



# FINAL REPORT ON THE RESULTS OF PRECISION EXPERIMENT

## Proficiency Testing Program Mechanical Properties of Plastics ZVP 2021/1

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## 1 Introduction and Important Contacts

In the year 2021, the Proficiency Testing Provider at the SZK FAST (PT Provider) initiated the Proficiency Testing Program (PTP) designated ZVP 2021/1 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  $\Delta H_{m1}$ ) [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]

Testing procedures No 5, 6, 8, 9, 11, 12, 13, 14, 17 and 18 were not open according to the low number of participants.

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.

16 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: List of participants (laboratories)

Laboratory	Address	Accr. No
Altran CZ a.s.	Příčná 2071, Hořice, 50801, Česká republika	1552
Institut pro testování a certifikaci, a.s.	třída Tomáše Bati 299, Louky, Zlín, 763 02, Česká republika	1004
Lummus Novolen Technology GmbH	Gotlieb-Daimler-Str.8, Mannheim, 68165, Germany	-
ORLEN Unipetrol RPA s.r.o. - POLYMER INSTITUTE BRNO, odštěpný závod	Tkalcovská 36/2, Brno, 60200, Česká republika	1380
ORLEN Unipetrol RPA s.r.o. - POLYMER INSTITUTE BRNO, odštěpný závod	Tkalcovská 36/2, Brno, 60200, Česká republika	1380
ORLEN Unipetrol RPA, s.r.o.	Záluží 1, DS 301, Litvínov 7, 43670, Česká republika	-
SYNPO, akciová společnost	S.K. Neumanna 1316, Pardubice, 532 07, ČR	-
Silon s.r.o	Průmyslová 451, Sezimovo Ústí 2, 39102, Česká republika	-
Technický a zkušební ústav stavební Praha, s.p. - pobočka Brno	Hněvkovského 77, Brno, 617 00, Česká republika	1018.3
Technický a zkušební ústav stavební Praha, s.p. - pobočka České Budějovice	Nemanická 441, České Budějovice, 370 10, Česká republika	1018.3
Technický a zkušební ústav stavební Praha, s.p. - zkušebna 0100 -Praha	Prosecká 811/76a, Praha, 190 00, Česká republika	1018.3
Testpolymer EU s.r.o.	Bohuslavice 123, Bohuslavice, 79856, Česká republika	1595
Textilní zkušební ústav, s.p.	Cejl 480/12, Brno, 60200, Česká republika	1001
VWUÚ, a.s.	Pikartská 1337/7, Ostrava-Radvanice, 716 07, Česká republika	1025
VÚSAPL, a.s.	Novozámocká, 57/179, Nitra 5, 94905, Slovensko	-
ŠKODA AUTO a.s.	Třída Václava Klementa 869, Mladá Boleslav, 29306, Česká republika	-

## 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.
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.
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  $\zeta$ -score (zeta-score). These characteristics assess the performance of individual participants by comparing it with the assigned value and measurement uncertainties. z-score and  $\zeta$ -score are compared with limit values. The resulting  $\zeta$ -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.

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 2021/1 (PT Program) organized by the PT Provider at the SZK FAST. 16 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
deef7	-	-	-	-	-	-	-	-	-	✓	-	-	-	-	X	-	-	-	-
5bcbc6	✓	✓	✓	✓	-	-	✓	-	-	✓	-	-	-	-	✓	✓	-	-	-
d3a0da	-	-	✓	✓	-	-	✓	-	-	-	-	-	-	-	-	✓	-	-	-
037e4d	✓	-	-	-	-	-	✓	-	-	-	-	-	-	-	✓	-	-	-	✓
d1a574	-	✓	-	✓	-	-	-	-	-	✓	-	-	-	-	✓	X	-	-	-
2ec6a6	✓	✓	✓	✓	-	-	✓	-	-	✓	-	-	-	-	✓	✓	-	-	✓
441c89	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	✓
1ac459	-	-	-	✓	-	-	-	-	-	✓	-	-	-	-	-	-	-	-	-
26b507	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	✓
268044	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	✓
5e442d	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
de037e	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
22280b	-	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
43e933	-	-	✓	✓	-	-	-	-	-	-	-	-	-	-	-	✓	-	-	-
970456	✓	✓	✓	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
32dadb	✓	✓	-	!	-	-	✓	-	-	✓	-	-	-	-	-	-	-	-	-



## References

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- [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.
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- [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.
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- [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.
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- [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*. 1997.
- [18] ISO 13 528. *Statistical methods for use in proficiency testing by interlaboratory comparisons*. 2005.
- [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 3: 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]								
32daddb	1246	1292	1341	1270	1260	33	1282.0	37.1	2.89
5bcbcb6	1287	1255	1326	1274	1394	110	1307.0	55.1	4.21
037e4d	1366	1289	1324	1242	1359	53	1316.0	51.5	3.92
2ec6a6	1256	1307	1363	1355	1322	86	1321.0	42.8	3.24
970456	1350	1340	1310	1330	1320	78	1330.0	15.8	1.19

#### 1.1.2 The Numerical Procedure for Determining Outliers

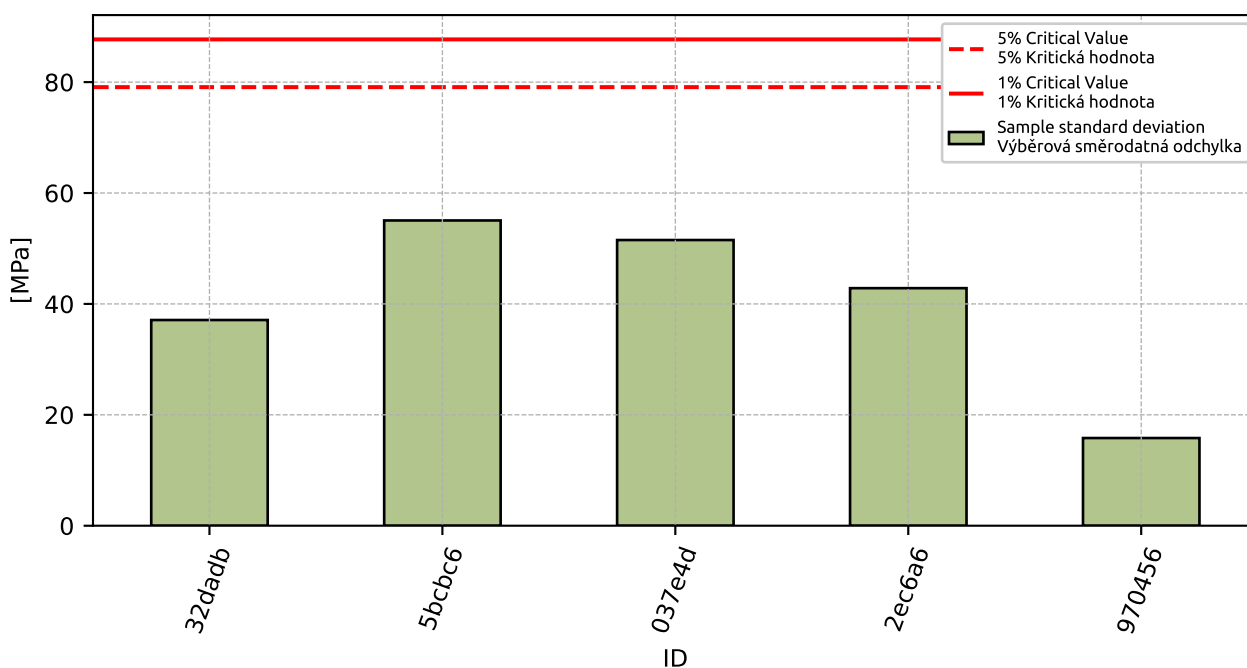


Figure 1: **Cochran's test** - sample standard deviations

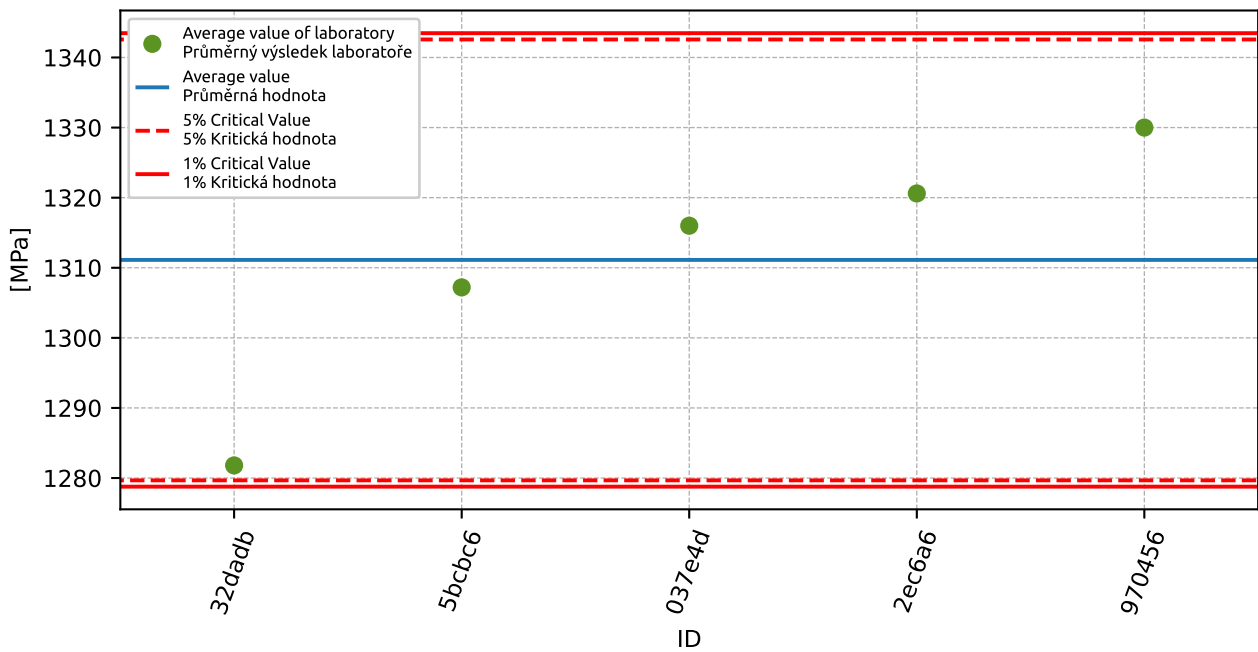


Figure 2: **Grubbs' test** - average values

### 1.1.3 Mandel's Statistics

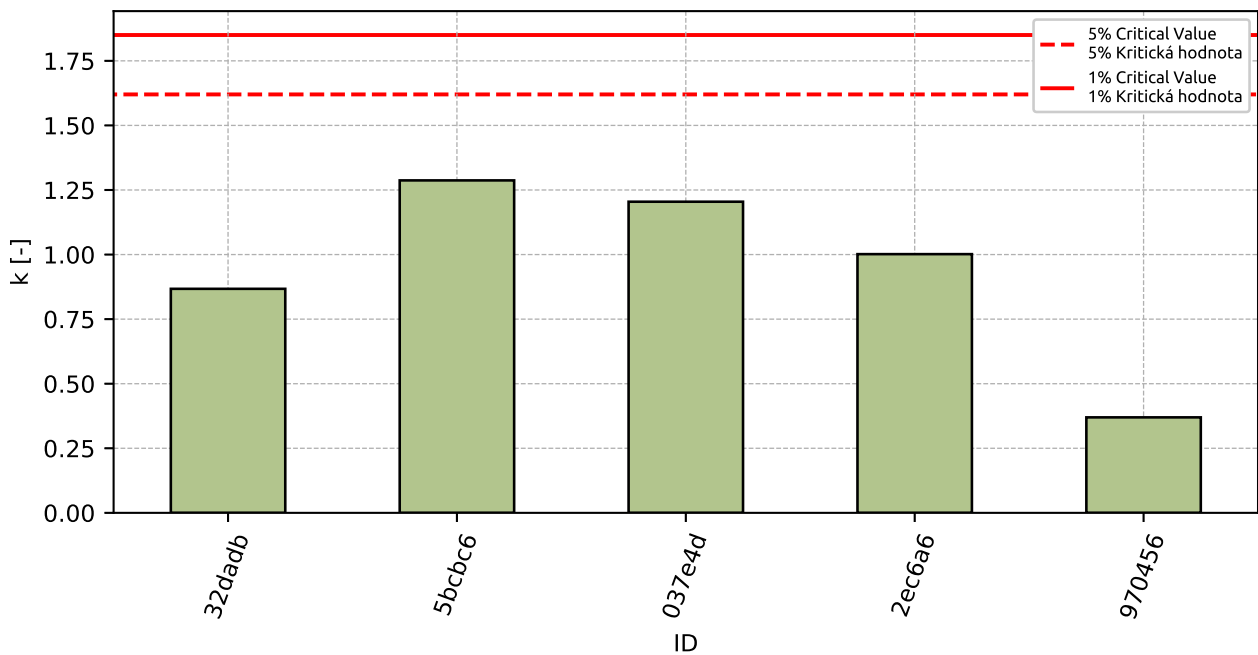


Figure 3: Intralaboratory Consistency Statistic

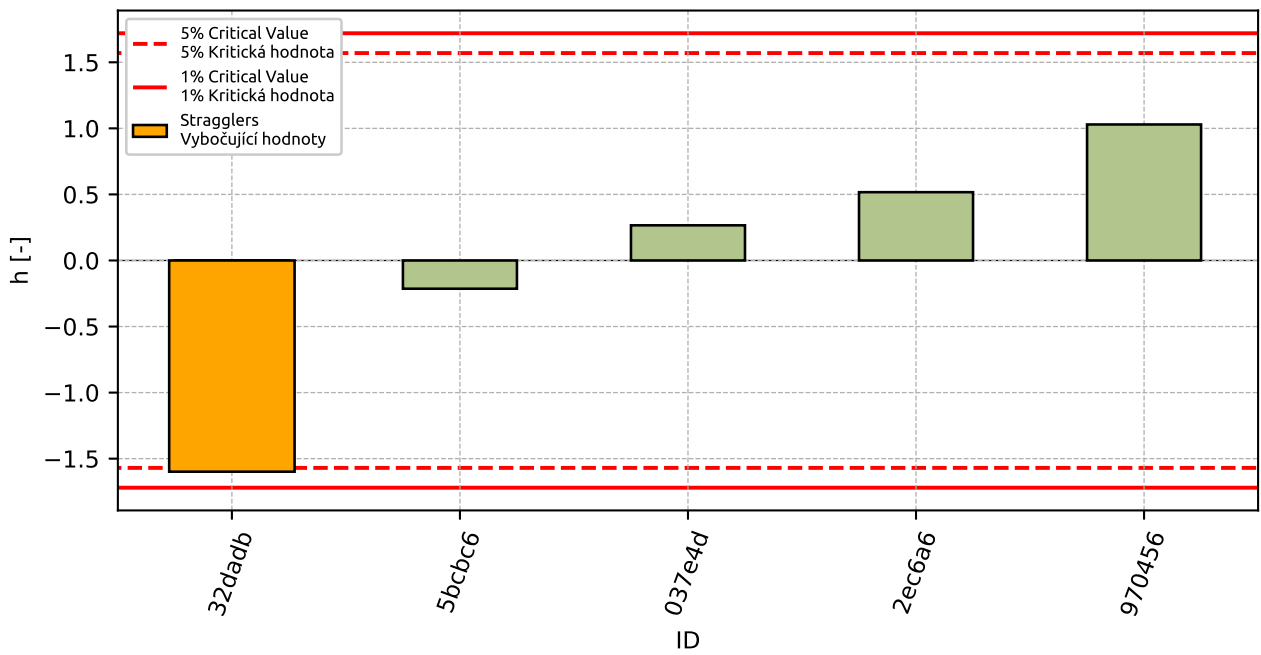


Figure 4: Interlaboratory Consistency Statistic

### 1.1.4 Descriptive statistics

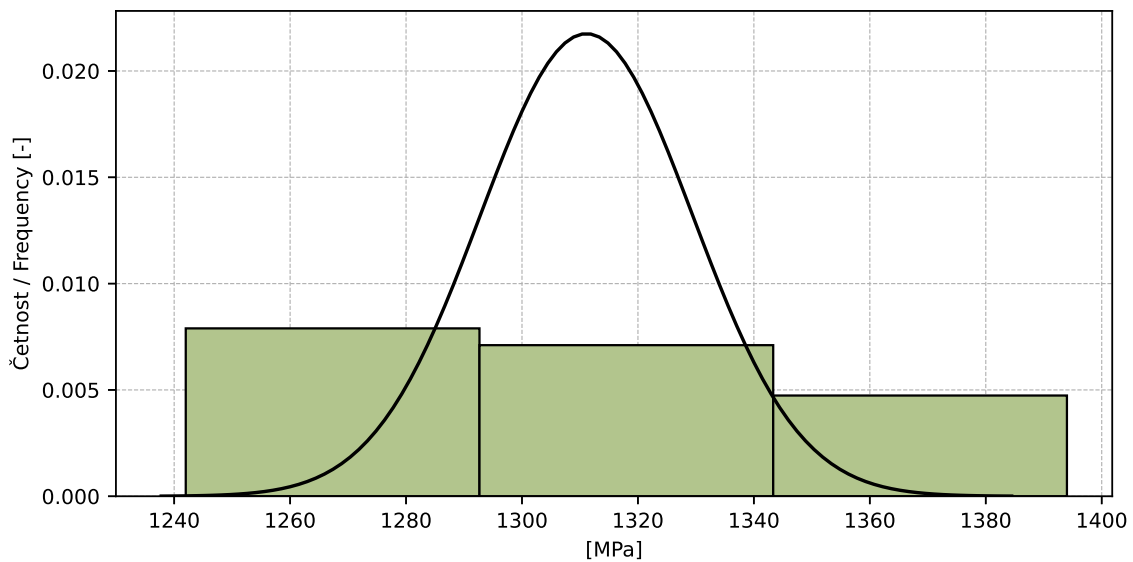


Figure 5: Histogram of all test results

Table 4: Descriptive statistics

Characteristics	[MPa]
Průměrná hodnota / Average value – $\bar{x}$	1311.0
Výběrová směrodatná odchylka / Sample standard deviation – $s$	18.3
Vztažná hodnota / Assigned value – $x^*$	1314.0
Robustní směrodatná odchylka / Robust standard deviation – $s^*$	13.0
Nejistota měření vztažné hodnoty / Measurement uncertainty of assigned value – $u_X$	7.3
$p$ -hodnota testu normality / $p$ -value of normality test	0.496 [-]
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – $s_r$	42.8
Opakovatelnost / Repeatability – $r$	120.0

### 1.1.5 Evaluation of Performance Statistics

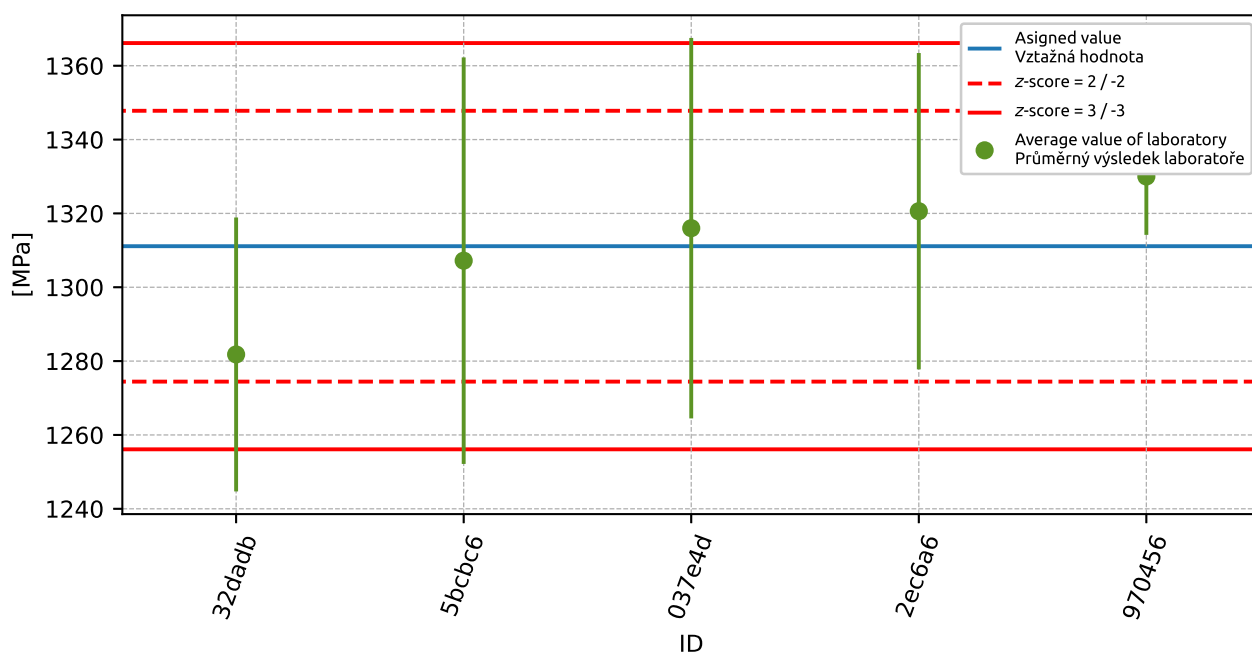


Figure 6: Average values and sample standard deviations

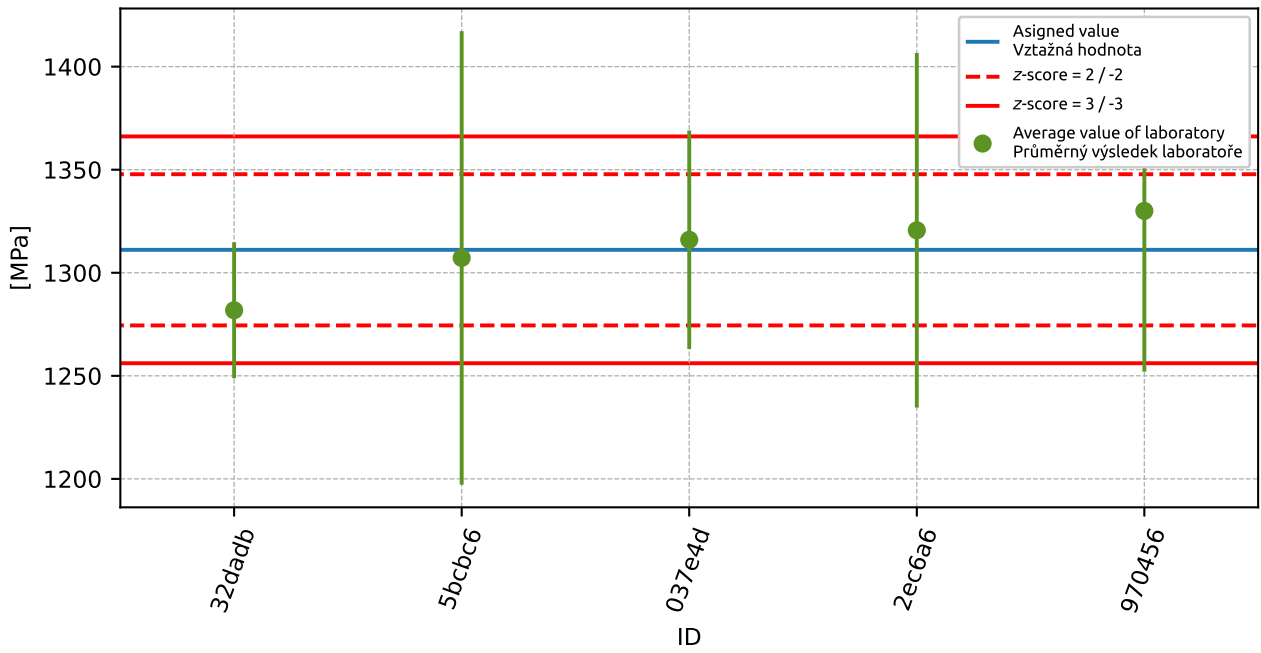


Figure 7: Average values and extended uncertainties of measurement

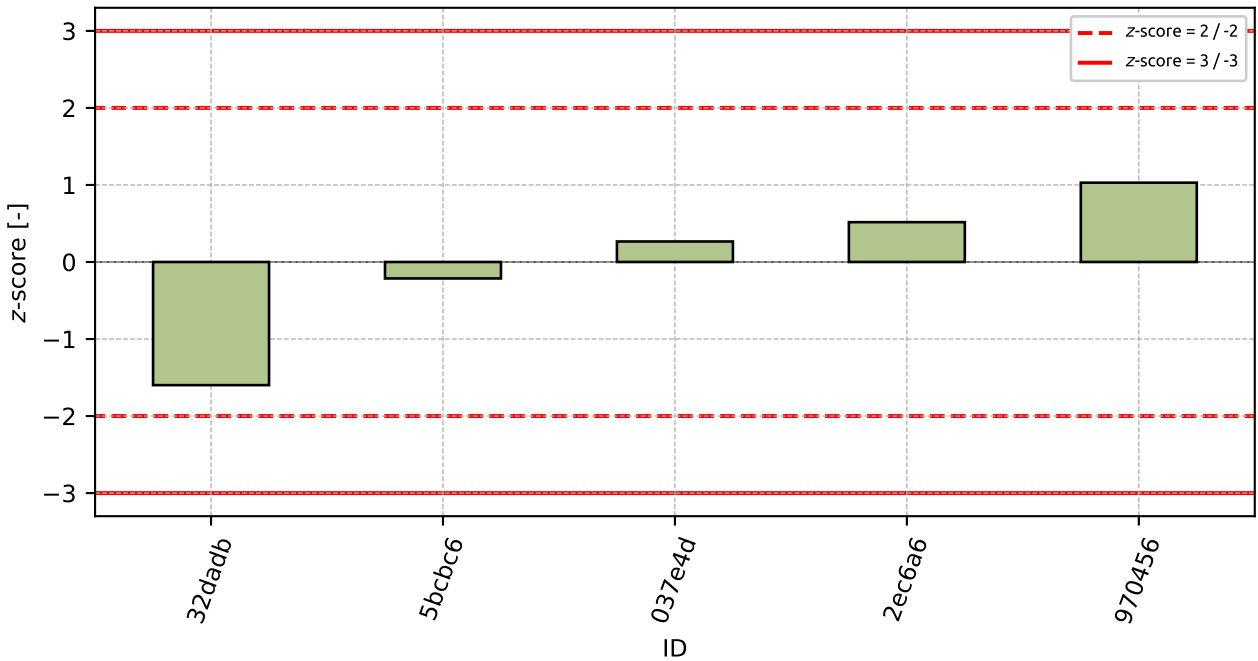
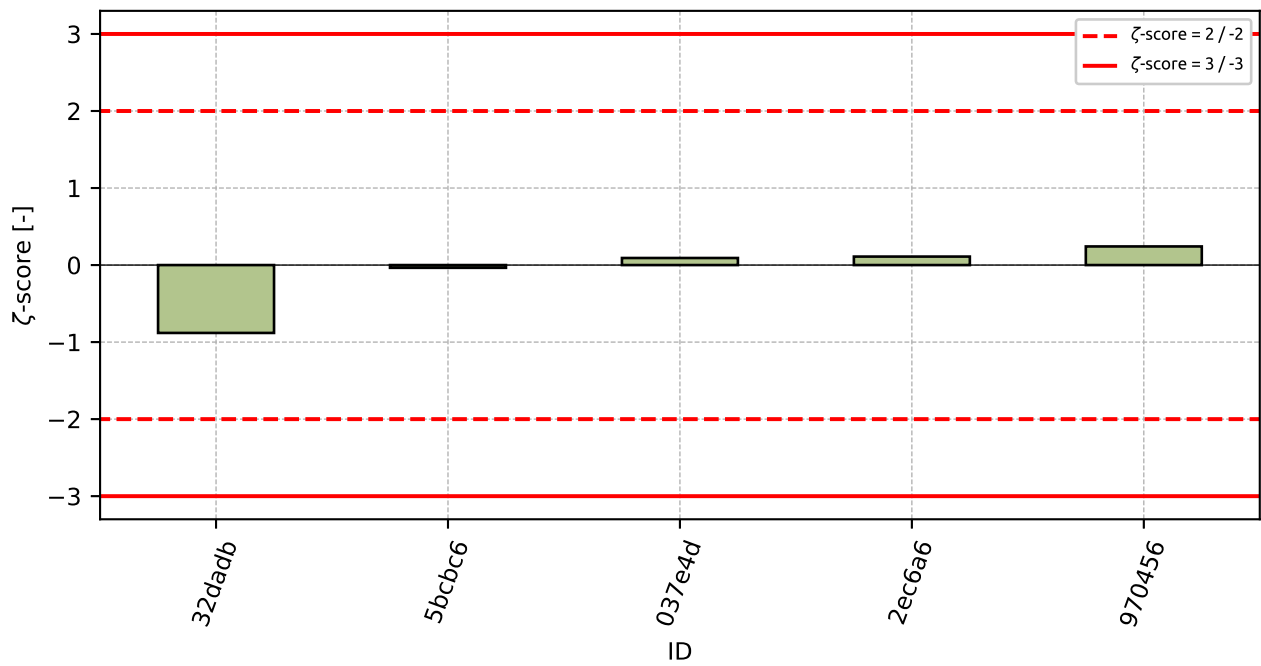


Figure 8: z-score

Figure 9:  $\zeta$ -scoreTable 5: z-score and  $\zeta$ -score

ID	z-score [-]	$\zeta$ -score [-]
32dadab	-1.6	-0.88
5bcbc6	-0.21	-0.04
037e4d	0.27	0.09
2ec6a6	0.52	0.11
970456	1.03	0.24

## 1.2 Sample B

### 1.2.1 Test results

Table 6: 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]								
32dad <b>b</b>	1902	1931	1969	1961	1922	25	1937.0	27.8	1.43
5bc <b>b</b> c6	1842	1880	1970	2067	1958	124	1943.0	87.3	4.49
2ec6a <b>6</b>	1953	1889	2004	2001	1934	96	1956.0	48.2	2.47
037e4 <b>d</b>	1978	1992	1942	1949	1956	44	1963.0	20.9	1.07
97045 <b>6</b>	2040	2030	1980	2000	2020	117	2014.0	24.1	1.2

### 1.2.2 The Numerical Procedure for Determining Outliers

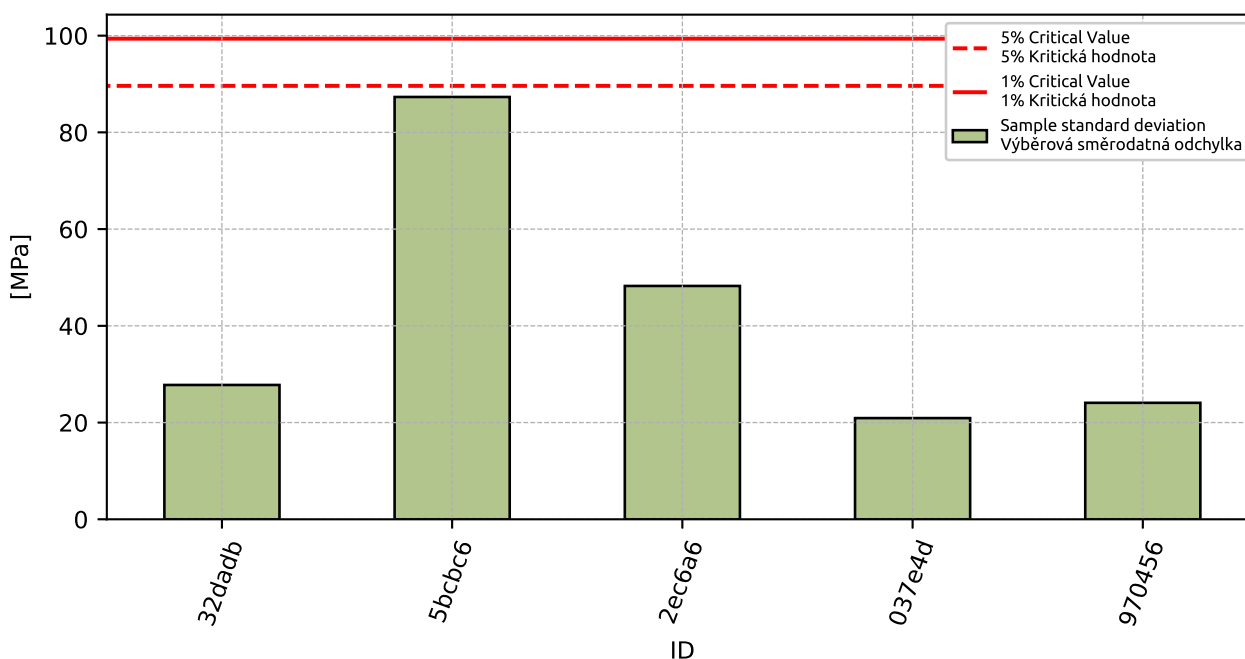


Figure 10: **Cochran's test** - sample standard deviations



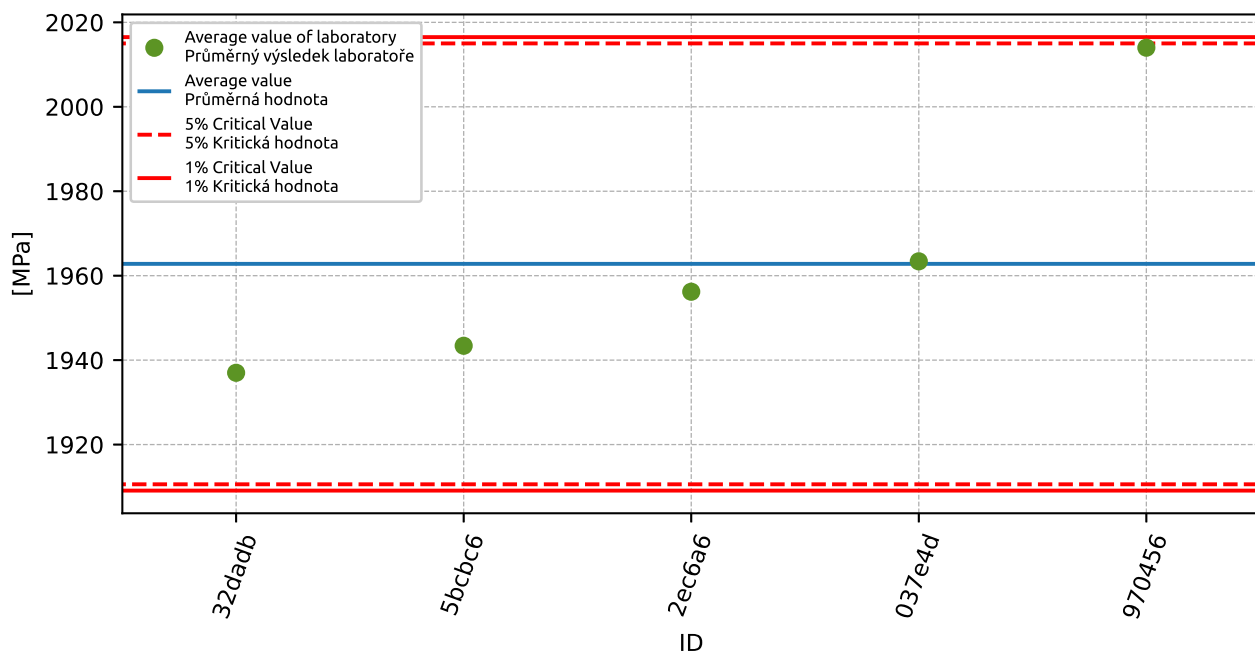


Figure 11: Grubbs' test - average values

### 1.2.3 Mandel's Statistics

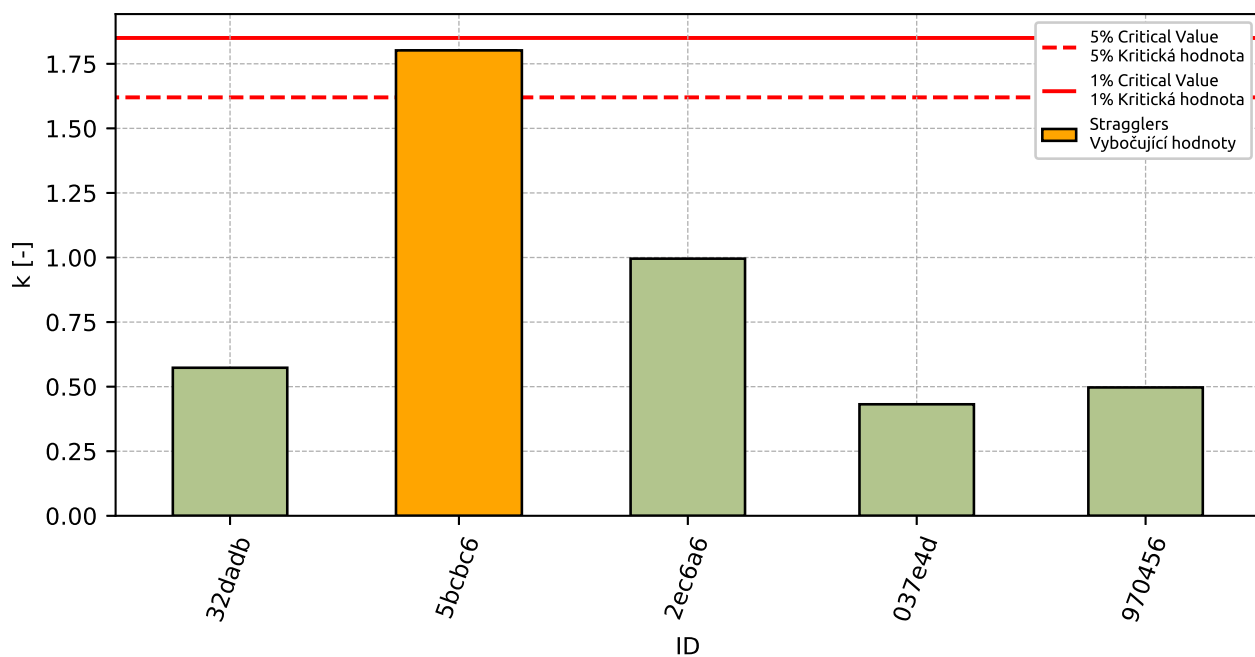


Figure 12: Intralaboratory Consistency Statistic

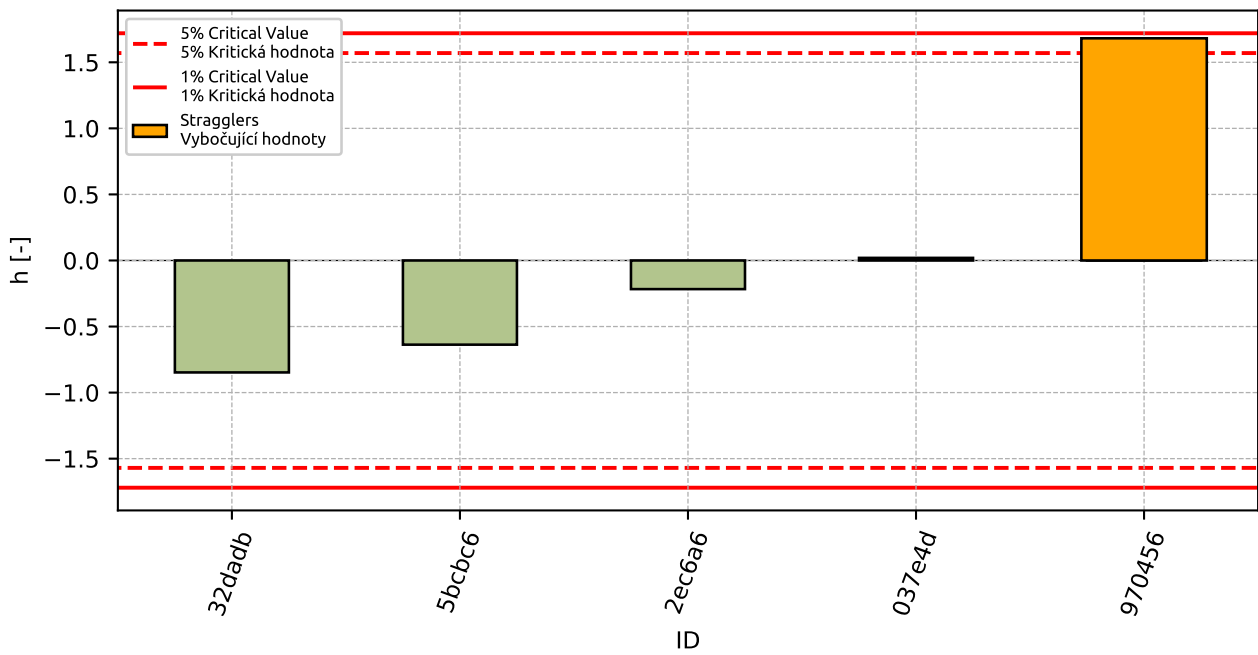


Figure 13: Interlaboratory Consistency Statistic

### 1.2.4 Descriptive statistics

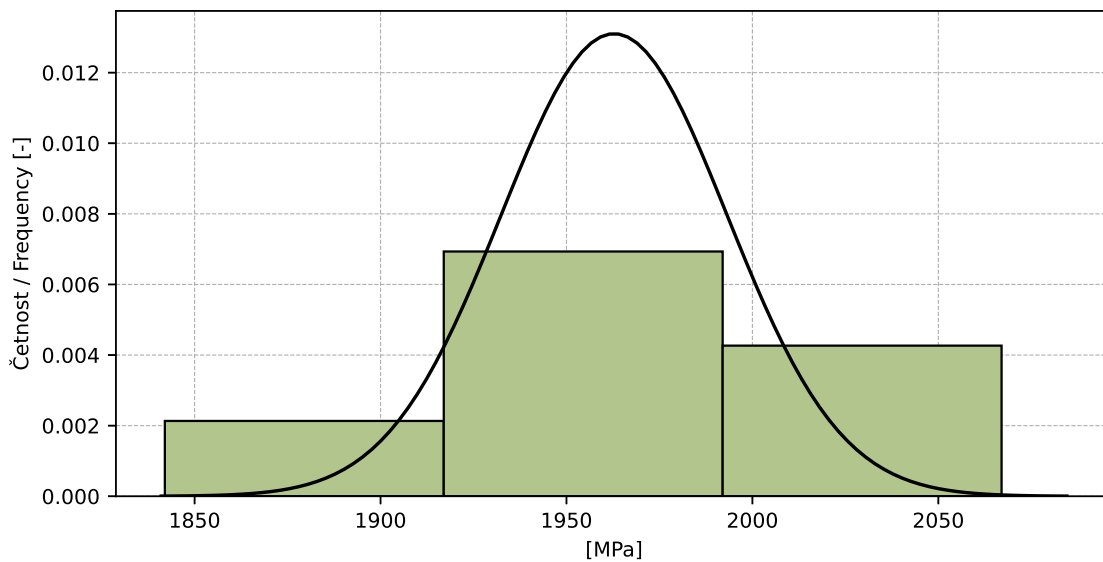


Figure 14: Histogram of all test results

Table 7: Descriptive statistics

Characteristics	[MPa]
Průměrná hodnota / Average value – $\bar{x}$	1963.0
Výběrová směrodatná odchylka / Sample standard deviation – $s$	30.4
Vztažná hodnota / Assigned value – $x^*$	1963.0
Robustní směrodatná odchylka / Robust standard deviation – $s^*$	30.4
Nejistota měření vztažné hodnoty / Measurement uncertainty of assigned value – $u_X$	5.5
$p$ -hodnota testu normality / $p$ -value of normality test	0.997 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – $s_L$	21.4
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – $s_r$	48.5
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – $s_R$	53.0
Opakovatelnost / Repeatability – $r$	136.0
Reprodukovatelnost / Reproducibility – $R$	148.0

### 1.2.5 Evaluation of Performance Statistics

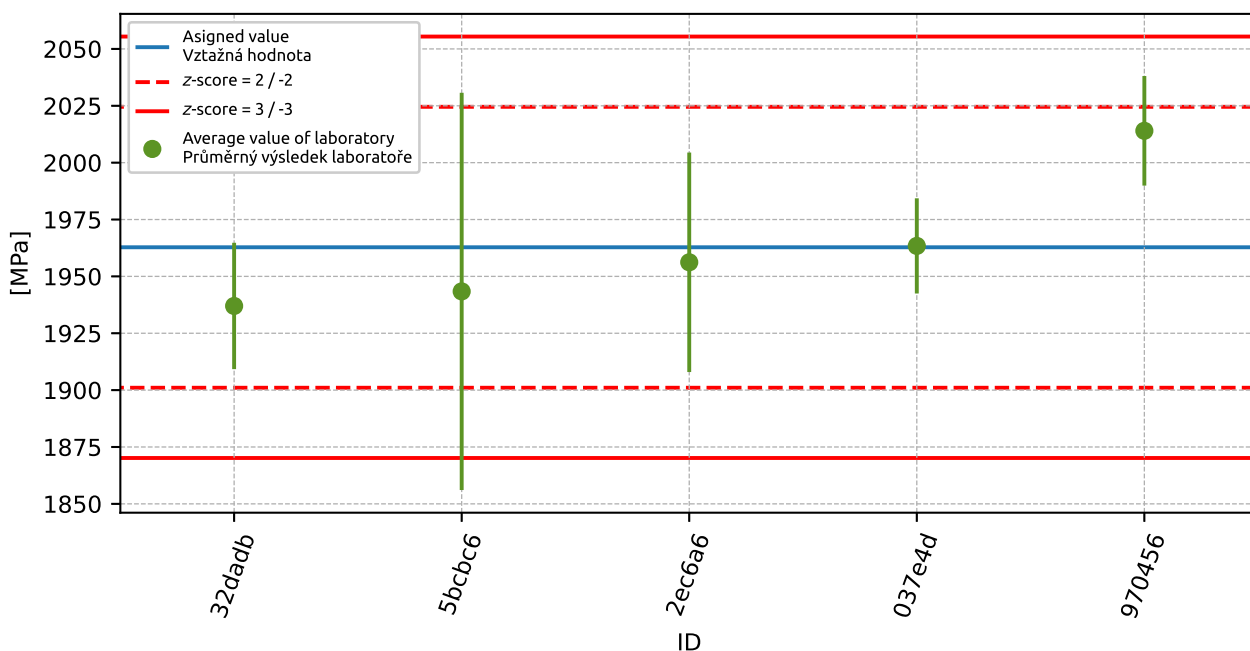


Figure 15: Average values and sample standard deviations

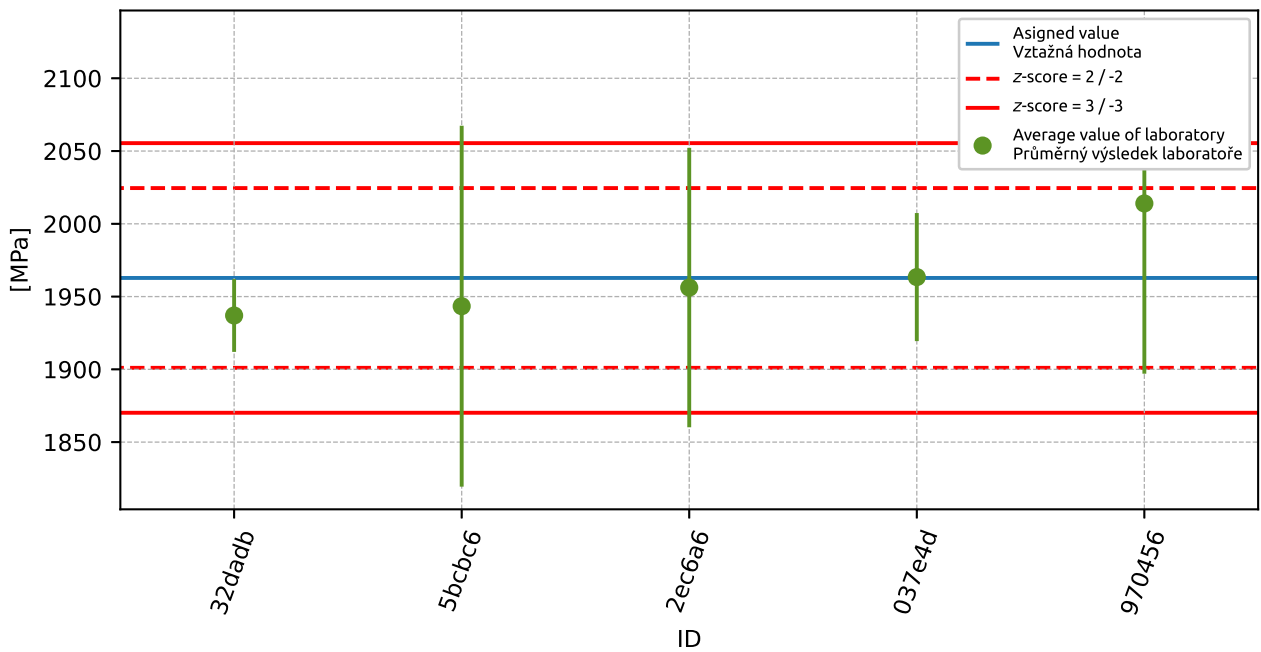


Figure 16: Average values and extended uncertainties of measurement

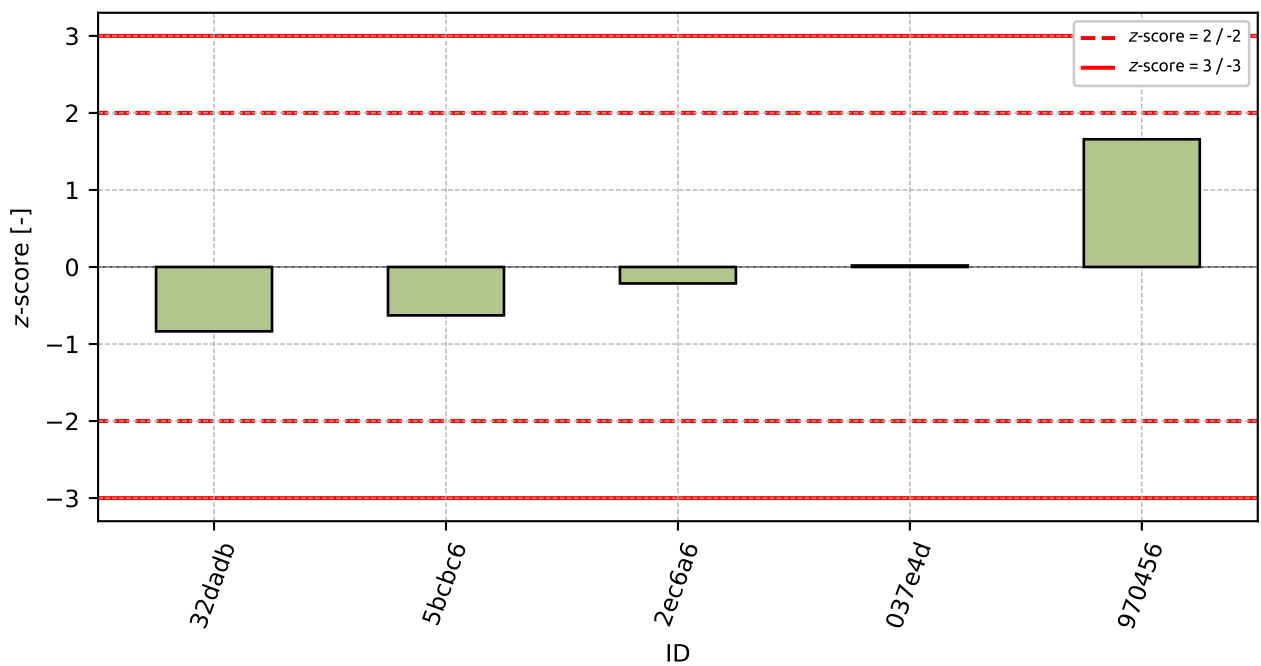


Figure 17: z-score

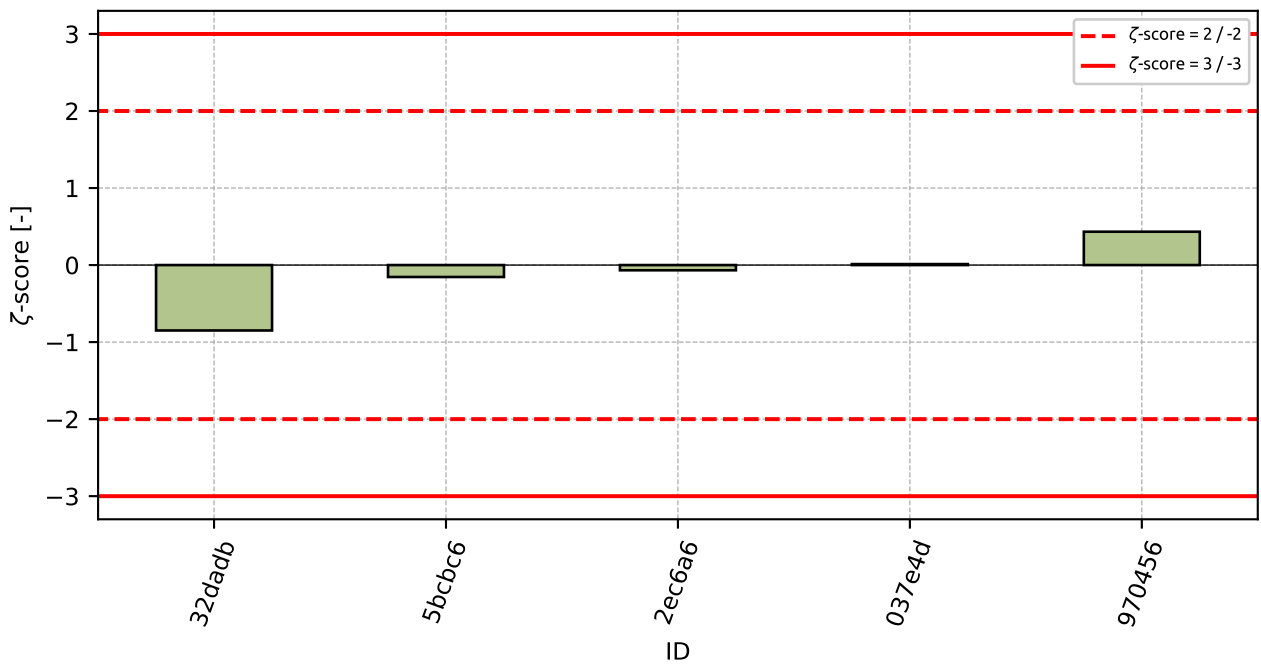


Figure 18: ζ-score

Table 8: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
32dadab	-0.84	-0.85
5bcbc6	-0.63	-0.15
2ec6a6	-0.21	-0.07
037e4d	0.02	0.01
970456	1.66	0.43

## 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 9: 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]								
22280b	26.5	25.5	25.7	25.3	25.5	1.0	25.7	0.47	1.83
32dadb	26.4	26.6	26.6	26.6	26.4	0.1	26.5	0.11	0.41
970456	27.0	27.4	27.6	27.1	26.8	0.5	27.2	0.32	1.18
2ec6a6	27.6	27.3	27.2	27.3	27.3	0.3	27.3	0.14	0.5
5bcbc6	27.4	27.4	27.4	27.4	27.2	0.1	27.4	0.08	0.27
de037e	27.1	29.1	28.5	27.3	28.2	1.2	28.0	0.84	2.98
d1a574	29.0	29.0	28.9	28.8	29.2	0.2	29.0	0.16	0.54
5e442d	28.8	29.7	29.6	29.1	28.7	0.8	29.2	0.45	1.56

#### The Numerical Procedure for Determining Outliers

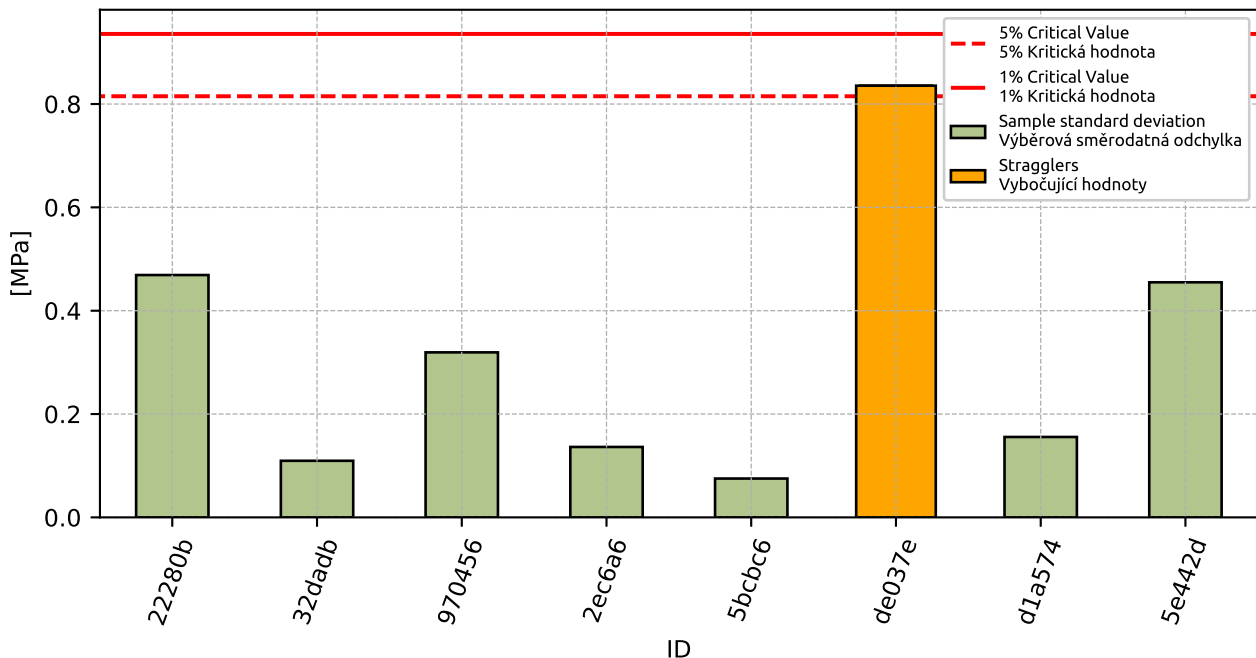


Figure 19: **Cochran's test** - sample standard deviations

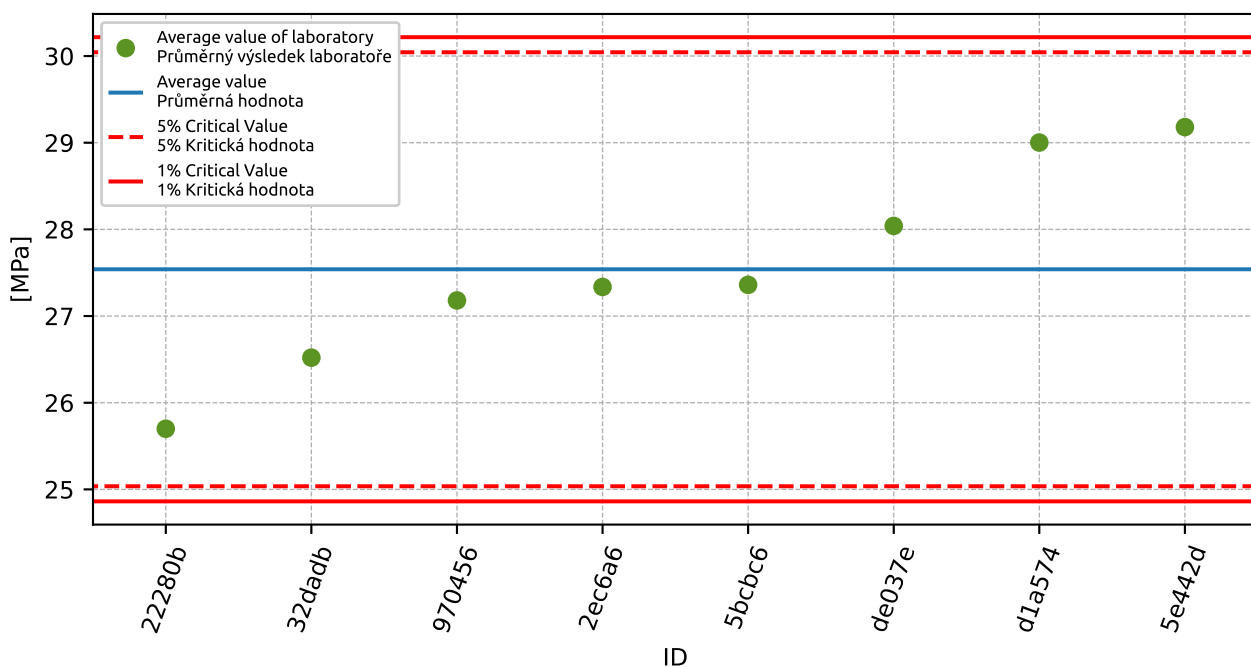


Figure 20: **Grubbs' test** - average values

**Mandel's Statistics**

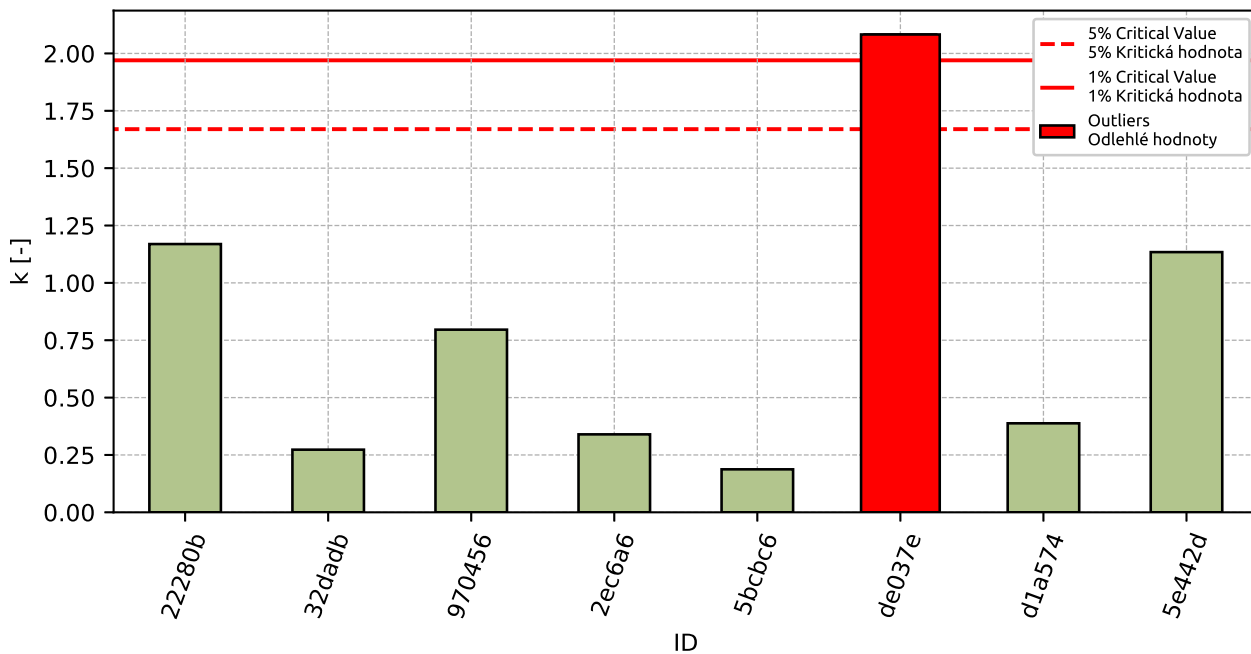


Figure 21: Intralaboratory Consistency Statistic

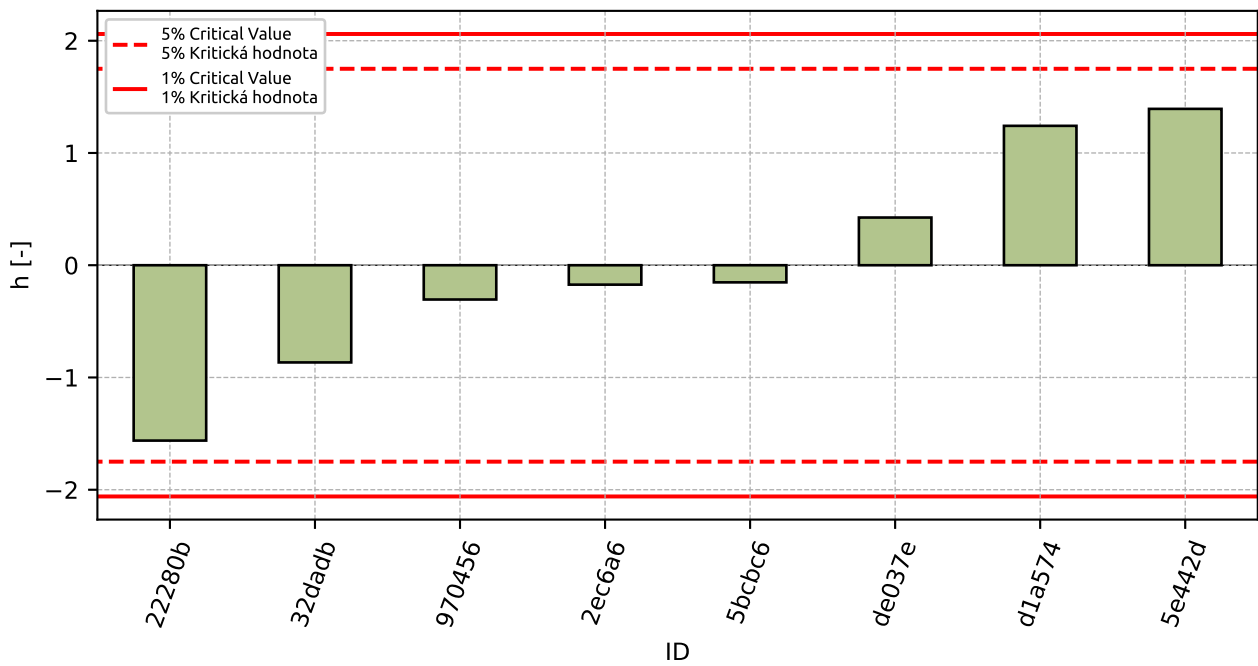


Figure 22: Interlaboratory Consistency Statistic

### Descriptive statistics

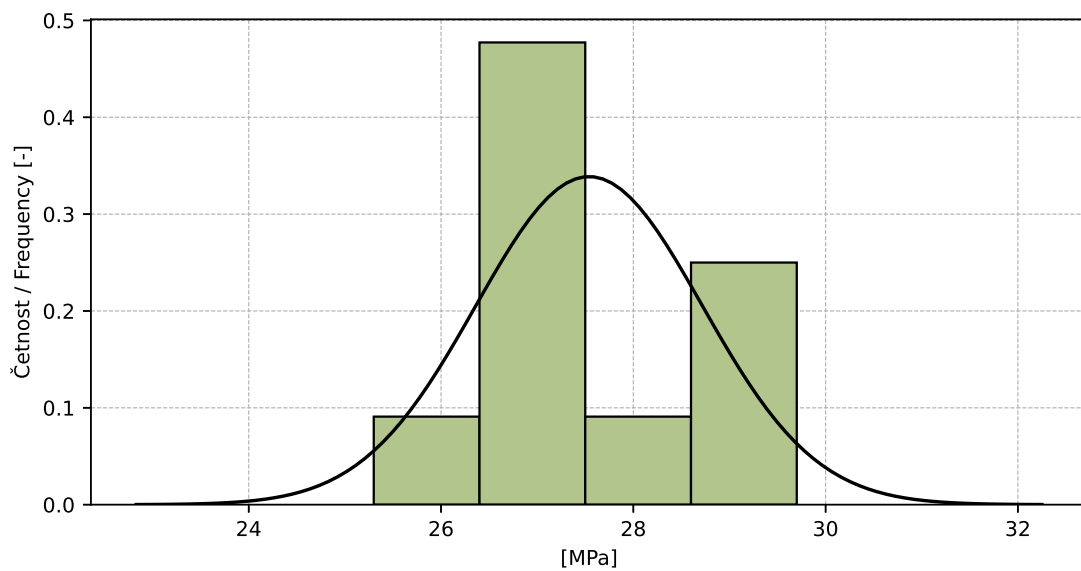


Figure 23: Histogram of all test results



Table 10: Descriptive statistics

Characteristics	[MPa]
Průměrná hodnota / Average value – $\bar{x}$	27.5
Výběrová směrodatná odchylka / Sample standard deviation – $s$	1.18
Vztažná hodnota / Assigned value – $x^*$	27.5
Robustní směrodatná odchylka / Robust standard deviation – $s^*$	1.25
Nejistota měření vztažné hodnoty / Measurement uncertainty of assigned value – $u_X$	0.55
$p$ -hodnota testu normality / $p$ -value of normality test	0.064 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – $s_L$	1.16
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – $s_r$	0.4
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – $s_R$	1.23
Opakovatelnost / Repeatability – $r$	1.1
Reprodukovatelnost / Reproducibility – $R$	3.4

### Evaluation of Performance Statistics

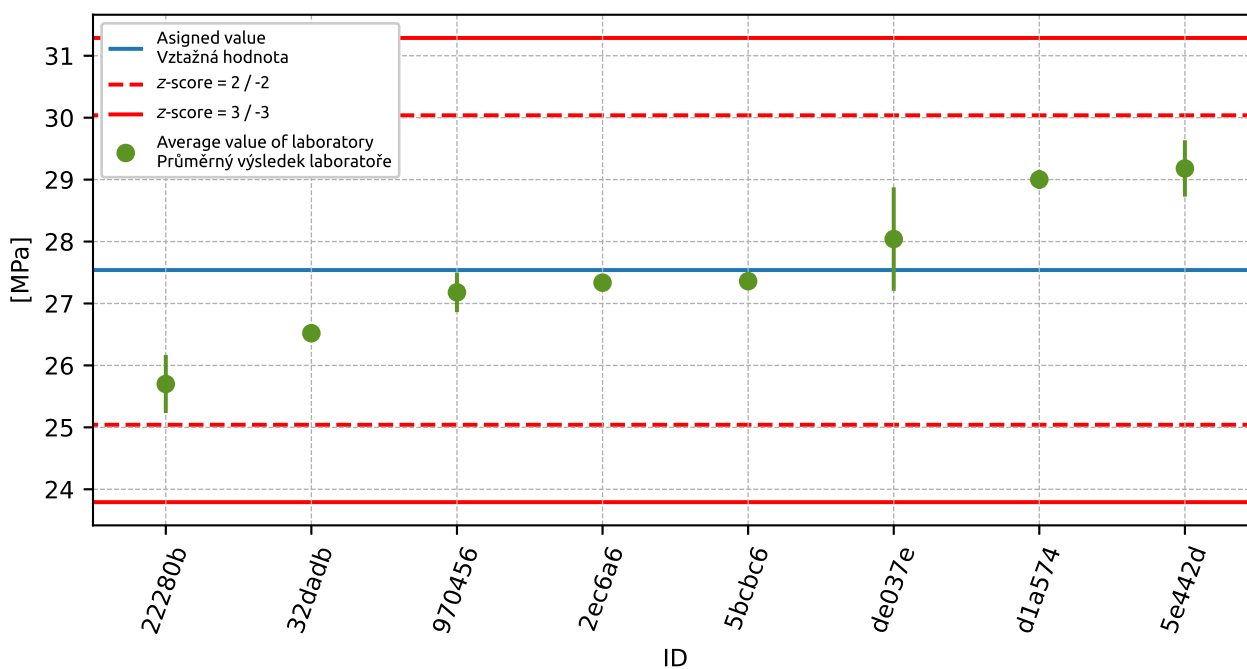


Figure 24: Average values and sample standard deviations

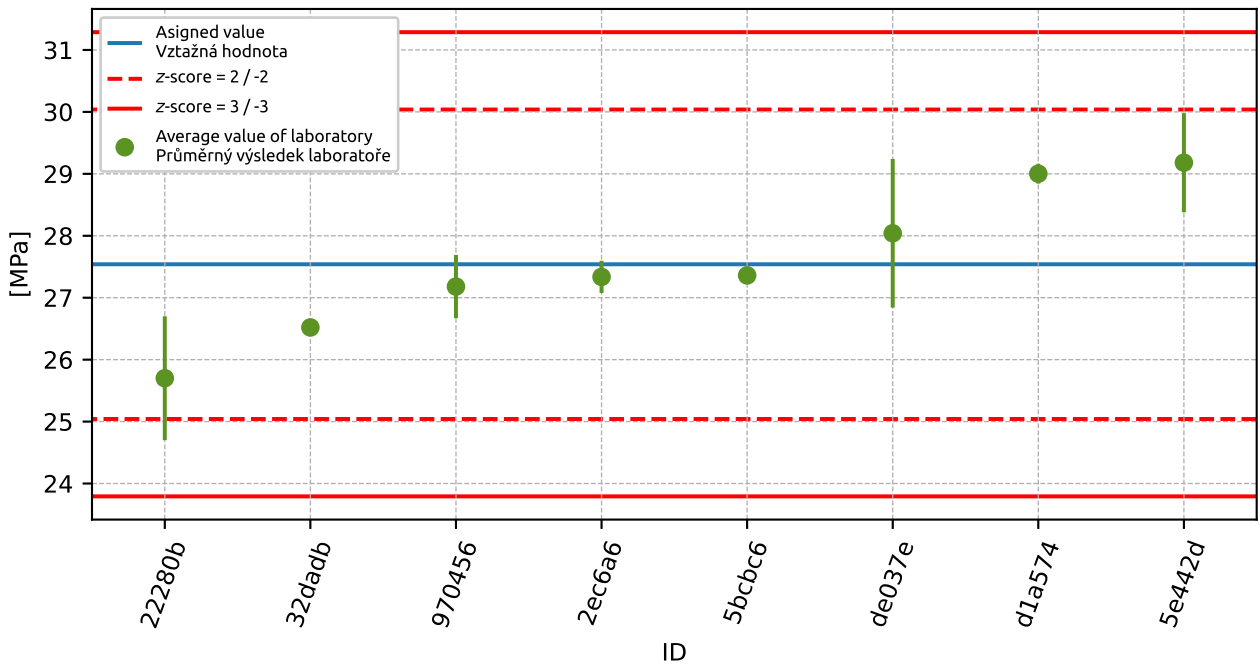


Figure 25: Average values and extended uncertainties of measurement

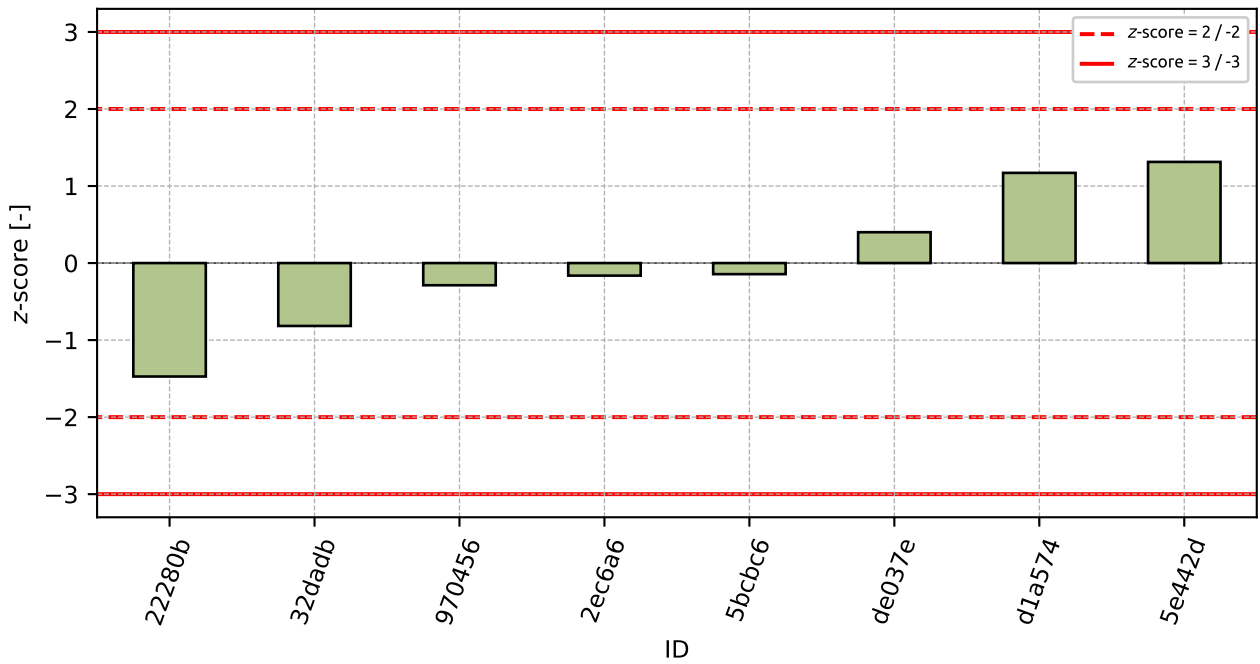
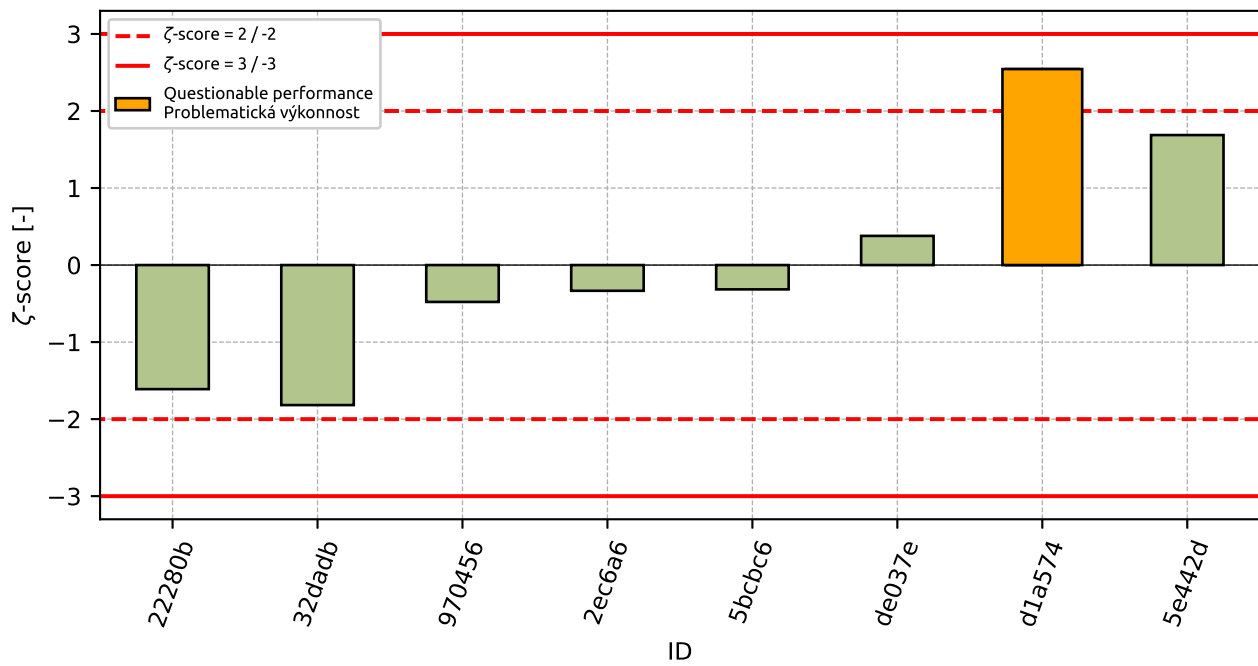


Figure 26: z-score

Figure 27:  $\zeta$ -scoreTable 11: z-score and  $\zeta$ -score

ID	z-score [-]	$\zeta$ -score [-]
22280b	-1.47	-1.61
32dad b	-0.82	-1.82
970456	-0.29	-0.48
2ec6a6	-0.16	-0.33
5bcbc6	-0.14	-0.32
de037e	0.4	0.38
d1a574	1.17	2.54
5e442d	1.31	1.69

## 2.1.2 Strain at yield

### Test results

Table 12: 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					$u_X$	$\bar{x}$	$s_0$	$V_X$
	[%]								
32dad <b>b</b>	7.4	7.3	7.2	7.4	7.4	0.1	7.3	0.09	1.22
970456	8.2	8.3	8.7	8.0	8.0	0.4	8.2	0.29	3.5
d1a574	8.4	8.3	8.4	8.5	8.0	0.2	8.3	0.18	2.21
5bcb <b>c6</b>	8.7	8.6	8.5	8.5	8.6	0.2	8.6	0.09	1.05
2ec6a6	8.4	8.3	8.4	9.2	8.6	0.8	8.6	0.38	4.42
de037e	8.0	10.0	9.5	9.0	9.0	-	9.1	0.74	8.15
22280b	10.0	10.7	8.8	9.9	9.8	1.0	9.8	0.67	6.82

### The Numerical Procedure for Determining Outliers

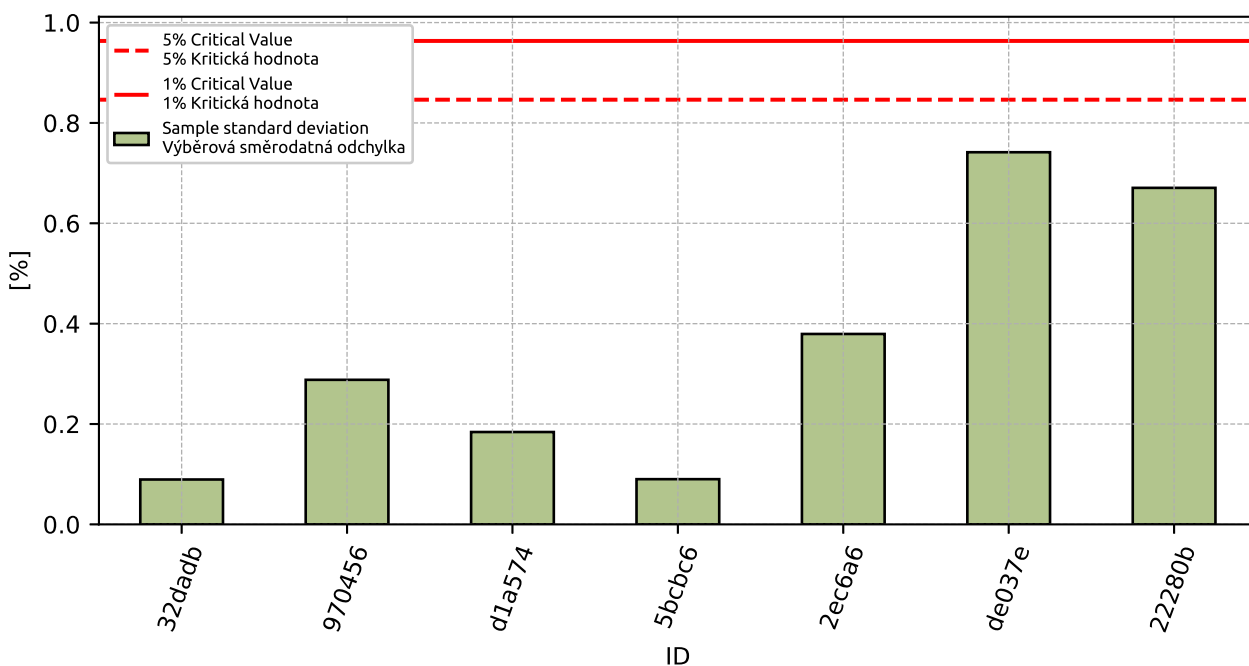


Figure 28: **Cochran's test** - sample standard deviations

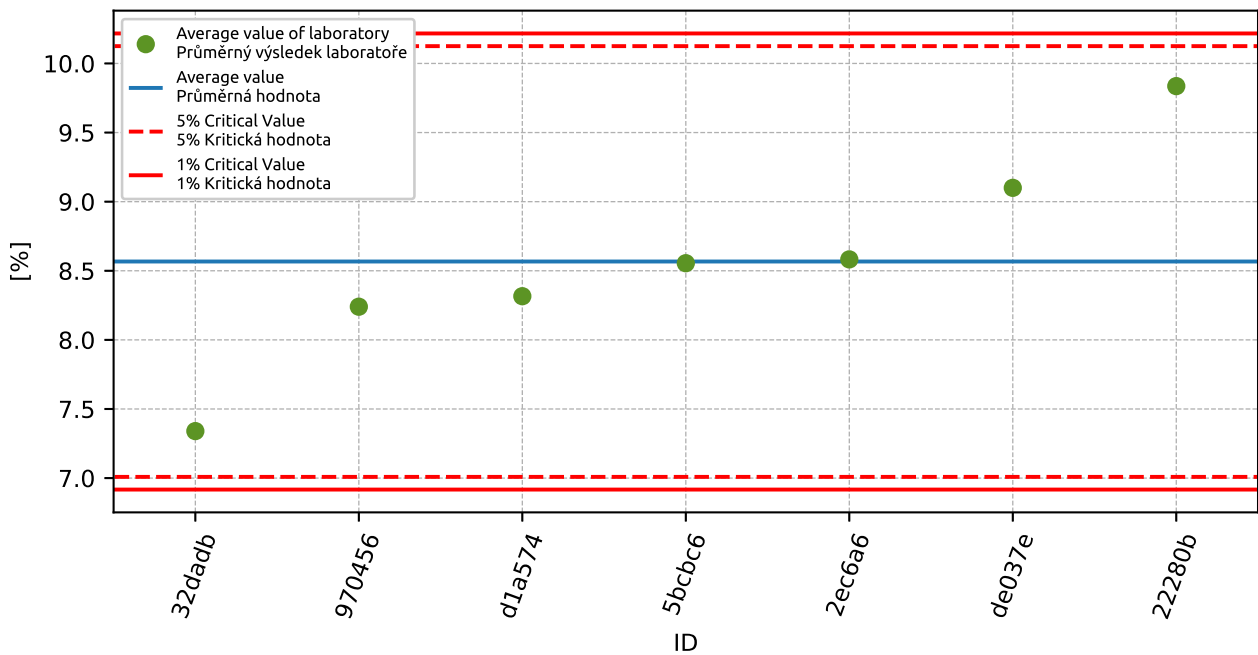


Figure 29: **Grubbs' test** - average values

### Mandel's Statistics

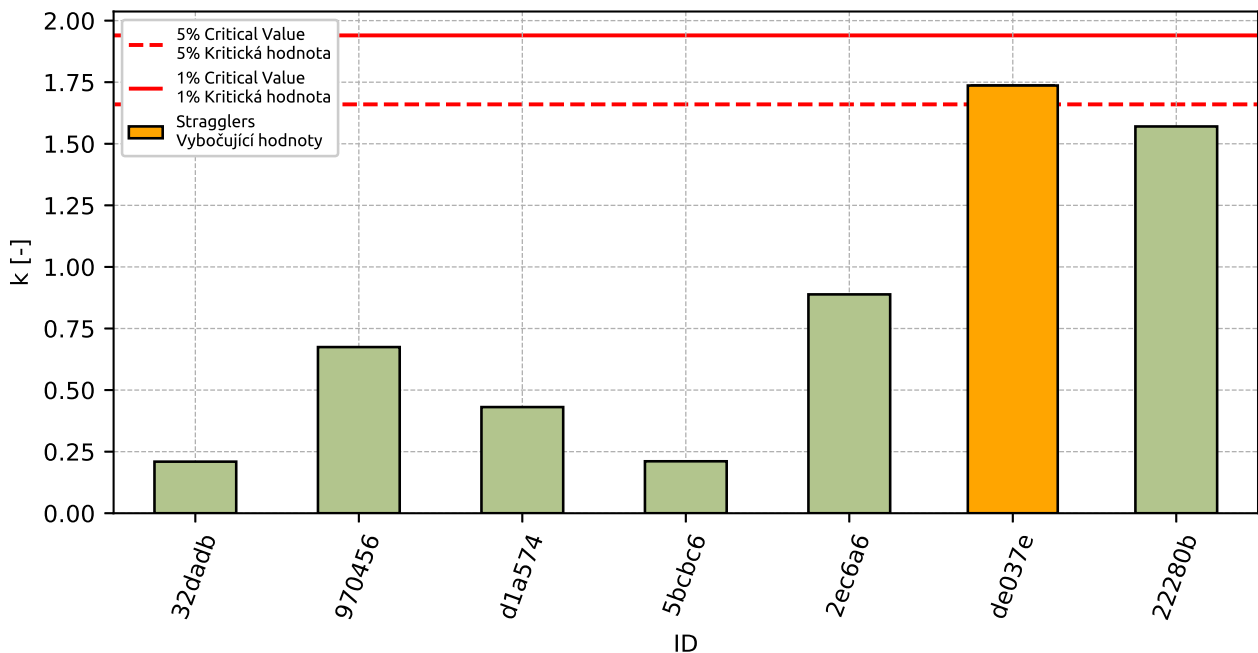


Figure 30: Intralaboratory Consistency Statistic

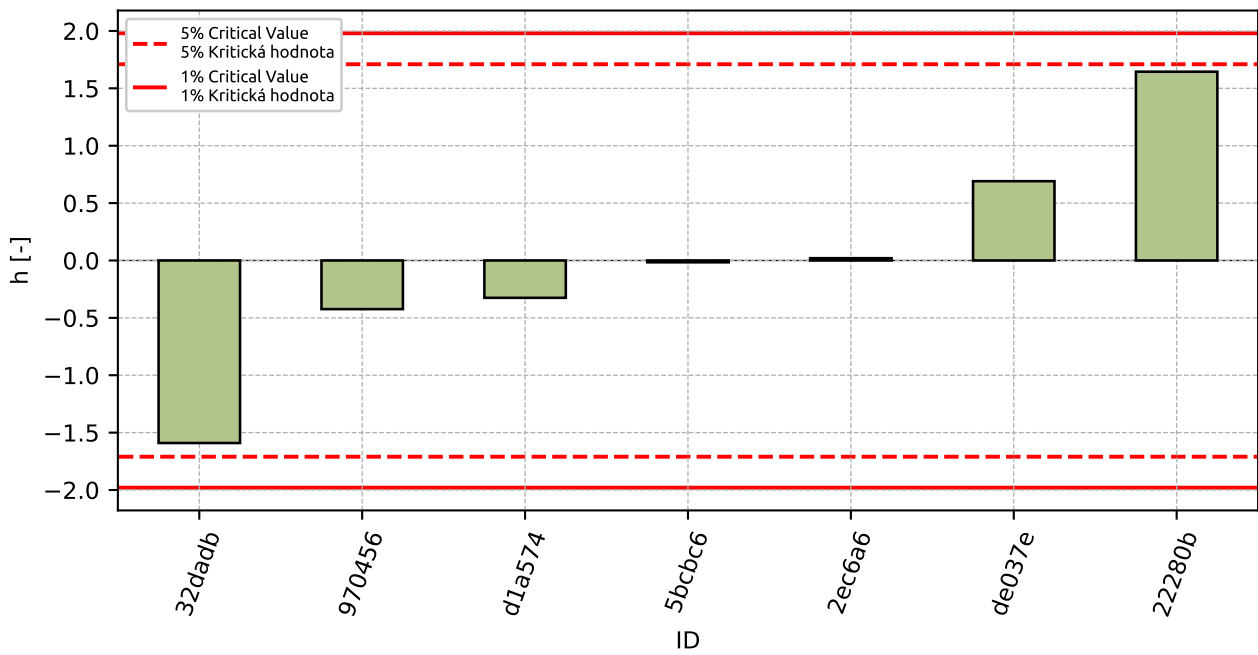


Figure 31: Interlaboratory Consistency Statistic

### Descriptive statistics

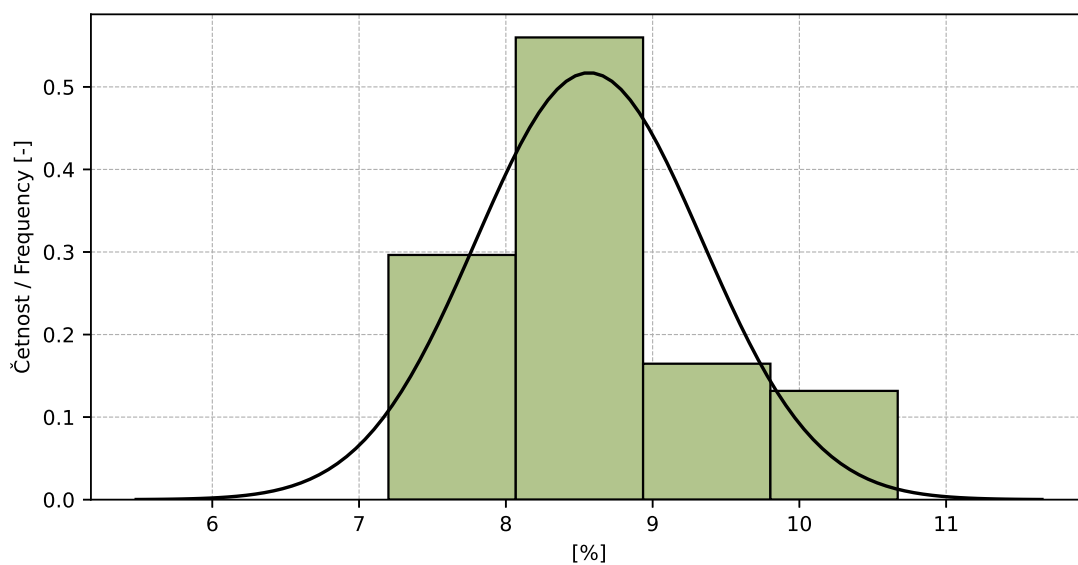


Figure 32: Histogram of all test results

Table 13: Descriptive statistics

Characteristics	[%]
Průměrná hodnota / Average value – $\bar{x}$	8.6
Výběrová směrodatná odchylka / Sample standard deviation – $s$	0.77
Vztažná hodnota / Assigned value – $x^*$	8.6
Robustní směrodatná odchylka / Robust standard deviation – $s^*$	0.68
Nejistota měření vztažné hodnoty / Measurement uncertainty of assigned value – $u_X$	0.32
$p$ -hodnota testu normality / $p$ -value of normality test	0.069 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – $s_L$	0.75
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – $s_r$	0.43
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – $s_R$	0.86
Opakovatelnost / Repeatability – $r$	1.2
Reprodukovatelnost / Reproducibility – $R$	2.4

### Evaluation of Performance Statistics

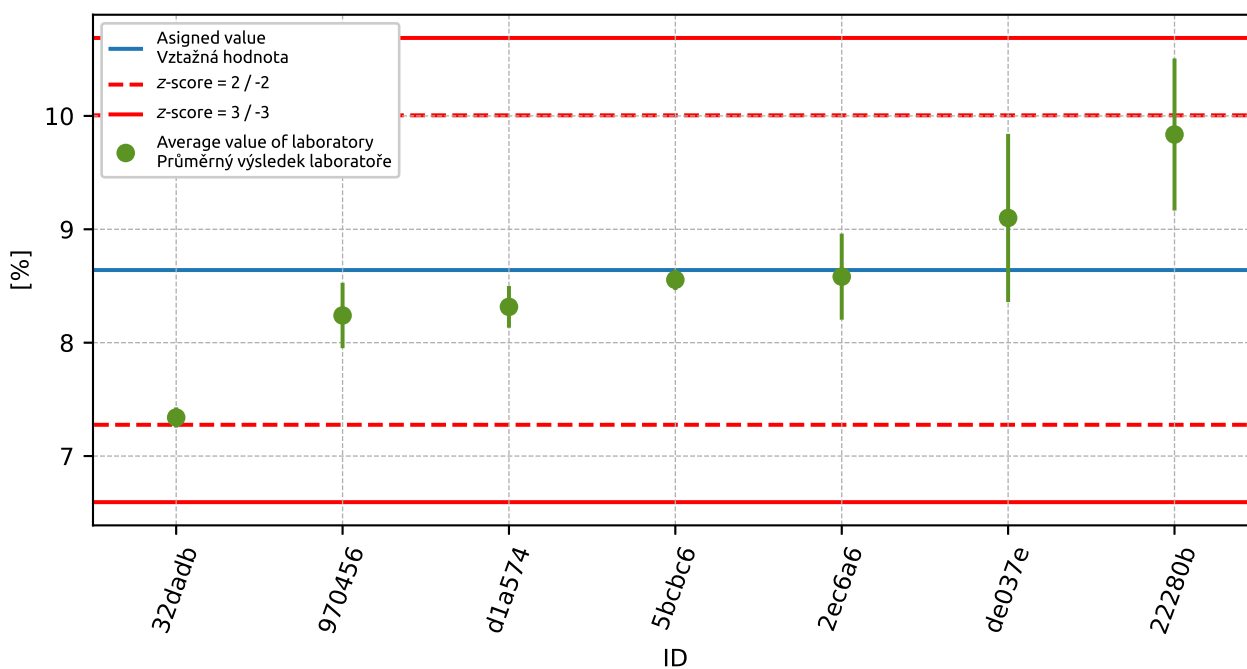


Figure 33: Average values and sample standard deviations

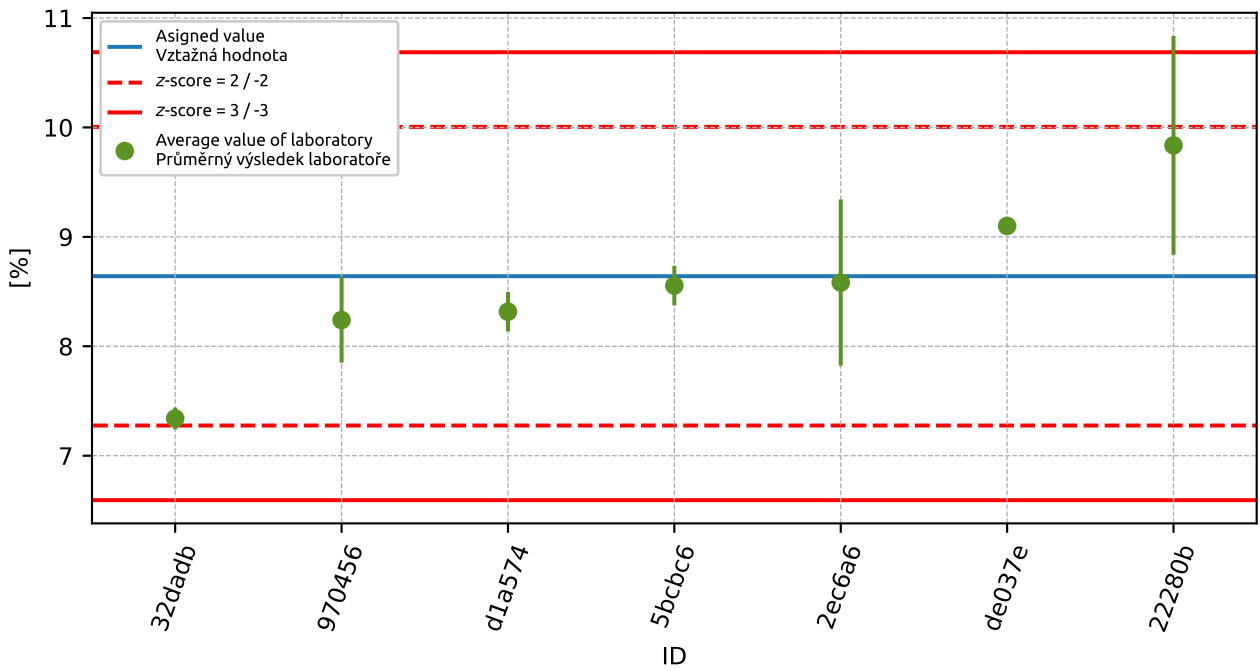


Figure 34: Average values and extended uncertainties of measurement

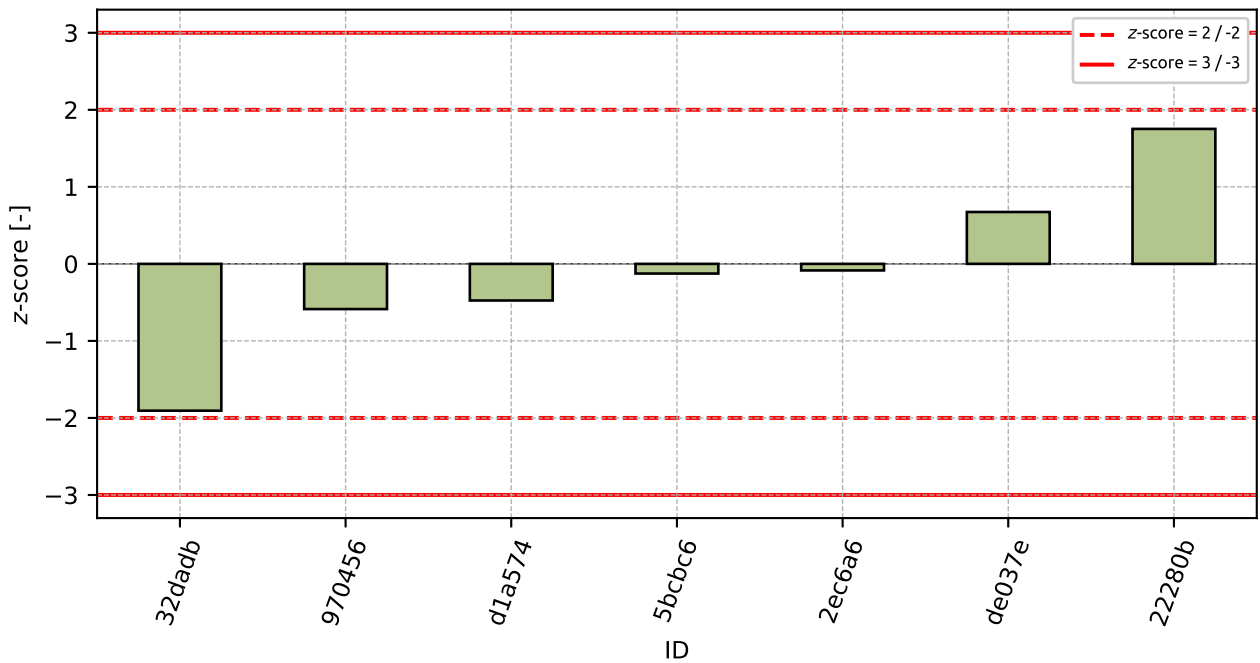
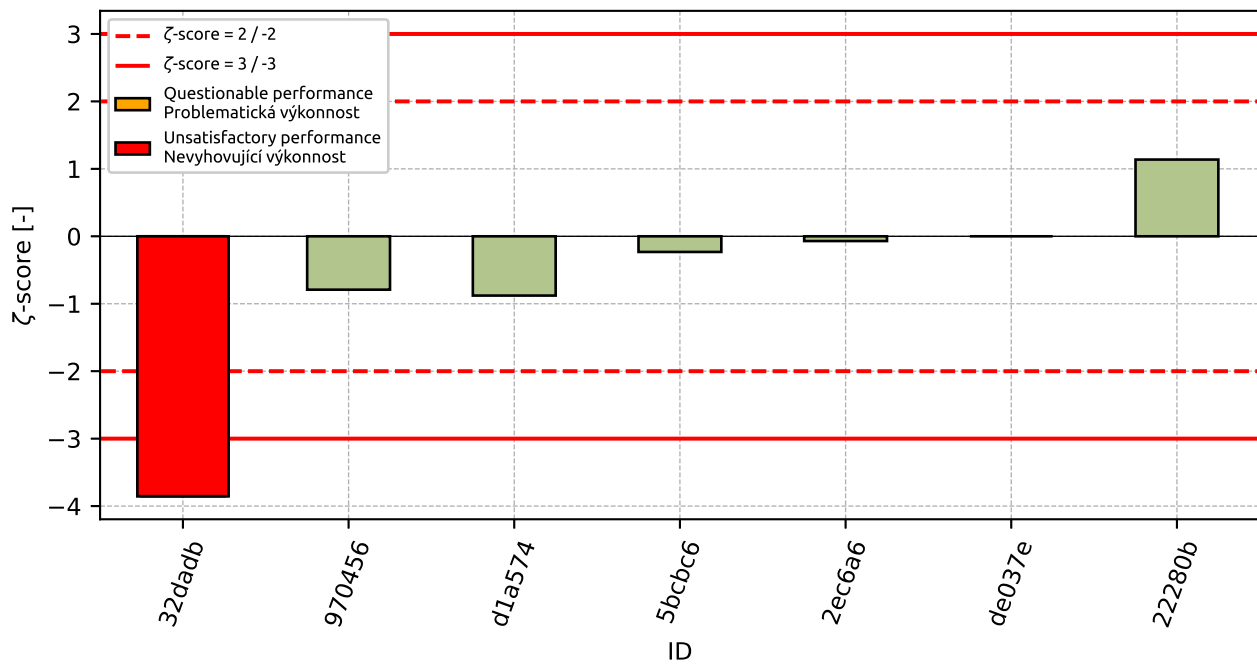


Figure 35: z-score



Figure 36:  $\zeta$ -scoreTable 14: z-score and  $\zeta$ -score

ID	z-score [-]	$\zeta$ -score [-]
32dadb	-1.91	-3.85
970456	-0.59	-0.79
d1a574	-0.48	-0.88
5bcbc6	-0.13	-0.23
2ec6a6	-0.09	-0.07
de037e	0.67	-
22280b	1.75	1.14

## 2.2 Sample B

### 2.2.1 Stress at yield

#### Test results

Table 15: 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]	$V_x$ [%]
22280b	36.3	36.0	36.1	35.8	35.7	1.0	36.0	0.24	0.66
32dadb	37.8	37.7	38.1	38.0	37.6	0.2	37.8	0.21	0.55
970456	38.0	38.2	38.1	39.8	38.0	1.1	38.4	0.78	2.02
5bcbc6	38.4	38.3	38.6	38.4	38.4	0.2	38.4	0.1	0.27
2ec6a6	38.2	38.5	38.6	38.5	38.5	0.3	38.4	0.15	0.4
de037e	39.9	39.7	40.3	38.9	37.1	1.8	39.2	1.27	3.24
5e442d	40.2	39.9	39.6	40.5	40.0	1.0	40.0	0.34	0.84
d1a574	40.3	40.4	40.3	40.4	40.3	0.1	40.3	0.07	0.18

#### The Numerical Procedure for Determining Outliers

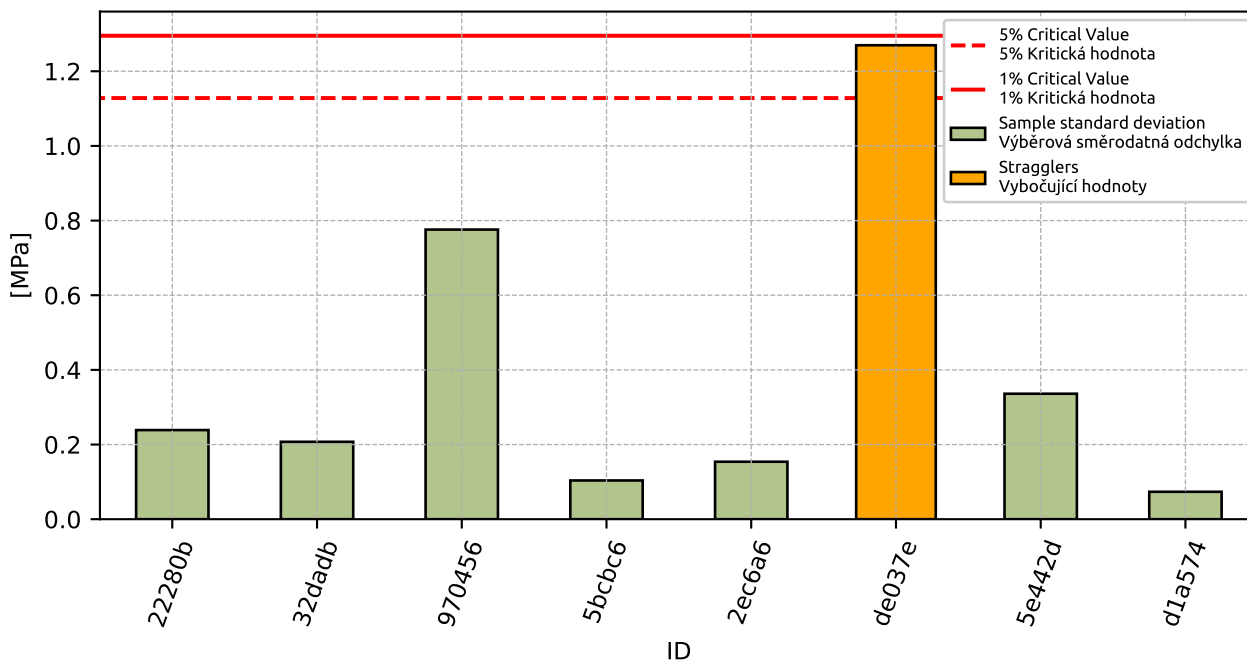


Figure 37: Cochran's test - sample standard deviations

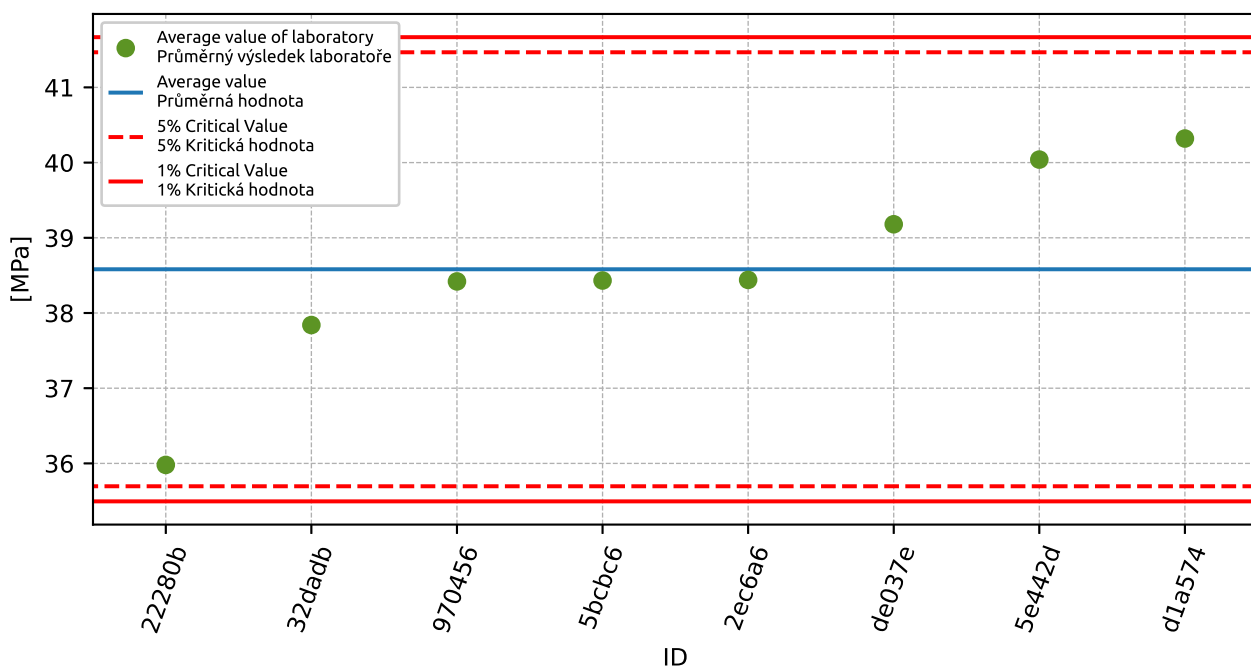


Figure 38: Grubbs' test - average values

Mandel's Statistics

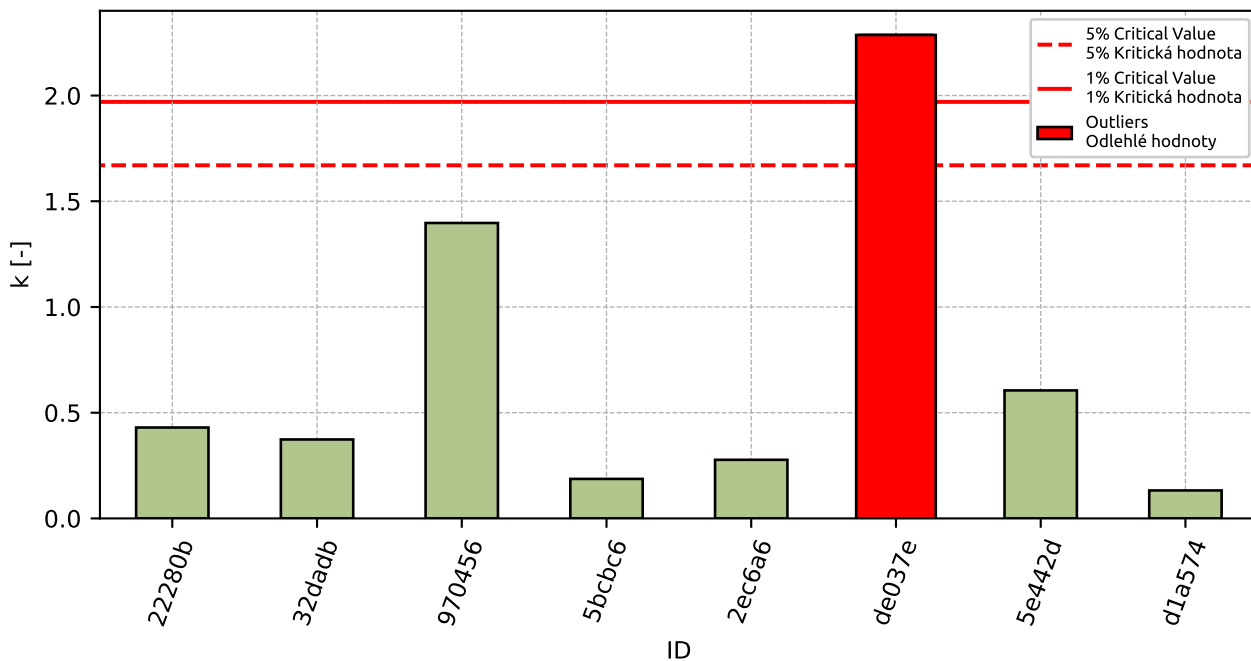


Figure 39: Intralaboratory Consistency Statistic

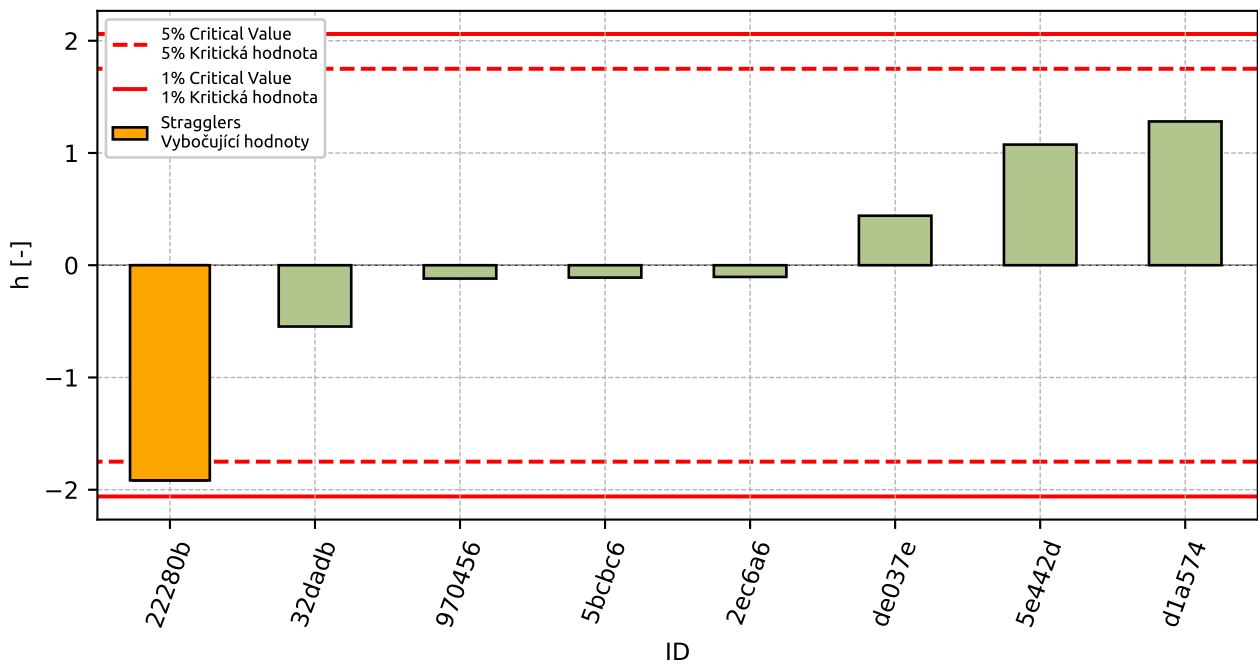


Figure 40: Interlaboratory Consistency Statistic

**Descriptive statistics**

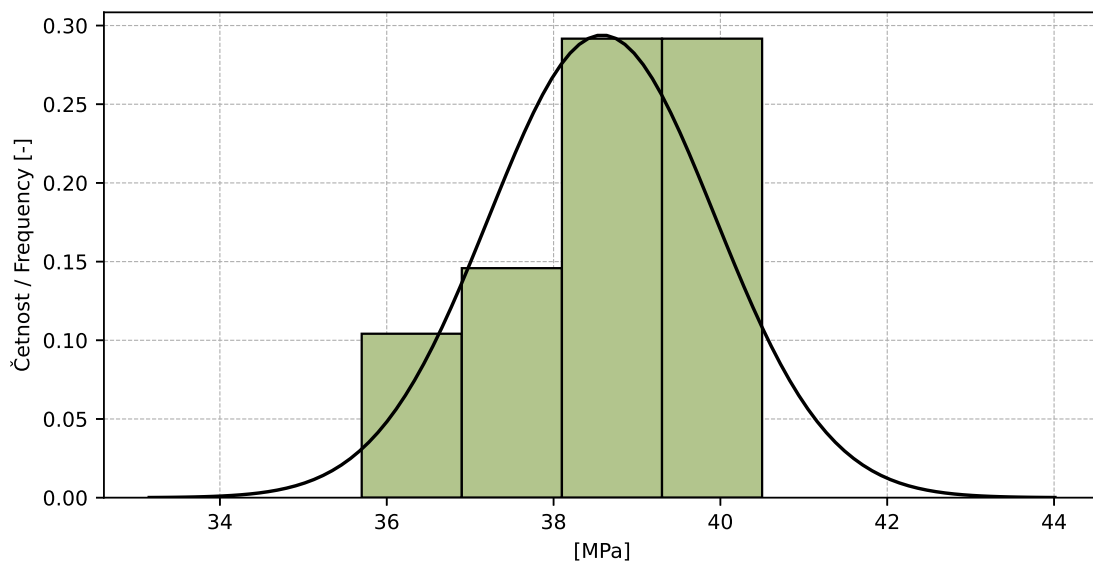


Figure 41: Histogram of all test results

Table 16: Descriptive statistics

Characteristics	[MPa]
Průměrná hodnota / Average value – $\bar{x}$	38.6
Výběrová směrodatná odchylka / Sample standard deviation – $s$	1.36
Vztažná hodnota / Assigned value – $x^*$	38.7
Robustní směrodatná odchylka / Robust standard deviation – $s^*$	1.16
Nejistota měření vztažné hodnoty / Measurement uncertainty of assigned value – $u_X$	0.51
$p$ -hodnota testu normality / $p$ -value of normality test	0.008 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – $s_L$	1.33
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – $s_r$	0.56
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – $s_R$	1.45
Opakovatelnost / Repeatability – $r$	1.6
Reprodukovatelnost / Reproducibility – $R$	4.0

### Evaluation of Performance Statistics

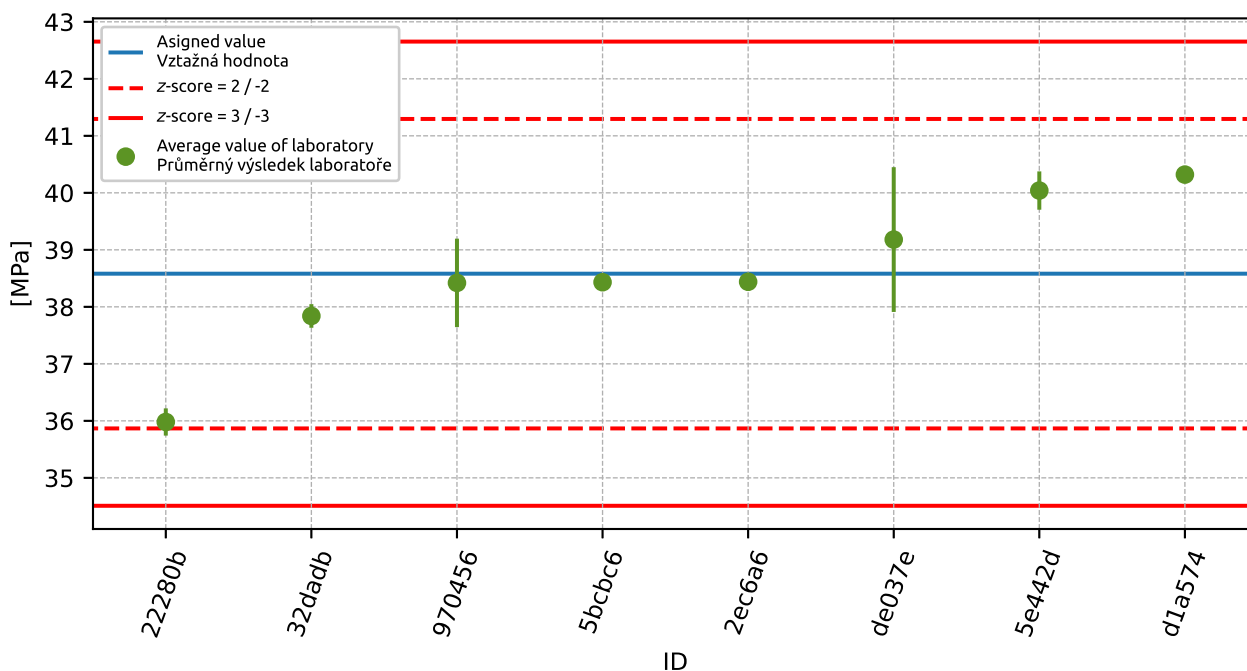


Figure 42: Average values and sample standard deviations

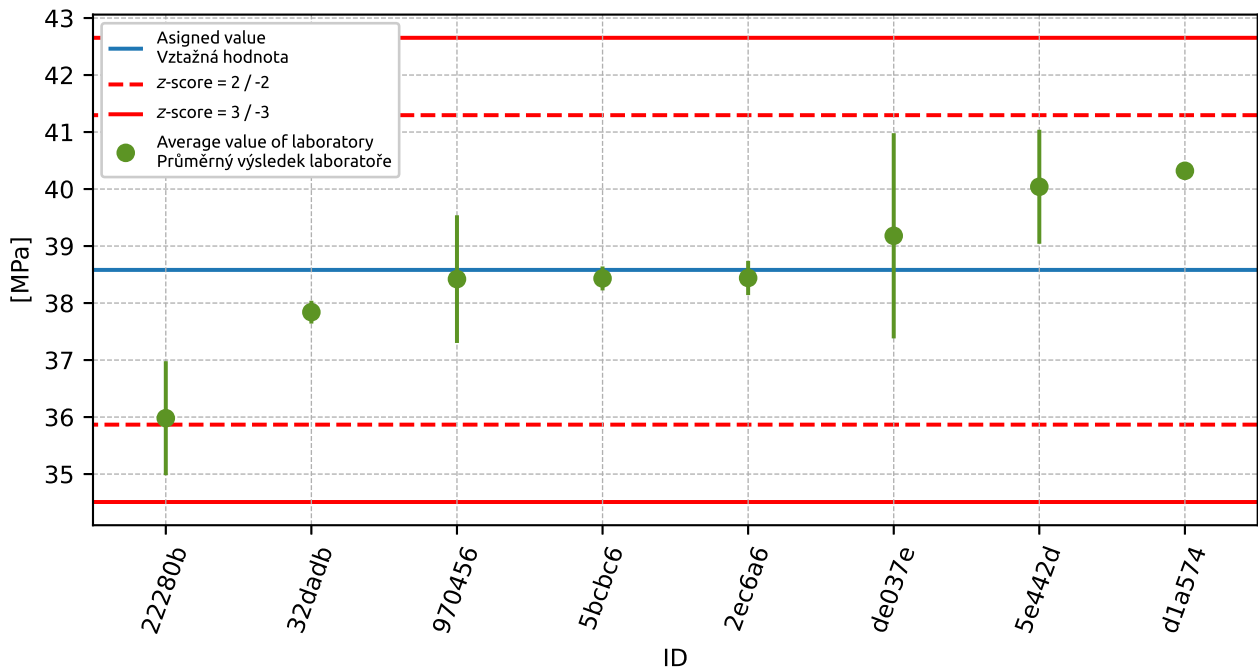


Figure 43: Average values and extended uncertainties of measurement

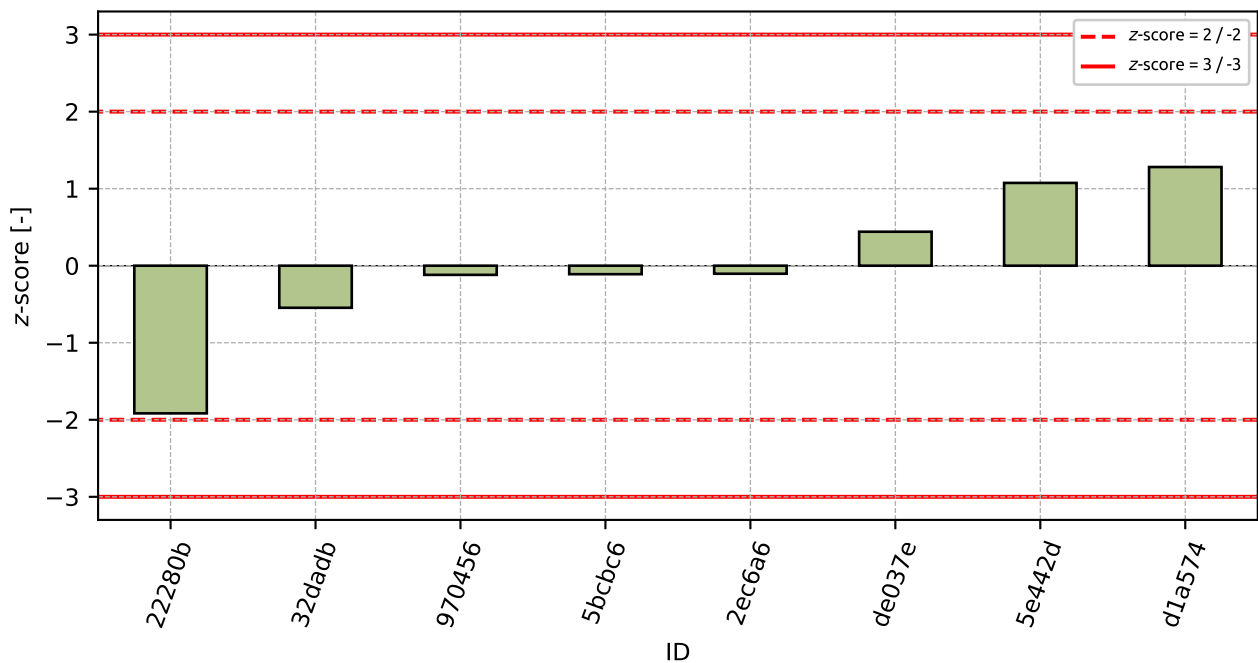


Figure 44: z-score

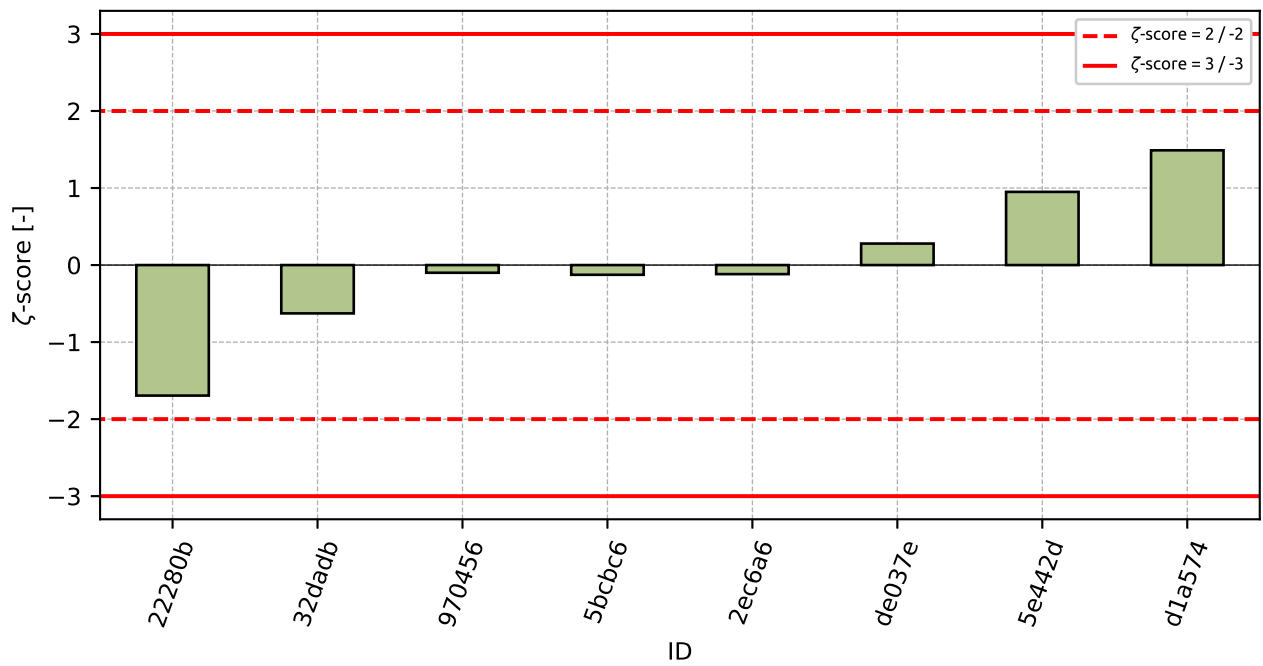


Figure 45: z-score

Table 17: z-score and z-score

ID	z-score [-]	z-score [-]
22280b	-1.92	-1.69
32dadb	-0.55	-0.63
970456	-0.12	-0.1
5bcbc6	-0.11	-0.13
2ec6a6	-0.1	-0.12
de037e	0.44	0.28
5e442d	1.07	0.95
d1a574	1.28	1.49

## 2.2.2 Strain at yield

### Test results

Table 18: 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					$u_X$	$\bar{x}$	$s_0$	$V_X$
	[%]								
32daddb	6.4	6.3	6.3	6.3	6.3	0.0	6.3	0.04	0.71
970456	6.8	6.8	6.8	6.7	7.0	0.2	6.8	0.11	1.61
d1a574	7.1	6.9	6.9	6.9	6.8	0.1	6.9	0.1	1.39
5bcbcb6	7.2	7.2	7.3	7.2	7.2	0.1	7.2	0.05	0.7
2ec6a6	7.2	7.4	7.2	7.2	7.3	0.2	7.2	0.08	1.11
de037e	8.0	7.0	7.5	8.0	7.0	-	7.5	0.5	6.67
22280b	8.2	8.3	8.0	-	7.5	1.0	8.0	0.35	4.43

### The Numerical Procedure for Determining Outliers

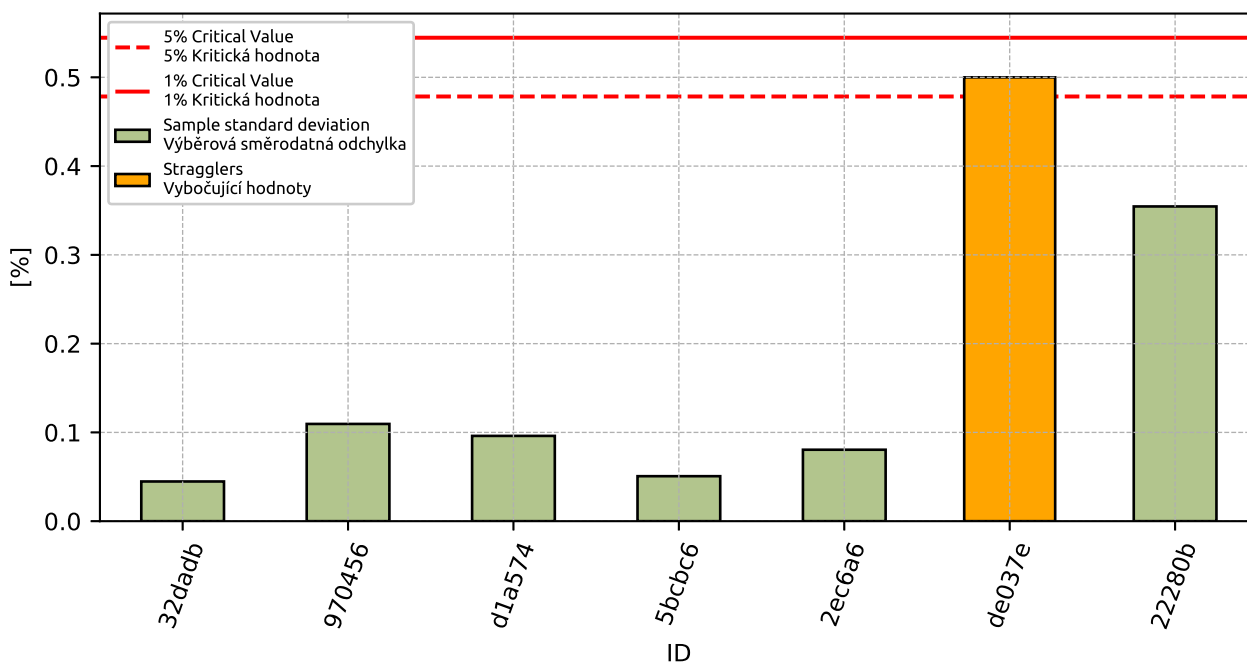


Figure 46: Cochran's test - sample standard deviations



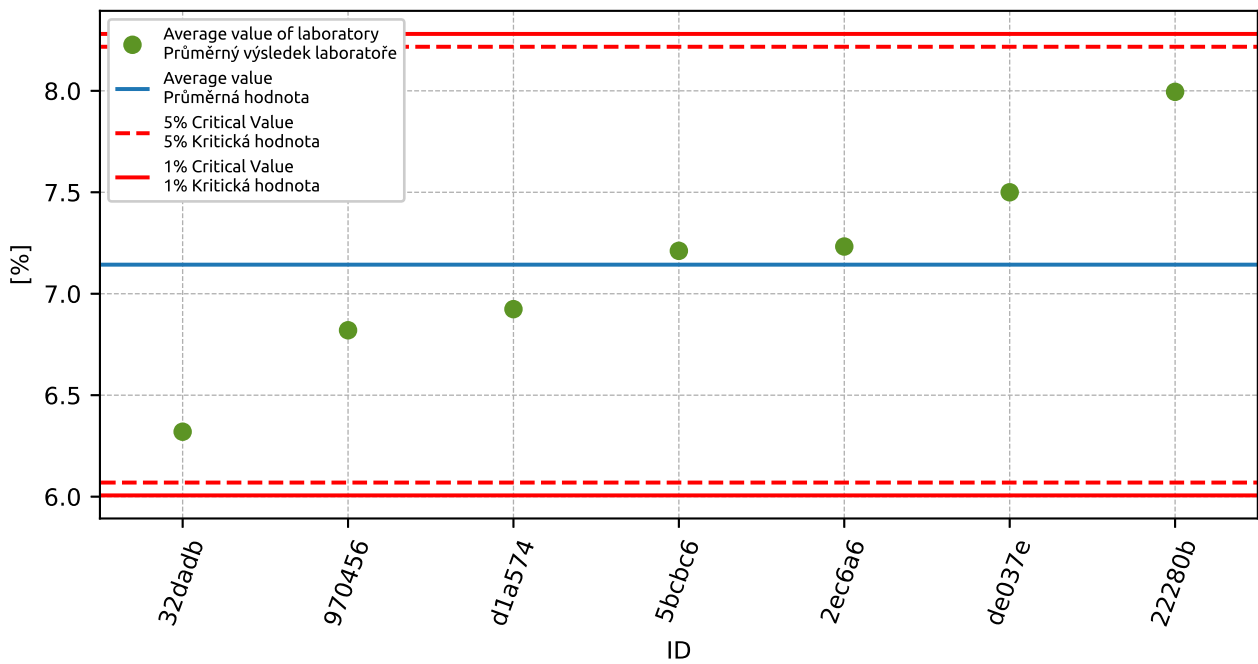


Figure 47: **Grubbs' test** - average values

### Mandel's Statistics

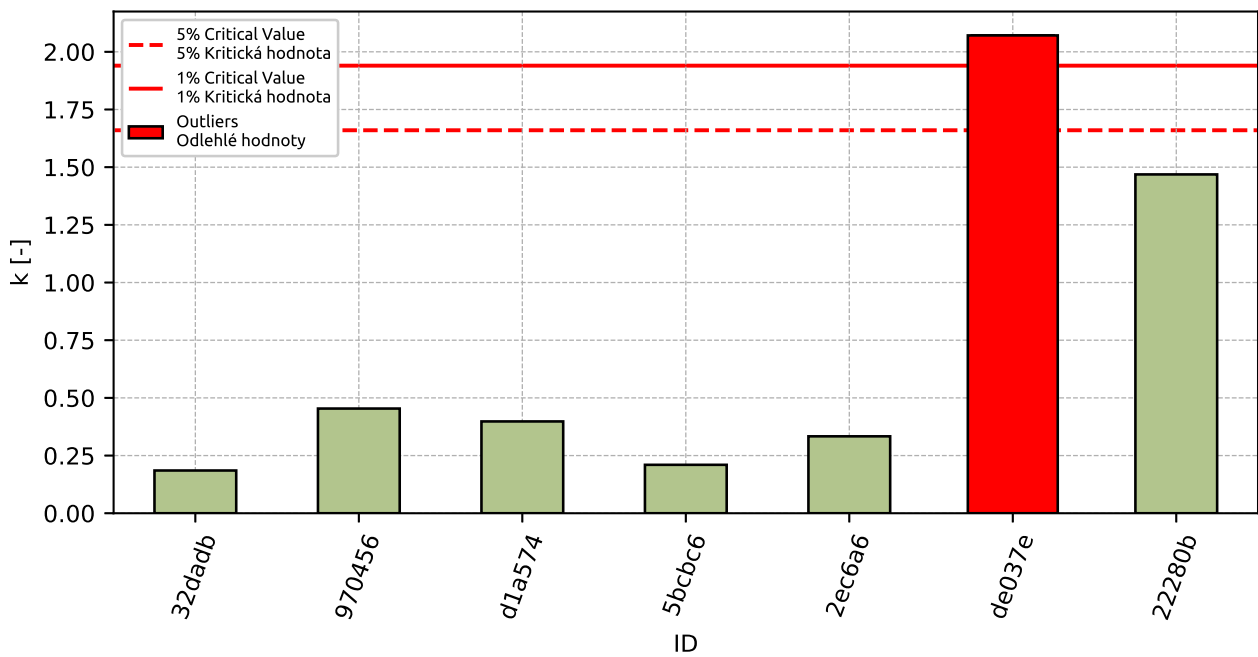


Figure 48: Intralaboratory Consistency Statistic

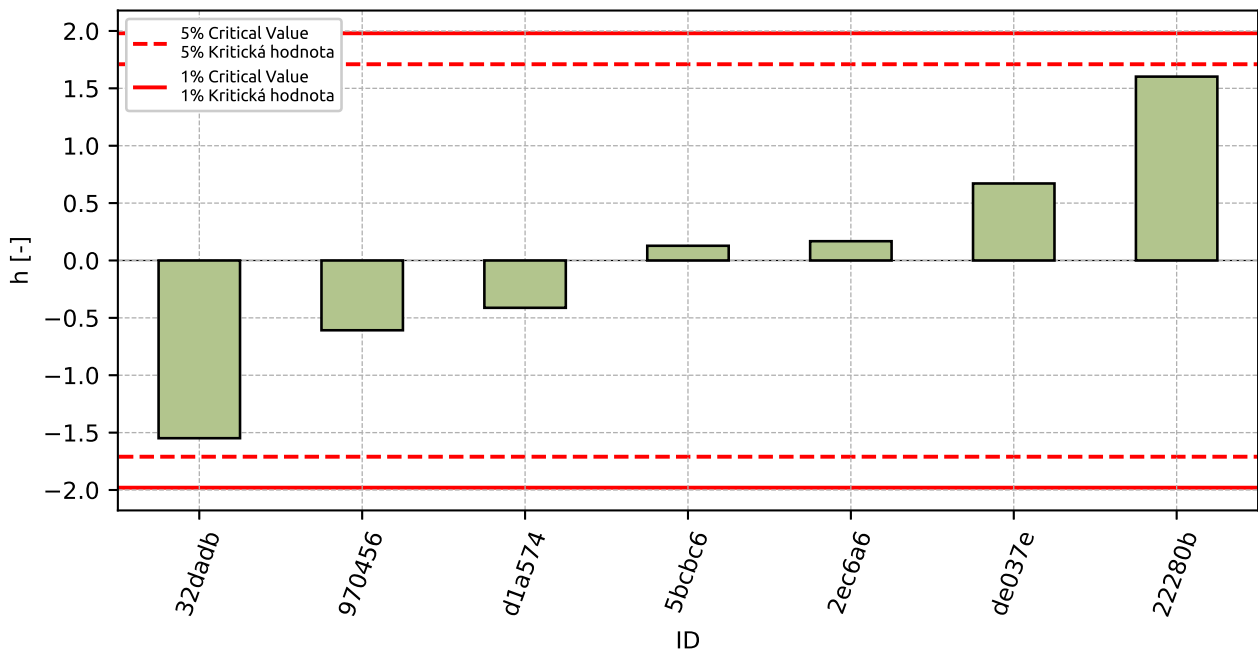


Figure 49: Interlaboratory Consistency Statistic

### Descriptive statistics

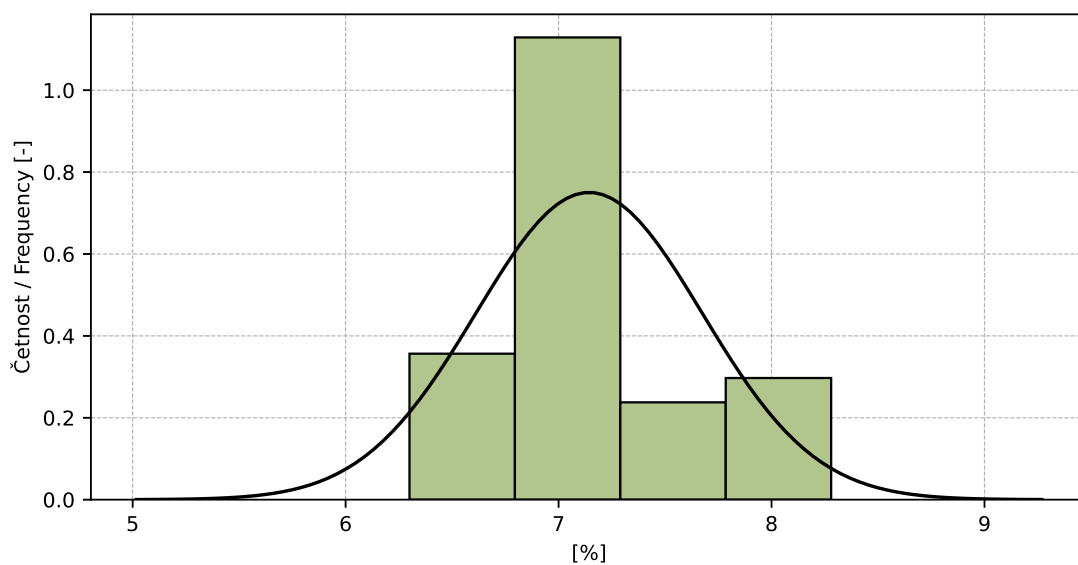


Figure 50: Histogram of all test results

Table 19: Descriptive statistics

Characteristics	[%]
Průměrná hodnota / Average value – $\bar{x}$	7.1
Výběrová směrodatná odchylka / Sample standard deviation – $s$	0.53
Vztažná hodnota / Assigned value – $x^*$	7.1
Robustní směrodatná odchylka / Robust standard deviation – $s^*$	0.53
Nejistota měření vztažné hodnoty / Measurement uncertainty of assigned value – $u_X$	0.73
$p$ -hodnota testu normality / $p$ -value of normality test	1.0 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – $s_L$	0.52
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – $s_r$	0.24
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – $s_R$	0.57
Opakovatelnost / Repeatability – $r$	0.7
Reprodukovatelnost / Reproducibility – $R$	1.6

### Evaluation of Performance Statistics

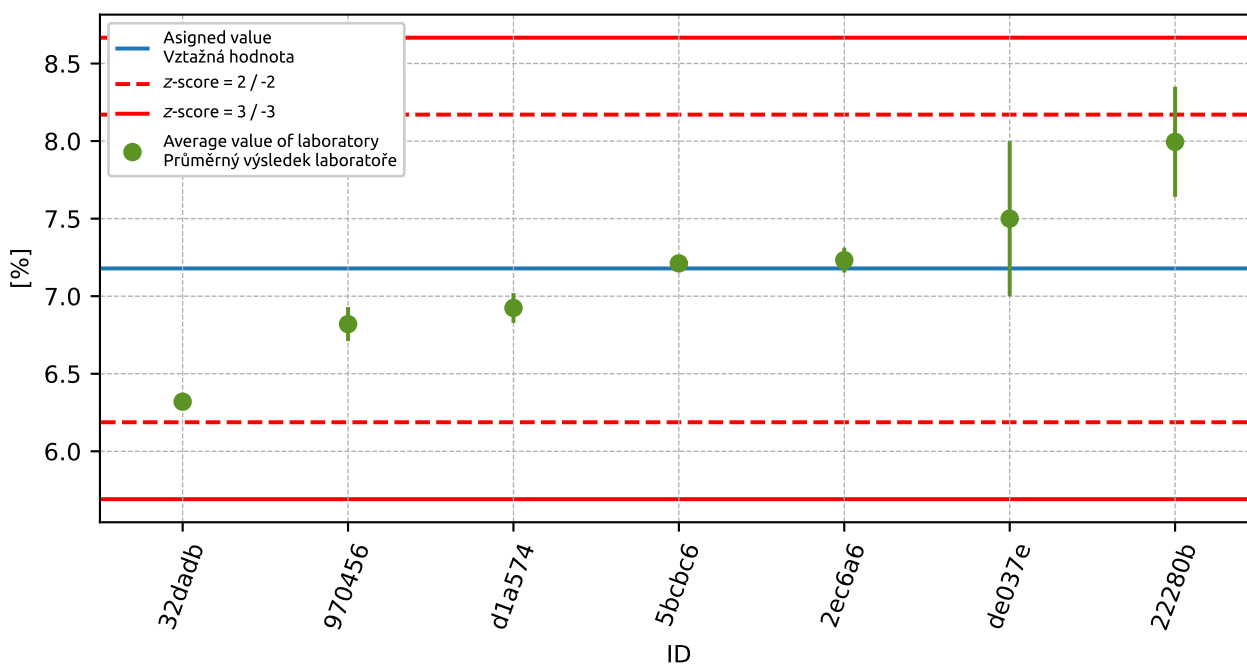


Figure 51: Average values and sample standard deviations

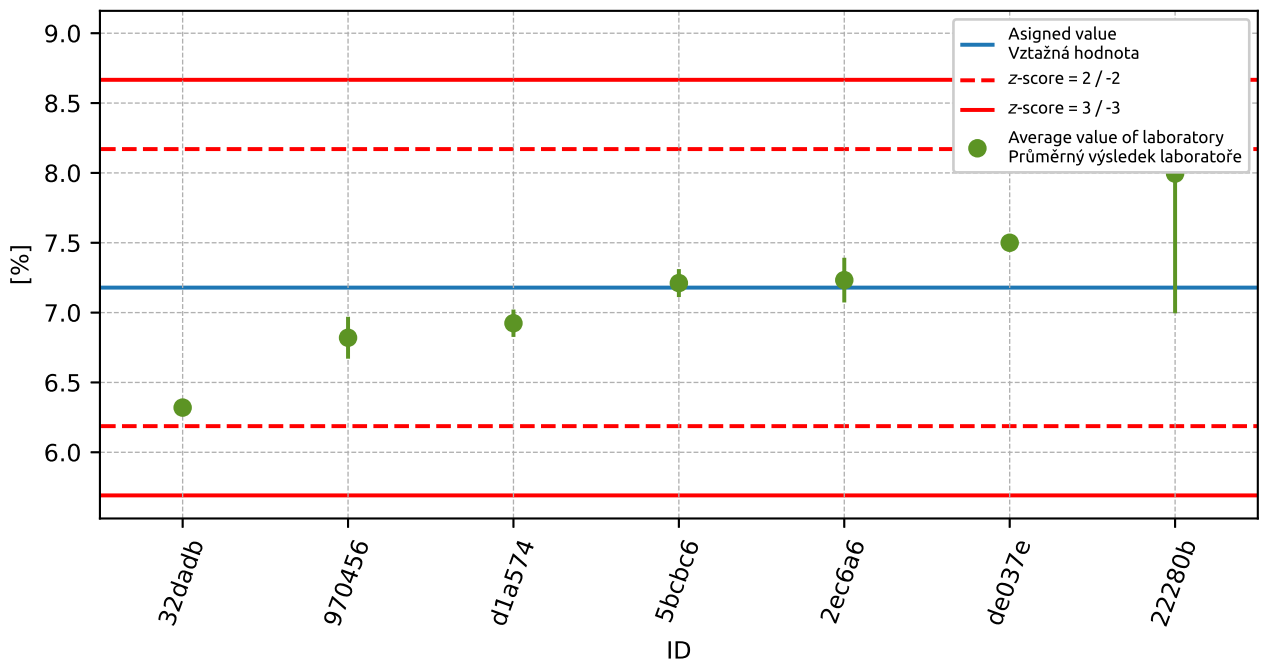


Figure 52: Average values and extended uncertainties of measurement

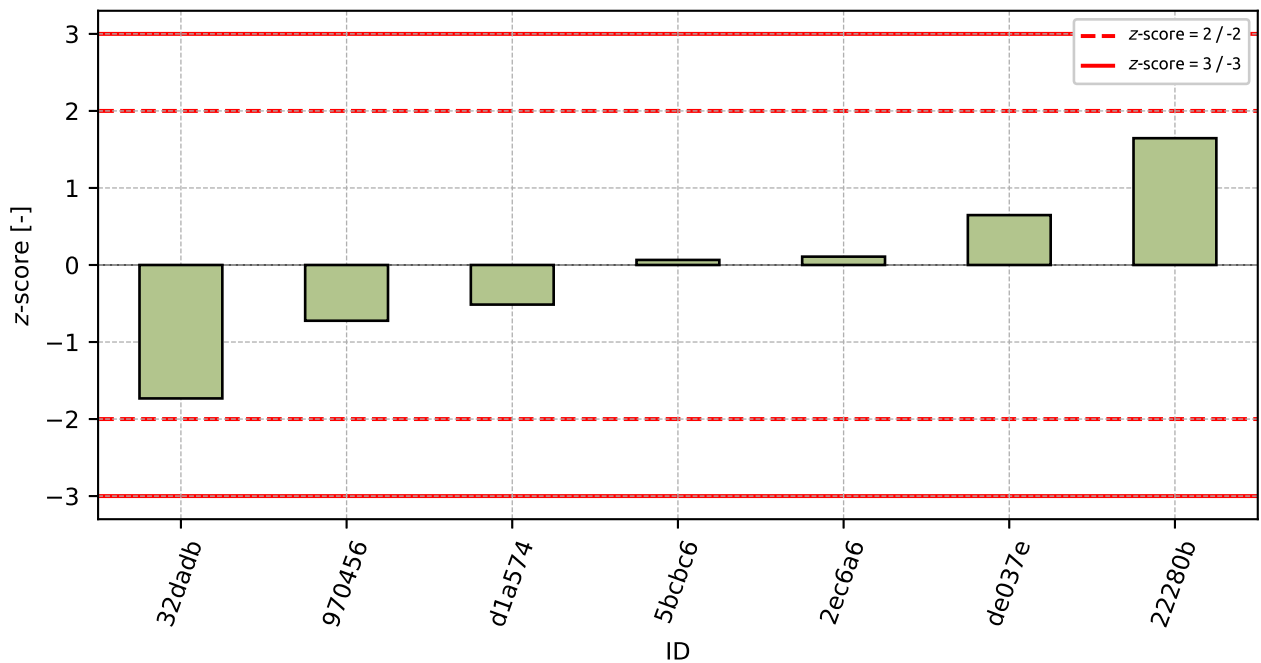
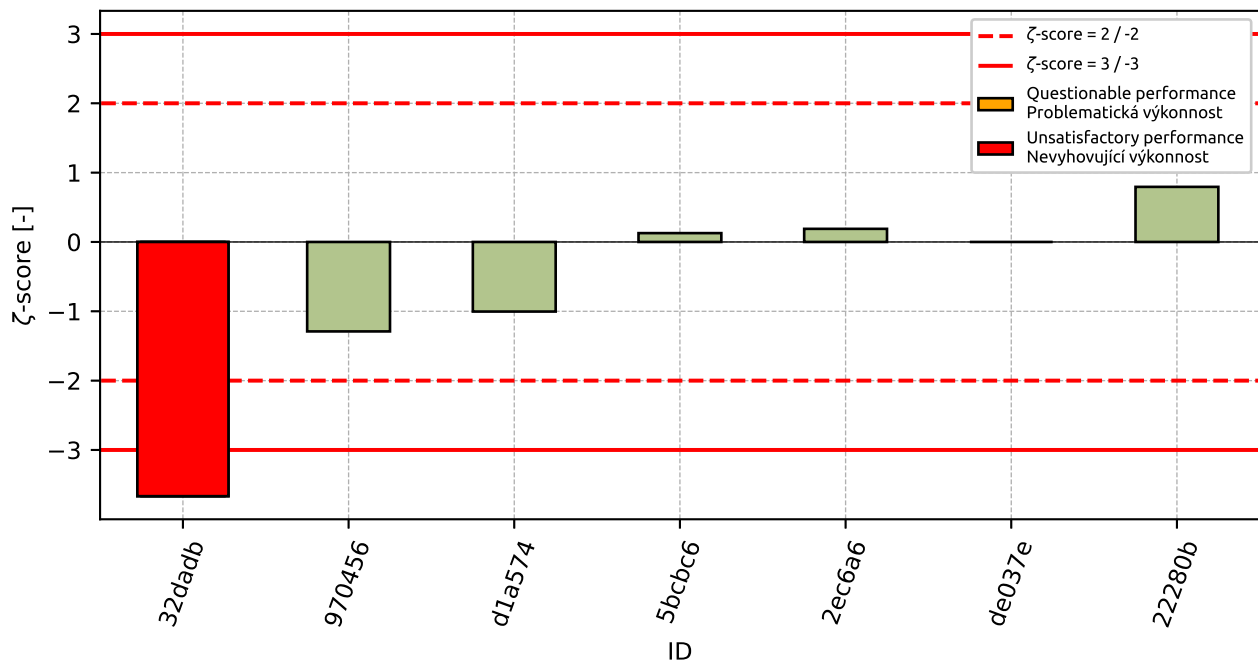


Figure 53: z-score

Figure 54:  $\zeta$ -scoreTable 20: z-score and  $\zeta$ -score

ID	z-score [-]	$\zeta$ -score [-]
32dad	-1.73	-3.67
970456	-0.72	-1.29
d1a574	-0.51	-1.0
5bcbc6	0.07	0.13
2ec6a6	0.11	0.19
de037e	0.65	-
22280b	1.65	0.79

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

#### 3.1 Sample A

##### 3.1.1 Test results

Table 21: 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					$u_x$	$\bar{x}$	$s_0$	$V_x$
	[MPa]								
5bcbc6	27.1	26.8	26.9	26.9	26.9	0.2	26.9	0.12	0.45
2ec6a6	26.7	27.1	27.1	27.1	27.2	0.4	27.0	0.2	0.74
43e933	26.6	27.5	27.1	27.2	27.2	0.3	27.1	0.33	1.21
970456	27.0	27.2	26.9	28.1	27.2	0.7	27.3	0.48	1.75
d3a0da	27.2	27.4	27.6	27.4	27.8	-	27.5	0.23	0.83

##### 3.1.2 The Numerical Procedure for Determining Outliers

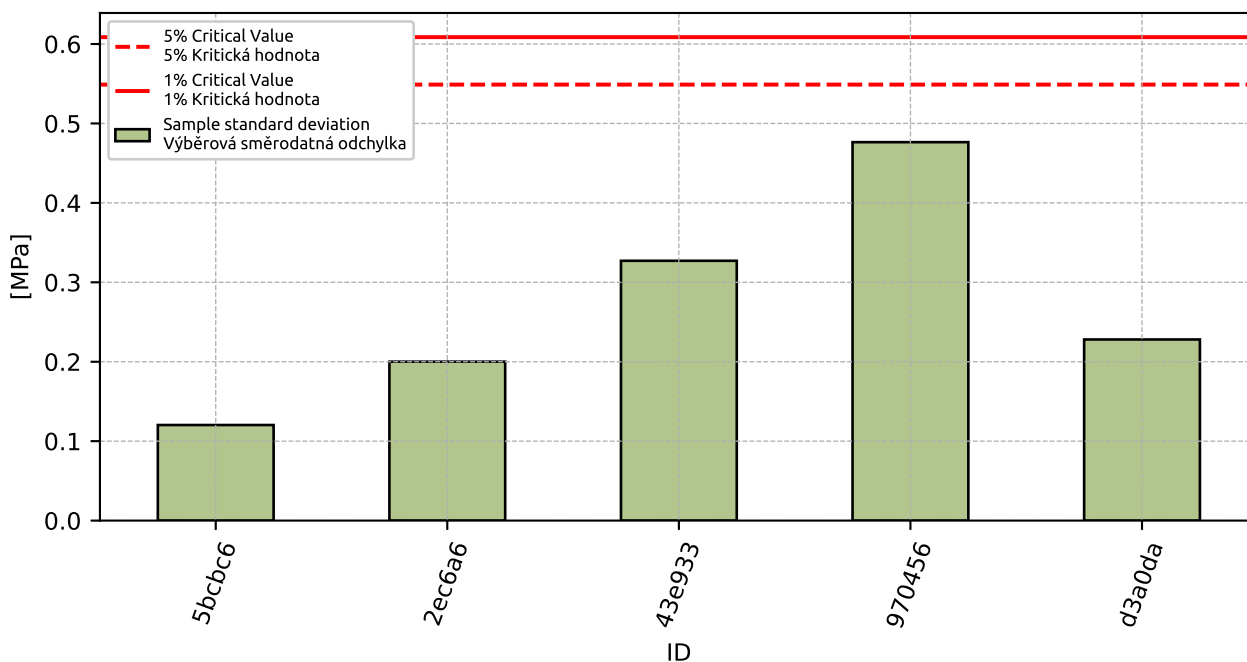


Figure 55: Cochran's test - sample standard deviations

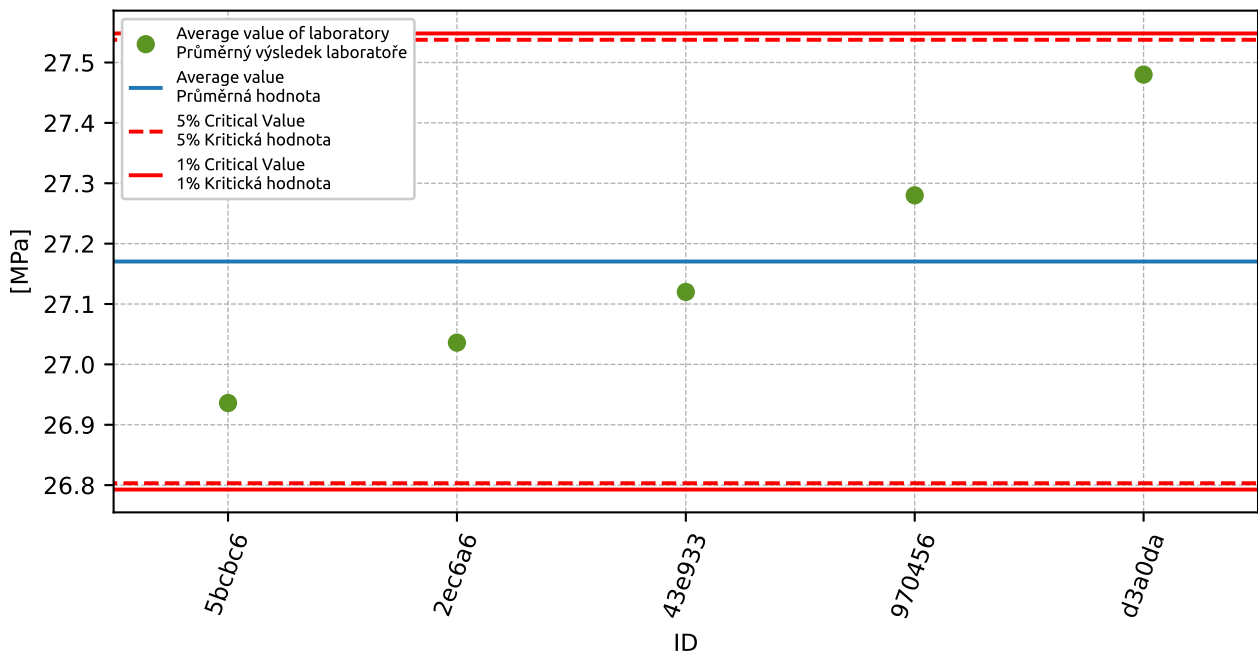


Figure 56: **Grubbs' test** - average values

### 3.1.3 Mandel's Statistics

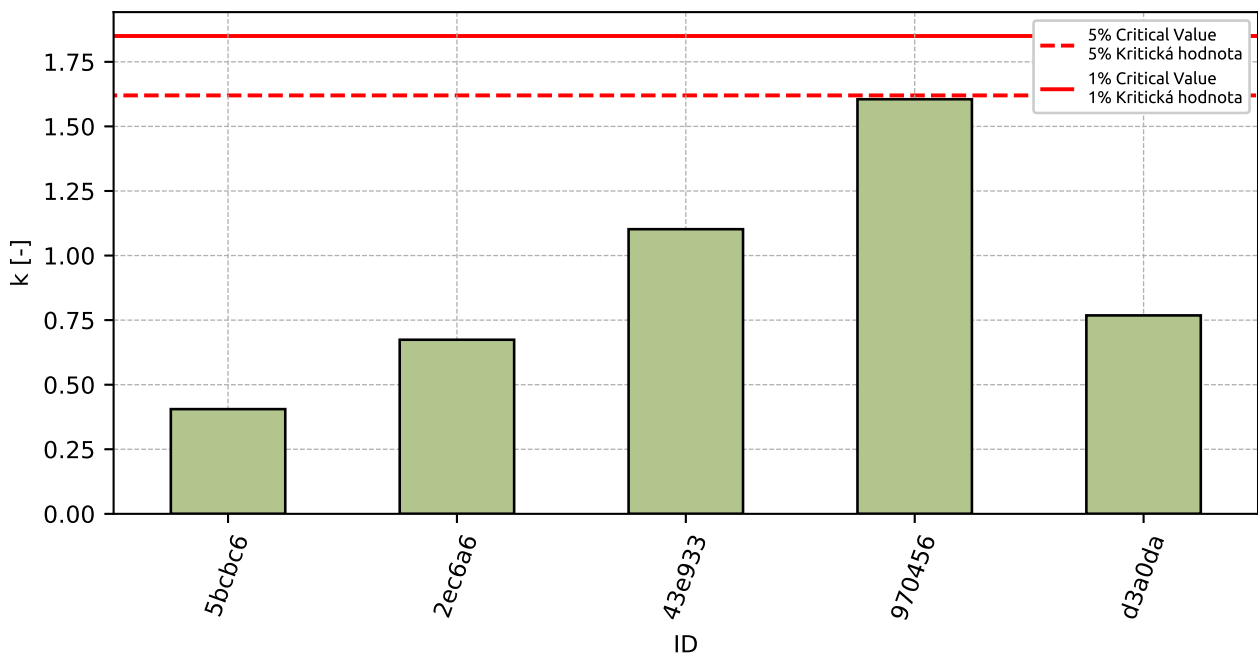


Figure 57: Intralaboratory Consistency Statistic

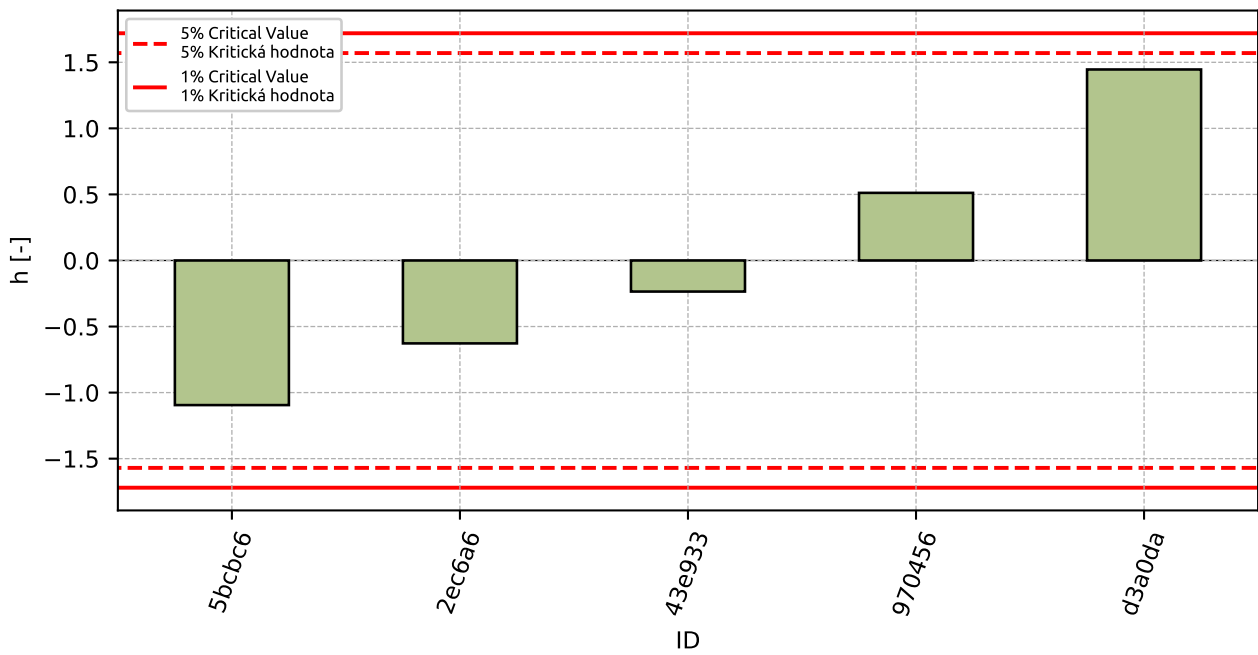


Figure 58: Interlaboratory Consistency Statistic

### 3.1.4 Descriptive statistics

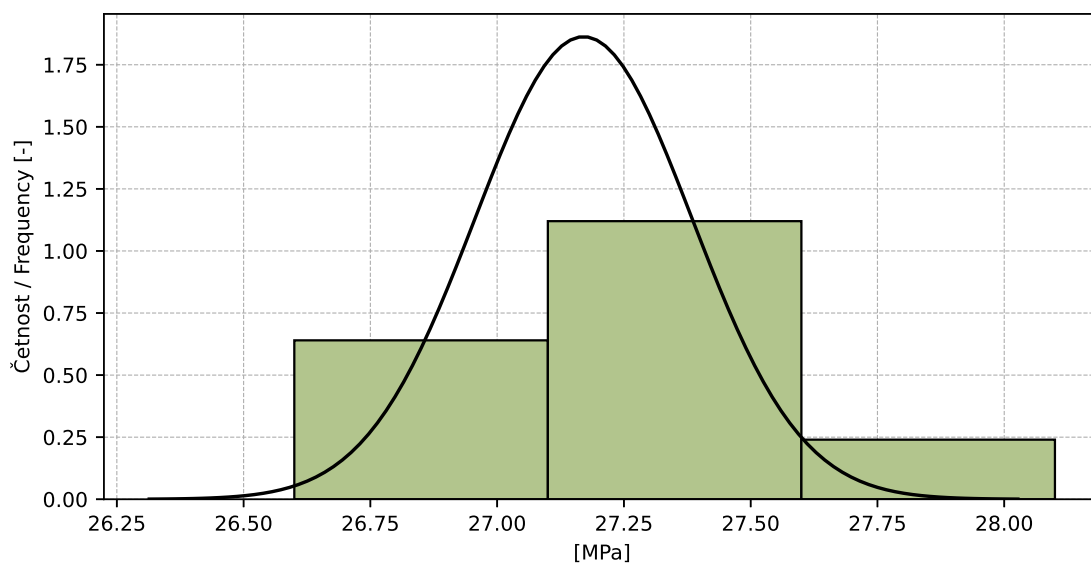


Figure 59: Histogram of all test results



Table 22: Descriptive statistics

Characteristics	[MPa]
Průměrná hodnota / Average value – $\bar{x}$	27.2
Výběrová směrodatná odchylka / Sample standard deviation – $s$	0.21
Vztažná hodnota / Assigned value – $x^*$	27.2
Robustní směrodatná odchylka / Robust standard deviation – $s^*$	0.22
Nejistota měření vztažné hodnoty / Measurement uncertainty of assigned value – $u_X$	0.12
$p$ -hodnota testu normality / $p$ -value of normality test	0.114 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – $s_L$	0.17
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – $s_r$	0.3
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – $s_R$	0.34
Opakovatelnost / Repeatability – $r$	0.8
Reprodukovatelnost / Reproducibility – $R$	1.0

### 3.1.5 Evaluation of Performance Statistics

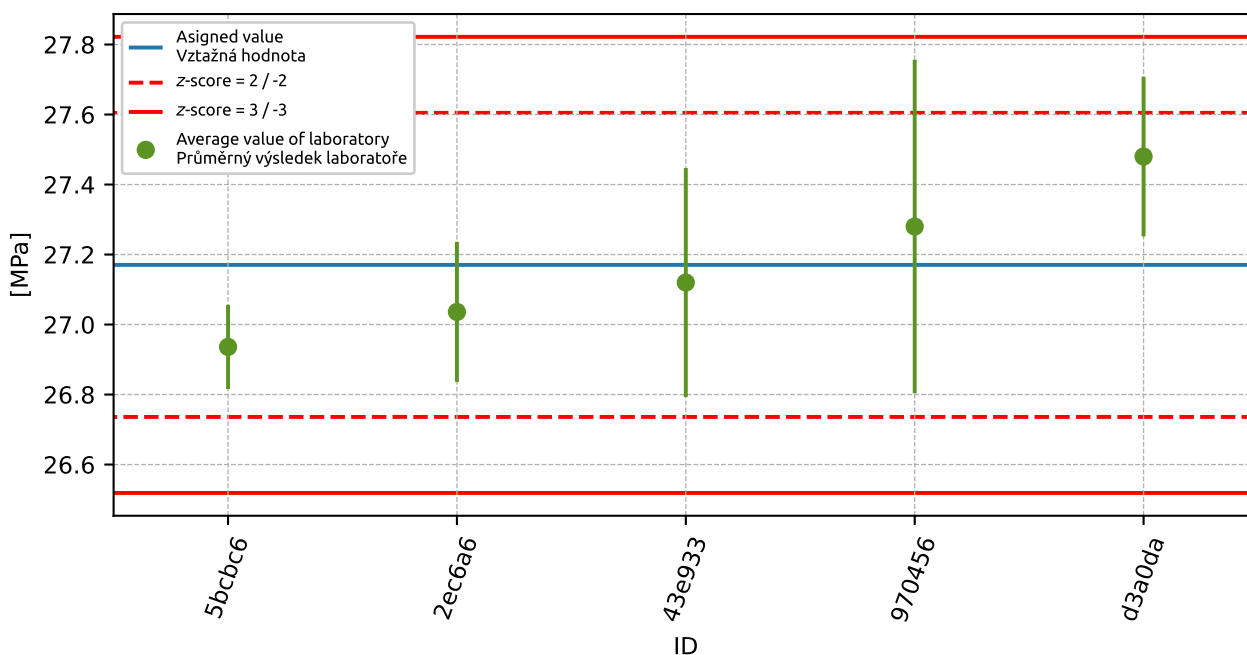


Figure 60: Average values and sample standard deviations

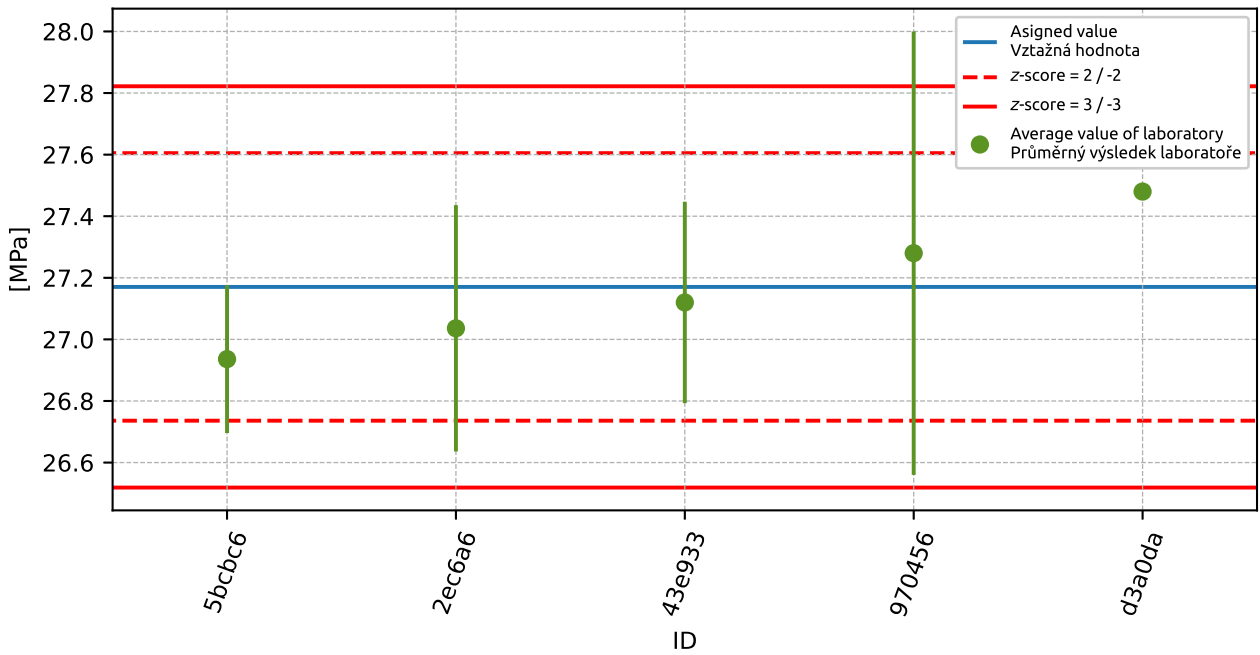


Figure 61: Average values and extended uncertainties of measurement

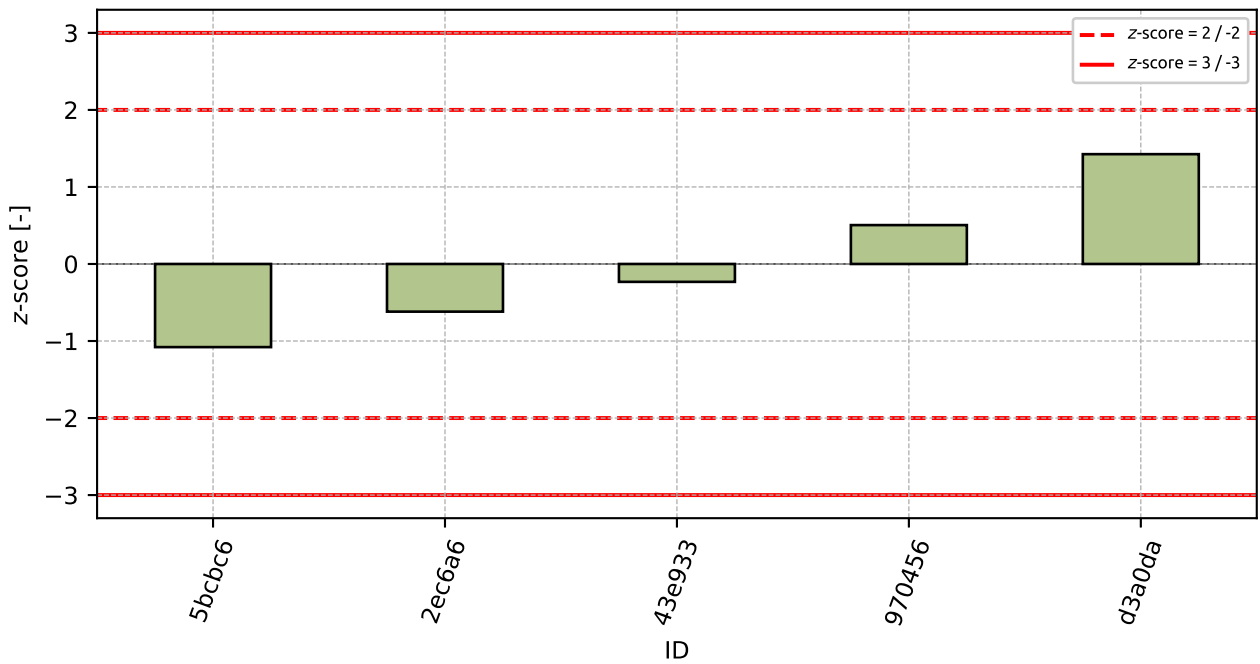


Figure 62: z-score

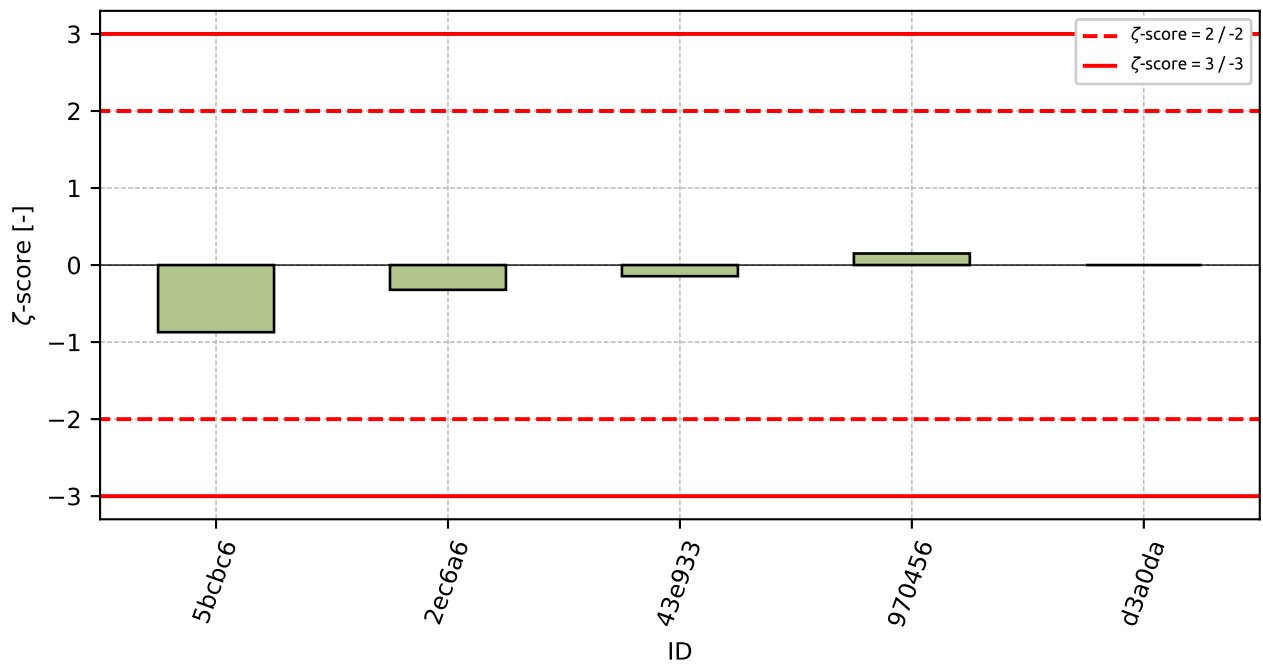


Figure 63:  $\zeta$ -score

Table 23: z-score and  $\zeta$ -score

ID	z-score [-]	$\zeta$ -score [-]
5bcbc6	-1.08	-0.87
2ec6a6	-0.62	-0.32
43e933	-0.23	-0.14
970456	0.5	0.15
d3a0da	1.43	-

### 3.2 Sample B

#### 3.2.1 Test results

Table 24: 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]	$V_x$ [%]
2ec6a6	37.9	37.8	38.1	38.0	38.0	0.2	38.0	0.09	0.24
970456	37.7	38.5	37.5	38.2	38.2	0.7	38.0	0.41	1.07
5bcbc6	38.1	38.0	38.1	38.1	38.2	0.1	38.1	0.07	0.19
43e933	37.9	38.2	38.6	38.1	37.8	0.3	38.1	0.31	0.82
d3a0da	38.3	38.5	38.6	38.4	38.5	-	38.5	0.11	0.3

#### 3.2.2 The Numerical Procedure for Determining Outliers

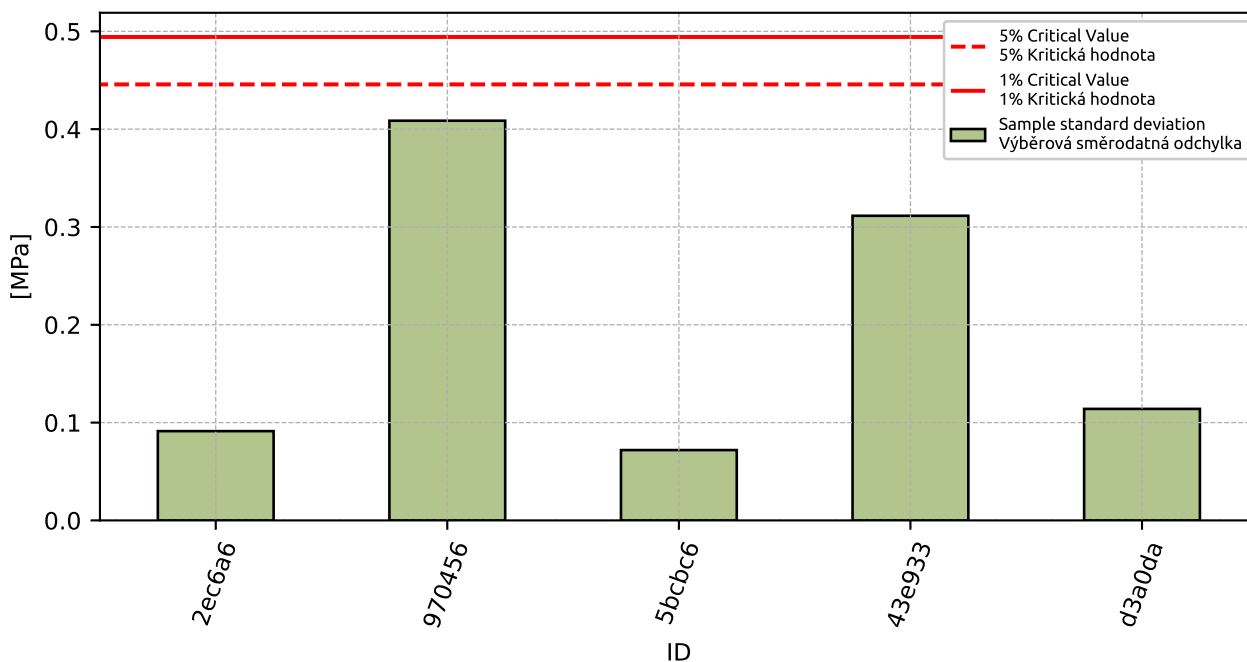


Figure 64: Cochran's test - sample standard deviations

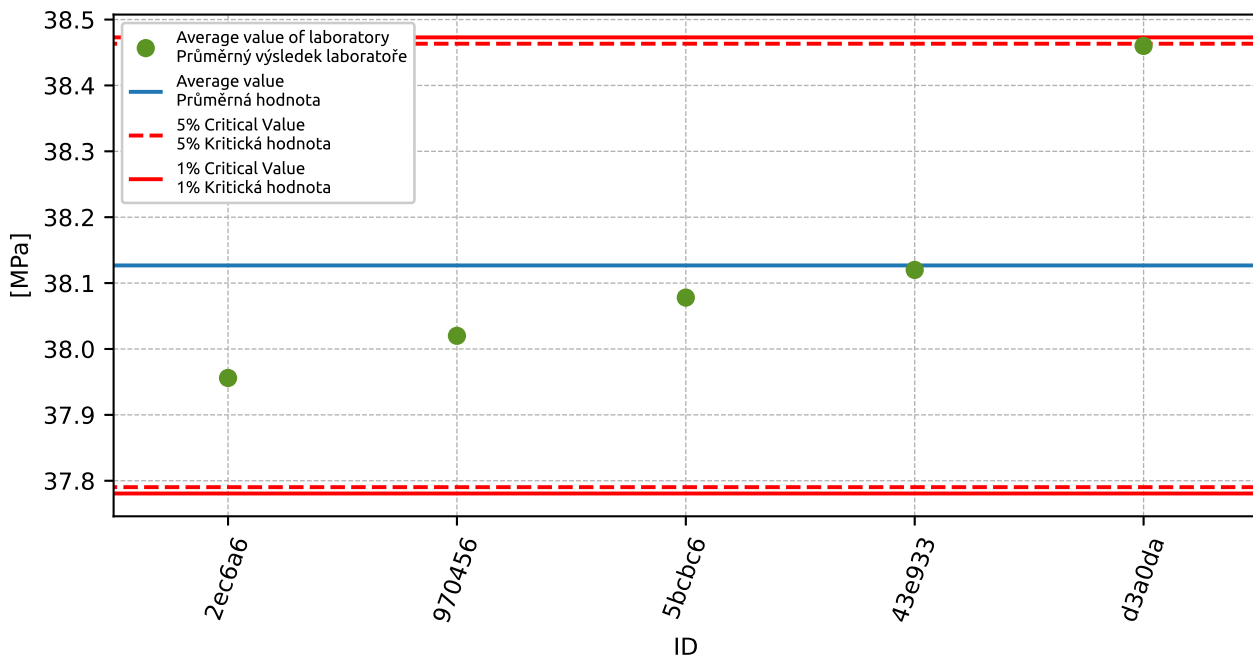


Figure 65: **Grubbs' test** - average values

### 3.2.3 Mandel's Statistics

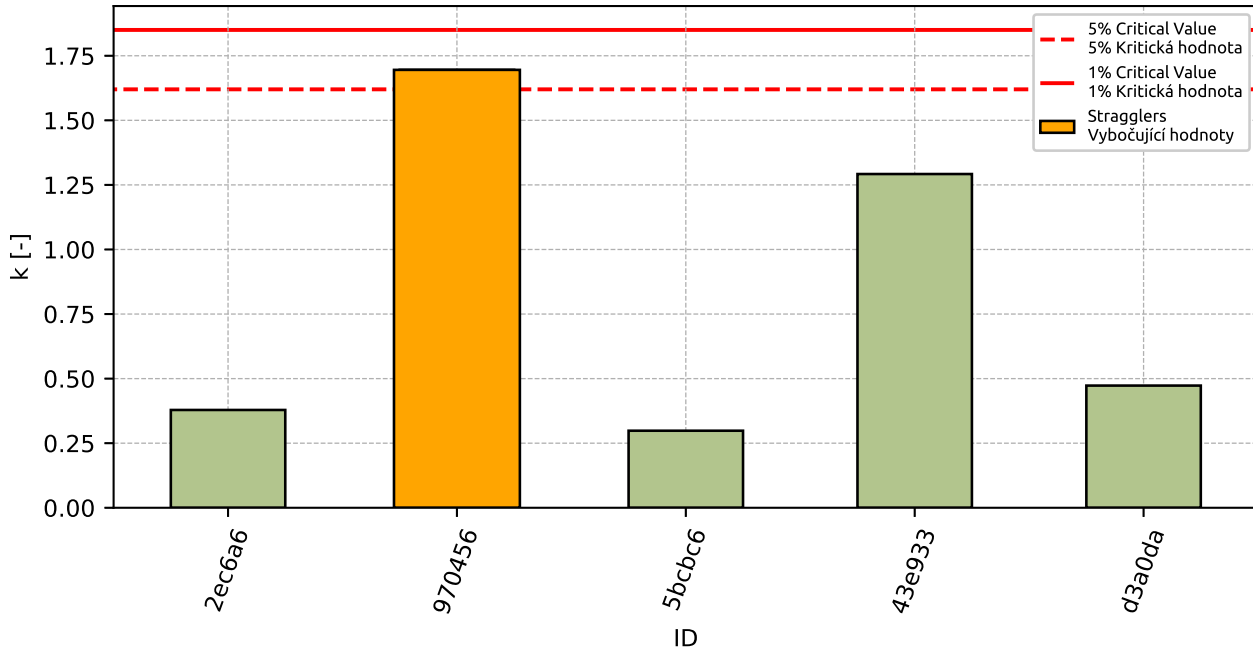


Figure 66: Intralaboratory Consistency Statistic

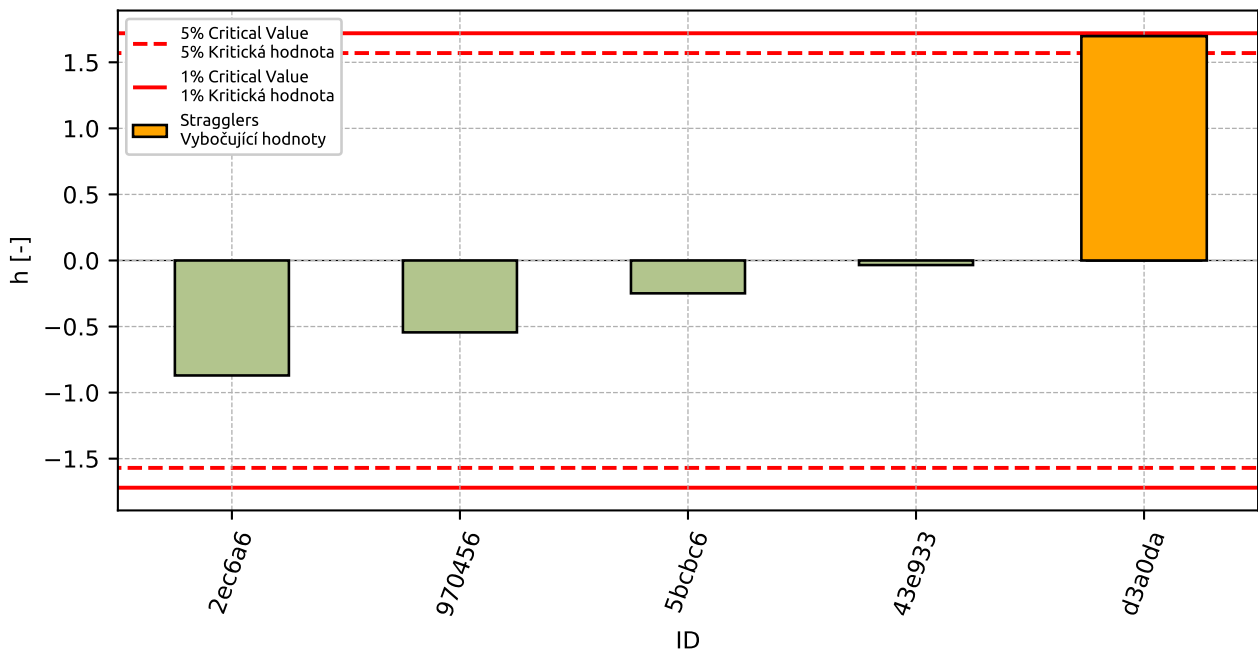


Figure 67: Interlaboratory Consistency Statistic

### 3.2.4 Descriptive statistics

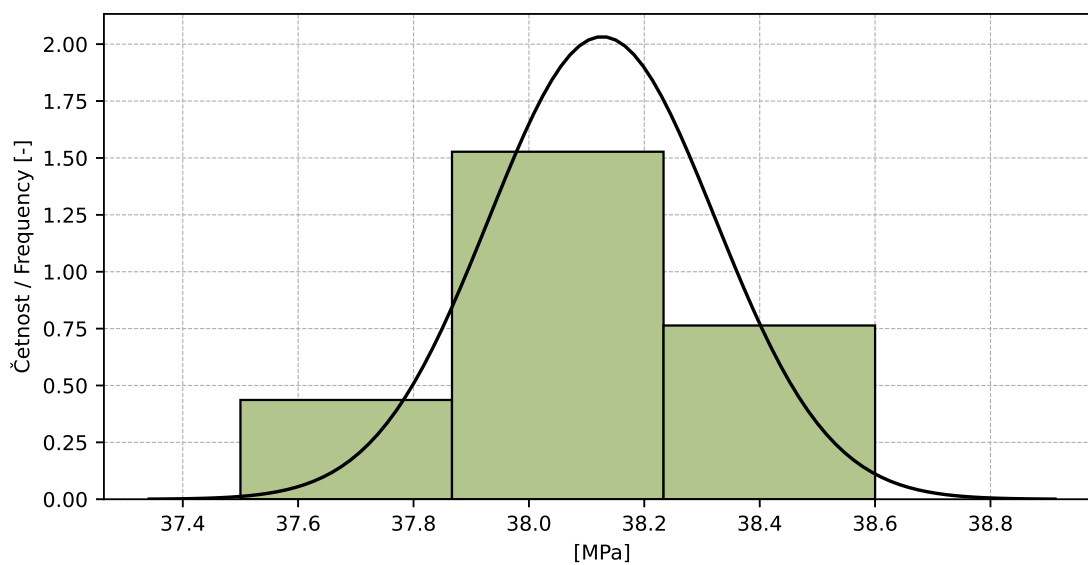


Figure 68: Histogram of all test results

Table 25: Descriptive statistics

Characteristics	[MPa]
Průměrná hodnota / Average value – $\bar{x}$	38.1
Výběrová směrodatná odchylka / Sample standard deviation – $s$	0.2
Vztažná hodnota / Assigned value – $x^*$	38.1
Robustní směrodatná odchylka / Robust standard deviation – $s^*$	0.2
Nejistota měření vztažné hodnoty / Measurement uncertainty of assigned value – $u_X$	0.11
$p$ -hodnota testu normality / $p$ -value of normality test	0.612 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – $s_L$	0.16
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – $s_r$	0.24
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – $s_R$	0.29
Opakovatelnost / Repeatability – $r$	0.7
Reprodukovatelnost / Reproducibility – $R$	0.8

### 3.2.5 Evaluation of Performance Statistics

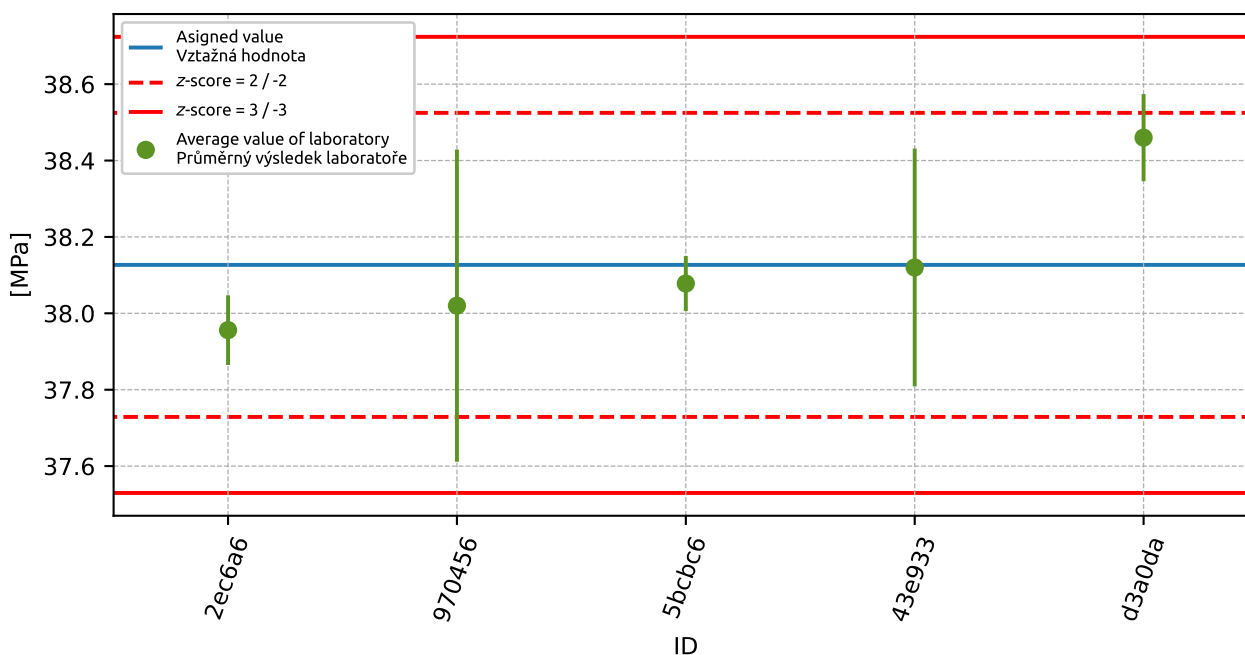


Figure 69: Average values and sample standard deviations

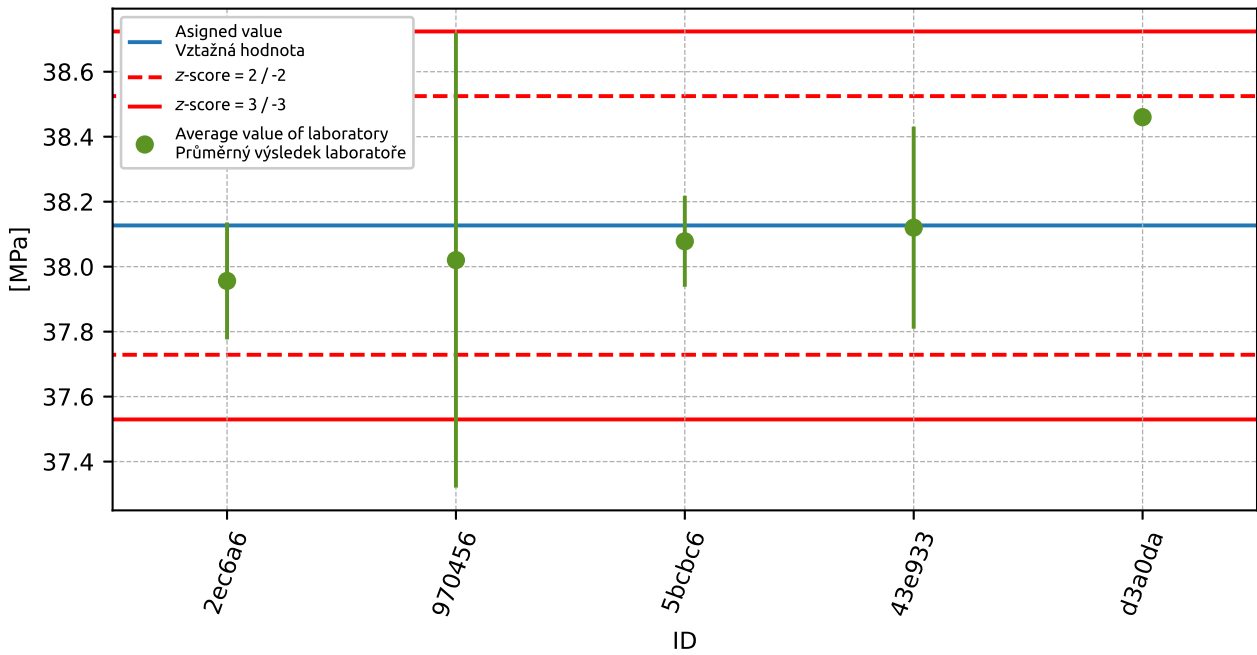


Figure 70: Average values and extended uncertainties of measurement

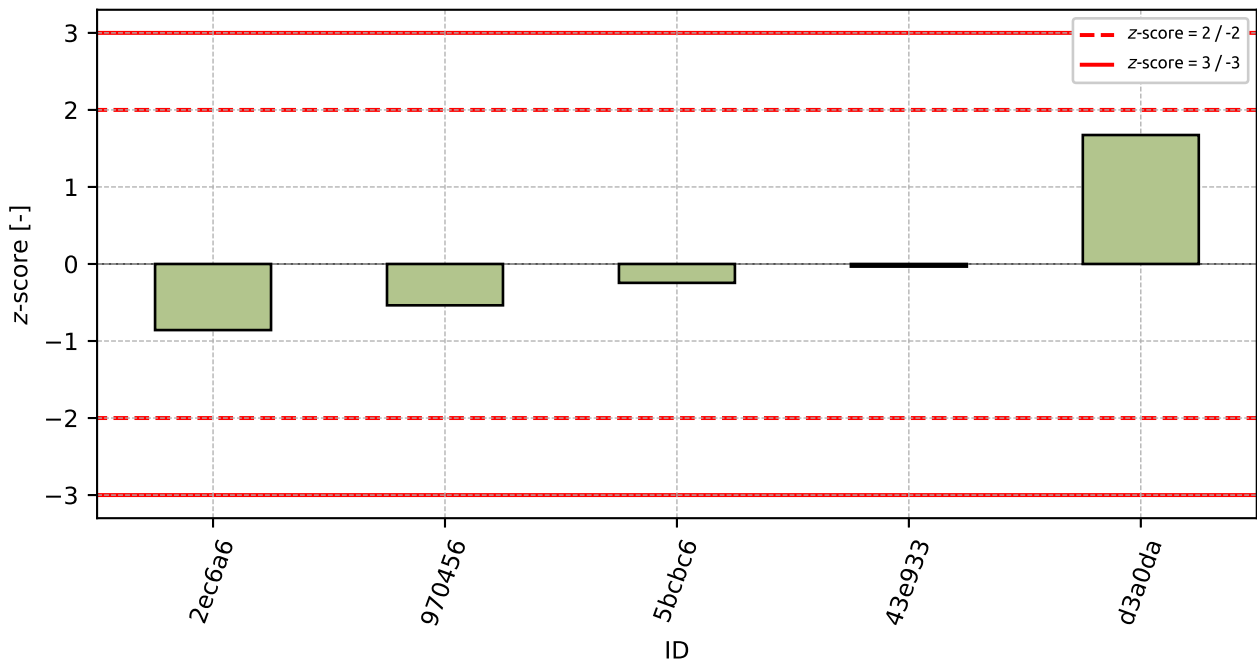


Figure 71: z-score



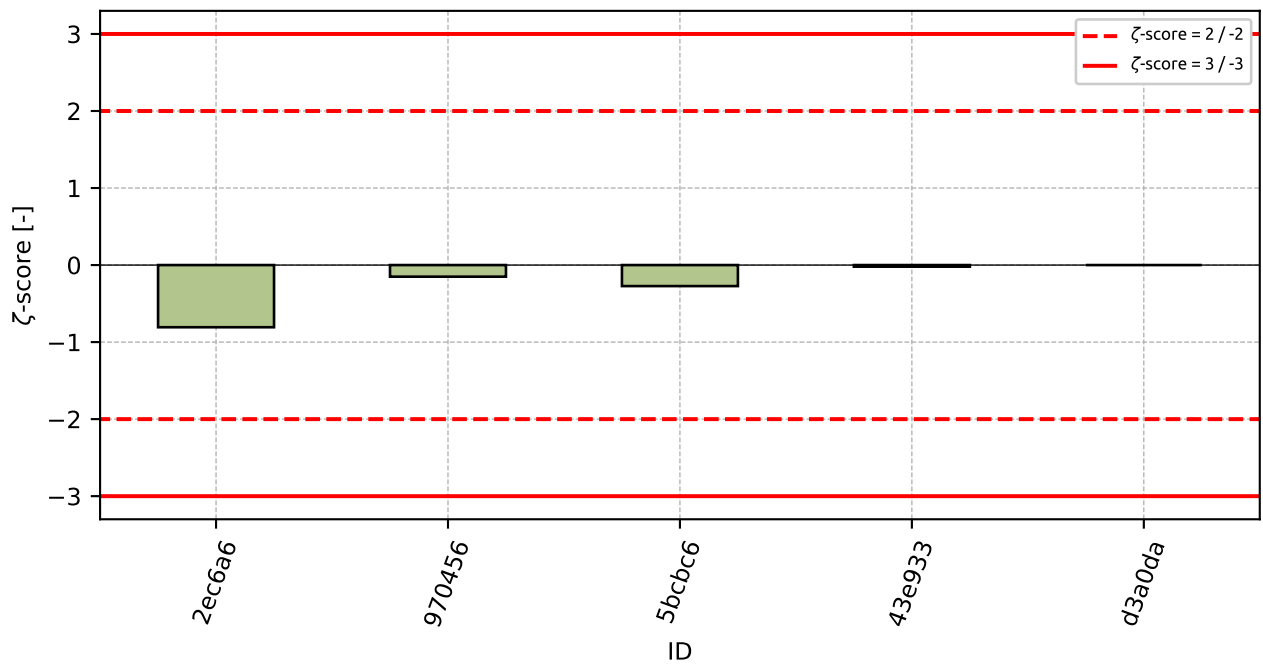


Figure 72:  $\zeta$ -score

Table 26: z-score and  $\zeta$ -score

ID	z-score [-]	$\zeta$ -score [-]
2ec6a6	-0.86	-0.81
970456	-0.54	-0.15
5bcbc6	-0.25	-0.27
43e933	-0.03	-0.02
d3a0da	1.67	-

## 4 Appendix – EN ISO 178 (Flexural modulus)

### 4.1 Sample A

#### 4.1.1 Test results

Table 27: 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]								
32daddb	1174	1170	1156	1143	1138	14	1156	15.9	1.38
2ec6a6	1270	1260	1240	1260	1260	18	1258	11.0	0.87
5bcbcb6	1270	1280	1270	1260	1270	18	1270	7.1	0.56
d3a0da	1289	1291	1312	1309	1296	-	1299	10.5	0.81
1ac459	1300	1370	1320	1280	1290	36	1312	35.6	2.72
43e933	1317	1314	1321	1314	1318	3	1317	2.9	0.22
d1a574	1378	1335	1351	1319	1353	22	1347	21.8	1.62

#### 4.1.2 The Numerical Procedure for Determining Outliers

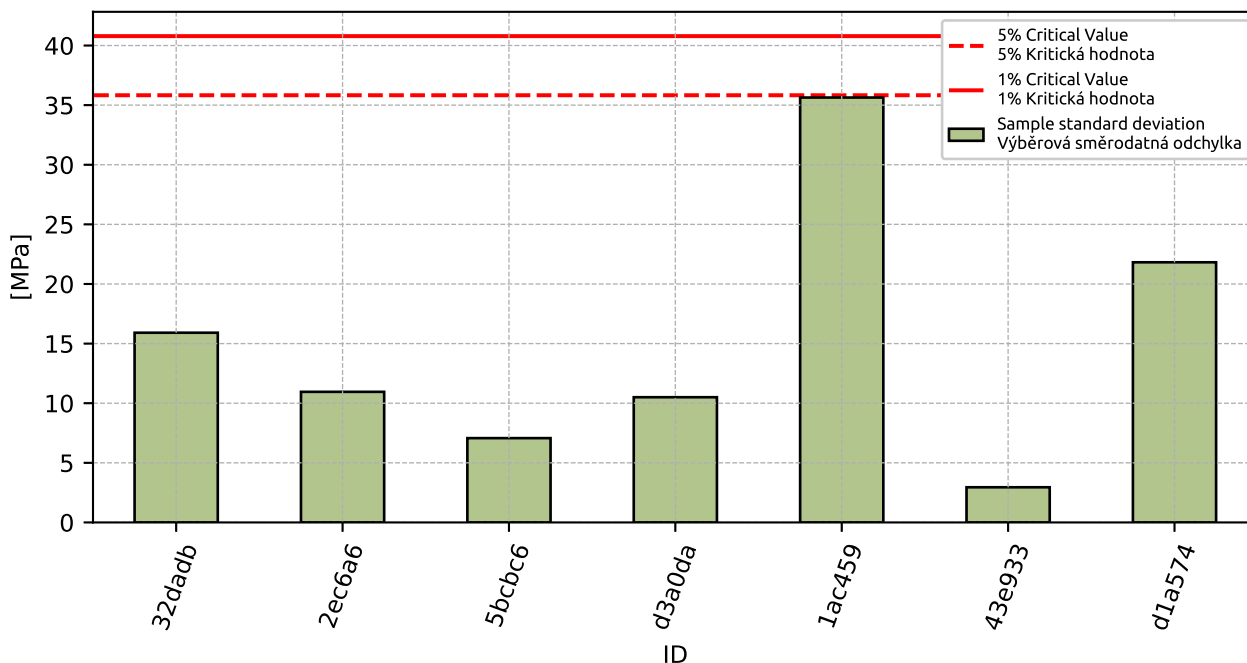


Figure 73: Cochran's test - sample standard deviations

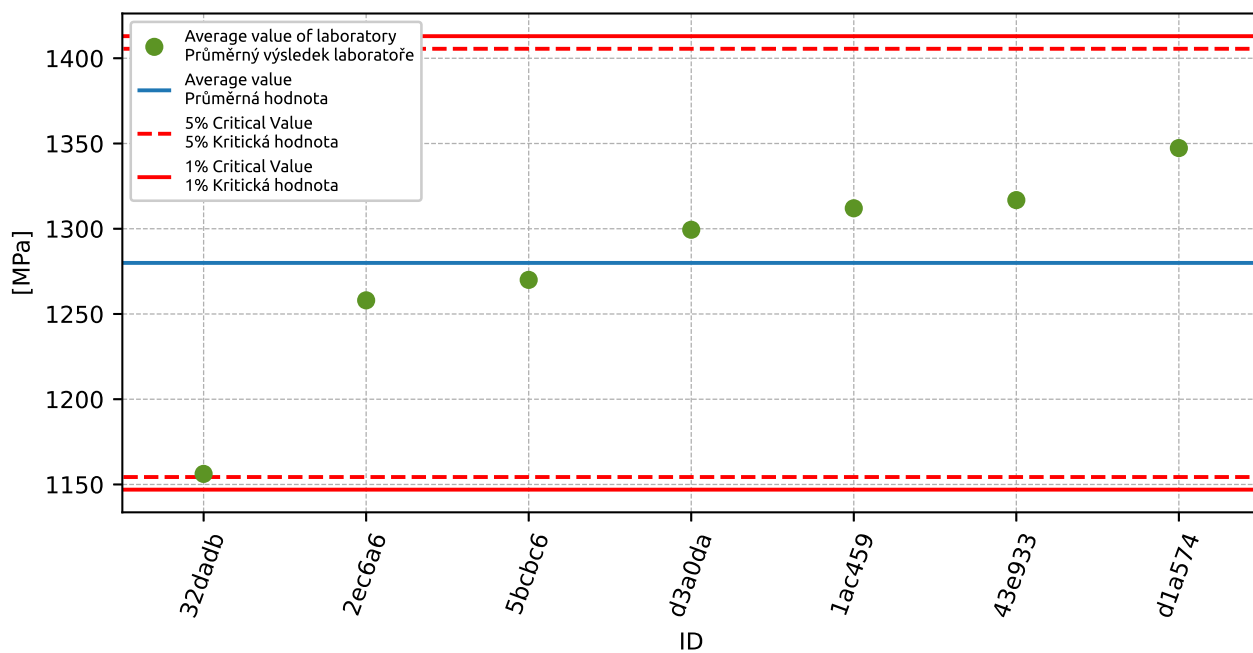


Figure 74: Grubbs' test - average values

### 4.1.3 Mandel's Statistics

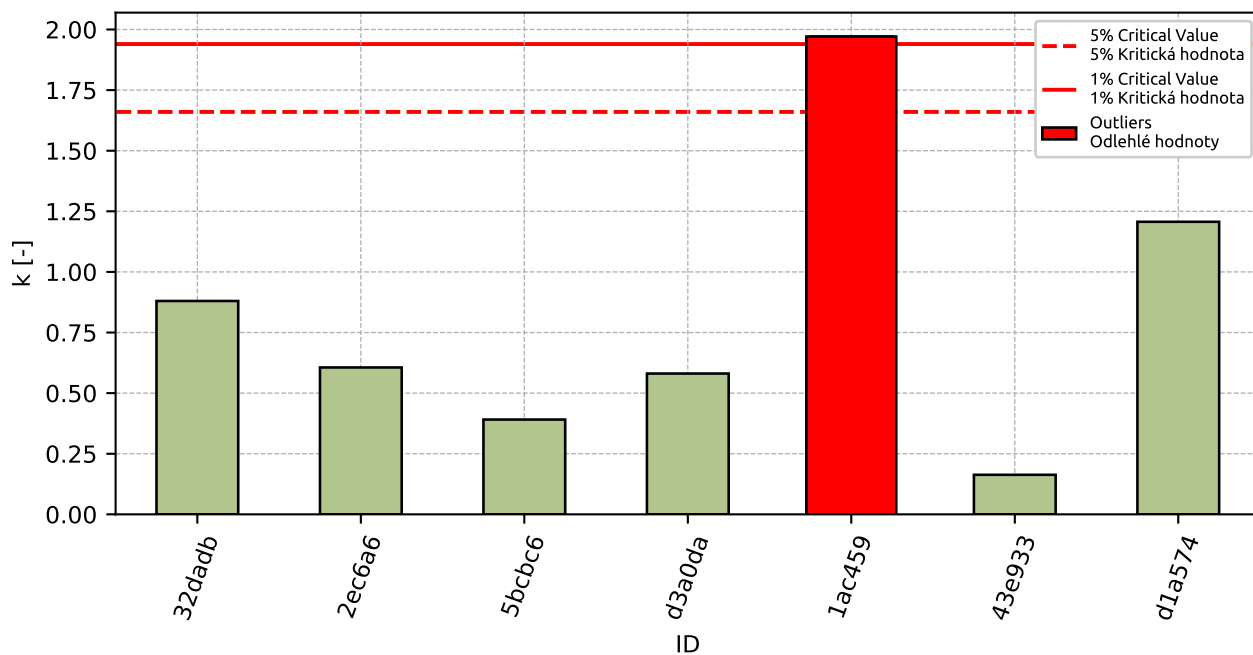


Figure 75: Intralaboratory Consistency Statistic

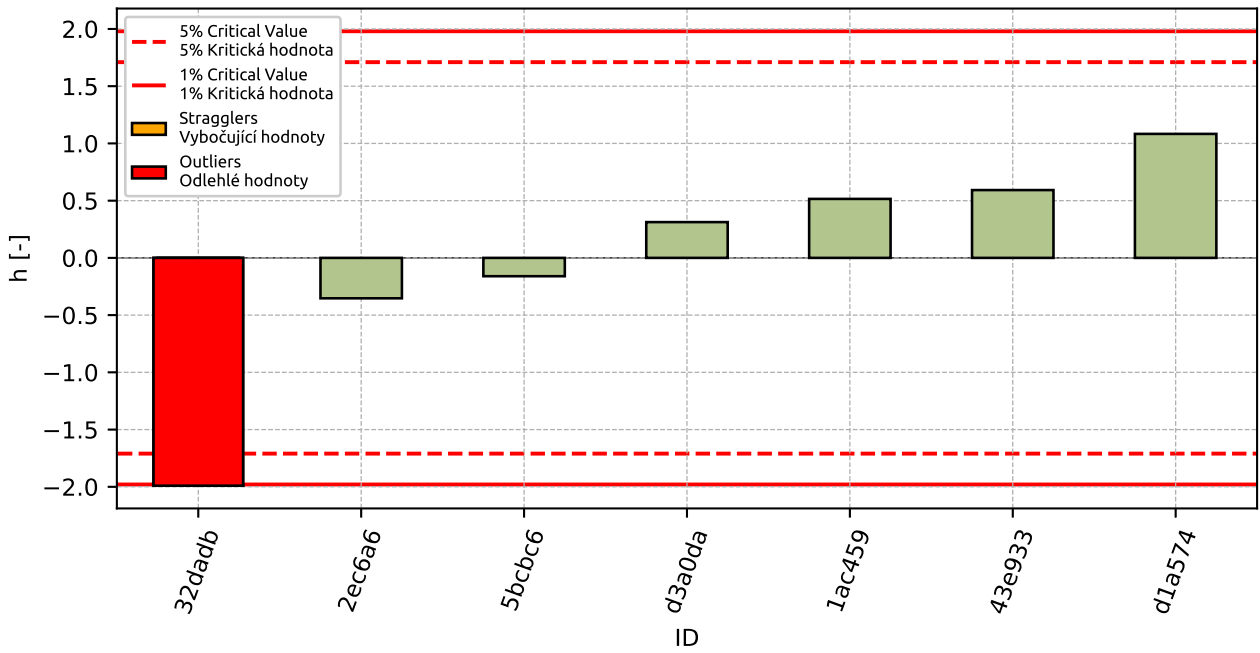


Figure 76: Interlaboratory Consistency Statistic

#### 4.1.4 Descriptive statistics

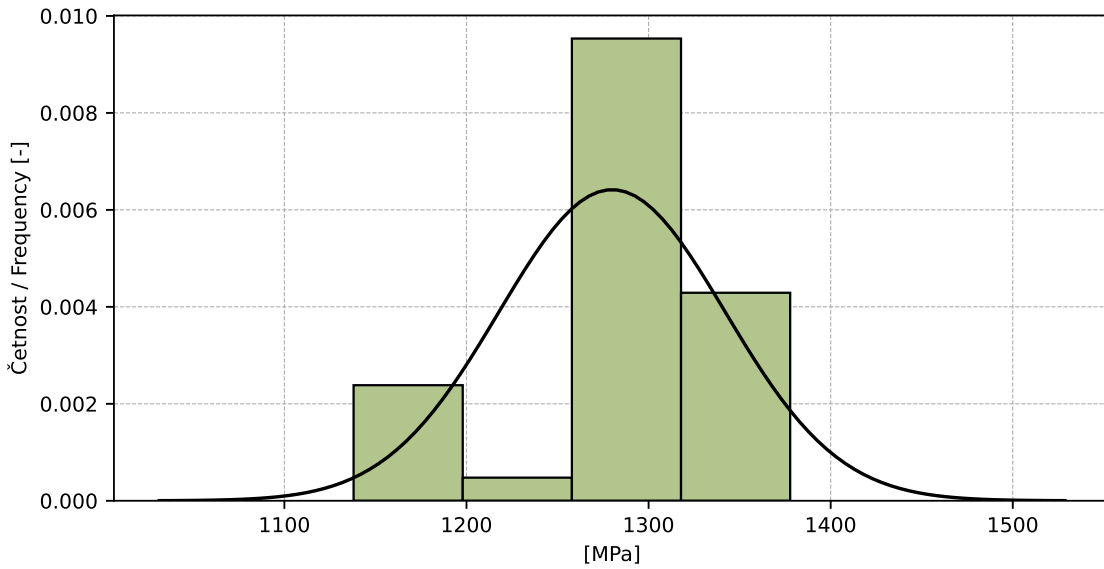


Figure 77: Histogram of all test results

Table 28: Descriptive statistics

Characteristics	[MPa]
Průměrná hodnota / Average value – $\bar{x}$	1280.0
Výběrová směrodatná odchylka / Sample standard deviation – $s$	62.2
Vztažná hodnota / Assigned value – $x^*$	1291.0
Robustní směrodatná odchylka / Robust standard deviation – $s^*$	40.9
Nejistota měření vztažné hodnoty / Measurement uncertainty of assigned value – $u_X$	19.3
$p$ -hodnota testu normality / $p$ -value of normality test	0.004 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – $s_L$	61.6
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – $s_r$	18.1
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – $s_R$	64.2
Opakovatelnost / Repeatability – $r$	51.0
Reprodukovatelnost / Reproducibility – $R$	180.0

#### 4.1.5 Evaluation of Performance Statistics

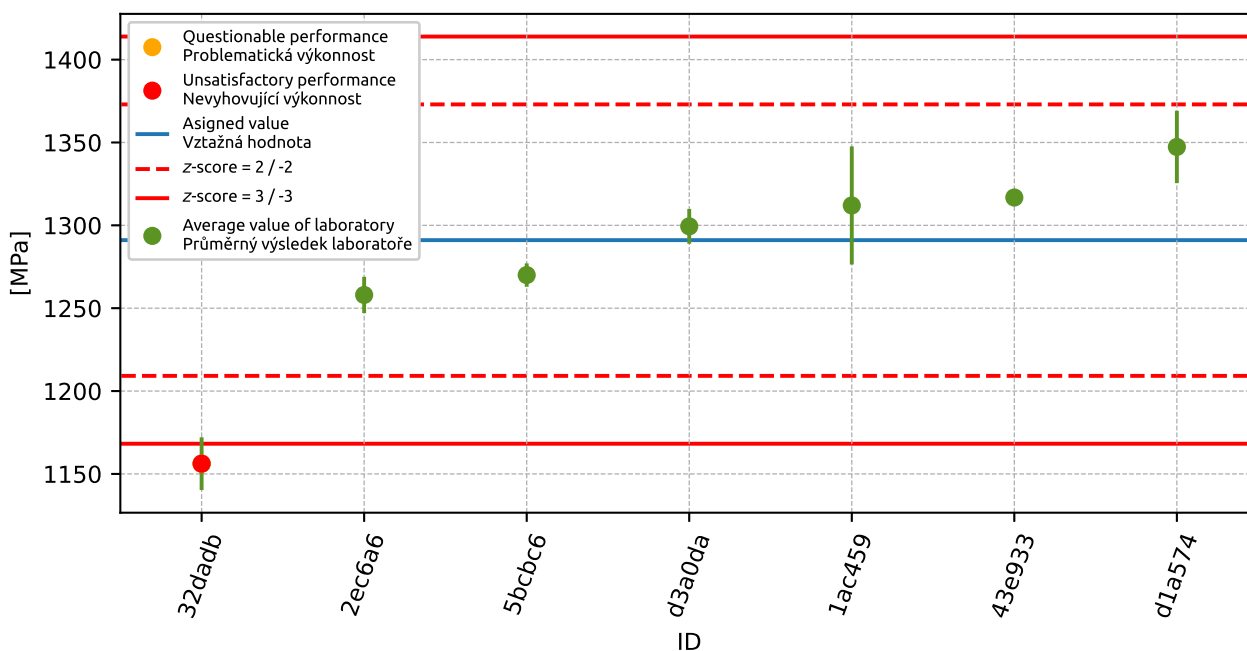


Figure 78: Average values and sample standard deviations

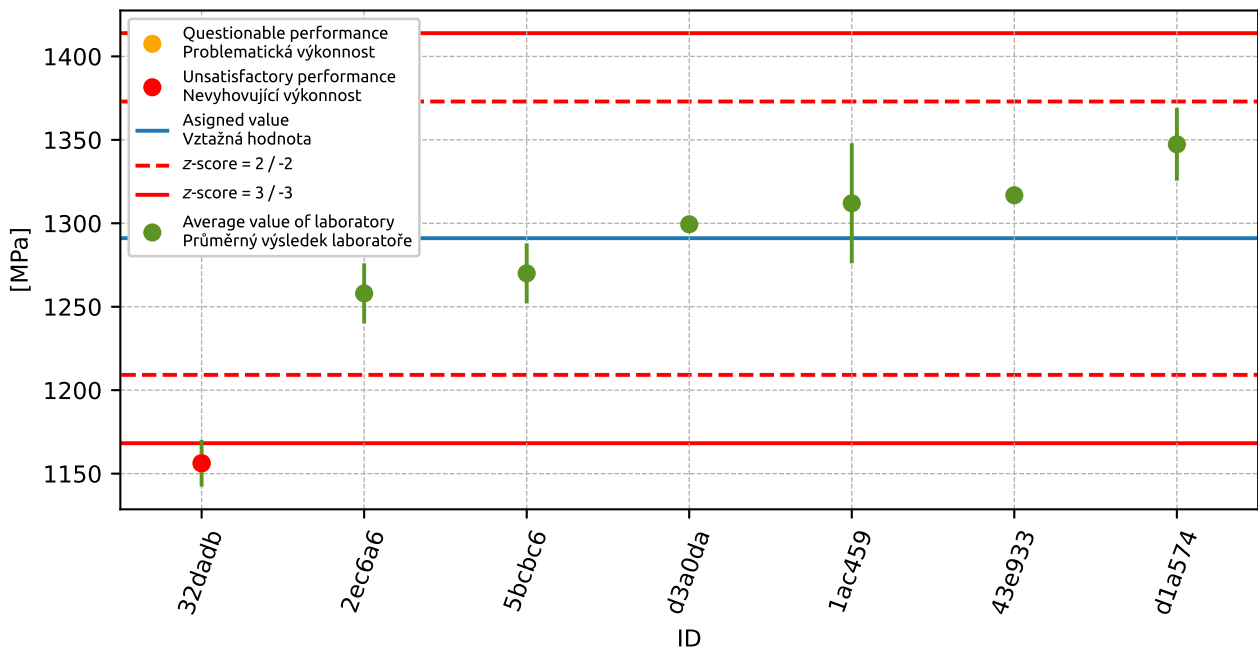


Figure 79: Average values and extended uncertainties of measurement

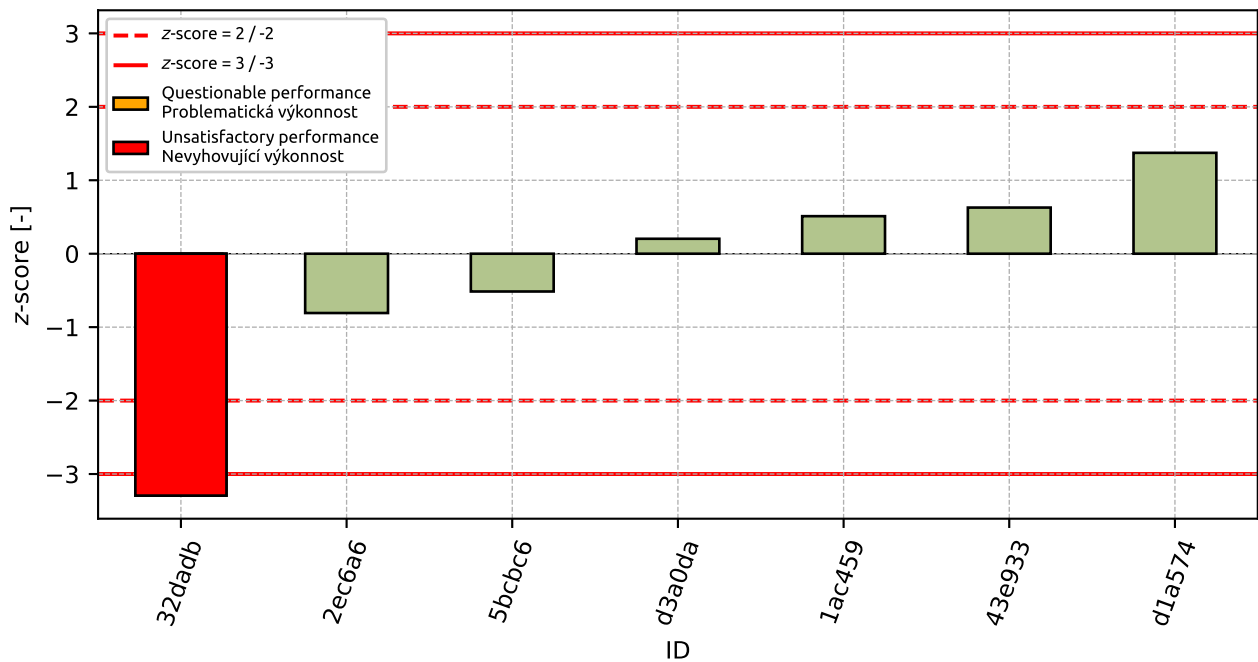
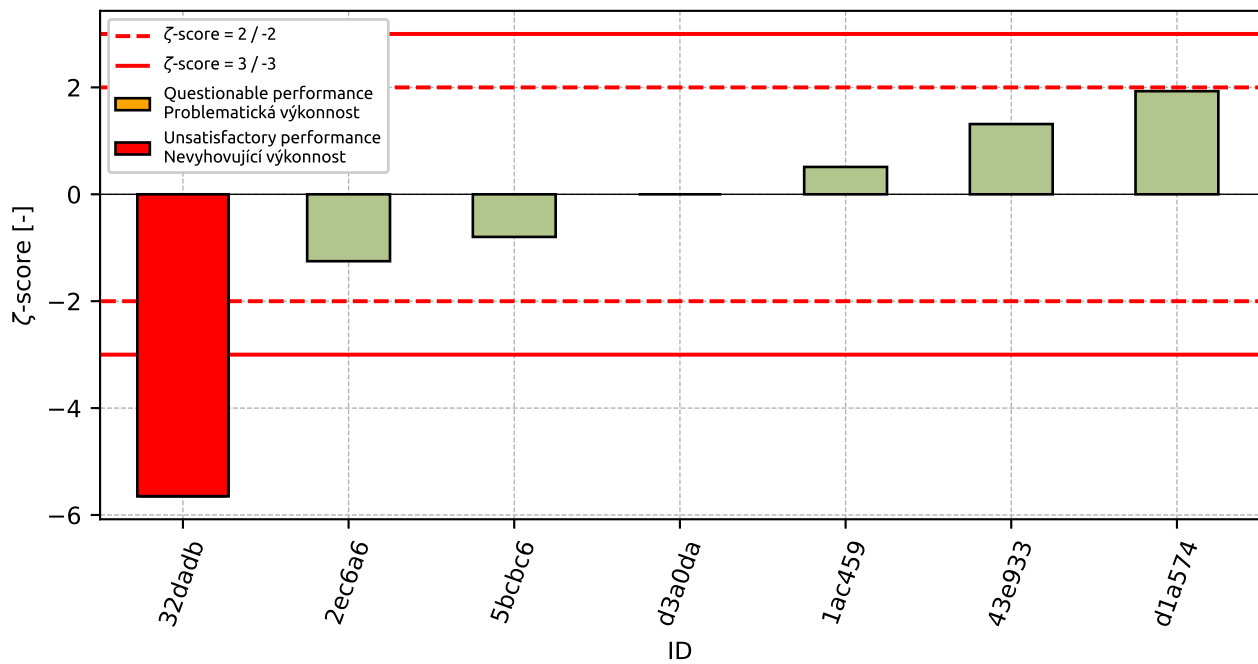


Figure 80: z-score

Figure 81:  $\zeta$ -scoreTable 29: z-score and  $\zeta$ -score

ID	z-score [-]	$\zeta$ -score [-]
32dadb	-3.29	-5.65
2ec6a6	-0.81	-1.25
5bcbc6	-0.51	-0.8
d3a0da	0.2	-
1ac459	0.51	0.51
43e933	0.63	1.31
d1a574	1.37	1.93

## 4.2 Sample B

### 4.2.1 Test results

Table 30: 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]								
32daddb	1750	1736	1747	1748	1743	5	1745	5.5	0.32
2ec6a6	1820	1840	1800	1800	1810	31	1814	16.7	0.92
5bc6c6	1850	1820	1860	1850	1830	34	1842	16.4	0.89
d1a574	1867	1902	1861	1871	1732	66	1847	65.7	3.56
1ac459	1890	1910	1930	1930	1900	18	1912	17.9	0.94
d3a0da	1929	1902	1931	1911	1947	-	1924	17.7	0.92
43e933	1926	1937	1918	1931	1930	7	1928	7.0	0.36

### 4.2.2 The Numerical Procedure for Determining Outliers

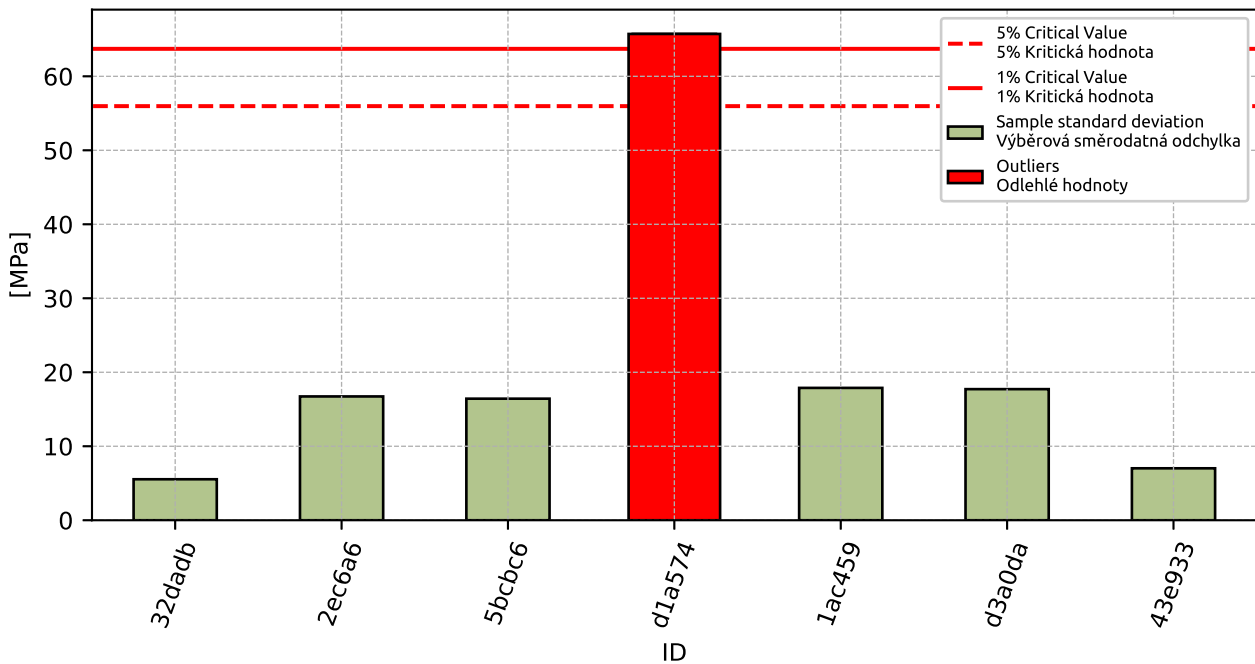


Figure 82: Cochran's test - sample standard deviations



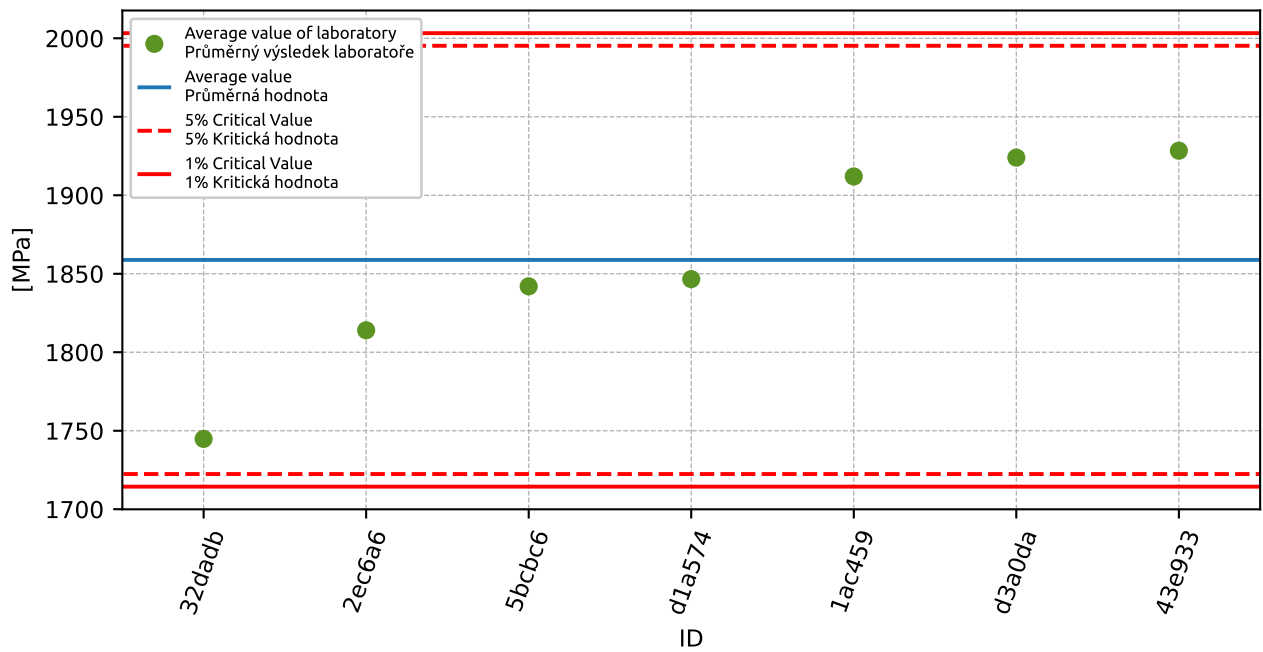


Figure 83: **Grubbs' test** - average values

### 4.2.3 Mandel's Statistics

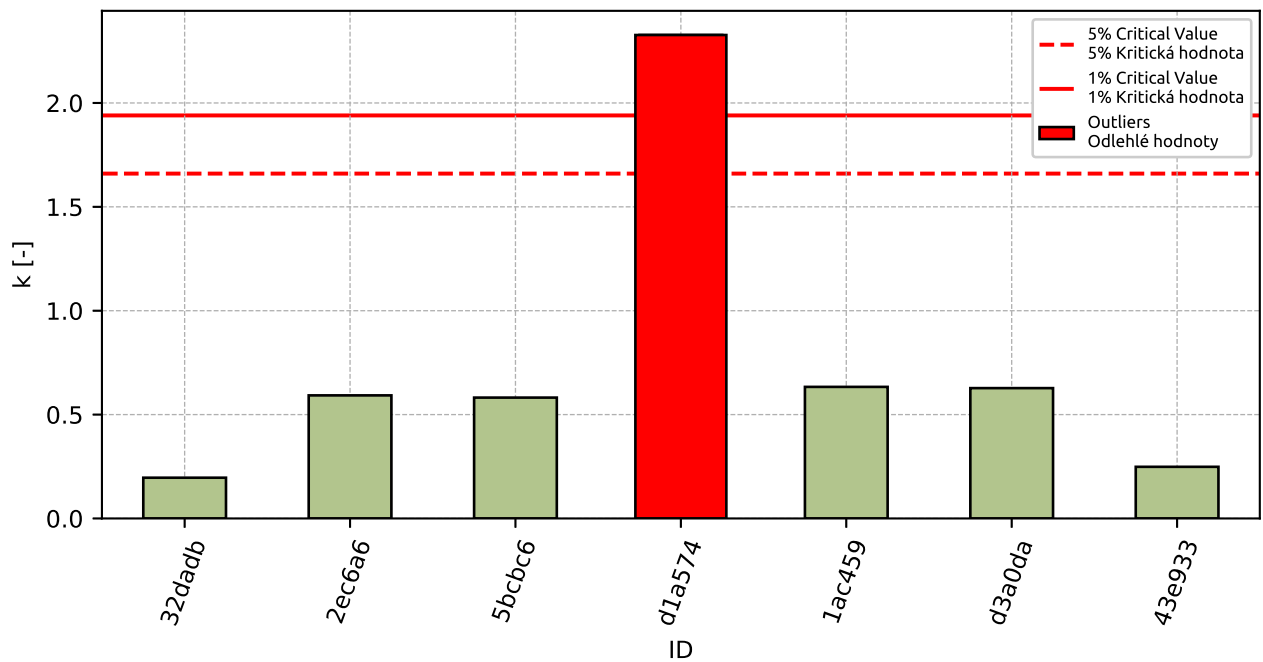


Figure 84: Intralaboratory Consistency Statistic

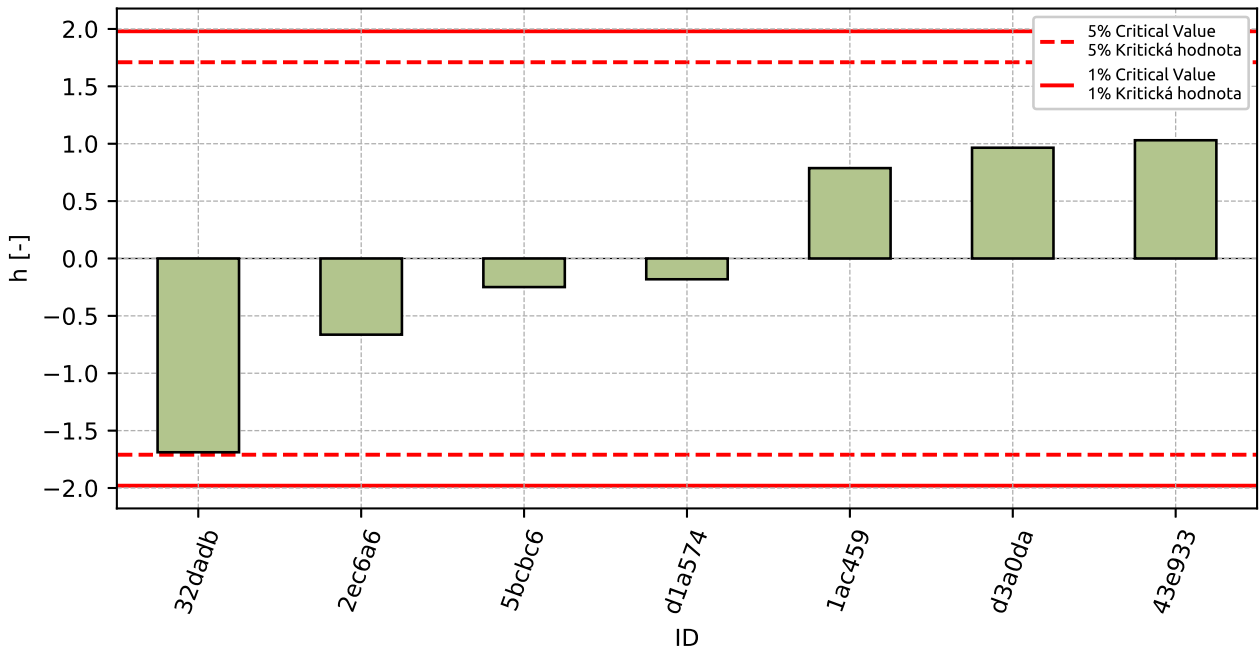


Figure 85: Interlaboratory Consistency Statistic

#### 4.2.4 Descriptive statistics

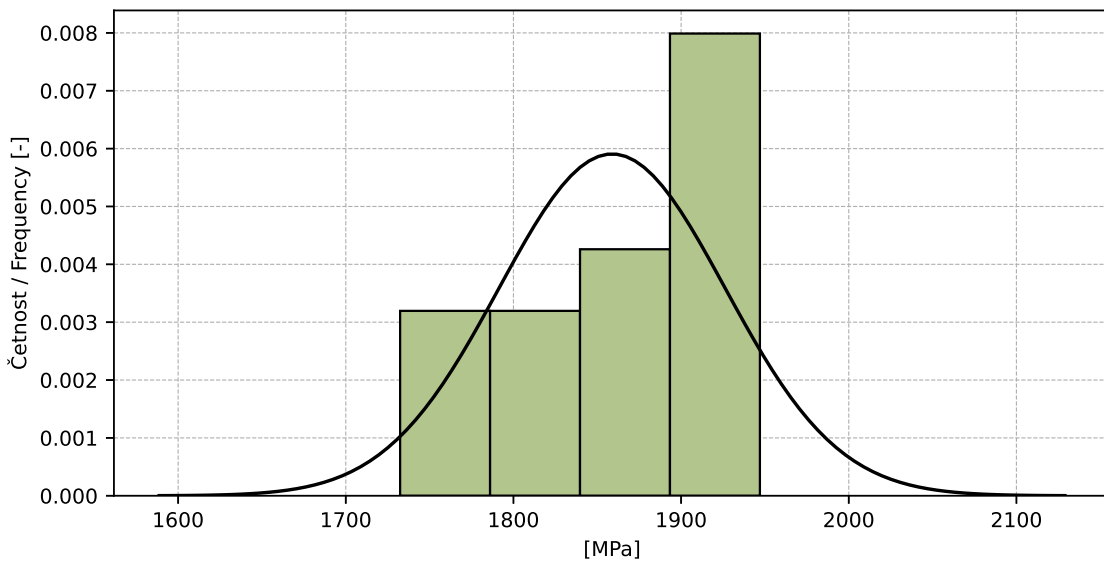


Figure 86: Histogram of all test results

Table 31: Descriptive statistics

Characteristics	[MPa]
Průměrná hodnota / Average value – $\bar{x}$	1859.0
Výběrová směrodatná odchylka / Sample standard deviation – $s$	67.5
Vztažná hodnota / Assigned value – $x^*$	1861.0
Robustní směrodatná odchylka / Robust standard deviation – $s^*$	65.8
Nejistota měření vztažné hodnoty / Measurement uncertainty of assigned value – $u_X$	31.1
$p$ -hodnota testu normality / $p$ -value of normality test	0.004 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – $s_L$	66.3
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – $s_r$	28.2
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – $s_R$	72.1
Opakovatelnost / Repeatability – $r$	79.0
Reprodukovatelnost / Reproducibility – $R$	202.0

#### 4.2.5 Evaluation of Performance Statistics

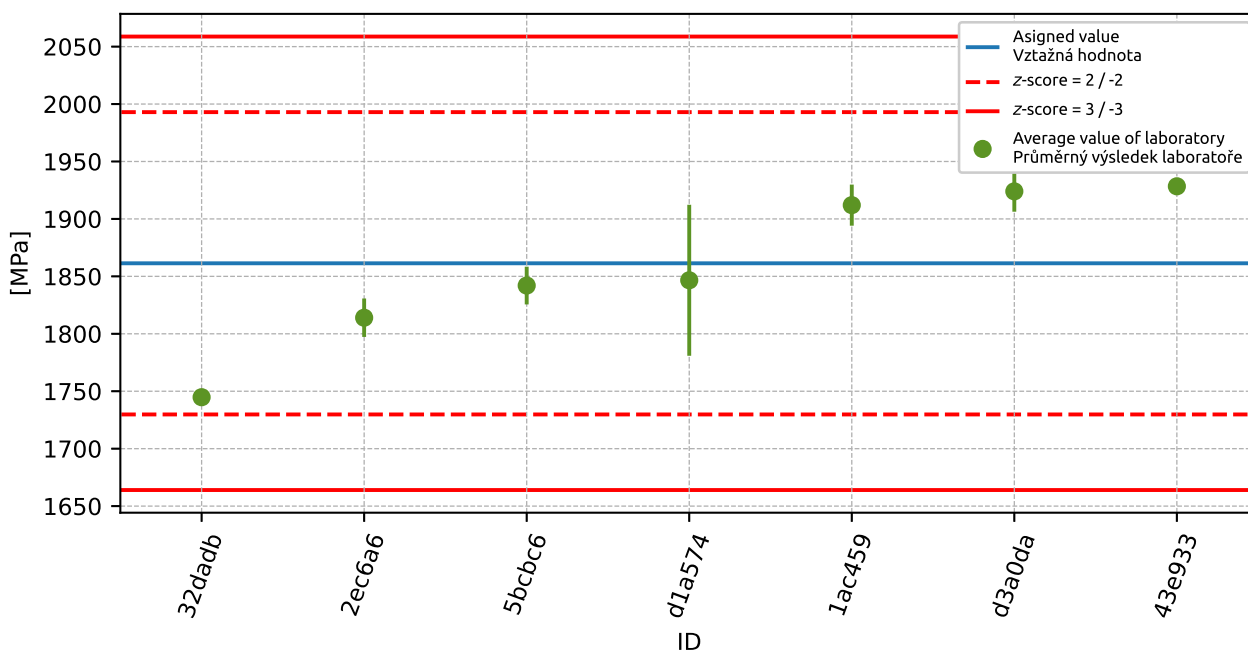


Figure 87: Average values and sample standard deviations

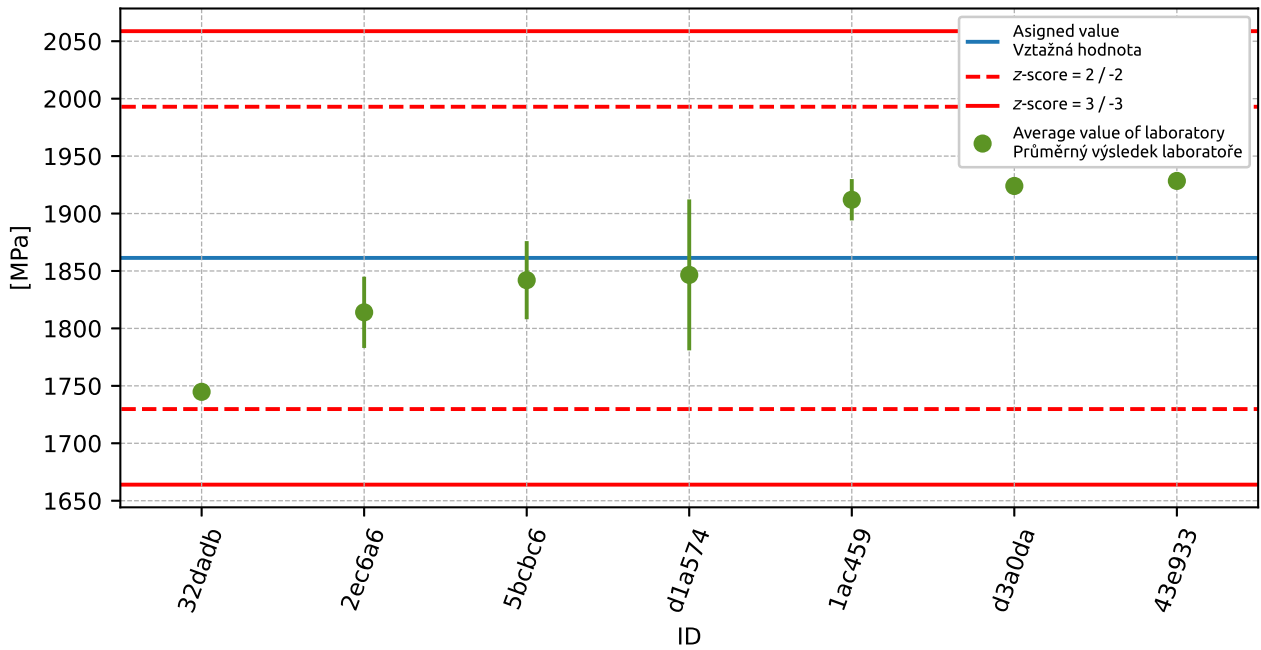


Figure 88: Average values and extended uncertainties of measurement

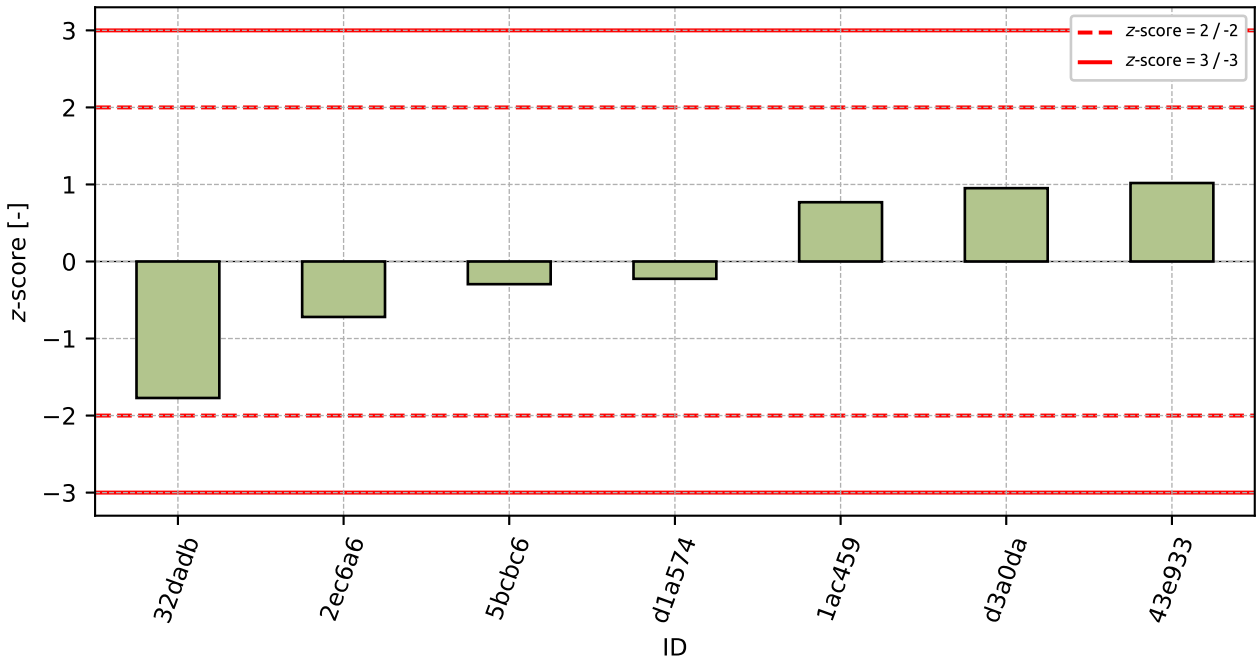
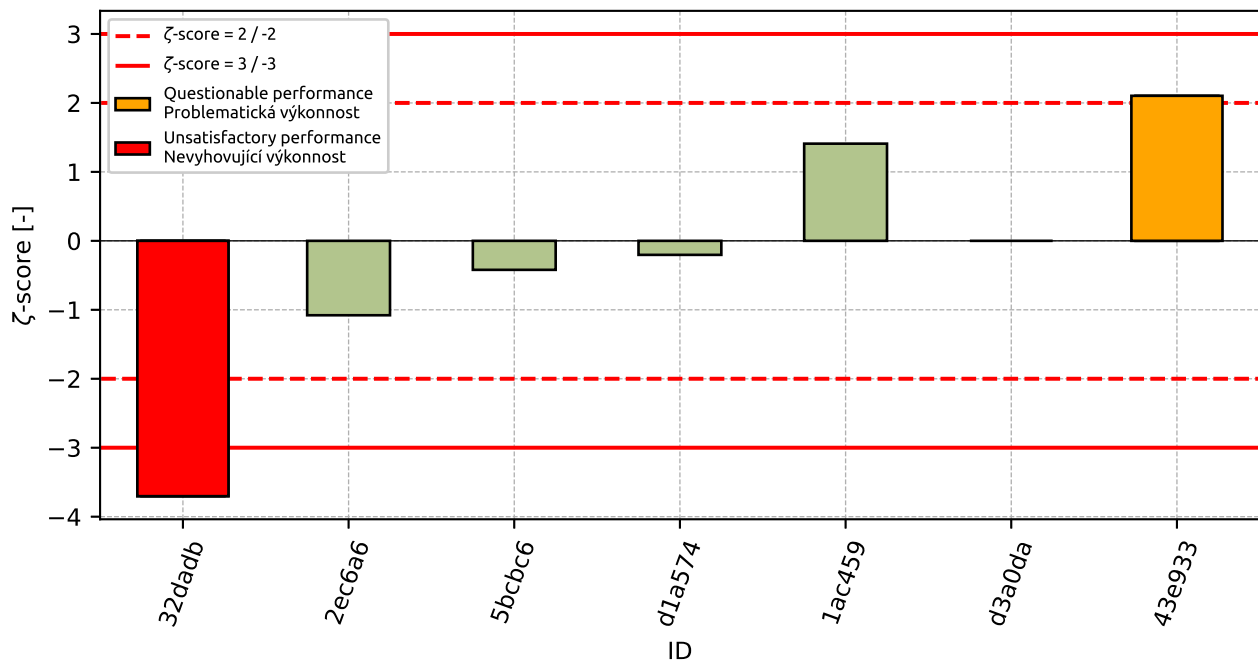


Figure 89: z-score

Figure 90:  $\zeta$ -scoreTable 32: z-score and  $\zeta$ -score

ID	z-score [-]	$\zeta$ -score [-]
32dadb	-1.77	-3.7
2ec6a6	-0.72	-1.08
5bcbc6	-0.29	-0.42
d1a574	-0.22	-0.2
1ac459	0.77	1.41
d3a0da	0.95	-
43e933	1.02	2.1

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

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

## **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))

### 7.1 Sample A

#### 7.1.1 Test results

Table 33: 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										$u_x$ [kJ/m <sup>2</sup> ]	$\bar{x}$ [kJ/m <sup>2</sup> ]	$s_0$ [kJ/m <sup>2</sup> ]	$V_x$ [%]
	[kJ/m <sup>2</sup> ]													
32dad <b>b</b>	88.7	89.7	90.5	87.8	88.9	88.7	88.7	90.8	88.4	87.1	1.1	88.9	1.13	1.27
d3a0da	90.4	90.5	89.1	87.0	90.0	90.2	89.9	90.4	90.9	89.7	-	89.8	1.1	1.23
2ec6a <b>6</b>	92.3	94.2	94.1	92.5	91.9	93.4	93.5	95.7	92.1	93.9	2.4	93.4	1.18	1.26
5bcb <b>c6</b>	94.1	93.8	92.0	95.5	92.2	93.4	95.1	92.8	95.7	95.1	2.7	94.0	1.36	1.45
037e4 <b>d</b>	94.8	99.3	92.7	93.4	98.4	92.0	93.6	93.5	95.0	89.6	2.2	94.2	2.87	3.05

#### 7.1.2 The Numerical Procedure for Determining Outliers

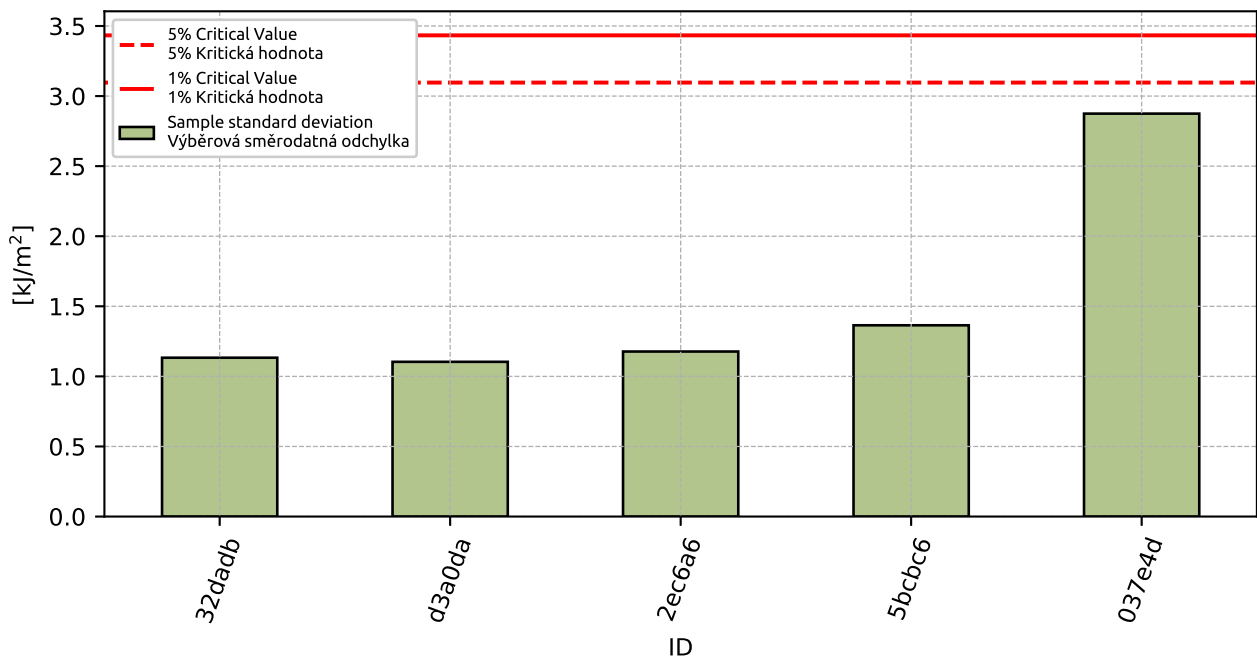


Figure 91: **Cochran's test** - sample standard deviations

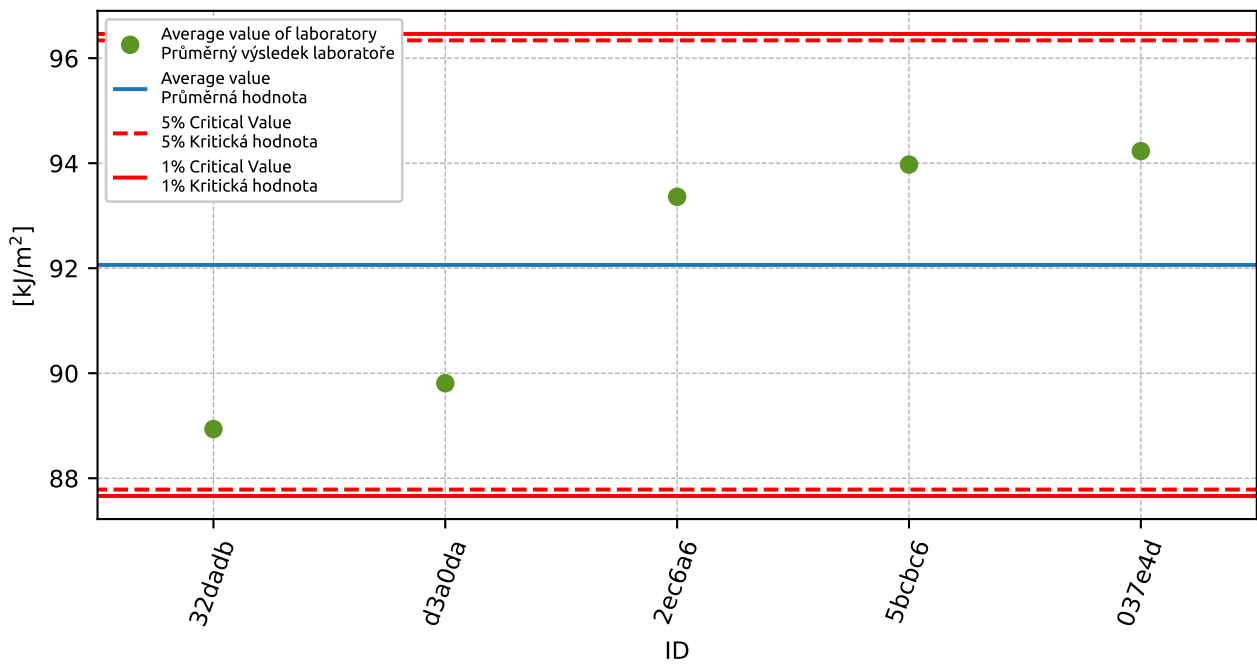


Figure 92: **Grubbs' test** - average values

### 7.1.3 Mandel's Statistics

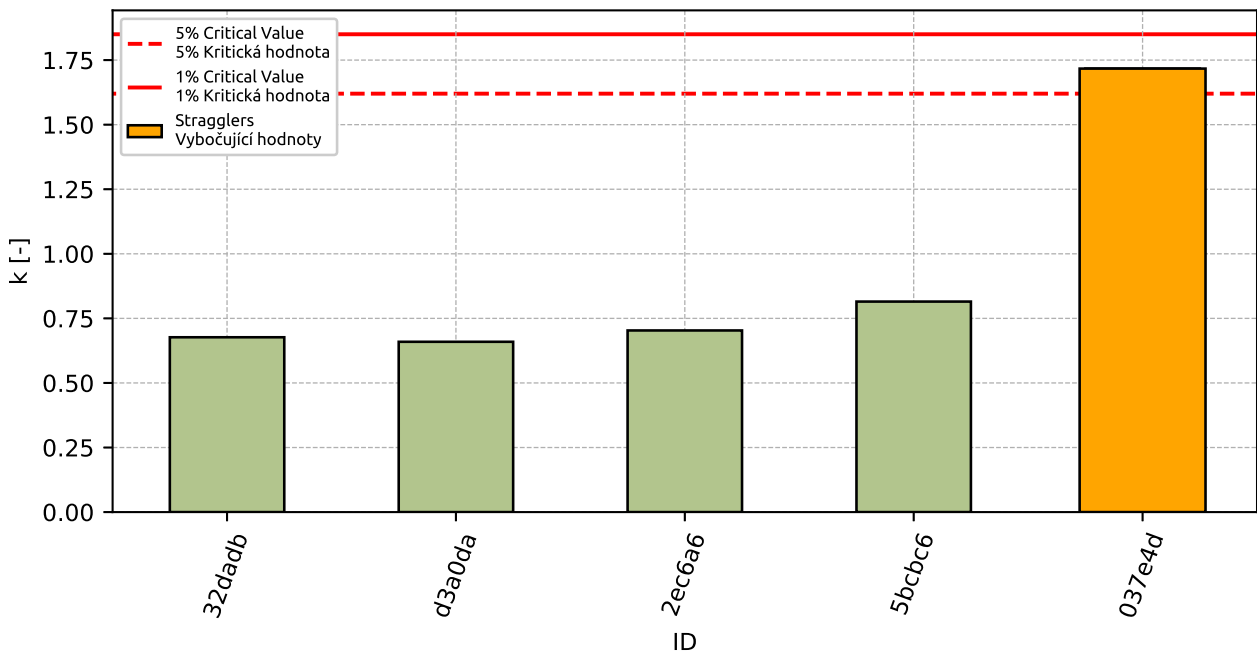


Figure 93: Intralaboratory Consistency Statistic



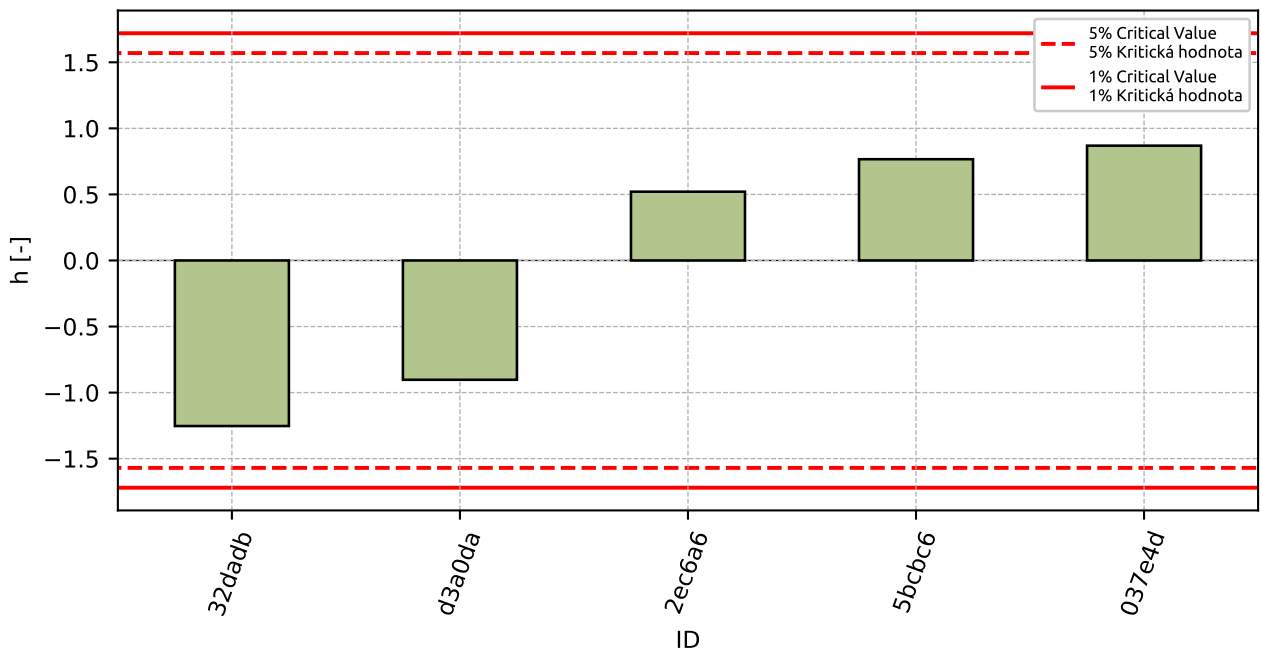


Figure 94: Interlaboratory Consistency Statistic

### 7.1.4 Descriptive statistics

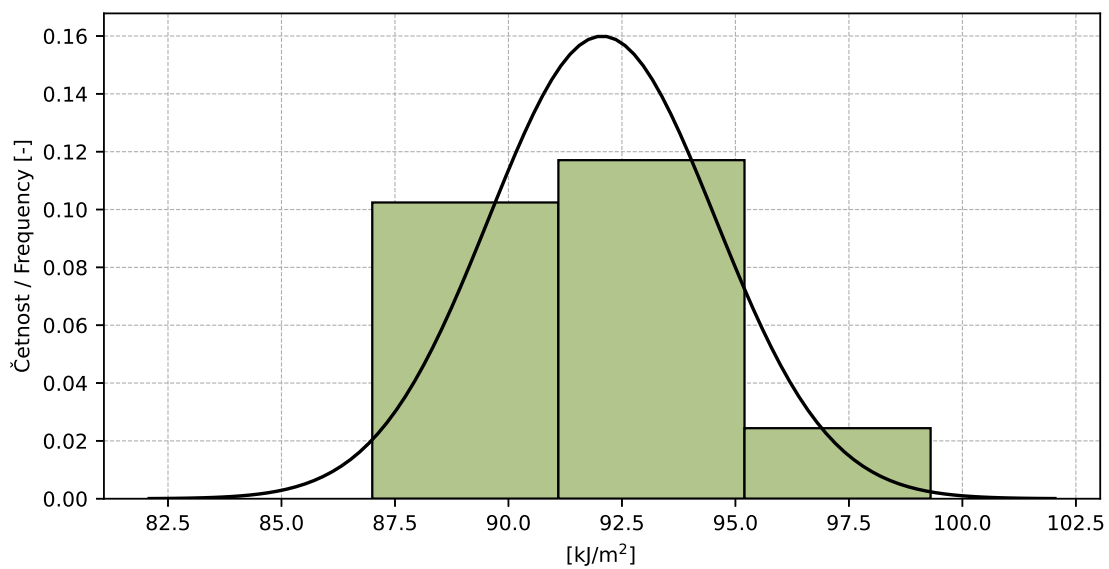


Figure 95: Histogram of all test results

Table 34: Descriptive statistics

Characteristics	[kJ/m <sup>2</sup> ]
Průměrná hodnota / Average value – $\bar{x}$	92.1
Výběrová směrodatná odchylka / Sample standard deviation – $s$	2.49
Vztažná hodnota / Assigned value – $x^*$	92.9
Robustní směrodatná odchylka / Robust standard deviation – $s^*$	1.39
Nejistota měření vztažné hodnoty / Measurement uncertainty of assigned value – $u_X$	0.77
$p$ -hodnota testu normality / $p$ -value of normality test	0.375 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – $s_L$	2.44
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – $s_r$	1.67
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – $s_R$	2.96
Opakovatelnost / Repeatability – $r$	4.7
Reprodukovatelnost / Reproducibility – $R$	8.3

### 7.1.5 Evaluation of Performance Statistics

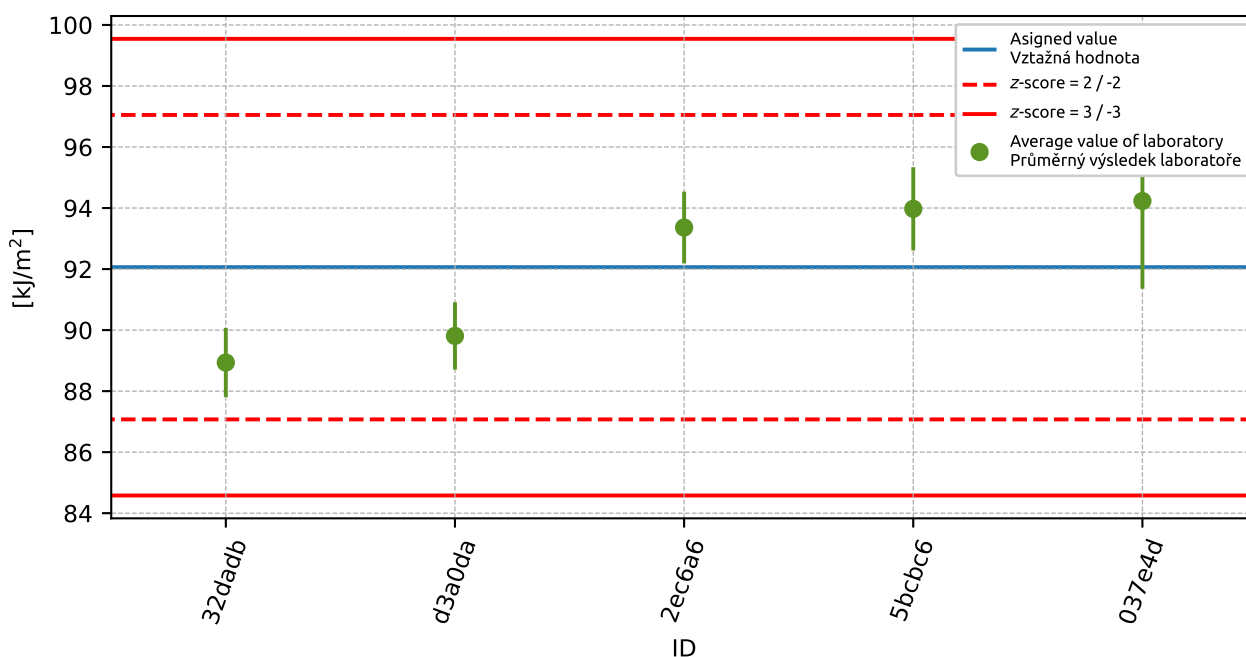


Figure 96: Average values and sample standard deviations

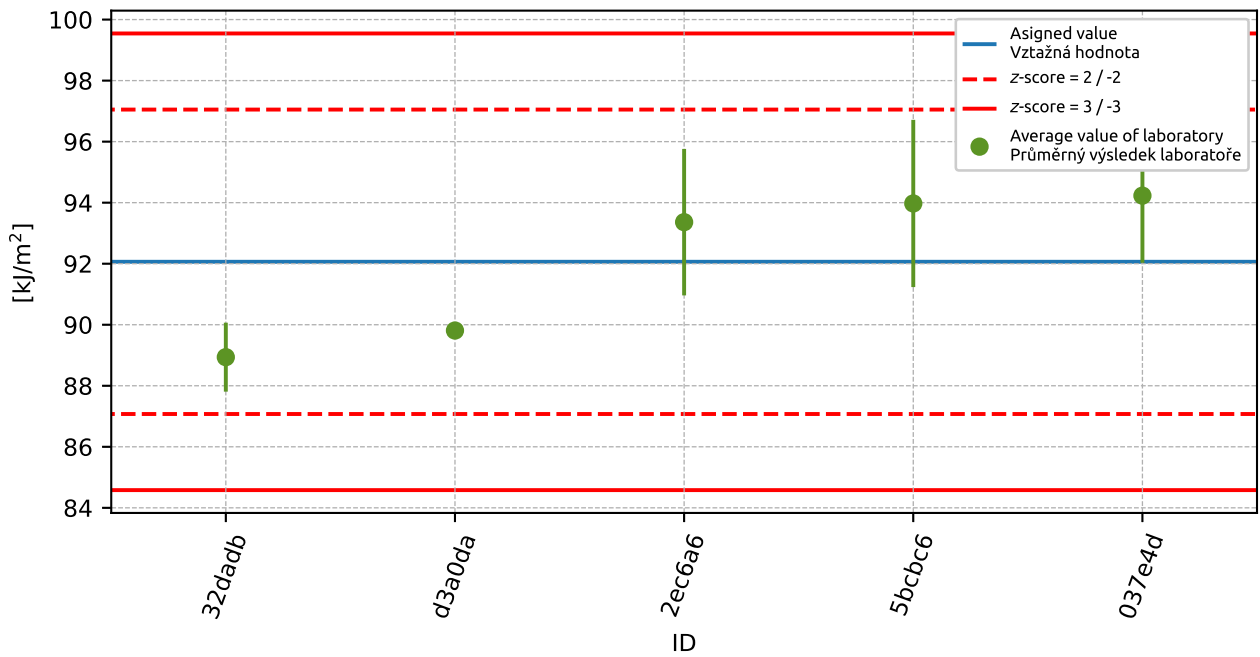


Figure 97: Average values and extended uncertainties of measurement

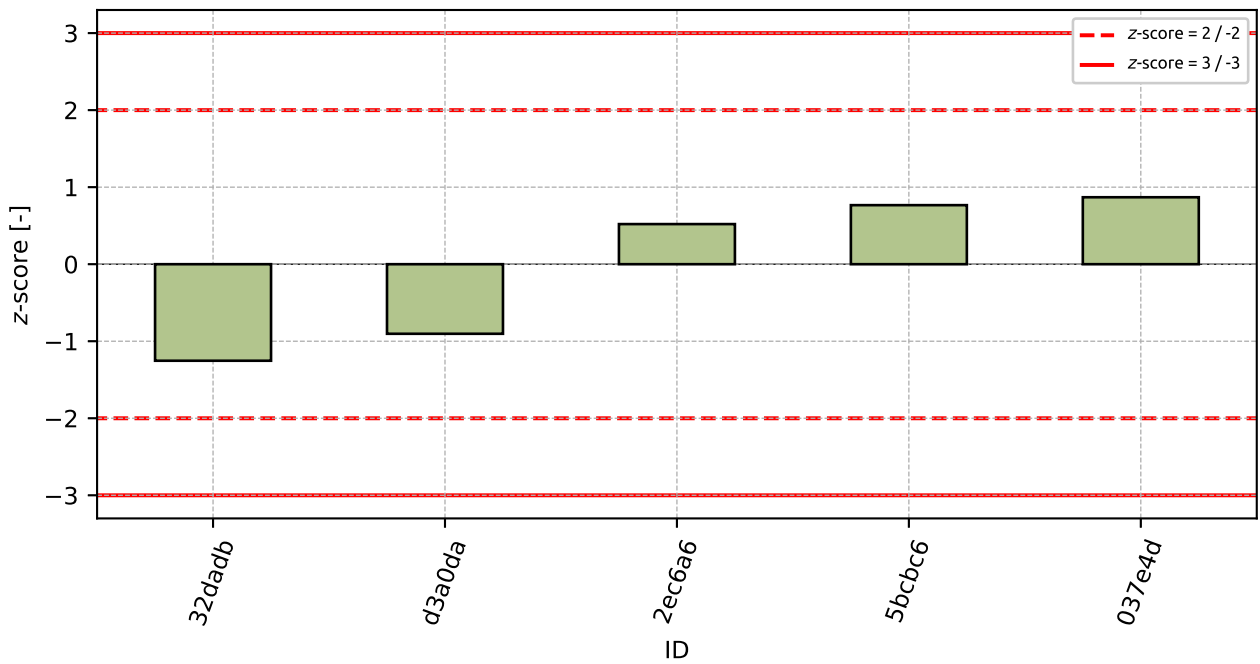


Figure 98: z-score

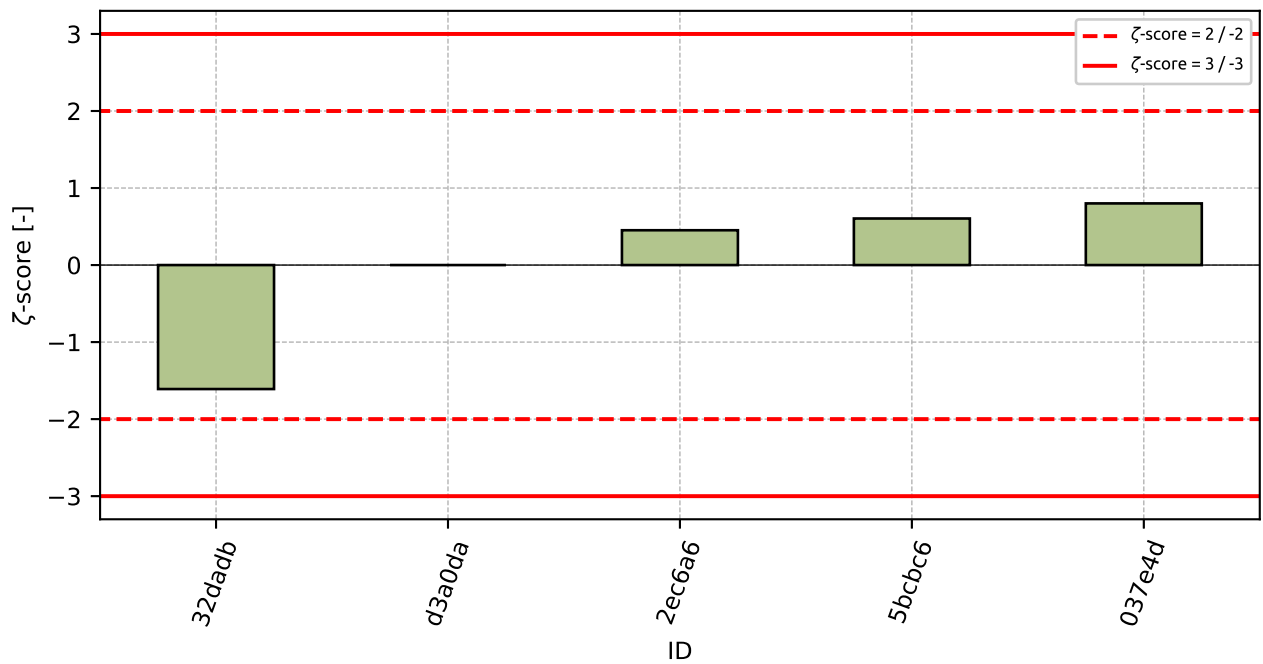


Figure 99: z-score

Table 35: z-score and z-score

ID	z-score [-]	z-score [-]
32dad b	-1.25	-1.61
d3a0da	-0.9	-
2ec6a6	0.52	0.45
5bcbc6	0.77	0.6
037e4d	0.87	0.8

## 7.2 Sample B

### 7.2.1 Test results

Table 36: 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										$u_x$ [kJ/m <sup>2</sup> ]	$\bar{x}$ [kJ/m <sup>2</sup> ]	$s_0$ [kJ/m <sup>2</sup> ]	$V_x$ [%]
	[kJ/m <sup>2</sup> ]													
d3a0da	2.9	2.6	2.6	2.7	2.6	2.9	2.7	2.6	2.7	2.9	-	2.72	0.132	4.84
32dadb	3.15	2.94	3.01	3.12	3.08	3.08	3.15	3.05	3.05	3.12	0.07	3.08	0.066	2.14
5bcbcb	3.35	3.29	3.26	3.26	3.28	3.29	3.29	3.15	3.11	3.25	0.14	3.25	0.071	2.18
2ec6a6	3.31	3.28	3.16	3.34	3.31	3.32	3.4	3.35	3.15	3.25	0.2	3.29	0.08	2.44
037e4d	3.93	3.34	3.98	3.61	3.46	3.33	4.28	3.44	2.45	2.36	0.4	3.42	0.617	18.06

### 7.2.2 The Numerical Procedure for Determining Outliers

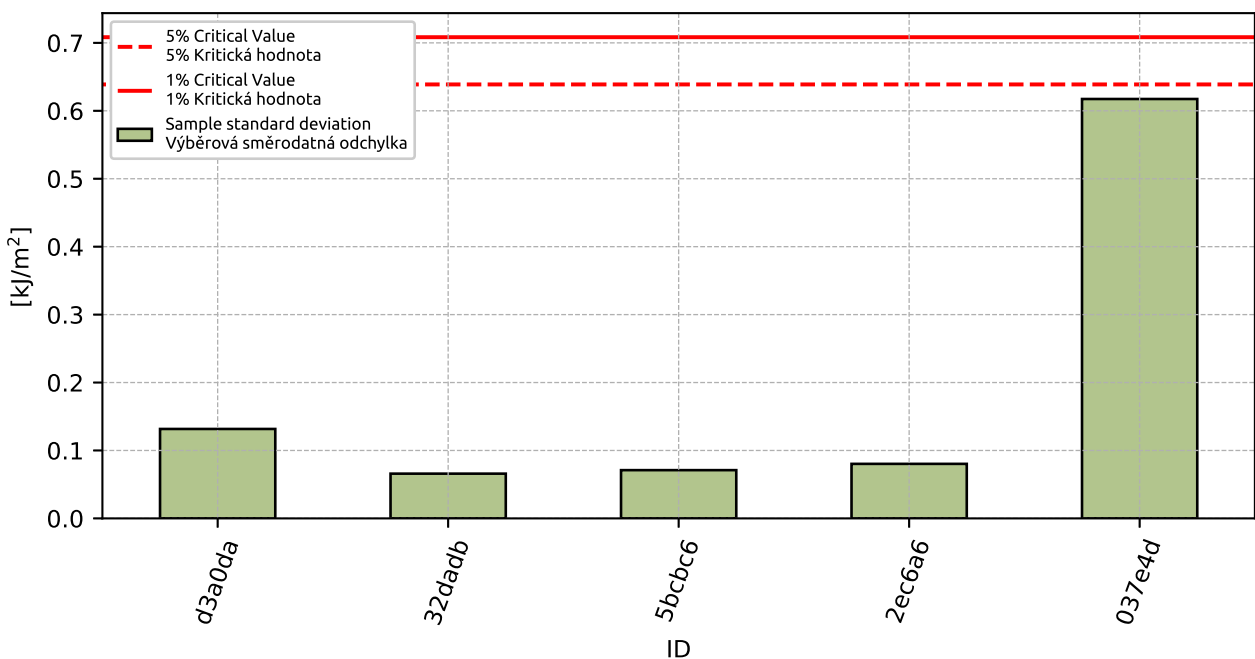


Figure 100: Cochran's test - sample standard deviations

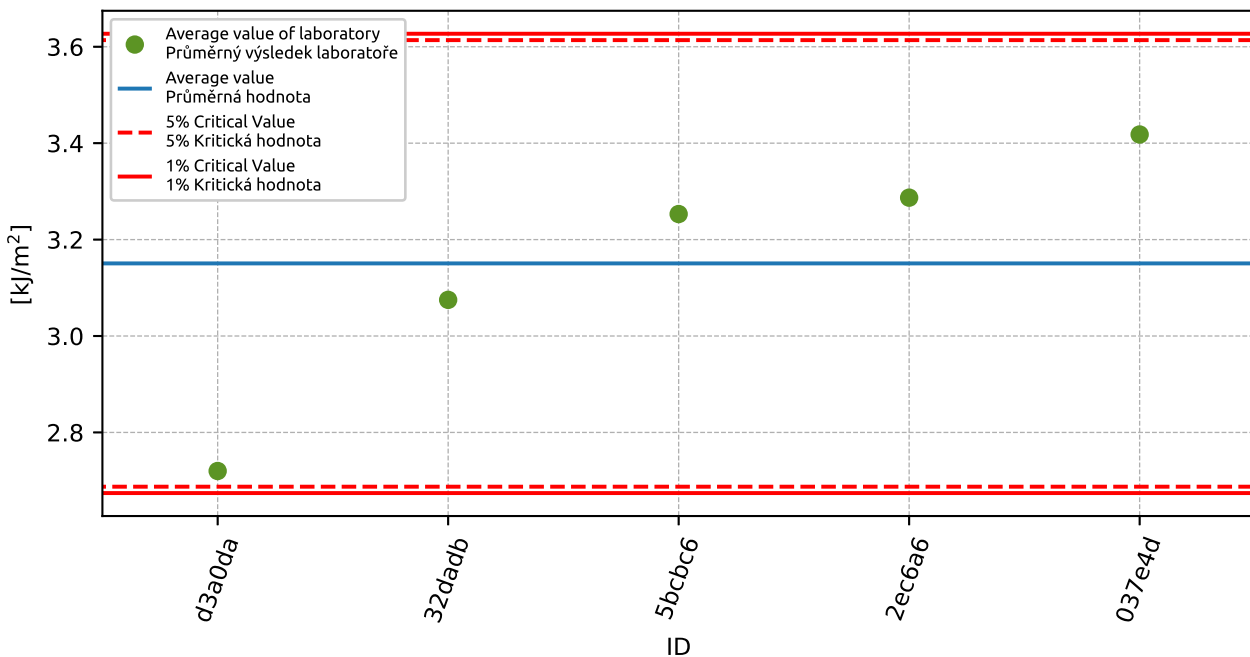


Figure 101: Grubbs' test - average values

### 7.2.3 Mandel's Statistics

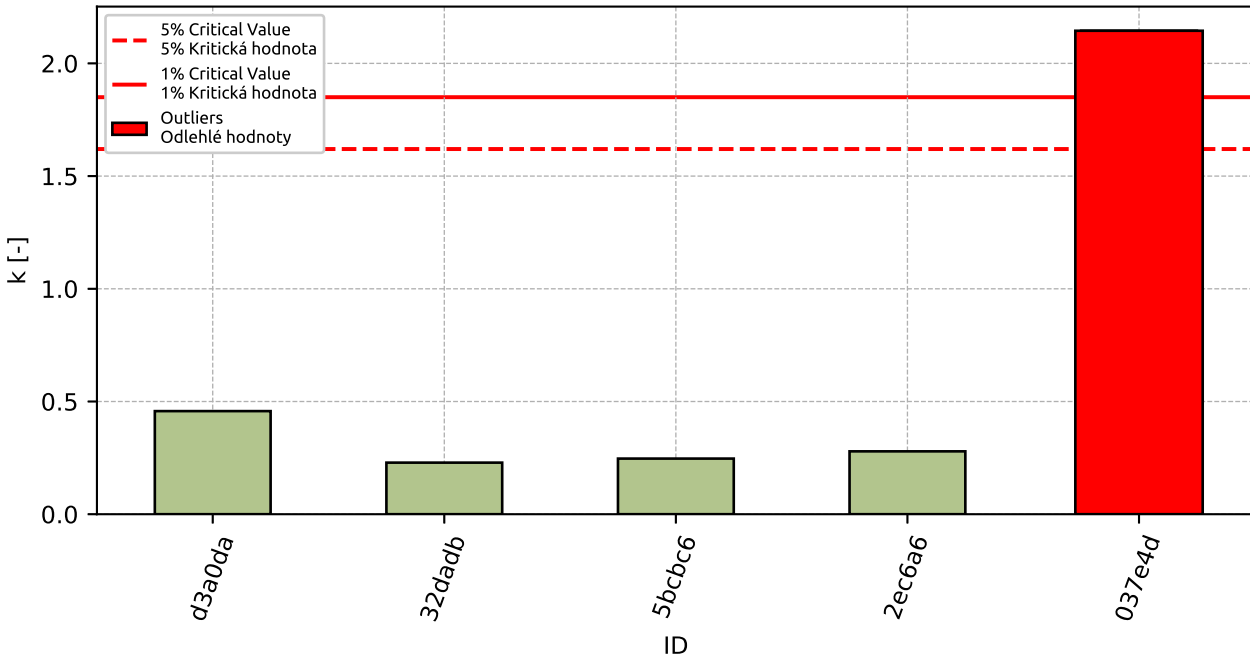


Figure 102: Intralaboratory Consistency Statistic

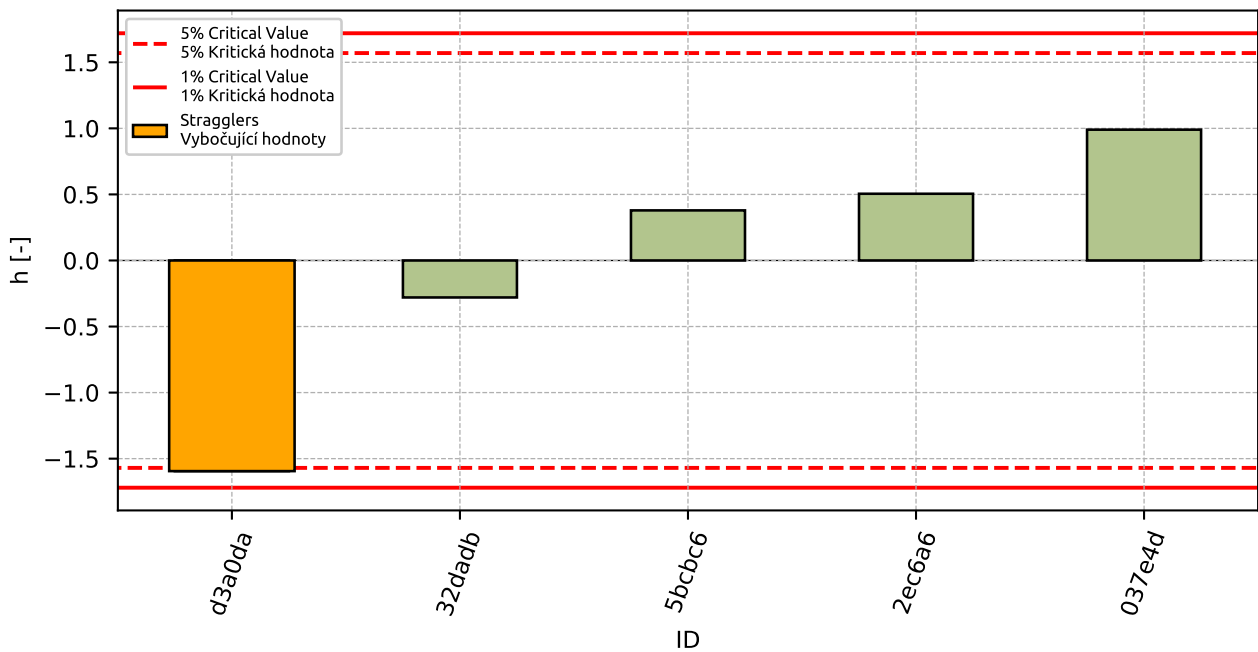


Figure 103: Interlaboratory Consistency Statistic

### 7.2.4 Descriptive statistics

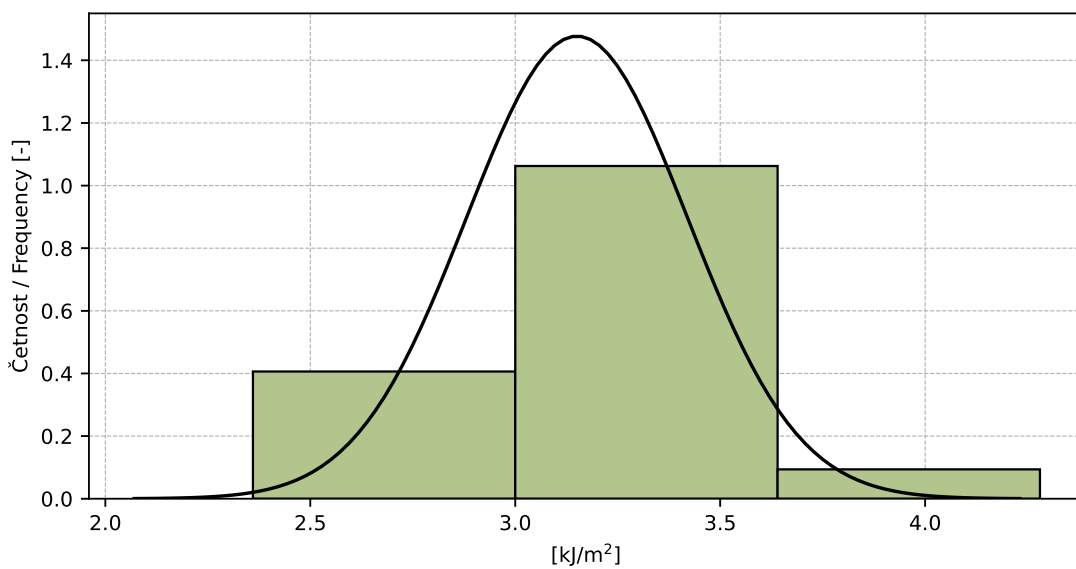


Figure 104: Histogram of all test results

Table 37: Descriptive statistics

Characteristics	[kJ/m <sup>2</sup> ]
Průměrná hodnota / Average value – $\bar{x}$	3.15
Výběrová směrodatná odchylka / Sample standard deviation – $s$	0.27
Vztažná hodnota / Assigned value – $x^*$	3.15
Robustní směrodatná odchylka / Robust standard deviation – $s^*$	0.27
Nejistota měření vztažné hodnoty / Measurement uncertainty of assigned value – $u_X$	0.52
$p$ -hodnota testu normality / $p$ -value of normality test	0.011 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – $s_L$	0.254
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – $s_r$	0.288
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – $s_R$	0.384
Opakovatelnost / Repeatability – $r$	0.81
Reprodukovatelnost / Reproducibility – $R$	1.08

## 7.2.5 Evaluation of Performance Statistics

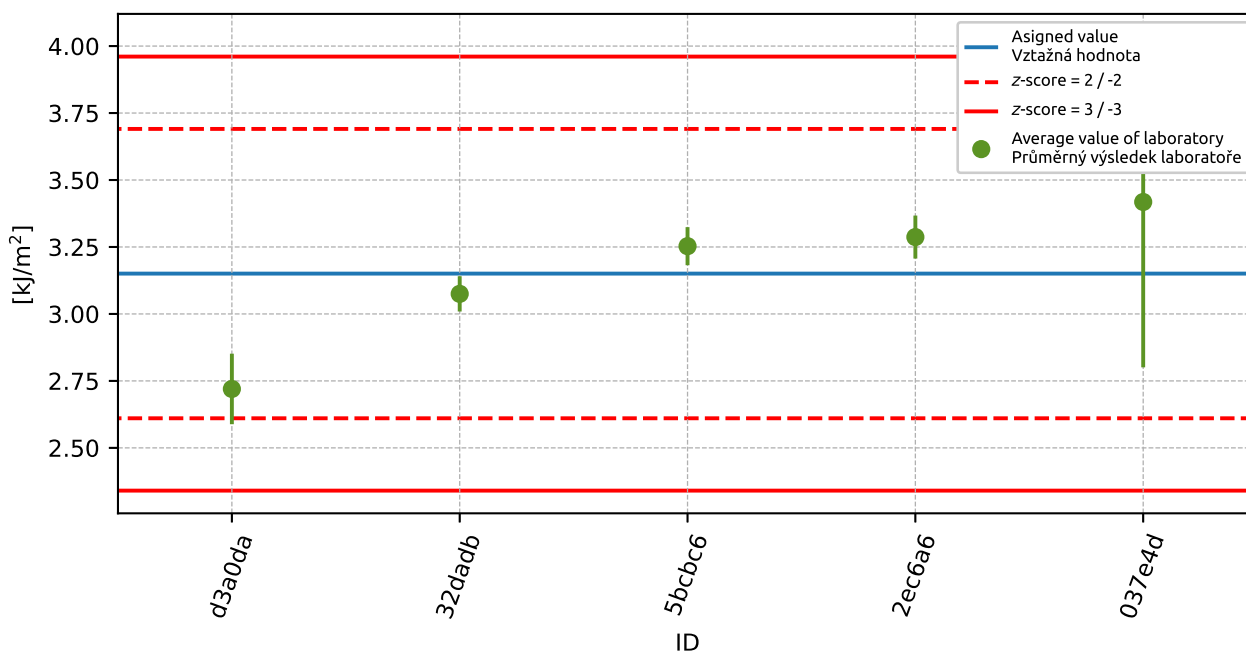


Figure 105: Average values and sample standard deviations



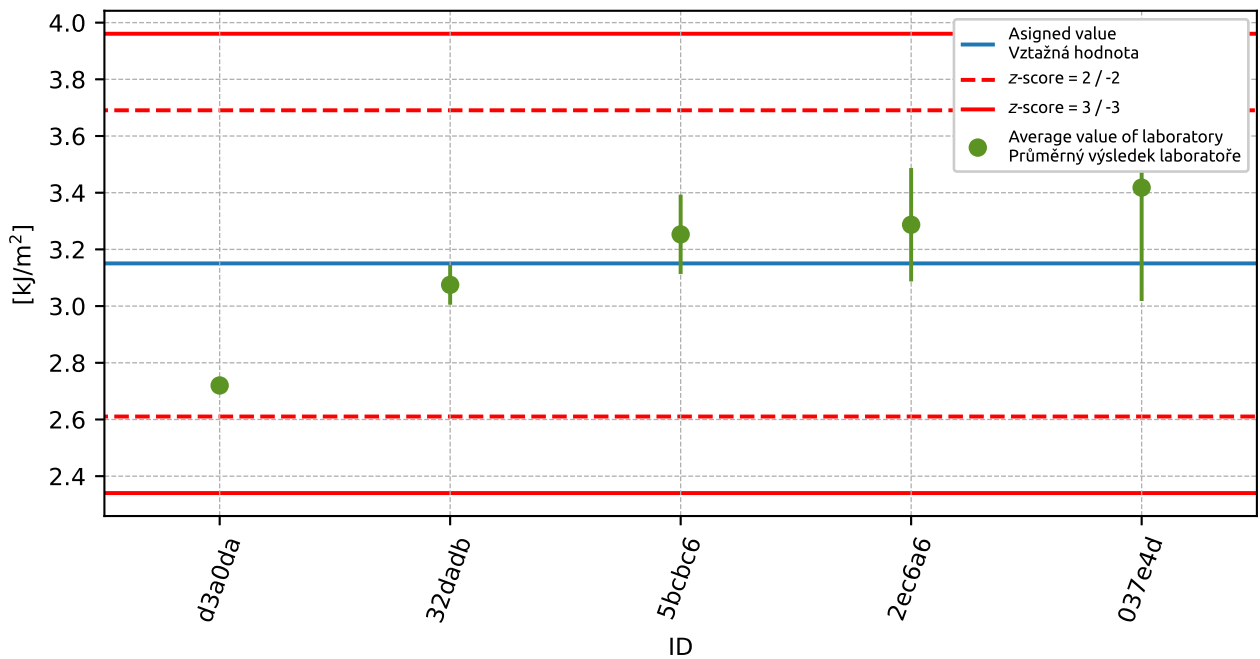


Figure 106: Average values and extended uncertainties of measurement

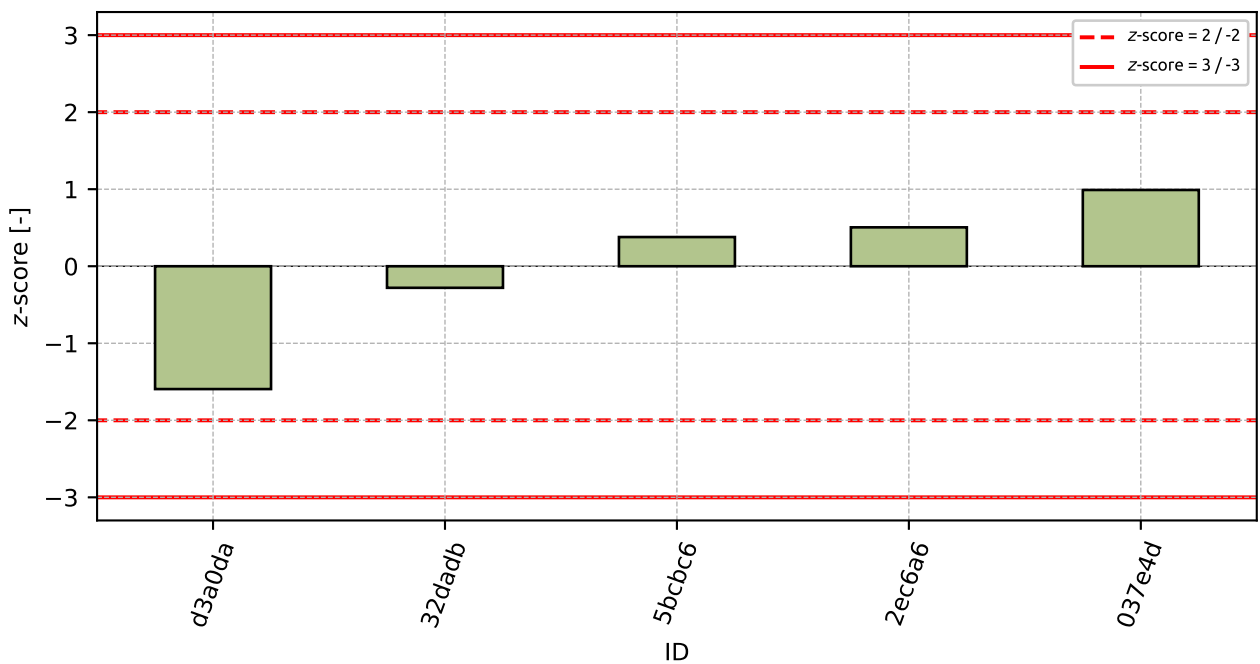


Figure 107: z-score

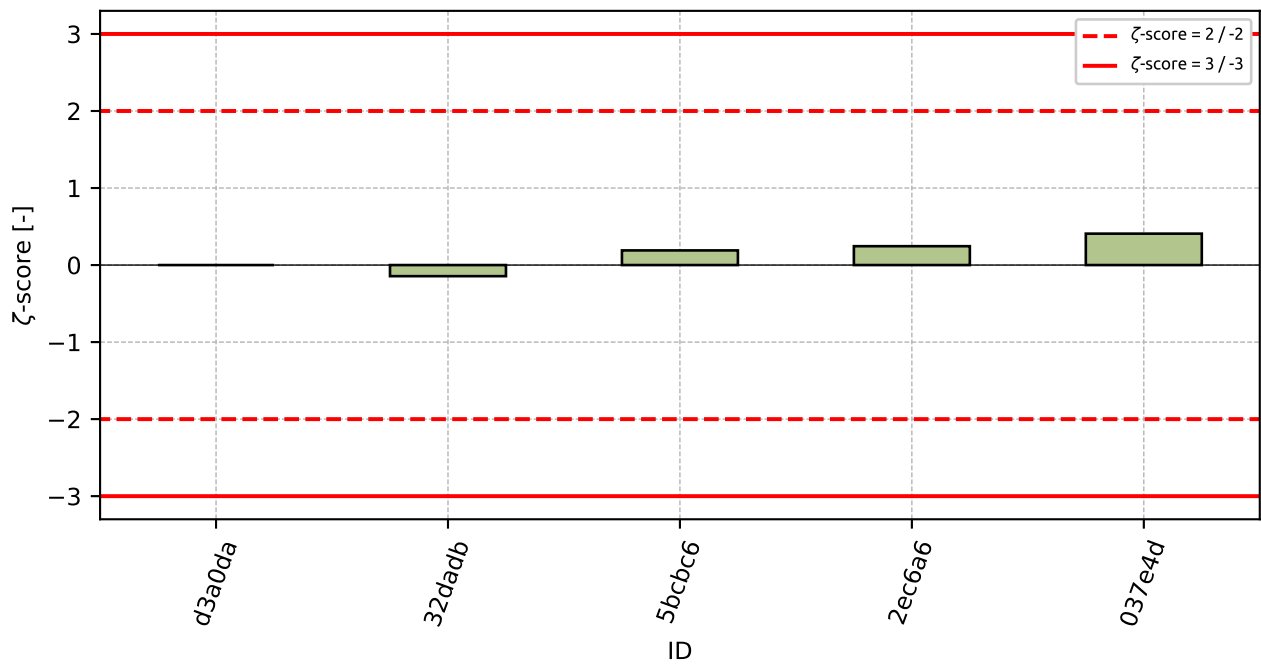


Figure 108: ζ-score

Table 38: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
d3a0da	-1.59	-
32dadab	-0.28	-0.14
5bcbc6	0.38	0.19
2ec6a6	0.51	0.24
037e4d	0.99	0.41

## **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)**

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

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

### 10.1 Sample A

#### 10.1.1 Test results

Table 39: 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			$u_x$ [°C]	$\bar{x}$ [°C]	$s_0$ [°C]	$V_x$ [%]
	[°C]	[°C]	[°C]				
d1a574	149.3	150.2	149.9	0.5	149.8	0.46	0.31
deef7	149.4	149.8	150.7	1.0	150.0	0.67	0.44
1ac459	150.7	150.8	151.1	0.2	150.9	0.21	0.14
5bcbc6	151.3	151.3	151.5	0.2	151.4	0.12	0.08
2ec6a6	151.6	151.8	151.4	0.4	151.6	0.2	0.13
32dad6	151.1	152.7	-	0.8	151.9	1.13	0.74

#### 10.1.2 The Numerical Procedure for Determining Outliers

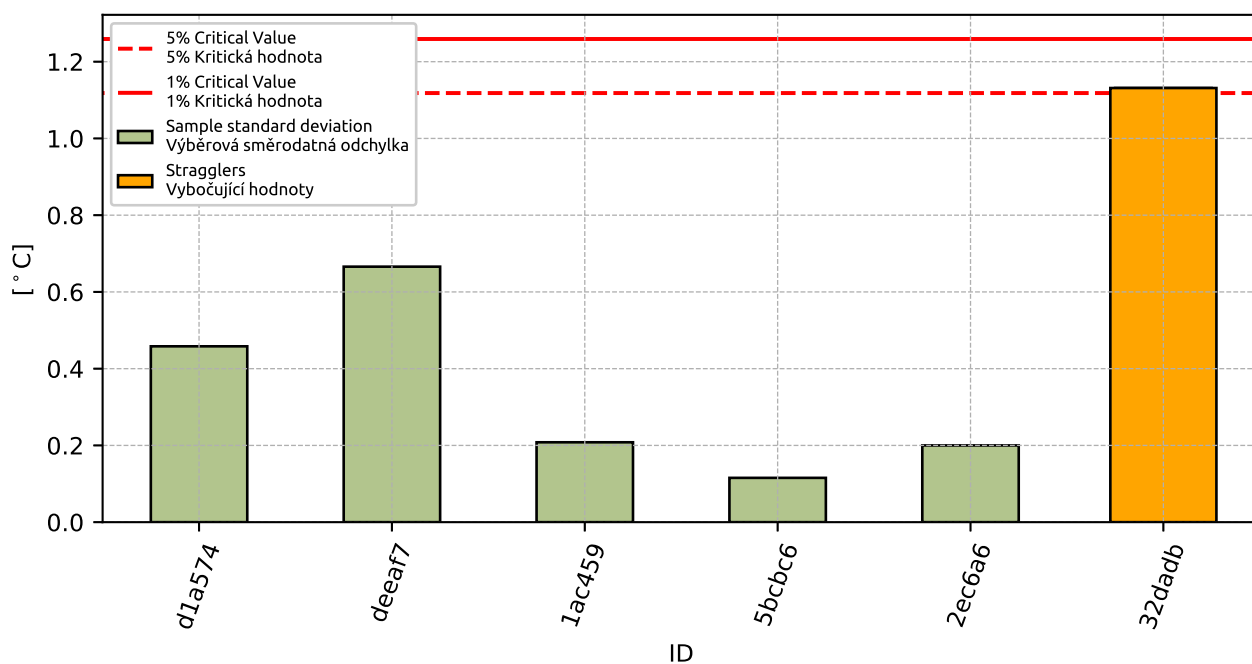


Figure 109: Cochran's test - sample standard deviations

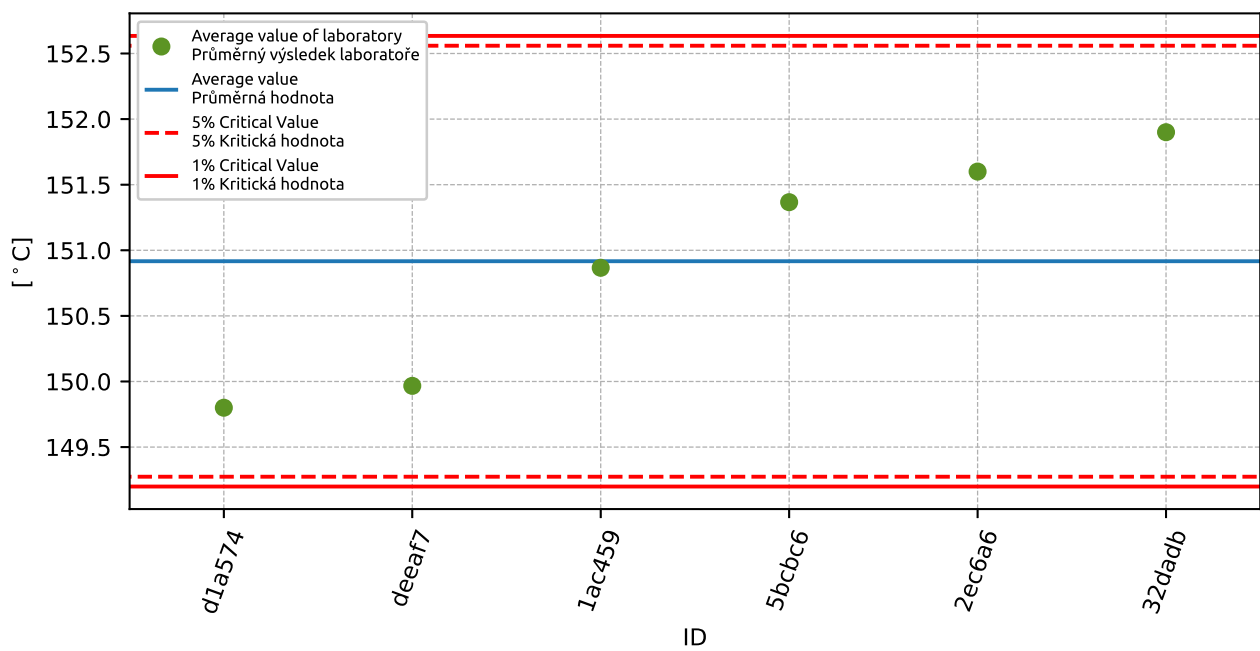


Figure 110: **Grubbs' test** - average values

### 10.1.3 Mandel's Statistics

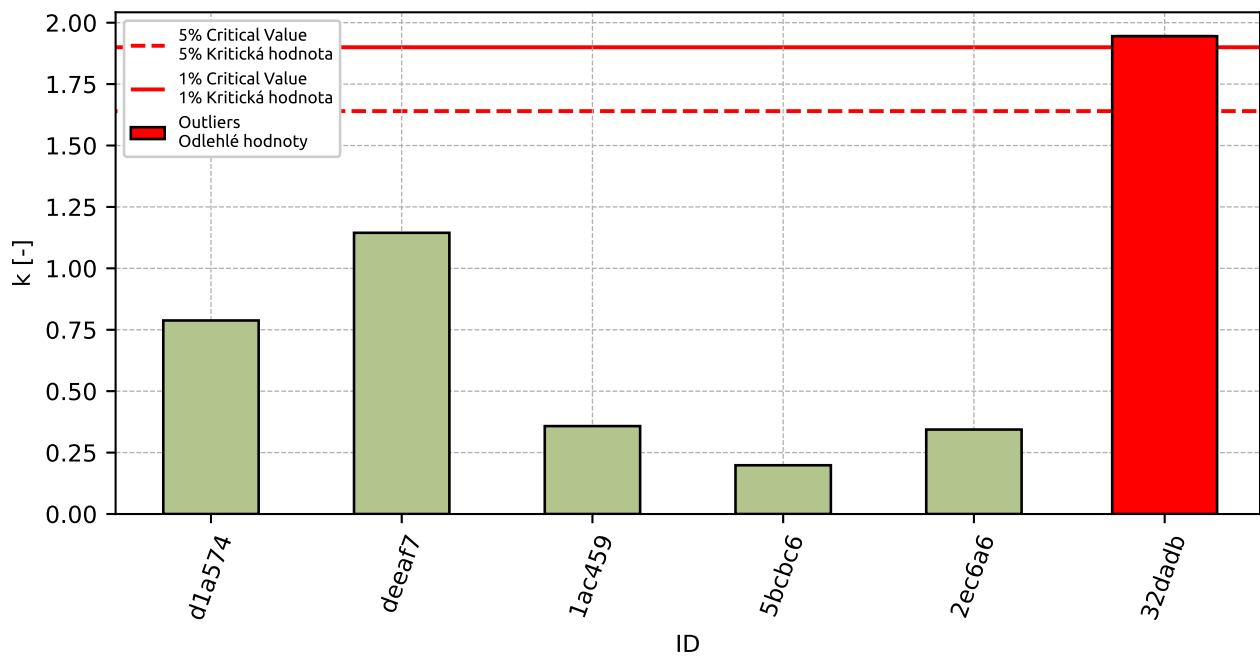


Figure 111: Intralaboratory Consistency Statistic

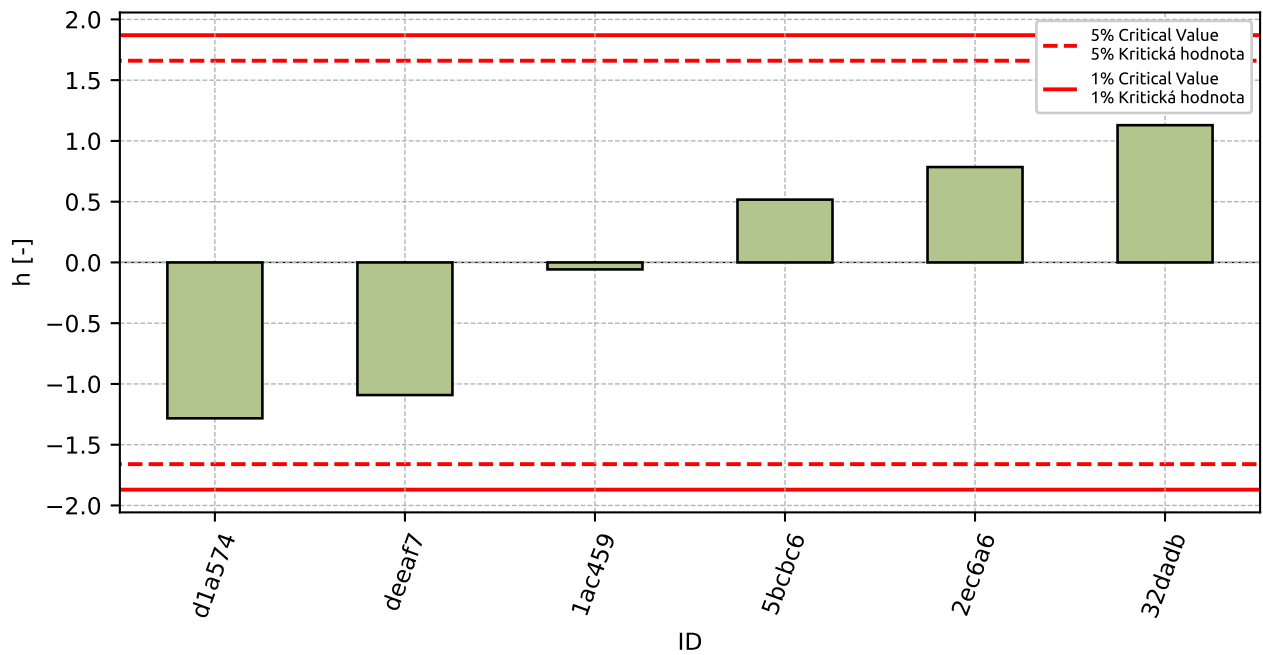


Figure 112: Interlaboratory Consistency Statistic

### 10.1.4 Descriptive statistics

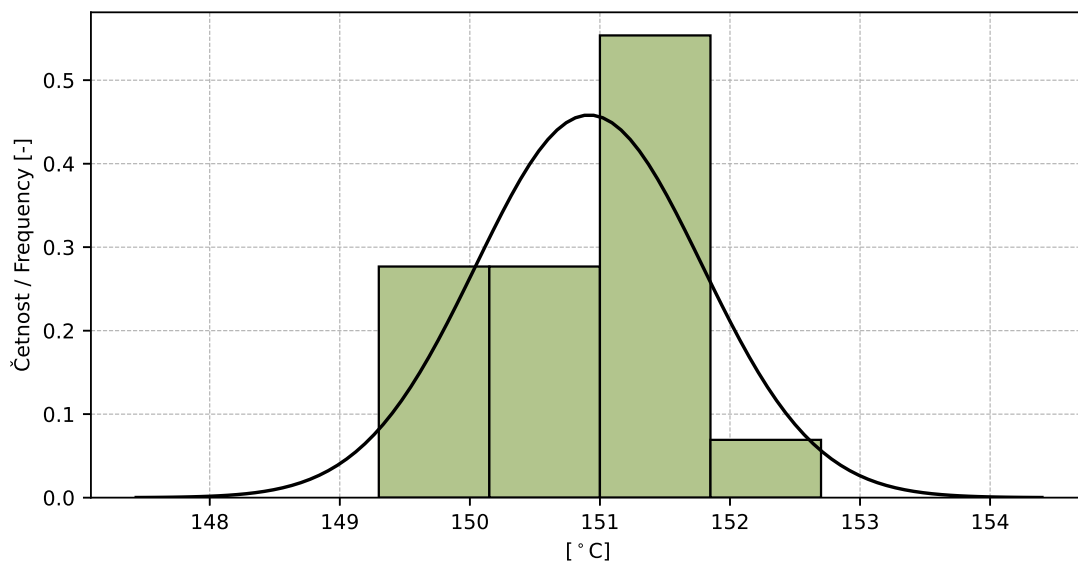


Figure 113: Histogram of all test results

Table 40: Descriptive statistics

Characteristics	[°C]
Průměrná hodnota / Average value – $\bar{x}$	150.9
Výběrová směrodatná odchylka / Sample standard deviation – $s$	0.87
Vztažná hodnota / Assigned value – $x^*$	150.9
Robustní směrodatná odchylka / Robust standard deviation – $s^*$	0.87
Nejistota měření vztažné hodnoty / Measurement uncertainty of assigned value – $u_X$	0.93
$p$ -hodnota testu normality / $p$ -value of normality test	1.0 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – $s_L$	0.8
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – $s_r$	0.58
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – $s_R$	0.99
Opakovatelnost / Repeatability – $r$	1.6
Reprodukovatelnost / Reproducibility – $R$	2.8

### 10.1.5 Evaluation of Performance Statistics

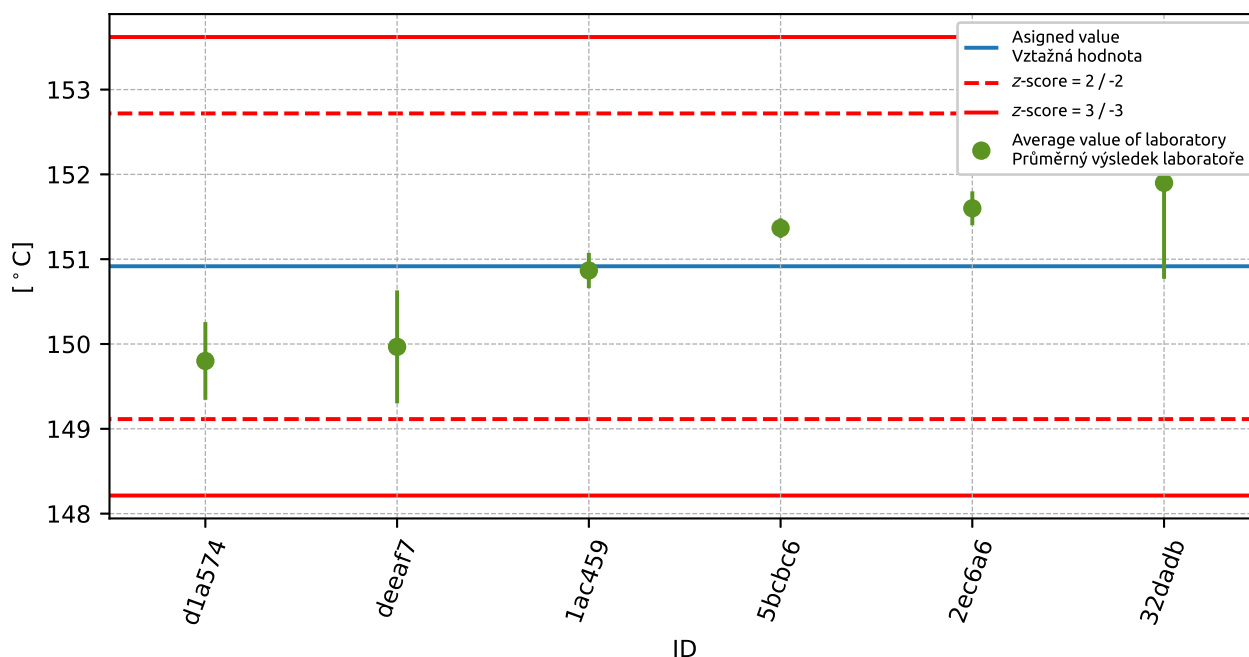


Figure 114: Average values and sample standard deviations

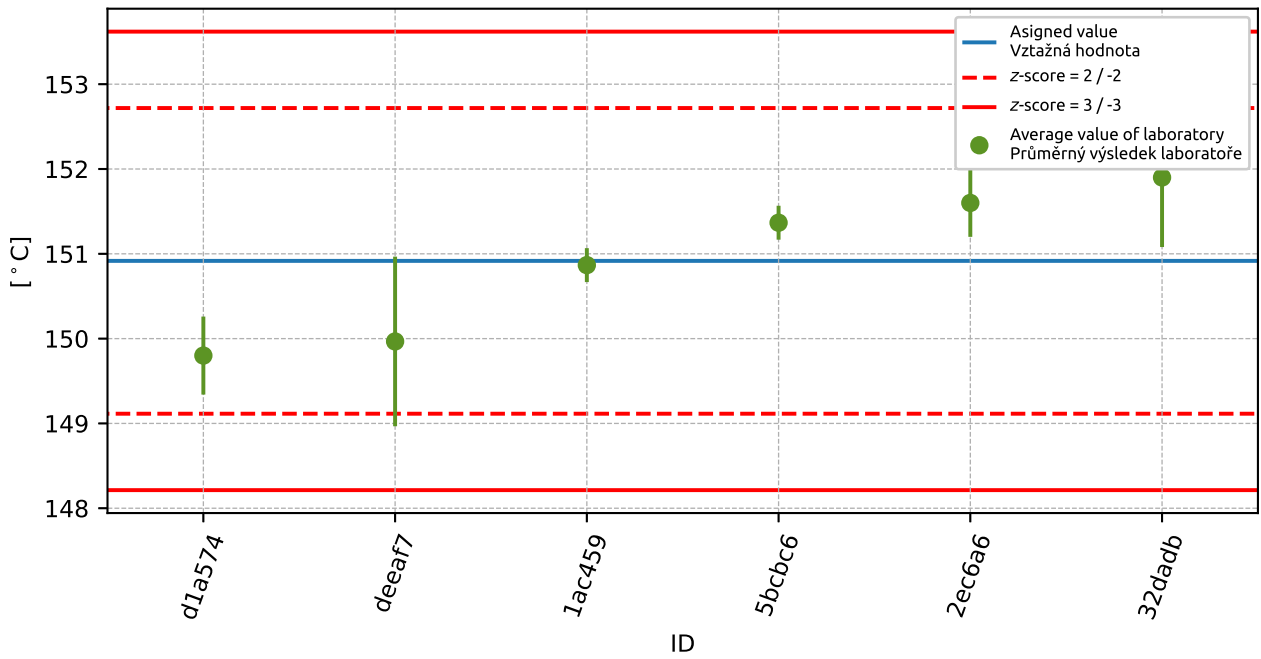


Figure 115: Average values and extended uncertainties of measurement

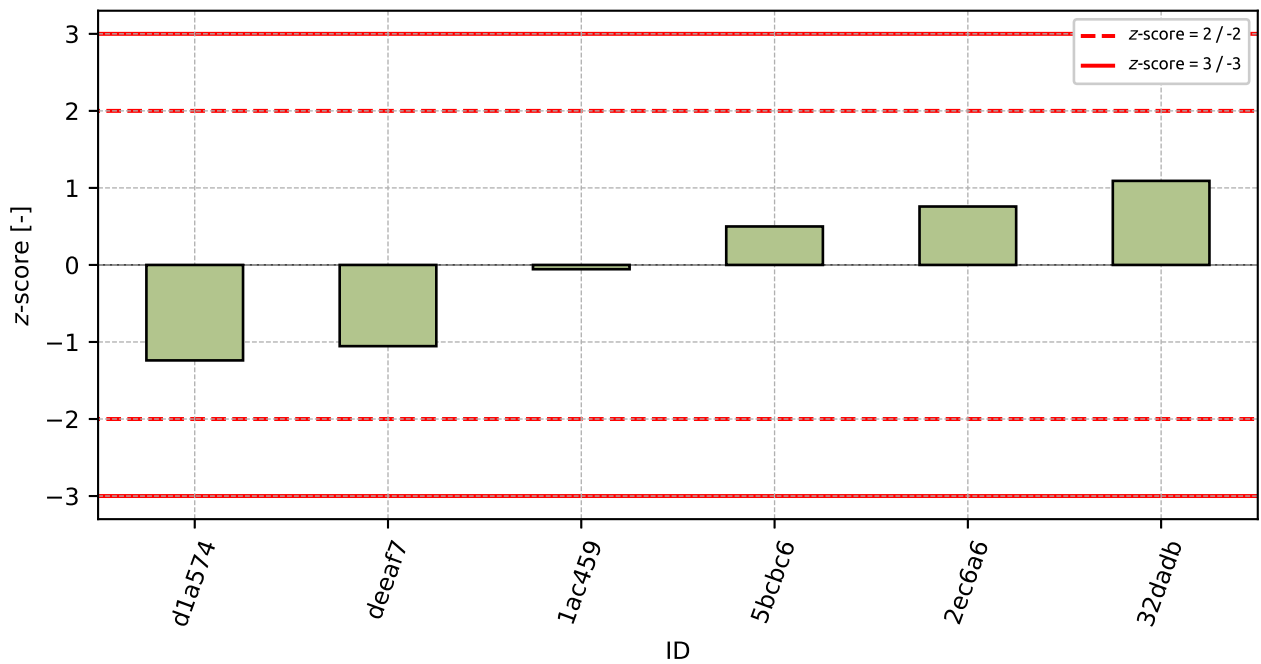


Figure 116: z-score



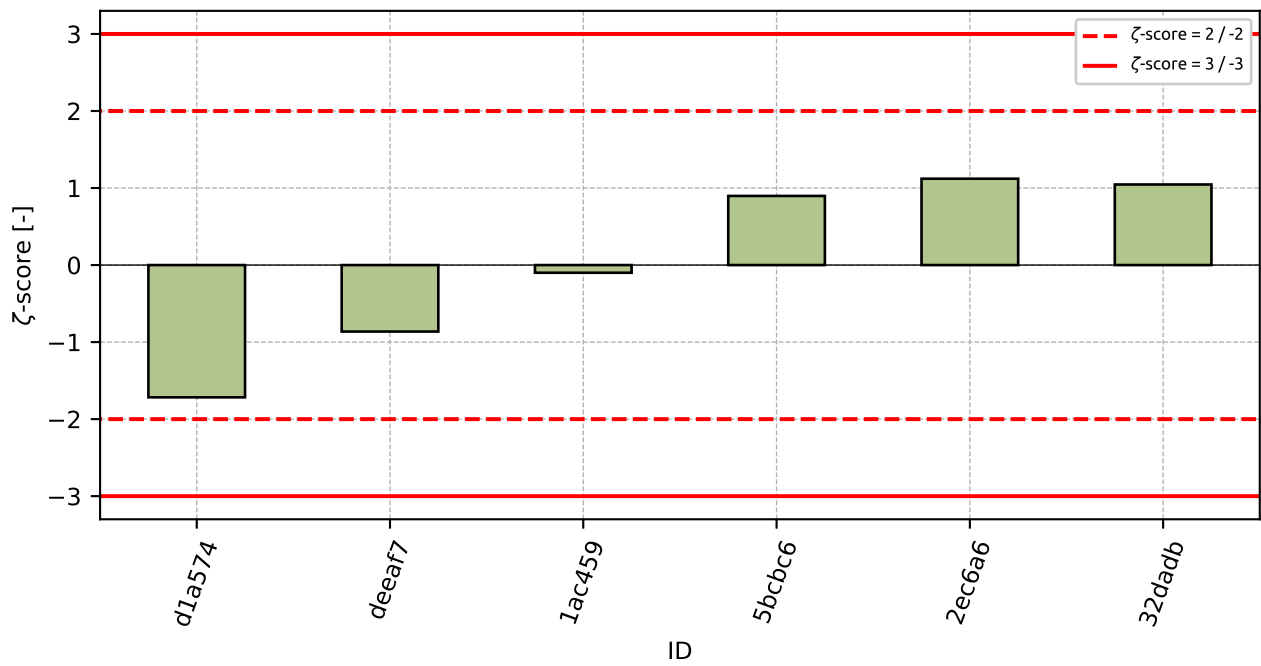


Figure 117: ζ-score

Table 41: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
d1a574	-1.24	-1.72
deef7	-1.05	-0.86
1ac459	-0.06	-0.1
5bcbc6	0.5	0.9
2ec6a6	0.76	1.12
32dadb	1.09	1.05

## 10.2 Sample B

### 10.2.1 Test results

Table 42: 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			$u_x$	$\bar{x}$	$s_0$	$V_x$
	[°C]						
1ac459	156.2	156.2	156.3	0.1	156.2	0.06	0.04
deef7	156.2	156.4	156.6	1.0	156.4	0.2	0.13
d1a574	156.8	156.5	155.9	0.5	156.4	0.46	0.29
5bcbc6	156.3	156.7	156.4	0.4	156.5	0.21	0.13
2ec6a6	156.8	157.0	156.6	0.4	156.8	0.2	0.13
32dad6	157.0	156.6	-	0.2	156.8	0.28	0.18

### 10.2.2 The Numerical Procedure for Determining Outliers

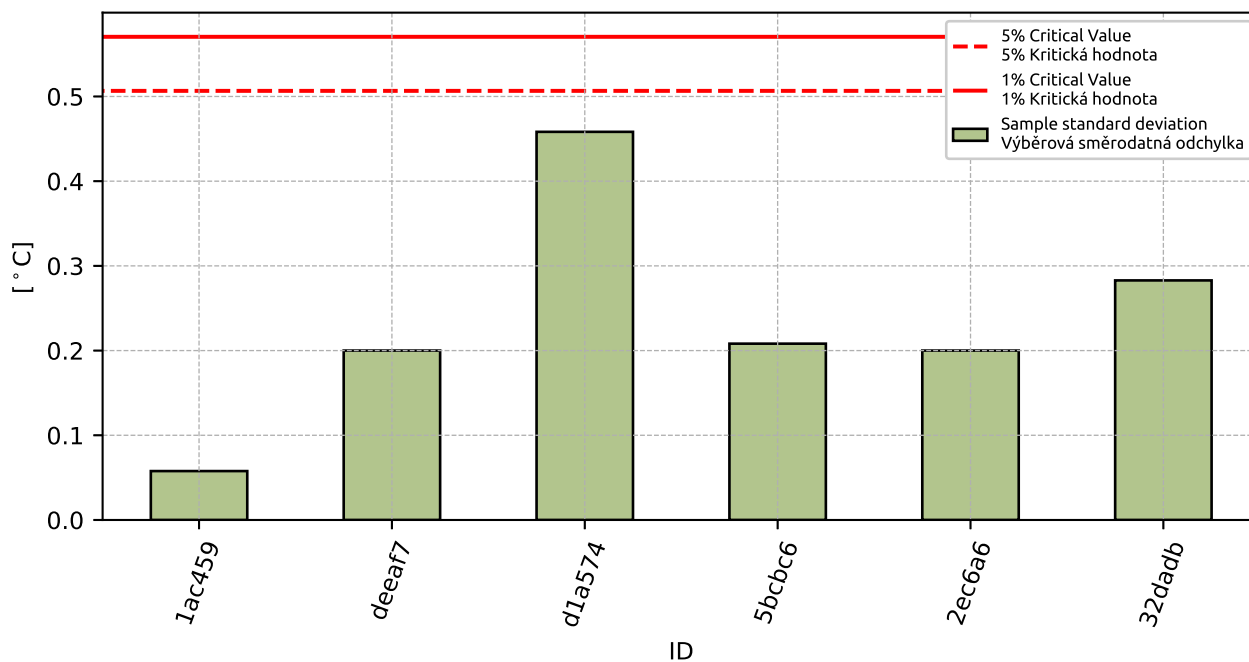


Figure 118: Cochran's test - sample standard deviations

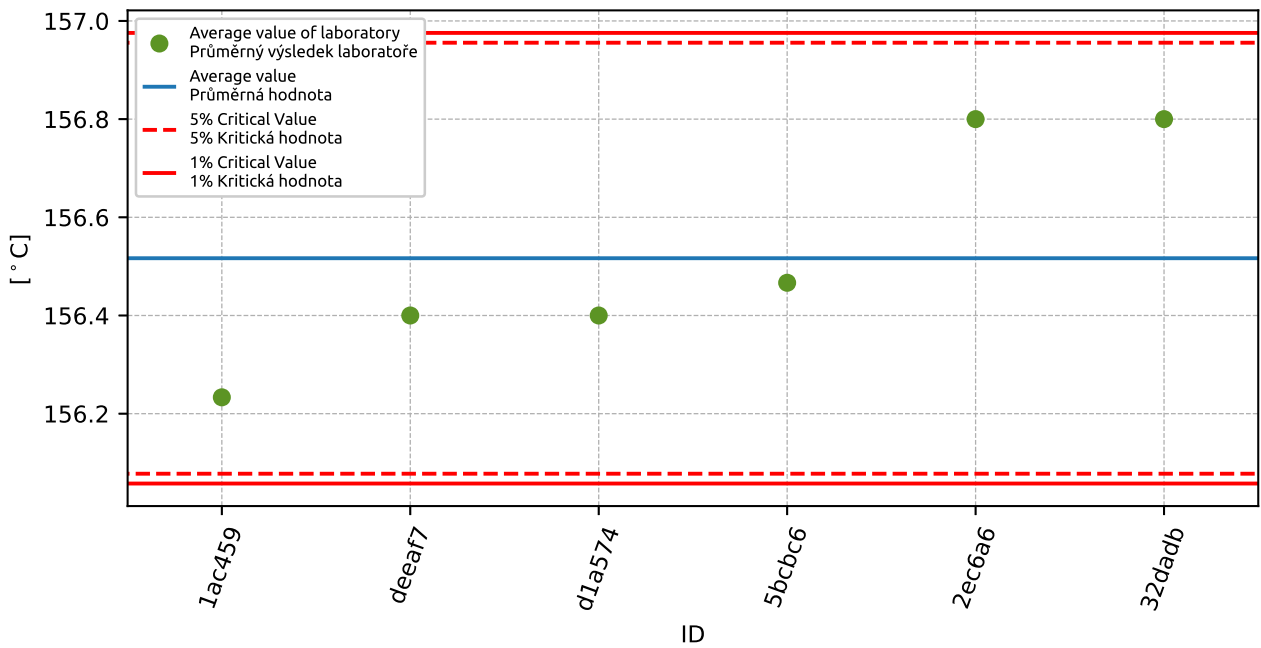


Figure 119: Grubbs' test - average values

### 10.2.3 Mandel's Statistics

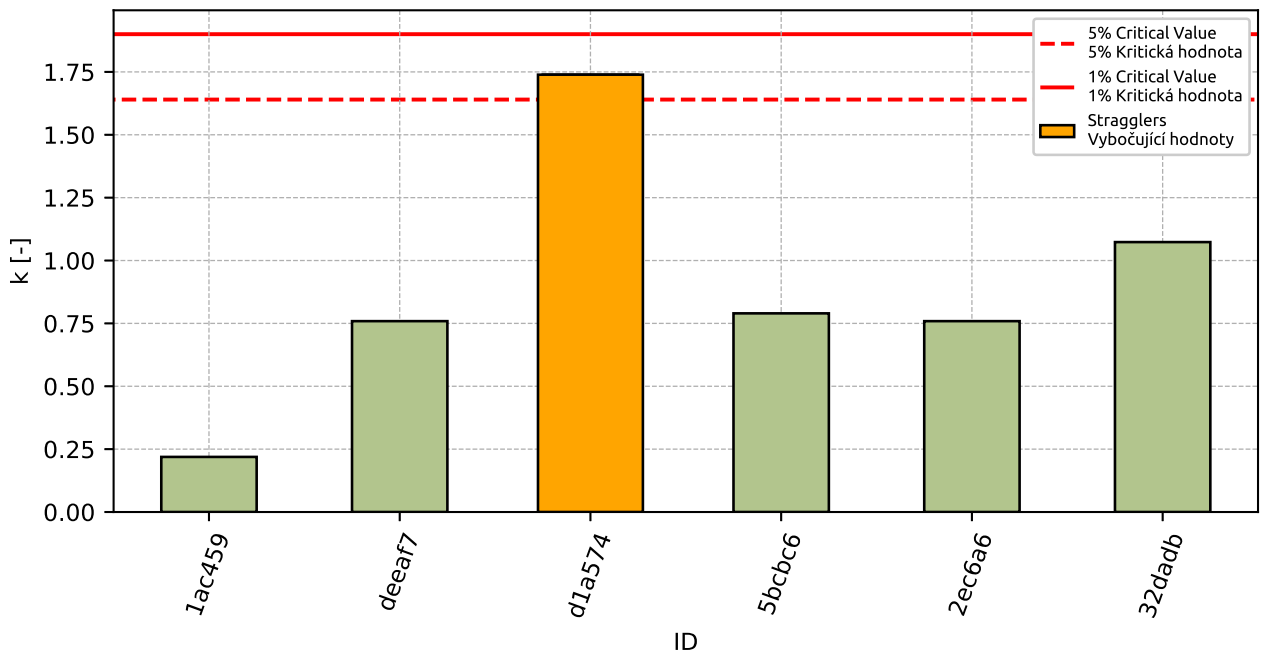


Figure 120: Intralaboratory Consistency Statistic

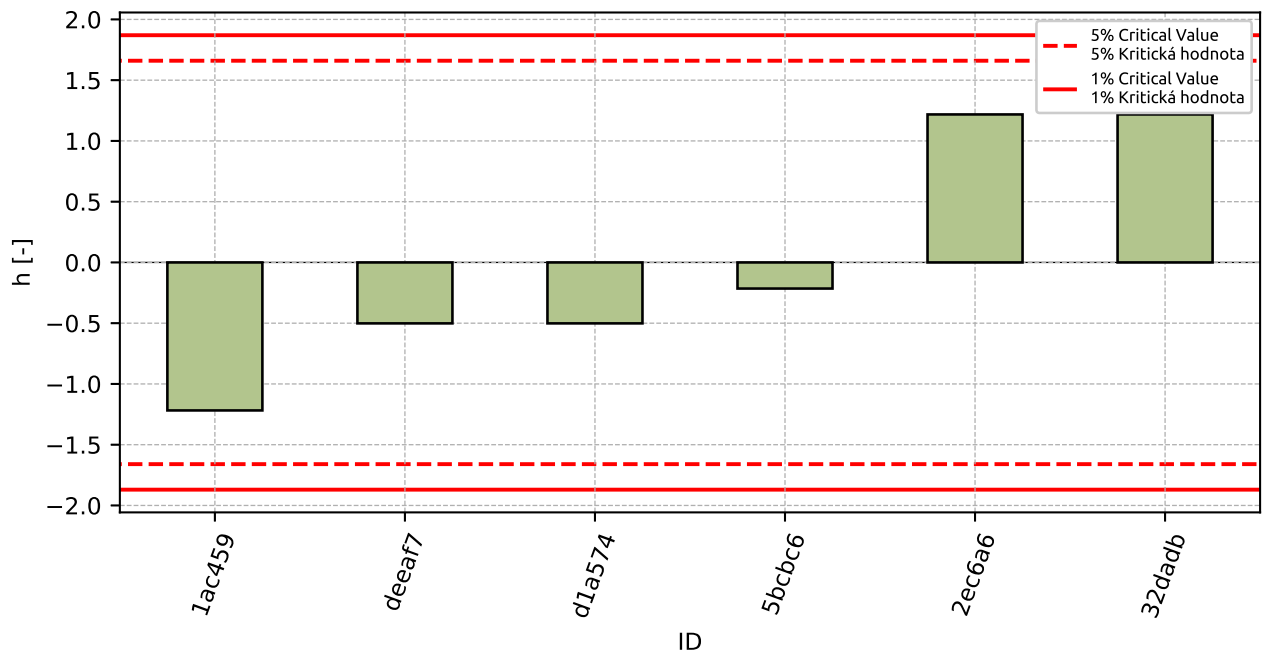


Figure 121: Interlaboratory Consistency Statistic

### 10.2.4 Descriptive statistics

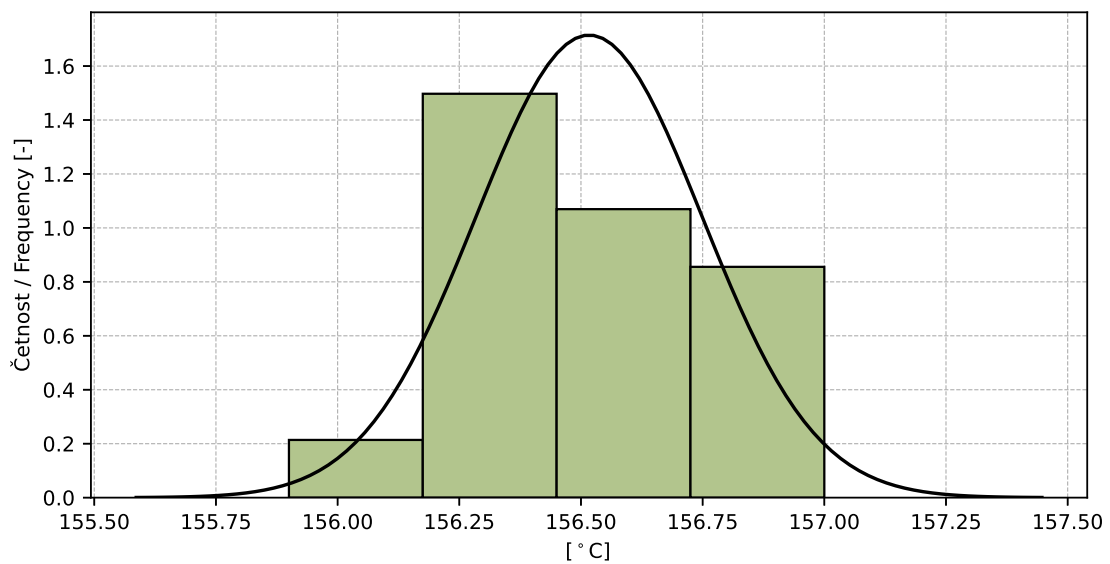


Figure 122: Histogram of all test results

Table 43: Descriptive statistics

Characteristics	[°C]
Průměrná hodnota / Average value – $\bar{x}$	156.5
Výběrová směrodatná odchylka / Sample standard deviation – $s$	0.23
Vztažná hodnota / Assigned value – $x^*$	156.5
Robustní směrodatná odchylka / Robust standard deviation – $s^*$	0.22
Nejistota měření vztažné hodnoty / Measurement uncertainty of assigned value – $u_X$	0.11
$p$ -hodnota testu normality / $p$ -value of normality test	1.0 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – $s_L$	0.18
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – $s_r$	0.26
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – $s_R$	0.32
Opakovatelnost / Repeatability – $r$	0.7
Reprodukovatelnost / Reproducibility – $R$	0.9

### 10.2.5 Evaluation of Performance Statistics

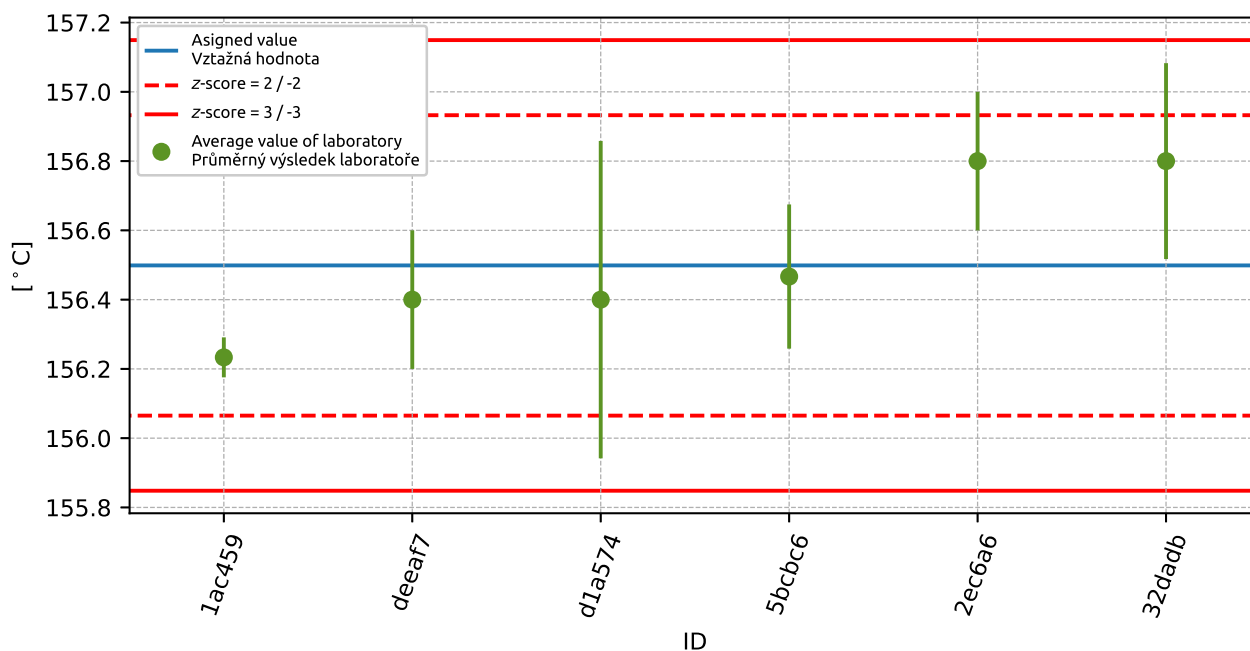


Figure 123: Average values and sample standard deviations

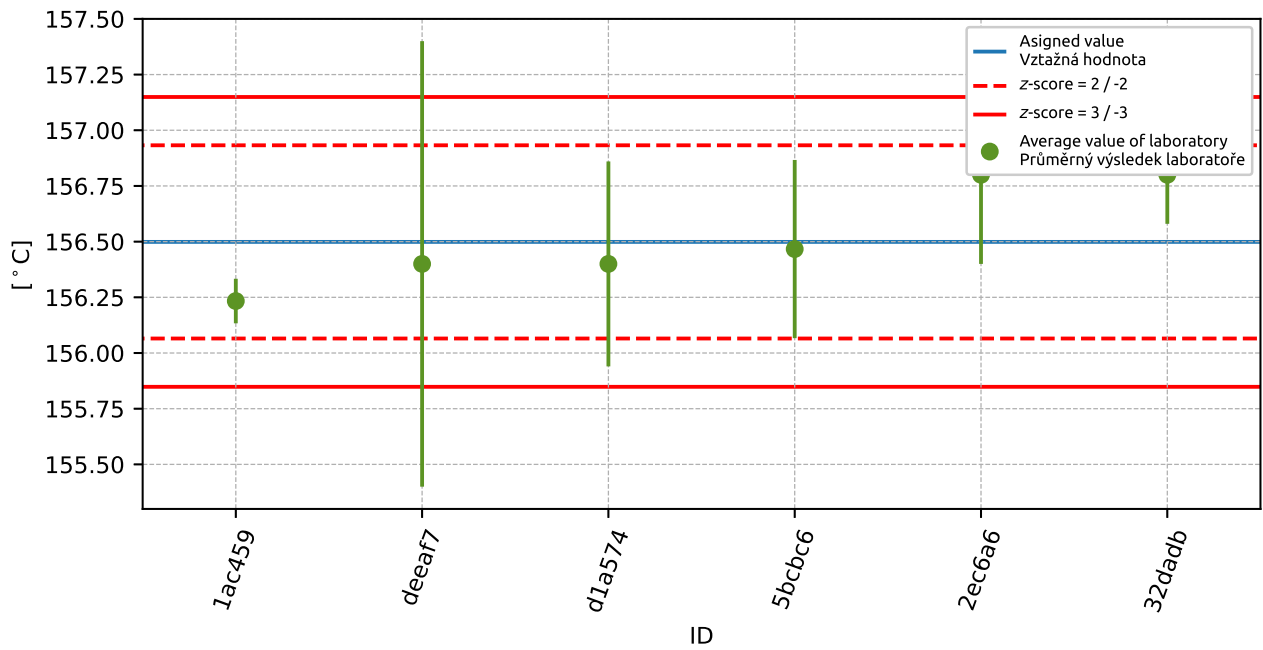


Figure 124: Average values and extended uncertainties of measurement

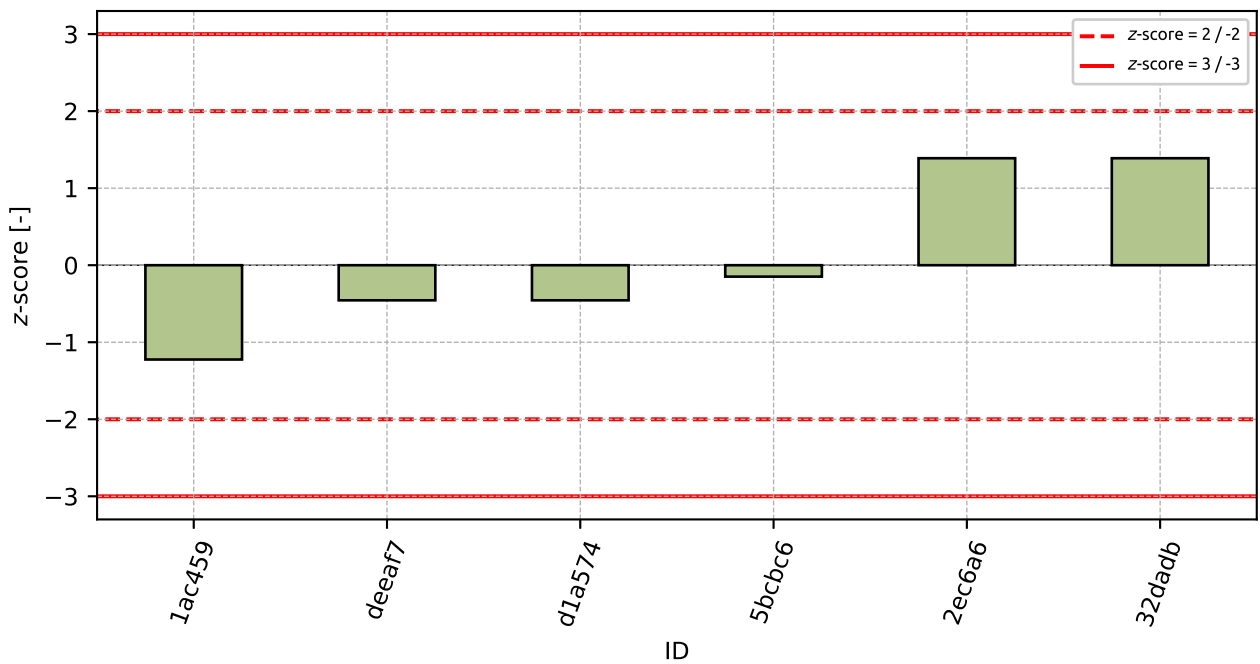
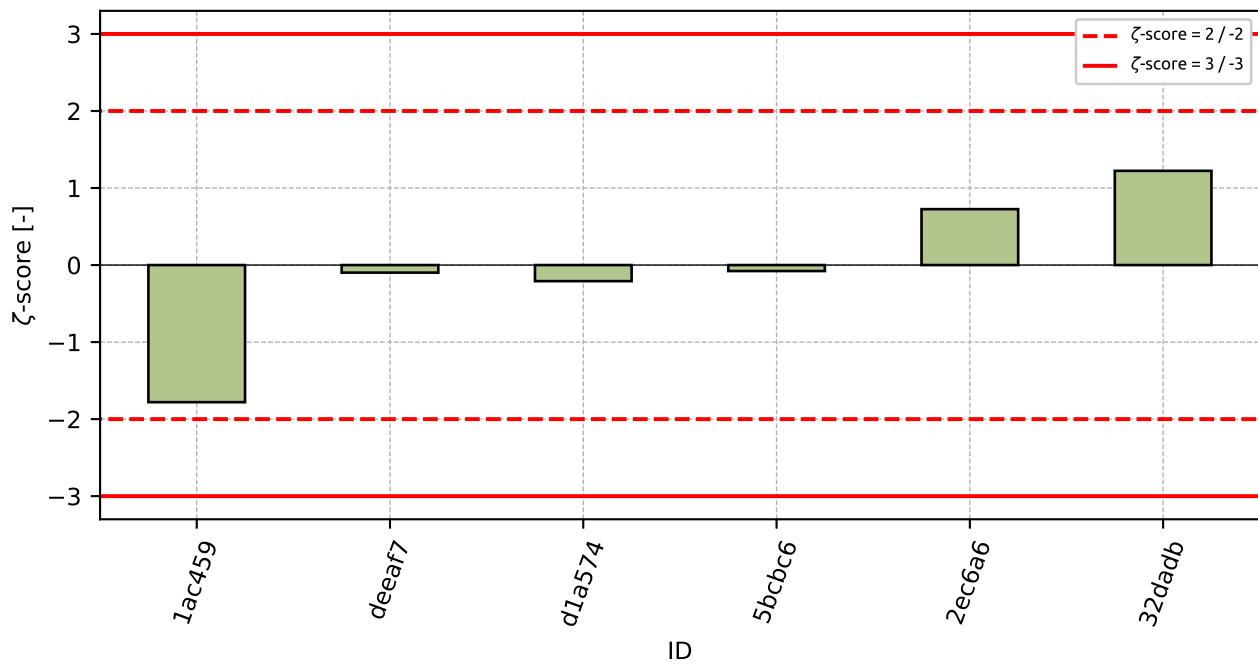


Figure 125: z-score

Figure 126:  $\zeta$ -scoreTable 44: z-score and  $\zeta$ -score

ID	z-score [-]	$\zeta$ -score [-]
1ac459	-1.22	-1.78
deef7	-0.46	-0.1
d1a574	-0.46	-0.21
5bcbc6	-0.15	-0.08
2ec6a6	1.39	0.73
32dadb	1.39	1.22

**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)**

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



## 15 Appendix – EN ISO 11357-1, -3 (Melting temperature $T_{m1}$ , Enthalpy of fusion $\Delta H_{m1}$ )

### 15.1 Sample A

#### 15.1.1 Melting temperature $T_{m1}$

##### Test results

Table 45: 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 [°C]			$u_x$ [°C]	$\bar{x}$ [°C]	$s_0$ [°C]	$V_x$ [%]
2ec6a6	165.29	165.54	165.19	0.1	165.34	0.18	0.11
5bc6c6	165.71	165.67	165.53	0.2	165.64	0.095	0.06
deea7	166.44	166.54	166.56	0.06	166.51	0.064	0.04
037e4d	166.8	166.5	168.1	1.3	167.13	0.85	0.51
d1a574	167.17	168.02	167.54	0.43	167.58	0.426	0.25

### The Numerical Procedure for Determining Outliers

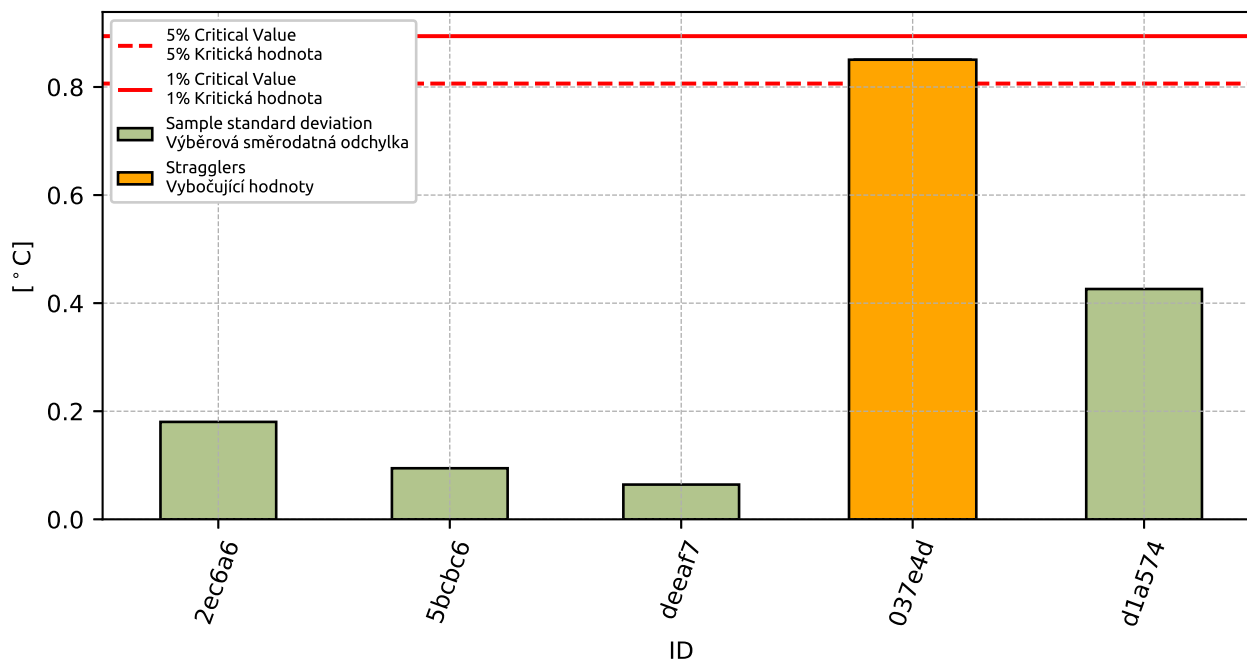


Figure 127: Cochran's test - sample standard deviations

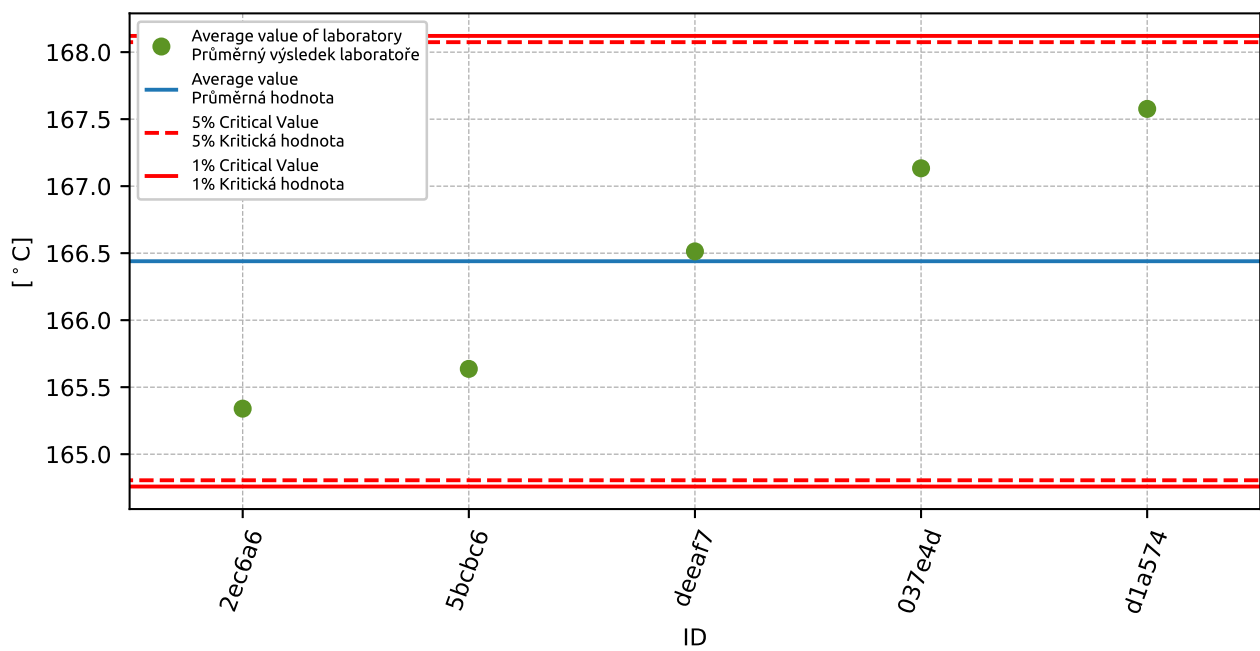


Figure 128: Grubbs' test - average values

### Mandel's Statistics

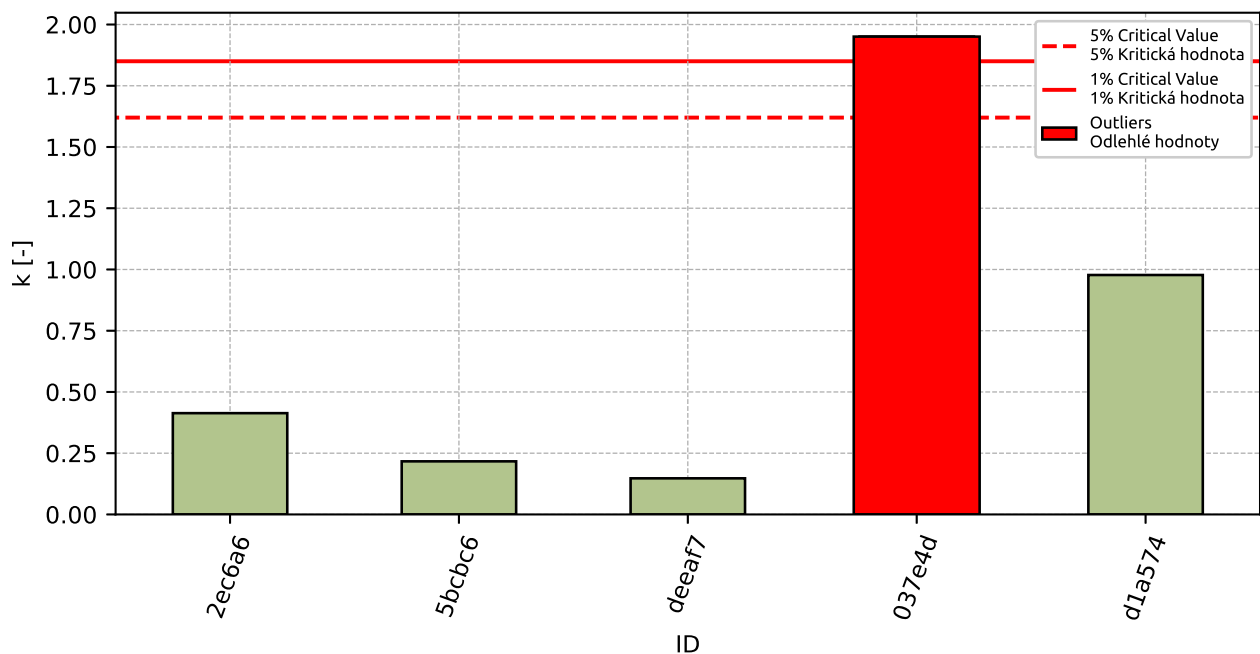


Figure 129: Intralaboratory Consistency Statistic

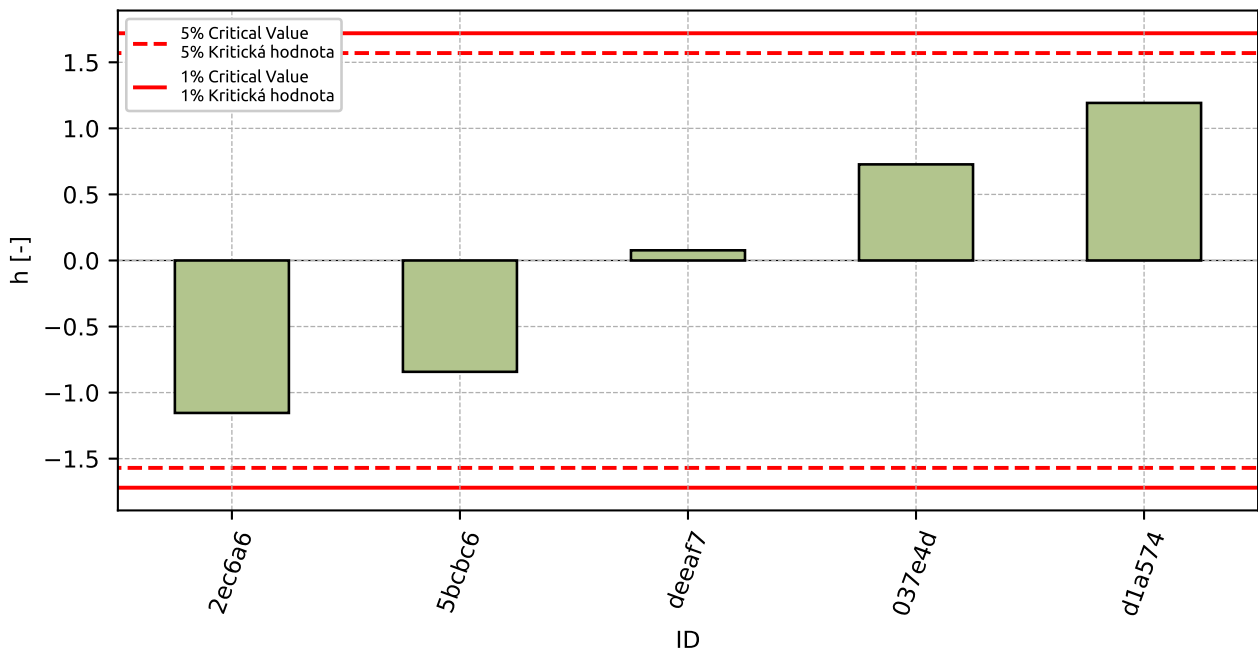


Figure 130: Interlaboratory Consistency Statistic

### Descriptive statistics

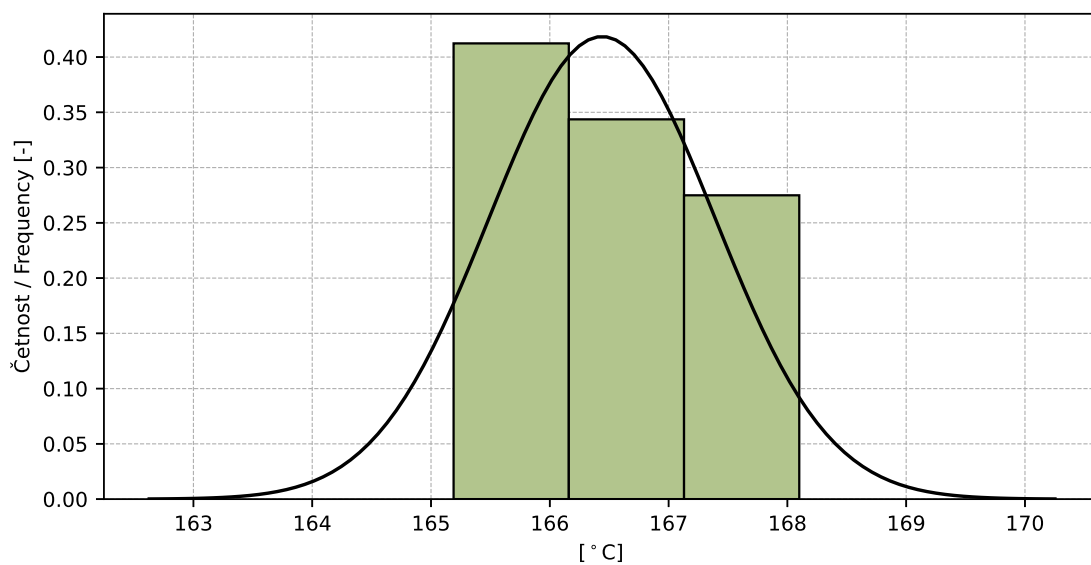


Figure 131: Histogram of all test results

Table 46: Descriptive statistics

Characteristics	[°C]
Průměrná hodnota / Average value – $\bar{x}$	166.44
Výběrová směrodatná odchylka / Sample standard deviation – $s$	0.953
Vztažná hodnota / Assigned value – $x^*$	166.44
Robustní směrodatná odchylka / Robust standard deviation – $s^*$	0.967
Nejistota měření vztažné hodnoty / Measurement uncertainty of assigned value – $u_X$	0.54
$p$ -hodnota testu normality / $p$ -value of normality test	0.229 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – $s_L$	0.919
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – $s_r$	0.436
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – $s_R$	1.017
Opakovatelnost / Repeatability – $r$	1.22
Reprodukovatelnost / Reproducibility – $R$	2.85

### Evaluation of Performance Statistics

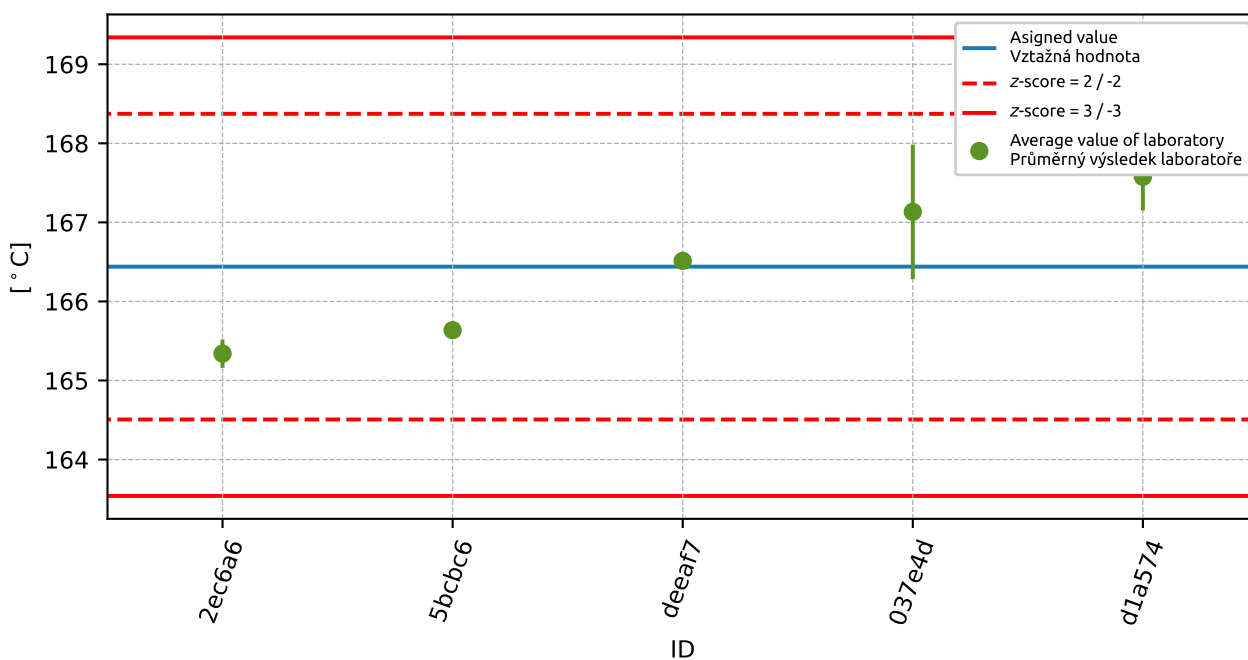


Figure 132: Average values and sample standard deviations

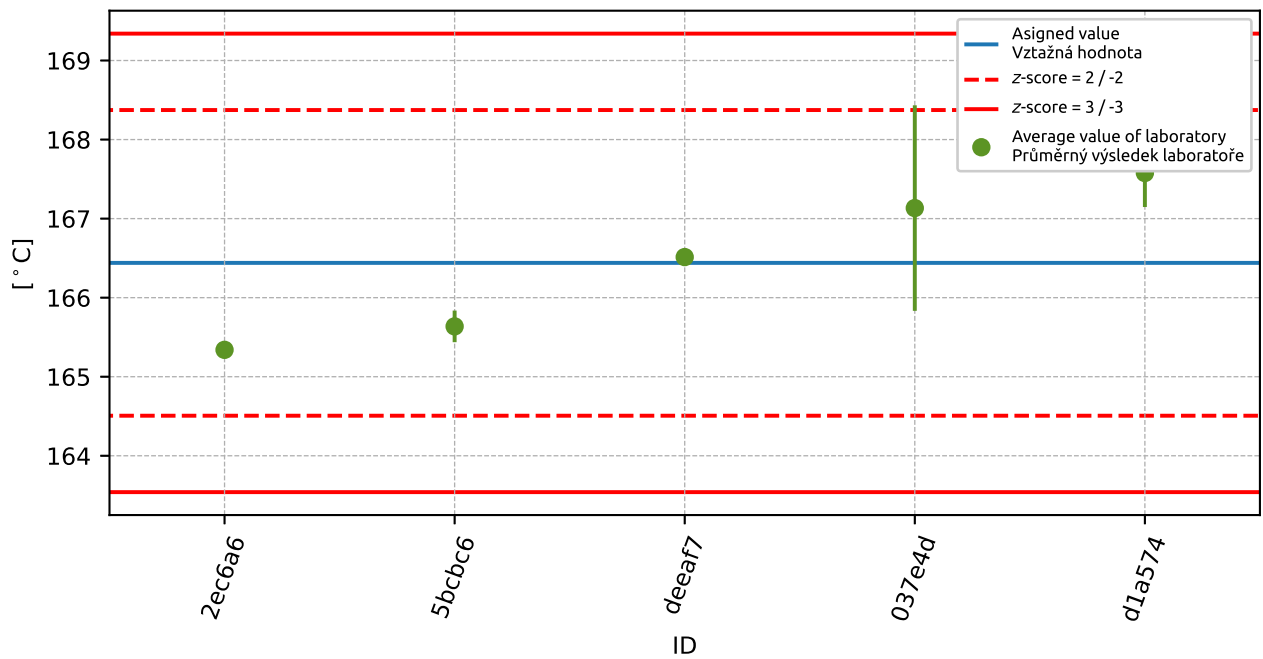


Figure 133: Average values and extended uncertainties of measurement

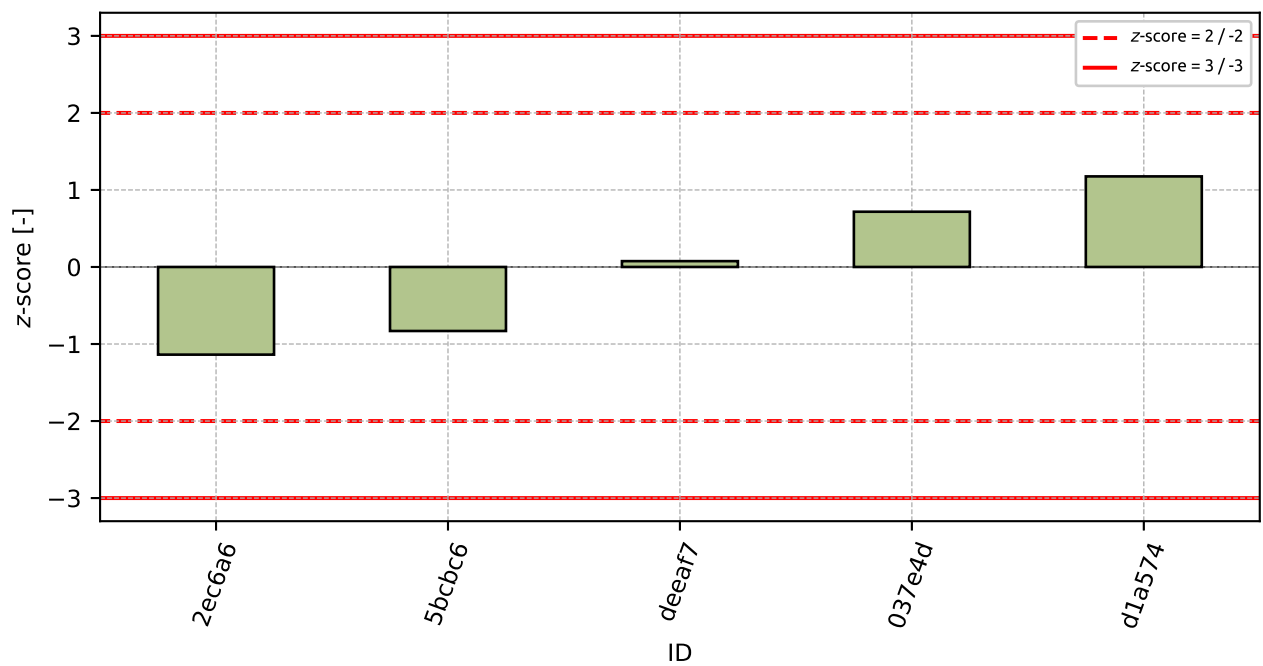
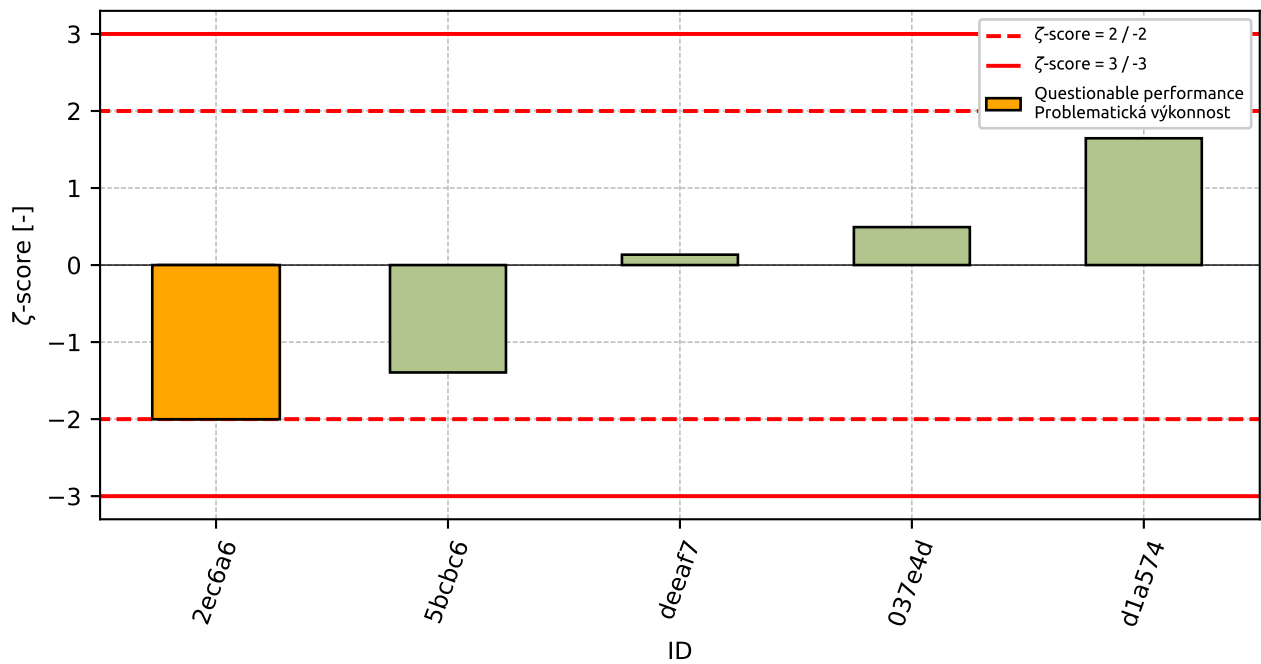


Figure 134: z-score

Figure 135:  $\zeta$ -scoreTable 47: z-score and  $\zeta$ -score

ID	z-score [-]	$\zeta$ -score [-]
2ec6a6	-1.14	-2.0
5bcbc6	-0.83	-1.39
deea7	0.08	0.13
037e4d	0.72	0.49
d1a574	1.18	1.65

### 15.1.2 Enthalpy of fusion $\Delta H_{m1}$

#### Test results

Table 48: 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			$u_X$	$\bar{x}$	$s_0$	$V_X$
	[J/g]						
037e4d	82.98	87.74	83.92	12.0	84.88	2.521	2.97
5bcbc6	86.75	86.07	88.57	2.1	87.13	1.293	1.48
2ec6a6	88.23	86.46	89.62	2.6	88.1	1.584	1.8
d1a574	101.38	101.59	101.49	0.1	101.49	0.103	0.1
deef7	458.71	422.92	444.08	17.99	441.9	17.994	4.07

#### The Numerical Procedure for Determining Outliers

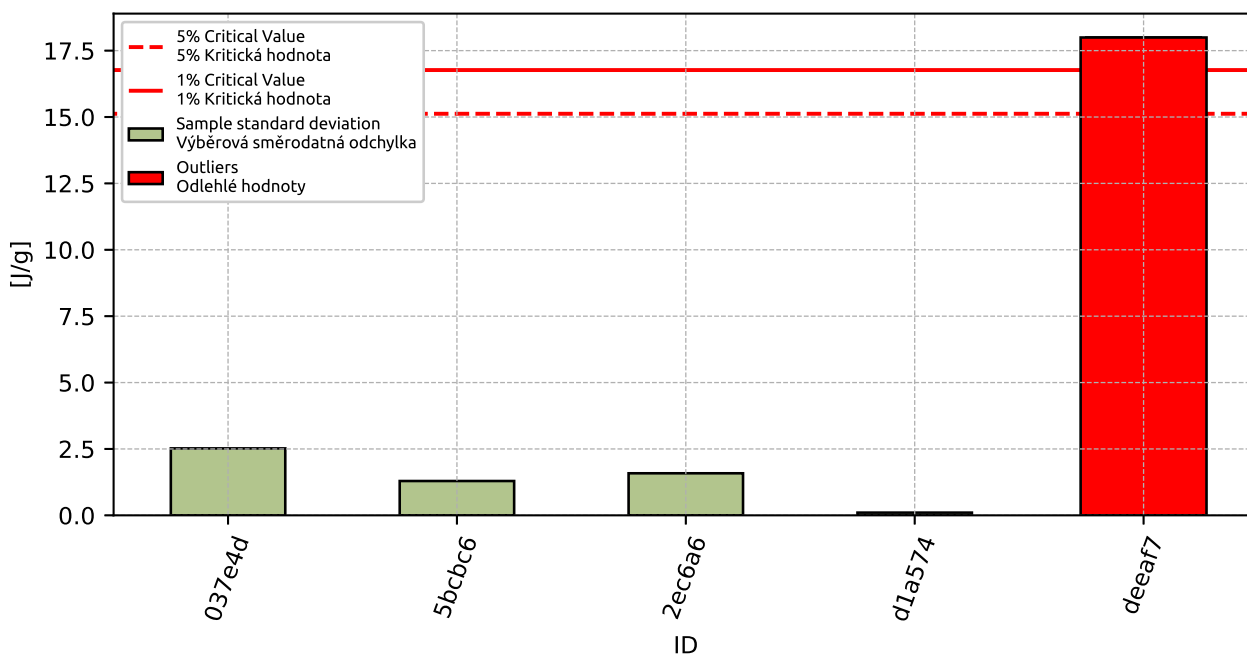


Figure 136: Cochran's test - sample standard deviations

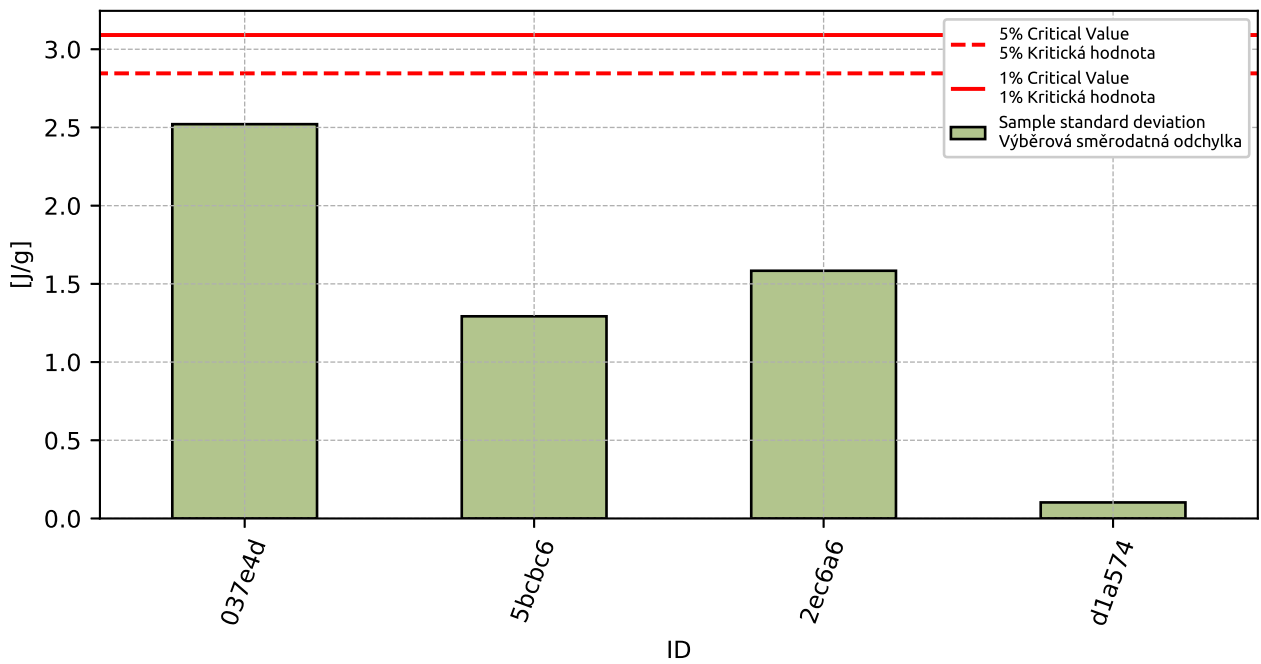


Figure 137: **Cochran's test** - sample standard deviations without outliers

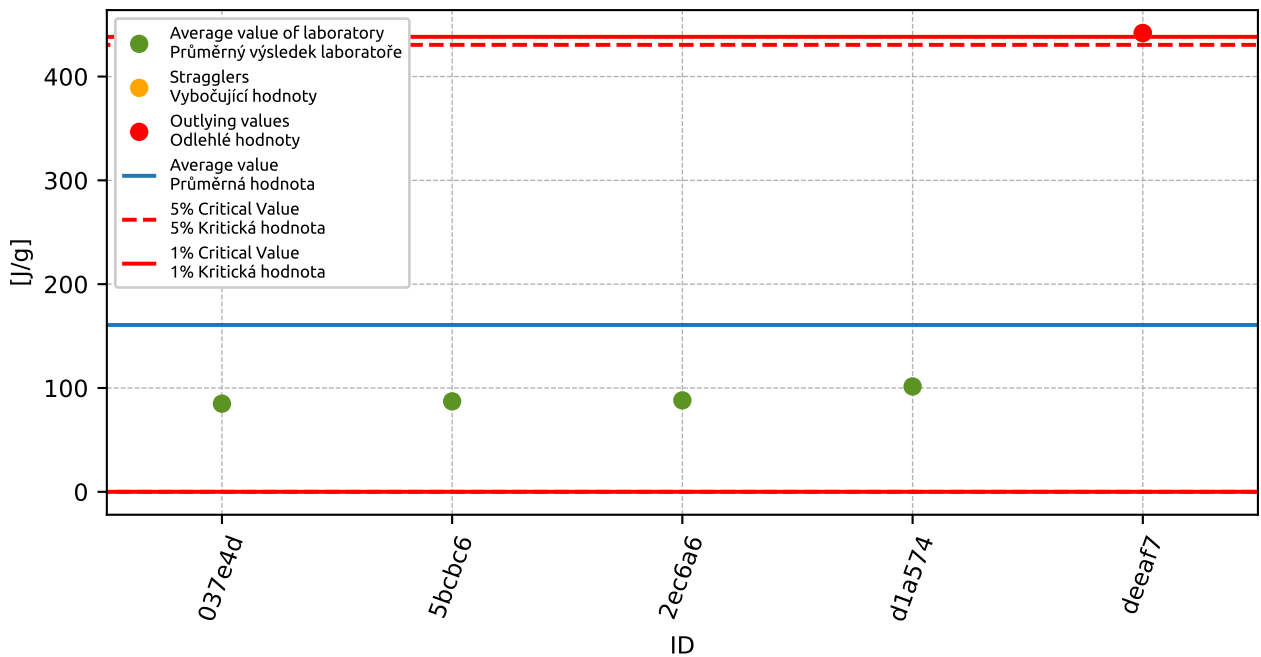


Figure 138: **Grubbs' test** - average values



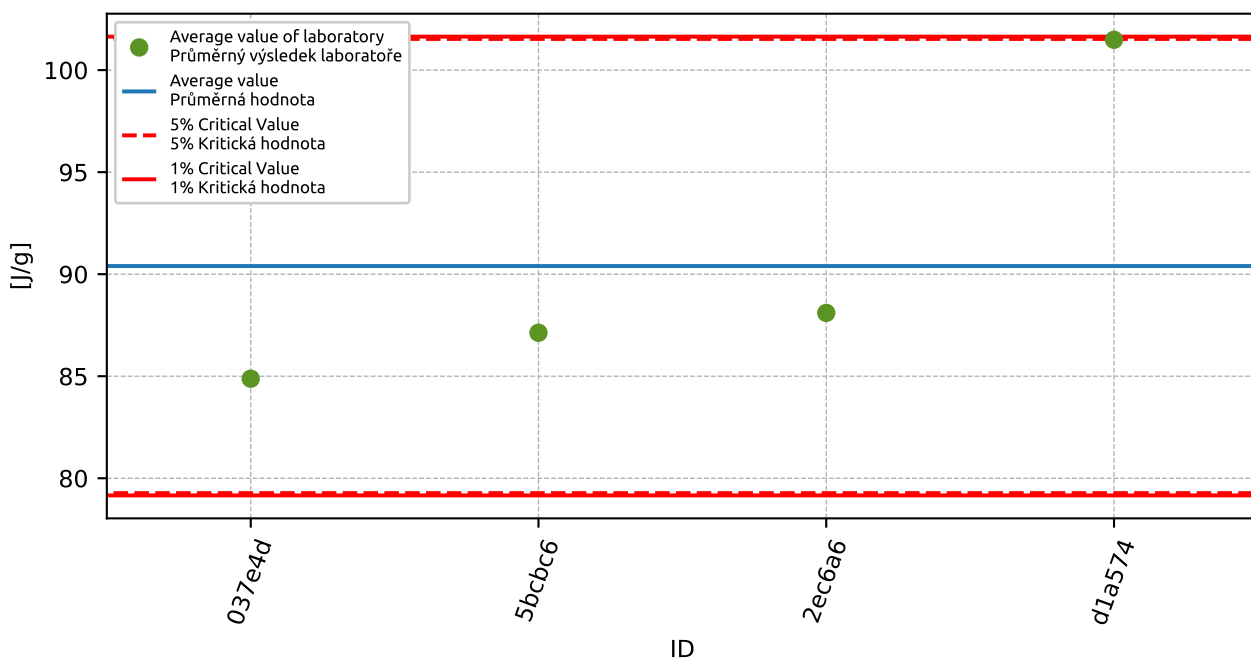


Figure 139: **Grubbs' test** - average values without outliers

**Mandel's Statistics**

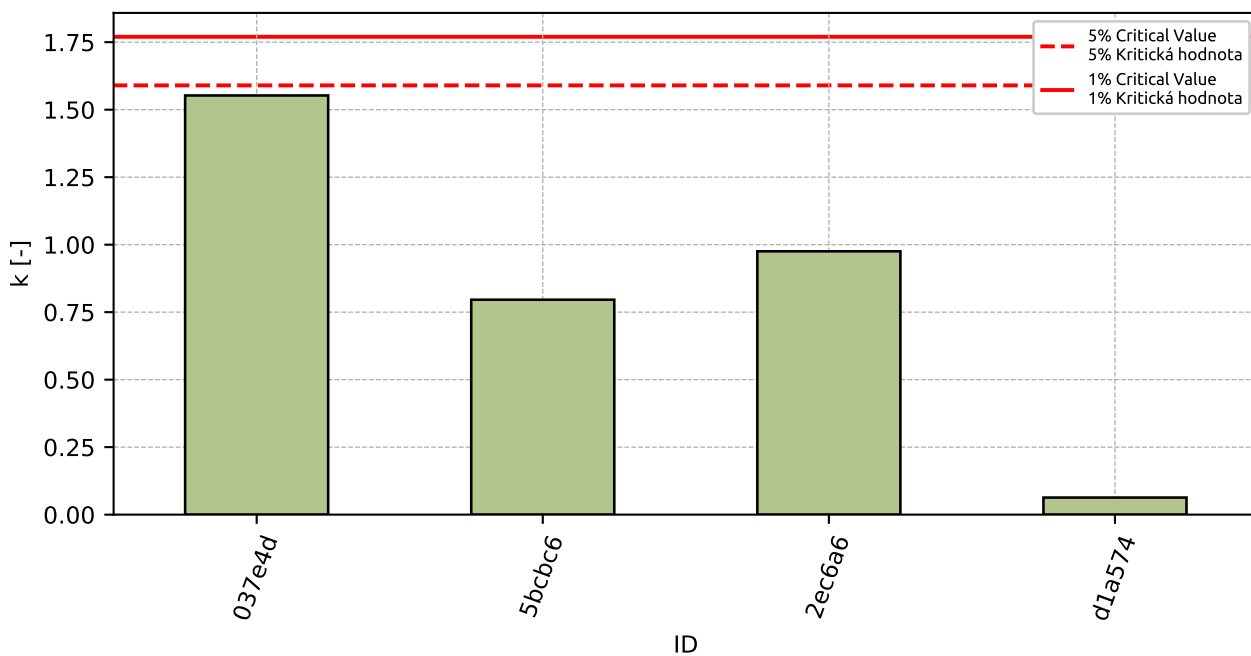


Figure 140: Intralaboratory Consistency Statistic

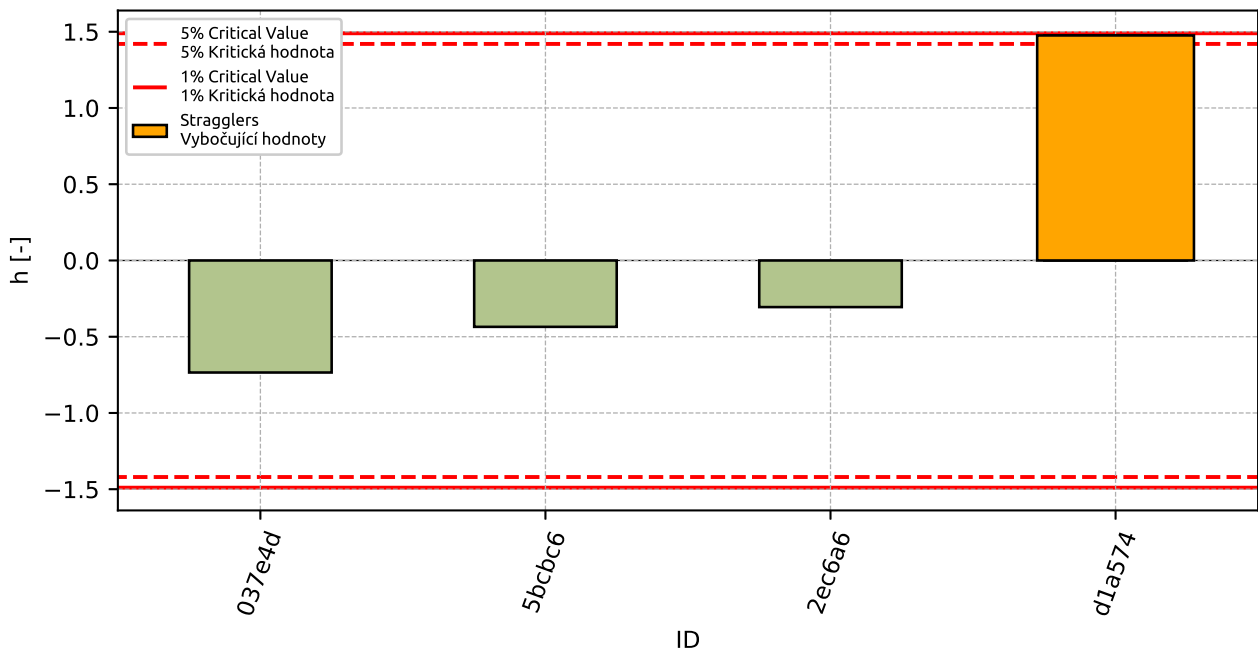


Figure 141: Interlaboratory Consistency Statistic

### Descriptive statistics

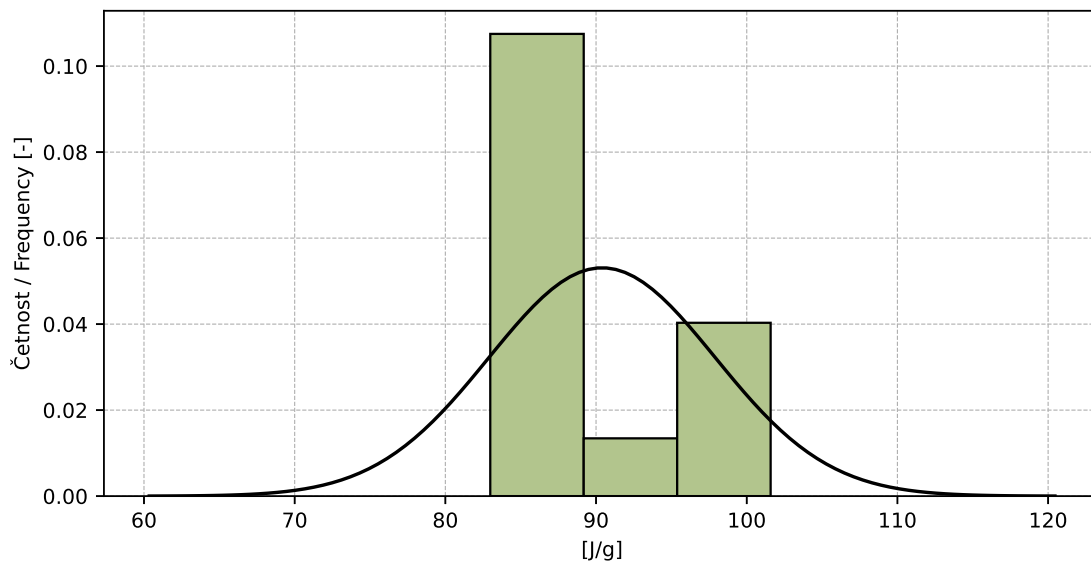


Figure 142: Histogram of all test results

Table 49: Descriptive statistics

Characteristics	[J/g]
Průměrná hodnota / Average value – $\bar{x}$	90.4
Výběrová směrodatná odchylka / Sample standard deviation – $s$	7.513
Vztažná hodnota / Assigned value – $x^*$	90.4
Robustní směrodatná odchylka / Robust standard deviation – $s^*$	7.379
Nejistota měření vztažné hodnoty / Measurement uncertainty of assigned value – $u_X$	4.612
$p$ -hodnota testu normality / $p$ -value of normality test	0.005 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – $s_L$	7.454
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – $s_r$	1.624
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – $s_R$	7.629
Opakovatelnost / Repeatability – $r$	4.55
Reprodukovatelnost / Reproducibility – $R$	21.36

### Evaluation of Performance Statistics

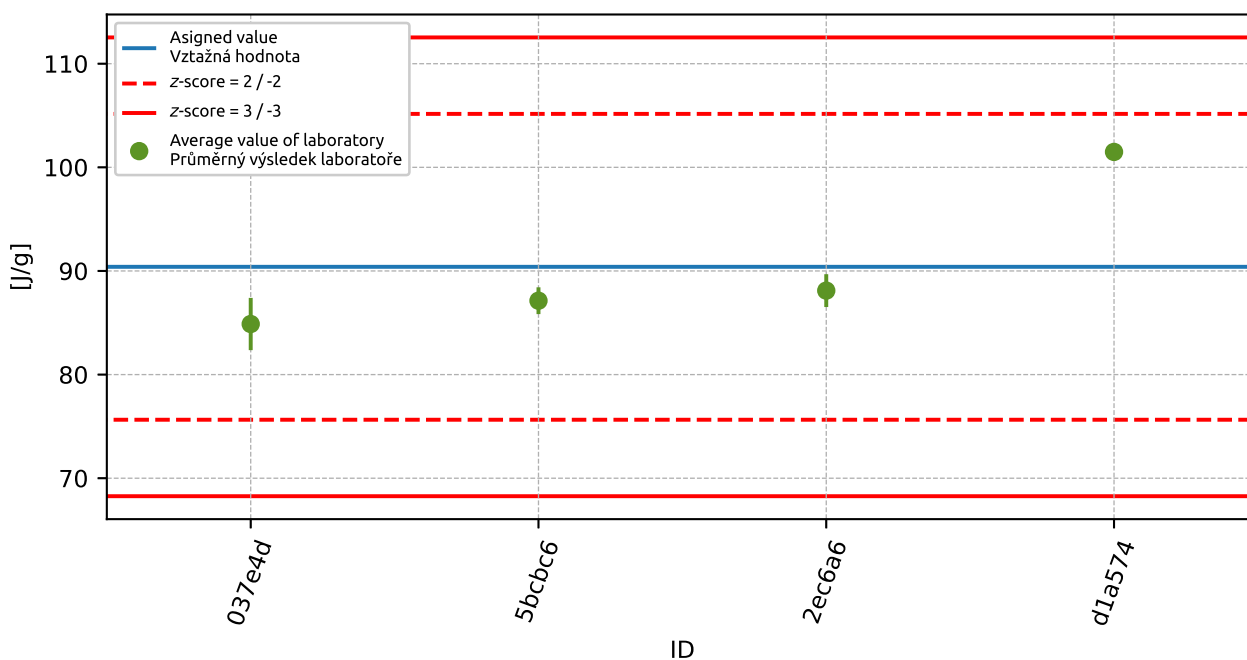


Figure 143: Average values and sample standard deviations

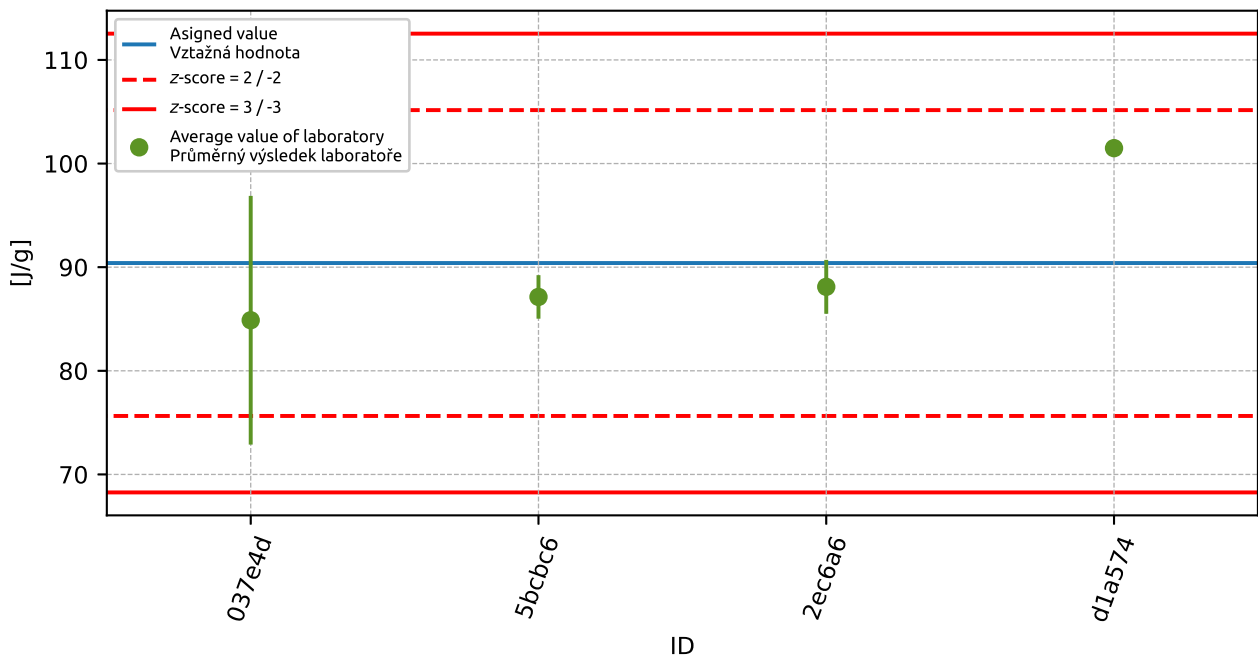


Figure 144: Average values and extended uncertainties of measurement

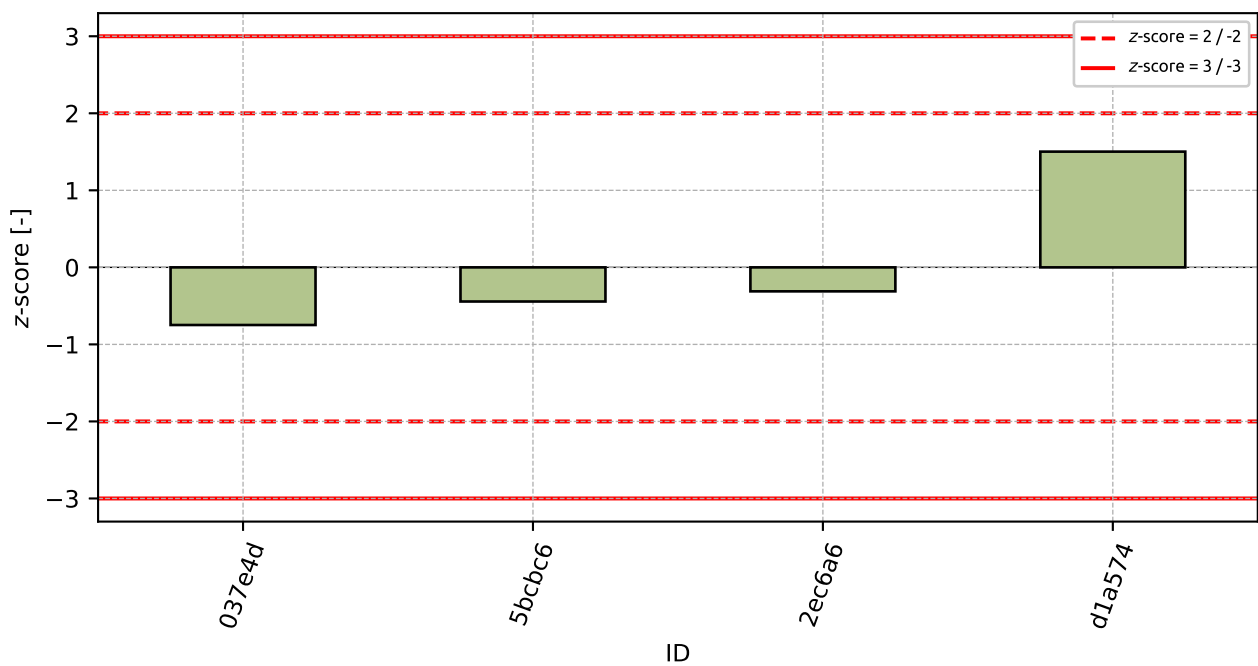
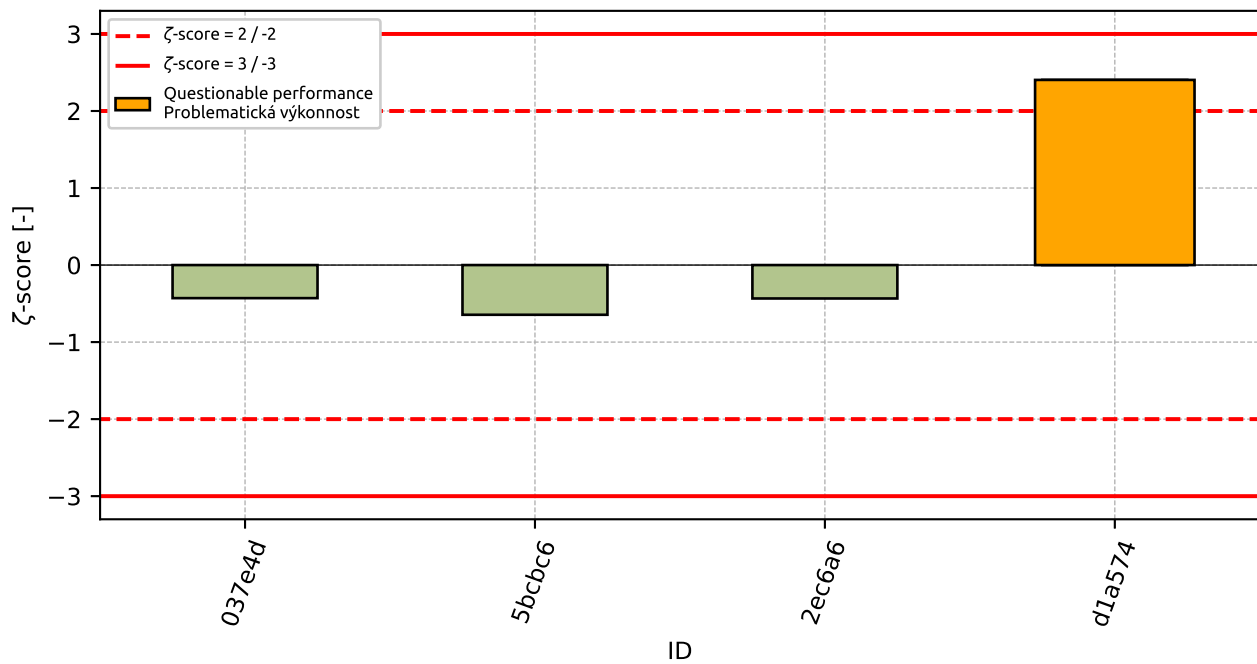


Figure 145: z-score

Figure 146:  $\zeta$ -scoreTable 50: z-score and  $\zeta$ -score

ID	z-score [-]	$\zeta$ -score [-]
037e4d	-0.75	-0.43
5bcbc6	-0.44	-0.65
2ec6a6	-0.31	-0.43
d1a574	1.5	2.4

## 15.2 Sample B

### 15.2.1 Melting temperature $T_{m1}$

#### Test results

Table 51: 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			$u_X$	$\bar{x}$	$s_0$	$V_X$
	[°C]						
5bcbc6	166.35	166.51	166.51	0.2	166.46	0.092	0.06
2ec6a6	167.14	166.62	167.13	0.5	166.96	0.297	0.18
deef7	166.87	167.18	166.91	0.17	166.99	0.169	0.1
037e4d	167.5	168.0	168.7	1.0	168.07	0.603	0.36
d1a574	167.82	168.42	168.12	0.3	168.12	0.3	0.18

#### The Numerical Procedure for Determining Outliers

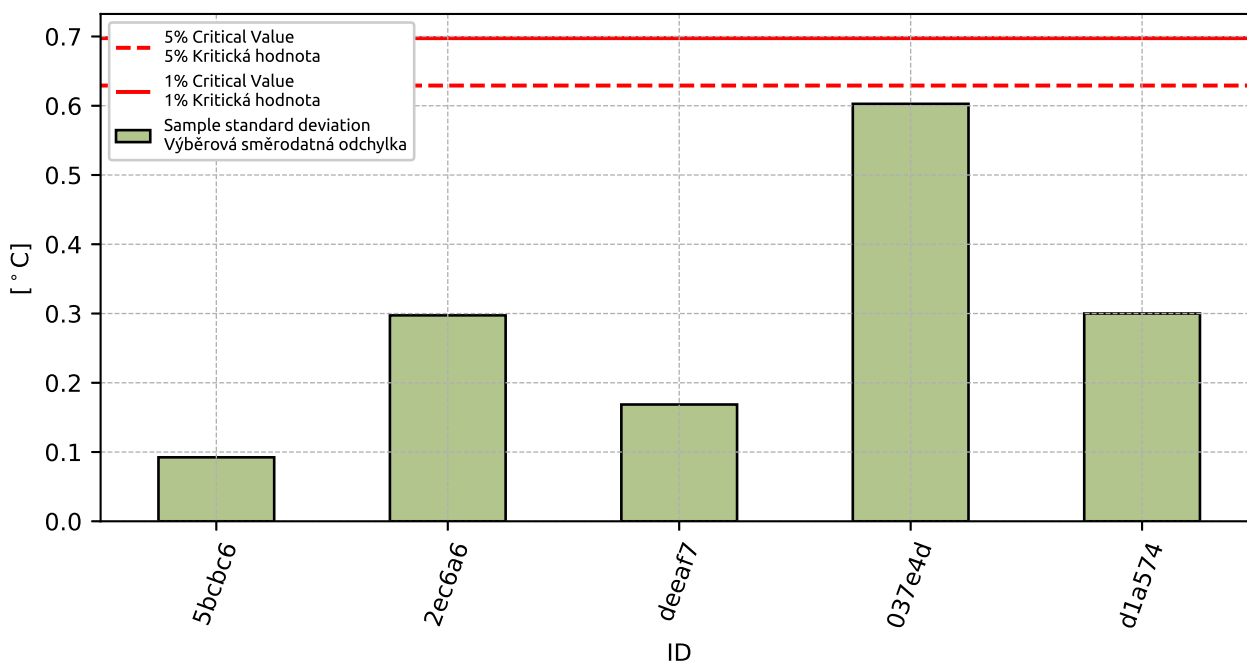


Figure 147: Cochran's test - sample standard deviations

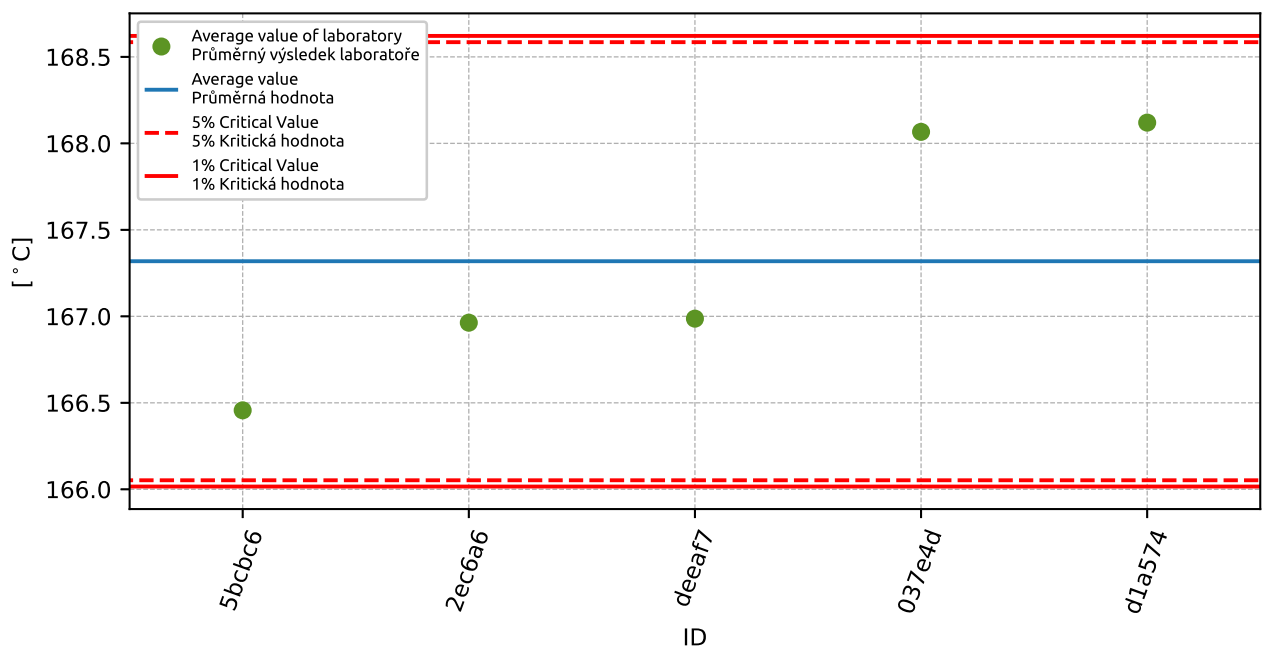


Figure 148: **Grubbs' test** - average values

**Mandel's Statistics**

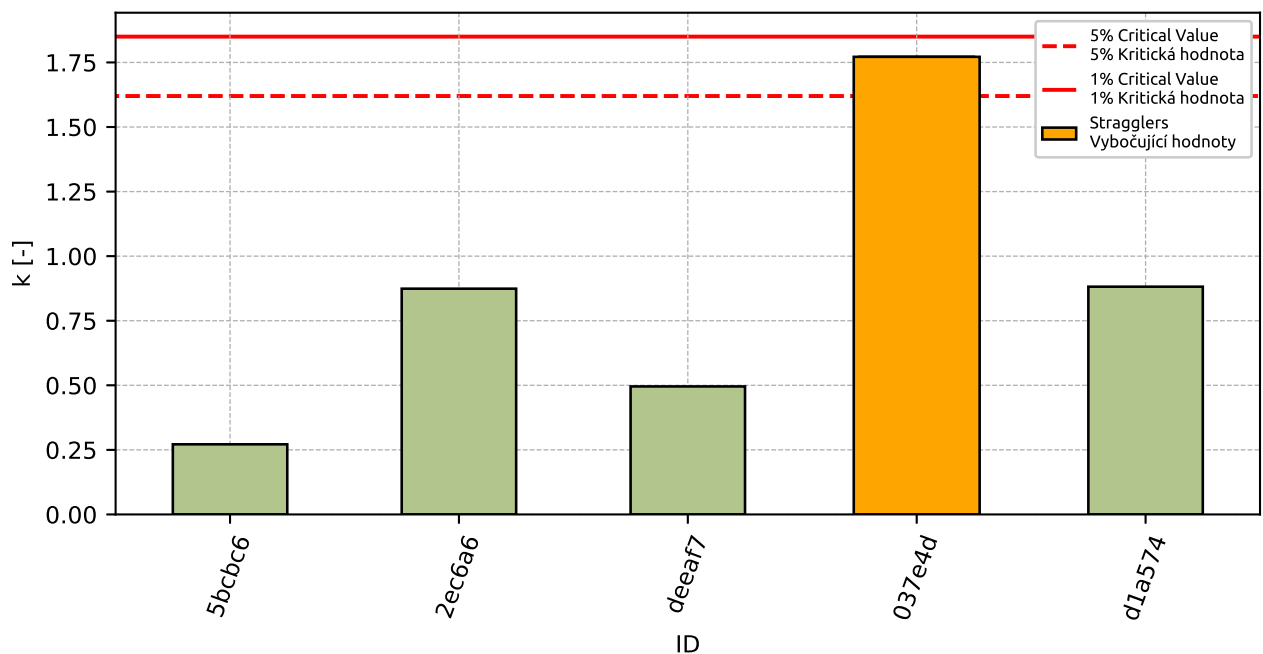


Figure 149: Intralaboratory Consistency Statistic

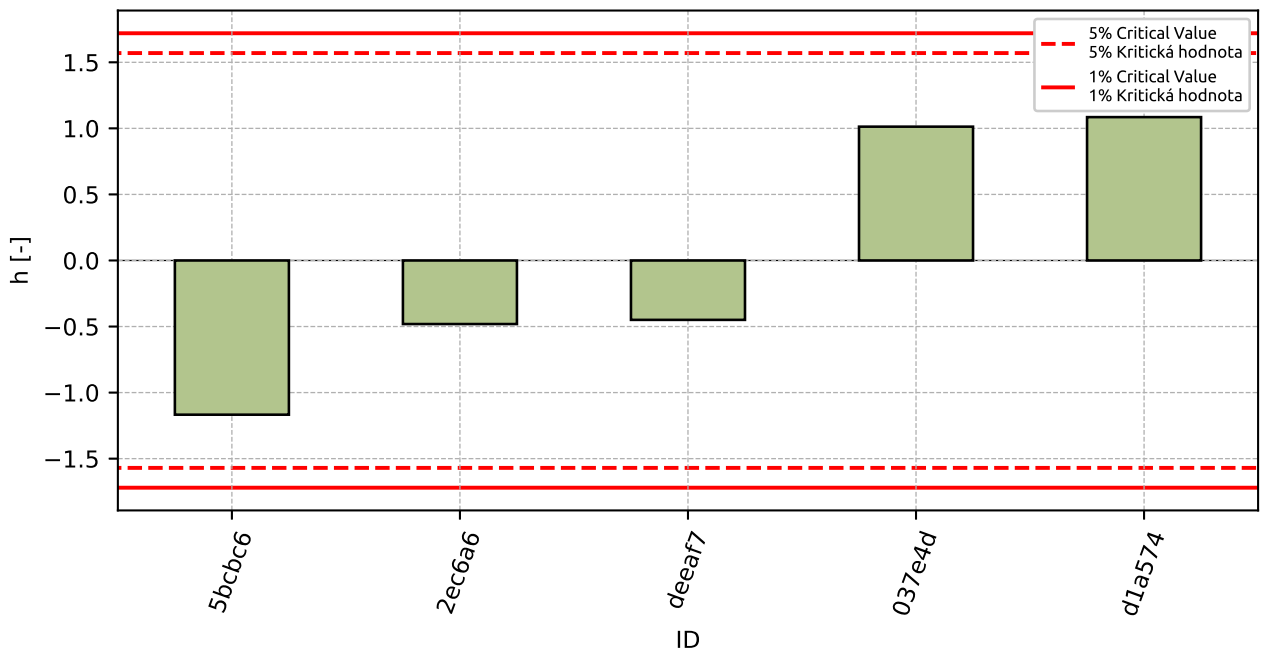


Figure 150: Interlaboratory Consistency Statistic

### Descriptive statistics

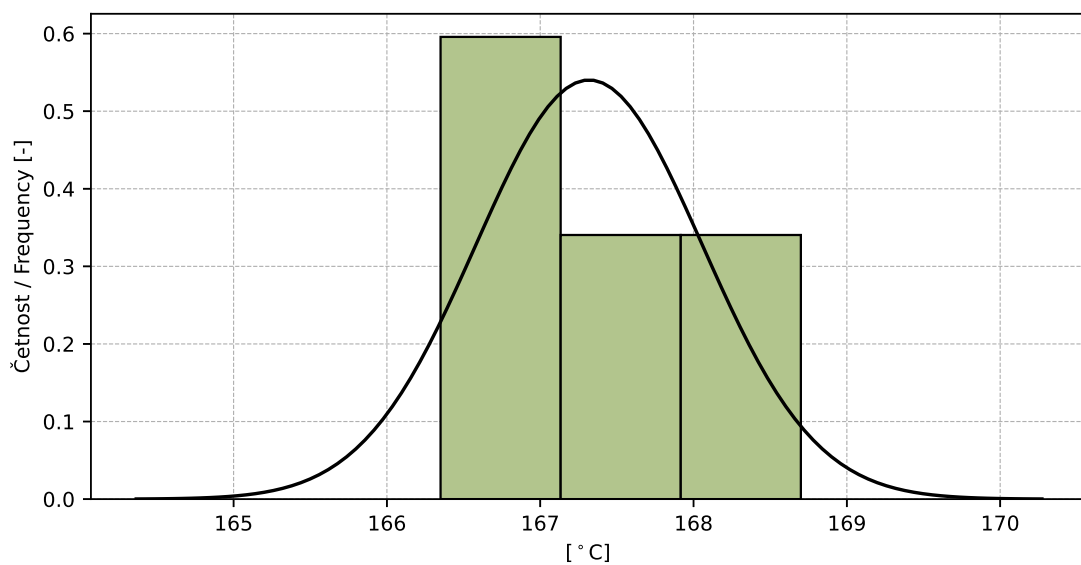


Figure 151: Histogram of all test results



Table 52: Descriptive statistics

Characteristics	[°C]
Průměrná hodnota / Average value – $\bar{x}$	167.32
Výběrová směrodatná odchylka / Sample standard deviation – $s$	0.738
Vztažná hodnota / Assigned value – $x^*$	167.32
Robustní směrodatná odchylka / Robust standard deviation – $s^*$	0.749
Nejistota měření vztažné hodnoty / Measurement uncertainty of assigned value – $u_X$	0.419
$p$ -hodnota testu normality / $p$ -value of normality test	0.338 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – $s_L$	0.712
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – $s_r$	0.34
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – $s_R$	0.789
Opakovatelnost / Repeatability – $r$	0.95
Reprodukovatelnost / Reproducibility – $R$	2.21

### Evaluation of Performance Statistics

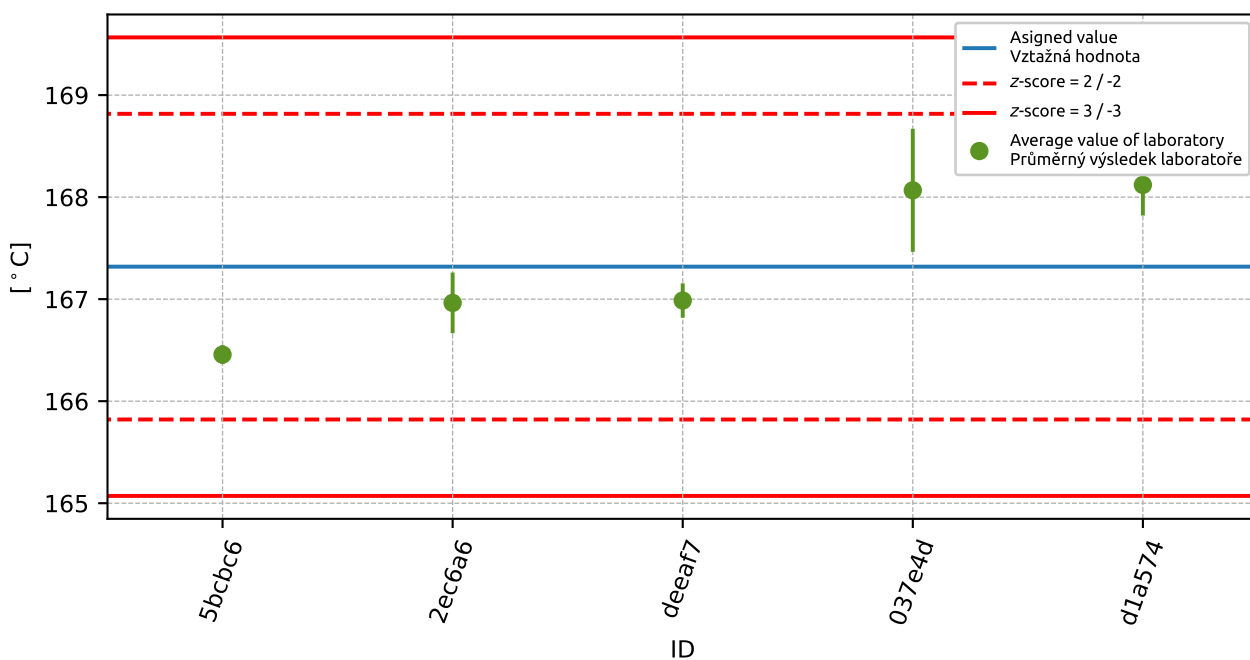


Figure 152: Average values and sample standard deviations

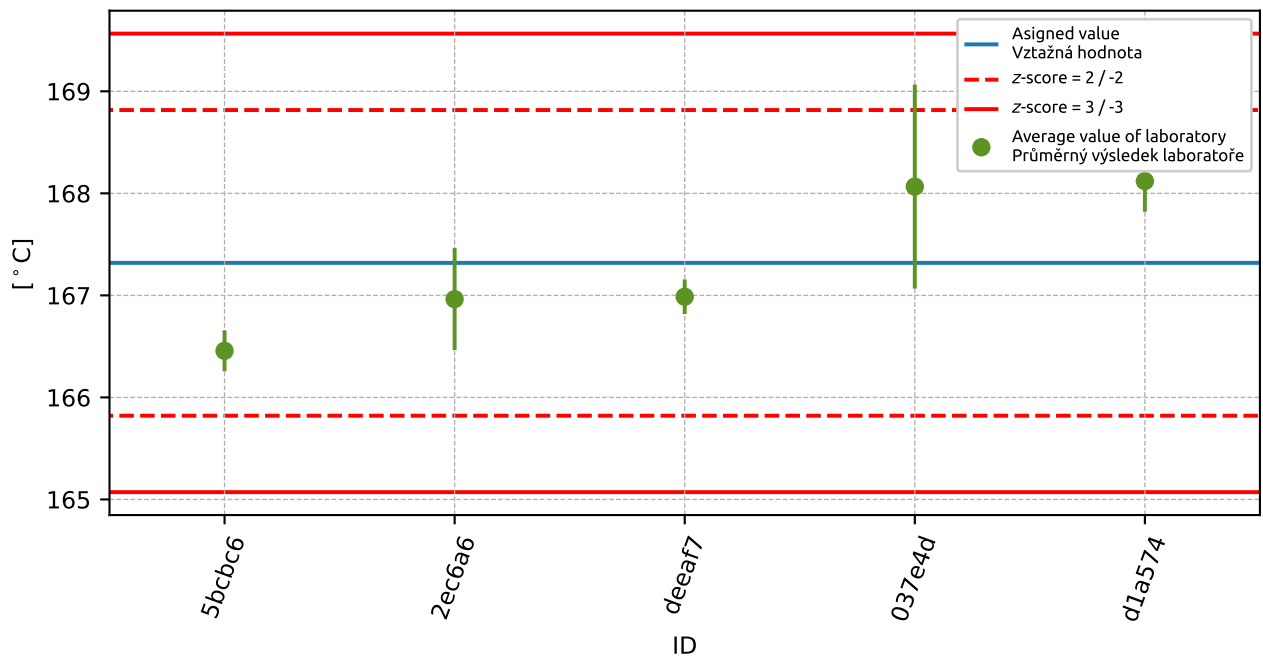


Figure 153: Average values and extended uncertainties of measurement

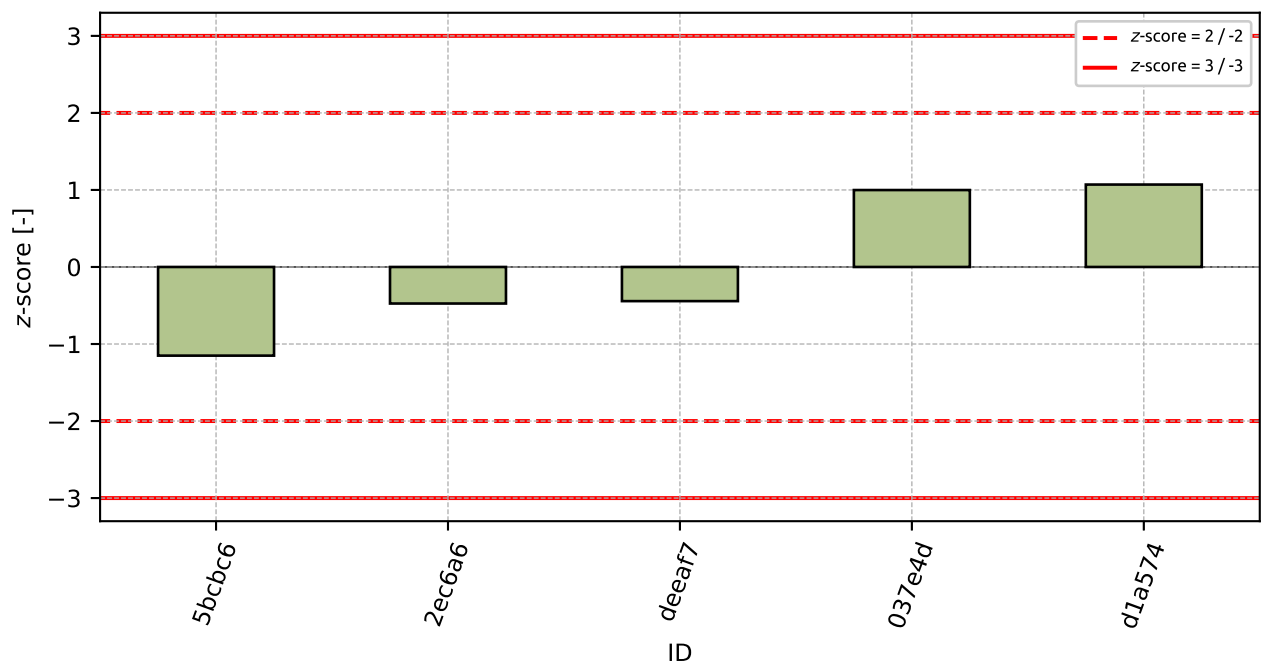
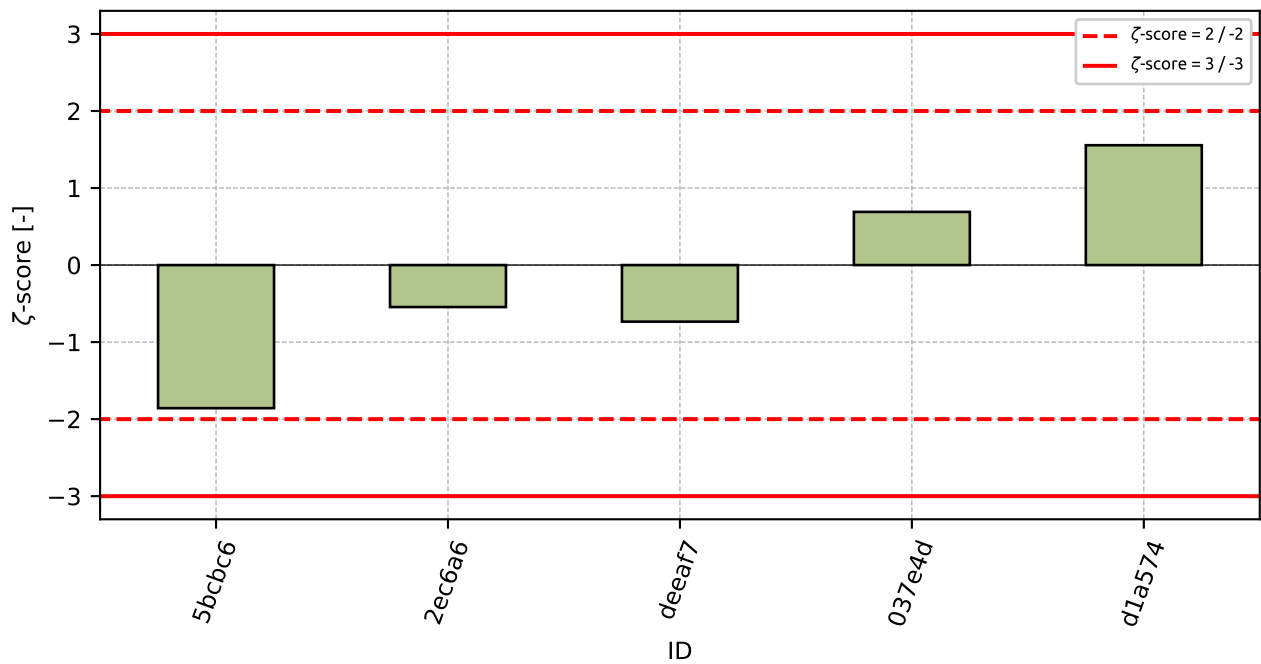


Figure 154: z-score

Figure 155:  $\zeta$ -scoreTable 53: z-score and  $\zeta$ -score

ID	z-score [-]	$\zeta$ -score [-]
5bcbc6	-1.15	-1.86
2ec6a6	-0.47	-0.54
deeaf7	-0.44	-0.73
037e4d	1.0	0.69
d1a574	1.07	1.56

### 15.2.2 Enthalpy of fusion $\Delta H_{m1}$

#### Test results

Table 54: 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			$u_X$	$\bar{x}$	$s_0$	$V_X$
	[J/g]	[J/g]	[J/g]				
037e4d	108.5	110.0	107.7	14.0	108.73	1.168	1.07
5bcbc6	109.6	110.9	109.8	1.1	110.1	0.7	0.64
2ec6a6	110.8	110.6	109.1	1.5	110.17	0.929	0.84
d1a574	134.86	133.26	134.25	0.81	134.13	0.807	0.6
deef7	493.75	509.14	502.39	7.71	501.76	7.714	1.54

#### The Numerical Procedure for Determining Outliers

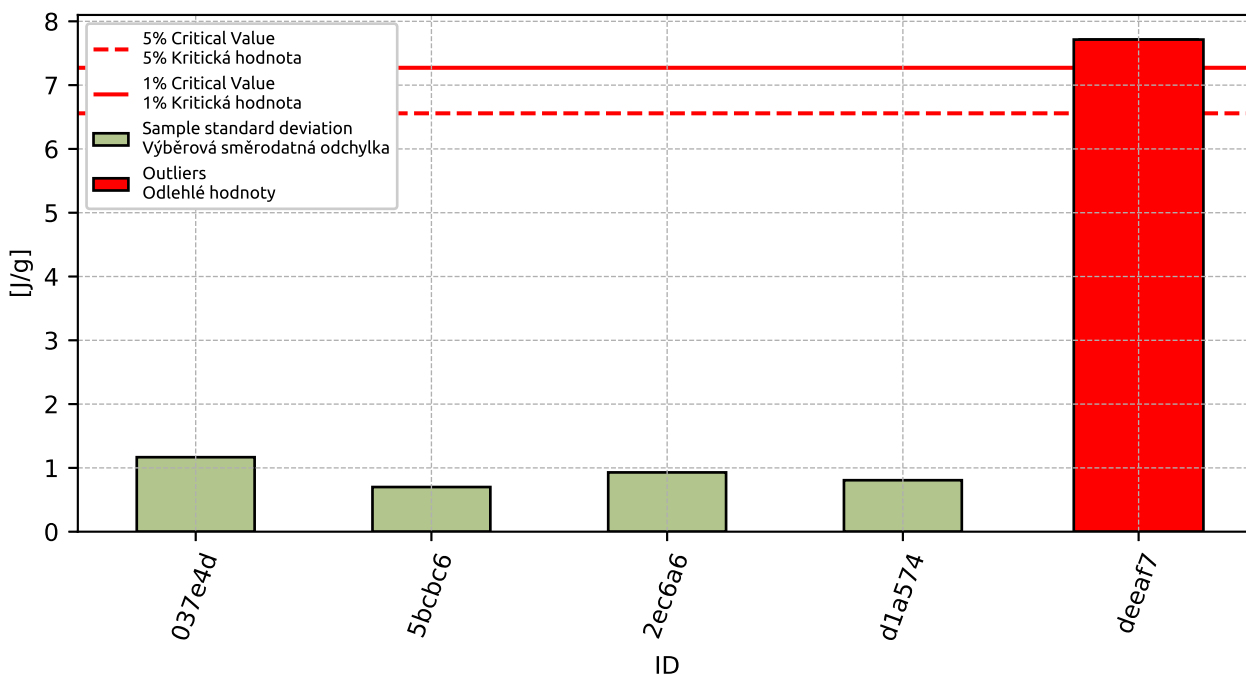


Figure 156: Cochran's test - sample standard deviations

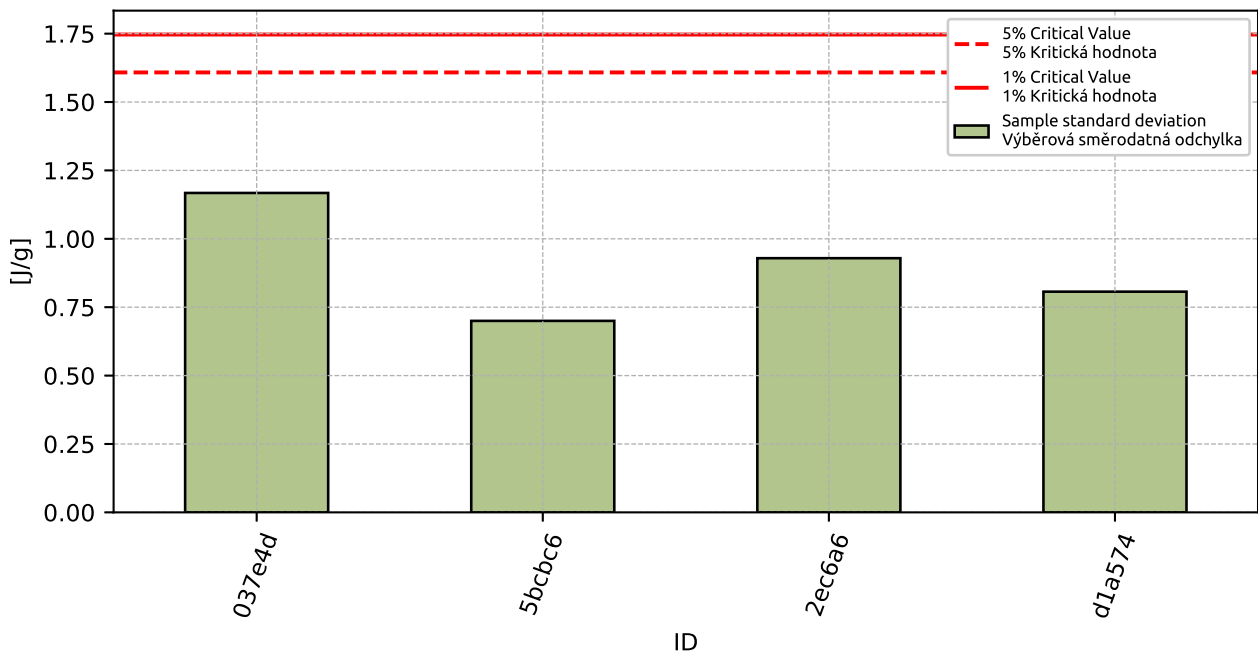


Figure 157: **Cochran's test** - sample standard deviations without outliers

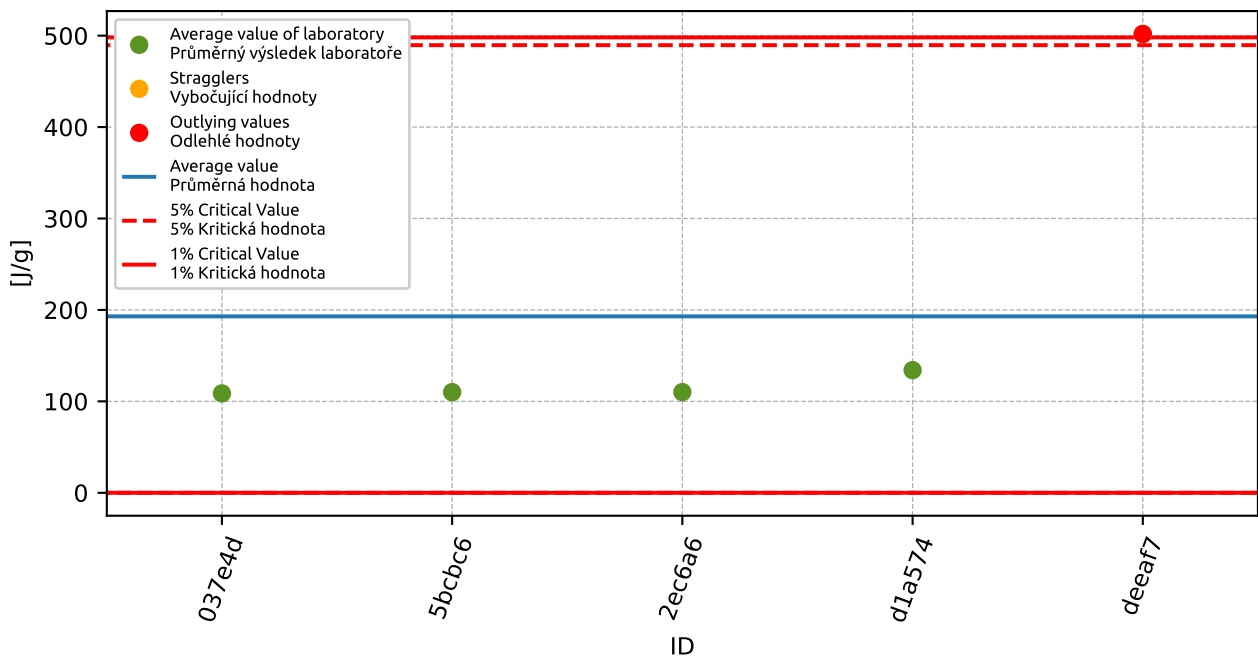


Figure 158: **Grubbs' test** - average values

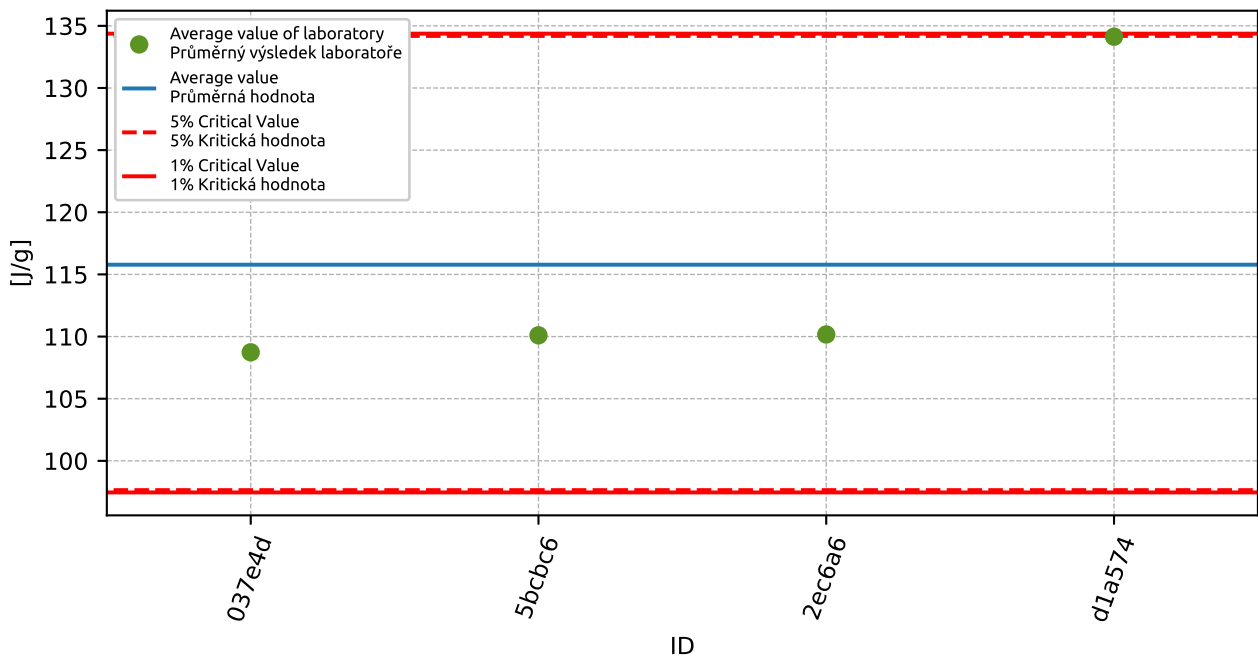


Figure 159: **Grubbs' test** - average values without outliers

**Mandel's Statistics**

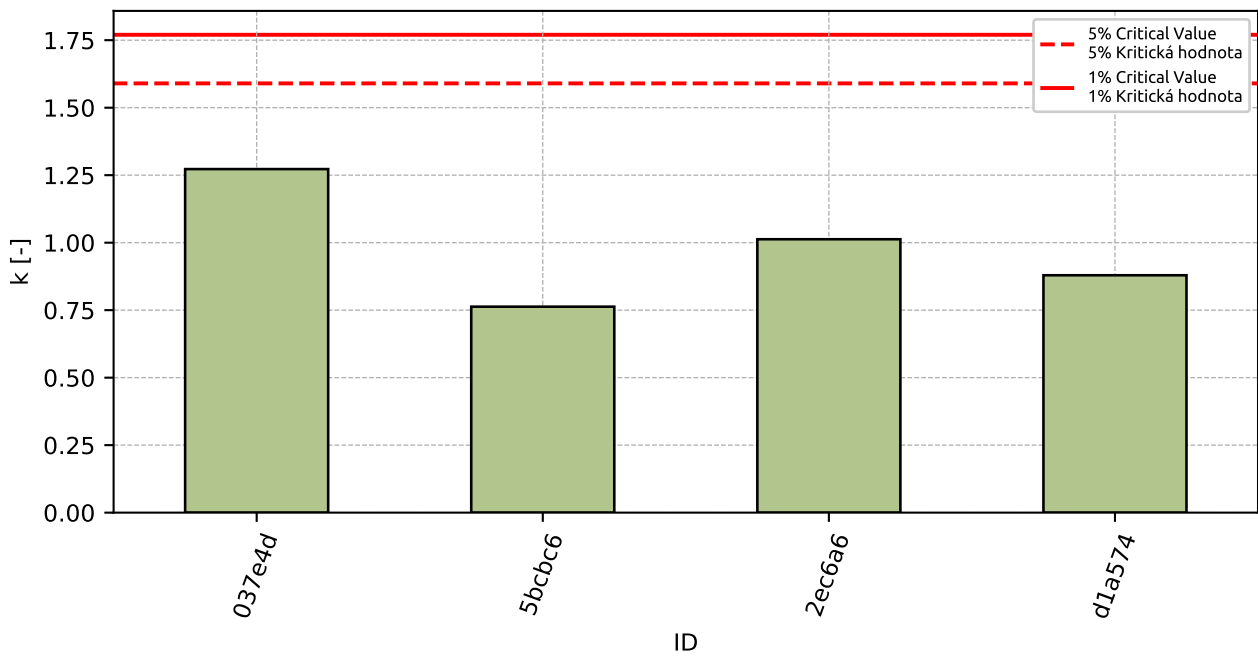


Figure 160: Intralaboratory Consistency Statistic

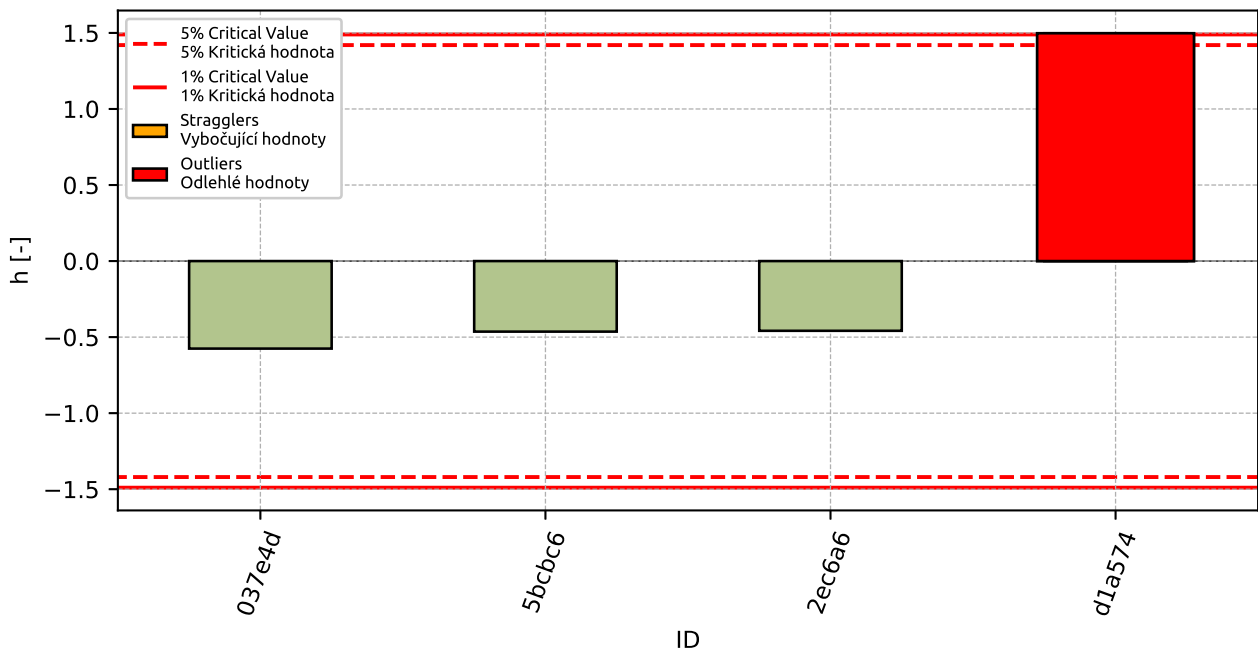


Figure 161: Interlaboratory Consistency Statistic

### Descriptive statistics

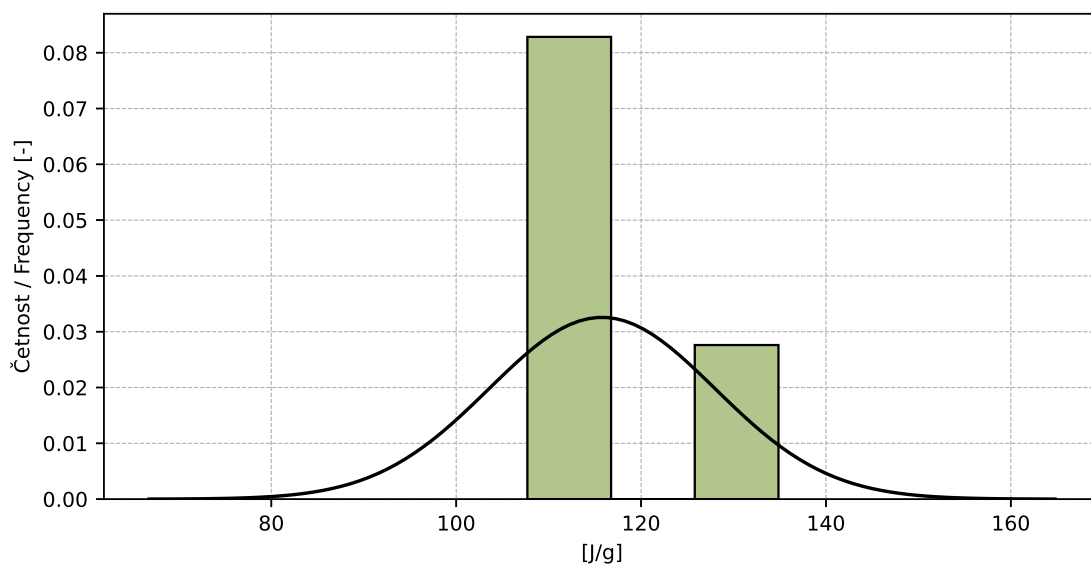


Figure 162: Histogram of all test results

Table 55: Descriptive statistics

Characteristics	[J/g]
Průměrná hodnota / Average value – $\bar{x}$	115.78
Výběrová směrodatná odchylka / Sample standard deviation – $s$	12.247
Vztažná hodnota / Assigned value – $x^*$	115.78
Robustní směrodatná odchylka / Robust standard deviation – $s^*$	12.028
Nejistota měření vztažné hodnoty / Measurement uncertainty of assigned value – $u_X$	7.517
$p$ -hodnota testu normality / $p$ -value of normality test	0.0 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – $s_L$	12.236
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – $s_r$	0.918
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – $s_R$	12.27
Opakovatelnost / Repeatability – $r$	2.57
Reprodukovatelnost / Reproducibility – $R$	34.36

### Evaluation of Performance Statistics

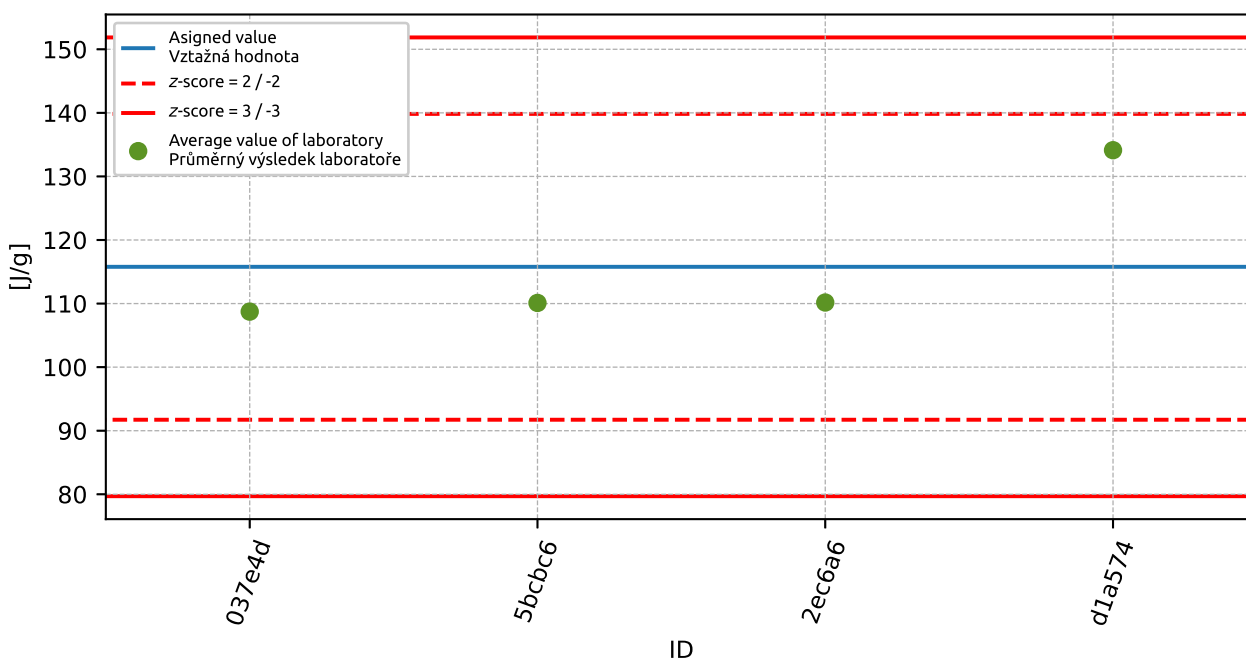


Figure 163: Average values and sample standard deviations



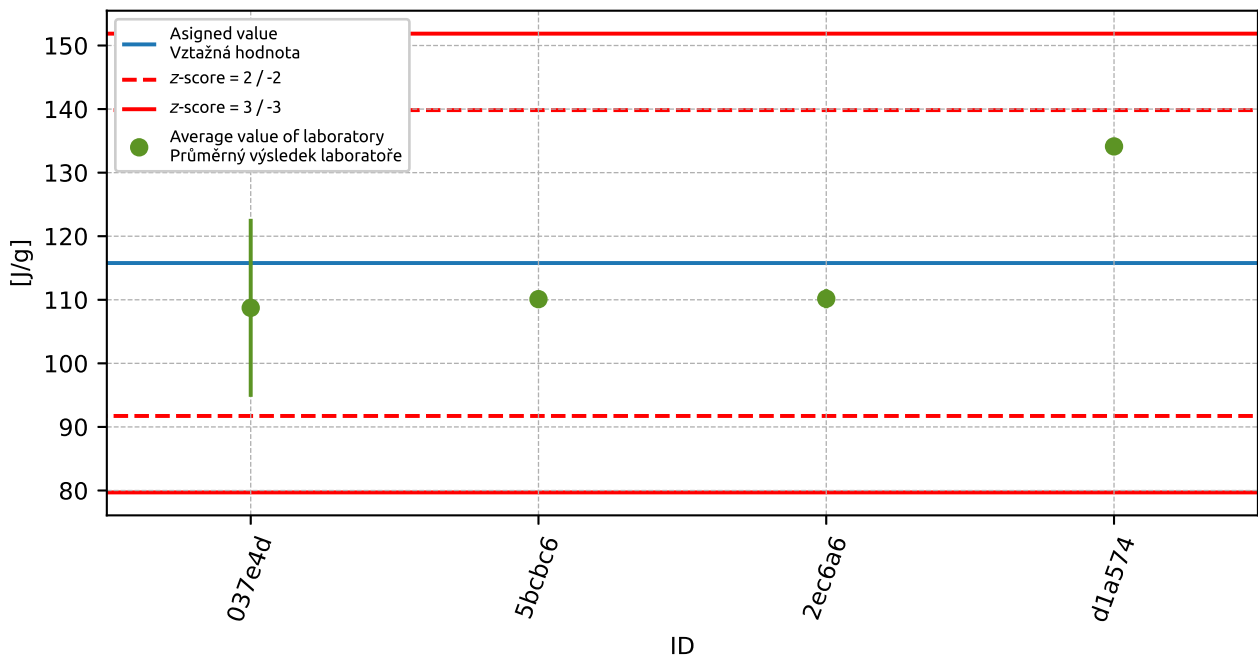


Figure 164: Average values and extended uncertainties of measurement

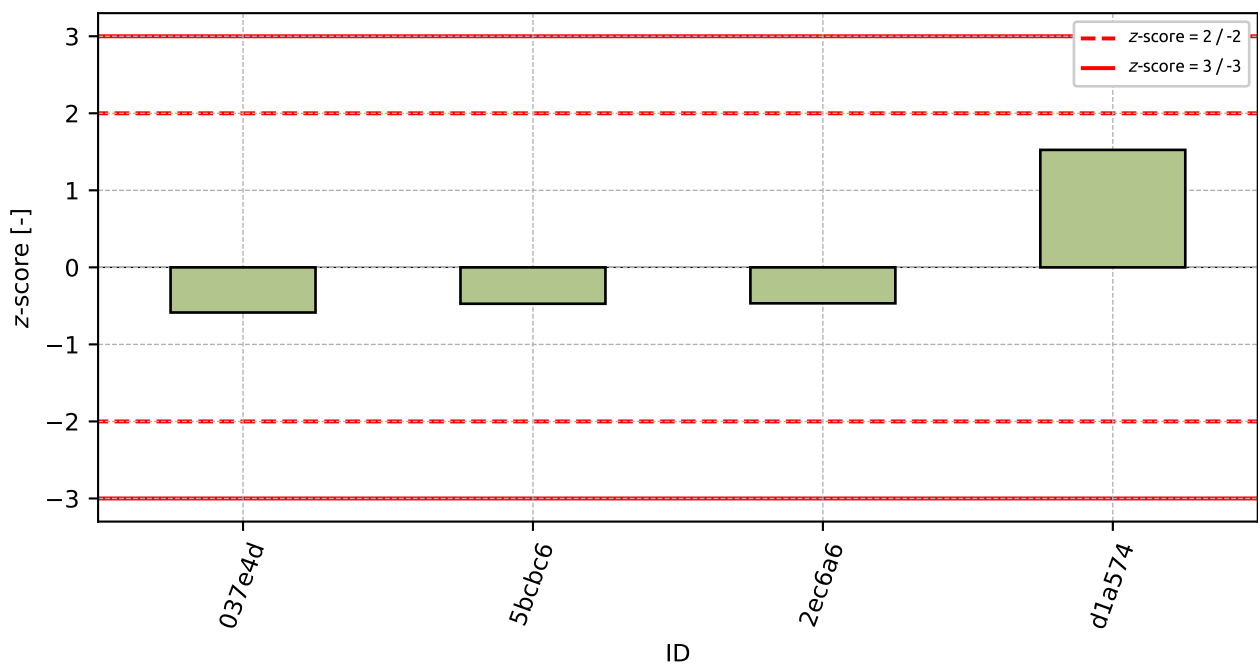


Figure 165: z-score

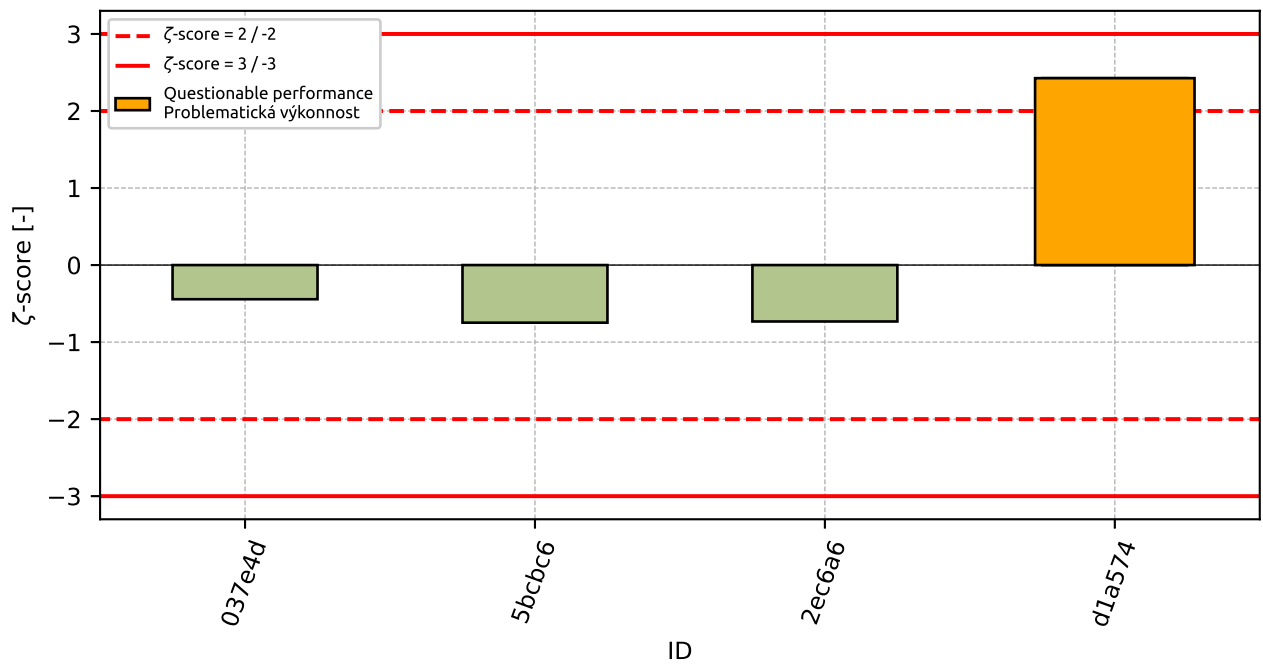


Figure 166: ζ-score

Table 56: z-score and ζ-score

ID	z-score [-]	ζ-score [-]
037e4d	-0.59	-0.44
5bcbc6	-0.47	-0.75
2ec6a6	-0.47	-0.73
d1a574	1.53	2.43

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

### 16.1 Sample A

#### 16.1.1 Test results

Table 57: 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			$u_X$ [g/10min]	$\bar{x}$ [g/10min]	$s_0$ [g/10min]	$V_X$ [%]
	[g/10min]	[g/10min]	[g/10min]				
43e933	0.45	0.45	0.46	0.01	0.45	0.006	1.27
5bcbcb6	0.44	0.46	0.47	0.03	0.46	0.015	3.34
d3a0da	0.46	0.45	0.46	-	0.46	0.006	1.26
2ec6a6	0.46	0.46	0.46	0.02	0.46	0.002	0.45
d1a574	0.6	0.61	0.61	0.01	0.61	0.007	1.14

#### 16.1.2 The Numerical Procedure for Determining Outliers

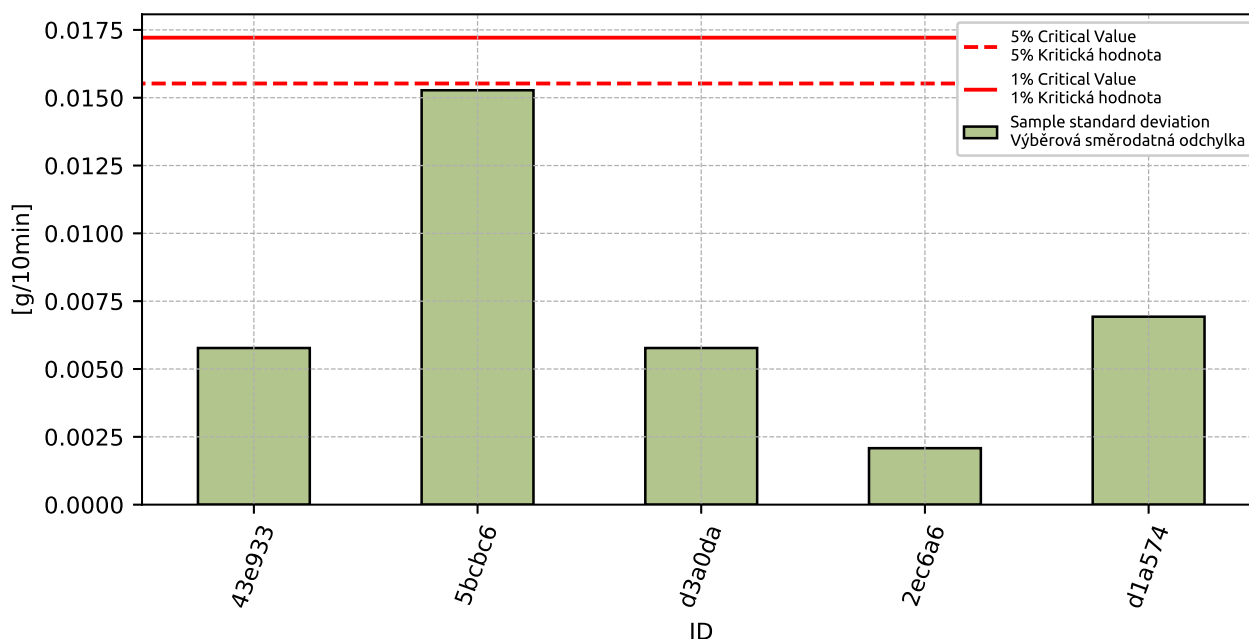


Figure 167: **Cochran's test** - sample standard deviations

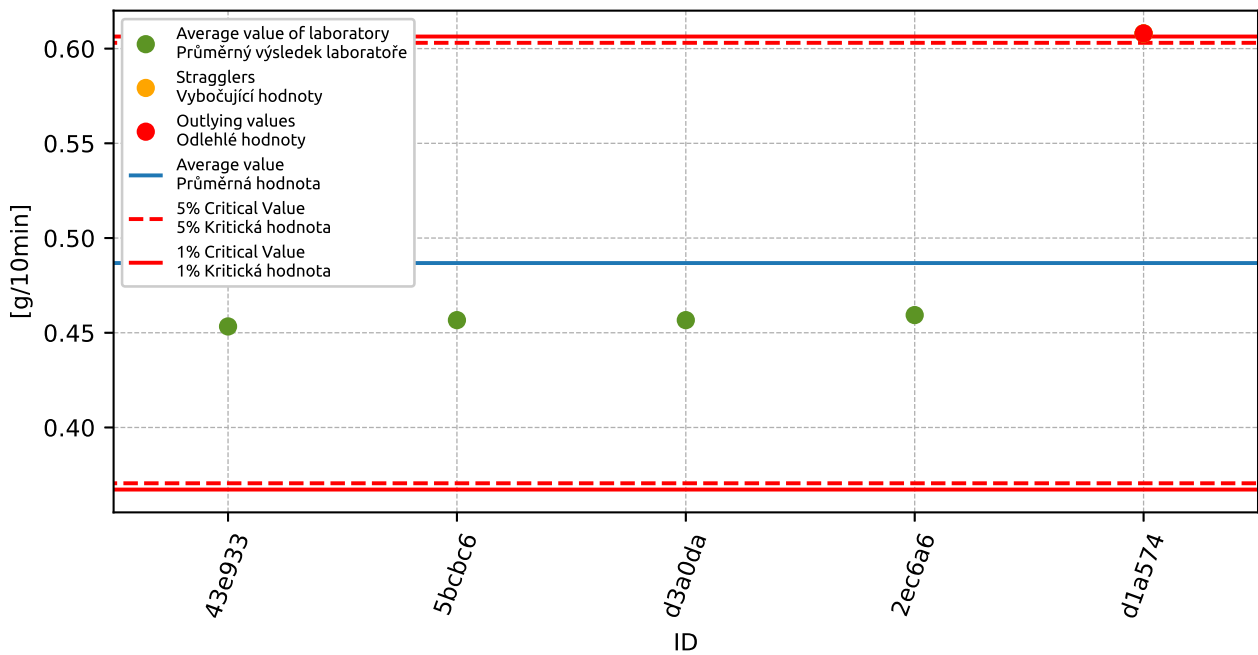


Figure 168: **Grubbs' test** - average values

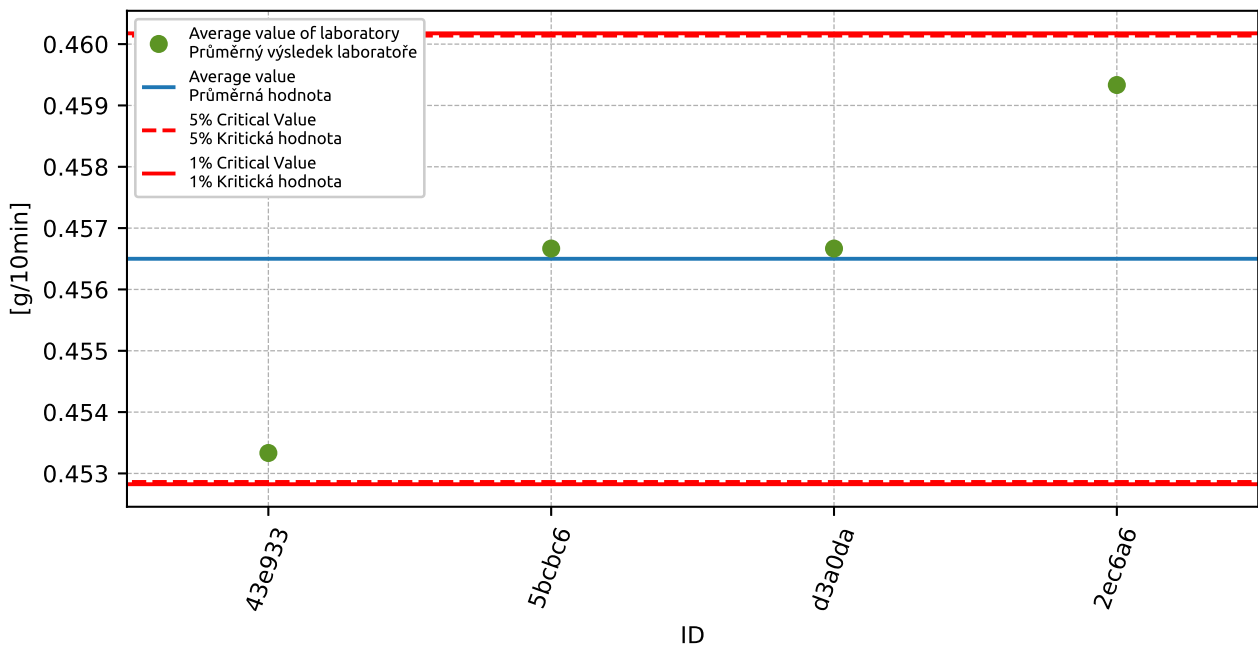


Figure 169: **Grubbs' test** - average values without outliers

### 16.1.3 Mandel's Statistics

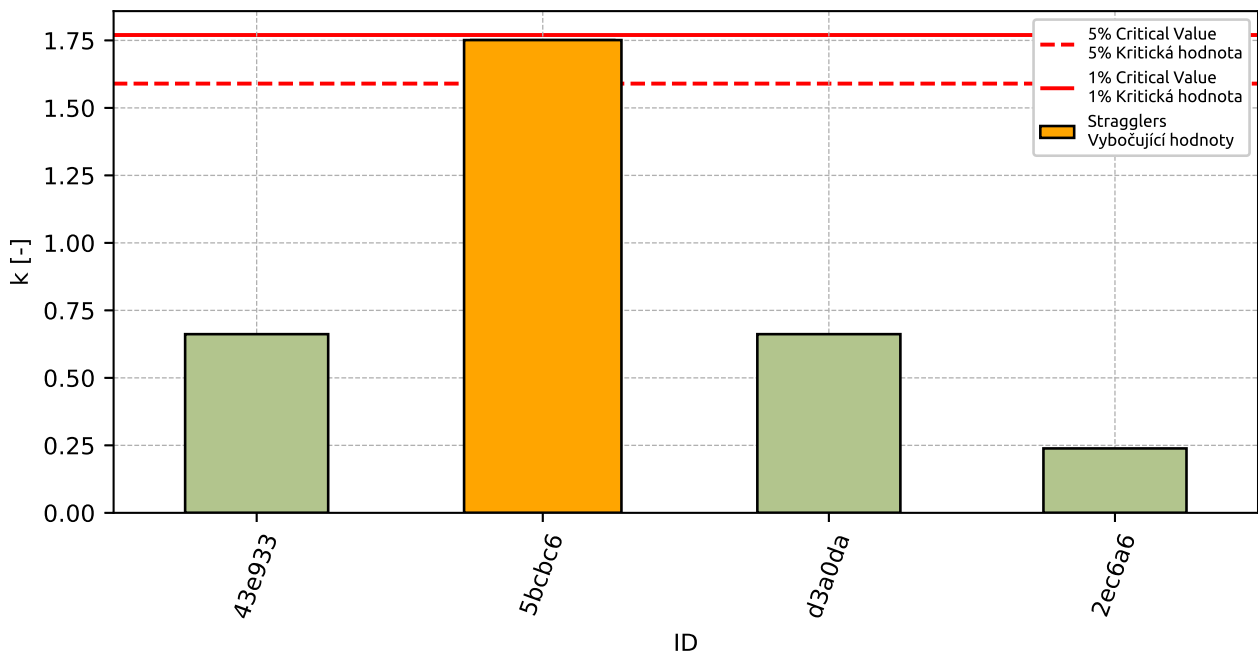


Figure 170: Intralaboratory Consistency Statistic

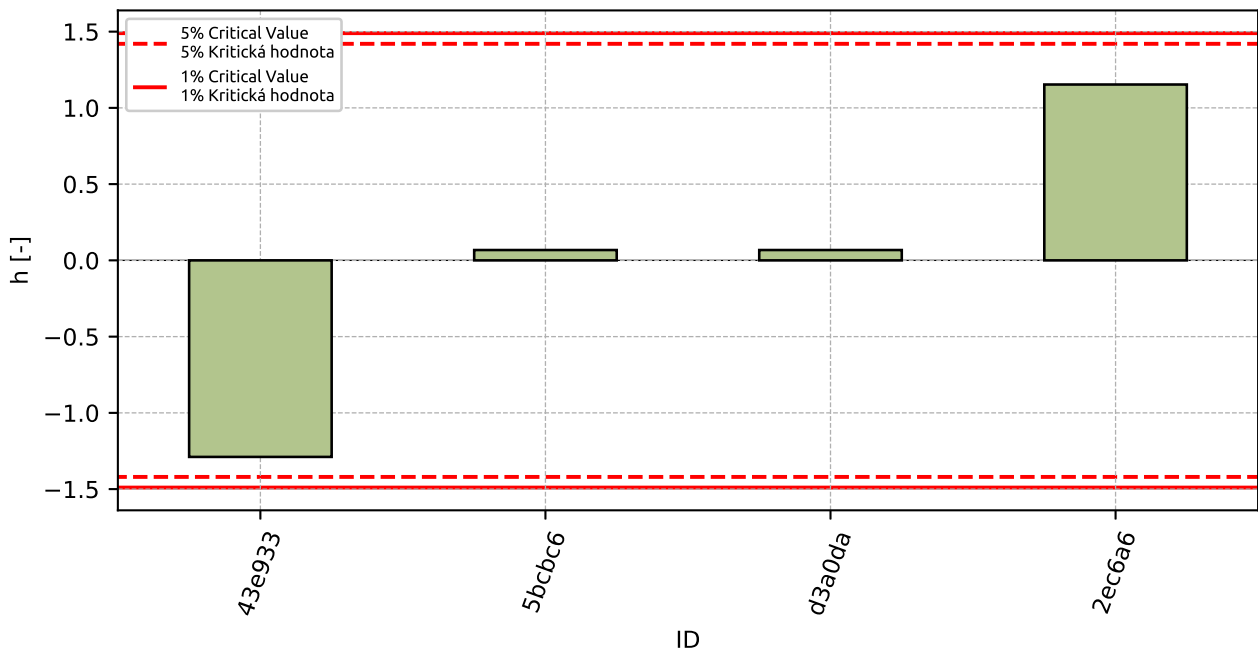


Figure 171: Interlaboratory Consistency Statistic

### 16.1.4 Descriptive statistics

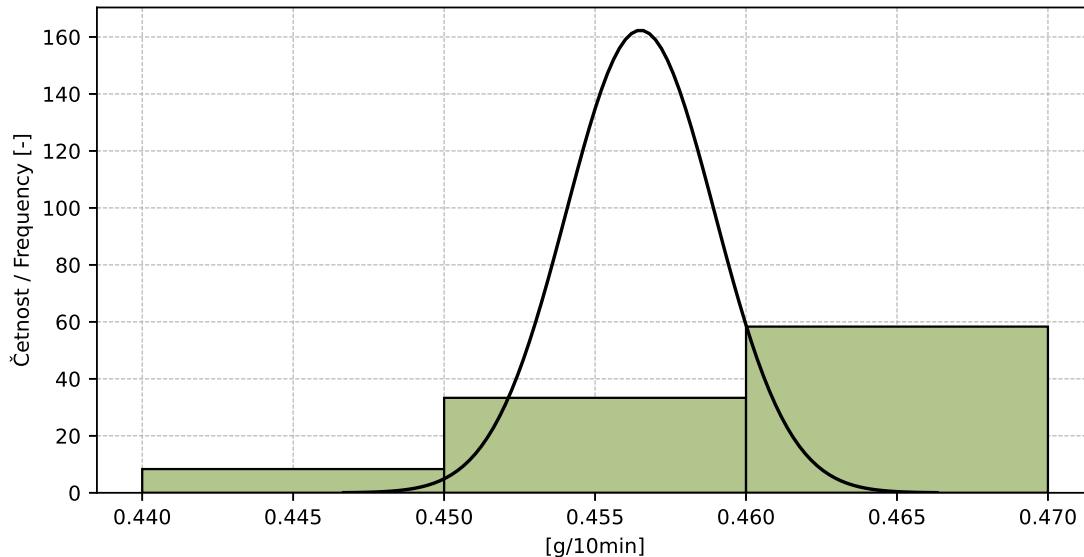


Figure 172: Histogram of all test results

Table 58: Descriptive statistics

Characteristics	[g/10min]
Průměrná hodnota / Average value – $\bar{x}$	0.46
Výběrová směrodatná odchylka / Sample standard deviation – $s$	0.002
Vztažná hodnota / Assigned value – $x^*$	0.46
Robustní směrodatná odchylka / Robust standard deviation – $s^*$	0.002
Nejistota měření vztažné hodnoty / Measurement uncertainty of assigned value – $u_X$	0.001
$p$ -hodnota testu normality / $p$ -value of normality test	0.118 [-]
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – $s_r$	0.009
Opakovatelnost / Repeatability – $r$	0.02

16.15 Evaluation of Performance Statistics

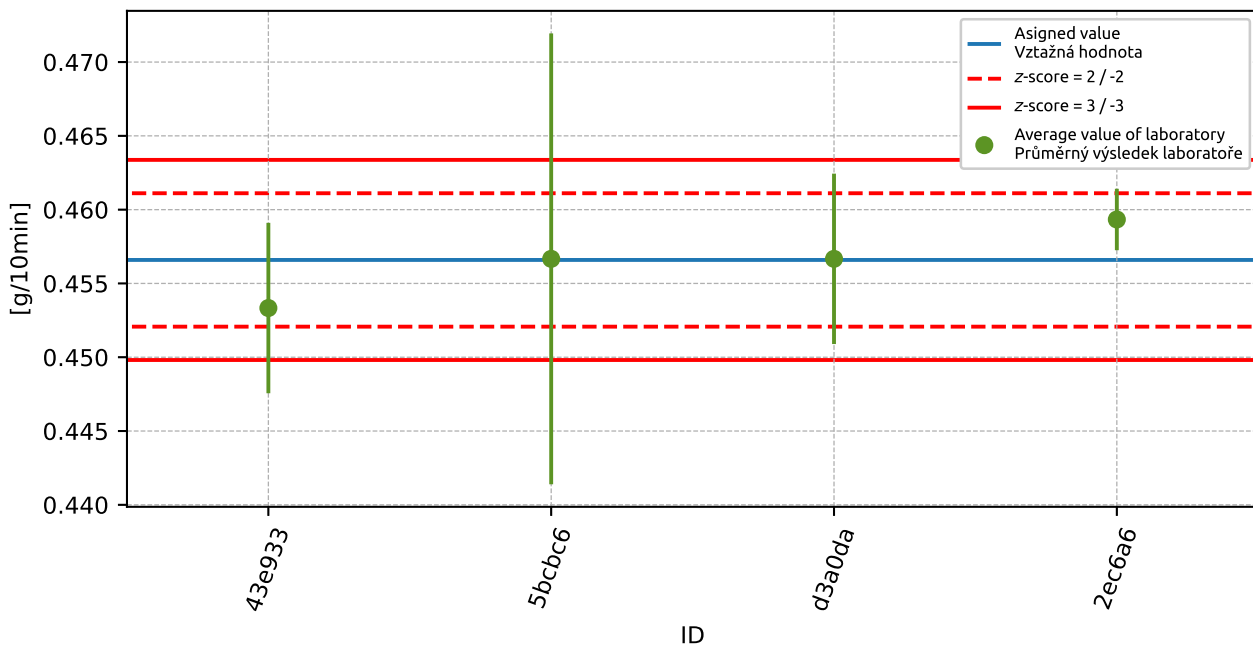


Figure 173: Average values and sample standard deviations

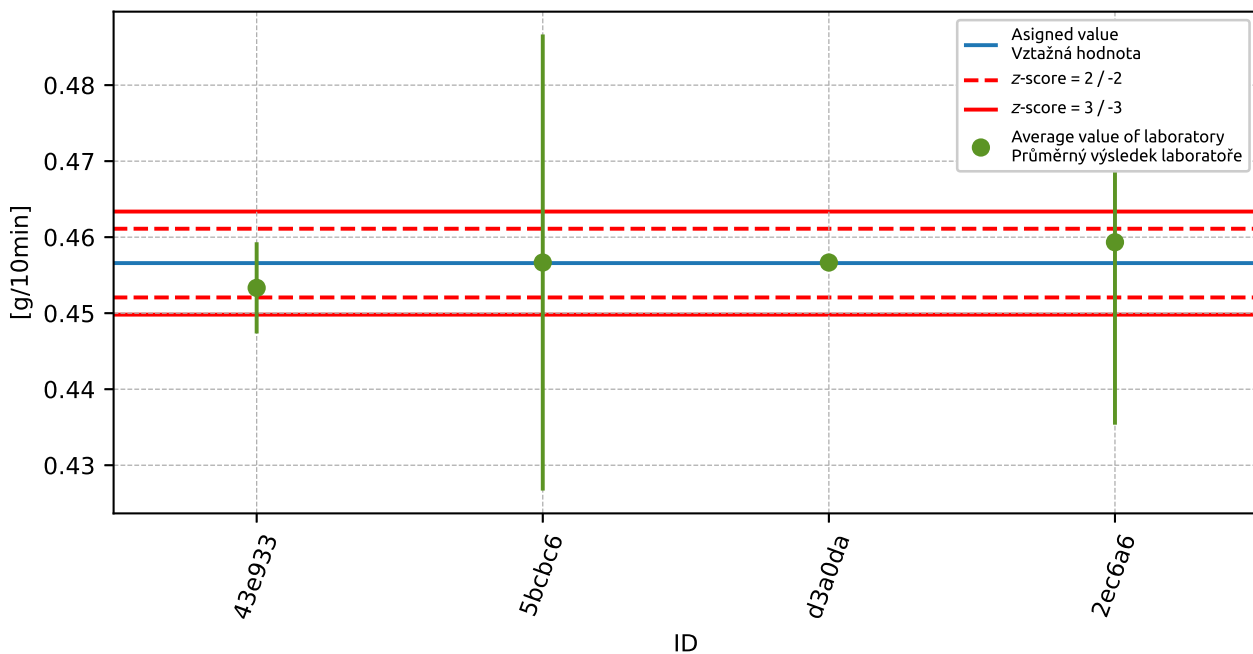


Figure 174: Average values and extended uncertainties of measurement

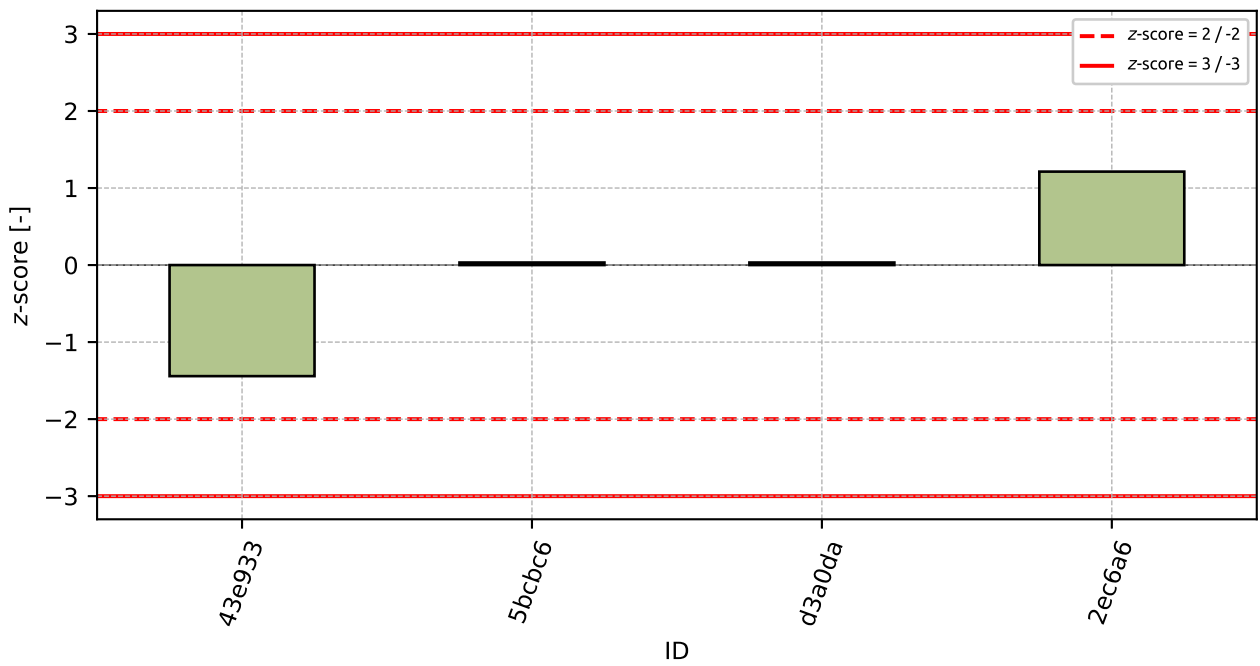


Figure 175: z-score

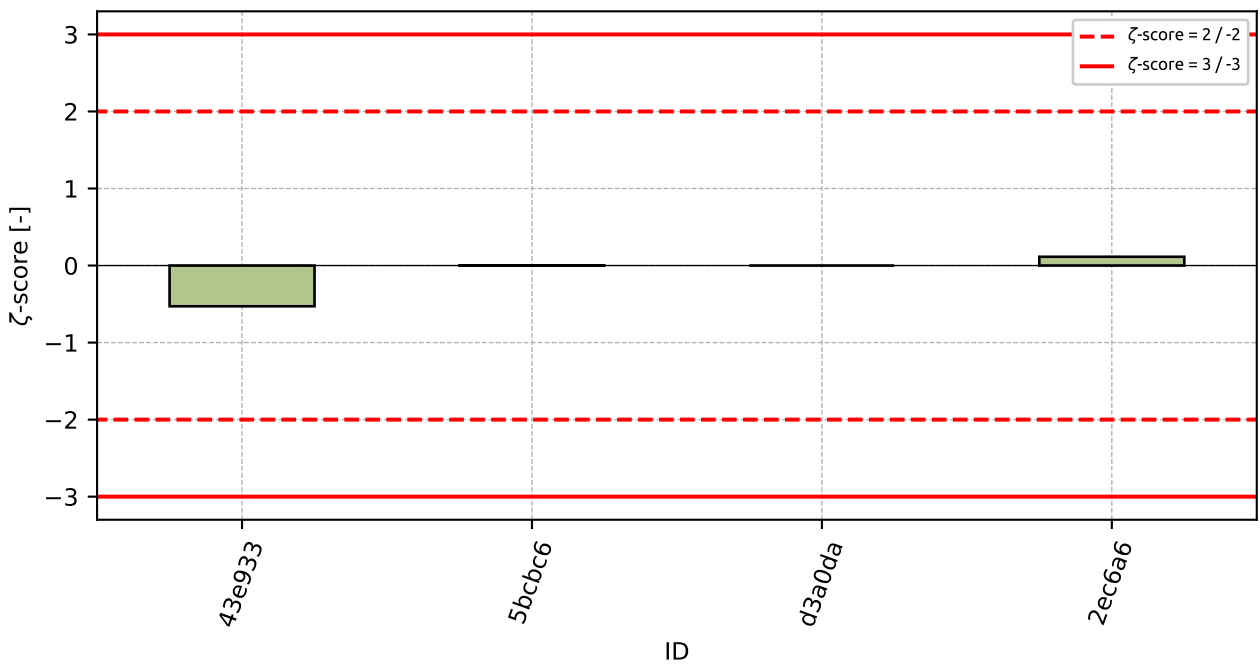


Figure 176: zeta-score



Table 59: z-score and  $\zeta$ -score

<b>ID</b>	<b>z-score [-]</b>	<b><math>\zeta</math>-score [-]</b>
43e933	-1.44	-0.53
5bcbc6	0.03	0.0
d3a0da	0.03	-
2ec6a6	1.21	0.11

## 16.2 Sample B

### 16.2.1 Test results

Table 60: 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]	$V_x$ [%]
d1a574	5.18	5.05	4.97	0.1	5.07	0.103	2.03
43e933	5.2	5.22	5.21	0.01	5.21	0.01	0.19
d3a0da	5.23	5.26	5.25	-	5.25	0.015	0.29
2ec6a6	5.27	5.28	5.28	0.42	5.27	0.005	0.09
5bc6c6	5.32	5.51	5.51	0.37	5.45	0.11	2.01

### 16.2.2 The Numerical Procedure for Determining Outliers

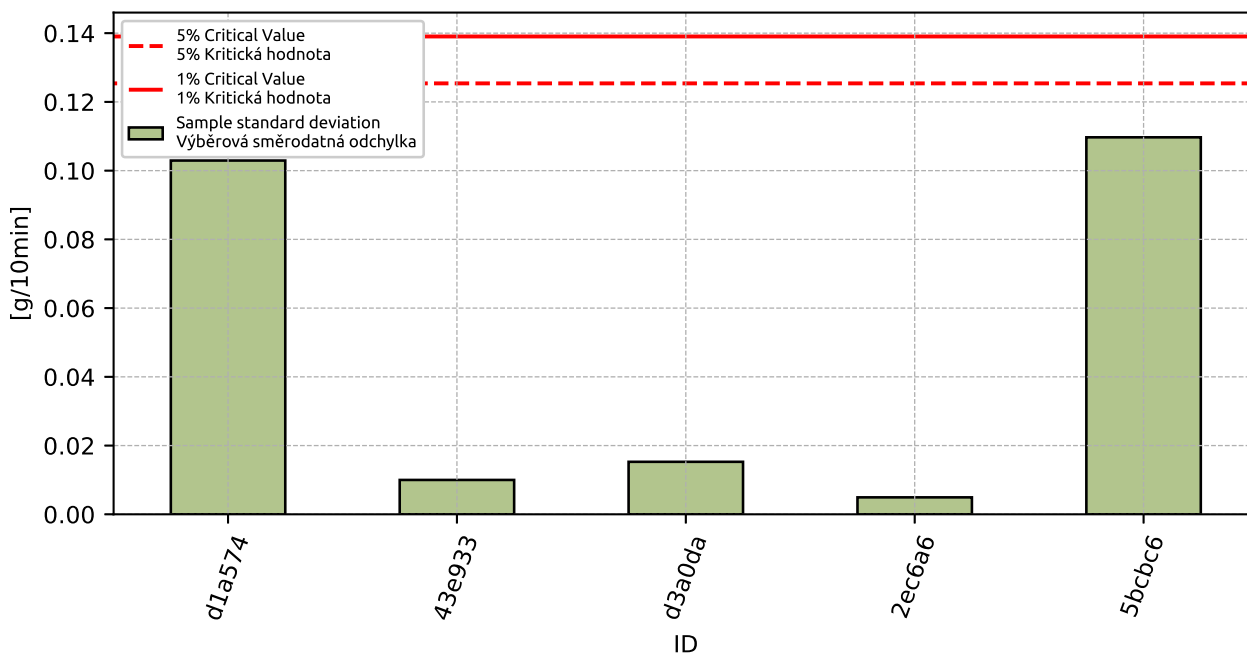


Figure 177: Cochran's test - sample standard deviations

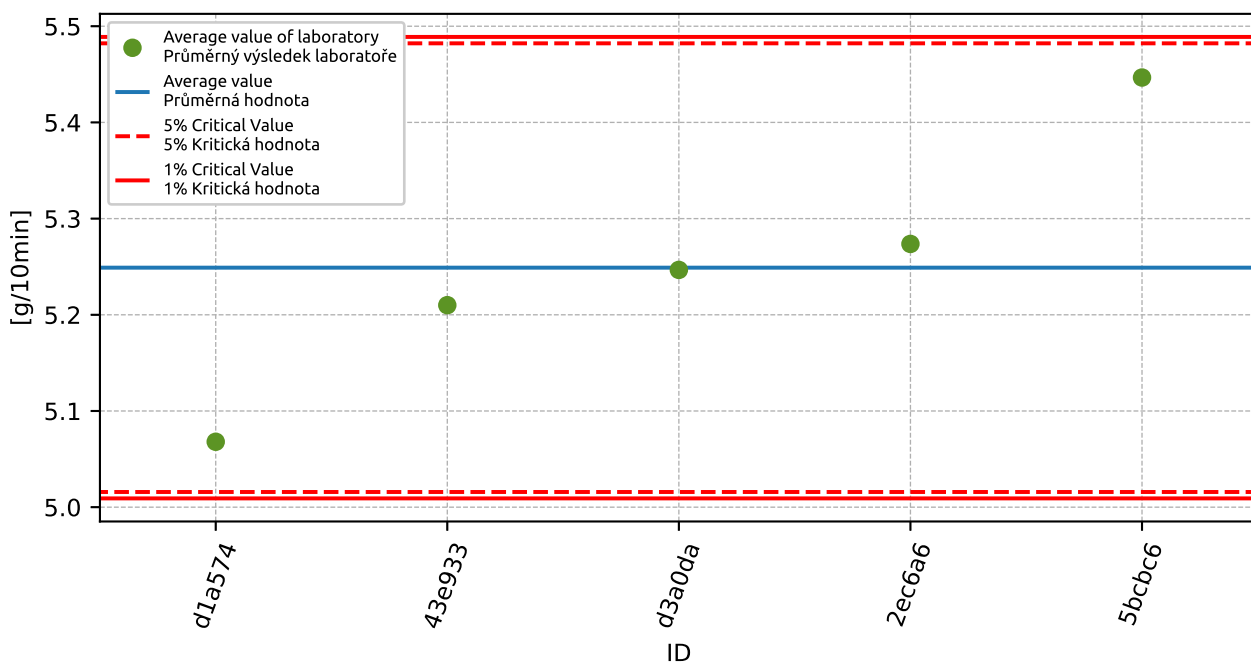


Figure 178: Grubbs' test - average values

### 16.2.3 Mandel's Statistics

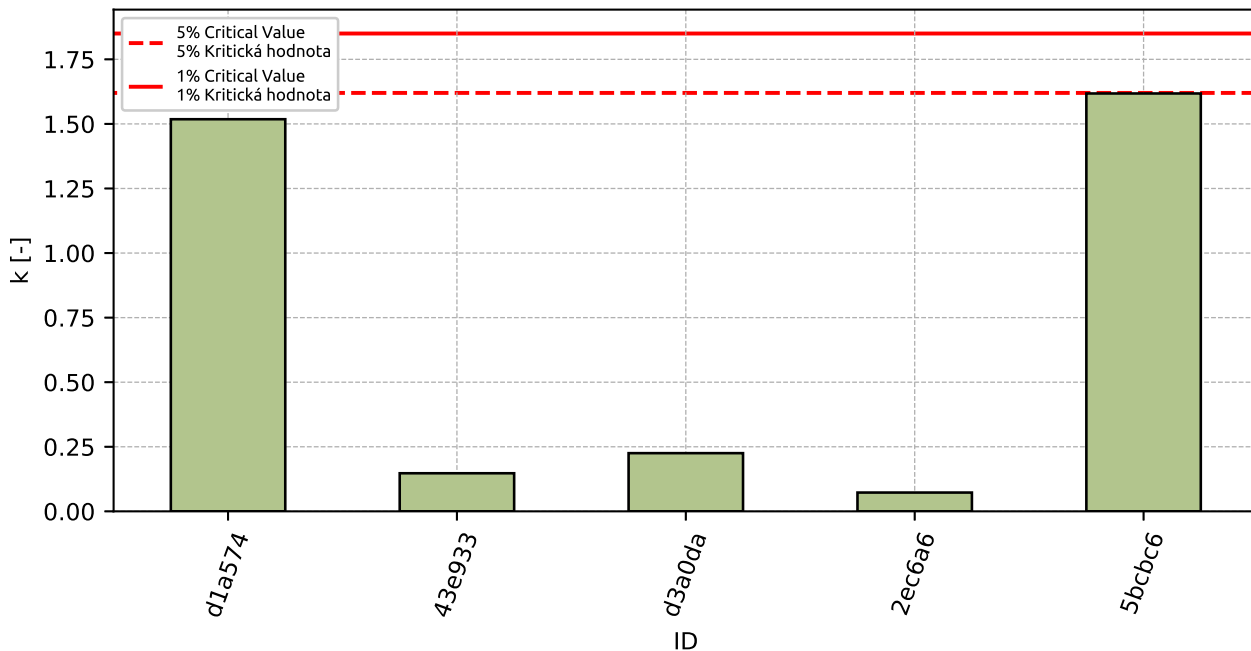


Figure 179: Intralaboratory Consistency Statistic

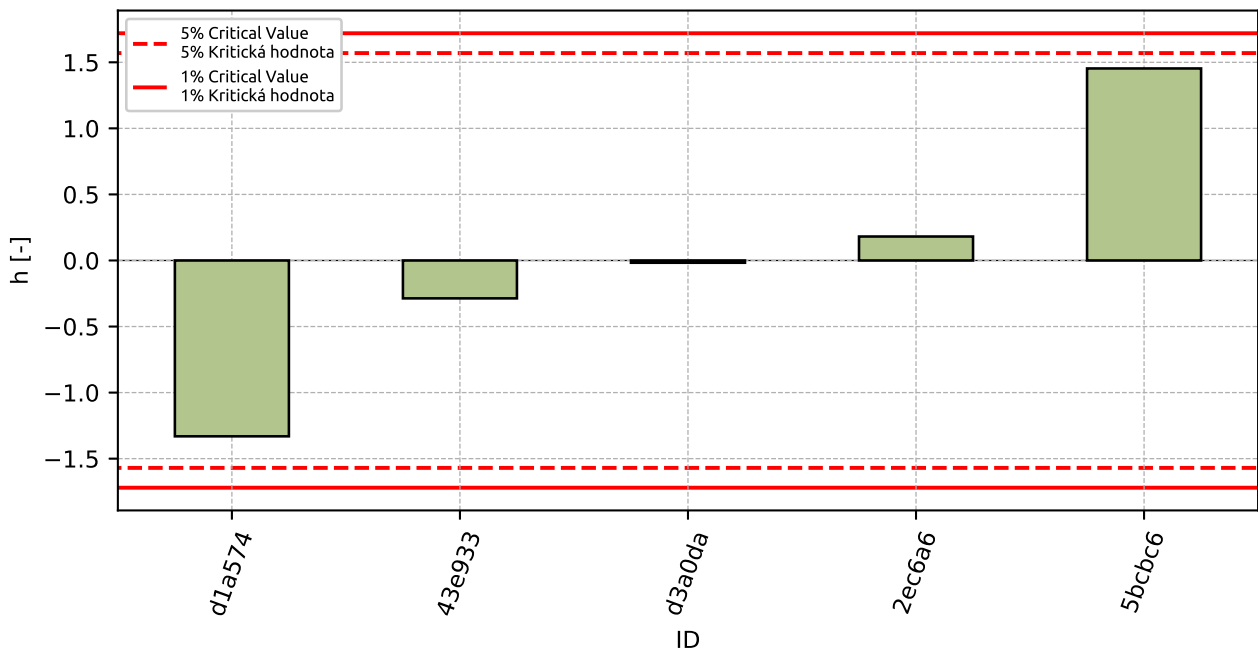


Figure 180: Interlaboratory Consistency Statistic

### 16.2.4 Descriptive statistics

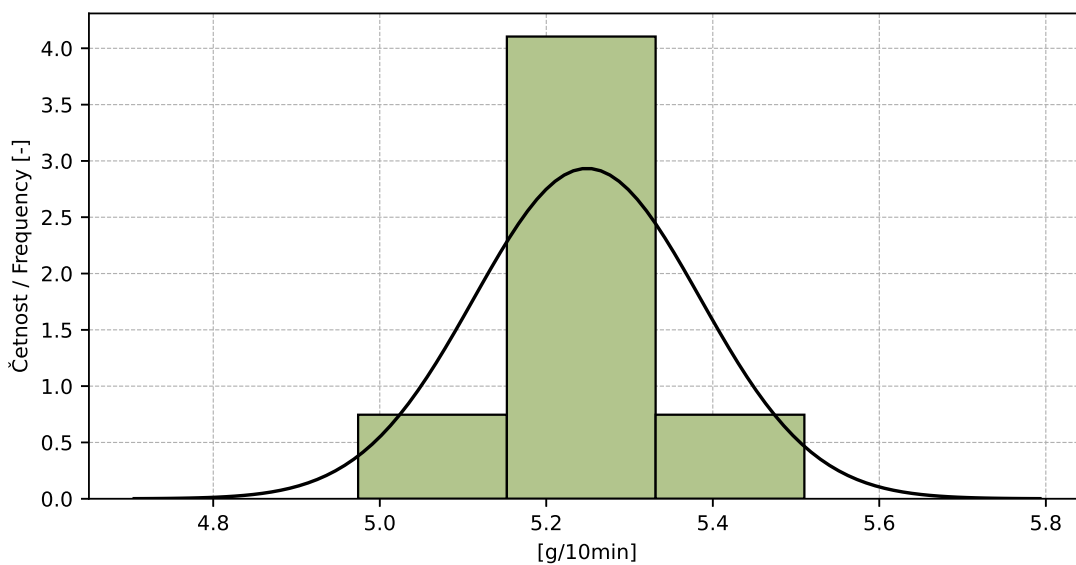


Figure 181: Histogram of all test results

Table 61: Descriptive statistics

Characteristics	[g/10min]
Průměrná hodnota / Average value – $\bar{x}$	5.25
Výběrová směrodatná odchylka / Sample standard deviation – $s$	0.136
Vztažná hodnota / Assigned value – $x^*$	5.27
Robustní směrodatná odchylka / Robust standard deviation – $s^*$	0.109
Nejistota měření vztažné hodnoty / Measurement uncertainty of assigned value – $u_X$	0.061
$p$ -hodnota testu normality / $p$ -value of normality test	0.107 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – $s_L$	0.13
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – $s_r$	0.068
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – $s_R$	0.147
Opakovatelnost / Repeatability – $r$	0.19
Reprodukovatelnost / Reproducibility – $R$	0.41

### 16.2.5 Evaluation of Performance Statistics

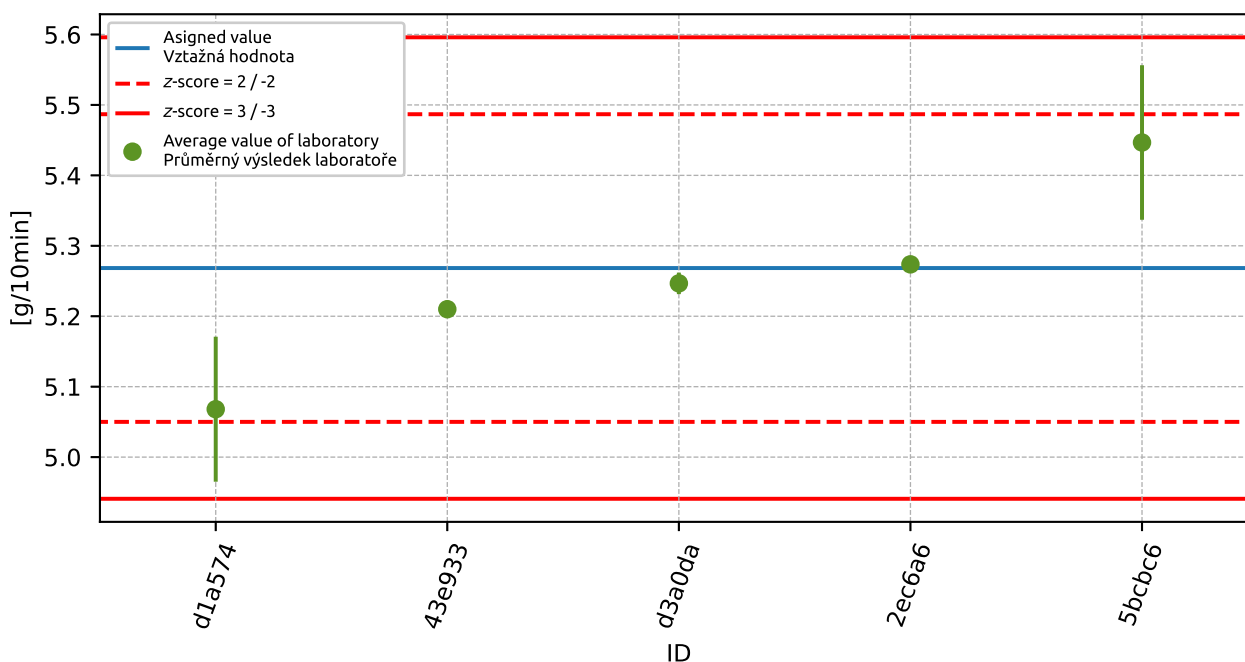


Figure 182: Average values and sample standard deviations

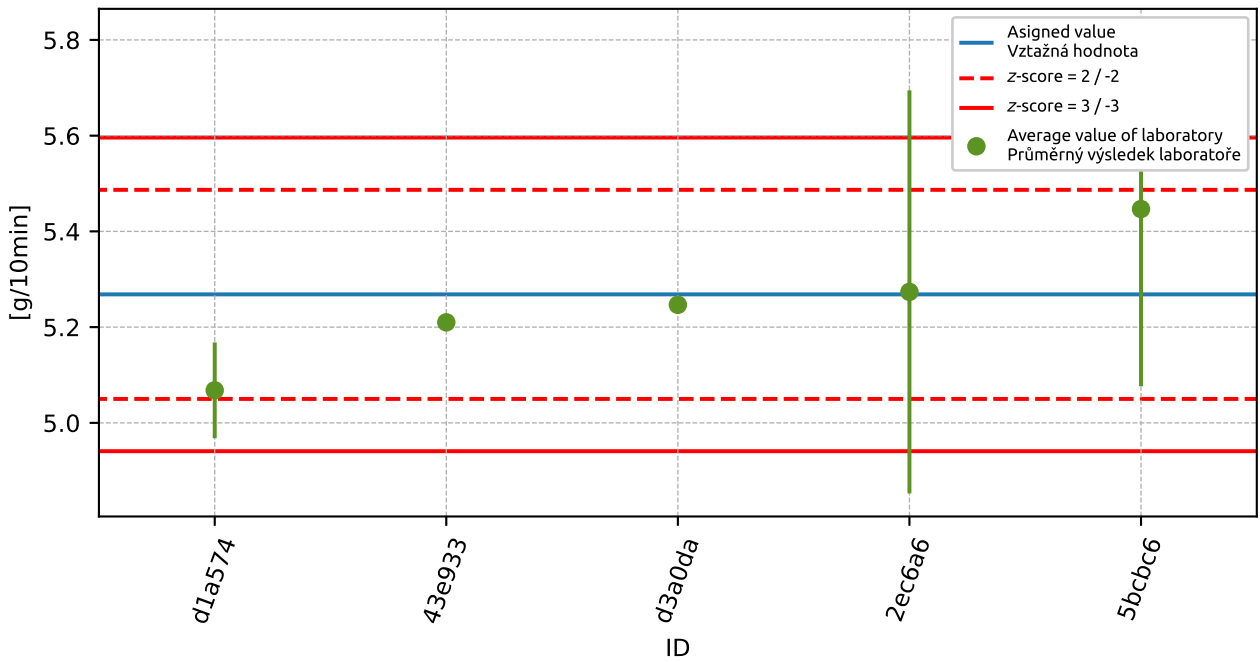


Figure 183: Average values and extended uncertainties of measurement

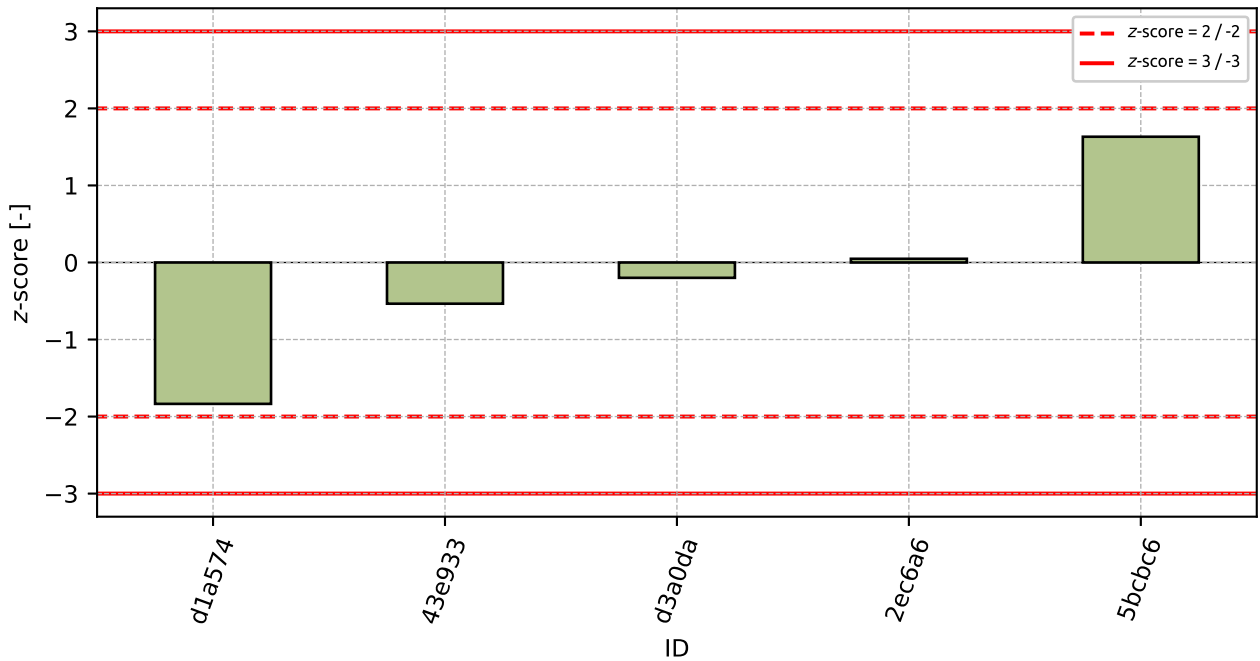


Figure 184: z-score

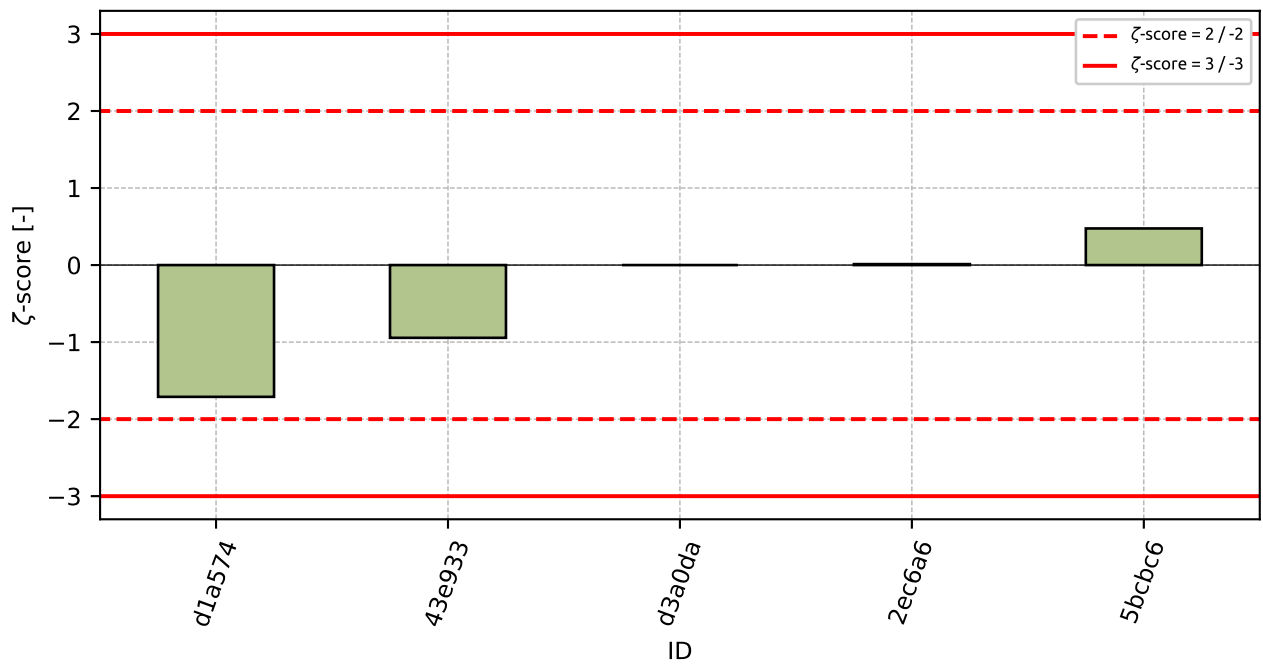


Figure 185: z-score

Table 62: z-score and z-score

ID	z-score [-]	z-score [-]
d1a574	-1.84	-1.71
43e933	-0.54	-0.94
d3a0da	-0.2	-
2ec6a6	0.05	0.01
5bcbc6	1.63	0.48

## **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)

### 19.1 Test results

Table 63: 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					$u_x$ [mm/min]	$\bar{x}$ [mm/min]	$s_0$ [mm/min]	$V_x$ [%]
	[mm/min]	[mm/min]	[mm/min]	[mm/min]	[mm/min]				
268044	22.0	33.5	19.8	22.4	24.6	4.8	24.5	5.33	21.8
441c89	26.1	25.7	27.3	29.7	28.5	-	27.5	1.66	6.06
037e4d	36.1	35.3	35.9	38.7	35.5	1.9	36.3	1.38	3.8
26b507	38.0	41.1	40.3	42.0	38.5	3.4	40.0	1.7	4.25
2ec6a6	45.1	44.7	43.0	46.2	45.5	2.1	44.9	1.2	2.67

### 19.2 The Numerical Procedure for Determining Outliers

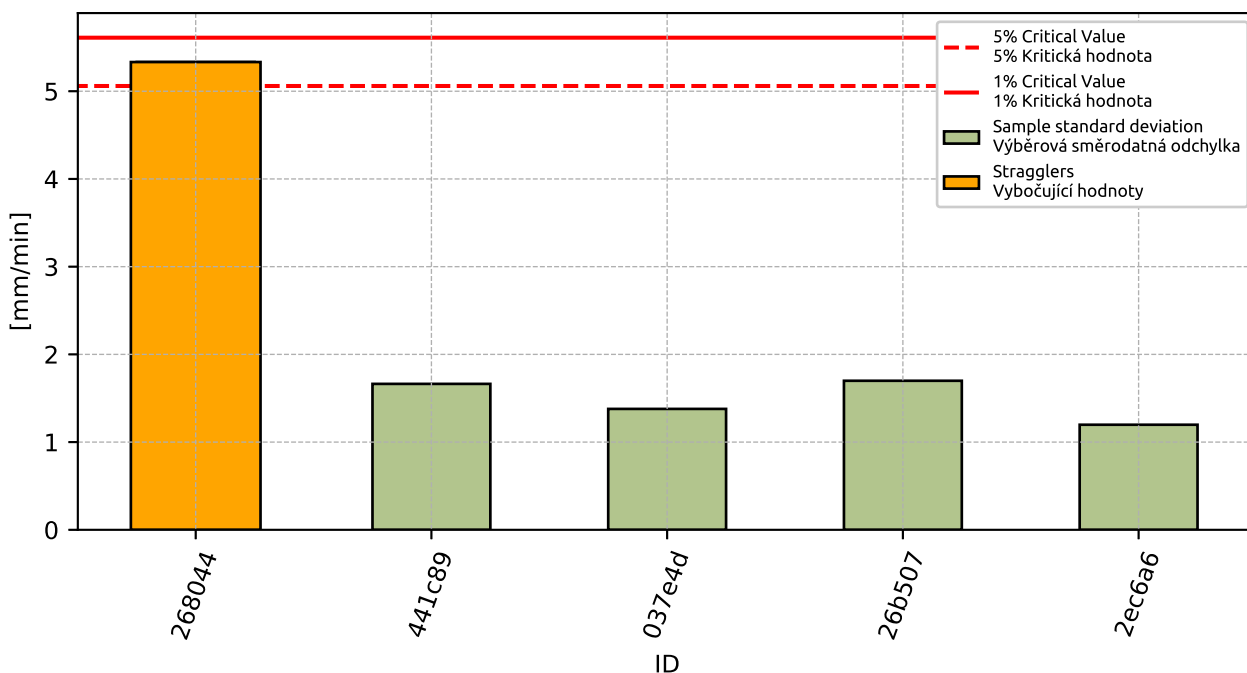


Figure 186: Cochran's test - sample standard deviations

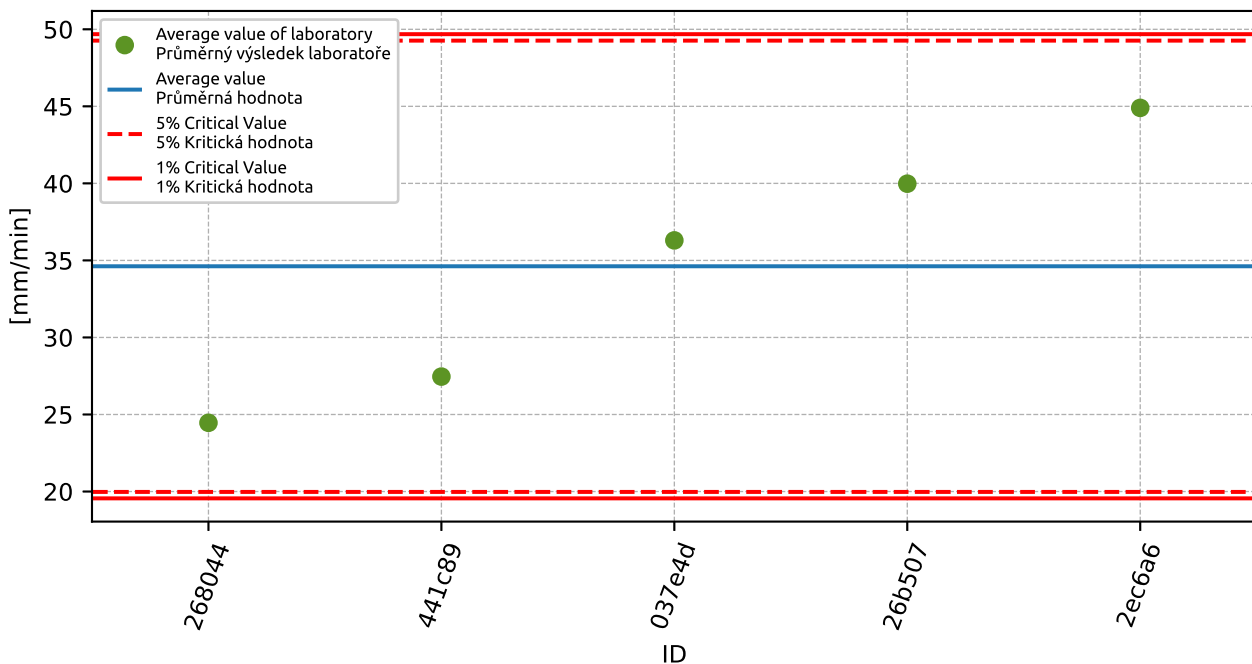


Figure 187: Grubbs' test - average values

### 19.3 Mandel's Statistics

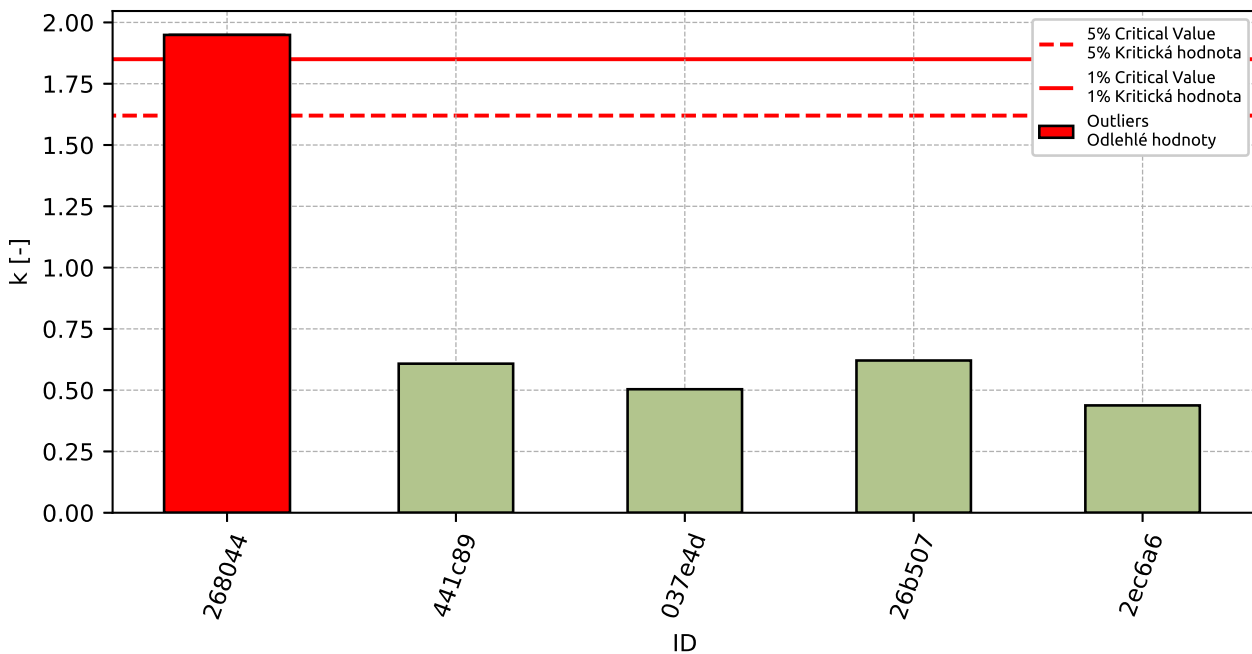


Figure 188: Intralaboratory Consistency Statistic

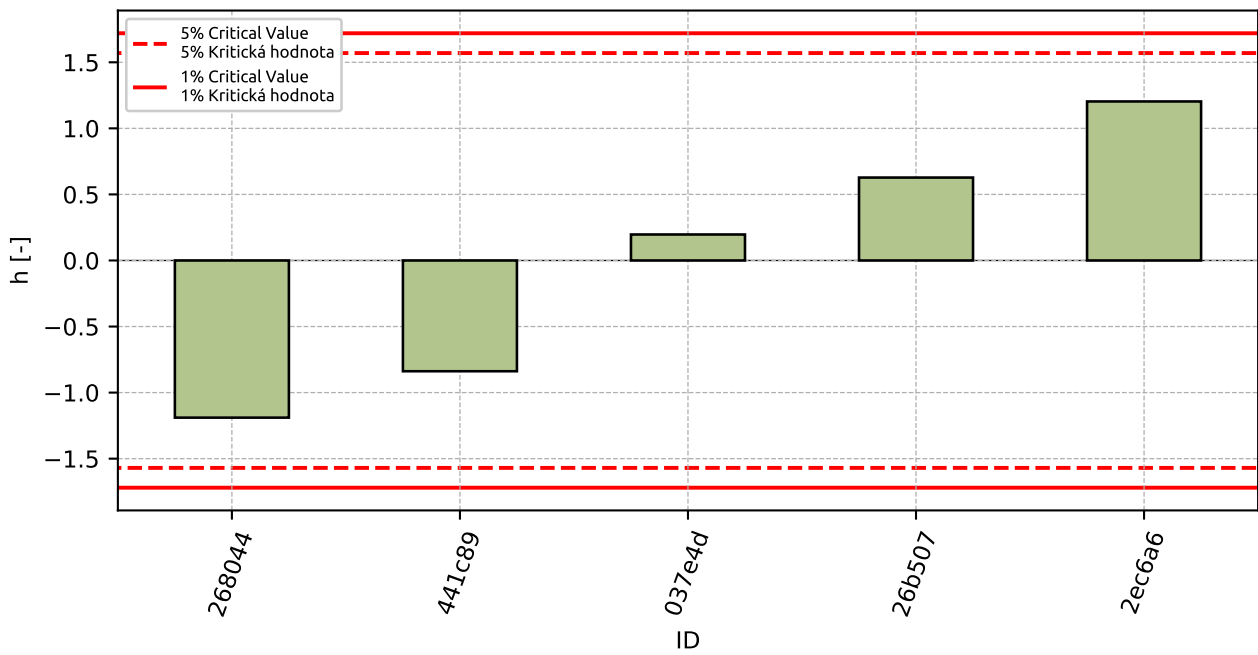


Figure 189: Interlaboratory Consistency Statistic

### 19.4 Descriptive statistics

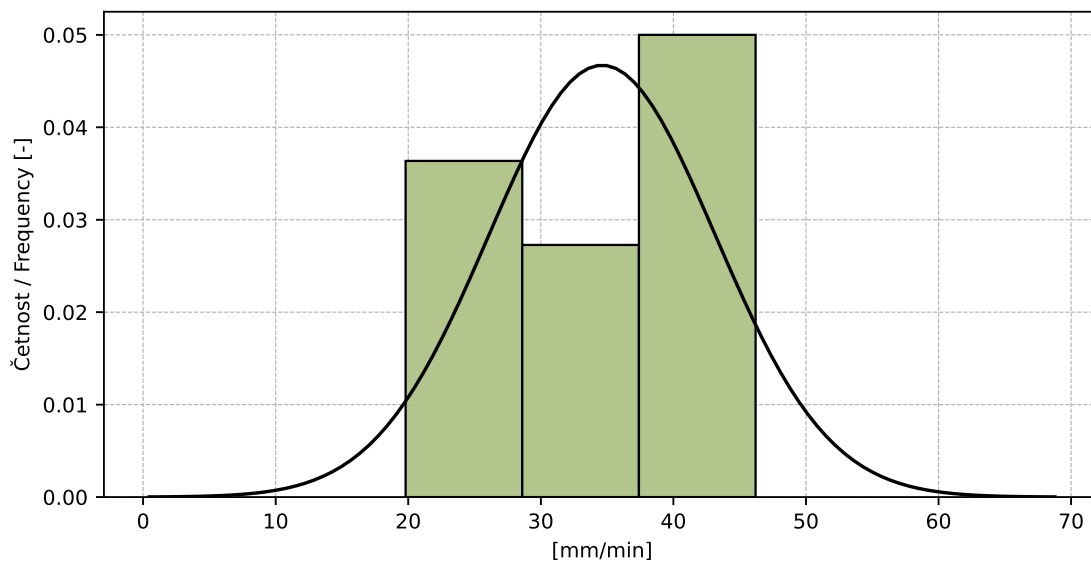


Figure 190: Histogram of all test results

Table 64: Descriptive statistics

Characteristics	[mm/min]
Průměrná hodnota / Average value – $\bar{x}$	34.6
Výběrová směrodatná odchylka / Sample standard deviation – $s$	8.54
Vztažná hodnota / Assigned value – $x^*$	34.6
Robustní směrodatná odchylka / Robust standard deviation – $s^*$	8.66
Nejistota měření vztažné hodnoty / Measurement uncertainty of assigned value – $u_X$	4.84
$p$ -hodnota testu normality / $p$ -value of normality test	0.139 [-]
Mezilaboratorní sm. odch. / Interlaboratory standard deviation – $s_L$	8.45
Směrodatná odchylka opakovatelnosti / Repeatability standard deviation – $s_r$	2.74
Směrodatná odchylka reprodukovatelnosti / Reproducibility standard deviation – $s_R$	8.88
Opakovatelnost / Repeatability – $r$	7.7
Reprodukovatelnost / Reproducibility – $R$	24.9

## 19.5 Evaluation of Performance Statistics

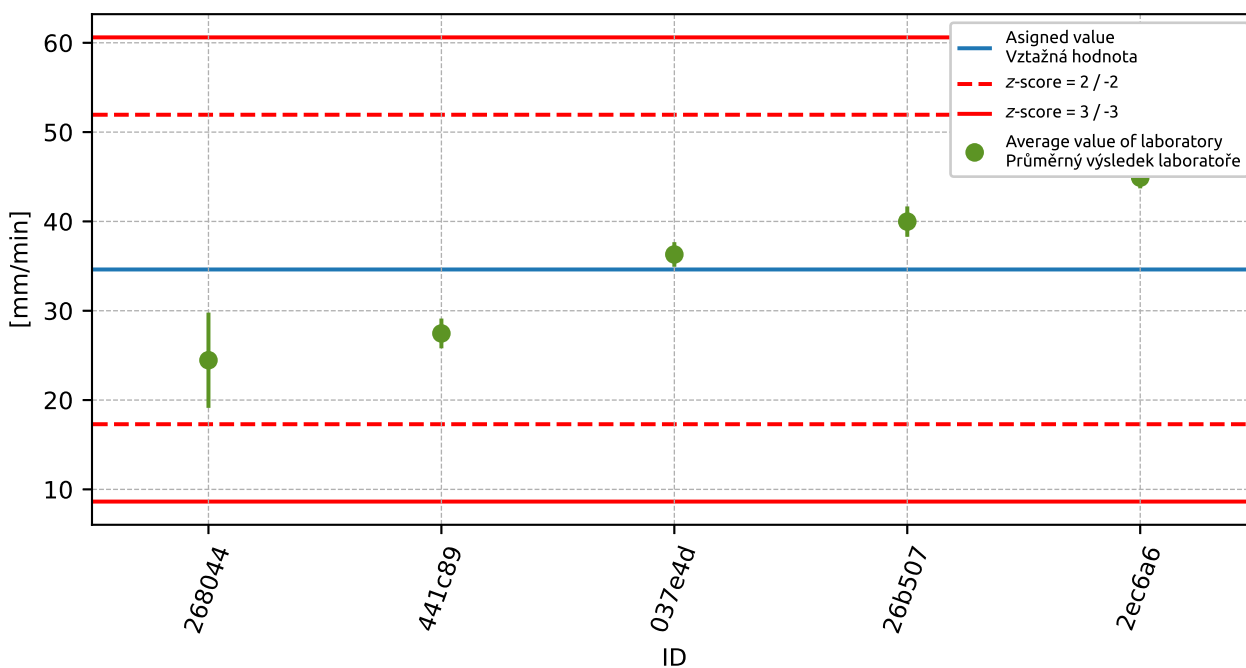


Figure 191: Average values and sample standard deviations

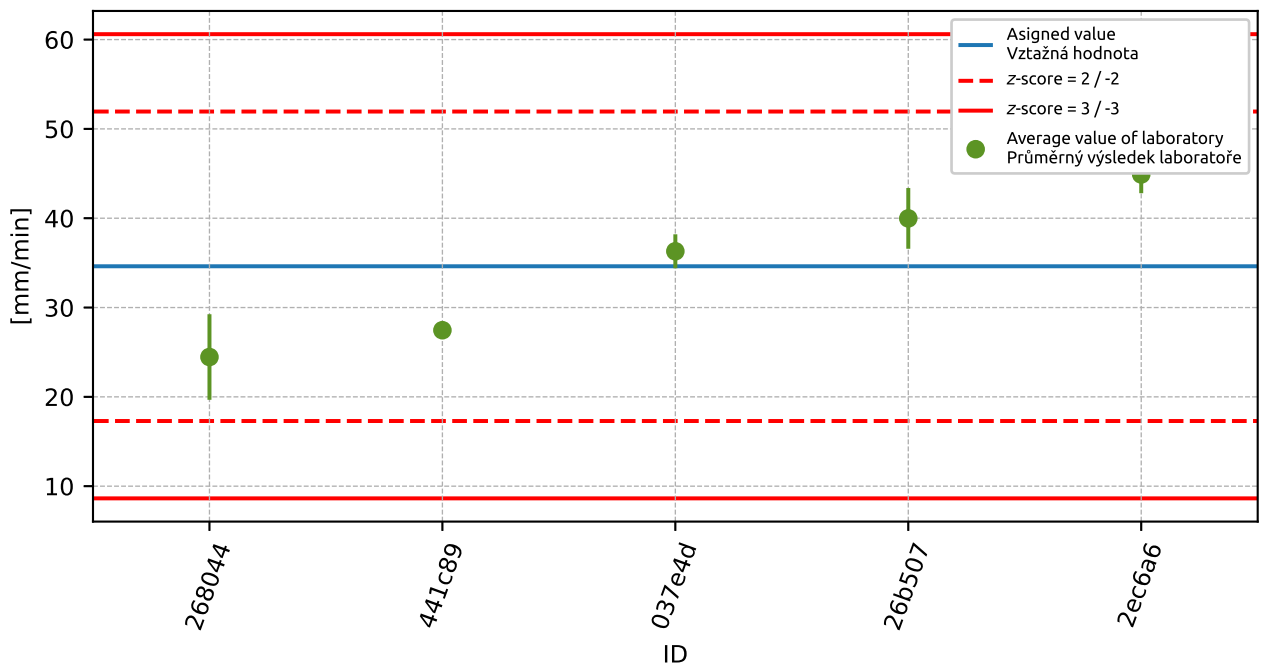


Figure 192: Average values and extended uncertainties of measurement

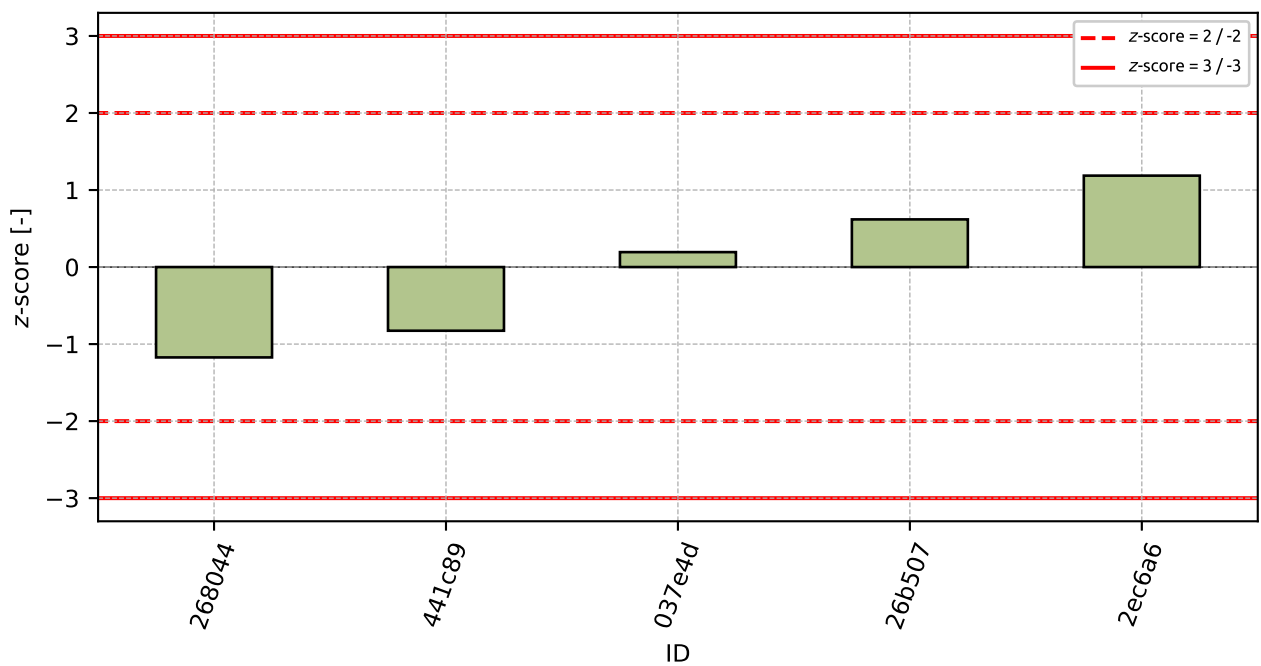


Figure 193: z-score

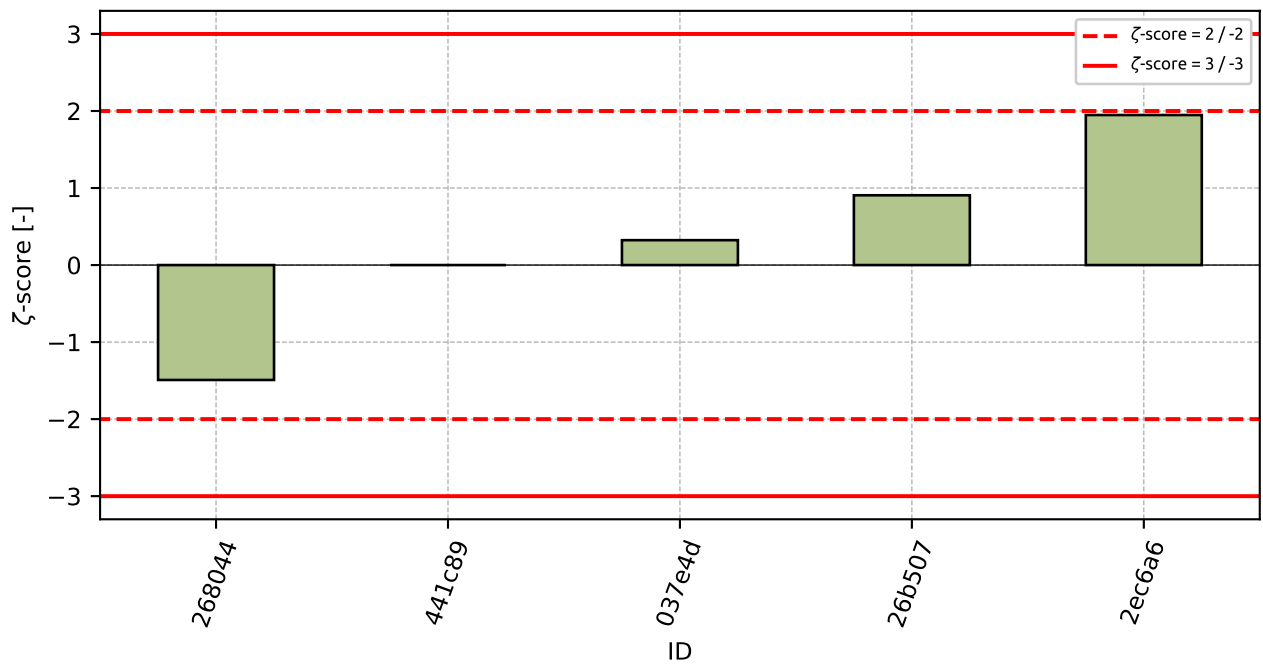


Figure 194:  $\zeta$ -score

Table 65: z-score and  $\zeta$ -score

ID	z-score [-]	$\zeta$ -score [-]
268044	-1.17	-1.49
441c89	-0.83	-
037e4d	0.19	0.32
26b507	0.62	0.91
2ec6a6	1.19	1.95