FINAL REPORT ON THE RESULTS OF PRECISION EXPERIMENT

Proficiency Testing Program
Soil Testing
ZZ 2024/1

Date: January 15, 2025

Poskytovatel zkoušení
způsobilosti při SZK FAST

Proficiency testing
provider at the SZK FAST

Z 7008

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Assoc. Prof. Ing. Tomáš Vymazal, Ph.D.
Head of the PT Provider, PTP coordinator

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

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1   Introduction and Important Contacts

In the year 2024, the Proficiency Testing Provider at the SZK FAST (PT Provider) initiated the Proficiency Testing Program (PTP) designated ZZ 2024/1 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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Coordinator of PTP result assessment PrZZ

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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.

70 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.

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Table 1: Participation of individual laboratories in the PTP

ID/Method	1	2	3	4	5	6	7	8	9	10
25aa05	X	X	X	X	X	X	X	X	X	X
86eb15	X	-	X	X	-	-	-	X	X	X
1357c8	X	X	X	X	X	-	X	X	-	-
01225f	-	X	X	-	-	-	-	-	-	-
ed0ab6	-	-	-	-	-	-	-	-	X	-
33459f	X	X	-	-	-	X	X	-	-	-
fed12a	-	-	-	-	-	-	-	-	X	-
c871a4	X	X	X	X	-	-	-	X	-	-
f8bc7a	X	X	X	X	X	X	X	X	X	X
d1ee17	X	X	X	X	-	-	X	X	X	X
96dae7	X	X	X	X	X	-	-	X	X	X
c0ca45	-	-	X	-	X	-	-	-	-	X
ecf0fd	-	-	X	-	-	-	-	-	-	-
589c5f	X	X	X	X	-	-	-	X	X	X
666124	X	X	X	-	X	X	X	X	-	-
7ac937	X	X	X	X	-	-	-	X	-	-
55e5c0	-	-	-	-	-	-	-	-	X	-
7d0a95	-	-	-	-	-	-	X	-	-	-
3832b5	X	-	-	-	-	-	-	-	X	-
fdd45f	X	-	-	-	-	-	-	-	X	-
4ee2d2	X	-	-	-	-	-	-	-	-	-
ce319a	X	-	X	X	-	-	-	X	X	X
60f194	X	-	-	-	-	-	-	-	X	X
de7330	X	-	-	-	-	-	-	-	X	X
bdbff6	-	-	-	-	-	-	X	-	-	-
22d484	-	-	-	-	X	-	X	-	-	-
1202ed	X	-	X	X	-	-	-	X	-	-
1632e2	X	X	-	X	-	-	-	X	-	-
53a71c	-	-	-	-	-	-	-	-	X	X
7ffaba	X	-	X	X	-	-	-	X	-	-
e81c64	X	-	X	-	-	-	-	-	X	-
cc7904	X	X	X	X	-	-	-	-	X	-
320ee2	-	-	X	X	-	-	-	-	-	-
f03e9c	X	X	-	-	X	-	-	-	-	-
54b338	-	-	-	-	X	-	-	X	-	-
b0c75b	X	X	X	X	X	X	X	X	X	-
33e846	-	-	X	-	-	-	-	X	-	-
390c3b	X	X	X	X	X	X	X	X	-	-
90dd12	X	-	X	-	-	X	X	X	-	-
7f895a	X	-	X	X	-	-	-	X	-	-
3ffebb	-	X	-	X	X	X	-	-	-	-
4a8427	X	X	X	X	-	-	-	X	-	-
779696	X	X	X	X	X	X	X	X	X	X
8aeb2c	X	-	-	-	-	-	-	X	-	X

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ID/Method	1	2	3	4	5	6	7	8	9	10
f2dd88	X	X	X	X	X	X	X	X	X	-
f90fb7	-	-	X	X	X	-	-	-	-	X
5b9821	-	-	-	-	-	-	-	X	-	-
e10589	X	X	X	X	X	X	X	X	-	-
a81bc3	X	-	X	-	-	-	-	X	X	X
9d12b7	-	-	X	X	-	-	-	-	-	-
4dbd08	X	-	-	-	-	-	-	-	-	-
087225	-	-	-	-	-	-	-	X	-	X
1b8e4c	X	X	X	X	-	X	X	X	X	-
2b2ff2	X	X	-	-	-	-	-	-	-	-
3a439b	-	-	-	-	-	-	-	X	X	-
5b2e25	X	X	X	X	-	-	-	X	-	-
3d61b1	X	-	X	-	-	-	-	X	-	-
25e875	X	X	X	X	-	-	-	X	-	-
5633d2	-	-	-	-	-	-	X	X	-	-
4ceca5	X	X	X	-	-	-	-	-	-	-
fc937d	X	-	X	-	-	-	-	X	X	X
f0ee71	X	-	-	-	-	-	-	-	-	-
df7d84	X	X	X	X	X	X	-	X	X	X
8f9b0e	X	-	-	-	-	-	-	-	X	-
1b001e	-	-	-	-	-	-	-	-	X	-
8b3490	X	-	-	-	-	-	-	-	X	X
5c1ea2	-	-	-	X	X	-	X	X	-	-
068f53	-	-	-	-	-	-	-	-	-	X
05920e	X	X	X	X	-	-	-	X	-	-
225f2b	X	X	X	X	X	X	X	X	-	X
b7b51c	X	-	X	-	-	-	-	X	-	-
67b760	X	X	X	X	X	X	X	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, 27624218	1518
ALS Czech Republic s.r.o.	Na Harfě 336/9, Praha 9, 19000, 27407551	-
AT-GEOTECH CJSC	Sh. Kurbanov str., Building 17, Khirdalan city, AZ 0100, Absheron region	-
AZ Consult, spol. s r.o.	Klíšská 1334/12, Ústí nad Labem, 400 01, 44567430	L1740

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Laboratory	Address	Accreditation number
AZ GEO, s.r.o.	Chittussiho 1186/14, Ostrava – Slezská Ostrava, 71000, Česká republika	1768
A&A MACEDONIA LAB TEST LTD	10, Moisi Street, Chlroraka, Paphos, 8220, Cyprus	-
Banat Inzenjering LBI DOO	Makedonska 15, Zrenjanin, 23000, Republic of Serbia	01-540
Bechtel ENKA UK Limited Ogranak Beograd	Jasički put 52đ, Kruševac, 37000, Serbia	-
C.S.R. S.r.l. Centro Sviluppo Ricerche	Via Feltrin, 125, Noale (Venezia), 30033, Italy	-
CONSULTEST s.r.o. - pracoviště Brno	Medkova 974/4, Brno - Tuřany, 62700, ČESKÁ REPUBLIKA	1211
CONSULTEST s.r.o. - pracoviště Napajedla	Medkova 974/4, Brno - Tuřany, 62700, ČESKÁ REPUBLIKA	1211
Civil Engineering Institute IG LLC Banja Luka	Kralja Petra I Karađorđevića 92-98, Banja Luka, 78000, BIH	-
EDAFOMICHANIKI S.A.	19 EMMANUEL PAPADAKI, NEO IRAKLEIO, 14121, GREECE	1269
Estonian Environmental Research Centre	Marja 4d, Tallinn, 10617, Harjumaa	L008
Eurovia Lietuva	Liepkalnio g. 85, Vilnius, 02120, Lithuania	-
GEMATEST s.r.o.	Dr. Janského 954, Černošice, 25228, Česká republika	-
GEODRILL s.r.o.	K Bukovinám 169/45, Brno, 63500, Česká Republika	1596
GEOSTAND AND ASSOCIATES S.A.	KALYMNOU 16, ATHENS, 11251, GREECE	-
GEOtest, a.s.	Šmahova 1244/112, Brno, 627 00, Česká republika	1271
GeoTec-GS, a.s.	Pekárenská 257/81, České Budějovice, 370 04, Česká republika	1772
Geohidroinzenering DOO Skopje	1606 No.8, Gjorce Petrov, Skopje, Skopje, 1000, N Macedonija	LT-096
Geom d.o.o. Beograd	Kumodraska 328, Beograd, 11010, Serbia	-
Geotech d.o.o.	Ciottina 21, Rijeka, 51000, Croatia	1717
Gradezen Institut "Makedonija" AD Skopje	Drezdenska No.52, Skopje, 1000, North Macedonia	LT-014
Gradjevinsko-arhitektonski fakultet Univerziteta u Nišu	Aleksandra Medvedeva 14, Niš, 18000, Serbia	01-202
IGSL	IGSL M7 Business Park Newhall, NAAS, W91 DY93, Ireland	-
INGEO-ENVILAB, s.r.o.	Bytčiská 16, Žilina, 01001, Slovensko	-
Impresa Bacchi S.r.l.	VIA DON DOSSETTI 19, carpiano (MI), 20080, 9BIE	1554L
Innovation Hub/PPC S.A.	Leontariou 9, Kantza Pallini, Athens, 15351, Greece	ed56ac

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Laboratory	Address	Accreditation number
Labgeo cz s.r.o.	Plzeňská 466/359, Ostrava, 724 00, Česká republika	1789
Labo Devlieger - Van Vooren	Industriepark Rosteyne 1, zelzate, 9060, Oost-Vlaanderen	296-TEST
Laboratoire des Travaux Publics de l'Ouest (LTP-Ouest)	Rond-point des CASTORS, Oran, 31000, ALGERIA	-
Lithuanian geology survey under ministry of environment	S. Konarskio 35, Vilnius, LT-03123, Lithuania	LA.215-01
MIRTEC S.A. - Thiva Branch	76th km of Athens-Lamia National Road (Ritsona exit, Schimatari, Boeotia, 32009, Greece	-
Mattest (Ireland) Ltd. Cork Laboratory	Unit 18, University Hall Ind. Park, Sarfield Rd. Wilton, Cork, T12 EV20, ROI	289T
Mega Infrastructure d.o.o., Beograd-Savski Venac, 11000, Belgrade, Serbia	Potez Ružaš, Irig, 22406, Serbia	-
NIEVELT Labor CZ s.r.o.	Za Olomouckou 4184/17, Prostějov, 79601, Česká republika	1716
NeXperta - afdeling Geotechiek	Technologiepark-Zwijnaarde 68, Gent, 9052, België	-
PUDIS a.s.	Podbabská 1014/20, Praha 6, 160 00, Česká republika	1762
Radis d.o.o PJ Radis Institut	Jovana Ducica 16, Istočno Sarajevo, 71123, Bosna i Hercegovina	-
Rina Consulting - GET	Via Albisola 64/66 Genova, genova, 16152, Genova	-
S.C. GEOSTUD S.R.L.	Str. Sîngerului, nr. 11, sector 1, Bucharest, 014617, RO13840425	LI 974
SG Geotechnika a.s.	Geologická 4, Praha 5, 15200, Česká republika	1119
Slovenian national building and civil engineering institute	Dimičeva ulica 12, Ljubljana, 1000, Slovenia	-
Structural Soils Ltd - BRISTOL	Unit 1A, Princess Street, Bedminster, Bristol, BS3 4AG, Bristol	-
Structural Soils Ltd - CASTELFORD	The Potteries, Pottery Street, Castleford, WF10 1NJ, West Yorkshire	-
Structural Soils Ltd - Hemel Hempstead	18 Frogmore Road, Hemel Hempstead, HP3 9RT, Hertfordshire	-
Structural Soils Ltd - TONBRIDGE lab	Structural Soils Ltd, Anerly Court, Half Moon Lane, Hildenborough, Tonbridge, TN11 9HU, Kent	-
Sweco Lietuva UAB	A. Strazdo g 22, Kaunas, LT-48488, Lithuania	-
TESScontrol, s. r. o., organizačná zloška, TESScontrol - Zkušební laboratoř Znojmo	Brněnská 3797/29, 669 02 Znojmo, Praha 8, 182 00, Česká republika	L-1793
TESTLAND SP. Z O.O.	ul. Kasztanowa 14, Łężyce, 84-207, 5862298514	-

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Laboratory	Address	Accreditation number
TPA ČR, s.r.o.	Vrbenská 1821/31, České Budějovice, 370 06, Česká republika	1181
TPA ČR, s.r.o.	Vrbenská 1821/31, České Budějovice, 370 06, Česká republika	1181
TRANSLAB LABORATORIUM	Oeverstraat 21, Lokeren, 9160, Belgium	-
TUV Austria Romania	Calea Plevnei, nr.139B, Bucharest, 060011, Romania	-
UAB "GeoFirma"	Sauletelio al. 15-515, Vilnius, 10224, Lithuania	-
UAB "Geoanalizė"	Užnerio g. 1A„ Kaunas, LT-47484, Lithuania	-
UAB Gruntira	Žiogupio g. 37D, Palanga, LT-00177, Lithuania	-
UAB Grunto Laboratorija	Guobų aklg. 1I, Kretinga, LT-97120, Lithuania	-
UAB"Rapasta"	Gedinimo 47- 02, Kaunas, LT-44242, Lithuania	-
UNIGEO a.s.	Místecká 329/258, Ostrava, 70200, Česká republika	1412
University of Belgrade - Faculty of Civil Engineering	Bulevar kralja Aleksandra 73, Belgrade, 11000, Serbia	-
VIALAB CZ s.r.o. - CL07	U Michelského lesa 1581/2, Praha 4, 14000, Česká republika	1112
VIALAB CZ s.r.o. - CL11	U Michelského lesa 1581/2, Praha 4, 14000, Česká republika	1112
VIALAB CZ s.r.o. - Laboratoř Morava, pracoviště LM1-Zlín	MU CODE 1545, PO Box 207, Praha 6, 16041, Česká republika	1170
VIALAB CZ s.r.o. - Laboratoř Morava, pracoviště LM3-Brno	MU CODE 1545, PO Box 207, Praha 6, 16041, Česká republika	1170
VIALAB CZ s.r.o. - Laboratoř Morava, pracoviště LM4-Ostrava	MU CODE 1545, PO Box 207, Praha 6, 16041, Česká republika	1170
Vilnius Gediminas technical university (VILNIUS TECH)	Saulėtekio ave. 11, Vilnius, LT-10223, Lithuania	LA.01.063
České vysoké učení technické v Praze	Thákurova 7, Praha, 16629, Česká republika	1048
České vysoké učení technické v Praze	Thákurova 2077/7, Praha, 16629, Česko	1048
Ředitelství silnic a dálnic s. p.	Na Pankráci 546/56, Praha 4, 145 00, Česká republika	1072
i2 Analytical Ltd. Sp. z o.o. Oddzial w Polsce	Pionierów 39, Ruda Śląska, 41-710, Poland	UKAS 4041

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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.

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3 Conclusions of the Statistical Analysis

The present report summarizes the results of the Proficiency Testing Program ZZ 2024/1(PT Program) organized by the PT Provider at the SZK FAST. 70 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 four 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
25aa05	✓	✓	✓	?	✓	✓	✓	✓	✓	✓
86eb15	✓	-	✓	✓	-	-	-	✓	✓	✓
1357c8	?	✓	✓	✓	✓	-	✓	?	-	-
01225f	-	✓	✓	-	-	-	-	-	-	-
ed0ab6	-	-	-	-	-	-	-	-	?	-
33459f	✓	✓	-	-	-	✓	✓	-	-	-
fed12a	-	-	-	-	-	-	-	-	✓	-
c871a4	✓	✓	✓	✓	-	-	-	✓	-	-
f8bc7a	✓	✓	✓	✓	✓	?	✓	✓	✓	✓
d1ee17	✓	✓	✓	✓	-	-	✓	✓	✓	✓
96dae7	✓	✓	✓	✓	✓	-	-	✓	✓	✓
c0ca45	-	-	✓	-	✓	-	-	-	-	✓
ecf0fd	-	-	✓	-	-	-	-	-	-	-
589c5f	✓	✓	?	✓	-	-	-	✓	✓	✓
666124	✓	✓	✓	-	✓	✓	?	✓	-	-
7ac937	✓	✓	✓	✓	-	-	✓	-	-	-
55e5c0	-	-	-	-	-	-	-	-	✓	-
7d0a95	-	-	-	-	-	-	✓	-	-	-
3832b5	✓	-	-	-	-	-	-	-	?	-
fdd45f	✓	-	-	-	-	-	-	-	✓	-
4ee2d2	✓	-	-	-	-	-	-	-	-	-
ce319a	✓	-	✓	✓	-	-	-	!	✓	✓
60f194	✓	-	-	-	-	-	-	-	✓	✓
de7330	✓	-	-	-	-	-	-	-	✓	✓
bdbff6	-	-	-	-	-	-	?	-	-	-
22d484	-	-	-	-	✓	-	✓	-	-	-
1202ed	✓	-	✓	✓	-	-	-	✓	-	-

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ID / Method	1	2	3	4	5	6	7	8	9	10
1632e2	✓	✓	-	✓	-	-	-	✓	-	-
53a71c	-	-	-	-	-	-	-	-	✓	✓
7ffaba	✓	-	✓	✓	-	-	-	✓	-	-
e81c64	✓	-	✓	-	-	-	-	-	✓	-
cc7904	✓	✓	✓	✓	-	-	-	-	?	-
320ee2	-	-	✓	✓	-	-	-	-	-	-
f03e9c	✓	✓	-	-	✓	-	-	-	-	-
54b338	-	-	-	-	✓	-	-	?	-	-
b0c75b	✓	✓	✓	✓	✓	✓	✓	✓	?	-
33e846	-	-	✓	-	-	-	-	✓	-	-
390c3b	✓	✓	✓	✓	✓	✓	✓	✓	-	-
90dd12	✓	-	✓	-	-	✓	✓	✓	-	-
7f895a	✓	-	✓	✓	-	-	-	✓	-	-
3ffebb	-	✓	-	✓	✓	✓	-	-	-	-
4a8427	✓	✓	✓	✓	-	-	-	✓	-	-
779696	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
8aeb2c	✓	-	-	-	-	-	-	!	-	✓
f2dd88	✓	✓	✓	✓	✓	✓	✓	✓	✓	-
f90fb7	-	-	✓	✓	✓	-	-	-	-	✓
5b9821	-	-	-	-	-	-	-	!	-	-
e10589	✓	✓	✓	✓	✓	✓	?	✓	-	-
a81bc3	✓	-	✓	-	-	-	-	?	?	✓
9d12b7	-	-	✓	✓	-	-	-	-	-	-
4dbd08	✓	-	-	-	-	-	-	-	-	-
087225	-	-	-	-	-	-	-	✓	-	✓
1b8e4c	✓	✓	✓	✓	-	✓	✓	✓	✓	-
2b2ff2	✓	✓	-	-	-	-	-	-	-	-
3a439b	-	-	-	-	-	-	-	?	?	-
5b2e25	✓	✓	✓	✓	-	-	-	✓	-	-
3d61b1	✓	-	?	-	-	-	-	✓	-	-
25e875	✓	✓	✓	✓	-	-	-	✓	-	-
5633d2	-	-	-	-	-	-	✓	✓	-	-
4ceca5	✓	✓	✓	-	-	-	-	-	-	-
fc937d	✓	-	✓	-	-	-	-	✓	✓	✓
f0ee71	✓	-	-	-	-	-	-	-	-	-
df7d84	✓	✓	✓	✓	✓	✓	-	✓	✓	✓
8f9b0e	✓	-	-	-	-	-	-	-	✓	-

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ID / Method	1	2	3	4	5	6	7	8	9	10
1b001e	-	-	-	-	-	-	-	-	✓	-
8b3490	✓	-	-	-	-	-	-	-	✓	✓
5c1ea2	-	-	-	✓	✓	-	✓	✓	-	-
068f53	-	-	-	-	-	-	-	-	-	✓
05920e	✓	✓	✓	✓	-	-	-	✓	-	-
225f2b	✓	✓	✓	✓	✓	✓	✓	✓	-	✓
b7b51c	✓	-	✓	-	-	-	-	✓	-	-
67b760	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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[1] EN ISO 17892-1. *Geotechnical investigation and testing - Laboratory testing of soil - Part 1: Determination of water content*. 2015.

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

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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 [%]
1357c8	5.5	5.2	5.3	-	5.3	0.17	3.11
2b2ff2	6.7	5.2	5.1	1.8	5.7	0.88	15.6
f8bc7a	5.6	5.7	5.8	3.8	5.7	0.1	1.75
4ee2d2	5.9	5.9	6.0	0.1	5.9	0.02	0.34
a81bc3	6.1	5.8	5.9	-	5.9	0.15	2.57
67b760	6.1	6.0	6.0	-	6.0	0.06	0.97
f0ee71	5.7	6.0	6.6	0.4	6.1	0.46	7.51
cc7904	6.2	6.0	6.1	0.2	6.1	0.08	1.23
f2dd88	6.1	6.2	6.2	0.1	6.2	0.06	0.94
5b2e25	6.0	6.4	6.4	-	6.3	0.26	4.11
e81c64	6.3	6.4	6.2	0.2	6.3	0.1	1.59
f03e9c	6.4	6.4	6.2	0.0	6.3	0.12	1.82
c871a4	6.6	5.9	6.5	3.8	6.3	0.38	5.98
1632e2	6.4	6.3	6.3	2.0	6.3	0.06	0.91
fdd45f	6.4	6.4	6.3	0.2	6.4	0.06	0.91
1b8e4c	6.4	6.4	6.3	1.3	6.4	0.06	0.91
1202ed	6.5	6.3	6.3	0.1	6.4	0.09	1.41
7ac937	6.2	6.4	6.6	0.9	6.4	0.2	3.12
779696	6.4	6.4	6.4	-	6.4	0.01	0.09
4a8427	6.4	6.4	6.4	0.0	6.4	0.01	0.09
3832b5	6.4	6.4	6.5	0.2	6.4	0.06	0.9
b7b51c	6.4	6.5	6.4	-	6.5	0.07	1.01
8aeb2c	6.3	6.5	6.6	0.6	6.5	0.16	2.4
86eb15	6.4	6.9	6.1	0.8	6.5	0.4	6.25
b0c75b	6.5	6.1	6.8	0.4	6.5	0.35	5.43
589c5f	6.5	6.5	6.5	0.1	6.5	0.01	0.09
8f9b0e	6.5	6.4	6.6	0.1	6.5	0.1	1.54
25aa05	6.3	6.6	6.6	0.0	6.5	0.17	2.66
33459f	6.5	6.5	6.5	-	6.5	0.01	0.15
de7330	6.5	6.5	6.5	-	6.5	0.0	0.0
8b3490	6.7	6.6	6.3	-	6.5	0.21	3.19
90dd12	6.2	6.2	7.3	-	6.6	0.64	9.67
3d61b1	6.6	6.6	6.6	-	6.6	0.0	0.0
25e875	6.4	6.8	6.6	0.3	6.6	0.2	3.03
05920e	6.6	-	-	-	6.6	0.0	0.0
60f194	6.8	6.5	6.6	-	6.6	0.15	2.3

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ID	Test results [%]			u_X [%]	$\bar{x}$ [%]	s_0 [%]	V_X [%]
ce319a	6.8	6.6	6.5	-	6.6	0.15	2.3
4ceca5	6.6	6.7	6.6	0.1	6.6	0.06	0.87
fc937d	6.7	6.7	6.5	4.0	6.6	0.12	1.74
96dae7	6.5	6.6	6.8	3.8	6.6	0.15	2.3
df7d84	6.5	6.8	6.7	-	6.7	0.15	2.29
d1ee17	7.0	7.1	5.9	3.8	6.7	0.67	9.99
390c3b	6.7	6.9	6.4	-	6.7	0.25	3.77
7f895a	6.7	6.8	6.7	-	6.7	0.06	0.82
7ffaba	6.8	6.7	6.8	0.8	6.8	0.06	0.85
225f2b	6.8	6.9	6.8	0.2	6.8	0.06	0.84
666124	6.8	6.9	7.0	0.4	6.9	0.1	1.45
4dbd08	6.8	6.9	7.0	0.2	6.9	0.11	1.53
e10589	6.9	7.0	7.0	0.9	7.0	0.06	0.83

1.2   The Numerical Procedure for Determining Outliers
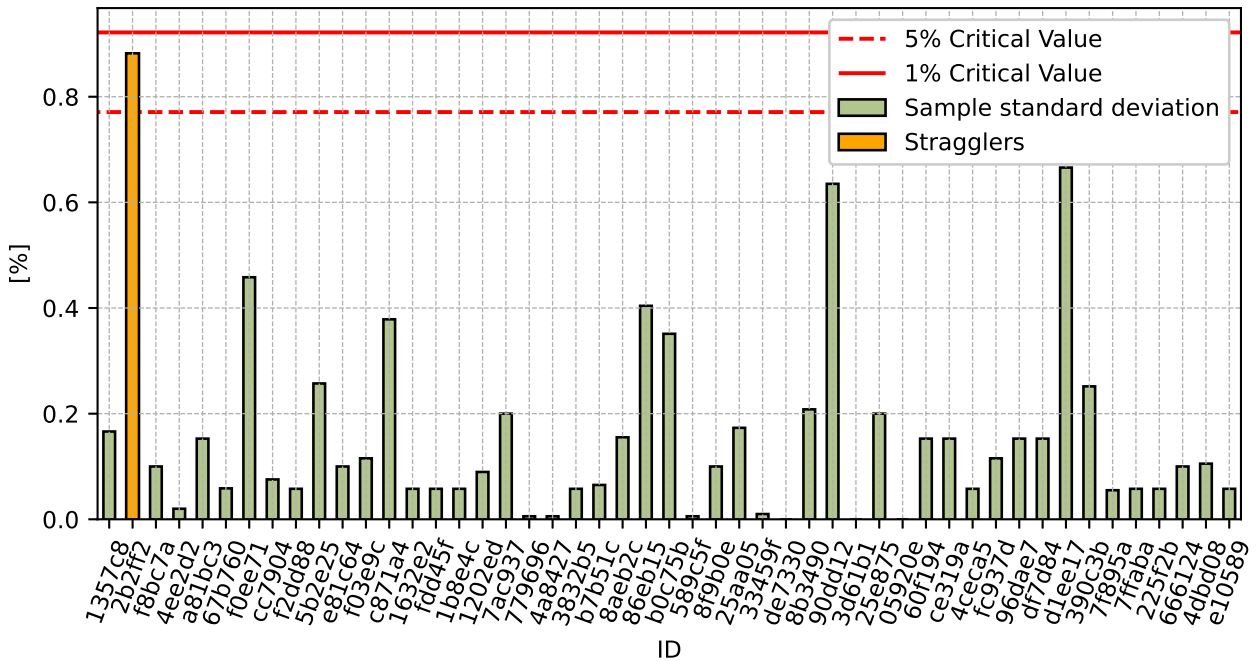
Figure 1: **Cochran's test** - sample standard deviations

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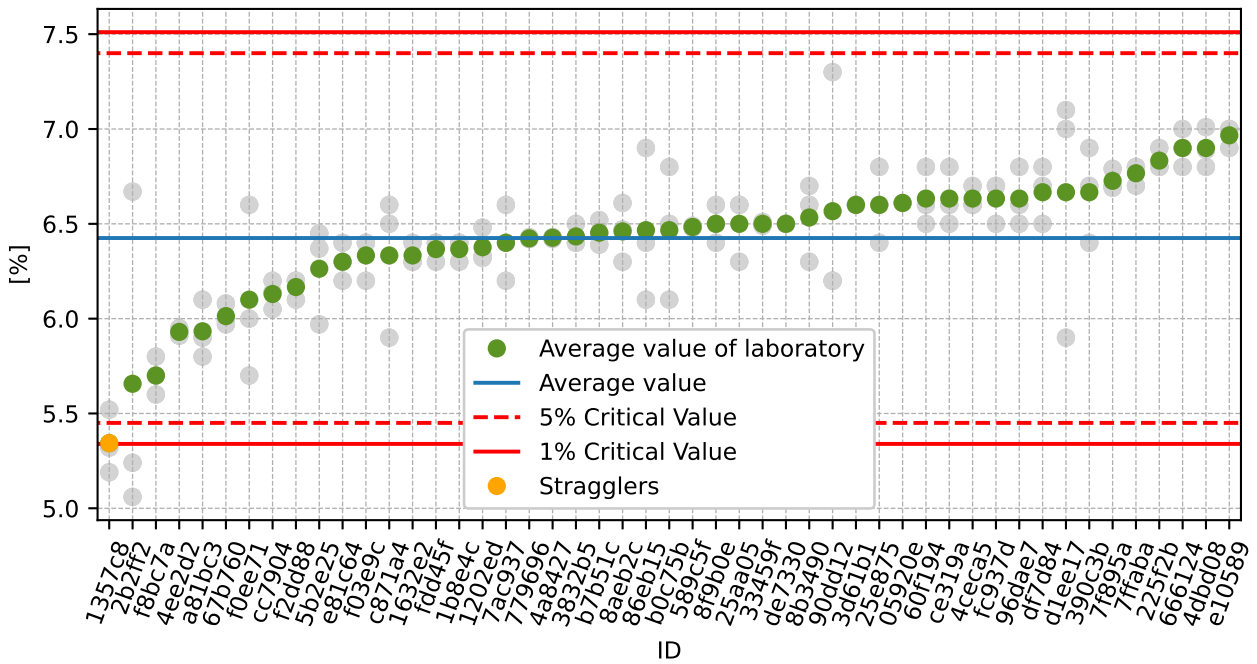
Figure 2: **Grubbs' test** - average values

1.3 Mandel's Statistics
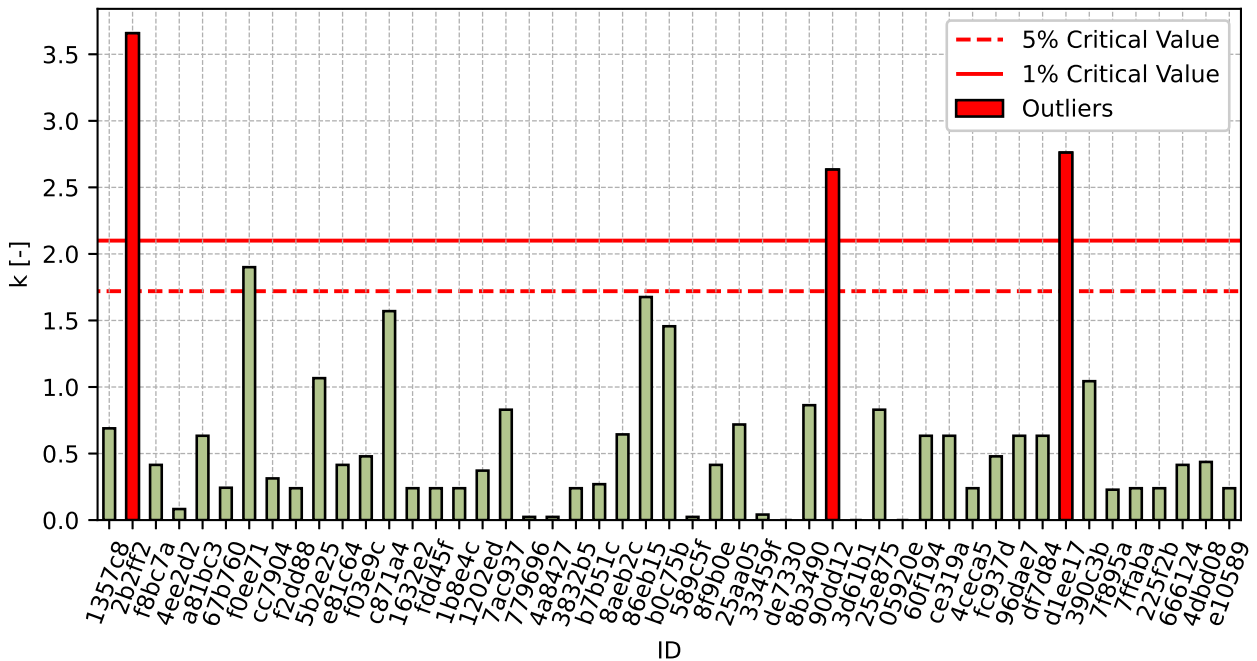
Figure 3: Intralaboratory Consistency Statistic

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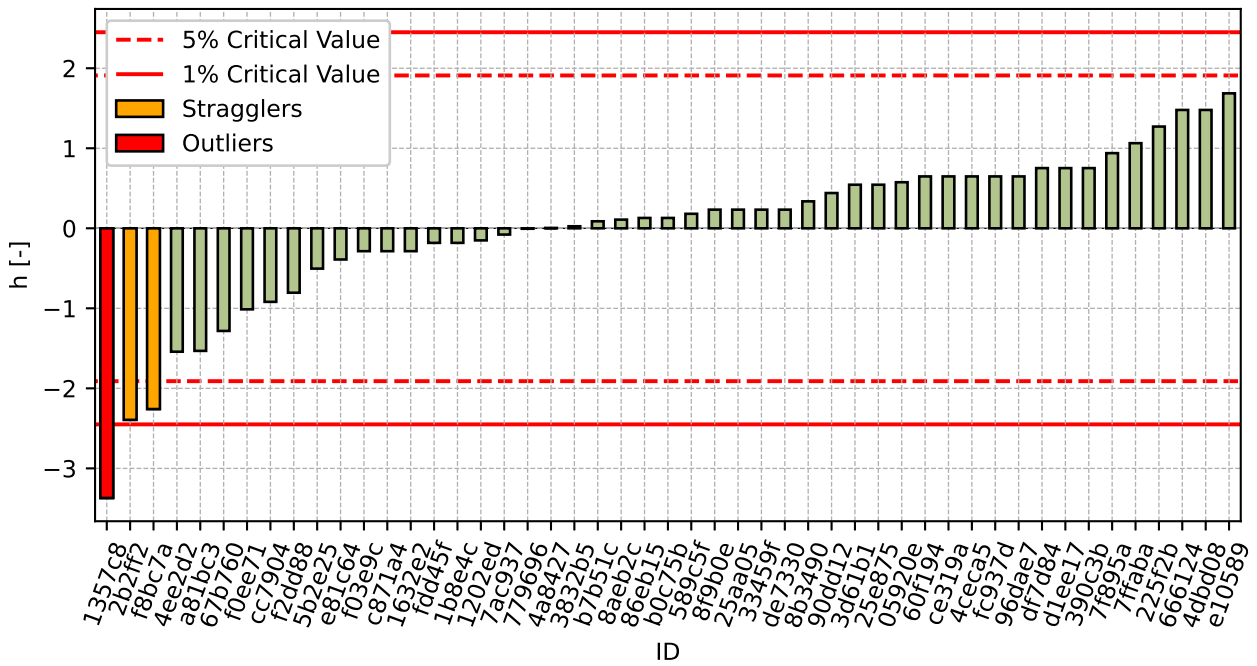
Figure 4: Interlaboratory Consistency Statistic

1.4 Descriptive statistics
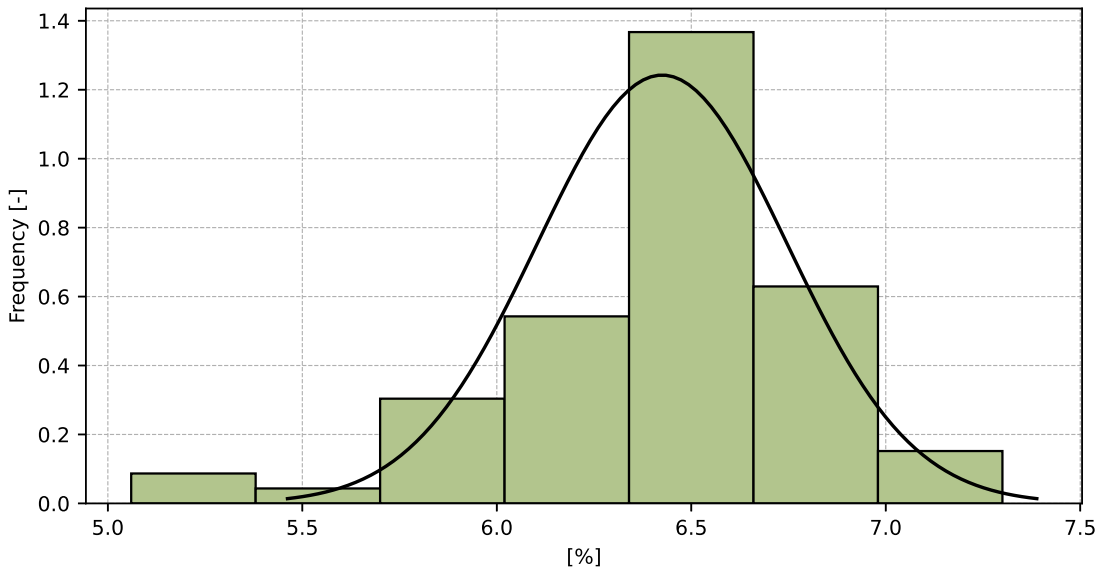
Figure 5: Histogram of all test results

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Table 5: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	6.4
Sample standard deviation – s	0.32
Asigned value – x^*	6.5
Robust standard deviation – s^*	0.45
Measurement uncertainty of asigned value – u_X	0.05
p-value of normality test	0.0 [-]
Interlaboratory standard deviation – s_L	0.29
Repeatability standard deviation – s_r	0.24
Reproducibility standard deviation – s_R	0.38
Repeatability – r	0.7
Reproducibility – R	1.1

1.5 Evaluation of Performance Statistics
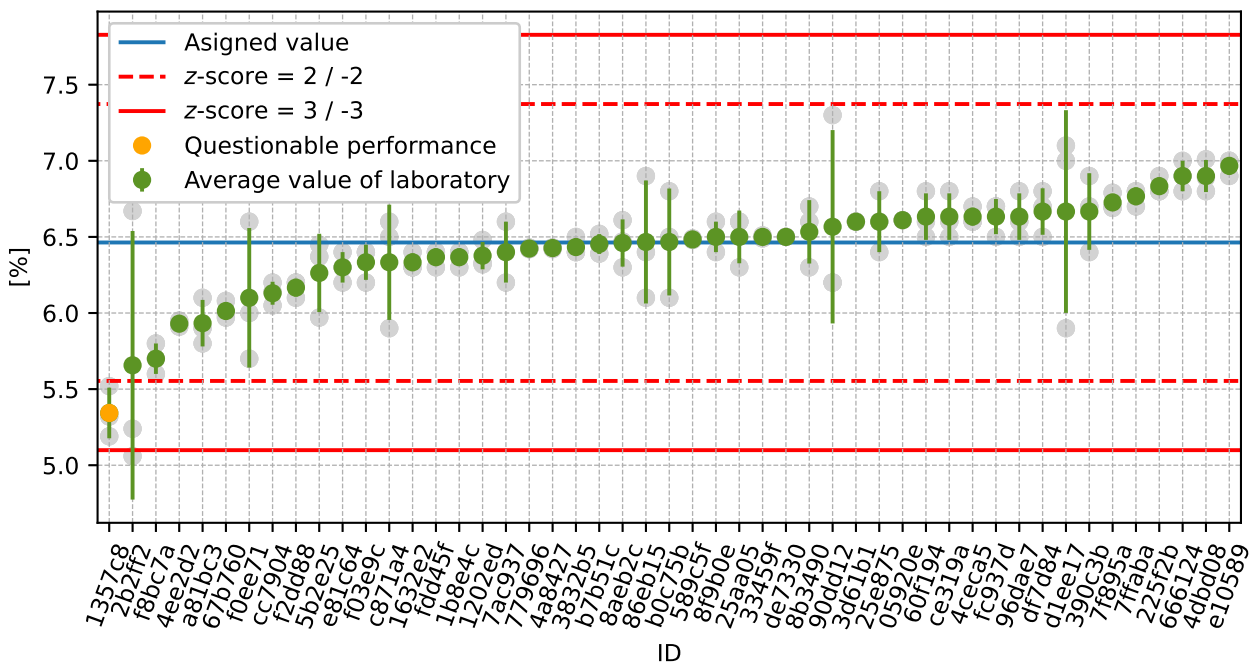
Figure 6: Average values and sample standard deviations

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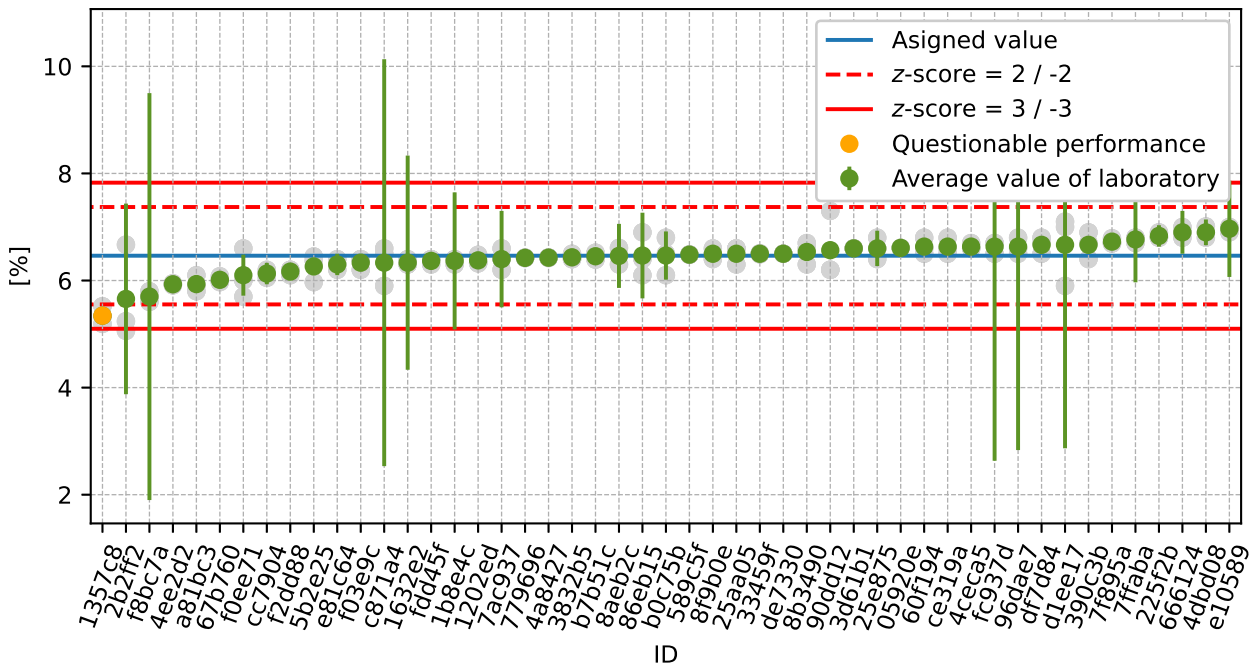
Figure 7: Average values and extended uncertainties of measurement

Figure 8: z-score

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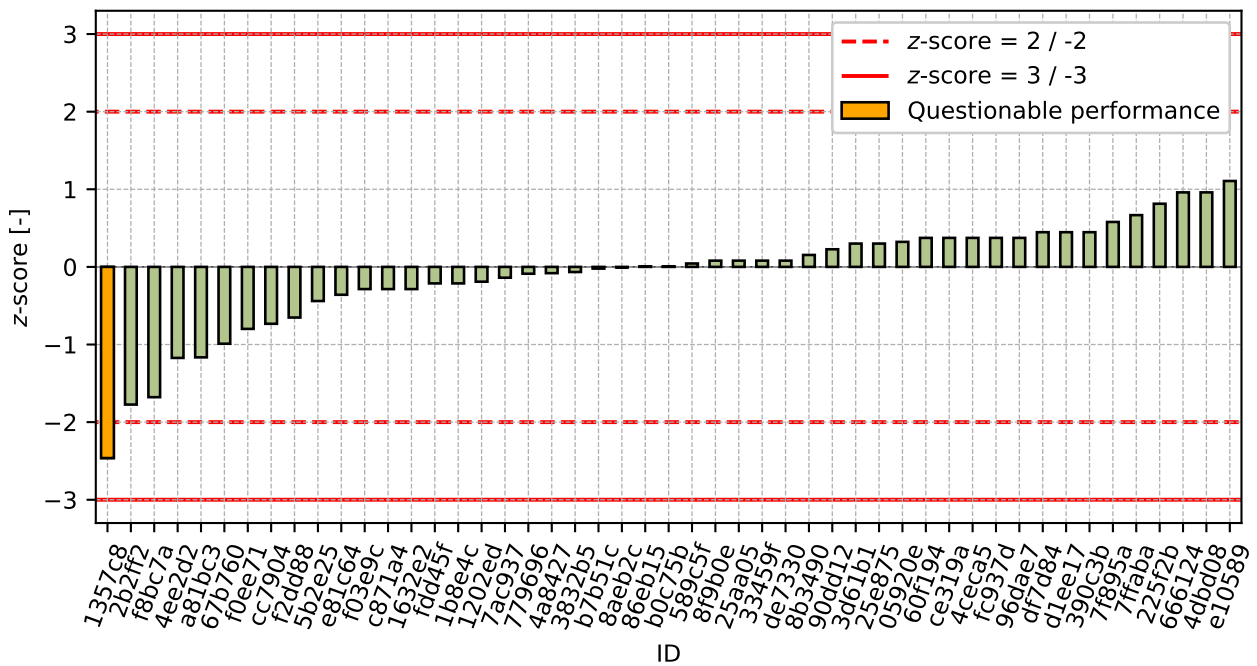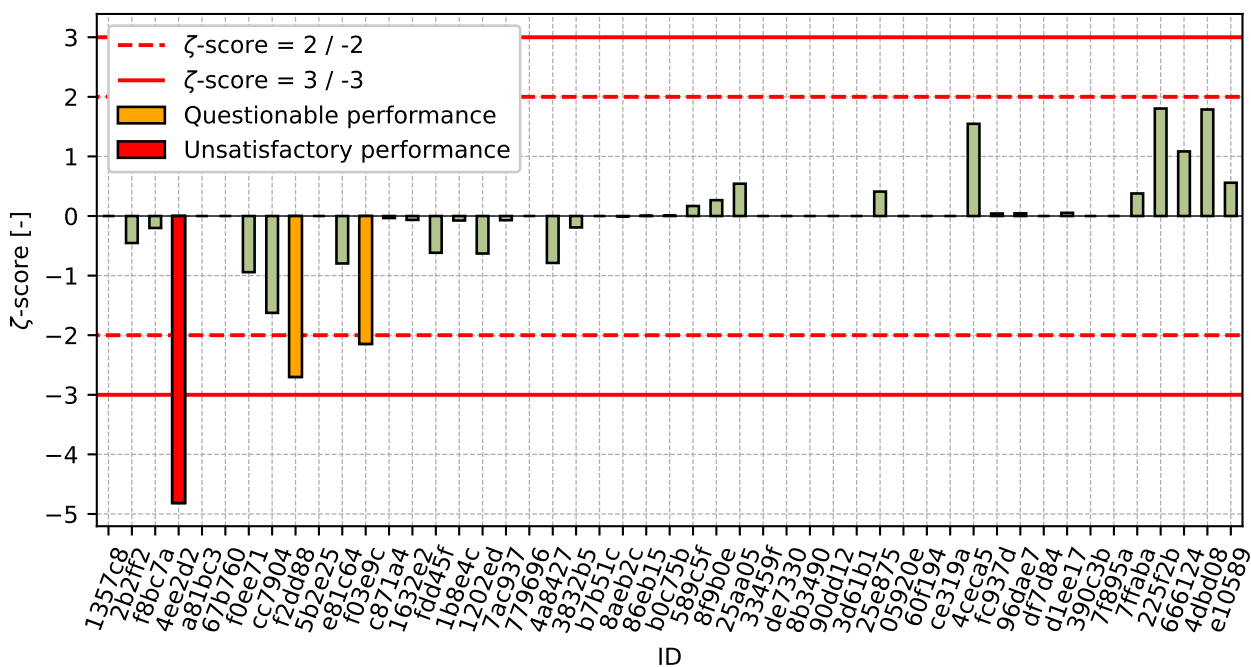
Figure 9: ζ-score

Table 6: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
1357c8	-2.46	-
2b2ff2	-1.77	-0.45
f8bc7a	-1.68	-0.2
4ee2d2	-1.17	-4.81
a81bc3	-1.17	-
67b760	-0.99	-
f0ee71	-0.8	-0.94
cc7904	-0.73	-1.63
f2dd88	-0.65	-2.7
5b2e25	-0.44	-
e81c64	-0.36	-0.8
f03e9c	-0.29	-2.15
c871a4	-0.29	-0.03
1632e2	-0.29	-0.06
fdd45f	-0.21	-0.62
1b8e4c	-0.21	-0.08
1202ed	-0.19	-0.63
7ac937	-0.14	-0.07
779696	-0.09	-
4a8427	-0.08	-0.79
3832b5	-0.07	-0.19
b7b51c	-0.02	-

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ID	z-score [-]	ζ-score [-]
8aeb2c	-0.01	-0.01
86eb15	0.01	0.0
b0c75b	0.01	0.01
589c5f	0.04	0.17
8f9b0e	0.08	0.27
25aa05	0.08	0.54
33459f	0.08	-
de7330	0.08	-
8b3490	0.15	-
90dd12	0.23	-
3d61b1	0.3	-
25e875	0.3	0.41
05920e	0.32	-
60f194	0.37	-
ce319a	0.37	-
4ceca5	0.37	1.55
fc937d	0.37	0.04
96dae7	0.37	0.04
df7d84	0.45	-
d1ee17	0.45	0.05
390c3b	0.45	-
7f895a	0.58	-
7ffaba	0.67	0.38
225f2b	0.81	1.8
666124	0.96	1.08
4dbd08	0.96	1.79
e10589	1.11	0.56

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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/m³]			u_X [Mg/m³]	$\bar{x}$ [Mg/m³]	s_0 [Mg/m³]	V_X [%]
c871a4	2.63	2.63	2.64	0.1	2.63	0.006	0.22
7ac937	2.65	2.63	-	-	2.64	0.014	0.54
67b760	2.66	2.66	2.66	-	2.66	0.005	0.17
cc7904	2.66	2.66	2.66	0.01	2.66	0.001	0.04
225f2b	2.66	2.66	2.67	0.04	2.66	0.006	0.22
f8bc7a	2.67	2.67	2.67	0.1	2.67	0.0	0.0
666124	2.66	2.67	2.68	0.14	2.67	0.01	0.37
33459f	2.68	2.68	2.67	-	2.68	0.005	0.17
1357c8	2.68	2.67	2.68	-	2.68	0.006	0.22
df7d84	2.69	2.69	2.66	0.04	2.68	0.017	0.65
96dae7	2.68	2.68	2.68	0.1	2.68	0.0	0.0
e10589	2.7	2.67	2.68	0.04	2.68	0.014	0.52
5b2e25	2.68	2.69	2.68	-	2.68	0.006	0.22
4a8427	2.68	2.68	2.68	0.01	2.68	0.001	0.04
4ceca5	2.68	2.68	2.7	-	2.69	0.011	0.4
d1ee17	2.69	2.69	2.69	0.1	2.69	0.0	0.0
f2dd88	2.69	2.7	2.69	0.05	2.69	0.006	0.21
b0c75b	2.7	2.69	2.7	0.03	2.7	0.006	0.21
589c5f	2.7	2.7	2.7	0.06	2.7	0.003	0.09
25aa05	2.69	2.7	2.71	0.08	2.7	0.01	0.37
1632e2	2.69	2.71	2.71	0.03	2.7	0.012	0.43
05920e	2.7	2.7	2.7	-	2.7	0.001	0.04
1b8e4c	2.71	2.71	2.7	1.24	2.71	0.006	0.21
3ffebb	2.71	2.71	2.71	0.01	2.71	0.0	0.0
25e875	2.72	2.71	2.72	0.04	2.72	0.006	0.21
779696	2.72	2.72	2.72	-	2.72	0.001	0.04
390c3b	2.73	2.73	2.72	-	2.73	0.004	0.13
2b2ff2	2.73	2.74	2.71	0.0	2.73	0.015	0.56
f03e9c	2.73	2.73	2.73	0.0	2.73	0.003	0.1
01225f	2.73	2.74	2.73	-	2.73	0.006	0.21

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2.2   The Numerical Procedure for Determining Outliers
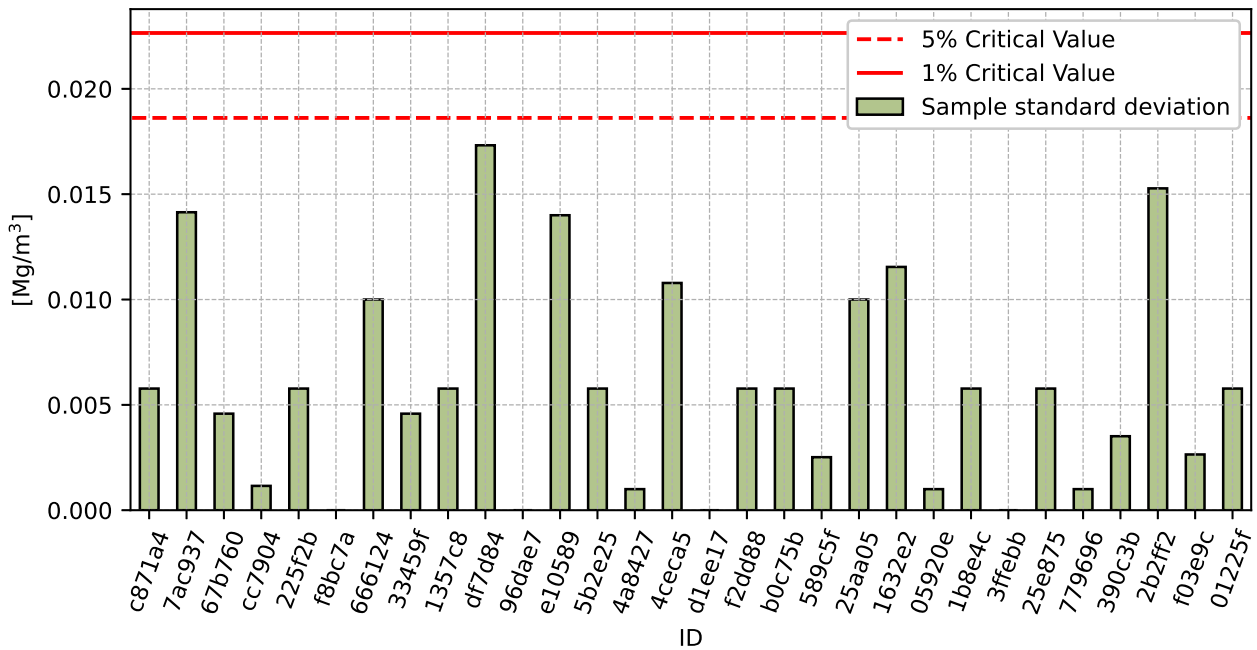
Figure 10: **Cochran's test** - sample standard deviations
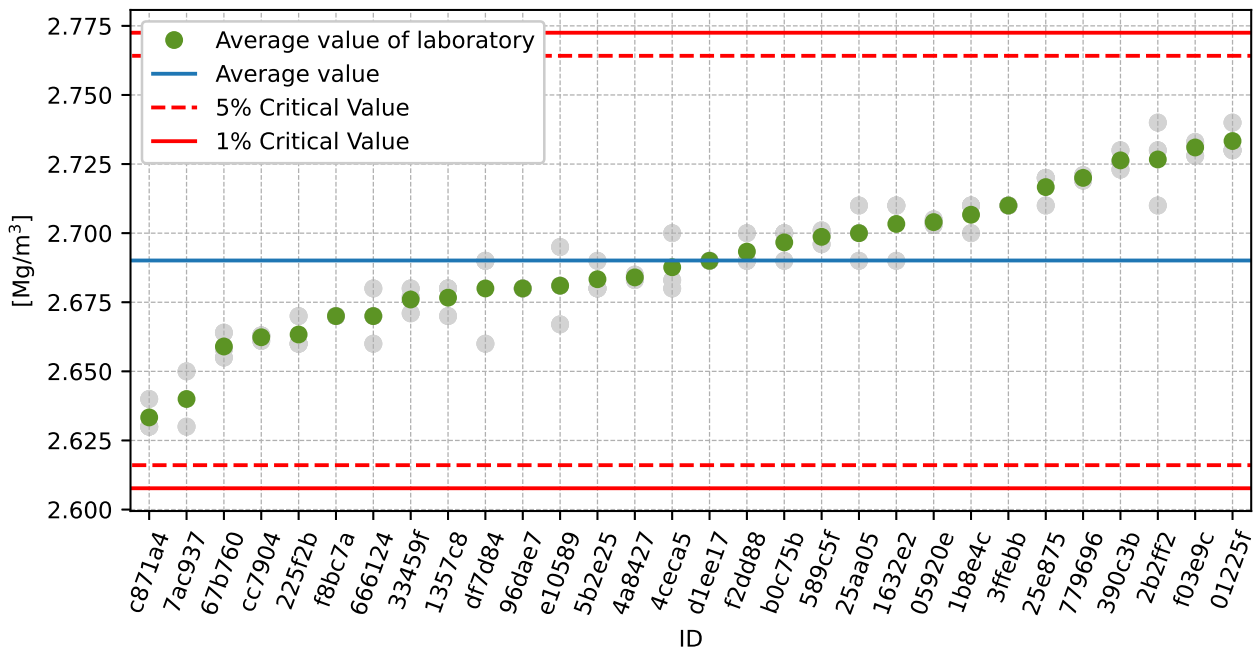
Figure 11: **Grubbs' test** - average values

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2.3 Mandel's Statistics
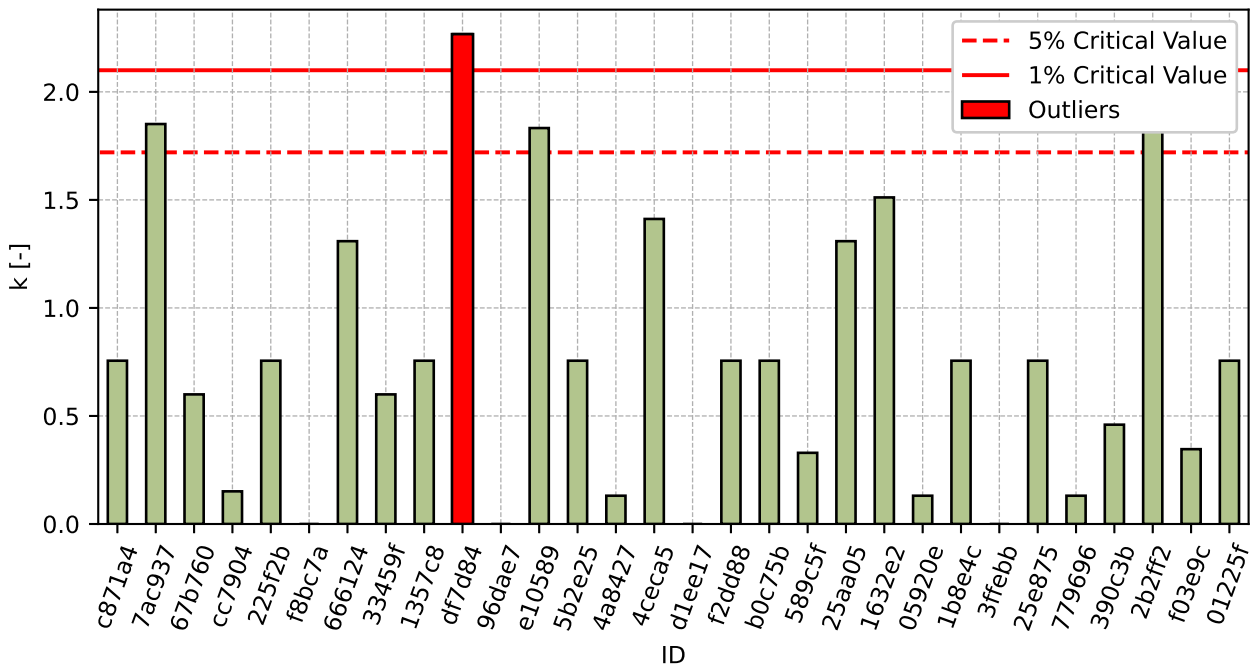
Figure 12: Intralaboratory Consistency Statistic
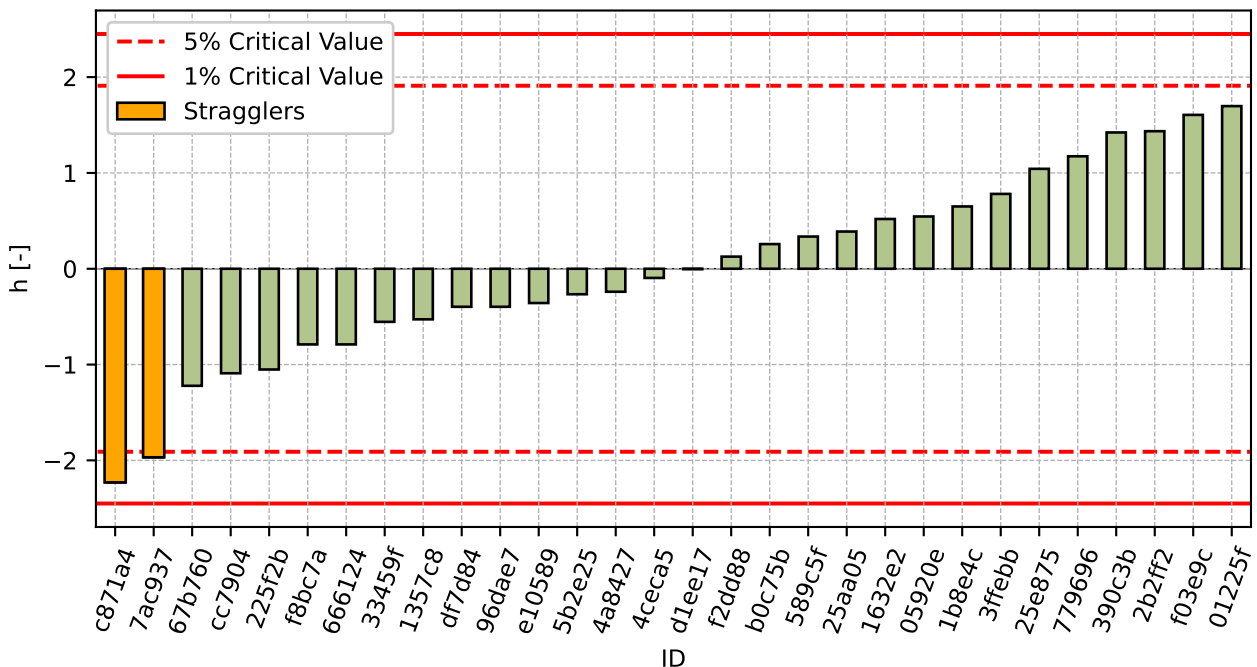
Figure 13: Interlaboratory Consistency Statistic

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2.4 Descriptive statistics
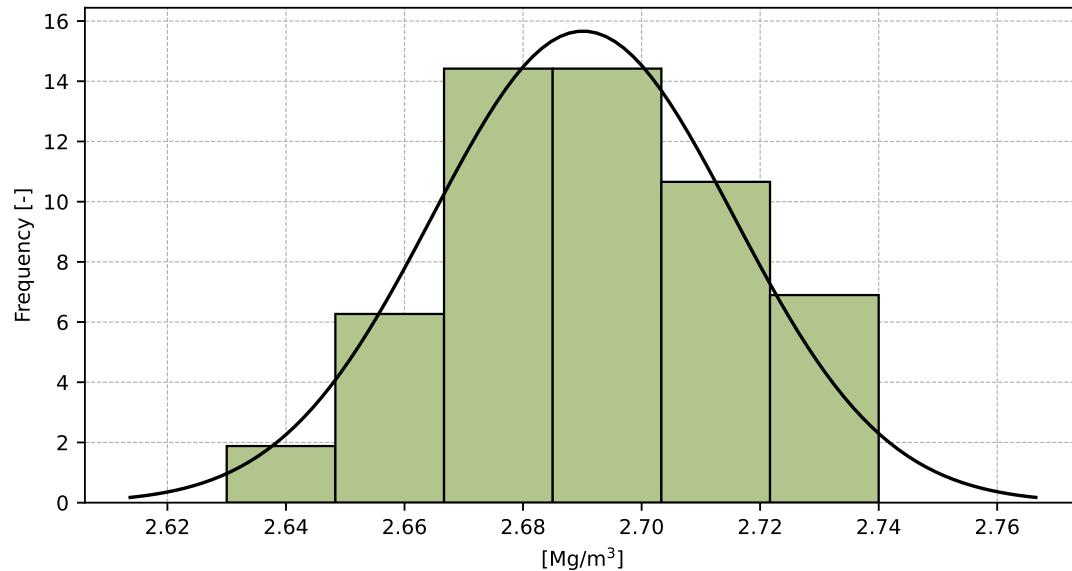
Figure 14: Histogram of all test results

Table 8: Descriptive statistics

Characteristics	[Mg/m³]
Average value – $\bar{x}$	2.69
Sample standard deviation – s	0.025
Asigned value – x^*	2.69
Robust standard deviation – s^*	0.031
Measurement uncertainty of asigned value – u_X	0.006
p-value of normality test	0.207 [-]
Interlaboratory standard deviation – s_L	0.025
Repeatability standard deviation – s_r	0.008
Reproducibility standard deviation – s_R	0.026
Repeatability – r	0.02
Reproducibility – R	0.07

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2.5 Evaluation of Performance Statistics
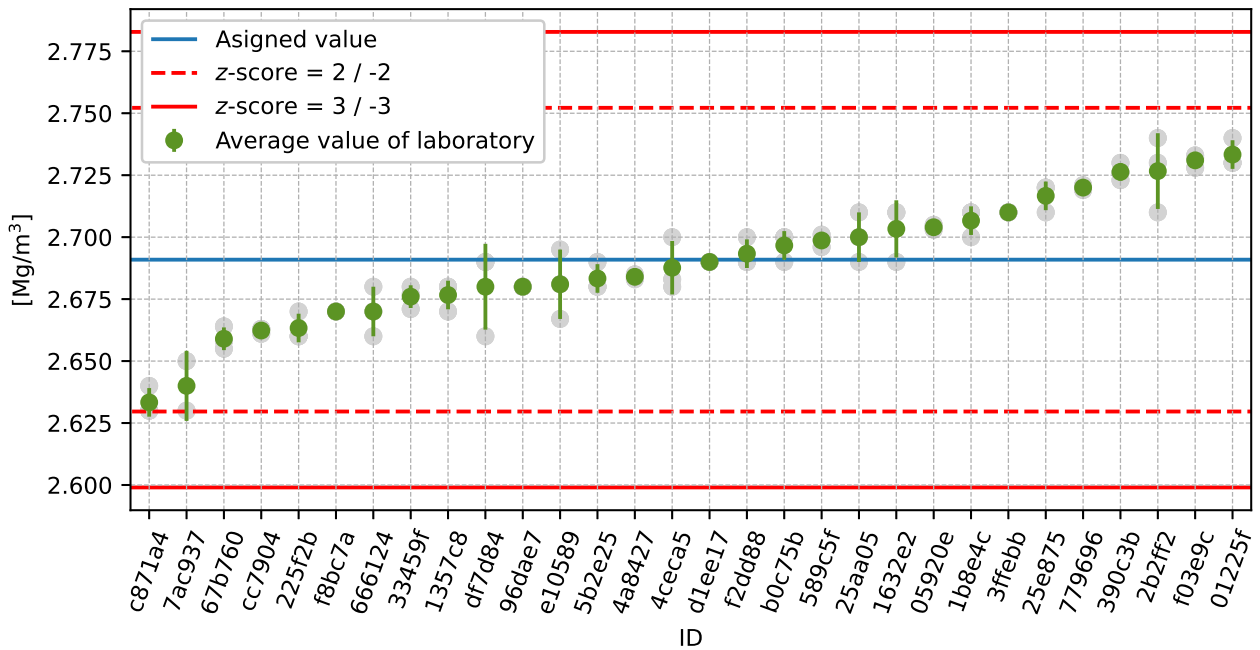
Figure 15: Average values and sample standard deviations
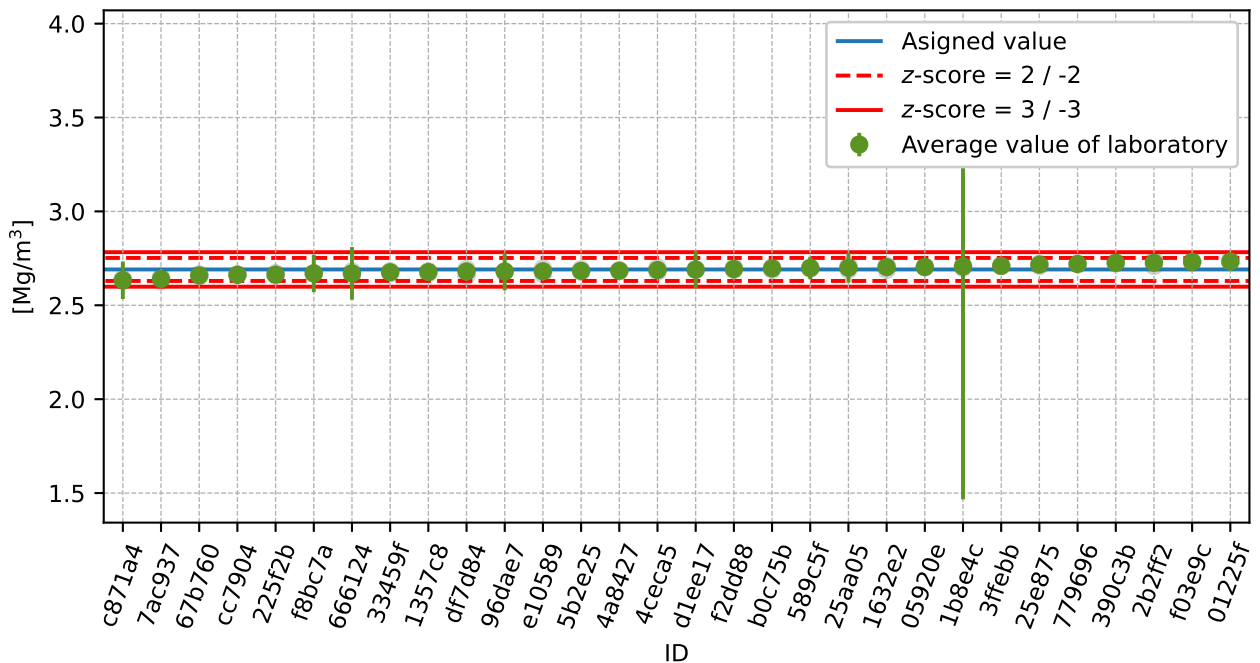
Figure 16: Average values and extended uncertainties of measurement

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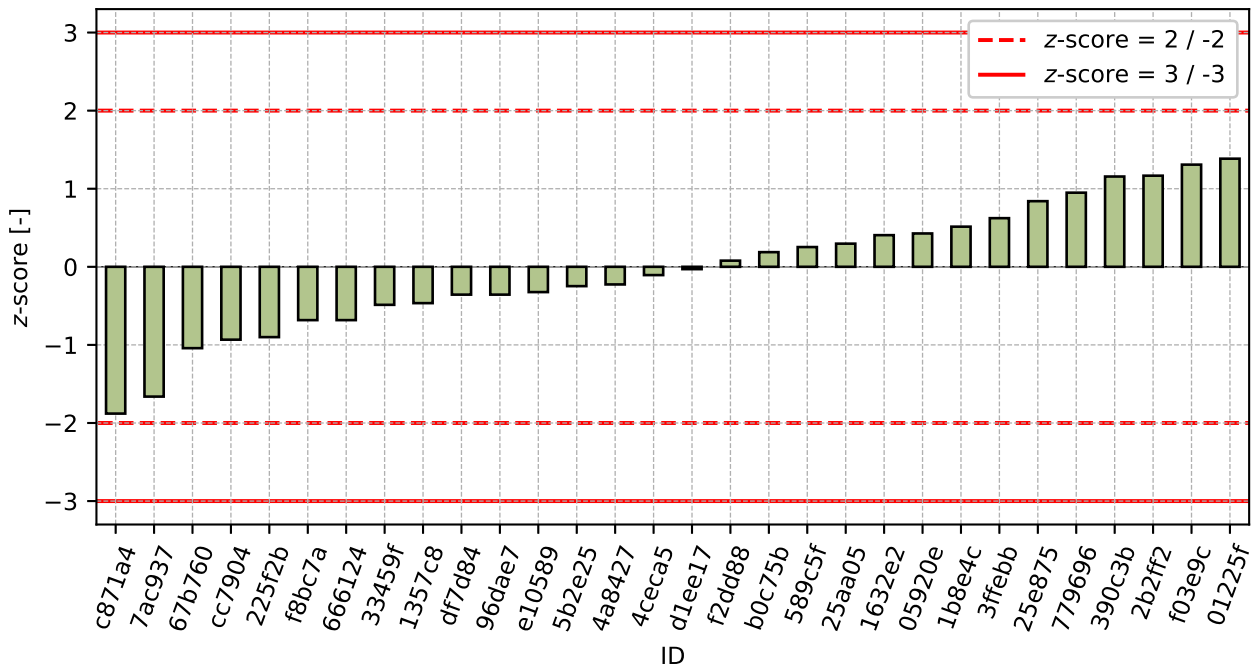
Figure 17: z-score

Figure 18: ζ-score

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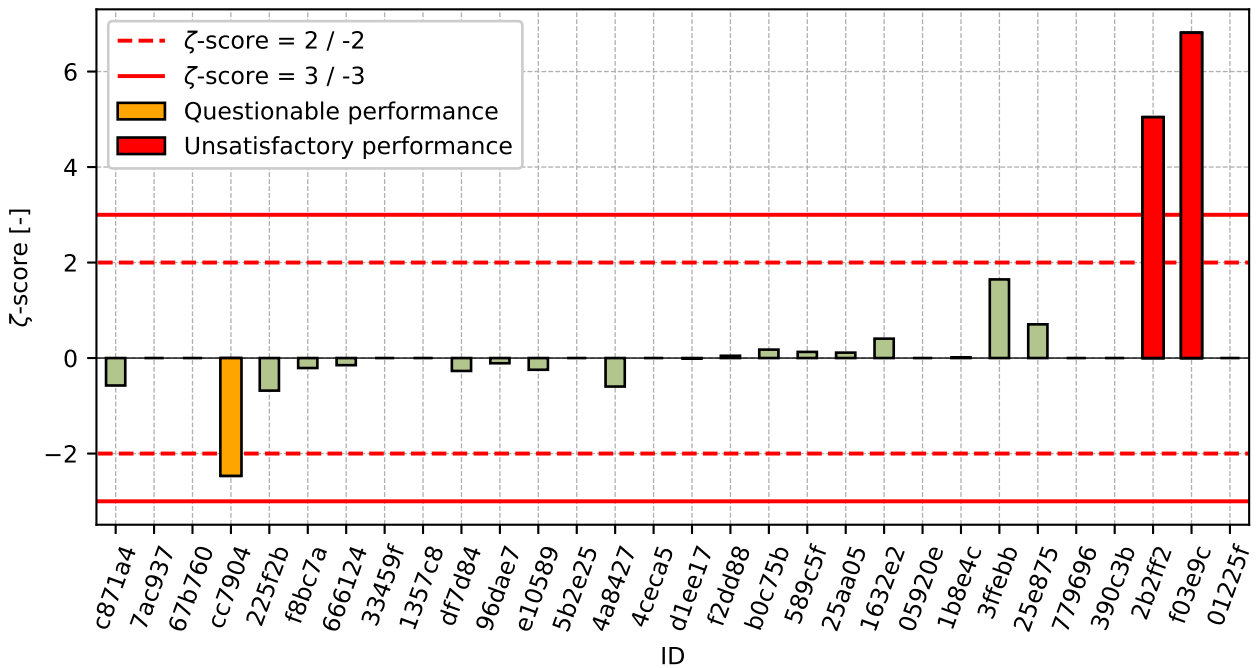
Table 9: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
c871a4	-1.88	-0.57
7ac937	-1.66	-
67b760	-1.04	-
cc7904	-0.93	-2.47
225f2b	-0.9	-0.68
f8bc7a	-0.68	-0.21
666124	-0.68	-0.15
33459f	-0.49	-
1357c8	-0.47	-
df7d84	-0.36	-0.27
96dae7	-0.36	-0.11
e10589	-0.32	-0.25
5b2e25	-0.25	-
4a8427	-0.23	-0.6
4ceca5	-0.11	-
d1ee17	-0.03	-0.01
f2dd88	0.08	0.05
b0c75b	0.19	0.18
589c5f	0.25	0.13
25aa05	0.3	0.11
1632e2	0.41	0.41
05920e	0.43	-
1b8e4c	0.51	0.01
3ffebb	0.62	1.65
25e875	0.84	0.71
779696	0.95	-
390c3b	1.16	-
2b2ff2	1.17	5.04
f03e9c	1.31	6.81
01225f	1.38	-

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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
fc937d	96.3	83.6	58.6	31.9	10.3	1.4	0.6
f90fb7	96.2	83.3	56.1	28.2	8.1	0.9	0.3
f8bc7a	-	85.0	-	-	-	-	1.0
f2dd88	96.8	80.5	54.3	26.6	7.8	1.2	0.5
ecf0fd	97.0	83.5	58.2	31.0	9.9	1.8	0.9
e81c64	97.0	83.7	60.1	32.5	10.4	1.6	0.6
e10589	98.7	86.6	61.8	33.4	11.1	1.6	0.9
df7d84	96.1	82.8	57.0	28.0	11.0	2.0	1.2
d1ee17	-	83.0	-	-	-	-	1.0
ce319a	97.0	83.0	57.0	31.0	10.0	2.0	0.9
cc7904	97.1	82.5	57.7	28.8	8.0	1.2	0.7
c871a4	-	85.0	-	-	-	-	1.0
c0ca45	96.1	82.2	57.2	29.2	12.1	6.8	6.4
b0c75b	96.9	83.6	60.5	34.2	14.8	5.0	1.2
a81bc3	96.6	82.6	57.9	31.9	10.4	1.9	1.2
9d12b7	96.9	82.9	58.3	30.9	7.3	1.2	0.6
96dae7	-	81.0	-	-	-	-	1.0
90dd12	99.0	85.0	61.0	30.0	10.0	5.0	1.0
86eb15	96.8	83.8	59.4	31.8	10.4	1.8	0.9
7ffaba	95.4	78.6	53.5	30.0	9.4	1.3	0.5
7f895a	96.2	79.6	54.4	29.9	9.3	1.3	0.4
7ac937	96.9	81.5	56.2	30.0	9.4	1.4	0.4
779696	95.6	82.8	57.4	29.4	9.2	1.0	0.2
666124	96.7	82.1	57.7	31.4	10.0	1.3	0.6
5b2e25	97.0	84.1	59.3	32.1	9.9	2.5	1.8
589c5f	97.3	86.8	65.8	37.0	12.5	3.8	2.2
4ceca5	96.8	82.4	58.1	31.5	9.4	1.5	0.7
4a8427	97.8	84.5	60.1	32.9	11.8	1.2	0.4
3d61b1	100.0	83.0	65.0	26.0	15.0	2.0	1.0
390c3b	97.0	83.5	58.9	31.3	10.1	1.5	0.5
33e846	96.8	82.5	56.8	36.4	23.7	14.3	6.3
320ee2	96.7	83.2	59.6	31.7	9.1	2.3	0.5
25e875	96.0	85.0	61.4	33.8	12.4	4.6	3.8
25aa05	97.0	84.0	59.0	32.0	10.0	2.0	0.9
225f2b	97.1	83.1	57.6	30.6	9.8	2.0	1.1
1b8e4c	97.1	84.0	58.9	31.2	9.5	1.4	0.7
1357c8	96.8	83.0	57.8	39.0	8.2	0.2	0.0
1202ed	97.1	92.3	63.8	32.0	11.3	3.8	2.8
05920e	96.6	82.9	66.2	31.6	9.9	1.6	0.7
01225f	96.0	82.0	59.3	28.5	7.2	1.2	0.8
b7b51c	99.5	87.3	63.3	27.1	8.5	3.3	1.2
67b760	97.0	83.7	61.2	36.2	9.3	1.0	0.4

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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}	1.651	2.232	1.905	1.921	1.156	0.922	0.878
G_{max}	3.182	4.054	2.404	2.754	4.742	4.938	3.861
$G_{0.05}$	3.014	3.036	3.014	3.014	3.014	3.014	3.036
$G_{0.01}$	3.356	3.381	3.356	3.356	3.356	3.356	3.381

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}	1.82	2.744	1.905	1.921	1.654	1.533	2.182
G_{max}	3.191	2.392	2.404	2.754	2.832	2.632	2.953
$G_{0.05}$	3.003	3.036	3.014	3.014	3.003	2.991	3.003
$G_{0.01}$	3.343	3.381	3.356	3.356	3.343	3.33	3.343

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Table 13: z-score

ID	z-score [-] / sieve						
of participant	4 mm	2 mm	1 mm	0.5 mm	0.25 mm	0.125 mm	0.063 mm
fc937d	-0.72	0.21	-0.18	0.2	0.13	-0.49	-0.47
f90fb7	-0.84	0.03	-1.02	-1.13	-1.14	-0.93	-1.33
f8bc7a	-	1.03	-	-	-	-	0.67
f2dd88	-0.11	-1.62	-1.63	-1.71	-1.31	-0.67	-0.76
ecf0fd	0.14	0.15	-0.31	-0.12	-0.1	-0.14	0.39
e81c64	0.14	0.27	0.33	0.42	0.19	-0.32	-0.47
e10589	2.21	1.98	0.91	0.74	0.59	-0.32	0.39
df7d84	-0.96	-0.26	-0.72	-1.2	0.53	0.03	1.24
d1ee17	-	-0.15	-	-	-	-	0.67
ce319a	0.14	-0.15	-0.72	-0.12	-0.04	0.03	0.39
cc7904	0.26	-0.44	-0.48	-0.91	-1.19	-0.67	-0.19
c871a4	-	1.03	-	-	-	-	0.67
c0ca45	-0.96	-0.62	-0.65	-0.77	1.16	-	-
b0c75b	0.01	0.21	0.47	1.03	2.72	2.63	1.24
a81bc3	-0.35	-0.38	-0.41	0.2	0.19	-0.06	1.24
9d12b7	0.01	-0.21	-0.28	-0.16	-1.6	-0.67	-0.47
96dae7	-	-1.33	-	-	-	-	0.67
90dd12	2.58	1.03	0.64	-0.48	-0.04	2.63	0.67
86eb15	-0.11	0.33	0.1	0.16	0.19	-0.14	0.39
7ffaba	-1.82	-2.74	-1.91	-0.48	-0.39	-0.58	-0.76
7f895a	-0.84	-2.15	-1.6	-0.52	-0.45	-0.58	-1.04
7ac937	0.01	-1.03	-0.99	-0.48	-0.39	-0.49	-1.04
779696	-1.58	-0.26	-0.58	-0.7	-0.5	-0.84	-1.61
666124	-0.23	-0.68	-0.48	0.02	-0.04	-0.58	-0.47
5b2e25	0.14	0.5	0.06	0.27	-0.1	0.46	2.95
589c5f	0.5	2.1	2.27	2.04	1.39	1.59	-
4ceca5	-0.11	-0.5	-0.34	0.06	-0.39	-0.4	-0.19
4a8427	1.11	0.74	0.33	0.56	0.99	-0.67	-1.04
3d61b1	-	-0.15	2.0	-2.07	2.83	0.03	0.67
390c3b	0.14	0.15	-0.07	-0.02	0.01	-0.4	-0.76
33e846	-0.11	-0.44	-0.79	1.82	-	-	-
320ee2	-0.23	-0.03	0.16	0.13	-0.56	0.29	-0.76
25e875	-1.09	1.03	0.78	0.88	1.34	2.28	-
25aa05	0.14	0.44	-0.04	0.24	-0.04	0.03	0.39
225f2b	0.26	-0.09	-0.51	-0.27	-0.16	0.03	0.96
1b8e4c	0.26	0.44	-0.07	-0.05	-0.33	-0.49	-0.19
1357c8	-0.11	-0.15	-0.45	2.75	-1.08	-1.53	-2.18
1202ed	0.26	-	1.59	0.24	0.7	1.59	-
05920e	-0.35	-0.21	2.4	0.09	-0.1	-0.32	-0.19
01225f	-1.09	-0.74	0.06	-1.02	-1.65	-0.67	0.1
b7b51c	3.19	2.39	1.42	-1.53	-0.91	1.16	1.24
67b760	0.14	0.27	0.71	1.75	-0.45	-0.84	-1.04

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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
25aa05	76.4	35.1	27.3	16.6	8.3
86eb15	80.1	56.1	38.0	28.8	21.0
1357c8	88.2	75.1	43.2	25.2	15.8
c871a4	-	57.0	-	34.0	24.0
f8bc7a	-	59.0	-	34.0	25.0
d1ee17	-	58.0	-	32.0	24.0
96dae7	-	56.0	-	31.0	22.0
589c5f	94.4	67.4	49.6	37.8	31.8
7ac937	83.9	53.1	41.3	29.4	25.4
1202ed	69.8	54.1	38.3	27.6	22.1
1632e2	65.0	52.0	38.0	32.0	28.0
7ffaba	88.3	61.2	42.1	31.2	22.1
320ee2	88.6	64.8	44.7	34.7	27.5
b0c75b	86.3	55.2	36.8	27.0	19.5
390c3b	91.0	58.6	41.1	32.5	24.2
7f895a	89.7	64.5	45.0	33.8	23.0
3ffebb	83.8	57.2	40.6	31.2	23.4
4a8427	84.5	57.8	42.3	31.7	26.4
f2dd88	82.5	50.2	33.6	23.4	16.6
f90fb7	80.7	56.0	36.8	28.8	21.4
e10589	63.9	50.0	35.8	25.0	14.1
9d12b7	91.9	67.6	49.2	37.4	23.9
1b8e4c	94.1	65.2	47.5	37.4	27.3
5b2e25	80.2	48.2	40.1	22.3	19.3
25e875	86.4	61.1	44.4	34.6	26.4
779696	86.8	53.0	35.8	24.8	15.4
df7d84	87.5	59.6	42.7	35.0	23.3
5c1ea2	92.3	61.0	45.5	36.5	28.4
cc7904	80.0	50.5	36.5	29.1	18.0
05920e	87.8	60.7	43.8	32.8	24.8
225f2b	90.3	68.5	49.5	40.0	30.2
67b760	86.5	48.0	30.5	19.5	10.0

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Table 15: Grubbs' test [%]

Value	0.02 mm	0.01 mm	0.002 mm	0.05 mm	0.005 mm
G_{min}	2.61	2.963	2.431	2.539	2.563
G_{max}	1.289	2.315	1.61	1.725	1.749
$G_{0.05}$	2.876	2.938	2.876	2.938	2.938
$G_{0.01}$	3.199	3.27	3.199	3.27	3.27

Table 16: z-score

| ID of participant | z-score [-] | | | | |
	0.02 mm	0.01 mm	0.002 mm	0.05 mm	0.005 mm
25aa05	-1.01	-2.96	-2.43	-2.54	-2.56
86eb15	-0.54	-0.19	-0.49	-0.32	-0.23
1357c8	0.5	2.32	0.45	-0.97	-1.19
c871a4	-	-0.07	-	0.63	0.32
f8bc7a	-	0.19	-	0.63	0.5
d1ee17	-	0.06	-	0.27	0.32
96dae7	-	-0.21	-	0.08	-0.05
589c5f	1.29	1.3	1.61	1.32	1.75
7ac937	-0.05	-0.59	0.11	-0.21	0.57
1202ed	-1.86	-0.46	-0.44	-0.53	-0.03
1632e2	-2.47	-0.73	-0.49	0.27	1.05
7ffaba	0.51	0.48	0.25	0.12	-0.03
320ee2	0.55	0.96	0.72	0.76	0.96
b0c75b	0.25	-0.31	-0.71	-0.64	-0.51
390c3b	0.85	0.14	0.07	0.36	0.35
7f895a	0.69	0.92	0.78	0.6	0.13
3ffebb	-0.07	-0.05	-0.02	0.12	0.21
4a8427	0.02	0.03	0.29	0.21	0.76
f2dd88	-0.23	-0.97	-1.29	-1.3	-1.04
f90fb7	-0.46	-0.21	-0.71	-0.32	-0.16
e10589	-2.61	-1.0	-0.89	-1.01	-1.5
9d12b7	0.97	1.33	1.54	1.25	0.3
1b8e4c	1.25	1.01	1.23	1.25	0.92
5b2e25	-0.53	-1.23	-0.11	-1.5	-0.54
25e875	0.27	0.47	0.67	0.74	0.76
779696	0.32	-0.6	-0.89	-1.04	-1.26
df7d84	0.41	0.27	0.36	0.81	0.19
5c1ea2	1.02	0.45	0.87	1.09	1.13
cc7904	-0.55	-0.93	-0.76	-0.26	-0.78
05920e	0.45	0.41	0.56	0.41	0.46
225f2b	0.76	1.44	1.59	1.72	1.46
67b760	0.28	-1.26	-1.85	-2.01	-2.25

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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]
666124	2.82	0.27
22d484	3.82	-
96dae7	3.85	-
f2dd88	4.46	0.22
f90fb7	5.23	0.78
54b338	5.56	0.0
25aa05	5.88	2.62
225f2b	6.0	0.2
67b760	6.17	-
b0c75b	7.5	-
e10589	7.89	-
c0ca45	7.9	-
5c1ea2	8.6	0.01
3ffebb	10.6	0.2
779696	10.8	-
390c3b	10.9	-
1357c8	13.19	-
f03e9c	13.34	0.22
f8bc7a	14.49	-
df7d84	14.9	-

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5.1.2   The Numerical Procedure for Determining Outliers
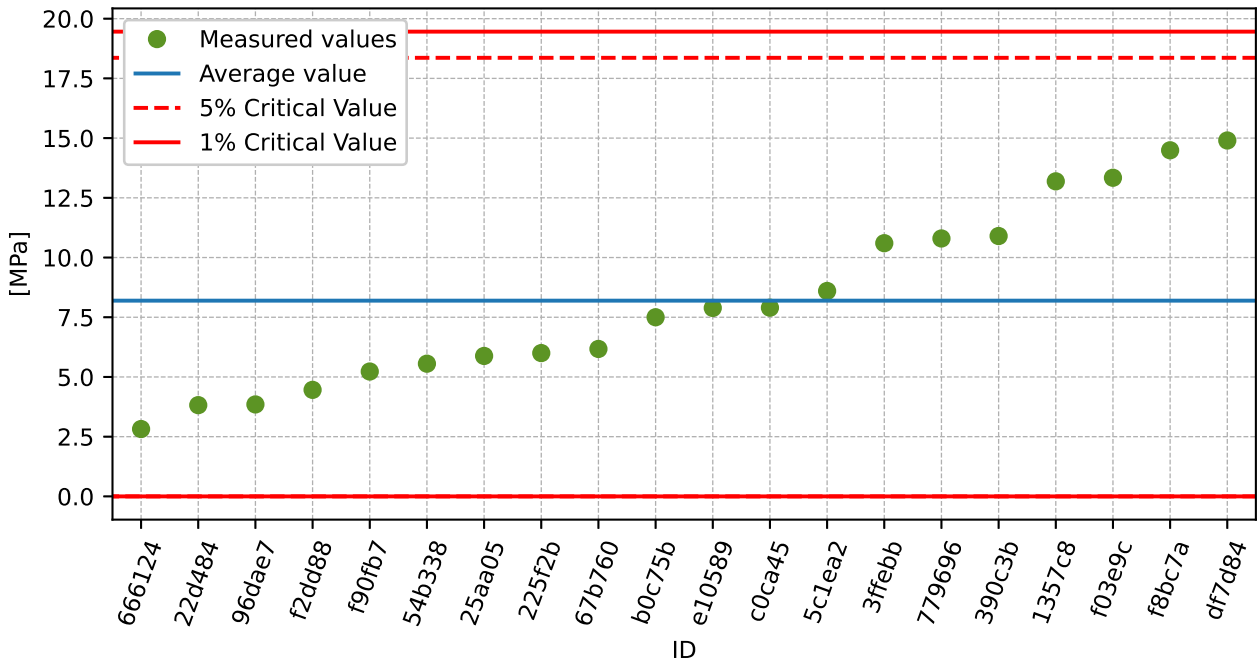

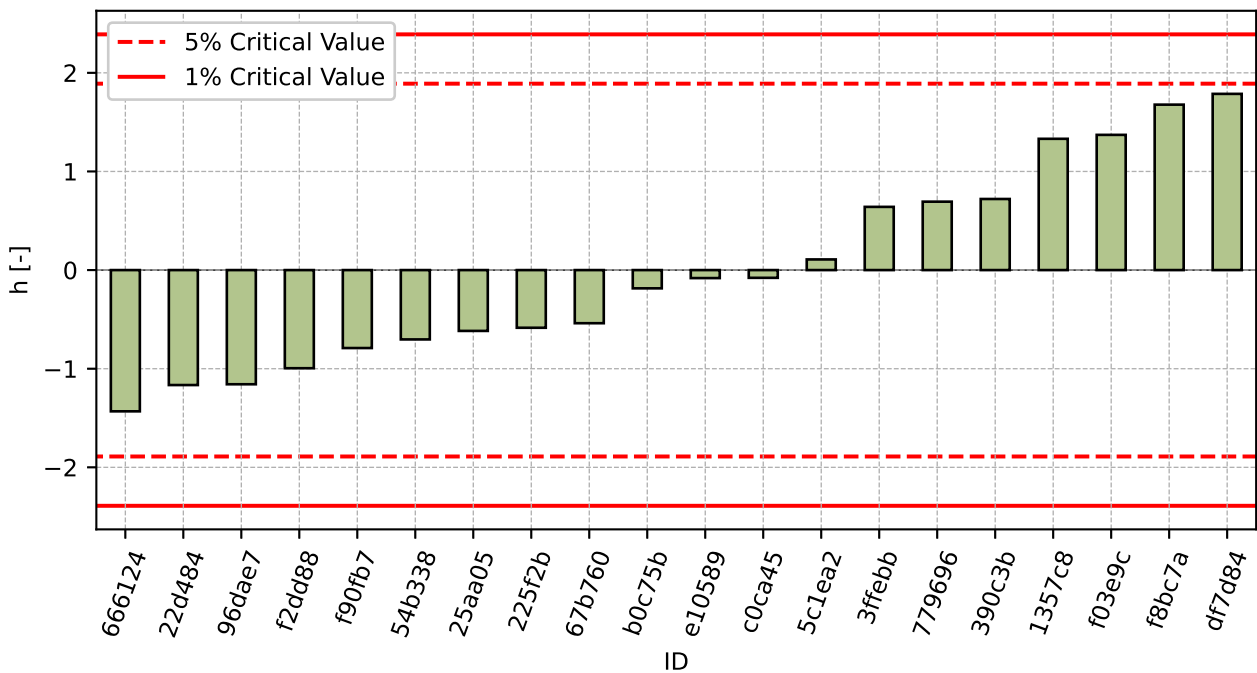Figure 19: **Grubbs' test** - average values

5.1.3   Mandel's Statistics

Figure 20: Interlaboratory Consistency Statistic

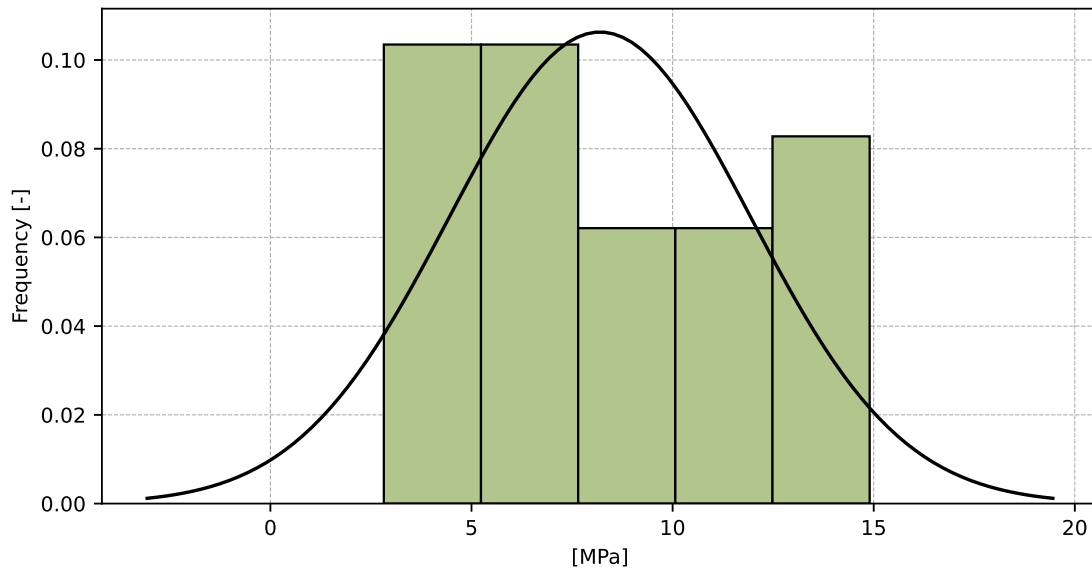Proficiency Testing Provider at the SZK FAST | Z 7008   37/118
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5.1.4   Descriptive statistics

Figure 21: Histogram of all test results

Table 18: Descriptive statistics

Characteristics	[MPa]
Average value – $\bar{x}$	8.19
Sample standard deviation – s	3.753
Asigned value – x^*	8.19
Robust standard deviation – s^*	4.137
Measurement uncertainty of asigned value – u_X	1.156
p-value of normality test	0.171 [-]

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5.1.5   Evaluation of Performance Statistics
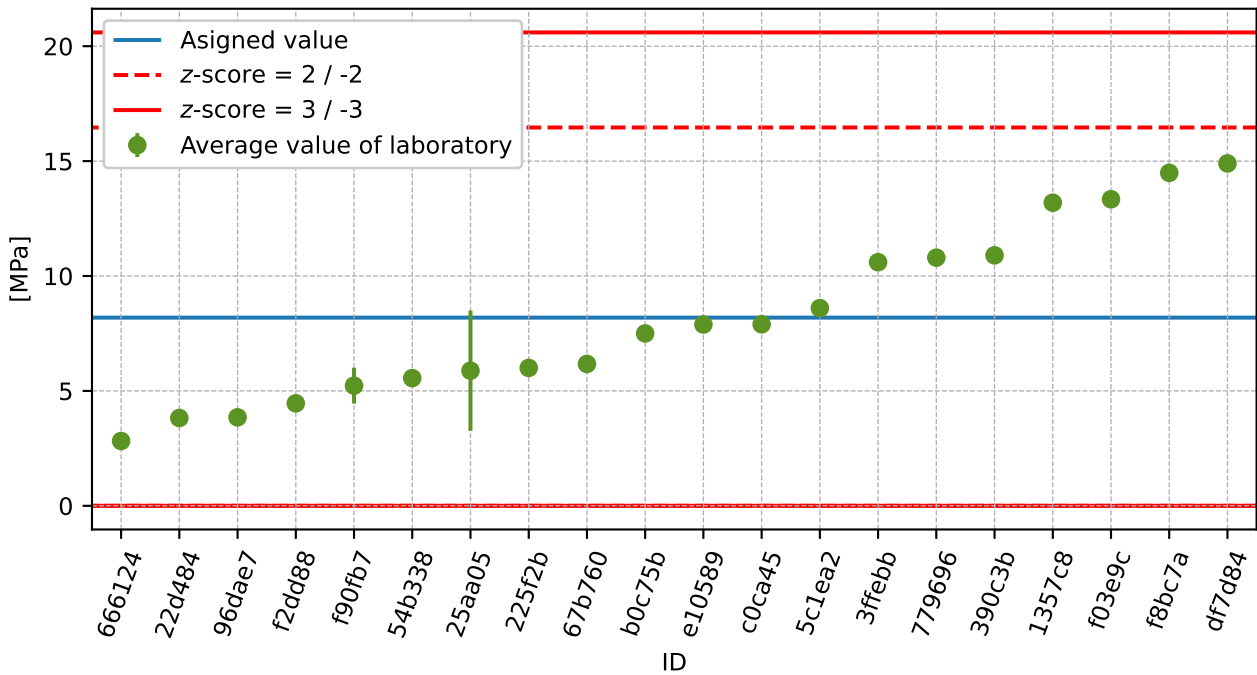
Figure 22: Average values and extended uncertainties of measurement

Figure 23: z-score

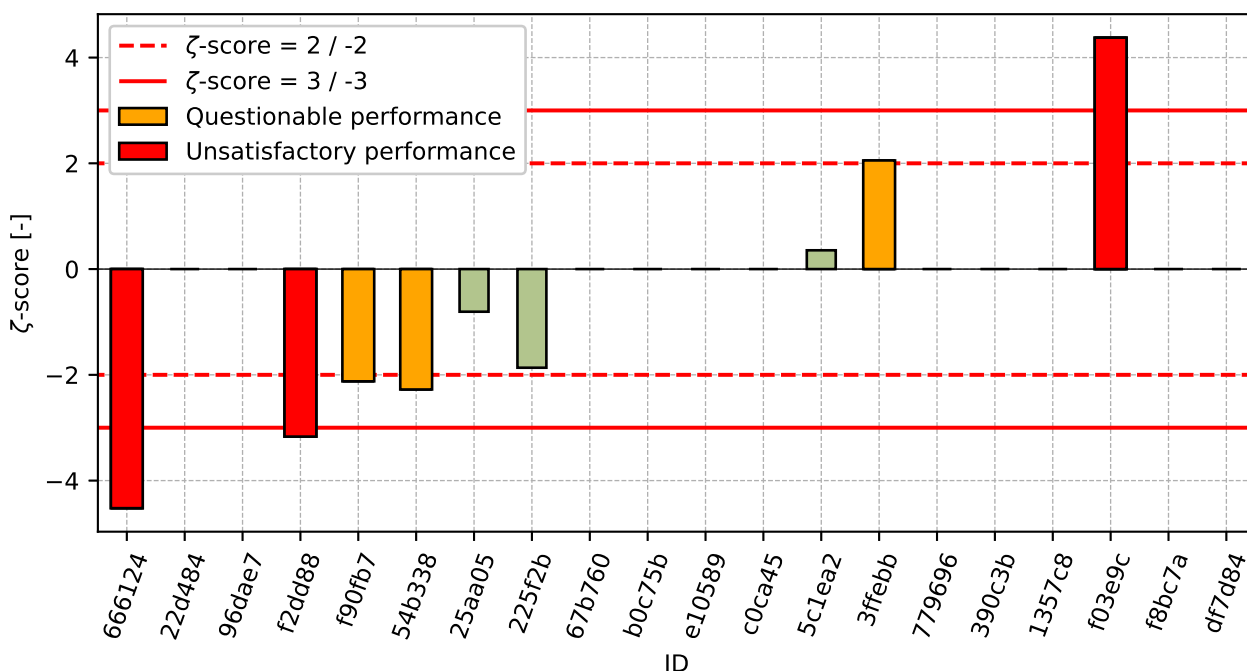Proficiency Testing Provider at the SZK FAST | Z 7008   39/118
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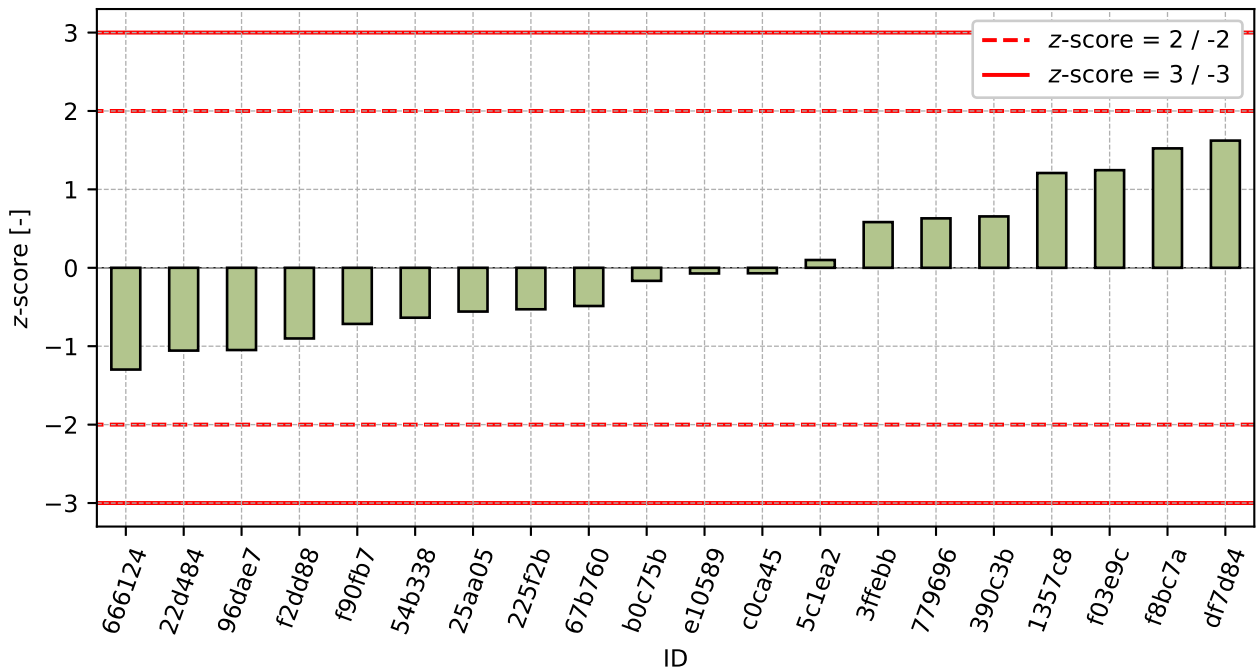
Figure 24: ζ-score

Table 19: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
666124	-1.3	-4.52
22d484	-1.06	-
96dae7	-1.05	-
f2dd88	-0.9	-3.17
f90fb7	-0.72	-2.12
54b338	-0.64	-2.28
25aa05	-0.56	-0.81
225f2b	-0.53	-1.87
67b760	-0.49	-
b0c75b	-0.17	-
e10589	-0.07	-
c0ca45	-0.07	-
5c1ea2	0.1	0.36
3ffebb	0.58	2.05
779696	0.63	-
390c3b	0.66	-
1357c8	1.21	-
f03e9c	1.25	4.38
f8bc7a	1.52	-
df7d84	1.62	-

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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]
666124	3.41	0.33
22d484	4.85	-
f2dd88	6.34	0.32
96dae7	6.67	-
225f2b	7.3	0.2
25aa05	7.34	1.84
54b338	7.41	0.0
f90fb7	8.03	1.2
67b760	8.77	-
b0c75b	9.4	-
e10589	10.0	-
5c1ea2	10.71	0.01
c0ca45	10.8	-
3ffebb	11.1	0.2
f03e9c	11.89	0.2
779696	13.58	-
390c3b	14.1	-
f8bc7a	14.71	-
df7d84	15.0	-
1357c8	16.69	-

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41/118
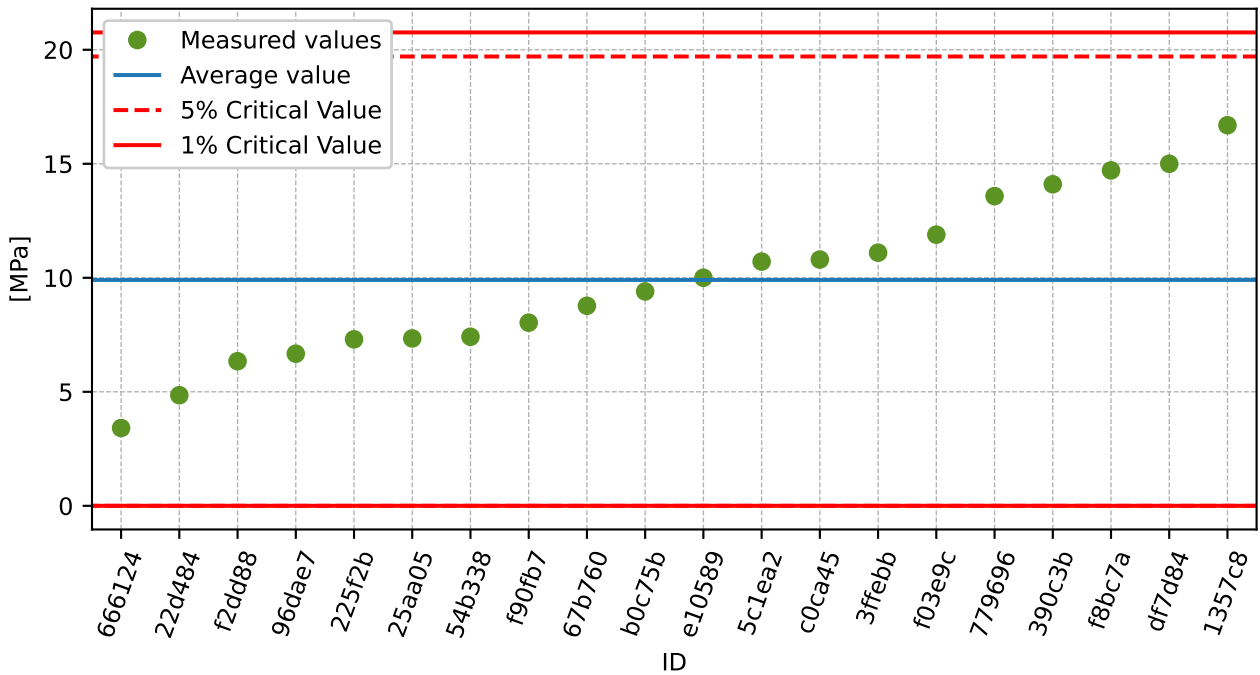
5.2.2 The Numerical Procedure for Determining Outliers

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

5.2.3 Mandel′s Statistics

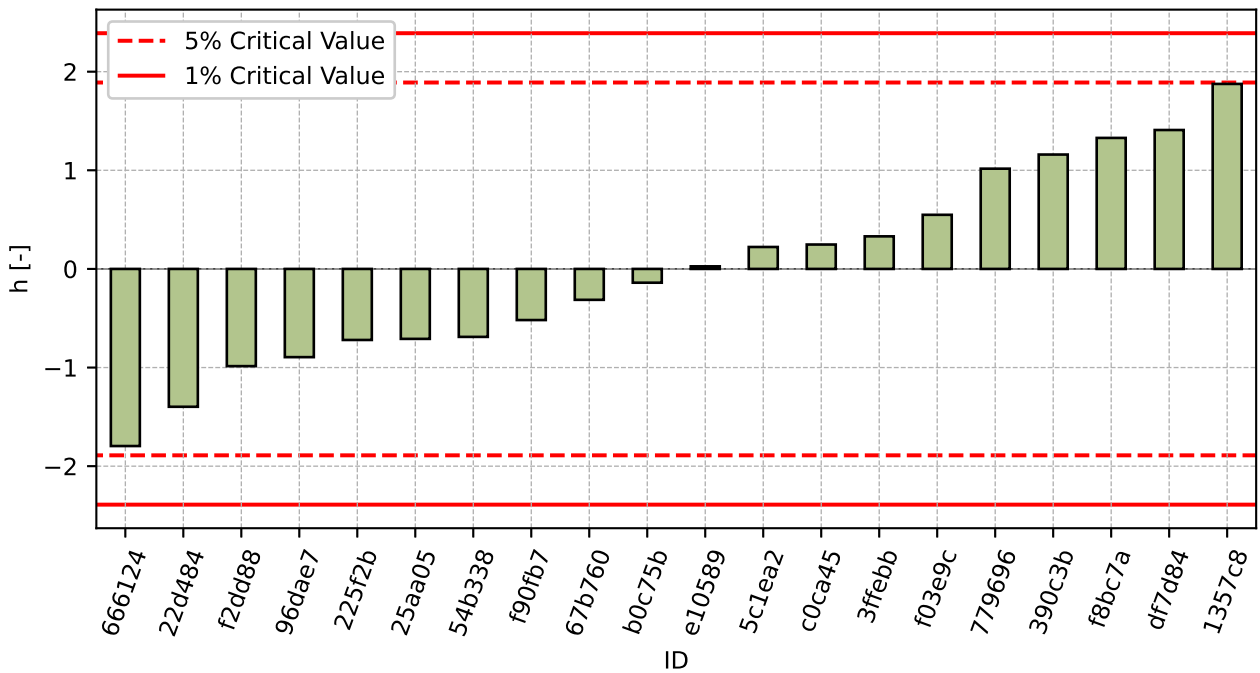Figure 26: Interlaboratory Consistency Statistic

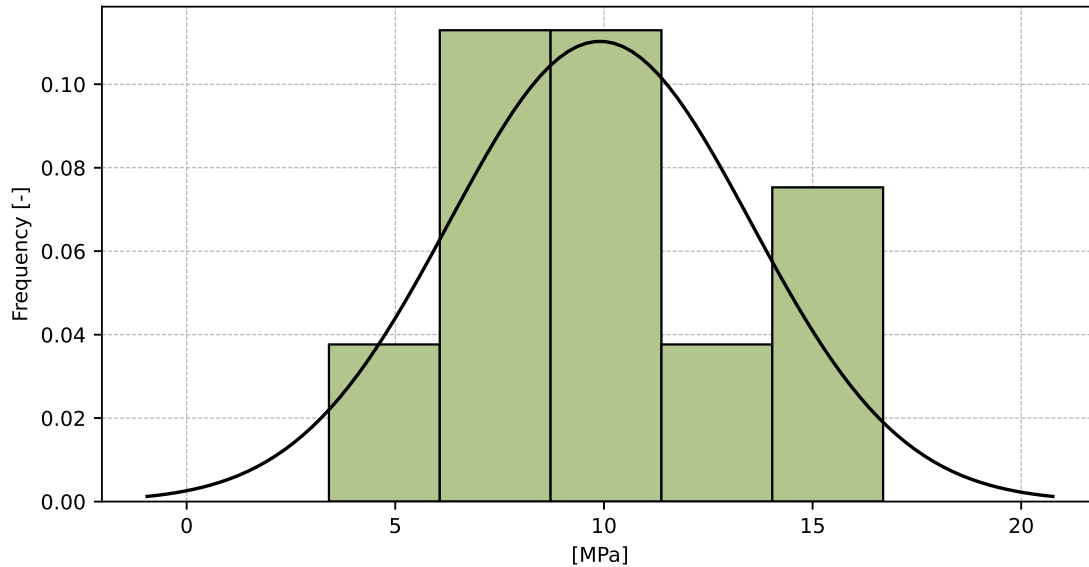Proficiency Testing Provider at the SZK FAST | Z 7008   42/118
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5.2.4   Descriptive statistics

Figure 27: Histogram of all test results

Table 21: Descriptive statistics

Characteristics	[MPa]
Average value – $\bar{x}$	9.91
Sample standard deviation – s	3.617
Asigned value – x^*	9.95
Robust standard deviation – s^*	3.9
Measurement uncertainty of asigned value – u_X	1.09
p-value of normality test	0.857 [-]

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5.2.5   Evaluation of Performance Statistics
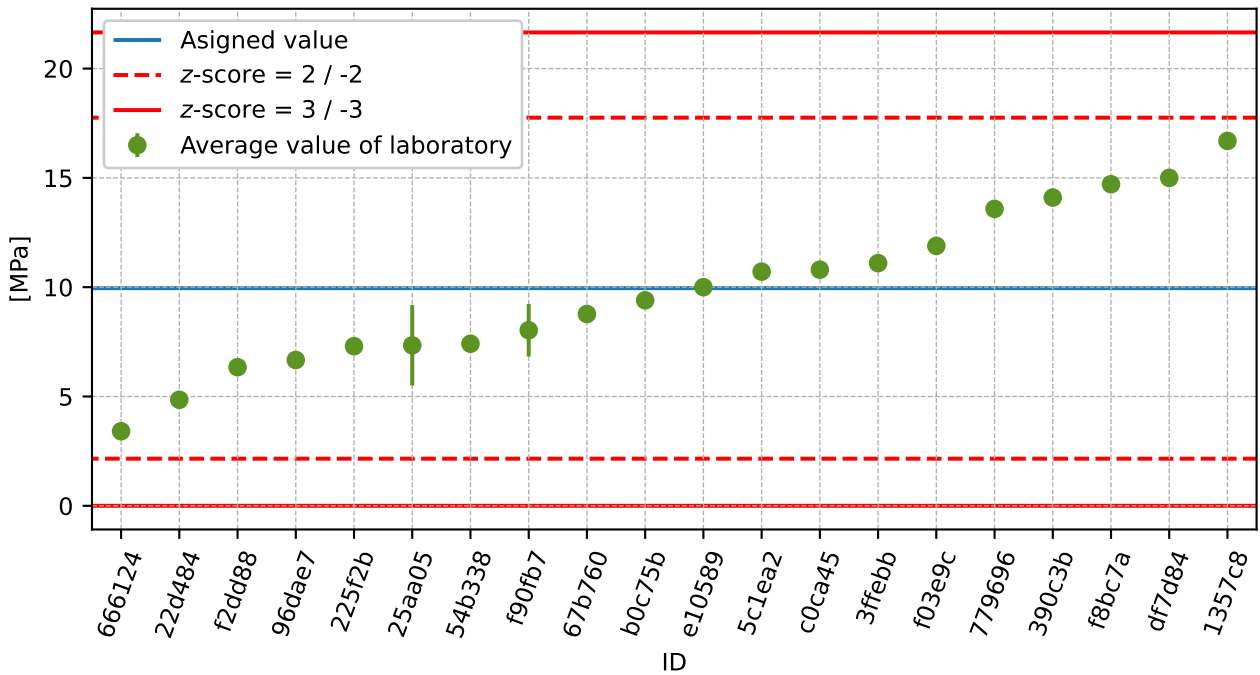
Figure 28: Average values and extended uncertainties of measurement

Figure 29: z-score

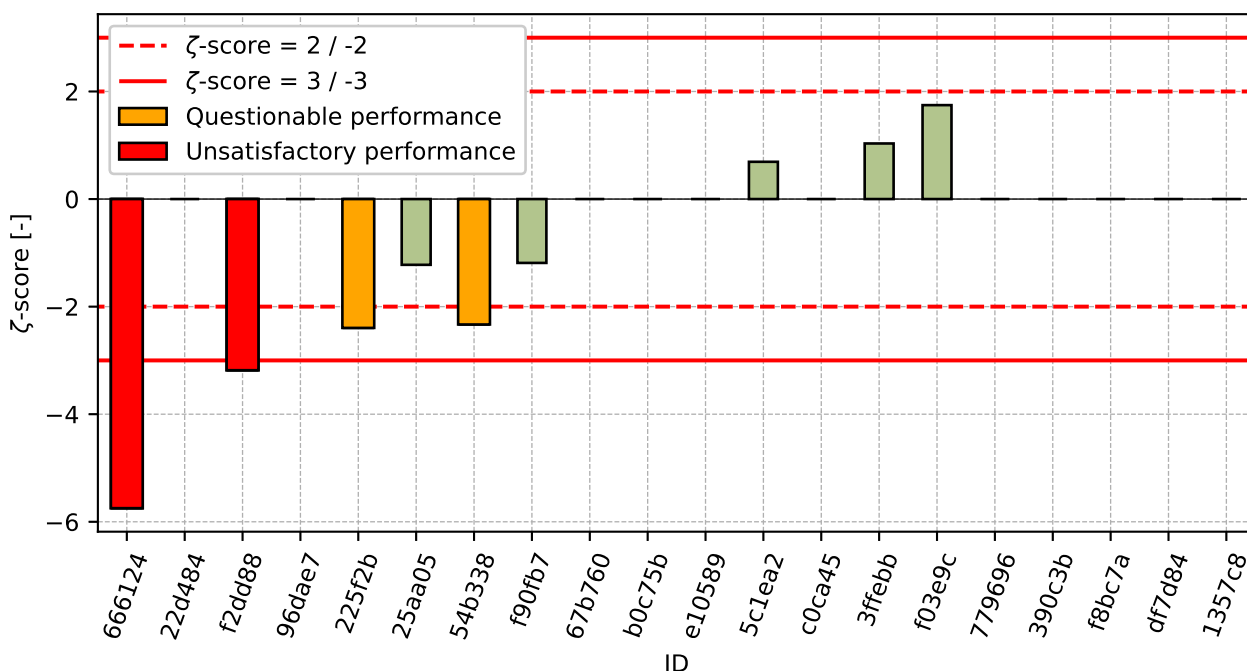Proficiency Testing Provider at the SZK FAST | Z 7008   44/118
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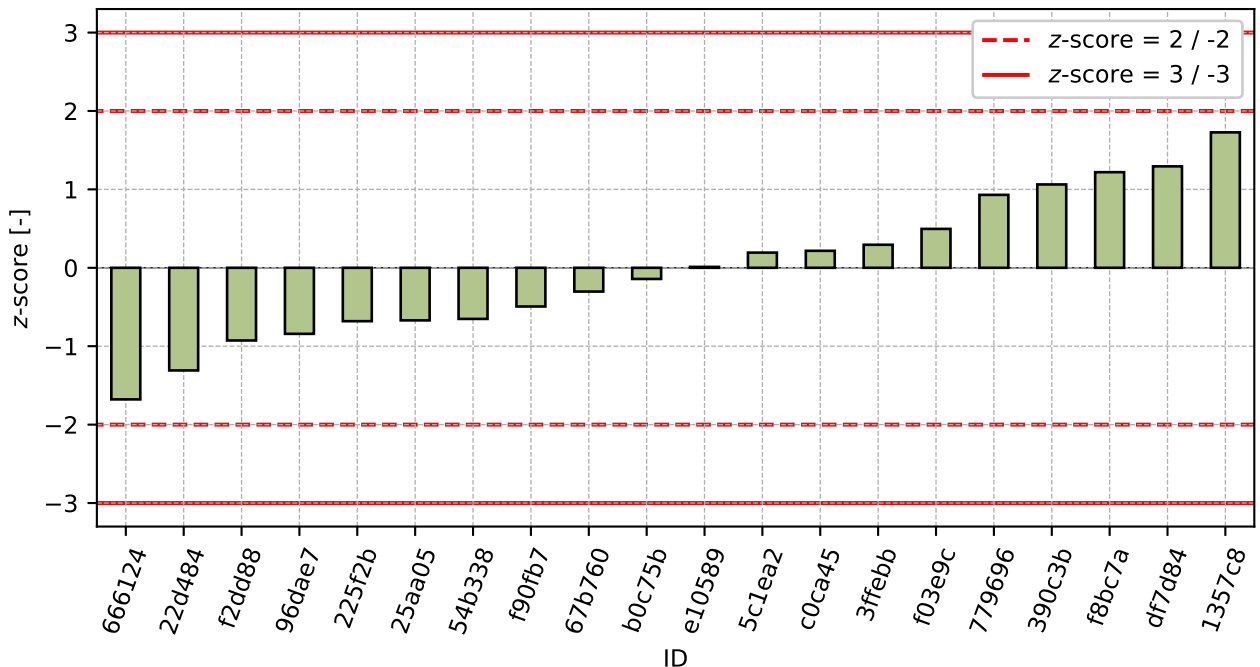
Figure 30: ζ-score

Table 22: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
666124	-1.68	-5.75
22d484	-1.31	-
f2dd88	-0.93	-3.18
96dae7	-0.84	-
225f2b	-0.68	-2.4
25aa05	-0.67	-1.22
54b338	-0.65	-2.33
f90fb7	-0.49	-1.19
67b760	-0.3	-
b0c75b	-0.14	-
e10589	0.01	-
5c1ea2	0.19	0.69
c0ca45	0.22	-
3ffebb	0.29	1.03
f03e9c	0.5	1.75
779696	0.93	-
390c3b	1.06	-
f8bc7a	1.22	-
df7d84	1.29	-
1357c8	1.73	-

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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]
666124	4.39	0.42
22d484	7.55	-
96dae7	7.69	-
54b338	9.09	0.0
f2dd88	10.17	0.51
225f2b	10.2	0.2
f03e9c	11.37	0.19
25aa05	11.58	1.33
f90fb7	13.26	1.33
67b760	13.7	-
c0ca45	14.0	-
3ffebb	15.3	0.2
b0c75b	15.7	-
e10589	16.6	-
5c1ea2	16.8	0.01
f8bc7a	19.61	-
390c3b	20.7	-
1357c8	20.76	-
779696	22.18	-
df7d84	23.2	-

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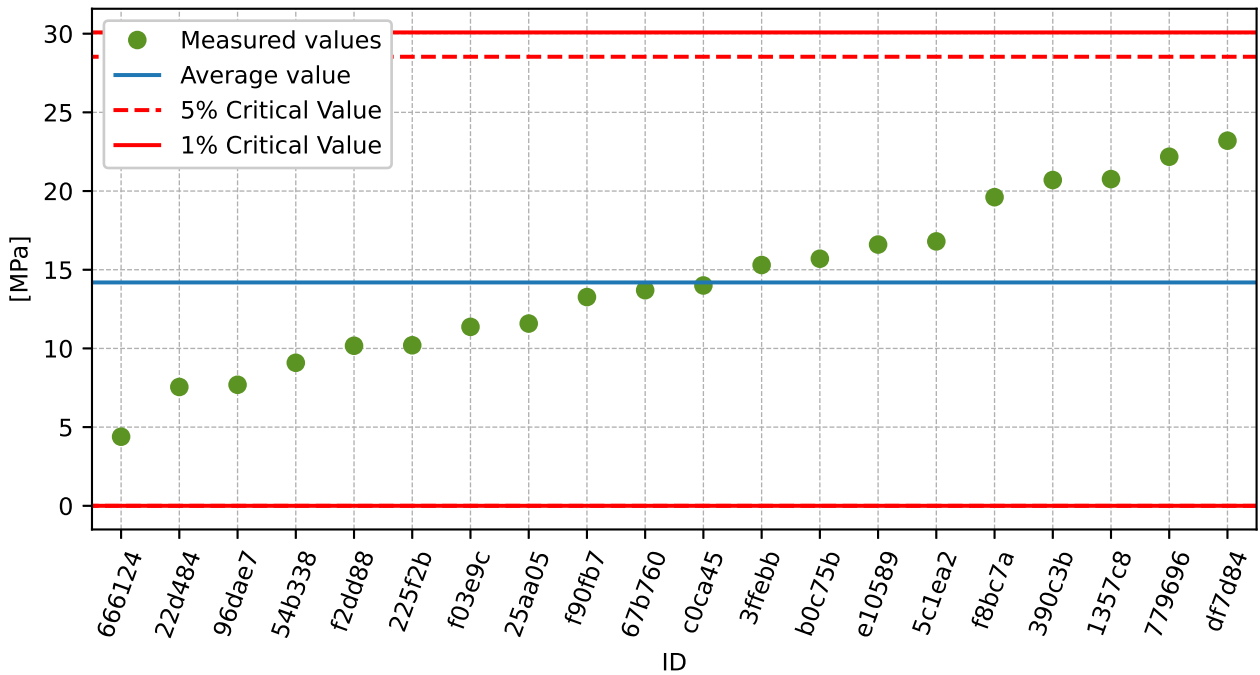## 5.3.2   The Numerical Procedure for Determining Outliers

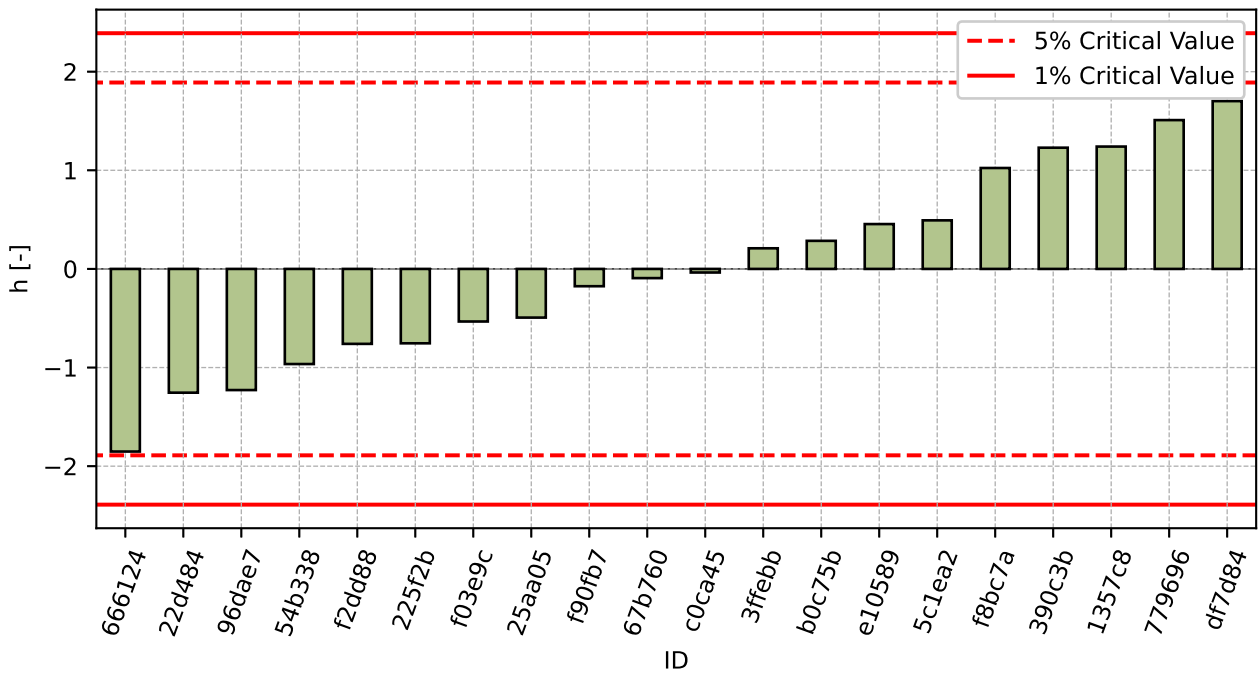Figure 31: **Grubbs' test** - average values

5.3.3   Mandel's Statistics

Figure 32: Interlaboratory Consistency Statistic

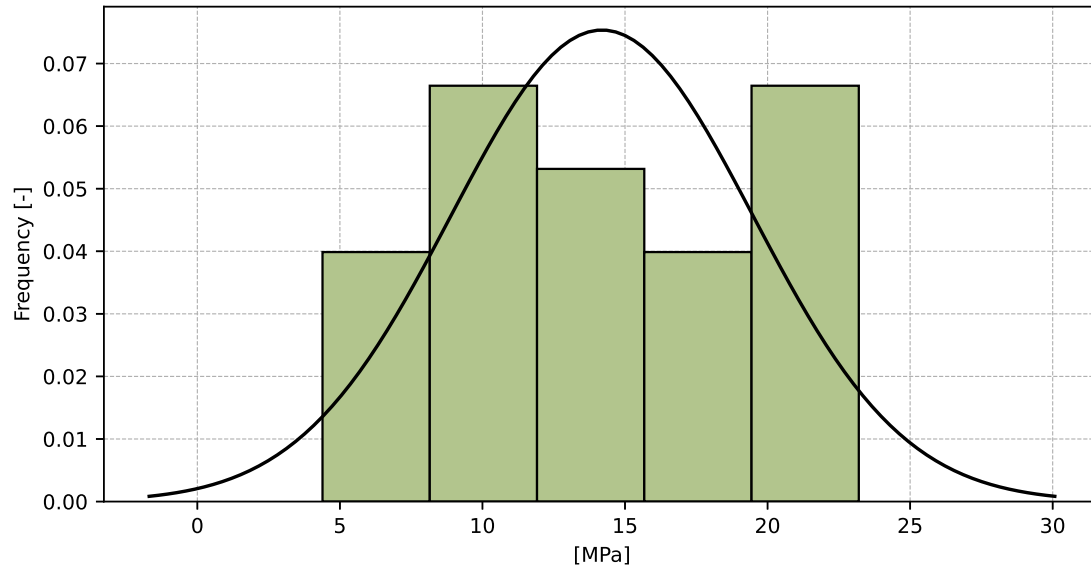Proficiency Testing Provider at the SZK FAST | Z 7008   47/118
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5.3.4   Descriptive statistics

Figure 33: Histogram of all test results

Table 24: Descriptive statistics

Characteristics	[MPa]
Average value – $\bar{x}$	14.19
Sample standard deviation – s	5.294
Asigned value – x^*	14.25
Robust standard deviation – s^*	5.702
Measurement uncertainty of asigned value – u_X	1.594
p-value of normality test	0.814 [-]

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5.3.5   Evaluation of Performance Statistics
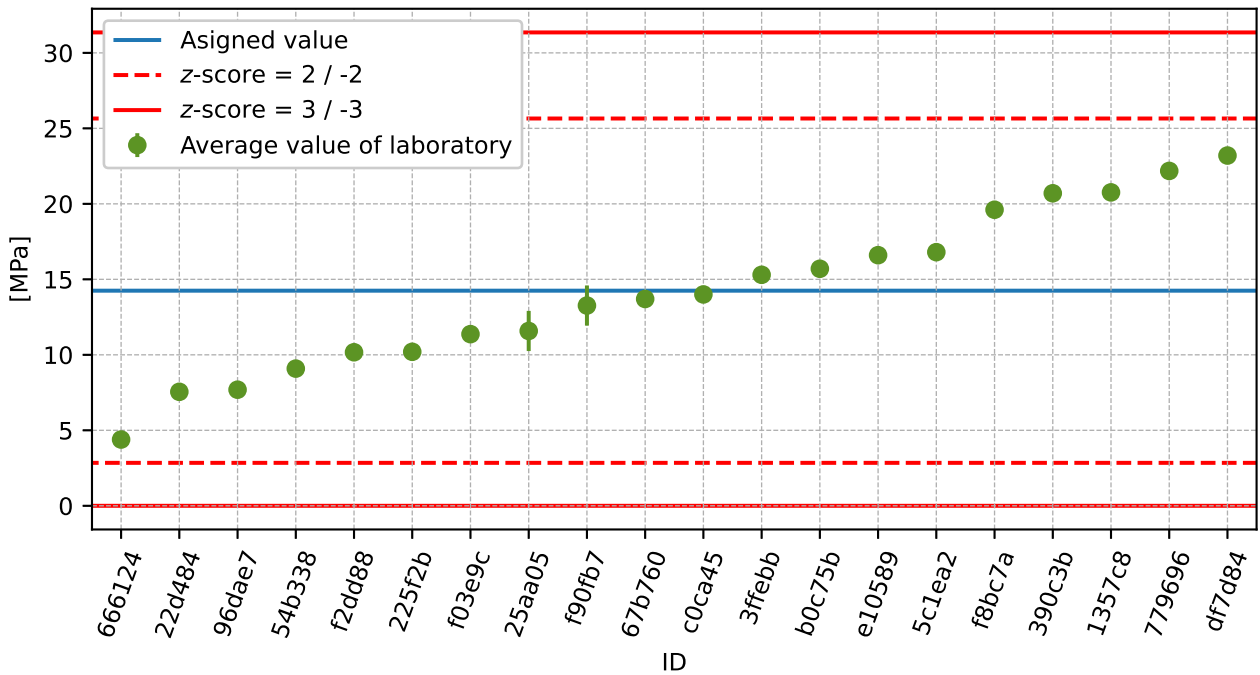
Figure 34: Average values and extended uncertainties of measurement

Figure 35: z-score

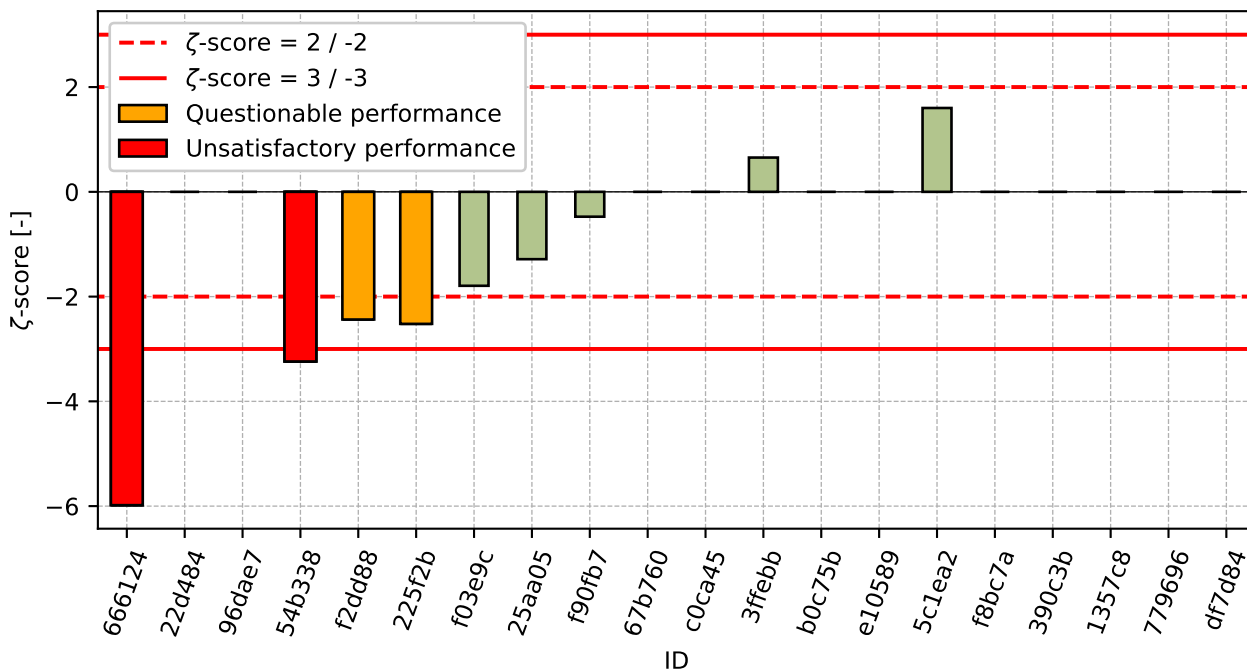Proficiency Testing Provider at the SZK FAST | Z 7008   49/118
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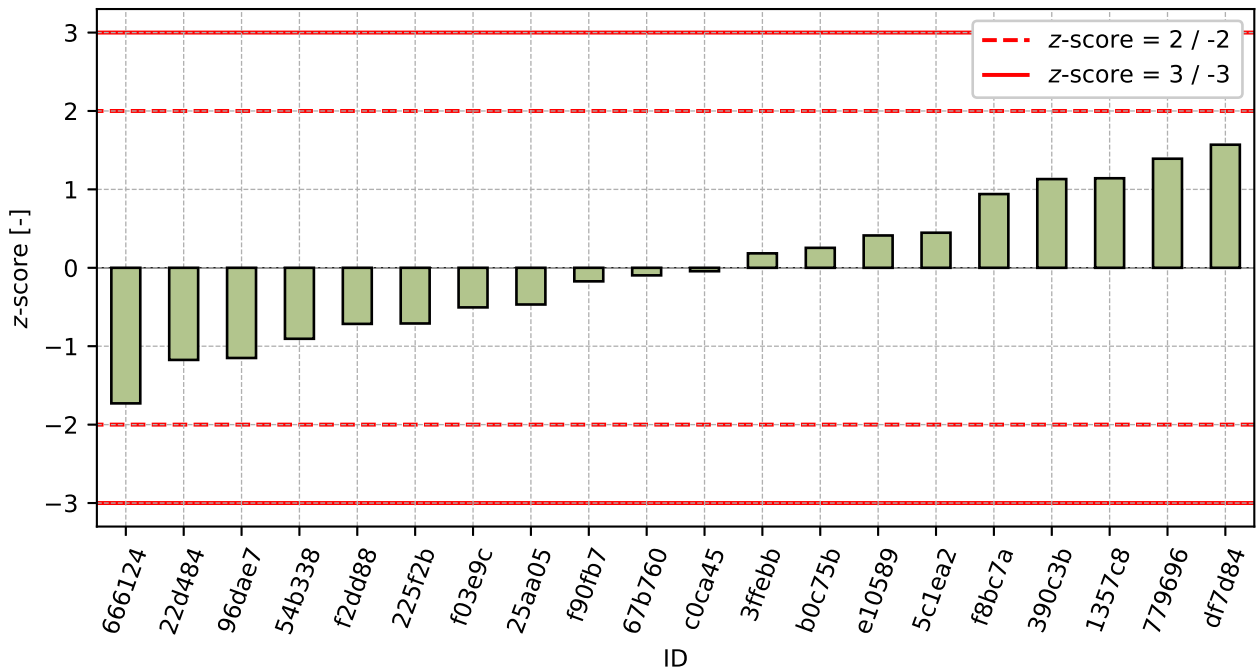
Figure 36: ζ-score

Table 25: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
666124	-1.73	-5.98
22d484	-1.17	-
96dae7	-1.15	-
54b338	-0.91	-3.24
f2dd88	-0.72	-2.44
225f2b	-0.71	-2.52
f03e9c	-0.5	-1.79
25aa05	-0.47	-1.29
f90fb7	-0.17	-0.47
67b760	-0.1	-
c0ca45	-0.04	-
3ffebb	0.18	0.65
b0c75b	0.25	-
e10589	0.41	-
5c1ea2	0.45	1.6
f8bc7a	0.94	-
390c3b	1.13	-
1357c8	1.14	-
779696	1.39	-
df7d84	1.57	-

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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 [%]
1b8e4c	0.14	0.145	0.147	0.149	-	0.145	0.0039	2.66
666124	0.15	0.15	0.15	0.15	0.01	0.15	0.0	0.0
67b760	0.175	0.186	0.18	-	-	0.18	0.0055	3.05
b0c75b	0.22	0.21	0.209	0.213	-	0.213	0.005	2.33
779696	0.218	0.2	0.2	0.247	-	0.216	0.0222	10.26
e10589	0.274	0.206	0.226	0.224	0.015	0.232	0.0291	12.51
225f2b	0.231	0.258	0.223	0.232	0.04	0.236	0.0152	6.44
3ffebb	0.216	0.279	0.253	0.227	0.005	0.244	0.0282	11.55
390c3b	0.26	0.257	0.254	0.265	-	0.259	0.0047	1.81
25aa05	0.25	0.27	0.29	0.28	0.007	0.272	0.0171	6.27
f2dd88	0.31	0.33	0.22	0.25	0.01	0.277	0.0512	18.46
df7d84	0.239	0.297	0.297	-	0.019	0.278	0.0335	12.06
90dd12	0.271	0.293	0.305	-	-	0.29	0.0172	5.95
33459f	0.355	0.289	0.344	0.254	-	0.31	0.0475	15.28
f8bc7a	0.53	0.41	0.34	0.53	-	0.452	0.0939	20.76

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6.1.2   The Numerical Procedure for Determining Outliers
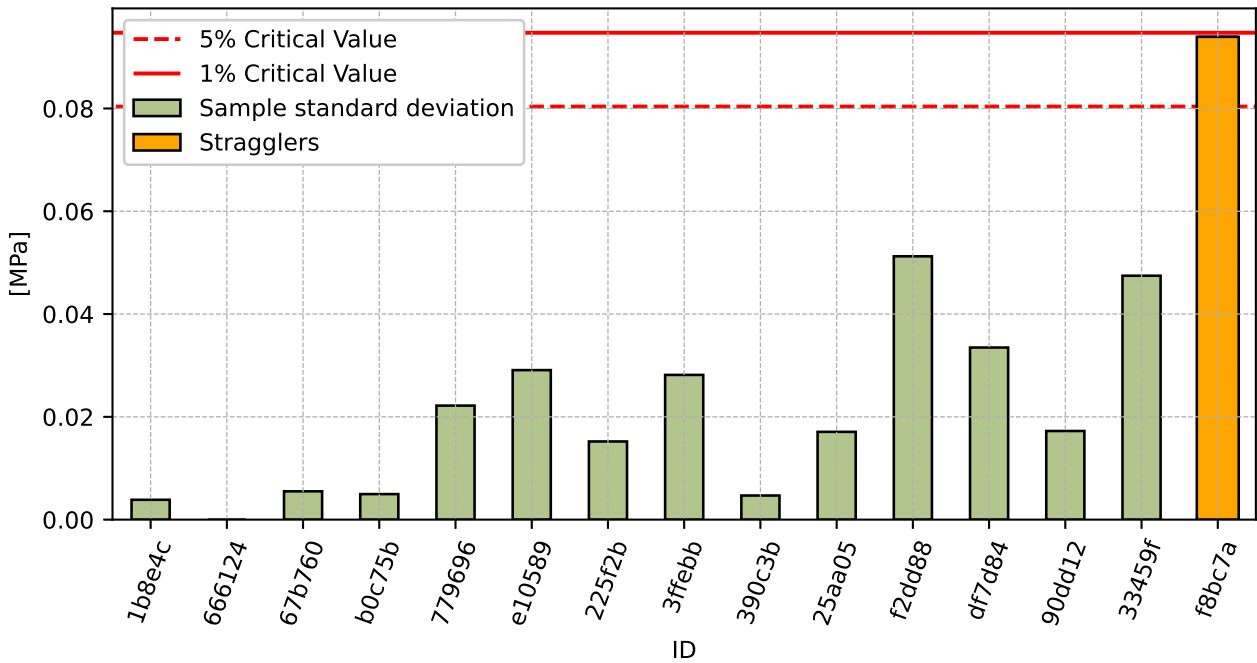
Figure 37: **Cochran's test** - sample standard deviations

Figure 38: **Grubbs' test** - average values
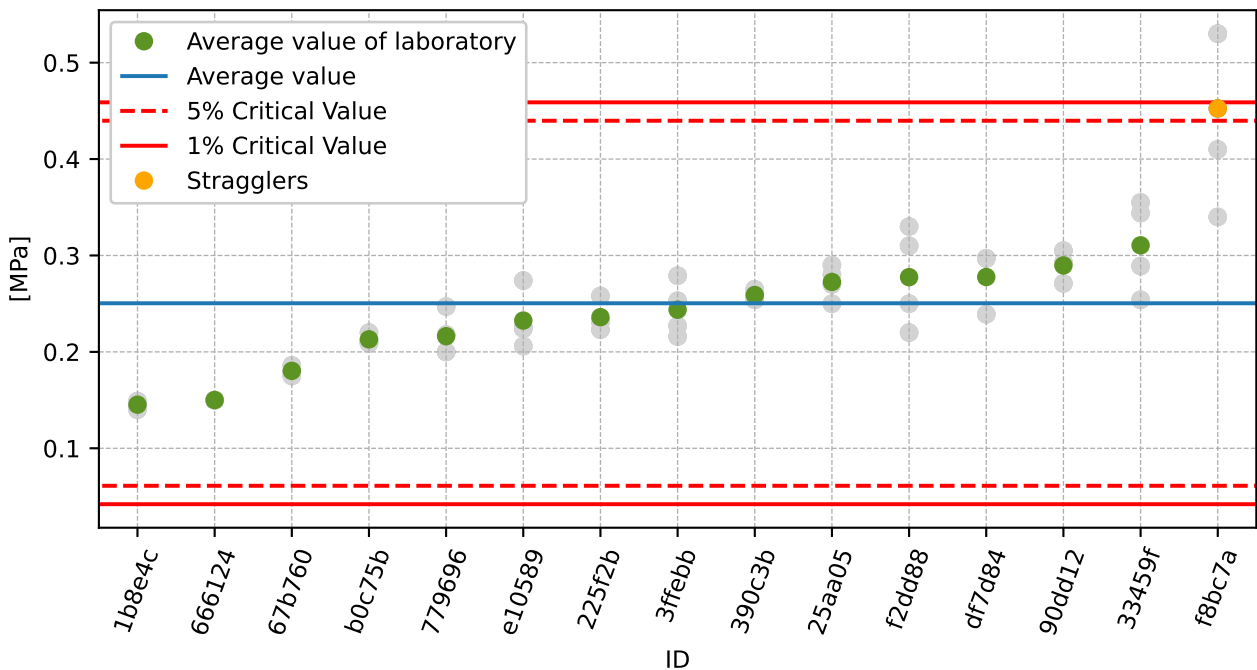
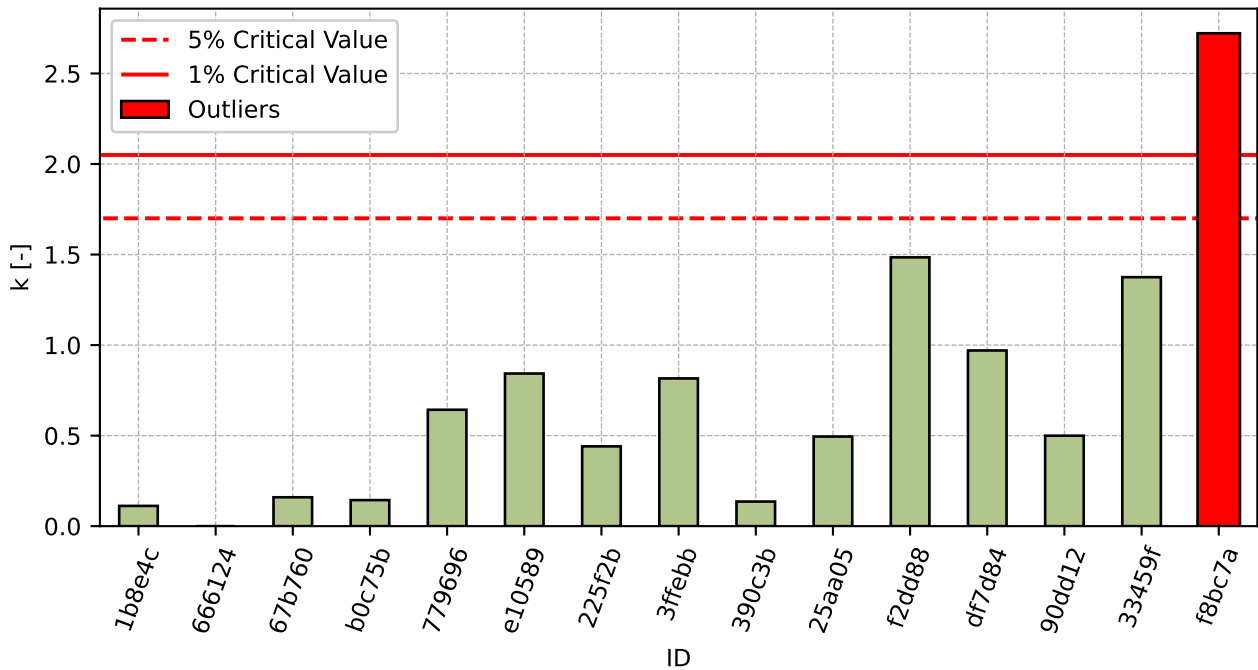Proficiency Testing Provider at the SZK FAST | Z 7008   52/118
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6.1.3   Mandel′s Statistics

Figure 39: Intralaboratory Consistency Statistic
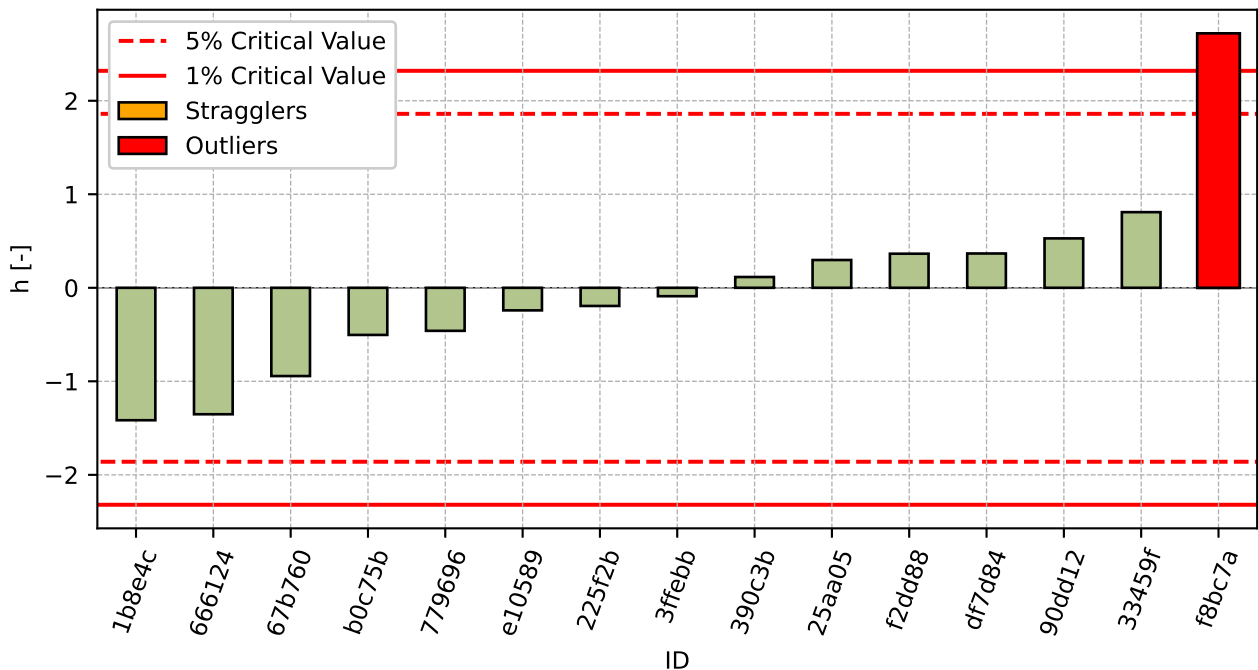
Figure 40: Interlaboratory Consistency Statistic

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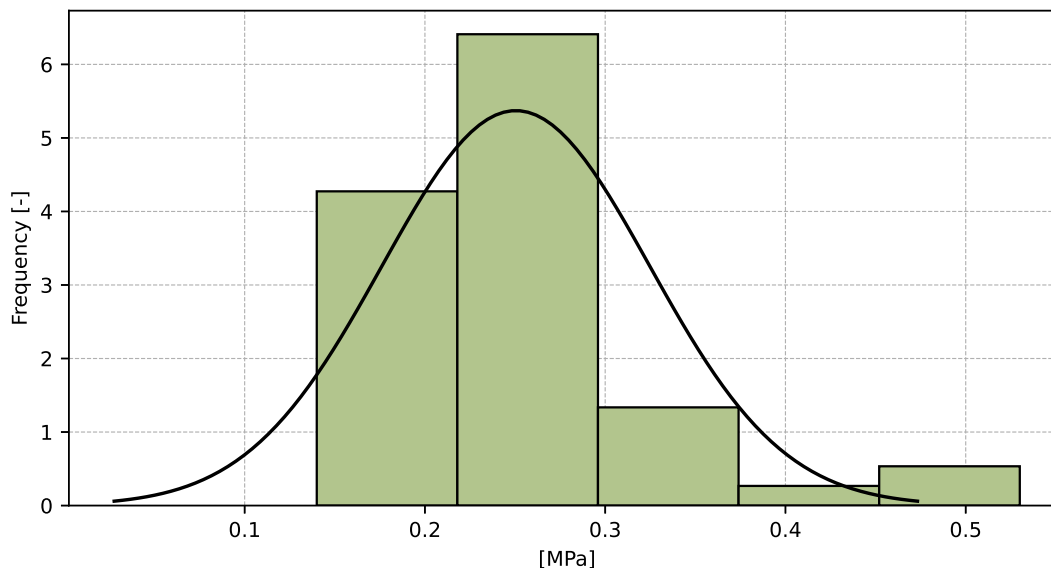Veveří 331/95 | 602 00 Brno | Czech Republic
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6.1.4 Descriptive statistics

Figure 41: Histogram of all test results

Table 27: Descriptive statistics

Characteristics	[MPa]
Average value – $\bar{x}$	0.25
Sample standard deviation – s	0.0743
Asigned value – x^*	0.253
Robust standard deviation – s^*	0.0771
Measurement uncertainty of asigned value – u_X	0.0249
p-value of normality test	0.0 [-]
Interlaboratory standard deviation – s_L	0.0722
Repeatability standard deviation – s_r	0.0345
Reproducibility standard deviation – s_R	0.0801
Repeatability – r	0.097
Reproducibility – R	0.224

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6.1.5 Evaluation of Performance Statistics
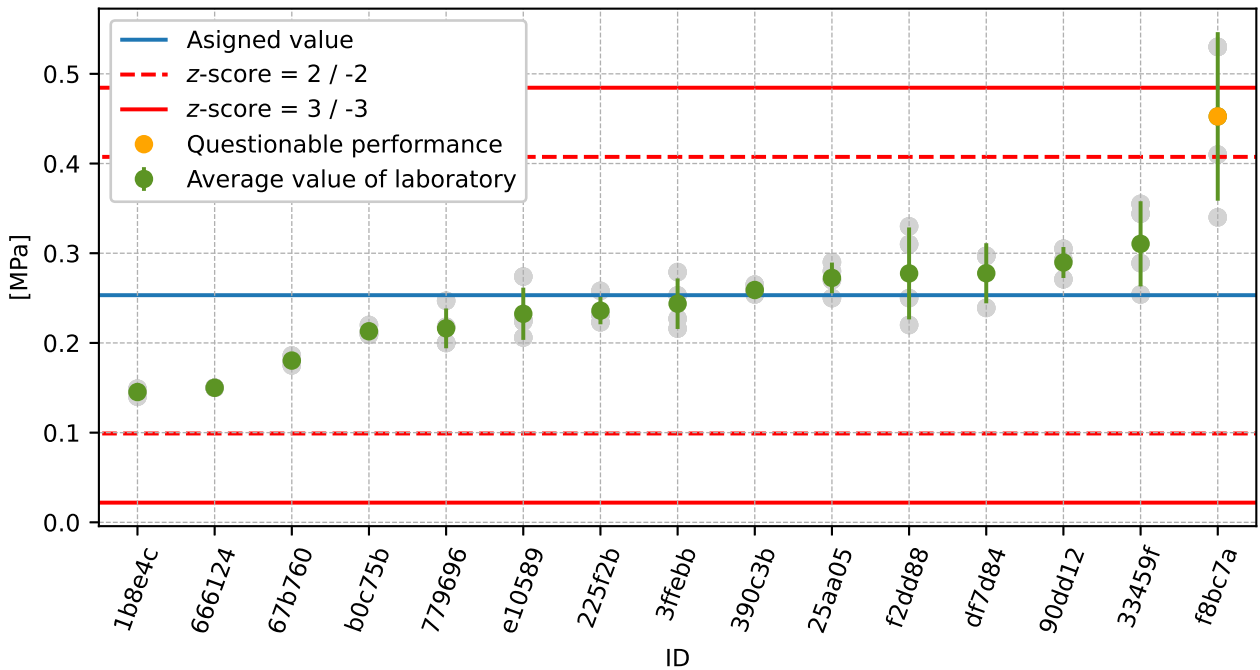

Figure 42: Average values and sample standard deviations
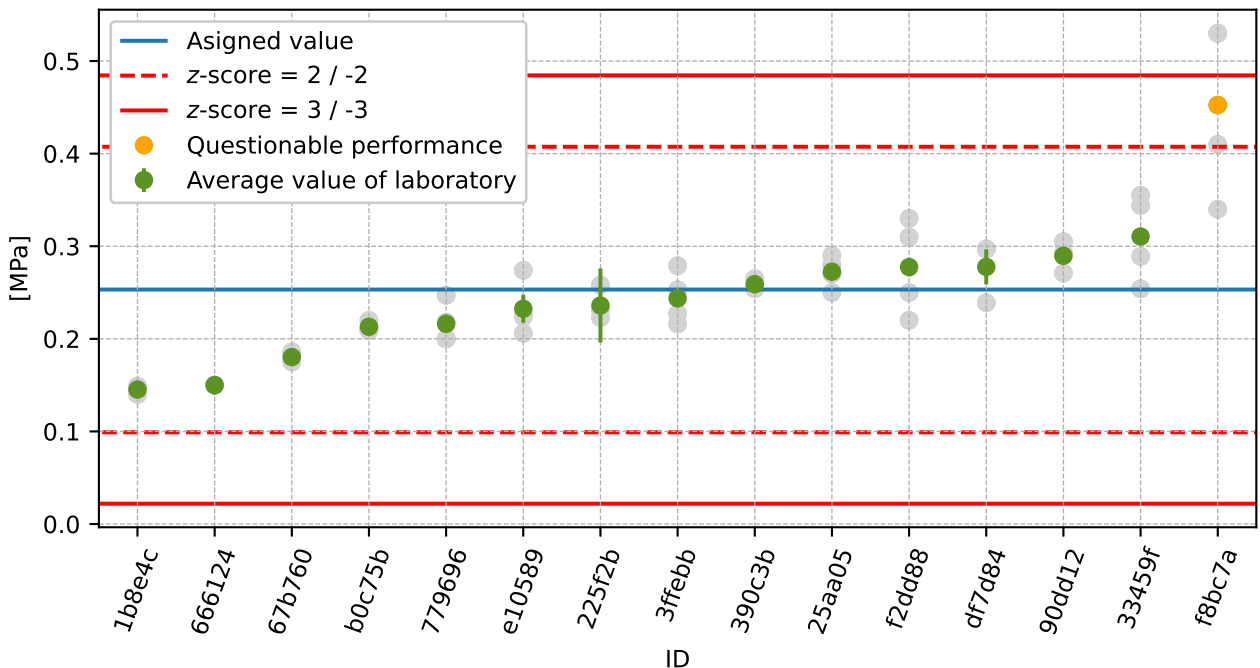
Figure 43: Average values and extended uncertainties of measurement

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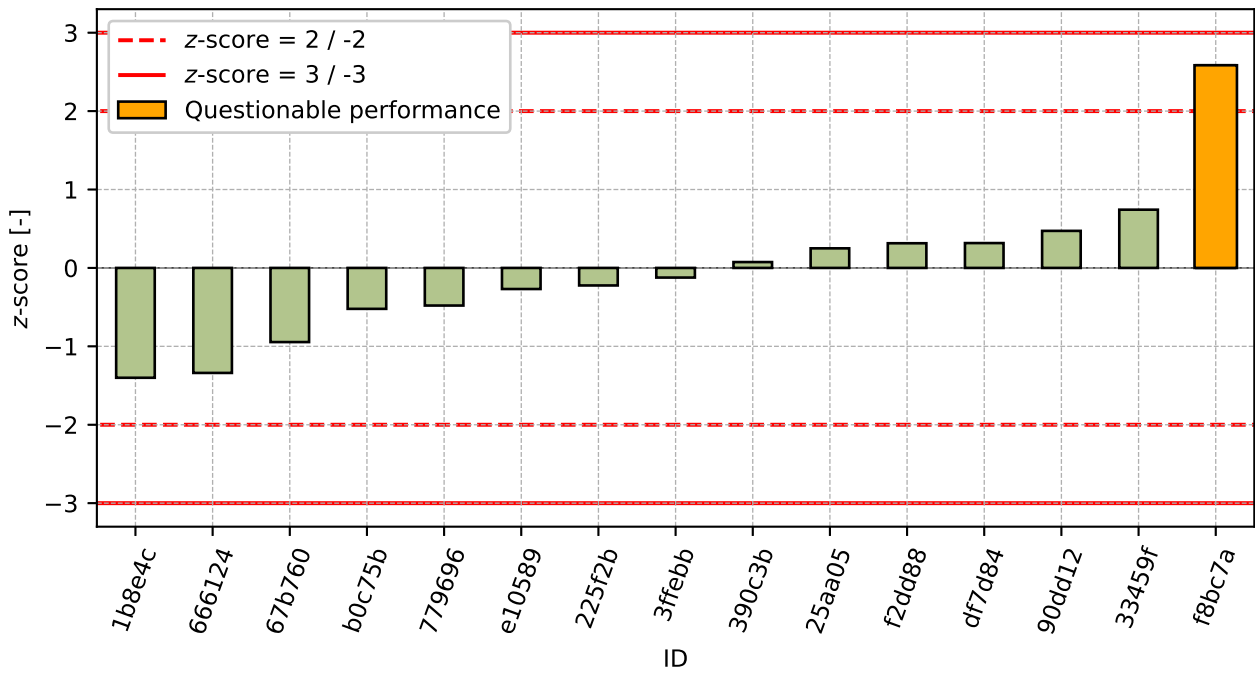
Figure 44: z-score

Figure 45: ζ-score

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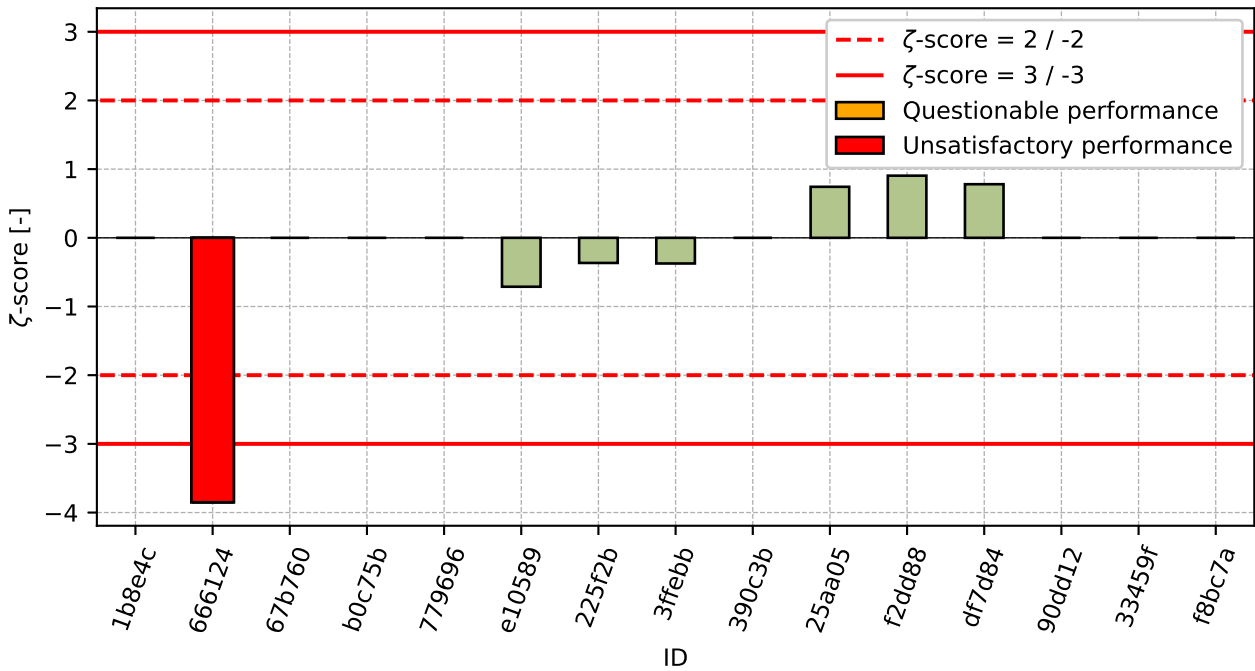
Table 28: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
1b8e4c	-1.4	-
666124	-1.34	-3.85
67b760	-0.95	-
b0c75b	-0.52	-
779696	-0.48	-
e10589	-0.27	-0.71
225f2b	-0.22	-0.37
3ffebb	-0.12	-0.37
390c3b	0.07	-
25aa05	0.25	0.74
f2dd88	0.31	0.9
df7d84	0.32	0.78
90dd12	0.47	-
33459f	0.74	-
f8bc7a	2.58	-

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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 [%]
df7d84	2.5	3.0	2.7	-	-	2.7	0.25	9.21
225f2b	3.4	3.8	3.3	3.4	0.3	3.5	0.22	6.38
779696	4.6	4.0	4.0	4.9	-	4.4	0.45	10.29
390c3b	4.4	4.8	4.5	4.9	-	4.6	0.24	5.12
666124	6.2	4.7	5.0	3.0	0.4	4.7	1.33	27.96
1b8e4c	5.2	5.8	4.0	4.9	1.2	5.0	0.75	15.08
67b760	5.4	5.0	5.2	-	-	5.2	0.2	3.85
f8bc7a	6.0	5.1	6.9	4.2	-	5.5	1.19	21.54
3ffebb	4.8	5.9	7.5	6.8	0.0	6.2	1.17	18.68
e10589	7.2	8.2	5.9	7.0	-	7.1	0.94	13.33
f2dd88	7.2	6.6	7.2	7.5	0.5	7.1	0.38	5.3
33459f	6.6	6.6	7.6	7.8	-	7.1	0.66	9.18
b0c75b	7.2	7.6	8.1	7.3	-	7.6	0.4	5.35
90dd12	9.5	8.6	8.9	-	-	9.0	0.46	5.09
25aa05	9.3	9.0	9.0	9.0	-	9.1	0.15	1.65

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6.2.2 The Numerical Procedure for Determining Outliers
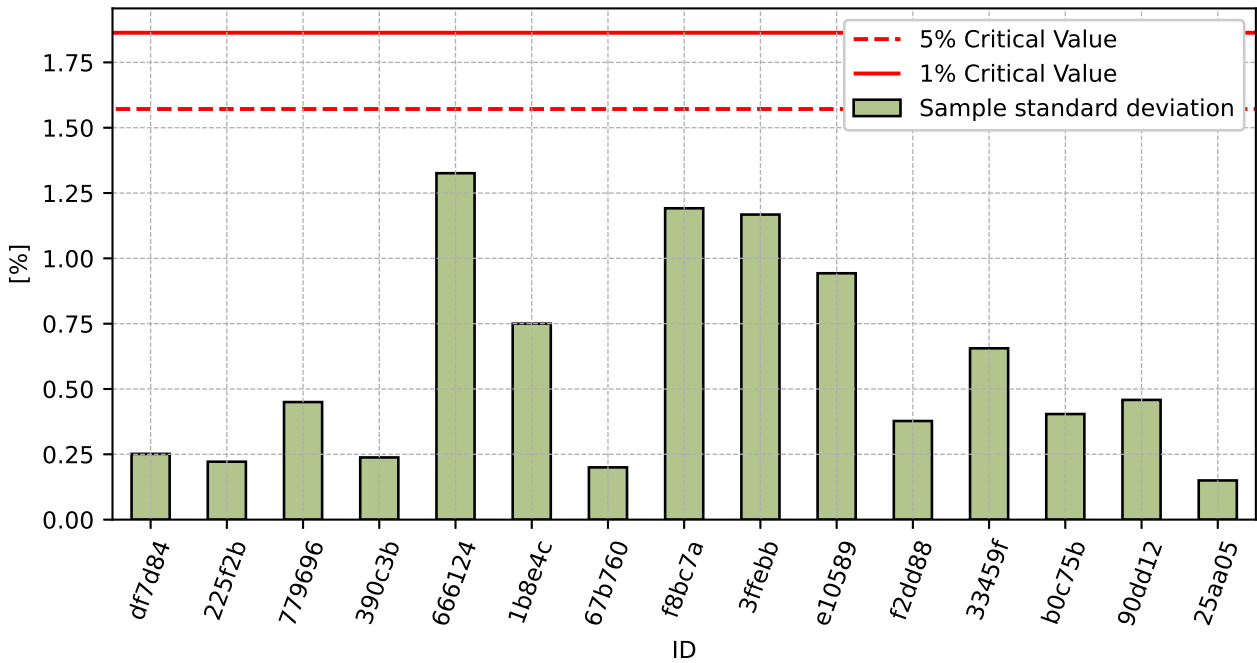
Figure 46: **Cochran's test** - sample standard deviations
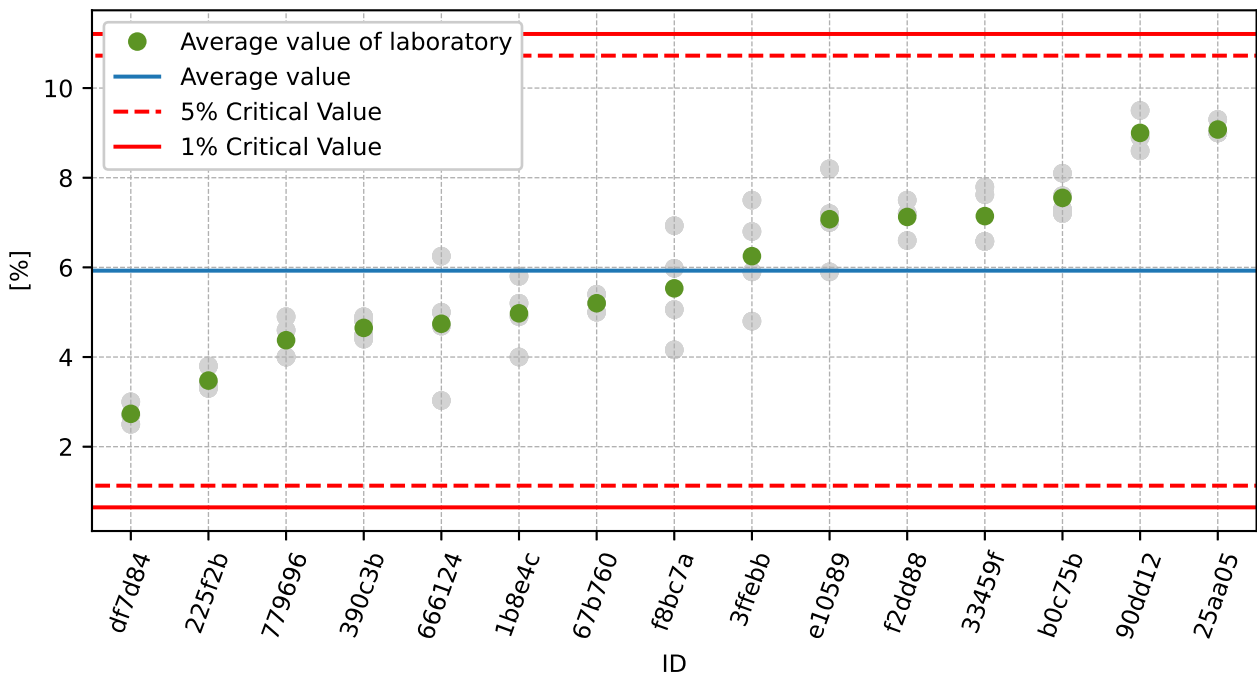
Figure 47: **Grubbs' test** - average values

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6.2.3 Mandel's Statistics
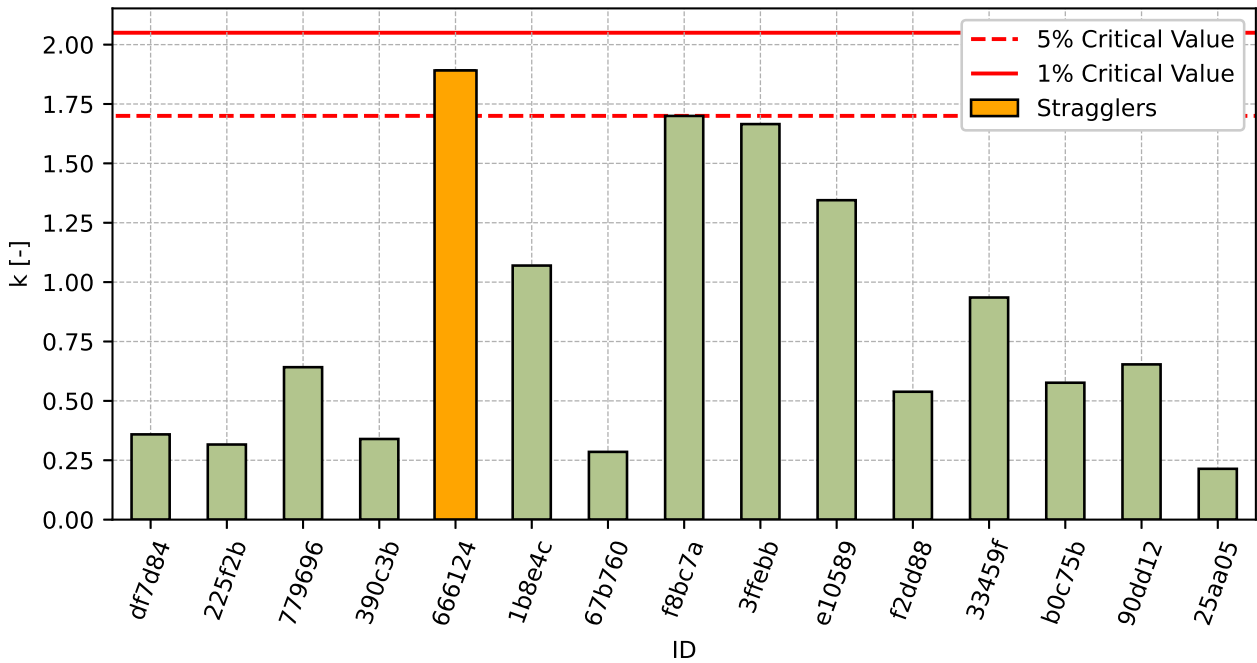
Figure 48: Intralaboratory Consistency Statistic
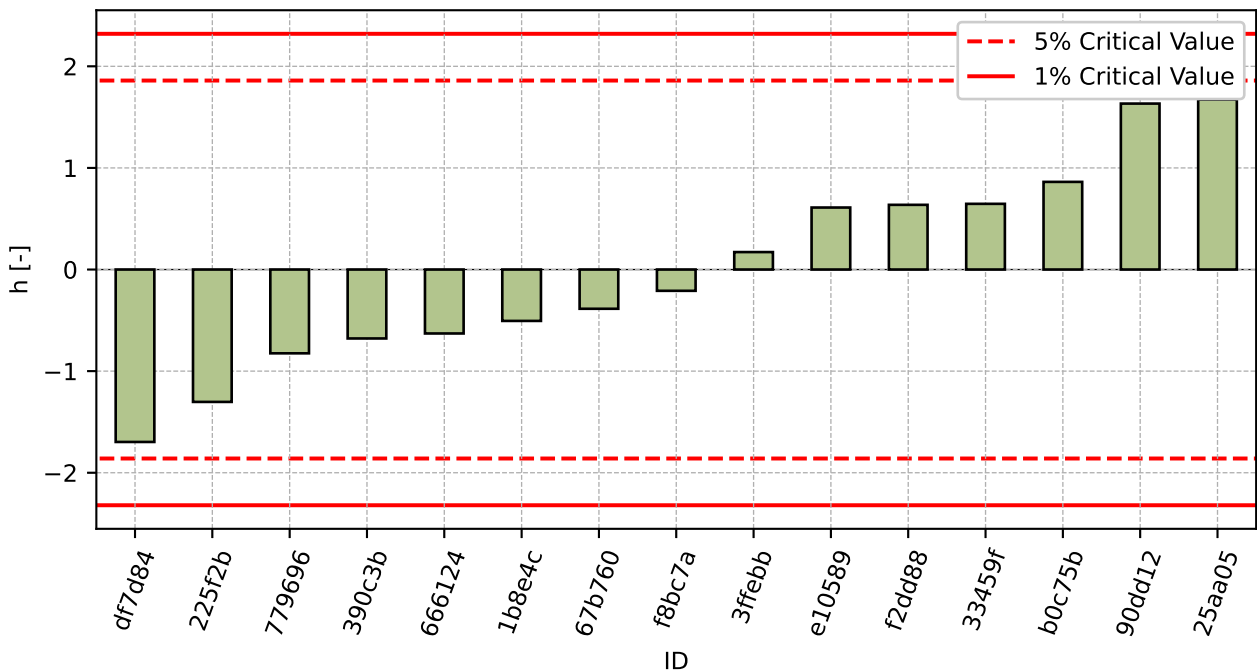
Figure 49: Interlaboratory Consistency Statistic

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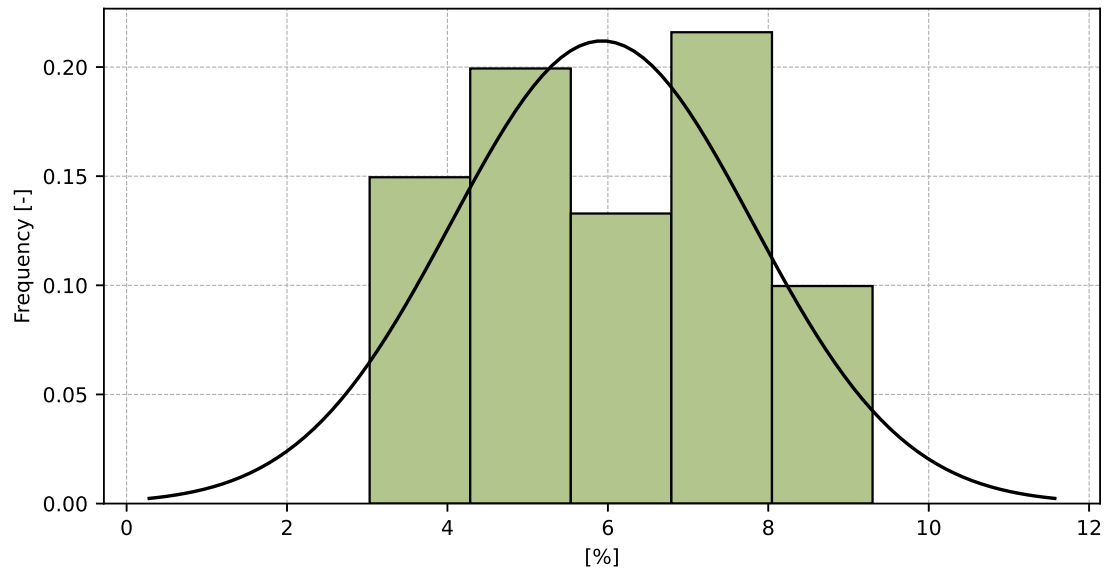Veveří 331/95 | 602 00 Brno | Czech Republic
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6.2.4 Descriptive statistics

Figure 50: Histogram of all test results

Table 30: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	5.9
Sample standard deviation – s	1.88
Asigned value – x^*	5.9
Robust standard deviation – s^*	2.04
Measurement uncertainty of asigned value – u_X	0.66
p-value of normality test	0.096 [-]
Interlaboratory standard deviation – s_L	1.85
Repeatability standard deviation – s_r	0.7
Reproducibility standard deviation – s_R	1.98
Repeatability – r	2.0
Reproducibility – R	5.5

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6.2.5   Evaluation of Performance Statistics
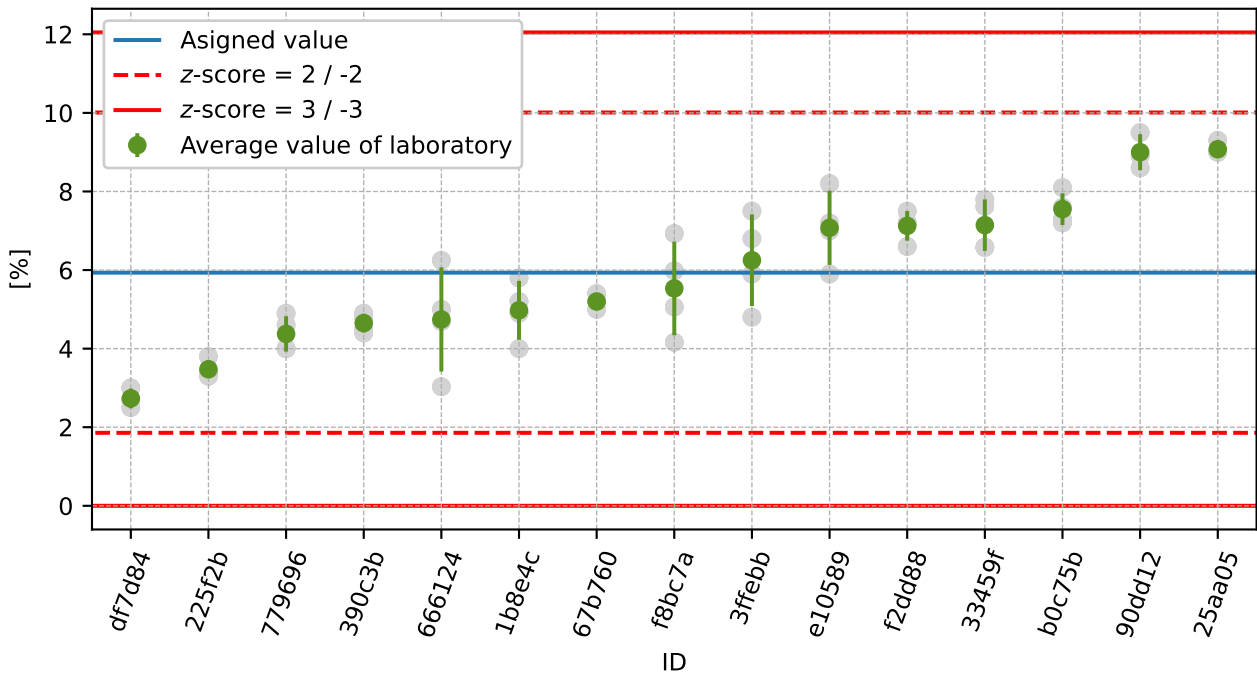
Figure 51: Average values and sample standard deviations
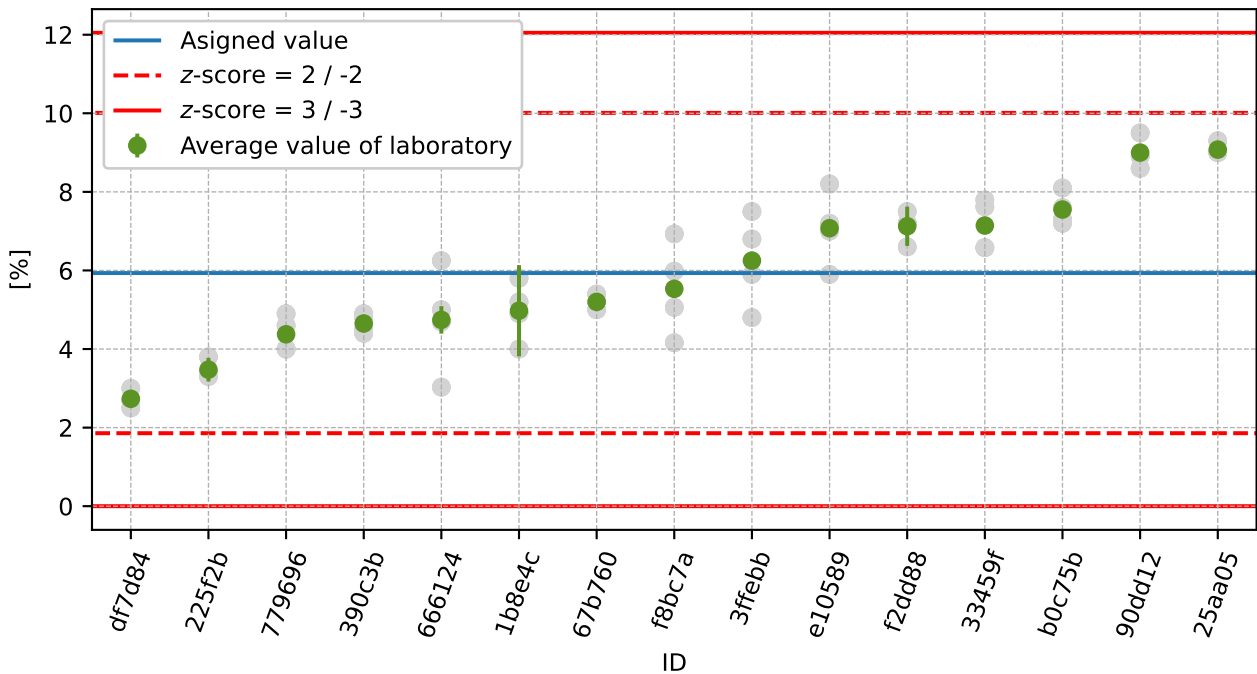
Figure 52: Average values and extended uncertainties of measurement

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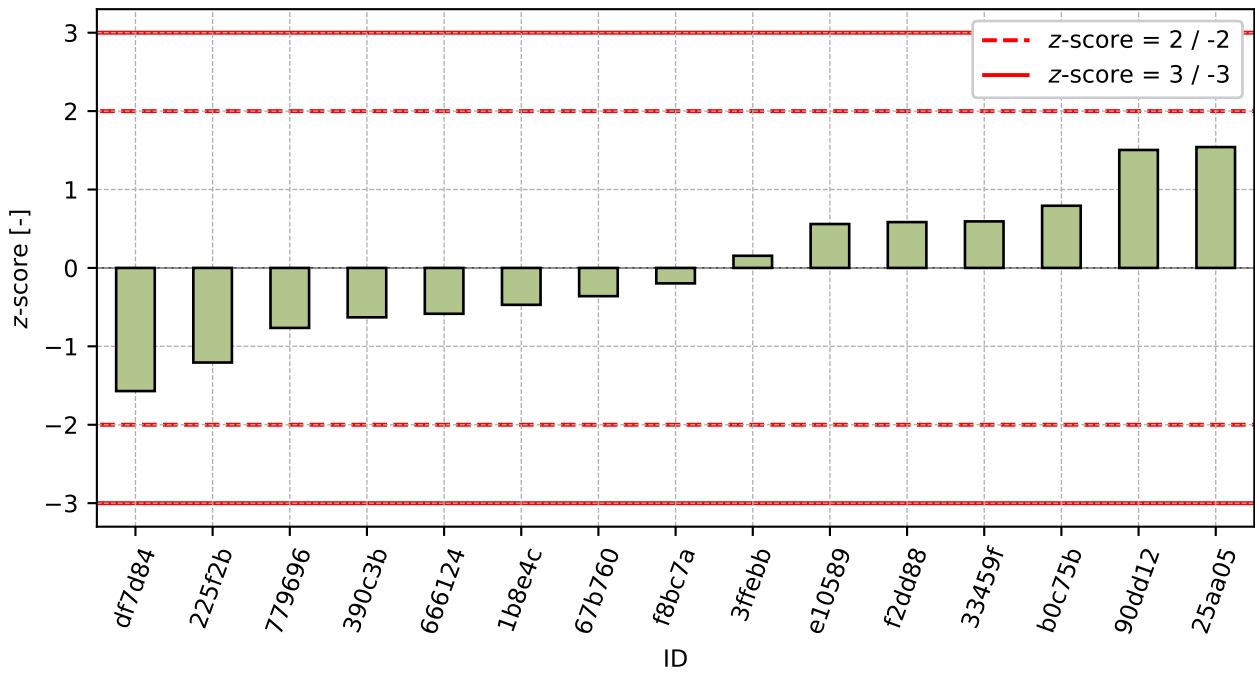
Figure 53: z-score

Figure 54: ζ-score

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Table 31: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
df7d84	-1.57	-
225f2b	-1.21	-3.4
779696	-0.76	-
390c3b	-0.63	-
666124	-0.58	-1.6
1b8e4c	-0.47	-0.72
67b760	-0.36	-
f8bc7a	-0.2	-
3ffebb	0.16	0.48
e10589	0.56	-
f2dd88	0.58	1.44
33459f	0.59	-
b0c75b	0.79	-
90dd12	1.5	-
25aa05	1.54	-

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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]
7d0a95	37.0	0.6
d1ee17	38.0	-
90dd12	39.7	-
225f2b	41.5	0.3
5c1ea2	42.1	0.1
1357c8	42.7	-
bdbff6	43.0	-
22d484	43.3	-
25aa05	43.6	0.8
33459f	45.3	-
f8bc7a	47.0	-
67b760	47.5	-
390c3b	50.1	-
b0c75b	52.0	-
f2dd88	55.0	3.0
5633d2	55.0	-
779696	57.0	-
e10589	69.0	4.0
666124	74.0	5.4

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7.1.2   The Numerical Procedure for Determining Outliers

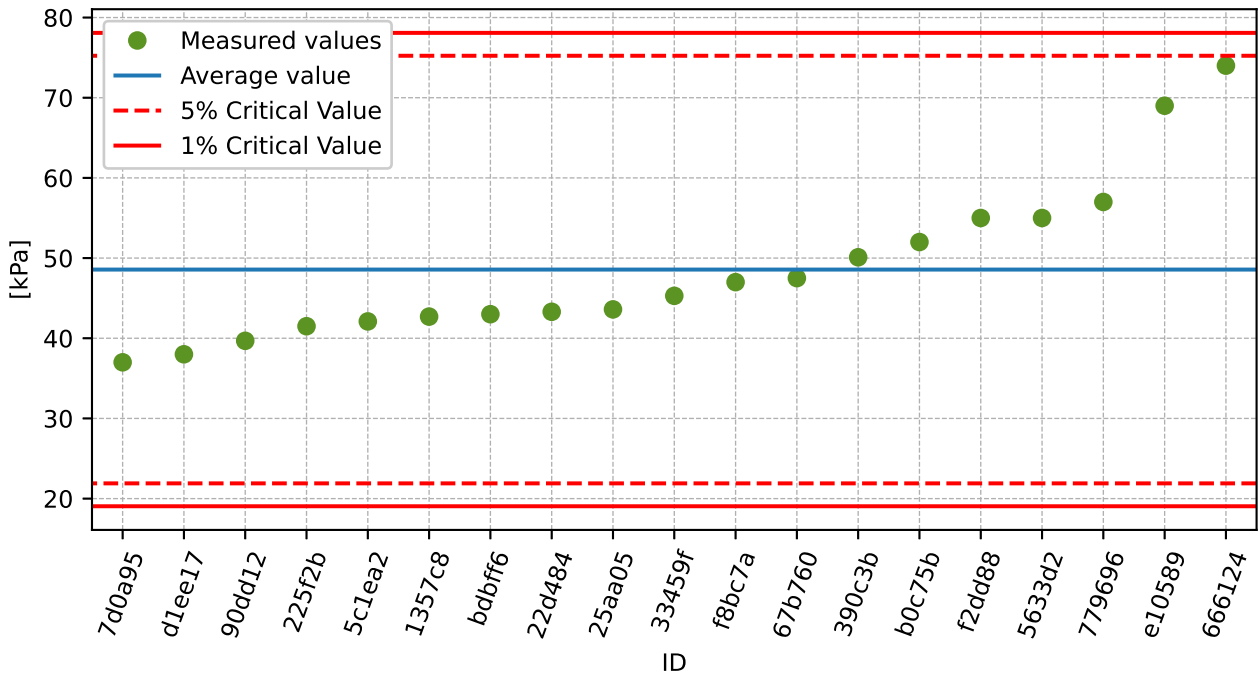Figure 55: **Grubbs' test** - average values

7.1.3   Mandel′s Statistics
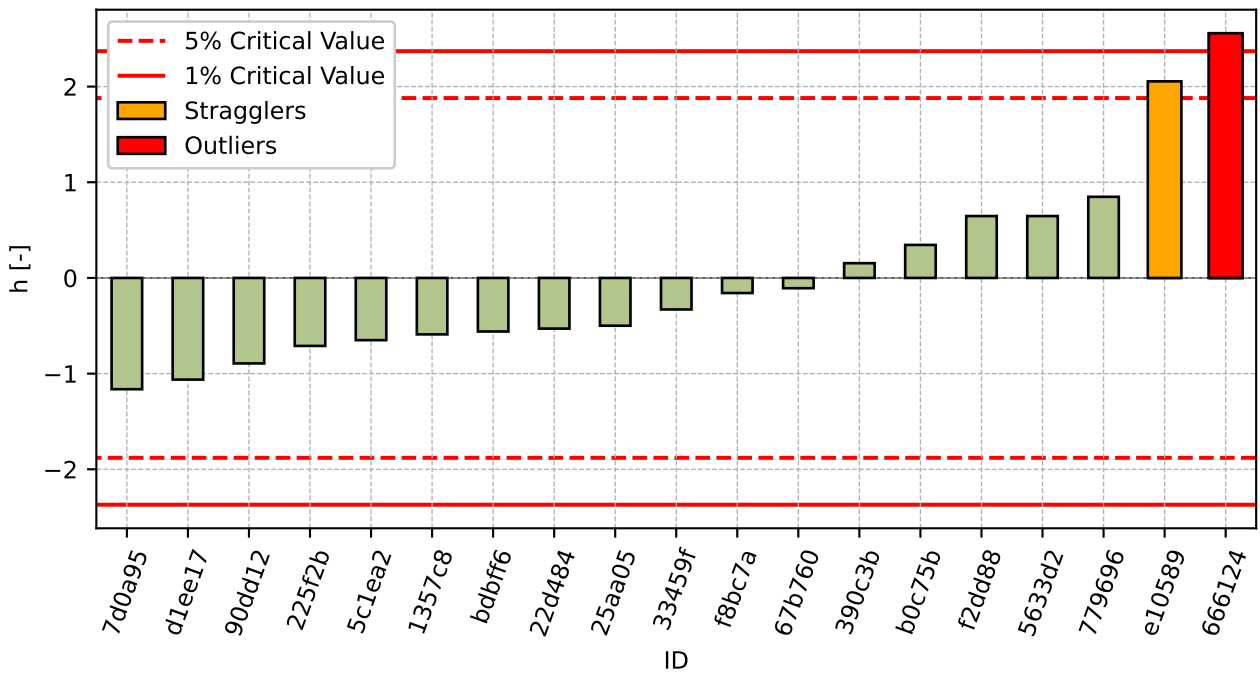
Figure 56: Interlaboratory Consistency Statistic

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7.1.4   Descriptive statistics
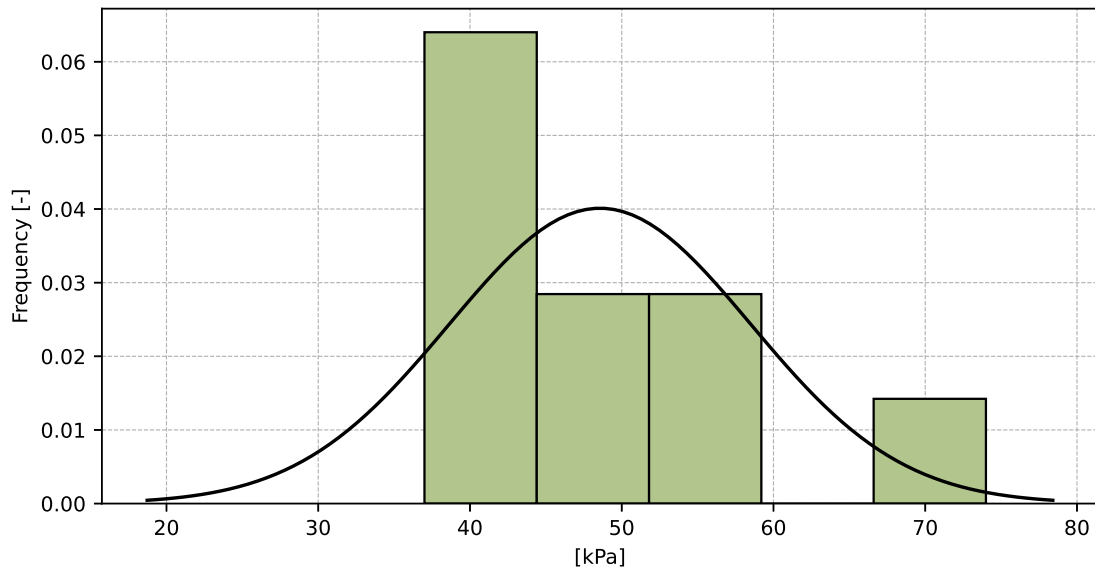
Figure 57: Histogram of all test results

Table 33: Descriptive statistics

Characteristics	[kPa]
Average value – $\bar{x}$	48.6
Sample standard deviation – s	9.95
Asigned value – x^*	47.8
Robust standard deviation – s^*	9.71
Measurement uncertainty of asigned value – u_X	2.78
p-value of normality test	0.014 [-]

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7.1.5   Evaluation of Performance Statistics
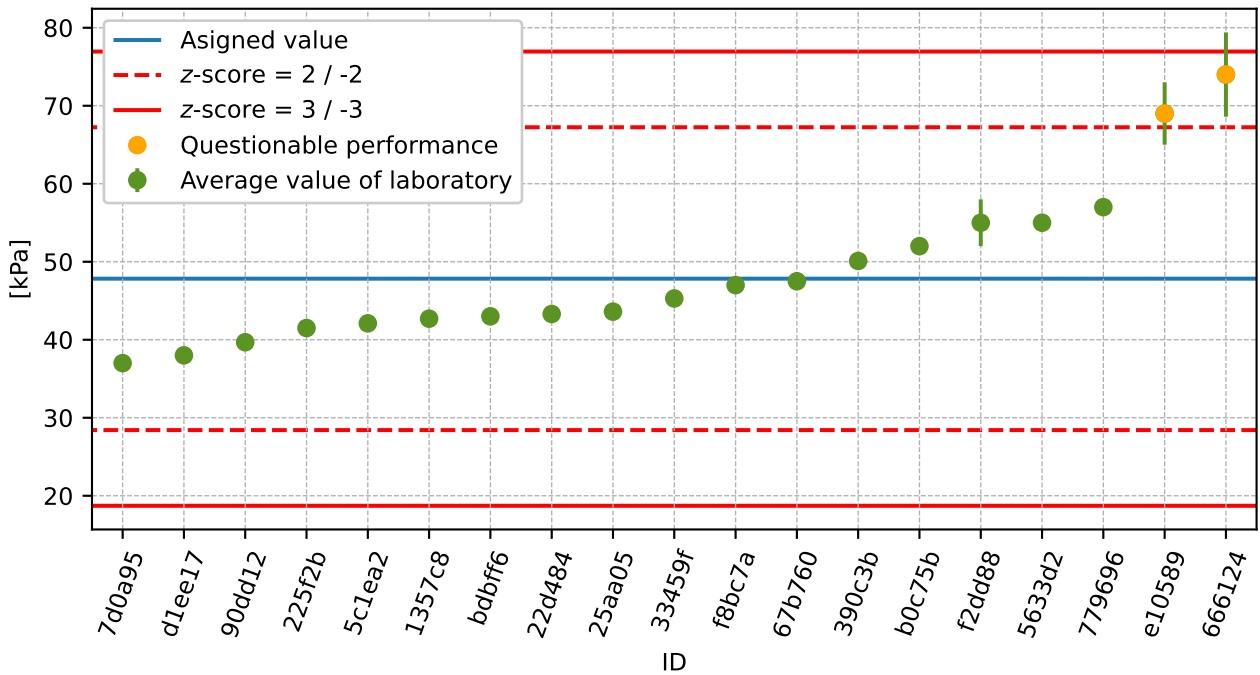
Figure 58: Average values and extended uncertainties of measurement

Figure 59: z-score

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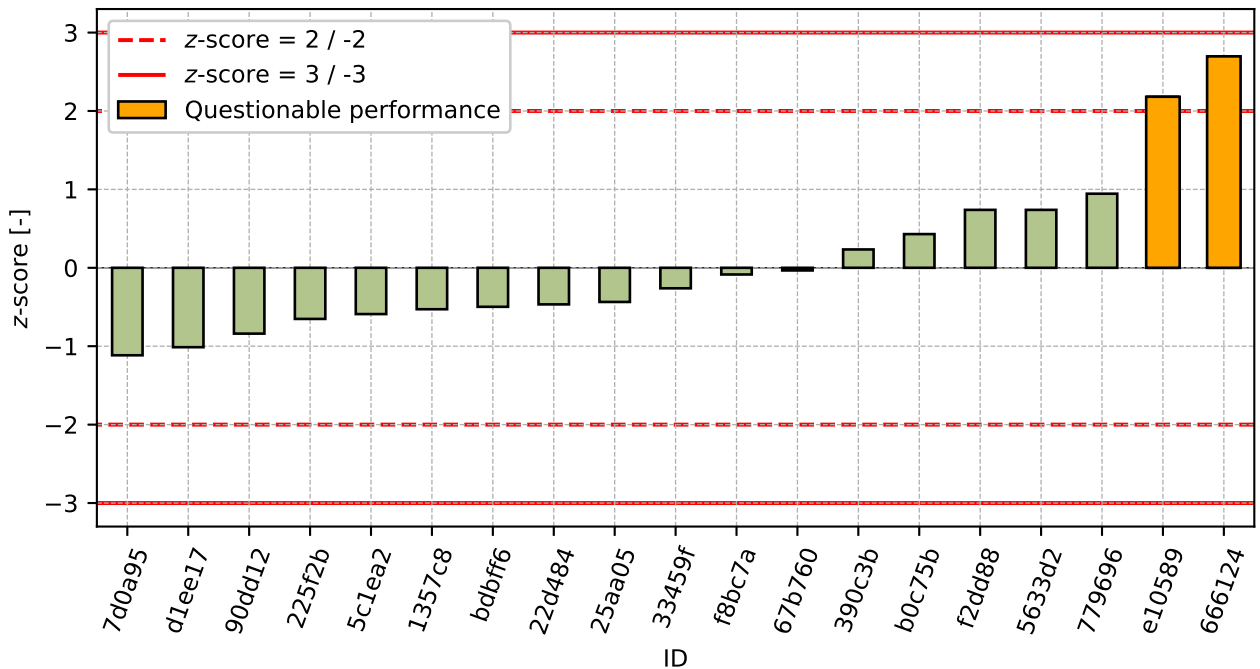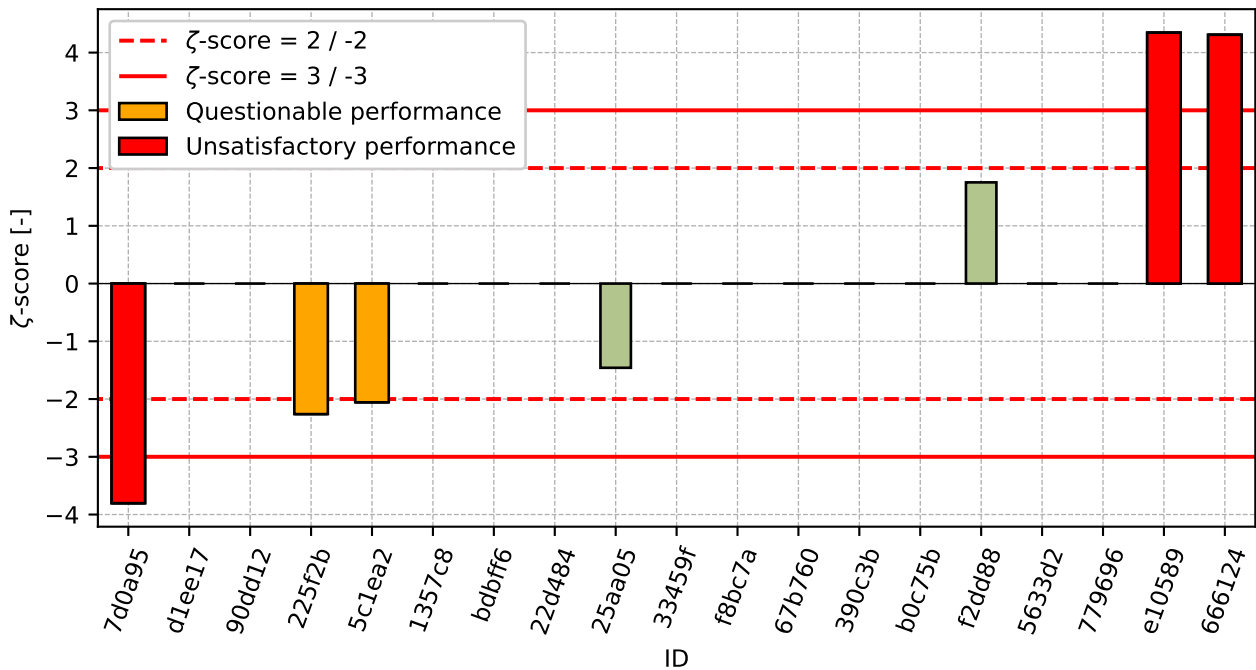
Figure 60: ζ-score

Table 34: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
7d0a95	-1.12	-3.8
d1ee17	-1.01	-
90dd12	-0.84	-
225f2b	-0.65	-2.26
5c1ea2	-0.59	-2.06
1357c8	-0.53	-
bdbff6	-0.5	-
22d484	-0.47	-
25aa05	-0.44	-1.46
33459f	-0.26	-
f8bc7a	-0.09	-
67b760	-0.03	-
390c3b	0.23	-
b0c75b	0.43	-
f2dd88	0.74	1.75
5633d2	0.74	-
779696	0.94	-
e10589	2.18	4.34
666124	2.7	4.31

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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]
1357c8	60.5	-
22d484	63.6	-
7d0a95	66.0	0.6
25aa05	71.1	1.3
33459f	71.5	-
225f2b	72.7	0.5
5c1ea2	78.1	0.1
bdbff6	79.0	-
390c3b	79.6	-
90dd12	81.8	-
f8bc7a	84.0	-
b0c75b	85.0	-
67b760	85.7	-
5633d2	86.0	-
d1ee17	88.0	-
779696	89.0	-
e10589	89.0	5.1
f2dd88	90.0	4.0
666124	108.0	7.9

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7.2.2   The Numerical Procedure for Determining Outliers

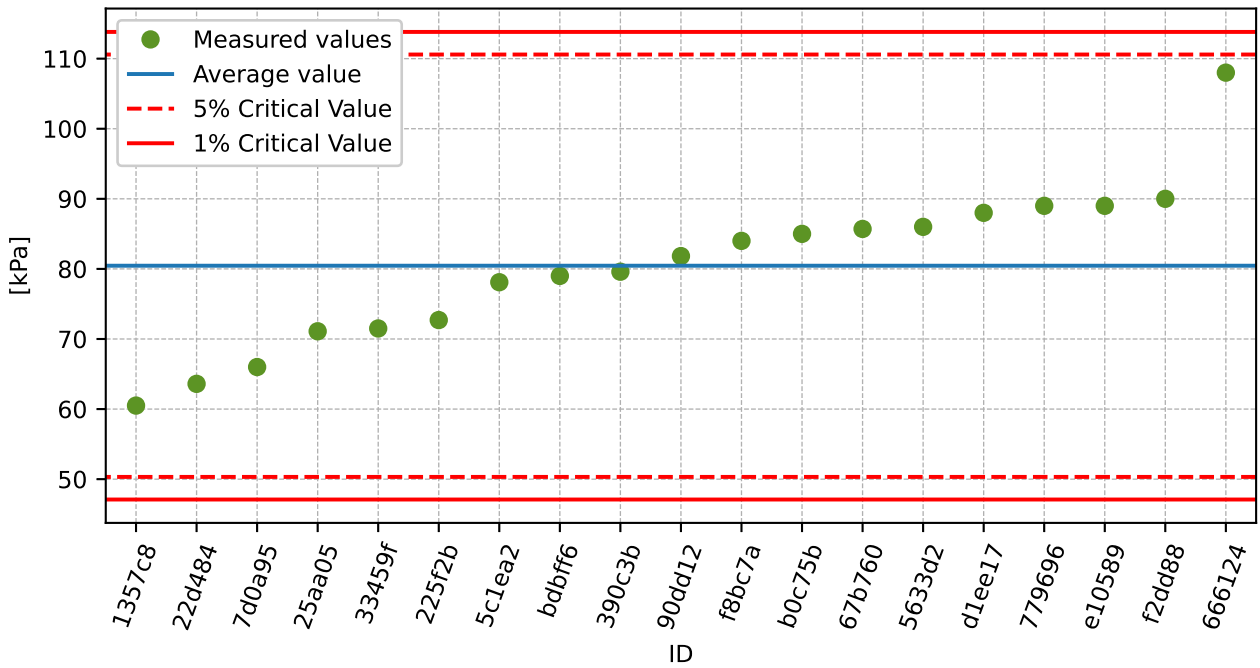Figure 61: **Grubbs' test** - average values

7.2.3   Mandel's Statistics
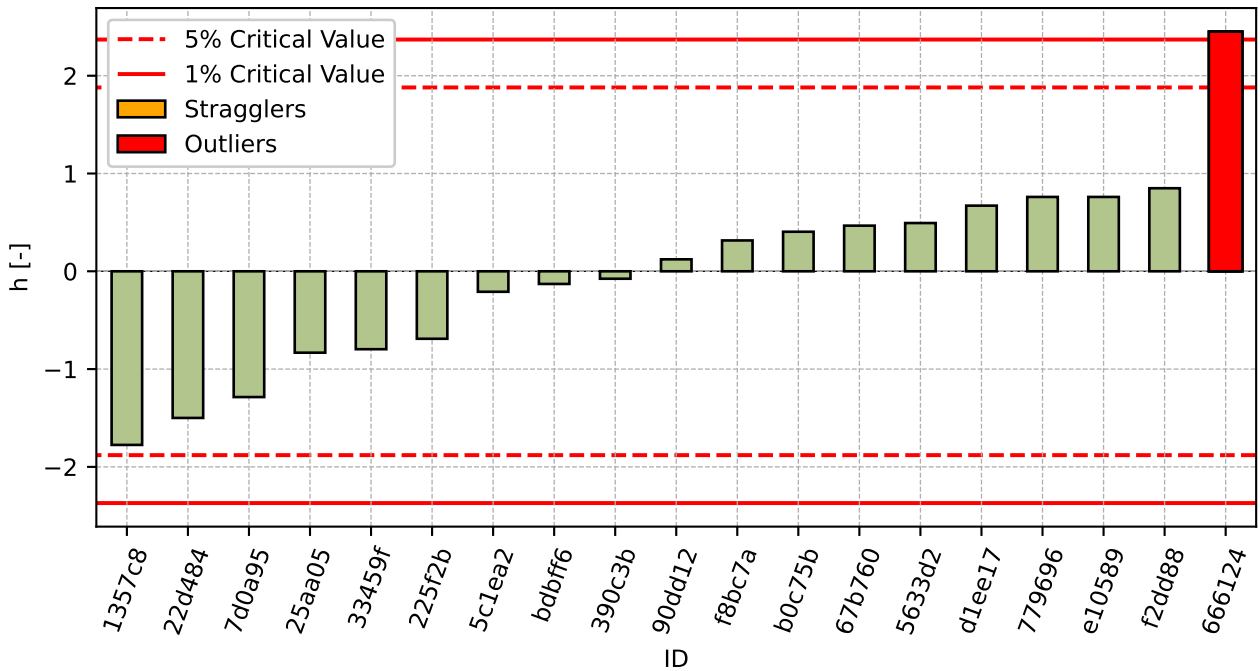
Figure 62: Interlaboratory Consistency Statistic

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7.2.4　Descriptive statistics
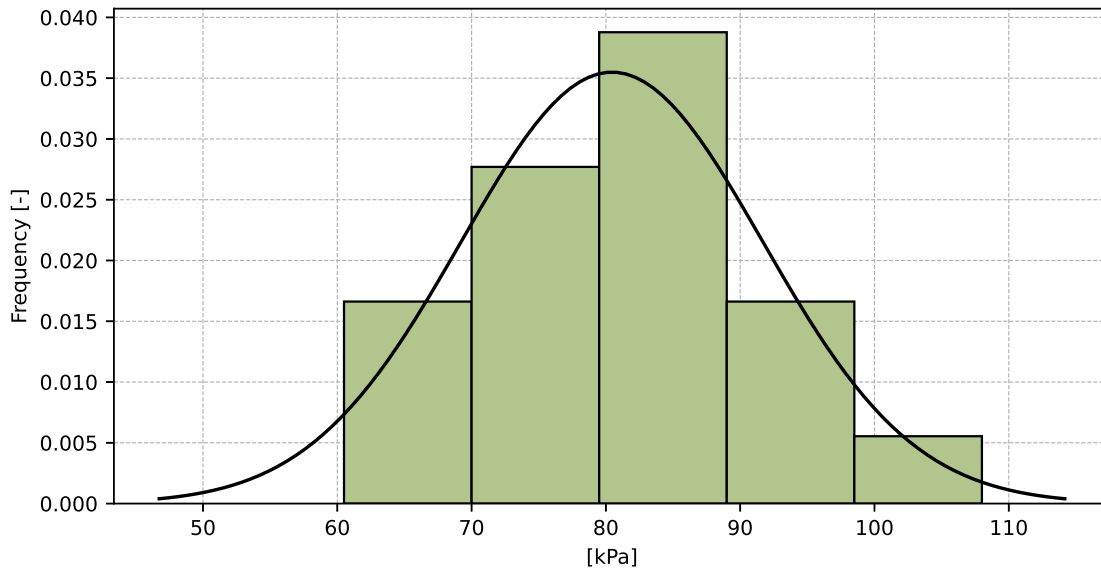
Figure 63: Histogram of all test results

Table 36: Descriptive statistics

Characteristics	[kPa]
Average value – $\bar{x}$	80.5
Sample standard deviation – s	11.24
Asigned value – x^*	80.9
Robust standard deviation – s^*	11.67
Measurement uncertainty of asigned value – u_X	3.35
p-value of normality test	0.445 [-]

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7.2.5 Evaluation of Performance Statistics
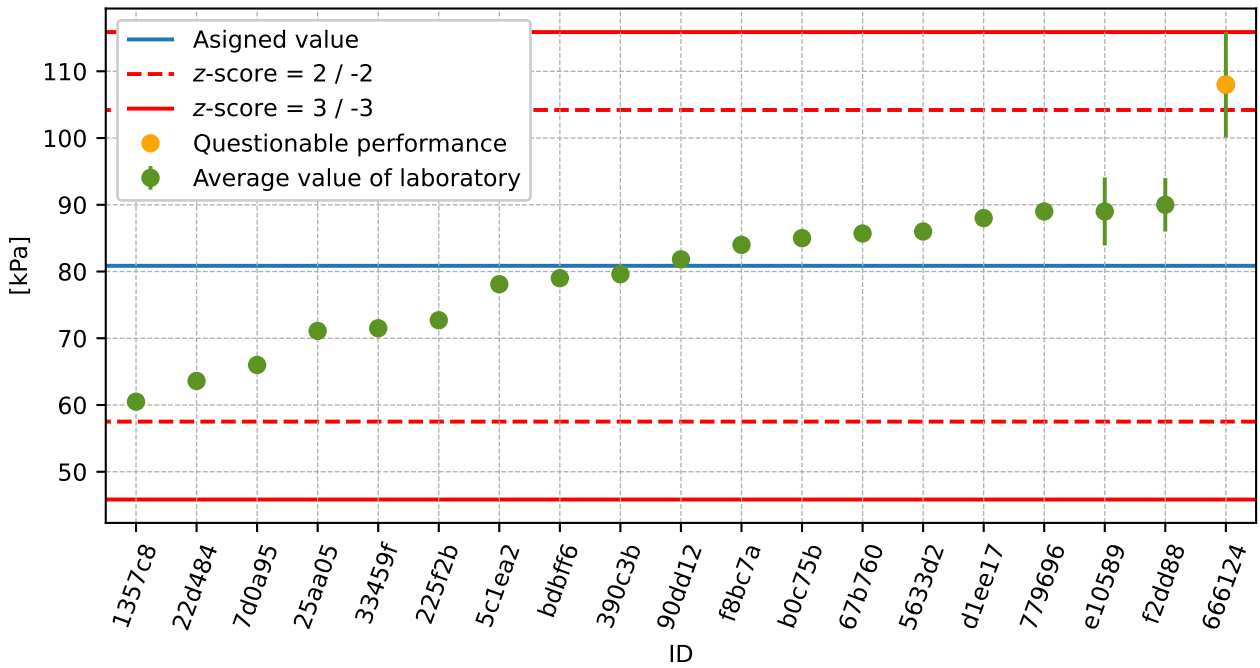
Figure 64: Average values and extended uncertainties of measurement

Figure 65: z-score

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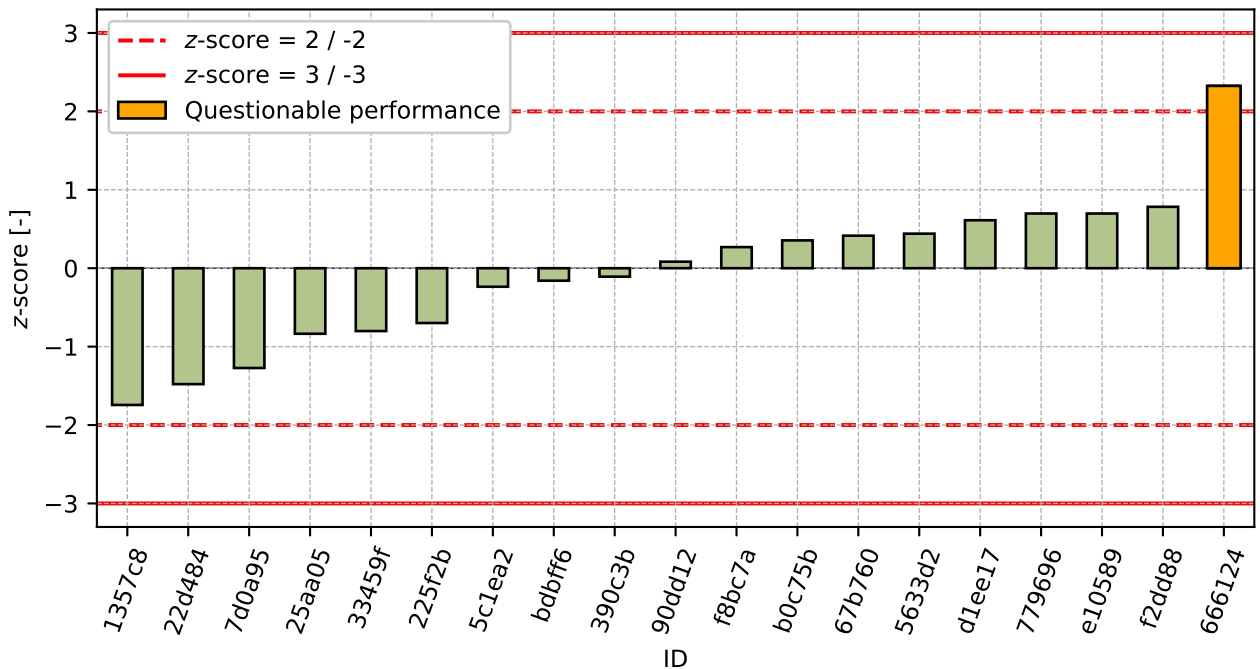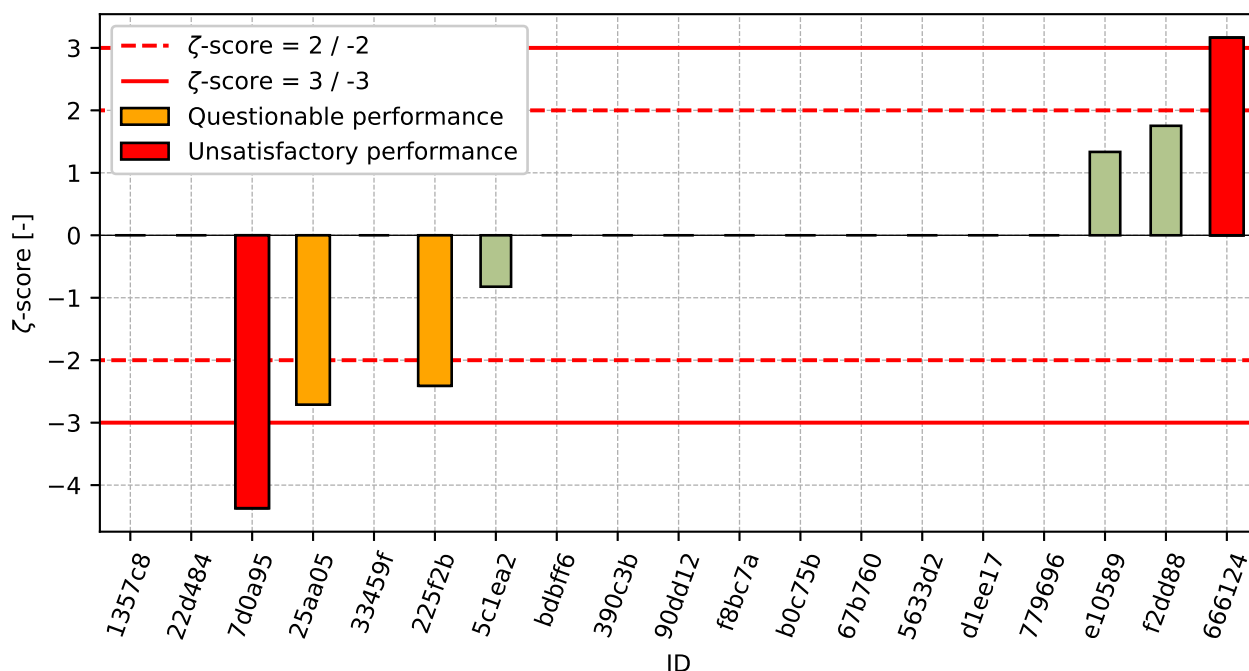
Figure 66: ζ-score

Table 37: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
1357c8	-1.74	-
22d484	-1.48	-
7d0a95	-1.27	-4.37
25aa05	-0.84	-2.71
33459f	-0.8	-
225f2b	-0.7	-2.41
5c1ea2	-0.24	-0.82
bdbff6	-0.16	-
390c3b	-0.11	-
90dd12	0.08	-
f8bc7a	0.27	-
b0c75b	0.35	-
67b760	0.41	-
5633d2	0.44	-
d1ee17	0.61	-
779696	0.7	-
e10589	0.7	1.33
f2dd88	0.78	1.75
666124	2.33	3.16

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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]
22d484	117.8	-
779696	125.0	-
225f2b	125.8	1.1
33459f	127.9	-
25aa05	130.7	1.4
f8bc7a	136.0	-
7d0a95	136.0	0.6
390c3b	138.5	-
d1ee17	143.0	-
67b760	143.1	-
5633d2	144.0	-
5c1ea2	151.1	0.1
90dd12	152.7	-
1357c8	153.0	-
f2dd88	160.0	8.0
666124	166.0	12.1
b0c75b	172.0	-
bdbff6	203.0	-
e10589	210.0	8.5

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7.3.2   The Numerical Procedure for Determining Outliers
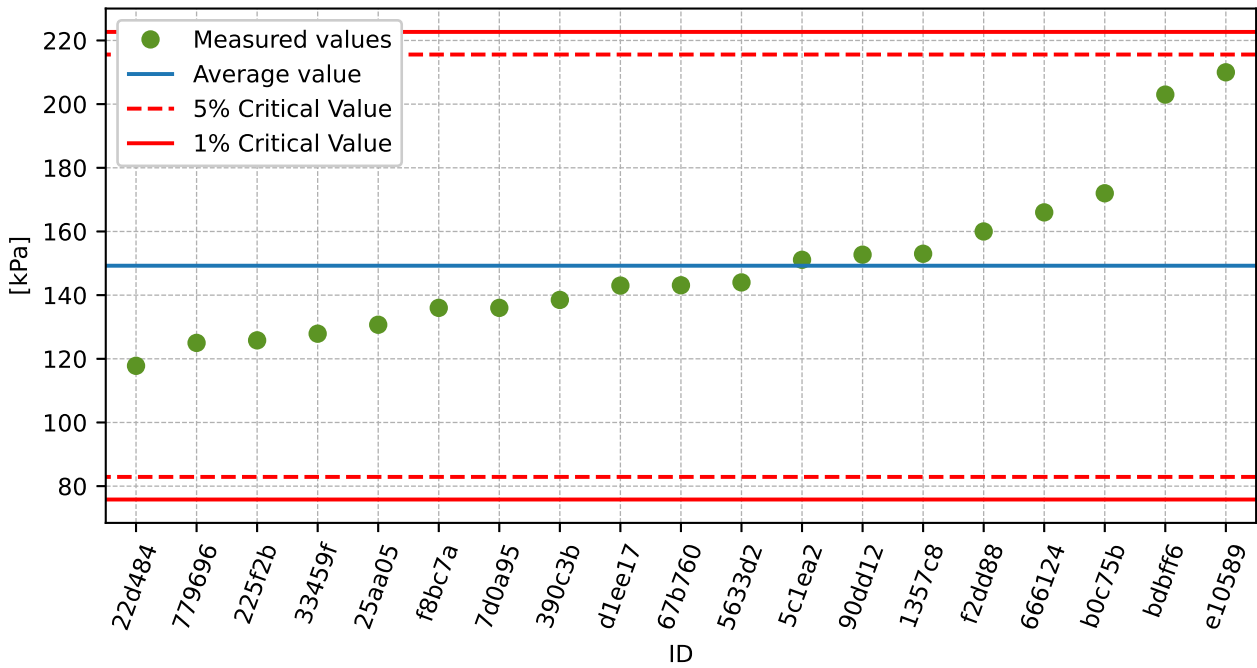
Figure 67: **Grubbs' test** - average values

7.3.3   Mandel's Statistics
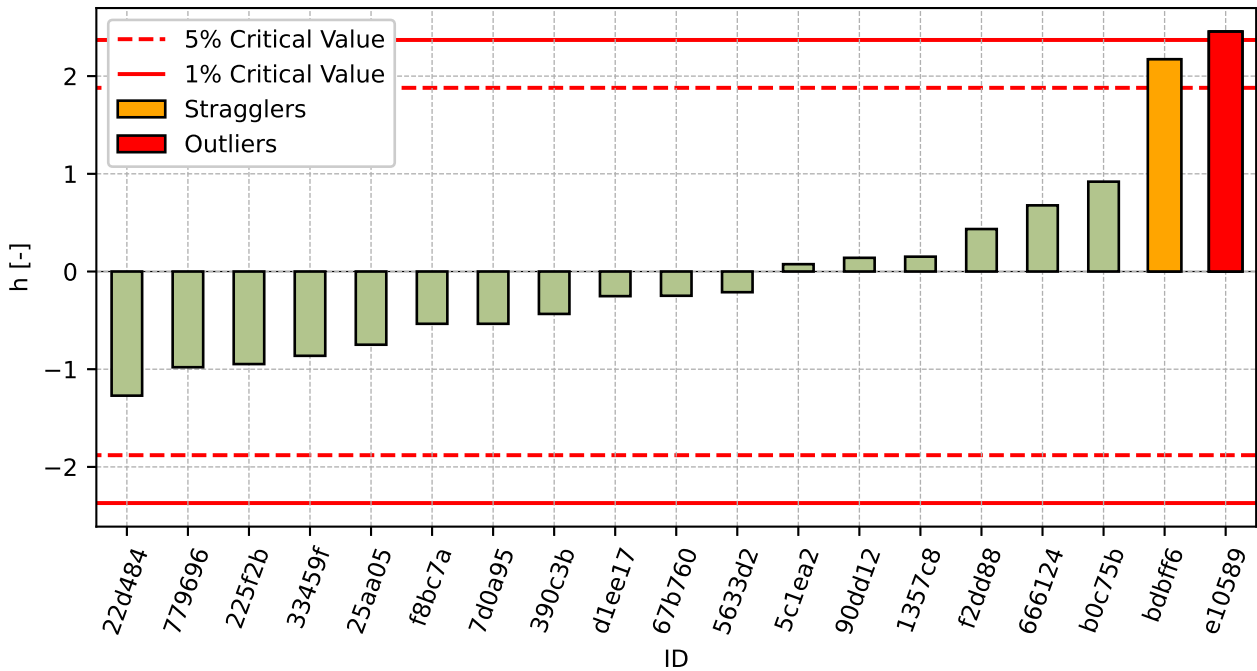
Figure 68: Interlaboratory Consistency Statistic

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7.3.4   Descriptive statistics
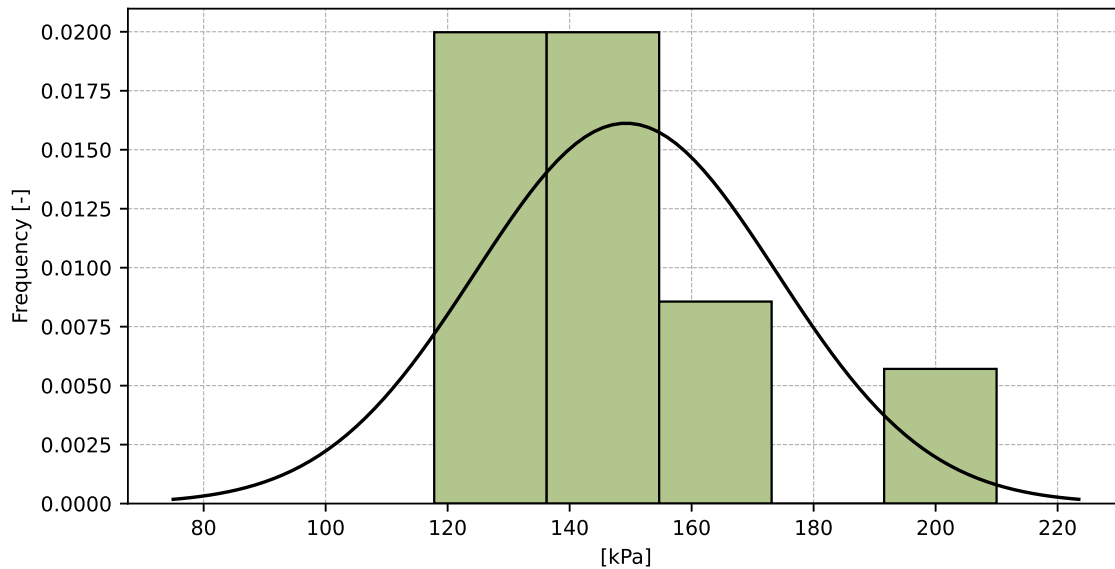
Figure 69: Histogram of all test results

Table 39: Descriptive statistics

Characteristics	[kPa]
Average value – $\bar{x}$	149.2
Sample standard deviation – s	24.74
Asigned value – x^*	147.5
Robust standard deviation – s^*	23.95
Measurement uncertainty of asigned value – u_X	6.87
p-value of normality test	0.023 [-]

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7.3.5 Evaluation of Performance Statistics
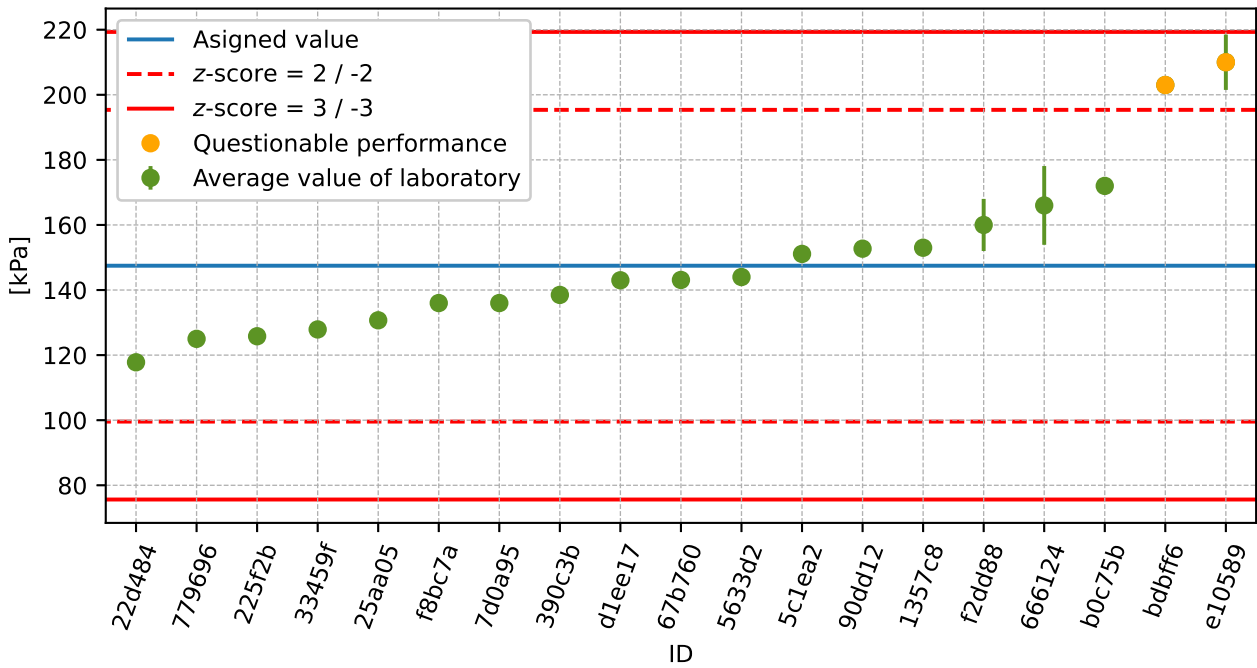
Figure 70: Average values and extended uncertainties of measurement

Figure 71: z-score

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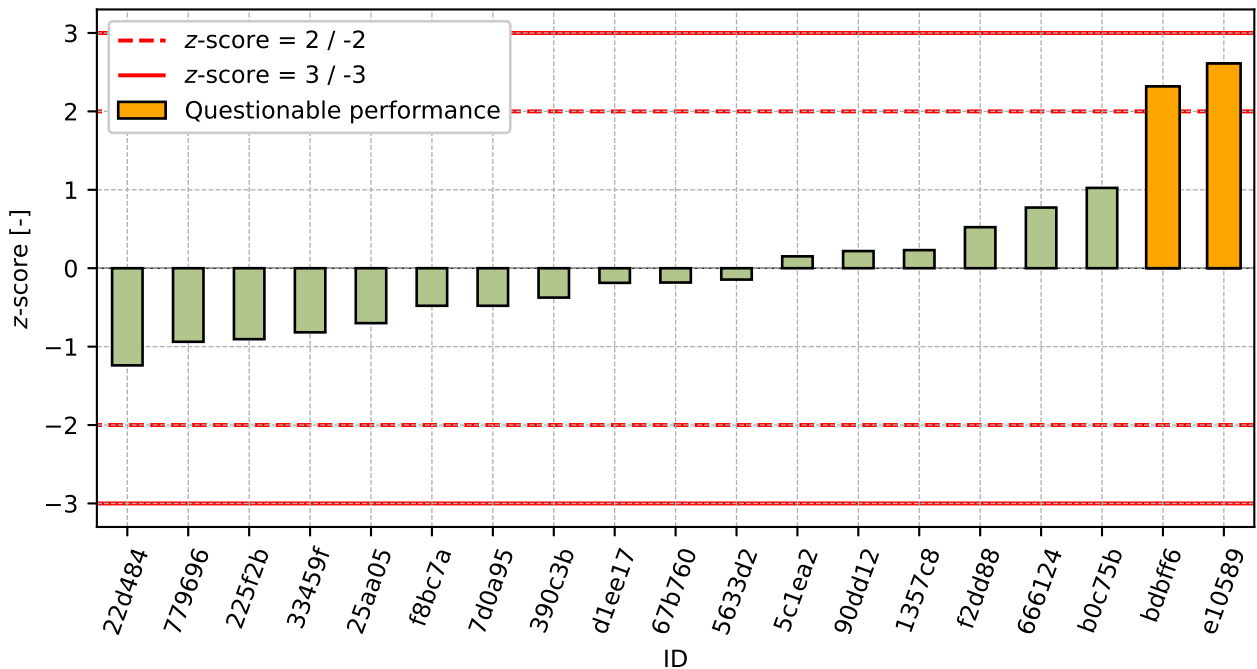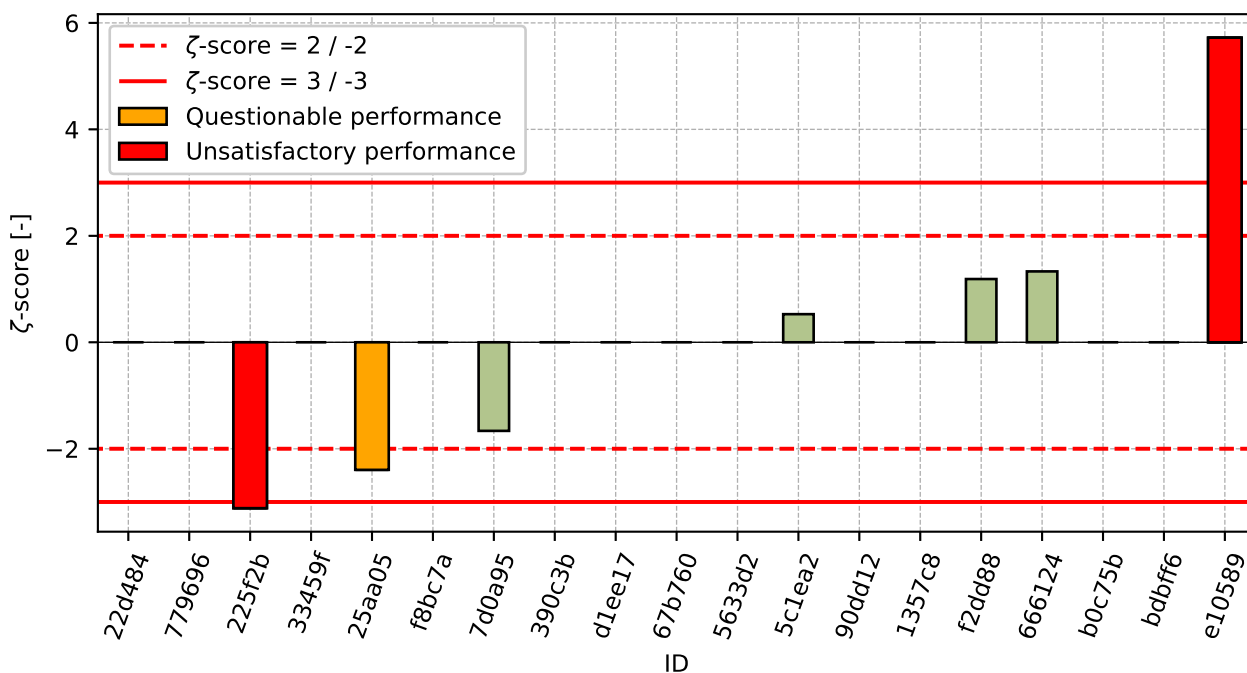
Figure 72: ζ-score

Table 40: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
22d484	-1.24	-
779696	-0.94	-
225f2b	-0.9	-3.12
33459f	-0.82	-
25aa05	-0.7	-2.4
f8bc7a	-0.48	-
7d0a95	-0.48	-1.66
390c3b	-0.37	-
d1ee17	-0.19	-
67b760	-0.18	-
5633d2	-0.14	-
5c1ea2	0.15	0.53
90dd12	0.22	-
1357c8	0.23	-
f2dd88	0.52	1.19
666124	0.77	1.33
b0c75b	1.02	-
bdbff6	2.32	-
e10589	2.61	5.72

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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]
666124	212.0	15.5
1357c8	228.7	-
33459f	237.2	-
779696	243.0	-
f8bc7a	247.0	-
25aa05	251.6	1.4
22d484	252.1	-
225f2b	254.9	2.0
5633d2	256.0	-
390c3b	256.5	-
7d0a95	271.0	0.6
b0c75b	272.0	-
e10589	280.0	11.4
67b760	286.4	-
5c1ea2	288.0	0.1
90dd12	288.4	-
d1ee17	294.0	-
f2dd88	320.0	16.0
bdbff6	353.0	-

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7.4.2 The Numerical Procedure for Determining Outliers
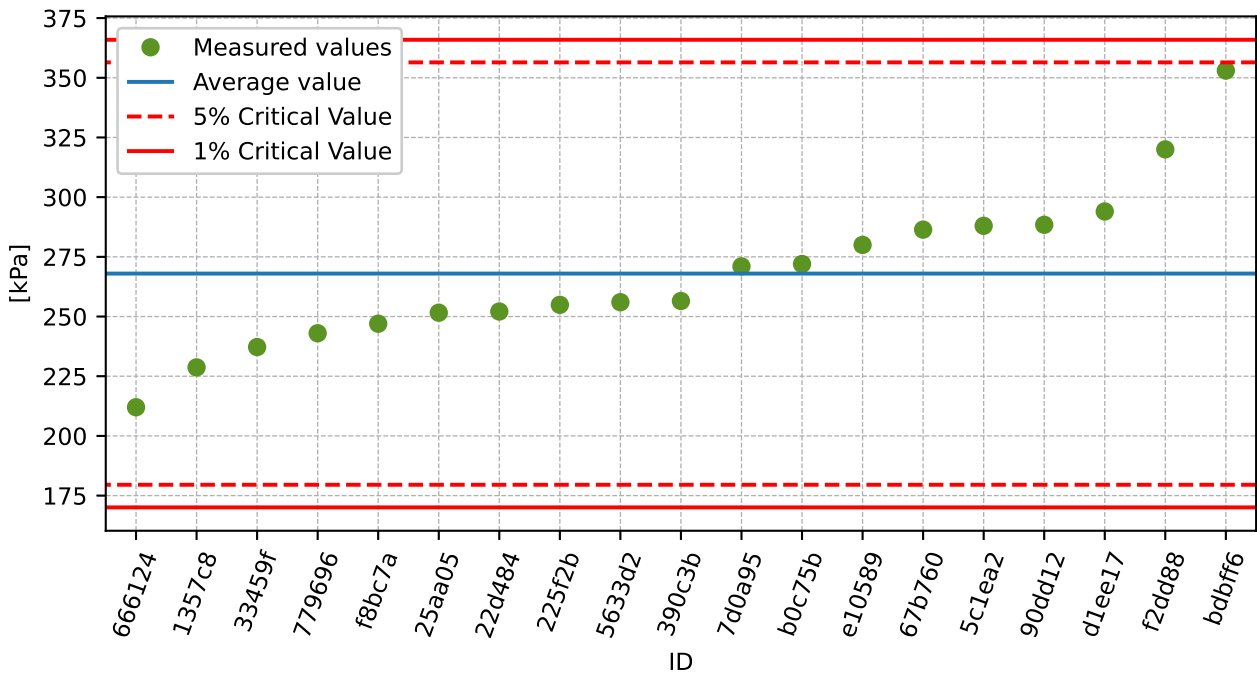

Figure 73: **Grubbs' test** - average values

7.4.3 Mandel's Statistics
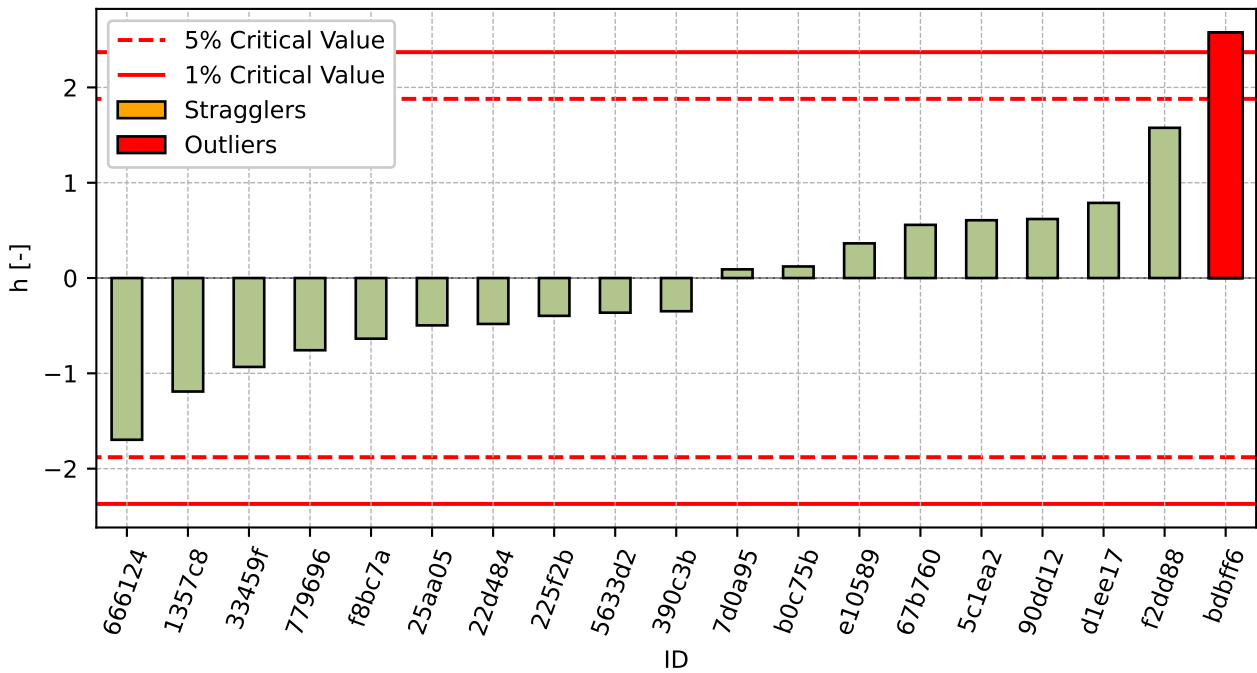
Figure 74: Interlaboratory Consistency Statistic

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7.4.4   Descriptive statistics
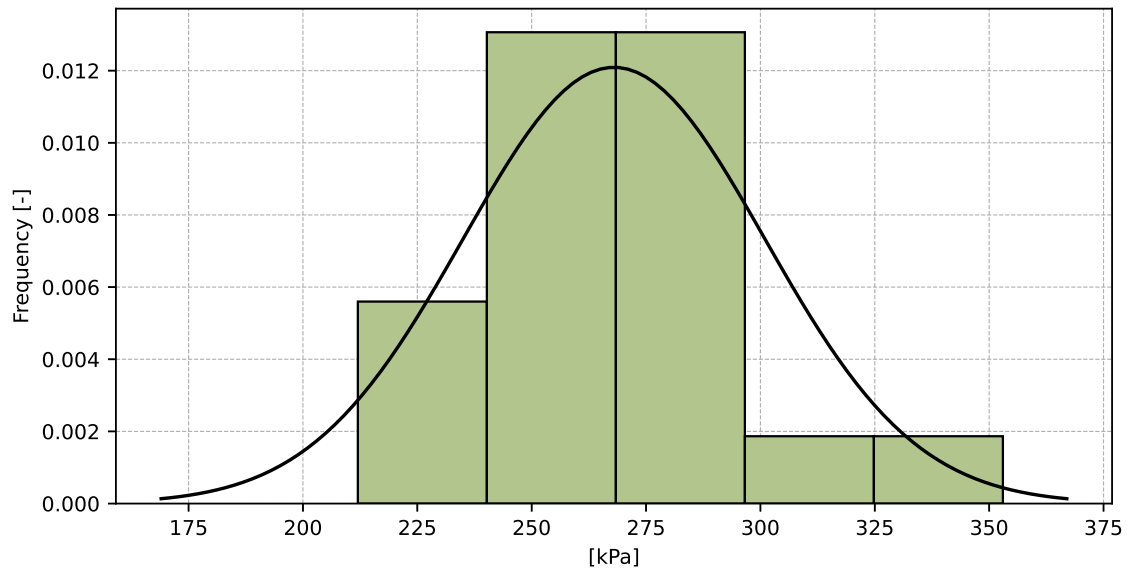
Figure 75: Histogram of all test results

Table 42: Descriptive statistics

Characteristics	[kPa]
Average value – $\bar{x}$	268.0
Sample standard deviation – s	32.99
Asigned value – x^*	267.1
Robust standard deviation – s^*	34.39
Measurement uncertainty of asigned value – u_X	9.86
p-value of normality test	0.401 [-]

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7.4.5 Evaluation of Performance Statistics
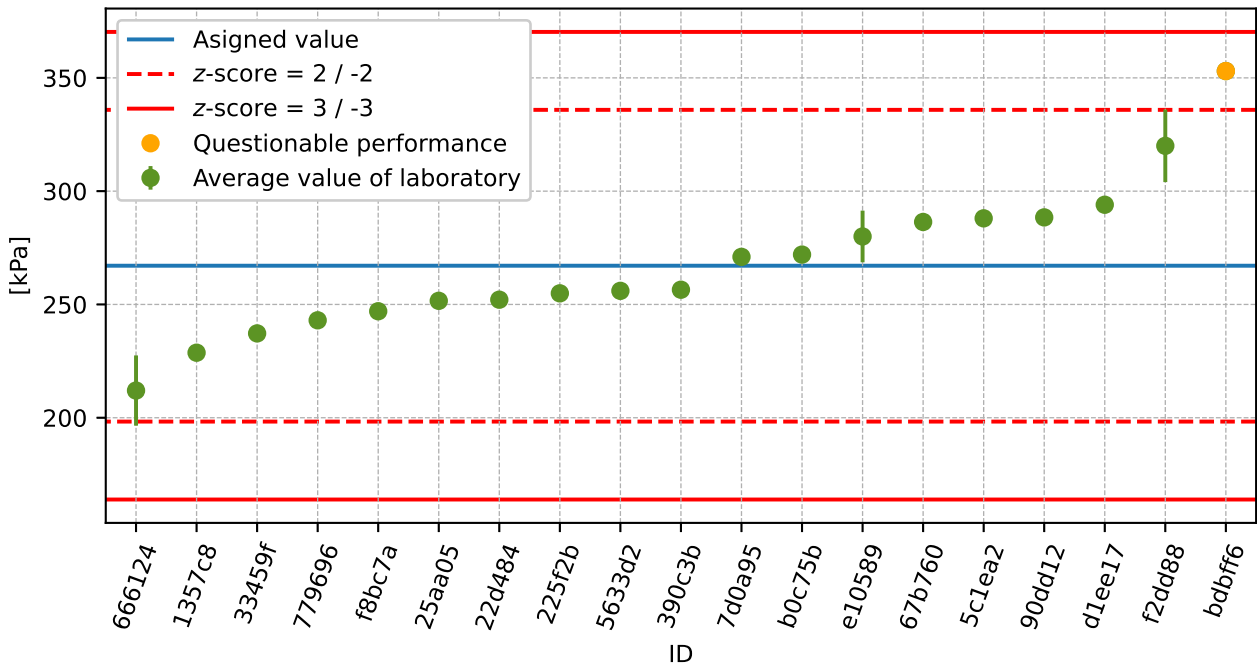
Figure 76: Average values and extended uncertainties of measurement

Figure 77: z-score

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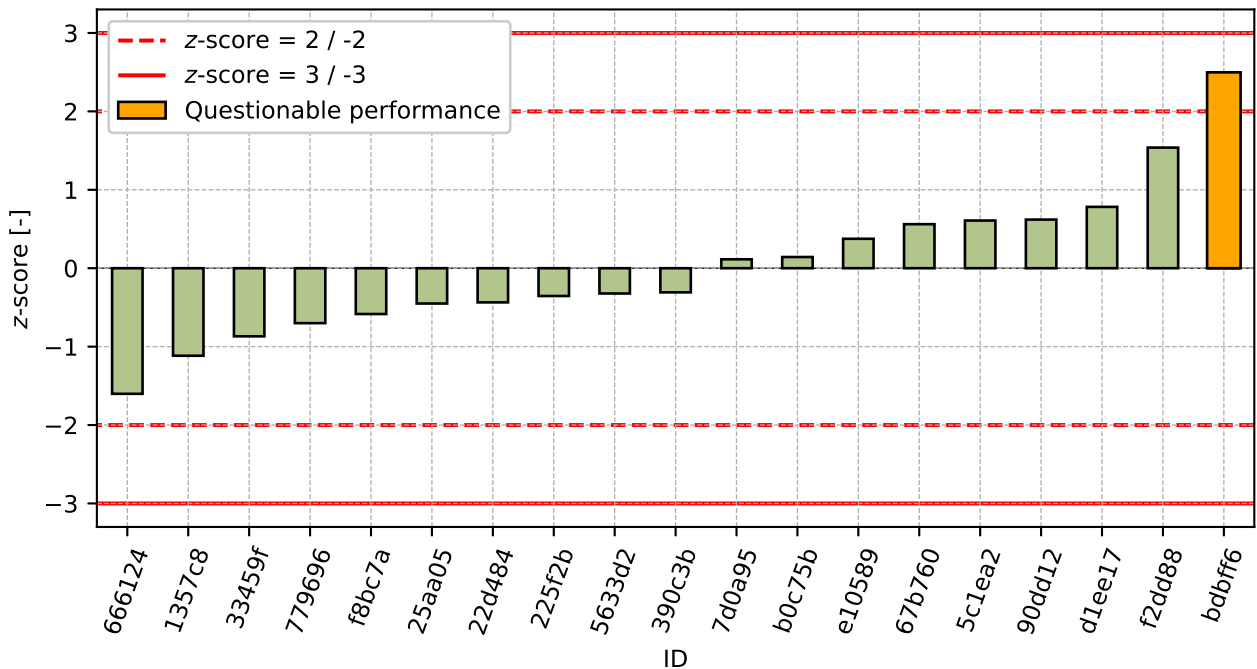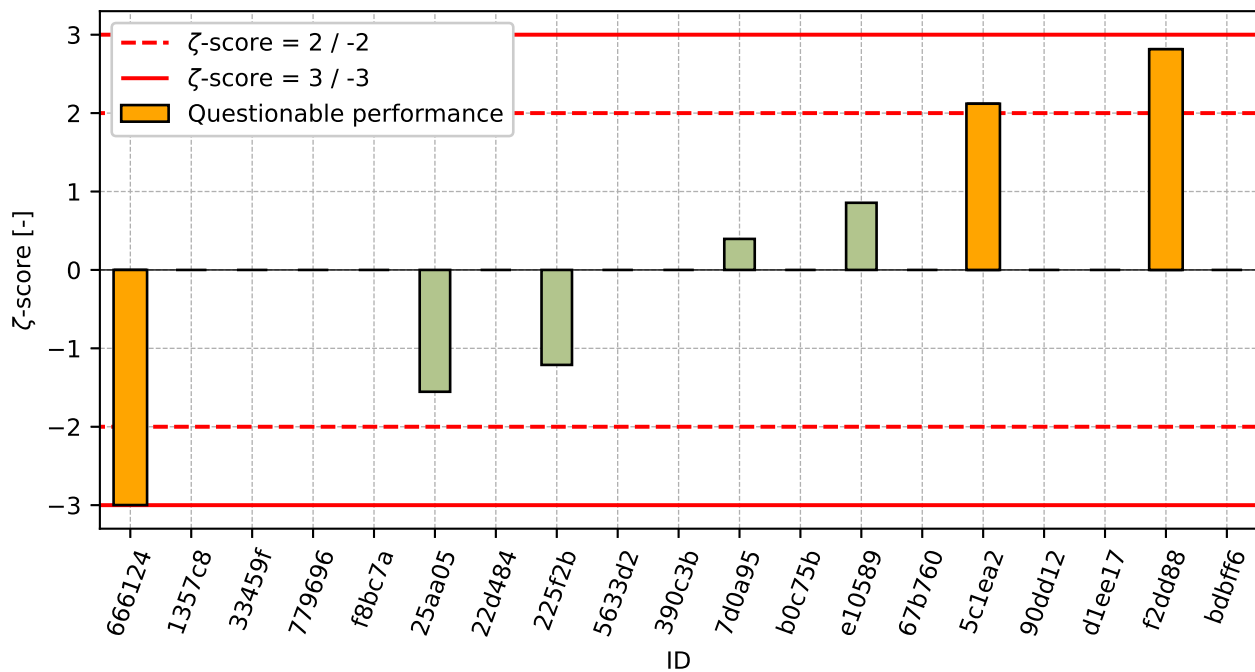
Figure 78: ζ-score

Table 43: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
666124	-1.6	-3.0
1357c8	-1.12	-
33459f	-0.87	-
779696	-0.7	-
f8bc7a	-0.58	-
25aa05	-0.45	-1.55
22d484	-0.44	-
225f2b	-0.35	-1.21
5633d2	-0.32	-
390c3b	-0.31	-
7d0a95	0.11	0.4
b0c75b	0.14	-
e10589	0.38	0.86
67b760	0.56	-
5c1ea2	0.61	2.12
90dd12	0.62	-
d1ee17	0.78	-
f2dd88	1.54	2.81
bdbff6	2.5	-

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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 [%]
8aeb2c	25.2	25.4	25.5	0.2	25.4	0.15	0.6
54b338	29.4	28.1	30.2	1.1	29.3	1.05	3.6
3a439b	30.5	29.5	30.3	-	30.1	0.53	1.76
1357c8	30.4	30.7	30.3	-	30.5	0.21	0.68
a81bc3	31.5	31.0	30.9	-	31.1	0.32	1.03
666124	31.7	32.3	33.2	3.1	32.4	0.75	2.33
fc937d	32.2	33.0	32.5	10.0	32.6	0.4	1.24
e10589	32.0	33.0	33.0	1.8	32.7	0.58	1.77
25aa05	33.0	33.0	33.0	2.4	33.0	0.0	0.0
5b2e25	33.1	32.5	33.6	-	33.1	0.55	1.67
779696	33.2	33.2	33.2	-	33.2	0.03	0.08
67b760	33.2	33.8	33.4	-	33.5	0.31	0.91
86eb15	33.0	34.0	34.0	1.8	33.7	0.58	1.71
b0c75b	33.7	34.5	33.5	2.3	33.9	0.53	1.56
5633d2	33.9	33.5	34.8	-	34.1	0.67	1.95
25e875	34.3	33.9	34.2	0.8	34.1	0.21	0.61
f2dd88	34.7	34.4	33.6	0.7	34.2	0.57	1.66
4a8427	34.2	34.2	34.5	0.2	34.3	0.17	0.5
390c3b	34.8	34.6	34.2	-	34.5	0.31	0.88
5b9821	34.9	34.6	34.3	1.0	34.6	0.3	0.87
c871a4	35.0	34.0	35.0	2.0	34.7	0.58	1.67
90dd12	34.9	35.1	34.3	-	34.8	0.42	1.2
05920e	34.6	36.0	34.5	-	35.0	0.84	2.39
087225	35.7	35.4	35.6	0.5	35.6	0.17	0.48
5c1ea2	35.6	36.0	35.4	0.2	35.6	0.33	0.91
d1ee17	37.0	35.0	35.0	2.0	35.7	1.15	3.24
7f895a	36.0	35.0	36.0	-	35.7	0.58	1.62
589c5f	35.7	35.9	36.1	0.6	35.9	0.2	0.56
ce319a	36.0	36.0	36.0	-	36.0	0.0	0.0
7ffaba	36.1	36.0	35.9	5.0	36.0	0.1	0.28
3d61b1	36.0	36.0	36.0	-	36.0	0.0	0.0
1b8e4c	36.0	36.0	36.1	4.3	36.0	0.06	0.16
33e846	35.0	37.0	36.5	0.3	36.2	1.04	2.88
1202ed	35.4	35.8	37.3	1.8	36.2	1.02	2.83

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ID	Test results [%]			u_X [%]	$\bar{x}$ [%]	s_0 [%]	V_X [%]
1632e2	37.0	37.0	36.0	2.0	36.7	0.58	1.57
f8bc7a	37.0	37.0	37.0	2.0	37.0	0.0	0.0
df7d84	37.0	37.1	37.7	1.0	37.3	0.38	1.02
96dae7	37.0	37.0	38.0	2.0	37.3	0.58	1.55
225f2b	37.0	38.0	38.0	1.3	37.7	0.58	1.53
7ac937	37.2	38.2	-	-	37.7	0.71	1.88

8.1.2   The Numerical Procedure for Determining Outliers
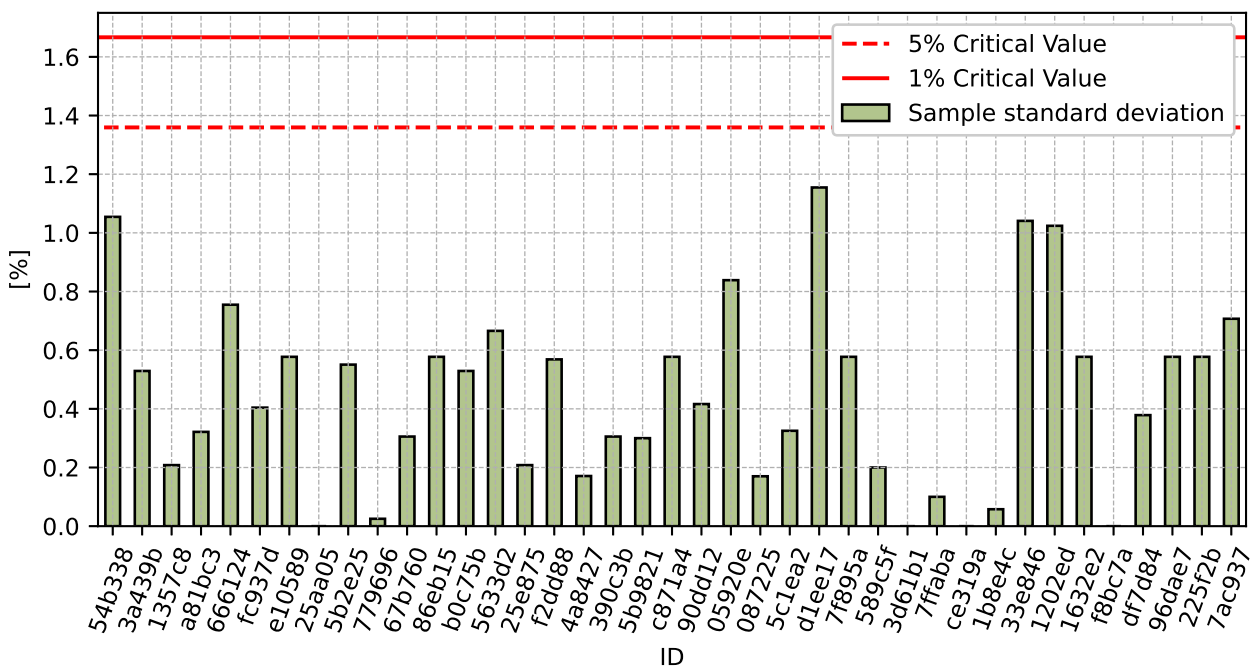
Figure 79: **Cochran's test** - sample standard deviations

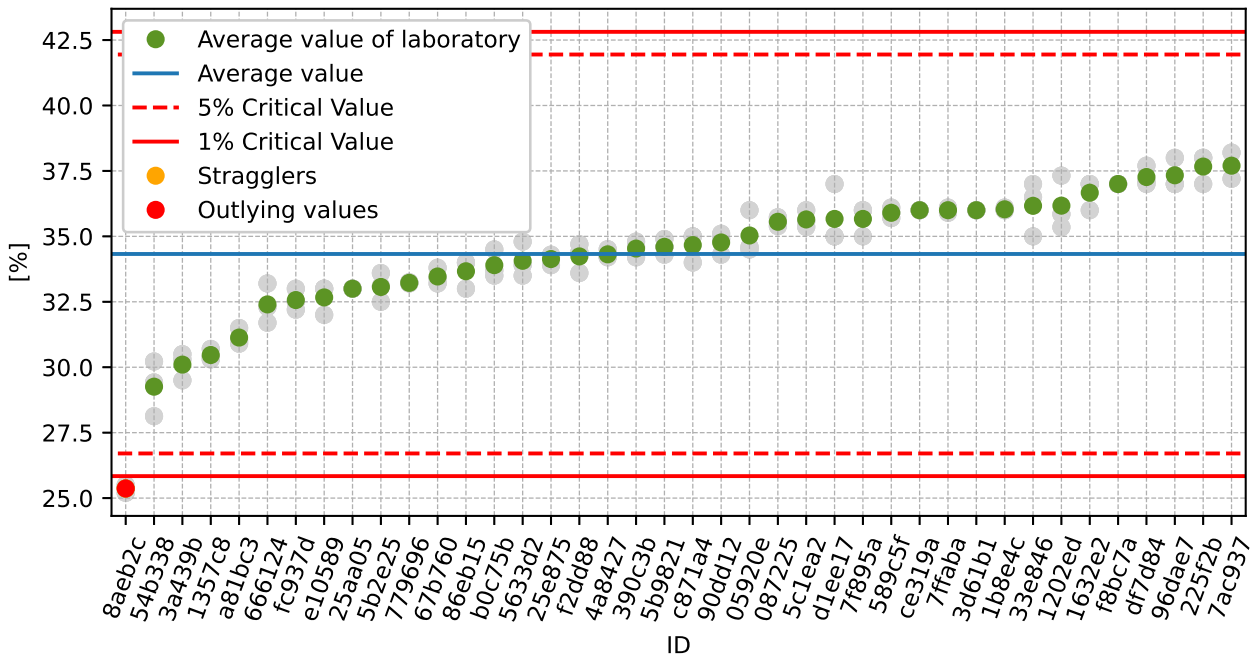Proficiency Testing Provider at the SZK FAST | Z 7008   86/118
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Figure 80: **Grubbs' test** - average values
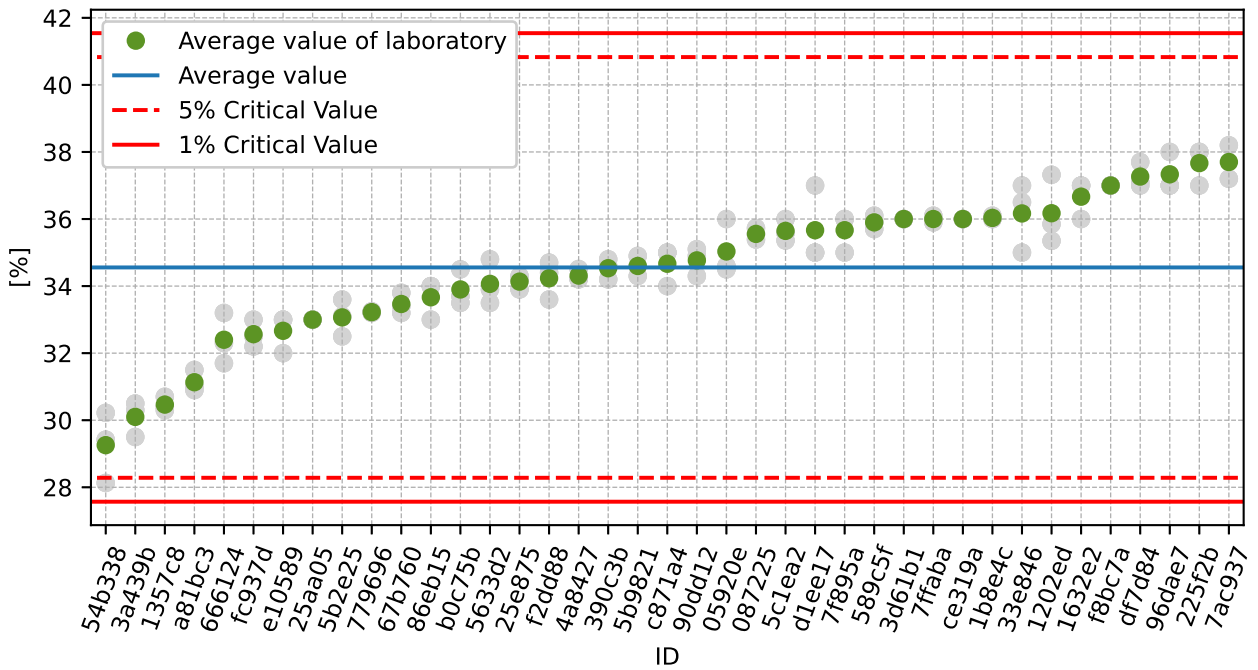
Figure 81: **Grubbs' test** - average values without outliers

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8.1.3 Mandel′s Statistics
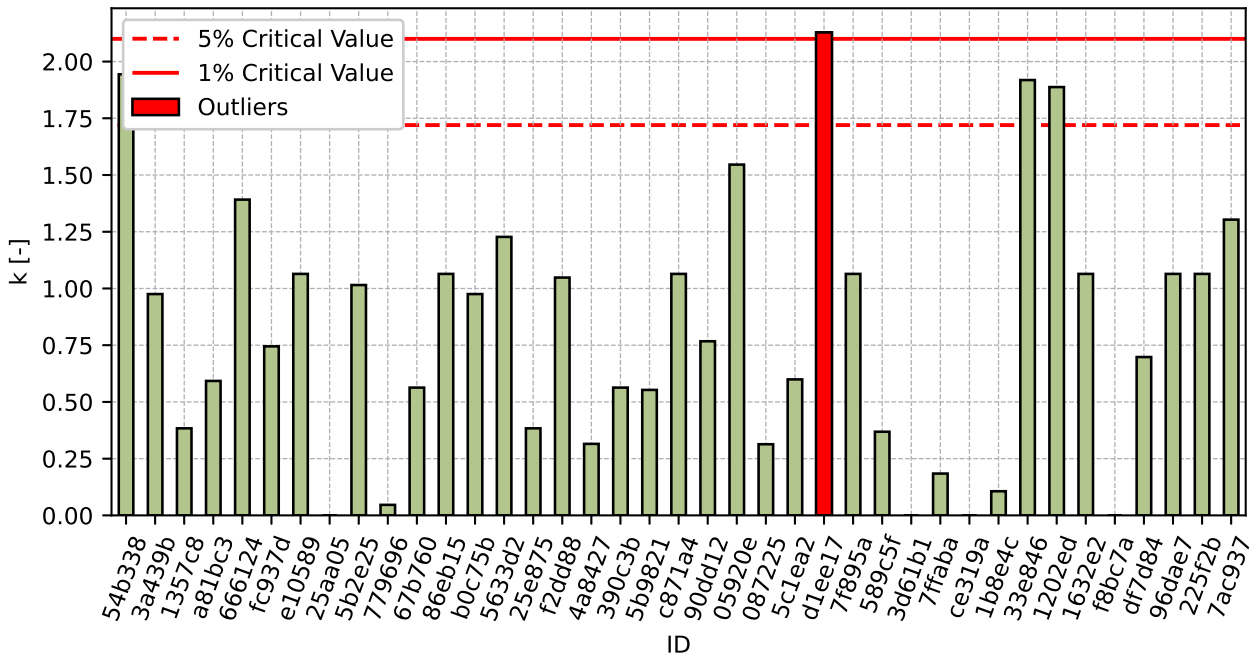
Figure 82: Intralaboratory Consistency Statistic
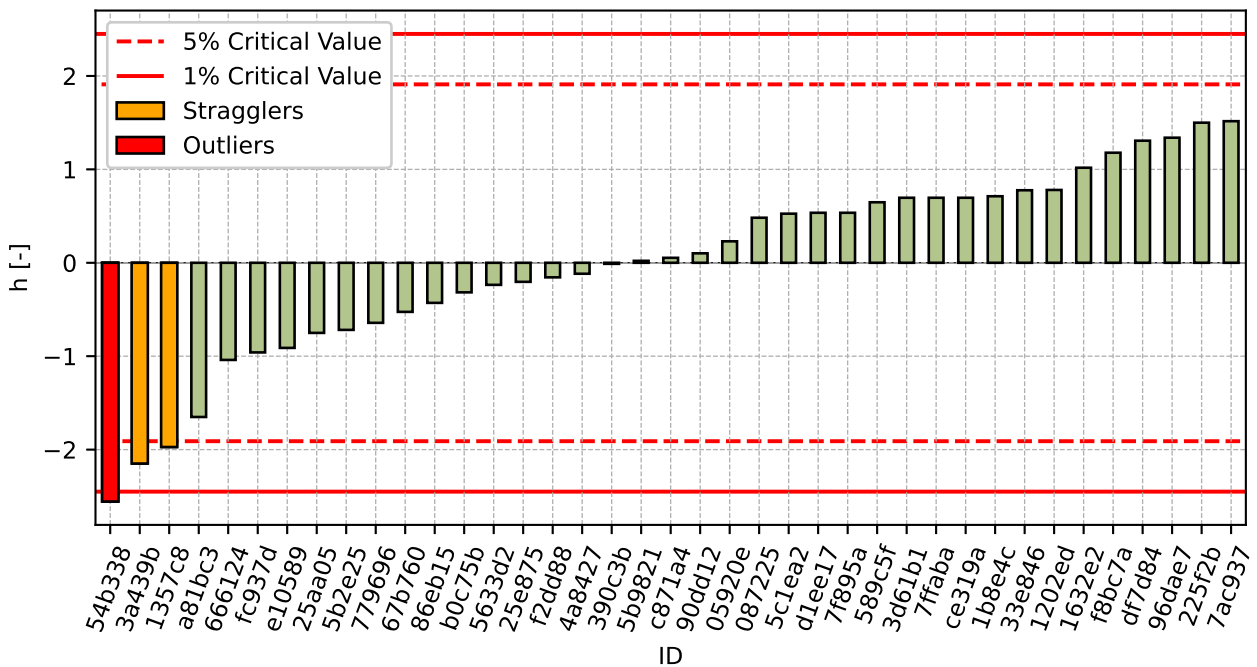
Figure 83: Interlaboratory Consistency Statistic

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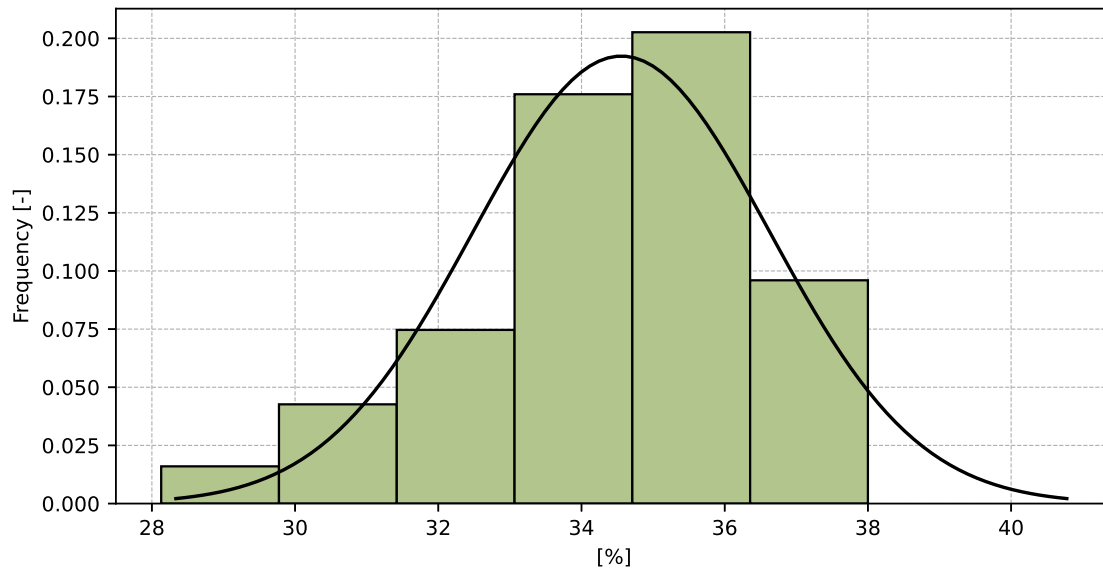Veveří 331/95 | 602 00 Brno | Czech Republic
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8.1.4 Descriptive statistics

Figure 84: Histogram of all test results

Table 45: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	34.6
Sample standard deviation – s	2.07
Asigned value – x^*	34.7
Robust standard deviation – s^*	1.96
Measurement uncertainty of asigned value – u_X	0.39
p-value of normality test	0.001 [-]
Interlaboratory standard deviation – s_L	2.05
Repeatability standard deviation – s_r	0.54
Reproducibility standard deviation – s_R	2.12
Repeatability – r	1.5
Reproducibility – R	5.9

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8.1.5   Evaluation of Performance Statistics
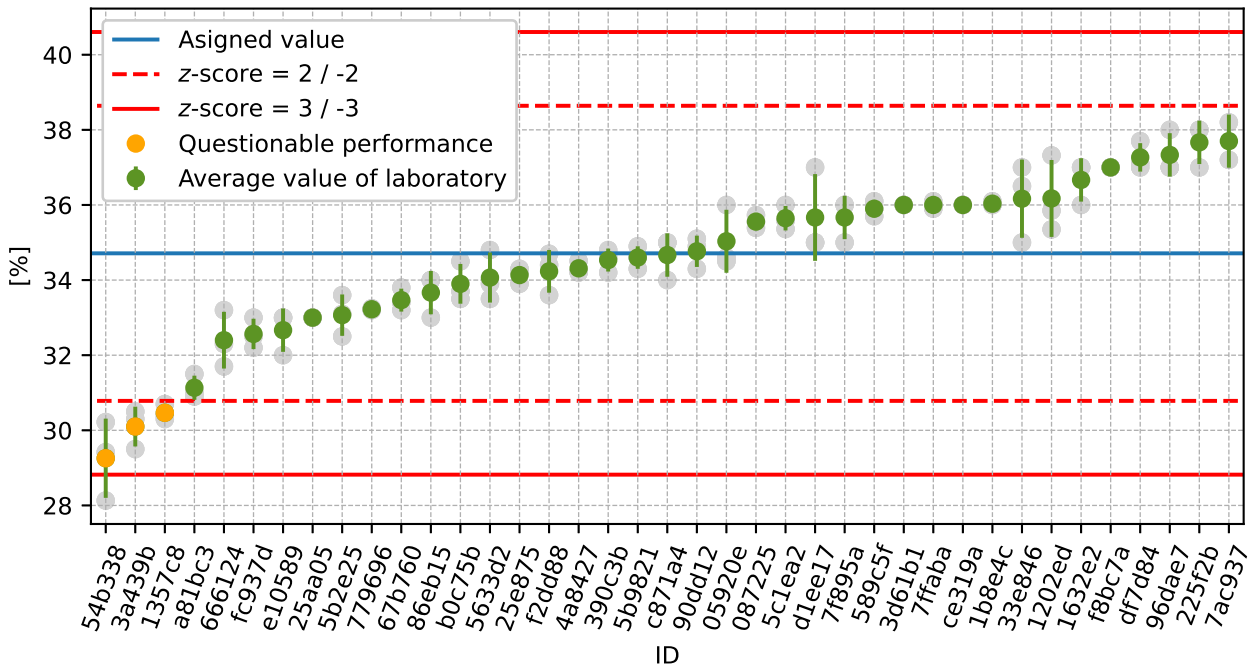
Figure 85: Average values and sample standard deviations
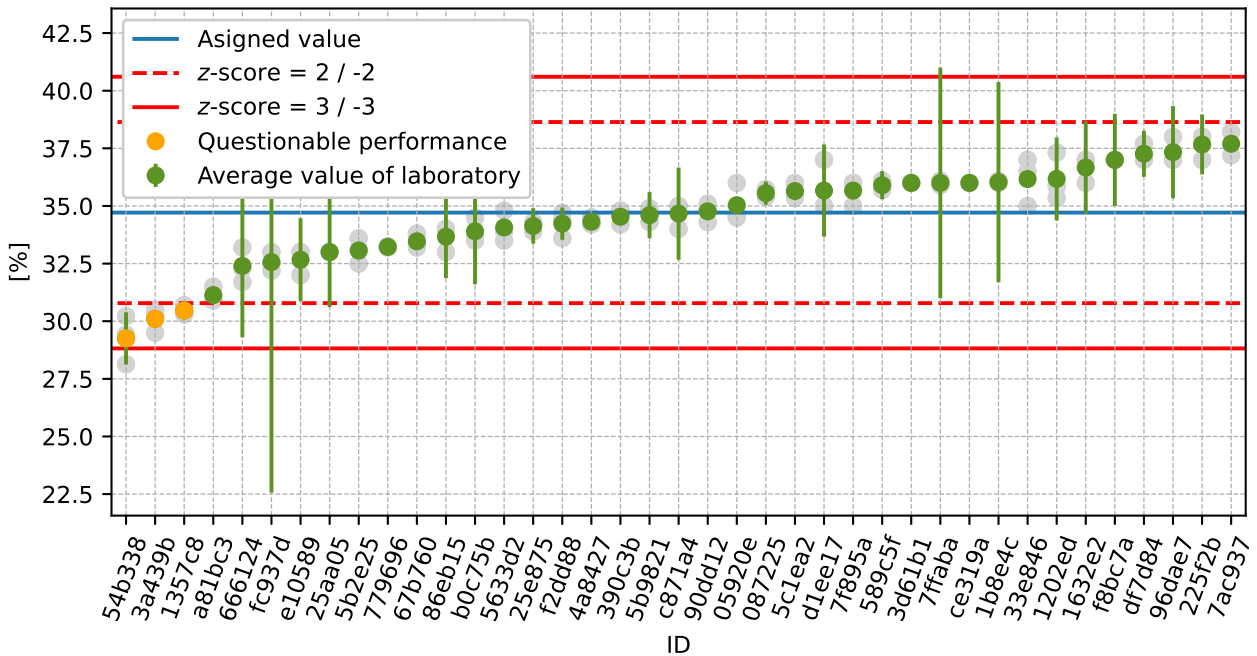
Figure 86: Average values and extended uncertainties of measurement

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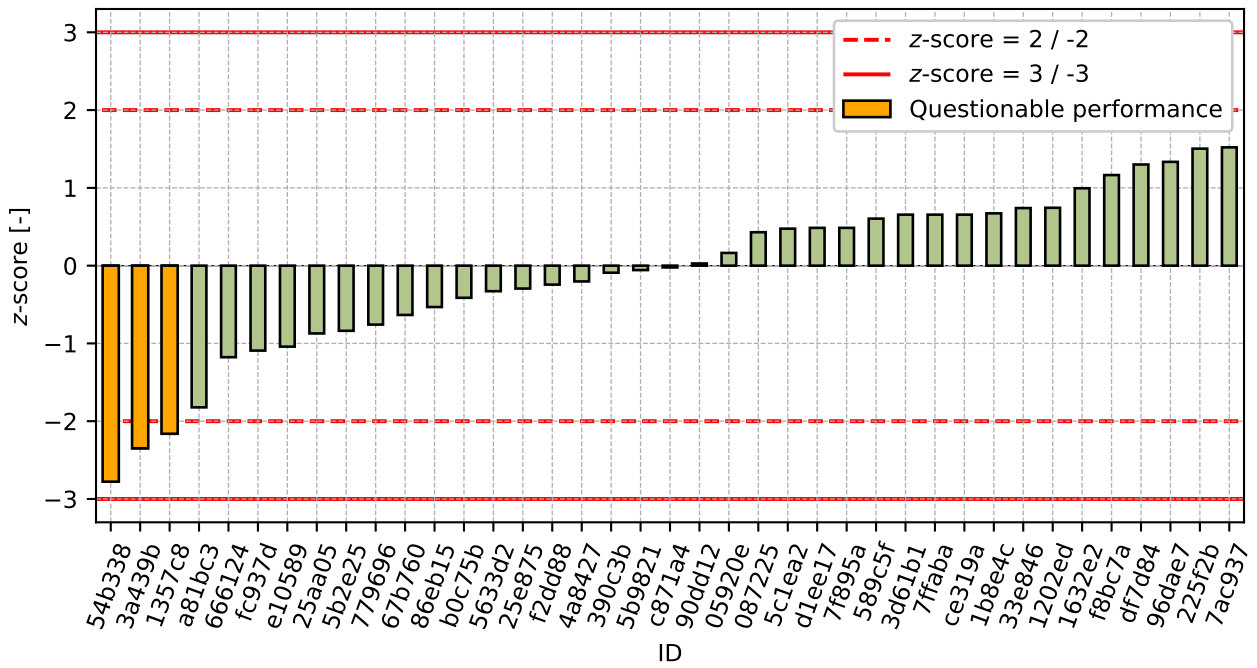
Figure 87: z-score

Figure 88: ζ-score

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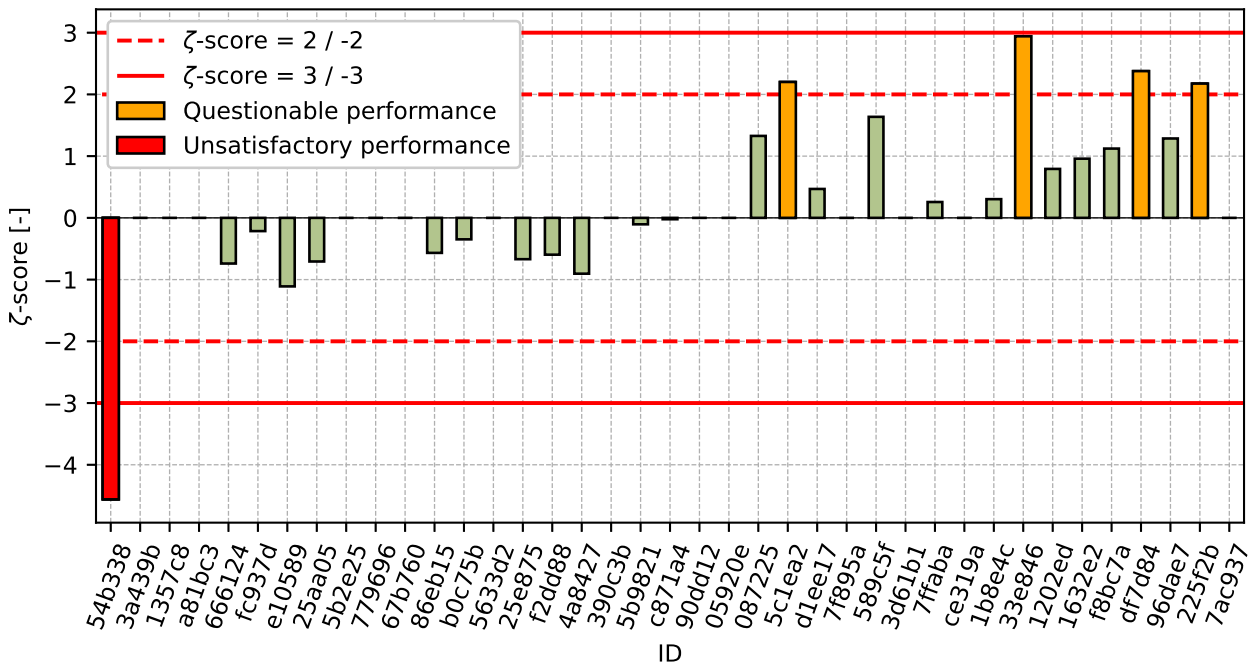
Table 46: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
54b338	-2.78	-4.56
3a439b	-2.35	-
1357c8	-2.16	-
a81bc3	-1.82	-
666124	-1.18	-0.74
fc937d	-1.09	-0.21
e10589	-1.04	-1.11
25aa05	-0.87	-0.71
5b2e25	-0.84	-
779696	-0.76	-
67b760	-0.63	-
86eb15	-0.53	-0.57
b0c75b	-0.41	-0.35
5633d2	-0.33	-
25e875	-0.29	-0.67
f2dd88	-0.24	-0.6
4a8427	-0.2	-0.9
390c3b	-0.09	-
5b9821	-0.06	-0.1
c871a4	-0.02	-0.02
90dd12	0.03	-
05920e	0.16	-
087225	0.43	1.33
5c1ea2	0.48	2.2
d1ee17	0.49	0.47
7f895a	0.49	-
589c5f	0.6	1.64
3d61b1	0.66	-
7ffaba	0.66	0.26
ce319a	0.66	-
1b8e4c	0.67	0.3
33e846	0.74	2.94
1202ed	0.74	0.79
1632e2	1.0	0.96
f8bc7a	1.16	1.12
df7d84	1.3	2.38
96dae7	1.33	1.29
225f2b	1.5	2.18
7ac937	1.52	-

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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 [%]
5b9821	14.1	14.7	14.2	1.1	14.3	0.32	2.24
ce319a	15.0	15.0	15.0	-	15.0	0.0	0.0
8aeb2c	15.2	15.7	15.4	0.2	15.4	0.25	1.63
1357c8	17.2	17.8	17.4	-	17.5	0.31	1.75
05920e	17.7	18.6	18.0	-	18.1	0.43	2.36
779696	18.6	18.6	18.6	-	18.6	0.01	0.05
e10589	19.0	19.0	19.0	2.1	19.0	0.0	0.0
54b338	19.1	18.4	19.9	1.1	19.1	0.73	3.8
390c3b	19.4	19.2	19.5	-	19.4	0.15	0.79
a81bc3	19.6	19.4	19.5	-	19.5	0.1	0.51
5633d2	19.5	19.9	19.3	-	19.6	0.31	1.56
5b2e25	19.5	20.1	19.3	-	19.6	0.42	2.12
7f895a	20.0	19.0	20.0	-	19.7	0.58	2.94
7ac937	19.1	20.3	-	-	19.7	0.85	4.31
67b760	19.5	20.2	20.0	-	19.9	0.36	1.81
225f2b	20.0	20.0	20.0	1.3	20.0	0.0	0.0
90dd12	20.0	20.0	20.0	-	20.0	0.0	0.0
589c5f	20.2	19.9	20.4	0.8	20.2	0.22	1.12
25e875	20.2	20.1	20.2	0.1	20.2	0.06	0.29
5c1ea2	20.0	20.2	20.3	0.2	20.2	0.14	0.69
25aa05	20.0	21.0	20.0	2.3	20.3	0.58	2.84
1632e2	21.0	20.0	20.0	2.0	20.3	0.58	2.84
86eb15	20.0	20.0	21.0	1.8	20.3	0.58	2.84
fc937d	20.2	20.6	20.4	10.0	20.4	0.2	0.98
df7d84	20.3	20.4	20.7	1.0	20.5	0.21	1.02
f8bc7a	21.0	21.0	20.0	2.0	20.7	0.58	2.79
c871a4	20.0	21.0	21.0	2.0	20.7	0.58	2.79
f2dd88	20.5	20.3	21.4	0.4	20.7	0.59	2.83
666124	20.2	21.3	21.0	2.0	20.8	0.57	2.73
7ffaba	20.9	20.8	20.9	2.5	20.9	0.06	0.28
3a439b	21.9	20.7	20.9	-	21.2	0.64	3.04
4a8427	21.3	21.2	21.3	0.1	21.3	0.04	0.19
087225	21.8	21.2	21.0	0.4	21.3	0.43	2.04
96dae7	21.0	22.0	21.0	2.0	21.3	0.58	2.71
d1ee17	22.0	21.0	21.0	2.0	21.3	0.58	2.71
b0c75b	22.2	21.3	21.7	2.4	21.7	0.45	2.07

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ID	Test results [%]			u_X [%]	$\bar{x}$ [%]	s_0 [%]	V_X [%]
1202ed	21.1	22.1	22.6	1.1	22.0	0.76	3.45
33e846	22.2	21.6	22.1	0.3	22.0	0.32	1.46
1b8e4c	22.0	22.0	22.0	4.0	22.0	0.0	0.0
3d61b1	23.0	23.0	23.0	-	23.0	0.0	0.0

8.2.2　The Numerical Procedure for Determining Outliers
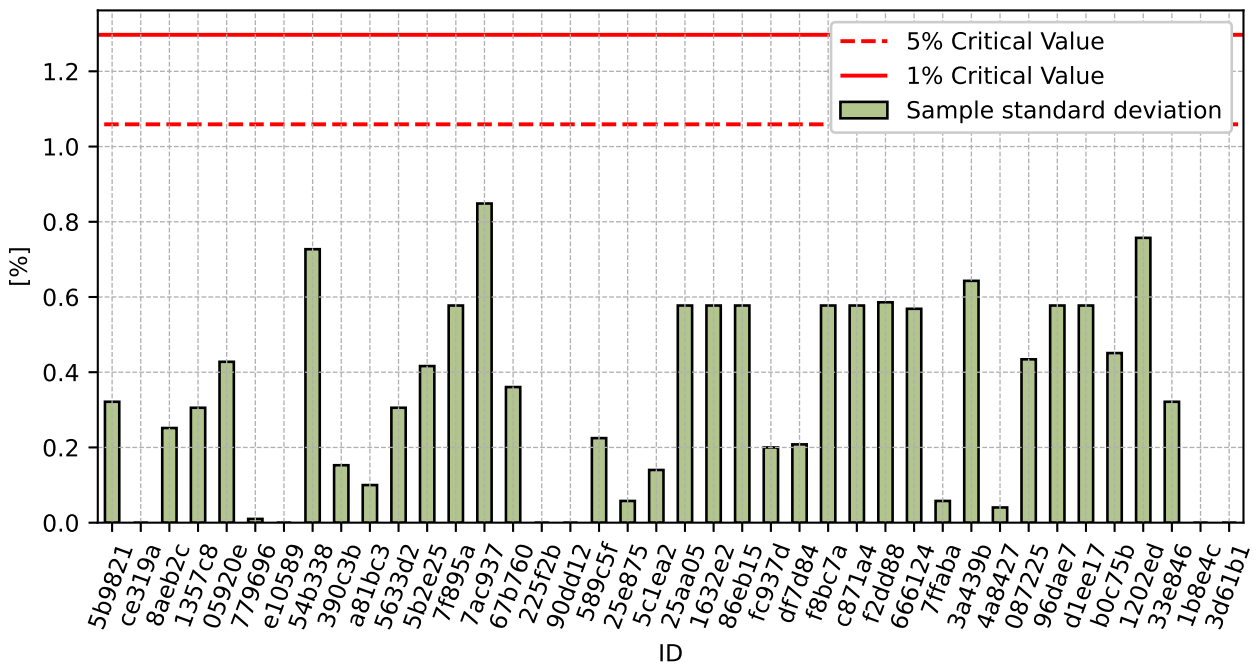
Figure 89: **Cochran's test** - sample standard deviations

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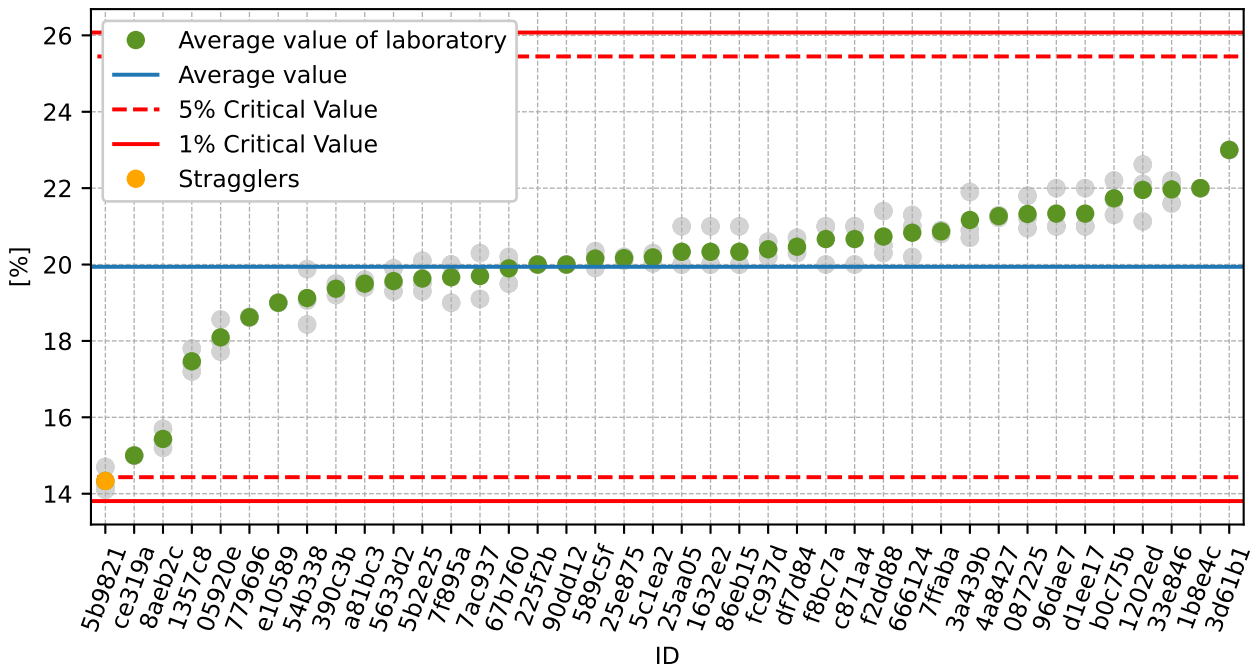
Figure 90: **Grubbs' test** - average values

8.2.3　Mandel's Statistics
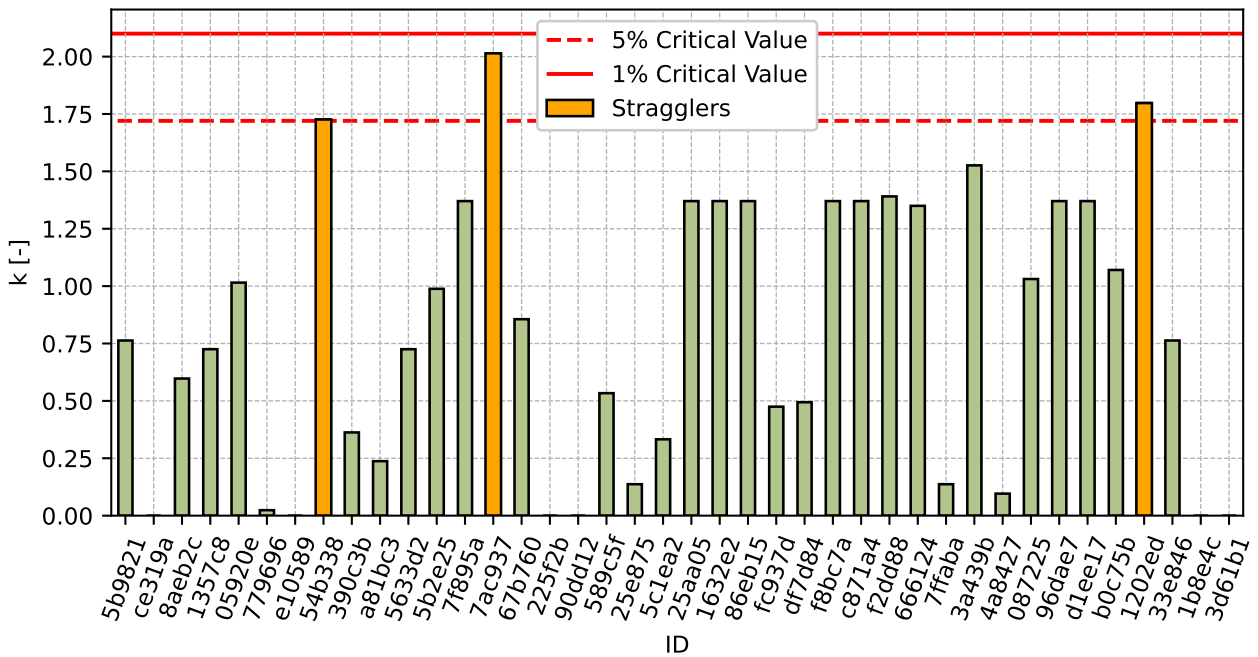
Figure 91: Intralaboratory Consistency Statistic

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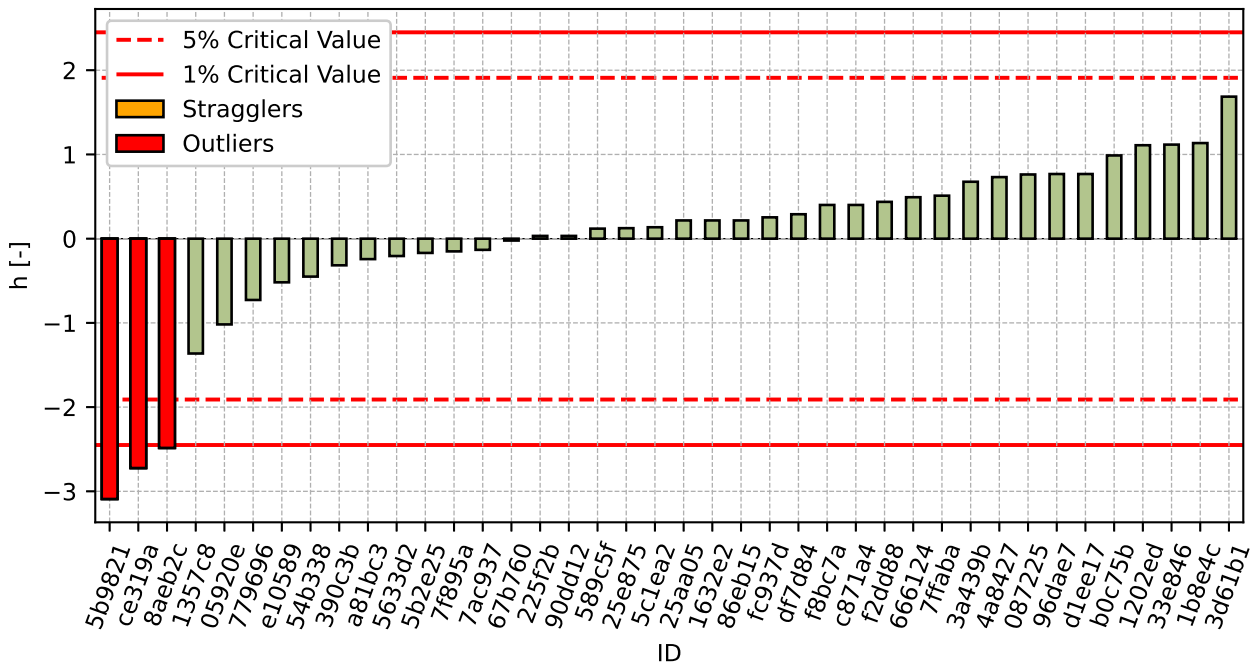Figure 92: Interlaboratory Consistency Statistic

8.2.4 Descriptive statistics
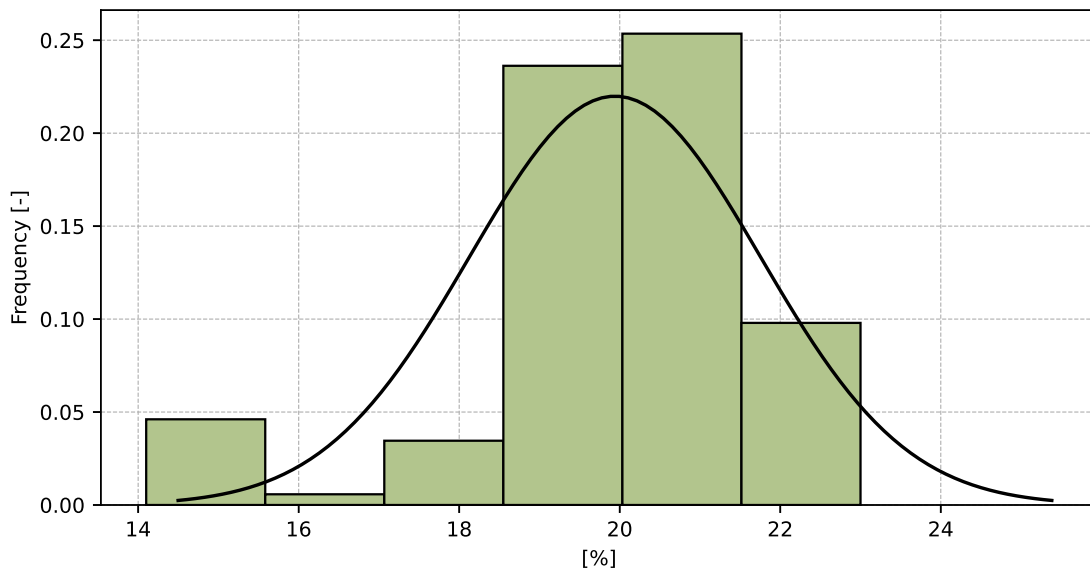
Figure 93: Histogram of all test results

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Table 48: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	19.9
Sample standard deviation – s	1.81
Asigned value – x^*	20.3
Robust standard deviation – s^*	1.21
Measurement uncertainty of asigned value – u_X	0.24
p-value of normality test	0.0 [-]
Interlaboratory standard deviation – s_L	1.8
Repeatability standard deviation – s_r	0.42
Reproducibility standard deviation – s_R	1.85
Repeatability – r	1.2
Reproducibility – R	5.2

8.2.5 Evaluation of Performance Statistics
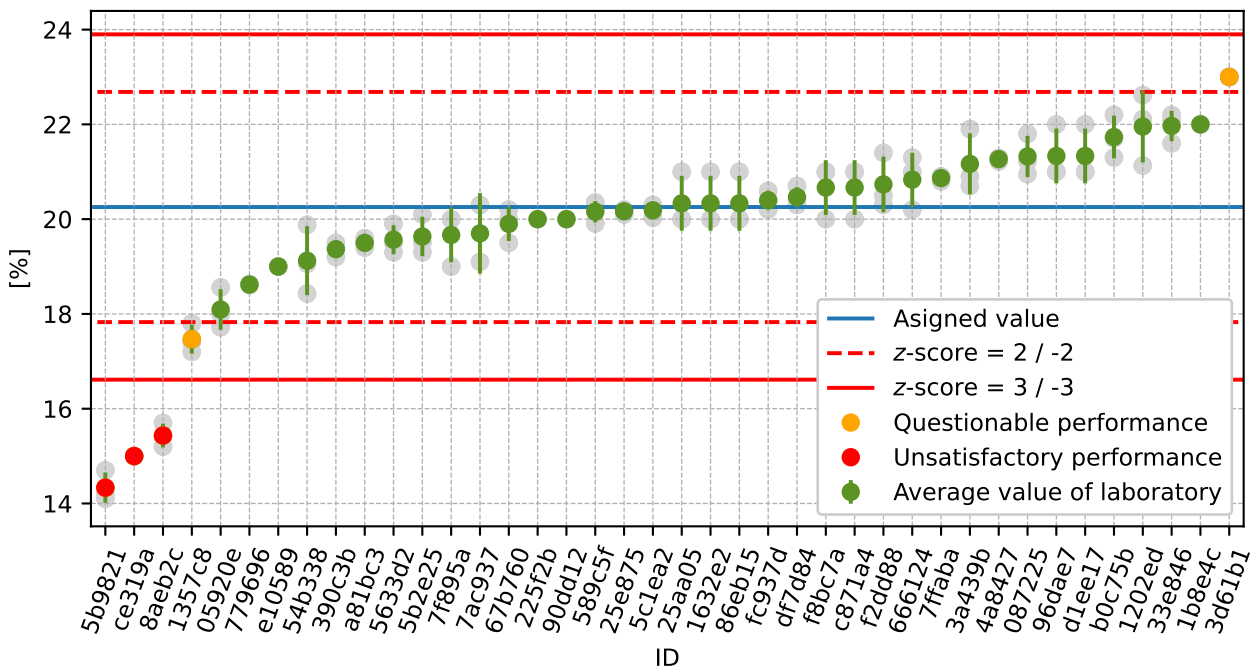
Figure 94: Average values and sample standard deviations

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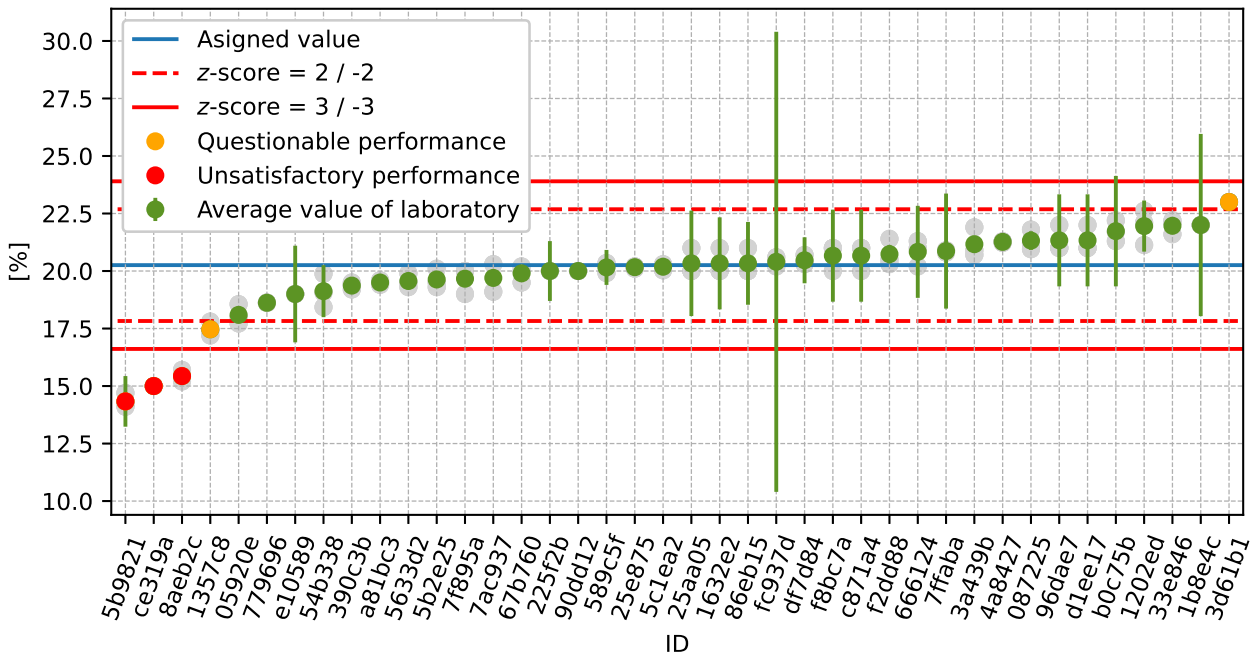
Figure 95: Average values and extended uncertainties of measurement

Figure 96: z-score

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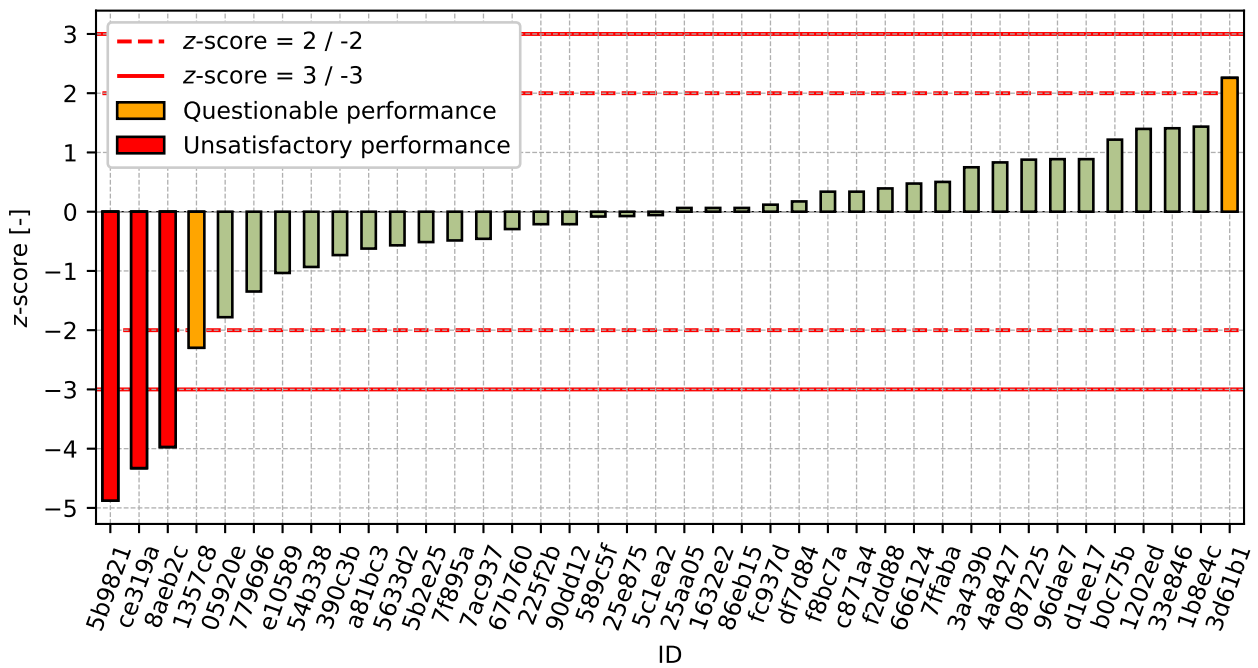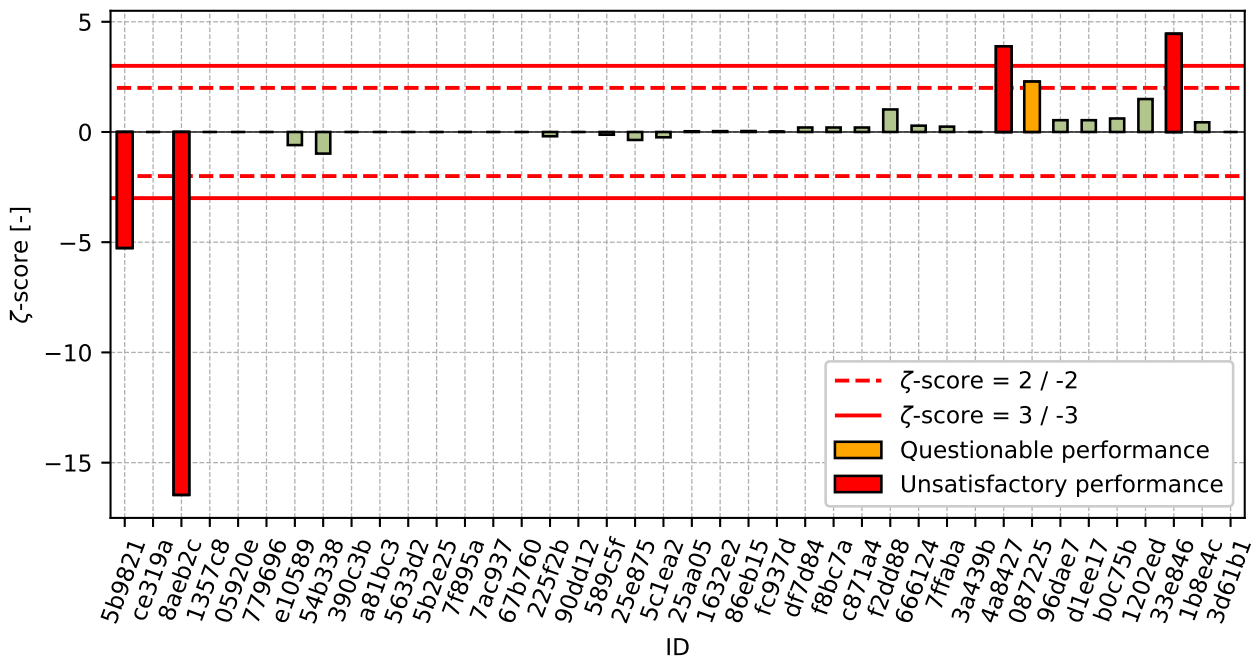
Figure 97: ζ-score

Table 49: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
5b9821	-4.88	-5.26
ce319a	-4.33	-
8aeb2c	-3.97	-16.46
1357c8	-2.3	-
05920e	-1.78	-
779696	-1.35	-
e10589	-1.03	-0.59
54b338	-0.93	-0.98
390c3b	-0.73	-
a81bc3	-0.62	-
5633d2	-0.57	-
5b2e25	-0.51	-
7f895a	-0.49	-
7ac937	-0.46	-
67b760	-0.29	-
225f2b	-0.21	-0.19
90dd12	-0.21	-
589c5f	-0.08	-0.12
25e875	-0.07	-0.36
5c1ea2	-0.06	-0.24
25aa05	0.06	0.03
1632e2	0.06	0.04
86eb15	0.06	0.04

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ID	z-score [-]	ζ-score [-]
fc937d	0.12	0.01
df7d84	0.17	0.2
f8bc7a	0.34	0.2
c871a4	0.34	0.2
f2dd88	0.39	1.02
666124	0.48	0.29
7ffaba	0.5	0.24
3a439b	0.75	-
4a8427	0.83	3.89
087225	0.88	2.29
96dae7	0.89	0.53
d1ee17	0.89	0.53
b0c75b	1.22	0.61
1202ed	1.4	1.49
33e846	1.41	4.45
1b8e4c	1.44	0.44
3d61b1	2.26	-

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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]
3832b5	1721	12
fdd45f	1739	12
b0c75b	1749	-
d1ee17	1760	7
53a71c	1770	0
fc937d	1770	1
8b3490	1770	-
55e5c0	1770	18
f2dd88	1780	0
67b760	1780	-
f8bc7a	1780	7
fed12a	1780	70
589c5f	1780	0
1b001e	1790	-
e81c64	1790	33
1b8e4c	1791	-
96dae7	1800	7
de7330	1800	-
df7d84	1810	50
25aa05	1810	53
779696	1810	-
86eb15	1818	23
8f9b0e	1820	17
60f194	1825	-
cc7904	1830	2
3a439b	1840	-
ce319a	1840	-
a81bc3	1850	-
ed0ab6	1892	-

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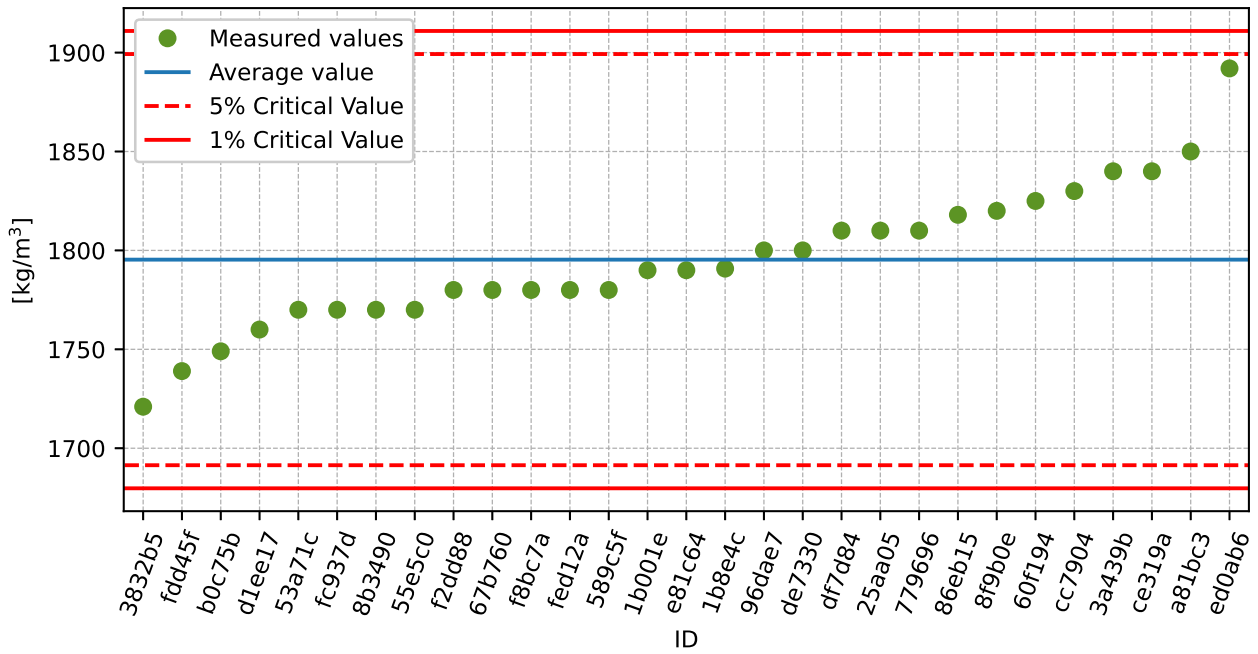
9.1.2 The Numerical Procedure for Determining Outliers

Figure 98: **Grubbs' test** - average values

9.1.3 Mandel's Statistics
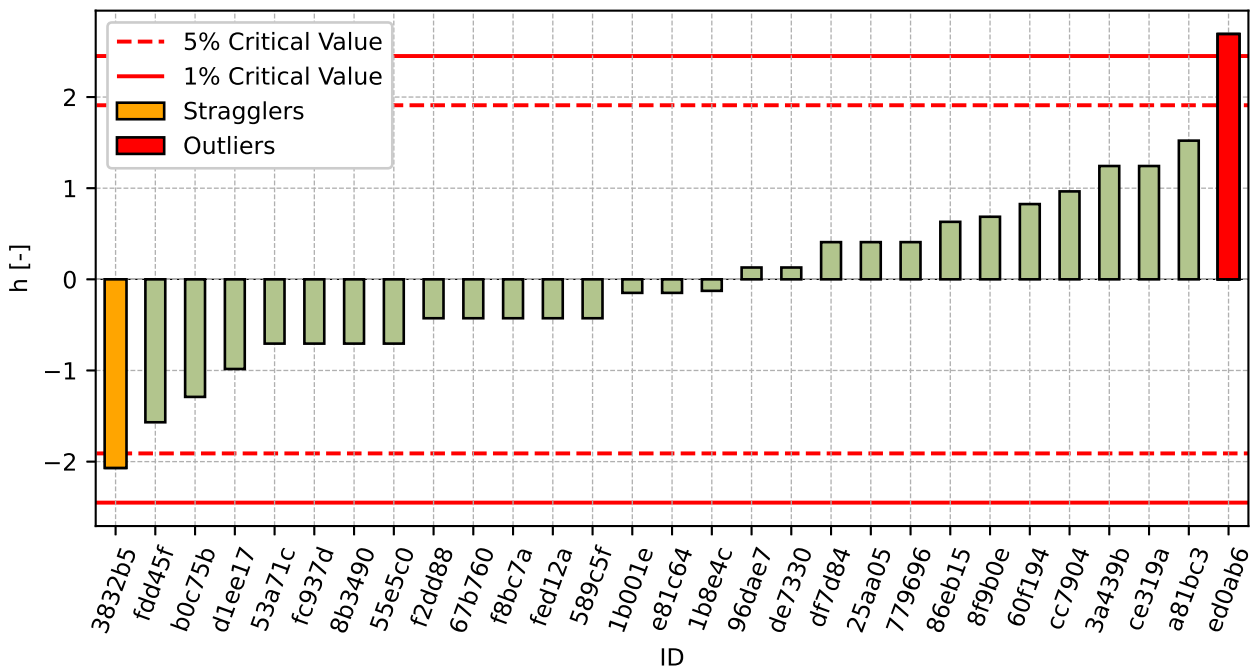
Figure 99: Interlaboratory Consistency Statistic

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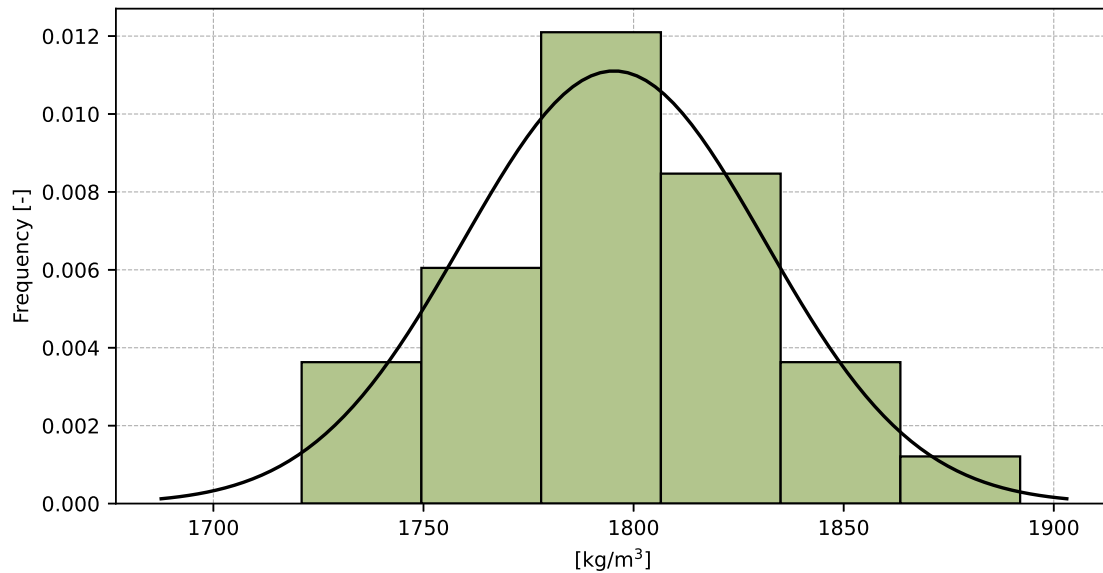Veveří 331/95 | 602 00 Brno | Czech Republic
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9.1.4   Descriptive statistics

Figure 100: Histogram of all test results

Table 51: Descriptive statistics

Characteristics	[kg/m^3]
Average value – $\bar{x}$	1795
Sample standard deviation – s	35.9
Asigned value – x^*	1795
Robust standard deviation – s^*	36.5
Measurement uncertainty of asigned value – u_X	8.5
p-value of normality test	0.773 [-]

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9.1.5   Evaluation of Performance Statistics
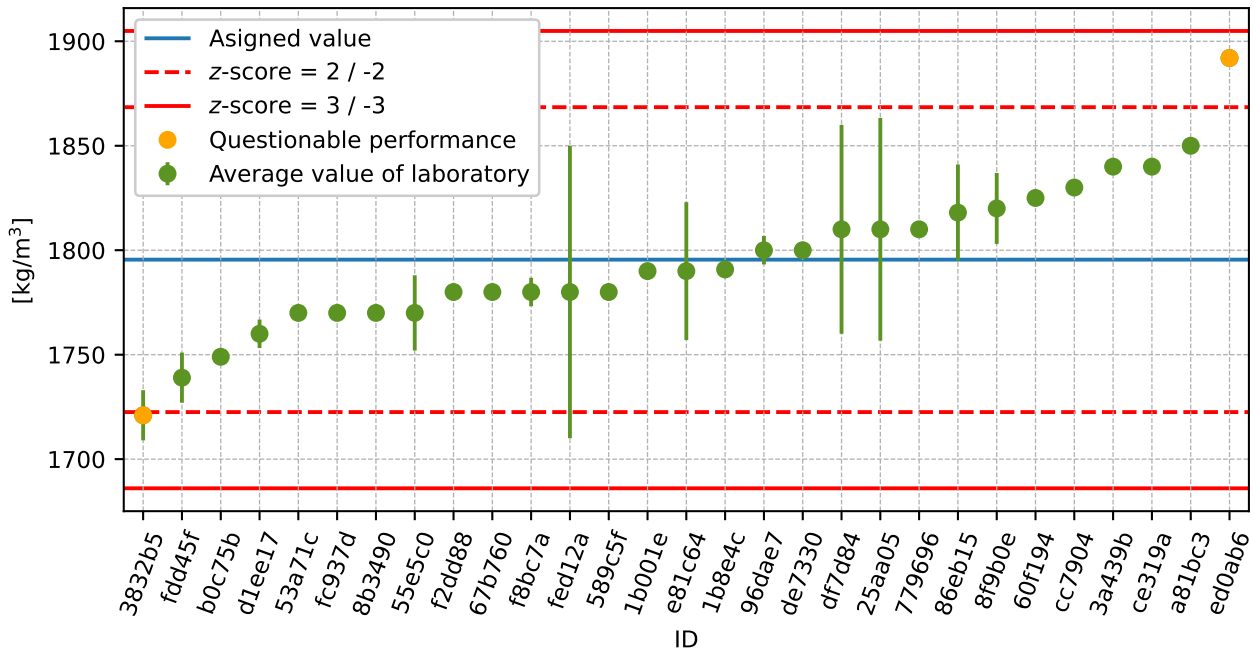
Figure 101: Average values and extended uncertainties of measurement

Figure 102: z-score
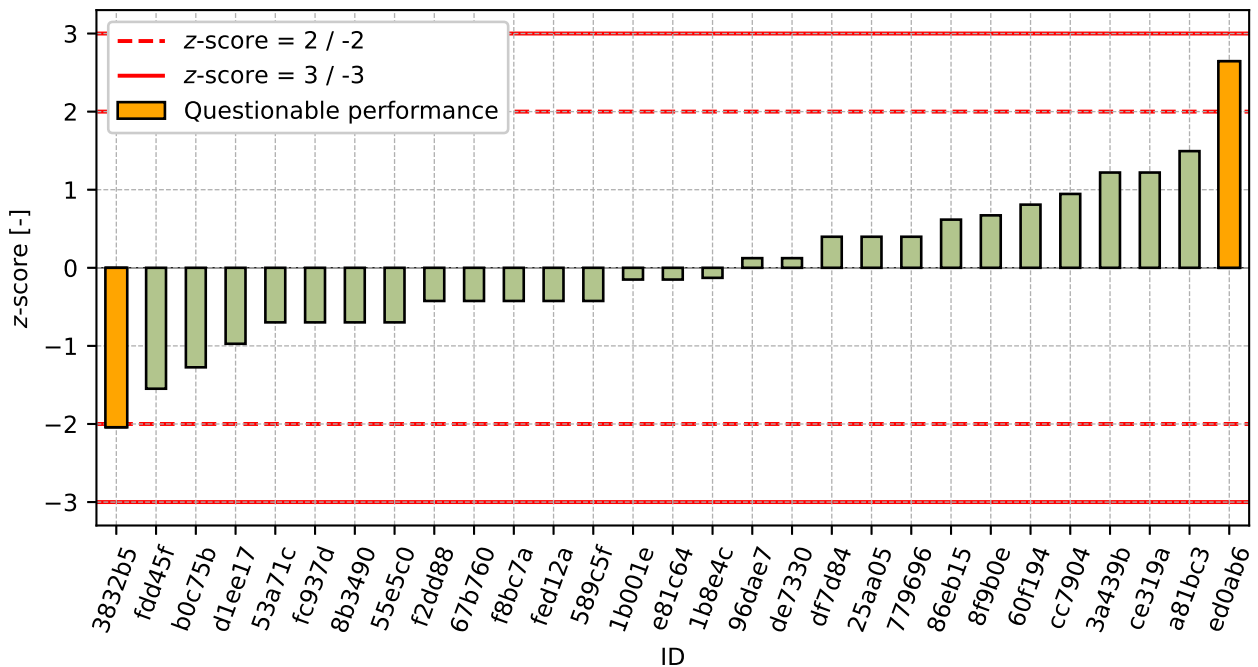
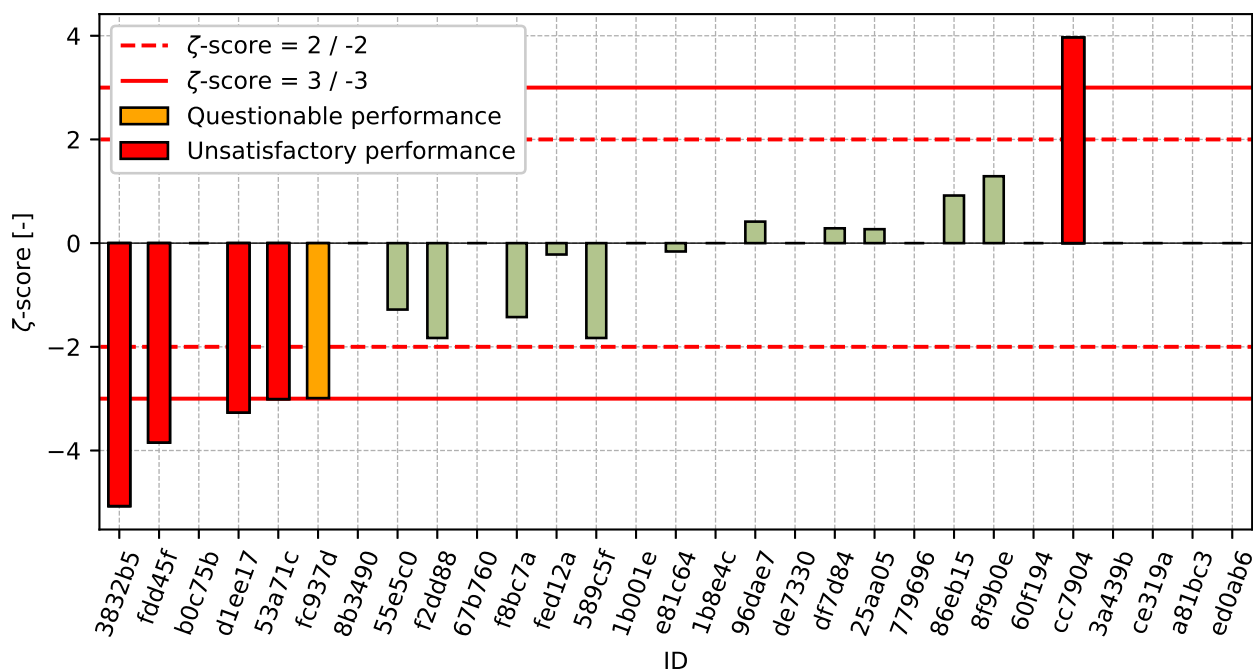Proficiency Testing Provider at the SZK FAST | Z 7008   104/118
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Figure 103: ζ-score

Table 52: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
3832b5	-2.04	-5.07
fdd45f	-1.55	-3.85
b0c75b	-1.27	-
d1ee17	-0.97	-3.27
53a71c	-0.7	-3.01
fc937d	-0.7	-2.99
8b3490	-0.7	-
55e5c0	-0.7	-1.28
f2dd88	-0.42	-1.83
67b760	-0.42	-
f8bc7a	-0.42	-1.43
fed12a	-0.42	-0.22
589c5f	-0.42	-1.83
1b001e	-0.15	-
e81c64	-0.15	-0.16
1b8e4c	-0.13	-
96dae7	0.12	0.42
de7330	0.12	-
df7d84	0.4	0.29
25aa05	0.4	0.27
779696	0.4	-
86eb15	0.62	0.92

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ID	z-score [-]	ζ-score [-]
8f9b0e	0.67	1.29
60f194	0.81	-
cc7904	0.95	3.97
3a439b	1.22	-
ce319a	1.22	-
a81bc3	1.49	-
ed0ab6	2.65	-

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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 [%]
ed0ab6	12.7	-
a81bc3	13.4	-
3a439b	13.5	-
cc7904	14.0	0.4
60f194	15.0	-
ce319a	15.0	-
25aa05	15.3	0.2
8b3490	15.4	-
55e5c0	15.5	0.7
86eb15	15.6	0.9
1b8e4c	15.9	-
779696	15.9	-
67b760	15.9	-
de7330	16.0	-
d1ee17	16.0	3.8
fed12a	16.0	1.8
df7d84	16.0	1.0
fc937d	16.1	4.0
589c5f	16.2	0.2
8f9b0e	16.2	0.1
3832b5	16.3	0.8
fdd45f	16.4	0.8
e81c64	16.5	0.5
f2dd88	16.7	0.3
96dae7	17.0	3.8
f8bc7a	17.0	3.8
1b001e	17.2	-
53a71c	17.3	0.1
b0c75b	18.0	-

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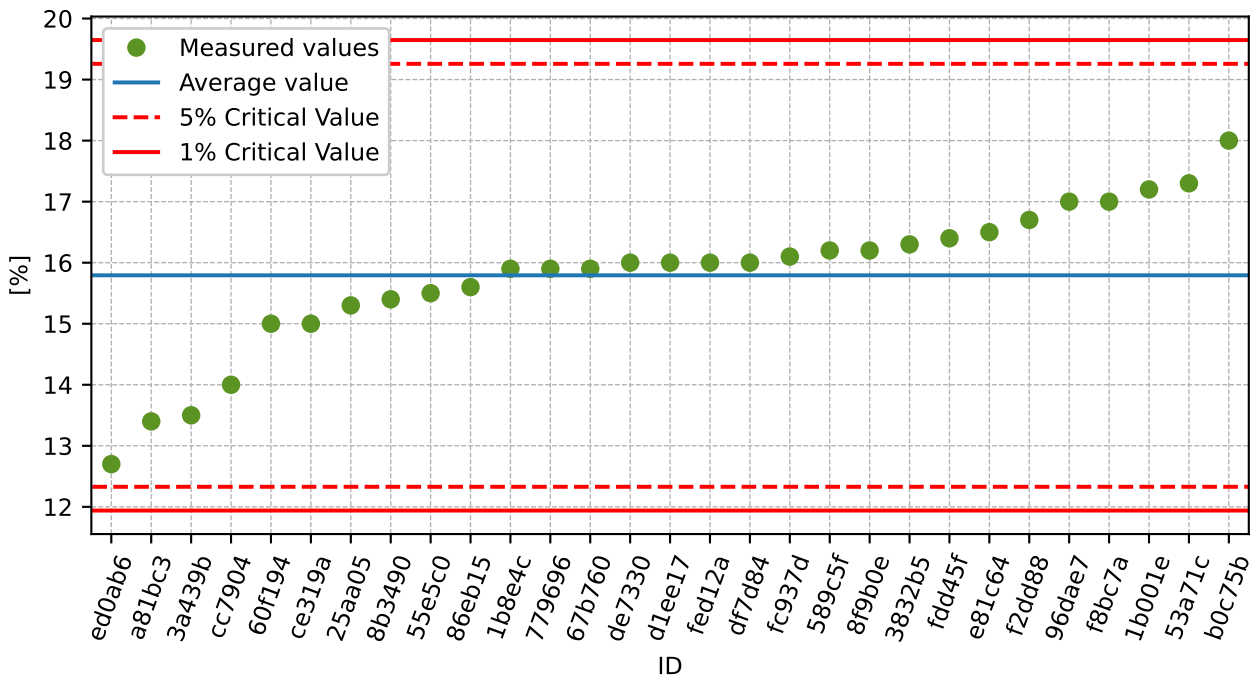## 9.2.2 The Numerical Procedure for Determining Outliers

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

9.2.3 Mandel's Statistics
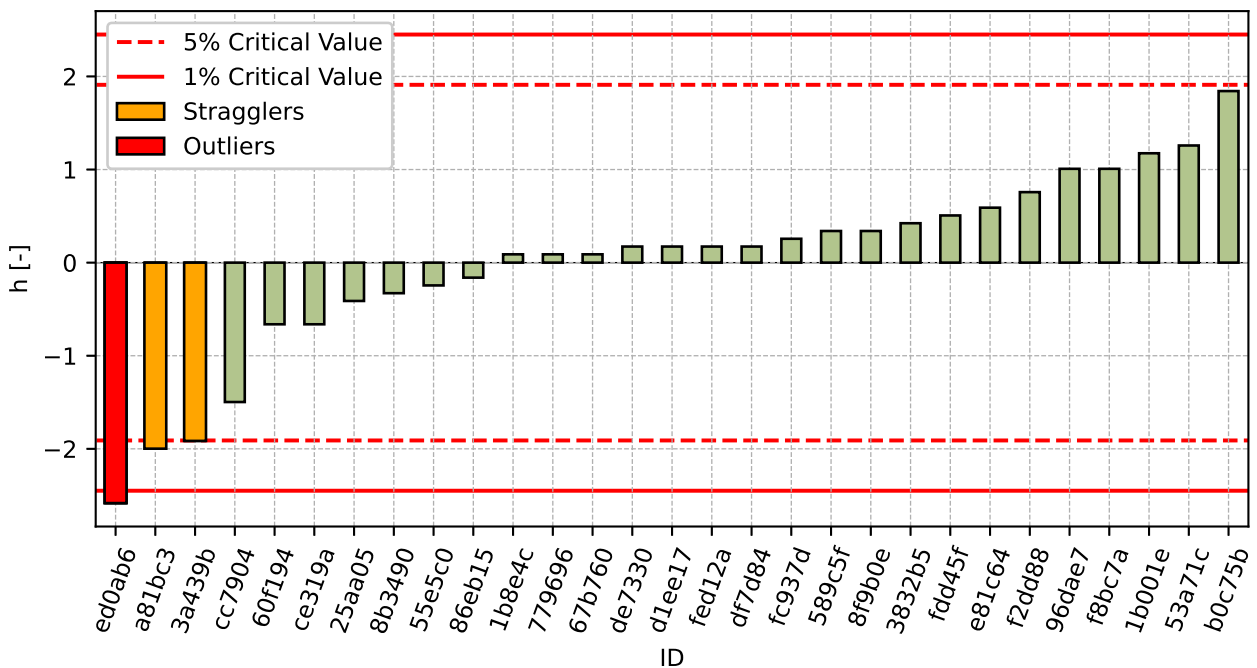
Figure 105: Interlaboratory Consistency Statistic

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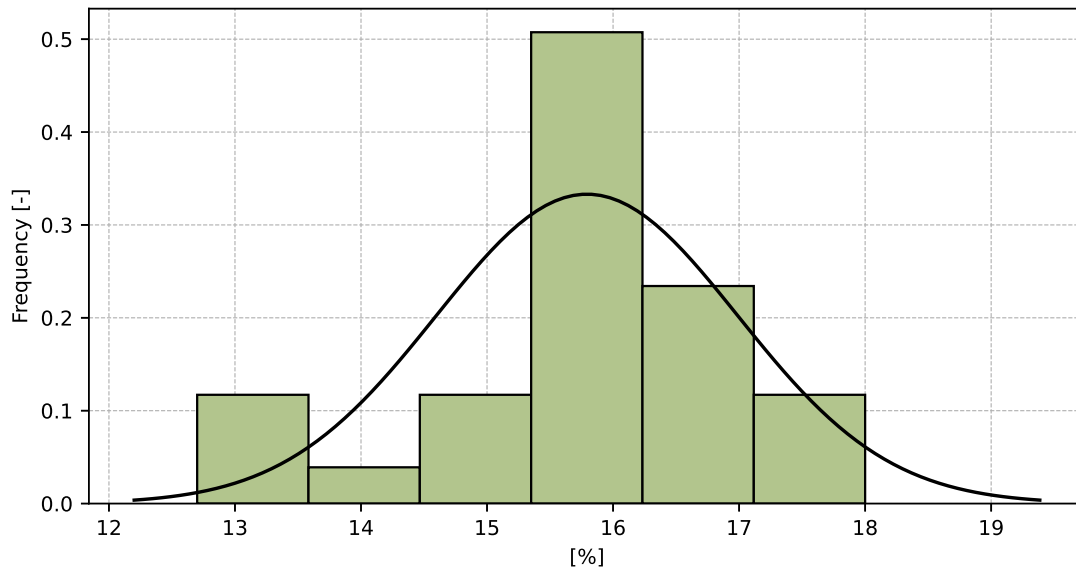Veveří 331/95 | 602 00 Brno | Czech Republic
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9.2.4 Descriptive statistics

Figure 106: Histogram of all test results

Table 54: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	15.8
Sample standard deviation – s	1.2
Asigned value – x^*	16.0
Robust standard deviation – s^*	0.89
Measurement uncertainty of asigned value – u_X	0.21
p-value of normality test	0.042 [-]

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9.2.5   Evaluation of Performance Statistics
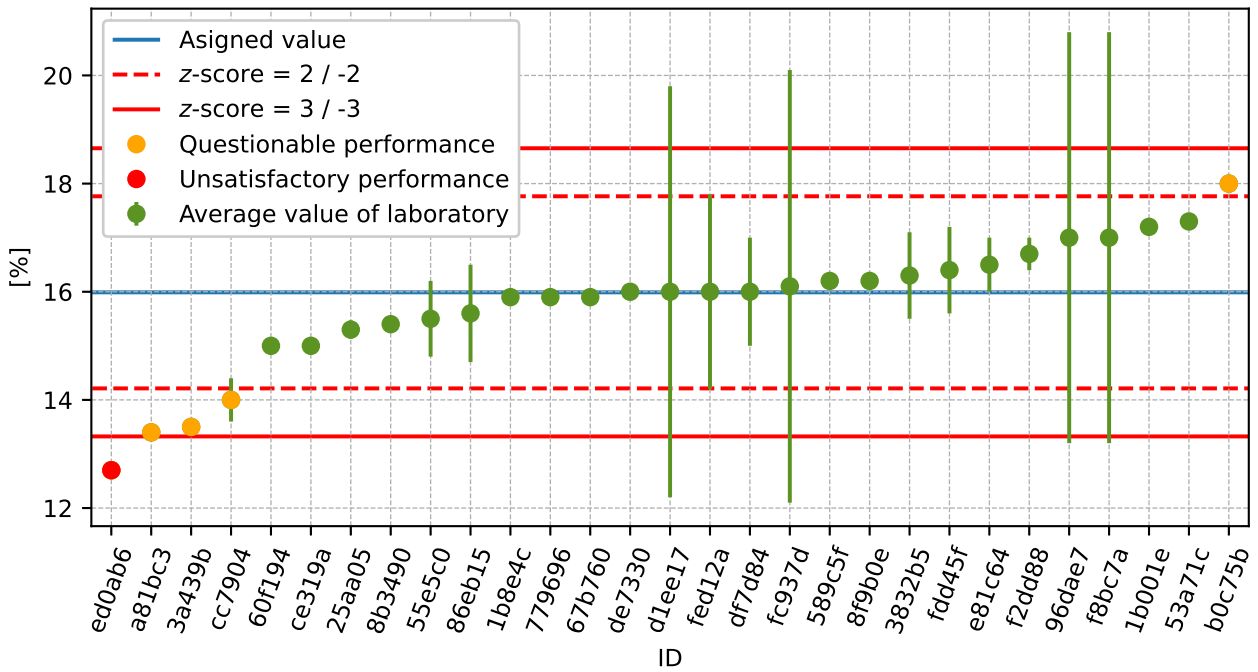
Figure 107: Average values and extended uncertainties of measurement

Figure 108: z-score

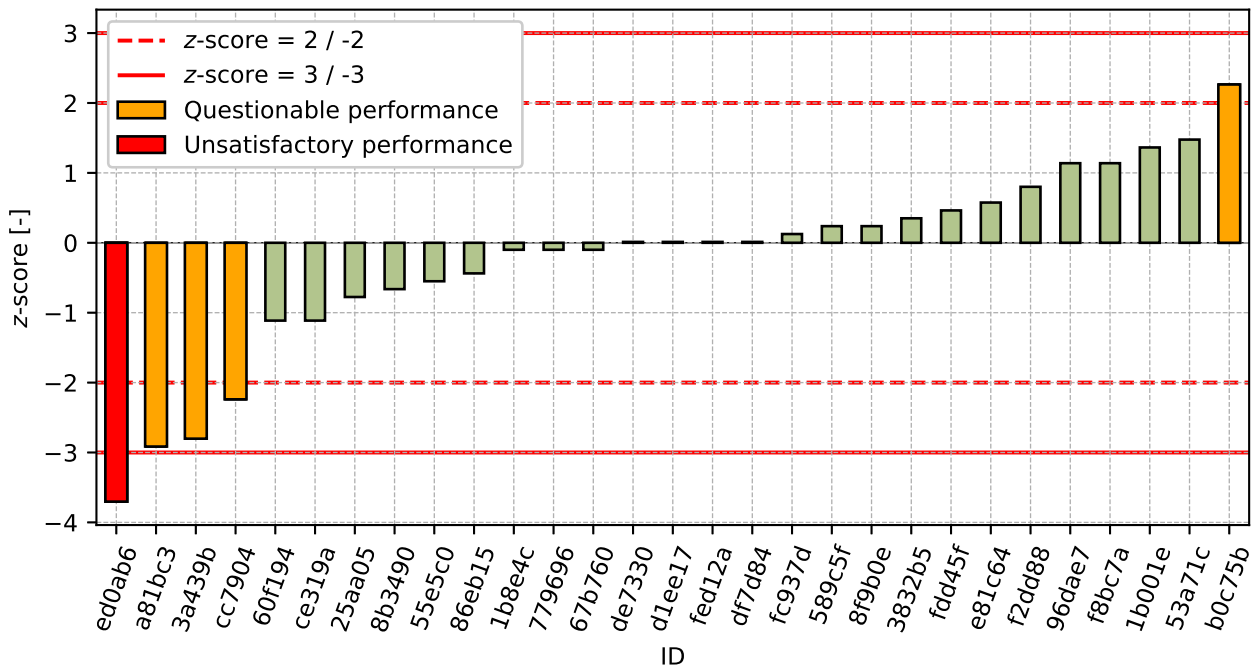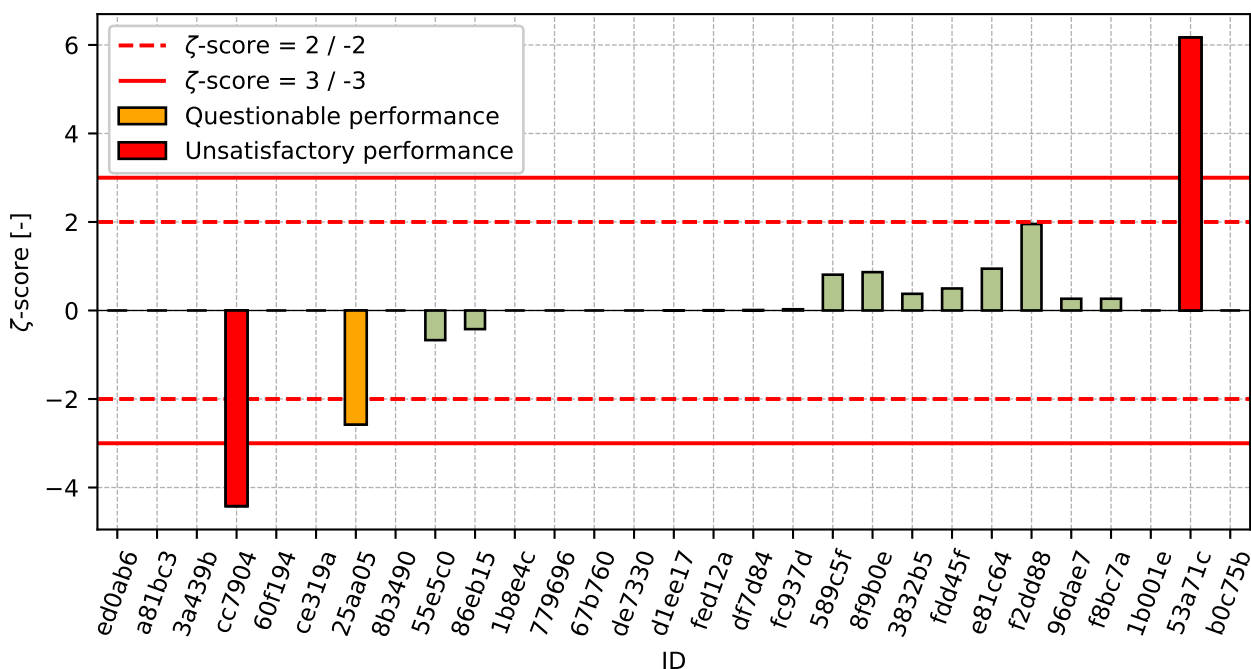Proficiency Testing Provider at the SZK FAST | Z 7008   110/118
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Figure 109: ζ-score

Table 55: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
ed0ab6	-3.7	-
a81bc3	-2.91	-
3a439b	-2.8	-
cc7904	-2.24	-4.42
60f194	-1.11	-
ce319a	-1.11	-
25aa05	-0.78	-2.58
8b3490	-0.66	-
55e5c0	-0.55	-0.67
86eb15	-0.44	-0.42
1b8e4c	-0.1	-
779696	-0.1	-
67b760	-0.1	-
de7330	0.01	-
d1ee17	0.01	0.0
fed12a	0.01	0.01
df7d84	0.01	0.01
fc937d	0.13	0.03
589c5f	0.24	0.81
8f9b0e	0.24	0.87
3832b5	0.35	0.38
fdd45f	0.46	0.5

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ID	*z*-score [-]	ζ-score [-]
e81c64	0.58	0.95
f2dd88	0.8	1.95
96dae7	1.14	0.27
f8bc7a	1.14	0.27
1b001e	1.36	-
53a71c	1.48	6.17
b0c75b	2.26	-

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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 [%]
fc937d	4	13
d1ee17	4	-
25aa05	5	1
068f53	6	-
86eb15	6	2
f90fb7	7	3
8aeb2c	7	0
96dae7	9	-
a81bc3	9	-
c0ca45	10	2
f8bc7a	11	-
ce319a	11	-
779696	11	-
087225	12	0
53a71c	12	-
60f194	12	-
67b760	12	-
de7330	13	-
df7d84	14	1
8b3490	14	-
225f2b	14	0
589c5f	16	1

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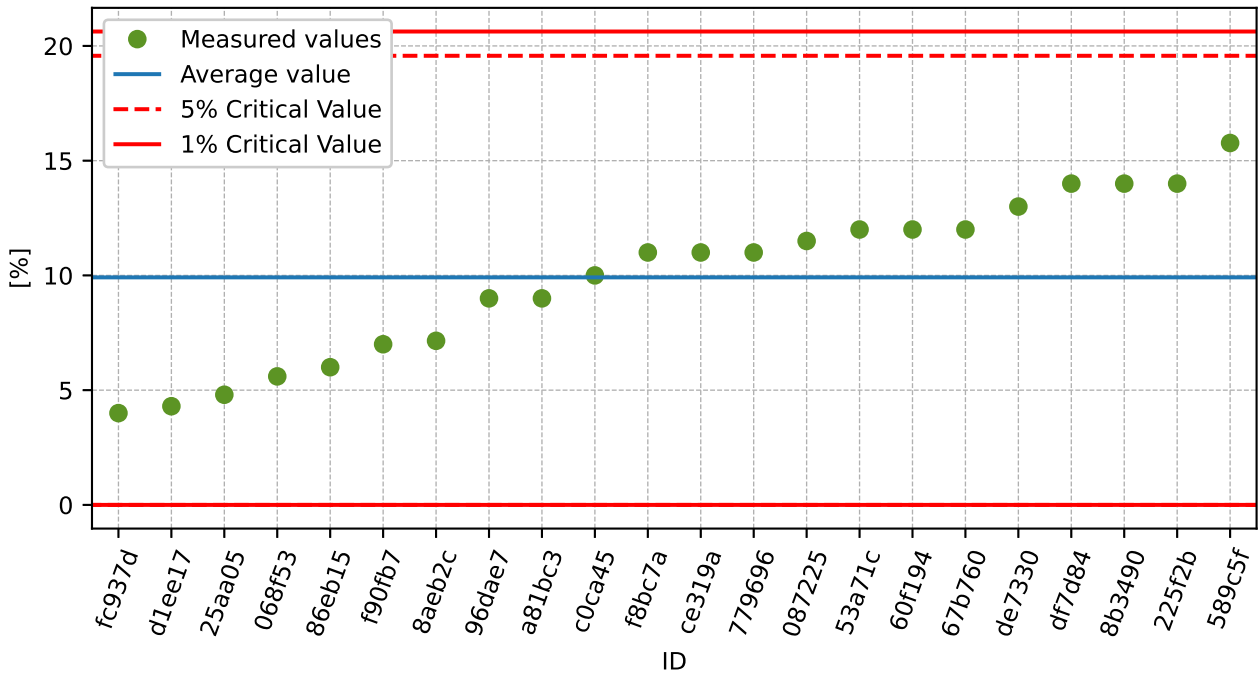## 10.2   The Numerical Procedure for Determining Outliers

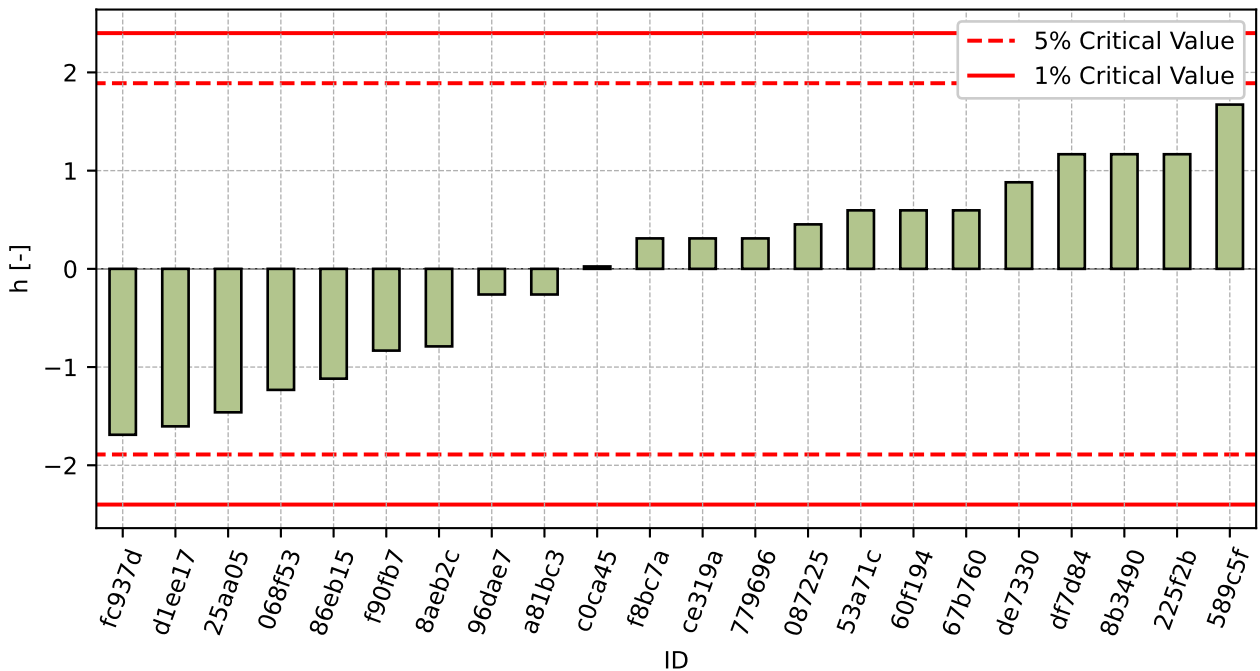Figure 110: **Grubbs' test** - average values

10.3   Mandel's Statistics

Figure 111: Interlaboratory Consistency Statistic

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10.4 Descriptive statistics
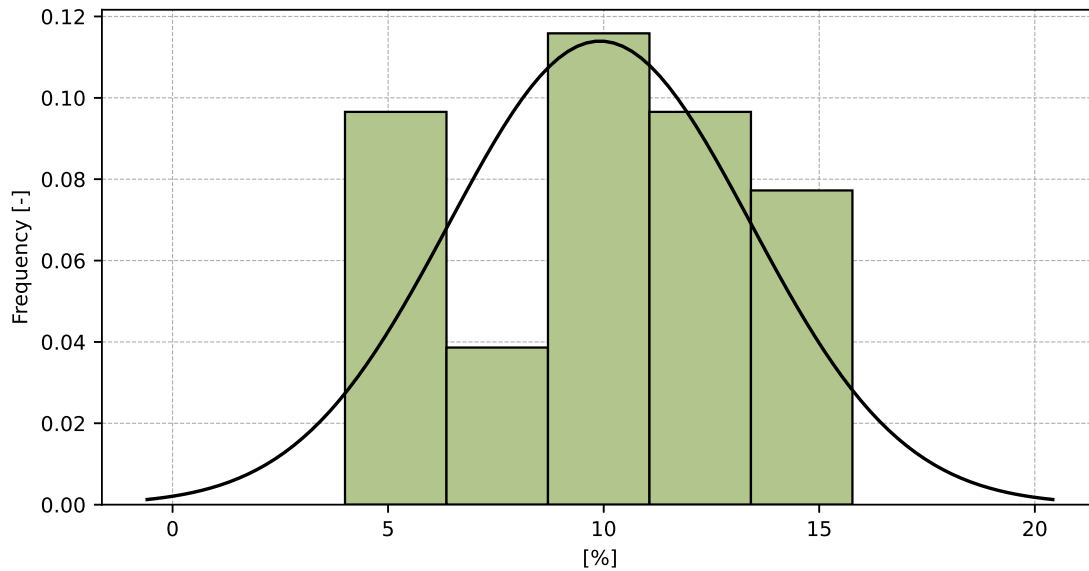
Figure 112: Histogram of all test results

Table 57: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	10
Sample standard deviation – s	3.5
Asigned value – x^*	10
Robust standard deviation – s^*	3.6
Measurement uncertainty of asigned value – u_X	1.0
p-value of normality test	0.228 [-]

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10.5   Evaluation of Performance Statistics
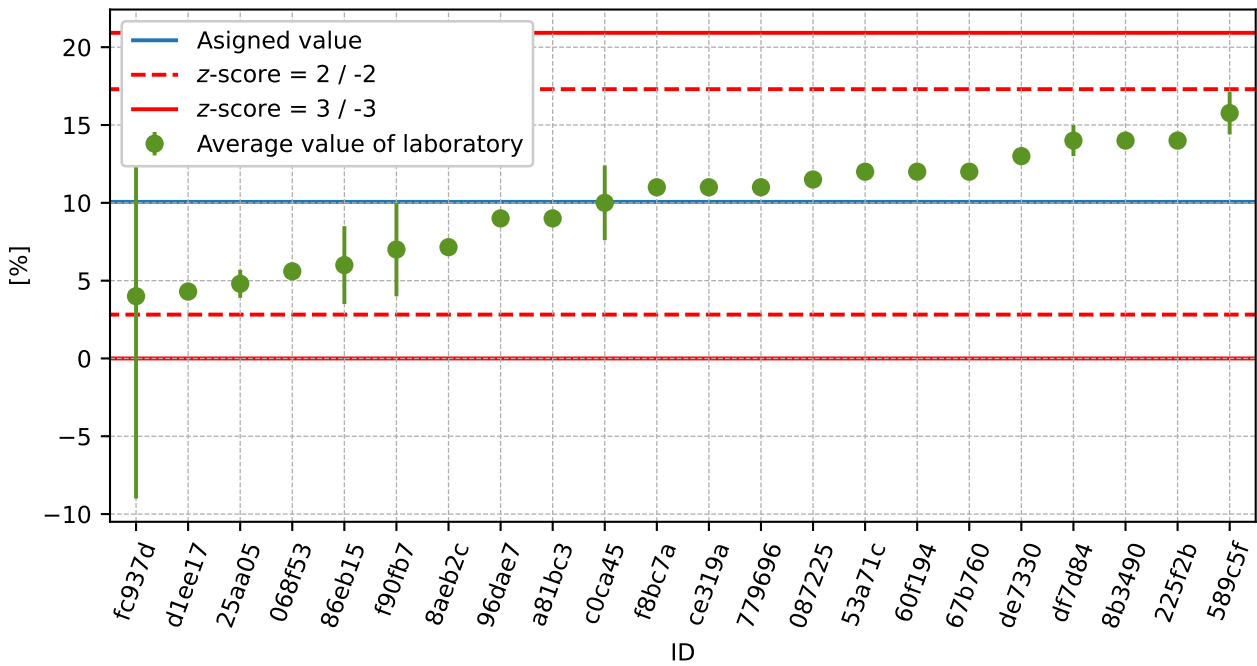
Figure 113: Average values and extended uncertainties of measurement

Figure 114: z-score

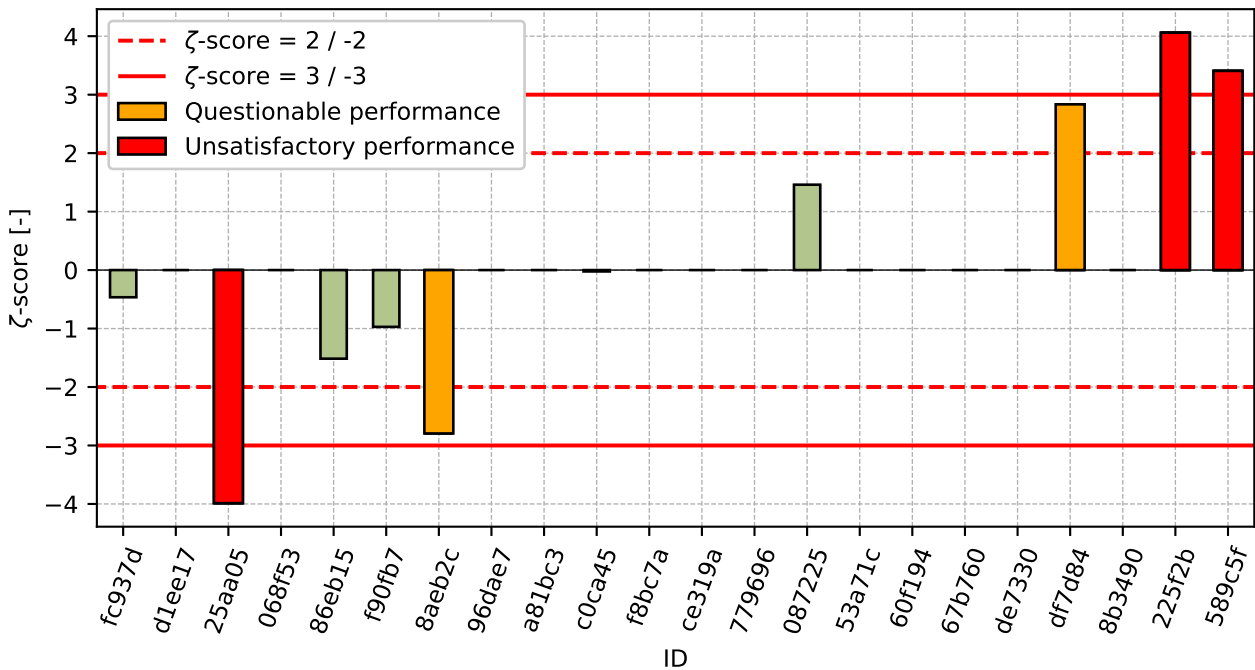Proficiency Testing Provider at the SZK FAST | Z 7008   116/118
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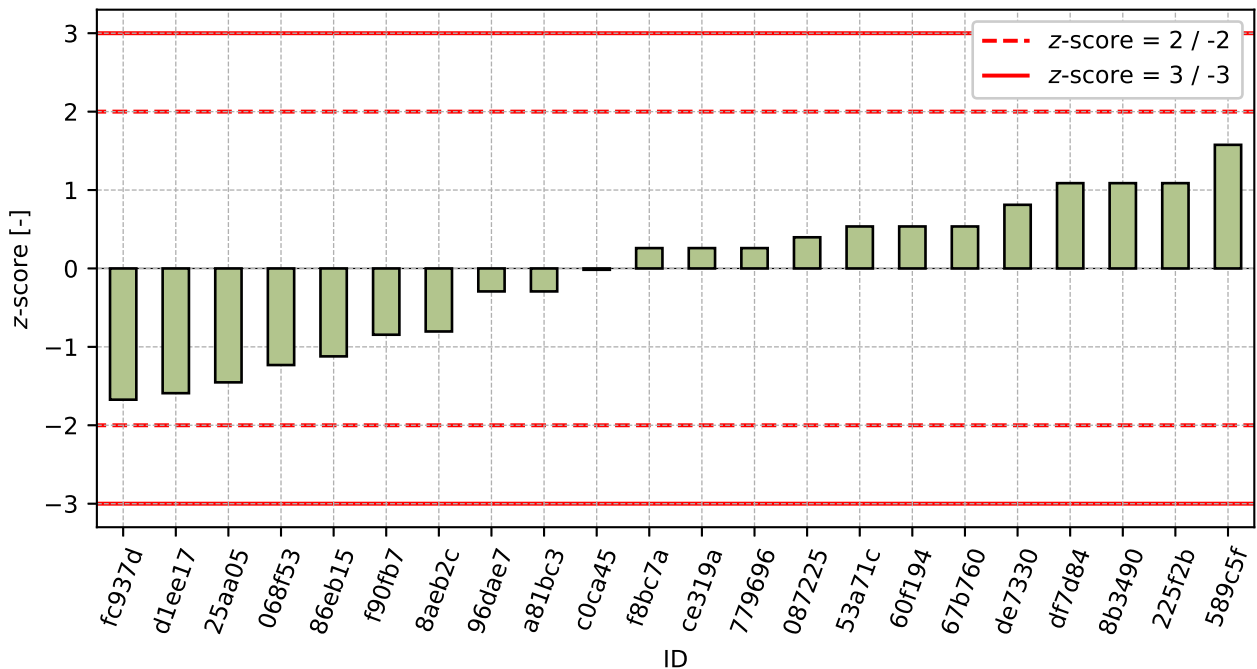
Figure 115: ζ-score

Table 58: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
fc937d	-1.67	-0.46
d1ee17	-1.59	-
25aa05	-1.45	-3.99
068f53	-1.23	-
86eb15	-1.12	-1.52
f90fb7	-0.85	-0.97
8aeb2c	-0.8	-2.79
96dae7	-0.29	-
a81bc3	-0.29	-
c0ca45	-0.02	-0.02
f8bc7a	0.26	-
ce319a	0.26	-
779696	0.26	-
087225	0.4	1.46
53a71c	0.54	-
60f194	0.54	-
67b760	0.54	-
de7330	0.81	-
df7d84	1.09	2.83
8b3490	1.09	-
225f2b	1.09	4.06
589c5f	1.58	3.41

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ID	z-score [-]	ζ-score [-]

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