BRNO UNIVERSITY OF TECHNOLOGY

FACULTY OF CIVIL ENGINEERING
institute of building testing

ilac-MRA

Z 7008

FINAL REPORT ON THE RESULTS OF PRECISION EXPERIMENT

Proficiency Testing Program
Aggregate Testing
ZK 2023/1

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

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

Date: August 14, 2023

Poskytovatel zkoušení způsobilosti při SZK FAST
Proficiency testing provider at the SZK FAST
Z 7008
Veveří 95
602 00 Brno
Czech Republic
szk.fce.vutbr.cz

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

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

Contents

1 Introduction and Important Contacts

At the beginning of 2023, the Proficiency Testing Provider at SZK FAST (PoZZ) launched a Proficiency Testing Programme (PrZZ), designated ZK 2023/1, to verify and assess the consistency of aggregate test results. The assessment of the results of the proficiency testing programme was carried out by a committee consisting of the following PT Provider employees:

Head of the PT Provider, PTP coordinator

Assoc. Prof. Tomáš Vymazal, Ph.D.
Brno University of Technology
Faculty of Civil Engineering
Institute of Building Testing
Veveří 95, Brno 602 00
Czech Republic
Tel.: +420 603 313 337
Email: Tomas.Vymazal@vutbr.cz

Coordinator of PTP result assessment PTP

Ing. Petr Misák, Ph.D.
Brno University of Technology
Faculty of Civil Engineering
Institute of Building Testing
Veveří 95, Brno 602 00
Czech Republic
Tel.: +420 774 980 255
Email: Petr.Misak@vutbr.cz

The subjects of proficiency testing were the following testing procedures:

1. EN 933-1 Determination of particle size distribution - Sieving method [1],
2. EN 933-3 Determination of particle shape - Flakiness index [2],
3. EN 933-4 Determination of particle shape - Shape index [3],
4. EN 933-8 Assessment of fines - Sand equivalent test [4],
5. EN 933-9 Assessment of fines - Methylene blue test [5],
6. EN 933-10 Assessment of fines - Grading of filler aggregates (air jet sieving) [6],
7. EN 1097-1 Determination of the resistance to wear (micro-Deval) [7],
8. EN 1097-2 Methods for the determination of resistance to fragmentation - chapter 5 [8],
9. EN 1097-2 Methods for the determination of resistance to fragmentation - chapter 6 [8],
10. EN 1097-3 Determination of loose bulk density and voids [9],
11. EN 1097-5 Determination of the water content by drying in a ventilated oven [10],
12. EN 1097-6 Determination of particle density and water absorption [11],
13. EN 1097-7 Determination of the particle density of filer - Pyknometer method [12],
14. EN 1367-1 Determination of resistance to freezing and thawing [13],
15. EN 1367-2 Magnesium sulfate test [14],
16. EN 1367-3 Boiling test for "Sonnenbrand basalt" [15],
17. TP 137 - Appendix 1 and 2 – Determination of reactivity of aggregates in connection with alkalies [16],
18. ČSN 72 1179 Determination of reactivity of aggregates in connection with alkalies – chapter B [17].

Test procedures 6, 9, 13, 16, 17 and 18 were not opened due to low interest of participants.

The supplier, BETOTECH s. r. o. (L 1195.3), was responsible for the preparation of testing samples for the PTP. The supplier is responsible for homogeneity and stability of testing samples.

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 [18] and with EN ISO/IEC 17043 [19].

The outcome is the present final report summarizing the results of the interlaboratory comparison, including statistical evaluation.

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

Table 1: Participation of individual laboratories in the PTP

ID/Method	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
7e36d6	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-
a51011	X	-	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-
c5a3f5	X	-	-	X	-	-	X	X	-	-	-	X	-	-	X	-	-	-
ff27cd	X	-	X	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
b0afd4	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-
a396b5	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
c3ab08	X	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
280514	X	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
fea11c	X	-	X	-	-	-	-	X	-	-	-	X	-	-	-	-	-	-
0a6d66	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
92e96e	X	X	-	-	X	-	-	X	-	-	X	X	-	-	X	-	-	-
416068	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
bded50	-	-	-	-	-	-	-	X	-	-	-	X	-	-	X	-	-	-
5bcbfa	-	-	-	-	-	-	-	X	-	-	-	-	-	-	X	-	-	-
154c4d	X	-	X	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-
cf83a2	X	-	X	-	-	-	-	-	-	-	X	X	-	X	-	-	-	-
0782f3	X	-	X	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-
5d0efa	X	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
4df247	X	-	-	X	-	-	X	X	-	-	-	X	-	-	X	-	-	-
c23bc6	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-	-
2f88fe	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
f1363c	X	X	-	-	X	-	X	X	-	-	-	X	-	-	-	-	-	-
562c38	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
c857ef	X	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
5acf80	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3c6f1d	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
92e563	X	X	X	X	-	-	-	X	-	-	-	X	-	-	-	-	-	-
7abdbd	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
da3a05	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
0fe6b5	X	-	X	-	-	-	-	-	-	-	X	-	X	X	-	-	-	-
0b8d00	X	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
d92da1	X	-	X	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
79965e	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
7a98ee	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
50b361	X	-	X	-	X	-	-	-	-	-	-	X	-	-	-	-	-	-
72ec44	X	-	-	-	-	-	X	X	-	X	X	X	X	X	-	-	-	-
fdfd05	X	-	X	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-

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ID/Method	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
e543af	X	X	-	-	-	-	-	X	-	-	X	-	-	-	-	-	-	-
2d41fb	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
d261c7	X	-	-	-	X	-	-	X	-	-	-	-	-	-	-	-	-	-
900d05	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-
6a0c4d	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ff50d6	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
639ddc	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
e1819f	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
1e9672	X	X	-	-	X	-	X	X	-	-	X	X	-	-	-	-	-	-
6192bc	X	-	X	-	-	-	-	-	-	X	X	X	-	-	-	-	-	-
8e8268	X	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
c8e70e	X	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
44e68c	X	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
968ceb	X	-	-	-	-	-	-	-	-	-	X	-	-	X	-	-	-	-
02be40	X	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
fa8544	-	-	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-
a3cf10	X	-	X	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-
55547e	X	-	X	-	-	-	-	X	-	X	X	X	-	X	-	-	-	-
478486	X	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
36026f	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4516b2	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
a0d668	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7d21b5	-	-	-	-	-	-	-	X	-	-	-	X	X	-	-	-	-	-
315309	X	-	X	X	X	-	X	X	-	X	X	X	-	X	X	-	-	-
978d47	X	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-
644bba	X	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
aa146e	X	X	X	-	-	-	X	X	-	X	X	X	-	-	X	-	-	-
17f205	X	-	X	-	-	-	-	X	-	-	-	X	-	-	-	-	-	-
8da3cb	-	-	-	-	X	-	-	-	-	-	-	-	-	X	-	-	-	-
52d231	-	X	-	-	-	-	-	-	-	X	-	-	X	X	-	-	-	-
82bd3a	X	-	X	X	-	-	-	-	-	X	X	X	-	-	-	-	-	-
68cc77	X	-	X	X	-	-	-	-	-	-	X	X	-	-	-	-	-	-
32a836	-	-	X	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
36b1a5	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
140849	X	-	X	X	-	-	-	X	-	-	X	-	-	-	-	-	-	-
3ca242	X	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-
69b2b6	-	X	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-
93bf8b	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-	-	-	-
e7e3fa	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
edf35f	X	-	X	X	-	-	-	-	-	-	X	X	-	X	-	-	-	-
b39bb2	X	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
7d4aa0	X	X	-	X	X	-	-	X	-	X	X	X	-	-	X	-	-	-
106bb0	X	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9f2452	X	-	-	-	X	-	-	-	-	-	-	-	-	X	-	-	-	-
066d89	X	-	-	-	-	-	-	-	-	-	X	X	-	-	X	-	-	-

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ID/Method	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
6e99ab	-	-	-	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
AG Institut doo Novi Sad, Sektor za laboratorijska ispitivanja - Laboratorija Beograd	Dr. Đorđa Joanovića 4/7 Novi Sad	01-457
AG Institut doo Novi Sad, Sektor za laboratorijska ispitivanja - Laboratorija Novi Sad	Dr. Đorđa Joanovića 4/7 Novi Sad	01-457
ALFA TEST	PALEOPANAGIAS 13, PEANIA, 190 02, ATTIKI	-
ARP GmbH	Johann-Sackl-Gasse 65-67, Leoben, 8700, Austria	-
B-PROJEKTY Teplice s.r.o.	Kollárova 1879/11, Teplice, 415 01, Česká republika	L 1428
BANAT INŽENJERING 223 DOO	Makedanska 15, Zrenjanin, 23000, Serbia	-
BETOTECH, s.r.o. - Pracoviště Beroun	Beroun 660, Beroun, 26601, Česká Republika	AZL 1195
BETOTECH, s.r.o. - Pracoviště Jindřichův Hradec	Beroun 660, Beroun, 26601, Česká Republika	AZL 1195
BETOTECH, s.r.o. - Pracoviště Most	Beroun 660, Beroun, 26601, Česká Republika	AZL 1195
BETOTECH, s.r.o. - Pracoviště Trutnov	Beroun 660, Beroun, 26601, Česká Republika	AZL 1195
BETOTECH, s.r.o. - pracoviště Brno	Beroun 660, Beroun, 26601, Česká republika	1195.3
BETOTECH, s.r.o. - pracoviště Ostrava	Beroun 660, Beroun, 266 01, Česká republika	1195.2
Baustoffprüfstelle an der HTBLuVA Villach	Tschinowitscherweg 5, Villach, 9500, Österreich	-
Bechtel ENKA UK Limited Ogranak Beograd	Jasički put 52đ, Kruševac, 37000, Serbia	01-510
Betotech s.r.o., laboratoř Mokrá	Beroun 660, Beroun, 266 01, Česká republika	1195.3
BetónRacio, s.r.o., Skúšobné laboratórium, Pracovisko Trnava	Skladová 2, Trnava, 917 01, Slovenská republika	S-320
BetónRacio, s.r.o., Skúšobné laboratórium, Pracovisko Veľký Šariš	Skladová 2, Trnava, 917 01, Slovenská republika	S-320
CEMEX Czech Republic, s.r.o.	Semtín 102, Pardubice, 53354, Česká republika	1302

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Laboratory	Address	Accreditation number
CONCRELAB S.A.S.	Calle 63D No. 71A-70, Bogotá D.C., 111061, Colombia	09-LAB-001
CS-BETON s.r.o.	Velké Žernoseky 184, Litoměřice, 412 01, Česká republika	1500
Cement Hranice, akciová společnost	Bělotínská 288, Hranice I - Město, 75301, Česká republika	1284
Centrum dopravního výzkumu, v. v. i.	Líšeňská 33a, Brno, 63600, Česká republika	1506
Concrefy B.V.	Olivier van Noortweg, 10, Venlo, 5928 LX, Nederland	L216
D.O.O.GEOMEHANIKA	Dobropoljska 21, Beograd, 011, Serbia	-
DSP a.s.	Kostěnice 111, Kostěnice, 530 02, Česká republika	1782
Danucem Slovensko a.s., Skúšobné laboratórium Bratislava	Pestovateľská 2, Bratislava, 82104, Slovenská republika	426/S-313
EDAFOMICHANIKI	19 EMMANUEL PAPADAKI, NEO IRAKLEIO, 14121, GREECE	-
Eurofins Umwelt Österreich GmbH & Co. KG	Palmersstrasse 2, Wiener Neudorf, 2351, Austria	0071
Ferriere Nord S.p.A.	Zona Industriale Rivoli di Osoppo, Osoppo (Udine), 33010, Italy	-
GEOtest a.s.	Šmahova 112, Brno, 62700, Česká republika	1271.2
Geo-Topics	Chemin des Maréchaux, 36, Wavre, 1300, Belgium	-
GeoTec-GS, a.s.	Chmelová 2920/6, Praha 10, 10600, Česká republika	1772
Group van Vooren	Industriepark Rosteyne 1, Zelzate, 9060, Oost-Vlaanderen	296-TEST
HeidelbergCement AG	Oberklamweg 2-4, Leimen, 69181, Germany	-
Heracles General Cement Company	32 Dionisiou Solomou Steet, Lycovrissi, 14123, Athens, Greece	-
Holcim (Hrvatska) d.o.o.	Koromačno 7b, Koromačno, 52222, Croatia	1528
INŻ-GEO Badania i Roboty Geotechniczne Sp. z o.o. Sp. komandytowa	Wolności 20, Psary, 51-180, Dolnośląskie	AB 1750
Ibis-inženjering ltd.	Omladinska 28, Banja Luka, 78000, Bosna and Hercegovin	LI-169-01
Institut technologie a testování betonu, s.r.o., Zkušební laboratoř ITTB Brno	K Babě 609/9, Brno, 62100, Česká republika	L1778
JSC Laboratoriniai tyrimai	R. Kalantos str. 85, Kaunas, 52310, Lithuania	-
LABORATOIRE DES TRAVAUX PUBLICS DU SUD	Zone des activités Bouhraoua- PB 332 GHARDAIA, GHARDAIA, 47000, 98-B-0862065	-

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Laboratory	Address	Accreditation number
LPM - Laboratorio Prove Materiali (Impresa Bacchi Srl)	Via Don Giuseppe Dossetti 19, Francolino di Carpiano, 20080, Italy	1554L
Laboratoire Central des Travaux Publics - Laboratoire Matériaux Hussein dey- LCTP	1. rue Kaddour RAHIM- HUSSEIN DEY, ALGER, 16005, Algérie	-
MIRTEC S.A.	76 km of Athens-Lamia National Road, Ritsona, 32009, Greece	-
Mario Alberto Huertas Cotes	Carrera 22A 85-20, Bogotá, 111211, Bogotá	14-LAB-012
Mattest Ireland Ltd (Cork)	Mattest (Ireland) Ltd. Cork Unit 18, University Hall Industrial Park, Sarsfield Road, Wilton, Cork, T12 EV20, ROI	-
Mattest Ireland Ltd. (Dublin)	MATTEST, Unit 2, Northwest Business Park, Ballycoolin. Dublin 15., Dublin, D15 EF1H, Dublin, Ireland	286T
Národná diaľničná spoločnosť a.s.	Dúbravská cesta 14, Bratislava, 841 04, Slovenská republika	456/S-328
Prüflab GmbH	Hintstein 25, Großraming, 4463, Austria	0423
QCONTROL s.r.o., odštěpný závod - pracoviště Olomouc	Lesní 693, Bílovice nad Svitavou, 66401, Česká republika	1737
QUALIFORM SLOVAKIA s.r.o. - Bratislava	Pasienkova 9D, Bratislava, 821 06, Slovenská republika	S-301
QUALIFORM SLOVAKIA s.r.o. - Svit	Pasienková 9D, Bratislava, 82106, Slovenská republika	S-301
QUALIFORM, a.s. - pracoviště Hradec Králové	Mlaty 672/8, Brno, 642 00, Česká republika	1008
QUALIFORM, a.s. - pracoviště Olomouc	Mlaty 672/8, Bosonohy, Brno, 642 00, Česká republika	1008
S.C. GEOSTUD S.R.L.	Str. Sîngerului, nr. 11, sector 1, Bucharest, 014617, Romania	LI 974
SQZ, s.r.o. - pracoviště Lišov	U místní dráhy 939/5, Olomouc, 779 00, Česká republika	1135.2
SQZ, s.r.o. - pracoviště Srch	U místní dráhy 939/5, Olomouc, 779 00, Česká republika	1135.2
Sibotec	Industriepark Oost 6, Beernem, 8730, West - Vlaanderen	-
Skanska a.s.	Křižíkova 682/34a, Praha 8- Karlín, 186 00, Česká republika	1355
Sourmelis Geotechnical Laboratories Ltd	68TH STREET 1, KATO POLEMIDIA, LIMASSOL, 4159, CYPRUS	L103
TESScontrol, s.r.o. Mobilné laboratórium M1	efaktury@tesscontrol.sk - preferovaná adresa; Hronská 3211/1, Zvolen, 960 93, Slovenská republika	S-375

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Laboratory	Address	Accreditation number
TESScontrol, s.r.o. Oblastné Laboratórium Bratislava, Laboratórium Bratislava	efaktury@tesscontrol.sk - preferovaná adresa; Hronská 3211/1, Zvolen, 960 93, Slovenská republika	S-375
TESScontrol, s.r.o. Oblastné Laboratórium Zvolen, Laboratórium Zvolen	efaktury@tesscontrol.sk - preferovaná adresa; Hronská 3211/1, Zvolen, 960 93, Slovenská republika	S-375
TESScontrol, s.r.o., organizačná zloška, Laboratoř Znojmo	efaktury@tesscontrol.cz - preferovaná adresa; K zahradnictví č. ev 13, Střížkov, Praha 8, 180 00, Slovenská republika	-
TPA EOOD CTC SOFIA	Rezbarska str. №7, SOFIA, 1510, BULGARIA	-
TPA za obezbeđenje kvaliteta i inovacije d.o.o. Beograd	Milutina Milankovića 3B, Novi Beograd, 11070, Serbia	01-280
TZÚS Praha, s.p. - České Budějovice	Nemanická 441/8, České Budějovice, 37010, Česká republika	1018.3
Technický a zkušební ústav stavební Praha, s. p., Centrální laboratoř - zkušebna Brno	Hněvkovského 77, Brno, 617 00, Česká republika	1018.3
Technický a zkušební ústav stavební Praha, s.p. - pracoviště Ostrava	U Studia 14, Ostrava-Zábřeh, 700 30, Česká republika	1018.3
Technický a zkušební ústav stavební Praha, s.p. - pracoviště Plzeň	Zahradní 15, Plzeň, 32600, Česko	-
Tiroler Qualitätszentrum für Umwelt, Bau und Rohstoffe GmbH	Gewerbestrasse 4, Ötztal Bahnhof, 6430, Österreich	0249
UNIGEO a.s.	Místecká 329/258, Ostrava - Hrabová (část), 72000, Česká republika	1412
VIALAB CZ, s.r.o. - Laboratoř Morava, pracoviště LM3 Brno	MUCODE 1593, PO BOX 207, Praha 6, 16041, Česká republika	1170
VIALAB CZ, s.r.o. - Laboratoř Morava, pracoviště LM4 Ostrava	MUCODE 1593, PO Box 207, Praha 6, 160 41, Česká republika	1170
VIALAB CZ, s.r.o., Laboratoř Morava, pracoviště LM1 Zlín	MUCODE 1593, PO Box 207, Praha 6, 160 41, Česká republika	1170
Valcir B de Oliveira Junior	New Road Enterprise Center, Unit 4, New Road, Thomondgate, Limerick, V94P9X4, Limerick/ Ireland	5T
Vysoké učení technické v Brně, Fakulta stavební, Zkušební laboratoř při ÚTHD FAST VUT v Brně	Veveří 331/95, Brno, 60200, Česká republika	L1396
VŠB - Technická univerzita Ostrava, Zkušební laboratoře výzkumného centra hornin, Hornicko-geologická fakulta	17. listopadu 2172/15, Ostrava-Poruba, 70800, Česká republika	1166.4
Zavod za gradbeništvo Slovenije (Slovenian National Building and Civil Engineering Institute)	Dimičeva ulica 12, Ljubljana, 1000, Slovenija	LP-005
Zkušebna kamene a kameniva, s.r.o.	Husova 2274, Hořice, 508 01, Česká republika	1046

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Laboratory	Address	Accreditation number
i2 Analytical Ltd. Sp. z o.o. Oddzial w Polsce	Pionierów 39, Ruda Śląska, 41-711, Polska	-
ČVUT Kloknerův ústav	Šolínova 7, Praha (okr. Hlavní město Praha), 16608, Česká republika	1061
Ředitelství silnic a dálnic ČR	Rebešovická 40, Brno-Chrlice, 643 00, Česká republika	1072

2 Procedures used in the Statistical Analysis of Laboratory Results

The statistical analysis is based on the following steps:

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

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

3 Conclusions of the Statistical Analysis

The present report summarizes the results of the Proficiency Testing Program ZK 2023/1 (PT Program) organized by the PT Provider at the SZK FAST. 83 participants (laboratories) took part in the PT Program. The PT program focused on ordinary standardized testing of aggregates. 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. In some cases, overcoming the critical values of the Cochran test due to incorrect rounding of test results by laboratories was not taken into account.

3.1 EN 933-1 Determination of Particle Size Distribution - Sieving Method

The test results were evaluated as multilevel experiment according to the sieve size: 4 mm, 2 mm, 1 mm, 0.5 mm, 0.25 mm, 0.125 mm and 0.063 mm. The outliers elimination and evaluation of statistical characteristics were carried out in every level of experiment. The test results are shown together with graphic presentation and evaluated statistical characteristics in part 1 of the Appendix. The test results were rated as outlying, questionable or unsatisfactory only if the limit values were exceeded in four levels at least.

The assigned value and its uncertainty was determined using the A algorithm (ISO 13528 [20]). Table 3 shows the performance evaluation and outliers.

Table 3: Evaluation of performance and outliers – testing method EN 933-1 [1].
✓ – satisfactory performance; ? – questionable performance; ! – unsatisfactory performance, X – outlier

ID	4 mm	2 mm	1 mm	0.5 mm	0.25 mm	0.125 mm	0.063 mm
a51011	✓	✓	✓	✓	✓	✓	✓
c5a3f5	✓	✓	✓	✓	✓	✓	✓
ff27cd	✓	✓	✓	✓	✓	✓	✓
c3ab08	✓	✓	✓	✓	✓	✓	✓
280514	✓	✓	✓	✓	✓	✓	✓
fea11c	✓	✓	✓	✓	✓	✓	✓
92e96e	✓	✓	✓	✓	✓	✓	✓
154c4d	✓	✓	✓	✓	✓	✓	✓
cf83a2	✓	✓	✓	✓	✓	✓	✓
0782f3	✓	✓	?	✓	✓	✓	✓
5d0efa	✓	✓	✓	✓	✓	✓	✓
4df247	✓	✓	✓	✓	✓	✓	X
f1363c	✓	✓	✓	✓	✓	✓	✓
562c38	✓	✓	?	✓	✓	✓	✓
c857ef	✓	✓	✓	✓	✓	✓	✓
5acf80	X	X	X	X	X	!	✓
3c6f1d	✓	?	✓	✓	✓	?	✓
92e563	✓	✓	✓	✓	✓	?	✓
7abdbd	✓	?	✓	✓	✓	✓	✓
0fe6b5	✓	✓	✓	✓	✓	?	✓

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ID	4 mm	2 mm	1 mm	0.5 mm	0.25 mm	0.125 mm	0.063 mm
0b8d00	X	✓	X	!	✓	X	X
d92da1	✓	✓	✓	✓	✓	✓	✓
7a98ee	✓	✓	✓	✓	✓	✓	?
50b361	✓	✓	✓	✓	✓	✓	✓
72ec44	✓	✓	✓	✓	✓	✓	✓
fdfd05	✓	✓	✓	✓	✓	✓	✓
e543af	✓	✓	✓	✓	✓	✓	✓
d261c7	✓	✓	✓	✓	✓	?	✓
ff50d6	✓	✓	✓	✓	✓	?	✓
1e9672	✓	✓	✓	✓	✓	✓	✓
6192bc	✓	✓	✓	✓	✓	✓	✓
8e8268	✓	✓	✓	✓	✓	✓	✓
c8e70e	✓	✓	✓	✓	✓	✓	✓
44e68c	✓	✓	✓	✓	✓	✓	✓
968ceb	✓	✓	✓	✓	✓	✓	✓
02be40	✓	✓	?	?	✓	✓	✓
a3cf10	✓	?	?	!	X	X	X
55547e	✓	✓	✓	✓	✓	✓	✓
478486	✓	✓	✓	✓	✓	✓	✓
4516b2	✓	!	!	?	✓	✓	✓
a0d668	✓	✓	✓	✓	✓	✓	✓
315309	✓	✓	✓	✓	✓	✓	✓
978d47	✓	✓	✓	✓	✓	✓	✓
644bba	✓	✓	✓	✓	✓	✓	✓
aa146e	✓	✓	✓	✓	✓	✓	✓
17f205	✓	✓	✓	✓	✓	✓	✓
82bd3a	✓	✓	✓	✓	✓	✓	✓
68cc77	✓	✓	✓	✓	✓	✓	✓
140849	✓	✓	X	✓	✓	✓	✓
3ca242	✓	✓	✓	✓	✓	✓	✓
edf35f	✓	✓	✓	✓	✓	✓	✓
b39bb2	✓	✓	✓	✓	✓	✓	✓
416068	✓	✓	✓	✓	✓	✓	✓
7d4aa0	✓	✓	✓	✓	✓	?	?
106bb0	✓	✓	✓	✓	✓	✓	✓
9f2452	✓	✓	✓	✓	✓	✓	✓
066d89	✓	✓	✓	✓	✓	✓	✓

3.2 Overall Performance Evaluation

Testing methods can be found in part 1 of this report.

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

ID / Method	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
7e36d6	-	-	-	-	-	-	-	-	-	-	✓	✓	-	-	-	-	-	-
a51011	✓	-	✓	-	-	-	-	✓	-	-	-	-	-	-	-	-	-	-
c5a3f5	✓	-	-	✓	-	-	✓	✓	-	-	-	✓	-	-	✓	-	-	-
ff27cd	✓	-	✓	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-
b0afd4	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-	-	-	-
a396b5	-	-	-	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
c3ab08	✓	-	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
280514	✓	-	?	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
fea11c	✓	-	✓	-	-	-	-	✓	-	-	-	?	-	-	-	-	-	-
0a6d66	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
92e96e	✓	✓	-	-	✓	-	-	✓	-	-	✓	✓	-	-	✓	-	-	-
416068	✓	-	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
bded50	-	-	-	-	-	-	-	✓	-	-	-	✓	-	-	✓	-	-	-
5bcbfa	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	✓	-	-	-
154c4d	✓	-	✓	-	-	-	-	-	-	-	✓	✓	-	-	-	-	-	-
cf83a2	✓	-	✓	-	-	-	-	-	-	-	✓	✓	-	✓	-	-	-	-
0782f3	✓	-	✓	-	-	-	-	-	-	-	✓	✓	-	-	-	-	-	-
5d0efa	✓	-	✓	-	-	-	-	-	-	-	✓	-	✓	-	-	-	-	-
4df247	✓	-	-	✓	-	-	✓	✓	-	-	-	X	-	-	✓	-	-	-
c23bc6	-	-	-	-	-	-	-	-	-	✓	-	✓	-	-	-	-	-	-
2f88fe	-	-	-	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
f1363c	✓	✓	-	-	✓	-	✓	✓	-	-	-	X	-	-	-	-	-	-
562c38	✓	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
c857ef	✓	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-
5acf80	X	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3c6f1d	✓	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
92e563	✓	✓	✓	✓	-	-	-	✓	-	-	-	✓	-	-	-	-	-	-
7abdbd	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
da3a05	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-
0fe6b5	✓	-	✓	-	-	-	-	-	-	-	✓	-	✓	✓	-	-	-	-
0b8d00	X	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-
d92da1	✓	-	✓	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-

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ID / Method	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
79965e	-	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-
7a98ee	✓	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
50b361	✓	-	✓	-	✓	-	-	-	-	-	-	✓	-	-	-	-	-	-
72ec44	✓	-	-	-	-	-	✓	✓	-	✓	✓	✓	✓	✓	-	-	-	-
fdfd05	✓	-	✓	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-
e543af	✓	✓	-	-	-	-	-	✓	-	-	✓	-	-	-	-	-	-	-
2d41fb	-	-	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
d261c7	✓	-	-	-	?	-	-	✓	-	-	-	-	-	-	-	-	-	-
900d05	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-	-
6a0c4d	-	-	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ff50d6	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
639ddc	-	-	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
e1819f	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-
1e9672	✓	✓	-	-	✓	-	✓	?	-	-	✓	✓	-	-	-	-	-	-
6192bc	✓	-	✓	-	-	-	-	-	-	?	✓	✓	-	-	-	-	-	-
8e8268	✓	-	✓	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-
c8e70e	✓	-	✓	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-
44e68c	✓	-	✓	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-
968ceb	✓	-	-	-	-	-	-	-	-	-	✓	-	-	✓	-	-	-	-
02be40	✓	-	-	-	-	-	-	-	-	-	?	-	-	-	-	-	-	-
fa8544	-	-	-	✓	-	-	-	✓	-	-	-	-	-	-	-	-	-	-
a3cf10	!	-	✓	-	-	-	-	-	-	-	✓	✓	-	-	-	-	-	-
55547e	✓	-	✓	-	-	-	-	X	-	✓	✓	✓	-	✓	-	-	-	-
478486	✓	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-
36026f	-	?	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4516b2	✓	-	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
a0d668	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7d21b5	-	-	-	-	-	-	-	✓	-	-	-	X	✓	-	-	-	-	-
315309	✓	-	?	✓	✓	-	✓	✓	-	✓	✓	✓	-	✓	✓	-	-	-
978d47	✓	-	-	-	-	-	-	✓	-	-	-	-	-	-	-	-	-	-
644bba	✓	-	✓	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-
aa146e	✓	✓	✓	-	-	-	✓	✓	-	!	✓	✓	-	-	✓	-	-	-
17f205	✓	-	✓	-	-	-	-	✓	-	-	-	?	-	-	-	-	-	-
8da3cb	-	-	-	-	✓	-	-	-	-	-	-	-	-	✓	-	-	-	-
52d231	-	✓	-	-	-	-	-	-	-	✓	-	-	✓	✓	-	-	-	-
82bd3a	✓	-	✓	✓	-	-	-	-	-	?	✓	✓	-	-	-	-	-	-
68cc77	✓	-	✓	✓	-	-	-	-	-	-	✓	✓	-	-	-	-	-	-

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ID / Method	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
32a836	-	-	?	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-
36b1a5	-	-	-	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
140849	✓	-	✓	✓	-	-	-	✓	-	-	✓	-	-	-	-	-	-	-
3ca242	✓	-	-	-	-	-	-	✓	-	-	-	-	-	-	-	-	-	-
69b2b6	-	✓	-	-	-	-	✓	-	-	-	-	-	-	-	-	-	-	-
93bf8b	-	-	-	-	-	-	-	-	-	✓	-	✓	-	-	-	-	-	-
e7e3fa	-	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-
edf35f	✓	-	✓	?	-	-	-	-	-	-	X	✓	-	✓	-	-	-	-
b39bb2	✓	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
7d4aa0	✓	✓	-	✓	✓	-	-	✓	-	✓	?	✓	-	-	✓	-	-	-
106bb0	✓	-	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9f2452	✓	-	-	-	✓	-	-	-	-	-	-	-	-	✓	-	-	-	-
066d89	✓	-	-	-	-	-	-	-	-	-	✓	✓	-	-	✓	-	-	-
6e99ab	-	-	-	?	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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1 Appendix – EN 933-1 Determination of particle size distribution - Sieving method

1.1 4 mm

1.1.1 Test results

Table 5: 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 [%]
5acf80	86	86	86	1	86	0.1	0.13
0b8d00	98	95	93	-	95	2.4	2.46
0782f3	97	96	97	2	97	0.2	0.22
02be40	97	97	96	-	97	0.6	0.6
968ceb	97	96	97	-	97	0.6	0.6
562c38	97	96	97	1	97	0.6	0.6
140849	97	97	96	-	97	0.5	0.53
a51011	97	97	97	3	97	0.0	0.0
c5a3f5	97	97	97	2	97	0.3	0.36
edf35f	97	97	97	-	97	0.0	0.0
c3ab08	97	97	97	-	97	0.0	0.0
280514	97	97	97	-	97	0.0	0.0
82bd3a	98	97	96	-	97	1.2	1.25
4df247	97	97	97	-	97	0.2	0.18
066d89	97	97	97	0	97	0.2	0.18
cf83a2	97	97	98	6	97	0.4	0.43
416068	98	97	97	0	97	0.3	0.36
fdfd05	98	97	97	-	97	0.3	0.27
b39bb2	98	97	96	-	97	1.0	0.98
1e9672	97	98	97	0	97	0.2	0.21
9f2452	97	98	97	2	97	0.6	0.59
d261c7	97	97	98	3	97	0.6	0.59
e543af	98	97	97	-	97	0.6	0.59
a0d668	97	97	97	1	97	0.0	0.04
315309	98	97	97	2	97	0.6	0.59
7a98ee	98	97	97	1	97	0.6	0.59
aa146e	98	97	97	1	97	0.6	0.59
ff27cd	97	97	97	4	97	0.1	0.12
7abdbd	97	97	98	3	97	0.6	0.59
55547e	98	97	97	1	97	0.6	0.59
154c4d	98	97	97	6	97	0.3	0.26
3ca242	98	98	98	-	98	0.0	0.0
f1363c	98	97	97	0	98	0.3	0.27
c857ef	97	98	97	2	98	0.3	0.33

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ID	Test results [%]			u_X [%]	$\bar{x}$ [%]	s_0 [%]	V_X [%]
44e68c	97	98	98	1	98	0.6	0.59
8e8268	98	97	98	3	98	0.6	0.59
106bb0	98	98	97	2	98	0.6	0.59
5d0efa	97	98	98	0	98	0.6	0.59
50b361	98	97	98	-	98	0.6	0.59
fea11c	98	98	98	0	98	0.1	0.08
ff50d6	98	98	98	-	98	0.1	0.1
68cc77	98	98	98	-	98	0.2	0.18
0fe6b5	98	98	98	0	98	0.1	0.06
978d47	98	98	98	-	98	0.0	0.0
644bba	98	98	98	7	98	0.0	0.0
c8e70e	98	98	98	2	98	0.0	0.0
17f205	98	98	98	1	98	0.0	0.0
92e96e	98	98	98	-	98	0.0	0.0
478486	98	-	-	-	98	0.0	0.0
6192bc	98	98	98	1	98	0.0	0.0
92e563	98	98	98	1	98	0.0	0.0
3c6f1d	98	98	98	-	98	0.0	0.0
7d4aa0	98	-	-	-	98	0.0	0.0
a3cf10	98	98	98	1	98	0.0	0.0
72ec44	98	98	98	1	98	0.0	0.0
d92da1	98	98	98	0	98	0.0	0.0
4516b2	98	98	98	-	98	0.4	0.42

1.1.2 The Numerical Procedure for Determining Outliers

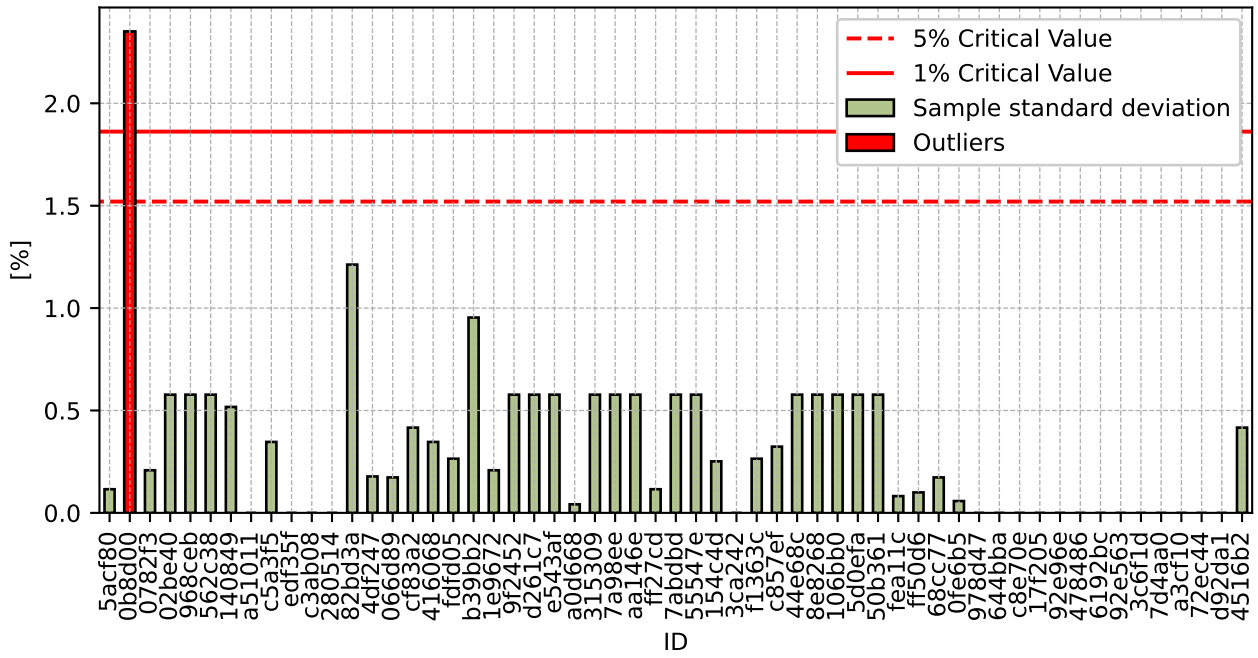

Figure 1: **Cochran's test** - sample standard deviations

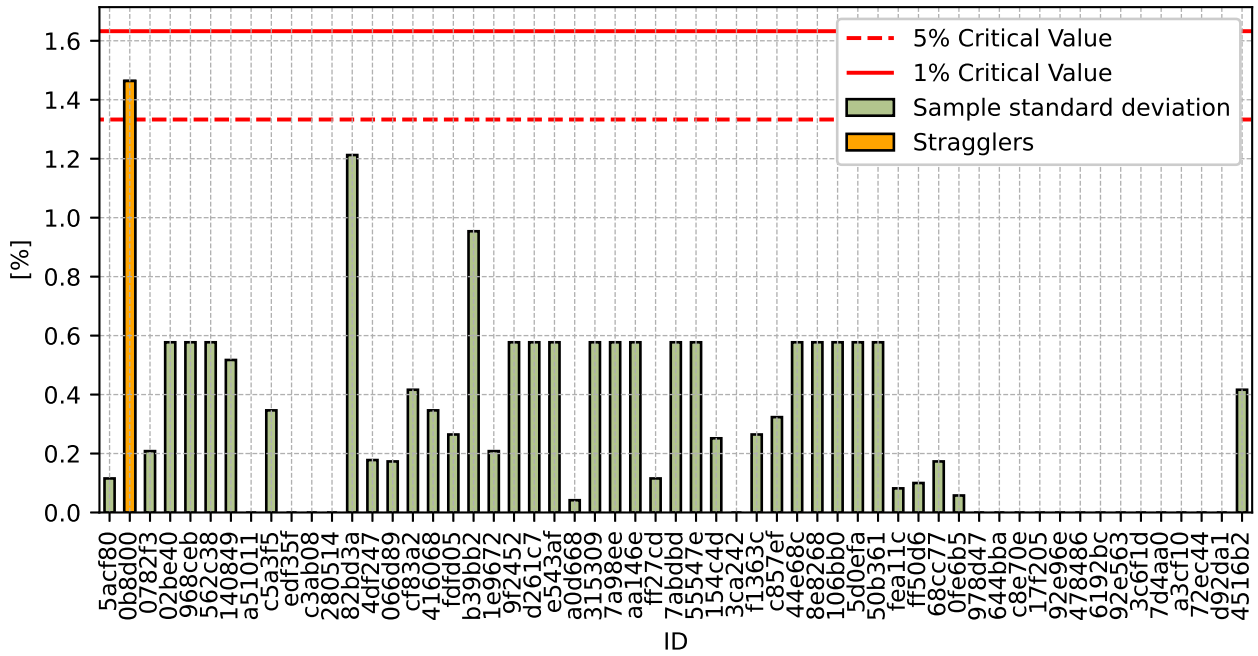

Figure 2: **Cochran's test** - sample standard deviations without outliers

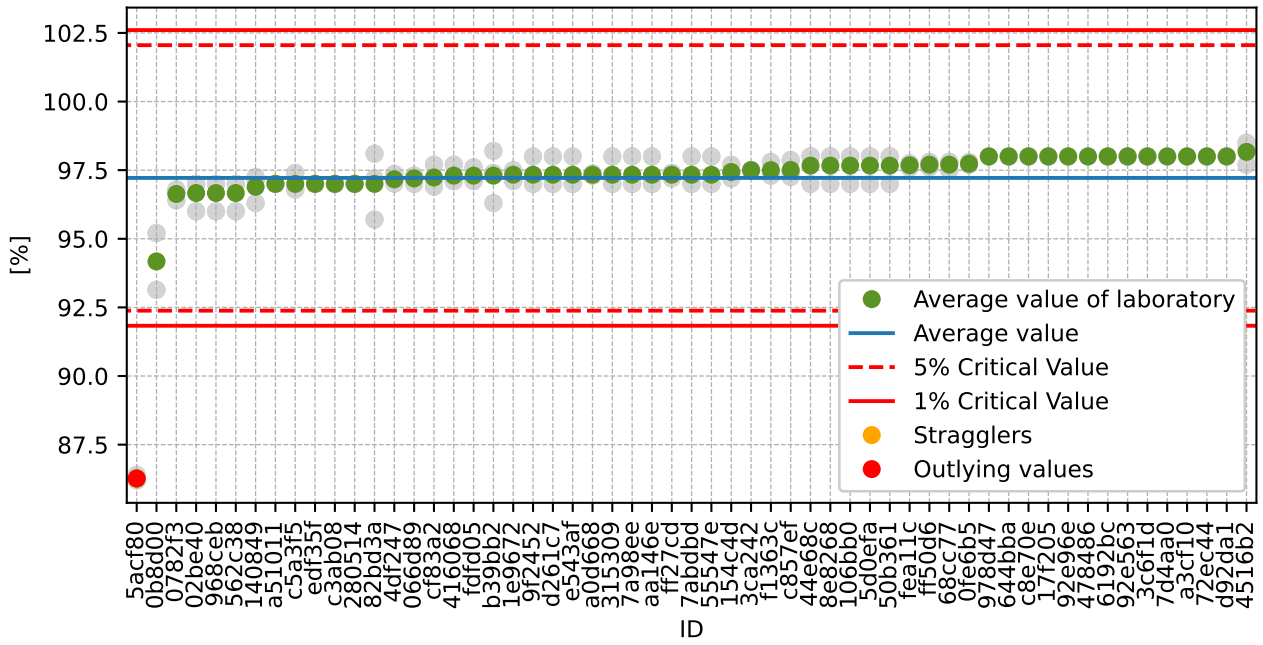

Figure 3: **Grubbs' test** - average values

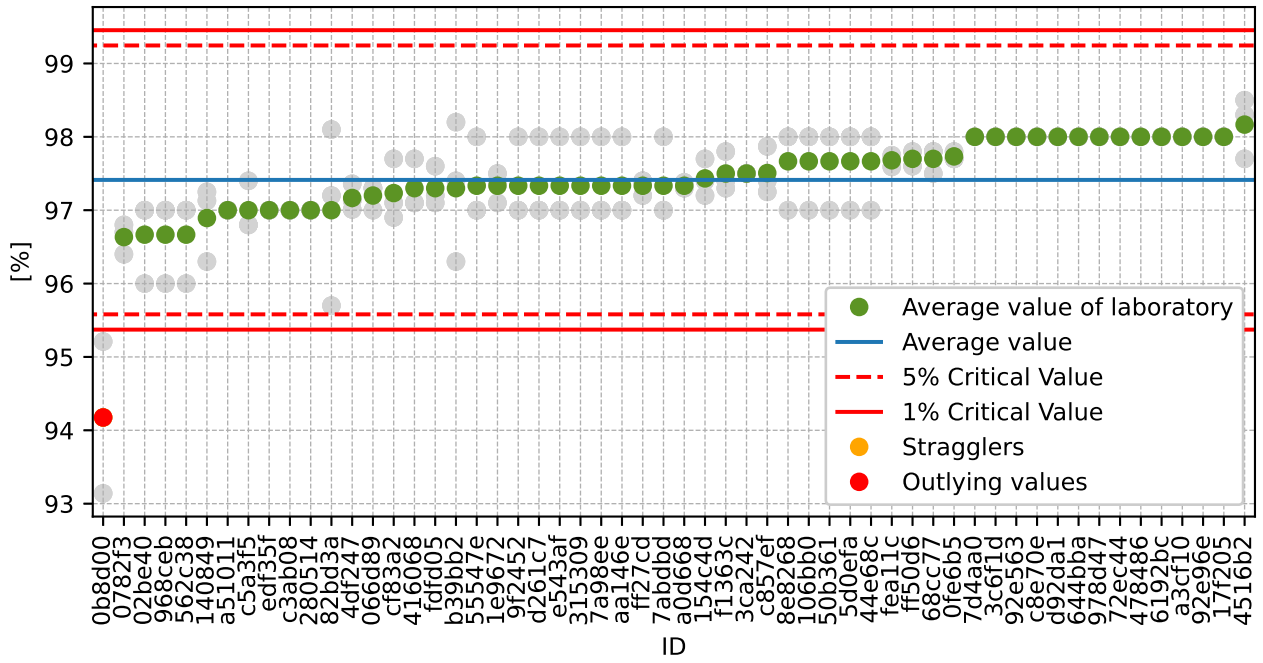

Figure 4: **Grubbs' test** - average values without outliers

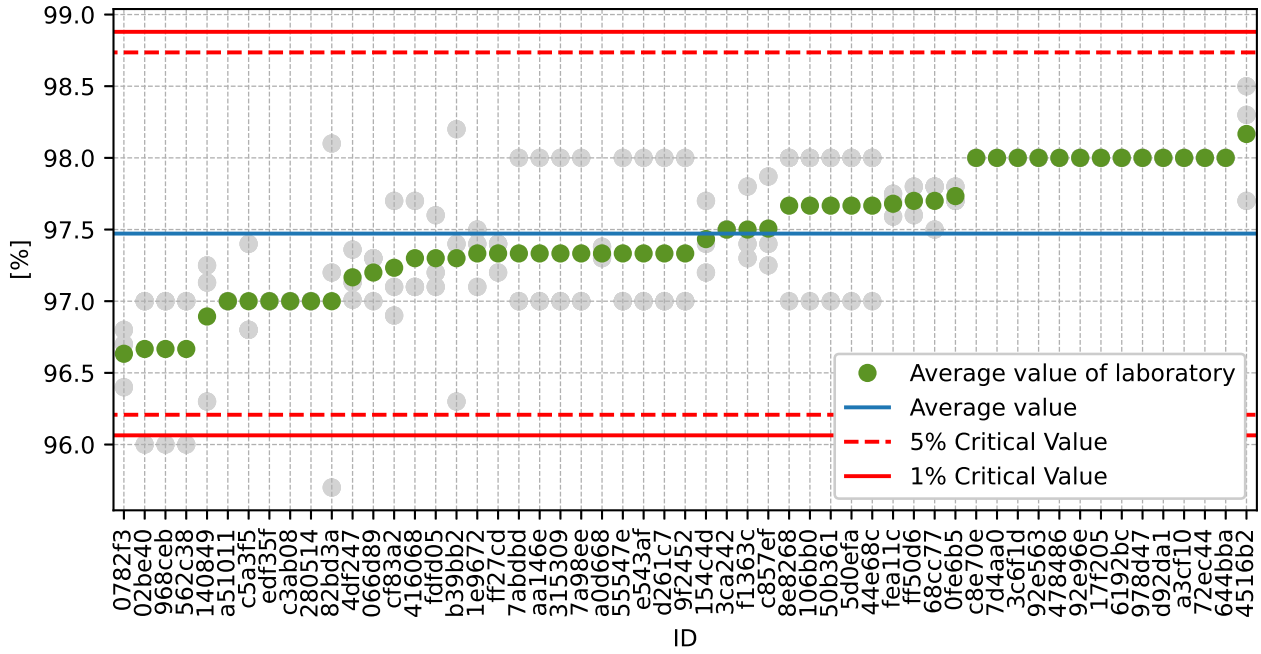

Figure 5: **Grubbs' test** - average values without outliers

1.1.3 Mandel's Statistics

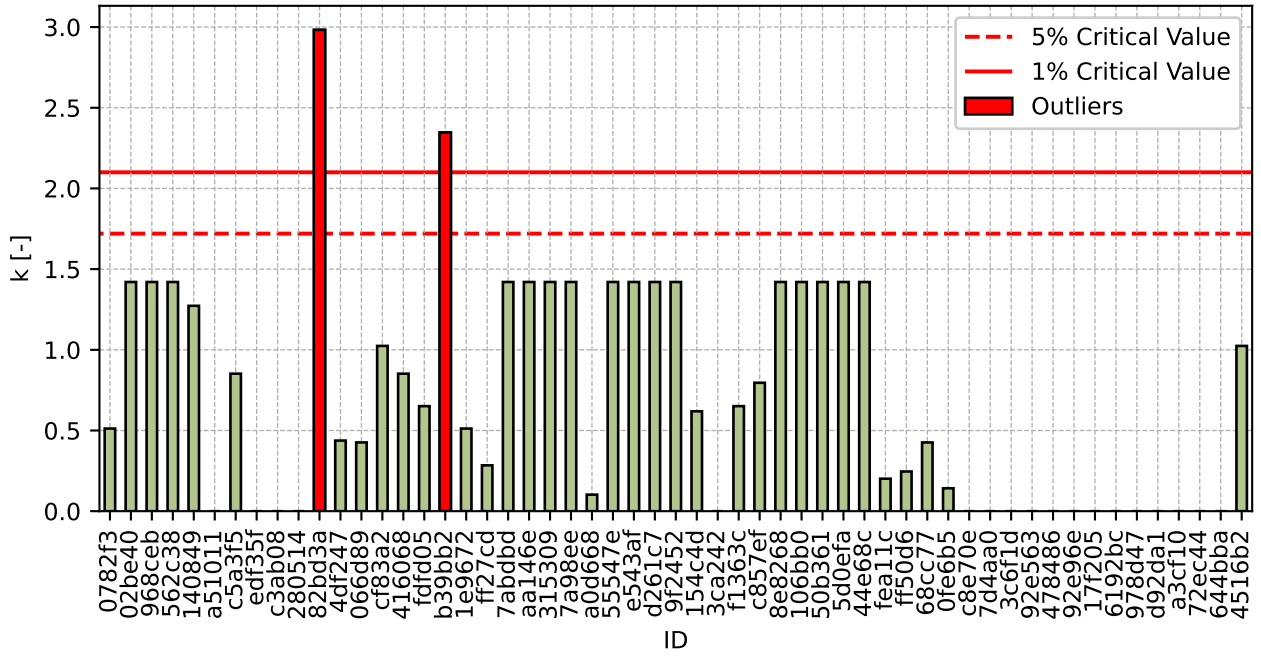

Figure 6: Intralaboratory Consistency Statistic

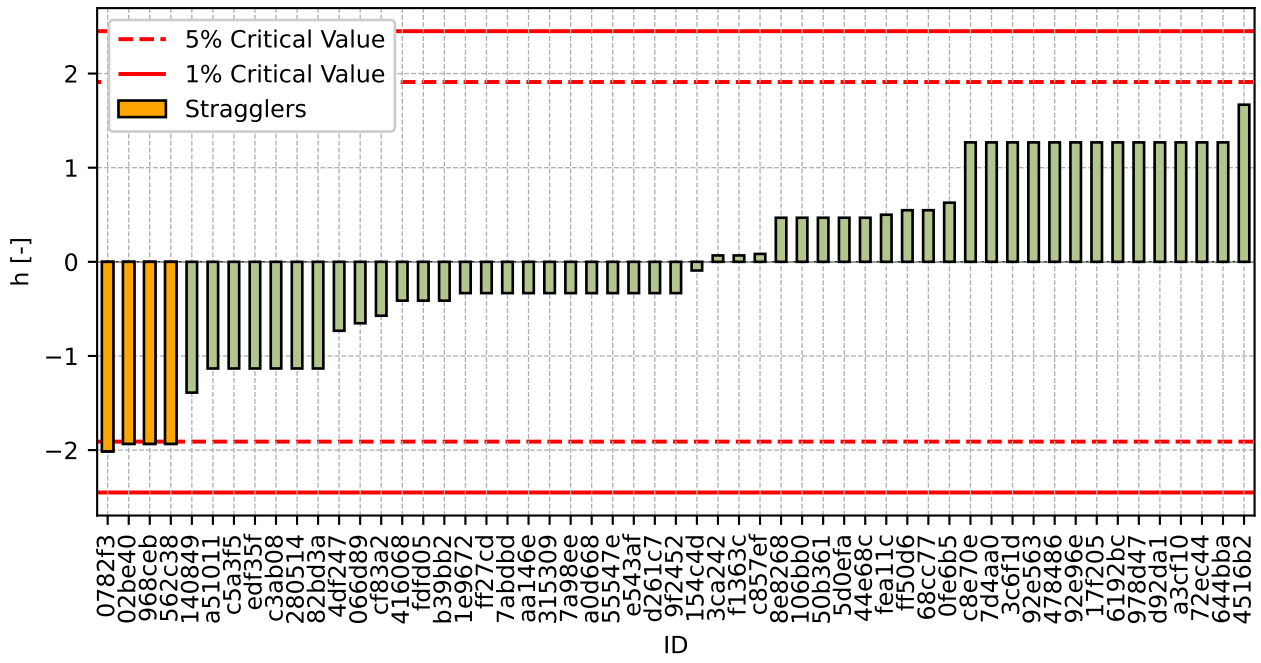

Figure 7: Interlaboratory Consistency Statistic

1.1.4 Descriptive statistics

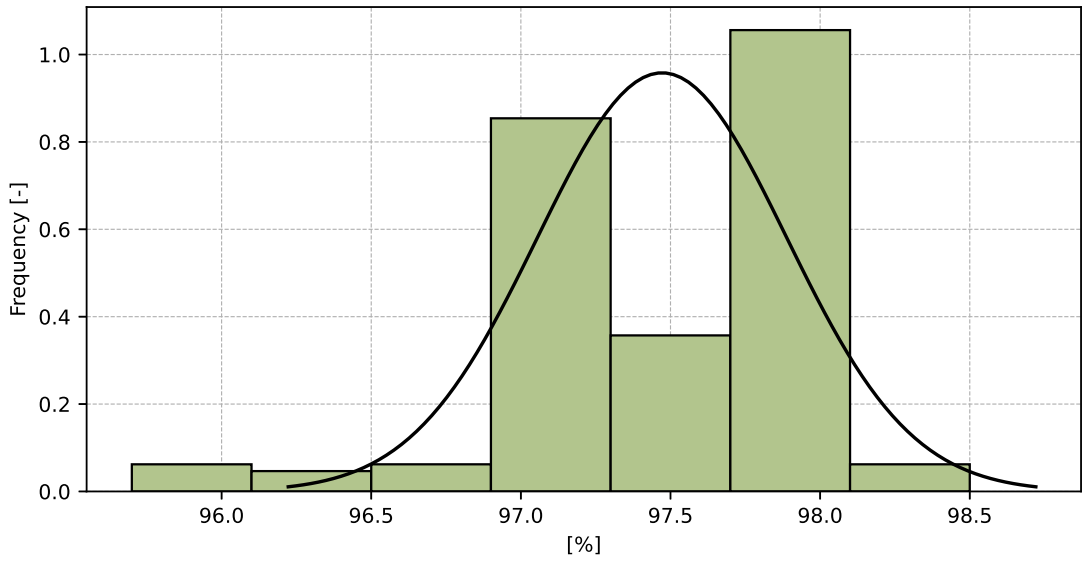

Figure 8: Histogram of all test results

Table 6: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	97
Sample standard deviation – s	0.4
Asigned value – x^*	97
Robust standard deviation – s^*	0.4
Measurement uncertainty of asigned value – u_X	0.1
p-value of normality test	1.0 [-]
Interlaboratory standard deviation – s_L	0.3
Repeatability standard deviation – s_r	0.4
Reproducibility standard deviation – s_R	0.5
Repeatability – r	1
Reproducibility – R	1

1.1.5 Evaluation of Performance Statistics

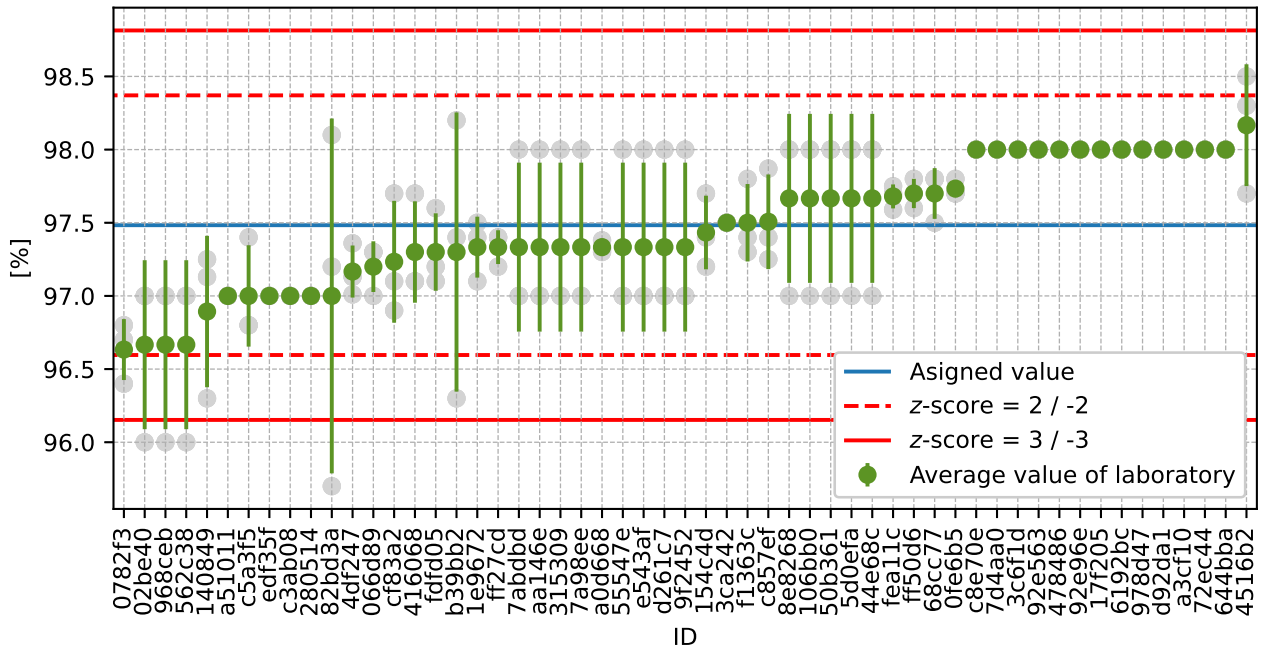

Figure 9: Average values and sample standard deviations

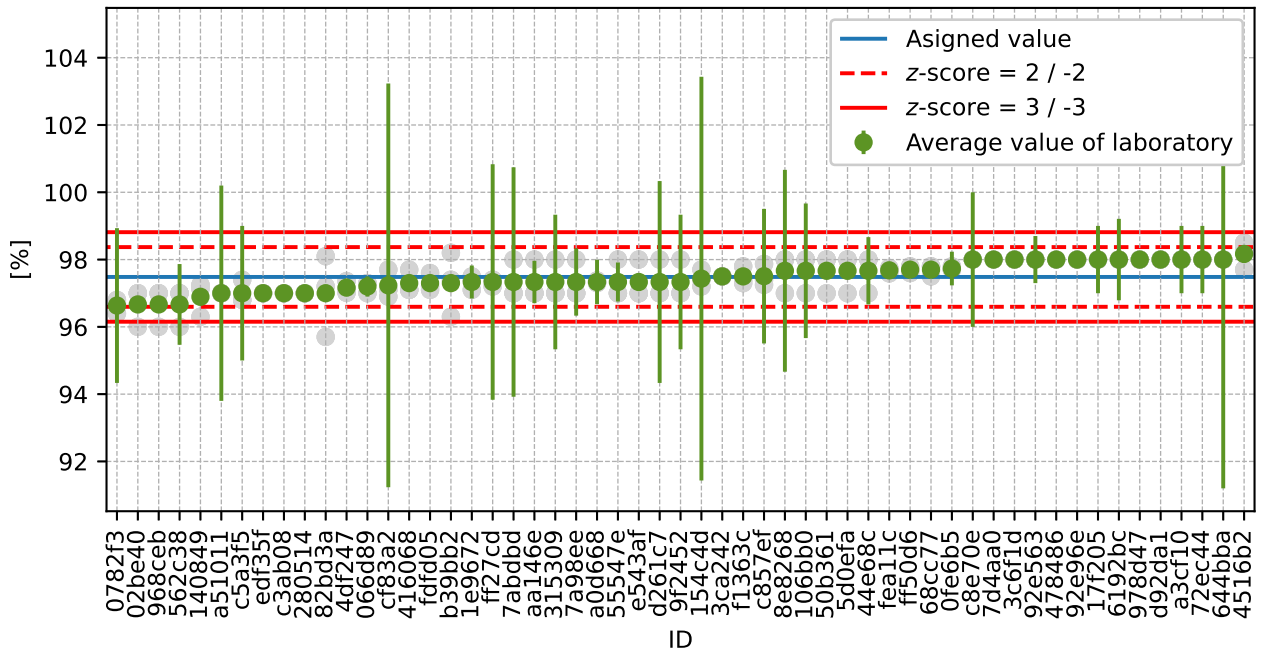

Figure 10: Average values and extended uncertainties of measurement

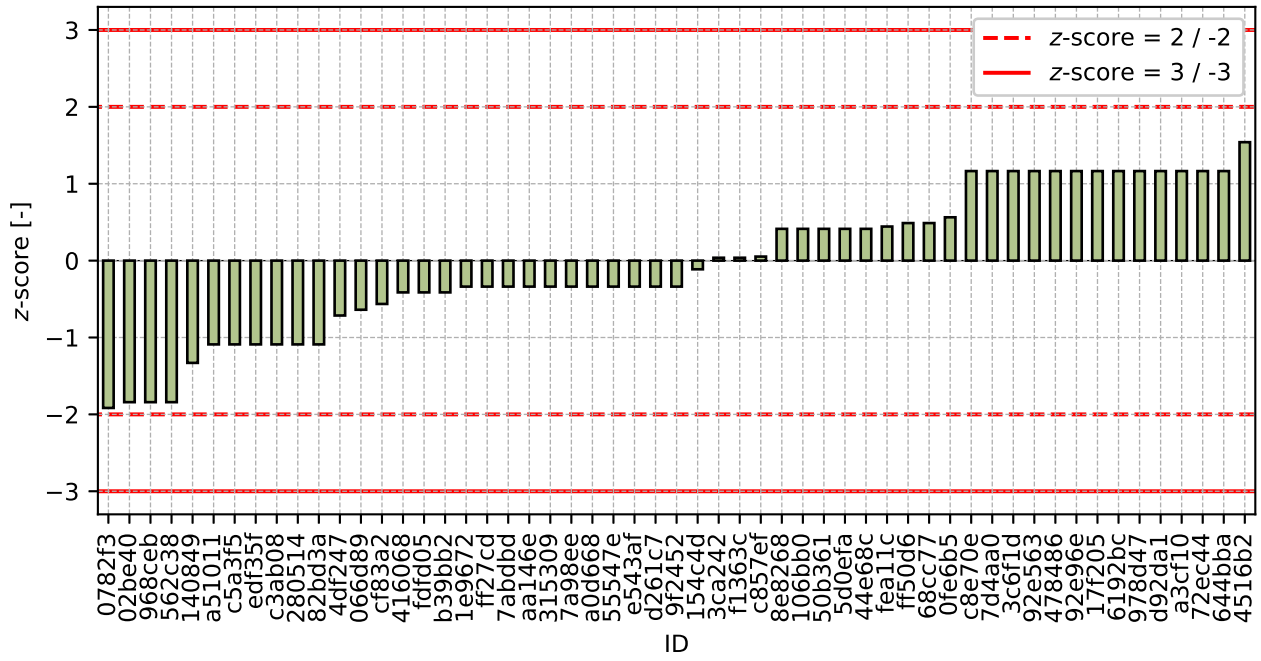

Figure 11: z-score

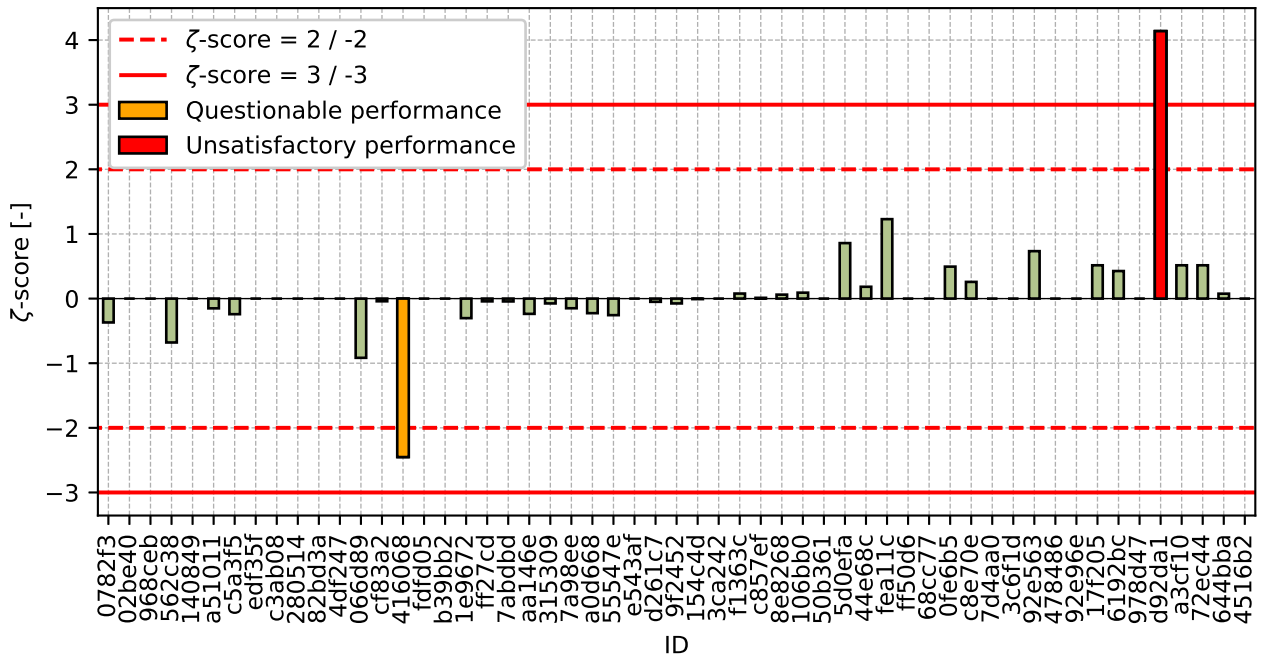

Figure 12: ζ-score

Table 7: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
0782f3	-1.92	-0.37
02be40	-1.84	-
968ceb	-1.84	-
562c38	-1.84	-0.68
140849	-1.33	-
a51011	-1.09	-0.15
c5a3f5	-1.09	-0.24
edf35f	-1.09	-
c3ab08	-1.09	-
280514	-1.09	-
82bd3a	-1.09	-
4df247	-0.71	-
066d89	-0.64	-0.92
cf83a2	-0.56	-0.04
416068	-0.41	-2.45
fdfd05	-0.41	-
b39bb2	-0.41	-
1e9672	-0.34	-0.3
ff27cd	-0.34	-0.04
7abdbd	-0.34	-0.04
aa146e	-0.34	-0.24
315309	-0.34	-0.07

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ID	*z*-score [-]	ζ-score [-]
7a98ee	-0.34	-0.15
a0d668	-0.34	-0.23
55547e	-0.34	-0.26
e543af	-0.34	-
d261c7	-0.34	-0.05
9f2452	-0.34	-0.07
154c4d	-0.11	-0.01
3ca242	0.04	-
f1363c	0.04	0.08
c857ef	0.05	0.01
8e8268	0.41	0.06
106bb0	0.41	0.09
50b361	0.41	-
5d0efa	0.41	0.86
44e68c	0.41	0.18
fea11c	0.44	1.23
ff50d6	0.49	-
68cc77	0.49	-
0fe6b5	0.56	0.49
c8e70e	1.16	0.26
7d4aa0	1.16	-
3c6f1d	1.16	-
92e563	1.16	0.73
478486	1.16	-
92e96e	1.16	-
17f205	1.16	0.52
6192bc	1.16	0.43
978d47	1.16	-
d92da1	1.16	4.14
a3cf10	1.16	0.52
72ec44	1.16	0.52
644bba	1.16	0.08
4516b2	1.54	-

1.2 2 mm

1.2.1 Test results

Table 8: 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 [%]
5acf80	62	61	62	1	62	0.2	0.32
7abdbd	79	79	80	3	79	0.6	0.73
cf83a2	79	79	84	5	80	3.0	3.77
562c38	82	78	82	5	81	2.3	2.86
c3ab08	81	81	81	-	81	0.0	0.0
0782f3	81	81	82	2	81	0.5	0.61
02be40	82	80	82	-	81	1.2	1.42
0b8d00	83	81	80	-	81	1.5	1.85
7d4aa0	82	-	-	-	82	0.0	0.0
68cc77	81	82	81	-	82	0.4	0.53
315309	83	81	81	2	82	1.2	1.41
968ceb	80	82	83	-	82	1.5	1.87
a0d668	82	82	82	1	82	0.1	0.17
154c4d	82	81	82	5	82	0.7	0.9
9f2452	81	83	82	2	82	1.0	1.22
a51011	83	81	82	3	82	1.0	1.22
55547e	82	82	82	0	82	0.0	0.0
4df247	83	81	82	-	82	0.9	1.1
fdfd05	82	82	82	-	82	0.4	0.43
c857ef	82	83	82	2	82	0.6	0.72
ff27cd	82	81	83	3	82	1.1	1.28
ff50d6	82	82	82	-	82	0.2	0.21
416068	83	82	82	0	82	0.6	0.68
8e8268	82	82	83	2	82	0.6	0.7
aa146e	84	82	81	1	82	1.5	1.86
1e9672	83	82	82	1	82	0.3	0.39
50b361	83	82	83	-	83	0.6	0.7
106bb0	84	83	81	2	83	1.5	1.85
e543af	84	82	82	-	83	1.2	1.4
d261c7	82	83	83	6	83	0.6	0.7
fea11c	82	83	83	0	83	0.3	0.4
82bd3a	85	83	81	-	83	2.0	2.36
0fe6b5	83	83	83	0	83	0.2	0.18
7a98ee	83	83	83	1	83	0.0	0.0
b39bb2	84	83	82	-	83	0.9	1.05
edf35f	83	83	83	-	83	0.0	0.0

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ID	Test results [%]			u_X [%]	$\bar{x}$ [%]	s_0 [%]	V_X [%]
17f205	83	83	83	1	83	0.0	0.0
644bba	83	83	83	6	83	0.0	0.0
066d89	84	83	82	1	83	0.6	0.72
478486	83	-	-	-	83	0.0	0.0
3ca242	83	83	83	-	83	0.1	0.07
d92da1	83	83	84	0	83	0.6	0.69
92e96e	84	83	83	-	83	0.6	0.69
c5a3f5	84	83	82	2	83	0.8	0.96
92e563	82	84	84	1	83	1.2	1.39
6192bc	83	83	84	1	83	0.6	0.69
140849	84	83	83	-	83	0.7	0.8
44e68c	83	84	84	1	84	0.6	0.69
c8e70e	84	83	84	2	84	0.6	0.69
f1363c	84	84	84	0	84	0.2	0.28
72ec44	84	84	84	2	84	0.0	0.0
280514	84	84	84	-	84	0.0	0.0
978d47	84	84	84	-	84	0.0	0.0
5d0efa	84	84	84	0	84	0.0	0.0
3c6f1d	85	85	85	-	85	0.0	0.0
a3cf10	86	86	86	1	86	0.0	0.0
4516b2	86	88	85	-	86	1.3	1.51

1.2.2 The Numerical Procedure for Determining Outliers

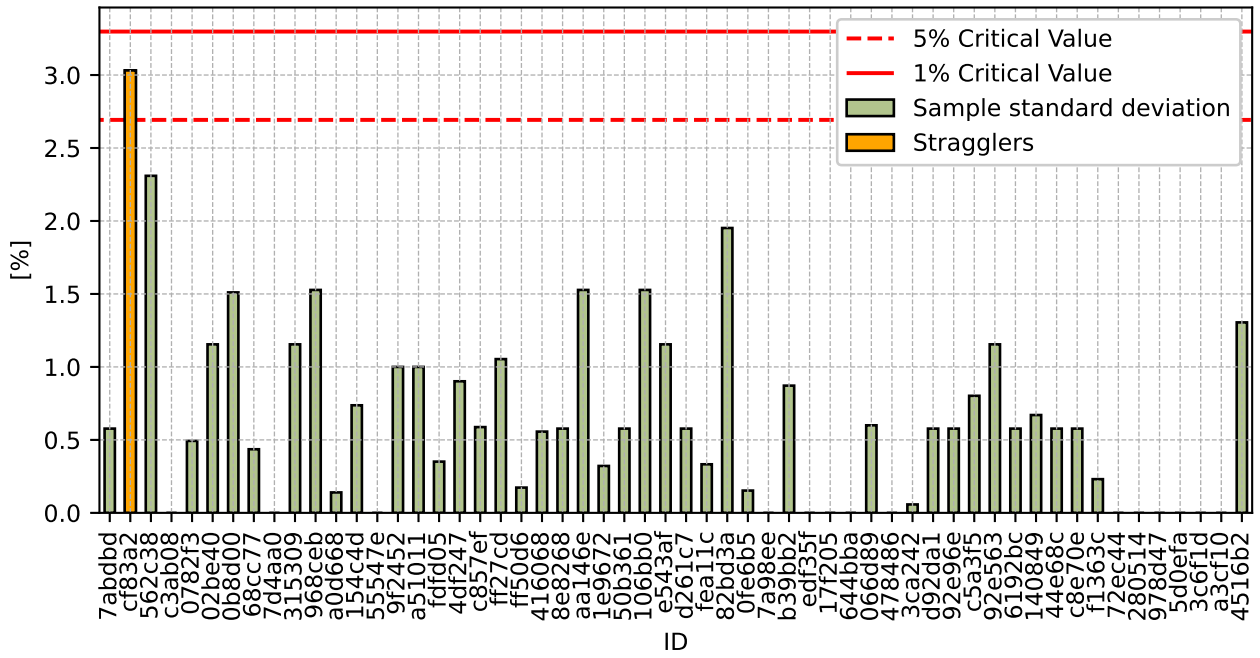

Figure 13: **Cochran's test** - sample standard deviations

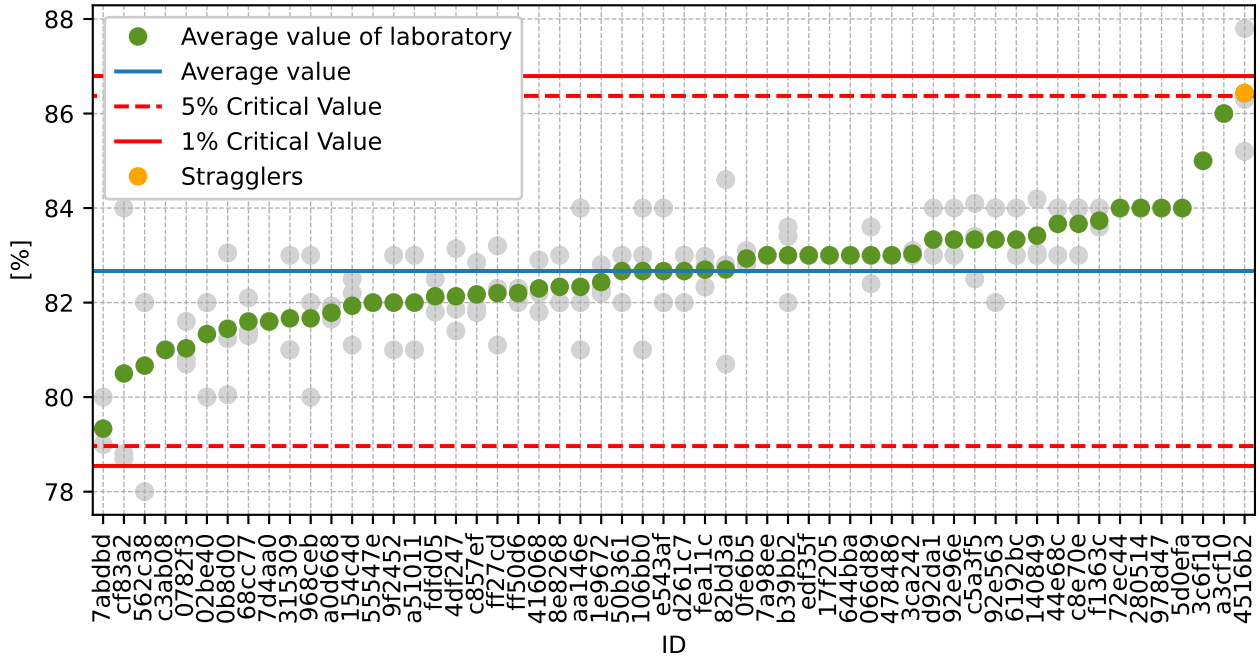

Figure 14: **Grubbs' test** - average values

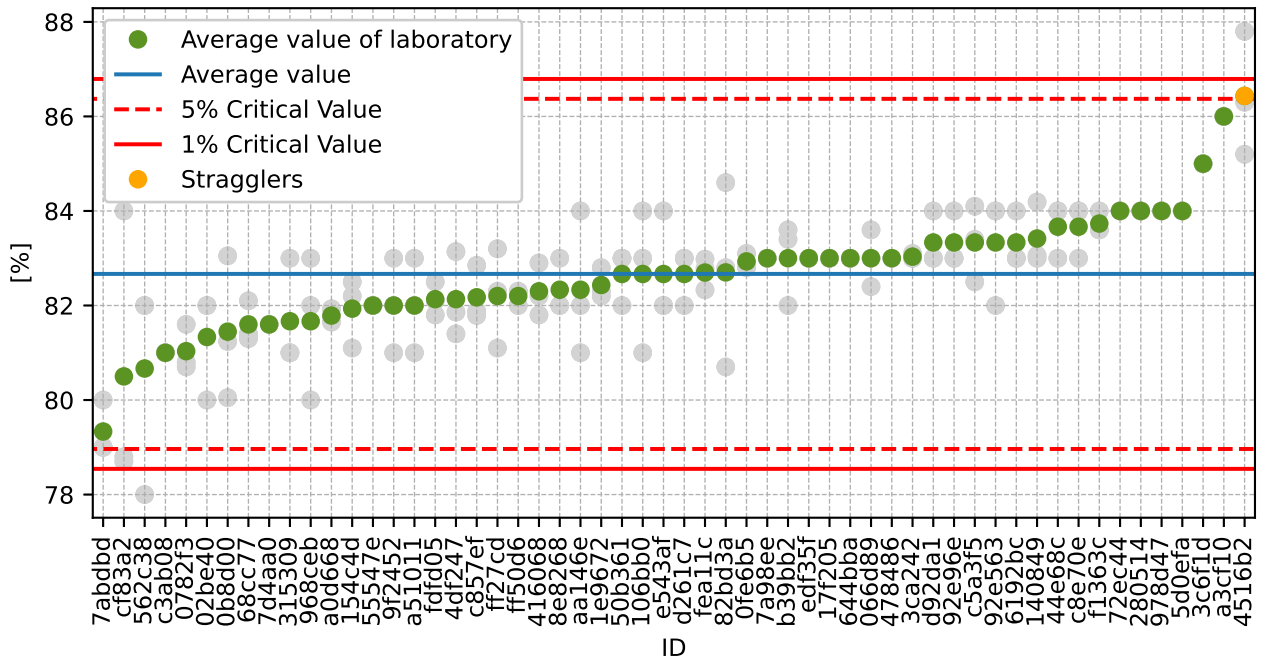

Figure 15: **Grubbs' test** - average values without outliers

1.2.3 Mandel's Statistics

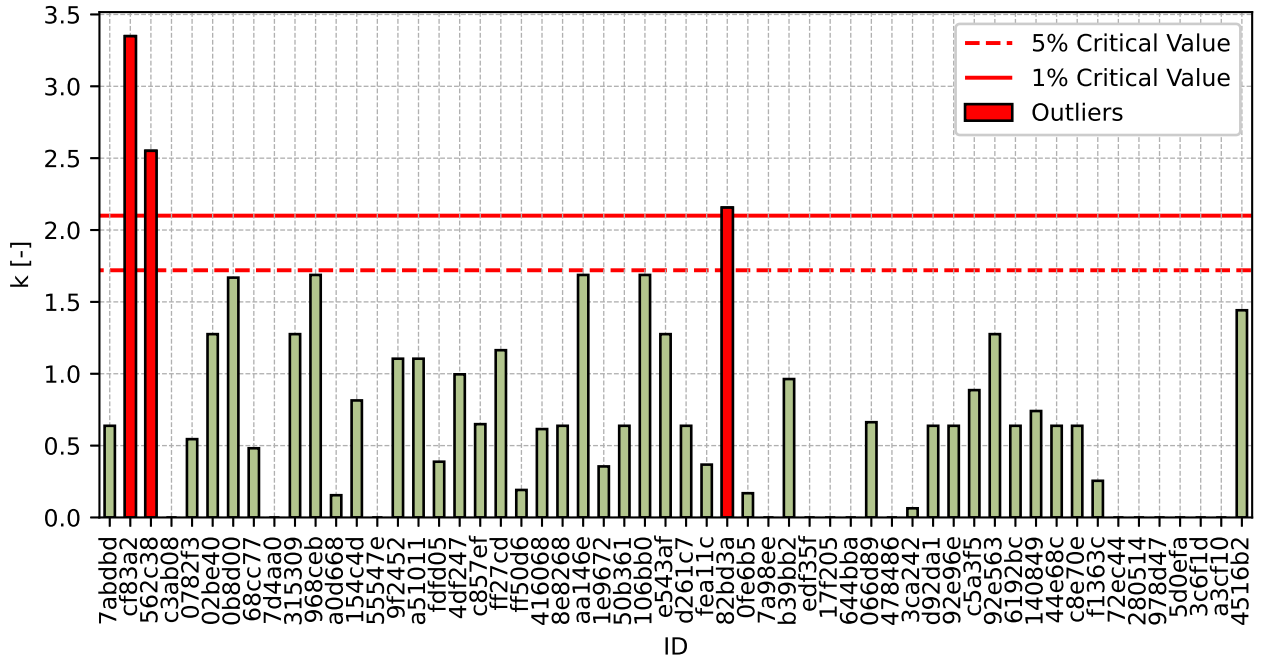

Figure 16: Intralaboratory Consistency Statistic

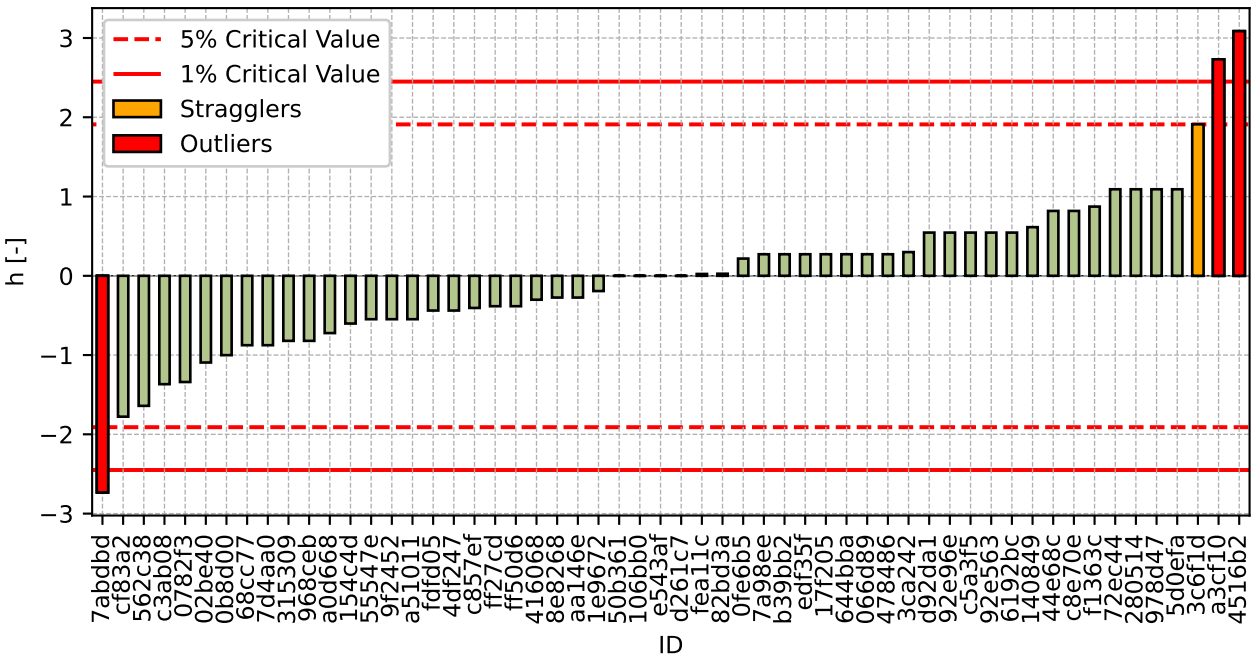

Figure 17: Interlaboratory Consistency Statistic

1.2.4 Descriptive statistics

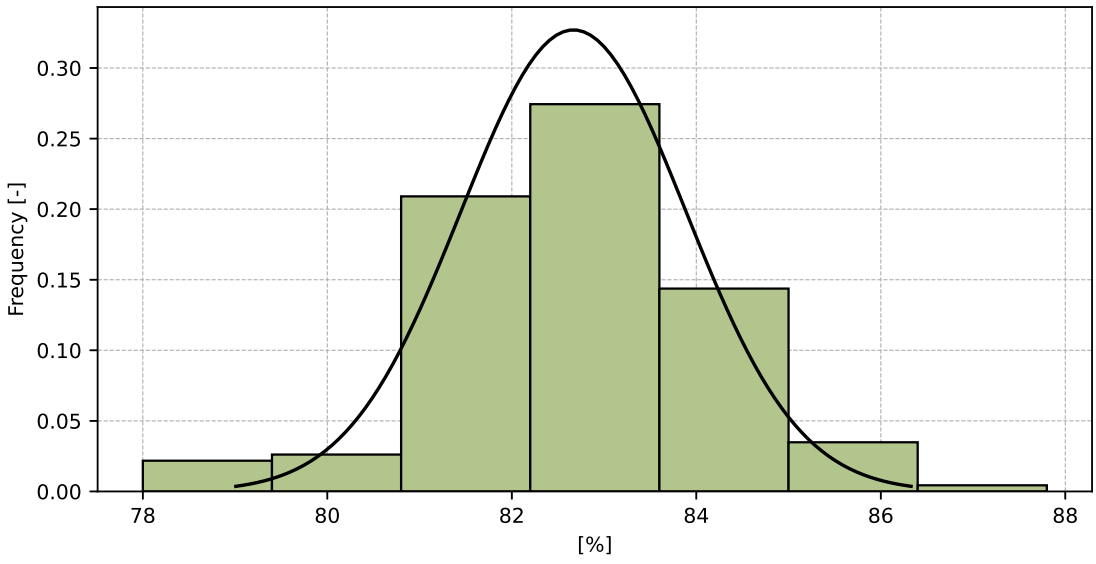

Figure 18: Histogram of all test results

Table 9: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	83
Sample standard deviation – s	1.2
Asigned value – x^*	83
Robust standard deviation – s^*	1.1
Measurement uncertainty of asigned value – u_X	0.2
p-value of normality test	1.0 [-]
Interlaboratory standard deviation – s_L	1.1
Repeatability standard deviation – s_r	0.9
Reproducibility standard deviation – s_R	1.4
Repeatability – r	3
Reproducibility – R	4

1.2.5 Evaluation of Performance Statistics

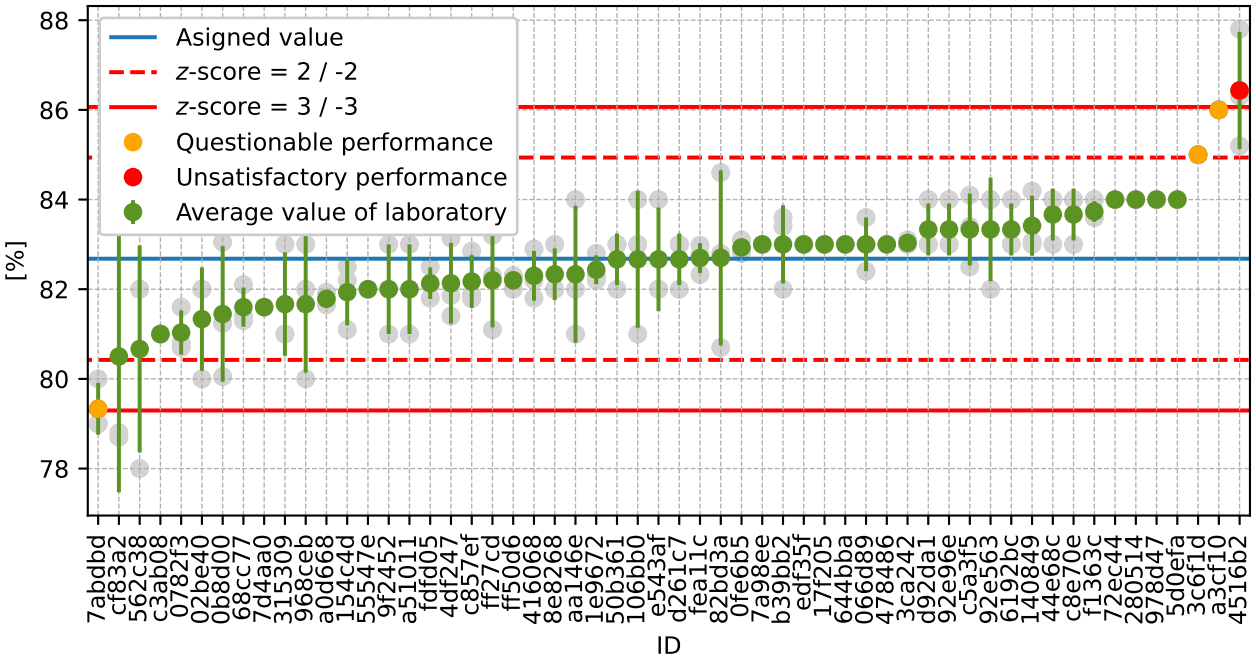

Figure 19: Average values and sample standard deviations

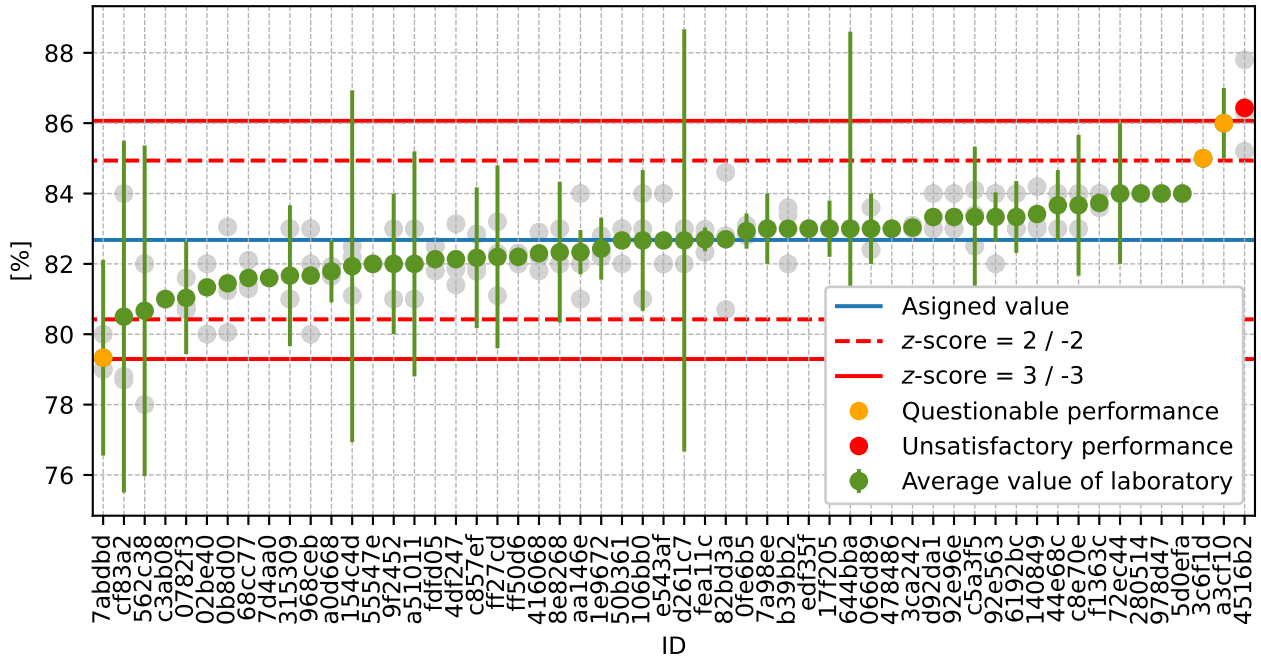

Figure 20: Average values and extended uncertainties of measurement

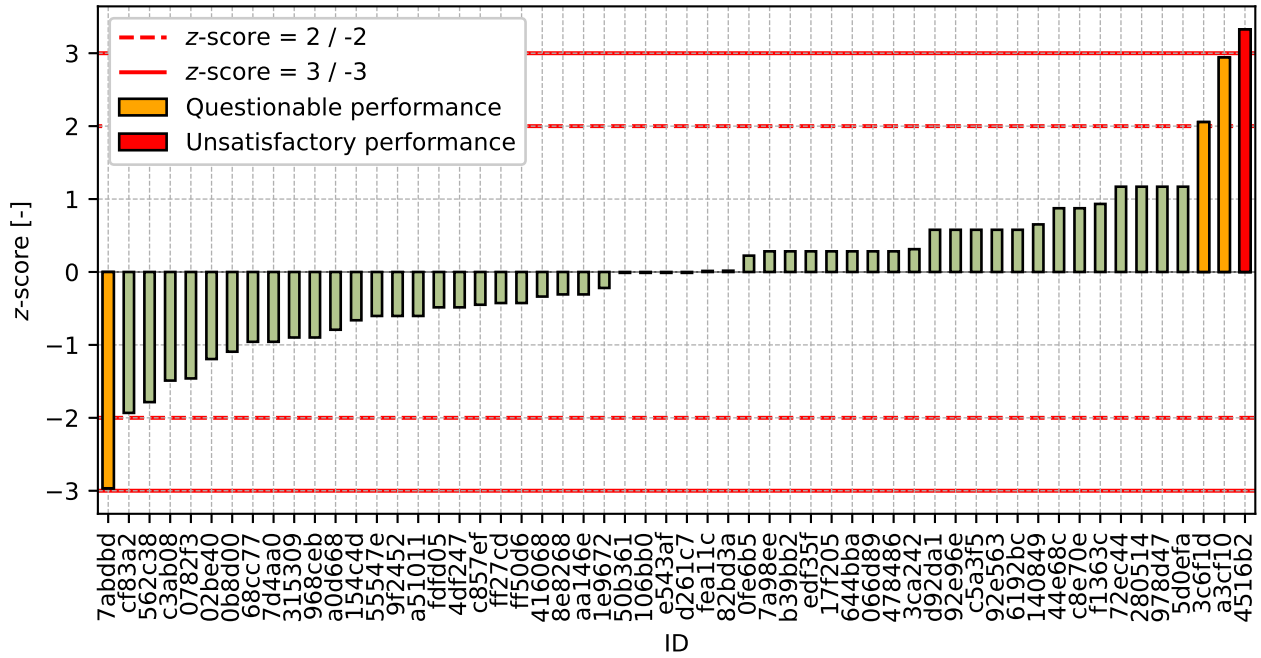

Figure 21: z-score

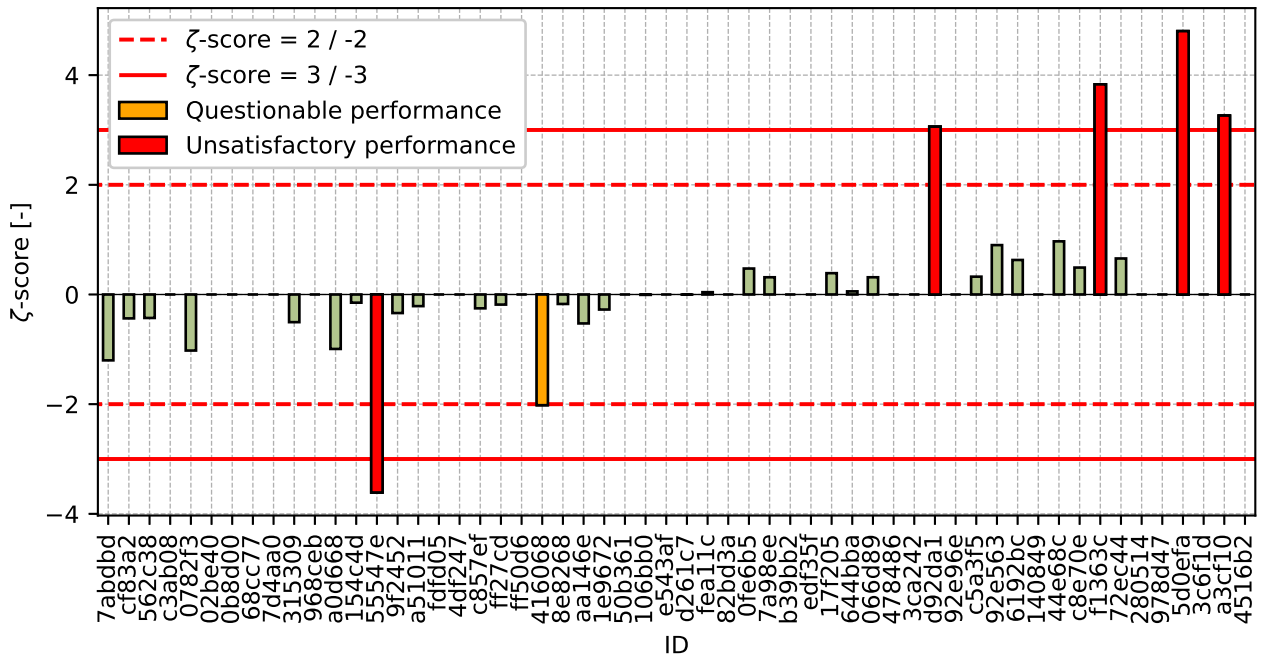

Figure 22: ζ-score

Table 10: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
7abdbd	-2.97	-1.2
cf83a2	-1.93	-0.44
562c38	-1.78	-0.43
c3ab08	-1.49	-
0782f3	-1.46	-1.02
02be40	-1.19	-
0b8d00	-1.09	-
68cc77	-0.96	-
7d4aa0	-0.96	-
315309	-0.9	-0.5
968ceb	-0.9	-
a0d668	-0.79	-0.99
154c4d	-0.66	-0.15
55547e	-0.6	-3.61
9f2452	-0.6	-0.34
a51011	-0.6	-0.21
fdfd05	-0.48	-
4df247	-0.48	-
c857ef	-0.45	-0.25
ff27cd	-0.43	-0.18
ff50d6	-0.43	-
416068	-0.34	-2.02

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ID	z-score [-]	ζ-score [-]
8e8268	-0.31	-0.17
aa146e	-0.31	-0.53
1e9672	-0.22	-0.27
50b361	-0.01	-
106bb0	-0.01	-0.01
e543af	-0.01	-
d261c7	-0.01	-0.0
fea11c	0.01	0.04
82bd3a	0.02	-
0fe6b5	0.22	0.47
7a98ee	0.28	0.31
b39bb2	0.28	-
edf35f	0.28	-
17f205	0.28	0.39
644bba	0.28	0.06
066d89	0.28	0.31
478486	0.28	-
3ca242	0.31	-
d92da1	0.58	3.06
92e96e	0.58	-
c5a3f5	0.58	0.33
92e563	0.58	0.9
6192bc	0.58	0.63
140849	0.65	-
44e68c	0.87	0.97
c8e70e	0.87	0.49
f1363c	0.93	3.83
72ec44	1.17	0.66
280514	1.17	-
978d47	1.17	-
5d0efa	1.17	4.8
3c6f1d	2.06	-
a3cf10	2.94	3.26
4516b2	3.33	-

1.3 1 mm

1.3.1 Test results

Table 11: 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 [%]
5acf80	32	32	32	1	32	0.1	0.18
0b8d00	53	50	49	-	51	2.1	4.1
02be40	54	54	53	-	54	0.6	1.08
562c38	55	51	56	6	54	2.6	4.9
0782f3	54	55	55	1	55	0.4	0.8
a0d668	55	55	55	1	55	0.0	0.08
154c4d	56	55	55	3	55	0.5	0.83
7d4aa0	55	-	-	-	55	0.0	0.0
cf83a2	53	53	59	3	55	3.5	6.37
968ceb	56	55	56	-	56	0.6	1.04
4df247	58	55	55	-	56	1.4	2.51
7abdbd	56	56	56	2	56	0.0	0.0
17f205	56	56	57	1	56	0.6	1.02
a51011	59	55	56	3	57	2.1	3.67
aa146e	58	56	56	1	57	1.2	2.04
6192bc	56	57	57	1	57	0.6	1.02
ff50d6	57	57	57	-	57	0.3	0.46
c3ab08	57	57	57	-	57	0.0	0.0
066d89	58	57	56	1	57	0.8	1.46
ff27cd	57	56	58	2	57	1.3	2.19
1e9672	58	57	57	1	57	0.4	0.61
315309	60	56	56	4	57	2.3	4.03
7a98ee	57	57	58	1	57	0.6	1.01
55547e	57	57	58	1	57	0.6	1.01
8e8268	57	57	58	2	57	0.6	1.01
0fe6b5	57	57	58	0	58	0.3	0.46
416068	58	58	57	0	58	0.7	1.14
fea11c	58	57	58	1	58	0.3	0.58
c857ef	58	58	57	2	58	0.6	0.96
9f2452	57	59	57	2	58	1.2	2.0
d92da1	58	57	58	0	58	0.6	1.0
b39bb2	58	58	57	-	58	0.9	1.61
e543af	60	56	57	-	58	2.1	3.61
f1363c	59	58	56	0	58	1.2	2.15
c5a3f5	59	58	56	2	58	1.5	2.59
50b361	58	58	58	-	58	0.0	0.0

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ID	Test results [%]			u_X [%]	$\bar{x}$ [%]	s_0 [%]	V_X [%]
978d47	58	58	58	-	58	0.0	0.0
edf35f	58	58	58	-	58	0.0	0.0
478486	58	-	-	-	58	0.0	0.0
d261c7	58	59	58	6	58	0.6	0.99
44e68c	58	58	59	1	58	0.6	0.99
82bd3a	59	59	57	-	58	1.1	1.81
68cc77	58	59	58	-	58	0.1	0.2
3ca242	59	59	59	-	59	0.1	0.1
92e96e	59	59	58	-	59	0.6	0.98
280514	59	59	59	-	59	0.0	0.0
644bba	59	59	59	4	59	0.0	0.0
72ec44	59	59	59	3	59	0.0	0.0
106bb0	60	58	59	2	59	1.0	1.69
92e563	58	60	60	1	59	1.2	1.95
c8e70e	59	60	59	2	59	0.6	0.97
5d0efa	59	60	59	0	59	0.6	0.97
fdfd05	57	61	60	-	59	2.0	3.31
3c6f1d	60	59	60	-	60	0.6	0.97
a3cf10	62	62	62	1	62	0.0	0.0
4516b2	62	64	60	-	62	1.8	2.81
140849	68	65	66	-	66	1.3	2.0

1.3.2 The Numerical Procedure for Determining Outliers

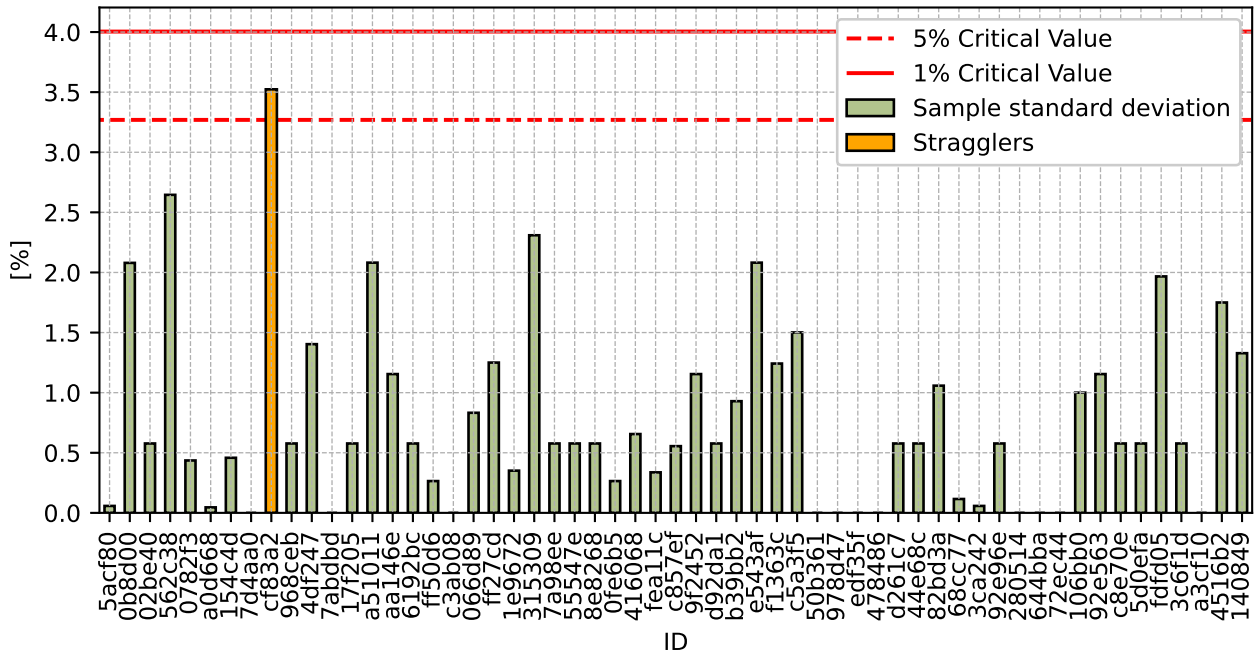

Figure 23: **Cochran's test** - sample standard deviations

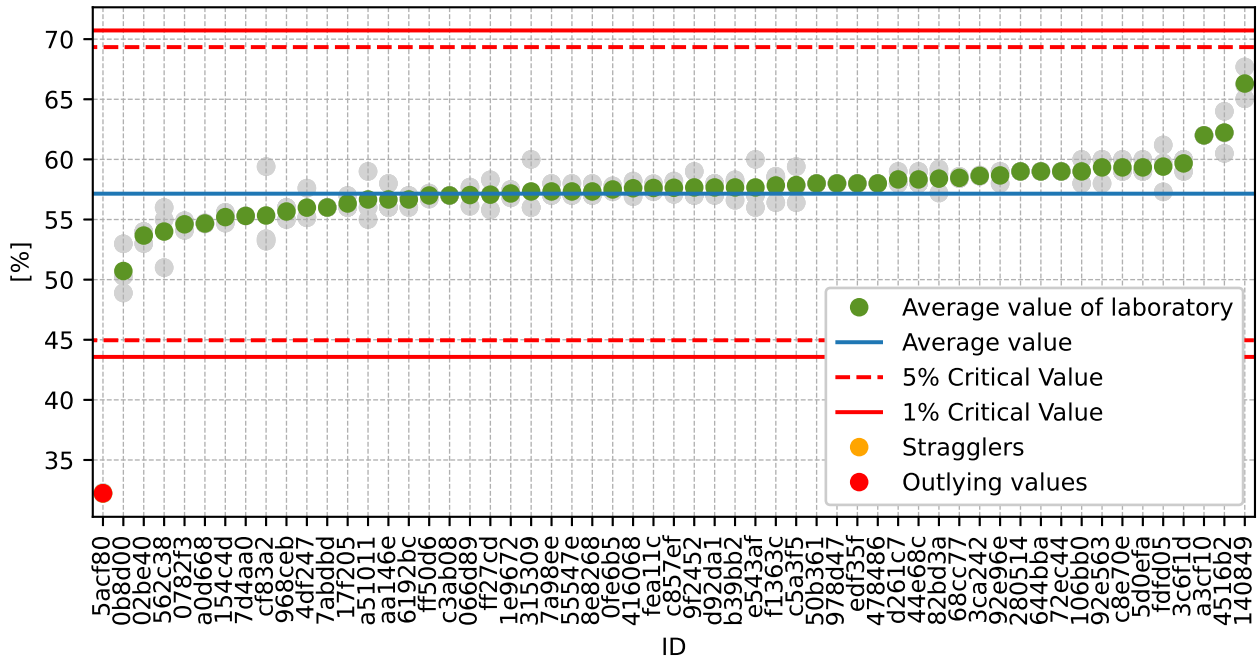

Figure 24: **Grubbs' test** - average values

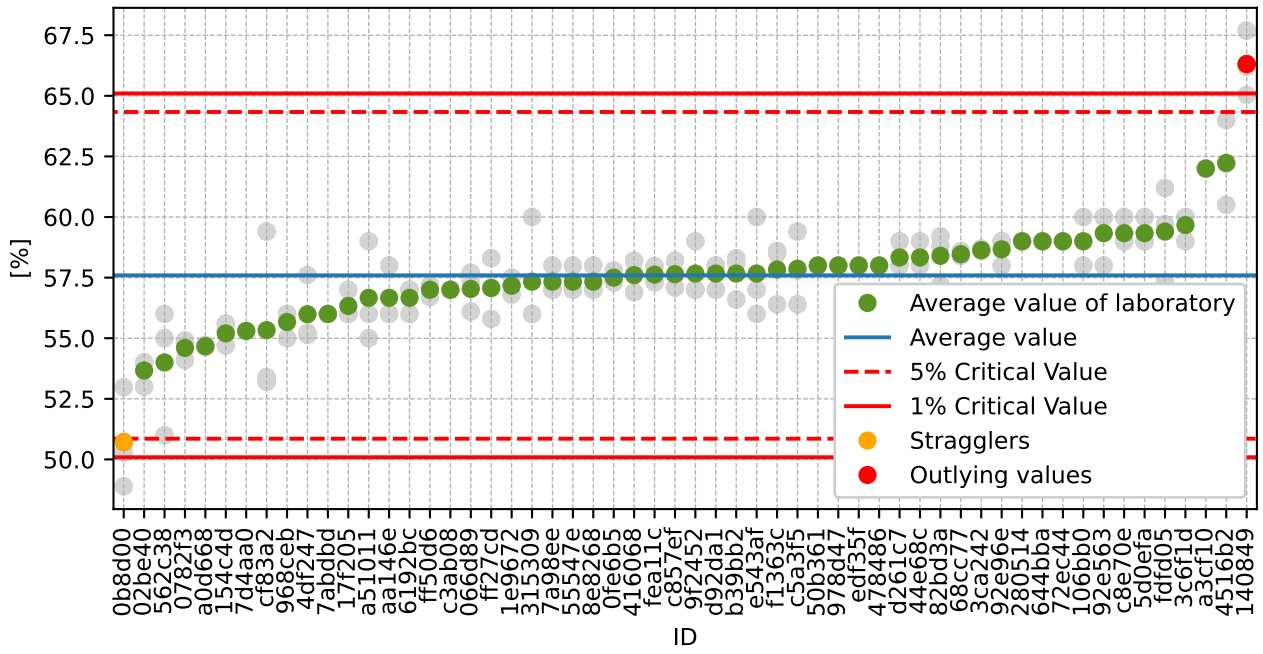

Figure 25: **Grubbs' test** - average values without outliers

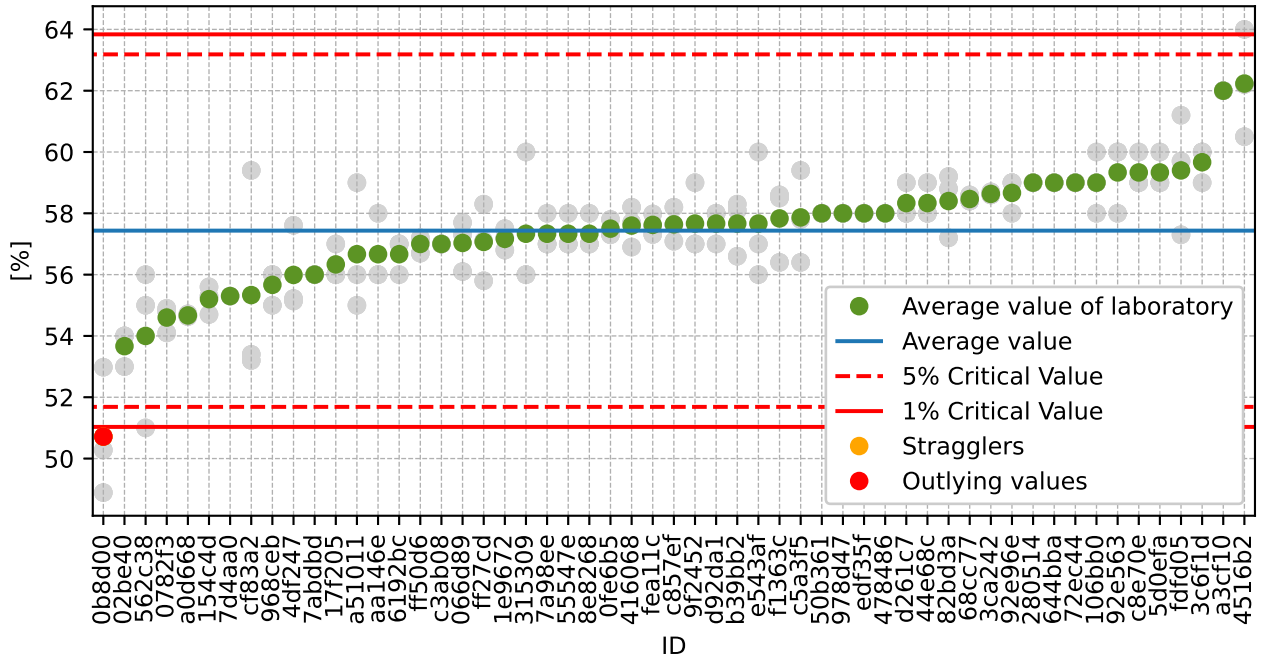

Figure 26: **Grubbs' test** - average values without outliers

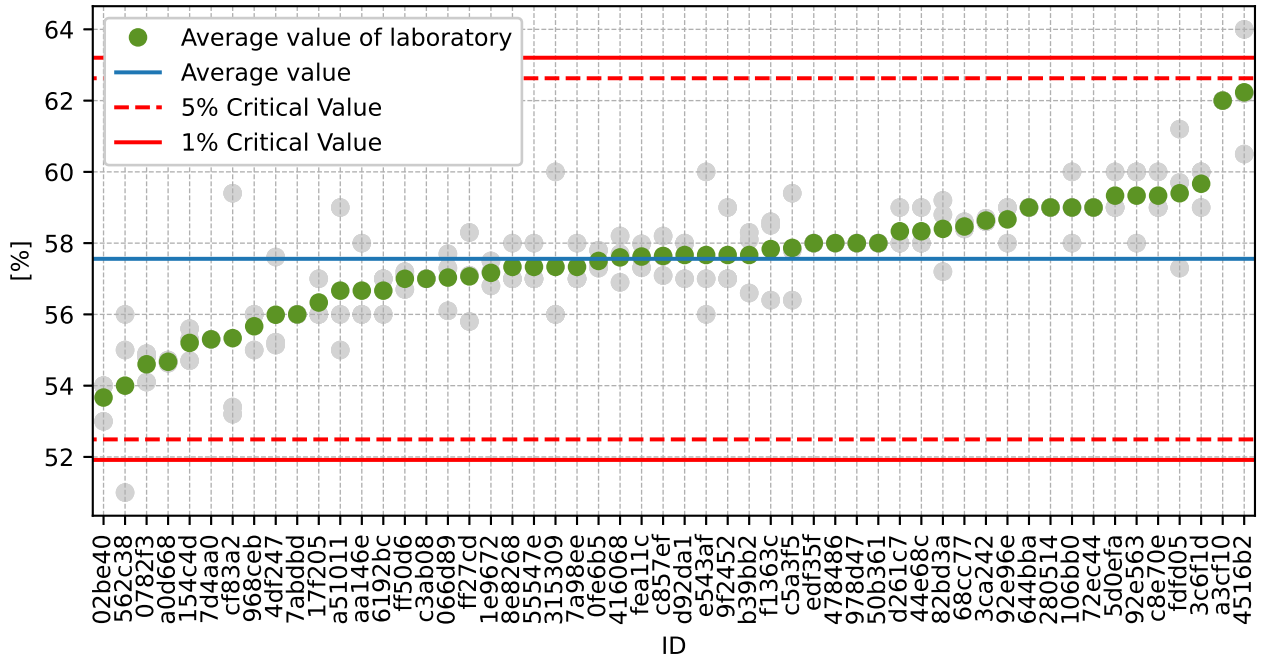

Figure 27: **Grubbs' test** - average values without outliers

1.3.3 Mandel's Statistics

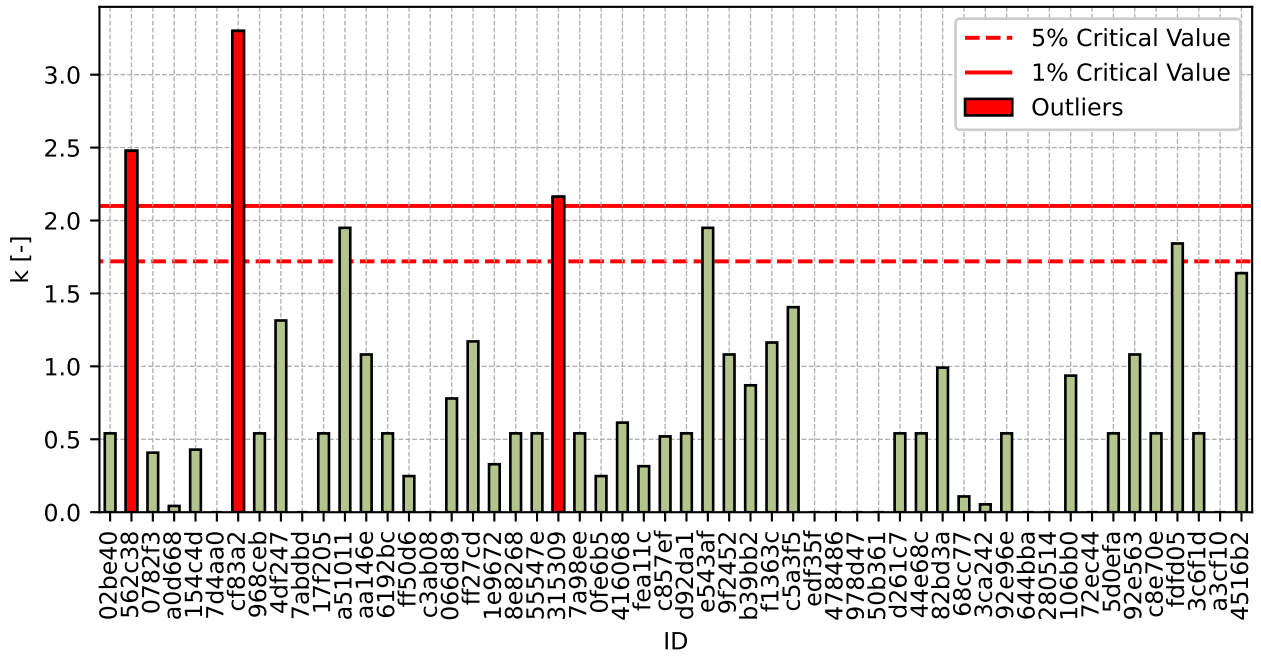

Figure 28: Intralaboratory Consistency Statistic

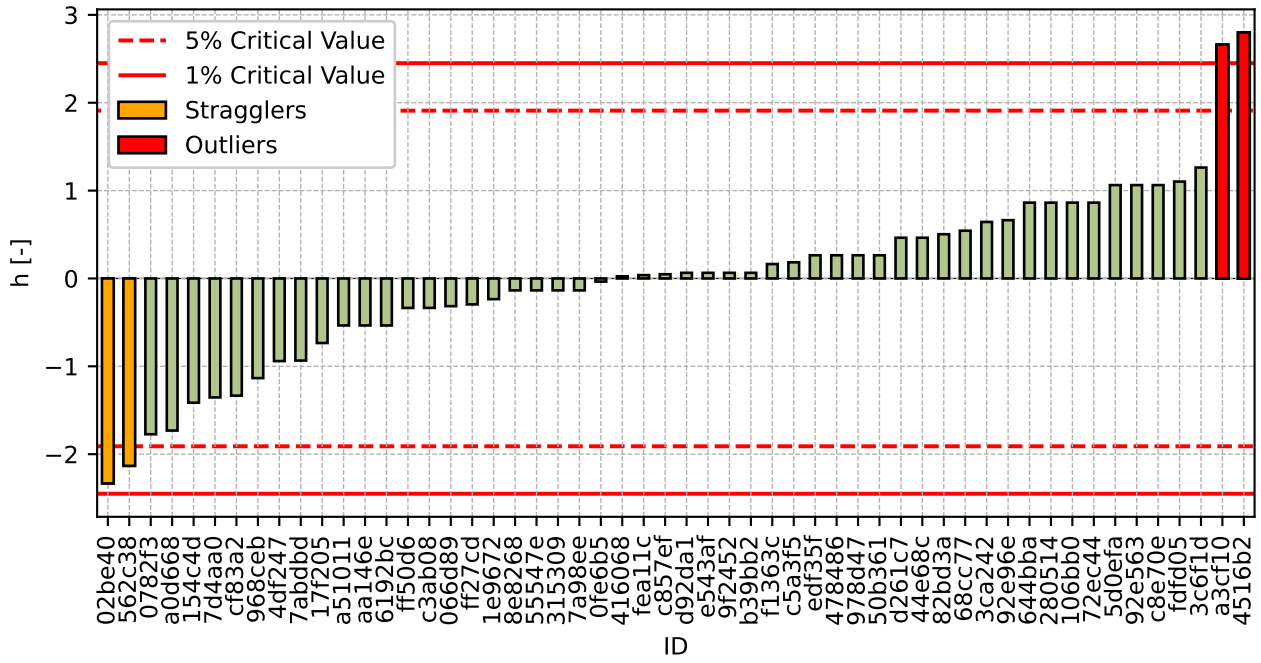

Figure 29: Interlaboratory Consistency Statistic

1.3.4 Descriptive statistics

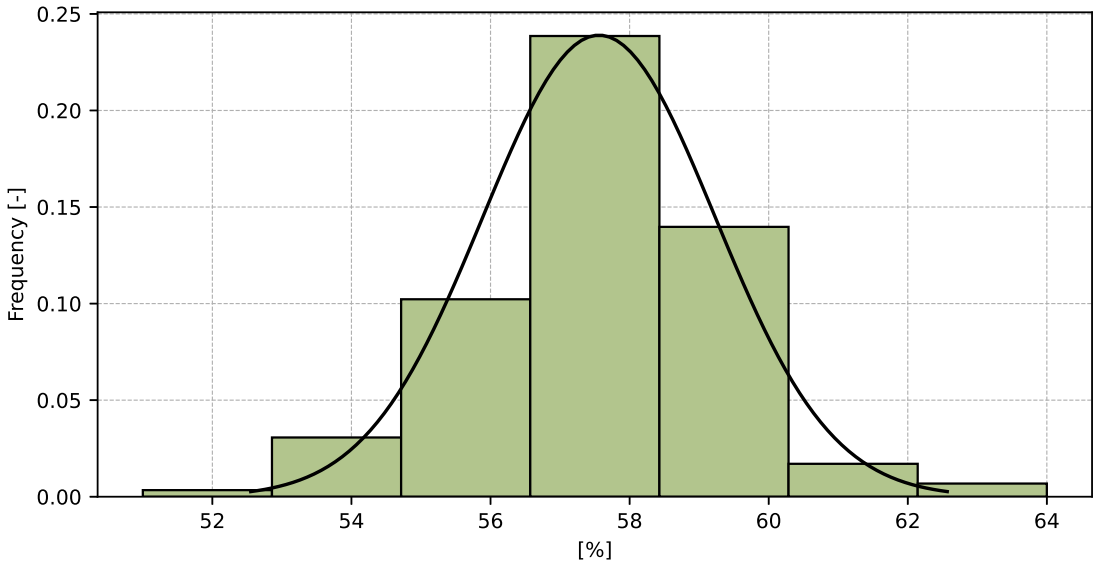

Figure 30: Histogram of all test results

Table 12: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	58
Sample standard deviation – s	1.7
Asigned value – x^*	58
Robust standard deviation – s^*	1.5
Measurement uncertainty of asigned value – u_X	0.3
p-value of normality test	1.0 [-]
Interlaboratory standard deviation – s_L	1.6
Repeatability standard deviation – s_r	1.1
Reproducibility standard deviation – s_R	1.9
Repeatability – r	3
Reproducibility – R	5

1.3.5 Evaluation of Performance Statistics

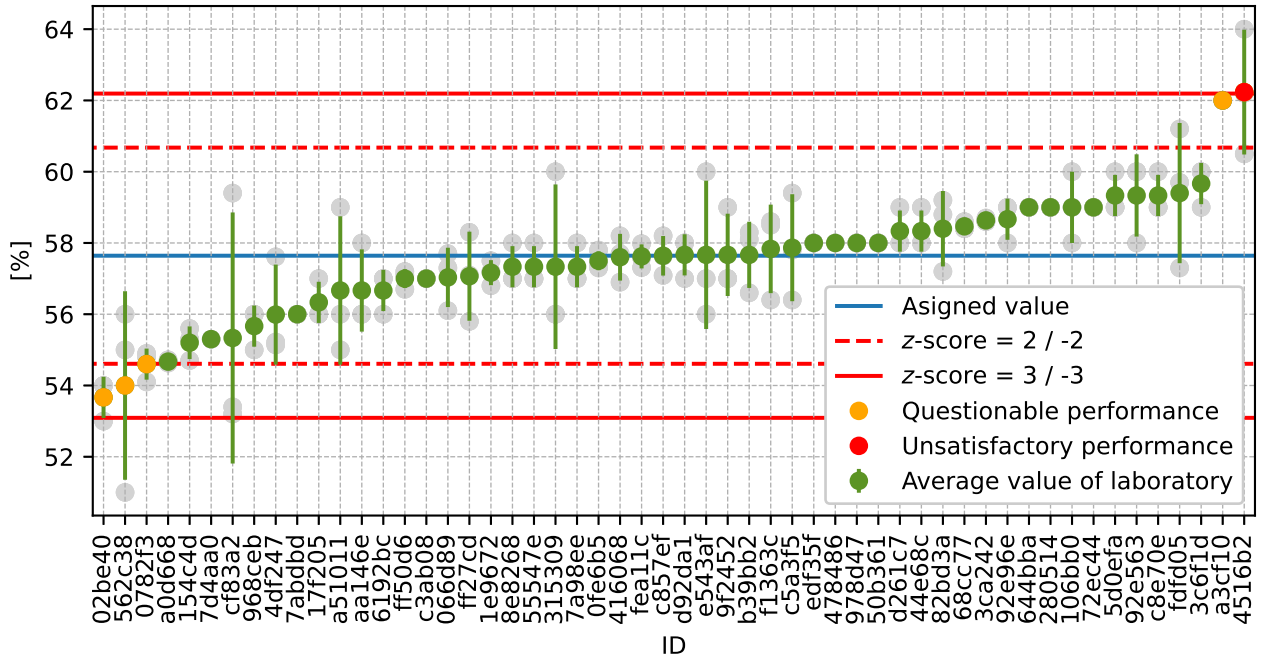

Figure 31: Average values and sample standard deviations

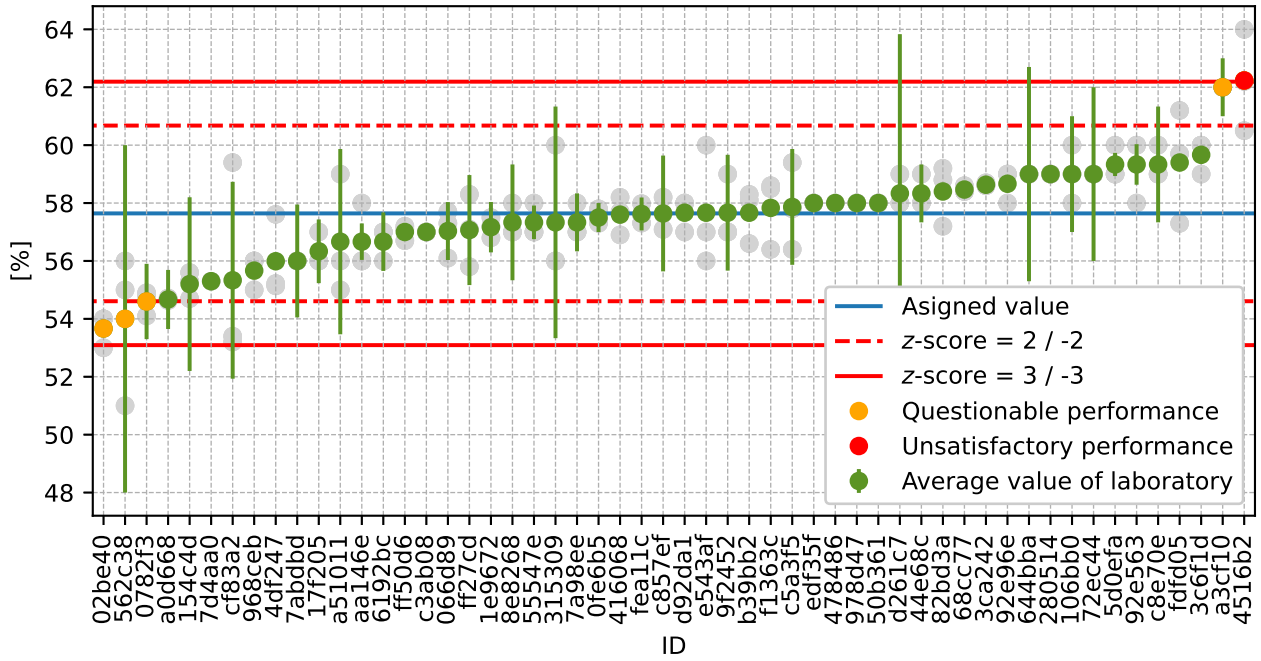

Figure 32: Average values and extended uncertainties of measurement

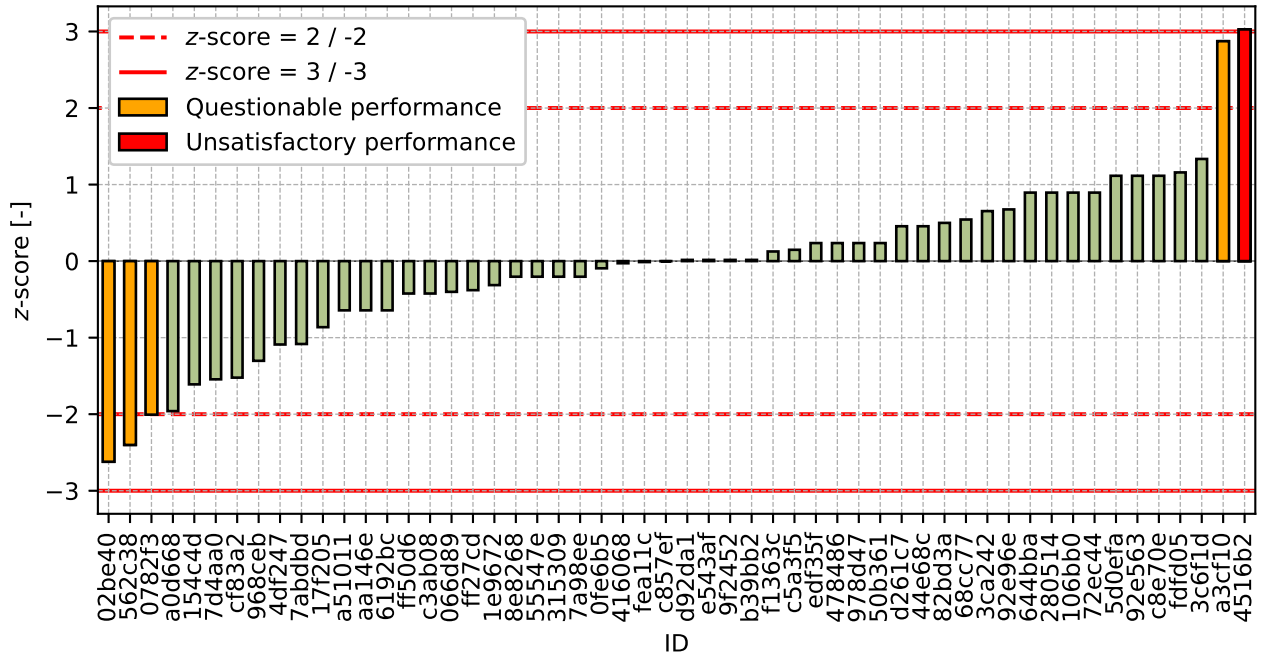

Figure 33: z-score

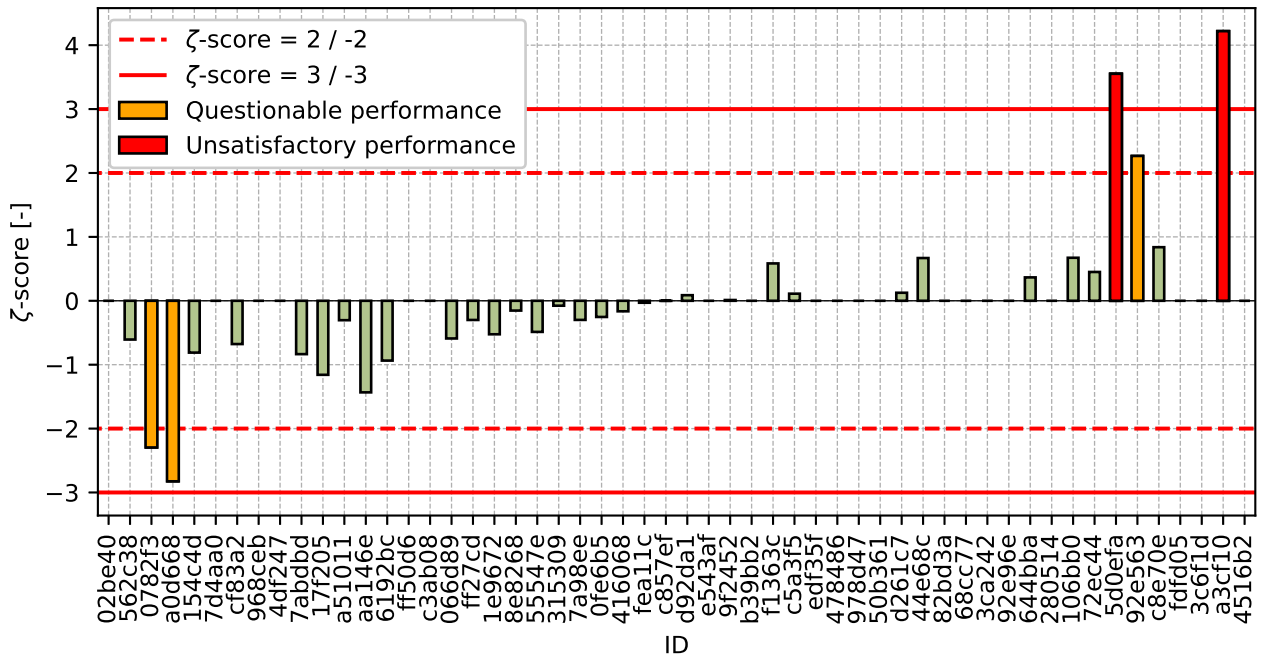

Figure 34: ζ-score

Table 13: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
02be40	-2.62	-
562c38	-2.4	-0.61
0782f3	-2.01	-2.3
a0d668	-1.96	-2.83
154c4d	-1.61	-0.81
7d4aa0	-1.54	-
cf83a2	-1.52	-0.68
968ceb	-1.3	-
4df247	-1.09	-
7abdbd	-1.08	-0.84
17f205	-0.86	-1.16
a51011	-0.64	-0.3
aa146e	-0.64	-1.43
6192bc	-0.64	-0.94
ff50d6	-0.42	-
c3ab08	-0.42	-
066d89	-0.4	-0.59
ff27cd	-0.38	-0.3
1e9672	-0.31	-0.52
8e8268	-0.2	-0.15
55547e	-0.2	-0.49
315309	-0.2	-0.08

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ID	z-score [-]	ζ-score [-]
7a98ee	-0.2	-0.3
0fe6b5	-0.09	-0.25
416068	-0.03	-0.16
fea11c	-0.01	-0.03
c857ef	-0.0	-0.0
d92da1	0.02	0.09
e543af	0.02	-
9f2452	0.02	0.01
b39bb2	0.02	-
f1363c	0.13	0.58
c5a3f5	0.15	0.11
edf35f	0.24	-
478486	0.24	-
978d47	0.24	-
50b361	0.24	-
d261c7	0.46	0.13
44e68c	0.46	0.67
82bd3a	0.5	-
68cc77	0.54	-
3ca242	0.65	-
92e96e	0.68	-
644bba	0.9	0.37
280514	0.9	-
106bb0	0.9	0.67
72ec44	0.9	0.45
5d0efa	1.11	3.55
92e563	1.11	2.27
c8e70e	1.11	0.84
fdfd05	1.16	-
3c6f1d	1.33	-
a3cf10	2.87	4.22
4516b2	3.03	-

1.4 0.5 mm

1.4.1 Test results

Table 14: 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 [%]
5acf80	9	9	9	0	9	0.1	0.63
0b8d00	27	25	24	-	25	1.4	5.7
02be40	26	27	26	-	26	0.6	2.19
7abdbd	27	27	27	1	27	0.0	0.0
562c38	27	26	29	4	27	1.5	5.59
0782f3	28	27	29	1	28	1.0	3.57
968ceb	28	28	29	-	28	0.6	2.04
4df247	30	28	28	-	28	1.1	4.03
154c4d	29	28	28	2	29	0.2	0.54
a0d668	29	29	29	1	29	0.2	0.69
aa146e	30	28	28	1	29	1.2	4.03
ff50d6	28	29	29	-	29	0.6	2.24
7d4aa0	29	-	-	-	29	0.0	0.0
6192bc	29	29	29	1	29	0.0	0.0
978d47	29	29	29	-	29	0.0	0.0
416068	29	30	29	0	29	0.4	1.2
82bd3a	30	29	28	-	29	0.9	3.14
92e96e	29	29	30	-	29	0.6	1.97
cf83a2	28	28	31	2	29	1.5	5.22
7a98ee	29	29	30	1	29	0.6	1.97
0fe6b5	29	29	30	0	29	0.3	1.04
ff27cd	29	29	30	2	29	0.4	1.41
066d89	30	30	29	1	30	0.8	2.54
a51011	32	29	29	3	30	1.7	5.77
17f205	30	30	30	1	30	0.0	0.0
edf35f	30	30	30	-	30	0.0	0.0
f1363c	30	31	29	0	30	0.7	2.19
c3ab08	30	30	30	-	30	0.0	0.0
3ca242	30	30	30	-	30	0.1	0.19
9f2452	30	31	30	2	30	0.6	1.9
55547e	30	31	30	1	30	0.6	1.9
8e8268	31	30	30	2	30	0.6	1.9
68cc77	31	30	31	-	31	0.3	0.82
b39bb2	30	31	31	-	31	0.3	0.82
d92da1	31	30	31	0	31	0.6	1.88
c8e70e	31	30	31	1	31	0.6	1.88

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ID	Test results [%]			u_X [%]	$\bar{x}$ [%]	s_0 [%]	V_X [%]
106bb0	31	30	31	1	31	0.6	1.88
fea11c	30	31	31	0	31	0.2	0.79
c857ef	31	31	31	2	31	0.3	0.97
1e9672	31	31	31	1	31	0.3	0.81
315309	32	31	30	2	31	1.0	3.23
50b361	31	31	31	-	31	0.0	0.0
d261c7	30	31	32	3	31	1.0	3.23
478486	31	-	-	-	31	0.0	0.0
fdfd05	30	32	31	-	31	1.1	3.56
5d0efa	32	31	31	0	31	0.6	1.84
644bba	32	31	31	2	31	0.6	1.84
44e68c	31	31	32	1	31	0.6	1.84
e543af	33	30	31	-	31	1.5	4.88
c5a3f5	33	32	30	2	32	1.5	4.79
92e563	31	32	32	1	32	0.6	1.82
3c6f1d	32	32	32	-	32	0.0	0.0
280514	32	32	32	-	32	0.0	0.0
72ec44	32	32	32	3	32	0.0	0.0
140849	34	31	32	-	32	1.7	5.24
4516b2	34	35	32	-	34	1.4	4.05
a3cf10	35	35	35	1	35	0.0	0.0

1.4.2 The Numerical Procedure for Determining Outliers

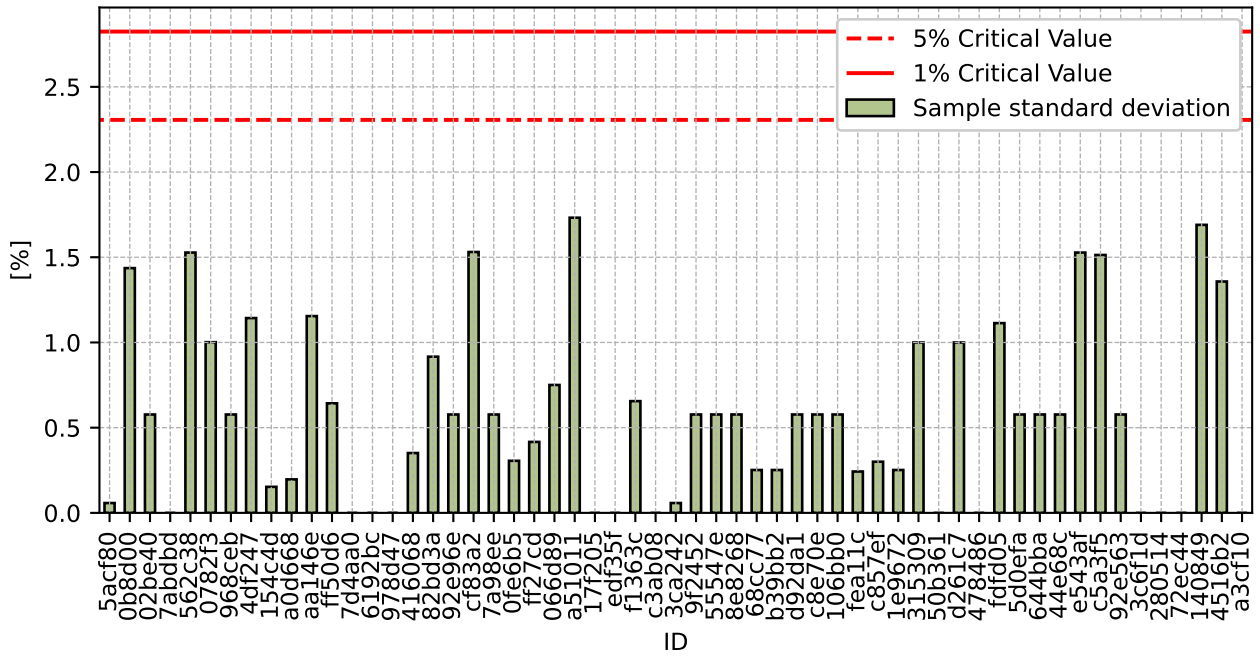

Figure 35: **Cochran's test** - sample standard deviations

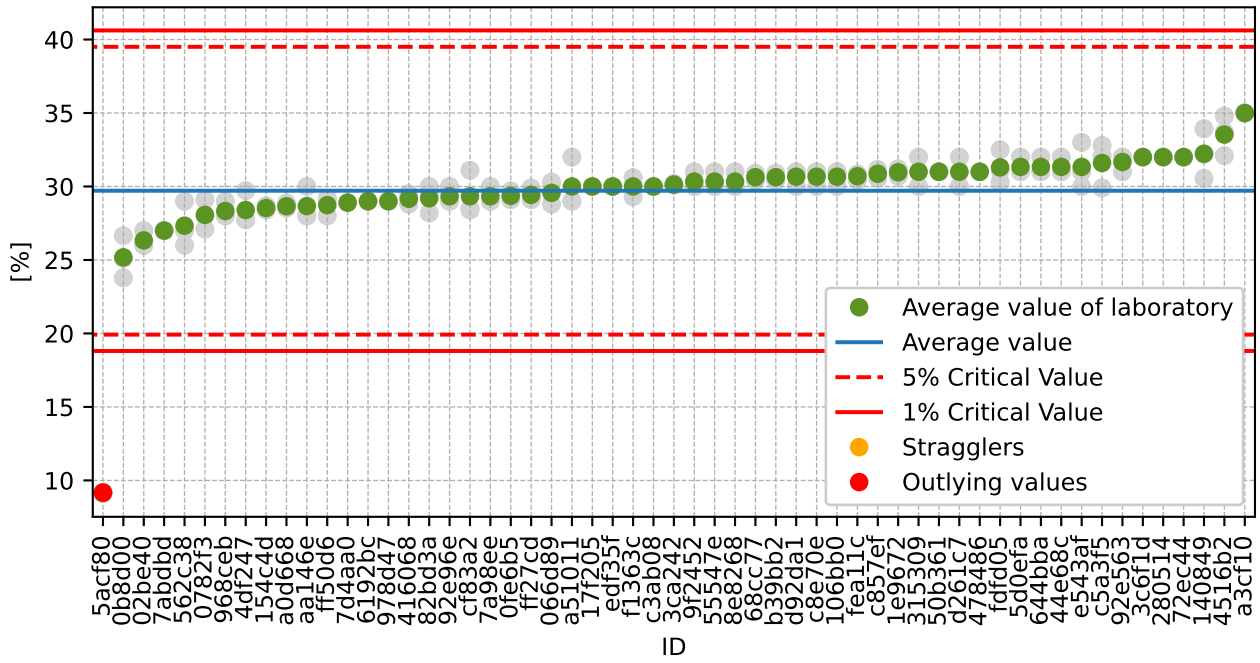

Figure 36: **Grubbs' test** - average values

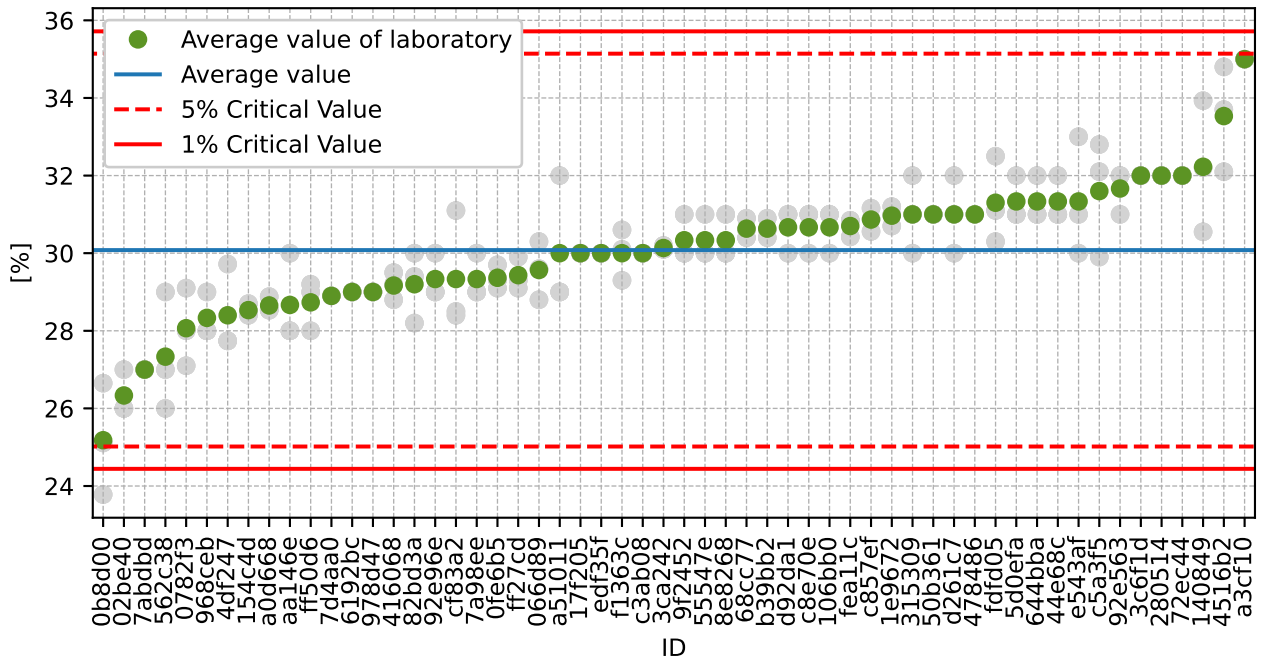

Figure 37: **Grubbs' test** - average values without outliers

1.4.3 Mandel's Statistics

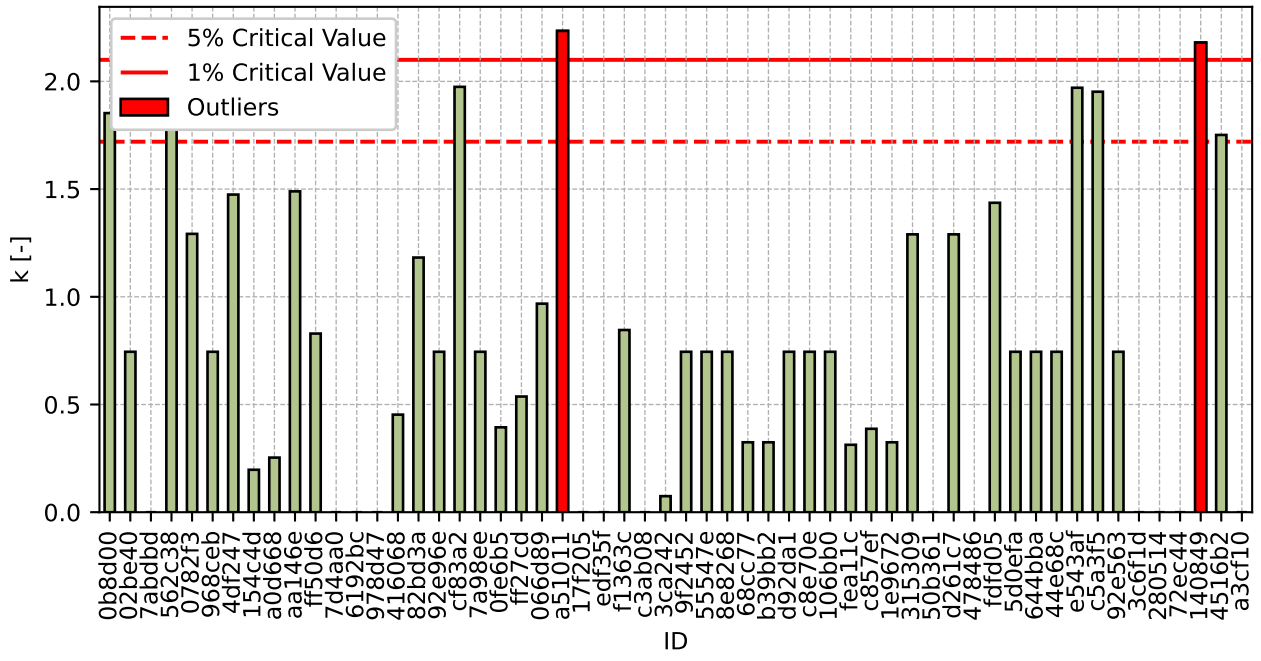

Figure 38: Intralaboratory Consistency Statistic

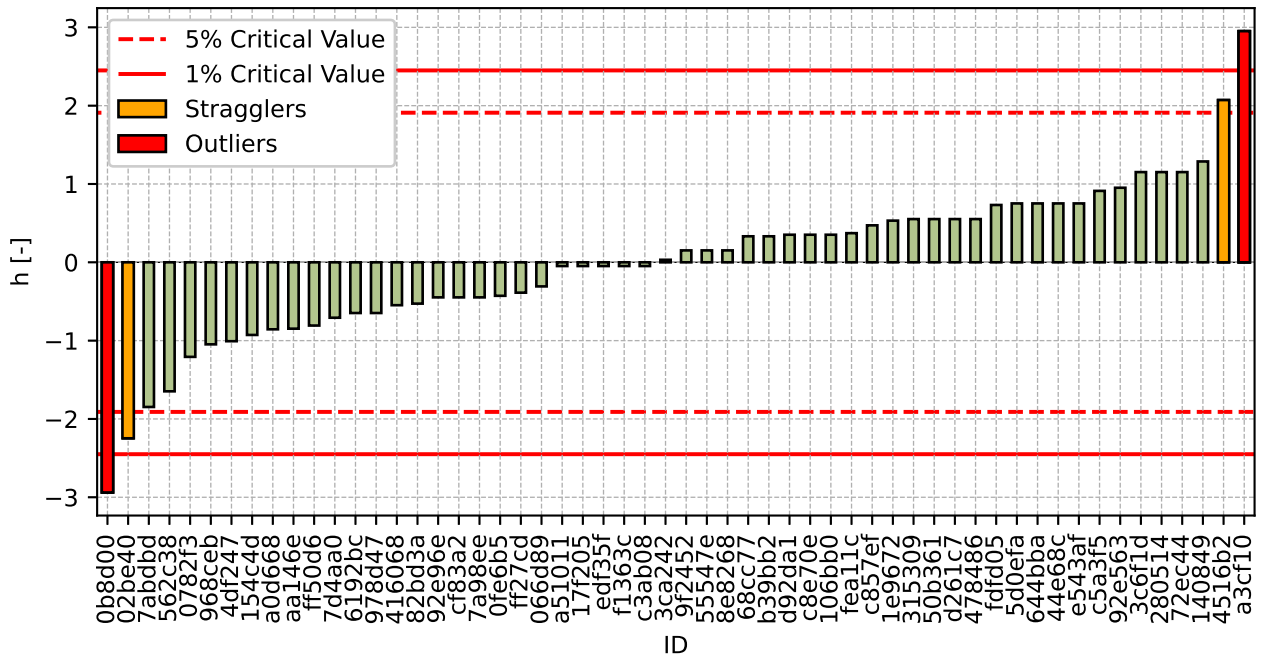

Figure 39: Interlaboratory Consistency Statistic

1.4.4 Descriptive statistics

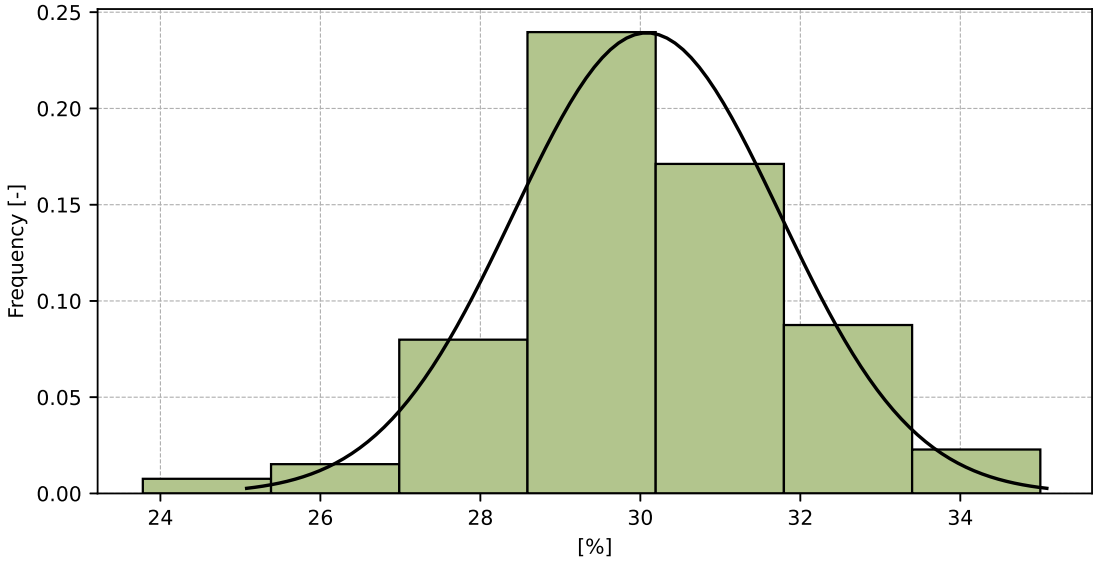

Figure 40: Histogram of all test results

Table 15: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	30
Sample standard deviation – s	1.7
Asigned value – x^*	30
Robust standard deviation – s^*	1.6
Measurement uncertainty of asigned value – u_X	0.3
p-value of normality test	1.0 [-]
Interlaboratory standard deviation – s_L	1.6
Repeatability standard deviation – s_r	0.8
Reproducibility standard deviation – s_R	1.8
Repeatability – r	2
Reproducibility – R	5

1.4.5 Evaluation of Performance Statistics

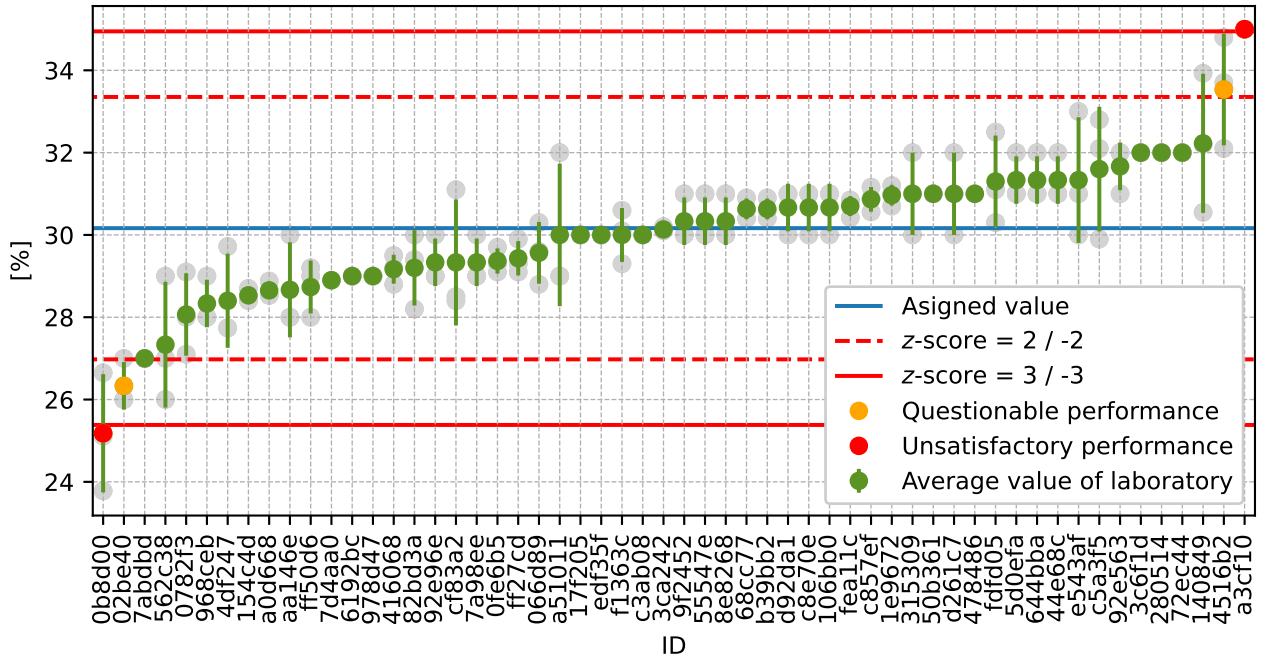

Figure 41: Average values and sample standard deviations

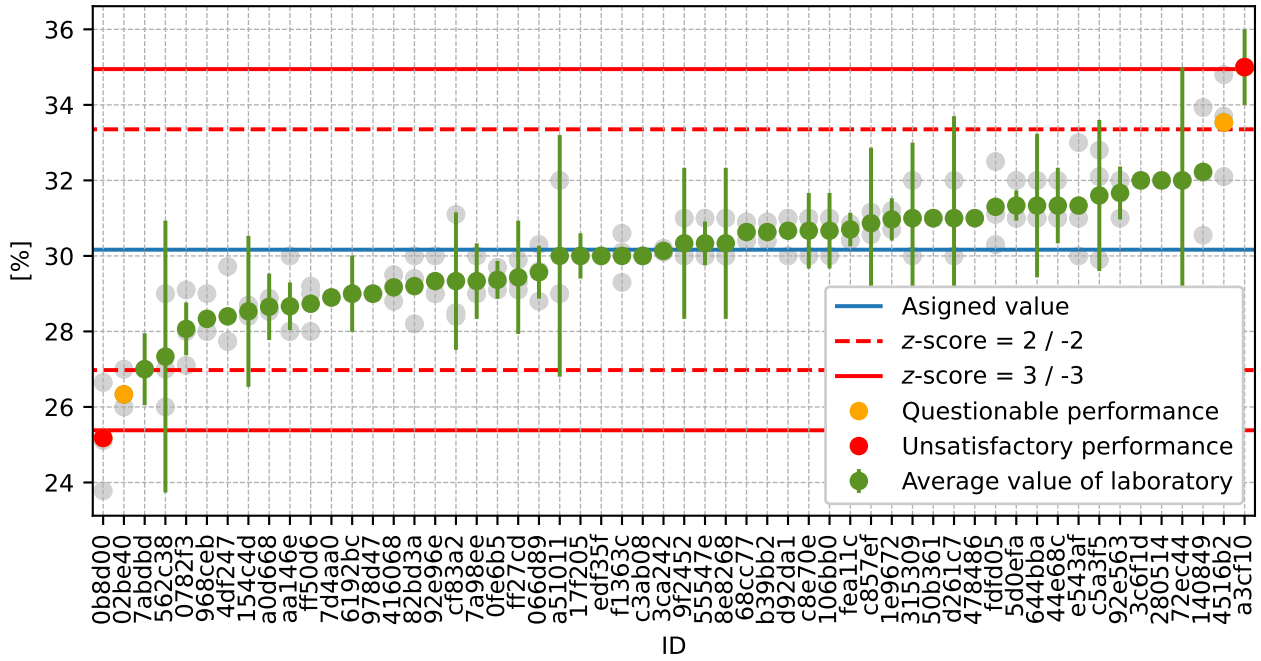

Figure 42: Average values and extended uncertainties of measurement

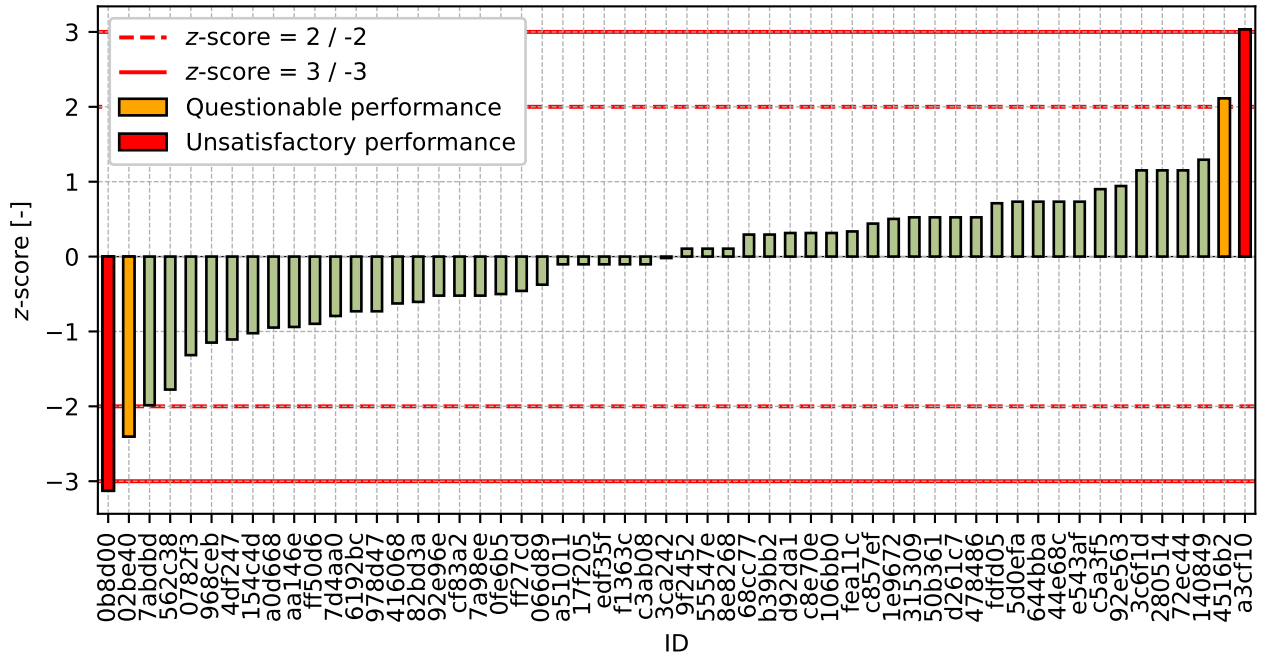

Figure 43: z-score

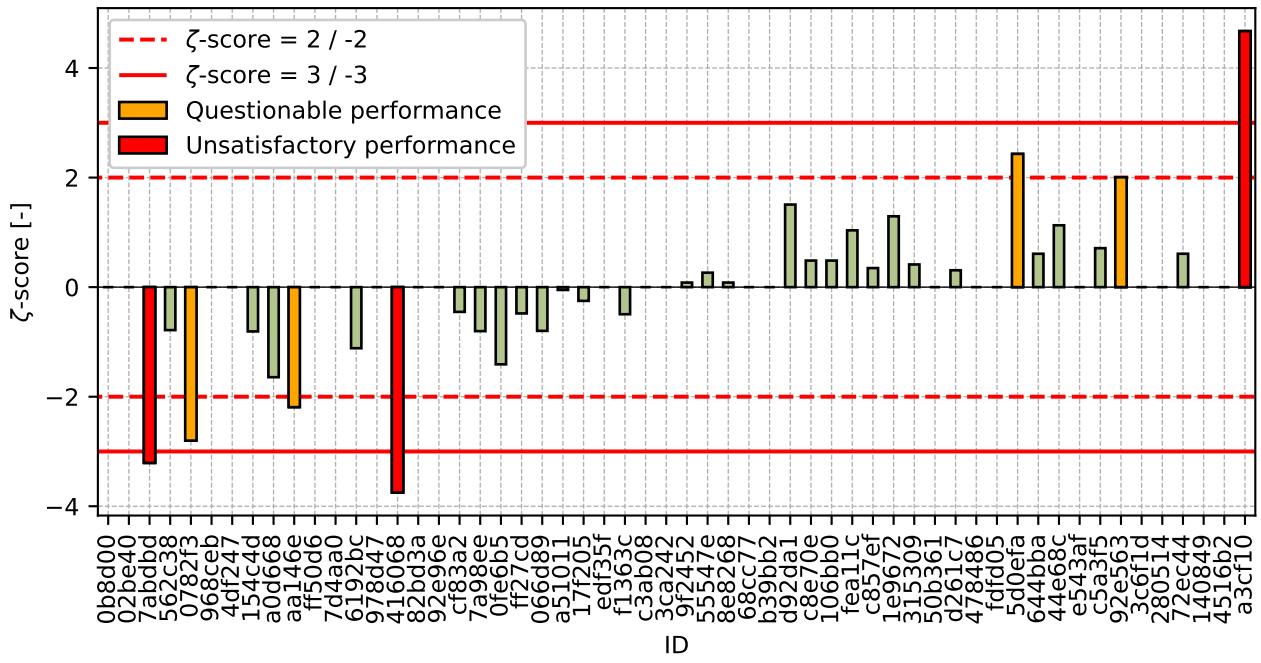

Figure 44: ζ-score

Table 16: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
0b8d00	-3.13	-
02be40	-2.4	-
7abdbd	-1.99	-3.21
562c38	-1.78	-0.78
0782f3	-1.32	-2.8
968ceb	-1.15	-
4df247	-1.11	-
154c4d	-1.02	-0.81
a0d668	-0.95	-1.64
aa146e	-0.94	-2.19
ff50d6	-0.9	-
7d4aa0	-0.79	-
6192bc	-0.73	-1.12
978d47	-0.73	-
416068	-0.63	-3.75
82bd3a	-0.61	-
92e96e	-0.52	-
cf83a2	-0.52	-0.45
7a98ee	-0.52	-0.8
0fe6b5	-0.5	-1.41
ff27cd	-0.46	-0.48
066d89	-0.38	-0.8

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ID	*z*-score [-]	ζ-score [-]
a51011	-0.1	-0.05
17f205	-0.1	-0.25
edf35f	-0.1	-
f1363c	-0.1	-0.49
c3ab08	-0.1	-
3ca242	-0.02	-
9f2452	0.11	0.08
55547e	0.11	0.26
8e8268	0.11	0.08
68cc77	0.29	-
b39bb2	0.29	-
d92da1	0.31	1.51
c8e70e	0.31	0.49
106bb0	0.31	0.49
fea11c	0.34	1.04
c857ef	0.44	0.35
1e9672	0.5	1.29
315309	0.52	0.41
50b361	0.52	-
d261c7	0.52	0.31
478486	0.52	-
fdfd05	0.71	-
5d0efa	0.73	2.43
644bba	0.73	0.61
44e68c	0.73	1.13
e543af	0.73	-
c5a3f5	0.9	0.71
92e563	0.94	2.01
3c6f1d	1.15	-
280514	1.15	-
72ec44	1.15	0.61
140849	1.29	-
4516b2	2.11	-
a3cf10	3.03	4.67

1.5 0.25 mm

1.5.1 Test results

Table 17: 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 [%]
5acf80	1	1	1	0	1	0.1	4.22
02be40	7	8	7	-	7	0.6	7.87
0fe6b5	7	8	8	0	8	0.5	6.03
92e96e	7	8	8	-	8	0.6	7.53
416068	8	8	8	0	8	0.1	1.3
ff50d6	7	8	8	-	8	0.4	5.2
0782f3	8	8	8	0	8	0.3	4.1
4df247	9	8	8	-	8	0.5	5.82
968ceb	8	8	8	-	8	0.0	0.0
aa146e	9	8	7	0	8	1.0	12.5
978d47	8	8	8	-	8	0.0	0.0
a0d668	8	8	8	1	8	0.1	1.32
7a98ee	8	8	9	1	8	0.6	6.93
562c38	8	8	9	1	8	0.6	6.93
f1363c	8	8	8	0	8	0.2	1.83
3ca242	8	8	8	-	8	0.0	0.0
154c4d	9	8	8	1	9	0.2	2.67
6192bc	9	8	9	1	9	0.6	6.66
82bd3a	9	9	8	-	9	0.2	2.63
1e9672	9	9	9	0	9	0.2	1.72
b39bb2	9	9	9	-	9	0.4	4.9
478486	9	-	-	-	9	0.0	0.0
edf35f	9	9	9	-	9	0.0	0.0
106bb0	9	9	9	1	9	0.0	0.0
9f2452	9	9	9	1	9	0.0	0.0
a51011	10	9	8	3	9	1.0	11.11
c3ab08	9	9	9	-	9	0.0	0.0
d92da1	9	9	9	0	9	0.0	0.0
5d0efa	9	9	9	0	9	0.0	0.0
3c6f1d	9	9	9	9	9	0.0	0.0
7abdbd	9	9	9	0	9	0.0	0.0
140849	10	8	9	-	9	0.9	9.76
cf83a2	9	9	9	1	9	0.3	2.91
066d89	9	9	9	0	9	0.3	3.51
0b8d00	10	9	9	-	9	0.5	4.93
fea11c	9	9	9	0	9	0.1	1.55

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ID	Test results [%]			u_X [%]	$\bar{x}$ [%]	s_0 [%]	V_X [%]
e543af	10	9	9	-	9	0.6	6.19
ff27cd	9	9	10	1	9	0.2	1.63
17f205	9	9	9	0	9	0.0	0.0
c857ef	10	10	9	2	10	0.2	1.6
55547e	10	10	9	1	10	0.6	5.97
44e68c	9	10	10	1	10	0.6	5.97
fdfd05	10	10	10	-	10	0.2	2.15
68cc77	10	9	10	-	10	0.4	4.31
4516b2	10	10	10	-	10	0.2	2.14
c5a3f5	10	10	9	1	10	0.9	9.36
d261c7	10	10	10	1	10	0.0	0.0
280514	10	10	10	-	10	0.0	0.0
72ec44	10	10	10	2	10	0.0	0.0
8e8268	10	10	10	1	10	0.0	0.0
c8e70e	10	10	10	1	10	0.0	0.0
644bba	10	10	10	1	10	0.0	0.0
50b361	10	10	10	-	10	0.0	0.0
315309	10	10	10	1	10	0.0	0.0
7d4aa0	10	-	-	-	10	0.0	0.0
92e563	11	10	11	1	11	0.6	5.41
a3cf10	13	13	13	1	13	0.0	0.0

1.5.2 The Numerical Procedure for Determining Outliers

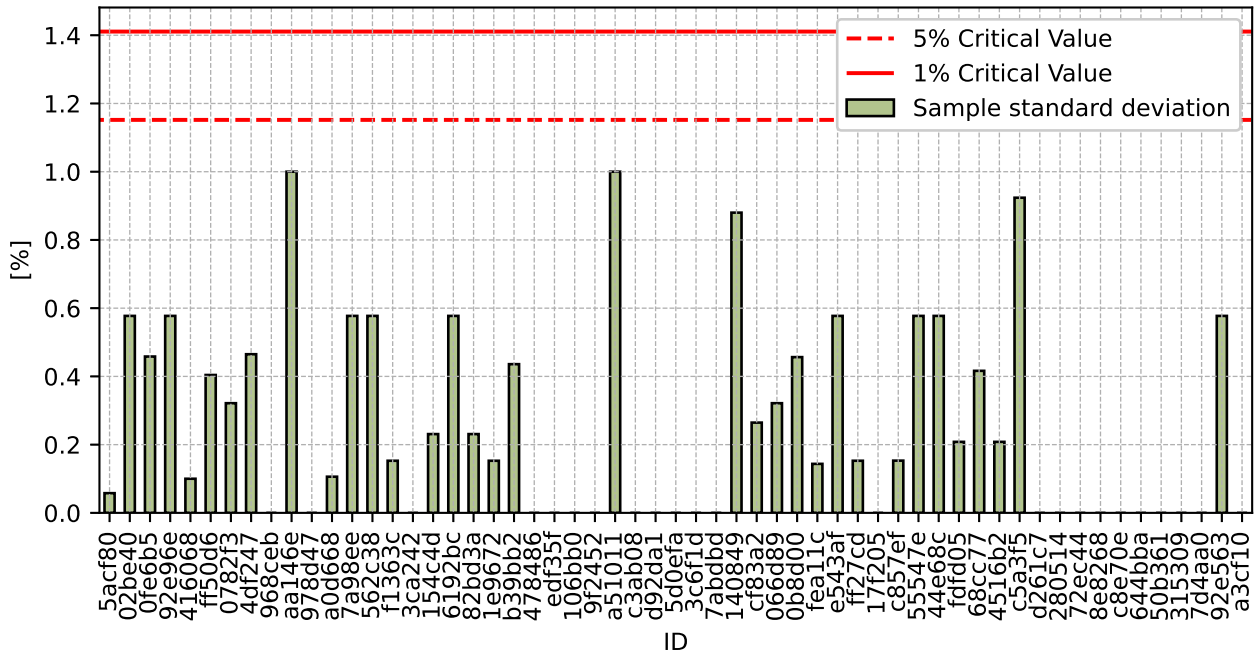

Figure 45: **Cochran's test** - sample standard deviations

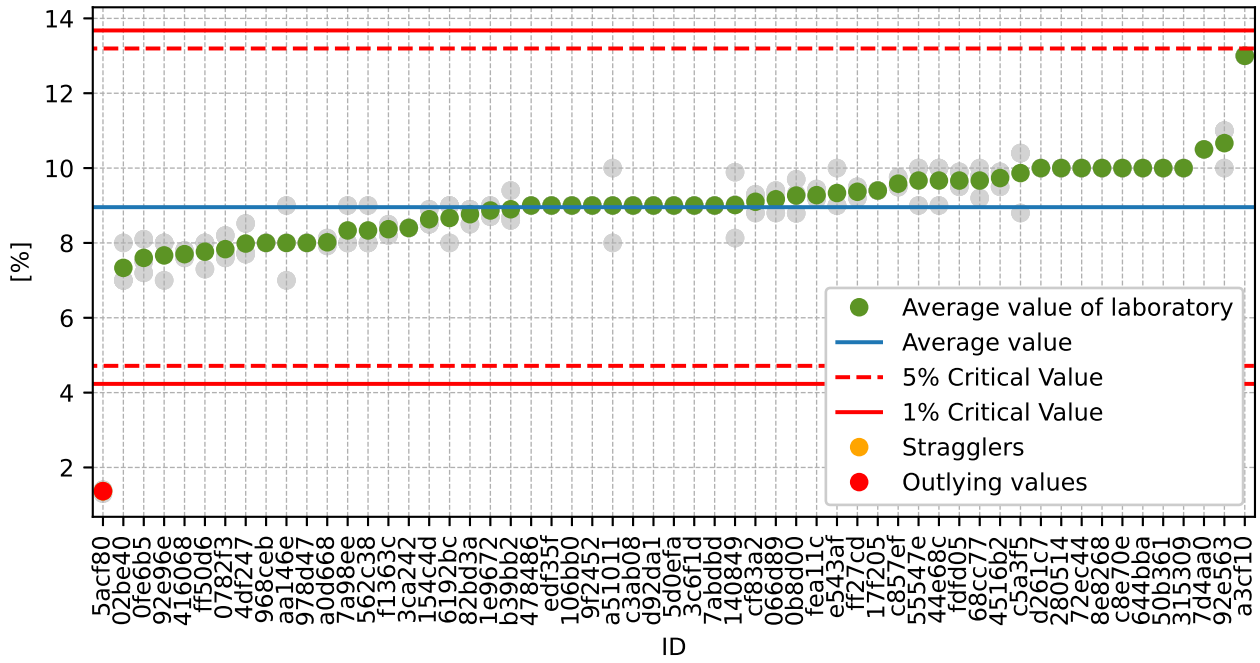

Figure 46: **Grubbs' test** - average values

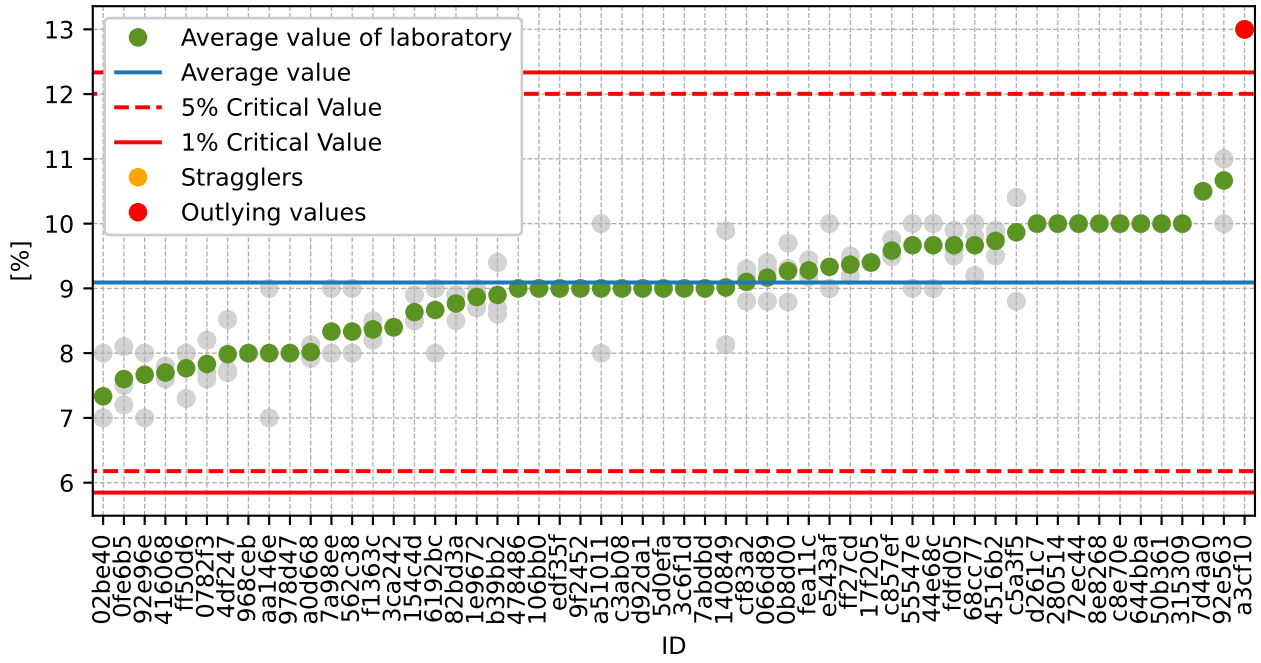

Figure 47: **Grubbs' test** - average values without outliers

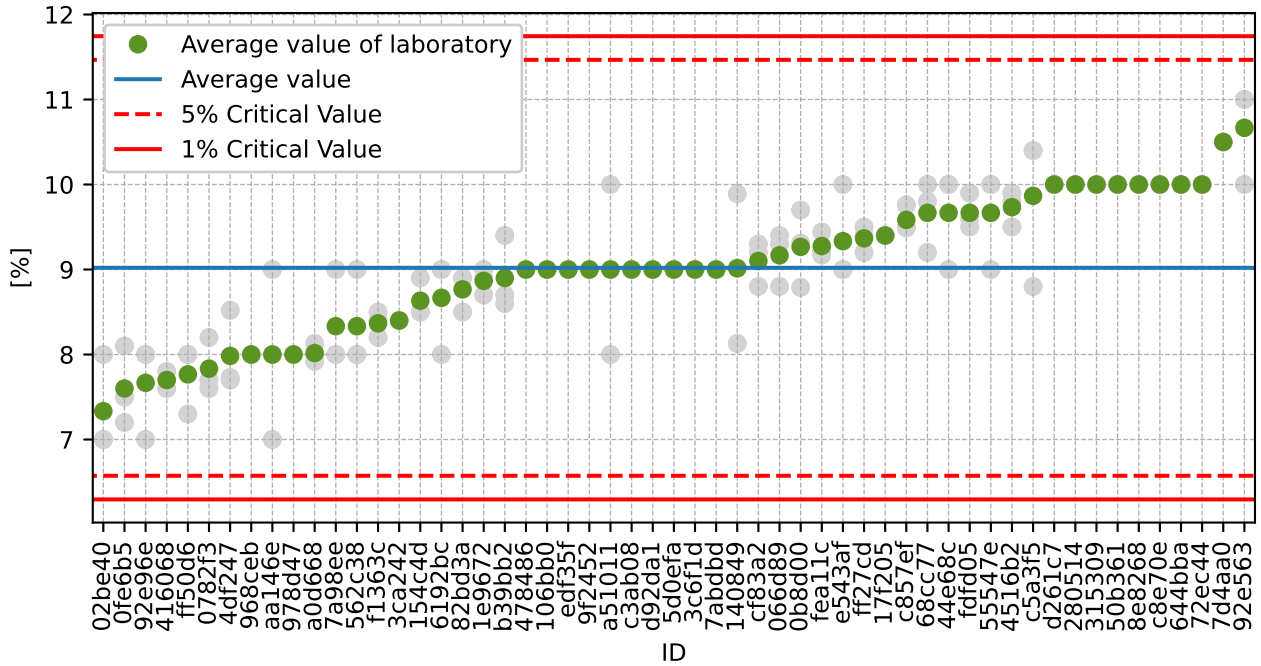

Figure 48: **Grubbs' test** - average values without outliers

1.5.3 Mandel's Statistics

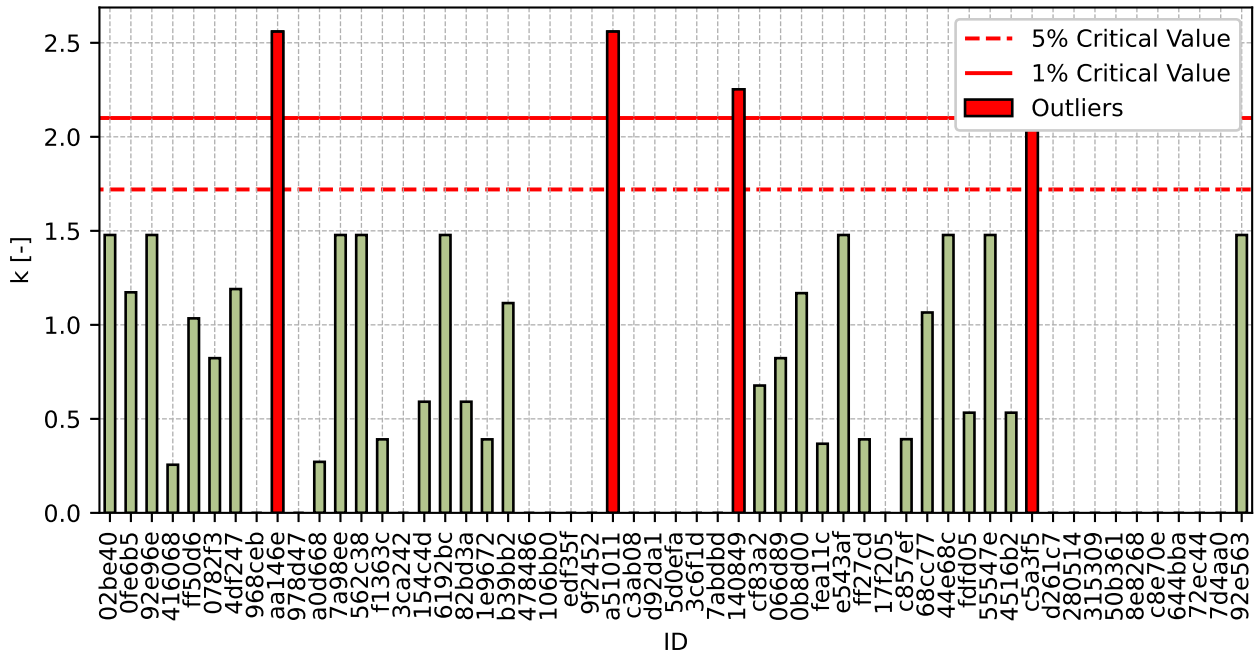

Figure 49: Intralaboratory Consistency Statistic

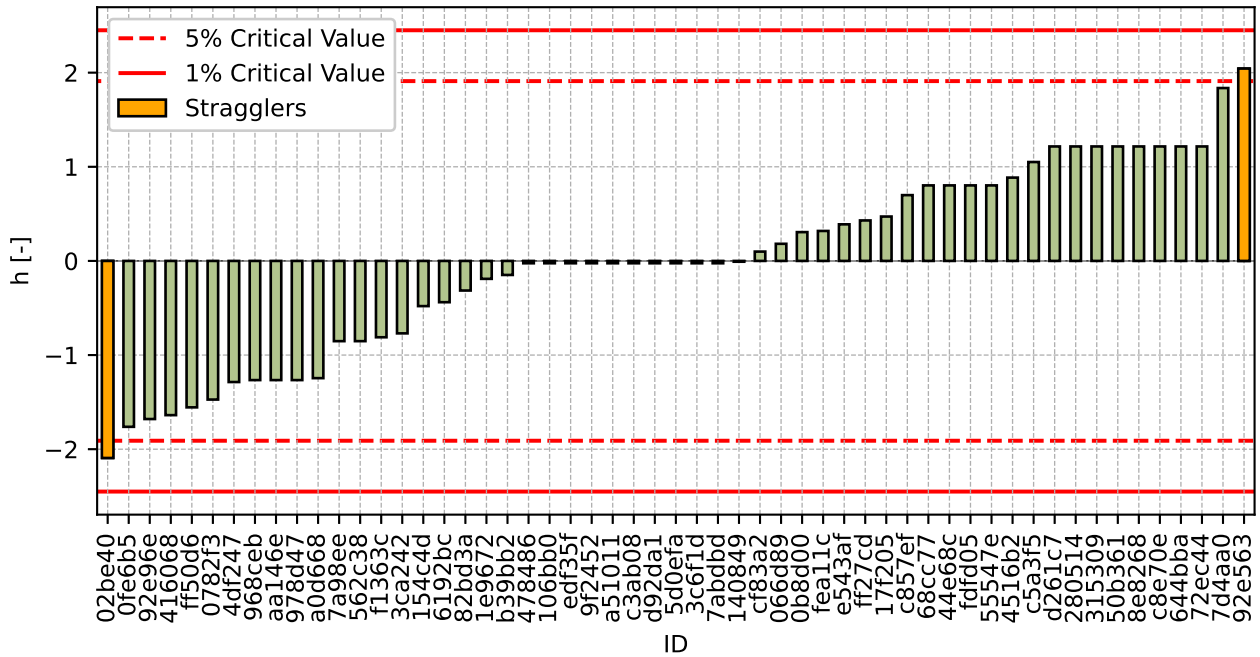

Figure 50: Interlaboratory Consistency Statistic

1.5.4 Descriptive statistics

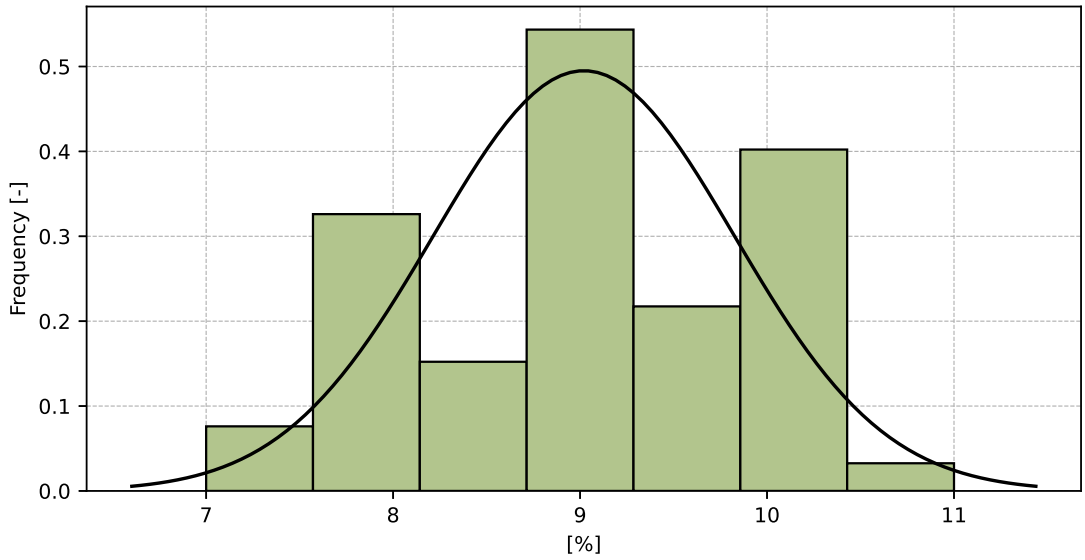

Figure 51: Histogram of all test results

Table 18: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	9
Sample standard deviation – s	0.8
Asigned value – x^*	9
Robust standard deviation – s^*	0.9
Measurement uncertainty of asigned value – u_X	0.1
p-value of normality test	1.0 [-]
Interlaboratory standard deviation – s_L	0.8
Repeatability standard deviation – s_r	0.4
Reproducibility standard deviation – s_R	0.9
Repeatability – r	1
Reproducibility – R	2

1.5.5 Evaluation of Performance Statistics

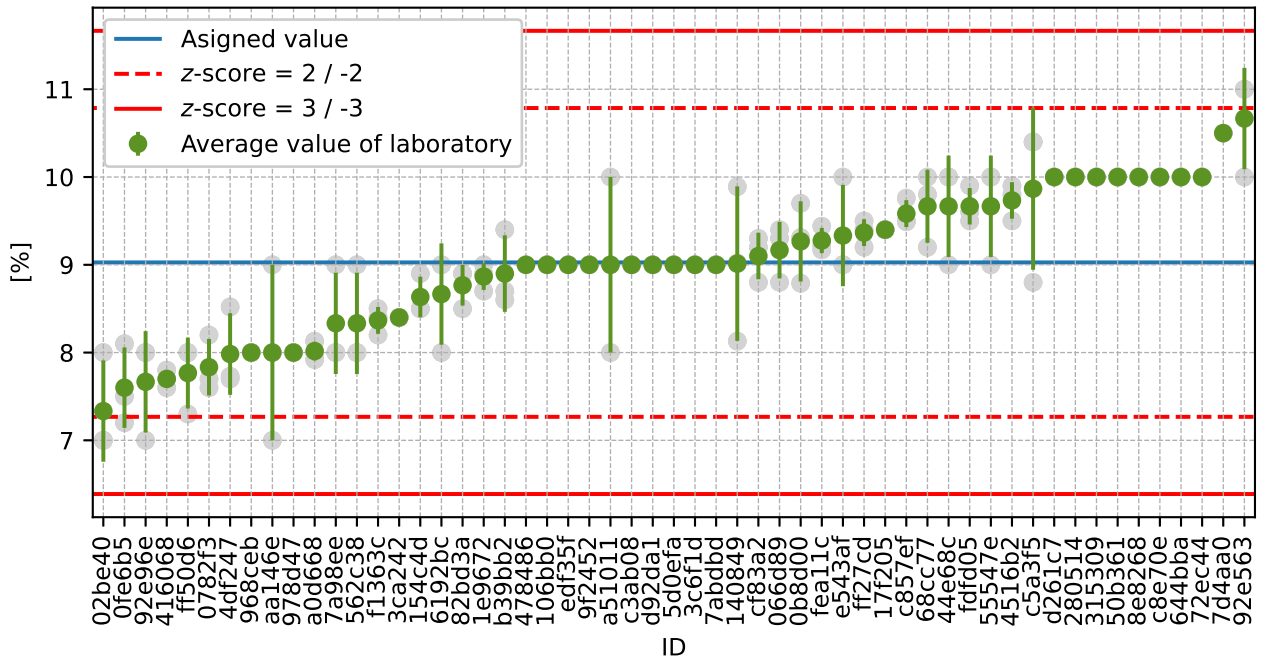

Figure 52: Average values and sample standard deviations

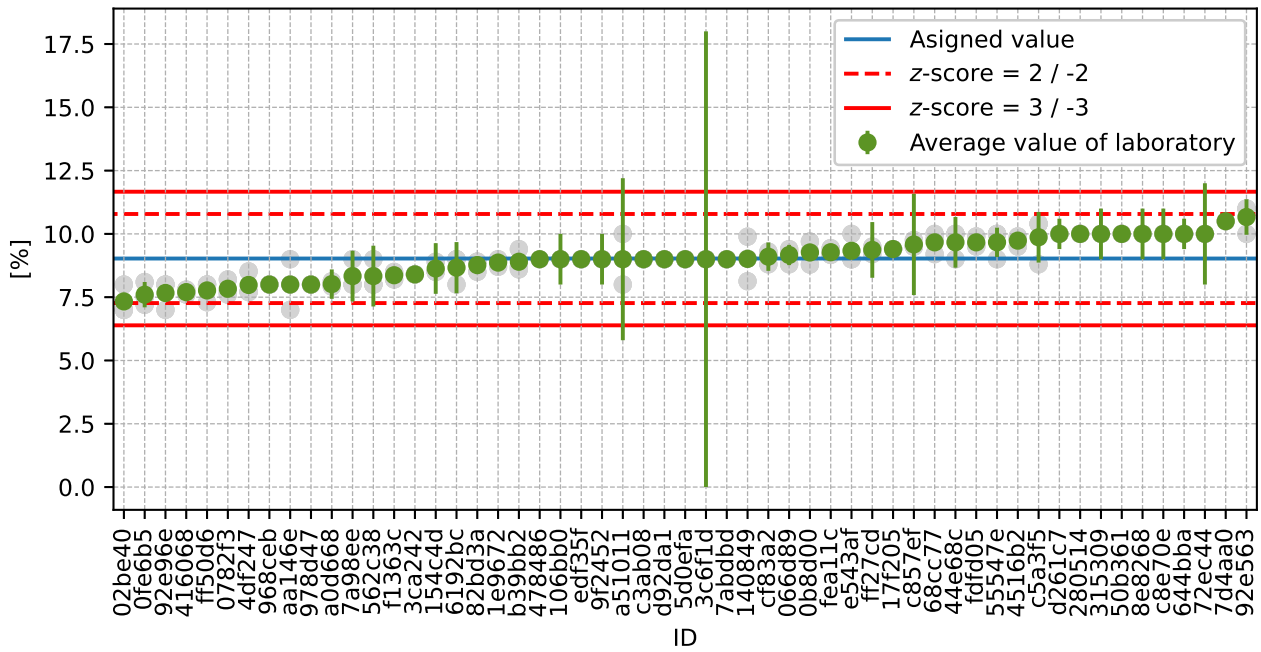

Figure 53: Average values and extended uncertainties of measurement

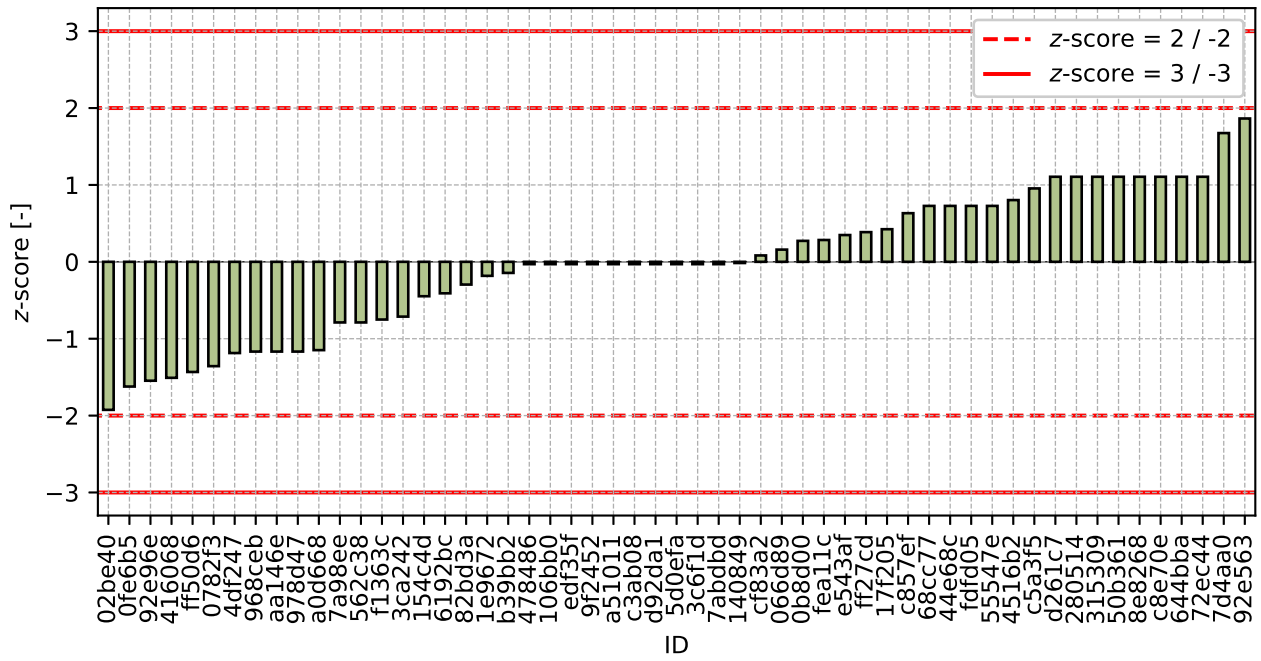

Figure 54: z-score

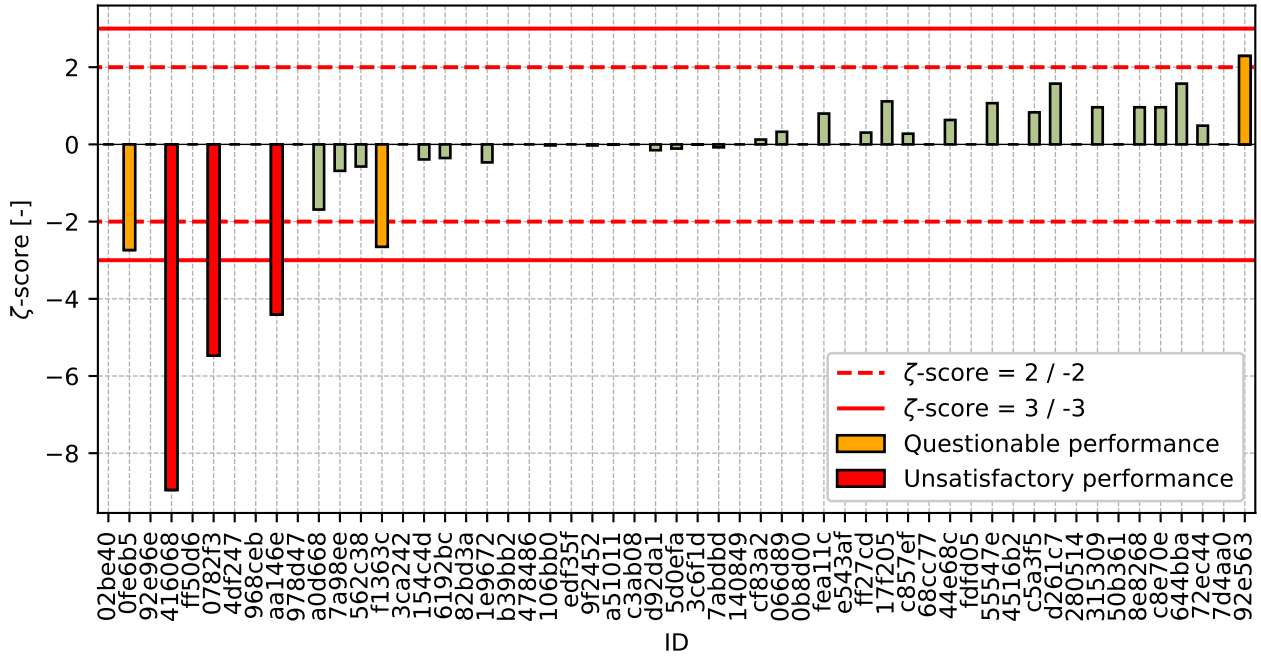

Figure 55: ζ-score

Table 19: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
02be40	-1.93	-
0fe6b5	-1.62	-2.74
92e96e	-1.55	-
416068	-1.51	-8.95
ff50d6	-1.43	-
0782f3	-1.36	-5.47
4df247	-1.19	-
968ceb	-1.17	-
aa146e	-1.17	-4.4
978d47	-1.17	-
a0d668	-1.15	-1.69
7a98ee	-0.79	-0.69
562c38	-0.79	-0.57
f1363c	-0.75	-2.65
3ca242	-0.71	-
154c4d	-0.45	-0.39
6192bc	-0.41	-0.35
82bd3a	-0.3	-
1e9672	-0.18	-0.47
b39bb2	-0.14	-
478486	-0.03	-
106bb0	-0.03	-0.03
edf35f	-0.03	-
9f2452	-0.03	-0.03
a51011	-0.03	-0.01
c3ab08	-0.03	-
d92da1	-0.03	-0.15
5d0efa	-0.03	-0.11
3c6f1d	-0.03	-0.0
7abdbd	-0.03	-0.08
140849	-0.02	-
cf83a2	0.08	0.13
066d89	0.16	0.33
0b8d00	0.27	-
fea11c	0.28	0.8
e543af	0.35	-
ff27cd	0.39	0.31
17f205	0.42	1.11
c857ef	0.63	0.28
68cc77	0.73	-
44e68c	0.73	0.63
fdfd05	0.73	-
55547e	0.73	1.07
4516b2	0.8	-

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ID	*z*-score [-]	ζ-score [-]
c5a3f5	0.95	0.83
d261c7	1.11	1.57
280514	1.11	-
315309	1.11	0.96
50b361	1.11	-
8e8268	1.11	0.96
c8e70e	1.11	0.96
644bba	1.11	1.57
72ec44	1.11	0.49
7d4aa0	1.67	-
92e563	1.86	2.29

1.6 0.125 mm

1.6.1 Test results

Table 20: 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 [%]
5acf80	1	1	1	0	1	0.1	9.12
0fe6b5	1	1	1	0	1	0.1	13.32
d261c7	1	1	1	0	1	0.0	0.0
3c6f1d	1	1	1	1	1	0.0	0.0
92e96e	1	1	1	-	1	0.0	0.0
ff50d6	1	1	1	-	1	0.2	15.75
416068	1	1	1	0	1	0.1	4.68
140849	1	1	1	-	1	0.2	13.6
3ca242	1	1	1	-	1	0.0	0.0
106bb0	1	1	2	1	1	0.6	43.3
aa146e	2	1	1	0	1	0.6	43.3
1e9672	1	1	1	0	1	0.1	4.33
02be40	1	2	1	-	1	0.6	43.3
4df247	1	1	1	-	1	0.1	3.73
fea11c	2	2	1	0	2	0.1	5.88
c5a3f5	2	2	1	1	2	0.3	19.92
f1363c	1	2	2	0	2	0.2	9.75
ff27cd	2	2	2	1	2	0.1	3.69
4516b2	2	2	2	-	2	0.1	6.25
9f2452	2	1	2	1	2	0.6	34.64
fdfd05	2	2	2	-	2	0.1	3.46
e543af	2	2	1	-	2	0.6	34.64
c8e70e	2	2	1	1	2	0.6	34.64
5d0efa	1	2	2	0	2	0.6	34.64
17f205	2	2	2	0	2	0.1	3.33
82bd3a	2	2	2	-	2	0.2	8.81
b39bb2	2	2	2	-	2	0.3	14.7
0782f3	2	2	2	0	2	0.1	6.19
a0d668	2	2	2	0	2	0.2	12.1
68cc77	2	1	2	-	2	0.5	24.12
066d89	2	2	2	0	2	0.2	7.9
154c4d	2	2	2	0	2	0.2	11.95
6192bc	2	2	2	1	2	0.0	0.0
c3ab08	2	2	2	-	2	0.0	0.0
280514	2	2	2	2	2	0.0	0.0
edf35f	2	2	2	-	2	0.0	0.0

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ID	Test results [%]			u_X [%]	$\bar{x}$ [%]	s_0 [%]	V_X [%]
562c38	2	2	2	-	2	0.0	0.0
7abdbd	2	2	2	0	2	0.0	0.0
644bba	2	2	2	0	2	0.0	0.0
978d47	2	2	2	-	2	0.0	0.0
d92da1	2	2	2	0	2	0.0	0.0
7a98ee	2	2	2	1	2	0.0	0.0
50b361	2	2	2	-	2	0.0	0.0
478486	2	-	-	-	2	0.0	0.0
55547e	2	2	2	0	2	0.0	0.0
72ec44	2	2	2	1	2	0.0	0.0
968ceb	2	2	2	-	2	0.0	0.0
44e68c	2	2	2	1	2	0.0	0.0
a51011	2	2	2	3	2	0.0	0.0
c857ef	2	2	2	2	2	0.1	3.17
cf83a2	2	3	2	0	2	0.4	18.18
8e8268	2	3	2	1	2	0.6	24.74
92e563	2	2	3	1	2	0.6	24.74
315309	2	3	2	1	2	0.6	24.74
7d4aa0	2	-	-	-	2	0.0	0.0

1.6.2 The Numerical Procedure for Determining Outliers

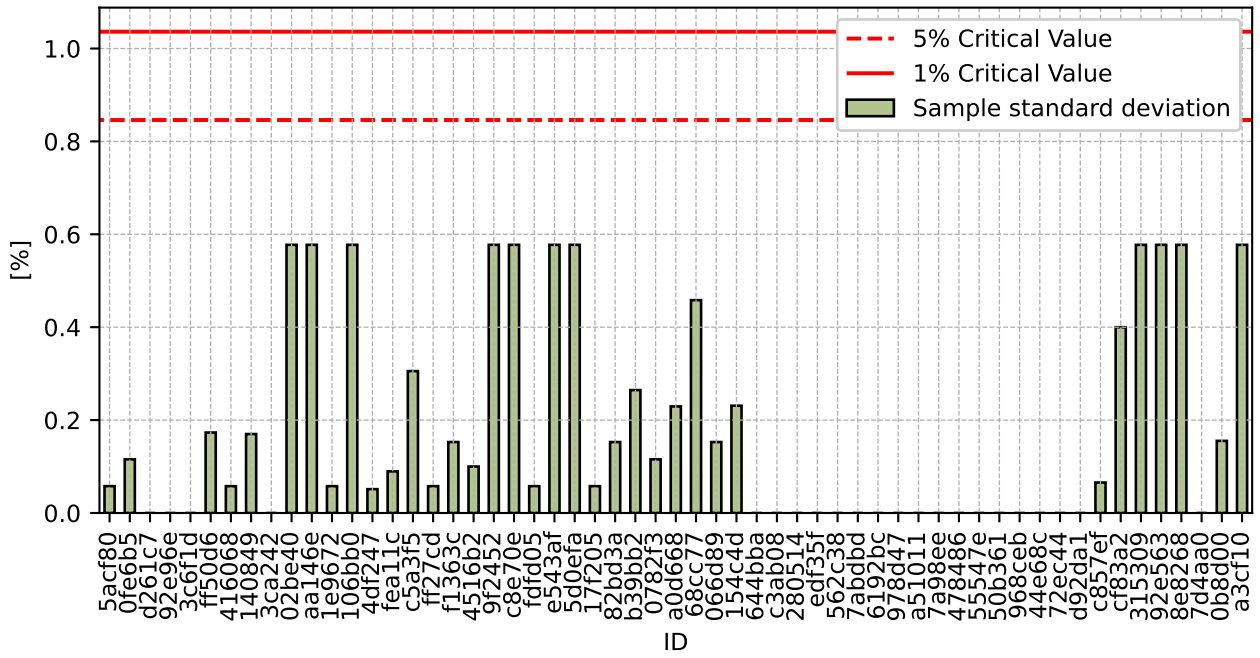

Figure 56: **Cochran's test** - sample standard deviations

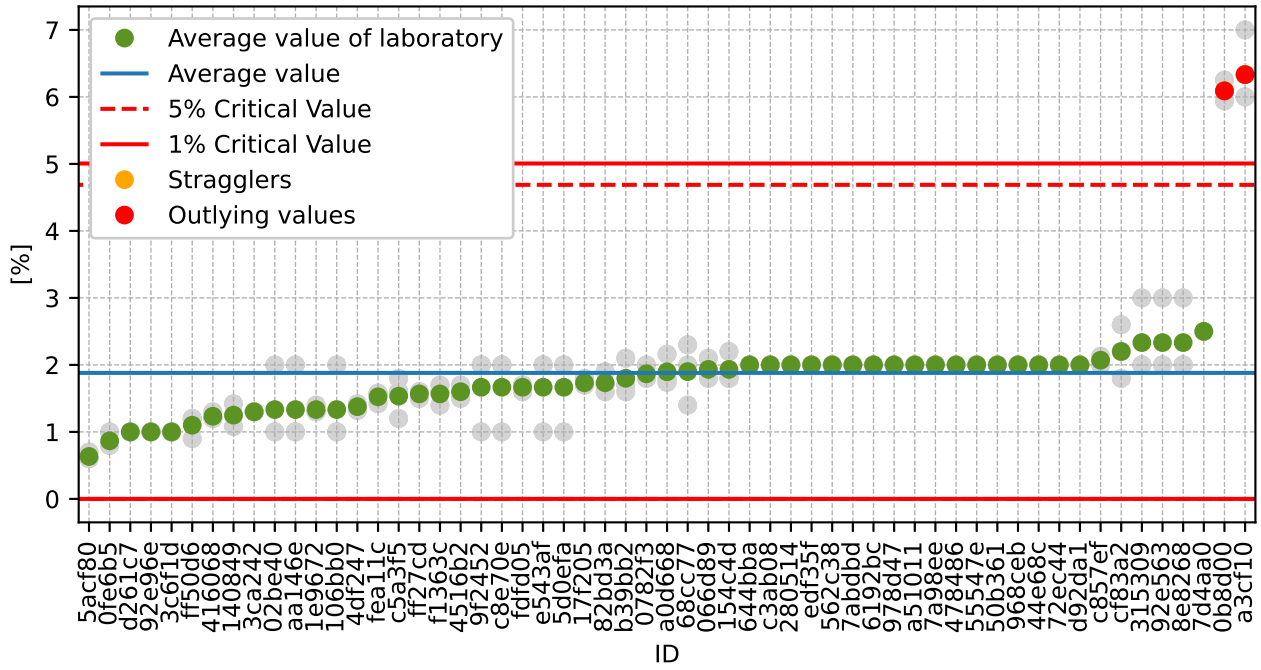

Figure 57: **Grubbs' test** - average values

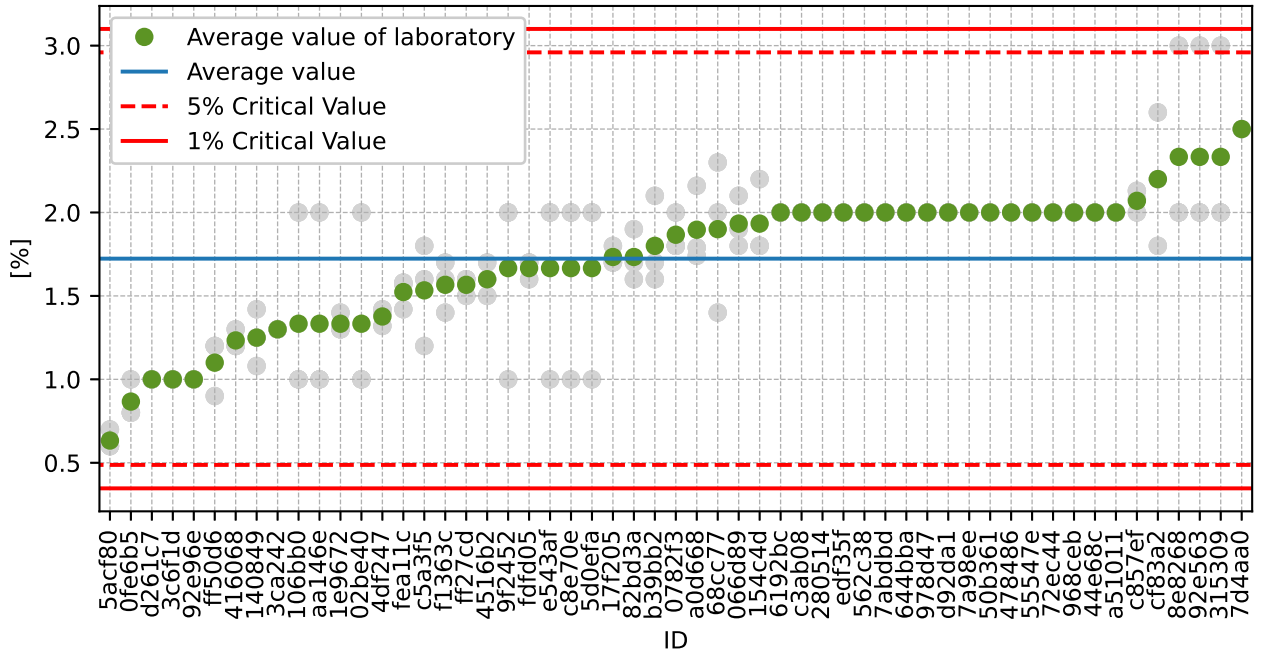

Figure 58: **Grubbs' test** - average values without outliers

1.6.3 Mandel's Statistics

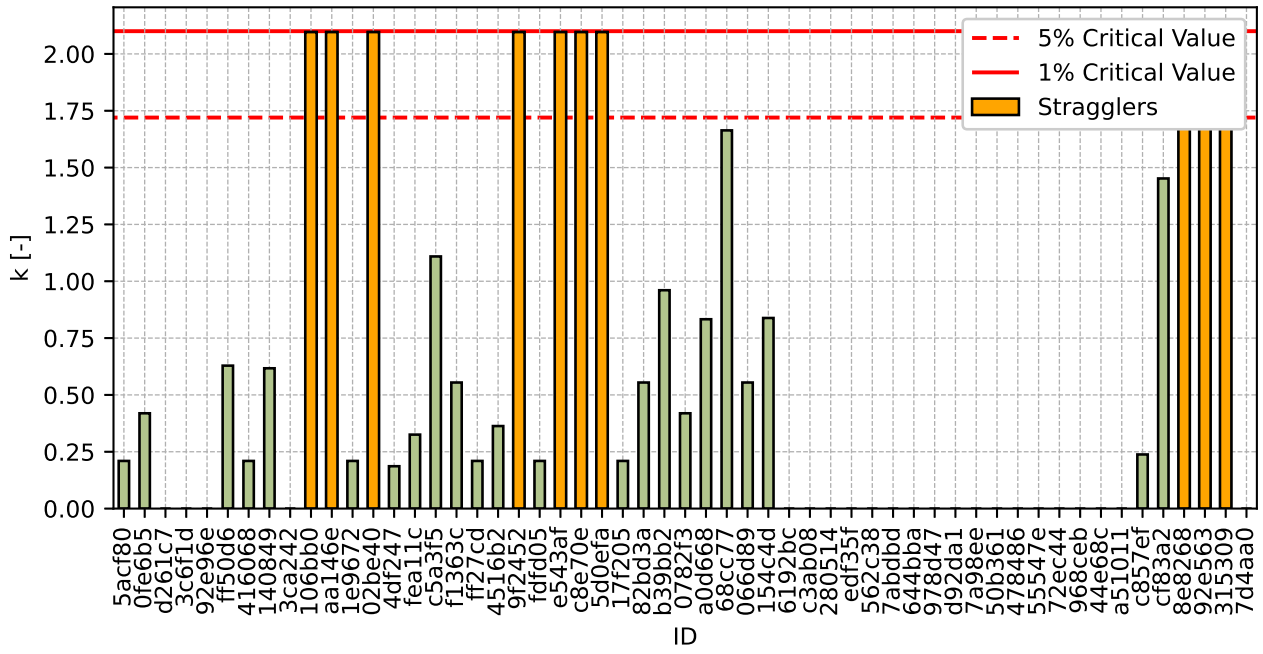

Figure 59: Intralaboratory Consistency Statistic

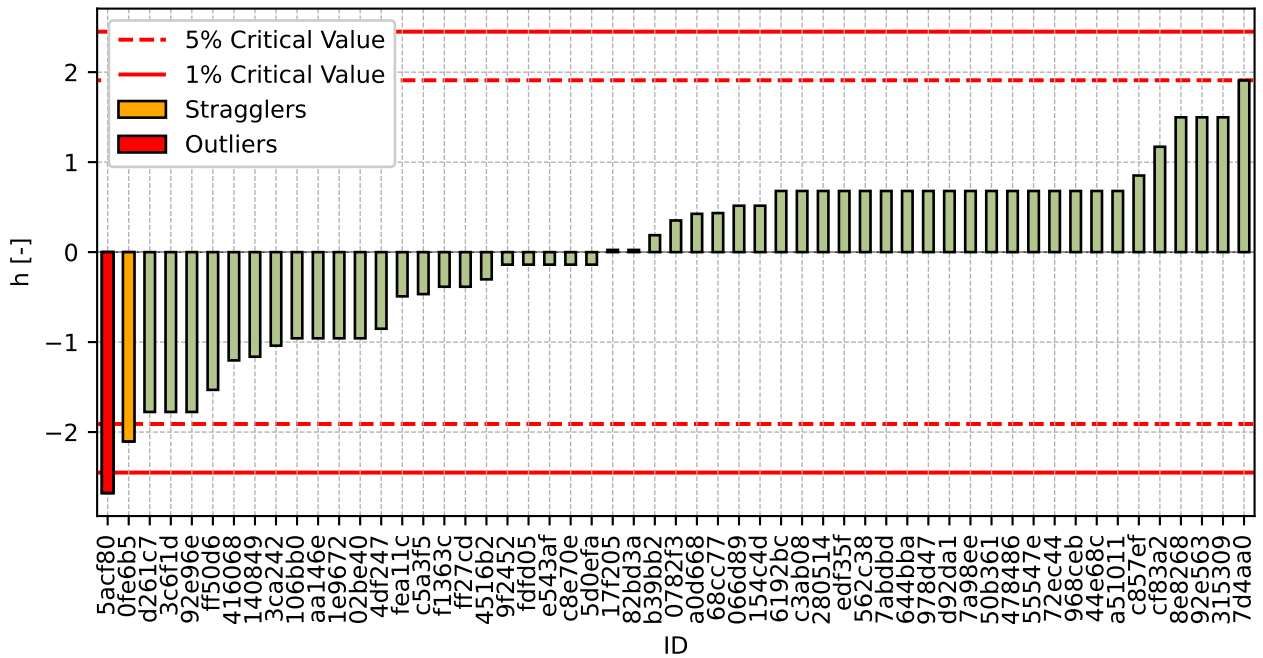

Figure 60: Interlaboratory Consistency Statistic

1.6.4 Descriptive statistics

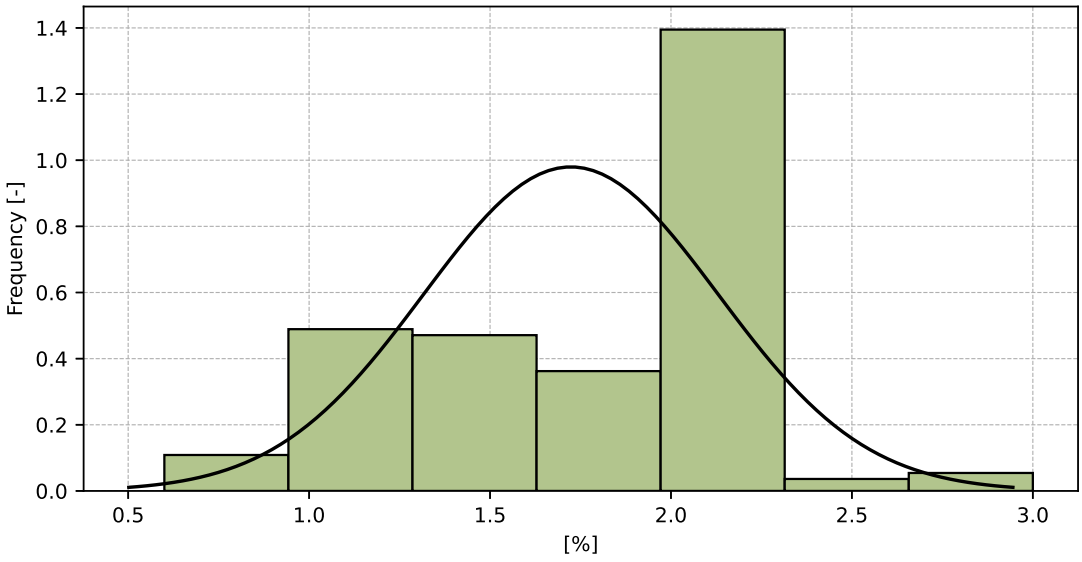

Figure 61: Histogram of all test results

Table 21: Descriptive statistics

Characteristics	**[%]**
Average value – $\bar{x}$	2
Sample standard deviation – s	0.4
Asigned value – x^*	2
Robust standard deviation – s^*	0.3
Measurement uncertainty of asigned value – u_X	0.1
p-value of normality test	1.0 [-]
Interlaboratory standard deviation – s_L	0.4
Repeatability standard deviation – s_r	0.3
Reproducibility standard deviation – s_R	0.5
Repeatability – r	1
Reproducibility – R	1

1.6.5 Evaluation of Performance Statistics

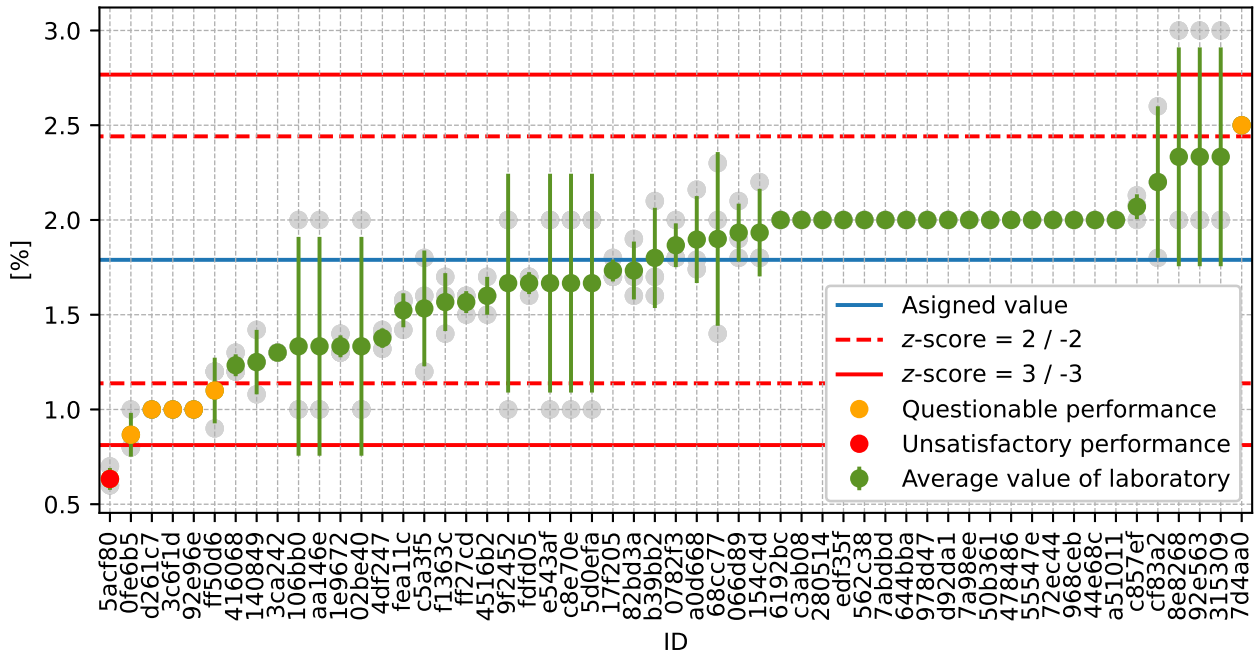

Figure 62: Average values and sample standard deviations

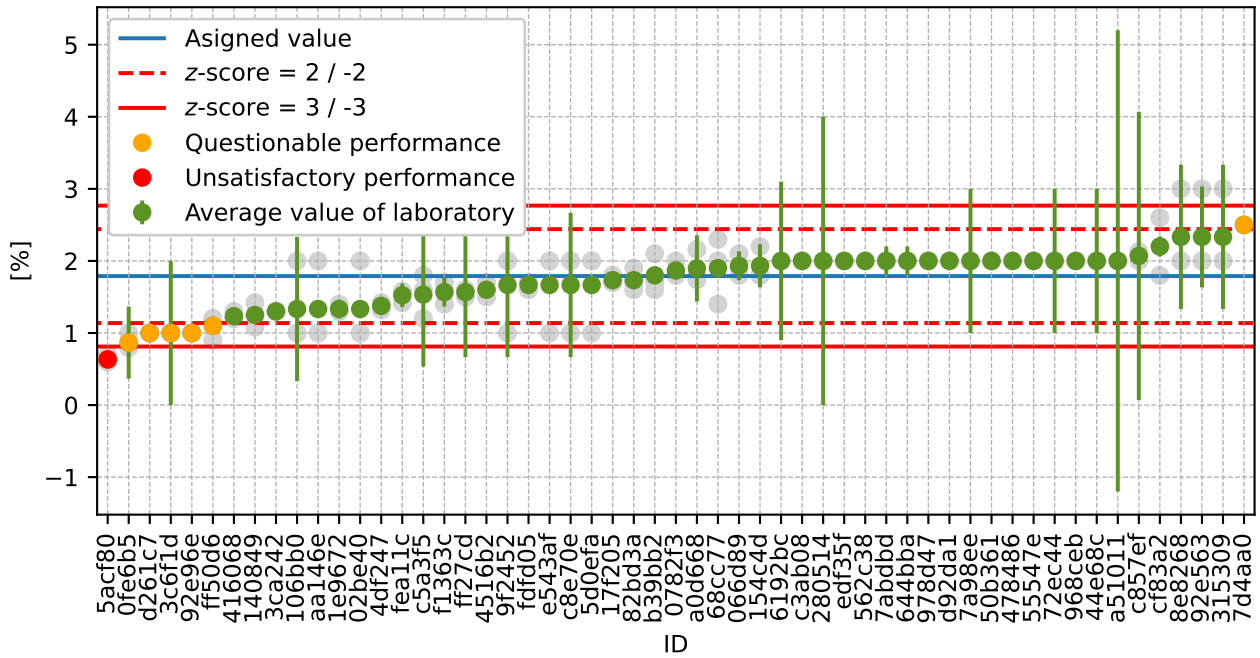

Figure 63: Average values and extended uncertainties of measurement

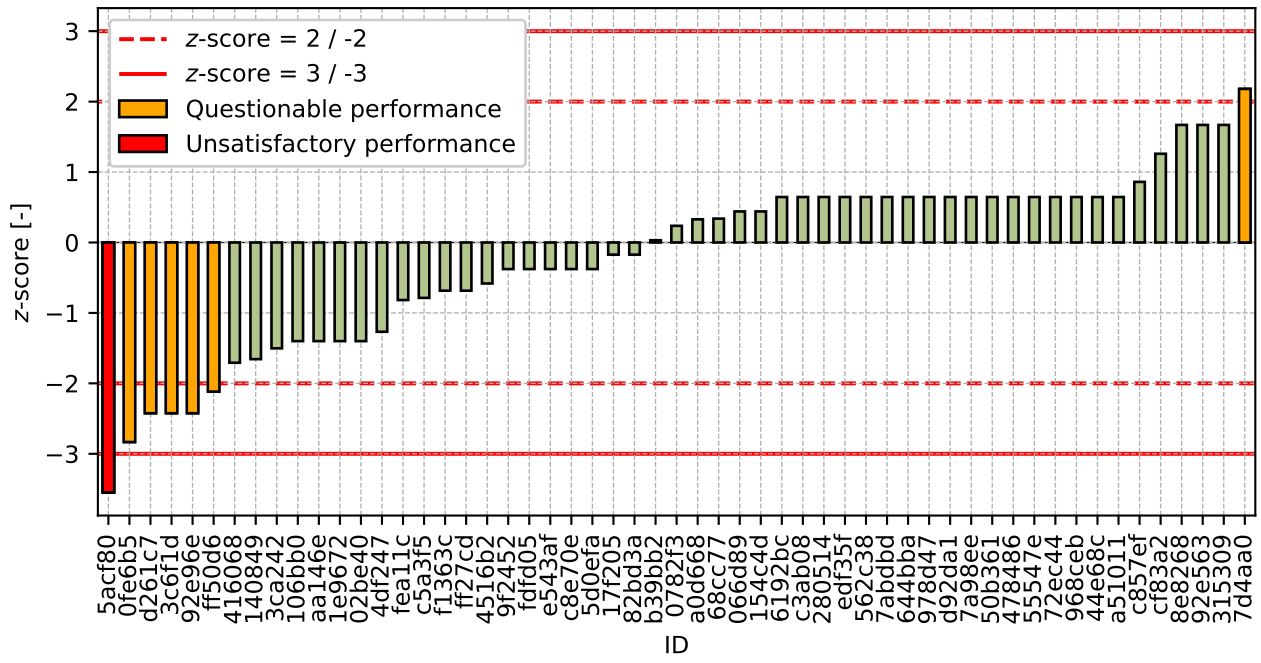

Figure 64: z-score

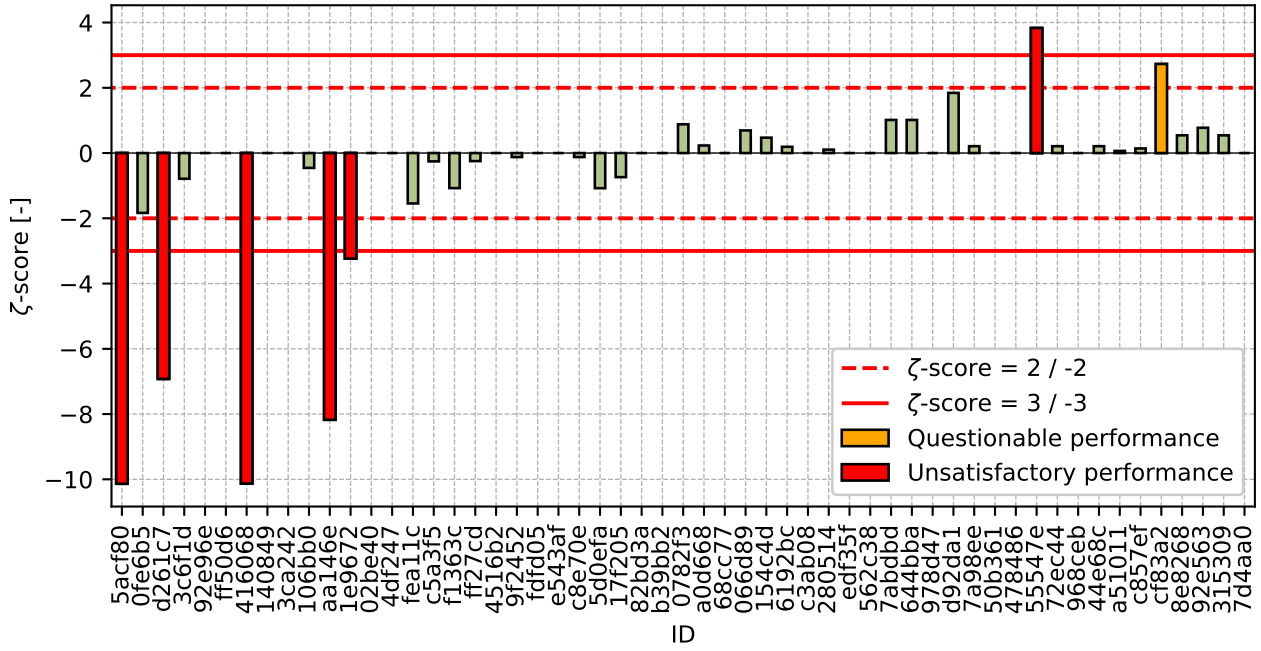

Figure 65: ζ-score

Table 22: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
5acf80	-3.55	-10.14
0fe6b5	-2.83	-1.83
d261c7	-2.42	-6.92
3c6f1d	-2.42	-0.79
92e96e	-2.42	-
ff50d6	-2.12	-
416068	-1.71	-10.13
140849	-1.66	-
3ca242	-1.5	-
106bb0	-1.4	-0.46
aa146e	-1.4	-8.17
1e9672	-1.4	-3.23
02be40	-1.4	-
4df247	-1.27	-
fea11c	-0.82	-1.55
c5a3f5	-0.79	-0.26
f1363c	-0.68	-1.08
ff27cd	-0.68	-0.25
4516b2	-0.58	-
9f2452	-0.38	-0.12
fdfd05	-0.38	-
e543af	-0.38	-
c8e70e	-0.38	-0.12
5d0efa	-0.38	-1.08
17f205	-0.17	-0.74
82bd3a	-0.17	-
b39bb2	0.03	-
0782f3	0.24	0.88
a0d668	0.33	0.23
68cc77	0.34	-
066d89	0.44	0.69
154c4d	0.44	0.47
6192bc	0.65	0.19
c3ab08	0.65	-
280514	0.65	0.11
edf35f	0.65	-
562c38	0.65	-
7abdbd	0.65	1.01
644bba	0.65	1.01
978d47	0.65	-
d92da1	0.65	1.84
7a98ee	0.65	0.21
50b361	0.65	-
478486	0.65	-

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ID	z-score [-]	ζ-score [-]
55547e	0.65	3.83
72ec44	0.65	0.21
968ceb	0.65	-
44e68c	0.65	0.21
a51011	0.65	0.07
c857ef	0.86	0.14
cf83a2	1.26	2.73
8e8268	1.67	0.54
92e563	1.67	0.77
315309	1.67	0.54
7d4aa0	2.18	-

1.7 0.063 mm

1.7.1 Test results

Table 23: Test results - ordered by average value. Outliers are marked by red color. u_X - extended uncertainty of measurement; $\bar{x}$ - average value; s_0 - sample standard deviation; V_X - variation coefficient

ID	Test results [%]			u_X [%]	$\bar{x}$ [%]	s_0 [%]	V_X [%]
7a98ee	0.0	0.0	0.0	1.0	0.0	0.0	-
3ca242	0.1	0.1	0.1	-	0.1	0.0	0.0
0fe6b5	0.1	0.1	0.2	0.1	0.1	0.06	43.3
aa146e	0.3	0.3	0.2	0.0	0.3	0.06	21.65
3c6f1d	0.3	0.3	0.3	0.3	0.3	0.0	0.0
ff50d6	0.3	0.3	0.3	-	0.3	0.0	0.0
1e9672	0.3	0.3	0.3	0.1	0.3	0.03	11.55
140849	0.4	0.3	0.3	-	0.3	0.05	14.39
d261c7	0.4	0.3	0.3	0.1	0.3	0.06	17.32
c5a3f5	0.6	0.2	0.2	1.0	0.3	0.23	69.28
92e96e	0.1	0.4	0.5	-	0.3	0.21	62.45
416068	0.4	0.4	0.4	0.0	0.4	0.0	0.0
5acf80	0.4	0.5	0.5	0.1	0.5	0.06	12.37
ff27cd	0.5	0.5	0.6	0.8	0.5	0.06	10.83
a0d668	0.6	0.6	0.5	0.4	0.5	0.02	3.83
c3ab08	0.6	0.5	0.6	-	0.6	0.06	10.19
e543af	0.7	0.6	0.5	-	0.6	0.1	16.67
106bb0	0.6	0.7	0.6	0.5	0.6	0.06	9.12
5d0efa	0.6	0.6	0.7	0.1	0.6	0.06	9.12
fea11c	0.7	0.7	0.5	0.1	0.6	0.11	16.54
9f2452	0.7	0.6	0.7	0.4	0.7	0.06	8.66
b39bb2	0.6	0.7	0.7	-	0.7	0.06	8.66
17f205	0.7	0.7	0.7	0.0	0.7	0.0	0.0
a51011	0.7	0.7	0.7	3.2	0.7	0.0	0.0
02be40	0.8	0.8	0.7	-	0.8	0.06	7.53
968ceb	0.8	0.7	0.8	-	0.8	0.06	7.53
82bd3a	0.6	0.9	0.8	-	0.8	0.15	19.92
4516b2	0.8	0.7	0.9	-	0.8	0.1	12.5
478486	0.8	-	-	-	0.8	0.0	0.0
280514	0.8	0.8	0.8	-	0.8	0.0	0.0
edf35f	0.7	0.9	0.8	-	0.8	0.1	12.5
fdfd05	0.8	0.8	0.9	-	0.8	0.06	6.93
644bba	0.9	0.9	0.7	0.1	0.8	0.12	13.86
d92da1	0.9	0.8	0.9	0.1	0.9	0.06	6.66
154c4d	1.0	0.8	0.9	0.2	0.9	0.1	11.11
315309	0.5	1.4	0.8	0.6	0.9	0.46	50.92

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ID	Test results [%]			u_X [%]	$\bar{x}$ [%]	s_0 [%]	V_X [%]
6192bc	0.9	0.9	0.9	3.4	0.9	0.0	0.0
f1363c	0.8	1.0	1.0	0.2	0.9	0.12	12.37
68cc77	1.3	0.5	1.0	-	0.9	0.4	43.3
44e68c	1.0	1.0	0.9	0.1	1.0	0.06	5.97
562c38	0.9	1.0	1.0	0.2	1.0	0.06	5.97
0782f3	1.0	1.1	0.9	0.1	1.0	0.1	10.0
978d47	1.0	1.0	1.0	-	1.0	0.0	0.0
7abdbd	1.0	1.1	1.0	0.1	1.0	0.06	5.59
066d89	1.0	1.2	0.9	0.2	1.0	0.15	14.78
cf83a2	1.0	1.4	0.8	0.1	1.1	0.31	28.64
c8e70e	1.1	1.0	1.1	0.1	1.1	0.06	5.41
72ec44	1.2	0.9	1.2	0.5	1.1	0.17	15.75
92e563	1.0	1.1	1.2	0.7	1.1	0.1	9.09
55547e	1.1	1.3	1.1	0.1	1.2	0.12	9.9
c857ef	1.1	1.2	1.2	2.0	1.2	0.06	5.16
50b361	1.4	1.2	1.1	-	1.2	0.15	12.39
8e8268	1.4	1.4	1.2	0.1	1.3	0.12	8.66
7d4aa0	1.6	-	-	-	1.6	0.0	0.0
0b8d00	5.8	5.2	5.0	-	5.3	0.4	7.43
a3cf10	5.6	5.7	5.6	0.1	5.6	0.06	1.02
4df247	7.9	7.1	7.1	-	7.3	0.44	6.05

1.7.2 The Numerical Procedure for Determining Outliers

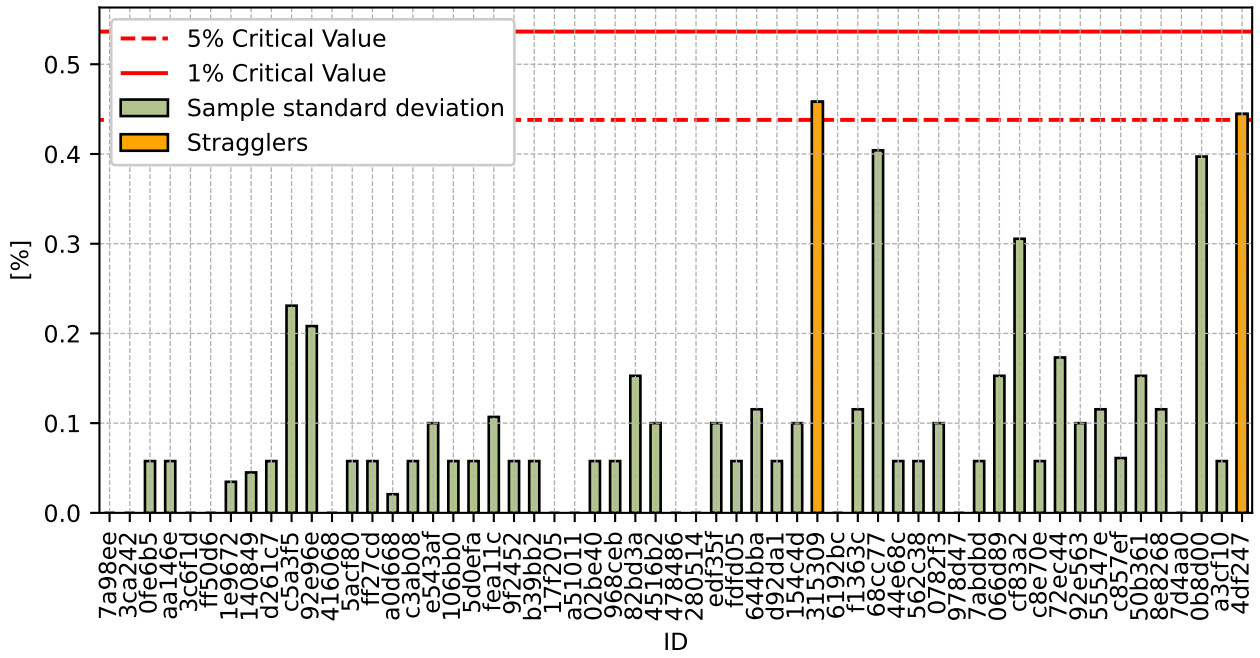

Figure 66: **Cochran's test** - sample standard deviations

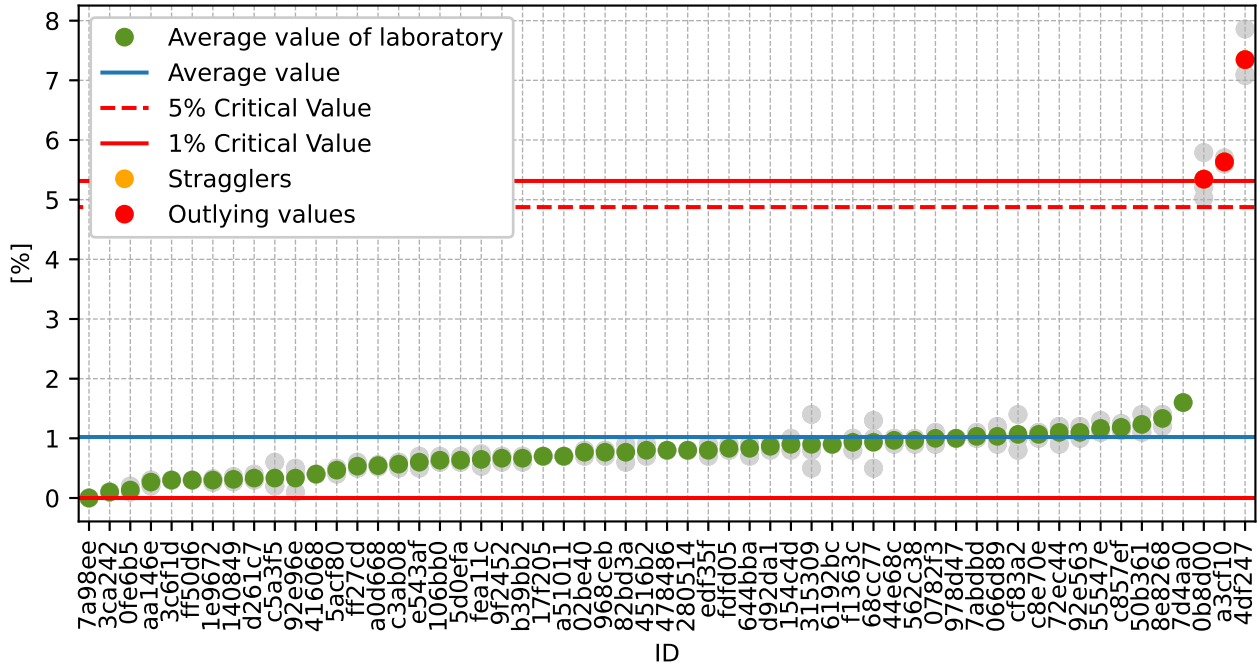

Figure 67: **Grubbs' test** - average values

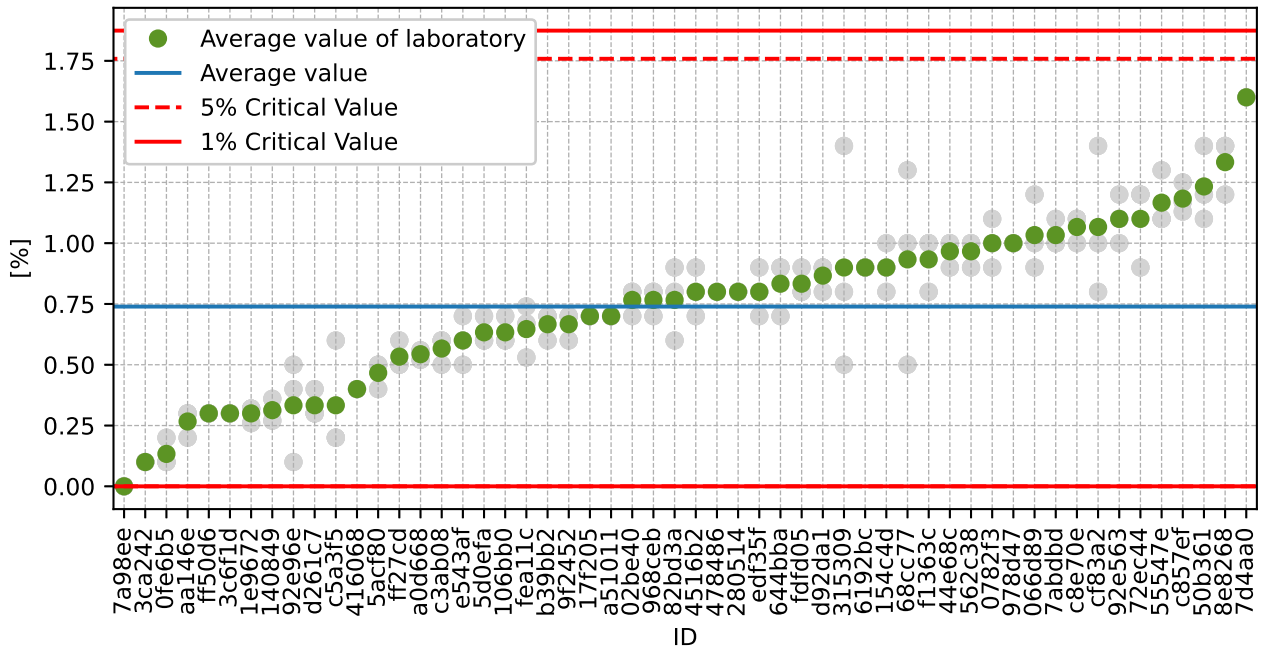

Figure 68: **Grubbs' test** - average values without outliers

1.7.3 Mandel's Statistics

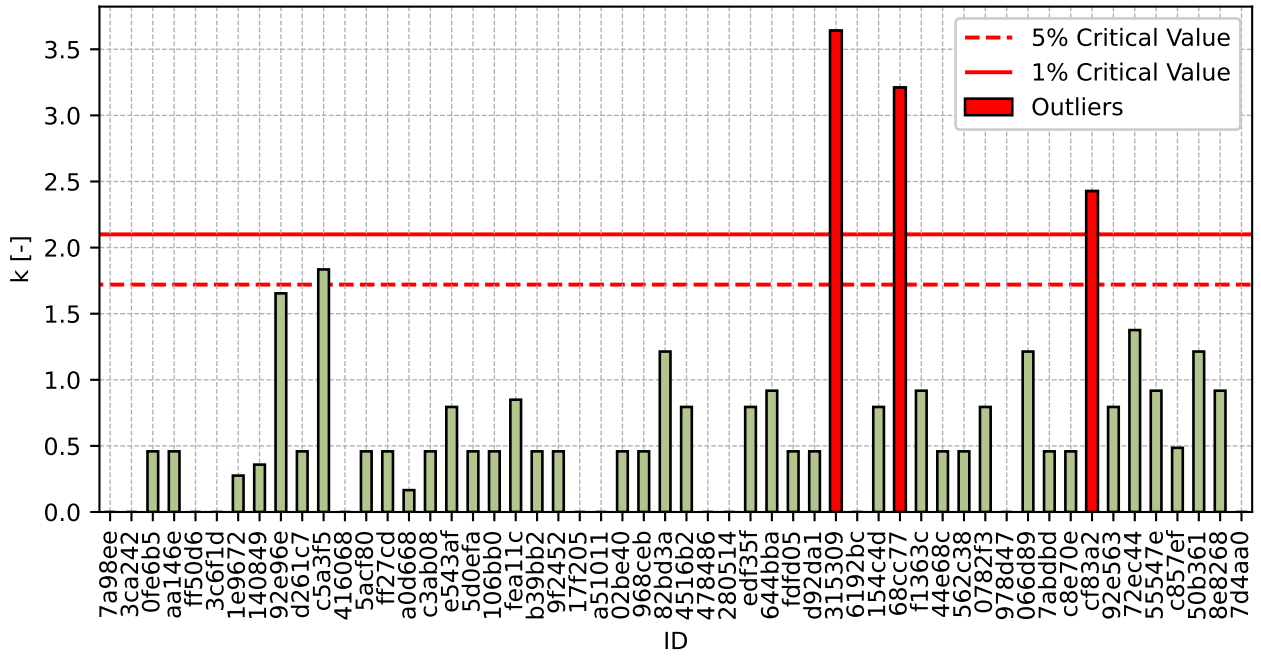

Figure 69: Intralaboratory Consistency Statistic

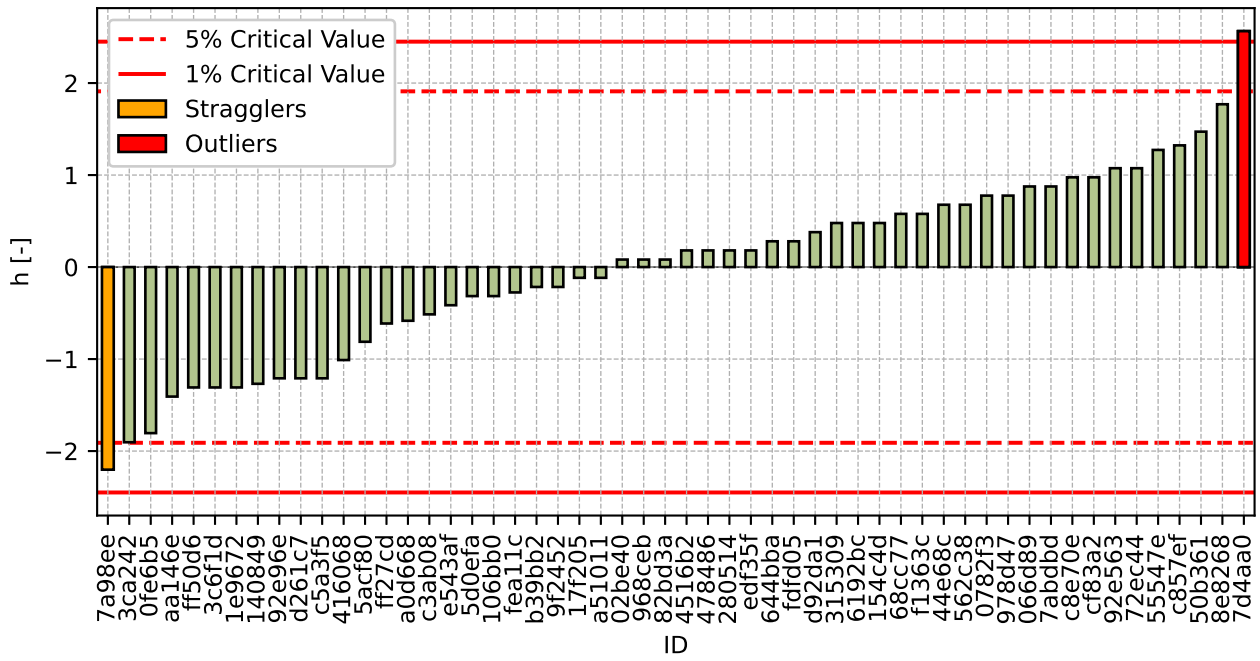

Figure 70: Interlaboratory Consistency Statistic

1.7.4 Descriptive statistics

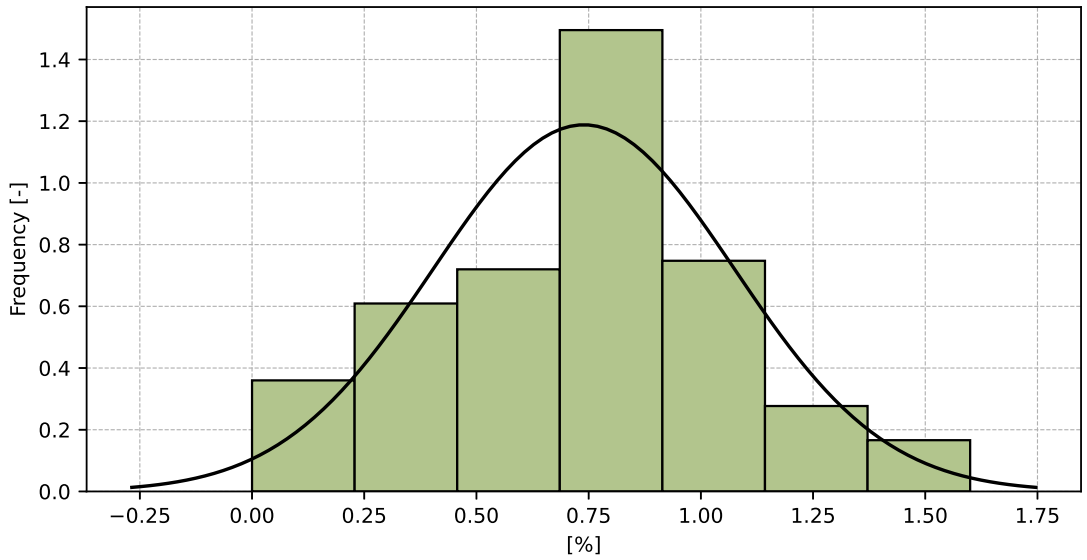

Figure 71: Histogram of all test results

Table 24: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	0.7
Sample standard deviation – s	0.34
Asigned value – x^*	0.8
Robust standard deviation – s^*	0.35
Measurement uncertainty of asigned value – u_X	0.06
p-value of normality test	1.0 [-]
Interlaboratory standard deviation – s_L	0.33
Repeatability standard deviation – s_r	0.13
Reproducibility standard deviation – s_R	0.35
Repeatability – r	0.4
Reproducibility – R	1.0

1.7.5 Evaluation of Performance Statistics

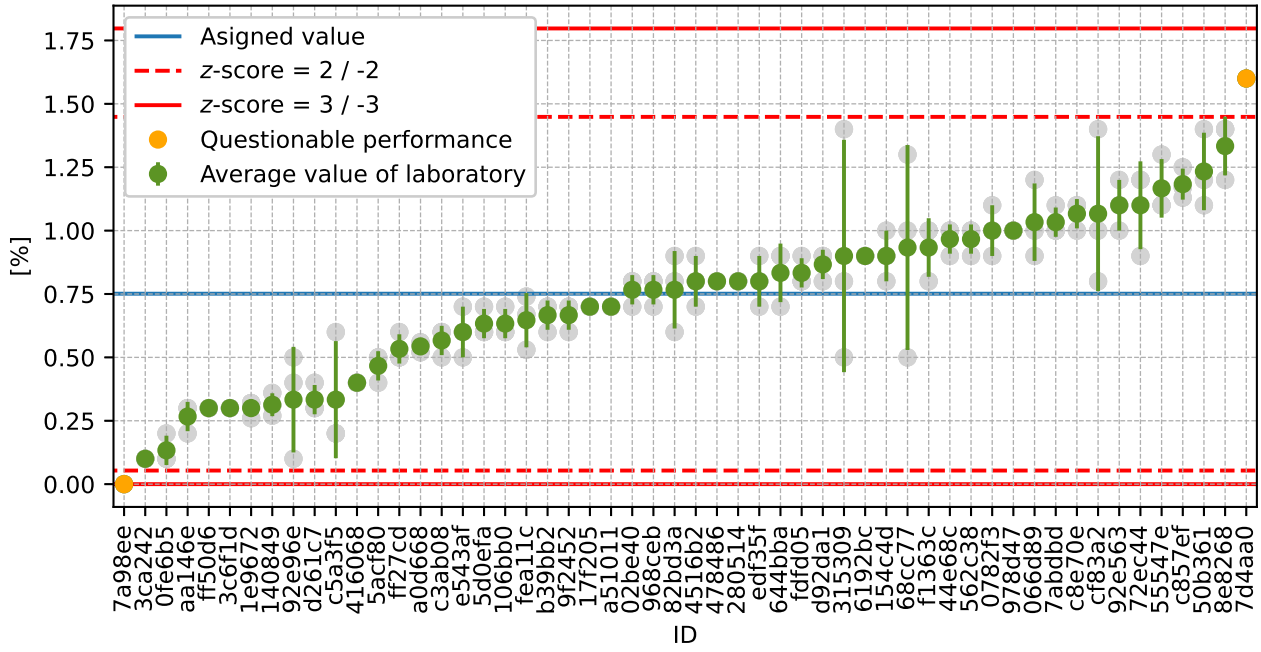

Figure 72: Average values and sample standard deviations

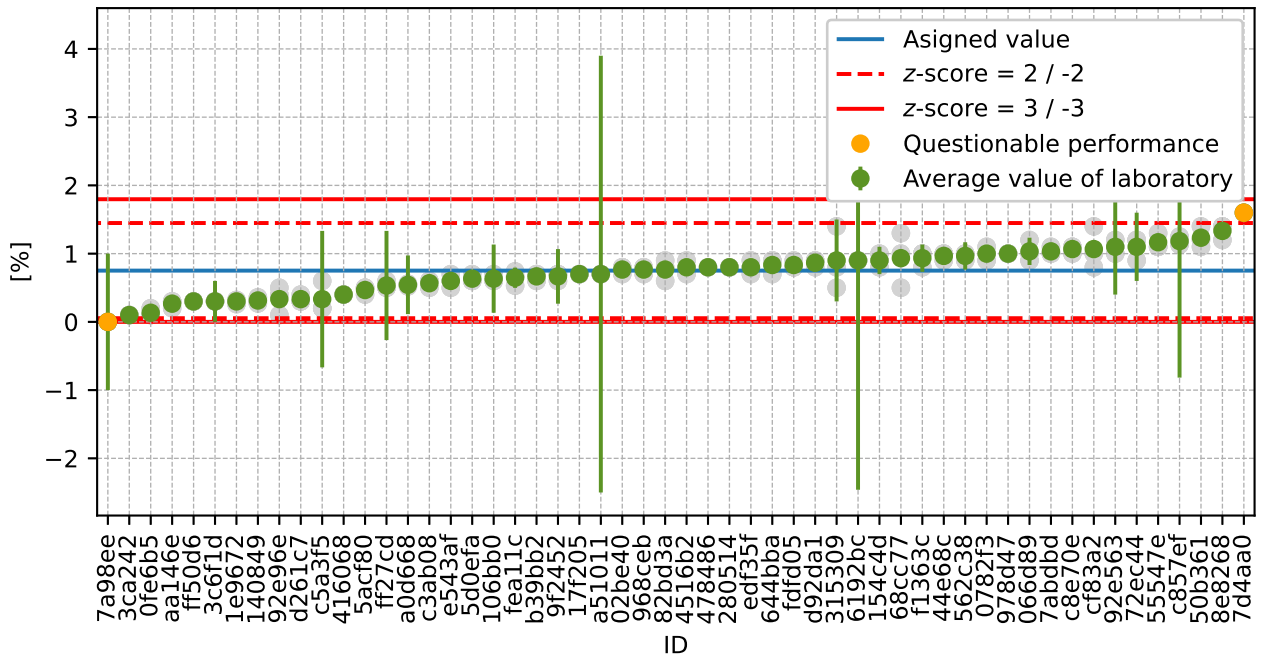

Figure 73: Average values and extended uncertainties of measurement

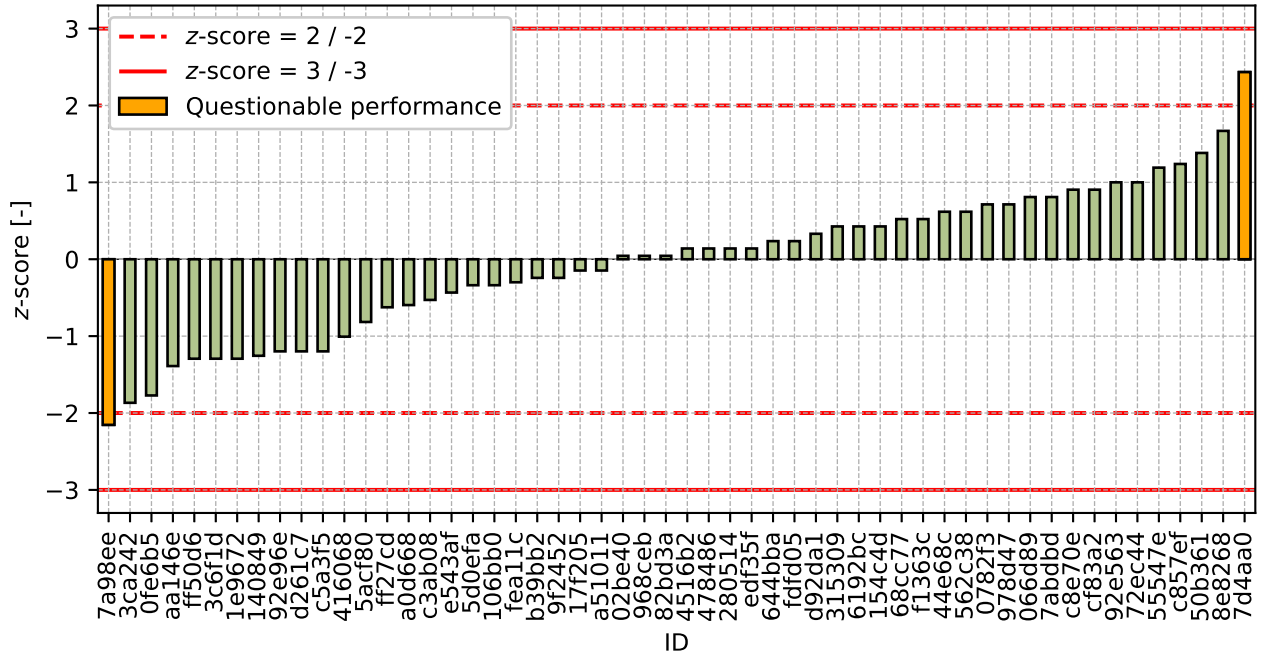

Figure 74: z-score

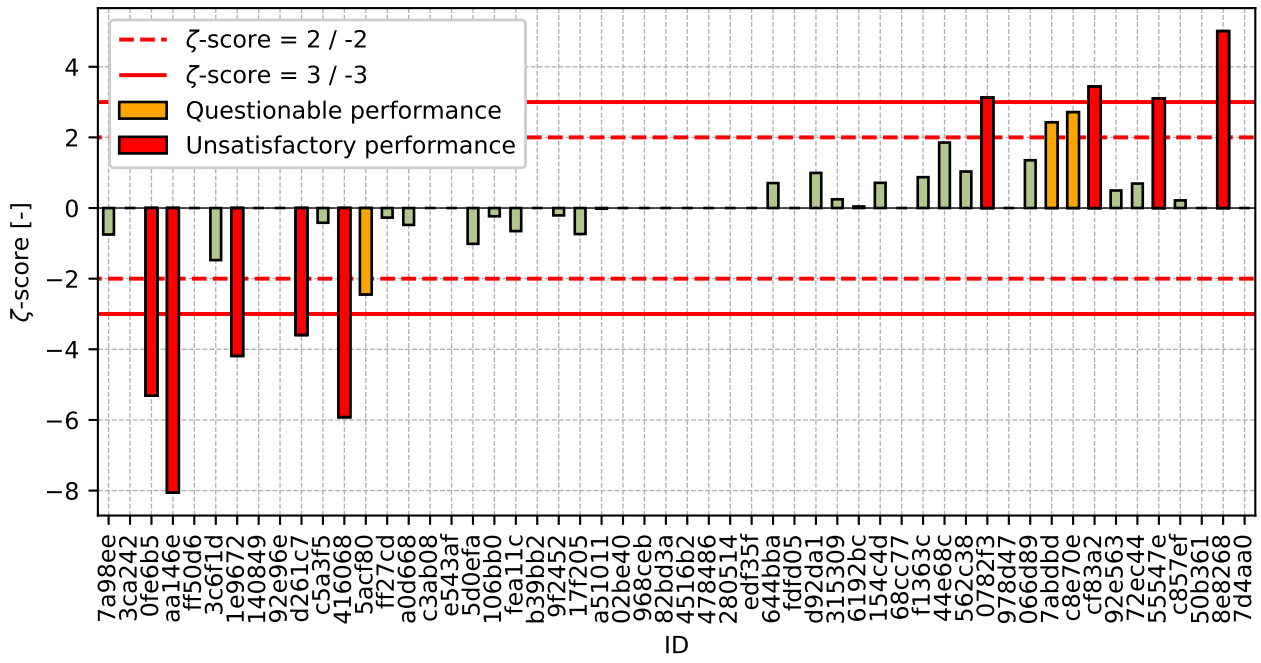

Figure 75: ζ-score

Table 25: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
7a98ee	-2.15	-0.75
3ca242	-1.87	-
0fe6b5	-1.77	-5.31
aa146e	-1.39	-8.05
ff50d6	-1.29	-
3c6f1d	-1.29	-1.48
1e9672	-1.29	-4.19
140849	-1.26	-
92e96e	-1.2	-
d261c7	-1.2	-3.59
c5a3f5	-1.2	-0.42
416068	-1.01	-5.92
5acf80	-0.82	-2.45
ff27cd	-0.62	-0.27
a0d668	-0.6	-0.48
c3ab08	-0.53	-
e543af	-0.43	-
5d0efa	-0.34	-1.01
106bb0	-0.34	-0.23
fea11c	-0.3	-0.65
b39bb2	-0.24	-
9f2452	-0.24	-0.21

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ID	*z*-score [-]	ζ-score [-]
17f205	-0.15	-0.74
a51011	-0.15	-0.02
02be40	0.04	-
968ceb	0.04	-
82bd3a	0.04	-
4516b2	0.14	-
478486	0.14	-
280514	0.14	-
edf35f	0.14	-
644bba	0.24	0.71
fdfd05	0.24	-
d92da1	0.33	0.99
315309	0.43	0.25
6192bc	0.43	0.04
154c4d	0.43	0.71
68cc77	0.52	-
f1363c	0.52	0.87
44e68c	0.62	1.85
562c38	0.62	1.03
0782f3	0.71	3.13
978d47	0.71	-
066d89	0.81	1.35
7abdbd	0.81	2.43
c8e70e	0.9	2.71
cf83a2	0.9	3.44
92e563	1.0	0.5
72ec44	1.0	0.69
55547e	1.19	3.1
c857ef	1.24	0.22
50b361	1.38	-
8e8268	1.67	5.01
7d4aa0	2.43	-

2 Appendix – EN 933-3 Determination of particle shape - Flakiness index

2.1 Test results

Table 26: Test results - ordered by average value. Outliers are marked by red color. u_X - extended uncertainty of measurement; $\bar{x}$ - average value; s_0 - sample standard deviation; V_X - variation coefficient

ID	Test results [%]			u_X [%]	$\bar{x}$ [%]	s_0 [%]	V_X [%]
aa146e	13	13	13	0	13	0.0	0.0
e543af	15	14	14	-	14	0.6	4.03
1e9672	15	15	15	0	15	0.2	1.15
7d4aa0	15	15	15	0	15	0.0	0.0
92e96e	15	16	15	-	15	0.6	3.77
52d231	16	16	16	-	16	0.4	2.2
f1363c	17	16	16	0	16	0.6	3.52
69b2b6	16	17	17	-	17	0.6	3.46
92e563	17	17	17	1	17	0.0	0.0
0a6d66	19	19	-	1	19	0.0	0.0
36026f	21	20	20	-	20	0.6	2.84

2.2 The Numerical Procedure for Determining Outliers

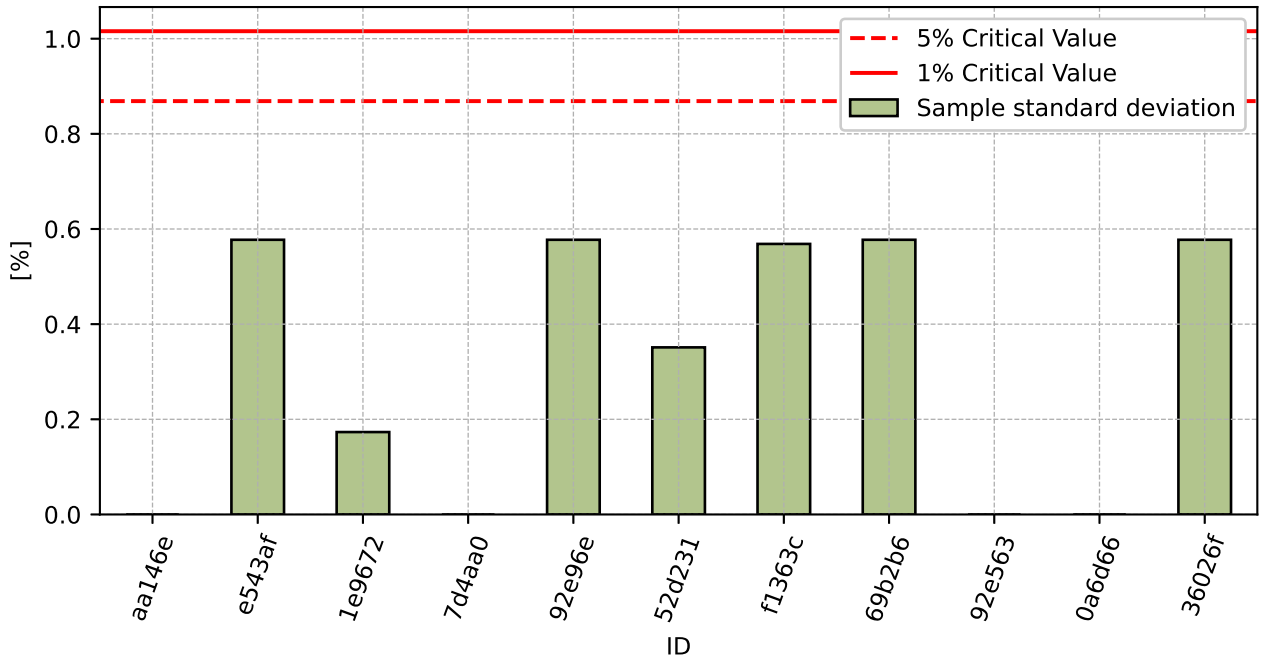

Figure 76: **Cochran's test** - sample standard deviations

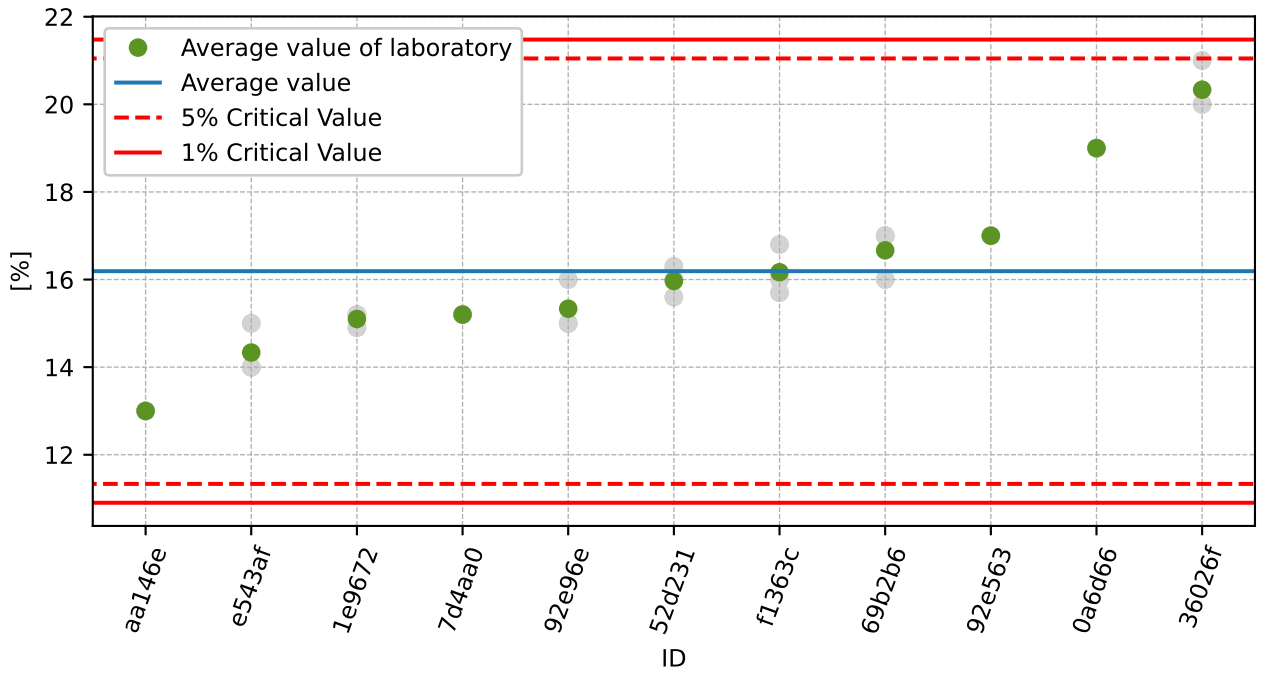

Figure 77: **Grubbs' test** - average values

2.3 Mandel's Statistics

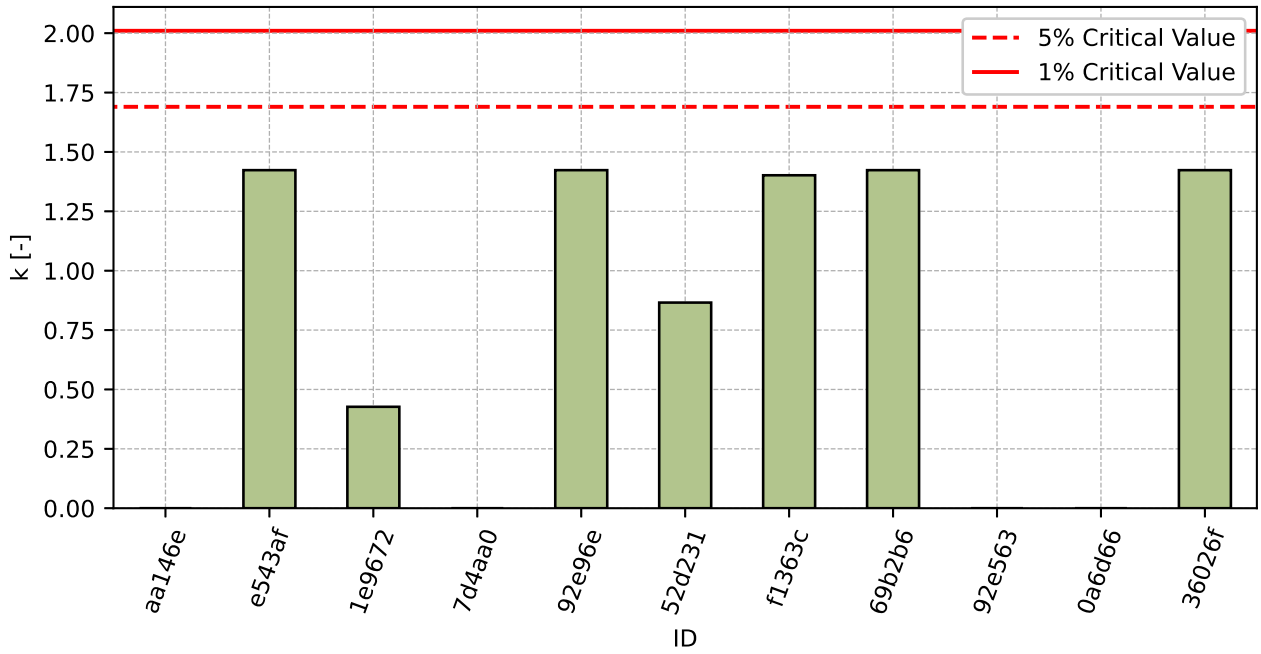

Figure 78: Intralaboratory Consistency Statistic

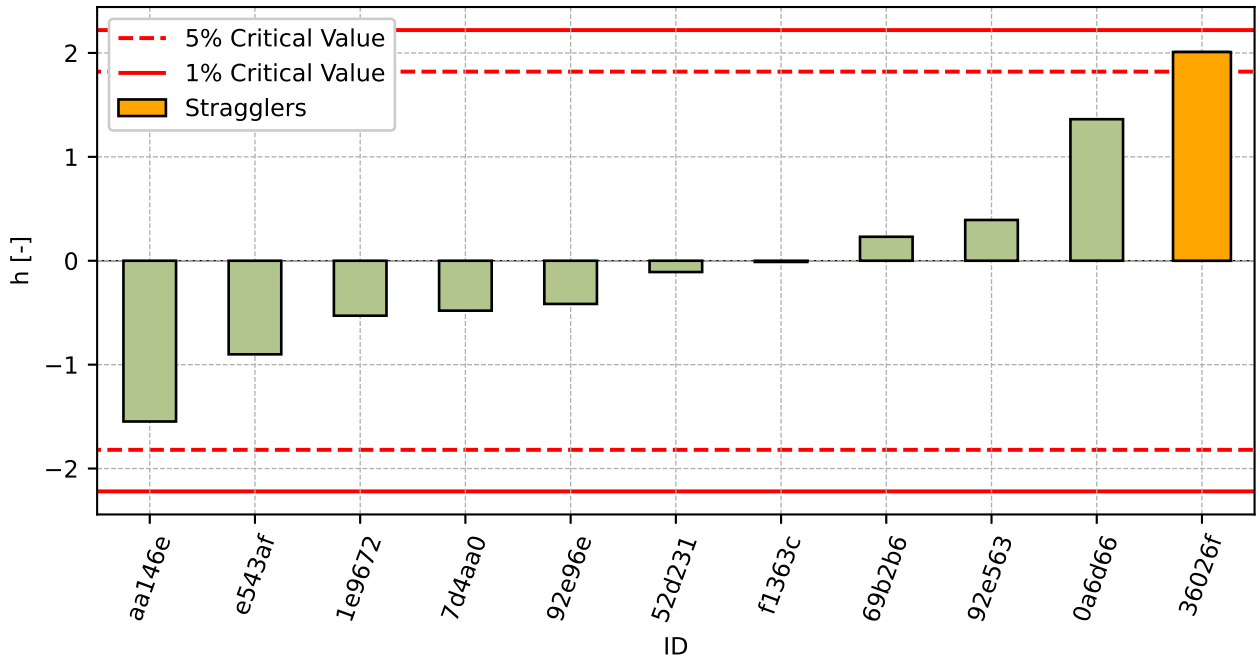

Figure 79: Interlaboratory Consistency Statistic

2.4 Descriptive statistics

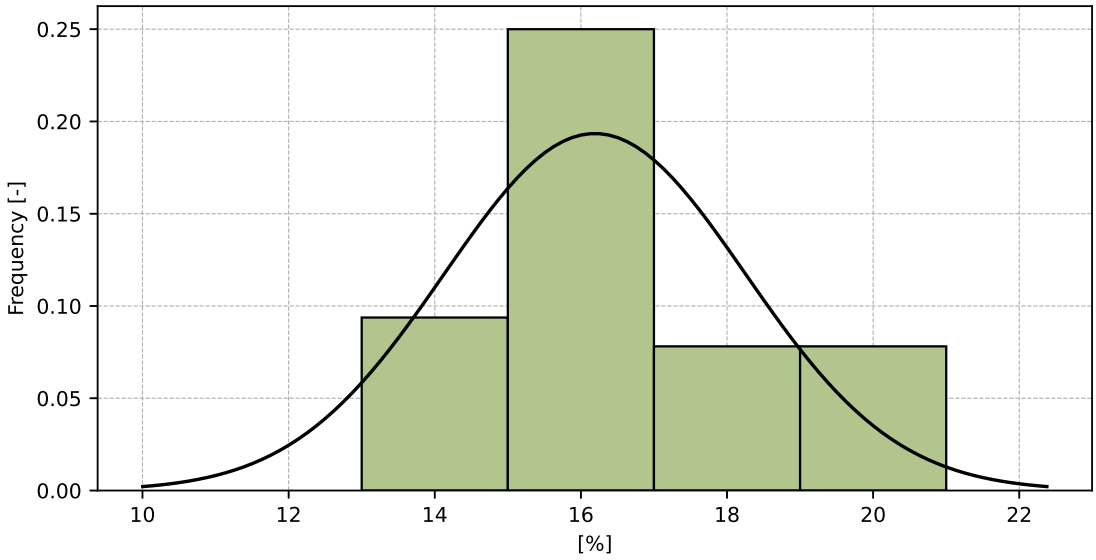

Figure 80: Histogram of all test results

Table 27: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	16
Sample standard deviation – s	2.1
Asigned value – x^*	16
Robust standard deviation – s^*	1.9
Measurement uncertainty of asigned value – u_X	0.7
p-value of normality test	1.0 [-]
Interlaboratory standard deviation – s_L	2.0
Repeatability standard deviation – s_r	0.4
Reproducibility standard deviation – s_R	2.1
Repeatability – r	1
Reproducibility – R	6

2.5 Evaluation of Performance Statistics

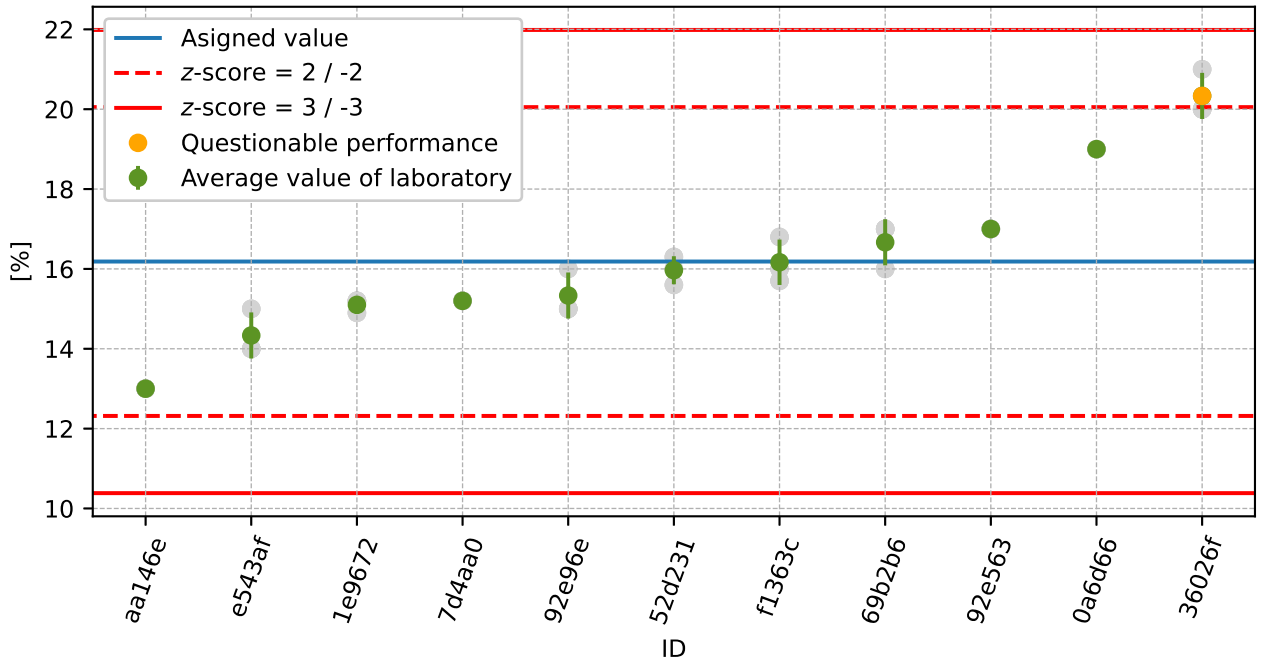

Figure 81: Average values and sample standard deviations

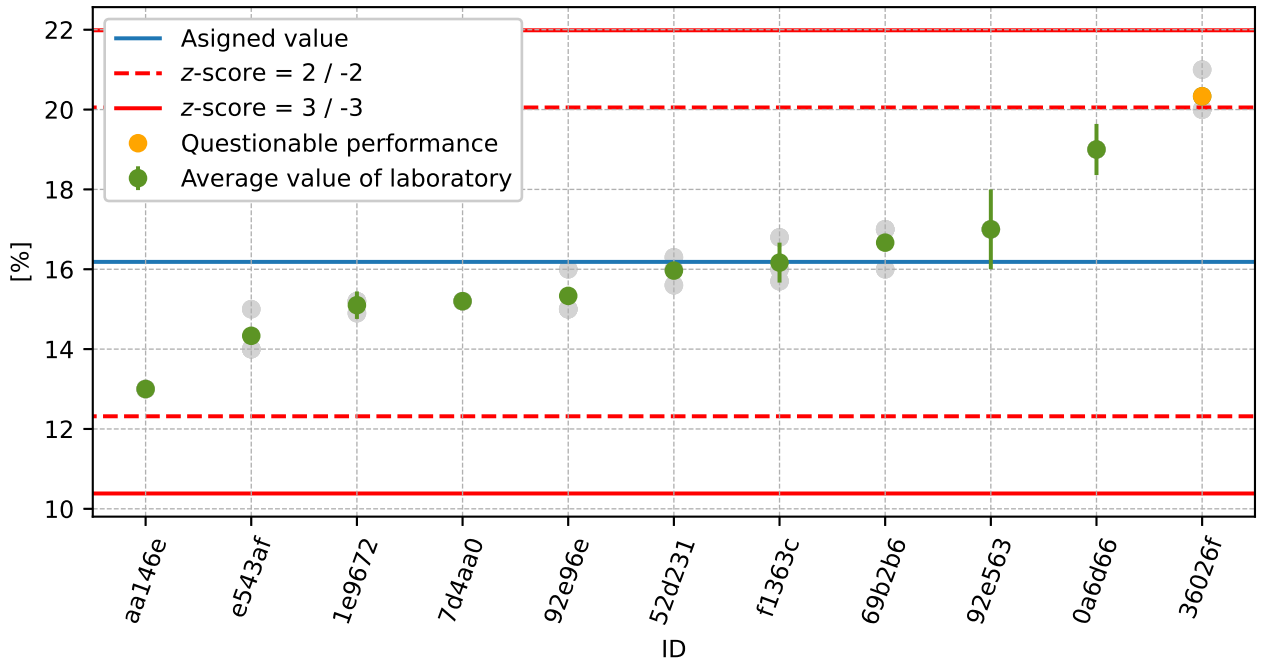

Figure 82: Average values and extended uncertainties of measurement

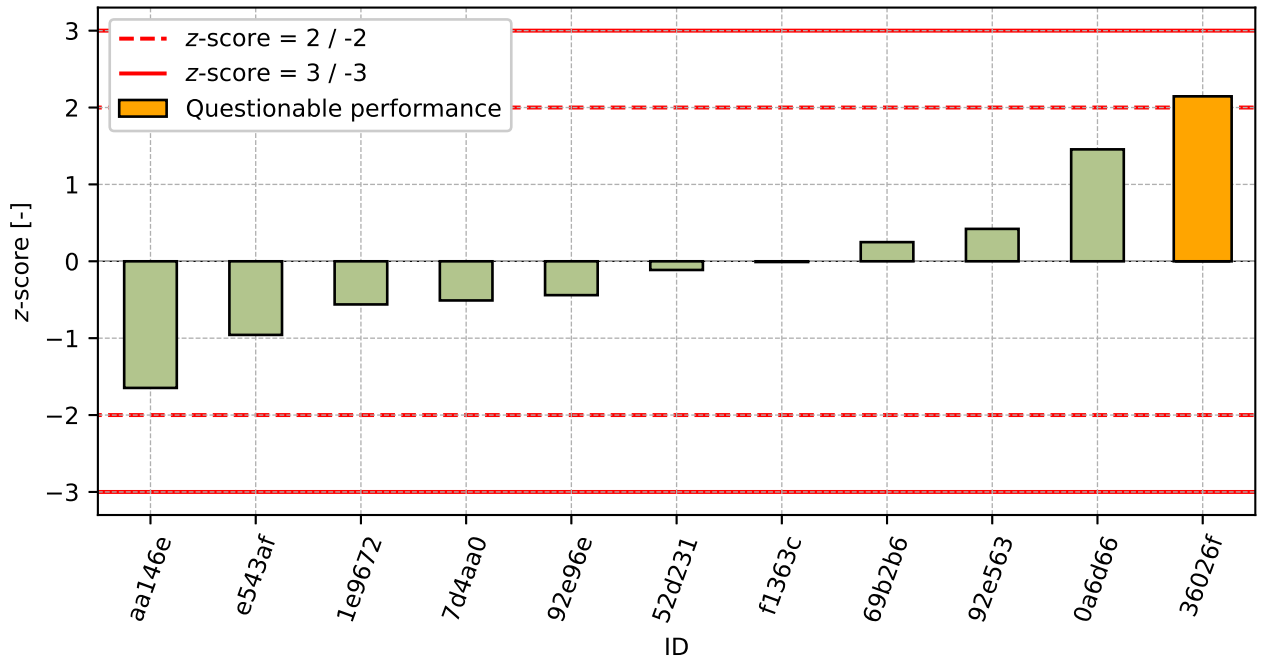

Figure 83: z-score

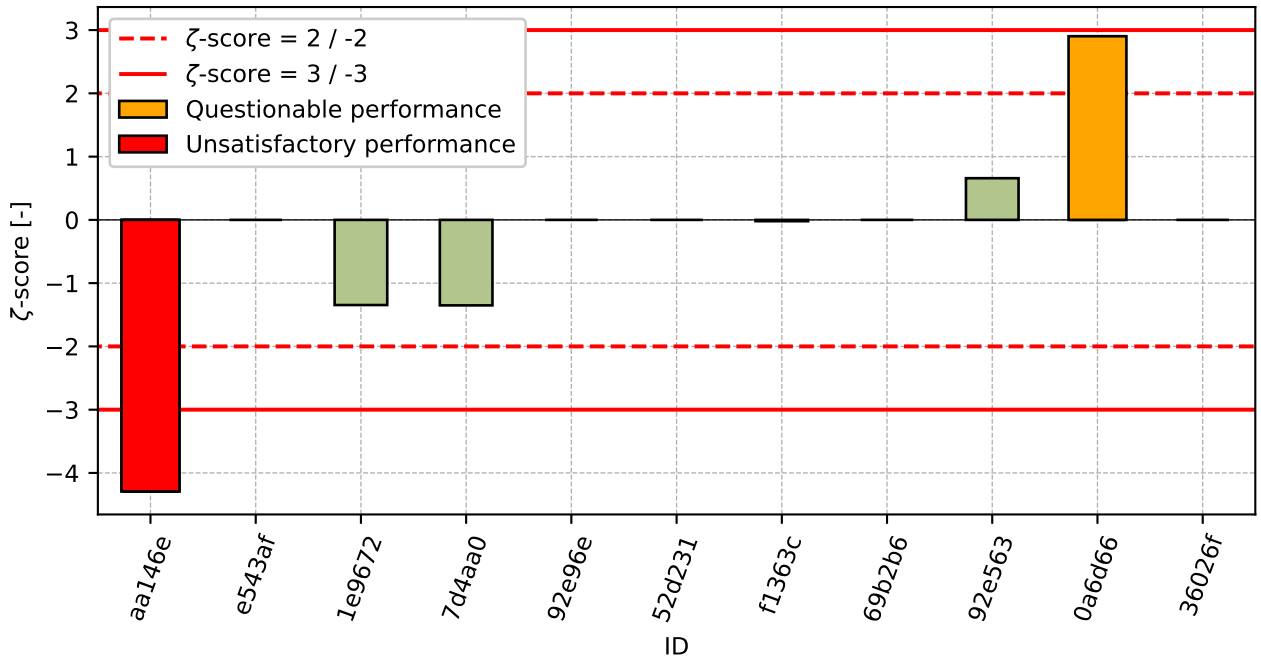

Figure 84: ζ-score

Table 28: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
aa146e	-1.65	-4.29
e543af	-0.96	-
1e9672	-0.56	-1.35
7d4aa0	-0.51	-1.35
92e96e	-0.44	-
52d231	-0.11	-
f1363c	-0.01	-0.02
69b2b6	0.25	-
92e563	0.42	0.66
0a6d66	1.46	2.9
36026f	2.15	-

3 Appendix – EN 933-4 Determination of particle shape - Shape index

3.1 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 [%]
315309	12	12	12	1	12	0.1	0.48
140849	14	15	14	-	14	0.6	4.03
0fe6b5	16	16	17	1	17	0.4	2.52
7a98ee	17	17	17	1	17	0.0	0.0
6192bc	17	17	17	1	17	0.1	0.34
c8e70e	18	18	18	0	18	0.0	0.0
154c4d	18	17	19	3	18	0.9	4.73
8e8268	19	19	19	0	19	0.0	0.0
44e68c	19	19	20	1	19	0.6	2.99
aa146e	20	20	20	0	20	0.0	0.0
55547e	20	21	19	1	20	1.0	5.0
562c38	20	20	20	-	20	0.0	0.0
3c6f1d	20	20	20	20	20	0.0	0.0
d92da1	22	20	21	0	21	1.0	4.76
c3ab08	21	21	22	-	21	0.6	2.71
a51011	22	21	22	1	22	0.6	2.66
fdfd05	22	21	22	-	22	0.6	2.66
50b361	22	22	22	-	22	0.2	0.7
68cc77	23	21	22	-	22	1.0	4.55
edf35f	23	23	23	-	23	0.0	0.0
92e563	23	23	24	1	23	0.6	2.47
106bb0	24	23	24	2	24	0.6	2.44
82bd3a	25	23	24	-	24	1.0	4.17
5acf80	24	24	24	1	24	0.2	0.63
17f205	24	25	24	3	24	0.6	2.37
a3cf10	26	24	25	1	25	1.0	4.0
0782f3	25	26	25	1	25	0.6	2.28
5d0efa	25	25	27	3	26	1.2	4.5
cf83a2	28	26	24	2	26	2.0	7.69
fea11c	28	25	26	0	26	1.5	5.8
644bba	29	29	26	2	28	1.7	6.19
ff27cd	28	27	29	7	28	1.0	3.57
32a836	31	30	31	1	31	0.6	1.88
280514	31	31	31	-	31	0.0	0.0

3.2 The Numerical Procedure for Determining Outliers

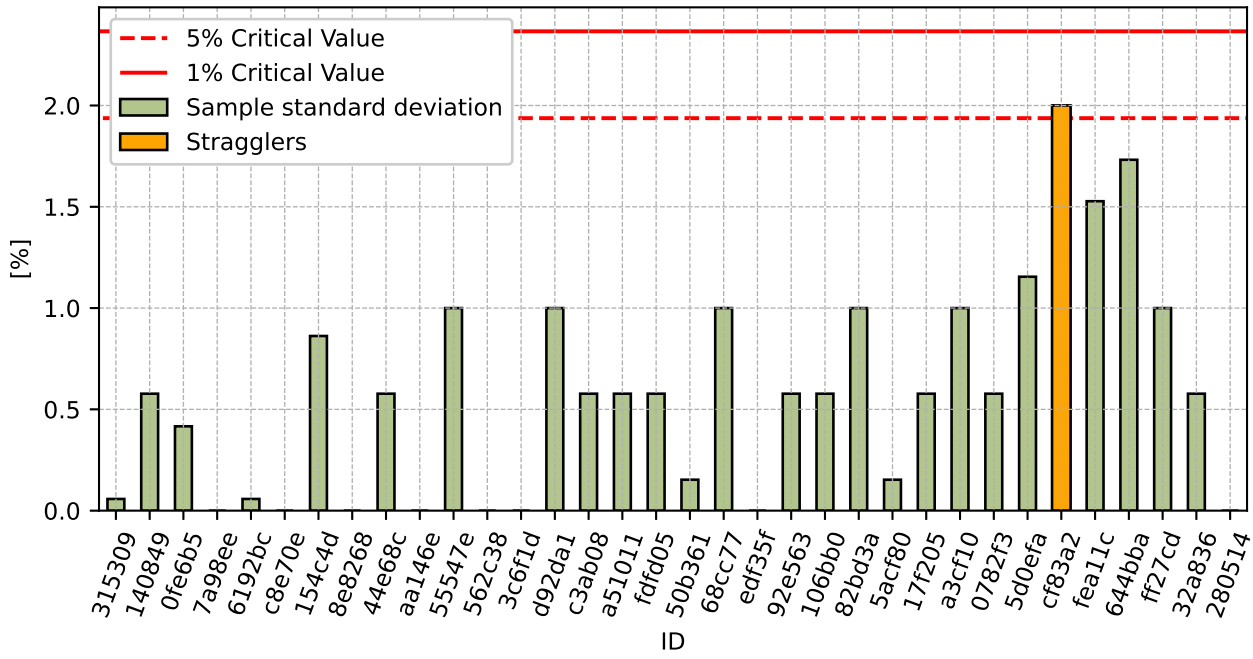

Figure 85: **Cochran's test** - sample standard deviations

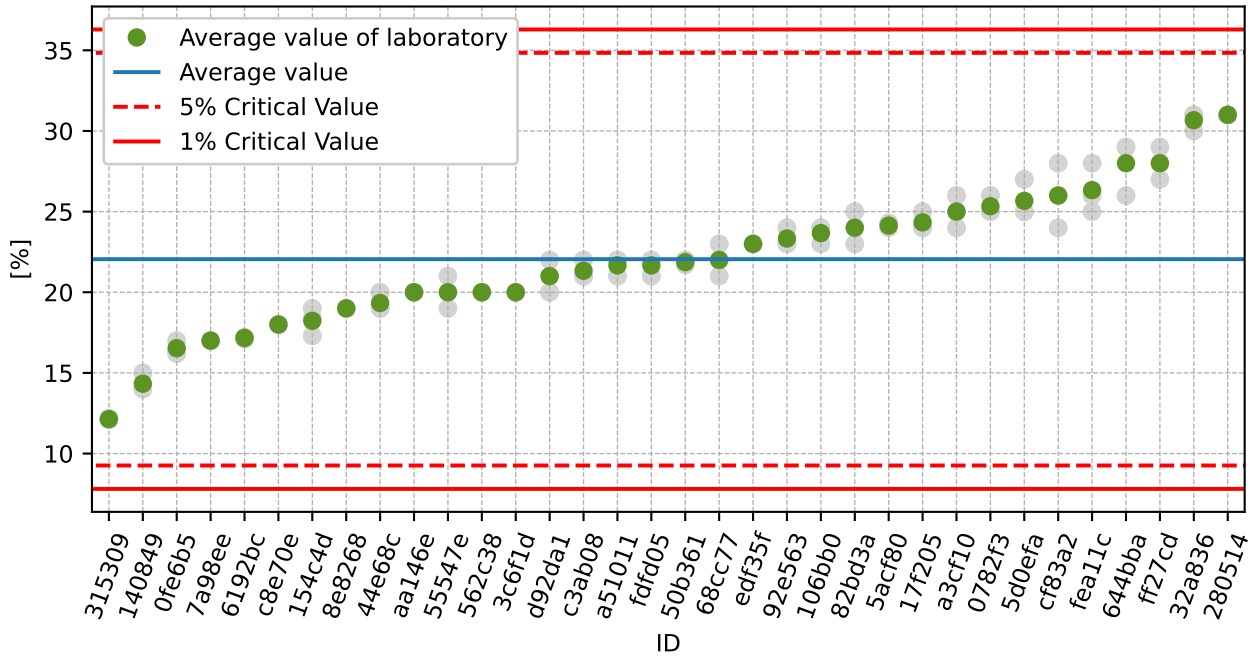

Figure 86: **Grubbs' test** - average values

3.3 Mandel's Statistics

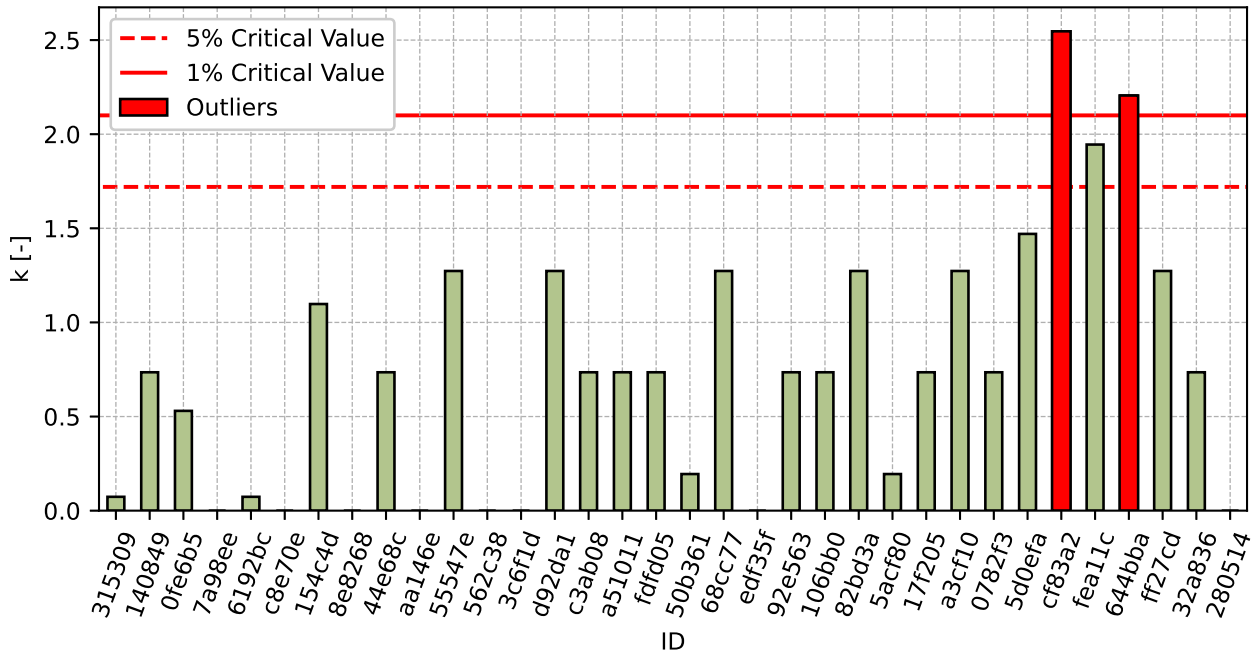

Figure 87: Intralaboratory Consistency Statistic

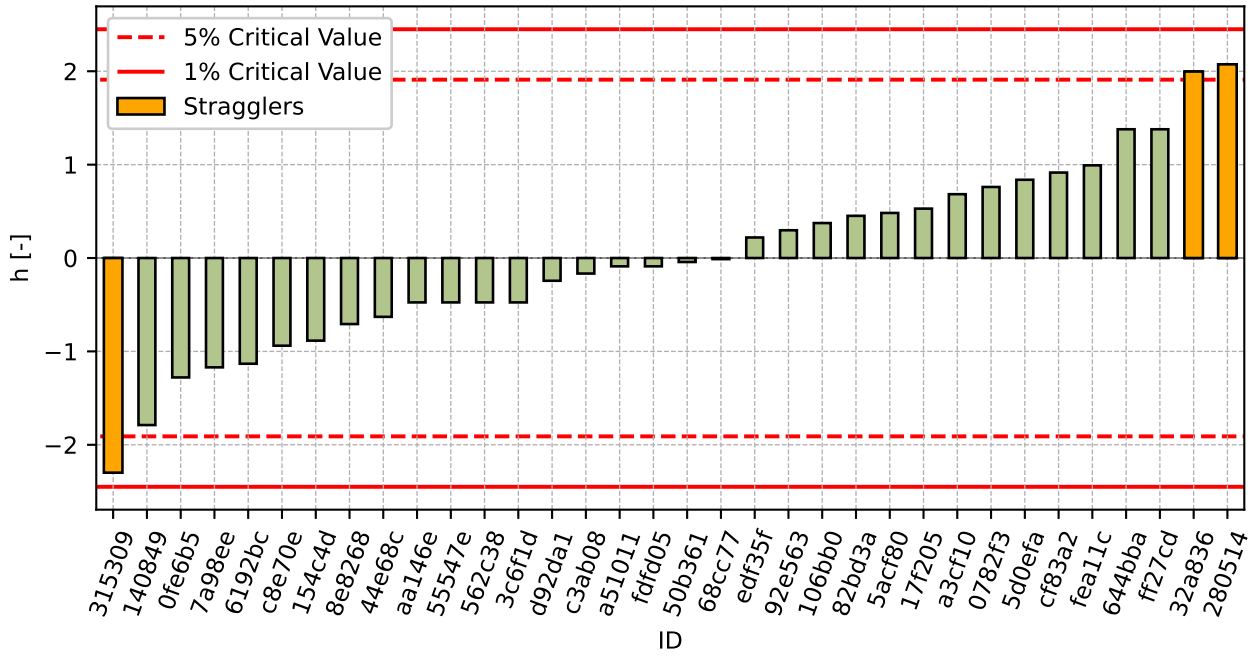

Figure 88: Interlaboratory Consistency Statistic

3.4 Descriptive statistics

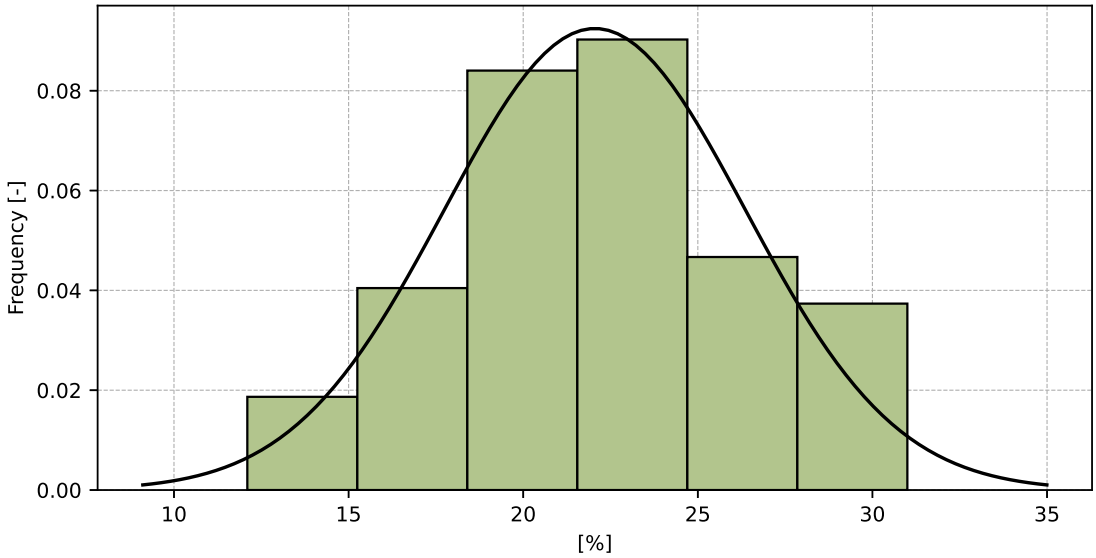

Figure 89: Histogram of all test results

Table 30: Descriptive statistics

Characteristics	**[%]**
Average value – $\bar{x}$	22
Sample standard deviation – s	4.3
Asigned value – x^*	22
Robust standard deviation – s^*	4.1
Measurement uncertainty of asigned value – u_X	0.9
p-value of normality test	0.201 [-]
Interlaboratory standard deviation – s_L	4.3
Repeatability standard deviation – s_r	0.8
Reproducibility standard deviation – s_R	4.4
Repeatability – r	2
Reproducibility – R	12

3.5 Evaluation of Performance Statistics

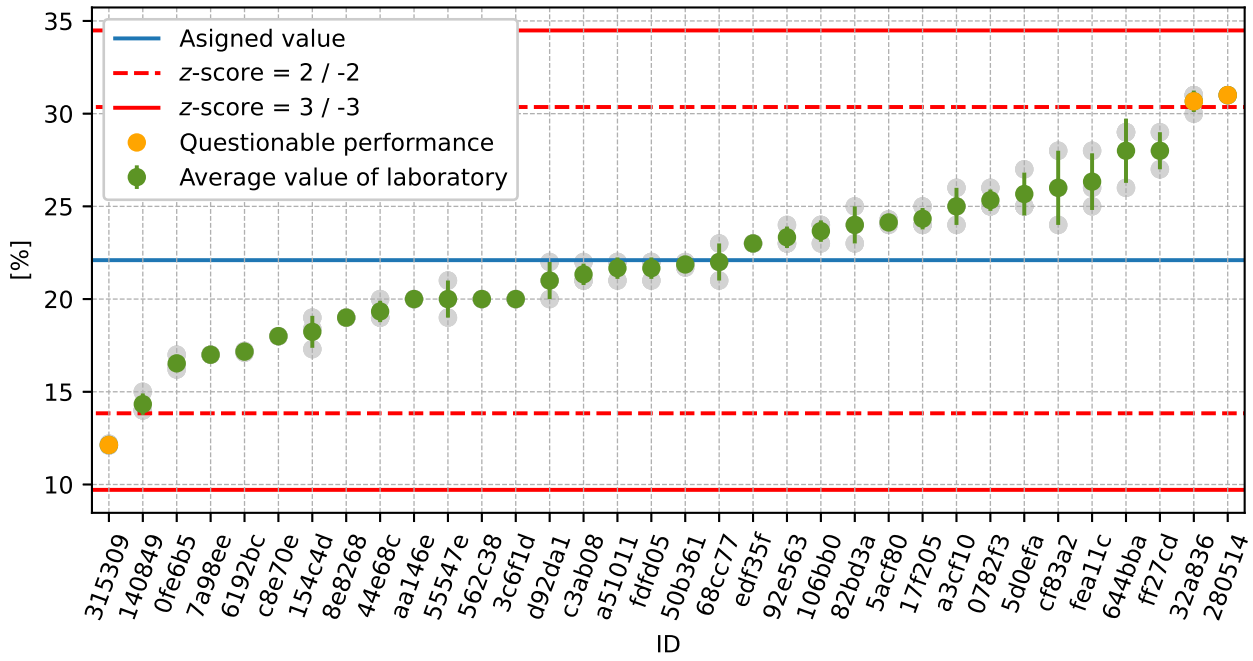

Figure 90: Average values and sample standard deviations

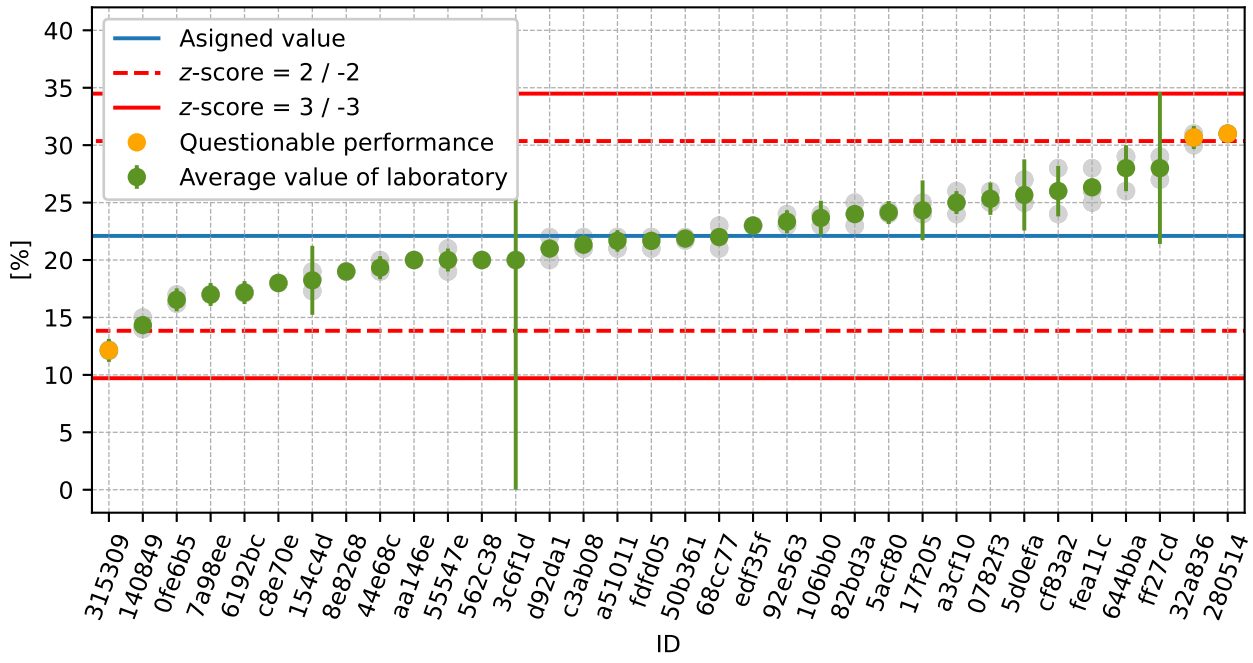

Figure 91: Average values and extended uncertainties of measurement

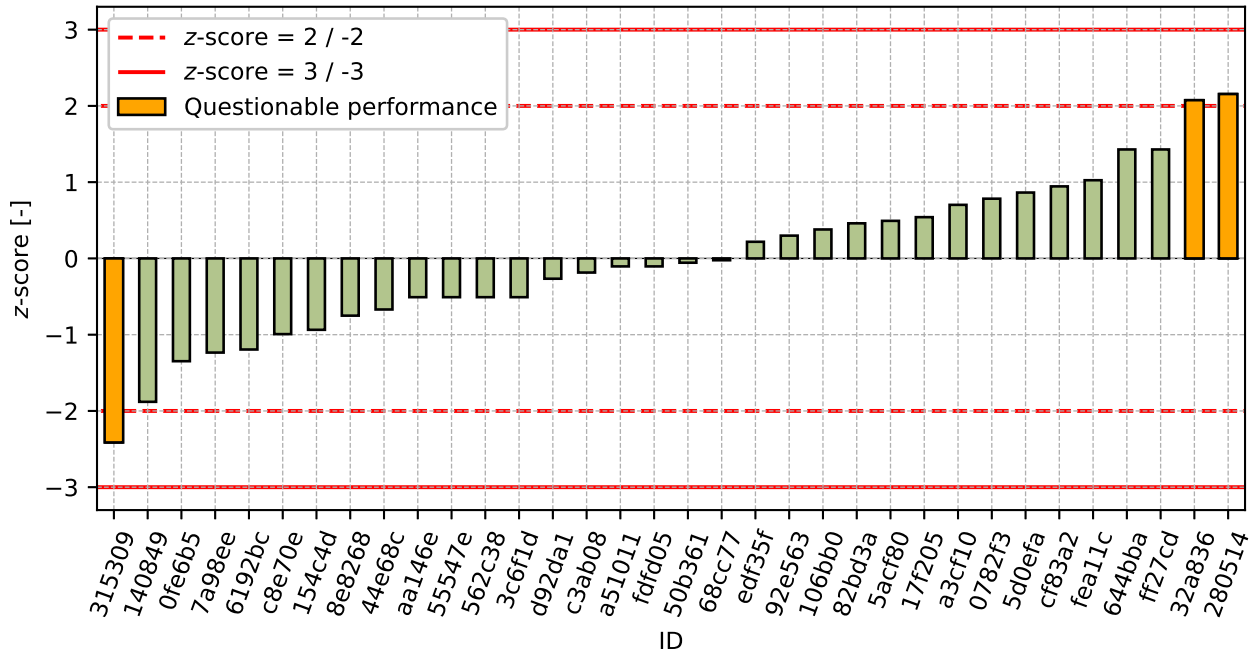

Figure 92: z-score

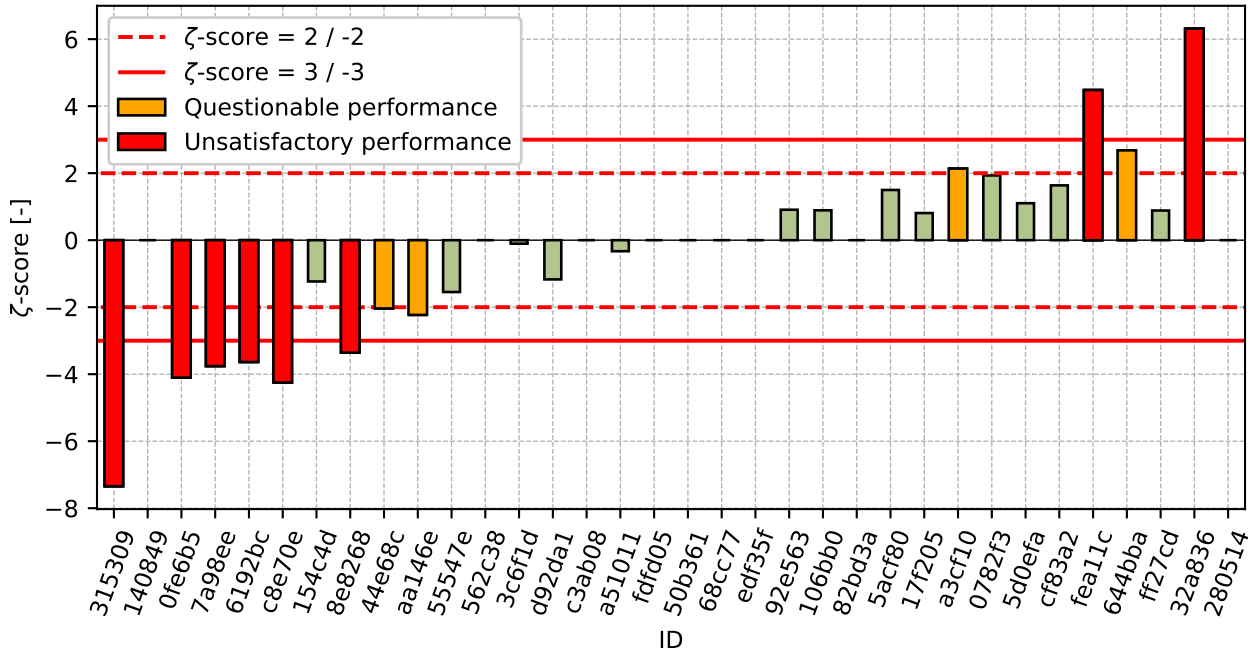

Figure 93: ζ-score

Table 31: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
315309	-2.41	-7.34
140849	-1.88	-
0fe6b5	-1.35	-4.1
7a98ee	-1.23	-3.76
6192bc	-1.19	-3.63
c8e70e	-0.99	-4.25
154c4d	-0.94	-1.23
8e8268	-0.75	-3.36
44e68c	-0.67	-2.04
aa146e	-0.51	-2.23
55547e	-0.51	-1.55
562c38	-0.51	-
3c6f1d	-0.51	-0.1
d92da1	-0.27	-1.17
c3ab08	-0.19	-
a51011	-0.1	-0.33
fdfd05	-0.1	-
50b361	-0.06	-
68cc77	-0.02	-
edf35f	0.22	-
92e563	0.3	0.91
106bb0	0.38	0.89
82bd3a	0.46	-
5acf80	0.49	1.5
17f205	0.54	0.81
a3cf10	0.7	2.14
0782f3	0.78	1.93
5d0efa	0.86	1.1
cf83a2	0.94	1.64
fea11c	1.03	4.48
644bba	1.43	2.68
ff27cd	1.43	0.89
32a836	2.07	6.31
280514	2.16	-

4 Appendix – EN 933-8 Assessment of fines - Sand equivalent test

4.1 Test results

Table 32: 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 [%]
6e99ab	43	40	44	2	42	2.1	4.92
315309	48	44	48	4	47	1.8	3.96
68cc77	46	49	49	-	48	1.7	3.61
fa8544	48	48	48	1	48	0.2	0.36
4df247	54	52	53	-	53	1.0	1.89
280514	54	51	54	-	53	1.7	3.27
140849	54	54	56	-	55	1.1	2.06
c3ab08	55	58	57	-	57	1.5	2.7
92e563	57	56	58	1	57	1.0	1.75
639ddc	57	58	57	1	57	0.6	1.01
7d4aa0	60	58	58	1	58	1.0	1.71
6a0c4d	58	59	59	-	59	0.6	0.98
106bb0	58	60	61	2	60	1.5	2.56
4516b2	59	61	60	2	60	1.0	1.67
c5a3f5	62	59	59	4	60	1.7	2.8
82bd3a	61	62	61	-	61	0.6	0.94
416068	67	66	67	2	67	0.6	0.87
edf35f	69	71	73	-	71	2.0	2.82

4.2 The Numerical Procedure for Determining Outliers

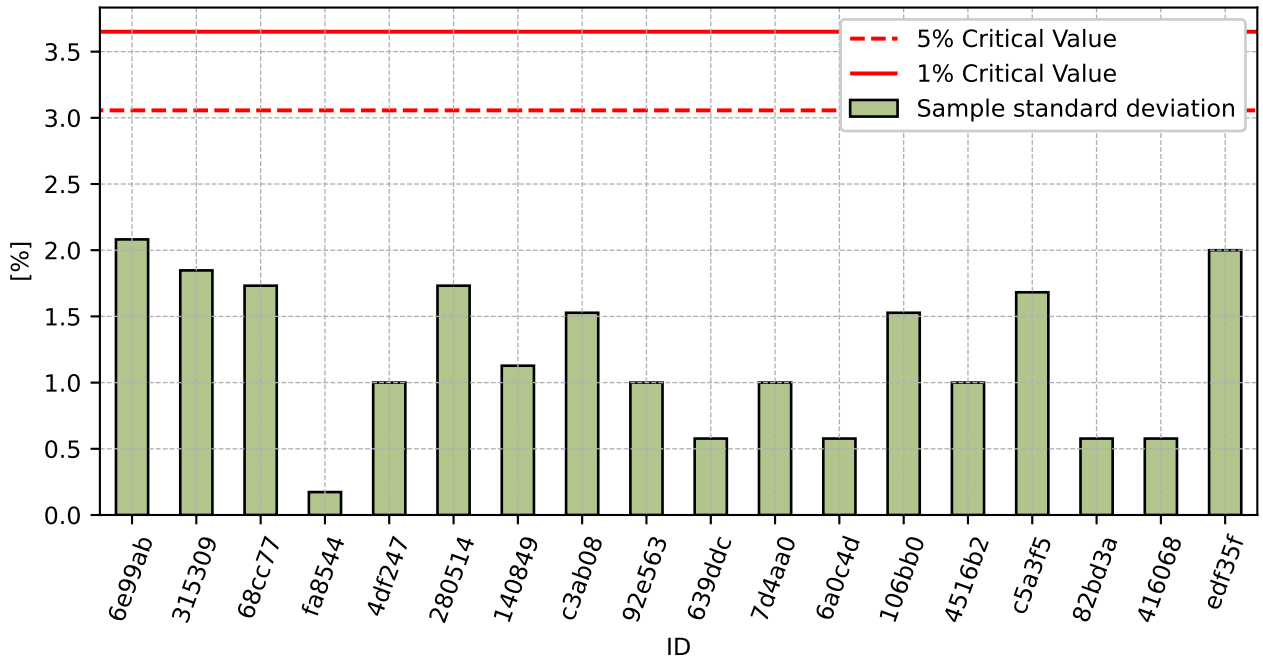

Figure 94: **Cochran's test** - sample standard deviations

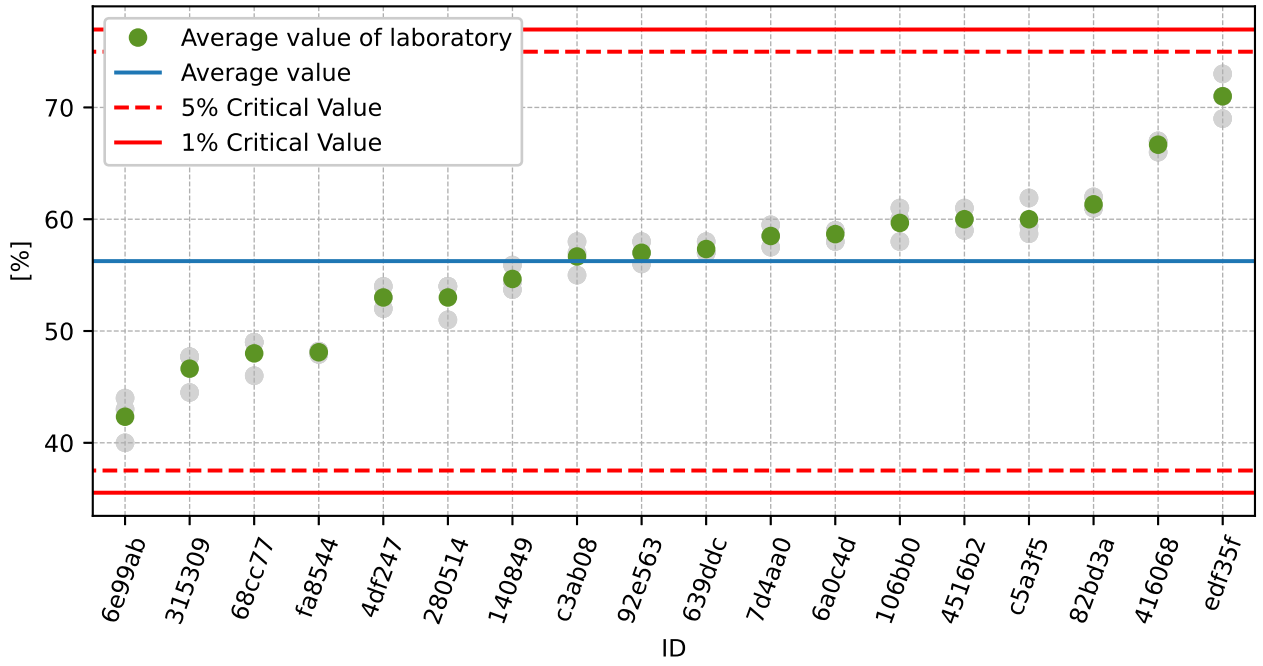

Figure 95: **Grubbs' test** - average values

4.3 Mandel's Statistics

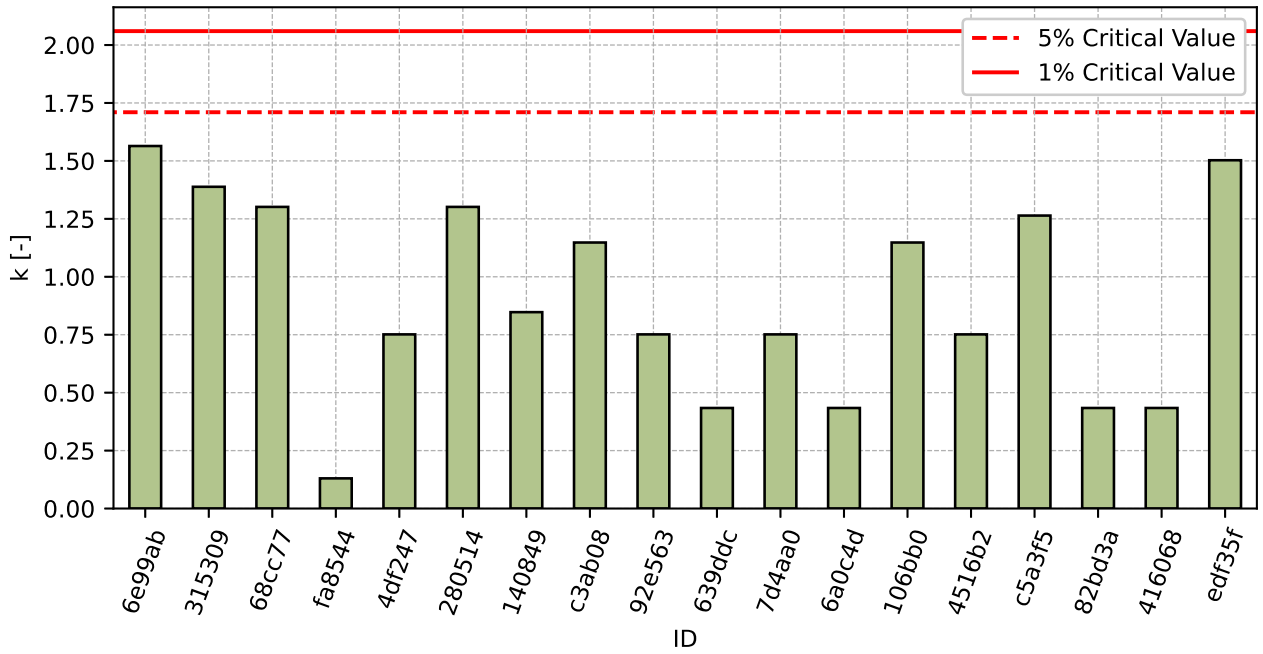

Figure 96: Intralaboratory Consistency Statistic

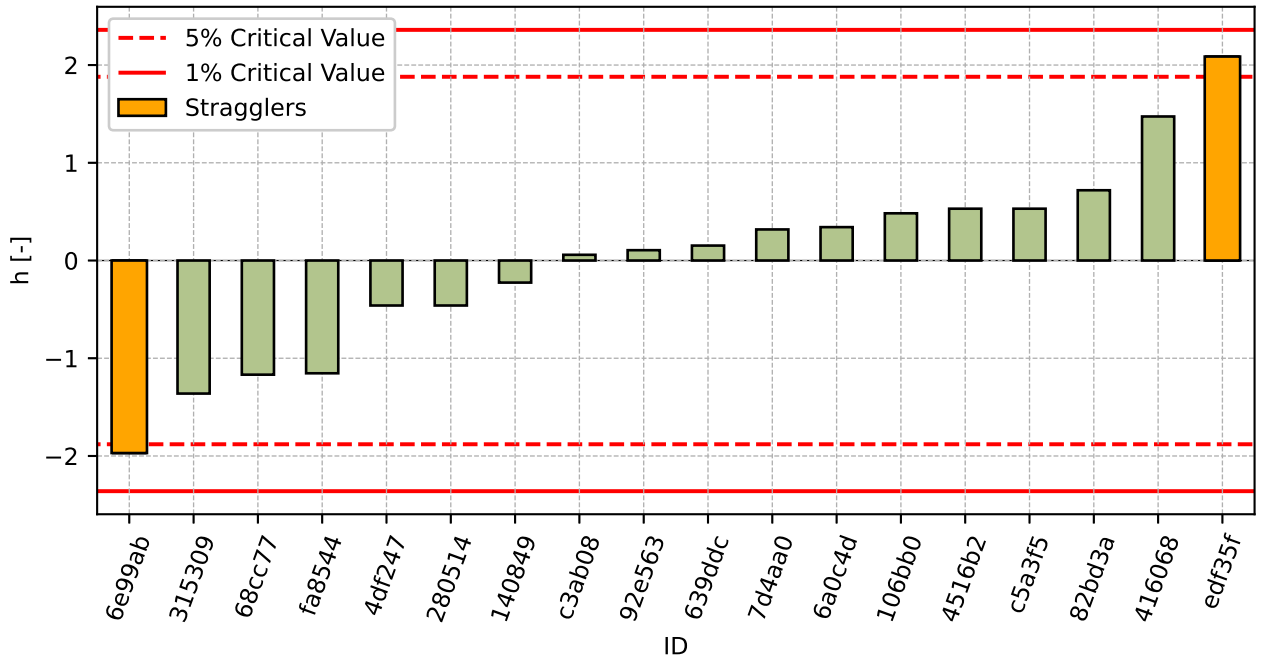

Figure 97: Interlaboratory Consistency Statistic

4.4 Descriptive statistics

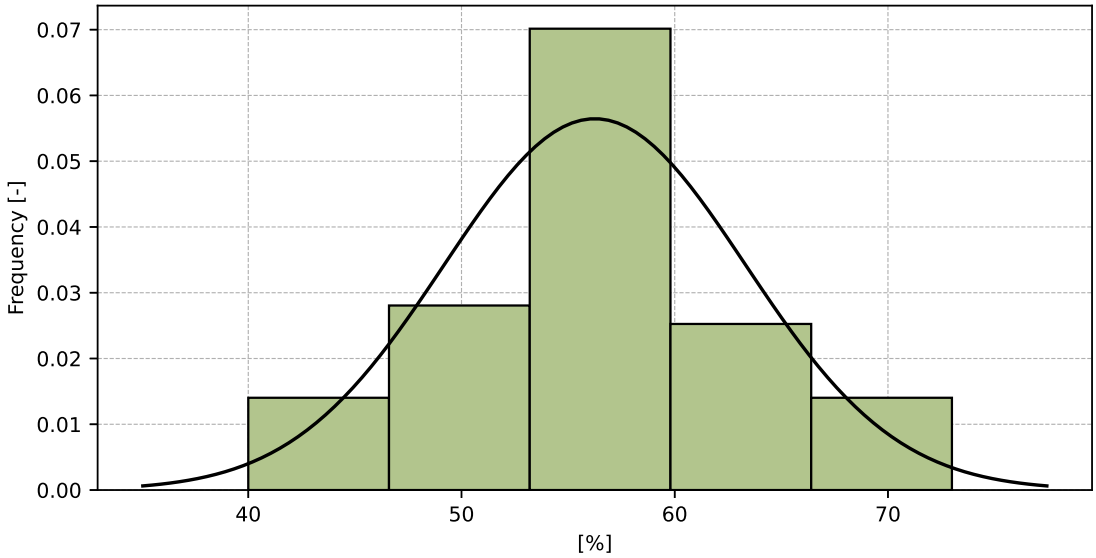

Figure 98: Histogram of all test results

Table 33: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	56
Sample standard deviation – s	7.1
Asigned value – x^*	57
Robust standard deviation – s^*	6.4
Measurement uncertainty of asigned value – u_X	1.9
p-value of normality test	0.305 [-]
Interlaboratory standard deviation – s_L	7.0
Repeatability standard deviation – s_r	1.3
Reproducibility standard deviation – s_R	7.1
Repeatability – r	4
Reproducibility – R	20

4.5 Evaluation of Performance Statistics

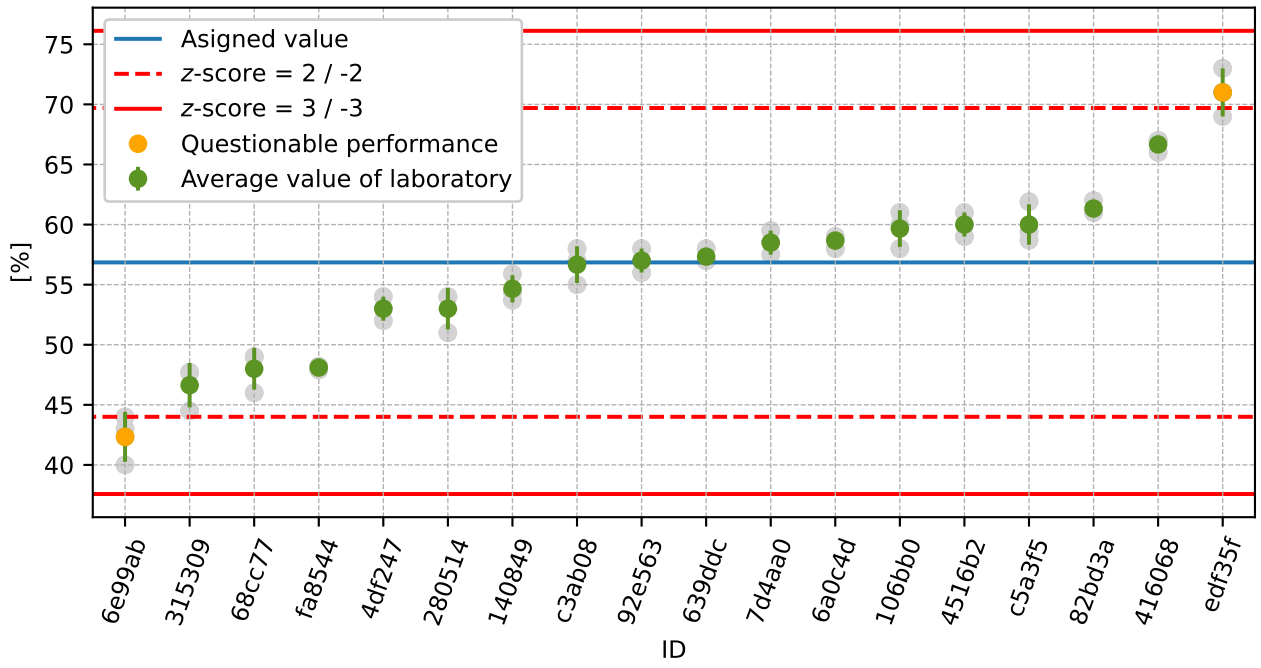

Figure 99: Average values and sample standard deviations

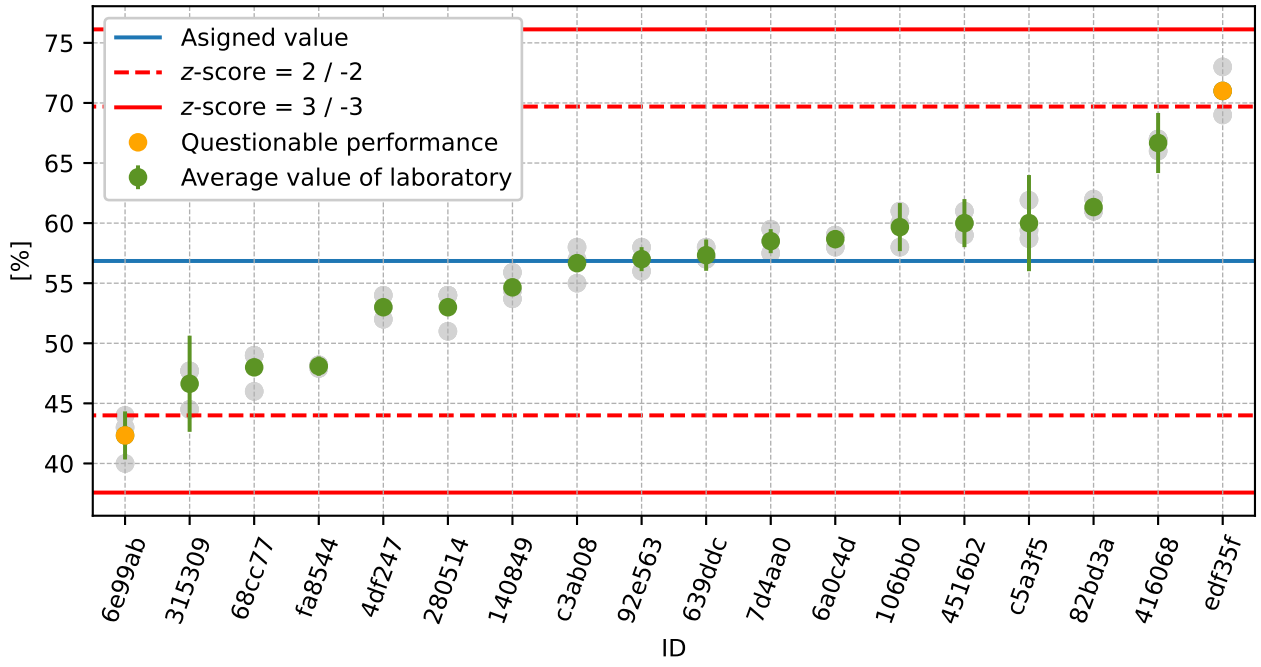

Figure 100: Average values and extended uncertainties of measurement

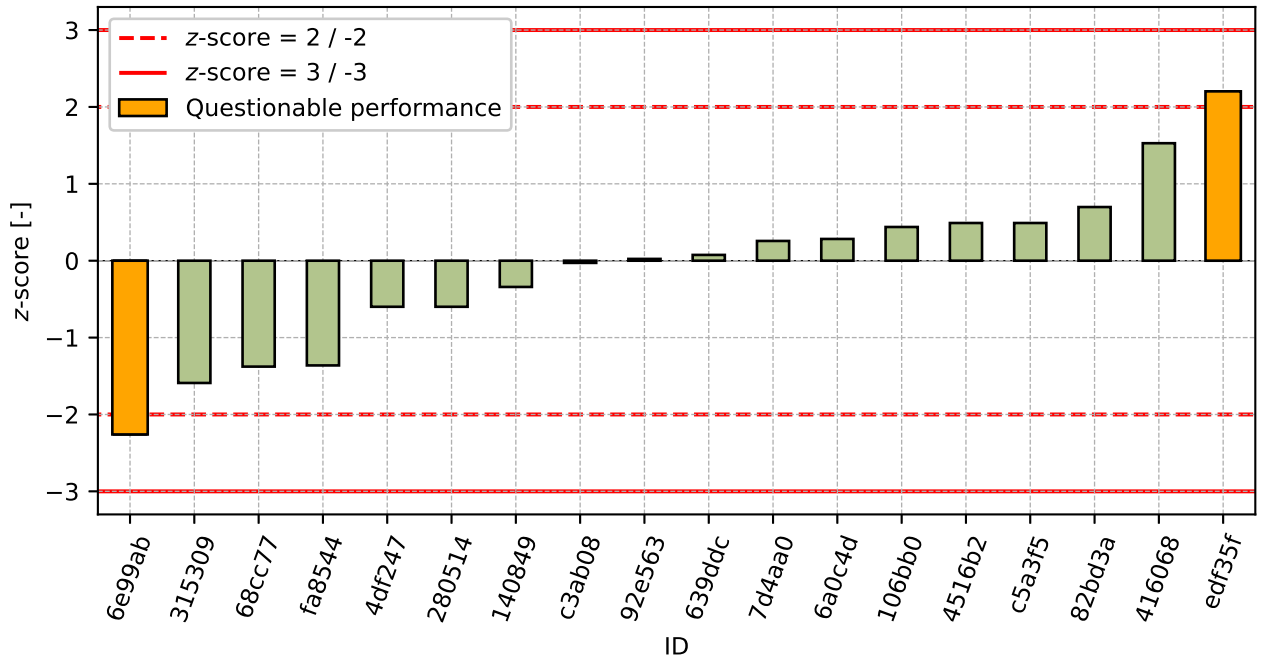

Figure 101: z-score

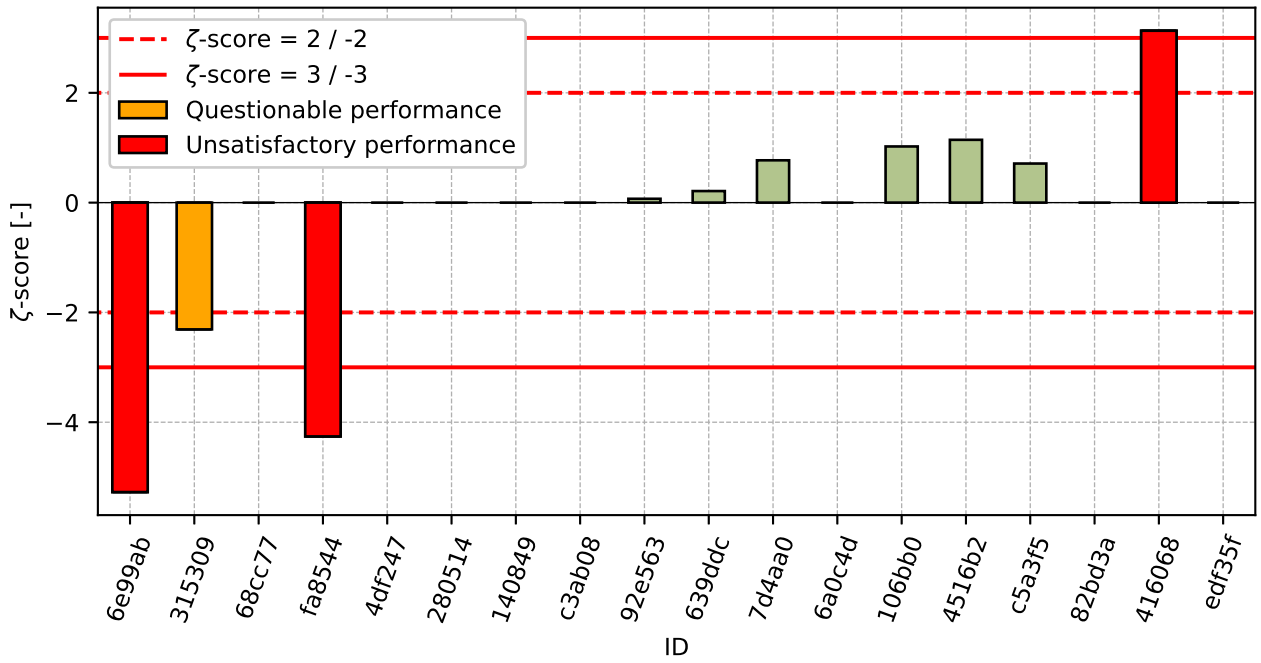

Figure 102: ζ-score

Table 34: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
6e99ab	-2.26	-5.27
315309	-1.59	-2.31
68cc77	-1.38	-
fa8544	-1.36	-4.26
4df247	-0.6	-
280514	-0.6	-
140849	-0.34	-
c3ab08	-0.03	-
92e563	0.02	0.07
639ddc	0.08	0.21
7d4aa0	0.26	0.77
6a0c4d	0.28	-
106bb0	0.44	1.02
4516b2	0.49	1.14
c5a3f5	0.49	0.71
82bd3a	0.7	-
416068	1.53	3.13
edf35f	2.2	-

5 Appendix – EN 933-9 Assessment of fines - Methylene blue test

5.1 Test results

Table 35: 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 [g/kg]			u_X [g/kg]	$\bar{x}$ [g/kg]	s_0 [g/kg]	V_X [%]
315309	0.4	0.4	0.5	0.2	0.4	0.06	13.32
92e96e	1.3	1.2	1.2	-	1.2	0.06	4.68
f1363c	1.2	1.5	1.3	0.2	1.3	0.15	11.46
7d4aa0	1.6	1.6	1.5	0.1	1.6	0.08	5.17
2f88fe	1.6	1.6	1.5	0.2	1.6	0.06	3.95
a396b5	1.7	1.7	1.7	0.7	1.7	0.0	0.0
1e9672	1.9	1.8	1.6	0.4	1.7	0.16	9.13
9f2452	1.8	1.8	1.9	0.3	1.8	0.06	3.15
8da3cb	2.1	2.1	2.0	0.3	2.1	0.06	2.79
36b1a5	2.8	3.0	2.8	0.1	2.9	0.12	4.03
50b361	4.0	3.8	-	-	3.9	0.2	5.09
d261c7	4.6	4.4	4.6	1.5	4.5	0.12	2.55

5.2 The Numerical Procedure for Determining Outliers

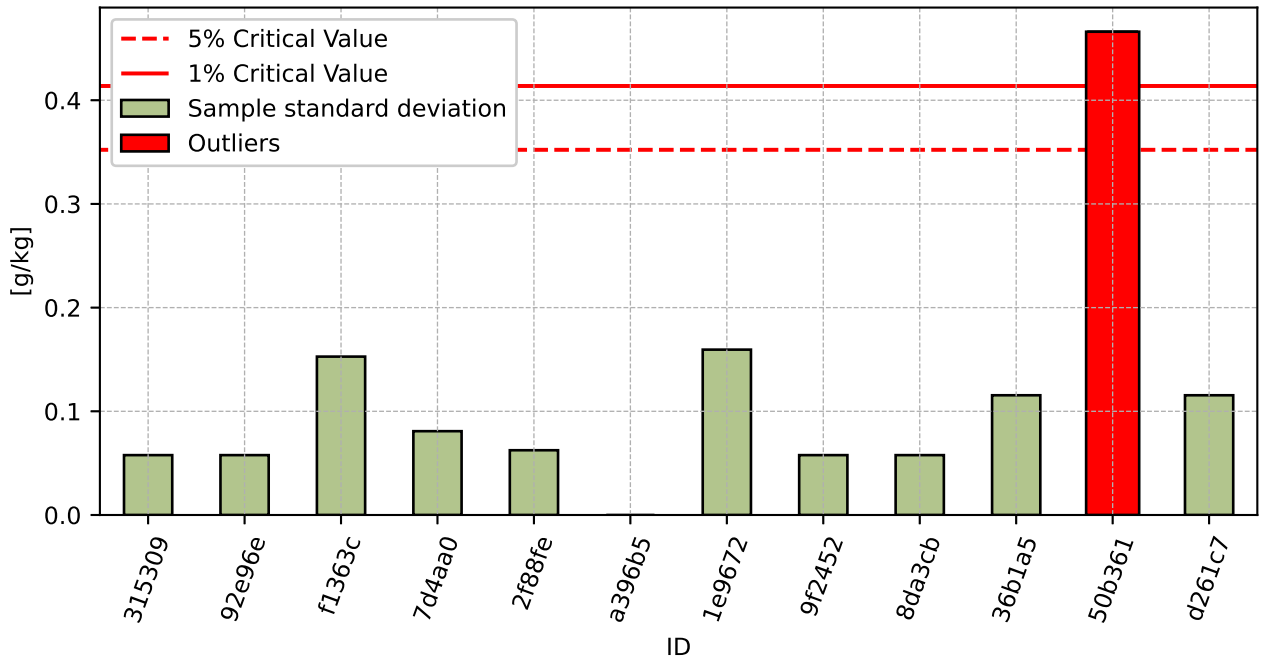

Figure 103: **Cochran's test** - sample standard deviations

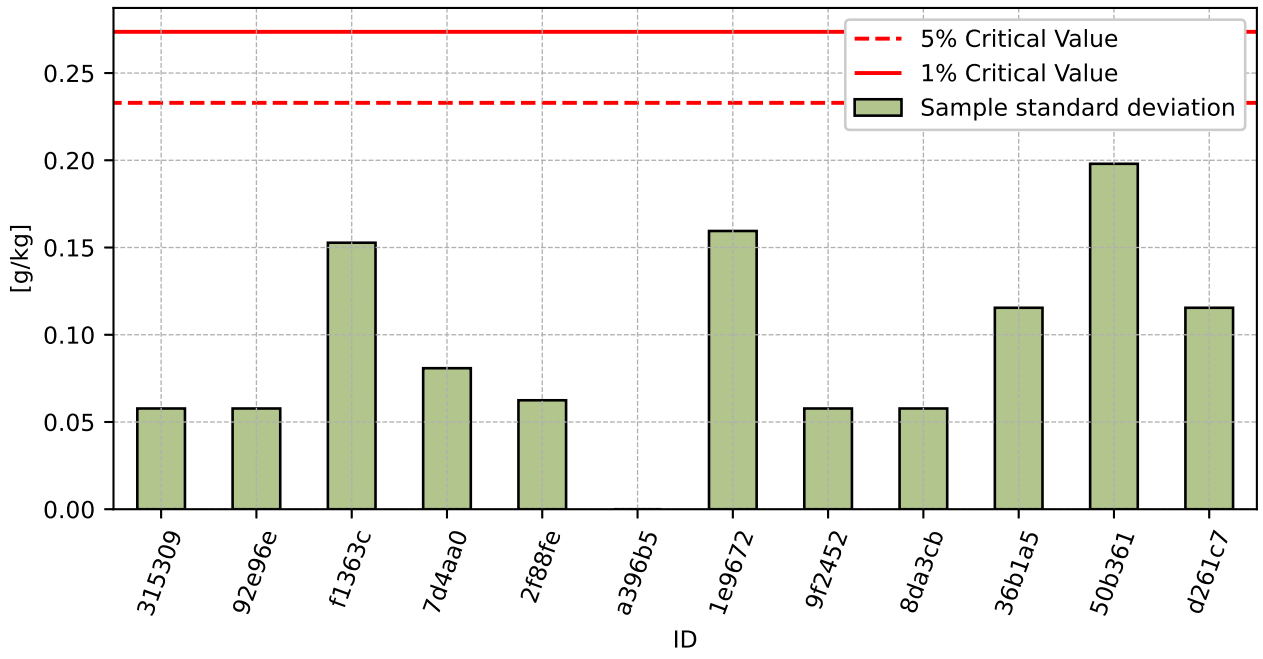

Figure 104: **Cochran's test** - sample standard deviations without outliers

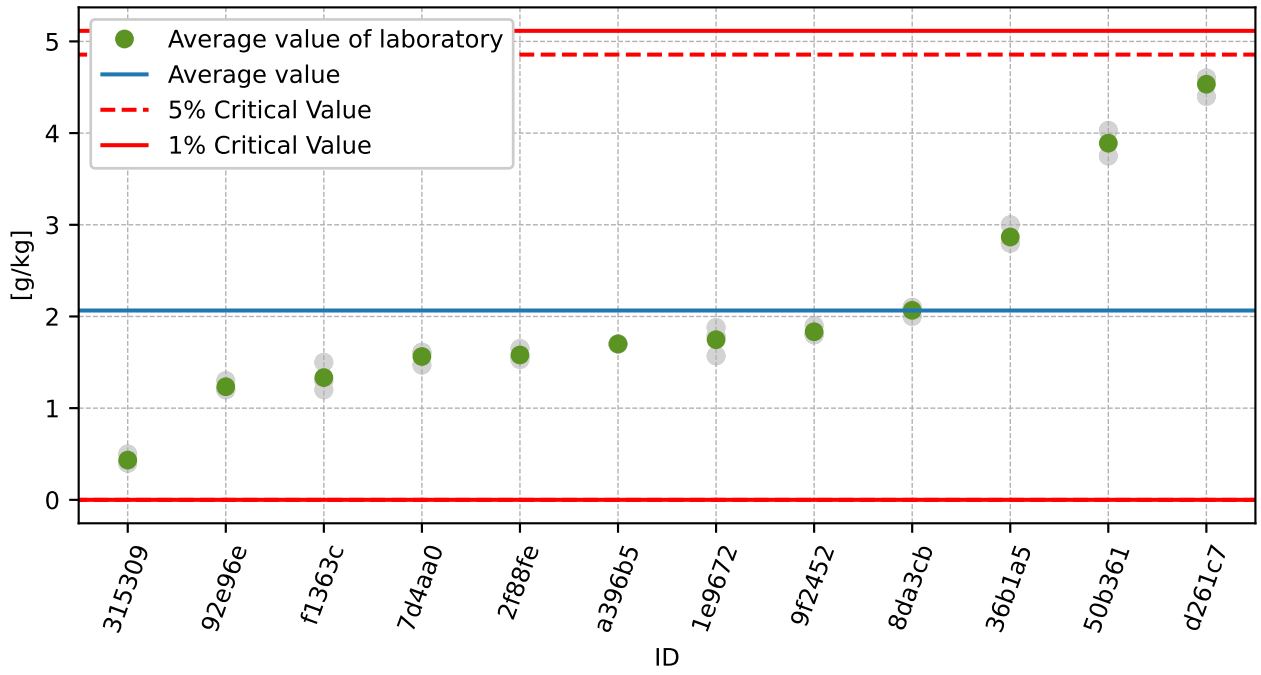

Figure 105: **Grubbs' test** - average values

5.3 Mandel's Statistics

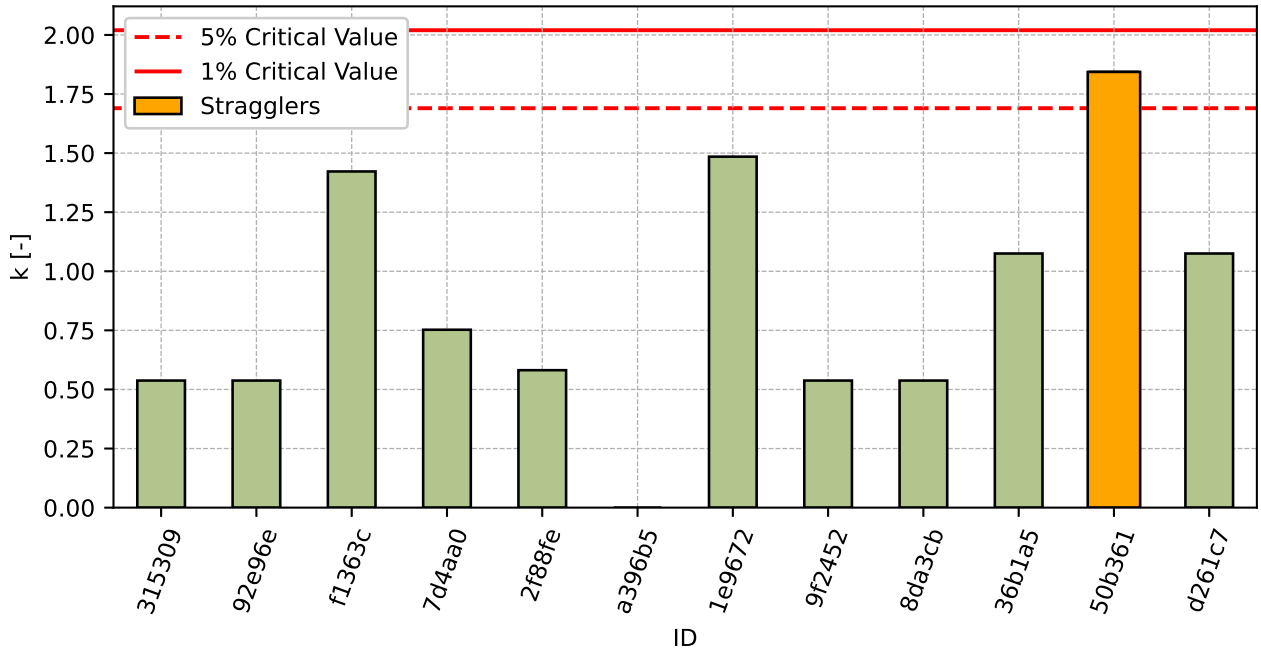

Figure 106: Intralaboratory Consistency Statistic

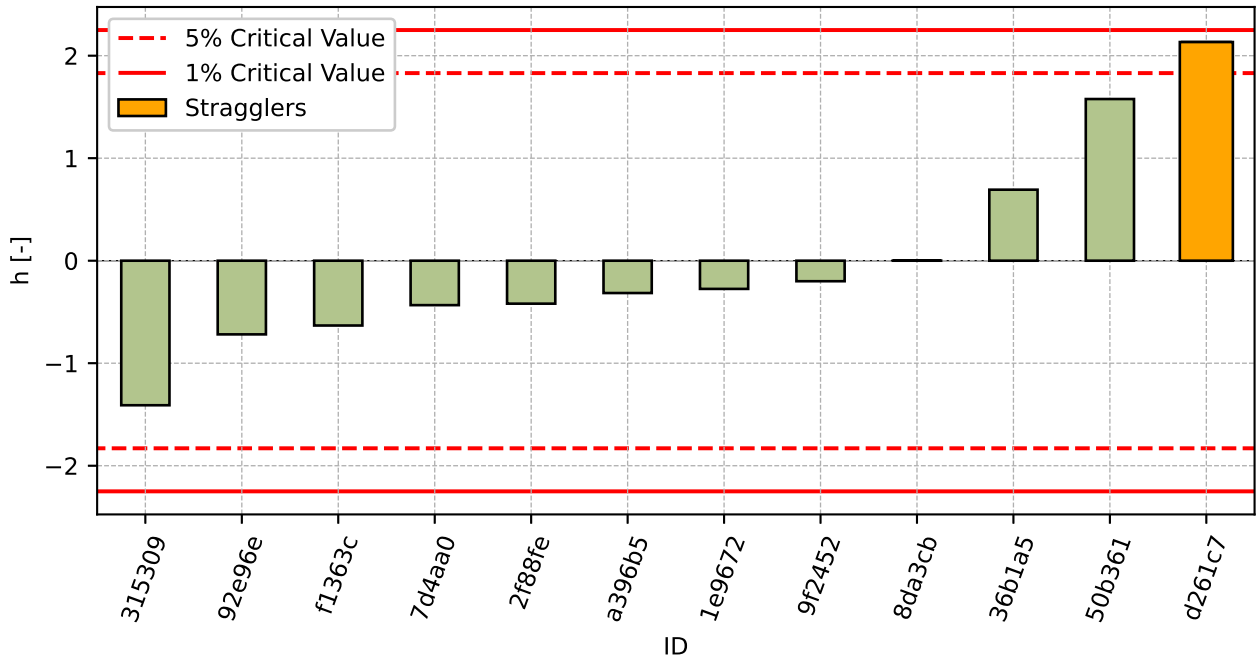

Figure 107: Interlaboratory Consistency Statistic

5.4 Descriptive statistics

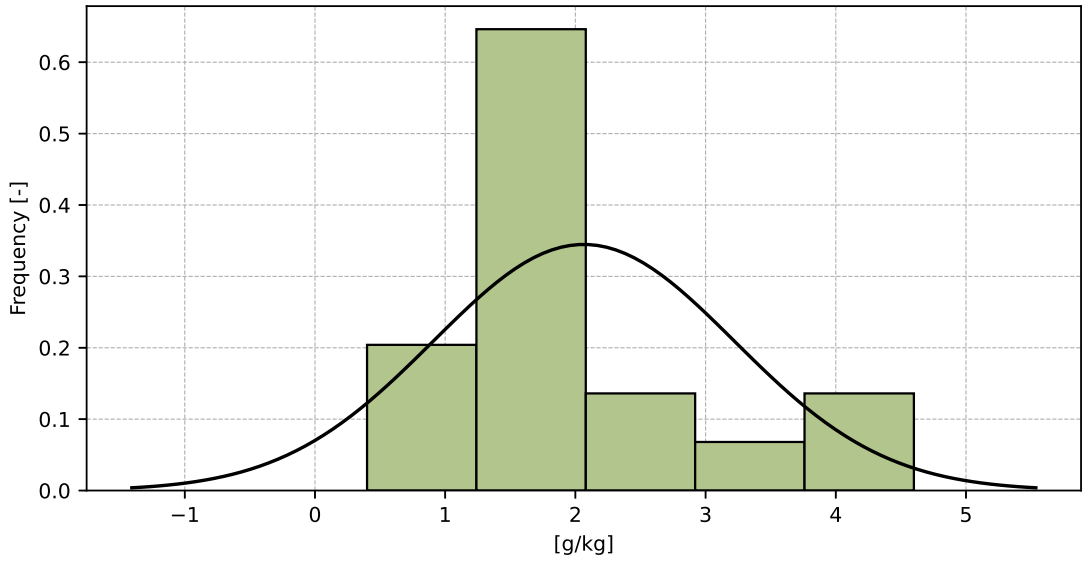

Figure 108: Histogram of all test results

Table 36: Descriptive statistics

Characteristics	[g/kg]
Average value – $\bar{x}$	2.1
Sample standard deviation – s	1.16
Asigned value – x^*	2.0
Robust standard deviation – s^*	1.02
Measurement uncertainty of asigned value – u_X	0.37
p-value of normality test	1.0 [-]
Interlaboratory standard deviation – s_L	1.16
Repeatability standard deviation – s_r	0.11
Reproducibility standard deviation – s_R	1.16
Repeatability – r	0.3
Reproducibility – R	3.2

5.5 Evaluation of Performance Statistics

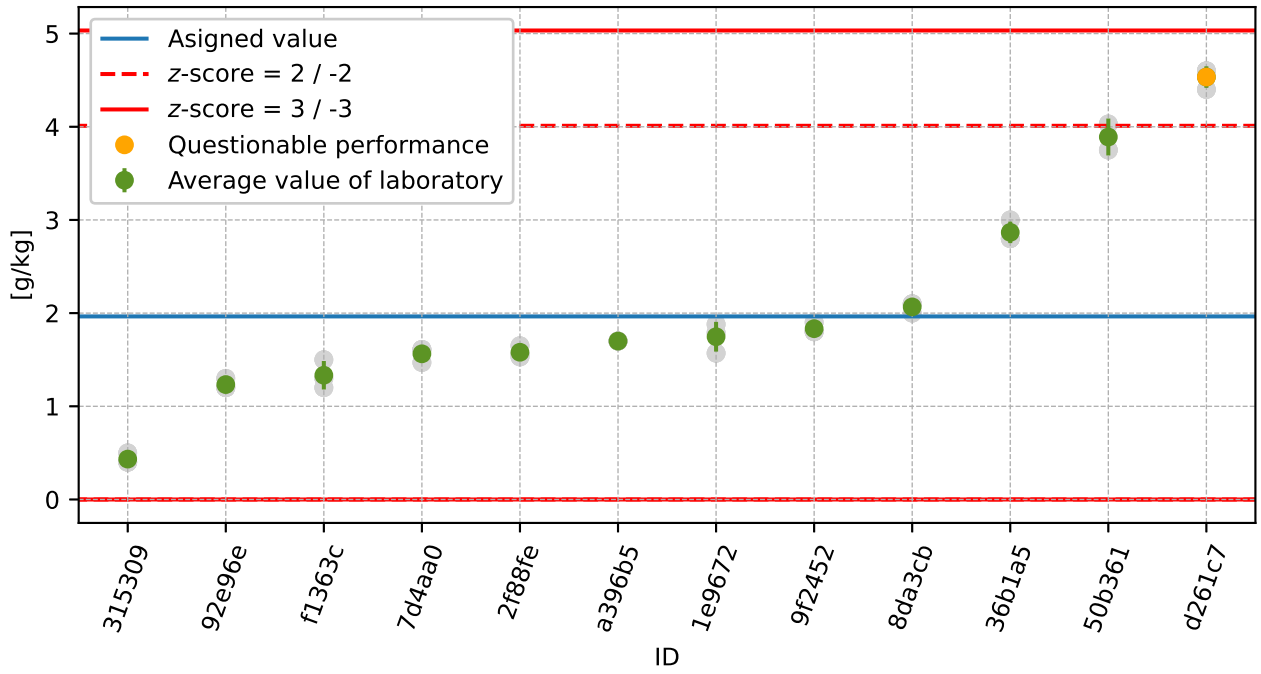

Figure 109: Average values and sample standard deviations

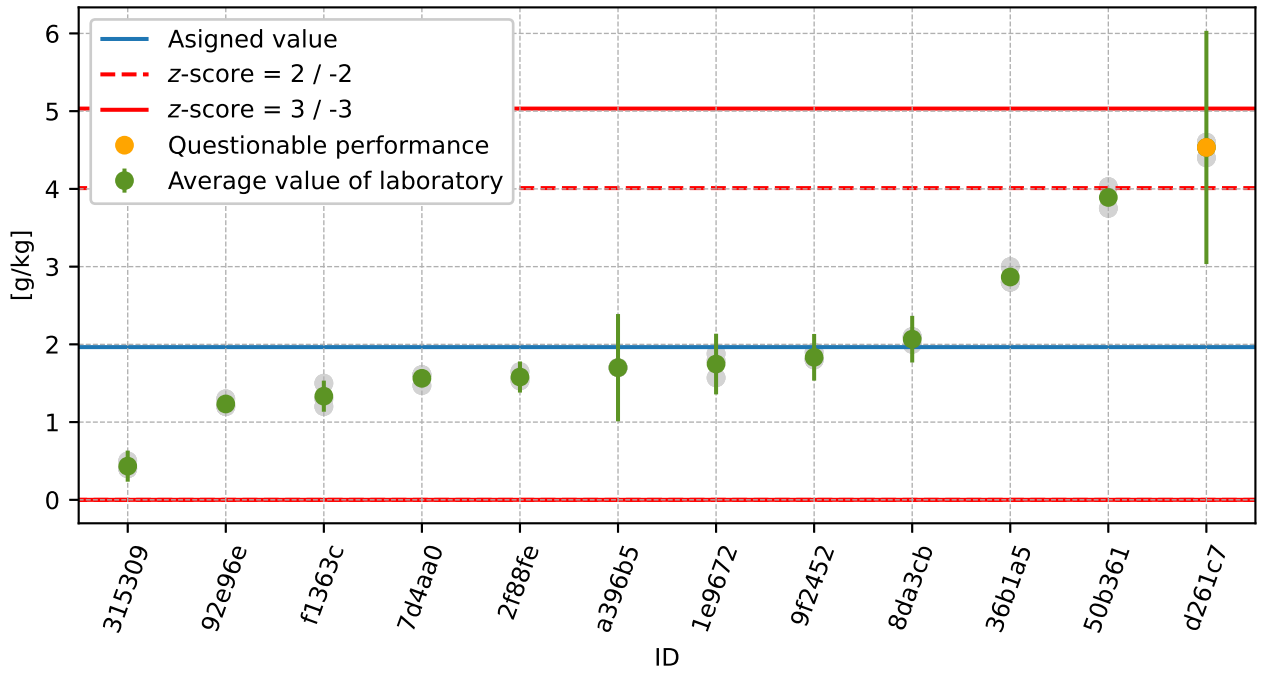

Figure 110: Average values and extended uncertainties of measurement

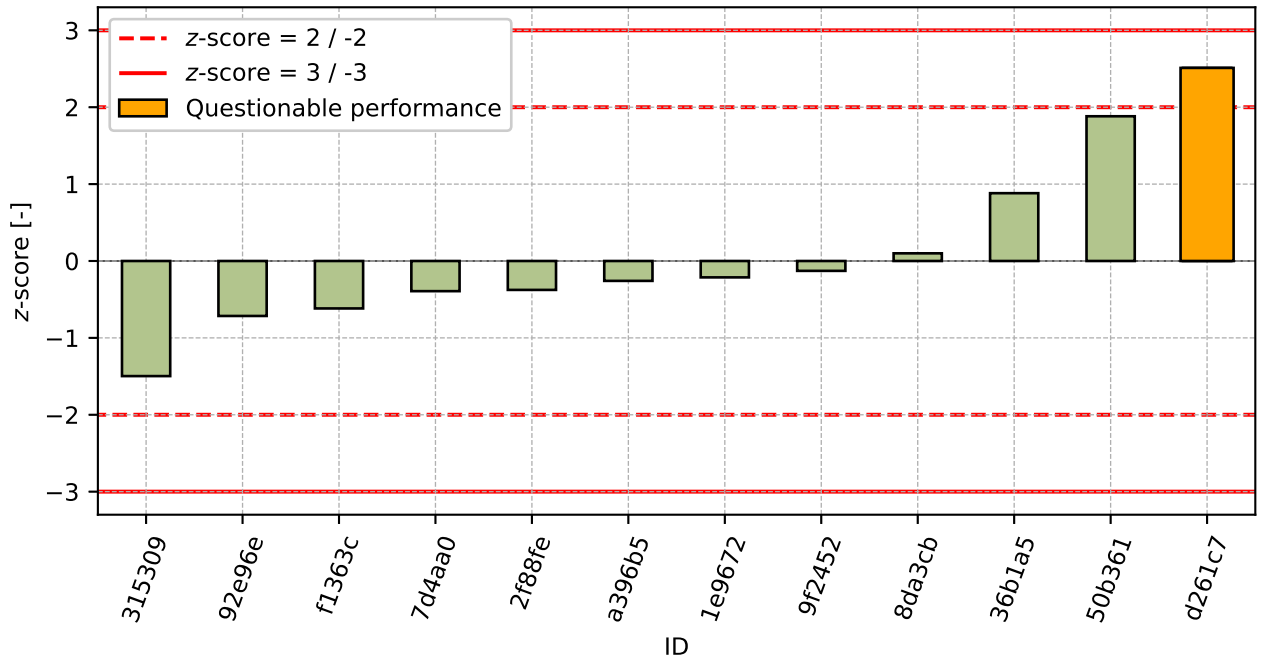

Figure 111: z-score

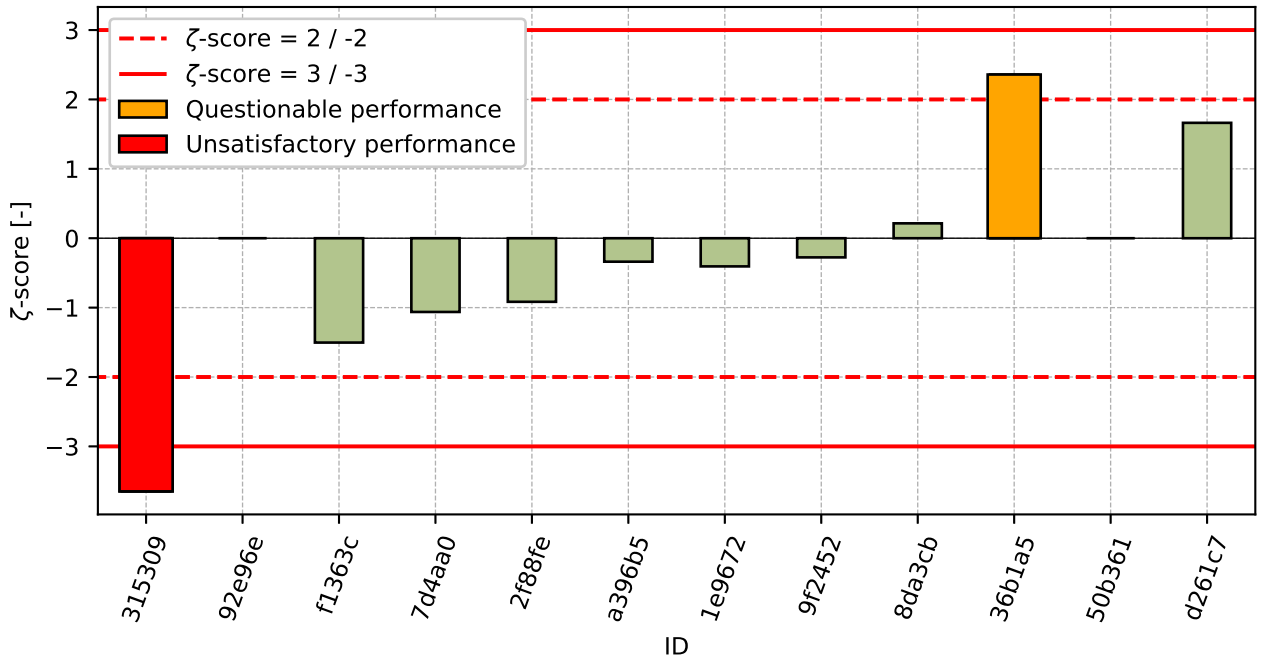

Figure 112: ζ-score

Table 37: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
315309	-1.5	-3.65
92e96e	-0.71	-
f1363c	-0.62	-1.5
7d4aa0	-0.39	-1.06
2f88fe	-0.38	-0.92
a396b5	-0.26	-0.34
1e9672	-0.21	-0.41
9f2452	-0.13	-0.28
8da3cb	0.1	0.21
36b1a5	0.88	2.36
50b361	1.88	-
d261c7	2.51	1.66

6 Appendix – EN 933-10 Assessment of fines - Grading of filler aggregates (air jet sieving)

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

7 Appendix – EN 1097-1 Determination of the resistance to wear (micro-Deval)

7.1 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 [-]	u_X [-]
72ec44	14.0	0.5
c5a3f5	14.5	0.5
f1363c	15.0	0.5
aa146e	15.0	0.1
69b2b6	15.0	-
4df247	16.4	-
315309	17.6	2.0
1e9672	17.9	2.0

7.2 The Numerical Procedure for Determining Outliers

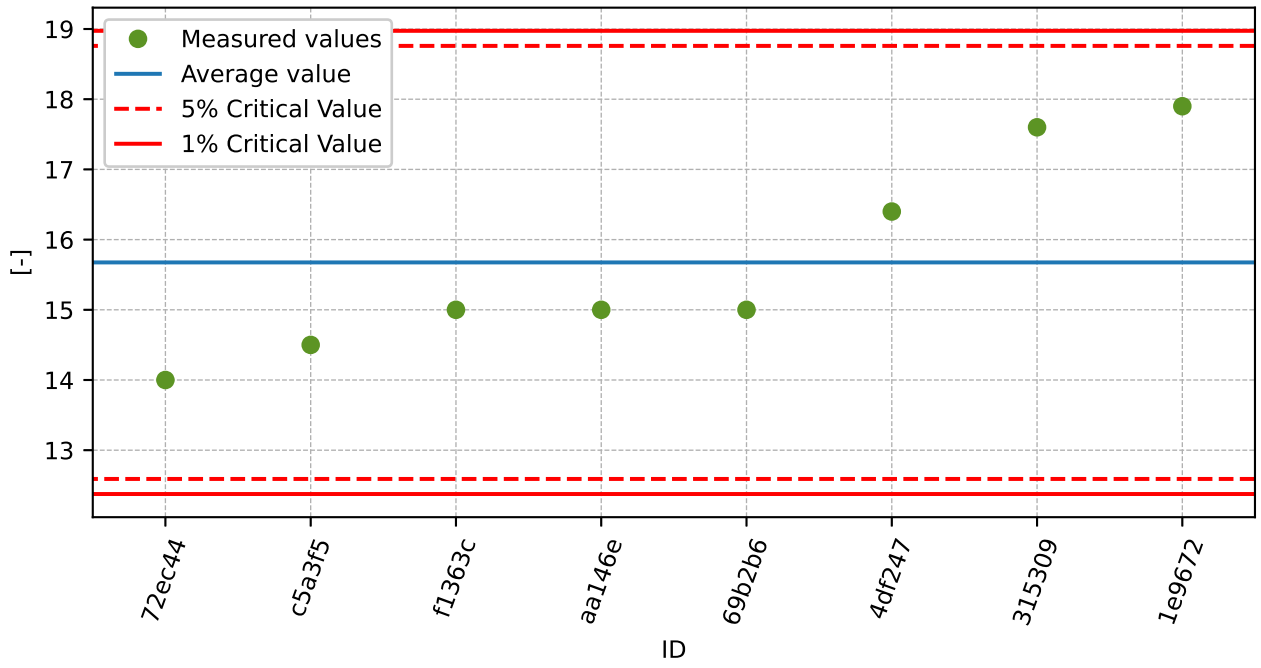

Figure 113: **Grubbs' test** - average values

7.3 Mandel's Statistics

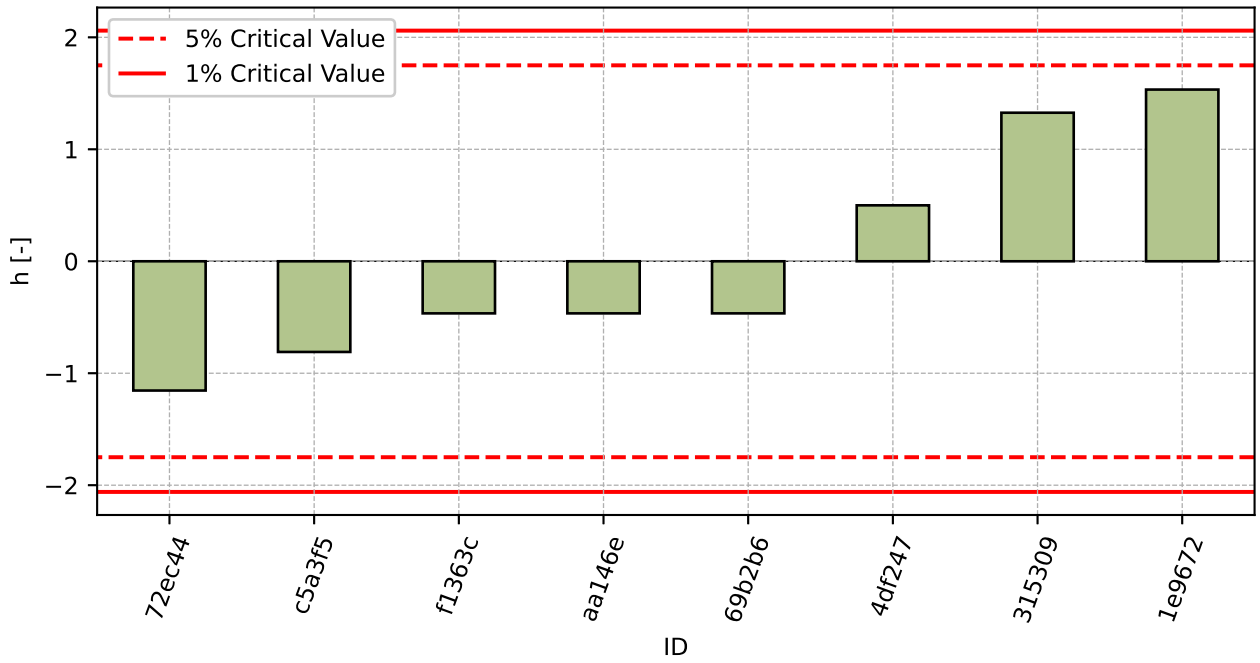

Figure 114: Interlaboratory Consistency Statistic

7.4 Descriptive statistics

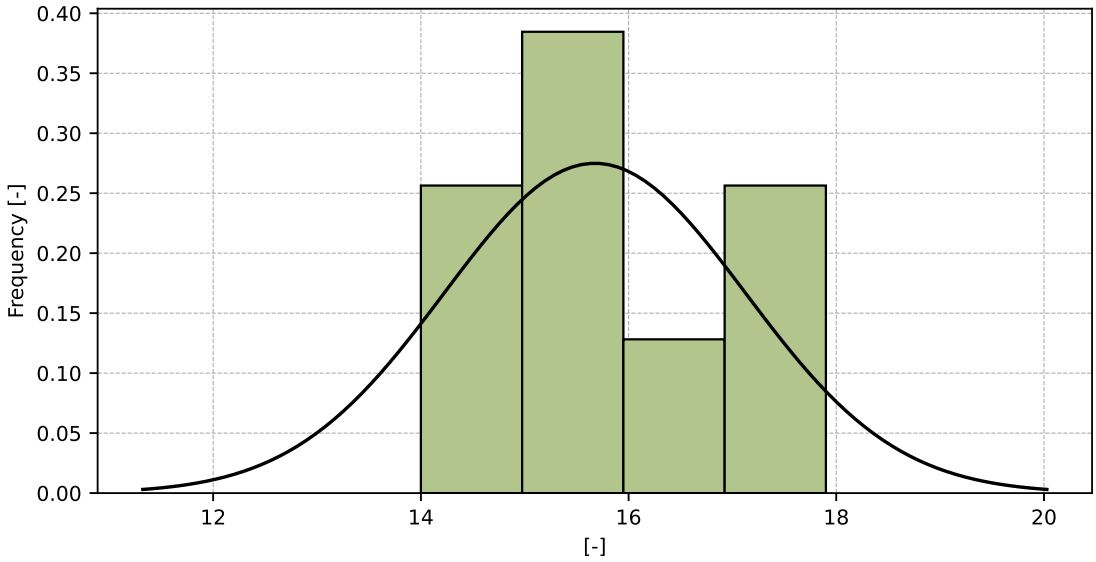

Figure 115: Histogram of all test results

Table 39: Descriptive statistics

Characteristics	[-]
Average value – $\bar{x}$	15.7
Sample standard deviation – s	1.45
Asigned value – x^*	15.6
Robust standard deviation – s^*	1.38
Measurement uncertainty of asigned value – u_X	0.61
p-value of normality test	0.159 [-]

7.5 Evaluation of Performance Statistics

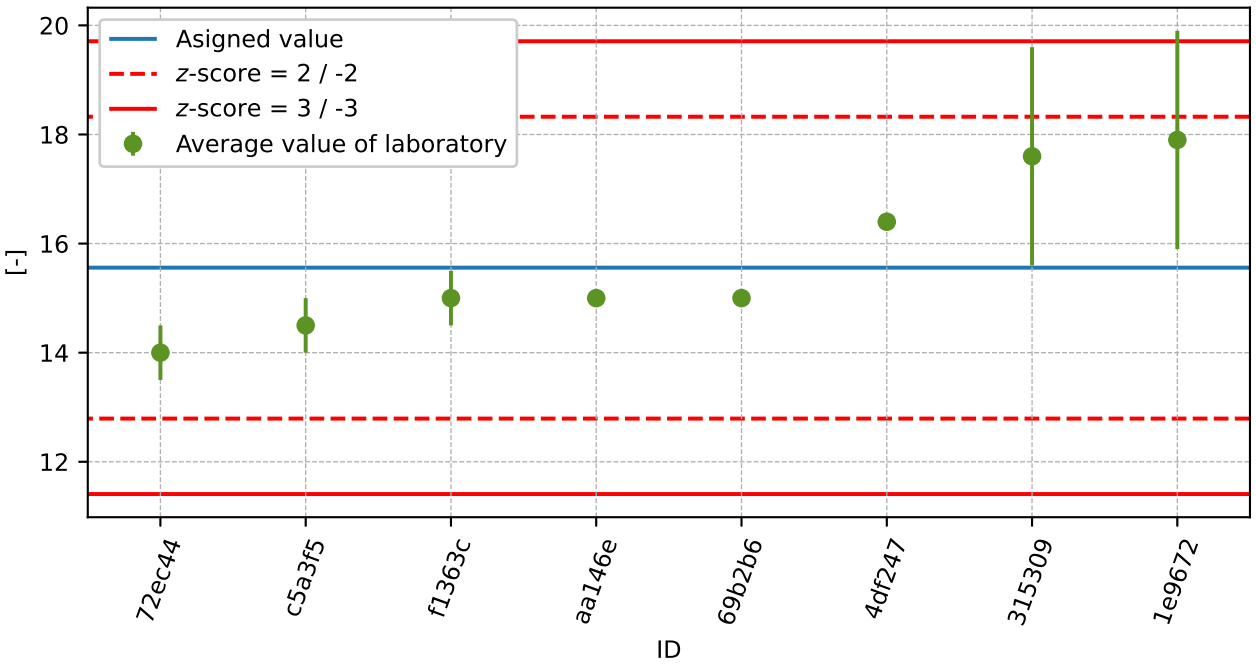

Figure 116: Average values and extended uncertainties of measurement

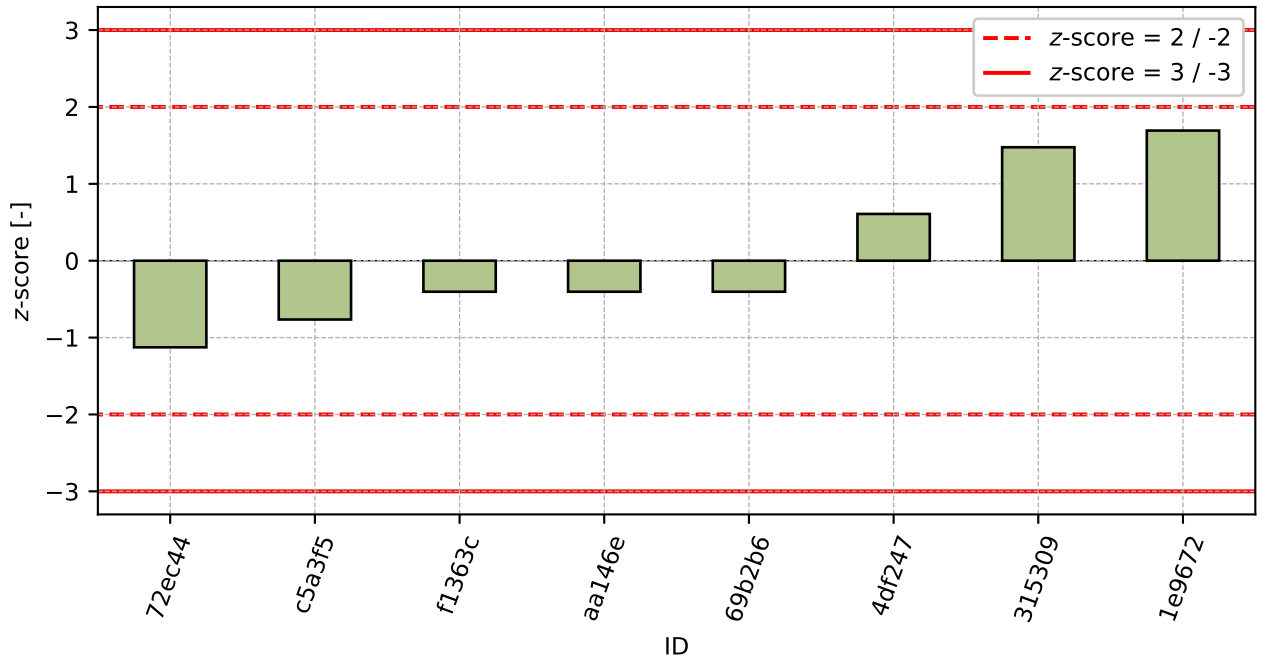

Figure 117: z-score

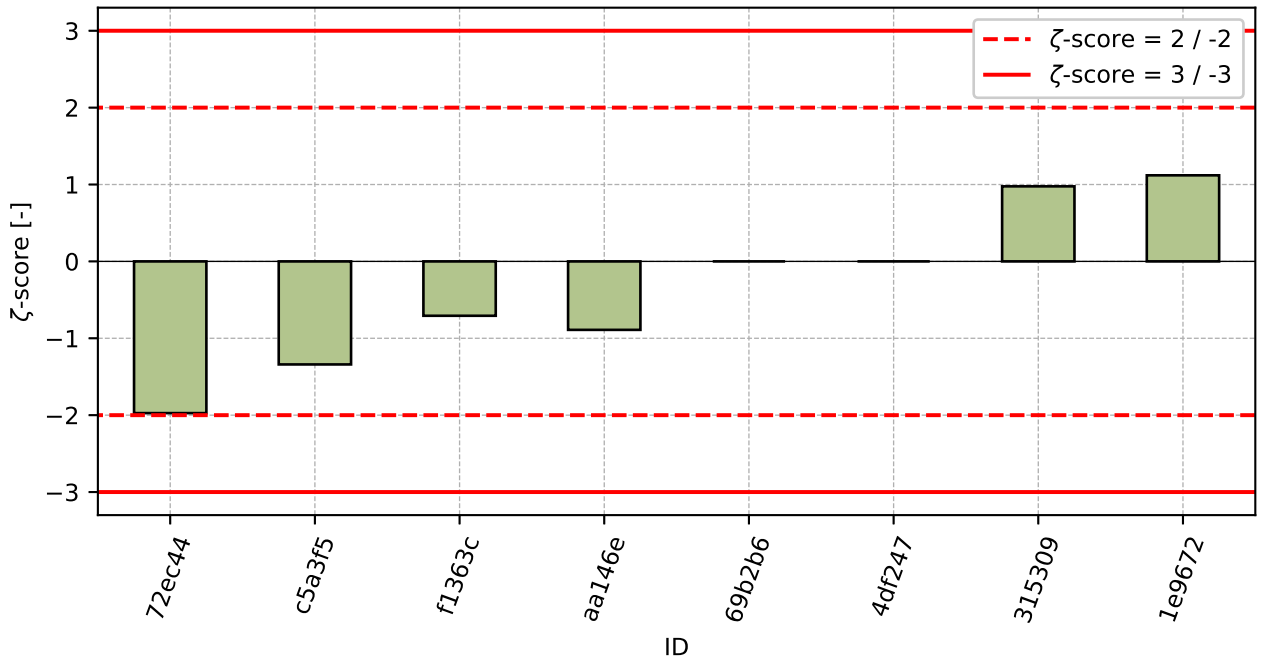

Figure 118: ζ-score

Table 40: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
72ec44	-1.13	-1.97
c5a3f5	-0.77	-1.34
f1363c	-0.4	-0.71
aa146e	-0.4	-0.89
69b2b6	-0.4	-
4df247	0.61	-
315309	1.48	0.98
1e9672	1.69	1.12

8 Appendix – EN 1097-2 Methods for the determination of resistance to fragmentation - chapter 5

8.1 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 [-]	u_X [-]
978d47	21	-
f1363c	21	1
c5a3f5	22	1
e543af	22	-
140849	22	-
92e96e	22	-
315309	22	2
fa8544	22	0
5bcbfa	23	-
72ec44	23	2
7d4aa0	23	0
bded50	23	1
92e563	23	1
3ca242	24	-
7d21b5	24	1
17f205	24	1
b0afd4	25	-
fea11c	25	0
aa146e	25	0
a51011	25	0
d261c7	26	3
4df247	26	-
1e9672	29	-
55547e	54	0

8.2 The Numerical Procedure for Determining Outliers

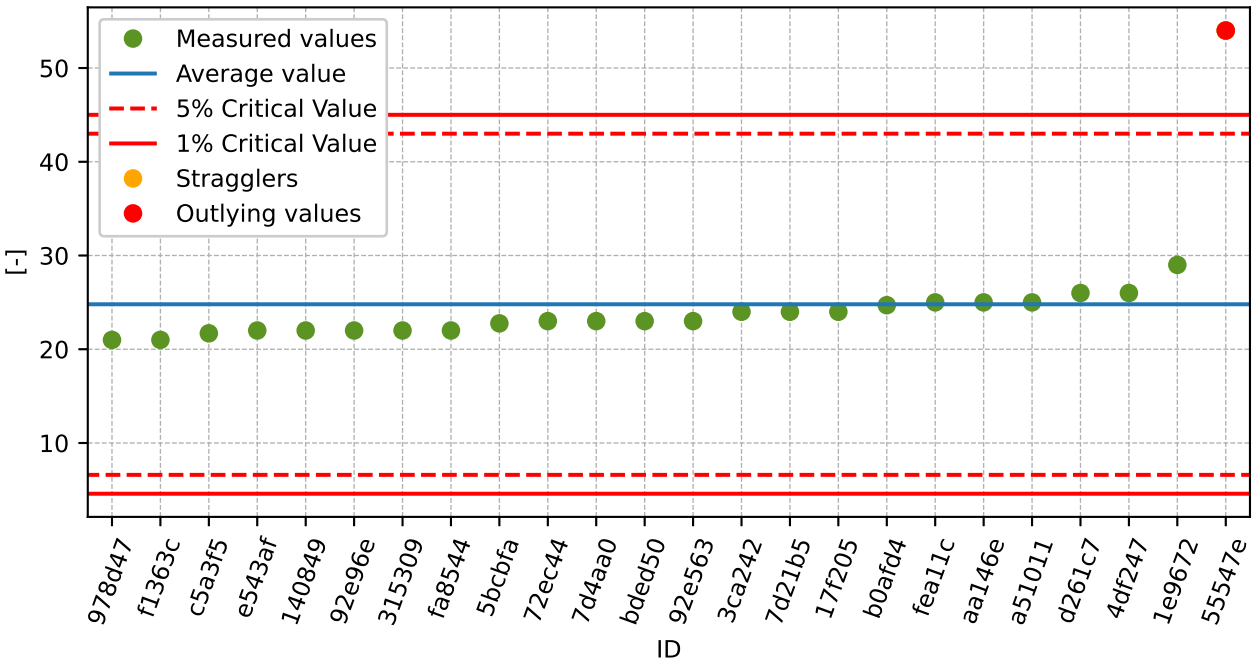

Figure 119: **Grubbs' test** - average values

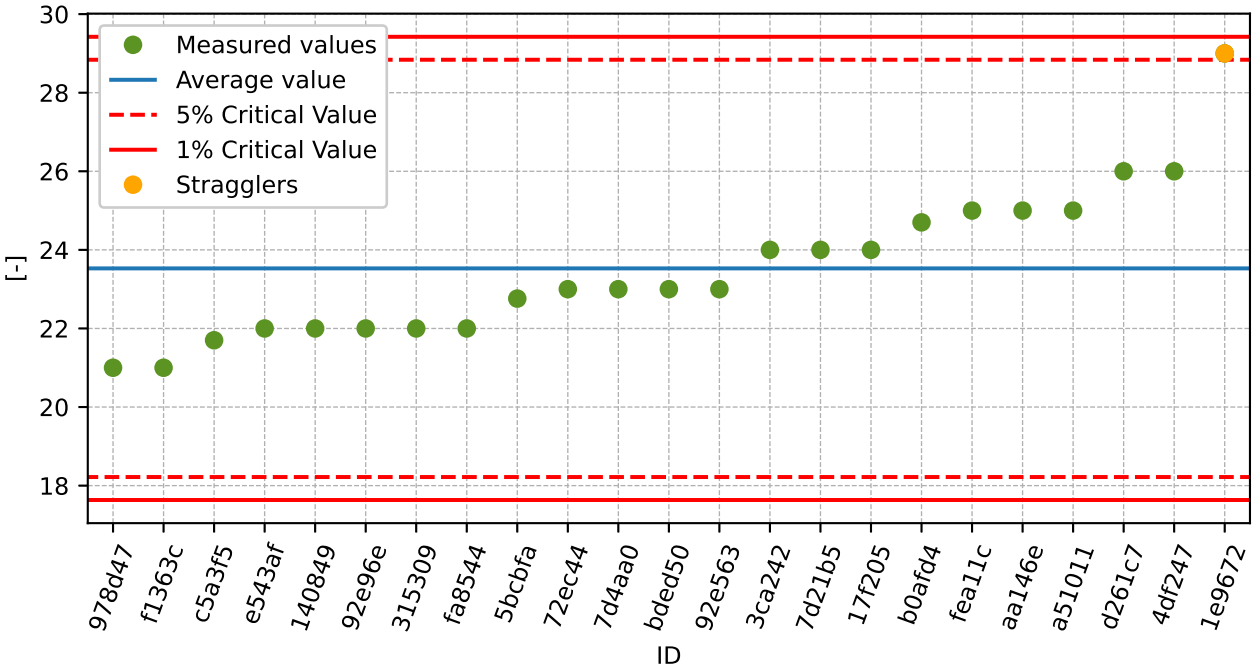

Figure 120: **Grubbs' test** - average values without outliers

8.3 Mandel's Statistics

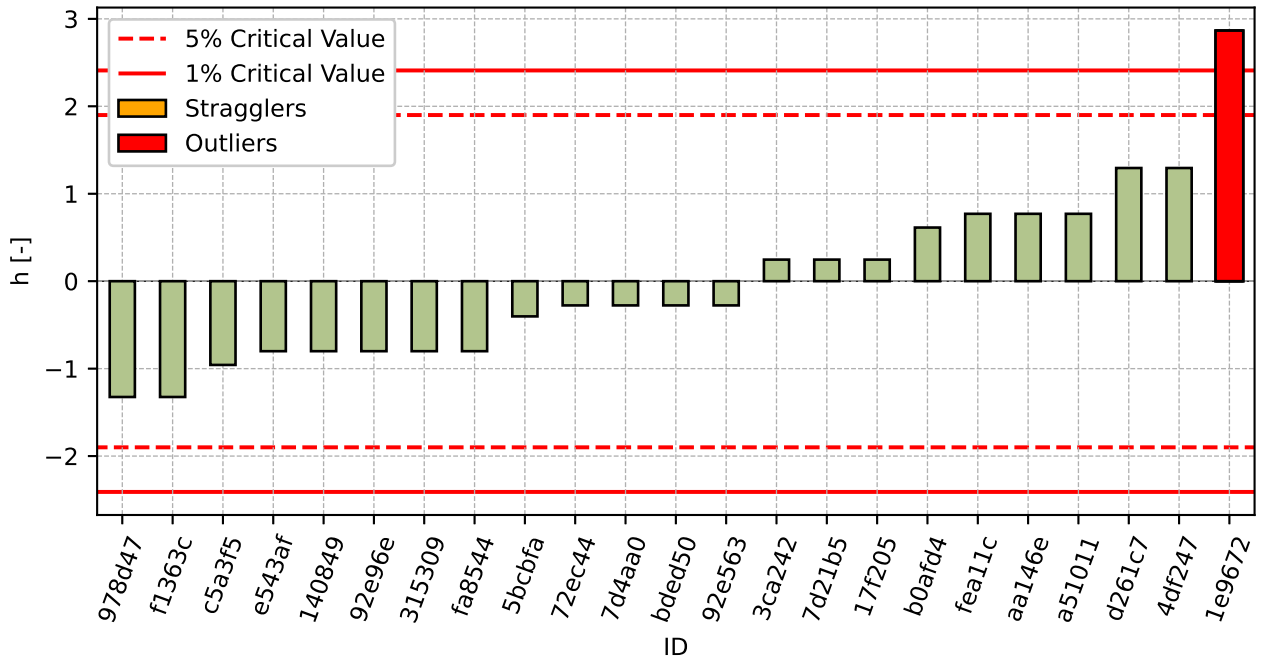

Figure 121: Interlaboratory Consistency Statistic

8.4 Descriptive statistics

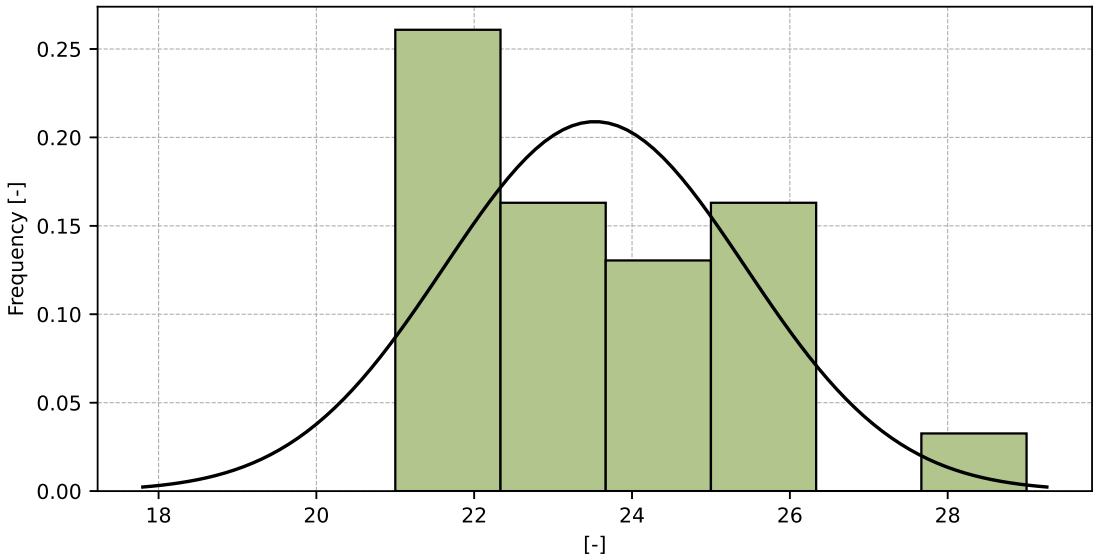

Figure 122: Histogram of all test results

Table 42: Descriptive statistics

Characteristics	[-]
Average value – $\bar{x}$	24
Sample standard deviation – s	1.9
Asigned value – x^*	23
Robust standard deviation – s^*	2.0
Measurement uncertainty of asigned value – u_X	0.5
p-value of normality test	0.05 [-]

8.5 Evaluation of Performance Statistics

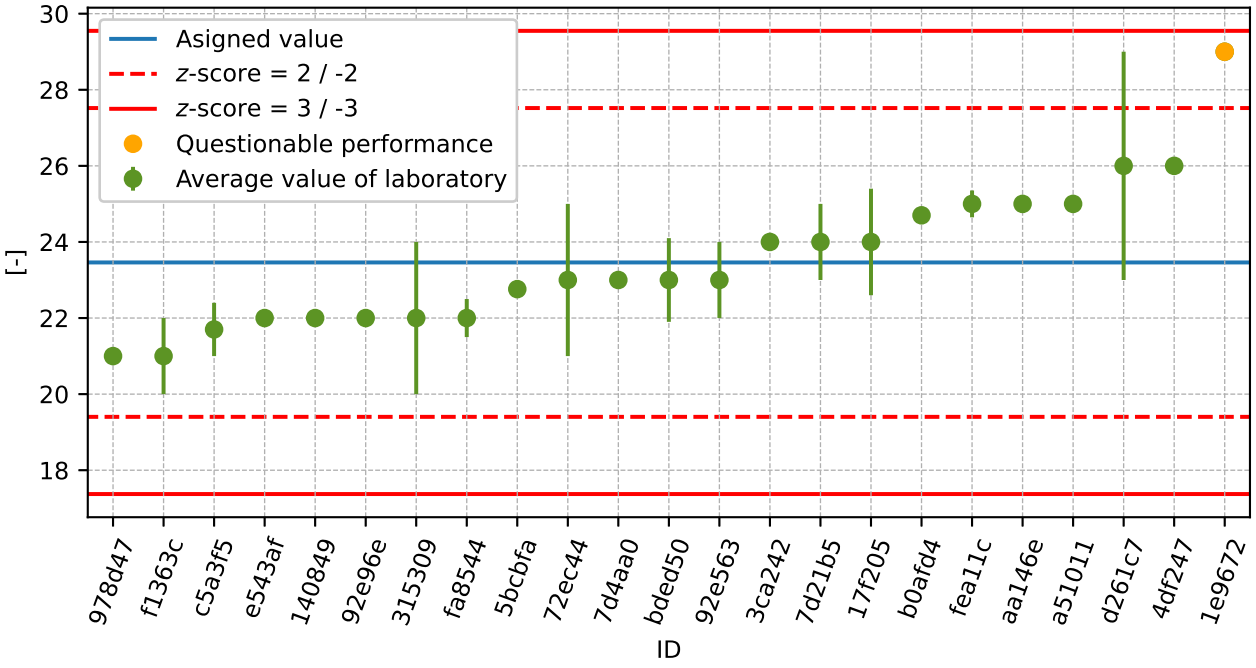

Figure 123: Average values and extended uncertainties of measurement

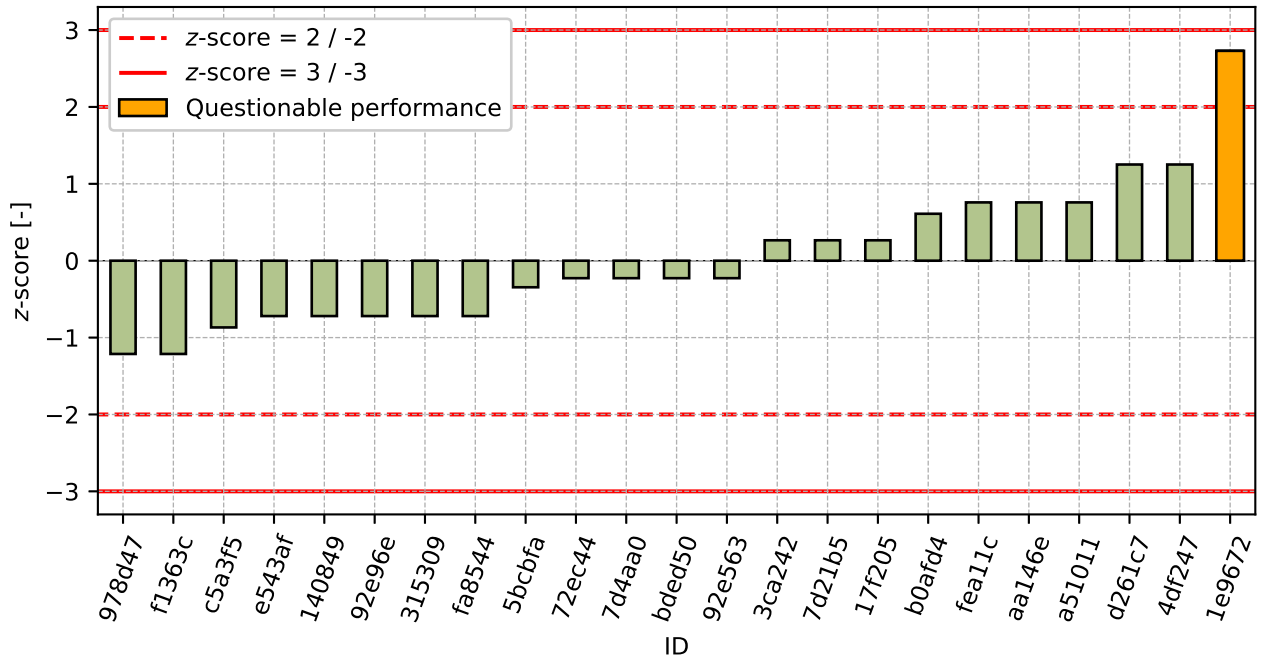

Figure 124: z-score

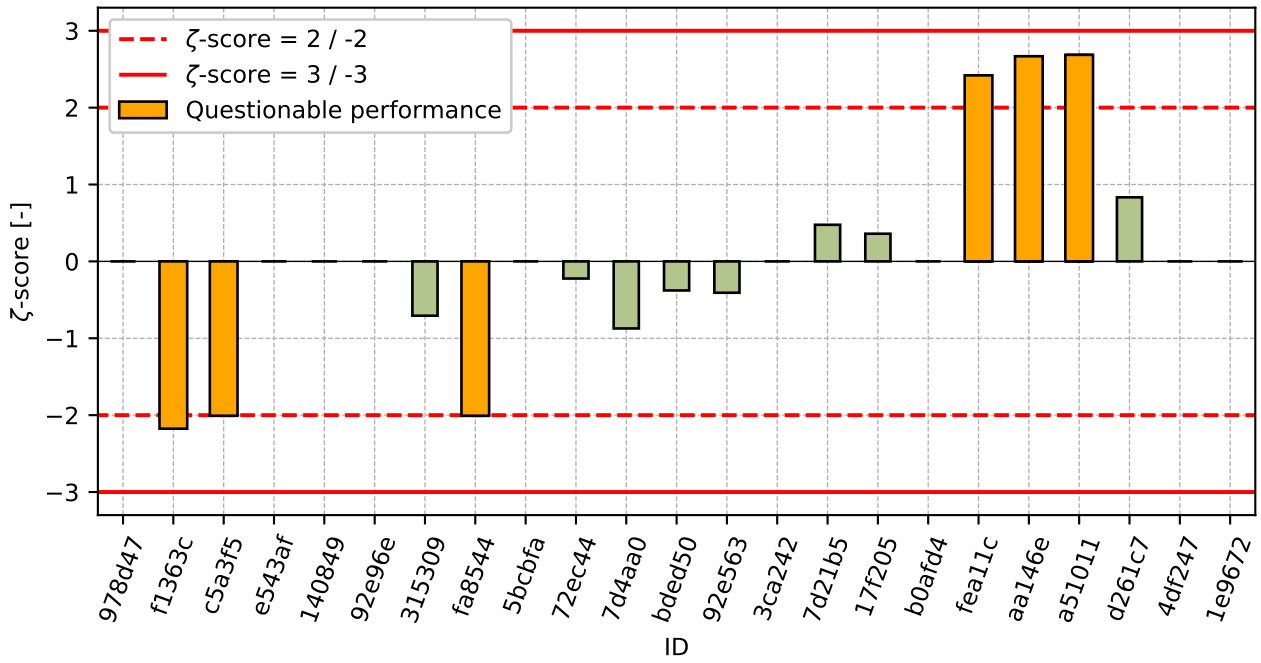

Figure 125: ζ-score

Table 43: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
978d47	-1.21	-
f1363c	-1.21	-2.18
c5a3f5	-0.87	-2.01
e543af	-0.72	-
140849	-0.72	-
92e96e	-0.72	-
315309	-0.72	-0.71
fa8544	-0.72	-2.01
5bcbfa	-0.35	-
72ec44	-0.23	-0.22
7d4aa0	-0.23	-0.87
bded50	-0.23	-0.38
92e563	-0.23	-0.41
3ca242	0.27	-
7d21b5	0.27	0.48
17f205	0.27	0.36
b0afd4	0.61	-
fea11c	0.76	2.42
aa146e	0.76	2.67
a51011	0.76	2.69
d261c7	1.25	0.83
4df247	1.25	-
1e9672	2.73	-

9 Appendix – EN 1097-2 Methods for the determination of resistance to fragmentation - chapter 6

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

10 Appendix – EN 1097-3 Determination of loose bulk density and voids

10.1 Loose bulk density

10.1.1 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 [Mg/m^3]			u_X [Mg/m^3]	$\bar{x}$ [Mg/m^3]	s_0 [Mg/m^3]	V_X [%]
aa146e	1.41	1.41	1.41	0.01	1.41	0.0	0.0
93bf8b	1.46	1.46	1.46	-	1.46	0.001	0.08
c23bc6	1.48	1.47	1.46	0.03	1.47	0.01	0.68
72ec44	1.46	1.47	1.48	0.08	1.47	0.01	0.68
315309	1.48	1.46	1.47	0.02	1.47	0.01	0.68
52d231	1.47	1.47	1.47	-	1.47	0.002	0.1
900d05	1.47	1.48	1.48	0.19	1.48	0.006	0.39
55547e	1.48	1.49	1.49	0.01	1.49	0.006	0.39
7d4aa0	1.49	1.48	1.49	0.01	1.49	0.006	0.39
82bd3a	1.48	1.49	1.5	-	1.49	0.009	0.59
6192bc	1.53	1.54	1.52	0.02	1.53	0.01	0.63

10.1.2 The Numerical Procedure for Determining Outliers

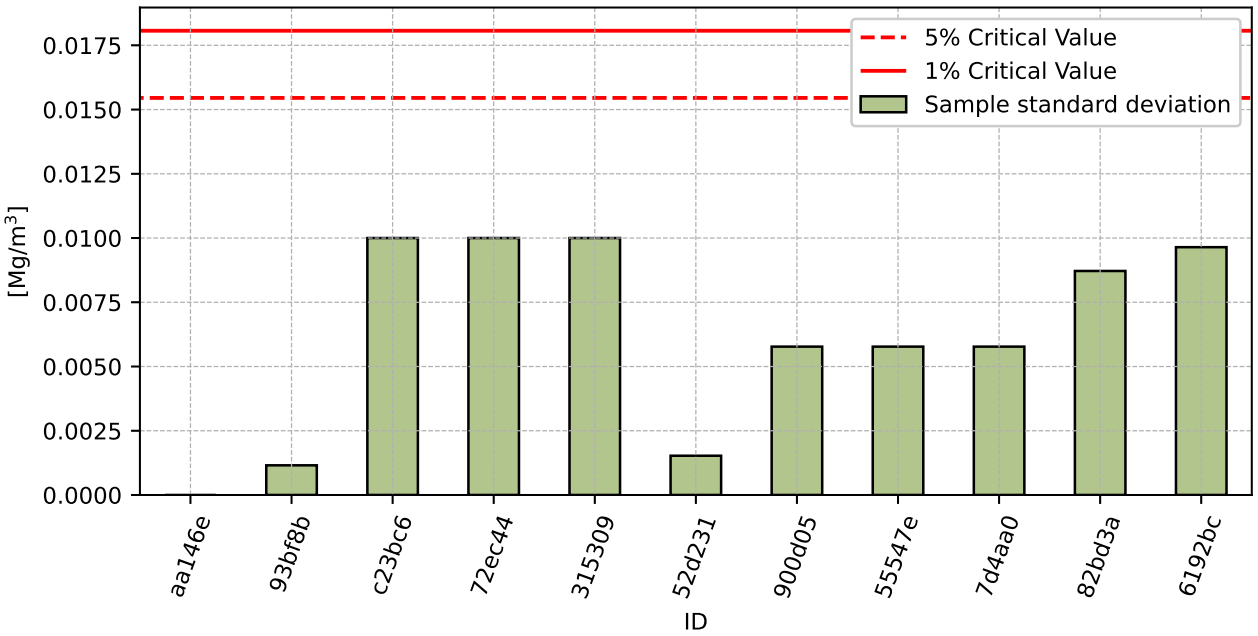

Figure 126: **Cochran's test** - sample standard deviations

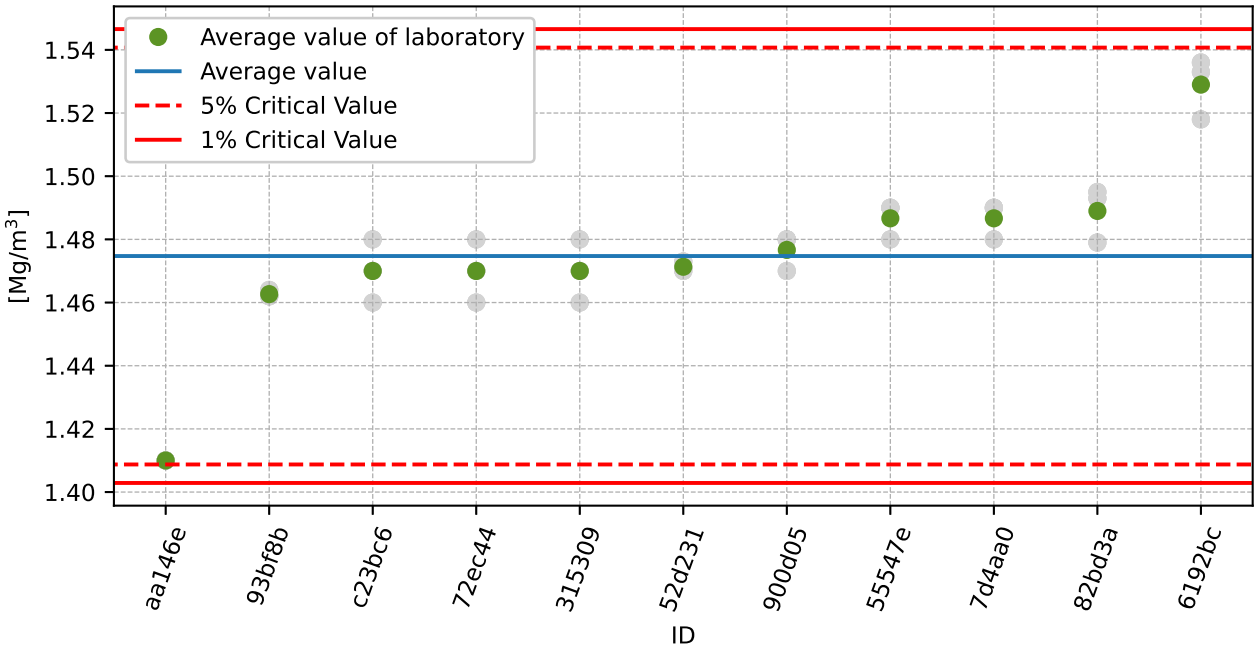

Figure 127: **Grubbs' test** - average values

10.1.3 Mandel's Statistics

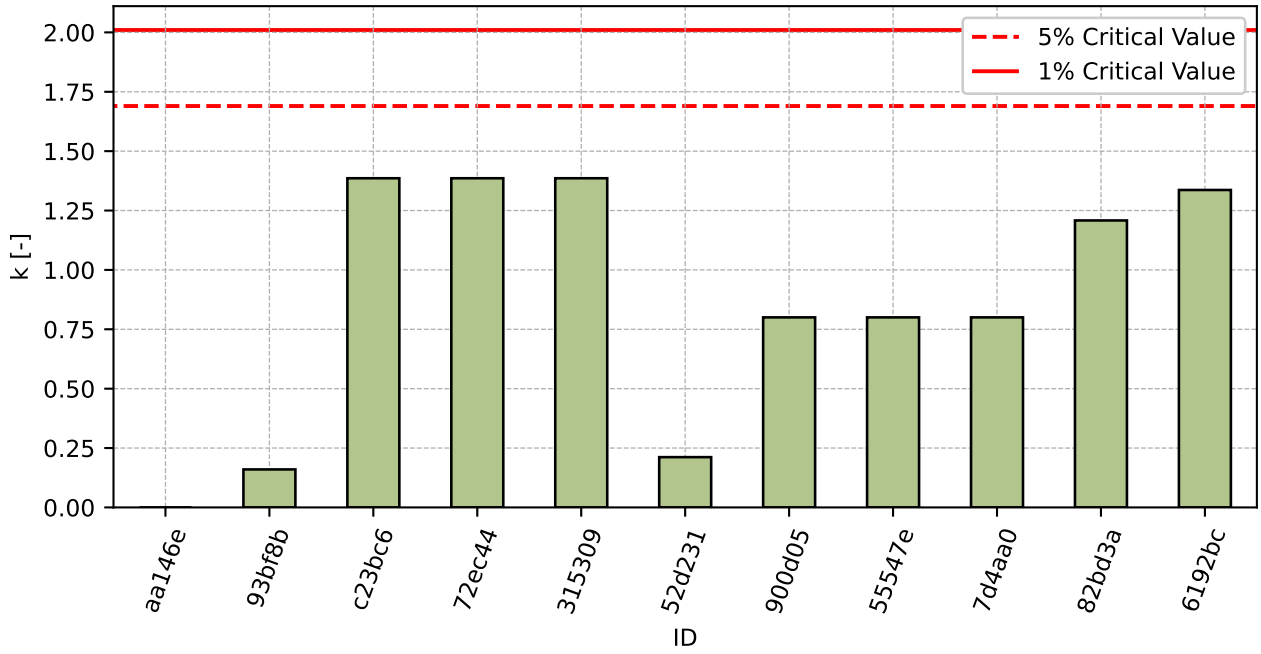

Figure 128: Intralaboratory Consistency Statistic

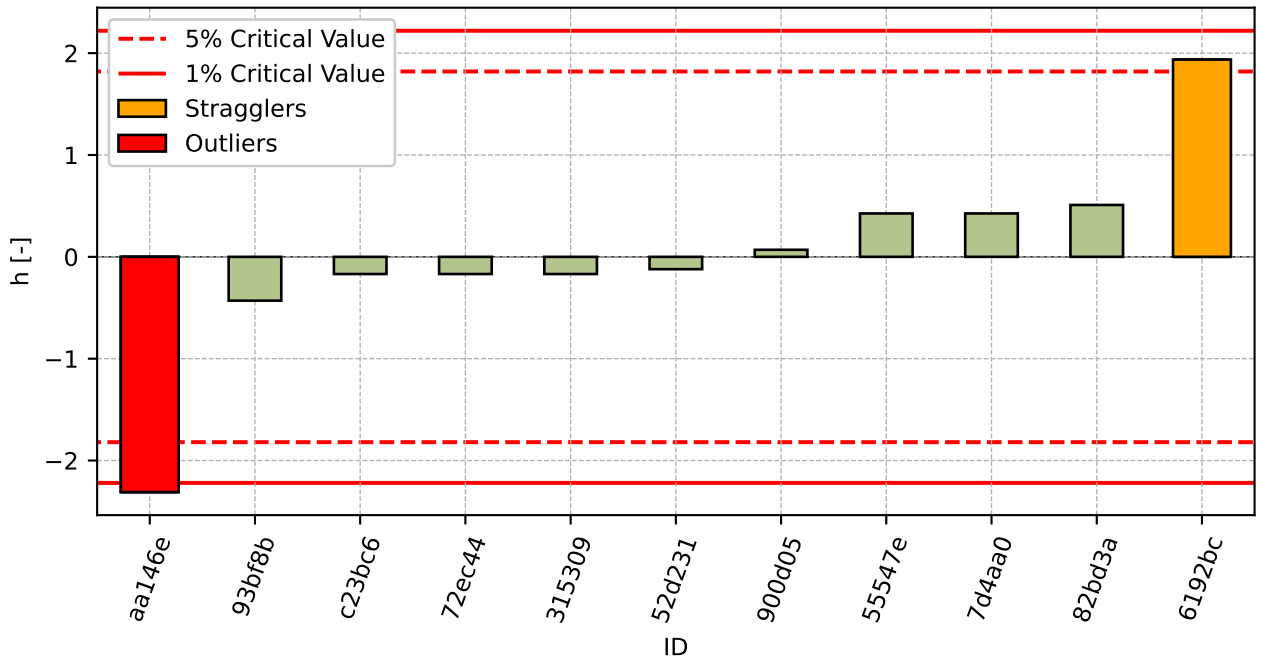

Figure 129: Interlaboratory Consistency Statistic

10.1.4 Descriptive statistics

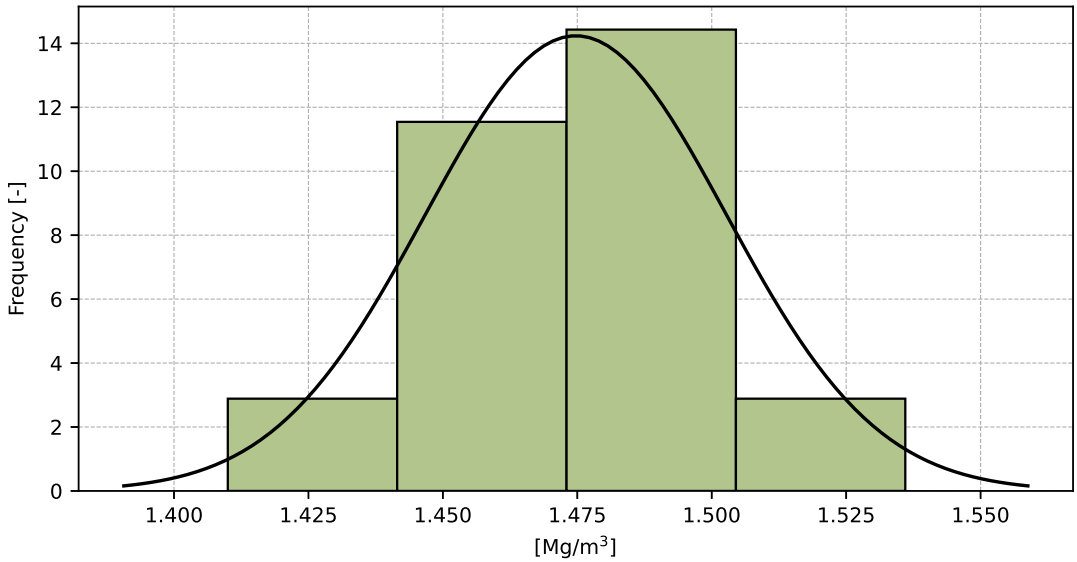

Figure 130: Histogram of all test results

Table 45: Descriptive statistics

Characteristics	**[Mg/m³]**
Average value – $\bar{x}$	1.47
Sample standard deviation – s	0.028
Asigned value – x^*	1.48
Robust standard deviation – s^*	0.022
Measurement uncertainty of asigned value – u_X	0.008
p-value of normality test	0.001 [-]
Interlaboratory standard deviation – s_L	0.028
Repeatability standard deviation – s_r	0.007
Reproducibility standard deviation – s_R	0.029
Repeatability – r	0.02
Reproducibility – R	0.08

10.1.5 Evaluation of Performance Statistics

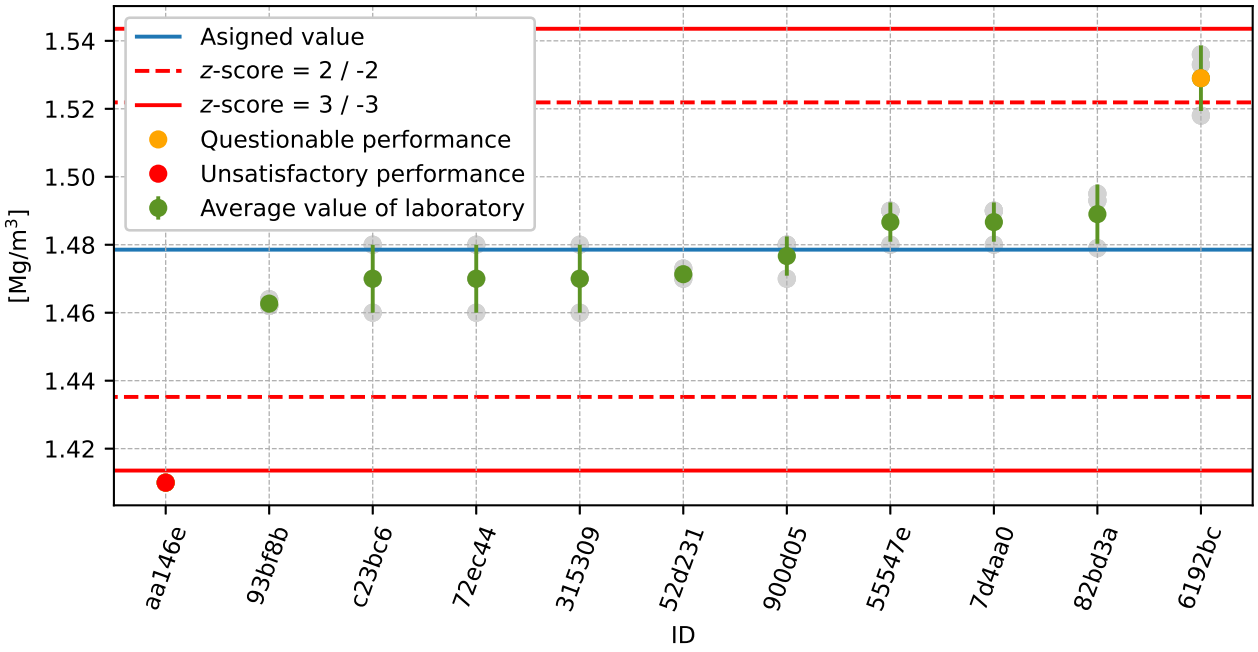

Figure 131: Average values and sample standard deviations

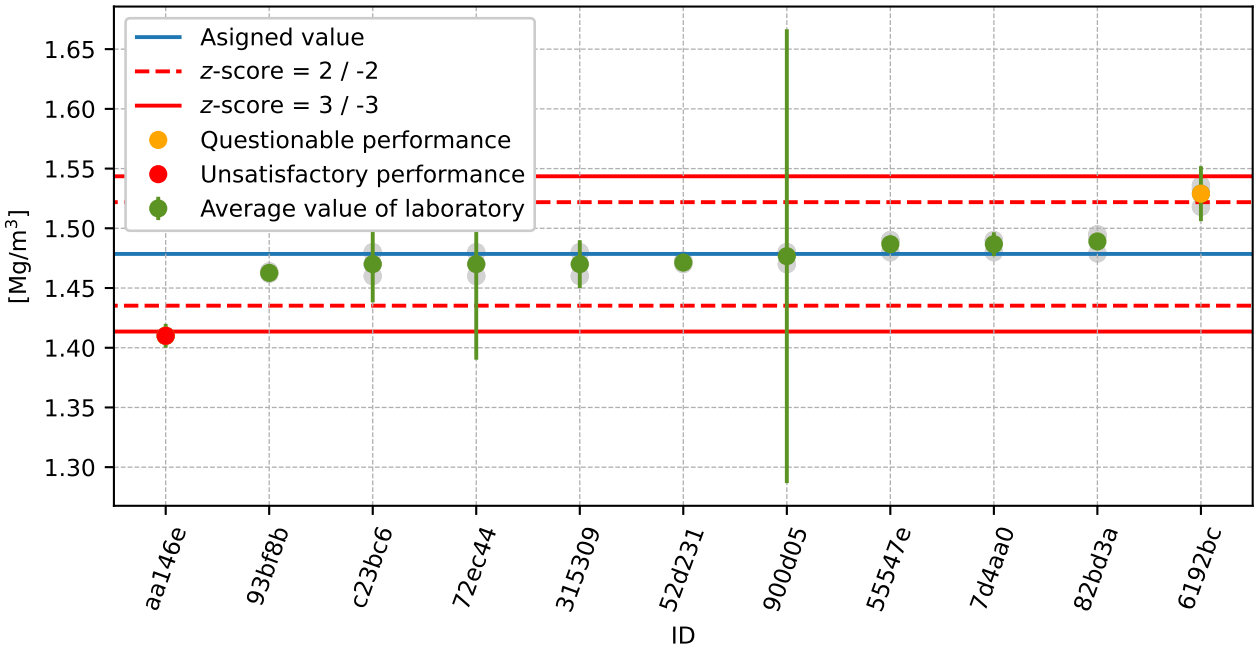

Figure 132: Average values and extended uncertainties of measurement

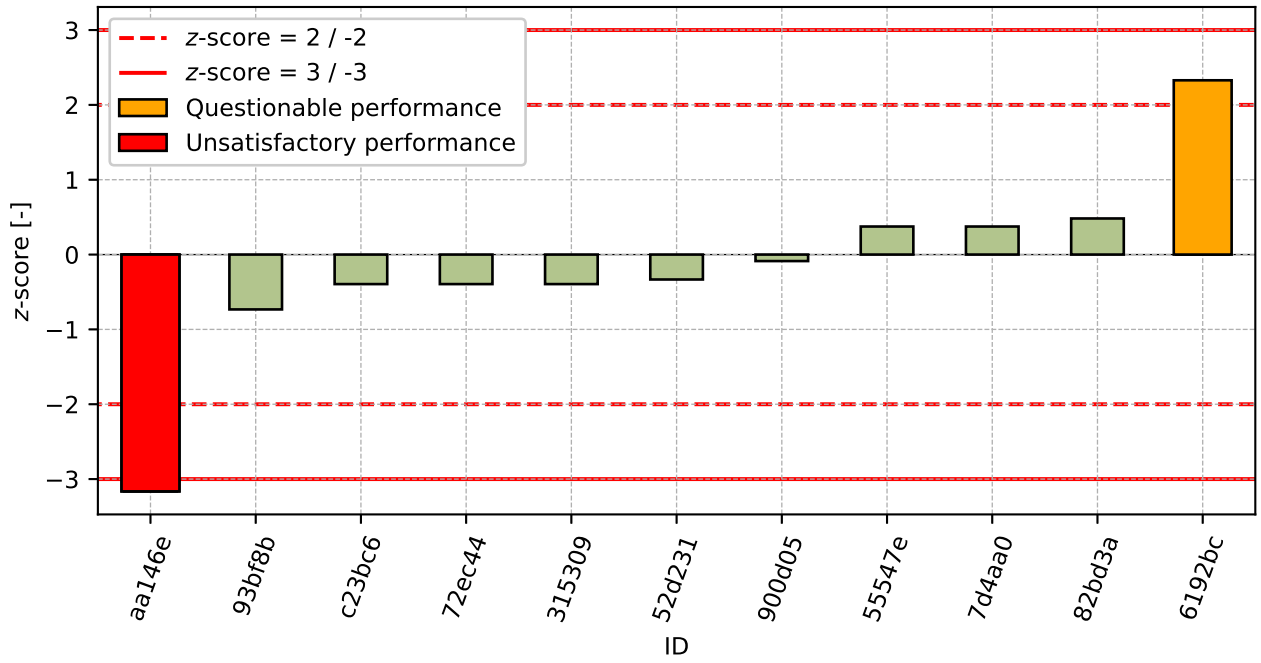

Figure 133: z-score

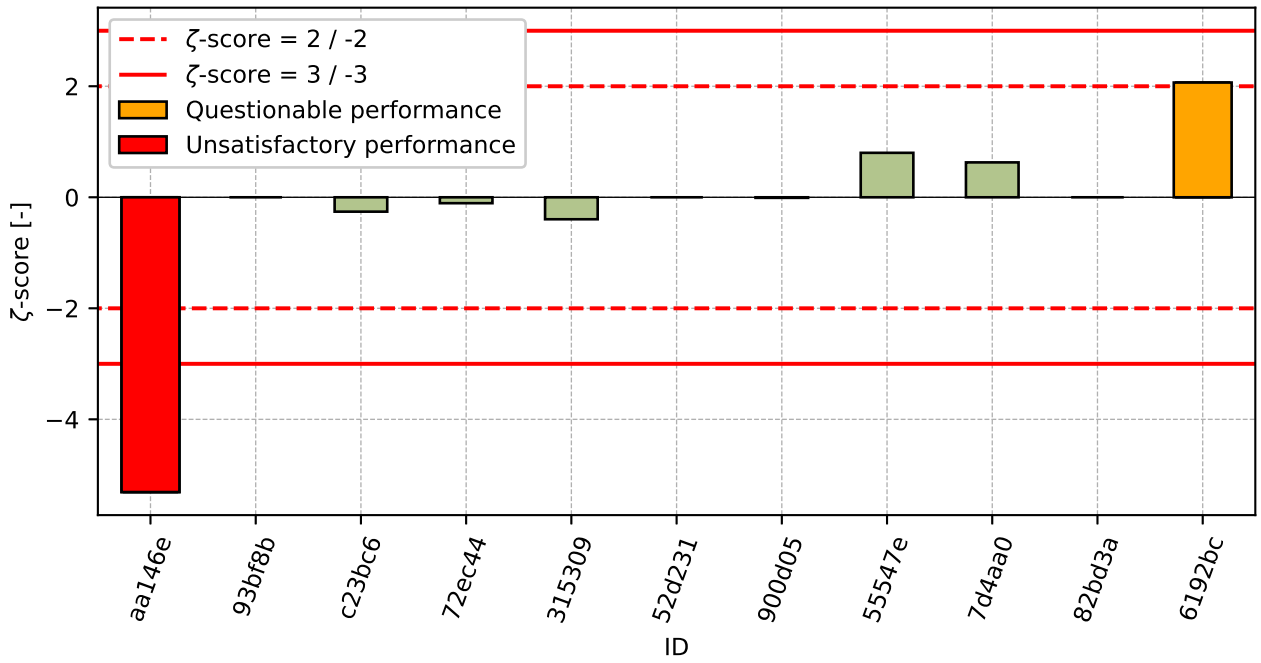

Figure 134: ζ-score

Table 46: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
aa146e	-3.16	-5.31
93bf8b	-0.73	-
c23bc6	-0.39	-0.26
72ec44	-0.39	-0.11
315309	-0.39	-0.4
52d231	-0.33	-
900d05	-0.09	-0.01
55547e	0.37	0.8
7d4aa0	0.37	0.63
82bd3a	0.48	-
6192bc	2.33	2.07

10.2 Voids

10.2.1 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 [%]
52d231	42.7	42.7	42.8	-	42.7	0.05	0.12
6192bc	42.8	42.7	43.4	0.0	43.0	0.38	0.88
55547e	43.0	43.0	43.0	0.0	43.0	0.0	0.0
aa146e	43.9	43.9	43.9	0.4	43.9	0.0	0.0
72ec44	44.9	44.1	43.7	6.0	44.2	0.61	1.38
900d05	44.5	44.2	44.2	0.5	44.3	0.22	0.5
315309	43.9	44.7	44.3	2.0	44.3	0.4	0.9
c23bc6	45.4	46.0	46.4	1.4	45.9	0.5	1.1
82bd3a	48.4	47.9	47.9	-	48.1	0.29	0.6

10.2.2 The Numerical Procedure for Determining Outliers

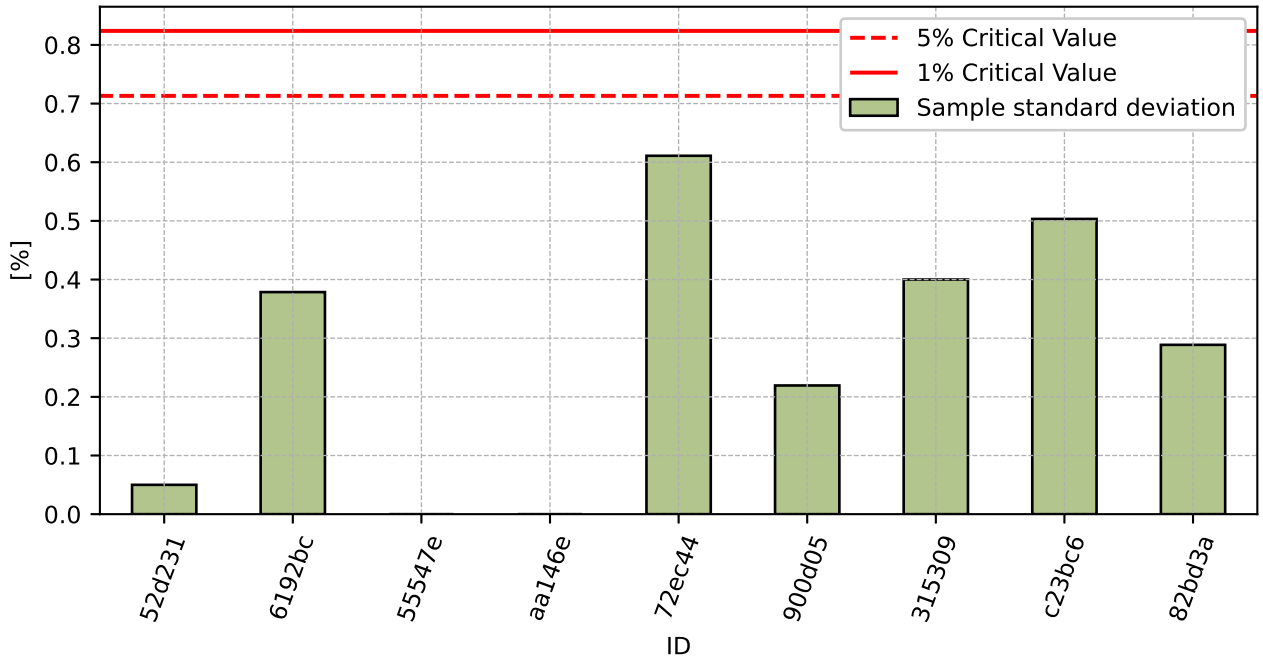

Figure 135: **Cochran's test** - sample standard deviations

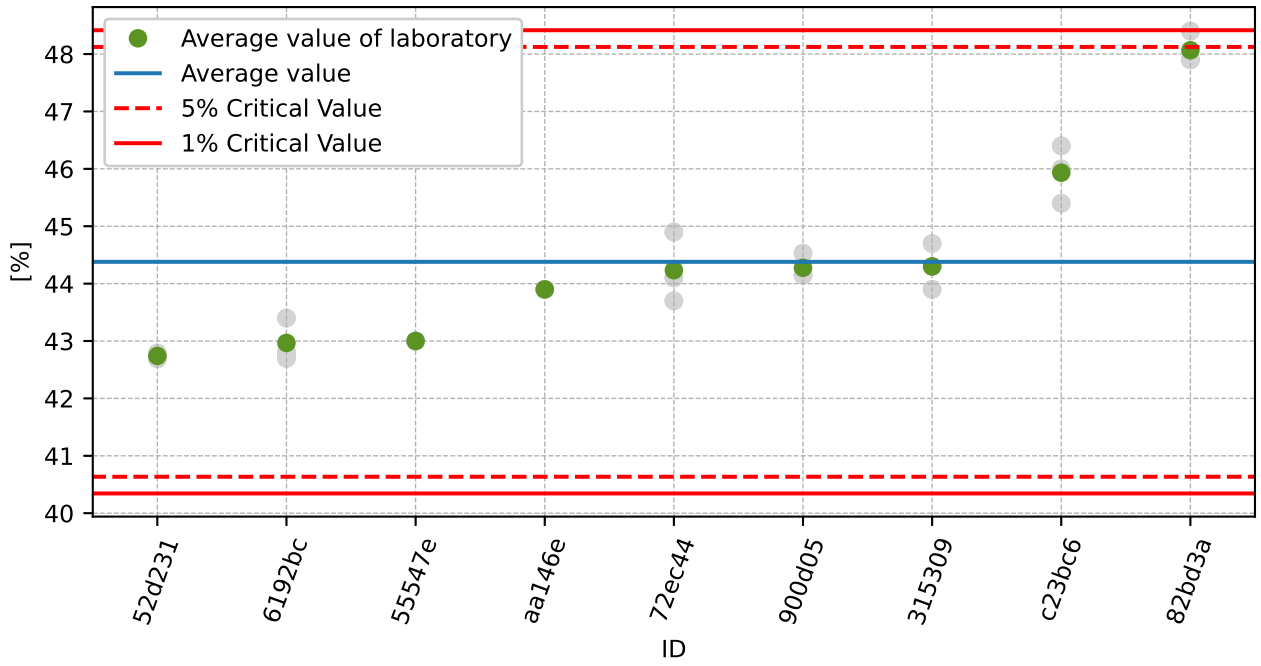

Figure 136: **Grubbs' test** - average values

10.2.3 Mandel's Statistics

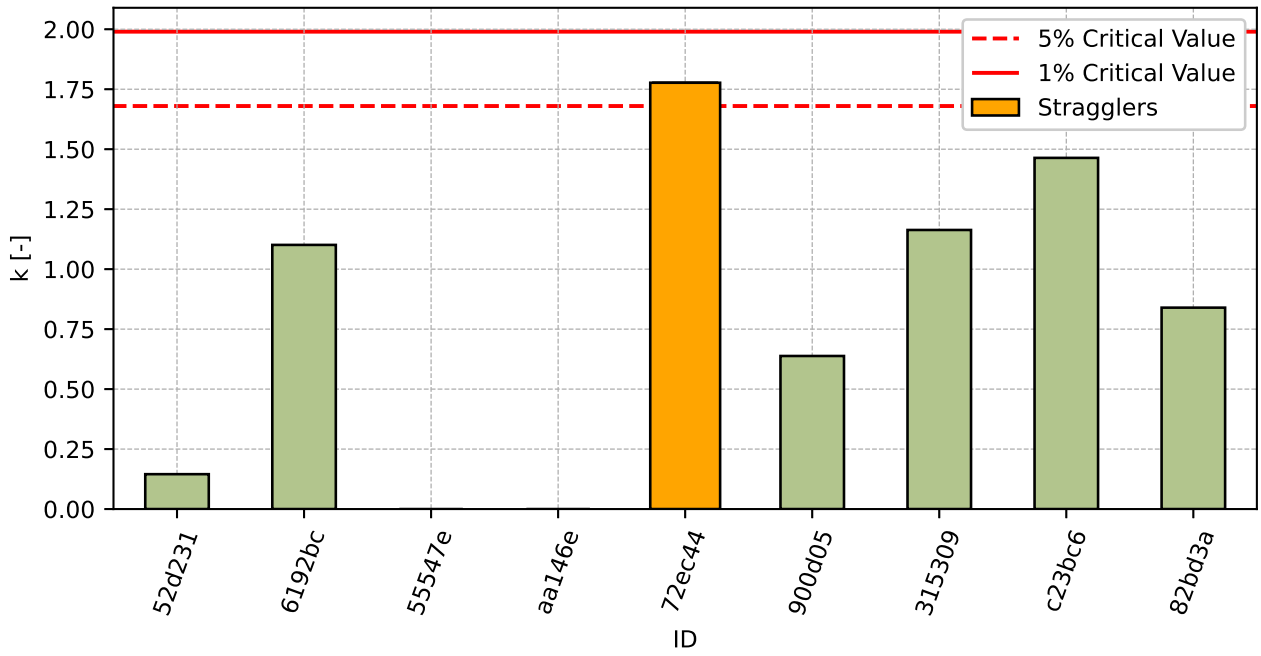

Figure 137: Intralaboratory Consistency Statistic

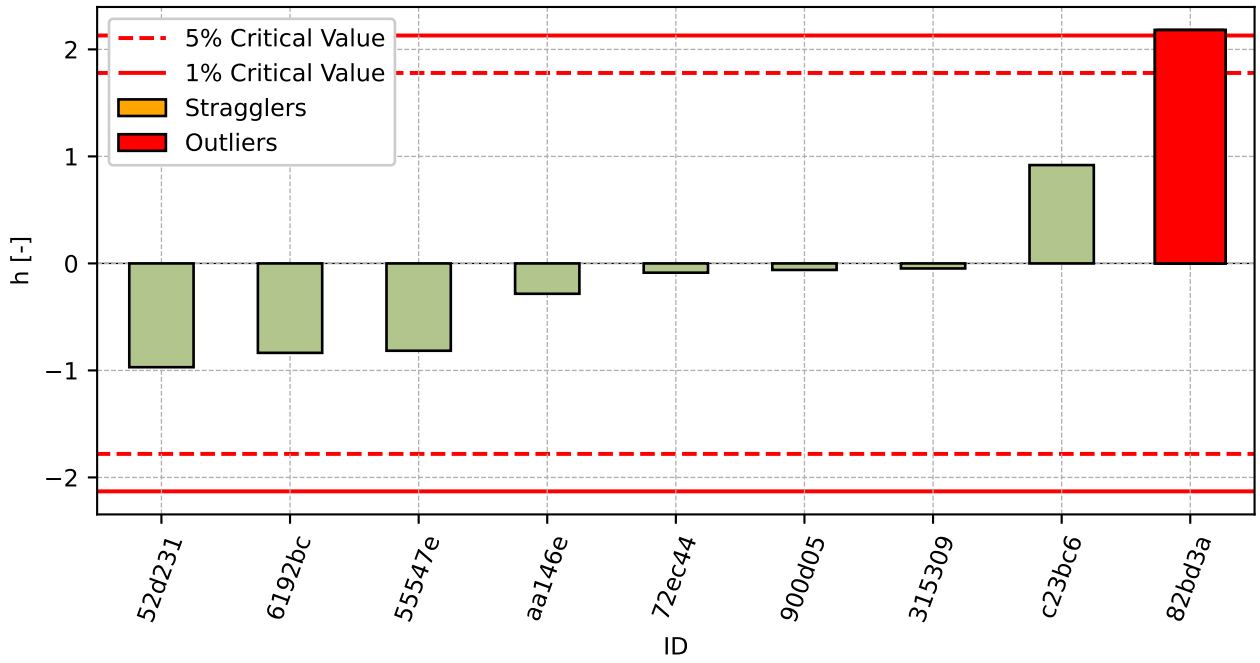

Figure 138: Interlaboratory Consistency Statistic

10.2.4 Descriptive statistics

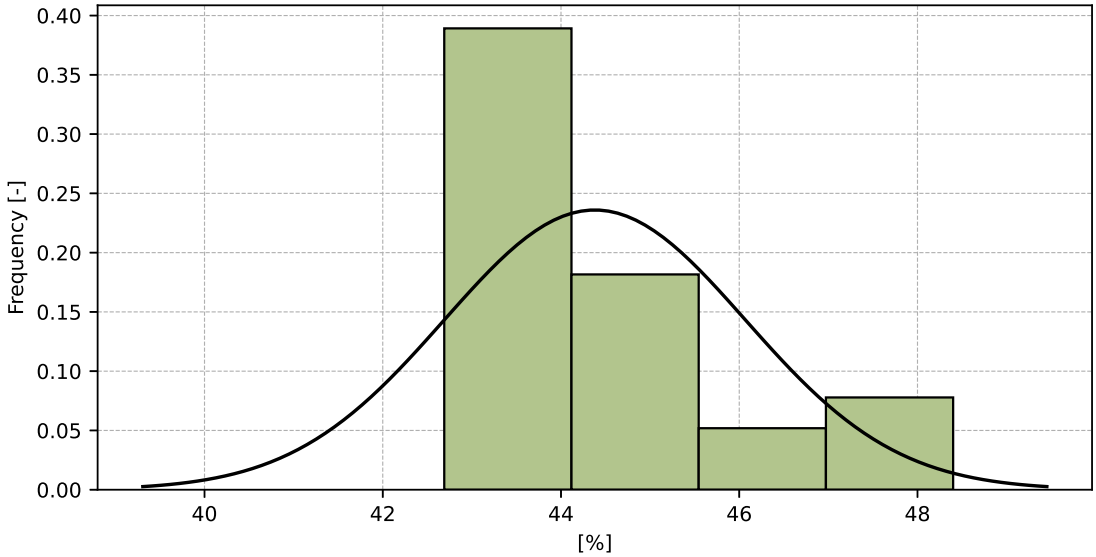

Figure 139: Histogram of all test results

Table 48: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	44.4
Sample standard deviation – s	1.69
Asigned value – x^*	44.4
Robust standard deviation – s^*	1.81
Measurement uncertainty of asigned value – u_X	0.75
p-value of normality test	0.001 [-]
Interlaboratory standard deviation – s_L	1.68
Repeatability standard deviation – s_r	0.34
Reproducibility standard deviation – s_R	1.71
Repeatability – r	1.0
Reproducibility – R	4.8

10.2.5 Evaluation of Performance Statistics

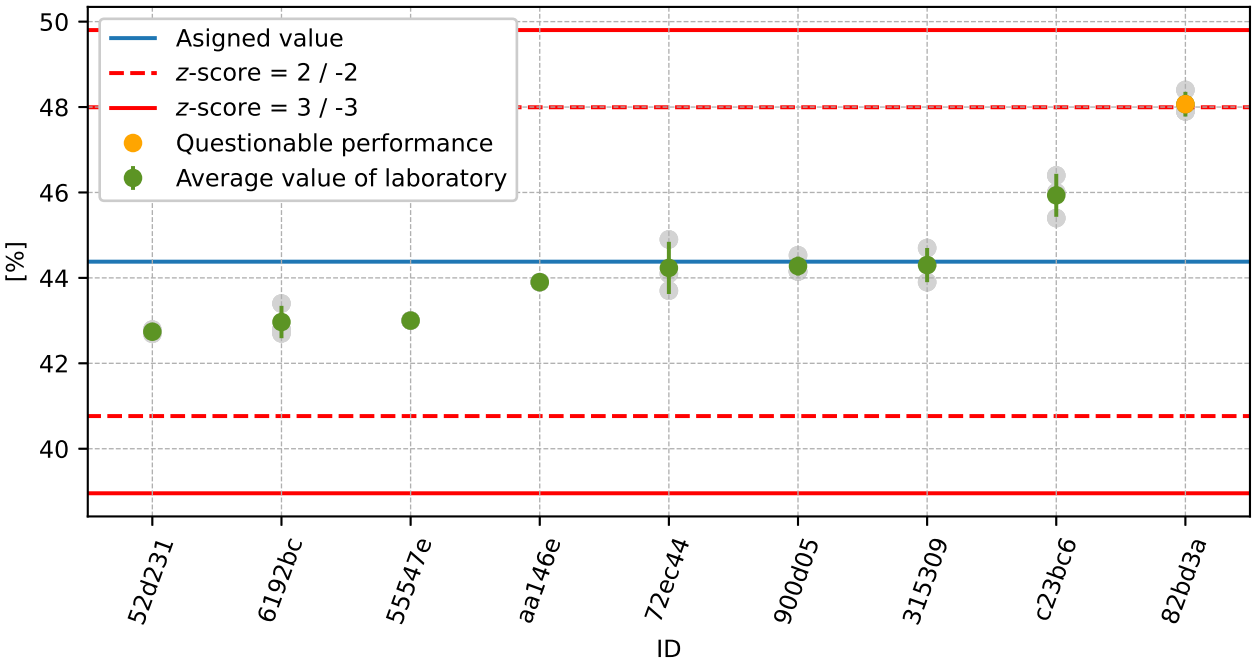

Figure 140: Average values and sample standard deviations

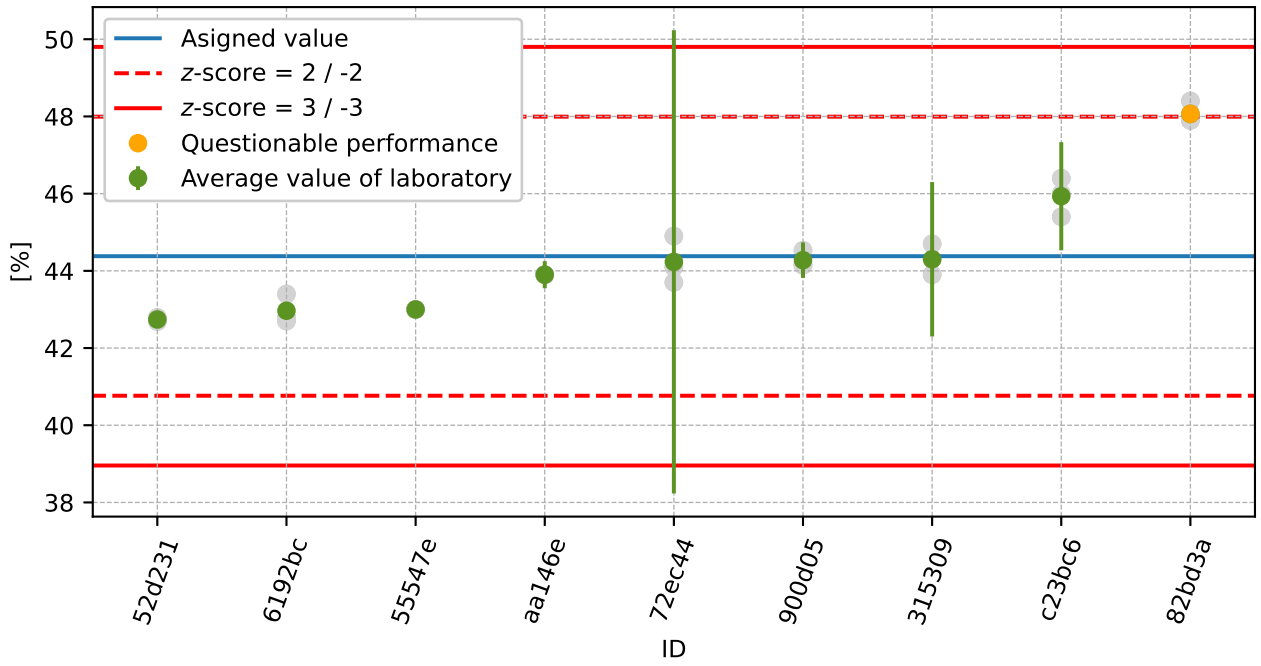

Figure 141: Average values and extended uncertainties of measurement

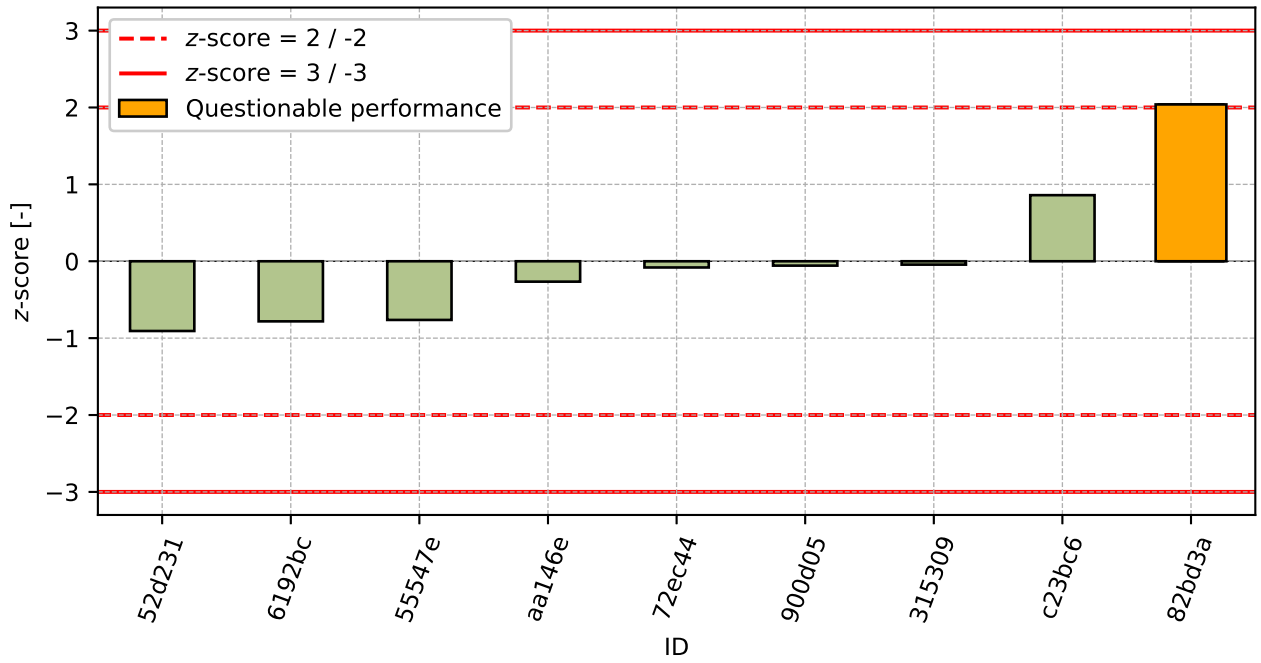

Figure 142: z-score

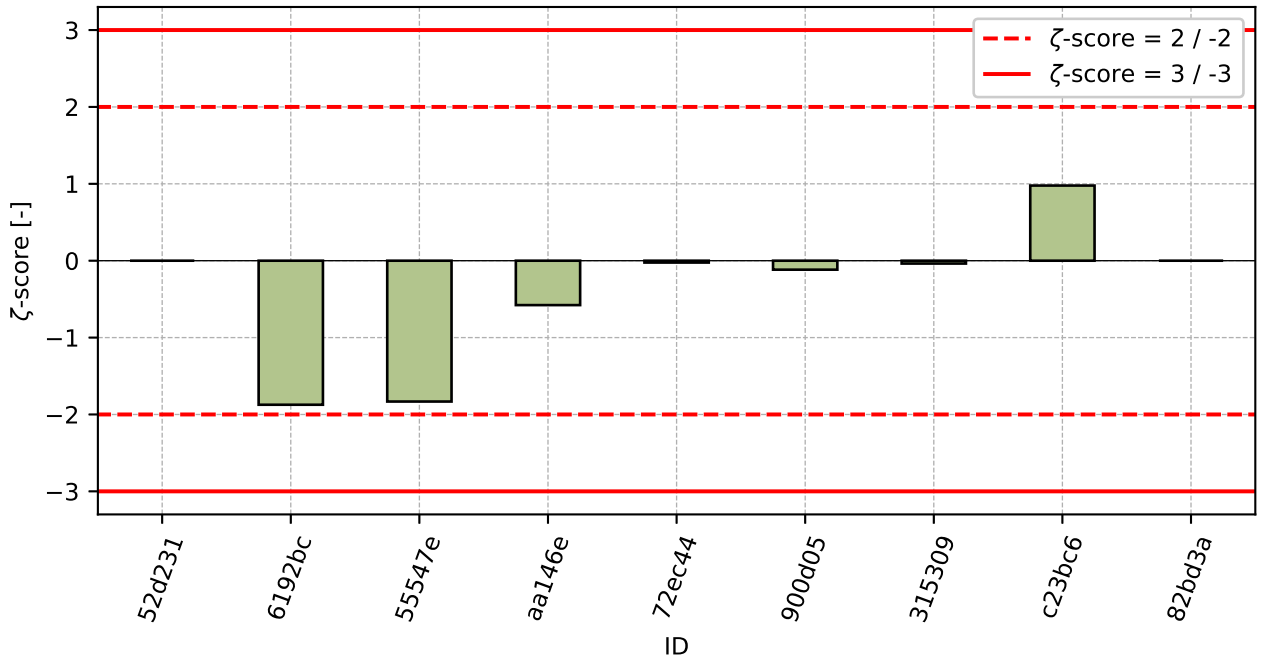

Figure 143: ζ-score

Table 49: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
52d231	-0.91	-
6192bc	-0.78	-1.87
55547e	-0.76	-1.83
aa146e	-0.27	-0.58
72ec44	-0.08	-0.02
900d05	-0.06	-0.12
315309	-0.04	-0.04
c23bc6	0.86	0.98
82bd3a	2.04	-

11 Appendix – EN 1097-5 Determination of the water content by drying in a ventilated oven

11.1 Test results

Table 50: 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 [%]
b39bb2	3.1	3.0	3.0	-	3.0	0.06	1.99
edf35f	3.1	2.9	3.1	-	3.0	0.1	3.25
02be40	4.9	5.0	4.9	-	4.9	0.06	1.17
7d4aa0	5.0	5.0	5.0	0.0	5.0	0.01	0.12
315309	5.0	5.1	5.0	0.2	5.0	0.06	1.15
72ec44	5.1	5.2	5.2	0.6	5.2	0.06	1.12
066d89	5.2	5.2	5.2	0.0	5.2	0.02	0.39
aa146e	5.3	5.2	5.1	0.2	5.2	0.1	1.92
55547e	5.0	5.6	5.0	0.4	5.2	0.35	6.66
68cc77	5.2	4.8	5.8	-	5.3	0.5	9.56
6192bc	5.3	5.2	5.3	-	5.3	0.06	1.1
c8e70e	5.3	5.3	5.2	0.1	5.3	0.06	1.1
140849	5.4	5.2	5.3	-	5.3	0.1	1.94
e1819f	5.3	5.2	5.4	0.4	5.3	0.1	1.89
968ceb	5.3	5.3	5.3	-	5.3	0.0	0.0
92e96e	5.3	5.4	5.3	-	5.3	0.06	1.08
8e8268	5.4	5.2	5.4	0.1	5.3	0.12	2.17
cf83a2	5.3	5.2	5.5	0.3	5.3	0.15	2.86
478486	5.3	5.4	-	-	5.4	0.07	1.32
a3cf10	5.4	5.4	5.3	0.4	5.4	0.06	1.08
c857ef	5.4	5.2	5.5	0.3	5.4	0.15	2.85
644bba	5.3	5.4	5.4	0.2	5.4	0.06	1.08
0fe6b5	5.4	5.4	5.4	0.1	5.4	0.04	0.67
82bd3a	4.7	6.1	5.5	-	5.4	0.7	12.93
44e68c	5.5	5.4	5.4	0.3	5.4	0.06	1.06
154c4d	5.7	5.3	5.4	0.4	5.5	0.21	3.81
da3a05	5.5	5.4	5.5	-	5.5	0.03	0.63
7e36d6	5.5	5.4	5.5	0.1	5.5	0.03	0.63
5d0efa	5.7	5.4	5.4	0.2	5.5	0.17	3.15
1e9672	5.4	5.6	5.8	0.4	5.6	0.2	3.57
e543af	5.6	5.7	5.6	-	5.6	0.06	1.02
0b8d00	5.7	5.6	5.6	-	5.6	0.05	0.89
0782f3	5.7	5.6	5.7	0.1	5.7	0.06	1.02

11.2 The Numerical Procedure for Determining Outliers

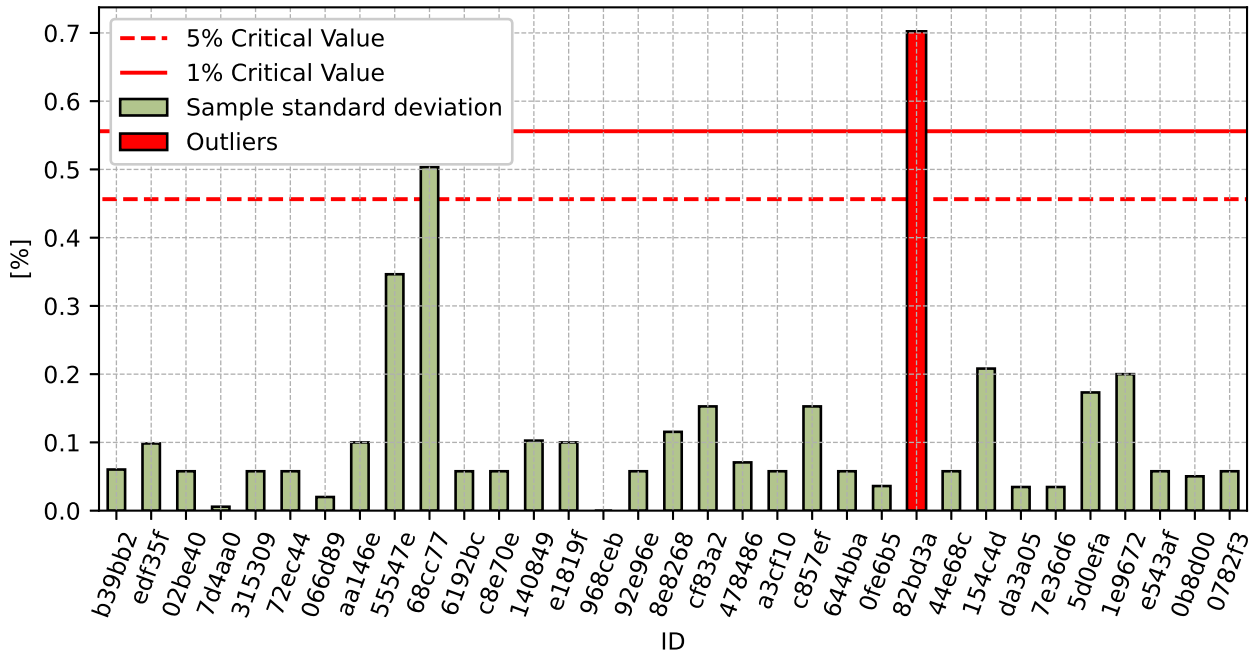

Figure 144: **Cochran's test** - sample standard deviations

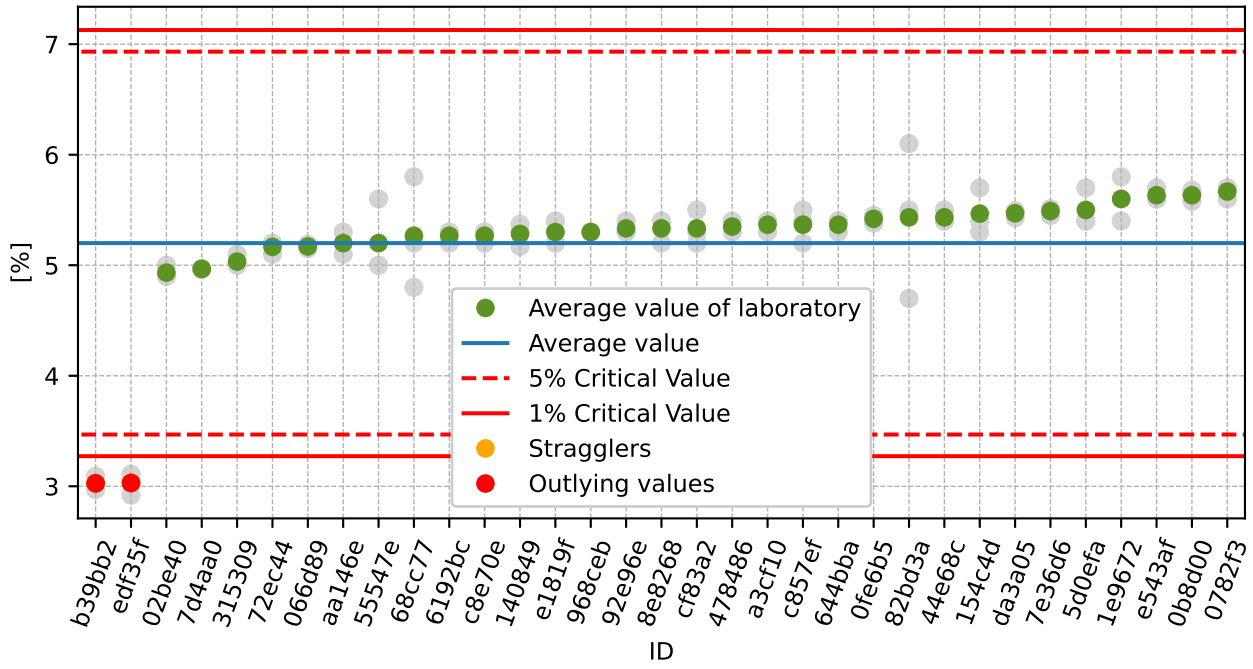

Figure 145: **Grubbs' test** - average values

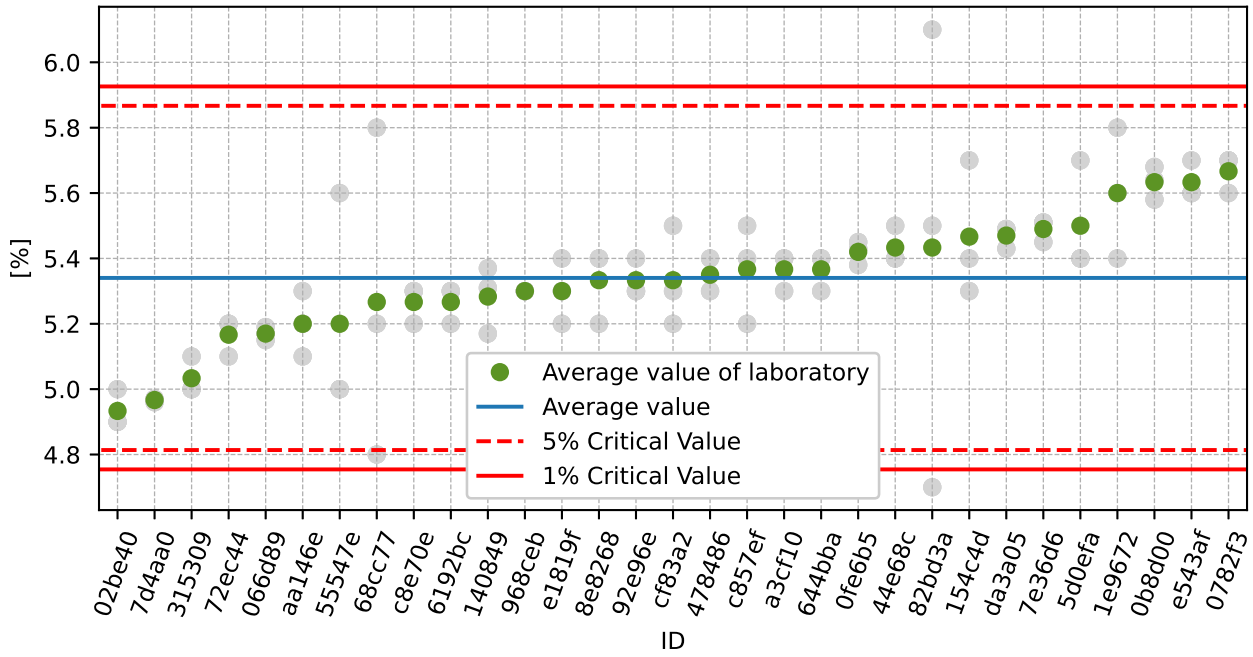

Figure 146: **Grubbs' test** - average values without outliers

11.3 Mandel's Statistics

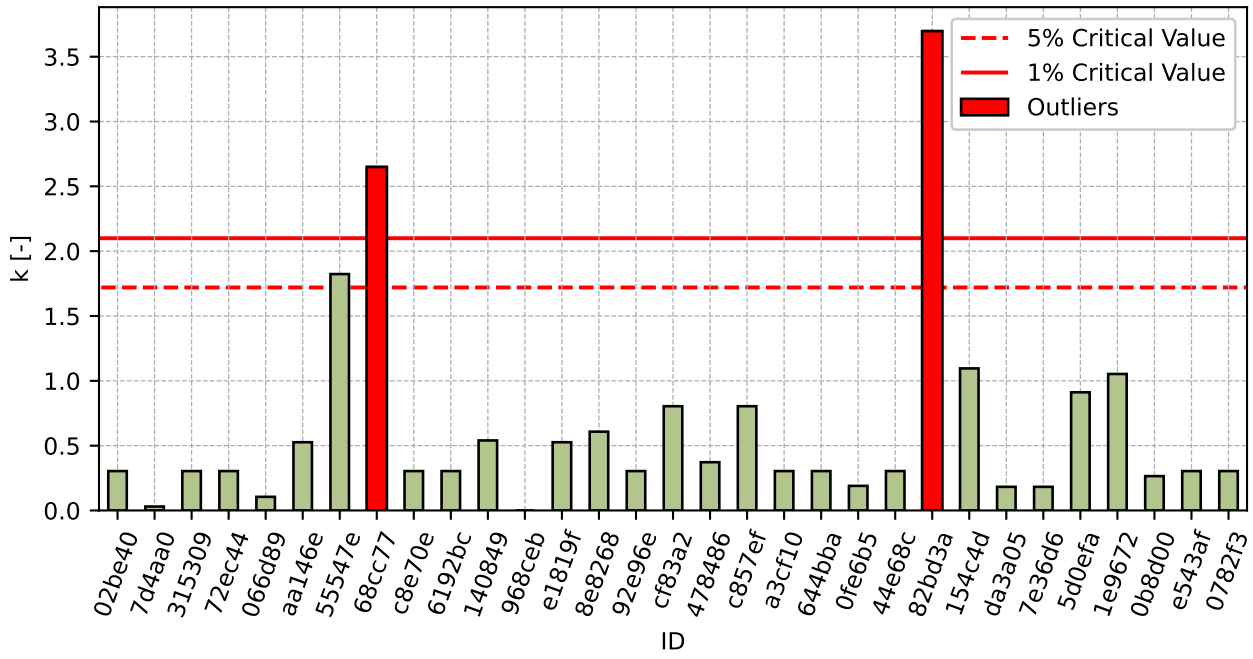

Figure 147: Intralaboratory Consistency Statistic

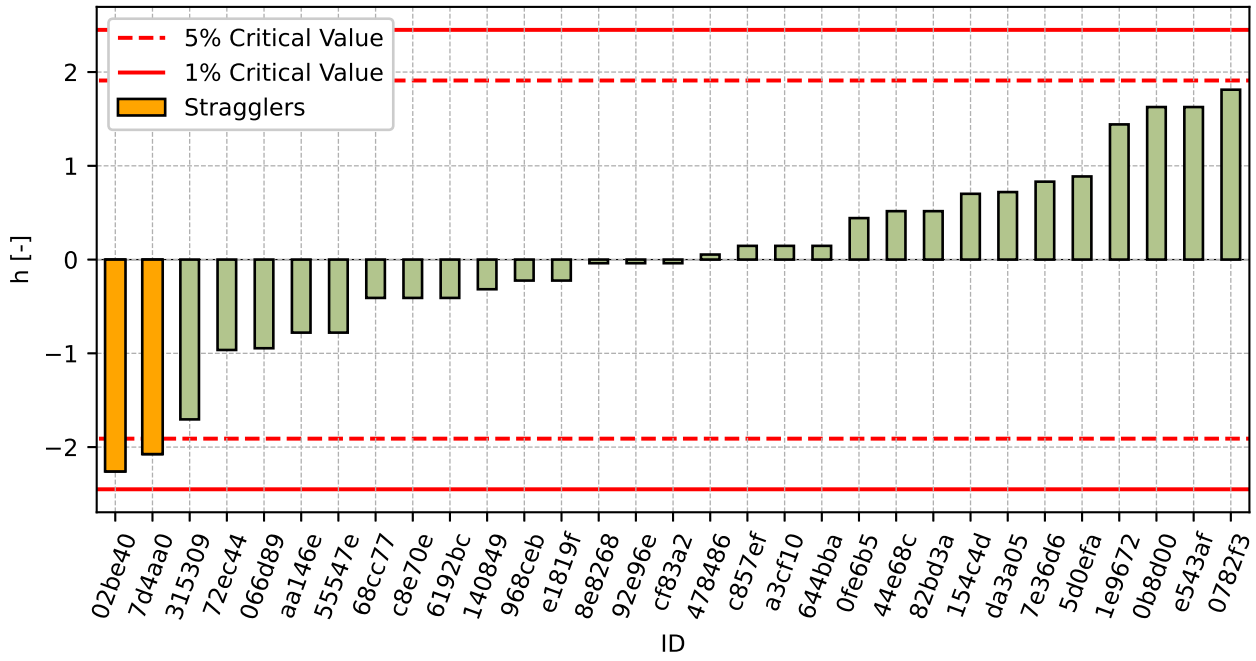

Figure 148: Interlaboratory Consistency Statistic

11.4 Descriptive statistics

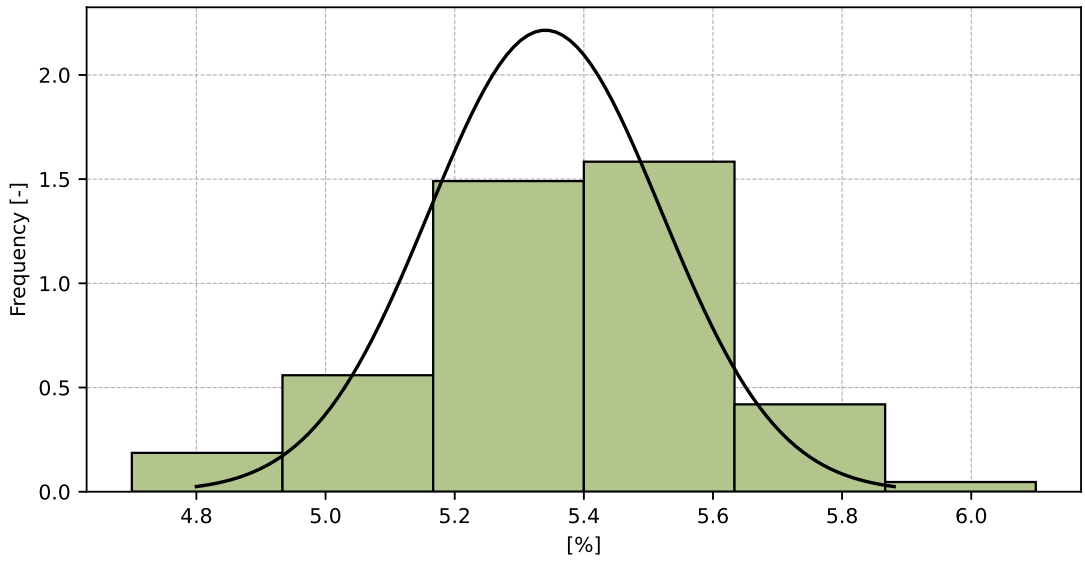

Figure 149: Histogram of all test results

Table 51: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	5.3
Sample standard deviation – s	0.18
Asigned value – x^*	5.3
Robust standard deviation – s^*	0.16
Measurement uncertainty of asigned value – u_X	0.04
p-value of normality test	1.0 [-]
Interlaboratory standard deviation – s_L	0.14
Repeatability standard deviation – s_r	0.19
Reproducibility standard deviation – s_R	0.24
Repeatability – r	0.5
Reproducibility – R	0.7

11.5 Evaluation of Performance Statistics

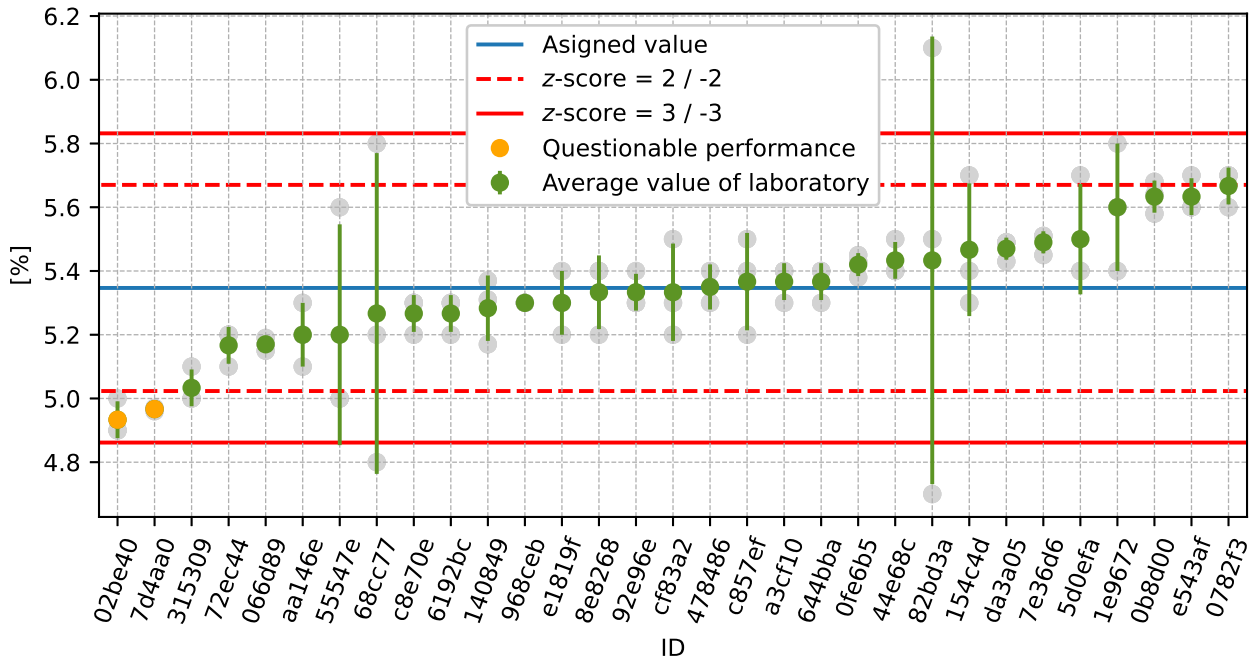

Figure 150: Average values and sample standard deviations

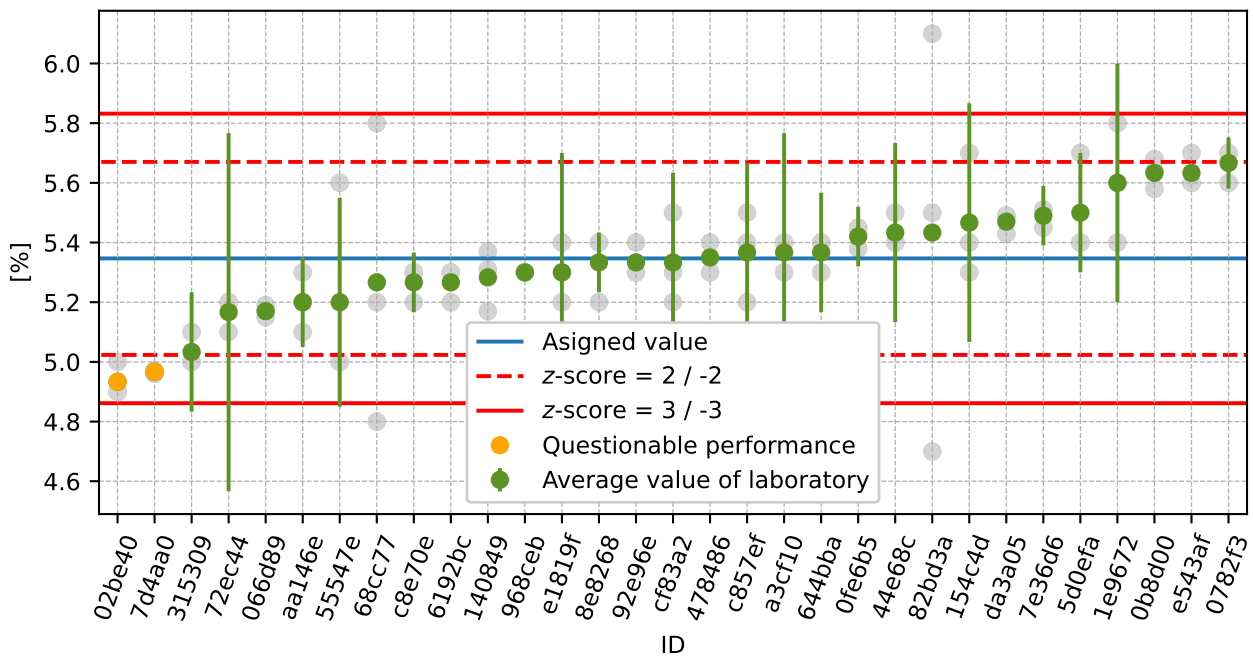

Figure 151: Average values and extended uncertainties of measurement

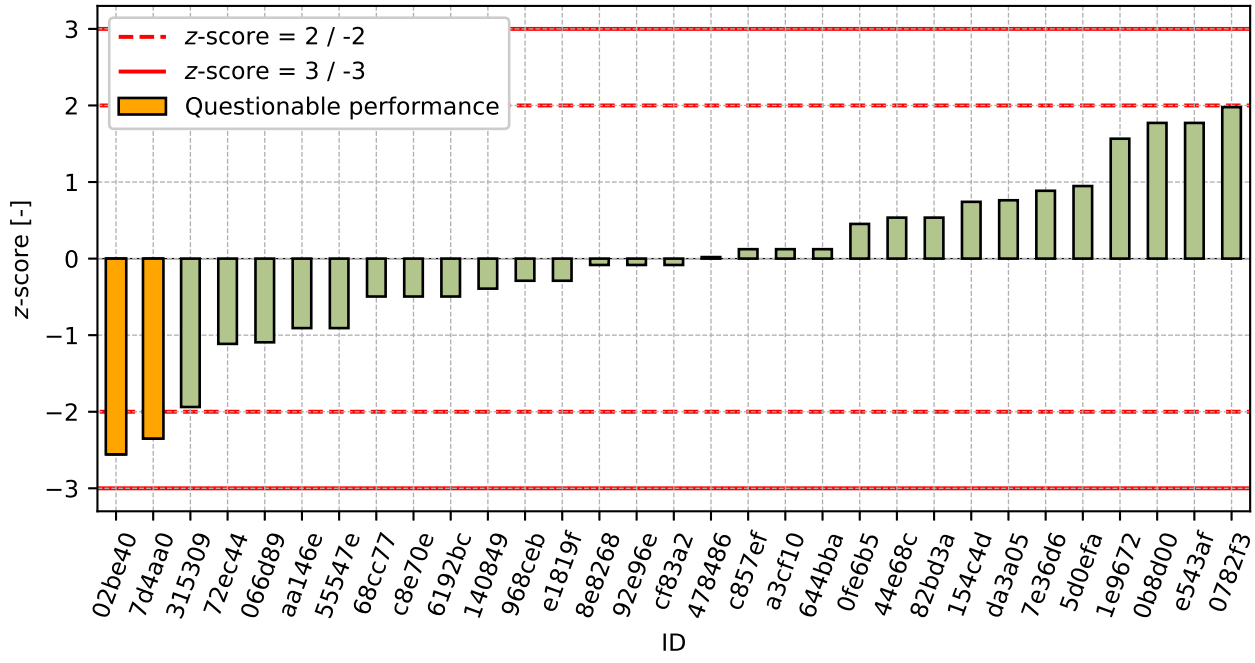

Figure 152: z-score

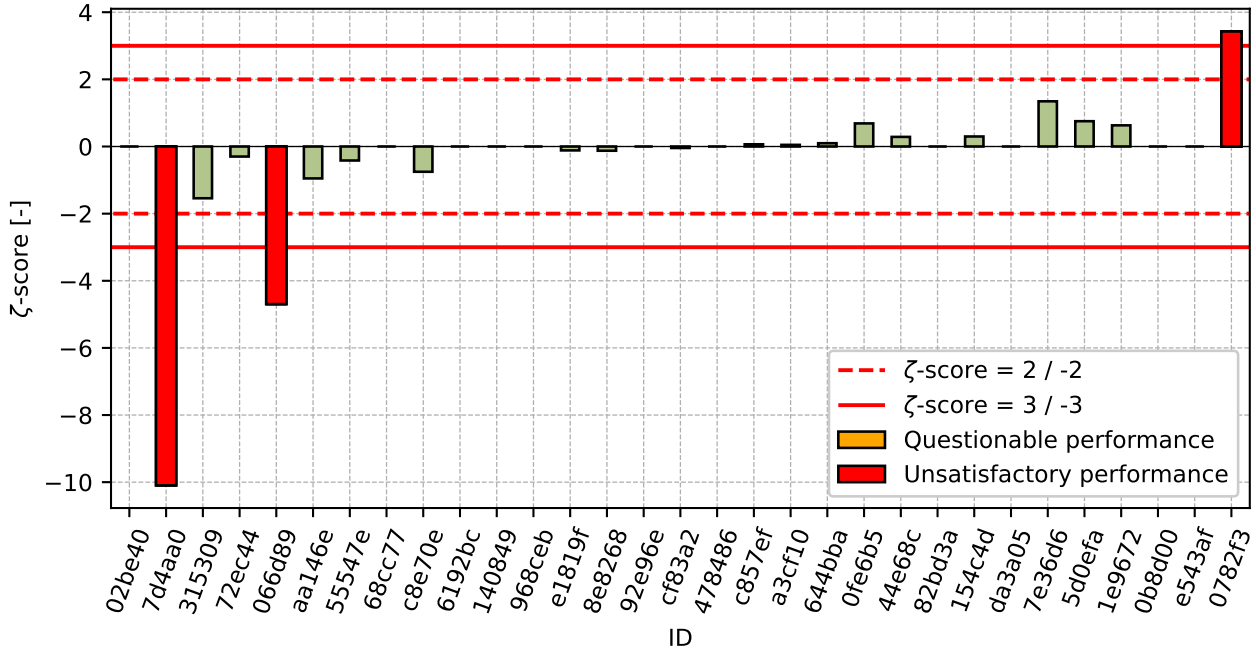

Figure 153: ζ-score

Table 52: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
02be40	-2.56	-
7d4aa0	-2.35	-10.09
315309	-1.94	-1.54
72ec44	-1.11	-0.3
066d89	-1.09	-4.69
aa146e	-0.91	-0.95
55547e	-0.91	-0.42
68cc77	-0.5	-
c8e70e	-0.5	-0.75
6192bc	-0.5	-
140849	-0.39	-
968ceb	-0.29	-
e1819f	-0.29	-0.12
8e8268	-0.08	-0.13
92e96e	-0.08	-
cf83a2	-0.08	-0.04
478486	0.02	-
c857ef	0.12	0.07
a3cf10	0.12	0.05
644bba	0.12	0.1
0fe6b5	0.45	0.69
44e68c	0.54	0.29

Continued on next page

Continued from previous page

ID	z-score [-]	ζ-score [-]
82bd3a	0.54	-
154c4d	0.74	0.3
da3a05	0.76	-
7e36d6	0.89	1.35
5d0efa	0.95	0.75
1e9672	1.57	0.63
0b8d00	1.77	-
e543af	1.77	-
0782f3	1.98	3.43

12 Appendix – EN 1097-6 Determination of particle density and water absorption

12.1 Particle density

12.1.1 Test results

Table 53: Test results - ordered by average value. Outliers are marked by red color. u_X - extended uncertainty of measurement; $\bar{x}$ - average value; s_0 - sample standard deviation; V_X - variation coefficient

ID	Test results [Mg/m^3]			u_X [Mg/m^3]	$\bar{x}$ [Mg/m^3]	s_0 [Mg/m^3]	V_X [%]
7d21b5	2.59	2.57	2.57	0.02	2.58	0.012	0.45
edf35f	2.68	2.68	2.59	-	2.65	0.052	1.96
50b361	2.67	2.66	2.67	-	2.67	0.006	0.22
315309	2.67	2.68	2.65	0.03	2.67	0.015	0.57
e7e3fa	2.67	2.67	2.67	-	2.67	0.0	0.0
55547e	2.67	2.67	2.67	0.0	2.67	0.0	0.0
6192bc	2.68	2.66	2.68	0.42	2.67	0.012	0.43
79965e	2.68	2.67	2.67	0.03	2.67	0.006	0.22
066d89	2.67	2.67	2.68	0.0	2.67	0.006	0.22
93bf8b	2.67	2.68	2.67	-	2.67	0.006	0.22
17f205	2.66	2.68	2.68	0.03	2.67	0.012	0.43
c5a3f5	2.69	2.67	2.66	0.2	2.68	0.017	0.62
aa146e	2.68	2.67	2.68	0.03	2.68	0.006	0.22
fdfd05	2.68	2.67	2.68	-	2.68	0.006	0.22
1e9672	2.68	2.68	2.68	0.01	2.68	0.003	0.11
68cc77	2.67	2.68	2.69	-	2.68	0.01	0.37
32a836	2.68	2.68	2.68	0.01	2.68	0.0	0.0
154c4d	2.68	2.68	2.68	0.15	2.68	0.0	0.0
7d4aa0	2.68	-	-	-	2.68	0.0	0.0
a3cf10	2.68	2.68	2.68	0.03	2.68	0.0	0.0
bded50	2.68	2.68	2.68	0.03	2.68	0.002	0.07
4df247	2.69	2.67	2.69	-	2.68	0.012	0.43
82bd3a	2.68	2.68	2.69	-	2.68	0.006	0.22
72ec44	2.69	2.68	2.68	0.06	2.68	0.006	0.22
c23bc6	2.7	2.67	2.68	0.04	2.68	0.015	0.57
ff27cd	2.68	2.68	2.69	0.03	2.68	0.006	0.22
d92da1	2.69	2.68	2.68	0.01	2.68	0.006	0.22
92e96e	2.71	2.72	2.65	-	2.69	0.038	1.41
7e36d6	2.7	2.7	2.7	0.04	2.7	0.002	0.08
92e563	2.69	2.7	2.71	0.01	2.7	0.009	0.32
fea11c	2.71	2.71	2.7	-	2.71	0.006	0.23
0782f3	2.71	2.7	2.71	-	2.71	0.006	0.22
cf83a2	2.68	2.74	2.74	0.02	2.72	0.032	1.18
f1363c	2.77	2.75	2.73	0.02	2.75	0.02	0.73

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ID	Test results [Mg/m³]	u_X [Mg/m³]	$\bar{x}$ [Mg/m³]	s_0 [Mg/m³]	V_X [%]

12.1.2 The Numerical Procedure for Determining Outliers

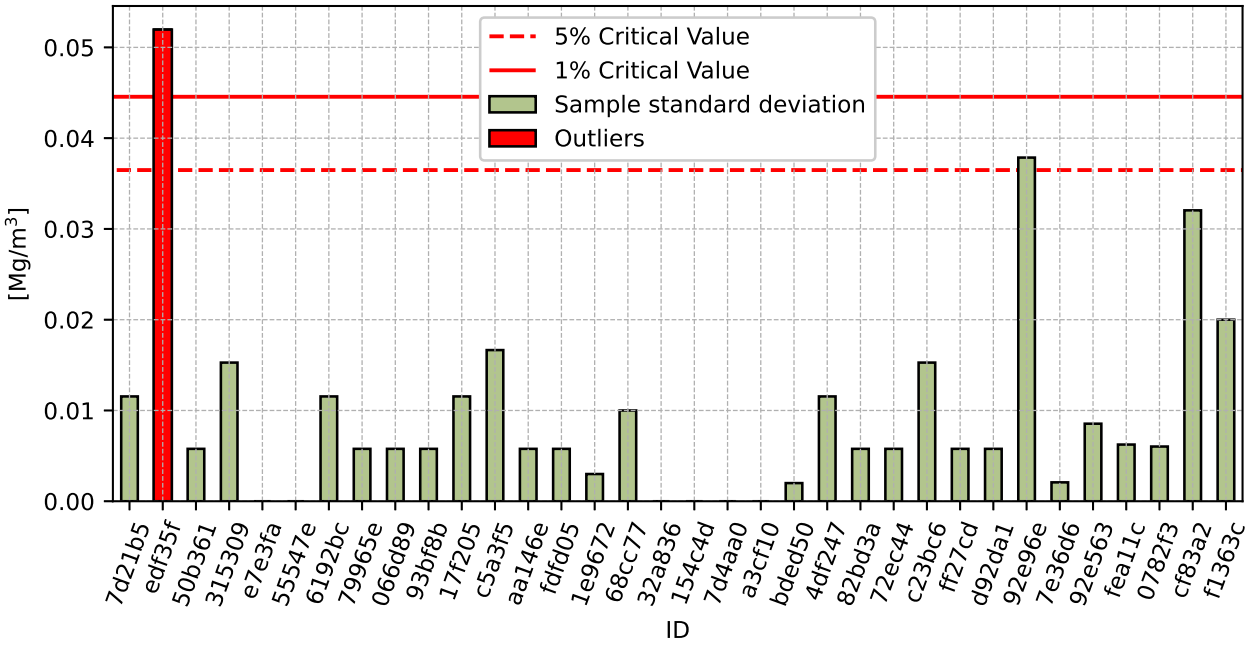

Figure 154: **Cochran's test** - sample standard deviations

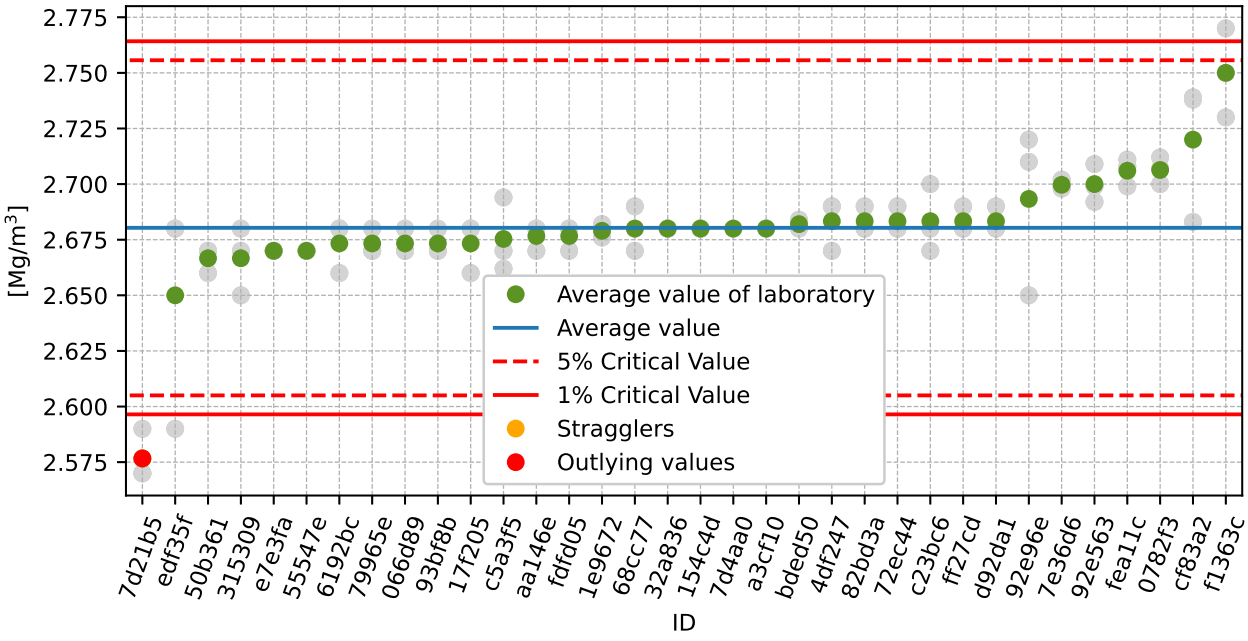

Figure 155: **Grubbs' test** - average values

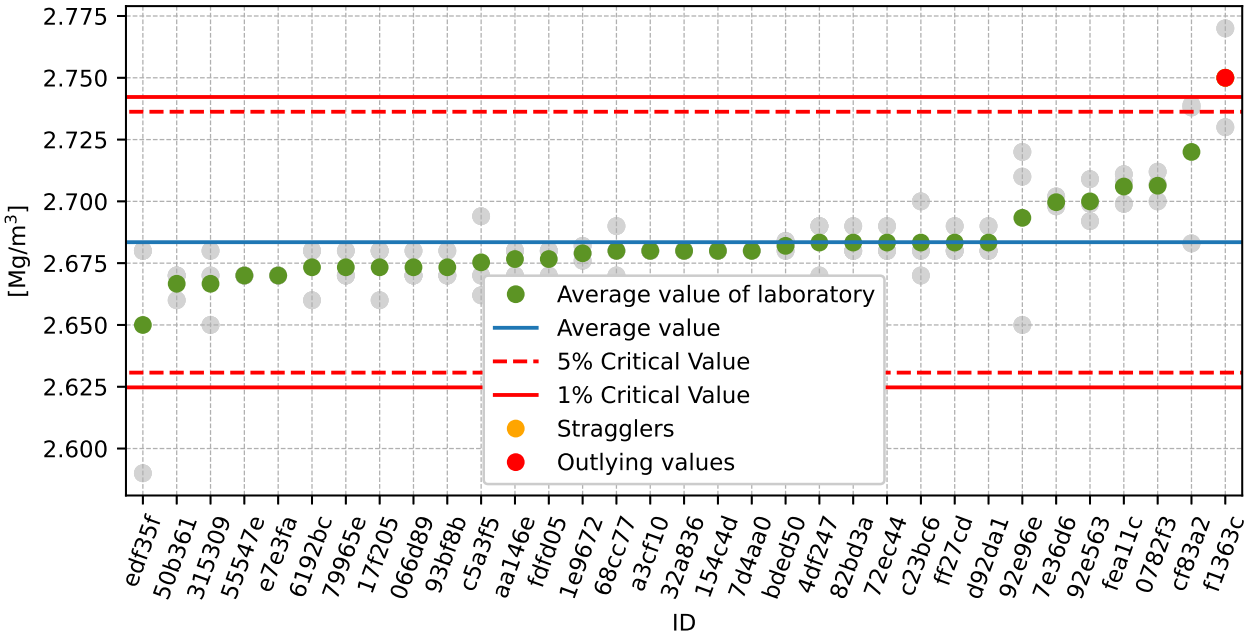

Figure 156: **Grubbs' test** - average values without outliers

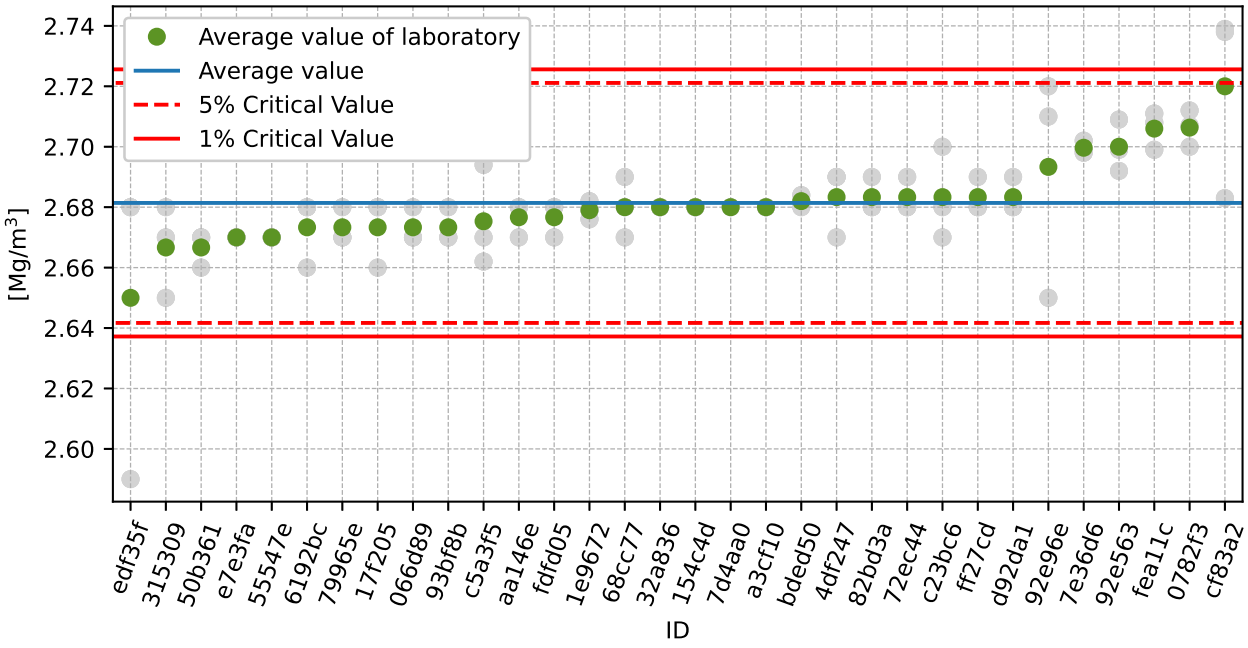

Figure 157: **Grubbs' test** - average values without outliers

12.1.3 Mandel's Statistics

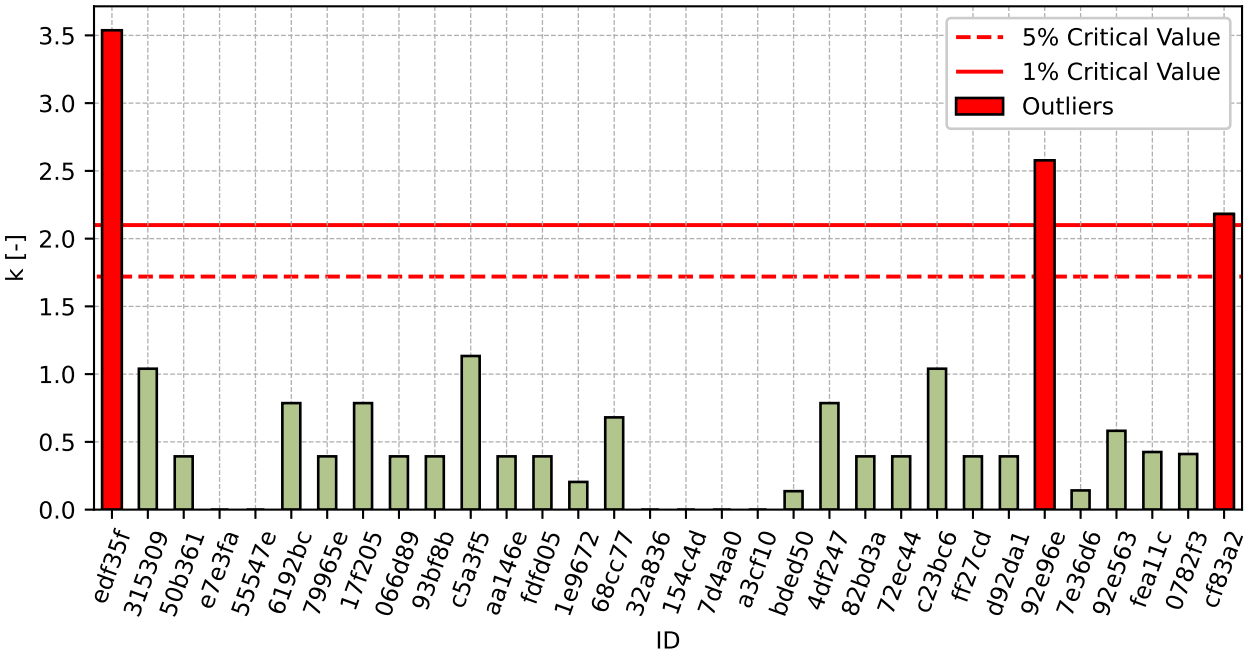

Figure 158: Intralaboratory Consistency Statistic

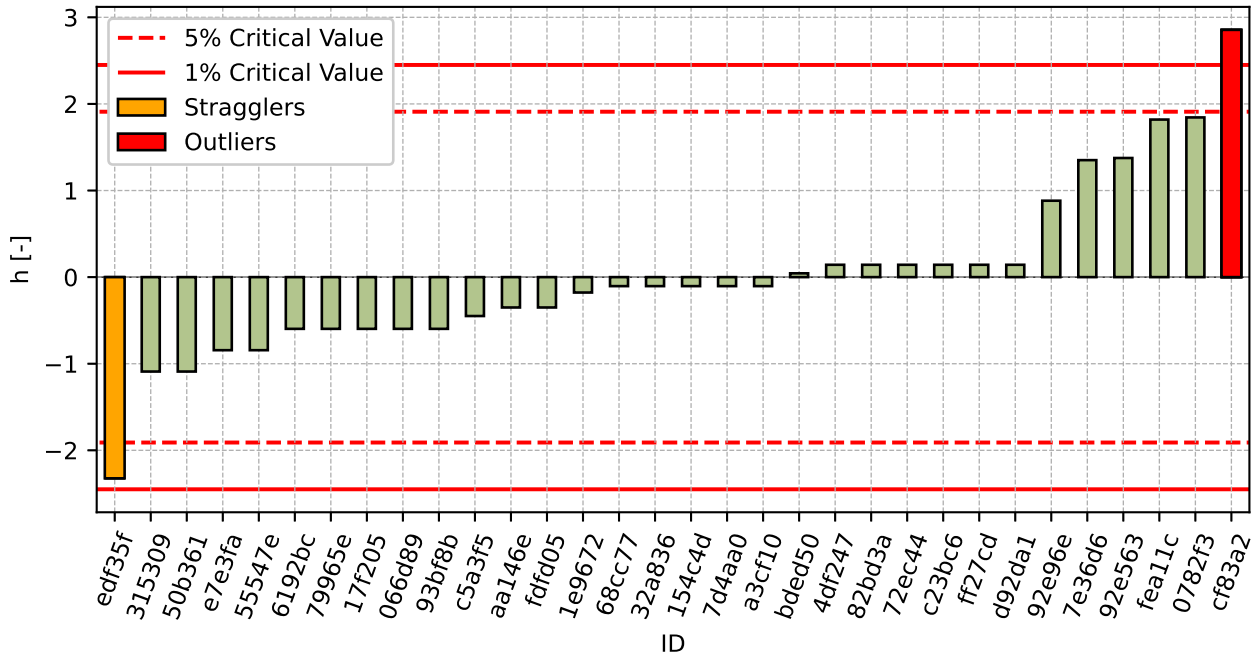

Figure 159: Interlaboratory Consistency Statistic

12.1.4 Descriptive statistics

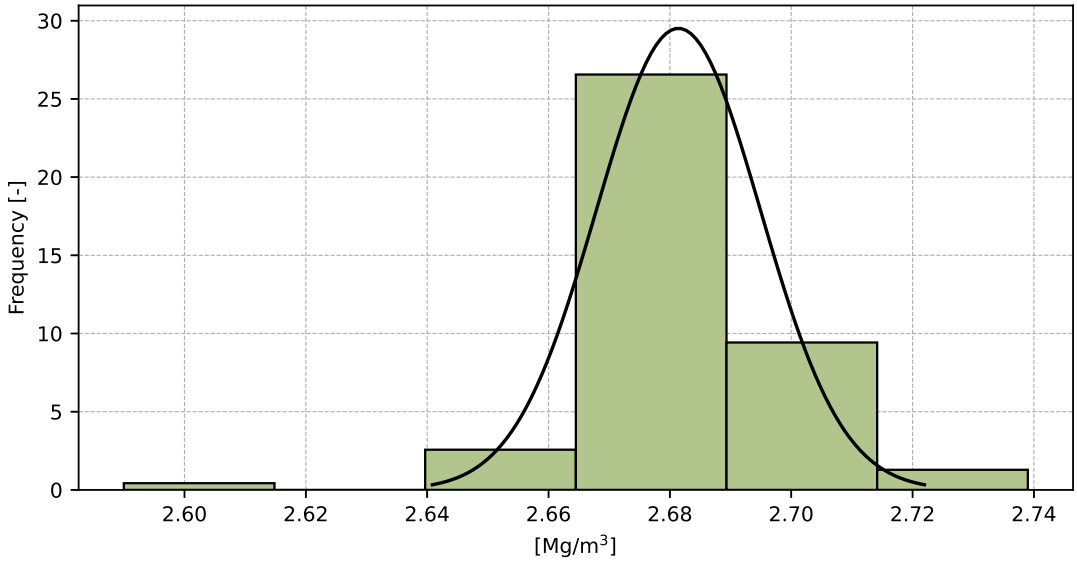

Figure 160: Histogram of all test results

Table 54: Descriptive statistics

Characteristics	[Mg/m^3]
Average value – $\bar{x}$	2.68
Sample standard deviation – s	0.014
Asigned value – x^*	2.68
Robust standard deviation – s^*	0.014
Measurement uncertainty of asigned value – u_X	0.002
p-value of normality test	1.0 [-]
Interlaboratory standard deviation – s_L	0.011
Repeatability standard deviation – s_r	0.015
Reproducibility standard deviation – s_R	0.018
Repeatability – r	0.04
Reproducibility – R	0.05

12.1.5 Evaluation of Performance Statistics

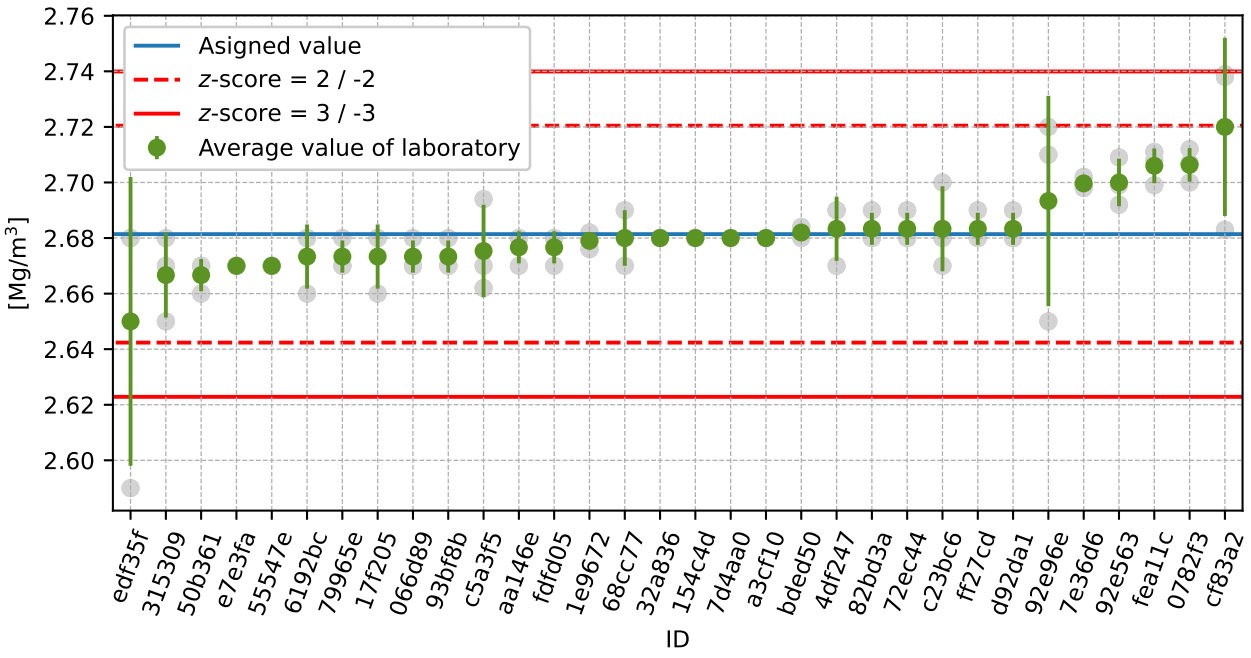

Figure 161: Average values and sample standard deviations

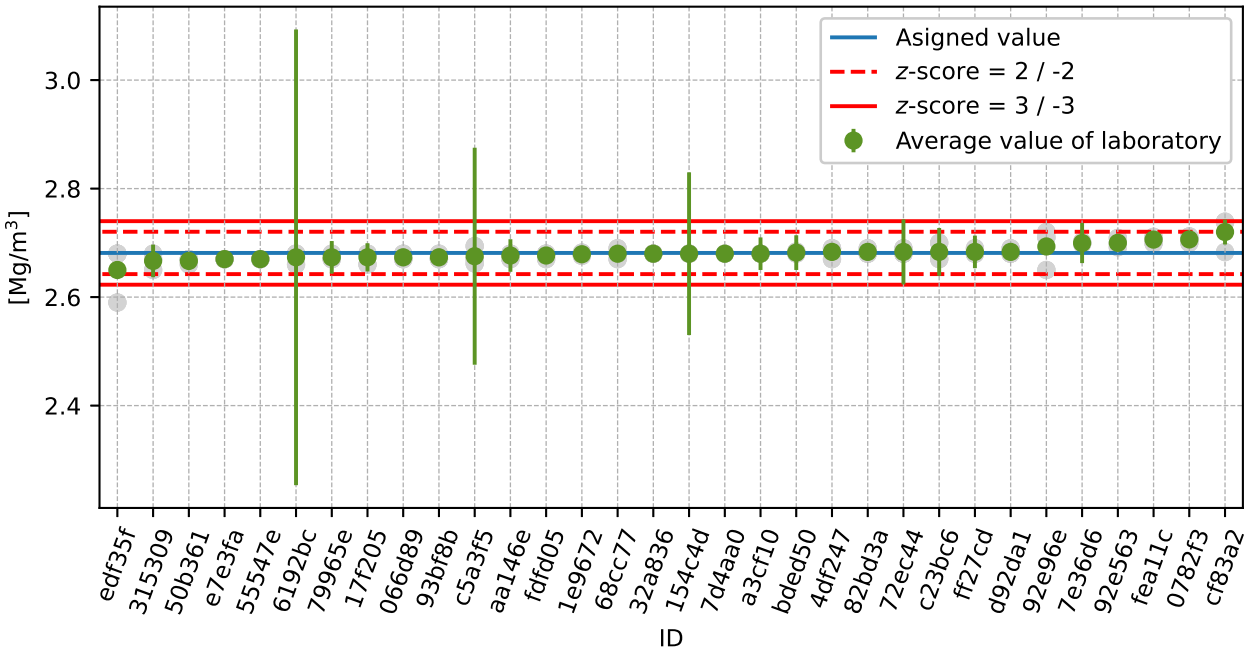

Figure 162: Average values and extended uncertainties of measurement

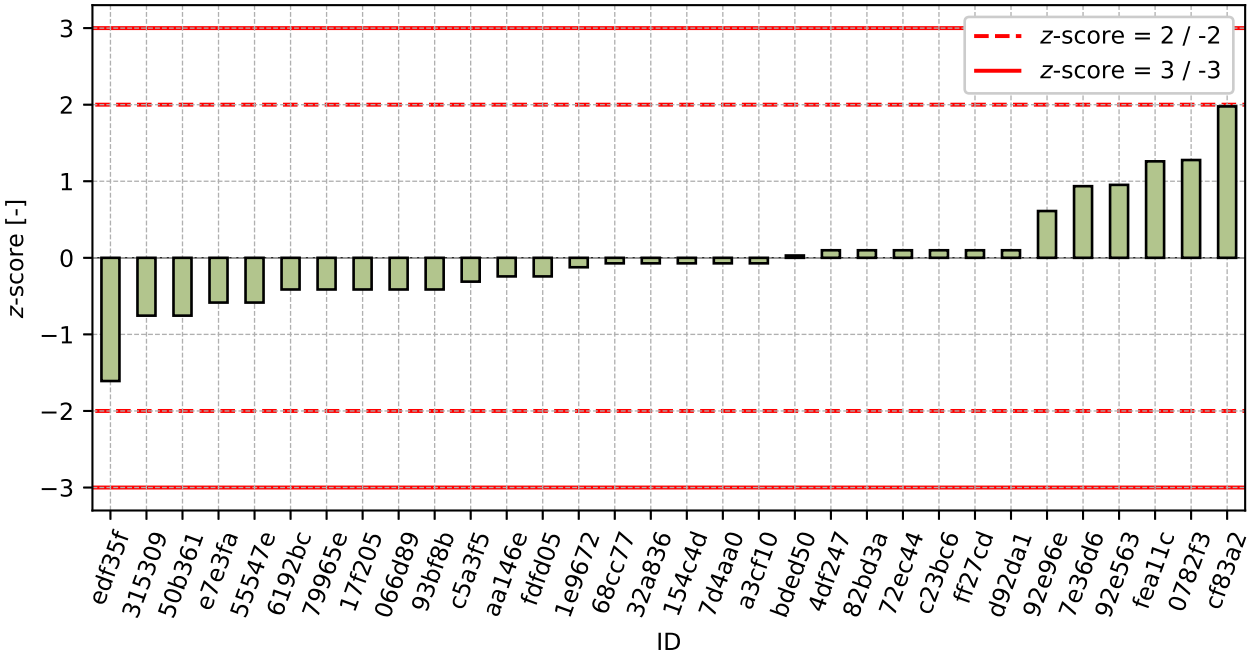

Figure 163: z-score

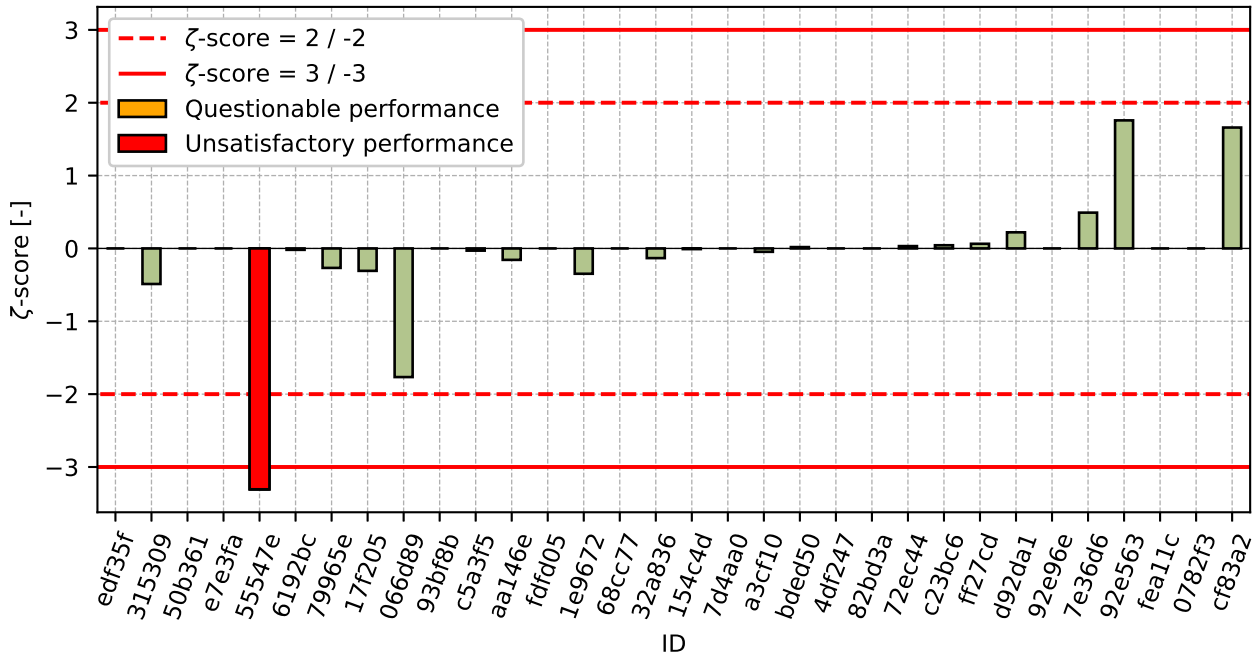

Figure 164: ζ-score

Table 55: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
edf35f	-1.61	-
315309	-0.76	-0.49
50b361	-0.76	-
e7e3fa	-0.58	-
55547e	-0.58	-3.31
6192bc	-0.41	-0.02
79965e	-0.41	-0.27
17f205	-0.41	-0.31
066d89	-0.41	-1.77
93bf8b	-0.41	-
c5a3f5	-0.31	-0.03
aa146e	-0.24	-0.16
fdfd05	-0.24	-
1e9672	-0.12	-0.35
68cc77	-0.07	-
32a836	-0.07	-0.13
154c4d	-0.07	-0.01
7d4aa0	-0.07	-
a3cf10	-0.07	-0.05
bded50	0.03	0.02
4df247	0.1	-
82bd3a	0.1	-

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ID	z-score [-]	ζ-score [-]
72ec44	0.1	0.03
c23bc6	0.1	0.04
ff27cd	0.1	0.06
d92da1	0.1	0.22
92e96e	0.61	-
7e36d6	0.94	0.49
92e563	0.95	1.76
fea11c	1.26	-
0782f3	1.28	-
cf83a2	1.98	1.66

12.2 Water absorption

12.2.1 Test results

Table 56: 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 [%]
17f205	0.4	0.4	0.5	0.0	0.4	0.03	7.59
066d89	0.7	0.7	0.7	0.0	0.7	0.0	0.0
50b361	0.7	0.8	0.8	-	0.8	0.06	7.53
55547e	0.8	0.7	0.9	0.1	0.8	0.1	12.5
92e96e	0.9	0.8	0.8	-	0.8	0.06	6.93
154c4d	0.9	0.9	0.8	0.1	0.9	0.06	6.66
ff27cd	0.9	0.9	0.9	0.2	0.9	0.0	0.0
93bf8b	0.9	1.0	1.0	-	1.0	0.03	3.2
0782f3	1.0	0.9	1.0	-	1.0	0.06	5.97
79965e	1.0	1.0	0.9	0.1	1.0	0.06	5.97
e7e3fa	1.0	1.0	1.0	-	1.0	0.01	1.03
6192bc	1.0	1.0	1.0	0.1	1.0	0.0	0.0
cf83a2	1.0	1.2	1.0	0.3	1.1	0.12	10.83
72ec44	1.1	1.0	1.2	0.4	1.1	0.1	9.09
aa146e	1.1	1.1	1.1	0.0	1.1	0.0	0.0
bded50	1.2	1.0	1.2	0.2	1.1	0.09	7.67
315309	1.2	1.2	1.0	0.2	1.1	0.12	10.19
fdfd05	1.2	1.1	1.1	-	1.1	0.06	5.09
d92da1	1.2	1.1	1.1	0.1	1.1	0.06	5.09
edf35f	1.2	1.2	1.1	-	1.2	0.06	4.95
a3cf10	1.2	1.2	1.1	0.2	1.2	0.06	4.95
1e9672	1.2	1.2	1.2	0.1	1.2	0.03	2.41
32a836	1.2	1.2	1.2	0.1	1.2	0.0	0.0
82bd3a	1.4	1.2	1.1	-	1.2	0.15	12.39
68cc77	1.3	1.2	1.2	-	1.2	0.06	4.68
7d21b5	1.1	1.3	1.4	0.2	1.3	0.15	12.06
7d4aa0	1.3	-	-	-	1.3	0.0	0.0
7e36d6	1.3	1.4	1.3	0.1	1.3	0.06	4.33
c5a3f5	1.3	1.5	1.4	0.2	1.4	0.11	7.6
f1363c	1.7	1.2	1.5	0.1	1.5	0.25	17.16
c23bc6	1.5	1.5	1.5	0.4	1.5	0.0	0.0
92e563	1.7	1.6	1.7	0.1	1.7	0.06	3.46
fea11c	1.8	1.9	2.0	0.3	1.9	0.06	3.18
4df247	2.9	2.7	2.8	-	2.8	0.1	3.57

12.2.2 The Numerical Procedure for Determining Outliers

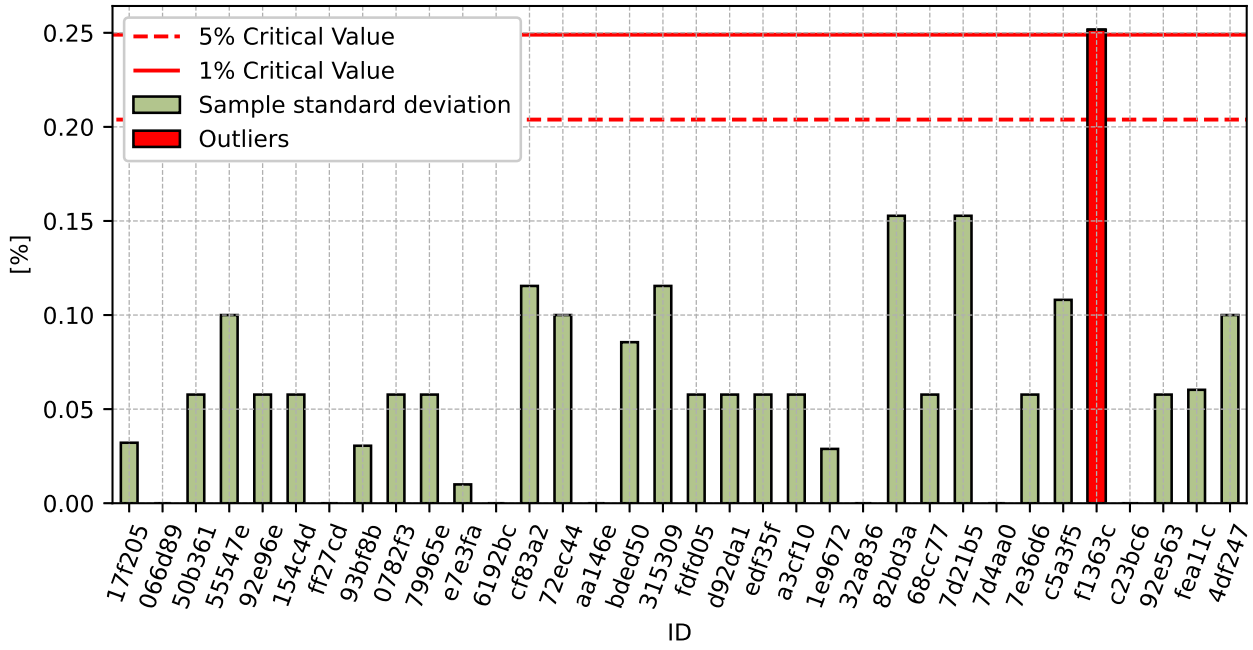

Figure 165: **Cochran's test** - sample standard deviations

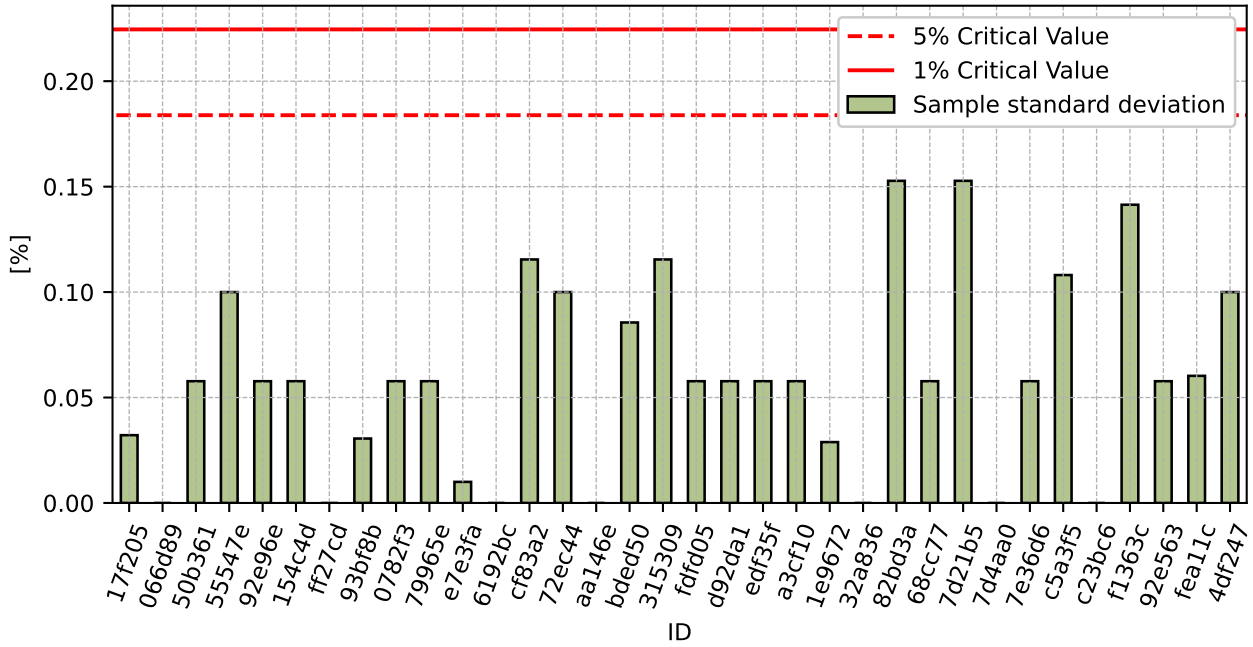

Figure 166: **Cochran's test** - sample standard deviations without outliers

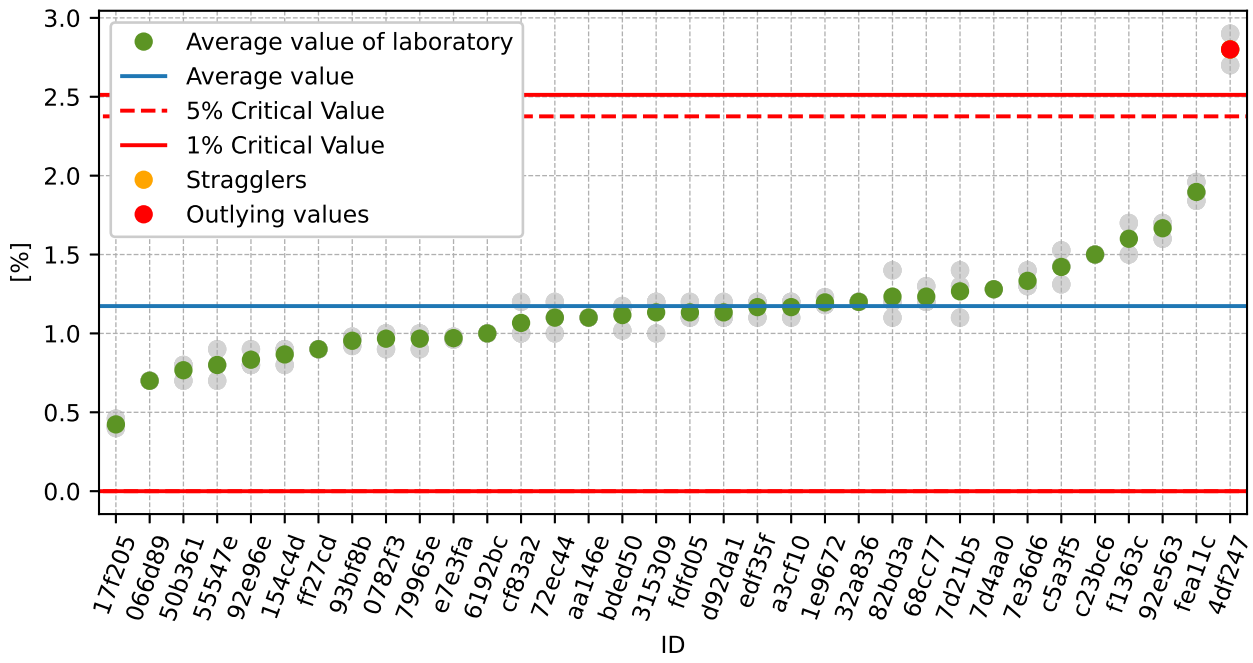

Figure 167: **Grubbs' test** - average values

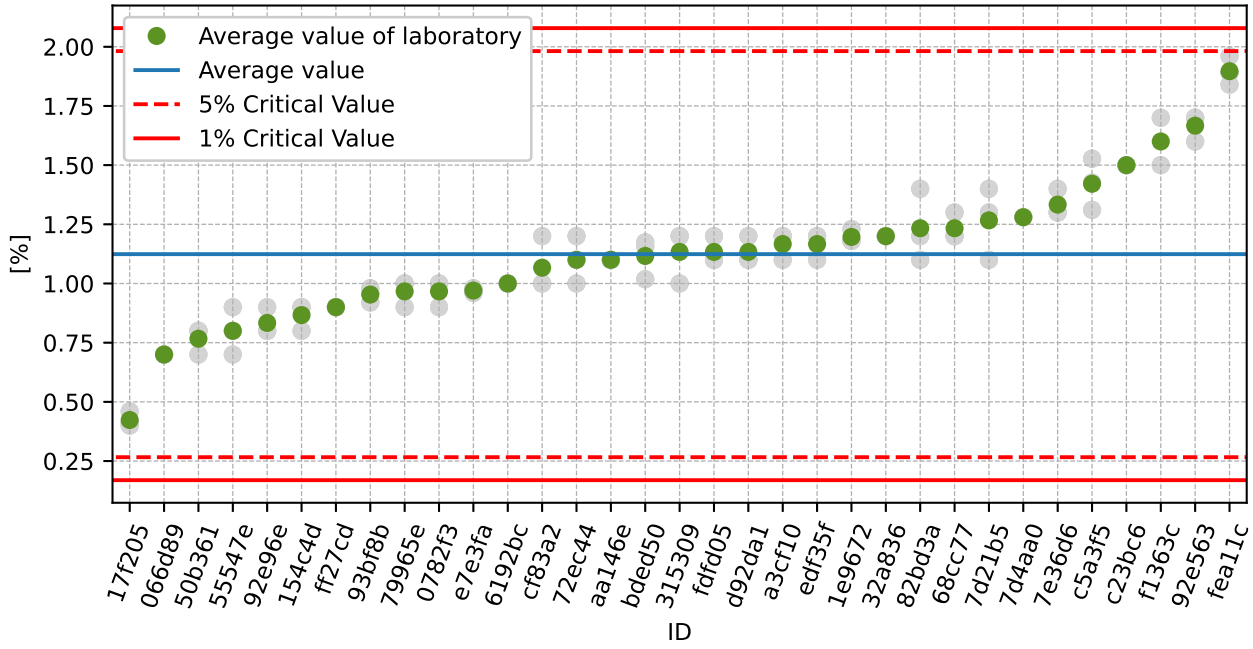

Figure 168: **Grubbs' test** - average values without outliers

12.2.3 Mandel's Statistics

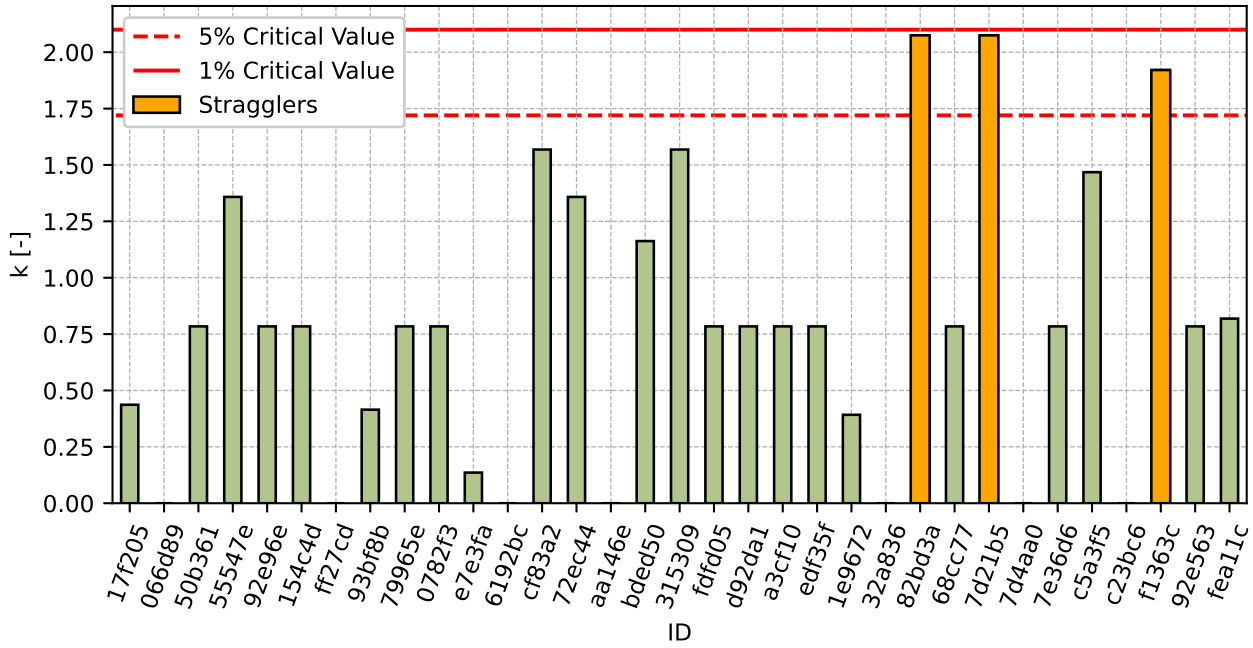

Figure 169: Intralaboratory Consistency Statistic

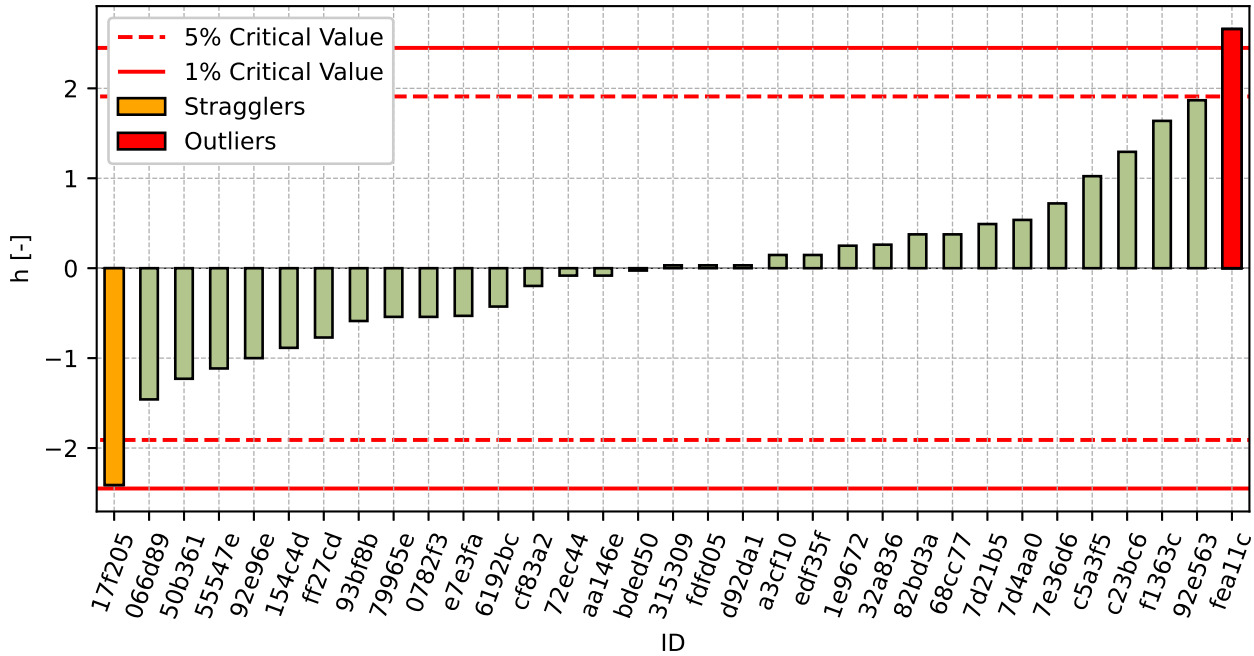

Figure 170: Interlaboratory Consistency Statistic

12.2.4 Descriptive statistics

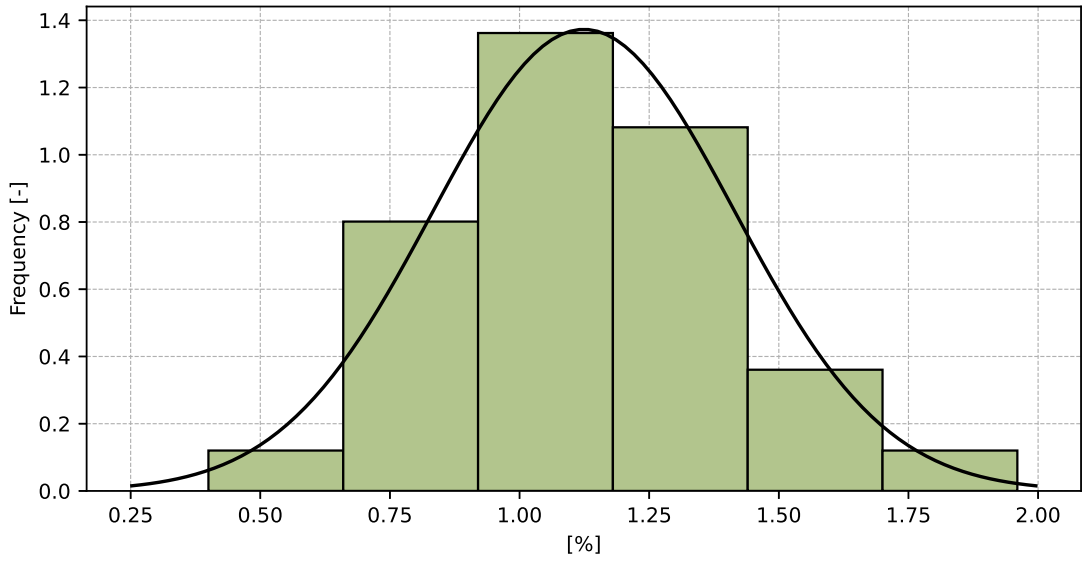

Figure 171: Histogram of all test results

Table 57: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	1.1
Sample standard deviation – s	0.29
Asigned value – x^*	1.1
Robust standard deviation – s^*	0.28
Measurement uncertainty of asigned value – u_X	0.06
p-value of normality test	1.0 [-]
Interlaboratory standard deviation – s_L	0.29
Repeatability standard deviation – s_r	0.07
Reproducibility standard deviation – s_R	0.3
Repeatability – r	0.2
Reproducibility – R	0.8

12.2.5 Evaluation of Performance Statistics

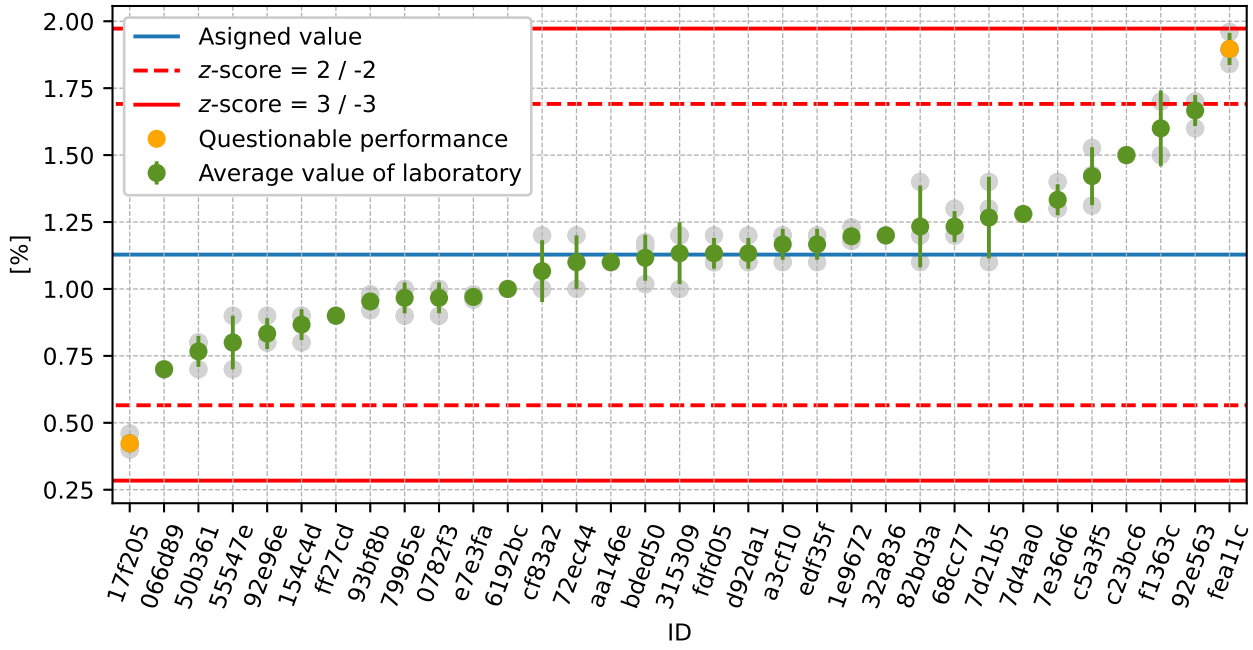

Figure 172: Average values and sample standard deviations

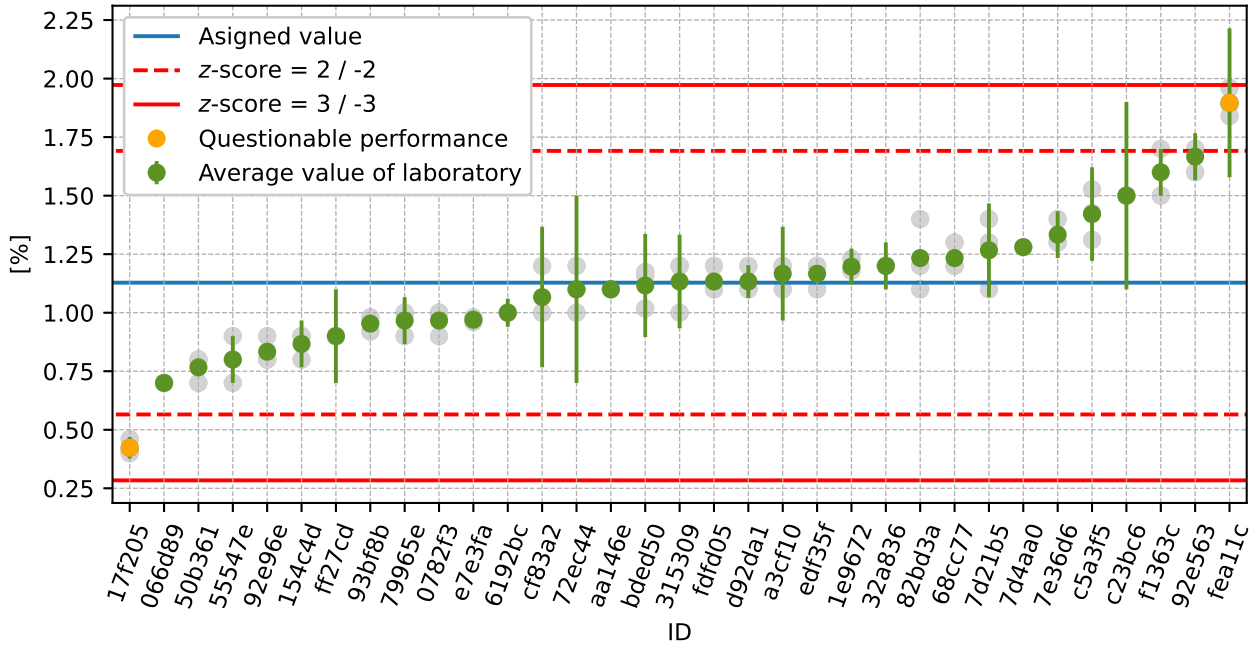

Figure 173: Average values and extended uncertainties of measurement

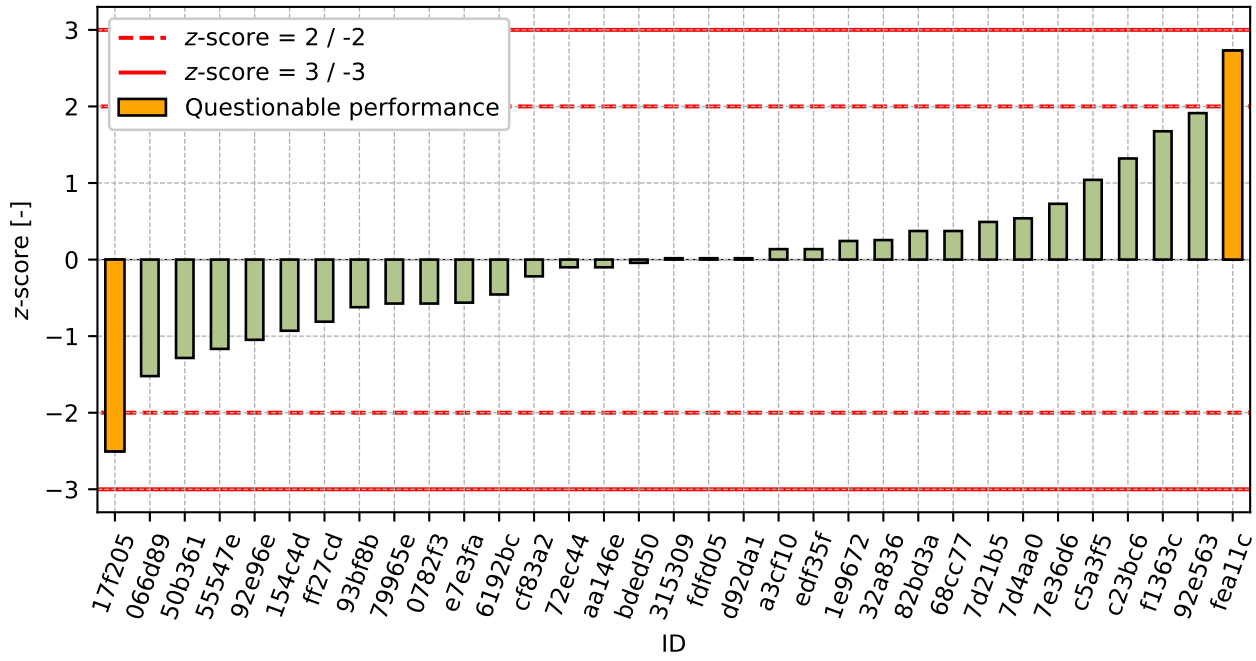

Figure 174: z-score

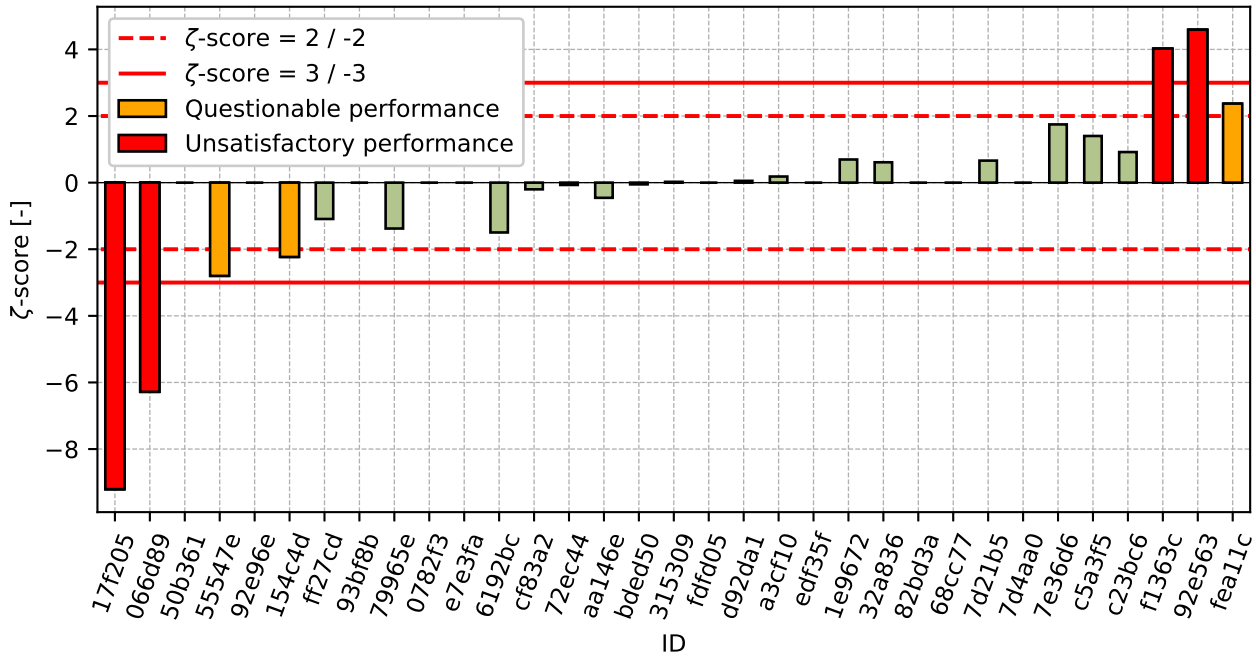

Figure 175: ζ-score

Table 58: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
17f205	-2.5	-9.2
066d89	-1.52	-6.28
50b361	-1.28	-
55547e	-1.17	-2.8
92e96e	-1.05	-
154c4d	-0.93	-2.23
ff27cd	-0.81	-1.09
93bf8b	-0.62	-
79965e	-0.57	-1.38
0782f3	-0.57	-
e7e3fa	-0.56	-
6192bc	-0.46	-1.5
cf83a2	-0.22	-0.2
72ec44	-0.1	-0.07
aa146e	-0.1	-0.46
bded50	-0.04	-0.05
315309	0.02	0.02
fdfd05	0.02	-
d92da1	0.02	0.05
a3cf10	0.14	0.18
edf35f	0.14	-
1e9672	0.24	0.69
32a836	0.25	0.61
82bd3a	0.37	-
68cc77	0.37	-
7d21b5	0.49	0.66
7d4aa0	0.54	-
7e36d6	0.73	1.75
c5a3f5	1.04	1.4
c23bc6	1.32	0.92
f1363c	1.68	4.02
92e563	1.91	4.59
fea11c	2.73	2.37

13 Appendix – EN 1097-7 Determination of the particle density of filer - Pyknometer method

13.1 Test results

Table 59: Test results - ordered by average value. Outliers are marked by red color. u_X - extended uncertainty of measurement.

ID	Test results [Mg/m^3]	u_X [Mg/m^3]
0fe6b5	2.7	0.0
2d41fb	2.71	0.02
52d231	2.72	-
72ec44	2.73	0.02
7d21b5	2.74	0.02

13.2 The Numerical Procedure for Determining Outliers

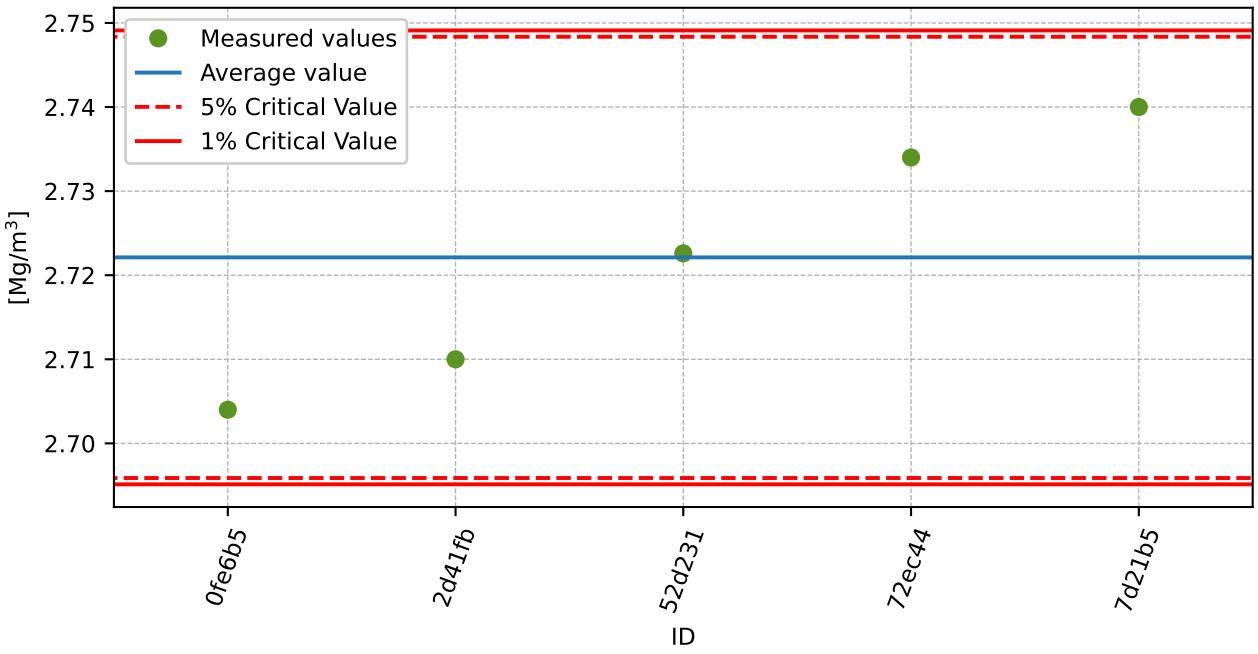

Figure 176: **Grubbs' test** - average values

13.3 Mandel's Statistics

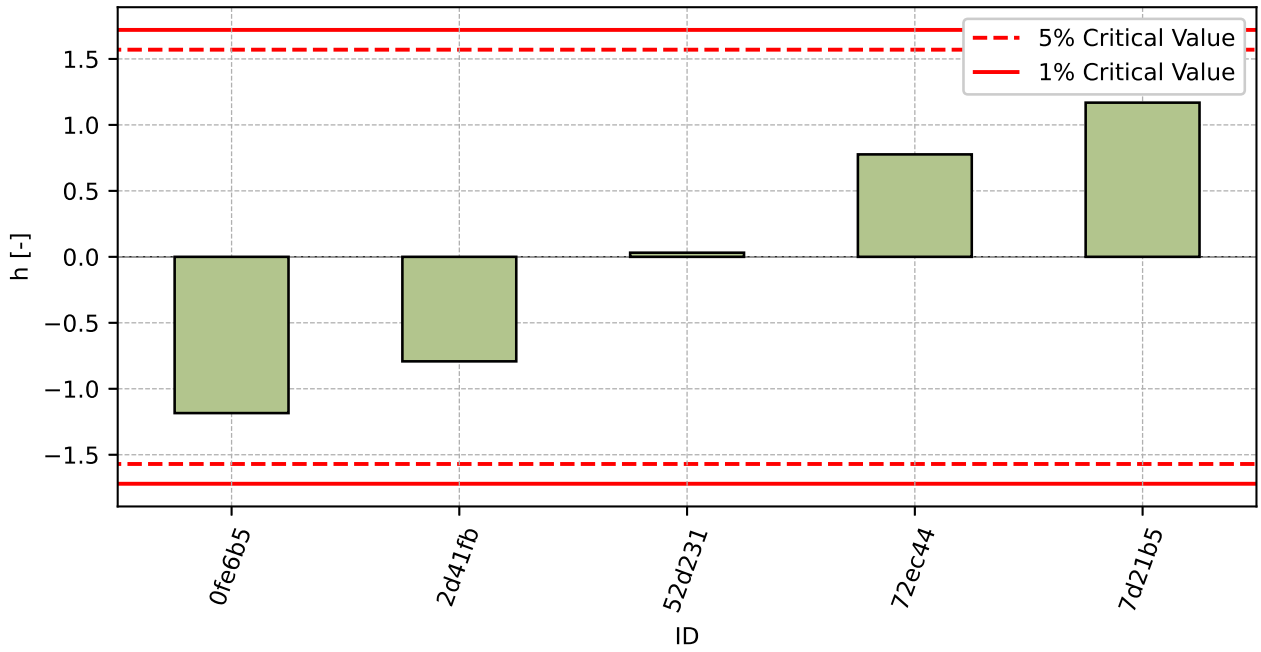

Figure 177: Interlaboratory Consistency Statistic

13.4 Descriptive statistics

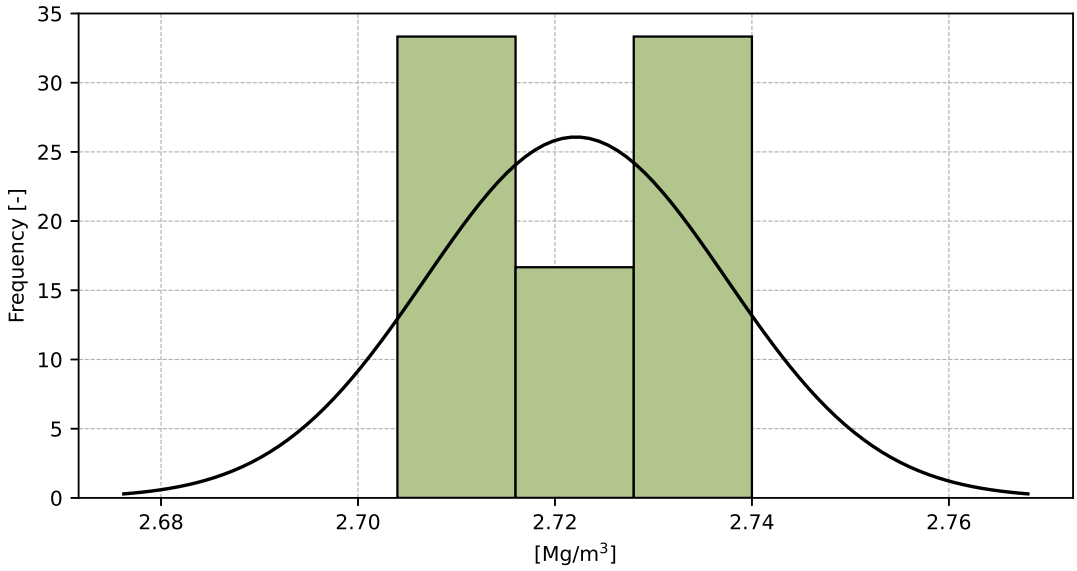

Figure 178: Histogram of all test results

Table 60: Descriptive statistics

Characteristics	[Mg/m^3]
Average value – $\bar{x}$	2.72
Sample standard deviation – s	0.015
Asigned value – x^*	2.72
Robust standard deviation – s^*	0.016
Measurement uncertainty of asigned value – u_X	0.009
p-value of normality test	0.69 [-]

13.5 Evaluation of Performance Statistics

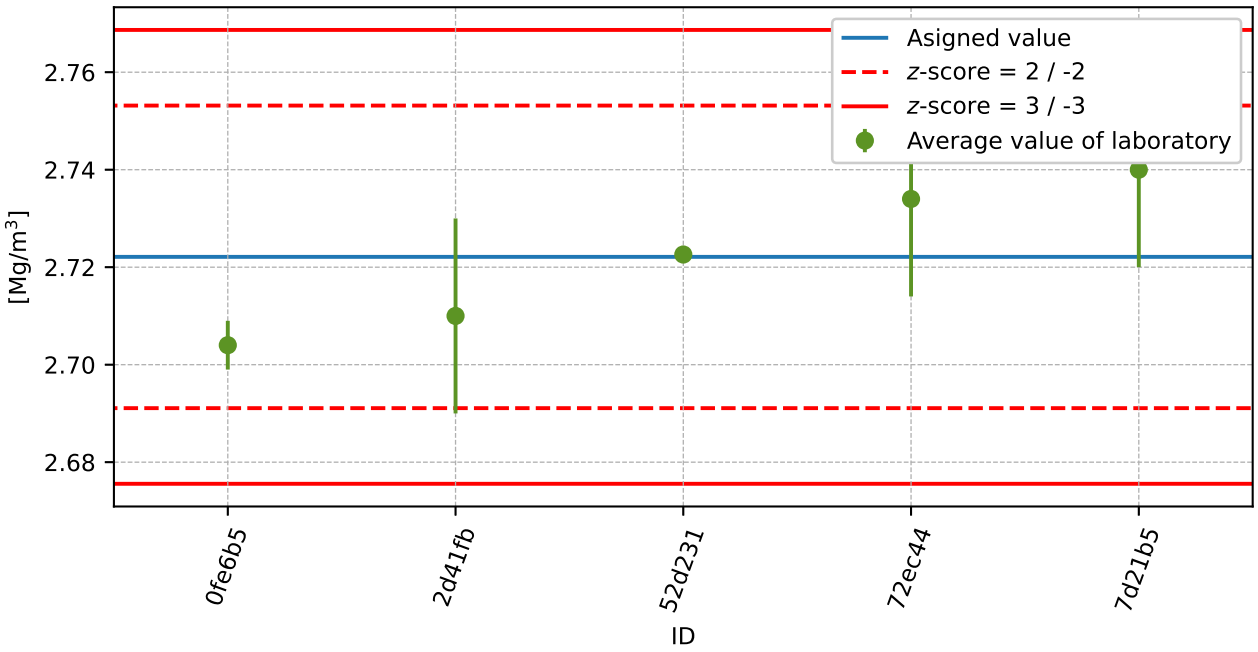

Figure 179: Average values and extended uncertainties of measurement

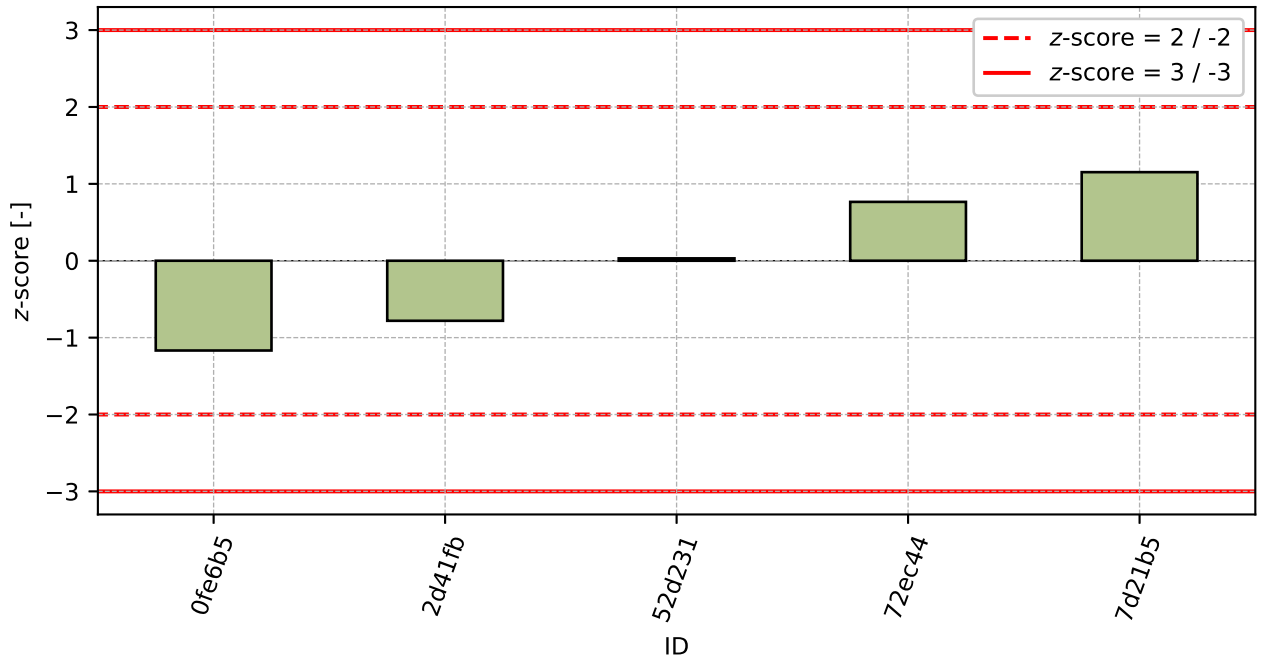

Figure 180: z-score

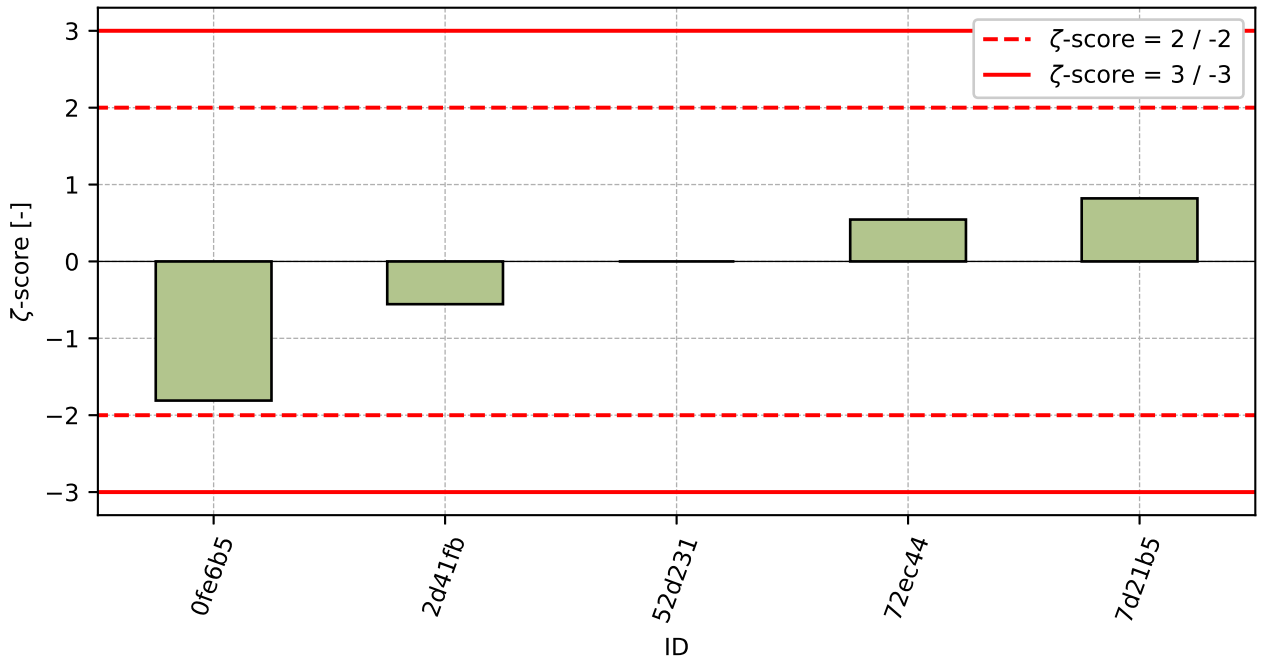

Figure 181: ζ-score

Table 61: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
0fe6b5	-1.17	-1.81
2d41fb	-0.78	-0.56
52d231	0.03	-
72ec44	0.77	0.54
7d21b5	1.15	0.82

14 Appendix – EN 1367-1 Determination of resistance to freezing and thawing

14.1 Test results

Table 62: 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 [%]
8da3cb	0.0	0.1	0.0	0.2	0.0	0.06	173.21
72ec44	0.1	0.2	0.1	0.8	0.1	0.06	43.3
55547e	0.2	0.2	0.2	0.0	0.2	0.0	0.0
315309	0.2	0.2	0.2	0.2	0.2	0.0	0.0
cf83a2	0.3	0.3	0.3	0.0	0.3	0.0	0.0
edf35f	0.3	0.3	0.3	-	0.3	0.0	0.0
52d231	0.3	0.3	0.3	-	0.3	0.02	6.79
0fe6b5	0.3	0.6	0.6	0.0	0.5	0.19	36.97
9f2452	0.8	0.5	0.7	0.4	0.7	0.15	22.91
968ceb	0.7	0.7	0.7	-	0.7	0.0	0.0

14.2 The Numerical Procedure for Determining Outliers

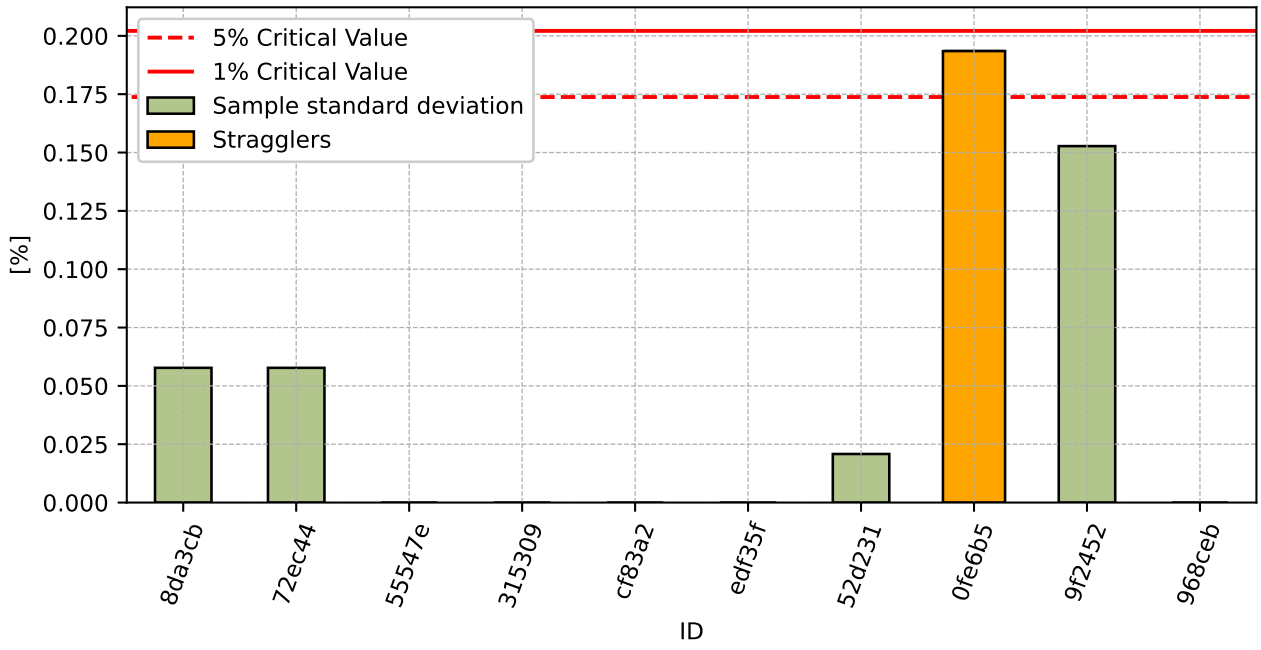

Figure 182: **Cochran's test** - sample standard deviations

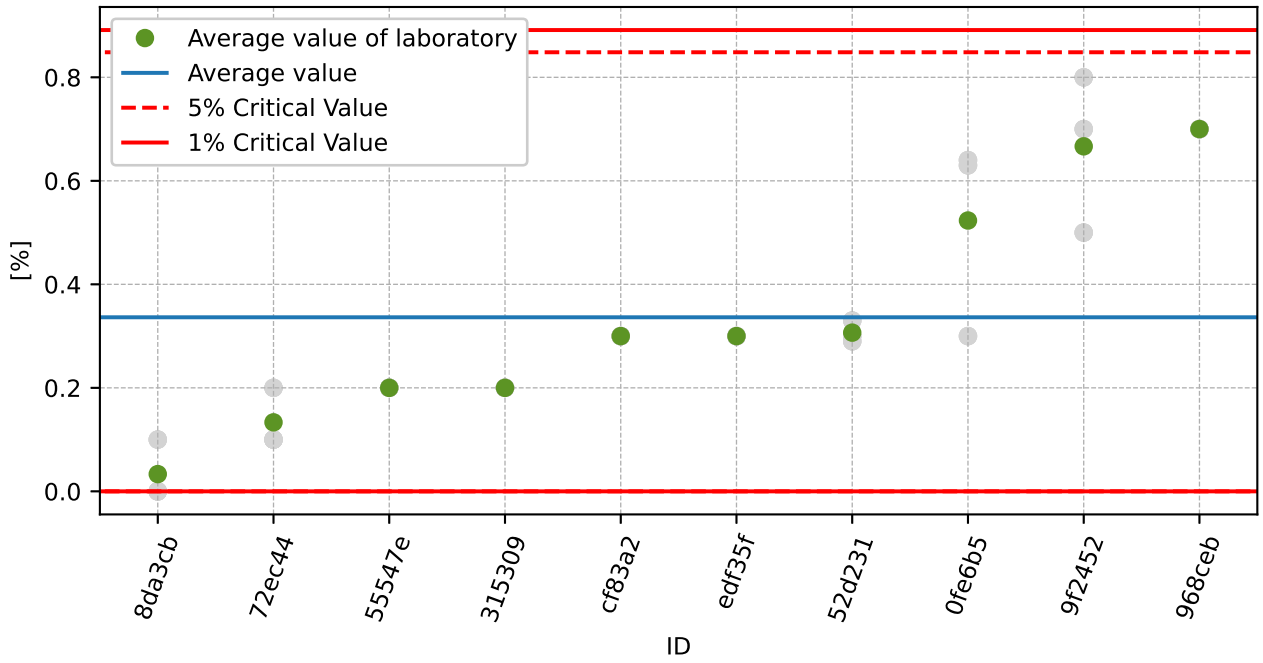

Figure 183: **Grubbs' test** - average values

14.3 Mandel's Statistics

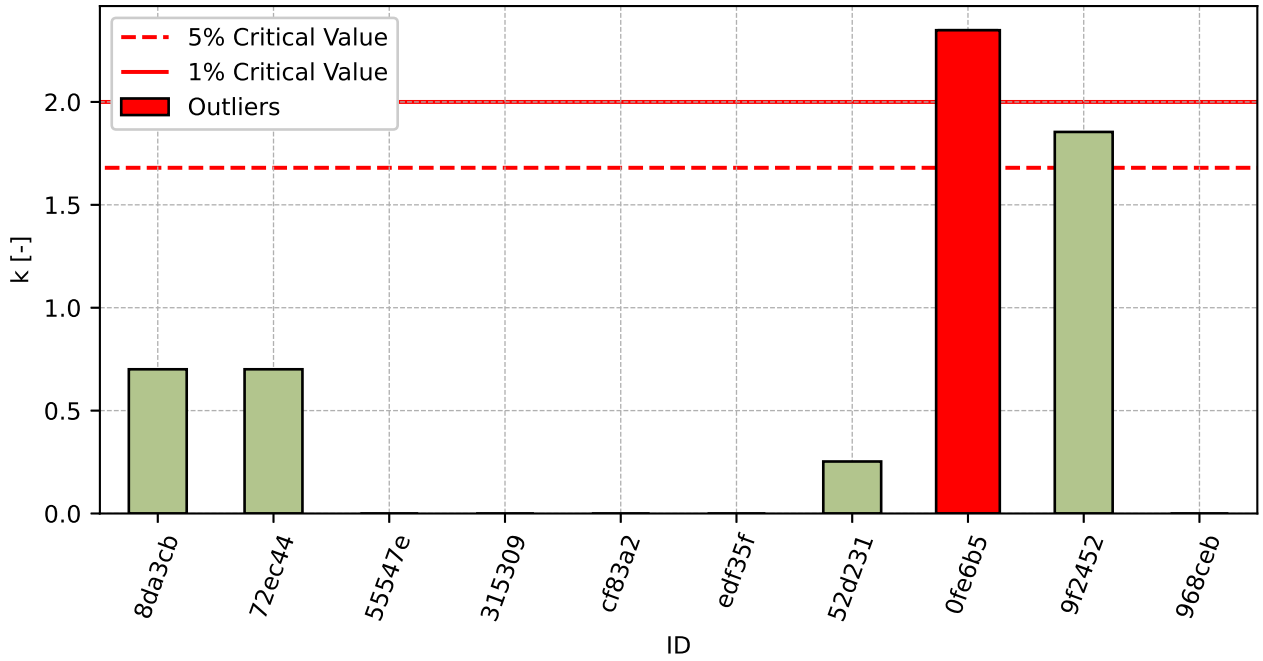

Figure 184: Intralaboratory Consistency Statistic

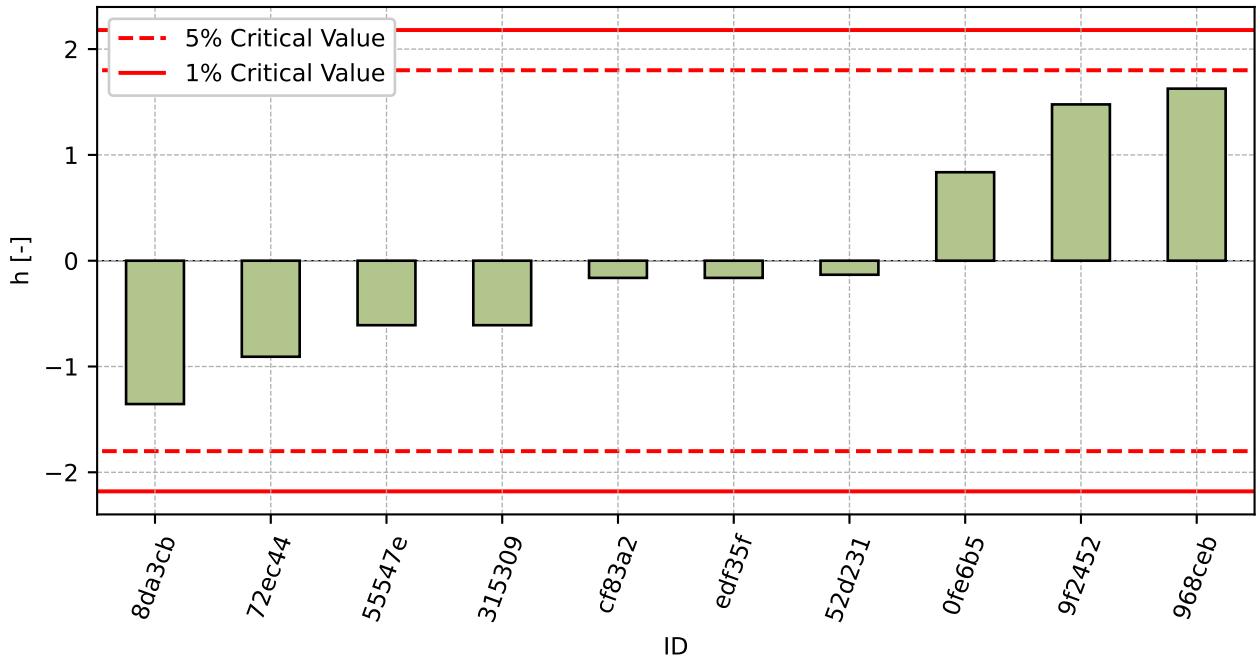

Figure 185: Interlaboratory Consistency Statistic

14.4 Descriptive statistics

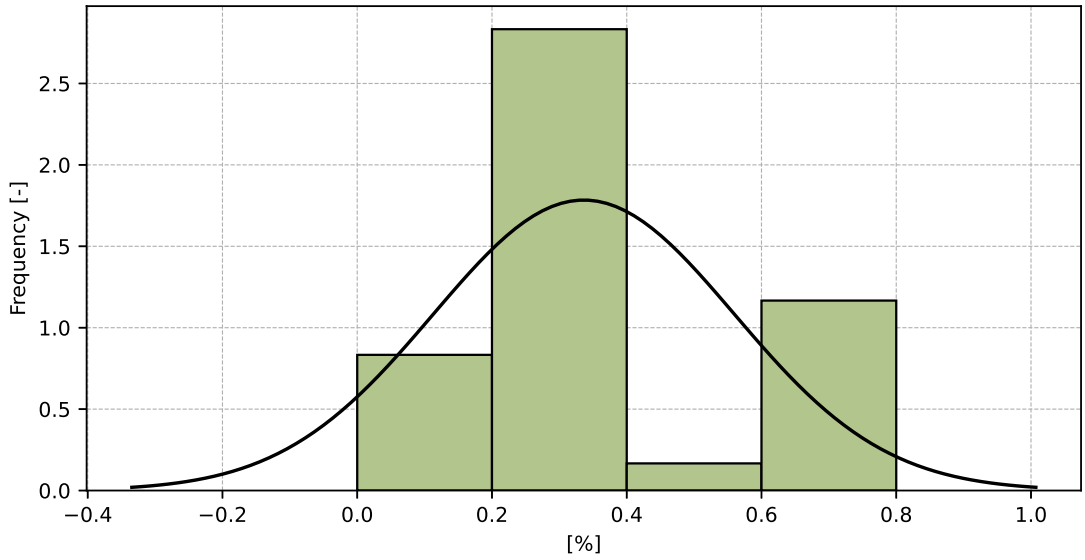

Figure 186: Histogram of all test results

Table 63: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	0.3
Sample standard deviation – s	0.22
Asigned value – x^*	0.3
Robust standard deviation – s^*	0.23
Measurement uncertainty of asigned value – u_X	0.09
p-value of normality test	0.003 [-]
Interlaboratory standard deviation – s_L	0.22
Repeatability standard deviation – s_r	0.08
Reproducibility standard deviation – s_R	0.23
Repeatability – r	0.2
Reproducibility – R	0.7

14.5 Evaluation of Performance Statistics

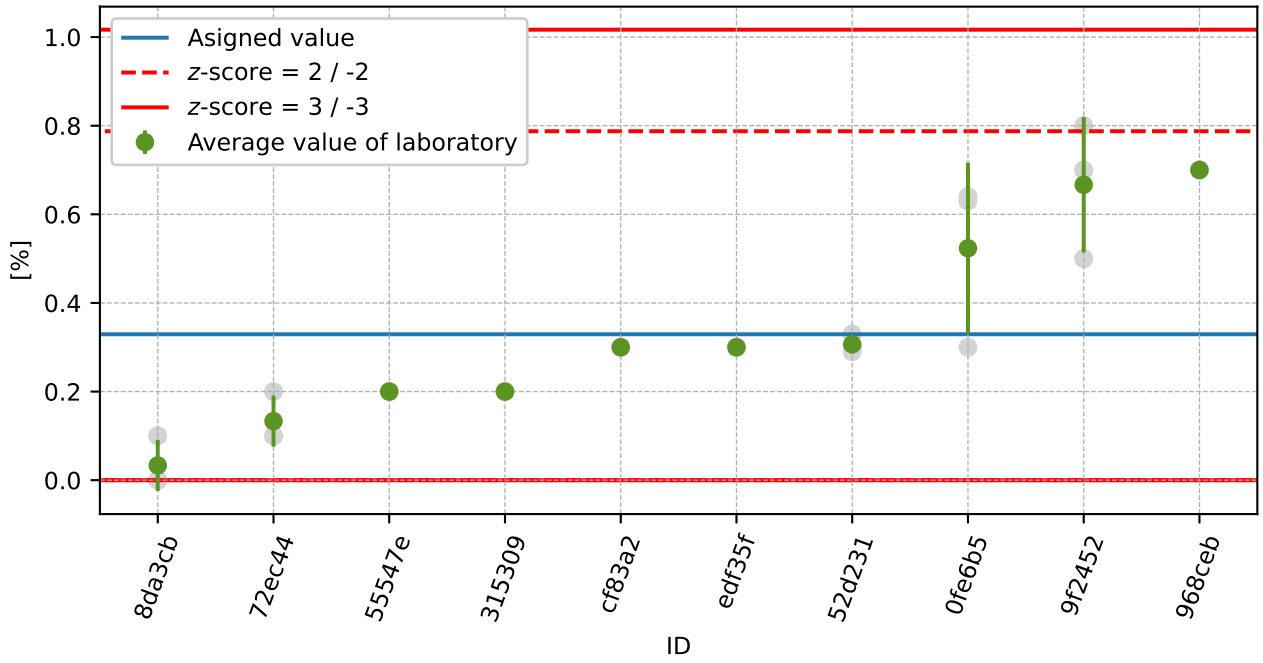

Figure 187: Average values and sample standard deviations

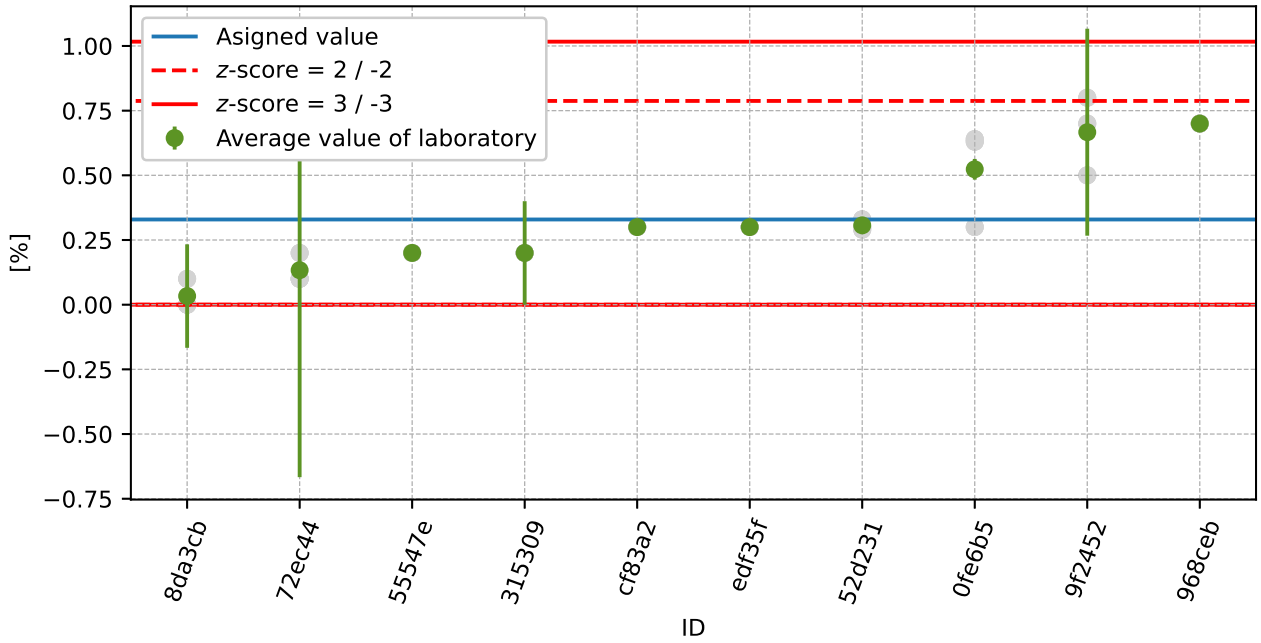

Figure 188: Average values and extended uncertainties of measurement

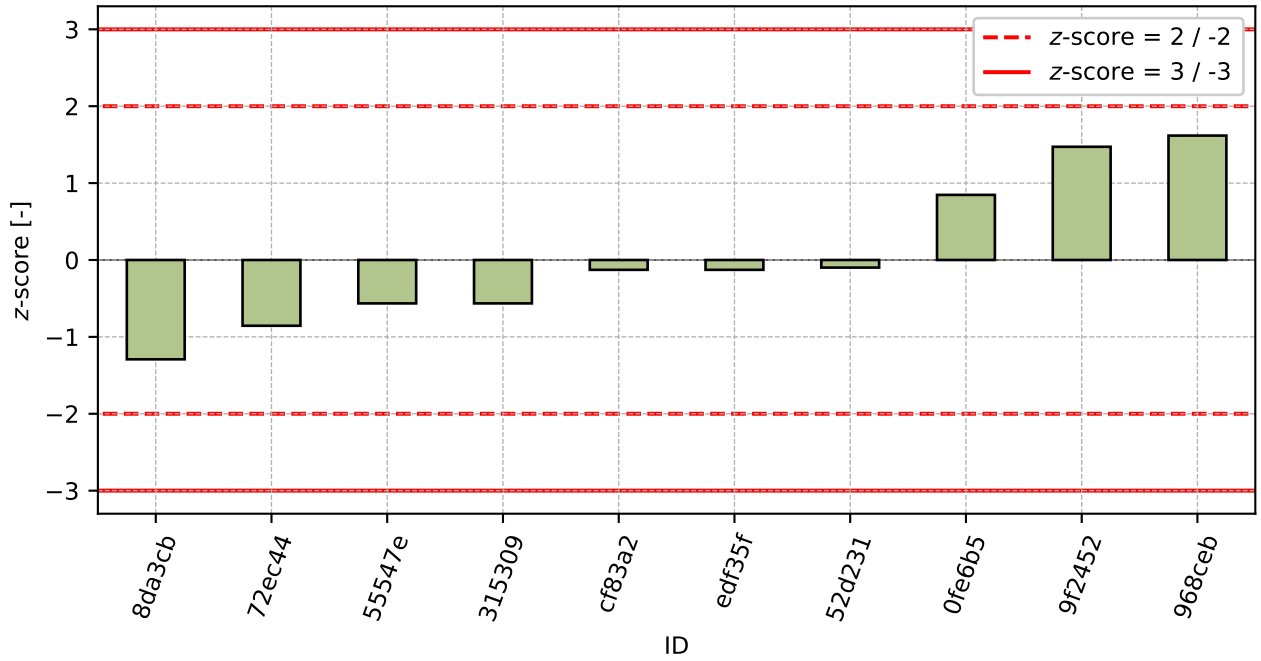

Figure 189: z-score

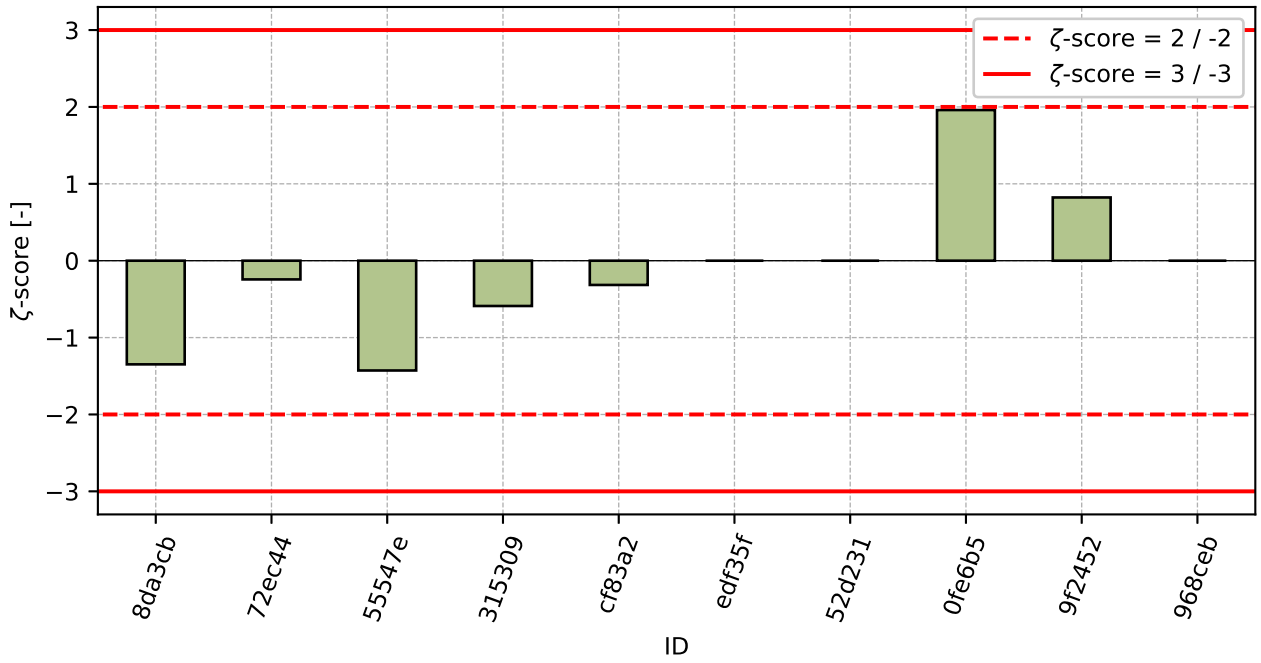

Figure 190: ζ-score

Table 64: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
8da3cb	-1.29	-1.35
72ec44	-0.86	-0.24
55547e	-0.56	-1.43
315309	-0.56	-0.59
cf83a2	-0.13	-0.32
edf35f	-0.13	-
52d231	-0.1	-
0fe6b5	0.85	1.96
9f2452	1.47	0.82
968ceb	1.62	-

15 Appendix – EN 1367-2 Magnesium sulfate test

15.1 Test results

Table 65: Test results - ordered by average value. Outliers are marked by red color. u_X - extended uncertainty of measurement.

ID	Test results [%]	u_X [%]
315309	2.6	2.0
066d89	6.8	0.8
7d4aa0	10.3	0.4
92e96e	11.0	-
5bcbfa	12.8	-
aa146e	14.0	0.1
bded50	16.0	9.5
4df247	21.2	-
c5a3f5	25.1	2.0

15.2 The Numerical Procedure for Determining Outliers

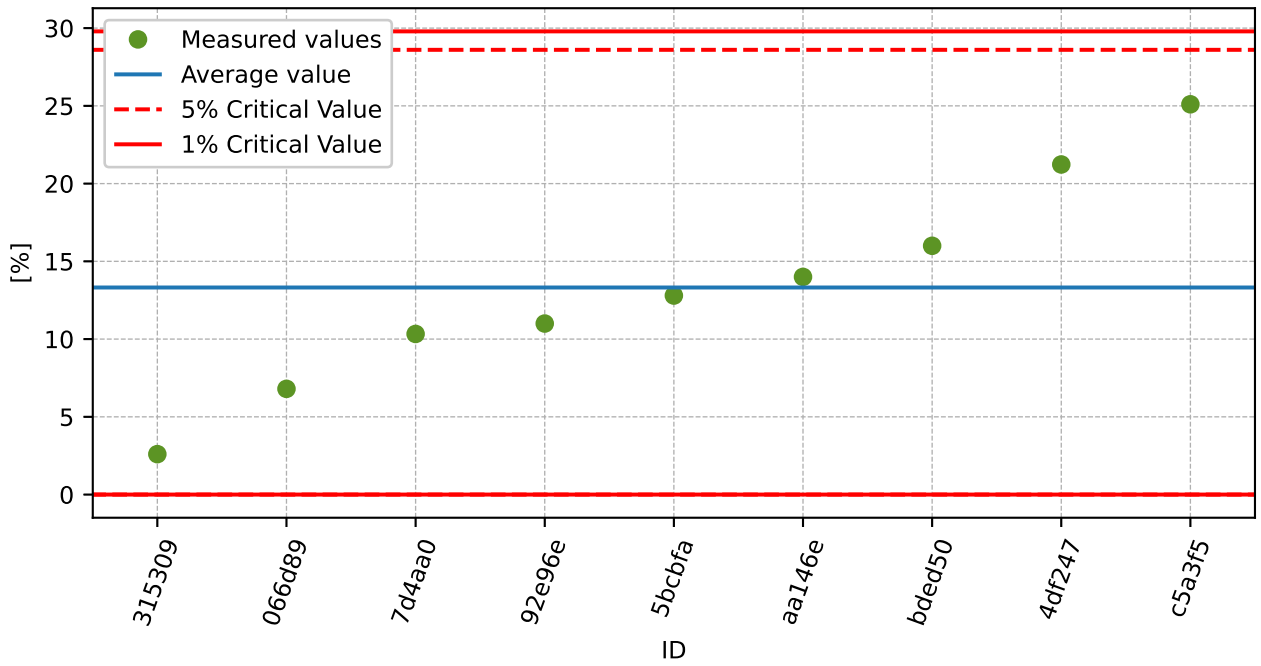

Figure 191: **Grubbs' test** - average values

15.3 Mandel's Statistics

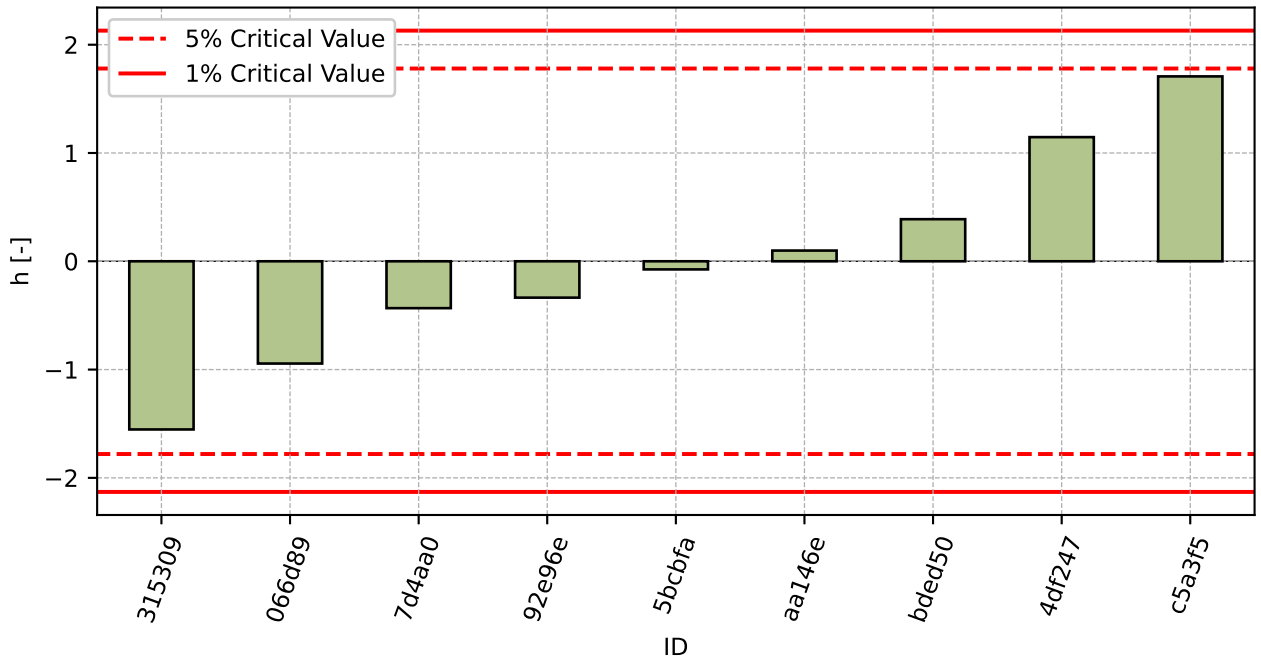

Figure 192: Interlaboratory Consistency Statistic

15.4 Descriptive statistics

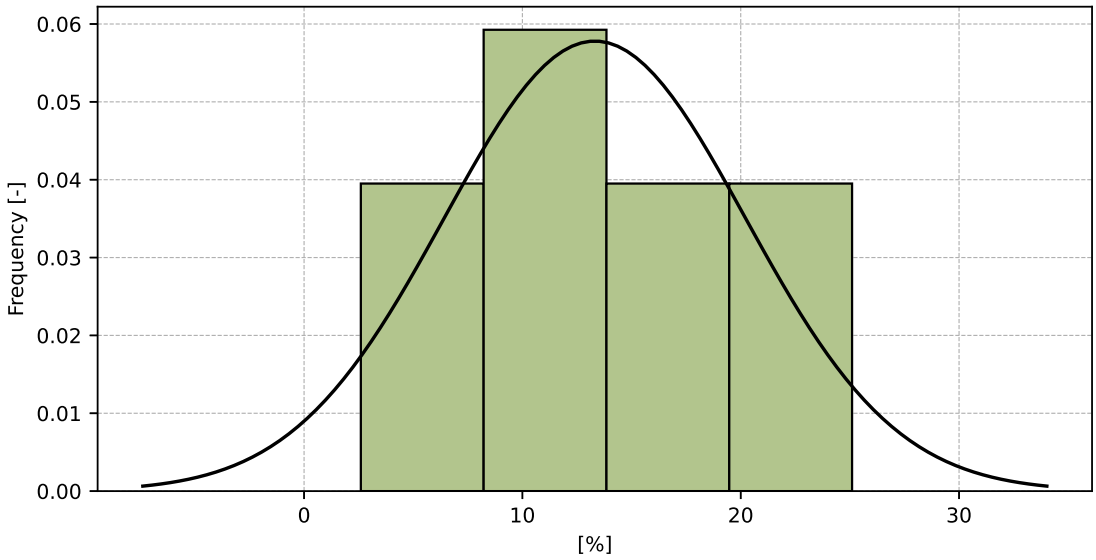

Figure 193: Histogram of all test results

Table 66: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	13.3
Sample standard deviation – s	6.9
Asigned value – x^*	13.5
Robust standard deviation – s^*	6.6
Measurement uncertainty of asigned value – u_X	2.75
p-value of normality test	0.969 [-]

15.5 Evaluation of Performance Statistics

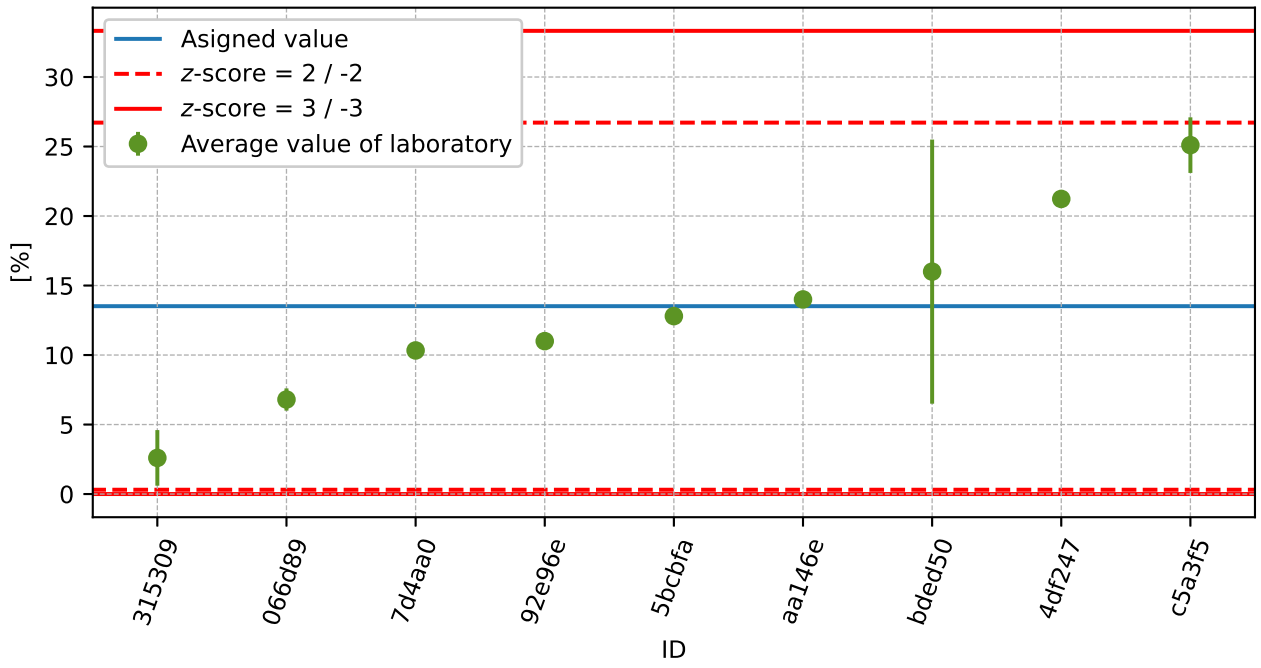

Figure 194: Average values and extended uncertainties of measurement

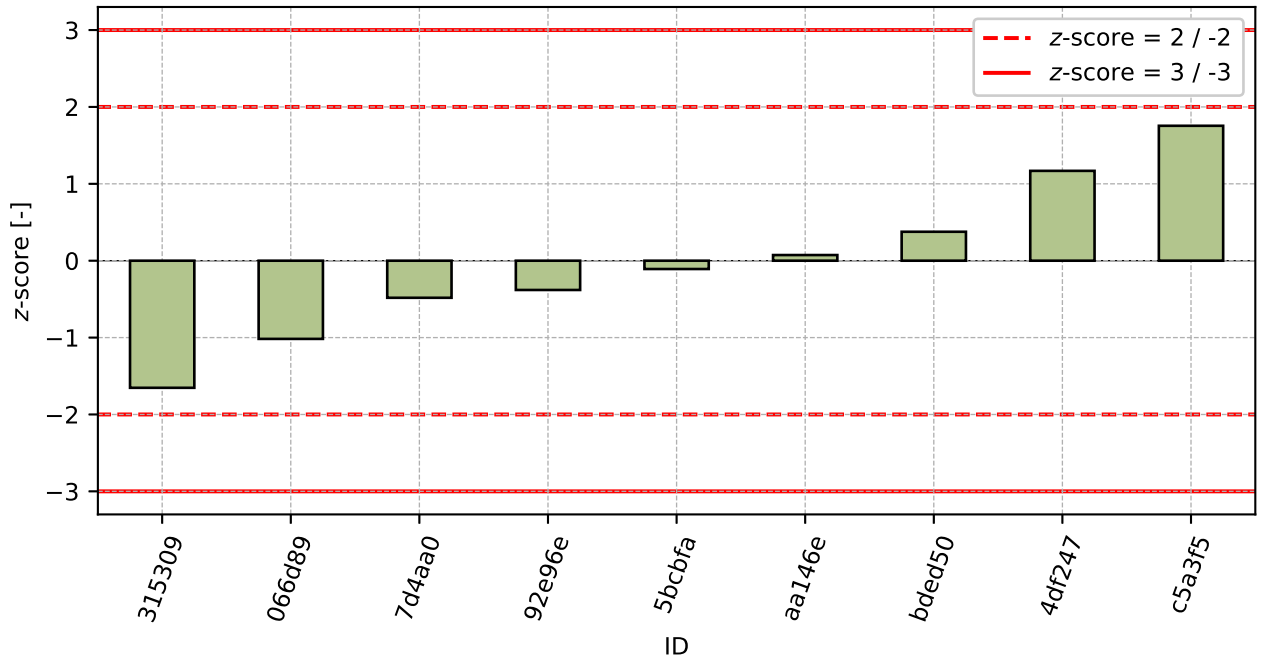

Figure 195: z-score

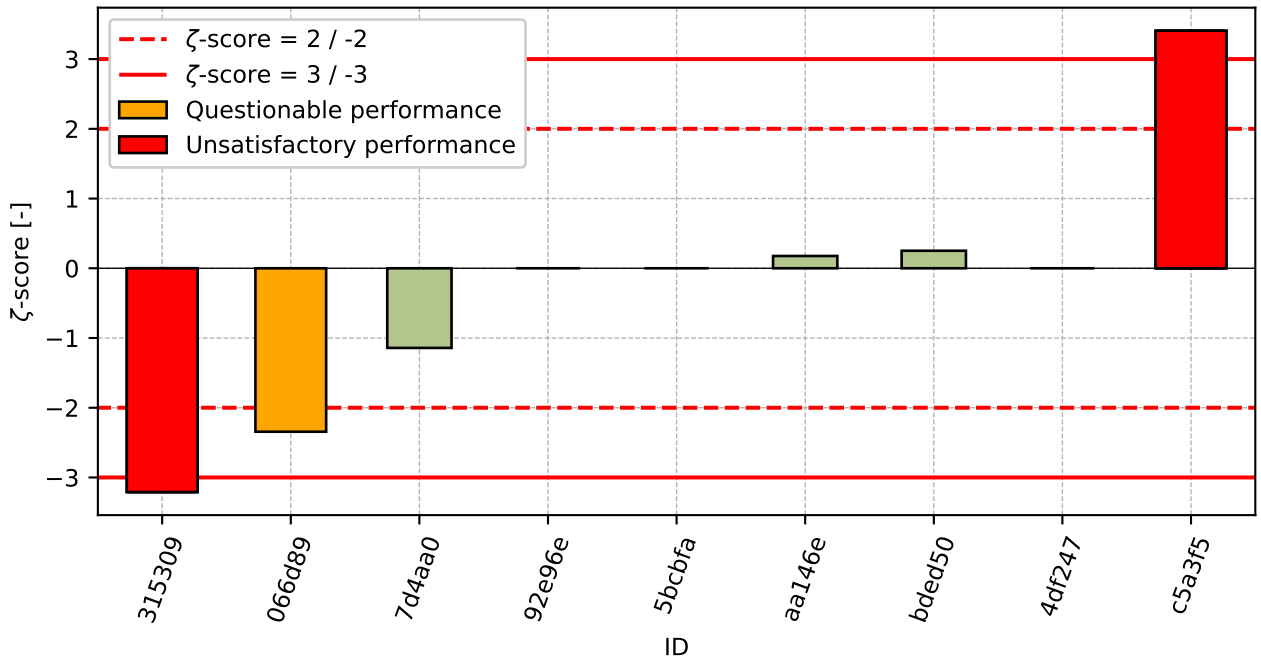

Figure 196: ζ-score

Table 67: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
315309	-1.65	-3.21
066d89	-1.02	-2.34
7d4aa0	-0.48	-1.14
92e96e	-0.38	-
5bcbfa	-0.11	-
aa146e	0.07	0.18
bded50	0.38	0.25
4df247	1.17	-
c5a3f5	1.75	3.41

16 Appendix – EN 1367-3 Boiling test for "Sonnenbrand basalt"

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

17 Appendix – TP 137 - Příloha 1 a 2 – Reaktivnost kameniva s alkáliemi

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

18 Appendix – ČSN 72 1179 Determination of reactivity of aggregates in connection with alkalies – chapter B

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