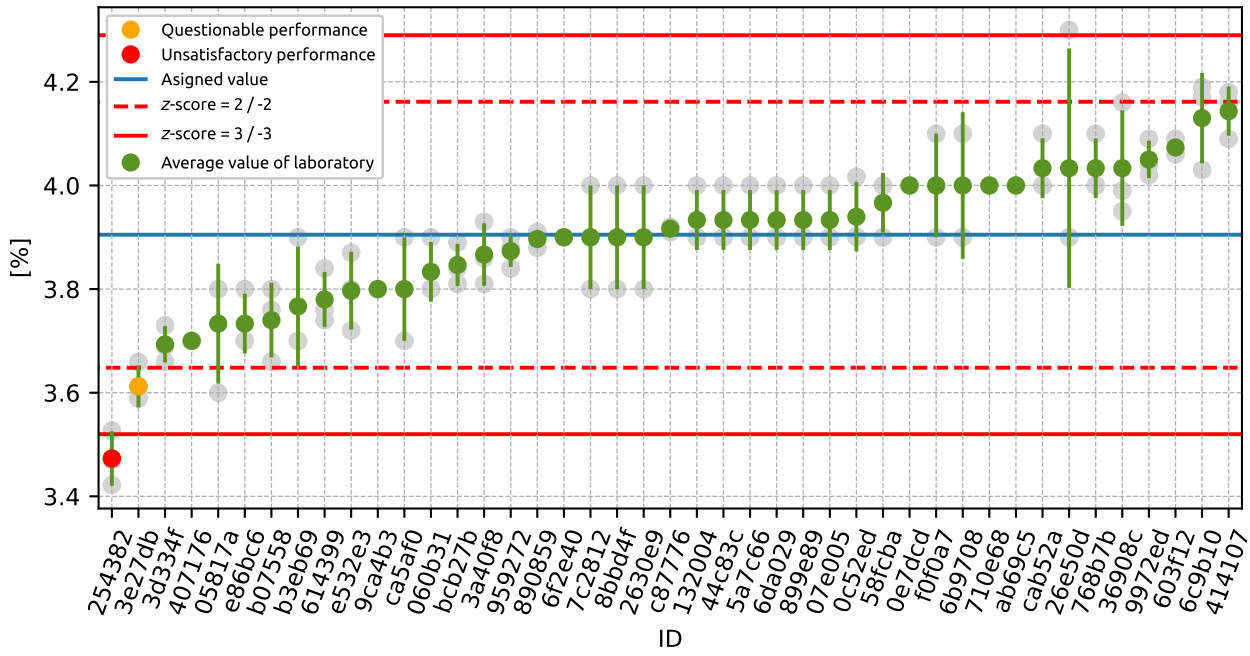

Figure 6: Average values and sample standard deviations

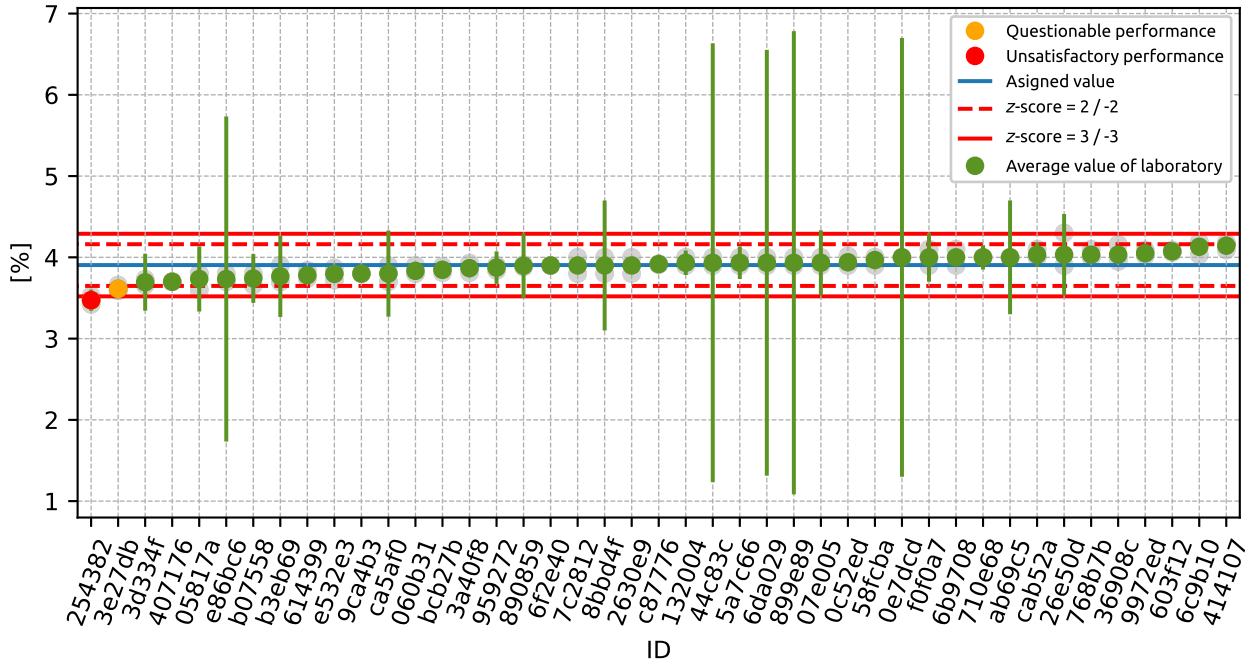

Figure 7: Average values and extended uncertainties of measurement

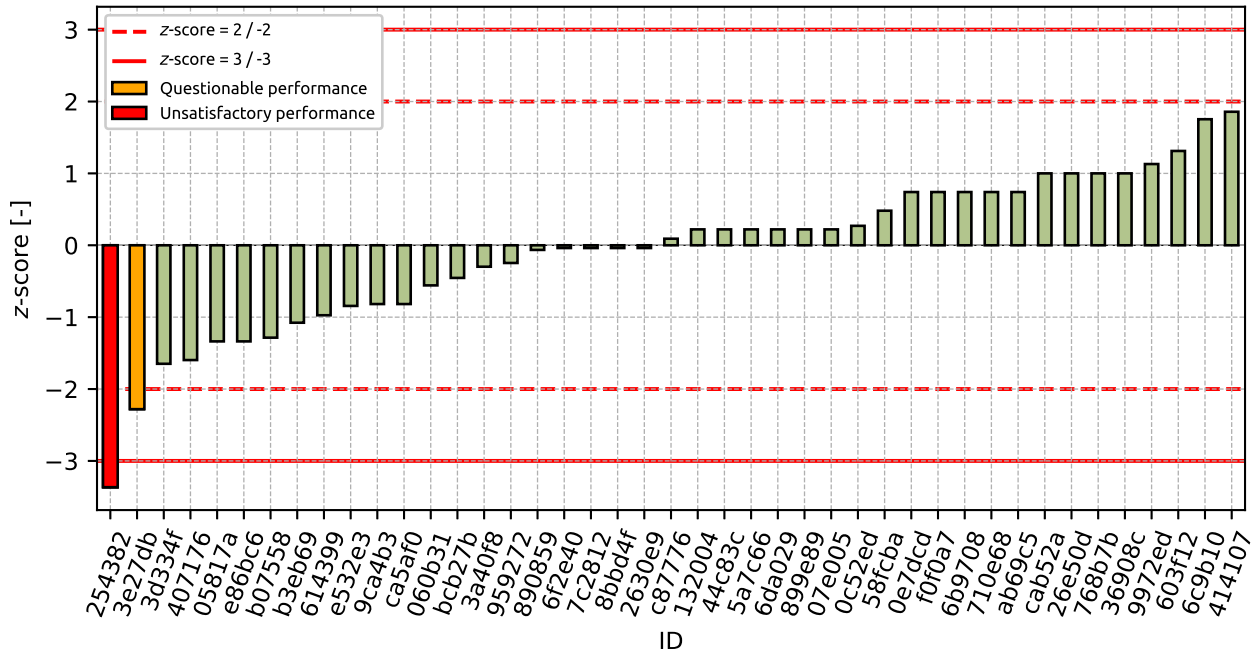

Figure 8: z-score

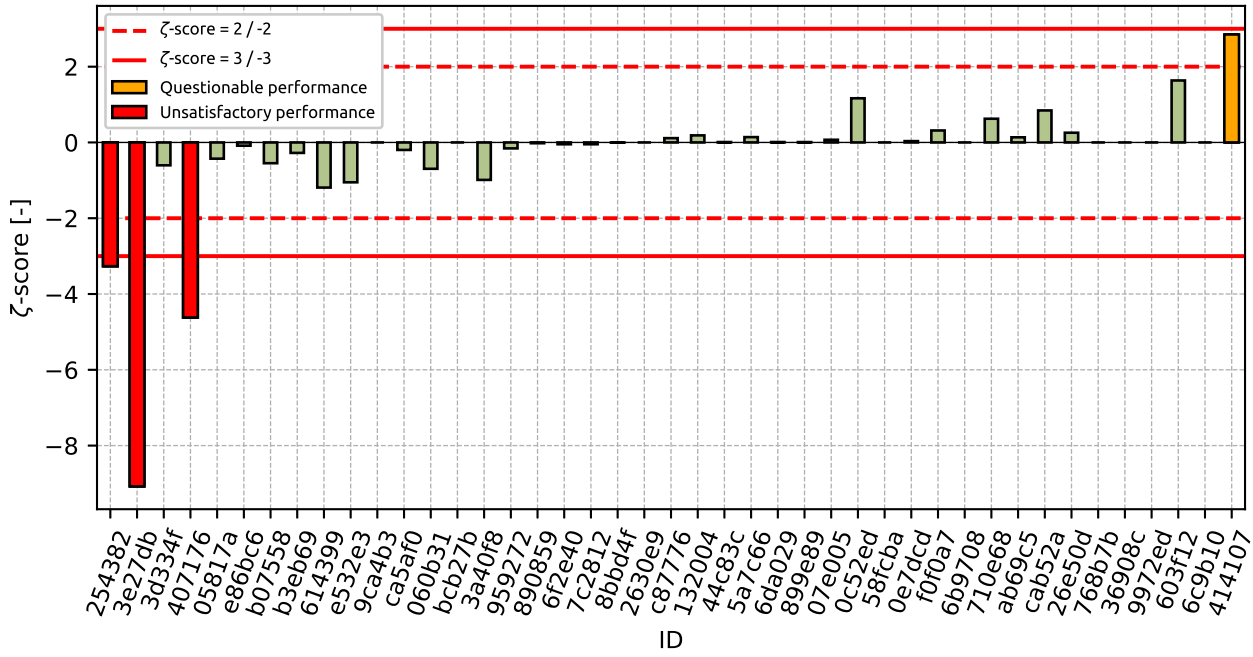

Figure 9: ζ-score

Table 6: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
254382	-3.37	-3.27
3e27db	-2.28	-9.08
3d334f	-1.65	-0.6
407176	-1.6	-4.62
05817a	-1.34	-0.43
e86bc6	-1.34	-0.09
b07558	-1.29	-0.55
b3eb69	-1.08	-0.28
614399	-0.97	-1.19
e532e3	-0.84	-1.05
9ca4b3	-0.82	-
ca5af0	-0.82	-0.2
060b31	-0.56	-0.7
bcb27b	-0.45	-
3a40f8	-0.3	-0.99
959272	-0.25	-0.16
890859	-0.06	-0.02
6f2e40	-0.04	-0.05
7c2812	-0.04	-0.05
8bbd4f	-0.04	-0.01
2630e9	-0.04	-
c87776	0.09	0.11
132004	0.22	0.19
44c83c	0.22	0.01
5a7c66	0.22	0.14
6da029	0.22	0.01
899e89	0.22	0.01
07e005	0.22	0.07
0c52ed	0.27	1.17
58fcba	0.48	-
0e7dcd	0.74	0.04
f0f0a7	0.74	0.32
6b9708	0.74	-
710e68	0.74	0.63
ab69c5	0.74	0.14
cab52a	1.0	0.84
26e50d	1.0	0.26
768b7b	1.0	-
36908c	1.0	-
9972ed	1.13	-
603f12	1.31	1.64
6c9b10	1.75	-
414107	1.86	2.85

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 [%]
414107	2.61	2.6	2.62	0.1	2.61	0.01	0.38
3d334f	2.62	2.62	2.63	0.01	2.63	0.001	0.02
9ca4b3	2.64	2.64	2.62	-	2.63	0.012	0.44
f0f0a7	2.63	2.64	2.64	0.03	2.64	0.006	0.22
b3eb69	2.64	2.64	2.64	0.14	2.64	0.0	0.0
e86bc6	2.64	2.63	2.69	0.02	2.65	0.032	1.21
e532e3	2.65	2.66	2.65	0.2	2.65	0.006	0.22
768b7b	2.66	2.66	2.65	-	2.66	0.006	0.22
36908c	2.68	2.65	2.66	-	2.66	0.015	0.57
05817a	2.66	2.66	2.68	0.02	2.67	0.012	0.43
6c9b10	2.66	2.67	2.67	-	2.67	0.002	0.08
26e50d	2.7	2.66	2.65	0.14	2.67	0.026	0.99
58fcba	2.68	2.68	2.67	-	2.68	0.006	0.22
da3822	2.68	2.68	2.68	0.03	2.68	0.0	0.0
ab69c5	2.7	2.7	2.7	0.01	2.7	0.0	0.0
adaf6b	2.72	2.72	2.72	-	2.72	0.0	0.0
717a59	2.72	2.73	2.71	0.05	2.72	0.01	0.37
a7b1ba	2.73	2.73	2.74	0.02	2.73	0.002	0.08
3a40f8	2.73	2.74	2.73	0.04	2.73	0.006	0.21

2.2 The Numerical Procedure for Determining Outliers

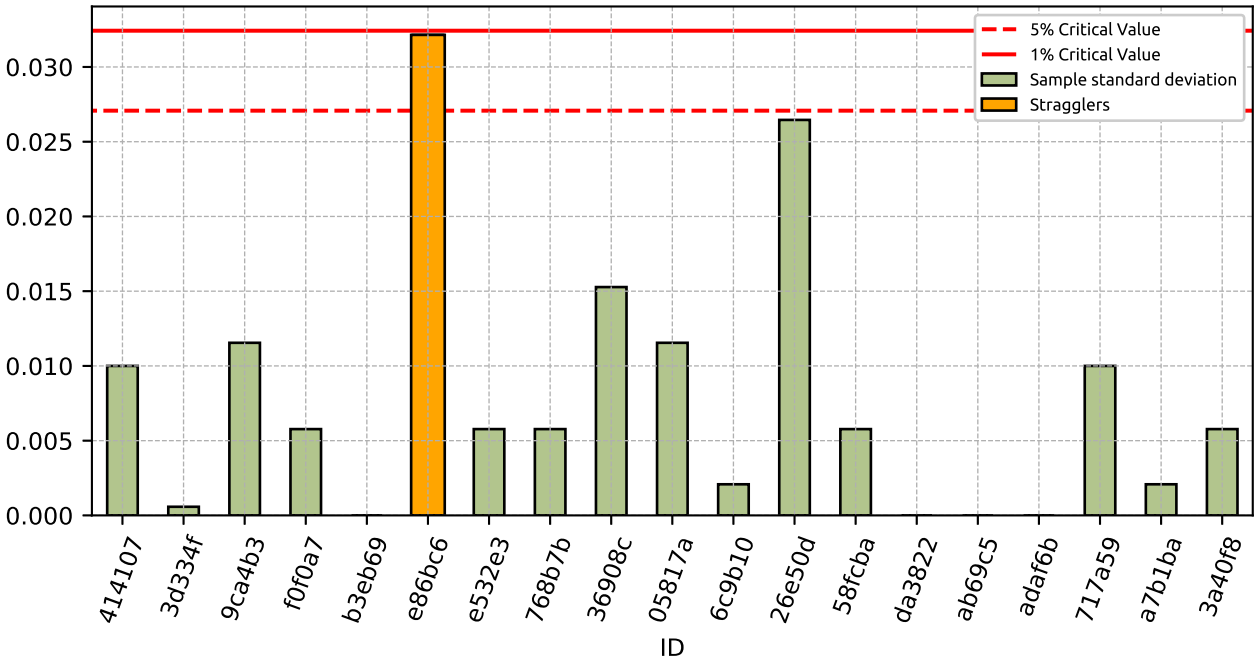

Figure 10: **Cochran's test** - sample standard deviations

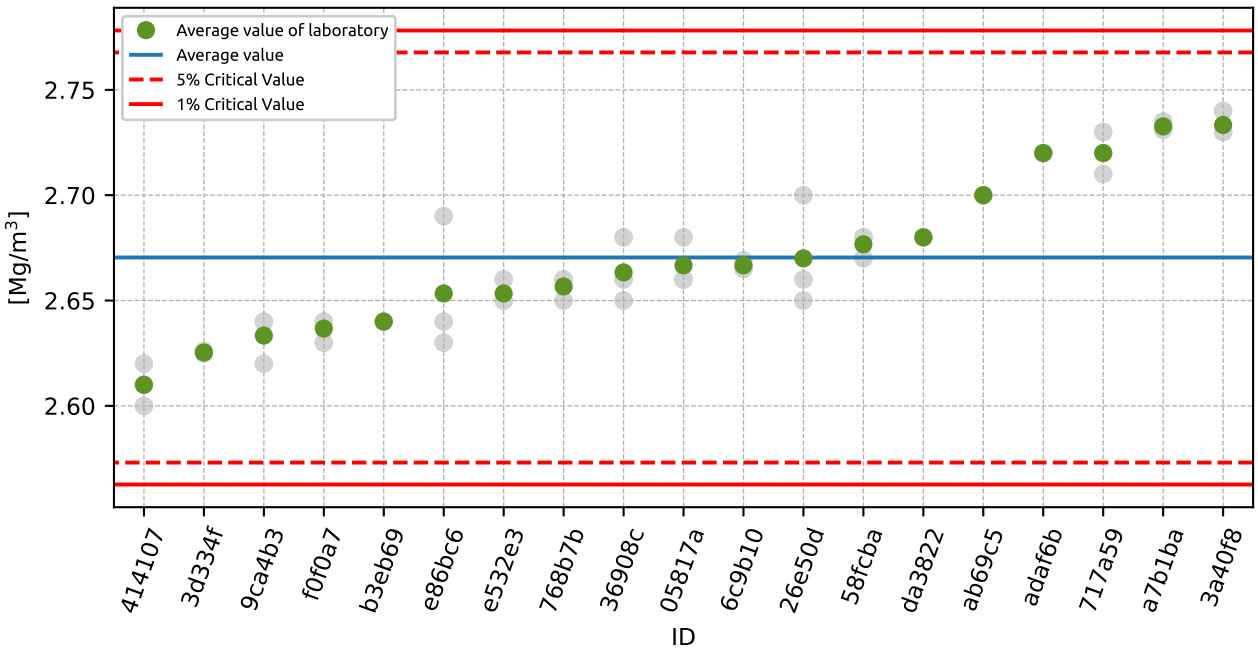

Figure 11: **Grubbs' test** - average values

2.3 Mandel's Statistics

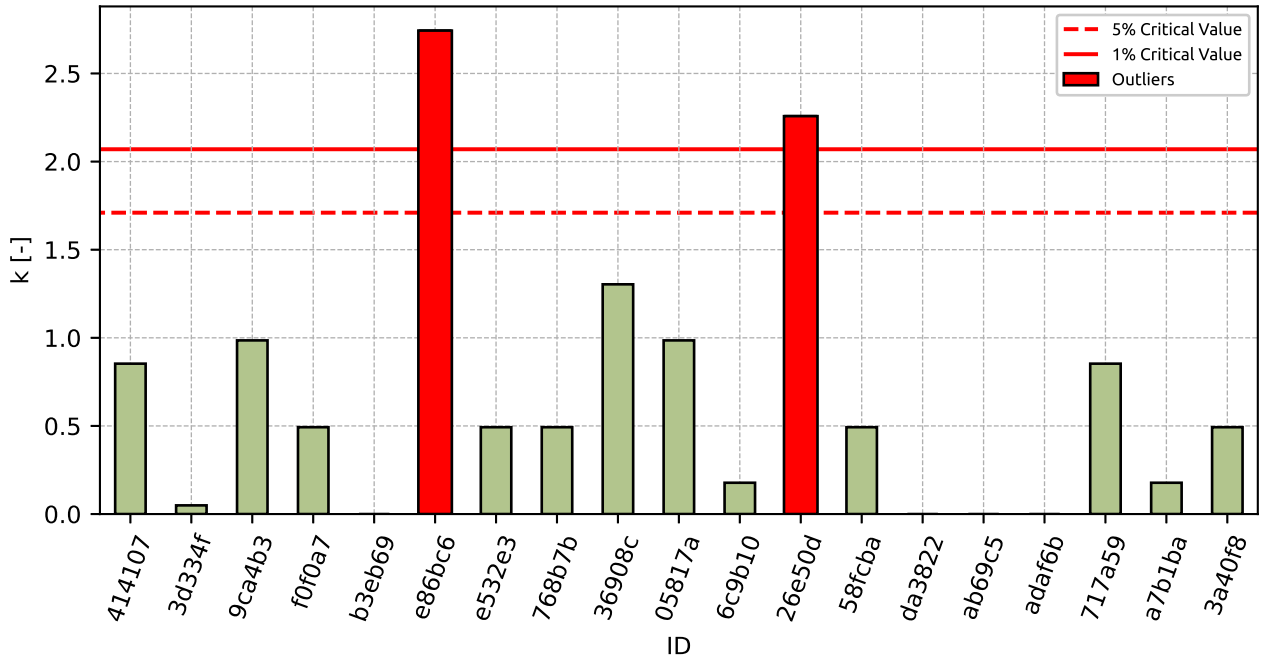

Figure 12: Intralaboratory Consistency Statistic

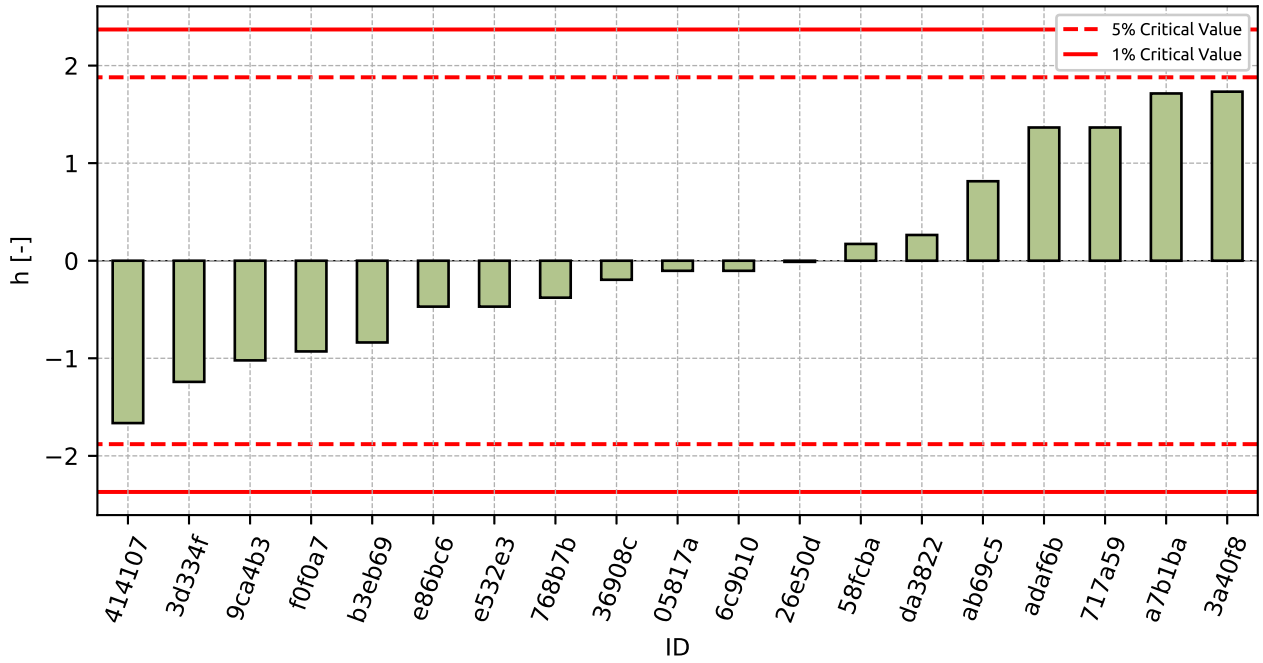

Figure 13: Interlaboratory Consistency Statistic

2.4 Descriptive statistics

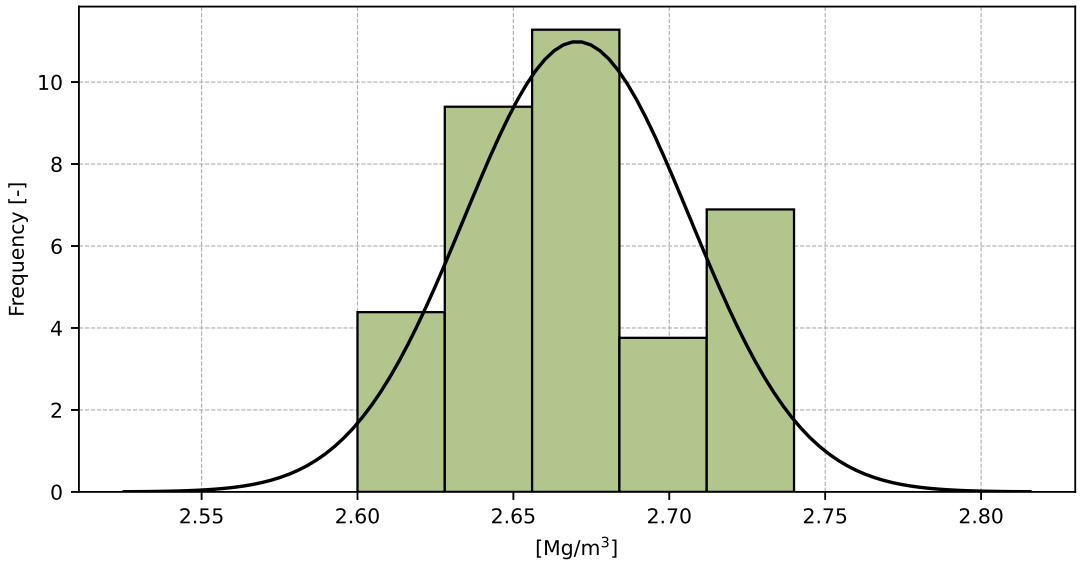

Figure 14: Histogram of all test results

Table 8: Descriptive statistics

Characteristics	**[Mg/m^3]**
Average value – $\bar{x}$	2.67
Sample standard deviation – s	0.036
Asigned value – x^*	2.67
Robust standard deviation – s^*	0.039
Measurement uncertainty of asigned value – u_X	0.011
p-value of normality test	0.021 [-]
Interlaboratory standard deviation – s_L	0.036
Repeatability standard deviation – s_r	0.012
Reproducibility standard deviation – s_R	0.038
Repeatability – r	0.03
Reproducibility – R	0.11

2.5 Evaluation of Performance Statistics

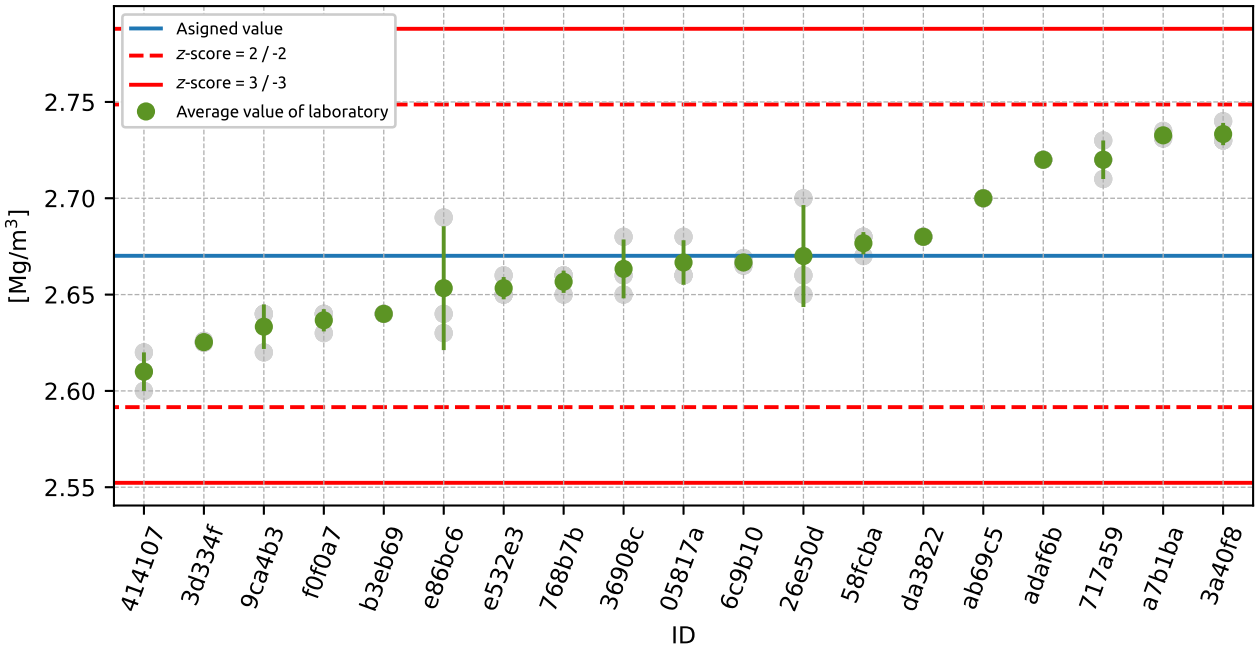

Figure 15: Average values and sample standard deviations

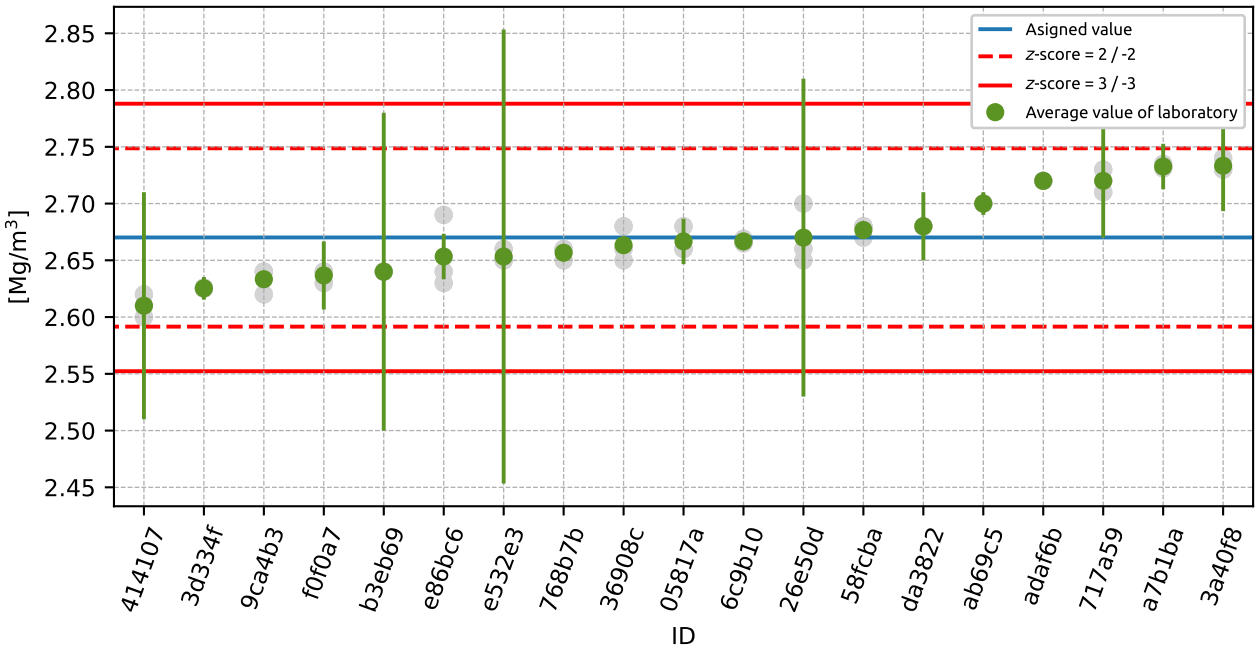

Figure 16: Average values and extended uncertainties of measurement

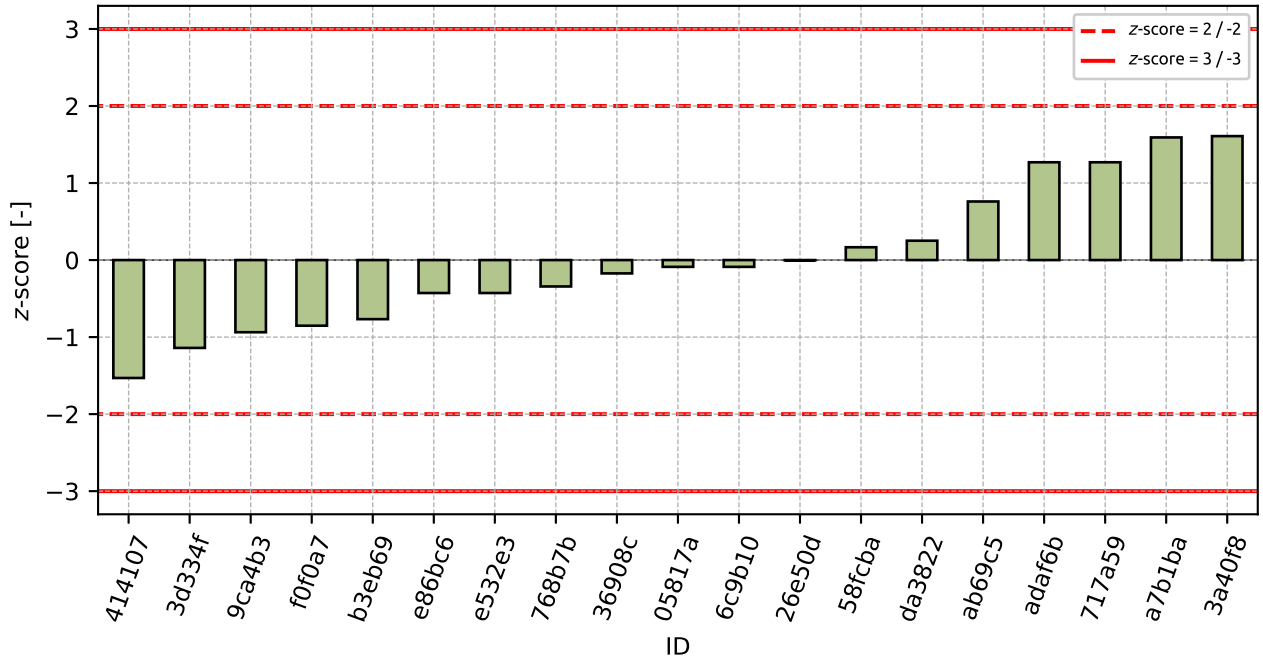

Figure 17: z-score

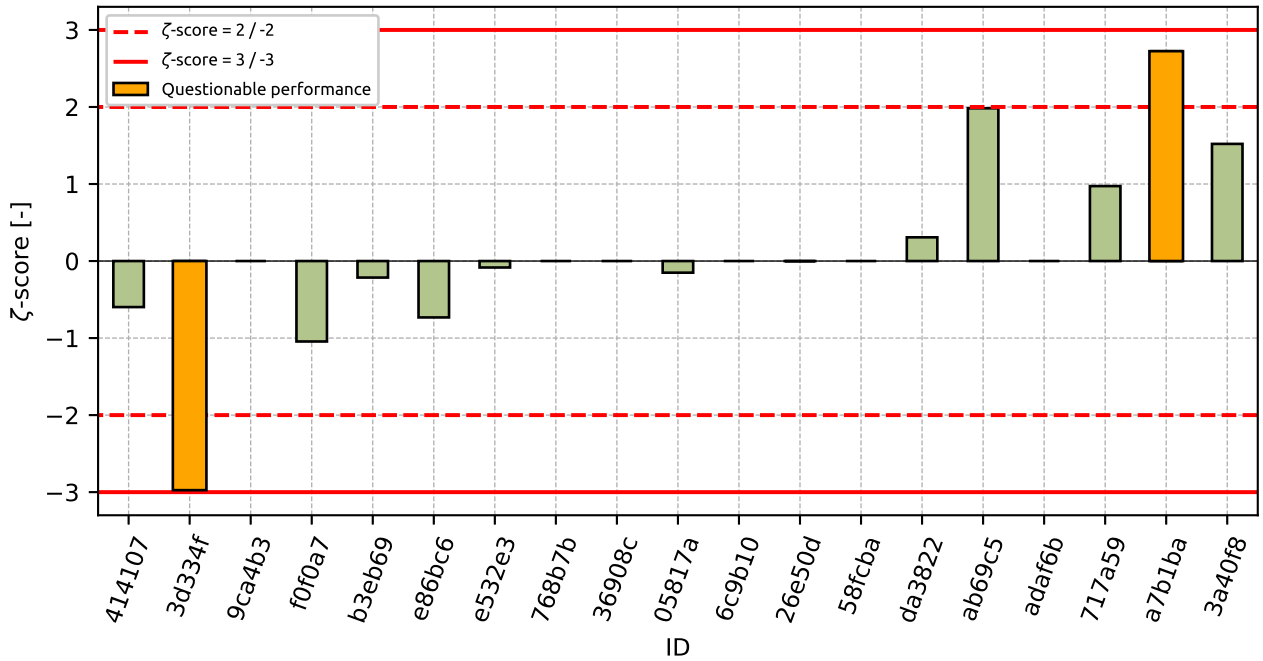

Figure 18: ζ-score

Table 9: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
414107	-1.53	-0.6
3d334f	-1.14	-2.97
9ca4b3	-0.94	-
f0f0a7	-0.85	-1.04
b3eb69	-0.77	-0.21
e86bc6	-0.43	-0.73
e532e3	-0.43	-0.08
768b7b	-0.34	-
36908c	-0.17	-
05817a	-0.09	-0.15
6c9b10	-0.09	-
26e50d	-0.0	-0.0
58fcba	0.17	-
da3822	0.25	0.31
ab69c5	0.76	1.98
adaf6b	1.27	-
717a59	1.27	0.97
a7b1ba	1.59	2.72
3a40f8	1.61	1.52

3 Appendix – EN ISO 17892-4 – Particle size distribution

Table 10: Test results - Sieve through [%]

ID	Sieve through [%]						
of participant	4 mm	2 mm	1 mm	0.5 mm	0.25 mm	0.125 mm	0.063 mm
414107	95.6	82.5	57.6	31.8	11.4	2.3	1.0
768b7b	95.0	77.0	52.0	28.0	10.0	6.0	1.0
26e50d	93.0	75.0	55.0	25.0	2.0	2.0	2.0
b3eb69	95.0	82.0	57.0	32.0	10.0	4.0	2.0
ab69c5	94.0	80.1	55.8	29.9	10.5	2.2	1.2
e86bc6	90.3	89.1	87.1	82.8	75.2	72.6	3.5
603f12	95.5	81.2	57.4	30.4	9.3	1.5	0.3
8bbd4f	96.0	81.0	56.0	29.0	10.0	2.0	1.0
adaf6b	96.0	82.0	58.0	32.0	12.0	3.0	1.6
9ca4b3	95.5	82.7	58.7	34.0	14.7	6.5	5.4
959272	96.0	85.5	58.5	33.1	14.3	5.4	4.2
3e27db	95.0	81.0	57.0	31.0	12.0	3.0	2.0
6b9708	94.7	81.6	69.6	44.7	17.0	3.5	1.8
a17694	97.1	85.9	61.4	33.7	11.7	2.3	1.2
154ca0	96.0	82.0	57.0	31.0	10.0	2.0	1.0
1520a4	95.0	81.0	56.0	30.0	10.0	2.0	2.0
2630e9	96.0	82.0	58.0	31.0	10.0	2.0	1.0
9aa5b6	94.6	80.0	56.3	30.5	9.6	2.4	1.3
6c9b10	96.4	83.3	65.6	31.9	9.3	1.6	0.5
e532e3	96.1	82.9	57.5	30.6	10.4	1.7	0.4
36908c	97.3	85.2	60.6	31.8	10.6	2.2	0.7
3d334f	95.4	81.3	56.6	30.6	10.5	1.5	0.3
05817a	94.7	80.7	54.1	27.9	7.9	1.9	0.8
58fcba	94.8	82.1	59.6	32.1	11.5	1.7	0.8
6f2e40	96.0	82.0	58.0	32.0	11.0	3.0	1.0
5a7c66	95.8	81.6	57.5	31.5	11.2	2.5	1.1
254382	95.4	80.3	61.1	30.6	10.5	4.1	0.8
f0f0a7	99.4	95.9	56.3	30.6	10.8	2.4	1.0
a7b1ba	95.5	82.0	58.0	31.1	10.6	1.9	0.6

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}	2.264	2.059	1.799	1.995	3.494	0.927	0.954
G_{max}	3.309	3.972	3.41	4.194	2.55	2.823	3.648
$G_{0.05}$	2.876	2.876	2.876	2.876	2.876	2.876	2.876
$G_{0.01}$	3.199	3.199	3.199	3.199	3.199	3.199	3.199

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}	2.761	2.988	2.207	3.169	2.006	0.927	1.506
G_{max}	2.067	1.928	3.104	1.702	2.761	2.823	1.725
$G_{0.05}$	2.859	2.859	2.859	2.859	2.841	2.876	2.841
$G_{0.01}$	3.178	3.178	3.178	3.178	3.157	3.199	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
414107	0.16	0.39	-0.02	0.51	0.45	-0.33	-0.18
768b7b	-0.52	-1.98	-2.21	-1.55	-0.53	2.45	-0.18
26e50d	-2.76	-2.99	-1.04	-3.17	-	-0.55	1.73
b3eb69	-0.52	0.17	-0.25	0.62	-0.53	0.95	1.73
ab69c5	-1.64	-0.69	-0.72	-0.52	-0.18	-0.4	0.2
603f12	0.05	-0.19	-0.1	-0.25	-1.02	-0.93	-1.51
8bbd4f	0.61	-0.28	-0.65	-1.0	-0.53	-0.55	-0.18
adaf6b	0.61	0.17	0.14	0.62	0.87	0.2	0.97
9ca4b3	0.05	0.48	0.41	1.7	2.76	2.82	-
959272	0.61	1.75	0.33	1.21	2.48	2.0	-
3e27db	-0.52	-0.28	-0.25	0.08	0.87	0.2	1.73
6b9708	-0.85	-0.01	-	-	-	0.57	1.35
a17694	1.84	1.93	1.46	1.54	0.66	-0.33	0.2
154ca0	0.61	0.17	-0.25	0.08	-0.53	-0.55	-0.18
1520a4	-0.52	-0.28	-0.65	-0.46	-0.53	-0.55	1.73
2630e9	0.61	0.17	0.14	0.08	-0.53	-0.55	-0.18
9aa5b6	-0.96	-0.73	-0.53	-0.19	-0.81	-0.25	0.39
6c9b10	1.06	0.76	3.1	0.57	-1.02	-0.85	-1.13
e532e3	0.72	0.57	-0.06	-0.14	-0.25	-0.78	-1.32
36908c	2.07	1.61	1.15	0.51	-0.11	-0.4	-0.75
3d334f	-0.07	-0.15	-0.41	-0.14	-0.18	-0.93	-1.51
05817a	-0.85	-0.42	-1.39	-1.6	-2.01	-0.63	-0.56
58fcba	-0.74	0.21	0.76	0.67	0.52	-0.78	-0.56
6f2e40	0.61	0.17	0.14	0.62	0.17	0.2	-0.18
5a7c66	0.38	-0.01	-0.06	0.35	0.31	-0.18	0.01
254382	-0.07	-0.6	1.35	-0.14	-0.18	1.02	-0.56
f0f0a7	-	-	-0.53	-0.14	0.03	-0.25	-0.18
a7b1ba	0.05	0.17	0.14	0.13	-0.11	-0.63	-0.94

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

4.1 50 – 100 kPa

4.1.1 Test results

Table 14: 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]
c87776	4.76	0.2
717a59	5.1	0.4
e532e3	5.39	-
307a20	7.11	-
36908c	7.75	-
e56609	8.86	-
bcb27b	9.26	-
559fc9	11.1	3.4
6c9b10	11.81	-
3d334f	12.35	2.0
9972ed	14.9	-
58fcba	16.73	-
768b7b	18.5	-
a7b1ba	21.2	-
9ca4b3	25.3	-

4.1.2 The Numerical Procedure for Determining Outliers

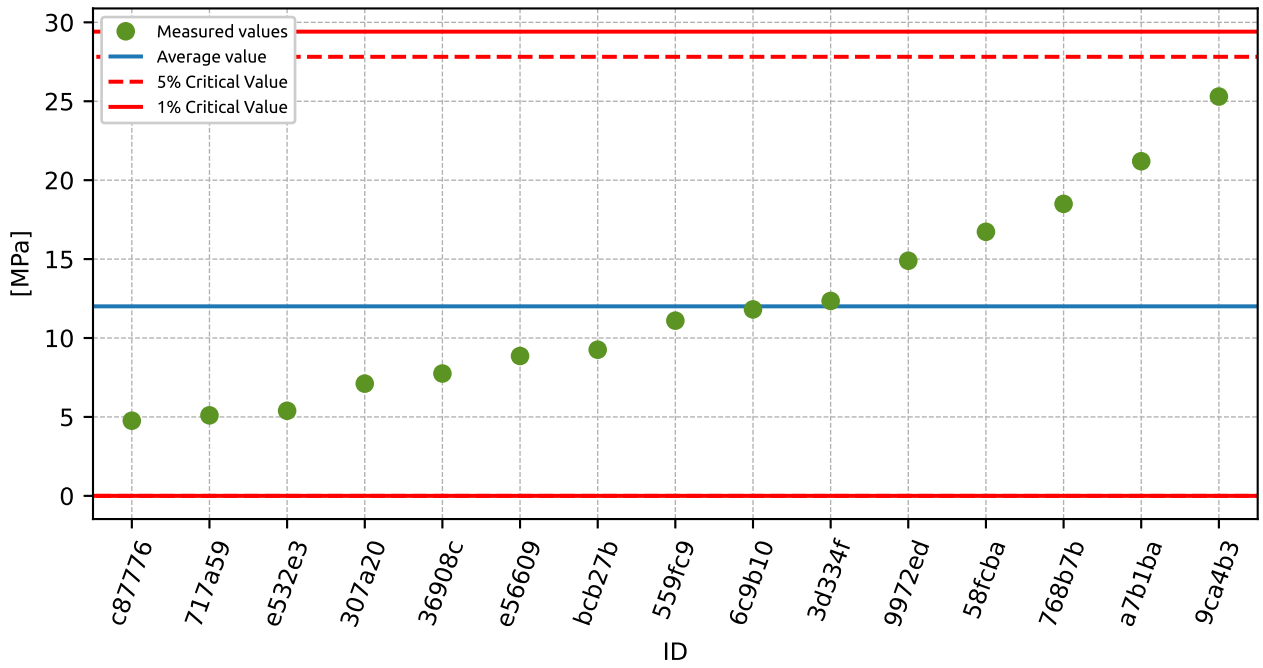

Figure 19: **Grubbs' test** - average values

4.1.3 Mandel's Statistics

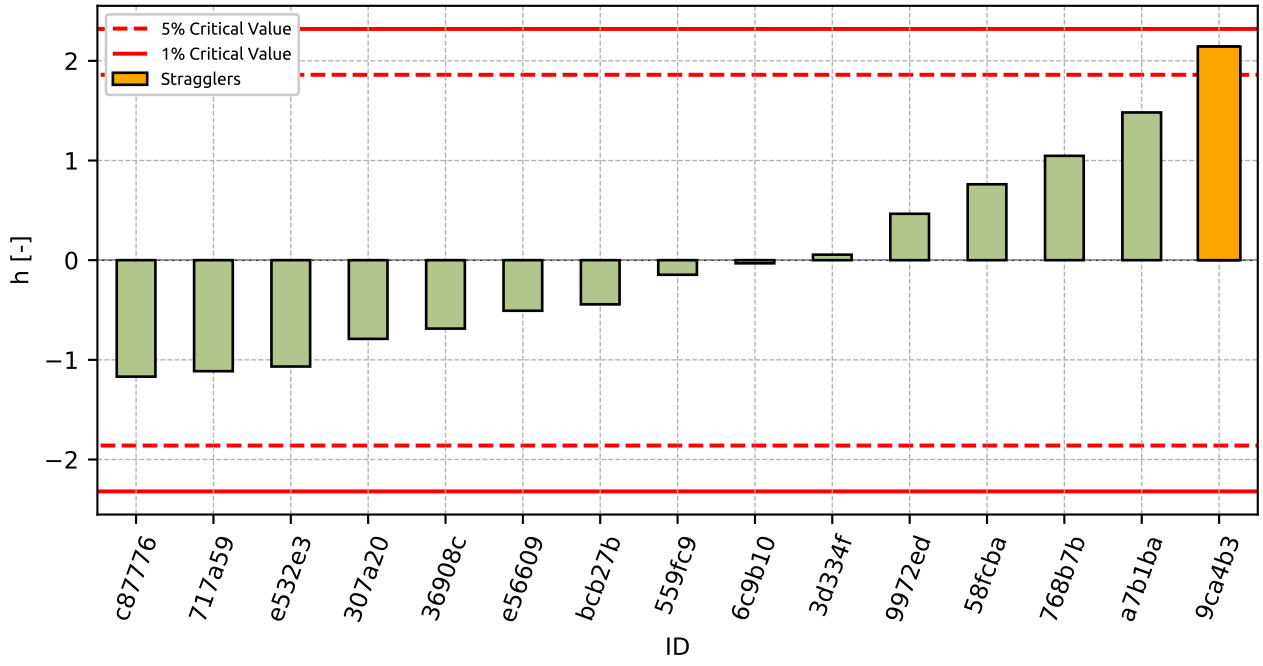

Figure 20: Interlaboratory Consistency Statistic

4.1.4 Descriptive statistics

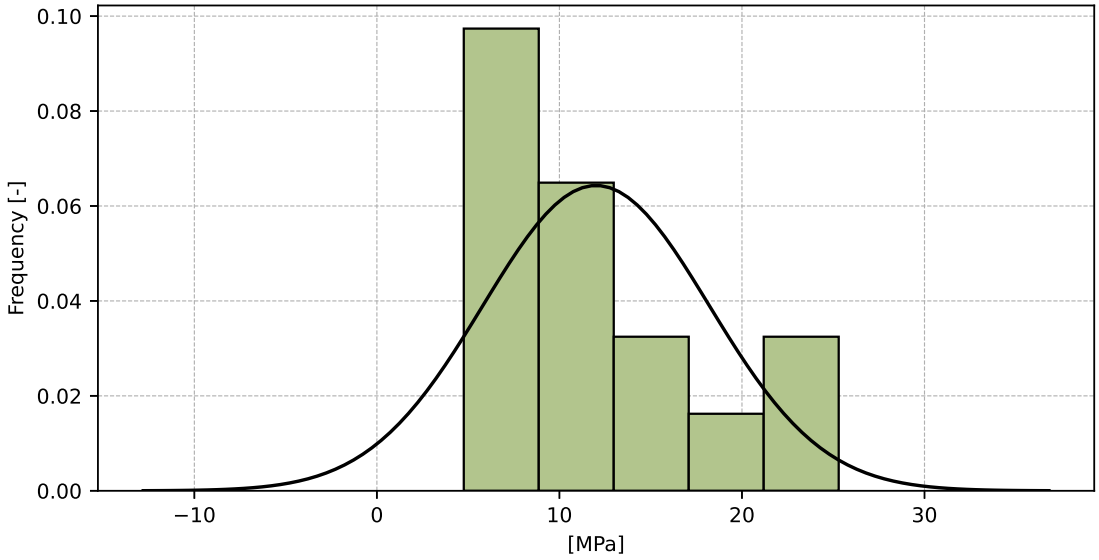

Figure 21: Histogram of all test results

Table 15: Descriptive statistics

Characteristics	[MPa]
Average value – $\bar{x}$	12.01
Sample standard deviation – s	6.202
Asigned value – x^*	11.93
Robust standard deviation – s^*	6.66
Measurement uncertainty of asigned value – u_X	2.15
p-value of normality test	0.26 [-]

4.1.5 Evaluation of Performance Statistics

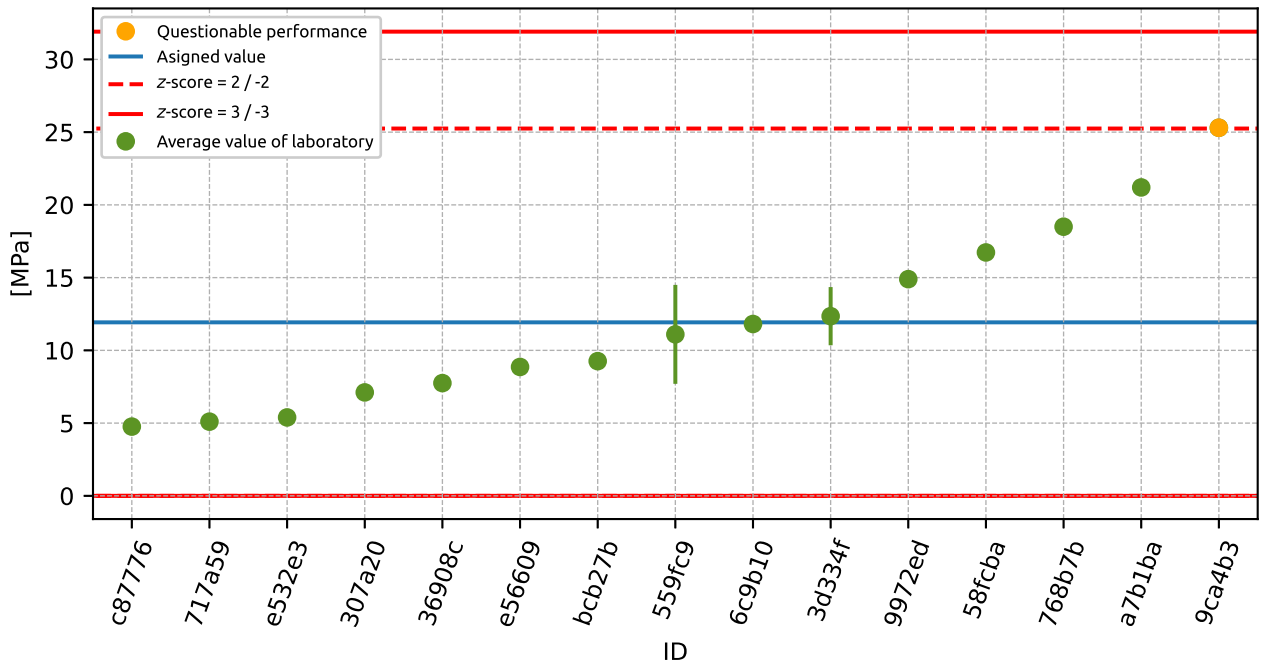

Figure 22: Average values and extended uncertainties of measurement

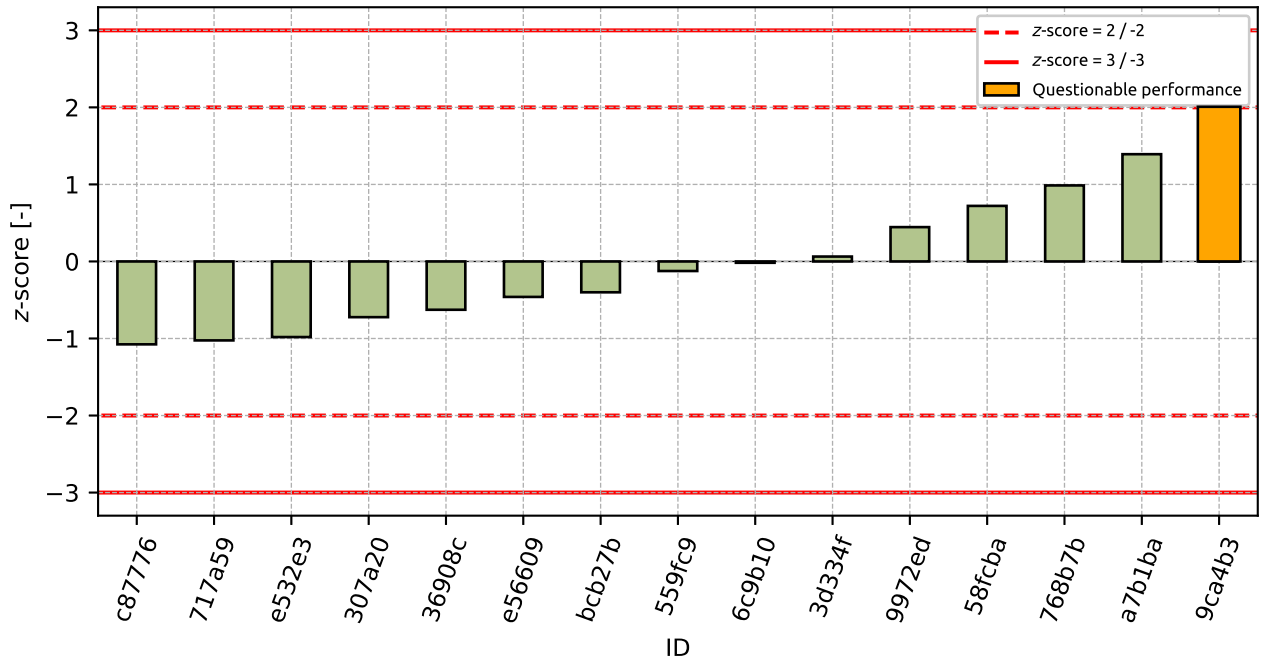

Figure 23: z-score

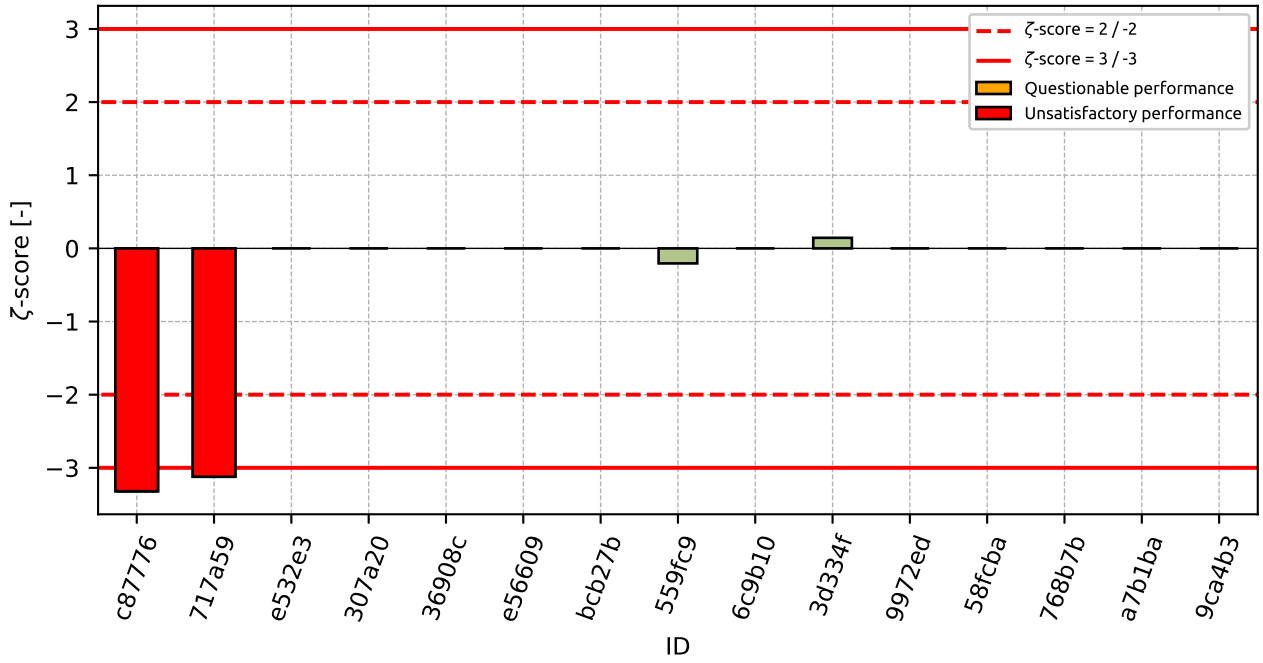

Figure 24: ζ-score

Table 16: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
c87776	-1.08	-3.32
717a59	-1.02	-3.12
e532e3	-0.98	-
307a20	-0.72	-
36908c	-0.63	-
e56609	-0.46	-
bcb27b	-0.4	-
559fc9	-0.12	-0.21
6c9b10	-0.02	-
3d334f	0.06	0.14
9972ed	0.45	-
58fcba	0.72	-
768b7b	0.99	-
a7b1ba	1.39	-
9ca4b3	2.01	-

4.2 100 – 200 kPa

4.2.1 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]
bcb27b	6.02	-
c87776	6.36	0.2
717a59	6.4	0.4
e532e3	9.03	-
559fc9	9.1	3.4
e56609	9.72	-
36908c	10.1	-
9ca4b3	10.81	-
307a20	11.17	-
3d334f	12.1	2.0
6c9b10	15.68	-
9972ed	15.78	-
58fcba	17.36	-
a7b1ba	17.8	-
768b7b	23.8	-

4.2.2 The Numerical Procedure for Determining Outliers

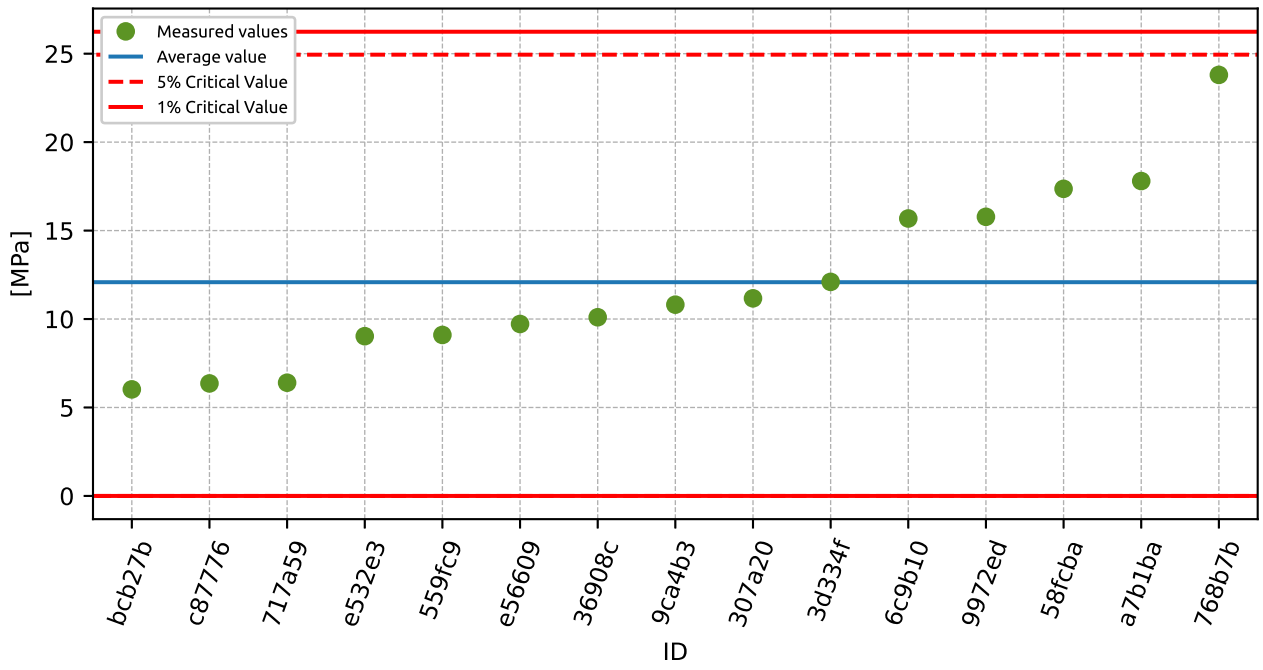

Figure 25: **Grubbs' test** - average values

4.2.3 Mandel's Statistics

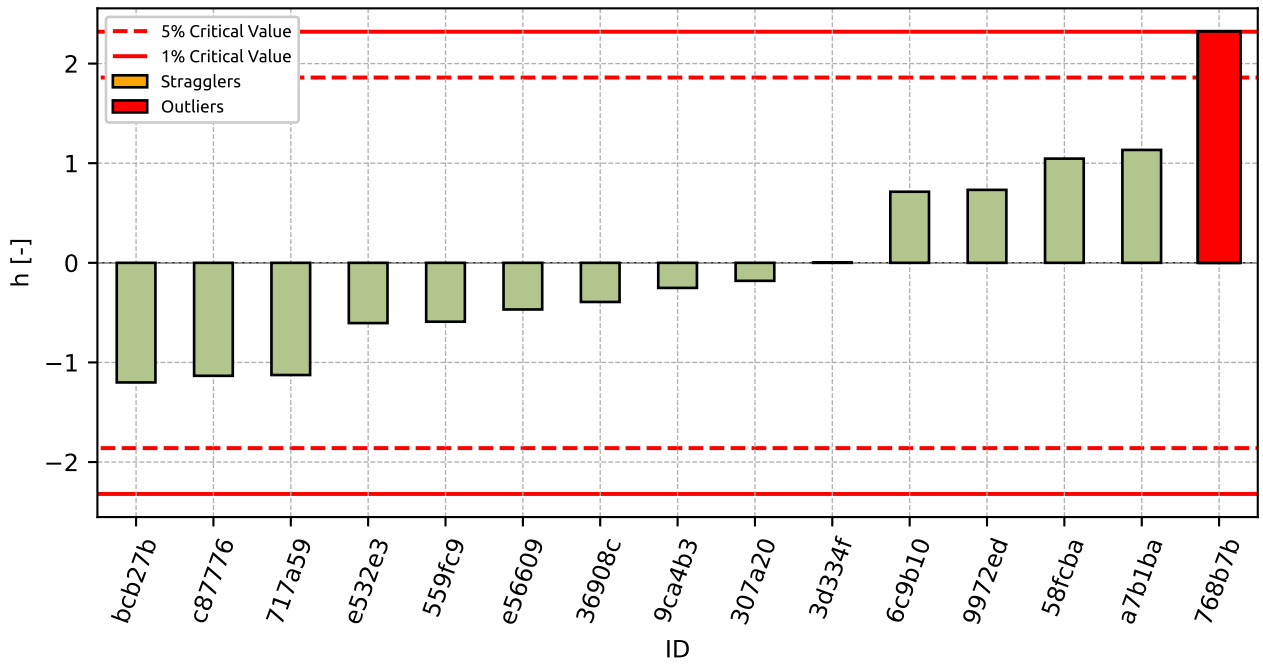

Figure 26: Interlaboratory Consistency Statistic

4.2.4 Descriptive statistics

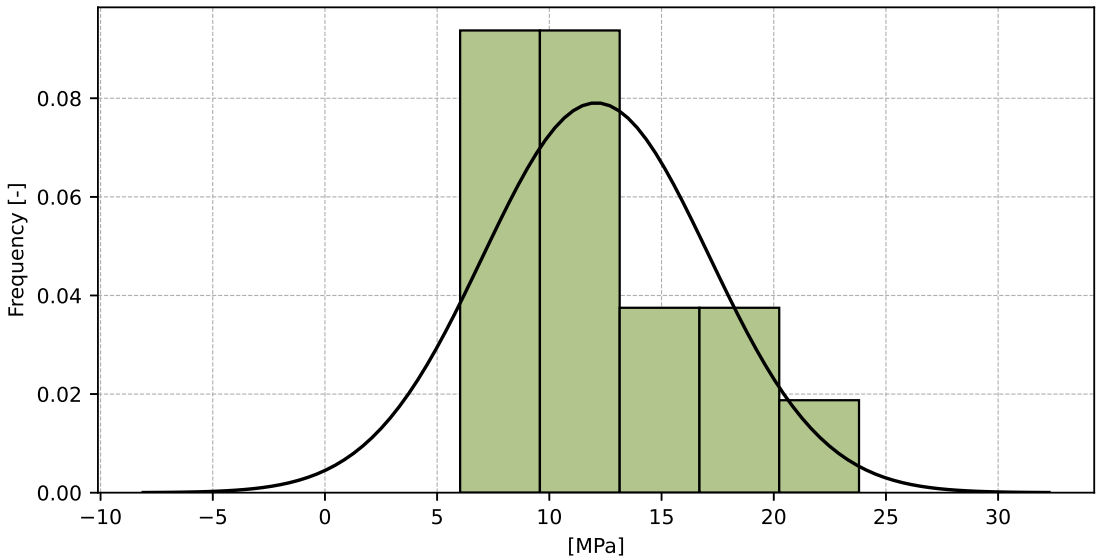

Figure 27: Histogram of all test results

Table 18: Descriptive statistics

Characteristics	[MPa]
Average value – $\bar{x}$	12.08
Sample standard deviation – s	5.045
Asigned value – x^*	12.08
Robust standard deviation – s^*	6.7
Measurement uncertainty of asigned value – u_X	1.784
p-value of normality test	0.178 [-]

4.2.5 Evaluation of Performance Statistics

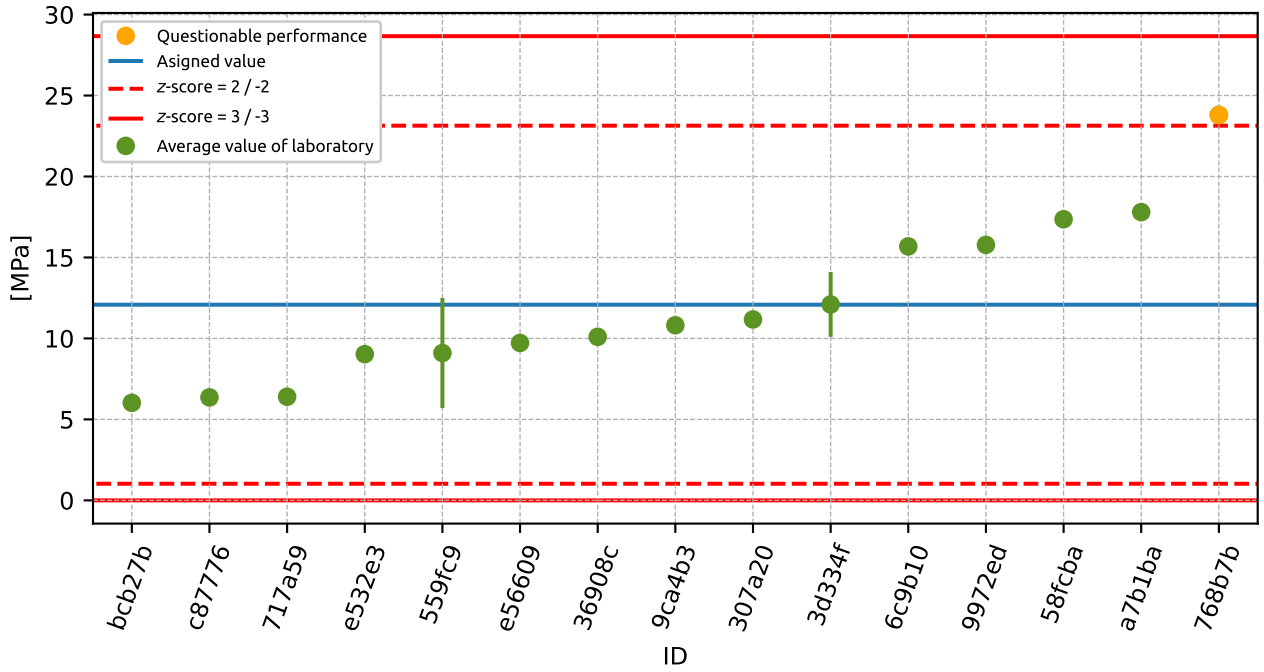

Figure 28: Average values and extended uncertainties of measurement

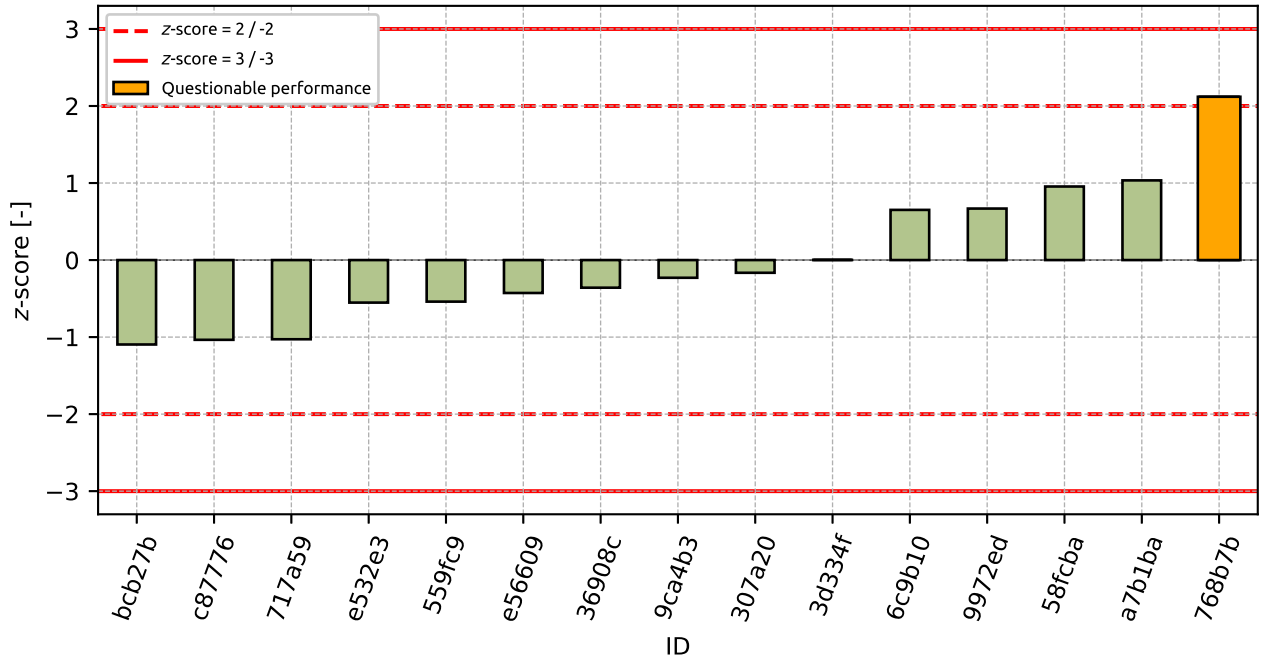

Figure 29: z-score

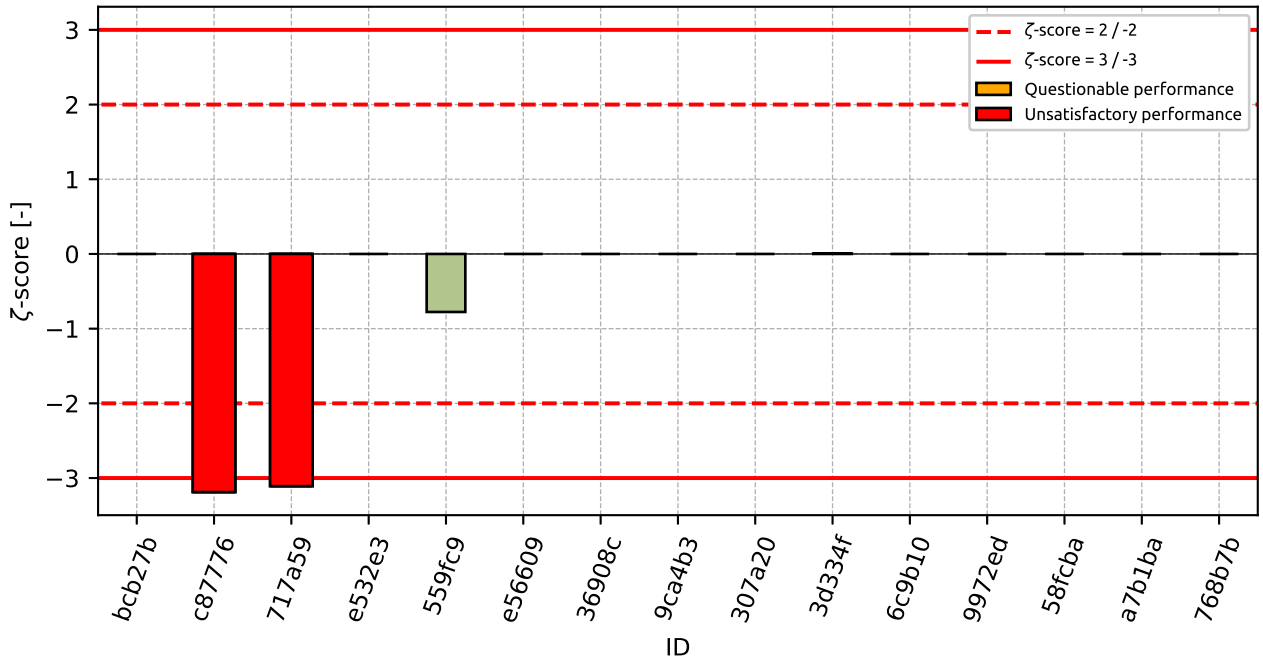

Figure 30: ζ-score

Table 19: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
bcb27b	-1.1	-
c87776	-1.04	-3.19
717a59	-1.03	-3.11
e532e3	-0.55	-
559fc9	-0.54	-0.78
e56609	-0.43	-
36908c	-0.36	-
9ca4b3	-0.23	-
307a20	-0.17	-
3d334f	0.0	0.01
6c9b10	0.65	-
9972ed	0.67	-
58fcba	0.95	-
a7b1ba	1.03	-
768b7b	2.12	-

4.3 200 – 400 kPa

4.3.1 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]
bcb27b	4.92	-
c87776	9.38	0.2
9ca4b3	10.54	-
717a59	10.8	0.8
e532e3	12.62	-
e56609	12.82	-
559fc9	12.9	3.4
3d334f	13.1	2.0
307a20	15.21	-
9972ed	16.36	-
6c9b10	17.93	-
36908c	17.94	-
58fcba	21.65	-
a7b1ba	25.0	-
768b7b	25.6	-

4.3.2 The Numerical Procedure for Determining Outliers

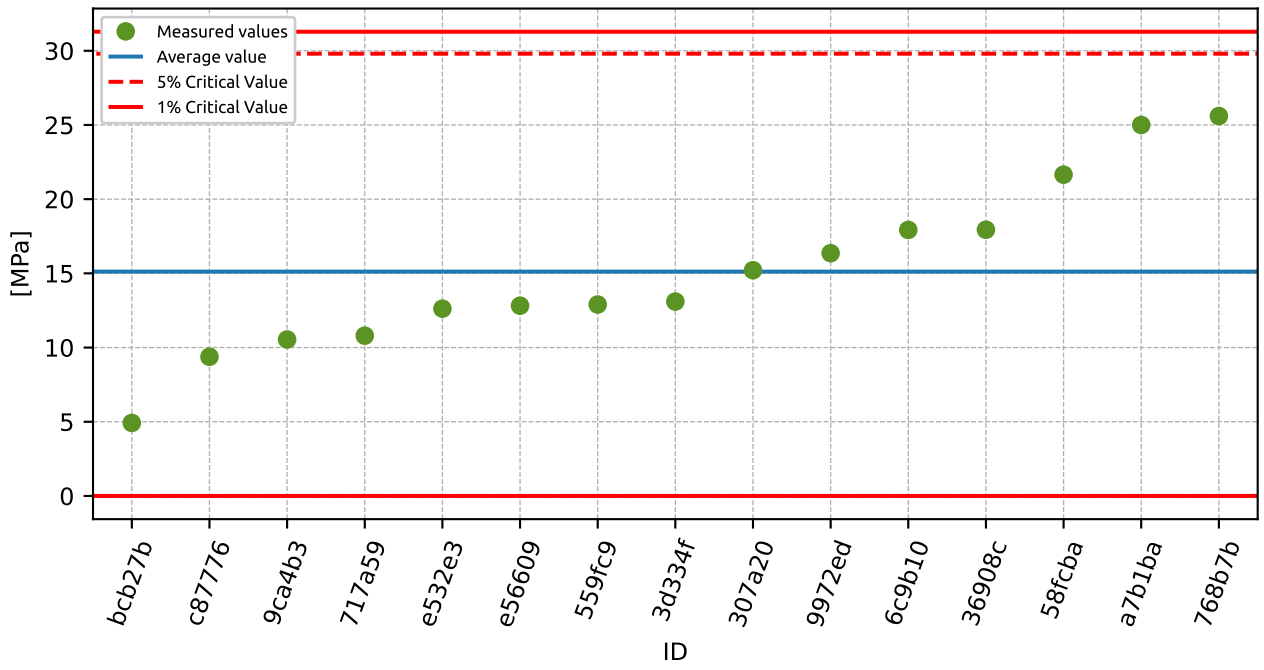

Figure 31: **Grubbs' test** - average values

4.3.3 Mandel's Statistics

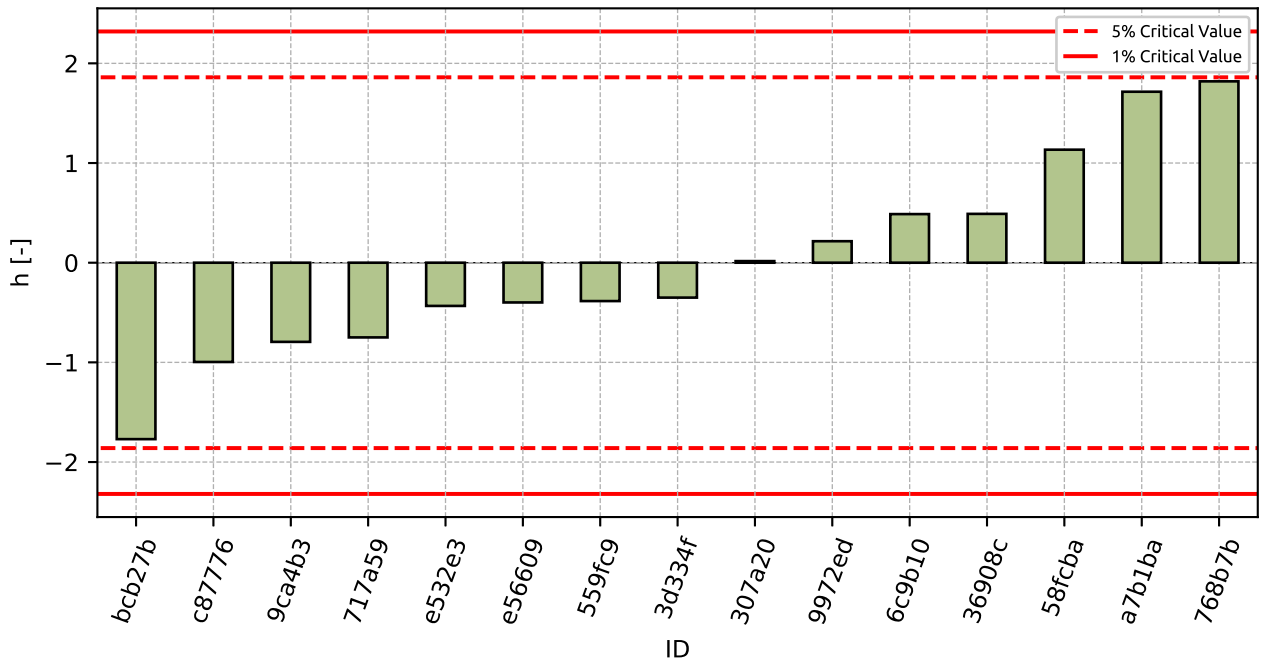

Figure 32: Interlaboratory Consistency Statistic

4.3.4 Descriptive statistics

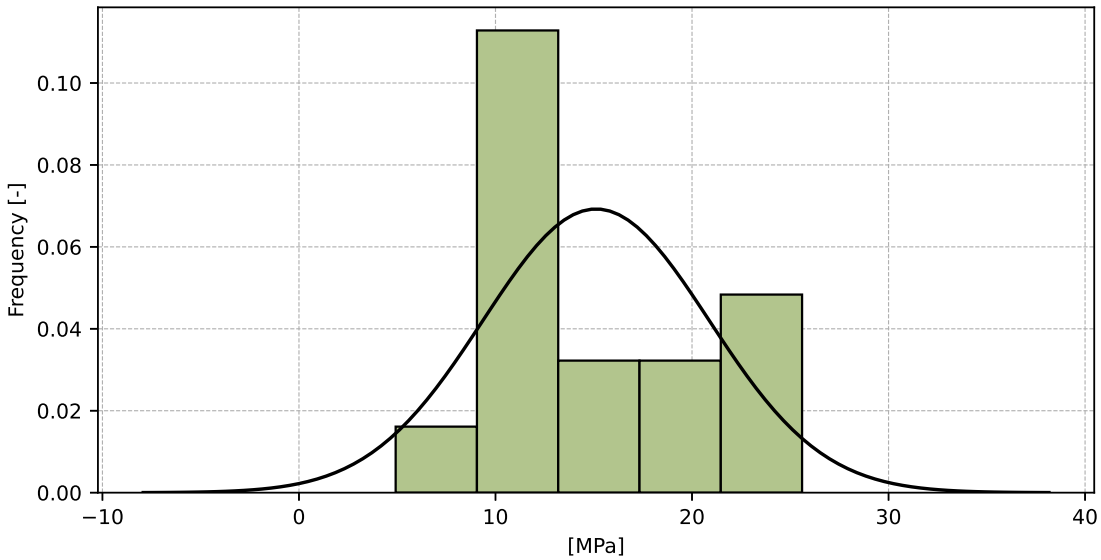

Figure 33: Histogram of all test results

Table 21: Descriptive statistics

Characteristics	[MPa]
Average value – $\bar{x}$	15.12
Sample standard deviation – s	5.761
Asigned value – x^*	14.84
Robust standard deviation – s^*	5.439
Measurement uncertainty of asigned value – u_X	1.756
p-value of normality test	0.595 [-]

4.3.5 Evaluation of Performance Statistics

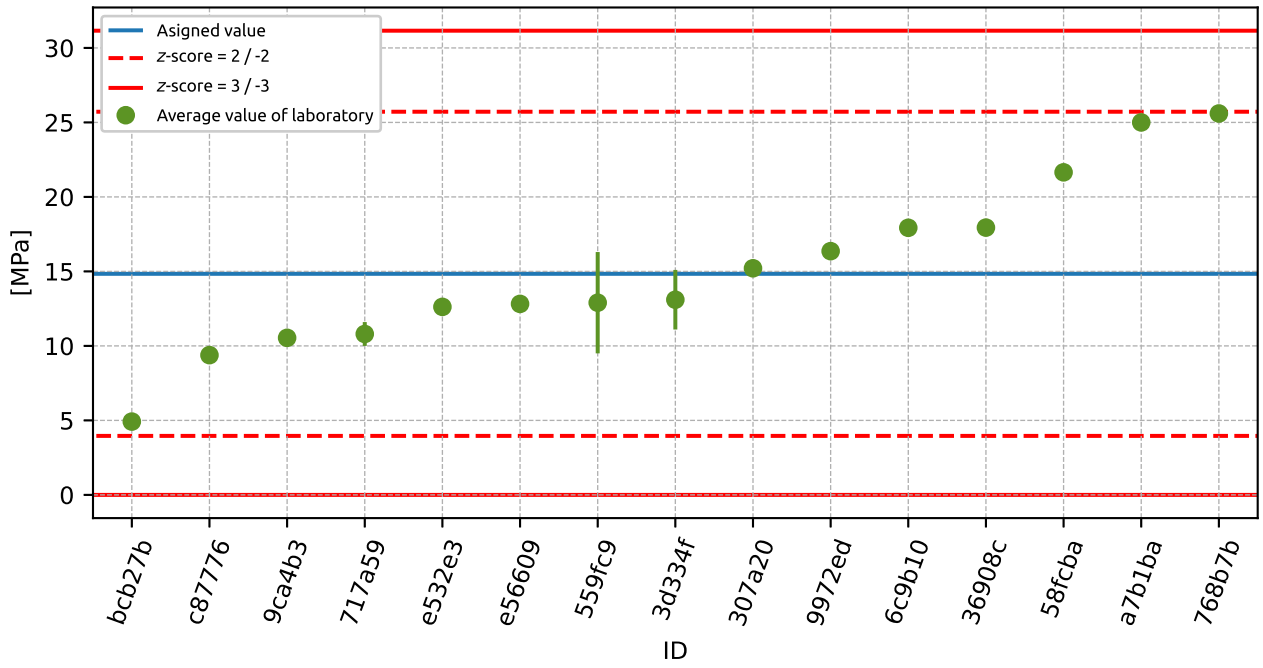

Figure 34: Average values and extended uncertainties of measurement

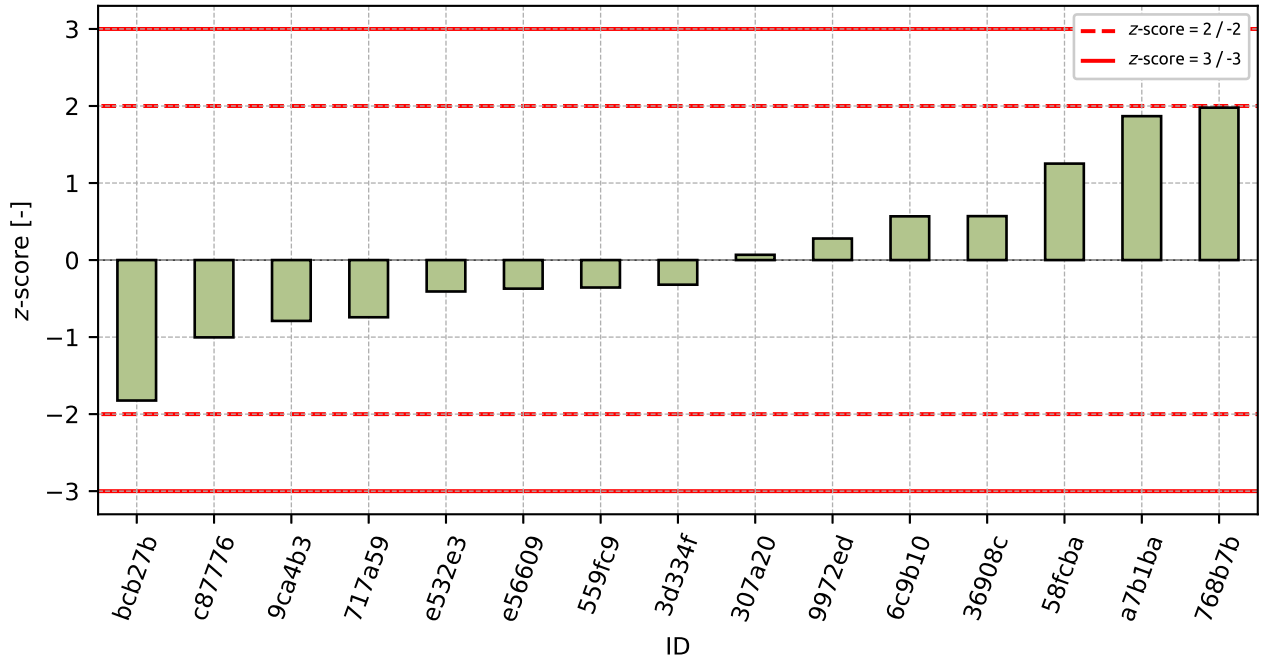

Figure 35: z-score

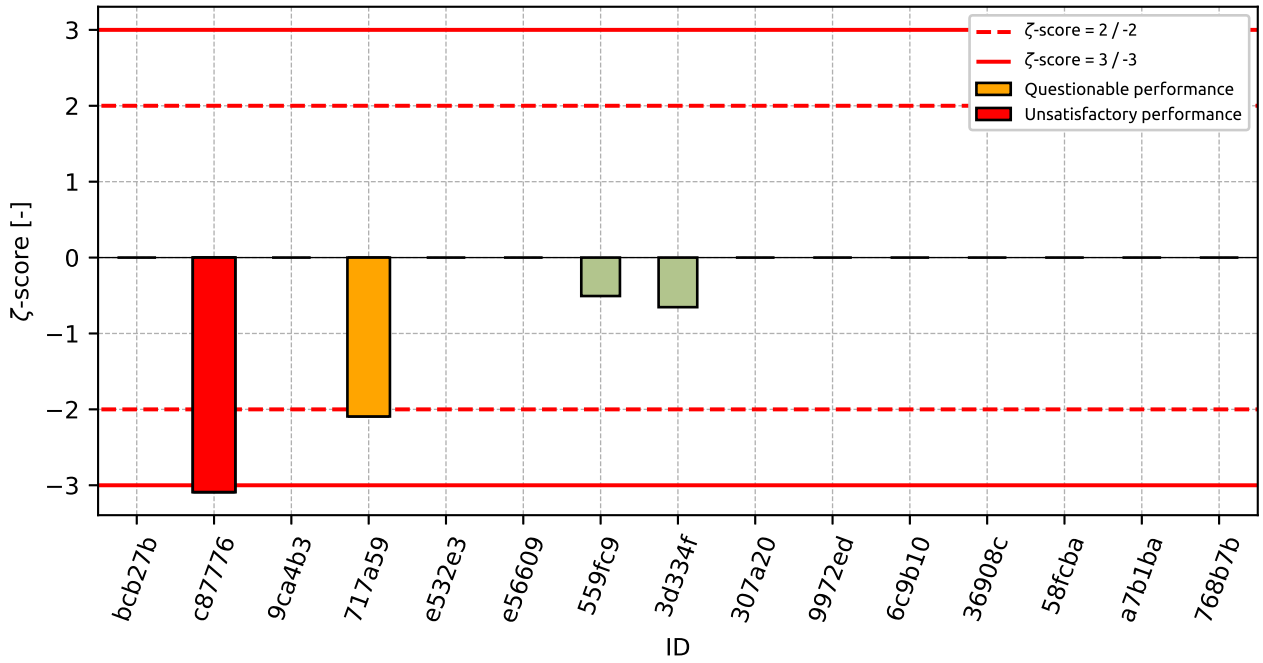

Figure 36: ζ-score

Table 22: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
bcb27b	-1.82	-
c87776	-1.0	-3.09
9ca4b3	-0.79	-
717a59	-0.74	-2.09
e532e3	-0.41	-
e56609	-0.37	-
559fc9	-0.36	-0.51
3d334f	-0.32	-0.65
307a20	0.07	-
9972ed	0.28	-
6c9b10	0.57	-
36908c	0.57	-
58fcba	1.25	-
a7b1ba	1.87	-
768b7b	1.98	-

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

5.1 Unconfined compressive strength

5.1.1 Test results

Table 23: 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 [%]
58fcba	0.184	0.189	0.201	-	-	0.191	0.0087	4.57
559fc9	0.202	0.213	0.217	0.21	0.18	0.21	0.0064	3.02
6c9b10	0.295	0.293	0.285	0.29	-	0.291	0.0043	1.5
3d334f	0.308	0.282	0.325	0.29	0.05	0.301	0.0192	6.38
7c68c6	0.293	0.299	0.313	-	-	0.302	0.0103	3.4
9ca4b3	0.305	0.302	0.311	-	-	0.306	0.0046	1.5
a7b1ba	0.328	0.337	0.324	-	-	0.33	0.0067	2.02
768b7b	0.5	0.42	0.39	-	-	0.437	0.0569	13.02

5.1.2 The Numerical Procedure for Determining Outliers

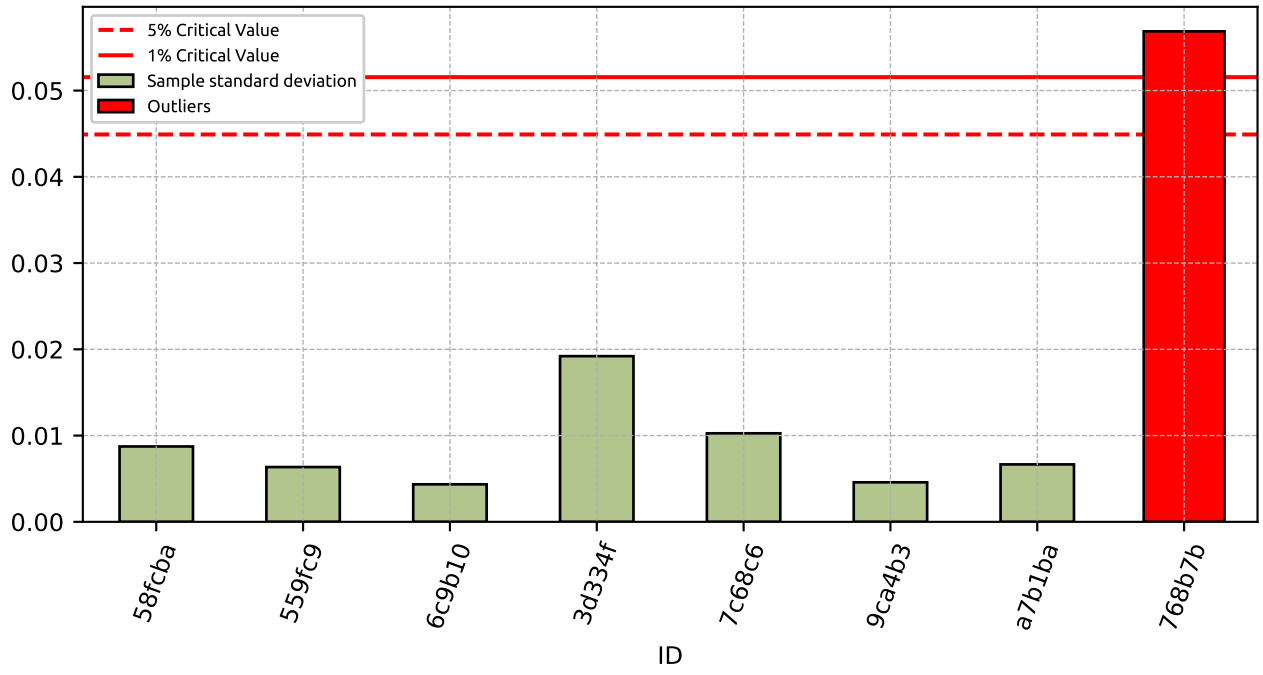

Figure 37: **Cochran's test** - sample standard deviations

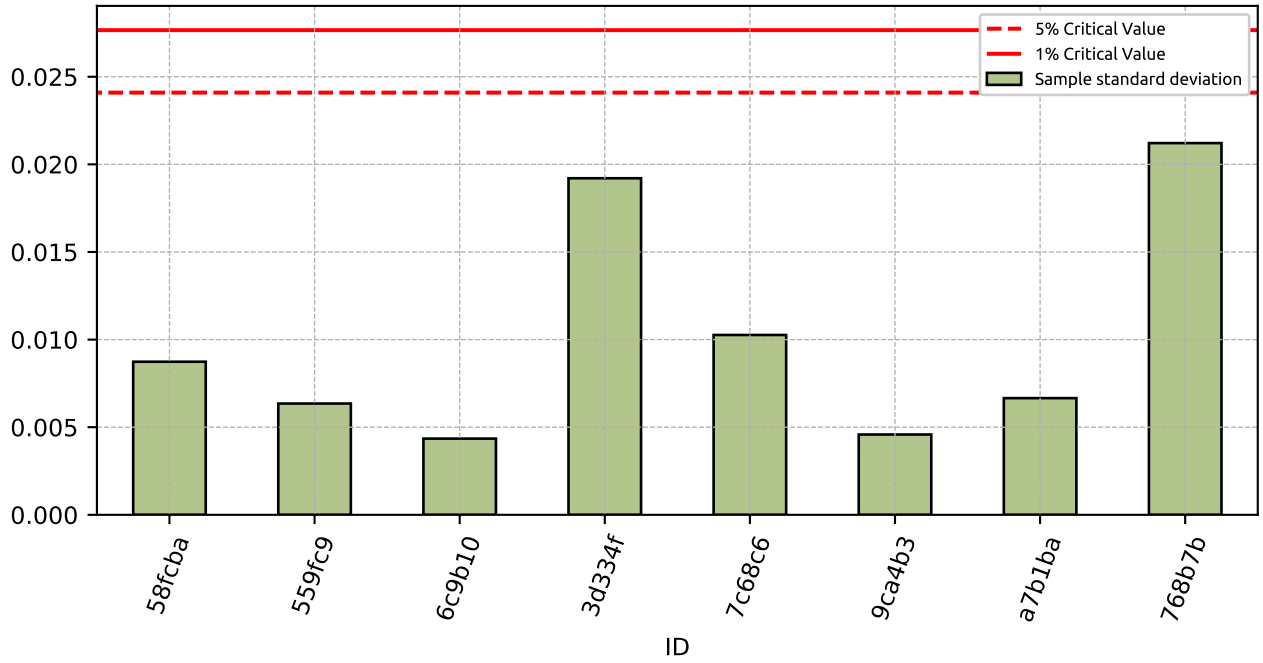

Figure 38: **Cochran's test** - sample standard deviations without outliers

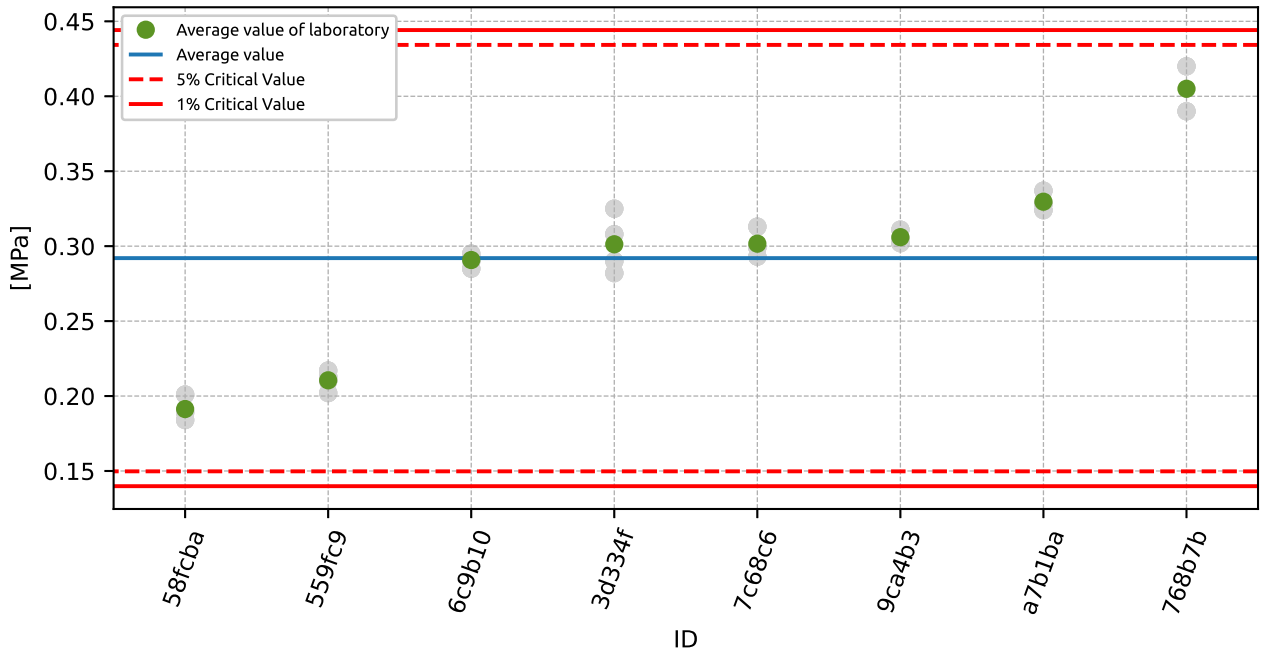

Figure 39: **Grubbs' test** - average values

5.1.3 Mandel's Statistics

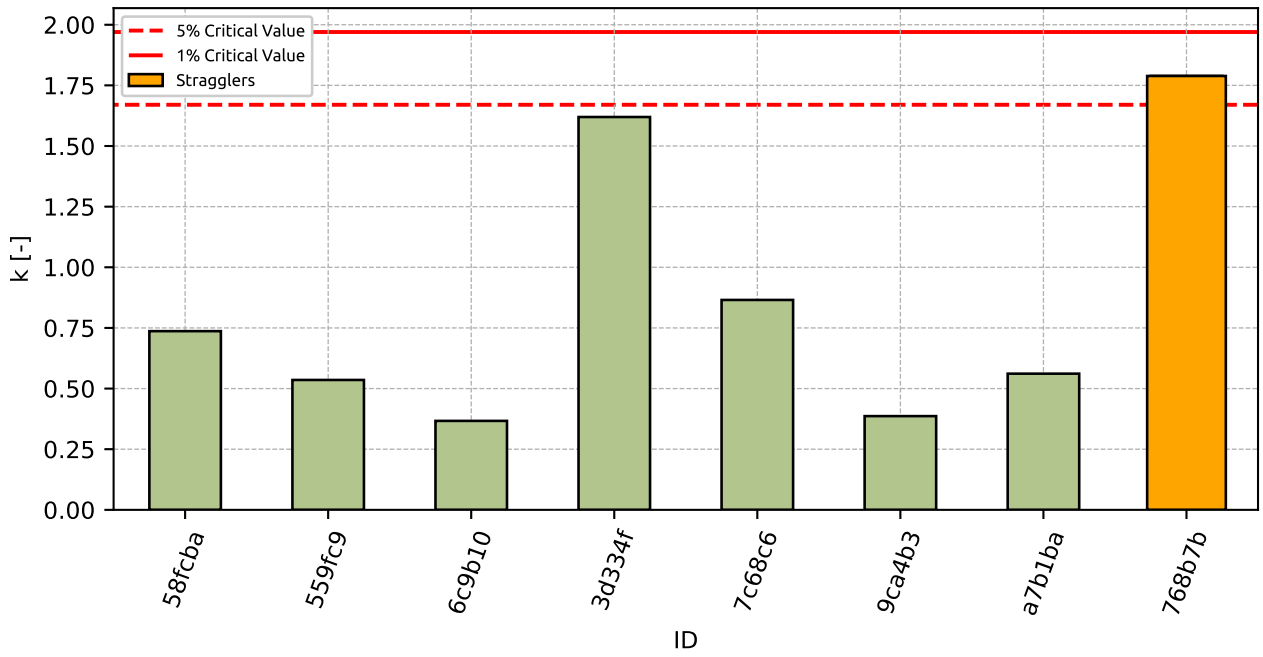

Figure 40: Intralaboratory Consistency Statistic

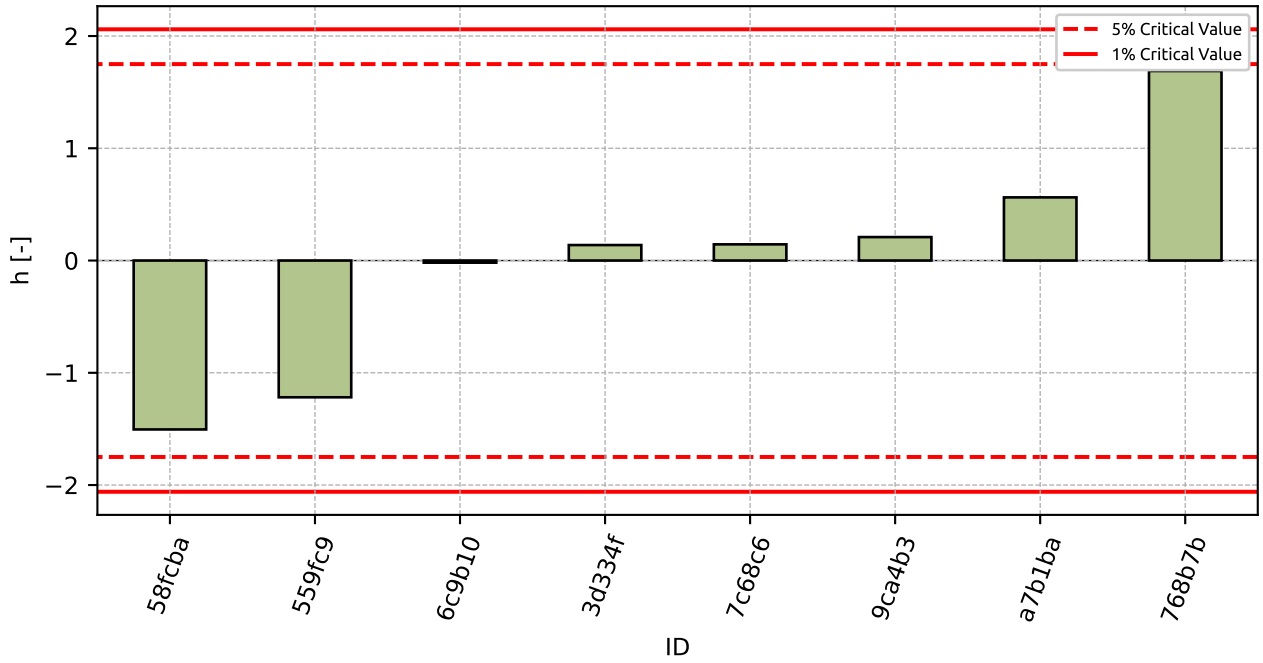

Figure 41: Interlaboratory Consistency Statistic

5.1.4 Descriptive statistics

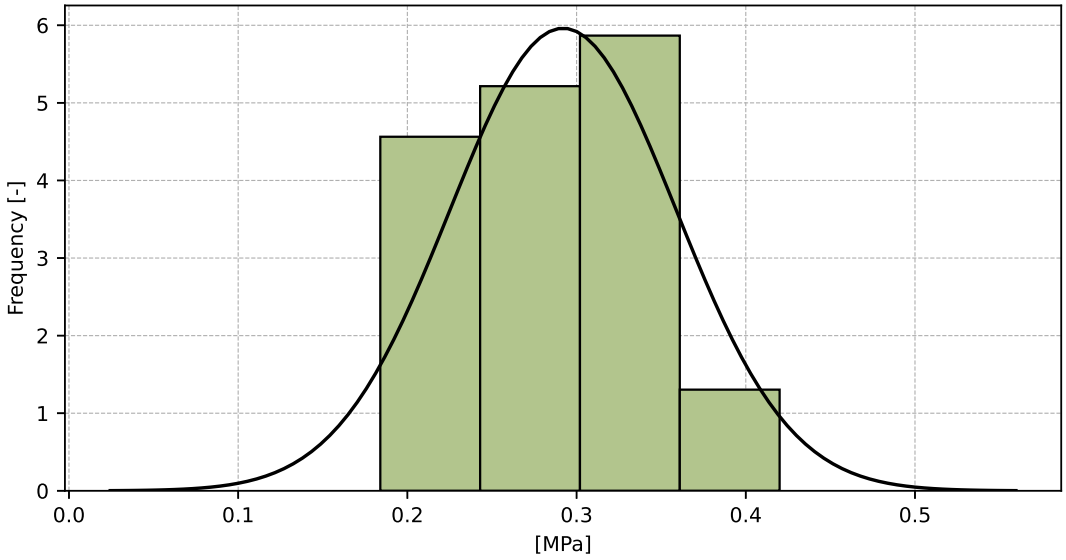

Figure 42: Histogram of all test results

Table 24: Descriptive statistics

Characteristics	[MPa]
Average value – $\bar{x}$	0.292
Sample standard deviation – s	0.0669
Asigned value – x^*	0.306
Robust standard deviation – s^*	0.0494
Measurement uncertainty of asigned value – u_X	0.0219
p-value of normality test	1.0 [-]
Interlaboratory standard deviation – s_L	0.0666
Repeatability standard deviation – s_r	0.0119
Reproducibility standard deviation – s_R	0.0677
Repeatability – r	0.033
Reproducibility – R	0.19

5.1.5 Evaluation of Performance Statistics

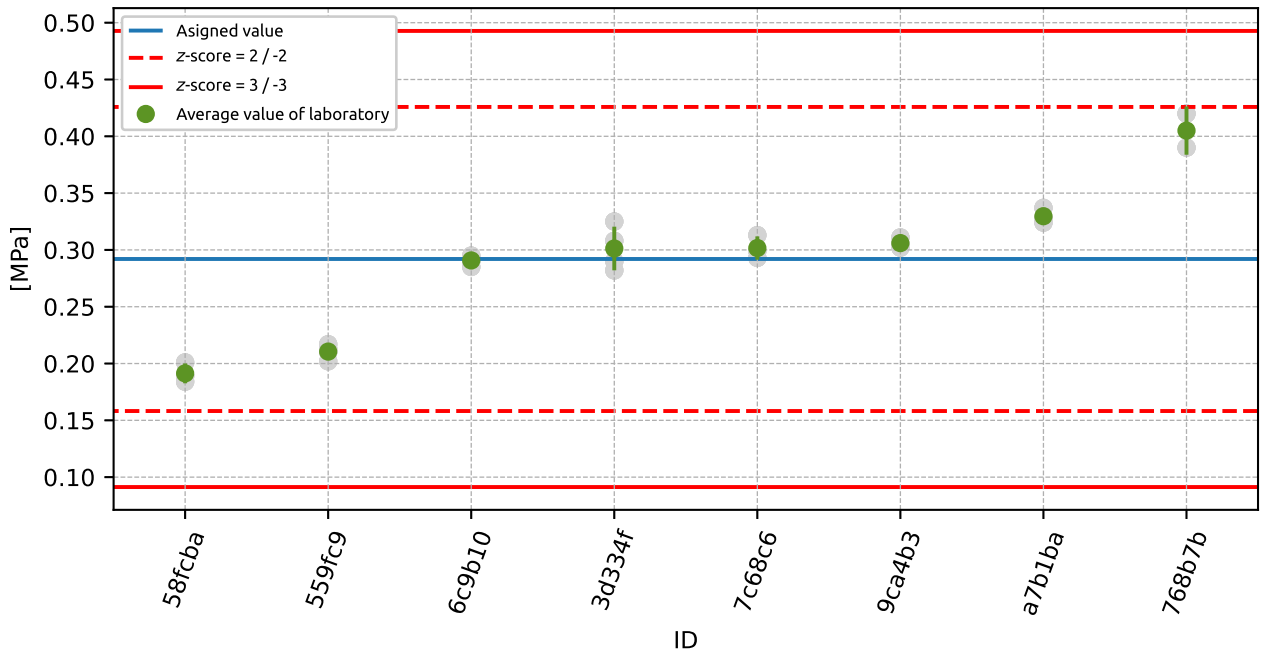

Figure 43: Average values and sample standard deviations

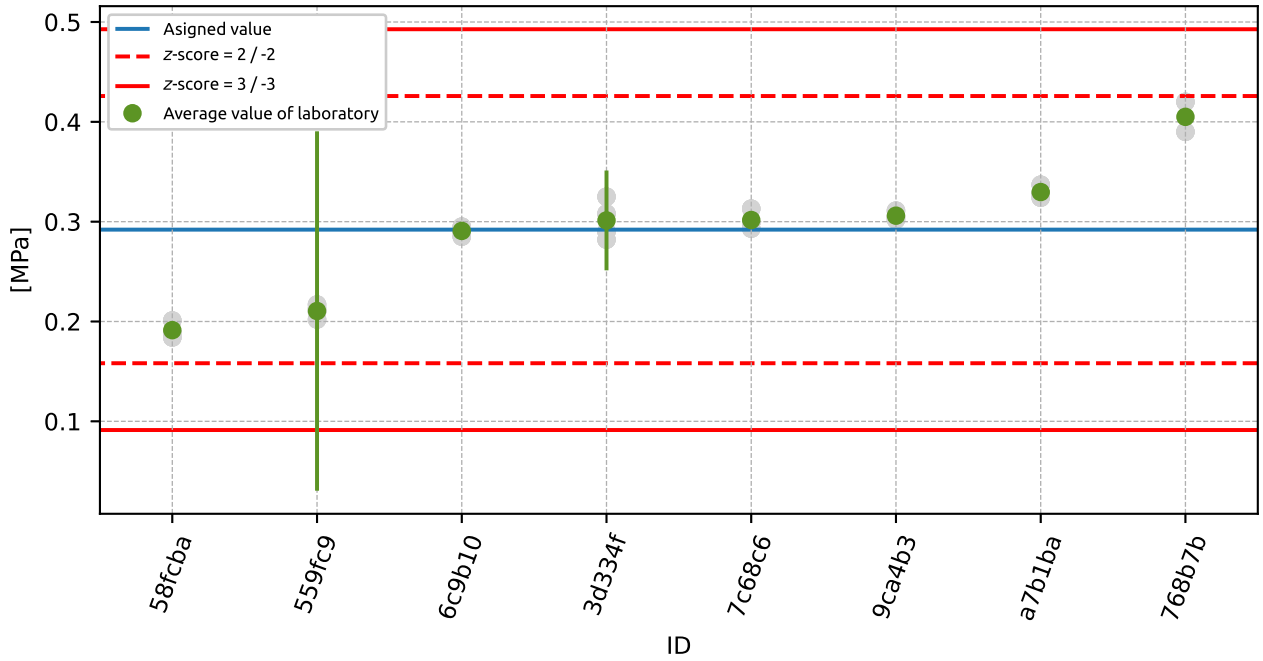

Figure 44: Average values and extended uncertainties of measurement

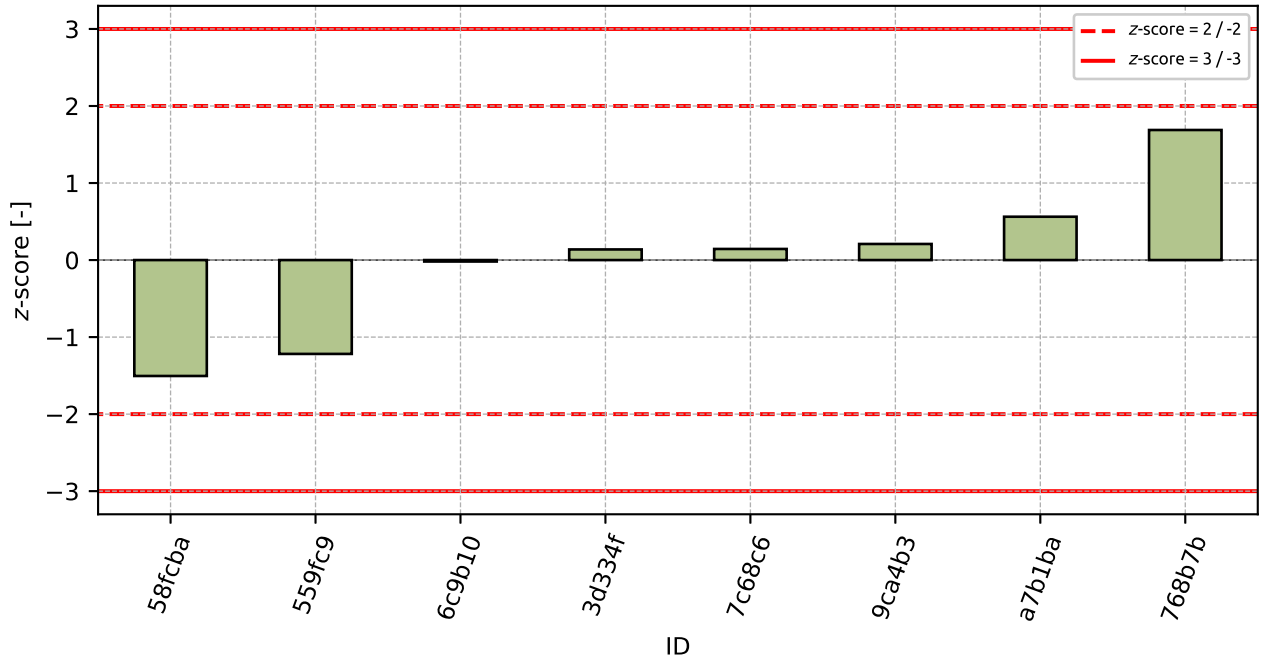

Figure 45: z-score

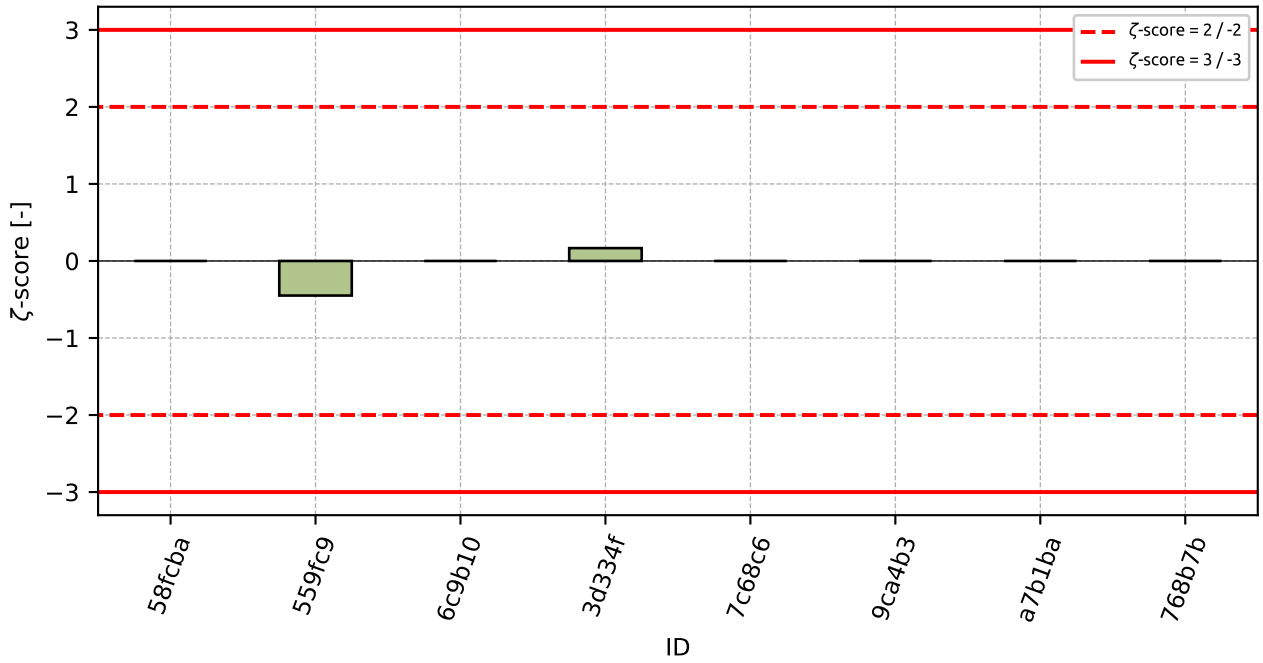

Figure 46: ζ-score

Table 25: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
58fcba	-1.5	-
559fc9	-1.22	-0.45
6c9b10	-0.02	-
3d334f	0.14	0.17
7c68c6	0.14	-
9ca4b3	0.21	-
a7b1ba	0.56	-
768b7b	1.69	-

5.2 Strain at failure

5.2.1 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 [%]				u_X [%]	$\bar{x}$ [%]	s_0 [%]	V_X [%]
559fc9	2.4	2.6	2.4	2.6	0.47	2.5	0.115	4.62
3d334f	3.01	2.82	2.7	2.68	0.3	2.8	0.153	5.46
6c9b10	2.89	3.15	2.75	2.9	-	2.92	0.167	5.7
768b7b	3.11	6.15	3.13	-	-	4.13	1.749	42.36
58fcba	3.95	4.21	4.47	-	-	4.21	0.26	6.18
a7b1ba	4.4	4.6	3.8	-	-	4.27	0.416	9.76
7c68c6	5.0	5.0	5.0	-	-	5.0	0.0	0.0
9ca4b3	5.49	4.94	5.24	-	-	5.22	0.275	5.27

5.2.2 The Numerical Procedure for Determining Outliers

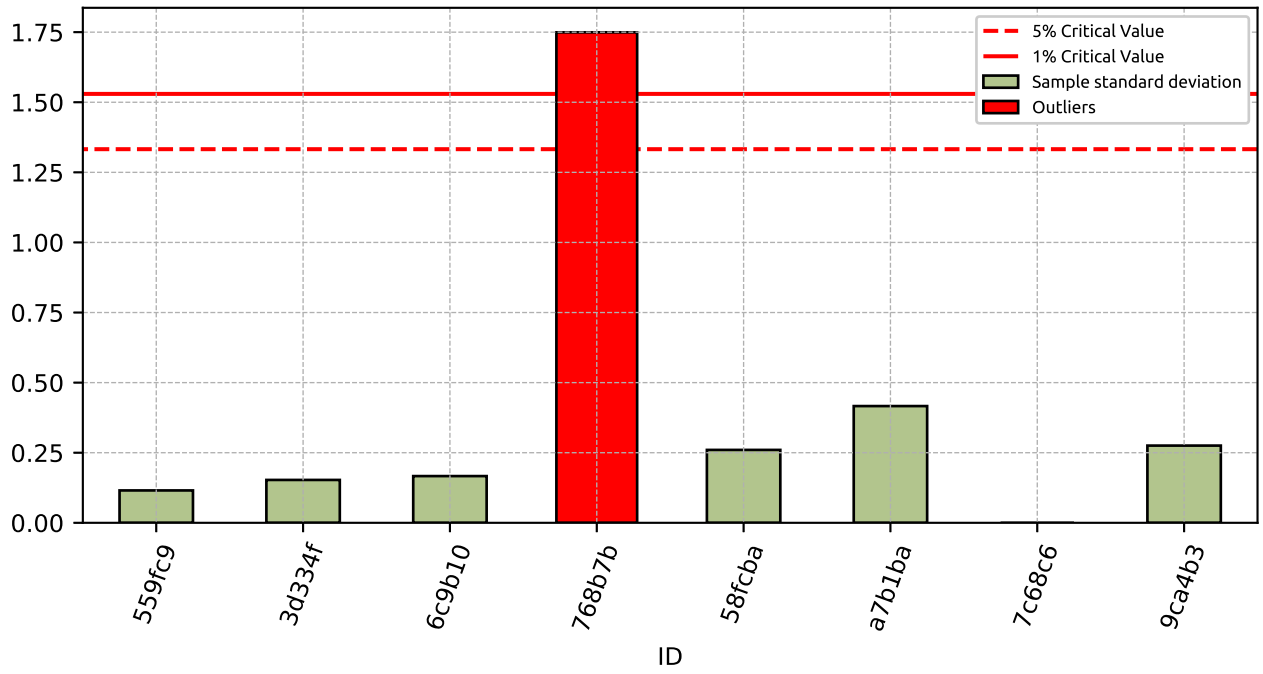

Figure 47: **Cochran's test** - sample standard deviations

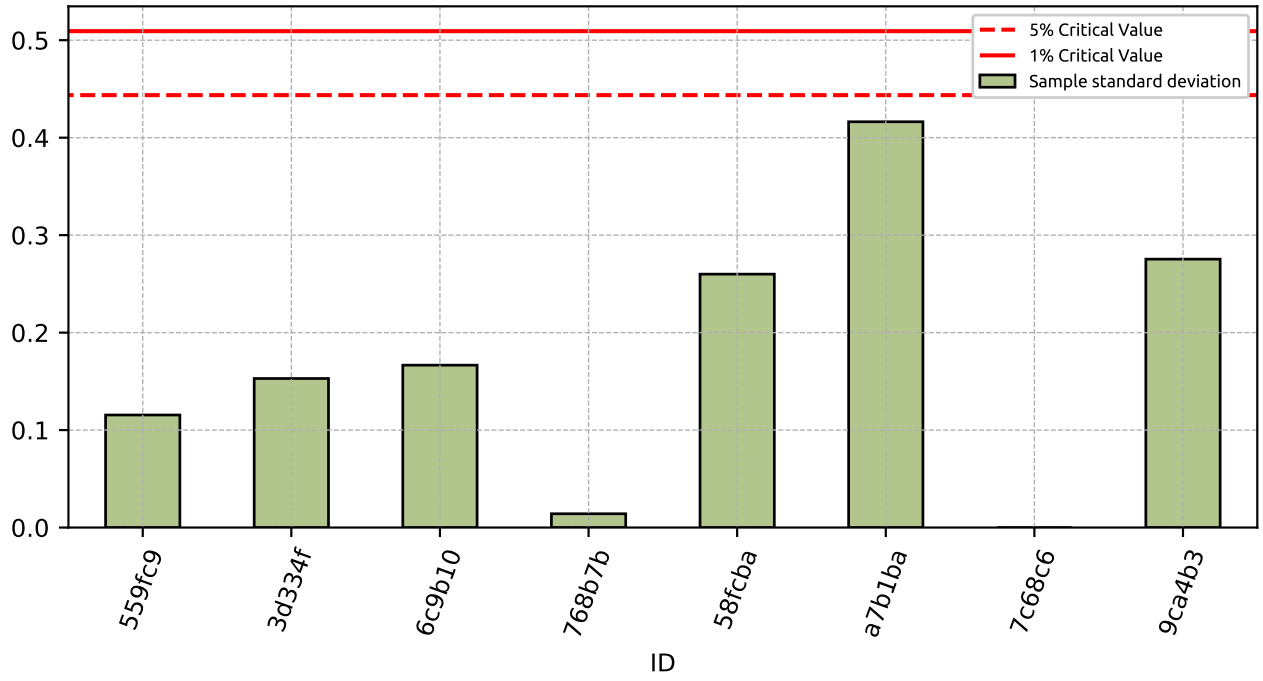

Figure 48: **Cochran's test** - sample standard deviations without outliers

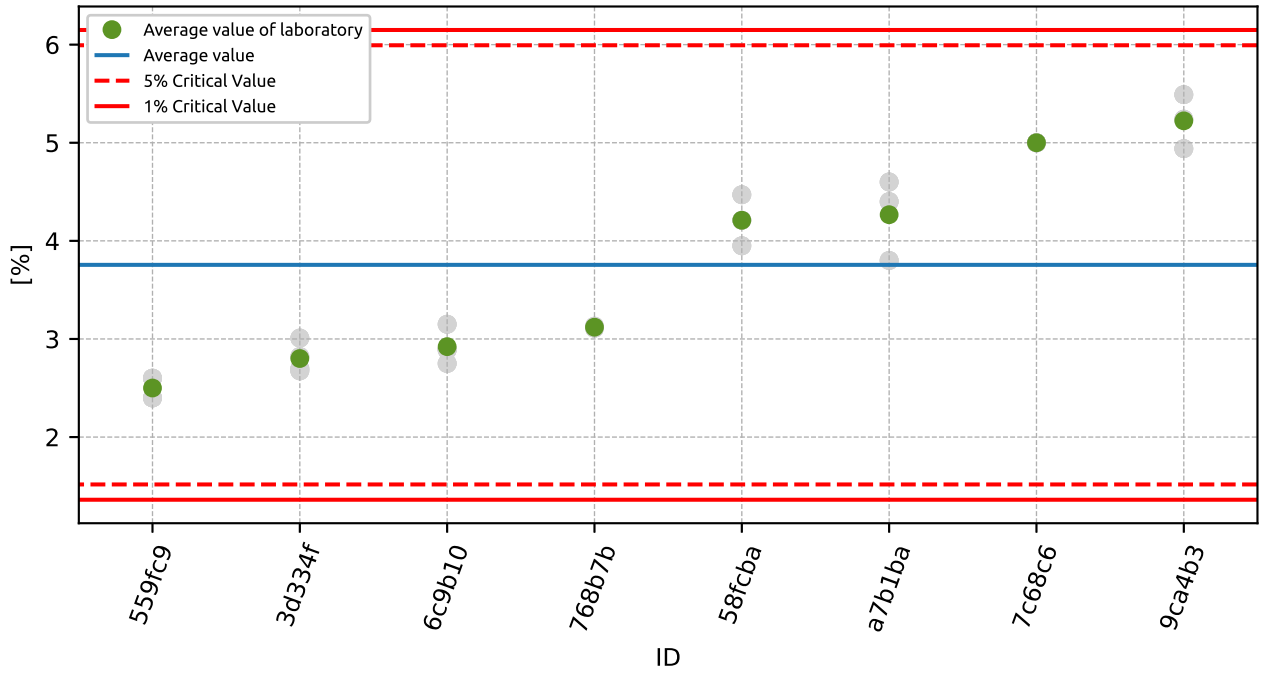

Figure 49: **Grubbs' test** - average values

5.2.3 Mandel's Statistics

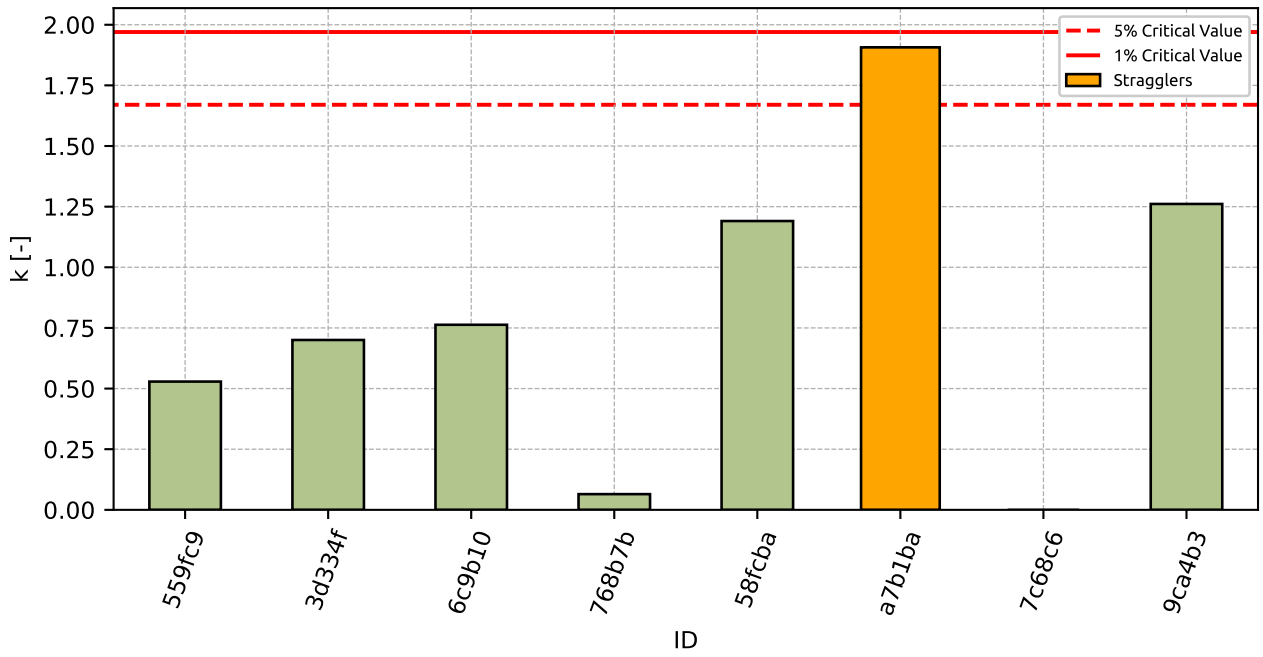

Figure 50: Intralaboratory Consistency Statistic

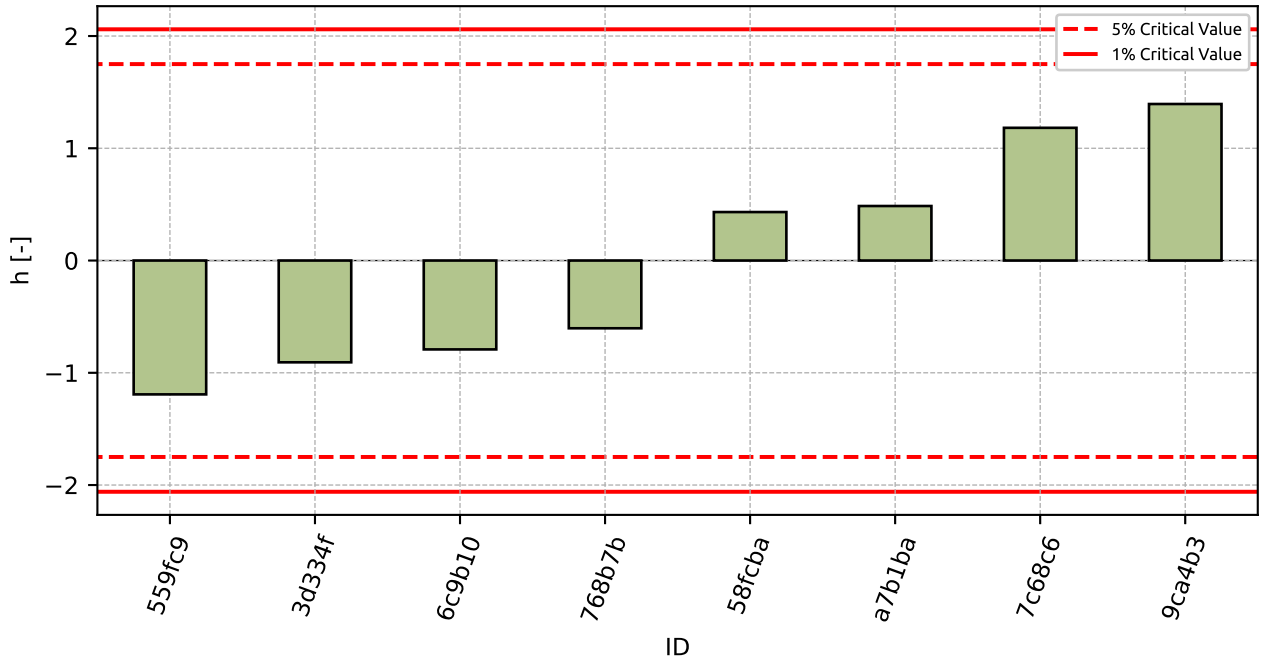

Figure 51: Interlaboratory Consistency Statistic

5.2.4 Descriptive statistics

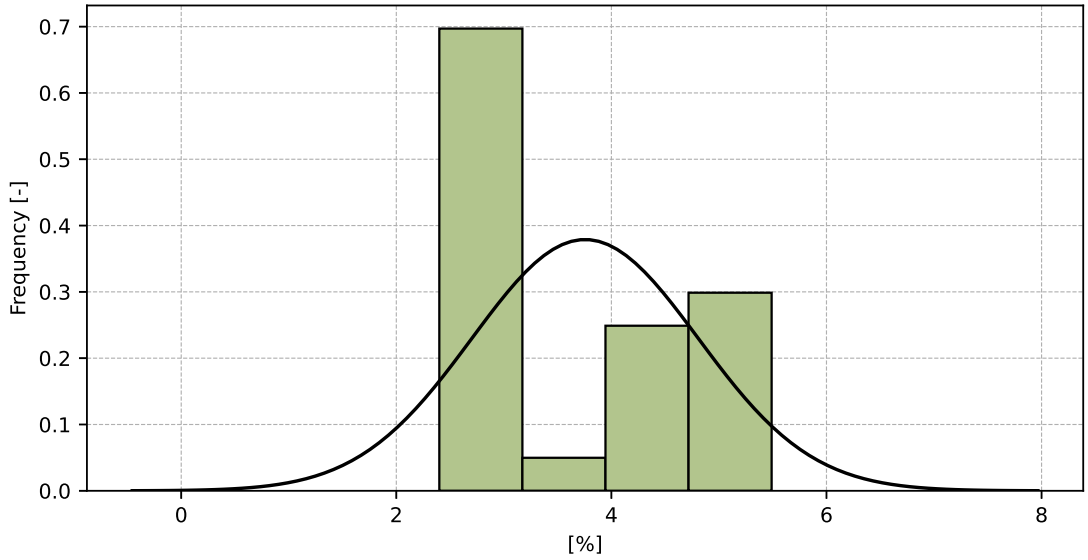

Figure 52: Histogram of all test results

Table 27: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	3.76
Sample standard deviation – s	1.053
Asigned value – x^*	3.76
Robust standard deviation – s^*	1.053
Measurement uncertainty of asigned value – u_X	0.372
p-value of normality test	1.0 [-]
Interlaboratory standard deviation – s_L	1.047
Repeatability standard deviation – s_r	0.218
Reproducibility standard deviation – s_R	1.07
Repeatability – r	0.61
Reproducibility – R	2.99

5.2.5 Evaluation of Performance Statistics

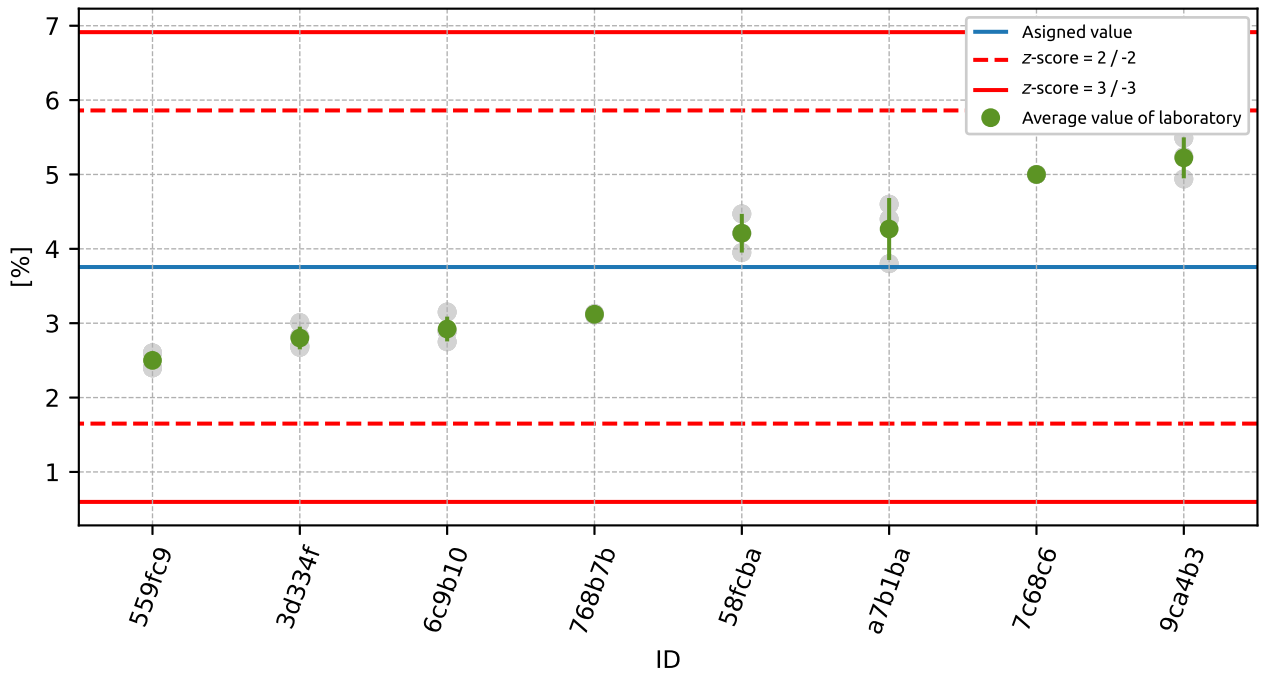

Figure 53: Average values and sample standard deviations

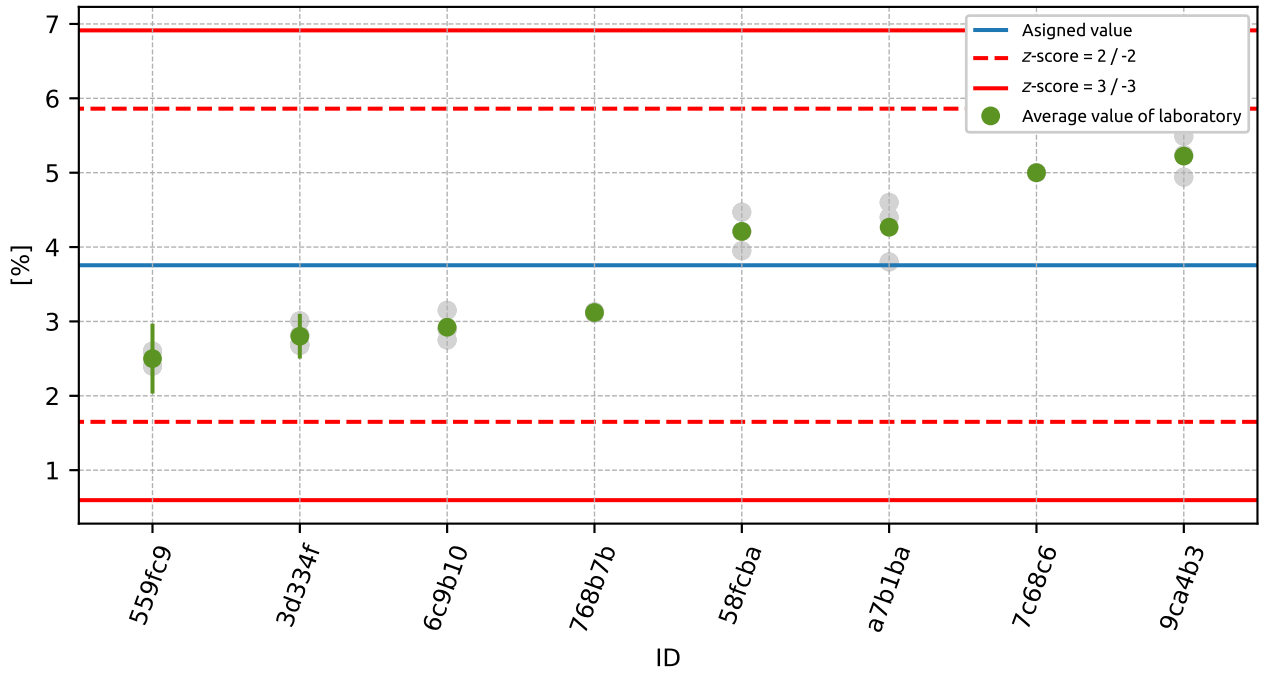

Figure 54: Average values and extended uncertainties of measurement

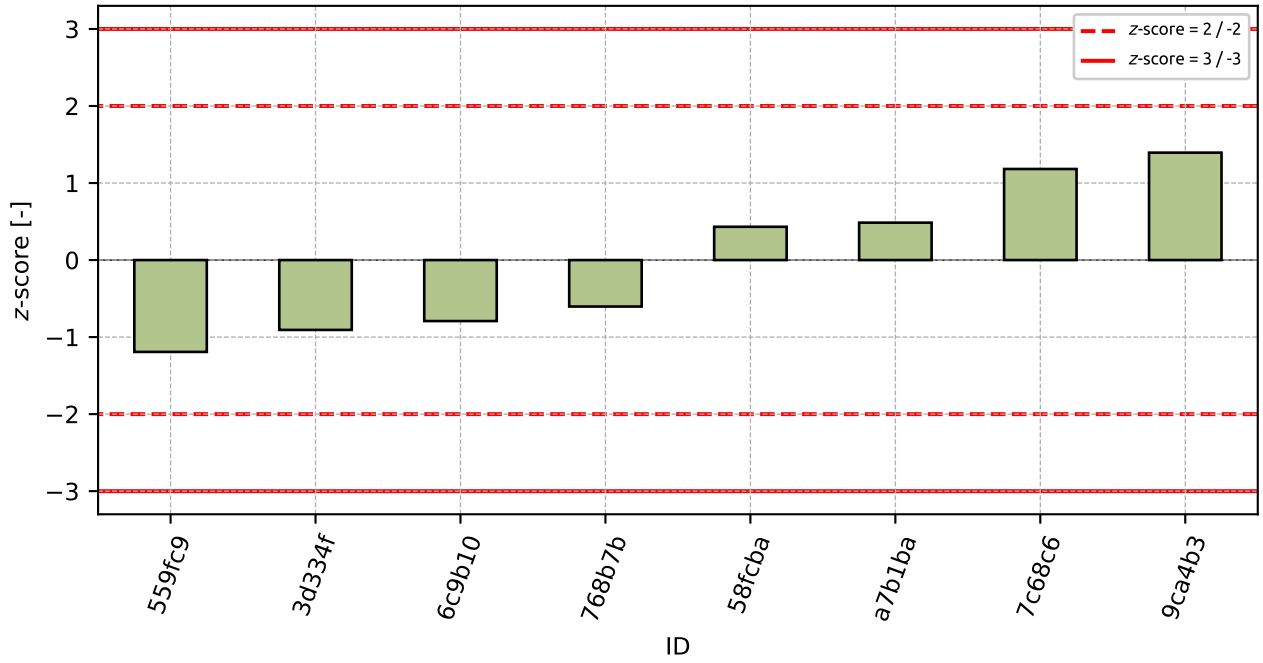

Figure 55: z-score

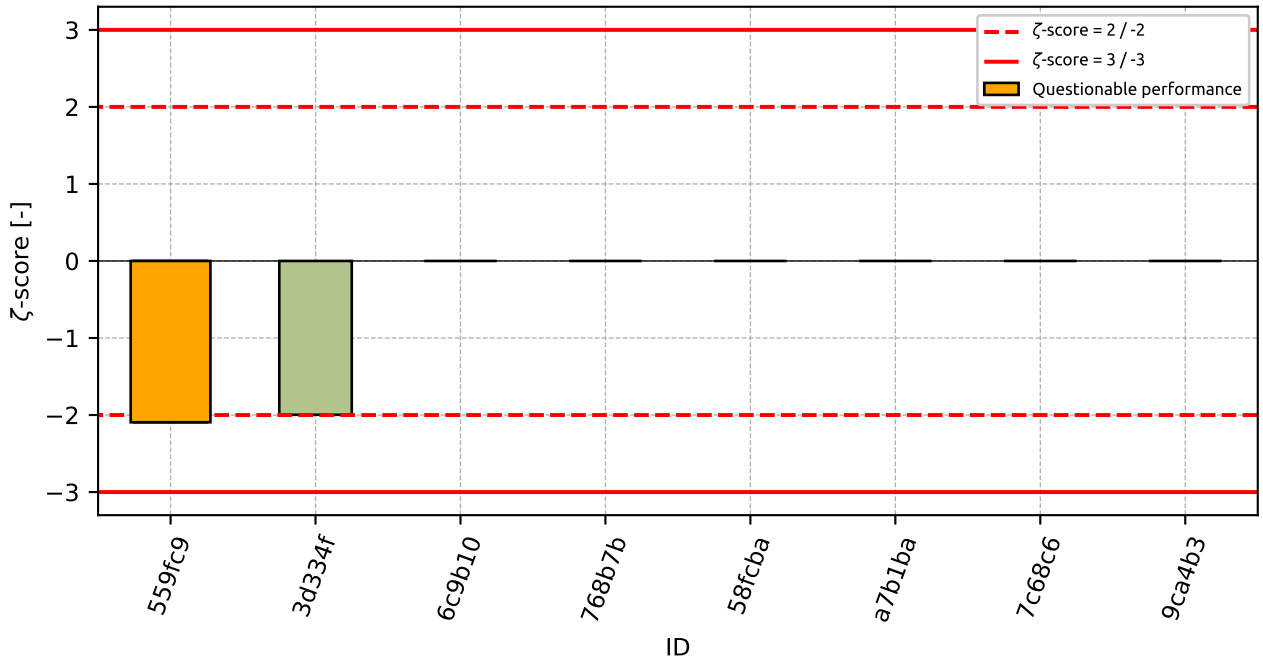

Figure 56: ζ-score

Table 28: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
559fc9	-1.19	-2.09
3d334f	-0.91	-2.0
6c9b10	-0.79	-
768b7b	-0.6	-
58fcba	0.43	-
a7b1ba	0.49	-
7c68c6	1.18	-
9ca4b3	1.39	-

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

6.1 50 kPa

6.1.1 Test results

Table 29: 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]
559fc9	21.0	2.1
9ca4b3	24.0	-
d1733b	29.7	6.0
58fcba	34.2	-
f0f0a7	35.0	-
521442	40.0	2.0
717a59	41.0	2.0
7c68c6	41.0	2.5
768b7b	45.0	-
3d334f	46.4	5.0
307a20	46.9	-
3d56aa	48.5	0.1
6c9b10	49.0	-
890859	51.0	1.0
a7b1ba	52.0	-
36908c	64.2	-
6b9708	110.0	1.0
e532e3	140.2	-

6.1.2 The Numerical Procedure for Determining Outliers

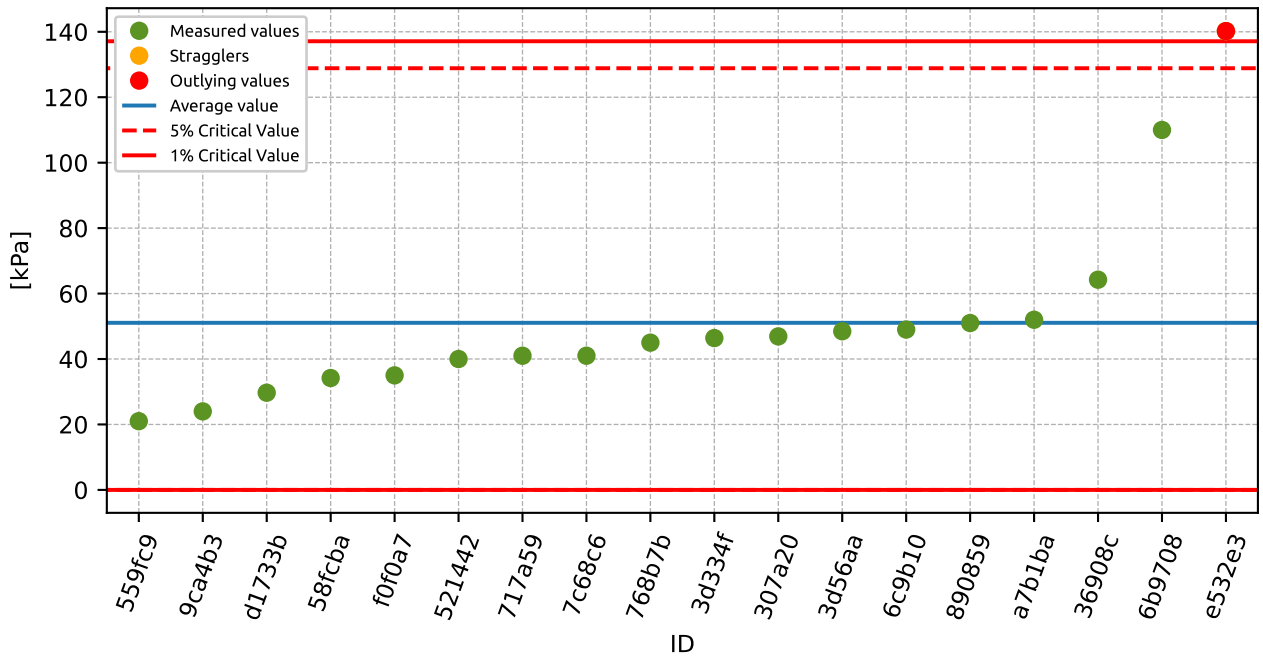

Figure 57: **Grubbs' test** - average values

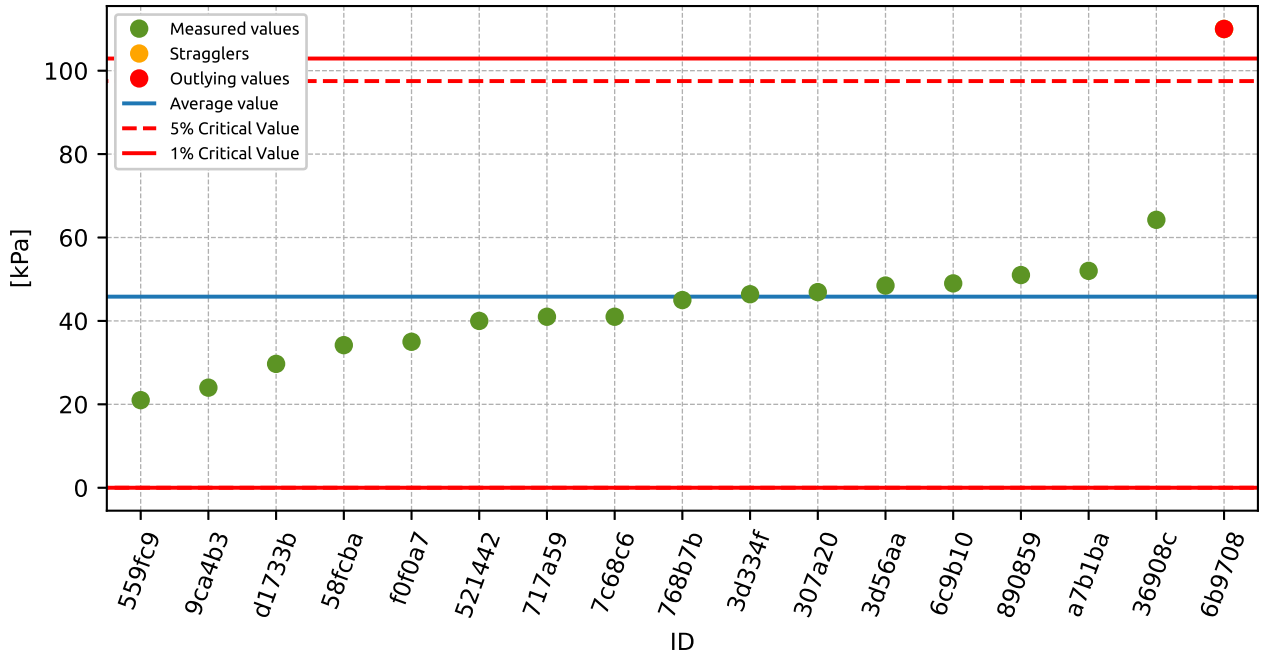

Figure 58: **Grubbs' test** - average values without outliers

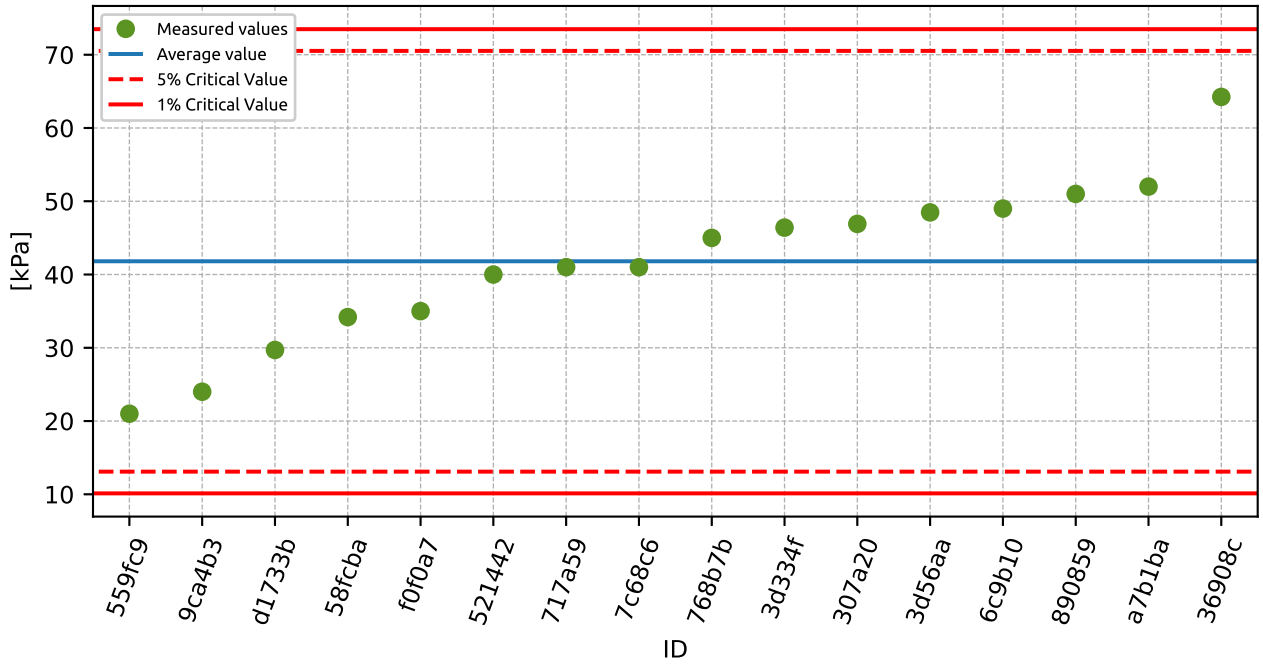

Figure 59: **Grubbs' test** - average values without outliers

6.1.3 Mandel's Statistics

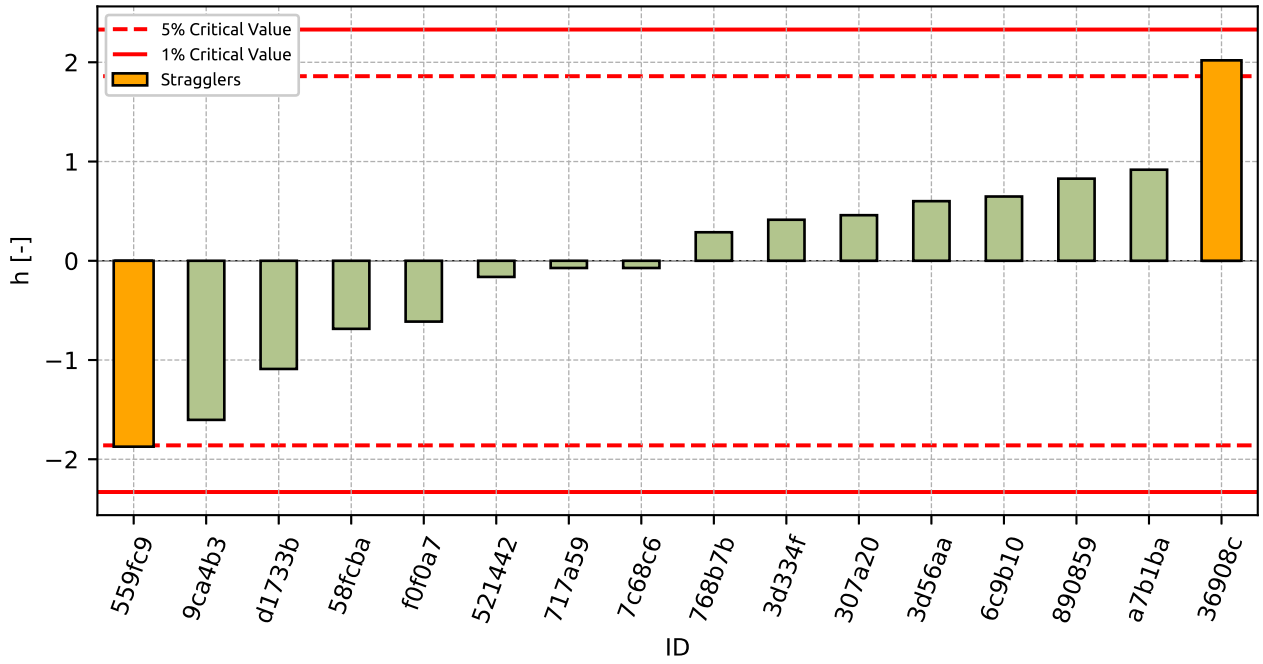

Figure 60: Interlaboratory Consistency Statistic

6.1.4 Descriptive statistics

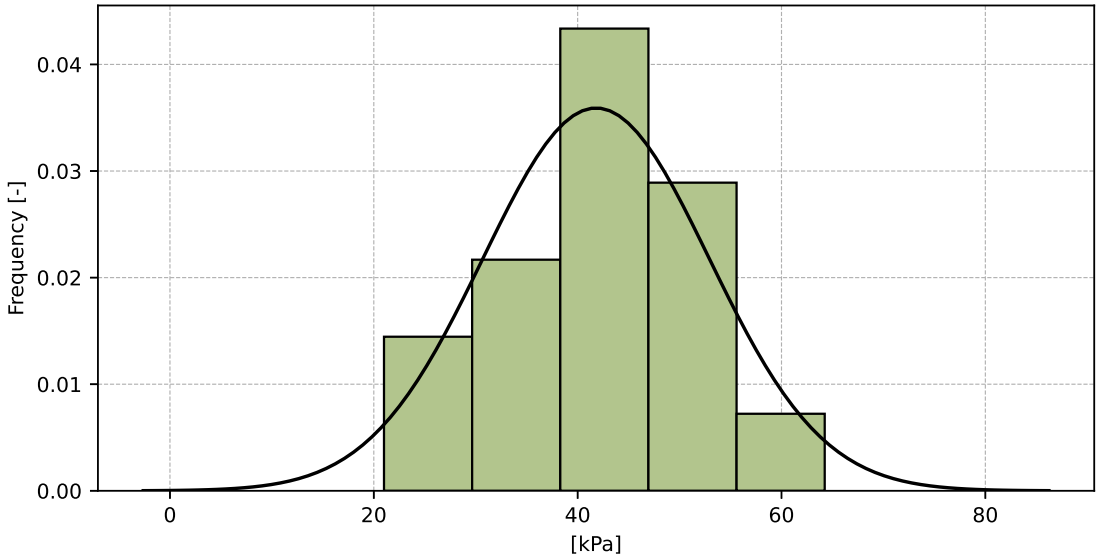

Figure 61: Histogram of all test results

Table 30: Descriptive statistics

Characteristics	**[kPa]**
Average value – $\bar{x}$	41.8
Sample standard deviation – s	11.11
Asigned value – x^*	42.4
Robust standard deviation – s^*	11.2
Measurement uncertainty of asigned value – u_X	3.44
p-value of normality test	0.832 [-]

6.1.5 Evaluation of Performance Statistics

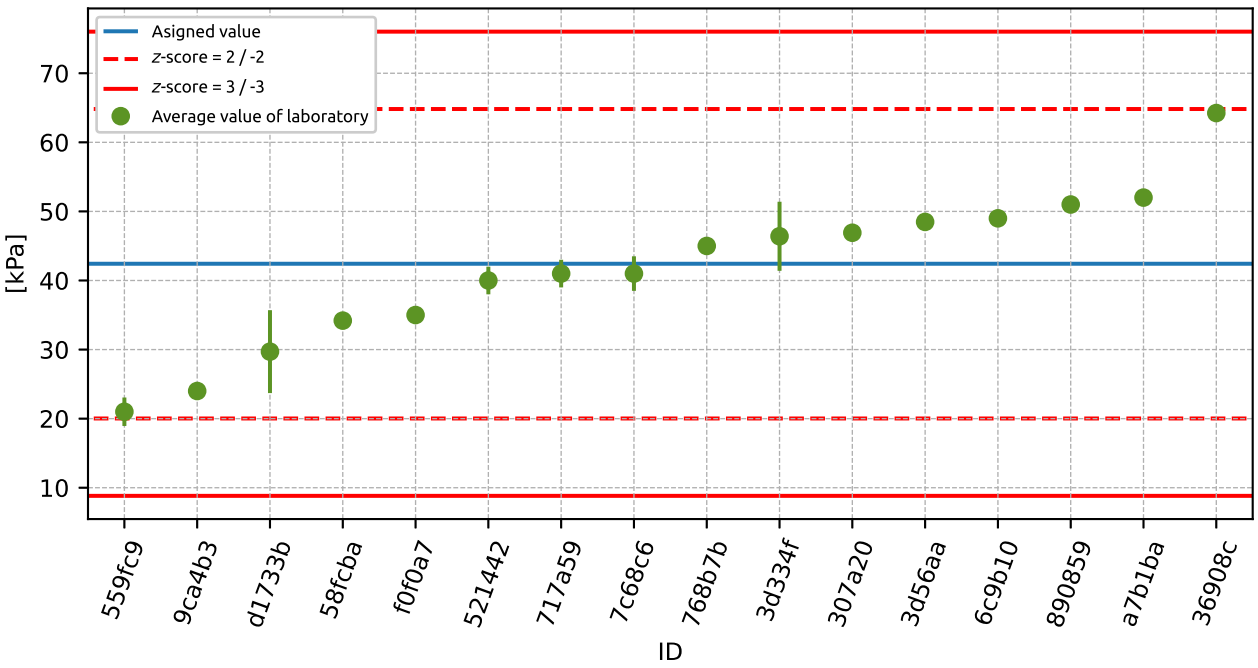

Figure 62: Average values and extended uncertainties of measurement

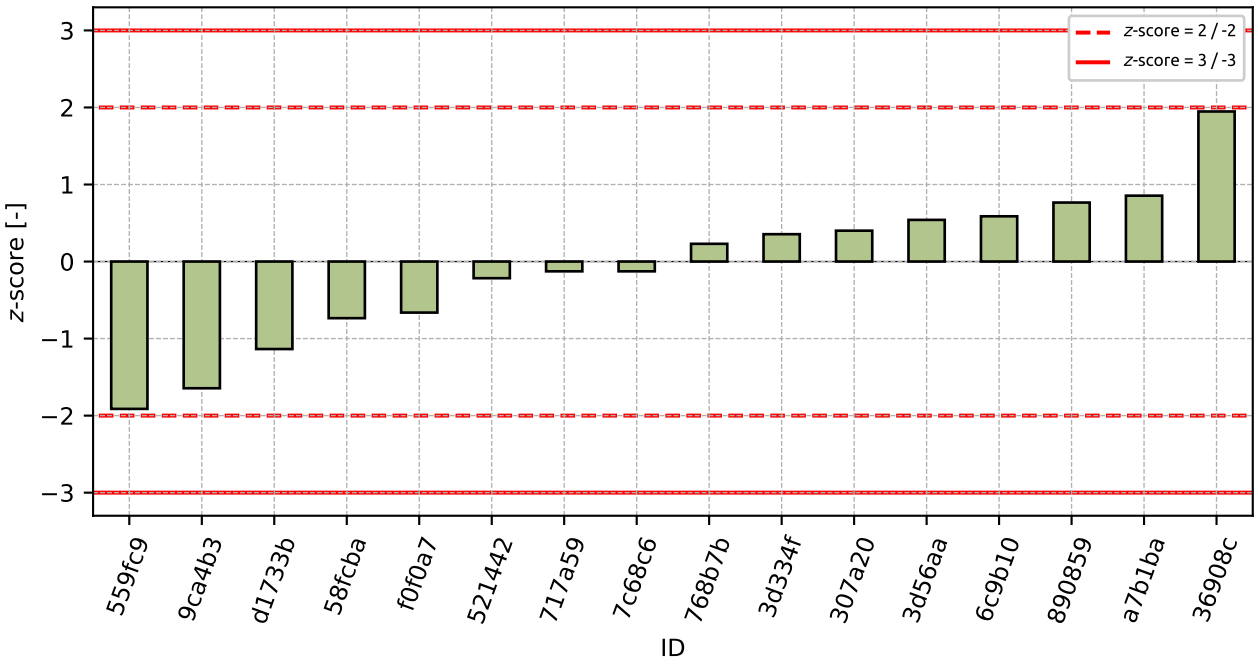

Figure 63: z-score

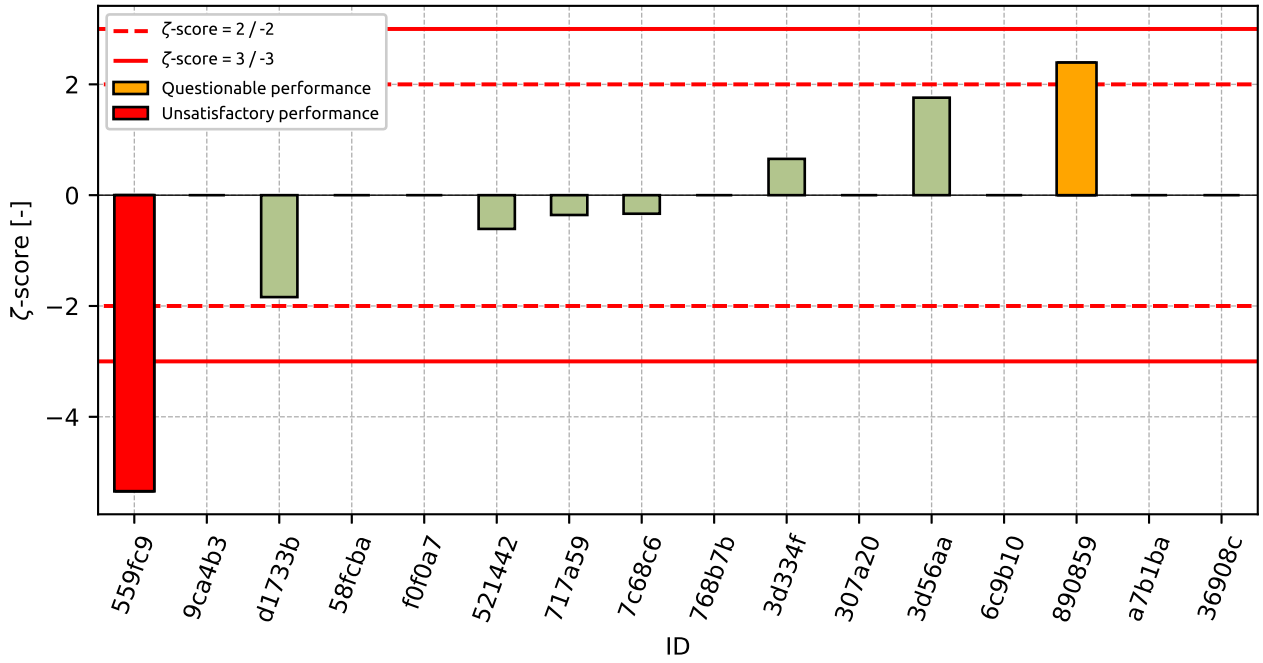

Figure 64: ζ-score

Table 31: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
559fc9	-1.91	-5.34
9ca4b3	-1.64	-
d1733b	-1.14	-1.84
58fcba	-0.74	-
f0f0a7	-0.66	-
521442	-0.22	-0.61
717a59	-0.13	-0.36
7c68c6	-0.13	-0.33
768b7b	0.23	-
3d334f	0.36	0.66
307a20	0.4	-
3d56aa	0.54	1.76
6c9b10	0.59	-
890859	0.77	2.39
a7b1ba	0.86	-
36908c	1.95	-

6.2 100 kPa

6.2.1 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]
9ca4b3	30.0	-
f0f0a7	61.0	-
d1733b	62.6	6.3
559fc9	65.2	2.1
768b7b	67.0	-
58fcba	71.5	-
717a59	74.0	3.0
521442	75.0	3.8
6c9b10	75.0	-
307a20	75.3	-
a7b1ba	75.7	-
3d56aa	76.8	0.1
3d334f	77.0	8.0
890859	79.0	1.0
7c68c6	86.0	5.2
36908c	89.8	-
6b9708	146.0	1.0
e532e3	148.3	-

6.2.2 The Numerical Procedure for Determining Outliers

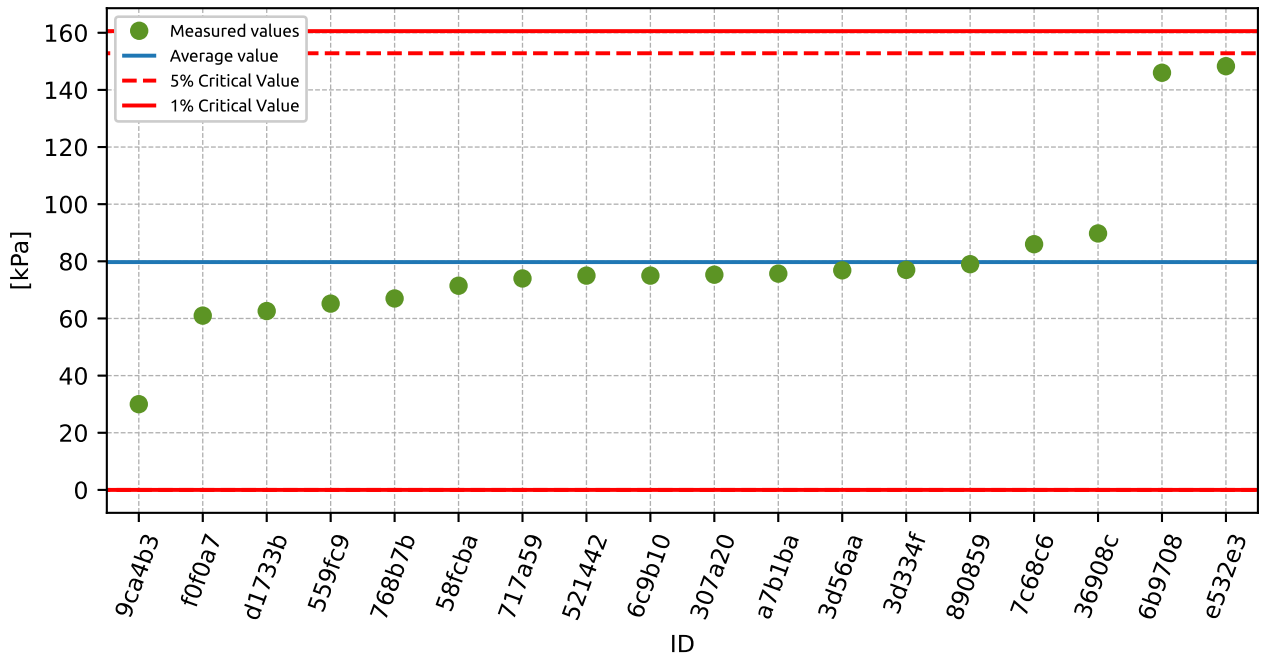

Figure 65: **Grubbs' test** - average values

6.2.3 Mandel's Statistics

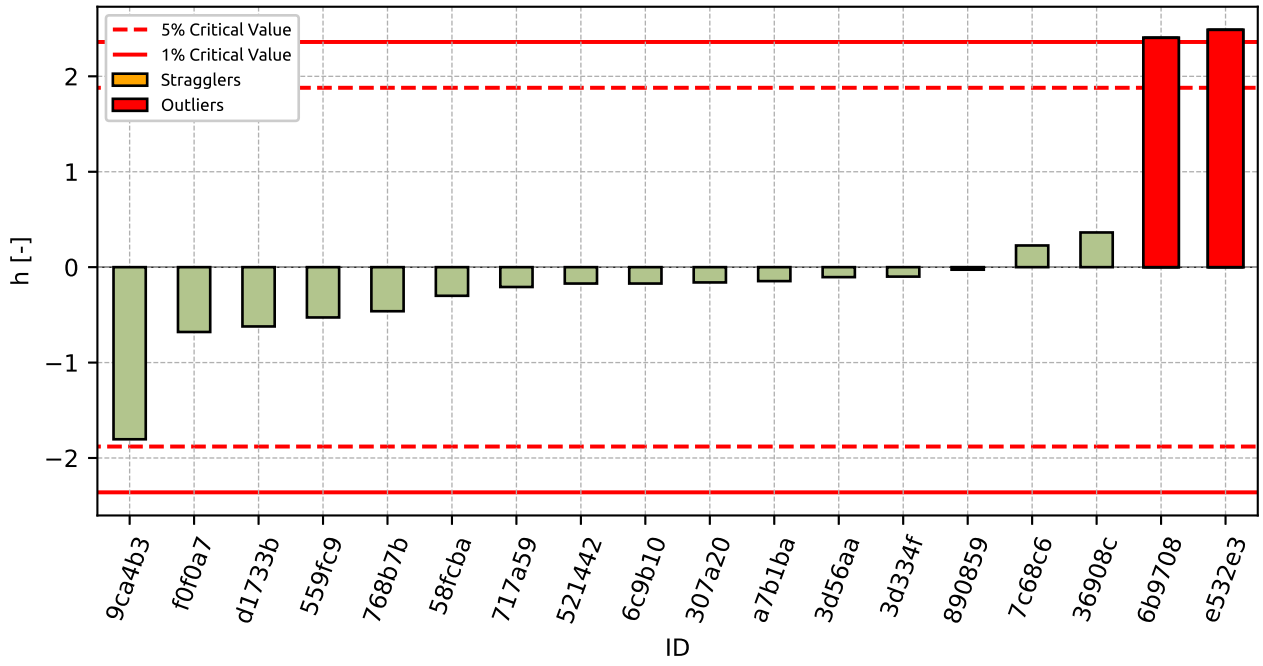

Figure 66: Interlaboratory Consistency Statistic

6.2.4 Descriptive statistics

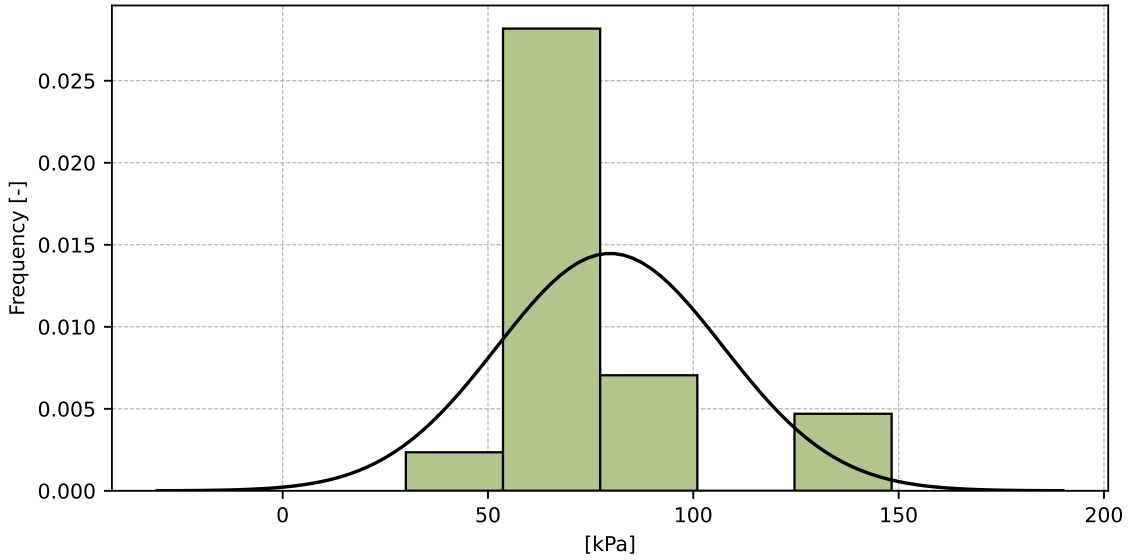

Figure 67: Histogram of all test results

Table 33: Descriptive statistics

Characteristics	[kPa]
Average value – $\bar{x}$	79.7
Sample standard deviation – s	27.57
Asigned value – x^*	78.3
Robust standard deviation – s^*	11.2
Measurement uncertainty of asigned value – u_X	6.28
p-value of normality test	0.001 [-]

6.2.5 Evaluation of Performance Statistics

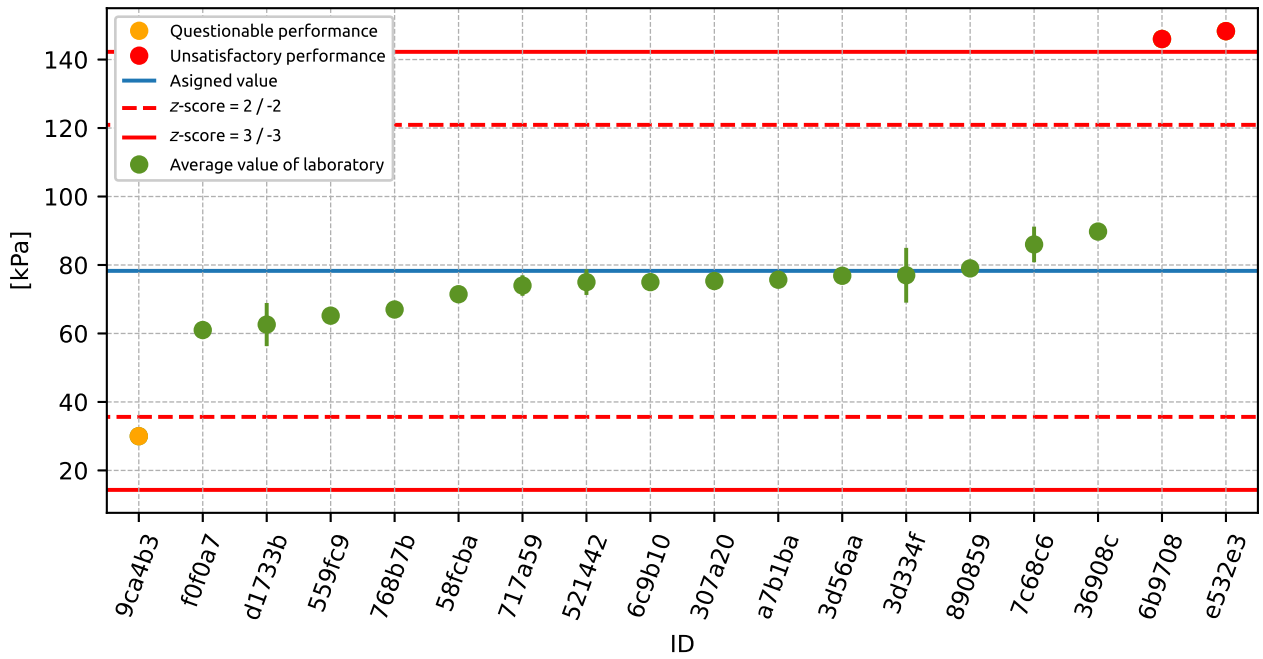

Figure 68: Average values and extended uncertainties of measurement

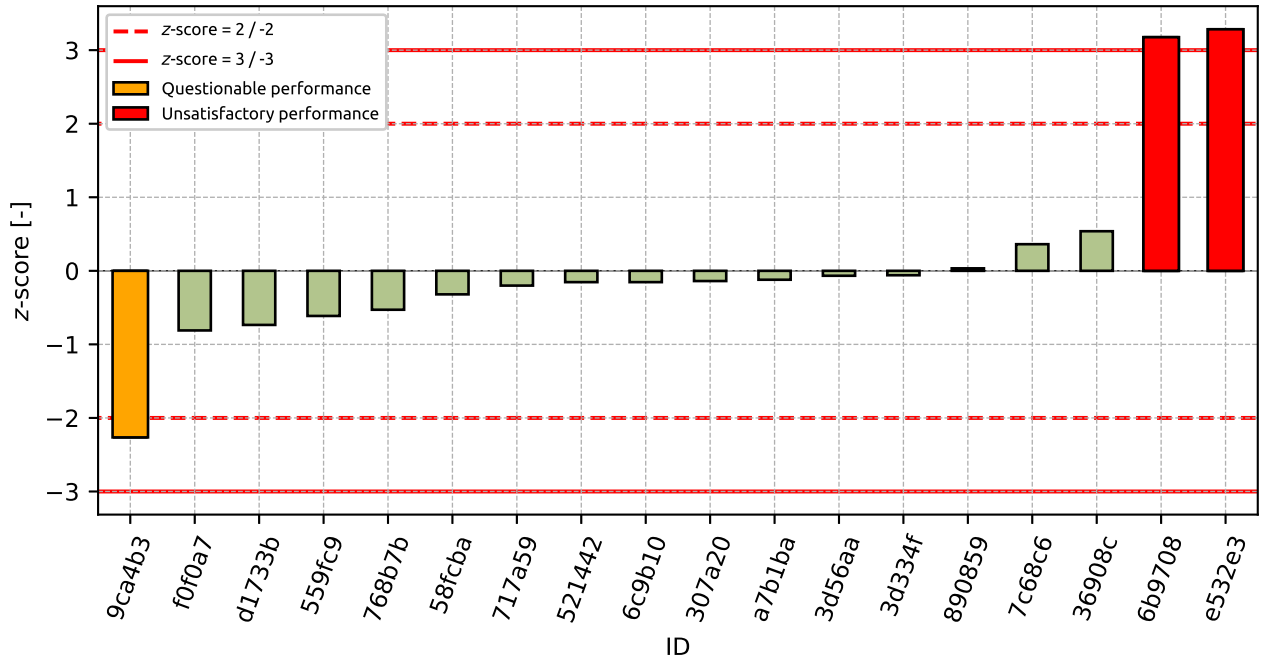

Figure 69: z-score

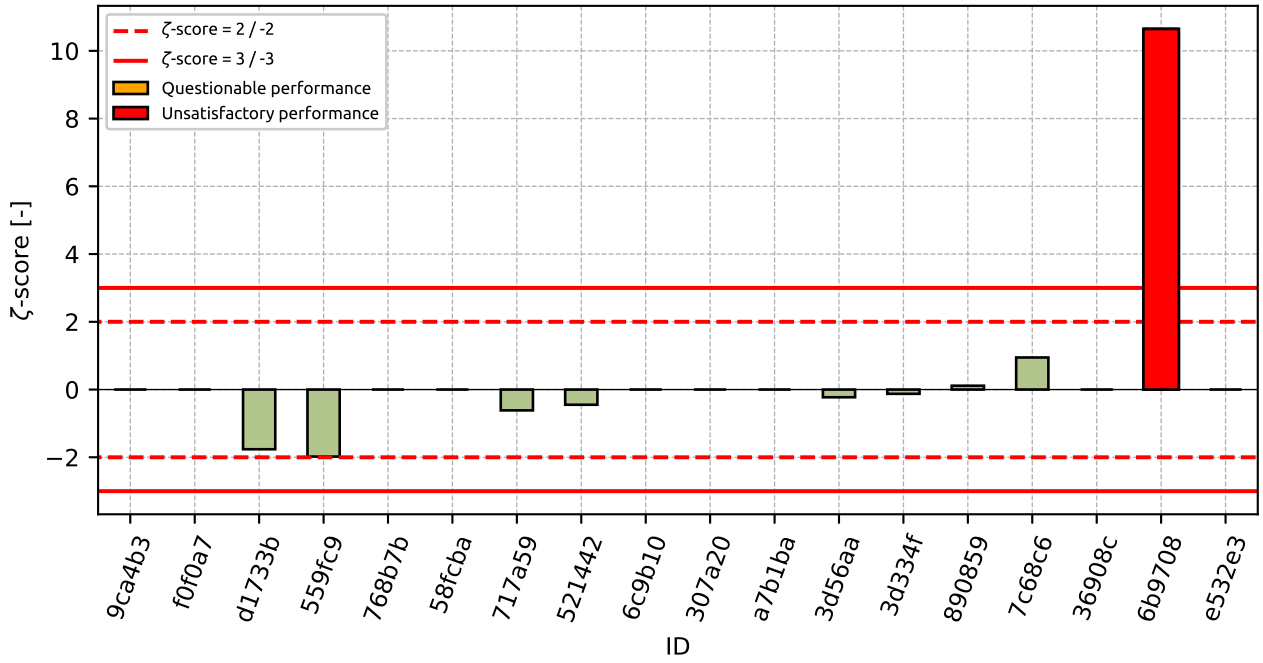

Figure 70: ζ-score

Table 34: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
9ca4b3	-2.26	-
f0f0a7	-0.81	-
d1733b	-0.74	-1.76
559fc9	-0.61	-1.98
768b7b	-0.53	-
58fcba	-0.32	-
717a59	-0.2	-0.62
521442	-0.15	-0.45
6c9b10	-0.15	-
307a20	-0.14	-
a7b1ba	-0.12	-
3d56aa	-0.07	-0.23
3d334f	-0.06	-0.13
890859	0.03	0.11
7c68c6	0.36	0.95
36908c	0.54	-
6b9708	3.18	10.65
e532e3	3.28	-

6.3 200 kPa

6.3.1 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]
9ca4b3	57.0	-
559fc9	80.0	2.1
7c68c6	104.0	6.2
58fcba	118.7	-
6c9b10	122.0	-
a7b1ba	124.6	-
307a20	124.6	-
3d56aa	127.3	0.2
3d334f	127.6	13.0
890859	128.0	1.0
f0f0a7	129.0	-
717a59	135.0	5.0
768b7b	136.0	-
521442	138.0	6.9
36908c	144.9	-
d1733b	152.4	6.2
e532e3	201.8	-
6b9708	204.0	1.0

6.3.2 The Numerical Procedure for Determining Outliers

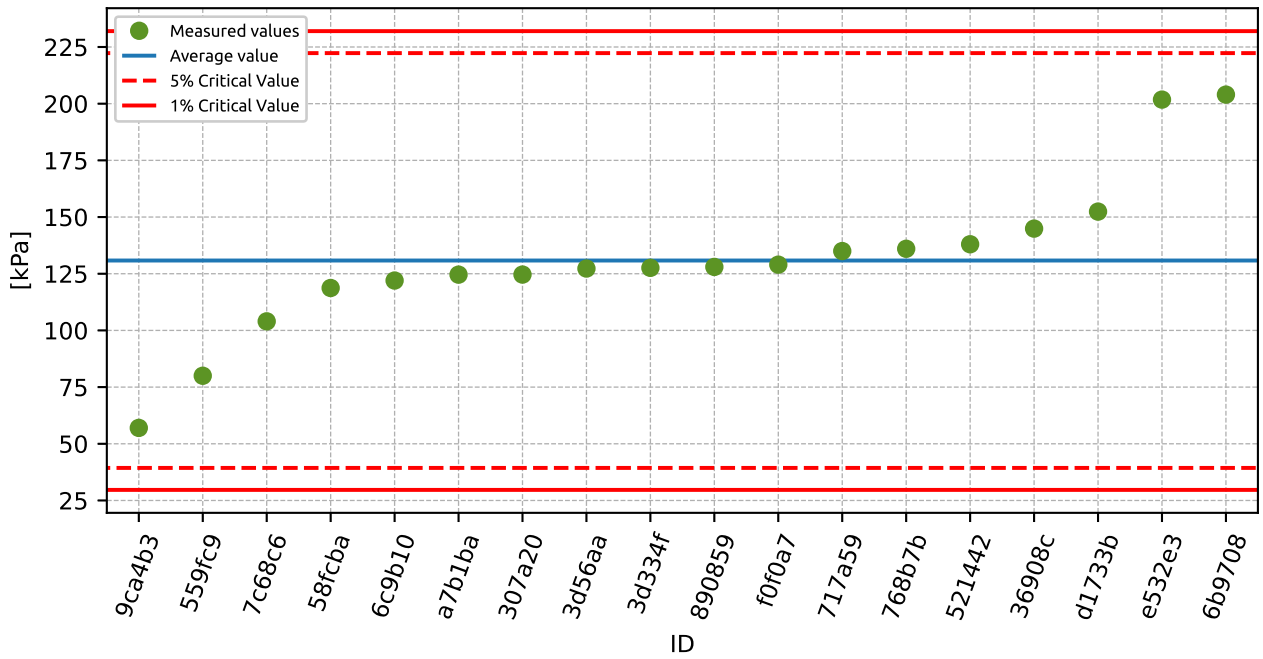

Figure 71: **Grubbs' test** - average values

6.3.3 Mandel's Statistics

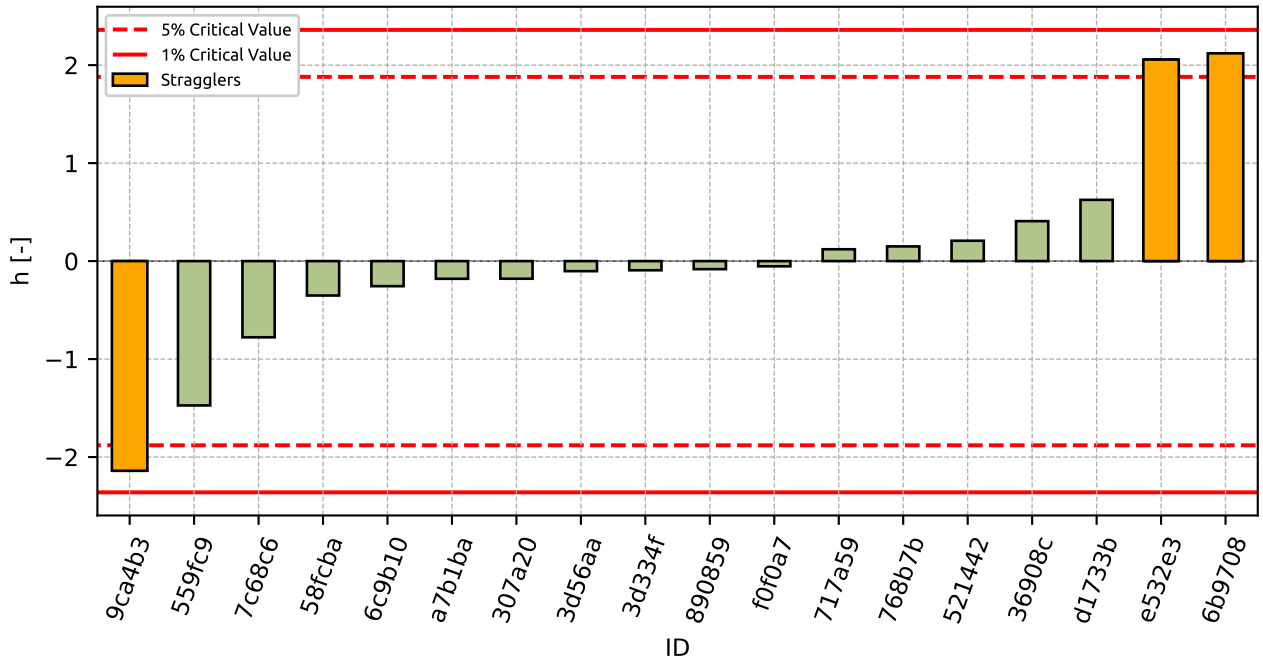

Figure 72: Interlaboratory Consistency Statistic

6.3.4 Descriptive statistics

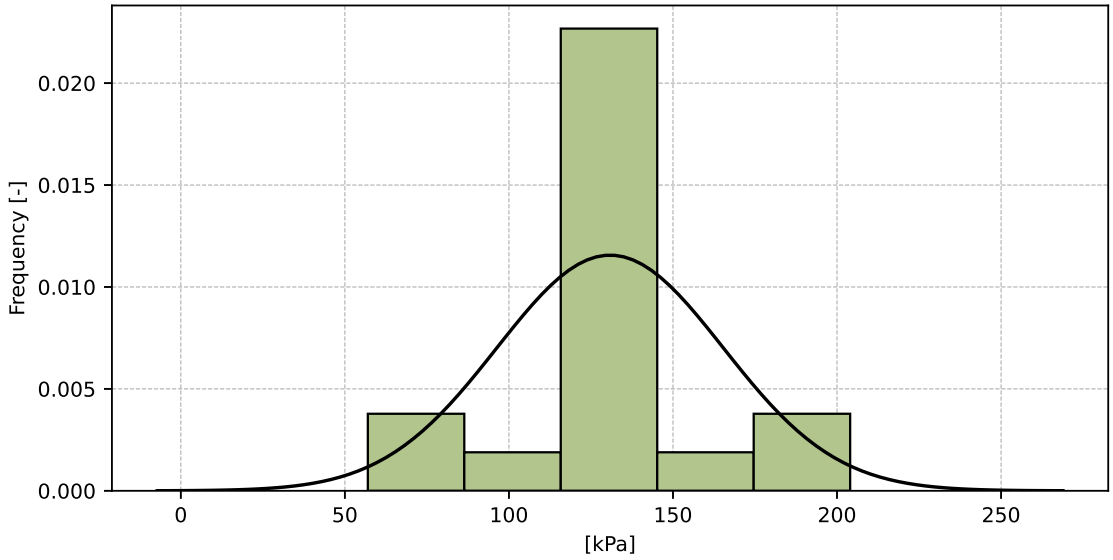

Figure 73: Histogram of all test results

Table 36: Descriptive statistics

Characteristics	**[kPa]**
Average value – $\bar{x}$	130.8
Sample standard deviation – s	34.51
Asigned value – x^*	132.2
Robust standard deviation – s^*	23.85
Measurement uncertainty of asigned value – u_X	7.03
p-value of normality test	0.034 [-]

6.3.5 Evaluation of Performance Statistics

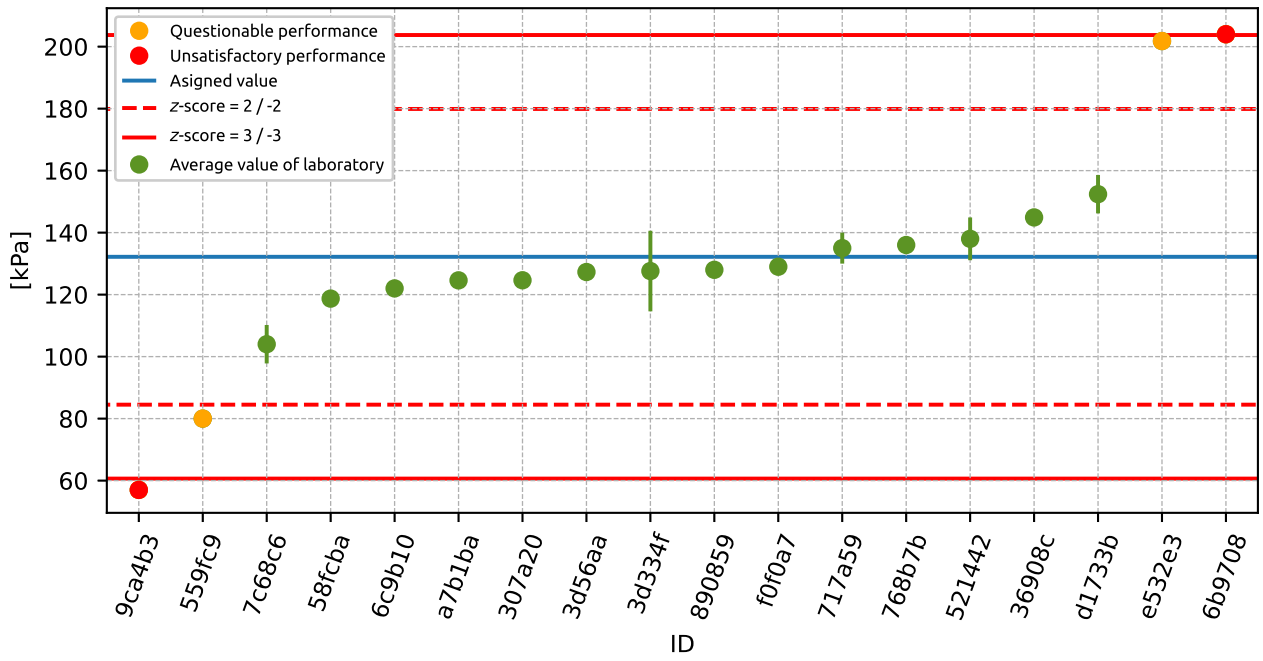

Figure 74: Average values and extended uncertainties of measurement

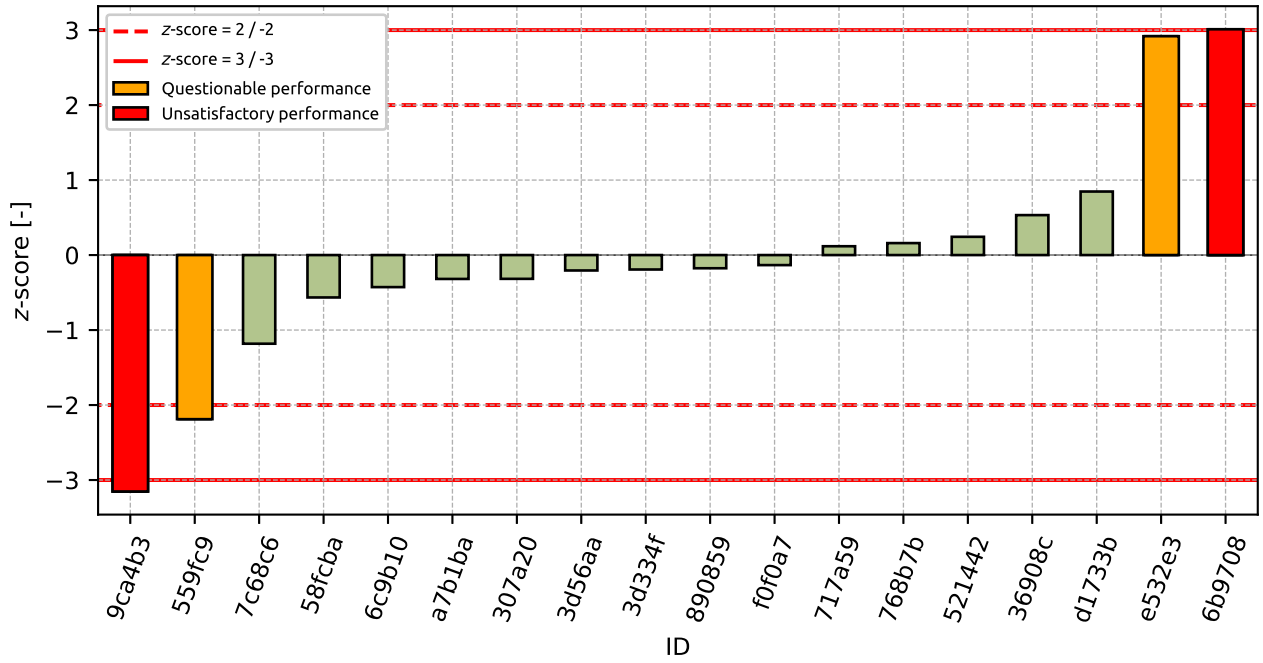

Figure 75: z-score

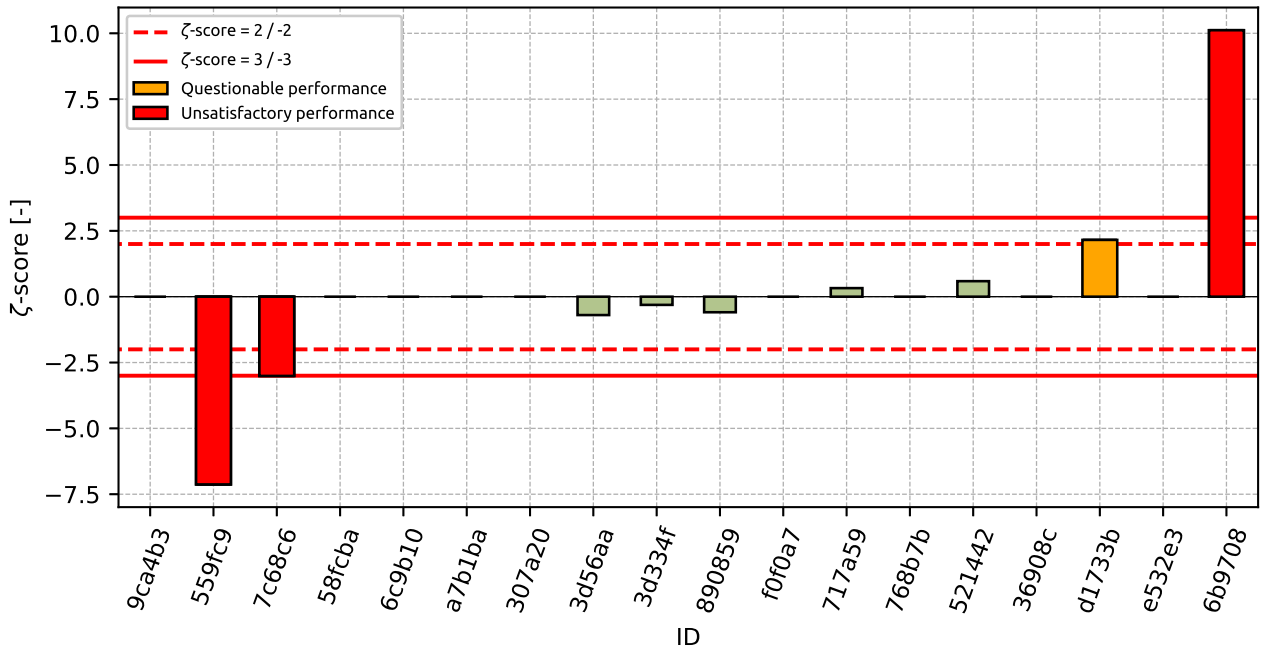

Figure 76: ζ-score

Table 37: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
9ca4b3	-3.15	-
559fc9	-2.19	-7.13
7c68c6	-1.18	-3.01
58fcba	-0.57	-
6c9b10	-0.43	-
a7b1ba	-0.32	-
307a20	-0.32	-
3d56aa	-0.21	-0.7
3d334f	-0.19	-0.31
890859	-0.18	-0.59
f0f0a7	-0.13	-
717a59	0.12	0.33
768b7b	0.16	-
521442	0.24	0.59
36908c	0.53	-
d1733b	0.85	2.16
e532e3	2.92	-
6b9708	3.01	10.12

6.4 400 kPa

6.4.1 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]
9ca4b3	138.0	-
3d56aa	167.7	0.2
559fc9	168.3	2.1
890859	201.0	1.0
a7b1ba	201.9	-
3d334f	209.9	21.0
7c68c6	211.0	12.7
d1733b	213.4	6.2
6c9b10	218.0	-
307a20	231.4	-
58fcba	248.4	-
36908c	251.7	-
717a59	255.0	10.0
521442	255.0	12.8
f0f0a7	266.0	-
768b7b	269.0	-
6b9708	277.0	1.0
e532e3	305.1	-

6.4.2 The Numerical Procedure for Determining Outliers

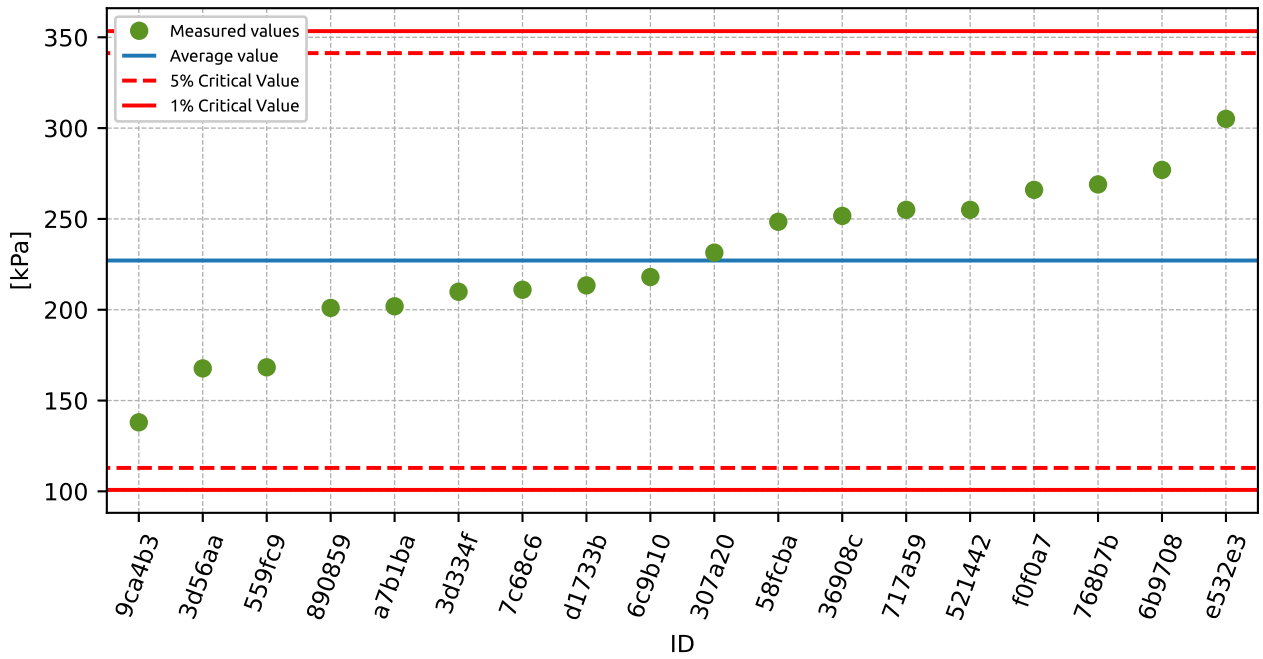

Figure 77: **Grubbs' test** - average values

6.4.3 Mandel's Statistics

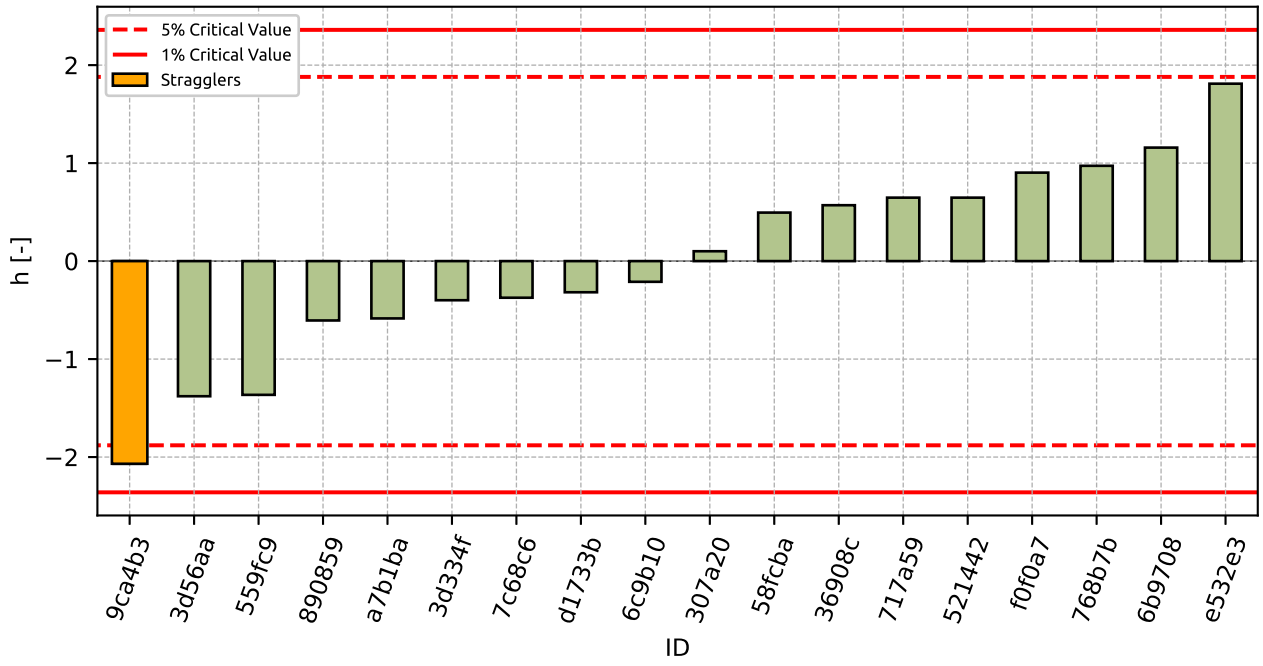

Figure 78: Interlaboratory Consistency Statistic

6.4.4 Descriptive statistics

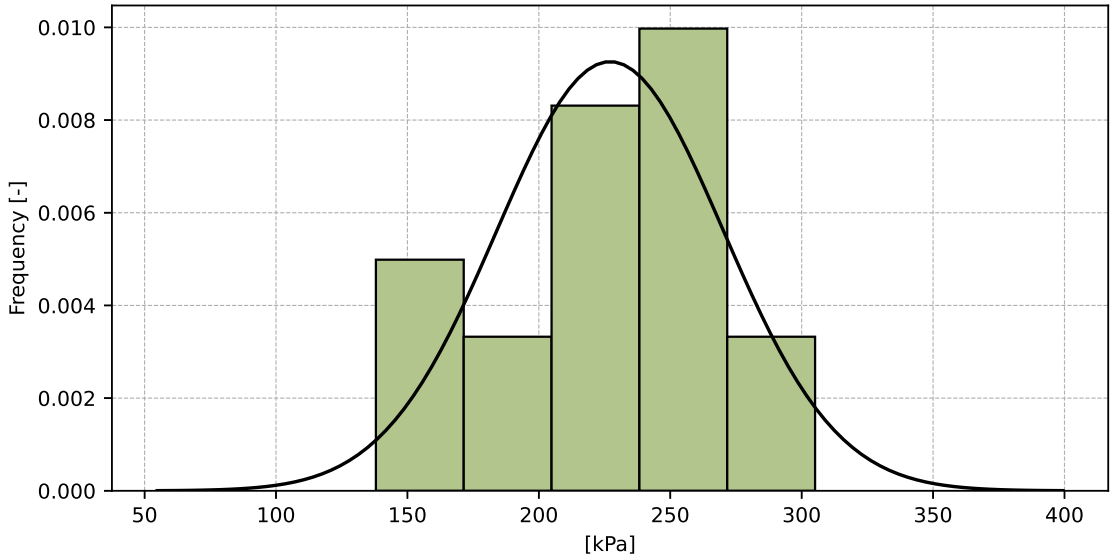

Figure 79: Histogram of all test results

Table 39: Descriptive statistics

Characteristics	**[kPa]**
Average value – $\bar{x}$	227.1
Sample standard deviation – s	43.08
Asigned value – x^*	228.4
Robust standard deviation – s^*	45.6
Measurement uncertainty of asigned value – u_X	13.15
p-value of normality test	0.863 [-]

6.4.5 Evaluation of Performance Statistics

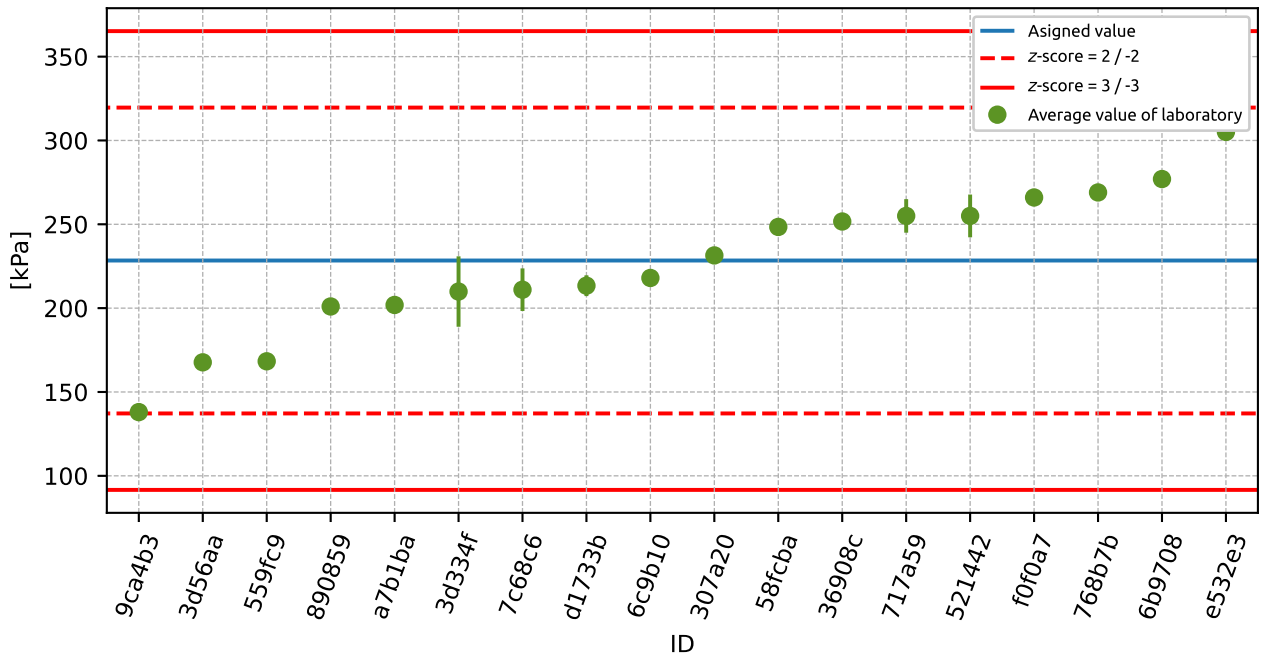

Figure 80: Average values and extended uncertainties of measurement

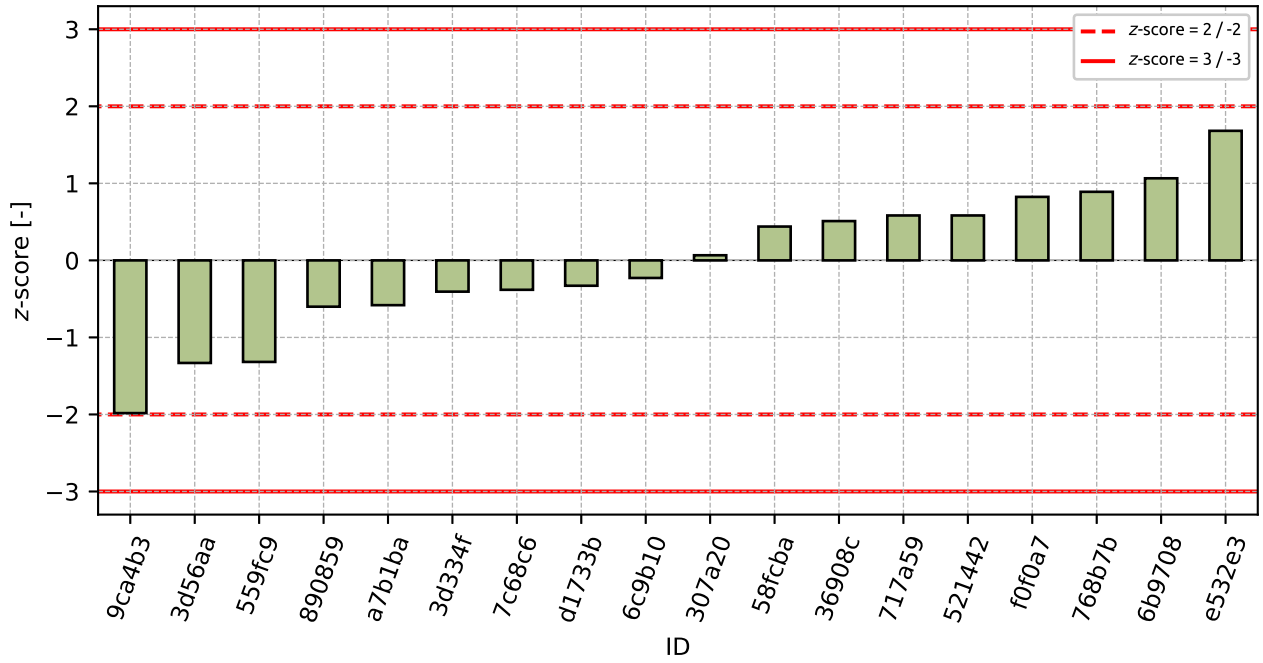

Figure 81: z-score

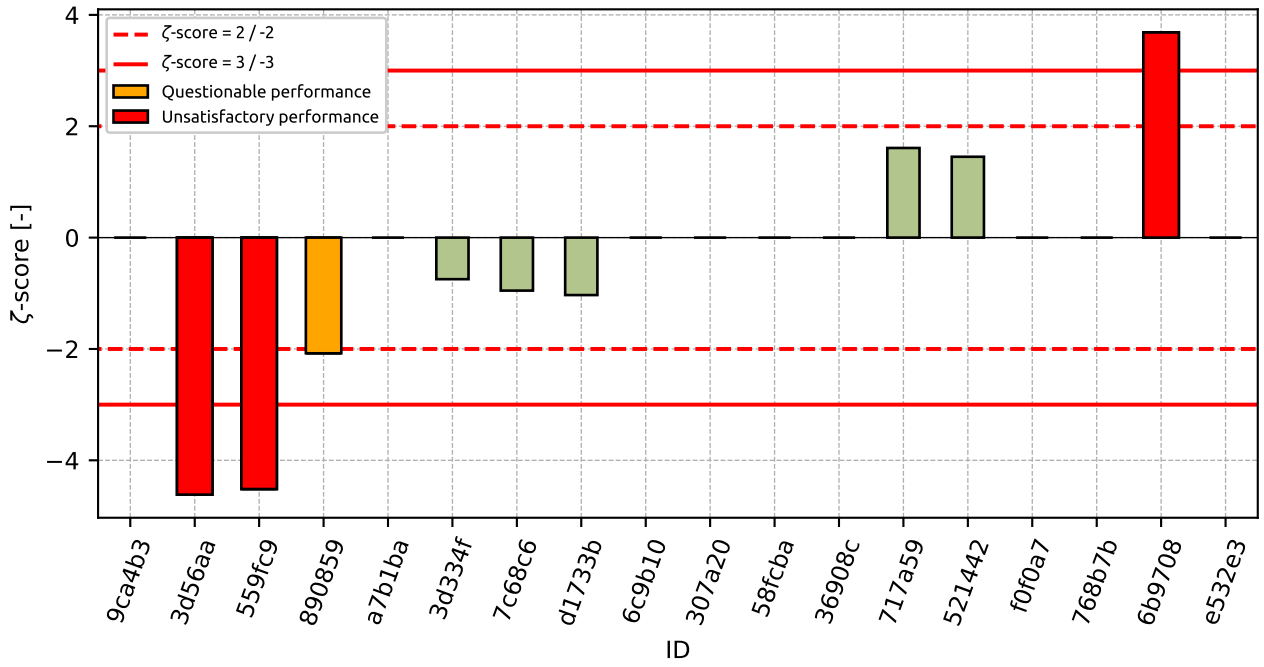

Figure 82: ζ-score

Table 40: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
9ca4b3	-1.98	-
3d56aa	-1.33	-4.62
559fc9	-1.32	-4.52
890859	-0.6	-2.08
a7b1ba	-0.58	-
3d334f	-0.41	-0.75
7c68c6	-0.38	-0.95
d1733b	-0.33	-1.03
6c9b10	-0.23	-
307a20	0.07	-
58fcba	0.44	-
36908c	0.51	-
717a59	0.58	1.61
521442	0.58	1.45
f0f0a7	0.82	-
768b7b	0.89	-
6b9708	1.07	3.68
e532e3	1.68	-

7 Appendix – EN ISO 17892-12 – Atterberg limits

7.1 Liquit limit

7.1.1 Test results

Table 41: 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 [%]
e532e3	28.8	28.8	28.8	0.4	28.8	0.04	0.12
f0f0a7	32.2	31.8	30.8	3.1	31.6	0.72	2.28
3d334f	31.7	31.7	31.8	3.0	31.7	0.06	0.18
6c9b10	32.2	32.0	32.6	-	32.3	0.34	1.06
a7b1ba	32.6	32.3	32.4	0.9	32.4	0.15	0.47
58fcba	33.0	31.9	32.6	-	32.5	0.56	1.71
57fb23	33.0	33.0	33.0	0.7	33.0	0.0	0.0
36908c	32.9	33.4	33.4	-	33.2	0.28	0.84
254382	31.8	32.9	35.4	0.5	33.4	1.87	5.6
9ca4b3	33.0	33.9	33.8	-	33.6	0.49	1.47
e56609	33.3	33.9	-	0.3	33.6	0.42	1.24
414107	34.5	33.4	33.4	2.9	33.8	0.64	1.88
c4cf19	33.6	33.9	34.1	0.5	33.9	0.25	0.74
70635a	34.0	34.0	35.0	1.0	34.3	0.58	1.68
6b9708	32.6	34.3	37.0	0.2	34.6	2.22	6.41
603f12	34.7	34.8	34.8	0.1	34.8	0.06	0.17
2630e9	35.0	35.0	35.0	-	35.0	0.0	0.0
e86bc6	35.0	36.0	34.0	2.0	35.0	1.0	2.86
3a40f8	35.5	36.1	34.0	0.6	35.2	1.08	3.07
05817a	35.3	35.4	35.1	0.8	35.3	0.15	0.43
b3eb69	36.0	35.0	35.0	1.3	35.3	0.58	1.63
768b7b	36.0	36.0	35.0	-	35.7	0.58	1.62
ab69c5	36.1	36.7	35.2	1.6	36.0	0.75	2.1
9972ed	35.8	36.2	36.1	-	36.0	0.23	0.62
959272	36.7	37.9	36.3	1.9	37.0	0.85	2.31
1520a4	37.2	36.9	37.8	4.0	37.3	0.46	1.23
26e50d	37.0	38.0	37.0	1.3	37.3	0.58	1.55
b07558	37.4	37.8	38.2	1.7	37.8	0.4	1.05
154ca0	37.5	38.5	37.9	4.0	38.0	0.5	1.33

7.1.2 The Numerical Procedure for Determining Outliers

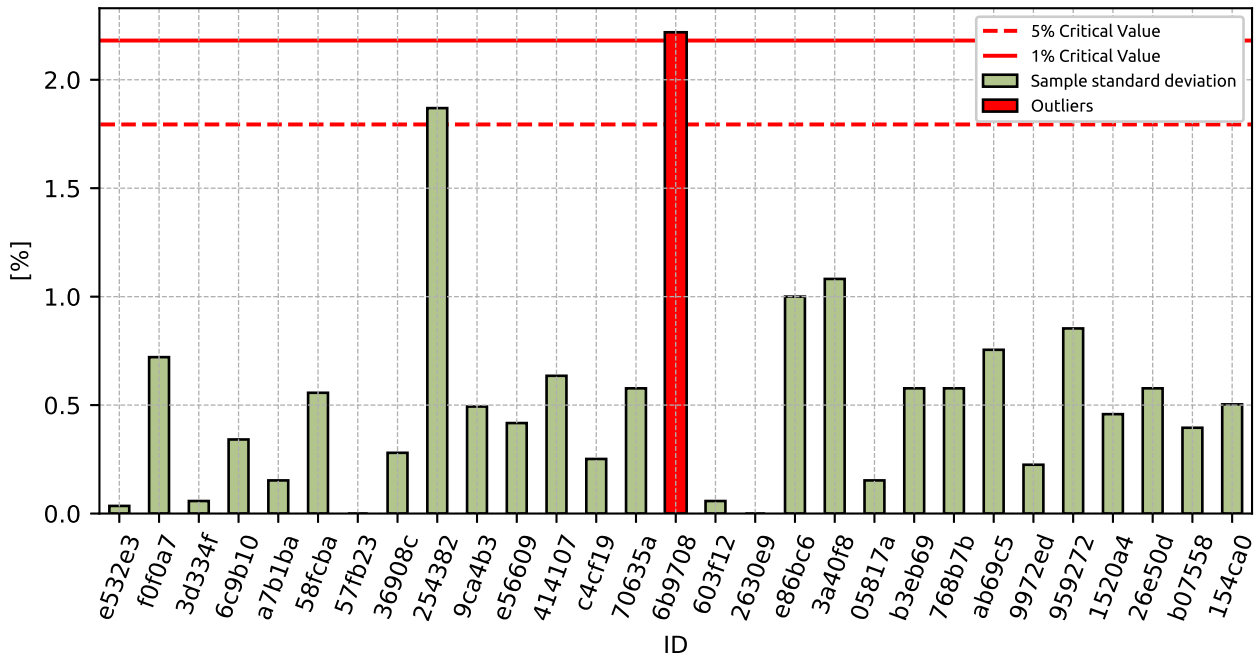

Figure 83: **Cochran's test** - sample standard deviations

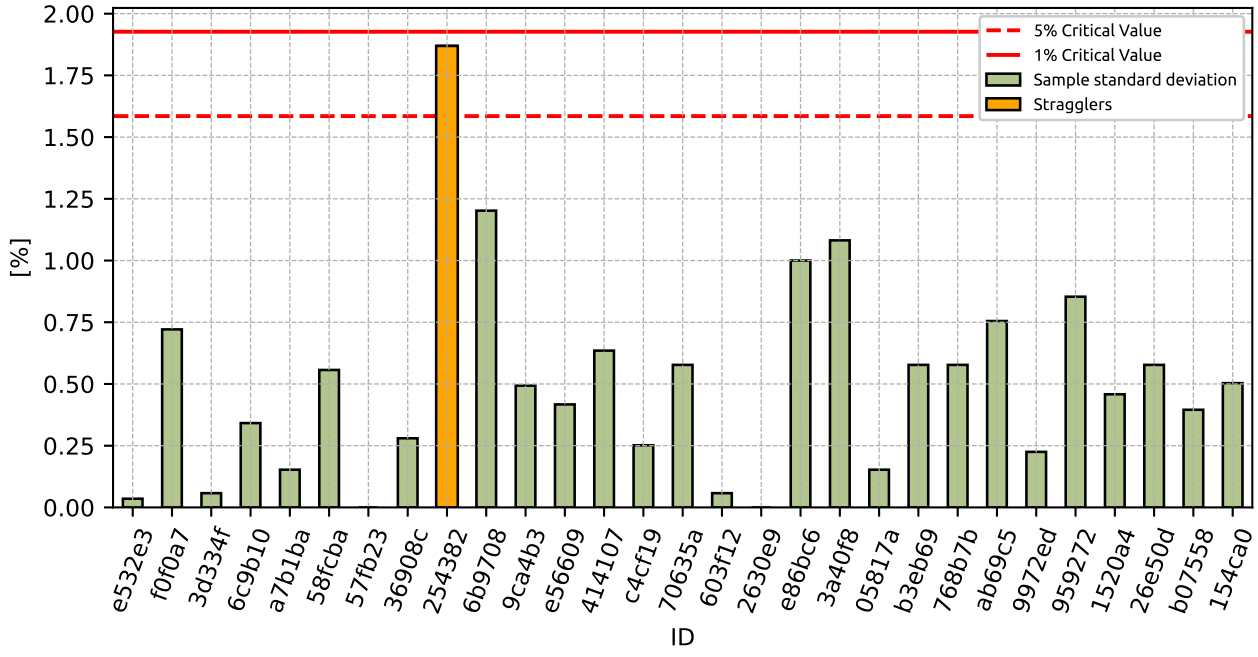

Figure 84: **Cochran's test** - sample standard deviations without outliers

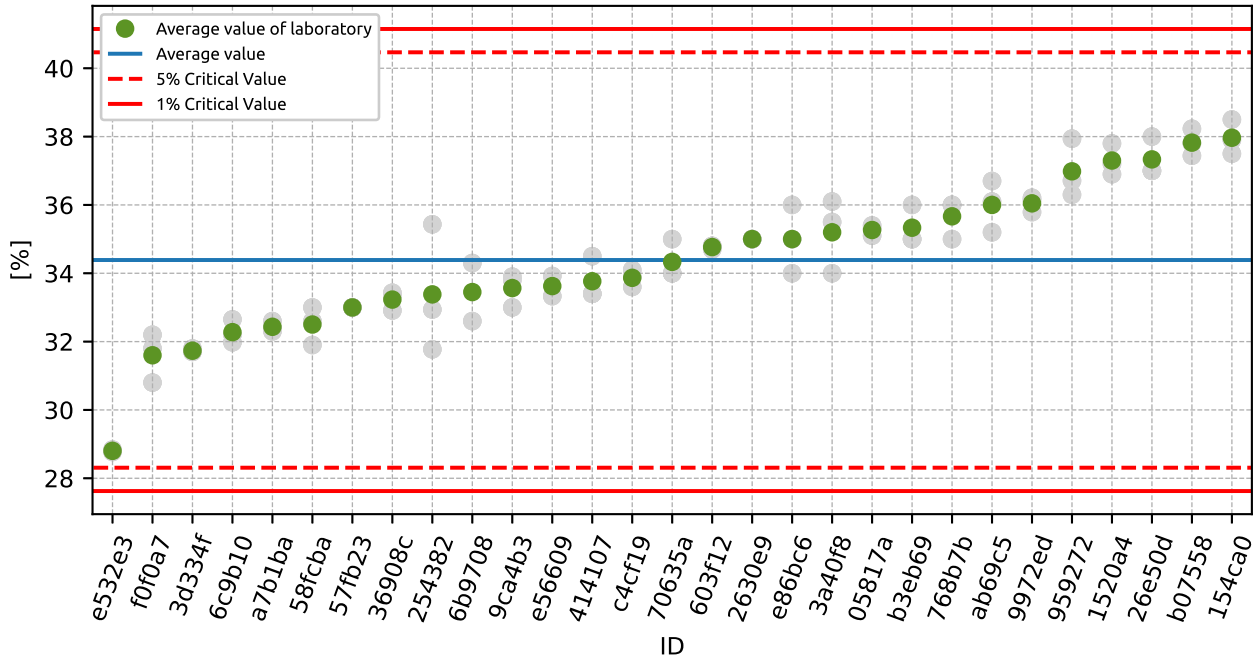

Figure 85: **Grubbs' test** - average values

7.1.3 Mandel's Statistics

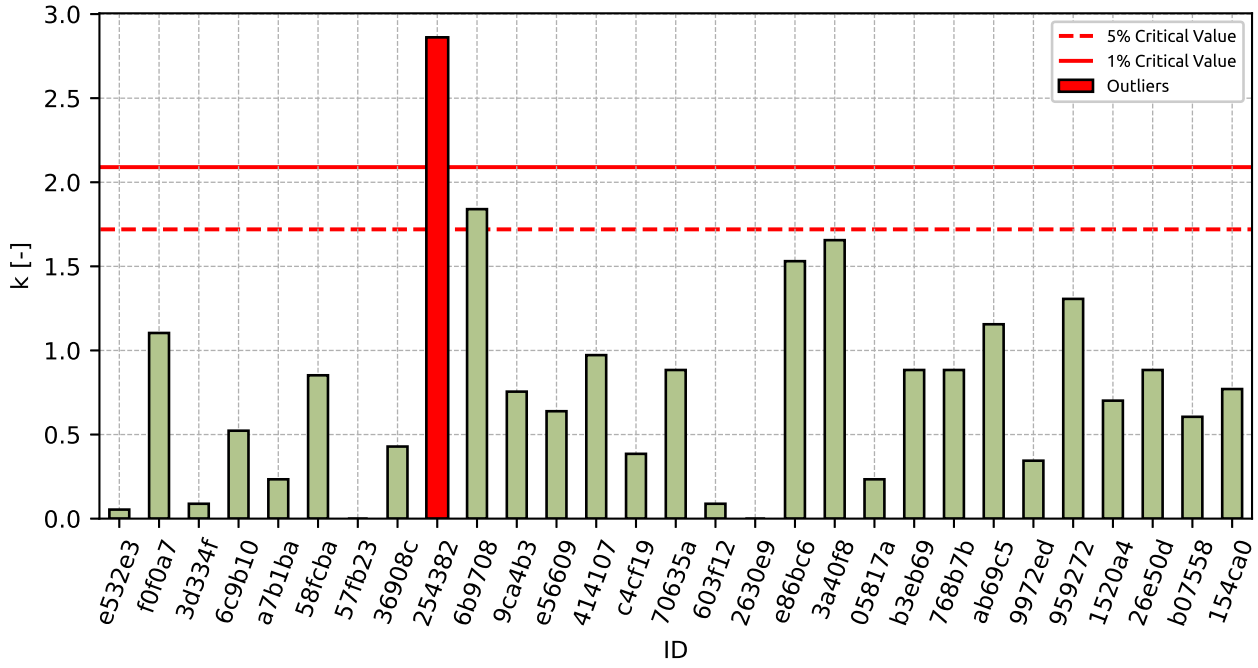

Figure 86: Intralaboratory Consistency Statistic

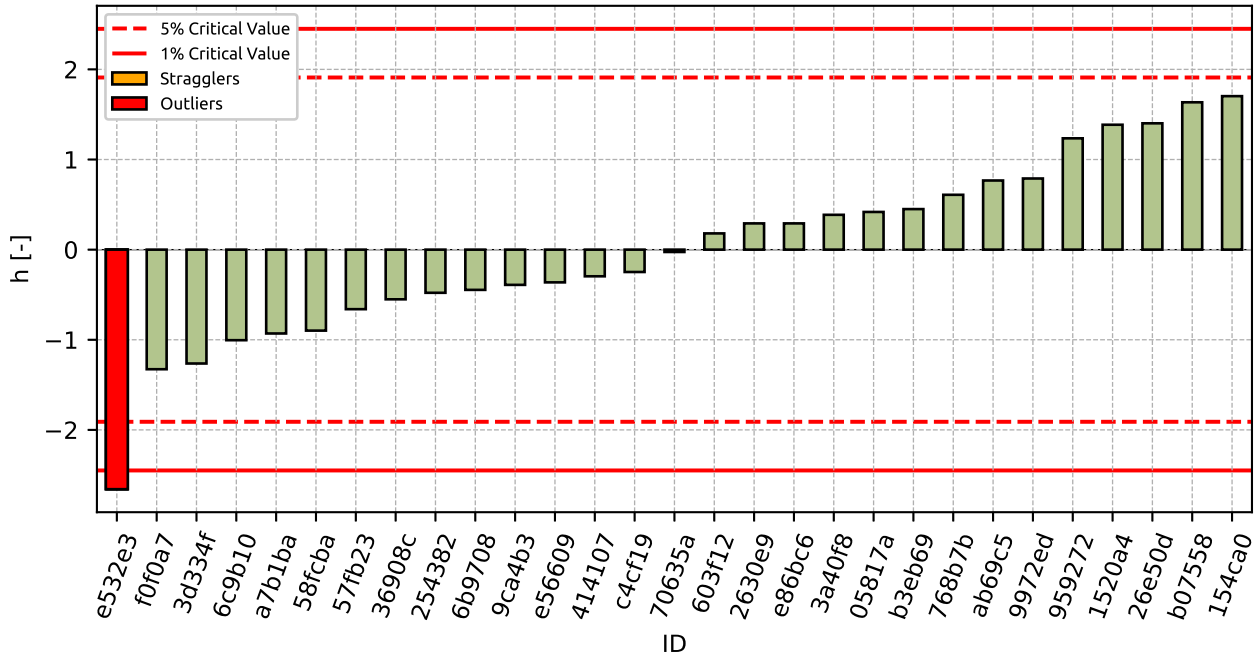

Figure 87: Interlaboratory Consistency Statistic

7.1.4 Descriptive statistics

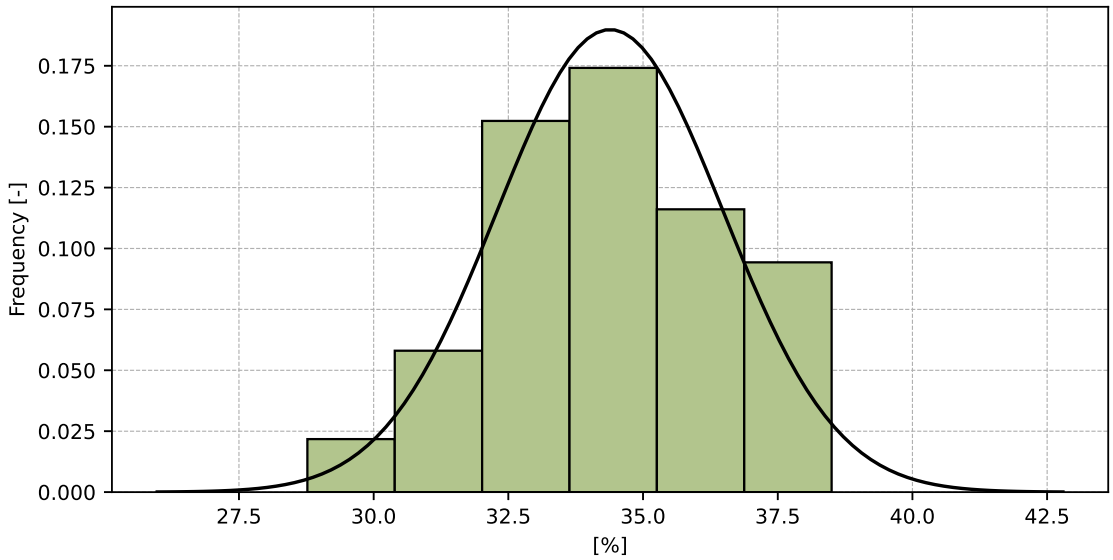

Figure 88: Histogram of all test results

Table 42: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	34.4
Sample standard deviation – s	2.1
Asigned value – x^*	34.5
Robust standard deviation – s^*	2.08
Measurement uncertainty of asigned value – u_X	0.48
p-value of normality test	1.0 [-]
Interlaboratory standard deviation – s_L	2.07
Repeatability standard deviation – s_r	0.65
Reproducibility standard deviation – s_R	2.17
Repeatability – r	1.8
Reproducibility – R	6.1

7.1.5 Evaluation of Performance Statistics

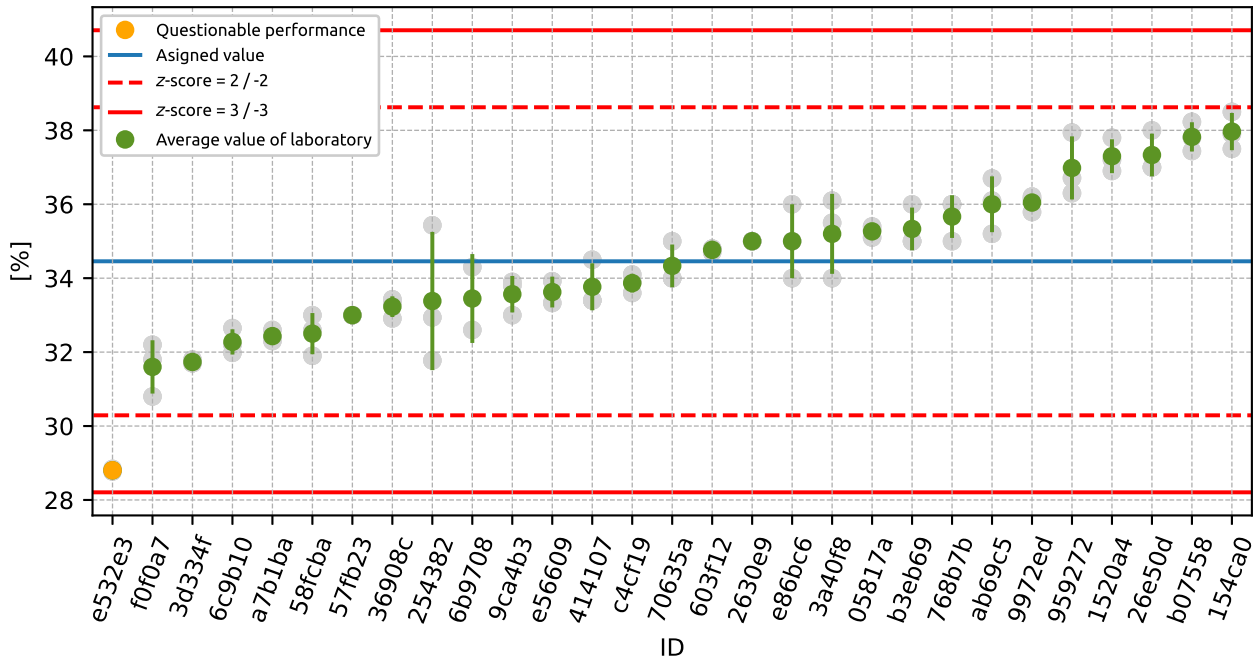

Figure 89: Average values and sample standard deviations

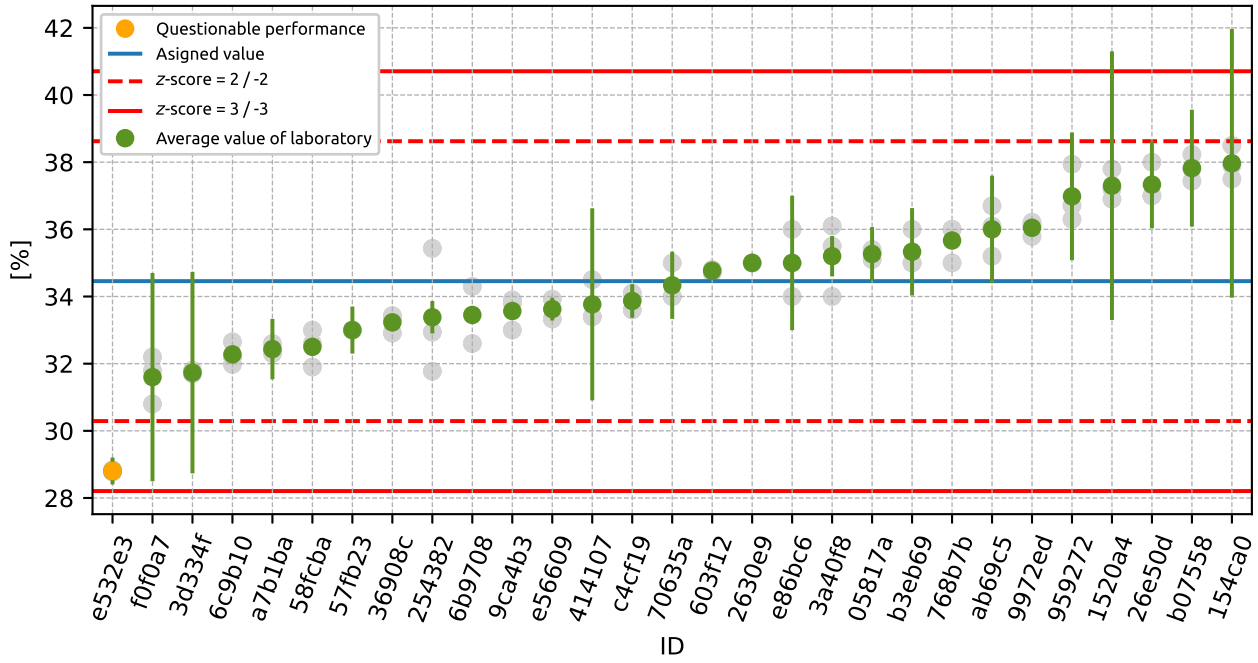

Figure 90: Average values and extended uncertainties of measurement

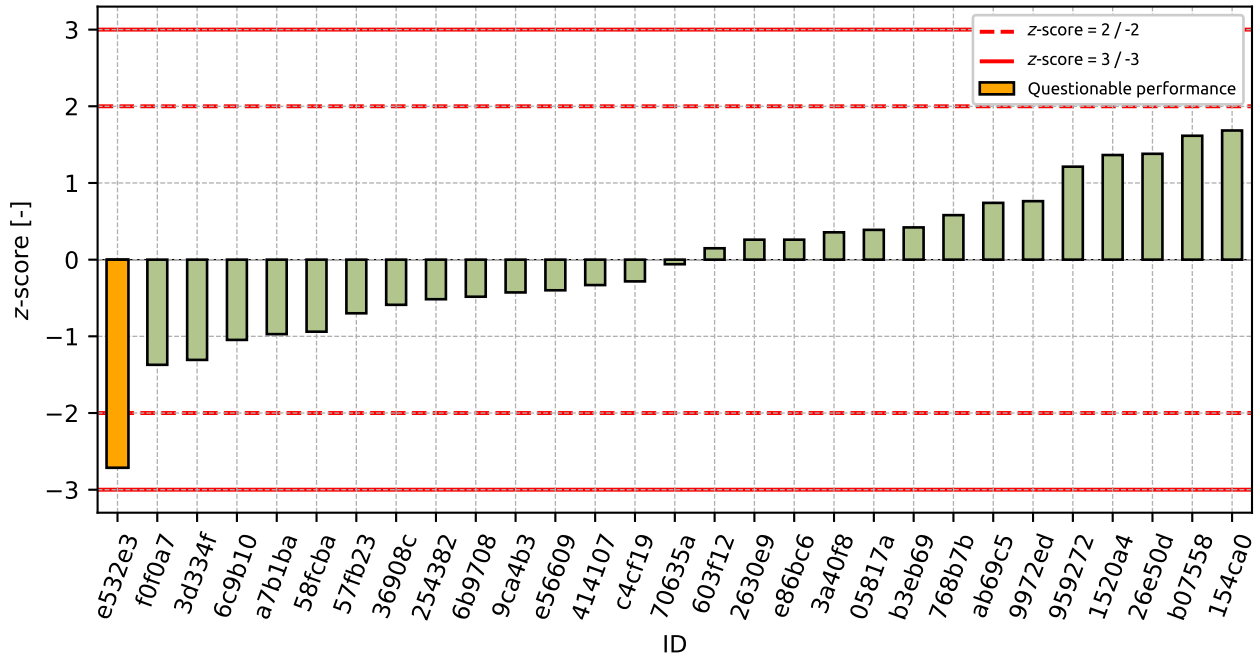

Figure 91: z-score

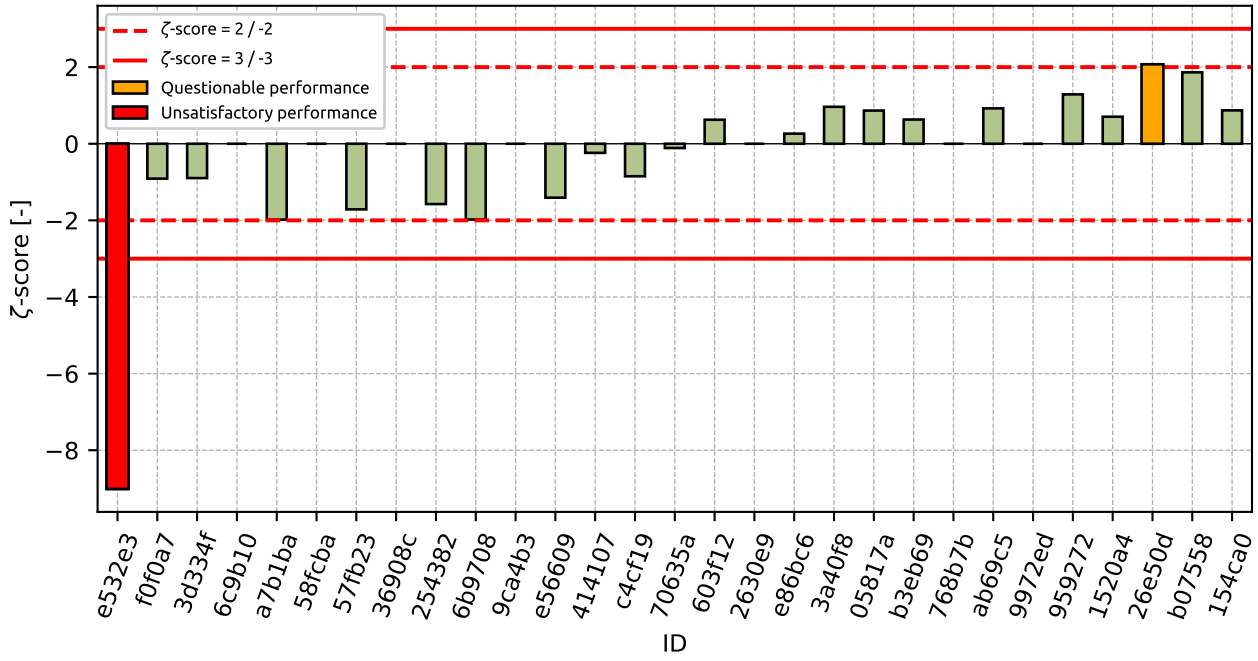

Figure 92: ζ-score

Table 43: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
e532e3	-2.71	-9.01
f0f0a7	-1.37	-0.91
3d334f	-1.31	-0.9
6c9b10	-1.05	-
a7b1ba	-0.97	-1.98
58fcba	-0.94	-
57fb23	-0.7	-1.71
36908c	-0.59	-
254382	-0.52	-1.57
6b9708	-0.48	-1.98
9ca4b3	-0.43	-
e56609	-0.4	-1.41
414107	-0.33	-0.24
c4cf19	-0.28	-0.85
70635a	-0.06	-0.11
603f12	0.15	0.63
2630e9	0.26	-
e86bc6	0.26	0.26
3a40f8	0.36	0.96
05817a	0.39	0.87
b3eb69	0.42	0.63
768b7b	0.58	-
ab69c5	0.74	0.92
9972ed	0.76	-
959272	1.21	1.29
1520a4	1.36	0.71
26e50d	1.38	2.07
b07558	1.62	1.86
154ca0	1.68	0.87

7.2 Plastic limit

7.2.1 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 [%]
e86bc6	0.0	0.0	0.0	0.0	0.0	0.0	-
e532e3	16.9	16.6	16.6	0.5	16.7	0.17	1.04
b07558	17.7	16.8	18.1	3.0	17.5	0.69	3.93
70635a	18.0	18.0	19.0	1.9	18.3	0.58	3.15
58fcba	19.5	18.8	18.4	-	18.9	0.56	2.95
1520a4	19.4	19.1	19.8	4.0	19.4	0.35	1.81
6b9708	19.7	19.7	19.7	0.2	19.7	0.01	0.03
414107	20.3	19.7	19.8	2.0	19.9	0.32	1.61
05817a	20.4	20.0	19.8	0.6	20.1	0.31	1.52
ab69c5	20.7	19.9	19.8	1.5	20.1	0.49	2.45
9972ed	19.7	20.5	20.4	-	20.2	0.43	2.13
36908c	19.9	20.4	20.6	-	20.3	0.34	1.66
9ca4b3	19.7	20.8	20.5	-	20.3	0.57	2.8
603f12	20.6	20.5	20.7	0.1	20.6	0.1	0.49
a7b1ba	20.8	20.4	20.7	0.6	20.6	0.21	1.01
768b7b	20.0	21.0	21.0	-	20.7	0.58	2.79
254382	21.1	20.4	20.8	0.1	20.8	0.35	1.67
57fb23	21.0	21.0	21.0	0.7	21.0	0.0	0.0
2630e9	21.0	21.0	21.0	-	21.0	0.0	0.0
e56609	21.1	21.0	-	0.2	21.1	0.08	0.37
3a40f8	21.4	21.3	20.9	0.5	21.2	0.26	1.25
b3eb69	21.0	21.0	22.0	2.0	21.3	0.58	2.71
154ca0	21.5	21.1	21.6	4.0	21.4	0.26	1.24
959272	21.4	21.5	21.4	1.1	21.4	0.05	0.24
3d334f	21.8	21.7	21.6	2.0	21.7	0.1	0.46
26e50d	22.0	22.0	22.0	2.0	22.0	0.0	0.0
6c9b10	22.2	22.6	22.0	-	22.2	0.29	1.32
f0f0a7	20.9	22.2	24.8	3.8	22.6	1.99	8.77
c4cf19	27.0	27.2	27.5	0.5	27.2	0.25	0.92

7.2.2 The Numerical Procedure for Determining Outliers

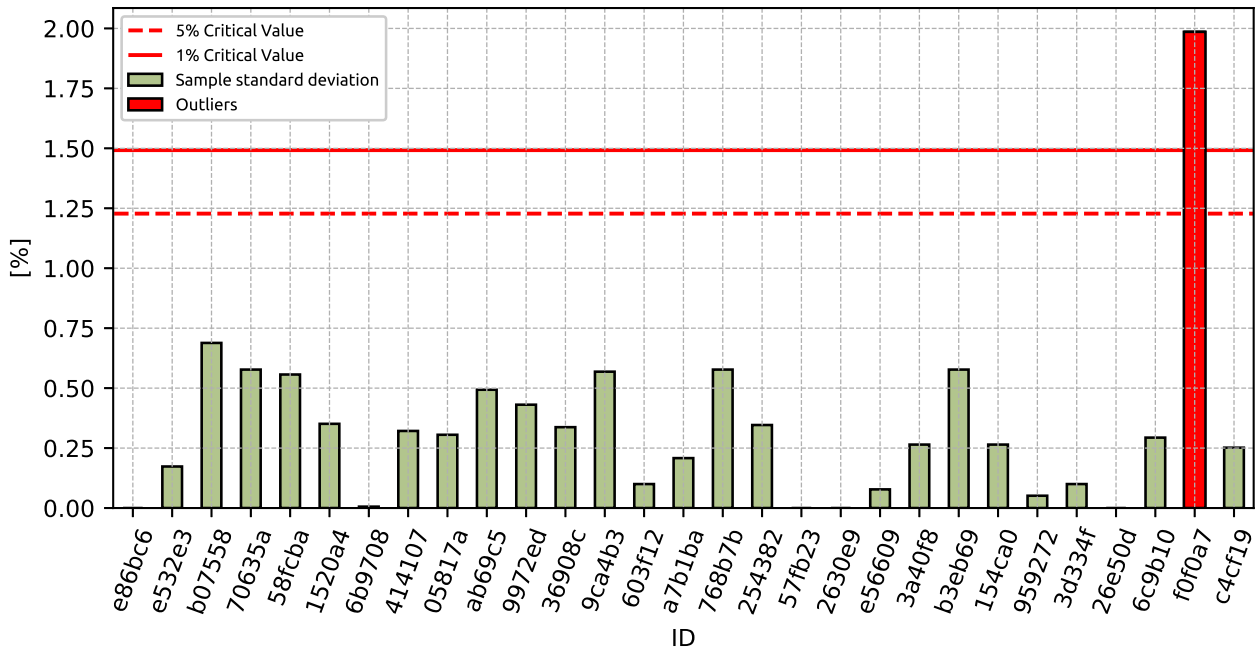

Figure 93: **Cochran's test** - sample standard deviations

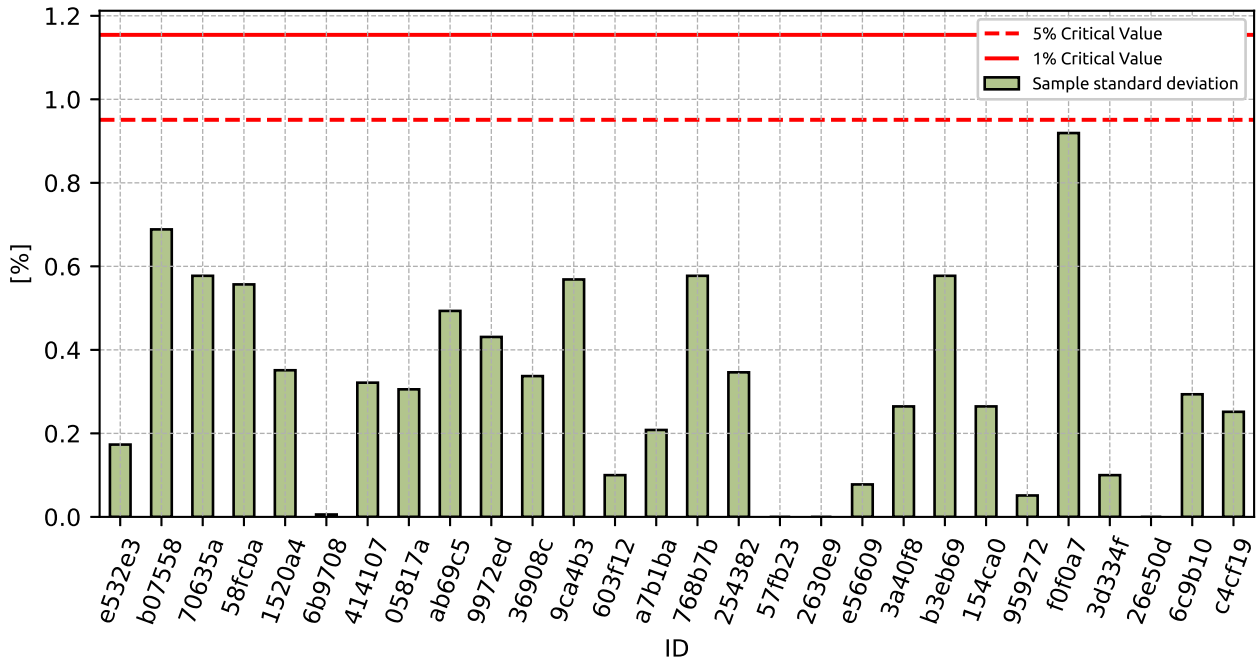

Figure 94: **Cochran's test** - sample standard deviations without outliers

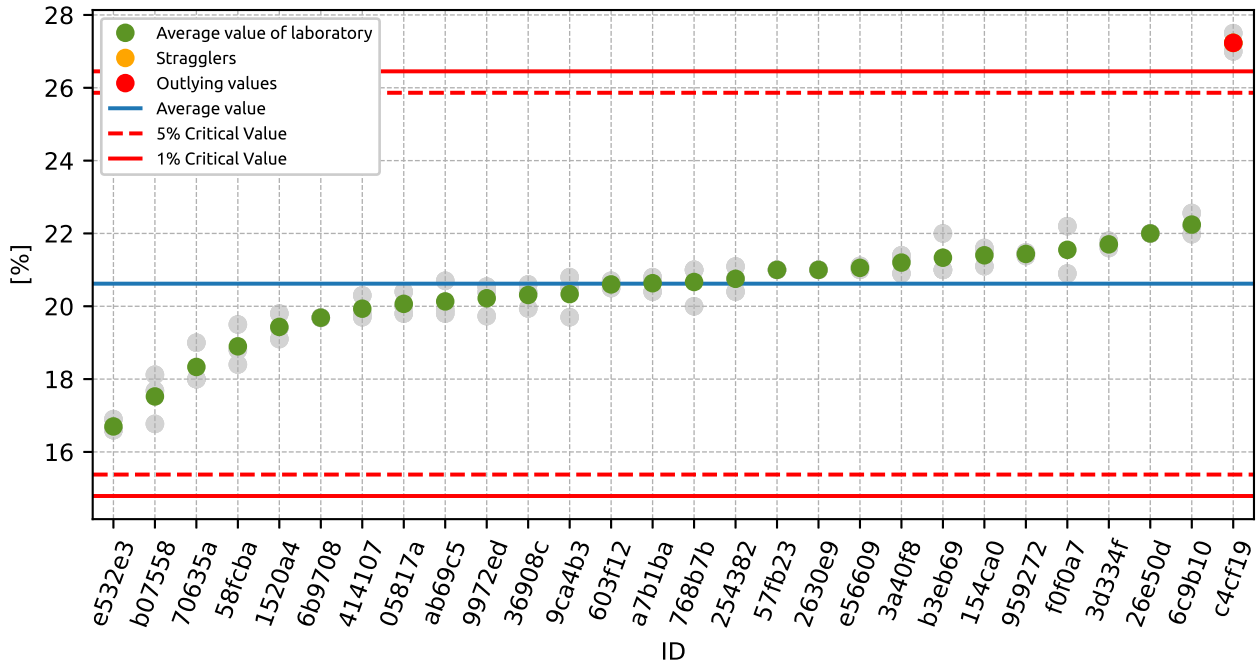

Figure 95: **Grubbs' test** - average values

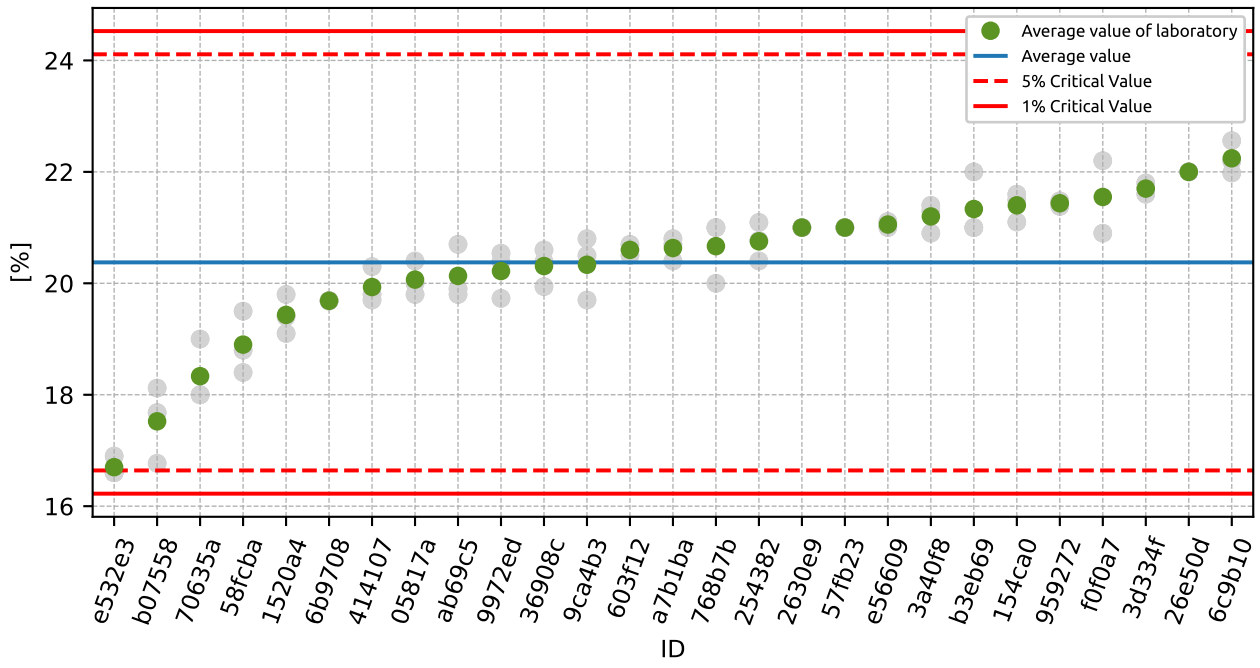

Figure 96: **Grubbs' test** - average values without outliers

7.2.3 Mandel's Statistics

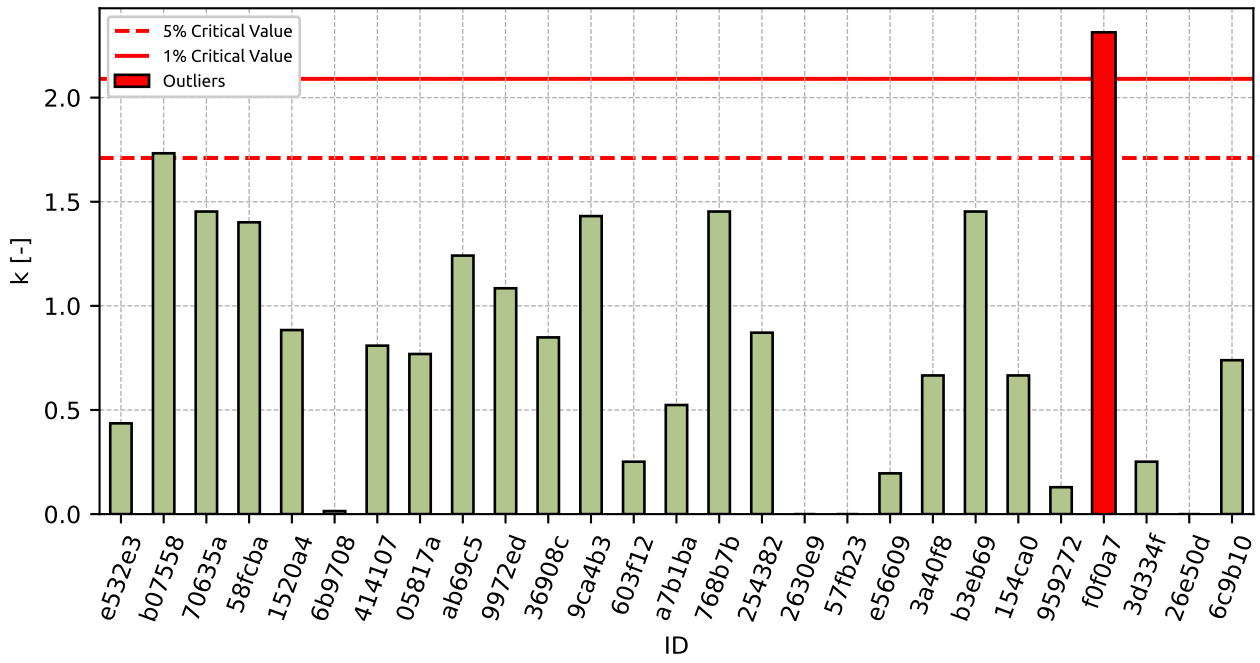

Figure 97: Intralaboratory Consistency Statistic

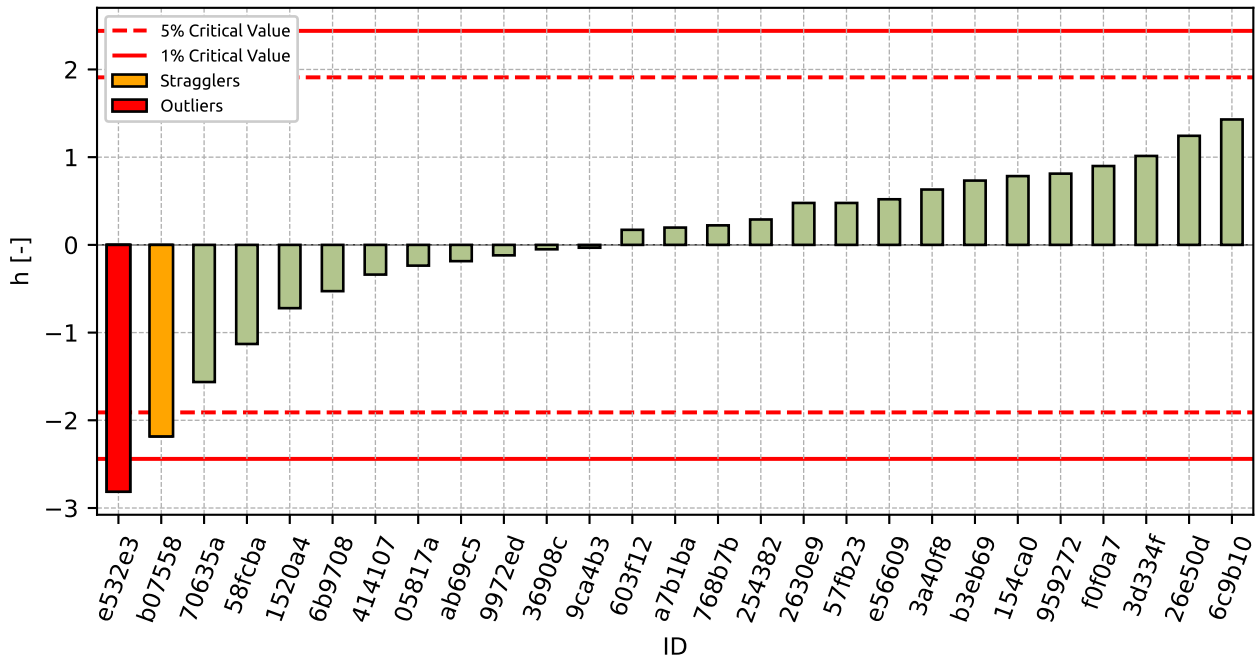

Figure 98: Interlaboratory Consistency Statistic

7.2.4 Descriptive statistics

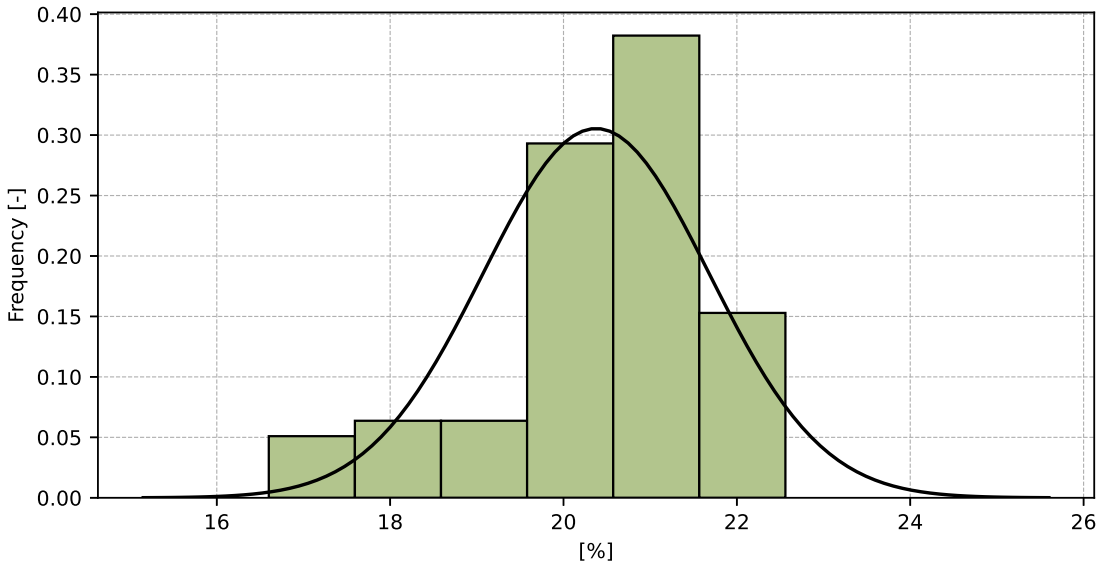

Figure 99: Histogram of all test results

Table 45: Descriptive statistics

Characteristics	**[%]**
Average value – $\bar{x}$	20.4
Sample standard deviation – s	1.31
Asigned value – x^*	20.6
Robust standard deviation – s^*	1.03
Measurement uncertainty of asigned value – u_X	0.25
p-value of normality test	1.0 [-]
Interlaboratory standard deviation – s_L	1.29
Repeatability standard deviation – s_r	0.4
Reproducibility standard deviation – s_R	1.35
Repeatability – r	1.1
Reproducibility – R	3.8

7.2.5 Evaluation of Performance Statistics

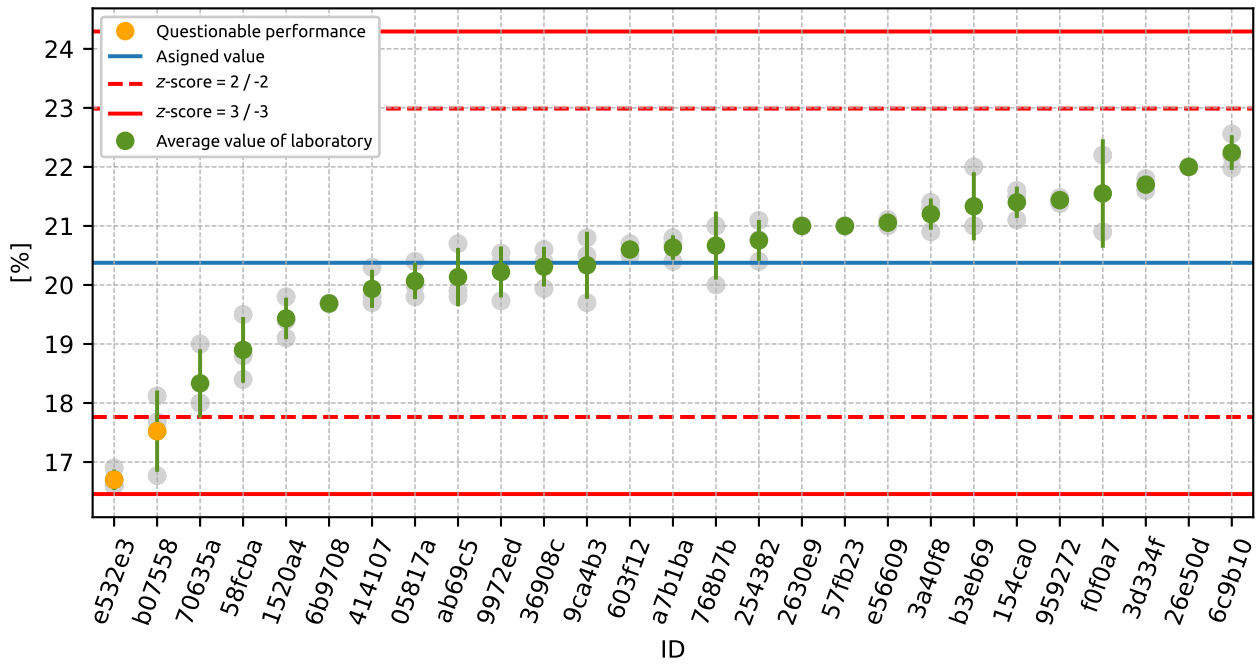

Figure 100: Average values and sample standard deviations

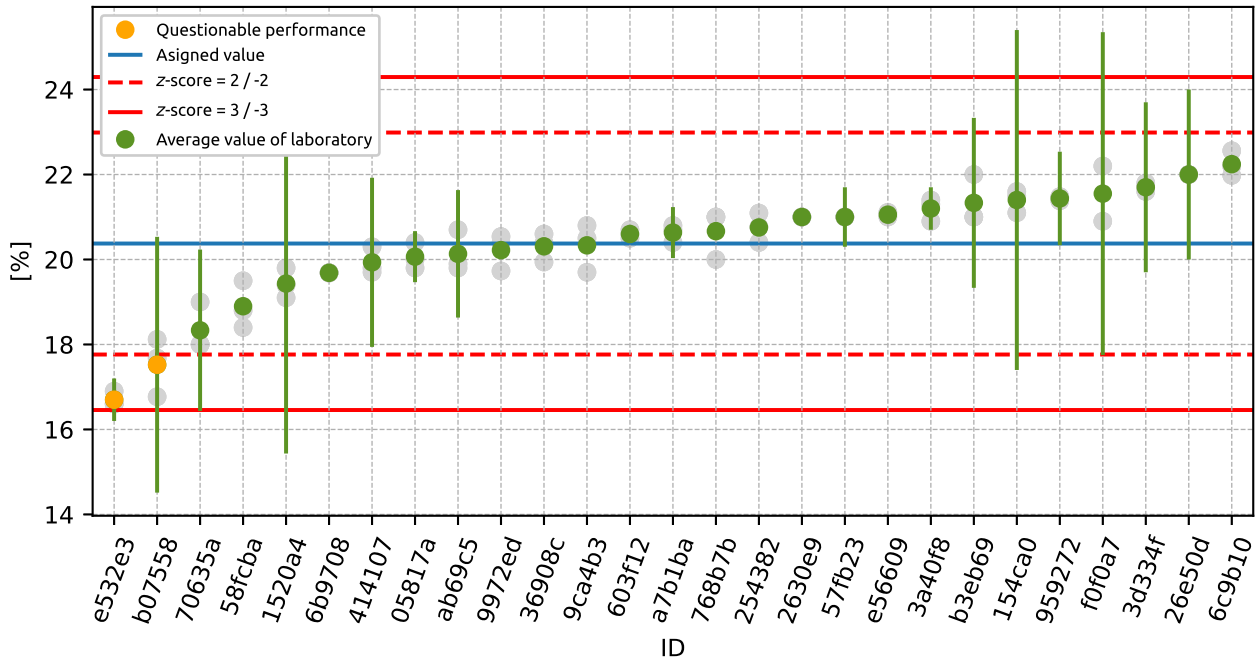

Figure 101: Average values and extended uncertainties of measurement

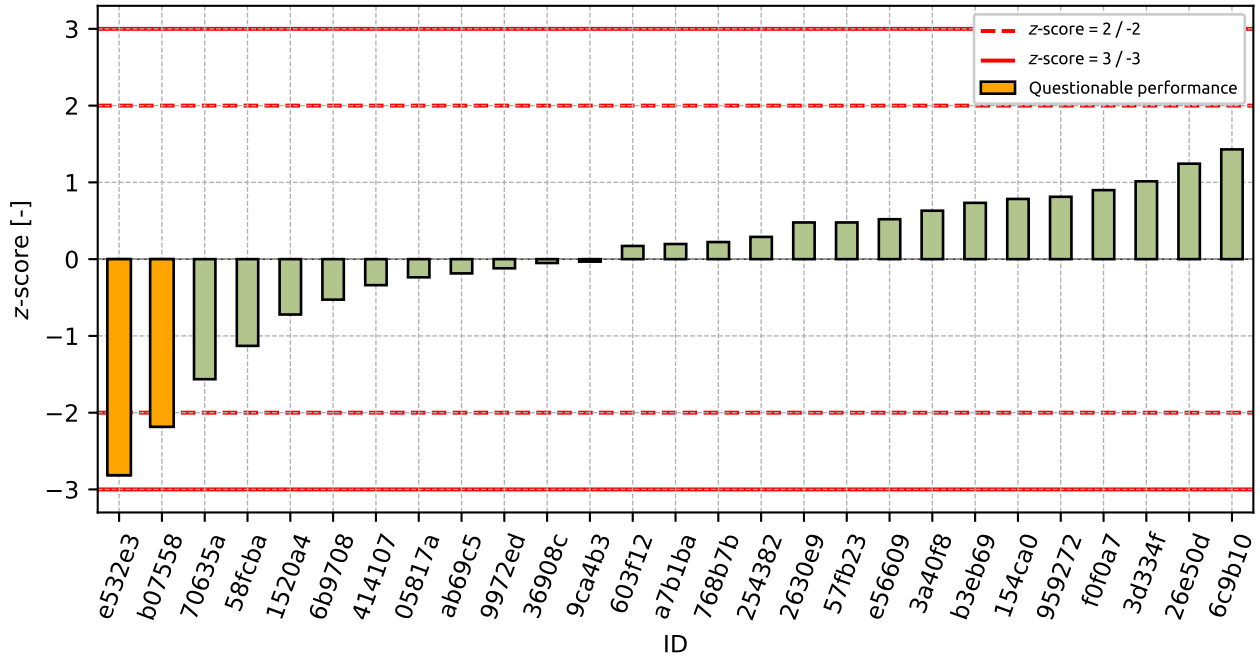

Figure 102: z-score

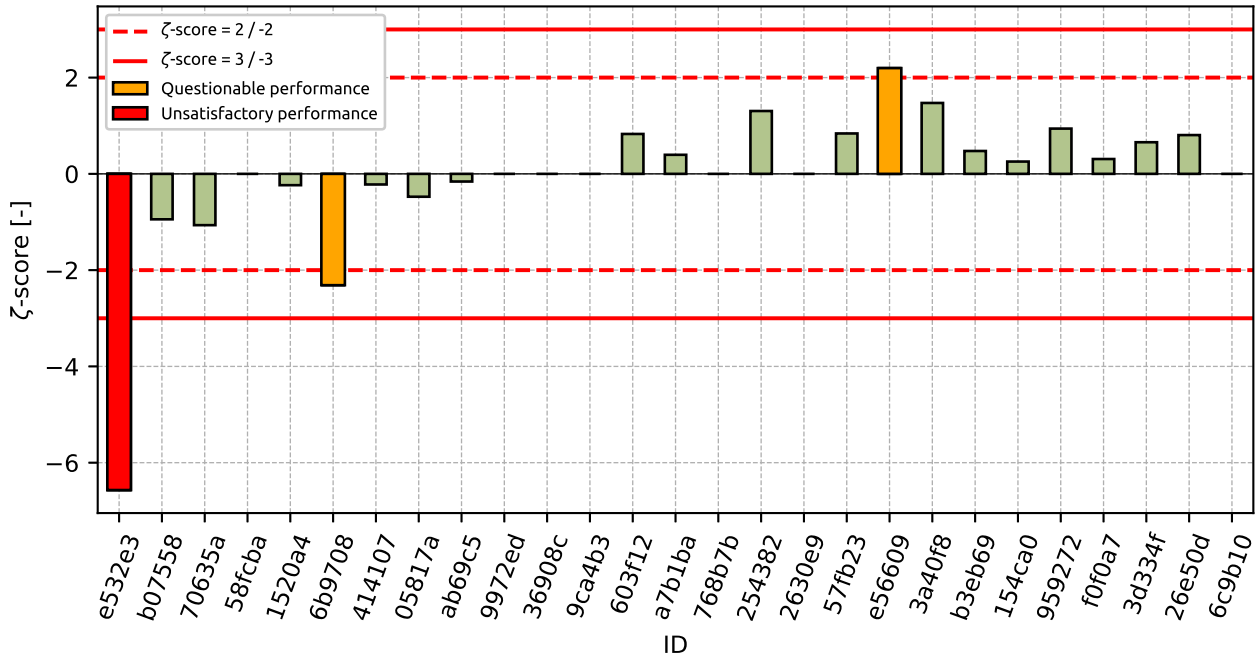

Figure 103: ζ-score

Table 46: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
e532e3	-2.81	-6.57
b07558	-2.18	-0.94
70635a	-1.56	-1.07
58fcba	-1.13	-
1520a4	-0.72	-0.24
6b9708	-0.53	-2.31
414107	-0.34	-0.22
05817a	-0.24	-0.48
ab69c5	-0.19	-0.16
9972ed	-0.12	-
36908c	-0.05	-
9ca4b3	-0.03	-
603f12	0.17	0.83
a7b1ba	0.2	0.4
768b7b	0.22	-
254382	0.29	1.31
2630e9	0.48	-
57fb23	0.48	0.84
e56609	0.52	2.2
3a40f8	0.63	1.47
b3eb69	0.73	0.48
154ca0	0.78	0.26
959272	0.81	0.94
f0f0a7	0.9	0.31
3d334f	1.01	0.66
26e50d	1.24	0.81
6c9b10	1.43	-

8 Appendix – EN 13286-2 – Proctor

8.1 Proctor density

8.1.1 Test results

Table 47: 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]
c76279	1650	2.0
768b7b	1680	-
9972ed	1685	-
36908c	1699	-
70635a	1700	20.0
132004	1710	12.0
58fcba	1717	-
037ad0	1722	4.0
603f12	1722	0.0
c87776	1730	10.0
f6afb9	1730	20.0
39fda6	1730	25.0
7bd050	1730	13.0
ab69c5	1738	25.0
899e89	1740	22.0
a17694	1740	1.0
3d334f	1740	60.0
8bbd4f	1740	2.0
6c9b10	1743	-
44c83c	1745	22.0
6da029	1750	22.0
344cdc	1750	20.0
26e50d	1750	226.0
710e68	1751	12.0
cab52a	1754	12.0
0e7dcd	1760	10.0
7c68c6	1760	10.0
e532e3	1762	43.0
d614a2	1763	3.0
3a16d4	1763	26.0
f0f0a7	1769	60.0
7c2812	1770	53.0
adaf6b	1770	-
414107	1770	0.0
05817a	1770	30.0
6f2e40	1771	110.0
5a7c66	1780	50.0
f90493	1780	-
ca5af0	1787	0.0
5c1c2a	1790	16.0
cbfb53	1810	30.0
19cf6e	1814	53.0
9ca4b3	1829	-

8.1.2 The Numerical Procedure for Determining Outliers

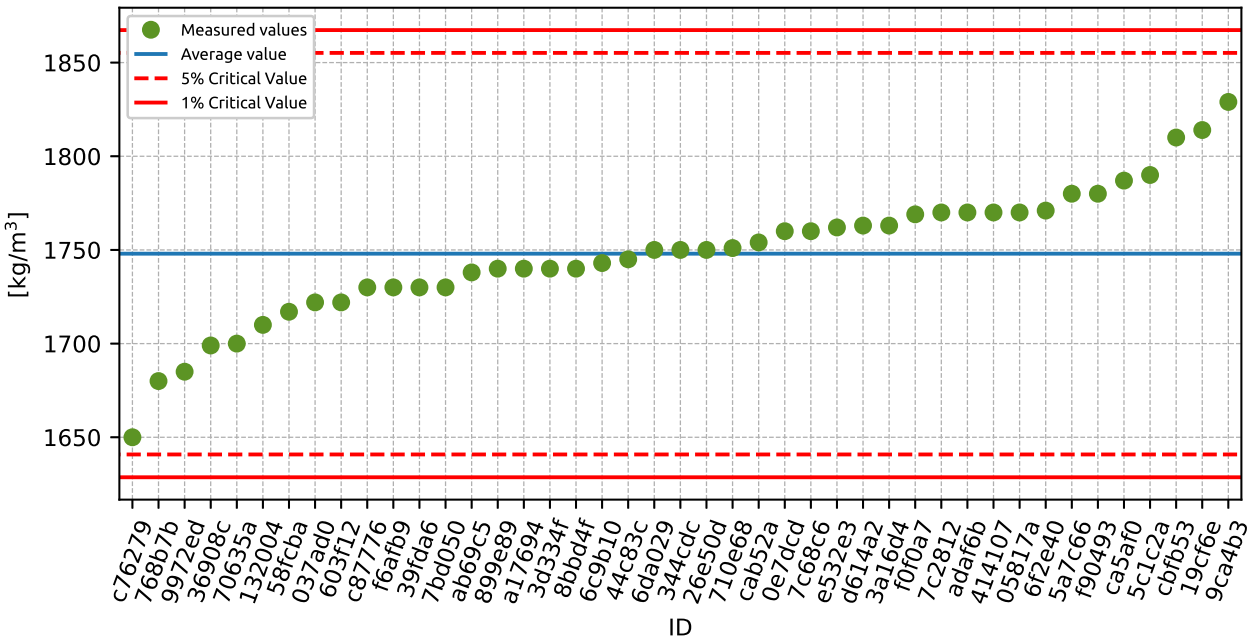

Figure 104: **Grubbs' test** - average values

8.1.3 Mandel's Statistics

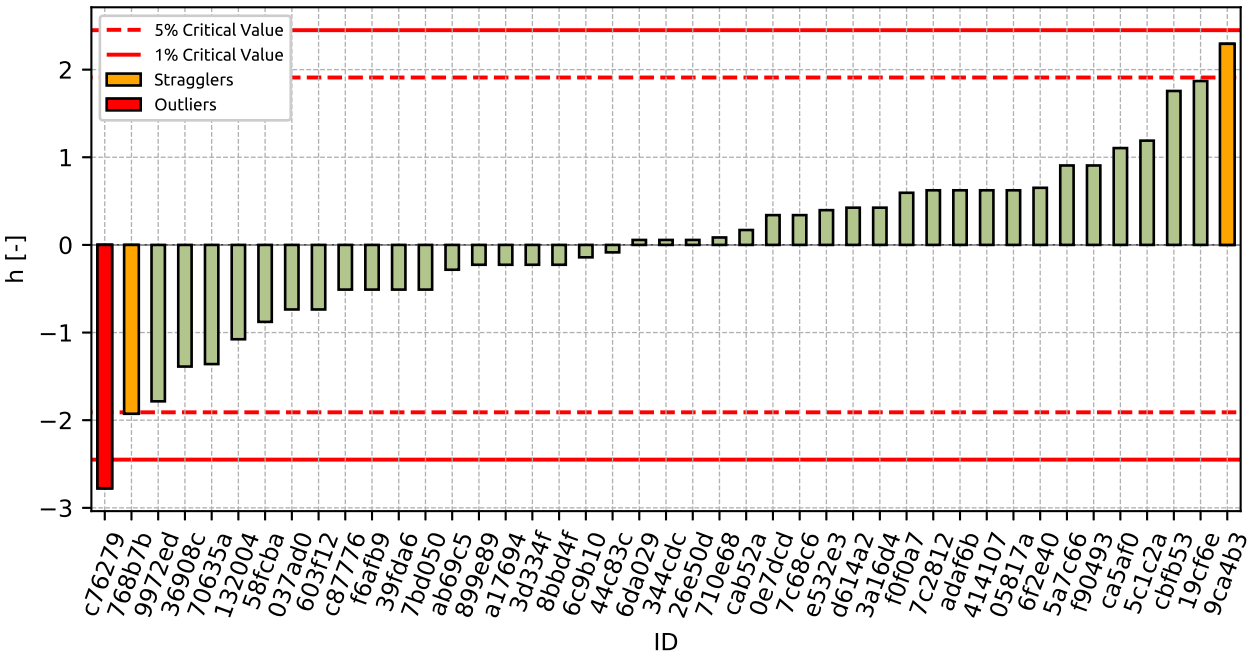

Figure 105: Interlaboratory Consistency Statistic

8.1.4 Descriptive statistics

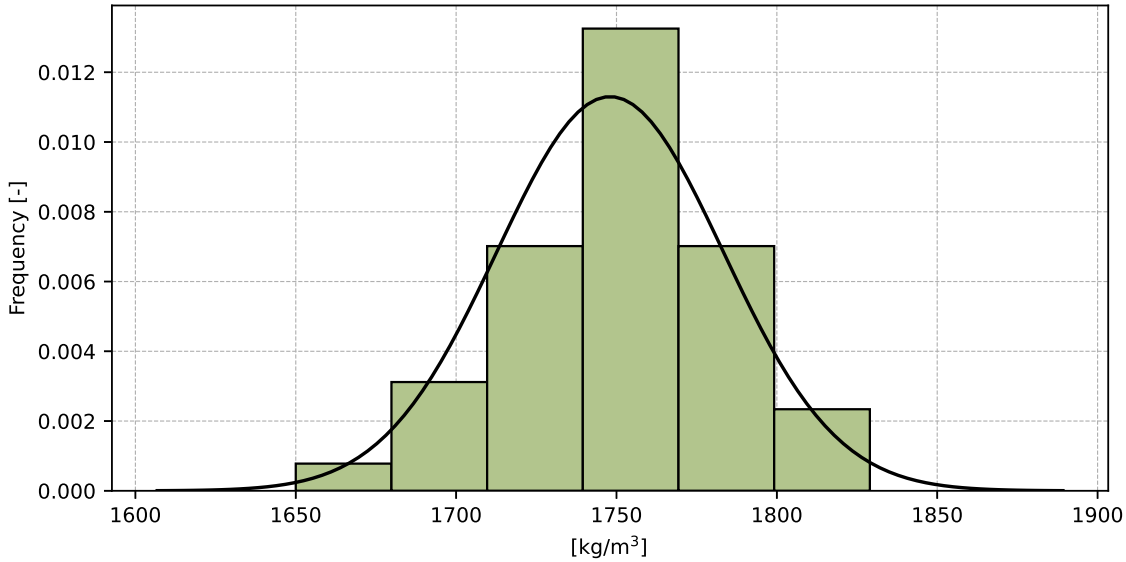

Figure 106: Histogram of all test results

Table 48: Descriptive statistics

Characteristics	**[kg/m^3]**
Average value – $\bar{x}$	1748.0
Sample standard deviation – s	35.3
Asigned value – x^*	1748.0
Robust standard deviation – s^*	35.3
Measurement uncertainty of asigned value – u_X	5.4
p-value of normality test	0.635 [-]

8.1.5 Evaluation of Performance Statistics

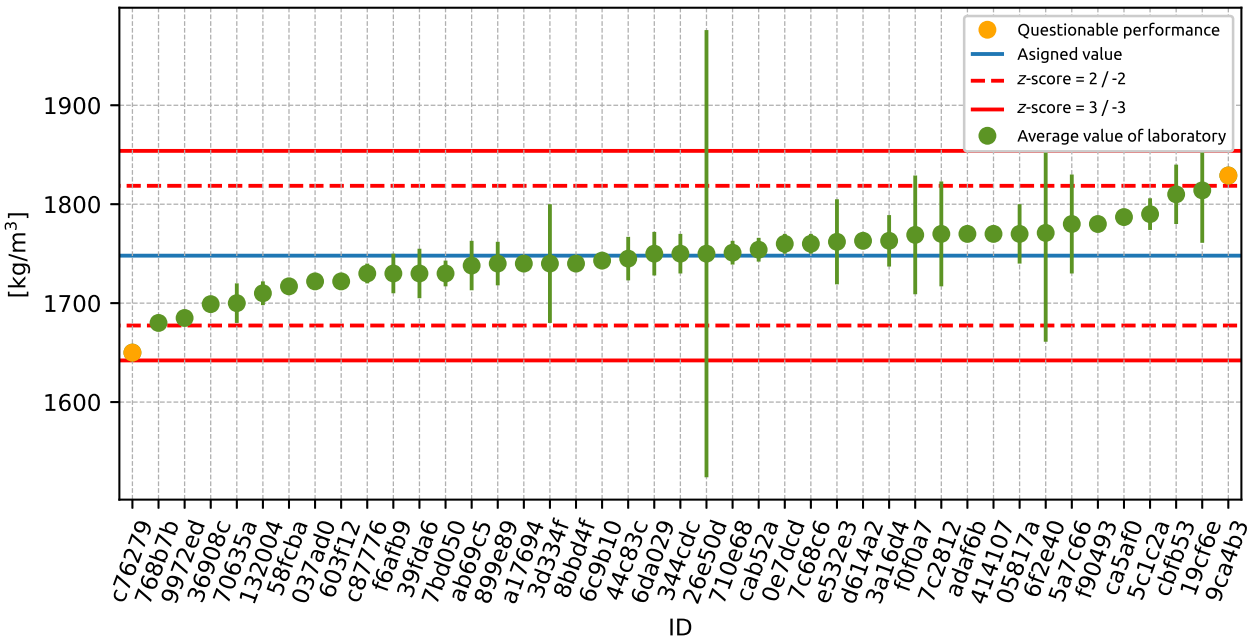

Figure 107: Average values and extended uncertainties of measurement

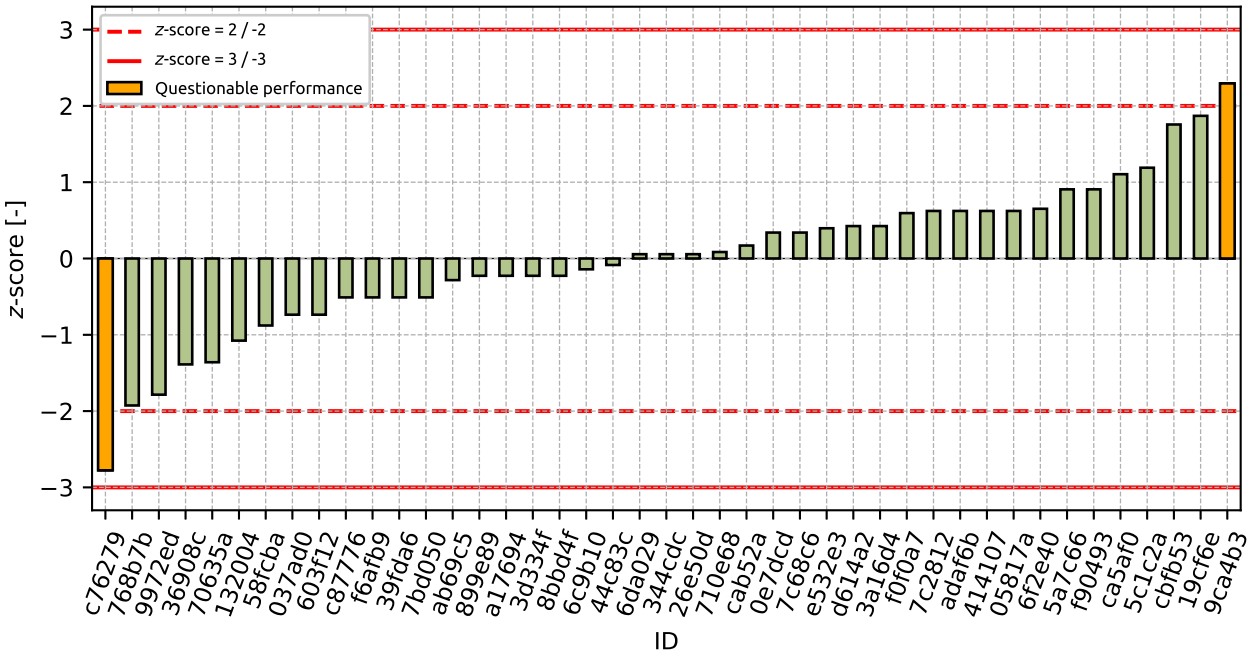

Figure 108: z-score

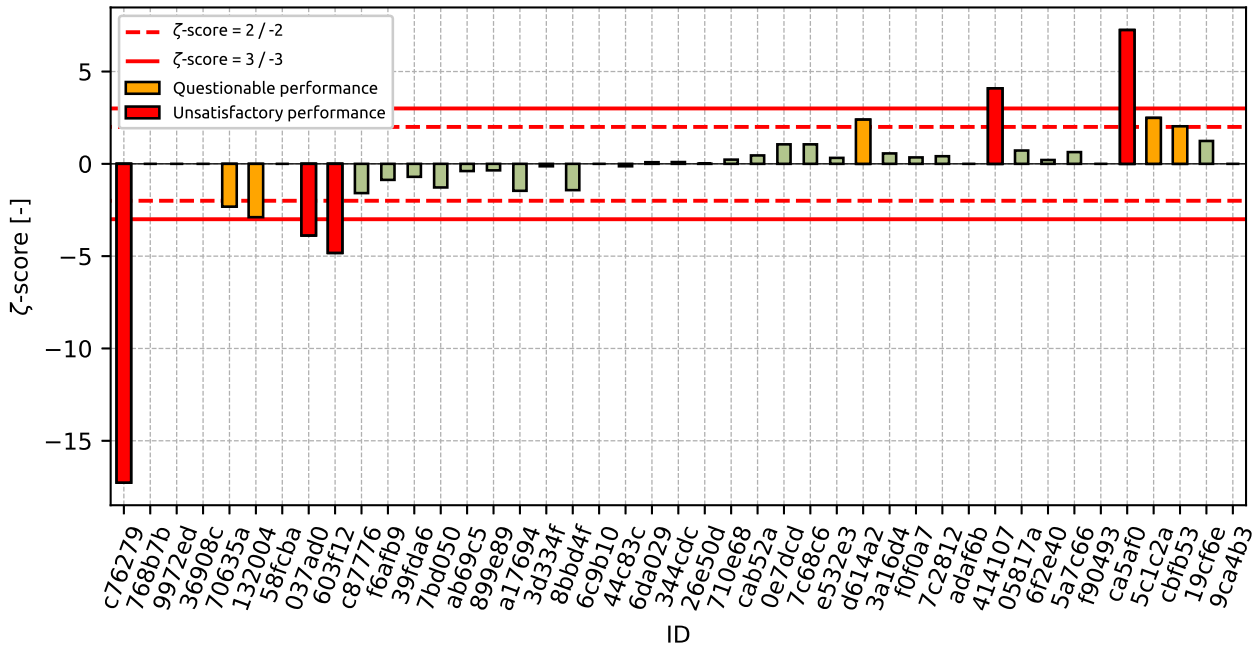

Figure 109: ζ-score

Table 49: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
c76279	-2.78	-17.27
768b7b	-1.93	-
9972ed	-1.78	-
36908c	-1.39	-
70635a	-1.36	-2.32
132004	-1.08	-2.89
58fcba	-0.88	-
037ad0	-0.74	-3.88
603f12	-0.74	-4.82
c87776	-0.51	-1.58
f6afb9	-0.51	-0.87
39fda6	-0.51	-0.7
7bd050	-0.51	-1.28
ab69c5	-0.28	-0.39
899e89	-0.23	-0.35
a17694	-0.23	-1.46
3d334f	-0.23	-0.13
8bbd4f	-0.23	-1.42
6c9b10	-0.14	-
44c83c	-0.08	-0.13
6da029	0.06	0.09
344cdc	0.06	0.1
26e50d	0.06	0.01
710e68	0.08	0.23
cab52a	0.17	0.46
0e7dcd	0.34	1.06
7c68c6	0.34	1.06
e532e3	0.4	0.32
d614a2	0.42	2.4
3a16d4	0.42	0.56
f0f0a7	0.59	0.35
7c2812	0.62	0.41
adaf6b	0.62	-
414107	0.62	4.09
05817a	0.62	0.72
6f2e40	0.65	0.21
5a7c66	0.91	0.64
f90493	0.91	-
ca5af0	1.1	7.24
5c1c2a	1.19	2.49
cbfb53	1.76	2.03
19cf6e	1.87	1.24
9ca4b3	2.29	-

8.2 Optimum water content

8.2.1 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 [%]	u_X [%]
7c68c6	14.0	0.4
899e89	14.5	2.8
9ca4b3	14.5	-
414107	14.8	0.9
5c1c2a	14.9	0.2
cbfb53	15.0	0.5
0e7dcd	15.0	2.7
f0f0a7	15.0	1.6
344cdc	15.0	1.0
05817a	15.0	0.4
f90493	15.0	-
70635a	15.1	1.0
132004	15.1	1.0
cab52a	15.1	1.0
ca5af0	15.2	0.1
5a7c66	15.2	1.0
19cf6e	15.3	0.2
710e68	15.3	1.0
8bbd4f	15.4	1.2
6da029	15.4	2.6
36908c	15.4	-
3a16d4	15.5	0.1
44c83c	15.5	2.7
037ad0	15.6	0.1
603f12	15.6	0.1
39fda6	15.6	0.7
adaf6b	15.8	-
3d334f	15.9	1.0
9972ed	16.0	-
a17694	16.1	0.0
e532e3	16.1	0.5
7bd050	16.2	0.6
7c2812	16.4	0.5
ab69c5	16.4	1.0
d614a2	16.7	0.0
c87776	16.8	0.4
26e50d	17.0	4.0
768b7b	17.0	-
f6afb9	17.0	1.0
6f2e40	17.2	0.6
6c9b10	17.3	-
58fcba	17.4	-
c76279	18.3	0.1

8.2.2 The Numerical Procedure for Determining Outliers

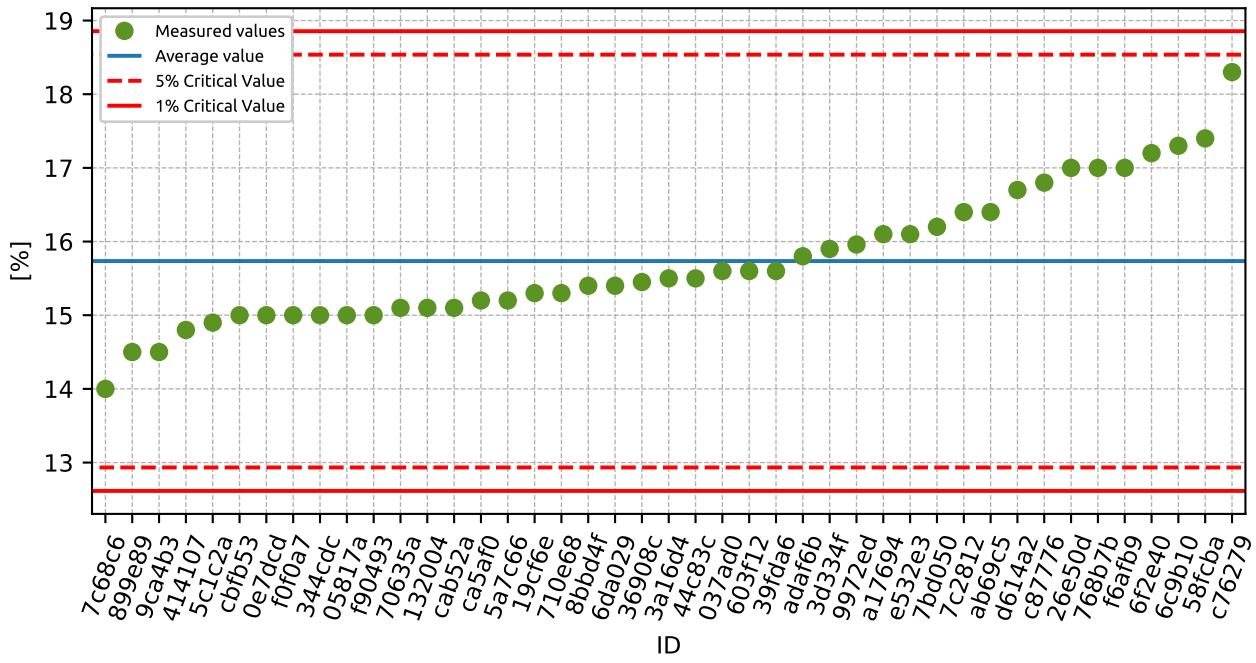

Figure 110: **Grubbs' test** - average values

8.2.3 Mandel's Statistics

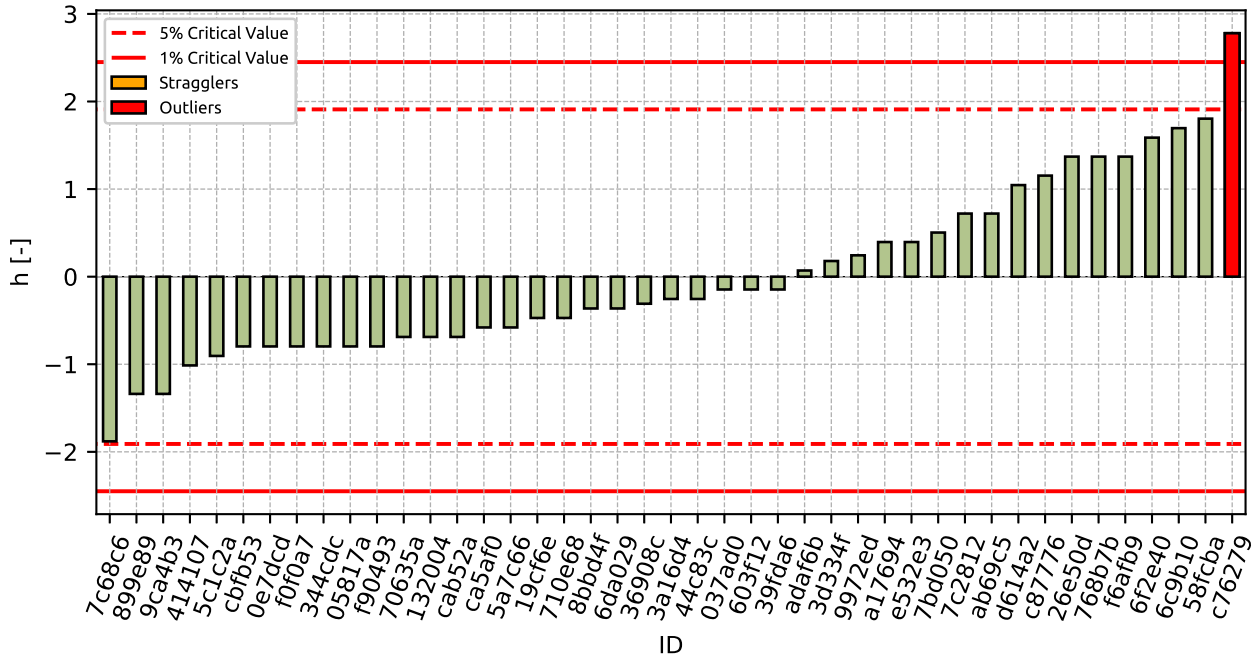

Figure 111: Interlaboratory Consistency Statistic

8.2.4 Descriptive statistics

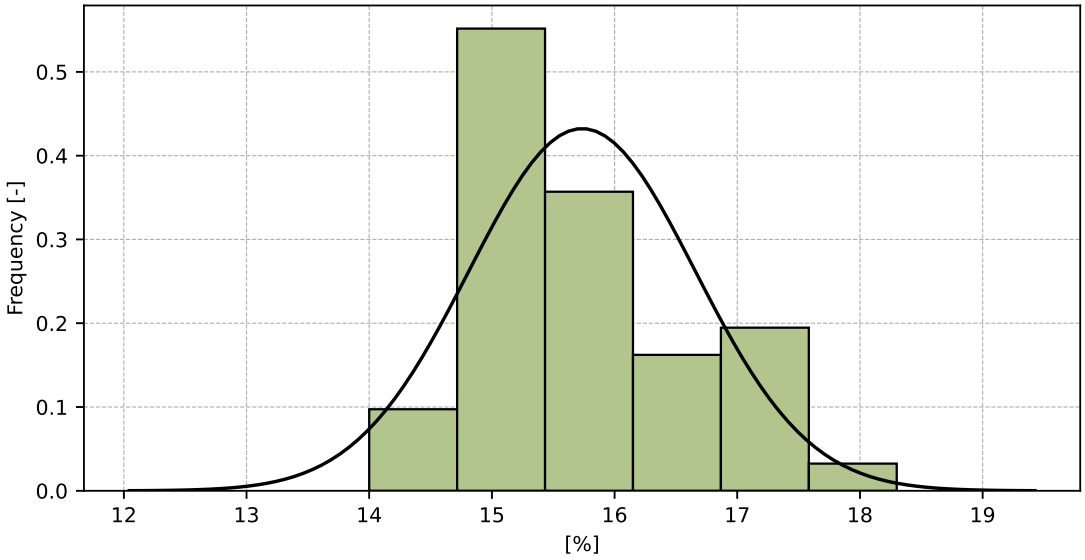

Figure 112: Histogram of all test results

Table 51: Descriptive statistics

Characteristics	**[%]**
Average value – $\bar{x}$	15.7
Sample standard deviation – s	0.92
Asigned value – x^*	15.7
Robust standard deviation – s^*	0.89
Measurement uncertainty of asigned value – u_X	0.17
p-value of normality test	0.03 [-]

8.2.5 Evaluation of Performance Statistics

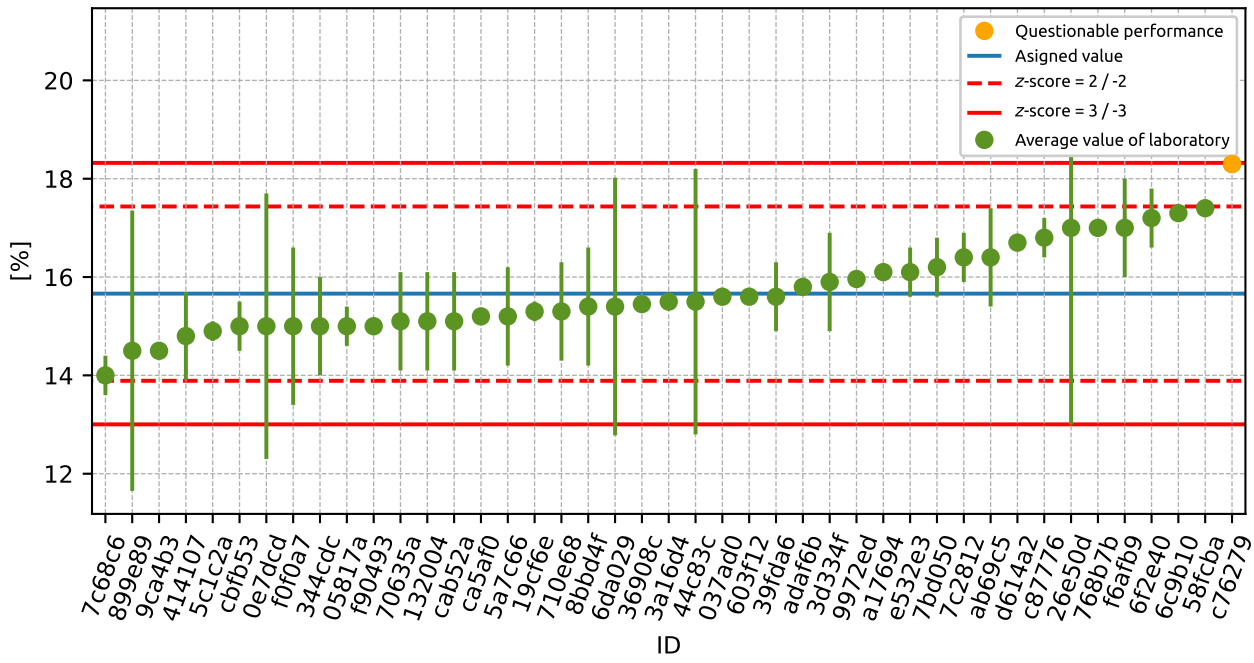

Figure 113: Average values and extended uncertainties of measurement

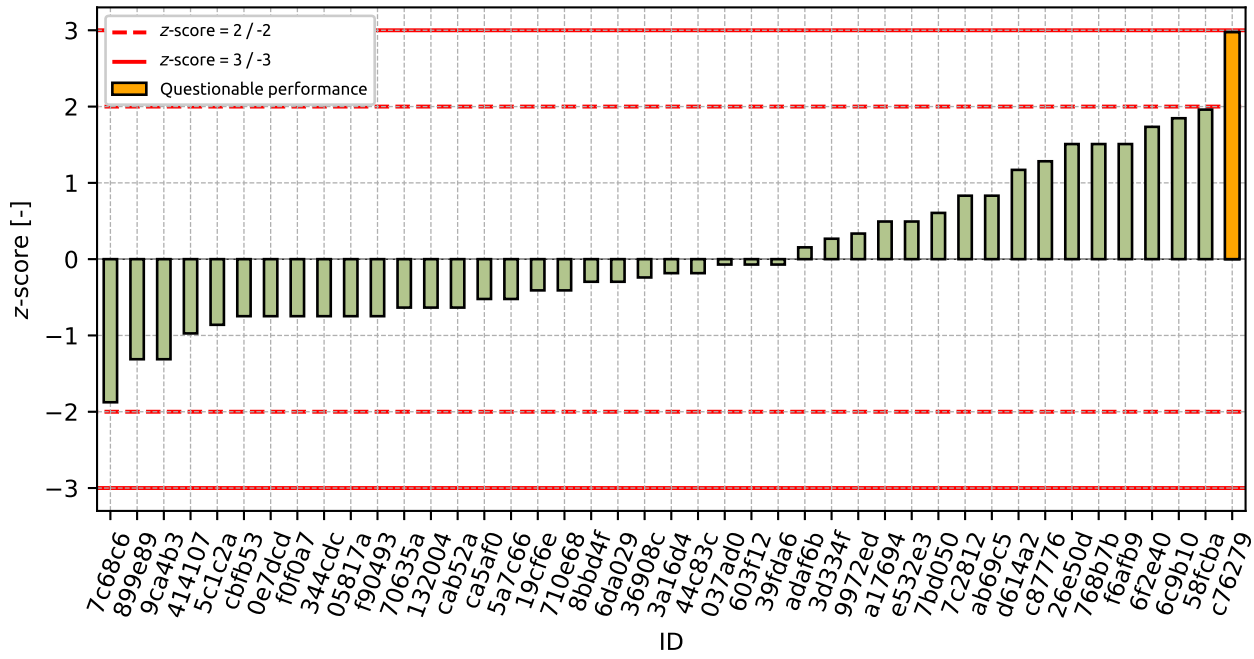

Figure 114: z-score

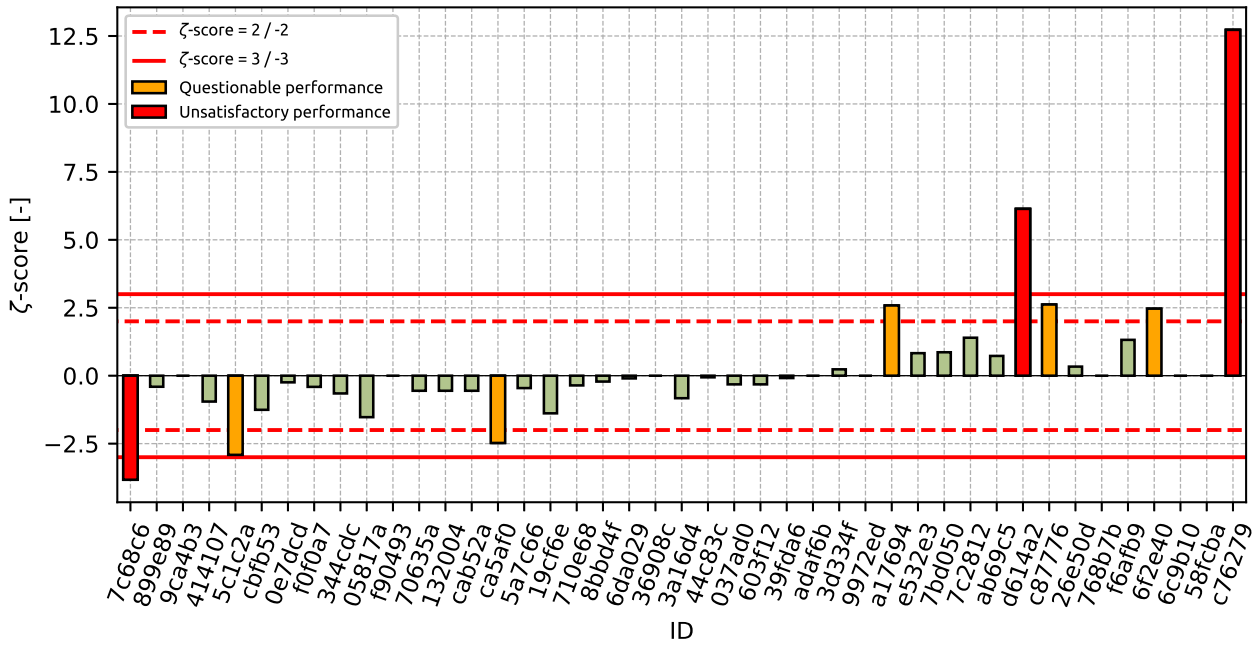

Figure 115: ζ-score

Table 52: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
7c68c6	-1.88	-3.83
899e89	-1.31	-0.41
9ca4b3	-1.31	-
414107	-0.97	-0.95
5c1c2a	-0.86	-2.91
cbfb53	-0.75	-1.26
0e7dcd	-0.75	-0.24
f0f0a7	-0.75	-0.41
344cdc	-0.75	-0.65
05817a	-0.75	-1.53
f90493	-0.75	-
70635a	-0.63	-0.55
132004	-0.63	-0.55
cab52a	-0.63	-0.55
ca5af0	-0.52	-2.48
5a7c66	-0.52	-0.46
19cf6e	-0.41	-1.39
710e68	-0.41	-0.36
8bbd4f	-0.3	-0.22
6da029	-0.3	-0.1
36908c	-0.24	-
3a16d4	-0.18	-0.83
44c83c	-0.18	-0.06
037ad0	-0.07	-0.32
603f12	-0.07	-0.32
39fda6	-0.07	-0.09
adaf6b	0.15	-
3d334f	0.27	0.23
9972ed	0.34	-
a17694	0.49	2.58
e532e3	0.49	0.83
7bd050	0.61	0.86
7c2812	0.83	1.4
ab69c5	0.83	0.73
d614a2	1.17	6.14
c87776	1.28	2.62
26e50d	1.51	0.33
768b7b	1.51	-
f6afb9	1.51	1.32
6f2e40	1.73	2.47
6c9b10	1.85	-
58fcba	1.96	-
c76279	2.98	12.73

9 Appendix – EN 13286-47 – IBI

9.1 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 [%]
6f2e40	8.0	0.3
ca5af0	8.0	0.3
9972ed	8.3	-
36908c	12.7	-
adaf6b	14.0	-
9ca4b3	14.8	-
6da029	15.0	1.7
6c9b10	15.0	-
e56609	15.2	0.9
a17694	16.9	0.1
58fcba	17.0	-
559fc9	17.0	1.2
037ad0	17.8	0.4
710e68	18.0	1.0
0e7dcd	19.0	2.1
132004	19.0	1.0
c87776	19.3	1.0
19cf6e	20.0	0.9
f6afb9	21.0	1.0
ab69c5	21.0	1.5
26e50d	21.0	7.4
cab52a	21.0	1.0
768b7b	21.0	-
8bbd4f	21.0	5.2
05817a	22.0	2.0
899e89	23.0	2.1
7c68c6	25.0	5.0
70635a	25.7	2.8

9.2 The Numerical Procedure for Determining Outliers

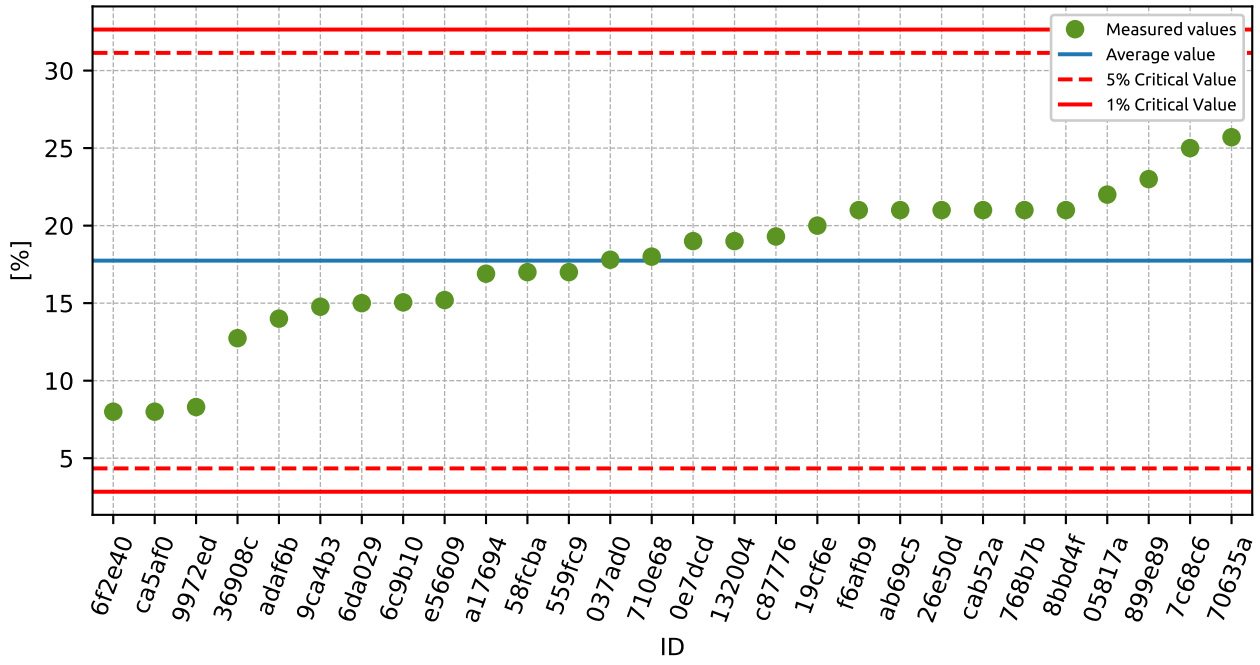

Figure 116: **Grubbs' test** - average values

9.3 Mandel's Statistics

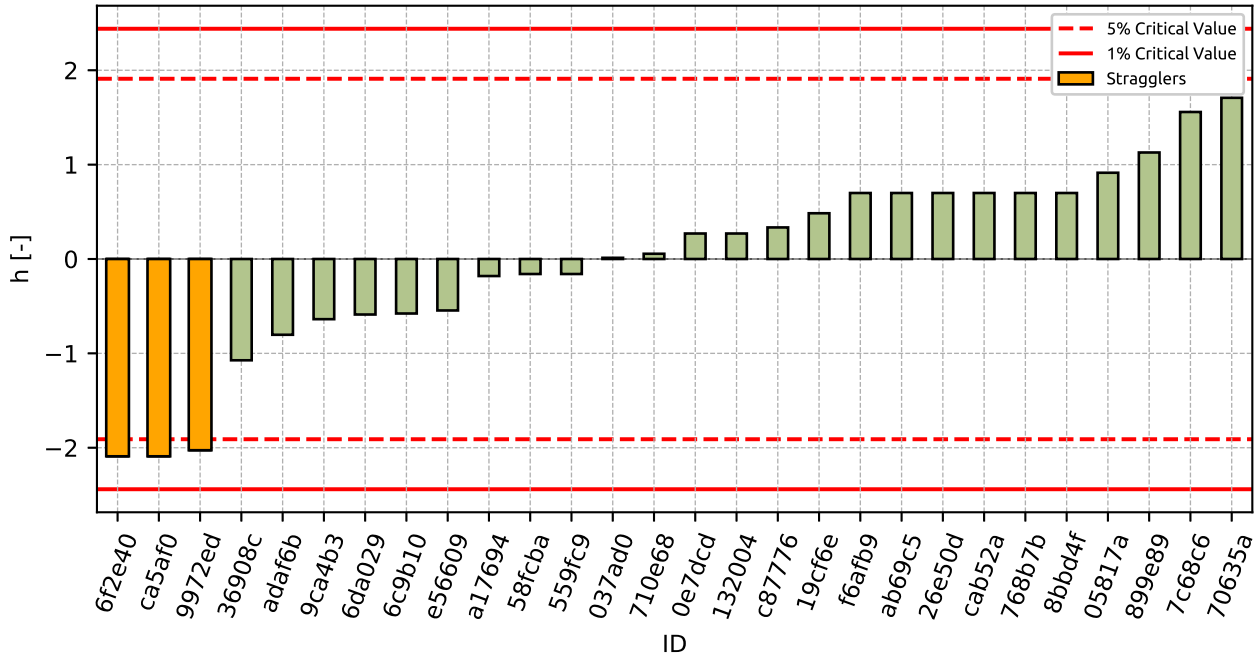

Figure 117: Interlaboratory Consistency Statistic

9.4 Descriptive statistics

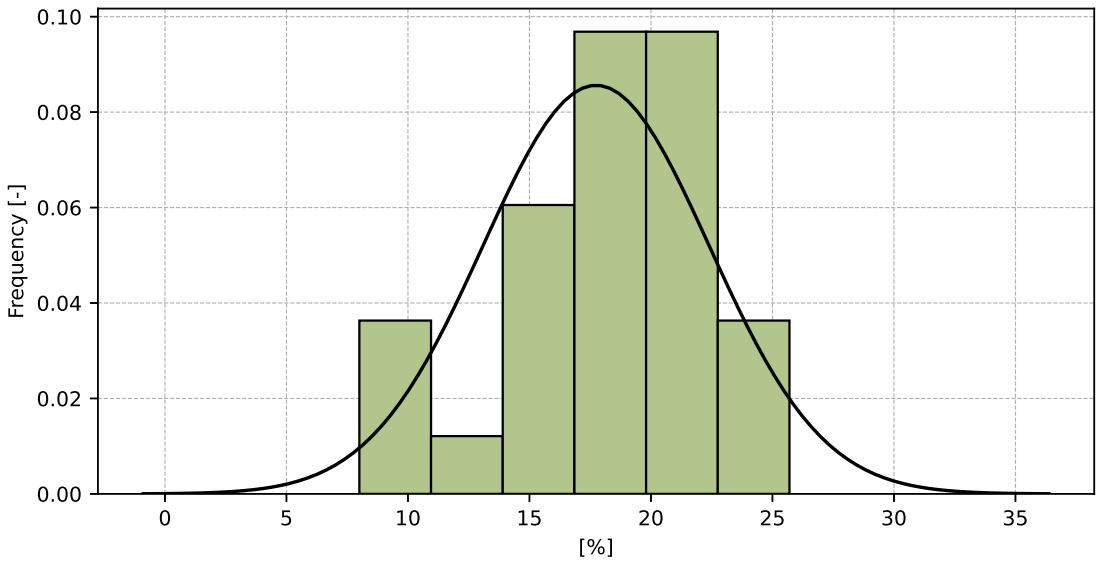

Figure 118: Histogram of all test results

Table 54: Descriptive statistics

Characteristics	**[%]**
Average value – $\bar{x}$	17.7
Sample standard deviation – s	4.66
Asigned value – x^*	18.2
Robust standard deviation – s^*	4.04
Measurement uncertainty of asigned value – u_X	0.95
p-value of normality test	0.108 [-]

9.5 Evaluation of Performance Statistics

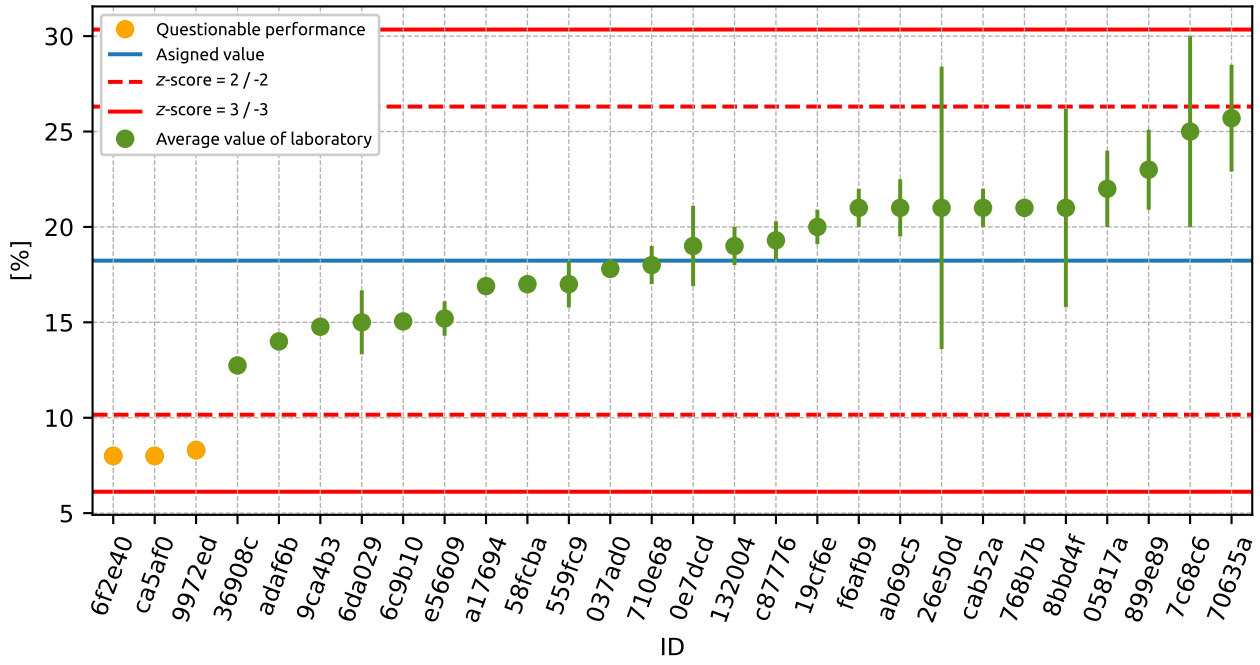

Figure 119: Average values and extended uncertainties of measurement

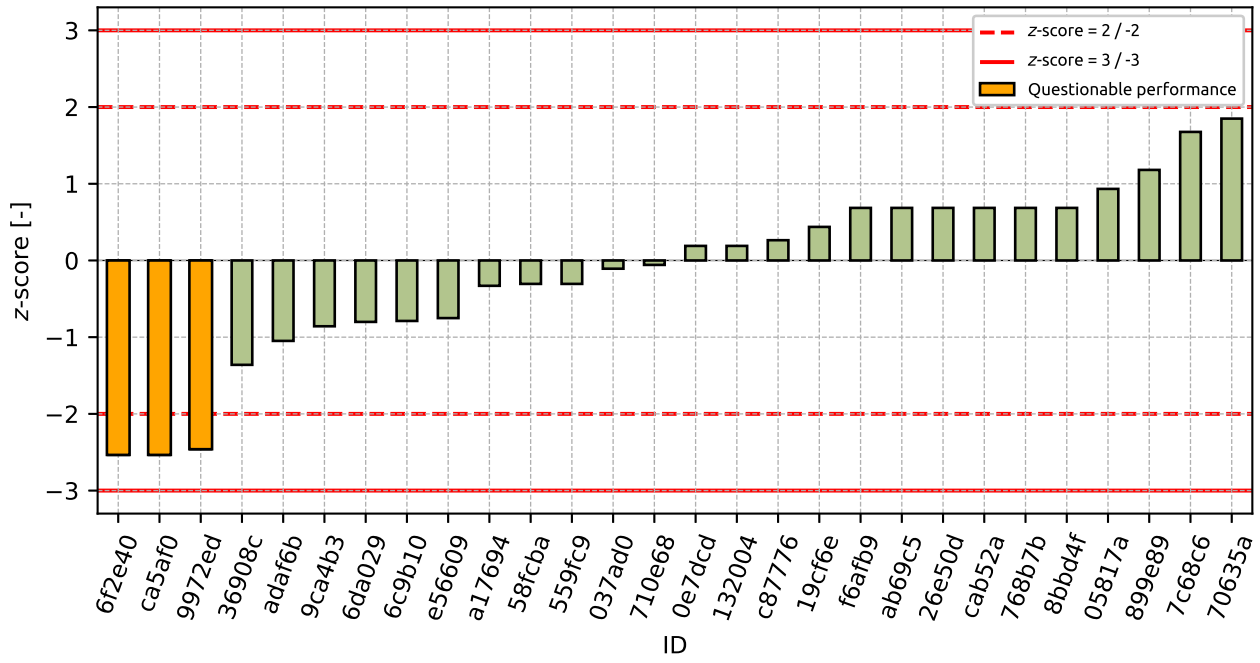

Figure 120: z-score

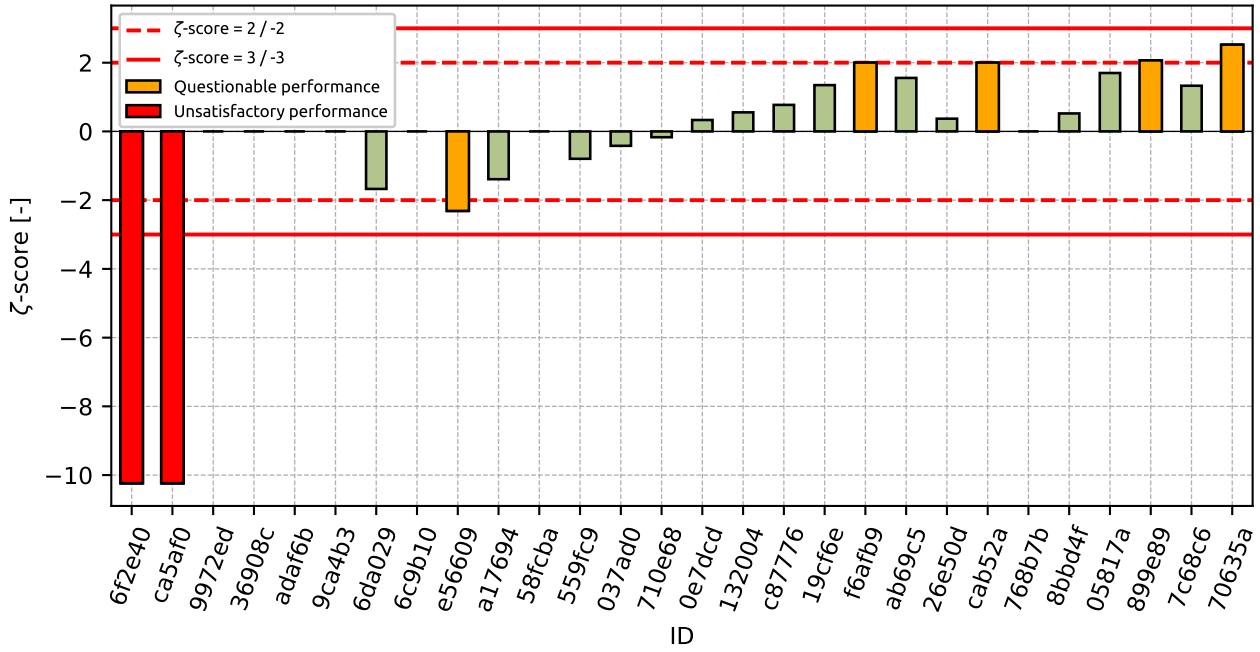

Figure 121: ζ-score

Table 55: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
6f2e40	-2.53	-10.24
ca5af0	-2.53	-10.24
9972ed	-2.46	-
36908c	-1.36	-
adaf6b	-1.05	-
9ca4b3	-0.86	-
6da029	-0.8	-1.67
6c9b10	-0.79	-
e56609	-0.75	-2.31
a17694	-0.33	-1.39
58fcba	-0.31	-
559fc9	-0.31	-0.8
037ad0	-0.11	-0.42
710e68	-0.06	-0.17
0e7dcd	0.19	0.33
132004	0.19	0.55
c87776	0.26	0.77
19cf6e	0.44	1.35
f6afb9	0.69	2.0
ab69c5	0.69	1.56
26e50d	0.69	0.37
cab52a	0.69	2.0
768b7b	0.69	-
8bbd4f	0.69	0.52
05817a	0.93	1.7
899e89	1.18	2.07
7c68c6	1.68	1.33
70635a	1.85	2.52