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 2025/1

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: July 2, 2025

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 2024, the Proficiency Testing Provider at SZK FAST (PoZZ) launched a Proficiency Testing Programme (PrZZ), designated ZK 2025/1, 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@vut.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@vut.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.

76 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
76d7ce	-	-	-	-	-	-	X	-	-	-	-	-	-	X	-	-	-	-
dd3919	X	-	-	X	-	-	X	X	-	-	-	X	-	-	-	-	-	-
d6f710	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-
f38a37	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
a03a0c	X	-	-	X	-	-	-	X	-	-	X	-	-	-	-	-	-	-
00c812	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
41bbcc	X	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-
c4b5f2	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
51d578	X	X	-	-	X	-	X	X	-	X	X	X	-	-	-	-	-	-
247e09	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
79f92f	X	X	-	-	X	-	X	X	-	-	-	X	-	-	-	-	-	-
46b491	X	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
2001a8	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
b648a0	X	X	-	-	-	-	-	-	-	X	X	-	-	X	-	-	-	-
300664	X	-	X	-	X	-	-	-	-	-	X	-	-	-	-	-	-	-
8ab3c0	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0d1159	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-
fa21fc	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
22cd3b	-	-	-	-	-	-	X	-	-	-	-	-	-	X	-	-	-	-
9ada5d	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
645c7c	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
02e7a9	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
c284dc	X	-	X	-	-	-	-	-	-	X	X	-	-	-	-	-	-	-
4787b2	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
ae8d08	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
f66f28	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
dbb4c3	X	X	X	-	-	-	X	X	-	X	X	-	-	X	X	-	-	-
923983	-	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
29f085	-	-	-	-	-	-	X	X	-	X	X	X	-	-	-	-	-	-
49455c	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-
3b0dca	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
c6c5dd	X	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
3afef0	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6f53c5	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
98272a	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
33b78c	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
44e308	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
c66d80	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
46465b	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4639b4	X	X	X	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-
771a16	X	-	X	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-
af953e	X	-	X	-	-	-	-	-	-	-	X	X	-	X	-	-	-	-
fd6a2c	X	-	X	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-
338553	X	-	X	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-
046607	X	X	-	X	X	-	-	X	-	-	-	X	-	-	X	-	-	-
1693e7	X	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
ce4914	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
b4b14f	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18da8e	X	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
b648c0	X	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
97676c	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1a5284	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4c6ddd	X	-	X	-	-	-	-	X	-	-	X	-	-	-	-	-	-	-
028c7e	X	-	-	-	-	-	-	X	-	X	X	X	-	-	-	-	-	-
64222a	-	-	-	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-
362270	X	-	X	-	-	-	-	X	-	-	-	X	-	-	-	-	-	-
c8cc78	-	-	-	-	X	-	-	-	-	-	-	-	-	X	-	-	-	-
c9c421	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
fc4d0d	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0214a2	-	-	-	-	-	-	-	X	-	-	-	X	-	X	-	-	-	-
a0ffe0	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-	-
e9a477	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-	-
eec547	X	X	-	-	X	-	X	X	-	-	-	X	-	X	-	-	-	-
0a063a	X	-	-	-	-	-	X	X	-	X	X	X	-	-	X	-	-	-
033508	-	-	X	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-
632c29	X	-	X	-	-	-	-	-	-	X	X	X	-	-	-	-	-	-
2ec012	X	-	X	-	-	-	-	X	-	X	X	-	-	-	-	-	-	-
f7fe0f	X	-	-	X	X	-	-	X	-	-	-	-	-	-	-	-	-	-
944de6	X	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-
ba5283	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
170637	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
5fdea4	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
226a97	X	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11fdb1	X	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
a866a4	-	-	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-

Table 2: List of participants (laboratories) – the order in the table does not correspond to the identification number in previous table

Laboratory	Address	Accreditation number
”STROIKONTROL 2003”LTD	Kostenetz str 12, Sifia, 1612, Bulgaria	182 LI

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Laboratory	Address	Accreditation number
AD "VOJVODINAPROJEKT"	Bulevar kralja Petra I 17, Novi Sad, 21000, Serbia	ATS 01-354
ARP GmbH	Johann-Sackl-Gasse 65-67, Leoben, 8700, Austria	-
ASCHEM di Dott. Giulio Nervi	Via Piave 21/4, Ovada, 15076, Italy	-
BETONTEST, spol. s r. o.	Trnkova 3083/162 628 00 Brno, Brno-Líšeň, 62800, Česká republika	1116
BETOTECH, s.r.o. - Pracoviště Beroun	Beroun 660, Beroun, 26601, Česká republika	1195
BETOTECH, s.r.o. - Pracoviště Jindřichův Hradec	Beroun 660, Beroun, 26601, Česká republika	1195
BETOTECH, s.r.o. - Pracoviště Most	Beroun 660, Beroun, 26601, Česká republika	1195
BETOTECH, s.r.o. - Pracoviště Trutnov	Beroun 660, Beroun, 26601, Česká republika	1195
BETOTECH, s.r.o. - pracoviště Brno	Beroun 660, Beroun, 26601, Česká republika	1195.3
Bechtel ENKA UK Limited Ogranak Beograd	Jasički put 52 đ, Kruševac, 37000, Serbia	-
Betotech s.r.o., laboratoř Mokrá	Beroun 660, Beroun, 266 01, Česká republika	1195.3
C.S.R. SRL CENTRO SVILUPPO RICERCHE	Strada Provinciale Mestrina, 46x, Noale (Venice), 30033, ITALY	-
CONCRELAB S.A.S.	Calle 63D No. 71A-70, Bogotá D.C., 111061, Colombia	09-LAB-001
CONSULTEST s.r.o. - pracoviště Brno	Medkova 974/4, Brno, 62700, Česká republika	-
Cement Hranice, akciová společnost - Betonářská laboratoř	Bělotínská 288, Hranice I - Město, 75301, Česká republika	1284
Cemex Czech Republic s.r.o.	Plzeňská 3217/16, Praha 5, 15000, Česká republika	1302
DIGITAL SOIL FACILITY MANAGEMENT	Krommewege 31G, Maldegem, 9990, België	409-TEST
DSP a.s.	Kostěnice 111, Kostěnice, 530 02, Česká republika	1782
EDAFOMICHANIKI S.A.	19 EMMANUEL PAPADAKI, NEO IRAKLEIO, 14121, GREECE	1269
EUROCERT TESTING IKE ATHANASIADIS STATHIS	89 Chlois St., Metamorphosi, GR 14452, Greece	-
FERRIERE NORD S.P.A.	Zona Industriale Rivoli di Osoppo, Osoppo, 33010, Italy	-
GEODRILL s.r.o.	K Bukovinám 169/45, Brno, 63500, Česká republika	1596
GEOtest, a.s.	Šmahova 1244/112, Brno, 62700, Česká republika	1271
Holcim (Hrvatska) d.o.o.	Koromačno 7b, Koromačno, 52222, Hrvatska	1528

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Laboratory	Address	Accreditation number
Institut pro testování a certifikaci, a.s.	třída Tomáše Bati 5264, areál Svit, 113. budova, Zlín, 760 01, Česká republika	1007.1
Institut technologie a testování betonu, s.r.o., Zkušební laboratoř ITTB Brno	Medkova 974/4, Brno - Tuřany, 62700, Česká republika	L1778
Kilsaran Concrete Unlimited Company - Ballinascorney	Piercetown, Dunboyne, Co.Meath, A86 W820, Ireland	241T
Kilsaran Concrete Unlimited Company - Clonee	Piercetown, Dunboyne, Co.Meath, A86 W820, Ireland	241T
Kilsaran Concrete Unlimited Company - Gallstown	Piercetown, Dunboyne, Co.Meath, A86 W820, Ireland	241T
Kilsaran Concrete Unlimited Company - Rossmore	Piercetown, Dunboyne, Co.Meath, A86 W820, Ireland	241T
Kilsaran Concrete Unlimited Company - Tullamore	Piercetown, Dunboyne, Co.Meath, A86 W820, Ireland	241T
Kiwa GmbH	Grüner Deich 1, Hamburg, 20097, Germany	D-PL-11217-01-01
Kiwa KOAC	Wilmersdorf 50, Wilmersdorf, 50, Nederland	RvA L007
Koridorisrbije d.o.o. Beograd	Kralja Petra 21, Belgrade, 11000, Srbija	-
Laboratorium Drogowe Szczecin Sp. z o.o.	Tama Pomorzańska 13L, Szczecin, 70-030, Polska	AB1806
Liviu Talos	Sângerului, Bucharest, 014617, Other	-
MIRTEC S.A., THIVA BRANCH	76th km of Athens-Lamia National Road (Ritsona exit), Schimatari, Boeotia, 32009, Greece	-
Mining and Metallurgy Institute Bor	Albert Ajnstajn 1, Bor, 19210, Serbia	01-308, ATS Serbia
Northern Regional Laboratory	Lot 7130, Block 1, Lambir Land District, Jalan Miri Bypass, Miri, 98000, Sarawak, Malaysia	-
Pavement Research Laboratory University of Belgrade, Faculty of Civil Engineering	Bul. kralja Aleksandra 73, Belgrade, 11000, Serbia	-
RECHLAB	104 Abou Techfinne, Tlemcen, 13000, ALGERIE	-
SQZ, s.r.o. - pracoviště Bílý Kámen	939/5 U místní dráhy, Olomouc, 779 00, Česká republika	1135.1
SQZ, s.r.o. - pracoviště Chvaletice	939/5 U místní dráhy, Olomouc, 779 00, Česká republika	1135.1
SQZ, s.r.o. - pracoviště Dobřany	939/5 U místní dráhy, Olomouc, 779 00, Česká republika	1135.1
SRL "FISTFOG"	Albisoara 70, ap. 25, Chisinau, 2005, Moldova	-
Sibotec	Industriepark Oost 6, Beernem, 8730, Belgium	-

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Laboratory	Address	Accreditation number
Skanska Transbeton, s.r.o. - Zkušební laboratoř Letňany	Skanska a.s., Křižíkova 682/34a, Praha 8 - Karlín, 186 00, Česká republika	1122
Skanska Transbeton, s.r.o. - Zkušební laboratoř Olomouc	Skanska a.s., Křižíkova 682/34a, Praha 8 - Karlín, 186 00, Česká republika	1122
Structural Soils Ltd	Stuart Edmunds, Structural Soils Ltd, Unit 1A Princess Street, Bedminster, Bristol, BS3 4AG, Bristol	-
TEPVERAM s.r.o.	Třibřichy 13, Třibřichy, 537 01, Česká republika	1759
TESTAROSA, s.r.o.	Pribylinská 12, Bratislava - mestská časť Rača, 831 04, Slovenská republika	-
TESTSTAV group s.r.o.	Orlovská 347/160, Ostrava, 71300, Česká republika	1290
TPA Spoločnosť pre zabezpečenie kvality a inovácie s.r.o. - pracovisko Geča	Neresnická cesta 3, Zvolen, 96001, Slovenská republika	211/S-176
TPA Spoločnosť pre zabezpečenie kvality a inovácie s.r.o. - pracovisko Podunajské Biskupice	Neresnická cesta 3, Zvolen, 96001, Slovenská republika	211/S-176
TPA Spoločnosť pre zabezpečenie kvality a inovácie s.r.o. - pracovisko Zvolen	Neresnická cesta 3, Zvolen, 96001, Slovenská republika	211/S-176
TPA ČR, s.r.o.	Vrbenská 1821/31, České Budějovice, 370 06, Česká republika	1181
TRANSLAB	Oeverstraat 21, Lokeren, 9160, Belgium	-
TZÚS Praha, s.p.	Nemanická 441/8, České Budějovice, 37010, Česká republika	1018.3
Technický a zkušební ústav stavební Praha, s.p.	U Studia 14, OSTRAVA, 70030, Česká republika	1018.3
Technický a zkušební ústav stavební Praha, s.p.	Prosecká 811/76a, Praha 9, 19000, Česká republika	1018.3
Technický a zkušební ústav stavební Praha, s.p.	Tolstého 447, Teplice, 41503, Česká republika	1018.3
Technický a zkušební ústav stavební Praha, s.p., Pobočka Plzeň	Zahradní 15, Plzeň, 326 00, Česká republika	1018.3
TesTec	Max Hermanlei 35, Brasschaat, 2930, Antwerpen	-
UAB Laboratoriniu bandymu centras	R.Kalantos st. 85a., Kaunas, 45293, Lithuania	LA.01.002
VIALAB CZ s.r.o. - laboratoř oblast LOMY, pracoviště LL1/Těškov	MUCODE 1593, PO Box 207 - emailová adresa pro doručení faktur: vialab.faktury@vinci-construction.com Praha 6, 16041, Česká republika	1771

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Laboratory	Address	Accreditation number
VIALAB CZ s.r.o. - laboratoř oblast LOMY, pracoviště LL3/Jakubčovice	MUCODE 1593, PO Box 207 - emailová adresa pro doručení faktur: vialab.faktury@vinci-construction.com, Praha 6, 16041, Česká republika	1771
Vysoké učení technické v Brně, Fakulta stavební, Zkušební laboratoř při ÚTHD FAST VUT v Brně	Veveří 331/95, Brno, 60200, Česká republika	L1396
Zavod za gradbeništvo Slovenije / Slovenian National Building and Civil Engineering Institute	Dimičeva ulica 12, Ljubljana, 1000, Slovenija	-
Zdravotní ústav se sídlem v Ústí nad Labem	Moskevská 15, Ústí nad Labem, 40001, Česká republika	1388
Zkušebna kamene a kameniva, s.r.o.	Husova 2274, Hořice, 508 01, Česká republika	1046
Zkušebna kameniva, s.r.o.	Fügnerova 64, Blatná, 38801, Česká republika	1141
i2 Analytical Limited Sp. z o.o. Oddział w Polsce	Pionierów 39, Ruda Śląska, 41-711, Polska	-
voestalpine Stahl Donawitz GmbH	Kerpelystrasse 199, Leoben, 8700, Austria	0362
Ředitelství silnic a dálnic s. p.	Čerčanská 2023/12, Praha 4 - Krč, 140 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 2025/1 (PT Program) organized by the PT Provider at the SZK FAST. 76 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 three 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
dd3919	✓	✓	✓	✓	✓	✓	✓
f38a37	✓	✓	✓	✓	✓	✓	✓
a03a0c	✓	✓	✓	✓	✓	✓	✓
00c812	✓	✓	✓	✓	✓	✓	✓
41bbcc	✓	✓	✓	✓	✓	✓	✓
51d578	?	✓	✓	✓	✓	✓	✓
247e09	✓	✓	✓	✓	✓	✓	✓
79f92f	✓	✓	✓	✓	✓	✓	✓
46b491	✓	✓	✓	✓	✓	✓	✓
2001a8	✓	✓	✓	✓	✓	✓	✓
b648a0	✓	✓	✓	✓	✓	✓	✓
300664	✓	✓	✓	✓	✓	✓	✓
8ab3c0	✓	✓	✓	✓	✓	✓	✓
c284dc	✓	✓	✓	✓	✓	✓	✓
dbb4c3	✓	✓	✓	✓	✓	✓	✓
c6c5dd	✓	✓	✓	?	✓	✓	✓
3afef0	✓	X	X	✓	!	✓	✓
98272a	✓	✓	✓	✓	✓	✓	✓
33b78c	✓	✓	✓	✓	✓	✓	✓
44e308	✓	✓	✓	✓	✓	✓	✓

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ID	4 mm	2 mm	1 mm	0.5 mm	0.25 mm	0.125 mm	0.063 mm
c66d80	✓	✓	✓	✓	✓	✓	✓
46465b	!	✓	✓	✓	✓	✓	✓
4639b4	✓	✓	✓	✓	✓	✓	✓
771a16	✓	✓	✓	✓	✓	✓	✓
af953e	✓	X	✓	✓	✓	✓	✓
fd6a2c	✓	✓	✓	✓	✓	✓	✓
338553	✓	✓	✓	✓	✓	✓	✓
046607	✓	✓	✓	✓	✓	✓	✓
1693e7	✓	?	?	✓	✓	✓	✓
ce4914	✓	✓	X	✓	?	✓	✓
b4b14f	✓	✓	✓	✓	✓	✓	✓
18da8e	✓	✓	✓	✓	✓	✓	✓
b648c0	✓	✓	✓	✓	✓	✓	✓
97676c	✓	?	X	✓	✓	✓	✓
4c6ddd	✓	✓	✓	✓	✓	✓	✓
028c7e	?	?	?	✓	✓	✓	✓
362270	✓	✓	✓	✓	✓	✓	✓
fc4d0d	✓	✓	✓	✓	✓	✓	✓
eec547	✓	✓	✓	✓	✓	✓	✓
0a063a	✓	✓	✓	✓	✓	✓	✓
632c29	✓	✓	✓	✓	✓	✓	✓
2ec012	✓	✓	✓	✓	✓	✓	✓
f7fe0f	!	X	X	?	?	✓	✓
944de6	✓	✓	✓	?	X	✓	✓
226a97	✓	✓	✓	✓	✓	✓	✓
11fdb1	✓	?	✓	✓	✓	✓	✓

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
76d7ce	-	-	-	-	-	-	?	-	-	-	-	-	-	✓	-	-	-	-
dd3919	✓	-	-	✓	-	-	✓	✓	-	-	-	✓	-	-	-	-	-	-
d6f710	-	-	-	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-

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ID / Method	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
f38a37	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
a03a0c	✓	-	-	✓	-	-	-	✓	-	-	✓	-	-	-	-	-	-	-
00c812	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
41bbcc	✓	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-
c4b5f2	-	-	-	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
51d578	✓	✓	-	-	✓	-	✓	✓	-	!	✓	✓	-	-	-	-	-	-
247e09	✓	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
79f92f	✓	✓	-	-	✓	-	✓	✓	-	-	-	✓	-	-	-	-	-	-
46b491	✓	-	✓	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-
2001a8	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
b648a0	✓	✓	-	-	-	-	-	-	-	✓	✓	-	-	✓	-	-	-	-
300664	✓	-	✓	-	✓	-	-	-	-	-	✓	-	-	-	-	-	-	-
8ab3c0	✓	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0d1159	-	-	-	-	-	-	✓	-	-	-	-	-	-	-	-	-	-	-
fa21fc	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-
22cd3b	-	-	-	-	-	-	✓	-	-	-	-	-	-	✓	-	-	-	-
9ada5d	-	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-
645c7c	-	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-
02e7a9	-	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-
c284dc	✓	-	✓	-	-	-	-	-	-	✓	✓	-	-	-	-	-	-	-
4787b2	-	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-
ae8d08	-	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-
f66f28	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-
dbb4c3	✓	✓	✓	-	-	-	✓	✓	-	✓	✓	-	-	✓	✓	-	-	-
923983	-	-	✓	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-
29f085	-	-	-	-	-	-	✓	✓	-	✓	✓	✓	-	-	-	-	-	-
49455c	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-	-
3b0dca	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
c6c5dd	✓	-	✓	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-
3afef0	!	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6f53c5	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-
98272a	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
33b78c	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
44e308	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
c66d80	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
46465b	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4639b4	✓	✓	✓	✓	-	-	-	-	-	-	-	✓	-	-	-	-	-	-

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ID / Method	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
771a16	✓	-	✓	-	-	-	-	-	-	-	✓	✓	-	-	-	-	-	-
af953e	✓	-	✓	-	-	-	-	-	-	-	✓	✓	-	✓	-	-	-	-
fd6a2c	✓	-	✓	-	-	-	-	-	-	-	✓	✓	-	-	-	-	-	-
338553	✓	-	✓	-	-	-	-	-	-	-	✓	✓	-	-	-	-	-	-
046607	✓	✓	-	✓	✓	-	-	✓	-	-	-	✓	-	-	✓	-	-	-
1693e7	✓	✓	-	-	?	-	-	-	-	-	-	-	-	-	-	-	-	-
ce4914	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
b4b14f	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18da8e	✓	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-
b648c0	✓	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-
97676c	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1a5284	-	-	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4c6ddd	✓	-	✓	-	-	-	-	✓	-	-	-	-	-	-	-	-	-	-
028c7e	?	-	-	-	-	-	-	✓	-	✓	?	✓	-	-	-	-	-	-
64222a	-	-	-	-	-	-	-	-	-	-	✓	✓	-	-	-	-	-	-
362270	✓	-	✓	-	-	-	-	✓	-	-	-	X	-	-	-	-	-	-
c8cc78	-	-	-	-	✓	-	-	-	-	-	-	-	-	✓	-	-	-	-
c9c421	-	-	-	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
fc4d0d	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
0214a2	-	-	-	-	-	-	-	✓	-	-	-	✓	-	✓	-	-	-	-
a0ffe0	-	-	-	-	-	-	-	-	-	-	-	✓	-	✓	-	-	-	-
e9a477	-	-	-	-	-	-	-	-	-	-	-	✓	-	?	-	-	-	-
eec547	✓	✓	-	-	✓	-	✓	✓	-	-	-	✓	-	✓	-	-	-	-
0a063a	✓	-	-	-	-	-	X	✓	-	✓	✓	✓	-	-	✓	-	-	-
033508	-	-	X	-	-	-	-	-	-	✓	-	-	-	-	-	-	-	-
632c29	✓	-	✓	-	-	-	-	-	-	✓	✓	✓	-	-	-	-	-	-
2ec012	✓	-	✓	-	-	-	-	✓	-	✓	✓	-	-	-	-	-	-	-
f7fe0f	!	-	-	✓	✓	-	-	✓	-	-	-	-	-	-	-	-	-	-
944de6	✓	-	-	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	-
ba5283	-	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-
170637	-	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-
5fdea4	-	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-
226a97	✓	-	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11fdb1	✓	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-
a866a4	-	-	-	✓	-	-	-	✓	-	-	-	-	-	-	-	-	-	-

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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 [%]
51d578	96	97	96	0	96	0.6	0.6
fc4d0d	97	96	97	1	97	0.6	0.6
dbb4c3	97	96	97	2	97	0.6	0.6
b648c0	97	97	97	-	97	0.0	0.0
33b78c	97	97	97	0	97	0.0	0.0
046607	98	97	97	-	97	0.4	0.36
dd3919	97	97	97	2	97	0.1	0.12
f38a37	97	98	97	1	97	0.6	0.59
0a063a	97	97	98	1	97	0.6	0.59
3afef0	98	96	98	2	97	1.2	1.19
b4b14f	97	97	98	1	97	0.2	0.16
11fdb1	97	97	98	0	97	0.2	0.21
4639b4	97	98	98	3	97	0.4	0.43
00c812	98	97	98	0	98	0.3	0.3
2001a8	98	98	98	-	98	0.1	0.06
ce4914	98	97	98	1	98	0.2	0.21
247e09	98	97	98	2	98	0.3	0.31
4c6ddd	98	98	98	0	98	0.0	0.0
362270	98	98	98	12	98	0.1	0.06
97676c	98	98	97	-	98	0.6	0.59
300664	98	98	97	1	98	0.6	0.59
79f92f	97	98	98	0	98	0.6	0.59
338553	98	97	98	0	98	0.6	0.59
8ab3c0	97	98	98	1	98	0.6	0.59
44e308	97	98	98	0	98	0.6	0.59
b648a0	98	98	97	1	98	0.6	0.59
98272a	97	98	98	0	98	0.6	0.59
226a97	98	98	98	-	98	0.3	0.26
a03a0c	98	98	98	1	98	0.2	0.16
eec547	98	98	97	1	98	0.4	0.36
632c29	97	98	98	6	98	0.4	0.36
af953e	98	98	98	2	98	0.0	0.0
944de6	98	98	98	0	98	0.0	0.0
2ec012	98	98	98	1	98	0.0	0.0

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ID	Test results [%]			u_X [%]	$\bar{x}$ [%]	s_0 [%]	V_X [%]
c6c5dd	98	-	-	-	98	0.0	0.0
46b491	98	98	98	7	98	0.0	0.0
fd6a2c	98	98	98	2	98	0.0	0.0
771a16	98	98	98	4	98	0.0	0.0
1693e7	98	98	98	-	98	0.2	0.18
41bbcc	98	98	98	1	98	0.1	0.06
c284dc	99	98	98	1	98	0.6	0.59
18da8e	98	98	99	2	98	0.6	0.59
c66d80	98	98	99	0	98	0.6	0.59
028c7e	100	98	99	-	99	0.6	0.63
46465b	100	100	100	0	100	0.0	0.0
f7fe0f	100	100	100	0	100	0.0	0.0

1.1.2 The Numerical Procedure for Determining Outliers

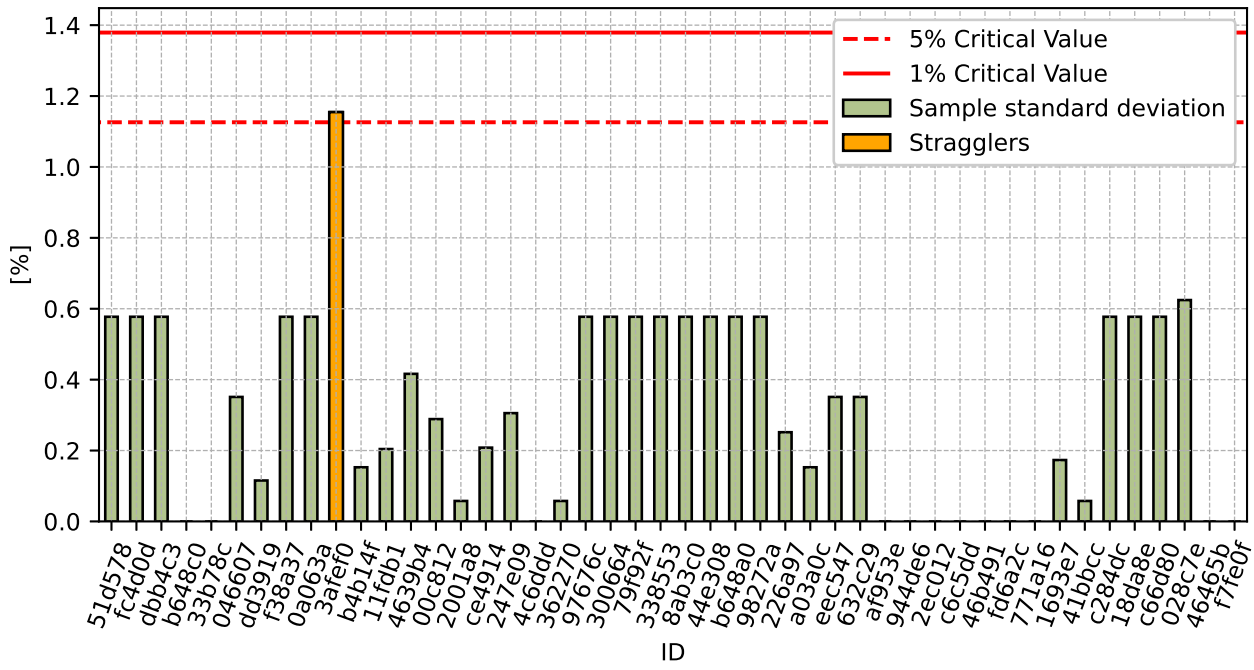

Figure 1: **Cochran's test** - sample standard deviations

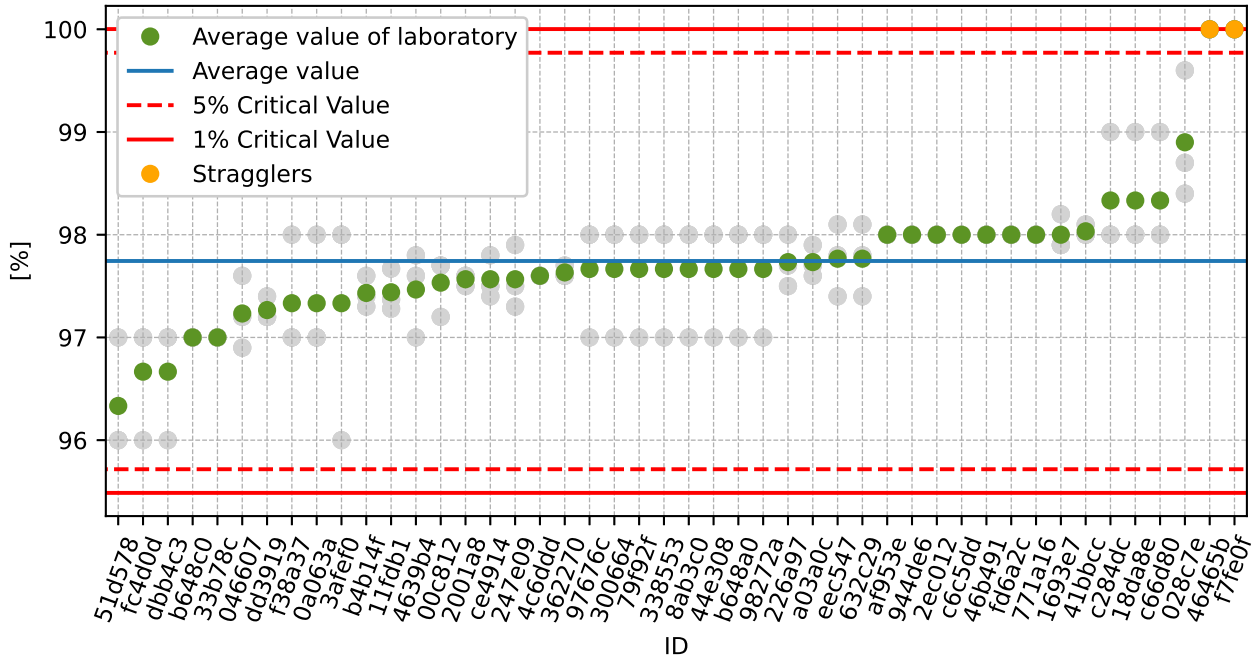

Figure 2: **Grubbs' test** - average values

1.1.3 Mandel's Statistics

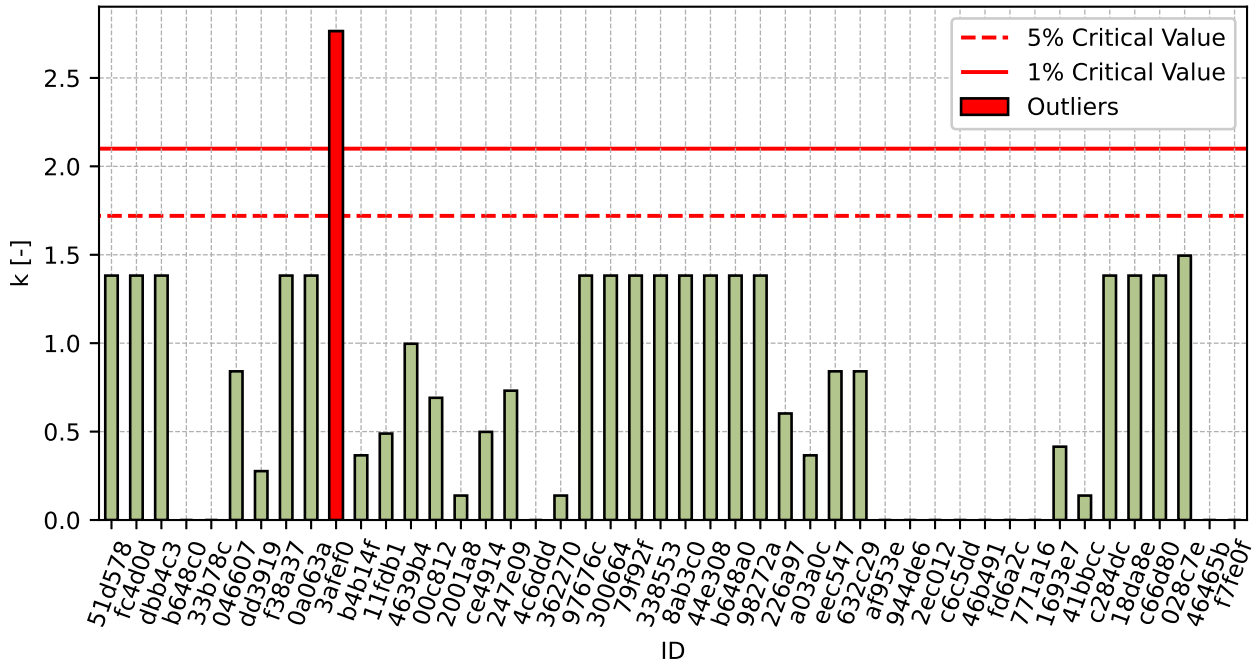

Figure 3: Intralaboratory Consistency Statistic

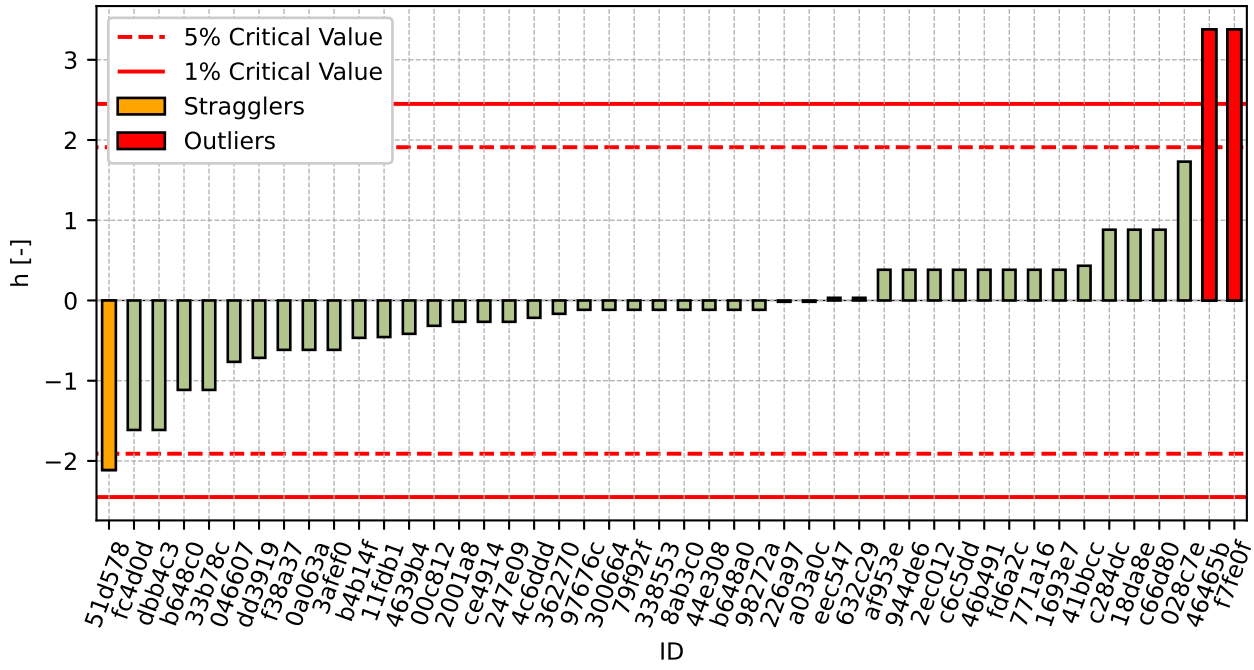

Figure 4: Interlaboratory Consistency Statistic

1.1.4 Descriptive statistics

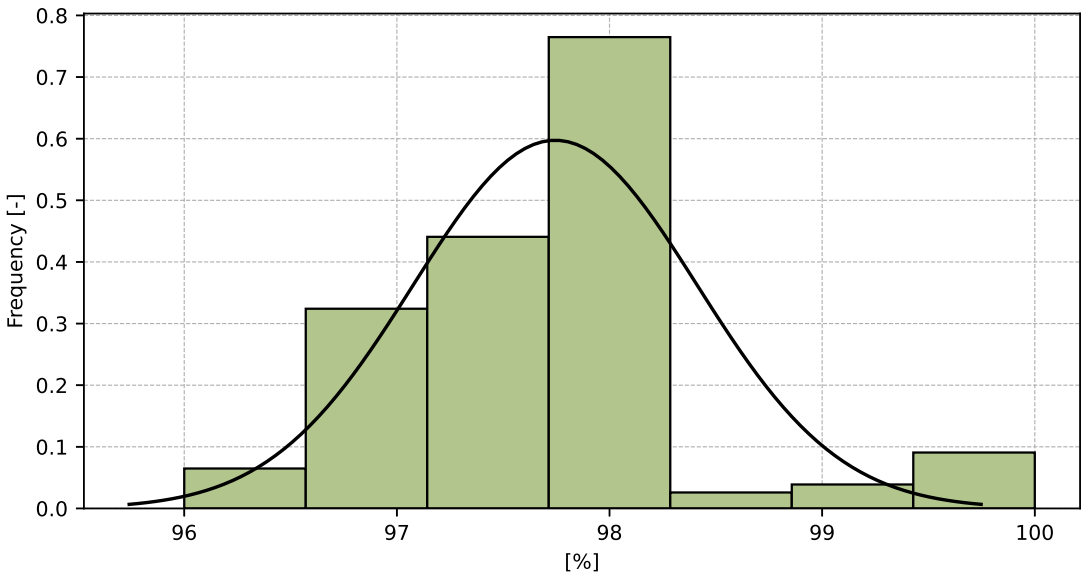

Figure 5: Histogram of all test results

Table 6: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	98
Sample standard deviation – s	0.7
Asigned value – x^*	98
Robust standard deviation – s^*	0.6
Measurement uncertainty of asigned value – u_X	0.1
p-value of normality test	0.0 [-]
Interlaboratory standard deviation – s_L	0.6
Repeatability standard deviation – s_r	0.4
Reproducibility standard deviation – s_R	0.7
Repeatability – r	1
Reproducibility – R	2

1.1.5 Evaluation of Performance Statistics

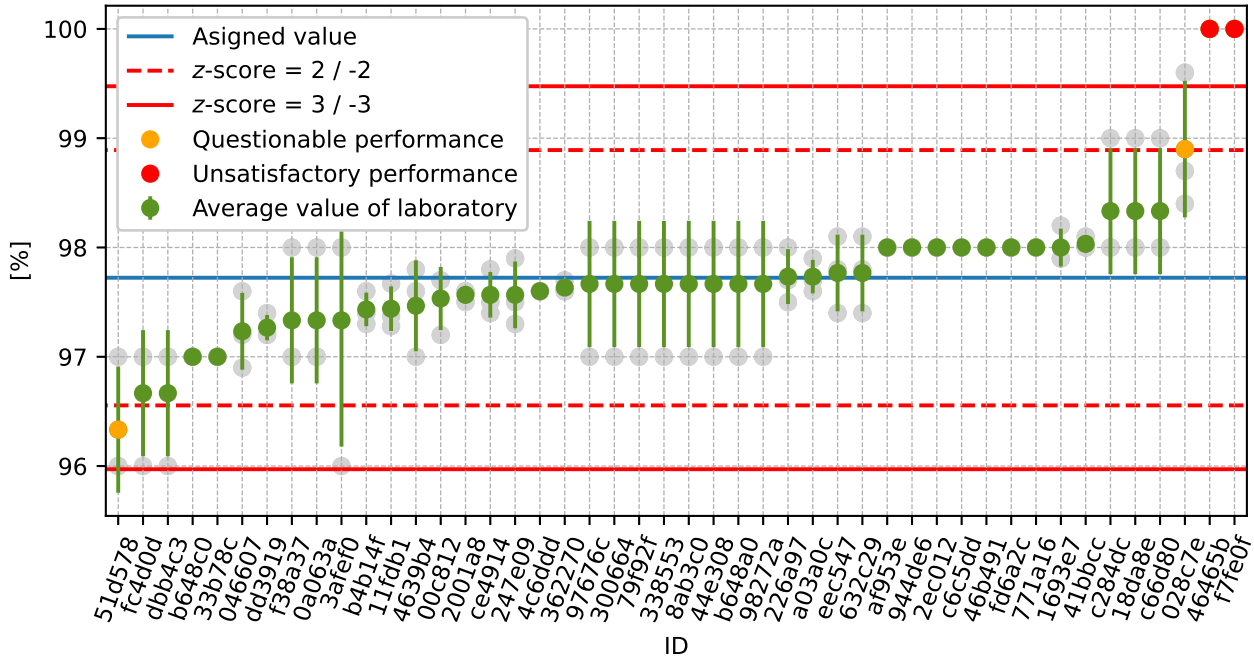

Figure 6: Average values and sample standard deviations

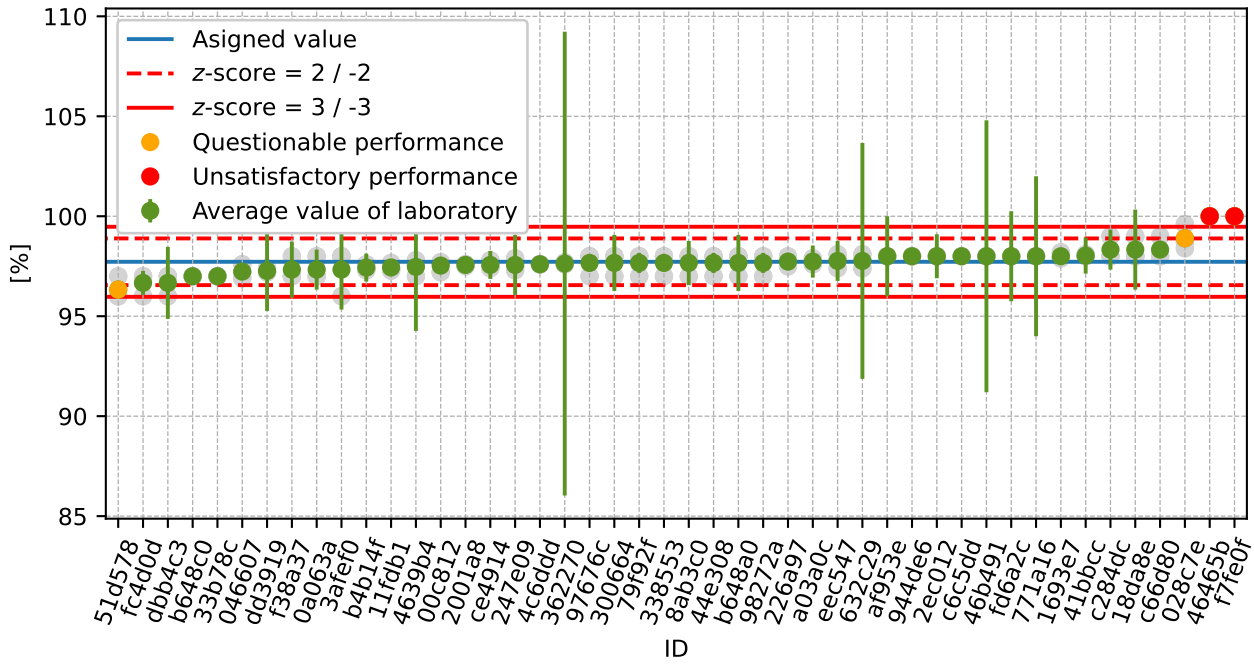

Figure 7: Average values and extended uncertainties of measurement

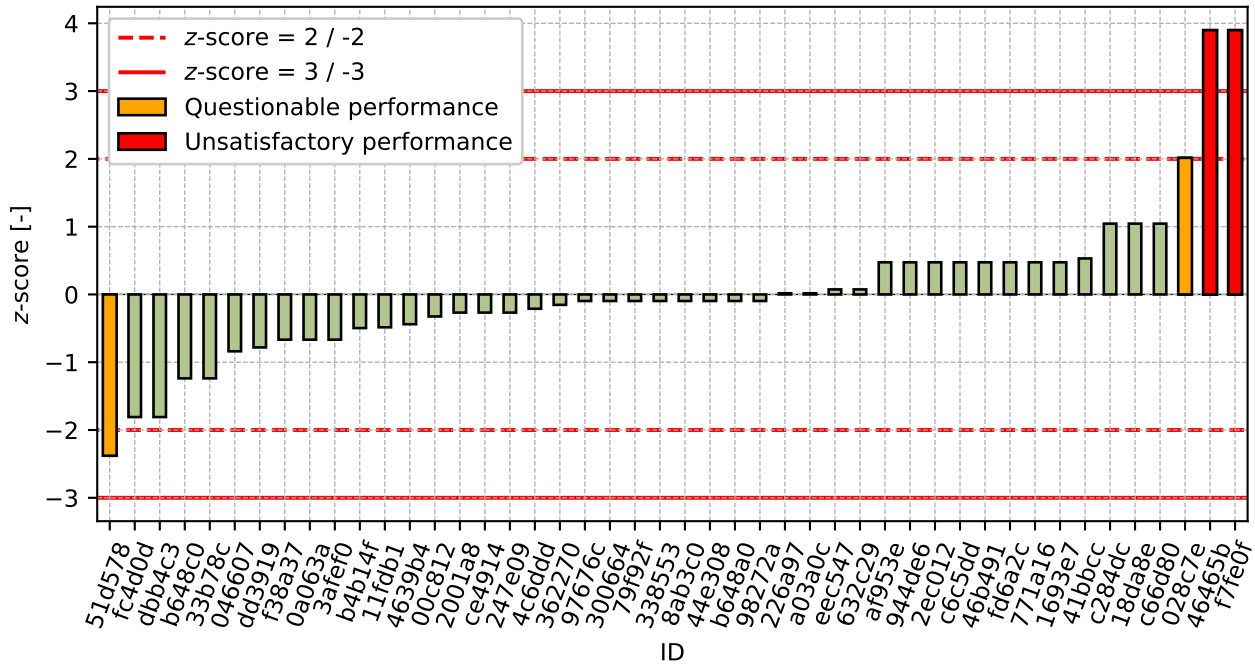

Figure 8: z-score

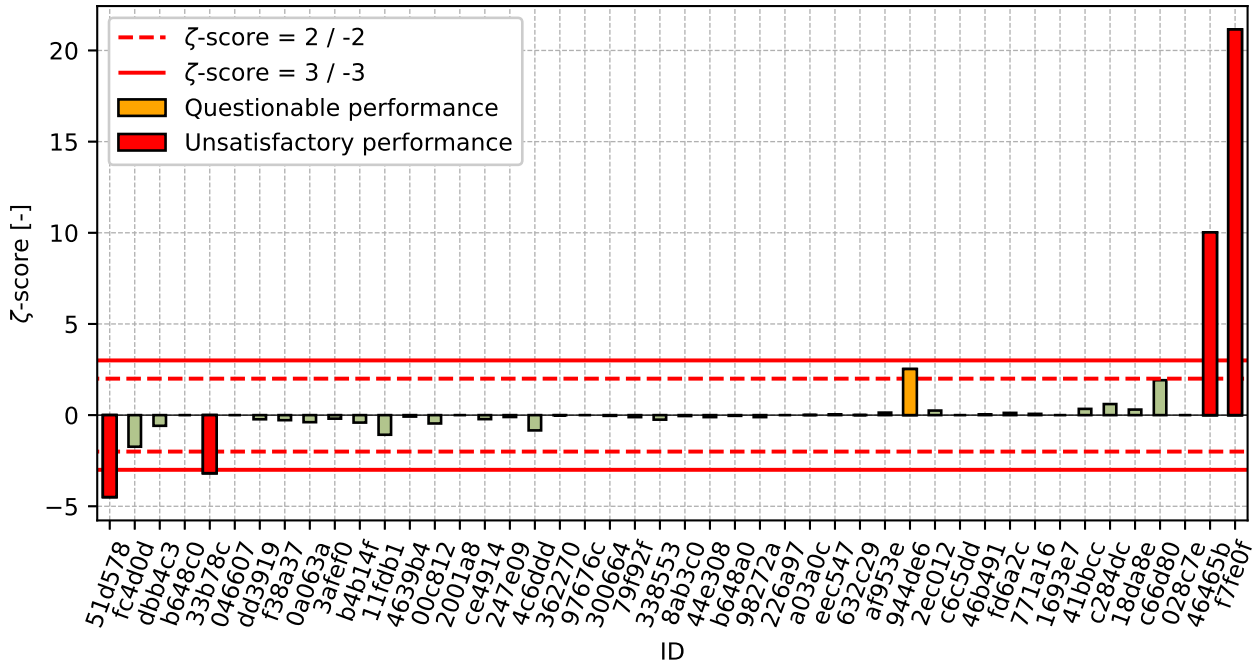

Figure 9: ζ-score

Table 7: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
51d578	-2.38	-4.49
fc4d0d	-1.81	-1.73
dbb4c3	-1.81	-0.59
b648c0	-1.24	-
33b78c	-1.24	-3.18
046607	-0.84	-
dd3919	-0.78	-0.23
f38a37	-0.67	-0.28
0a063a	-0.67	-0.39
3afef0	-0.67	-0.19
b4b14f	-0.5	-0.41
11fdb1	-0.48	-1.08
4639b4	-0.44	-0.08
00c812	-0.33	-0.46
2001a8	-0.27	-
ce4914	-0.27	-0.22
247e09	-0.27	-0.1
4c6ddd	-0.21	-0.84
362270	-0.15	-0.01
97676c	-0.1	-
300664	-0.1	-0.04
79f92f	-0.1	-0.11

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ID	z-score [-]	ζ-score [-]
338553	-0.1	-0.25
8ab3c0	-0.1	-0.05
44e308	-0.1	-0.11
b648a0	-0.1	-0.04
98272a	-0.1	-0.11
226a97	0.02	-
a03a0c	0.02	0.01
eec547	0.07	0.04
632c29	0.07	0.01
af953e	0.47	0.14
944de6	0.47	2.53
2ec012	0.47	0.25
c6c5dd	0.47	-
46b491	0.47	0.04
fd6a2c	0.47	0.12
771a16	0.47	0.07
1693e7	0.47	-
41bbcc	0.53	0.34
c284dc	1.04	0.61
18da8e	1.04	0.3
c66d80	1.04	1.91
028c7e	2.02	-
46465b	3.9	10.02
f7fe0f	3.9	21.15

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 [%]
f7fe0f	73	73	74	1	73	0.7	0.91
11fdb1	83	83	83	0	83	0.1	0.11
028c7e	85	83	83	-	84	0.9	1.07
c6c5dd	84	-	-	-	84	0.0	0.0
0a063a	84	83	86	1	84	1.5	1.81
300664	84	85	84	1	84	0.6	0.68
b4b14f	85	84	84	1	84	0.4	0.49
2ec012	85	85	84	1	85	0.6	0.68
fc4d0d	85	85	84	1	85	0.6	0.68
b648a0	85	86	83	1	85	1.5	1.8
338553	84	85	85	0	85	0.6	0.68
fd6a2c	84	85	85	2	85	0.6	0.68
dbb4c3	84	85	85	2	85	0.6	0.68
2001a8	85	85	85	-	85	0.1	0.12
046607	85	85	84	-	85	0.4	0.41
eec547	85	86	84	2	85	1.2	1.44
dd3919	85	85	85	2	85	0.1	0.07
944de6	85	85	85	0	85	0.0	0.0
79f92f	84	86	85	0	85	1.0	1.18
771a16	85	85	85	3	85	0.0	0.0
8ab3c0	85	85	85	1	85	0.0	0.0
51d578	84	86	85	1	85	1.0	1.18
362270	85	85	85	10	85	0.1	0.07
18da8e	85	85	86	3	85	0.6	0.68
b648c0	85	84	87	-	85	1.5	1.79
46465b	86	85	85	0	85	0.6	0.68
ce4914	86	85	85	2	85	0.3	0.38
46b491	85	85	86	6	85	0.6	0.68
632c29	86	85	85	5	85	0.2	0.23
00c812	86	85	86	0	86	0.1	0.12
4c6ddd	86	85	86	0	86	0.7	0.81
226a97	86	86	84	-	86	1.0	1.19
247e09	85	86	86	2	86	0.4	0.42
a03a0c	86	86	86	2	86	0.2	0.18
f38a37	85	86	86	3	86	0.6	0.67
98272a	86	85	86	0	86	0.6	0.67

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ID	Test results [%]			u_X [%]	$\bar{x}$ [%]	s_0 [%]	V_X [%]
33b78c	86	85	86	0	86	0.6	0.67
4639b4	85	86	86	3	86	0.5	0.53
c66d80	87	86	85	1	86	1.0	1.16
44e308	86	86	86	0	86	0.0	0.0
41bbcc	86	86	86	2	86	0.1	0.12
1693e7	86	89	86	-	87	1.7	1.93
c284dc	86	88	88	2	87	1.2	1.32
97676c	89	88	85	-	87	2.1	2.38
af953e	89	89	89	2	89	0.0	0.0
3afef0	93	91	96	2	93	2.5	2.7

1.2.2 The Numerical Procedure for Determining Outliers

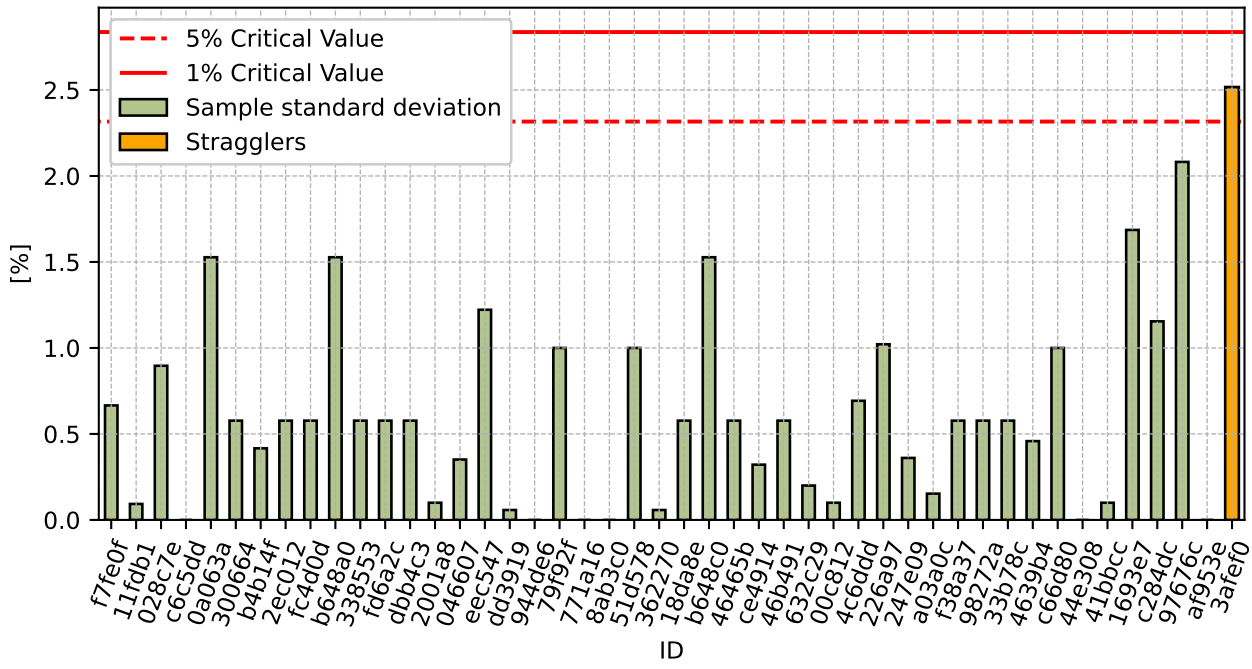

Figure 10: **Cochran's test** - sample standard deviations

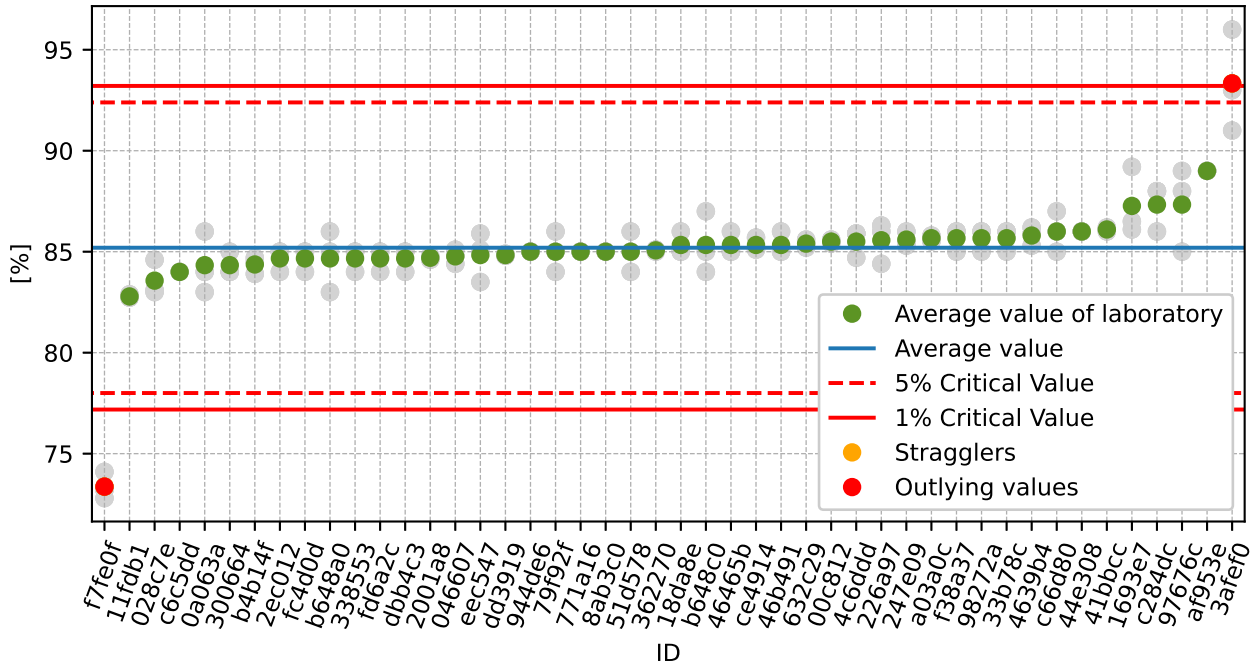

Figure 11: **Grubbs' test** - average values

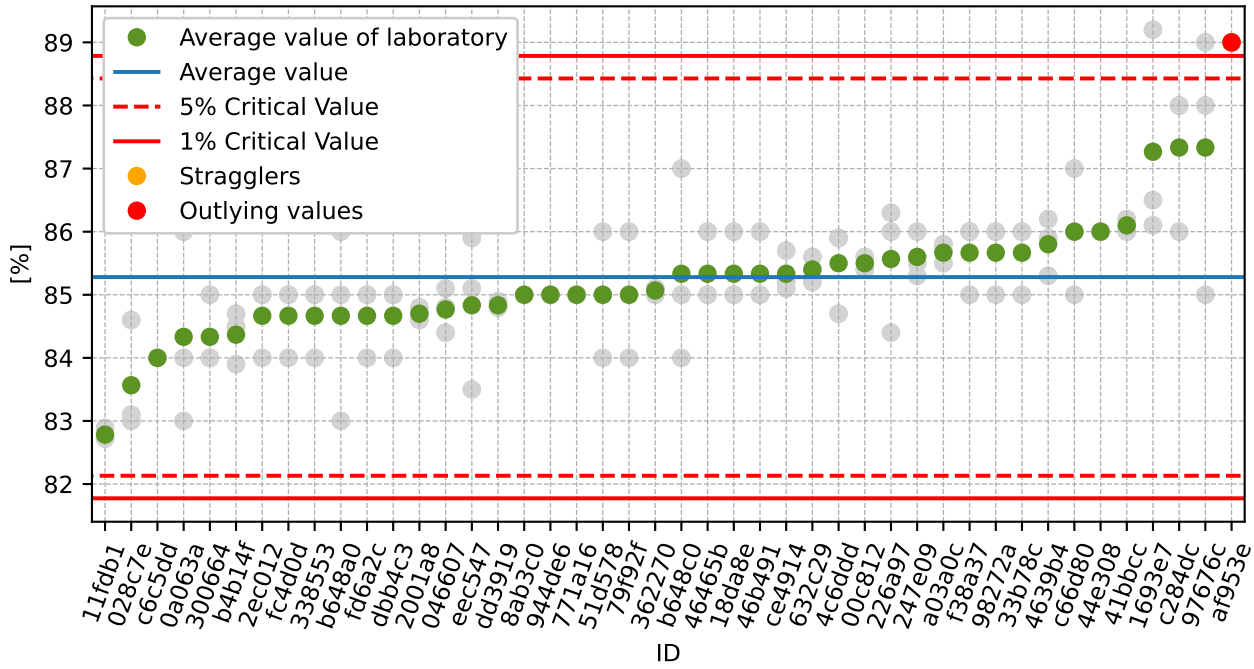

Figure 12: **Grubbs' test** - average values without outliers

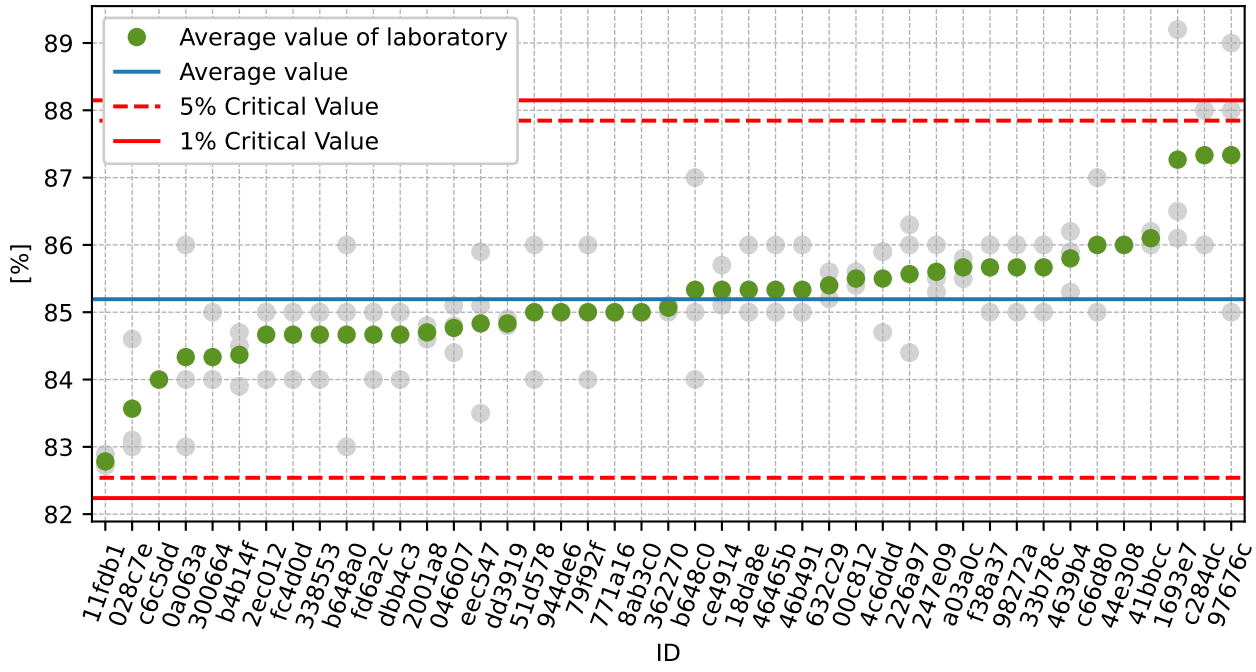

Figure 13: **Grubbs' test** - average values without outliers

1.2.3 Mandel's Statistics

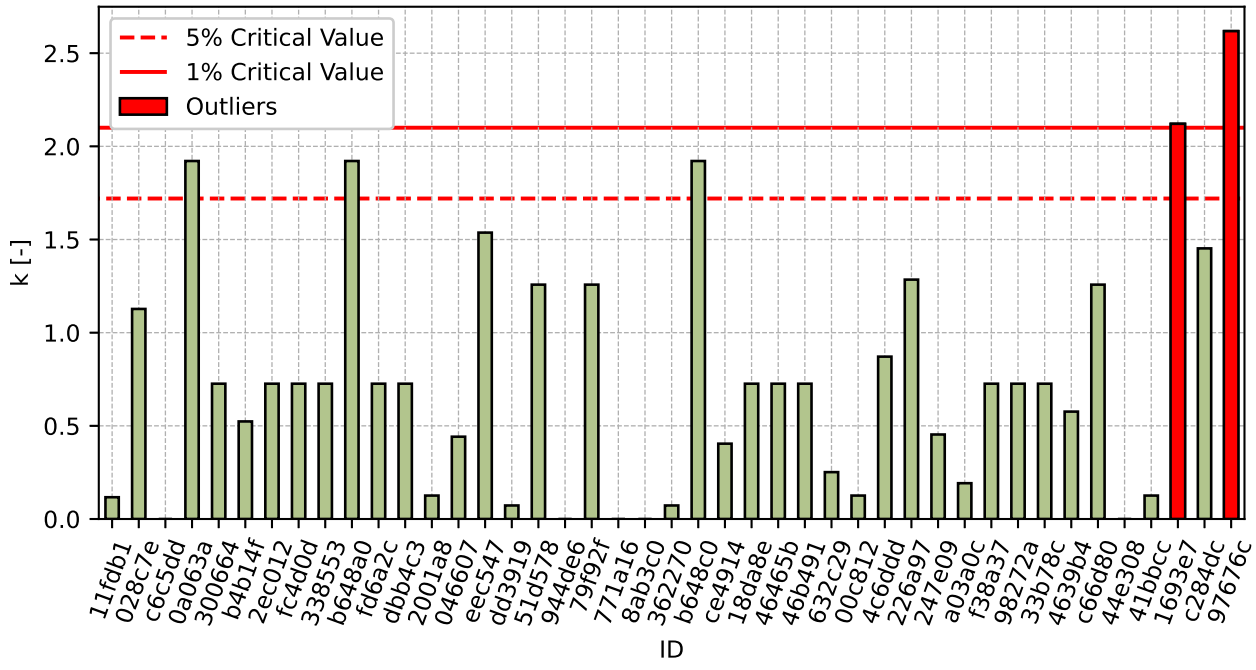

Figure 14: Intralaboratory Consistency Statistic

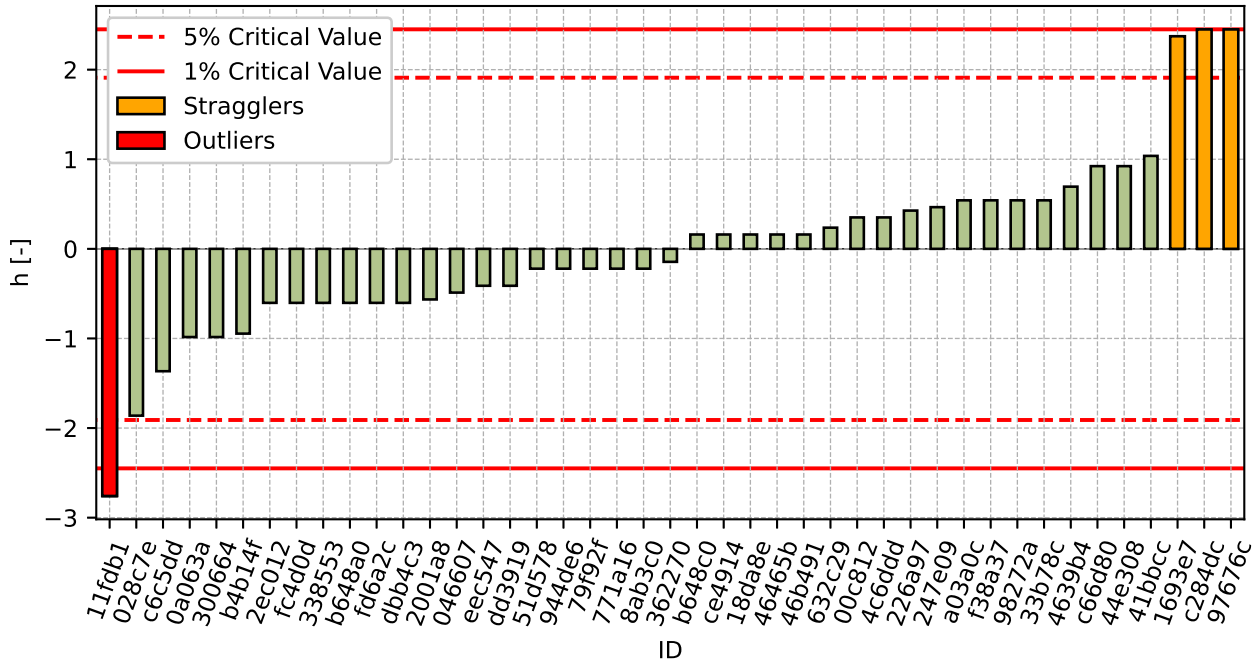

Figure 15: Interlaboratory Consistency Statistic

1.2.4 Descriptive statistics

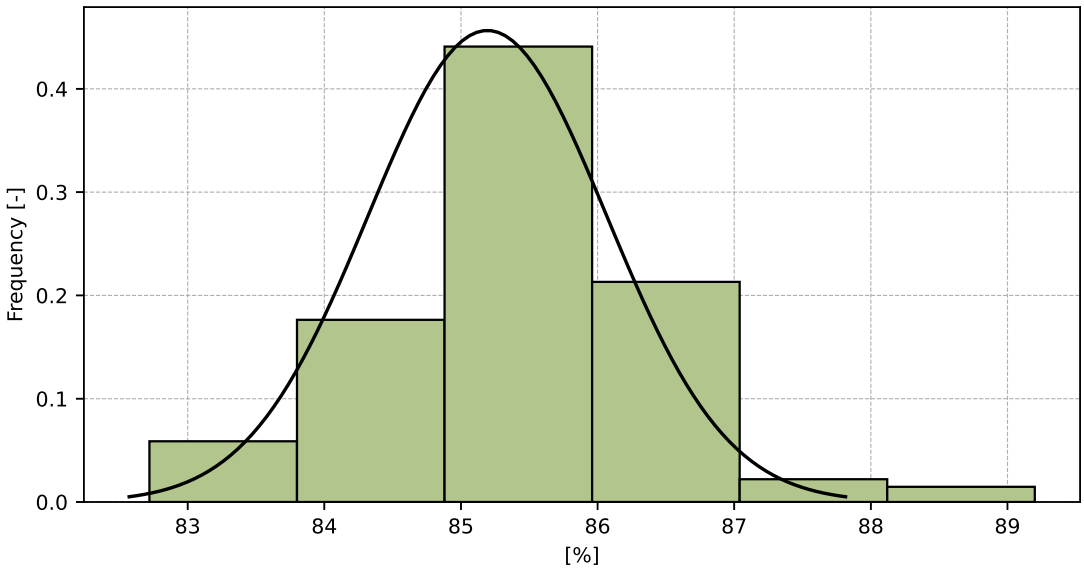

Figure 16: Histogram of all test results

Table 9: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	85
Sample standard deviation – s	0.9
Asigned value – x^*	85
Robust standard deviation – s^*	0.8
Measurement uncertainty of asigned value – u_X	0.1
p-value of normality test	0.0 [-]
Interlaboratory standard deviation – s_L	0.7
Repeatability standard deviation – s_r	0.8
Reproducibility standard deviation – s_R	1.1
Repeatability – r	2
Reproducibility – R	3

1.2.5 Evaluation of Performance Statistics

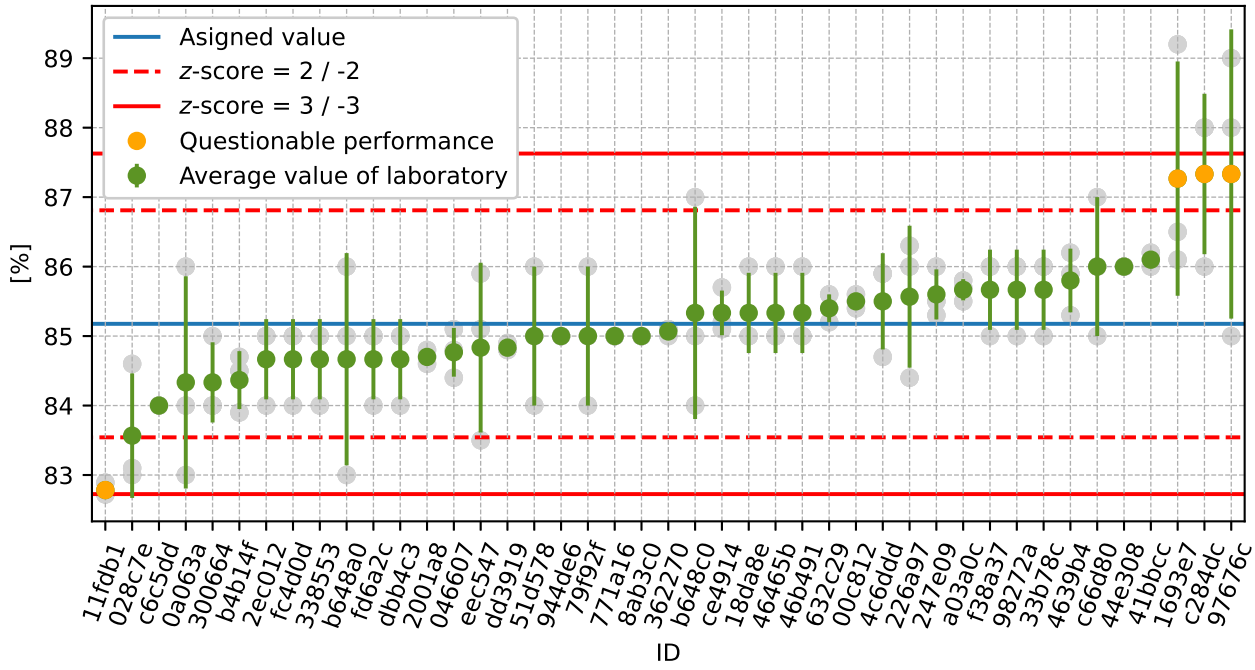

Figure 17: Average values and sample standard deviations

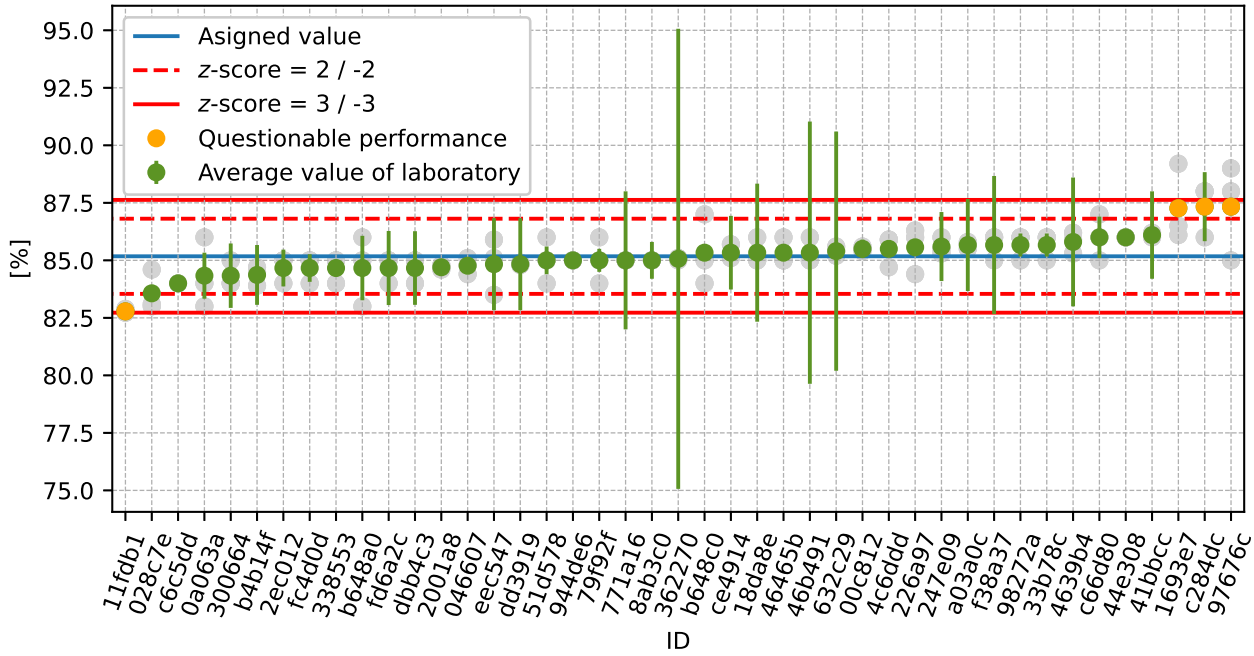

Figure 18: Average values and extended uncertainties of measurement

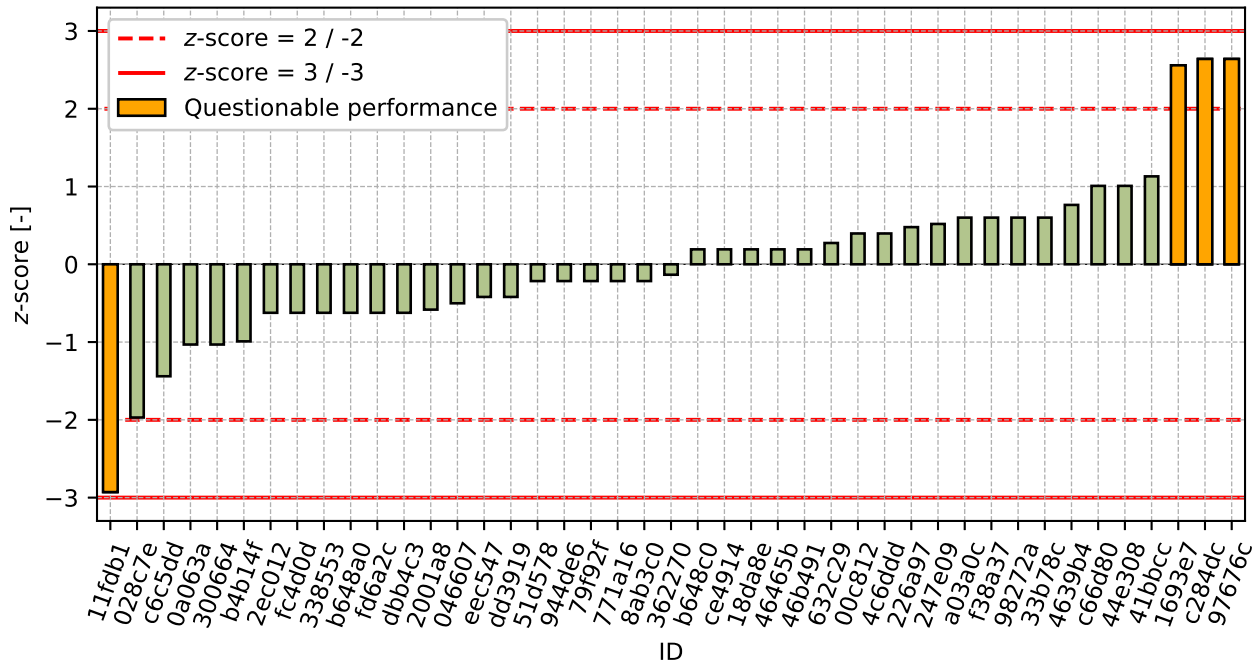

Figure 19: z-score

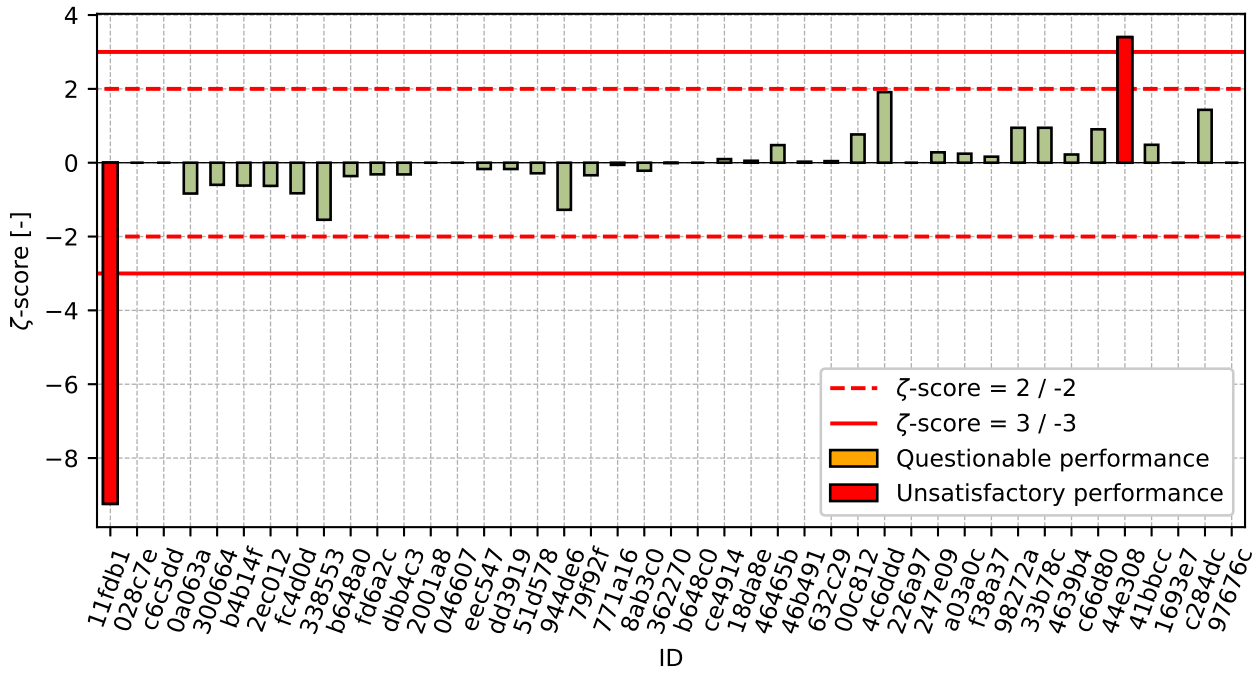

Figure 20: ζ-score

Table 10: *z*-score and ζ-score

ID	*z*-score [-]	ζ-score [-]
11fdb1	-2.93	-9.24
028c7e	-1.97	-
c6c5dd	-1.44	-
0a063a	-1.03	-0.84
300664	-1.03	-0.6
b4b14f	-0.99	-0.62
2ec012	-0.62	-0.63
fc4d0d	-0.62	-0.83
338553	-0.62	-1.55
b648a0	-0.62	-0.36
fd6a2c	-0.62	-0.32
dbb4c3	-0.62	-0.32
2001a8	-0.58	-
046607	-0.5	-
eec547	-0.42	-0.17
dd3919	-0.42	-0.17
51d578	-0.22	-0.29
944de6	-0.22	-1.28
79f92f	-0.22	-0.34
771a16	-0.22	-0.06
8ab3c0	-0.22	-0.22
362270	-0.13	-0.01

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ID	z-score [-]	ζ-score [-]
b648c0	0.19	-
ce4914	0.19	0.1
18da8e	0.19	0.05
46465b	0.19	0.48
46b491	0.19	0.03
632c29	0.27	0.04
00c812	0.4	0.77
4c6ddd	0.4	1.91
226a97	0.48	-
247e09	0.52	0.28
a03a0c	0.6	0.24
f38a37	0.6	0.16
98272a	0.6	0.95
33b78c	0.6	0.95
4639b4	0.76	0.22
c66d80	1.01	0.9
44e308	1.01	3.4
41bbcc	1.13	0.48
1693e7	2.56	-
c284dc	2.64	1.43
97676c	2.64	-

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 [%]
f7fe0f	53	52	53	2	53	0.8	1.59
ce4914	57	55	54	1	55	1.4	2.47
028c7e	60	58	58	-	59	1.5	2.59
632c29	60	60	59	4	59	0.2	0.35
11fdb1	59	60	59	0	60	0.2	0.27
dd3919	60	60	60	2	60	0.2	0.29
046607	60	60	60	-	60	0.2	0.29
b4b14f	60	60	60	2	60	0.4	0.67
2ec012	60	60	60	1	60	0.0	0.0
771a16	60	60	60	2	60	0.0	0.0
c6c5dd	60	-	-	-	60	0.0	0.0
338553	60	60	61	0	60	0.6	0.96
eec547	60	62	59	3	60	1.4	2.25
fd6a2c	60	61	60	1	60	0.6	0.96
b648a0	60	63	58	1	60	2.5	4.17
362270	60	60	60	7	60	0.1	0.1
fc4d0d	60	61	61	1	61	0.6	0.95
44e308	61	60	61	0	61	0.6	0.95
18da8e	60	61	61	4	61	0.6	0.95
226a97	61	61	60	-	61	0.8	1.38
4c6ddd	61	60	61	0	61	0.6	0.99
2001a8	61	61	61	-	61	0.2	0.34
46465b	61	61	61	0	61	0.0	0.0
51d578	59	62	62	1	61	1.7	2.84
a03a0c	61	61	61	3	61	0.0	0.0
8ab3c0	61	61	61	1	61	0.0	0.0
0a063a	60	59	65	1	61	3.2	5.24
b648c0	60	60	64	-	61	2.3	3.77
af953e	61	61	62	1	61	0.6	0.94
247e09	61	61	62	2	61	0.4	0.62
00c812	61	62	62	0	62	0.2	0.25
c66d80	62	62	61	0	62	0.6	0.94
79f92f	61	62	62	0	62	0.6	0.94
f38a37	61	62	62	4	62	0.6	0.94
4639b4	61	62	62	2	62	0.5	0.83
41bbcc	62	62	62	3	62	0.1	0.16

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ID	Test results [%]			u_X [%]	$\bar{x}$ [%]	s_0 [%]	V_X [%]
98272a	62	62	62	0	62	0.0	0.0
dbb4c3	63	62	61	2	62	1.0	1.61
c284dc	60	63	63	2	62	1.7	2.79
300664	62	62	62	1	62	0.0	0.0
46b491	62	62	62	5	62	0.0	0.0
33b78c	63	62	63	0	63	0.6	0.92
944de6	62	63	63	0	63	0.6	0.92
1693e7	62	68	61	-	64	3.7	5.76
97676c	67	66	64	-	66	1.5	2.33
3afef0	71	78	68	2	72	5.1	7.09

1.3.2 The Numerical Procedure for Determining Outliers

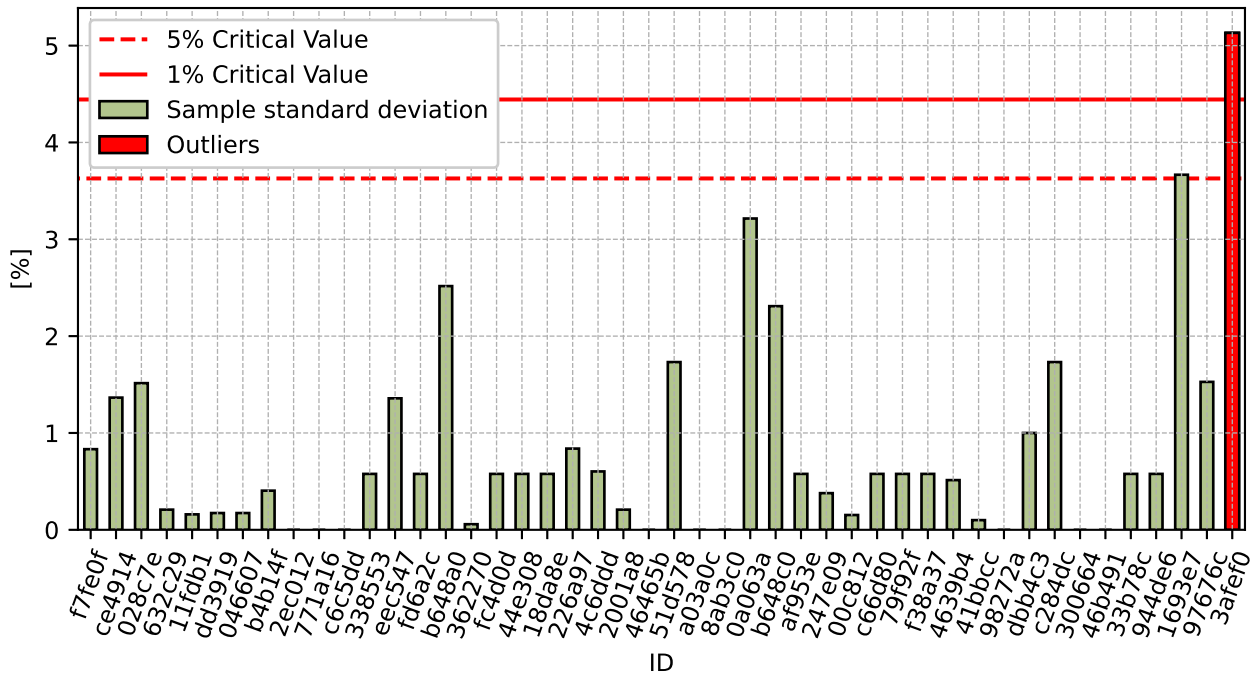

Figure 21: **Cochran's test** - sample standard deviations

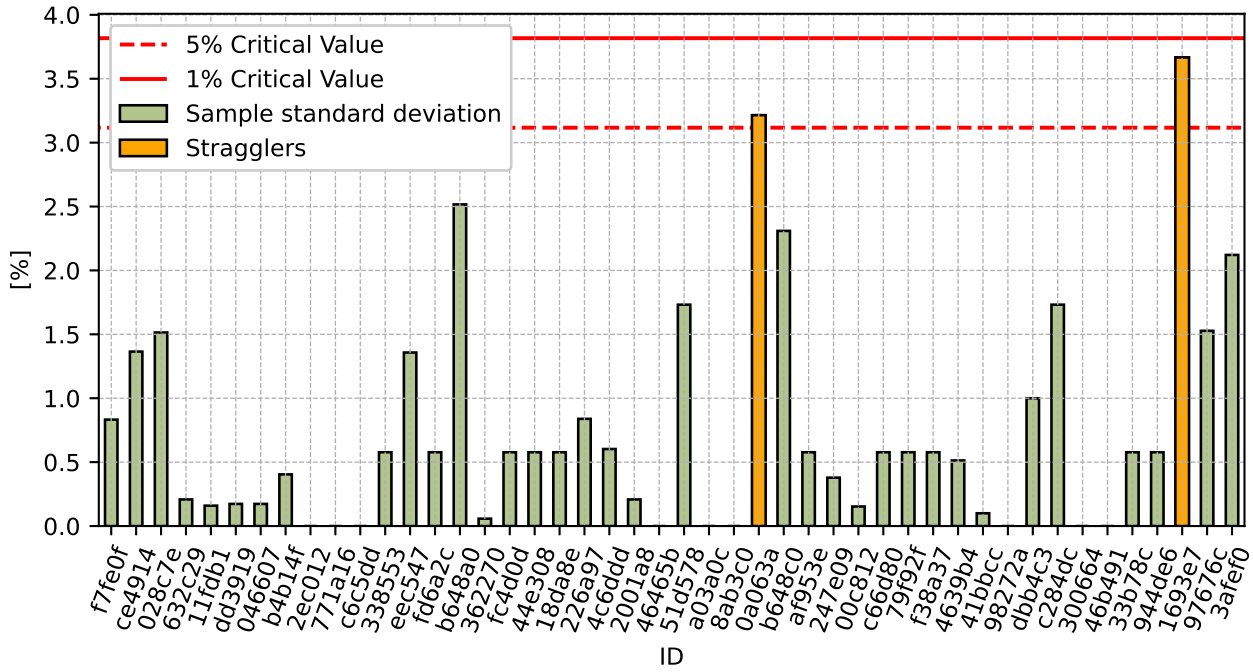

Figure 22: **Cochran's test** - sample standard deviations without outliers

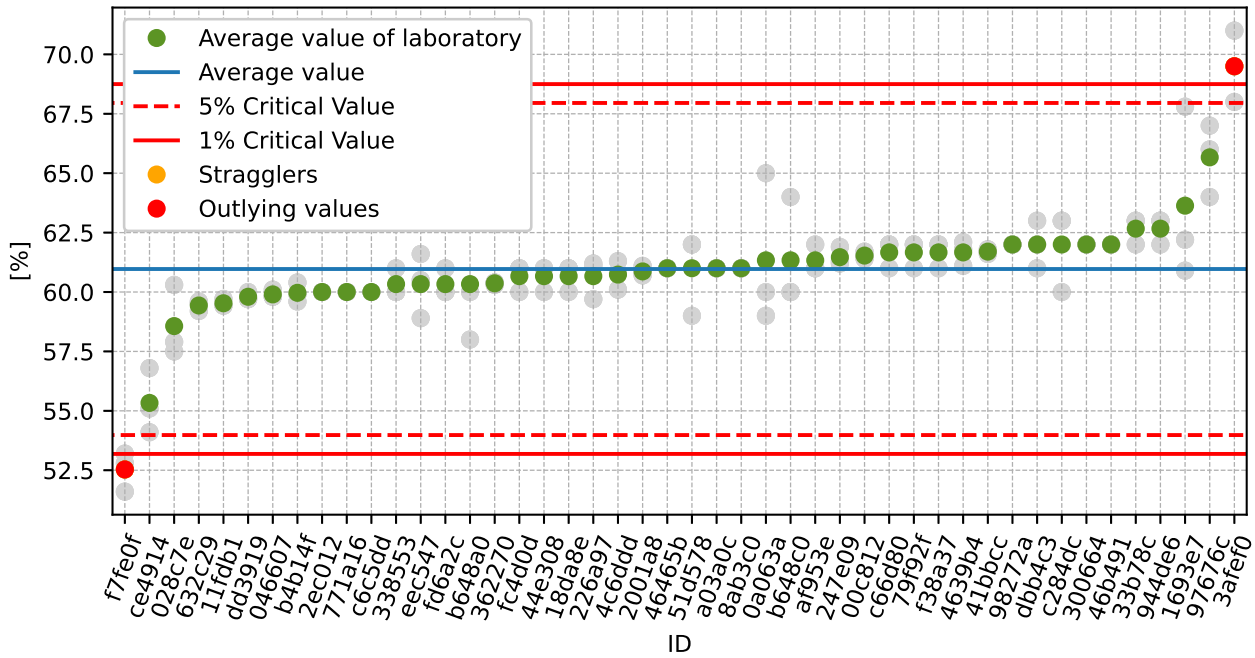

Figure 23: **Grubbs' test** - average values

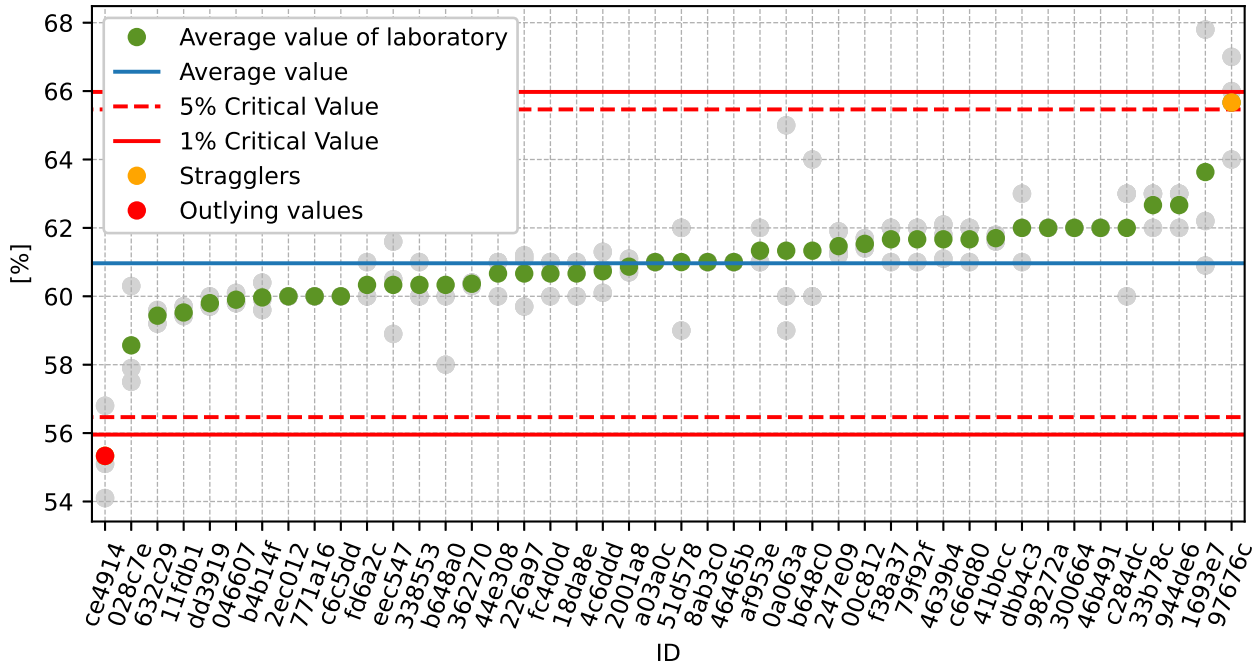

Figure 24: **Grubbs' test** - average values without outliers

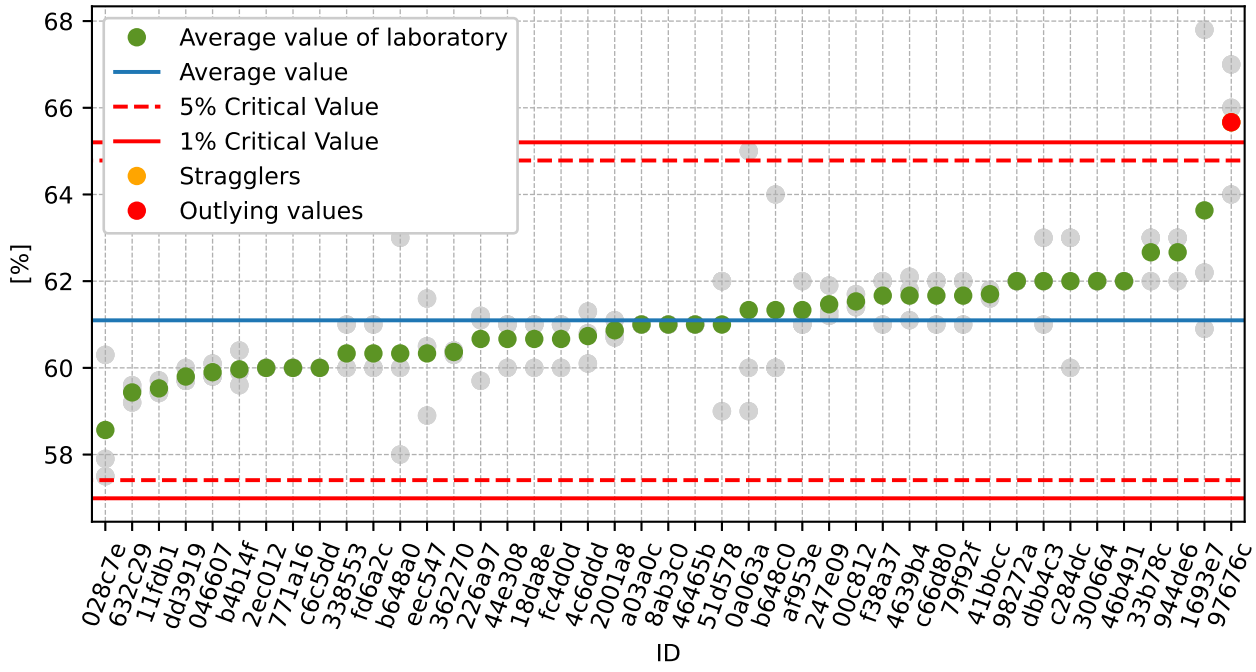

Figure 25: **Grubbs' test** - average values without outliers

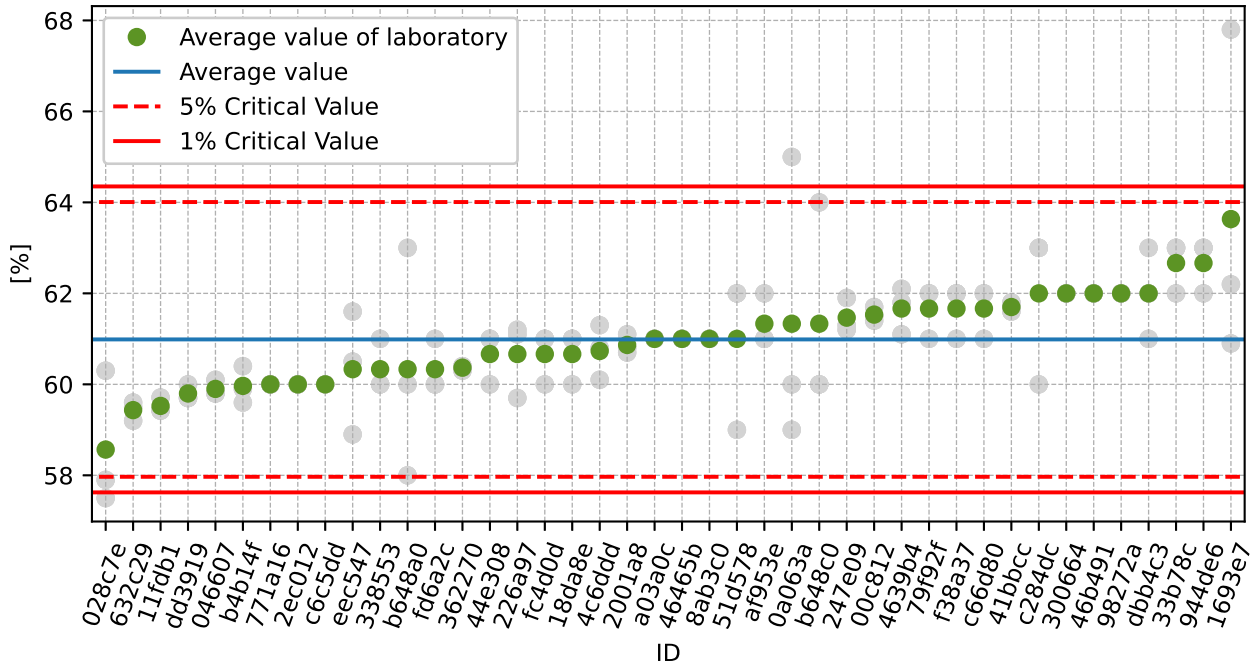

Figure 26: **Grubbs' test** - average values without outliers

1.3.3 Mandel's Statistics

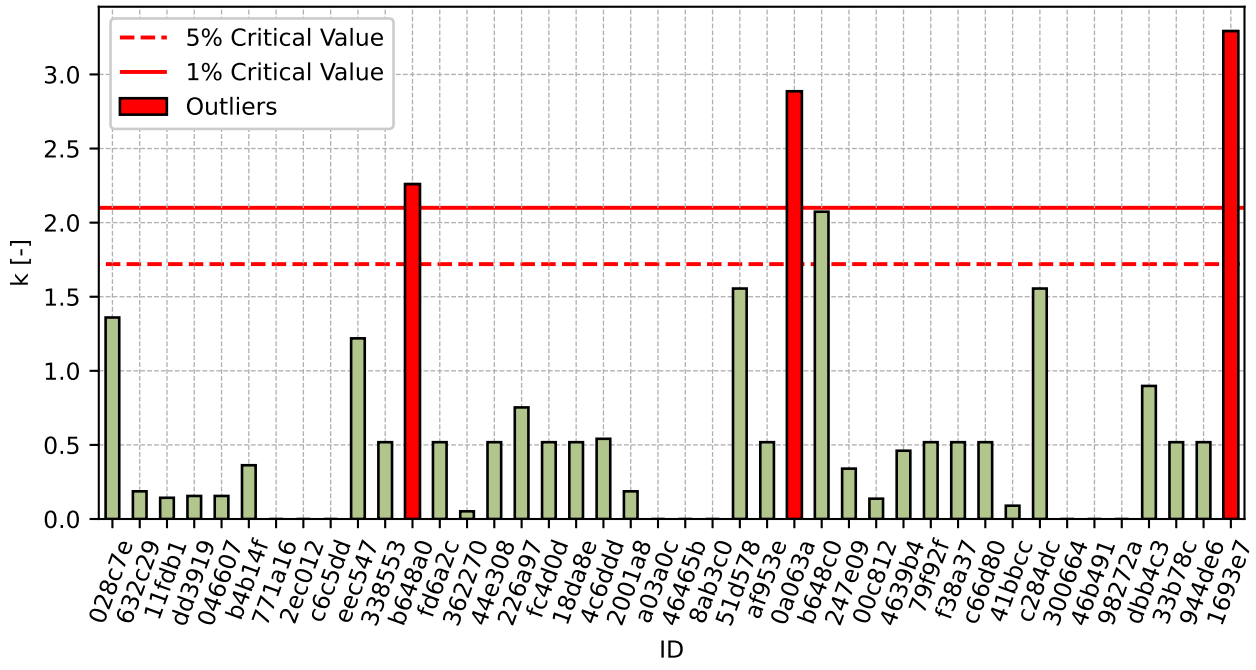

Figure 27: Intralaboratory Consistency Statistic

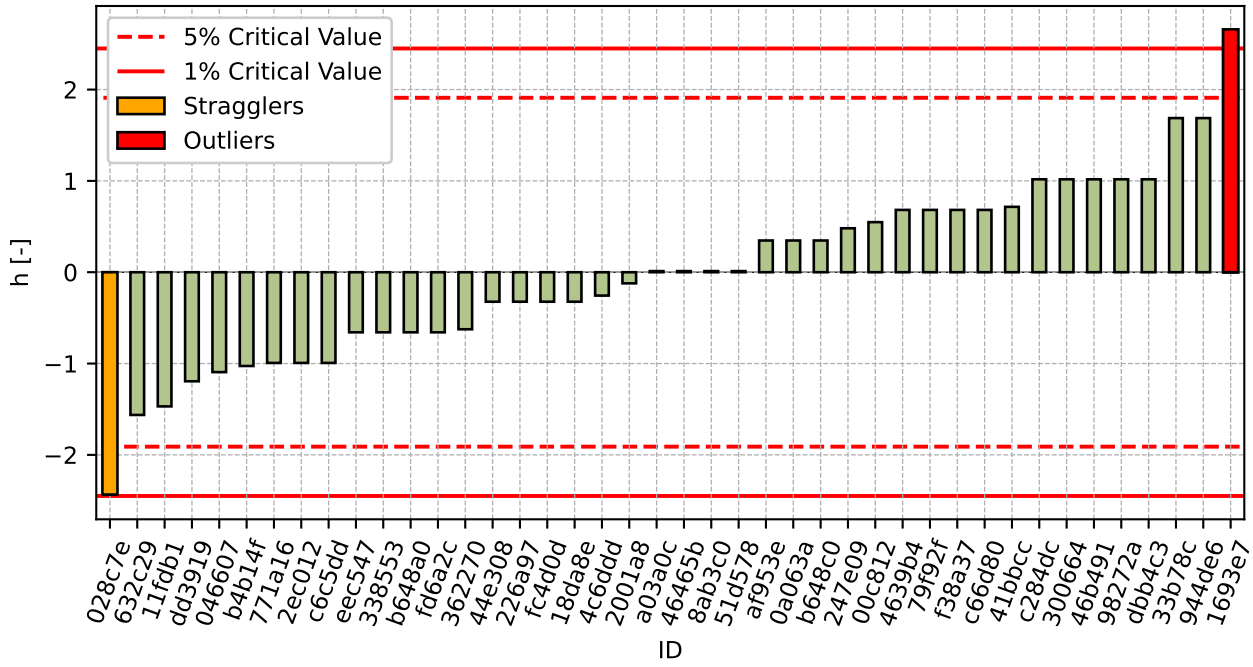

Figure 28: Interlaboratory Consistency Statistic

1.3.4 Descriptive statistics

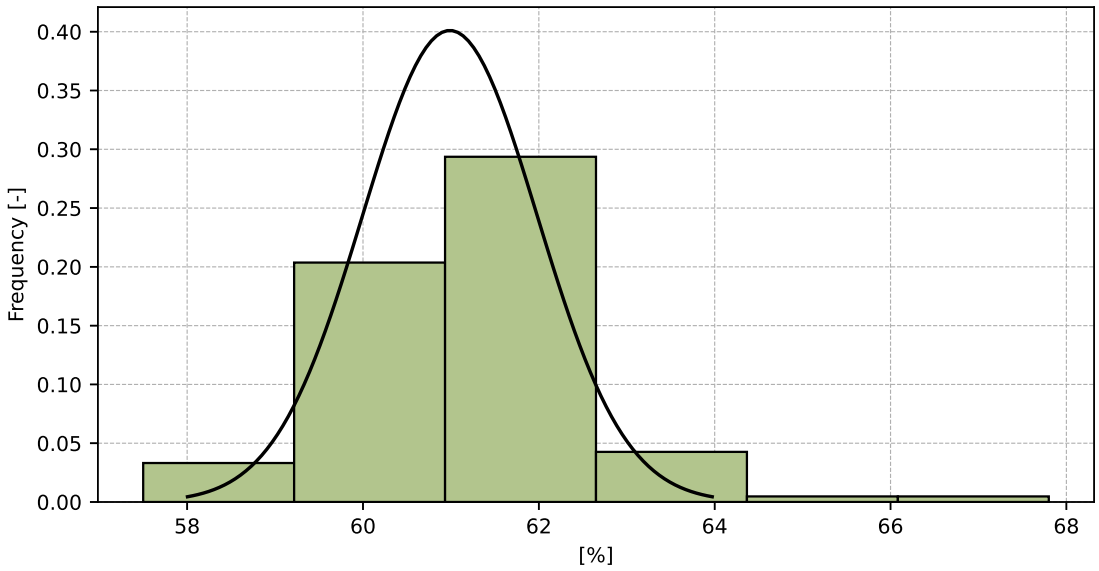

Figure 29: Histogram of all test results

Table 12: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	61
Sample standard deviation – s	1.0
Asigned value – x^*	61
Robust standard deviation – s^*	1.1
Measurement uncertainty of asigned value – u_X	0.2
p-value of normality test	0.0 [-]
Interlaboratory standard deviation – s_L	0.8
Repeatability standard deviation – s_r	1.1
Reproducibility standard deviation – s_R	1.3
Repeatability – r	3
Reproducibility – R	4

1.3.5 Evaluation of Performance Statistics

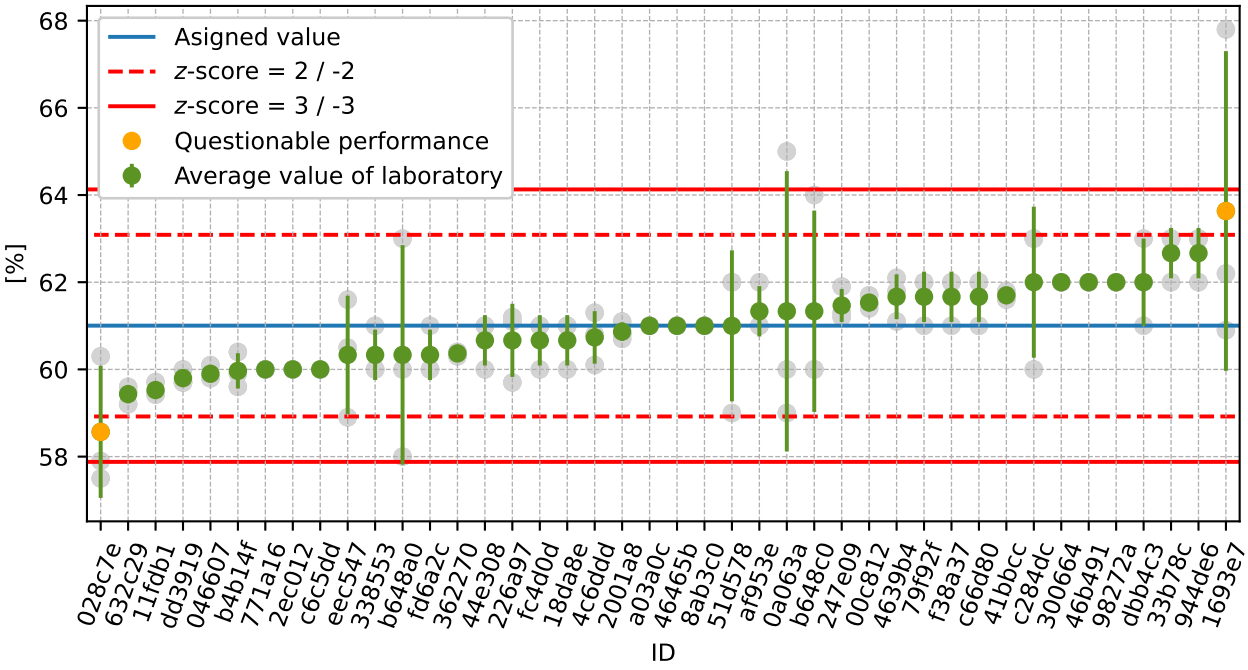

Figure 30: Average values and sample standard deviations

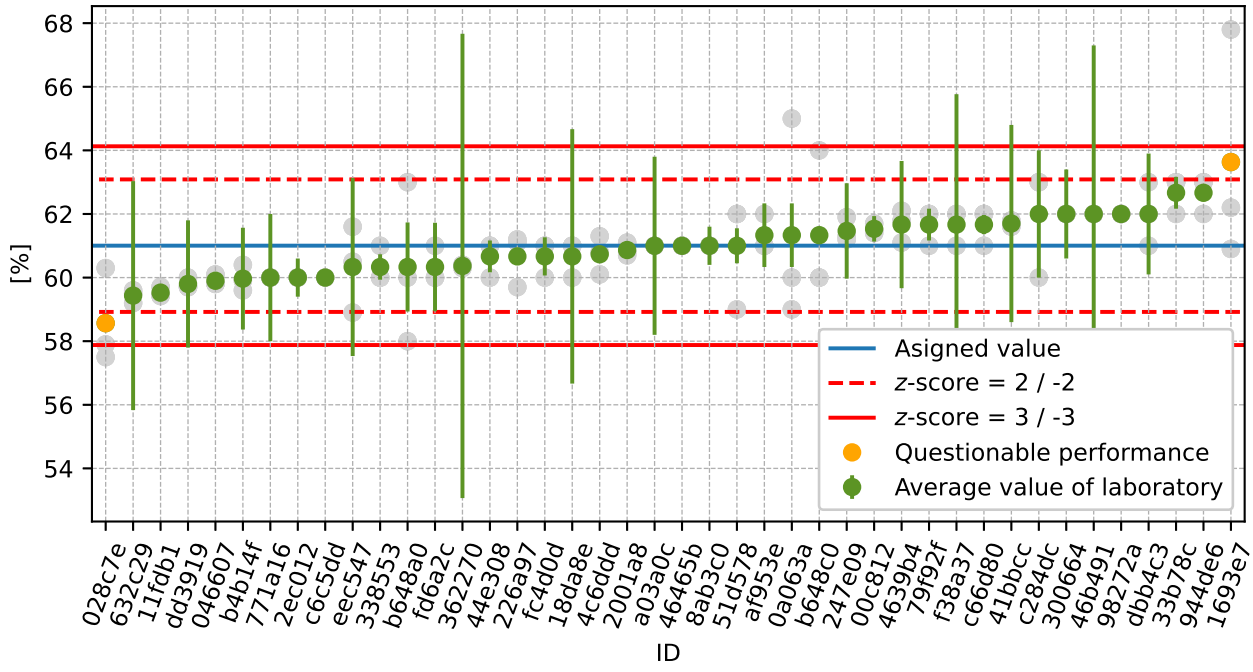

Figure 31: Average values and extended uncertainties of measurement

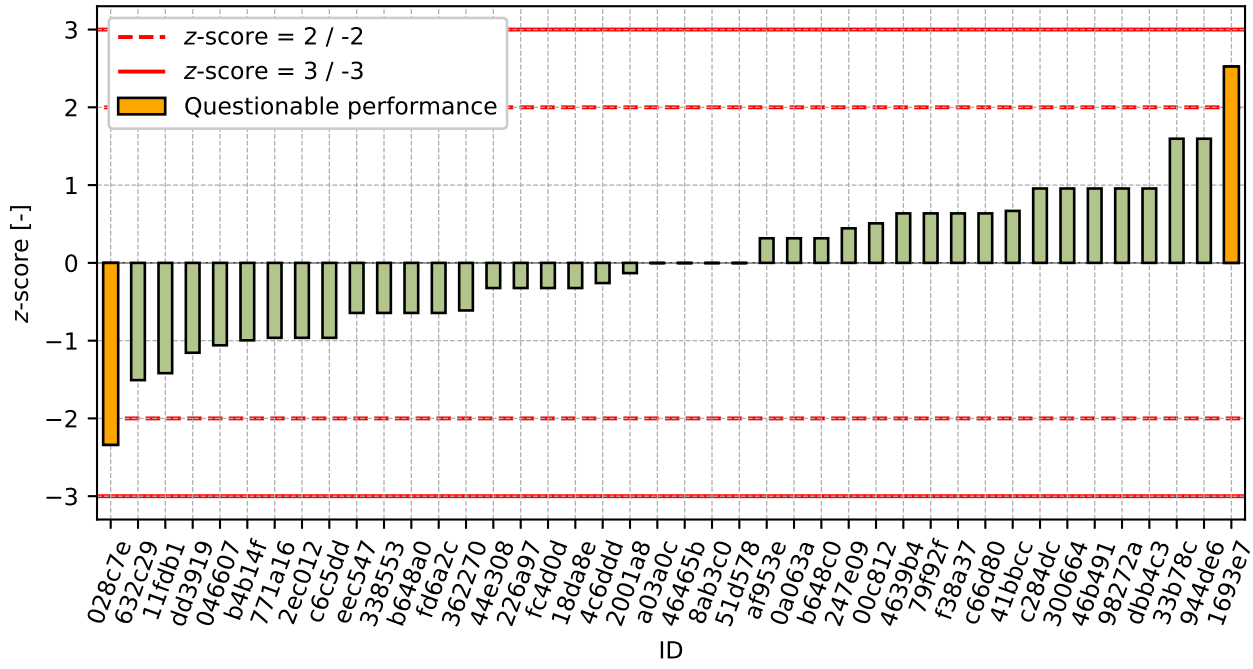

Figure 32: z-score

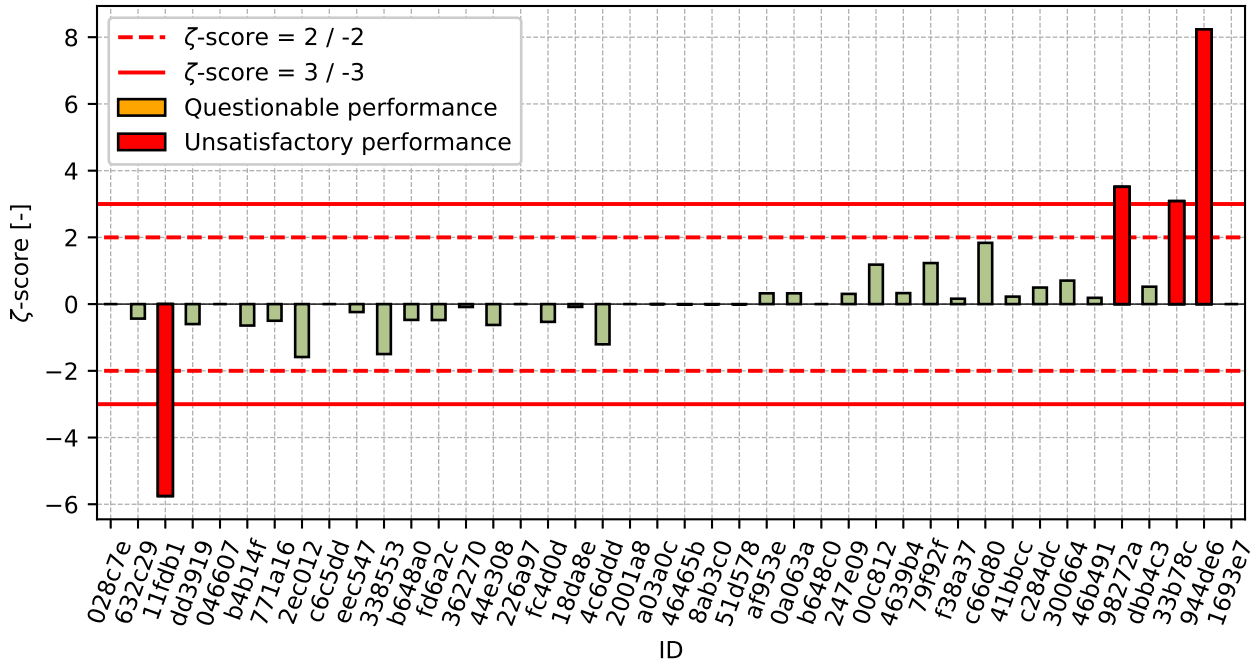

Figure 33: ζ-score

Table 13: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
028c7e	-2.34	-
632c29	-1.51	-0.44
11fdb1	-1.42	-5.75
dd3919	-1.16	-0.6
046607	-1.06	-
b4b14f	-1.0	-0.64
771a16	-0.96	-0.5
2ec012	-0.96	-1.59
c6c5dd	-0.96	-
eec547	-0.64	-0.24
338553	-0.64	-1.5
b648a0	-0.64	-0.47
fd6a2c	-0.64	-0.48
362270	-0.61	-0.09
44e308	-0.32	-0.63
226a97	-0.32	-
fc4d0d	-0.32	-0.53
18da8e	-0.32	-0.08
4c6ddd	-0.26	-1.21
2001a8	-0.13	-
a03a0c	-0.0	-0.0
46465b	-0.0	-0.01

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ID	*z*-score [-]	ζ-score [-]
8ab3c0	-0.0	-0.01
51d578	-0.0	-0.01
af953e	0.32	0.32
0a063a	0.32	0.32
b648c0	0.32	-
247e09	0.44	0.31
00c812	0.51	1.18
4639b4	0.64	0.33
79f92f	0.64	1.23
f38a37	0.64	0.16
c66d80	0.64	1.84
41bbcc	0.67	0.22
c284dc	0.96	0.5
300664	0.96	0.7
46b491	0.96	0.19
98272a	0.96	3.51
dbb4c3	0.96	0.52
33b78c	1.6	3.09
944de6	1.6	8.24
1693e7	2.52	-

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 [%]
c6c5dd	28	-	-	-	28	0.0	0.0
f7fe0f	29	27	29	2	28	0.8	2.77
028c7e	31	29	30	-	30	0.8	2.5
44e308	32	29	30	1	30	1.5	5.04
226a97	31	30	31	-	30	0.5	1.7
ce4914	30	30	32	1	30	0.9	2.86
b4b14f	31	31	30	1	31	0.7	2.29
0a063a	31	31	30	1	31	0.6	1.88
632c29	31	31	31	2	31	0.2	0.49
fd6a2c	31	31	32	1	31	0.6	1.84
3afef0	32	27	35	2	31	4.0	12.9
771a16	31	32	31	1	31	0.6	1.84
362270	31	32	32	4	31	0.3	0.84
247e09	31	31	32	2	32	0.4	1.38
11fdb1	32	32	31	0	32	0.4	1.13
f38a37	32	32	32	4	32	0.0	0.0
2001a8	32	33	32	-	32	0.7	2.12
046607	32	32	32	-	32	0.2	0.54
eec547	32	33	32	3	32	0.7	2.17
79f92f	32	33	33	0	33	0.6	1.77
46465b	33	33	32	0	33	0.6	1.77
dbb4c3	33	32	33	2	33	0.6	1.77
338553	33	33	33	0	33	0.0	0.0
2ec012	33	33	33	0	33	0.0	0.0
af953e	33	33	33	1	33	0.0	0.0
dd3919	33	33	33	2	33	0.2	0.46
4c6ddd	33	33	34	0	33	0.2	0.63
51d578	32	34	34	0	33	1.2	3.46
b648c0	31	33	36	-	33	2.5	7.55
b648a0	33	35	32	1	33	1.5	4.58
fc4d0d	33	34	33	1	33	0.6	1.73
00c812	34	34	33	0	33	0.2	0.62
4639b4	33	34	34	3	34	0.4	1.24
c284dc	33	34	34	1	34	0.6	1.71
18da8e	34	33	34	4	34	0.6	1.71
c66d80	34	34	33	0	34	0.6	1.71

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ID	Test results [%]			u_X [%]	$\bar{x}$ [%]	s_0 [%]	V_X [%]
a03a0c	34	34	34	3	34	0.2	0.59
46b491	34	34	34	2	34	0.0	0.0
33b78c	34	34	34	0	34	0.0	0.0
300664	34	34	34	1	34	0.0	0.0
1693e7	33	39	32	-	35	3.7	10.54
8ab3c0	35	35	34	1	35	0.6	1.67
41bbcc	35	35	35	3	35	0.1	0.29
98272a	35	35	35	0	35	0.0	0.0
97676c	36	36	35	-	36	0.6	1.62
944de6	37	37	36	0	37	0.6	1.57

1.4.2 The Numerical Procedure for Determining Outliers

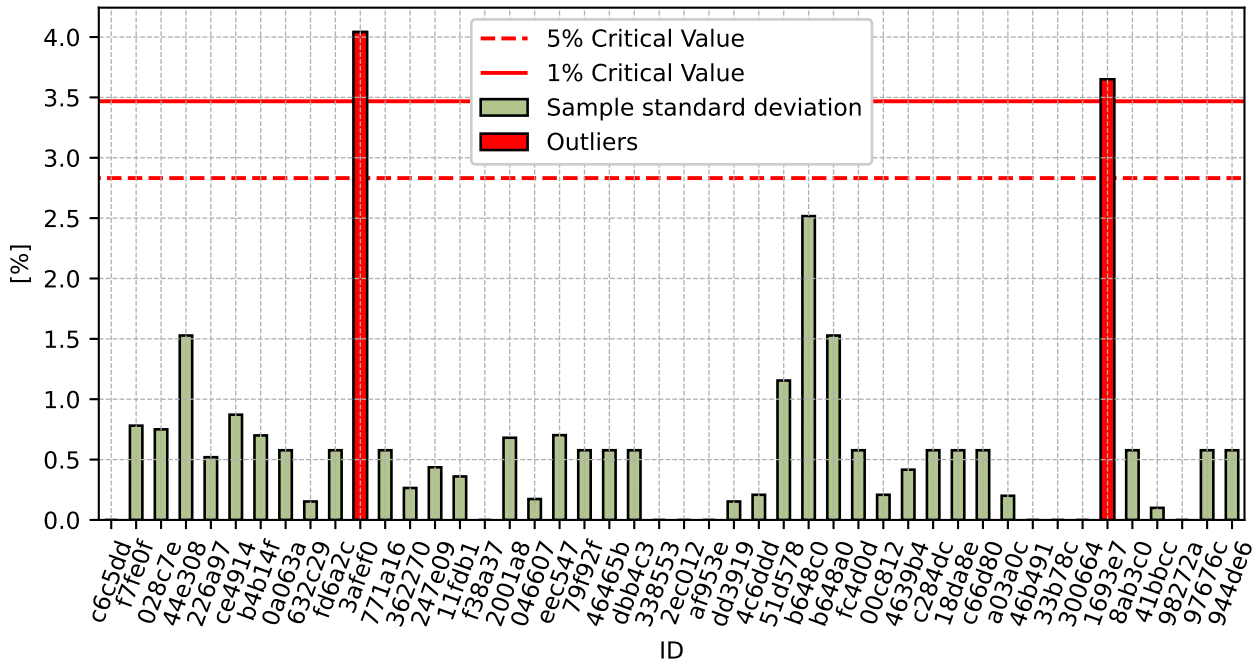

Figure 34: **Cochran's test** - sample standard deviations

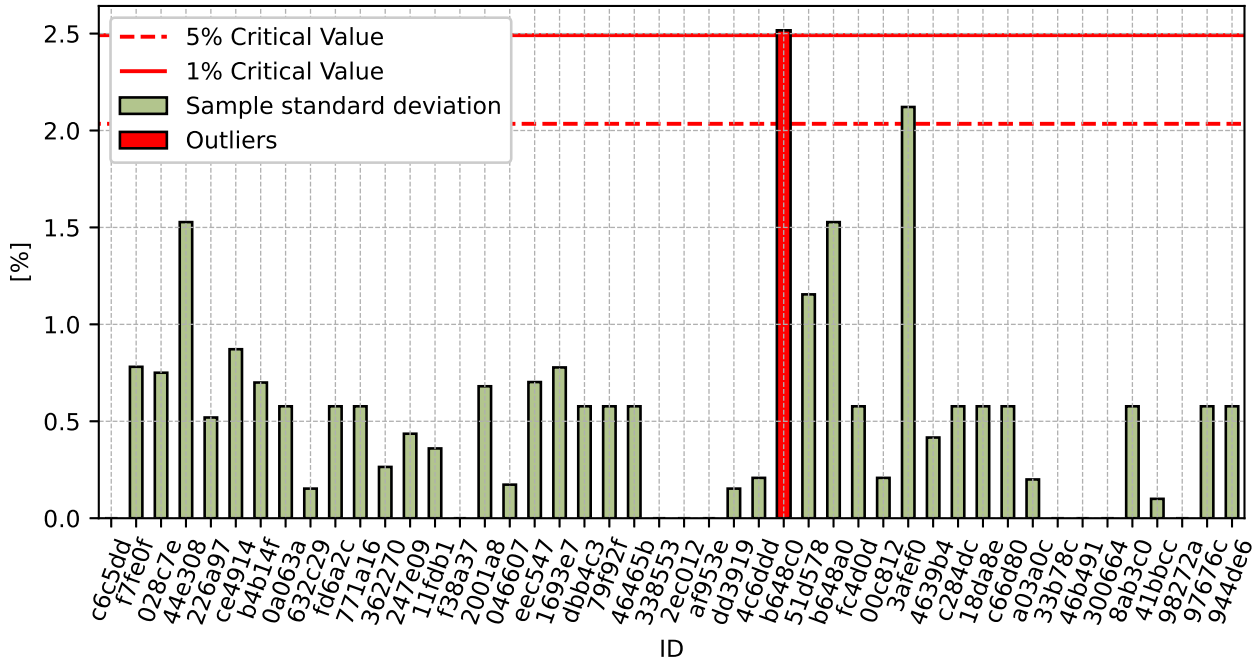

Figure 35: **Cochran's test** - sample standard deviations without outliers

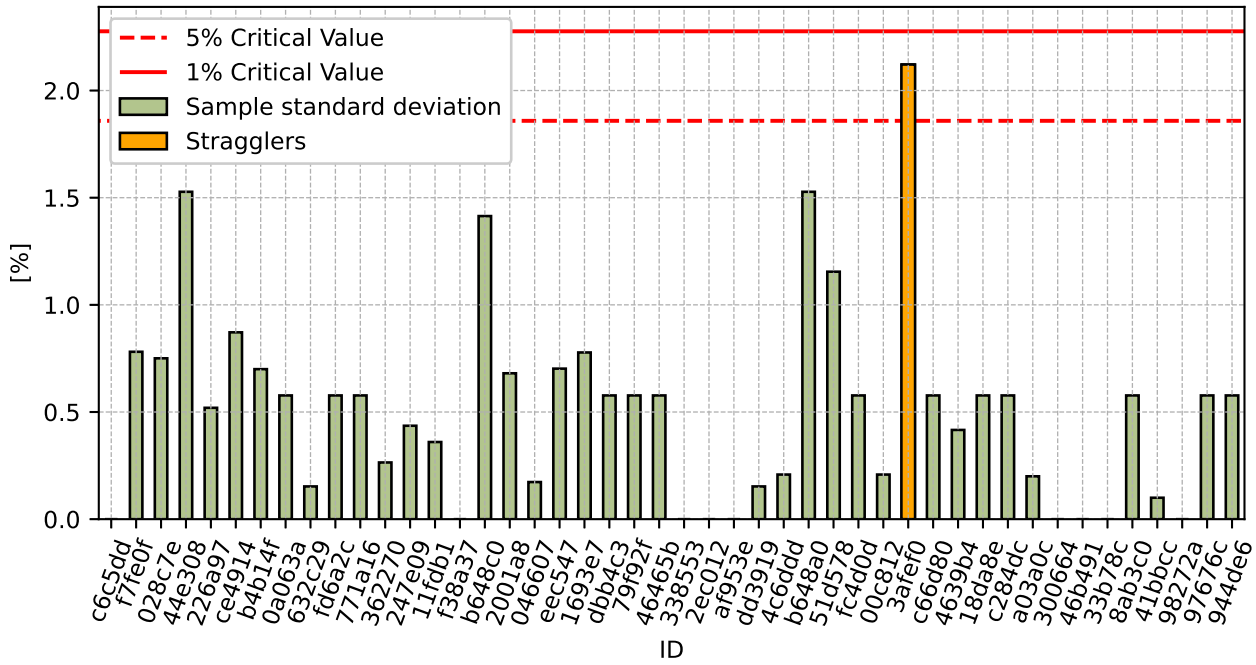

Figure 36: **Cochran's test** - sample standard deviations without outliers

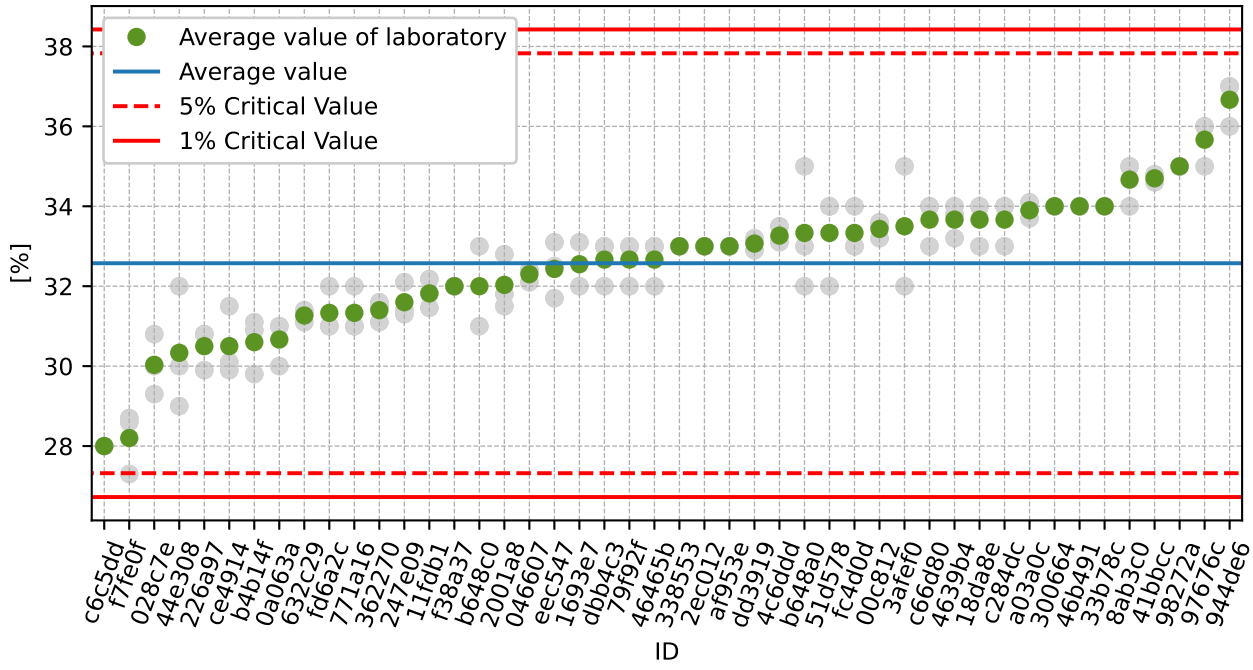

Figure 37: **Grubbs' test** - average values

1.4.3 Mandel's Statistics

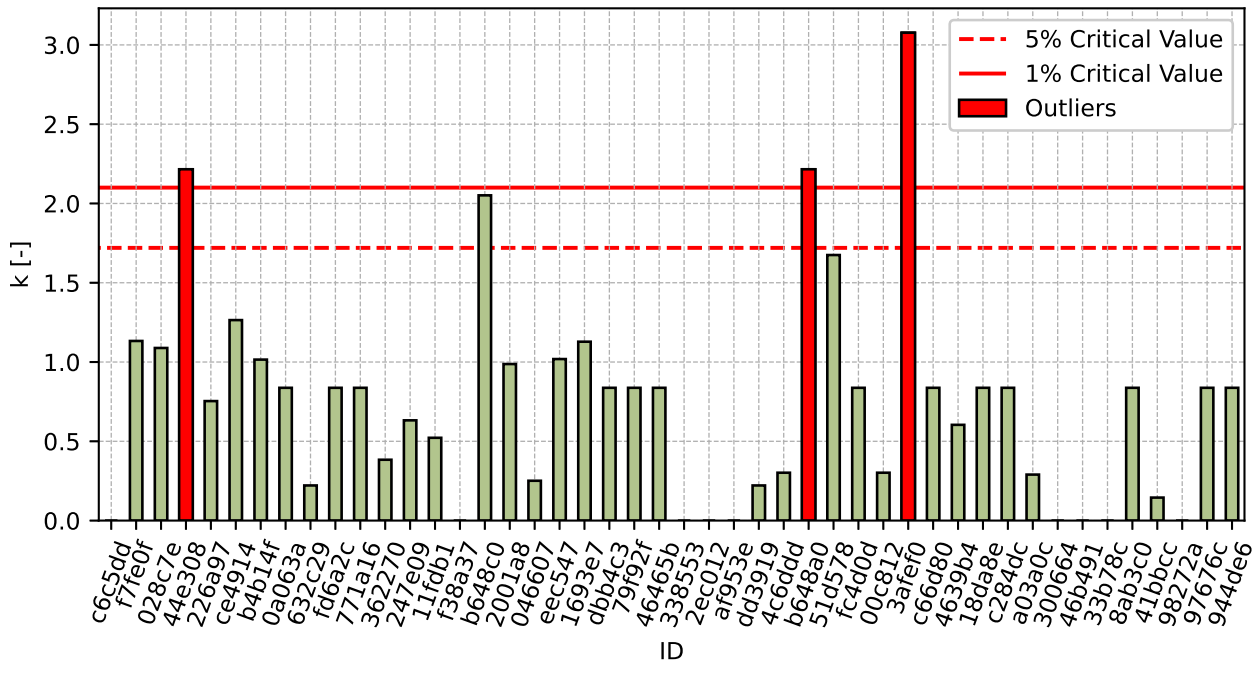

Figure 38: Intralaboratory Consistency Statistic

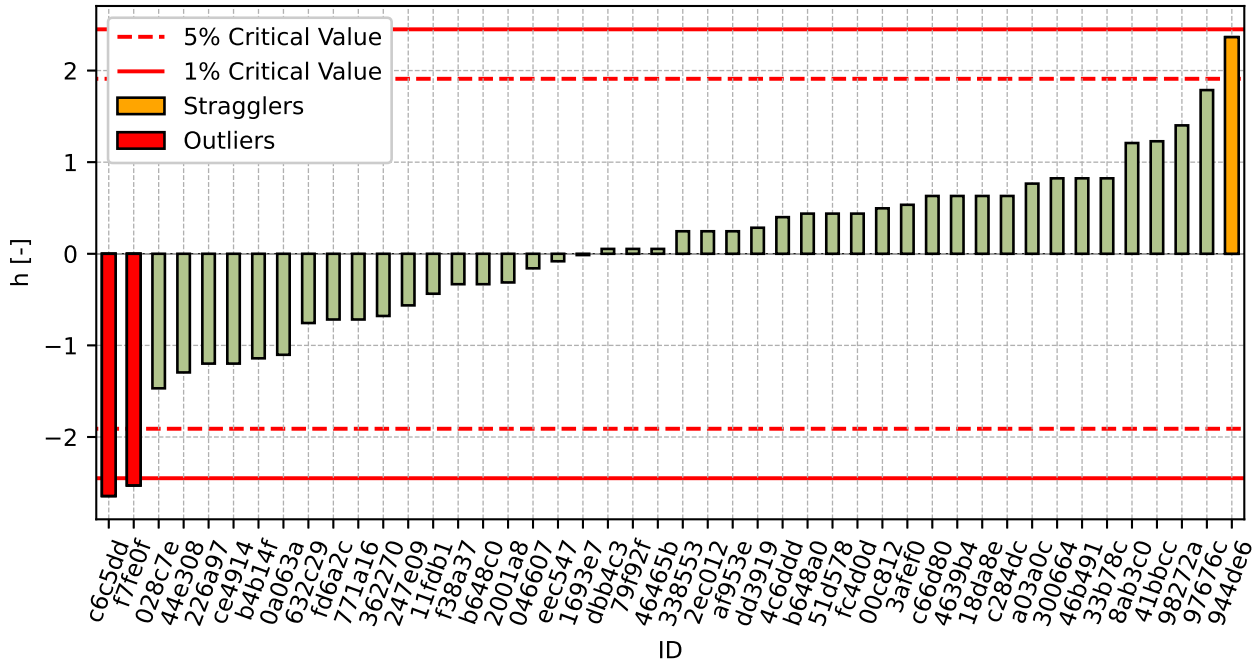

Figure 39: Interlaboratory Consistency Statistic

1.4.4 Descriptive statistics

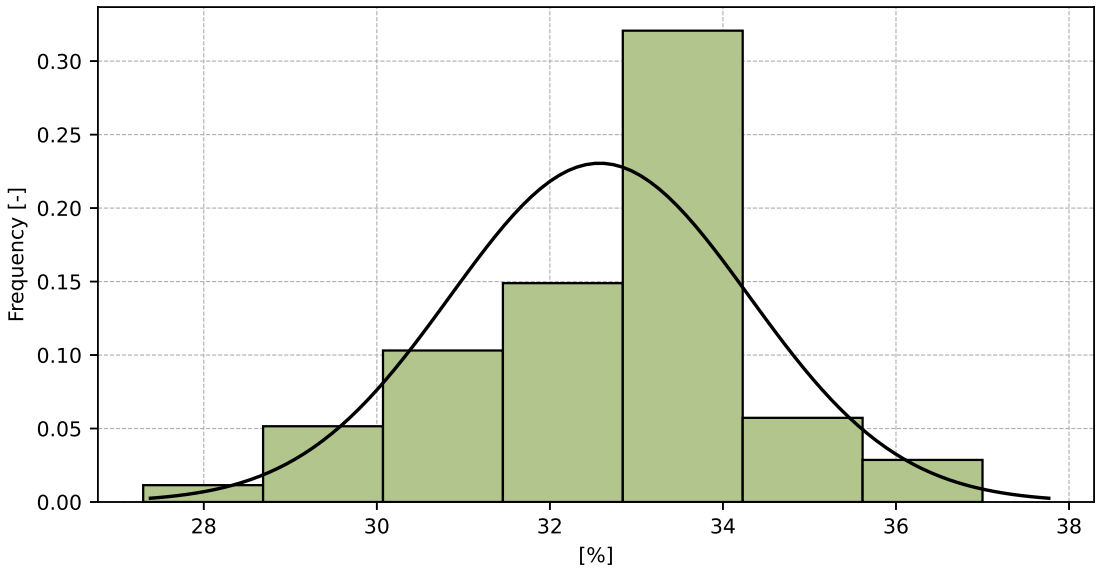

Figure 40: Histogram of all test results

Table 15: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	33
Sample standard deviation – s	1.7
Asigned value – x^*	33
Robust standard deviation – s^*	1.7
Measurement uncertainty of asigned value – u_X	0.3
p-value of normality test	0.052 [-]
Interlaboratory standard deviation – s_L	1.7
Repeatability standard deviation – s_r	0.7
Reproducibility standard deviation – s_R	1.8
Repeatability – r	2
Reproducibility – R	5

1.4.5 Evaluation of Performance Statistics

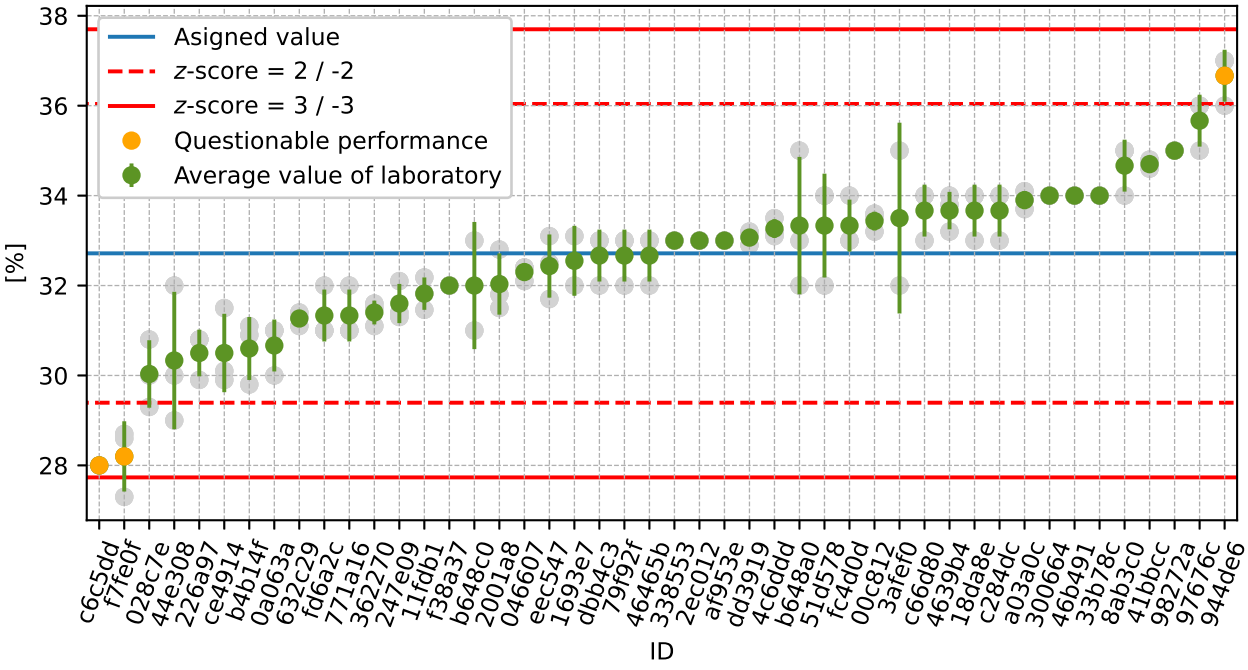

Figure 41: Average values and sample standard deviations

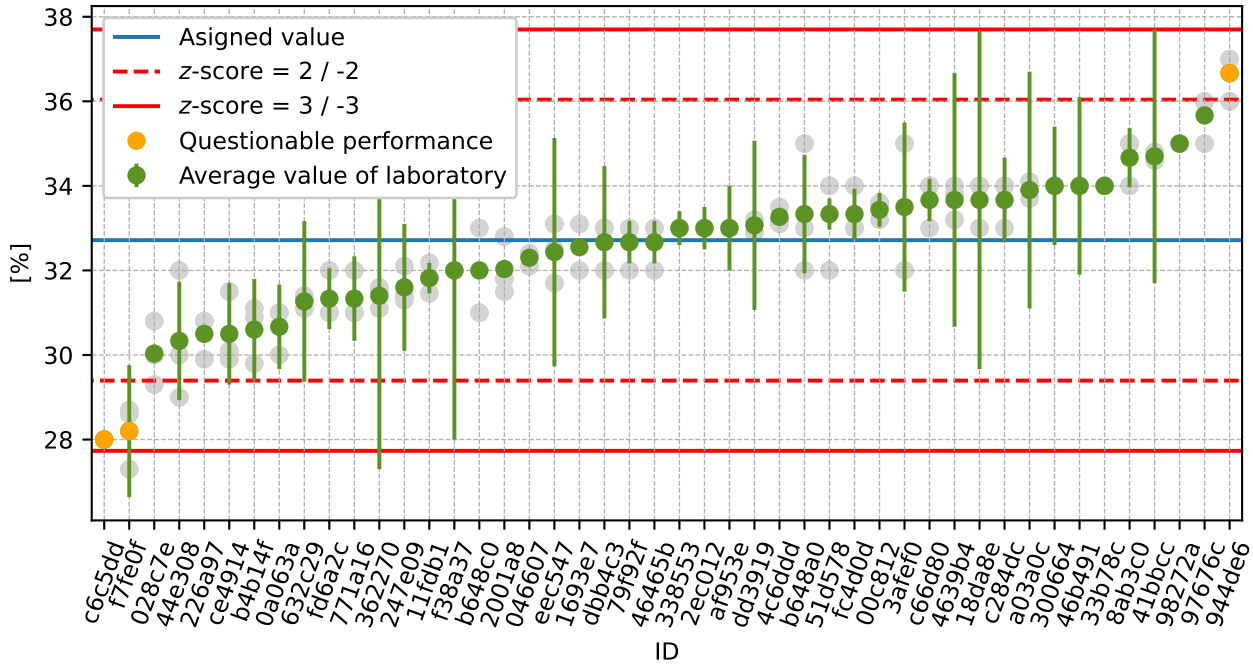

Figure 42: Average values and extended uncertainties of measurement

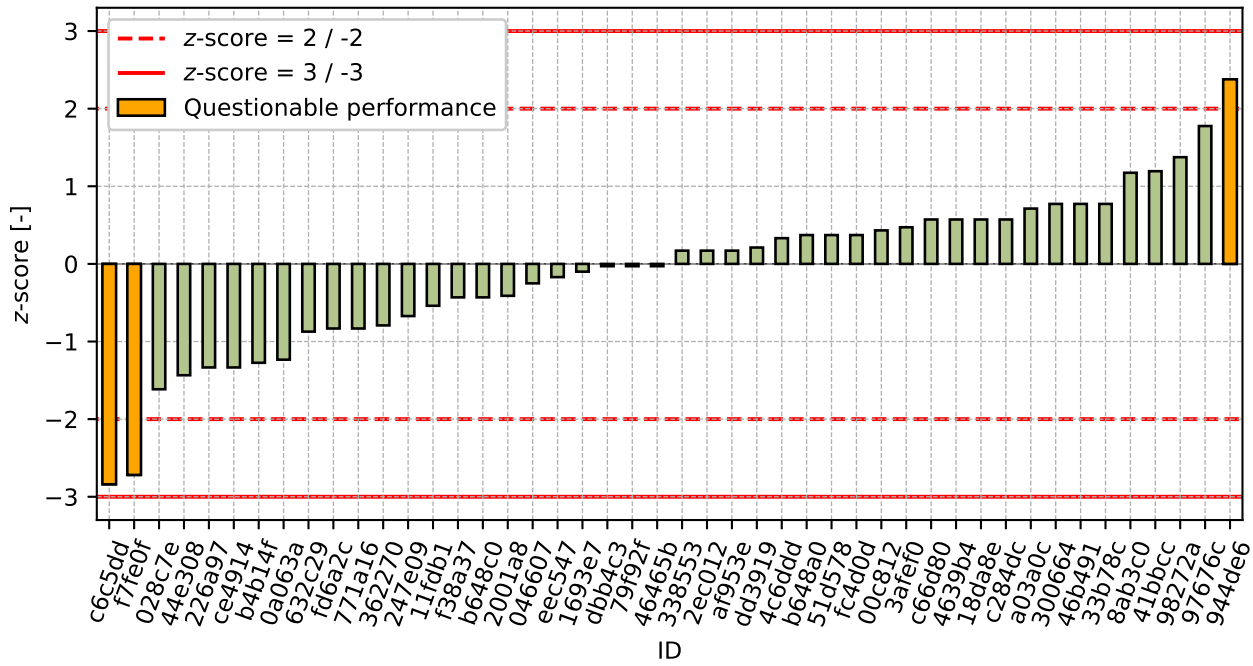

Figure 43: z-score

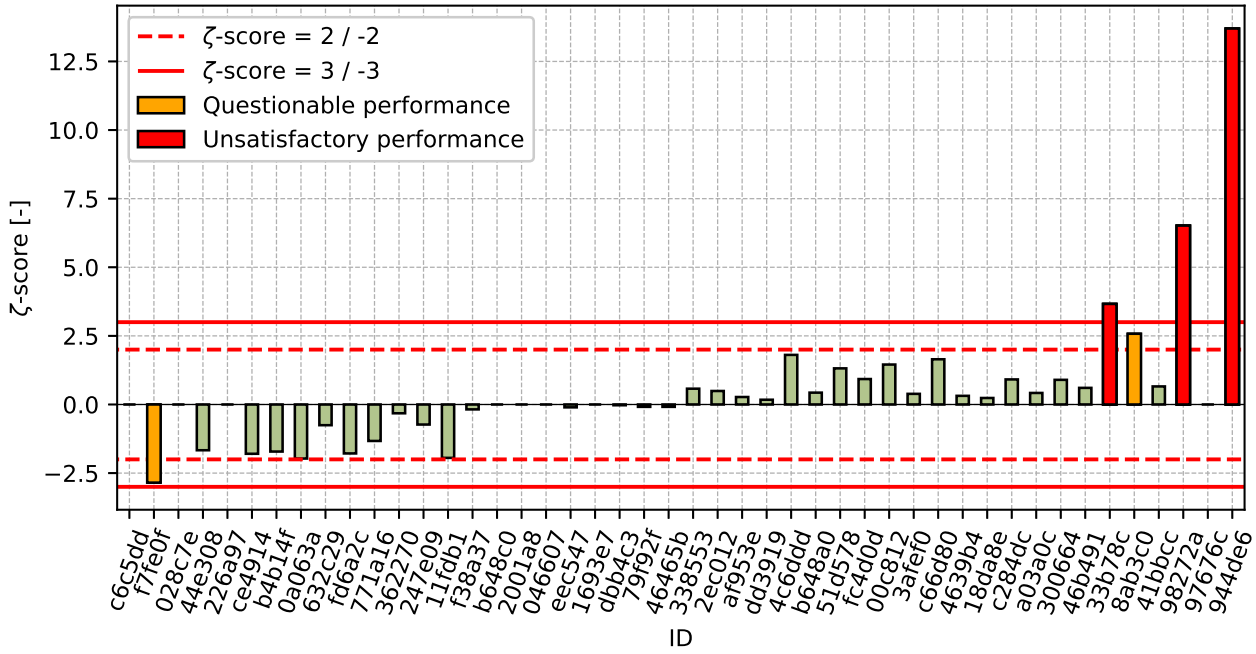

Figure 44: ζ-score

Table 16: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
c6c5dd	-2.84	-
f7fe0f	-2.72	-2.85
028c7e	-1.62	-
44e308	-1.43	-1.67
226a97	-1.33	-
ce4914	-1.33	-1.8
b4b14f	-1.27	-1.71
0a063a	-1.23	-1.97
632c29	-0.87	-0.75
fd6a2c	-0.83	-1.78
771a16	-0.83	-1.33
362270	-0.79	-0.32
247e09	-0.67	-0.73
11fdb1	-0.54	-1.94
f38a37	-0.43	-0.18
b648c0	-0.43	-
2001a8	-0.41	-
046607	-0.25	-
eec547	-0.17	-0.1
1693e7	-0.1	-
dbb4c3	-0.03	-0.03
79f92f	-0.03	-0.09
46465b	-0.03	-0.09

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ID	z-score [-]	ζ-score [-]
338553	0.17	0.58
2ec012	0.17	0.49
af953e	0.17	0.27
dd3919	0.21	0.17
4c6ddd	0.33	1.81
b648a0	0.37	0.43
51d578	0.37	1.32
fc4d0d	0.37	0.93
00c812	0.43	1.46
3afef0	0.47	0.39
c66d80	0.57	1.65
4639b4	0.57	0.32
18da8e	0.57	0.24
c284dc	0.57	0.91
a03a0c	0.71	0.42
300664	0.77	0.9
46b491	0.77	0.61
33b78c	0.77	3.66
8ab3c0	1.17	2.58
41bbcc	1.19	0.66
98272a	1.37	6.52
97676c	1.78	-
944de6	2.38	13.7

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 [%]
3afef0	6	5	8	1	6	1.5	24.12
ce4914	7	8	7	0	8	0.6	7.28
f7fe0f	8	7	8	1	8	0.3	4.21
c6c5dd	8	-	-	-	8	0.0	0.0
226a97	8	8	9	-	8	0.4	4.91
0a063a	8	8	9	1	8	0.6	6.93
028c7e	9	9	9	-	9	0.1	0.67
44e308	10	8	9	1	9	1.0	11.11
b4b14f	9	10	9	0	9	0.5	5.55
247e09	9	9	9	0	9	0.2	2.28
046607	9	9	10	-	9	0.3	3.08
2001a8	9	10	9	-	9	0.6	6.64
632c29	10	10	9	1	9	0.3	2.66
79f92f	9	10	10	0	10	0.6	5.97
fd6a2c	10	10	9	0	10	0.6	5.97
362270	10	10	10	1	10	0.2	1.56
4c6ddd	10	10	10	0	10	0.1	1.0
771a16	10	10	10	0	10	0.0	0.0
46465b	10	10	10	0	10	0.0	0.0
2ec012	10	10	10	0	10	0.0	0.0
98272a	10	10	10	0	10	0.0	0.0
51d578	10	10	10	0	10	0.0	0.0
dbb4c3	10	11	10	2	10	0.6	5.59
b648c0	9	10	12	-	10	1.5	14.78
eec547	10	11	10	2	10	0.3	2.43
1693e7	10	12	10	-	11	1.5	13.7
c66d80	11	11	10	0	11	0.6	5.41
f38a37	11	11	10	3	11	0.6	5.41
fc4d0d	10	11	11	1	11	0.6	5.41
41bbcc	11	11	11	2	11	0.1	1.07
11fdb1	11	11	11	0	11	0.3	2.45
4639b4	11	11	11	5	11	0.4	3.7
338553	11	11	11	0	11	0.0	0.0
af953e	11	11	11	1	11	0.0	0.0
33b78c	11	11	11	0	11	0.0	0.0
c284dc	11	11	11	1	11	0.0	0.0

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ID	Test results [%]			u_X [%]	$\bar{x}$ [%]	s_0 [%]	V_X [%]
300664	11	11	11	1	11	0.0	0.0
dd3919	11	11	11	2	11	0.2	1.55
8ab3c0	12	11	11	1	11	0.6	5.09
b648a0	11	12	11	1	11	0.6	5.09
46b491	11	11	12	1	11	0.6	5.09
18da8e	11	11	12	3	11	0.6	5.09
00c812	12	11	11	0	11	0.1	0.5
a03a0c	12	11	12	2	12	0.3	2.18
97676c	11	12	12	-	12	0.6	4.95
944de6	15	15	15	0	15	0.0	0.0

1.5.2 The Numerical Procedure for Determining Outliers

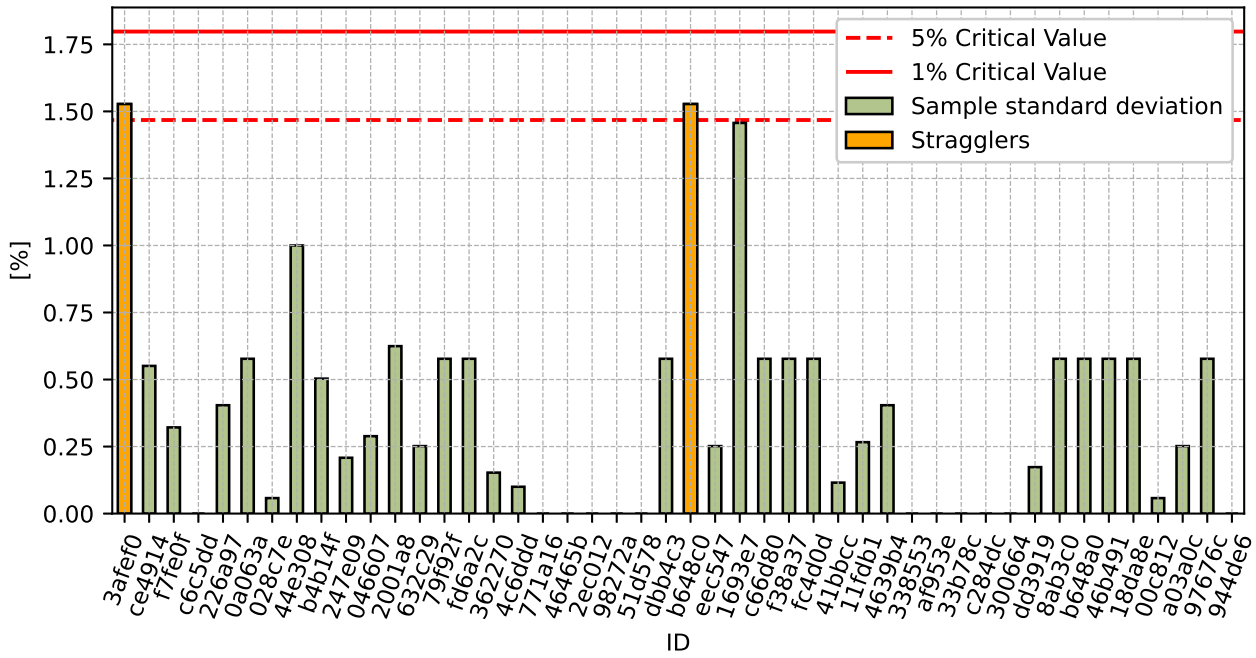

Figure 45: **Cochran's test** - sample standard deviations

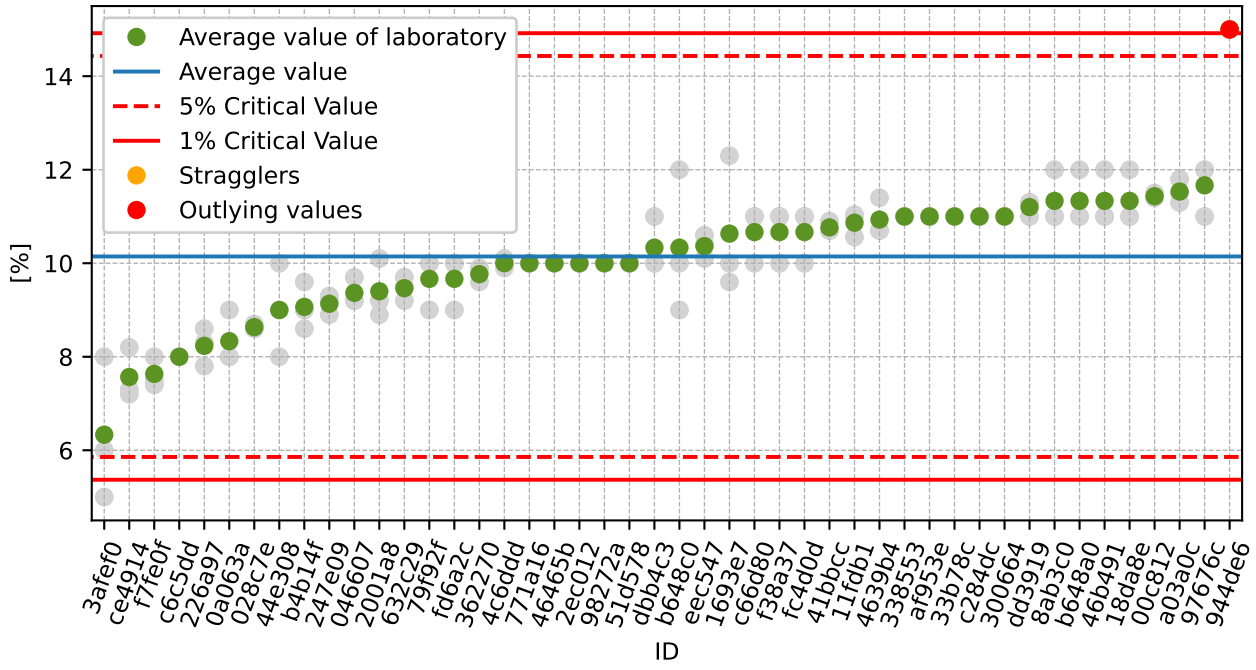

Figure 46: **Grubbs' test** - average values

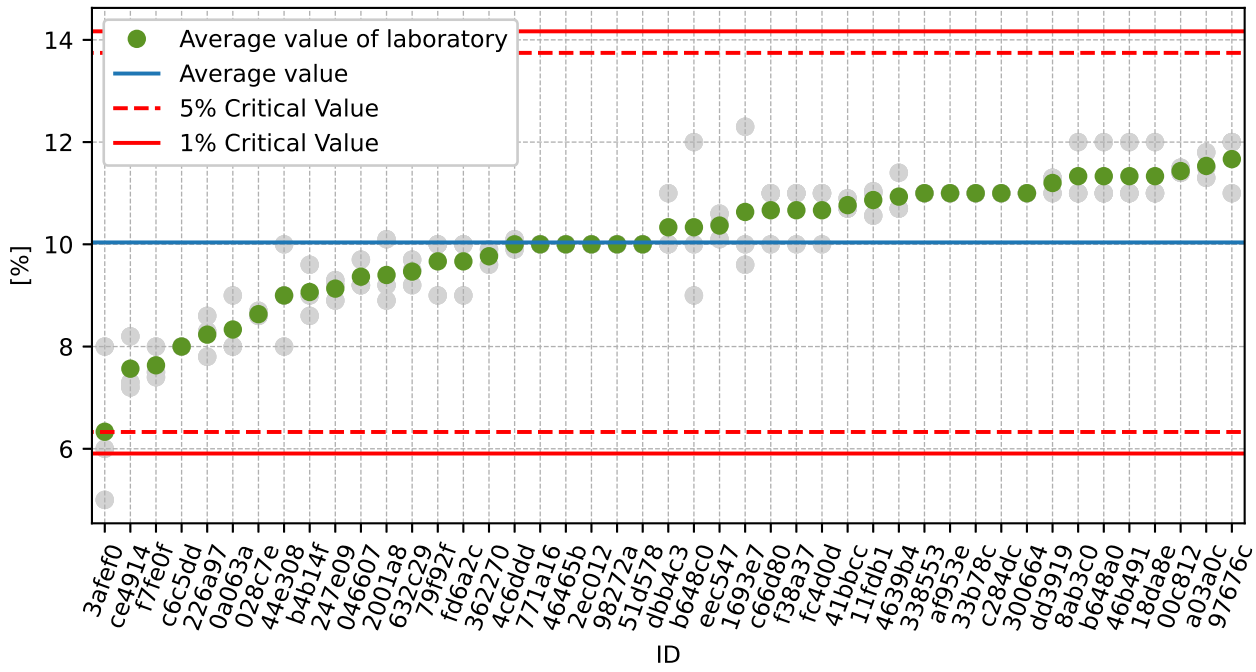

Figure 47: **Grubbs' test** - average values without outliers

1.5.3 Mandel's Statistics

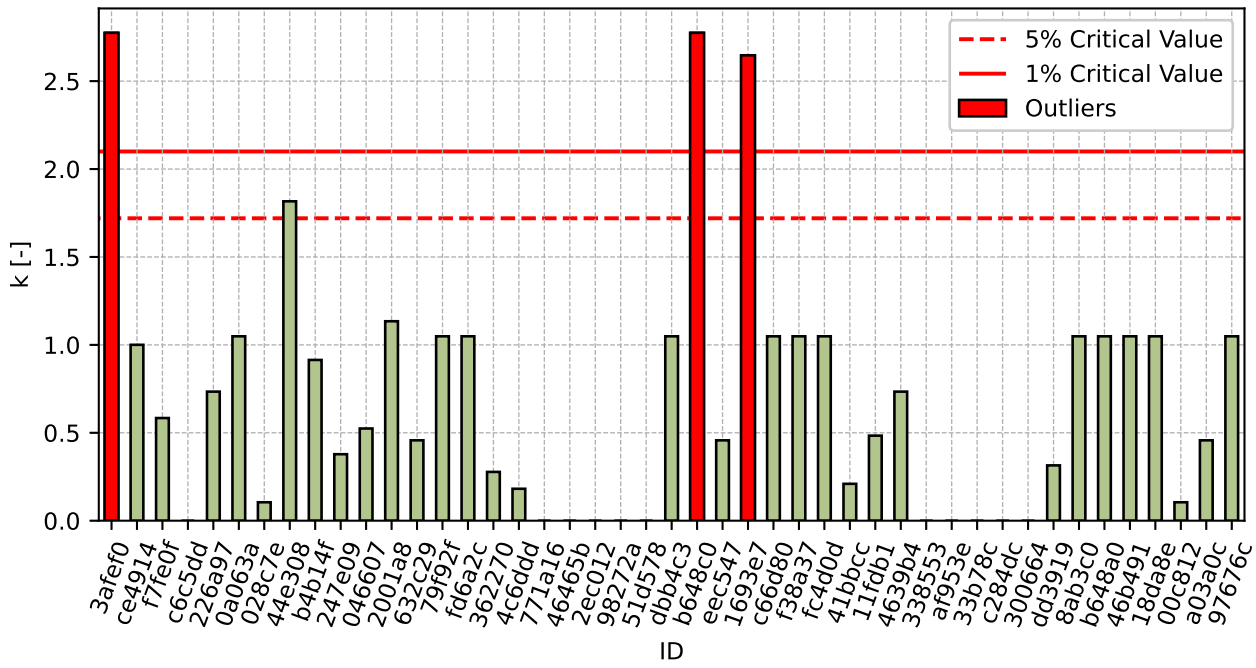

Figure 48: Intralaboratory Consistency Statistic

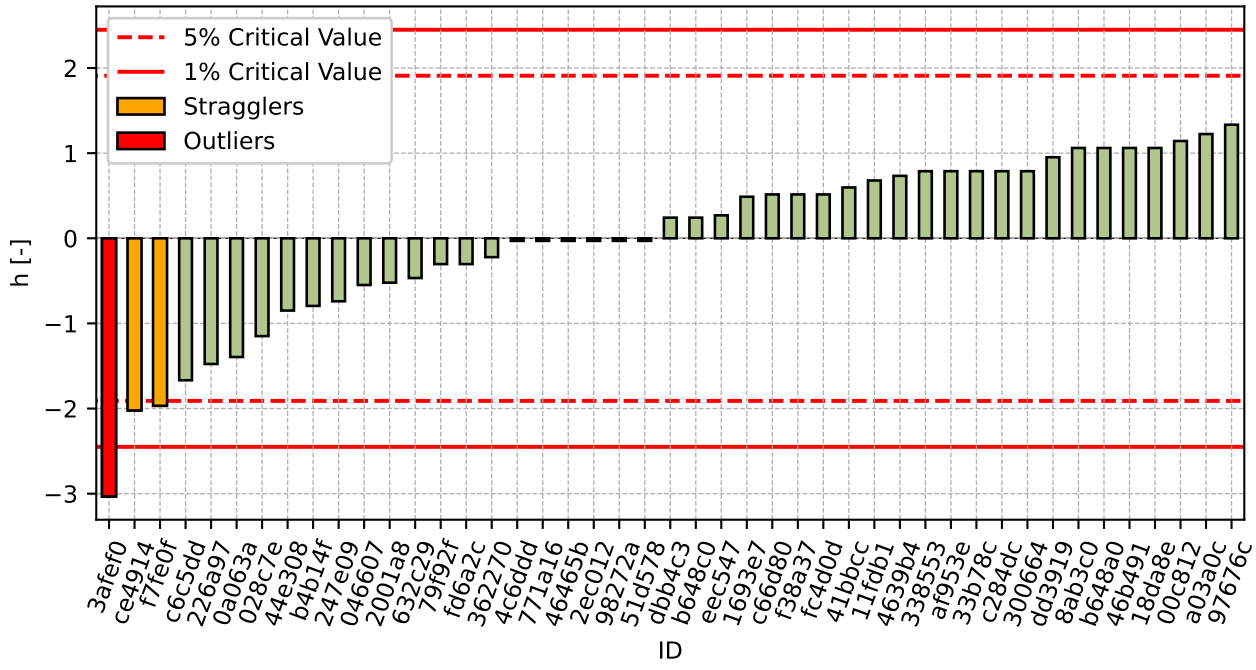

Figure 49: Interlaboratory Consistency Statistic

1.5.4 Descriptive statistics

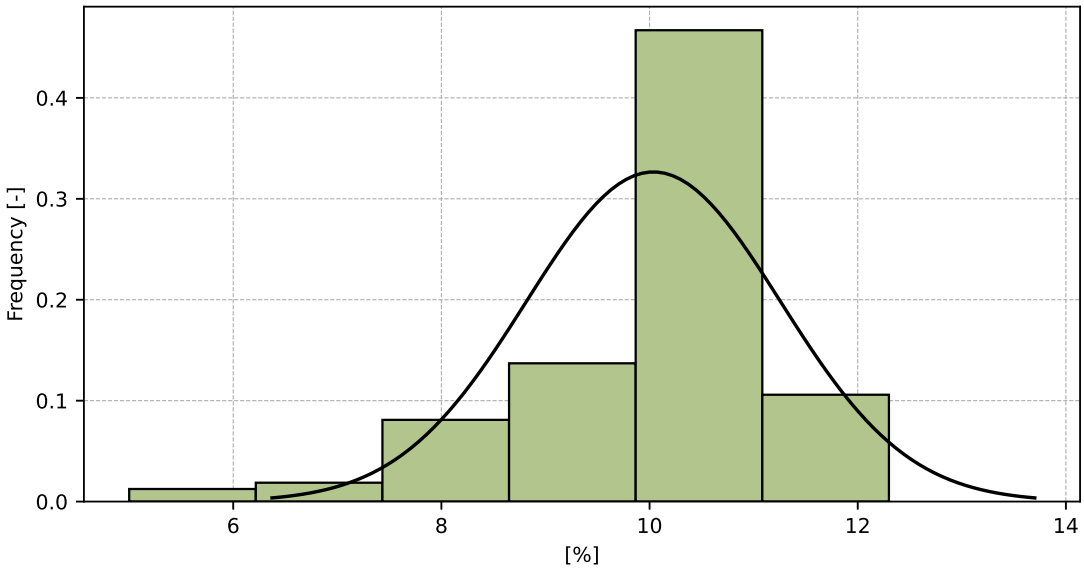

Figure 50: Histogram of all test results

Table 18: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	10
Sample standard deviation – s	1.2
Asigned value – x^*	10
Robust standard deviation – s^*	1.1
Measurement uncertainty of asigned value – u_X	0.2
p-value of normality test	0.0 [-]
Interlaboratory standard deviation – s_L	1.2
Repeatability standard deviation – s_r	0.6
Reproducibility standard deviation – s_R	1.3
Repeatability – r	2
Reproducibility – R	4

1.5.5 Evaluation of Performance Statistics

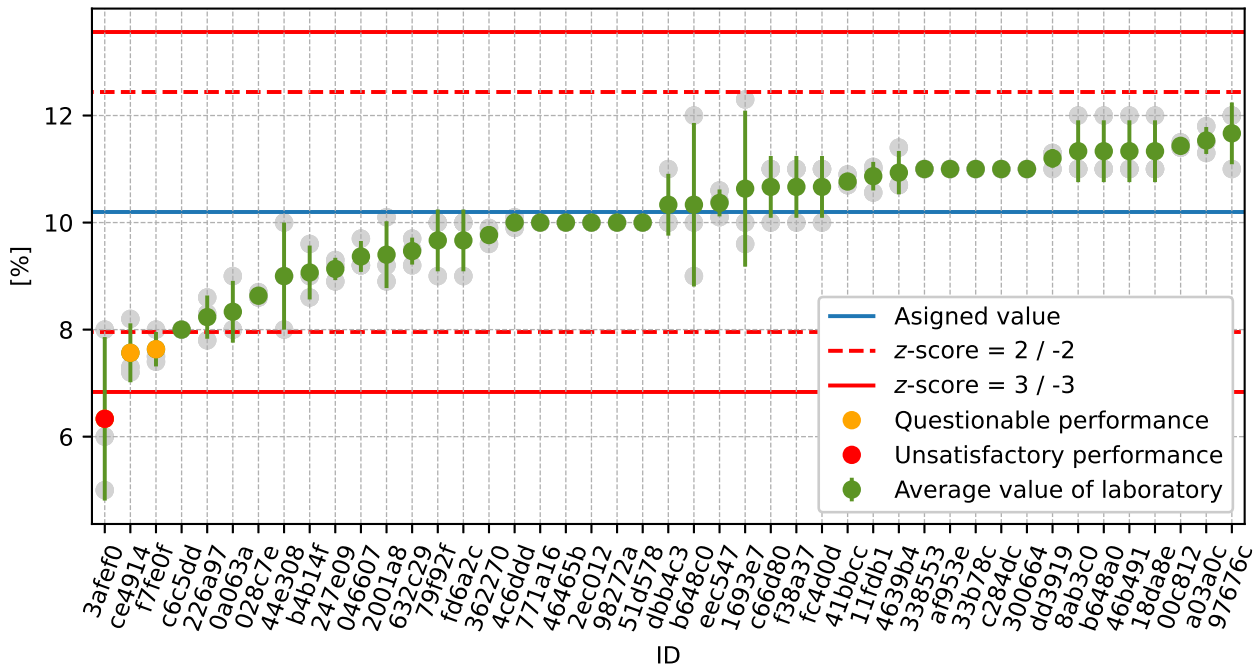

Figure 51: Average values and sample standard deviations

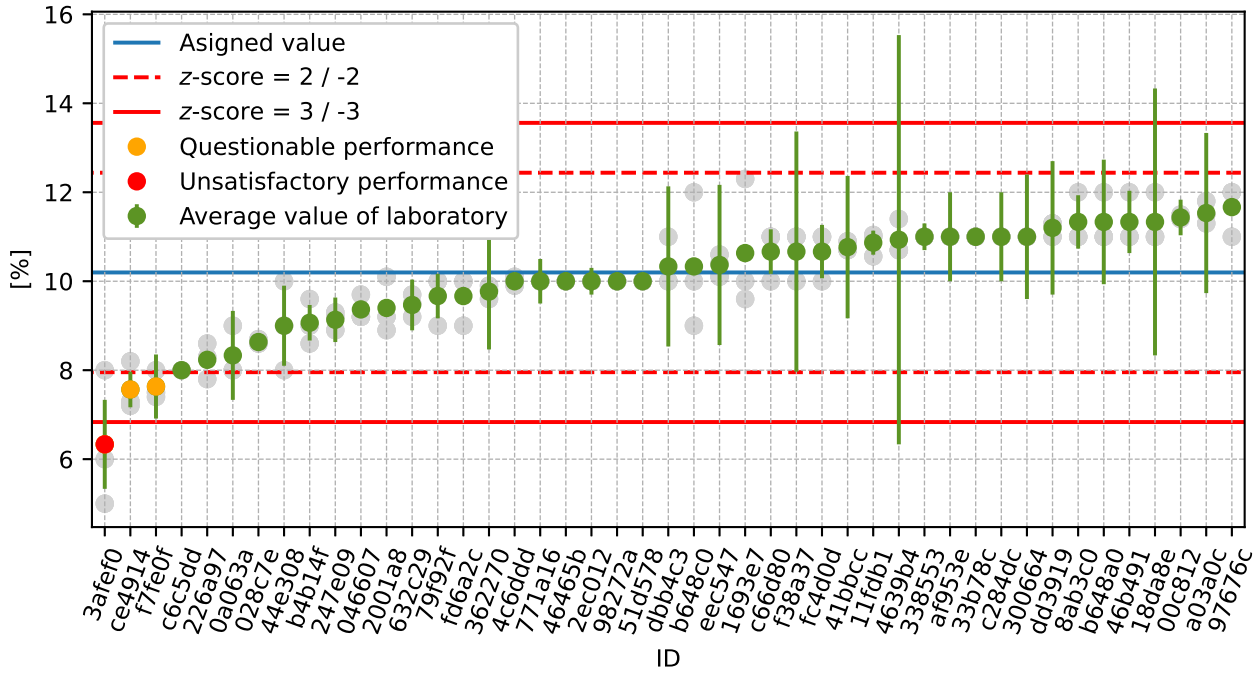

Figure 52: Average values and extended uncertainties of measurement

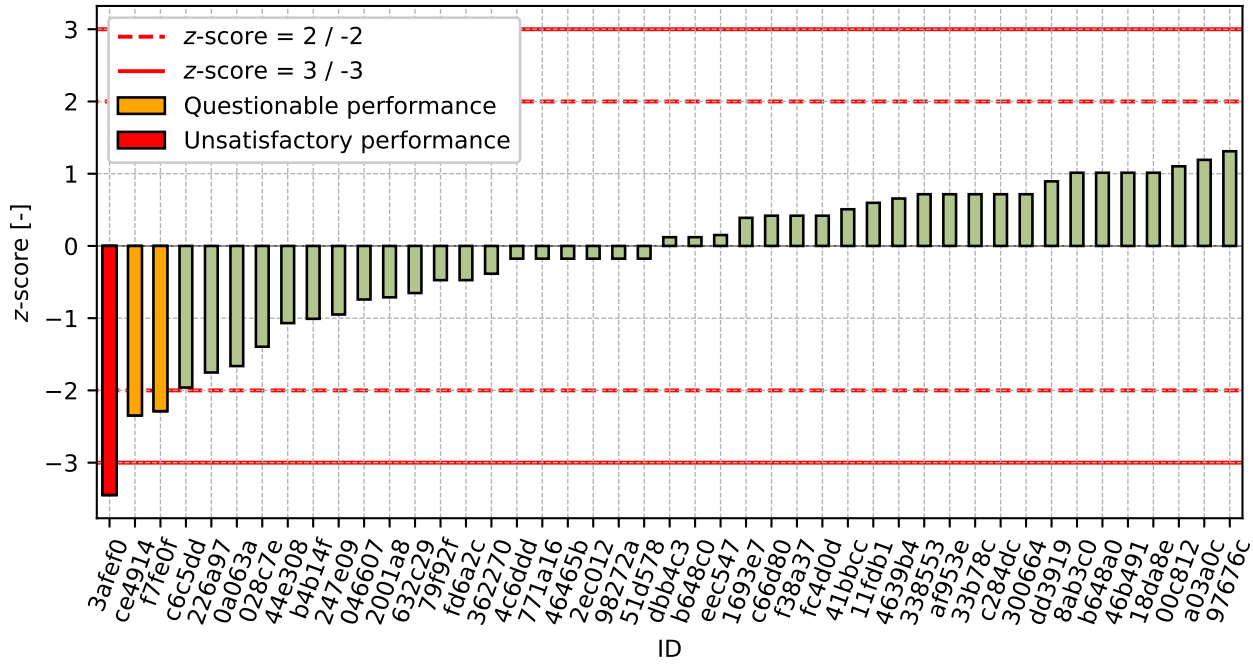

Figure 53: z-score

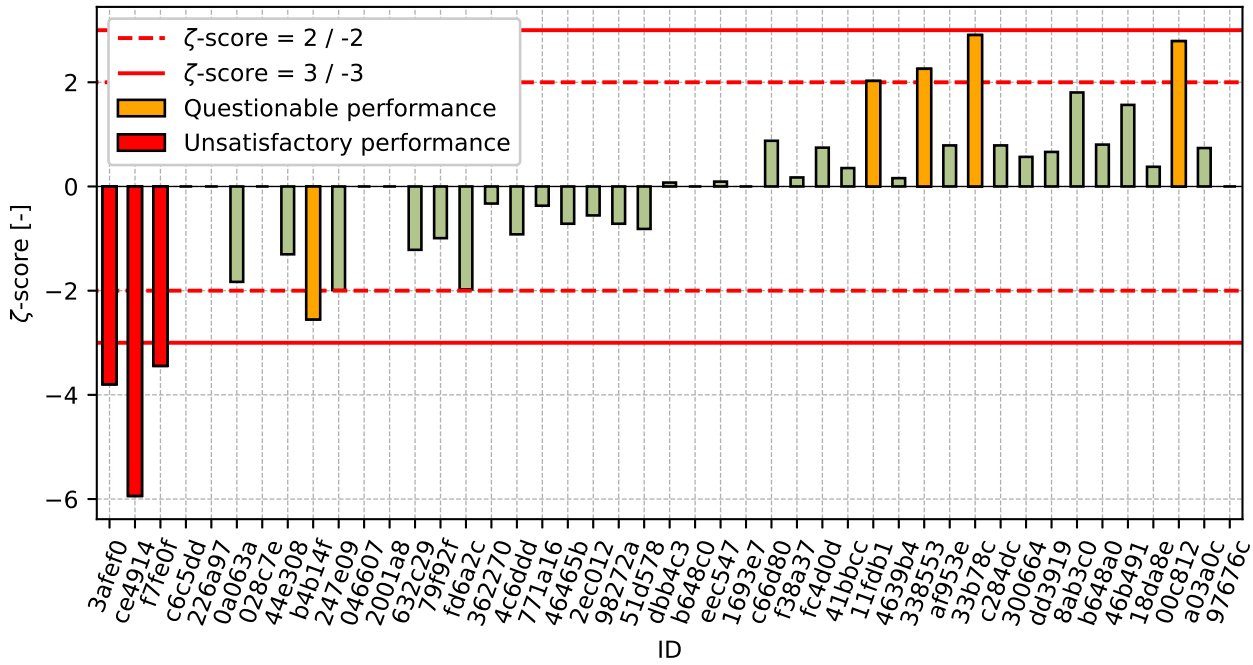

Figure 54: ζ-score

Table 19: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
3afef0	-3.45	-3.8
ce4914	-2.35	-5.94
f7fe0f	-2.29	-3.44
c6c5dd	-1.96	-
226a97	-1.75	-
0a063a	-1.66	-1.83
028c7e	-1.4	-
44e308	-1.07	-1.3
b4b14f	-1.01	-2.55
247e09	-0.95	-1.99
046607	-0.74	-
2001a8	-0.71	-
632c29	-0.65	-1.22
79f92f	-0.47	-0.99
fd6a2c	-0.47	-1.97
362270	-0.38	-0.33
4c6ddd	-0.18	-0.92
771a16	-0.18	-0.37
46465b	-0.18	-0.72
2ec012	-0.18	-0.56
98272a	-0.18	-0.72
51d578	-0.18	-0.82
dbb4c3	0.12	0.08
b648c0	0.12	-
eec547	0.15	0.09
1693e7	0.39	-
c66d80	0.42	0.88
f38a37	0.42	0.17
fc4d0d	0.42	0.75
41bbcc	0.51	0.35
11fdb1	0.6	2.03
4639b4	0.66	0.16
338553	0.72	2.26
af953e	0.72	0.79
33b78c	0.72	2.91
c284dc	0.72	0.79
300664	0.72	0.57
dd3919	0.89	0.66
8ab3c0	1.01	1.8
b648a0	1.01	0.8
46b491	1.01	1.57
18da8e	1.01	0.38
00c812	1.1	2.79
a03a0c	1.19	0.74

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ID	z-score [-]	ζ-score [-]
97676c	1.31	-

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 [%]
f7fe0f	1	1	1	0	1	0.1	6.93
028c7e	1	1	1	-	1	0.1	10.0
98272a	1	1	1	0	1	0.0	0.0
c6c5dd	1	-	-	-	1	0.0	0.0
dbb4c3	1	1	1	1	1	0.0	0.0
44e308	1	1	1	0	1	0.0	0.0
46465b	1	1	1	0	1	0.0	0.0
247e09	1	1	1	0	1	0.1	4.68
226a97	1	1	2	-	1	0.2	15.61
0a063a	1	1	2	1	1	0.6	43.3
eec547	1	2	1	1	1	0.2	11.18
2001a8	1	2	1	-	1	0.1	8.45
362270	1	2	1	0	1	0.1	7.14
046607	1	2	1	-	1	0.1	4.03
3afef0	1	1	3	0	2	1.2	69.28
c66d80	2	2	1	0	2	0.6	34.64
1693e7	2	2	1	-	2	0.5	29.61
632c29	2	2	2	0	2	0.1	6.66
ce4914	2	2	2	0	2	0.2	11.78
4c6ddd	2	2	2	0	2	0.1	3.27
41bbcc	2	2	2	1	2	0.2	10.58
11fdb1	2	2	2	0	2	0.2	11.26
b648a0	2	2	2	1	2	0.0	0.0
771a16	2	2	2	0	2	0.0	0.0
2ec012	2	2	2	0	2	0.0	0.0
fd6a2c	2	2	2	0	2	0.0	0.0
338553	2	2	2	0	2	0.0	0.0
79f92f	2	2	2	0	2	0.0	0.0
51d578	2	2	2	0	2	0.0	0.0
944de6	2	2	2	0	2	0.0	0.0
b4b14f	2	2	2	0	2	0.1	5.0
18da8e	2	2	2	2	2	0.0	0.0
fc4d0d	2	2	2	1	2	0.0	0.0
97676c	2	2	2	-	2	0.0	0.0
f38a37	2	2	2	1	2	0.0	0.0
300664	2	2	2	1	2	0.0	0.0

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ID	Test results [%]			u_X [%]	$\bar{x}$ [%]	s_0 [%]	V_X [%]
33b78c	2	2	2	0	2	0.0	0.0
4639b4	2	3	2	1	2	0.4	18.1
af953e	2	2	2	0	2	0.1	2.47
c284dc	3	2	2	0	2	0.6	24.74
8ab3c0	3	2	2	1	2	0.6	24.74
46b491	2	2	3	0	2	0.6	24.74
a03a0c	2	2	2	1	2	0.1	2.47
b648c0	2	2	3	-	2	0.6	24.74
dd3919	2	2	2	1	2	0.1	4.95
00c812	2	2	2	0	2	0.1	2.34

1.6.2 The Numerical Procedure for Determining Outliers

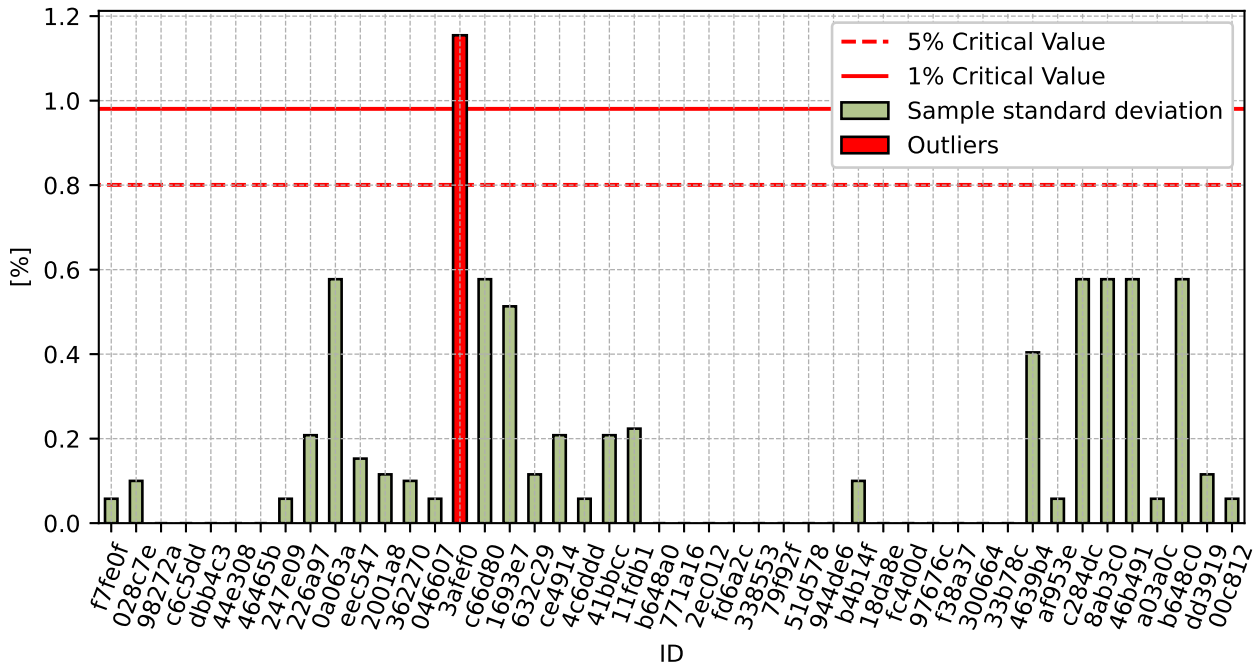

Figure 55: **Cochran's test** - sample standard deviations

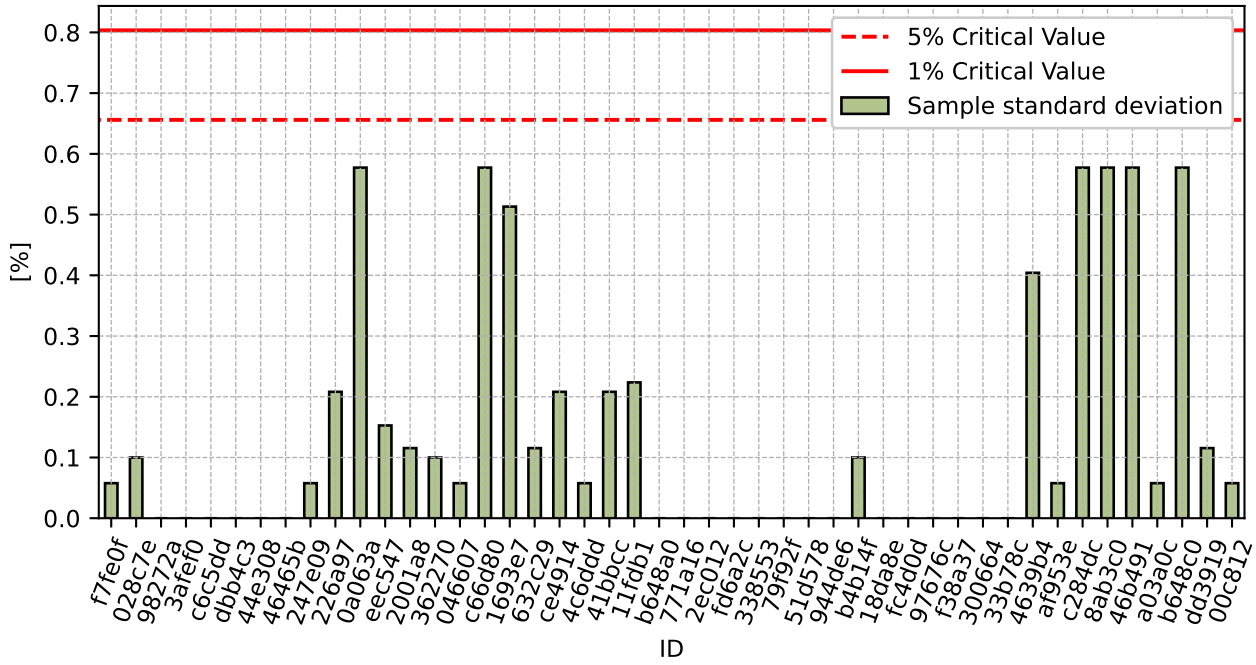

Figure 56: **Cochran's test** - sample standard deviations without outliers

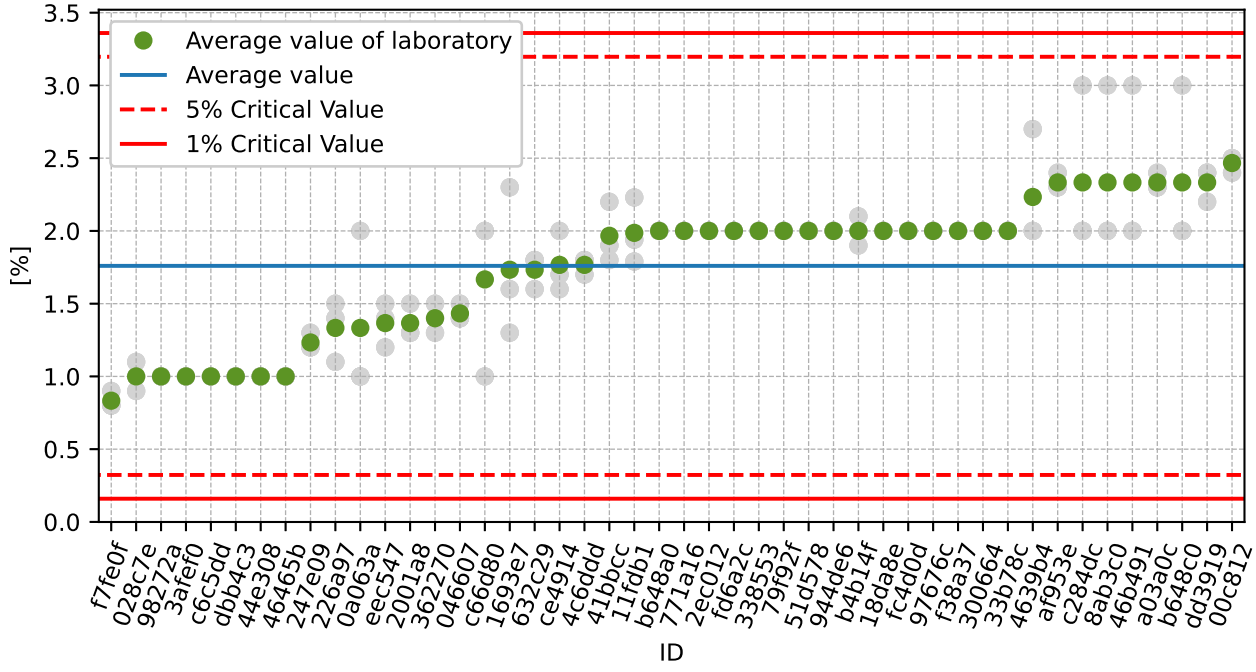

Figure 57: **Grubbs' test** - average values

1.6.3 Mandel's Statistics

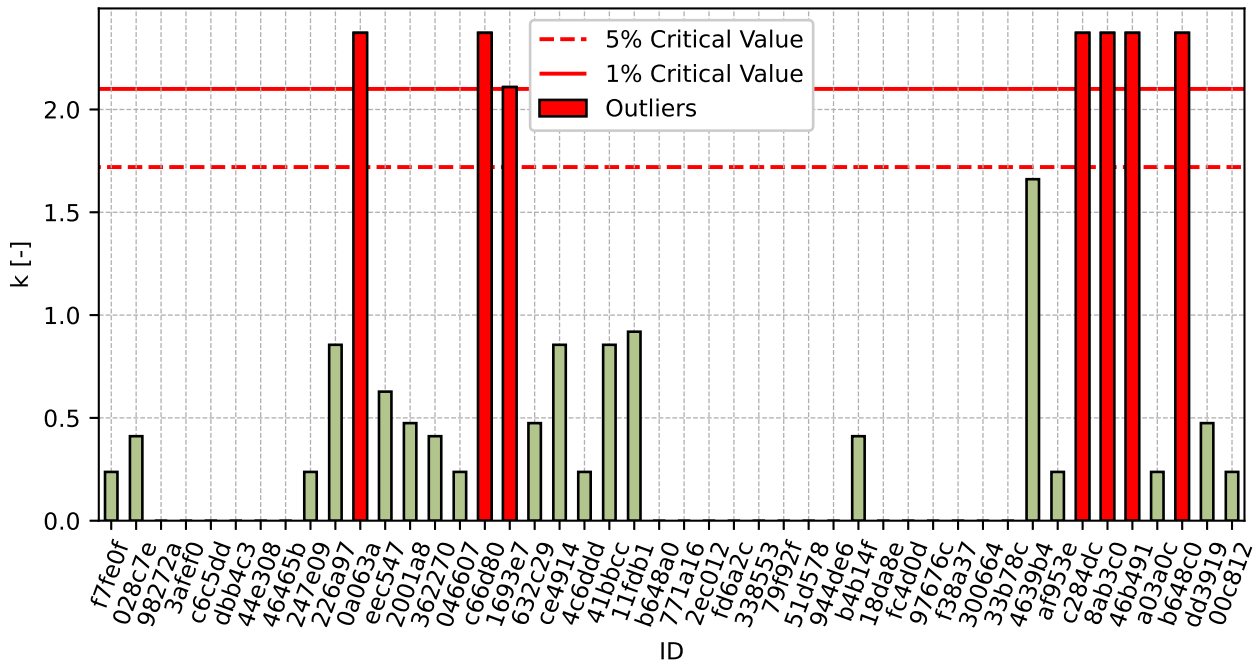

Figure 58: Intralaboratory Consistency Statistic

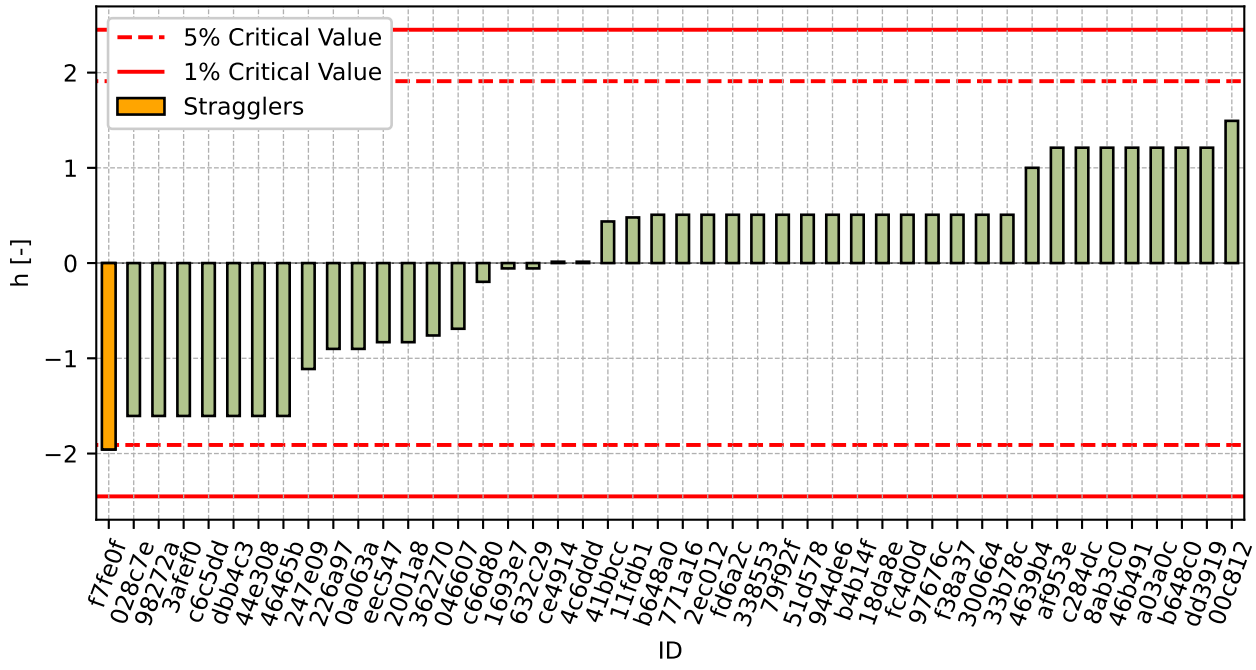

Figure 59: Interlaboratory Consistency Statistic

1.6.4 Descriptive statistics

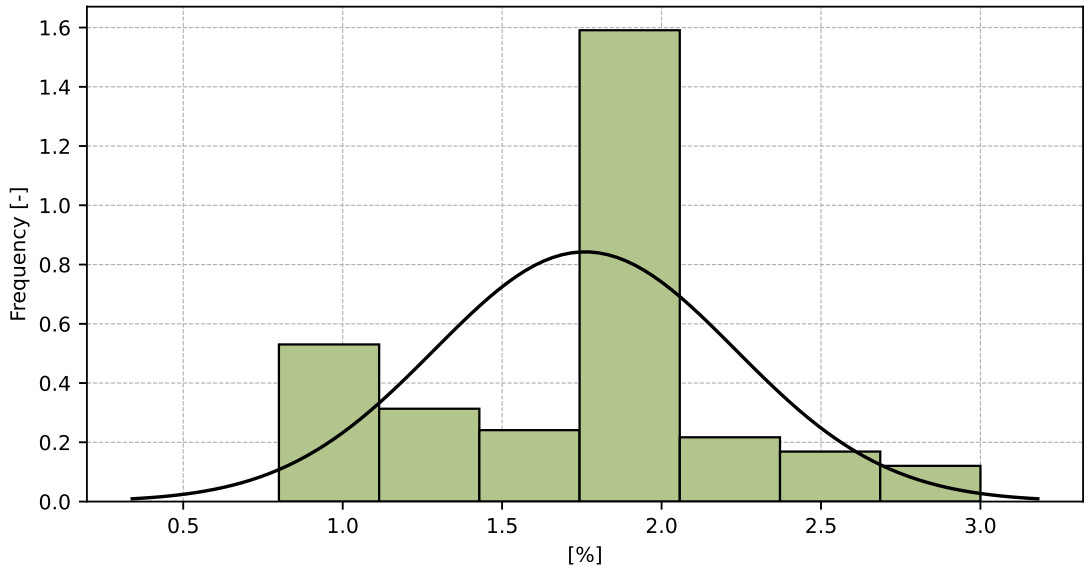

Figure 60: Histogram of all test results

Table 21: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	2
Sample standard deviation – s	0.5
Asigned value – x^*	2
Robust standard deviation – s^*	0.5
Measurement uncertainty of asigned value – u_X	0.1
p-value of normality test	0.0 [-]
Interlaboratory standard deviation – s_L	0.5
Repeatability standard deviation – s_r	0.2
Reproducibility standard deviation – s_R	0.5
Repeatability – r	1
Reproducibility – R	1

1.6.5 Evaluation of Performance Statistics

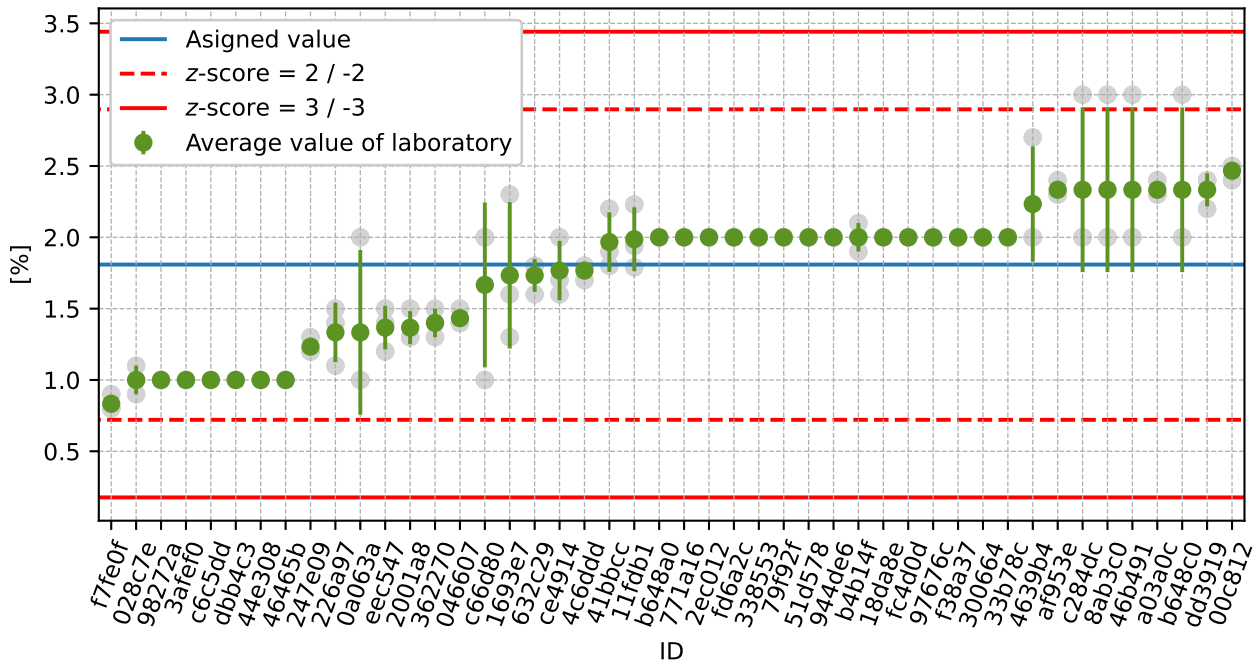

Figure 61: Average values and sample standard deviations

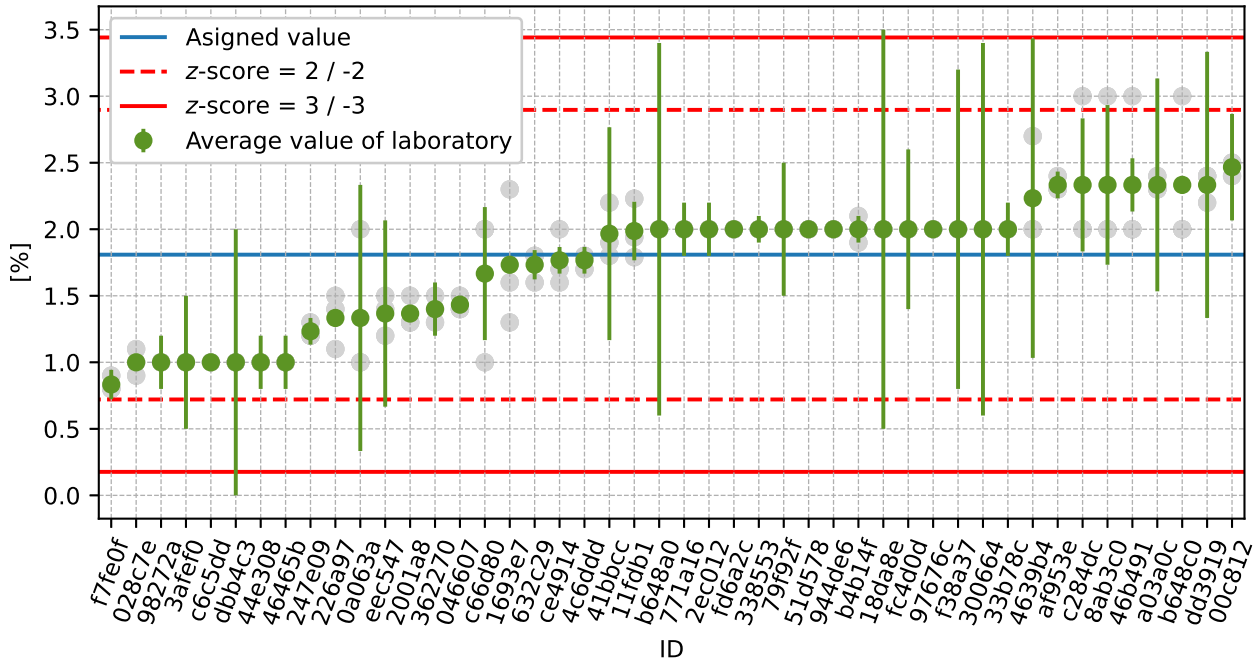

Figure 62: Average values and extended uncertainties of measurement

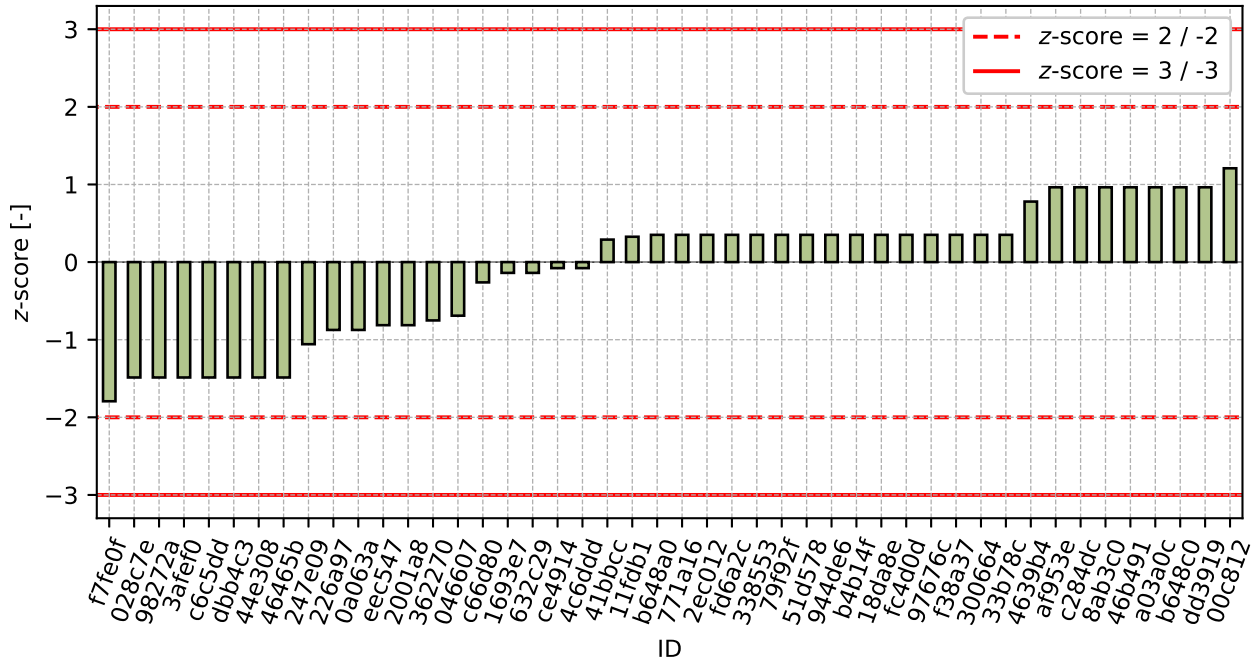

Figure 63: z-score

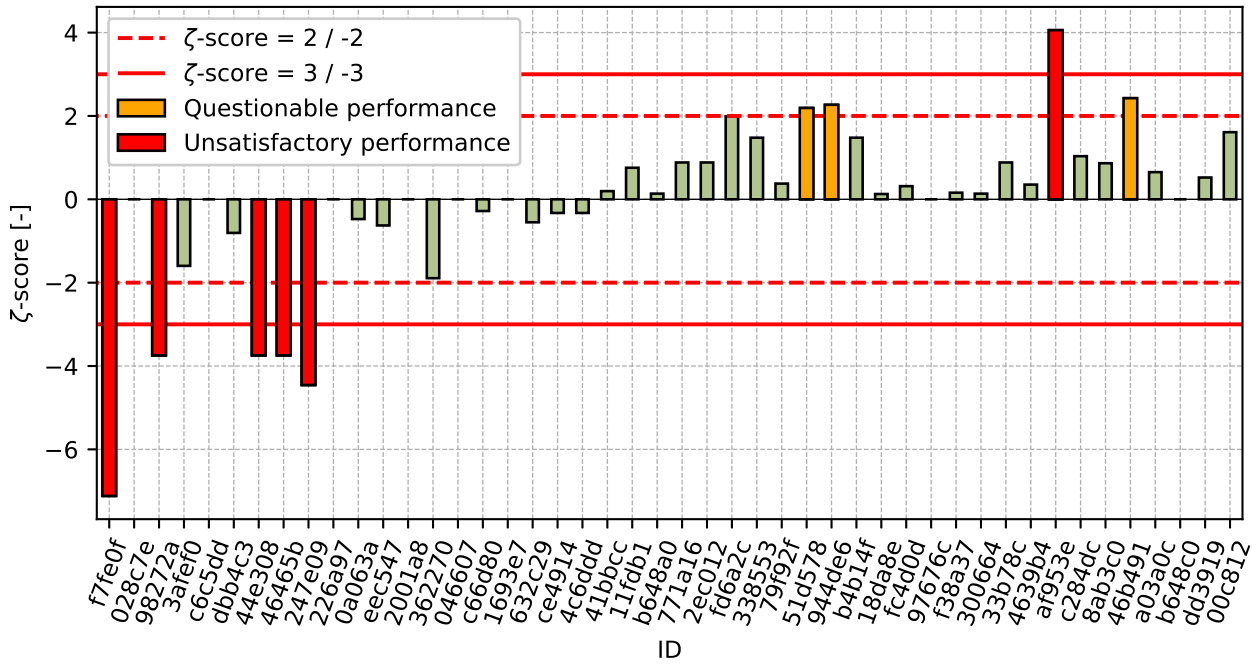

Figure 64: ζ-score

Table 22: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
f7fe0f	-1.79	-7.12
028c7e	-1.49	-
98272a	-1.49	-3.74
3afef0	-1.49	-1.6
c6c5dd	-1.49	-
dbb4c3	-1.49	-0.81
44e308	-1.49	-3.74
46465b	-1.49	-3.74
247e09	-1.06	-4.45
226a97	-0.87	-
0a063a	-0.87	-0.47
eec547	-0.81	-0.63
2001a8	-0.81	-
362270	-0.75	-1.89
046607	-0.69	-
c66d80	-0.26	-0.28
1693e7	-0.14	-
632c29	-0.14	-0.55
ce4914	-0.08	-0.33
4c6ddd	-0.08	-0.33
41bbcc	0.29	0.2
11fdb1	0.33	0.76
b648a0	0.35	0.14
771a16	0.35	0.88
2ec012	0.35	0.88
fd6a2c	0.35	1.99
338553	0.35	1.48
79f92f	0.35	0.38
51d578	0.35	2.19
944de6	0.35	2.27
b4b14f	0.35	1.48
18da8e	0.35	0.13
fc4d0d	0.35	0.32
97676c	0.35	-
f38a37	0.35	0.16
300664	0.35	0.14
33b78c	0.35	0.88
4639b4	0.78	0.35
af953e	0.96	4.06
c284dc	0.96	1.03
8ab3c0	0.96	0.87
46b491	0.96	2.43
a03a0c	0.96	0.65
b648c0	0.96	-

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ID	z-score [-]	ζ-score [-]
dd3919	0.96	0.52
00c812	1.21	1.61

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 [%]
3afef0	0	0	0	0	0	0.1	69.28
f7fe0f	0	0	0	0	0	0.0	0.0
c6c5dd	0	-	-	-	0	0.0	0.0
44e308	0	0	0	0	0	0.1	33.33
247e09	0	0	0	0	0	0.0	0.0
98272a	0	0	0	0	0	0.1	17.32
2001a8	0	0	0	-	0	0.1	17.32
028c7e	0	0	0	-	0	0.2	41.66
eec547	0	0	0	0	0	0.0	0.0
362270	0	0	0	0	0	0.0	0.0
226a97	0	0	1	-	0	0.2	48.04
c66d80	0	0	0	0	0	0.1	12.37
1693e7	0	1	0	-	0	0.2	34.64
46465b	0	0	1	0	0	0.1	20.0
33b78c	1	0	0	0	0	0.1	20.0
0a063a	0	1	0	0	1	0.1	10.83
944de6	1	0	1	0	1	0.1	16.67
18da8e	1	1	0	1	1	0.1	16.67
046607	1	1	1	-	1	0.1	8.66
41bbcc	1	1	1	1	1	0.1	8.66
f38a37	1	1	1	1	1	0.2	24.74
fd6a2c	1	1	1	0	1	0.1	12.5
79f92f	1	1	1	0	1	0.1	12.5
4c6ddd	1	1	1	0	1	0.0	5.66
2ec012	1	1	1	0	1	0.1	6.66
51d578	1	1	1	0	1	0.1	13.32
b648c0	1	1	1	-	1	0.1	11.11
11fdb1	1	1	1	0	1	0.2	25.55
632c29	1	1	1	0	1	0.1	6.19
ce4914	1	1	1	0	1	0.1	11.95
b4b14f	1	1	1	0	1	0.1	11.95
dd3919	1	1	1	0	1	0.1	6.44
771a16	1	1	1	0	1	0.0	0.0
dbb4c3	1	1	1	1	1	0.0	0.0
c284dc	1	1	1	0	1	0.0	0.0
fc4d0d	1	1	1	1	1	0.1	5.59

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ID	Test results [%]			u_X [%]	$\bar{x}$ [%]	s_0 [%]	V_X [%]
300664	1	1	1	1	1	0.1	5.41
8ab3c0	2	1	1	0	1	0.4	32.78
00c812	1	1	1	0	1	0.1	5.09
338553	1	1	1	0	1	0.1	5.09
b648a0	1	1	1	1	1	0.1	5.09
46b491	1	1	1	0	1	0.2	13.48
a03a0c	1	1	1	1	1	0.1	5.09
4639b4	1	2	1	1	1	0.4	34.64
af953e	1	1	1	0	1	0.0	4.1
97676c	1	1	2	-	1	0.3	18.87

1.7.2 The Numerical Procedure for Determining Outliers

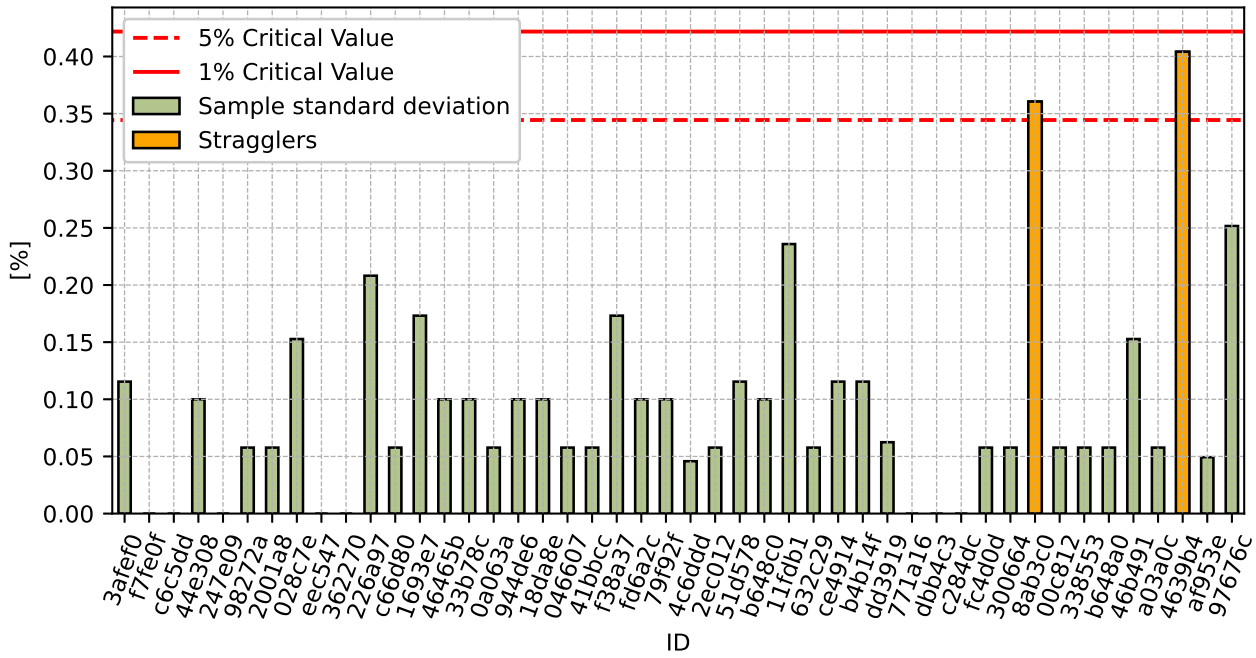

Figure 65: **Cochran's test** - sample standard deviations

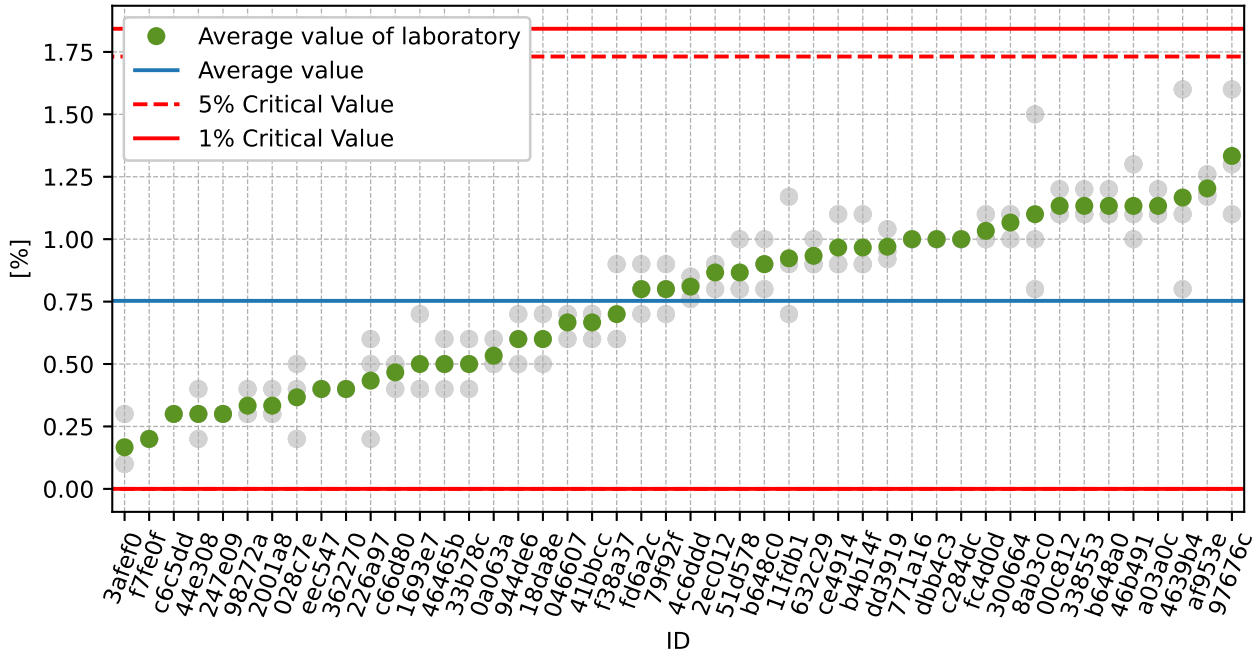

Figure 66: **Grubbs' test** - average values

1.7.3 Mandel's Statistics

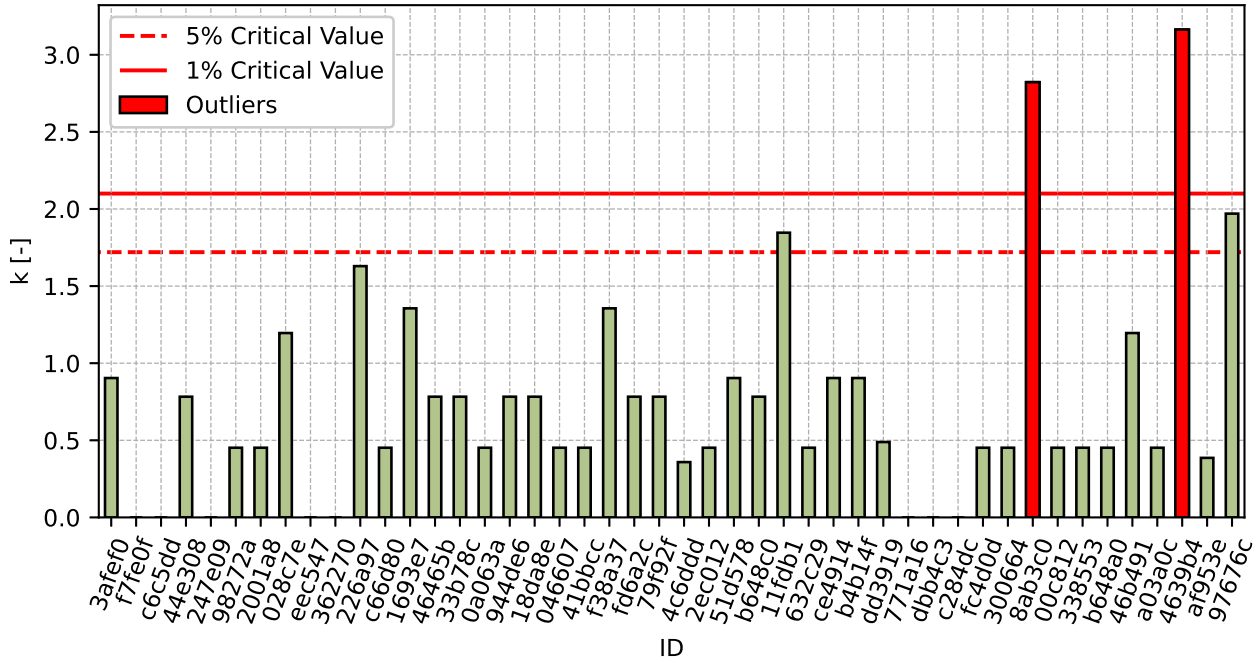

Figure 67: Intralaboratory Consistency Statistic

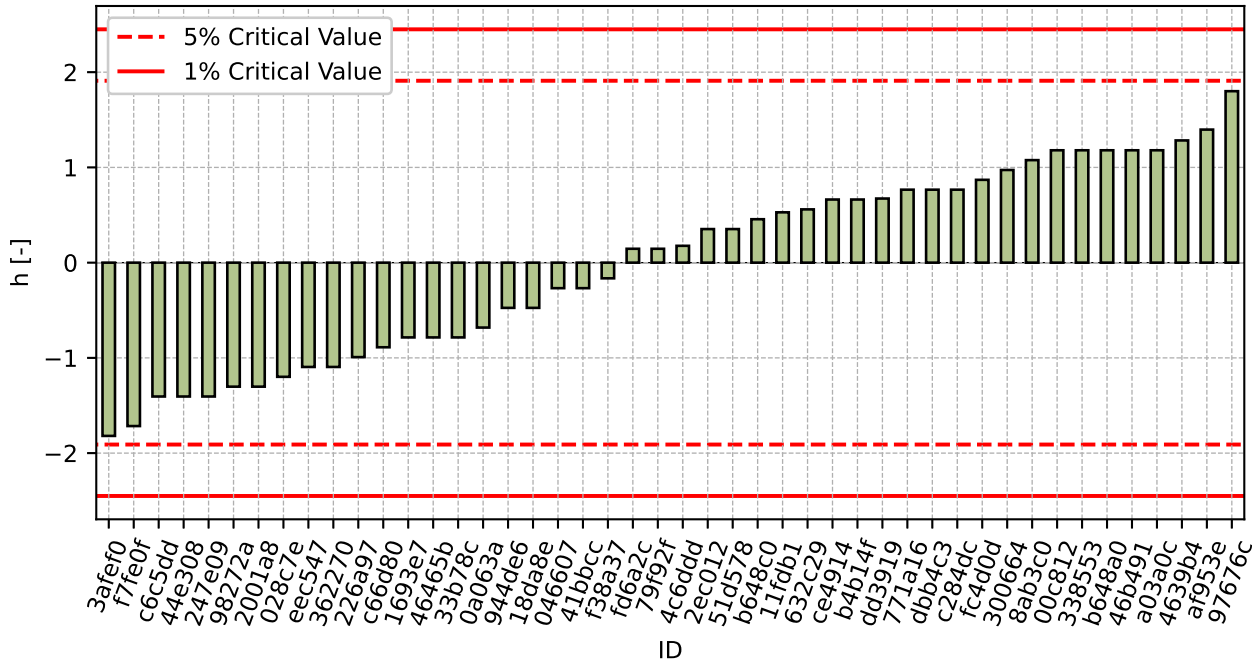

Figure 68: Interlaboratory Consistency Statistic

1.7.4 Descriptive statistics

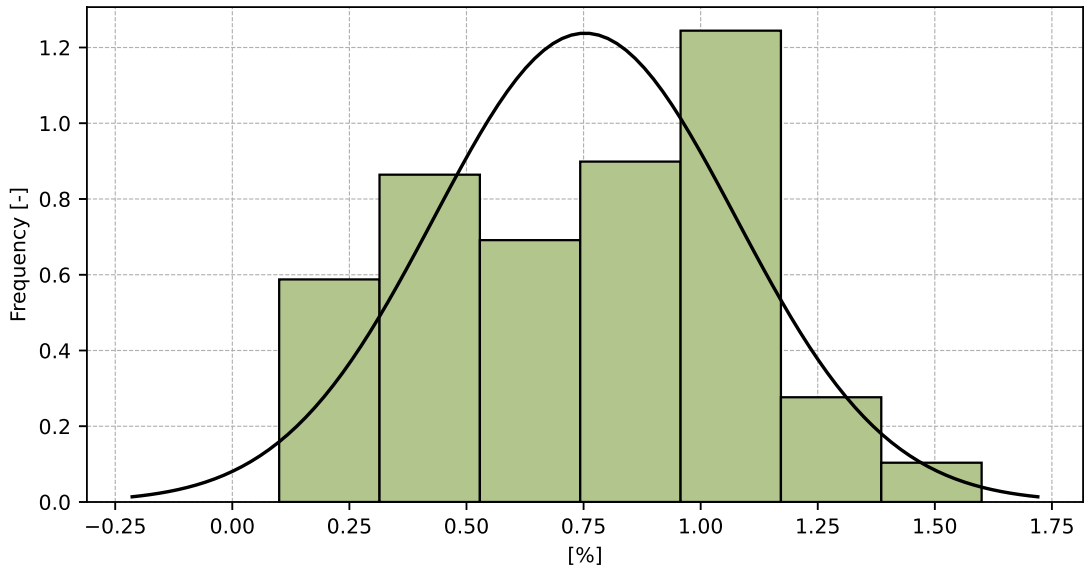

Figure 69: Histogram of all test results

Table 24: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	1
Sample standard deviation – s	0.3
Asigned value – x^*	1
Robust standard deviation – s^*	0.4
Measurement uncertainty of asigned value – u_X	0.1
p-value of normality test	0.002 [-]
Interlaboratory standard deviation – s_L	0.3
Repeatability standard deviation – s_r	0.1
Reproducibility standard deviation – s_R	0.3
Repeatability – r	0
Reproducibility – R	1

1.7.5 Evaluation of Performance Statistics

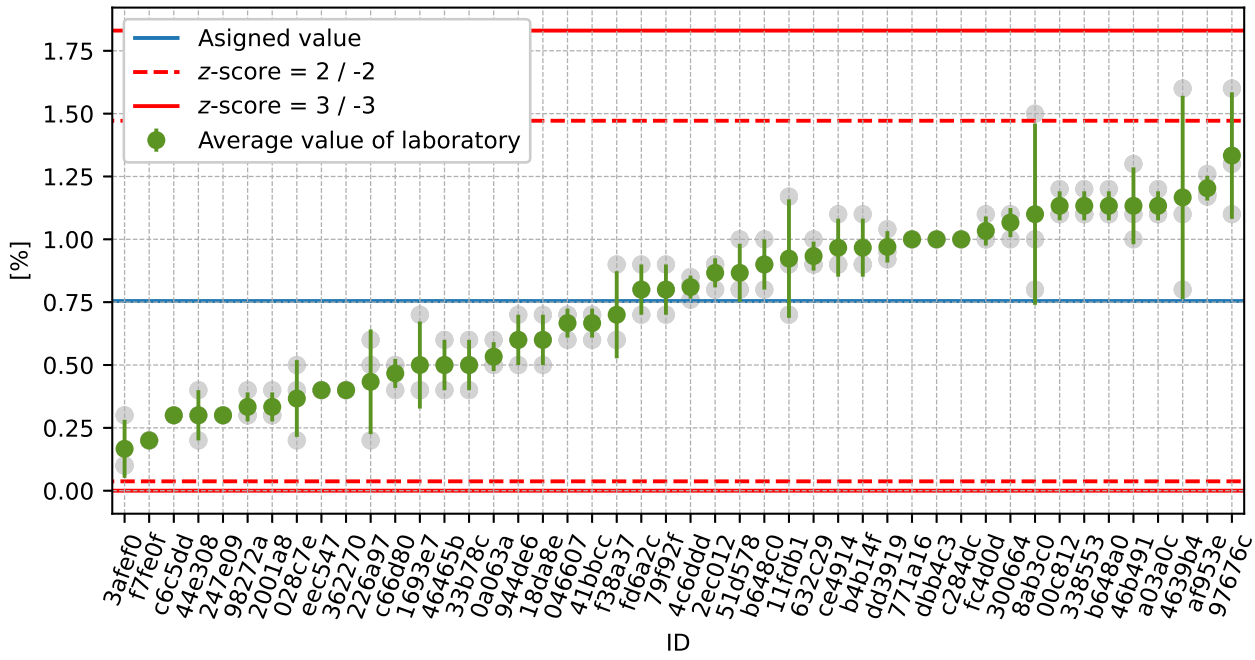

Figure 70: Average values and sample standard deviations

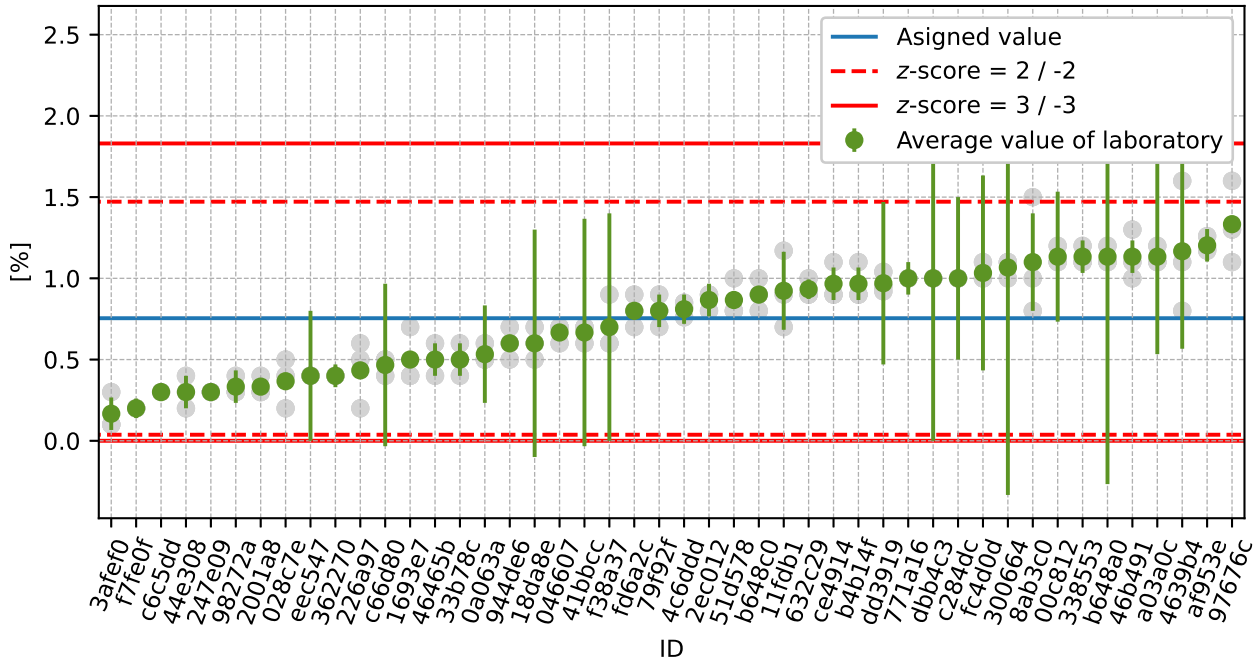

Figure 71: Average values and extended uncertainties of measurement

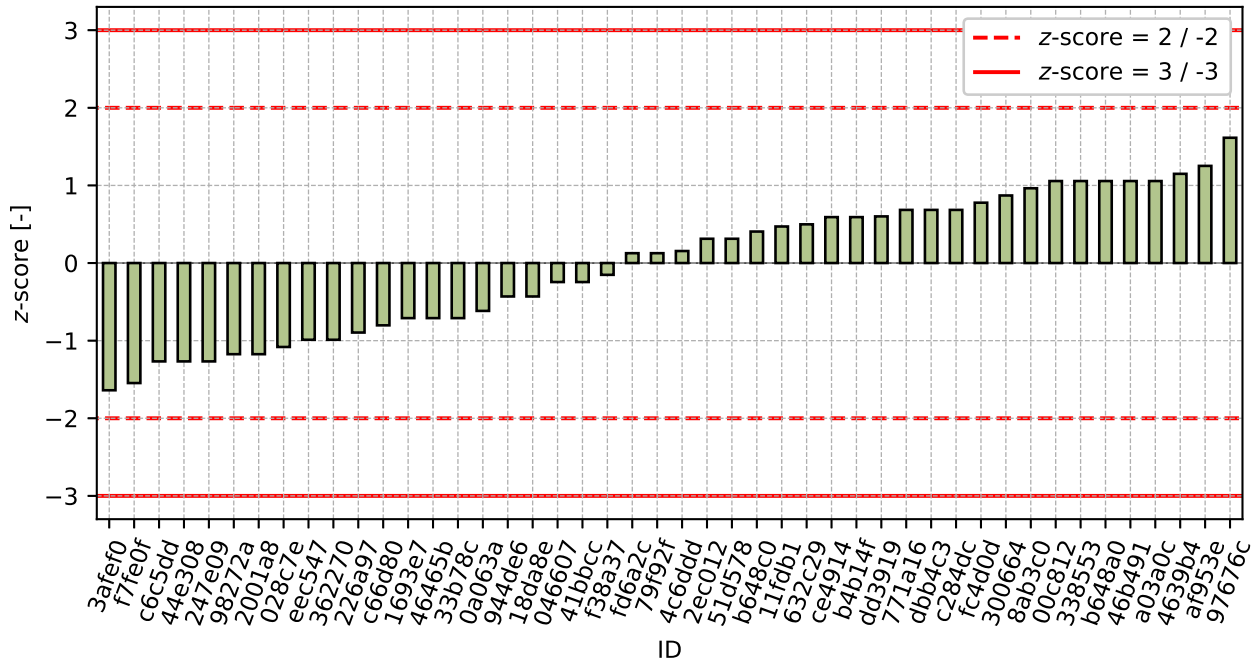

Figure 72: z-score

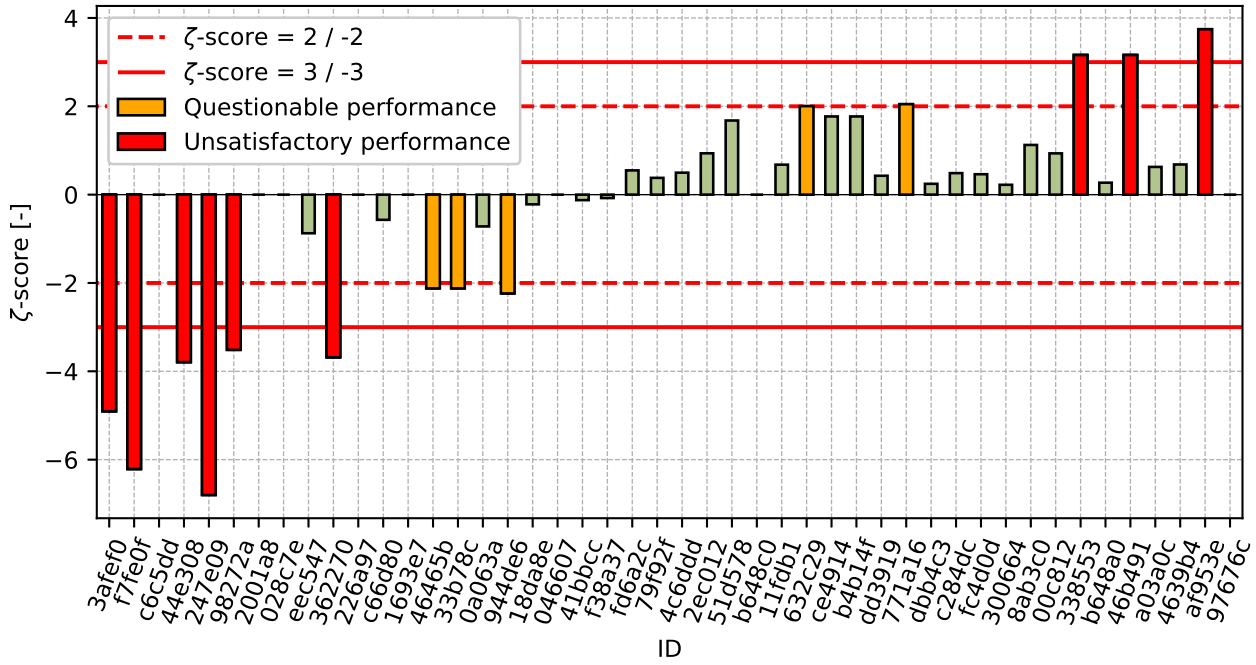

Figure 73: ζ-score

Table 25: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
3afef0	-1.64	-4.9
f7fe0f	-1.55	-6.21
c6c5dd	-1.27	-
44e308	-1.27	-3.79
247e09	-1.27	-6.8
98272a	-1.17	-3.51
2001a8	-1.17	-
028c7e	-1.08	-
eec547	-0.99	-0.87
362270	-0.99	-3.68
226a97	-0.9	-
c66d80	-0.8	-0.57
1693e7	-0.71	-
46465b	-0.71	-2.12
33b78c	-0.71	-2.12
0a063a	-0.62	-0.72
944de6	-0.43	-2.24
18da8e	-0.43	-0.22
046607	-0.24	-
41bbcc	-0.24	-0.12
f38a37	-0.15	-0.08
fd6a2c	0.13	0.55

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ID	z-score [-]	ζ-score [-]
79f92f	0.13	0.38
4c6ddd	0.15	0.5
2ec012	0.31	0.94
51d578	0.31	1.68
b648c0	0.41	-
11fdb1	0.47	0.68
632c29	0.5	2.0
ce4914	0.59	1.77
b4b14f	0.59	1.77
dd3919	0.6	0.43
771a16	0.68	2.05
dbb4c3	0.68	0.24
c284dc	0.68	0.49
fc4d0d	0.78	0.46
300664	0.87	0.22
8ab3c0	0.96	1.12
00c812	1.06	0.93
338553	1.06	3.16
b648a0	1.06	0.27
46b491	1.06	3.16
a03a0c	1.06	0.63
4639b4	1.15	0.68
af953e	1.25	3.74
97676c	1.61	-

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 [%]
33b78c	27	28	27	0	27	0.6	2.11
eec547	28	28	28	2	28	0.0	0.0
b648a0	29	29	29	3	29	0.0	0.0
98272a	30	29	31	1	30	1.0	3.33
79f92f	31	29	31	1	31	1.3	4.25
c66d80	31	31	30	0	31	0.6	1.88
4639b4	33	32	32	3	32	0.6	1.79
46465b	33	33	33	0	33	0.0	0.0
1693e7	33	33	33	-	33	0.3	0.76
51d578	35	34	33	1	34	1.0	2.94
44e308	35	35	35	0	35	0.0	0.0
046607	35	35	35	-	35	0.0	0.0
dbb4c3	38	38	38	1	38	0.1	0.27
247e09	79	78	80	0	79	1.0	1.27

2.2 The Numerical Procedure for Determining Outliers

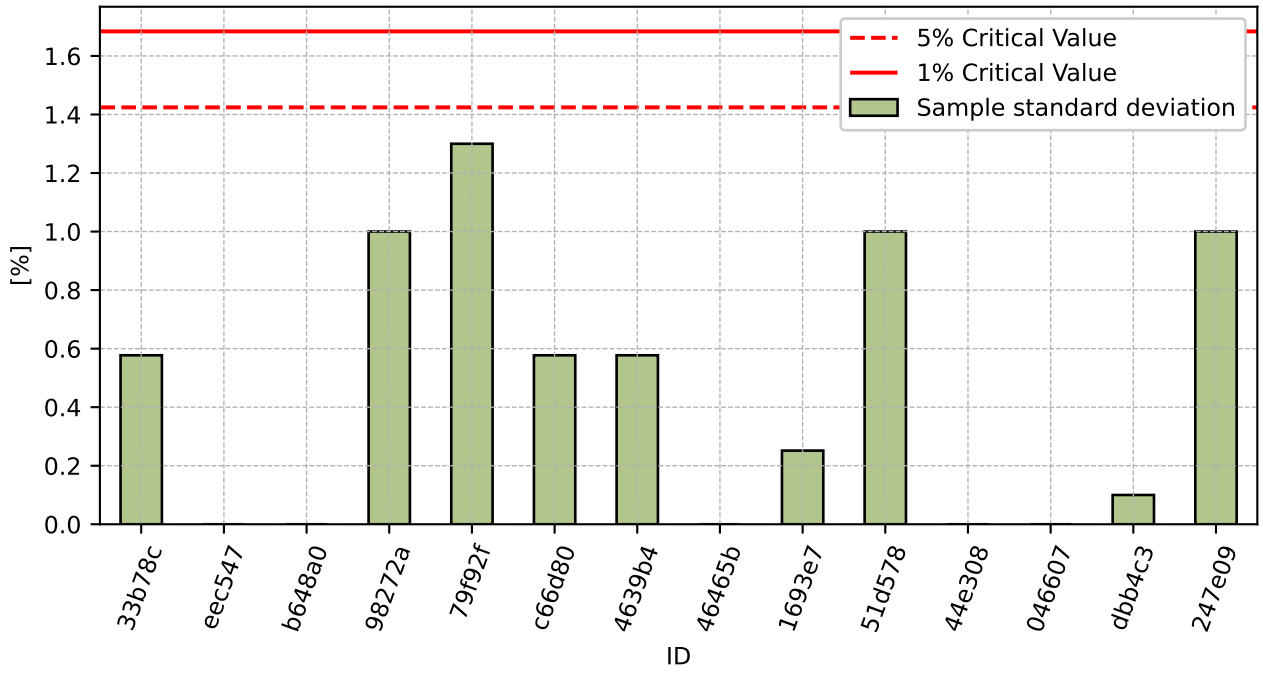

Figure 74: **Cochran's test** - sample standard deviations

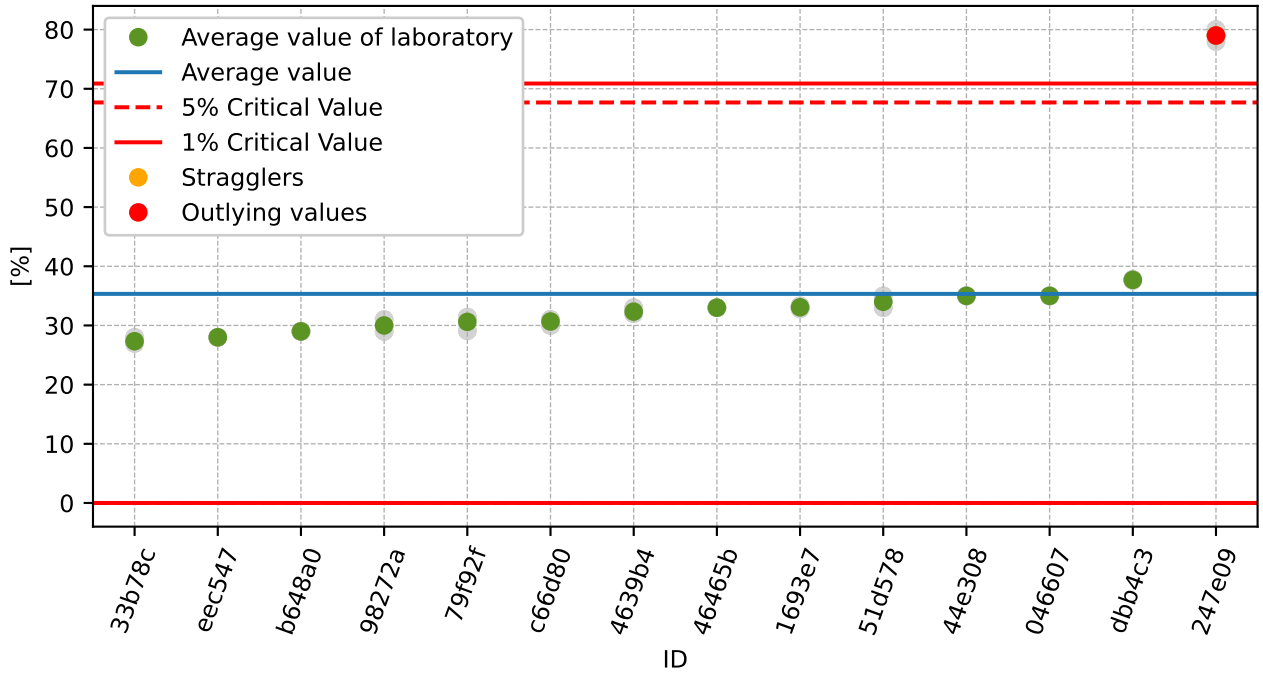

Figure 75: **Grubbs' test** - average values

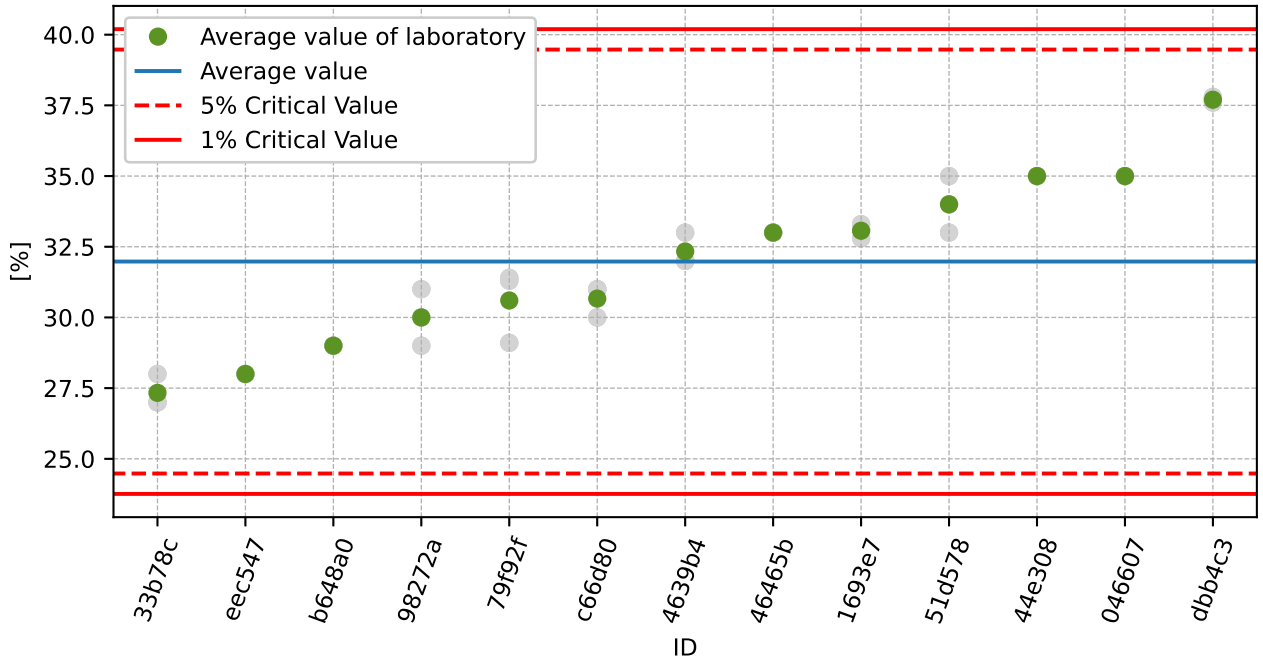

Figure 76: **Grubbs' test** - average values without outliers

2.3 Mandel's Statistics

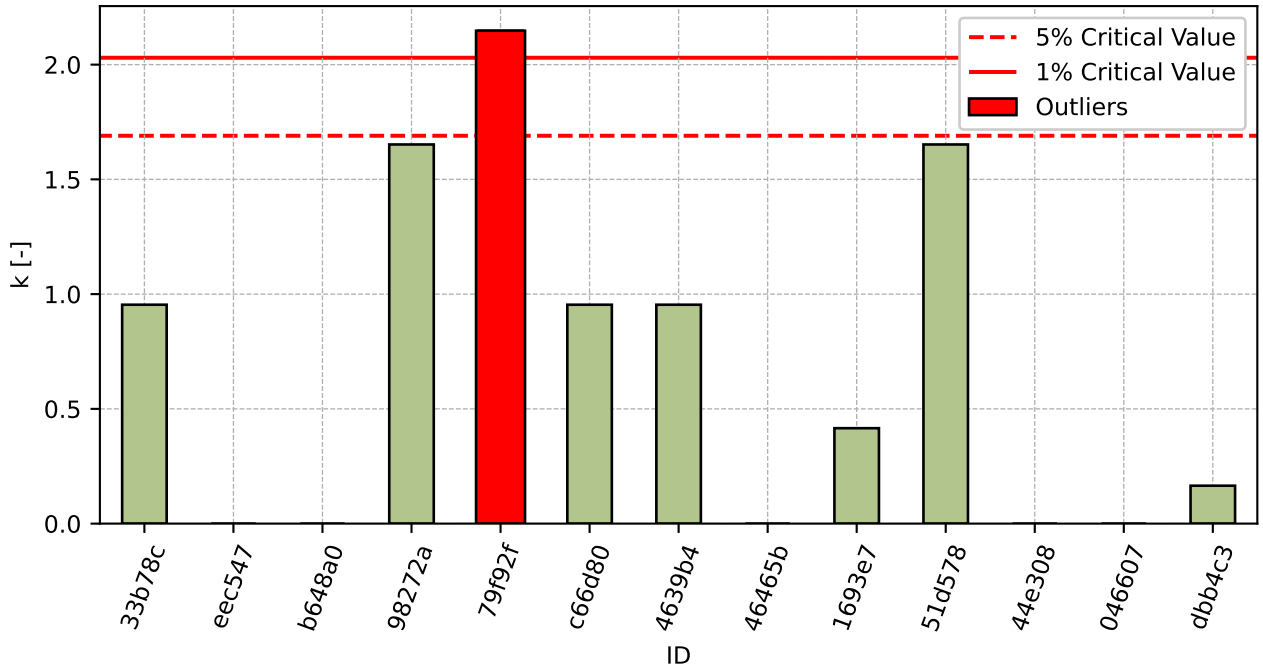

Figure 77: Intralaboratory Consistency Statistic

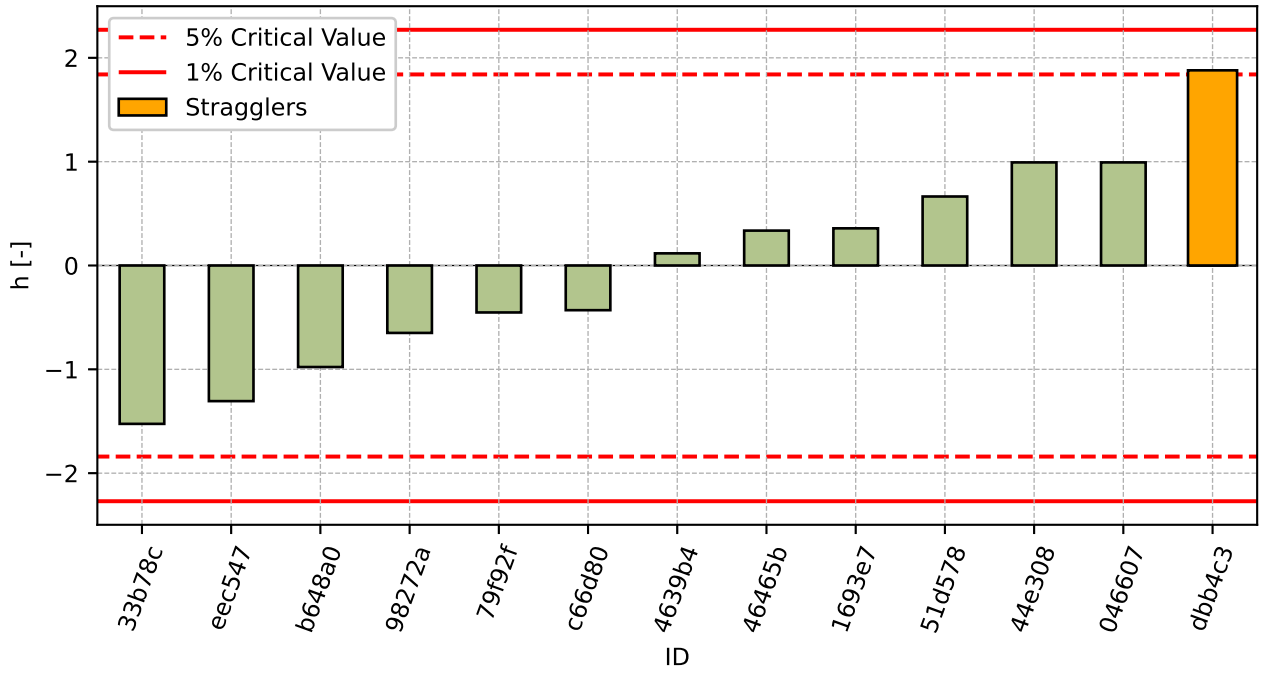

Figure 78: Interlaboratory Consistency Statistic

2.4 Descriptive statistics

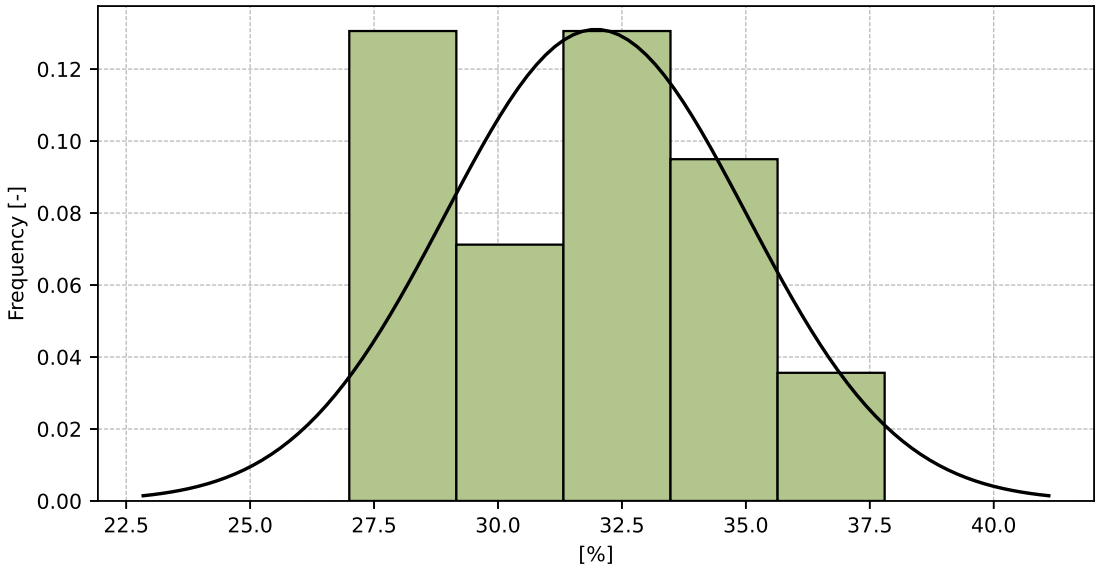

Figure 79: Histogram of all test results

Table 27: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	32
Sample standard deviation – s	3.0
Asigned value – x^*	32
Robust standard deviation – s^*	3.3
Measurement uncertainty of asigned value – u_X	1.2
p-value of normality test	0.111 [-]
Interlaboratory standard deviation – s_L	3.0
Repeatability standard deviation – s_r	0.6
Reproducibility standard deviation – s_R	3.1
Repeatability – r	2
Reproducibility – R	9

2.5 Evaluation of Performance Statistics

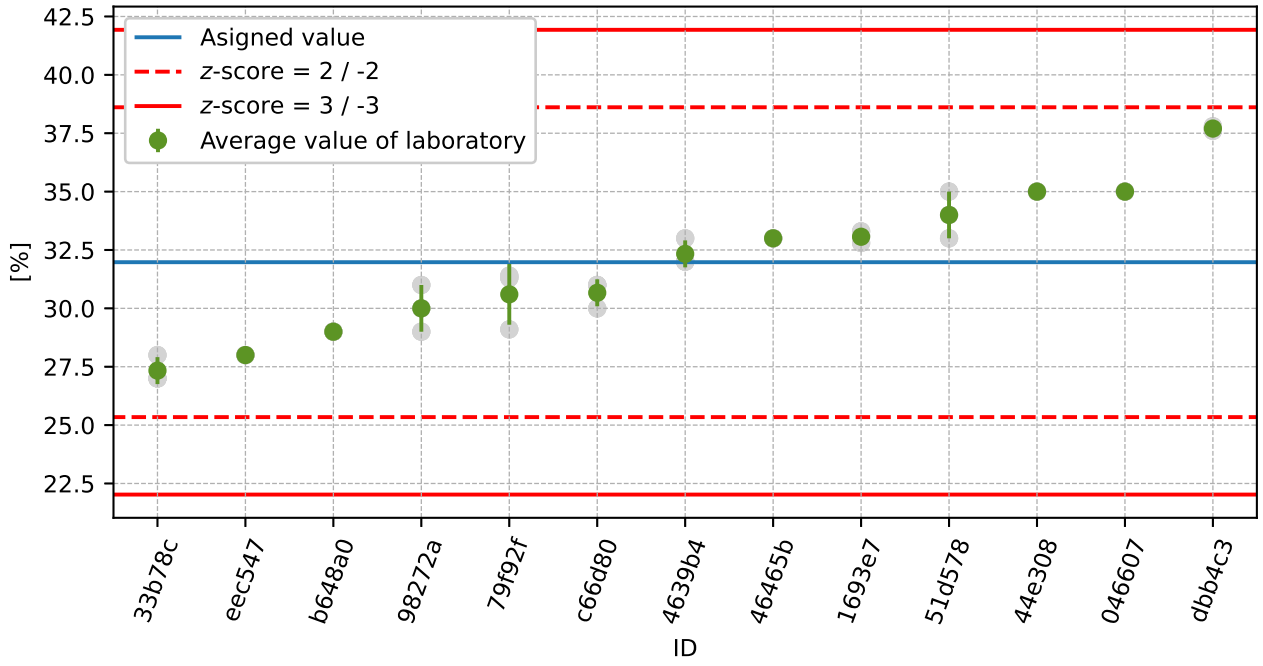

Figure 80: Average values and sample standard deviations

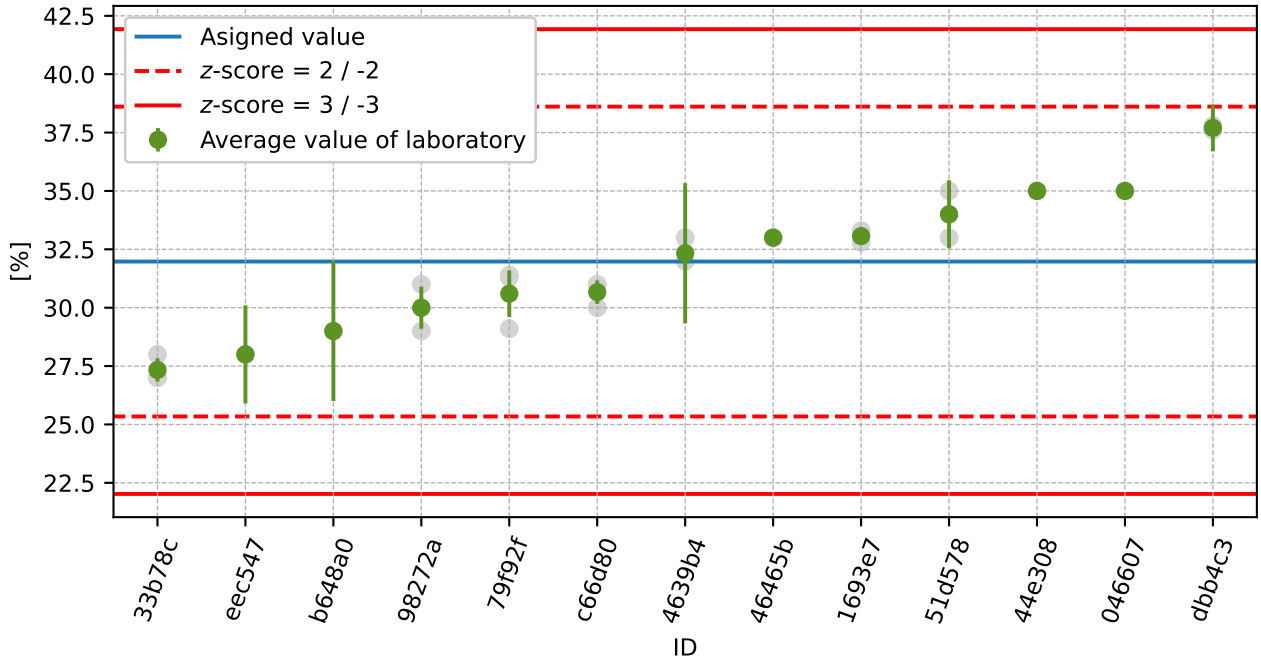

Figure 81: Average values and extended uncertainties of measurement

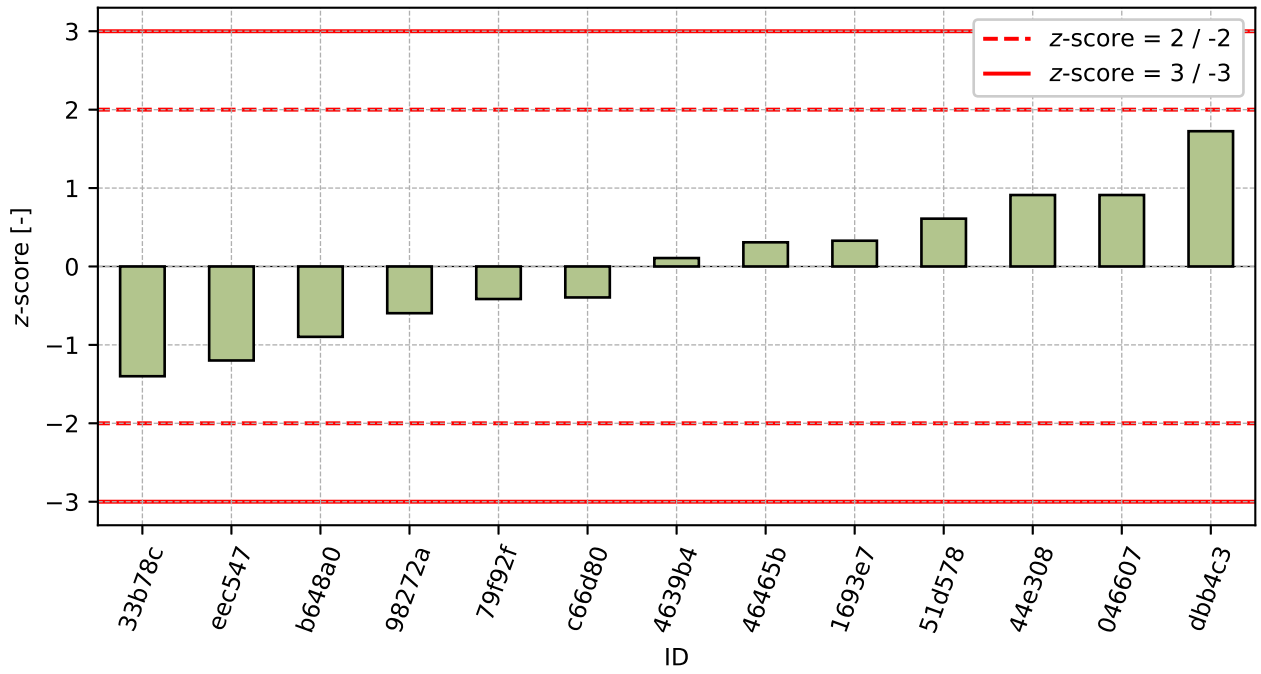

Figure 82: z-score

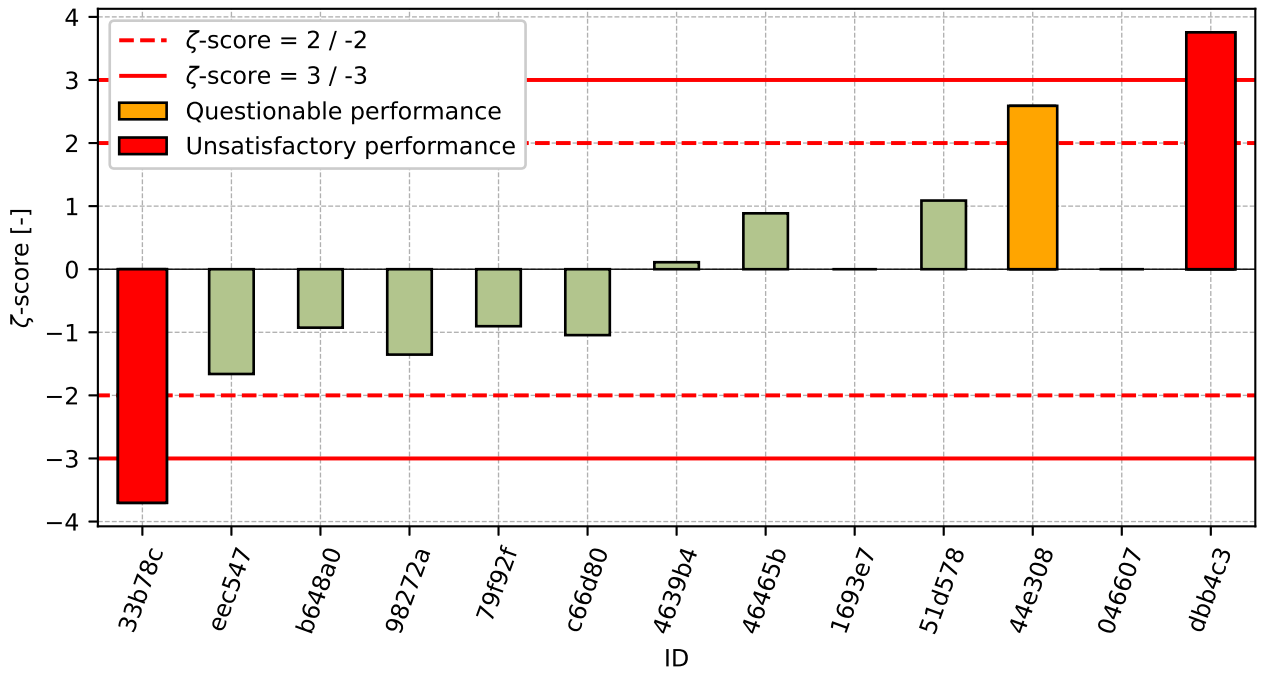

Figure 83: ζ-score

Table 28: *z*-score and ζ-score

ID	*z*-score [-]	ζ-score [-]
33b78c	-1.4	-3.7
eec547	-1.2	-1.66
b648a0	-0.9	-0.93
98272a	-0.6	-1.35
79f92f	-0.42	-0.9
c66d80	-0.39	-1.04
4639b4	0.11	0.11
46465b	0.31	0.89
1693e7	0.33	-
51d578	0.61	1.09
44e308	0.91	2.59
046607	0.91	-
dbb4c3	1.73	3.76

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 [%]
033508	35	35	34	2	35	0.3	0.87
dbb4c3	46	45	46	2	46	0.6	1.26
af953e	46	45	46	1	46	0.6	1.26
300664	46	47	46	3	46	0.6	1.25
c284dc	47	46	48	3	47	1.0	2.13
8ab3c0	47	47	48	1	47	0.6	1.22
632c29	50	48	48	2	49	1.2	2.37
771a16	49	49	49	4	49	0.0	0.0
338553	48	51	50	6	50	1.5	3.08
2ec012	49	50	51	0	50	1.0	2.0
c6c5dd	50	50	50	-	50	0.0	0.0
fd6a2c	51	51	51	3	51	0.0	0.0
923983	53	50	52	2	52	1.5	2.79
4c6ddd	52	52	53	0	53	0.5	0.97
4639b4	54	52	53	2	53	1.0	1.89
46b491	53	53	54	3	53	0.6	1.08
362270	55	55	54	16	55	0.6	1.06

3.2 The Numerical Procedure for Determining Outliers

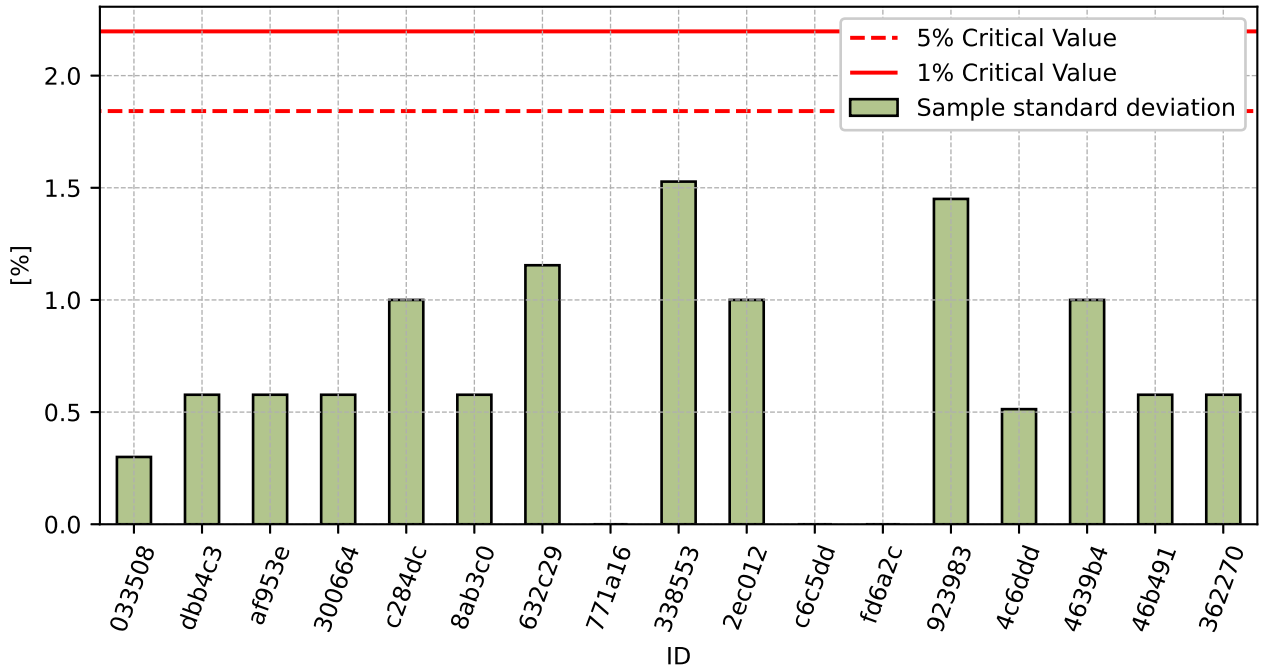

Figure 84: **Cochran's test** - sample standard deviations

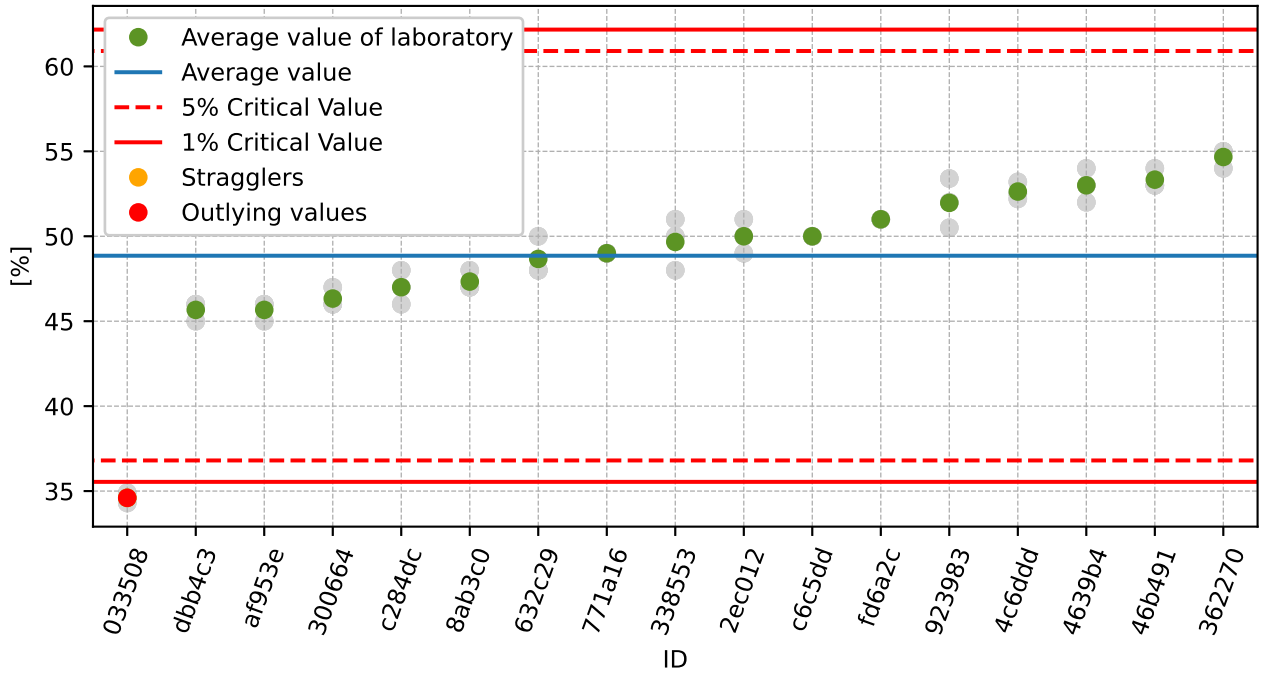

Figure 85: **Grubbs' test** - average values

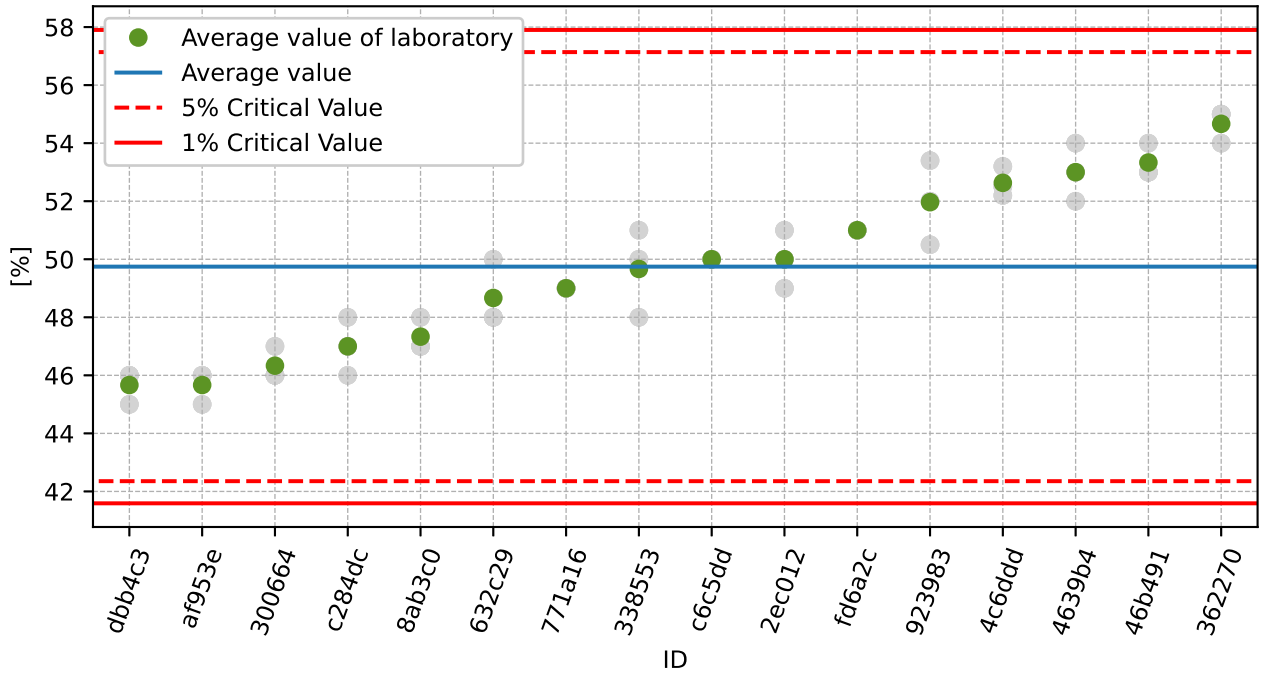

Figure 86: **Grubbs' test** - average values without outliers

3.3 Mandel's Statistics

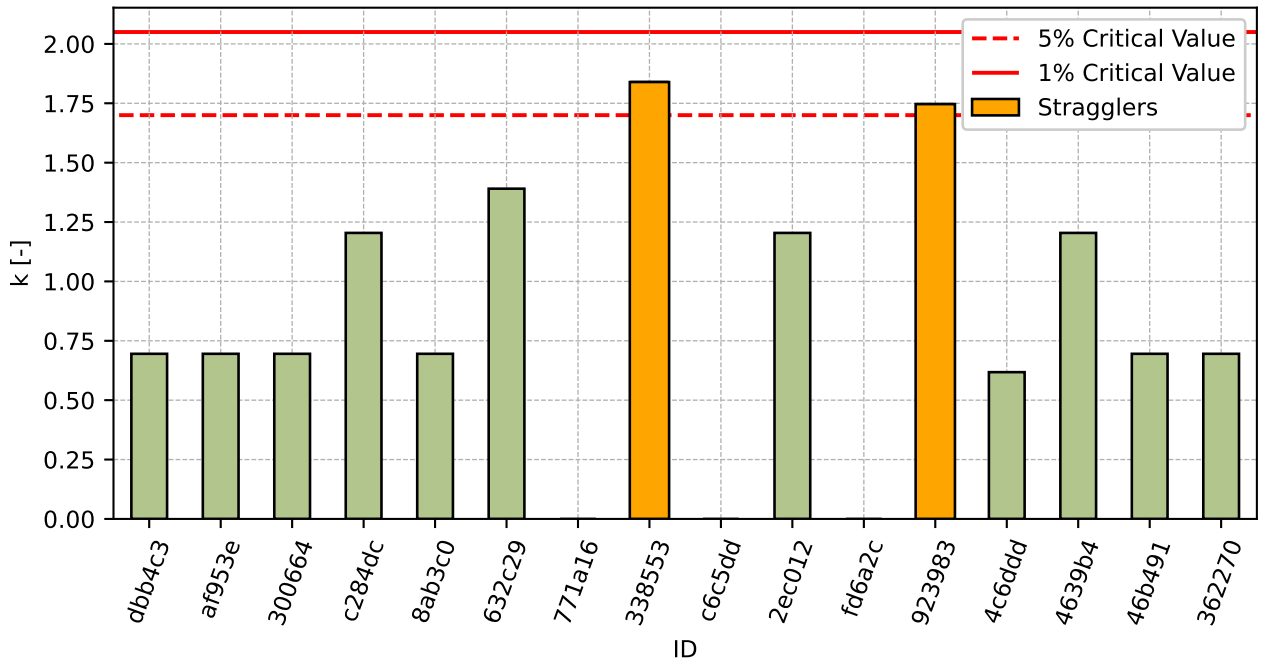

Figure 87: Intralaboratory Consistency Statistic

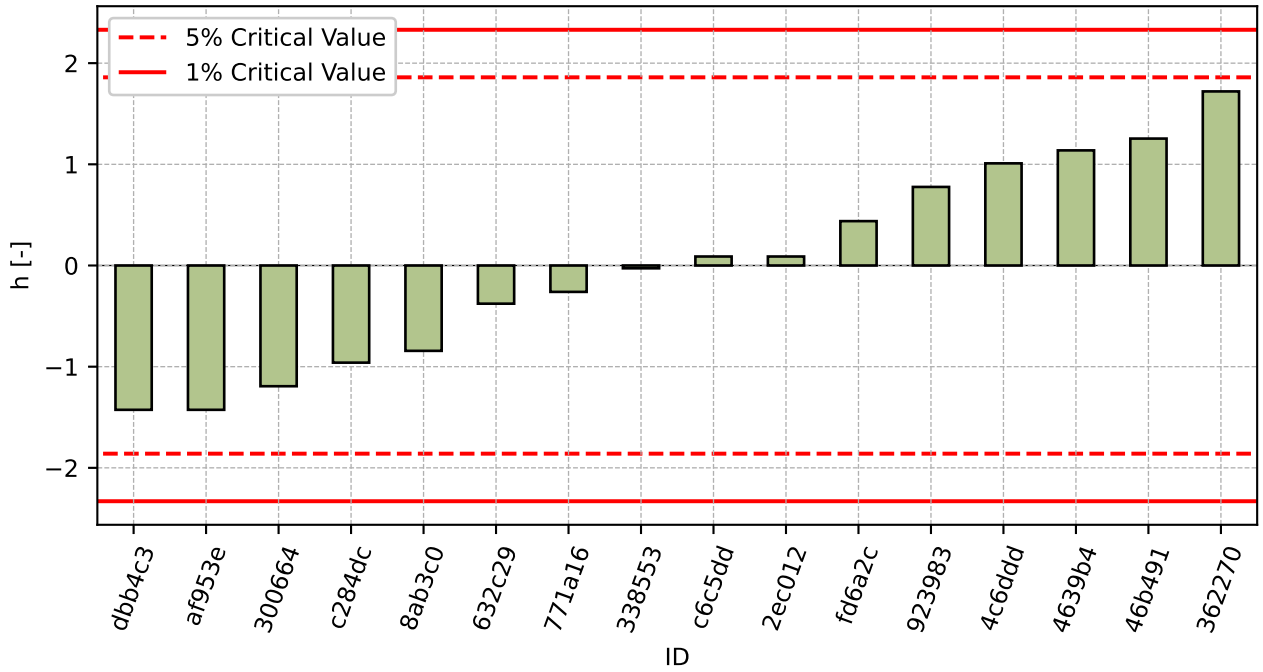

Figure 88: Interlaboratory Consistency Statistic

3.4 Descriptive statistics

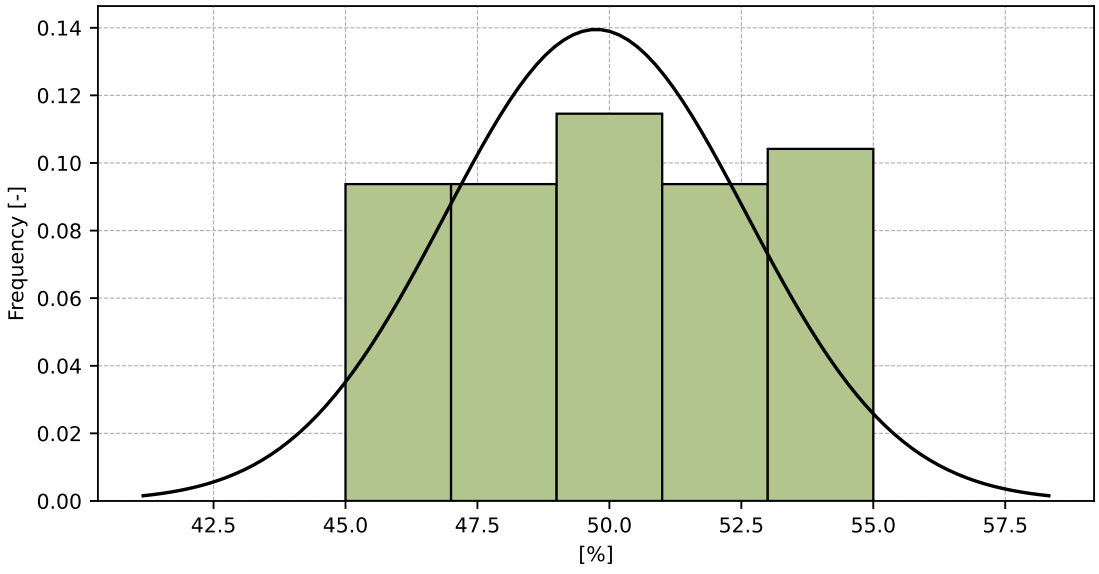

Figure 89: Histogram of all test results

Table 30: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	50
Sample standard deviation – s	2.9
Asigned value – x^*	50
Robust standard deviation – s^*	3.1
Measurement uncertainty of asigned value – u_X	1.0
p-value of normality test	0.05 [-]
Interlaboratory standard deviation – s_L	2.8
Repeatability standard deviation – s_r	0.8
Reproducibility standard deviation – s_R	2.9
Repeatability – r	2
Reproducibility – R	8

3.5 Evaluation of Performance Statistics

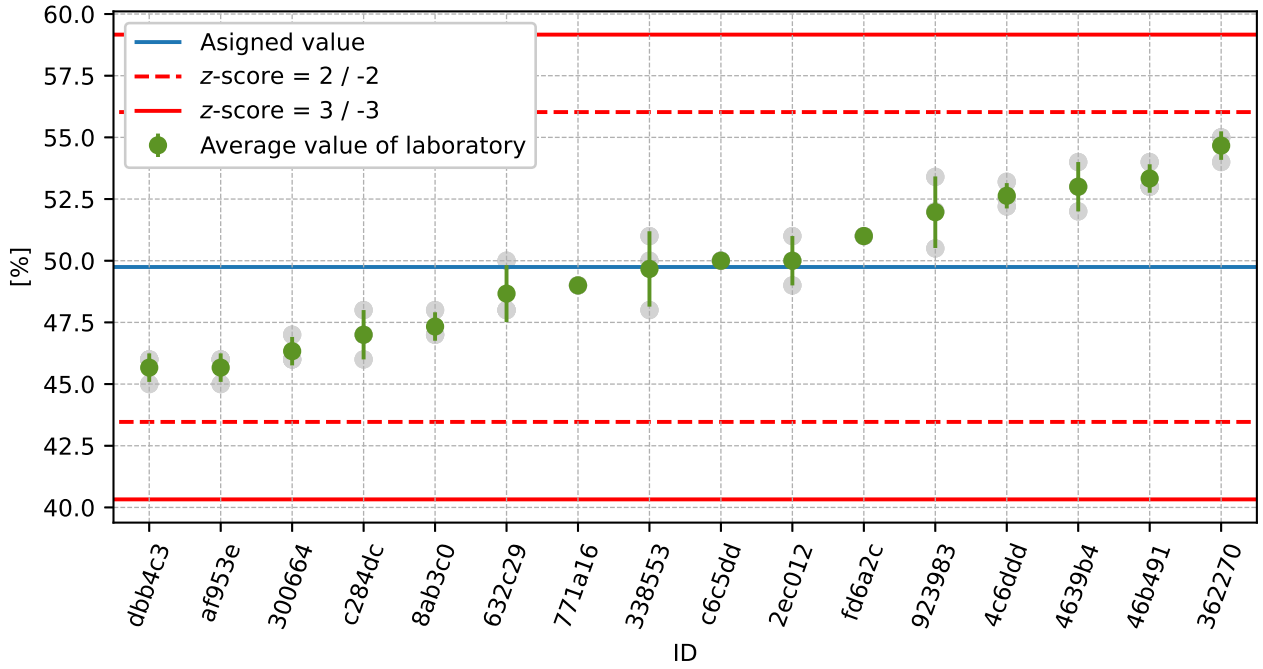

Figure 90: Average values and sample standard deviations

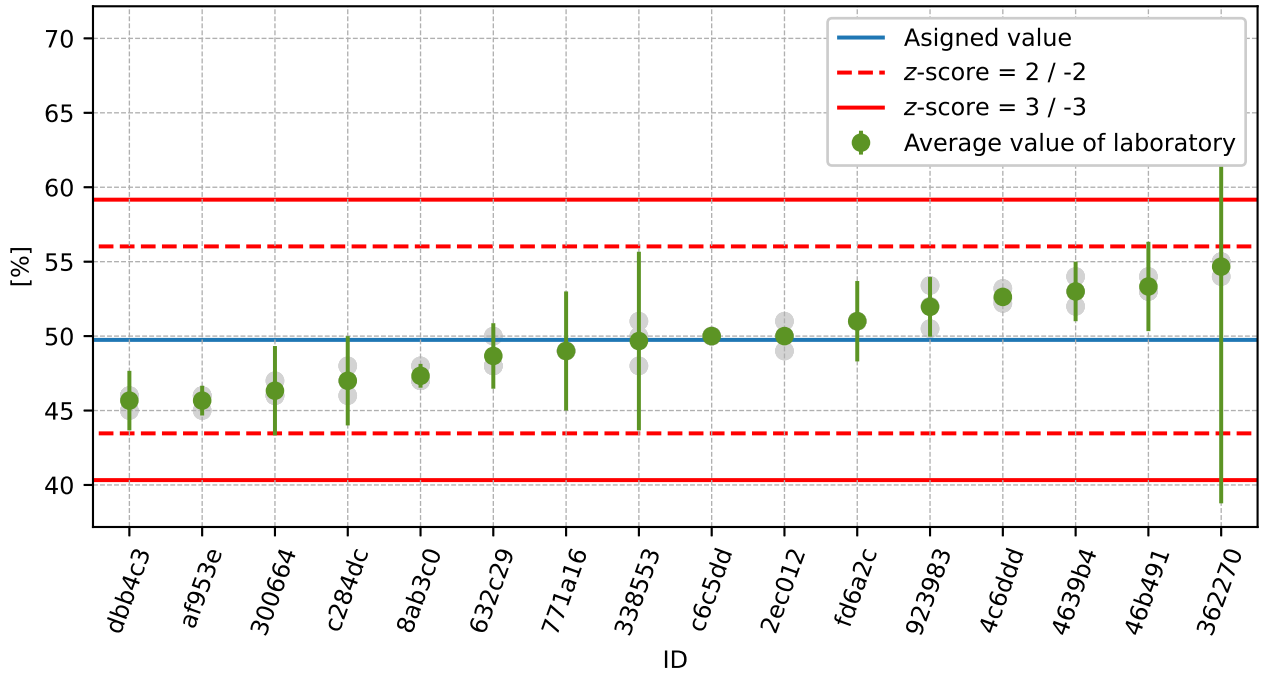

Figure 91: Average values and extended uncertainties of measurement

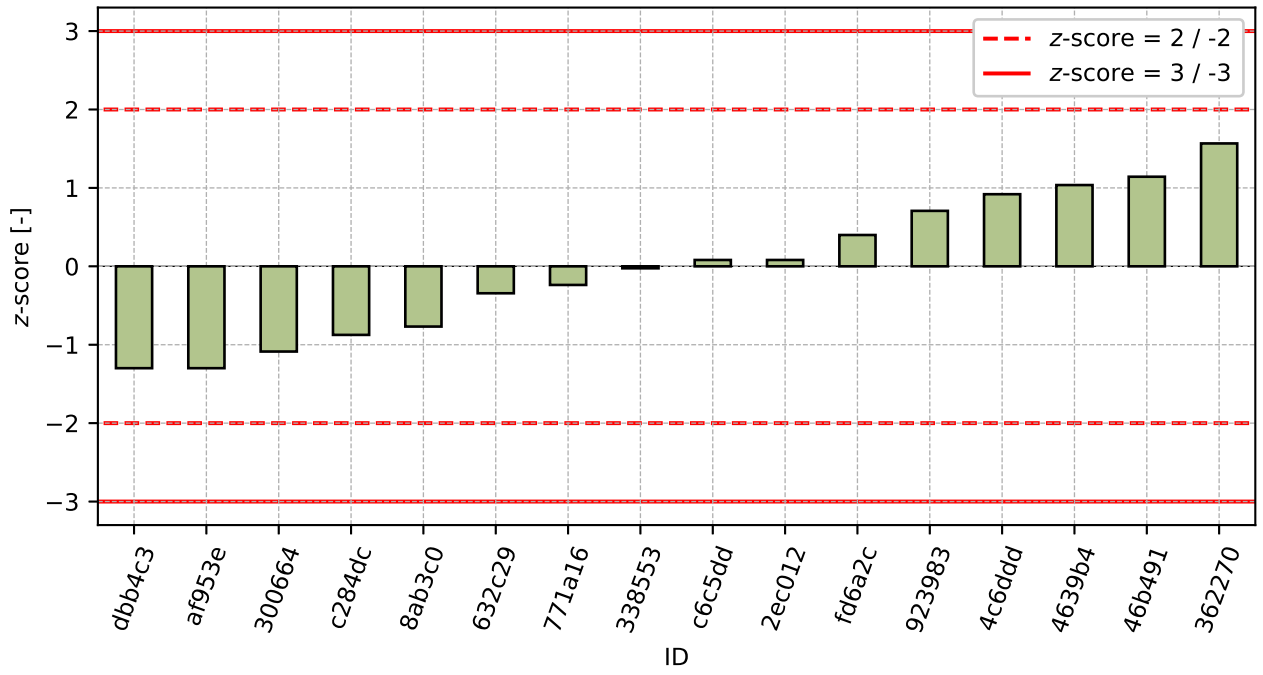

Figure 92: z-score

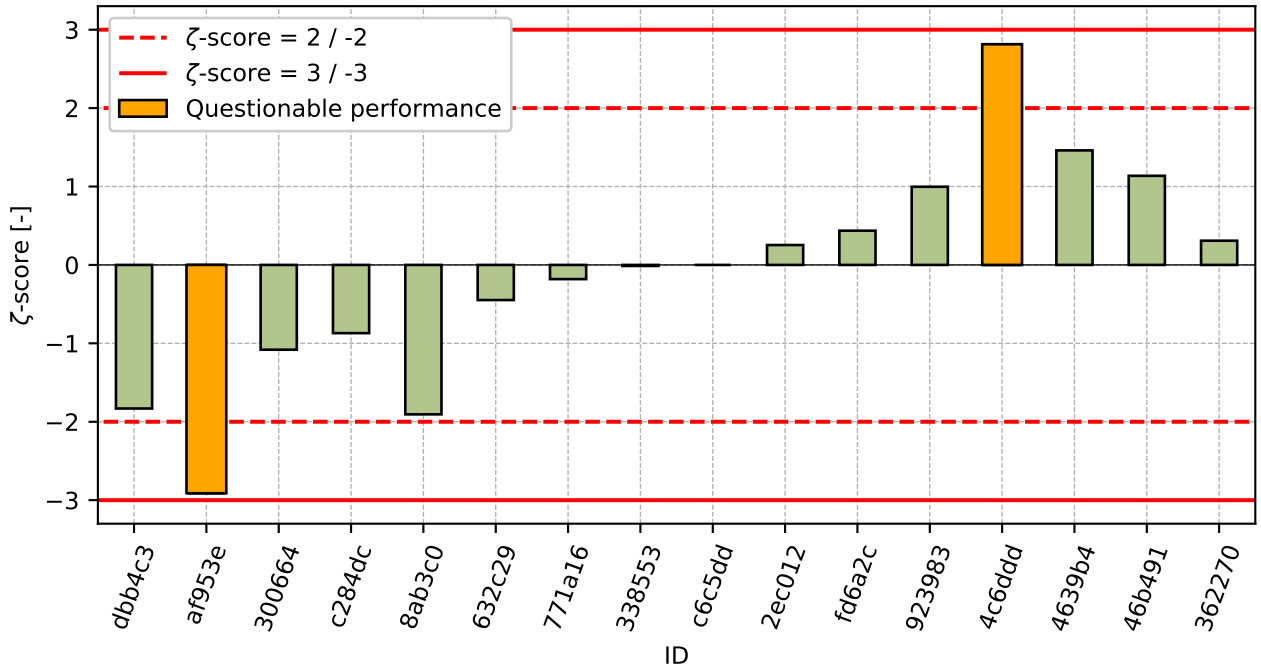

Figure 93: ζ-score

Table 31: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
dbb4c3	-1.3	-1.83
af953e	-1.3	-2.91
300664	-1.09	-1.08
c284dc	-0.87	-0.87
8ab3c0	-0.77	-1.91
632c29	-0.34	-0.45
771a16	-0.24	-0.18
338553	-0.03	-0.01
c6c5dd	0.08	-
2ec012	0.08	0.25
fd6a2c	0.4	0.44
923983	0.71	1.0
4c6ddd	0.92	2.81
4639b4	1.04	1.46
46b491	1.14	1.14
362270	1.57	0.31

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 [%]
3b0dca	34	34	34	-	34	0.0	0.0
dd3919	55	58	57	4	57	1.5	2.7
f7fe0f	58	59	59	1	59	0.4	0.64
1a5284	61	61	62	1	61	0.4	0.65
4639b4	61	61	62	3	61	0.6	0.94
a866a4	63	64	65	-	64	1.1	1.66
226a97	64	65	64	-	64	0.8	1.25
046607	66	65	67	-	66	1.0	1.52
d6f710	69	68	70	4	69	1.0	1.45
a03a0c	75	74	75	1	75	0.6	0.77

4.2 The Numerical Procedure for Determining Outliers

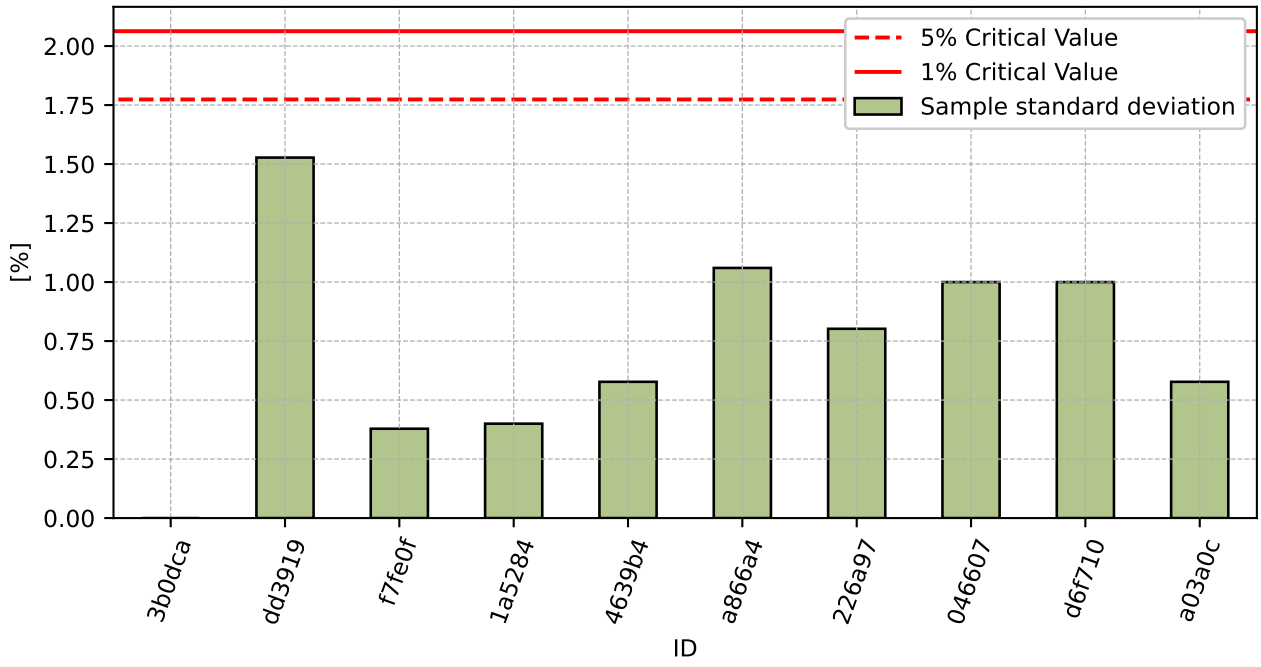

Figure 94: **Cochran's test** - sample standard deviations

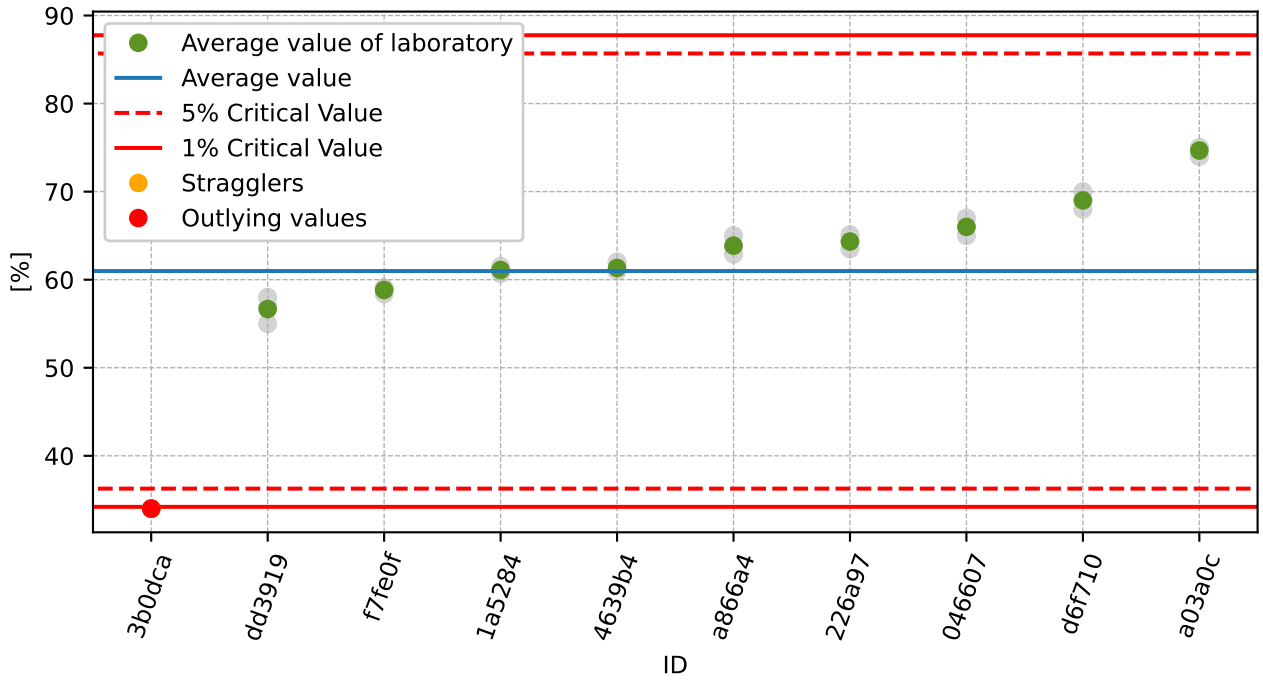

Figure 95: **Grubbs' test** - average values

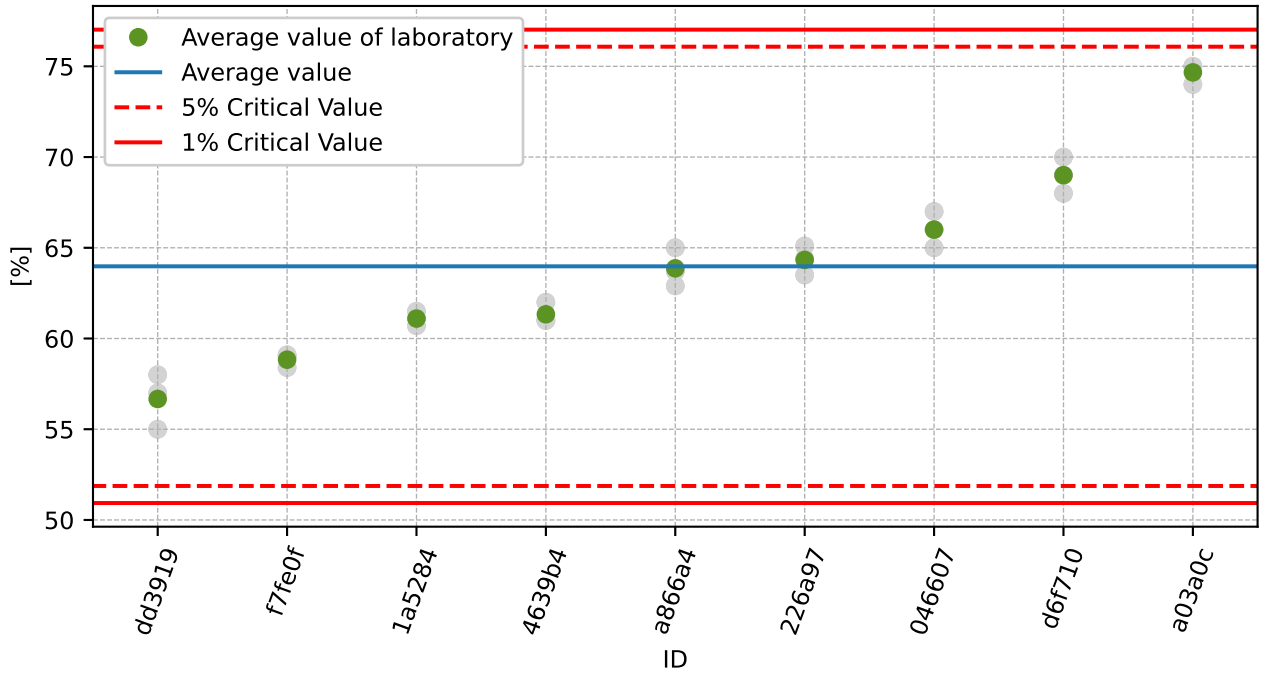

Figure 96: **Grubbs' test** - average values without outliers

4.3 Mandel's Statistics

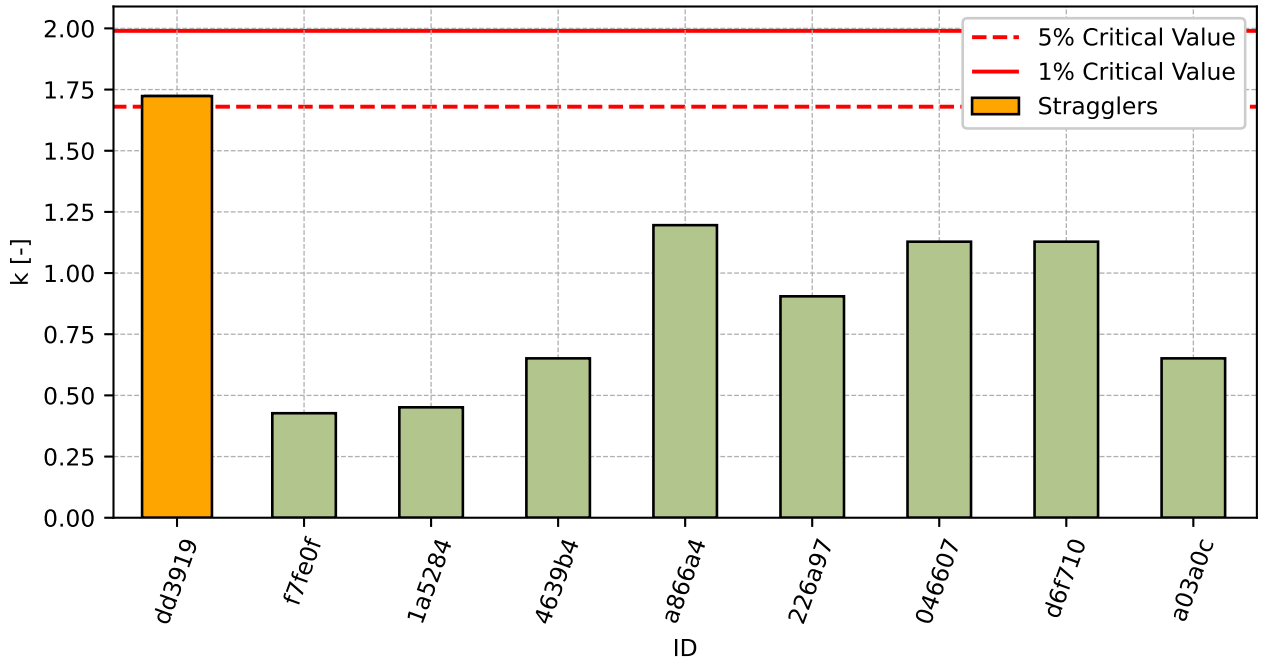

Figure 97: Intralaboratory Consistency Statistic

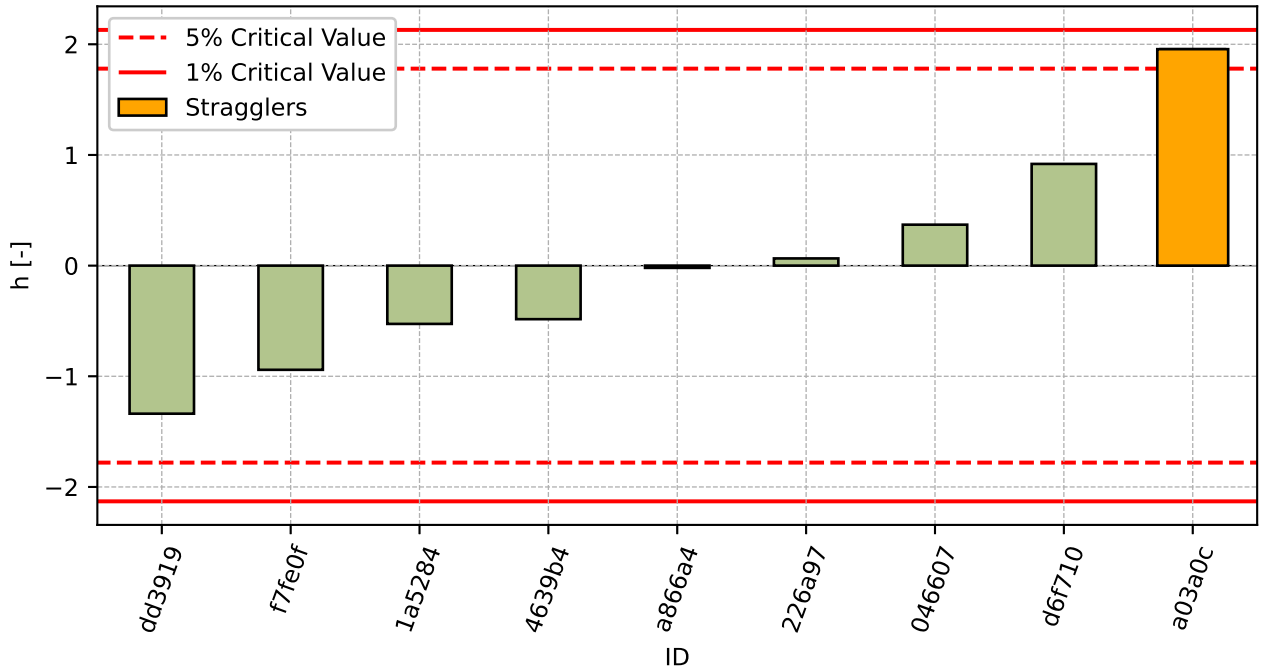

Figure 98: Interlaboratory Consistency Statistic

4.4 Descriptive statistics

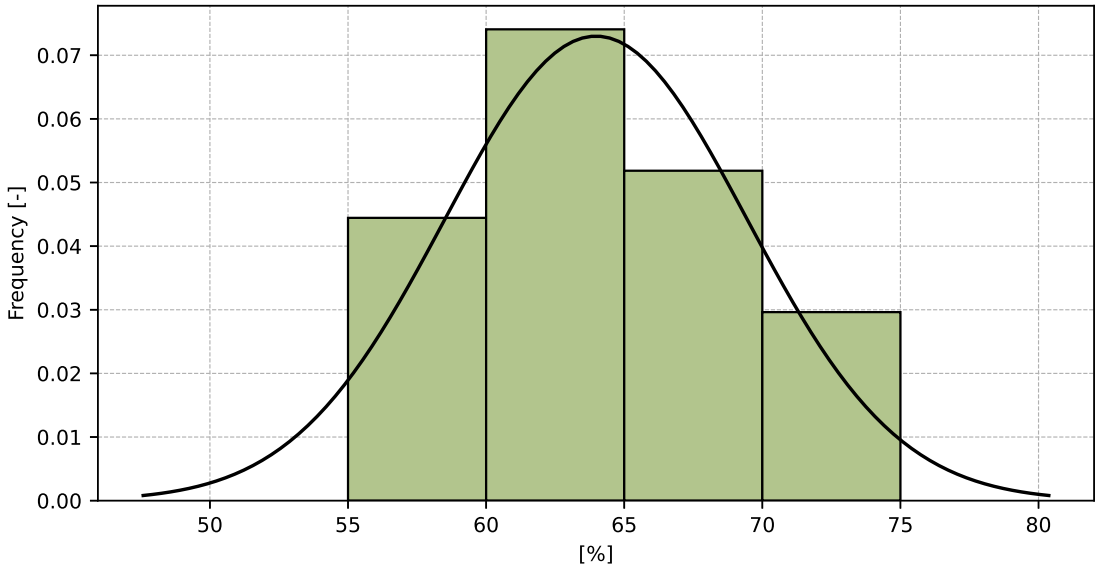

Figure 99: Histogram of all test results

Table 33: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	64
Sample standard deviation – s	5.5
Asigned value – x^*	64
Robust standard deviation – s^*	5.7
Measurement uncertainty of asigned value – u_X	2.4
p-value of normality test	0.209 [-]
Interlaboratory standard deviation – s_L	5.4
Repeatability standard deviation – s_r	0.9
Reproducibility standard deviation – s_R	5.5
Repeatability – r	2
Reproducibility – R	15

4.5 Evaluation of Performance Statistics

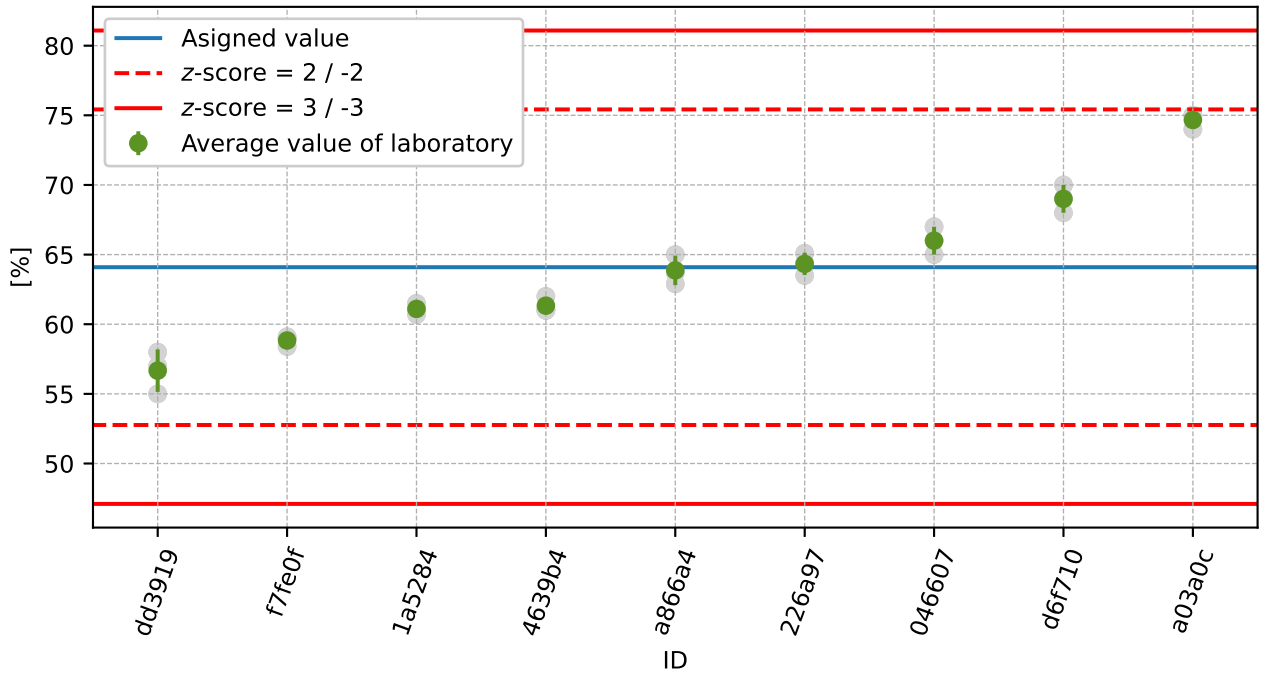

Figure 100: Average values and sample standard deviations

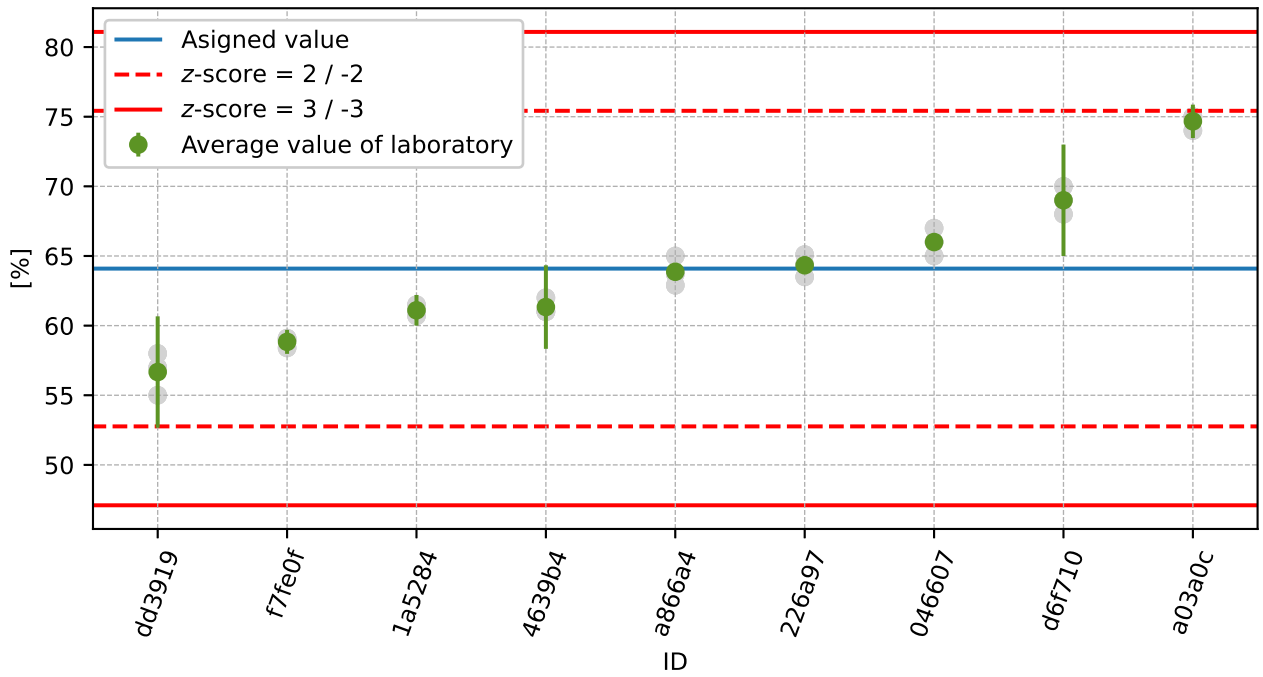

Figure 101: Average values and extended uncertainties of measurement

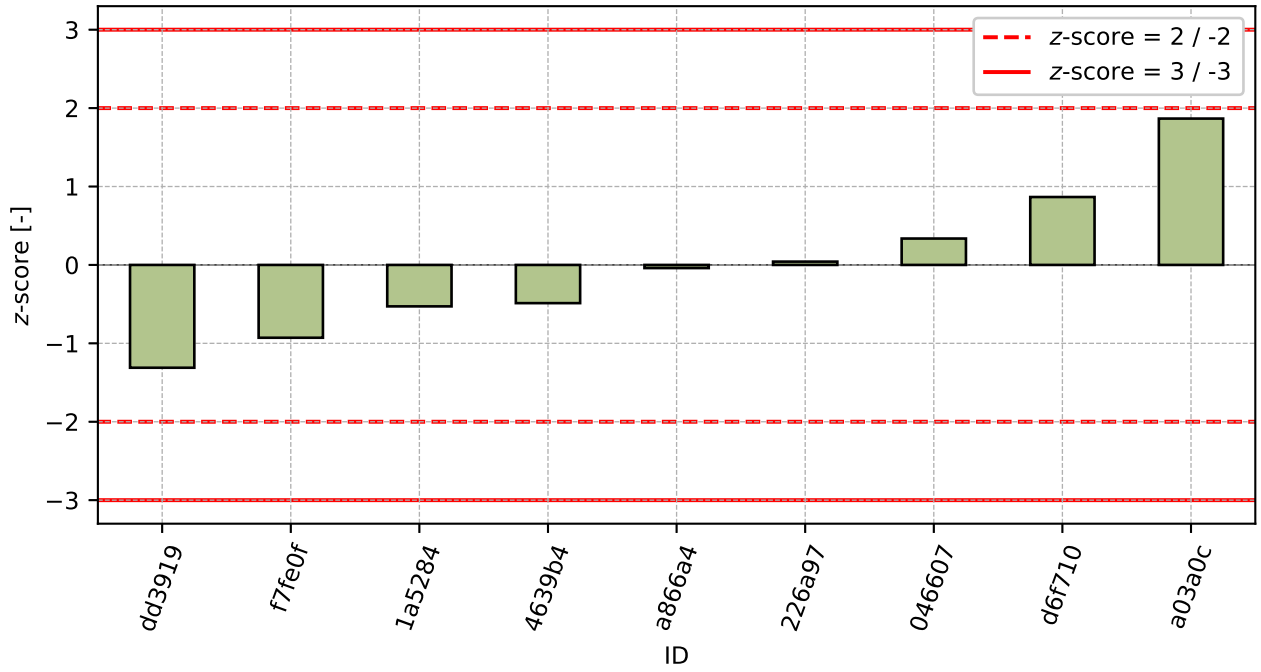

Figure 102: z-score

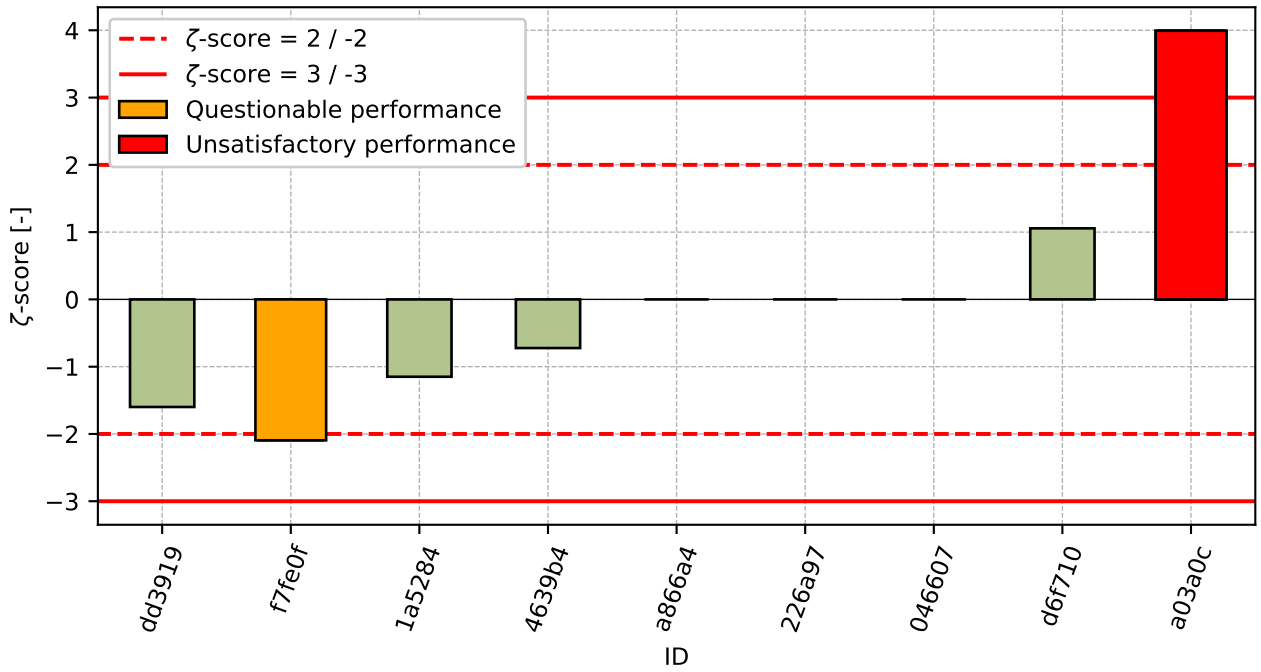

Figure 103: ζ-score

Table 34: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
dd3919	-1.31	-1.6
f7fe0f	-0.93	-2.09
1a5284	-0.53	-1.15
4639b4	-0.49	-0.72
a866a4	-0.04	-
226a97	0.04	-
046607	0.34	-
d6f710	0.87	1.06
a03a0c	1.87	3.99

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 [%]
c4b5f2	1.9	1.2	1.0	-	1.4	0.47	34.58
79f92f	1.6	1.6	1.6	0.2	1.6	0.0	0.0
d6f710	1.7	1.7	1.8	0.3	1.7	0.06	3.33
51d578	1.7	1.8	1.8	0.2	1.8	0.06	3.27
046607	1.9	1.8	1.9	-	1.9	0.06	3.09
c8cc78	2.0	2.0	2.2	0.0	2.1	0.12	5.59
300664	2.5	2.5	2.5	0.2	2.5	0.0	0.0
eec547	3.3	3.3	4.0	0.4	3.5	0.4	11.44
c9c421	3.9	3.9	4.0	0.4	3.9	0.06	1.47
f7fe0f	4.4	3.9	4.3	0.5	4.2	0.26	6.3
1693e7	5.0	5.0	5.0	-	5.0	0.0	0.0

5.2 The Numerical Procedure for Determining Outliers

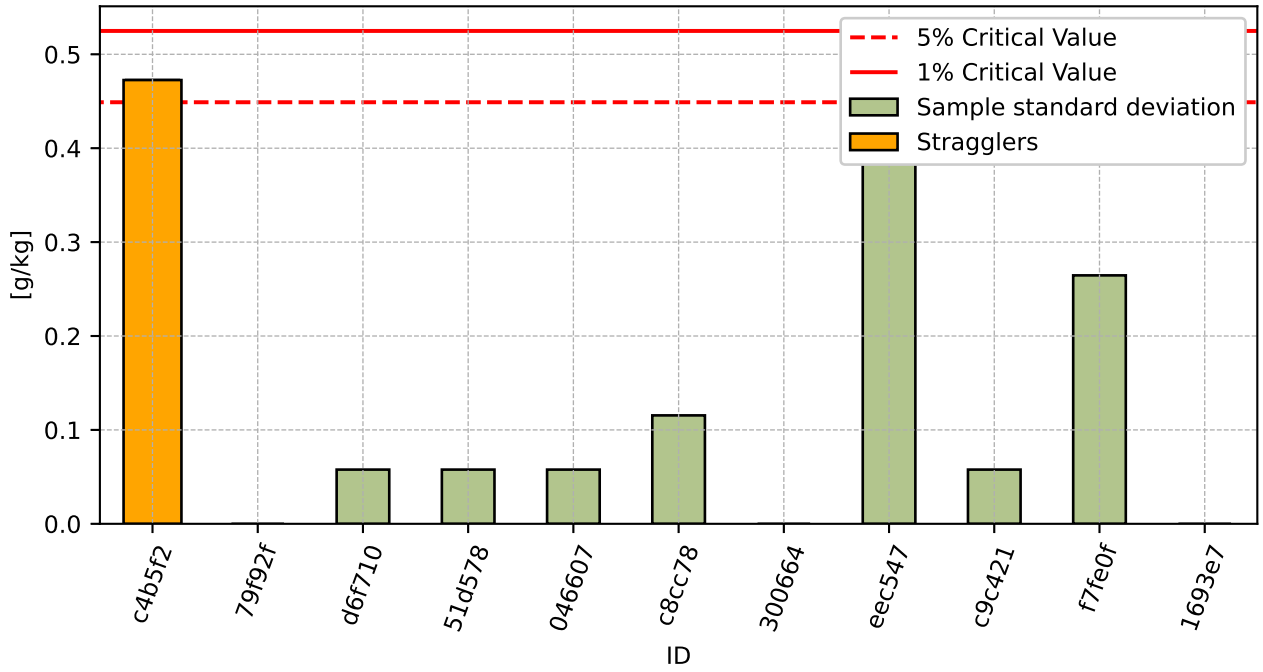

Figure 104: **Cochran's test** - sample standard deviations

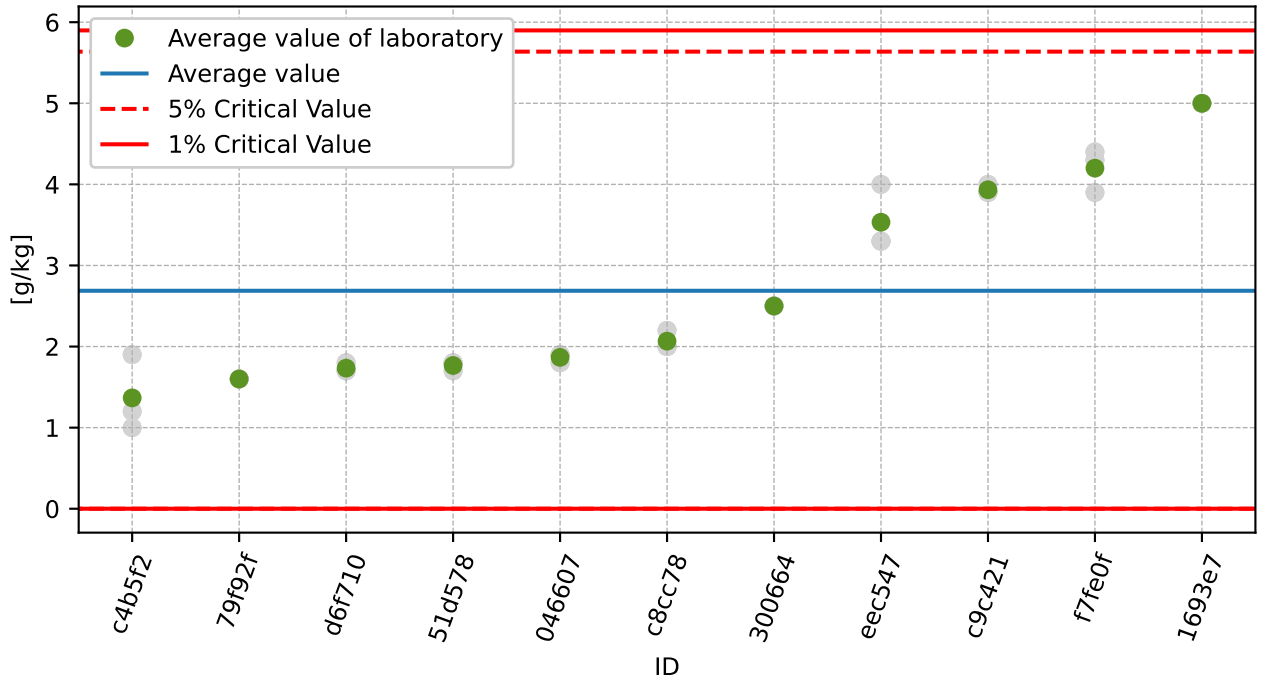

Figure 105: **Grubbs' test** - average values

5.3 Mandel's Statistics

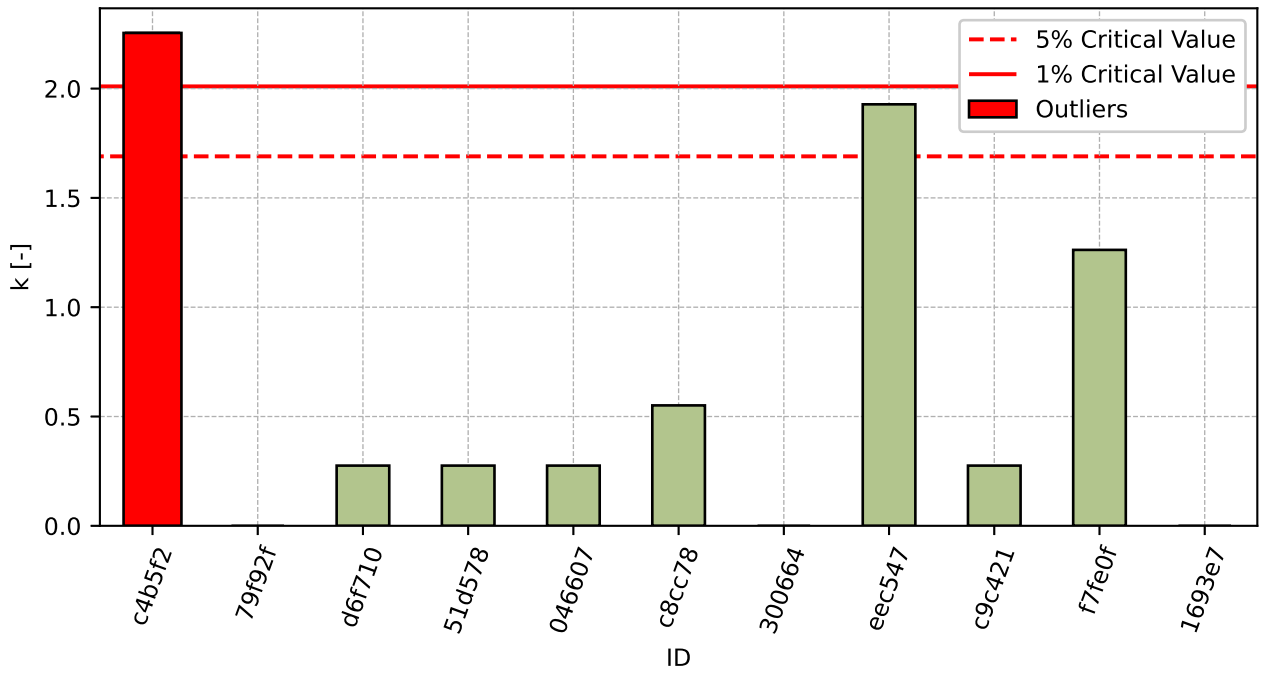

Figure 106: Intralaboratory Consistency Statistic

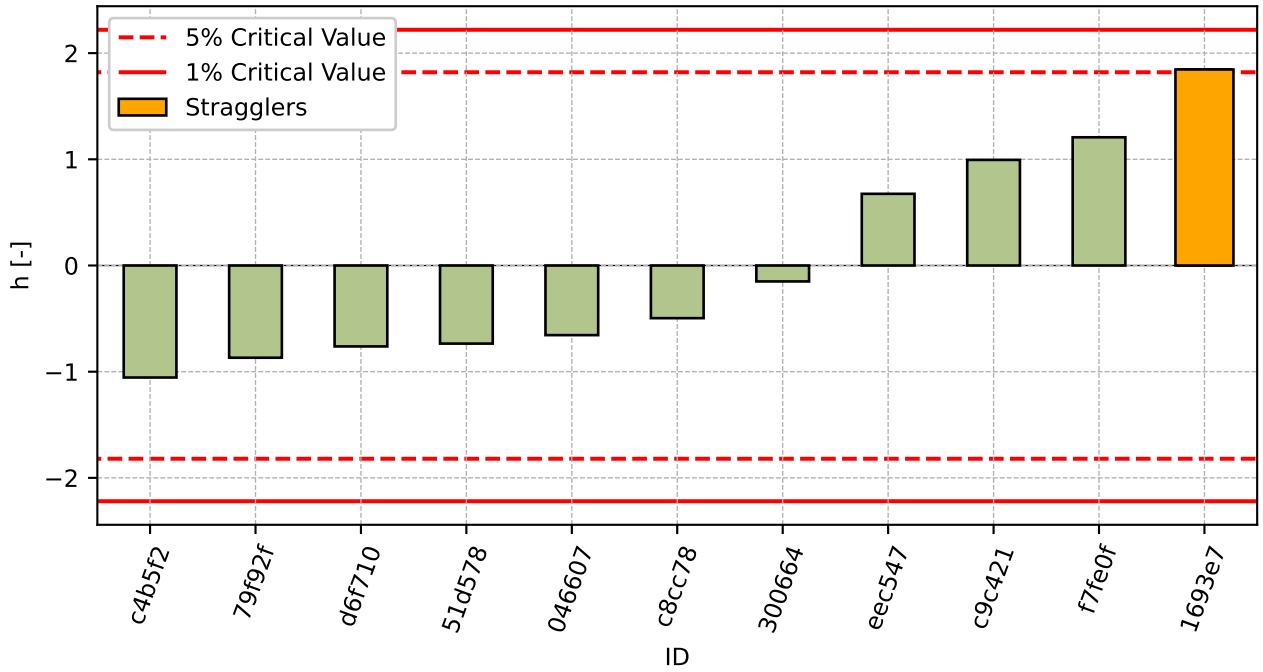

Figure 107: Interlaboratory Consistency Statistic

5.4 Descriptive statistics

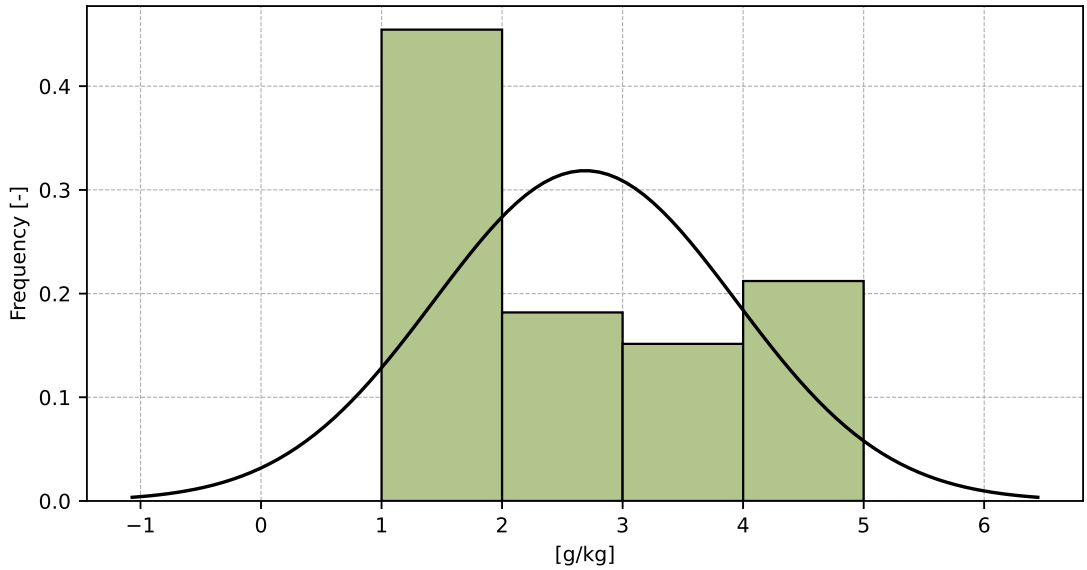

Figure 108: Histogram of all test results

Table 36: Descriptive statistics

Characteristics	[g/kg]
Average value – $\bar{x}$	2.7
Sample standard deviation – s	1.25
Asigned value – x^*	2.5
Robust standard deviation – s^*	1.14
Measurement uncertainty of asigned value – u_X	0.43
p-value of normality test	0.001 [-]
Interlaboratory standard deviation – s_L	1.25
Repeatability standard deviation – s_r	0.21
Reproducibility standard deviation – s_R	1.26
Repeatability – r	0.6
Reproducibility – R	3.5

5.5 Evaluation of Performance Statistics

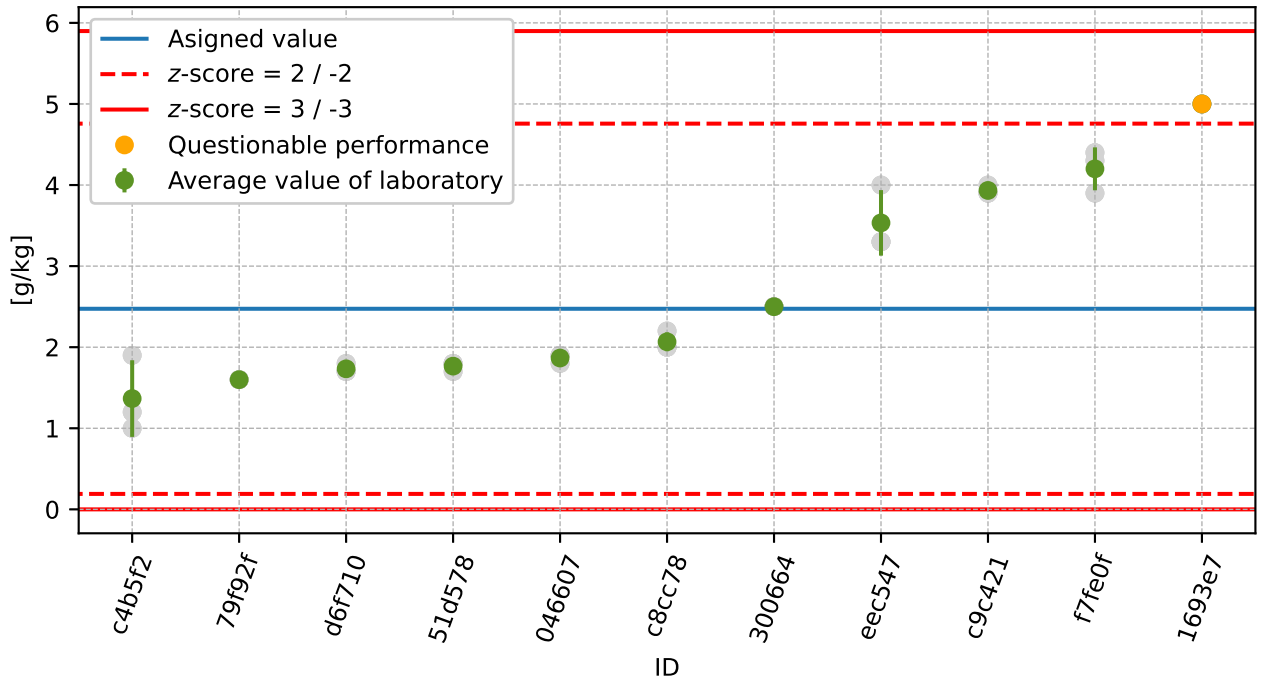

Figure 109: Average values and sample standard deviations

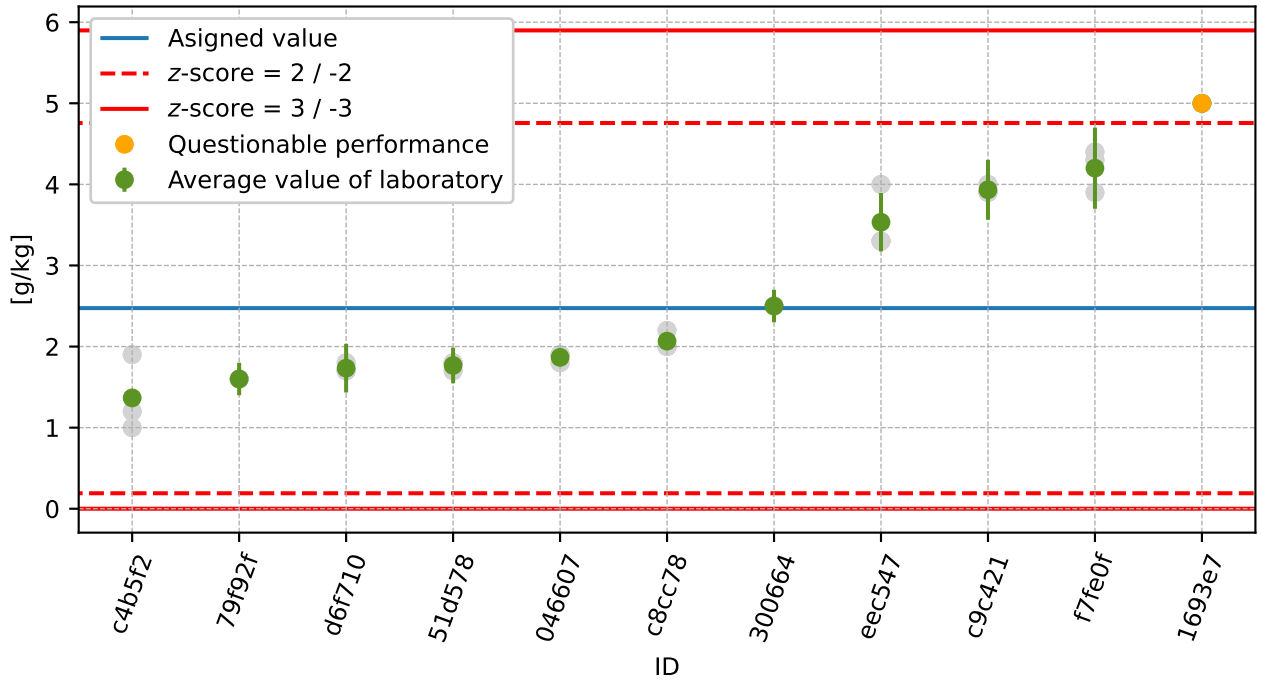

Figure 110: Average values and extended uncertainties of measurement

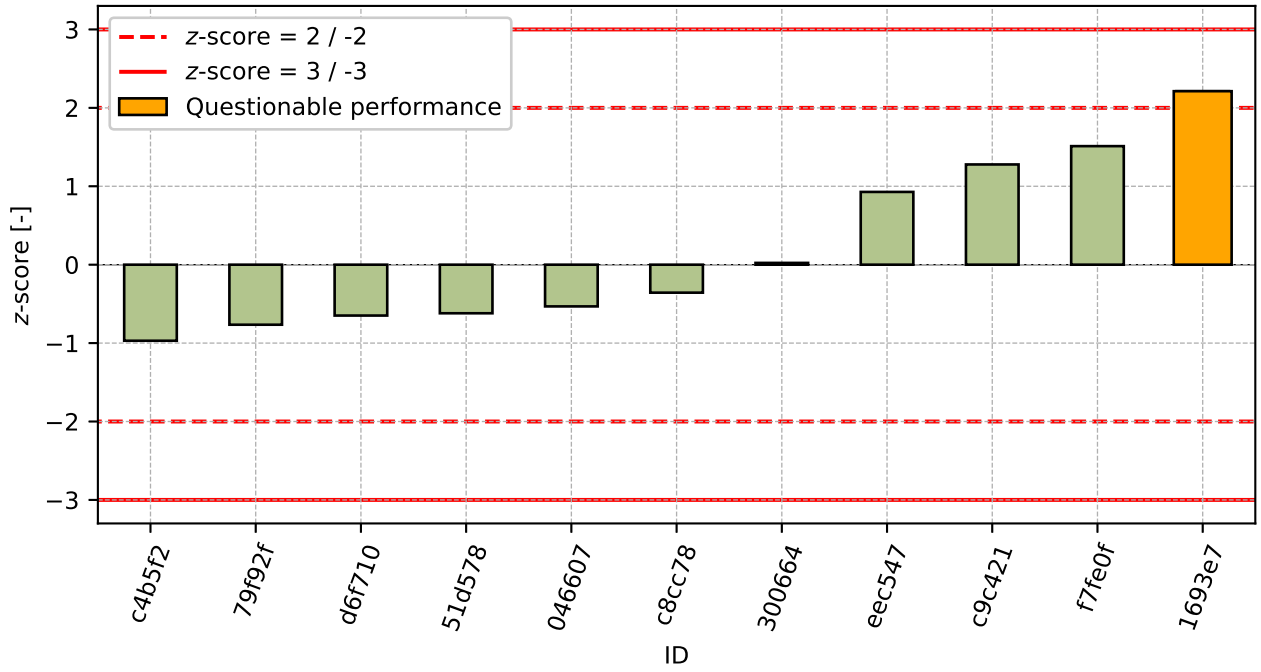

Figure 111: z-score

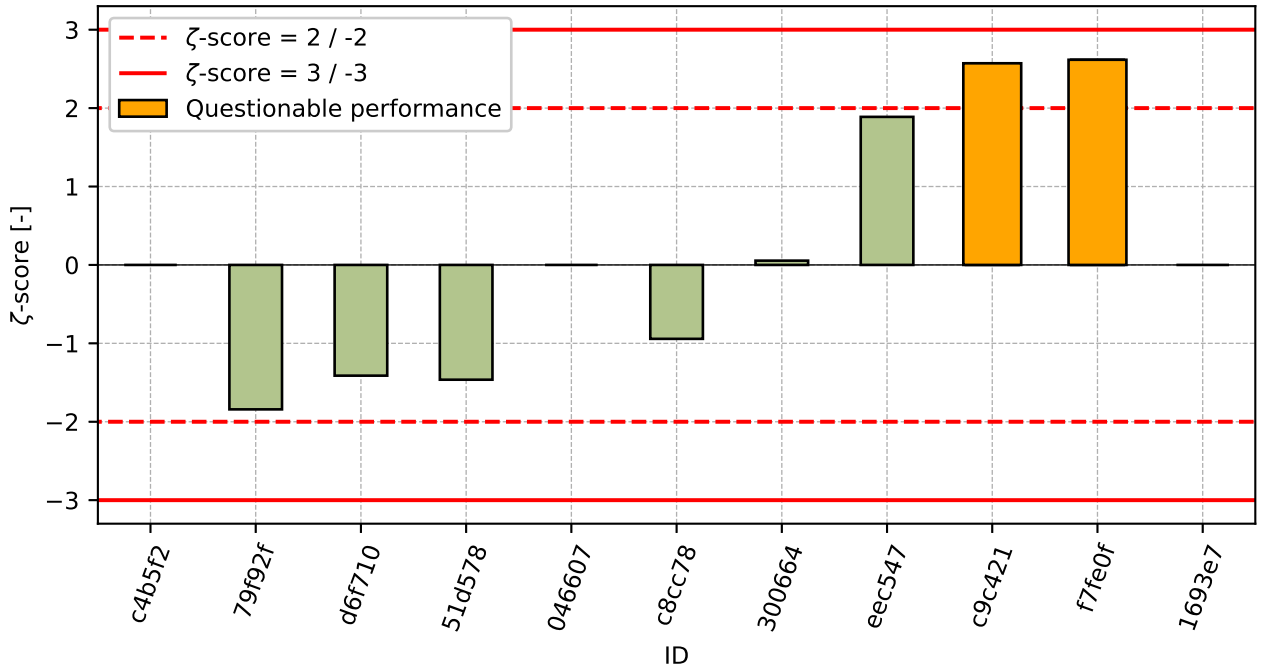

Figure 112: ζ-score

Table 37: *z*-score and ζ-score

ID	*z*-score [-]	ζ-score [-]
c4b5f2	-0.97	-
79f92f	-0.77	-1.84
d6f710	-0.65	-1.41
51d578	-0.62	-1.46
046607	-0.53	-
c8cc78	-0.36	-0.94
300664	0.02	0.05
eec547	0.93	1.89
c9c421	1.28	2.57
f7fe0f	1.51	2.62
1693e7	2.21	-

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 [-]
0a063a	3.0	1.0
0d1159	6.5	1.9
eec547	6.6	-
dd3919	6.8	0.5
51d578	7.0	0.1
79f92f	7.0	1.0
22cd3b	7.0	0.2
dbb4c3	7.0	1.0
29f085	7.0	-
76d7ce	8.0	0.4

7.2 The Numerical Procedure for Determining Outliers

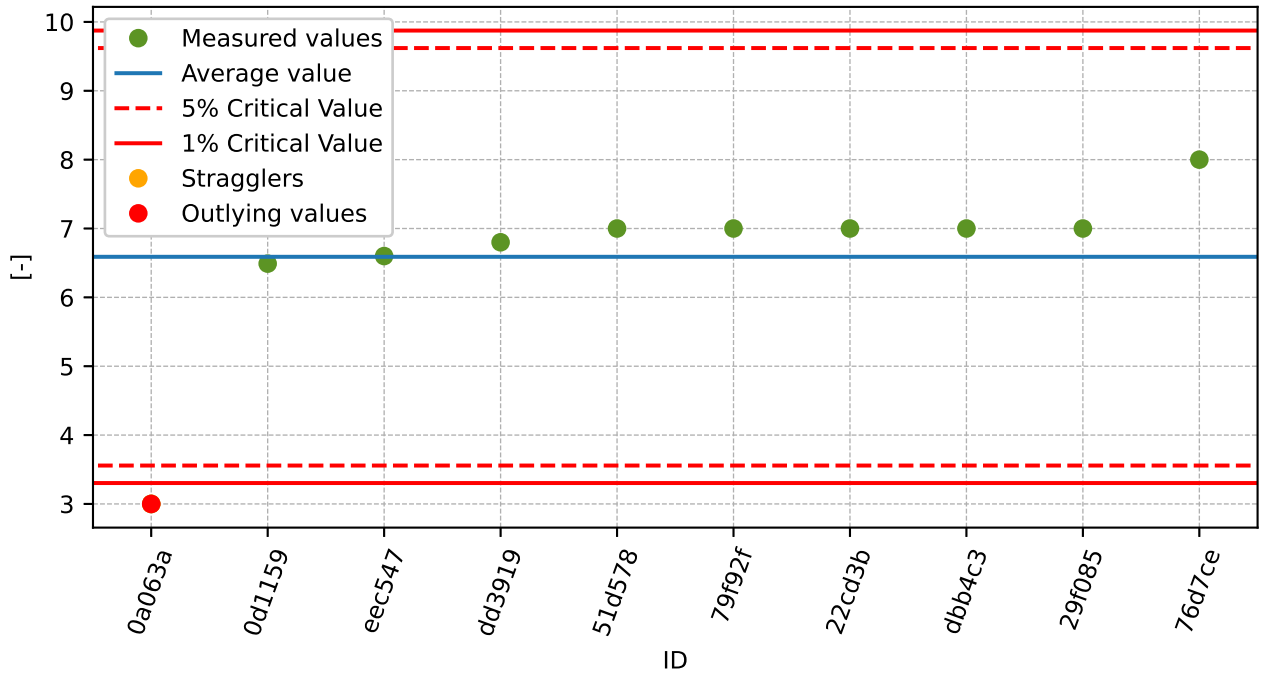

Figure 113: **Grubbs' test** - average values

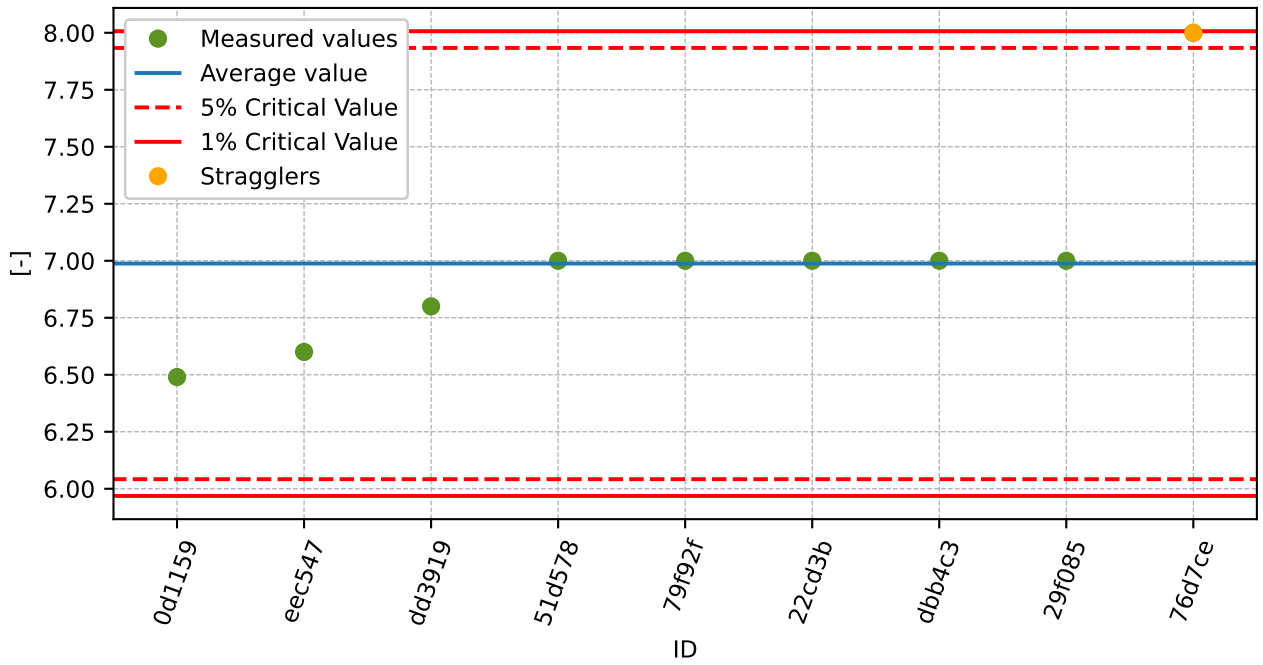

Figure 114: **Grubbs' test** - average values without outliers

7.3 Mandel's Statistics

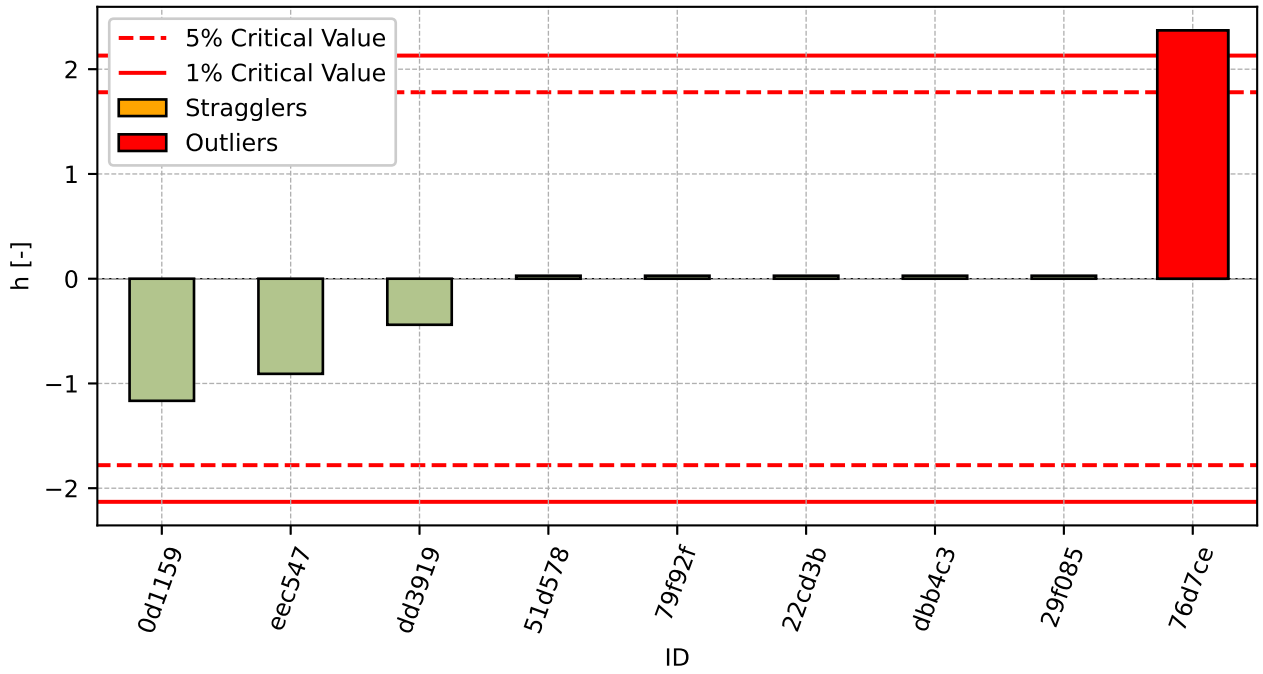

Figure 115: Interlaboratory Consistency Statistic

7.4 Descriptive statistics

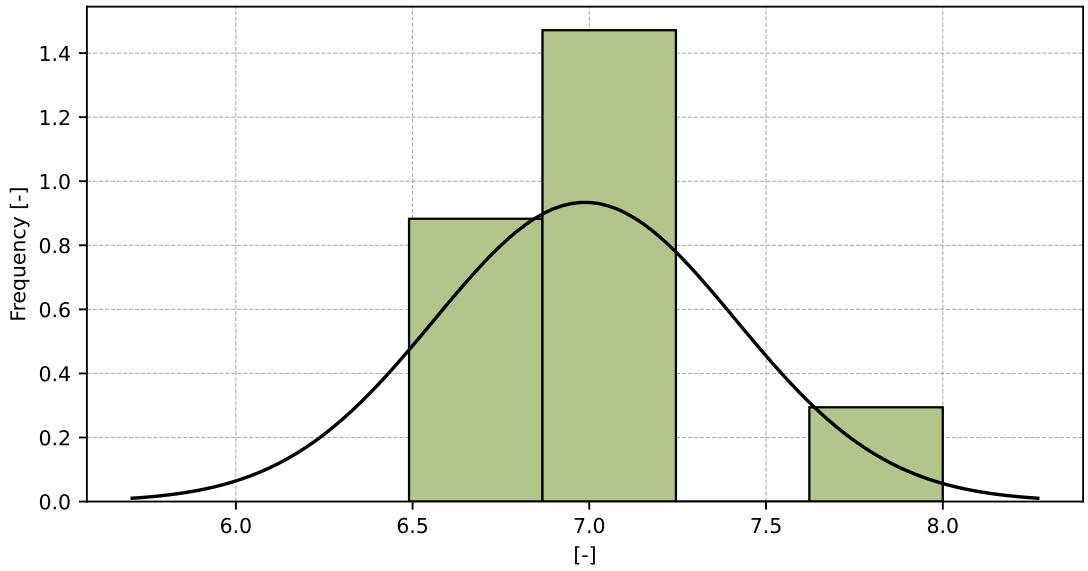

Figure 116: Histogram of all test results

Table 39: Descriptive statistics

Characteristics	[-]
Average value – $\bar{x}$	7.0
Sample standard deviation – s	0.43
Asigned value – x^*	7.1
Robust standard deviation – s^*	0.36
Measurement uncertainty of asigned value – u_X	0.15
p-value of normality test	0.009 [-]

7.5 Evaluation of Performance Statistics

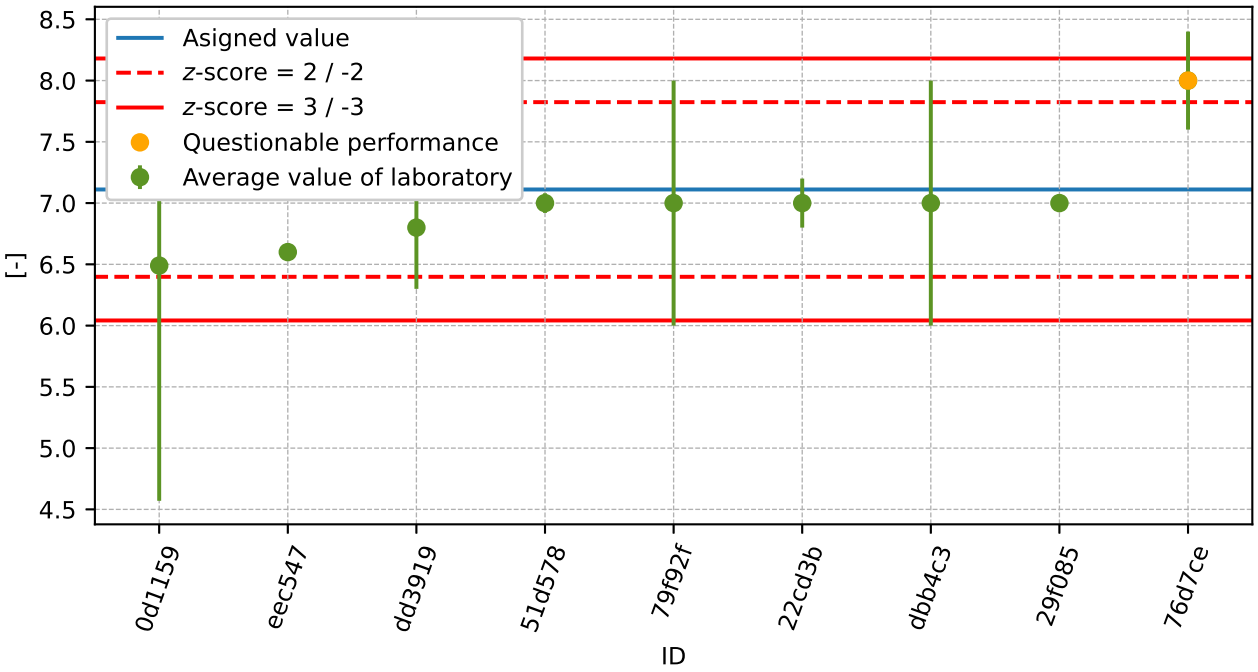

Figure 117: Average values and extended uncertainties of measurement

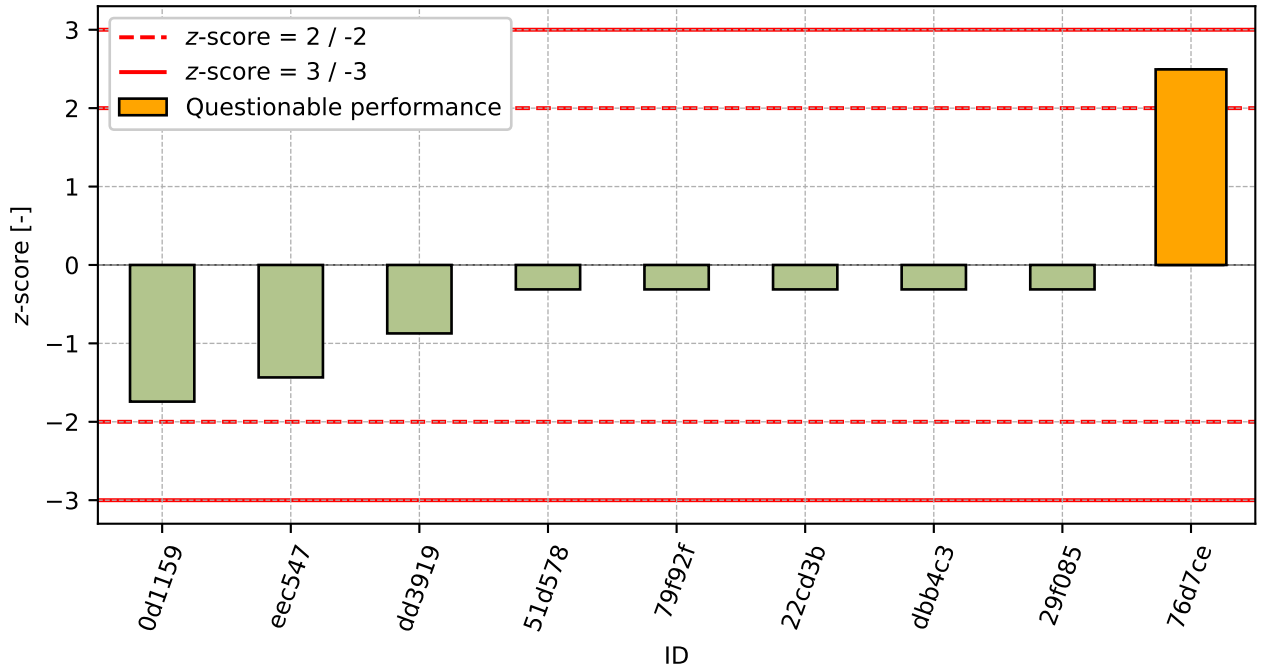

Figure 118: z-score

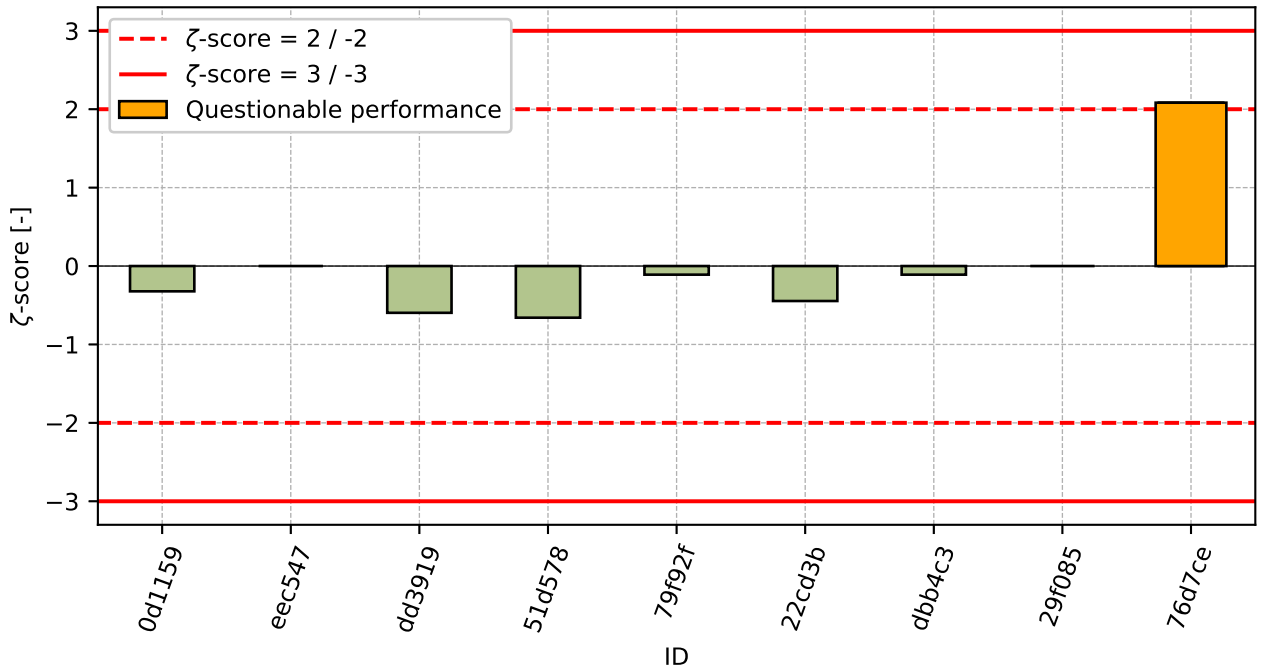

Figure 119: ζ-score

Table 40: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
0d1159	-1.74	-0.32
eec547	-1.43	-
dd3919	-0.87	-0.6
51d578	-0.31	-0.66
79f92f	-0.31	-0.11
22cd3b	-0.31	-0.45
dbb4c3	-0.31	-0.11
29f085	-0.31	-
76d7ce	2.49	2.08

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 [-]
dbb4c3	16	1
dd3919	16	0
0a063a	17	1
eec547	17	19
362270	18	2
a866a4	18	-
a03a0c	18	1
028c7e	19	-
046607	19	-
0214a2	19	3
2ec012	19	1
4c6ddd	19	1
29f085	20	-
51d578	20	0
79f92f	20	1
f7fe0f	21	1
41bbcc	25	3

8.2 The Numerical Procedure for Determining Outliers

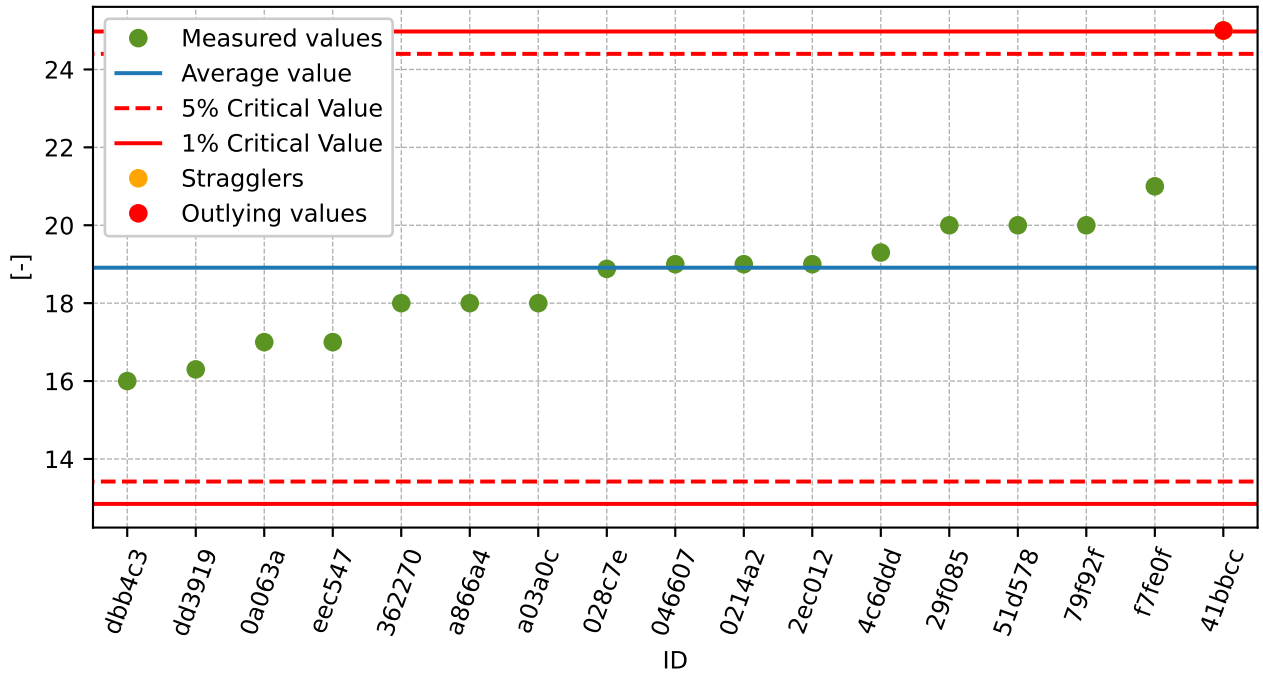

Figure 120: **Grubbs' test** - average values

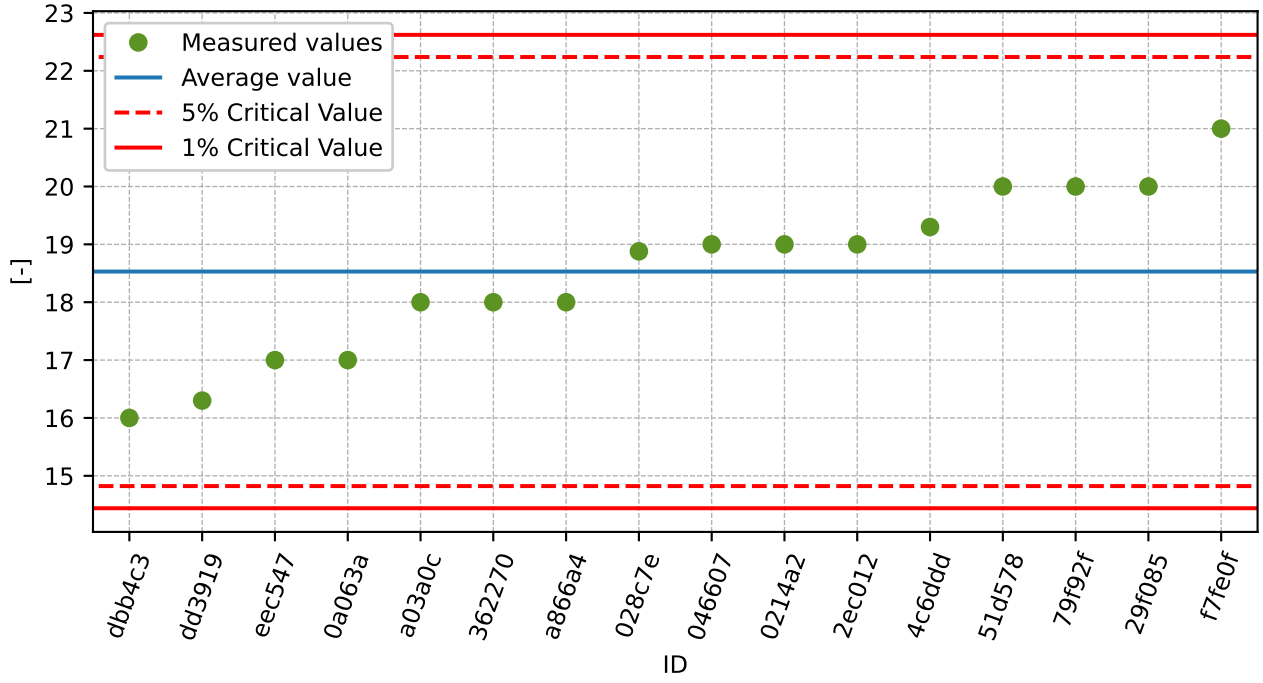

Figure 121: **Grubbs' test** - average values without outliers

8.3 Mandel's Statistics

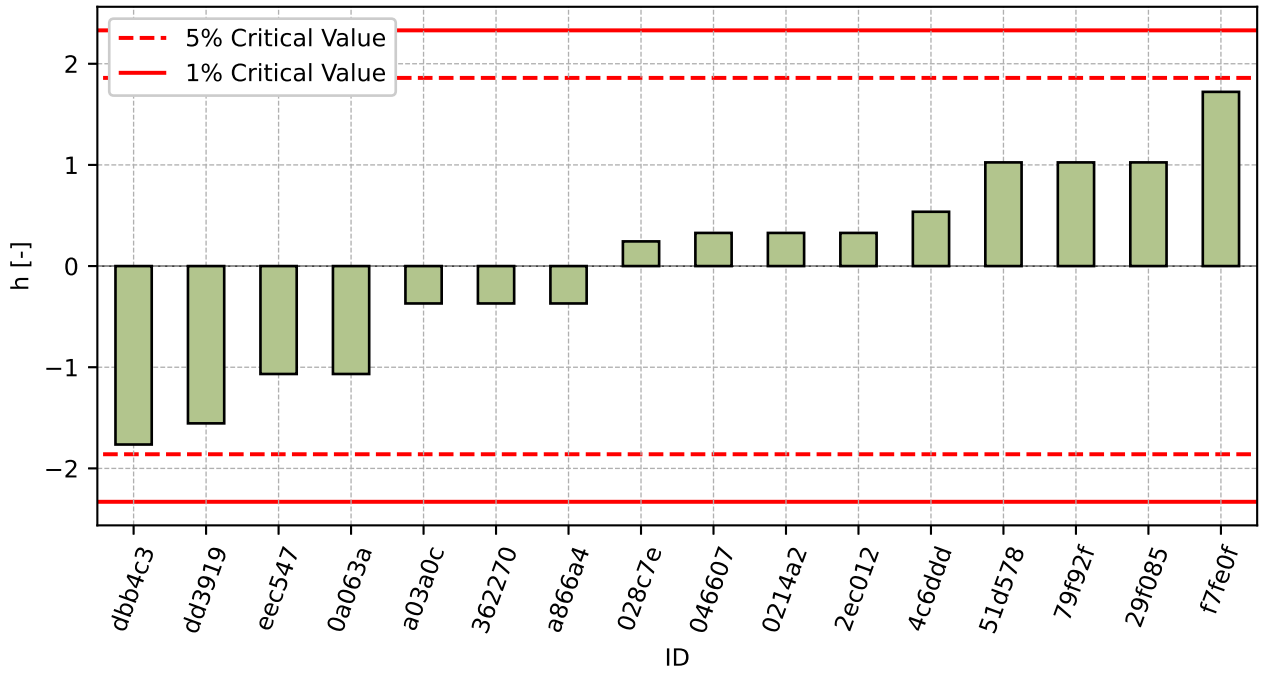

Figure 122: Interlaboratory Consistency Statistic

8.4 Descriptive statistics

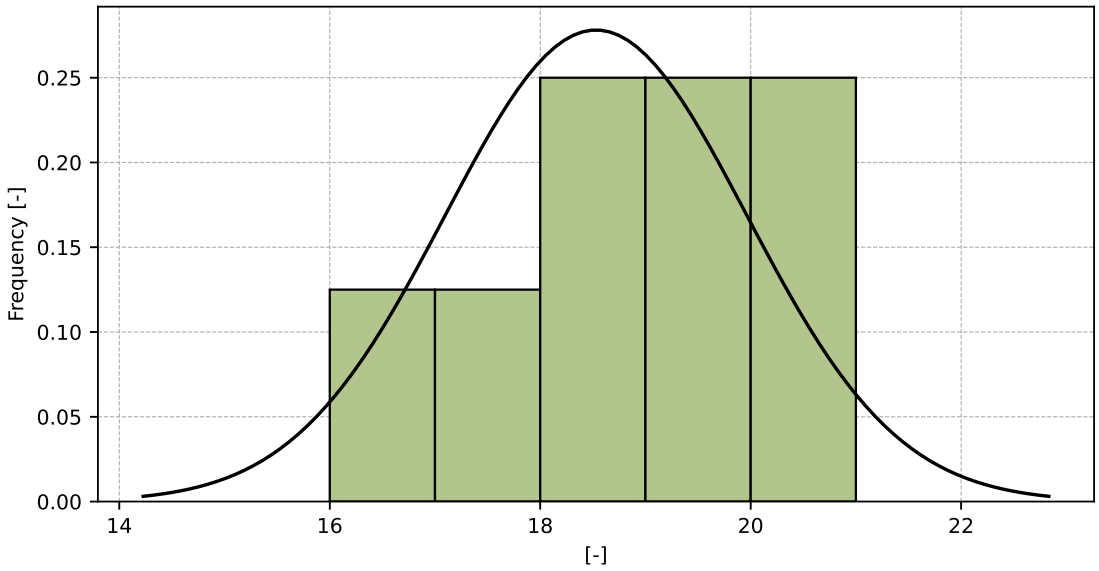

Figure 123: Histogram of all test results

Table 42: Descriptive statistics

Characteristics	[-]
Average value – $\bar{x}$	19
Sample standard deviation – s	1.4
Asigned value – x^*	19
Robust standard deviation – s^*	1.4
Measurement uncertainty of asigned value – u_X	0.5
p-value of normality test	0.603 [-]

8.5 Evaluation of Performance Statistics

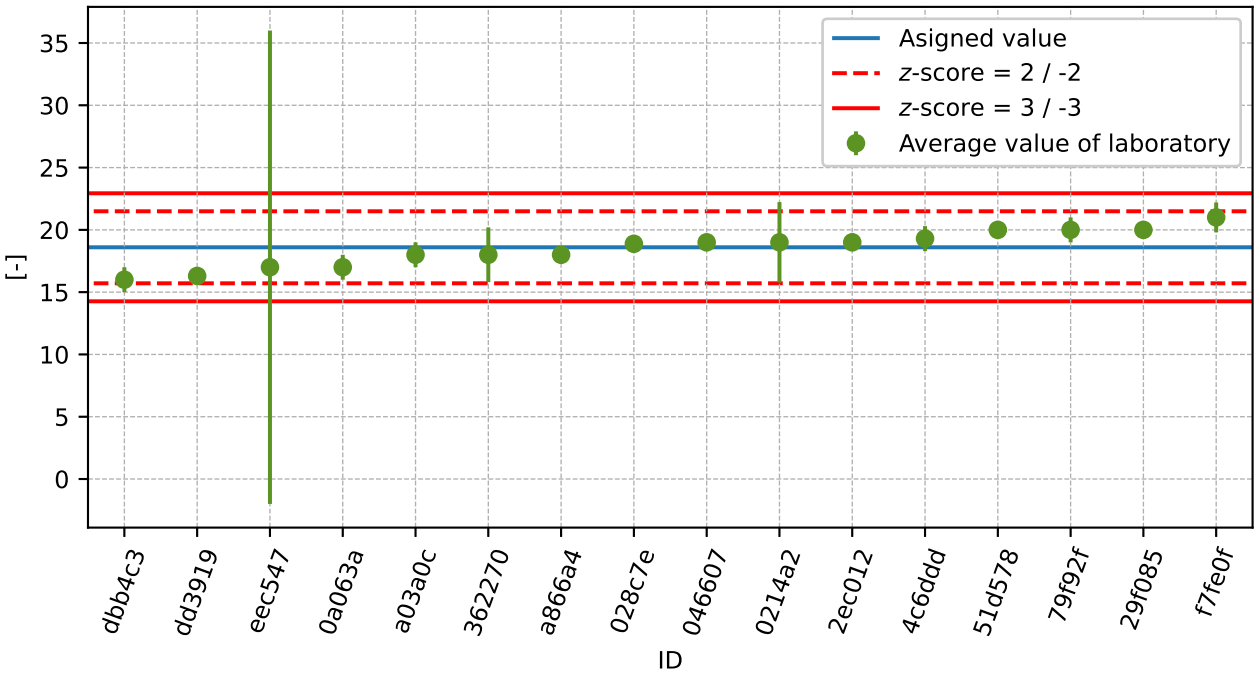

Figure 124: Average values and extended uncertainties of measurement

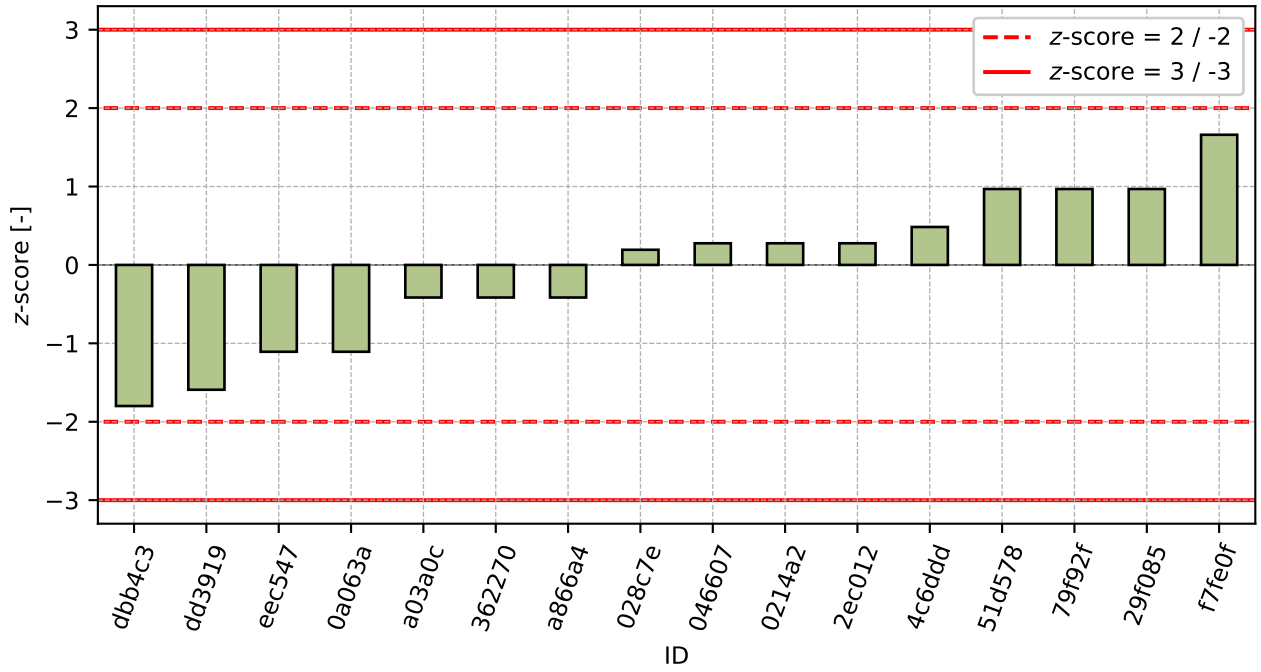

Figure 125: z-score

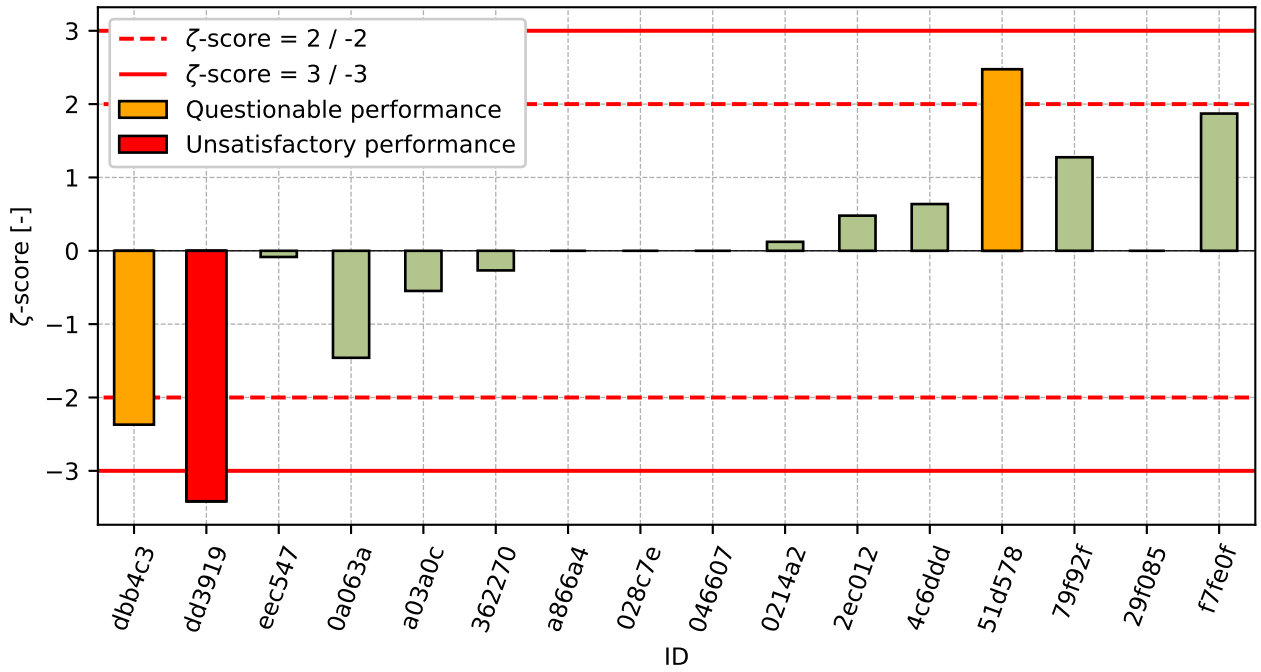

Figure 126: ζ-score

Table 43: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
dbb4c3	-1.8	-2.37
dd3919	-1.59	-3.41
eec547	-1.11	-0.08
0a063a	-1.11	-1.46
a03a0c	-0.42	-0.55
362270	-0.42	-0.27
a866a4	-0.42	-
028c7e	0.19	-
046607	0.28	-
0214a2	0.28	0.12
2ec012	0.28	0.48
4c6ddd	0.48	0.64
51d578	0.97	2.48
79f92f	0.97	1.28
29f085	0.97	-
f7fe0f	1.66	1.87

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 [%]
51d578	1.18	1.18	1.18	0.1	1.18	0.0	0.0
29f085	1.33	1.33	1.33	-	1.33	0.002	0.13
2ec012	1.36	1.36	1.37	0.02	1.36	0.006	0.42
49455c	1.37	-	-	-	1.37	0.0	0.0
dbb4c3	1.39	1.39	1.39	0.01	1.39	0.002	0.17
0a063a	1.39	1.39	1.4	0.02	1.39	0.006	0.41
c284dc	1.37	1.42	1.43	0.02	1.41	0.032	2.29
632c29	1.43	1.4	1.41	0.03	1.41	0.015	1.08
028c7e	1.46	1.44	1.45	-	1.45	0.013	0.87
b648a0	1.45	1.46	1.47	0.02	1.46	0.01	0.71
033508	1.48	1.49	1.48	0.01	1.49	0.004	0.24

10.1.2 The Numerical Procedure for Determining Outliers

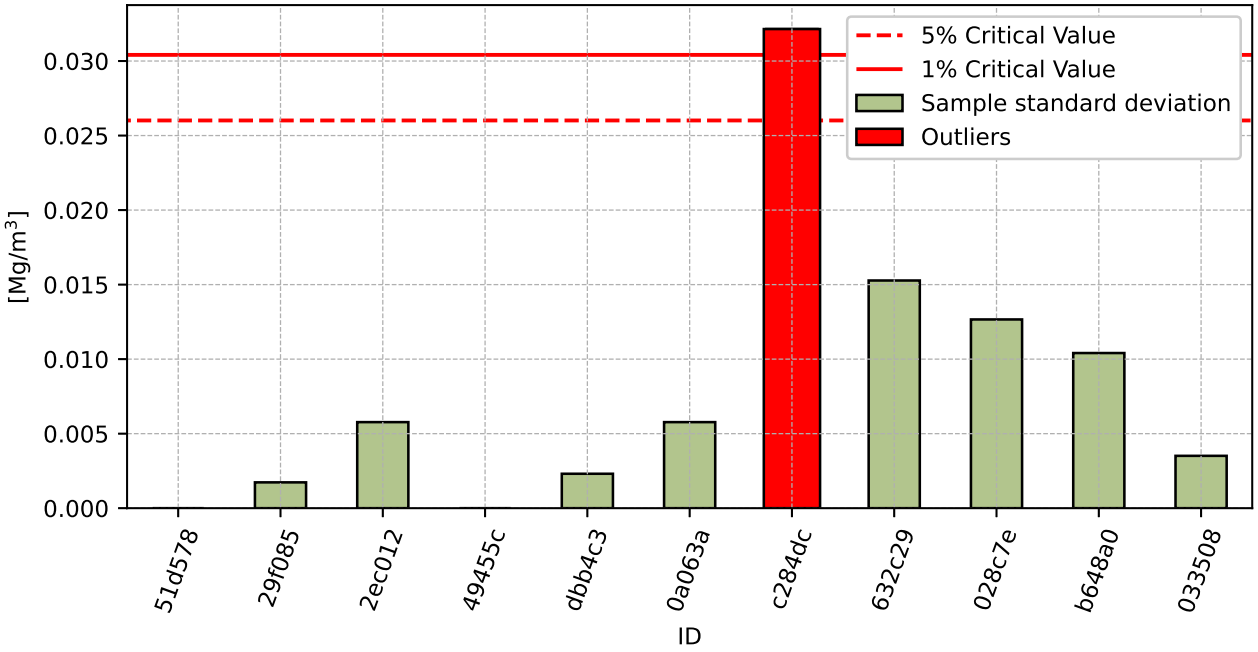

Figure 127: **Cochran's test** - sample standard deviations

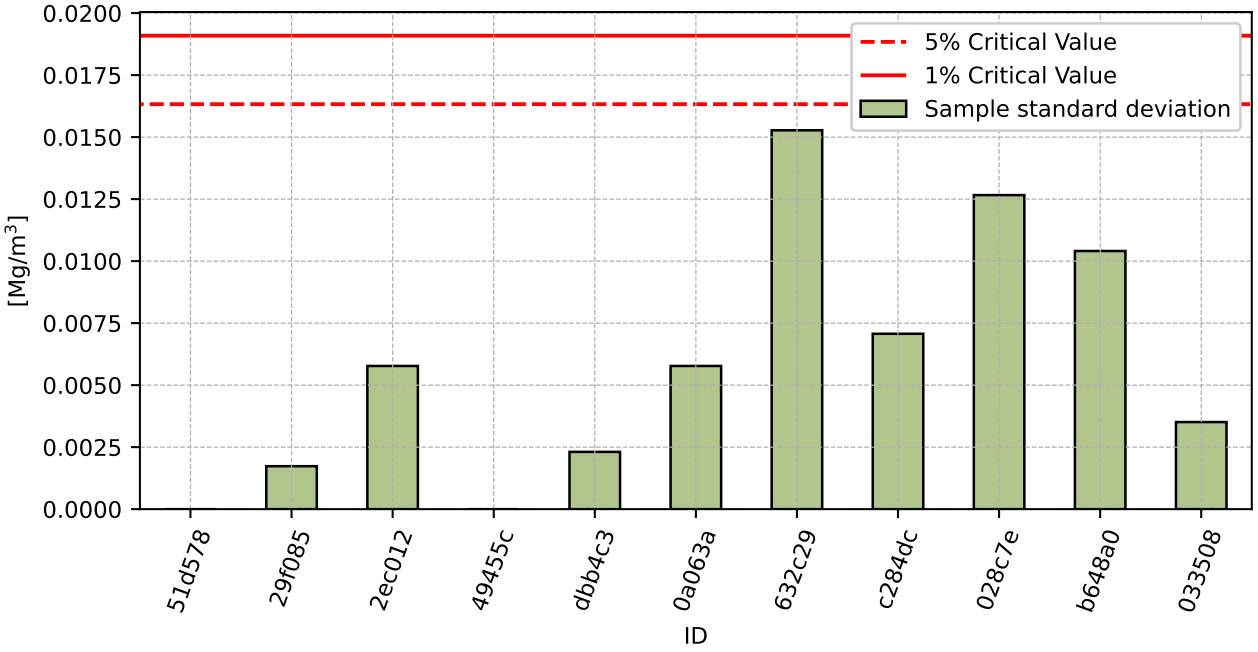

Figure 128: **Cochran's test** - sample standard deviations without outliers

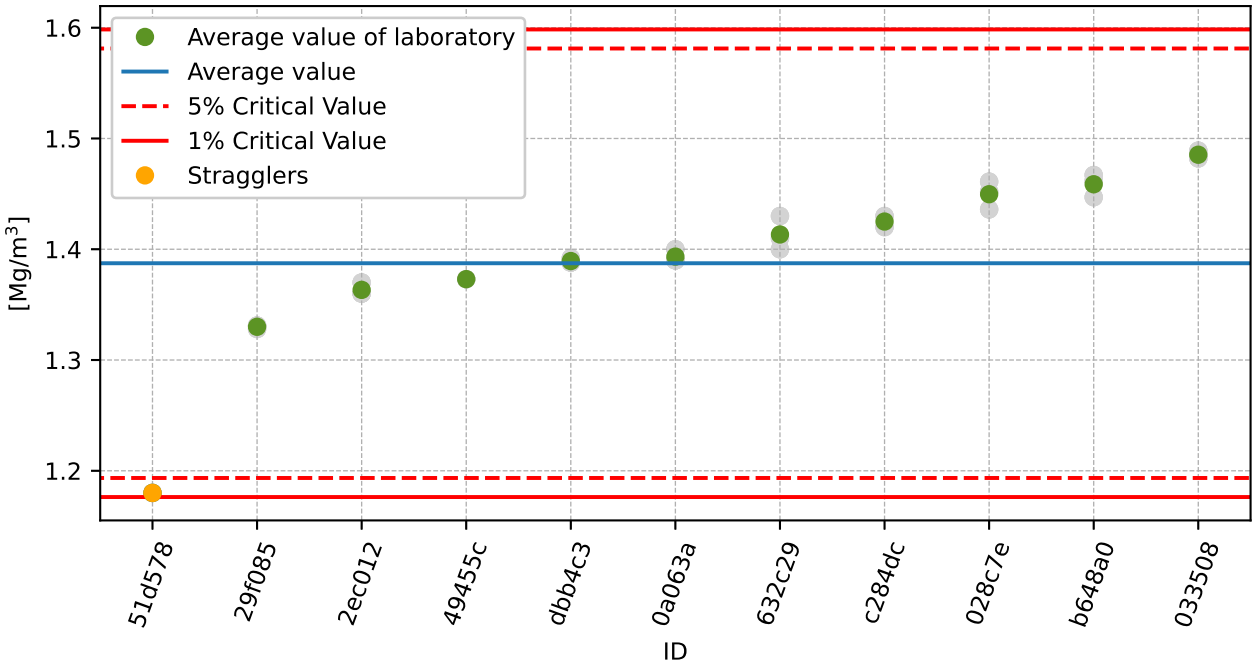

Figure 129: **Grubbs' test** - average values

10.1.3 Mandel's Statistics

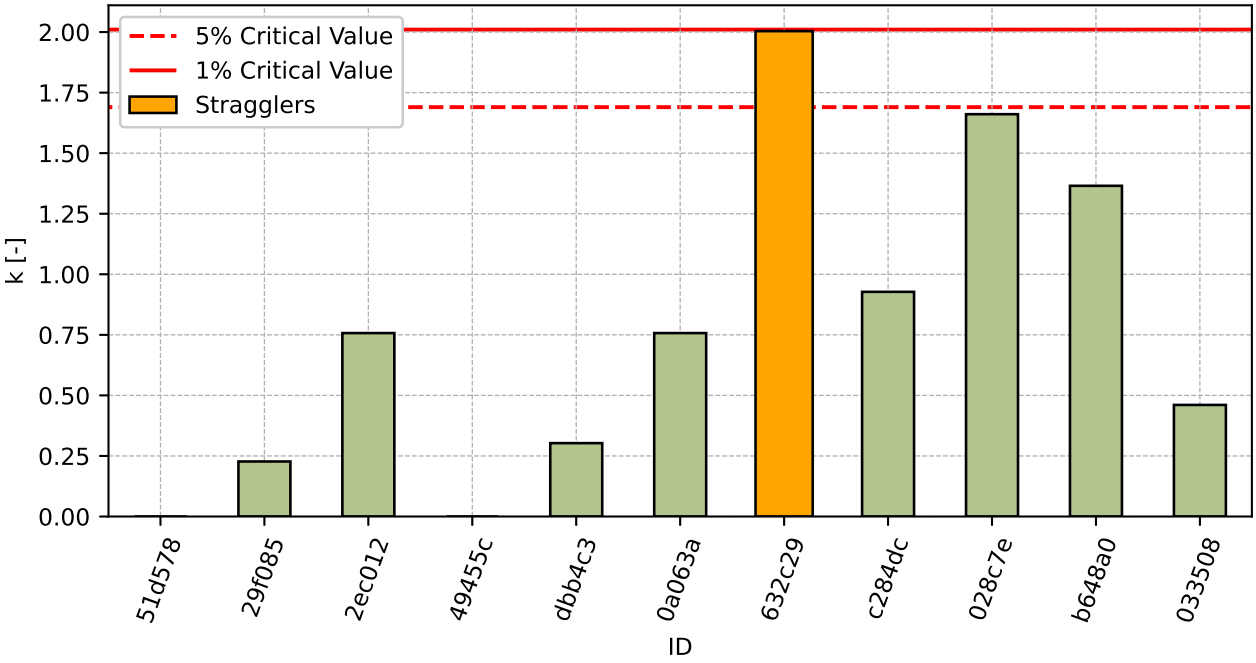

Figure 130: Intralaboratory Consistency Statistic

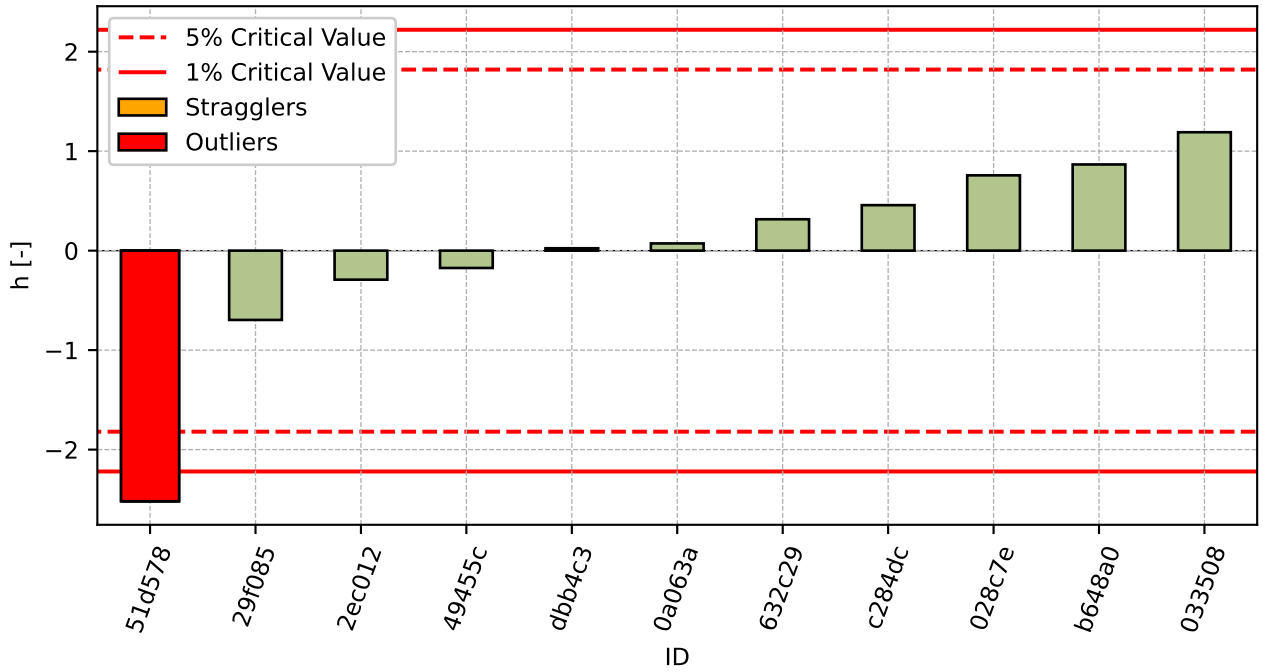

Figure 131: Interlaboratory Consistency Statistic

10.1.4 Descriptive statistics

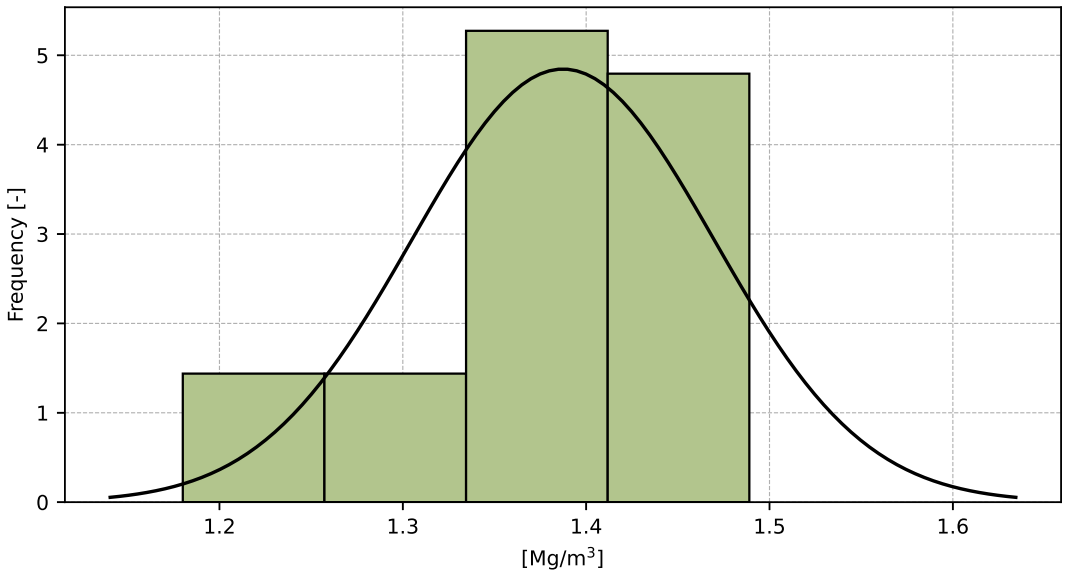

Figure 132: Histogram of all test results

Table 45: Descriptive statistics

Characteristics	[Mg/m³]
Average value – $\bar{x}$	1.39
Sample standard deviation – s	0.082
Asigned value – x^*	1.4
Robust standard deviation – s^*	0.056
Measurement uncertainty of asigned value – u_X	0.021
p-value of normality test	0.001 [-]
Interlaboratory standard deviation – s_L	0.082
Repeatability standard deviation – s_r	0.008
Reproducibility standard deviation – s_R	0.083
Repeatability – r	0.02
Reproducibility – R	0.23

10.1.5 Evaluation of Performance Statistics

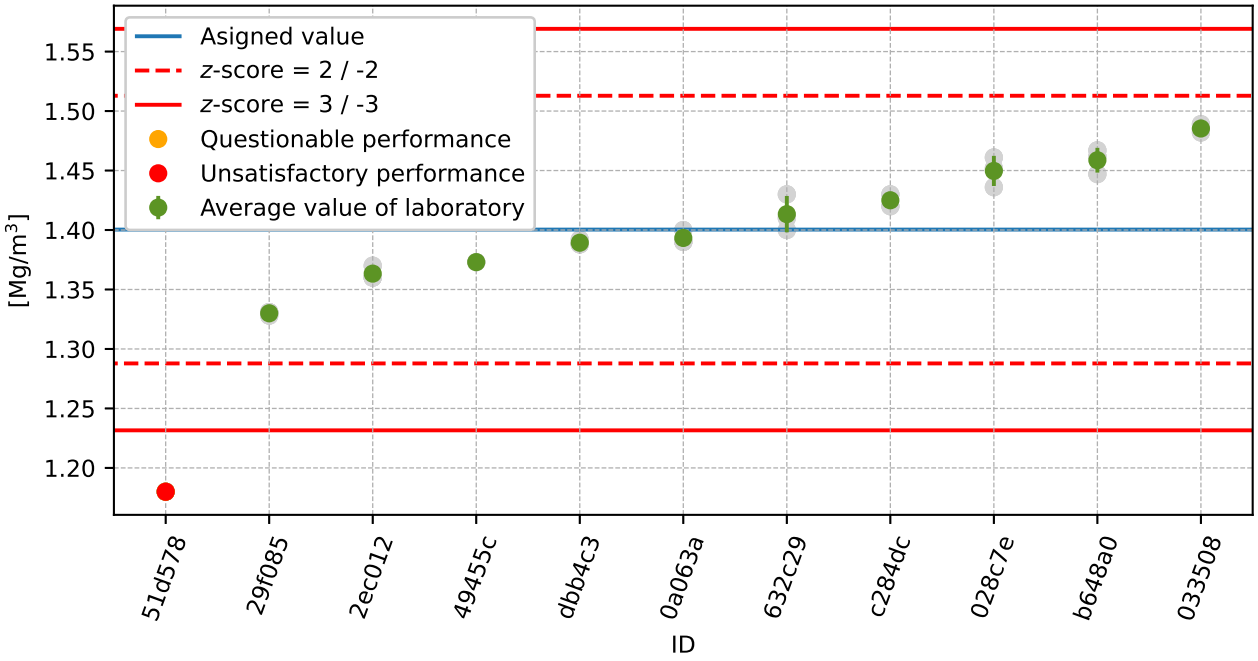

Figure 133: Average values and sample standard deviations

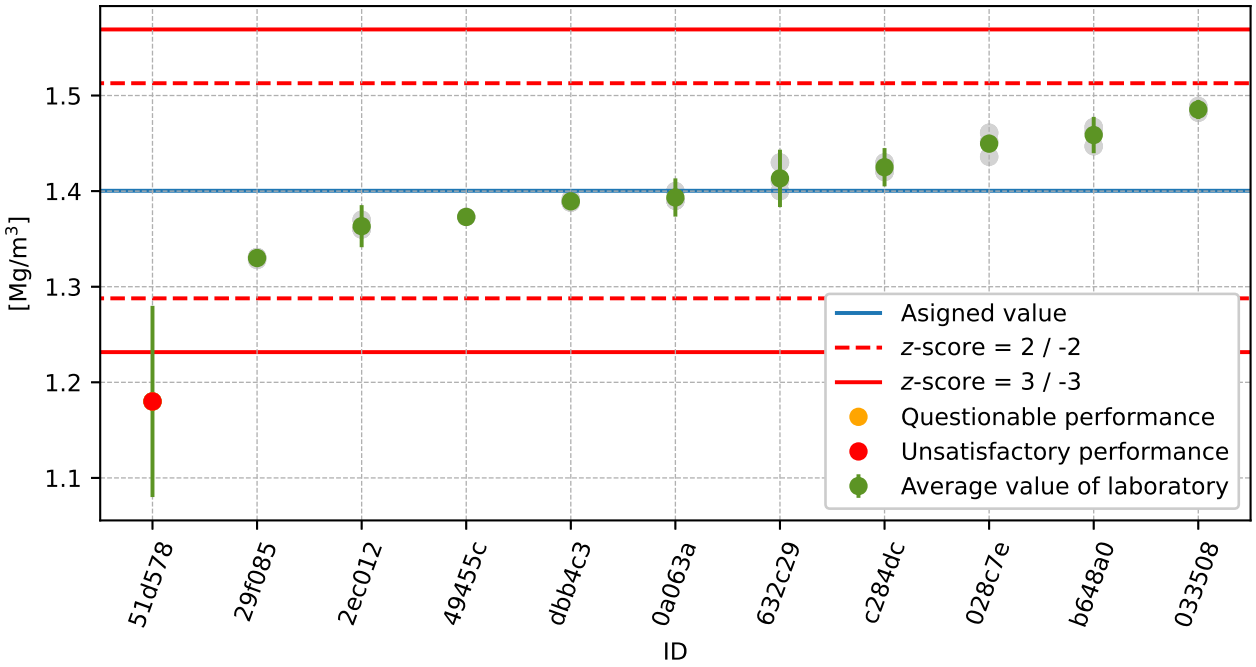

Figure 134: Average values and extended uncertainties of measurement

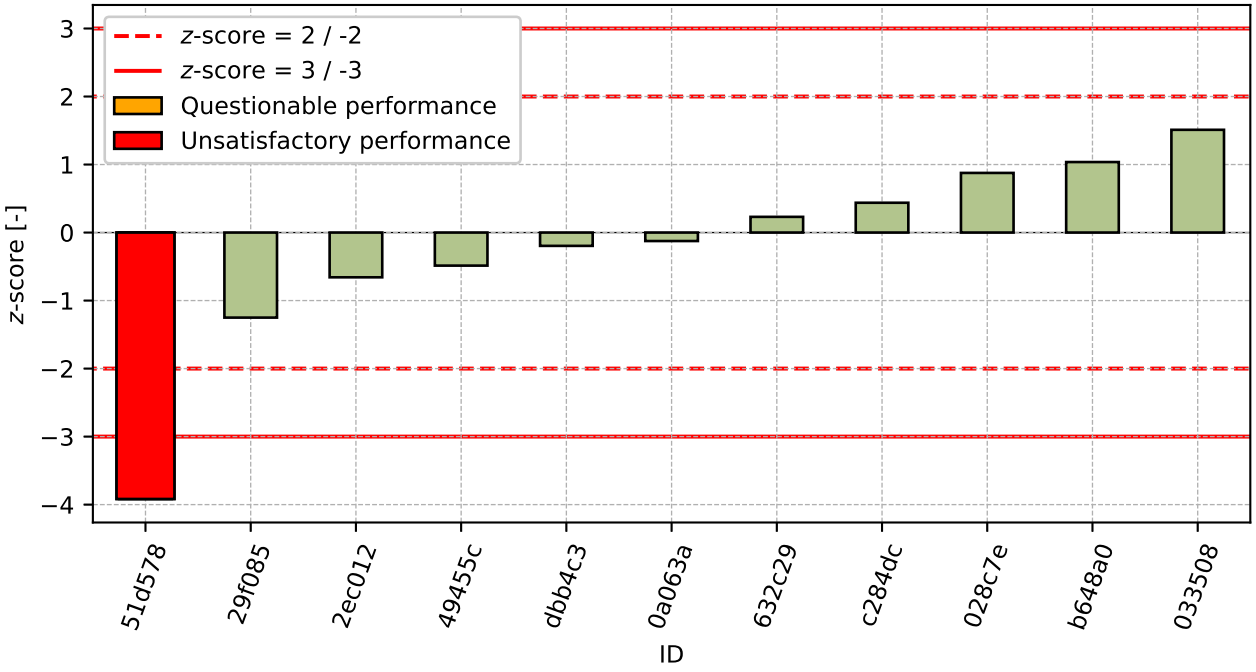

Figure 135: z-score

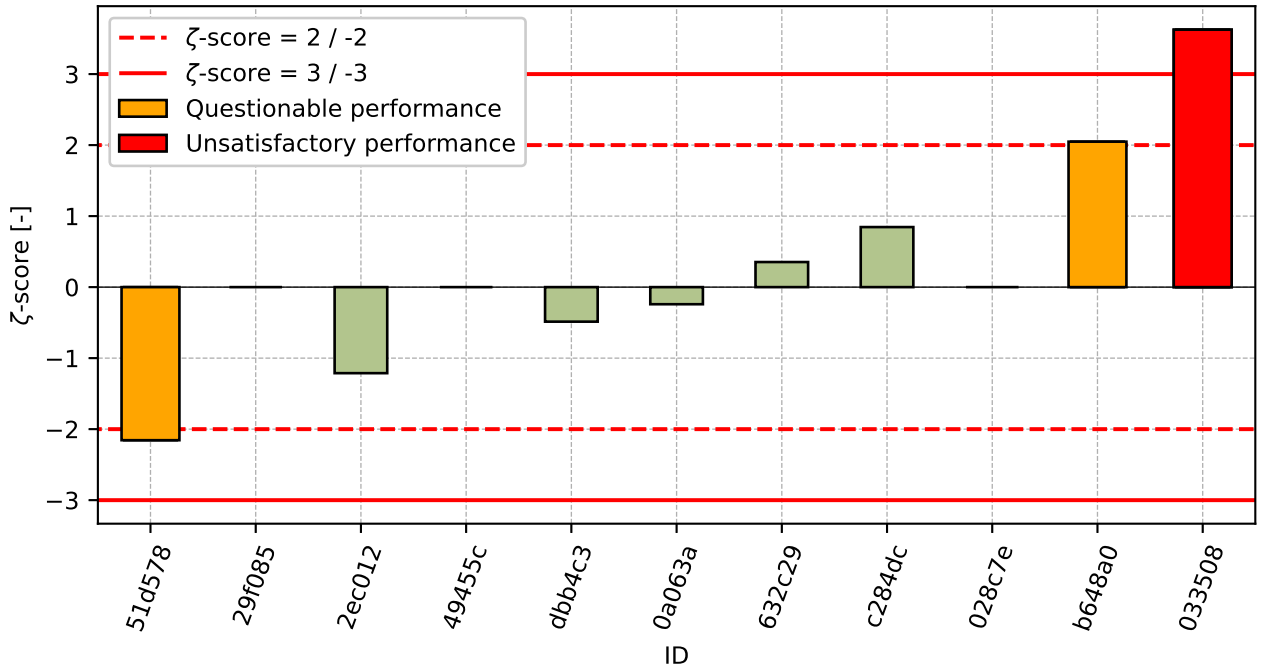

Figure 136: ζ-score

Table 46: *z*-score and ζ-score

ID	*z*-score [-]	ζ-score [-]
51d578	-3.92	-2.16
29f085	-1.25	-
2ec012	-0.66	-1.21
49455c	-0.49	-
dbb4c3	-0.2	-0.49
0a063a	-0.12	-0.24
632c29	0.23	0.35
c284dc	0.44	0.85
028c7e	0.88	-
b648a0	1.04	2.05
033508	1.51	3.63

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 [%]
033508	41.6	41.4	41.7	2.9	41.6	0.15	0.37
b648a0	43.6	43.0	42.9	0.3	43.2	0.38	0.88
49455c	45.7	-	-	-	45.7	0.0	0.0
c284dc	47.0	46.0	45.0	0.6	46.0	1.0	2.17
0a063a	45.9	46.2	45.9	0.4	46.0	0.17	0.38
dbb4c3	46.1	46.3	46.3	0.2	46.2	0.12	0.25
028c7e	46.8	49.3	47.4	-	47.8	1.31	2.73
29f085	50.1	50.3	50.3	-	50.2	0.12	0.23
51d578	55.0	55.0	55.0	-	55.0	0.0	0.0

10.2.2 The Numerical Procedure for Determining Outliers

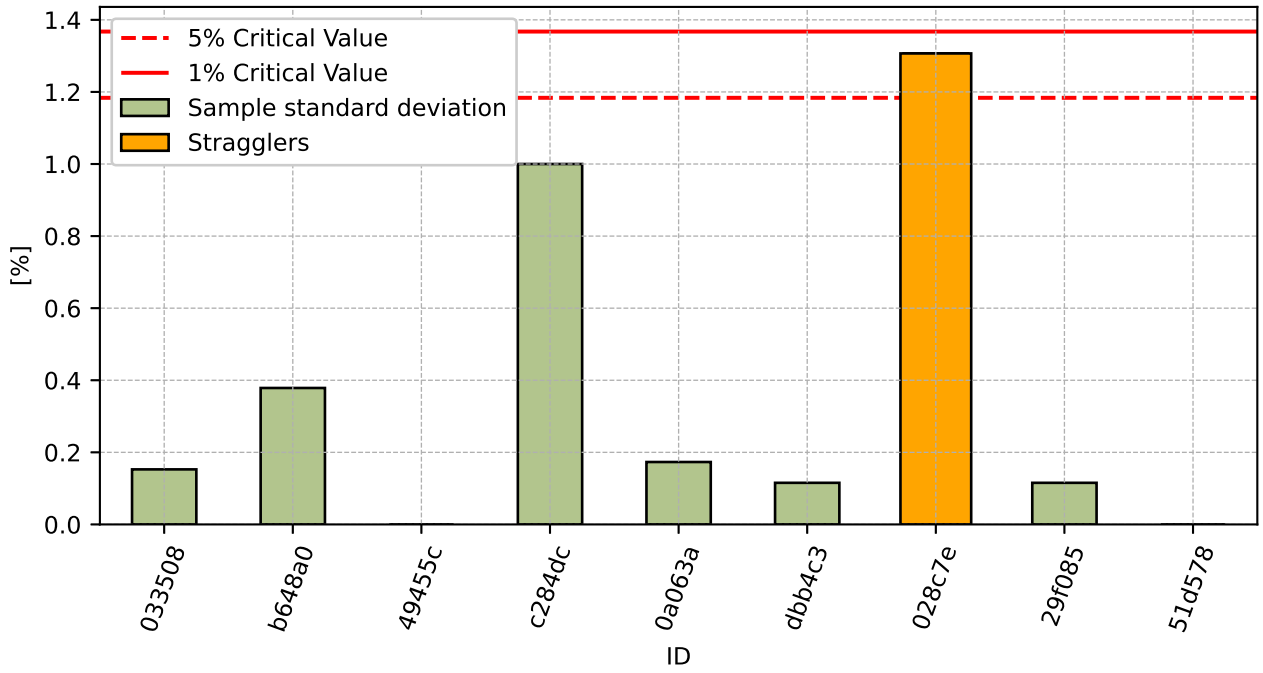

Figure 137: **Cochran's test** - sample standard deviations

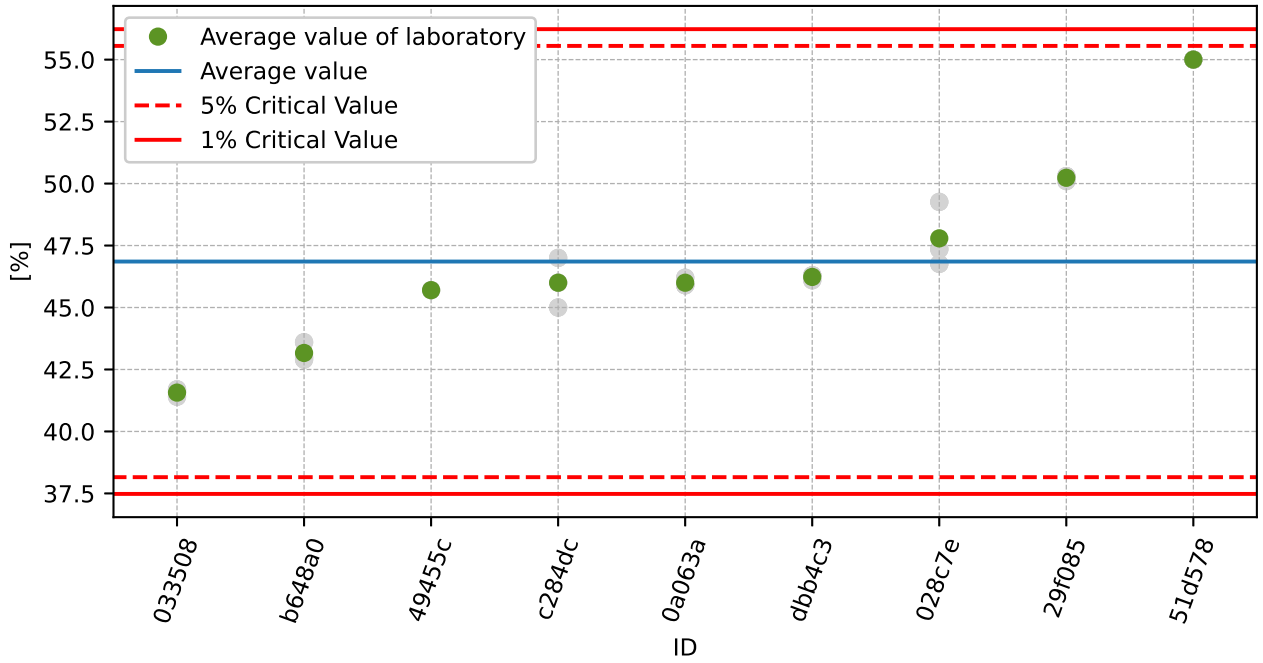

Figure 138: **Grubbs' test** - average values

10.2.3 Mandel's Statistics

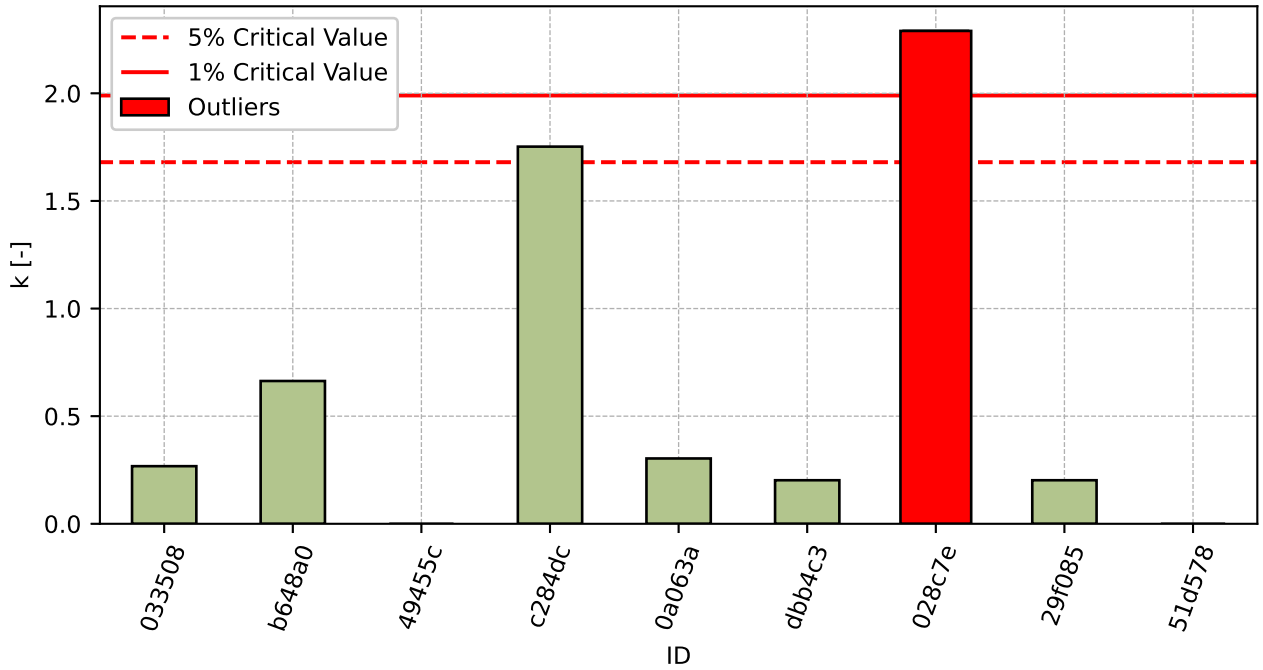

Figure 139: Intralaboratory Consistency Statistic

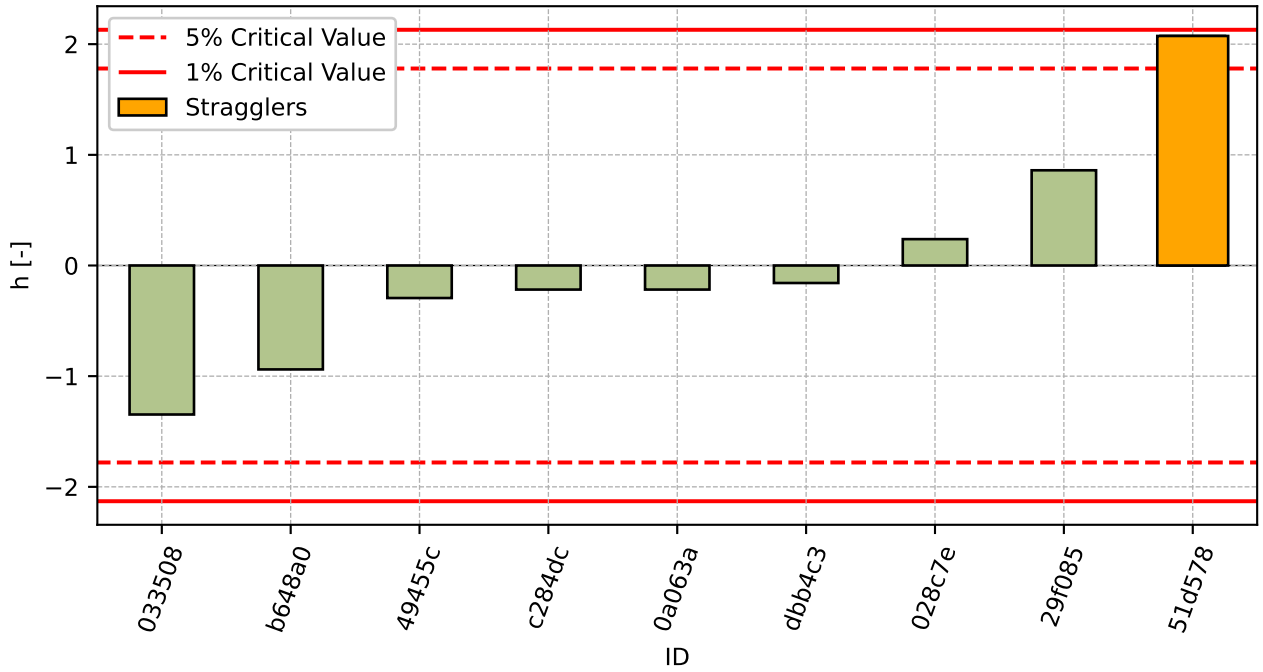

Figure 140: Interlaboratory Consistency Statistic

10.2.4 Descriptive statistics

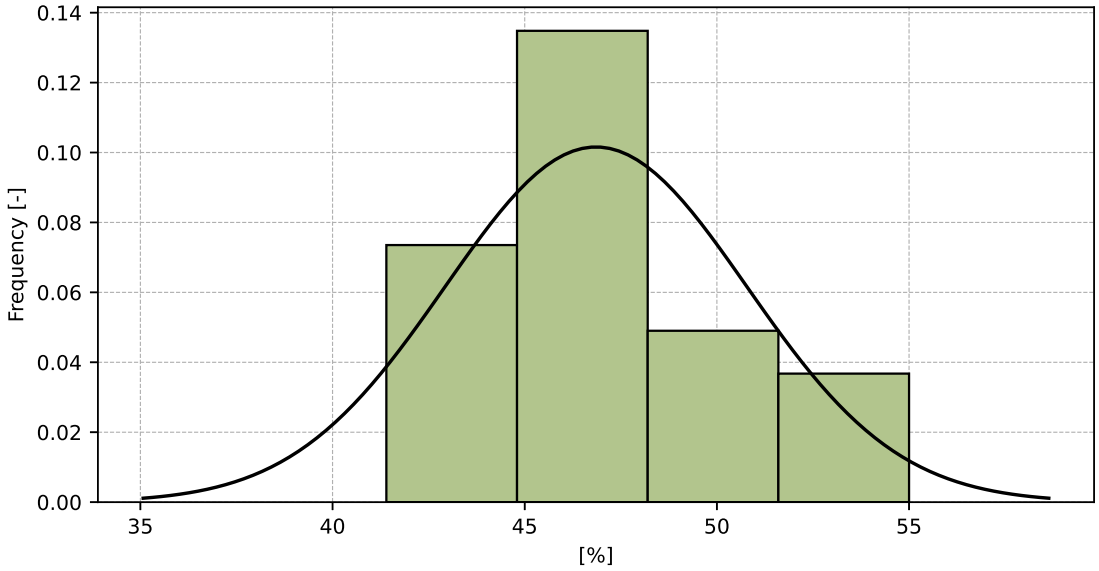

Figure 141: Histogram of all test results

Table 48: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	46.9
Sample standard deviation – s	3.93
Asigned value – x^*	46.9
Robust standard deviation – s^*	4.09
Measurement uncertainty of asigned value – u_X	1.7
p-value of normality test	0.032 [-]
Interlaboratory standard deviation – s_L	3.91
Repeatability standard deviation – s_r	0.57
Reproducibility standard deviation – s_R	3.95
Repeatability – r	1.6
Reproducibility – R	11.1

10.2.5 Evaluation of Performance Statistics

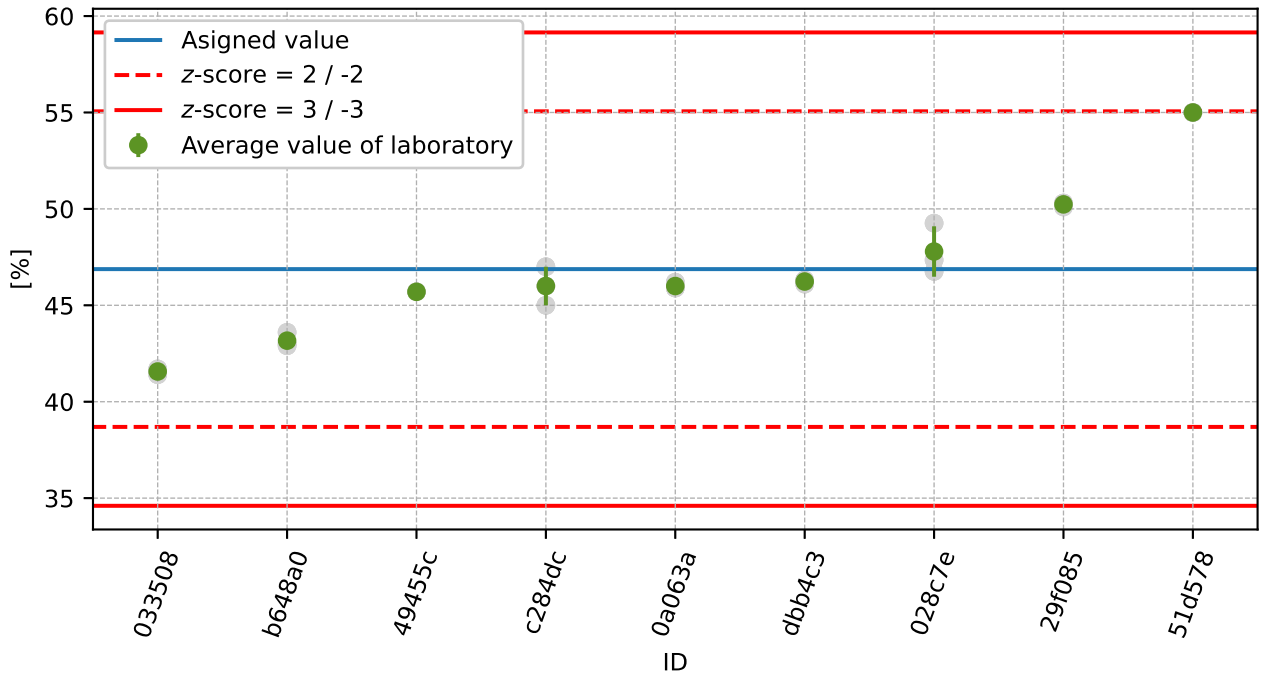

Figure 142: Average values and sample standard deviations

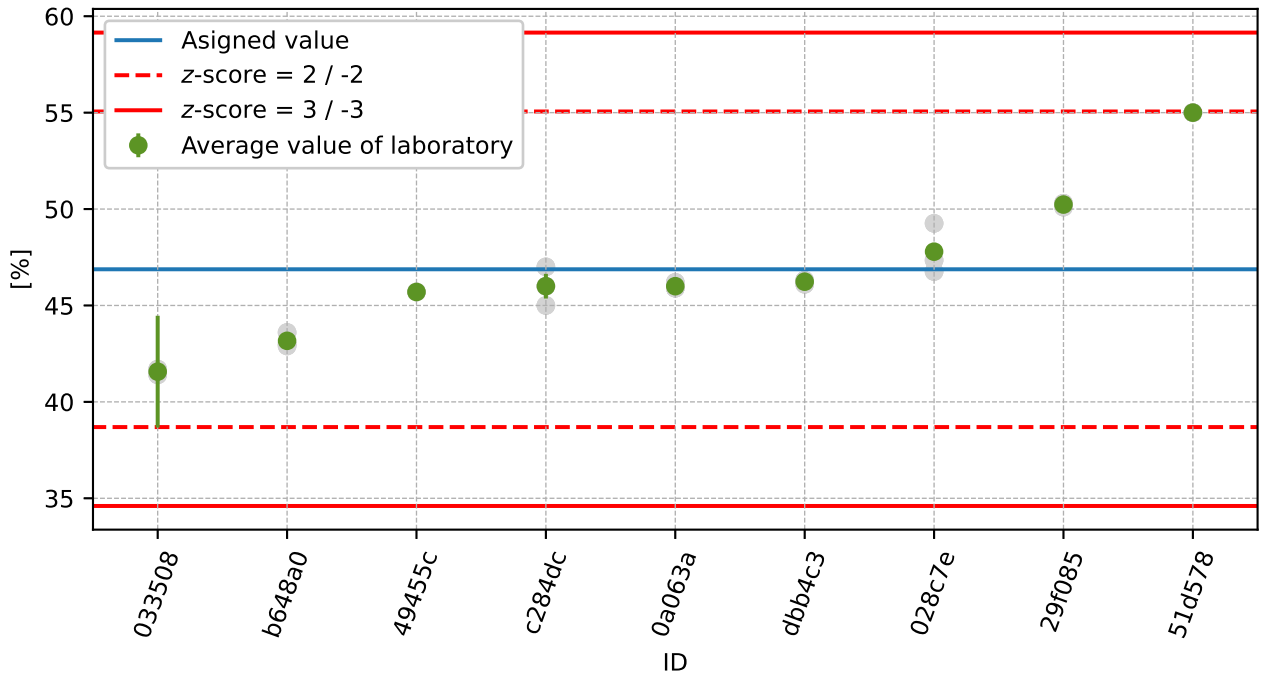

Figure 143: Average values and extended uncertainties of measurement

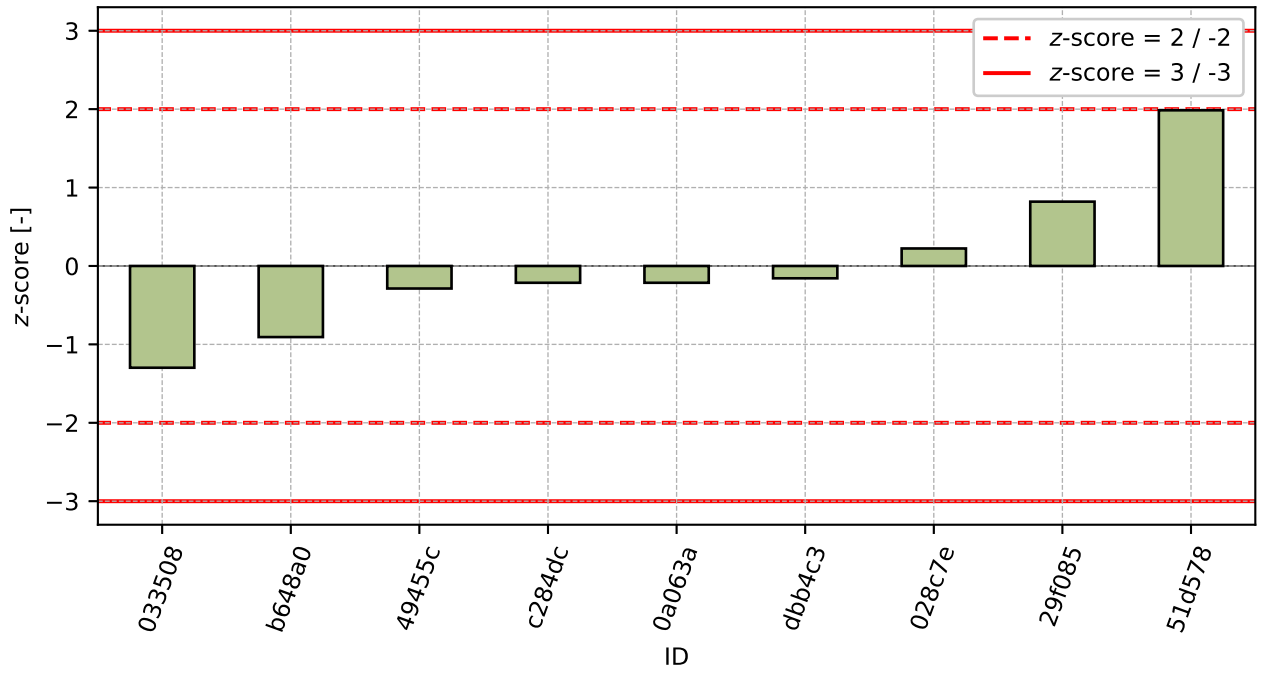

Figure 144: z-score

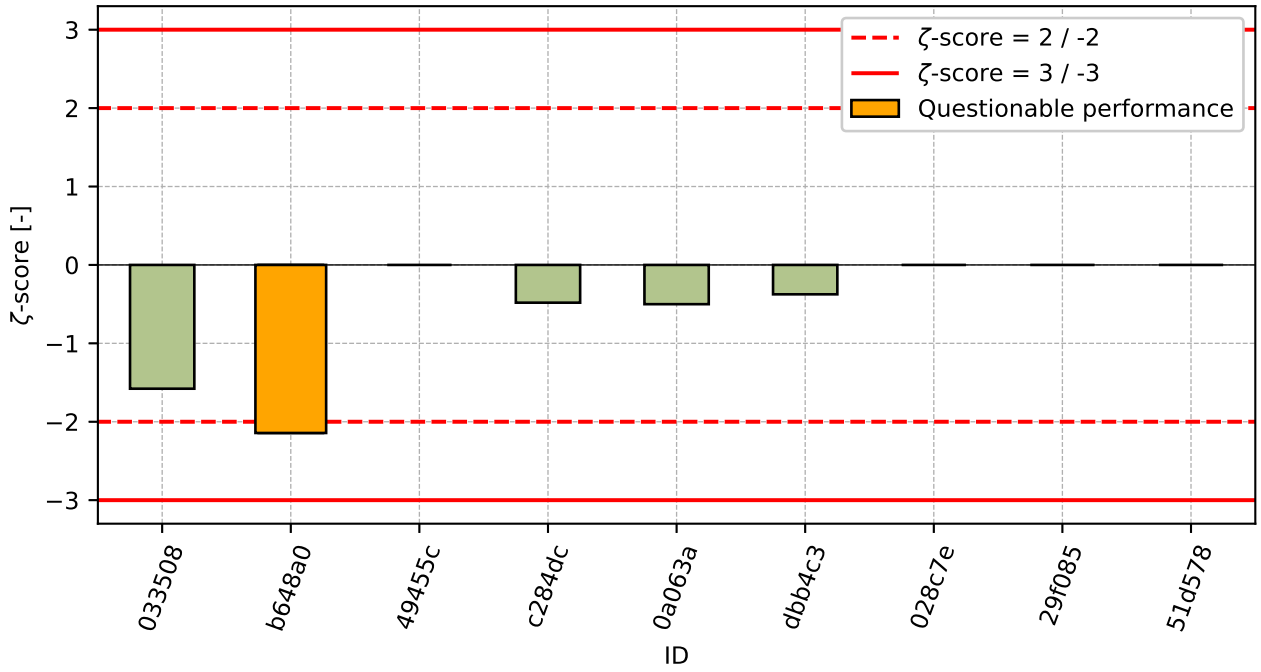

Figure 145: ζ-score

Table 49: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
033508	-1.3	-1.58
b648a0	-0.91	-2.14
49455c	-0.29	-
c284dc	-0.21	-0.48
0a063a	-0.21	-0.5
dbb4c3	-0.16	-0.37
028c7e	0.22	-
29f085	0.82	-
51d578	1.99	-

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 [%]
028c7e	6.1	6.3	6.3	-	6.2	0.1	1.64
dbb4c3	6.5	6.5	6.4	0.3	6.5	0.06	0.89
a03a0c	6.6	6.4	6.5	0.2	6.5	0.1	1.54
64222a	6.7	6.6	6.7	-	6.7	0.06	0.87
300664	6.7	6.7	6.8	0.2	6.7	0.06	0.86
0a063a	6.8	6.8	6.6	0.2	6.7	0.12	1.71
b648a0	6.7	6.8	6.8	0.2	6.8	0.06	0.85
923983	6.8	7.0	6.6	0.3	6.8	0.2	2.94
fa21fc	6.9	6.8	6.8	0.7	6.8	0.06	0.84
c284dc	6.8	6.6	7.1	0.6	6.8	0.25	3.68
46b491	6.8	6.8	6.9	0.2	6.8	0.06	0.84
f66f28	7.2	6.8	7.0	0.4	7.0	0.21	2.94
18da8e	6.7	7.2	7.0	1.4	7.0	0.25	3.61
c6c5dd	7.0	7.0	7.0	-	7.0	0.0	0.0
338553	7.1	7.0	6.9	0.3	7.0	0.1	1.43
51d578	6.9	6.9	7.3	0.1	7.0	0.23	3.28
b648c0	6.8	7.0	7.4	-	7.1	0.31	4.32
11fdb1	7.2	7.2	7.0	0.1	7.1	0.13	1.83
632c29	7.1	7.3	7.1	0.4	7.2	0.12	1.61
6f53c5	7.2	7.1	7.2	0.3	7.2	0.06	0.81
fd6a2c	7.4	7.3	7.1	0.2	7.3	0.15	2.1
771a16	7.2	7.3	7.3	0.5	7.3	0.06	0.79
2ec012	7.2	7.3	7.4	0.1	7.3	0.1	1.37
29f085	7.3	7.4	7.4	-	7.4	0.05	0.62
af953e	7.3	7.6	7.4	0.2	7.4	0.15	2.05

11.2 The Numerical Procedure for Determining Outliers

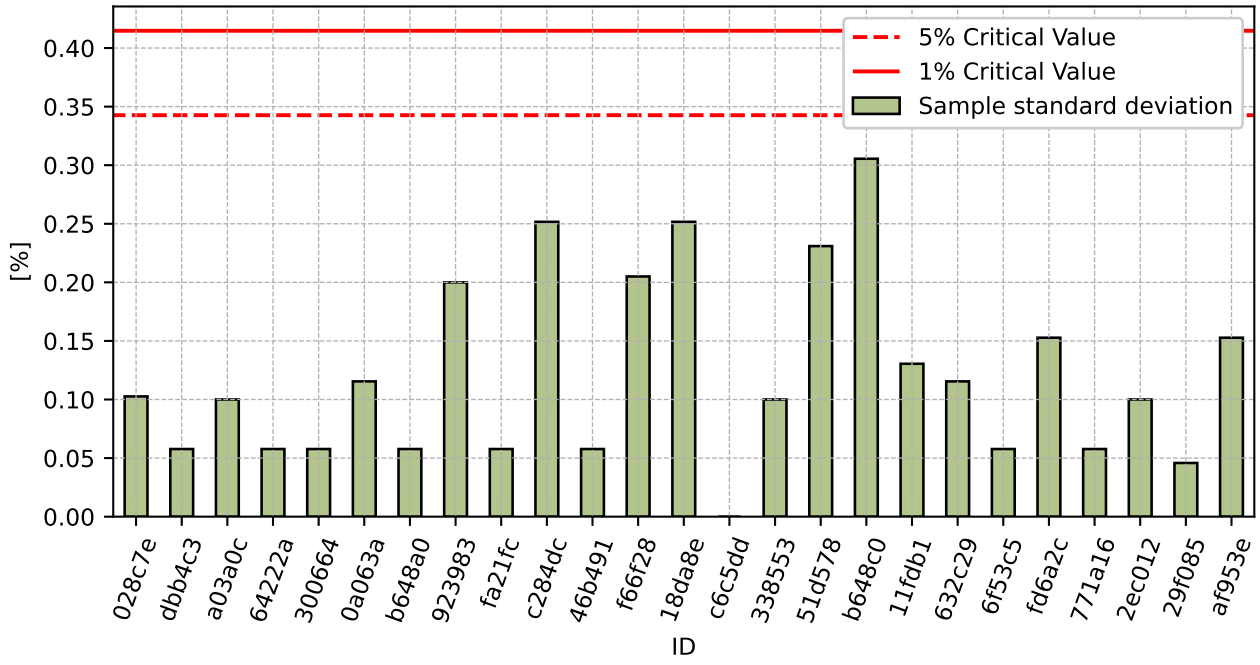

Figure 146: **Cochran's test** - sample standard deviations

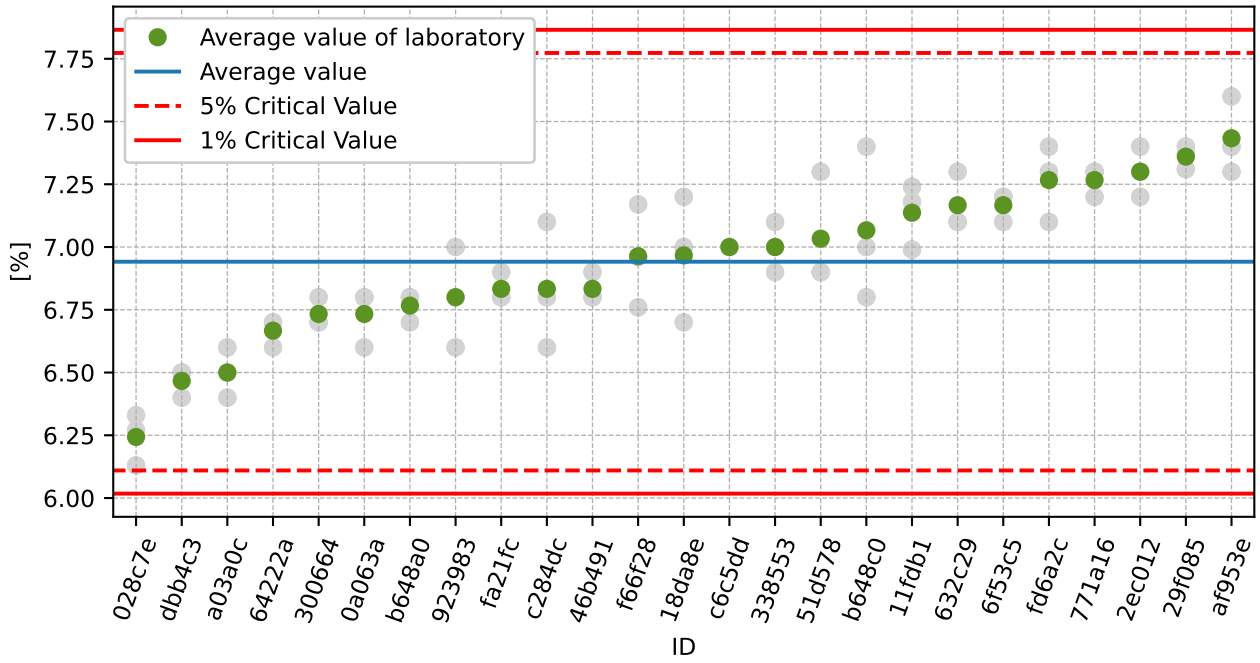

Figure 147: **Grubbs' test** - average values

11.3 Mandel's Statistics

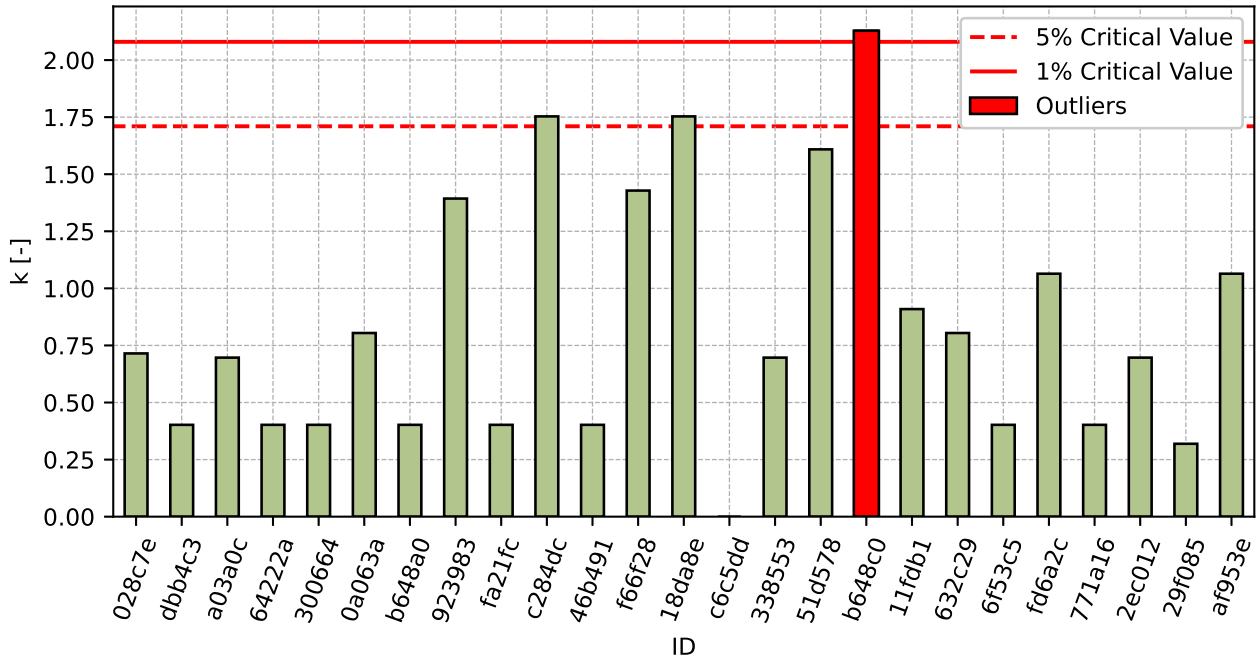

Figure 148: Intralaboratory Consistency Statistic

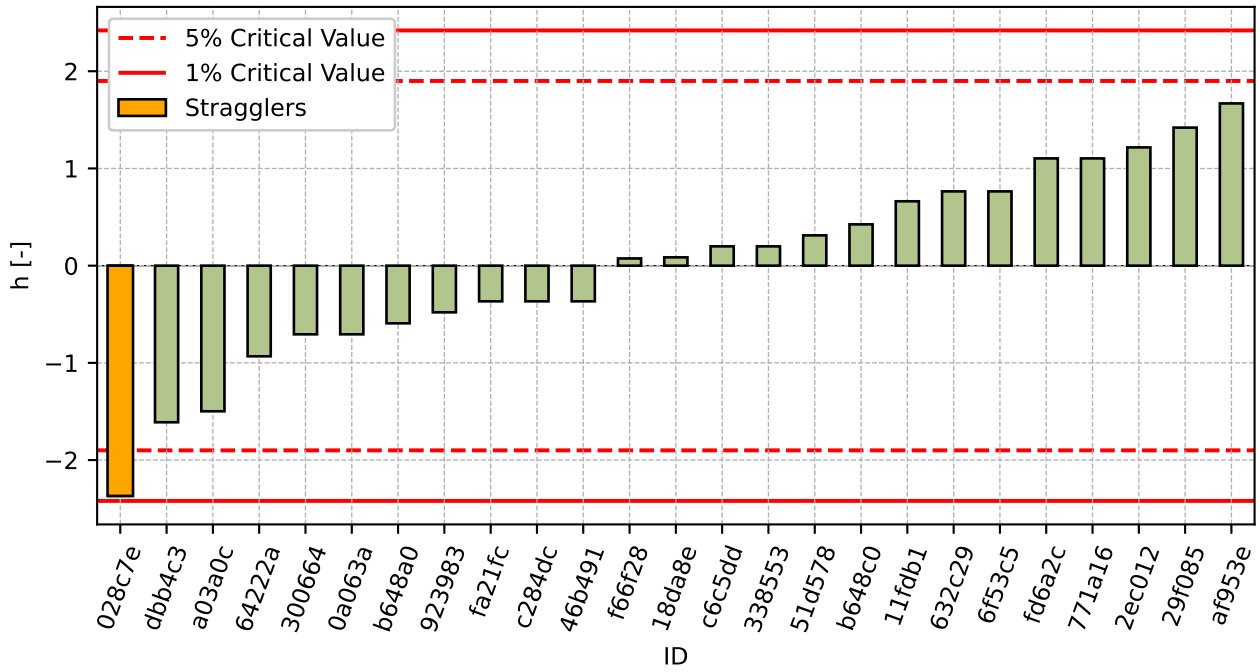

Figure 149: Interlaboratory Consistency Statistic

11.4 Descriptive statistics

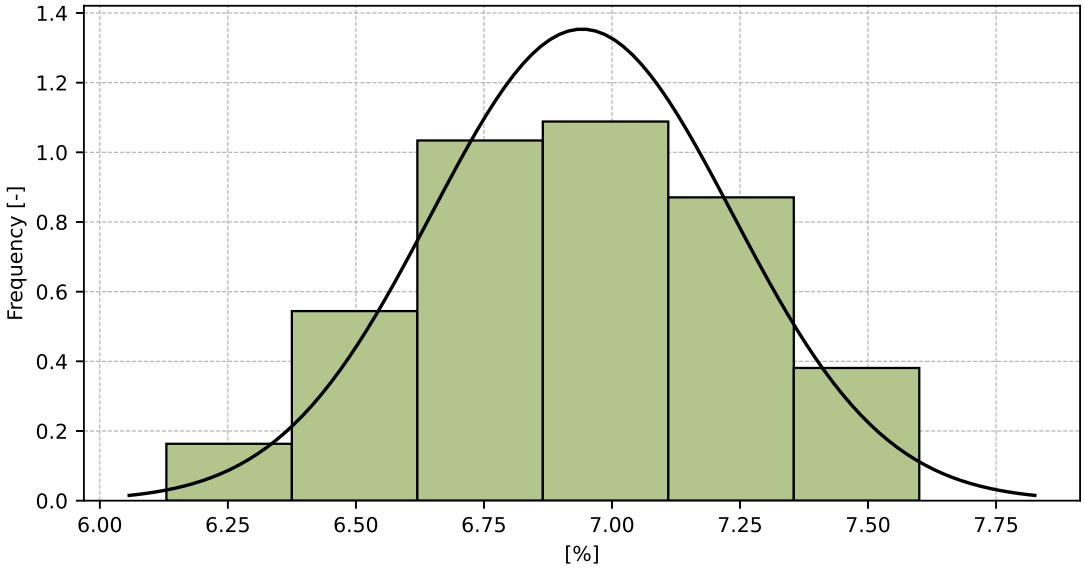

Figure 150: Histogram of all test results

Table 51: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	6.9
Sample standard deviation – s	0.29
Asigned value – x^*	7.0
Robust standard deviation – s^*	0.3
Measurement uncertainty of asigned value – u_X	0.07
p-value of normality test	0.175 [-]
Interlaboratory standard deviation – s_L	0.28
Repeatability standard deviation – s_r	0.14
Reproducibility standard deviation – s_R	0.32
Repeatability – r	0.4
Reproducibility – R	0.9

11.5 Evaluation of Performance Statistics

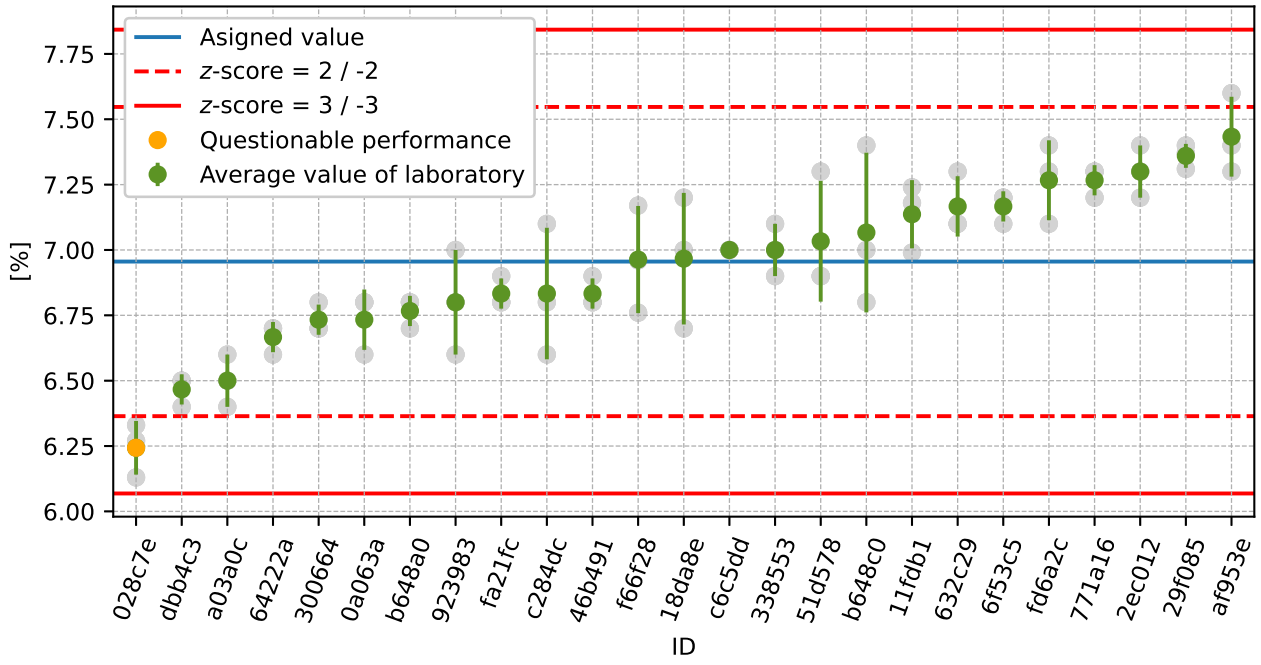

Figure 151: Average values and sample standard deviations

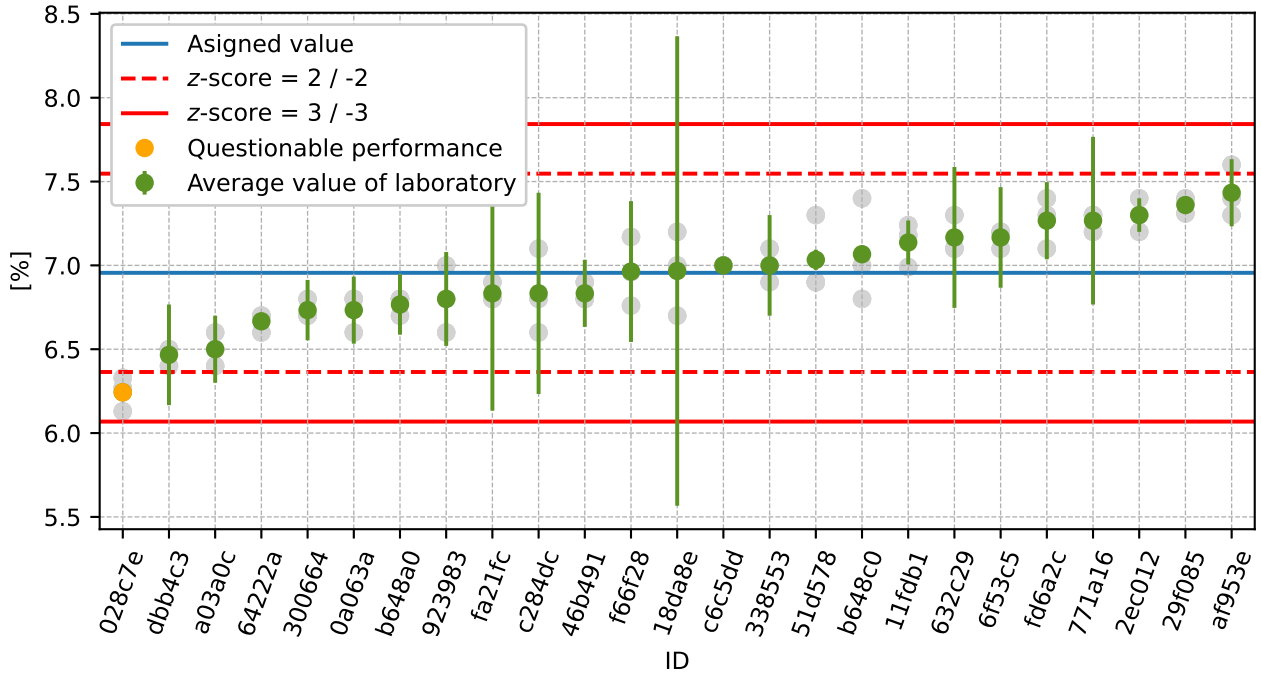

Figure 152: Average values and extended uncertainties of measurement

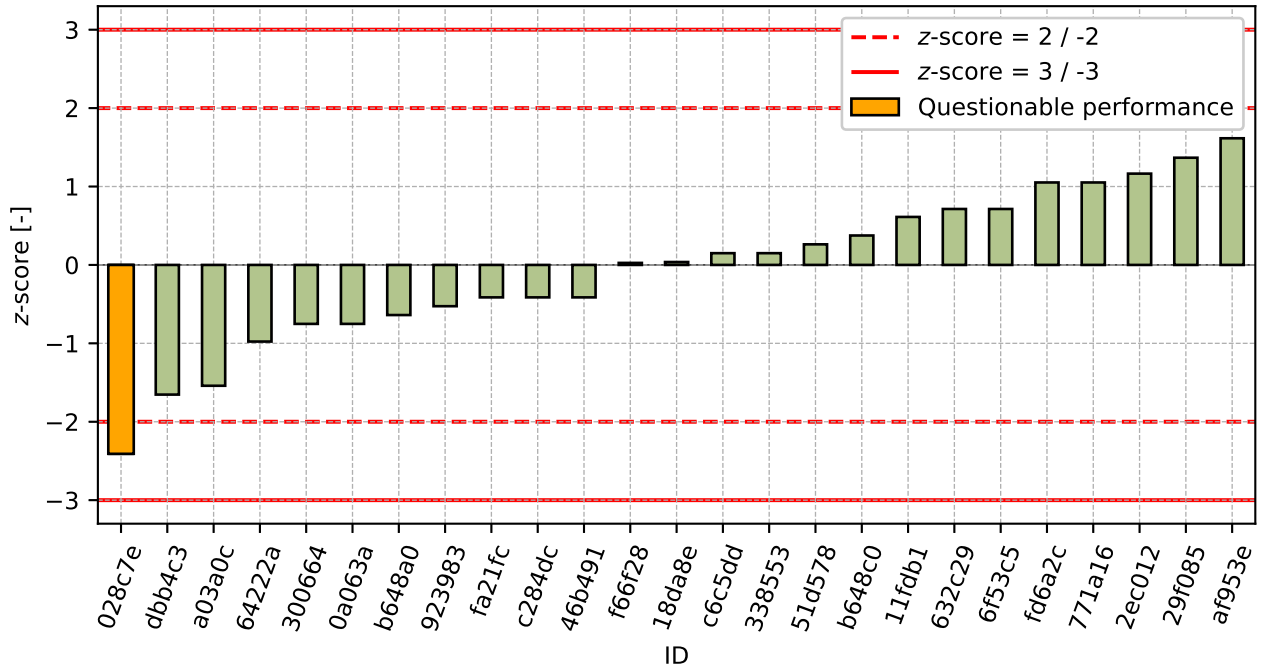

Figure 153: z-score

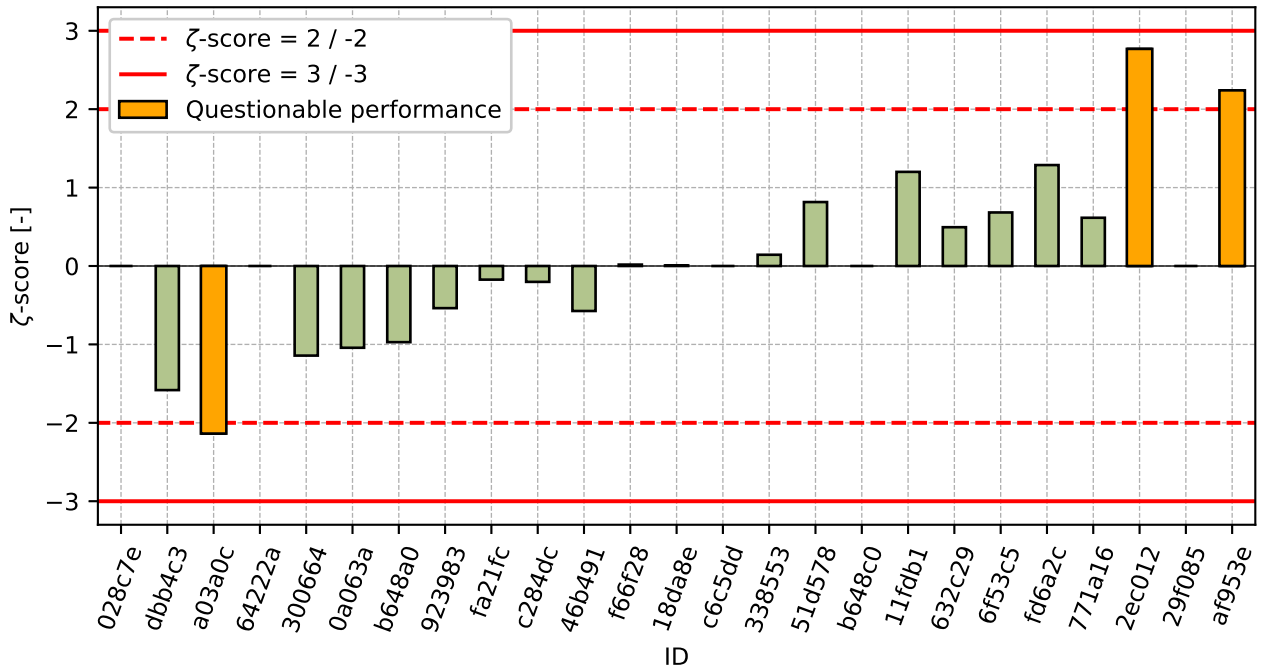

Figure 154: ζ-score

Table 52: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
028c7e	-2.41	-
dbb4c3	-1.65	-1.58
a03a0c	-1.54	-2.14
64222a	-0.98	-
300664	-0.75	-1.14
0a063a	-0.75	-1.04
b648a0	-0.64	-0.97
923983	-0.53	-0.54
fa21fc	-0.41	-0.17
c284dc	-0.41	-0.2
46b491	-0.41	-0.57
f66f28	0.03	0.02
18da8e	0.04	0.01
c6c5dd	0.15	-
338553	0.15	0.14
51d578	0.26	0.82
b648c0	0.38	-
11fdb1	0.61	1.2
632c29	0.71	0.49
6f53c5	0.71	0.68
fd6a2c	1.05	1.29
771a16	1.05	0.62
2ec012	1.16	2.77
29f085	1.37	-
af953e	1.62	2.24

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 [%]
645c7c	2.63	2.63	2.62	0.0	2.63	0.006	0.22
0214a2	2.62	2.63	2.63	0.03	2.63	0.006	0.22
ae8d08	2.63	2.63	2.63	0.03	2.63	0.0	0.0
51d578	2.62	2.64	2.65	0.01	2.64	0.015	0.58
e9a477	2.64	2.65	2.64	0.03	2.64	0.006	0.22
632c29	2.64	2.66	2.64	0.01	2.65	0.012	0.44
4787b2	2.65	2.65	2.65	0.08	2.65	0.0	0.0
dd3919	2.65	2.66	2.65	0.1	2.65	0.006	0.21
4639b4	2.67	2.66	2.65	0.03	2.66	0.01	0.38
046607	2.66	2.66	2.66	-	2.66	0.0	0.0
eec547	2.66	2.66	2.67	0.22	2.66	0.006	0.22
338553	2.66	2.67	2.66	0.1	2.66	0.006	0.22
9ada5d	2.66	2.67	2.66	0.08	2.66	0.002	0.06
028c7e	2.68	2.63	2.69	-	2.67	0.03	1.14
fd6a2c	2.66	2.67	2.67	0.07	2.67	0.006	0.22
771a16	2.67	2.67	2.66	0.06	2.67	0.006	0.22
ba5283	2.66	2.67	2.67	0.01	2.67	0.006	0.22
64222a	2.67	2.67	2.67	-	2.67	0.0	0.0
a0ffe0	2.67	2.67	2.67	0.01	2.67	0.0	0.0
170637	2.67	2.68	2.67	0.1	2.67	0.006	0.22
af953e	2.68	2.67	2.68	0.01	2.68	0.006	0.22
5fdea4	2.68	2.67	2.68	0.11	2.68	0.006	0.22
02e7a9	2.68	2.68	2.67	0.02	2.68	0.006	0.22
29f085	2.69	2.68	2.68	-	2.68	0.004	0.16
79f92f	2.69	2.69	2.69	0.02	2.69	0.0	0.0
0a063a	2.67	2.67	2.78	0.06	2.71	0.064	2.35
362270	2.76	2.76	2.75	0.04	2.76	0.006	0.21

12.1.2 The Numerical Procedure for Determining Outliers

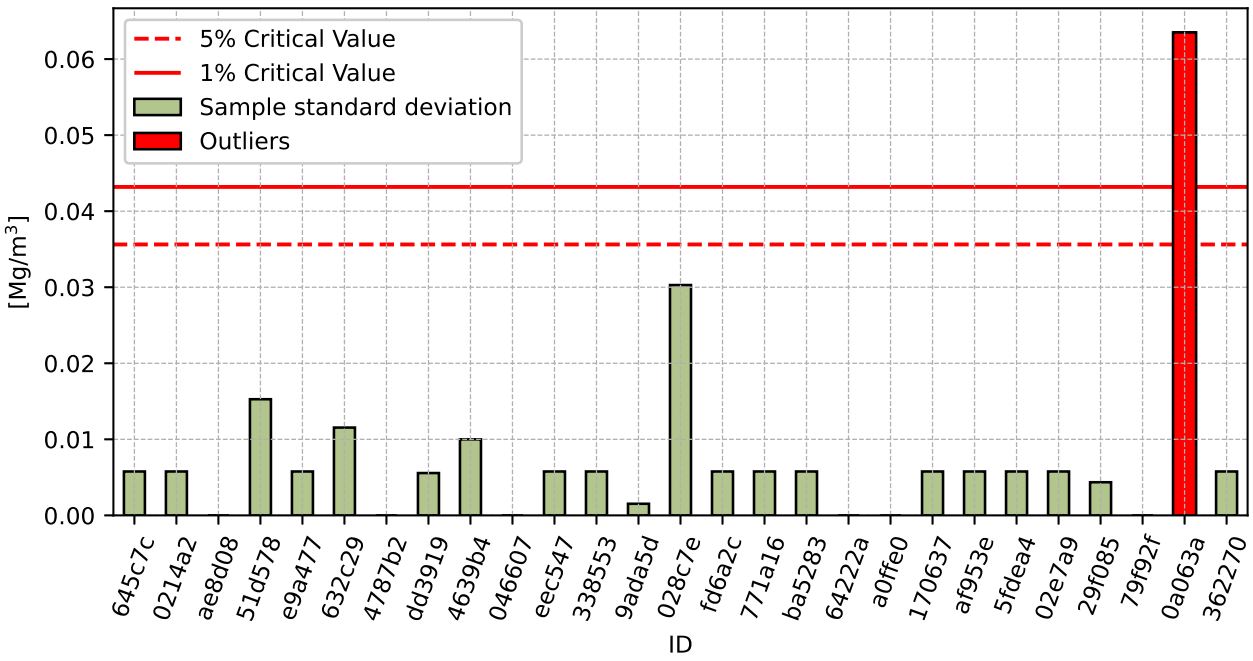

Figure 155: **Cochran's test** - sample standard deviations

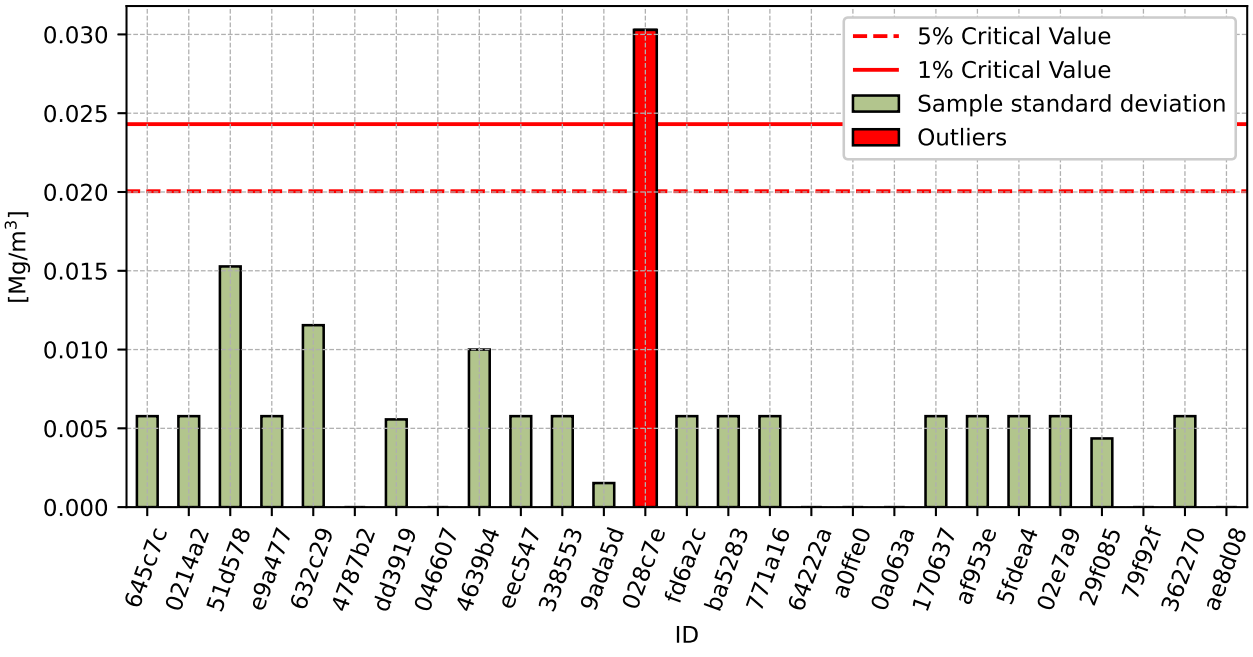

Figure 156: **Cochran's test** - sample standard deviations without outliers

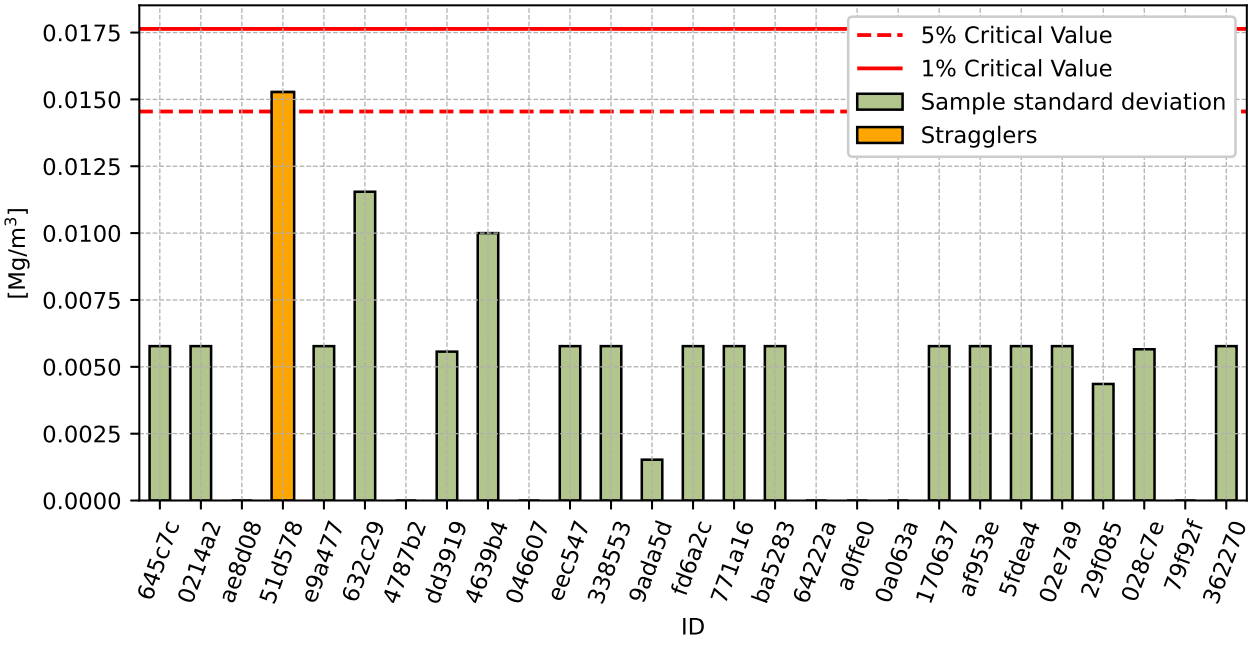

Figure 157: **Cochran's test** - sample standard deviations without outliers

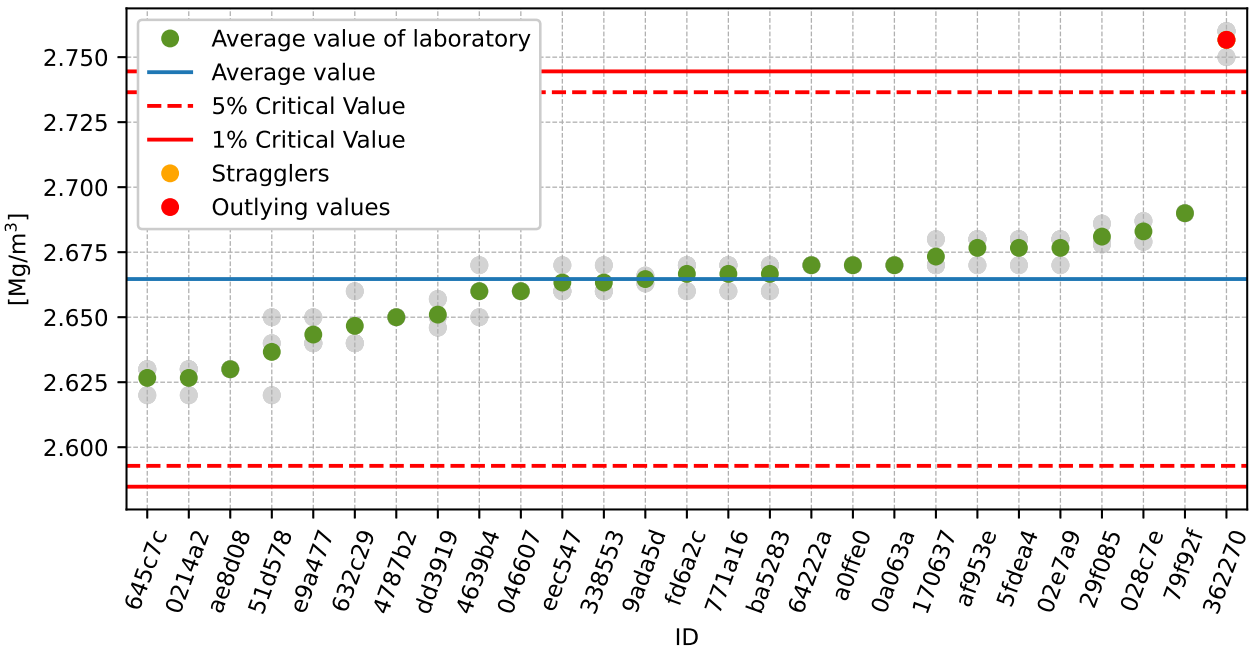

Figure 158: **Grubbs' test** - average values

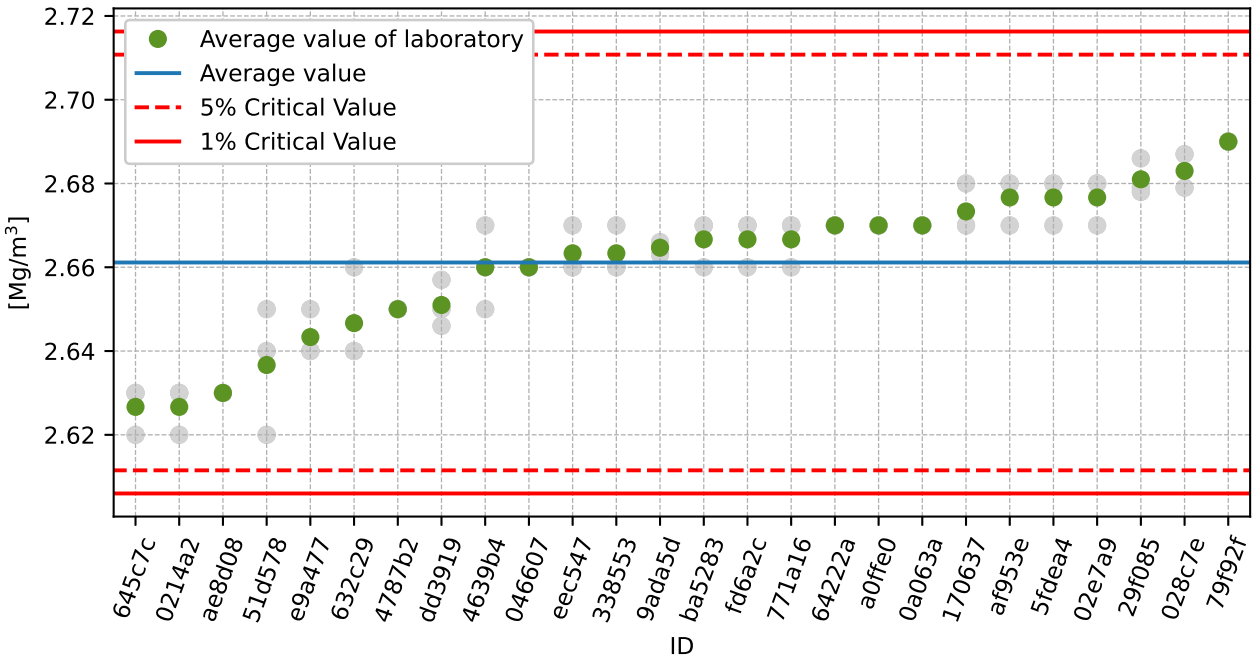

Figure 159: **Grubbs' test** - average values without outliers

12.1.3 Mandel's Statistics

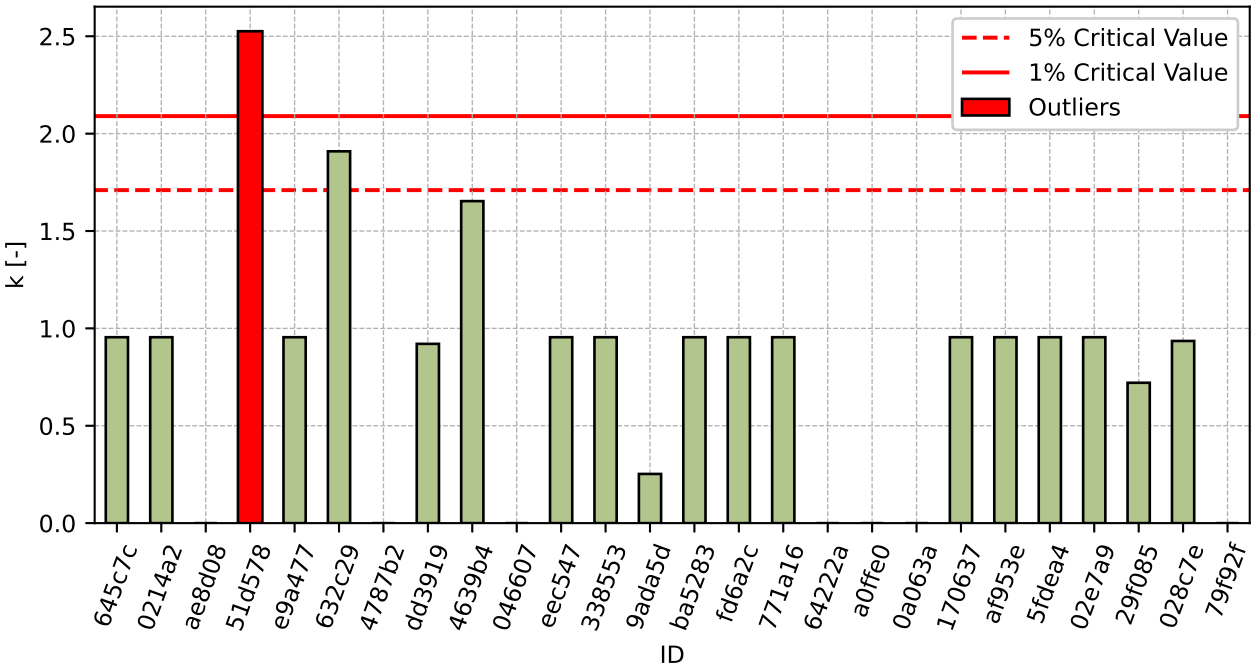

Figure 160: Intralaboratory Consistency Statistic

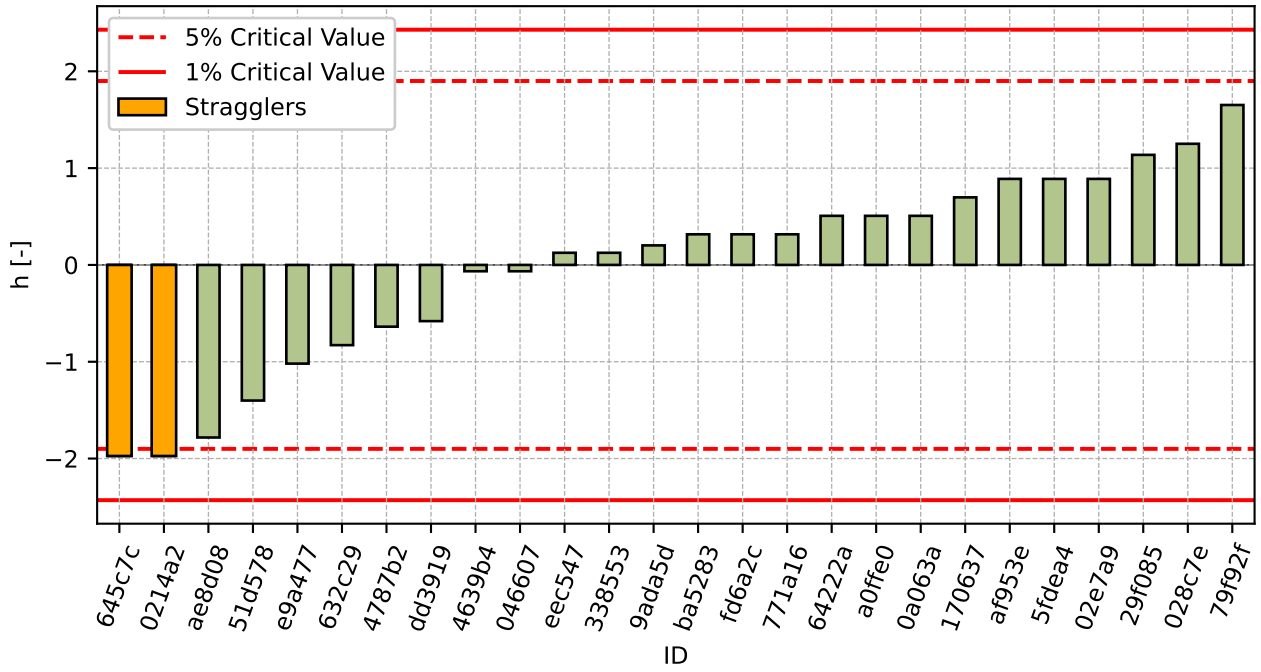

Figure 161: Interlaboratory Consistency Statistic

12.1.4 Descriptive statistics

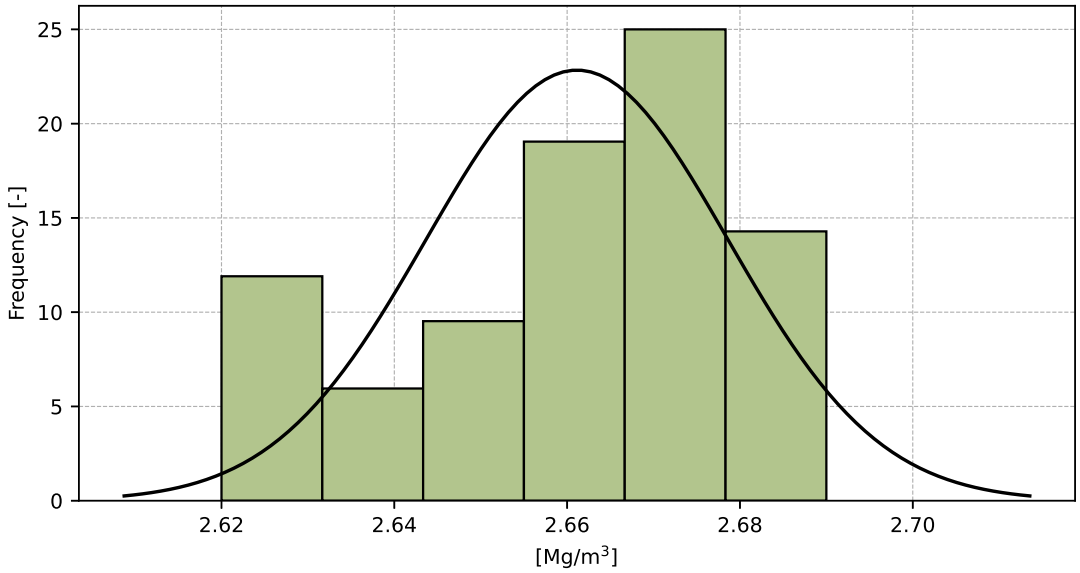

Figure 162: Histogram of all test results

Table 54: Descriptive statistics

Characteristics	[Mg/m³]
Average value – $\bar{x}$	2.66
Sample standard deviation – s	0.017
Asigned value – x^*	2.66
Robust standard deviation – s^*	0.019
Measurement uncertainty of asigned value – u_X	0.004
p-value of normality test	0.001 [-]
Interlaboratory standard deviation – s_L	0.017
Repeatability standard deviation – s_r	0.006
Reproducibility standard deviation – s_R	0.018
Repeatability – r	0.02
Reproducibility – R	0.05

12.1.5 Evaluation of Performance Statistics

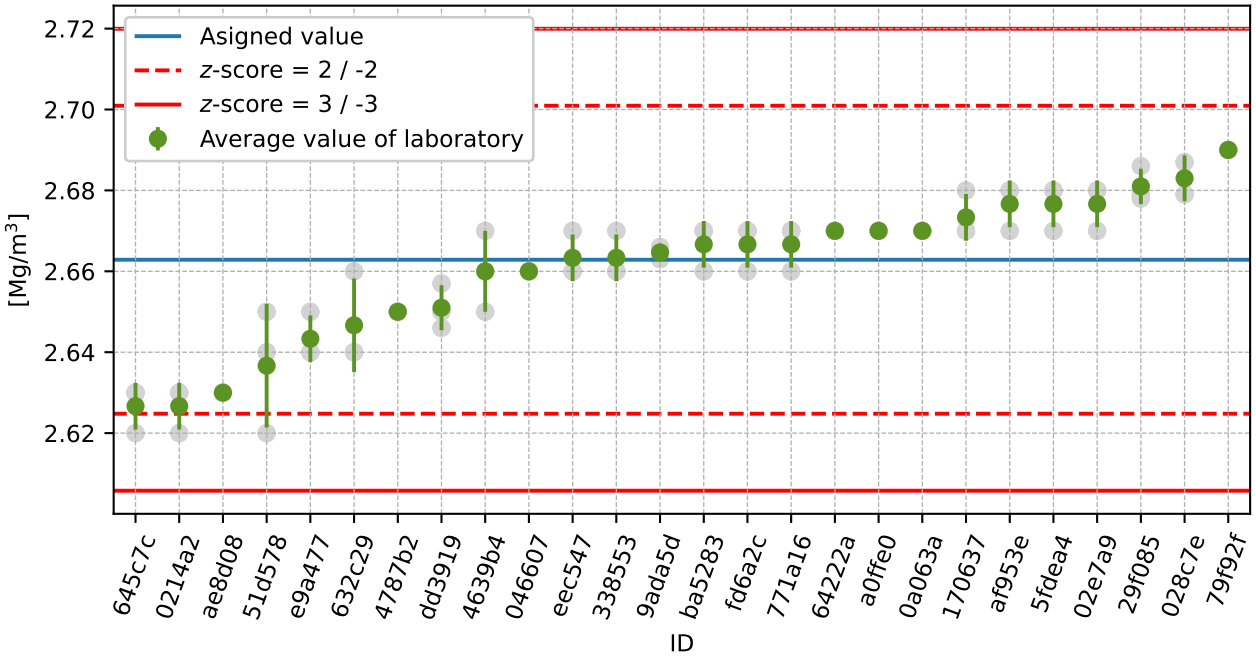

Figure 163: Average values and sample standard deviations

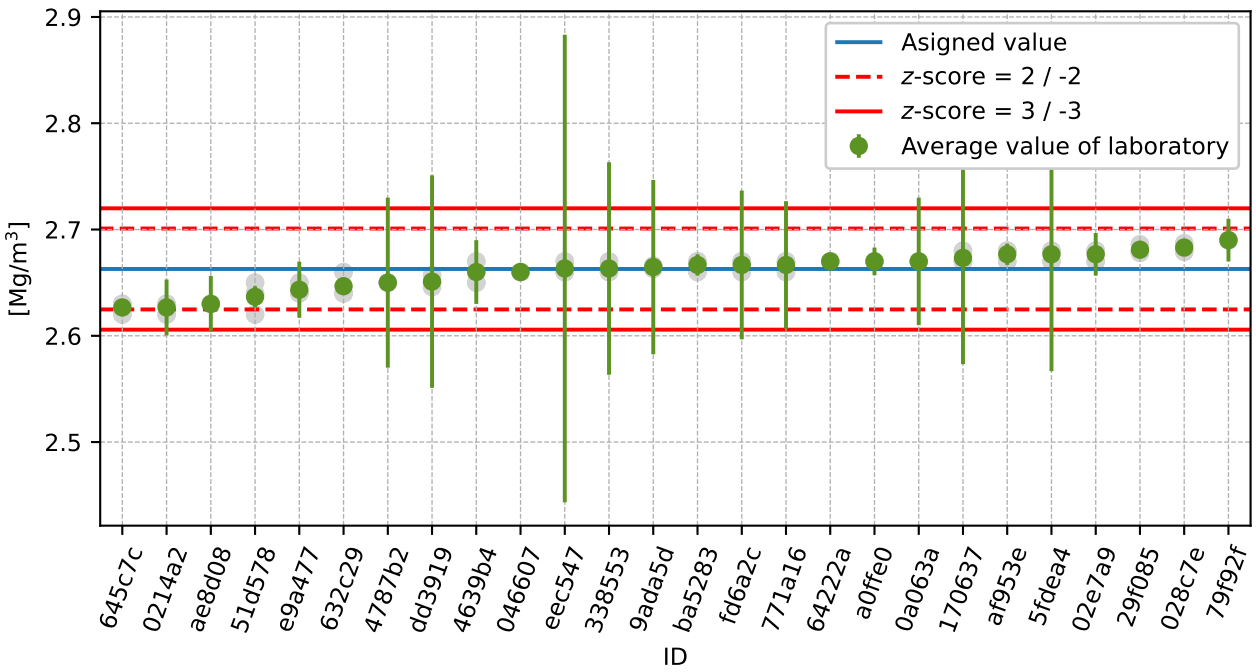

Figure 164: Average values and extended uncertainties of measurement

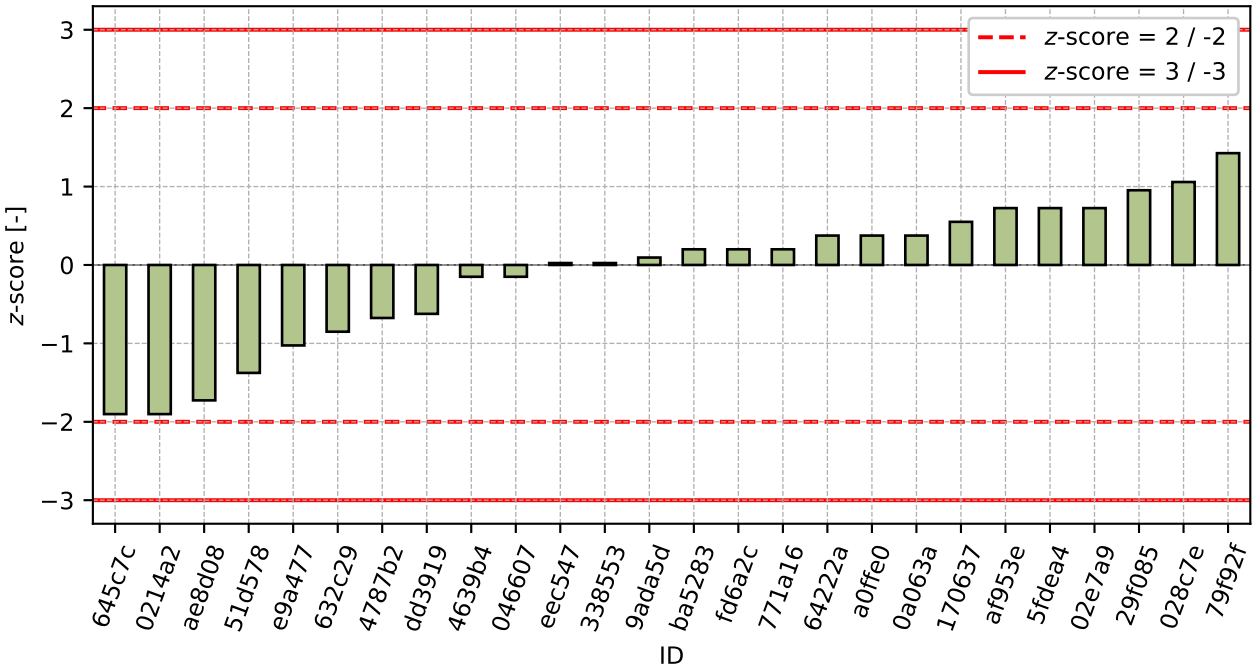

Figure 165: z-score

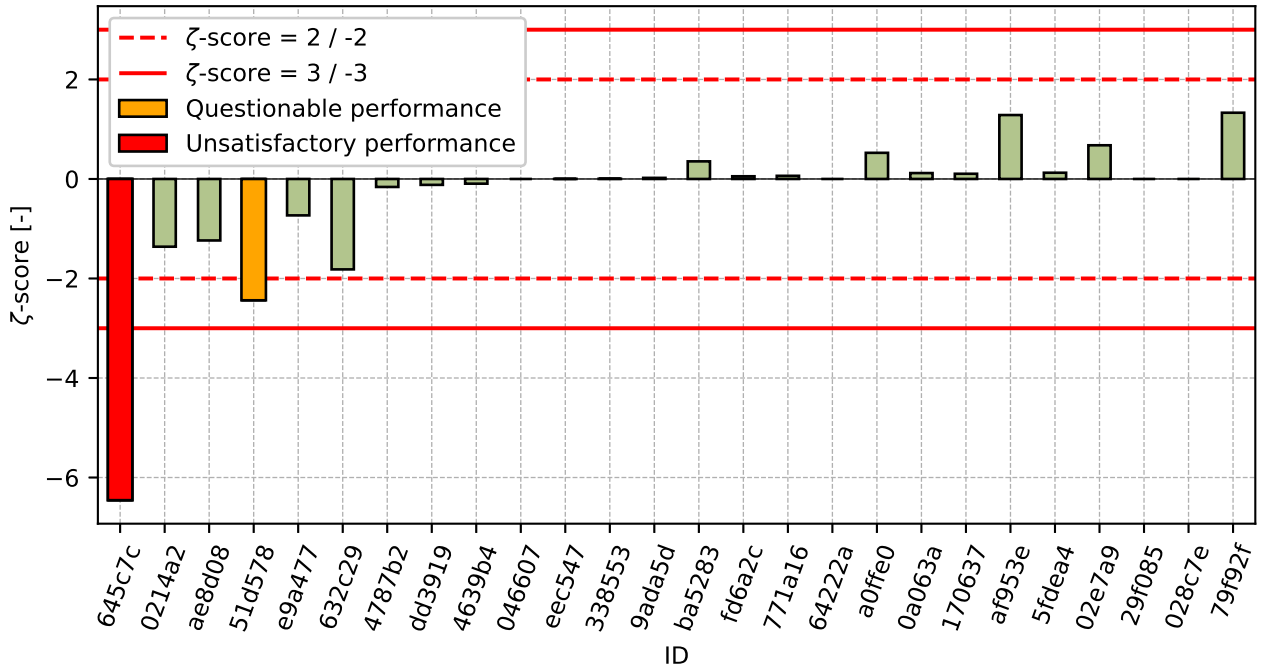

Figure 166: ζ-score

Table 55: *z*-score and ζ-score

ID	*z*-score [-]	ζ-score [-]
645c7c	-1.9	-6.46
0214a2	-1.9	-1.36
ae8d08	-1.73	-1.24
51d578	-1.38	-2.44
e9a477	-1.03	-0.73
632c29	-0.85	-1.82
4787b2	-0.68	-0.16
dd3919	-0.62	-0.12
4639b4	-0.15	-0.09
046607	-0.15	-
eec547	0.02	0.0
338553	0.02	0.0
9ada5d	0.09	0.02
ba5283	0.2	0.35
fd6a2c	0.2	0.05
771a16	0.2	0.06
64222a	0.37	-
a0ffe0	0.37	0.53
0a063a	0.37	0.12
170637	0.55	0.1
af953e	0.73	1.28
5fdea4	0.73	0.13

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ID	z-score [-]	ζ-score [-]
02e7a9	0.73	0.68
29f085	0.95	-
028c7e	1.06	-
79f92f	1.43	1.33

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 [%]
4787b2	0.2	0.2	0.2	0.0	0.2	0.0	0.0
645c7c	0.4	0.4	0.4	0.0	0.4	0.0	0.0
e9a477	0.5	0.3	0.5	0.1	0.4	0.12	26.65
eec547	0.4	0.5	0.4	0.6	0.4	0.06	13.32
79f92f	0.5	0.5	0.4	0.1	0.5	0.06	12.37
ba5283	0.5	0.6	0.4	0.3	0.5	0.1	20.0
4639b4	0.5	0.5	0.6	0.0	0.5	0.02	3.7
02e7a9	0.6	0.6	0.5	0.2	0.6	0.06	10.19
771a16	0.5	0.6	0.6	0.1	0.6	0.06	10.19
0214a2	0.6	0.6	0.6	0.1	0.6	0.0	0.0
51d578	0.5	0.7	0.6	0.1	0.6	0.1	16.67
29f085	0.6	0.6	0.6	-	0.6	0.01	1.64
ae8d08	0.6	0.6	0.6	0.0	0.6	0.02	2.41
a0ffe0	0.6	0.7	0.6	0.1	0.6	0.06	9.12
9ada5d	0.6	0.6	0.6	0.1	0.6	0.01	1.56
046607	0.7	0.7	0.6	-	0.7	0.06	8.66
64222a	0.7	0.6	0.7	-	0.7	0.06	8.66
632c29	0.7	0.8	0.7	0.1	0.7	0.06	7.87
5fdea4	0.9	0.7	0.7	0.3	0.8	0.12	15.06
af953e	0.9	0.7	0.8	0.1	0.8	0.1	12.5
170637	0.9	0.9	0.7	0.3	0.8	0.12	13.86
fd6a2c	0.8	0.9	0.8	0.1	0.8	0.06	6.93
028c7e	0.8	0.5	1.2	-	0.8	0.38	44.64
362270	0.9	0.9	1.0	0.3	0.9	0.06	6.19
338553	1.1	0.9	1.0	0.1	1.0	0.1	10.0
dd3919	1.1	1.1	1.0	0.1	1.1	0.08	7.12
0a063a	1.0	1.1	1.2	0.2	1.1	0.1	9.09

12.2.2 The Numerical Procedure for Determining Outliers

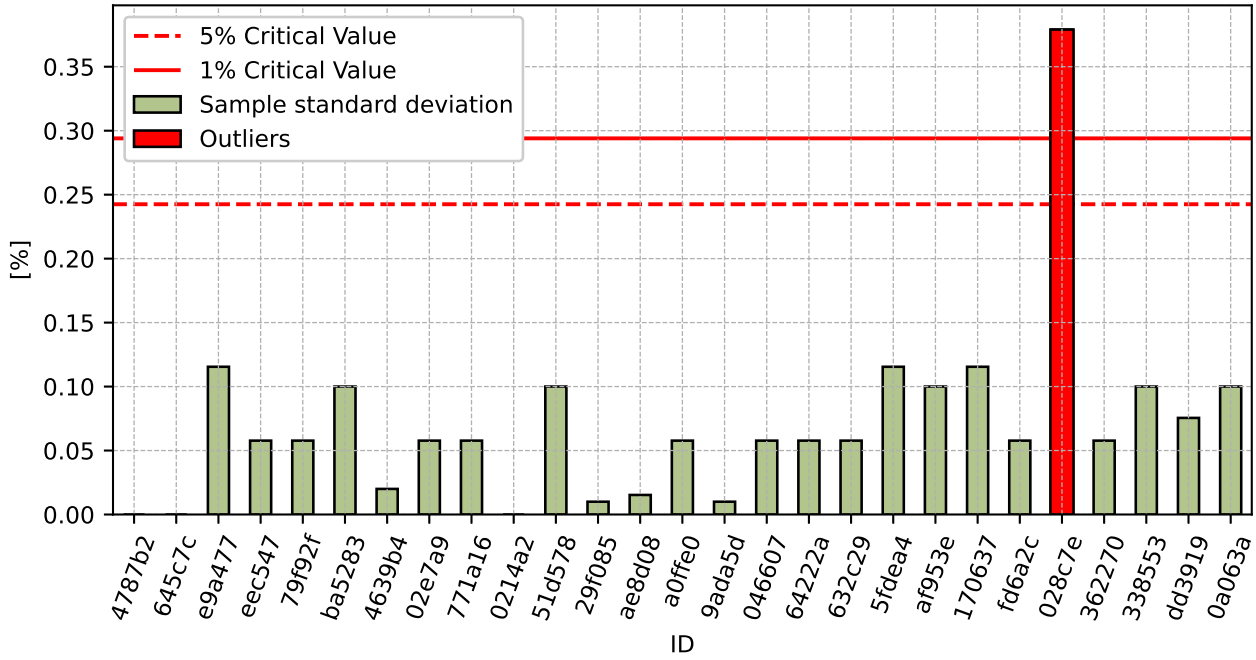

Figure 167: **Cochran's test** - sample standard deviations

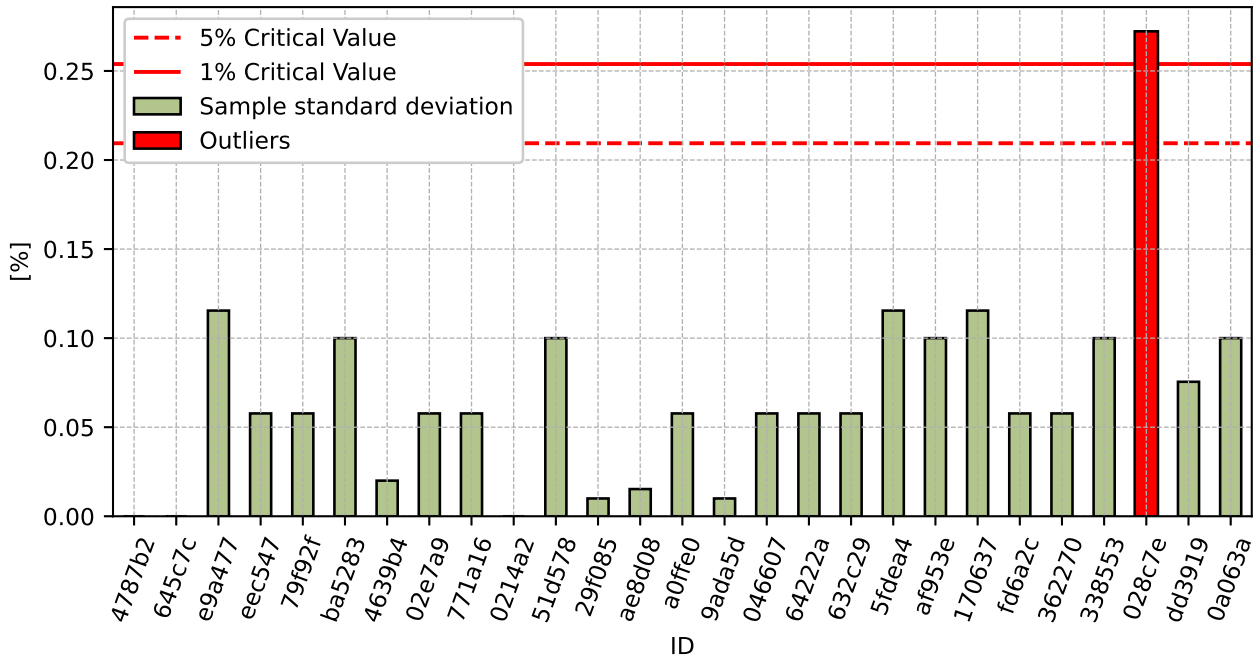

Figure 168: **Cochran's test** - sample standard deviations without outliers

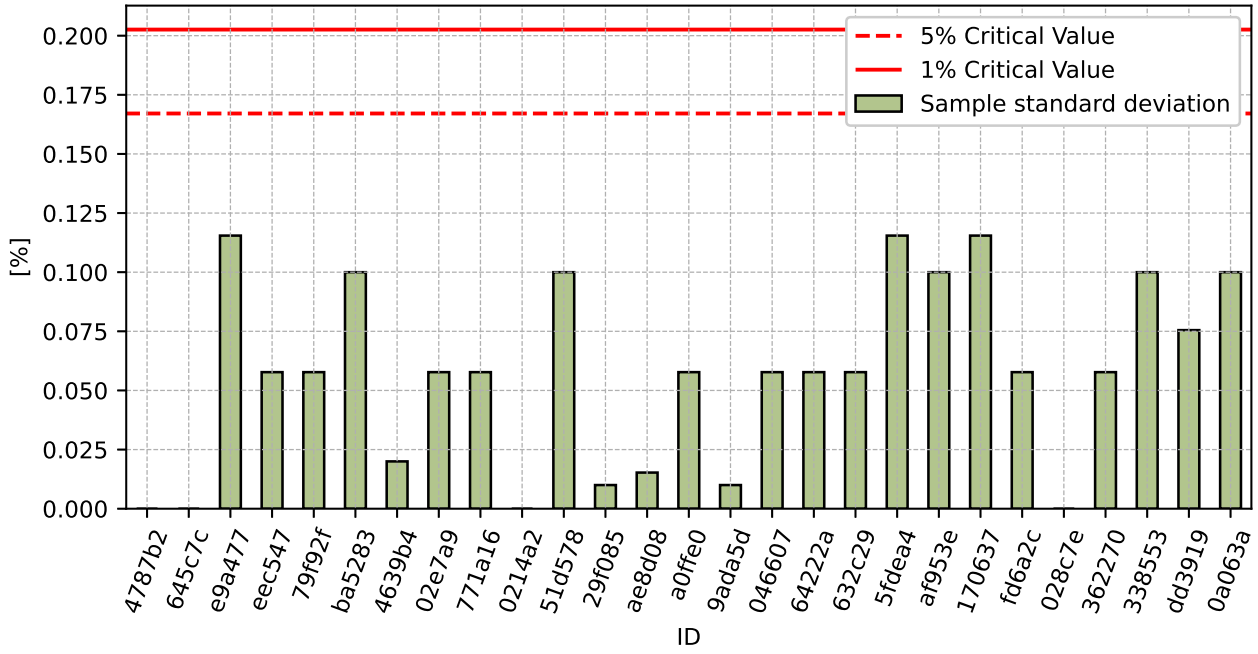

Figure 169: **Cochran's test** - sample standard deviations without outliers

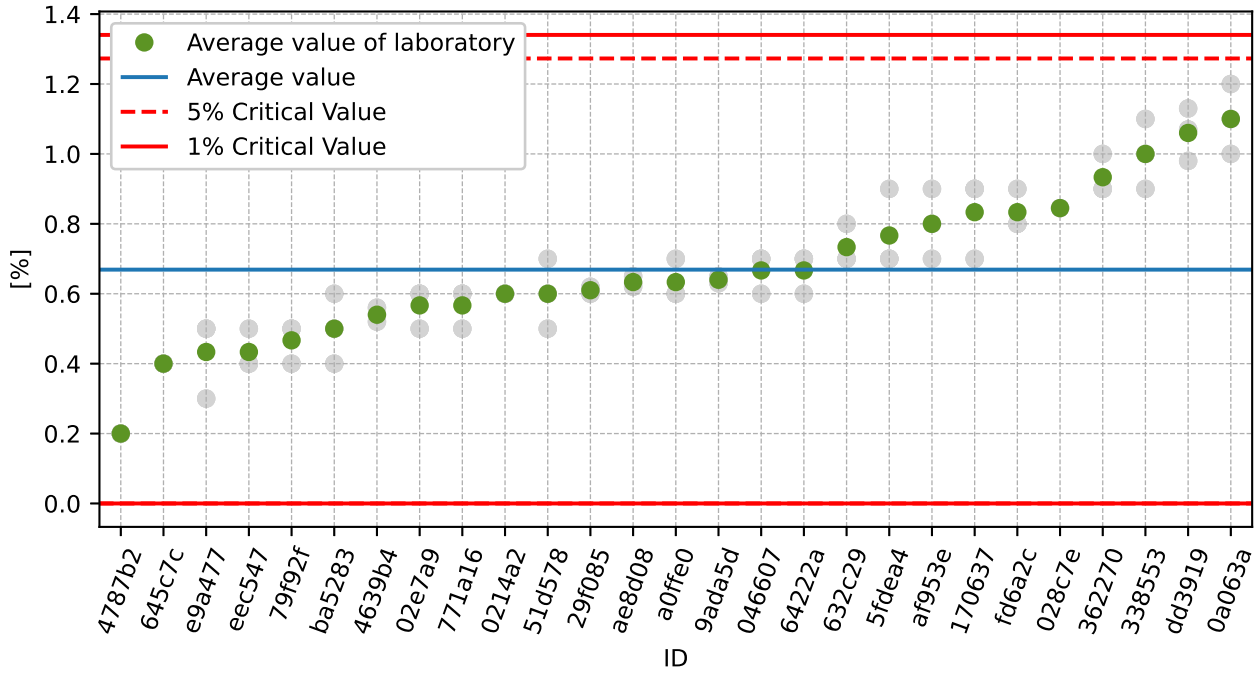

Figure 170: **Grubbs' test** - average values

12.2.3 Mandel's Statistics

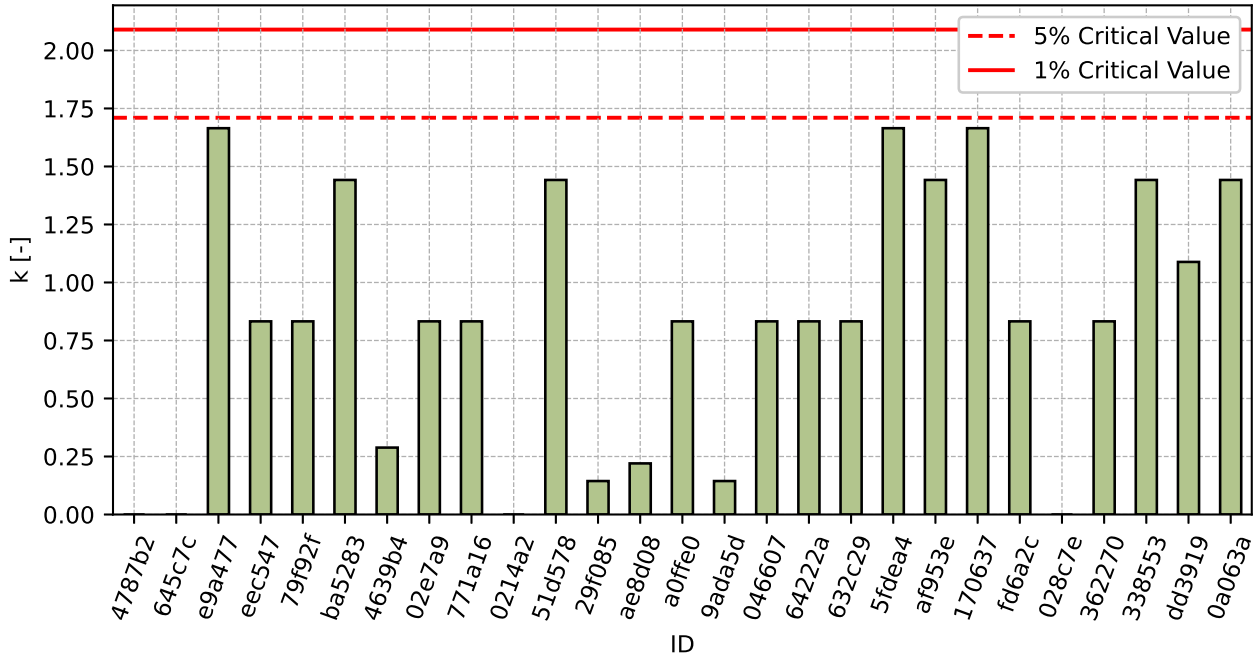

Figure 171: Intralaboratory Consistency Statistic

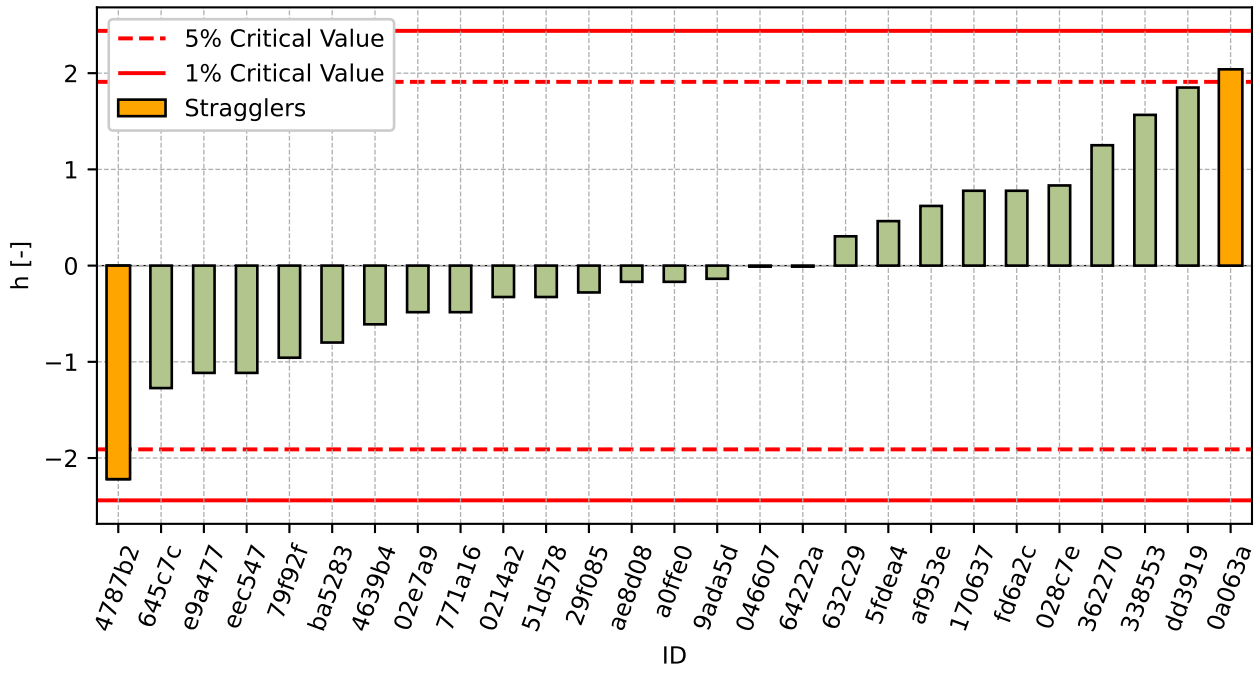

Figure 172: Interlaboratory Consistency Statistic

12.2.4 Descriptive statistics

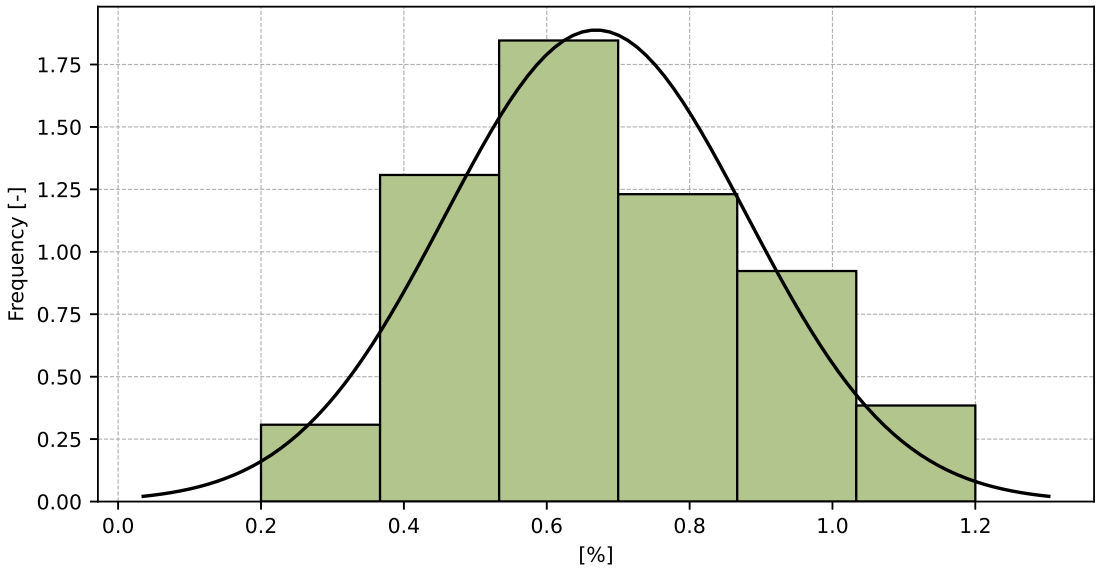

Figure 173: Histogram of all test results

Table 57: Descriptive statistics

Characteristics	**[%]**
Average value – $\bar{x}$	0.7
Sample standard deviation – s	0.21
Asigned value – x^*	0.7
Robust standard deviation – s^*	0.24
Measurement uncertainty of asigned value – u_X	0.05
p-value of normality test	0.023 [-]
Interlaboratory standard deviation – s_L	0.21
Repeatability standard deviation – s_r	0.07
Reproducibility standard deviation – s_R	0.22
Repeatability – r	0.2
Reproducibility – R	0.6

12.2.5 Evaluation of Performance Statistics

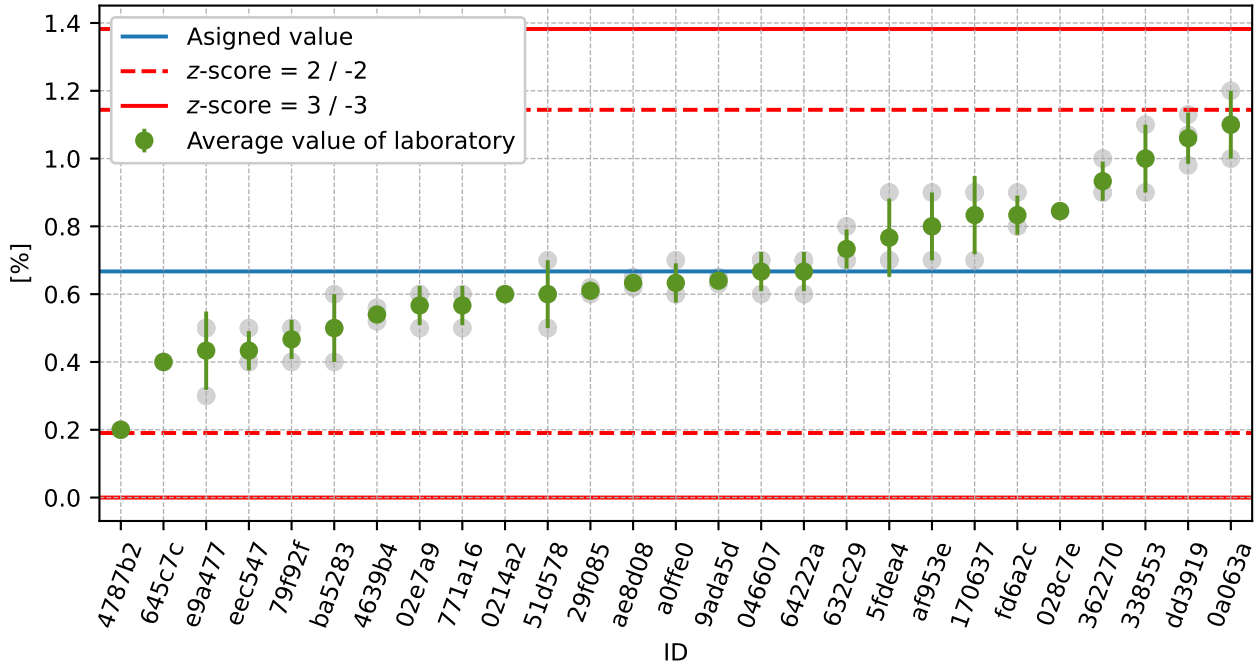

Figure 174: Average values and sample standard deviations

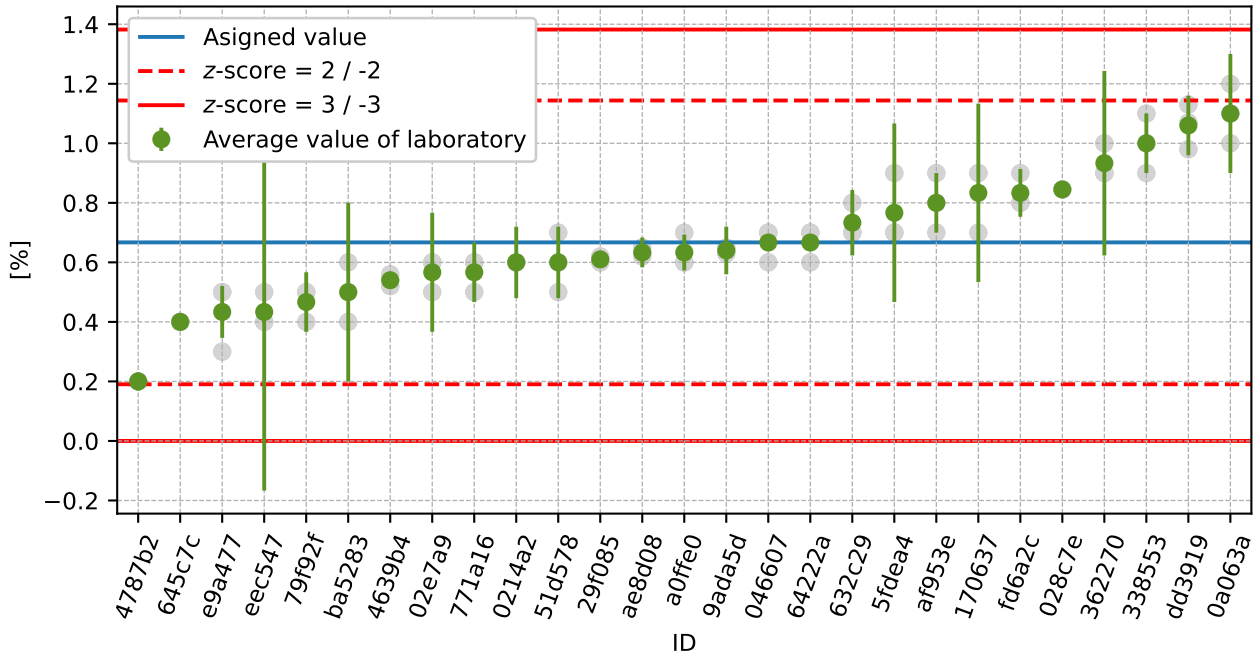

Figure 175: Average values and extended uncertainties of measurement

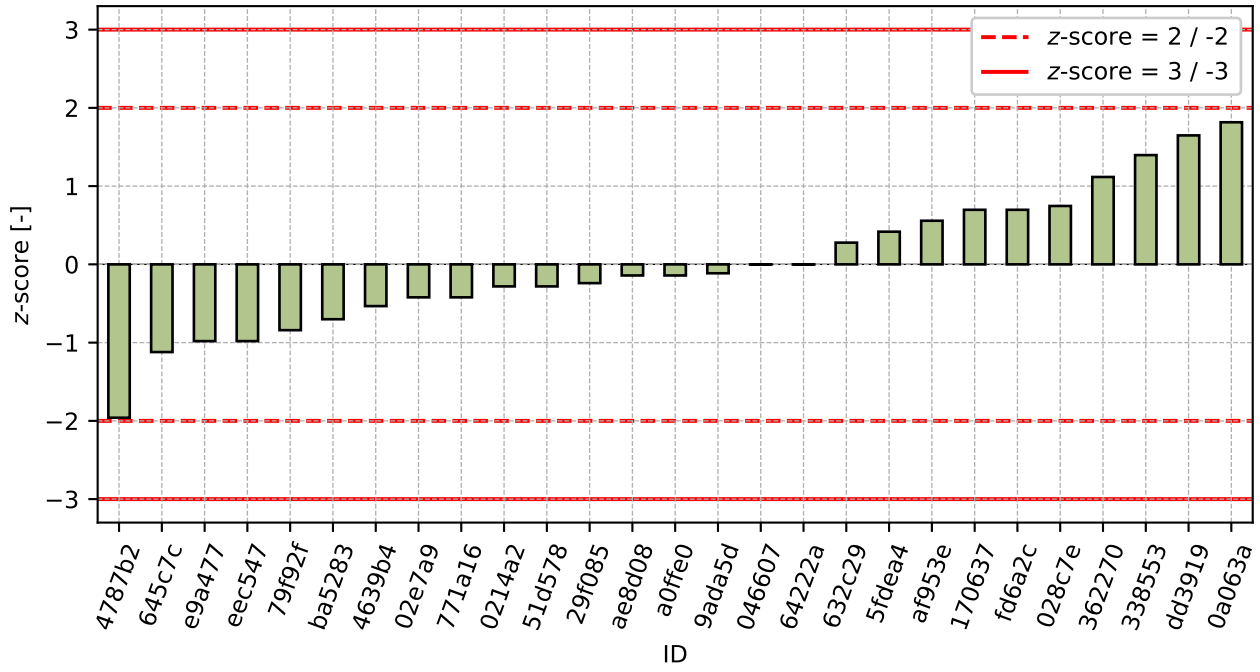

Figure 176: z-score

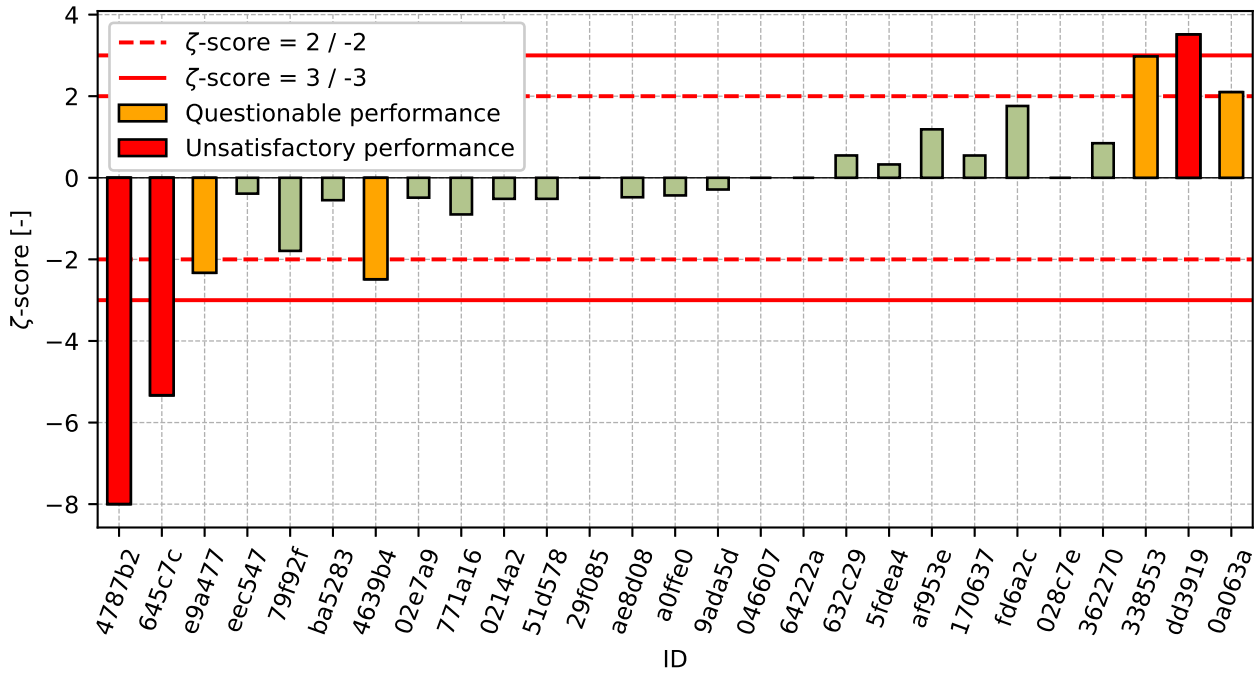

Figure 177: ζ-score

Table 58: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
4787b2	-1.96	-8.0
645c7c	-1.12	-5.33
e9a477	-0.98	-2.33
eec547	-0.98	-0.39
79f92f	-0.84	-1.79
ba5283	-0.7	-0.55
4639b4	-0.53	-2.49
02e7a9	-0.42	-0.49
771a16	-0.42	-0.9
0214a2	-0.28	-0.52
51d578	-0.28	-0.52
29f085	-0.24	-
ae8d08	-0.14	-0.48
a0ffe0	-0.14	-0.43
9ada5d	-0.11	-0.29
046607	-0.0	-
64222a	-0.0	-
632c29	0.28	0.55
5fdea4	0.42	0.33
af953e	0.56	1.19
170637	0.7	0.55
fd6a2c	0.7	1.76
028c7e	0.75	-
362270	1.12	0.85
338553	1.4	2.98
dd3919	1.65	3.51
0a063a	1.82	2.1

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

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

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

14.1 Test results

Table 59: 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 [%]
76d7ce	0.2	0.1	0.2	0.0	0.2	0.04	29.06
dbb4c3	0.2	0.2	0.1	0.1	0.2	0.06	34.64
c8cc78	0.2	0.2	0.1	0.0	0.2	0.06	34.64
a0ffe0	0.2	0.3	0.0	0.0	0.2	0.15	91.65
b648a0	0.2	0.2	0.1	0.3	0.2	0.05	27.99
af953e	0.2	0.2	0.2	0.1	0.2	0.0	0.0
944de6	0.3	0.3	0.2	0.0	0.3	0.06	21.65
eec547	0.3	0.2	0.4	0.1	0.3	0.1	33.33
22cd3b	0.3	0.4	0.4	0.1	0.4	0.06	15.75
0214a2	0.5	0.4	0.3	0.0	0.4	0.1	25.0
e9a477	0.5	0.5	0.6	0.0	0.5	0.06	10.83

14.2 The Numerical Procedure for Determining Outliers

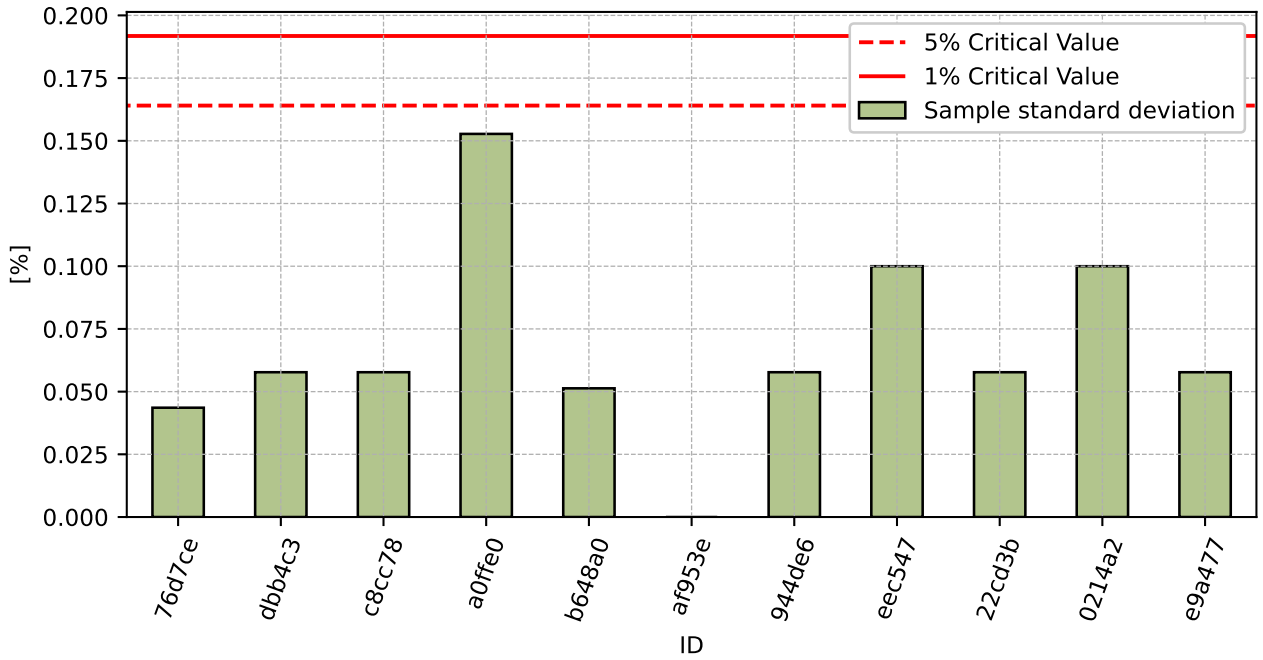

Figure 178: **Cochran's test** - sample standard deviations

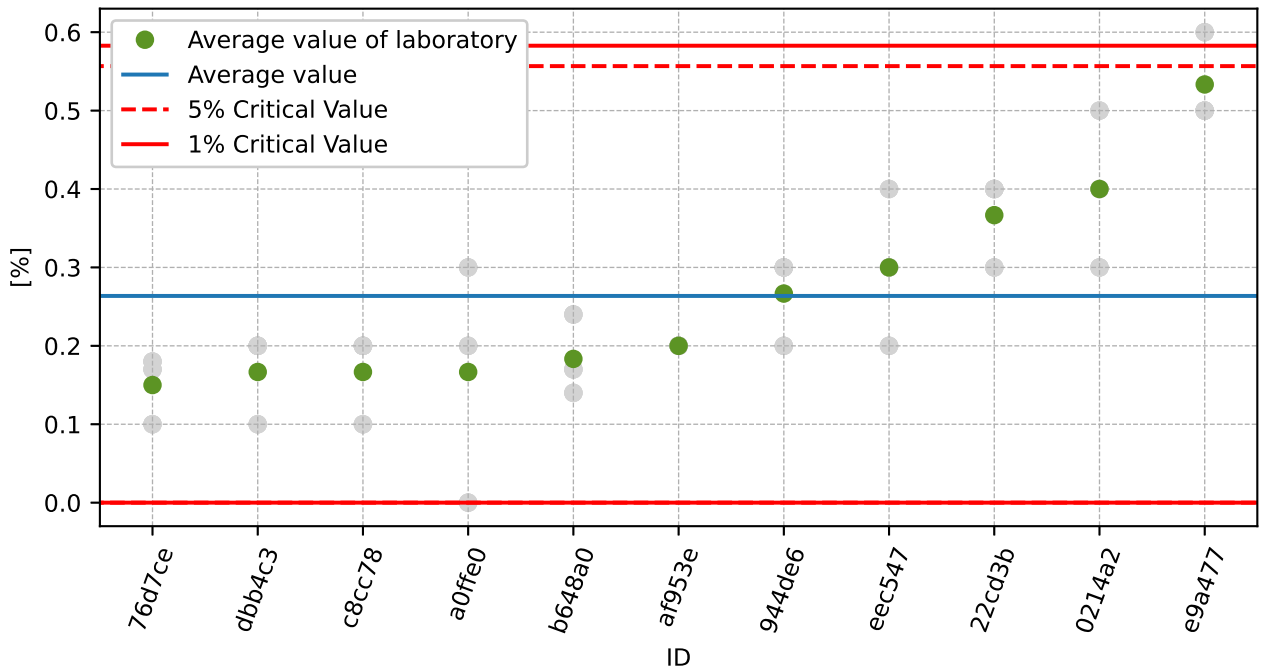

Figure 179: **Grubbs' test** - average values

14.3 Mandel's Statistics

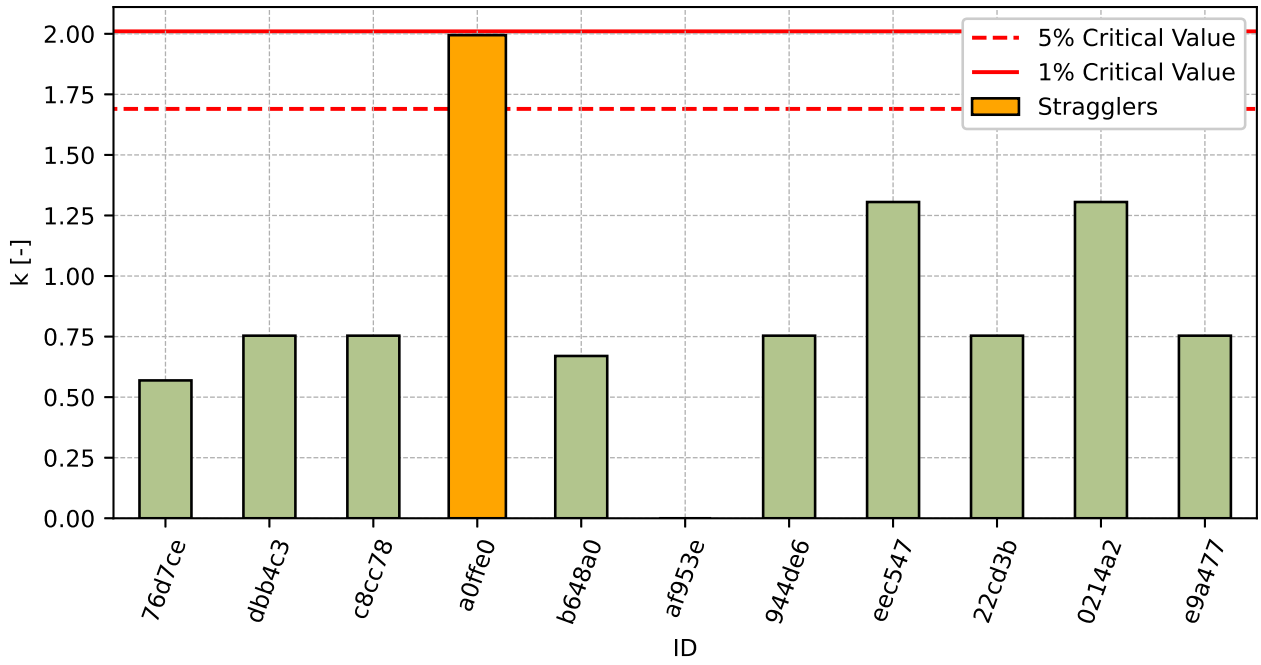

Figure 180: Intralaboratory Consistency Statistic

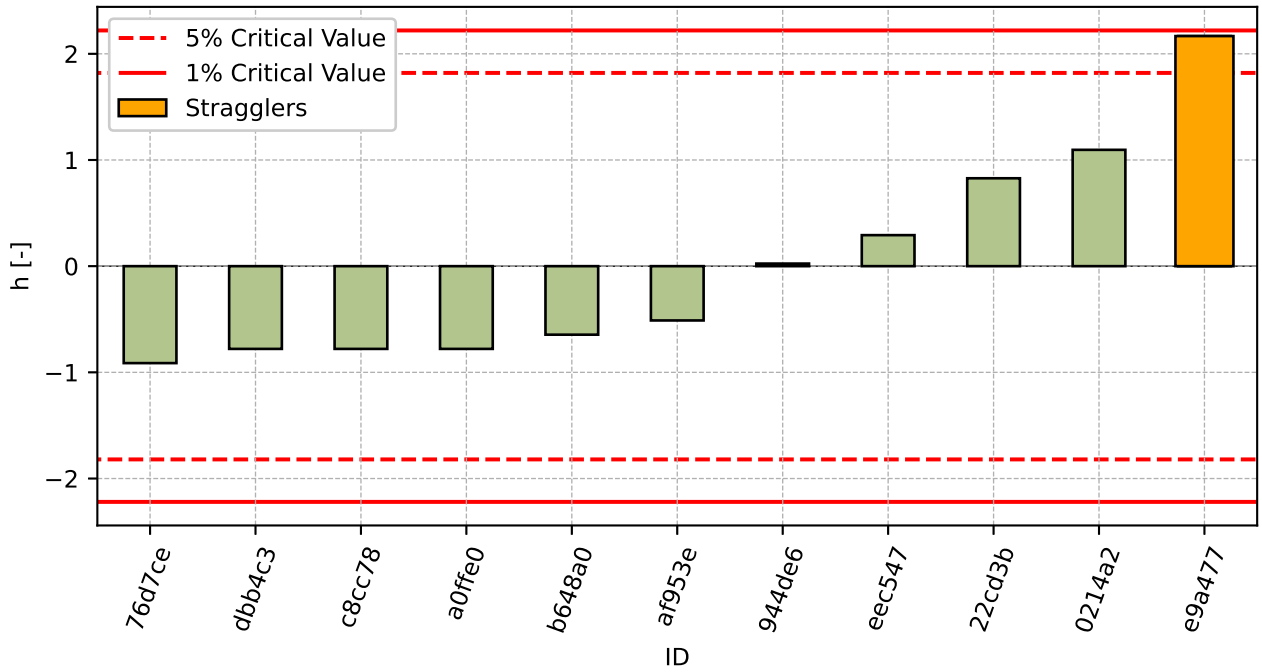

Figure 181: Interlaboratory Consistency Statistic

14.4 Descriptive statistics

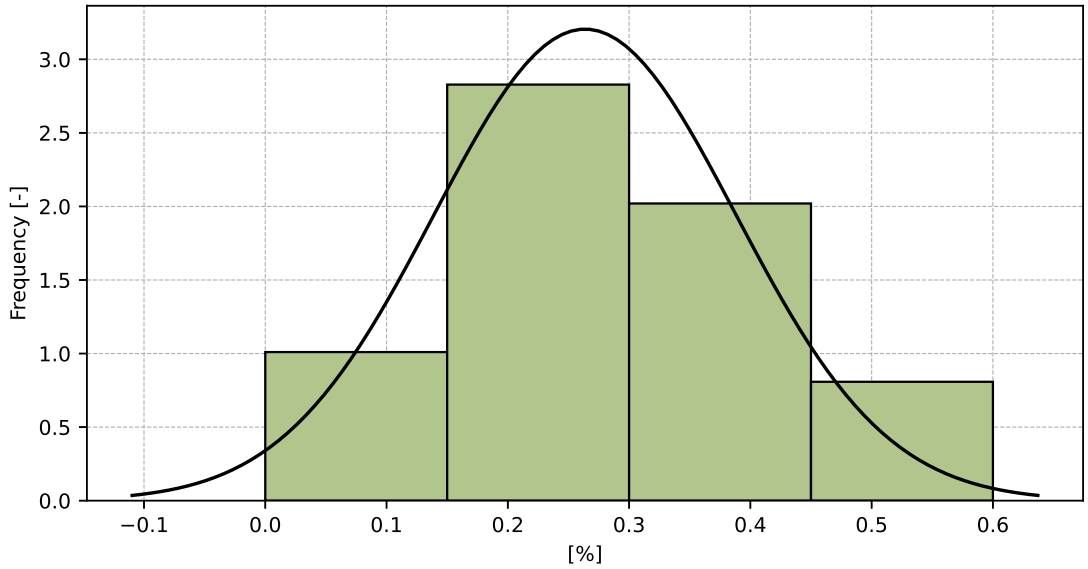

Figure 182: Histogram of all test results

Table 60: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	0.3
Sample standard deviation – s	0.12
Asigned value – x^*	0.3
Robust standard deviation – s^*	0.12
Measurement uncertainty of asigned value – u_X	0.05
p-value of normality test	0.033 [-]
Interlaboratory standard deviation – s_L	0.12
Repeatability standard deviation – s_r	0.08
Reproducibility standard deviation – s_R	0.14
Repeatability – r	0.2
Reproducibility – R	0.4

14.5 Evaluation of Performance Statistics

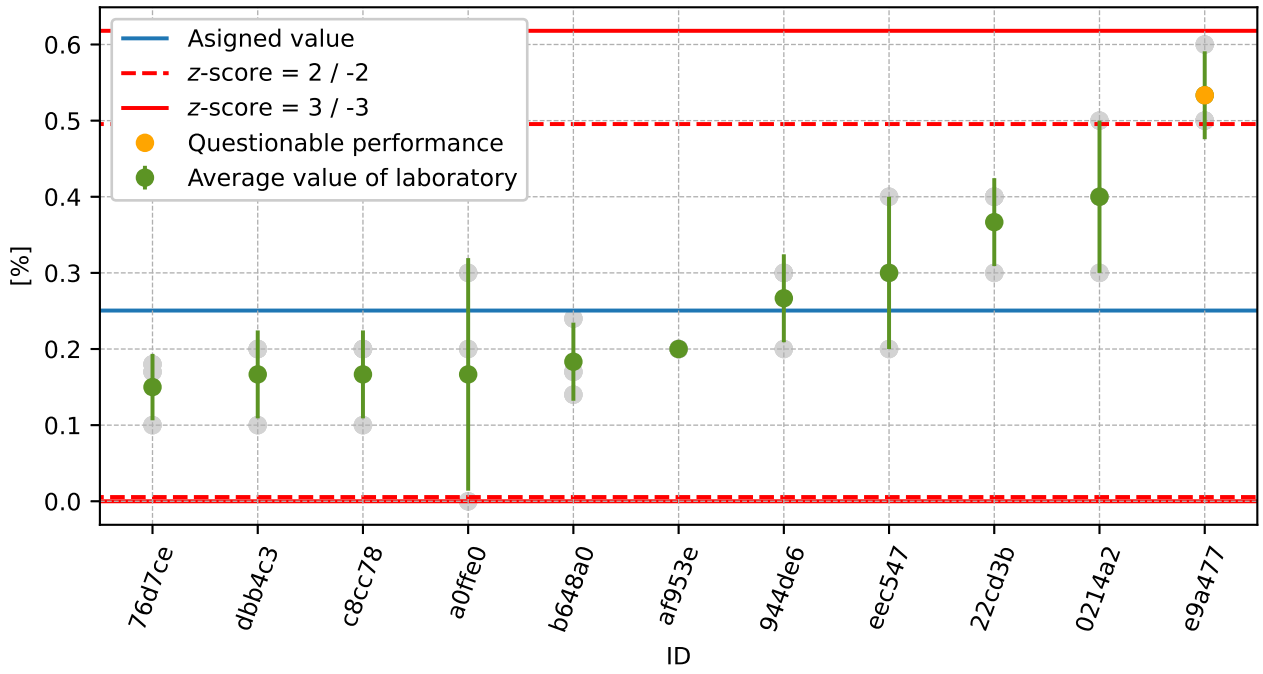

Figure 183: Average values and sample standard deviations

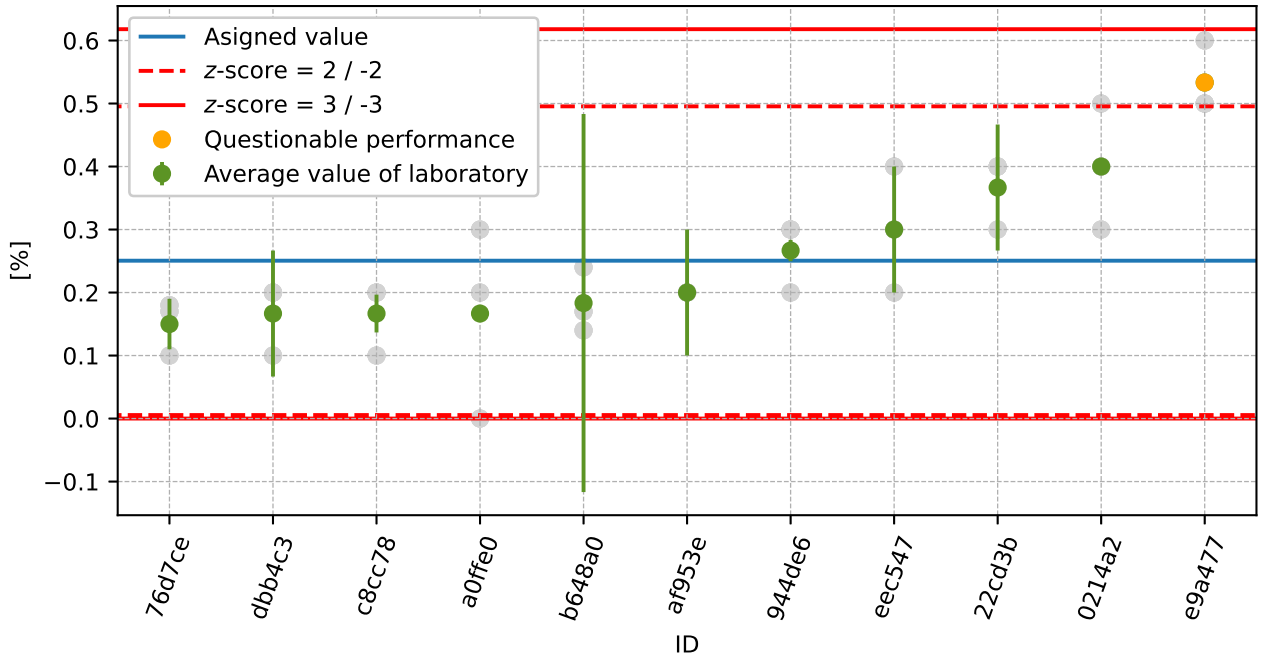

Figure 184: Average values and extended uncertainties of measurement

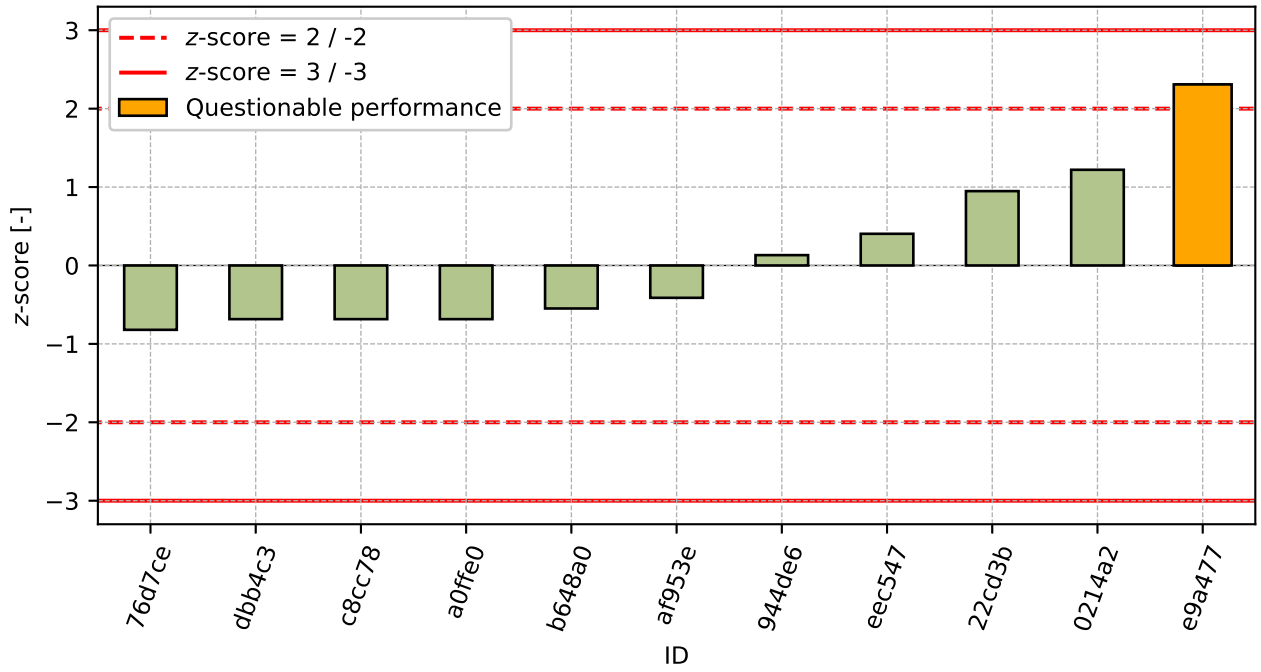

Figure 185: z-score

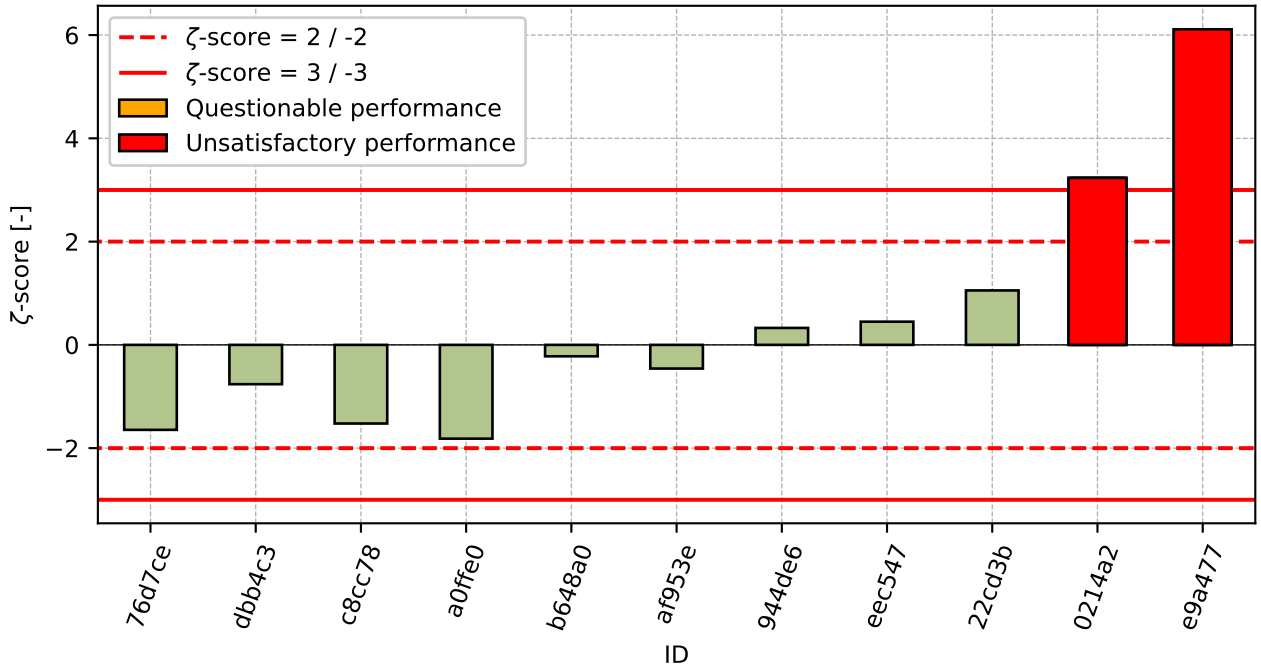

Figure 186: ζ-score

Table 61: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
76d7ce	-0.82	-1.65
dbb4c3	-0.68	-0.76
c8cc78	-0.68	-1.52
a0ffe0	-0.68	-1.82
b648a0	-0.55	-0.22
af953e	-0.41	-0.46
944de6	0.13	0.33
eec547	0.4	0.45
22cd3b	0.95	1.05
0214a2	1.22	3.23
e9a477	2.31	6.11

15 Appendix – EN 1367-2 Magnesium sulfate test

15.1 Test results

Table 62: Test results - ordered by average value. Outliers are marked by red color. u_X - extended uncertainty of measurement.

ID	Test results [%]	u_X [%]
dbb4c3	2.0	1.0
0a063a	4.0	0.2
046607	8.2	-

15.2 The Numerical Procedure for Determining Outliers

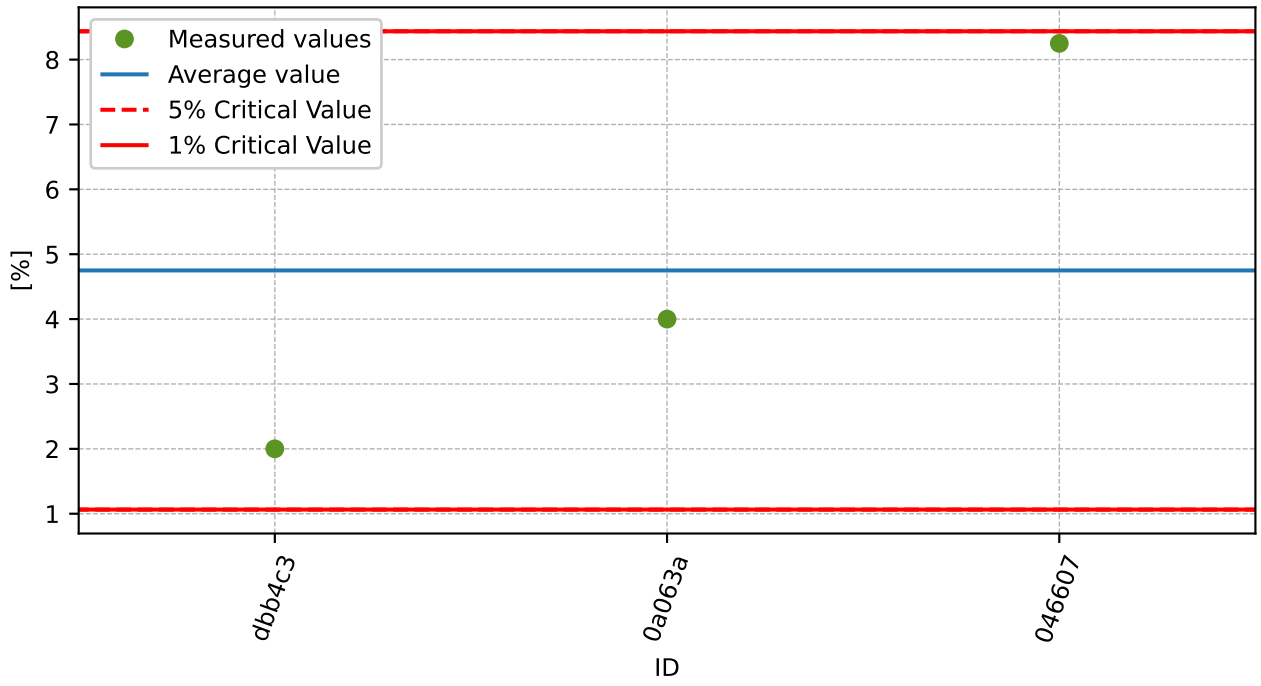

Figure 187: **Grubbs' test** - average values

15.3 Mandel's Statistics

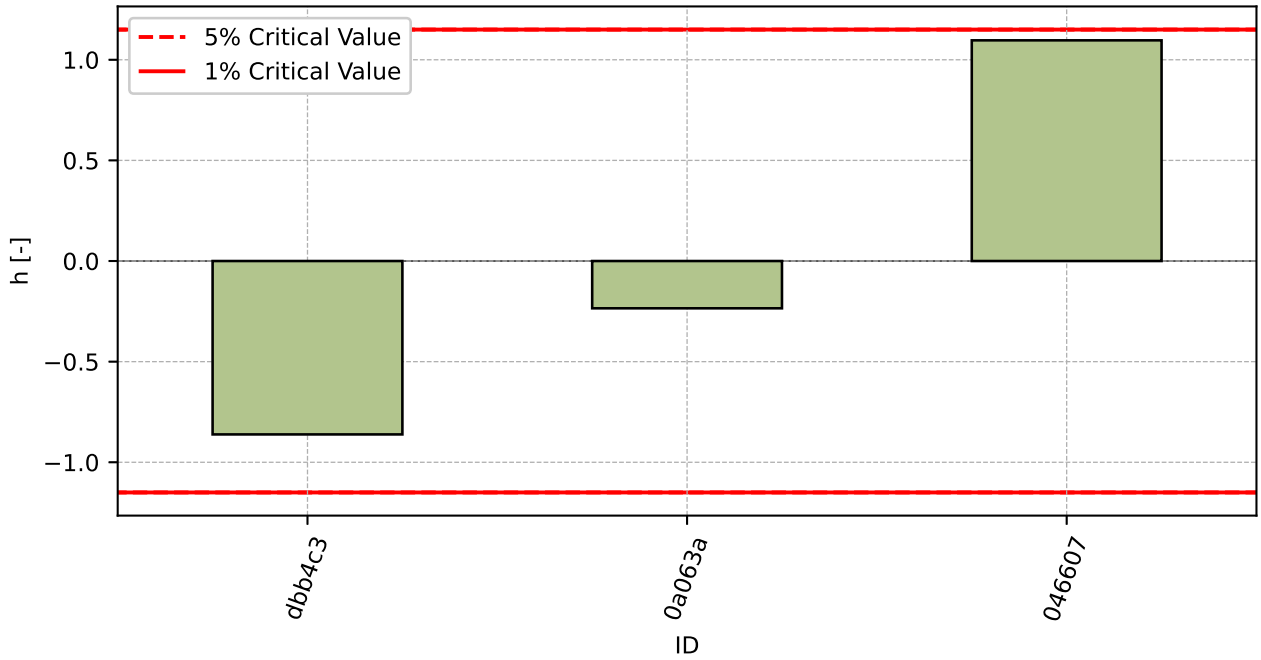

Figure 188: Interlaboratory Consistency Statistic

15.4 Descriptive statistics

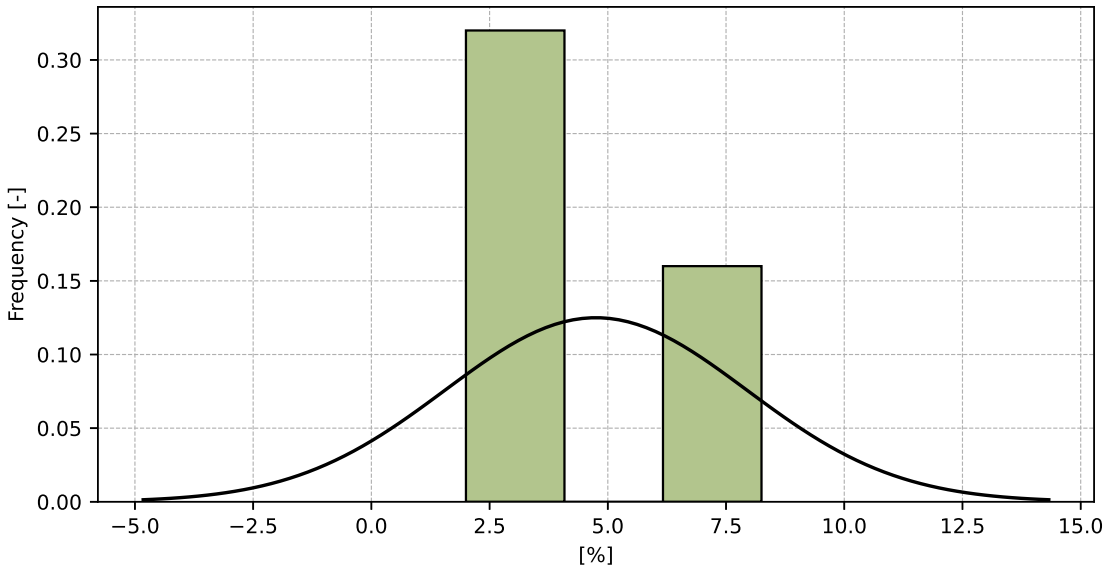

Figure 189: Histogram of all test results

Table 63: Descriptive statistics

Characteristics	[%]
Average value – $\bar{x}$	4.8
Sample standard deviation – s	3.19
Asigned value – x^*	4.8
Robust standard deviation – s^*	2.96
Measurement uncertainty of asigned value – u_X	2.13
p-value of normality test	0.609 [-]

15.5 Evaluation of Performance Statistics

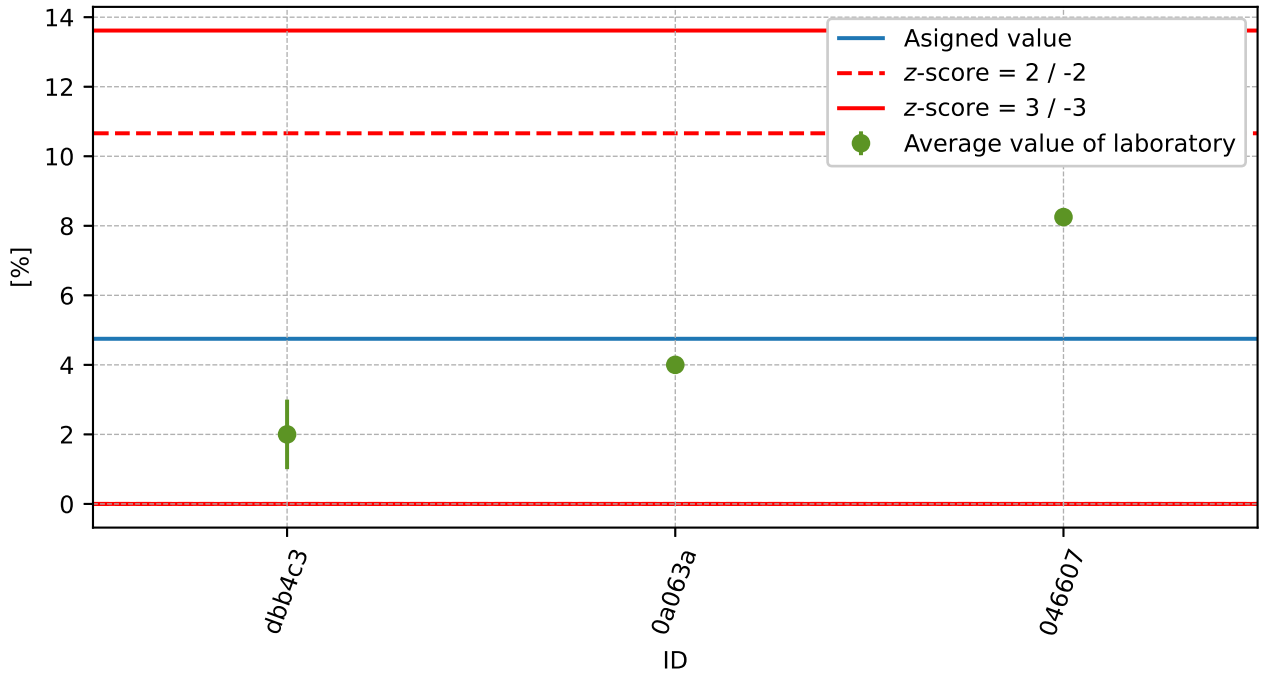

Figure 190: Average values and extended uncertainties of measurement

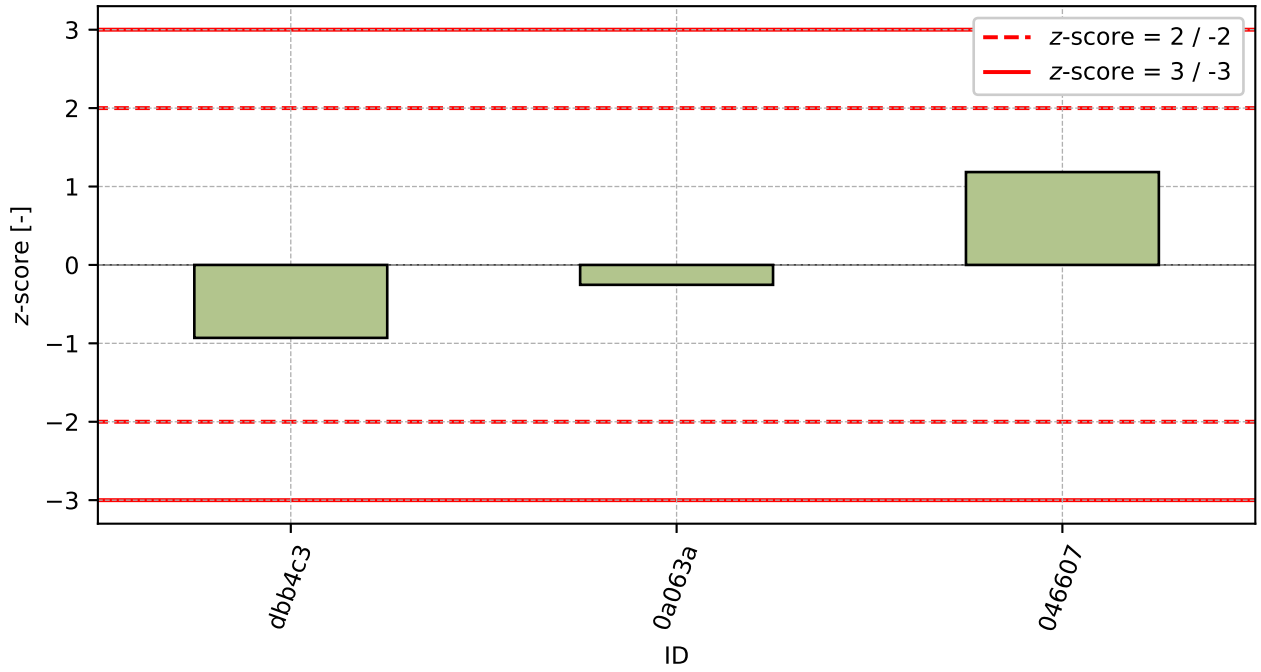

Figure 191: z-score

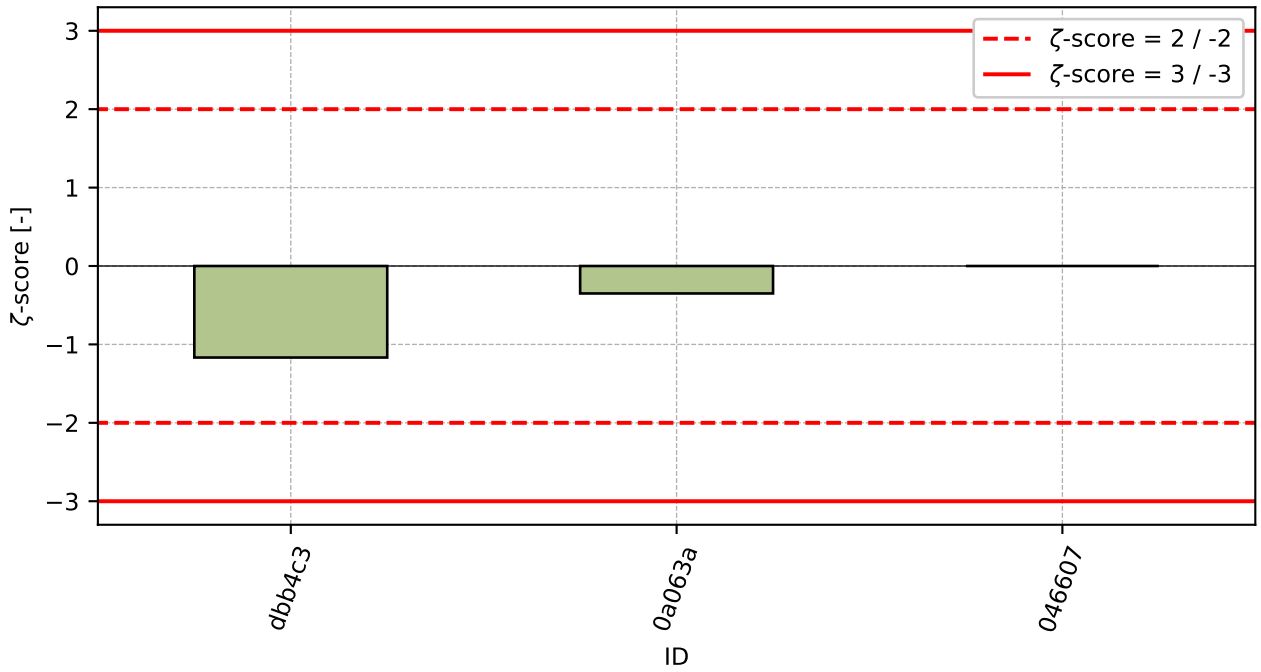

Figure 192: ζ-score

Table 64: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
dbb4c3	-0.93	-1.17
0a063a	-0.25	-0.35
046607	1.18	-

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.