BRNO UNIVERSITY OF TECHNOLOGY

FACULTY OF CIVIL ENGINEERING
institute of building testing

Z 7008

FINAL REPORT ON THE RESULTS OF PRECISION EXPERIMENT

Proficiency Testing Program
Aggregate Testing
ZK 2020/1

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: 9/24/2020

Poskytovatel zkoušení
způsobilosti při SZK FAST

Proficiency testing
provider at the SZK FAST
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Veveří 95
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Assoc. Prof. Ing. Tomáš Vymazal, Ph.D.
Head of the PT Provider, PTP coordinator

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

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1   Introduction and Important Contacts

In the year 2020, the Proficiency Testing Provider at the SZK FAST (PT Provider) initiated the Proficiency Testing Program (PTP) designated ZK 2020/1 whose aim was to verify and assess the conformity of test results across laboratories when testing aggregate.

The assessment of the results of the Proficiency Testing Program was carried out by a committee consisting of the following PT Provider employees:

Head of the PT Provider, PTP coordinator	Coordinator of PTP result assessment PTP
Assoc. Prof. Tomáš Vymazal, Ph.D.	**Ing. Petr Misák, Ph.D**.
Brno University of Technology	Brno University of Technology
Faculty of Civil Engineering	Faculty of Civil Engineering
Institute of Building Testing	Institute of Building Testing
Veveří 95, Brno 602 00	Veveří 95, Brno 602 00
Czech Republic	Czech Republic
Tel.: +420 603 313 337	Tel.: +420 774 980 255
Email: Tomas.Vymazal@vutbr.cz	Email: Petr.Misak@vutbr.cz

The subjects of proficiency testing were the following testing procedures:

1. EN 933-1 Determination of particle size distribution - Sieving method [1],

2. EN 933-3 Determination of particle shape - Flakiness index [2],

3. EN 933-4 Determination of particle shape - Shape index [3],

4. EN 933-8 Assessment of fines - Sand equivalent test [4],

5. EN 933-9 Assessment of fines - Methylene blue test [5],

6. EN 933-10 Assessment of fines - Grading of filler aggregates (air jet sieving) [6],

7. EN 1097-1 Determination of the resistance to wear (micro-Deval) [7],

8. EN 1097-2 Methods for the determination of resistance to fragmentation - chapter 5 [8],

9. EN 1097-2 Methods for the determination of resistance to fragmentation - chapter 6 [8],

10. EN 1097-3 Determination of loose bulk density and voids [9],

11. EN 1097-5 Determination of the water content by drying in a ventilated oven [10],

12. EN 1097-6 Determination of particle density and water absorption [11],

13. EN 1097-7 Determination of the particle density of filer - Pyknometer method [12],

14. EN 1367-1 Determination of resistance to freezing and thawing [13],

15. EN 1367-2 Magnesium sulfate test [14],

16. EN 1367-3 Boiling test for "Sonnenbrand basalt" [15],

17. TP 137 - Příloha 1 a 2 – Reaktivnost kameniva s alkáliemi [16],

18. ČSN 72 1179 Determination of reactivity of aggregates in connection with alkalies – chapter B [17].

Testing procedures No 9, 13, 16, 17 and 18 were not open due to the low number 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

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

68 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
3bfa79	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
b577cd	-	-	-	-	-	-	X	-	-	X	-	-	-	-	-	-	-	-
1ad821	X	-	-	-	X	-	-	-	-	-	X	X	-	-	-	-	-	-
119d89	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6cb763	X	-	X	-	-	-	-	X	-	X	-	-	-	-	-	-	-	-
b2e5a7	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ea6b6f	-	-	-	-	X	-	X	X	-	-	-	X	-	-	X	-	-	-
332b9d	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
b74bb7	-	-	-	-	X	-	-	-	-	-	X	-	-	-	X	-	-	-
bd8a5f	X	-	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-
664b70	X	-	X	-	-	-	-	-	-	X	X	X	-	-	-	-	-	-
b023e3	-	-	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-
5f3943	X	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
9eaaa0	X	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
9308e6	X	X	-	-	X	-	-	-	-	-	X	X	-	X	-	-	-	-
a5f90f	X	-	-	-	X	-	-	-	-	X	-	-	-	X	-	-	-	-
09b709	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
d1fea8	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5cd479	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
d24f52	X	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
3b1853	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
473f5c	X	X	-	-	X	-	-	X	-	-	-	X	-	-	-	-	-	-
1559c5	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
b63fd6	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
b58068	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
41bb56	X	X	-	X	X	-	-	X	-	X	X	X	-	X	-	-	-	-
e9a2b5	X	-	X	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-
51f258	X	-	X	-	-	-	-	-	-	-	X	X	-	X	-	-	-	-
4970e4	X	-	X	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-
526f8f	X	-	X	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-
968ace	X	-	X	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-
081752	X	-	X	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-
191e81	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
946645	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
228ae5	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
a9702a	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5afa3f	X	-	X	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-

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ID/Method	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
7d1284	X	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9d28f5	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
f04bc3	-	-	-	X	-	-	X	X	-	-	-	-	-	-	-	-	-	-
694b2b	-	-	-	X	-	-	-	X	-	-	-	X	-	-	-	-	-	-
27f302	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1e0c28	X	-	X	-	-	-	-	X	-	-	-	X	-	-	-	-	-	-
9de317	X	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
1fd599	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
797873	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4089af	X	-	X	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-
b4ab8c	X	-	X	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-
503d35	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
ad4665	-	-	-	-	-	-	X	-	-	-	-	-	-	-	X	-	-	-
856fbd	X	-	-	X	-	-	X	-	-	X	X	X	-	-	-	-	-	-
c7c309	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
aef78b	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-
3d85a9	-	-	-	X	-	-	-	-	-	-	X	-	-	X	-	-	-	-
f26de6	-	-	-	X	-	X	-	-	-	-	X	X	-	-	X	-	-	-
92ab3d	X	-	-	X	X	-	-	X	-	-	-	-	-	-	-	-	-	-
9623eb	X	-	X	-	-	-	-	-	-	-	X	X	-	-	-	-	-	-
1760ff	X	-	X	-	X	-	X	X	-	X	X	X	-	X	X	-	-	-
165952	X	X	X	-	-	-	X	X	-	X	X	X	-	X	X	-	-	-
e27853	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
cea6a8	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8a28b3	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ed90bd	X	-	-	-	-	-	X	-	-	-	-	X	-	-	-	-	-	-
e75474	-	-	-	-	-	-	-	-	-	-	X	X	-	-	X	-	-	-
ce37e5	-	-	-	-	X	-	-	-	-	-	-	-	-	-	X	-	-	-
8c786e	-	-	-	-	X	X	-	-	-	-	-	-	-	-	-	-	-	-
31ccbc	X	-	-	-	X	X	-	-	-	X	X	-	-	X	-	-	-	-

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

Laboratory	Address	Accreditation number
AG Institut d.o.o. Novi Sad	dr Djordja Joanovica 4, Novi Sad, 21000, Republika Srbija	01-457
ANTONIS BOTSARIS	KENTAVROU 1 7103 INDUSTRIAL AREA ARADIPPOU, LARNACA, 7103, CYPRUS	-
ARP GesmbH	Johann-Sackl-Gasse 65-67, Leoben, 8700, Austria	-
BETOTECH, s.r.o. - pracoviště Beroun	Beroun 660, Beroun, 26601, Česká republika	AZL 1195
BETOTECH, s.r.o. - pracoviště Brno	Beroun 660, Beroun, 266 01, Česká republika	1195.3

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Laboratory	Address	Accreditation number
BETOTECH, s.r.o. - pracoviště Jindřichův Hradec	Beroun 660, Beroun, 26601, Česká republika	AZL 1195
BETOTECH, s.r.o. - pracoviště Most	Beroun 660, Beroun, 26601, Česká republika	AZL 1195
BETOTECH, s.r.o. - pracoviště Trutnov	Beroun 660, Beroun, 26601, Česká republika	AZL 1195
Betotech s.r.o., Brno - kamenivo	Beroun 660, Beroun, 266 01, Česká republika	1195.3
Building Research Institute NISI	86 Nikola Petkov Blvd., Sofia, 1618, Bulgaria	88 ЛИ
CEMEX Czech Republic, s.r.o.	Semtín 102, Pardubice, 53354, Česká republika	1302
CRH (Slovensko) a. s., 906 38 Rohožník	CRH (Slovensko) a. s., Rohožník, 906 38, Slovenská republika	-
Central Laboratory, (C/o Limassol District Laboratory) Public Works Department of CYPRUS	SEMELI BLOCK, ETKO Harbour Tower, Aktaias Avenue, Limassol, 3013, Cyprus	-
Concrefy B.V.	Olivier van Noortweg 10, Venlo, 5928 LX, Limburg	RvA L216
EPE/SPA LABORATOIRE DES TRAVAUX PUBLICS DE L'EST	ZONE INDUSTRIELLE 24 FEVRIER 1956 CONSTANTINE, ZONE INDUSTRIELLE 24 FEVRIER 1956 CONSTANTINE, 25000, ALGERIA	-
ESLAB, spol. s r.o.	Běluňská 2913/11, Praha, 198 00, Česká republika	1699
Eurofins Umwelt Österreich GmbH & Co. KG	Palmersstrasse 2, Wiener Neudorf, 2351, Austria	-
Ferriere Nord S.p.A – Laboratorio	Zona Industriale Rivoli, Osoppo (UD), 33010, Italy	1561L
GEODRILL s.r.o.	K Bukovinám 169/45, Brno, 63500, Česká republika	1596
GEOSTAR, spol. s r.o. - pracoviště Brno	Tuřanka 111, Brno, 62700, Česká republika	1373
GEOSTAR, spol. s r.o. - pracoviště Hranice	Tuřanka 111, Brno, 62700, Česká republika	1373
GEOTEST SHPK (Geotechnical and Material Laboratory and Consulting)	Autostrada Tirane-Durres, Km 2, Building no. 7, Mezez, Kashar, Tirane, 1001, Albania	-
GEOtest, a.s.	Šmahova 1244/112, Brno, 62700, Česká republika	1271.2
GIM-TEST d.o.o. Banja Luka, Business unit GIM-LAB Central laboratory	Palih boraca 55, Lokal No. 2, Banja Luka, 78000, BiH	LI-152-01
GUBT GmbH	Gewerbeparkstrasse 5, Markgrafneusiedl, 2282, Austria	-
Geo Consultants LTD	Olīvu iela 9, Rīga, LV-1004, Latvija	-
Geo-Topics SPRL	Chemin des Maréchaux, 36, Wavre, 1300, Belgium	-

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Laboratory	Address	Accreditation number
Gilberto Rodríguez Chávez	Carrera 59C N°. 130-38, Bogotá, D.C., 111111, Bogotá, Colombia	-
Holcim (Hrvatska) d.o.o.	Koromačno 7b, Koromačno, 52222, Hrvatska	1528
IGH d.o.o.	Bišće polje bb, Mostar, 88000, Bosna i Hercegovina	-
Institut pro testování a certifikaci, a.s.	třída Tomáše Bati 299, Louky, Zlín, 76302, CZ	1004
Institut za građevinarstvo "IG" d.o.o. Banja Luka	Kralja Petra I Karađorđevića 92-94, Banja Luka, 78000, RS/BiH	-
Institut za građevinarstvo "IG" d.o.o. Banja Luka	Kralja Petra I Karađorđevića 92-94, Banja Luka, 78000, Bosnia	LI-71-01
JV EPTISA SERVICIOS DE INGENIERIA SL – THEODOROS PAPAIOANNOU	1 Marinou Antipa str., Ampelonas, Larisa, 404 00, Greece	-
Kaunas university of Technology	Studentu str. 48, Kaunas, LT-51367, Lithuania	-
LABORATOIRE DES TRAVAUX PUBLICS DU SUD	Zone des activités Bouhraoua- PB 332 GHARDAIA, GHARDAIA, 47000, ALGERIA	-
Laboratoire Central des Travaux Publics - LCTP - Hussein Dey -Algiers	1, rue Kaddour RAHIM - HUSSEIN DEY, ALGER, 16040, ALGERIE	-
M.I.S. a.s.	Resslova 956/13, Hradec Králové, 500 02, Česká republika	1197
MIRTEC S.A., Thiva Branch	76 Km of Athens-Lamia National Road, Sximatari, GR-32009, Greece	-
NIEVELT Labor CZ s.r.o.	Za Olomouckou 4184/17, Prostějov, 79601, Česká republika	1716
SAC Testing & Consulting doo Sarajevo, BiH	Rajlovac bb, Sarajevo, 71000, Bosnia and Herzegovi	-
SIBOTEC CVBA	Industriepark Oost 6, Beernem, 8730, Česká republika	-
SQZ, s.r.o. - organizačná zložka Bratislava - Badín	U místní dráhy 939/5, Olomouc, 77900, Česká republika	566/S-376
SQZ, s.r.o. - organizačná zložka Bratislava - Chminianská n. Ves	U místní dráhy 939/5, Olomouc, 77900, Česká republika	566/S-376
SQZ, s.r.o. - Ústřední laboratoř Olomouc - pracoviště Chotýšany	U místní dráhy 939/5, Olomouc, 779 00, Česká republika	1135.1
SQZ, s.r.o. - Ústřední laboratoř Praha - pracoviště Dobřany	U místní dráhy 939/5, Olomouc, 779 00, Česká republika	1135.1
SQZ, s.r.o. - Ústřední laboratoř Praha - pracoviště Rohanský ostrov	U místní dráhy 939/5, Olomouc, 779 00, Česká republika	1135.2
STACHEMA Bratislava a.s.	Železničná 714/180, Rovinka, 900 41, Slovenská republika	S-275
Skanska a.s.	Křižíkova 682/34a, Praha 8-Karlín, 186 00, Česká republika	1355
TECHNICKÝ A ZKUŠEBNÍ ÚSTAV STAVEBNÍ PRAHA, s.p., pobočka Ostrava	U Studia 14, Ostrava-Zábřeh, 700 30, Česká republika	1018.3

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Laboratory	Address	Accreditation number
TPA spoločnosť pre zabezpečenie kvality a inovácie s.r.o - pracovisko Zvolen	Neresnická cesta 3, Zvolen, 960 01, Slovenská republika	211/S-176
TPA za obezbeđenje kvaliteta i inovacije d.o.o. Beograd	Milutina Milankovića 3b, Novi Beograd, 11070, Srbija	01-280
TZÚS Praha, s.p. - pobočka České Budějovice	Nemanická 441, České Budějovice, 37010, Česká republika	1018.3
Technický a zkušební ústav stavební Praha, s. p., Centrální laboratoř - zkušebna Brno	Hněvkovského 77, Brno, 617 00, Česká republika	1018.3
Technický a zkušební ústav stavební Praha, s.p. - pobočka Plzeň	Zahradní 2180/15, Plzeň, 326 00, Česká republika	1018.3
Technický a zkušební ústav stavební Praha, s.p. - pobočka Praha	Prosecká 76a/811, Praha 9, 190 00, Česká republika	1018.3
Technický a zkušební ústav stavební Praha, s.p. - pobočka Teplice	Tolstého 447, Teplice, 41503, Česká republika	1018.3
Teststav spol s r.o.	Františka Lýska 1599/6, Ostrava - Bělský Les, 700 30, Česká republika	1290
VIAMONT d.o.o.Kolašin	Prve proleterske 5, Podgorica, 81000, Montenegro	-
Vilnius Gediminas Technical University	Sauletekio av. 11, Vilnius, LT-10223, Lithuania	LA.01.063
Vysoká škola báňská - Technická univerzita Ostrava, Zkušební laboratoře výzkumného centra hornin, Hornicko-geologická fakulta	17. listopadu 2172/15, Ostrava-Poruba, 70800, Česká republika	1166.4
Vysoké učení technické v Brně, Fakulta stavební, Akreditovaná zkušební laboratoř při ÚTHD FAST VUT v Brně	Veveří 331/95, Brno, 60200, Česká republika	L1396
Výzkumný ústav pozemních staveb - Certifikační společnost, s.r.o.	Pražská 810/16, Praha 10, 10221, Česká republika	1234
Zkušebna kamene a kameniva s.r.o.	Husova 2274, Hořice, 508 01, Česká republika	1046
iTER solutions	Rue du Tronquoy, 24, Fernelmont, 5380, BELGIUM	BELAC 422-TEST
Ředitelství silnic a dálnic ČR	Rebešovická 40, Brno-Chrlice, 643 00, Česká republika	1072
Ředitelství silnic a dálnic ČR	Na Pankráci 546/56, Praha 4 - Nusle, 14000, Česká republika	1734

2   Procedures used in the Statistical Analysis of Laboratory Results

The statistical analysis is based on the following steps:

1. Evaluation of intralaboratory variabilities by Cochran's C test: If 5% or 1% critical value is exceeded, the effect of the individual observations is first considered. If the results indicate that high participant variability is caused by a single observation, this value is excluded from the experiment, but the participant is not excluded as outlying. By overcoming 1% of the critical value, the participant's results can be marked as outlying and excluded from the experiment (symbol **X**).

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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 2020/1 (PT Program) organized by the PT Provider at the SZK FAST. 68 participants (laboratories) took part in the PT Program. 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.

Testing method No. 6: The evaluation of intralaboratory variability was not used due to the different number of observations.

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

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

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

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

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ID	4 mm	2 mm	1 mm	0.5 mm	0.25 mm	0.125 mm	0.063 mm
3bfa79	✓	✓	✓	✓	✓	✓	✓
1ad821	✓	✓	✓	?	✓	✓	✓
119d89	✓	✓	✓	✓	✓	✓	✓
6cb763	✓	✓	✓	✓	✓	✓	✓
bd8a5f	✓	✓	✓	✓	✓	✓	✓
664b70	✓	✓	✓	✓	✓	✓	✓
5f3943	✓	✓	✓	✓	✓	✓	✓
9eaaa0	✓	✓	✓	✓	✓	✓	✓
9308e6	✓	✓	✓	✓	✓	✓	✓
a5f90f	✓	✓	✓	✓	✓	✓	?
d1fea8	✓	✓	✓	✓	✓	✓	✓
5cd479	✓	✓	✓	✓	✓	✓	✓
d24f52	?	✓	✓	?	!	X	X
3b1853	✓	✓	✓	✓	✓	✓	✓
473f5c	✓	✓	✓	✓	✓	✓	✓
1559c5	✓	✓	✓	✓	✓	✓	✓
b63fd6	?	✓	✓	✓	✓	✓	✓
b58068	✓	✓	?	X	?	✓	✓
41bb56	✓	?	✓	✓	✓	✓	✓
e9a2b5	✓	✓	✓	✓	✓	✓	✓
51f258	✓	?	✓	✓	✓	✓	?
4970e4	✓	✓	✓	✓	✓	✓	✓
526f8f	✓	✓	✓	✓	✓	✓	✓
968ace	✓	✓	✓	✓	✓	?	✓
081752	X	✓	✓	✓	✓	✓	✓
191e81	✓	✓	✓	✓	✓	✓	✓
946645	✓	✓	✓	✓	X	✓	✓
a9702a	✓	✓	✓	✓	✓	✓	✓
5afa3f	✓	✓	✓	✓	✓	✓	X
7d1284	✓	?	✓	✓	?	X	X
9d28f5	✓	✓	✓	✓	✓	✓	✓
27f302	?	✓	✓	✓	✓	✓	✓
1e0c28	?	✓	?	✓	✓	✓	✓
9de317	✓	✓	✓	✓	✓	✓	✓
1fd599	✓	✓	✓	✓	✓	-	✓
797873	✓	✓	✓	✓	✓	✓	✓
4089af	✓	✓	✓	✓	✓	✓	✓

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ID	4 mm	2 mm	1 mm	0.5 mm	0.25 mm	0.125 mm	0.063 mm
b4ab8c	✓	✓	✓	✓	✓	✓	✓
503d35	✓	✓	✓	✓	✓	✓	✓
856fbd	✓	✓	✓	✓	✓	✓	✓
92ab3d	✓	✓	?	!	✓	?	✓
9623eb	✓	✓	✓	✓	✓	✓	✓
1760ff	✓	✓	✓	✓	✓	✓	✓
165952	✓	✓	✓	✓	?	X	✓
e27853	✓	✓	✓	✓	✓	✓	✓
cea6a8	✓	✓	✓	✓	✓	✓	✓
8a28b3	✓	✓	✓	✓	✓	✓	✓
ed90bd	✓	✓	✓	✓	✓	✓	✓
31ccbc	✓	✓	✓	✓	✓	✓	✓

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
3bfa79	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
b577cd	-	-	-	-	-	-	✓	-	-	✓	-	-	-	-	-	-	-	-
1ad821	✓	-	-	-	✓	-	-	-	-	-	✓	X	-	-	-	-	-	-
119d89	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6cb763	✓	-	✓	-	-	-	-	✓	-	✓	-	-	-	-	-	-	-	-
b2e5a7	-	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ea6b6f	-	-	-	-	✓	-	✓	✓	-	-	-	?	-	-	✓	-	-	-
332b9d	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-
b74bb7	-	-	-	-	✓	-	-	-	-	-	✓	-	-	-	✓	-	-	-
bd8a5f	✓	-	✓	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
664b70	✓	-	✓	-	-	-	-	-	-	✓	✓	✓	-	-	-	-	-	-
b023e3	-	-	-	-	✓	-	-	-	✓	-	-	-	-	-	-	-	-	-
5f3943	✓	-	✓	-	-	-	-	-	-	-	?	-	-	-	-	-	-	-
9eaaa0	✓	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-
9308e6	✓	✓	-	-	✓	-	-	-	-	-	✓	✓	-	✓	-	-	-	-
a5f90f	✓	-	-	-	✓	-	-	-	-	✓	-	-	-	✓	-	-	-	-
09b709	-	-	-	-	-	✓	-	-	-	-	-	-	-	-	-	-	-	-
d1fea8	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

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ID / Method	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
5cd479	✓	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
d24f52	?	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-
3b1853	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
473f5c	✓	✓	-	-	✓	-	-	✓	-	-	-	✓	-	-	-	-	-	-
1559c5	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
b63fd6	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
b58068	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
41bb56	✓	✓	-	!	✓	-	-	✓	-	✓	✓	✓	-	✓	-	-	-	-
e9a2b5	✓	-	✓	-	-	-	-	-	-	-	✓	✓	-	-	-	-	-	-
51f258	✓	-	✓	-	-	-	-	-	-	-	✓	✓	-	✓	-	-	-	-
4970e4	✓	-	✓	-	-	-	-	-	-	-	✓	✓	-	-	-	-	-	-
526f8f	✓	-	✓	-	-	-	-	-	-	-	✓	✓	-	-	-	-	-	-
968ace	✓	-	✓	-	-	-	-	-	-	-	✓	✓	-	-	-	-	-	-
081752	✓	-	✓	-	-	-	-	-	-	-	?	✓	-	-	-	-	-	-
191e81	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
946645	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
228ae5	-	-	-	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
a9702a	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5afa3f	✓	-	✓	-	-	-	-	-	-	-	-	?	-	-	-	-	-	-
7d1284	?	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9d28f5	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
f04bc3	-	-	-	✓	-	-	✓	✓	-	-	-	-	-	-	-	-	-	-
694b2b	-	-	-	✓	-	-	-	✓	-	-	-	✓	-	-	-	-	-	-
27f302	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1e0c28	✓	-	✓	-	-	-	-	✓	-	-	-	✓	-	-	-	-	-	-
9de317	✓	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-
1fd599	✓	-	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-
797873	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4089af	✓	-	✓	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-
b4ab8c	✓	-	✓	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-
503d35	✓	-	-	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-
ad4665	-	-	-	-	-	-	✓	-	-	-	-	-	-	-	✓	-	-	-
856fbd	✓	-	-	✓	-	-	✓	-	-	✓	✓	✓	-	-	-	-	-	-
c7c309	-	-	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
aef78b	-	-	-	-	-	✓	-	-	-	-	-	-	-	-	-	-	-	-
3d85a9	-	-	-	✓	-	-	-	-	-	-	-	✓	-	✓	-	-	-	-
f26de6	-	-	-	✓	-	✓	-	-	-	-	✓	✓	-	-	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
92ab3d	✓	-	-	✓	✓	-	-	?	-	-	-	-	-	-	-	-	-	-
9623eb	✓	-	✓	-	-	-	-	-	-	-	✓	✓	-	-	-	-	-	-
1760ff	✓	-	✓	-	✓	-	✓	✓	-	✓	✓	✓	-	✓	✓	-	-	-
165952	✓	✓	?	-	-	-	✓	✓	-	✓	✓	✓	-	✓	✓	-	-	-
e27853	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
cea6a8	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8a28b3	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ed90bd	✓	-	-	-	-	-	✓	-	-	-	-	✓	-	-	-	-	-	-
e75474	-	-	-	-	-	-	-	-	-	-	✓	✓	-	-	✓	-	-	-
ce37e5	-	-	-	-	✓	-	-	-	-	-	-	-	-	-	✓	-	-	-
8c786e	-	-	-	-	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-
31ccbc	✓	-	-	-	✓	?	-	-	-	✓	✓	-	-	✓	-	-	-	-

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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 [%]
081752	98.0	98.0	98.0	5.0	98.0	0.0	0.0
27f302	98.7	97.7	98.6	3.5	98.3	0.55	0.56
b63fd6	98.0	98.0	99.0	2.0	98.3	0.58	0.59
d24f52	98.0	99.0	98.0	2.0	98.3	0.58	0.59
191e81	98.5	98.5	98.5	0.0	98.5	0.0	0.0
a9702a	98.7	98.6	98.6	0.1	98.6	0.06	0.06
968ace	99.0	98.0	99.0	5.0	98.7	0.58	0.59
526f8f	98.0	99.0	99.0	2.3	98.7	0.58	0.59
4970e4	99.0	99.0	98.0	0.2	98.7	0.58	0.59
1559c5	99.0	98.0	99.0	2.0	98.7	0.58	0.59
31ccbc	98.0	99.0	99.0	2.0	98.7	0.58	0.59
5f3943	98.0	99.0	99.0	2.5	98.7	0.58	0.59
a5f90f	99.0	99.0	98.0	0.1	98.7	0.58	0.59
e9a2b5	98.8	98.6	98.7	2.0	98.7	0.1	0.1
797873	98.6	98.6	98.9	-	98.7	0.17	0.18
9de317	98.7	98.7	98.7	0.4	98.7	0.03	0.03
9eaaa0	98.7	98.6	98.9	2.5	98.7	0.14	0.14
664b70	98.8	98.8	98.6	4.0	98.7	0.12	0.12
1760ff	98.7	99.0	98.6	5.0	98.8	0.21	0.21
9308e6	98.9	98.8	98.6	0.4	98.8	0.15	0.15
51f258	98.9	98.5	99.1	1.0	98.8	0.31	0.31
4089af	98.8	98.9	98.9	0.1	98.9	0.06	0.06
b58068	98.5	99.2	98.9	0.0	98.9	0.31	0.32
ed90bd	98.7	99.1	98.9	10.0	98.9	0.2	0.2
5cd479	98.7	98.9	99.2	0.5	98.9	0.27	0.27
8a28b3	99.0	99.0	99.0	14.0	99.0	0.0	0.0
cea6a8	99.0	99.0	99.0	14.0	99.0	0.0	0.0
9623eb	99.0	99.0	99.0	0.1	99.0	0.0	0.0
92ab3d	99.0	99.0	99.0	1.0	99.0	0.0	0.0
856fbd	99.0	99.0	99.0	1.0	99.0	0.0	0.0
503d35	99.0	99.0	99.0	0.9	99.0	0.0	0.0
e27853	99.0	99.0	99.0	1.0	99.0	0.0	0.0

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ID	Test results			u_X	$\bar{x}$	s_0	V_X
	[%]			[%]	[%]	[%]	[%]
165952	99.0	99.0	99.0	0.1	99.0	0.0	0.0
7d1284	99.0	-	-	-	99.0	0.0	0.0
119d89	99.0	99.0	99.0	-	99.0	0.0	0.0
9d28f5	99.0	-	-	-	99.0	0.0	0.0
d1fea8	99.0	99.0	99.0	0.7	99.0	0.0	0.0
5afa3f	99.0	-	-	-	99.0	0.0	0.0
6cb763	99.0	99.0	99.0	0.6	99.0	0.0	0.0
946645	99.0	99.0	99.0	1.0	99.0	0.0	0.0
bd8a5f	99.0	99.0	99.0	0.1	99.0	0.0	0.0
41bb56	99.0	99.0	99.0	1.0	99.0	0.0	0.0
473f5c	99.0	99.0	99.0	1.0	99.0	0.0	0.0
3b1853	99.0	99.0	99.0	2.0	99.0	0.0	0.0
3bfa79	99.0	99.0	99.0	1.0	99.0	0.0	0.0
b4ab8c	99.0	98.9	99.3	1.1	99.1	0.21	0.21
1ad821	99.2	99.4	98.6	0.3	99.1	0.45	0.45
1fd599	99.2	99.2	99.2	-	99.2	0.01	0.01
1e0c28	99.3	99.4	99.2	7.8	99.3	0.1	0.1

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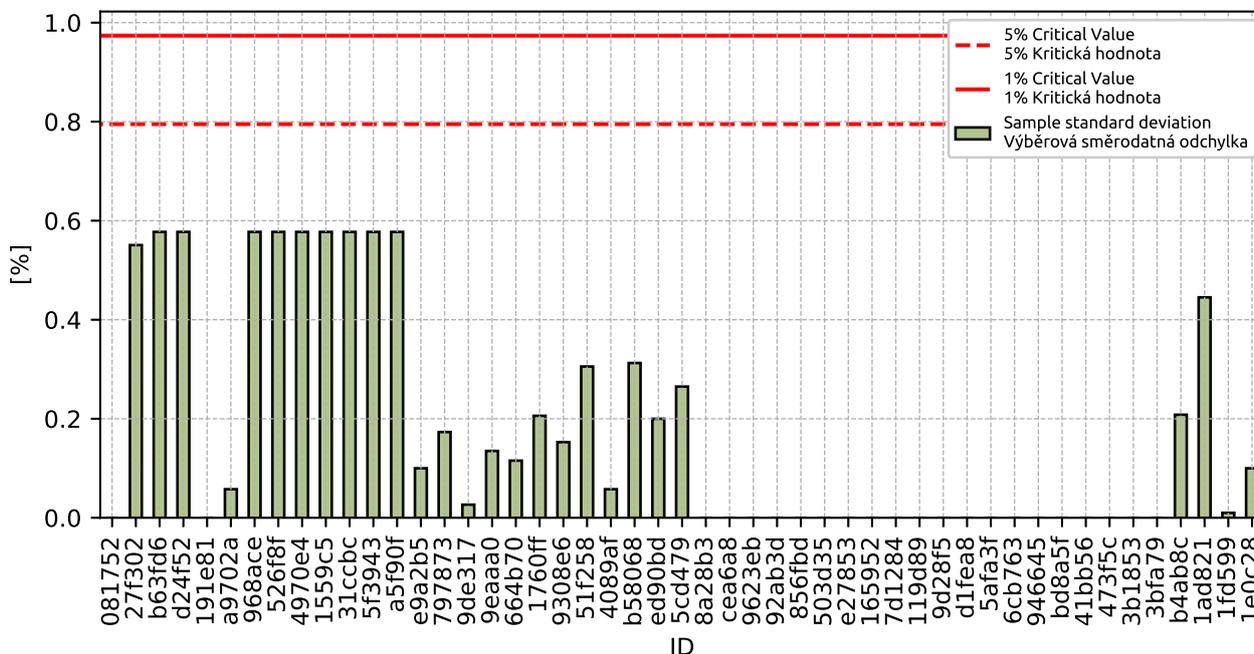
Figure 1: **Cochran's test** - sample standard deviations

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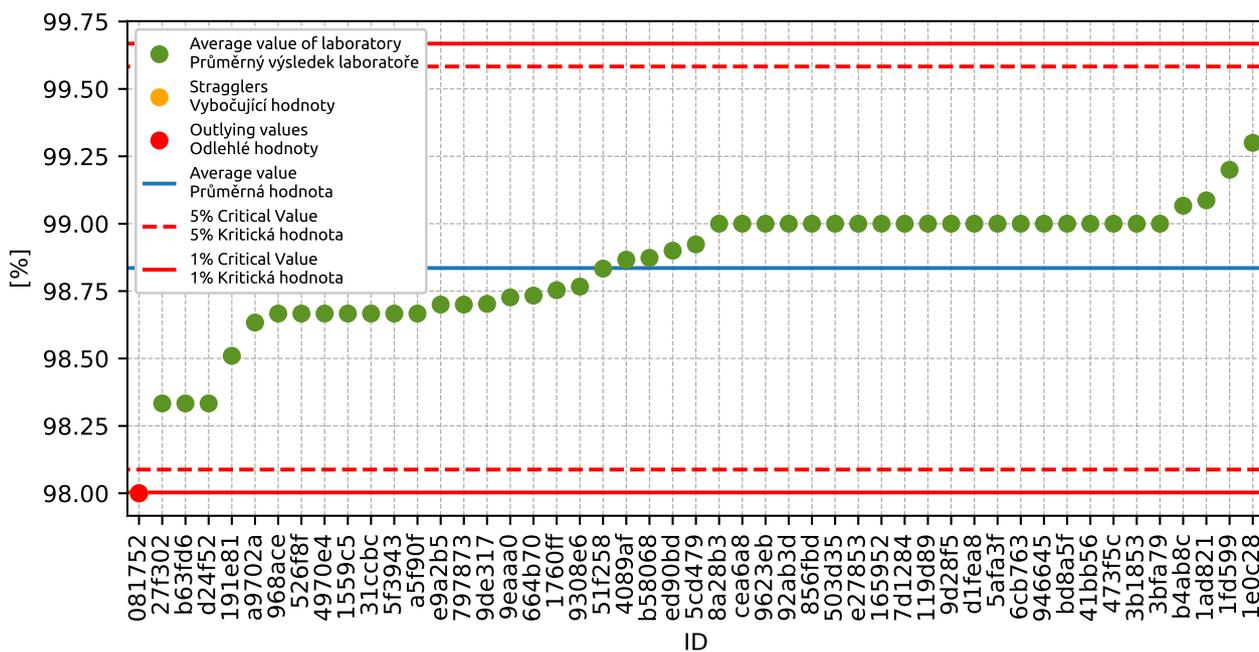
Figure 2: **Grubbs' test** - average values
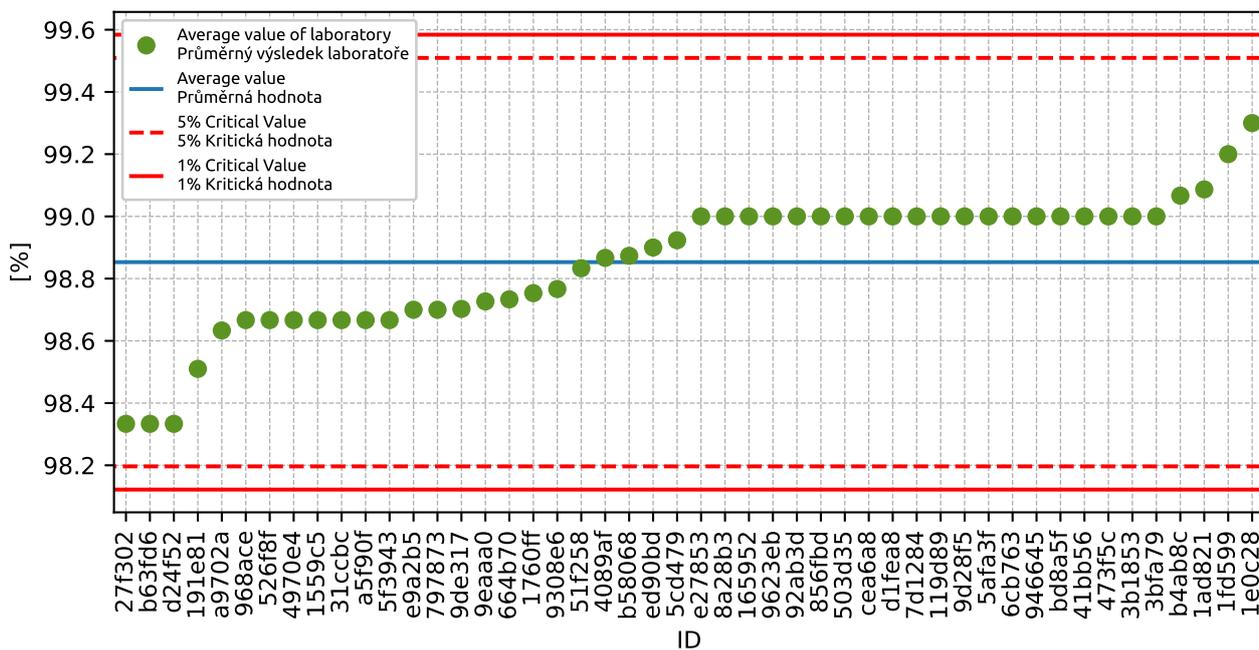
Figure 3: **Grubbs' test** - average values without outliers

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1.1.3 Mandel′s Statistics
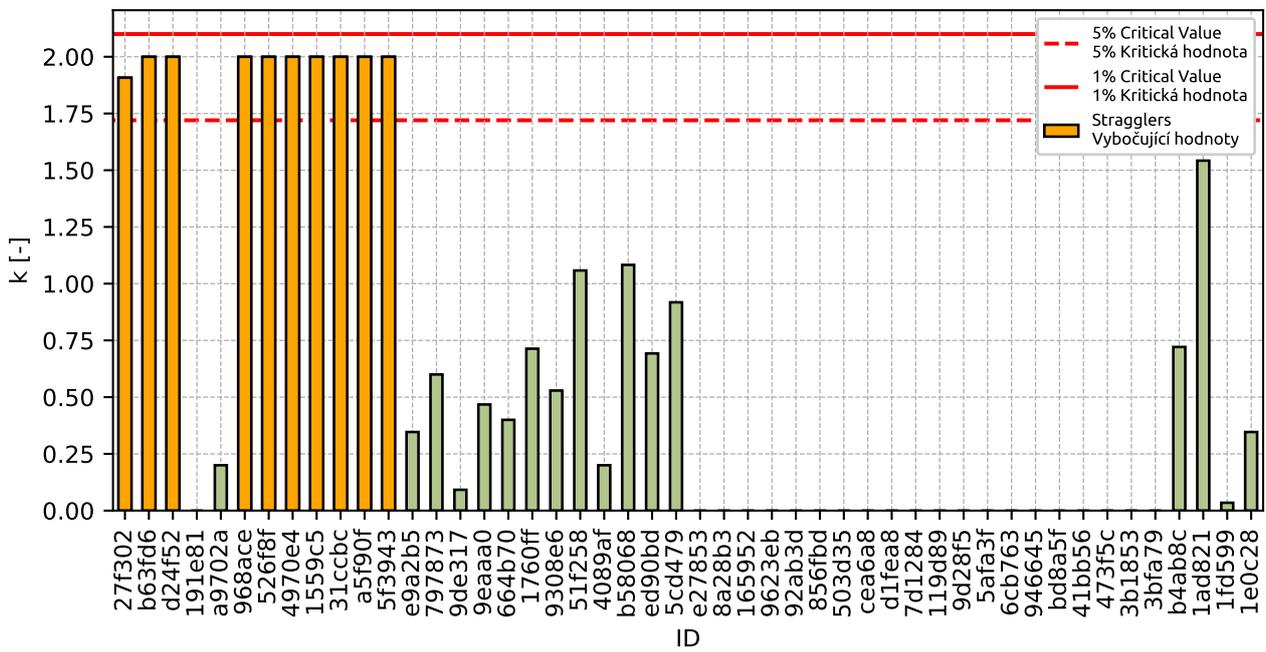
Figure 4: Intralaboratory Consistency Statistic
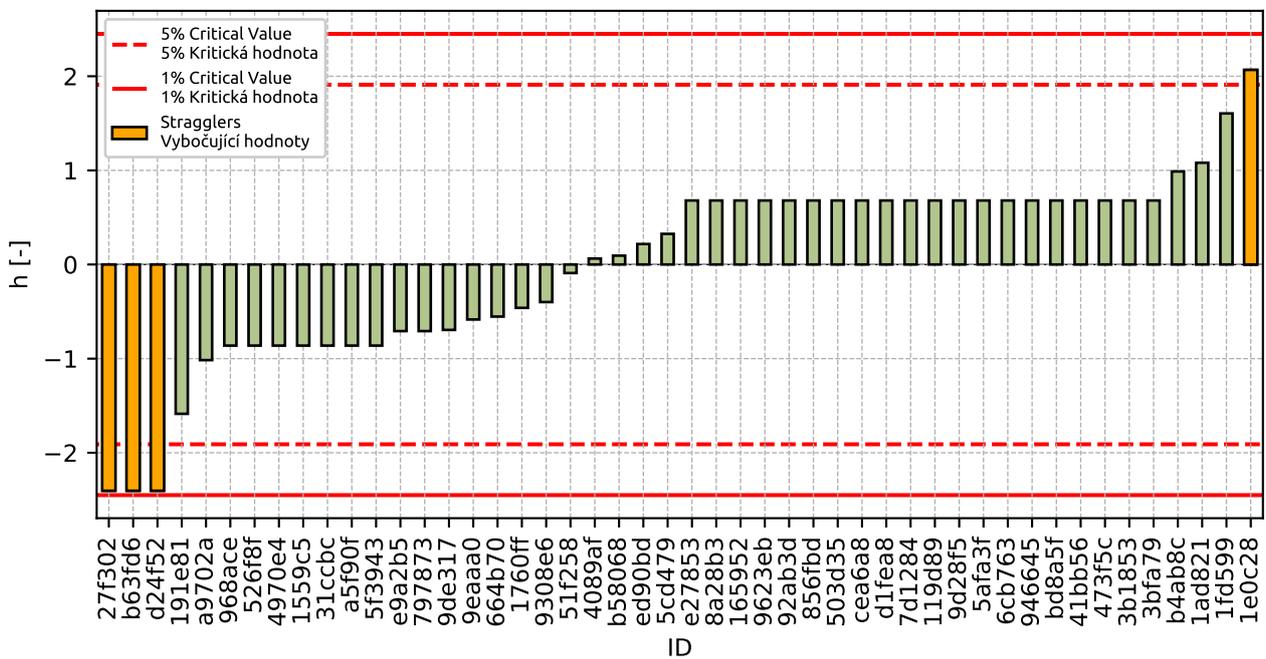
Figure 5: Interlaboratory Consistency Statistic

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1.1.4   Descriptive statistics
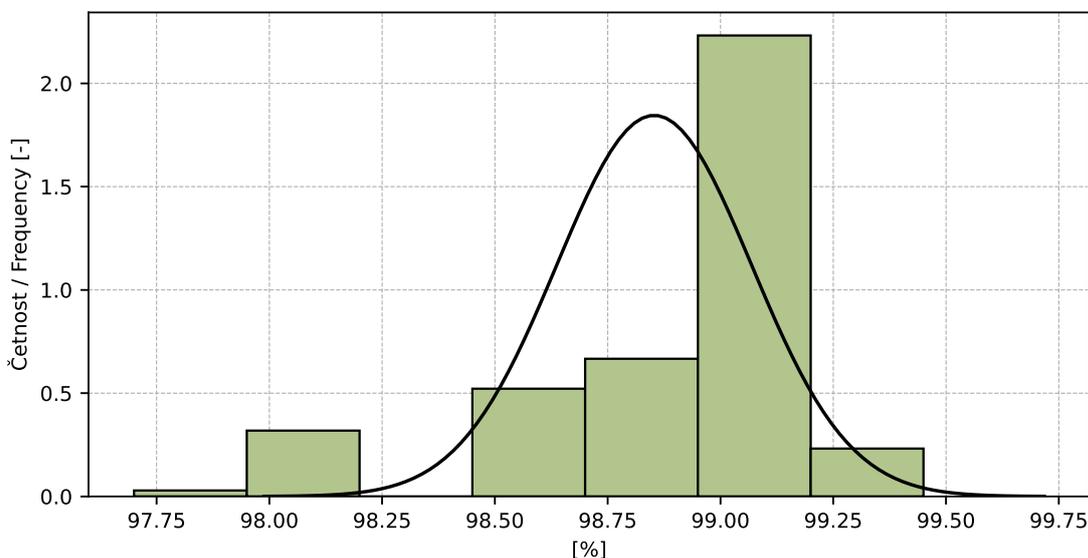
Figure 6: Histogram of all test results

Table 6: Descriptive statistics

Characteristics	[%]
Průměrná hodnota / Average value – $\bar{x}$	98.9
Výběrová směrodatná odchylka / Sample standard deviation – s	0.22
Vztažná hodnota / Asigned value – x^*	98.9
Robustní směrodatná odchylka / Robust standard deviation – s^*	0.22
Nejistota měření vztažné hodnoty / Measurement uncertainty of asigned value – u_X	0.46
p-hodnota testu normality / p-value of normality test	1.0 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – s_L	0.14
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – s_r	0.29
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – s_R	0.32
Opakovatelnost / Repeatability – r	0.8
Reprodukovatelnost / Reproducibility – R	0.9

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1.1.5 Evaluation of Performance Statistics
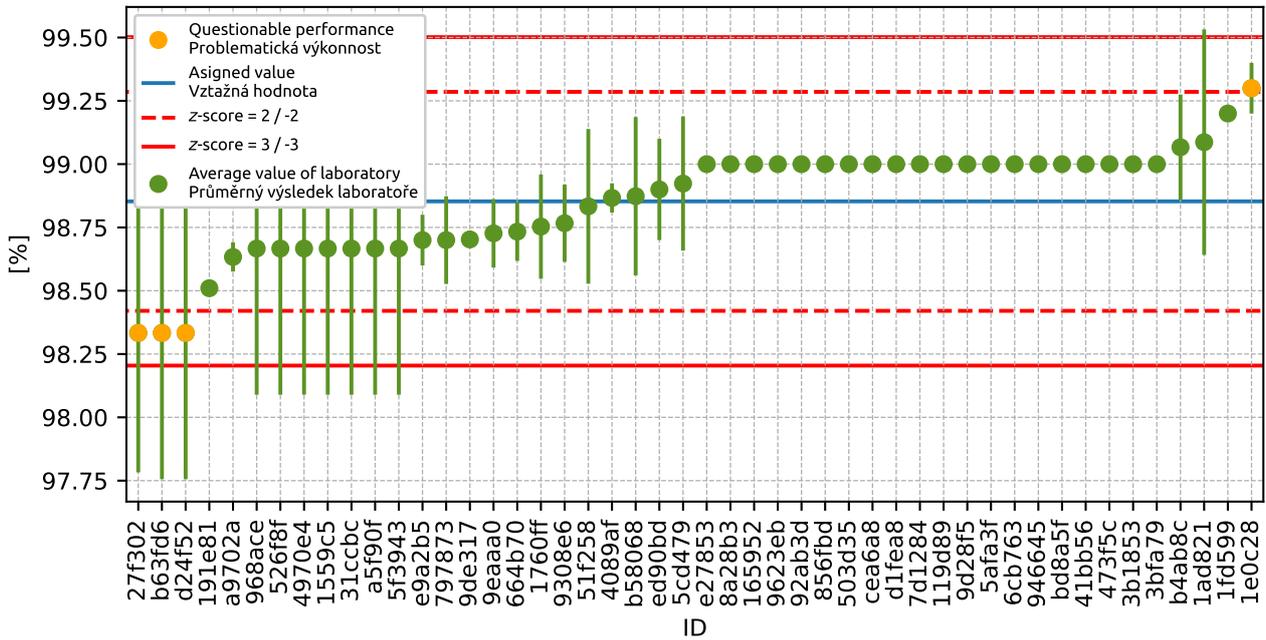
Figure 7: Average values and sample standard deviations
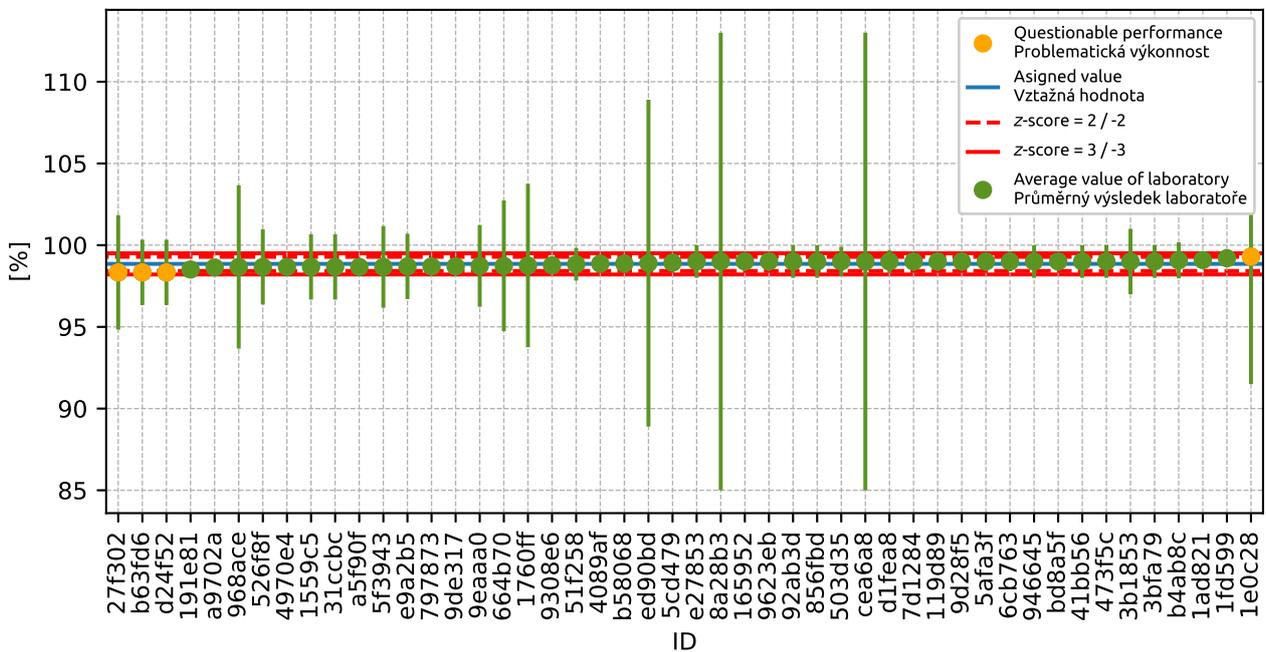
Figure 8: Average values and extended uncertainties of measurement

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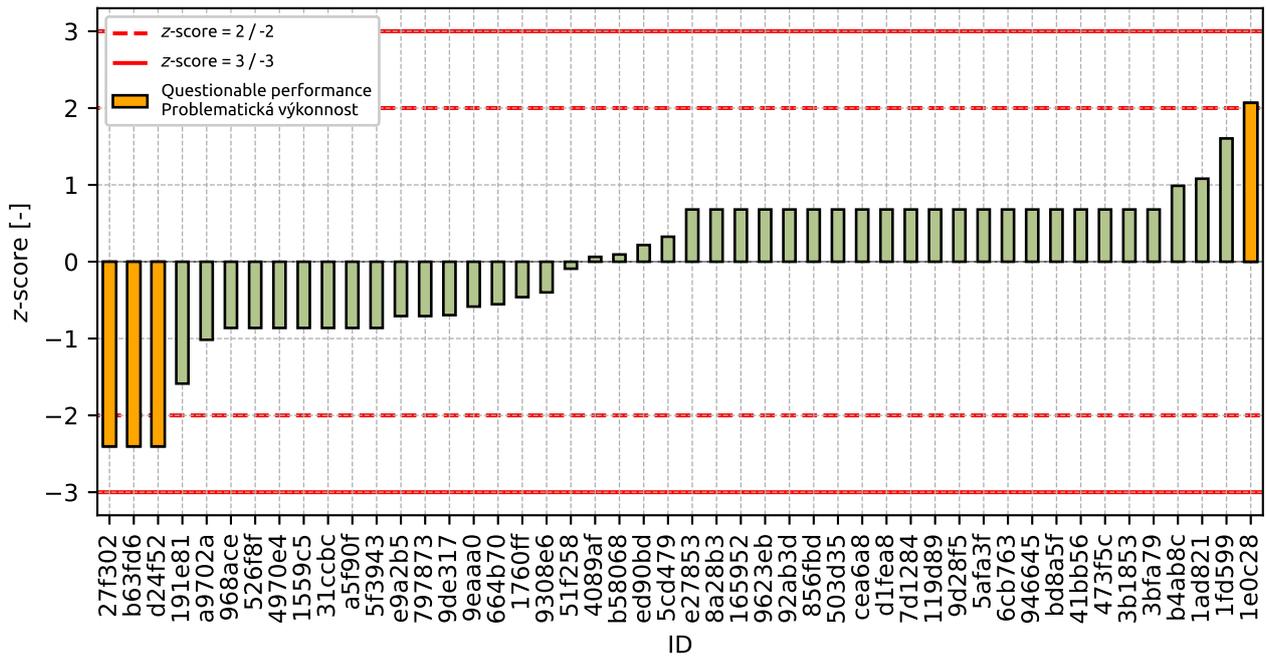
Figure 9: z-score

Figure 10: ζ-score

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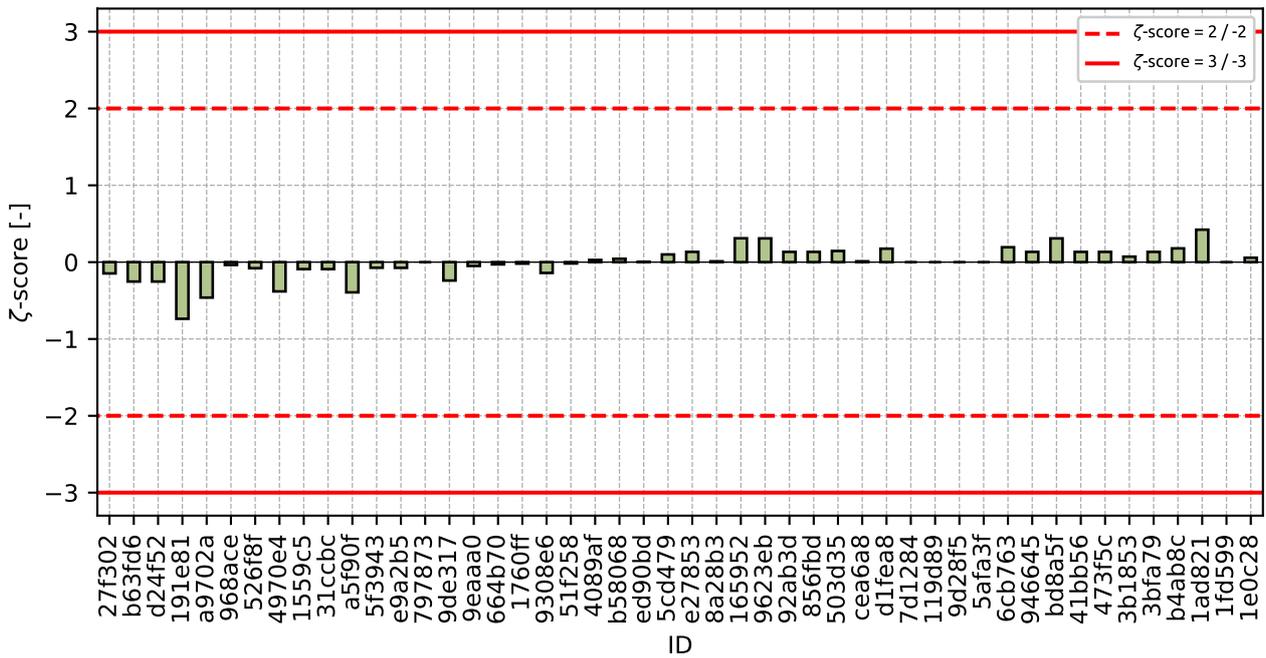
Table 7: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
27f302	-2.4	-0.15
b63fd6	-2.4	-0.25
d24f52	-2.4	-0.25
191e81	-1.59	-0.74
a9702a	-1.02	-0.46
968ace	-0.86	-0.04
526f8f	-0.86	-0.08
4970e4	-0.86	-0.38
1559c5	-0.86	-0.09
31ccbc	-0.86	-0.09
a5f90f	-0.86	-0.39
5f3943	-0.86	-0.07
e9a2b5	-0.71	-0.07
797873	-0.71	-
9de317	-0.7	-0.24
9eaaa0	-0.58	-0.05
664b70	-0.55	-0.03
1760ff	-0.46	-0.02
9308e6	-0.4	-0.14
51f258	-0.09	-0.02
4089af	0.06	0.03
b58068	0.09	0.04
ed90bd	0.22	0.0
5cd479	0.33	0.1
e27853	0.68	0.13
8a28b3	0.68	0.01
165952	0.68	0.31
9623eb	0.68	0.31
92ab3d	0.68	0.13
856fbd	0.68	0.13
503d35	0.68	0.15
cea6a8	0.68	0.01
d1fea8	0.68	0.17
7d1284	0.68	-
119d89	0.68	-
9d28f5	0.68	-
5afa3f	0.68	-
6cb763	0.68	0.19
946645	0.68	0.13
bd8a5f	0.68	0.31
41bb56	0.68	0.13

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ID	z-score [-]	ζ-score [-]
473f5c	0.68	0.13
3b1853	0.68	0.07
3bfa79	0.68	0.13
b4ab8c	0.99	0.18
1ad821	1.08	0.42
1fd599	1.61	-
1e0c28	2.07	0.06

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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 [%]
a9702a	84.4	84.2	84.5	0.1	84.4	0.15	0.18
081752	85.0	85.0	85.0	1.0	85.0	0.0	0.0
b58068	86.4	84.5	84.5	0.2	85.1	1.12	1.32
b4ab8c	85.6	84.0	86.0	1.1	85.2	1.06	1.24
9eaaa0	84.8	85.2	85.7	2.5	85.2	0.47	0.55
968ace	85.0	86.0	85.0	2.0	85.3	0.58	0.68
1559c5	86.0	85.0	85.0	2.0	85.3	0.58	0.68
856fbd	86.0	85.0	85.0	1.0	85.3	0.58	0.68
a5f90f	85.0	86.0	85.0	0.1	85.3	0.58	0.68
526f8f	86.0	85.0	86.0	2.0	85.7	0.58	0.67
4970e4	85.0	86.0	86.0	0.3	85.7	0.58	0.67
9623eb	85.0	86.0	86.0	0.1	85.7	0.58	0.67
1760ff	85.9	85.8	85.5	5.0	85.8	0.21	0.24
664b70	86.0	85.9	85.5	4.0	85.8	0.26	0.31
191e81	85.9	86.0	85.9	0.2	85.9	0.06	0.07
27f302	86.2	86.0	85.6	3.5	85.9	0.31	0.36
1fd599	86.2	85.9	85.7	-	85.9	0.26	0.3
165952	86.0	86.0	86.0	0.1	86.0	0.0	0.0
e27853	86.0	86.0	86.0	1.0	86.0	0.0	0.0
cea6a8	86.0	86.0	86.0	14.0	86.0	0.0	0.0
8a28b3	86.0	86.0	86.0	14.0	86.0	0.0	0.0
92ab3d	86.0	85.0	87.0	2.0	86.0	1.0	1.16
3bfa79	86.0	86.0	86.0	2.0	86.0	0.0	0.0
119d89	86.0	86.0	86.0	-	86.0	0.0	0.0
b63fd6	84.0	85.0	89.0	6.0	86.0	2.65	3.08
d24f52	86.0	86.0	86.0	2.0	86.0	0.0	0.0
473f5c	84.0	86.0	88.0	1.0	86.0	2.0	2.33
e9a2b5	86.1	86.3	85.8	2.0	86.1	0.25	0.29
5cd479	85.6	86.5	86.3	1.0	86.1	0.5	0.58
9de317	86.5	86.5	85.8	0.2	86.3	0.4	0.46
5f3943	86.0	87.0	86.0	2.5	86.3	0.58	0.67
31ccbc	86.0	87.0	86.0	2.0	86.3	0.58	0.67
9308e6	86.7	86.5	85.9	1.0	86.4	0.42	0.48
1ad821	84.0	87.3	88.1	0.1	86.4	2.2	2.54

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ID	Test results			u_X	$\bar{x}$	s_0	V_X
	[%]			[%]	[%]	[%]	[%]
d1fea8	86.0	87.0	87.0	0.7	86.7	0.58	0.67
3b1853	87.0	86.0	87.0	2.0	86.7	0.58	0.67
6cb763	87.0	86.0	87.0	0.6	86.7	0.58	0.67
bd8a5f	86.0	87.0	87.0	0.1	86.7	0.58	0.67
946645	86.0	87.0	87.0	1.0	86.7	0.58	0.67
ed90bd	86.4	86.1	87.8	10.0	86.8	0.91	1.05
1e0c28	86.8	86.9	86.9	5.7	86.9	0.06	0.07
4089af	86.7	86.8	87.1	0.3	86.9	0.21	0.24
5afa3f	87.0	-	-	-	87.0	0.0	0.0
9d28f5	87.0	-	-	-	87.0	0.0	0.0
503d35	88.0	88.0	87.0	2.9	87.7	0.58	0.66
797873	88.6	86.5	88.4	-	87.8	1.16	1.32
41bb56	89.0	89.0	88.0	1.0	88.7	0.58	0.65
51f258	88.8	89.1	88.2	0.9	88.7	0.46	0.52
7d1284	89.0	-	-	-	89.0	0.0	0.0

1.2.2 The Numerical Procedure for Determining Outliers
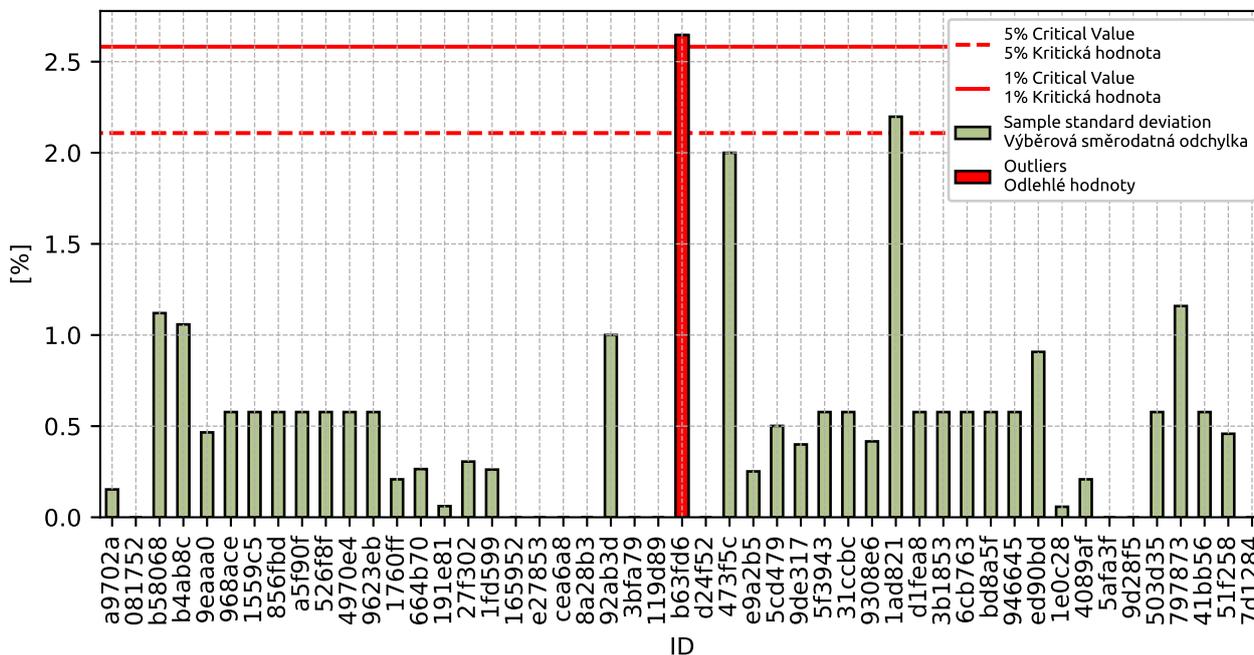
Figure 11: **Cochran's test** - sample standard deviations

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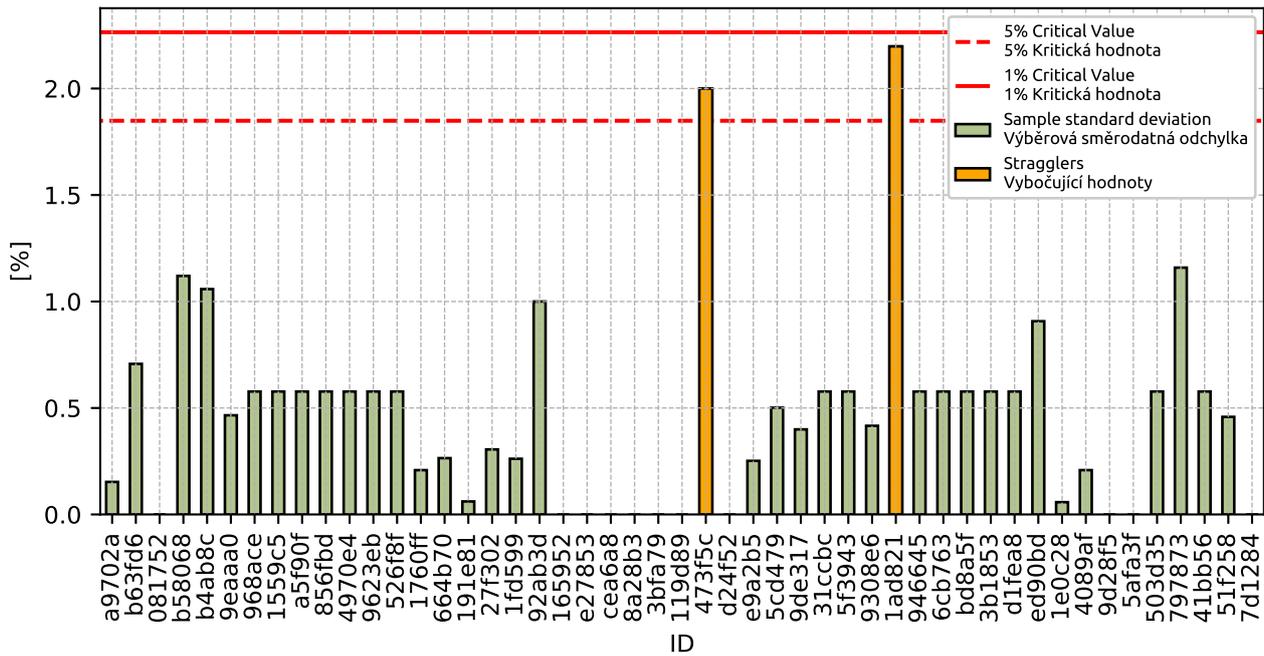
Figure 12: **Cochran's test** - sample standard deviations without outliers
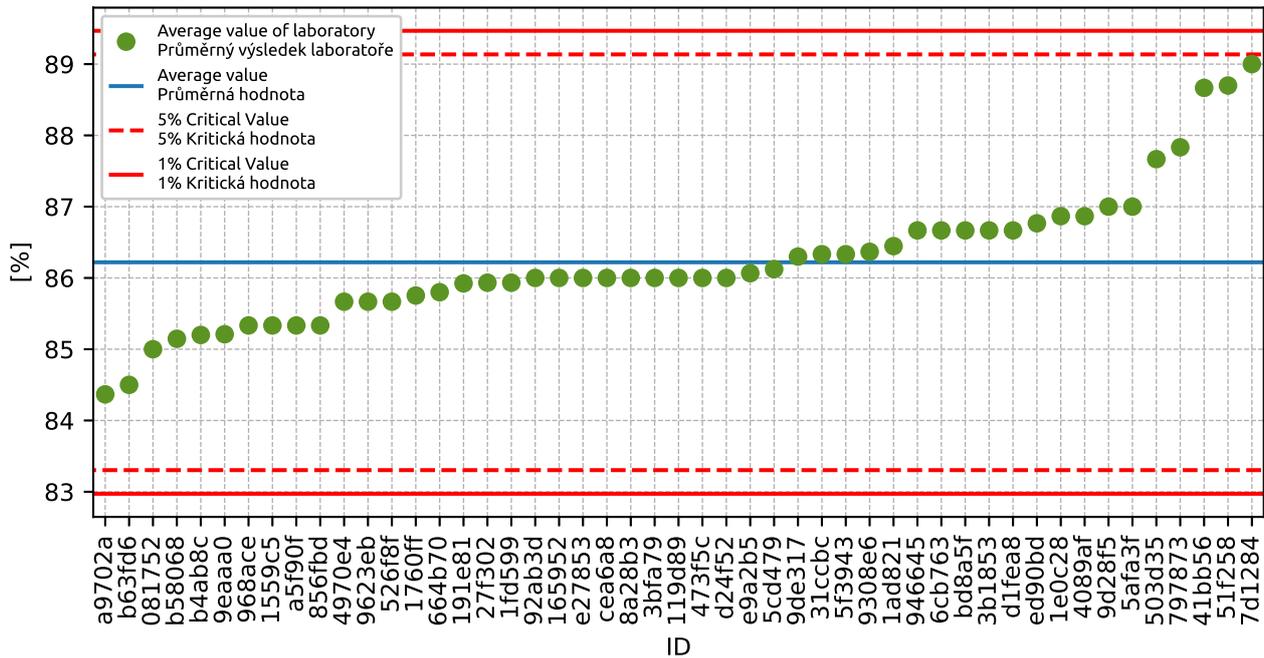
Figure 13: **Grubbs' test** - average values

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1.2.3   Mandel′s Statistics
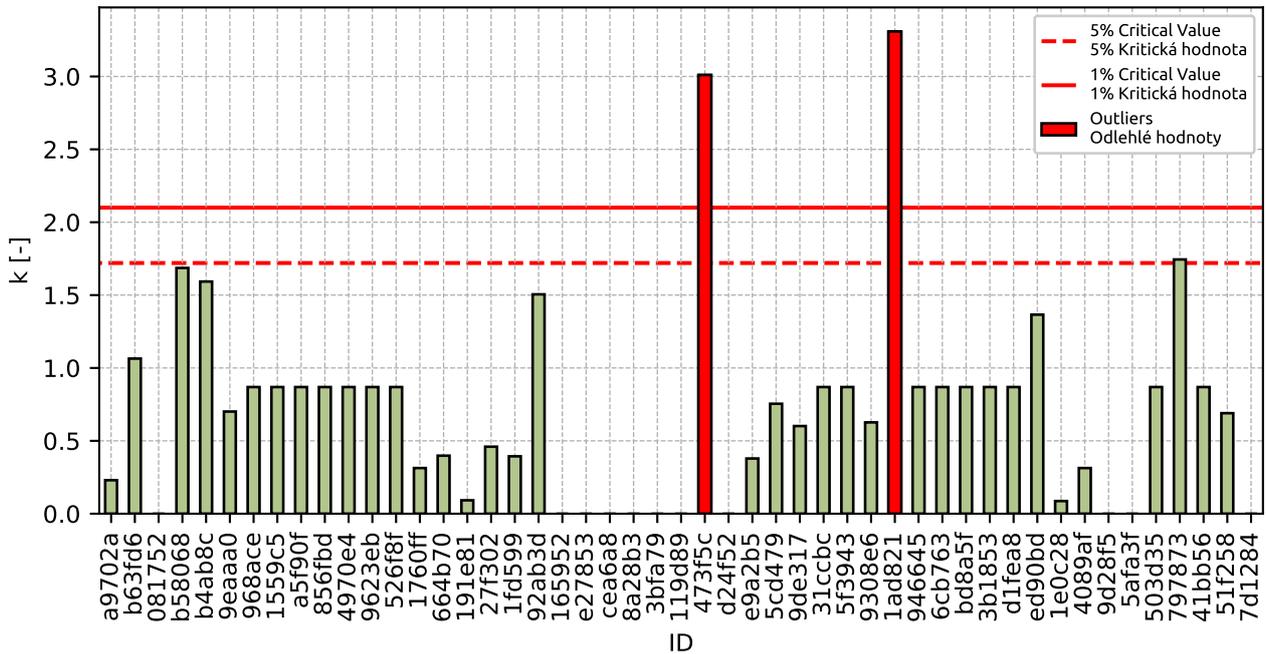
Figure 14: Intralaboratory Consistency Statistic
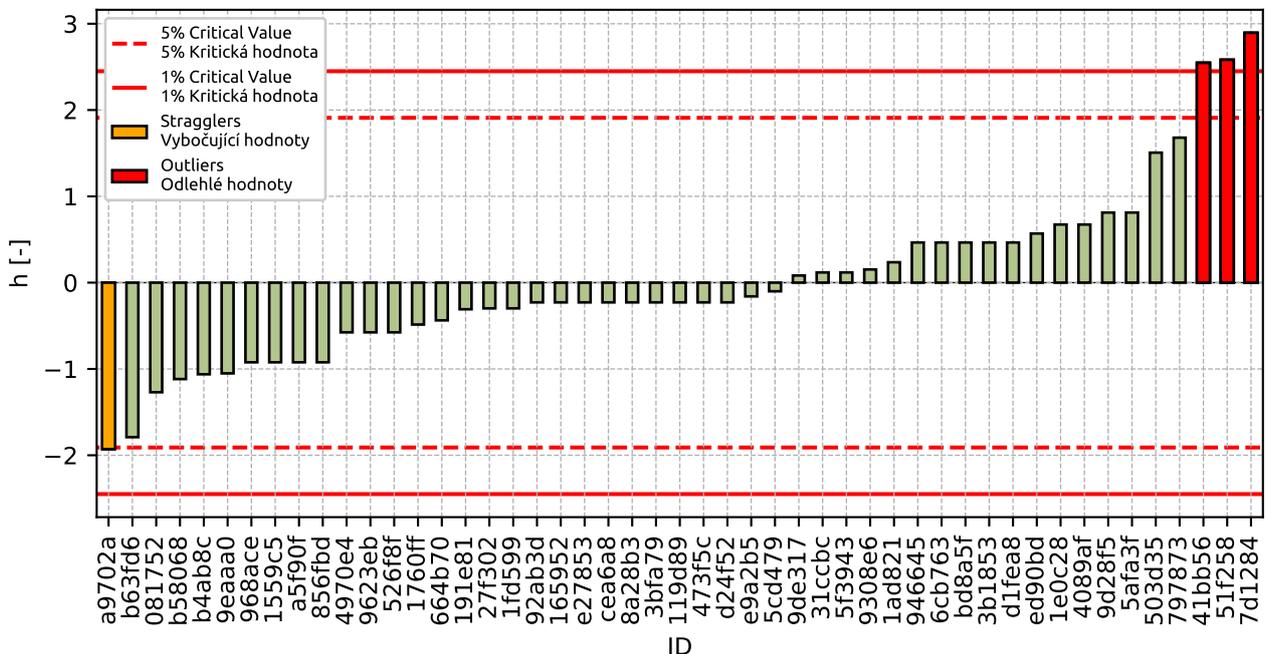
Figure 15: Interlaboratory Consistency Statistic

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1.2.4 Descriptive statistics
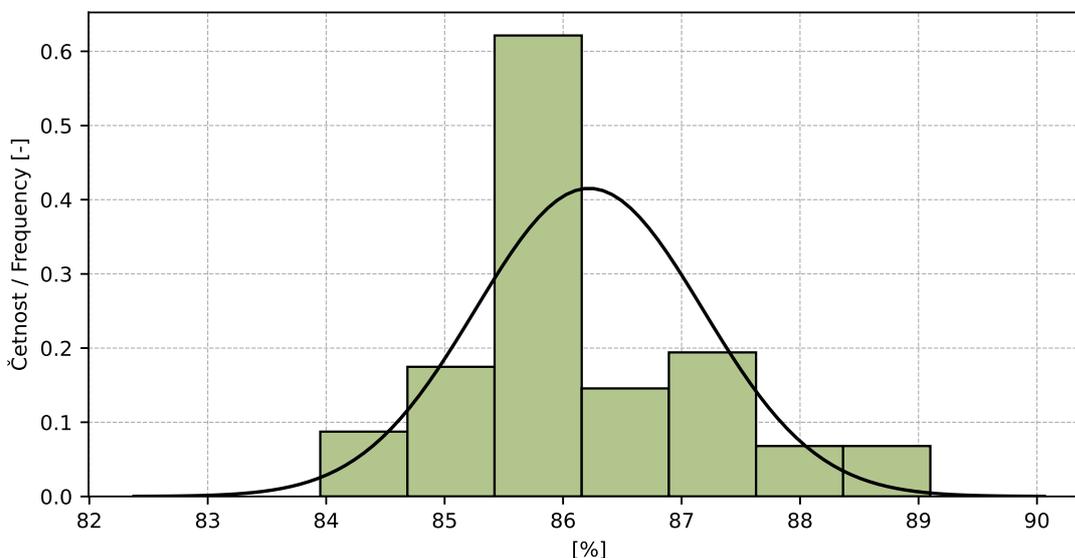
Figure 16: Histogram of all test results

Table 9: Descriptive statistics

Characteristics	[%]
Průměrná hodnota / Average value – $\bar{x}$	86.2
Výběrová směrodatná odchylka / Sample standard deviation – s	0.96
Vztažná hodnota / Asigned value – x^*	86.2
Robustní směrodatná odchylka / Robust standard deviation – s^*	0.96
Nejistota měření vztažné hodnoty / Measurement uncertainty of asigned value – u_X	0.98
p-hodnota testu normality / p-value of normality test	1.0 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – s_L	0.88
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – s_r	0.66
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – s_R	1.1
Opakovatelnost / Repeatability – r	1.9
Reprodukovatelnost / Reproducibility – R	3.1

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1.2.5   Evaluation of Performance Statistics
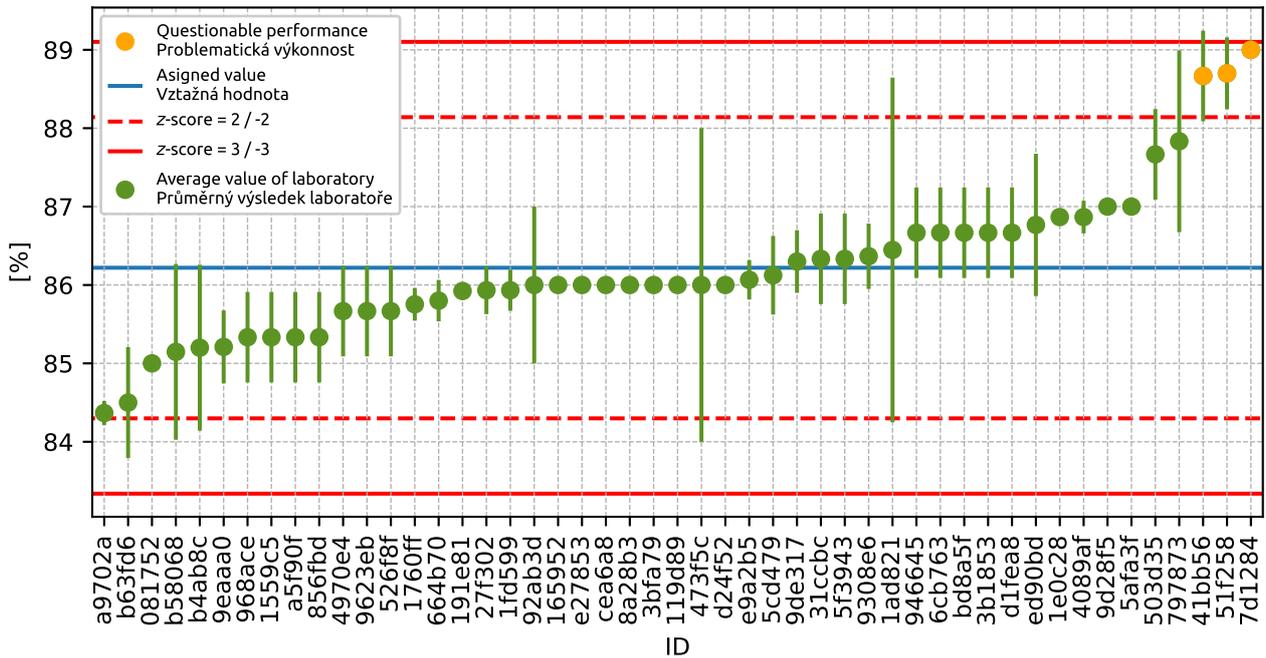

Figure 17: Average values and sample standard deviations
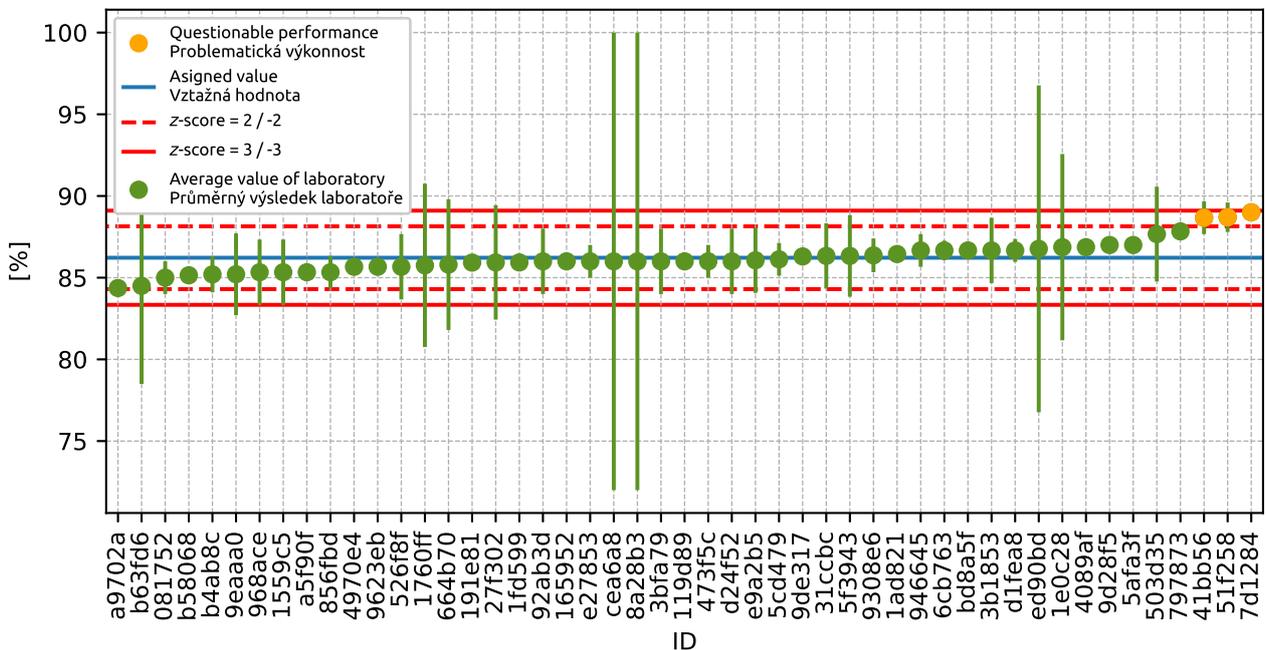
Figure 18: Average values and extended uncertainties of measurement

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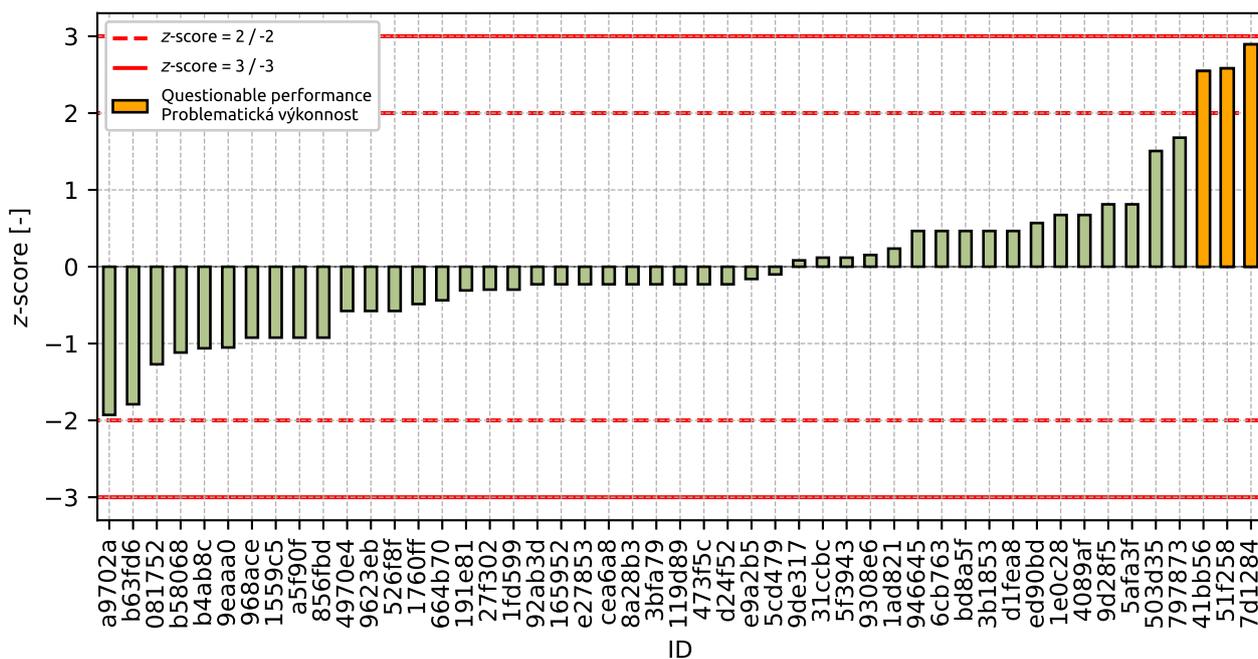
Figure 19: z-score

Figure 20: ζ-score

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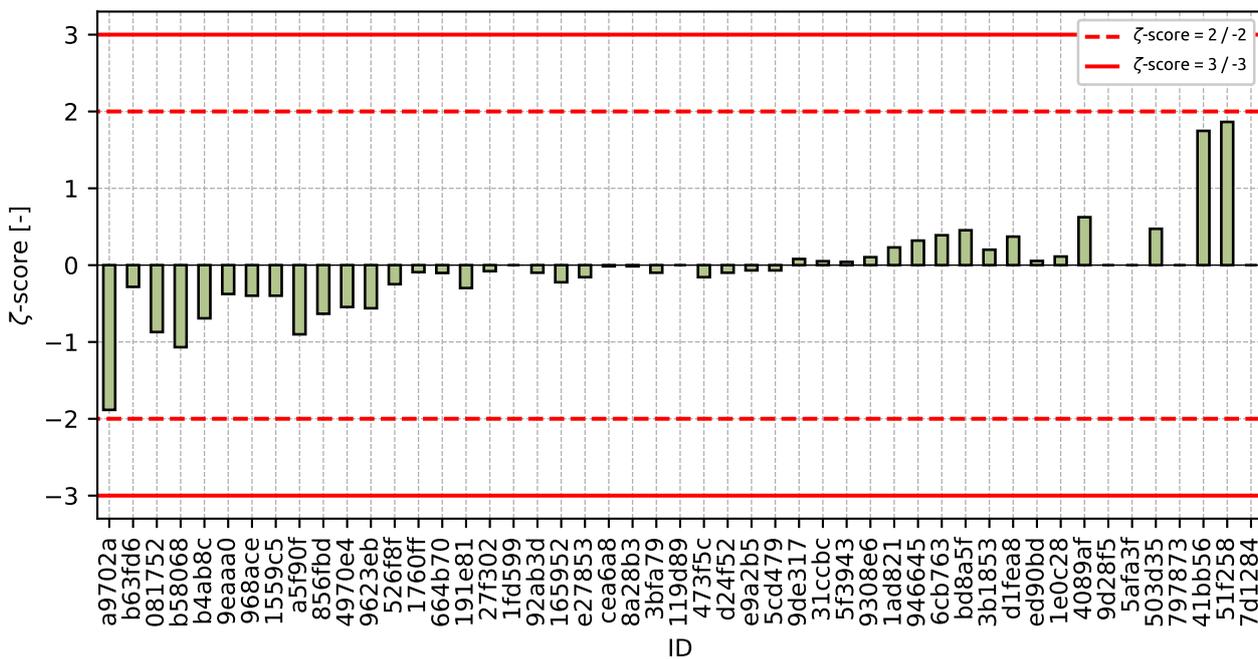
Table 10: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
a9702a	-1.93	-1.88
b63fd6	-1.79	-0.28
081752	-1.27	-0.87
b58068	-1.12	-1.07
b4ab8c	-1.06	-0.69
9eaaa0	-1.05	-0.38
968ace	-0.92	-0.4
1559c5	-0.92	-0.4
a5f90f	-0.92	-0.9
856fbd	-0.92	-0.63
4970e4	-0.58	-0.55
9623eb	-0.58	-0.56
526f8f	-0.58	-0.25
1760ff	-0.49	-0.09
664b70	-0.44	-0.1
191e81	-0.31	-0.3
27f302	-0.3	-0.08
1fd599	-0.3	-
92ab3d	-0.23	-0.1
165952	-0.23	-0.22
e27853	-0.23	-0.16
cea6a8	-0.23	-0.02
8a28b3	-0.23	-0.02
3bfa79	-0.23	-0.1
119d89	-0.23	-
473f5c	-0.23	-0.16
d24f52	-0.23	-0.1
e9a2b5	-0.16	-0.07
5cd479	-0.1	-0.07
9de317	0.08	0.08
31ccbc	0.12	0.05
5f3943	0.12	0.04
9308e6	0.15	0.1
1ad821	0.24	0.23
946645	0.47	0.32
6cb763	0.47	0.39
bd8a5f	0.47	0.45
3b1853	0.47	0.2
d1fea8	0.47	0.37
ed90bd	0.57	0.05
1e0c28	0.67	0.11

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ID	z-score [-]	ζ-score [-]
4089af	0.67	0.62
9d28f5	0.81	-
5afa3f	0.81	-
503d35	1.51	0.47
797873	1.68	-
41bb56	2.55	1.75
51f258	2.58	1.86
7d1284	2.89	-

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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
	[%]			[%]	[%]	[%]	[%]
b58068	61.2	57.2	56.3	0.5	58.2	2.59	4.45
92ab3d	59.0	57.0	61.0	5.0	59.0	2.0	3.39
b4ab8c	60.2	57.0	62.2	1.1	59.8	2.62	4.39
e9a2b5	60.0	60.2	60.0	2.0	60.1	0.12	0.19
9eaaa0	60.4	59.8	60.5	2.5	60.2	0.35	0.58
b63fd6	56.0	60.0	66.0	12.0	60.7	5.03	8.3
664b70	60.8	61.3	60.5	4.0	60.9	0.4	0.66
081752	61.0	61.0	61.0	1.0	61.0	0.0	0.0
8a28b3	61.0	61.0	61.0	14.0	61.0	0.0	0.0
cea6a8	61.0	61.0	61.0	14.0	61.0	0.0	0.0
1fd599	62.0	61.2	60.7	-	61.3	0.67	1.09
856fbd	62.0	61.0	61.0	1.0	61.3	0.58	0.94
e27853	61.0	61.0	62.0	1.0	61.3	0.58	0.94
119d89	61.0	62.0	61.0	-	61.3	0.58	0.94
a5f90f	60.0	63.0	61.0	0.1	61.3	1.53	2.49
968ace	62.0	61.0	62.0	1.0	61.7	0.58	0.94
27f302	62.0	62.2	61.4	3.5	61.9	0.42	0.67
a9702a	62.0	61.7	61.9	0.1	61.9	0.15	0.25
165952	62.0	62.0	62.0	0.1	62.0	0.0	0.0
7d1284	62.0	-	-	-	62.0	0.0	0.0
4970e4	61.0	61.0	64.0	0.4	62.0	1.73	2.79
3bfa79	62.0	62.0	62.0	3.0	62.0	0.0	0.0
1559c5	62.0	62.0	62.0	1.0	62.0	0.0	0.0
9de317	62.2	62.5	61.8	0.2	62.2	0.35	0.57
1ad821	53.1	61.2	72.5	0.1	62.3	9.74	15.65
526f8f	62.0	62.0	63.0	1.5	62.3	0.58	0.93
5f3943	62.0	63.0	62.0	2.5	62.3	0.58	0.93
3b1853	63.0	62.0	62.0	2.0	62.3	0.58	0.93
946645	62.0	63.0	62.0	1.0	62.3	0.58	0.93
1760ff	62.5	62.7	62.0	5.0	62.4	0.4	0.65
5cd479	62.6	62.5	62.6	0.1	62.6	0.05	0.08
6cb763	63.0	62.0	63.0	0.6	62.7	0.58	0.92
9308e6	63.2	63.0	62.2	1.2	62.8	0.53	0.84
ed90bd	63.1	60.6	65.1	10.0	62.9	2.25	3.58

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ID	Test results			u_X	$\bar{x}$	s_0	V_X
	[%]			[%]	[%]	[%]	[%]
9d28f5	63.0	-	-	-	63.0	0.0	0.0
bd8a5f	63.0	63.0	63.0	0.3	63.0	0.0	0.0
191e81	63.2	63.3	63.1	0.3	63.2	0.11	0.17
51f258	63.1	63.2	63.5	0.6	63.3	0.21	0.33
473f5c	64.0	65.0	61.0	1.0	63.3	2.08	3.29
4089af	63.1	63.4	63.5	0.3	63.3	0.21	0.33
d1fea8	63.0	64.0	63.0	0.6	63.3	0.58	0.91
9623eb	63.0	64.0	63.0	0.1	63.3	0.58	0.91
31ccbc	63.0	64.0	64.0	2.0	63.7	0.58	0.91
d24f52	64.0	64.0	63.0	2.0	63.7	0.58	0.91
41bb56	64.0	64.0	63.0	1.0	63.7	0.58	0.91
503d35	65.0	63.0	63.0	4.1	63.7	1.15	1.81
5afa3f	64.0	-	-	-	64.0	0.0	0.0
797873	64.5	61.5	66.9	-	64.3	2.71	4.21
1e0c28	65.0	65.0	64.7	5.3	64.9	0.17	0.27

1.3.2   The Numerical Procedure for Determining Outliers
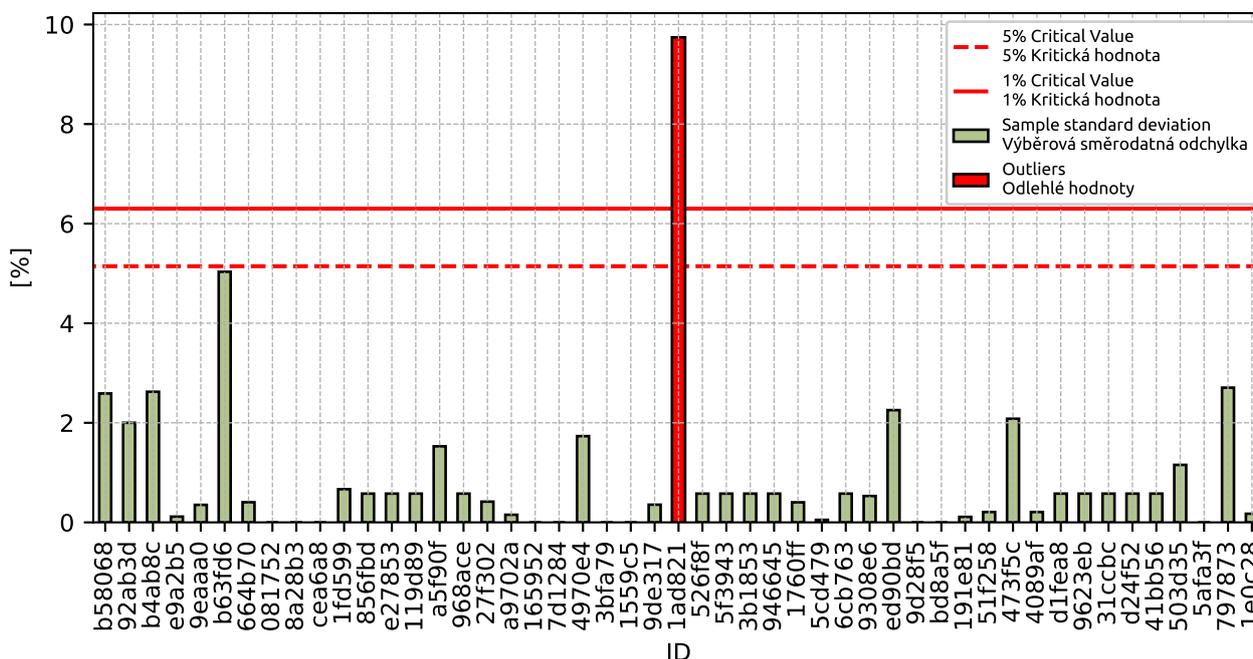
Figure 21: **Cochran's test** - sample standard deviations

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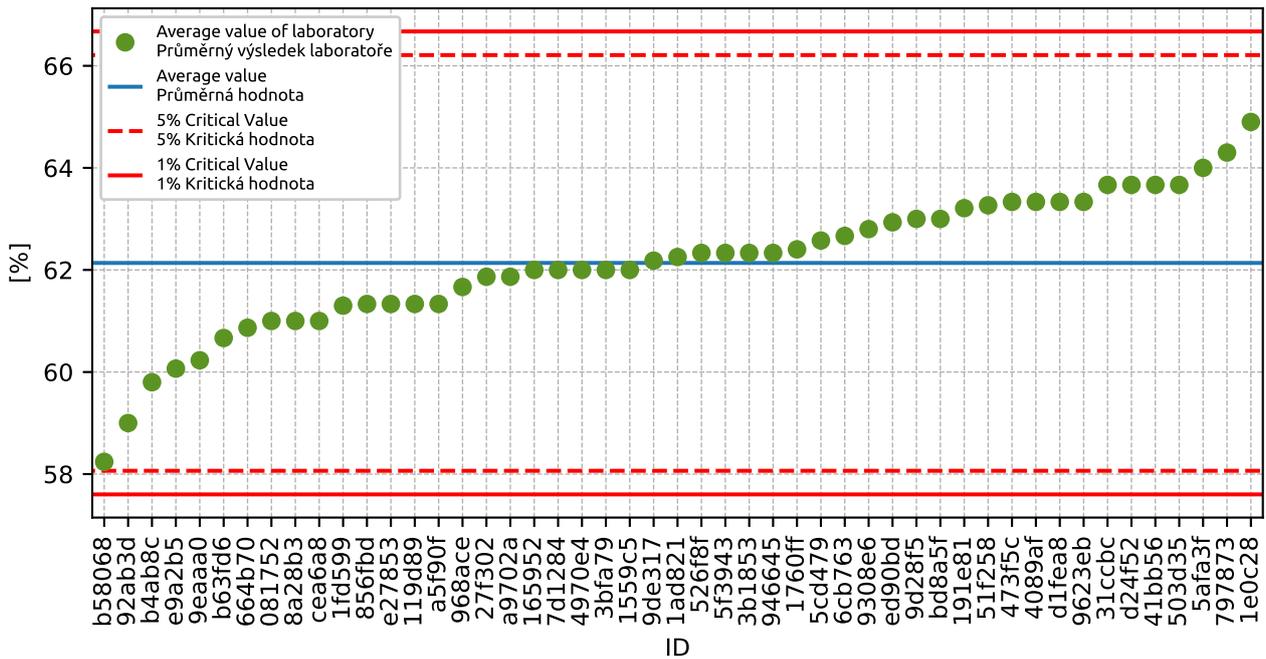
Figure 22: **Grubbs' test** - average values

1.3.3 Mandel's Statistics
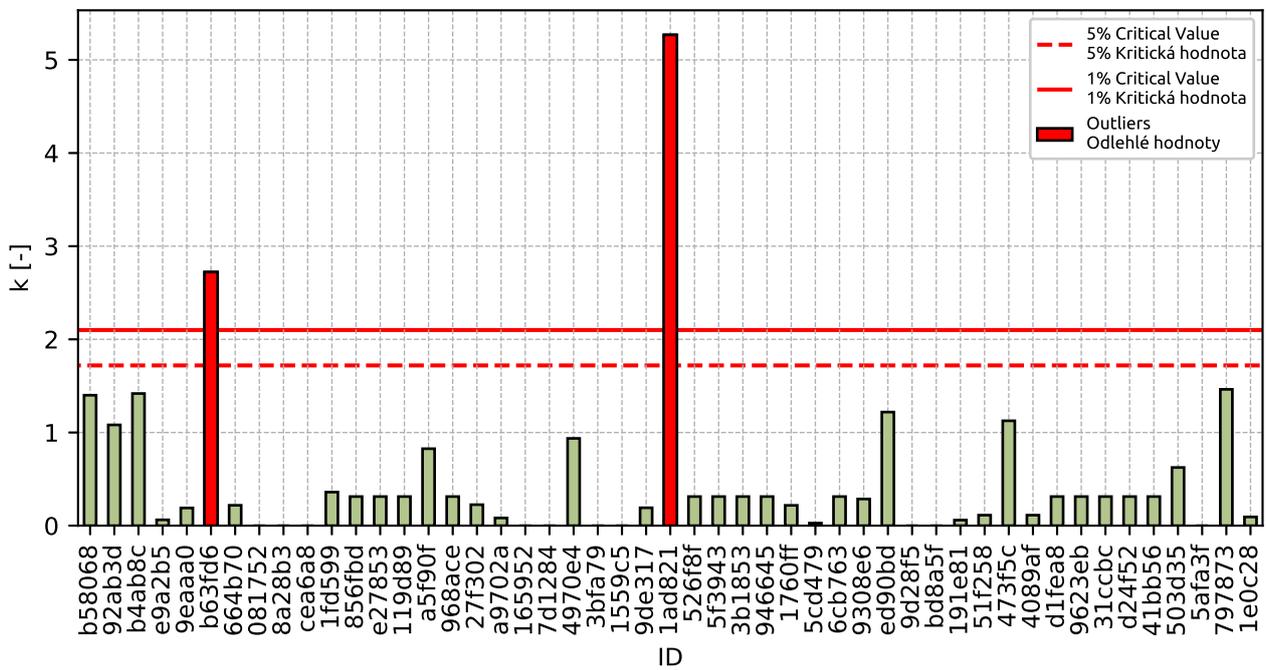
Figure 23: Intralaboratory Consistency Statistic

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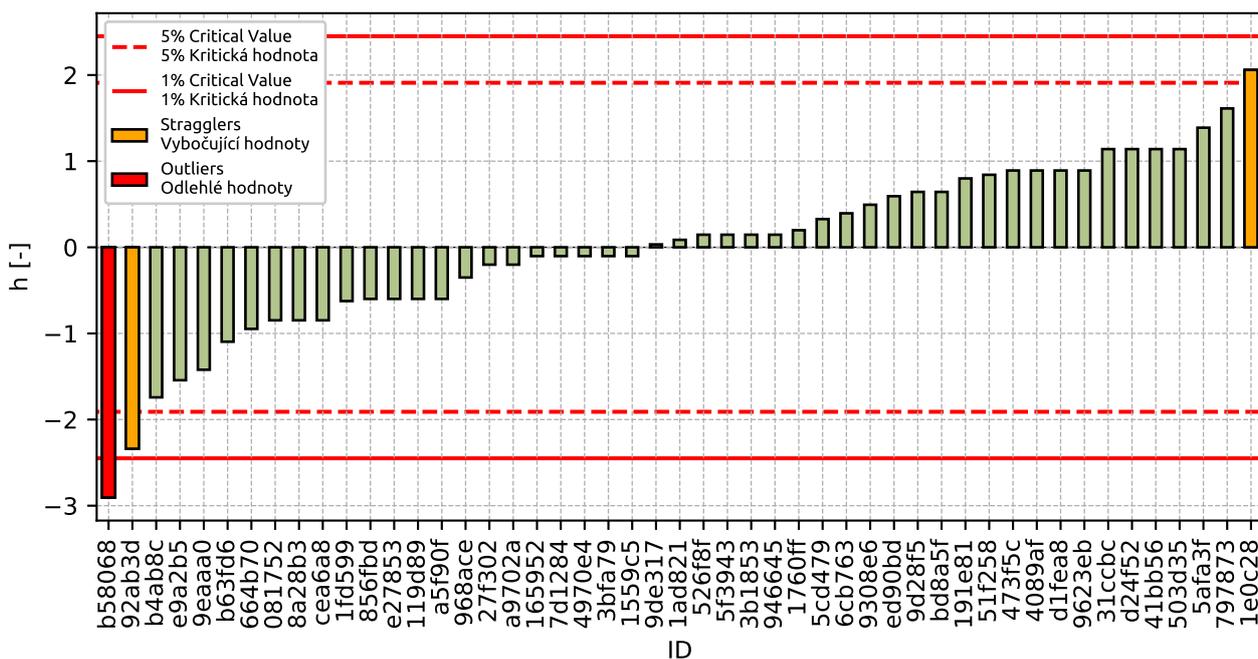
Figure 24: Interlaboratory Consistency Statistic

1.3.4   Descriptive statistics
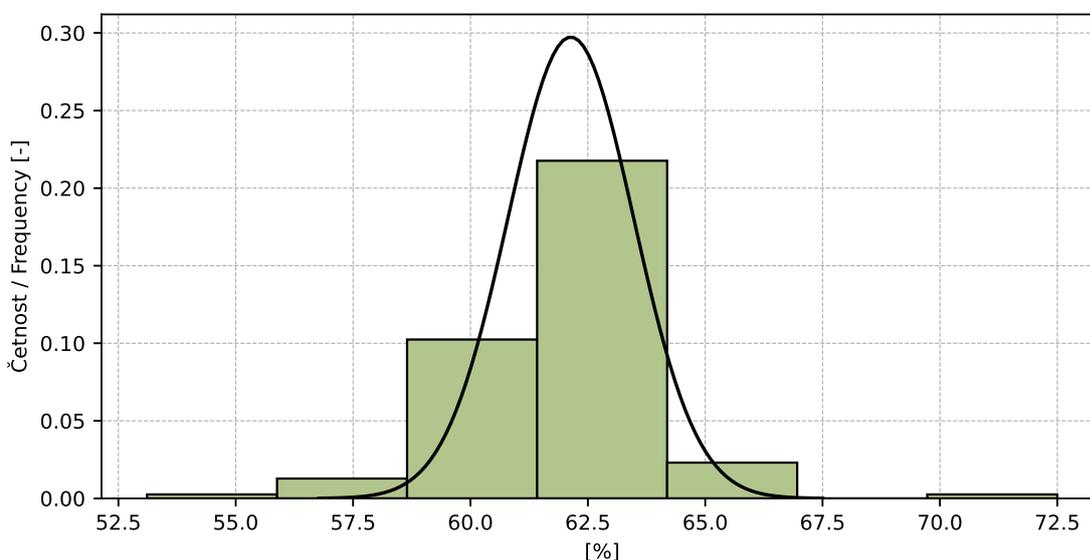
Figure 25: Histogram of all test results

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Table 12: Descriptive statistics

| Characteristics	[%]
Průměrná hodnota / Average value – $\bar{x}$	62.1
Výběrová směrodatná odchylka / Sample standard deviation – s	1.34
Vztažná hodnota / Asigned value – x^*	62.1
Robustní směrodatná odchylka / Robust standard deviation – s^*	1.34
Nejistota měření vztažné hodnoty / Measurement uncertainty of asigned value – u_X	1.16
p-hodnota testu normality / p-value of normality test	1.0 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – s_L	0.81
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – s_r	1.85
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – s_R	2.02
Opakovatelnost / Repeatability – r	5.2
Reprodukovatelnost / Reproducibility – R	5.7

1.3.5   Evaluation of Performance Statistics
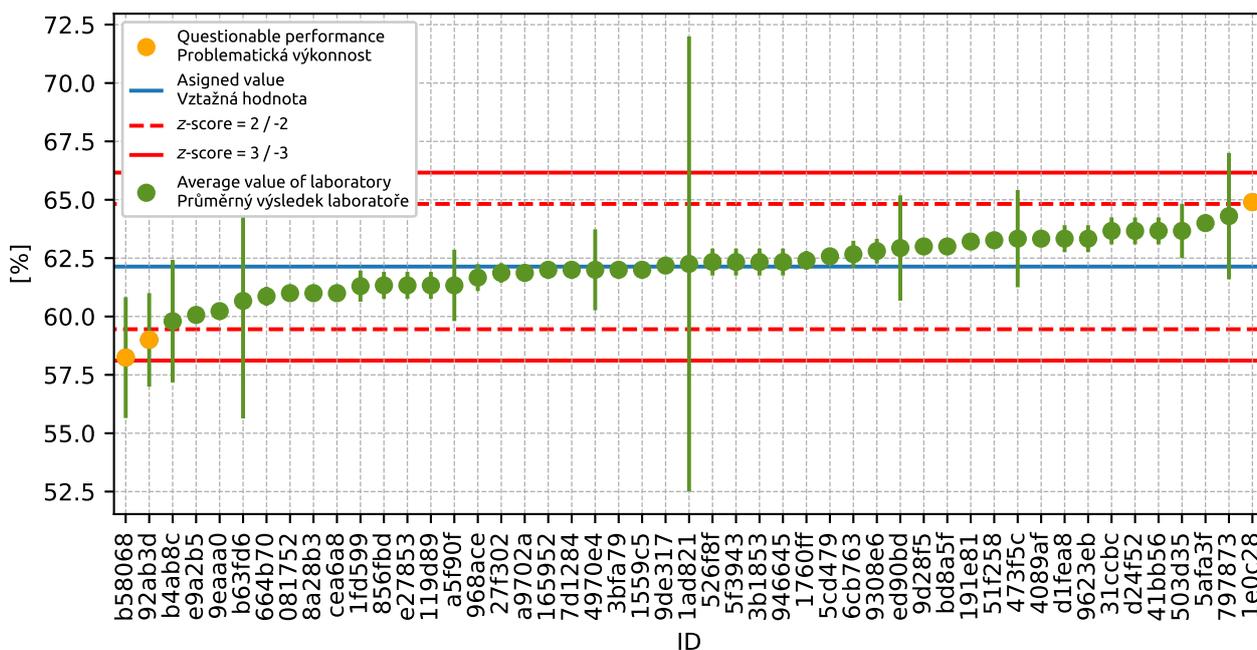
Figure 26: Average values and sample standard deviations

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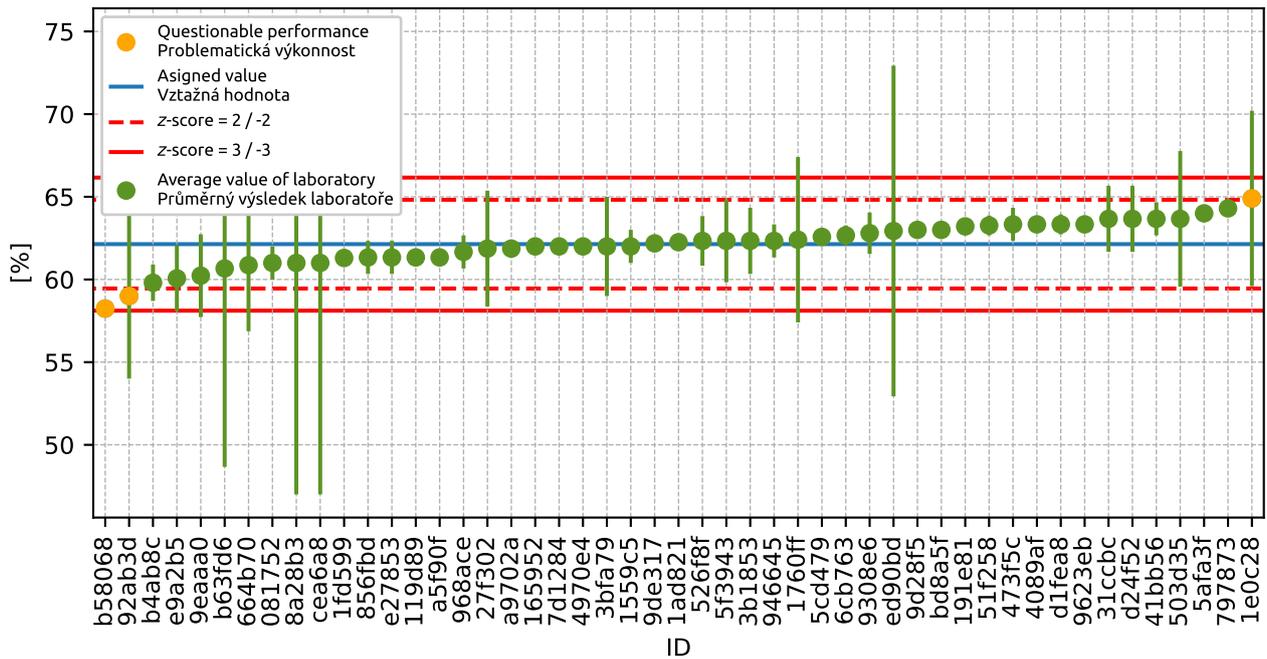
Figure 27: Average values and extended uncertainties of measurement

Figure 28: z-score

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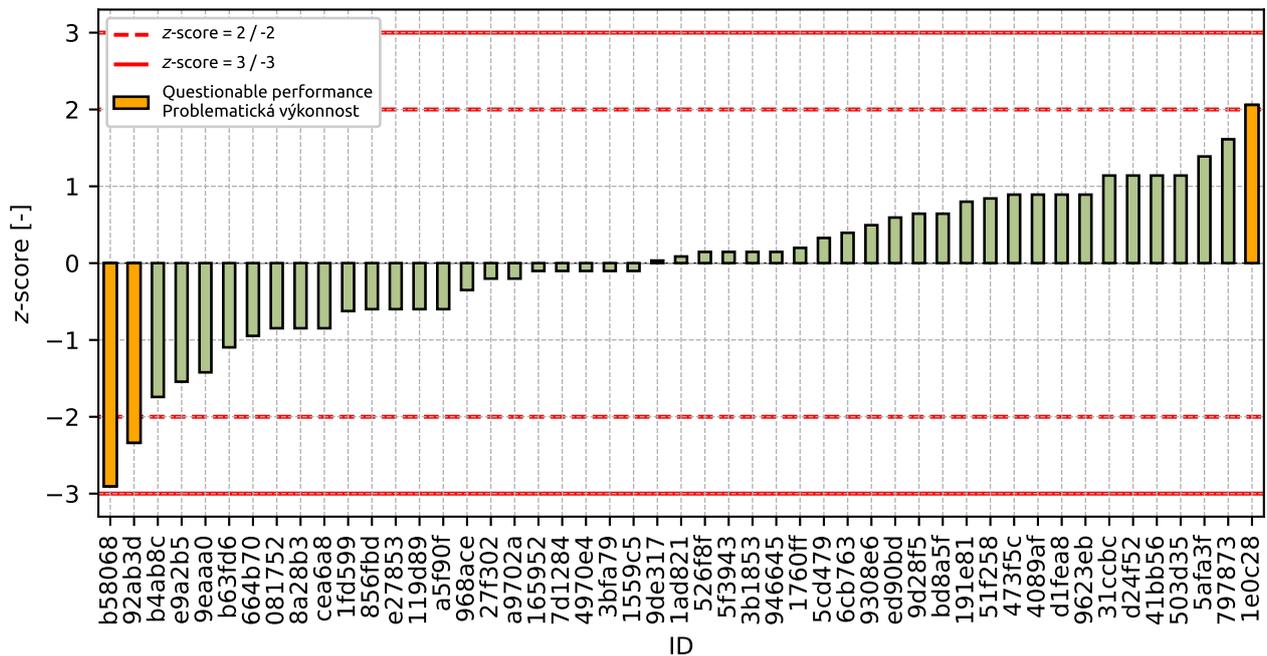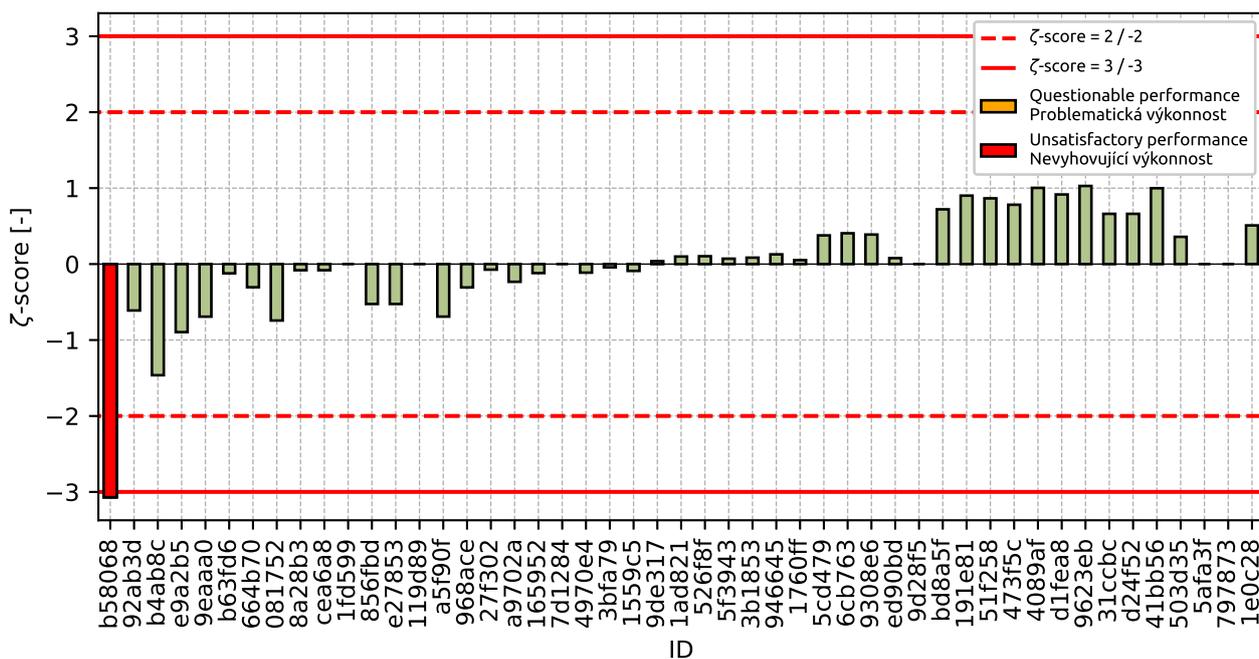
Figure 29: ζ-score

Table 13: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
b58068	-2.91	-3.07
92ab3d	-2.34	-0.61
b4ab8c	-1.74	-1.46
e9a2b5	-1.54	-0.9
9eaaa0	-1.42	-0.69
b63fd6	-1.1	-0.12
664b70	-0.95	-0.31
081752	-0.85	-0.74
8a28b3	-0.85	-0.08
cea6a8	-0.85	-0.08
1fd599	-0.62	-
856fbd	-0.6	-0.53
e27853	-0.6	-0.53
119d89	-0.6	-
a5f90f	-0.6	-0.69
968ace	-0.35	-0.31
27f302	-0.2	-0.07
a9702a	-0.2	-0.23
165952	-0.1	-0.12
7d1284	-0.1	-
4970e4	-0.1	-0.11

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ID	z-score [-]	ζ-score [-]
3bfa79	-0.1	-0.04
1559c5	-0.1	-0.09
9de317	0.03	0.04
1ad821	0.09	0.1
526f8f	0.15	0.1
5f3943	0.15	0.07
3b1853	0.15	0.08
946645	0.15	0.13
1760ff	0.2	0.05
5cd479	0.33	0.38
6cb763	0.39	0.41
9308e6	0.49	0.39
ed90bd	0.59	0.08
9d28f5	0.64	-
bd8a5f	0.64	0.72
191e81	0.8	0.9
51f258	0.84	0.87
473f5c	0.89	0.78
4089af	0.89	1.0
d1fea8	0.89	0.92
9623eb	0.89	1.03
31ccbc	1.14	0.66
d24f52	1.14	0.66
41bb56	1.14	1.0
503d35	1.14	0.36
5afa3f	1.39	-
797873	1.61	-
1e0c28	2.06	0.51

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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 [%]
b58068	30.5	29.3	27.9	0.4	29.2	1.28	4.39
92ab3d	31.0	28.0	31.0	5.0	30.0	1.73	5.77
e9a2b5	32.1	32.0	32.2	1.5	32.1	0.1	0.31
b4ab8c	31.9	30.2	35.6	1.1	32.6	2.76	8.48
cea6a8	32.0	33.0	33.0	14.0	32.7	0.58	1.77
856fbd	34.0	32.0	33.0	2.0	33.0	1.0	3.03
3bfa79	33.0	33.0	33.0	2.9	33.0	0.0	0.0
b63fd6	28.0	34.0	37.0	11.0	33.0	4.58	13.89
8a28b3	34.0	33.0	33.0	14.0	33.3	0.58	1.73
9eaaa0	33.9	33.0	33.2	2.5	33.4	0.45	1.36
664b70	33.2	34.1	33.0	4.0	33.4	0.59	1.75
119d89	34.0	34.0	33.0	-	33.7	0.58	1.71
1ad821	30.1	37.8	33.3	0.0	33.7	3.85	11.4
9de317	33.4	33.8	34.4	0.2	33.9	0.52	1.53
1e0c28	33.9	34.1	33.8	3.3	33.9	0.15	0.45
27f302	34.0	34.2	33.8	3.5	34.0	0.2	0.59
165952	34.0	34.0	34.0	0.1	34.0	0.0	0.0
081752	34.0	34.0	34.0	1.0	34.0	0.0	0.0
191e81	34.1	34.1	34.0	0.1	34.1	0.04	0.1
a5f90f	33.0	36.0	34.0	0.1	34.3	1.53	4.45
e27853	34.0	34.0	35.0	1.0	34.3	0.58	1.68
3b1853	35.0	34.0	34.0	1.0	34.3	0.58	1.68
bd8a5f	34.0	34.0	35.0	0.3	34.3	0.58	1.68
a9702a	34.7	34.5	34.5	0.0	34.6	0.12	0.33
ed90bd	35.2	31.9	36.8	10.0	34.6	2.5	7.21
473f5c	34.0	35.0	35.0	1.0	34.7	0.58	1.67
4970e4	34.0	33.0	37.0	0.4	34.7	2.08	6.0
d1fea8	34.0	35.0	35.0	0.6	34.7	0.58	1.67
968ace	34.0	36.0	34.0	1.0	34.7	1.15	3.33
797873	34.8	34.1	35.1	-	34.7	0.51	1.48
5f3943	34.0	35.0	35.0	2.5	34.7	0.58	1.67
51f258	35.0	34.9	34.9	0.4	34.9	0.06	0.17
1fd599	36.1	35.0	33.9	-	35.0	1.11	3.17
41bb56	36.0	35.0	34.0	1.0	35.0	1.0	2.86

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ID	Test results			u_X	$\bar{x}$	s_0	V_X
	[%]			[%]	[%]	[%]	[%]
7d1284	35.0	-	-	-	35.0	0.0	0.0
503d35	35.0	35.0	35.0	4.1	35.0	0.0	0.0
946645	35.0	35.0	35.0	1.0	35.0	0.0	0.0
526f8f	34.0	36.0	35.0	0.9	35.0	1.0	2.86
1559c5	35.0	35.0	35.0	1.0	35.0	0.0	0.0
5afa3f	35.0	-	-	-	35.0	0.0	0.0
1760ff	34.4	35.5	35.3	3.0	35.0	0.6	1.73
9623eb	35.0	36.0	35.0	0.1	35.3	0.58	1.63
6cb763	36.0	35.0	35.0	0.6	35.3	0.58	1.63
31ccbc	35.0	36.0	36.0	2.0	35.7	0.58	1.62
9d28f5	36.0	-	-	-	36.0	0.0	0.0
9308e6	36.5	36.5	36.0	0.7	36.3	0.29	0.79
5cd479	36.9	35.8	36.3	1.0	36.3	0.53	1.45
4089af	36.5	36.7	36.5	0.2	36.6	0.12	0.32
d24f52	38.0	38.0	37.0	2.0	37.7	0.58	1.53

1.4.2   The Numerical Procedure for Determining Outliers
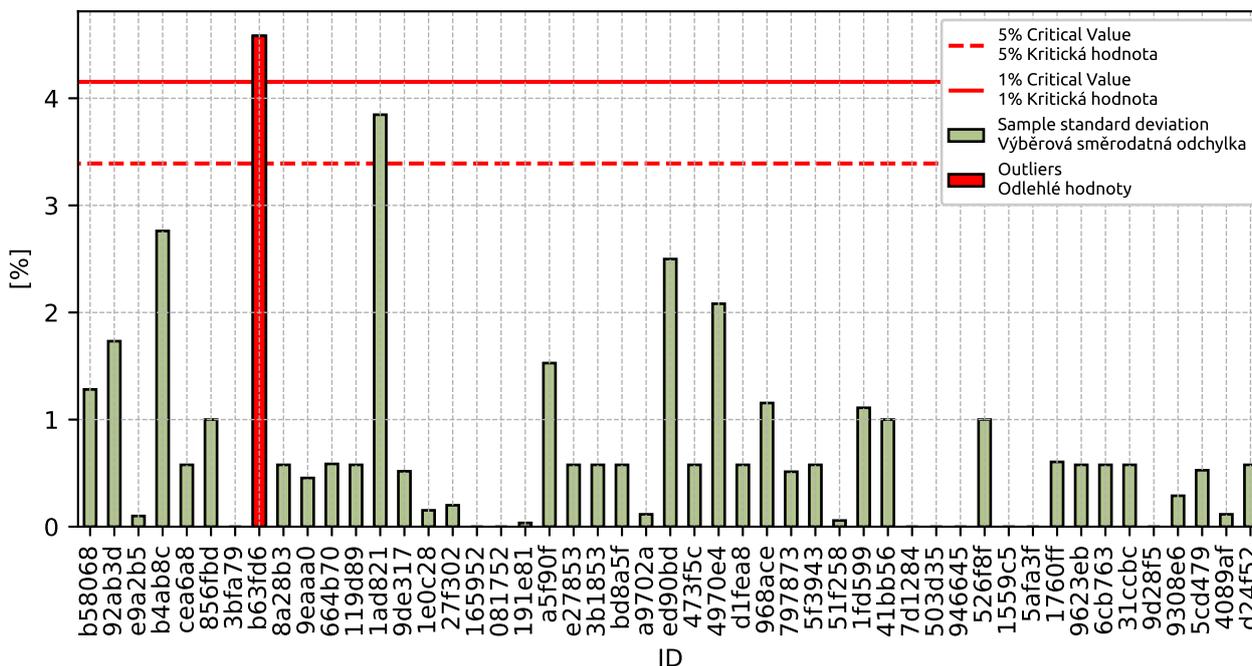
Figure 30: **Cochran's test** - sample standard deviations

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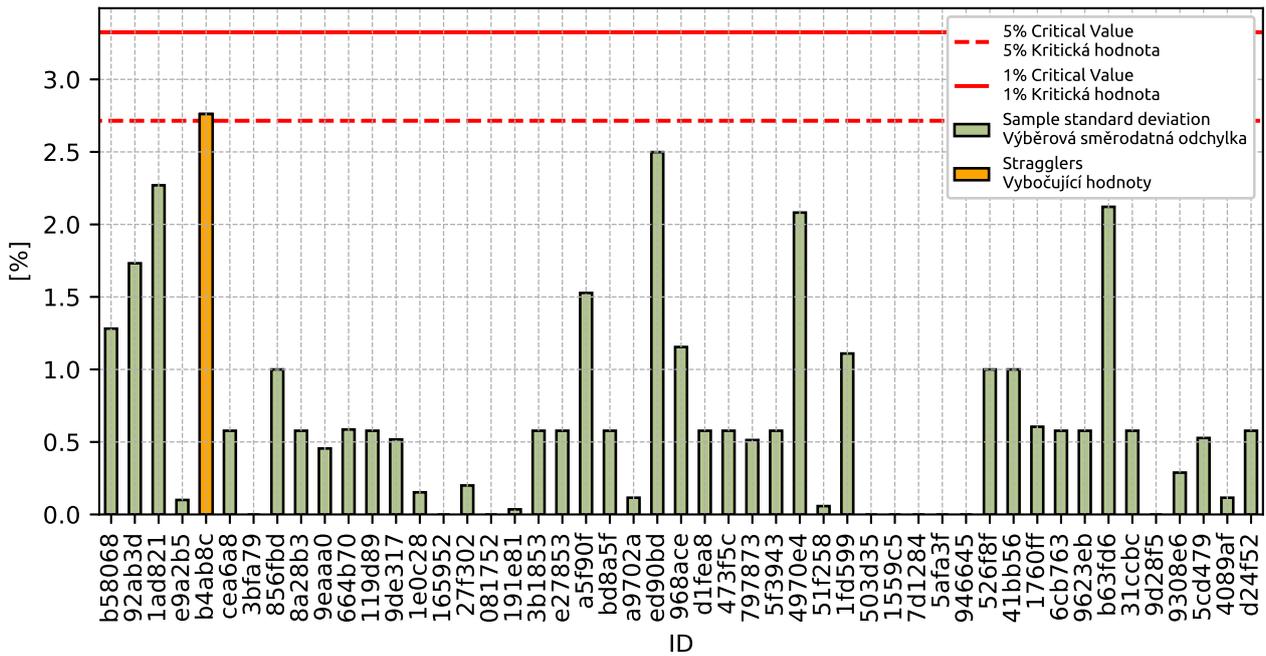
Figure 31: **Cochran's test** - sample standard deviations without outliers
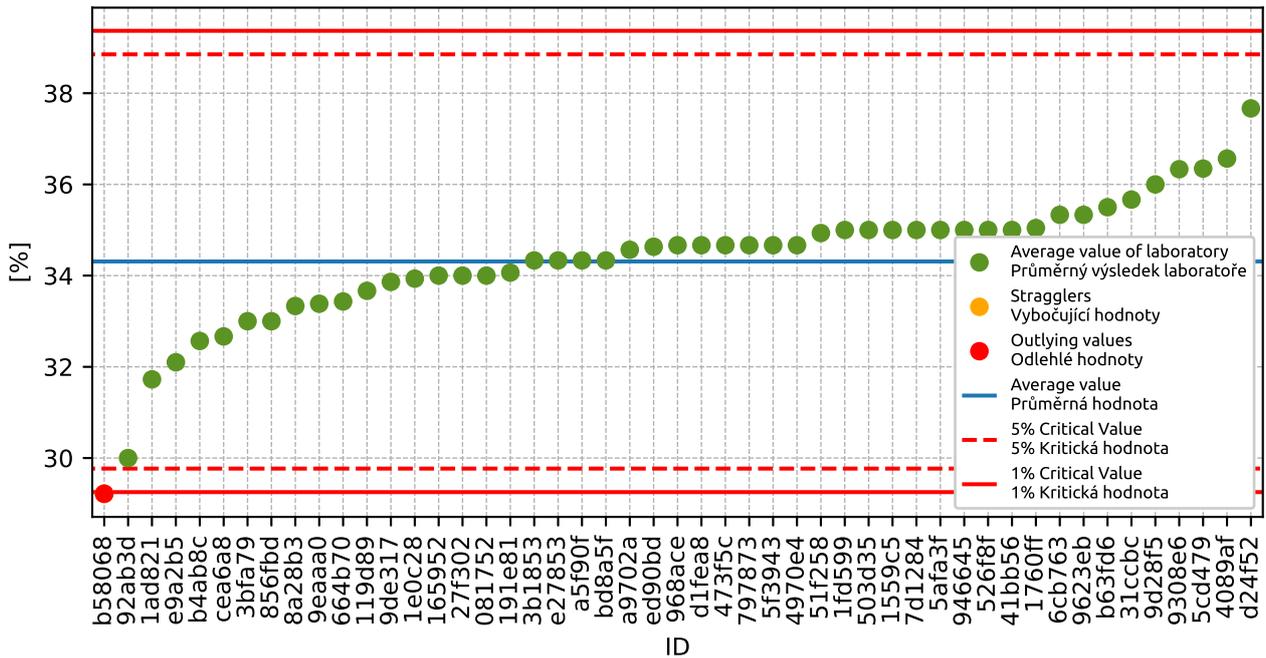
Figure 32: **Grubbs' test** - average values

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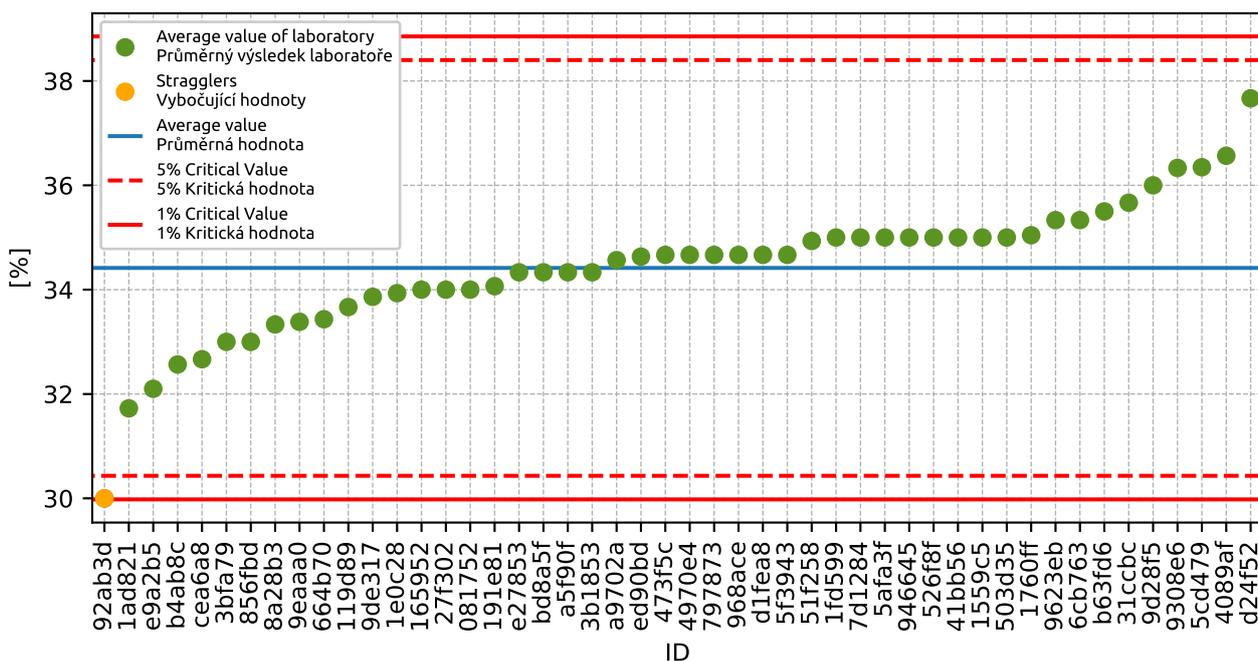
Figure 33: **Grubbs' test** - average values without outliers

1.4.3   Mandel's Statistics
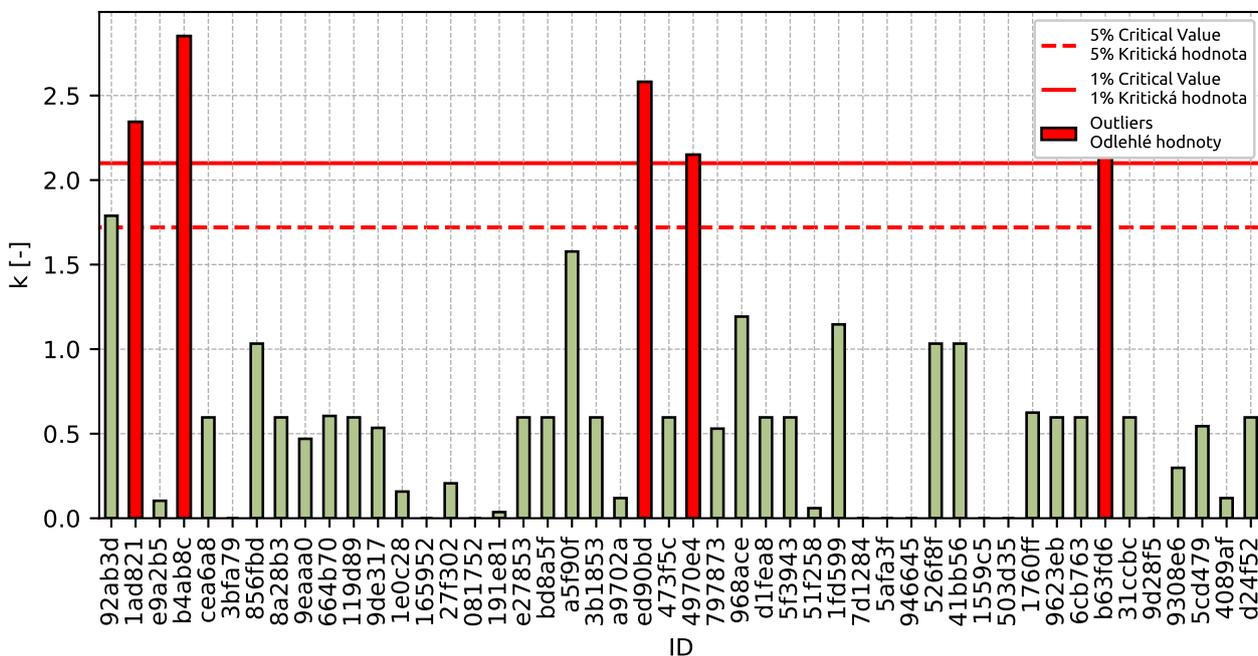
Figure 34: Intralaboratory Consistency Statistic

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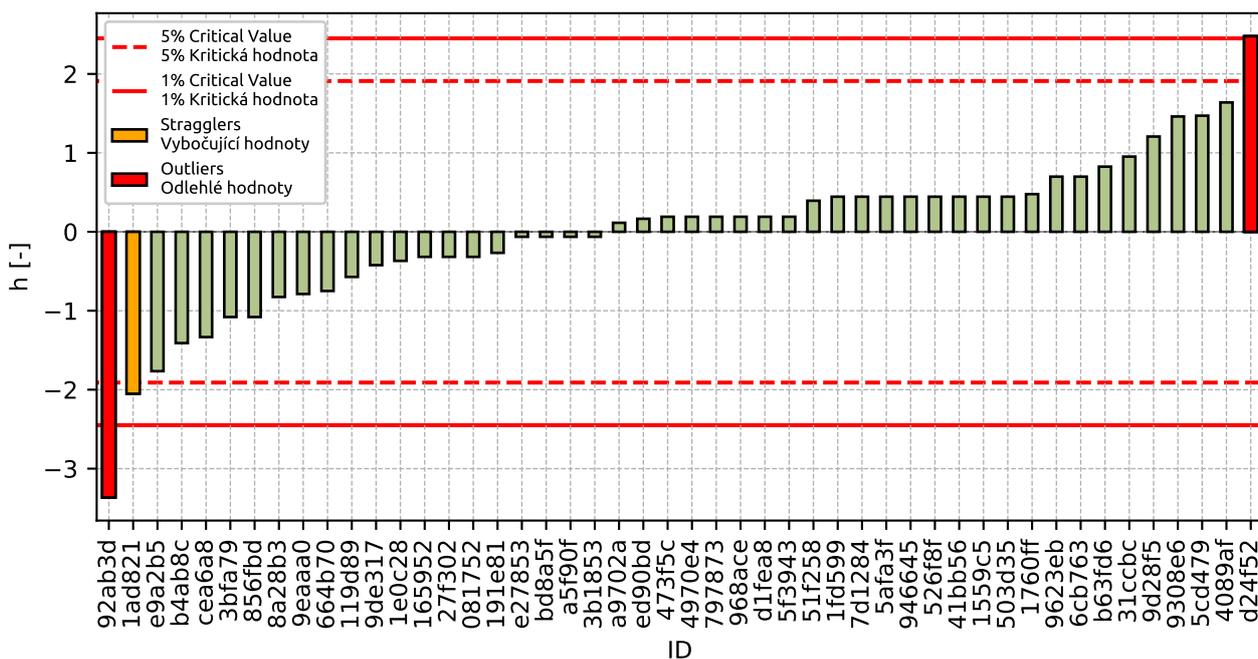
Figure 35: Interlaboratory Consistency Statistic

1.4.4   Descriptive statistics
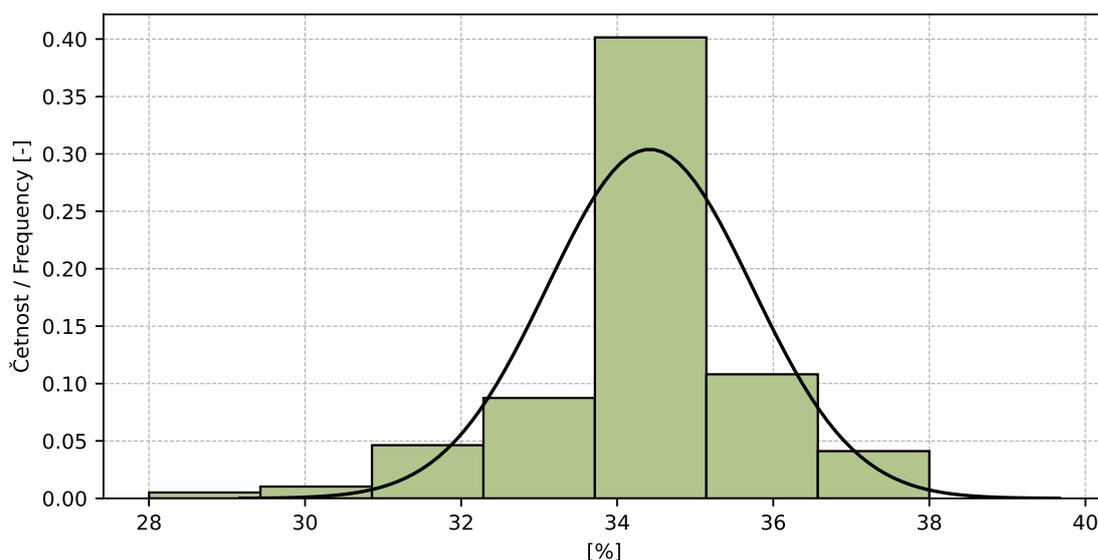
Figure 36: Histogram of all test results

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Table 15: Descriptive statistics

Characteristics	[%]
Průměrná hodnota / Average value – $\bar{x}$	34.4
Výběrová směrodatná odchylka / Sample standard deviation – s	1.31
Vztažná hodnota / Asigned value – x^*	34.4
Robustní směrodatná odchylka / Robust standard deviation – s^*	1.31
Nejistota měření vztažné hodnoty / Measurement uncertainty of asigned value – u_X	1.15
p-hodnota testu normality / p-value of normality test	1.0 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – s_L	1.19
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – s_r	0.97
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – s_R	1.53
Opakovatelnost / Repeatability – r	2.7
Reprodukovatelnost / Reproducibility – R	4.3

1.4.5　Evaluation of Performance Statistics
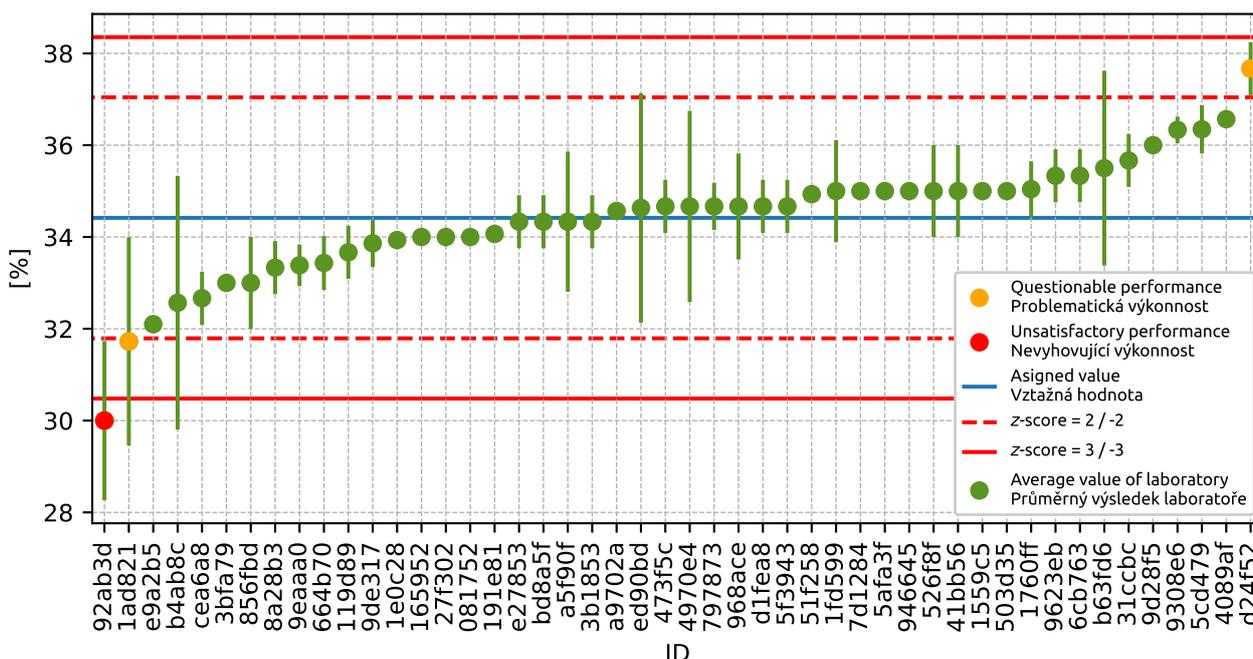
Figure 37: Average values and sample standard deviations

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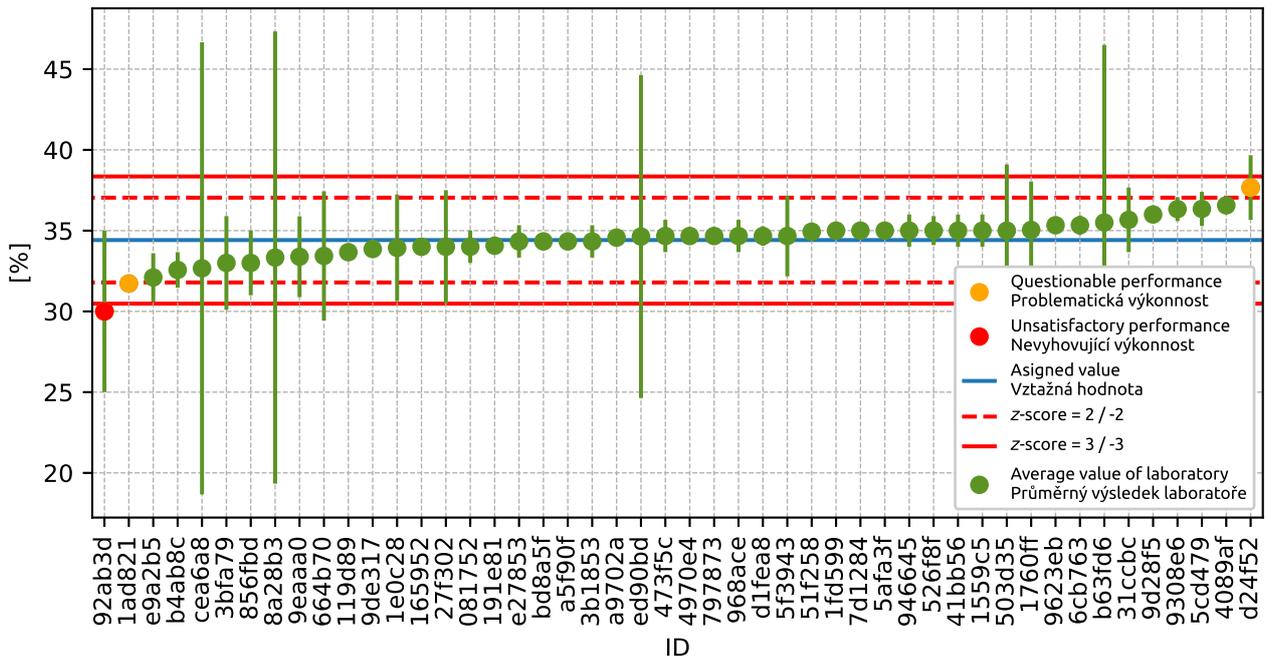
Figure 38: Average values and extended uncertainties of measurement

Figure 39: z-score

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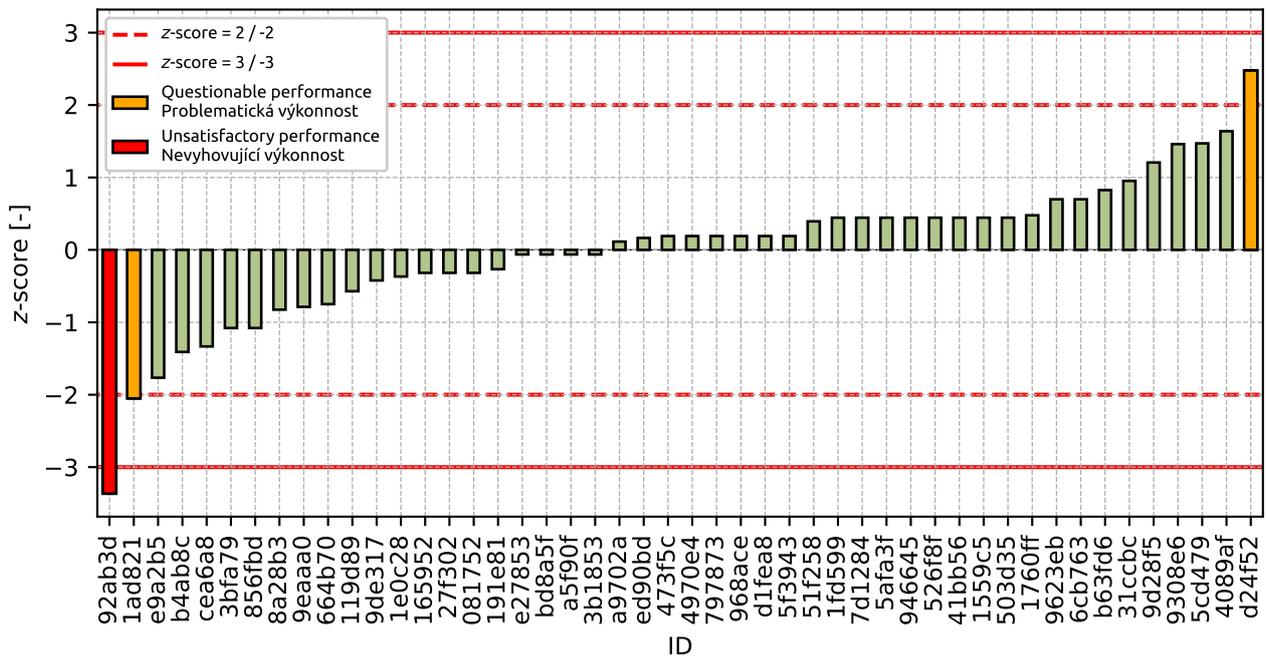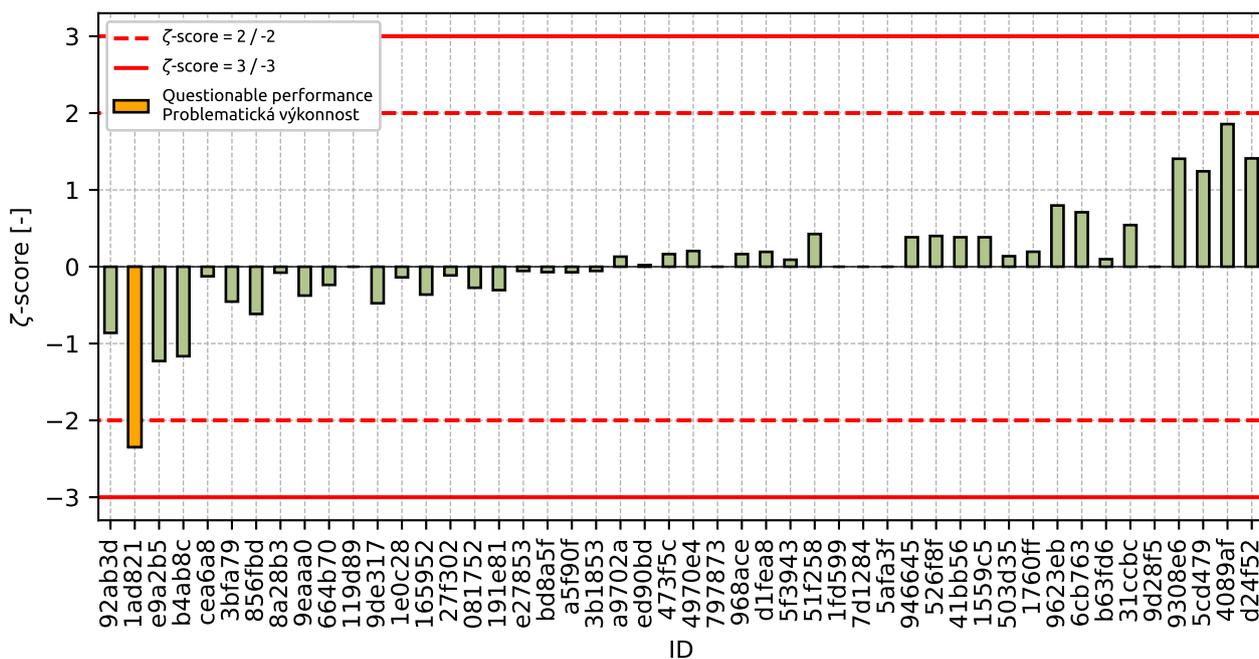
Figure 40: ζ-score

Table 16: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
92ab3d	-3.37	-0.86
1ad821	-2.05	-2.35
e9a2b5	-1.77	-1.23
b4ab8c	-1.41	-1.16
cea6a8	-1.33	-0.12
3bfa79	-1.08	-0.45
856fbd	-1.08	-0.61
8a28b3	-0.83	-0.08
9eaaa0	-0.79	-0.38
664b70	-0.75	-0.24
119d89	-0.57	-
9de317	-0.42	-0.48
1e0c28	-0.37	-0.14
165952	-0.32	-0.36
27f302	-0.32	-0.11
081752	-0.32	-0.27
191e81	-0.27	-0.3
e27853	-0.06	-0.05
bd8a5f	-0.06	-0.07
a5f90f	-0.06	-0.07
3b1853	-0.06	-0.05

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ID	z-score [-]	ζ-score [-]
a9702a	0.11	0.13
ed90bd	0.17	0.02
473f5c	0.19	0.16
4970e4	0.19	0.2
797873	0.19	-
968ace	0.19	0.16
d1fea8	0.19	0.19
5f3943	0.19	0.09
51f258	0.39	0.43
1fd599	0.44	-
7d1284	0.44	-
5afa3f	0.44	-
946645	0.44	0.38
526f8f	0.44	0.4
41bb56	0.44	0.38
1559c5	0.44	0.38
503d35	0.44	0.14
1760ff	0.48	0.2
9623eb	0.7	0.8
6cb763	0.7	0.71
b63fd6	0.83	0.1
31ccbc	0.95	0.54
9d28f5	1.21	-
9308e6	1.46	1.41
5cd479	1.47	1.24
4089af	1.64	1.86
d24f52	2.48	1.41

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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 [%]
b58068	7.9	7.7	6.5	0.3	7.4	0.74	10.08
92ab3d	8.0	8.0	8.0	1.0	8.0	0.0	0.0
1fd599	10.0	8.7	7.5	-	8.7	1.26	14.43
3bfa79	9.0	9.0	9.0	2.0	9.0	0.0	0.0
cea6a8	8.0	10.0	9.0	14.0	9.0	1.0	11.11
b63fd6	7.0	9.0	11.0	5.0	9.0	2.0	22.22
e9a2b5	9.3	9.2	9.2	1.0	9.2	0.06	0.63
856fbd	11.0	9.0	9.0	2.0	9.7	1.15	11.95
191e81	9.8	9.7	9.7	0.1	9.7	0.05	0.48
8a28b3	11.0	10.0	9.0	14.0	10.0	1.0	10.0
bd8a5f	10.0	10.0	10.0	0.3	10.0	0.0	0.0
41bb56	10.0	10.0	10.0	0.8	10.0	0.0	0.0
1760ff	9.0	10.9	10.2	2.0	10.0	0.96	9.61
9de317	10.3	10.1	9.7	0.2	10.0	0.32	3.21
a9702a	10.1	10.2	10.0	0.0	10.1	0.1	0.99
1ad821	8.0	13.9	8.5	0.0	10.1	3.29	32.42
b4ab8c	10.2	9.2	11.5	1.1	10.3	1.15	11.2
1e0c28	10.2	10.3	10.9	1.0	10.5	0.38	3.62
9308e6	10.7	10.8	10.5	0.3	10.7	0.15	1.43
119d89	11.0	11.0	10.0	-	10.7	0.58	5.41
526f8f	10.0	11.0	11.0	0.3	10.7	0.58	5.41
9eaaa0	11.3	10.3	10.5	2.5	10.7	0.54	5.06
797873	10.5	10.5	11.2	-	10.7	0.4	3.77
664b70	10.9	11.1	10.9	4.0	11.0	0.12	1.05
e27853	11.0	11.0	11.0	1.0	11.0	0.0	0.0
9d28f5	11.0	-	-	-	11.0	0.0	0.0
5afa3f	11.0	-	-	-	11.0	0.0	0.0
081752	11.0	11.0	11.0	1.0	11.0	0.0	0.0
31ccbc	11.0	11.0	11.0	1.0	11.0	0.0	0.0
a5f90f	11.0	11.0	11.0	0.1	11.0	0.0	0.0
d1fea8	11.0	11.0	11.0	0.5	11.0	0.0	0.0
473f5c	11.0	11.0	11.0	1.0	11.0	0.0	0.0
3b1853	11.0	11.0	11.0	1.0	11.0	0.0	0.0
27f302	11.2	11.3	11.0	3.5	11.2	0.15	1.37

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ID	Test results			u_X	$\bar{x}$	s_0	V_X
	[%]			[%]	[%]	[%]	[%]
4089af	11.2	11.4	11.0	0.3	11.2	0.2	1.79
968ace	11.0	12.0	11.0	1.0	11.3	0.58	5.09
51f258	11.8	10.9	11.7	0.1	11.5	0.49	4.3
5f3943	11.0	12.0	12.0	2.5	11.7	0.58	4.95
9623eb	12.0	12.0	11.0	0.1	11.7	0.58	4.95
ed90bd	11.9	10.2	13.1	10.0	11.7	1.46	12.42
1559c5	12.0	12.0	12.0	1.0	12.0	0.0	0.0
4970e4	12.0	11.0	13.0	0.3	12.0	1.0	8.33
6cb763	12.0	12.0	12.0	0.6	12.0	0.0	0.0
503d35	12.0	12.0	12.0	2.8	12.0	0.0	0.0
5cd479	13.1	11.9	12.4	1.2	12.4	0.62	5.01
7d1284	14.0	-	-	-	14.0	0.0	0.0
165952	15.0	15.0	15.0	0.1	15.0	0.0	0.0
d24f52	16.0	16.0	16.0	2.0	16.0	0.0	0.0
946645	23.0	23.0	18.0	1.0	21.3	2.89	13.53

1.5.2   The Numerical Procedure for Determining Outliers
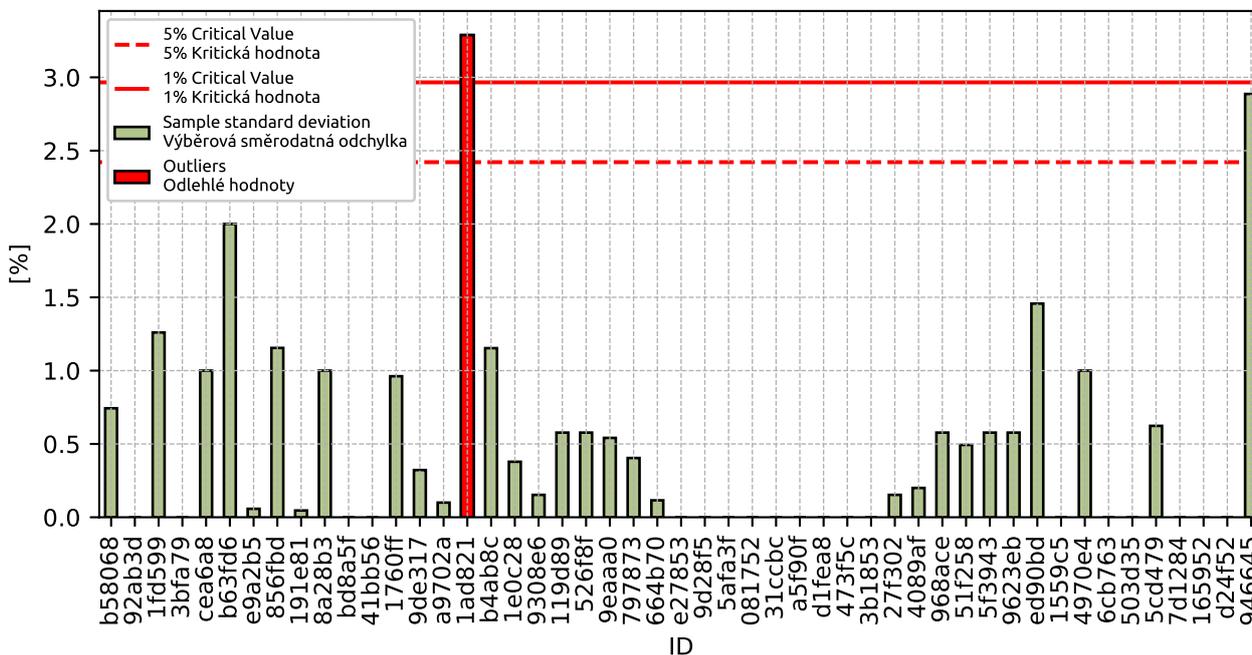
Figure 41: **Cochran's test** - sample standard deviations

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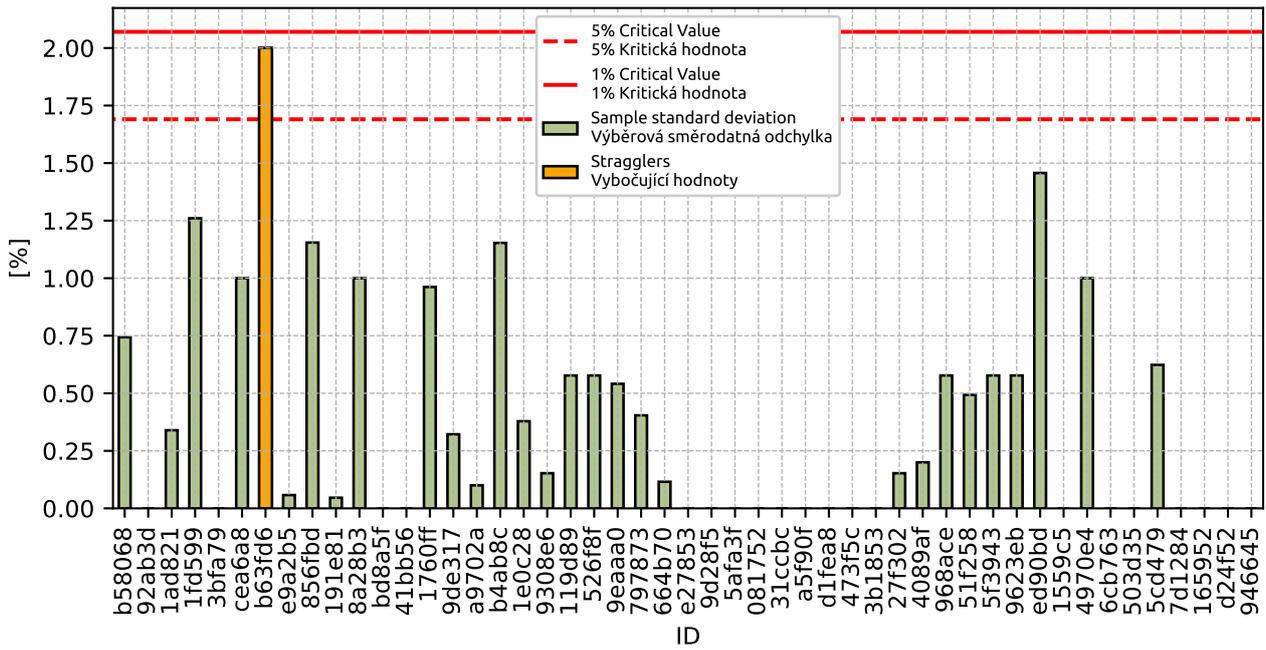
Figure 42: **Cochran's test** - sample standard deviations without outliers
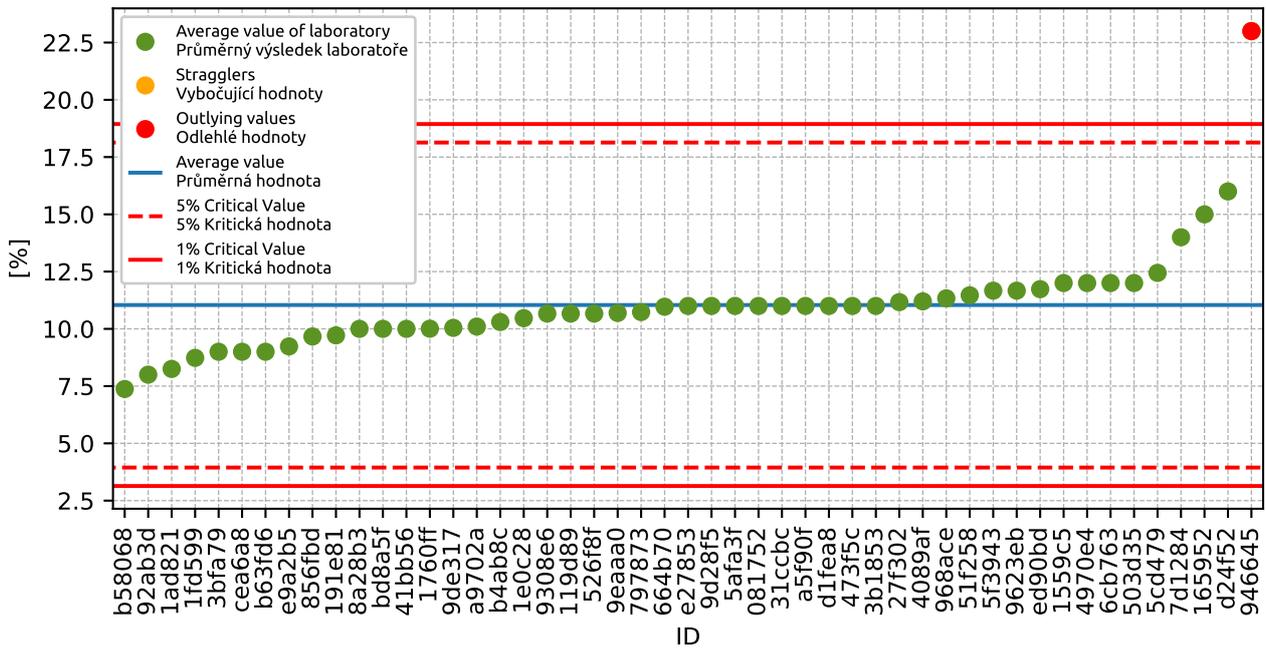
Figure 43: **Grubbs' test** - average values

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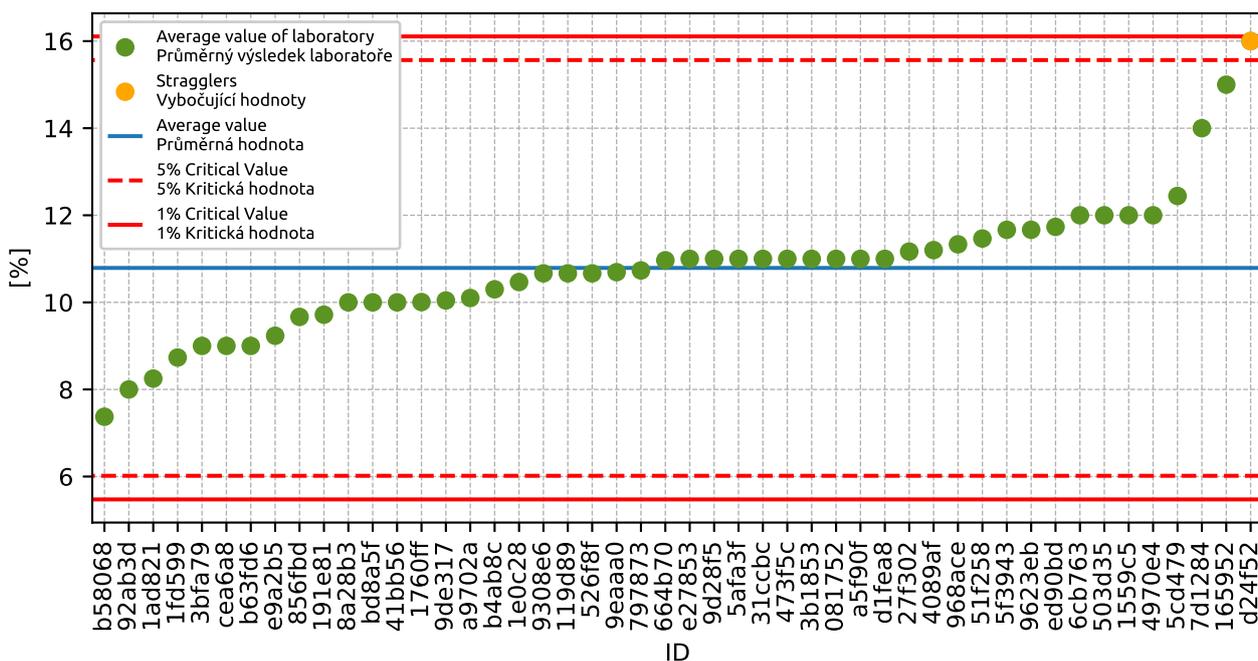
Figure 44: **Grubbs' test** - average values without outliers

1.5.3   Mandel's Statistics
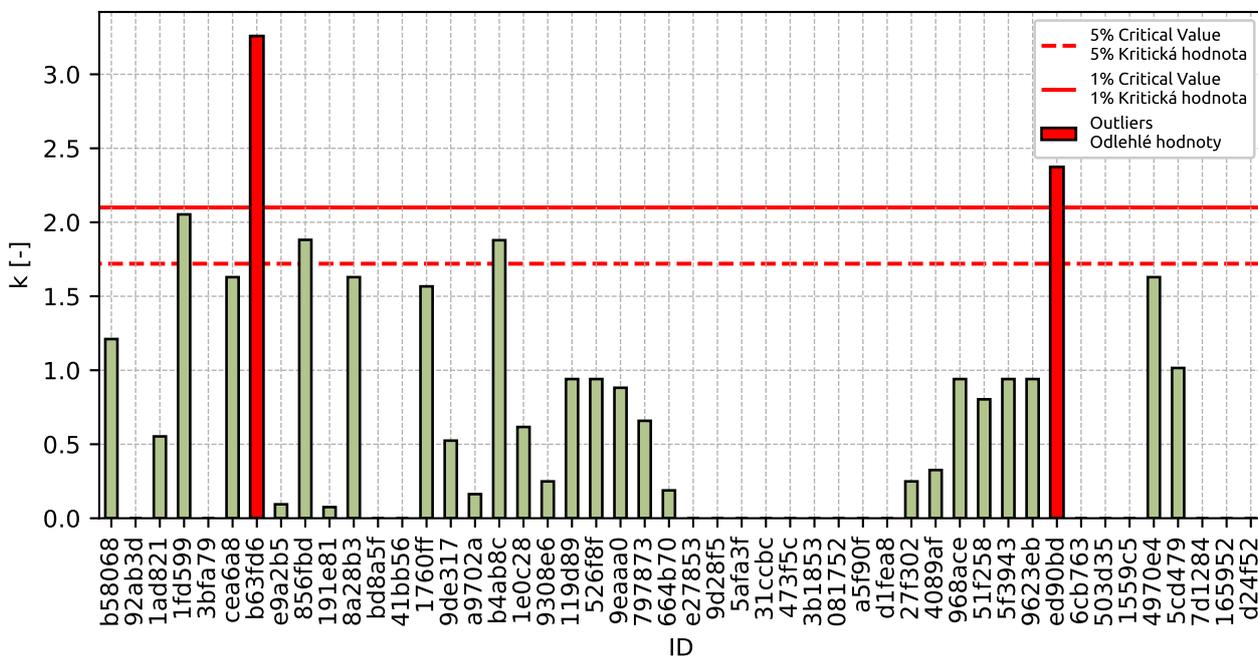
Figure 45: Intralaboratory Consistency Statistic

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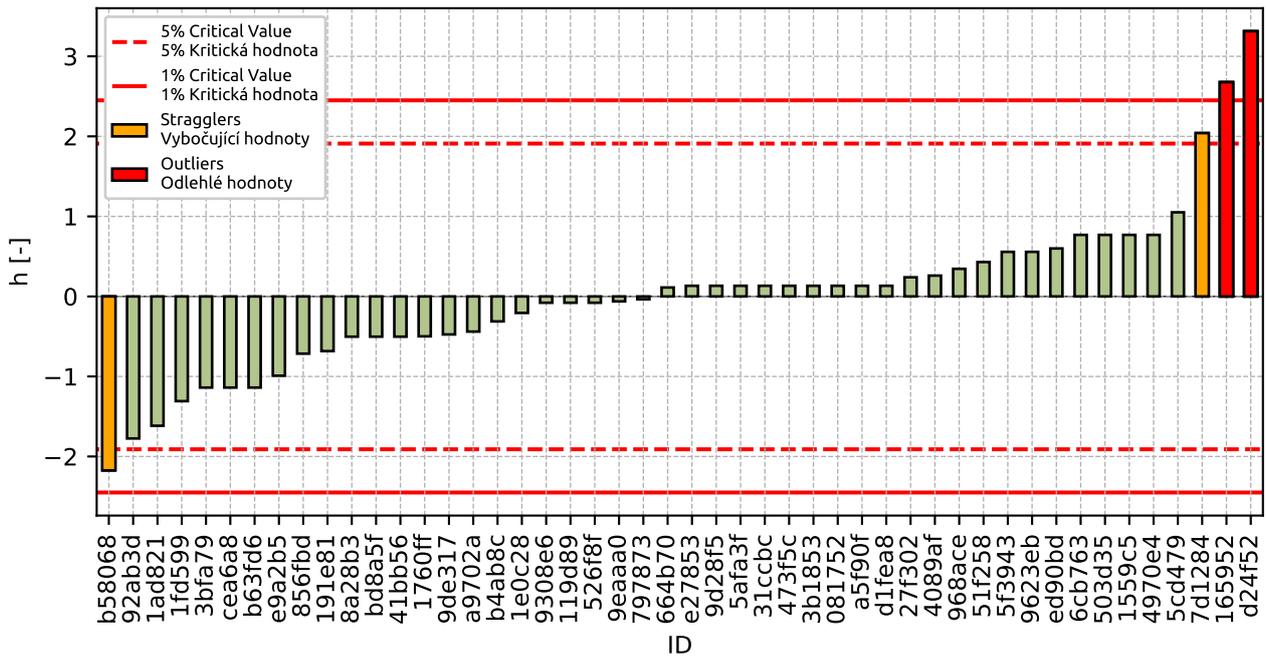
Figure 46: Interlaboratory Consistency Statistic

1.5.4 Descriptive statistics
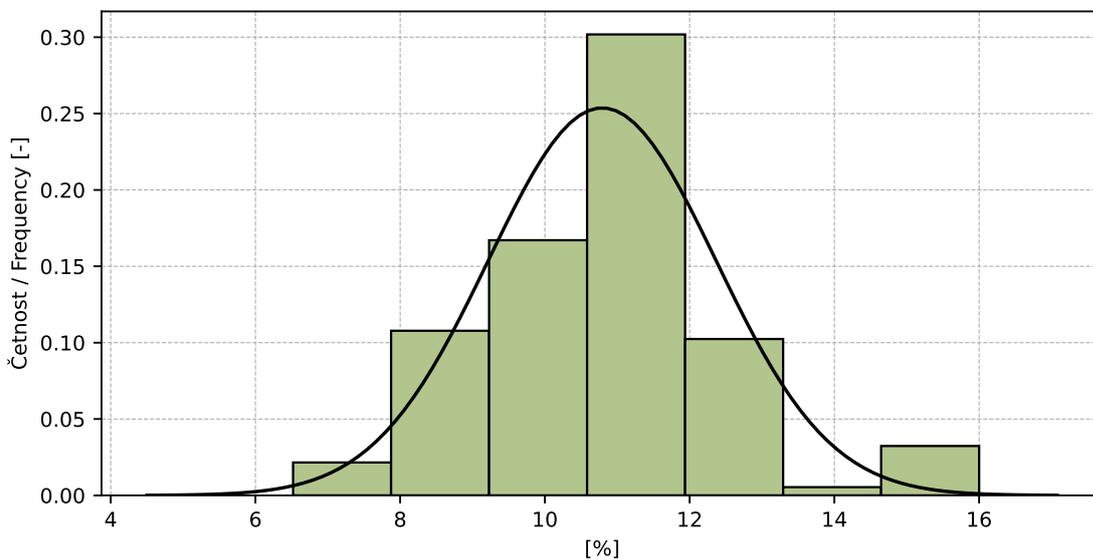
Figure 47: Histogram of all test results

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Table 18: Descriptive statistics

Characteristics	[%]
Průměrná hodnota / Average value – $\bar{x}$	10.8
Výběrová směrodatná odchylka / Sample standard deviation – s	1.57
Vztažná hodnota / Asigned value – x^*	10.8
Robustní směrodatná odchylka / Robust standard deviation – s^*	1.57
Nejistota měření vztažné hodnoty / Measurement uncertainty of asigned value – u_X	1.25
p-hodnota testu normality / p-value of normality test	1.0 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – s_L	1.53
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – s_r	0.61
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – s_R	1.65
Opakovatelnost / Repeatability – r	1.7
Reprodukovatelnost / Reproducibility – R	4.6

1.5.5   Evaluation of Performance Statistics
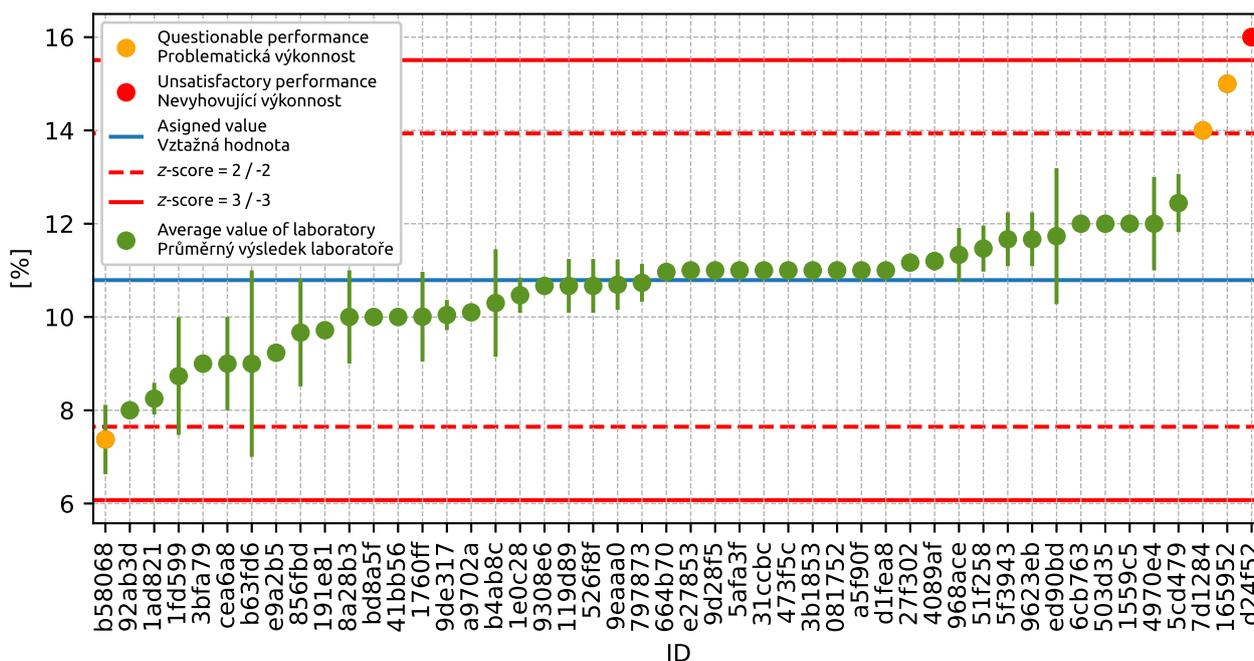
Figure 48: Average values and sample standard deviations

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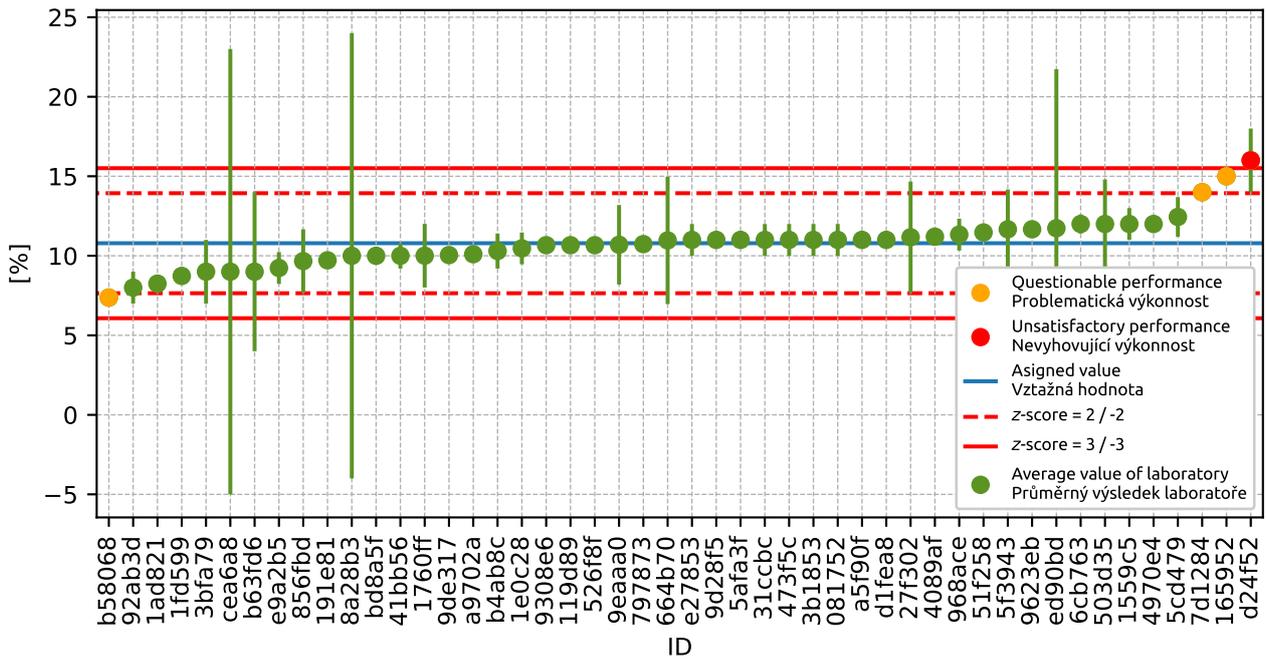
Figure 49: Average values and extended uncertainties of measurement

Figure 50: z-score

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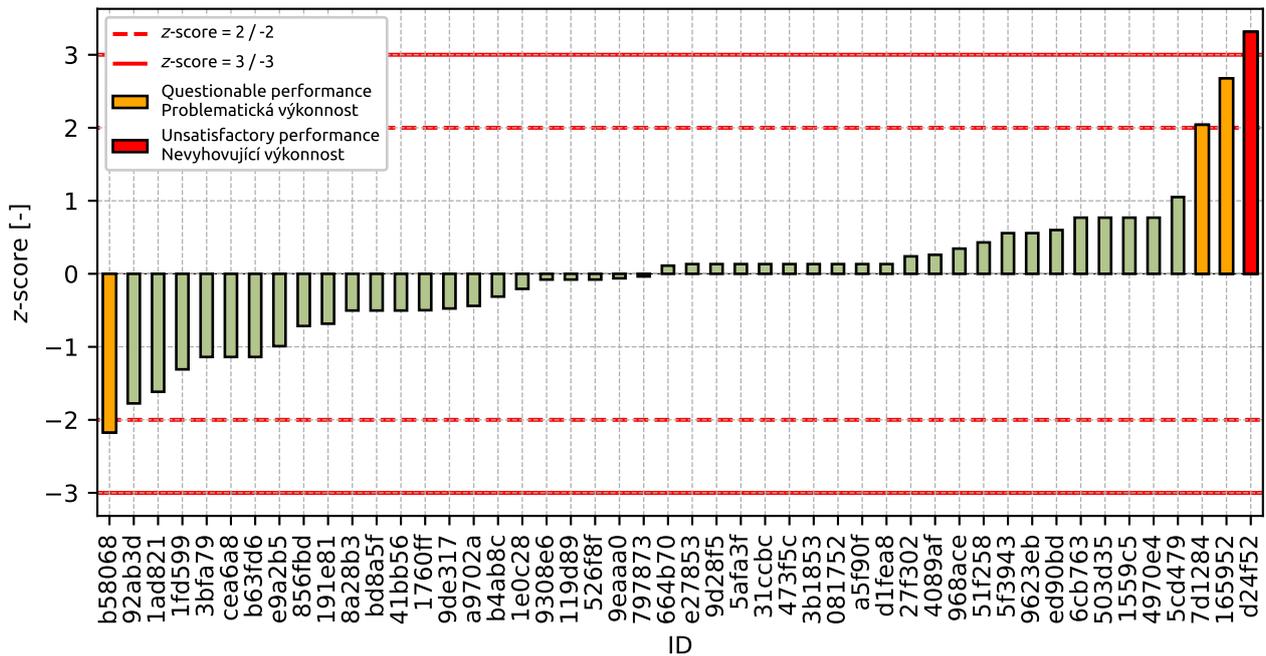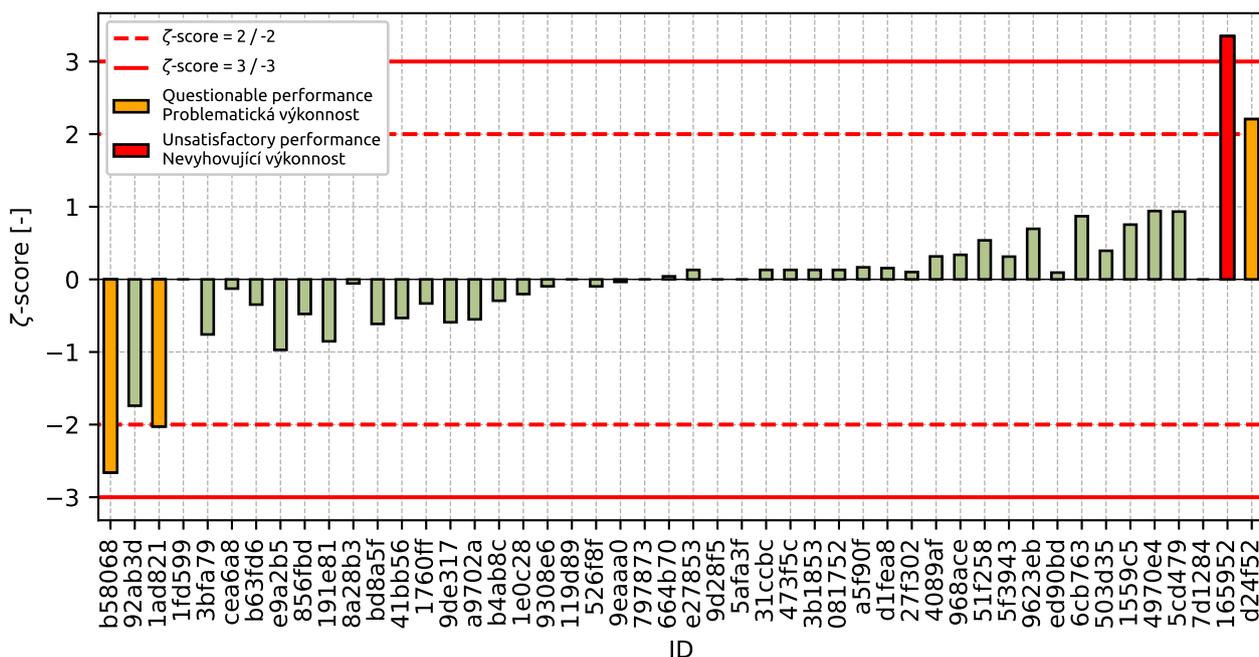
Figure 51: ζ-score

Table 19: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
b58068	-2.17	-2.66
92ab3d	-1.77	-1.74
1ad821	-1.62	-2.03
1fd599	-1.31	-
3bfa79	-1.14	-0.76
cea6a8	-1.14	-0.13
b63fd6	-1.14	-0.35
e9a2b5	-0.99	-0.97
856fbd	-0.71	-0.48
191e81	-0.68	-0.85
8a28b3	-0.5	-0.06
bd8a5f	-0.5	-0.61
41bb56	-0.5	-0.53
1760ff	-0.5	-0.33
9de317	-0.48	-0.59
a9702a	-0.44	-0.55
b4ab8c	-0.31	-0.29
1e0c28	-0.21	-0.2
9308e6	-0.08	-0.1
119d89	-0.08	-
526f8f	-0.08	-0.1

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ID	z-score [-]	ζ-score [-]
9eaaa0	-0.06	-0.03
797873	-0.04	-
664b70	0.11	0.04
e27853	0.13	0.13
9d28f5	0.13	-
5afa3f	0.13	-
31ccbc	0.13	0.13
473f5c	0.13	0.13
3b1853	0.13	0.13
081752	0.13	0.13
a5f90f	0.13	0.17
d1fea8	0.13	0.15
27f302	0.24	0.1
4089af	0.26	0.32
968ace	0.35	0.34
51f258	0.43	0.54
5f3943	0.56	0.31
9623eb	0.56	0.7
ed90bd	0.6	0.09
6cb763	0.77	0.87
503d35	0.77	0.39
1559c5	0.77	0.75
4970e4	0.77	0.94
5cd479	1.05	0.93
7d1284	2.04	-
165952	2.68	3.35
d24f52	3.31	2.21

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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 [%]
92ab3d	0.0	1.0	1.0	1.0	0.7	0.58	86.6
3bfa79	1.0	1.0	1.0	-	1.0	0.0	0.0
b58068	1.2	1.1	1.1	0.2	1.1	0.07	6.38
191e81	1.3	1.2	1.3	0.0	1.3	0.02	1.84
856fbd	2.0	1.0	1.0	1.0	1.3	0.58	43.3
9308e6	1.4	1.4	1.5	0.1	1.4	0.06	4.03
1e0c28	1.5	1.5	1.6	0.2	1.5	0.06	3.77
1ad821	1.5	1.5	1.7	0.0	1.6	0.1	6.49
ed90bd	1.6	1.3	2.1	10.0	1.7	0.4	24.25
1760ff	1.6	1.6	1.9	0.5	1.7	0.18	10.6
a9702a	1.7	1.7	1.7	0.0	1.7	0.0	0.0
797873	1.9	1.8	1.9	-	1.9	0.06	3.09
4089af	1.9	1.9	1.9	0.0	1.9	0.0	0.0
503d35	2.0	2.0	2.0	1.2	2.0	0.0	0.0
946645	2.0	2.0	2.0	1.0	2.0	0.0	0.0
9623eb	2.0	2.0	2.0	0.1	2.0	0.0	0.0
e27853	2.0	2.0	2.0	1.0	2.0	0.0	0.0
9d28f5	2.0	-	-	-	2.0	0.0	0.0
526f8f	2.0	2.0	2.0	0.1	2.0	0.0	0.0
31ccbc	2.0	2.0	2.0	1.0	2.0	0.0	0.0
d1fea8	2.0	2.0	2.0	0.5	2.0	0.0	0.0
41bb56	2.0	2.0	2.0	0.5	2.0	0.0	0.0
b63fd6	2.0	2.0	2.0	1.0	2.0	0.0	0.0
473f5c	2.0	2.0	2.0	1.0	2.0	0.0	0.0
3b1853	2.0	2.0	2.0	0.5	2.0	0.0	0.0
bd8a5f	2.0	2.0	2.0	0.1	2.0	0.0	0.0
664b70	2.1	2.0	2.0	4.0	2.0	0.06	2.84
9de317	2.5	2.0	1.9	0.2	2.1	0.35	16.48
9eaaa0	2.6	1.9	2.0	2.5	2.2	0.34	15.81
b4ab8c	2.1	2.0	2.5	0.1	2.2	0.26	12.03
e9a2b5	2.0	2.2	2.4	0.3	2.2	0.2	9.09
6cb763	3.0	2.0	2.0	0.6	2.3	0.58	24.74
8a28b3	3.0	2.0	2.0	14.0	2.3	0.58	24.74
27f302	2.3	2.4	2.4	3.5	2.4	0.06	2.44

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ID	Test results [%]			u_X [%]	$\bar{x}$ [%]	s_0 [%]	V_X [%]
cea6a8	2.0	3.0	3.0	14.0	2.7	0.58	21.65
4970e4	3.0	2.0	3.0	0.1	2.7	0.58	21.65
5f3943	2.0	3.0	3.0	2.5	2.7	0.58	21.65
5cd479	3.2	2.7	3.0	0.5	3.0	0.26	8.63
51f258	3.1	2.8	3.0	0.0	3.0	0.15	5.15
119d89	3.0	3.0	3.0	-	3.0	0.0	0.0
1559c5	3.0	3.0	3.0	1.0	3.0	0.0	0.0
081752	3.0	3.0	3.0	2.0	3.0	0.0	0.0
a5f90f	3.0	3.0	3.0	0.1	3.0	0.0	0.0
968ace	3.0	3.0	4.0	1.0	3.3	0.58	17.32
7d1284	6.0	-	-	-	6.0	0.0	0.0
165952	6.0	6.0	6.0	0.1	6.0	0.0	0.0
d24f52	7.0	7.0	7.0	2.0	7.0	0.0	0.0

1.6.2   The Numerical Procedure for Determining Outliers
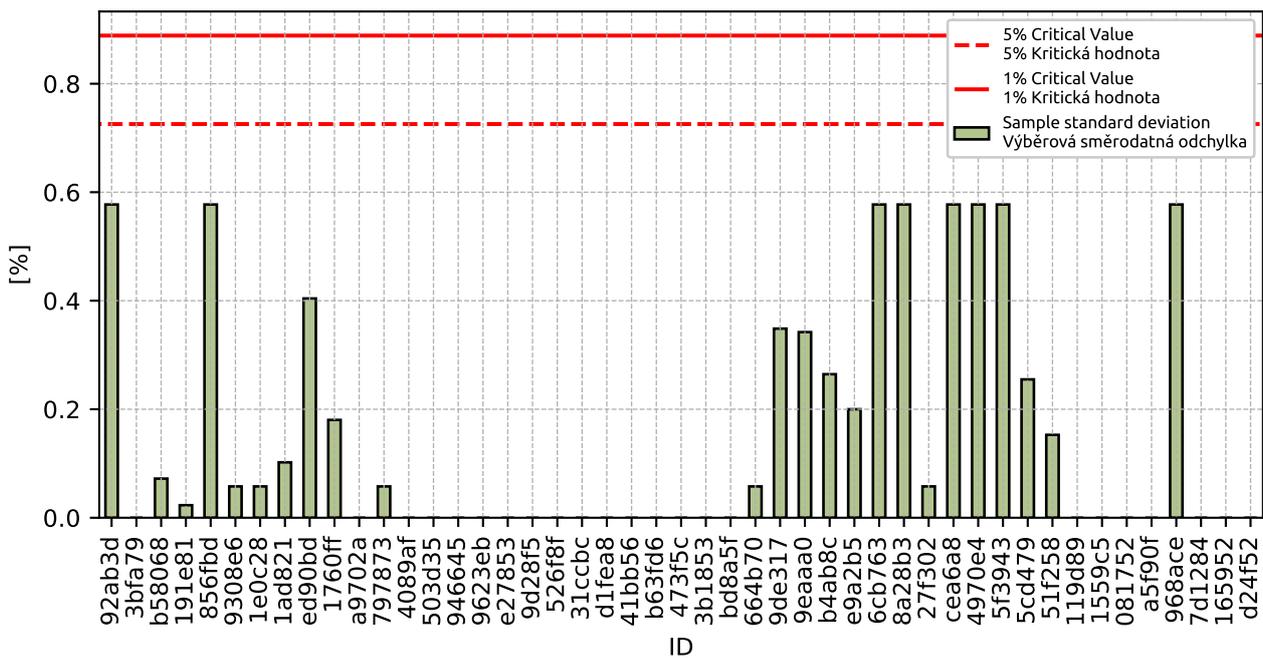
Figure 52: **Cochran's test** - sample standard deviations

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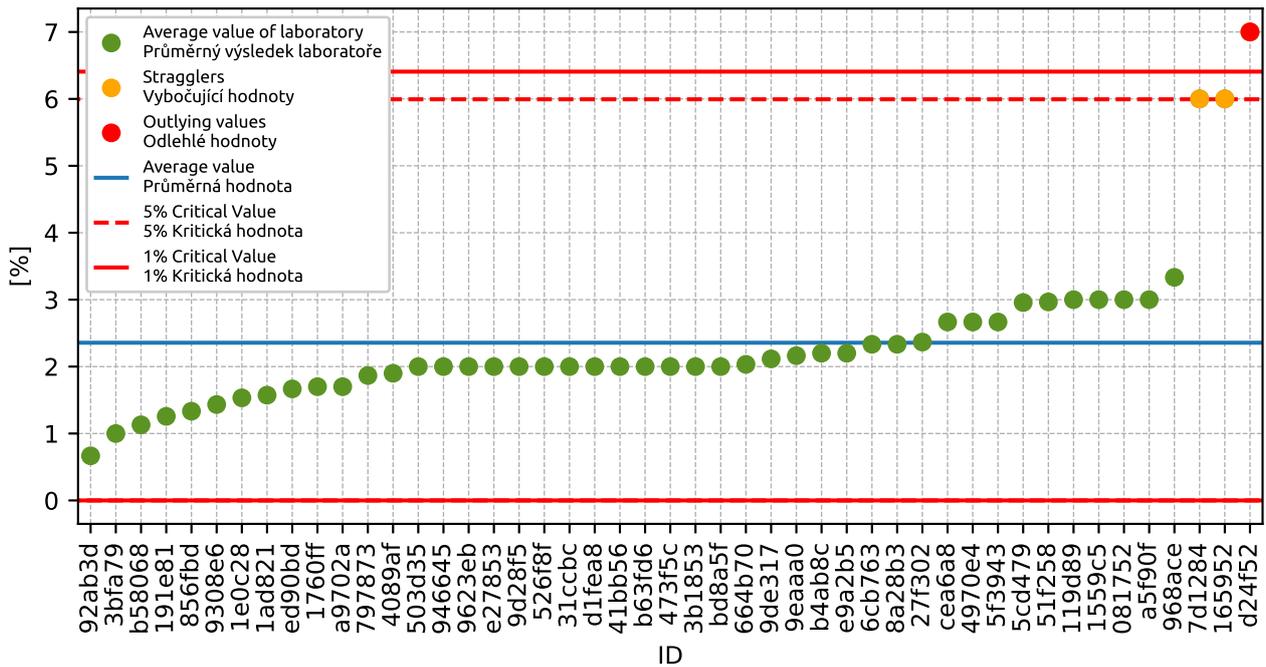
Figure 53: **Grubbs' test** - average values
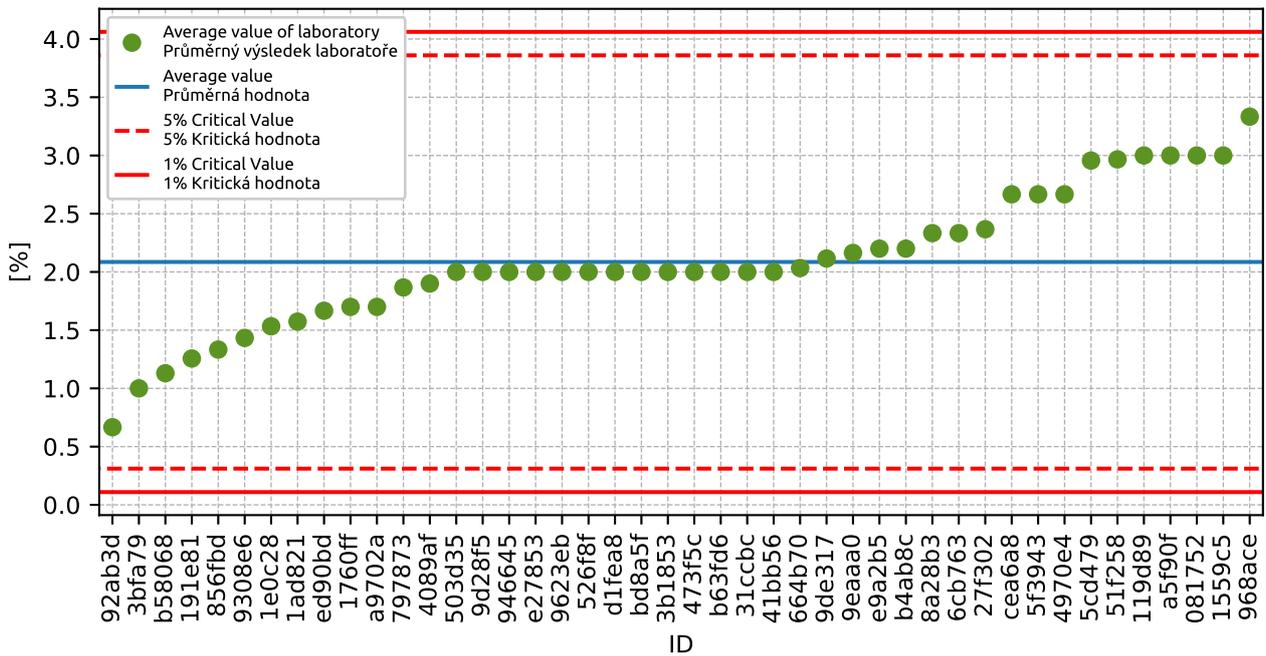
Figure 54: **Grubbs' test** - average values without outliers

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1.6.3 Mandel's Statistics
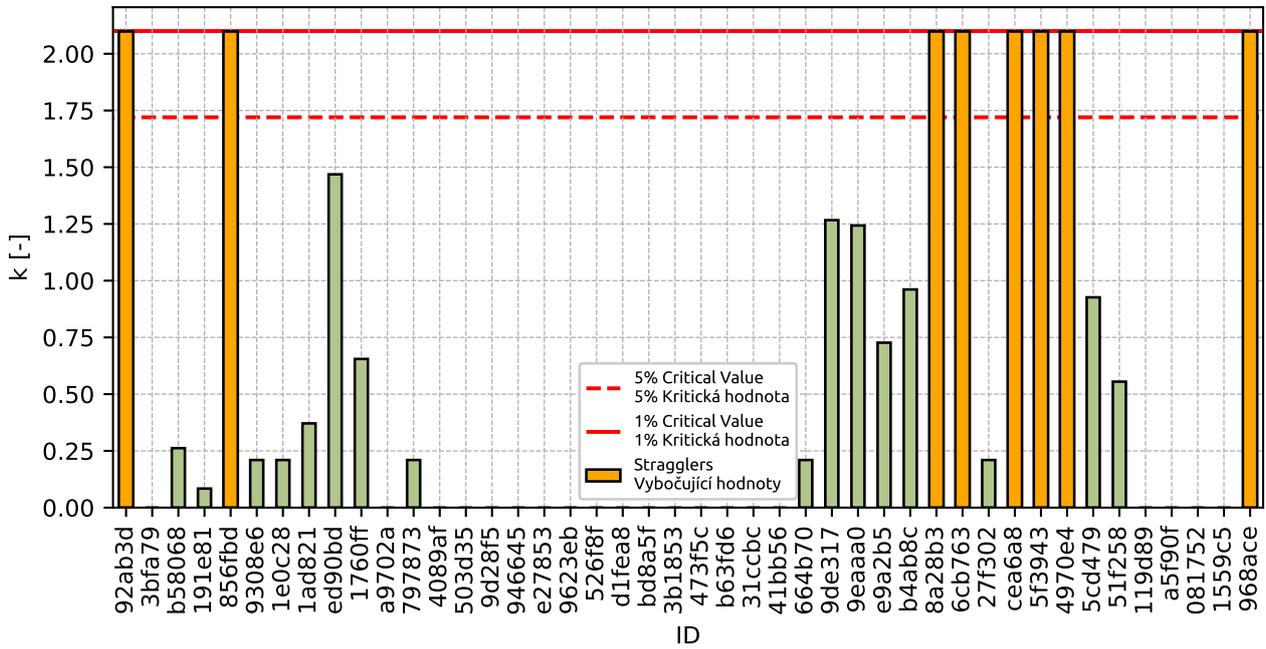
Figure 55: Intralaboratory Consistency Statistic
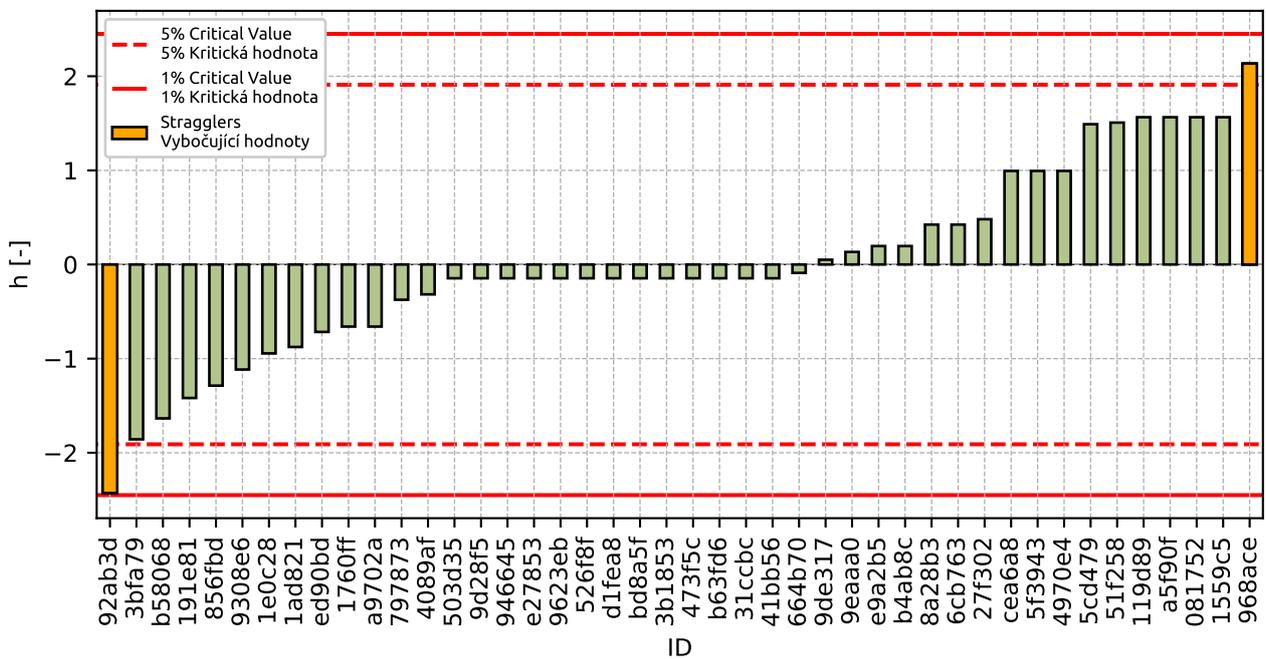
Figure 56: Interlaboratory Consistency Statistic

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1.6.4   Descriptive statistics
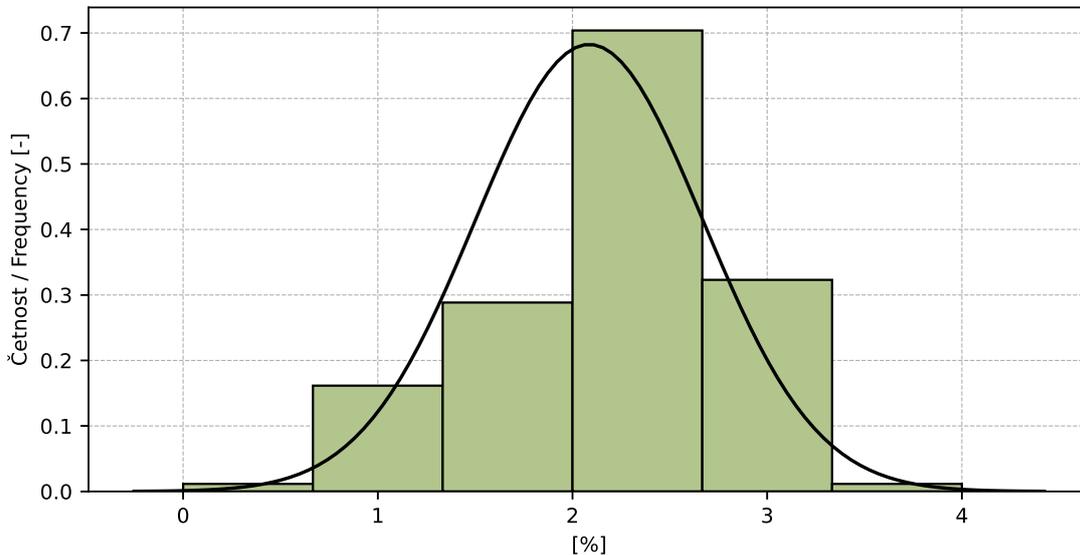
Figure 57: Histogram of all test results

Table 21: Descriptive statistics

Characteristics	[%]
Průměrná hodnota / Average value – $\bar{x}$	2.1
Výběrová směrodatná odchylka / Sample standard deviation – s	0.58
Vztažná hodnota / Asigned value – x^*	2.1
Robustní směrodatná odchylka / Robust standard deviation – s^*	0.58
Nejistota měření vztažné hodnoty / Measurement uncertainty of asigned value – u_X	0.76
p-hodnota testu normality / p-value of normality test	1.0 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – s_L	0.56
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – s_r	0.28
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – s_R	0.63
Opakovatelnost / Repeatability – r	0.8
Reprodukovatelnost / Reproducibility – R	1.8

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1.6.5   Evaluation of Performance Statistics
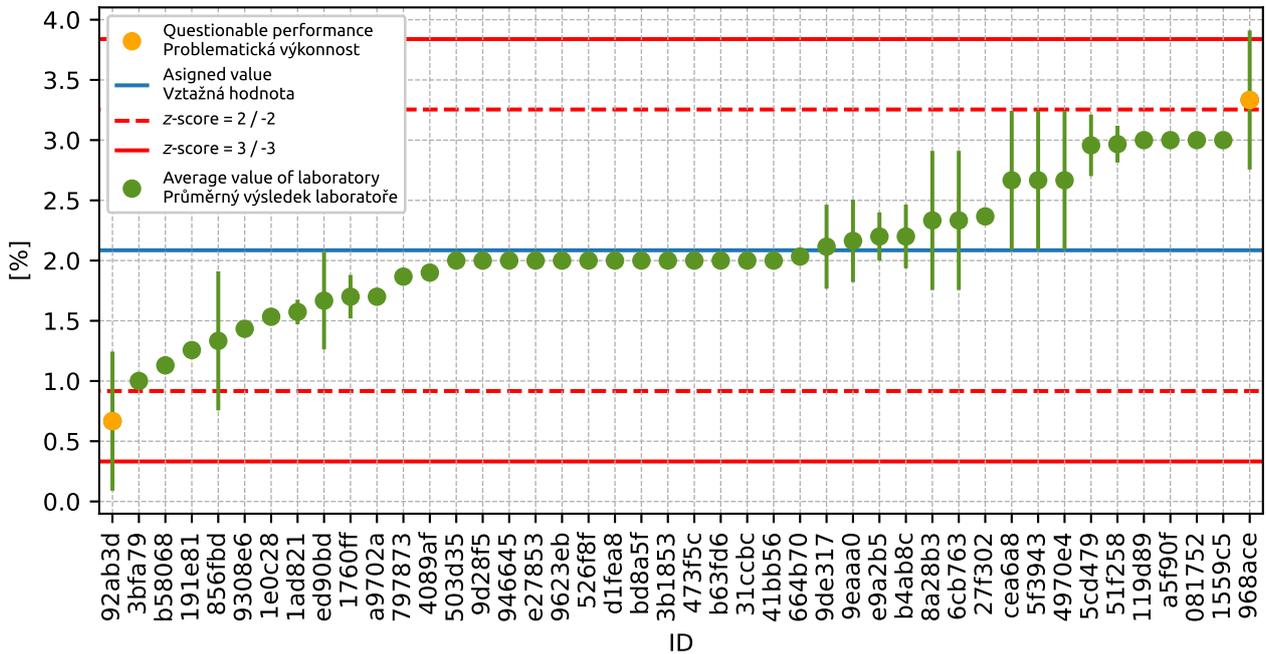
Figure 58: Average values and sample standard deviations
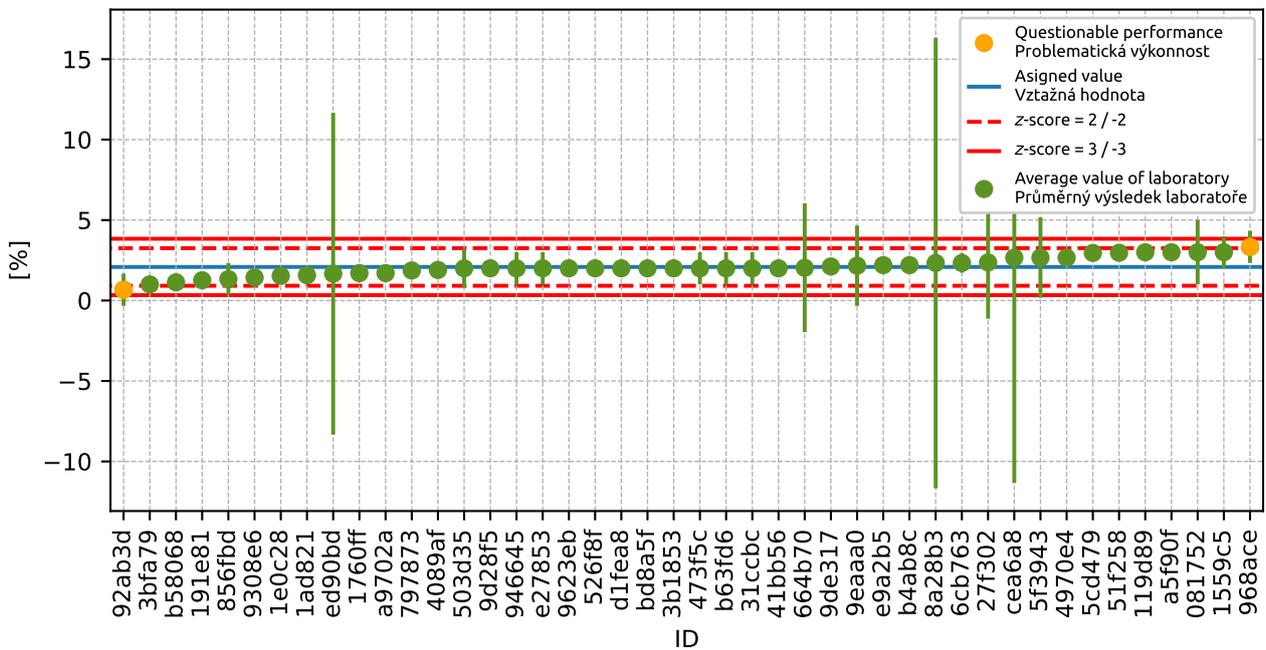
Figure 59: Average values and extended uncertainties of measurement

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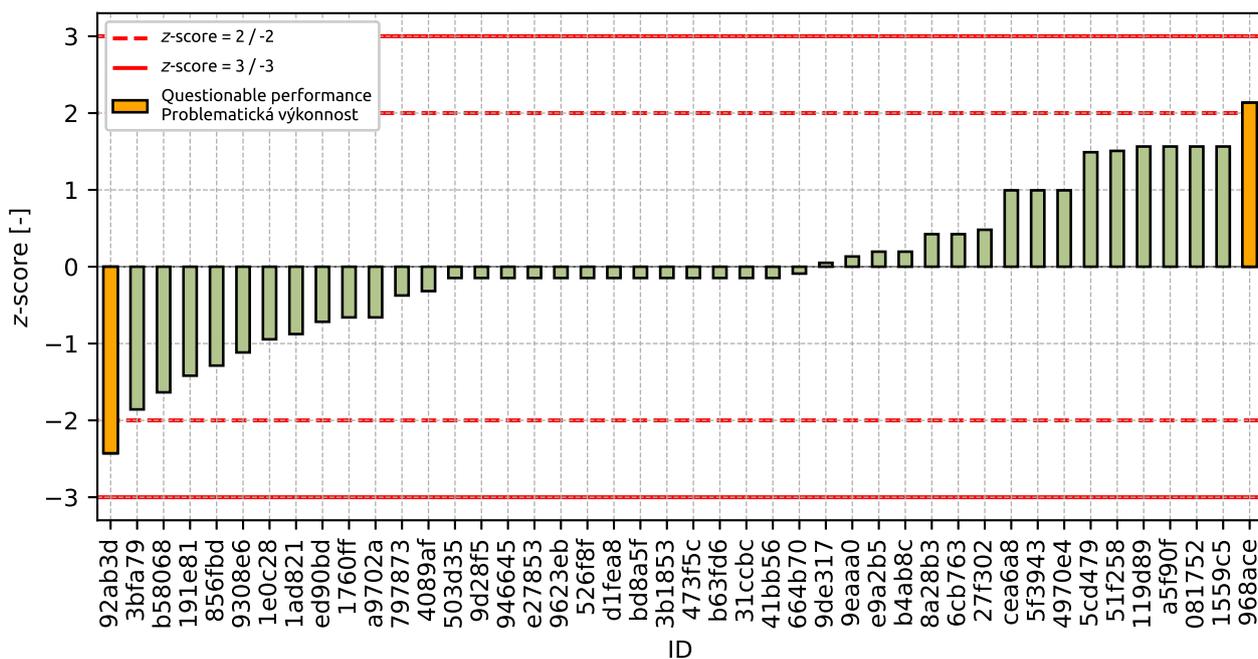
Figure 60: z-score

Figure 61: ζ-score

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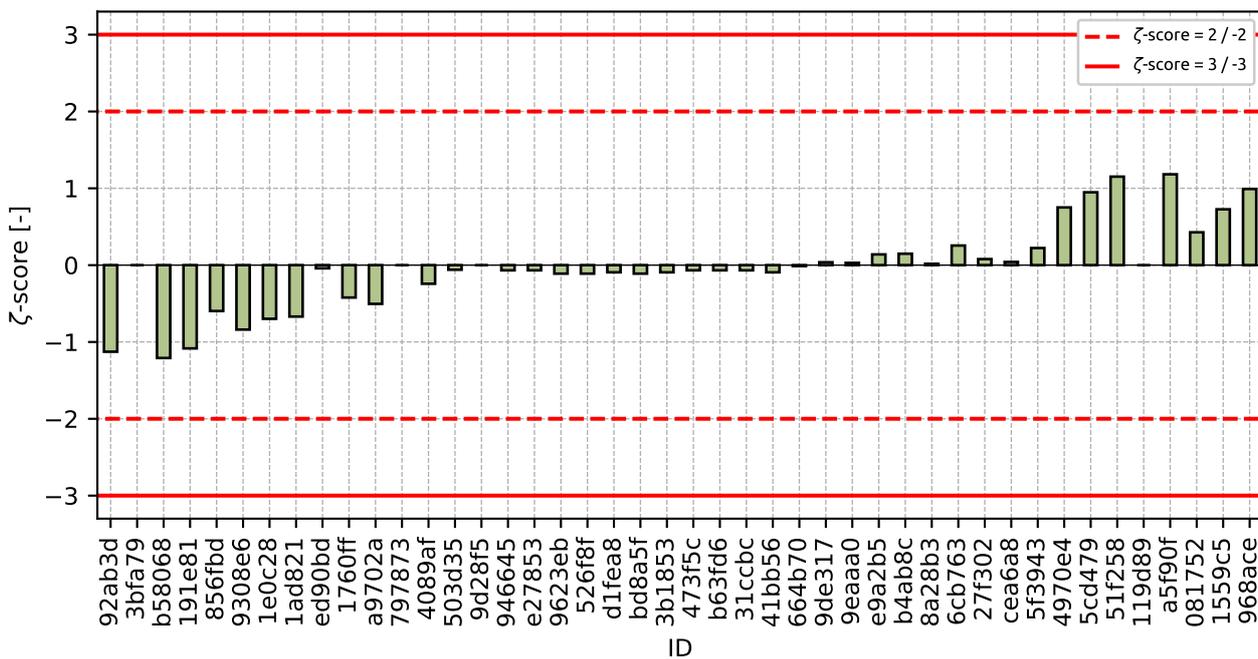
Table 22: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
92ab3d	-2.43	-1.13
3bfa79	-1.86	-
b58068	-1.63	-1.21
191e81	-1.42	-1.08
856fbd	-1.29	-0.6
9308e6	-1.12	-0.84
1e0c28	-0.94	-0.7
1ad821	-0.88	-0.67
ed90bd	-0.72	-0.04
1760ff	-0.66	-0.42
a9702a	-0.66	-0.5
797873	-0.37	-
4089af	-0.32	-0.24
503d35	-0.15	-0.06
9d28f5	-0.15	-
946645	-0.15	-0.07
e27853	-0.15	-0.07
9623eb	-0.15	-0.11
526f8f	-0.15	-0.11
d1fea8	-0.15	-0.09
bd8a5f	-0.15	-0.11
3b1853	-0.15	-0.09
473f5c	-0.15	-0.07
b63fd6	-0.15	-0.07
31ccbc	-0.15	-0.07
41bb56	-0.15	-0.09
664b70	-0.09	-0.01
9de317	0.05	0.04
9eaaa0	0.13	0.03
e9a2b5	0.2	0.14
b4ab8c	0.2	0.15
8a28b3	0.42	0.02
6cb763	0.42	0.26
27f302	0.48	0.08
cea6a8	0.99	0.04
5f3943	0.99	0.22
4970e4	0.99	0.75
5cd479	1.49	0.95
51f258	1.51	1.15
119d89	1.56	-
a5f90f	1.56	1.18

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ID	z-score [-]	ζ-score [-]
081752	1.56	0.43
1559c5	1.56	0.73
968ace	2.14	0.99

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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 [%]
165952	0.0	0.0	0.0	0.0	0.0	0.0	-
92ab3d	0.0	0.0	0.0	1.0	0.0	0.0	-
9308e6	0.1	0.2	0.3	0.2	0.2	0.1	50.0
3bfa79	0.4	0.3	0.3	0.3	0.3	0.06	17.32
1760ff	0.3	0.4	0.3	0.2	0.4	0.08	22.88
191e81	0.4	0.4	0.4	0.0	0.4	0.0	0.0
b58068	0.4	0.3	0.5	0.0	0.4	0.09	21.44
ed90bd	0.4	0.3	0.6	10.0	0.4	0.15	35.25
1e0c28	0.4	0.4	0.5	0.1	0.4	0.06	13.32
856fbd	0.7	0.5	0.3	0.5	0.5	0.2	40.0
41bb56	0.6	0.5	0.5	0.1	0.5	0.06	10.83
1ad821	0.7	0.8	0.2	0.0	0.6	0.35	63.65
797873	0.6	0.5	0.6	-	0.6	0.03	5.49
a9702a	0.6	0.6	0.6	0.0	0.6	0.0	0.0
503d35	0.6	0.7	0.6	0.7	0.6	0.06	9.12
4089af	0.7	0.7	0.7	0.0	0.7	0.01	1.47
d1fea8	0.7	0.8	0.8	0.4	0.8	0.06	7.53
9de317	1.4	0.5	0.5	0.2	0.8	0.51	65.68
1fd599	0.8	0.8	0.8	-	0.8	0.01	1.25
bd8a5f	0.9	0.8	0.8	0.1	0.8	0.06	6.93
473f5c	0.8	0.9	0.8	0.5	0.8	0.06	6.93
946645	0.8	0.8	1.0	1.0	0.9	0.12	13.32
31ccbc	0.9	0.8	0.9	0.3	0.9	0.06	6.66
e9a2b5	0.9	0.9	0.8	0.2	0.9	0.06	6.66
9d28f5	0.9	-	-	-	0.9	0.0	0.0
526f8f	0.8	1.0	0.9	0.1	0.9	0.1	11.11
b63fd6	0.9	1.0	1.0	0.2	1.0	0.06	5.97
664b70	1.0	0.9	1.0	4.0	1.0	0.06	5.97
3b1853	1.0	1.0	1.0	0.2	1.0	0.0	0.0
9623eb	1.1	1.1	0.9	0.1	1.0	0.12	11.17
e27853	1.0	1.0	1.1	0.1	1.0	0.06	5.59
b4ab8c	0.9	1.2	1.1	0.1	1.1	0.15	14.32
27f302	1.0	1.2	1.1	3.5	1.1	0.1	9.09
9eaaa0	1.5	0.9	1.0	2.5	1.1	0.33	29.53

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ID	Test results			u_X	$\bar{x}$	s_0	V_X
	[%]			[%]	[%]	[%]	[%]
5f3943	1.1	1.3	1.2	2.5	1.2	0.1	8.33
4970e4	1.3	1.1	1.3	0.1	1.2	0.12	9.36
8a28b3	1.1	1.4	1.2	2.0	1.2	0.15	12.39
6cb763	1.3	1.3	1.2	0.6	1.3	0.06	4.56
1559c5	1.5	1.5	1.5	0.2	1.5	0.0	0.0
5cd479	1.6	1.4	1.6	0.3	1.5	0.15	9.69
cea6a8	1.7	1.5	1.6	2.0	1.6	0.1	6.25
119d89	1.7	1.7	1.6	-	1.7	0.06	3.46
968ace	2.0	2.0	1.0	1.0	1.7	0.58	34.64
081752	2.0	1.0	2.0	2.0	1.7	0.58	34.64
51f258	2.0	1.7	1.9	0.2	1.9	0.15	8.18
a5f90f	2.0	2.0	2.0	0.1	2.0	0.0	0.0
5afa3f	3.0	-	-	-	3.0	0.0	0.0
7d1284	5.2	-	-	-	5.2	0.0	0.0
d24f52	6.2	6.2	6.2	2.0	6.2	0.0	0.0

1.7.2 The Numerical Procedure for Determining Outliers
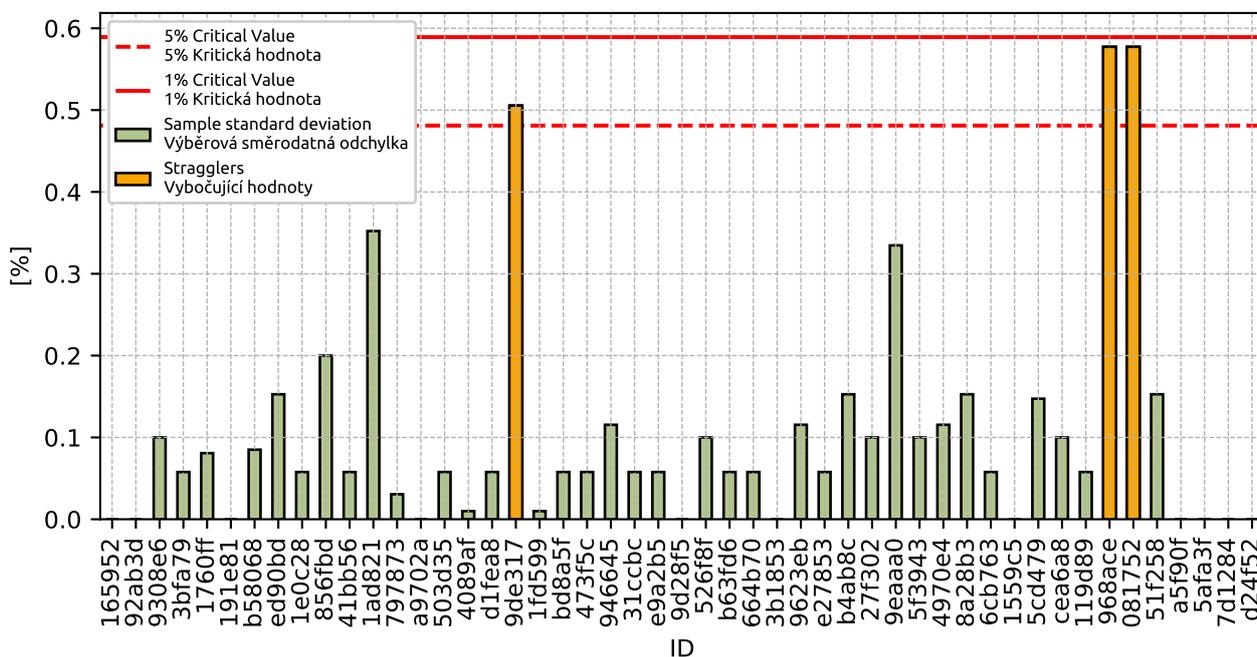
Figure 62: **Cochran's test** - sample standard deviations

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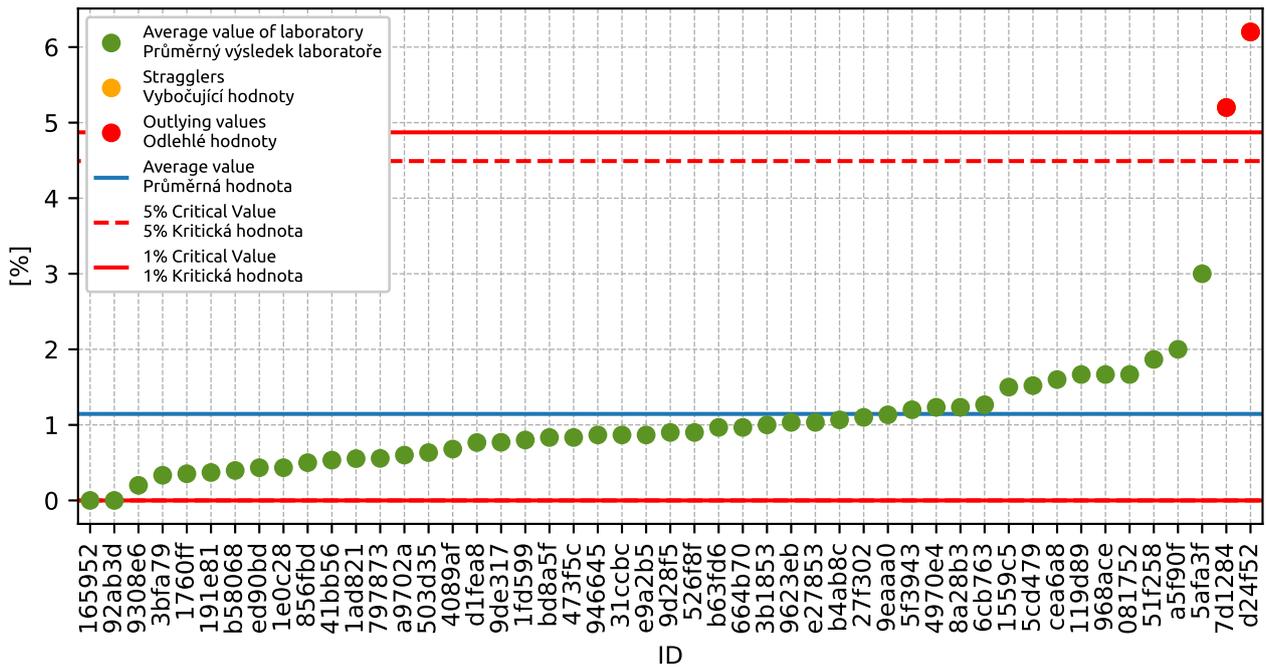
Figure 63: **Grubbs' test** - average values
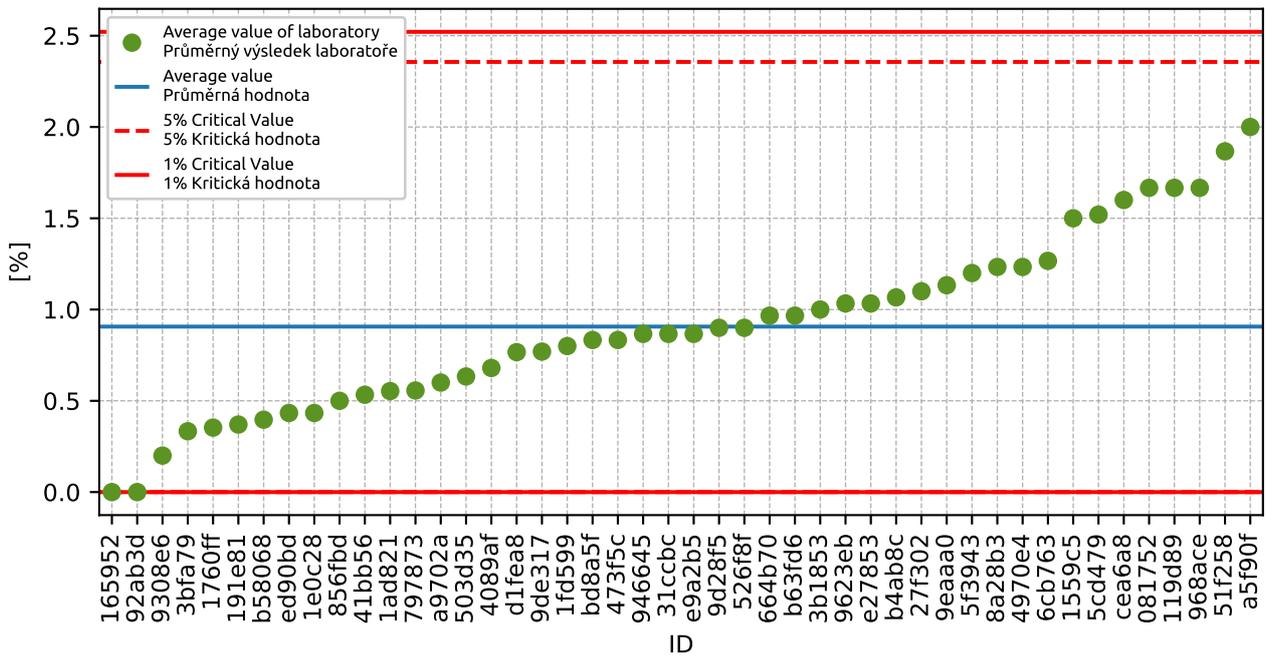
Figure 64: **Grubbs' test** - average values without outliers

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1.7.3   Mandelʾs Statistics
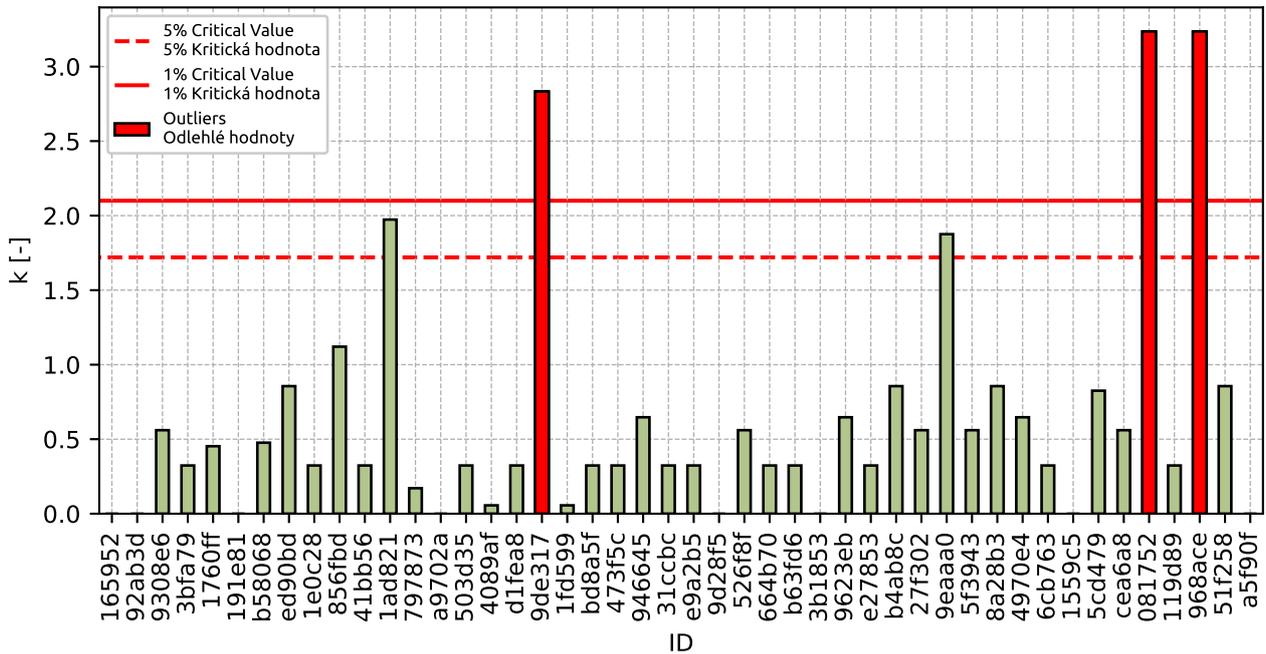
Figure 65: Intralaboratory Consistency Statistic
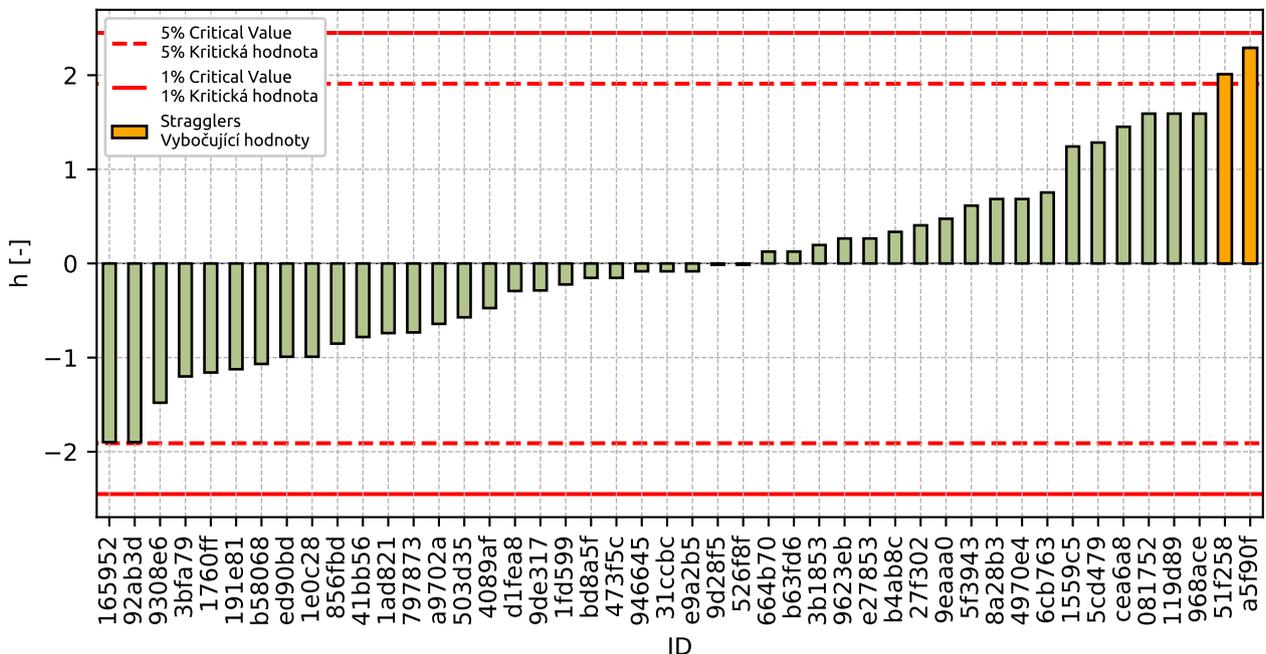
Figure 66: Interlaboratory Consistency Statistic

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1.7.4 Descriptive statistics
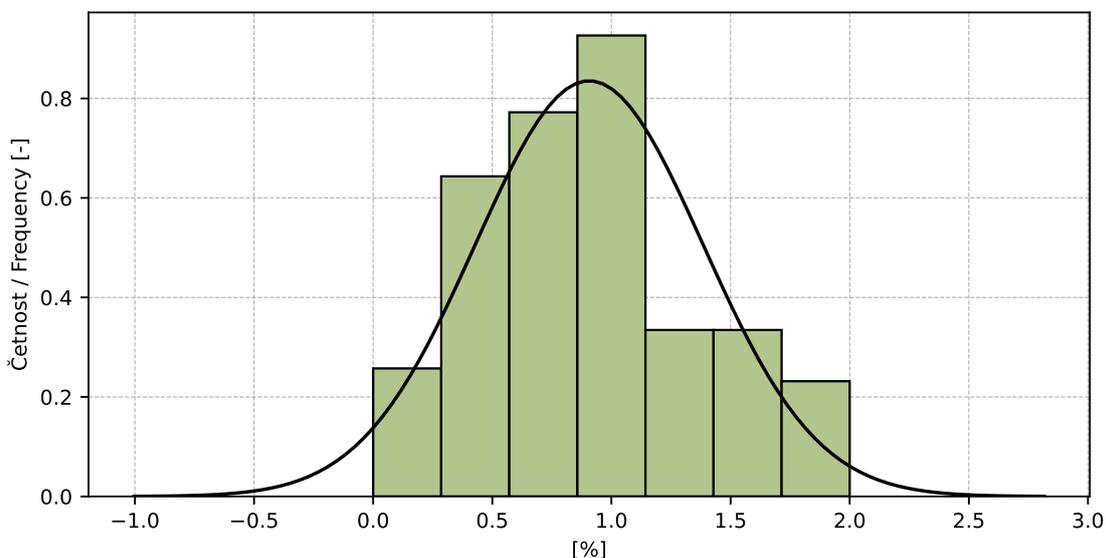
Figure 67: Histogram of all test results

Table 24: Descriptive statistics

Characteristics	[%]
Průměrná hodnota / Average value – $\bar{x}$	0.9
Výběrová směrodatná odchylka / Sample standard deviation – s	0.48
Vztažná hodnota / Asigned value – x^*	0.9
Robustní směrodatná odchylka / Robust standard deviation – s^*	0.48
Nejistota měření vztažné hodnoty / Measurement uncertainty of asigned value – u_X	0.69
p-hodnota testu normality / p-value of normality test	1.0 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – s_L	0.47
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – s_r	0.18
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – s_R	0.5
Opakovatelnost / Repeatability – r	0.5
Reprodukovatelnost / Reproducibility – R	1.4

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1.7.5   Evaluation of Performance Statistics
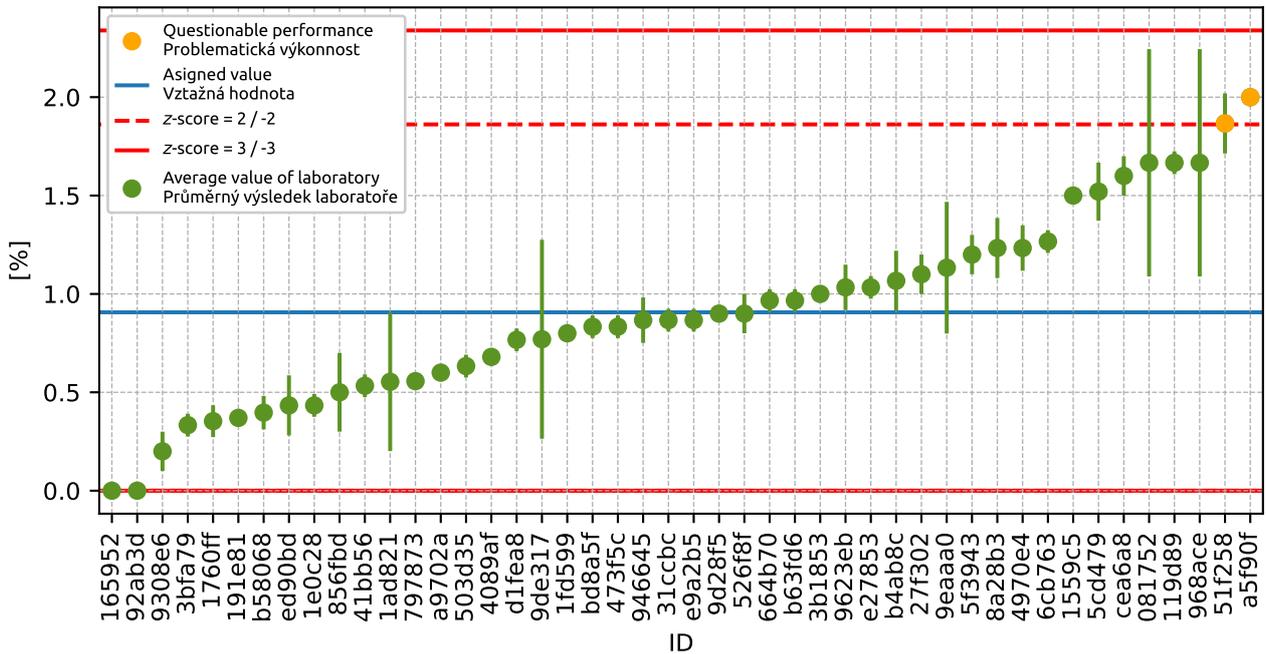
Figure 68: Average values and sample standard deviations
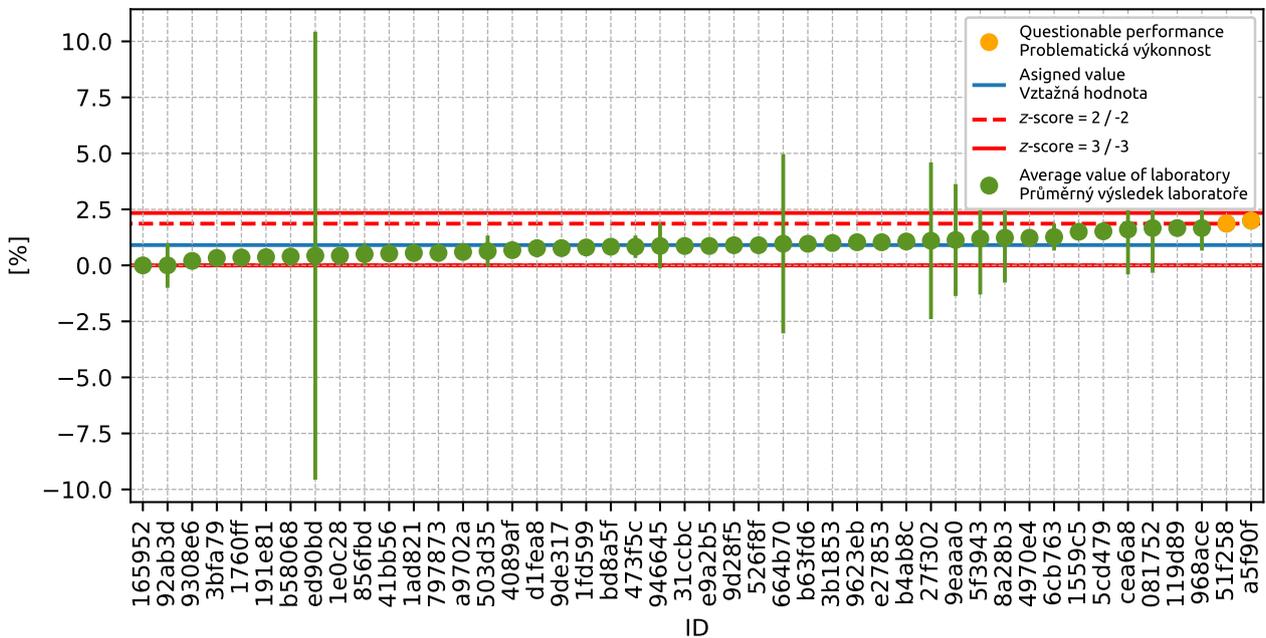
Figure 69: Average values and extended uncertainties of measurement

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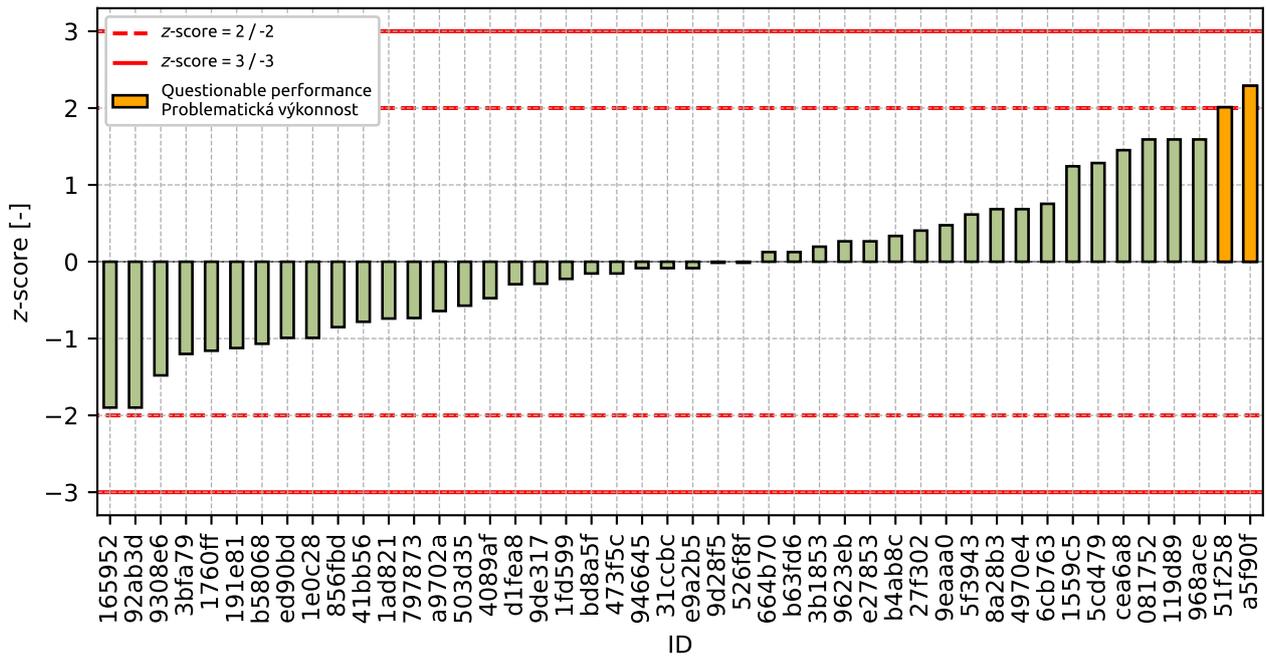
Figure 70: z-score

Figure 71: ζ-score

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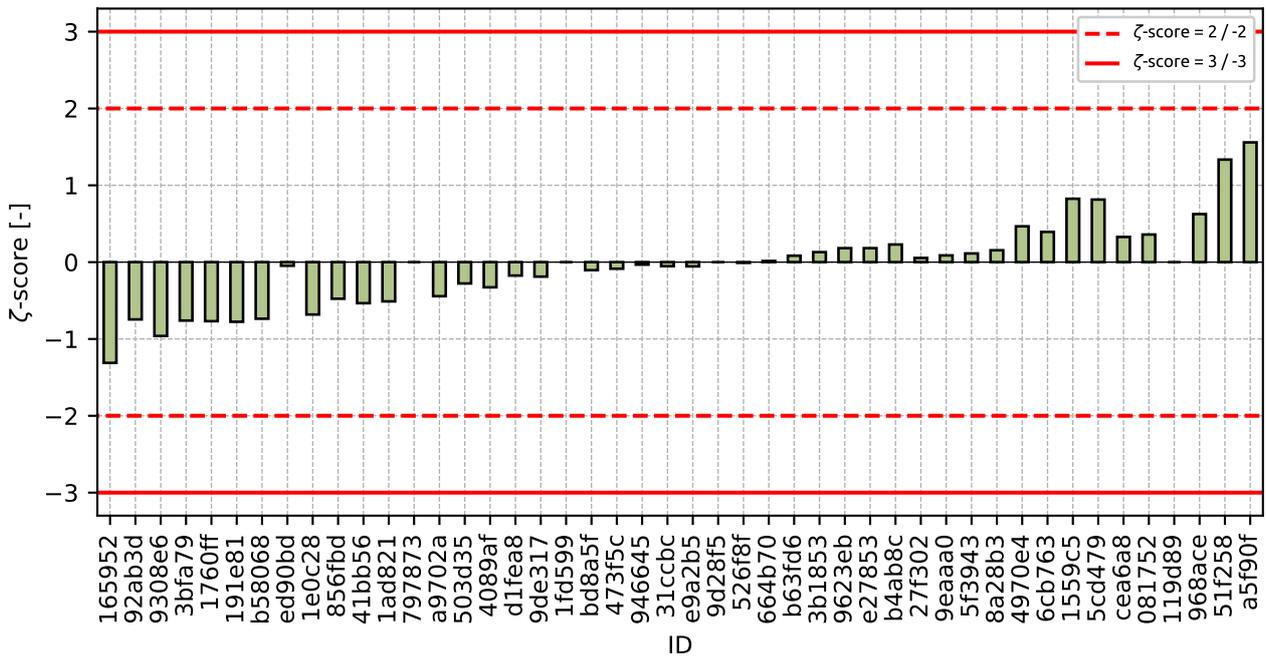
Table 25: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
165952	-1.9	-1.31
92ab3d	-1.9	-0.75
9308e6	-1.48	-0.96
3bfa79	-1.2	-0.76
1760ff	-1.16	-0.77
191e81	-1.12	-0.78
b58068	-1.07	-0.74
ed90bd	-0.99	-0.05
1e0c28	-0.99	-0.68
856fbd	-0.85	-0.48
41bb56	-0.78	-0.53
1ad821	-0.74	-0.51
797873	-0.73	-
a9702a	-0.64	-0.44
503d35	-0.57	-0.28
4089af	-0.47	-0.33
d1fea8	-0.29	-0.18
9de317	-0.29	-0.19
1fd599	-0.22	-
bd8a5f	-0.15	-0.1
473f5c	-0.15	-0.09
946645	-0.08	-0.03
31ccbc	-0.08	-0.05
e9a2b5	-0.08	-0.06
9d28f5	-0.01	-
526f8f	-0.01	-0.01
664b70	0.13	0.01
b63fd6	0.13	0.08
3b1853	0.2	0.13
9623eb	0.27	0.18
e27853	0.27	0.18
b4ab8c	0.34	0.23
27f302	0.41	0.05
9eaaa0	0.47	0.09
5f3943	0.61	0.11
8a28b3	0.68	0.15
4970e4	0.68	0.47
6cb763	0.75	0.39
1559c5	1.24	0.82
5cd479	1.28	0.81
cea6a8	1.45	0.33

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ID	z-score [-]	ζ-score [-]
081752	1.59	0.36
119d89	1.59	-
968ace	1.59	0.63
51f258	2.01	1.33
a5f90f	2.29	1.56

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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
	[%]			[%]	[%]	[%]	[%]
473f5c	8.0	8.0	7.0	1.0	7.7	0.58	7.53
165952	8.0	8.0	8.0	0.1	8.0	0.0	0.0
41bb56	8.0	9.0	8.0	1.0	8.3	0.58	6.93
9308e6	9.7	9.5	9.6	0.3	9.6	0.1	1.04
797873	11.0	11.0	11.0	-	11.0	0.0	0.0

2.2   The Numerical Procedure for Determining Outliers
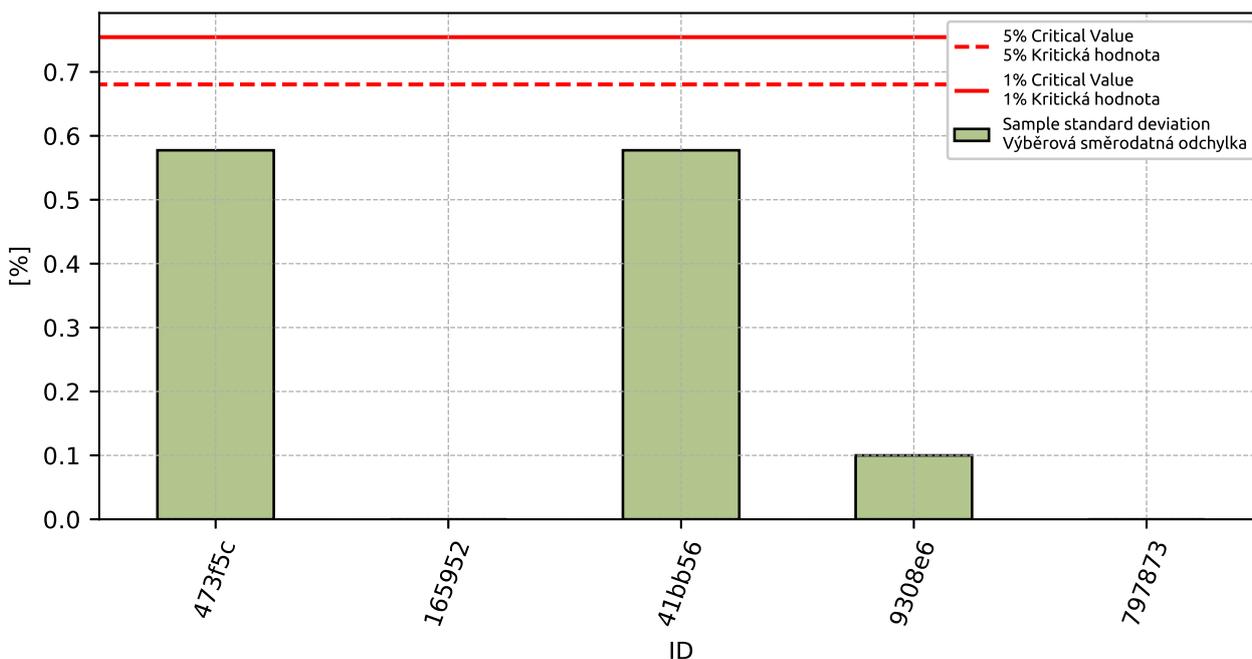
Figure 72: **Cochran's test** - sample standard deviations

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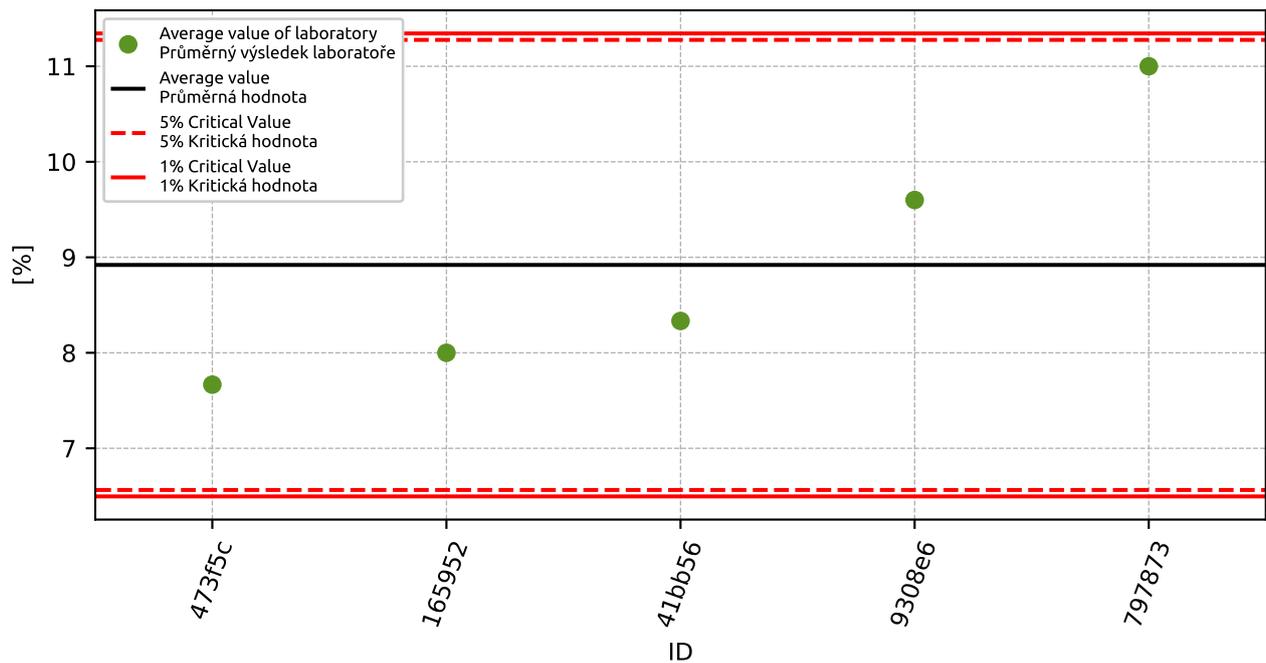
Figure 73: **Grubbs' test** - average values

2.3 Mandel′s Statistics
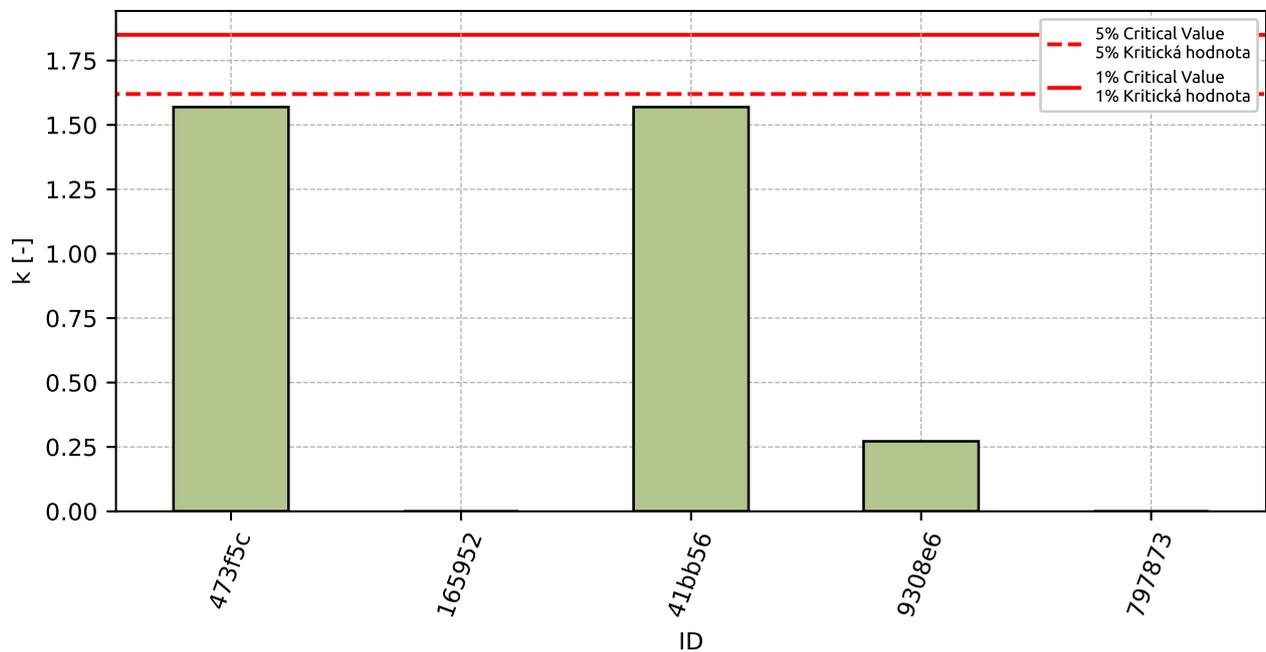
Figure 74: Intralaboratory Consistency Statistic

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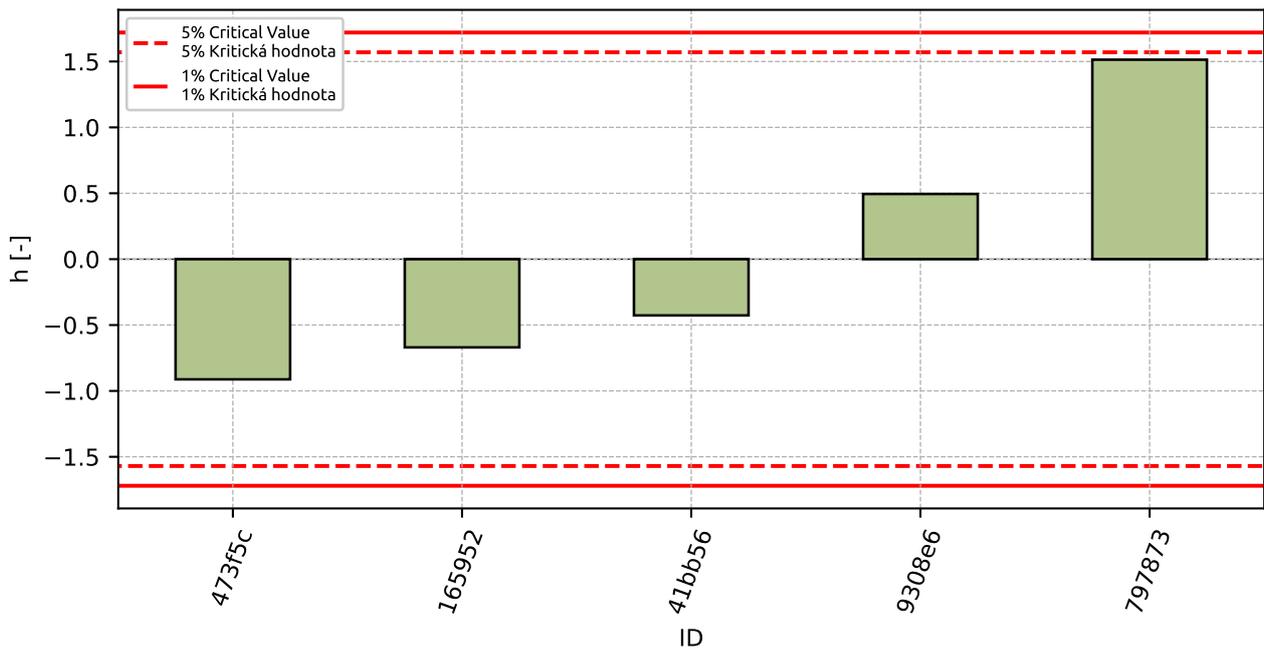
Figure 75: Interlaboratory Consistency Statistic

2.4 Descriptive statistics
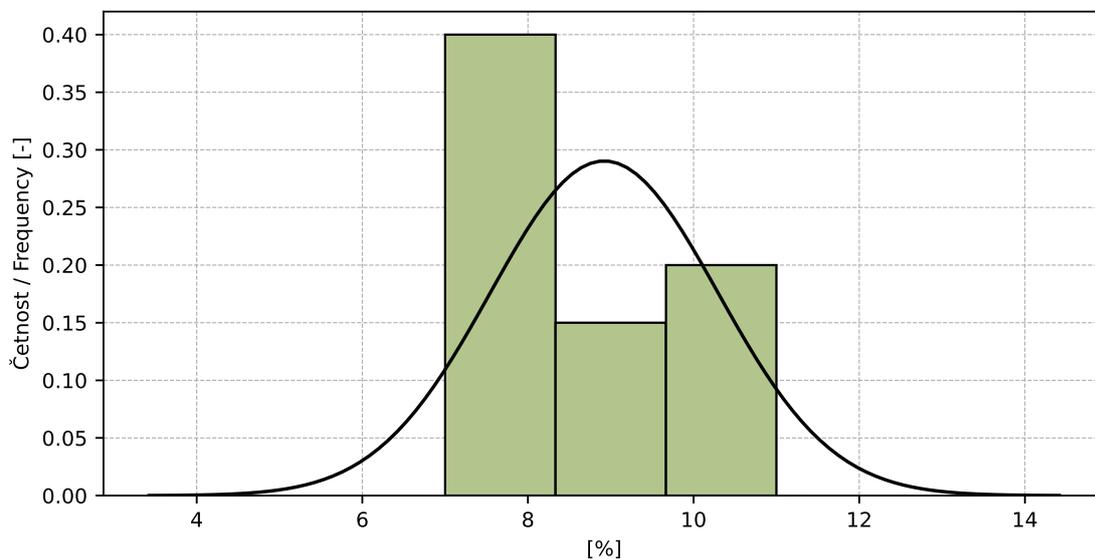
Figure 76: Histogram of all test results

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Table 27: Descriptive statistics

Characteristics	[%]
Průměrná hodnota / Average value – $\bar{x}$	8.9
Výběrová směrodatná odchylka / Sample standard deviation – s	1.37
Vztažná hodnota / Asigned value – x^*	8.9
Robustní směrodatná odchylka / Robust standard deviation – s^*	1.39
Nejistota měření vztažné hodnoty / Measurement uncertainty of asigned value – u_X	0.78
p-hodnota testu normality / p-value of normality test	0.016 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – s_L	1.36
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – s_r	0.37
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – s_R	1.41
Opakovatelnost / Repeatability – r	1.0
Reprodukovatelnost / Reproducibility – R	3.9

2.5   Evaluation of Performance Statistics
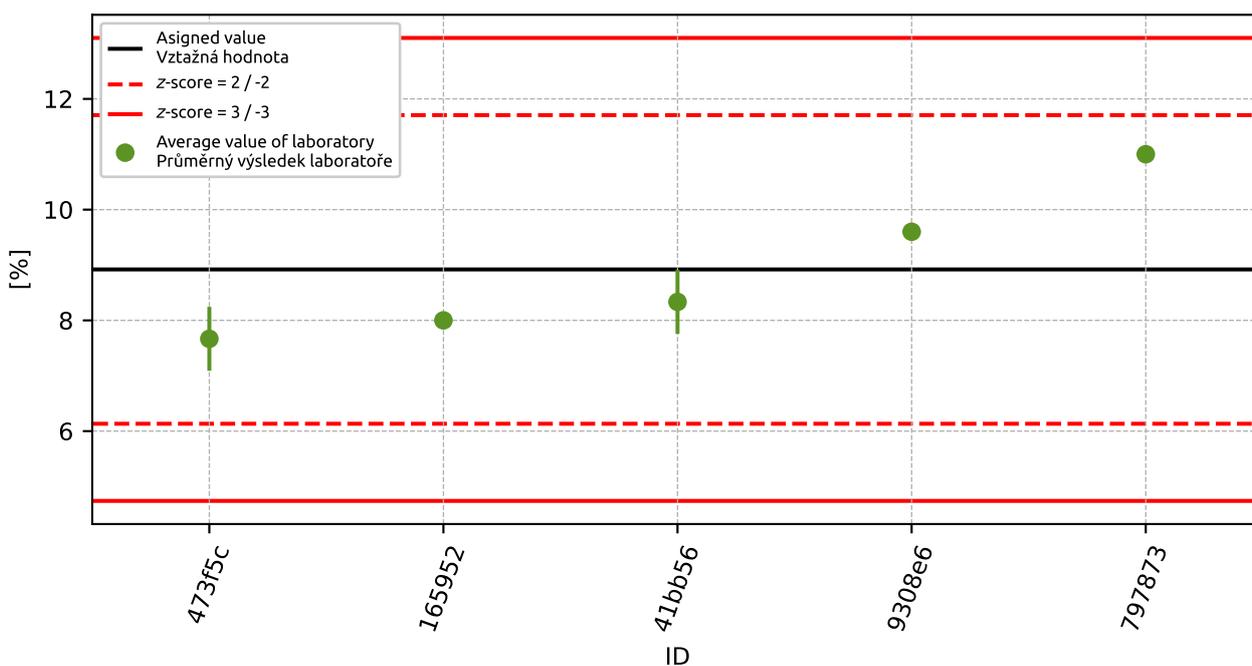
Figure 77: Average values and sample standard deviations

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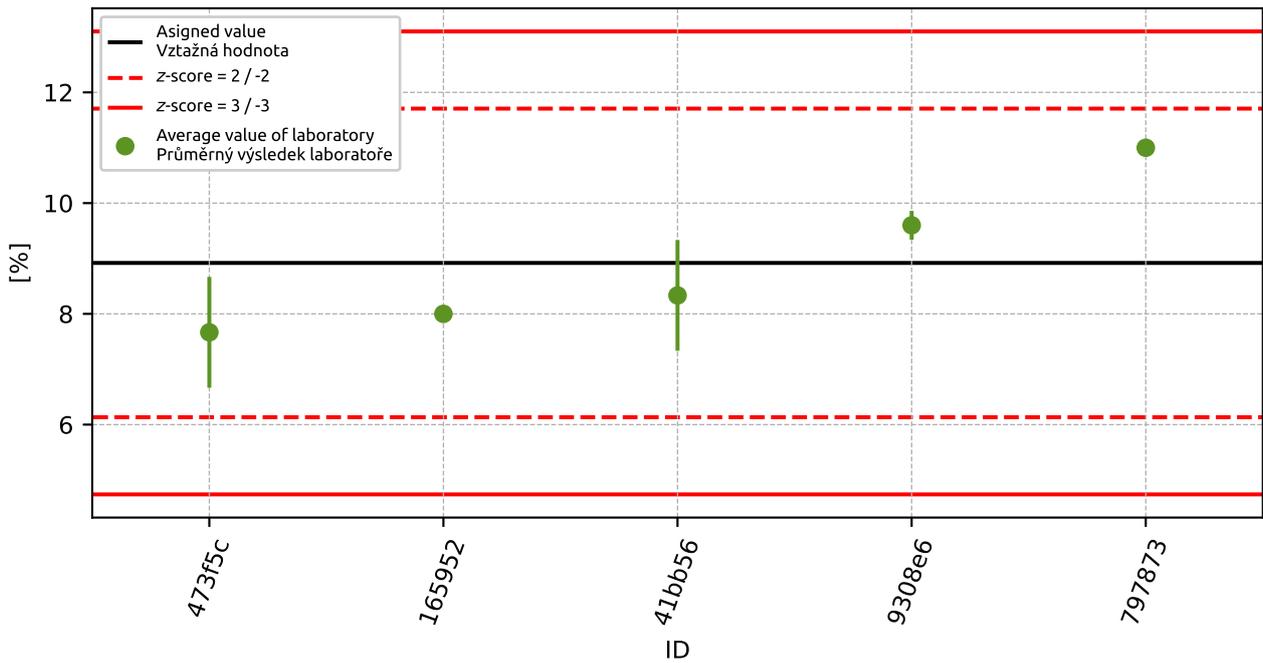
Figure 78: Average values and extended uncertainties of measurement

Figure 79: z-score

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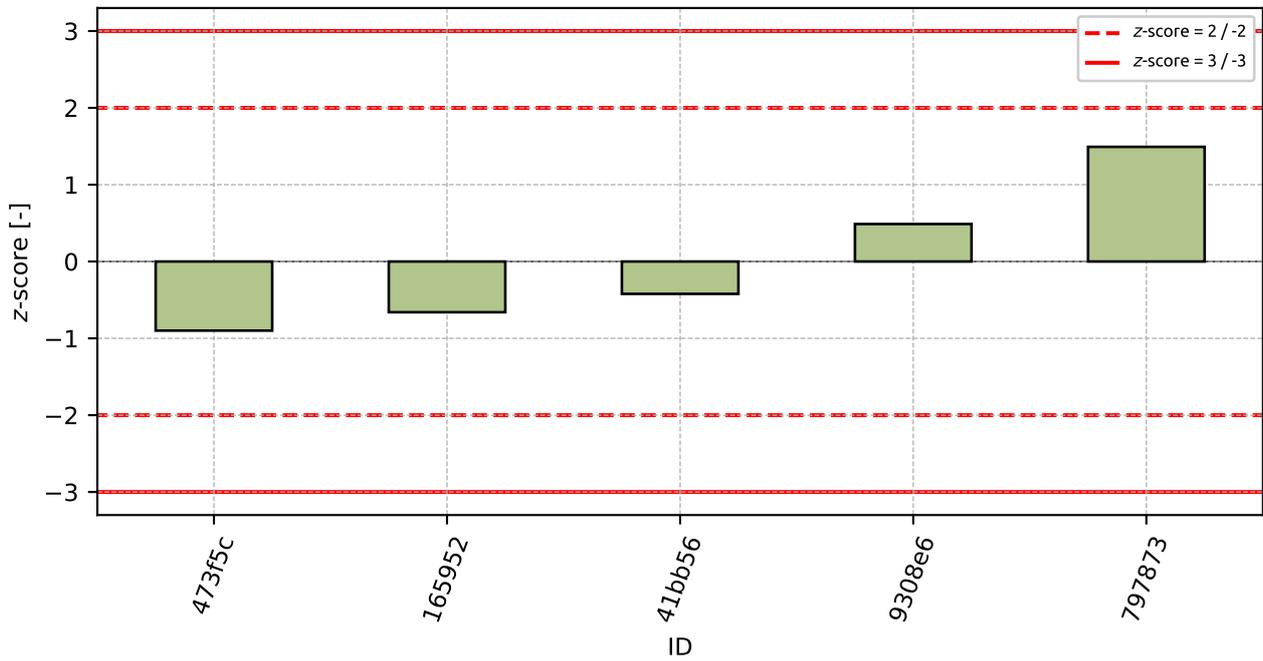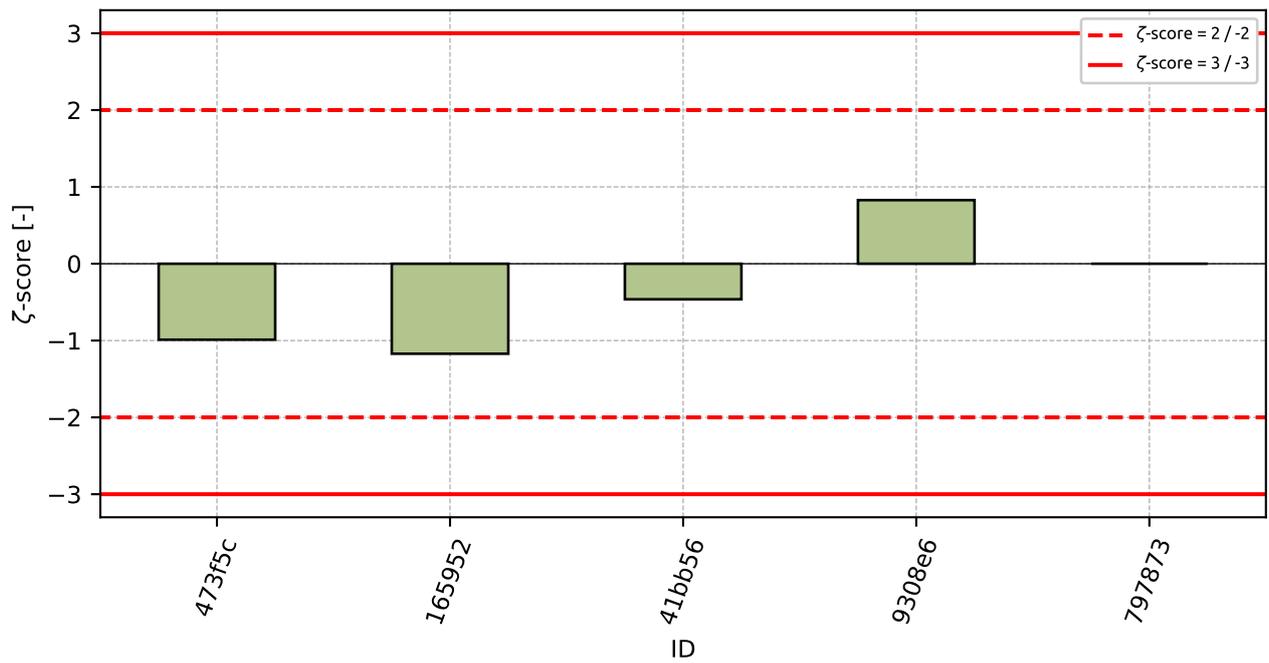
Figure 80: ζ-score

Table 28: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
473f5c	-0.9	-0.99
165952	-0.66	-1.17
41bb56	-0.42	-0.46
9308e6	0.49	0.83
797873	1.49	-

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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 [%]
c7c309	8.0	8.0	8.0	3.5	8.0	0.0	0.0
b4ab8c	7.5	9.0	8.1	0.4	8.2	0.75	9.21
e9a2b5	8.4	8.4	8.4	0.6	8.4	0.0	0.0
081752	9.3	9.4	9.5	1.0	9.4	0.1	1.06
664b70	10.7	9.6	8.4	2.0	9.6	1.15	12.02
6cb763	9.0	10.0	10.0	1.0	9.7	0.58	5.97
bd8a5f	10.0	10.0	9.0	0.1	9.7	0.58	5.97
4970e4	9.7	10.1	9.5	1.2	9.8	0.31	3.13
51f258	9.5	9.8	10.1	0.4	9.8	0.3	3.06
5f3943	9.2	9.9	10.3	1.3	9.8	0.56	5.68
5afa3f	10.0	-	-	-	10.0	0.0	0.0
b2e5a7	10.0	11.0	10.0	-	10.3	0.58	5.59
968ace	10.8	10.5	10.6	1.0	10.6	0.15	1.44
1e0c28	10.0	11.0	11.0	1.7	10.7	0.58	5.41
9623eb	11.0	11.0	11.0	0.2	11.0	0.0	0.0
526f8f	11.5	10.7	11.2	0.6	11.1	0.4	3.63
4089af	11.6	12.0	13.3	1.5	12.3	0.89	7.23
7d1284	13.0	-	-	-	13.0	0.0	0.0
5cd479	12.0	13.0	14.0	-	13.0	1.0	7.69
1760ff	15.0	13.0	12.0	2.0	13.3	1.53	11.46
165952	15.0	15.0	15.0	0.2	15.0	0.0	0.0

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3.2   The Numerical Procedure for Determining Outliers
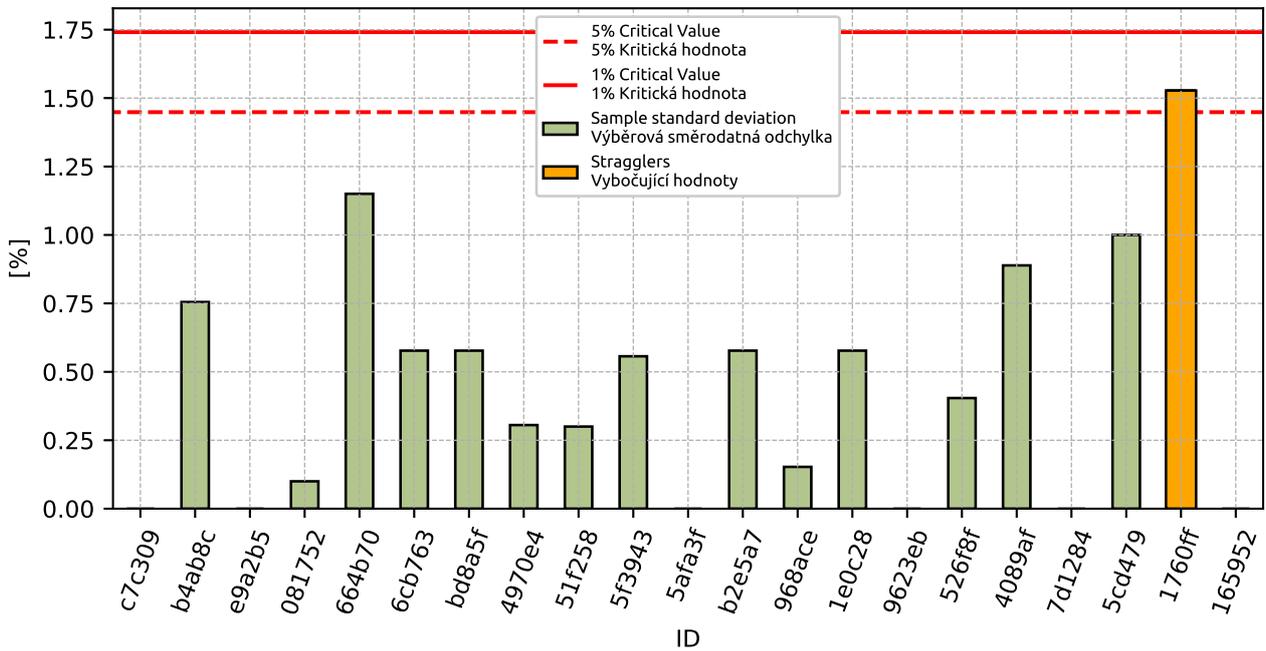
Figure 81: **Cochran's test** - sample standard deviations
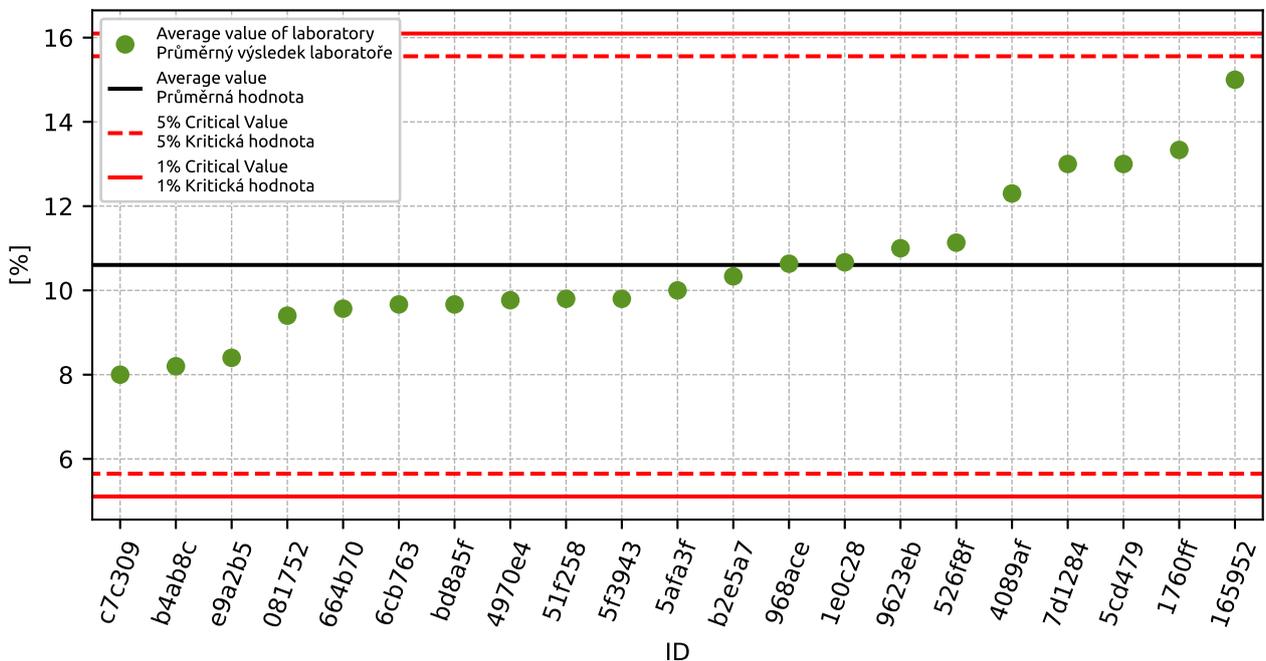
Figure 82: **Grubbs' test** - average values

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3.3   Mandel′s Statistics
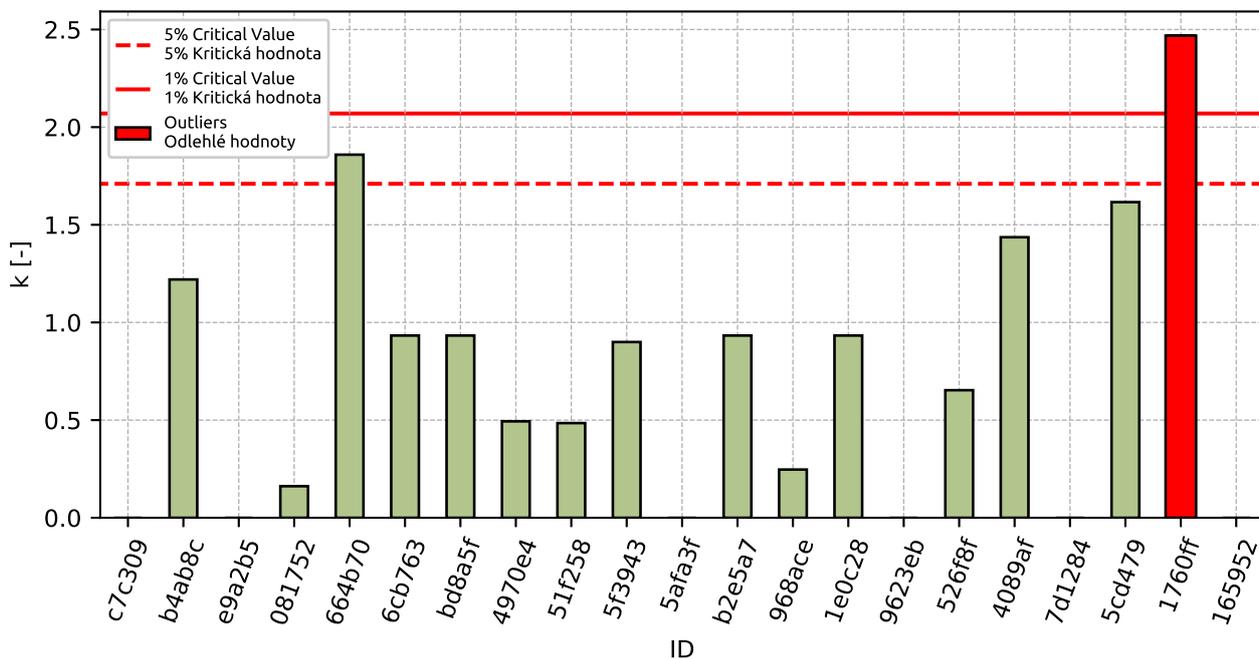
Figure 83: Intralaboratory Consistency Statistic
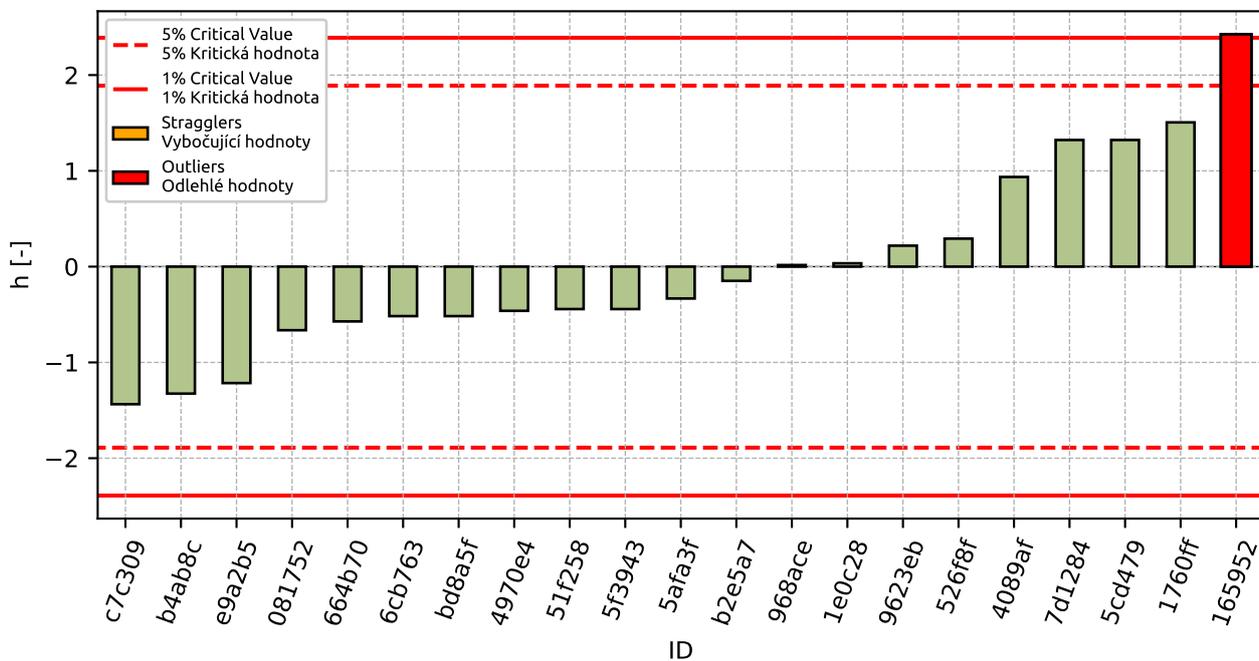
Figure 84: Interlaboratory Consistency Statistic

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3.4   Descriptive statistics
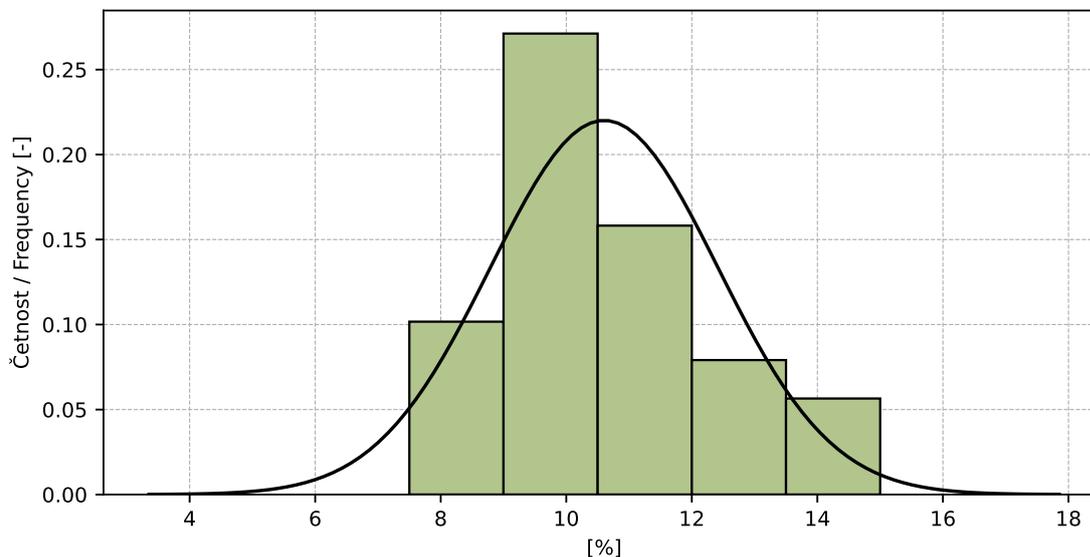
Figure 85: Histogram of all test results

Table 30: Descriptive statistics

Characteristics	[%]
Průměrná hodnota / Average value – $\bar{x}$	10.6
Výběrová směrodatná odchylka / Sample standard deviation – s	1.81
Vztažná hodnota / Asigned value – x^*	10.4
Robustní směrodatná odchylka / Robust standard deviation – s^*	1.6
Nejistota měření vztažné hodnoty / Measurement uncertainty of asigned value – u_X	0.44
p-hodnota testu normality / p-value of normality test	1.0 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – s_L	1.78
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – s_r	0.62
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – s_R	1.88
Opakovatelnost / Repeatability – r	1.7
Reprodukovatelnost / Reproducibility – R	5.3

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3.5 Evaluation of Performance Statistics
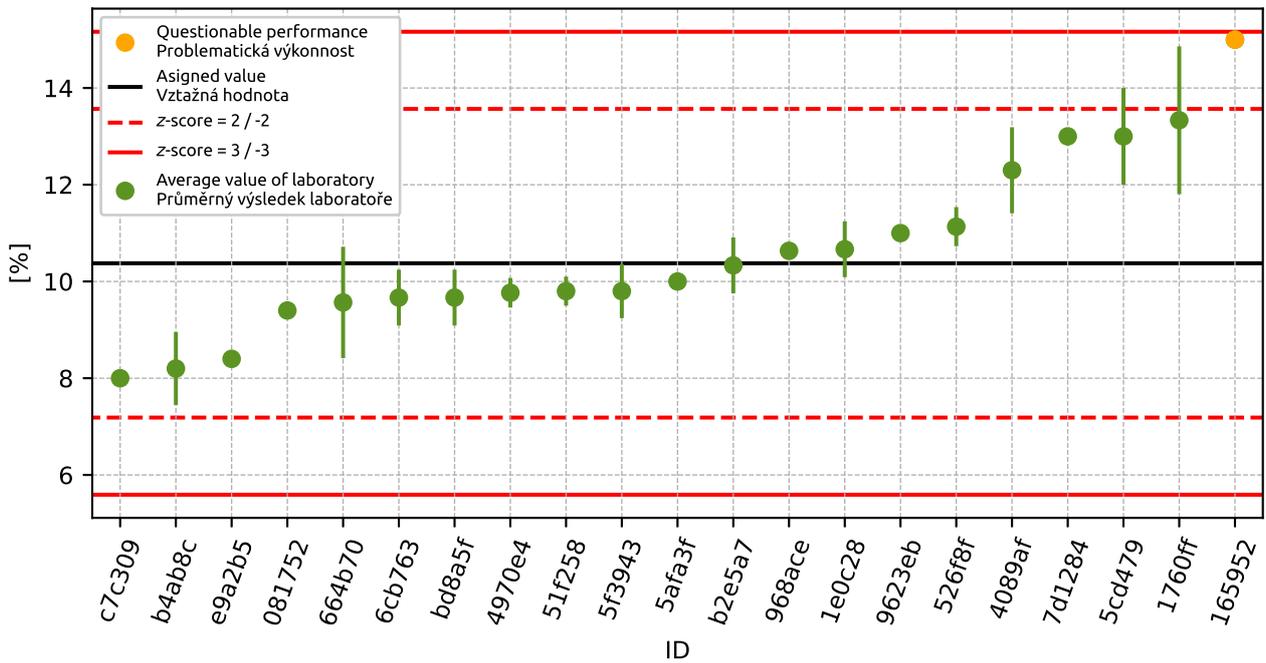
Figure 86: Average values and sample standard deviations
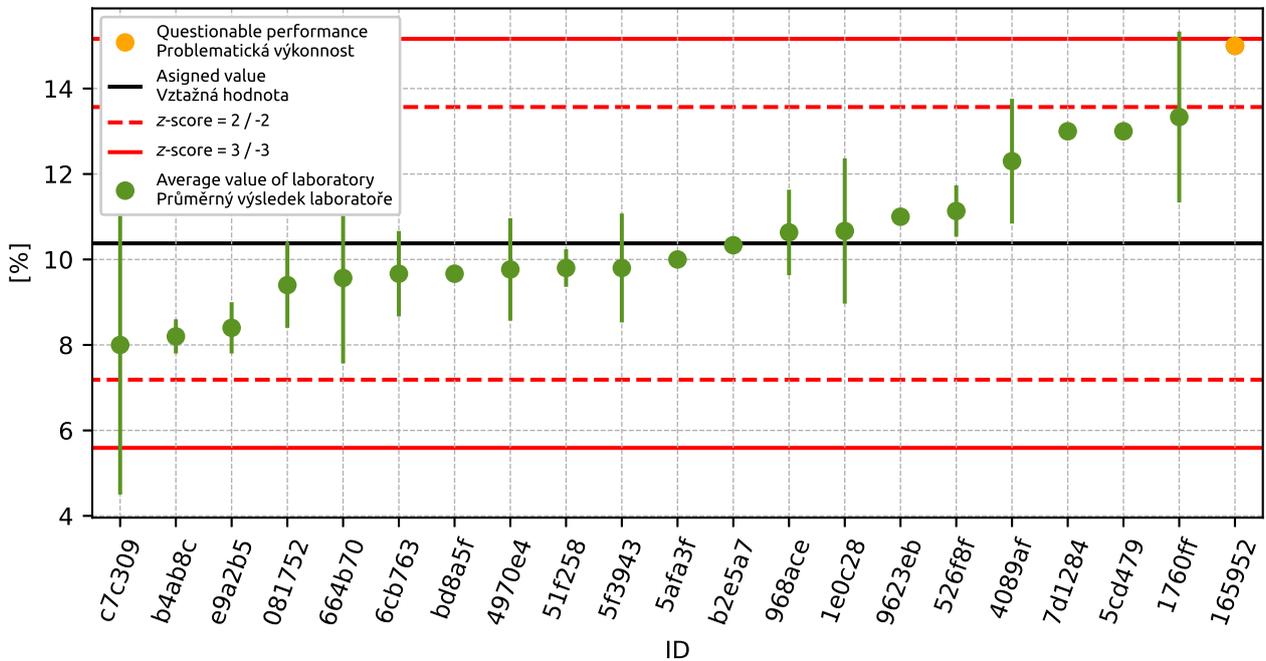
Figure 87: Average values and extended uncertainties of measurement

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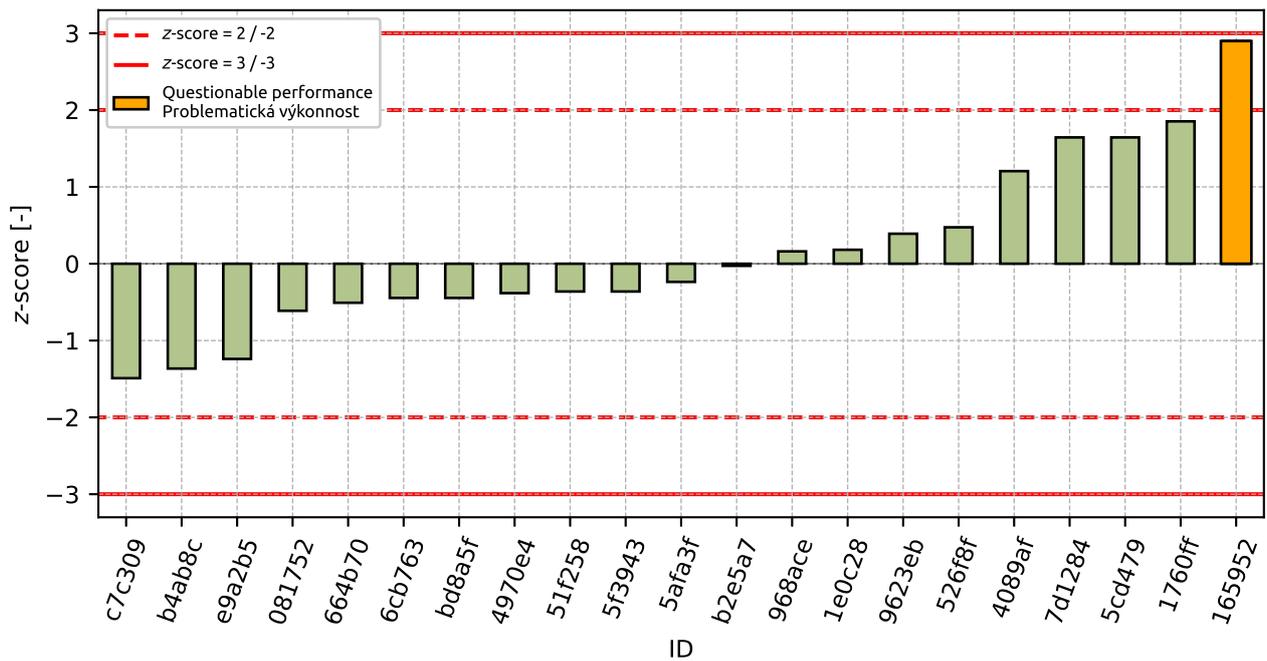
Figure 88: z-score

Figure 89: ζ-score

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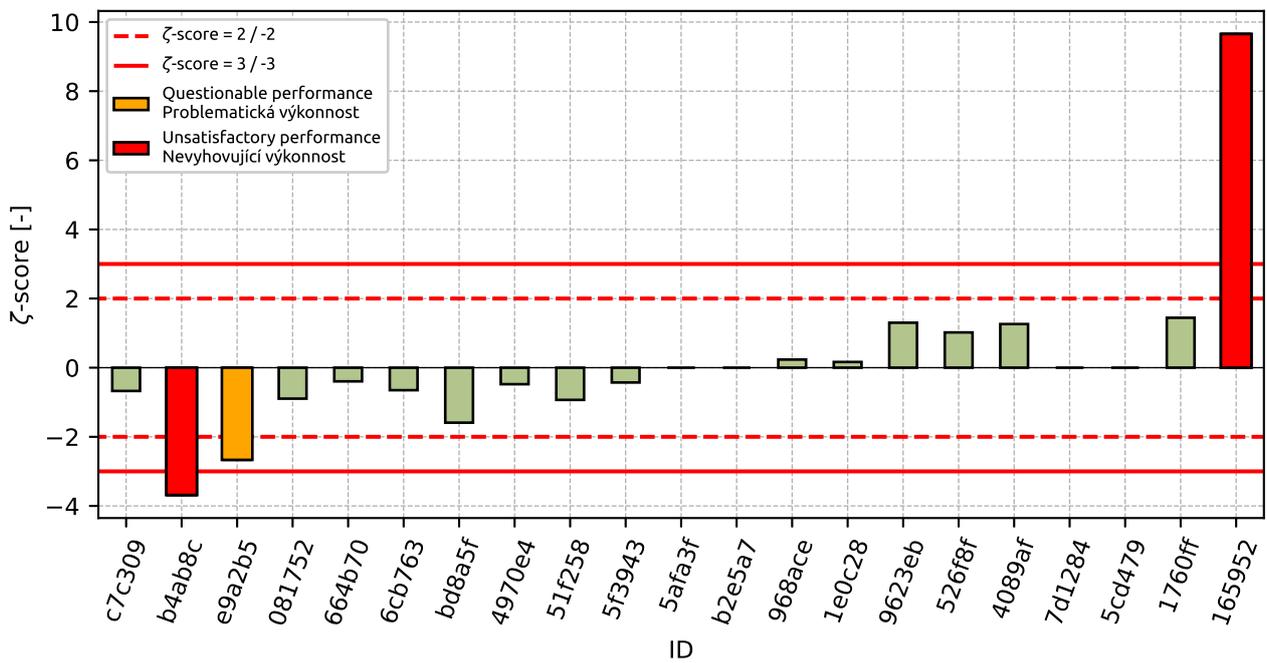
Table 31: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
c7c309	-1.49	-0.67
b4ab8c	-1.36	-3.68
e9a2b5	-1.24	-2.67
081752	-0.61	-0.9
664b70	-0.51	-0.4
6cb763	-0.45	-0.65
bd8a5f	-0.45	-1.59
4970e4	-0.38	-0.48
51f258	-0.36	-0.93
5f3943	-0.36	-0.43
5afa3f	-0.24	-
b2e5a7	-0.03	-
968ace	0.16	0.24
1e0c28	0.18	0.17
9623eb	0.39	1.3
526f8f	0.47	1.02
4089af	1.21	1.26
7d1284	1.64	-
5cd479	1.64	-
1760ff	1.85	1.44
165952	2.9	9.65

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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
	[%]			[%]	[%]	[%]	[%]
41bb56	44.0	44.0	43.0	2.0	43.7	0.58	1.32
bd8a5f	56.0	58.0	58.0	1.1	57.3	1.15	2.01
f26de6	58.0	58.0	59.0	1.0	58.3	0.58	0.99
92ab3d	59.5	60.3	59.9	1.1	59.9	0.4	0.67
694b2b	61.2	62.8	60.7	-	61.6	1.1	1.78
3d85a9	62.9	62.5	63.2	-	62.9	0.35	0.56
c7c309	66.4	66.1	64.4	7.0	65.6	1.08	1.64
b023e3	66.0	66.7	66.4	2.1	66.4	0.34	0.51
856fbd	67.4	66.9	66.4	2.0	66.9	0.5	0.75
f04bc3	68.0	66.7	67.3	0.8	67.3	0.65	0.97

4.2   The Numerical Procedure for Determining Outliers
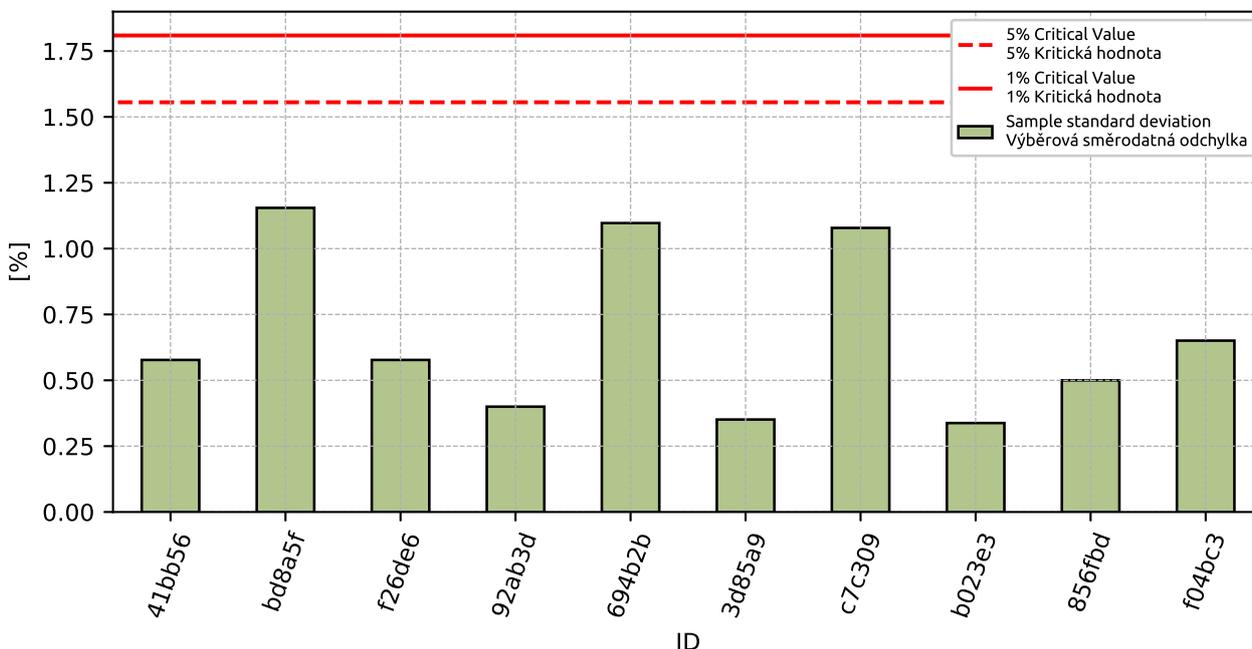
Figure 90: **Cochran's test** - sample standard deviations

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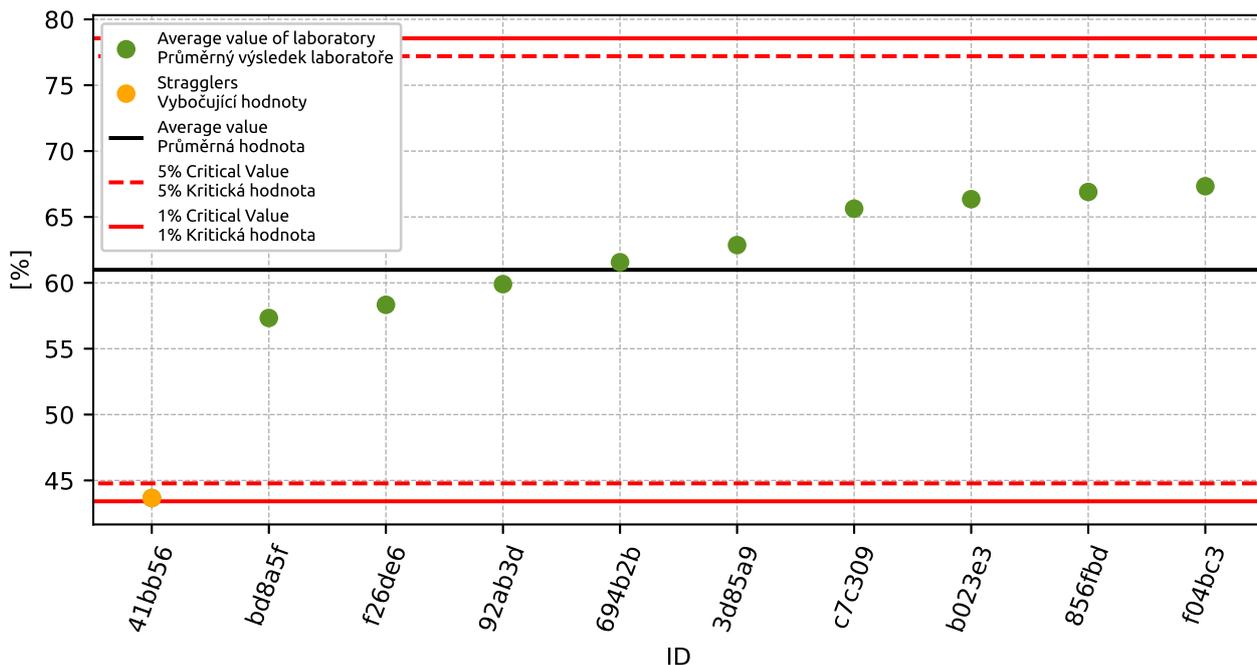
Figure 91: **Grubbs' test** - average values

4.3   Mandel's Statistics
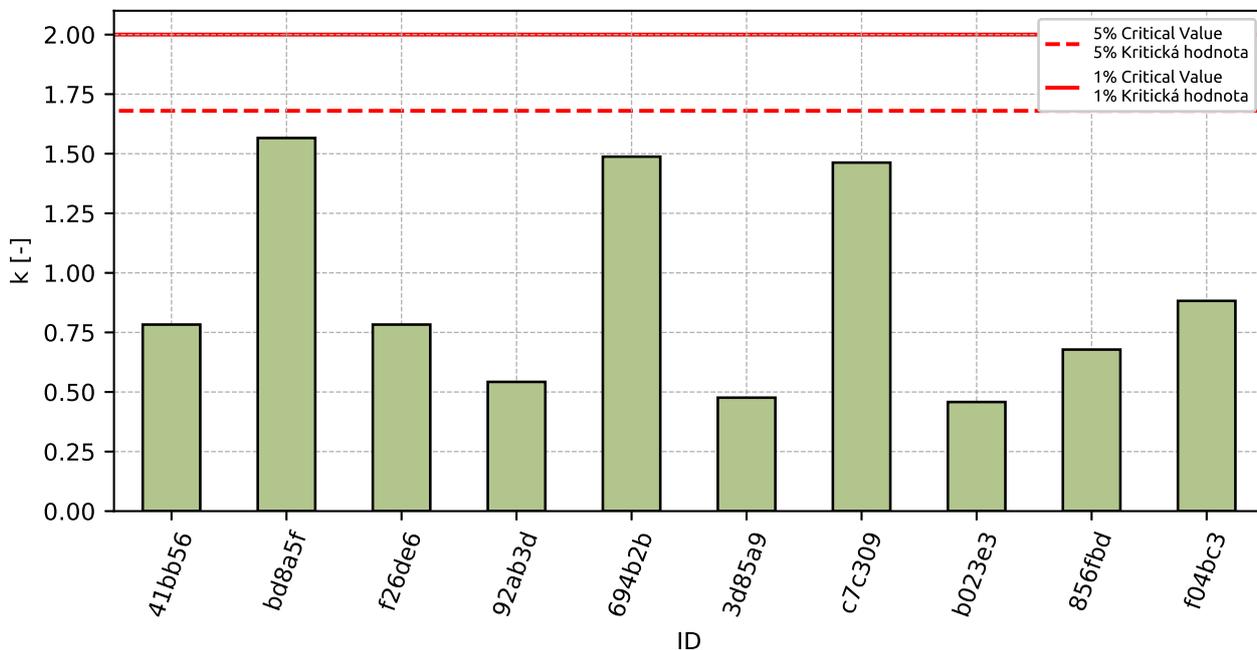
Figure 92: Intralaboratory Consistency Statistic

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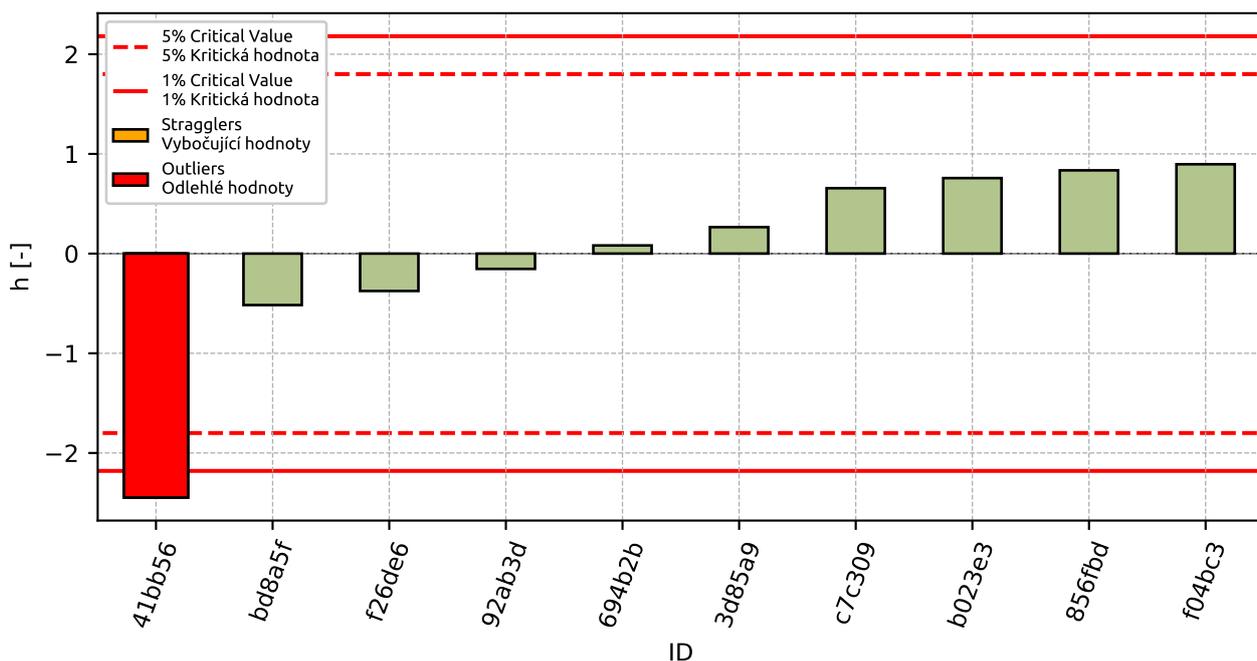
Figure 93: Interlaboratory Consistency Statistic

4.4 Descriptive statistics
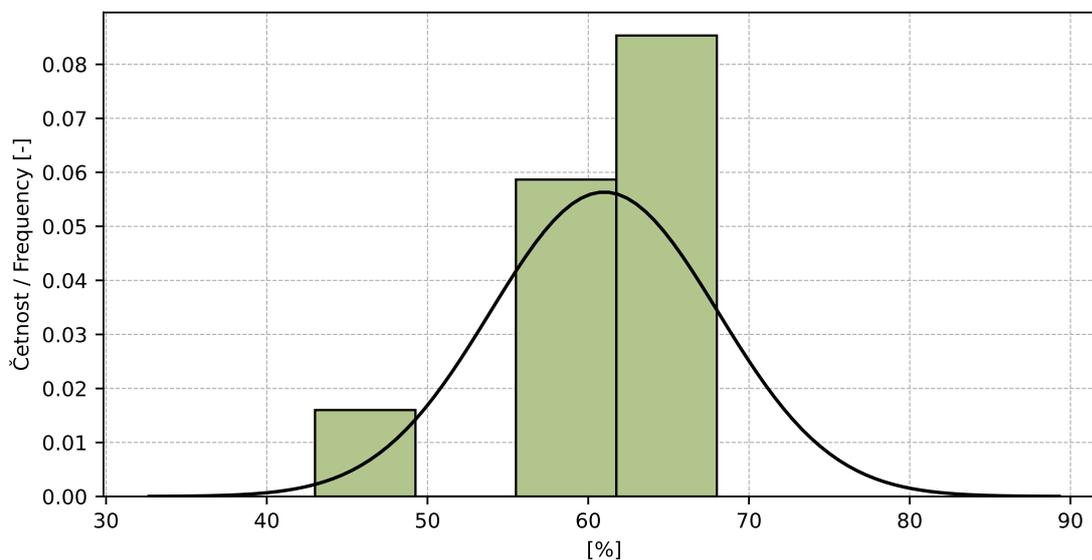
Figure 94: Histogram of all test results

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Table 33: Descriptive statistics

Characteristics	[%]
Průměrná hodnota / Average value – $\bar{x}$	61.0
Výběrová směrodatná odchylka / Sample standard deviation – s	7.08
Vztažná hodnota / Asigned value – x^*	62.1
Robustní směrodatná odchylka / Robust standard deviation – s^*	4.72
Nejistota měření vztažné hodnoty / Measurement uncertainty of asigned value – u_X	1.87
p-hodnota testu normality / p-value of normality test	0.0 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – s_L	7.07
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – s_r	0.74
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – s_R	7.1
Opakovatelnost / Repeatability – r	2.1
Reprodukovatelnost / Reproducibility – R	19.9

4.5 Evaluation of Performance Statistics
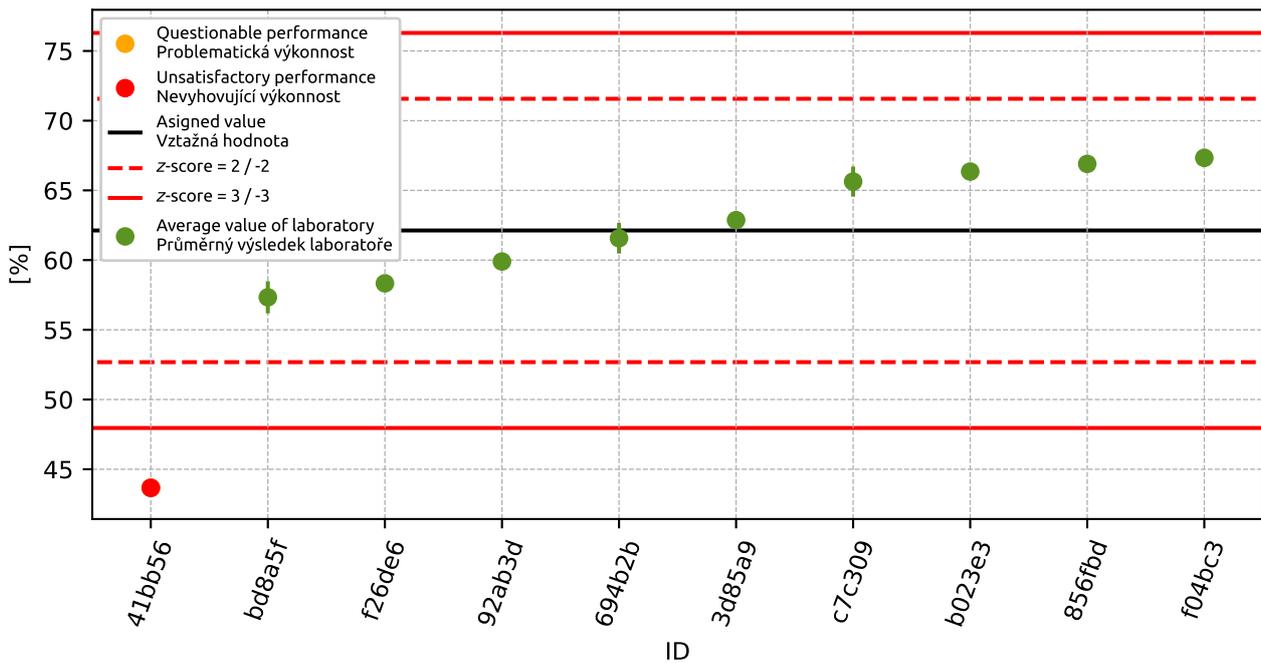
Figure 95: Average values and sample standard deviations

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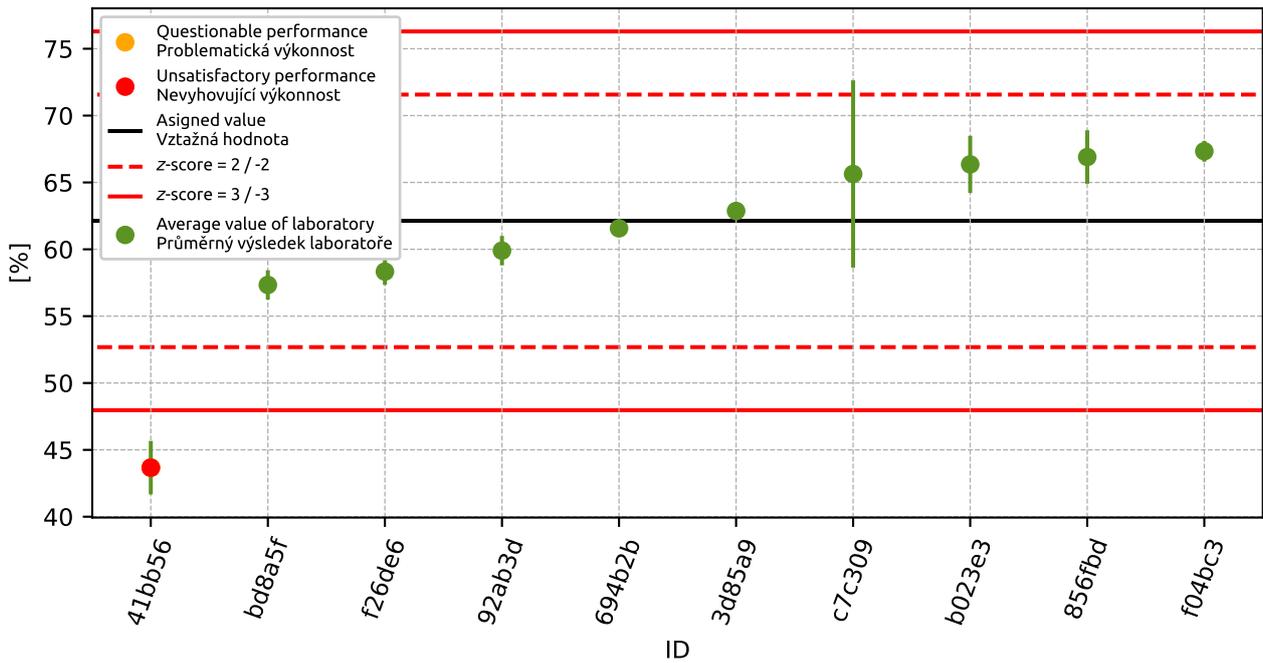
Figure 96: Average values and extended uncertainties of measurement

Figure 97: z-score

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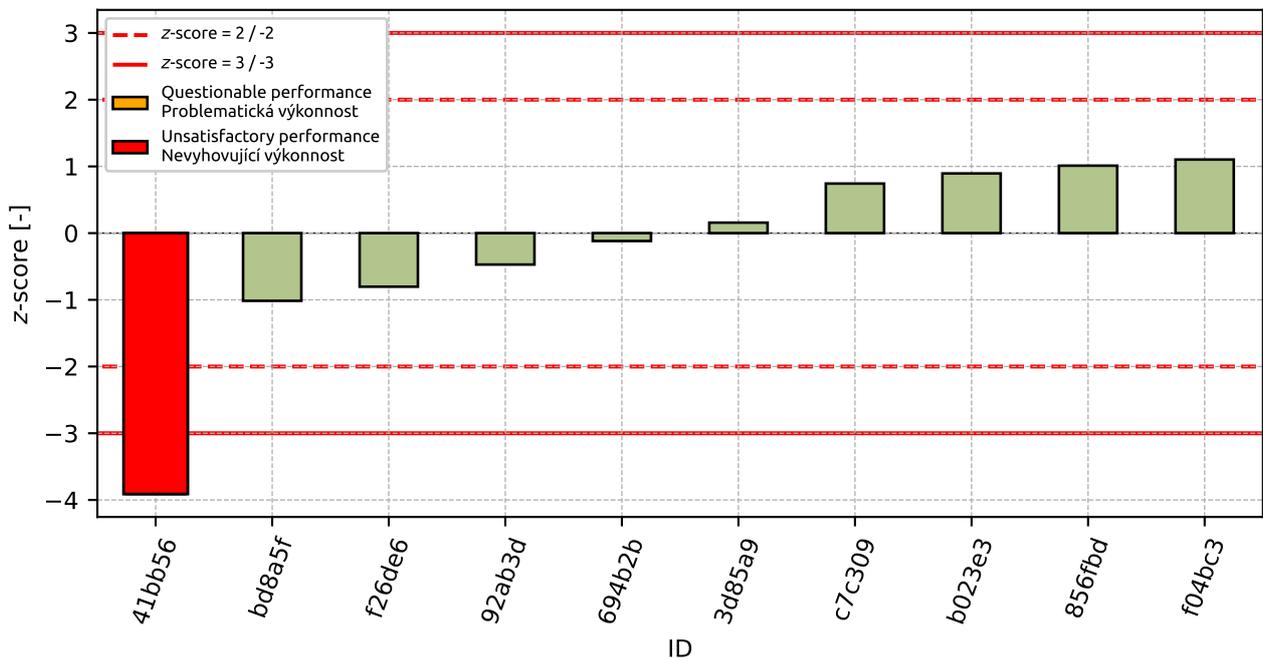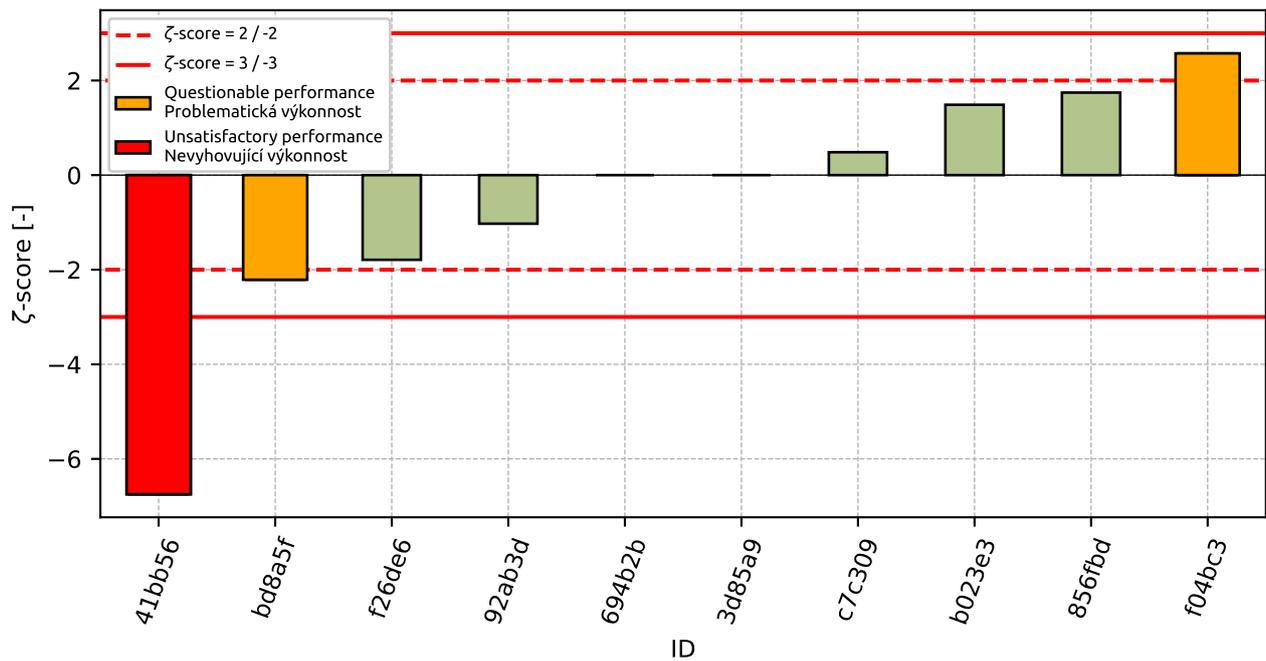
Figure 98: ζ-score

Table 34: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
41bb56	-3.91	-6.75
bd8a5f	-1.01	-2.21
f26de6	-0.8	-1.79
92ab3d	-0.47	-1.03
694b2b	-0.12	-
3d85a9	0.16	-
c7c309	0.74	0.48
b023e3	0.89	1.49
856fbd	1.01	1.75
f04bc3	1.1	2.57

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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			u_X	$\bar{x}$	s_0	V_X
	[%]			[%]	[%]	[%]	[%]
41bb56	0.7	0.7	0.7	0.1	0.7	0.0	0.0
503d35	0.7	0.7	0.7	0.2	0.7	0.0	0.0
31ccbc	0.8	0.8	0.8	0.2	0.8	0.0	0.0
1ad821	0.9	0.9	1.0	0.0	0.9	0.06	6.19
bd8a5f	0.9	0.9	1.0	0.0	0.9	0.06	6.19
9308e6	0.9	0.9	1.0	0.1	0.9	0.03	2.7
473f5c	0.9	1.0	1.0	0.1	1.0	0.06	5.97
a5f90f	1.0	1.0	1.0	0.0	1.0	0.0	0.05
b74bb7	1.0	1.0	1.0	0.0	1.0	0.0	0.0
ce37e5	1.0	1.1	1.0	0.1	1.0	0.06	5.64
228ae5	1.2	1.2	1.2	0.3	1.2	0.0	0.0
ea6b6f	1.2	1.2	1.2	0.2	1.2	0.03	2.34
1760ff	1.3	1.2	1.2	0.2	1.2	0.06	4.68
92ab3d	1.4	1.5	1.4	0.1	1.4	0.06	4.03
8c786e	1.5	1.8	1.5	0.5	1.6	0.17	10.83
1fd599	4.3	4.3	4.2	-	4.3	0.03	0.59

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5.2   The Numerical Procedure for Determining Outliers
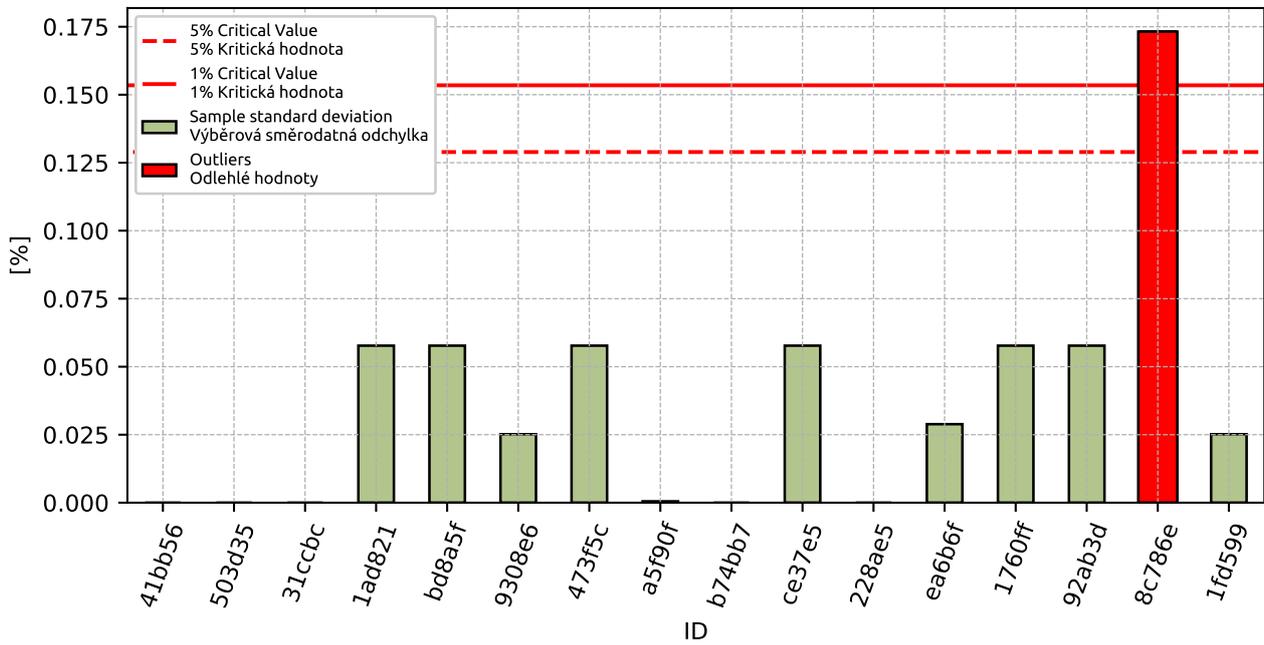
Figure 99: **Cochran's test** - sample standard deviations
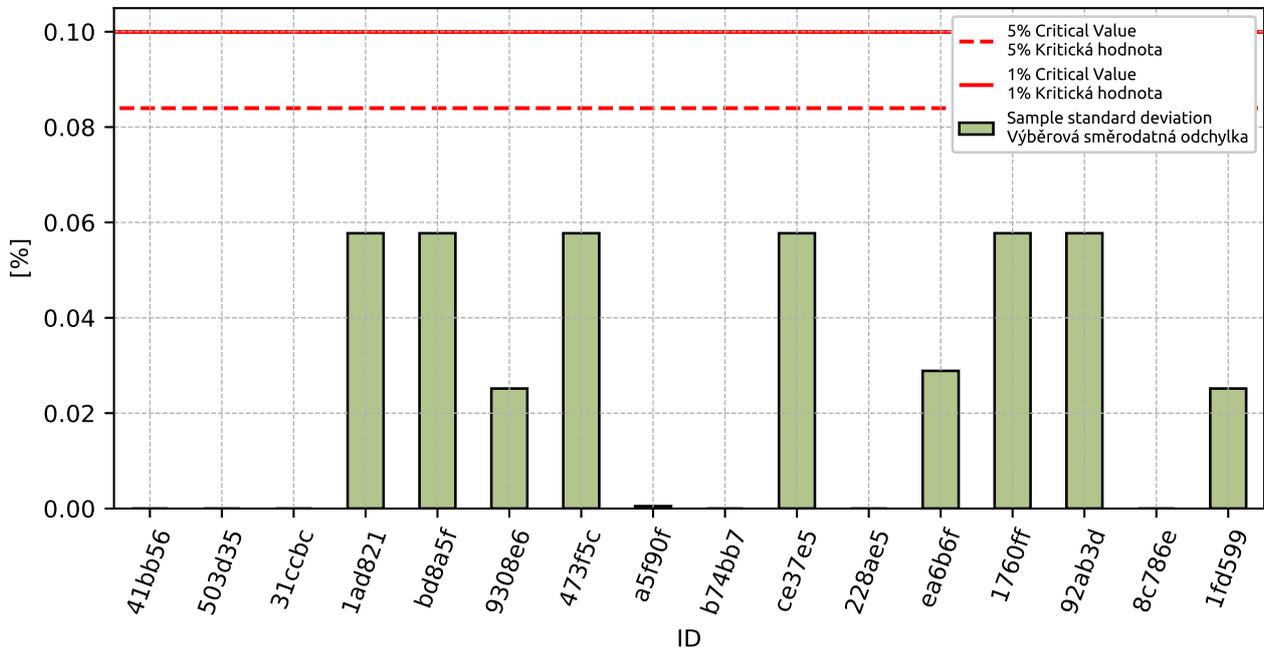
Figure 100: **Cochran's test** - sample standard deviations without outliers

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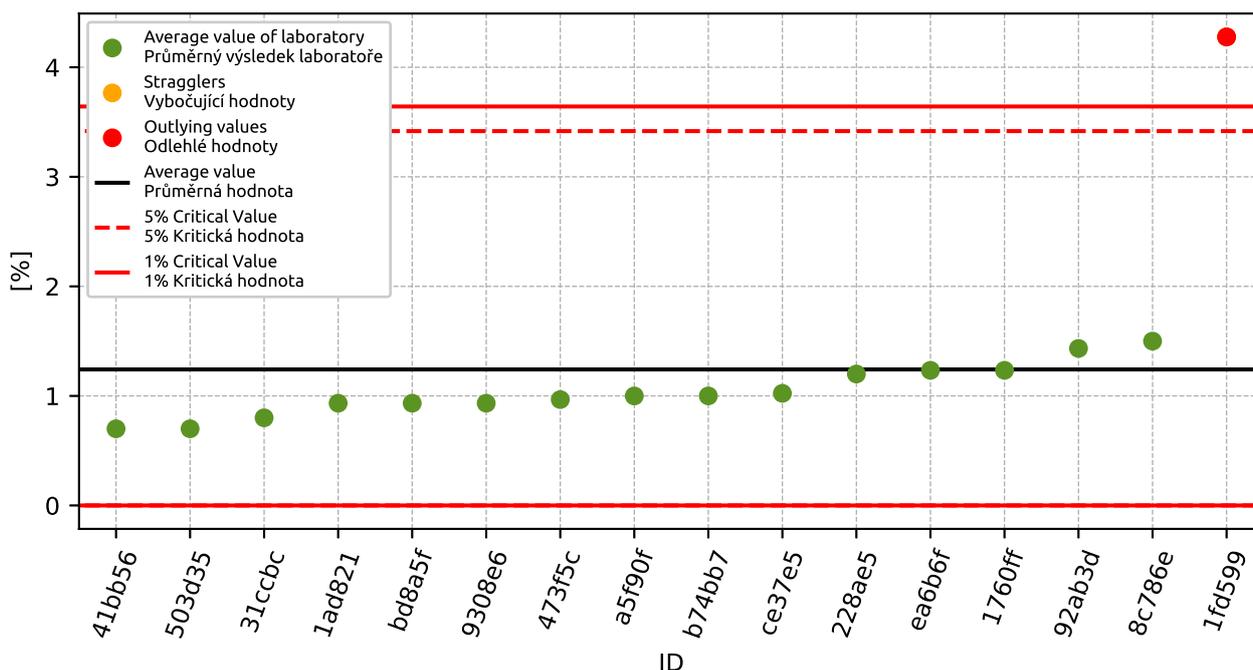
Figure 101: **Grubbs' test** - average values
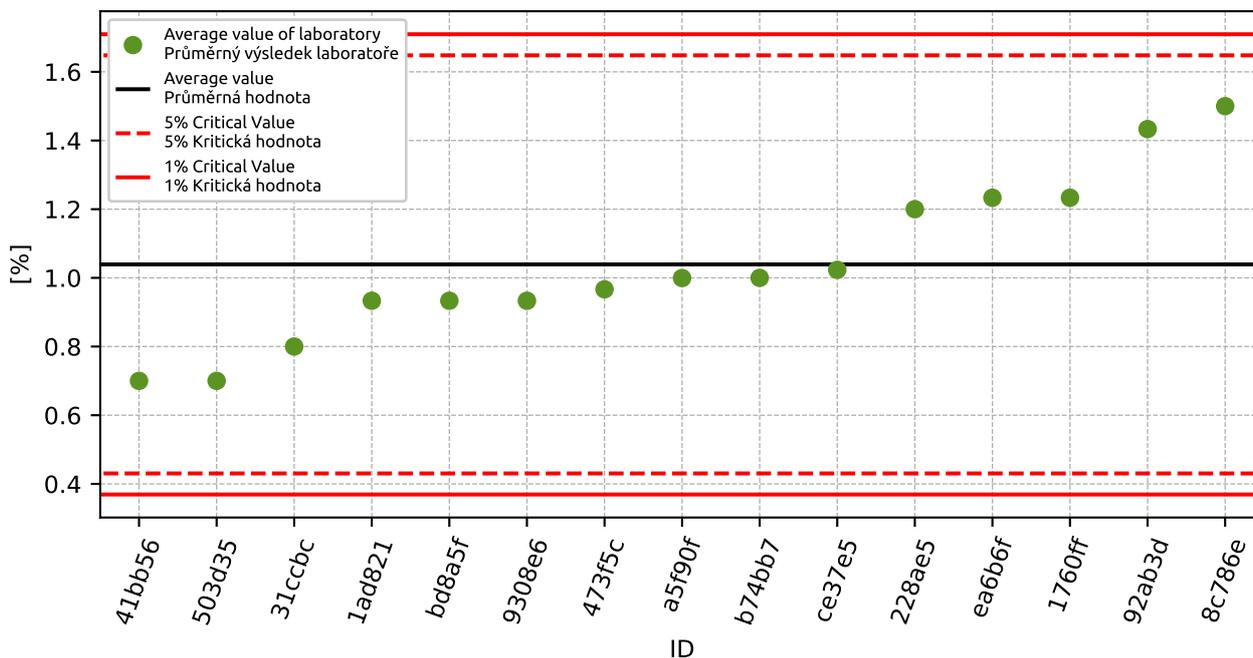
Figure 102: **Grubbs' test** - average values without outliers

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5.3 Mandel′s Statistics
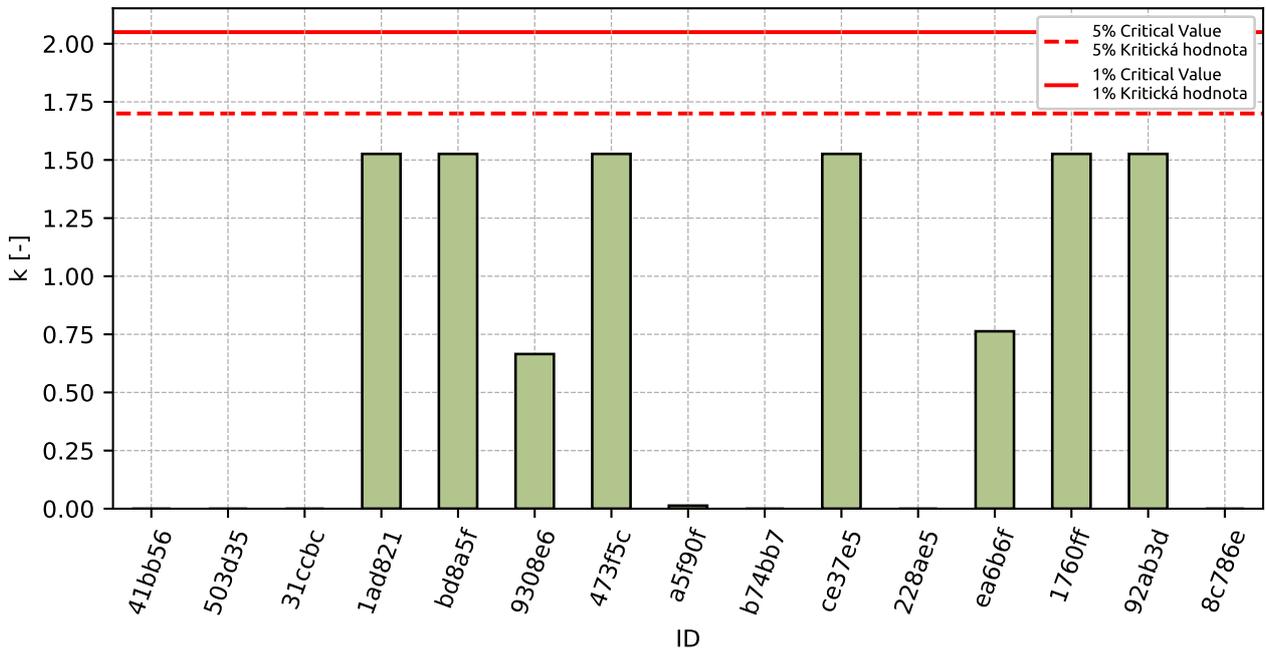
Figure 103: Intralaboratory Consistency Statistic
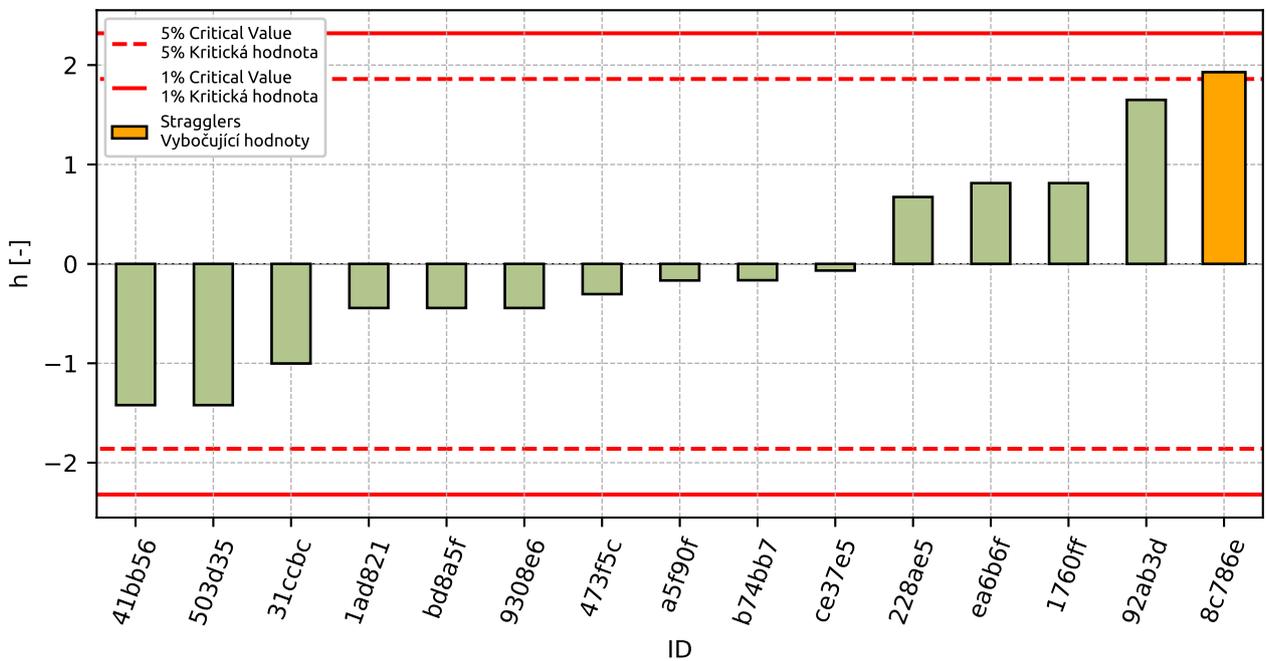
Figure 104: Interlaboratory Consistency Statistic

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5.4   Descriptive statistics
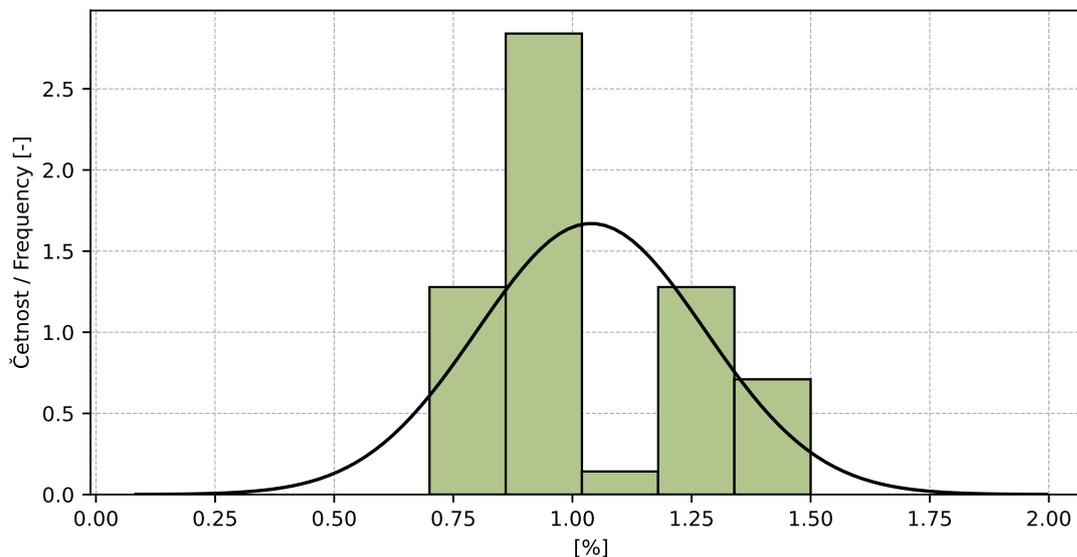
Figure 105: Histogram of all test results

Table 36: Descriptive statistics

Characteristics	[%]
Průměrná hodnota / Average value – $\bar{x}$	1.0
Výběrová směrodatná odchylka / Sample standard deviation – s	0.24
Vztažná hodnota / Asigned value – x^*	1.0
Robustní směrodatná odchylka / Robust standard deviation – s^*	0.26
Nejistota měření vztažné hodnoty / Measurement uncertainty of asigned value – u_X	0.08
p-hodnota testu normality / p-value of normality test	1.0 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – s_L	0.24
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – s_r	0.04
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – s_R	0.24
Opakovatelnost / Repeatability – r	0.1
Reprodukovatelnost / Reproducibility – R	0.7

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5.5   Evaluation of Performance Statistics
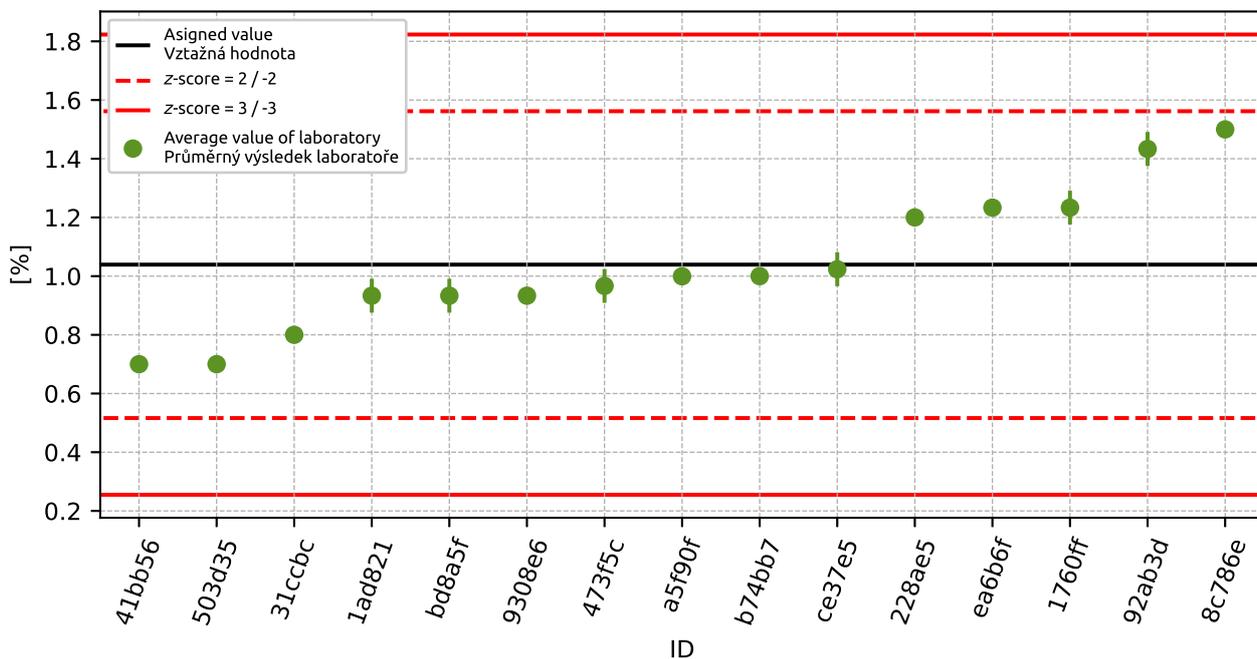
Figure 106: Average values and sample standard deviations
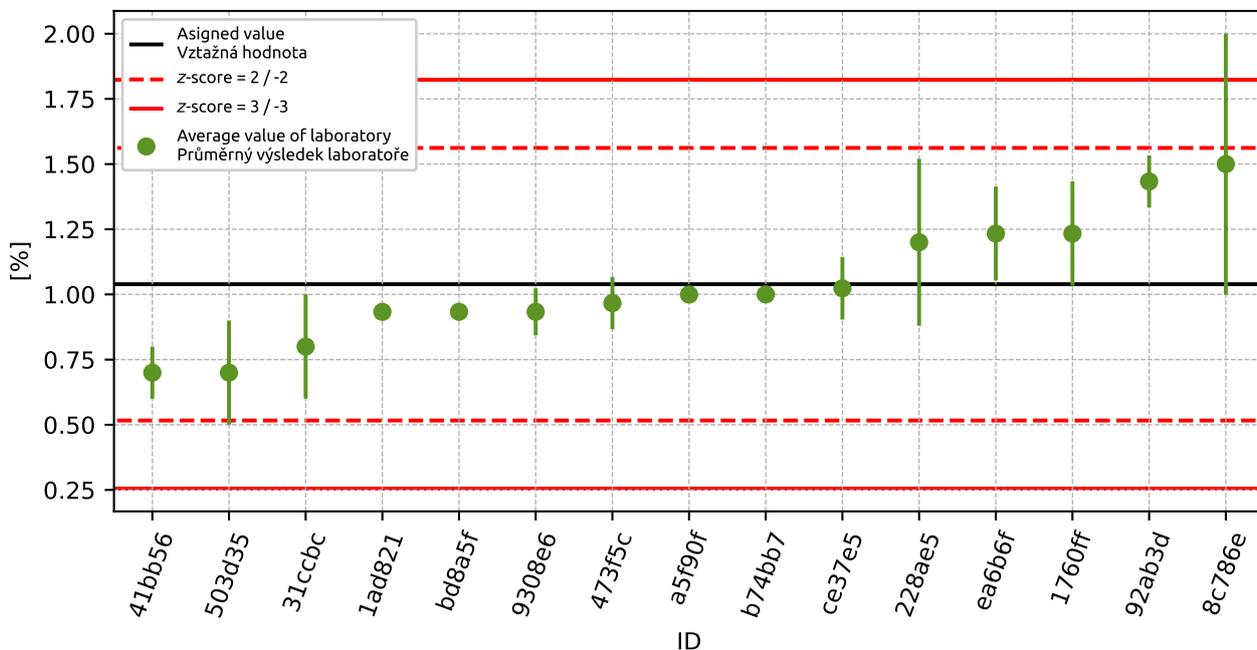
Figure 107: Average values and extended uncertainties of measurement

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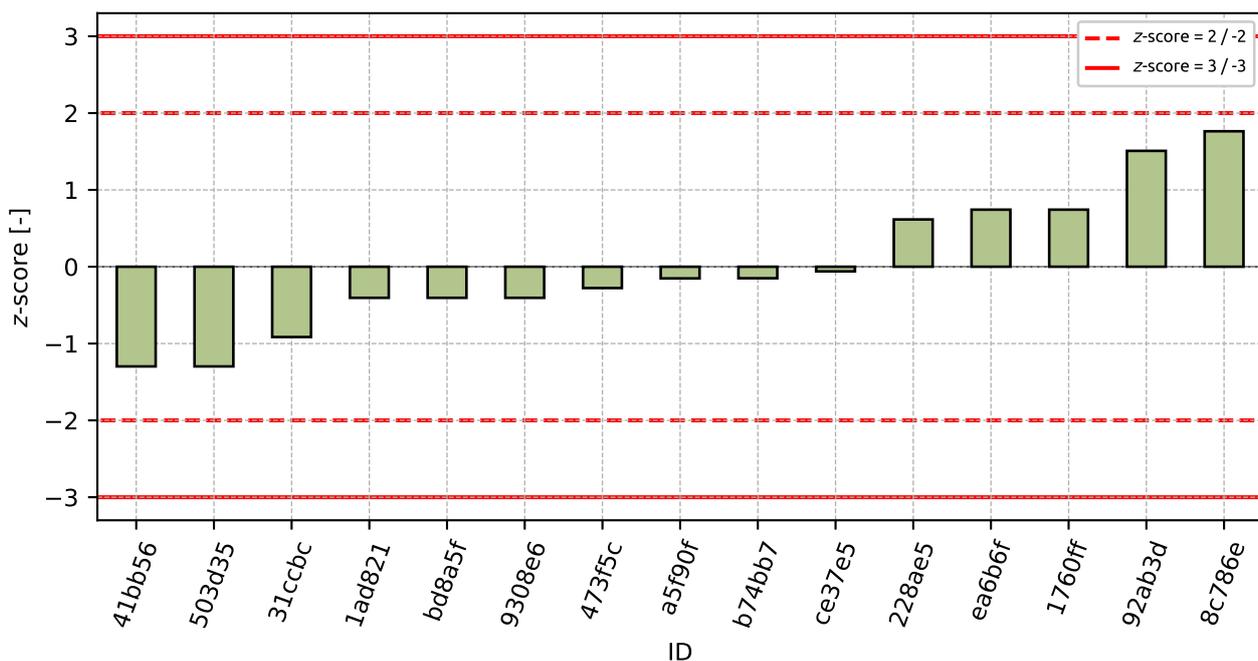
Figure 108: z-score

Figure 109: ζ-score

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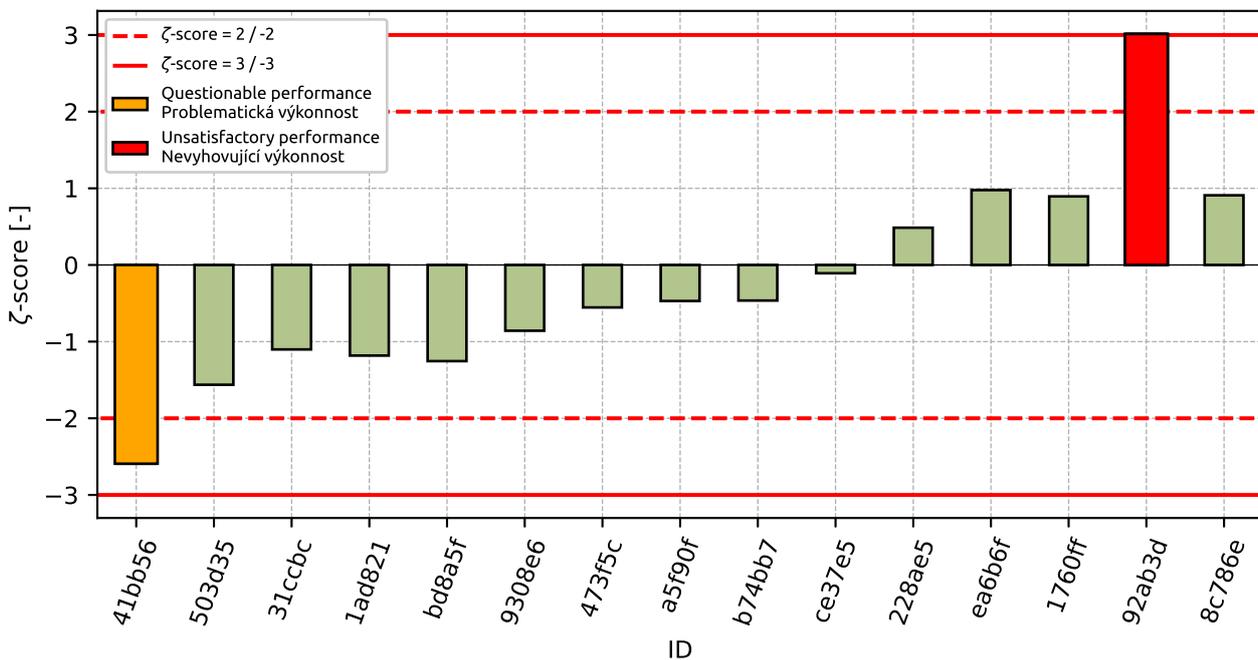
Table 37: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
41bb56	-1.3	-2.59
503d35	-1.3	-1.56
31ccbc	-0.92	-1.1
1ad821	-0.4	-1.18
bd8a5f	-0.4	-1.25
9308e6	-0.4	-0.86
473f5c	-0.28	-0.55
a5f90f	-0.15	-0.47
b74bb7	-0.15	-0.46
ce37e5	-0.06	-0.11
228ae5	0.62	0.49
ea6b6f	0.74	0.98
1760ff	0.74	0.89
92ab3d	1.51	3.01
8c786e	1.76	0.91

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

6.1   Test results

Table 38: 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
	[%]			[%]	[%]	[%]	[%]
31ccbc	75.0	74.0	75.0	2.0	74.7	0.58	0.77
8c786e	80.6	80.8	80.4	0.7	80.6	0.2	0.25
f26de6	82.0	81.0	81.0	1.0	81.3	0.58	0.71
09b709	83.6	82.8	82.8	1.0	83.1	0.46	0.56
aef78b	84.0	83.0	84.0	3.2	83.7	0.58	0.69

6.2   The Numerical Procedure for Determining Outliers
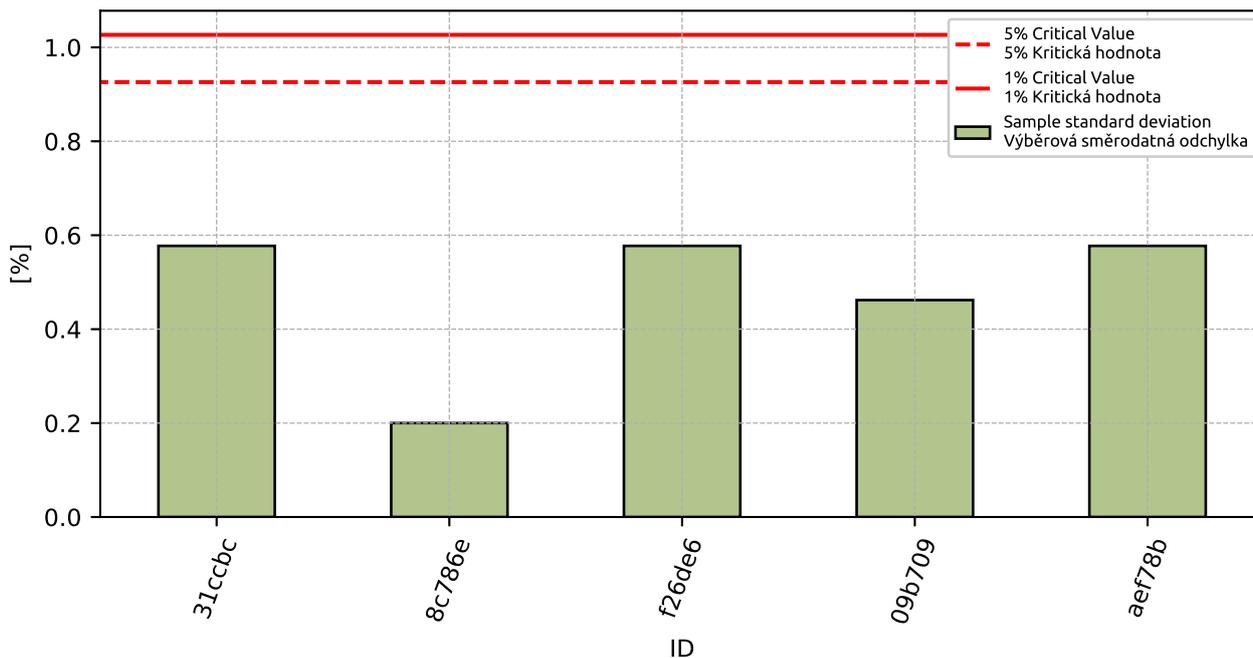
Figure 110: **Cochran's test** - sample standard deviations

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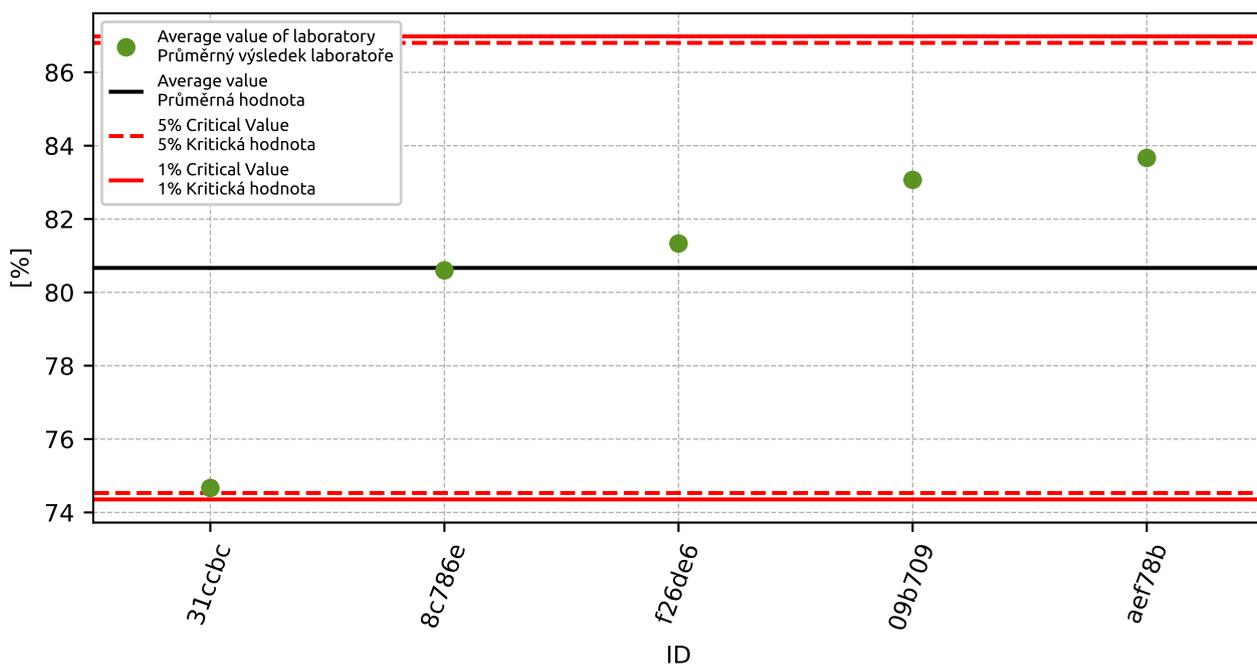
Figure 111: **Grubbs' test** - average values

6.3   Mandel's Statistics
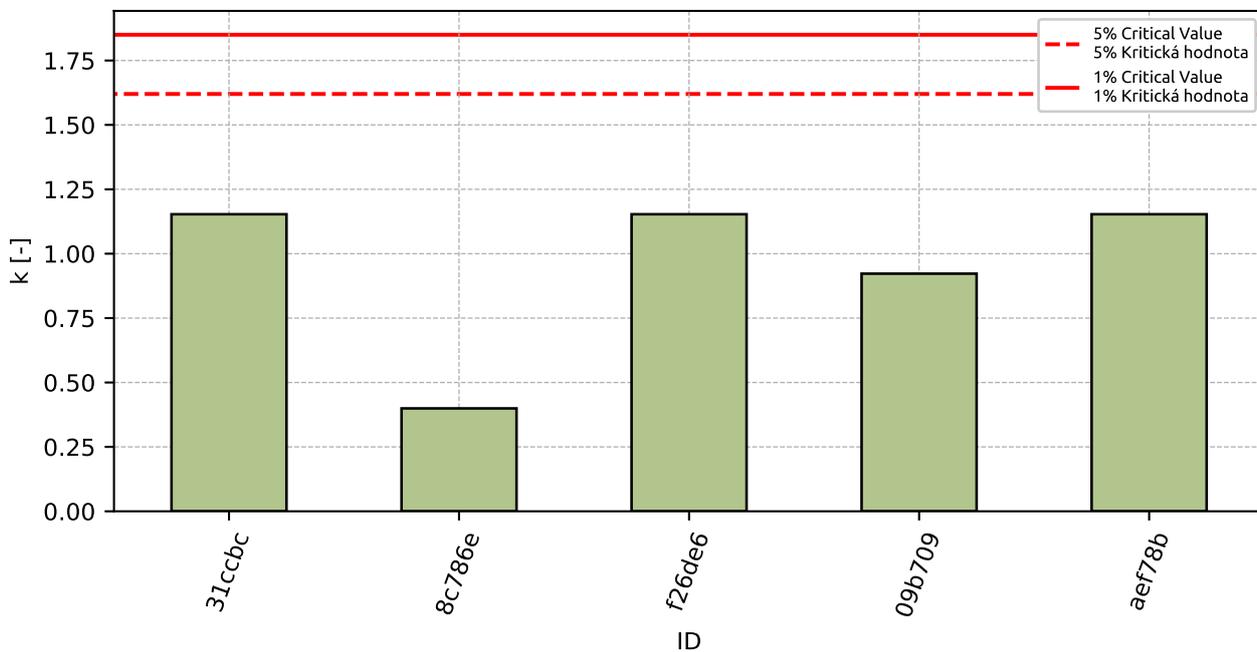
Figure 112: Intralaboratory Consistency Statistic

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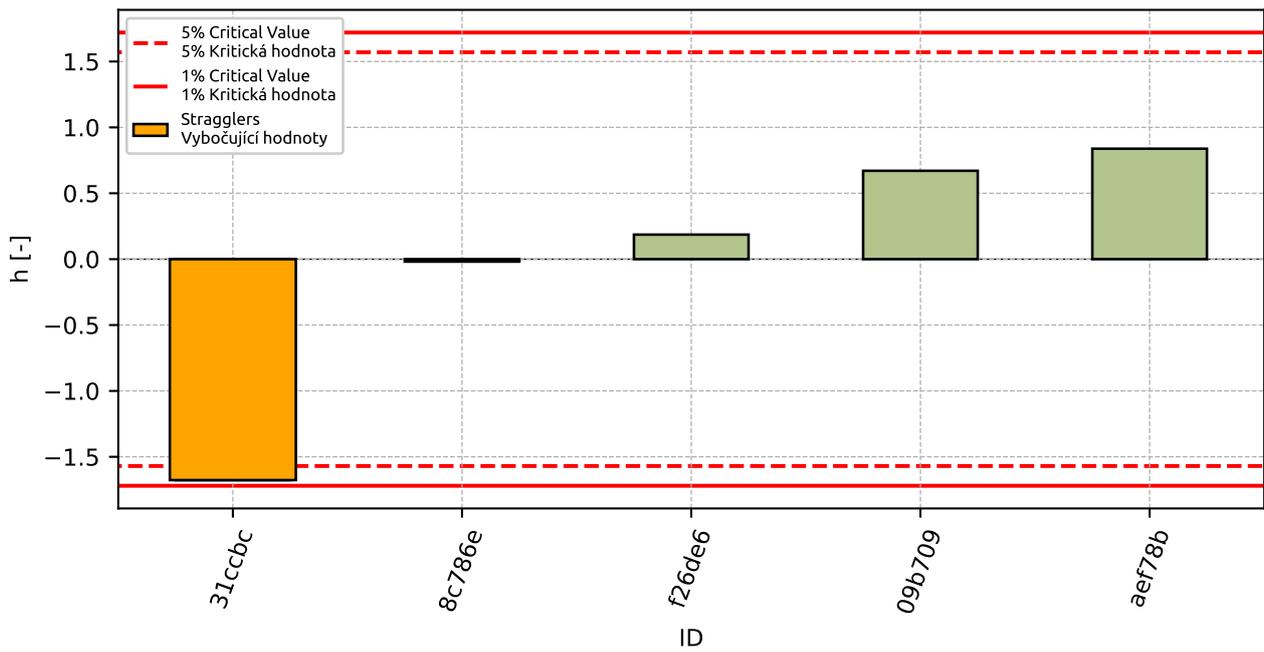
Figure 113: Interlaboratory Consistency Statistic

6.4 Descriptive statistics
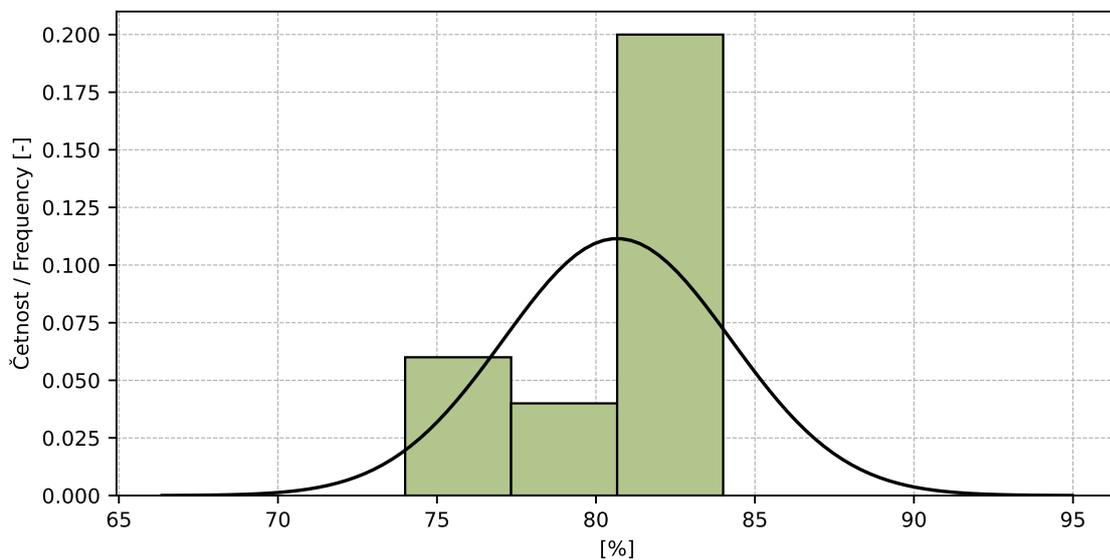
Figure 114: Histogram of all test results

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Table 39: Descriptive statistics

Characteristics	[%]
Průměrná hodnota / Average value – $\bar{x}$	80.7
Výběrová směrodatná odchylka / Sample standard deviation – s	3.58
Vztažná hodnota / Asigned value – x^*	81.3
Robustní směrodatná odchylka / Robust standard deviation – s^*	2.41
Nejistota měření vztažné hodnoty / Measurement uncertainty of asigned value – u_X	1.35
p-hodnota testu normality / p-value of normality test	0.006 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – s_L	3.57
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – s_r	0.5
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – s_R	3.6
Opakovatelnost / Repeatability – r	1.4
Reprodukovatelnost / Reproducibility – R	10.1

6.5　Evaluation of Performance Statistics
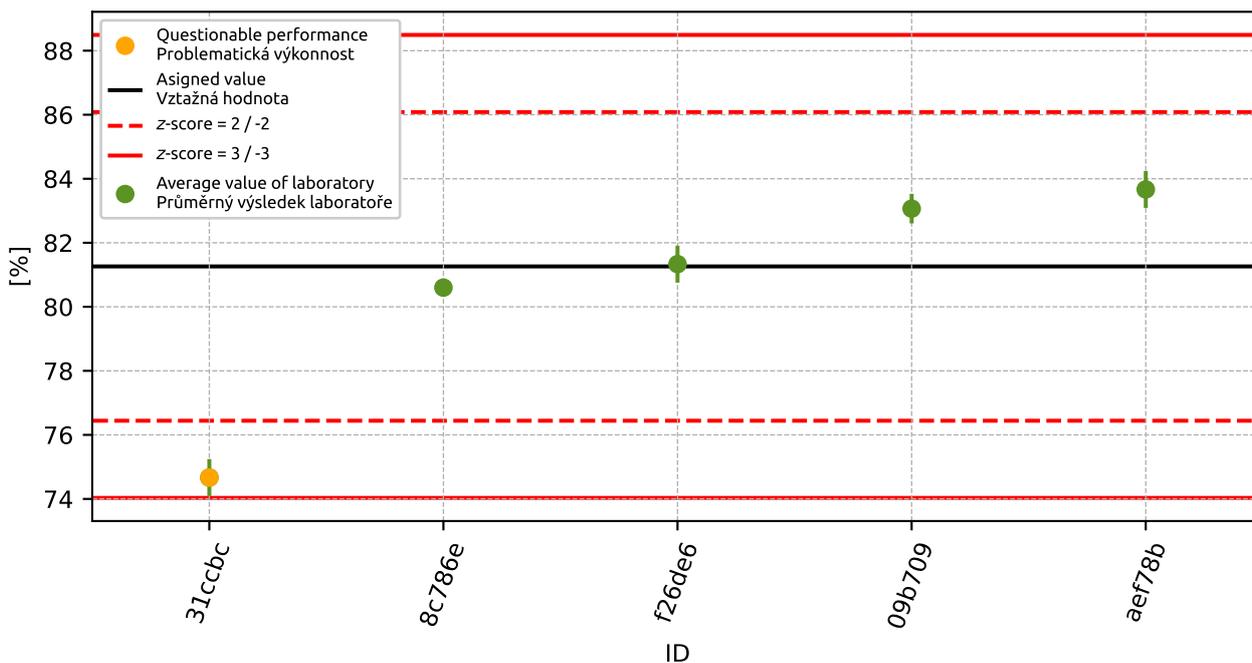
Figure 115: Average values and sample standard deviations

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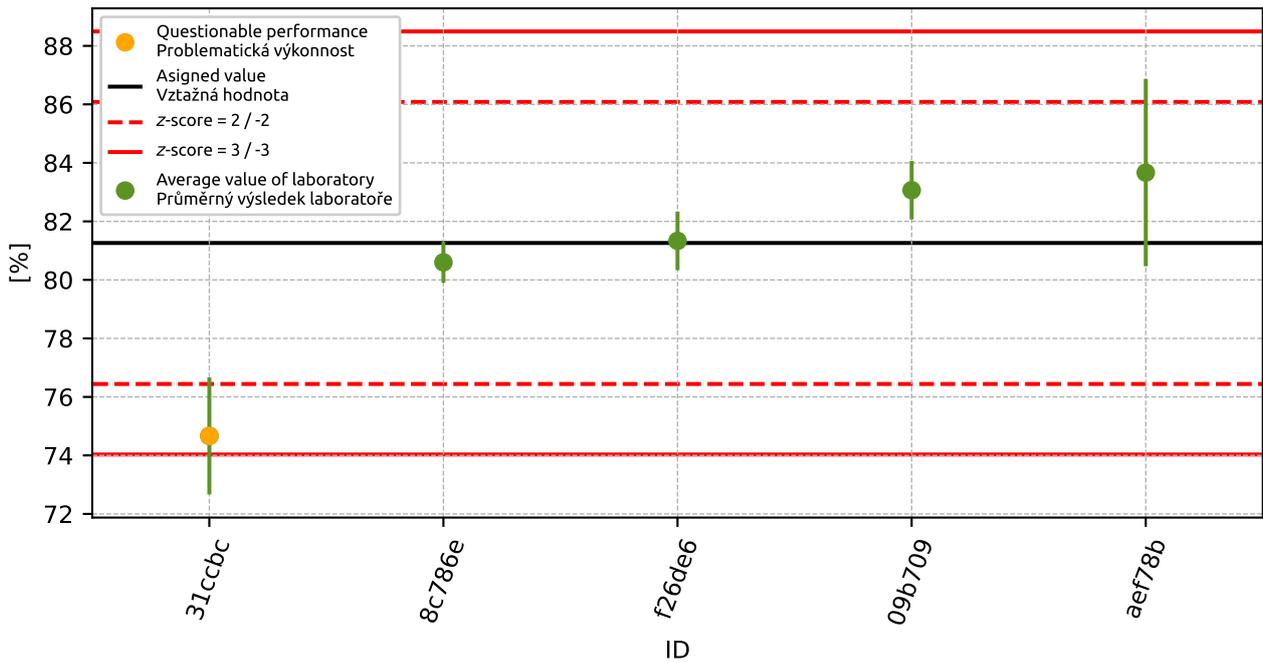
Figure 116: Average values and extended uncertainties of measurement

Figure 117: z-score

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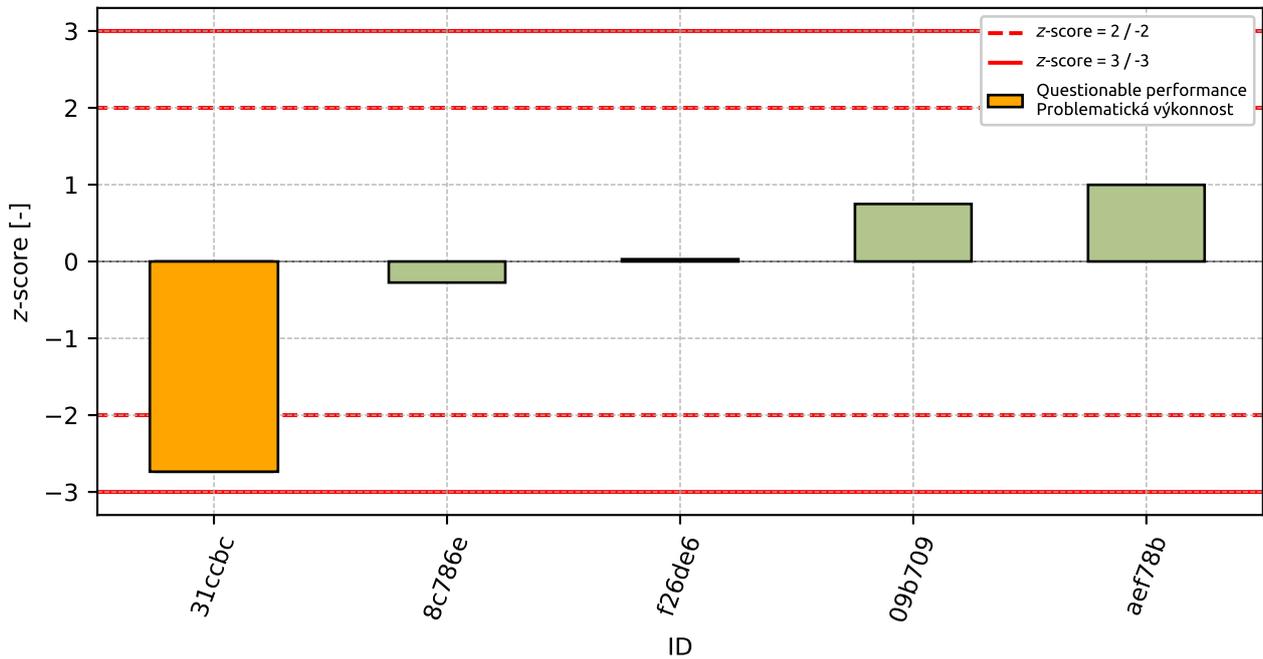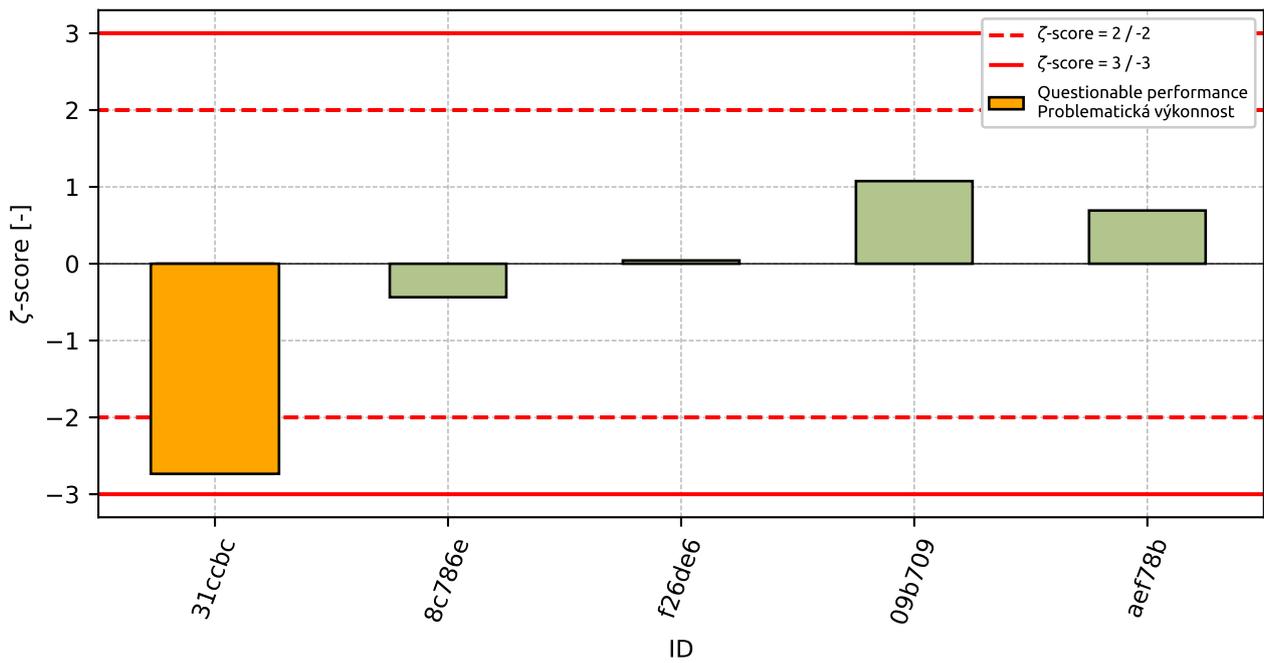
Figure 118: ζ-score

Table 40: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
31ccbc	-2.74	-2.73
8c786e	-0.27	-0.44
f26de6	0.03	0.04
09b709	0.75	1.08
aef78b	1.0	0.69

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

7.1 Test results

Table 41: Test results - ordered by average value. Outliers are marked by red color. u_X - extended uncertainty of measurement; $\bar{x}$ - average value; s_0 - sample standard deviation; V_X - variation coefficient

ID	Test results	u_X
	[-]	[-]
856fbd	13.0	1.0
ea6b6f	13.8	0.4
1760ff	13.9	0.5
b577cd	14.0	0.1
f04bc3	14.0	0.6
165952	14.0	0.0
ed90bd	15.0	1.5
ad4665	16.0	1.0

7.2 The Numerical Procedure for Determining Outliers
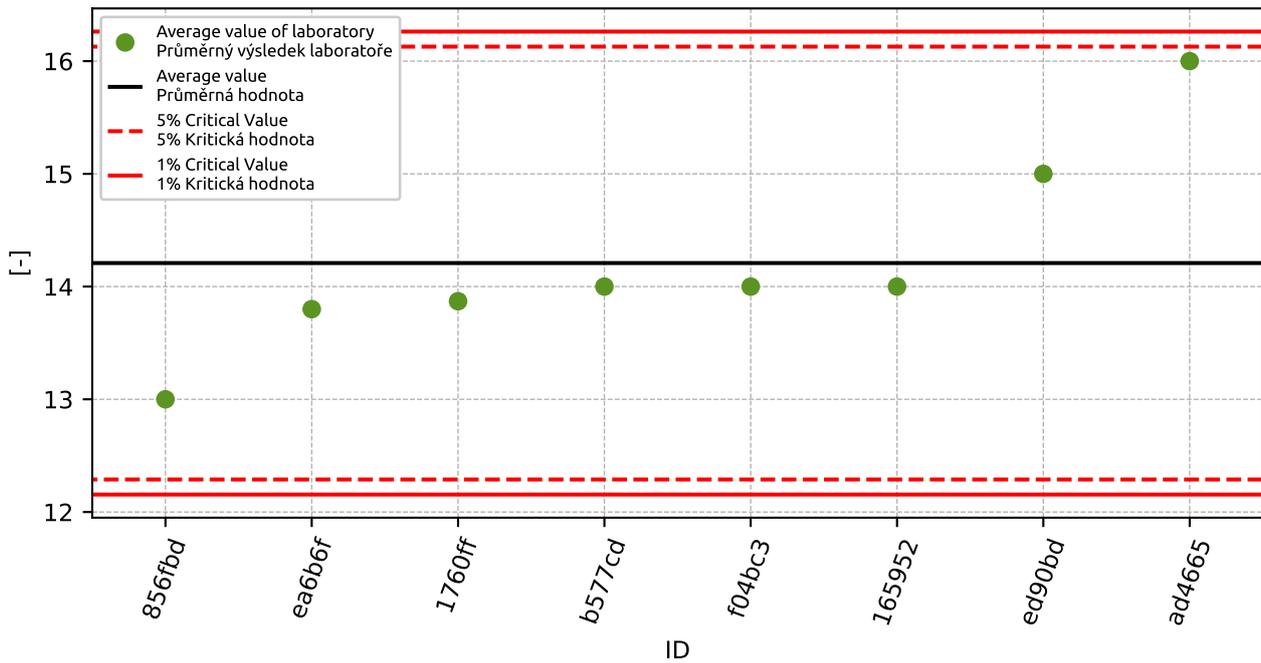
Figure 119: **Grubbs' test** - average values

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7.3   Mandel's Statistics
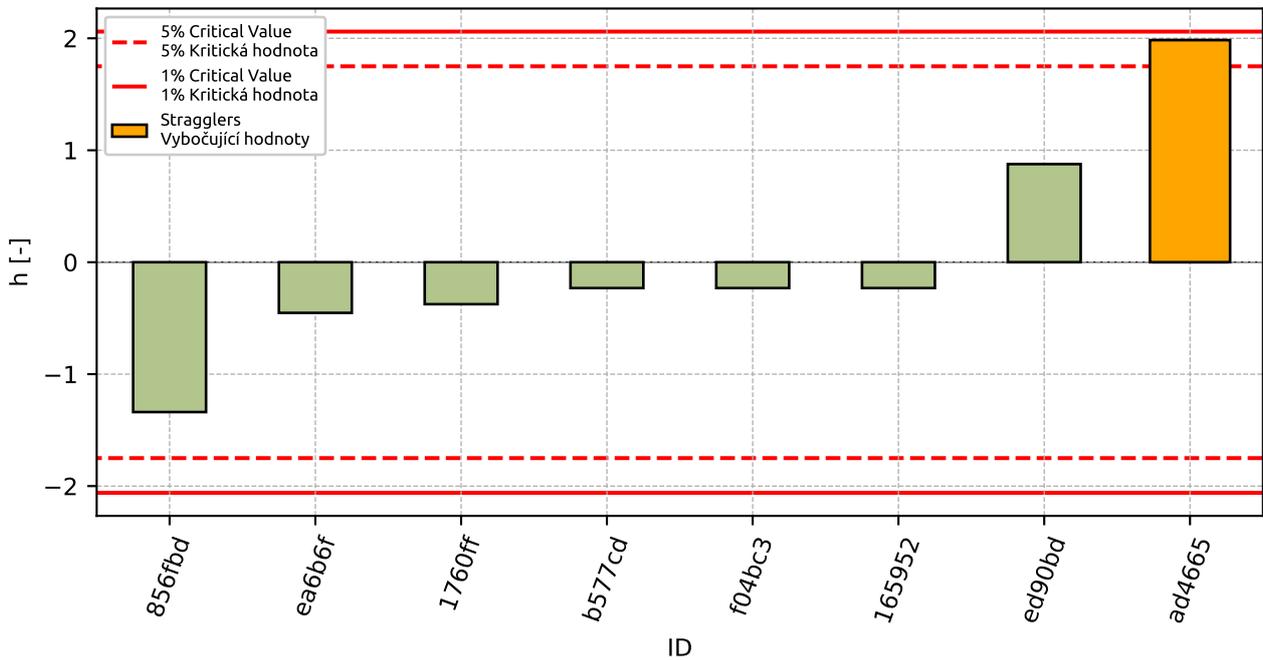
Figure 120: Interlaboratory Consistency Statistic

7.4   Descriptive statistics
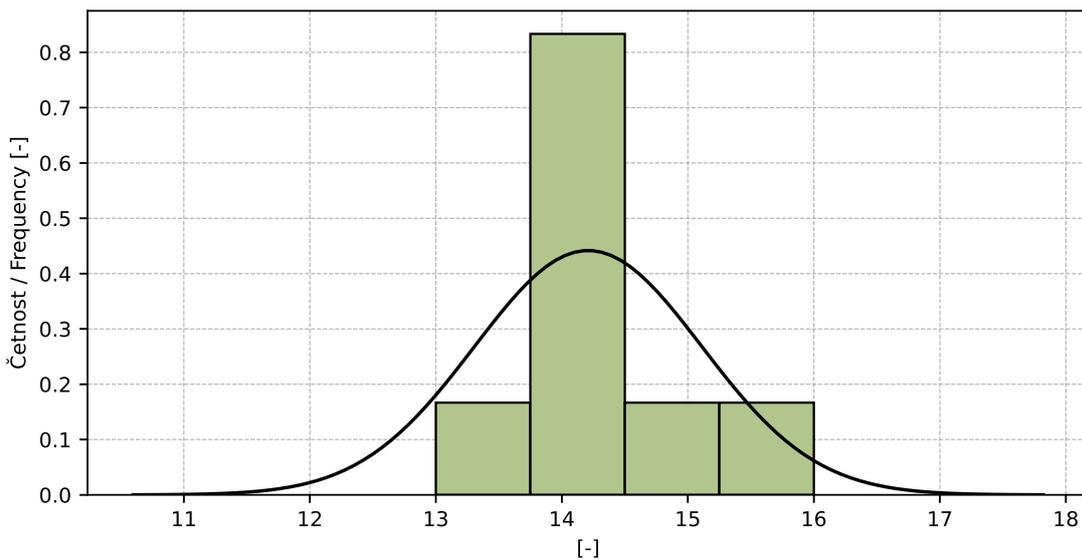
Figure 121: Histogram of all test results

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Table 42: Descriptive statistics

Characteristics	[-]
Průměrná hodnota / Average value – $\bar{x}$	14.2
Výběrová směrodatná odchylka / Sample standard deviation – s	0.9
Vztažná hodnota / Asigned value – x^*	14.2
Robustní směrodatná odchylka / Robust standard deviation – s^*	0.8
Nejistota měření vztažné hodnoty / Measurement uncertainty of asigned value – u_X	0.35
p-hodnota testu normality / p-value of normality test	0.124 [-]

7.5   Evaluation of Performance Statistics
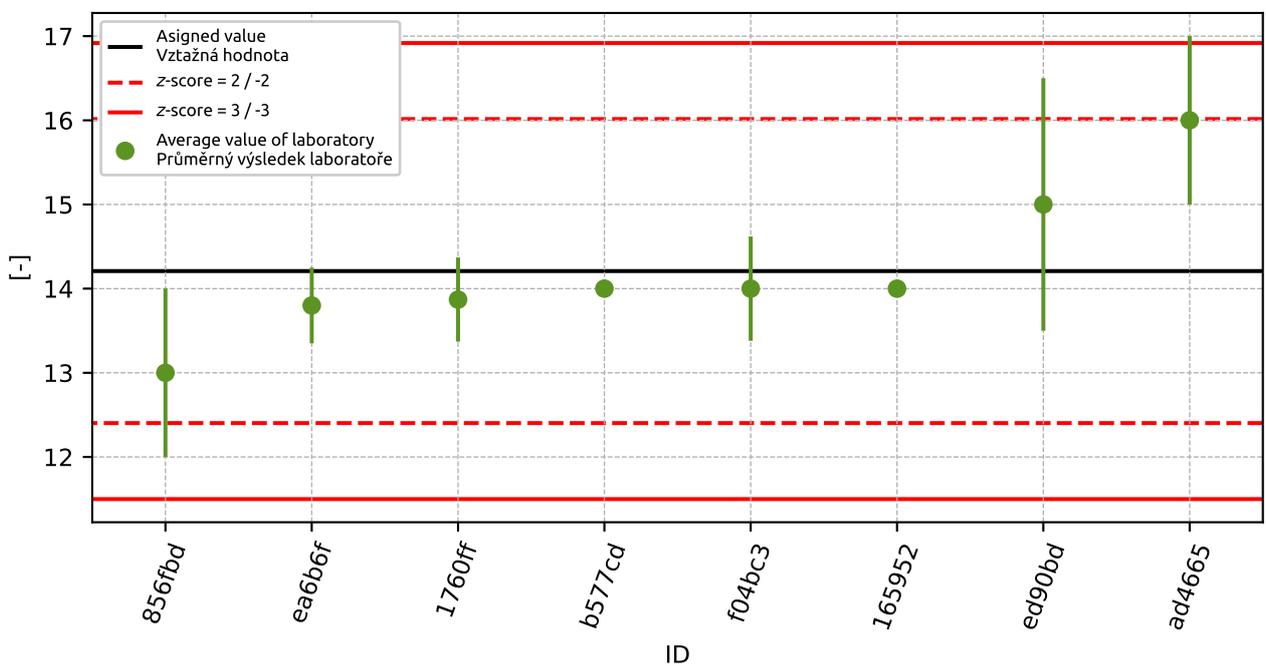
Figure 122: Average values and extended uncertainties of measurement

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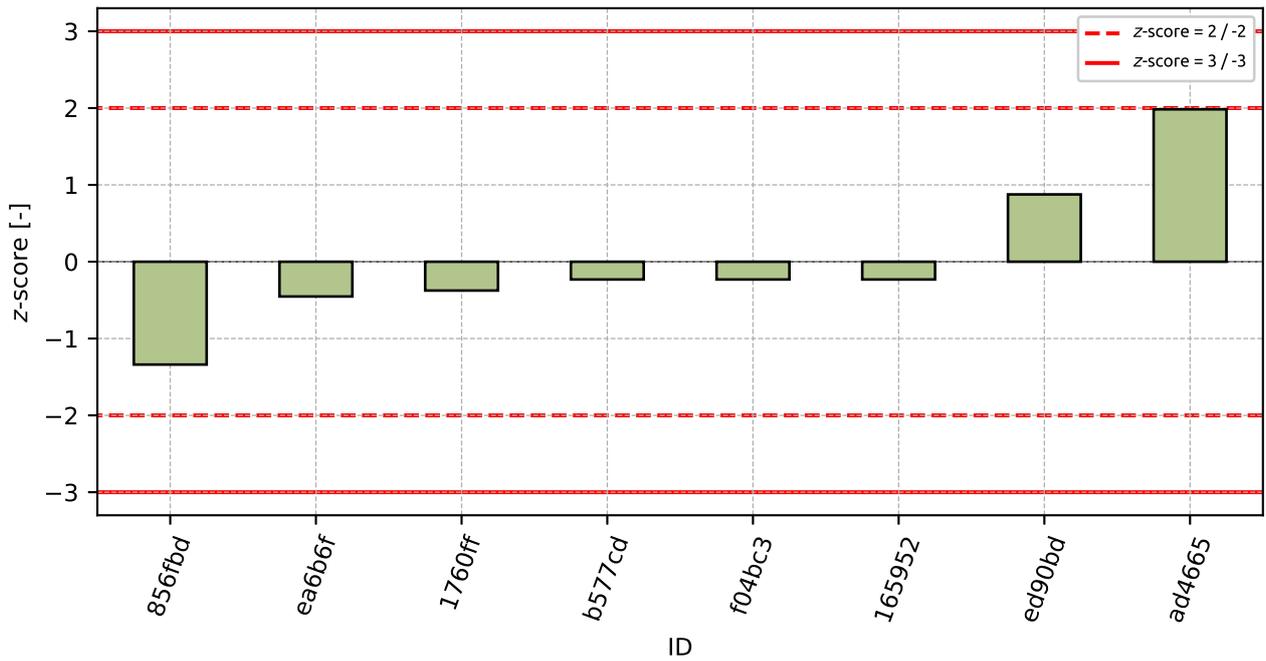
Figure 123: z-score

Figure 124: ζ-score

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Table 43: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
856fbd	-1.34	-0.88
ea6b6f	-0.45	-0.39
1760ff	-0.38	-0.32
b577cd	-0.23	-0.22
f04bc3	-0.23	-0.18
165952	-0.23	-0.22
ed90bd	0.88	0.45
ad4665	1.98	1.3

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

8.1   Test results

Table 44: Test results - ordered by average value. Outliers are marked by red color. u_X - extended uncertainty of measurement; $\bar{x}$ - average value; s_0 - sample standard deviation; V_X - variation coefficient

ID	Test results [-]	u_X [-]
6cb763	14.0	1.0
1760ff	15.0	2.0
f04bc3	15.0	0.7
ea6b6f	15.2	0.4
b023e3	15.9	0.2
473f5c	16.0	1.0
41bb56	16.0	1.0
694b2b	16.1	-
1e0c28	18.0	0.5
165952	18.0	0.0
92ab3d	22.0	-

8.2   The Numerical Procedure for Determining Outliers
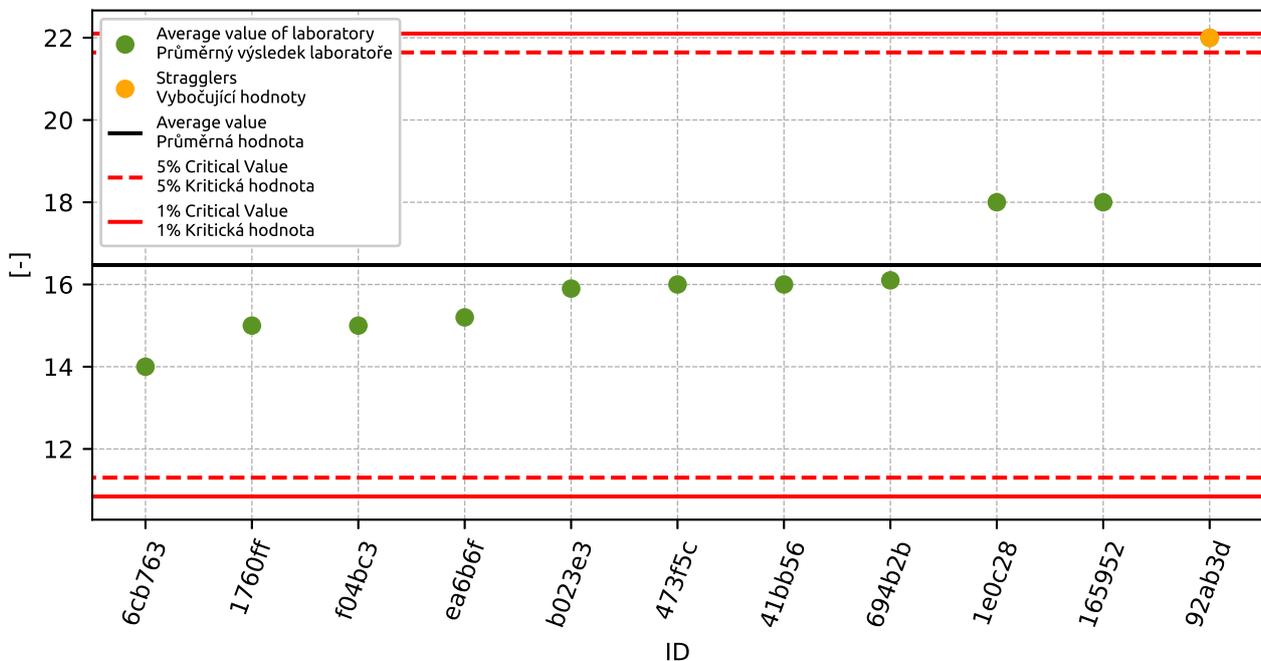
Figure 125: **Grubbs' test** - average values

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8.3　Mandel′s Statistics
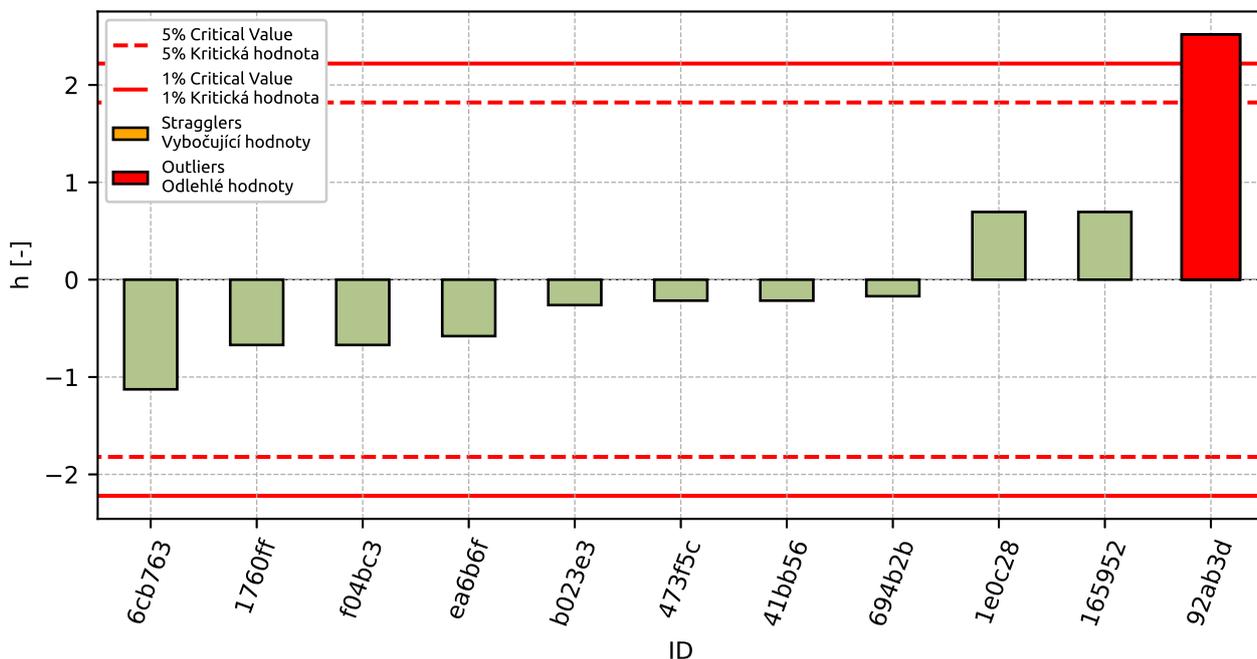
Figure 126: Interlaboratory Consistency Statistic

8.4　Descriptive statistics
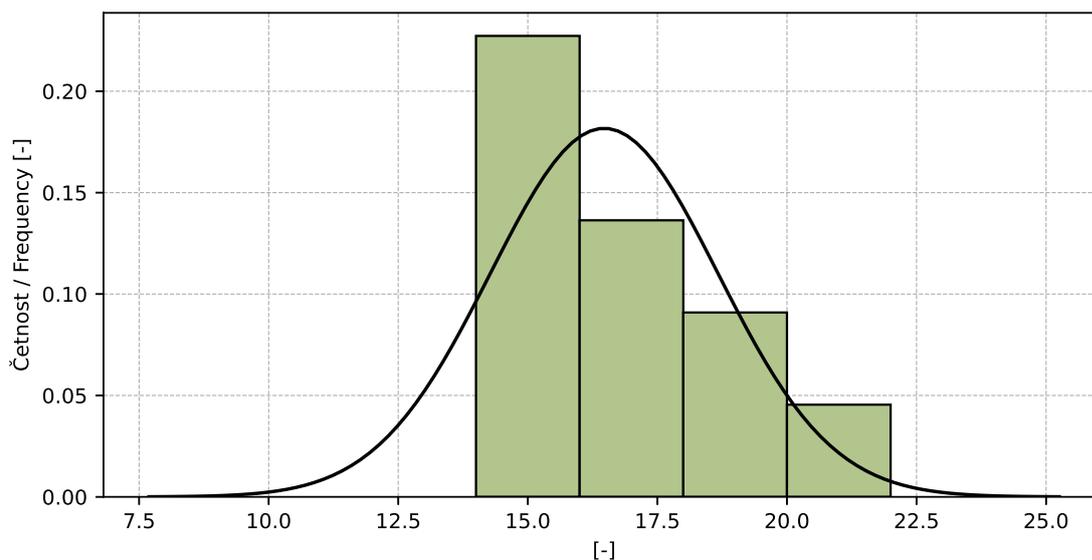
Figure 127: Histogram of all test results

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Table 45: Descriptive statistics

Characteristics	[-]
Průměrná hodnota / Average value – $\bar{x}$	16.5
Výběrová směrodatná odchylka / Sample standard deviation – s	2.2
Vztažná hodnota / Asigned value – x^*	16.5
Robustní směrodatná odchylka / Robust standard deviation – s^*	2.37
Nejistota měření vztažné hodnoty / Measurement uncertainty of asigned value – u_X	0.89
p-hodnota testu normality / p-value of normality test	0.017 [-]

8.5   Evaluation of Performance Statistics
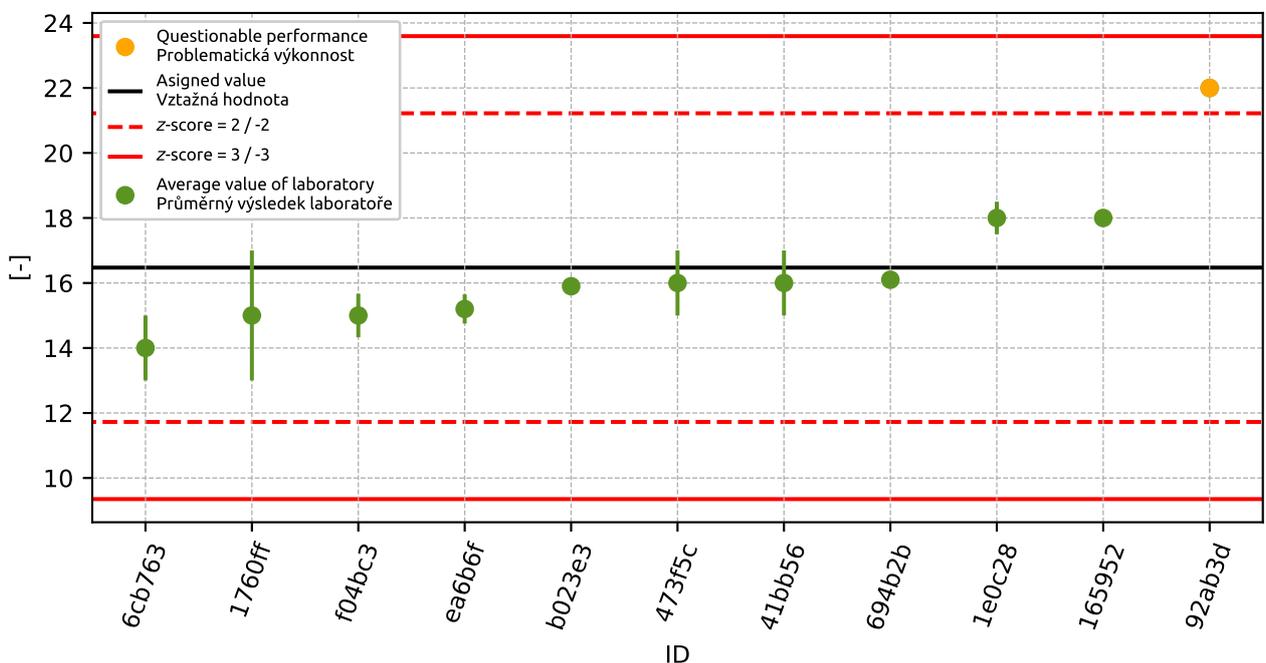
Figure 128: Average values and extended uncertainties of measurement

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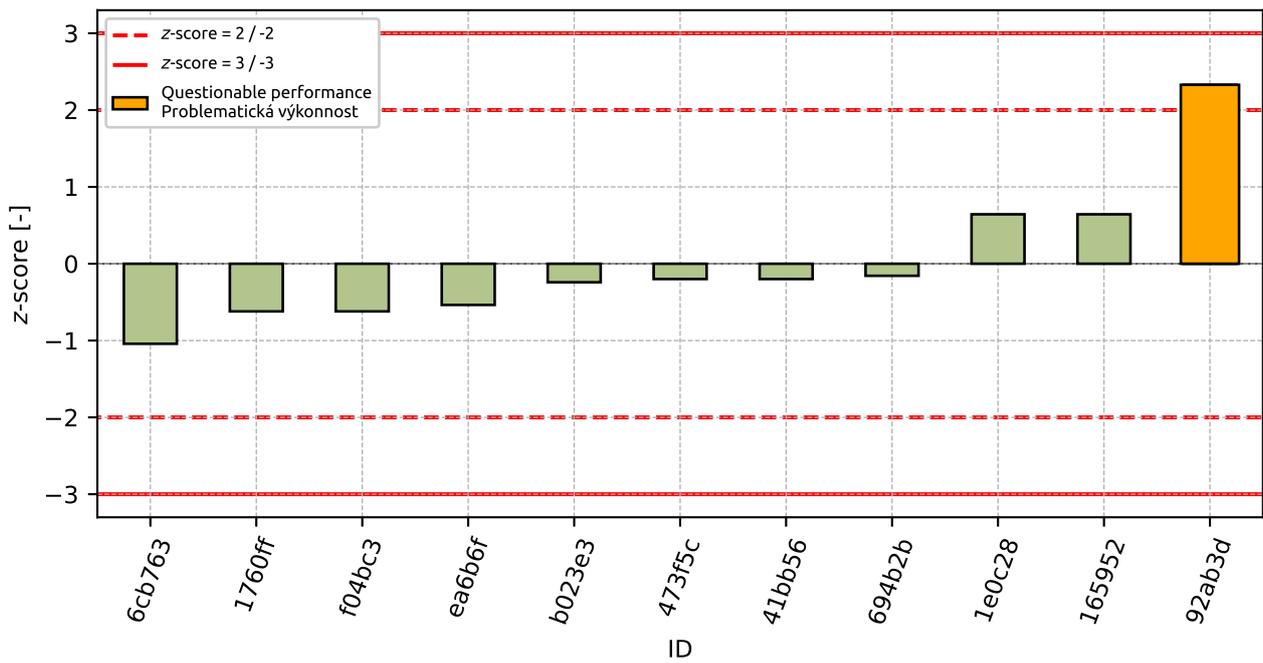
Figure 129: z-score

Figure 130: ζ-score

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Table 46: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
6cb763	-1.04	-1.84
1760ff	-0.62	-0.67
f04bc3	-0.62	-1.32
ea6b6f	-0.54	-1.27
b023e3	-0.24	-0.62
473f5c	-0.2	-0.35
41bb56	-0.2	-0.35
694b2b	-0.16	-
1e0c28	0.64	1.49
165952	0.64	1.71
92ab3d	2.33	-

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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 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 [Mg/m^3]			u_X [Mg/m^3]	$\bar{x}$ [Mg/m^3]	s_0 [Mg/m^3]	V_X [%]
6cb763	1.22	1.22	1.22	0.03	1.22	0.0	0.0
856fbd	1.23	1.23	1.23	0.02	1.23	0.001	0.08
b577cd	1.24	1.24	1.22	0.02	1.23	0.012	0.94
a5f90f	1.24	1.24	1.24	0.1	1.24	0.0	0.0
664b70	1.24	1.25	1.25	0.02	1.25	0.004	0.28
41bb56	1.26	1.25	1.26	0.02	1.26	0.006	0.46
165952	1.26	1.26	1.25	0.01	1.26	0.003	0.24
31ccbc	1.3	1.3	1.29	0.03	1.3	0.006	0.45
1760ff	1.31	1.31	1.3	0.1	1.31	0.006	0.44

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10.1.2   The Numerical Procedure for Determining Outliers
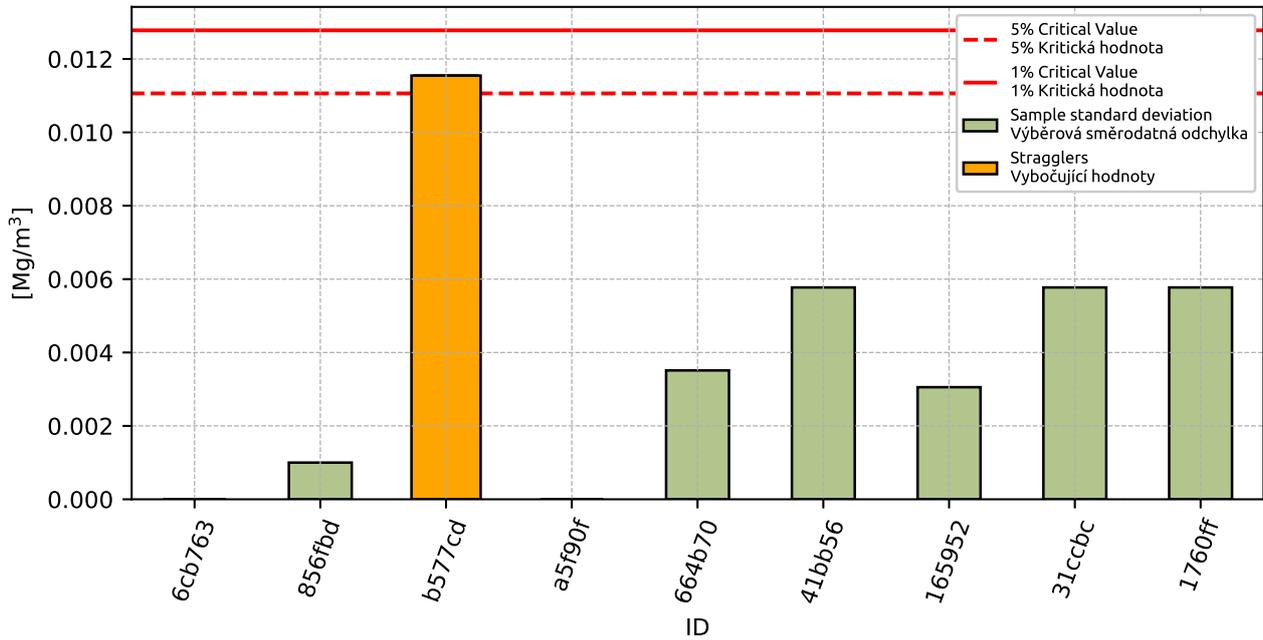
Figure 131: **Cochran's test** - sample standard deviations
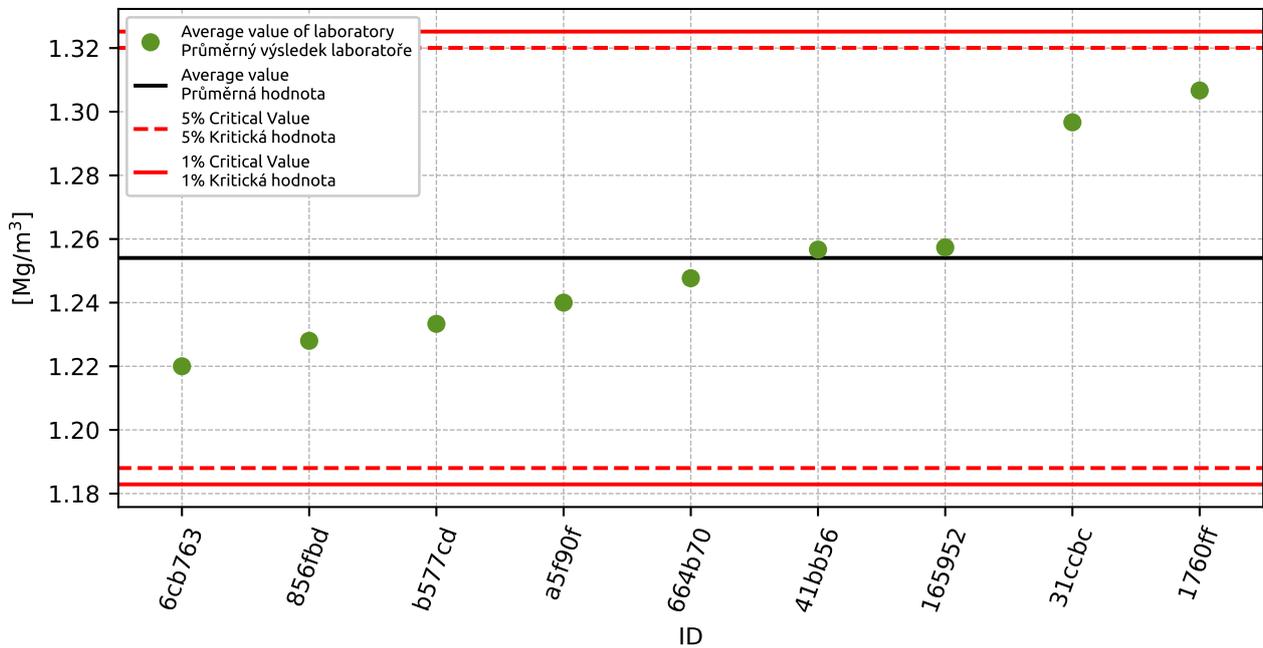
Figure 132: **Grubbs' test** - average values

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10.1.3   Mandel′s Statistics
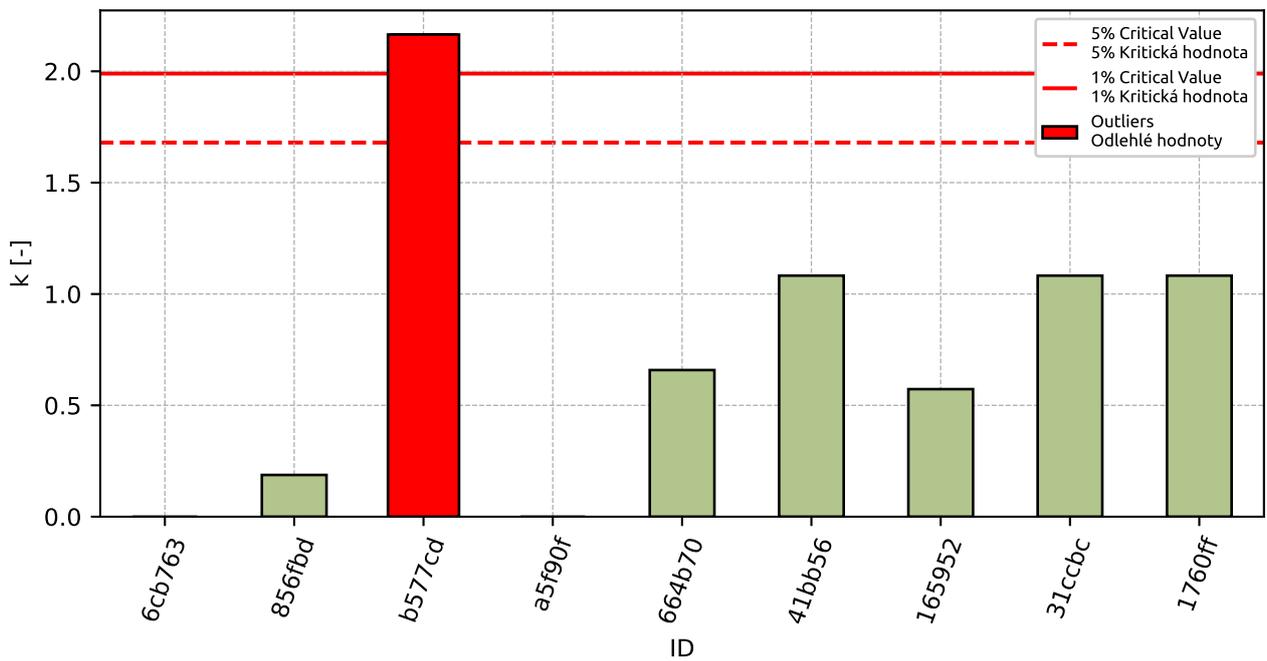
Figure 133: Intralaboratory Consistency Statistic
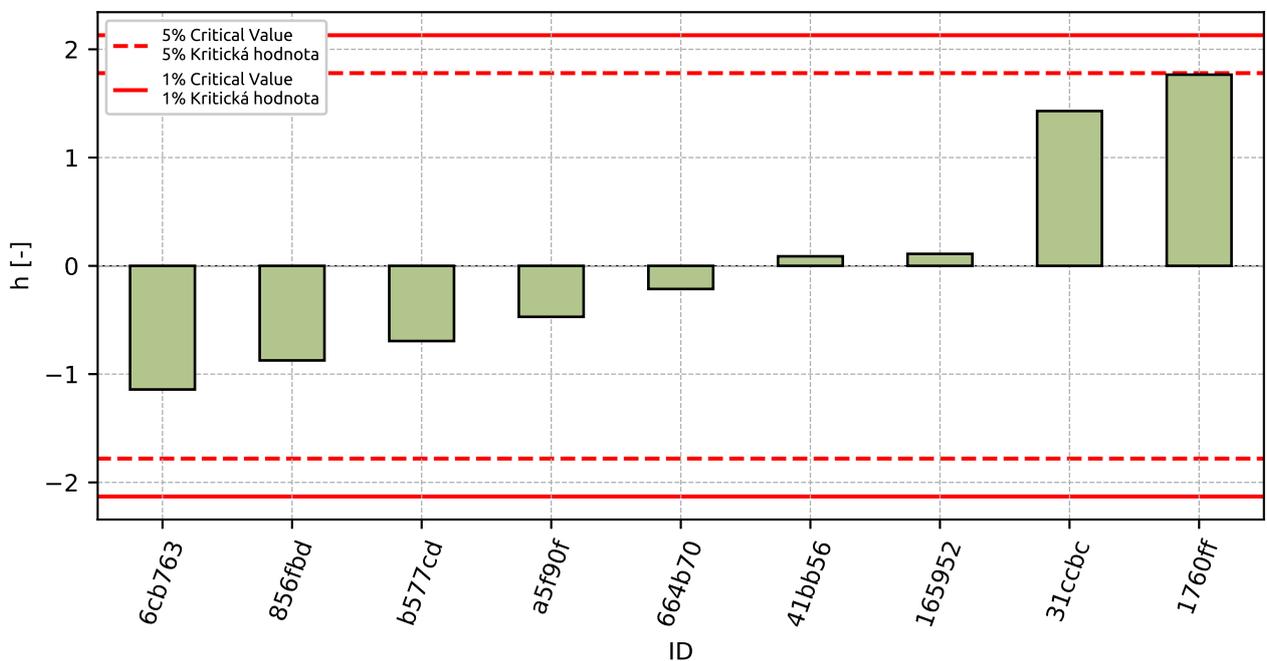
Figure 134: Interlaboratory Consistency Statistic

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10.1.4   Descriptive statistics
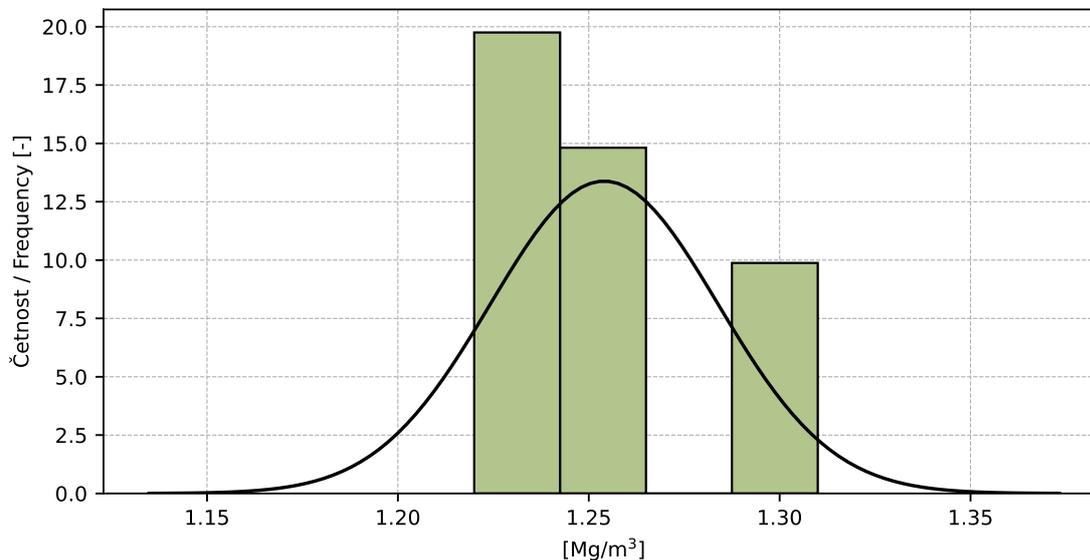
Figure 135: Histogram of all test results

Table 48: Descriptive statistics

Characteristics	[Mg/m^3]
Průměrná hodnota / Average value – $\bar{x}$	1.25
Výběrová směrodatná odchylka / Sample standard deviation – s	0.03
Vztažná hodnota / Asigned value – x^*	1.25
Robustní směrodatná odchylka / Robust standard deviation – s^*	0.029
Nejistota měření vztažné hodnoty / Measurement uncertainty of asigned value – u_X	0.012
p-hodnota testu normality / p-value of normality test	0.004 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – s_L	0.03
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – s_r	0.005
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – s_R	0.03
Opakovatelnost / Repeatability – r	0.01
Reprodukovatelnost / Reproducibility – R	0.08

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10.1.5   Evaluation of Performance Statistics
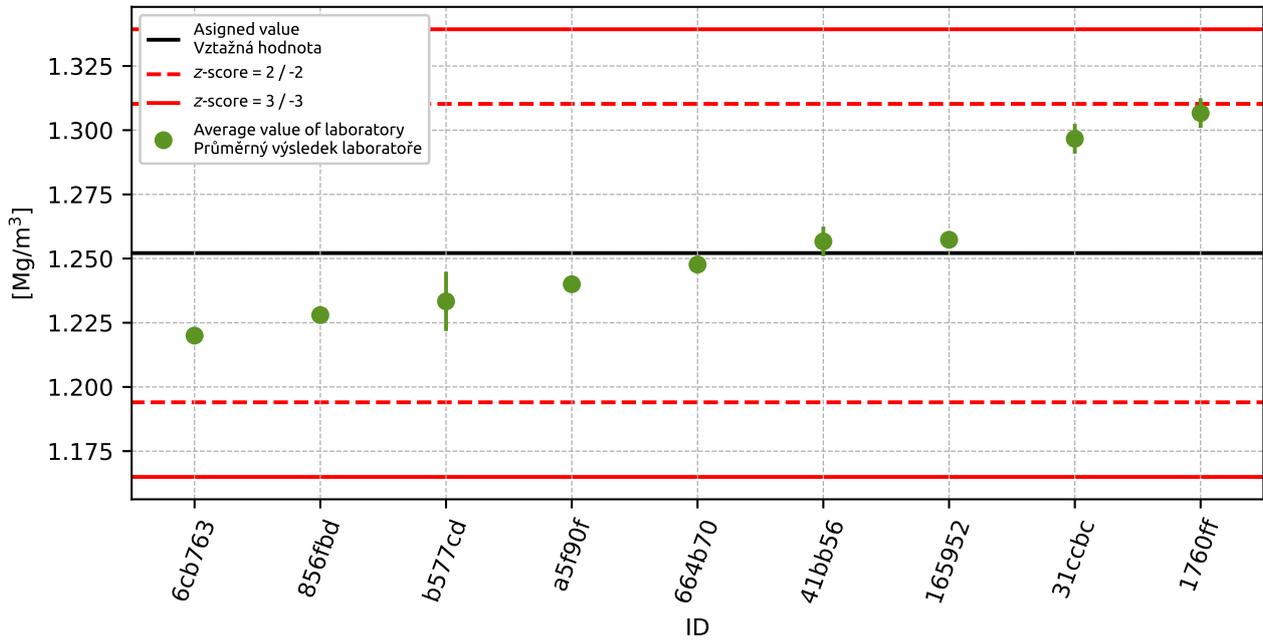
Figure 136: Average values and sample standard deviations
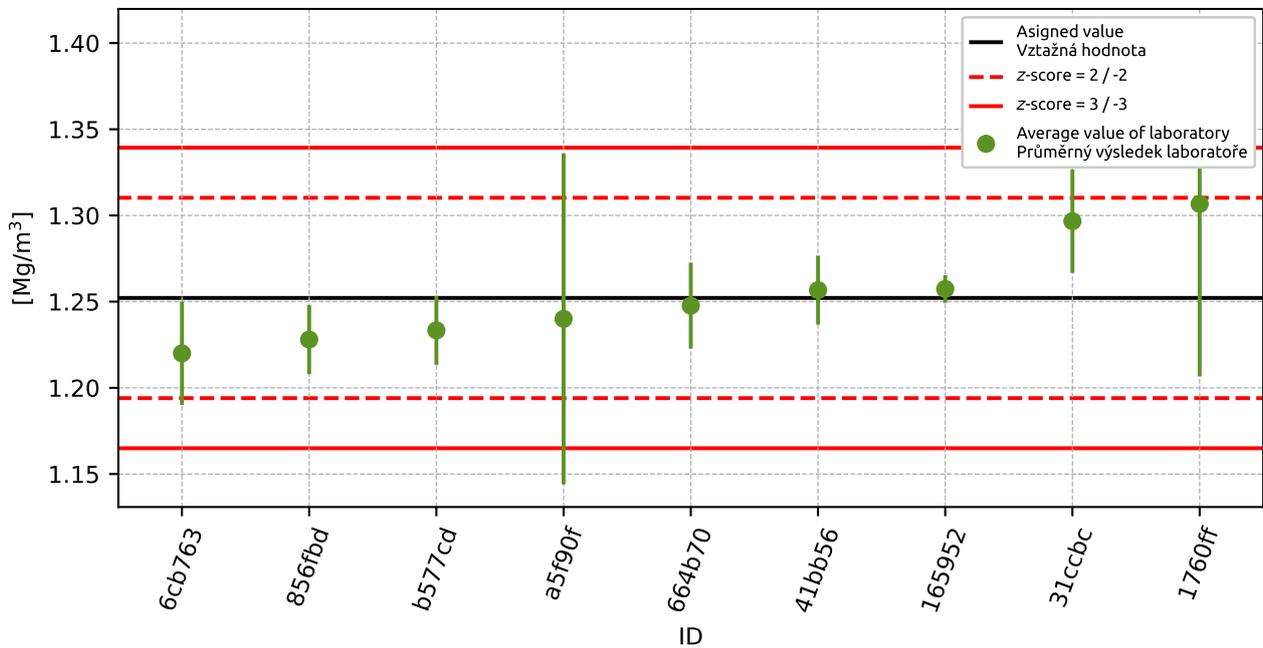
Figure 137: Average values and extended uncertainties of measurement

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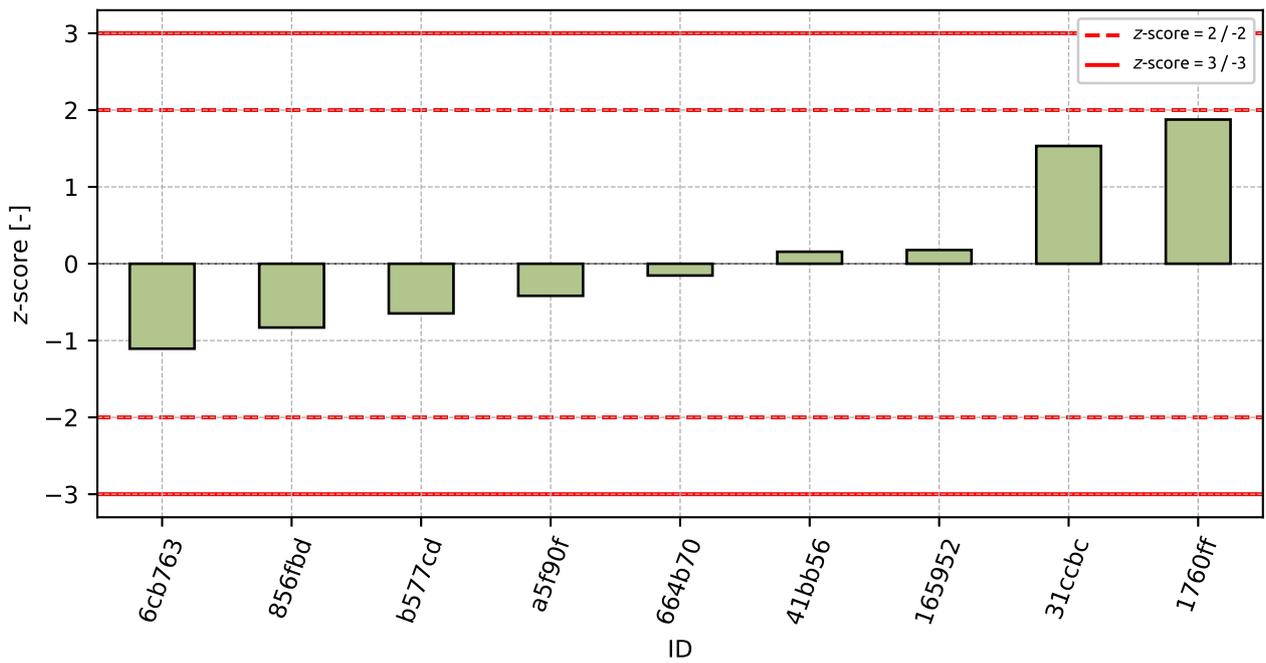
Figure 138: z-score

Figure 139: ζ-score

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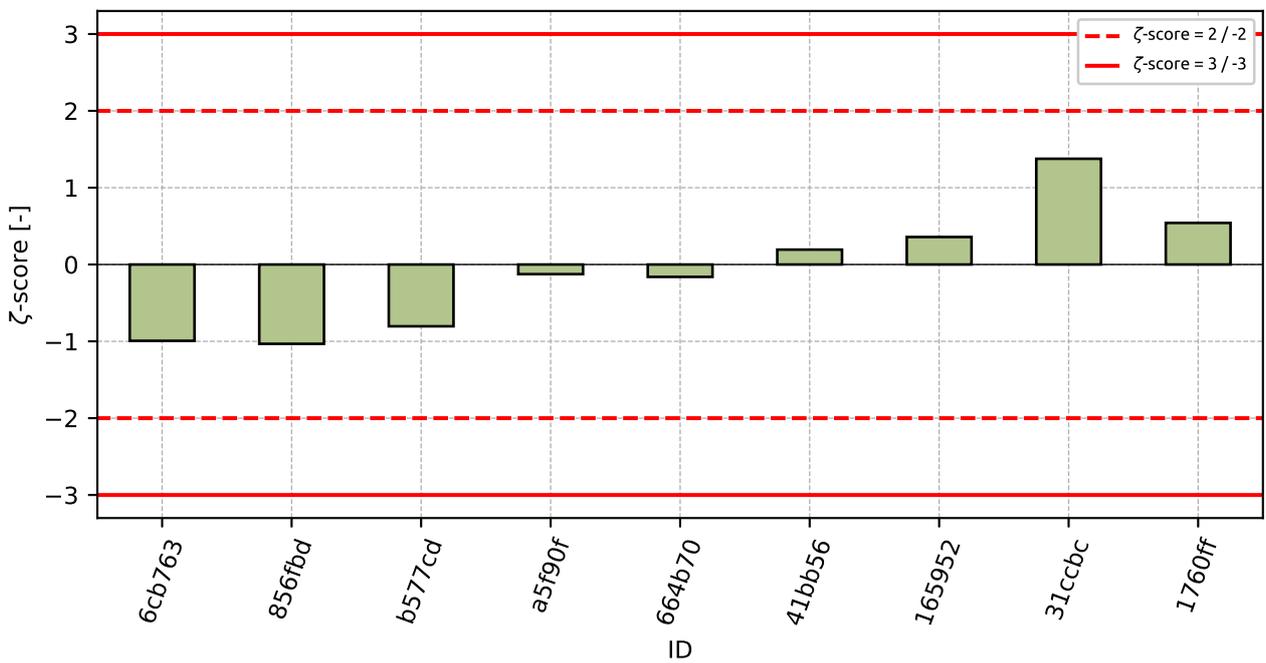
Table 49: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
6cb763	-1.11	-0.99
856fbd	-0.83	-1.03
b577cd	-0.65	-0.8
a5f90f	-0.42	-0.13
664b70	-0.15	-0.16
41bb56	0.16	0.19
165952	0.18	0.36
31ccbc	1.53	1.38
1760ff	1.88	0.54

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10.2 Voids

10.2.1 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 [%]
1760ff	50.3	51.2	49.8	5.0	50.4	0.71	1.41
31ccbc	51.0	51.0	51.0	2.0	51.0	0.0	0.0
b577cd	53.0	53.3	53.7	0.5	53.3	0.35	0.66
856fbd	53.9	53.8	53.8	1.0	53.8	0.06	0.11
41bb56	54.1	54.2	53.5	2.0	53.9	0.38	0.7
165952	54.3	54.0	53.5	0.5	53.9	0.4	0.75

10.2.2 The Numerical Procedure for Determining Outliers
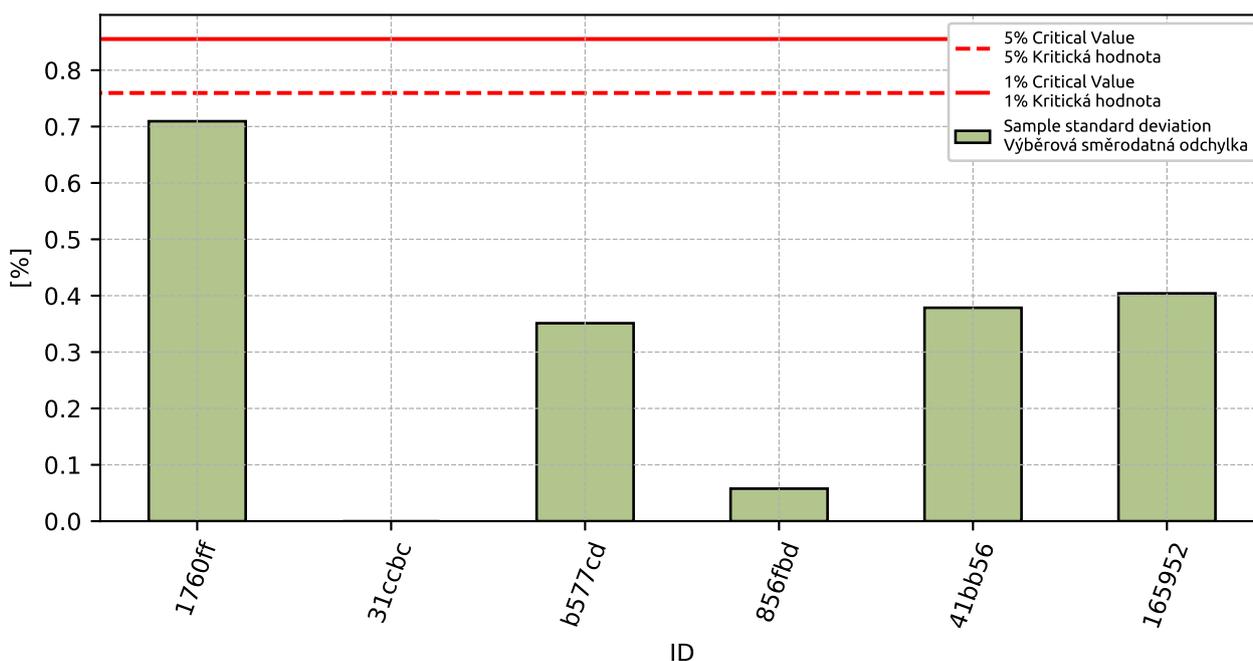
Figure 140: **Cochran's test** - sample standard deviations

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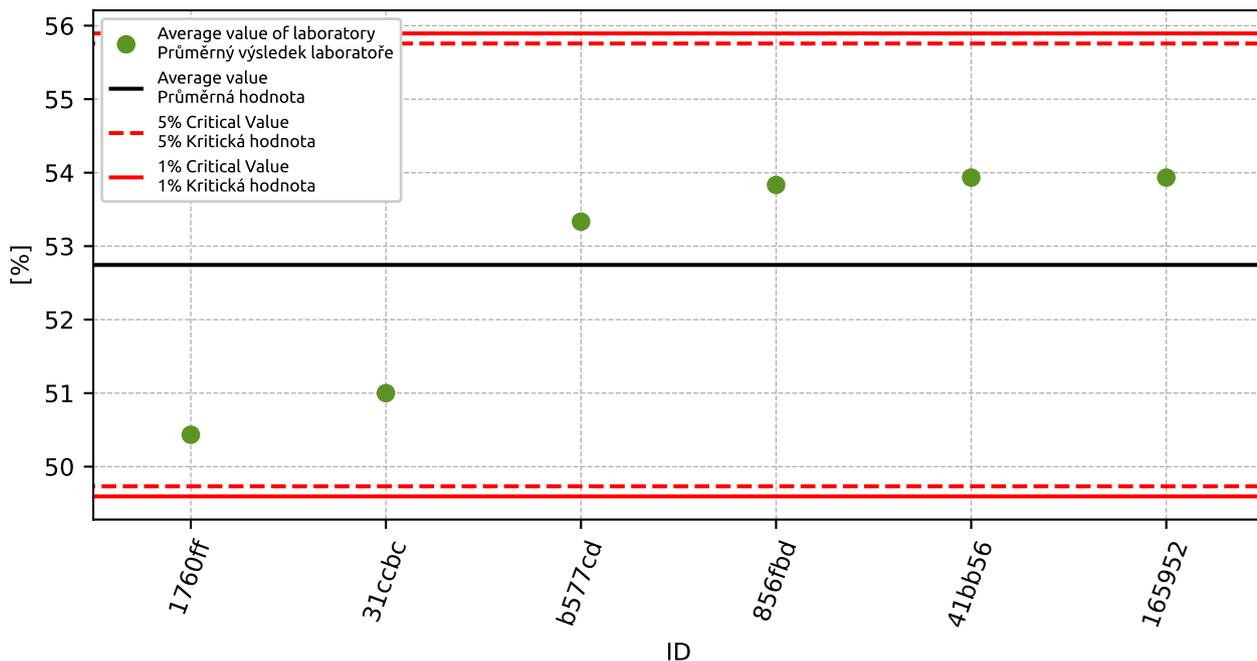
Figure 141: **Grubbs' test** - average values

10.2.3   Mandel's Statistics
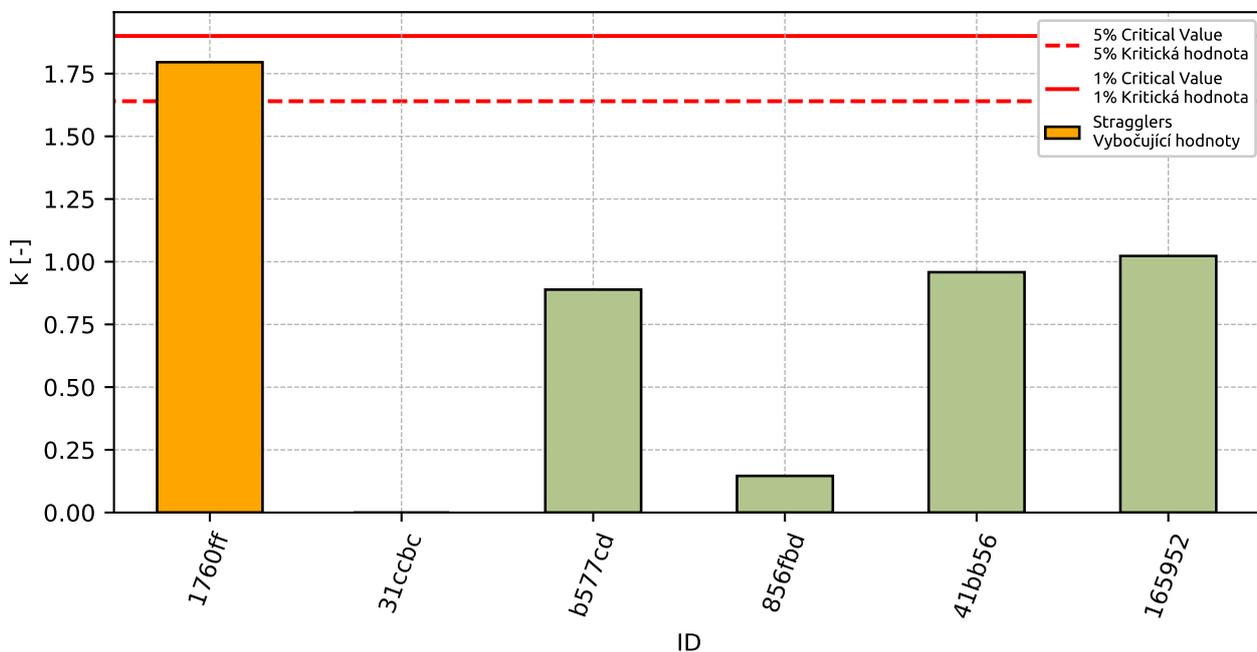
Figure 142: Intralaboratory Consistency Statistic

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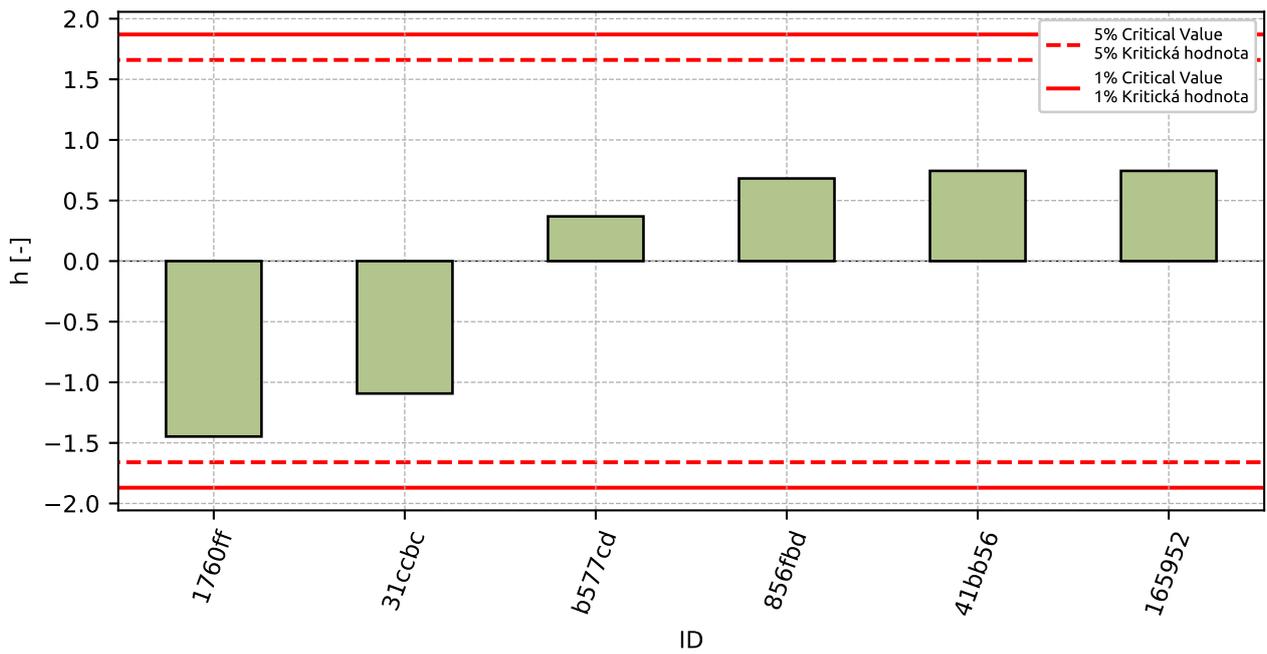
Figure 143: Interlaboratory Consistency Statistic

10.2.4   Descriptive statistics
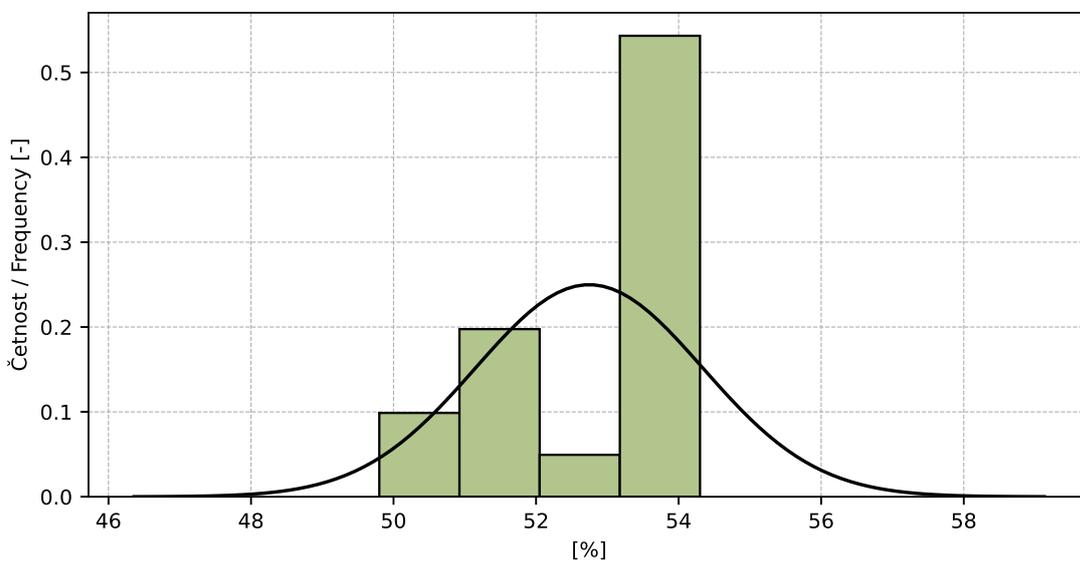
Figure 144: Histogram of all test results

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Table 51: Descriptive statistics

| Characteristics	[%]
Průměrná hodnota / Average value – $\bar{x}$	52.7
Výběrová směrodatná odchylka / Sample standard deviation – s	1.6
Vztažná hodnota / Asigned value – x^*	53.4
Robustní směrodatná odchylka / Robust standard deviation – s^*	0.56
Nejistota měření vztažné hodnoty / Measurement uncertainty of asigned value – u_X	0.29
p-hodnota testu normality / p-value of normality test	0.003 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – s_L	1.58
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – s_r	0.4
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – s_R	1.63
Opakovatelnost / Repeatability – r	1.1
Reprodukovatelnost / Reproducibility – R	4.6

10.2.5 Evaluation of Performance Statistics
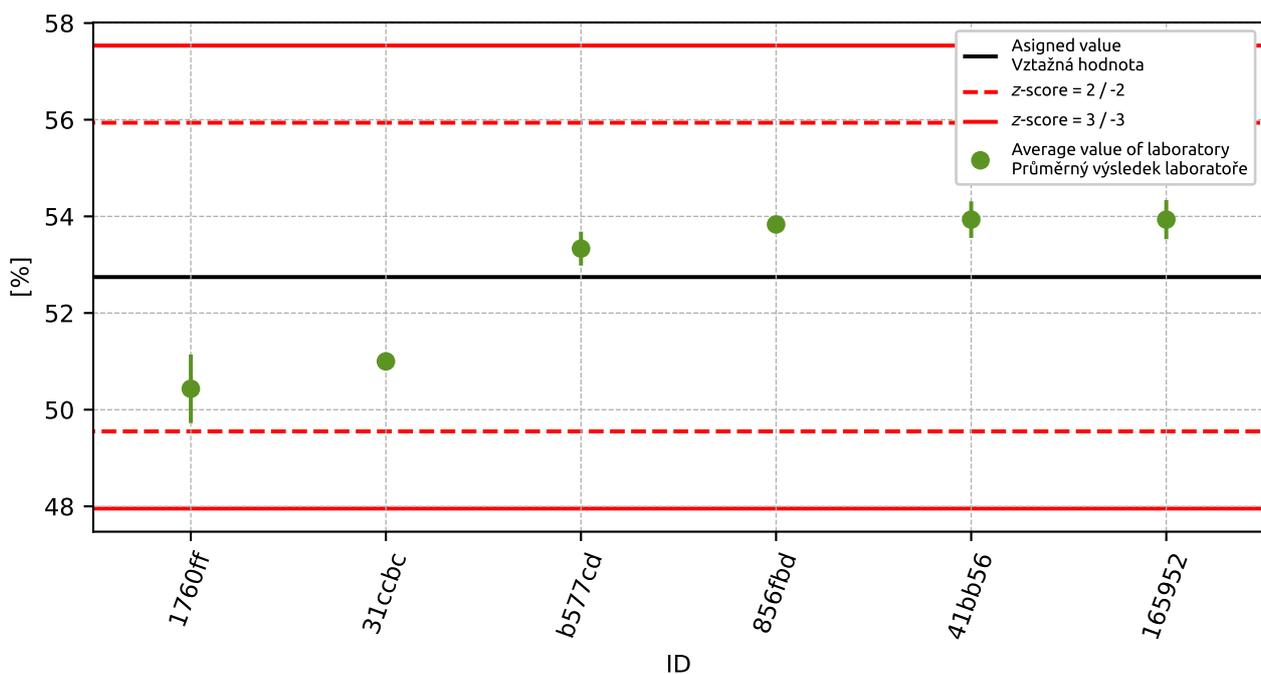
Figure 145: Average values and sample standard deviations

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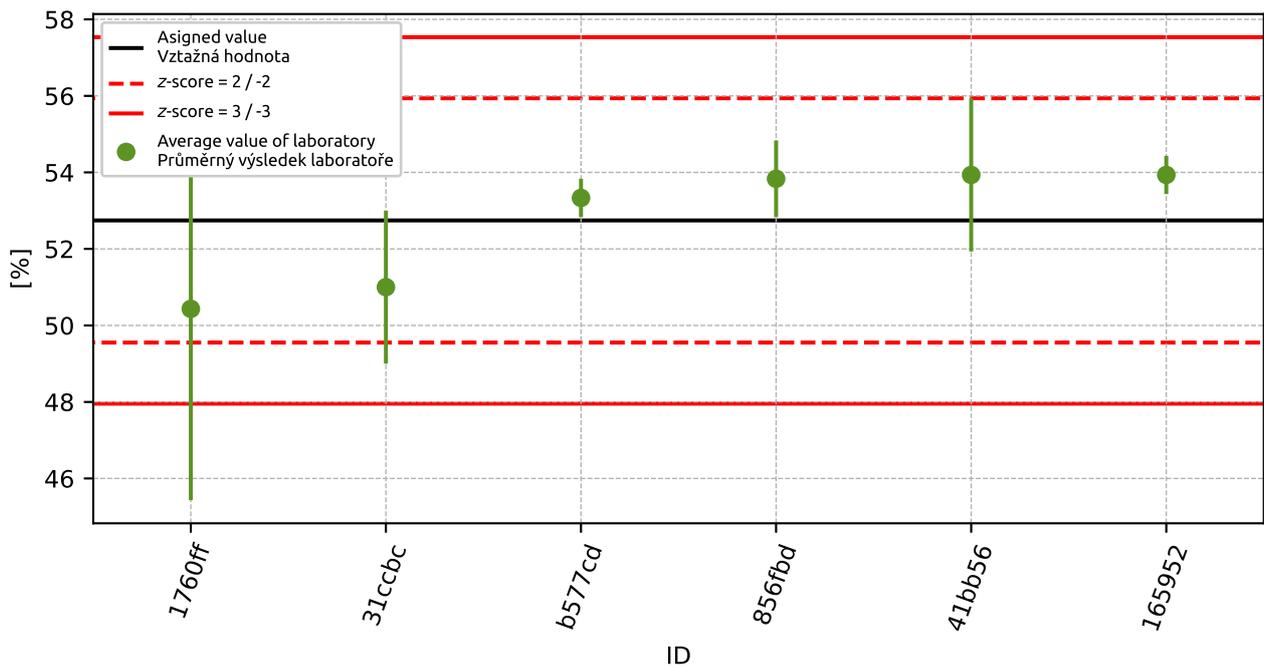
Figure 146: Average values and extended uncertainties of measurement

Figure 147: z-score

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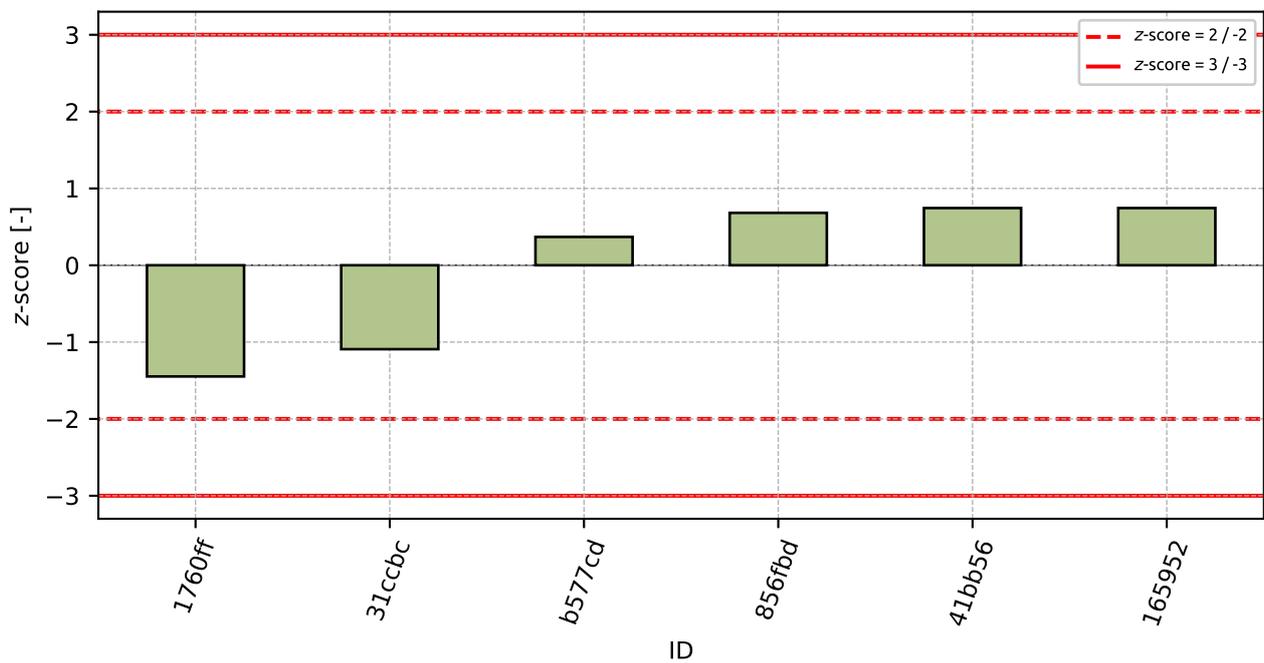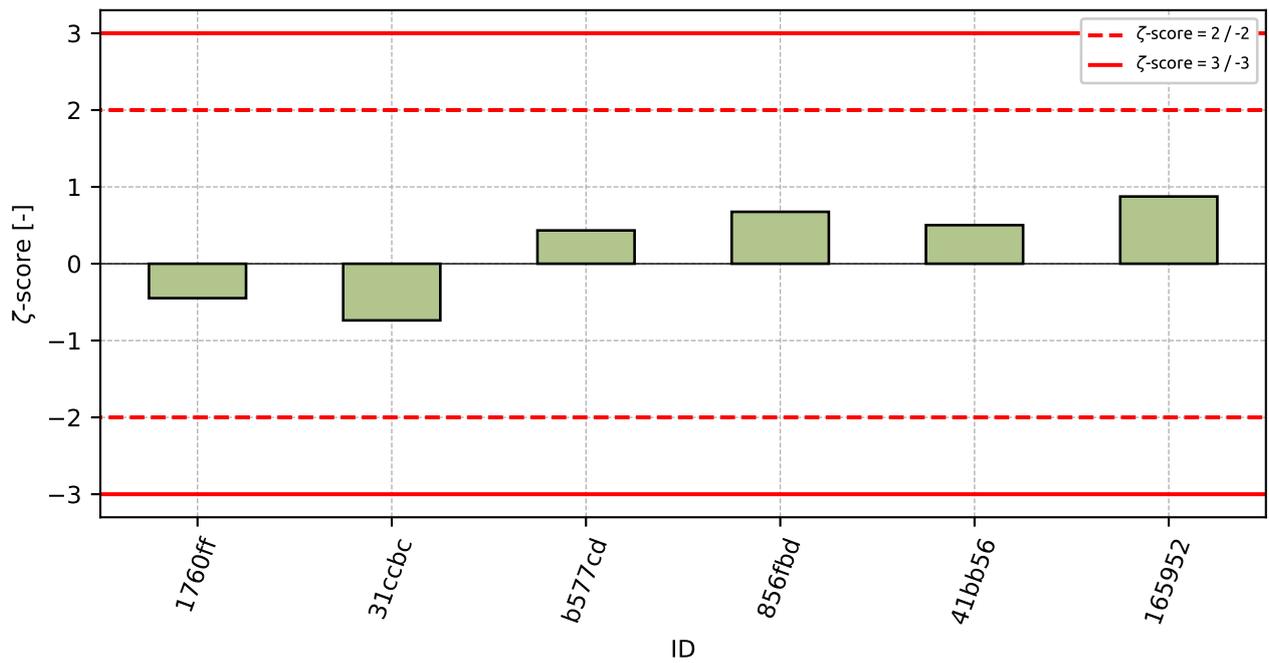
Figure 148: ζ-score

Table 52: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
1760ff	-1.45	-0.45
31ccbc	-1.09	-0.74
b577cd	0.37	0.43
856fbd	0.68	0.68
41bb56	0.74	0.5
165952	0.74	0.87

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

11.1 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 [%]			u_X [%]	$\bar{x}$ [%]	s_0 [%]	V_X [%]
081752	4.1	4.8	4.2	1.9	4.4	0.38	8.67
968ace	4.7	4.6	4.8	1.9	4.7	0.1	2.13
e75474	5.2	5.1	5.2	0.0	5.1	0.02	0.3
9de317	5.7	5.4	4.6	0.7	5.2	0.53	10.18
4970e4	5.1	5.3	5.4	0.2	5.3	0.15	2.9
664b70	5.4	5.4	5.4	4.4	5.4	0.0	0.0
1760ff	5.5	5.3	5.6	0.5	5.5	0.14	2.58
3d85a9	5.3	5.6	5.6	-	5.5	0.17	3.15
526f8f	5.5	5.4	5.6	0.1	5.5	0.1	1.82
e9a2b5	5.4	5.6	5.5	0.5	5.5	0.1	1.82
51f258	5.5	5.6	5.5	0.1	5.5	0.06	1.04
f26de6	5.5	5.6	5.6	0.5	5.6	0.06	1.04
9623eb	5.6	5.5	5.6	1.5	5.6	0.06	1.04
165952	5.6	5.6	5.5	0.0	5.6	0.06	1.04
d24f52	5.6	5.8	5.4	6.0	5.6	0.2	3.57
856fbd	5.5	5.7	5.6	0.2	5.6	0.1	1.79
9eaaa0	5.6	5.7	5.5	0.3	5.6	0.1	1.79
31ccbc	5.5	5.7	5.6	0.5	5.6	0.07	1.27
41bb56	5.7	5.7	5.5	0.2	5.6	0.12	2.05
b4ab8c	5.6	5.7	5.6	0.2	5.6	0.06	1.02
9308e6	5.4	5.7	6.1	0.9	5.7	0.35	6.13
1ad821	6.1	5.8	6.0	0.0	6.0	0.14	2.29
b74bb7	6.1	5.9	5.9	0.2	6.0	0.12	1.94
5f3943	6.8	6.5	6.6	1.6	6.6	0.15	2.3

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11.2　The Numerical Procedure for Determining Outliers
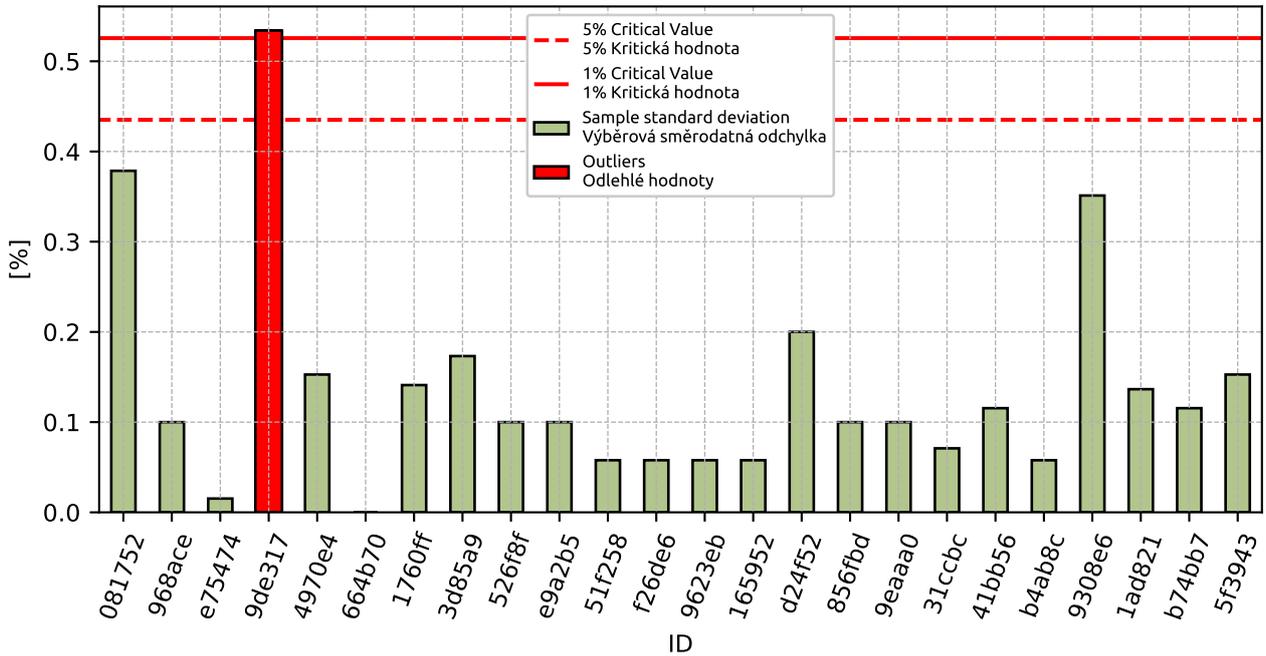

Figure 149: **Cochran's test** - sample standard deviations
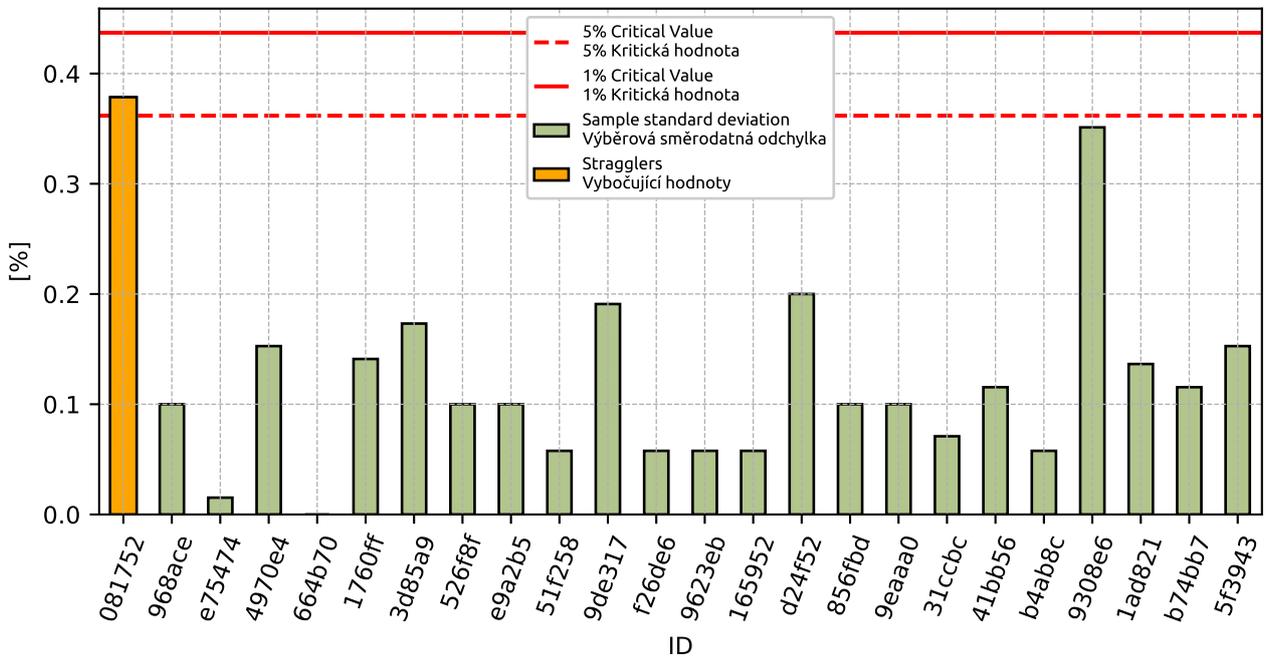
Figure 150: **Cochran's test** - sample standard deviations without outliers

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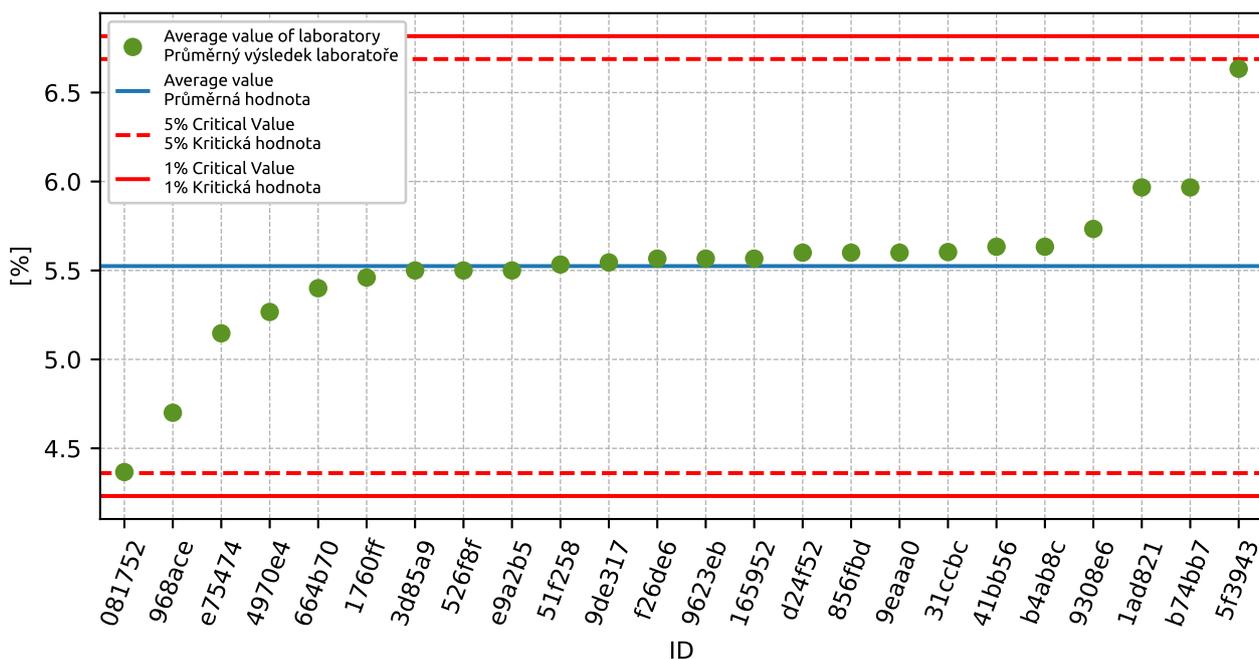
Figure 151: **Grubbs' test** - average values

11.3   Mandel's Statistics
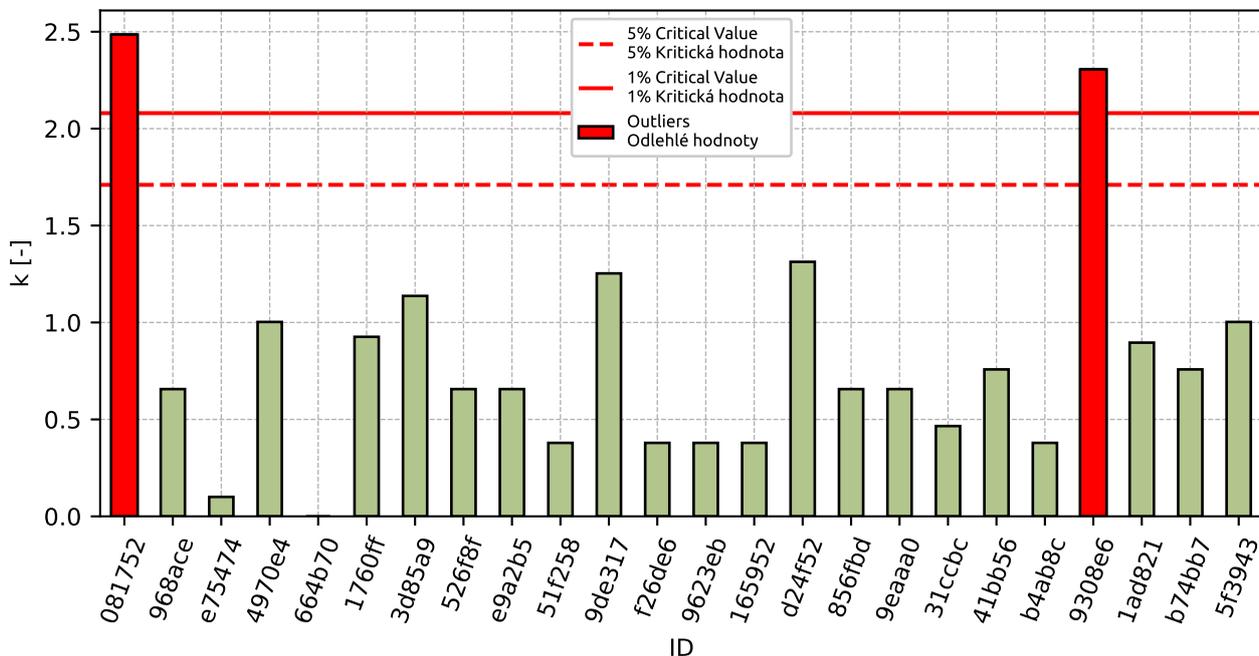
Figure 152: Intralaboratory Consistency Statistic

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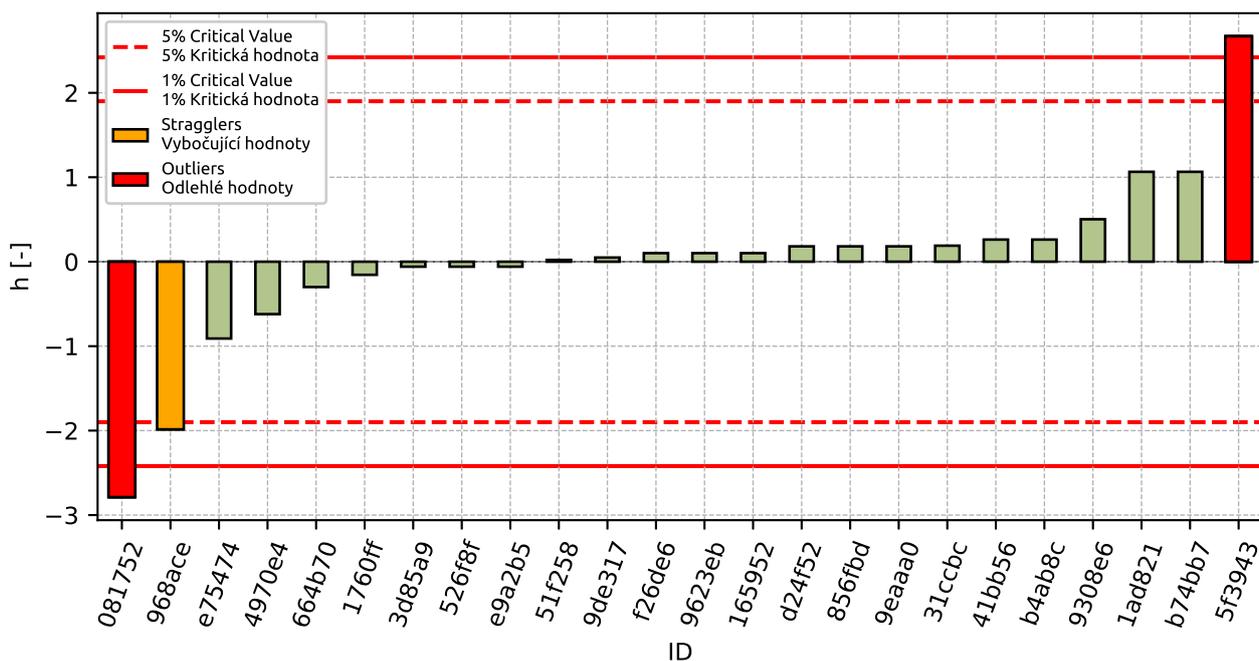
Figure 153: Interlaboratory Consistency Statistic

11.4 Descriptive statistics
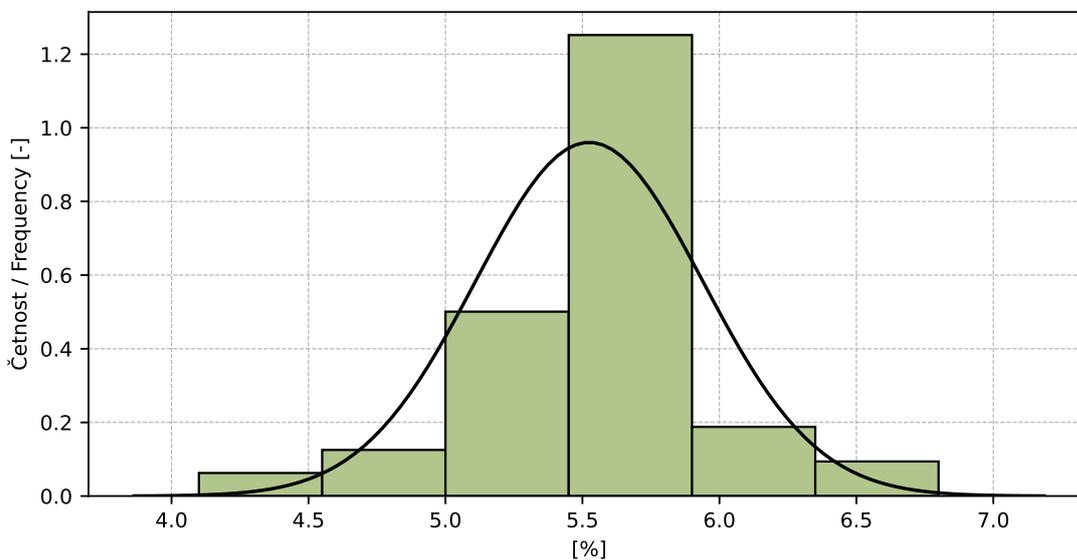
Figure 154: Histogram of all test results

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Table 54: Descriptive statistics

| Characteristics	[%]
Průměrná hodnota / Average value – $\bar{x}$	5.5
Výběrová směrodatná odchylka / Sample standard deviation – s	0.42
Vztažná hodnota / Asigned value – x^*	5.5
Robustní směrodatná odchylka / Robust standard deviation – s^*	0.42
Nejistota měření vztažné hodnoty / Measurement uncertainty of asigned value – u_X	0.64
p-hodnota testu normality / p-value of normality test	1.0 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – s_L	0.41
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – s_r	0.15
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – s_R	0.43
Opakovatelnost / Repeatability – r	0.4
Reprodukovatelnost / Reproducibility – R	1.2

11.5   Evaluation of Performance Statistics
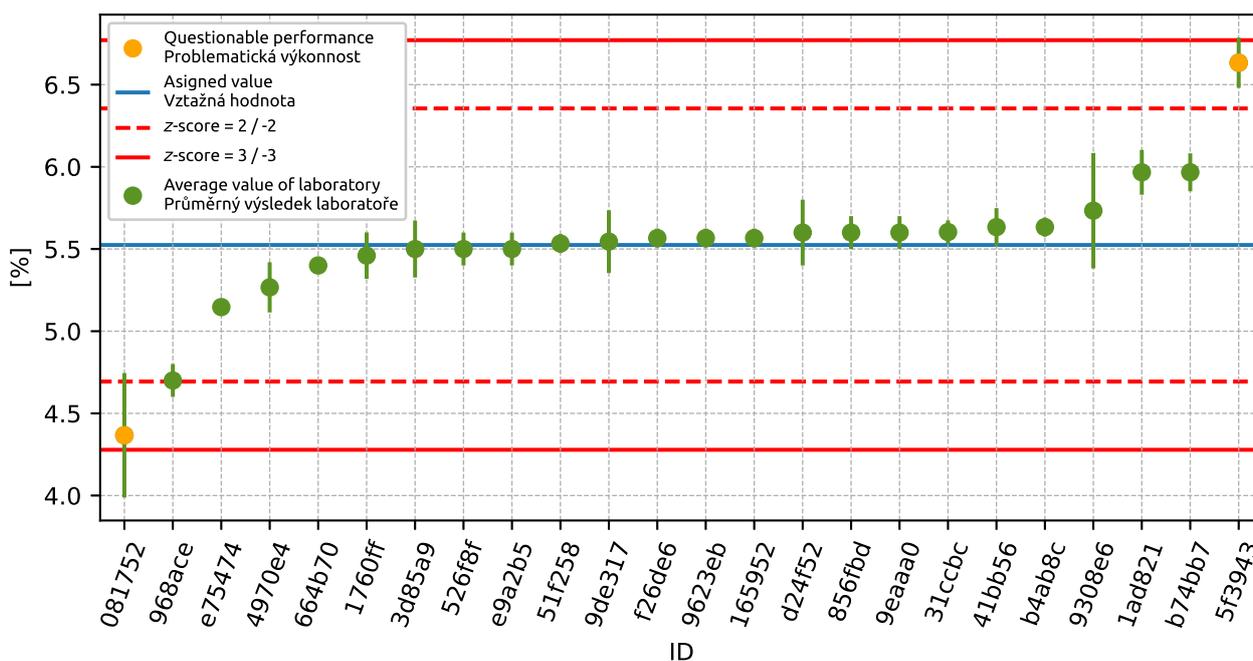
Figure 155: Average values and sample standard deviations

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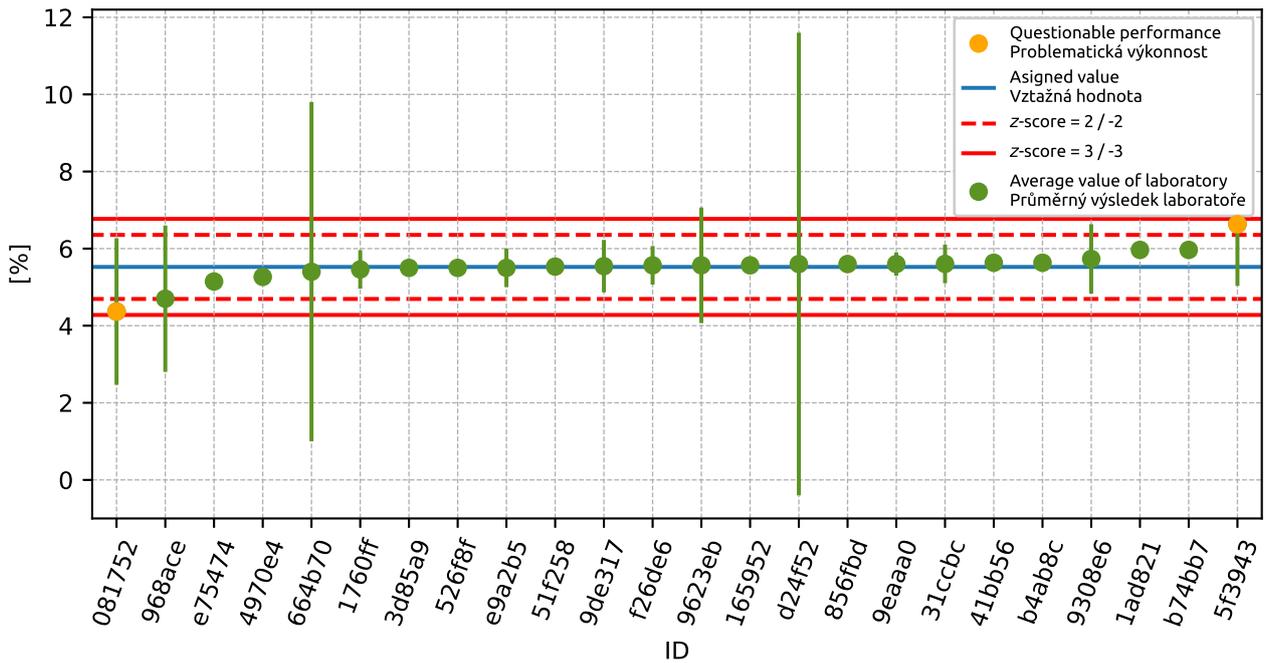
Figure 156: Average values and extended uncertainties of measurement

Figure 157: z-score

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Figure 158: ζ-score

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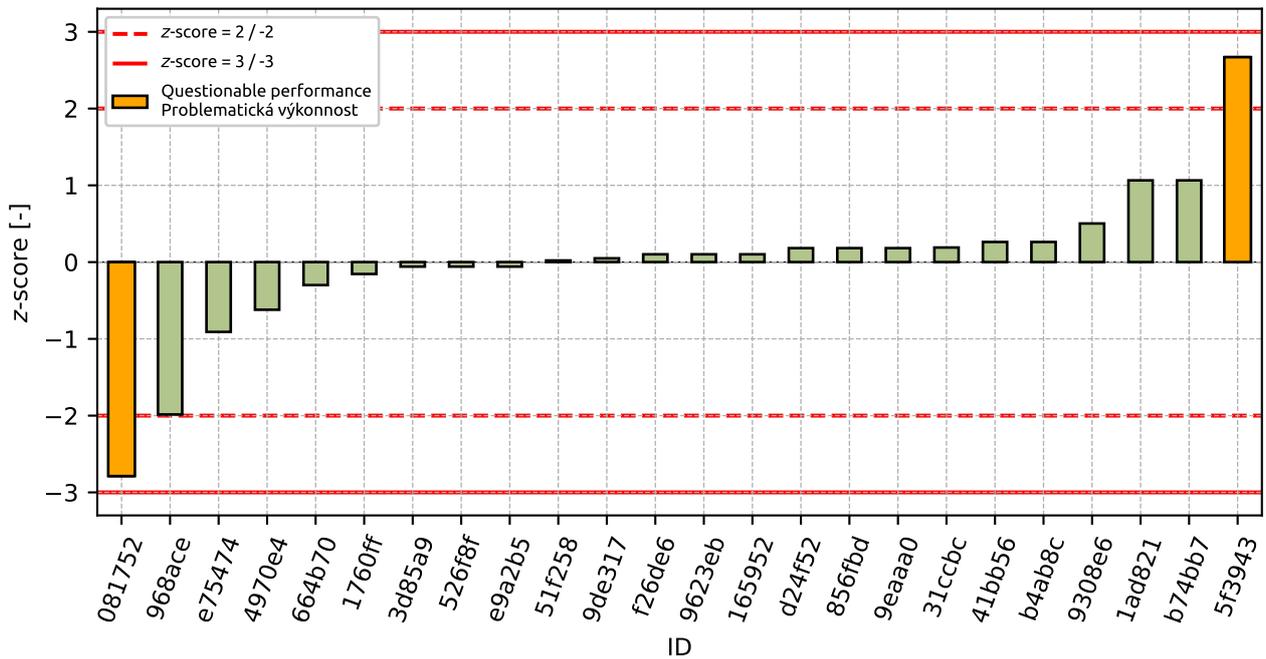
Table 55: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
081752	-2.79	-0.58
968ace	-1.99	-0.41
e75474	-0.91	-0.59
4970e4	-0.62	-0.38
664b70	-0.3	-0.03
1760ff	-0.16	-0.08
3d85a9	-0.06	-
526f8f	-0.06	-0.04
e9a2b5	-0.06	-0.03
51f258	0.02	0.01
9de317	0.05	0.02
f26de6	0.1	0.05
9623eb	0.1	0.03
165952	0.1	0.07
d24f52	0.18	0.01
856fbd	0.18	0.11
9eaaa0	0.18	0.11
31ccbc	0.19	0.1
41bb56	0.26	0.16
b4ab8c	0.26	0.16
9308e6	0.5	0.19
1ad821	1.06	0.69
b74bb7	1.06	0.66
5f3943	2.67	0.64

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

12.1   Particle density

12.1.1   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
	[Mg/m^3]			[Mg/m^3]	[Mg/m^3]	[Mg/m^3]	[%]
ea6b6f	2.71	2.74	2.72	0.05	2.72	0.015	0.56
694b2b	2.72	2.73	2.73	-	2.73	0.003	0.11
081752	2.73	2.73	2.74	0.03	2.73	0.006	0.21
e9a2b5	2.74	2.74	2.75	0.05	2.74	0.006	0.21
51f258	2.74	2.76	2.73	0.14	2.74	0.017	0.62
968ace	2.75	2.74	2.75	0.03	2.75	0.006	0.21
1760ff	2.74	2.75	2.75	0.3	2.75	0.006	0.21
473f5c	2.75	2.74	2.75	0.05	2.75	0.006	0.21
4970e4	2.74	2.76	2.74	0.06	2.75	0.012	0.42
e75474	2.75	2.75	2.75	0.0	2.75	0.0	0.02
f26de6	2.75	2.75	2.75	0.01	2.75	0.0	0.0
9623eb	2.75	2.75	2.75	0.12	2.75	0.0	0.0
165952	2.75	2.75	2.75	0.0	2.75	0.001	0.04
1e0c28	2.76	2.75	2.75	0.05	2.75	0.006	0.21
4089af	2.75	2.76	2.75	0.0	2.75	0.006	0.21
664b70	2.75	2.76	2.76	0.2	2.76	0.005	0.18
856fbd	2.76	2.76	2.75	0.02	2.76	0.006	0.21
ed90bd	2.76	2.76	2.75	0.08	2.76	0.003	0.1
332b9d	2.76	2.76	2.76	-	2.76	0.0	0.0
9308e6	2.76	2.77	2.77	0.02	2.77	0.006	0.21
41bb56	2.77	2.77	2.77	0.02	2.77	0.0	0.0
526f8f	2.78	2.77	2.79	0.05	2.78	0.01	0.36
1ad821	2.94	2.85	2.82	0.02	2.87	0.062	2.18

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12.1.2   The Numerical Procedure for Determining Outliers
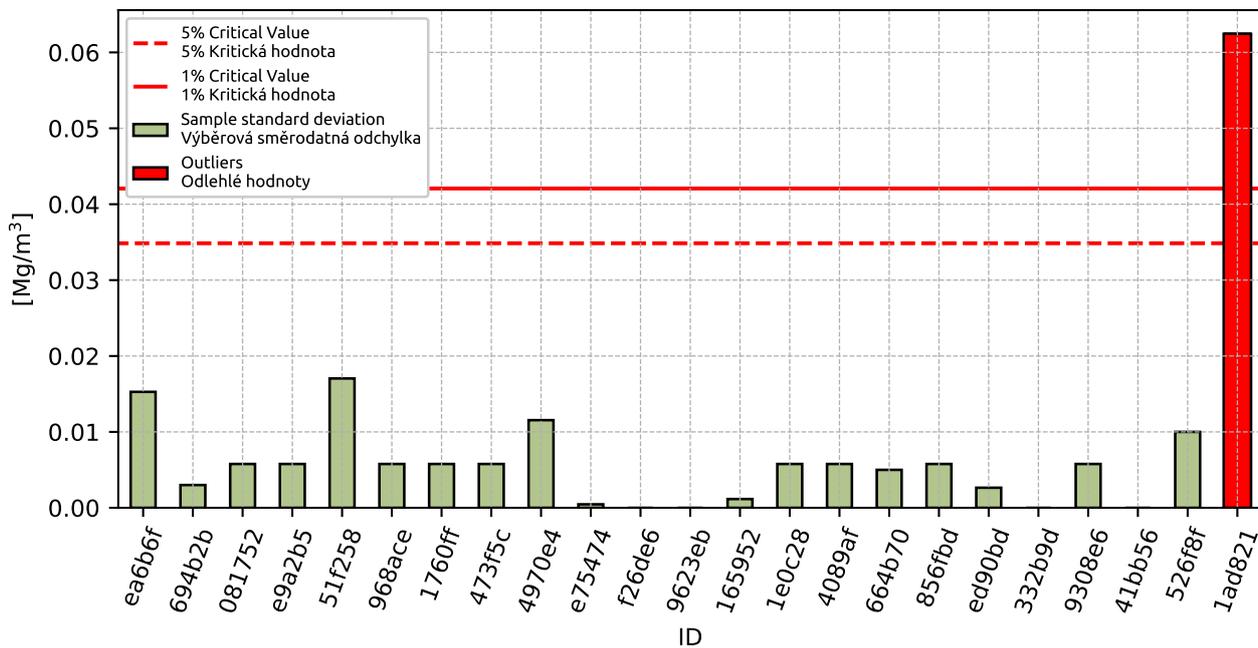
Figure 159: **Cochran's test** - sample standard deviations
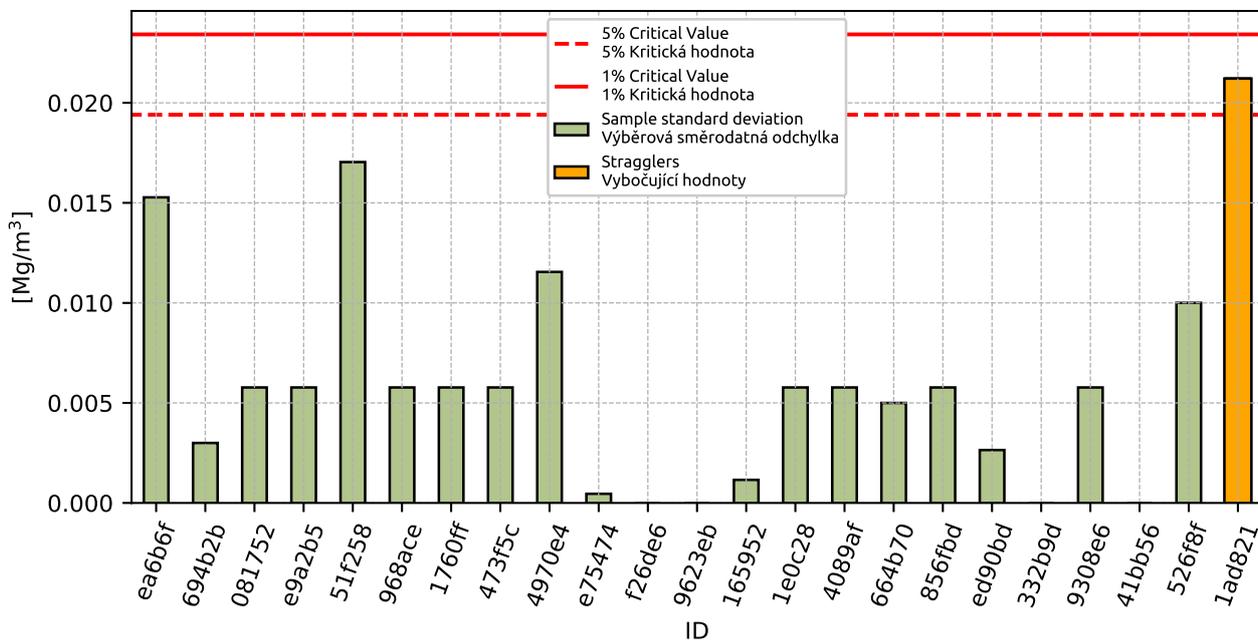
Figure 160: **Cochran's test** - sample standard deviations without outliers

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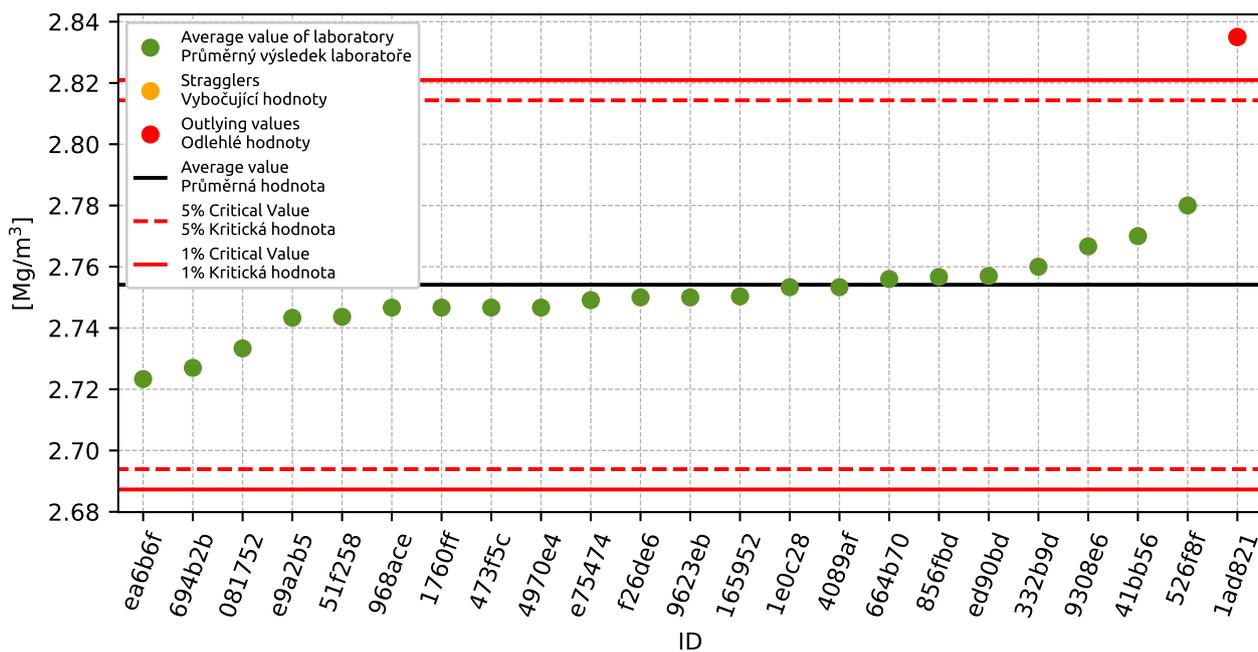
Figure 161: **Grubbs' test** - average values
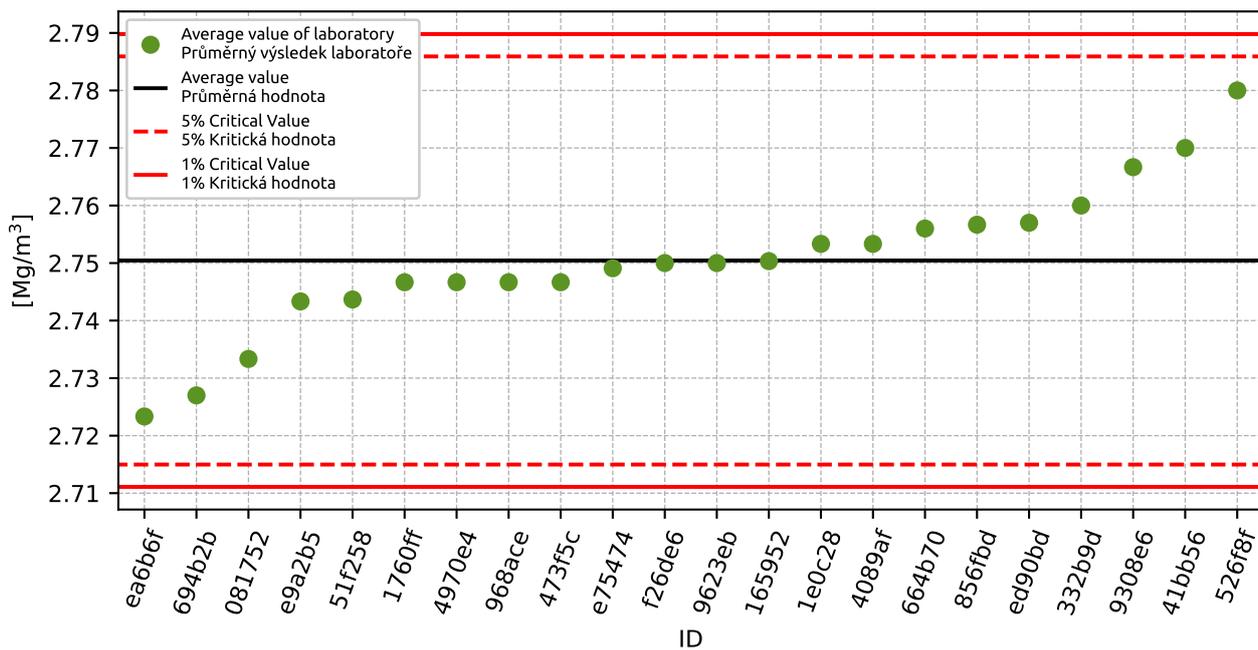
Figure 162: **Grubbs' test** - average values without outliers

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12.1.3 Mandel's Statistics
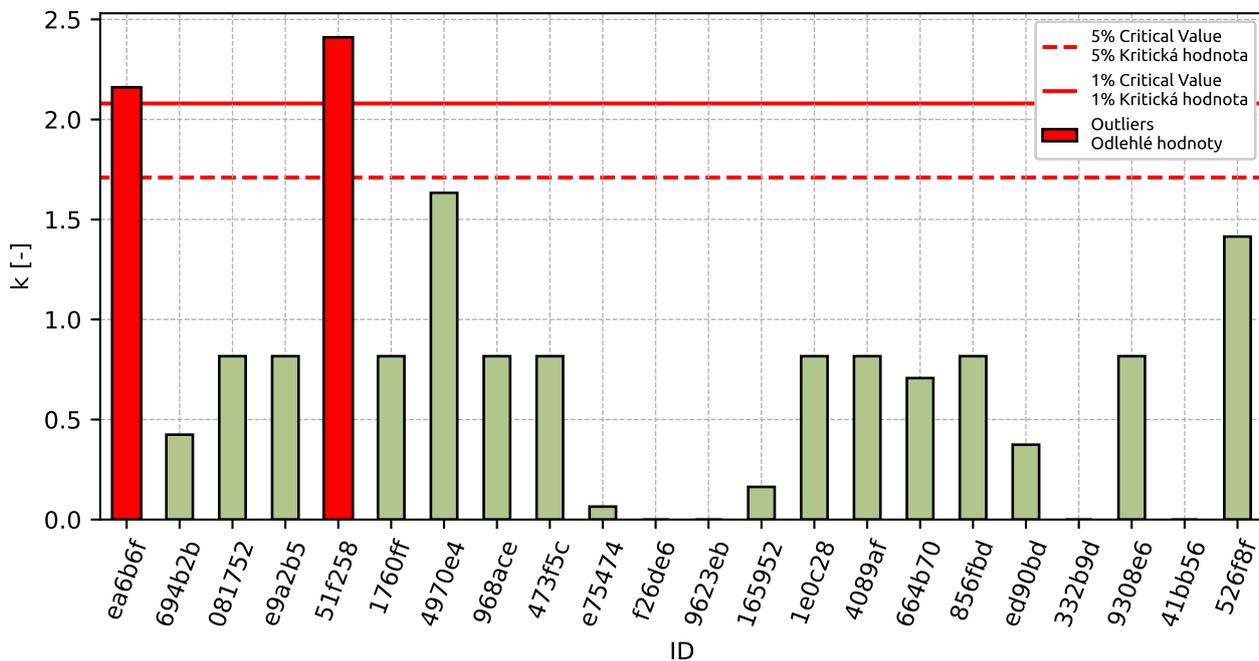
Figure 163: Intralaboratory Consistency Statistic
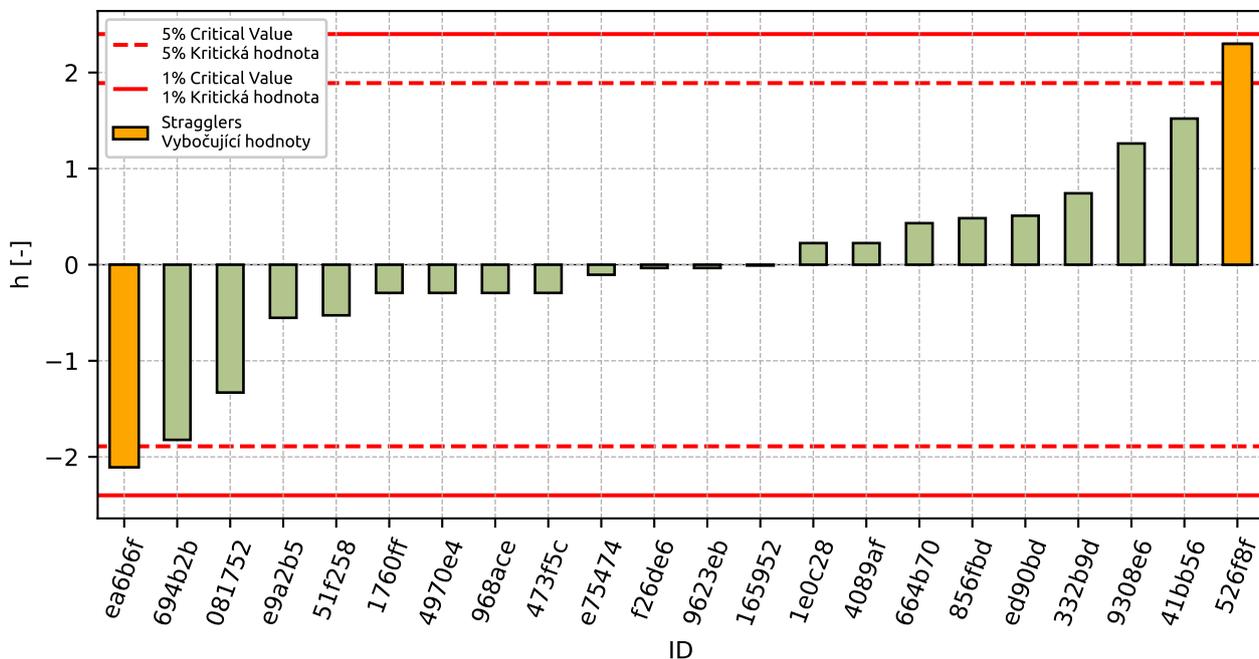
Figure 164: Interlaboratory Consistency Statistic

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12.1.4 Descriptive statistics
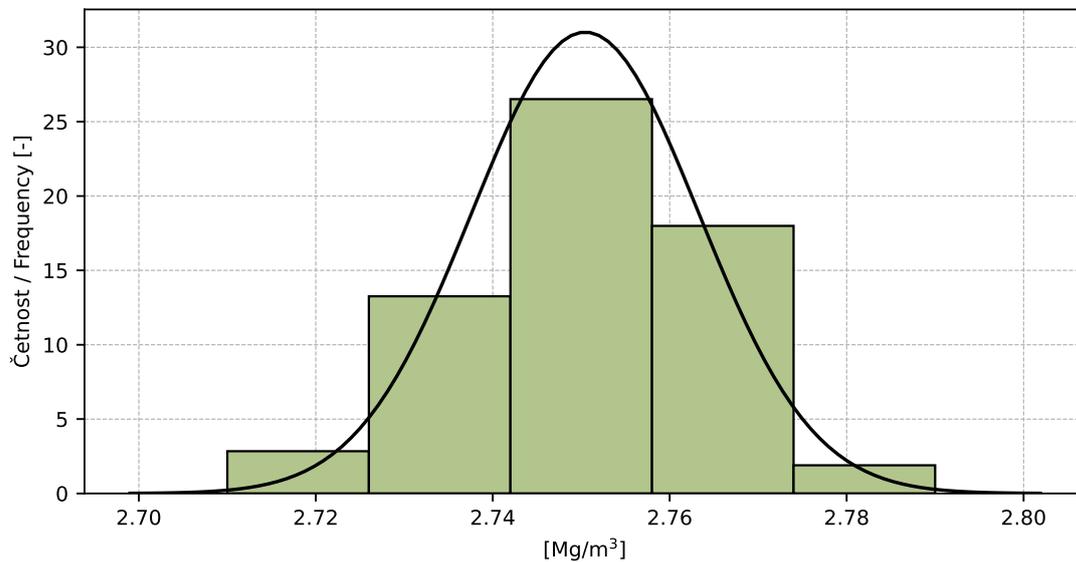
Figure 165: Histogram of all test results

Table 57: Descriptive statistics

Characteristics	[Mg/m^3]
Průměrná hodnota / Average value – $\bar{x}$	2.75
Výběrová směrodatná odchylka / Sample standard deviation – s	0.013
Vztažná hodnota / Asigned value – x^*	2.75
Robustní směrodatná odchylka / Robust standard deviation – s^*	0.013
Nejistota měření vztažné hodnoty / Measurement uncertainty of asigned value – u_X	0.113
p-hodnota testu normality / p-value of normality test	0.01 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – s_L	0.012
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – s_r	0.007
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – s_R	0.014
Opakovatelnost / Repeatability – r	0.02
Reprodukovatelnost / Reproducibility – R	0.04

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12.1.5   Evaluation of Performance Statistics
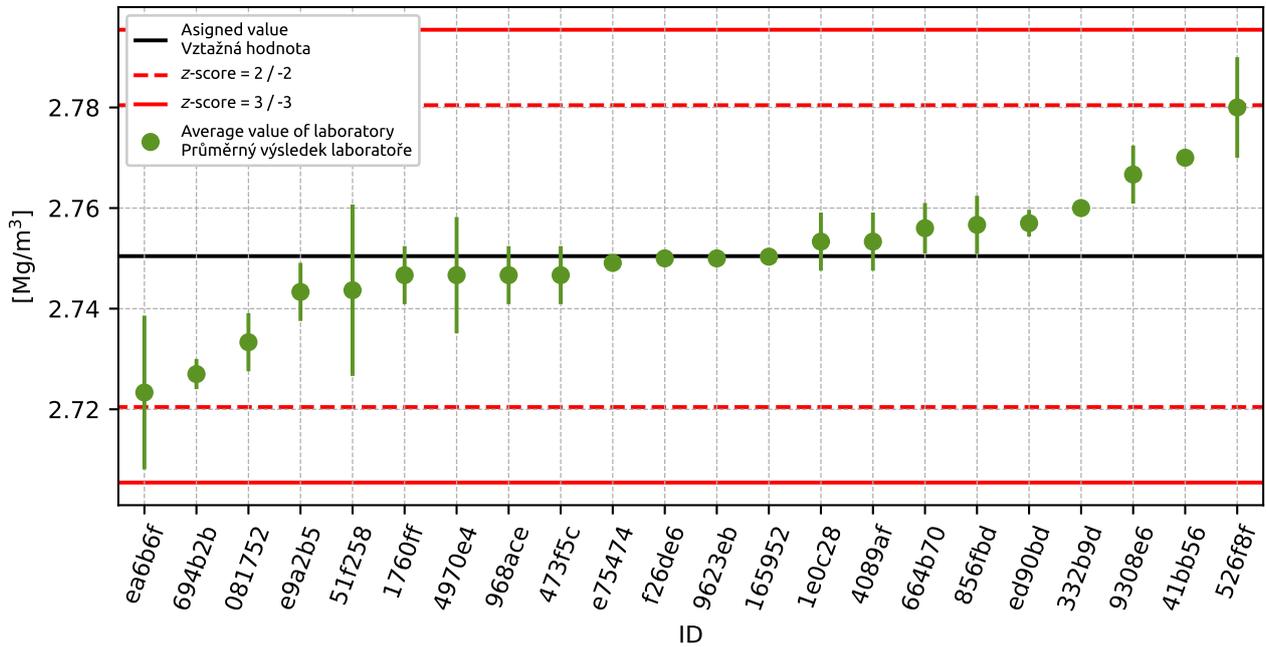

Figure 166: Average values and sample standard deviations
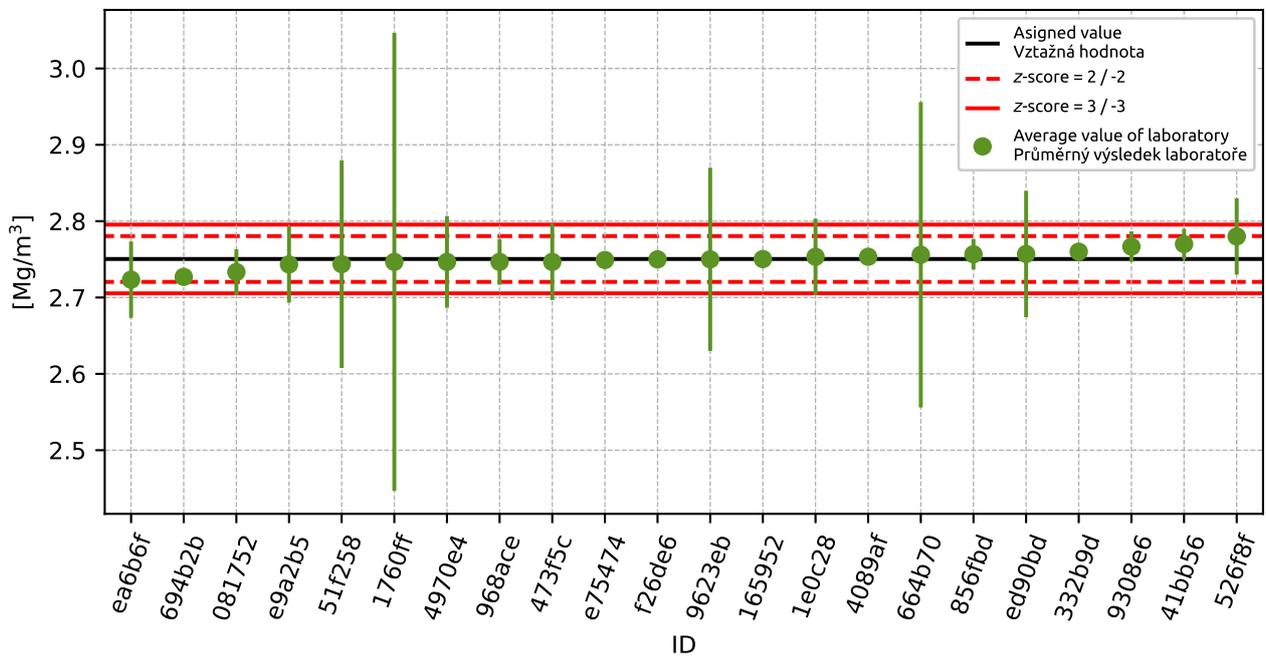
Figure 167: Average values and extended uncertainties of measurement

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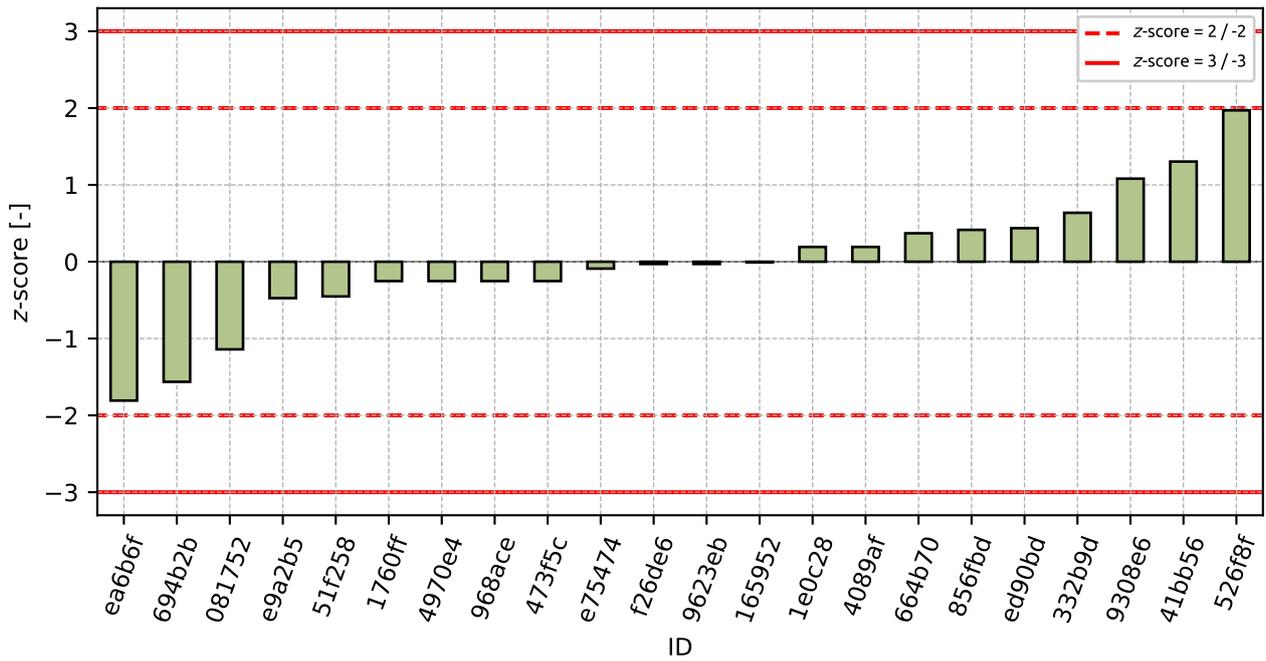
Figure 168: z-score

Figure 169: ζ-score

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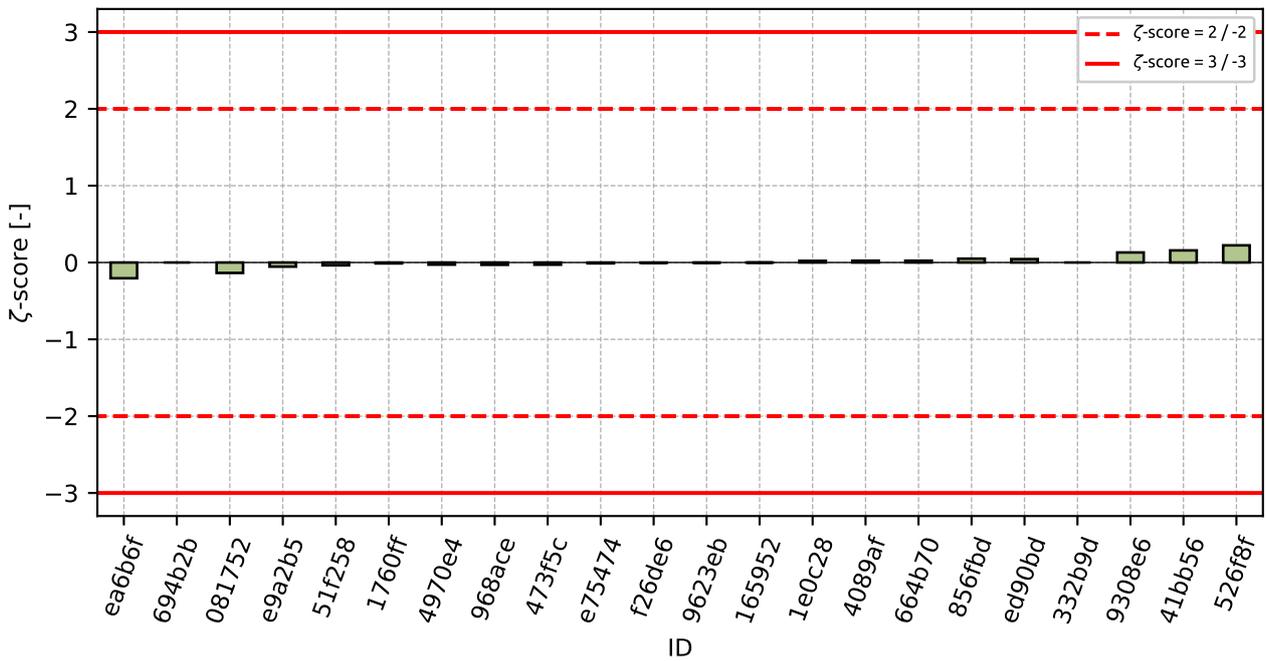
Table 58: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
ea6b6f	-1.81	-0.2
694b2b	-1.56	-
081752	-1.14	-0.14
e9a2b5	-0.47	-0.05
51f258	-0.45	-0.04
1760ff	-0.25	-0.01
4970e4	-0.25	-0.03
968ace	-0.25	-0.03
473f5c	-0.25	-0.03
e75474	-0.09	-0.01
f26de6	-0.03	-0.0
9623eb	-0.03	-0.0
165952	-0.01	-0.0
1e0c28	0.19	0.02
4089af	0.19	0.02
664b70	0.37	0.02
856fbd	0.41	0.05
ed90bd	0.44	0.04
332b9d	0.64	-
9308e6	1.08	0.13
41bb56	1.3	0.16
526f8f	1.97	0.22

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12.2 Water absorption

12.2.1 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 [%]
4089af	0.2	0.3	0.3	0.1	0.2	0.06	24.76
473f5c	0.3	0.3	0.4	0.1	0.3	0.06	17.32
f26de6	0.4	0.4	0.4	0.0	0.4	0.0	0.0
856fbd	0.4	0.5	0.5	0.1	0.5	0.06	12.37
e75474	0.5	0.5	0.5	0.0	0.5	0.01	1.36
e9a2b5	0.6	0.6	0.5	0.0	0.6	0.06	10.19
664b70	0.5	0.6	0.6	0.0	0.6	0.06	10.19
ed90bd	0.6	0.6	0.7	0.1	0.6	0.04	6.75
526f8f	0.8	0.6	0.7	0.1	0.7	0.1	14.29
694b2b	0.7	0.7	0.7	-	0.7	0.0	0.0
165952	0.7	0.7	0.7	0.0	0.7	0.0	0.0
51f258	0.9	0.6	0.6	0.1	0.7	0.17	24.74
9623eb	0.7	0.8	0.7	0.7	0.7	0.06	7.87
1e0c28	0.7	0.8	0.7	0.1	0.7	0.06	7.87
1760ff	0.8	0.7	0.8	0.1	0.7	0.03	3.58
41bb56	0.8	0.8	0.7	0.1	0.8	0.06	7.53
4970e4	0.7	0.9	0.7	0.0	0.8	0.12	15.06
332b9d	0.9	1.0	0.8	-	0.9	0.1	11.11
081752	0.9	0.9	0.9	0.2	0.9	0.0	0.0
1ad821	0.9	1.0	0.9	0.0	0.9	0.06	6.16
968ace	0.9	1.0	0.9	0.2	0.9	0.06	6.19
9308e6	0.8	1.0	1.3	0.6	1.0	0.25	24.35
ea6b6f	1.3	1.4	1.4	0.4	1.4	0.09	6.28
5afa3f	1.4	-	-	-	1.4	0.0	0.0

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12.2.2   The Numerical Procedure for Determining Outliers
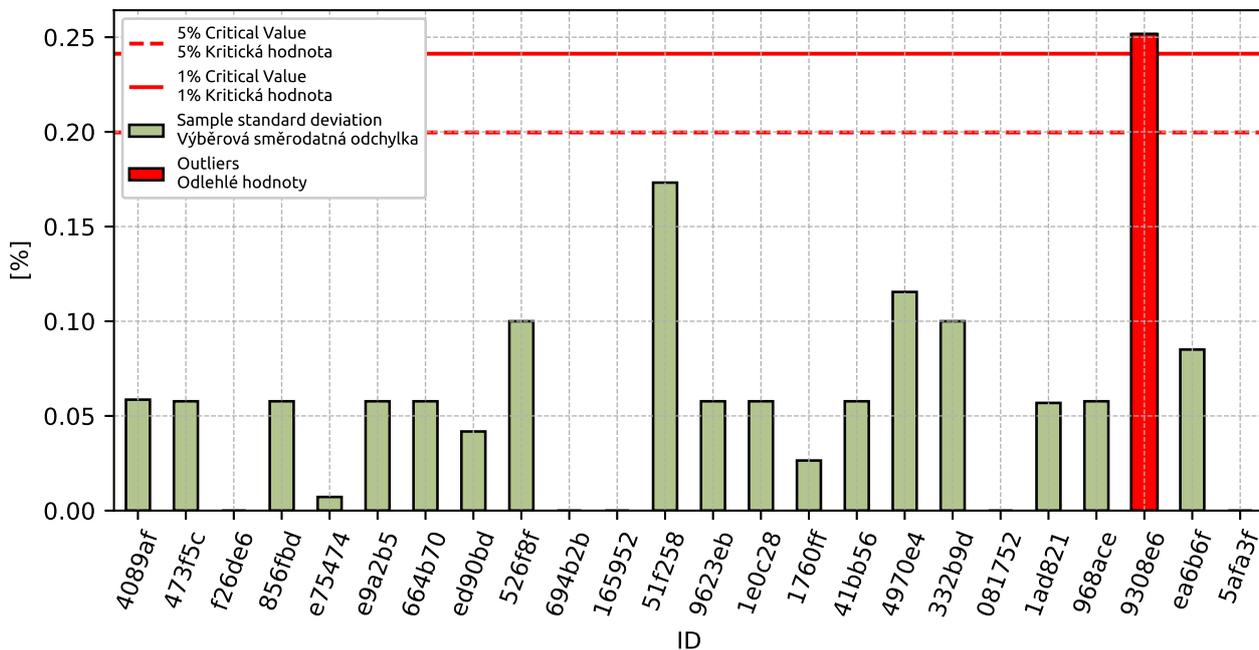
Figure 170: **Cochran's test** - sample standard deviations
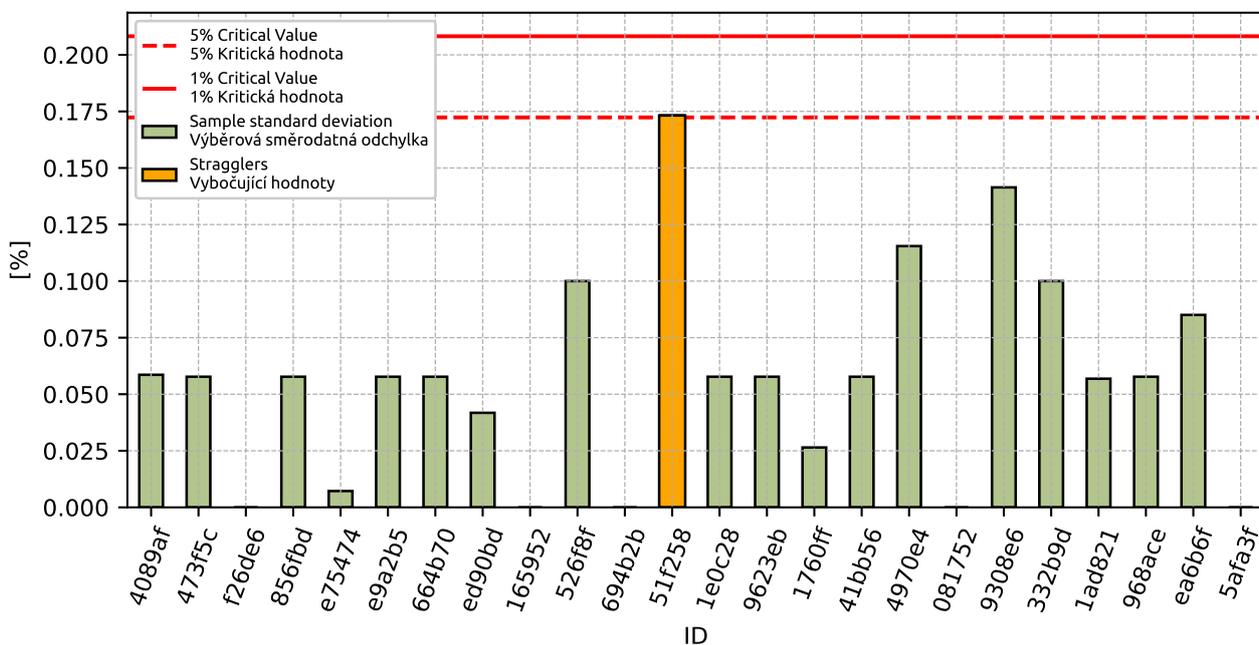
Figure 171: **Cochran's test** - sample standard deviations without outliers

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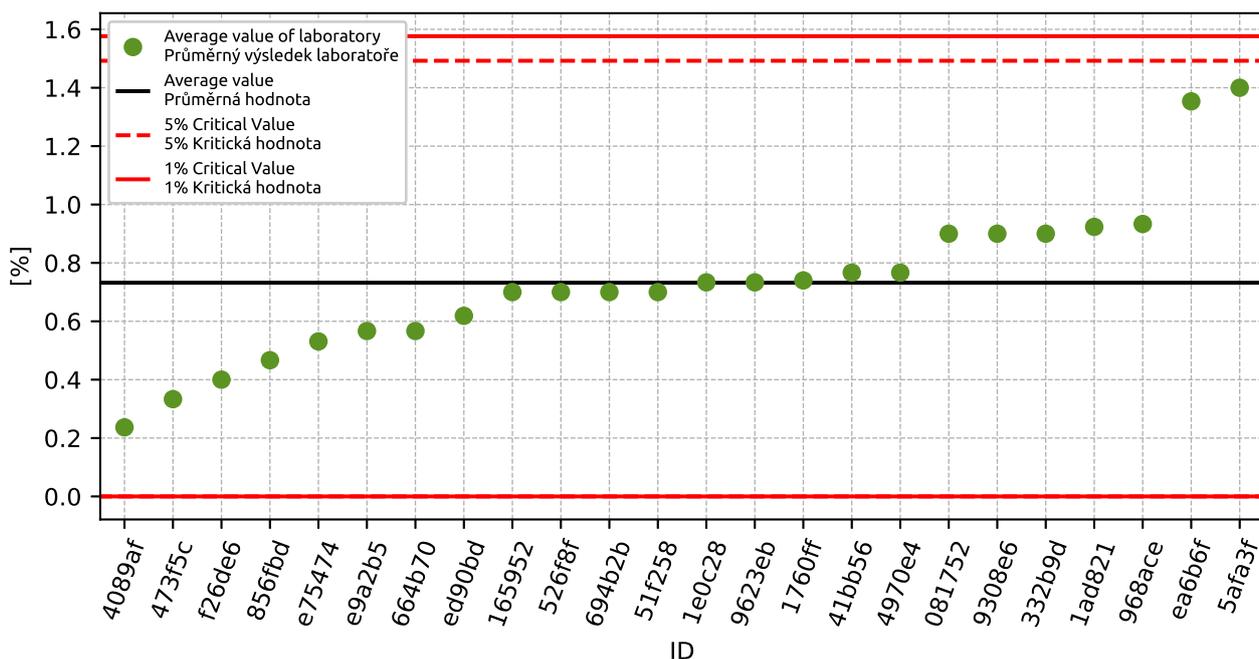
Figure 172: **Grubbs' test** - average values

12.2.3   Mandel's Statistics
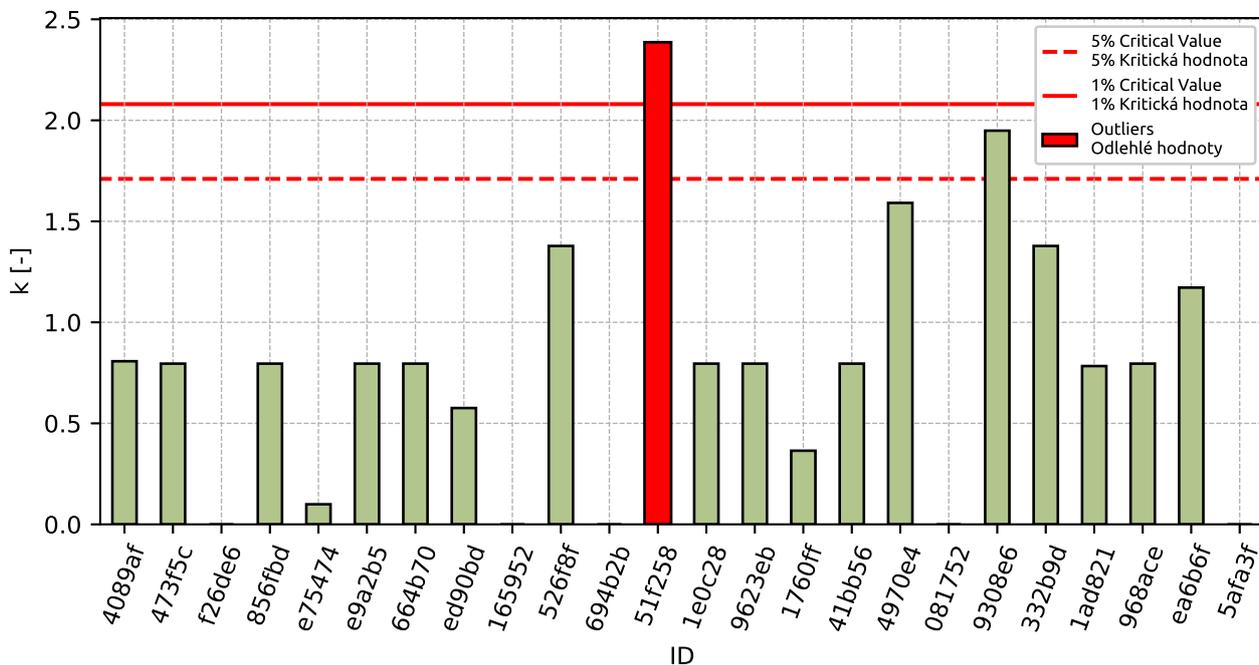
Figure 173: Intralaboratory Consistency Statistic

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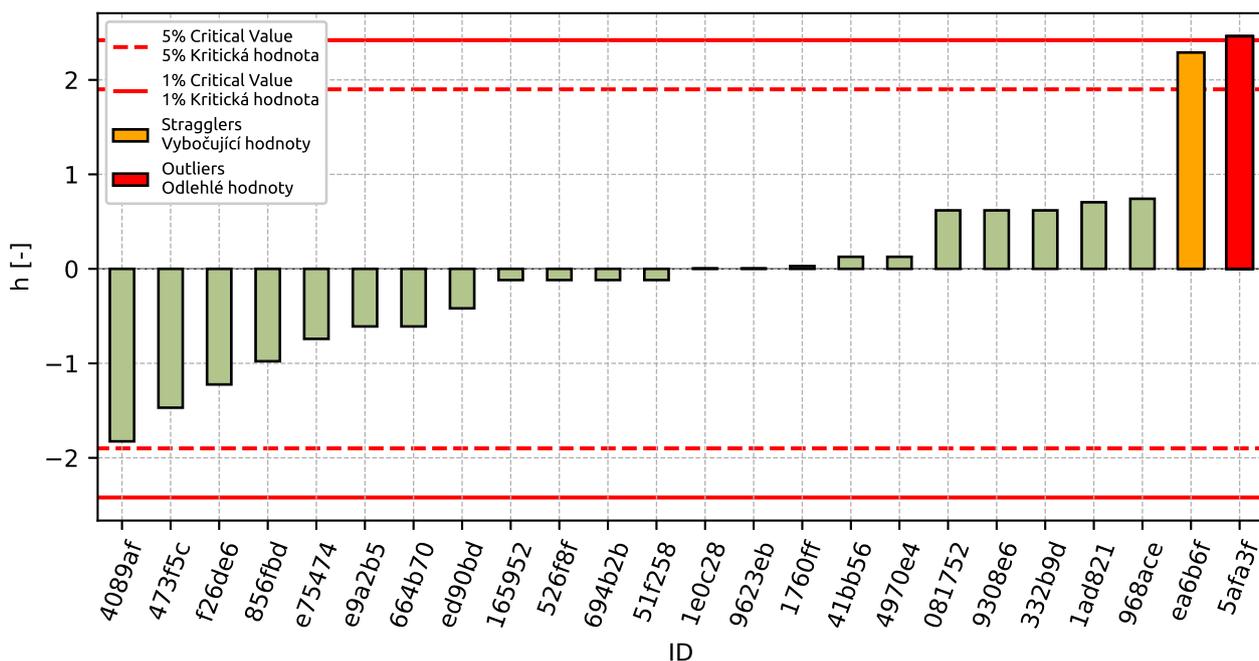
Figure 174: Interlaboratory Consistency Statistic

12.2.4   Descriptive statistics
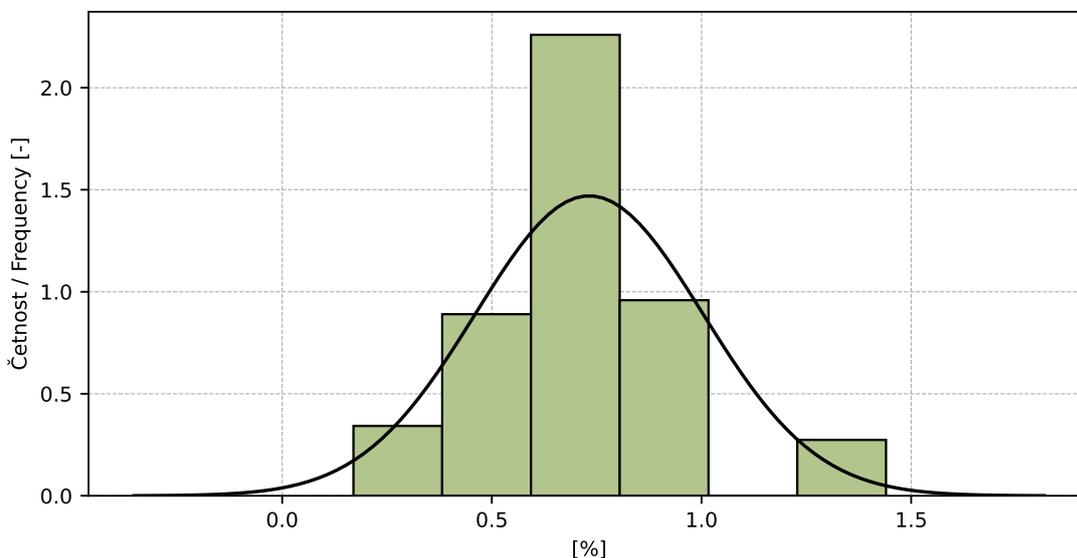
Figure 175: Histogram of all test results

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Table 60: Descriptive statistics

| Characteristics	[%]
Průměrná hodnota / Average value – $\bar{x}$	0.7
Výběrová směrodatná odchylka / Sample standard deviation – s	0.27
Vztažná hodnota / Asigned value – x^*	0.7
Robustní směrodatná odchylka / Robust standard deviation – s^*	0.27
Nejistota měření vztažné hodnoty / Measurement uncertainty of asigned value – u_X	0.07
p-hodnota testu normality / p-value of normality test	1.0 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – s_L	0.27
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – s_r	0.07
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – s_R	0.28
Opakovatelnost / Repeatability – r	0.2
Reprodukovatelnost / Reproducibility – R	0.8

12.2.5 Evaluation of Performance Statistics
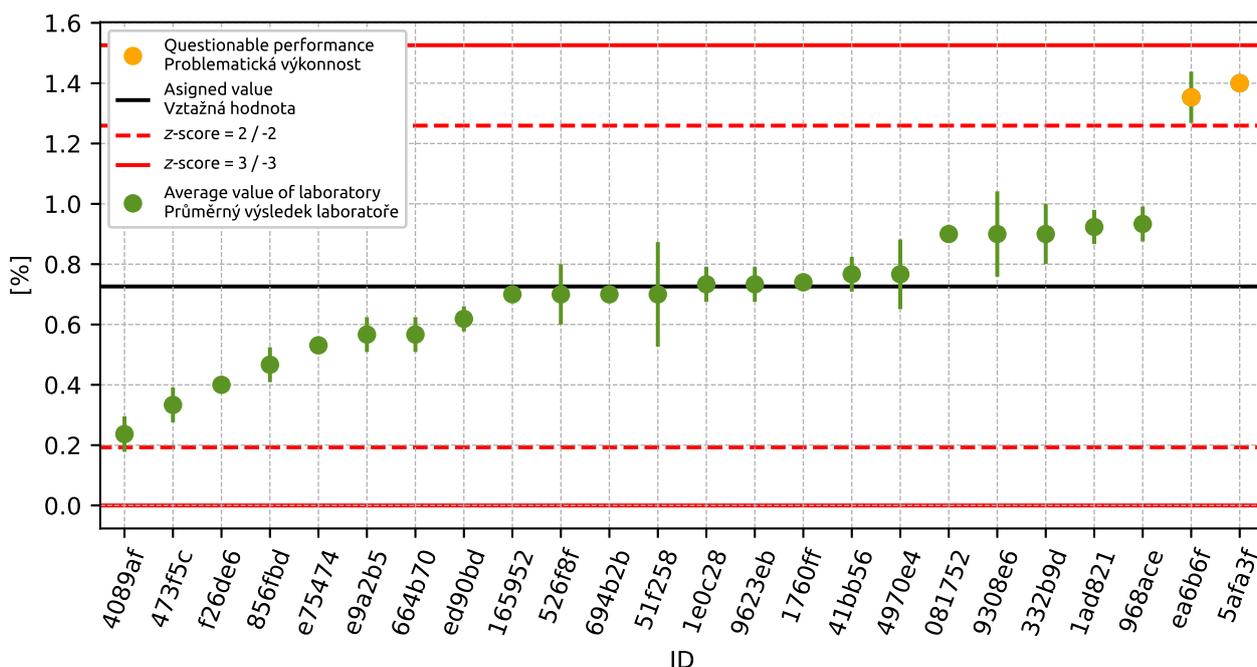
Figure 176: Average values and sample standard deviations

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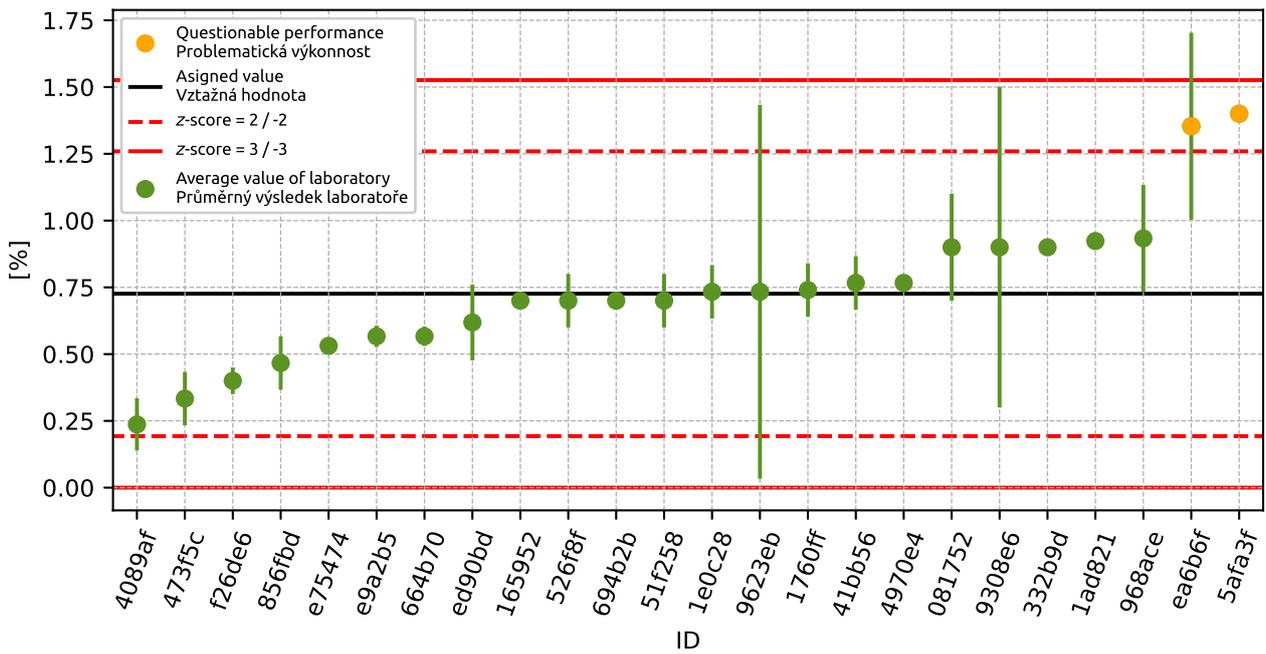
Figure 177: Average values and extended uncertainties of measurement

Figure 178: z-score

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Figure 179: ζ-score

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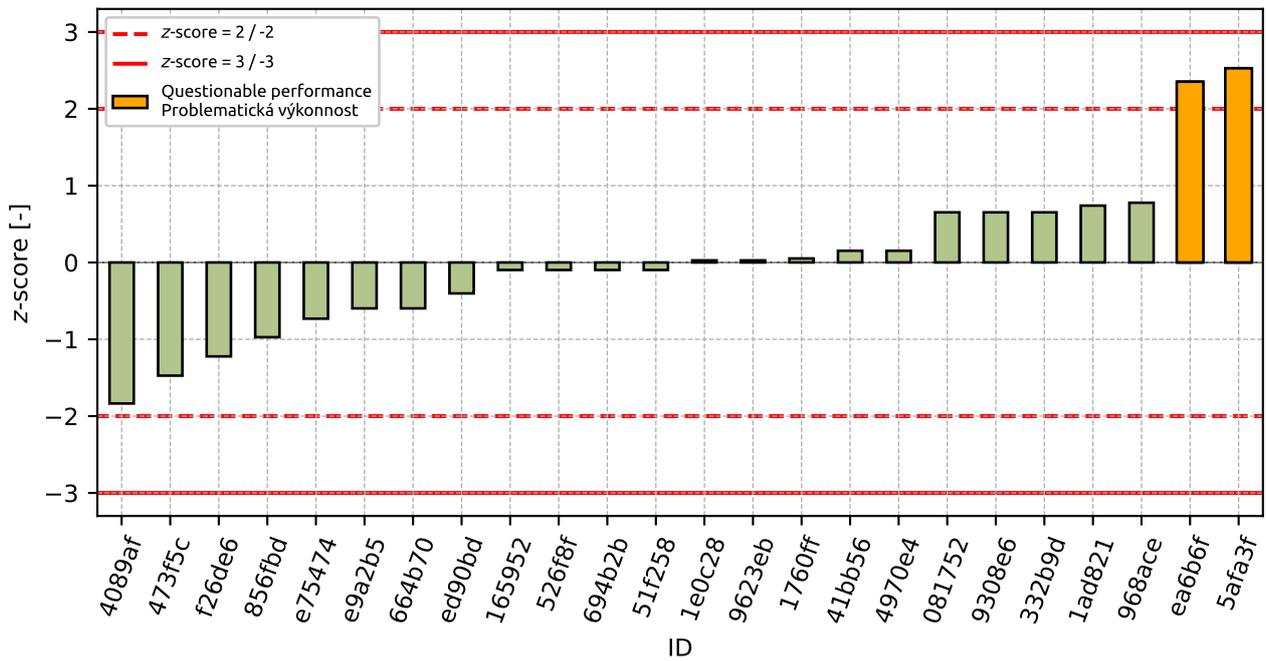
Table 61: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
4089af	-1.84	-4.1
473f5c	-1.47	-3.25
f26de6	-1.22	-3.86
856fbd	-0.97	-2.14
e75474	-0.73	-2.87
e9a2b5	-0.6	-2.02
664b70	-0.6	-2.07
ed90bd	-0.4	-0.68
165952	-0.1	-0.38
526f8f	-0.1	-0.22
694b2b	-0.1	-
51f258	-0.1	-0.22
1e0c28	0.03	0.06
9623eb	0.03	0.01
1760ff	0.05	0.12
41bb56	0.15	0.34
4970e4	0.15	0.57
081752	0.65	0.82
9308e6	0.65	0.29
332b9d	0.65	-
1ad821	0.74	2.78
968ace	0.78	0.98
ea6b6f	2.35	1.76
5afa3f	2.53	-

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

ID	Test results [%]			u_X [%]	$\bar{x}$ [%]	s_0 [%]	V_X [%]
51f258	0.1	0.1	0.1	0.0	0.1	0.0	0.0
165952	0.1	0.1	0.1	0.0	0.1	0.0	0.0
1760ff	0.1	0.1	0.1	0.0	0.1	0.02	22.61
3d85a9	0.1	0.2	0.1	-	0.1	0.06	38.42
9308e6	0.2	0.2	0.2	0.0	0.2	0.0	0.0
41bb56	0.2	0.3	0.2	0.1	0.2	0.06	24.74
31ccbc	0.3	0.2	0.3	0.2	0.3	0.06	21.65
a5f90f	0.3	0.3	0.3	0.1	0.3	0.01	1.84

14.2 The Numerical Procedure for Determining Outliers
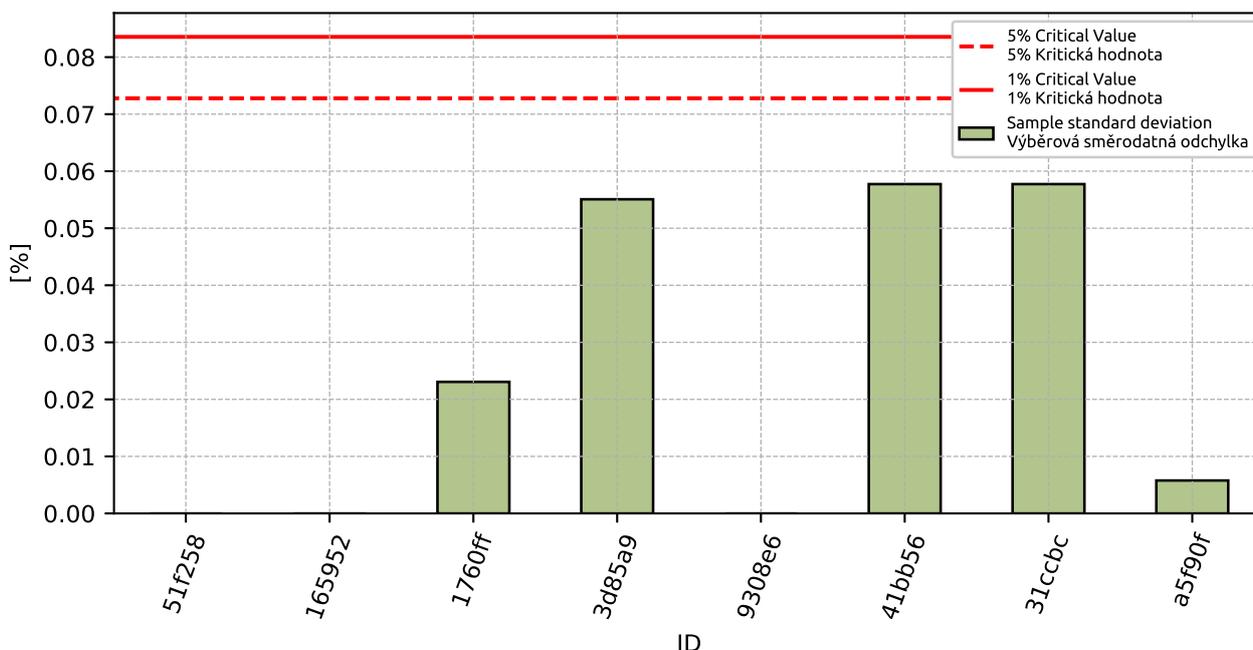
Figure 180: **Cochran's test** - sample standard deviations

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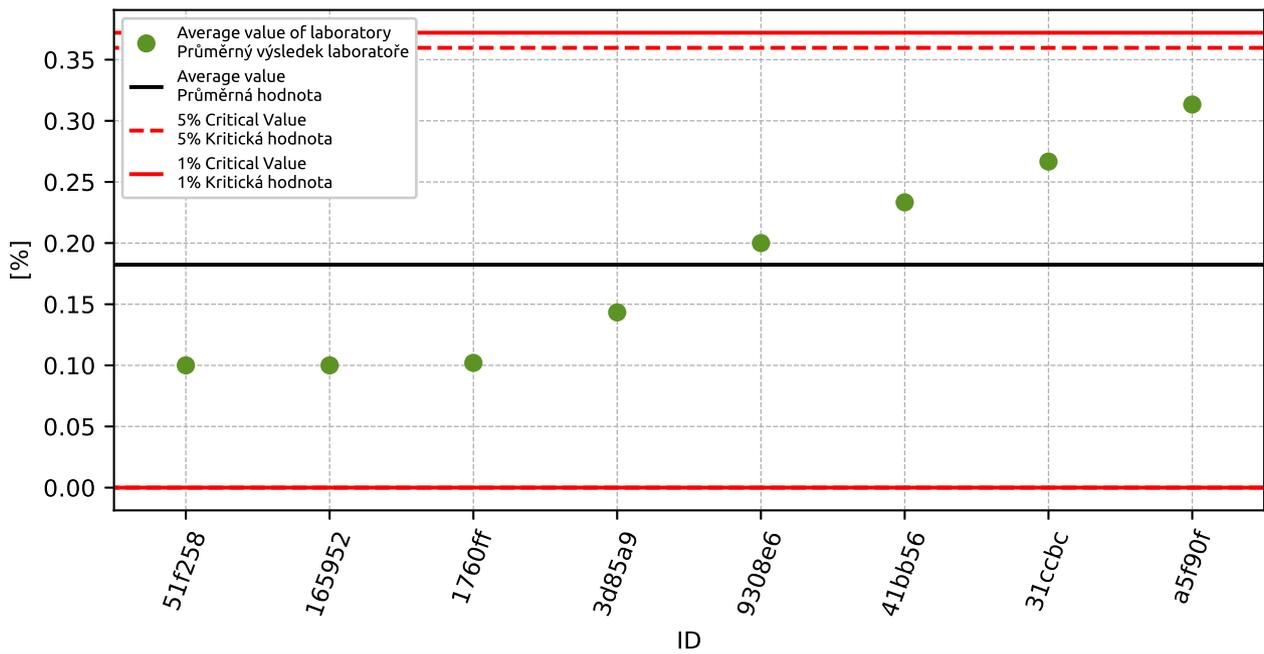
Figure 181: **Grubbs' test** - average values

14.3   Mandel's Statistics
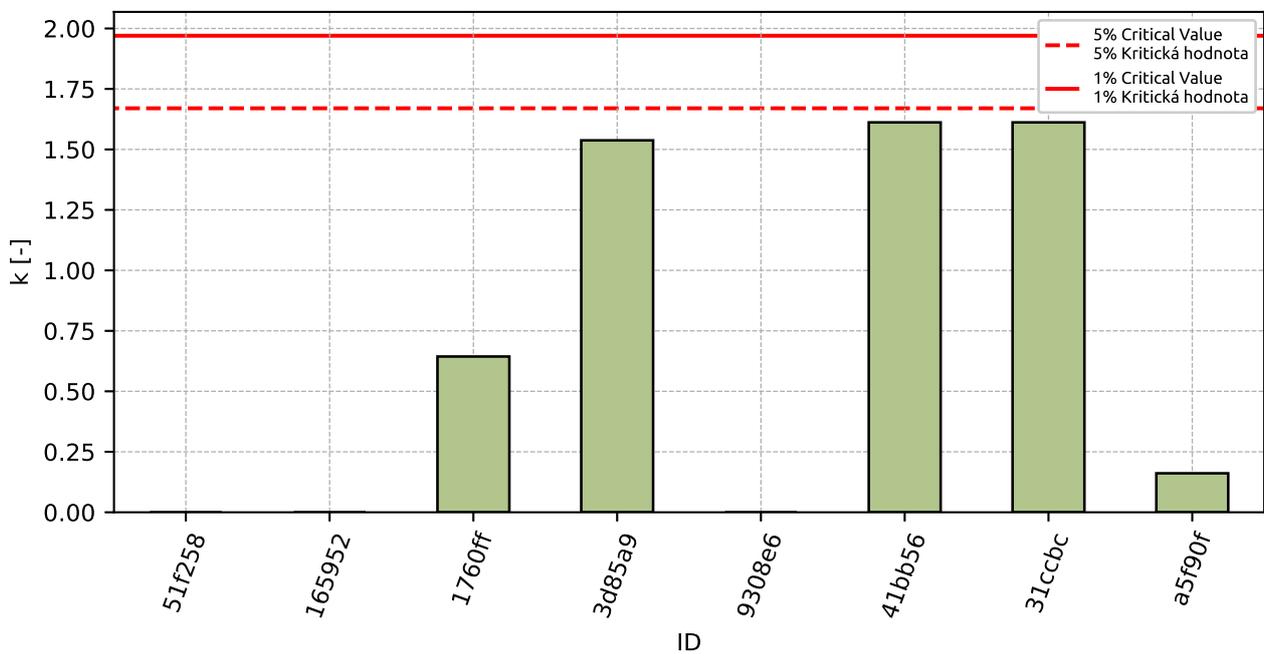
Figure 182: Intralaboratory Consistency Statistic

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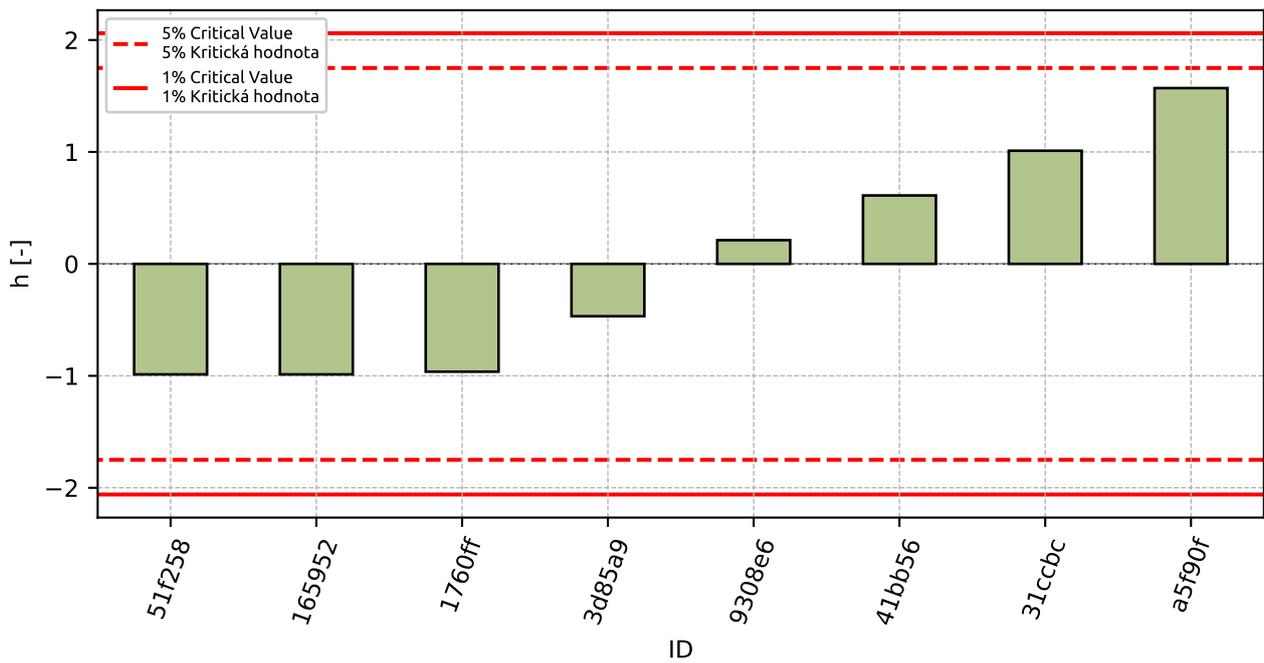
Figure 183: Interlaboratory Consistency Statistic

14.4 Descriptive statistics
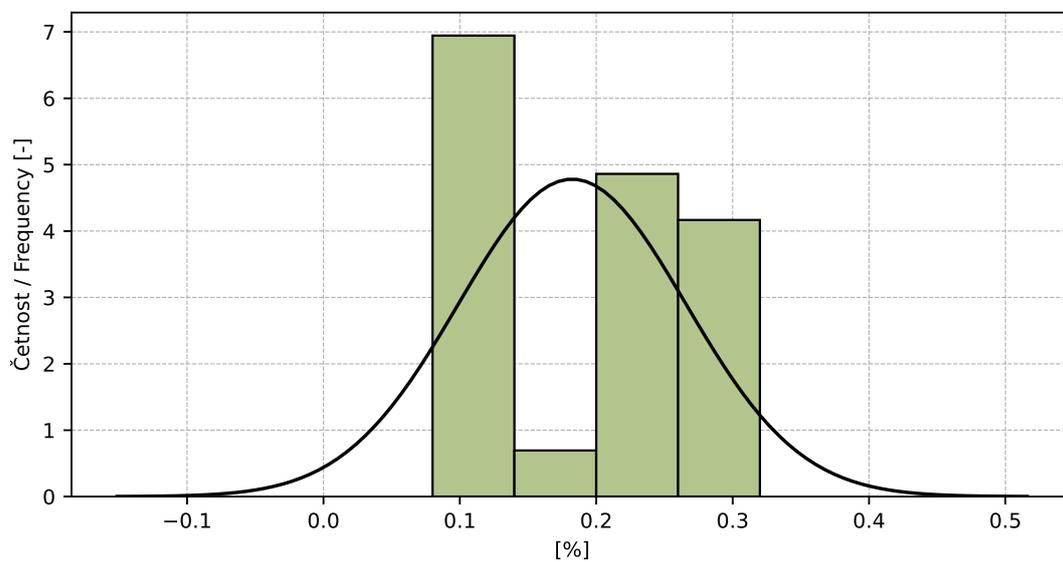
Figure 184: Histogram of all test results

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Table 63: Descriptive statistics

| Characteristics	[%]
Průměrná hodnota / Average value – $\bar{x}$	0.2
Výběrová směrodatná odchylka / Sample standard deviation – s	0.08
Vztažná hodnota / Asigned value – x^*	0.2
Robustní směrodatná odchylka / Robust standard deviation – s^*	0.09
Nejistota měření vztažné hodnoty / Measurement uncertainty of asigned value – u_X	0.04
p-hodnota testu normality / p-value of normality test	0.002 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – s_L	0.08
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – s_r	0.04
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – s_R	0.09
Opakovatelnost / Repeatability – r	0.1
Reprodukovatelnost / Reproducibility – R	0.2

14.5 Evaluation of Performance Statistics
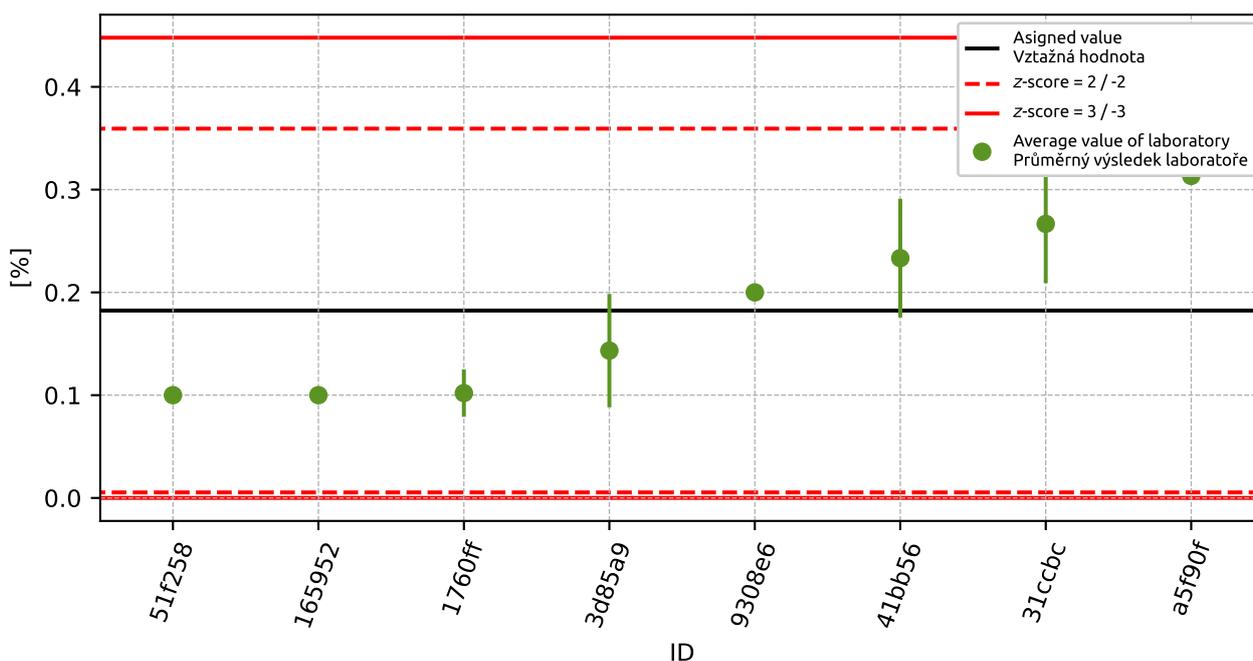
Figure 185: Average values and sample standard deviations

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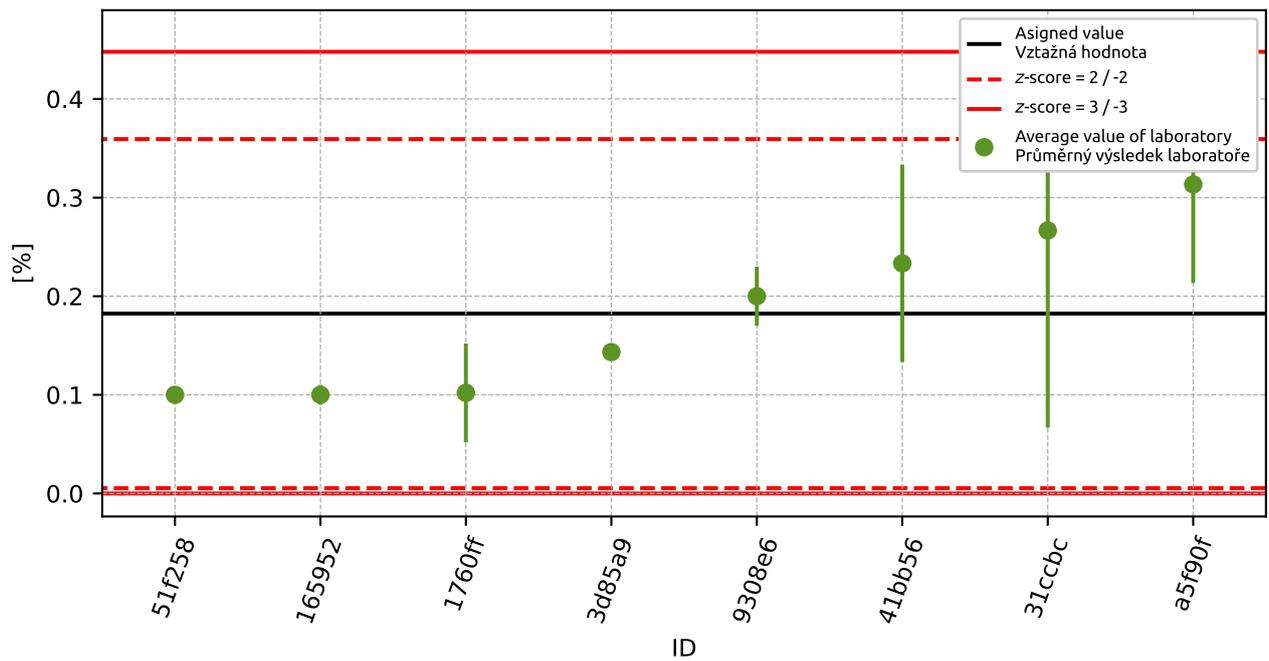
Figure 186: Average values and extended uncertainties of measurement

Figure 187: z-score

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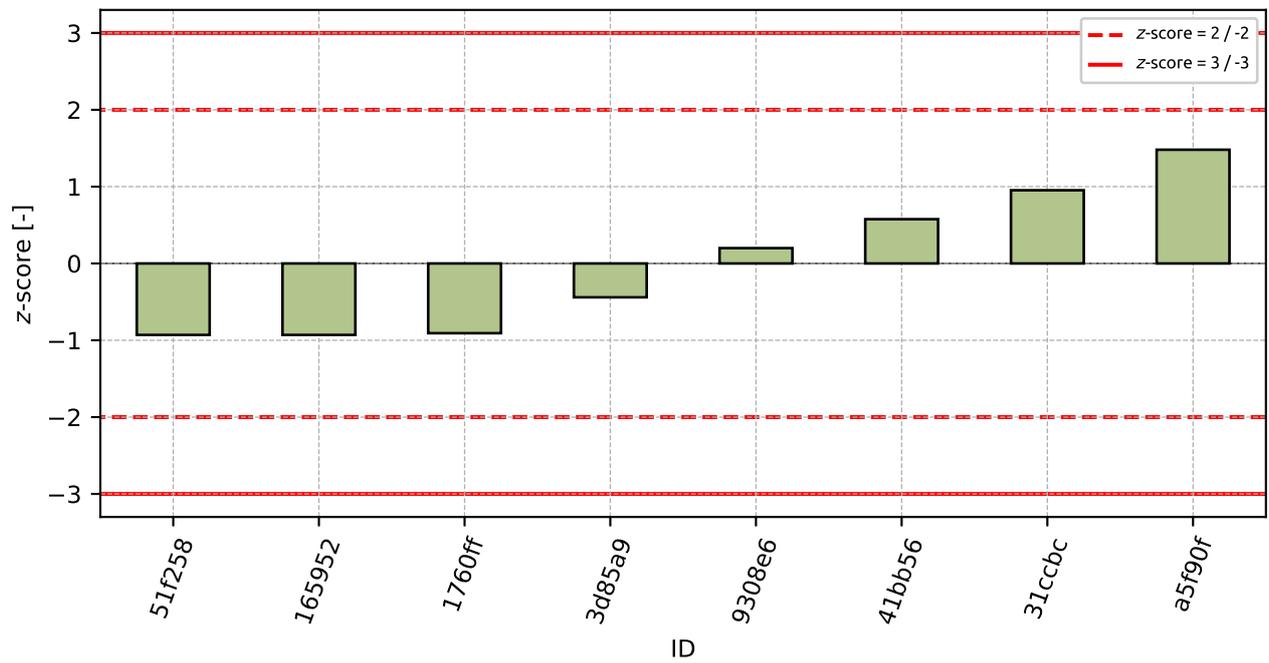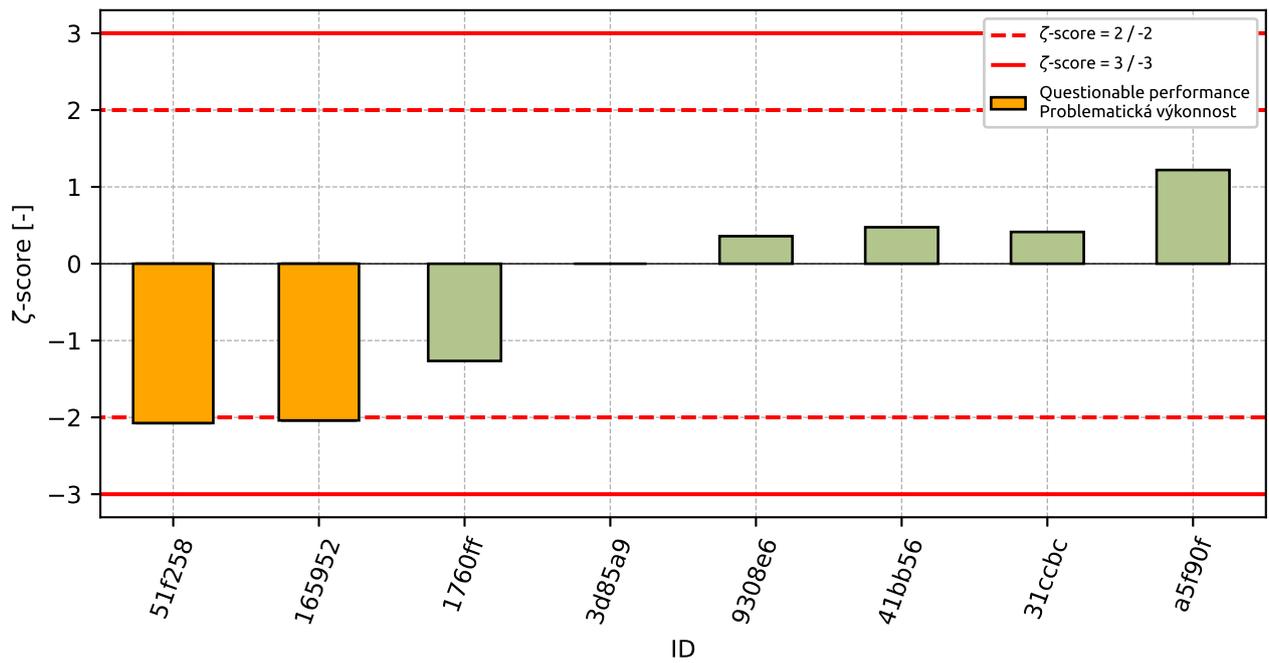
Figure 188: ζ-score

Table 64: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
51f258	-0.93	-2.07
165952	-0.93	-2.04
1760ff	-0.91	-1.27
3d85a9	-0.44	-
9308e6	0.2	0.36
41bb56	0.58	0.47
31ccbc	0.95	0.41
a5f90f	1.48	1.22

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15   Appendix – EN 1367-2 Magnesium sulfate test

15.1   Test results

Table 65: Test results - ordered by average value. Outliers are marked by red color. u_X - extended uncertainty of measurement; $\bar{x}$ - average value; s_0 - sample standard deviation; V_X - variation coefficient

ID	Test results [%]	u_X [%]
ad4665	0.3	1.7
e75474	0.58	0.0
b74bb7	0.9	0.1
165952	1.0	0.05
ce37e5	1.59	0.65
ea6b6f	2.47	0.15
1760ff	2.72	0.5
f26de6	8.0	0.2

15.2   The Numerical Procedure for Determining Outliers
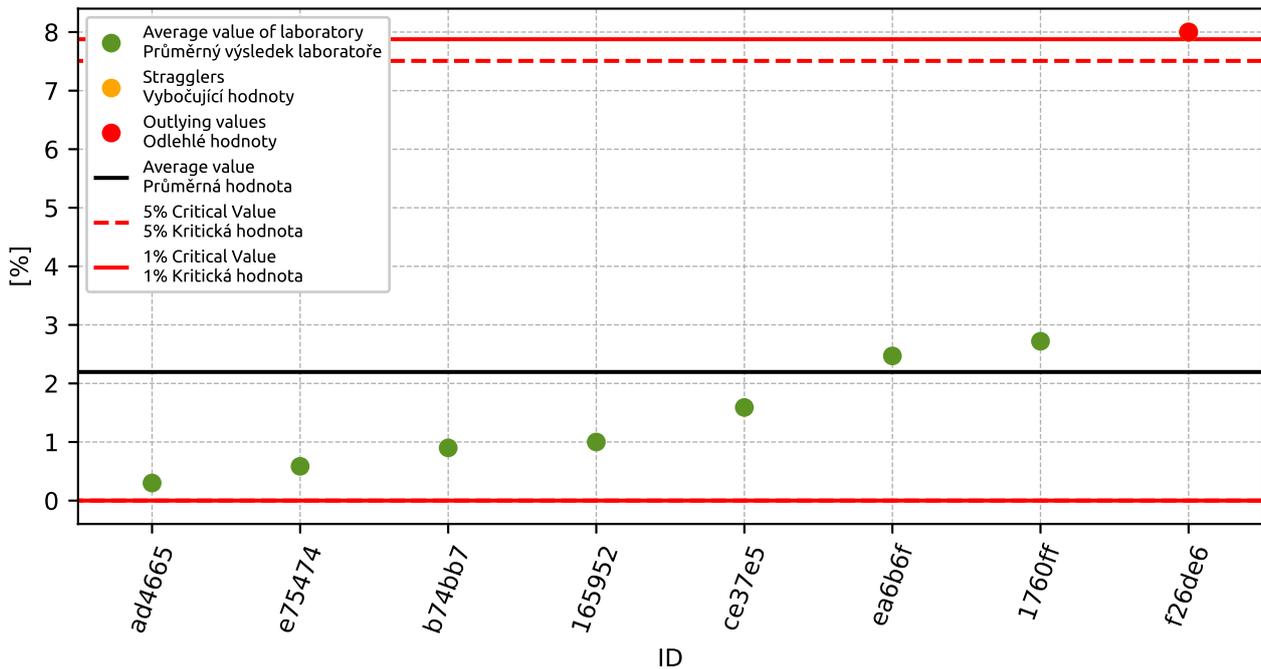
Figure 189: **Grubbs' test** - average values

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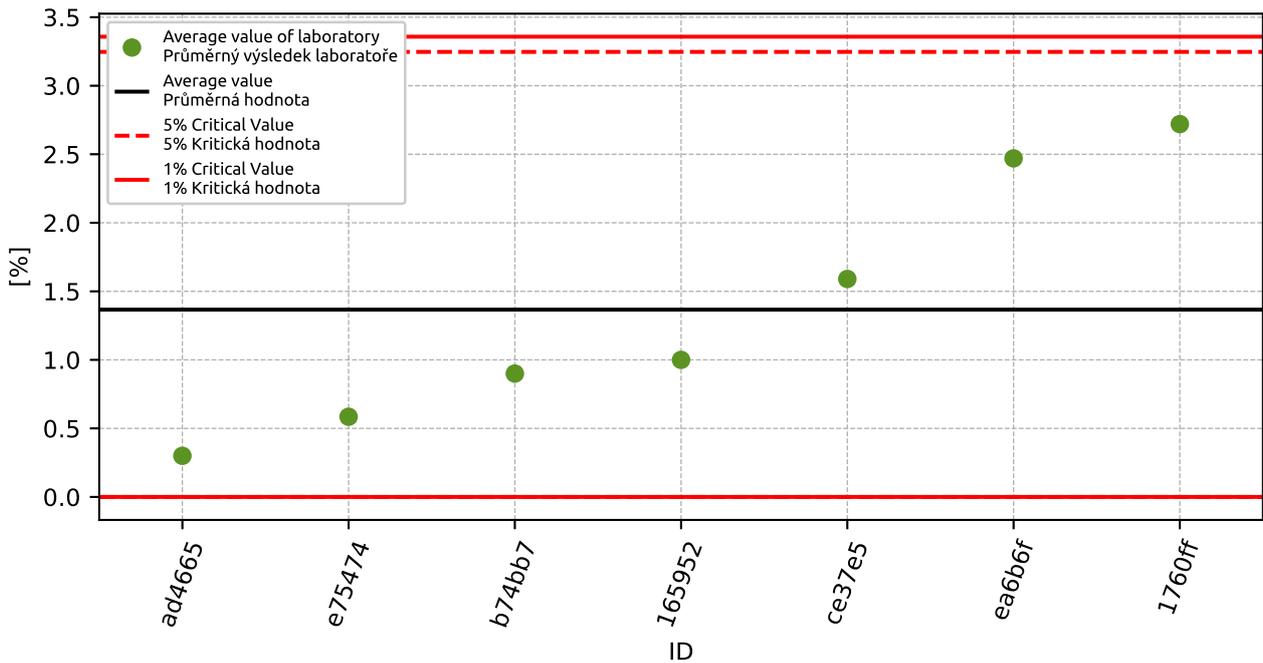
Figure 190: **Grubbs' test** - average values without outliers

15.3   Mandel's Statistics
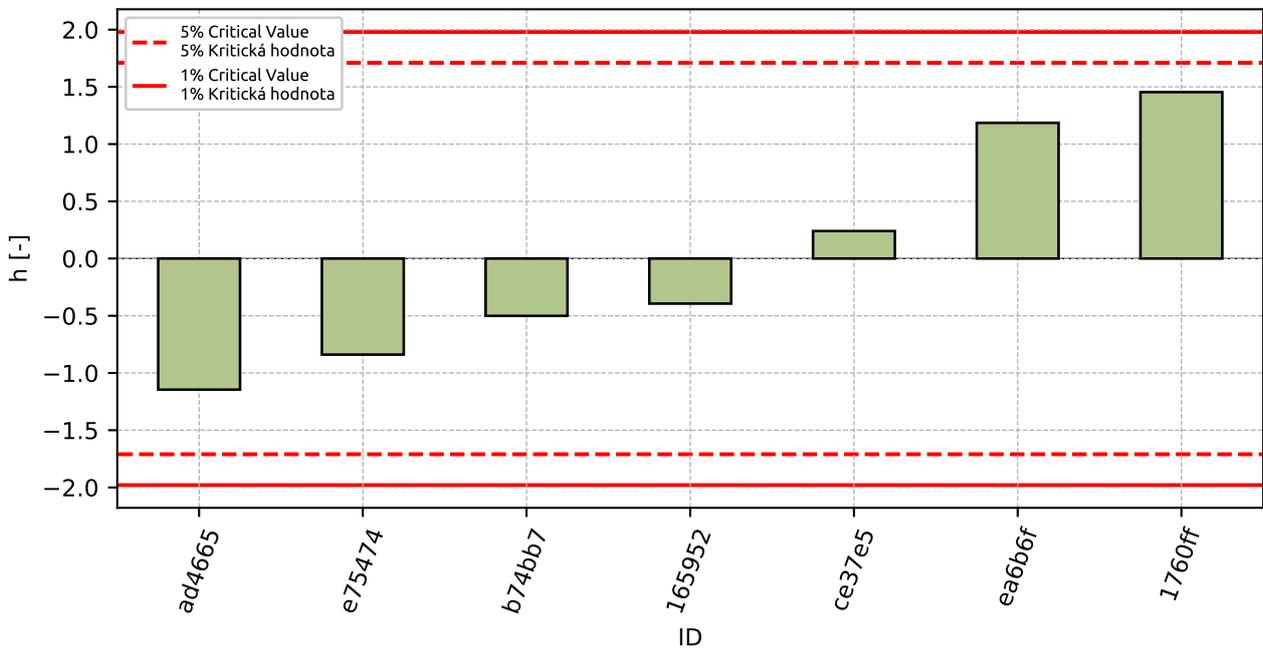
Figure 191: Interlaboratory Consistency Statistic

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15.4   Descriptive statistics
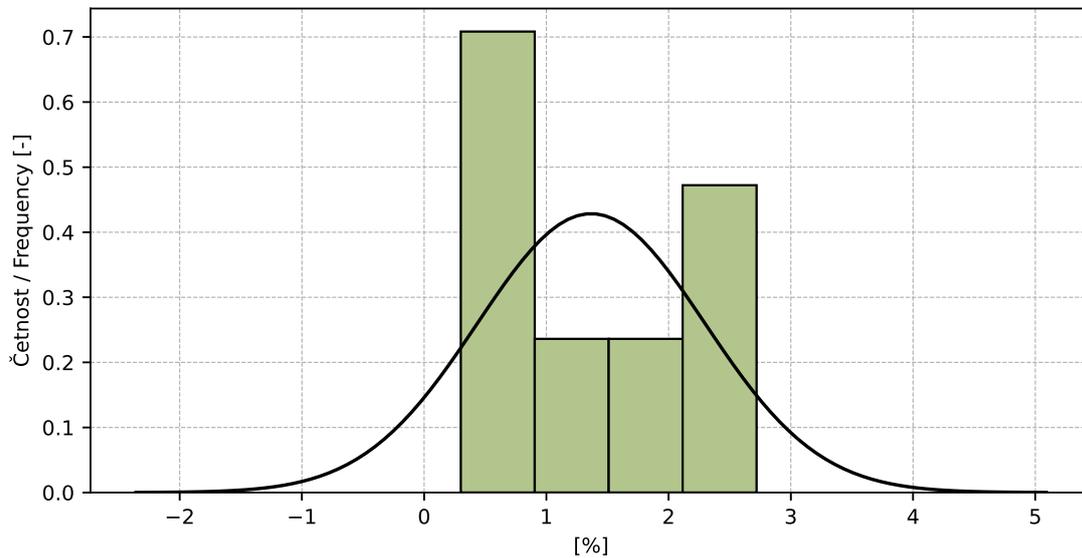
Figure 192: Histogram of all test results

Table 66: Descriptive statistics

Characteristics	[%]
Průměrná hodnota / Average value – $\bar{x}$	1.37
Výběrová směrodatná odchylka / Sample standard deviation – s	0.931
Vztažná hodnota / Asigned value – x^*	1.34
Robustní směrodatná odchylka / Robust standard deviation – s^*	0.946
Nejistota měření vztažné hodnoty / Measurement uncertainty of asigned value – u_X	0.447
p-hodnota testu normality / p-value of normality test	0.403 [-]

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15.5   Evaluation of Performance Statistics
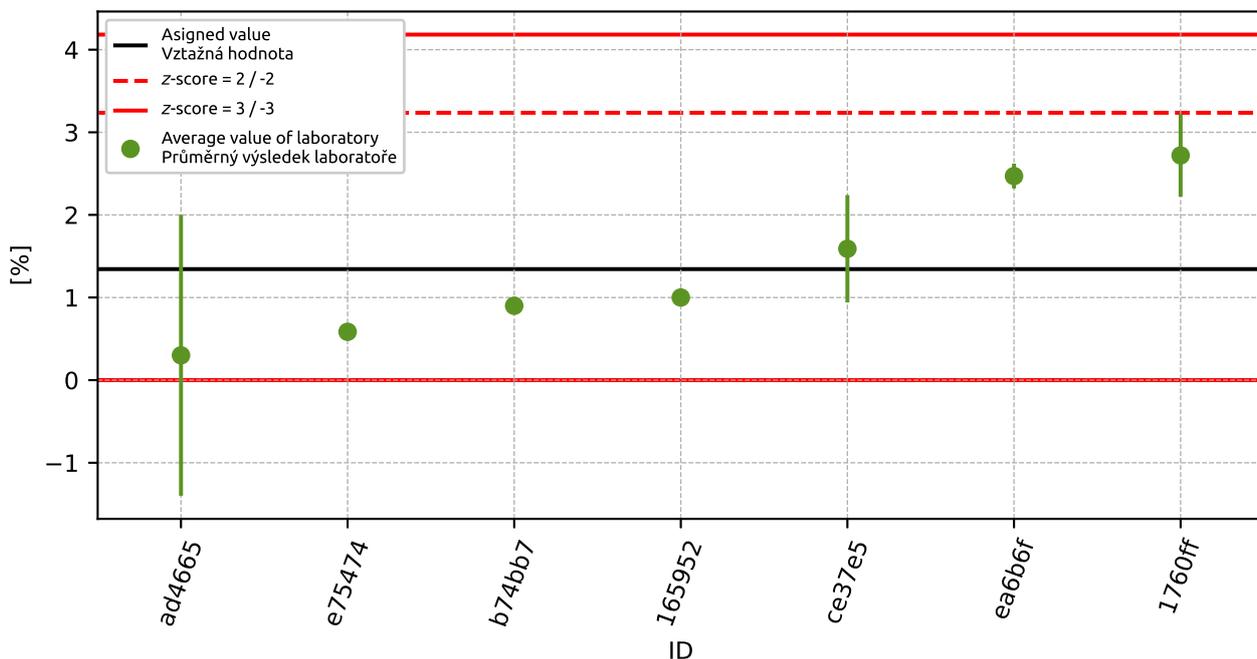
Figure 193: Average values and extended uncertainties of measurement

Figure 194: z-score

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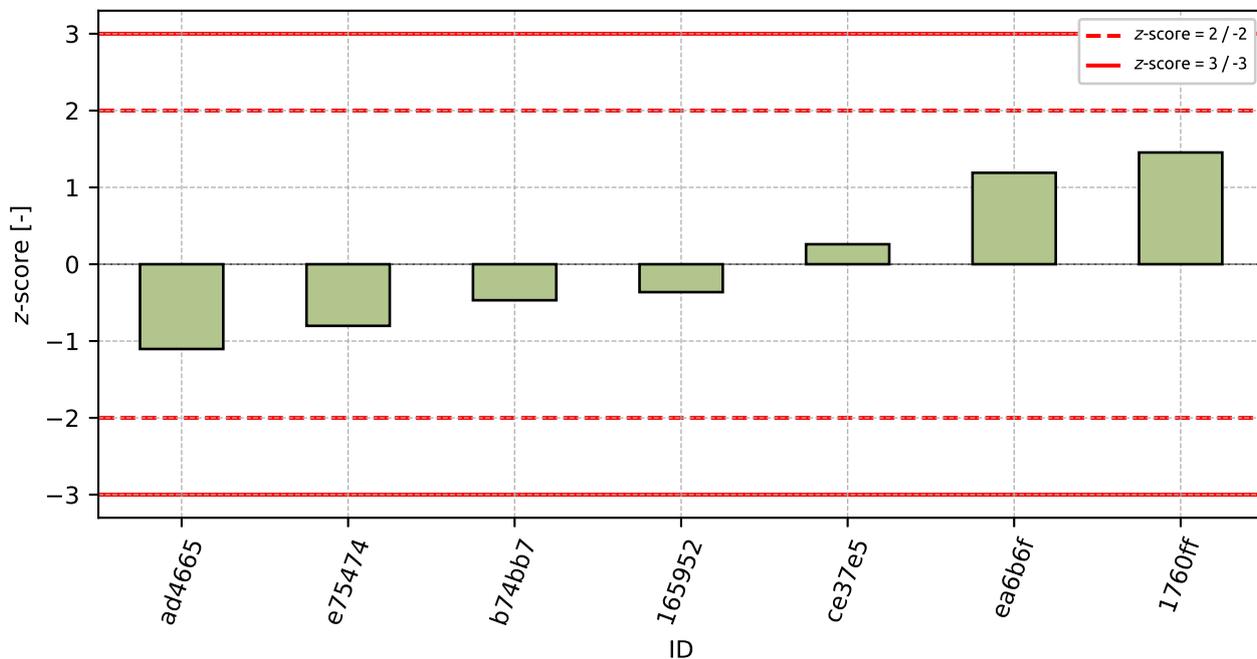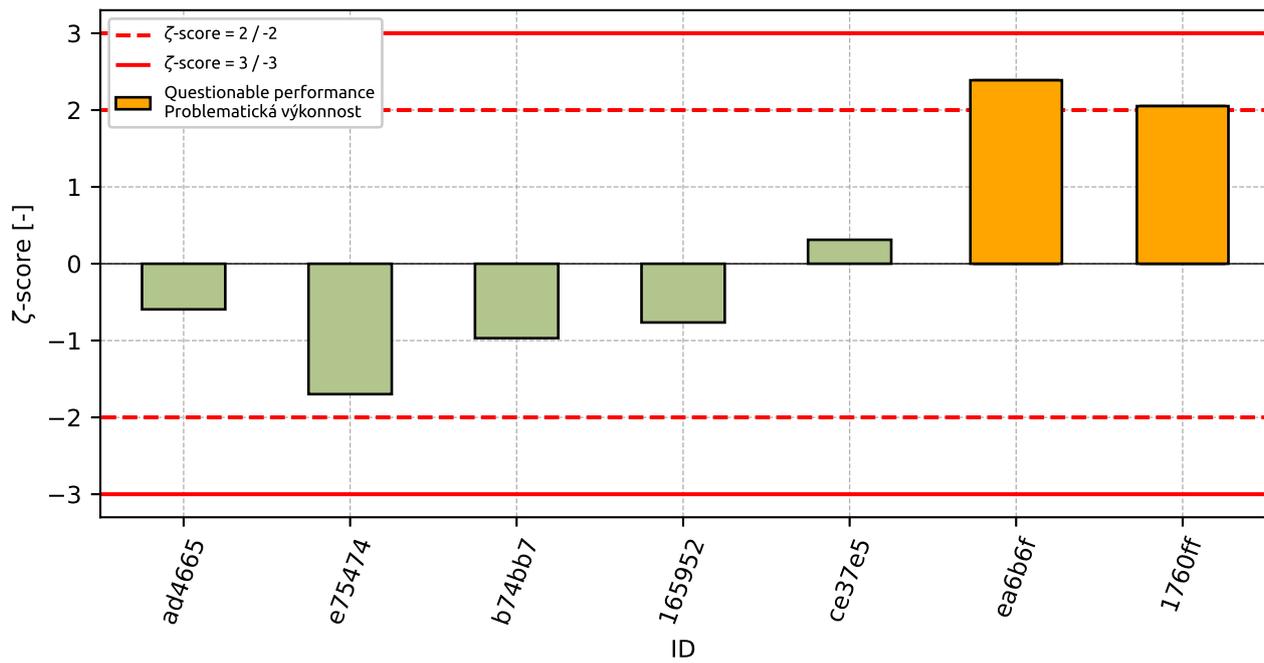
Figure 195: ζ-score

Table 67: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
ad4665	-1.1	-0.59
e75474	-0.8	-1.7
b74bb7	-0.47	-0.97
165952	-0.36	-0.76
ce37e5	0.26	0.31
ea6b6f	1.19	2.39
1760ff	1.45	2.05

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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.

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