



FINAL REPORT ON THE RESULTS OF PRECISION EXPERIMENT

Proficiency Testing Program Mechanical Properties of Plastics ZVP 2025/1

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1 Introduction and Important Contacts

In the year 2025, the Proficiency Testing Provider at the SZK FAST (PT Provider) initiated the Proficiency Testing Program (PTP) designated ZVP 2025/1 whose aim was to verify and assess the conformity of test results across laboratories when testing plastics. 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

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The subjects of proficiency testing were the following testing procedures:

1. EN ISO 527-1, 2 (Tensile modulus) [1, 2]
2. EN ISO 527-1, 2 (Stress at yield, Strain at yield) [1, 2]
3. EN ISO 527-1, 2 (Stress at yield) [1, 2]
4. EN ISO 178 (Flexural modulus) [3]
5. EN ISO 178 (Flexural strength, Flexural strain at flexural strength) [3]
6. EN ISO 179-1 (Charpy unnotched impact strength) [4]
7. EN ISO 179-1 (Charpy notched impact strength (note: notch made by distributor)) [4]
8. EN ISO 179-1 (Charpy notched impact strength (note: notch made by laboratory)) [4]
9. EN ISO 868 (Shore hardness D) [5]
10. EN ISO 306 (Vicat softening temperature VST/A/50) [6]
11. EN ISO 306 (Vicat softening temperature VST/B/50) [6]
12. EN ISO 75-1, -2 (Temperature of deflection under load, method A) [7, 8]
13. EN ISO 75-1, -2 (Temperature of deflection under load, method B) [7, 8]
14. EN ISO 1183-1 (Density) [9]
15. EN ISO 11357-1, -3 (Melting temperature T_{m1} , Enthalpy of fusion ΔH_{m1}) [10, 11]
16. EN ISO 1133-1 (Melt mass-flow rate) [12]
17. EN ISO 1628-1, -5 (Viscosity) [13, 14]
18. EN ISO 11358-1 (Filler content) [15]
19. ISO 3795 (Burning Rate) [16]

Due to lack of interested participants were open following methods only: **No 1, 2, 4, 5, 9, 14 and 16.**

The supplier, UNIPETROL RPA, s.r.o. – POLYMER INSTITUTE BRNO, odštěpný závod, 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 [17], ISO 13528 [18] and EN ISO/IEC 17043 [19]. The outcome is the present final report summarizing the results of the interlaboratory comparison, including statistical evaluation.

10 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 table 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	19
88c02c	X	X	X	X	X	-	-	-	X	-	-	-	-	X	-	X	-	-	-
045e0d	X	X	-	X	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-
18de5e	X	X	X	X	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-
354b78	-	-	-	-	-	-	-	-	-	-	-	-	-	X	-	-	-	-	-
b07b25	-	-	X	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
108c2a	X	-	-	X	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-
1726f5	-	X	-	-	X	-	-	-	X	-	-	-	-	-	-	-	-	-	-
9c10dc	-	-	-	-	-	-	-	-	X	-	-	-	-	-	-	-	-	-	-
c01900	-	-	X	X	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-
27d4a4	X	X	-	-	-	-	-	-	-	-	-	-	-	X	-	X	-	-	-

Table 2: List of participants (laboratories)

Laboratory	Address	Accr. No
Aquanet Laboratorium Sp. z o.o.	Dolna Wilda 126, Poznań, 61-492, Polska	AB 700
Fundação de Apoio Institucional ao Desenvolvimento Científico e Tecnológico	Rod Washington Luis KM 235, São Carlos, 13565-905, São Paulo - Brazil	-
Institut pro testování a certifikaci, a.s. - 1007.1	třída Tomáše Bati 299, Louky, Zlín, 76302, Česká republika	1007.1
ORLEN Unipetrol RPA s.r.o. - POLYMER INSTITUTE BRNO, odštěpný závod	Tkalcovská 36/2, Brno, 60200, Česká republika	L1380
ORLEN Unipetrol RPA, s.r.o.	Záluží, Litvínov 7, 43670, Česká republika	-
SILON CZ s.r.o.	Průmyslová 451, Sezimovo Ústí 2, 39102, Česká republika	-
Technický a skúšobný ústav stavebný n.o.	Bellova 72/24, Tatranská Štrba, 82104, Slovenská republika	004/S-045
Testpolymer EU s.r.o.	Střemeničko 44, Luká, 783 24, Česká republika	1595
Vojenský výzkumný ústav, s. p.	Veslařská 230, Brno, 63700, Česká republika	1449
Výzkumný ústav pozemních staveb - Certifikační společnost, s.r.o.	Pražská 16/810, Praha - Hostivař, 10200, Česká republika	AZL 1234

2 Procedures used in the Statistical Analysis of Laboratory Results

The statistical analysis is based on the following steps:

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

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

3 Conclusions of the Statistical Analysis

The present report summarizes the results of the Proficiency Testing Program ZVP 2025/1 (PT Program) organized by the PT Provider at the SZK FAST. 10 participants (laboratories) took part in the PT Program. PT program focused on ordinary standardized testing of plastics. The test results are evaluated separately for each observed test procedure and sample. An evaluation of statistical characteristics is included in the Appendix, as well as test results and graphic presentations. The designation of the test procedures is given in the section 1 of this report.

Table 2: 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	19
88c02c	✓	✓	✓	✓	✓	-	-	-	✓	-	-	-	-	✓	-	✓	-	-	-
045e0d	✓	✓	-	✓	✓	-	-	-	✓	-	-	-	-	-	-	-	-	-	-
18de5e	✓	✓	✓	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-
354b78	-	-	-	-	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	-
b07b25	-	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
108c2a	✓	-	-	✓	-	-	-	-	-	-	-	-	-	✓	-	✓	-	-	-
1726f5	-	✓	-	-	✓	-	-	-	✓	-	-	-	-	-	-	-	-	-	-
9c10dc	-	-	-	-	-	-	-	-	✓	-	-	-	-	-	-	-	-	-	-
c01900	-	-	✓	✓	-	-	-	-	-	-	-	-	-	✓	-	✓	-	-	-
27d4a4	✓	✓	-	-	-	-	-	-	-	-	-	-	-	✓	-	✓	-	-	-

References

- [1] EN ISO 527-1. *Plastics - Determination of tensile properties - Part 1: General principles*. 2019.
- [2] EN ISO 527-2. *Plastics - Determination of tensile properties - Part 2: Test conditions for moulding and extrusion plastics*. 2012.
- [3] EN ISO 178. *Plastics - Determination of flexural properties*. 2019.
- [4] EN ISO 179-1. *Plastics - Determination of Charpy impact properties - Part 1: Non-instrumented impact test*. 2010.
- [5] EN ISO 868. *Plastics and ebonite - Determination of indentation hardness by means of a durometer (Shore hardness)*. 2003.
- [6] EN ISO 306. *Plastics - Thermoplastic materials - Determination of Vicat softening temperature (VST)*. 2014.
- [7] EN ISO 75-1. *Plastics - Determination of temperature of deflection under load - Part 1: General test method*. 2013.
- [8] EN ISO 75-2. *Plastics - Determination of temperature of deflection under load - Part 2: Plastics and ebonite*. 2013.
- [9] EN ISO 1183-1. *Plastics - Methods for determining the density of non-cellular plastics - Part 1: Immersion method, liquid pycnometer method and titration method*. 2019.
- [10] EN ISO 11357-1. *Plastics - Differential scanning calorimetry (DSC) - Part 1: General principles*. 2017.
- [11] EN ISO 11357-3. *Plastics - Differential scanning calorimetry (DSC) - Part 3: Determination of temperature and enthalpy of melting and crystallization*. 2018.
- [12] EN ISO 1133-1. *Plastics - Determination of the melt mass-flow rate (MFR) and melt volume-flow rate (MVR) of thermoplastics - Part 1: Standard method*. 2012.
- [13] EN ISO 1628-1. *Plastics - Determination of the viscosity of polymers in dilute solution using capillary viscometers - Part 1: General principles*. 2009.
- [14] EN ISO 1628-5. *Plastics - Determination of the viscosity of polymers in dilute solution using capillary viscometers - Part 5: Thermoplastic polyester (TP) homopolymers and copolymers*. 2015.
- [15] EN ISO 11358-1. *Plastics - Thermogravimetry (TG) of polymers - Part 1: General principles*. 2014.
- [16] ISO 3795. *Road vehicles and tractors and machinery for agriculture and forestry. Determination of burning behaviour of interior materials*. 1994.
- [17] ISO 5725-2. *Accuracy (trueness and precision) of measurement methods and results - Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method*. 2019.
- [18] ISO 13 528. *Statistical methods for use in proficiency testing by interlaboratory comparisons*. 2022.
- [19] EN ISO/IEC 17043. *Conformity assessment - General requirements for proficiency testing*. 2010.

1 Appendix – EN ISO 527-1, 2 (Tensile modulus)

1.1 Sample A

1.1.1 Test results

Table 4: Test results - ordered by average value. Outliers are marked by red color. u_x - extended uncertainty of measurement; \bar{x} - average value; s_0 - sample standard deviation; V_x - variation coefficient

ID	Test results [MPa]					u_x [MPa]	\bar{x} [MPa]	s_0 [MPa]	V_x [%]
108c2a	1650	1650	1680	1670	1650	14	1660	14.1	0.85
88c02c	1648	1701	1641	1718	1666	68	1675	33.5	2.0
18de5e	1856	1610	1677	1817	1829	103	1758	107.9	6.14
045e0d	1955	1920	1931	1932	1931	26	1934	12.8	0.66
27d4a4	1992	2018	2027	2175	1927	82	2028	91.1	4.49

1.1.2 The Numerical Procedure for Determining Outliers

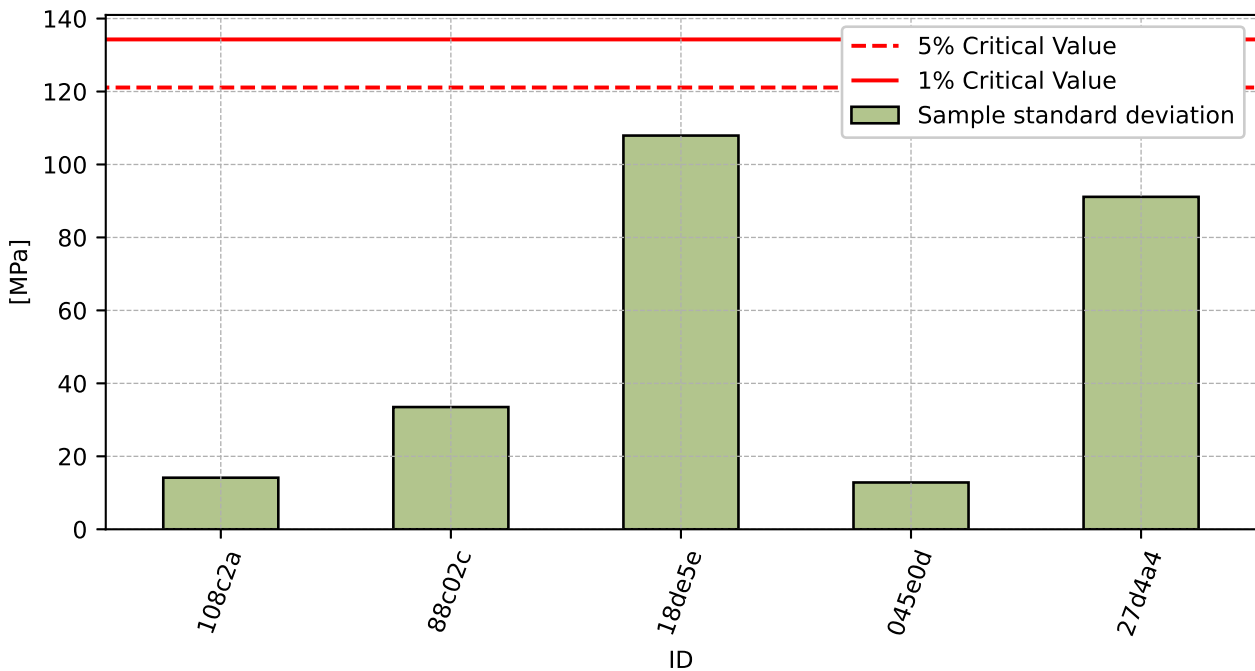


Figure 1: Cochran's test - sample standard deviations

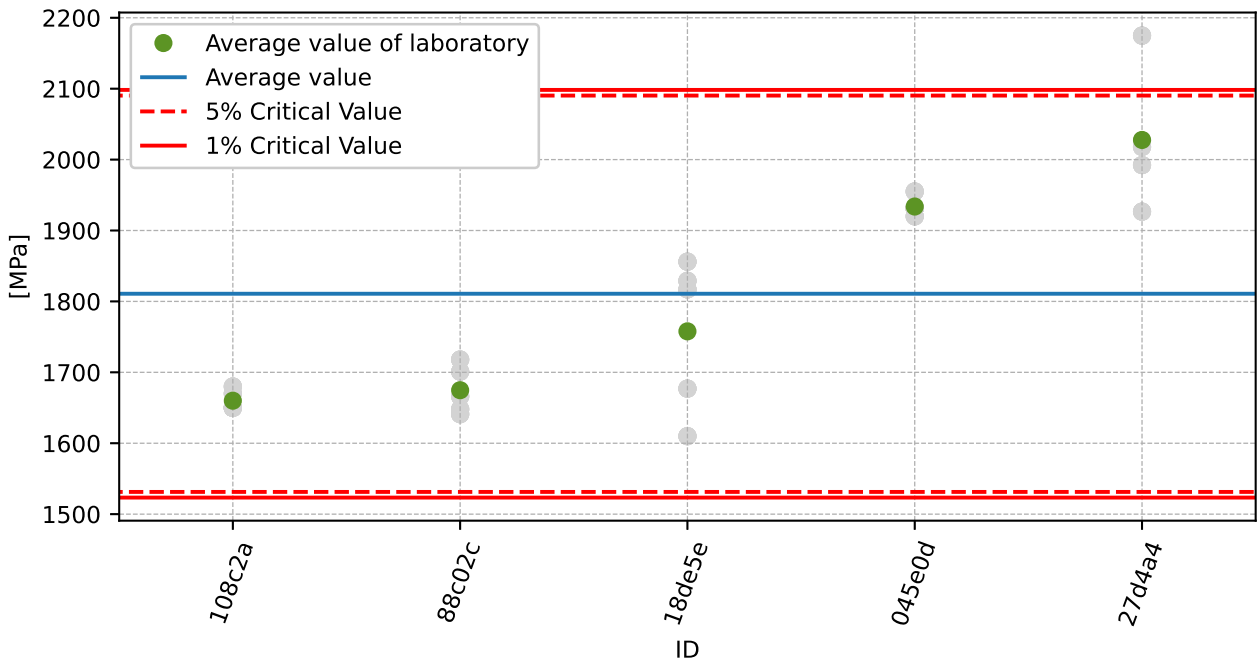


Figure 2: **Grubbs' test** - average values

1.1.3 Mandel's Statistics

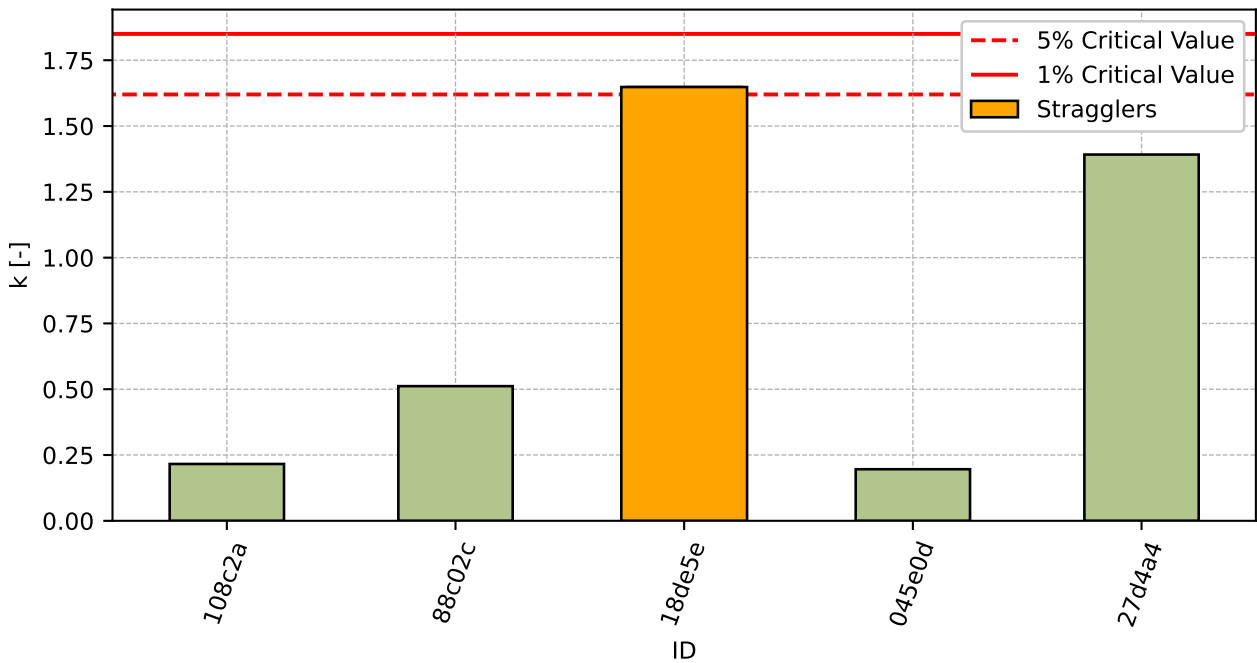


Figure 3: Intralaboratory Consistency Statistic

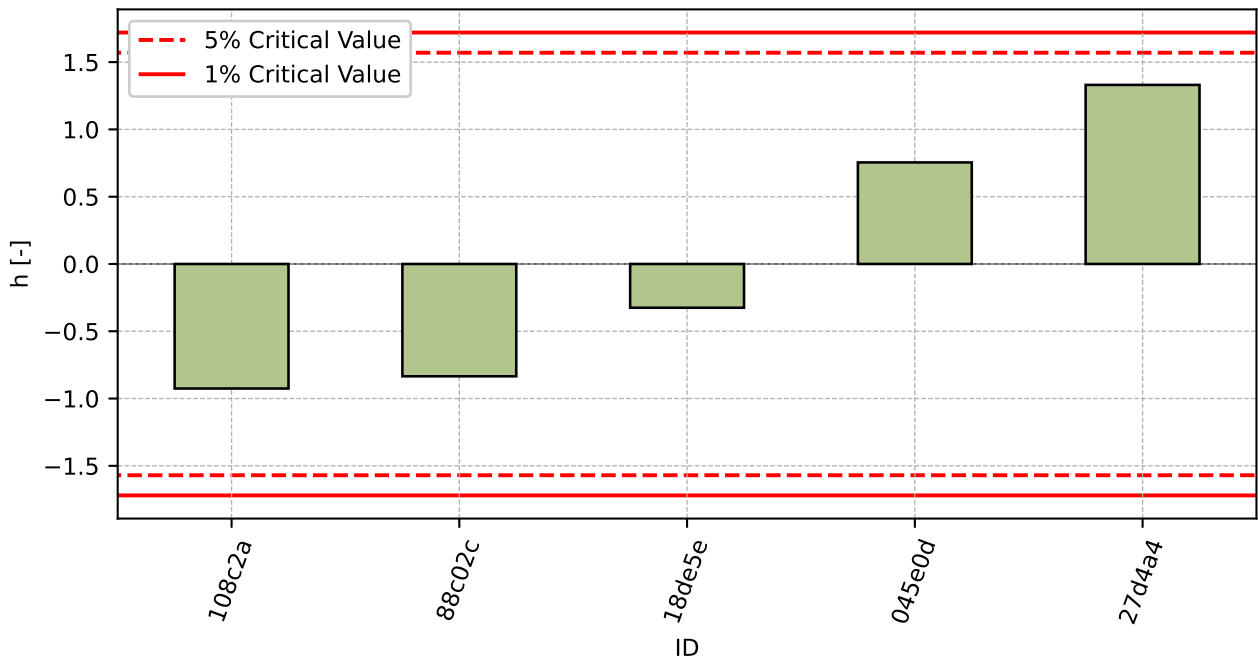


Figure 4: Interlaboratory Consistency Statistic

1.1.4 Descriptive statistics

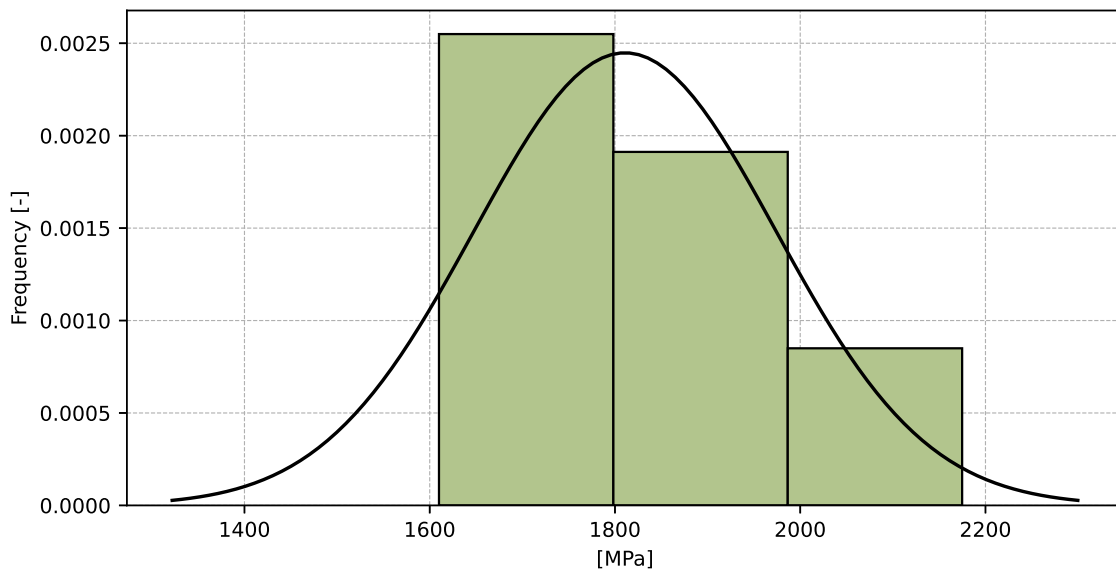


Figure 5: Histogram of all test results

Table 5: Descriptive statistics

Characteristics	[MPa]
Average value – \bar{x}	1811
Sample standard deviation – s	163.0
Assigned value – x^*	1811
Robust standard deviation – s^*	165.3
Measurement uncertainty of assigned value – u_X	92.4
p -value of normality test	0.012 [-]
Interlaboratory standard deviation – s_L	160.3
Repeatability standard deviation – s_r	65.5
Reproducibility standard deviation – s_R	173.2
Repeatability – r	183
Reproducibility – R	485

1.1.5 Evaluation of Performance Statistics

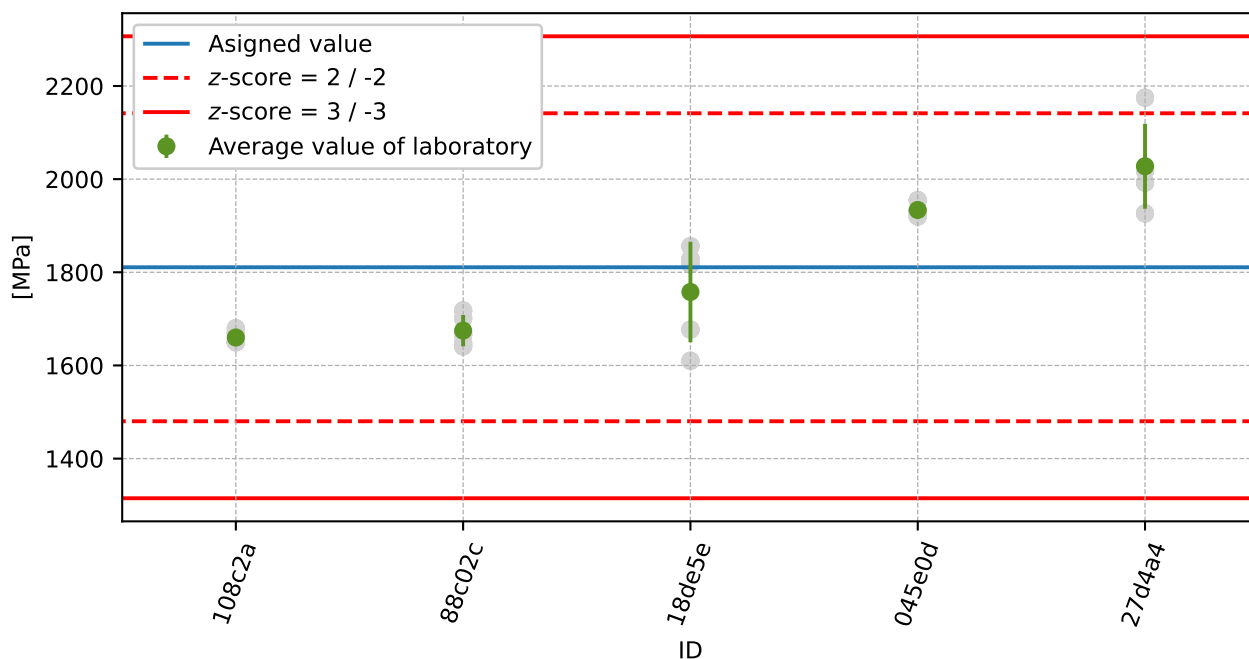


Figure 6: Average values and sample standard deviations

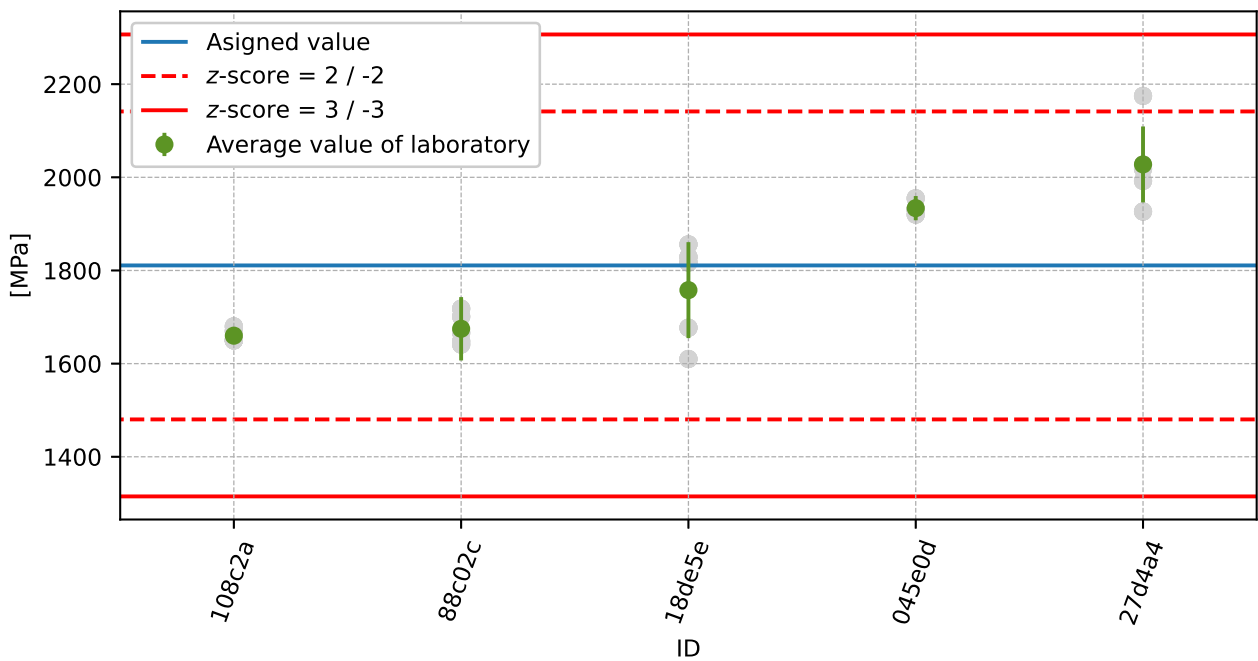


Figure 7: Average values and extended uncertainties of measurement

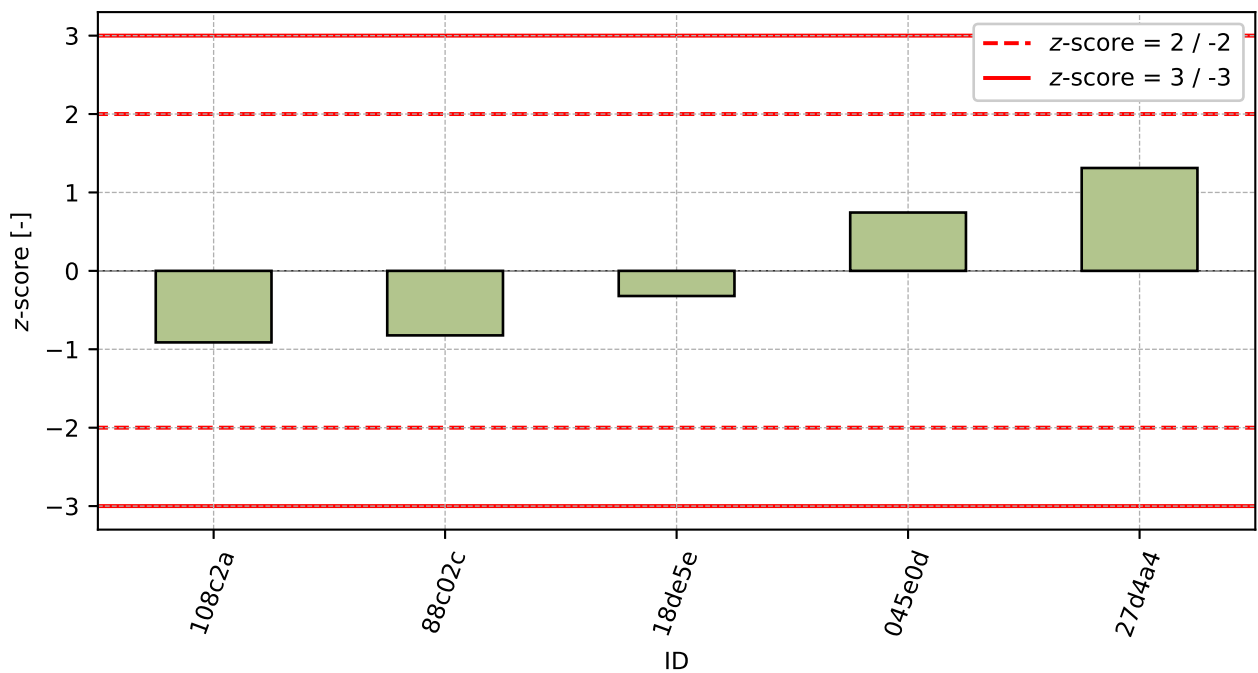
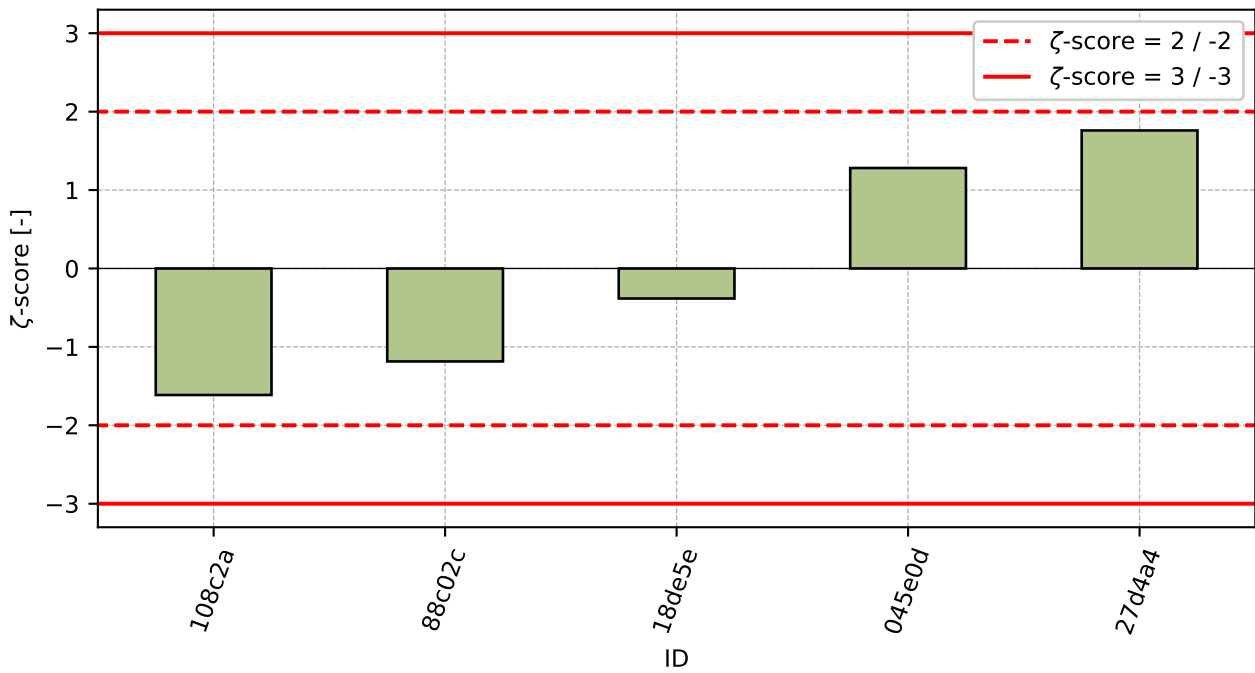


Figure 8: z-score

Figure 9: ζ -scoreTable 6: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
108c2a	-0.91	-1.61
88c02c	-0.82	-1.19
18de5e	-0.32	-0.38
045e0d	0.74	1.28
27d4a4	1.31	1.76

1.2 Sample B

1.2.1 Test results

Table 7: Test results - ordered by average value. Outliers are marked by red color. u_x - extended uncertainty of measurement; \bar{x} - average value; s_0 - sample standard deviation; V_x - variation coefficient

ID	Test results					u_x [MPa]	\bar{x} [MPa]	s_0 [MPa]	V_x [%]
	[MPa]								
88c02c	1432	1410	1446	1383	1406	48	1415	24.4	1.72
108c2a	1420	1400	1440	1400	1440	20	1420	20.0	1.41
18de5e	1775	1472	1553	1537	1483	115	1564	122.9	7.86
045e0d	1605	1647	1648	1659	1640	42	1640	20.6	1.26
27d4a4	1719	1744	1704	1659	1699	28	1705	31.2	1.83

1.2.2 The Numerical Procedure for Determining Outliers

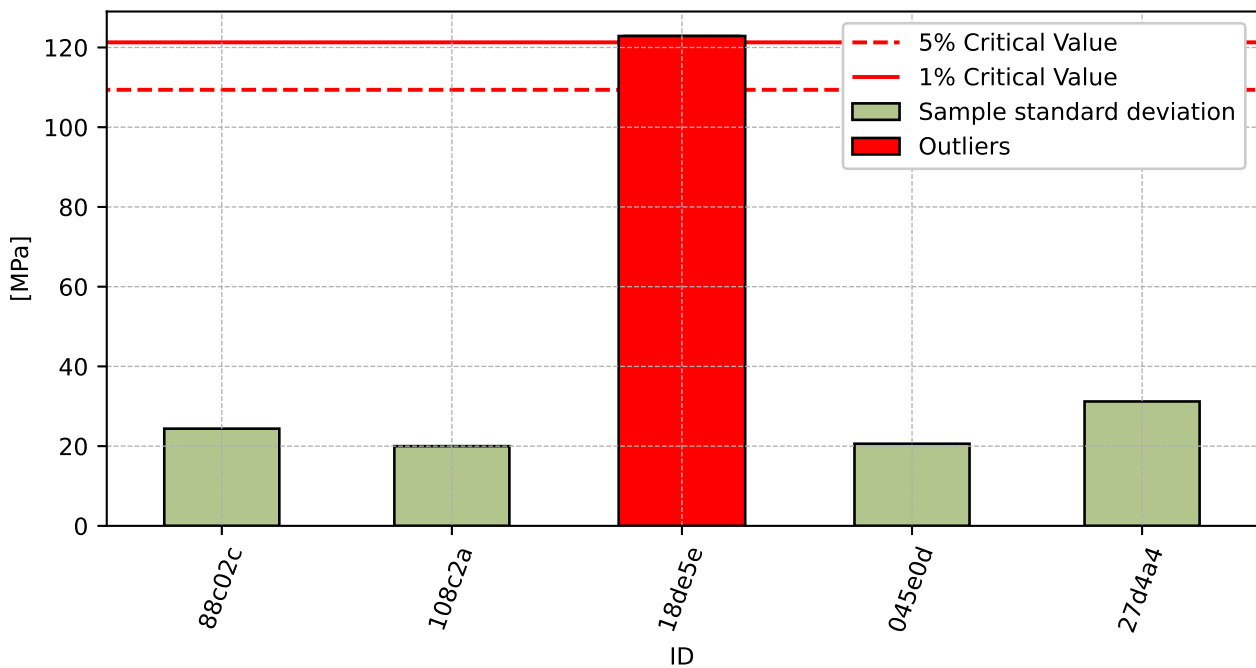


Figure 10: Cochran's test - sample standard deviations

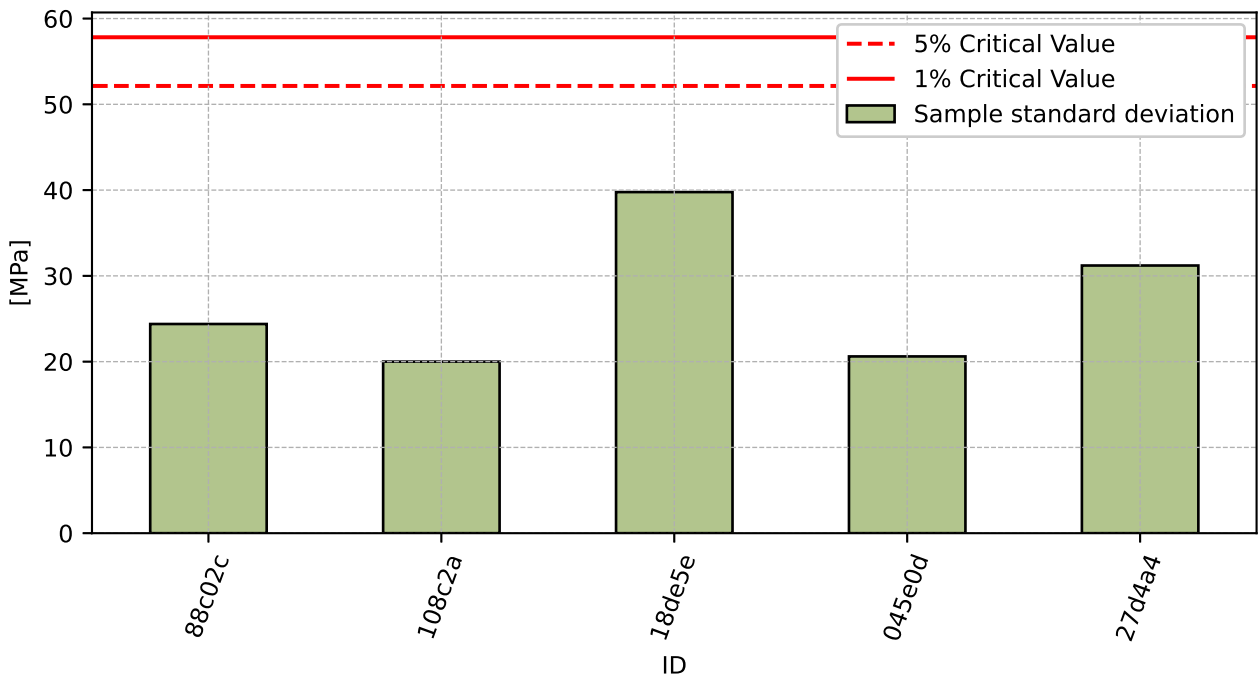


Figure 11: **Cochran's test** - sample standard deviations without outliers

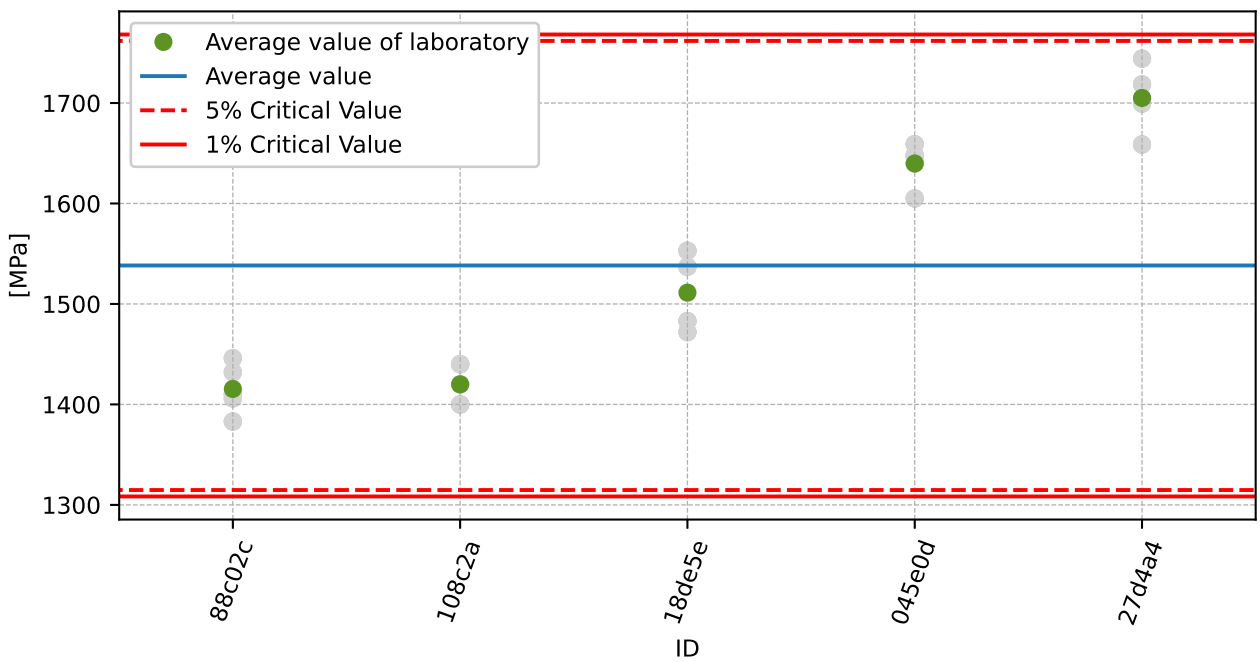


Figure 12: **Grubbs' test** - average values

1.2.3 Mandel's Statistics

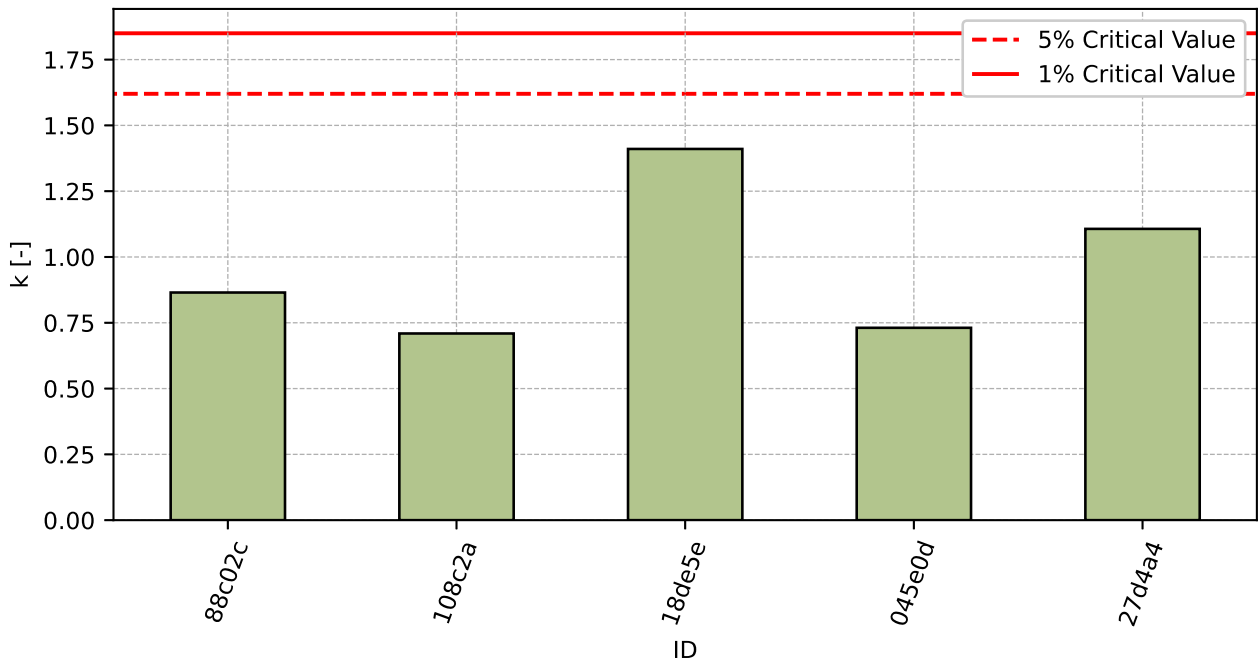


Figure 13: Intralaboratory Consistency Statistic

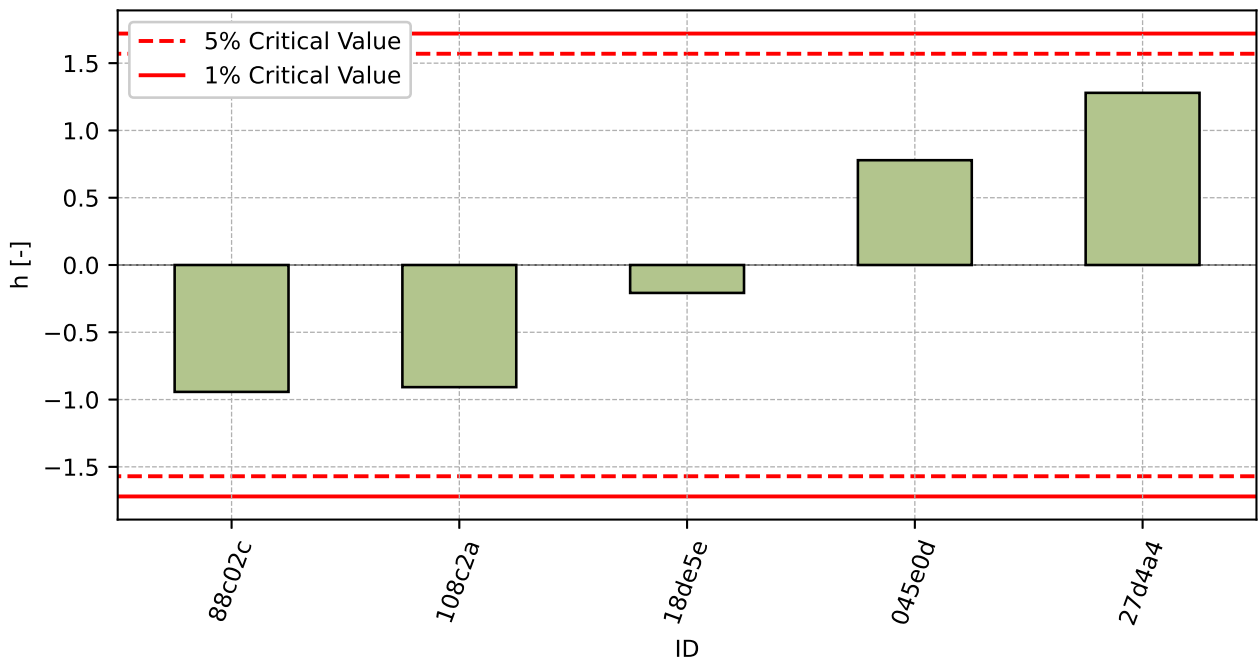


Figure 14: Interlaboratory Consistency Statistic

1.2.4 Descriptive statistics

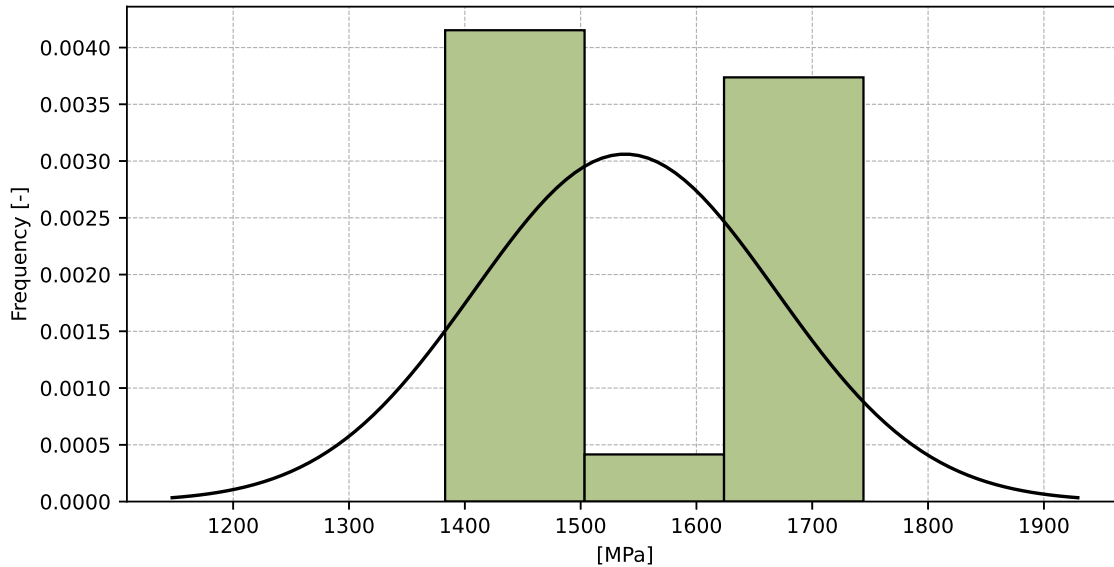


Figure 15: Histogram of all test results

Table 8: Descriptive statistics

Characteristics	[MPa]
Average value – \bar{x}	1538
Sample standard deviation – s	130.3
Assigned value – x^*	1538
Robust standard deviation – s^*	132.2
Measurement uncertainty of assigned value – u_X	73.9
p -value of normality test	0.002 [-]
Interlaboratory standard deviation – s_L	129.7
Repeatability standard deviation – s_r	28.2
Reproducibility standard deviation – s_R	132.7
Repeatability – r	79
Reproducibility – R	372

1.2.5 Evaluation of Performance Statistics

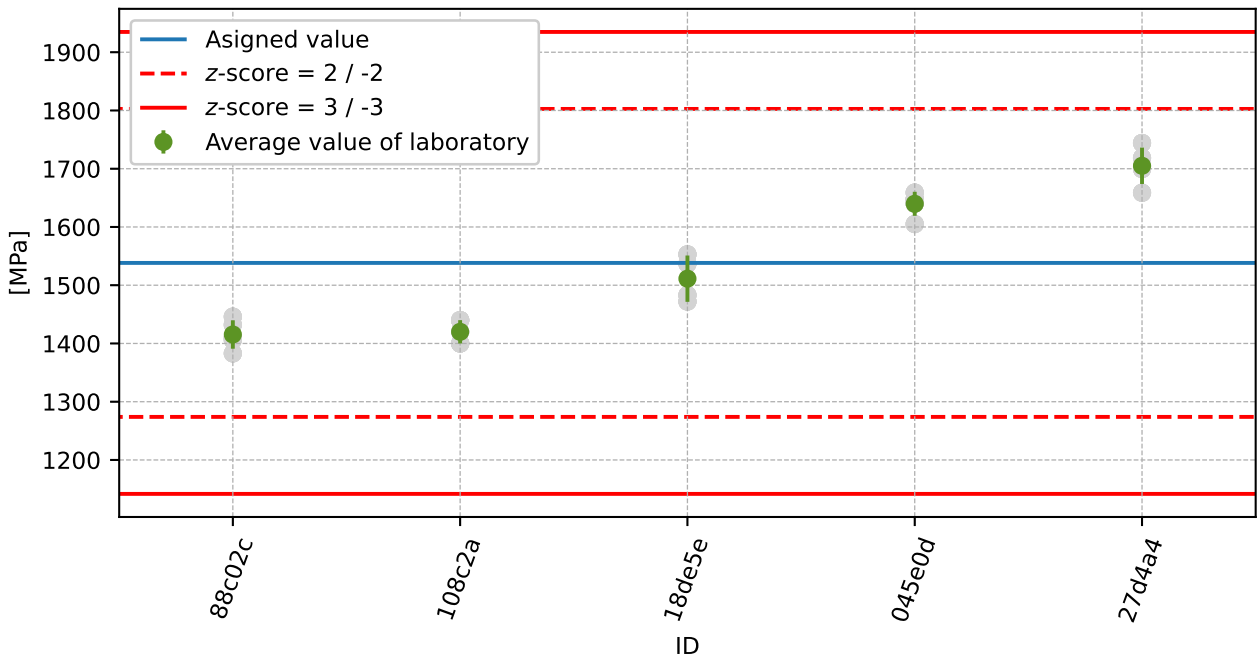


Figure 16: Average values and sample standard deviations

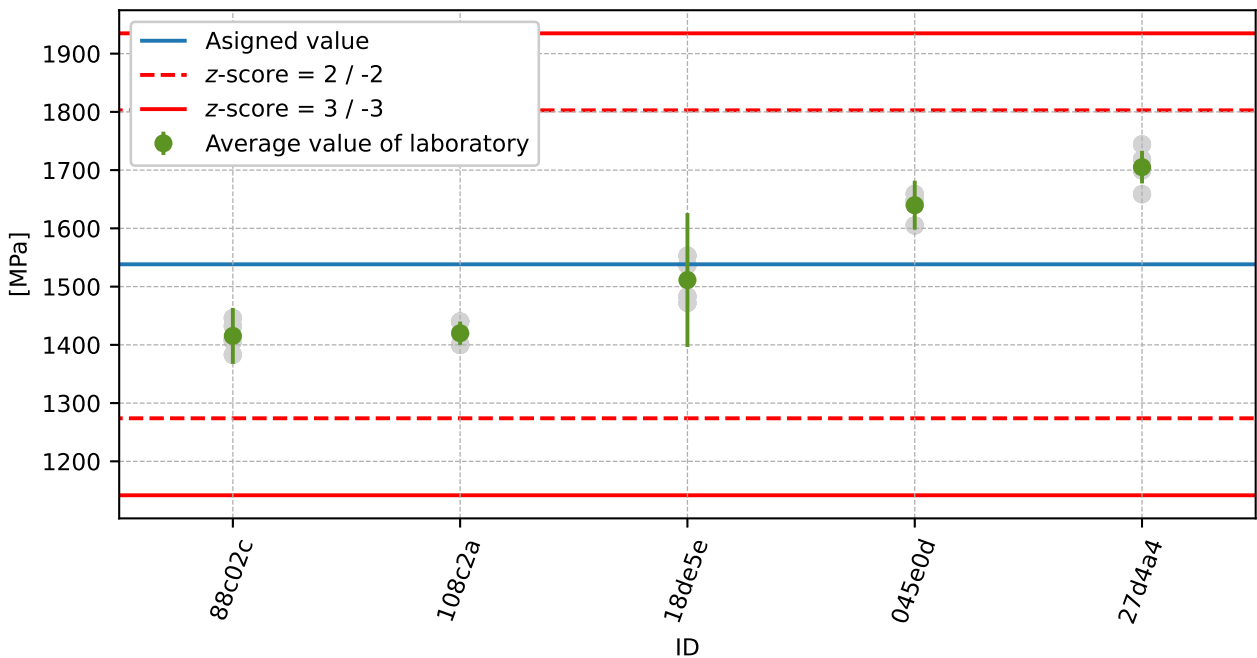


Figure 17: Average values and extended uncertainties of measurement

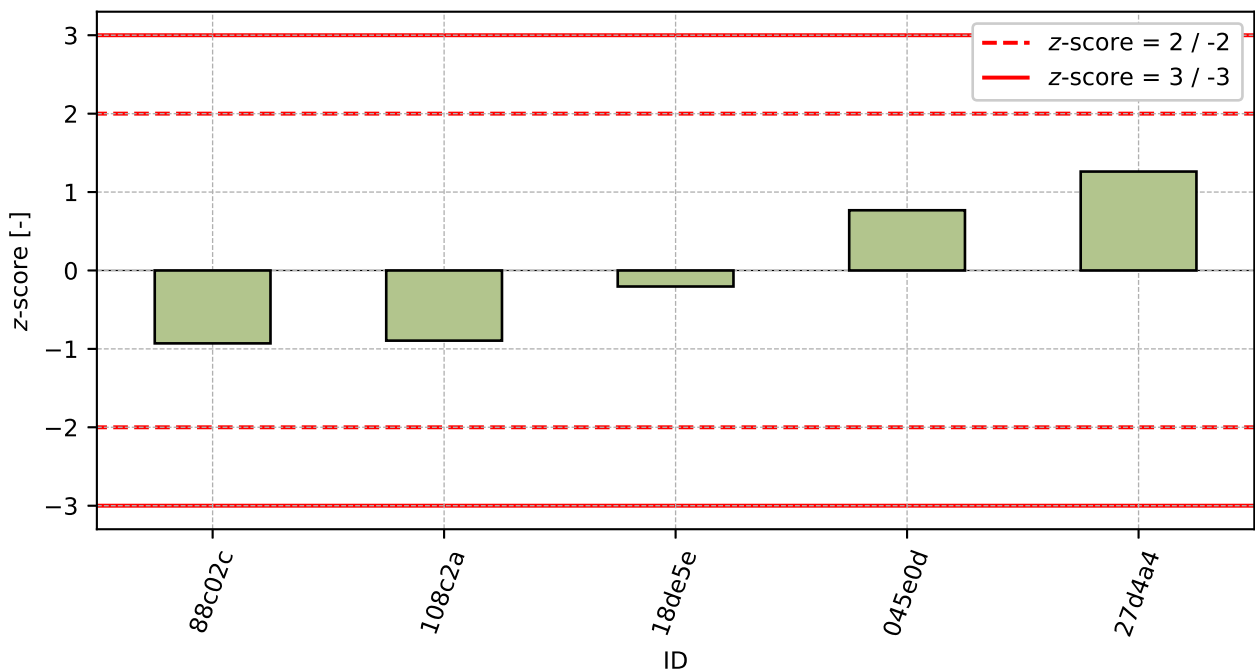


Figure 18: z-score

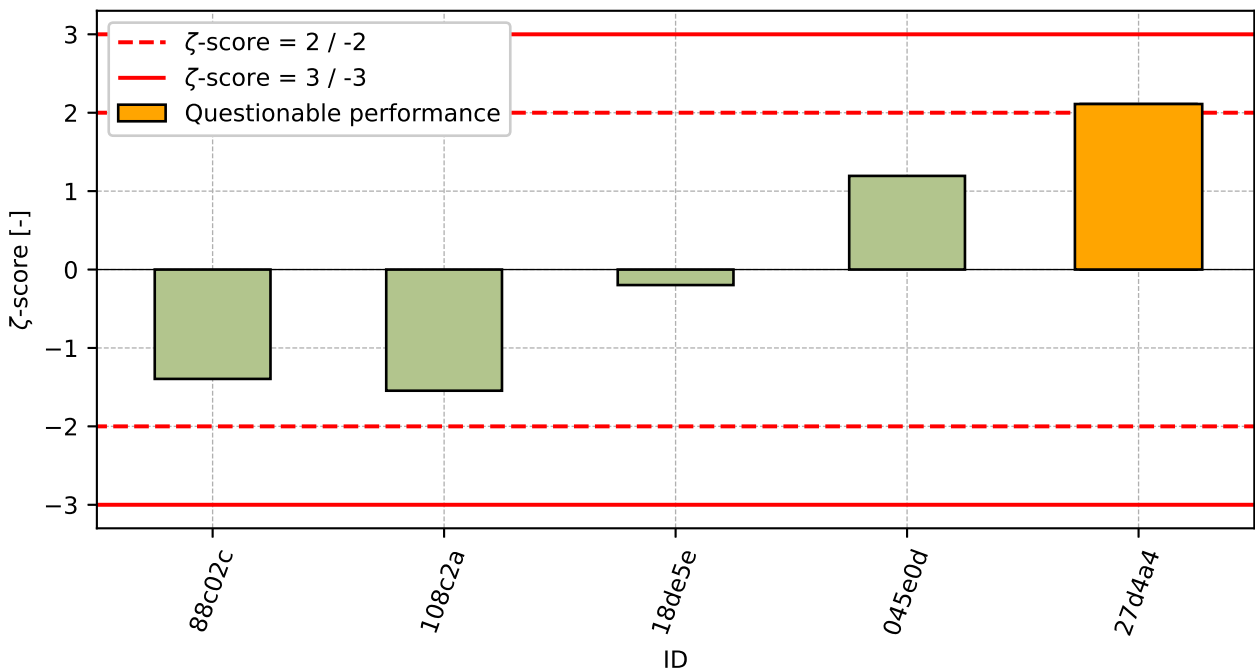


Figure 19: ζ-score

Table 9: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
88c02c	-0.93	-1.39
108c2a	-0.89	-1.55
18de5e	-0.2	-0.2
045e0d	0.77	1.19
27d4a4	1.26	2.11

2 Appendix – EN ISO 527-1, 2 (Stress at yield, Strain at yield)

2.1 Sample A

2.1.1 Stress at yield

Test results

Table 10: Test results - ordered by average value. Outliers are marked by red color. u_x - extended uncertainty of measurement; \bar{x} - average value; s_0 - sample standard deviation; V_x - variation coefficient

ID	Test results [MPa]					u_x [MPa]	\bar{x} [MPa]	s_0 [MPa]	V_x [%]
18de5e	37.4	36.8	36.5	37.5	36.4	0.9	36.9	0.51	1.37
27d4a4	36.9	37.2	37.0	37.0	37.0	0.1	37.0	0.1	0.28
88c02c	37.0	37.2	37.1	37.2	37.0	0.2	37.1	0.1	0.26
1726f5	37.3	37.1	37.2	37.1	37.0	1.3	37.1	0.11	0.31
045e0d	37.4	37.2	37.2	37.2	37.0	6.1	37.2	0.13	0.36

The Numerical Procedure for Determining Outliers

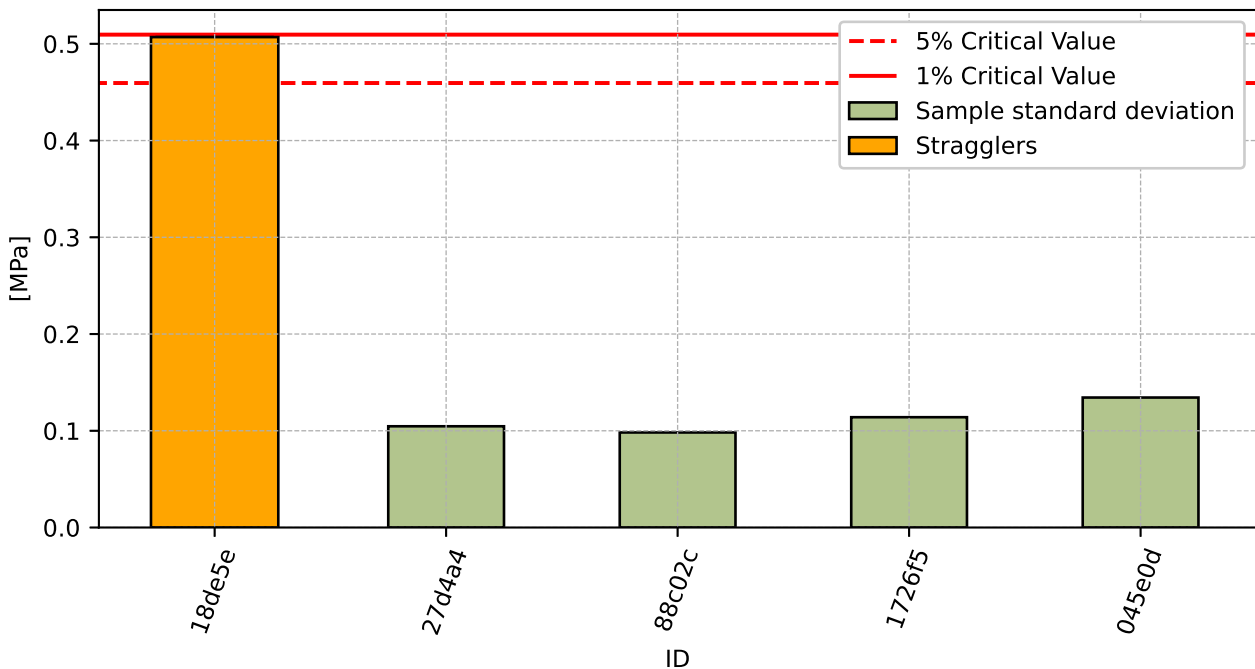


Figure 20: Cochran's test - sample standard deviations

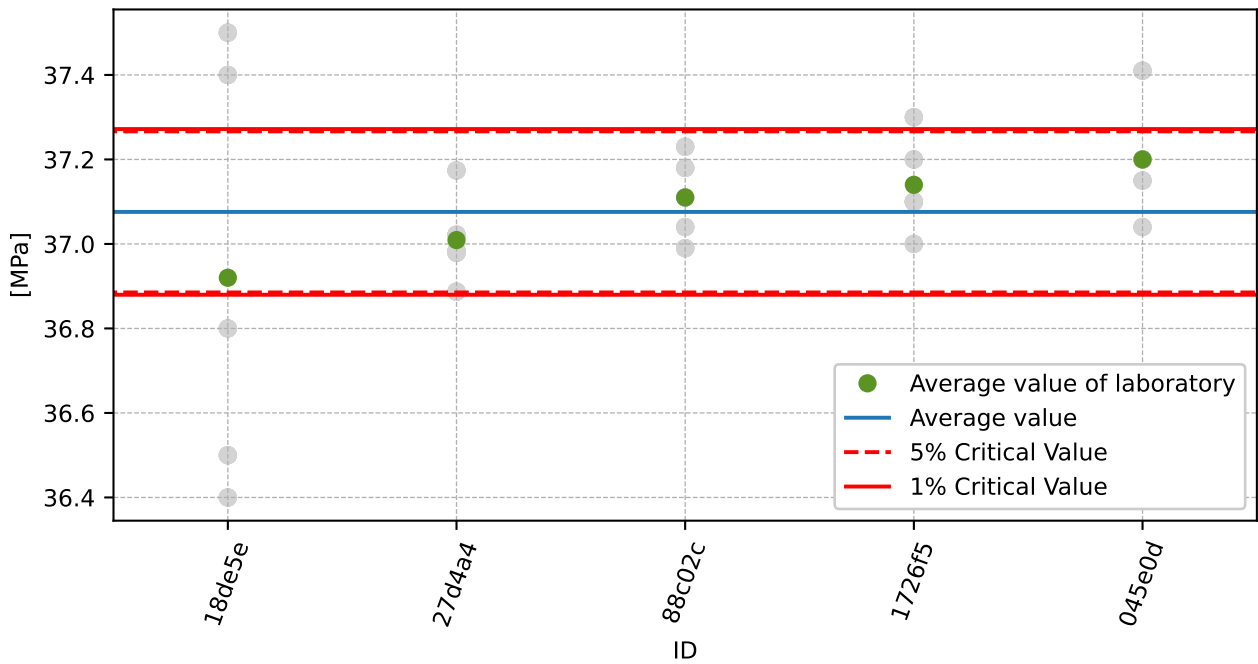


Figure 21: **Grubbs' test** - average values

Mandel's Statistics

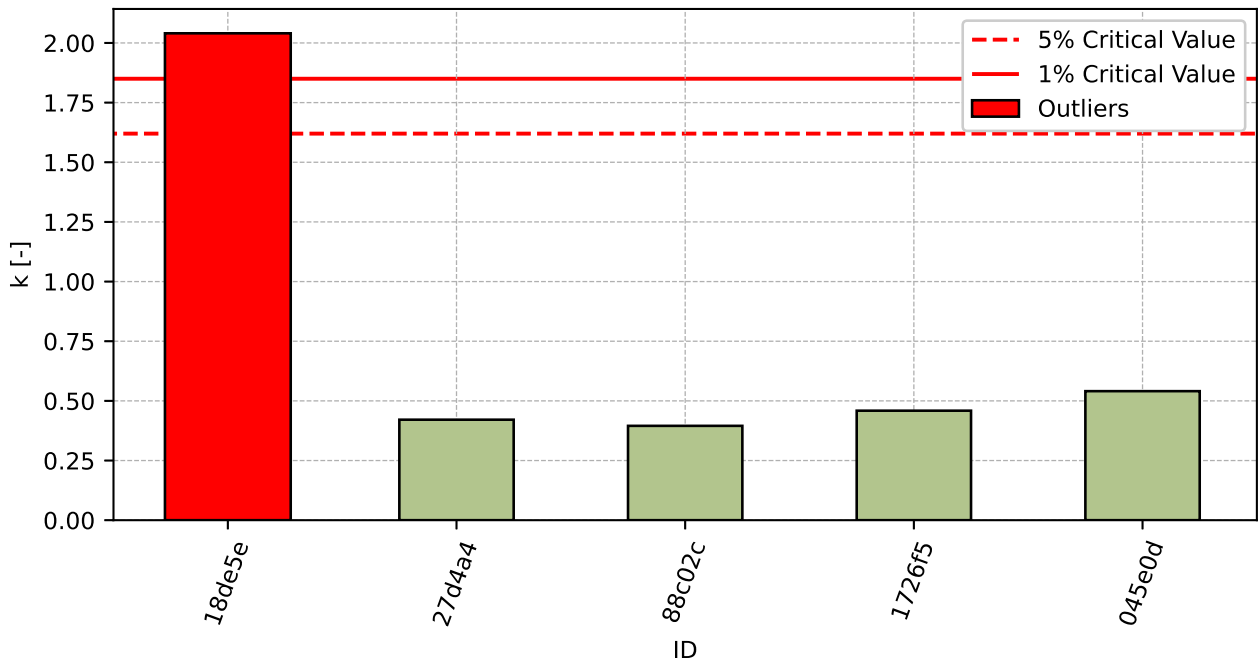


Figure 22: Intralaboratory Consistency Statistic

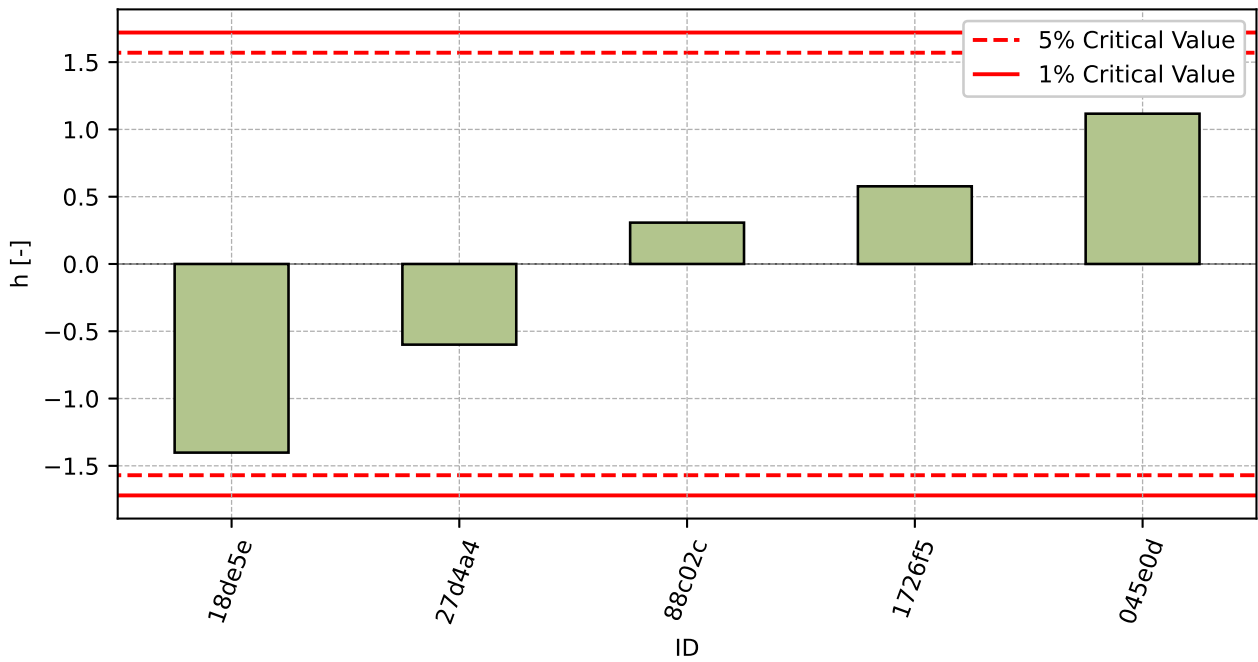


Figure 23: Interlaboratory Consistency Statistic

Descriptive statistics

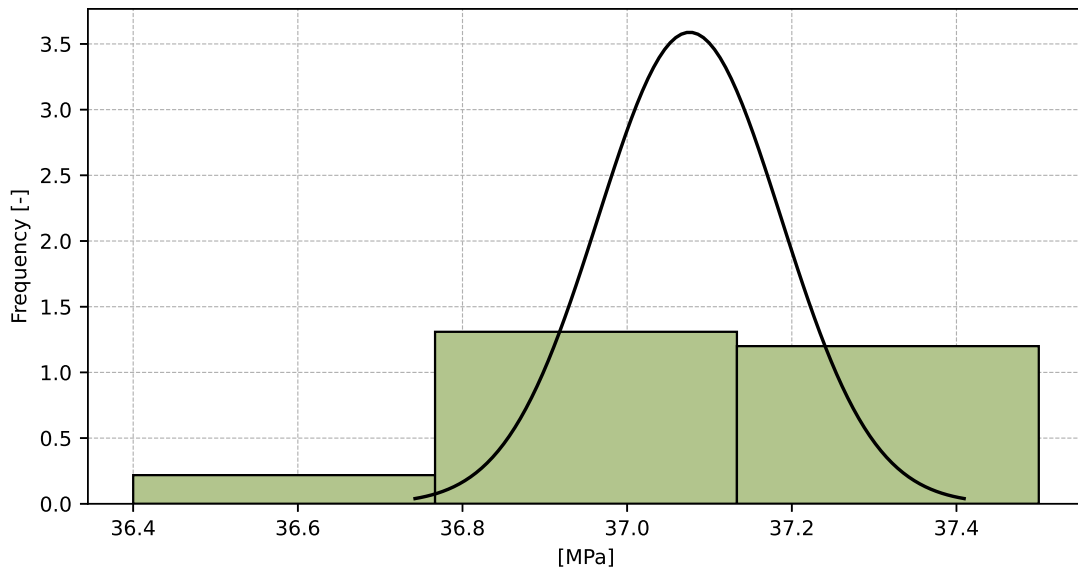


Figure 24: Histogram of all test results

Table 11: Descriptive statistics

Characteristics	[MPa]
Average value – \bar{x}	37.1
Sample standard deviation – s	0.11
Assigned value – x^*	37.1
Robust standard deviation – s^*	0.11
Measurement uncertainty of assigned value – u_X	0.06
p -value of normality test	0.036 [-]
Interlaboratory standard deviation – s_L	0.0
Repeatability standard deviation – s_r	0.25
Reproducibility standard deviation – s_R	0.25
Repeatability – r	0.7
Reproducibility – R	0.7

Evaluation of Performance Statistics

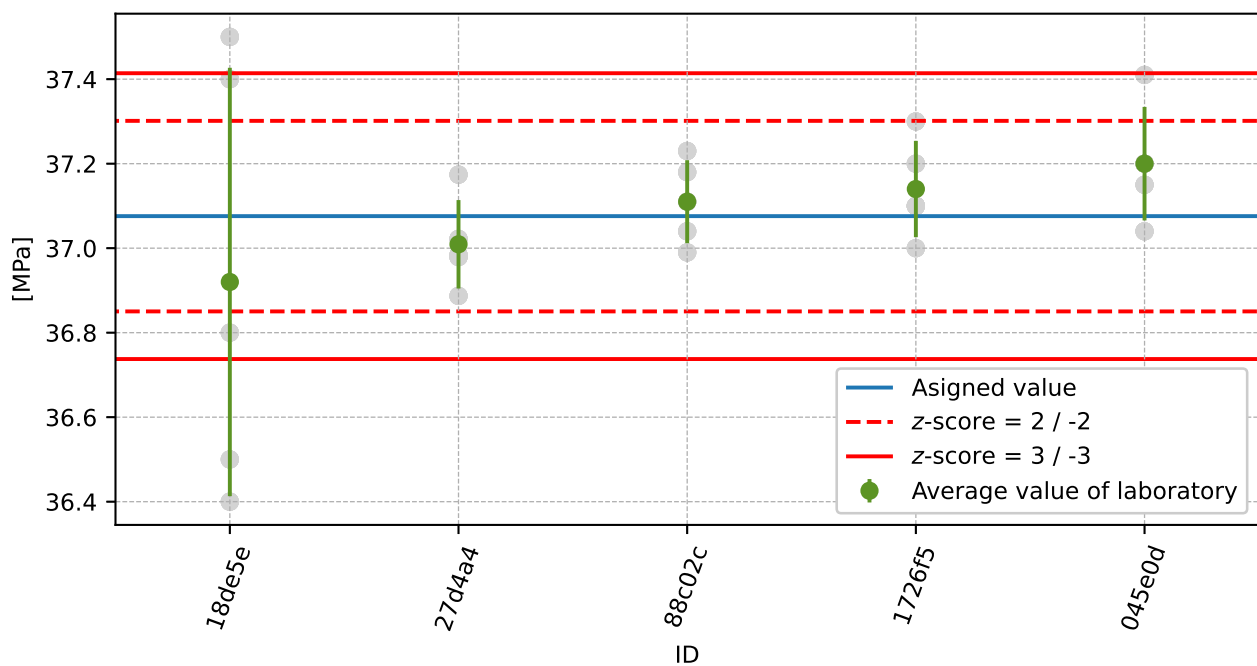


Figure 25: Average values and sample standard deviations

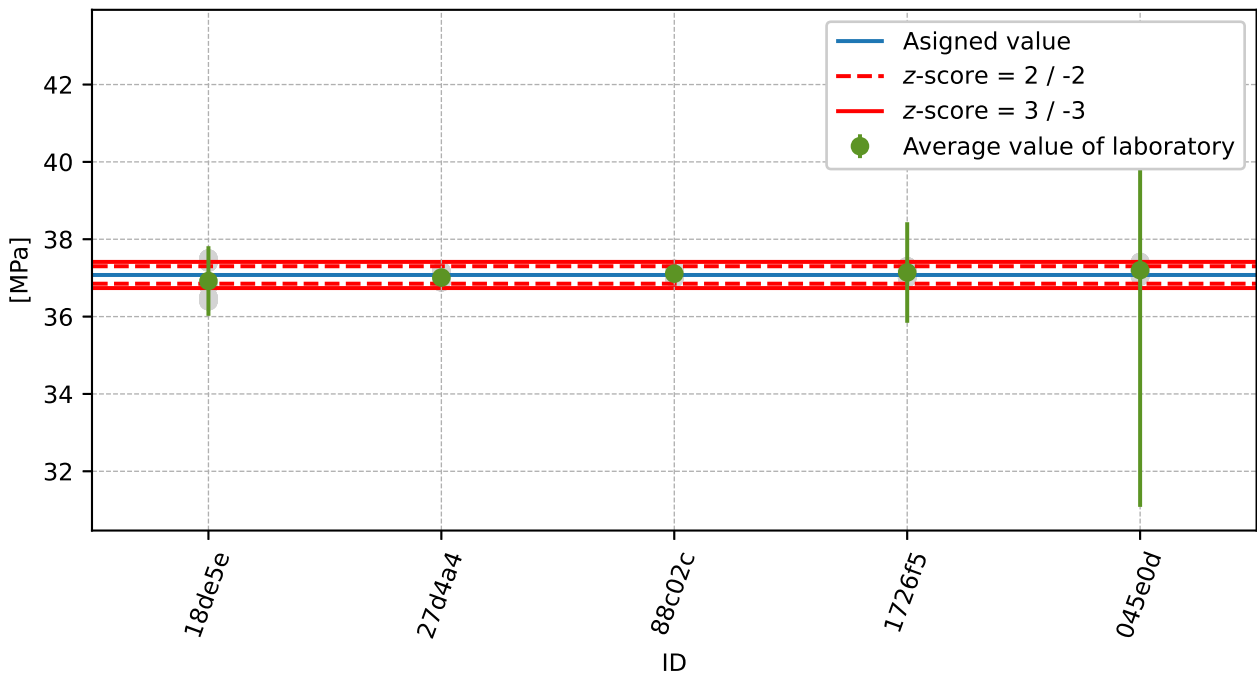


Figure 26: Average values and extended uncertainties of measurement

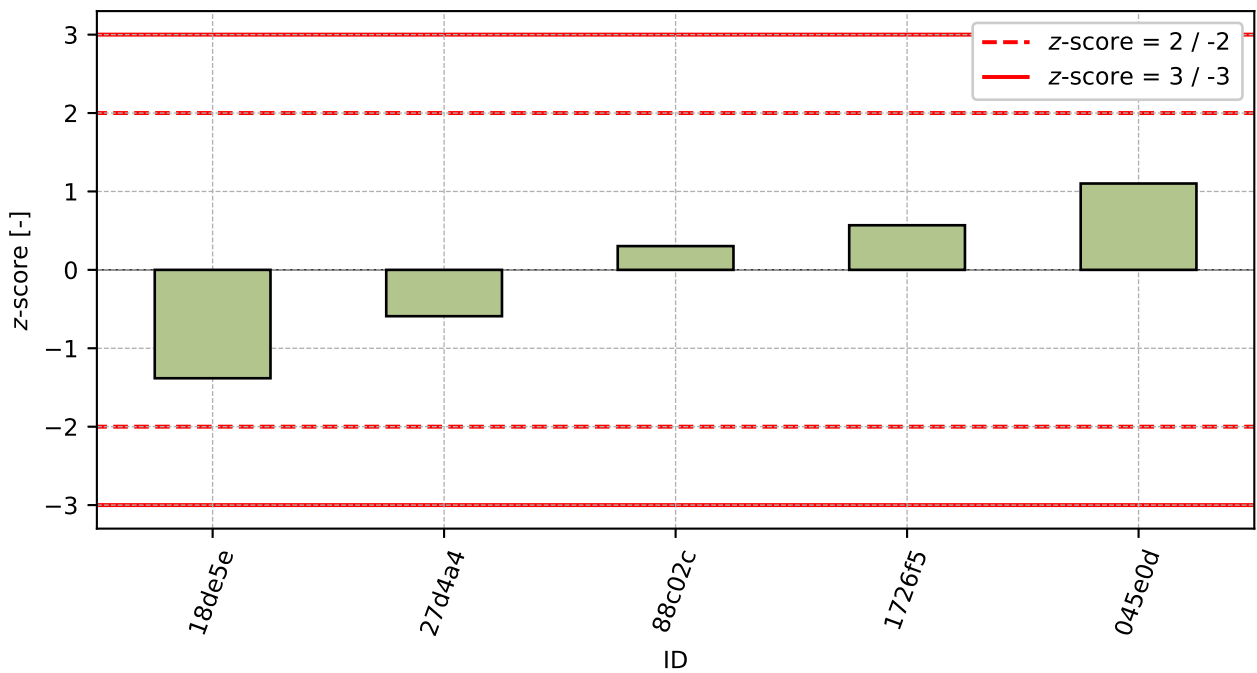
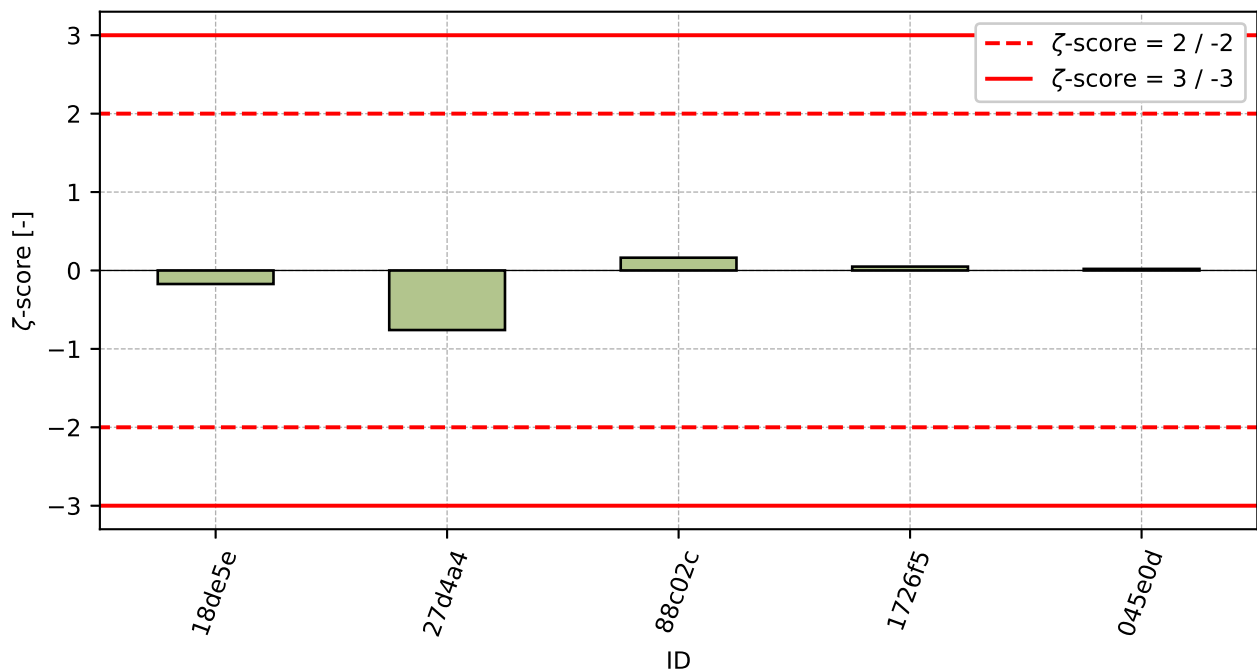


Figure 27: z-score

Figure 28: ζ -scoreTable 12: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
18de5e	-1.38	-0.17
27d4a4	-0.59	-0.76
88c02c	0.3	0.16
1726f5	0.57	0.05
045e0d	1.1	0.02

2.1.2 Strain at yield

Test results

Table 13: 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 [%]
1726f5	7.2	7.2	7.2	7.2	7.3	0.5	7.2	0.04	0.62
27d4a4	7.2	7.2	7.2	7.4	7.4	0.1	7.3	0.1	1.36
045e0d	7.3	7.4	7.5	7.4	7.3	0.4	7.4	0.06	0.82
18de5e	7.4	7.3	7.5	7.6	7.5	0.2	7.5	0.11	1.53
88c02c	7.4	7.7	7.5	7.5	7.6	0.2	7.6	0.12	1.56

The Numerical Procedure for Determining Outliers

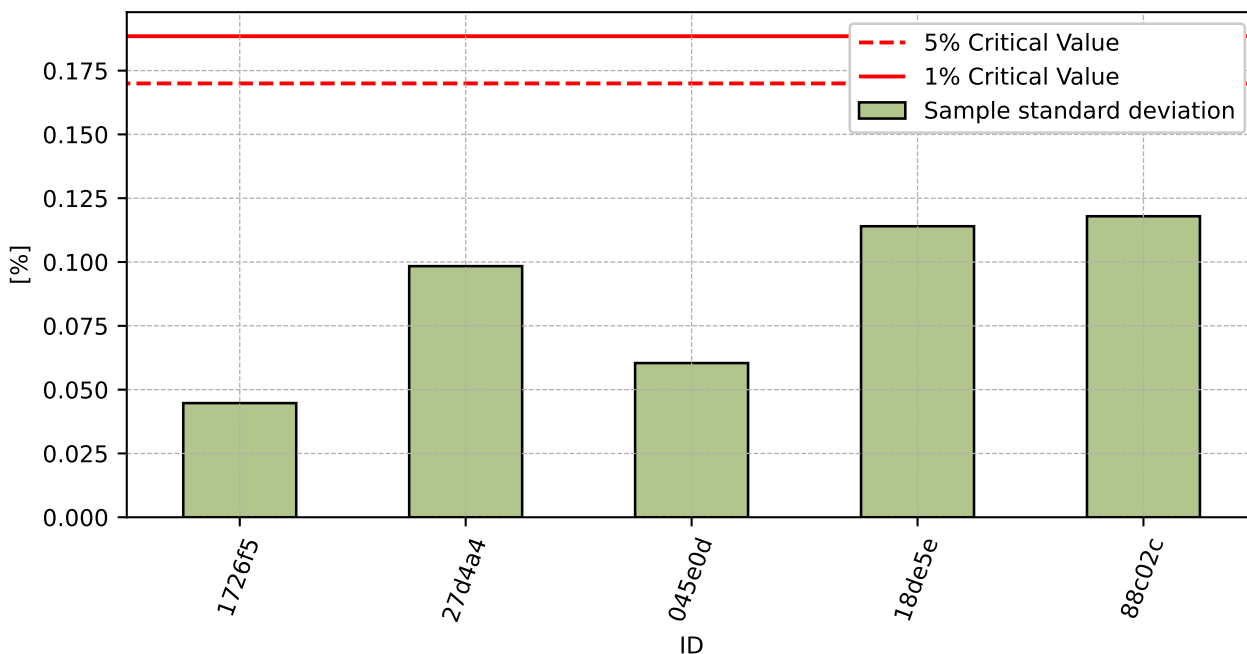


Figure 29: Cochran's test - sample standard deviations

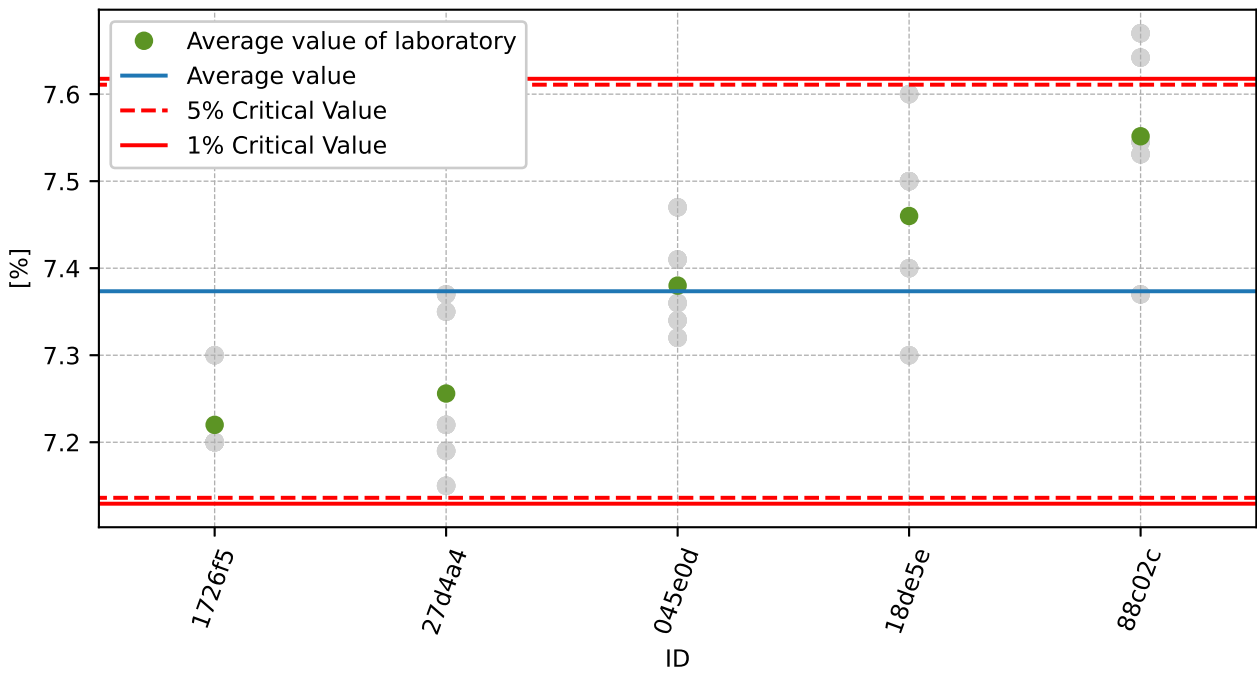


Figure 30: **Grubbs' test** - average values

Mandel's Statistics

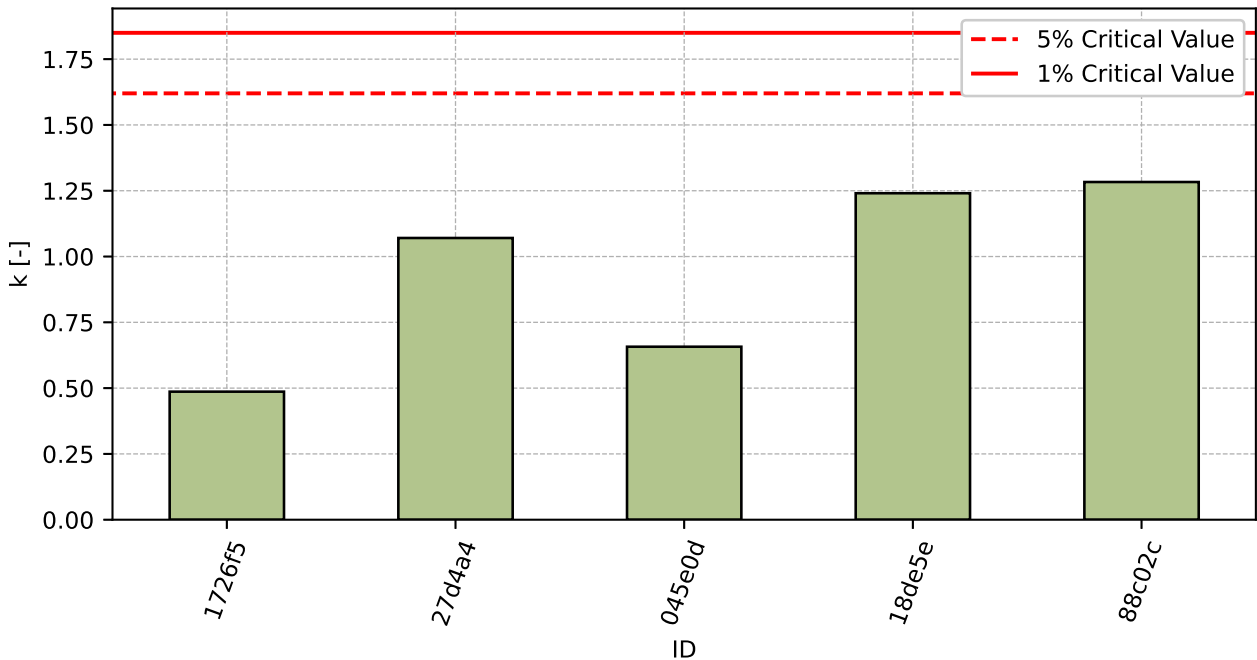


Figure 31: Intralaboratory Consistency Statistic

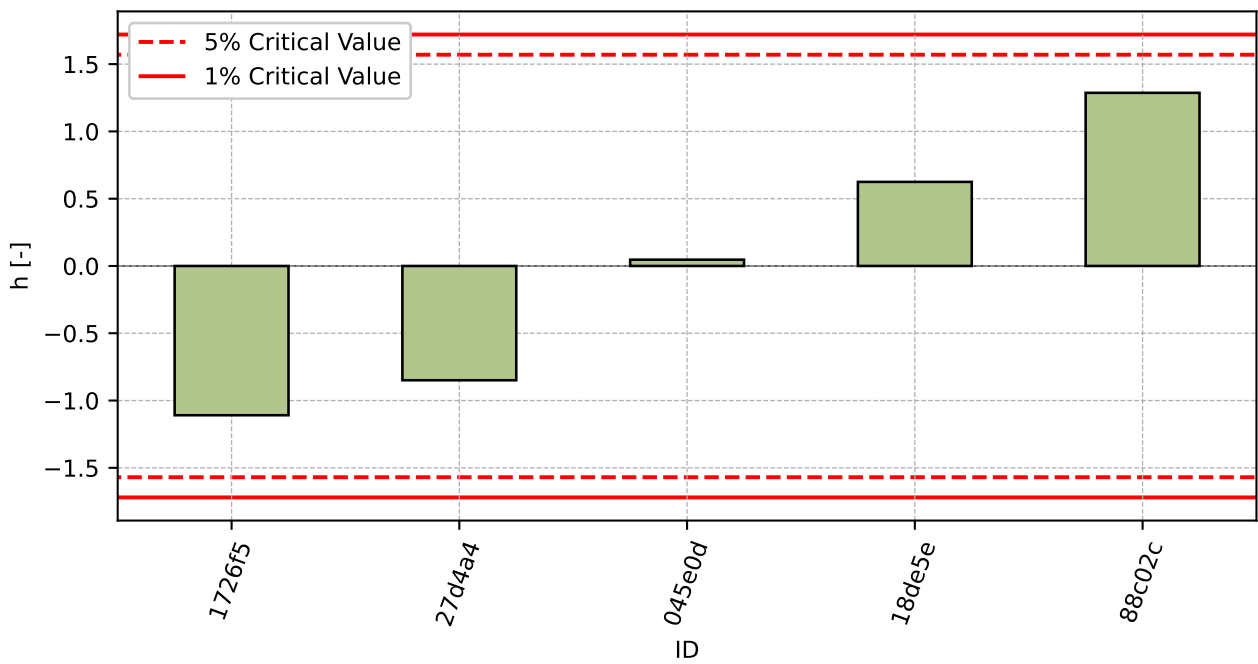


Figure 32: Interlaboratory Consistency Statistic

Descriptive statistics

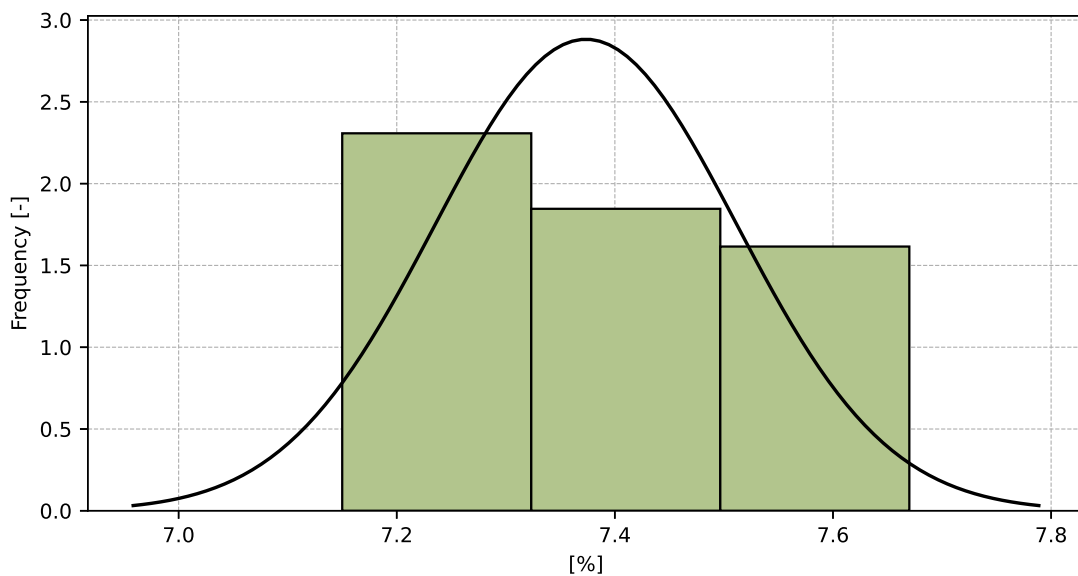


Figure 33: Histogram of all test results

Table 14: Descriptive statistics

Characteristics	[%]
Average value – \bar{x}	7.4
Sample standard deviation – s	0.14
Assigned value – x^*	7.4
Robust standard deviation – s^*	0.14
Measurement uncertainty of assigned value – u_X	0.08
p -value of normality test	0.194 [-]
Interlaboratory standard deviation – s_L	0.13
Repeatability standard deviation – s_r	0.09
Reproducibility standard deviation – s_R	0.16
Repeatability – r	0.3
Reproducibility – R	0.5

Evaluation of Performance Statistics

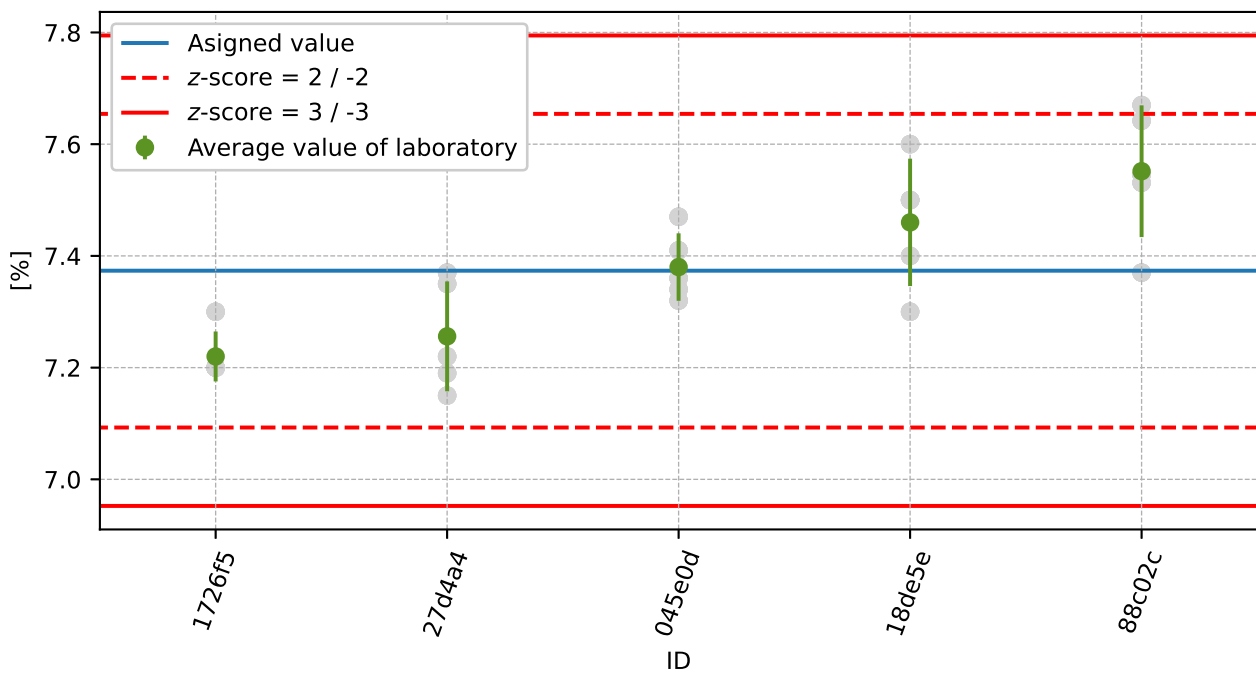


Figure 34: Average values and sample standard deviations

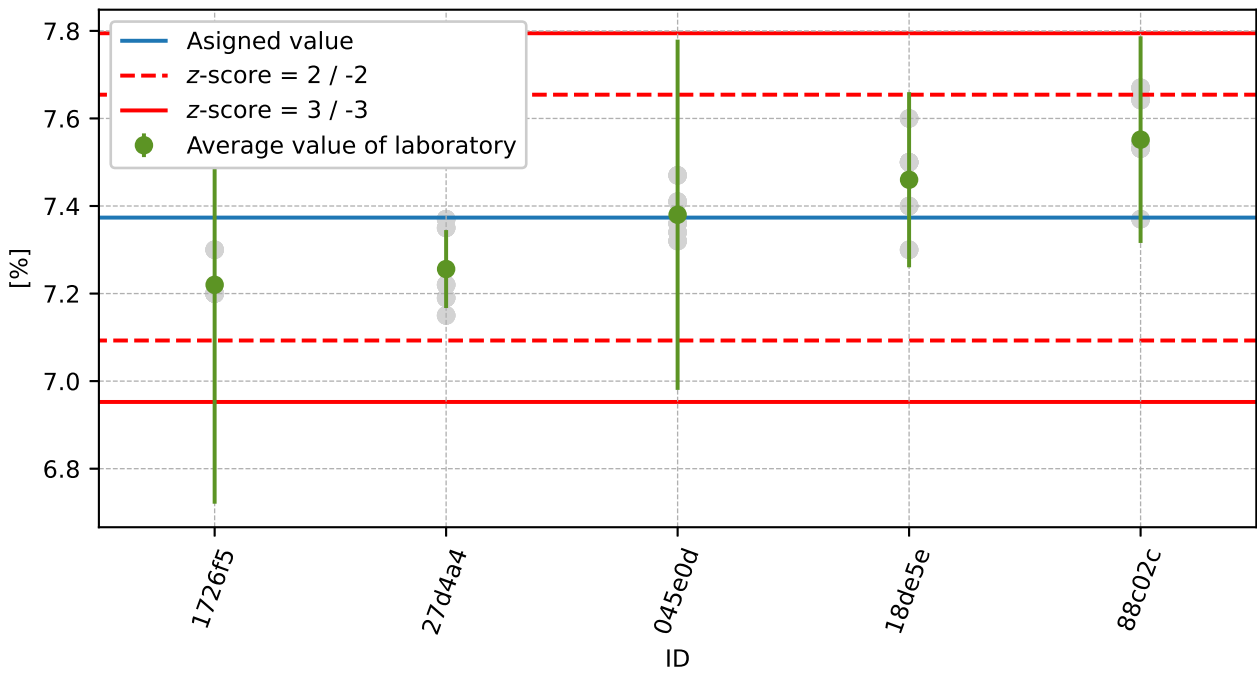


Figure 35: Average values and extended uncertainties of measurement

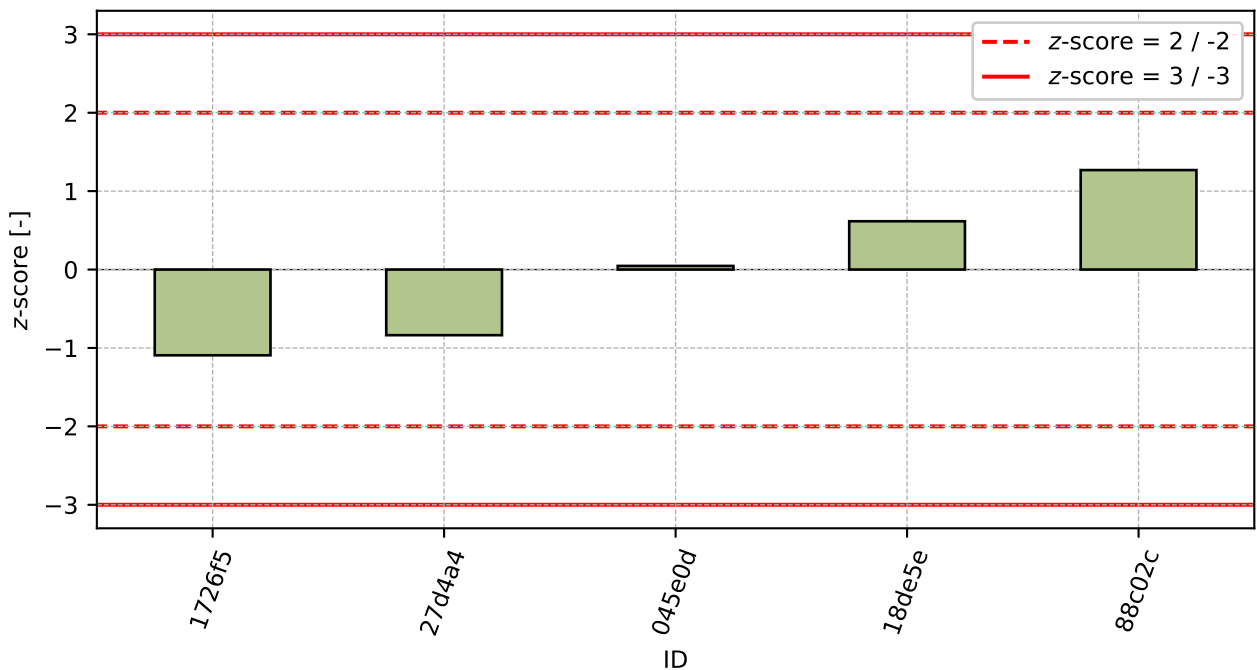
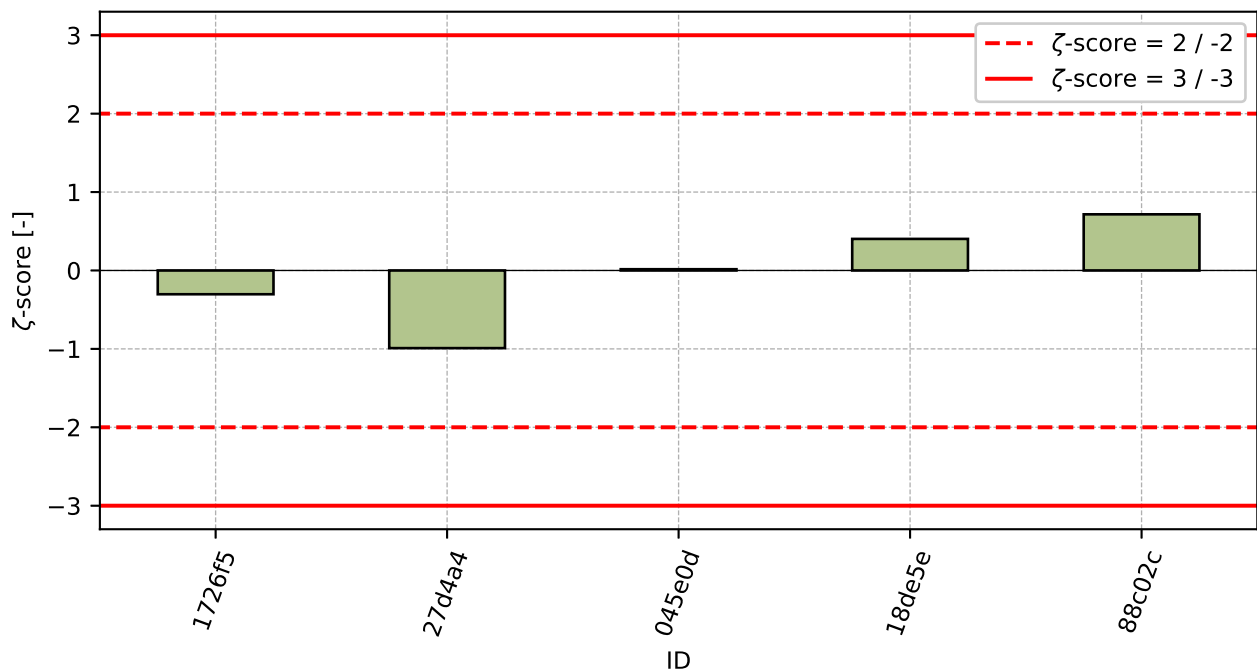


Figure 36: z-score

Figure 37: ζ -scoreTable 15: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
1726f5	-1.09	-0.3
27d4a4	-0.84	-0.99
045e0d	0.05	0.02
18de5e	0.62	0.4
88c02c	1.27	0.72

2.2 Sample B

2.2.1 Stress at yield

Test results

Table 16: 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 [MPa]	\bar{x} [MPa]	s_0 [MPa]	V_X [%]
	[MPa]								
045e0d	28.8	28.8	28.8	28.5	28.6	6.1	28.7	0.15	0.53
27d4a4	28.8	28.8	28.8	29.0	29.0	0.1	28.9	0.1	0.34
1726f5	29.0	28.9	28.9	28.8	28.9	1.2	28.9	0.07	0.24
88c02c	29.0	29.0	28.9	28.9	28.9	0.1	28.9	0.07	0.24
18de5e	29.0	29.6	29.2	29.2	29.2	0.7	29.2	0.22	0.75

The Numerical Procedure for Determining Outliers

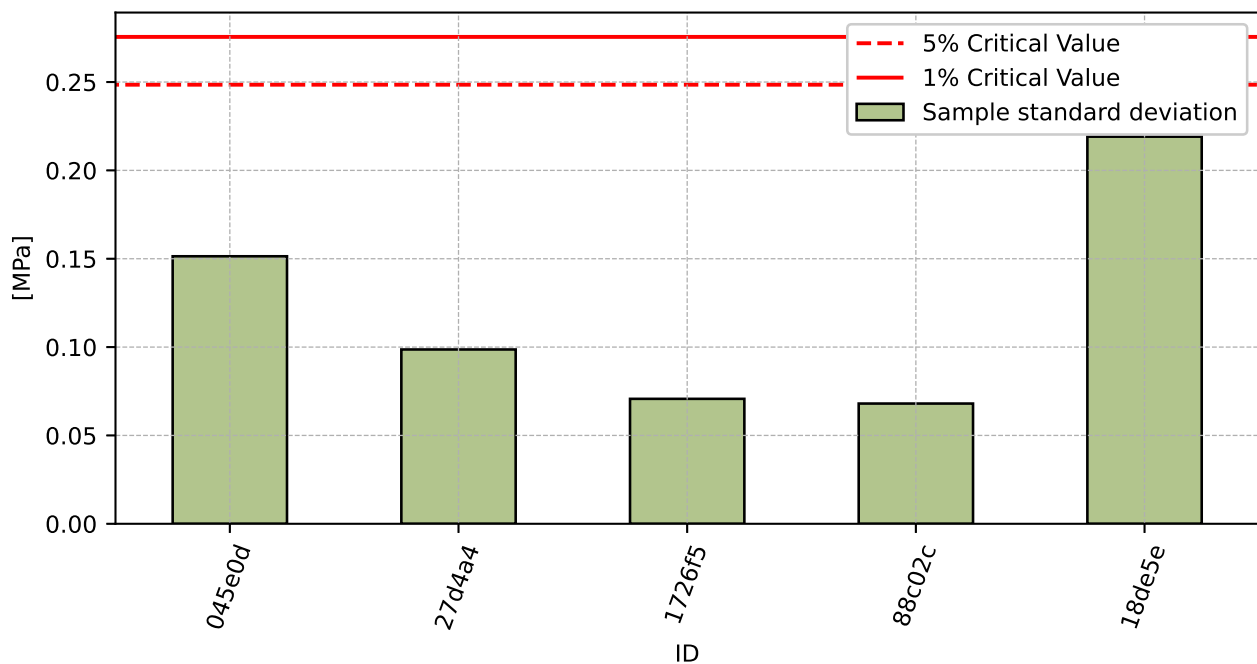


Figure 38: **Cochran's test** - sample standard deviations

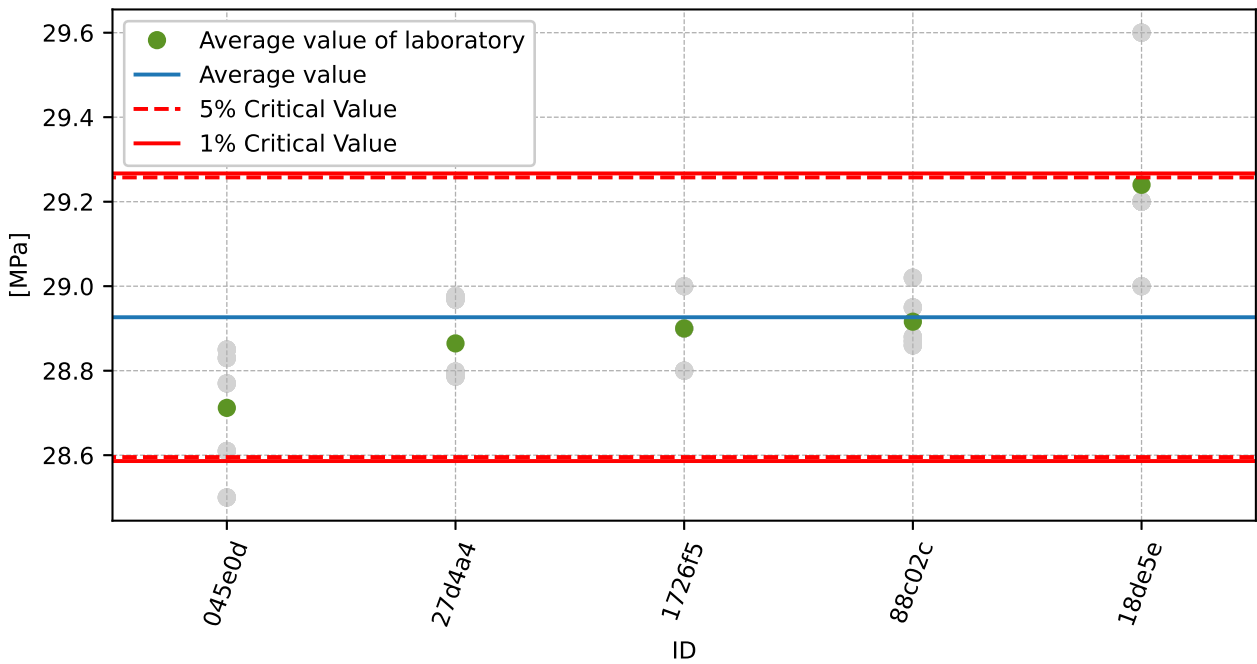


Figure 39: **Grubbs' test** - average values

Mandel's Statistics

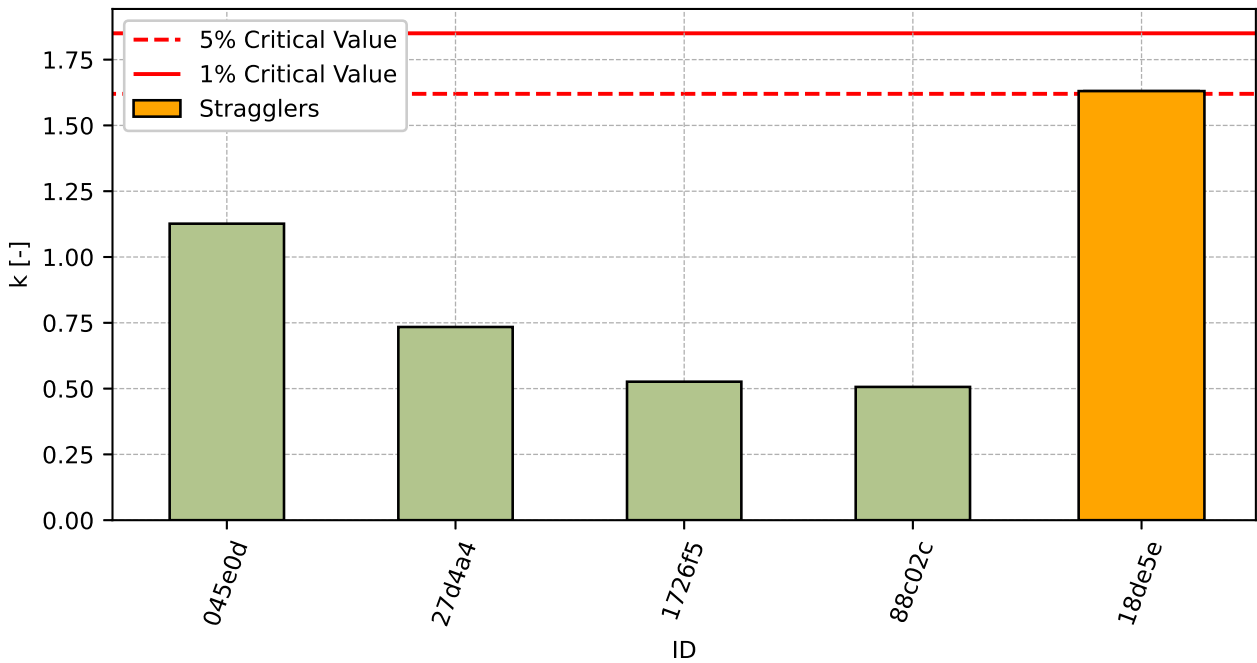


Figure 40: Intralaboratory Consistency Statistic

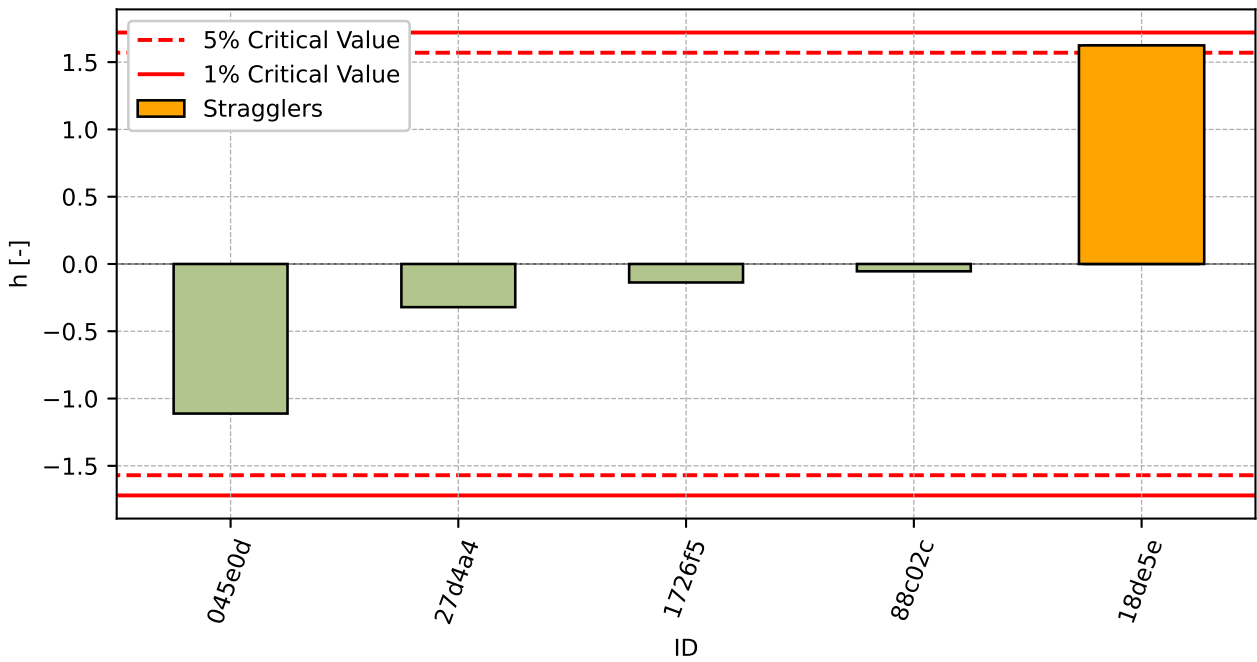


Figure 41: Interlaboratory Consistency Statistic

Descriptive statistics

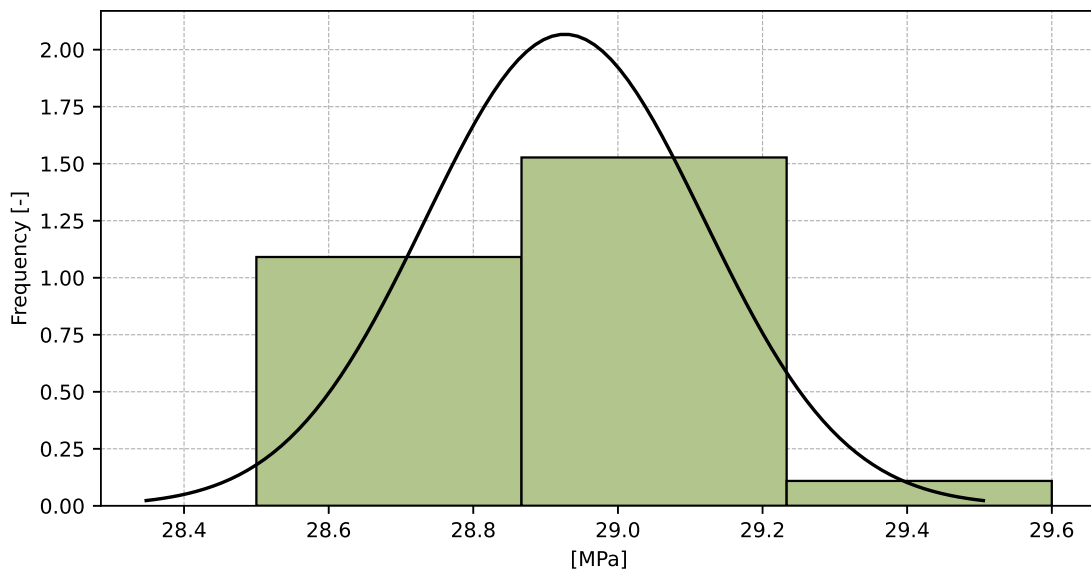


Figure 42: Histogram of all test results

Table 17: Descriptive statistics

Characteristics	[MPa]
Average value – \bar{x}	28.9
Sample standard deviation – s	0.19
Assigned value – x^*	28.9
Robust standard deviation – s^*	0.17
Measurement uncertainty of assigned value – u_X	0.09
p -value of normality test	0.019 [-]
Interlaboratory standard deviation – s_L	0.18
Repeatability standard deviation – s_r	0.13
Reproducibility standard deviation – s_R	0.23
Repeatability – r	0.4
Reproducibility – R	0.6

Evaluation of Performance Statistics

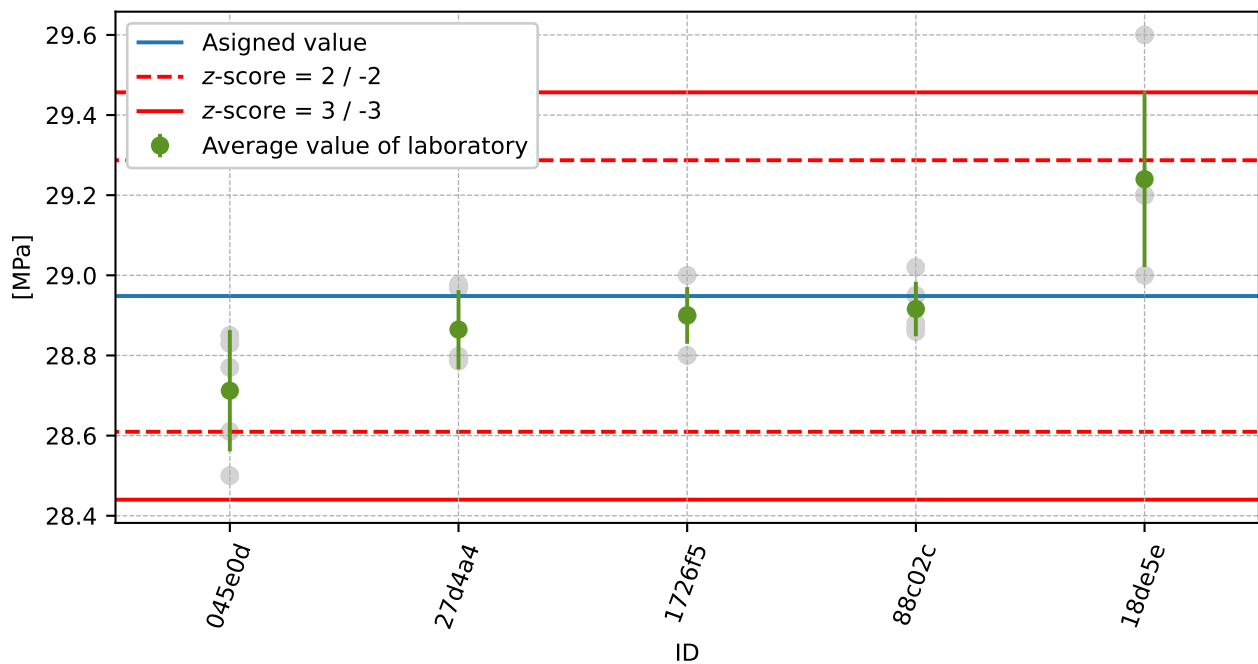


Figure 43: Average values and sample standard deviations

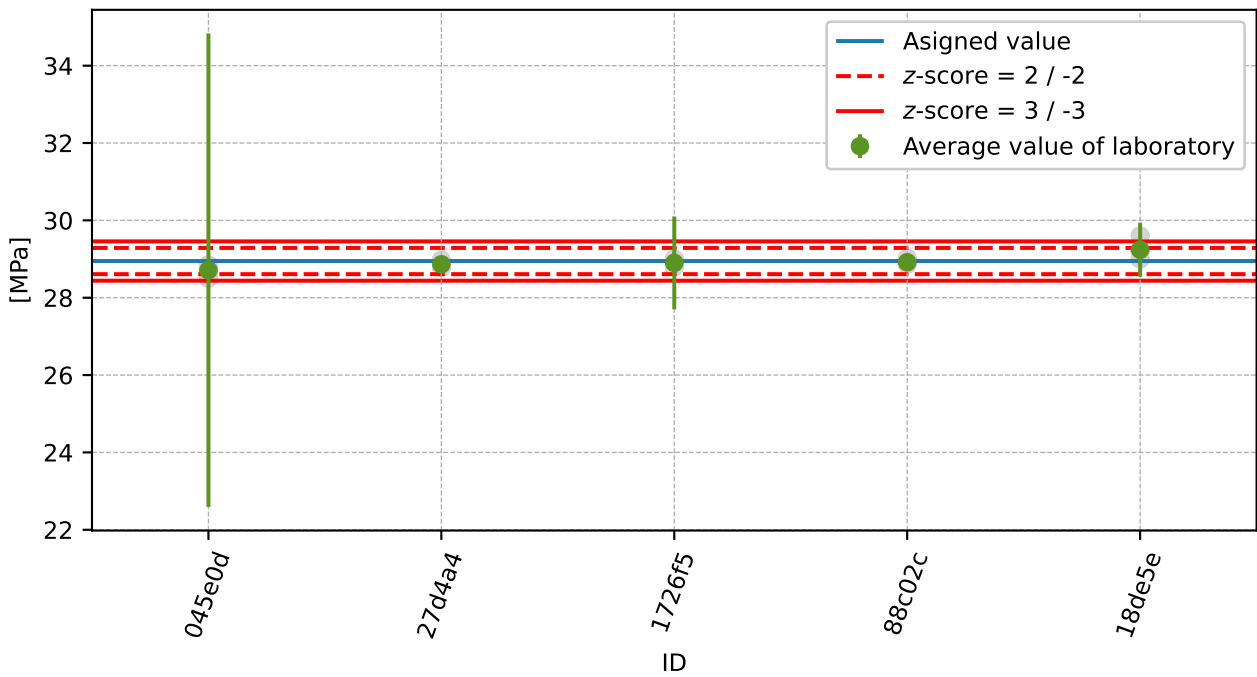


Figure 44: Average values and extended uncertainties of measurement

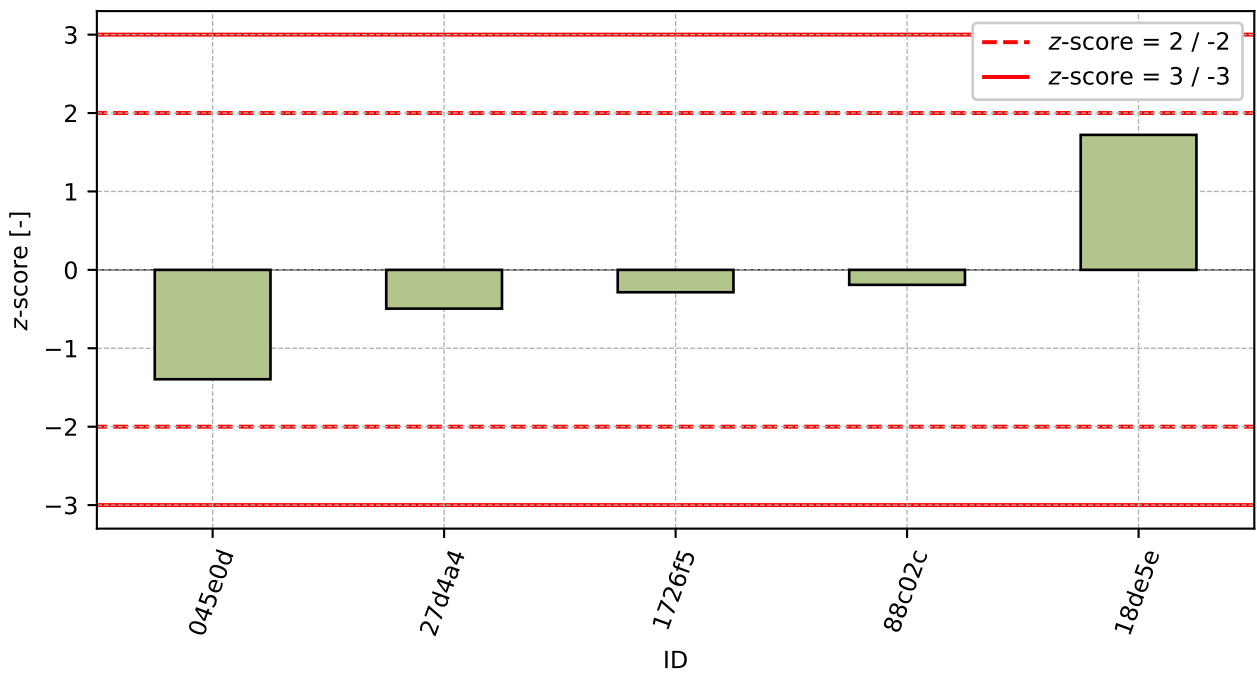


Figure 45: z-score

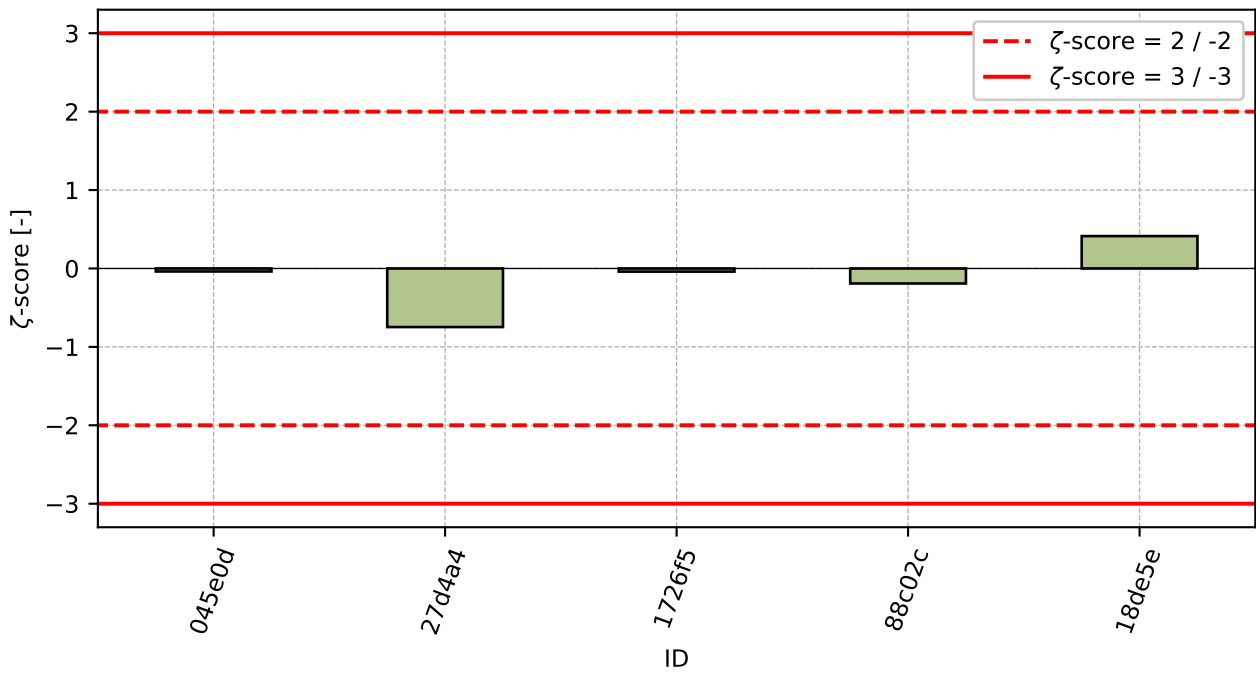


Figure 46: ζ -score

Table 18: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
045e0d	-1.4	-0.04
27d4a4	-0.49	-0.75
1726f5	-0.29	-0.04
88c02c	-0.19	-0.19
18de5e	1.72	0.41

2.2.2 Strain at yield

Test results

Table 19: 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 [%]
1726f5	4.7	4.8	4.7	4.7	4.8	0.5	4.7	0.05	1.16
27d4a4	4.8	4.9	4.9	4.8	4.8	0.1	4.8	0.04	0.91
18de5e	4.8	4.9	4.9	5.0	4.9	0.2	4.9	0.07	1.44
045e0d	4.8	4.9	5.0	5.2	5.2	0.5	5.0	0.18	3.68
88c02c	5.1	5.2	5.1	5.0	5.0	0.2	5.1	0.09	1.86

The Numerical Procedure for Determining Outliers

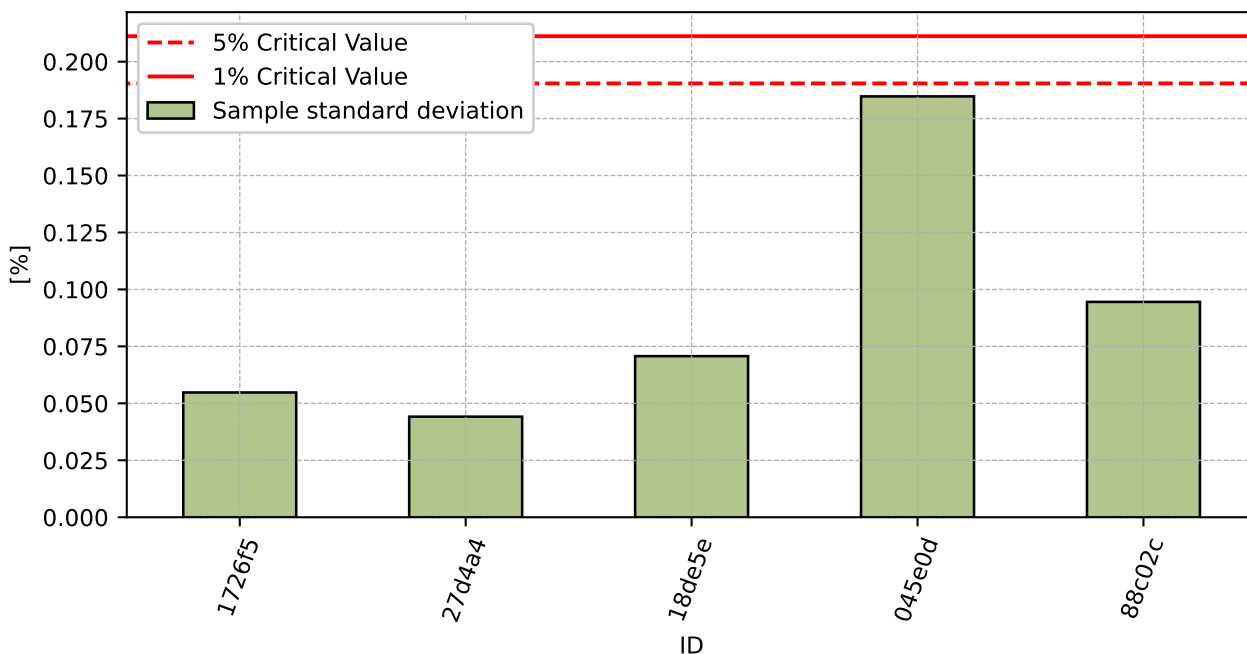


Figure 47: Cochran's test - sample standard deviations

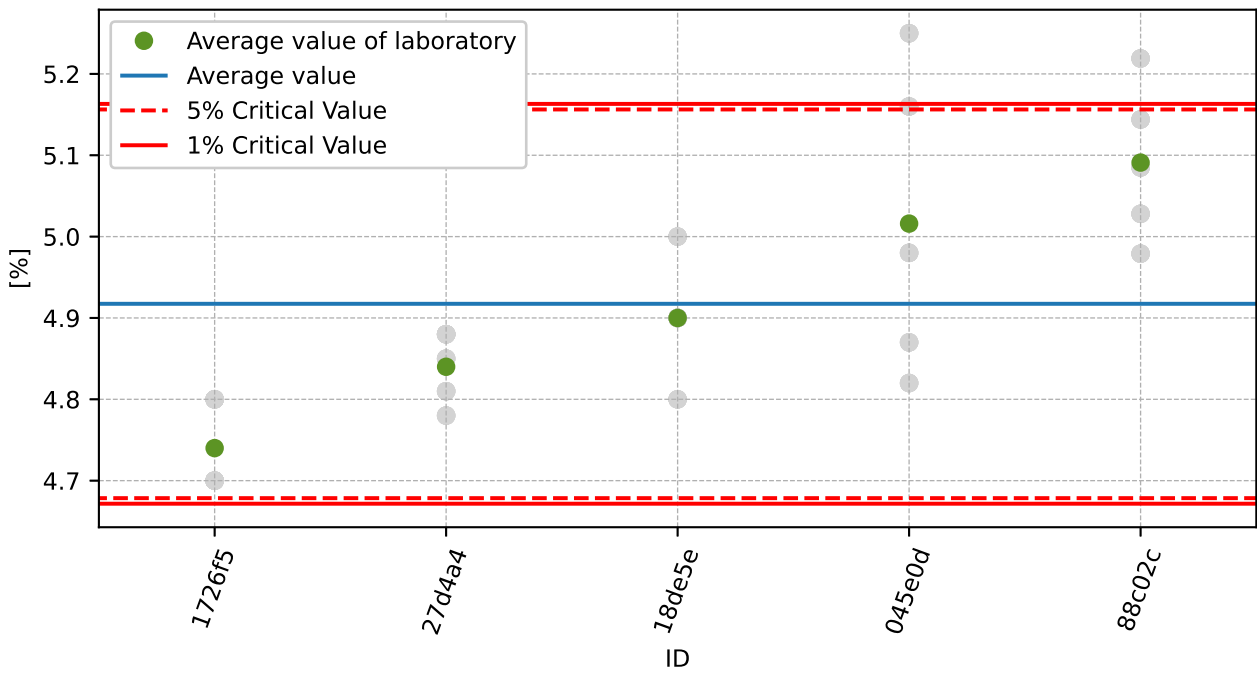


Figure 48: **Grubbs' test** - average values

Mandel's Statistics

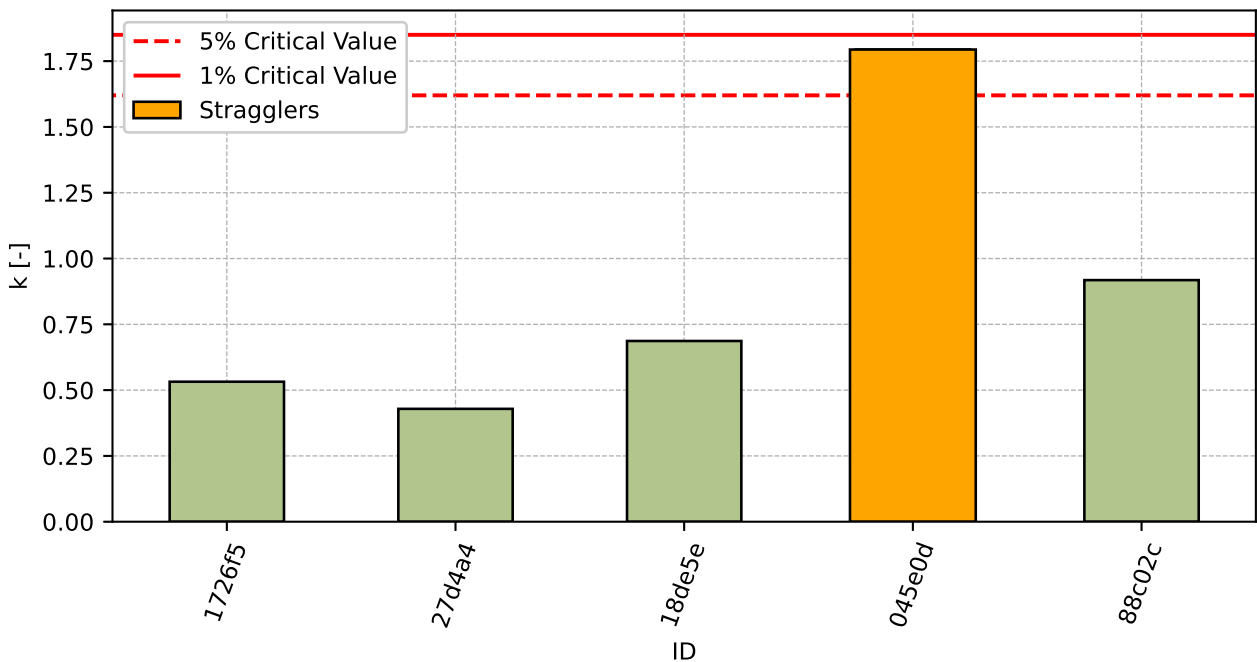


Figure 49: Intralaboratory Consistency Statistic

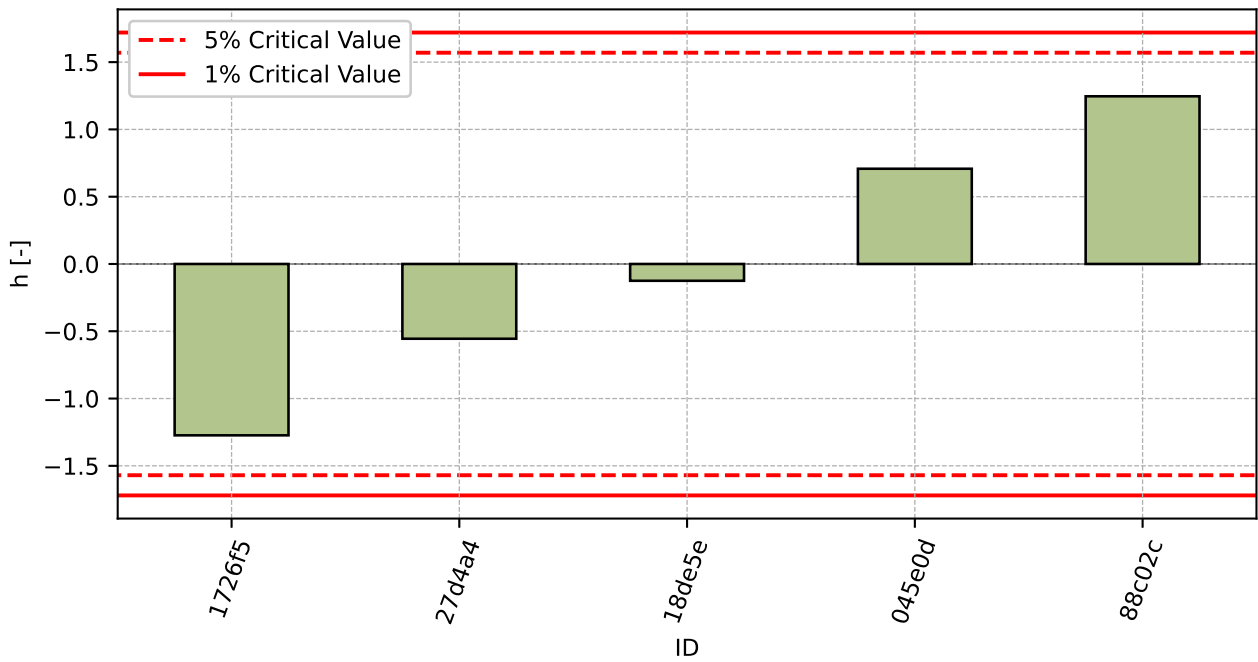


Figure 50: Interlaboratory Consistency Statistic

Descriptive statistics

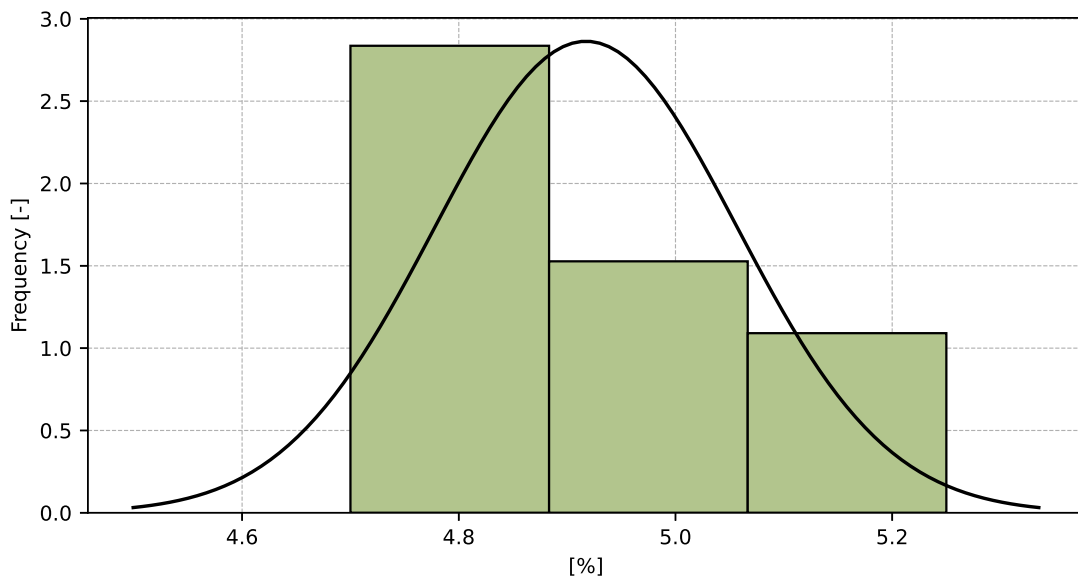


Figure 51: Histogram of all test results

Table 20: Descriptive statistics

Characteristics	[%]
Average value – \bar{x}	4.9
Sample standard deviation – s	0.14
Assigned value – x^*	4.9
Robust standard deviation – s^*	0.14
Measurement uncertainty of assigned value – u_X	0.08
p -value of normality test	0.1 [-]
Interlaboratory standard deviation – s_L	0.13
Repeatability standard deviation – s_r	0.1
Reproducibility standard deviation – s_R	0.17
Repeatability – r	0.3
Reproducibility – R	0.5

Evaluation of Performance Statistics

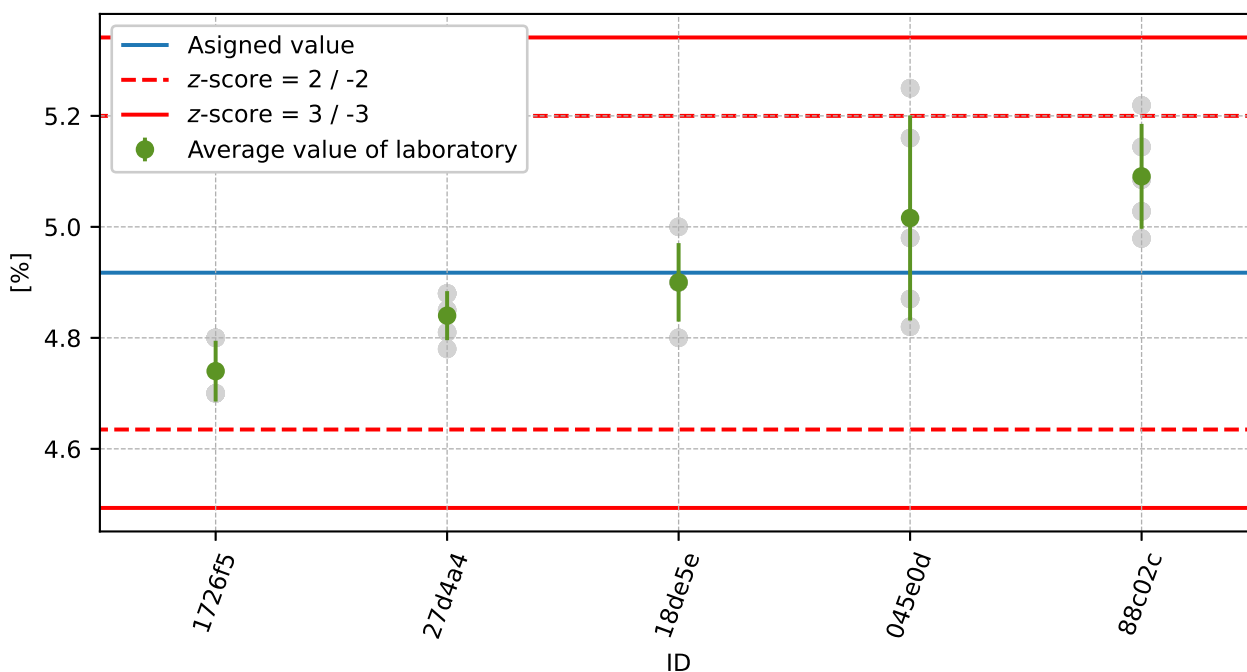


Figure 52: Average values and sample standard deviations

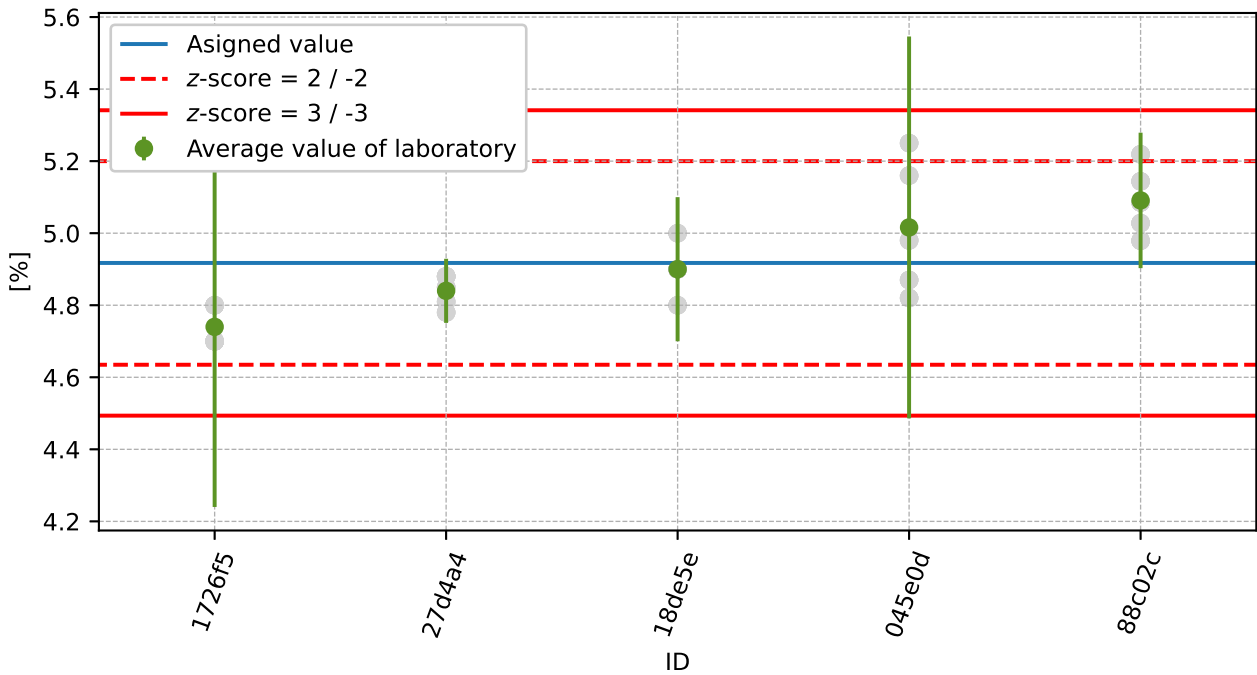


Figure 53: Average values and extended uncertainties of measurement

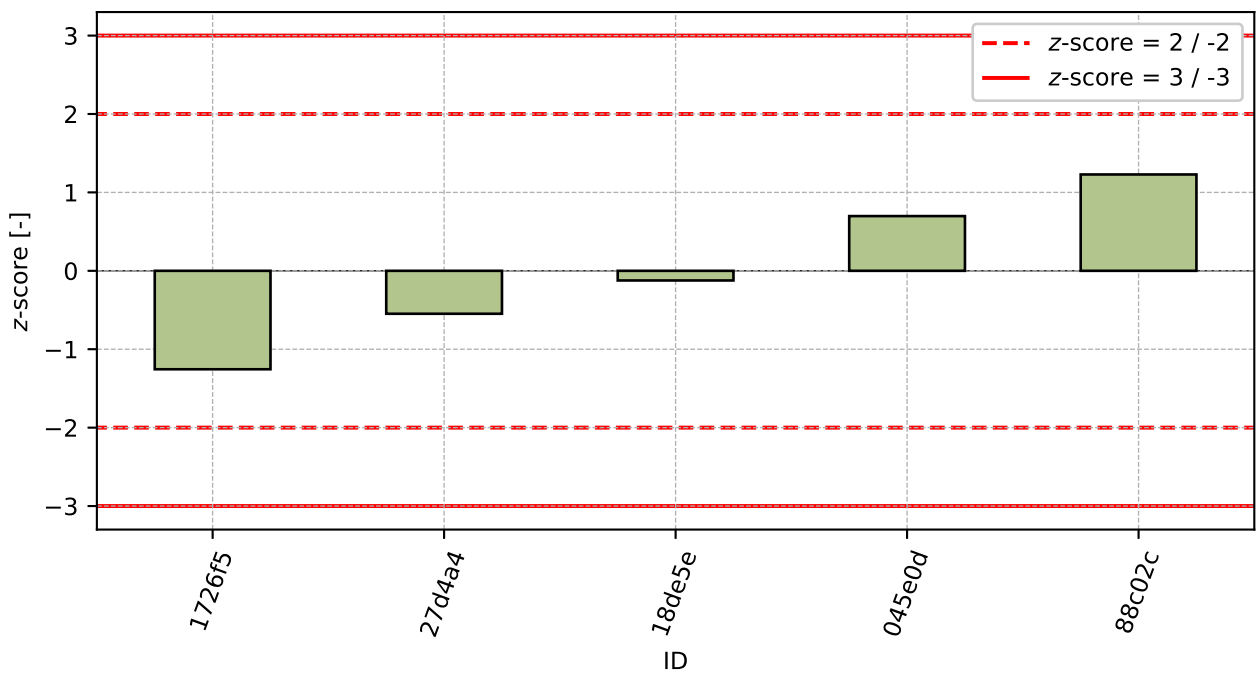
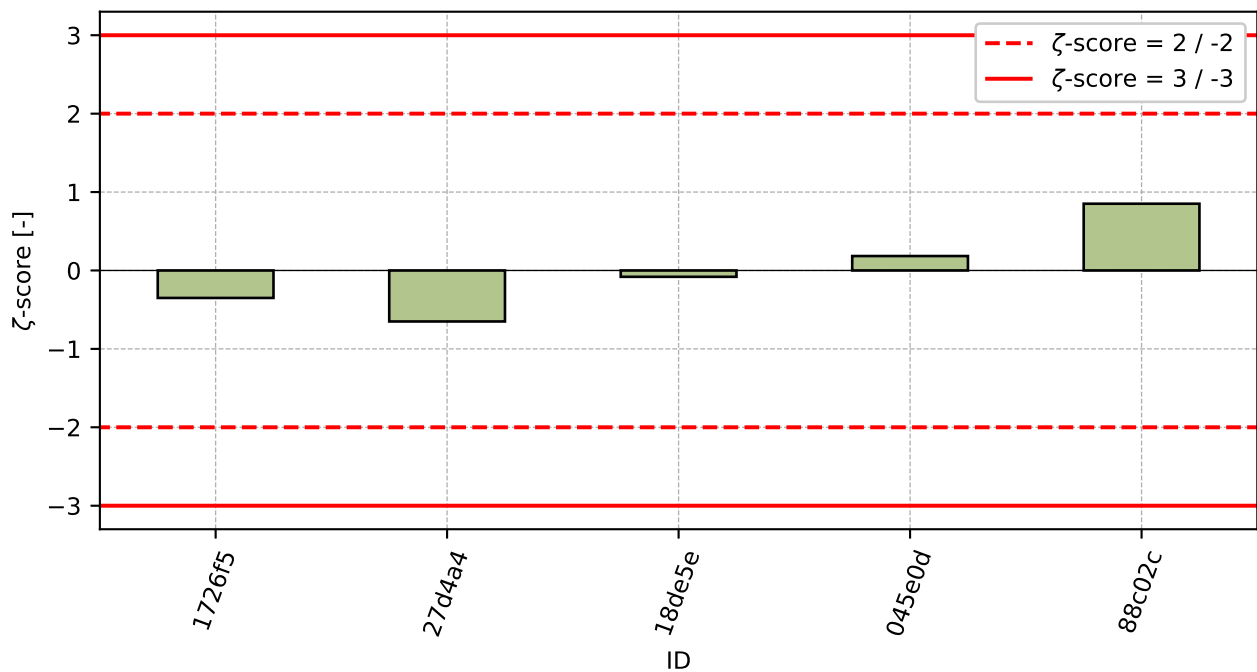


Figure 54: z-score

Figure 55: ζ -scoreTable 21: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
1726f5	-1.26	-0.35
27d4a4	-0.55	-0.65
18de5e	-0.12	-0.08
045e0d	0.7	0.18
88c02c	1.23	0.85

3 Appendix – EN ISO 527-1, 2 (Stress at yield)

3.1 Sample A

3.1.1 Test results

Table 22: Test results - ordered by average value. Outliers are marked by red color. u_x - extended uncertainty of measurement; \bar{x} - average value; s_0 - sample standard deviation; V_x - variation coefficient

ID	Test results [MPa]					u_x [MPa]	\bar{x} [MPa]	s_0 [MPa]	V_x [%]
c01900	34.9	34.9	35.2	35.0	35.1	-	35.0	0.13	0.37
18de5e	35.6	35.5	36.1	35.8	36.7	0.9	35.9	0.48	1.34
88c02c	37.3	37.2	37.3	37.1	37.0	0.3	37.2	0.15	0.39
b07b25	41.9	42.2	42.3	43.4	40.8	0.9	42.1	0.9	2.14

3.1.2 The Numerical Procedure for Determining Outliers

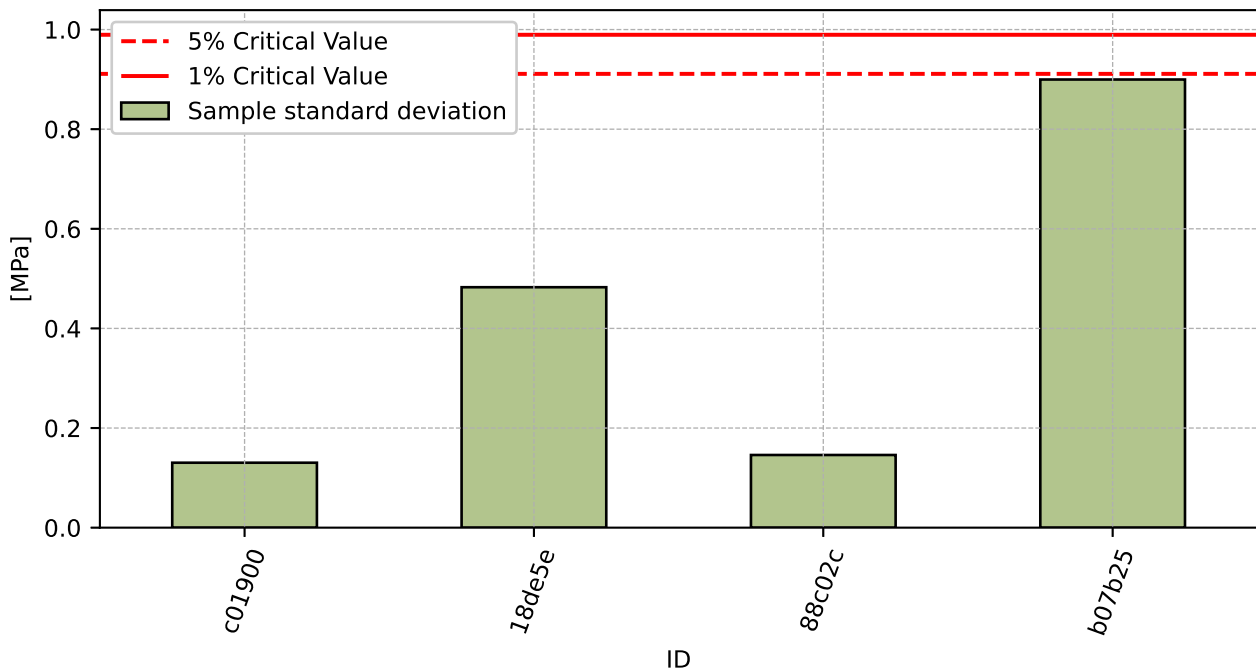


Figure 56: Cochran's test - sample standard deviations

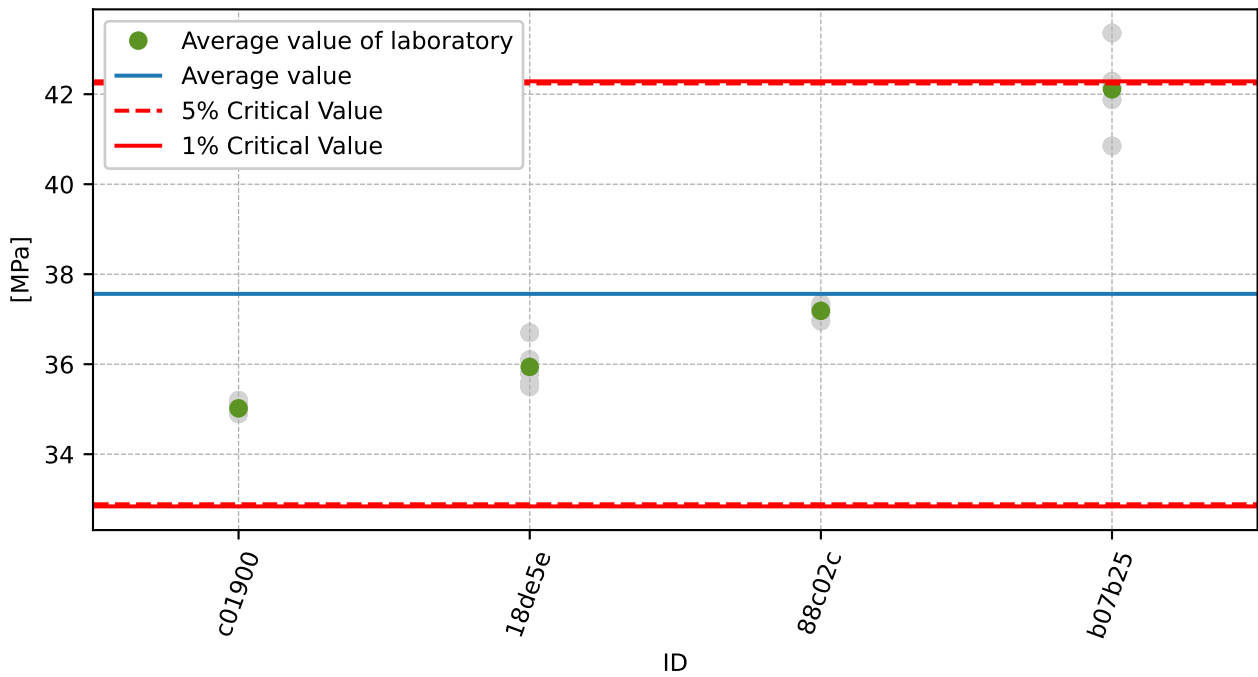


Figure 57: **Grubbs' test** - average values

3.1.3 Mandel's Statistics

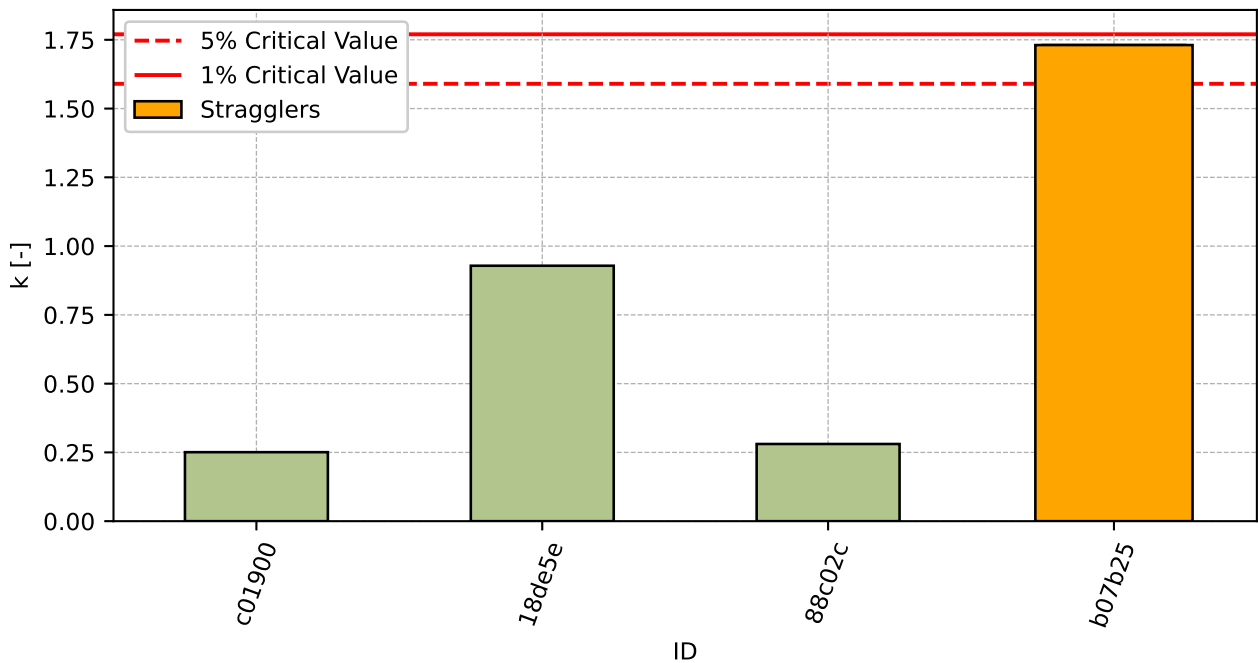


Figure 58: Intralaboratory Consistency Statistic

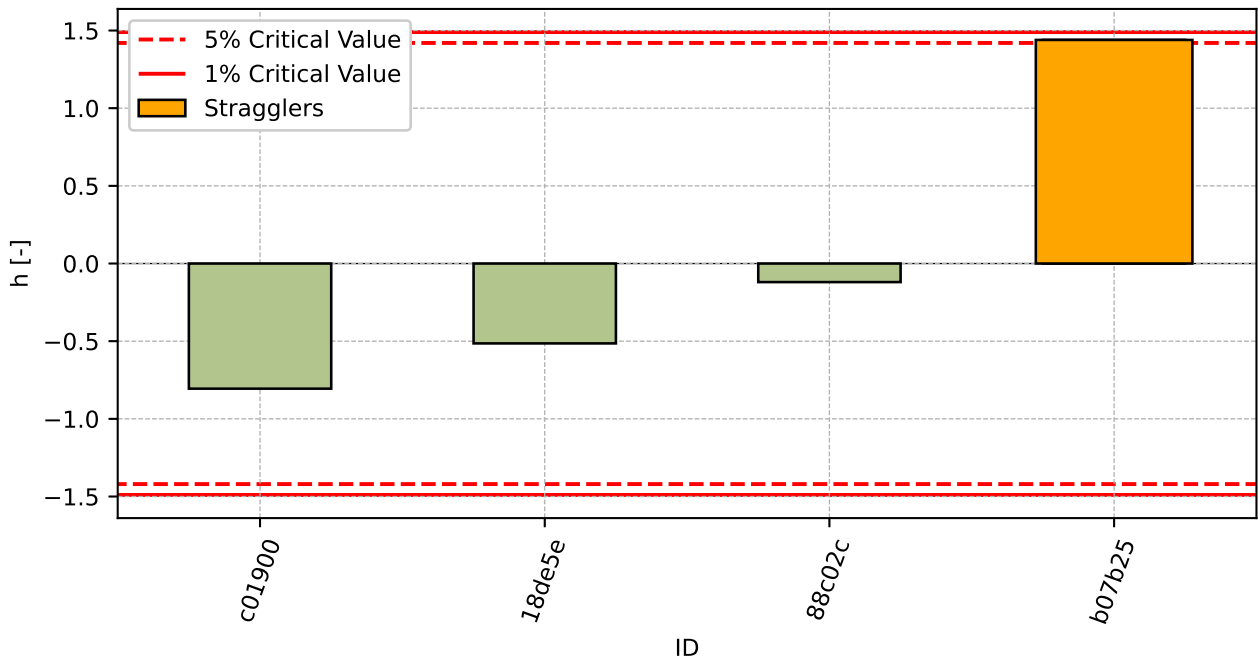


Figure 59: Interlaboratory Consistency Statistic

3.1.4 Descriptive statistics

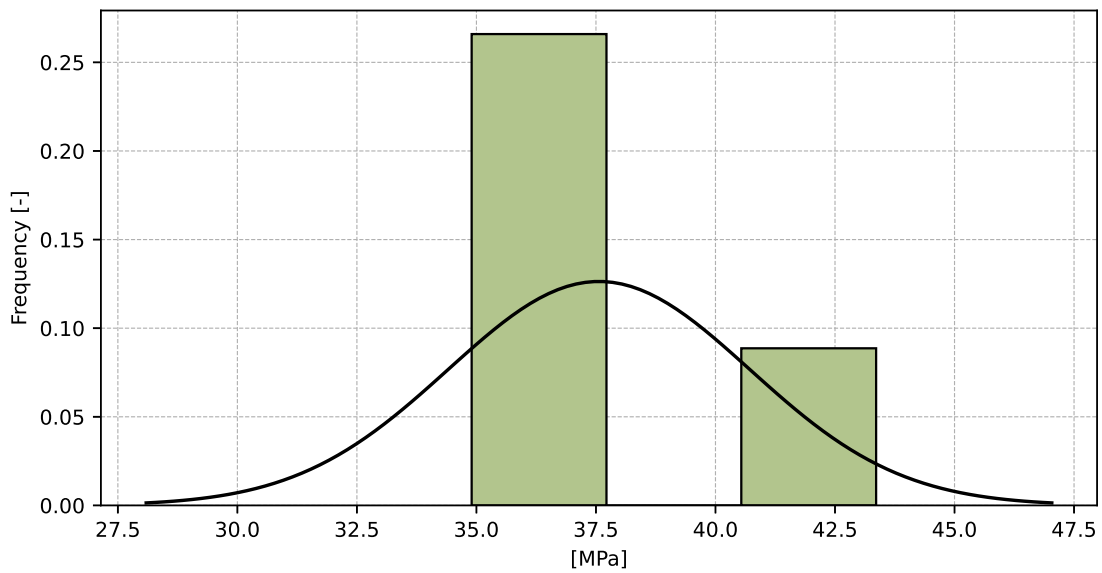


Figure 60: Histogram of all test results

Table 23: Descriptive statistics

Characteristics	[MPa]
Average value – \bar{x}	37.6
Sample standard deviation – s	3.16
Assigned value – x^*	37.6
Robust standard deviation – s^*	3.1
Measurement uncertainty of assigned value – u_X	1.94
p -value of normality test	0.001 [-]
Interlaboratory standard deviation – s_L	3.15
Repeatability standard deviation – s_r	0.52
Reproducibility standard deviation – s_R	3.19
Repeatability – r	1.5
Reproducibility – R	8.9

3.1.5 Evaluation of Performance Statistics

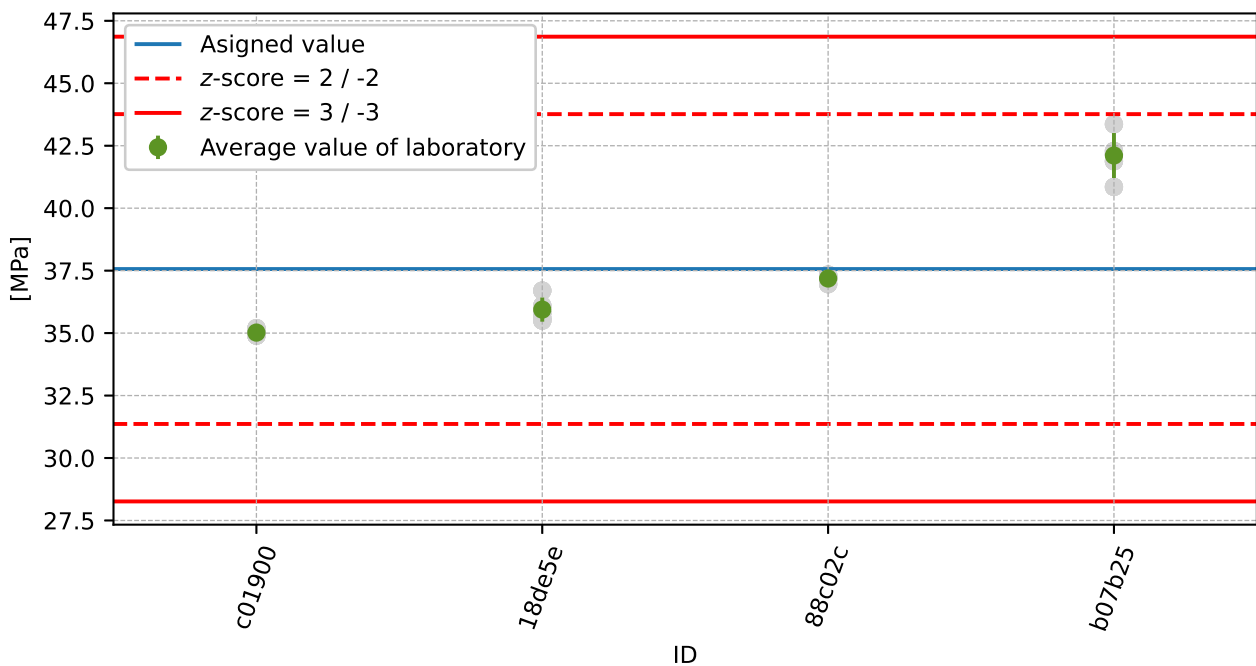


Figure 61: Average values and sample standard deviations

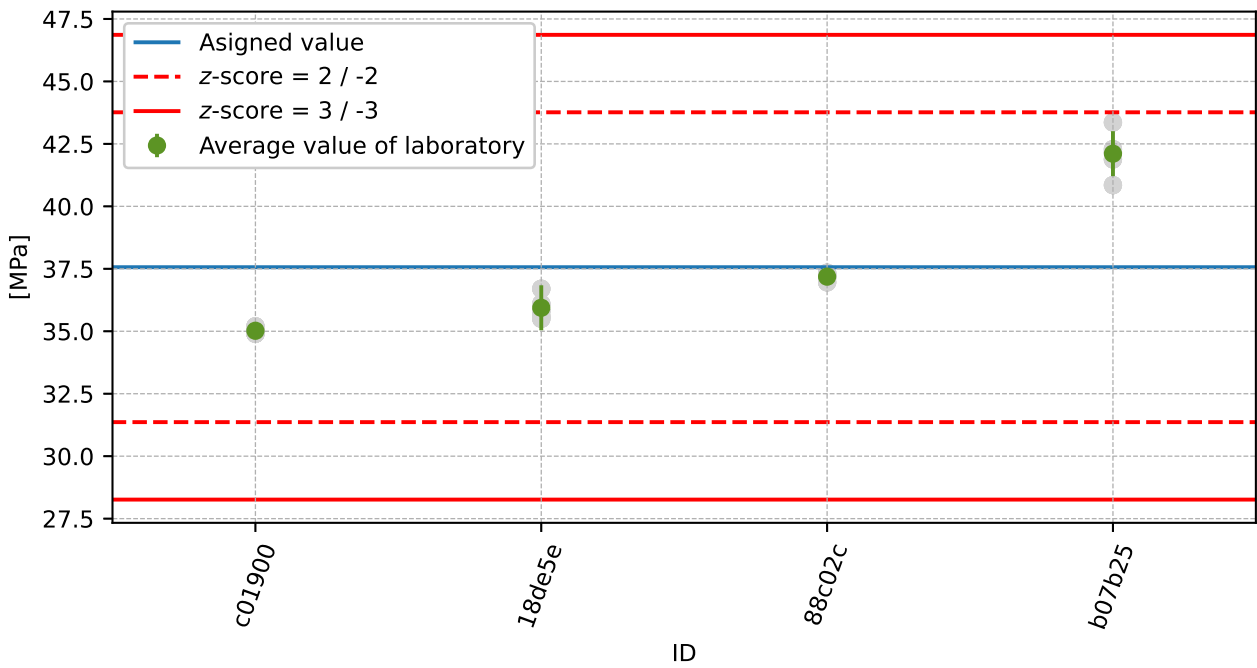


Figure 62: Average values and extended uncertainties of measurement

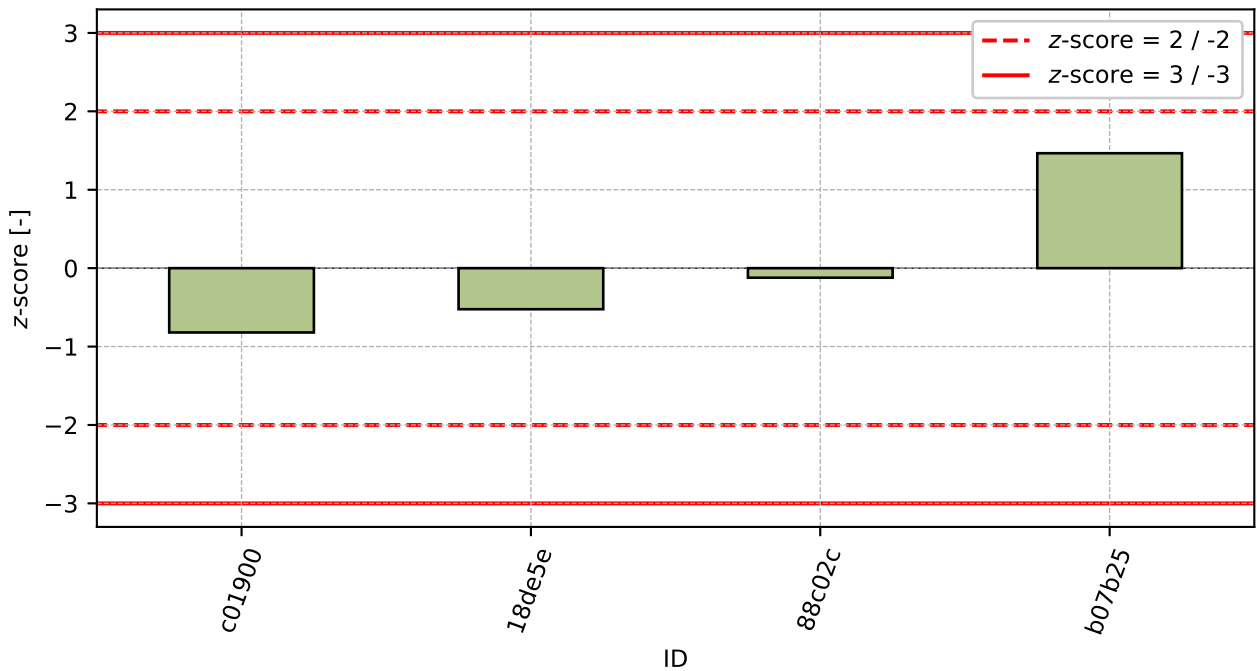


Figure 63: z-score

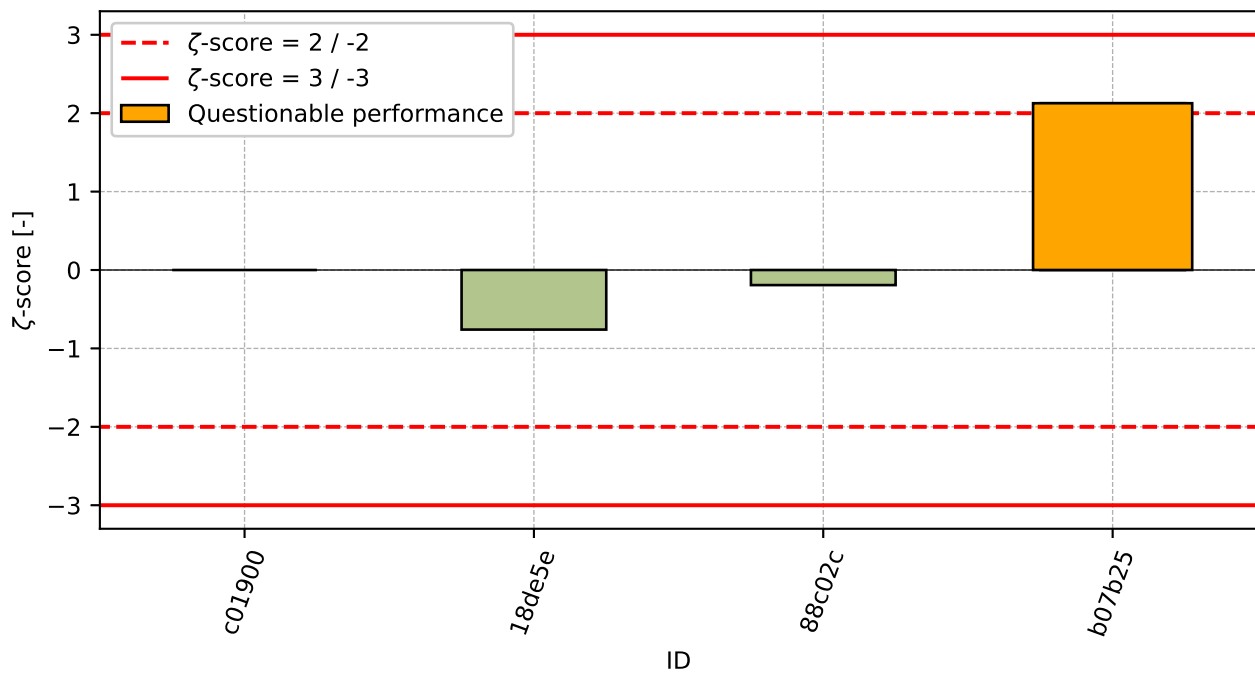


Figure 64: z-score

Table 24: z-score and z-score

ID	z-score [-]	z-score [-]
c01900	-0.82	-
18de5e	-0.52	-0.76
88c02c	-0.12	-0.19
b07b25	1.47	2.13

3.2 Sample B

3.2.1 Test results

Table 25: 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 [MPa]	\bar{x} [MPa]	s_0 [MPa]	V_x [%]
	[MPa]								
c01900	27.4	27.5	27.4	27.7	27.7	-	27.5	0.15	0.55
18de5e	27.9	28.3	28.7	28.3	28.3	0.7	28.3	0.28	1.0
88c02c	29.0	28.7	28.6	28.6	28.7	0.3	28.7	0.14	0.47
b07b25	32.6	32.5	31.7	34.6	33.1	1.1	32.9	1.06	3.23

3.2.2 The Numerical Procedure for Determining Outliers

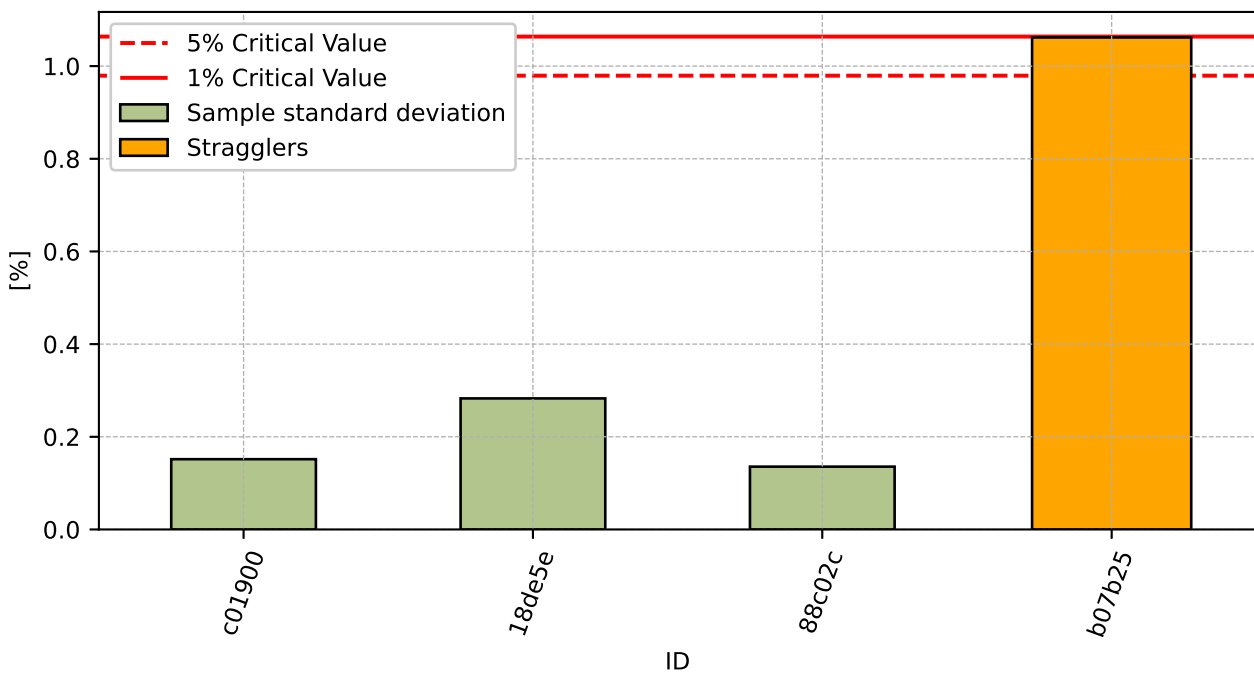


Figure 65: Cochran's test - sample standard deviations

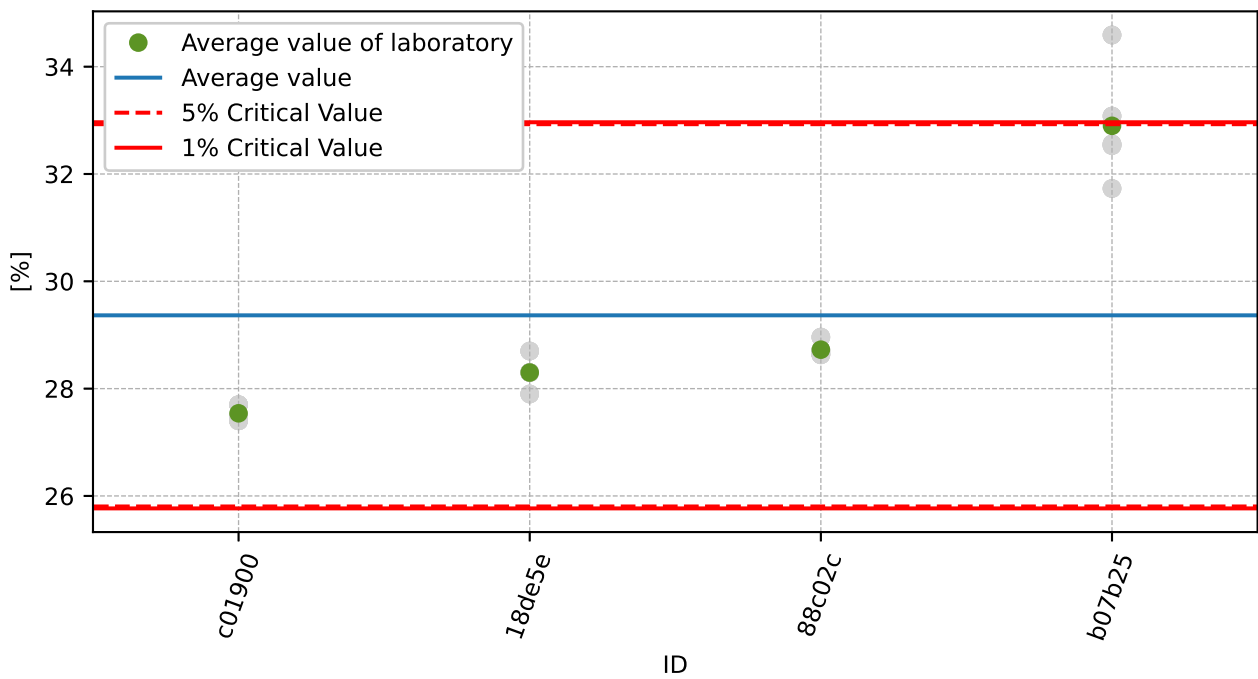


Figure 66: **Grubbs' test** - average values

3.2.3 Mandel's Statistics

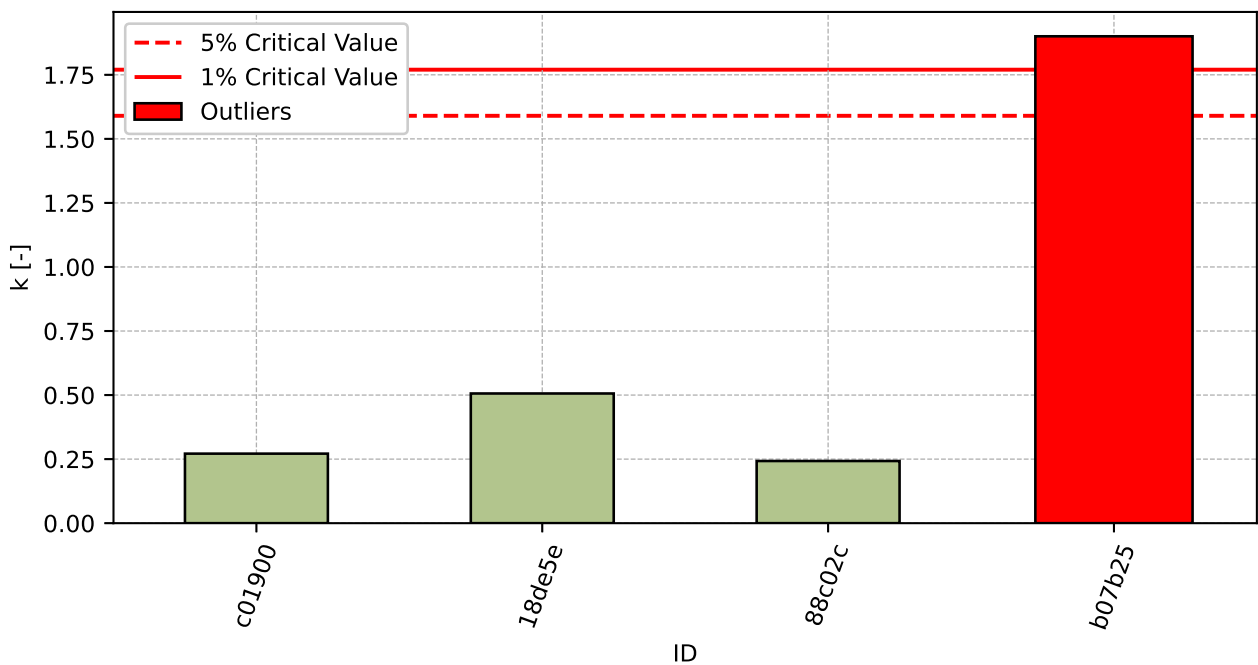


Figure 67: Intralaboratory Consistency Statistic

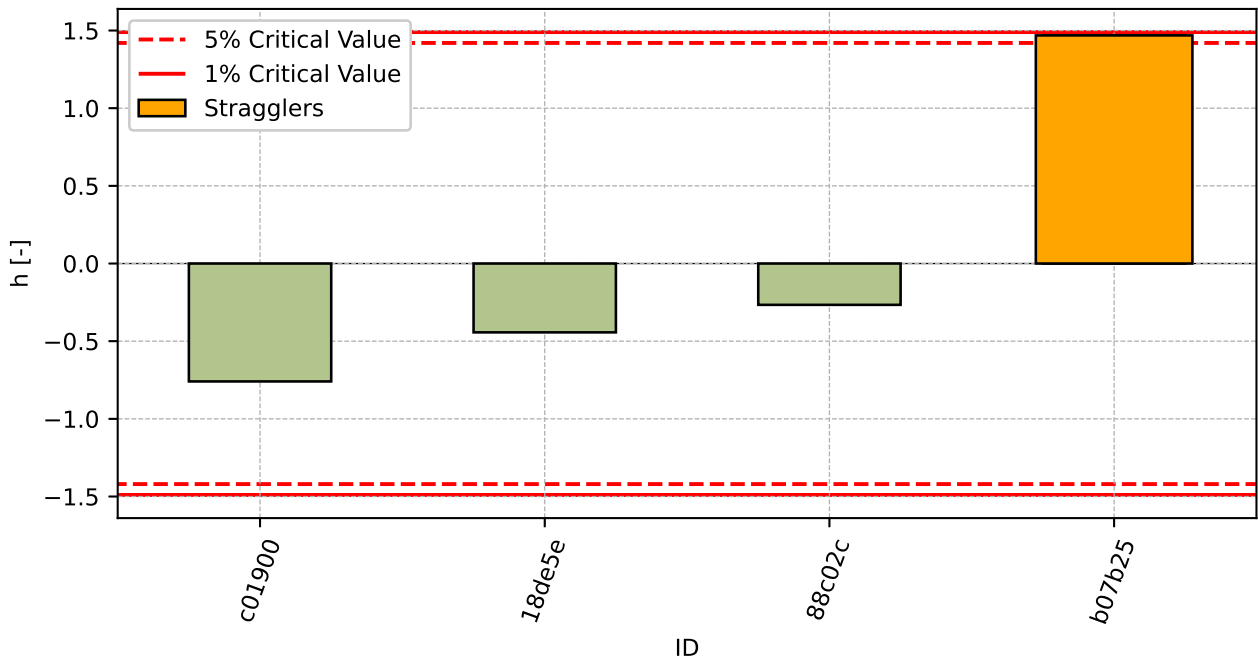


Figure 68: Interlaboratory Consistency Statistic

3.2.4 Descriptive statistics

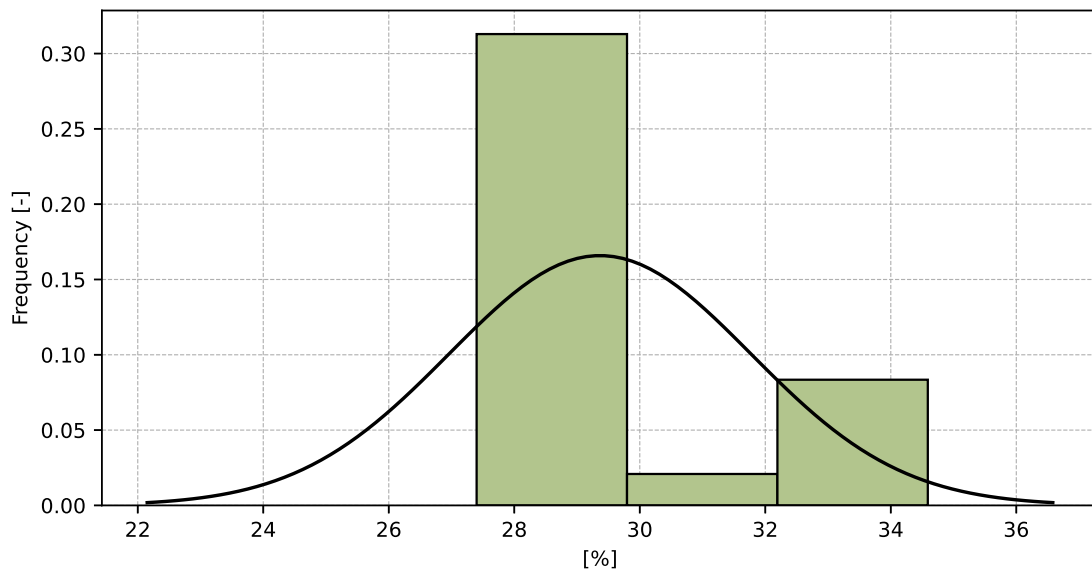


Figure 69: Histogram of all test results

Table 26: Descriptive statistics

Characteristics	[MPa]
Average value – \bar{x}	29.4
Sample standard deviation – s	2.41
Assigned value – x^*	29.4
Robust standard deviation – s^*	2.36
Measurement uncertainty of assigned value – u_X	1.48
p -value of normality test	0.0 [-]
Interlaboratory standard deviation – s_L	2.39
Repeatability standard deviation – s_r	0.56
Reproducibility standard deviation – s_R	2.46
Repeatability – r	1.6
Reproducibility – R	6.9

3.2.5 Evaluation of Performance Statistics

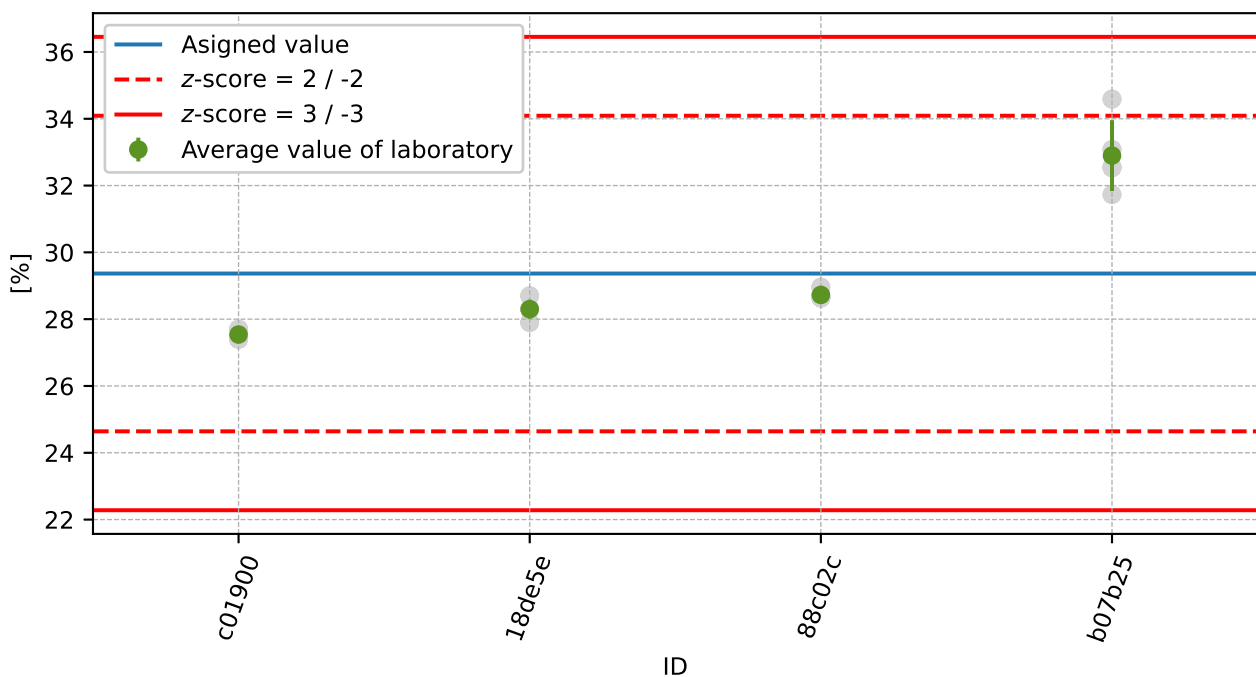


Figure 70: Average values and sample standard deviations

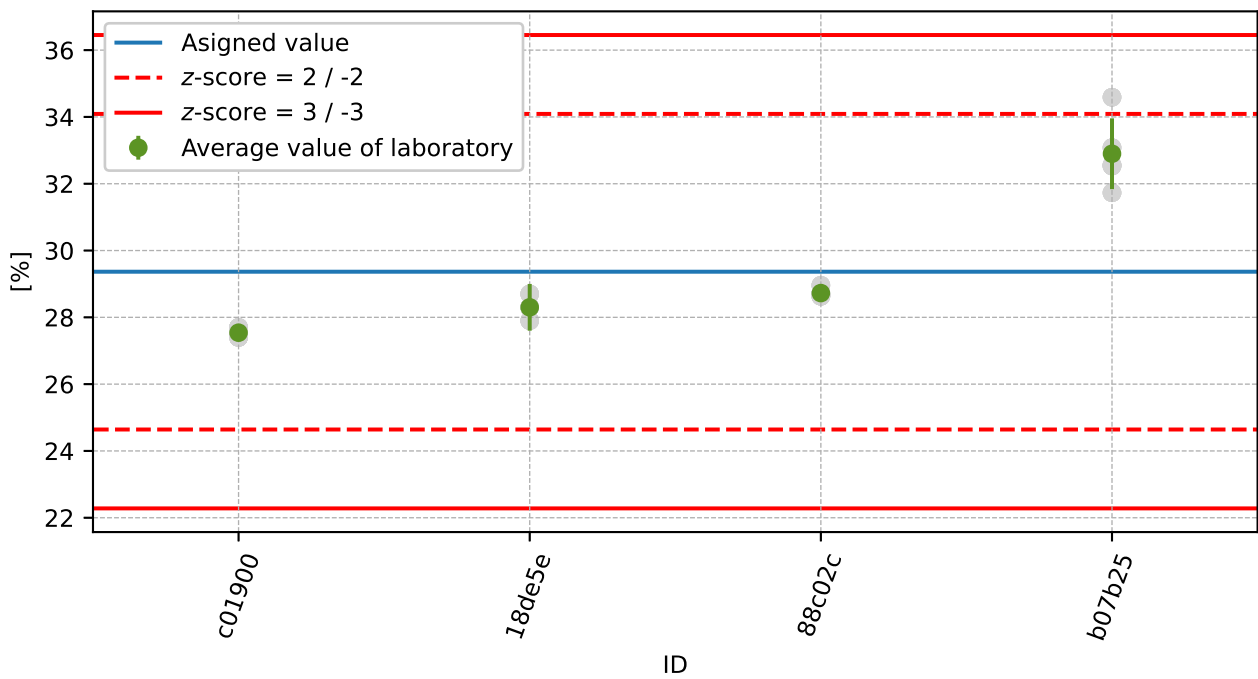


Figure 71: Average values and extended uncertainties of measurement

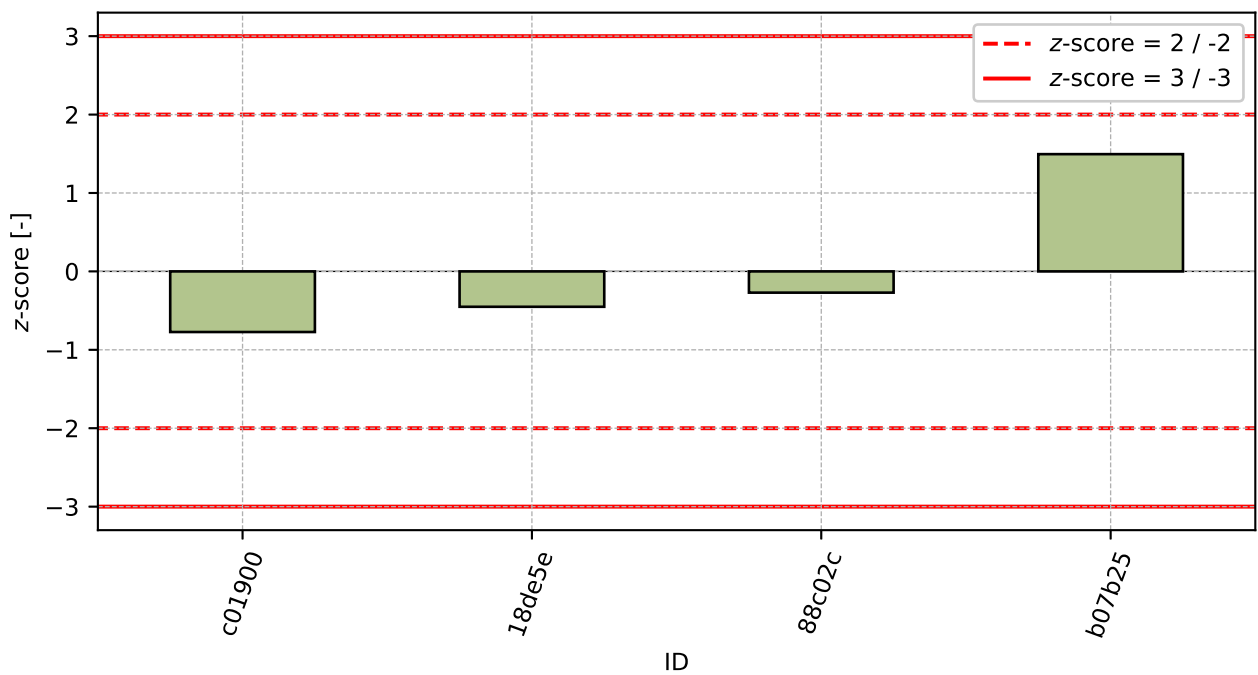


Figure 72: z-score

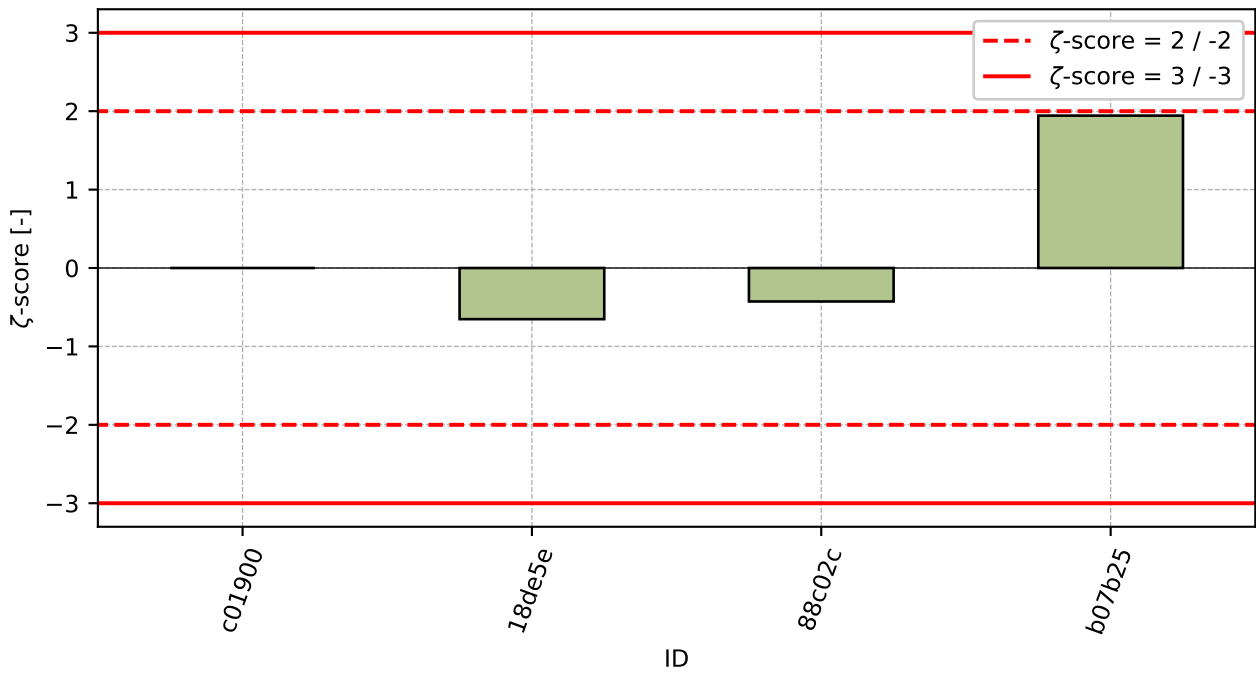


Figure 73: ζ -score

Table 27: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
c01900	-0.77	-
18de5e	-0.45	-0.65
88c02c	-0.27	-0.43
b07b25	1.5	1.94

4 Appendix – EN ISO 178 (Flexural modulus)

4.1 Sample A

4.1.1 Test results

Table 28: 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 [MPa]	\bar{x} [MPa]	s_0 [MPa]	V_x [%]
	[MPa]								
c01900	1590	1522	1552	1557	1564	24	1557	24.4	1.57
88c02c	1630	1680	1700	1690	1700	62	1680	29.2	1.74
108c2a	1770	1767	1782	1771	1766	6	1771	6.4	0.36
18de5e	1830	1836	1846	1794	1839	41	1829	20.4	1.12
045e0d	1974	1918	1931	1906	1903	58	1926	28.8	1.5

4.1.2 The Numerical Procedure for Determining Outliers

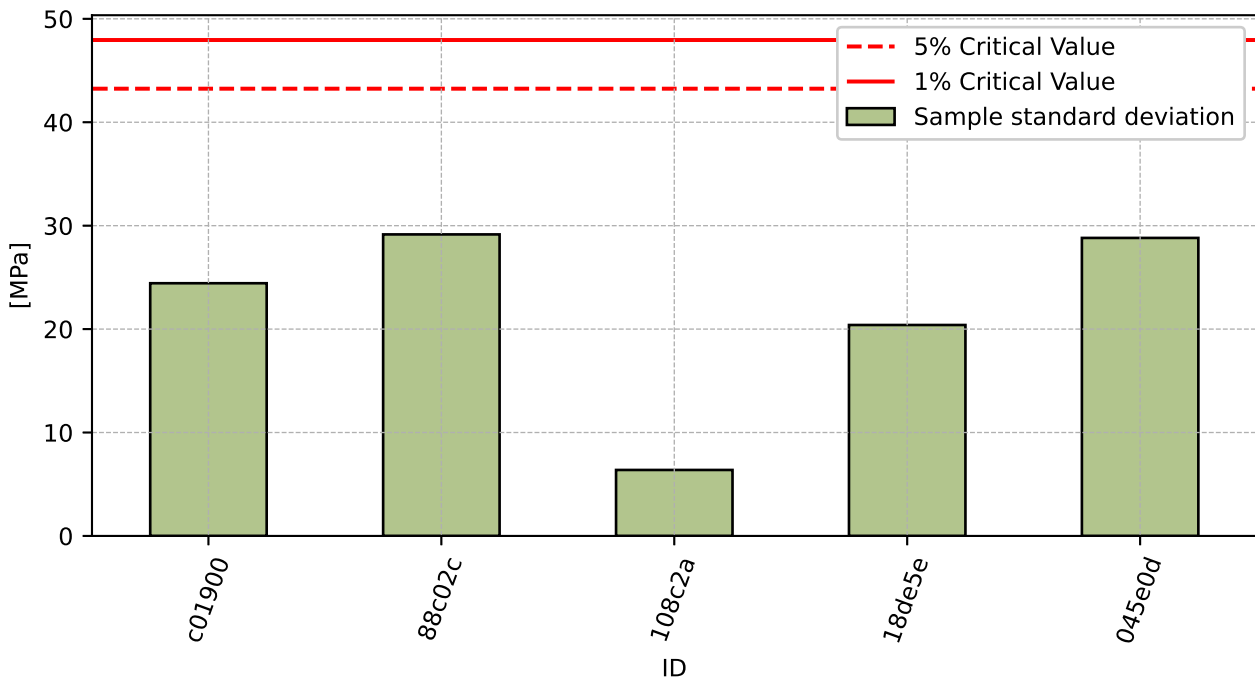


Figure 74: Cochran's test - sample standard deviations

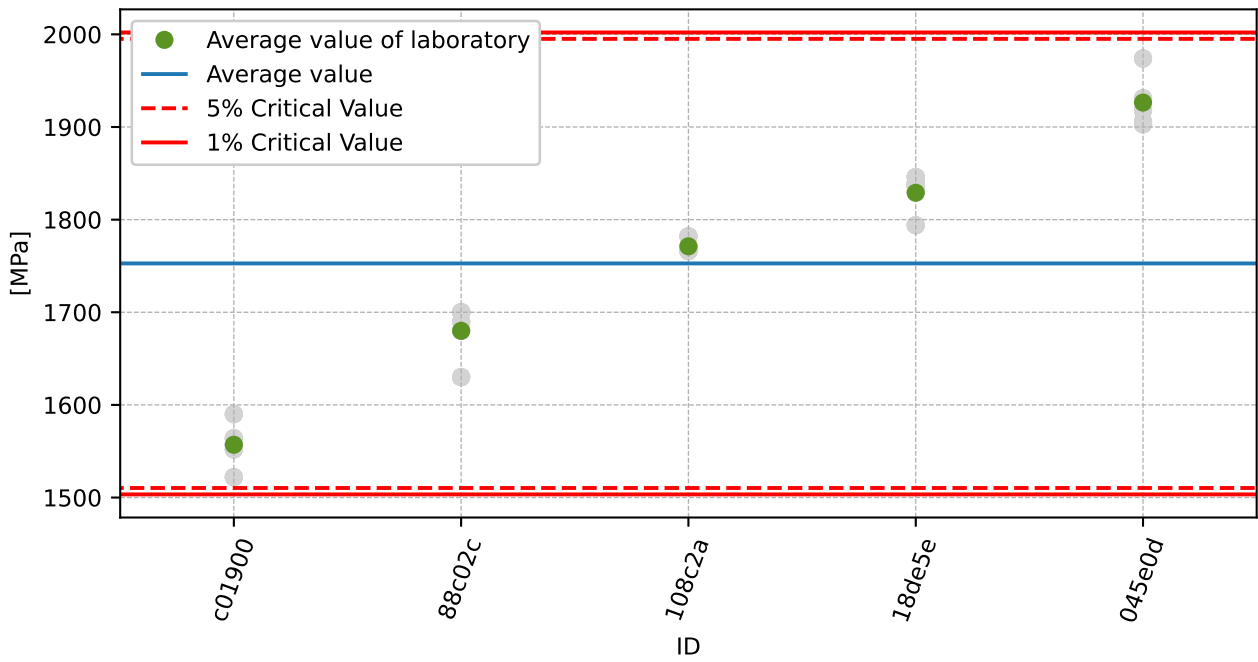


Figure 75: **Grubbs' test** - average values

4.1.3 Mandel's Statistics

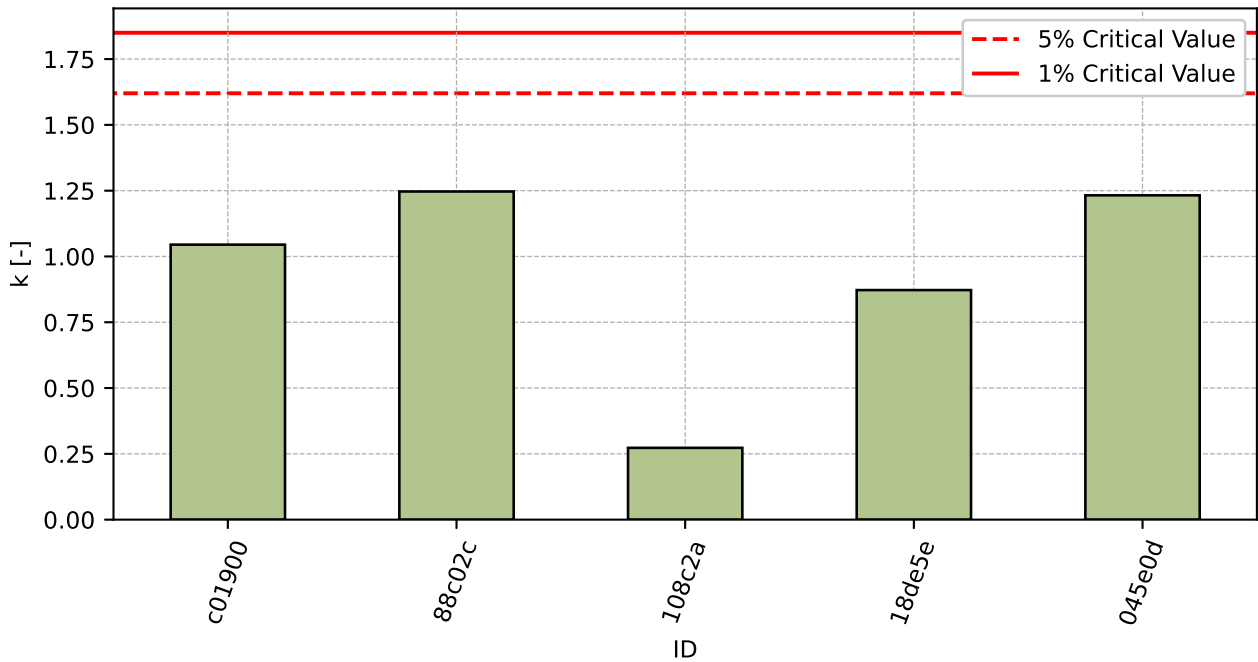


Figure 76: Intralaboratory Consistency Statistic

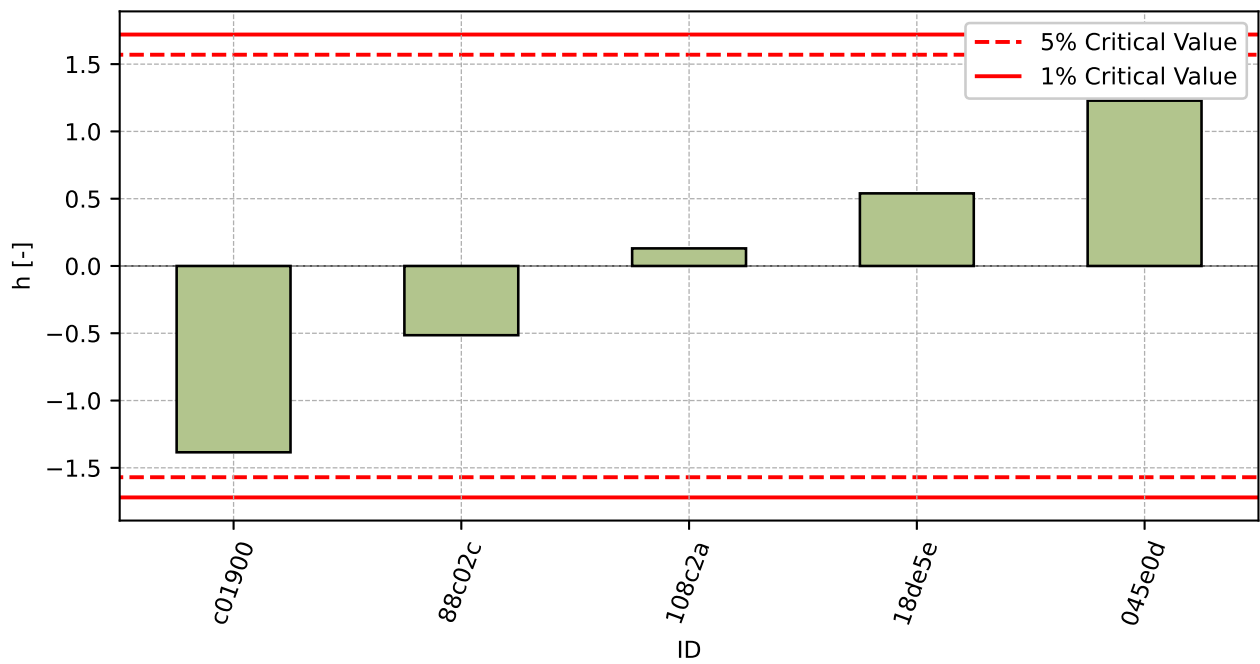


Figure 77: Interlaboratory Consistency Statistic

4.1.4 Descriptive statistics



Figure 78: Histogram of all test results

Table 29: Descriptive statistics

Characteristics	[MPa]
Average value – \bar{x}	1753
Sample standard deviation – s	141.4
Assigned value – x^*	1755
Robust standard deviation – s^*	139.4
Measurement uncertainty of assigned value – u_X	77.9
p -value of normality test	0.332 [-]
Interlaboratory standard deviation – s_L	141.0
Repeatability standard deviation – s_r	23.4
Reproducibility standard deviation – s_R	142.9
Repeatability – r	65
Reproducibility – R	400

4.1.5 Evaluation of Performance Statistics

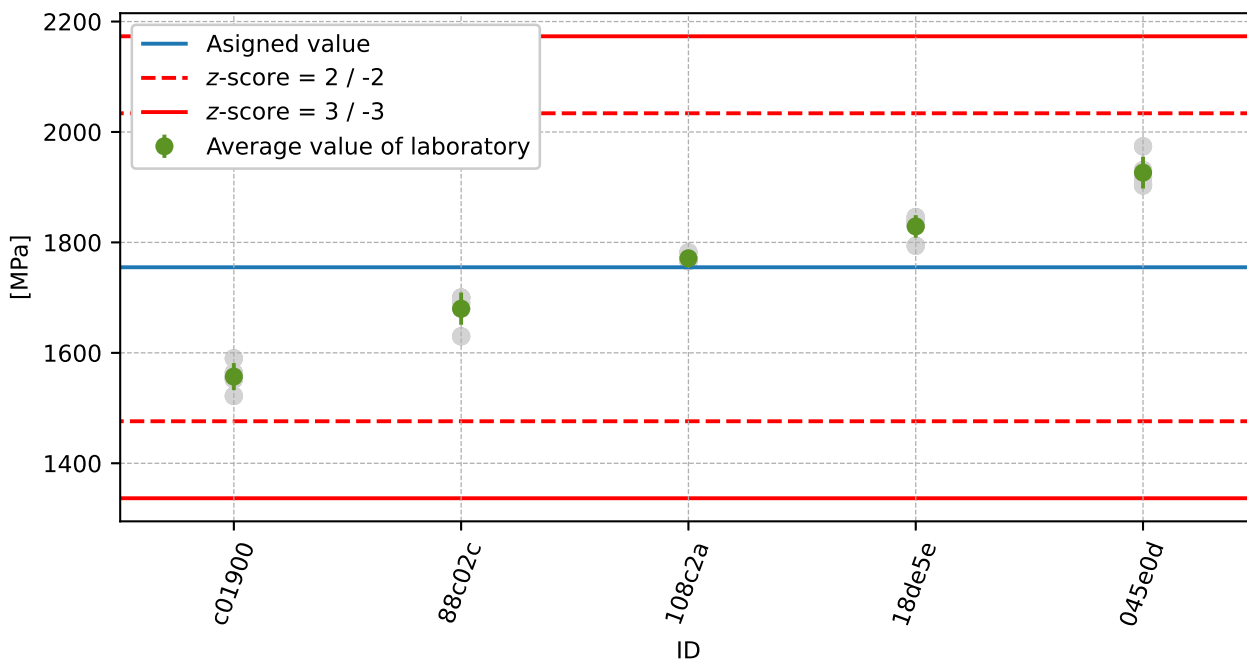


Figure 79: Average values and sample standard deviations

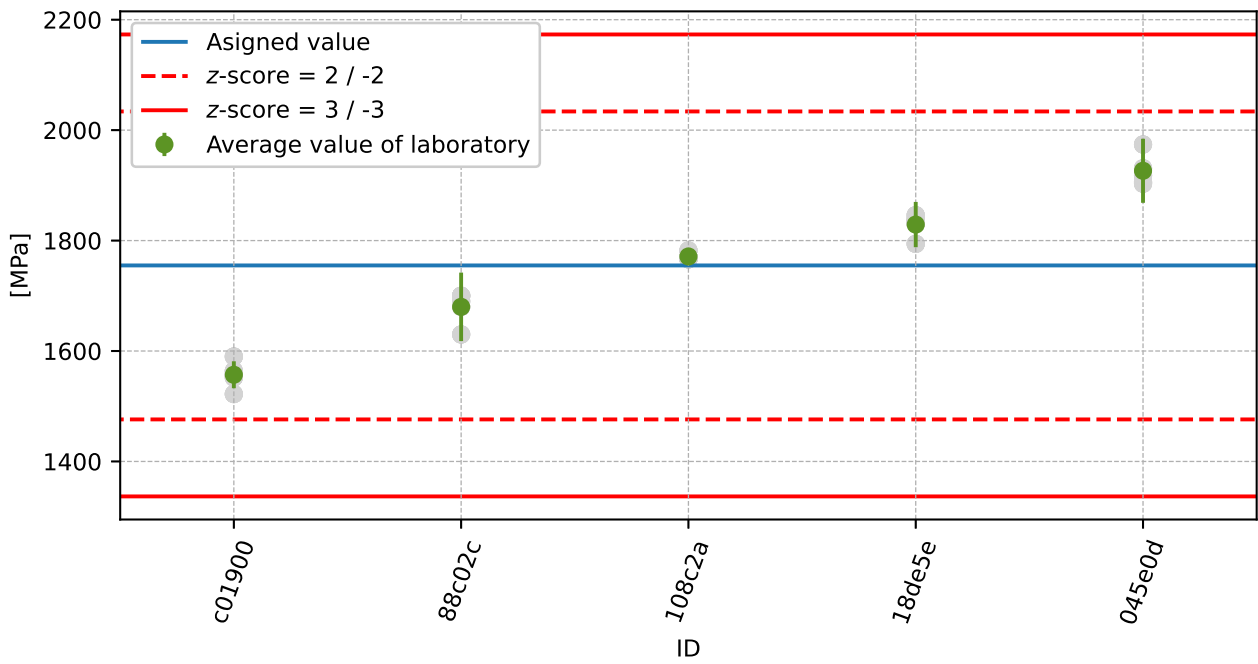


Figure 80: Average values and extended uncertainties of measurement

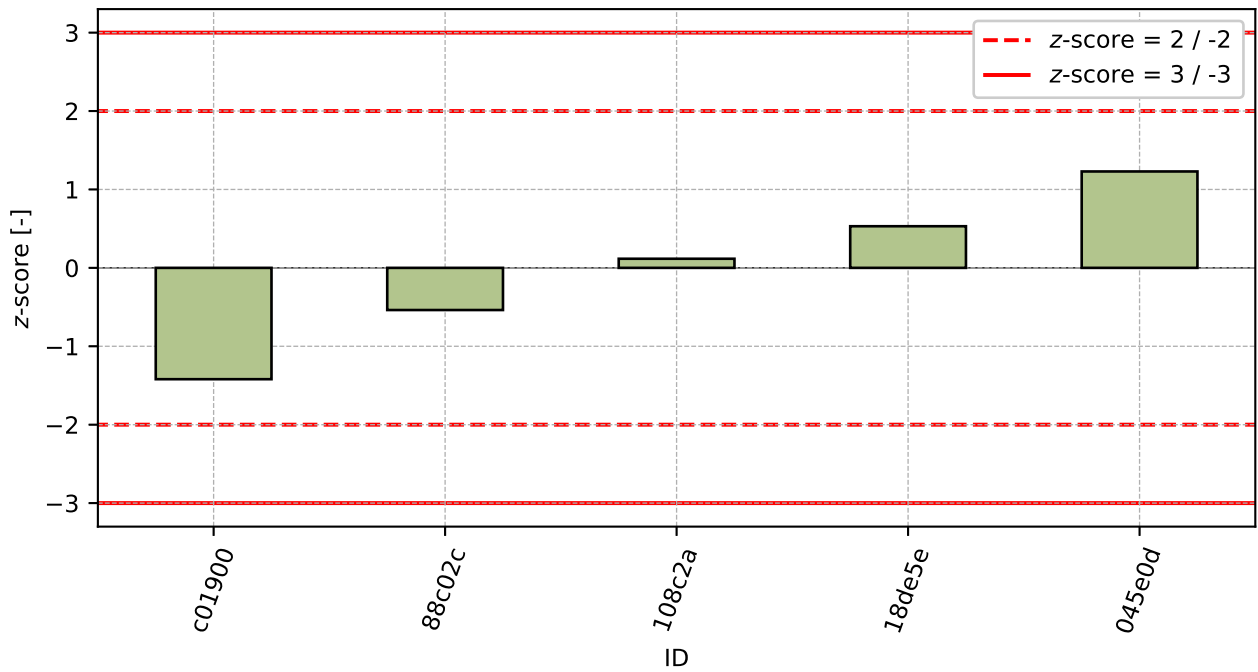


Figure 81: z-score

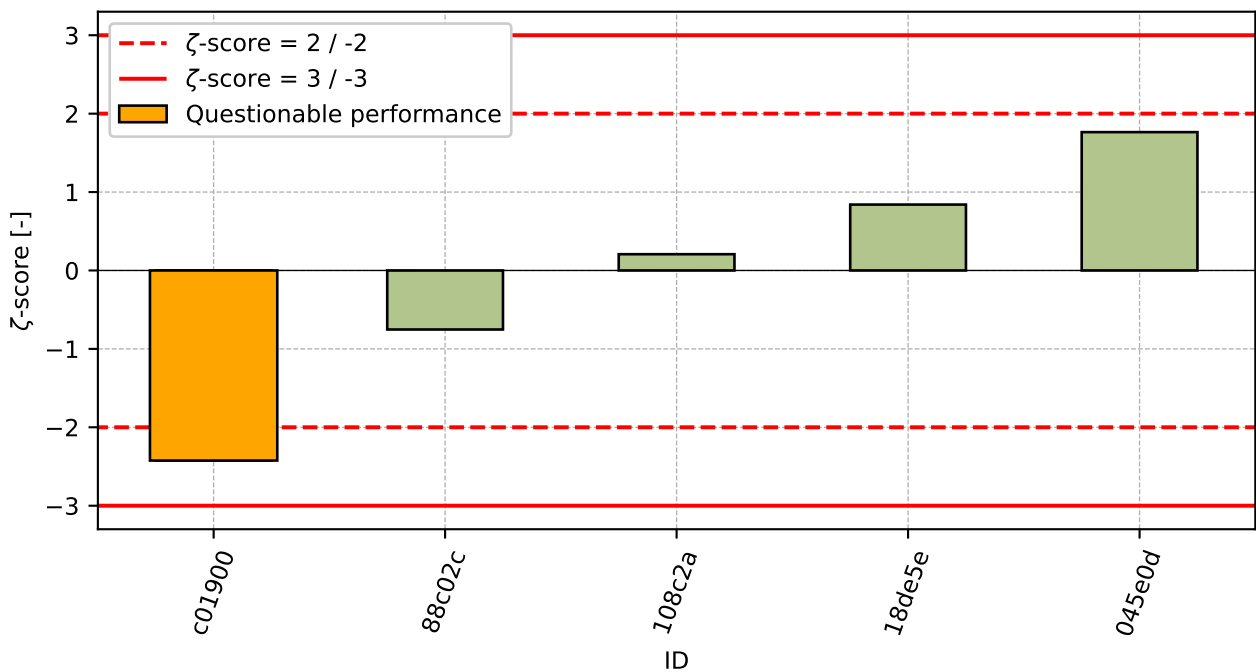


Figure 82: ζ -score

Table 30: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
c01900	-1.42	-2.42
88c02c	-0.54	-0.75
108c2a	0.12	0.21
18de5e	0.53	0.84
045e0d	1.23	1.76

4.2 Sample B

4.2.1 Test results

Table 31: 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 [MPa]	\bar{x} [MPa]	s_0 [MPa]	V_x [%]
	[MPa]								
c01900	1369	1366	1372	1367	1374	3	1370	3.4	0.25
88c02c	1440	1440	1440	1440	1450	7	1442	4.5	0.31
108c2a	1528	1524	1527	1531	1524	3	1527	2.9	0.19
18de5e	1568	1599	1603	1566	1559	37	1579	20.4	1.29
045e0d	1659	1674	1679	1677	1678	18	1673	8.3	0.49

4.2.2 The Numerical Procedure for Determining Outliers

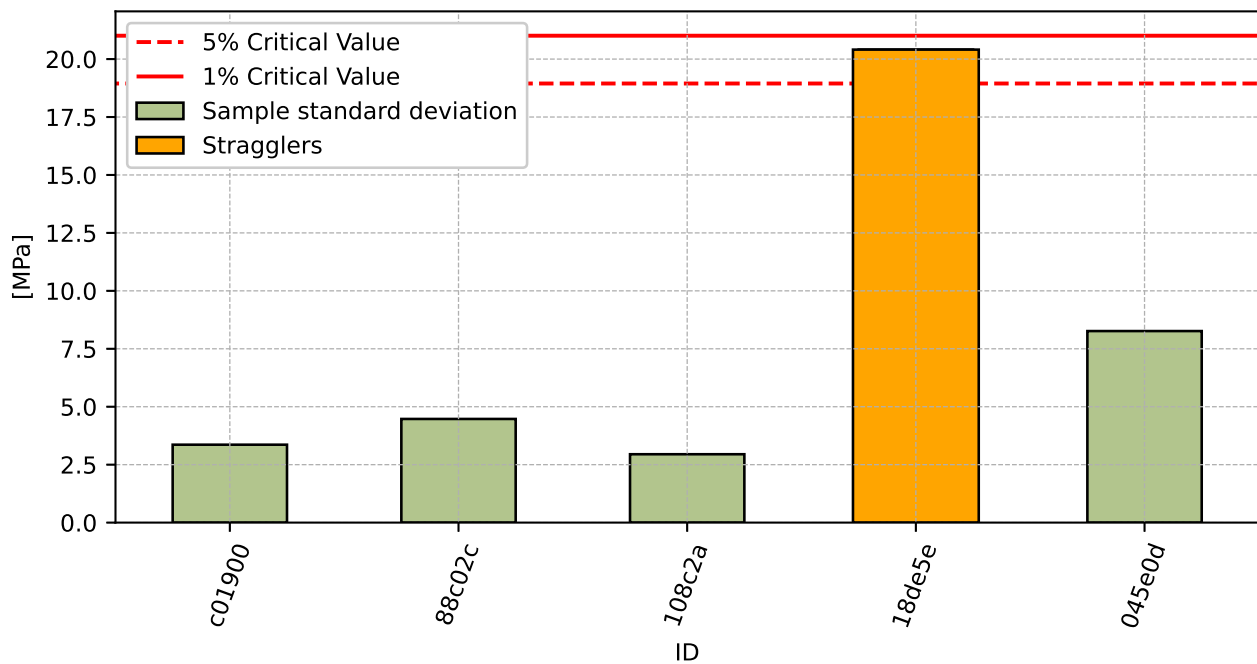


Figure 83: Cochran's test - sample standard deviations

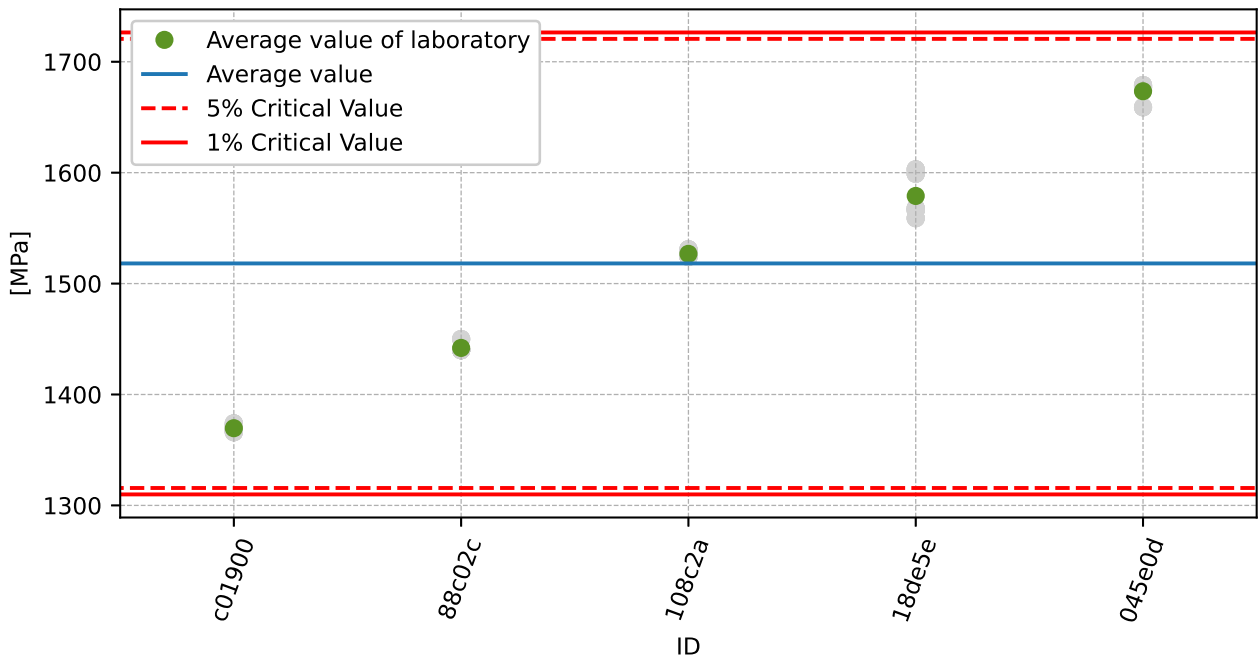


Figure 84: **Grubbs' test** - average values

4.2.3 Mandel's Statistics

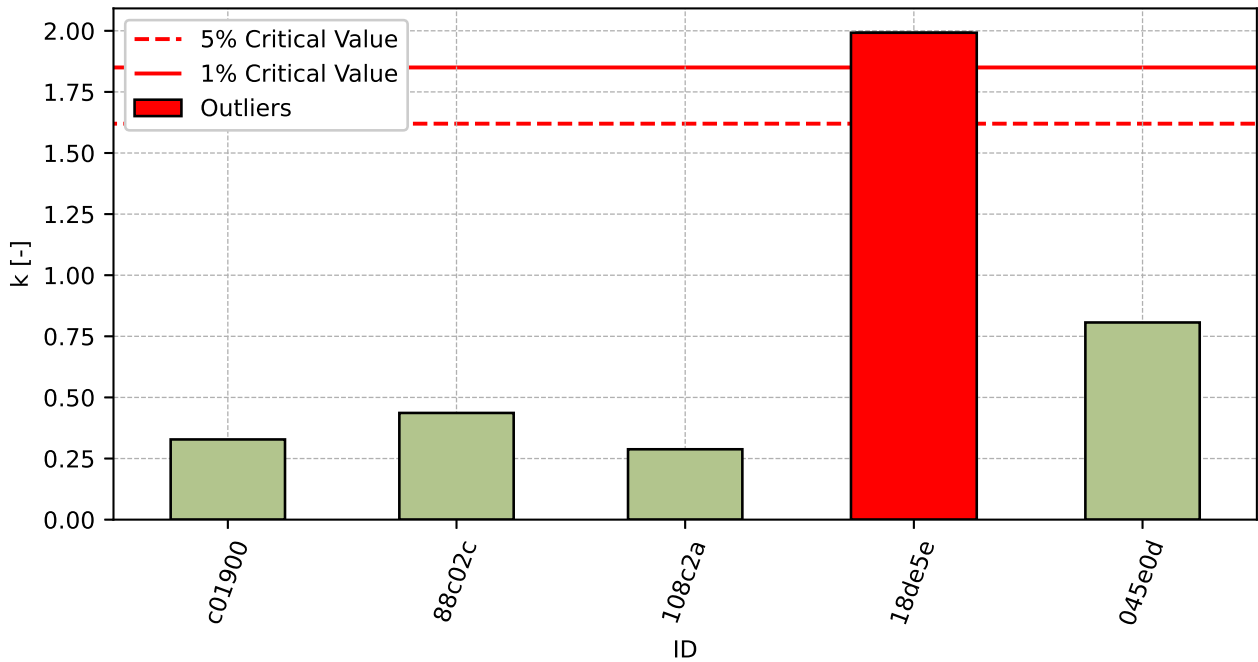


Figure 85: Intralaboratory Consistency Statistic

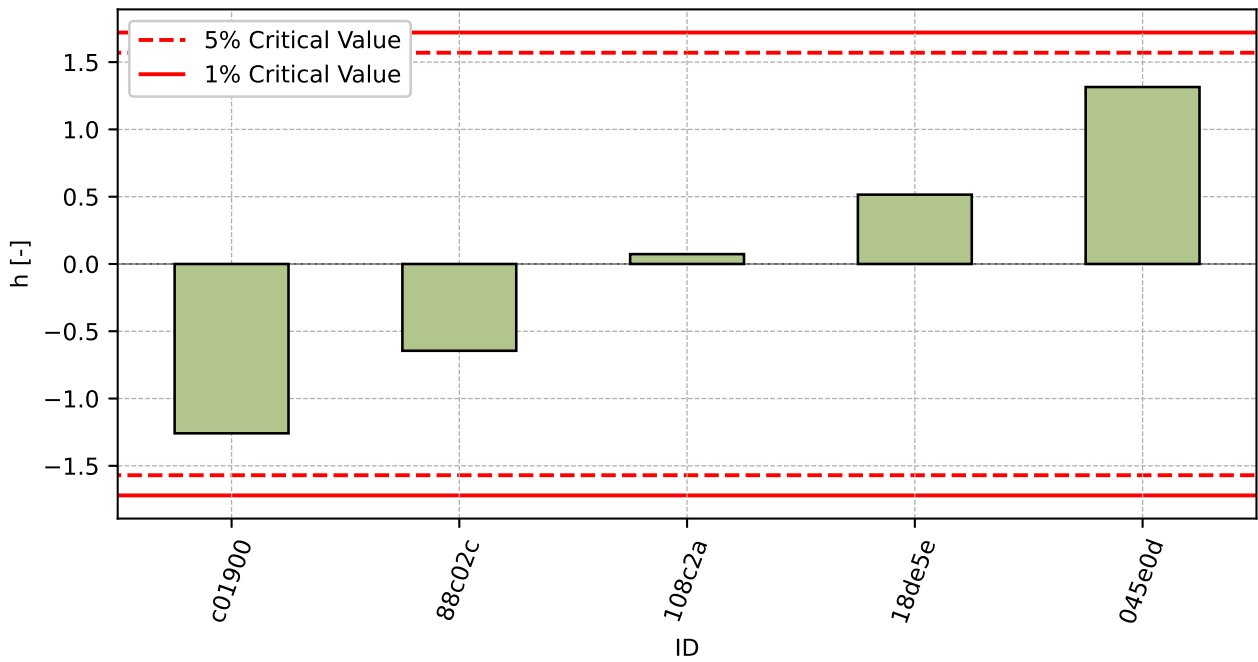


Figure 86: Interlaboratory Consistency Statistic

4.2.4 Descriptive statistics

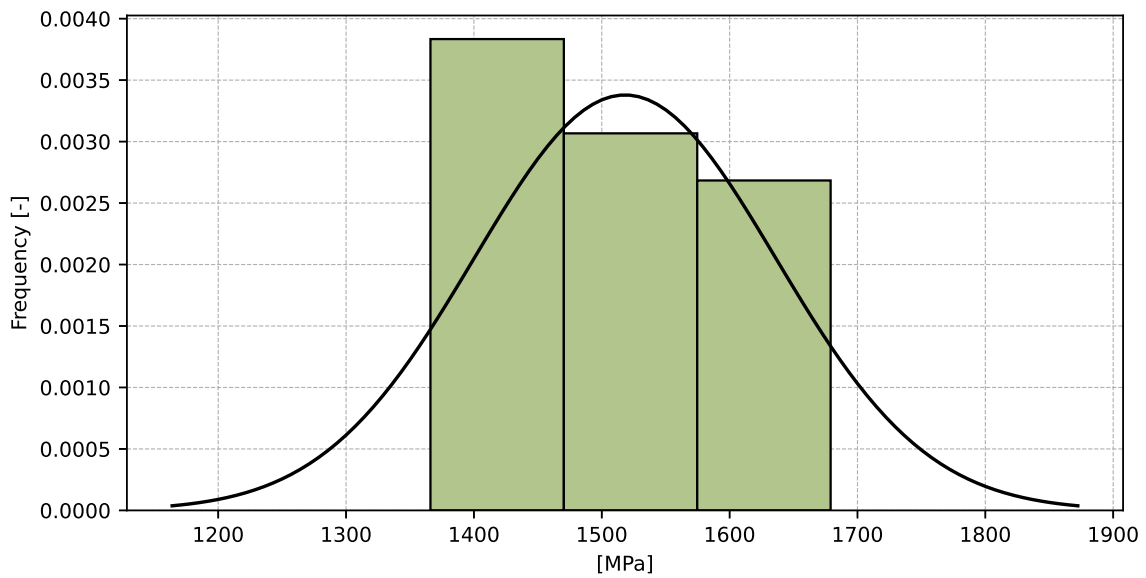


Figure 87: Histogram of all test results

Table 32: Descriptive statistics

Characteristics	[MPa]
Average value – \bar{x}	1518
Sample standard deviation – s	118.1
Assigned value – x^*	1518
Robust standard deviation – s^*	119.7
Measurement uncertainty of assigned value – u_X	66.9
p -value of normality test	0.038 [-]
Interlaboratory standard deviation – s_L	118.0
Repeatability standard deviation – s_r	10.2
Reproducibility standard deviation – s_R	118.4
Repeatability – r	29
Reproducibility – R	332

4.2.5 Evaluation of Performance Statistics

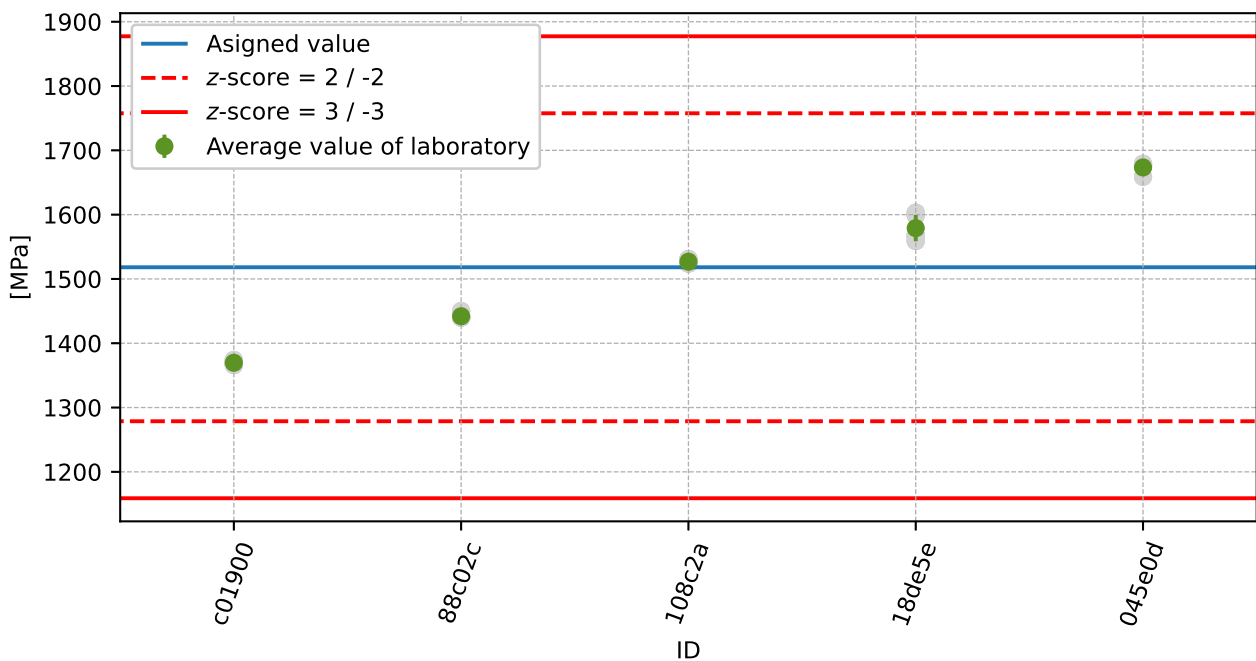


Figure 88: Average values and sample standard deviations

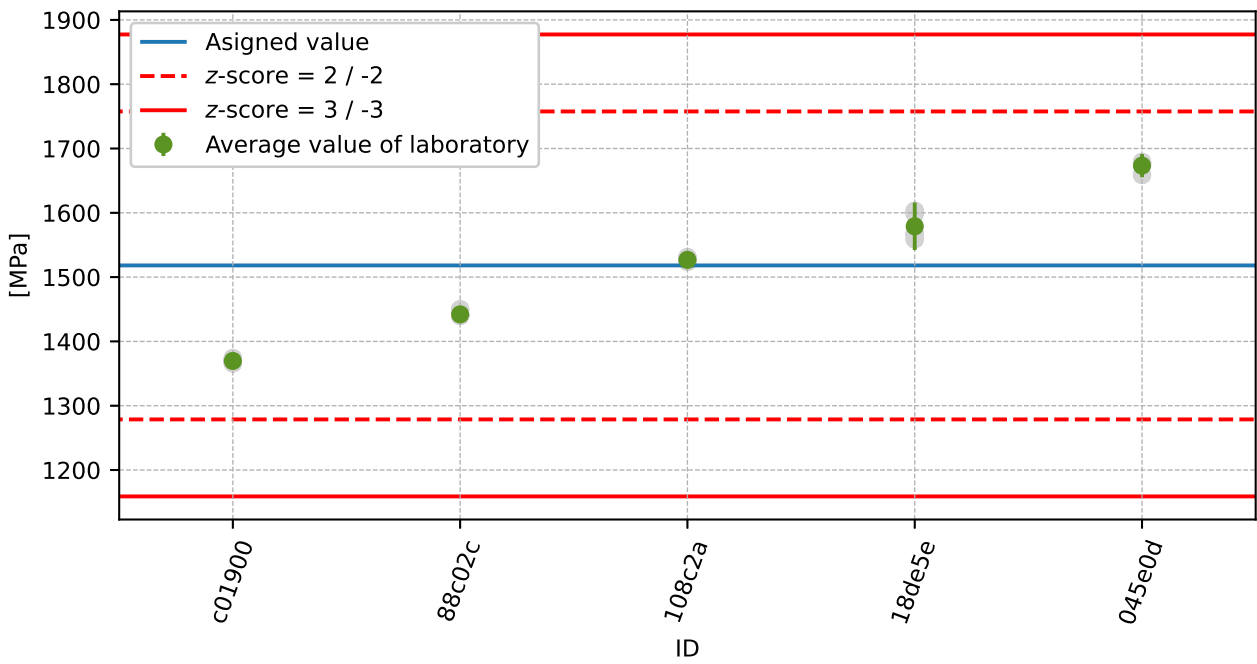


Figure 89: Average values and extended uncertainties of measurement

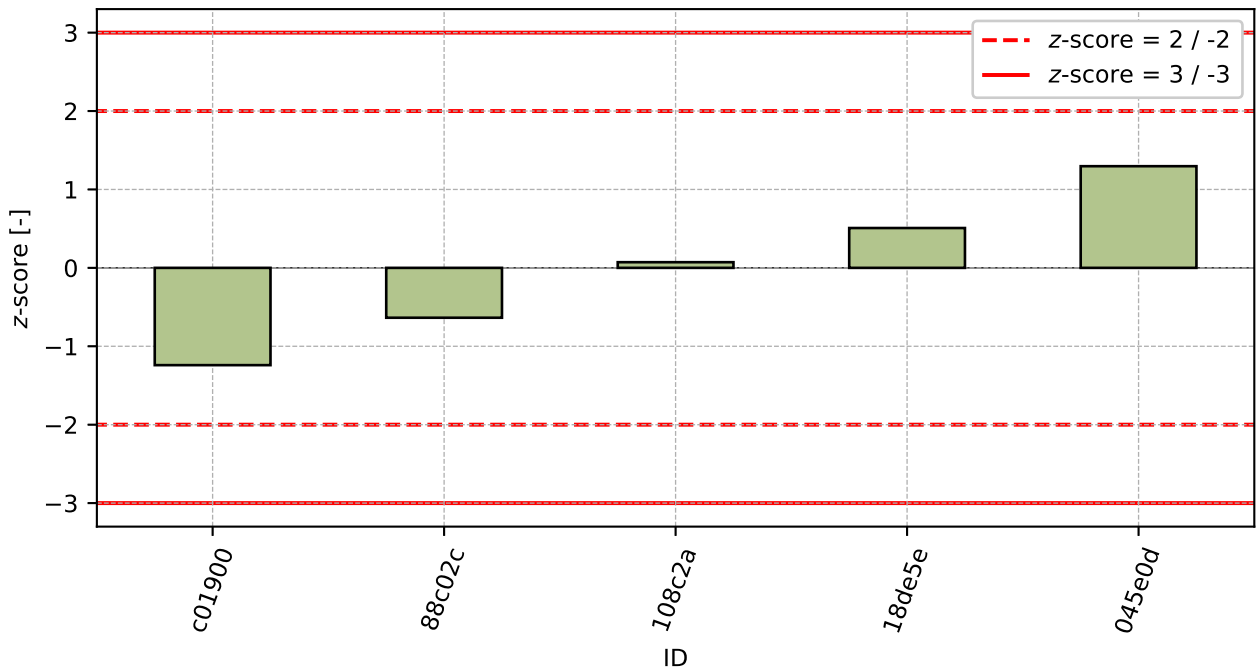
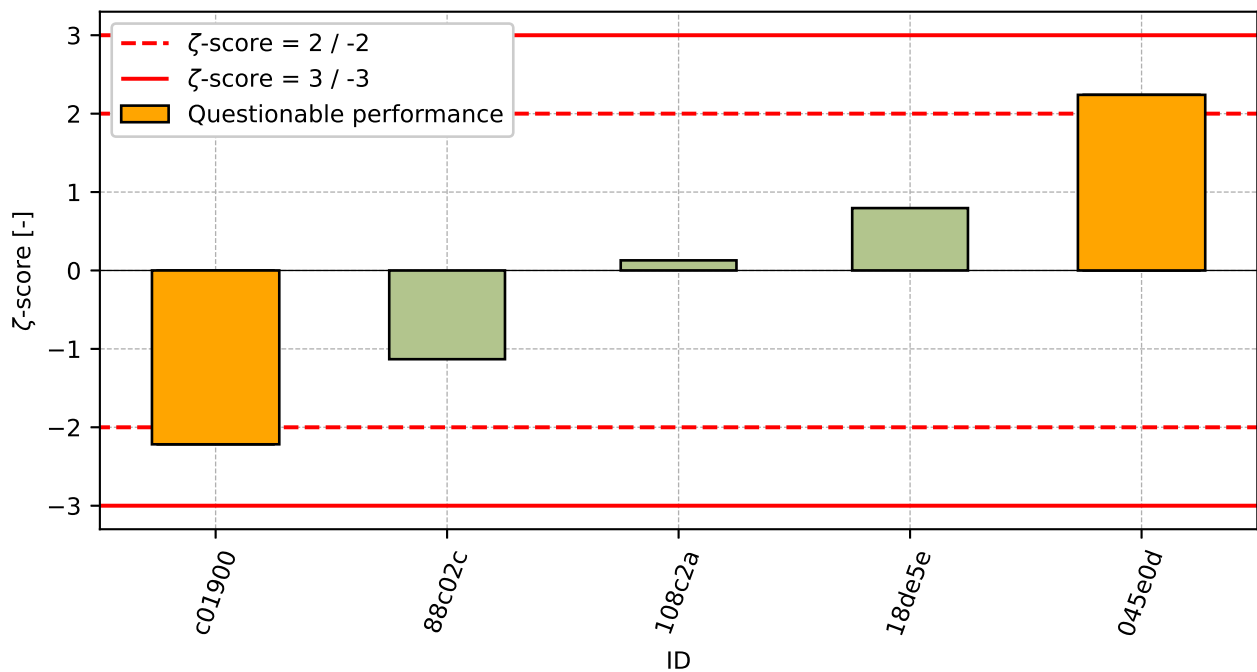


Figure 90: z-score

Figure 91: ζ -scoreTable 33: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
c01900	-1.24	-2.22
88c02c	-0.64	-1.13
108c2a	0.07	0.13
18de5e	0.51	0.8
045e0d	1.3	2.24

5 Appendix – EN ISO 178 (Flexural strength, Flexural strain at flexural strength)

5.1 Flexural strain at flexural strength

5.1.1 Sample A

Test results

Table 34: 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 [%]
88c02c	6.8	6.9	6.8	6.8	6.8	0.1	6.8	0.04	0.66
18de5e	6.6	6.7	6.8	7.1	6.9	0.3	6.8	0.19	2.82
045e0d	6.9	6.9	6.9	7.0	7.0	0.4	7.0	0.06	0.82
1726f5	7.1	6.9	7.1	7.1	6.9	0.5	7.0	0.11	1.56

The Numerical Procedure for Determining Outliers

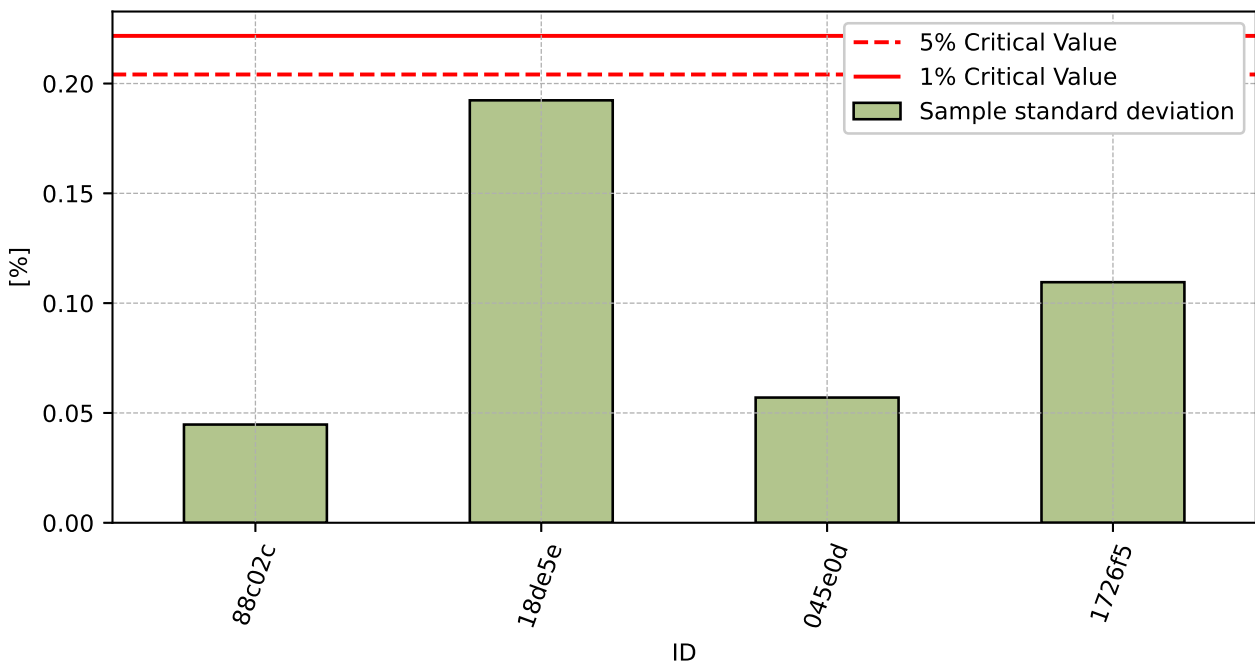


Figure 92: Cochran's test - sample standard deviations

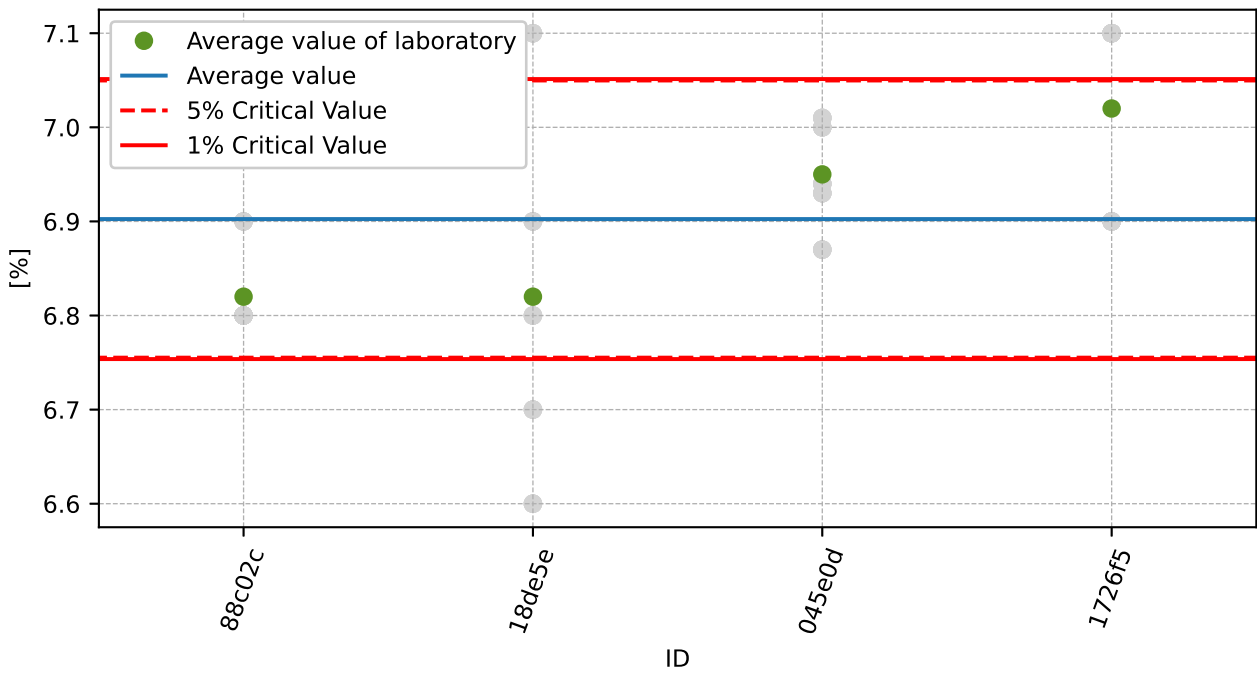


Figure 93: **Grubbs' test** - average values

Mandel's Statistics

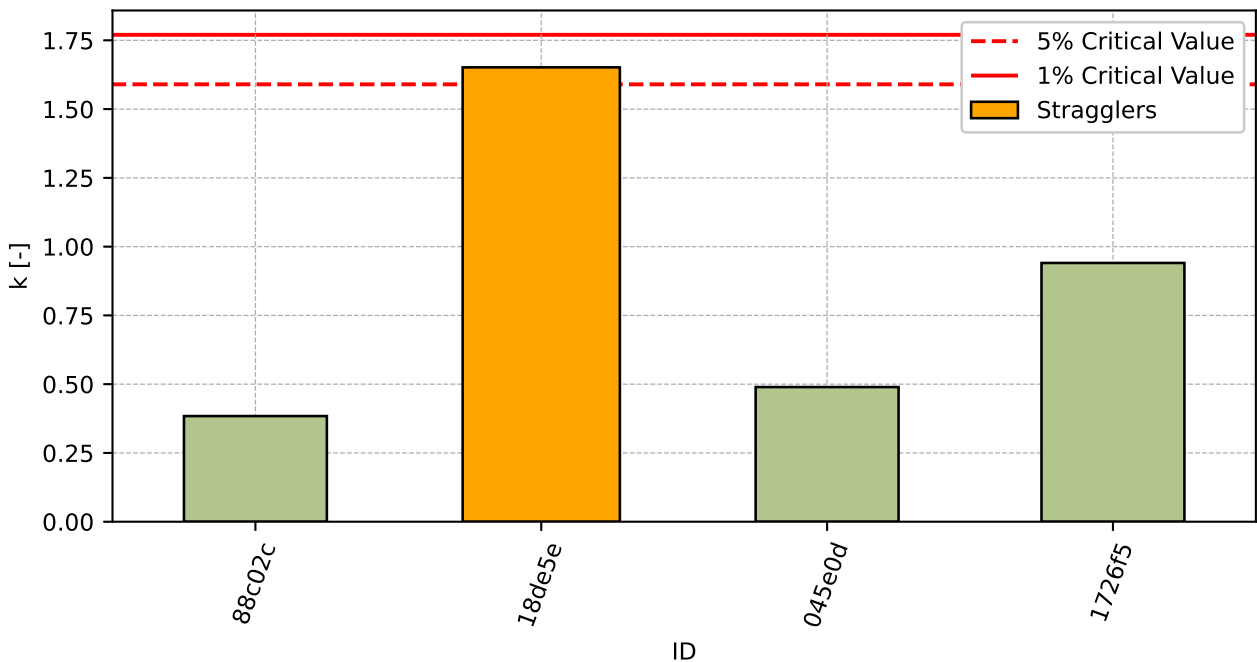


Figure 94: Intralaboratory Consistency Statistic

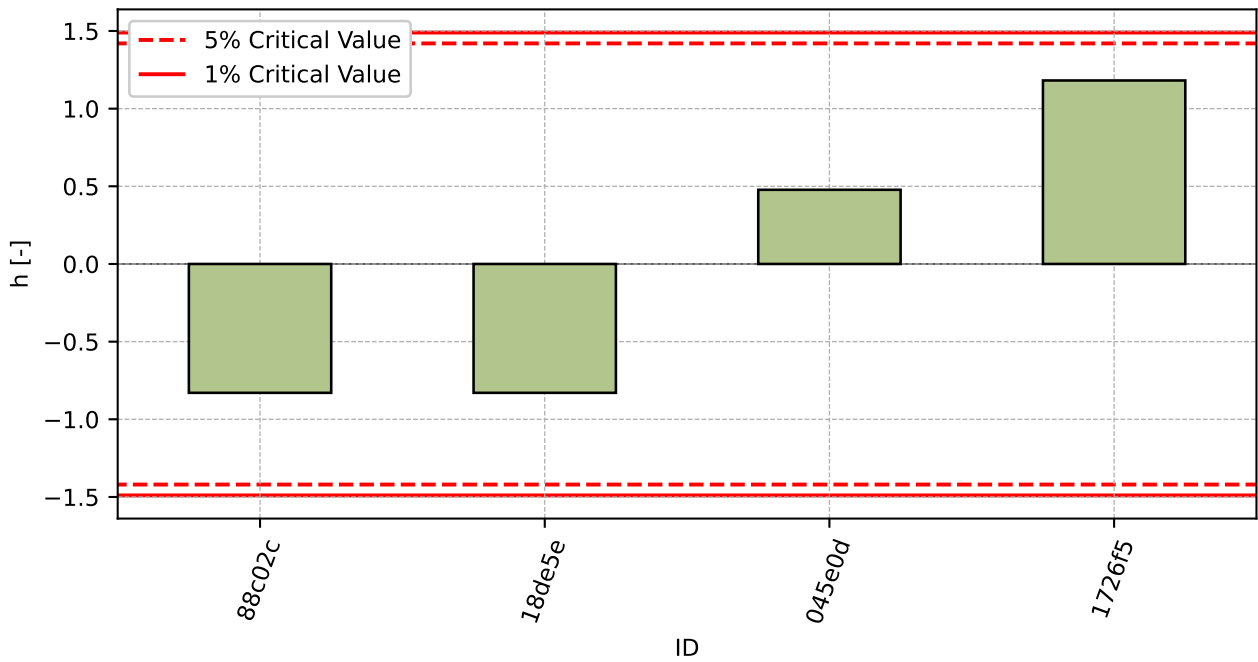


Figure 95: Interlaboratory Consistency Statistic

Descriptive statistics

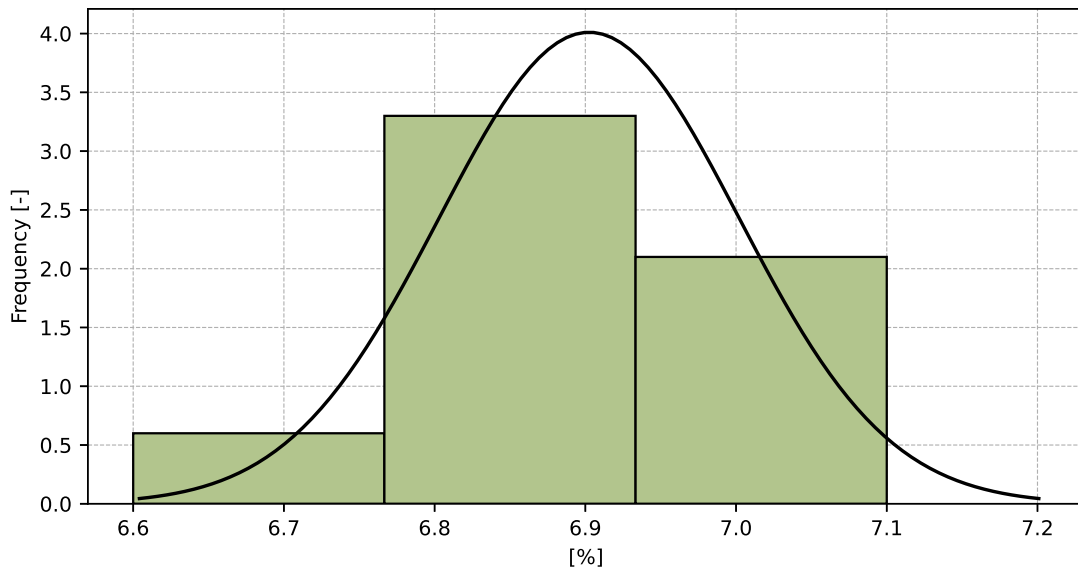


Figure 96: Histogram of all test results

Table 35: Descriptive statistics

Characteristics	[%]
Average value – \bar{x}	6.9
Sample standard deviation – s	0.1
Assigned value – x^*	6.9
Robust standard deviation – s^*	0.1
Measurement uncertainty of assigned value – u_X	0.06
p -value of normality test	0.212 [-]
Interlaboratory standard deviation – s_L	0.08
Repeatability standard deviation – s_r	0.12
Reproducibility standard deviation – s_R	0.14
Repeatability – r	0.3
Reproducibility – R	0.4

Evaluation of Performance Statistics

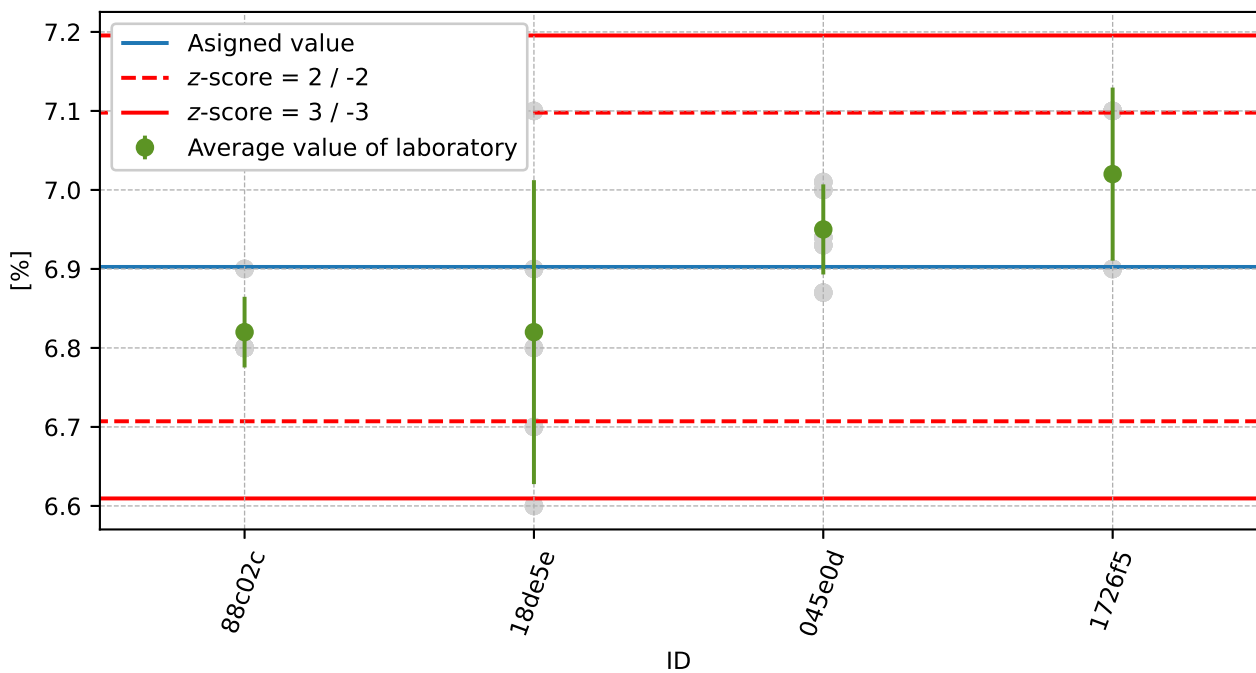


Figure 97: Average values and sample standard deviations

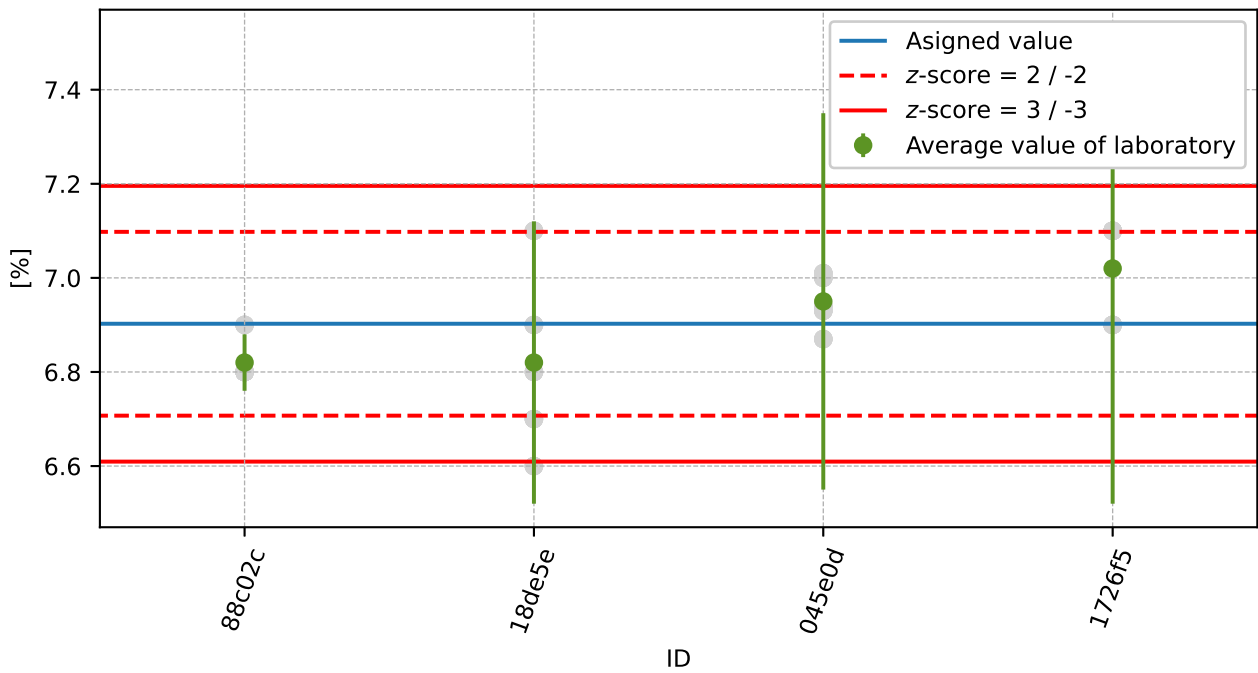


Figure 98: Average values and extended uncertainties of measurement

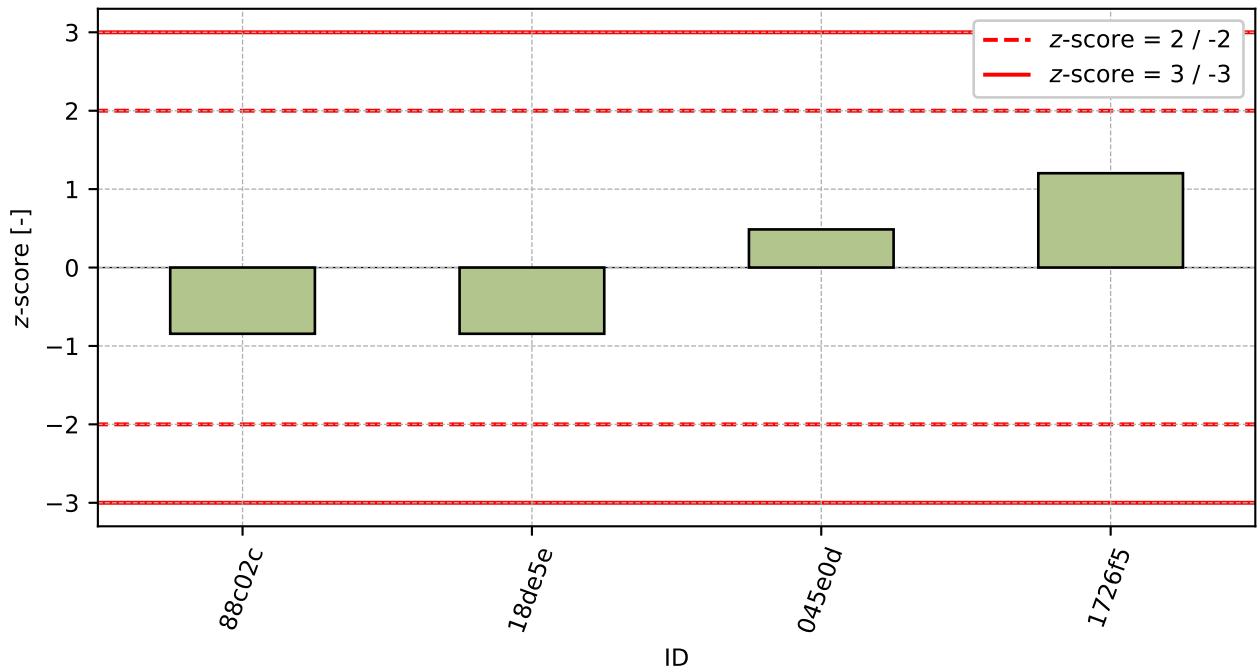
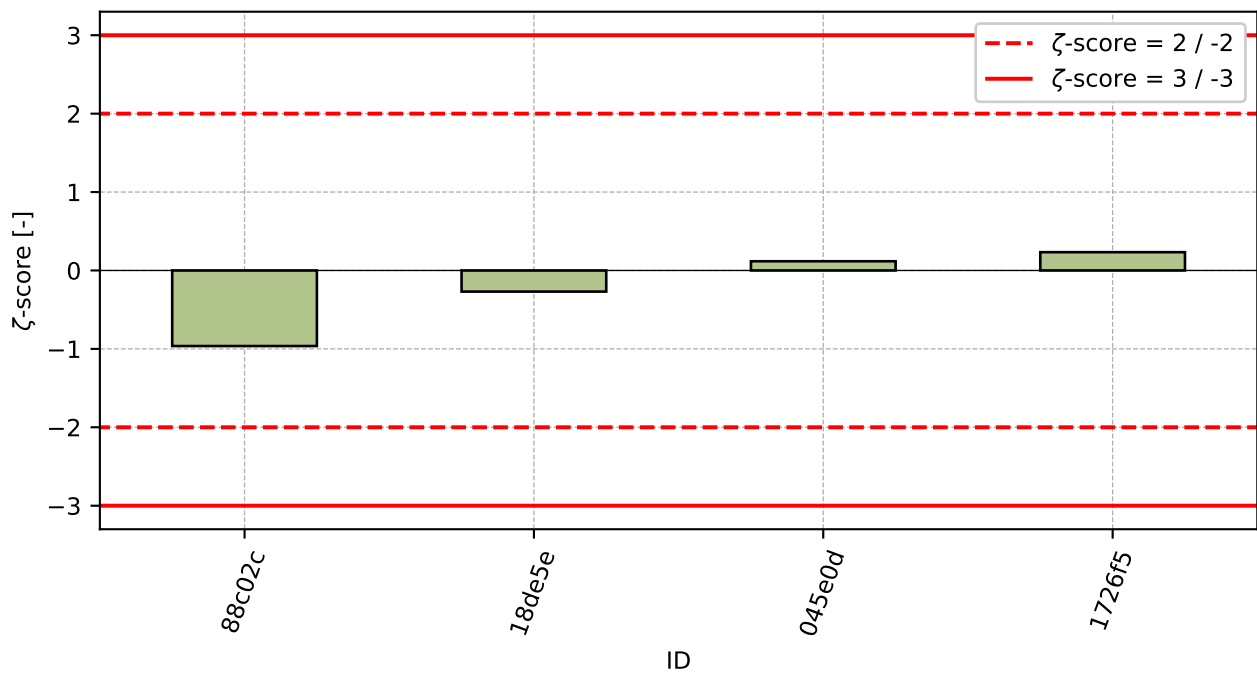


Figure 99: z-score

Figure 100: ζ -scoreTable 36: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
88c02c	-0.84	-0.96
18de5e	-0.84	-0.27
045e0d	0.49	0.12
1726f5	1.2	0.23

5.1.2 Sample B

Test results

Table 37: 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 [%]
	[%]								
18de5e	6.1	6.2	6.4	6.2	6.2	0.2	6.2	0.11	1.76
1726f5	6.4	6.4	6.5	6.5	6.4	0.5	6.4	0.05	0.85
045e0d	6.5	6.2	6.5	6.5	6.5	0.4	6.4	0.11	1.72
88c02c	6.7	6.7	6.8	6.8	6.7	0.1	6.7	0.05	0.81

The Numerical Procedure for Determining Outliers

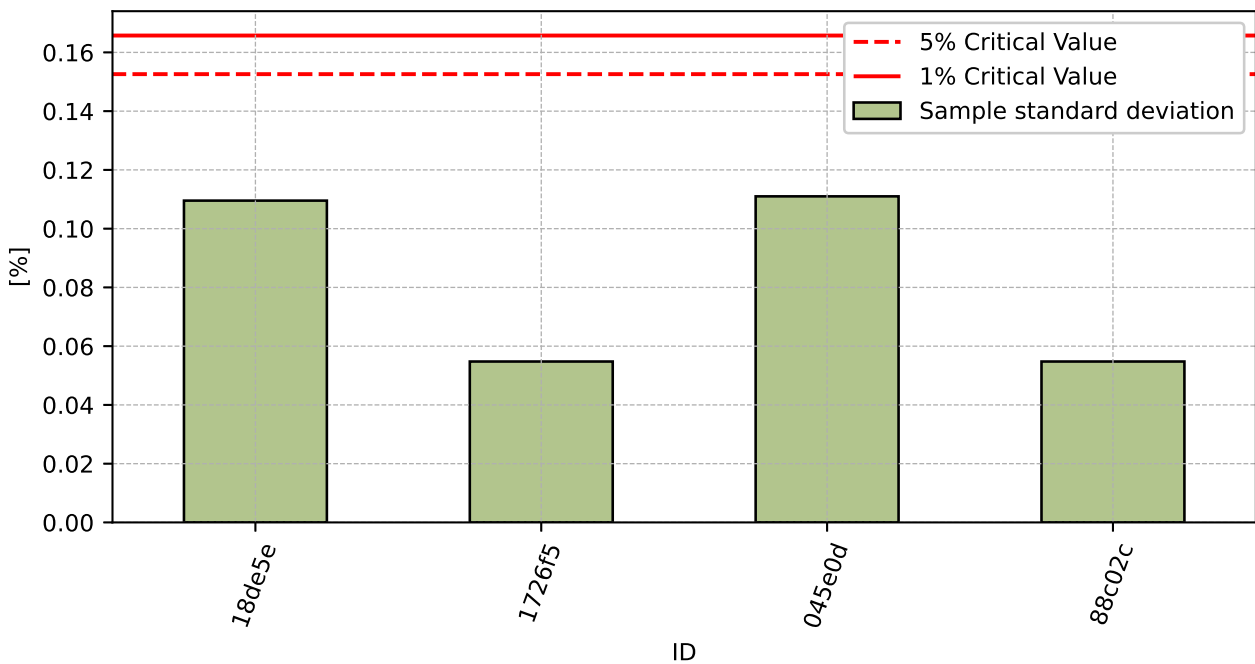


Figure 101: **Cochran's test** - sample standard deviations

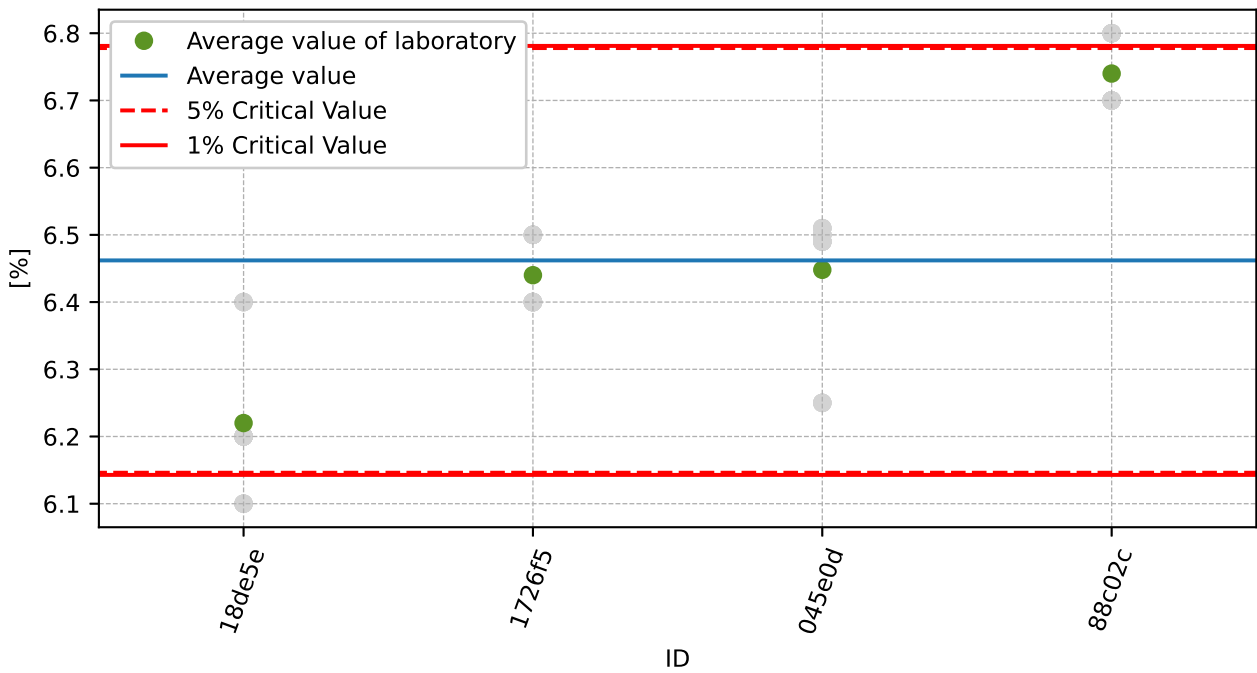


Figure 102: Grubbs' test - average values

Mandel's Statistics

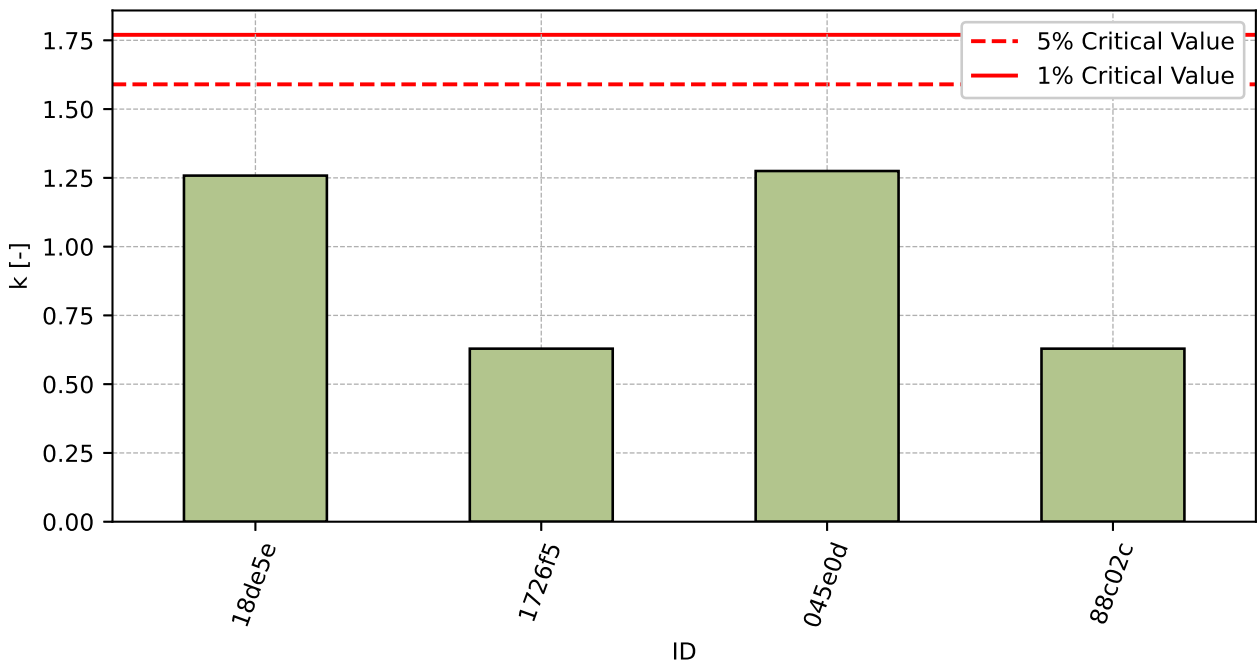


Figure 103: Intralaboratory Consistency Statistic

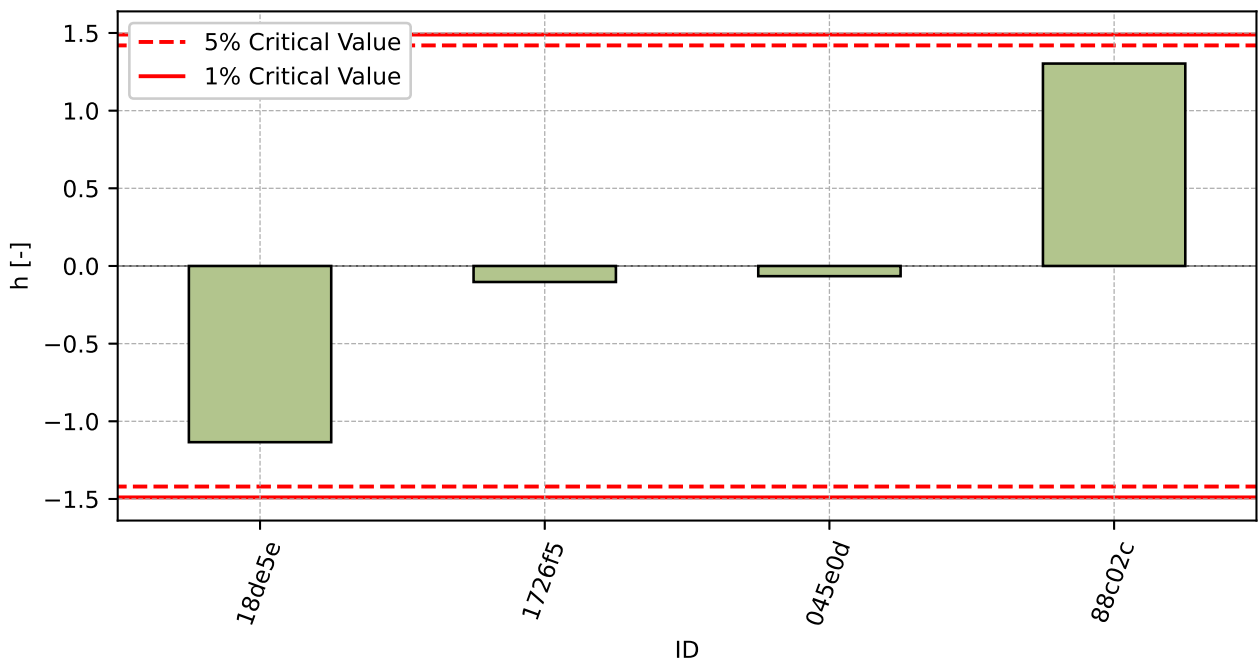


Figure 104: Interlaboratory Consistency Statistic

Descriptive statistics

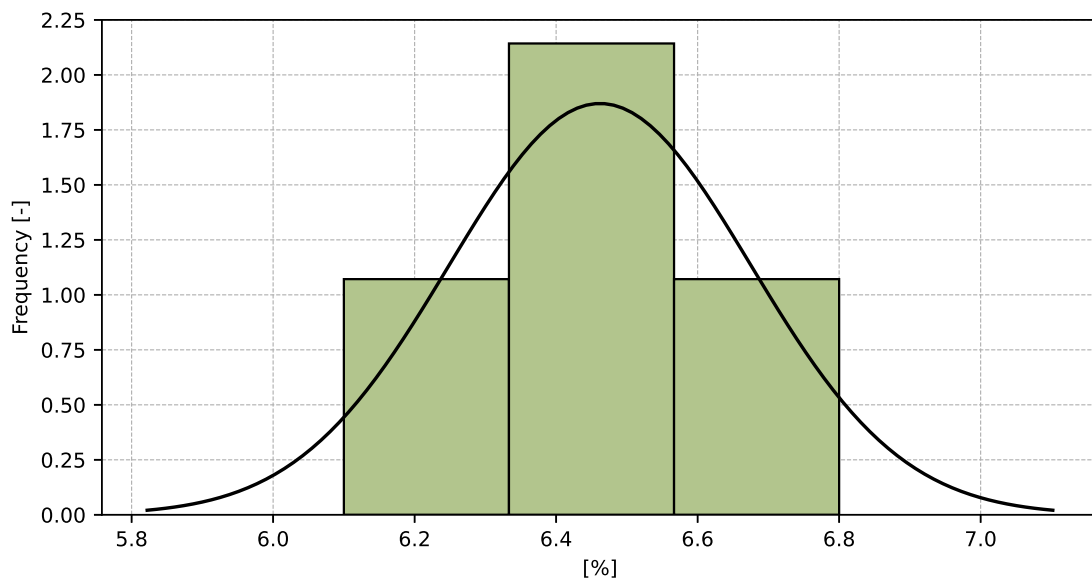


Figure 105: Histogram of all test results

Table 38: Descriptive statistics

Characteristics	[%]
Average value – \bar{x}	6.5
Sample standard deviation – s	0.21
Assigned value – x^*	6.5
Robust standard deviation – s^*	0.21
Measurement uncertainty of assigned value – u_X	0.13
p -value of normality test	0.222 [-]
Interlaboratory standard deviation – s_L	0.21
Repeatability standard deviation – s_r	0.09
Reproducibility standard deviation – s_R	0.23
Repeatability – r	0.2
Reproducibility – R	0.6

Evaluation of Performance Statistics

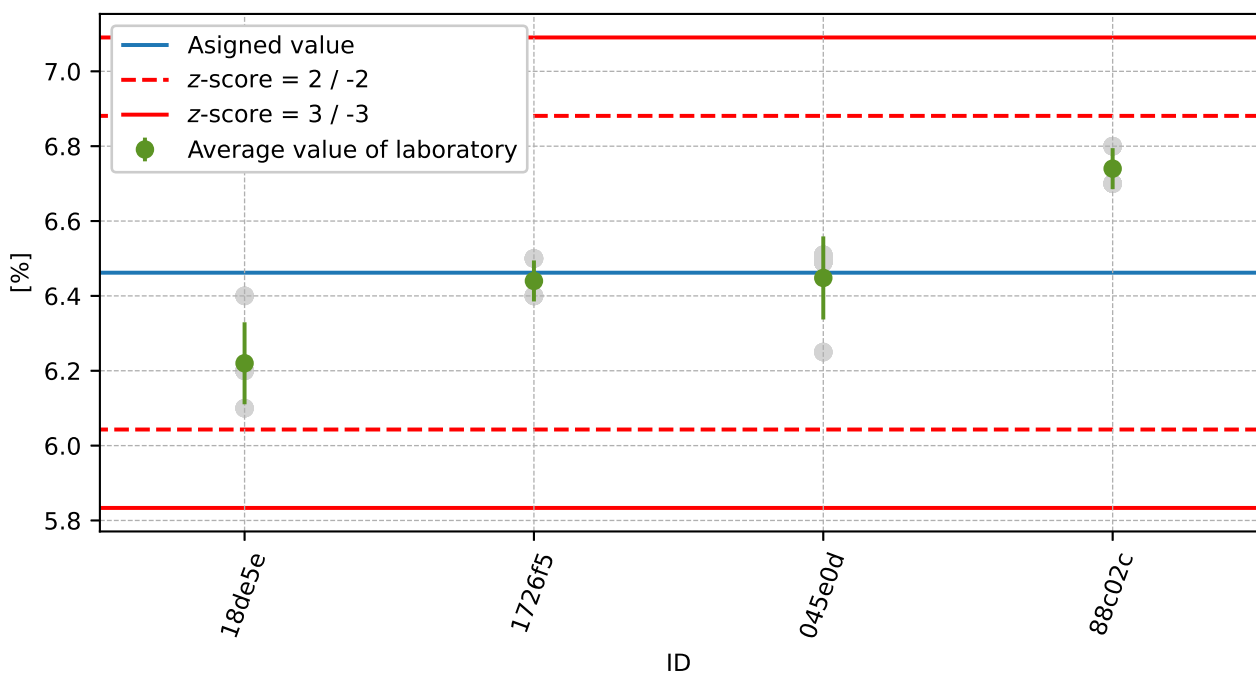


Figure 106: Average values and sample standard deviations

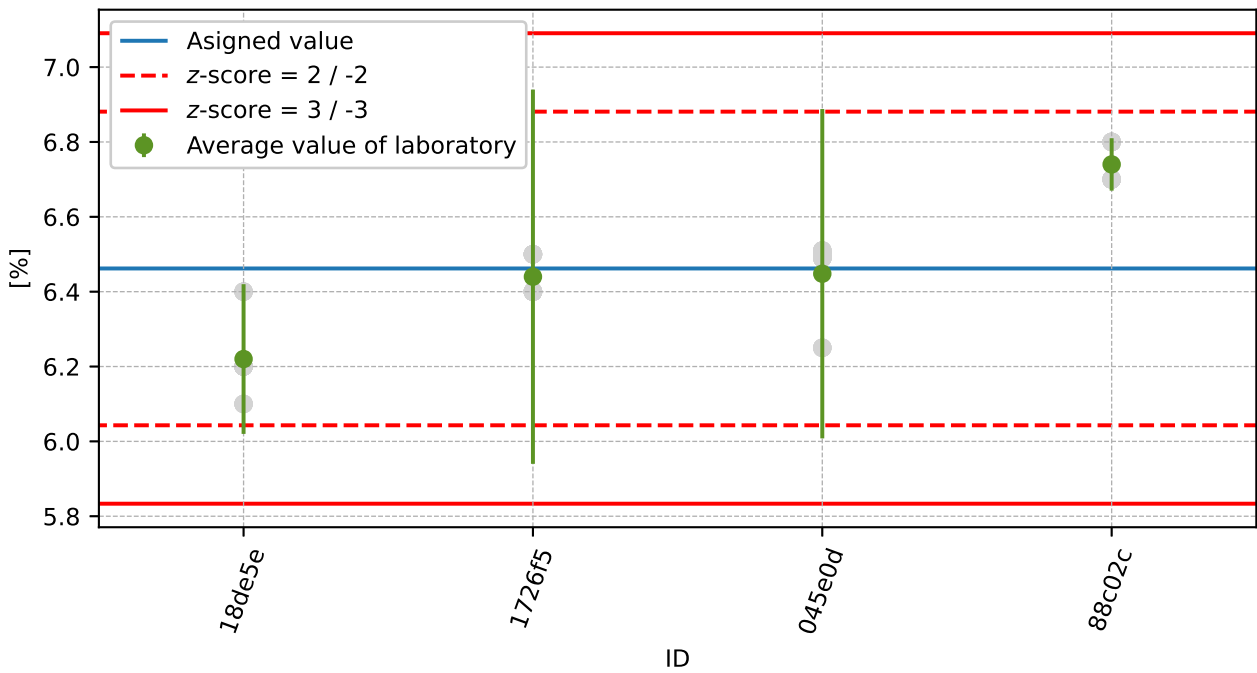


Figure 107: Average values and extended uncertainties of measurement

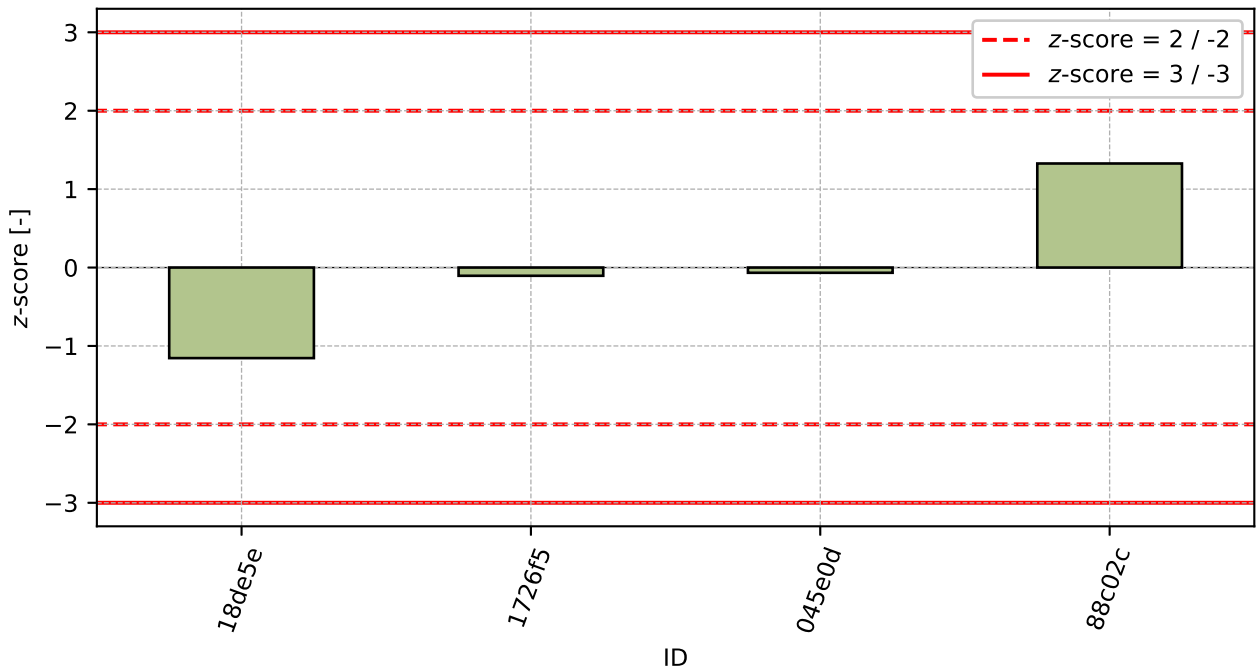
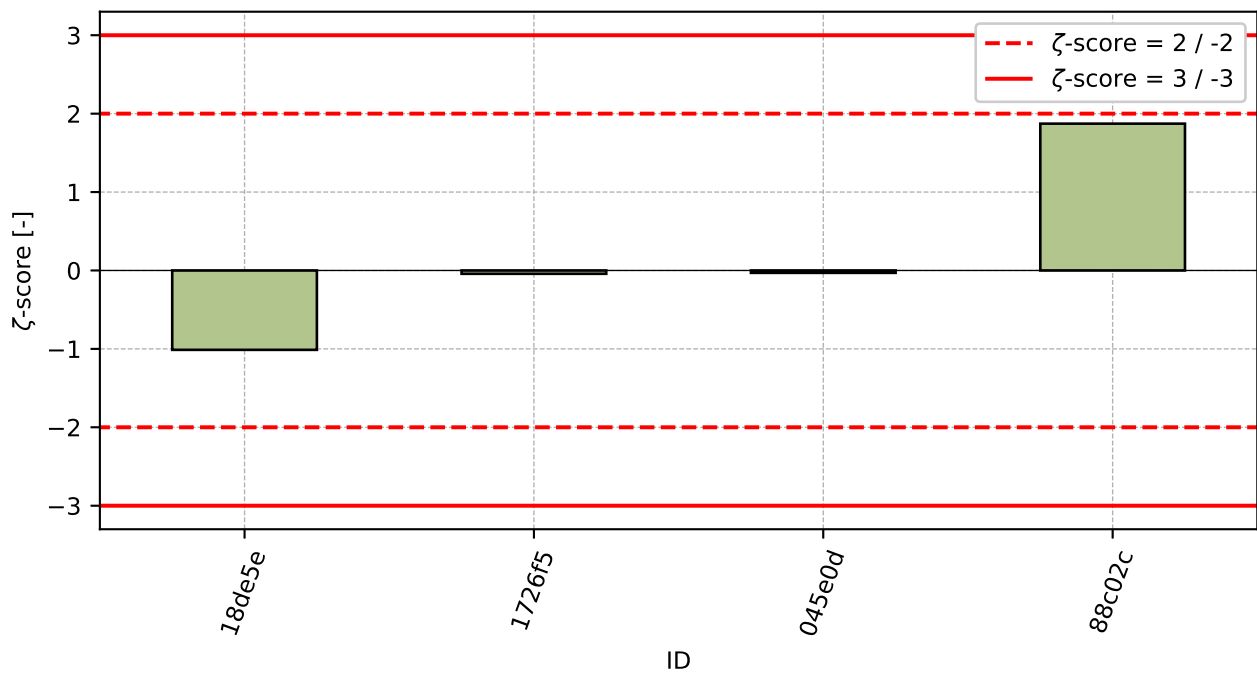


Figure 108: z-score

Figure 109: ζ -scoreTable 39: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
18de5e	-1.16	-1.01
1726f5	-0.11	-0.04
045e0d	-0.07	-0.03
88c02c	1.33	1.87

5.2 Flexural strength

5.2.1 Sample A

Test results

Table 40: 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 [MPa]	\bar{x} [MPa]	s_0 [MPa]	V_x [%]
	[MPa]								
88c02c	44.5	44.5	44.4	44.5	44.5	0.1	44.5	0.04	0.1
045e0d	47.8	47.3	47.6	47.6	47.4	6.0	47.6	0.2	0.42
1726f5	50.8	50.5	50.3	50.6	50.3	2.1	50.5	0.21	0.42
18de5e	51.6	51.3	52.0	51.3	51.2	1.1	51.5	0.33	0.64

The Numerical Procedure for Determining Outliers

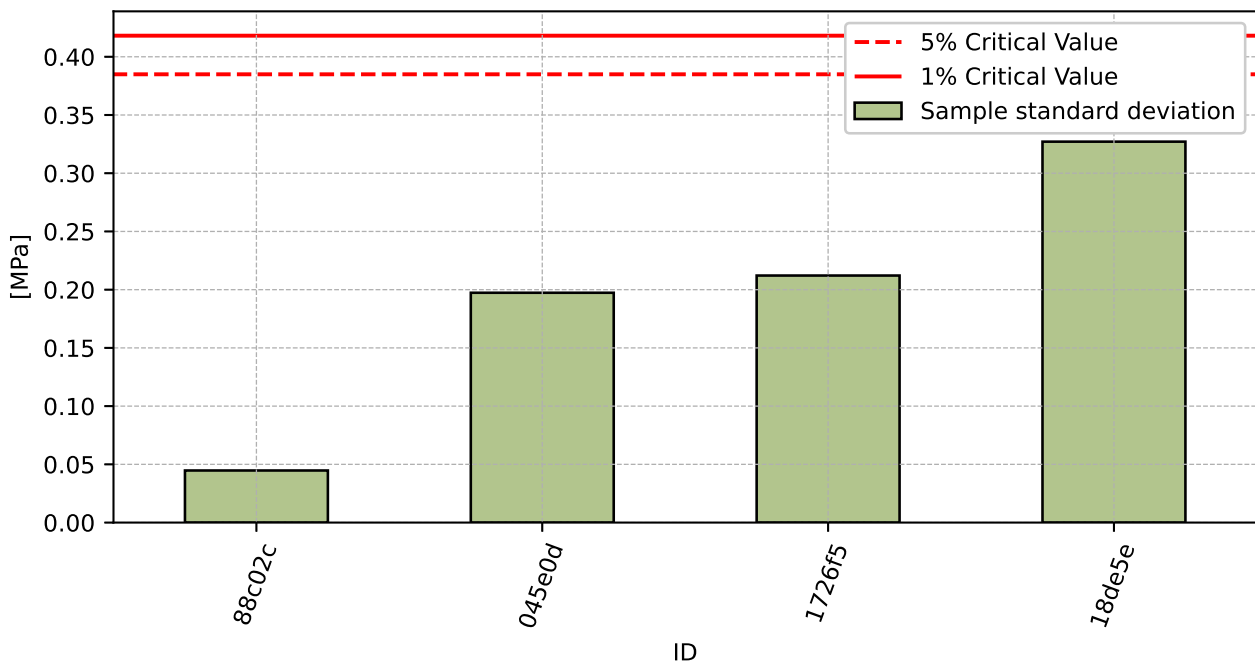


Figure 110: Cochran's test - sample standard deviations

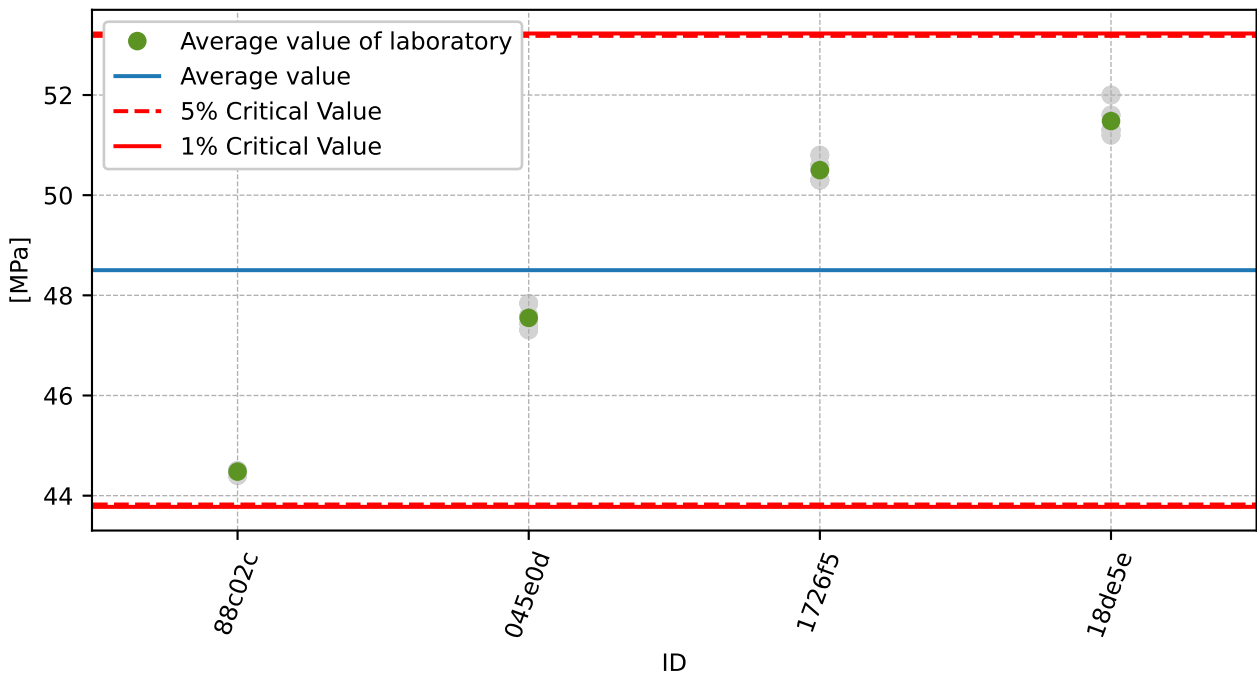


Figure 111: **Grubbs' test** - average values

Mandel's Statistics

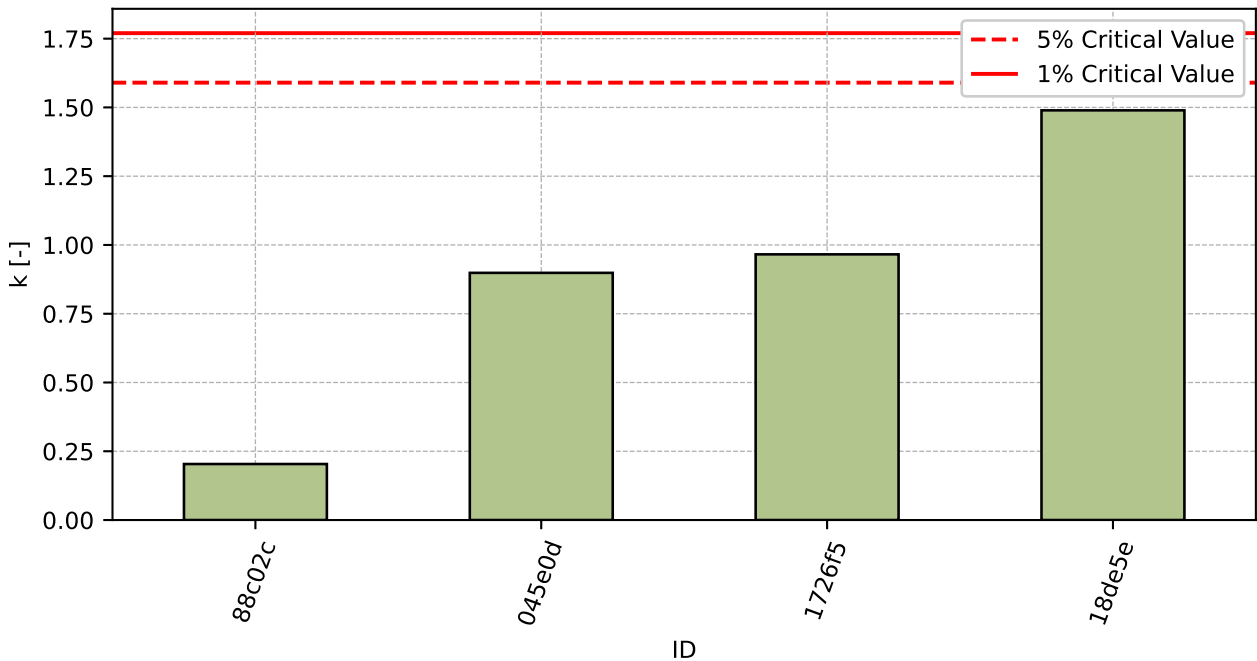


Figure 112: Intralaboratory Consistency Statistic

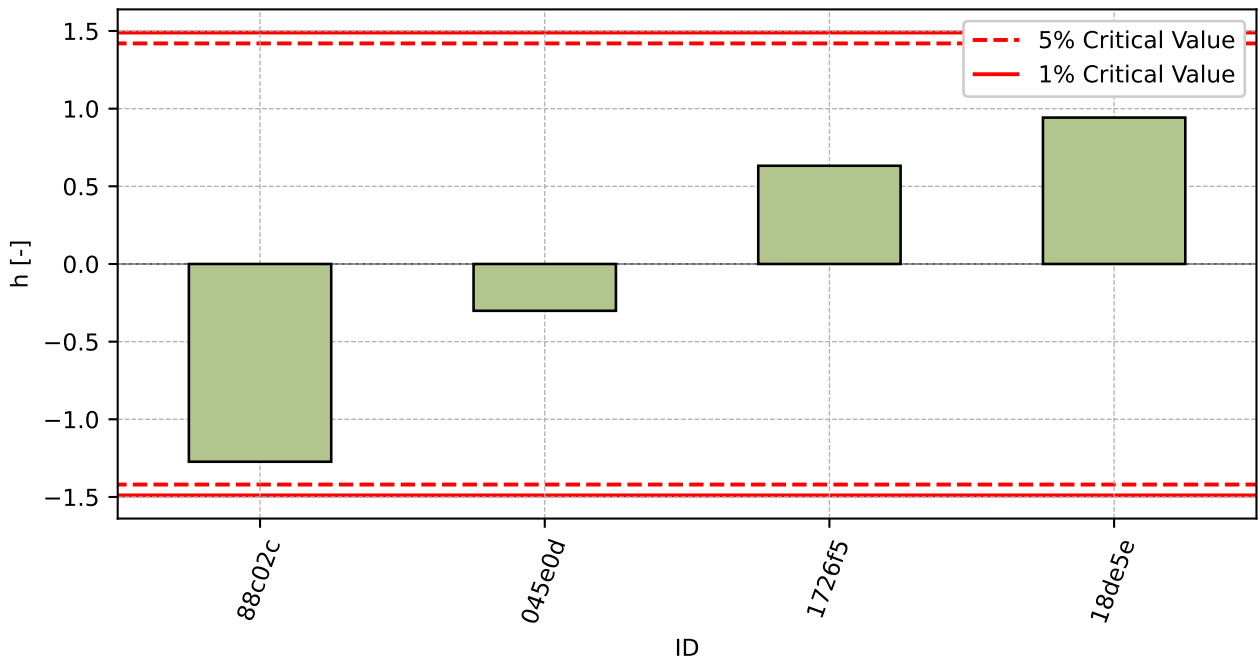


Figure 113: Interlaboratory Consistency Statistic

Descriptive statistics

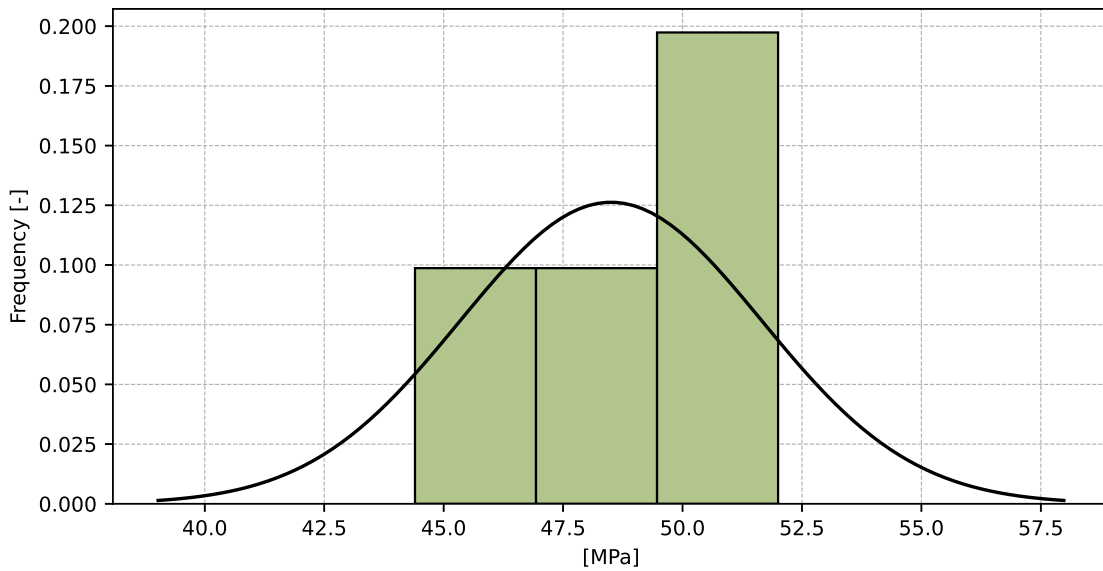


Figure 114: Histogram of all test results

Table 41: Descriptive statistics

Characteristics	[MPa]
Average value – \bar{x}	48.5
Sample standard deviation – s	3.16
Assigned value – x^*	48.5
Robust standard deviation – s^*	3.03
Measurement uncertainty of assigned value – u_X	1.89
p -value of normality test	0.005 [-]
Interlaboratory standard deviation – s_L	3.16
Repeatability standard deviation – s_r	0.22
Reproducibility standard deviation – s_R	3.17
Repeatability – r	0.6
Reproducibility – R	8.9

Evaluation of Performance Statistics

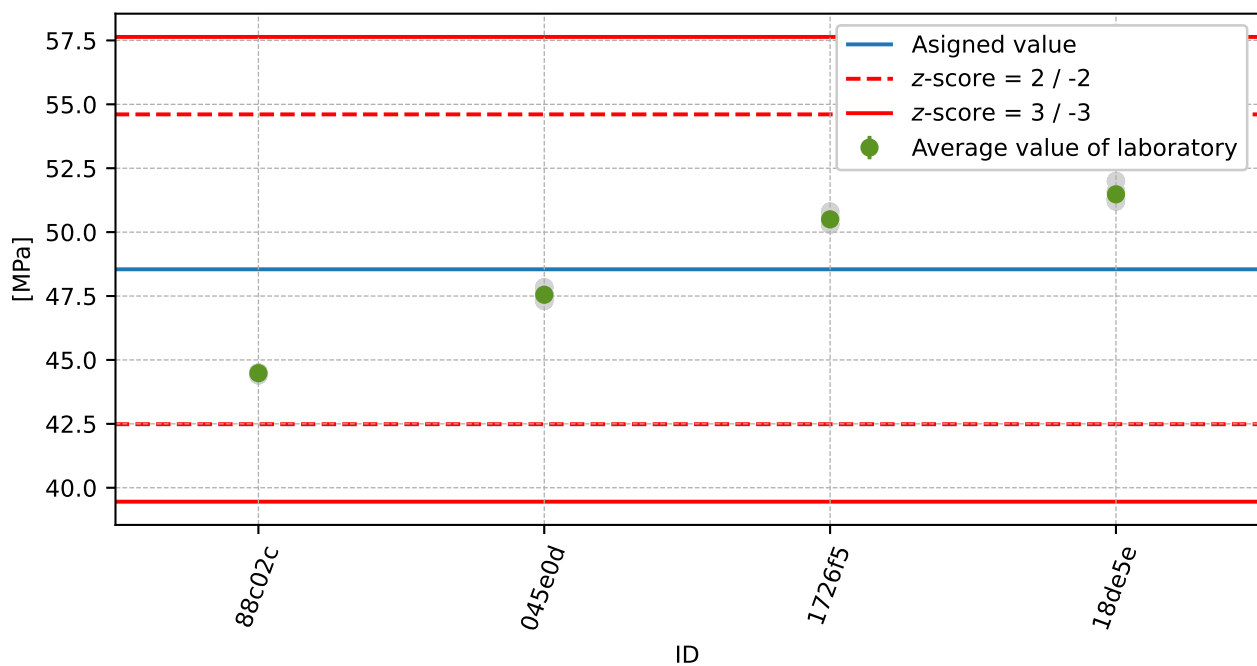


Figure 115: Average values and sample standard deviations

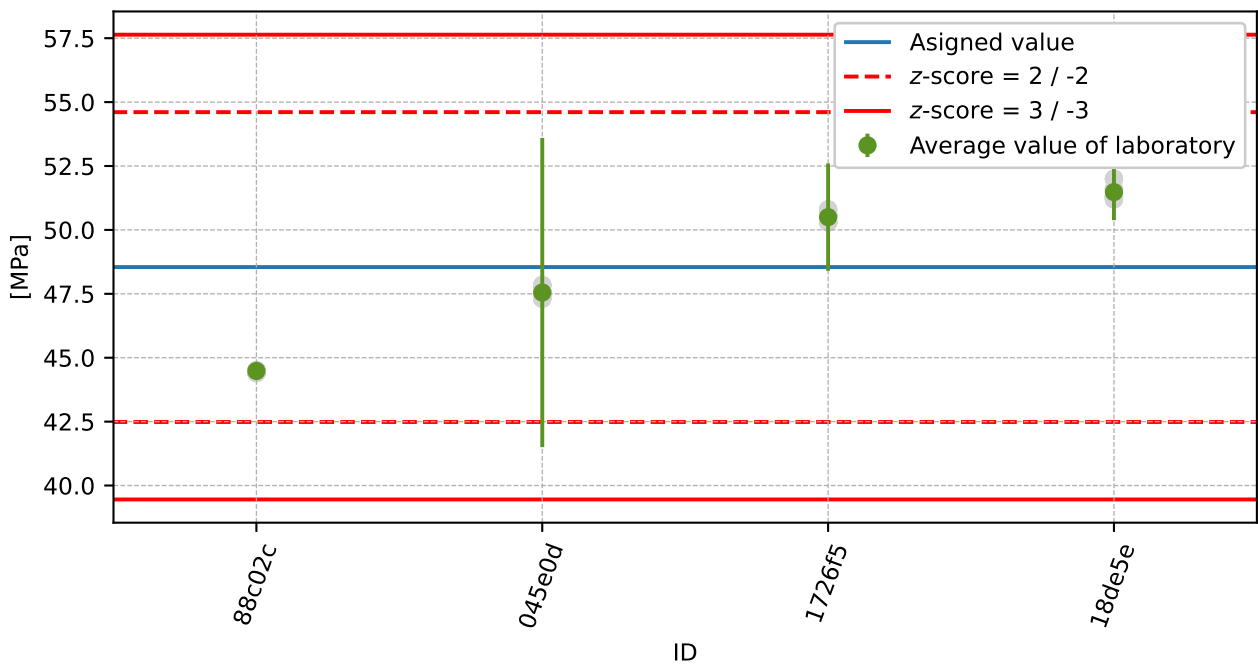


Figure 116: Average values and extended uncertainties of measurement

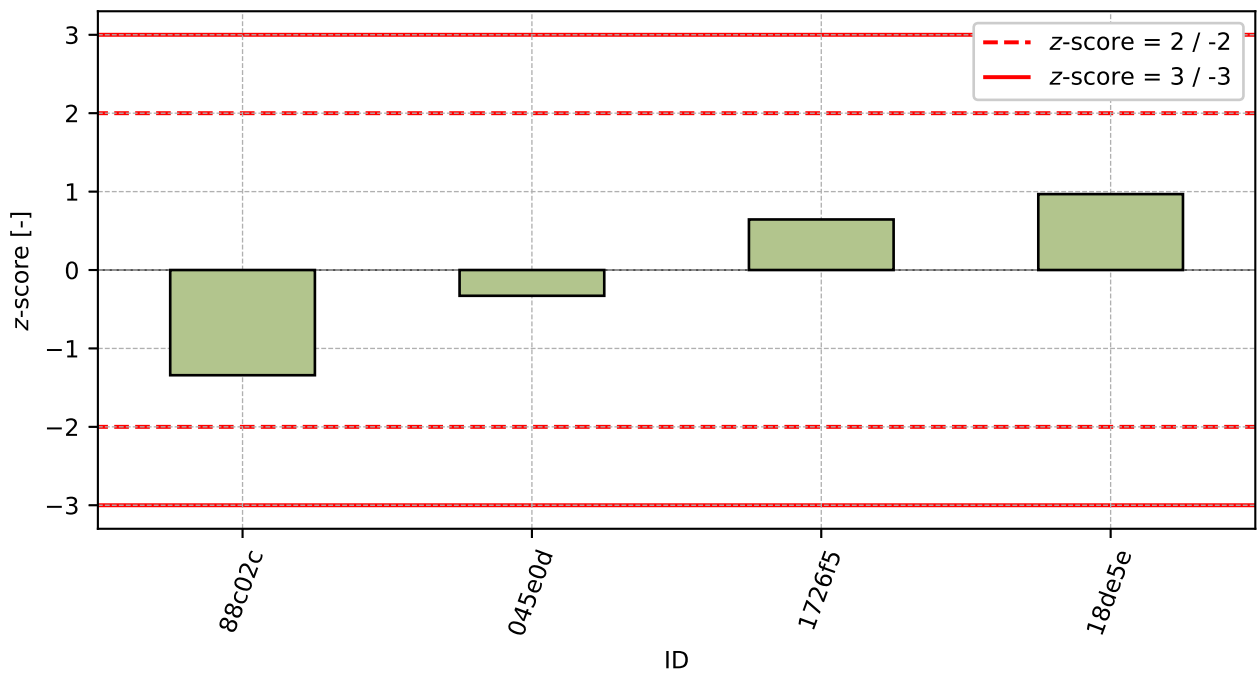


Figure 117: z-score

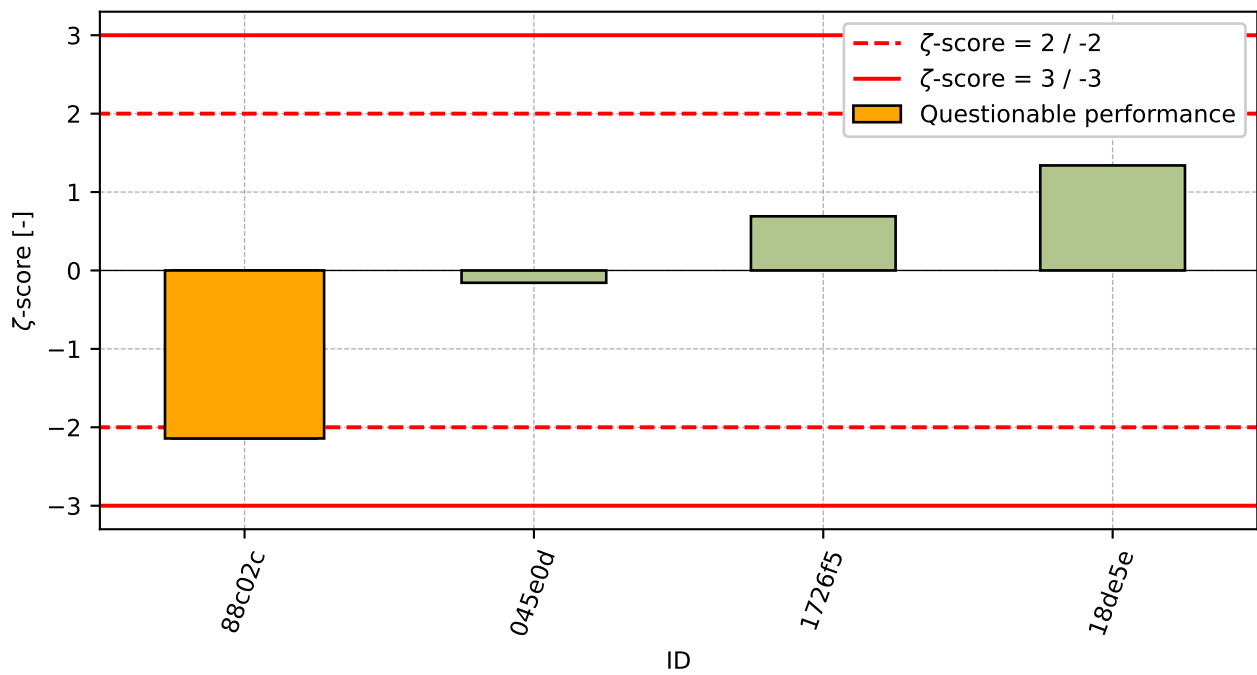


Figure 118: ζ-score

Table 42: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
88c02c	-1.34	-2.14
045e0d	-0.33	-0.16
1726f5	0.64	0.69
18de5e	0.97	1.34

5.2.2 Sample B

Test results

Table 43: 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 [MPa]	\bar{x} [MPa]	s_0 [MPa]	V_x [%]
	[MPa]								
88c02c	35.7	35.6	35.9	35.6	35.8	0.2	35.7	0.13	0.37
045e0d	38.0	38.0	38.2	38.3	38.1	6.0	38.1	0.14	0.37
1726f5	41.2	41.0	40.8	40.9	41.0	1.9	41.0	0.15	0.36
18de5e	42.2	41.8	41.6	41.9	42.0	0.9	41.9	0.22	0.53

The Numerical Procedure for Determining Outliers

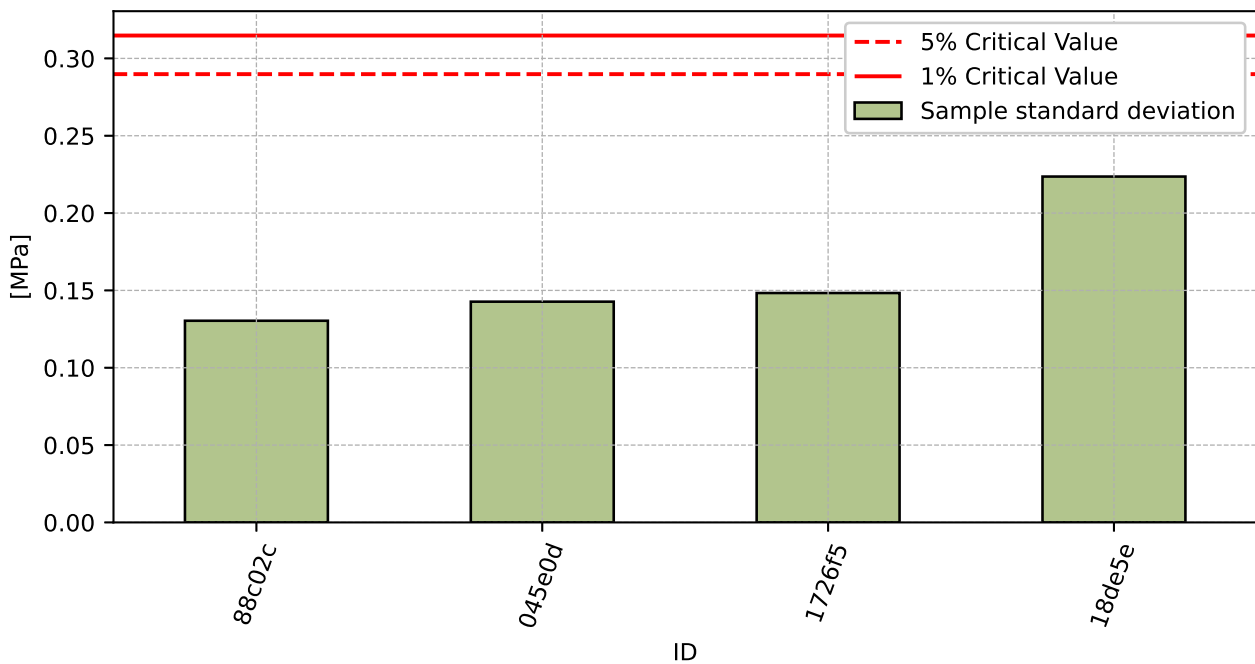


Figure 119: Cochran's test - sample standard deviations

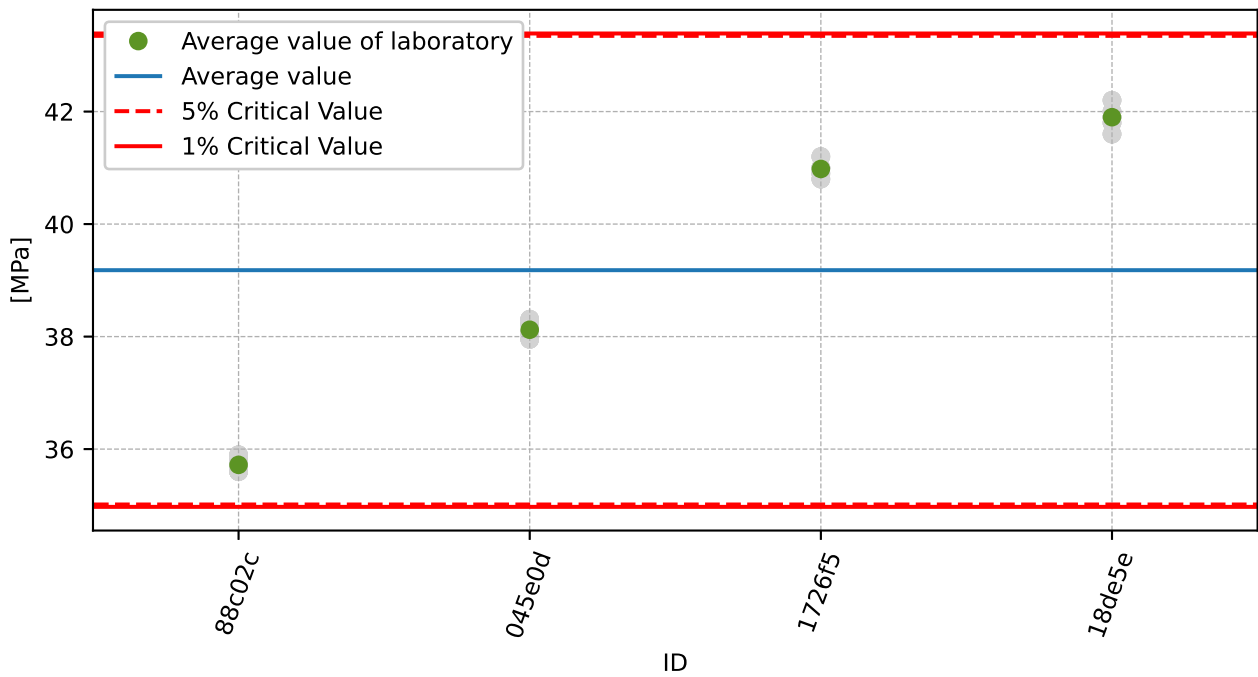


Figure 120: **Grubbs' test** - average values

Mandel's Statistics

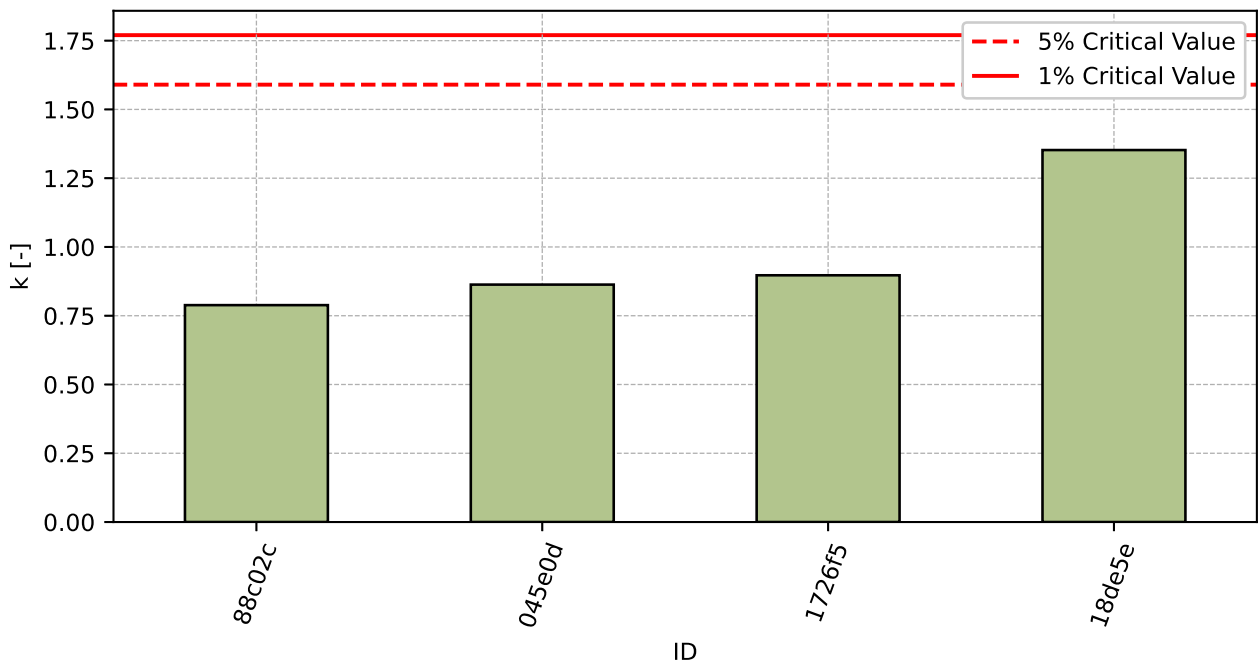


Figure 121: Intralaboratory Consistency Statistic

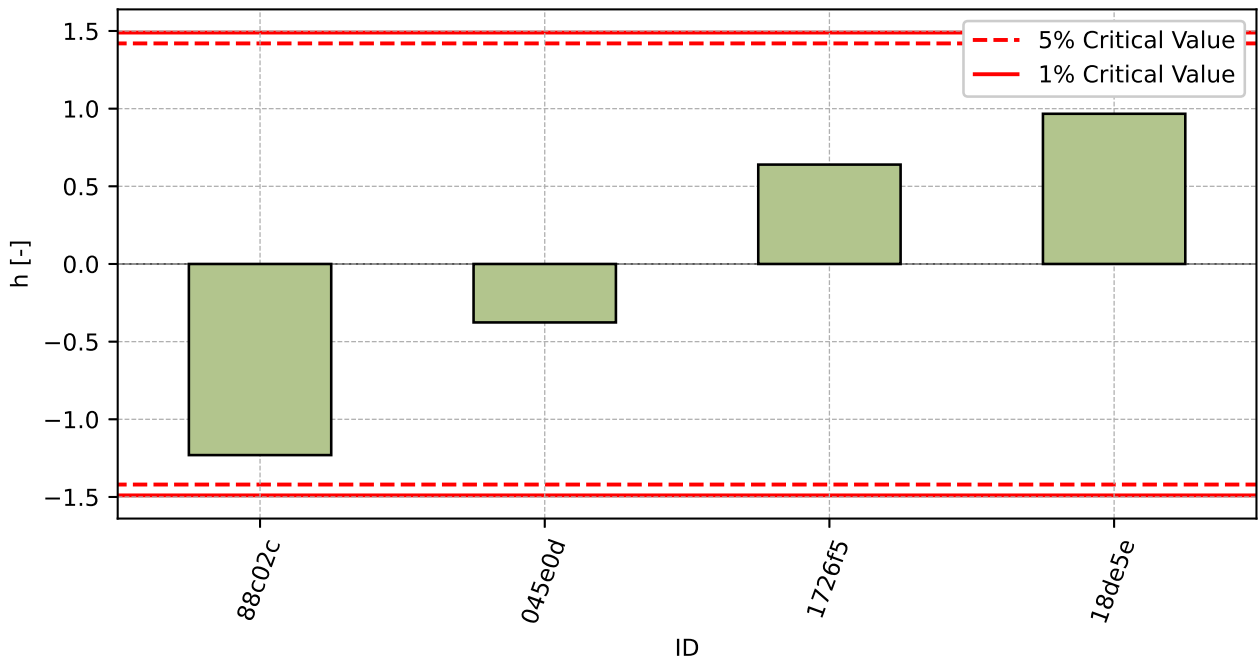


Figure 122: Interlaboratory Consistency Statistic

Descriptive statistics

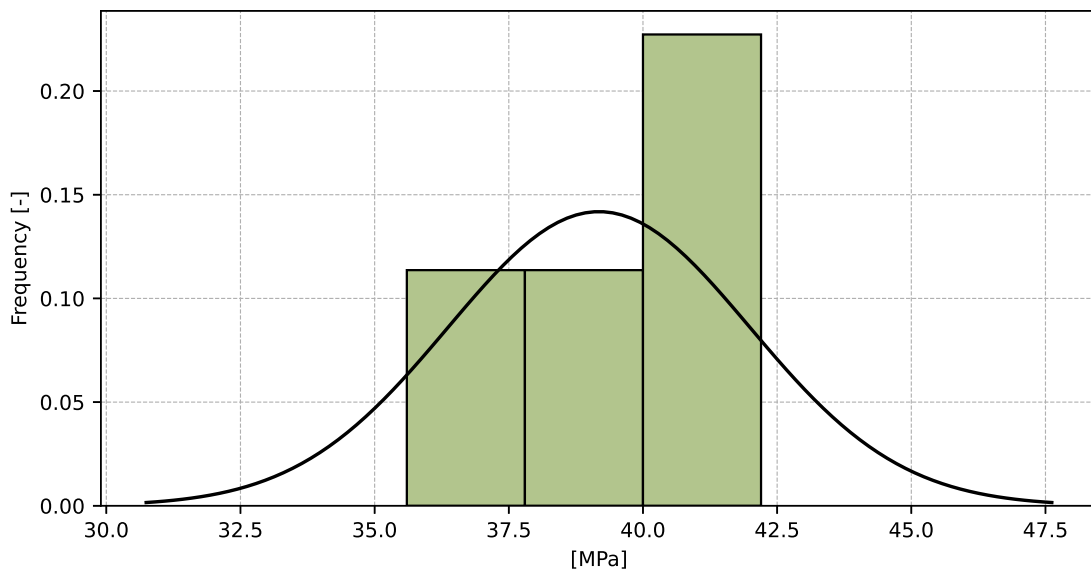


Figure 123: Histogram of all test results

Table 44: Descriptive statistics

Characteristics	[MPa]
Average value – \bar{x}	39.2
Sample standard deviation – s	2.81
Assigned value – x^*	39.2
Robust standard deviation – s^*	2.76
Measurement uncertainty of assigned value – u_X	1.73
p -value of normality test	0.006 [-]
Interlaboratory standard deviation – s_L	2.81
Repeatability standard deviation – s_r	0.17
Reproducibility standard deviation – s_R	2.82
Repeatability – r	0.5
Reproducibility – R	7.9

Evaluation of Performance Statistics

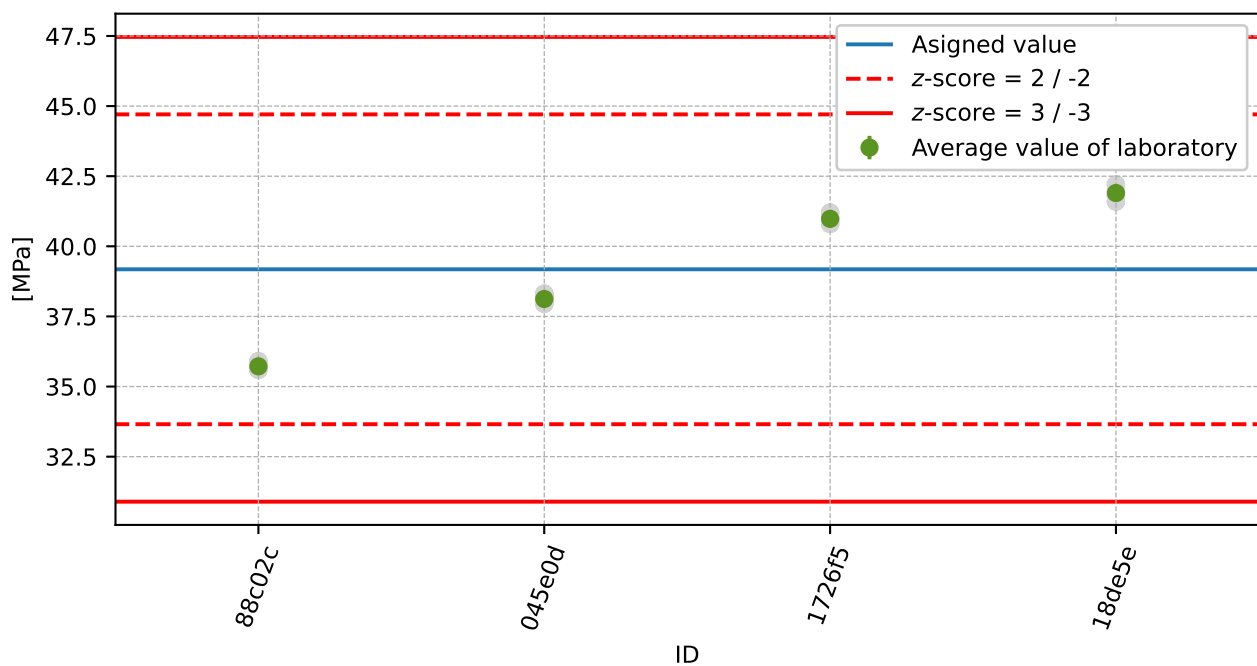


Figure 124: Average values and sample standard deviations

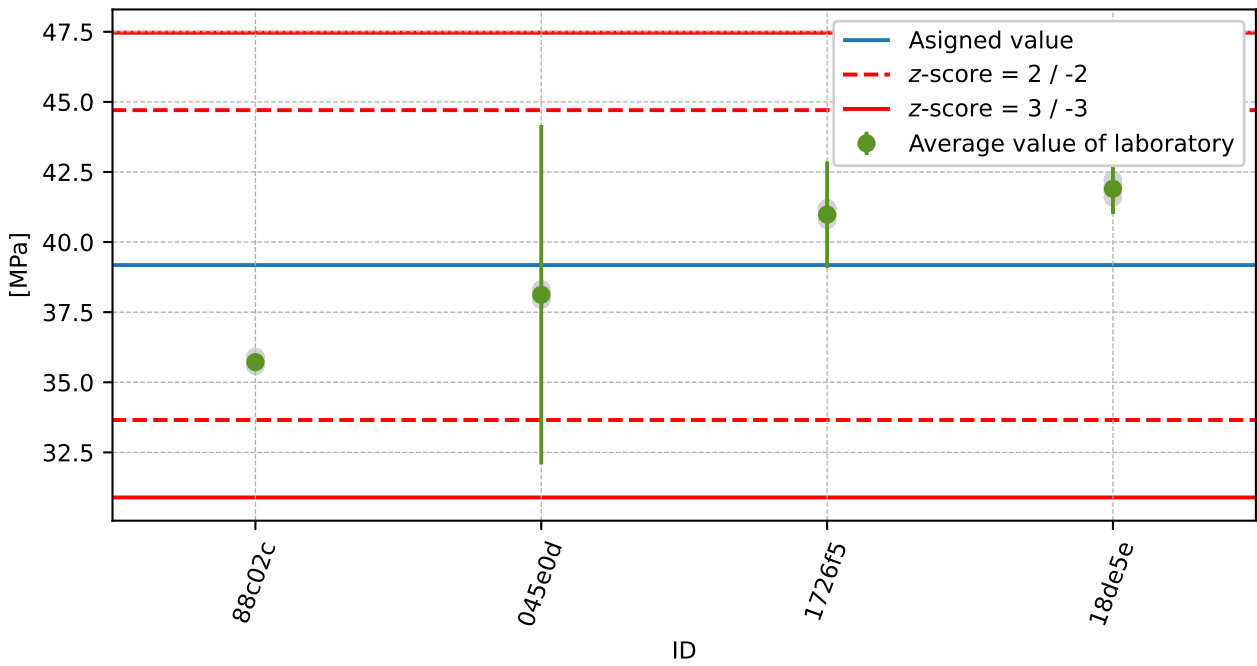


Figure 125: Average values and extended uncertainties of measurement

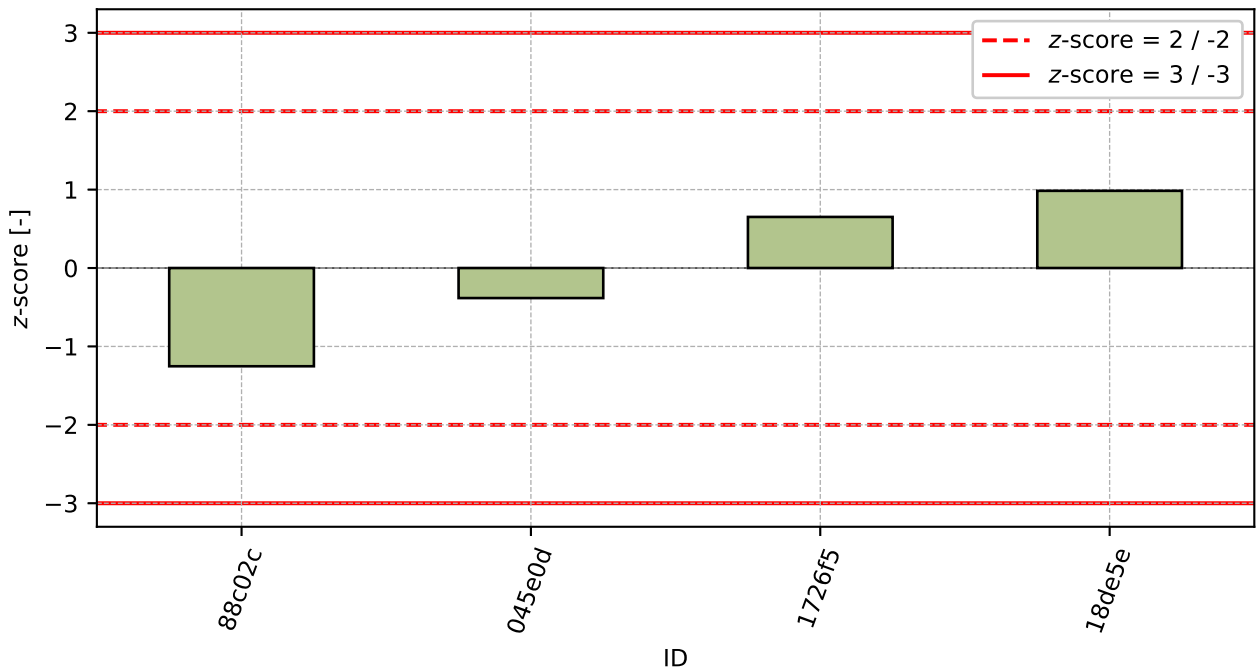


Figure 126: z-score

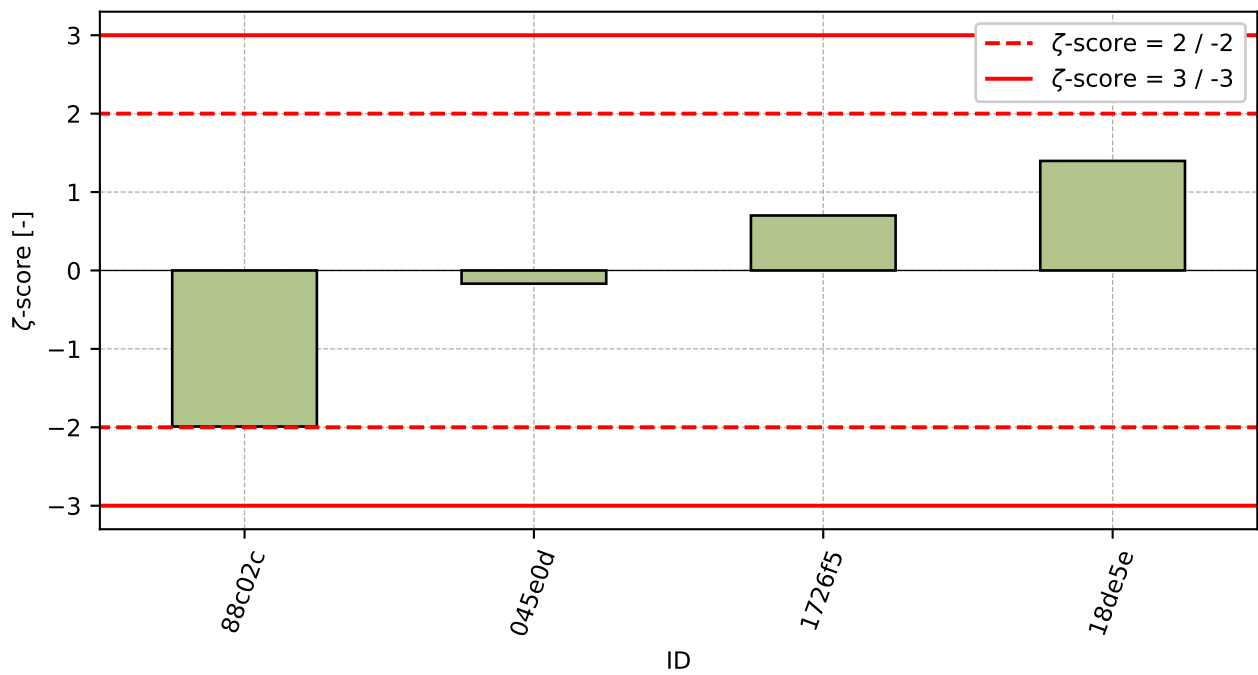


Figure 127: z-score

Table 45: z-score and z-score

ID	z-score [-]	z-score [-]
88c02c	-1.25	-1.99
045e0d	-0.38	-0.17
1726f5	0.65	0.7
18de5e	0.98	1.4

6 Appendix – EN ISO 179-1 (Charpy unnotched impact strength)

The test method was not opened due to the low number of participants.

7 Appendix – EN ISO 179-1 (Charpy notched impact strength (note: notch made by distributor))

The test method was not opened due to the low number of participants.

8 Appendix – EN ISO 179-1 (Charpy notched impact strength (note: notch made by laboratory))

The test method was not opened due to the low number of participants.

9 Appendix – EN ISO 868 (Shore hardness D)

9.1 Sample A

9.1.1 Test results

Table 46: 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 [%]
	[°]	[°]	[°]	[°]	[°]				
1726f5	68	69	69	69	69	2	69	0.4	0.65
9c10dc	69	69	70	69	70	1	69	0.3	0.4
88c02c	70	70	70	70	70	0	70	0.1	0.16
045e0d	71	70	70	71	70	3	70	0.5	0.78

9.1.2 The Numerical Procedure for Determining Outliers

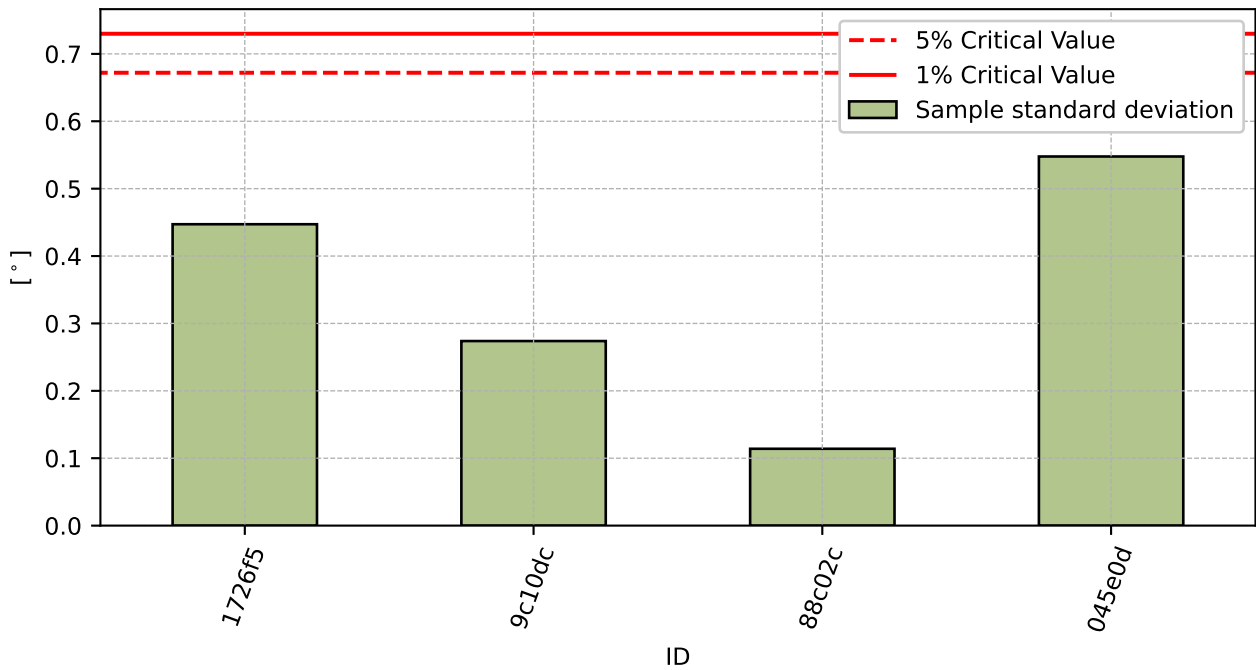


Figure 128: **Cochran's test** - sample standard deviations

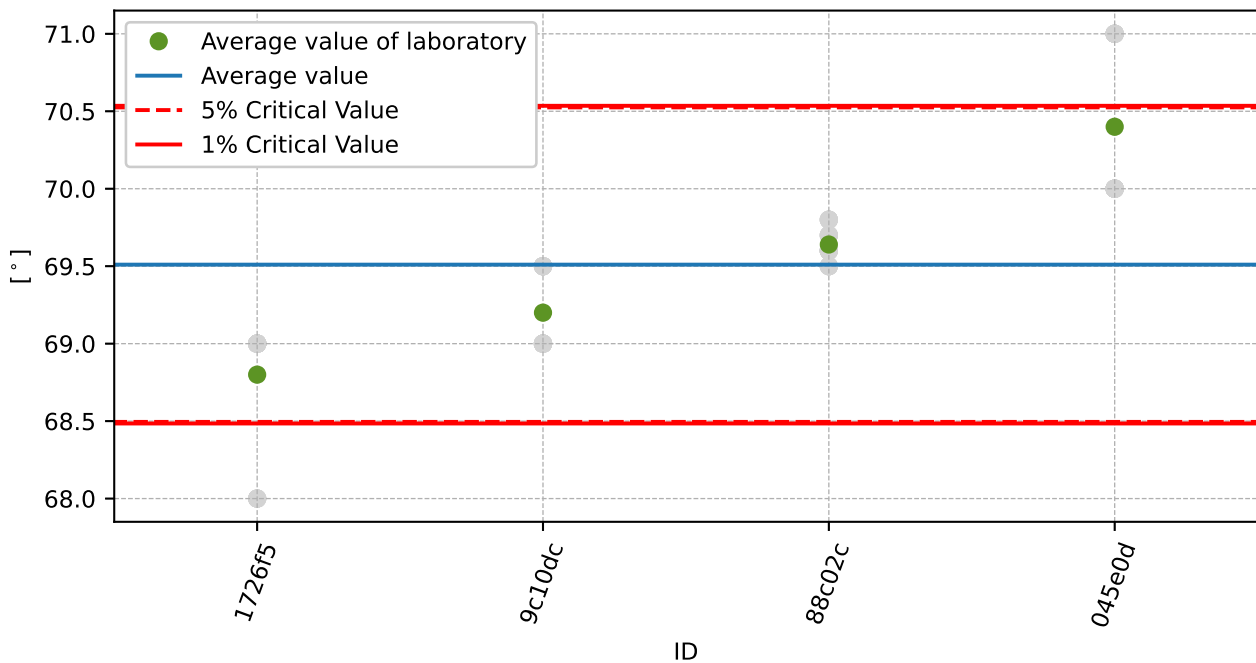


Figure 129: **Grubbs' test** - average values

9.1.3 Mandel's Statistics

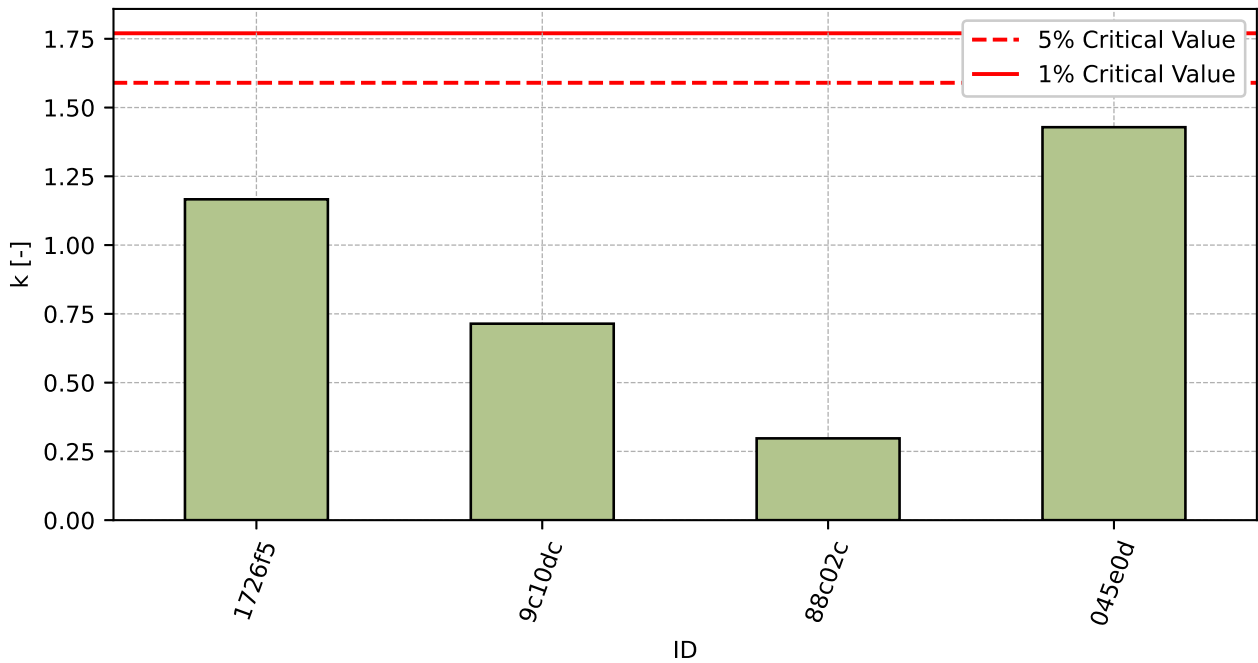


Figure 130: Intralaboratory Consistency Statistic

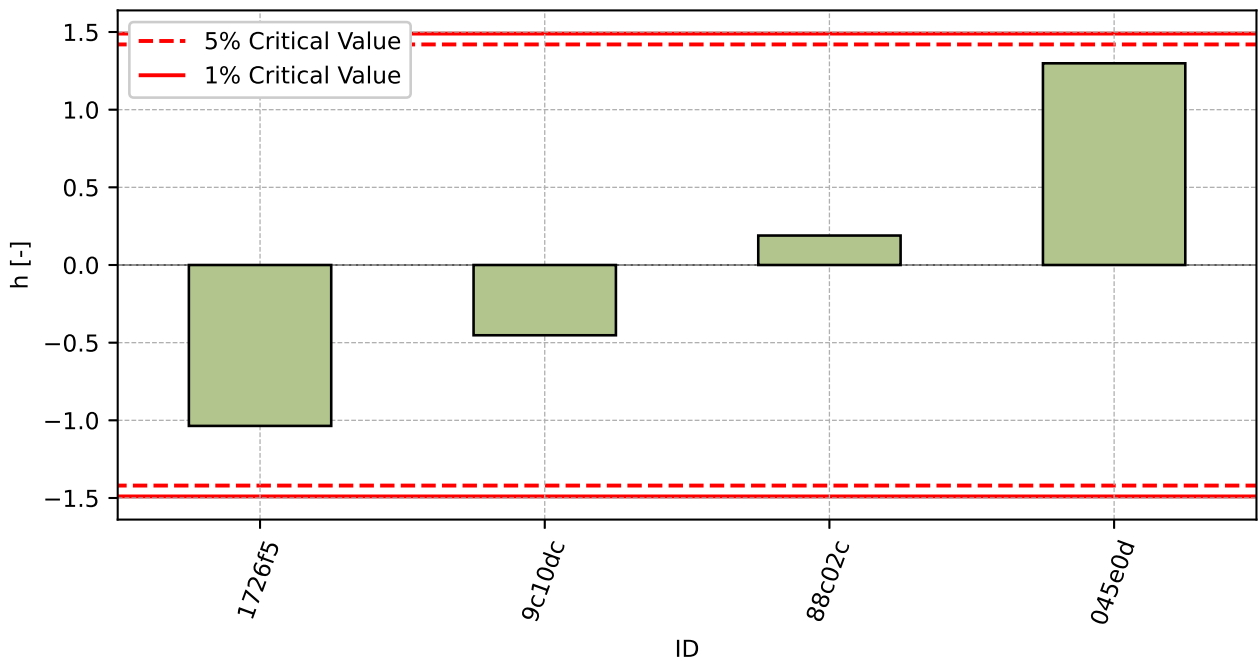


Figure 131: Interlaboratory Consistency Statistic

9.1.4 Descriptive statistics

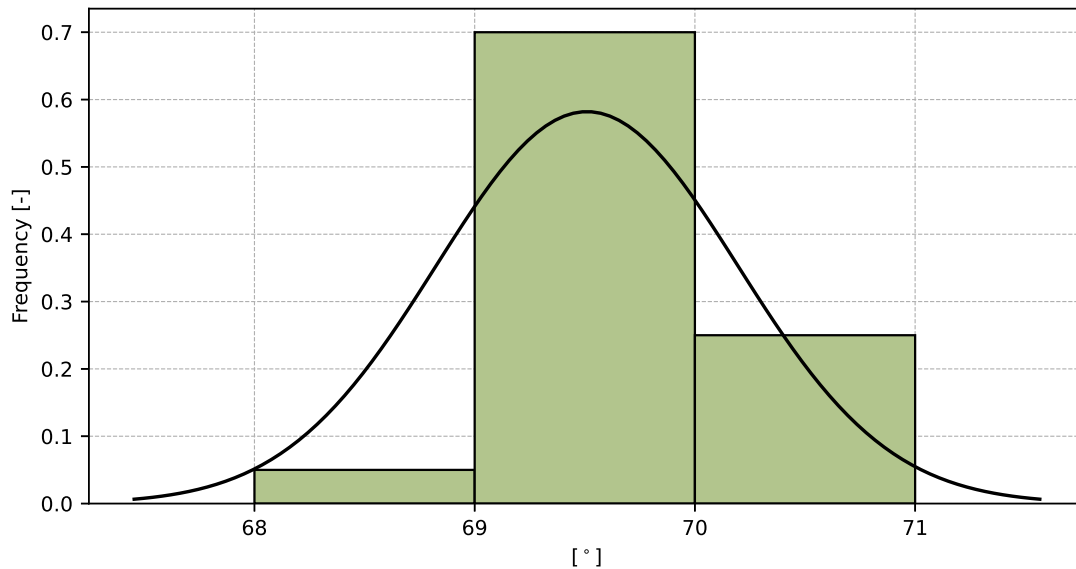


Figure 132: Histogram of all test results

Table 47: Descriptive statistics

Characteristics	[°]
Average value – \bar{x}	70
Sample standard deviation – s	0.7
Assigned value – x^*	70
Robust standard deviation – s^*	0.7
Measurement uncertainty of assigned value – u_X	0.3
p -value of normality test	0.058 [-]
Interlaboratory standard deviation – s_L	0.7
Repeatability standard deviation – s_r	0.4
Reproducibility standard deviation – s_R	0.8
Repeatability – r	1
Reproducibility – R	2

9.1.5 Evaluation of Performance Statistics

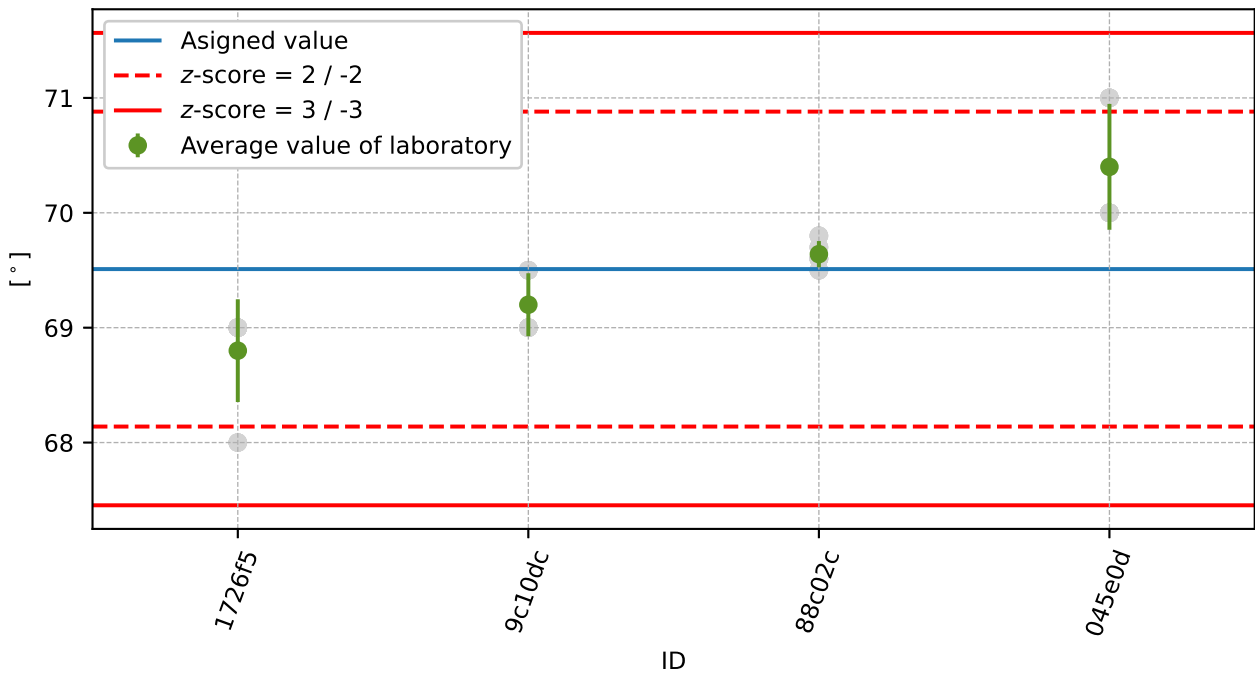


Figure 133: Average values and sample standard deviations

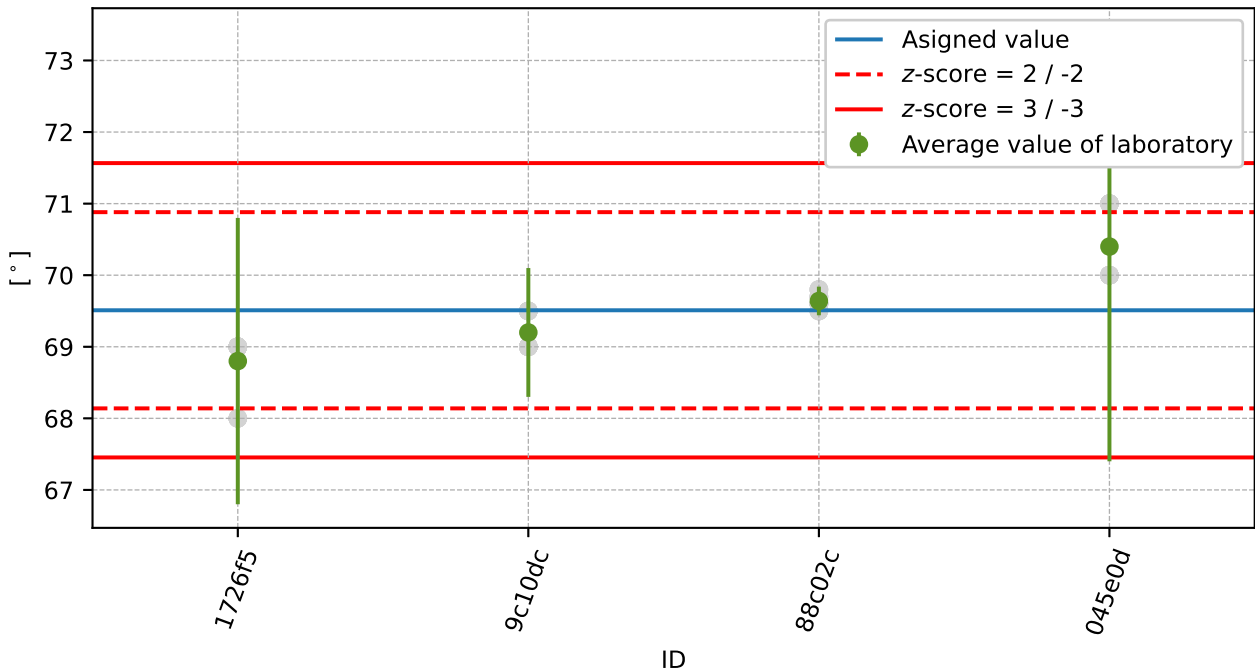


Figure 134: Average values and extended uncertainties of measurement

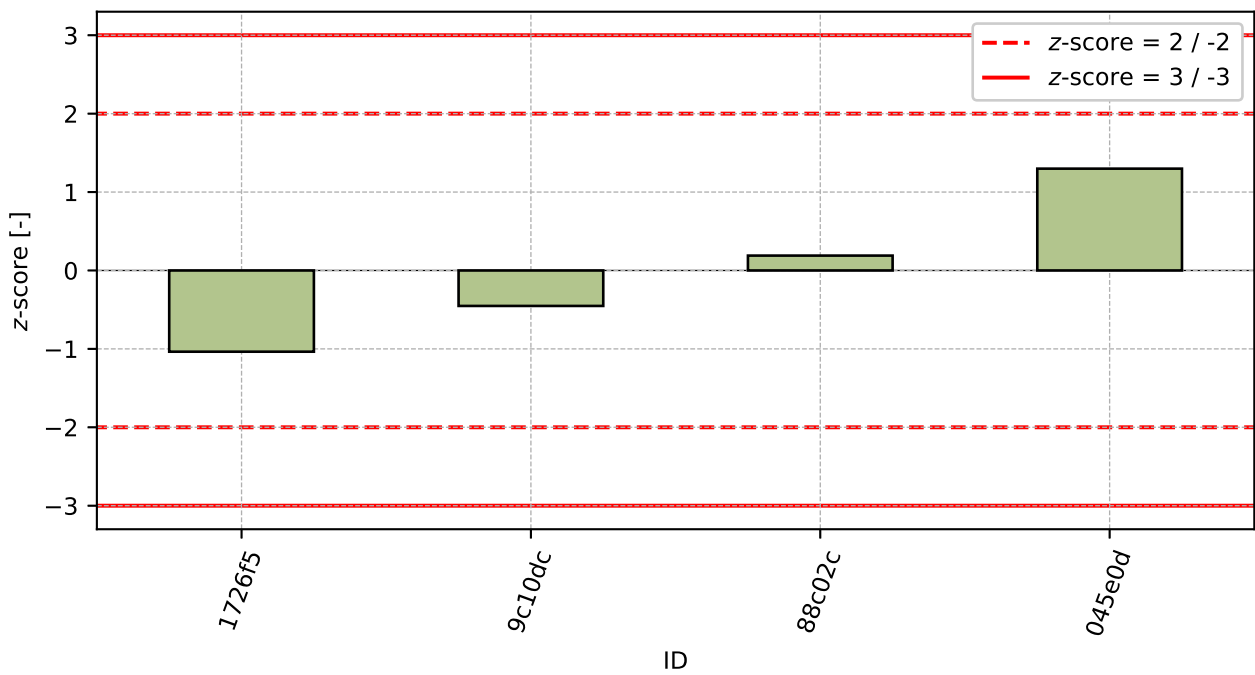


Figure 135: z-score

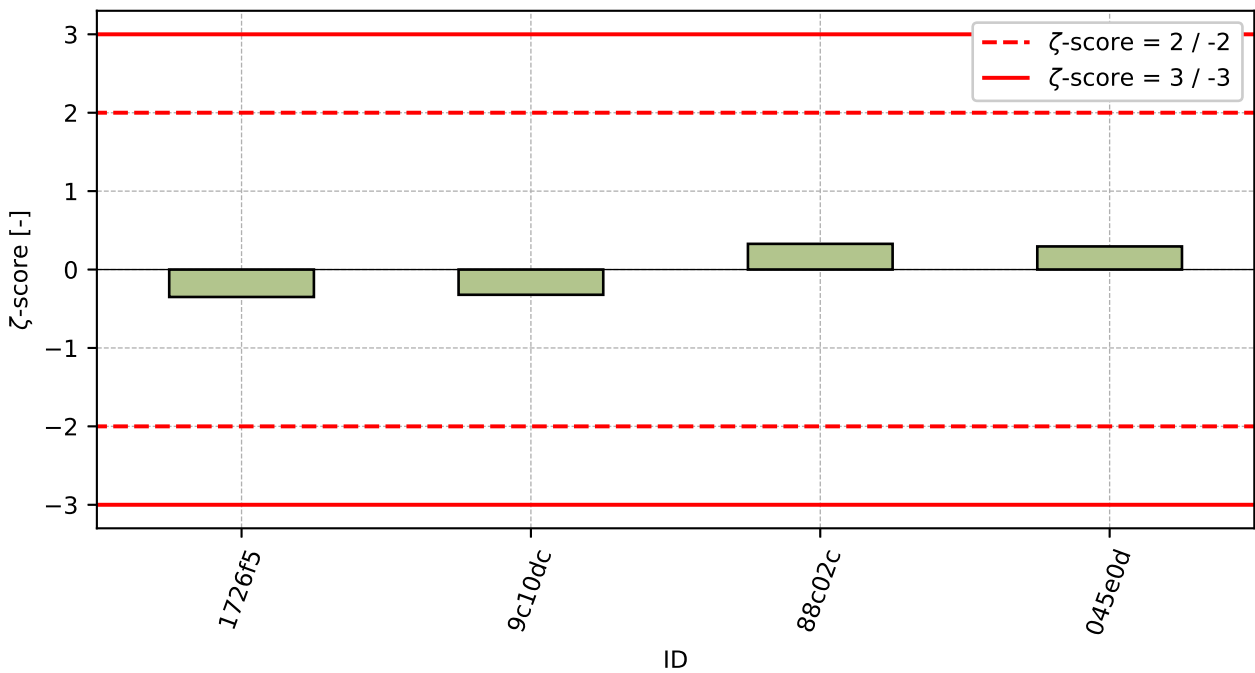


Figure 136: zeta-score

Table 48: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
1726f5	-1.04	-0.35
9c10dc	-0.45	-0.32
88c02c	0.19	0.33
045e0d	1.3	0.29

9.2 Sample B

9.2.1 Test results

Table 49: 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 [%]
	[°]								
1726f5	66	65	65	64	65	2	65	0.7	1.09
9c10dc	66	66	66	66	66	1	66	0.2	0.34
045e0d	67	67	66	66	66	3	66	0.5	0.82
88c02c	67	67	66	66	66	0	67	0.1	0.2

9.2.2 The Numerical Procedure for Determining Outliers

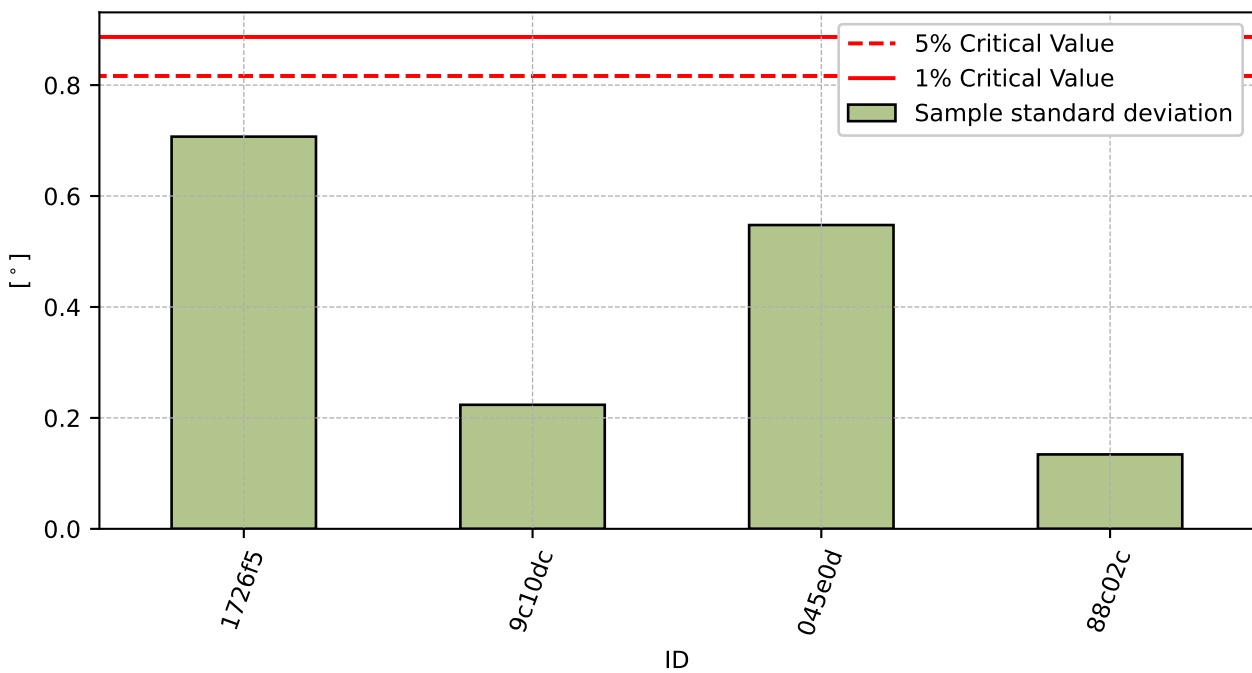


Figure 137: **Cochran's test** - sample standard deviations

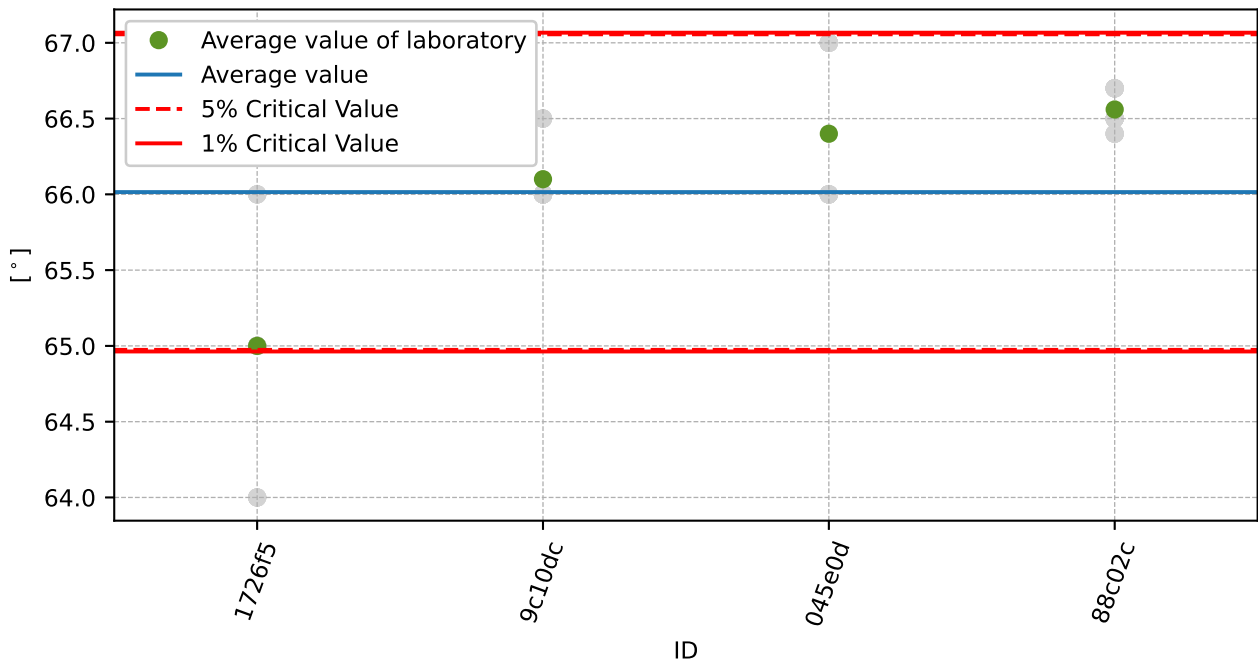


Figure 138: **Grubbs' test** - average values

9.2.3 Mandel's Statistics

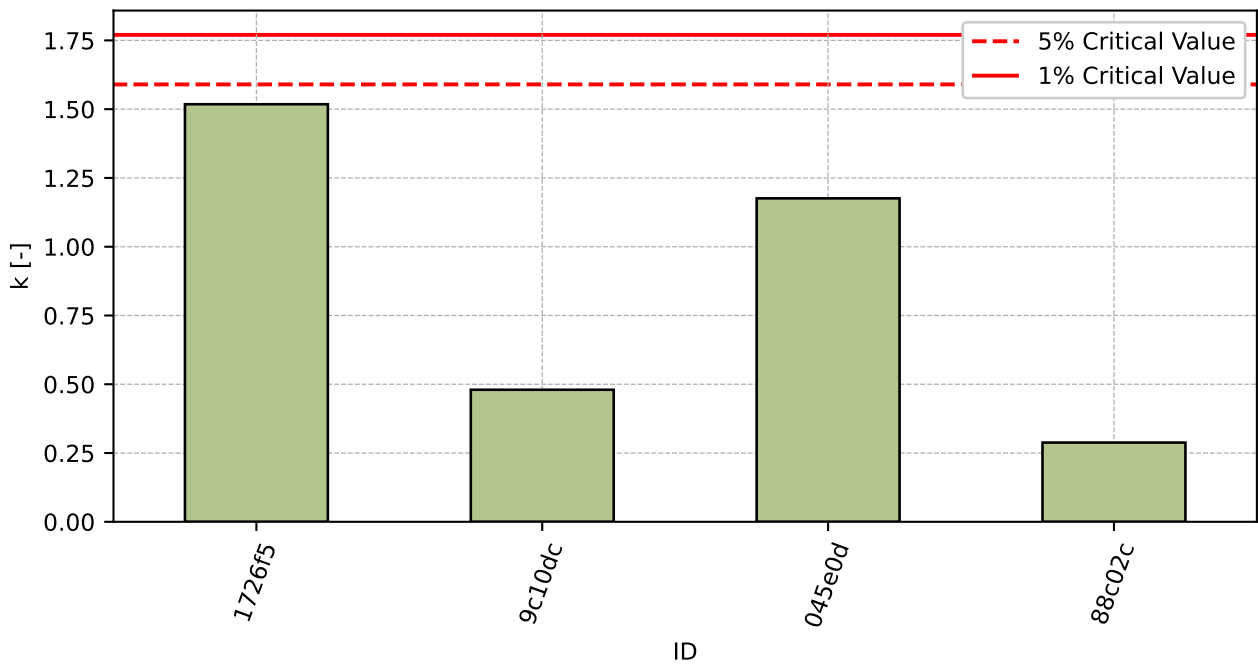


Figure 139: Intralaboratory Consistency Statistic

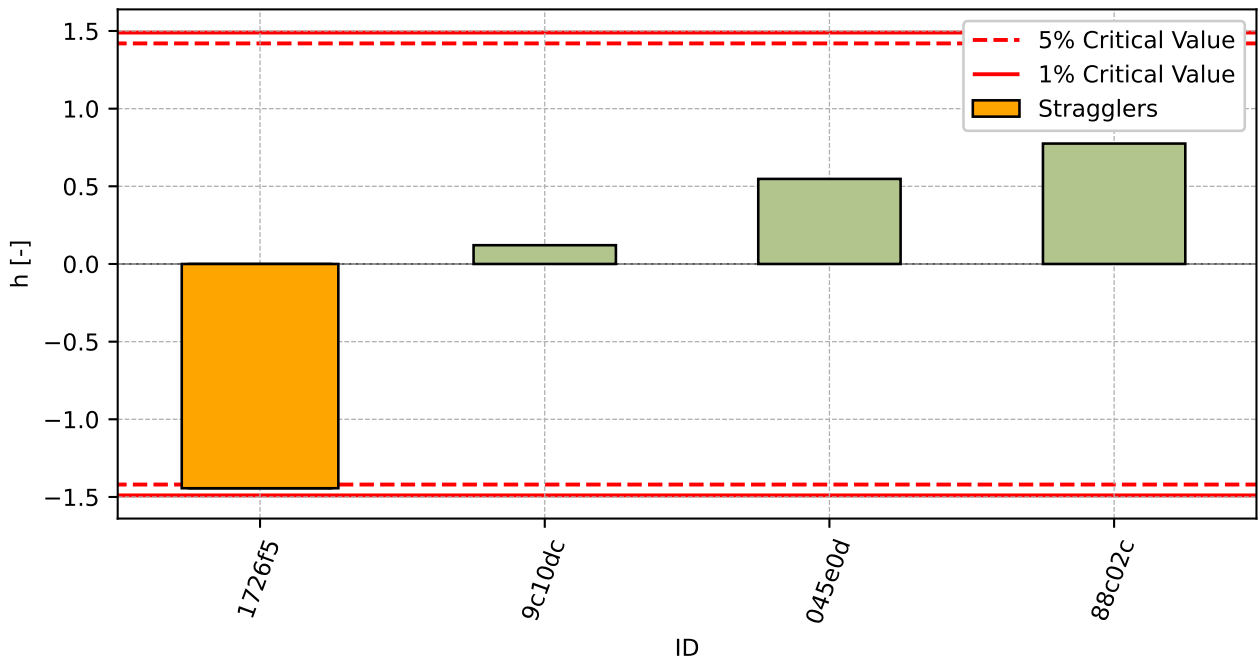


Figure 140: Interlaboratory Consistency Statistic

9.2.4 Descriptive statistics

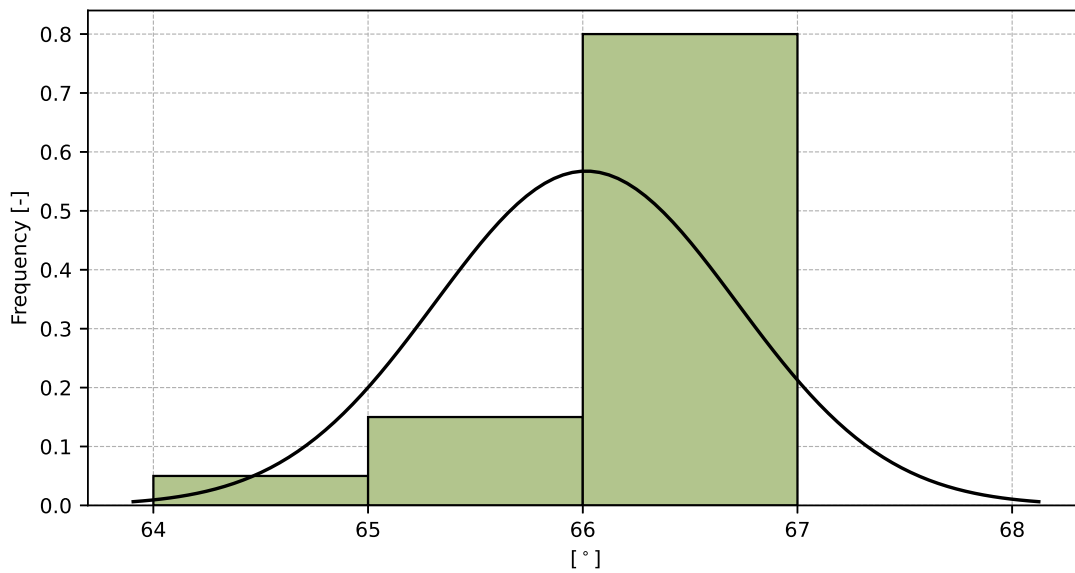


Figure 141: Histogram of all test results

Table 50: Descriptive statistics

Characteristics	[°]
Average value – \bar{x}	66
Sample standard deviation – s	0.7
Assigned value – x^*	66
Robust standard deviation – s^*	0.7
Measurement uncertainty of assigned value – u_X	0.4
p -value of normality test	0.013 [-]
Interlaboratory standard deviation – s_L	0.7
Repeatability standard deviation – s_r	0.5
Reproducibility standard deviation – s_R	0.8
Repeatability – r	1
Reproducibility – R	2

9.2.5 Evaluation of Performance Statistics

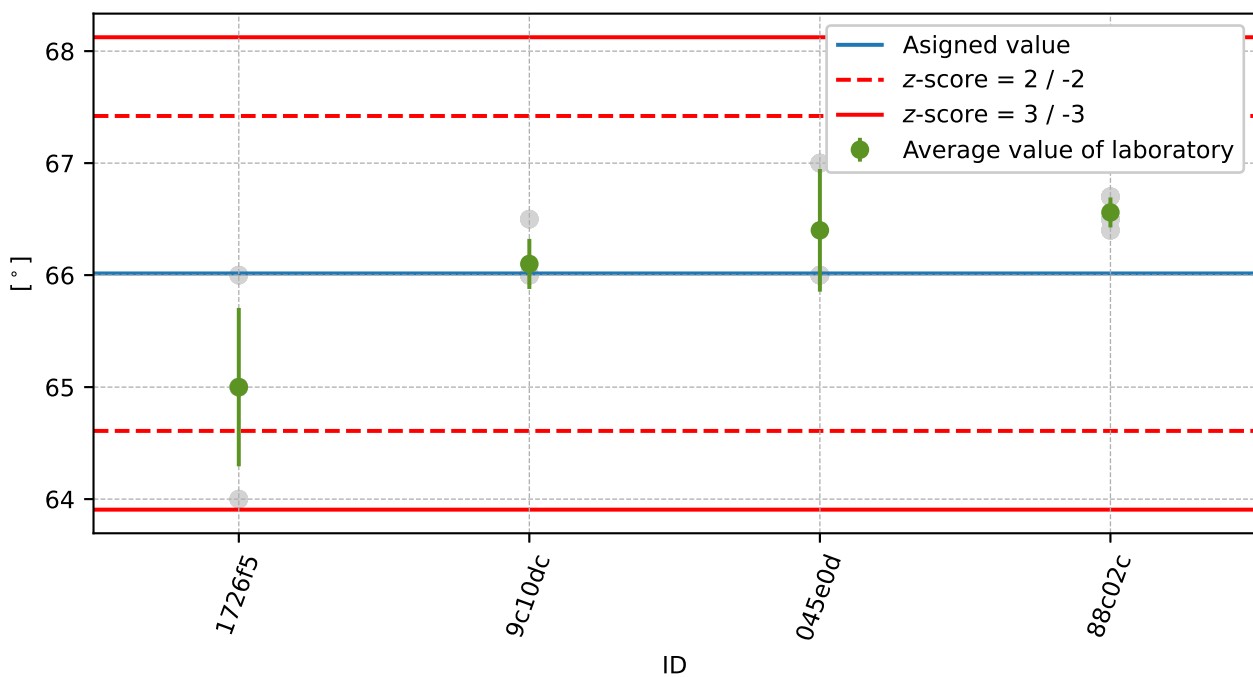


Figure 142: Average values and sample standard deviations

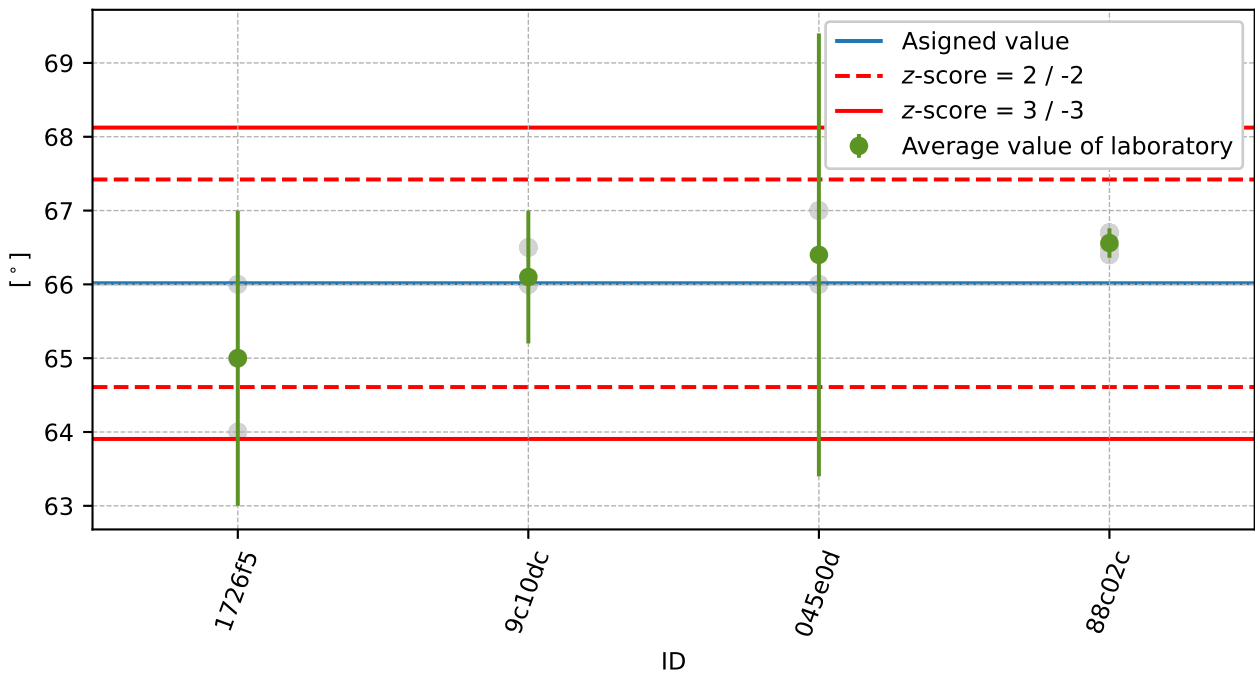


Figure 143: Average values and extended uncertainties of measurement

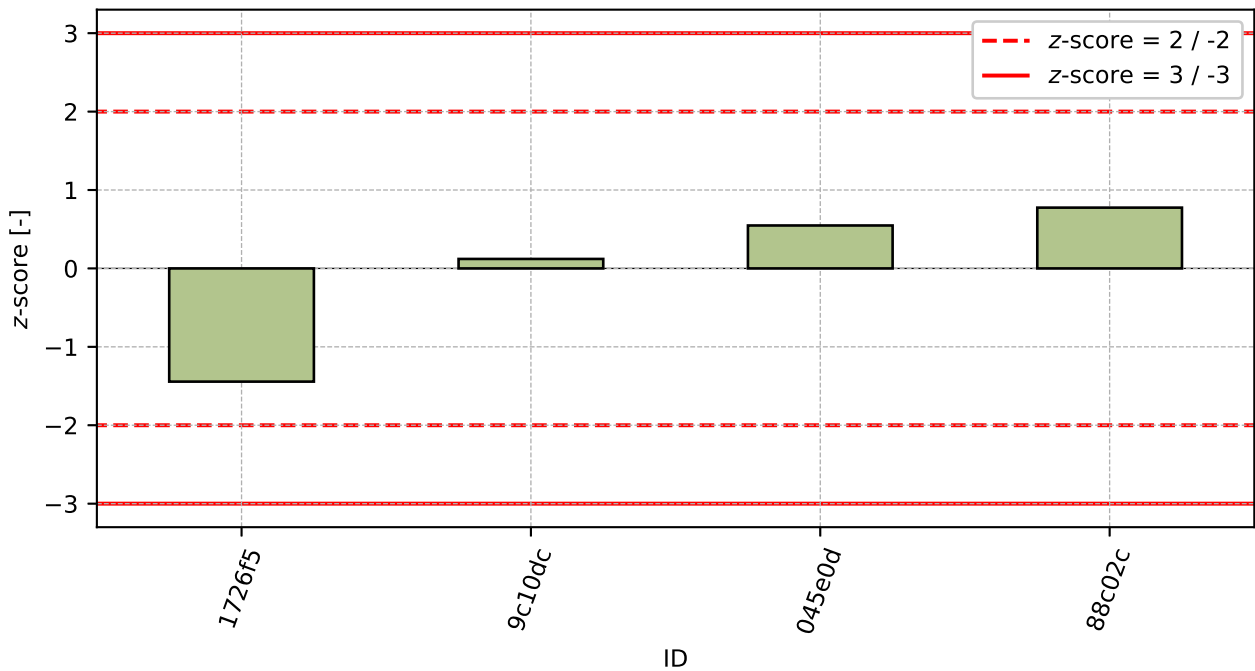


Figure 144: z-score

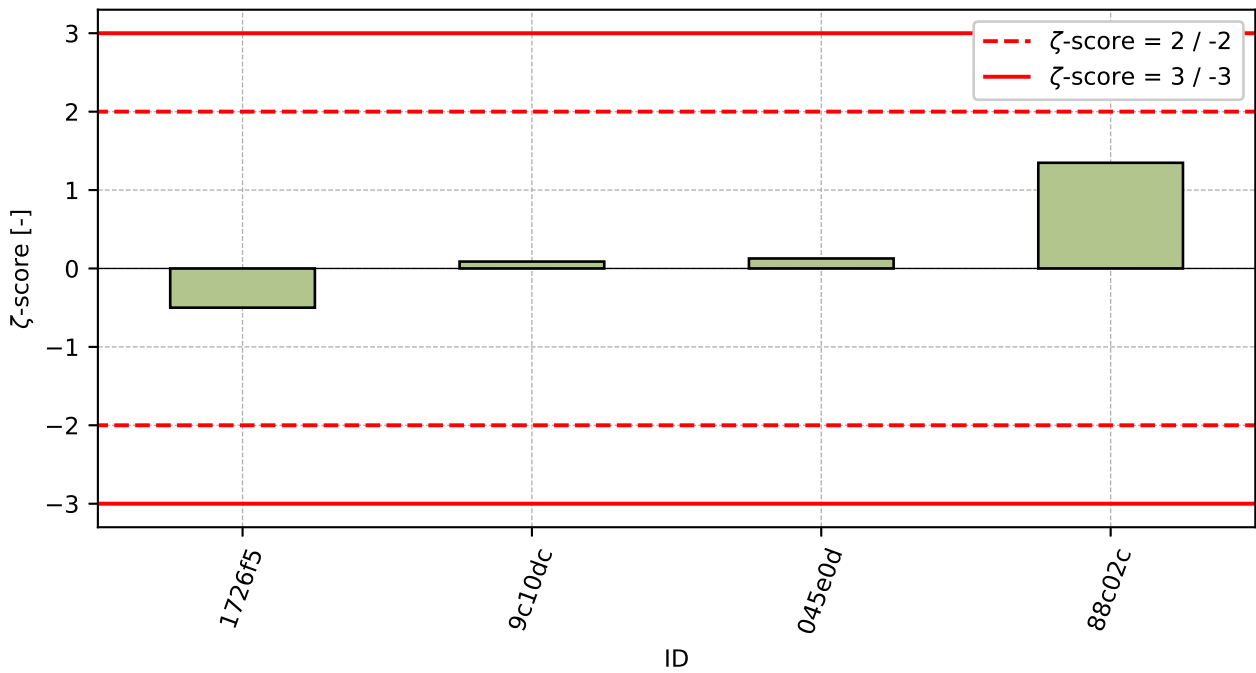


Figure 145: ζ -score

Table 51: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
1726f5	-1.44	-0.5
9c10dc	0.12	0.09
045e0d	0.55	0.13
88c02c	0.78	1.35

10 Appendix – EN ISO 306 (Vicat softening temperature VST/A/50)

The test method was not opened due to the low number of participants.

11 Appendix – EN ISO 306 (Vicat softening temperature VST/B/50)

The test method was not opened due to the low number of participants.

12 Appendix – EN ISO 75-1, -2 (Temperature of deflection under load, method A)

The test method was not opened due to the low number of participants.

13 Appendix – EN ISO 75-1, -2 (Temperature of deflection under load, method B)

The test method was not opened due to the low number of participants.

14 Appendix – EN ISO 1183-1 (Density)

14.1 Sample A

14.1.1 Test results

Table 52: 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 [kg/m ³]	\bar{x} [kg/m ³]	s_0 [kg/m ³]	V_x [%]
	[kg/m ³]	[kg/m ³]	[kg/m ³]				
c01900	899.3	900.0	899.6	0.7	899.6	0.35	0.04
88c02c	905.9	905.7	905.8	0.6	905.8	0.1	0.01
108c2a	906.3	906.3	906.3	0.0	906.3	0.02	0.0
27d4a4	906.8	907.7	907.6	25.0	907.4	0.49	0.05
354b78	909.0	909.0	911.0	1.0	909.7	1.15	0.13

14.1.2 The Numerical Procedure for Determining Outliers

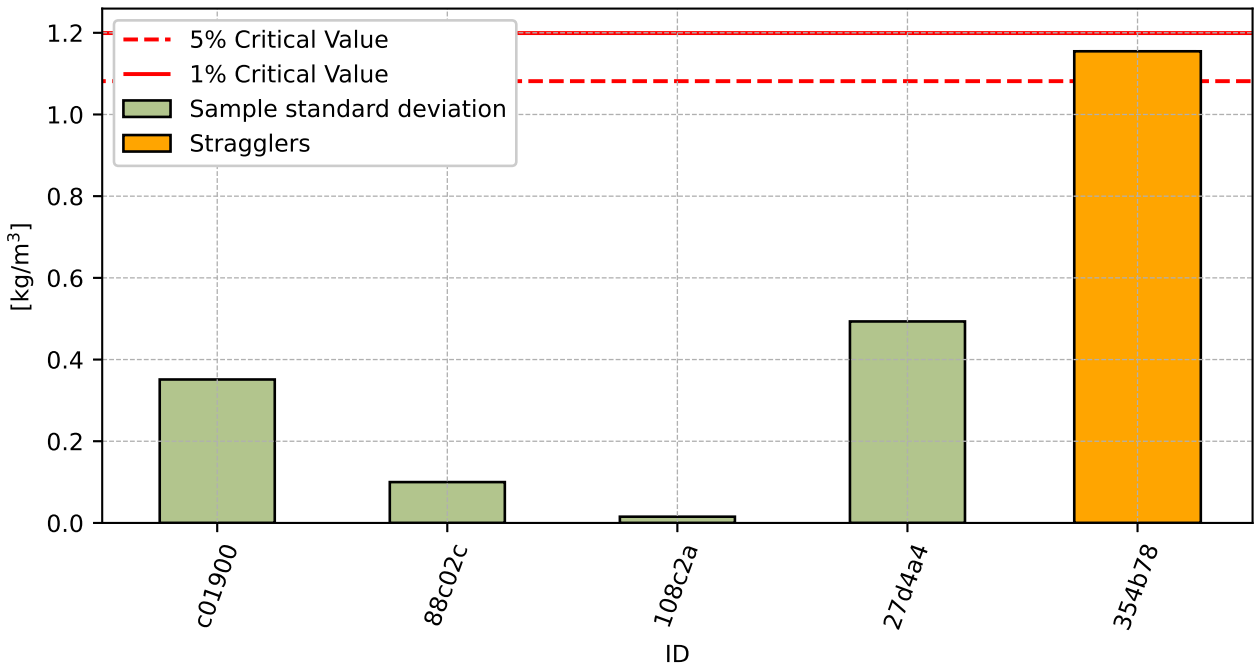


Figure 146: **Cochran's test** - sample standard deviations

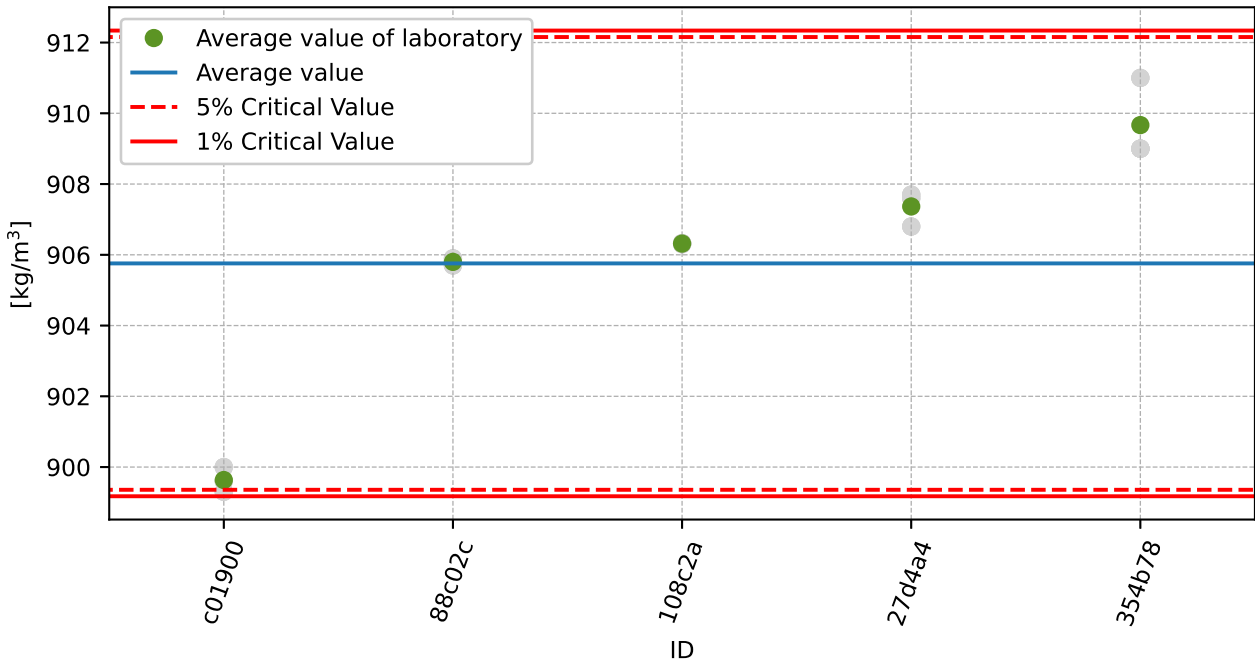


Figure 147: **Grubbs' test** - average values

14.1.3 Mandel's Statistics

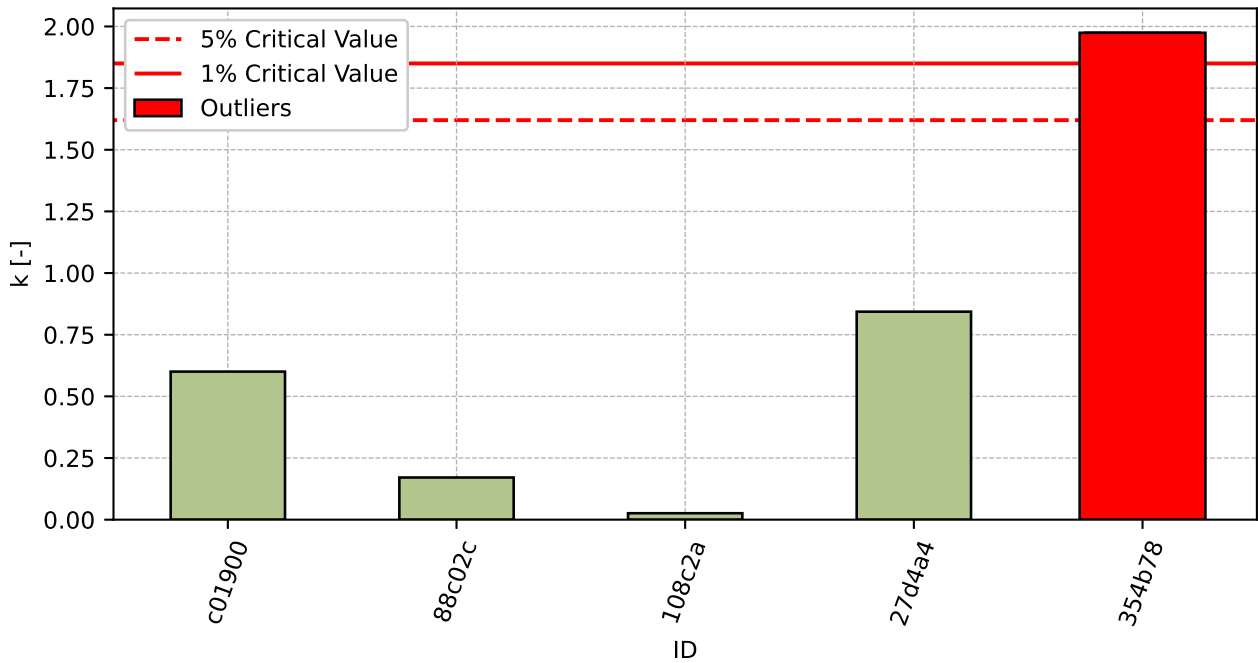


Figure 148: Intralaboratory Consistency Statistic

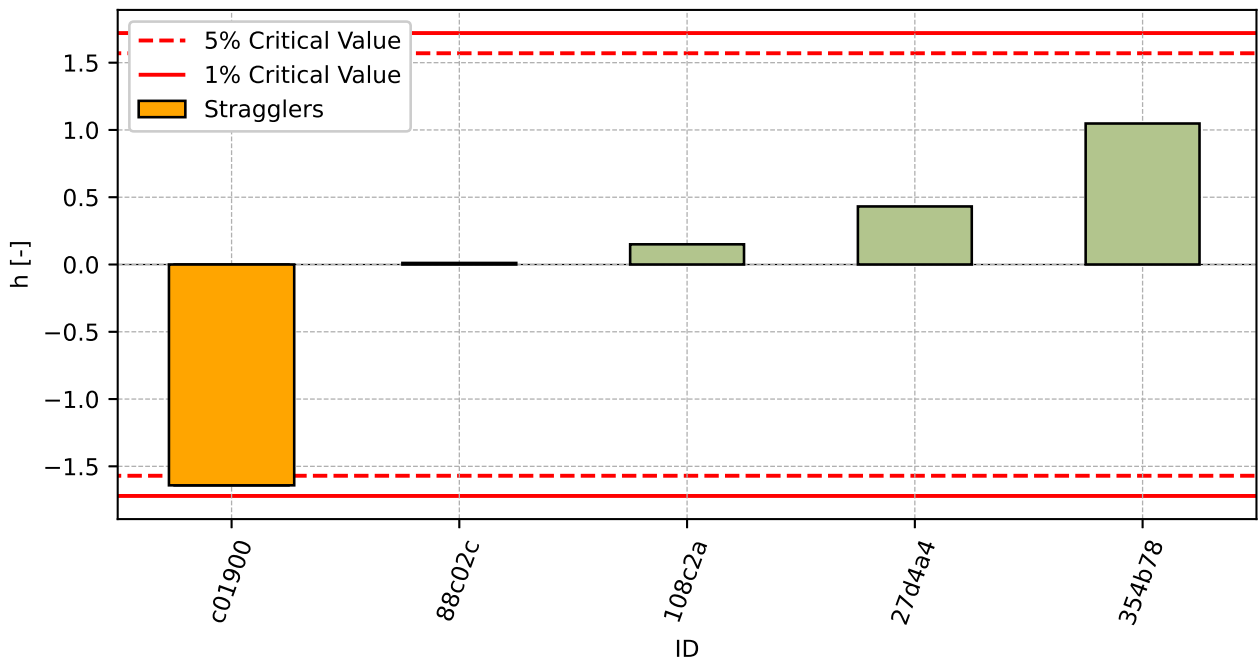


Figure 149: Interlaboratory Consistency Statistic

14.1.4 Descriptive statistics

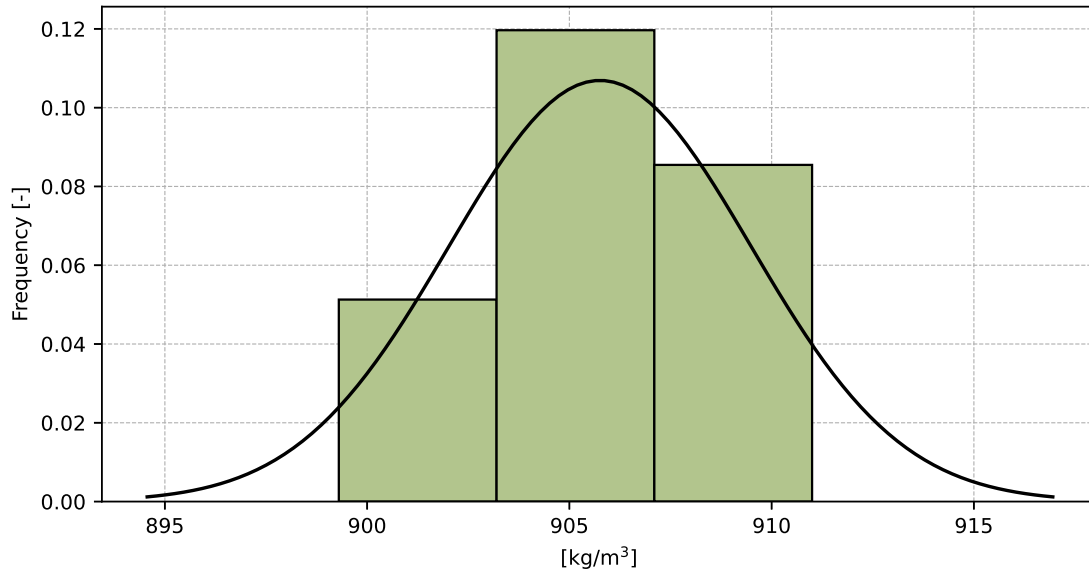


Figure 150: Histogram of all test results

Table 53: Descriptive statistics

Characteristics	[kg/m^3]
Average value – \bar{x}	905.8
Sample standard deviation – s	3.73
Assigned value – x^*	905.8
Robust standard deviation – s^*	3.73
Measurement uncertainty of assigned value – u_X	1.67
p -value of normality test	0.021 [-]
Interlaboratory standard deviation – s_L	3.72
Repeatability standard deviation – s_r	0.58
Reproducibility standard deviation – s_R	3.76
Repeatability – r	1.6
Reproducibility – R	10.5

14.1.5 Evaluation of Performance Statistics

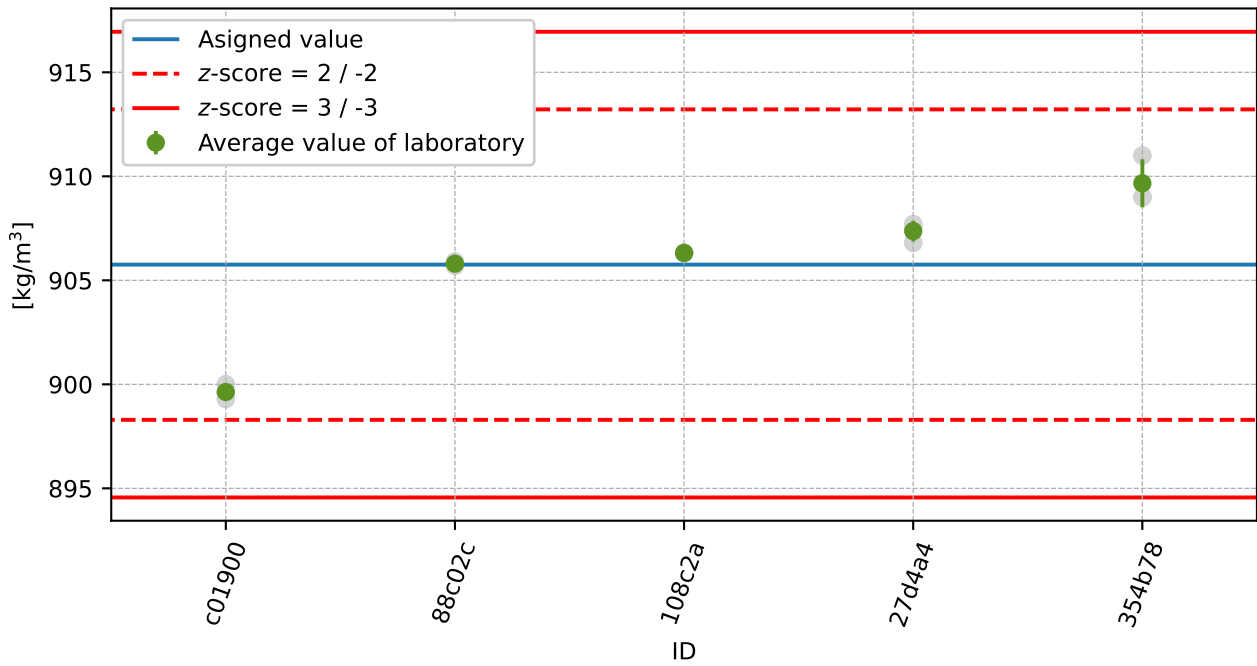


Figure 151: Average values and sample standard deviations

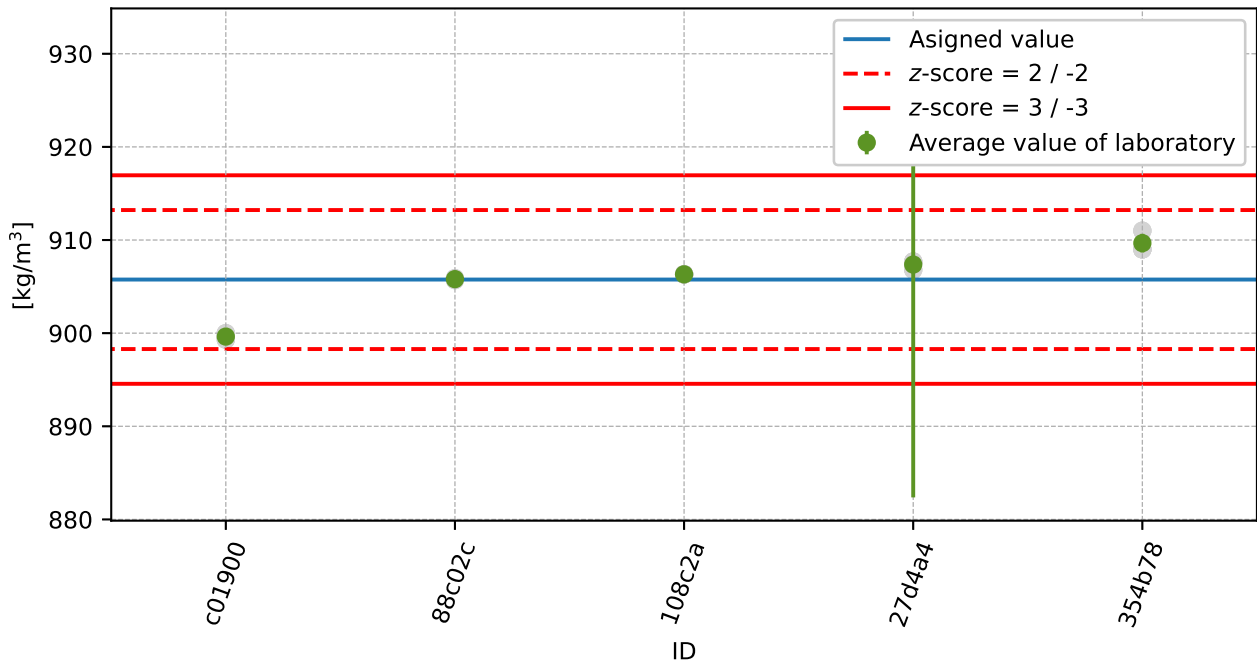


Figure 152: Average values and extended uncertainties of measurement

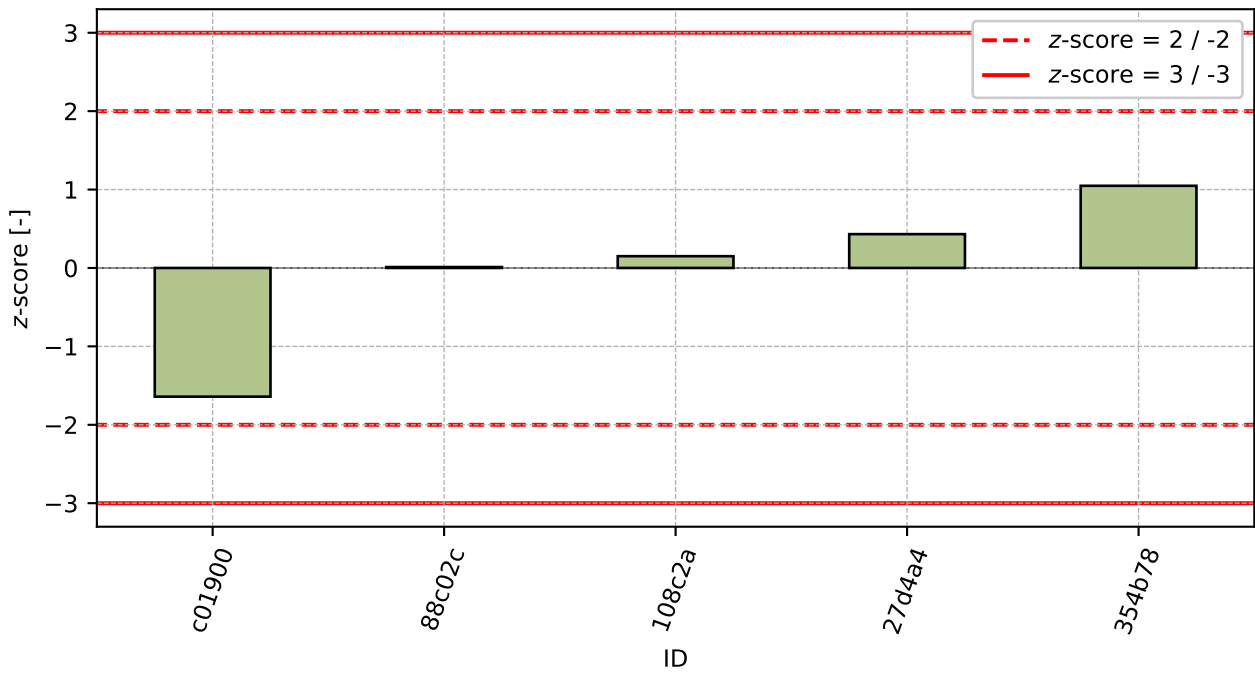


Figure 153: z-score

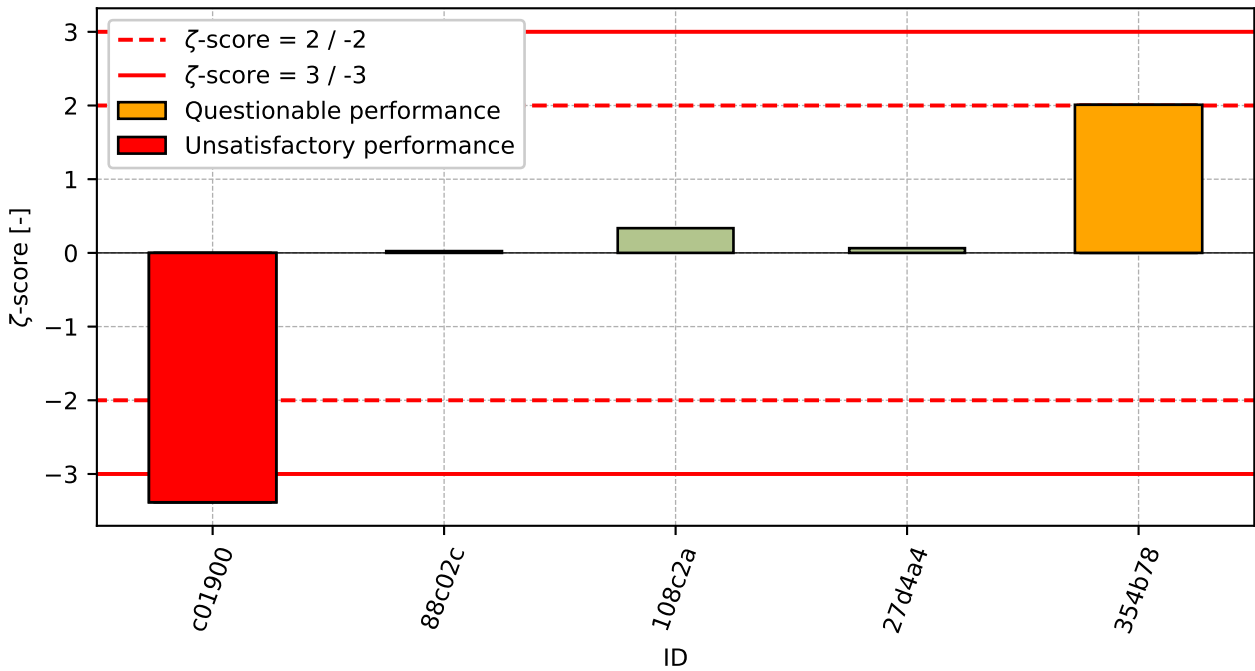


Figure 154: ζ -score

Table 54: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
c01900	-1.64	-3.38
88c02c	0.01	0.02
108c2a	0.15	0.34
27d4a4	0.43	0.06
354b78	1.05	2.01

14.2 Sample B

14.2.1 Test results

Table 55: 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 [kg/m ³]	\bar{x} [kg/m ³]	s_0 [kg/m ³]	V_X [%]
	[kg/m ³]						
c01900	895.9	895.8	896.5	0.7	896.1	0.38	0.04
88c02c	902.4	902.4	902.5	0.6	902.4	0.06	0.01
108c2a	903.1	903.1	903.0	0.0	903.1	0.04	0.0
27d4a4	903.9	904.2	903.6	25.0	903.9	0.3	0.03
354b78	907.0	906.0	908.0	1.0	907.0	1.0	0.11

14.2.2 The Numerical Procedure for Determining Outliers

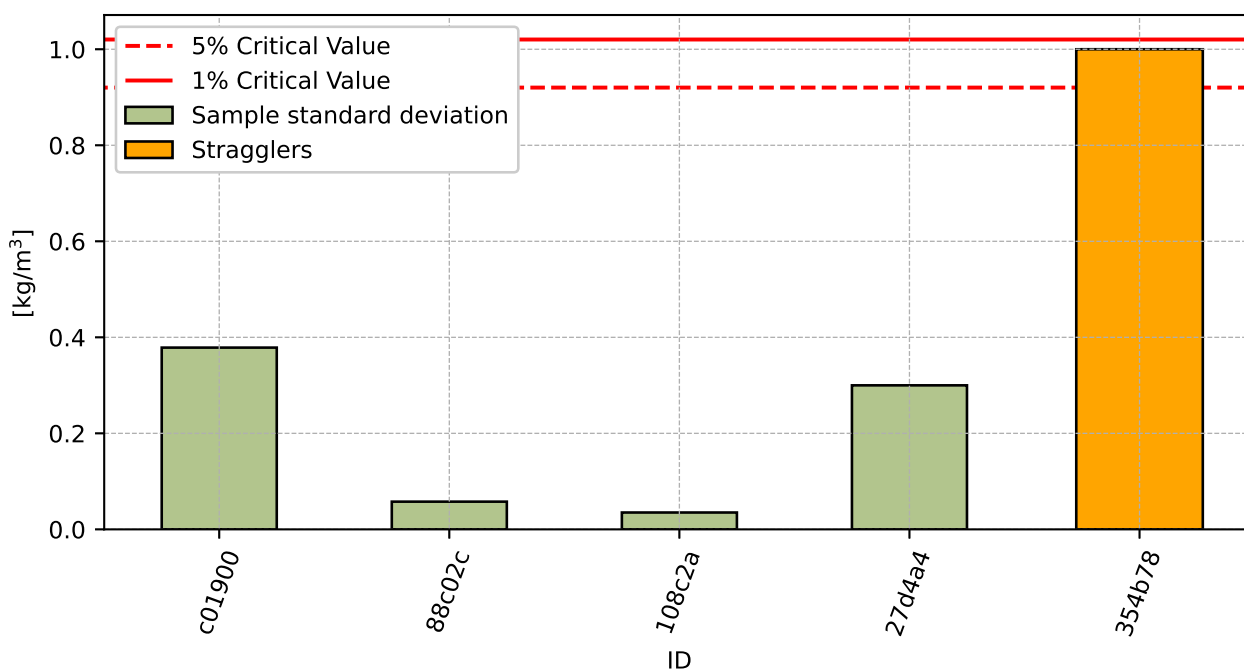


Figure 155: Cochran's test - sample standard deviations

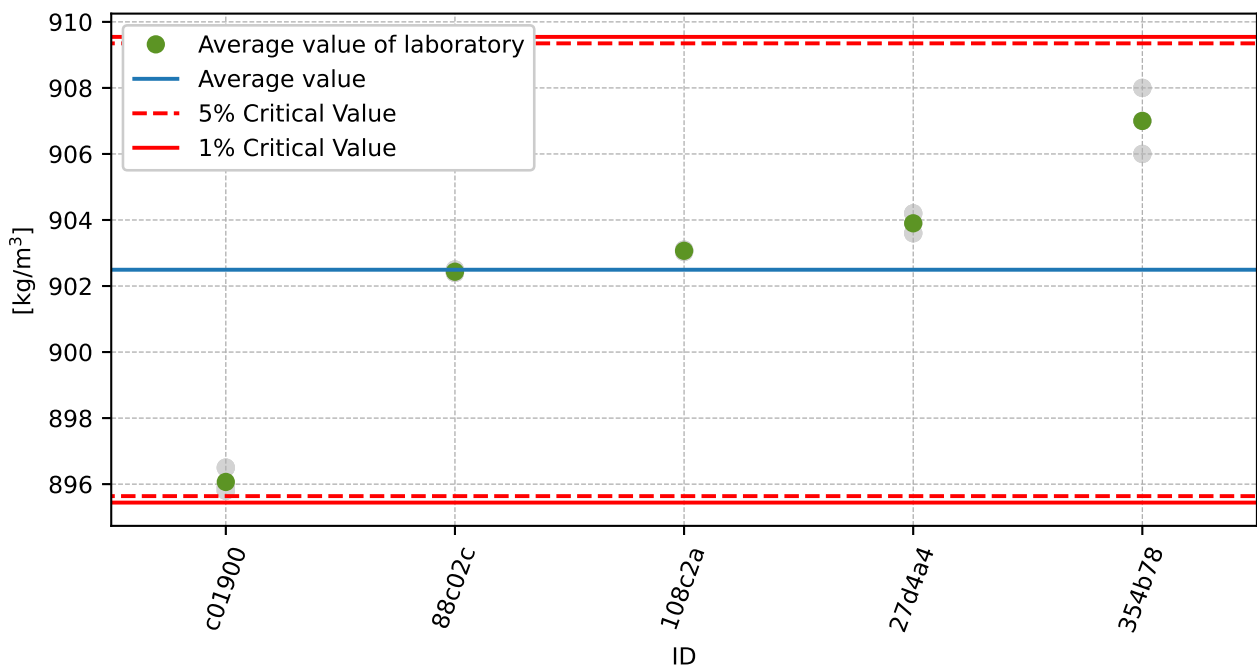


Figure 156: Grubbs' test - average values

14.2.3 Mandel's Statistics

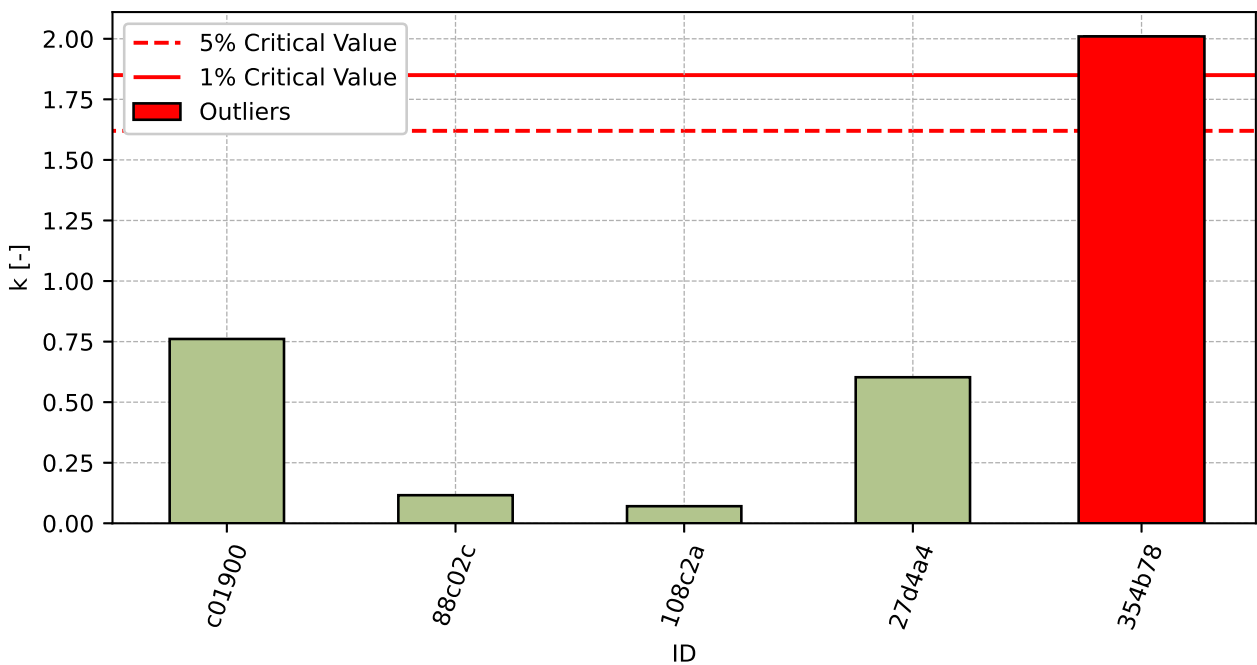


Figure 157: Intralaboratory Consistency Statistic

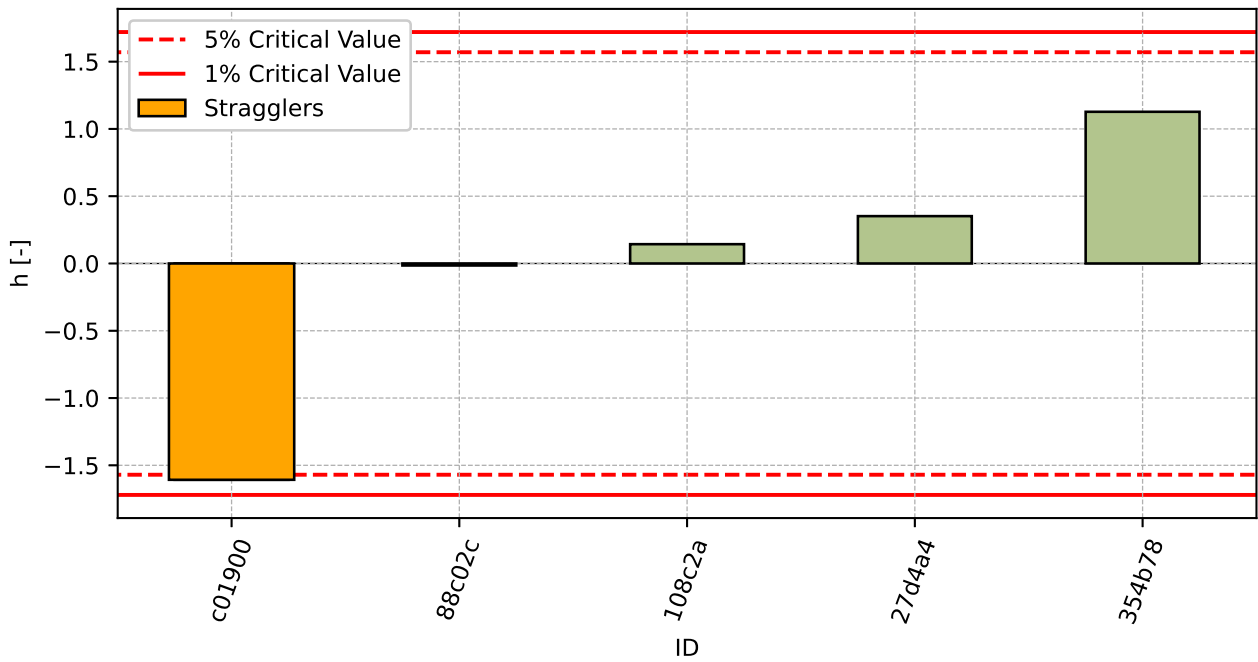


Figure 158: Interlaboratory Consistency Statistic

14.2.4 Descriptive statistics

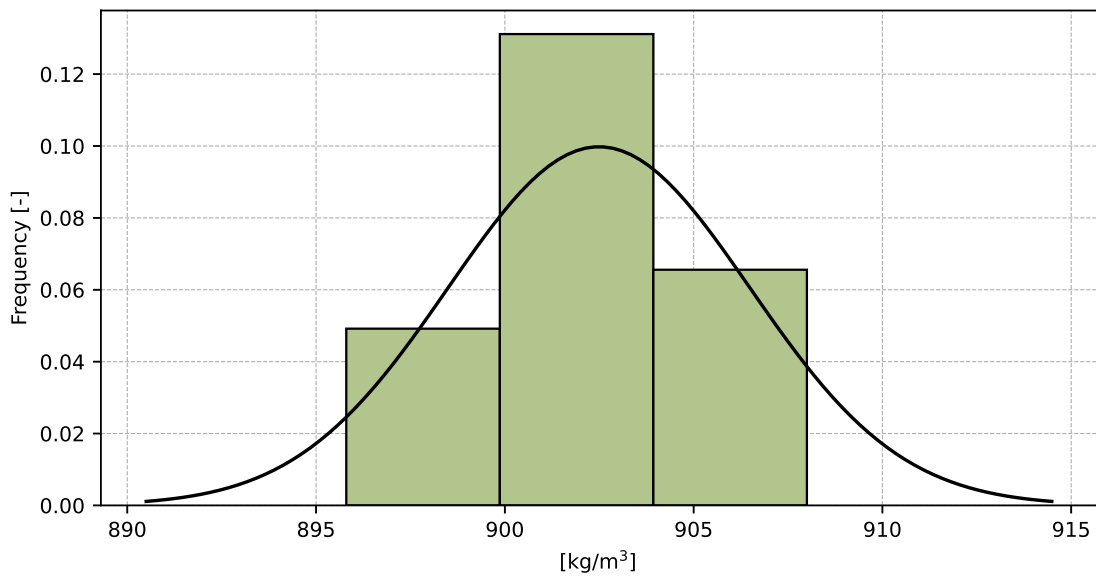


Figure 159: Histogram of all test results

Table 56: Descriptive statistics

Characteristics	[kg/m ³]
Average value – \bar{x}	902.5
Sample standard deviation – s	4.0
Assigned value – x^*	902.5
Robust standard deviation – s^*	4.0
Measurement uncertainty of assigned value – u_X	1.79
p -value of normality test	0.029 [-]
Interlaboratory standard deviation – s_L	3.99
Repeatability standard deviation – s_r	0.5
Reproducibility standard deviation – s_R	4.02
Repeatability – r	1.4
Reproducibility – R	11.3

14.2.5 Evaluation of Performance Statistics

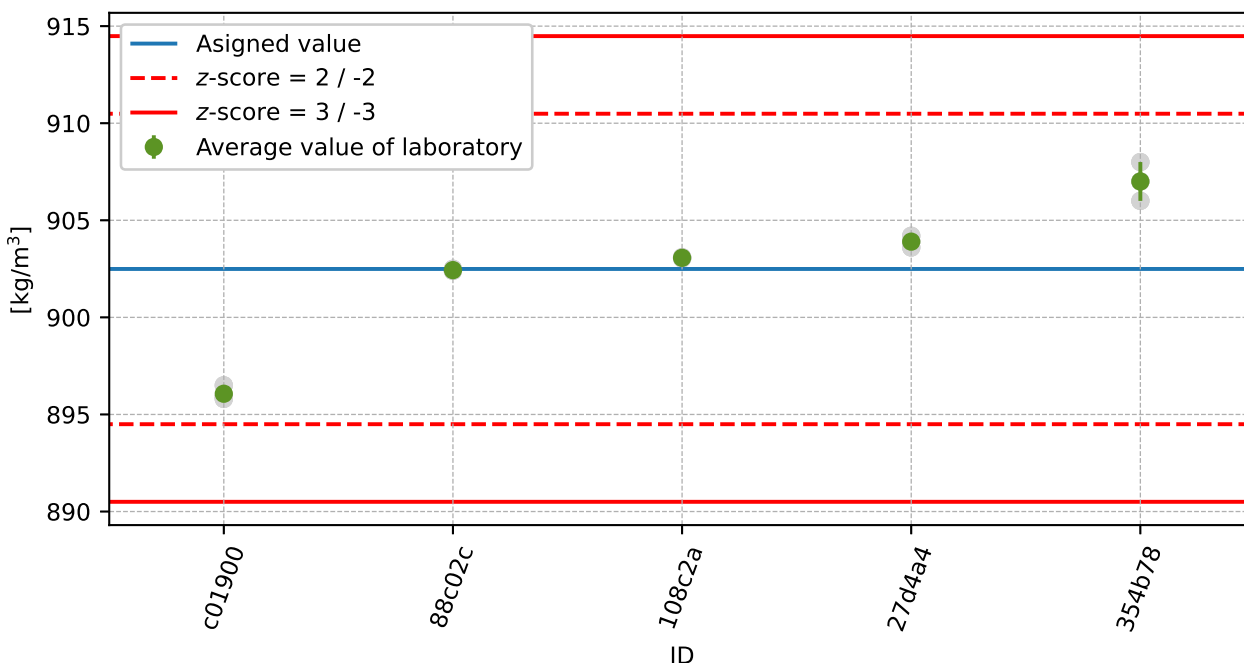


Figure 160: Average values and sample standard deviations

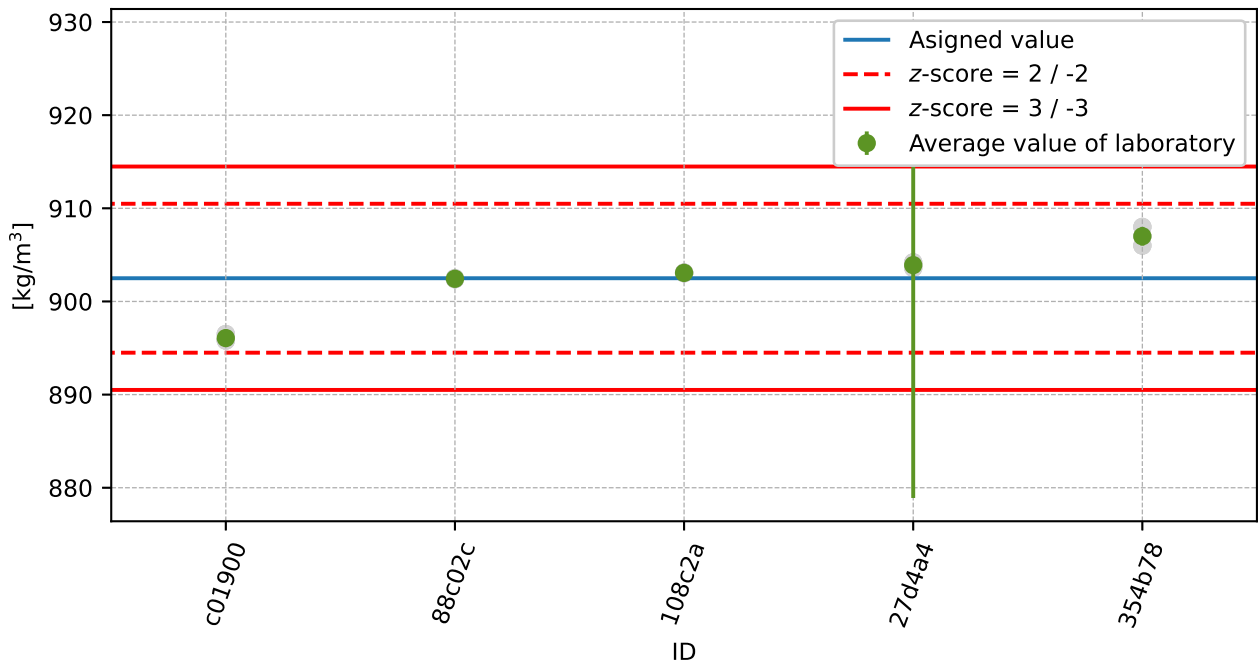


Figure 161: Average values and extended uncertainties of measurement

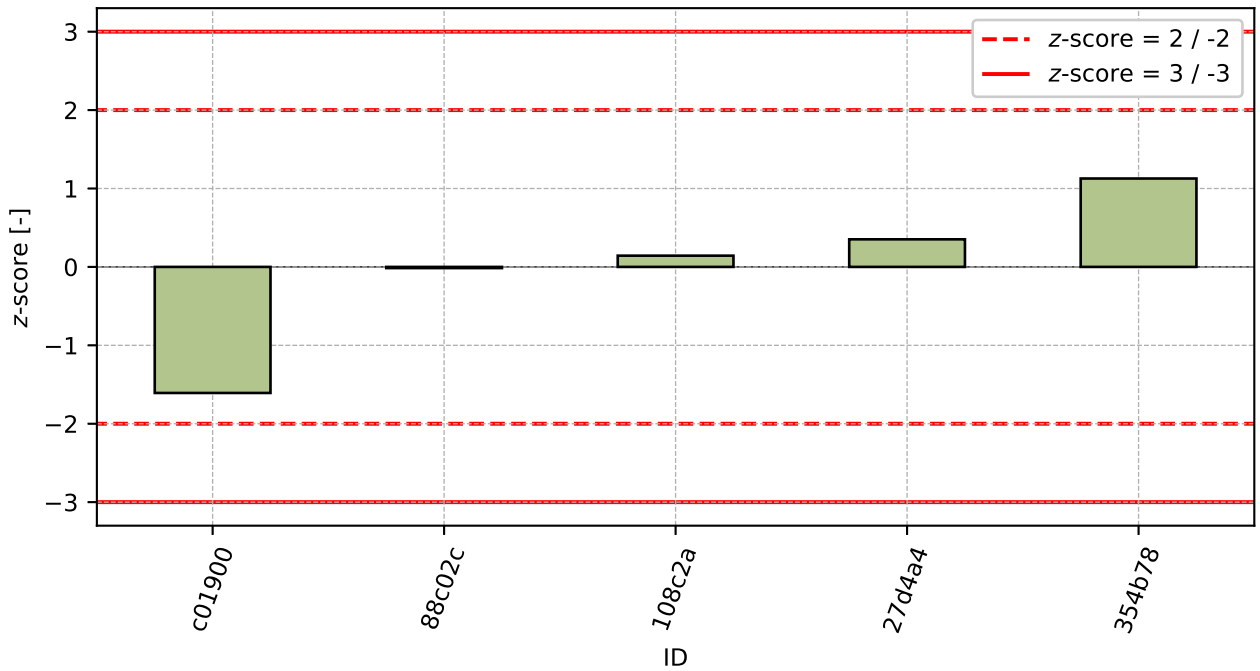


Figure 162: z-score

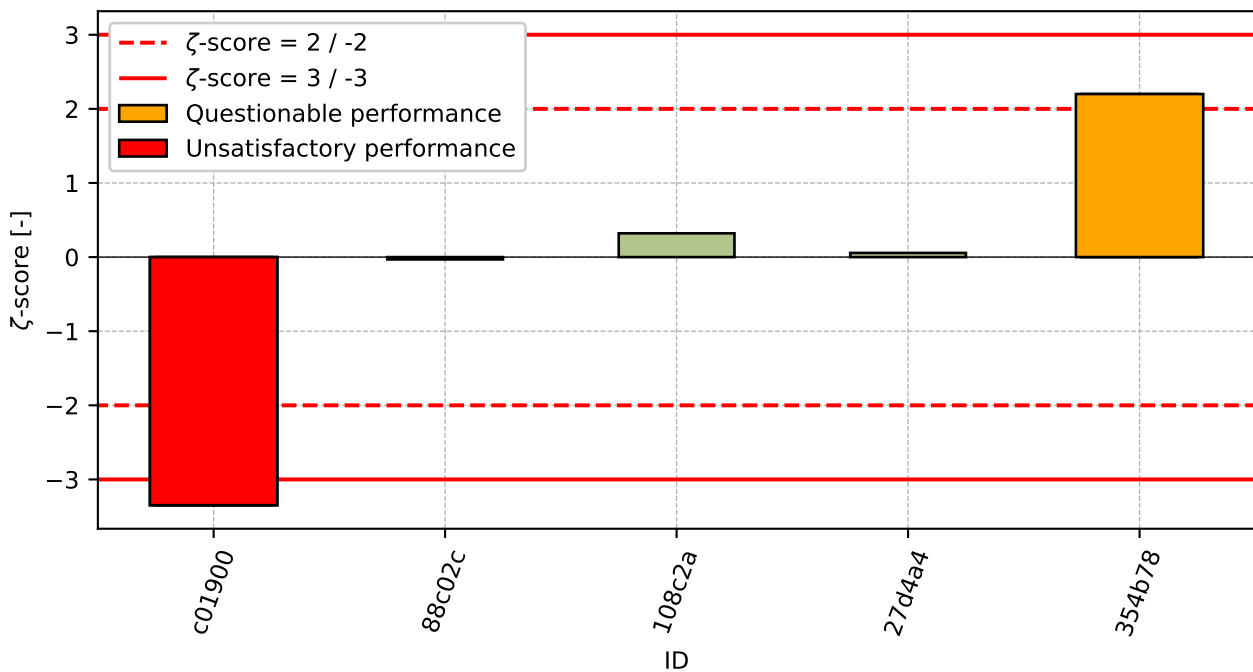


Figure 163: z-score

Table 57: z-score and z-score

ID	z-score [-]	z-score [-]
c01900	-1.61	-3.35
88c02c	-0.02	-0.03
108c2a	0.14	0.32
27d4a4	0.35	0.06
354b78	1.13	2.2

15 Appendix – EN ISO 11357-1, -3 (Melting temperature T_{m1} , Enthalpy of fusion ΔH_{m1})

The test method was not opened due to the low number of participants.

16 Appendix – EN ISO 1133-1 (Melt mass-flow rate)

16.1 Sample A

16.1.1 Test results

Table 58: Test results - ordered by average value. Outliers are marked by red color. u_x - extended uncertainty of measurement; \bar{x} - average value; s_0 - sample standard deviation; V_x - variation coefficient

ID	Test results [g/10min]			u_x [g/10min]	\bar{x} [g/10min]	s_0 [g/10min]	V_x [%]
c01900	7.79	7.87	7.83	-	7.83	0.04	0.51
108c2a	7.98	8.01	7.99	0.02	7.99	0.015	0.19
88c02c	8.6	8.75	8.44	0.3	8.6	0.156	1.82
27d4a4	8.67	8.75	8.76	-	8.73	0.05	0.57

16.1.2 The Numerical Procedure for Determining Outliers

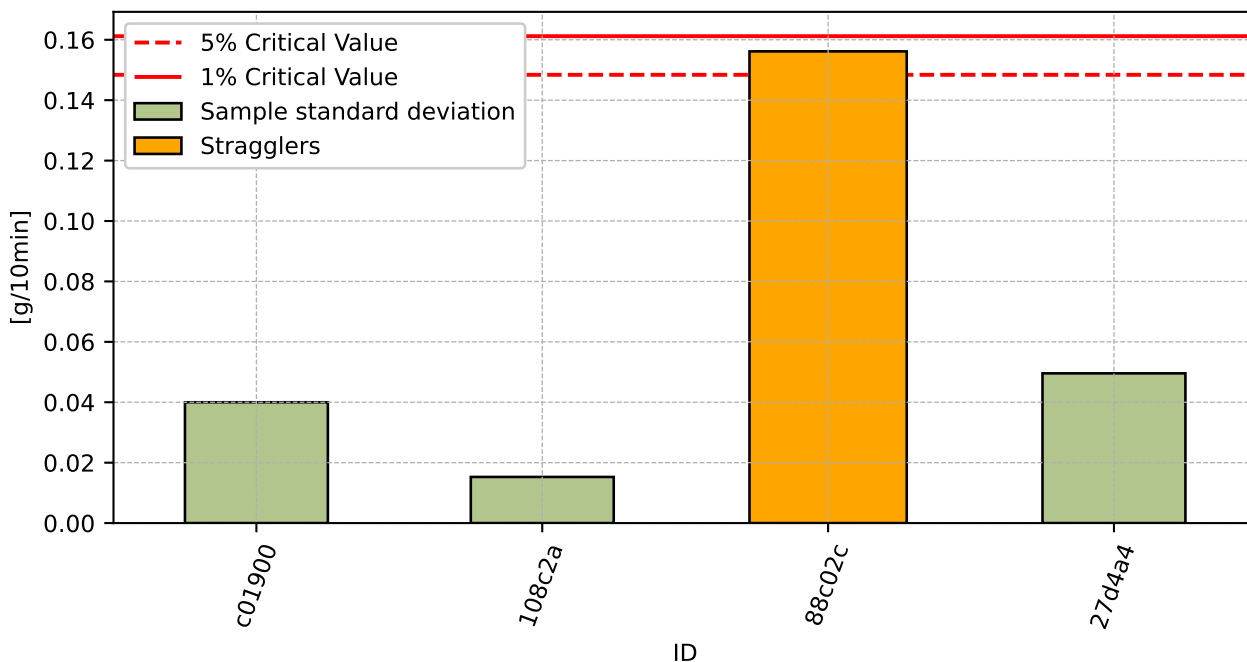


Figure 164: Cochran's test - sample standard deviations

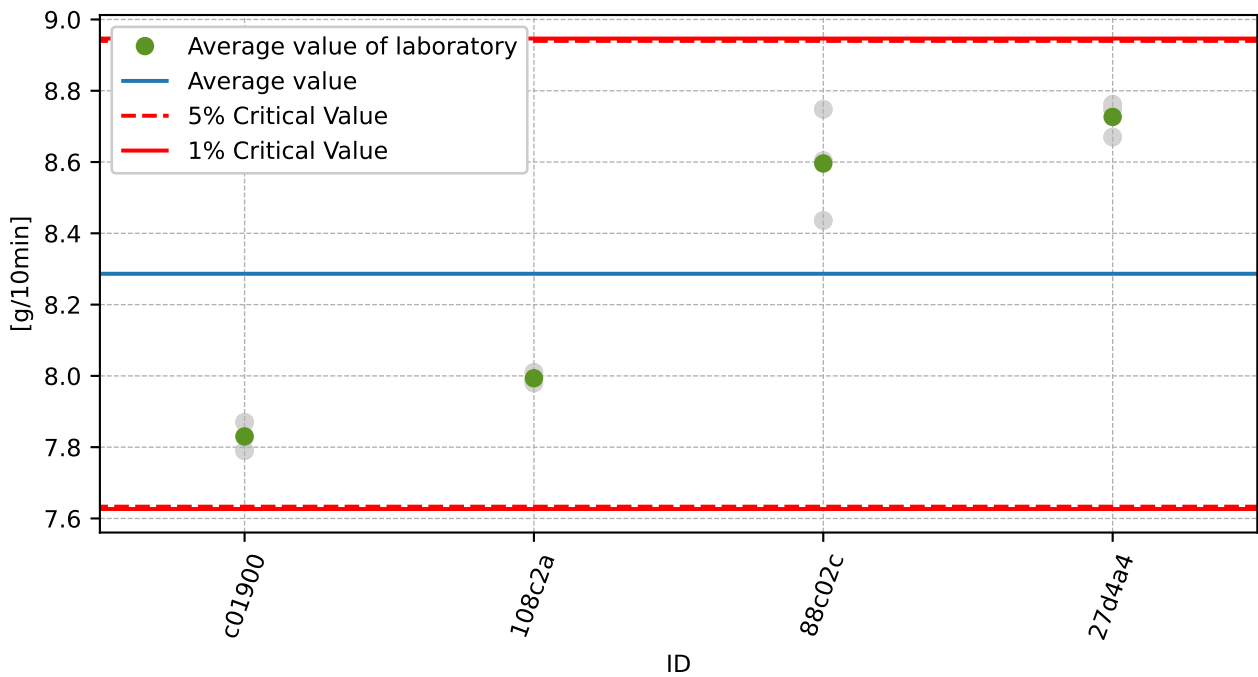


Figure 165: **Grubbs' test** - average values

16.1.3 Mandel's Statistics

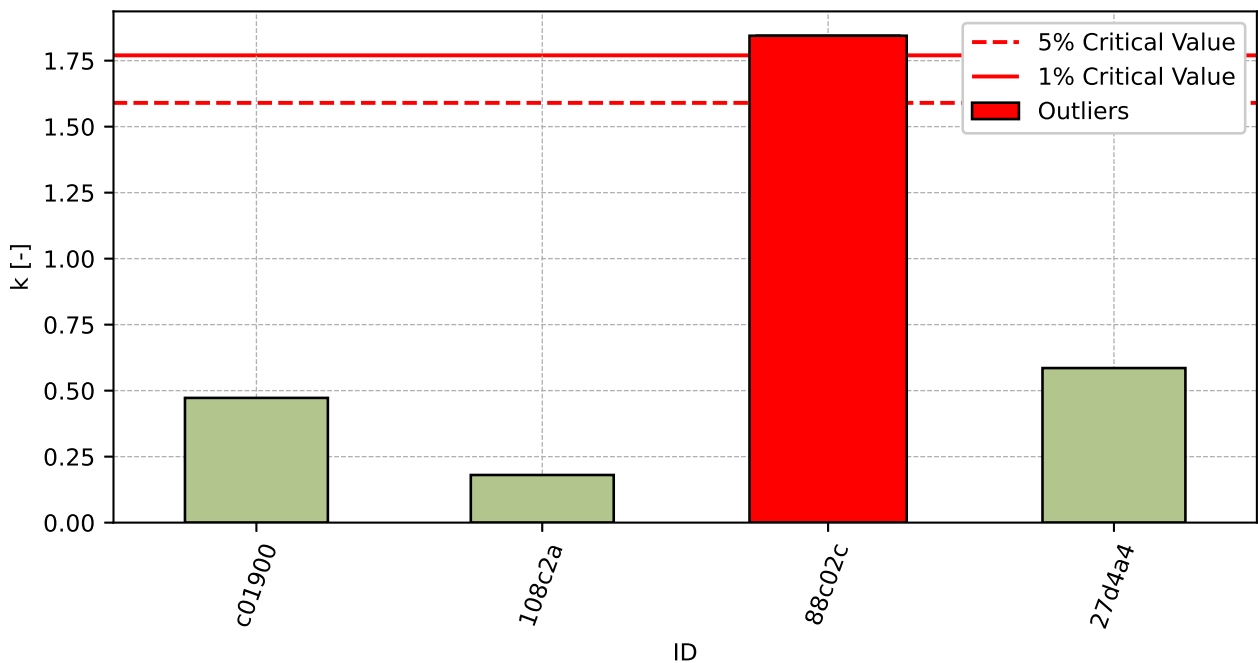


Figure 166: Intralaboratory Consistency Statistic

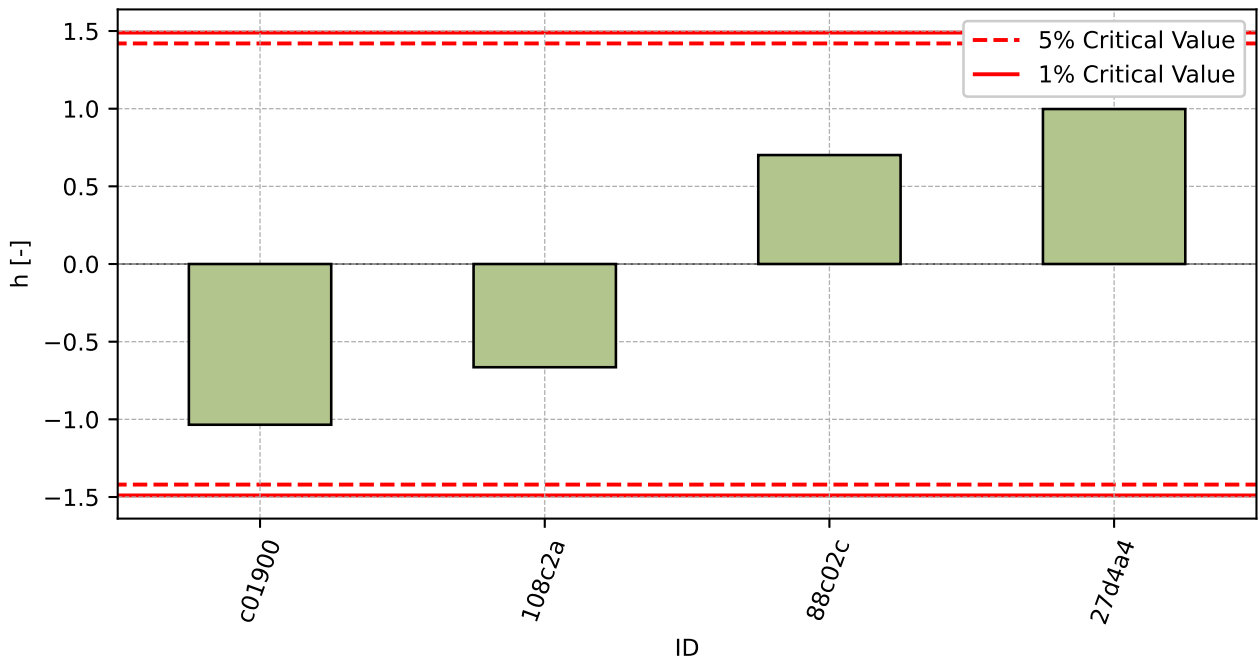


Figure 167: Interlaboratory Consistency Statistic

16.1.4 Descriptive statistics

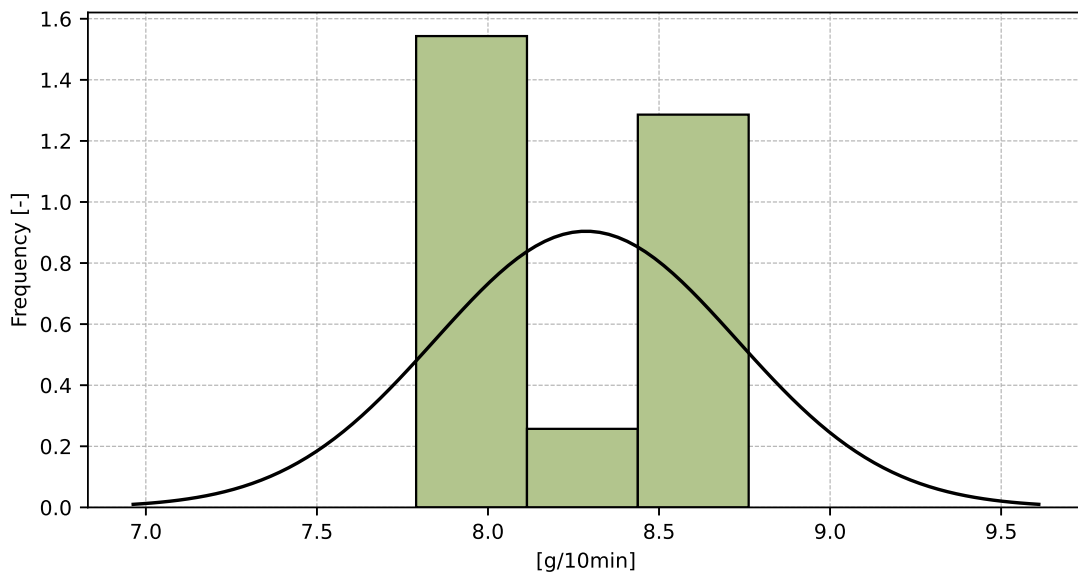


Figure 168: Histogram of all test results

Table 59: Descriptive statistics

Characteristics	[g/10min]
Average value – \bar{x}	8.29
Sample standard deviation – s	0.441
Assigned value – x^*	8.29
Robust standard deviation – s^*	0.433
Measurement uncertainty of assigned value – u_X	0.271
p -value of normality test	0.019 [-]
Interlaboratory standard deviation – s_L	0.438
Repeatability standard deviation – s_r	0.085
Reproducibility standard deviation – s_R	0.447
Repeatability – r	0.24
Reproducibility – R	1.25

16.1.5 Evaluation of Performance Statistics

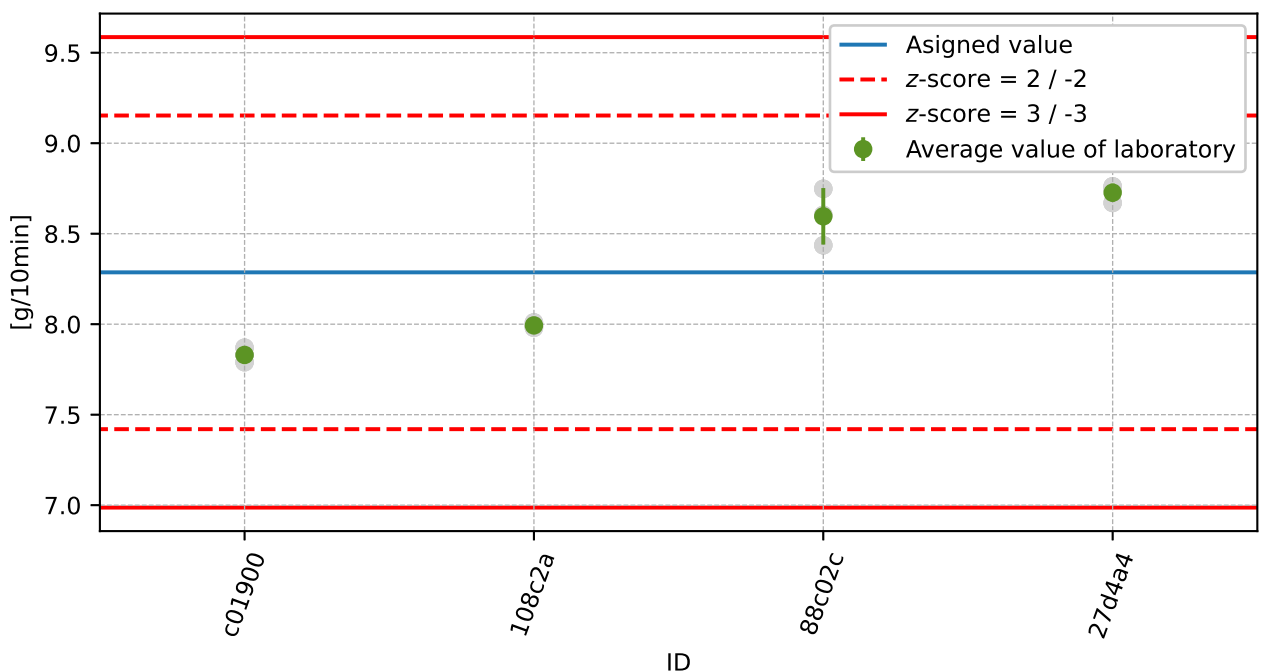


Figure 169: Average values and sample standard deviations

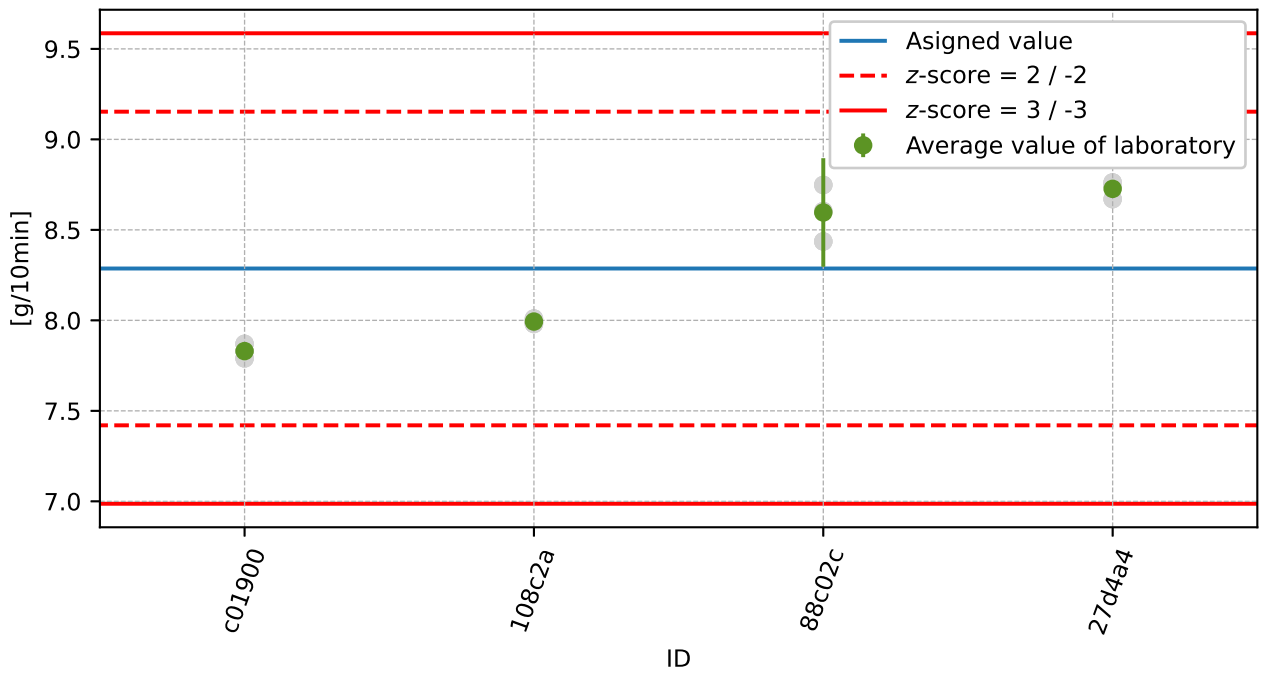


Figure 170: Average values and extended uncertainties of measurement

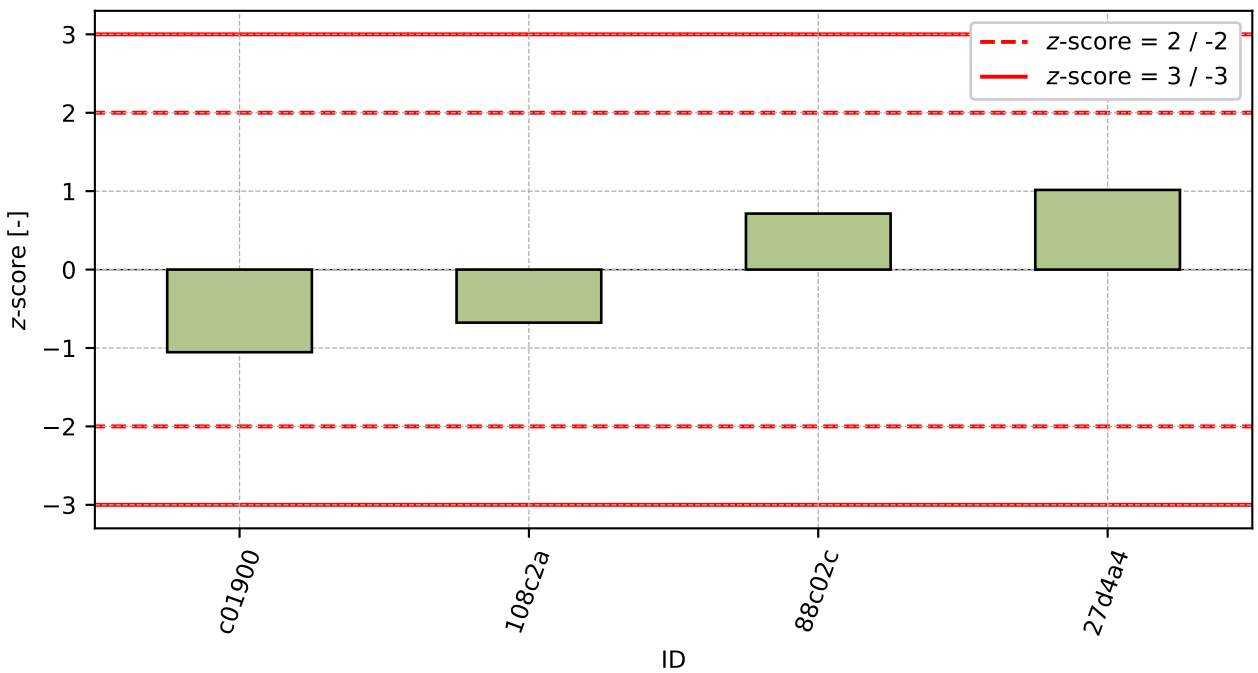


Figure 171: z-score

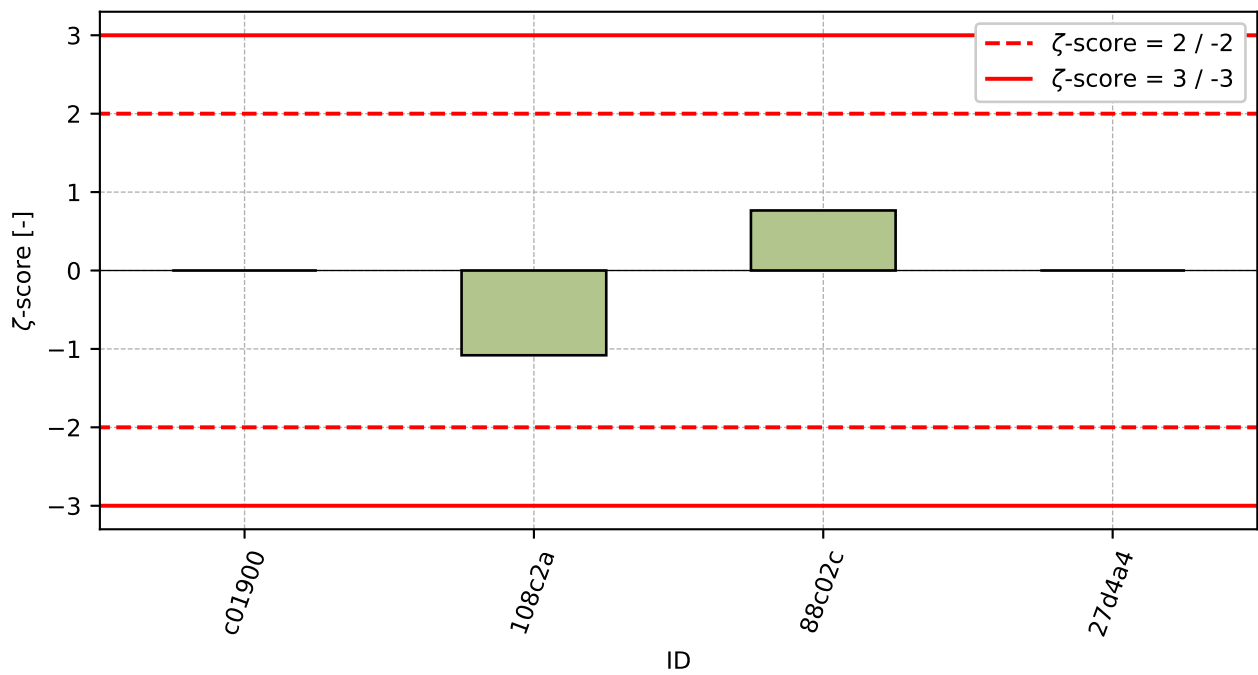


Figure 172: ζ -score

Table 60: z-score and ζ -score

ID	z-score [-]	ζ -score [-]
c01900	-1.05	-
108c2a	-0.68	-1.08
88c02c	0.71	0.77
27d4a4	1.02	-

16.2 Sample B

16.2.1 Test results

Table 61: Test results - ordered by average value. Outliers are marked by red color. u_x - extended uncertainty of measurement; \bar{x} - average value; s_0 - sample standard deviation; V_x - variation coefficient

ID	Test results [g/10min]			u_x [g/10min]	\bar{x} [g/10min]	s_0 [g/10min]	V_x [%]
108c2a	6.73	6.69	6.74	0.03	6.72	0.026	0.39
c01900	6.82	6.85	6.84	-	6.84	0.015	0.22
88c02c	7.34	7.32	7.25	0.1	7.3	0.049	0.67
27d4a4	7.69	7.49	7.52	-	7.57	0.105	1.39

16.2.2 The Numerical Procedure for Determining Outliers

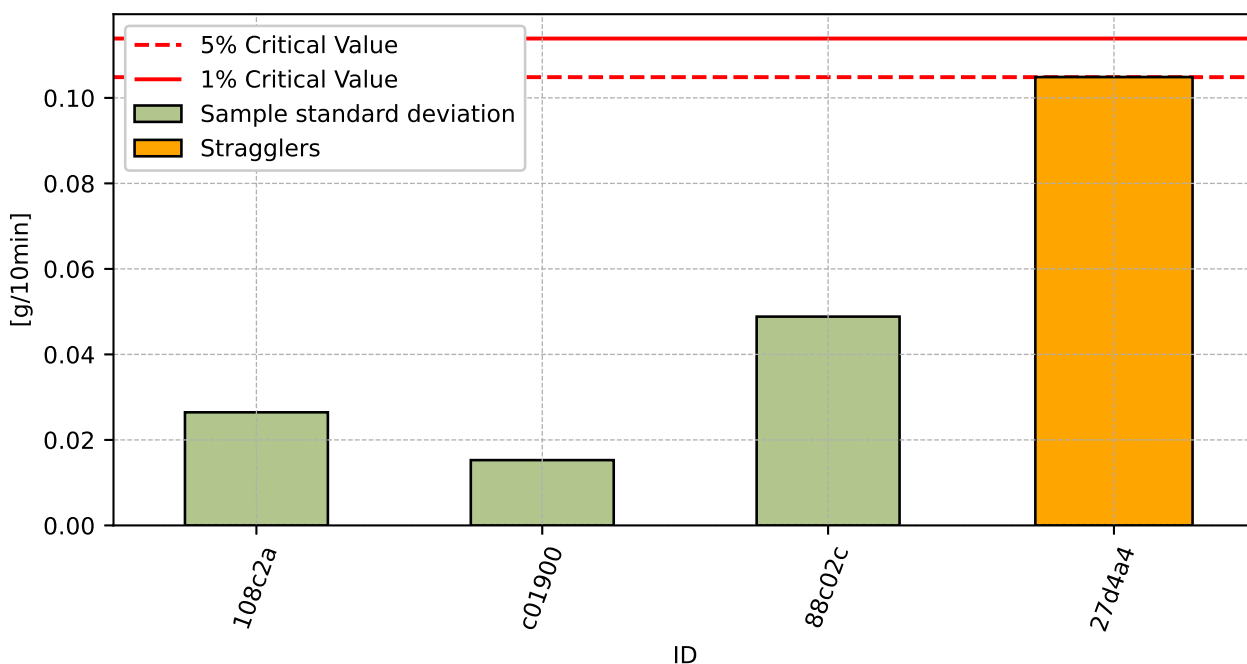


Figure 173: Cochran's test - sample standard deviations

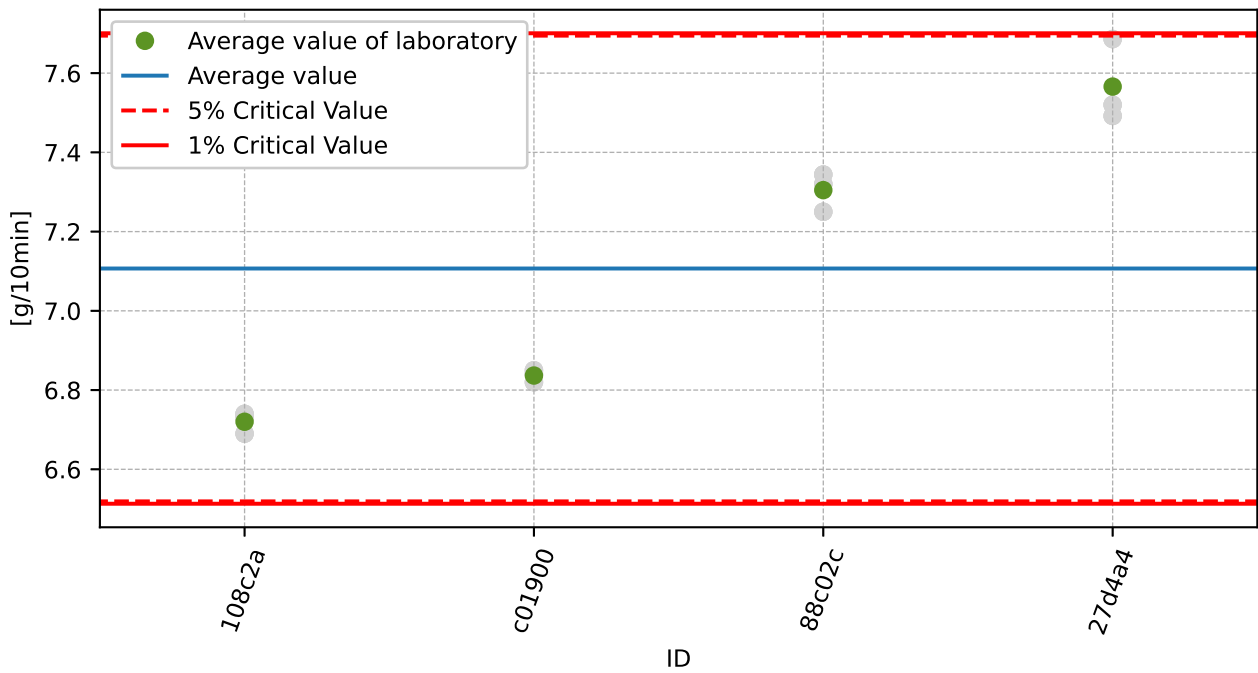


Figure 174: Grubbs' test - average values

16.2.3 Mandel's Statistics

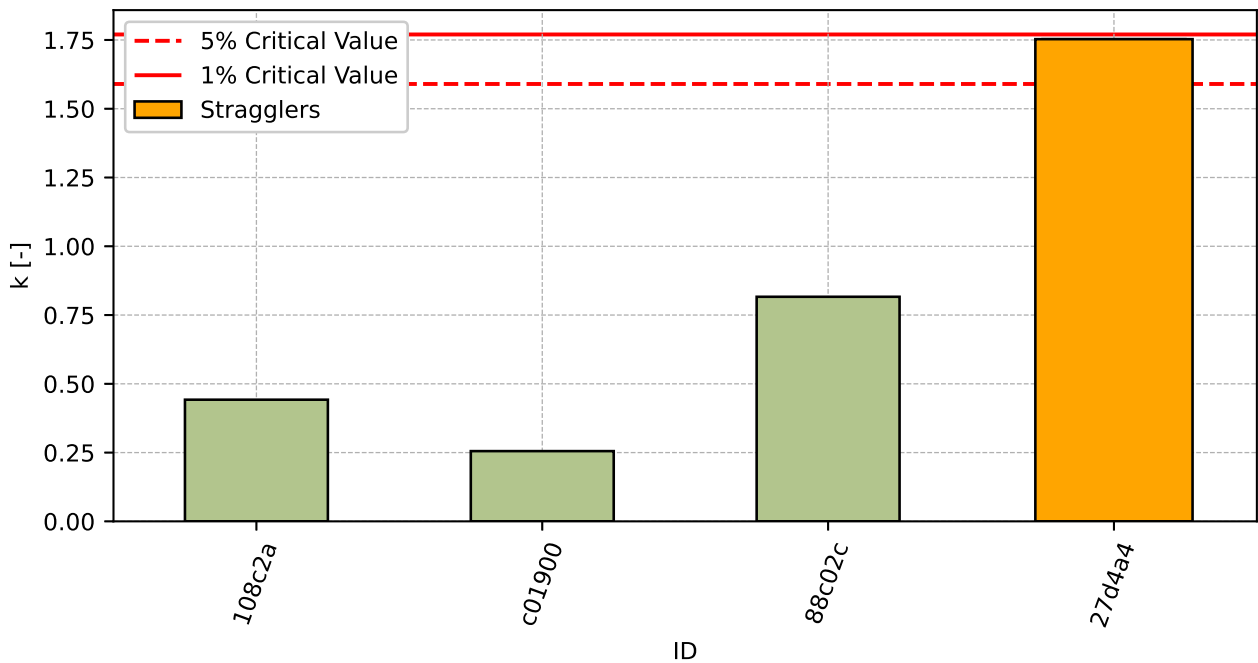


Figure 175: Intralaboratory Consistency Statistic

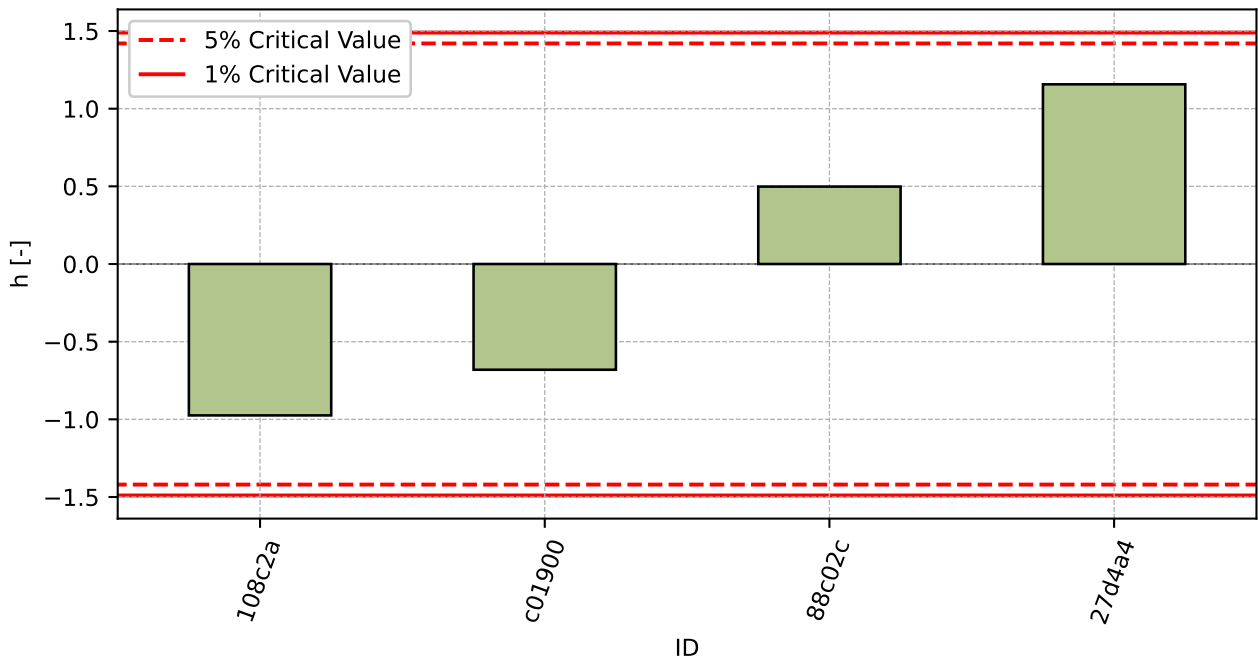


Figure 176: Interlaboratory Consistency Statistic

16.2.4 Descriptive statistics

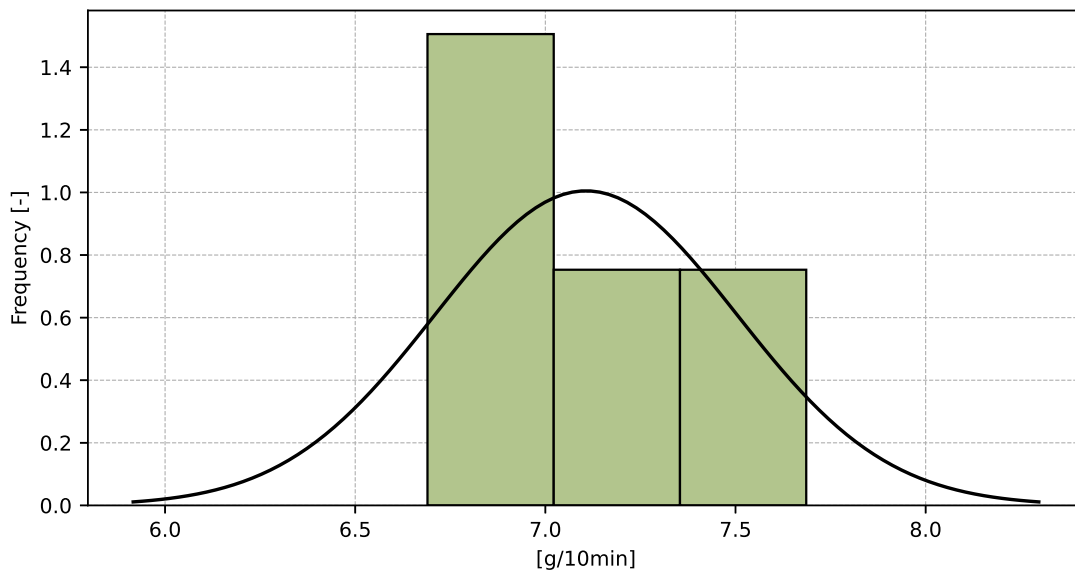


Figure 177: Histogram of all test results

Table 62: Descriptive statistics

Characteristics	[g/10min]
Average value – \bar{x}	7.11
Sample standard deviation – s	0.397
Assigned value – x^*	7.11
Robust standard deviation – s^*	0.39
Measurement uncertainty of assigned value – u_X	0.244
p -value of normality test	0.073 [-]
Interlaboratory standard deviation – s_L	0.395
Repeatability standard deviation – s_r	0.06
Reproducibility standard deviation – s_R	0.4
Repeatability – r	0.17
Reproducibility – R	1.12

16.2.5 Evaluation of Performance Statistics

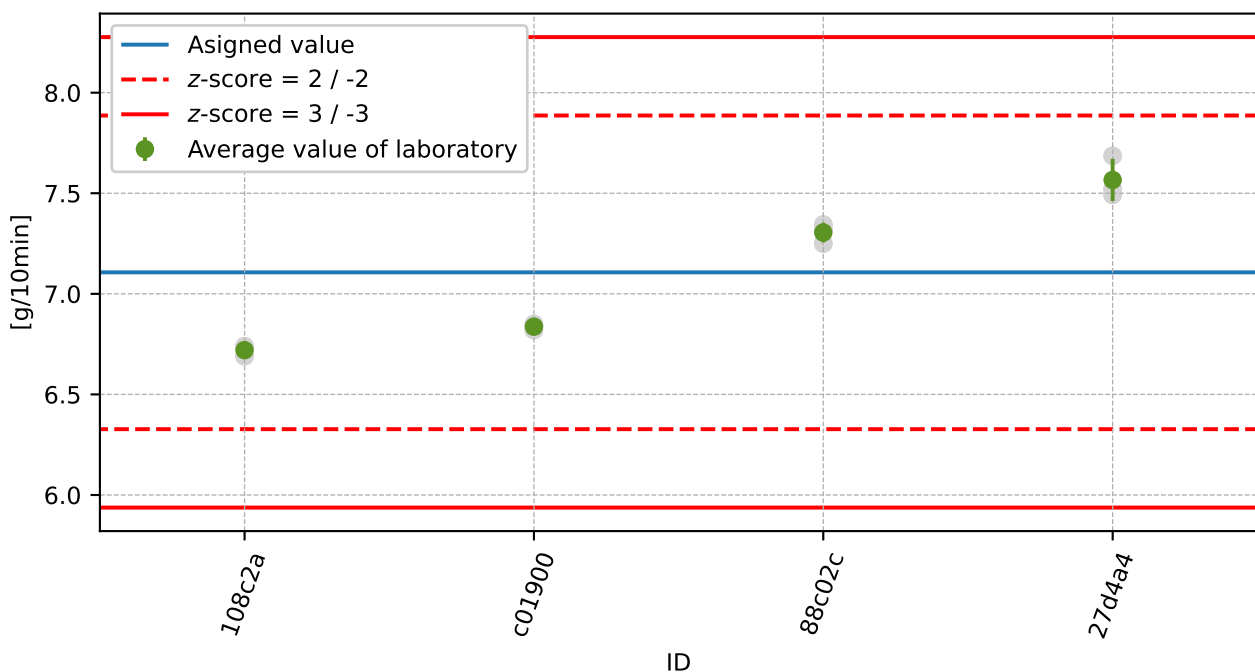


Figure 178: Average values and sample standard deviations

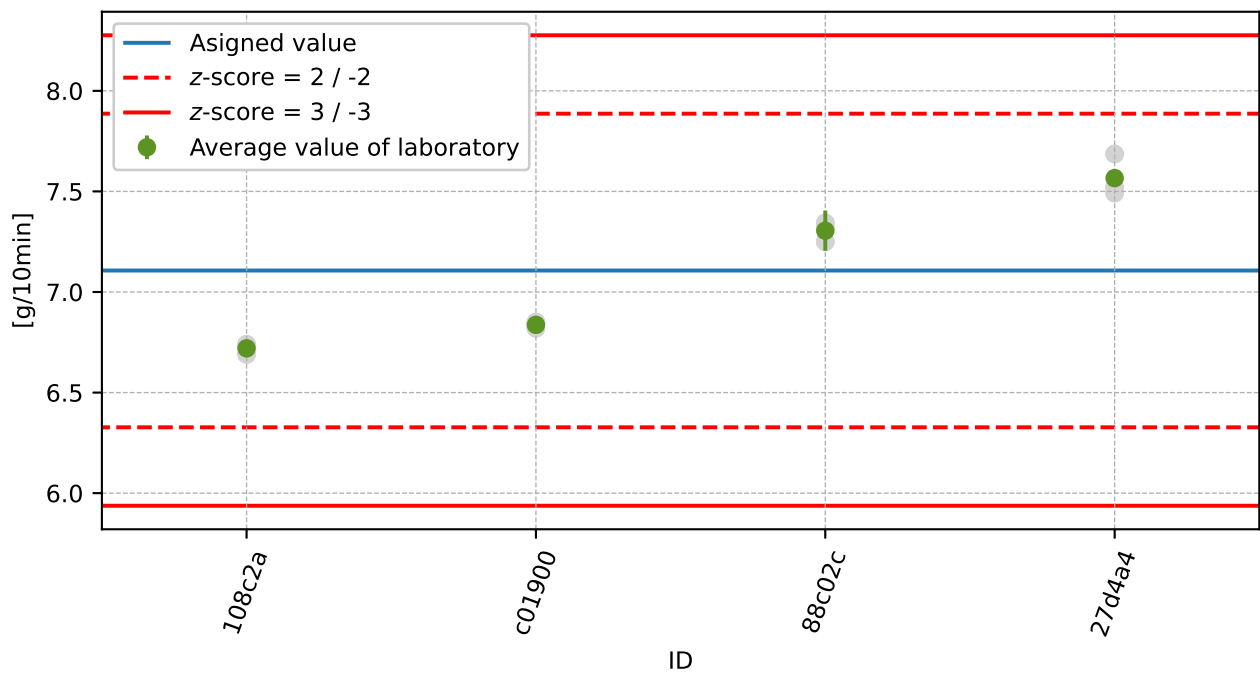


Figure 179: Average values and extended uncertainties of measurement

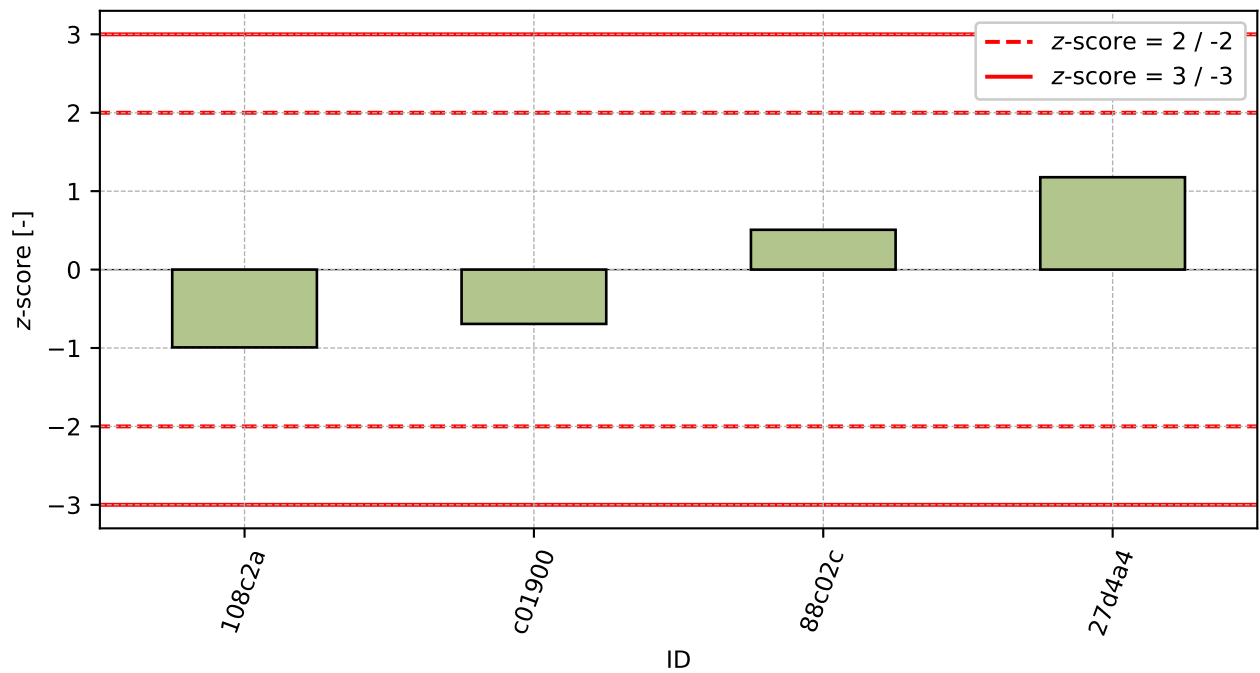


Figure 180: z-score

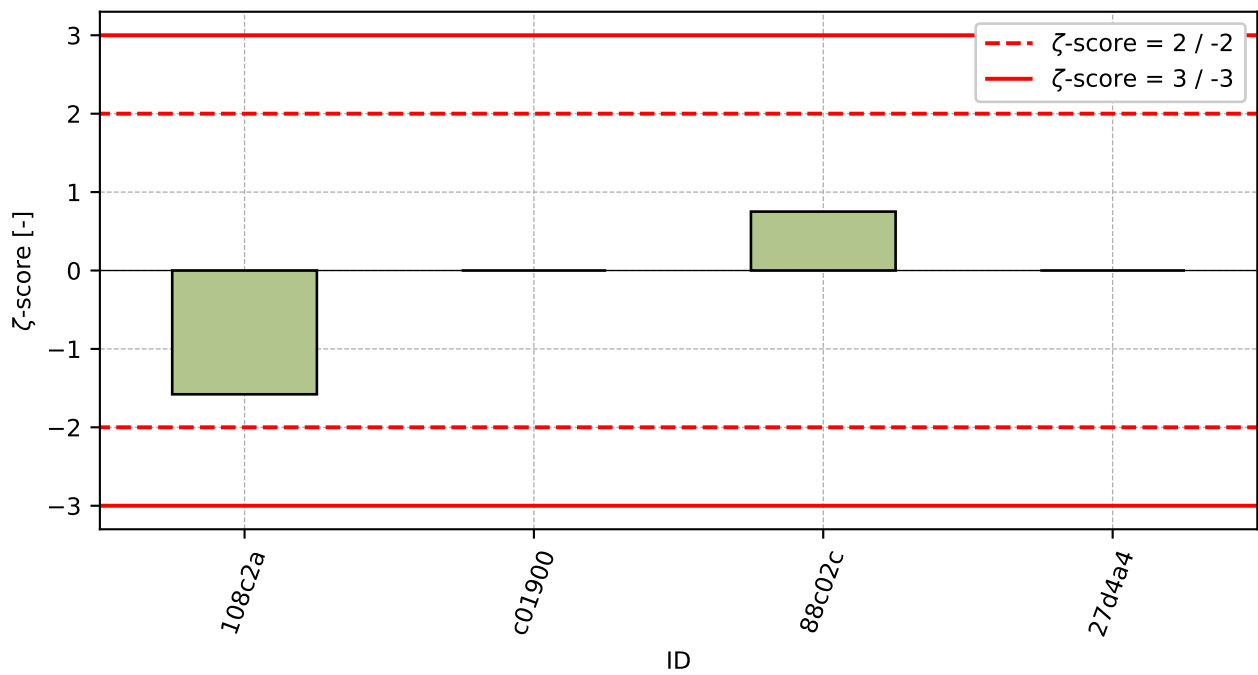


Figure 181: ζ-score

Table 63: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
108c2a	-0.99	-1.58
c01900	-0.69	-
88c02c	0.51	0.75
27d4a4	1.18	-

17 Appendix – EN ISO 1628-1, -5 (Viscosity)

The test method was not opened due to the low number of participants.

18 Appendix – EN ISO 11358-1 (Filler content)

The test method was not opened due to the low number of participants.

19 Appendix – ISO 3795 (Burning Rate)

The test method was not opened due to the low number of participants.