

Proficiency testing for in-house measuring laboratories – Results and Evaluation

Proficiency testing scheme Metals on filters July/August 2018

Institute for Occupational Safety and Health of the
German Social Accident Insurance (IFA)
Prof. Dr. D. Breuer, B. Maybaum, K. Gusbeth, F. Nürnberger
Franziska Nürnberger
Alte Heerstraße 111, 53757 Sankt Augustin, Germany
Phone.: +49 30 13001 3299
Email: proficiency-testing@dguv.de

Summary of laboratory test results

Sample 1

	cobalt	Z score	copper	Z score	lead	Z score	nickel	Z score	zinc	Z score
Unit	µg absolute		µg absolute		µg absolute		µg absolute		µg absolute	
5	8,50	1,51	7,69	1,51	39,41	-0,03	11,88	1,20	136,10	0,34
6	7,78	0,54	7,17	0,73	41,97	0,61	11,36	0,71	139,80	0,62
38	7,59	0,28	6,96	0,42	41,40	0,47	10,84	0,22	135,22	0,28
40	7,39	0,01	6,58	-0,15	41,10	0,39	9,37	-1,17	131,30	-0,02
41	7,68	0,40	7,07	0,59	40,40	0,22	10,90	0,28	141,00	0,71
57	7,28	-0,14	6,74	0,09	39,84	0,08	10,70	0,09	131,59	0,00
68	7,55	0,22	6,45	-0,34	37,20	-0,59	11,10	0,46	137,00	0,41
70	6,80	-0,79	6,02	-0,98	37,85	-0,43	10,09	-0,49	126,10	-0,42
71	7,29	-0,13	7,07	0,59	38,66	-0,22	10,72	0,11	134,06	0,19
80	7,16	-0,31	6,07	-0,91	38,95	-0,15	10,29	-0,30	135,20	0,27
82	6,53	-1,16	6,21	-0,70	37,50	-0,52	9,80	-0,76	113,00	-1,41
90	7,21	-0,24	6,75	0,11	39,30	-0,06	10,60	-0,01	133,00	0,11
91	7,14	-0,33	6,42	-0,39	42,11	0,65	10,11	-0,47	120,04	-0,88
110	7,66	0,37	6,62	-0,09	39,70	0,04	10,30	-0,29	139,00	0,56
112	7,46	0,10	6,94	0,39	39,80	0,07	10,70	0,09	133,00	0,11
129	7,17	-0,30	6,25	-0,65	38,32	-0,31	11,25	0,60	124,76	-0,52
130	6,86	-0,71	6,13	-0,82	39,40	-0,04	9,80	-0,76	129,00	-0,20
138	7,86	0,64	6,75	0,11	38,10	-0,36	10,90	0,28	140,00	0,64
151	7,20	-0,25	7,00	0,48	40,00	0,12	10,60	-0,01	127,40	-0,32
161	8,43	1,41	6,77	0,14	47,30	1,96 B	12,60	1,88	152,00	1,55
177	5,60	-2,42 BE	7,40	1,08	39,00	-0,14	9,40	-1,14	123,00	-0,65
201	7,40	0,02	6,86	0,27	40,20	0,17	10,30	-0,29	131,00	-0,04
203	6,80	-0,79	6,10	-0,86	38,00	-0,39	9,70	-0,86	121,00	-0,80
231	7,15	-0,32	6,69	0,02	38,90	-0,16	10,50	-0,10	134,00	0,18
252	6,90	-0,66	6,40	-0,42	42,70	0,80	10,10	-0,48	126,90	-0,36
255	7,64	0,34	6,78	0,15			11,20	0,56	121,80	-0,74
279	7,59	0,28	6,40	-0,42	38,70	-0,21	11,30	0,65	136,70	0,39

	cobalt Z score	copper Z score	lead Z score	nickel Z score	zinc Z score
Method	ISO 5725-2	ISO 5725-2	ISO 5725-2	ISO 5725-2	ISO 5725-2
Assessment	Z ≤2,00	Z ≤2,00	Z ≤2,00	Z ≤2,00	Z ≤2,00
No. of laboratories that submitted results	27	27	26	27	27
Mean	7,39	6,68	39,54	10,61	131,59
Reproducibility s.d.	0,46	0,42	1,46	0,74	8,09
Rel. reproducibility s.d.	6,23 %	6,25 %	3,69 %	6,94 %	6,15 %
Reference value	7,27	6,73	39,46	10,52	130,92
Target s.d.	0,74	0,67	3,95	1,06	13,16
Rel. target s.d.	10,00 %	10,00 %	10,00 %	10,00 %	10,00 %
Lower limit of tolerance	5,91	5,34	31,63	8,49	105,27
Upper limit of tolerance	8,86	8,01	47,45	12,73	157,91
Type B outliers	1		1		
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	26	27	25	27	27
Explanation of outlier types					
A: Single outlier	Grubbs				
B: Differing laboratory mean	Grubbs				
C: Excessive laboratory s.d.	Cochran				
D: Excluded manually					
E: mean outside tolerance limits					
F: Z-Score >3,5					

Summary of laboratory test results

Sample 2

Unit	cobalt		copper		lead		nickel	
	µg absolute	Z score	µg absolute	Z score	µg absolute	Z score	µg absolute	Z score
5	24,56	12,62 BE	26,05	1,96	107,67	2,56 BE	12,58	11,39 BE
6	11,66	0,74	23,31	0,71	92,19	0,76	6,44	0,95
38	11,07	0,20	21,68	-0,04	87,09	0,16	5,77	-0,18
40	11,20	0,32	22,20	0,20	89,80	0,48	4,87	-1,72
41	11,10	0,23	22,30	0,24	85,30	-0,05	5,89	0,02
57	10,45	-0,37	21,47	-0,14	83,48	-0,26	5,76	-0,20
68	11,10	0,23	21,20	-0,26	80,00	-0,66	5,95	0,12
70	10,43	-0,39	20,11	-0,76	84,66	-0,12	5,70	-0,30
71	10,80	-0,05	22,41	0,29	83,47	-0,26	6,00	0,21
80	10,71	-0,13	21,28	-0,23	86,88	0,14	5,70	-0,30
82	9,75	-1,02	19,90	-0,86	85,00	-0,08	5,72	-0,27
90	10,50	-0,33	21,50	-0,13	83,10	-0,30	5,75	-0,22
91	8,99	-1,72	17,42	-2,00	77,75	-0,93	4,60	-2,17 E
110	11,06	0,19	21,40	-0,17	87,00	0,15	5,80	-0,13
112	11,20	0,32	22,40	0,29	88,20	0,29	5,91	0,05
129	11,49	0,58	21,50	-0,13	84,58	-0,13	6,11	0,39
130	10,90	0,04	21,40	-0,17	76,40	-1,08	5,58	-0,51
138	11,40	0,50	23,30	0,70	86,80	0,13	6,07	0,33
151	10,90	0,04	22,40	0,29	87,70	0,23	5,90	0,04
161	12,50	1,52	22,00	0,10	102,00	1,90 B	7,01	1,93
177	9,10	-1,62	23,30	0,70	83,00	-0,31	5,00	-1,49
201	10,90	0,04	22,50	0,33	89,70	0,47	6,38	0,85
203	10,00	-0,79	20,00	-0,81	85,00	-0,08	5,60	-0,47
231	10,70	-0,14	21,40	-0,17	88,00	0,27	5,94	0,11
252	10,50	-0,33	21,40	-0,17	97,80	1,41	5,70	-0,30
255	11,53	0,62	23,32	0,71			6,31	0,73
279	12,30	1,33	20,70	-0,49	83,70	-0,23	7,38	2,55 E

	cobalt Z score	copper Z score	lead Z score	nickel Z score
Method	ISO 5725-2	ISO 5725-2	ISO 5725-2	ISO 5725-2
Assessment	Z ≤2,00	Z ≤2,00	Z ≤2,00	Z ≤2,00
No. of laboratories that submitted results	27	27	26	27
Mean	10,86	21,77	85,69	5,88
Reproducibility s.d.	0,81	1,53	4,46	0,57
Rel. reproducibility s.d.	7,42 %	7,03 %	5,20 %	9,72 %
Reference value	10,76	21,75	85,22	5,84
Target s.d.	1,09	2,18	8,57	0,59
Rel. target s.d.	10,00 %	10,00 %	10,00 %	10,00 %
Lower limit of tolerance	8,68	17,42	68,55	4,70
Upper limit of tolerance	13,03	26,13	102,83	7,05
Type B outliers	1		2	1
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	26	27	24	26
Explanation of outlier types				
A: Single outlier	Grubbs			
B: Differing laboratory mean	Grubbs			
C: Excessive laboratory s.d.	Cochran			
D: Excluded manually				
E: mean outside tolerance limits				
F: Z-Score >3,5				
zinc Z score				
Unit	µg absolute			
5	101,37	2,83	BE	
6	84,71	0,72		
38	78,66	-0,04		

	zinc	Z score
40	79,00	0,00
41	80,60	0,20
57	76,51	-0,31
68	95,10	2,04 BE
70	77,20	-0,23
71	79,80	0,10
80	82,46	0,44
82	72,10	-0,87
90	79,00	0,00
91	61,83	-2,17 BE
110	82,90	0,50
112	80,00	0,13
129	74,83	-0,53
130	82,20	0,41
138	81,60	0,33
151	77,60	-0,18
161	91,70	1,61 B
177	79,00	0,00
201	80,10	0,14
203	75,00	-0,51
231	79,40	0,05
252	78,50	-0,06
255	74,00	-0,63
279	81,60	0,33
-	-	--
Method	ISO 5725-2	
Assessment	Z <=2,00	
No. of laboratories that submitted results	27	
Mean	78,99	
Reproducibility s.d.	3,07	
Rel. reproducibility s.d.	3,88 %	
Reference value	78,72	
Target s.d.	7,90	

zinc Z score

Rel. target s.d.	10,00 %
Low er limit of tolerance	63,19
Upper limit of tolerance	94,79
Type B outliers	4
No. of laboratories after elimination of outliers type A-D and F (w ithout laboratories that only gave states but no measured values)	23

Summary of laboratory test results

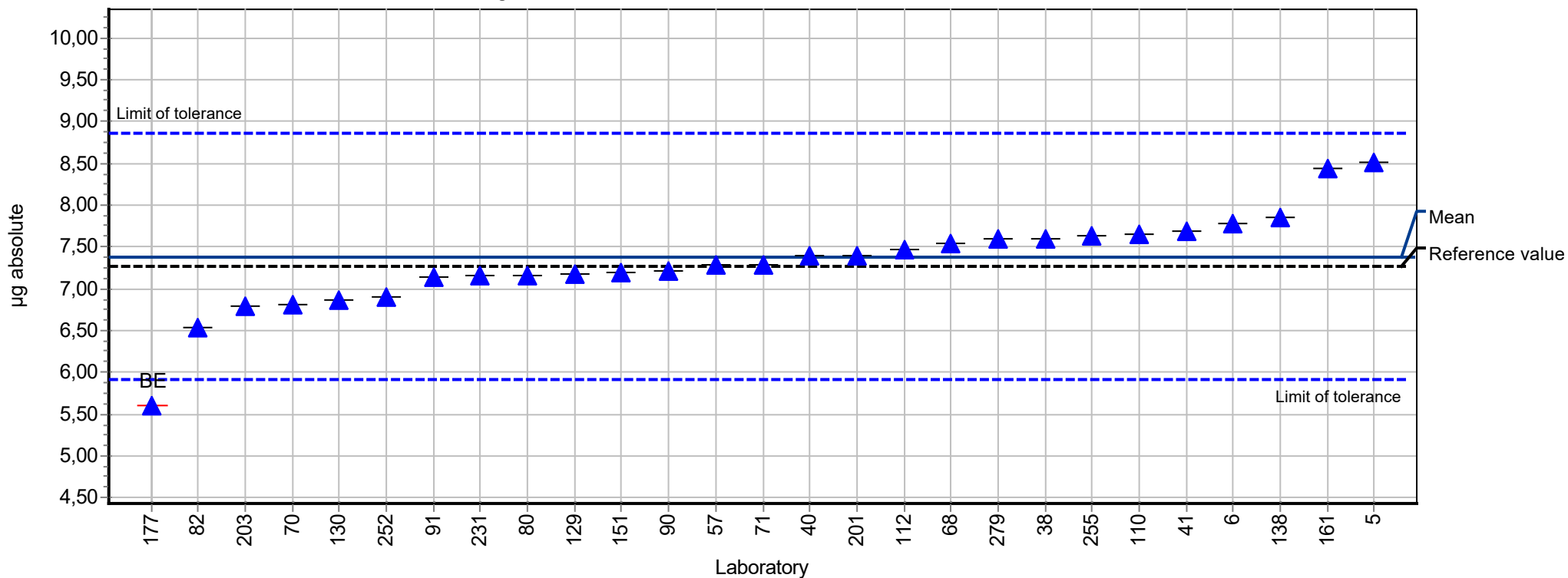
Sample 3

Unit	cobalt		copper		lead		nickel		zinc	
	µg absolute	Z score	µg absolute	Z score	µg absolute	Z score	µg absolute	Z score	µg absolute	Z score
5	5,98	6,07 BE	12,80	1,54	148,26	1,10	19,63	1,97	41,91	1,44
6	4,03	0,85	12,02	0,84	140,30	0,50	17,48	0,66	40,25	0,99
38	3,79	0,19	11,13	0,04	133,91	0,02	15,88	-0,31	36,81	0,05
40	3,72	0,00	10,90	-0,17	134,10	0,04	15,00	-0,85	35,10	-0,42
41	3,82	0,27	11,50	0,37	131,00	-0,19	16,20	-0,12	37,30	0,18
57	3,63	-0,24	11,19	0,09	129,87	-0,28	16,11	-0,17	36,28	-0,09
68	3,80	0,22	10,80	-0,26	122,80	-0,81	16,80	0,25	78,80	11,52 BE
70	3,62	-0,26	10,52	-0,51	129,30	-0,32	15,53	-0,53	36,46	-0,05
71	3,78	0,16	11,73	0,58	128,80	-0,36	16,48	0,05	38,06	0,39
80	3,62	-0,27	10,85	-0,21	132,40	-0,09	15,75	-0,39	41,48	1,33
82	3,32	-1,07	10,00	-0,98	126,00	-0,57	14,70	-1,03	30,70	-1,62
90	3,54	-0,48	10,90	-0,17	127,00	-0,49	15,60	-0,48	36,40	-0,06
91	3,76	0,11	10,54	-0,49	139,50	0,44	15,21	-0,72	33,81	-0,77
110	3,90	0,49	11,00	-0,08	131,90	-0,13	15,70	-0,42	38,30	0,46
112	3,88	0,43	11,60	0,46	137,00	0,26	16,80	0,25	37,30	0,18
129	3,69	-0,09	10,77	-0,28	125,21	-0,63	16,59	0,12	33,49	-0,86
130	3,56	-0,43	10,30	-0,71	137,00	0,26	15,20	-0,73	35,00	-0,44
138	3,84	0,32	11,50	0,37	138,00	0,33	17,50	0,68	37,40	0,21
151	3,60	-0,32	11,40	0,28	131,70	-0,14	16,00	-0,24	36,00	-0,17
161	4,32	1,62 B	11,30	0,19	157,00	1,75	19,00	1,59	42,80	1,69
177	2,00	-4,62 BE	11,50	0,37	112,00	-1,62	13,50	-1,76	32,00	-1,26
201	3,62	-0,27	11,00	-0,08	129,00	-0,34	20,10	2,26 E	37,80	0,32
203	3,60	-0,32	10,00	-0,98	132,00	-0,12	15,00	-0,85	35,00	-0,44
231	3,63	-0,24	10,80	-0,26	140,00	0,48	15,70	-0,42	35,10	-0,42
252	3,60	-0,32	11,00	-0,08	148,20	1,09	15,60	-0,48	35,80	-0,23
255	3,94	0,59	11,73	0,58			17,24	0,52	33,80	-0,77
279	3,97	0,67	10,60	-0,44	130,80	-0,21	18,30	1,16	37,90	0,35

	cobalt Z score	copper Z score	lead Z score	nickel Z score	zinc Z score
Method	ISO 5725-2	ISO 5725-2	ISO 5725-2	ISO 5725-2	ISO 5725-2
Assessment	Z ≤2,00	Z ≤2,00	Z ≤2,00	Z ≤2,00	Z ≤2,00
No. of laboratories that submitted results	27	27	26	27	27
Mean	3,72	11,09	133,58	16,39	36,62
Reproducibility s.d.	0,16	0,61	8,93	1,52	2,87
Rel. reproducibility s.d.	4,40 %	5,54 %	6,69 %	9,27 %	7,83 %
Reference value	3,61	11,03	129,42	15,77	36,23
Target s.d.	0,37	1,11	13,36	1,64	3,66
Rel. target s.d.	10,00 %	10,00 %	10,00 %	10,00 %	10,00 %
Lower limit of tolerance	2,98	8,87	106,86	13,11	29,30
Upper limit of tolerance	4,46	13,31	160,29	19,67	43,95
Type B outliers	3				1
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	24	27	26	27	26
Explanation of outlier types					
A: Single outlier	Grubbs				
B: Differing laboratory mean	Grubbs				
C: Excessive laboratory s.d.	Cochran				
D: Excluded manually					
E: mean outside tolerance limits					
F: Z-Score >3,5					

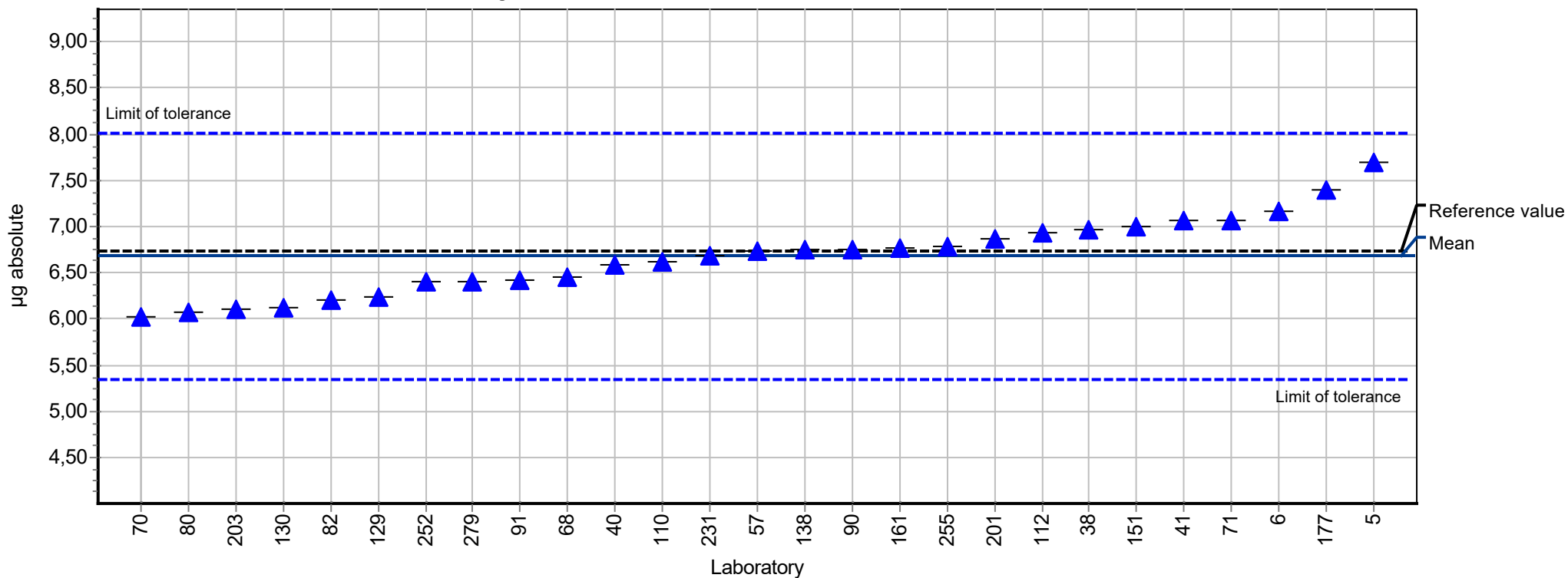
Summary results

Measurand:	cobalt	Mean:	7,39 µg absolute
Sample:	1	Reprod. s.d.:	0,46 µg absolute
Method:	ISO 5725-2	Rel.reprod. s.d.:	6,23%
Rel.target s.d.:	10,00% (Limited)	Reference value:	7,27 µg absolute
No. of laboratories:	26	Range of tolerance:	5,91 - 8,86 µg absolute ($ Z\text{-Score} \leq 2,00$)



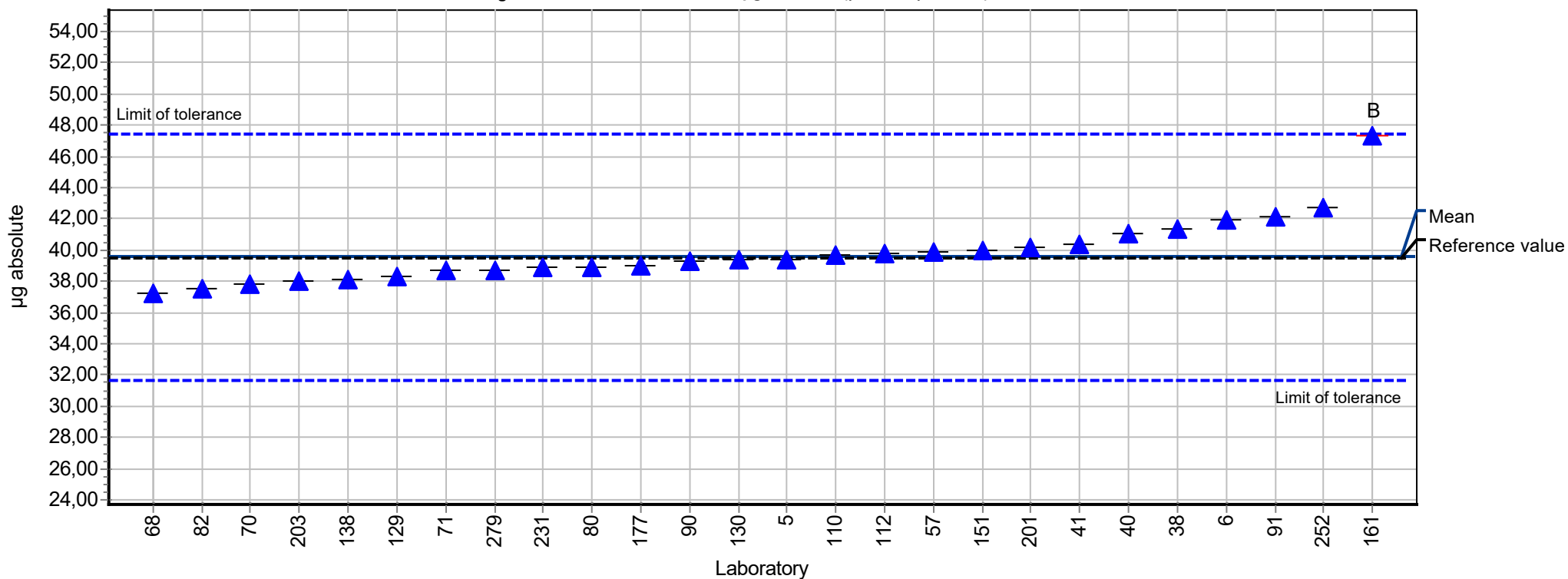
Summary results

Measurand:	copper	Mean:	6,68 µg absolute
Sample:	1	Reprod. s.d.:	0,42 µg absolute
Method:	ISO 5725-2	Rel.reprod. s.d.:	6,25%
Rel.target s.d.:	10,00% (Limited)	Reference value:	6,73 µg absolute
No. of laboratories:	27	Range of tolerance:	5,34 - 8,01 µg absolute ($ Z\text{-Score} \leq 2,00$)



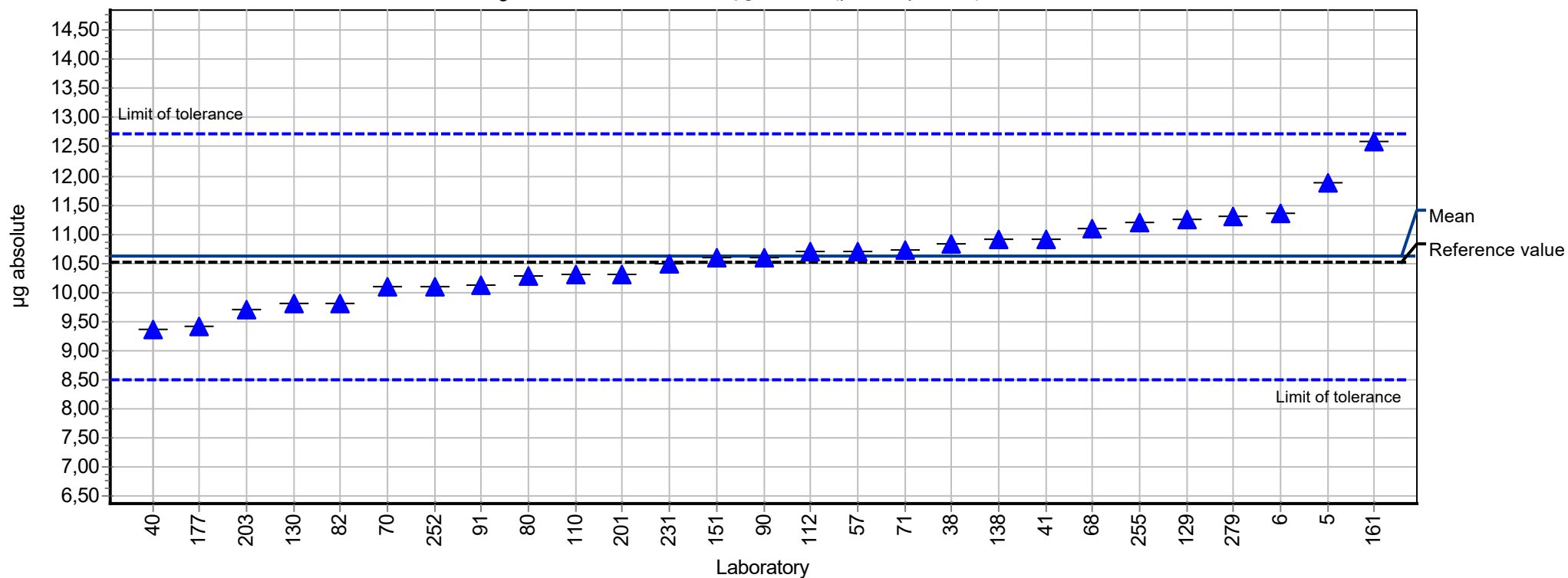
Summary results

Measurand:	lead	Mean:	39,54 µg absolute
Sample:	1	Reprod. s.d.:	1,46 µg absolute
Method:	ISO 5725-2	Rel.reprod. s.d.:	3,69%
Rel.target s.d.:	10,00% (Limited)	Reference value:	39,46 µg absolute
No. of laboratories:	25	Range of tolerance:	31,63 - 47,45 µg absolute (Z-Score ≤ 2,00)



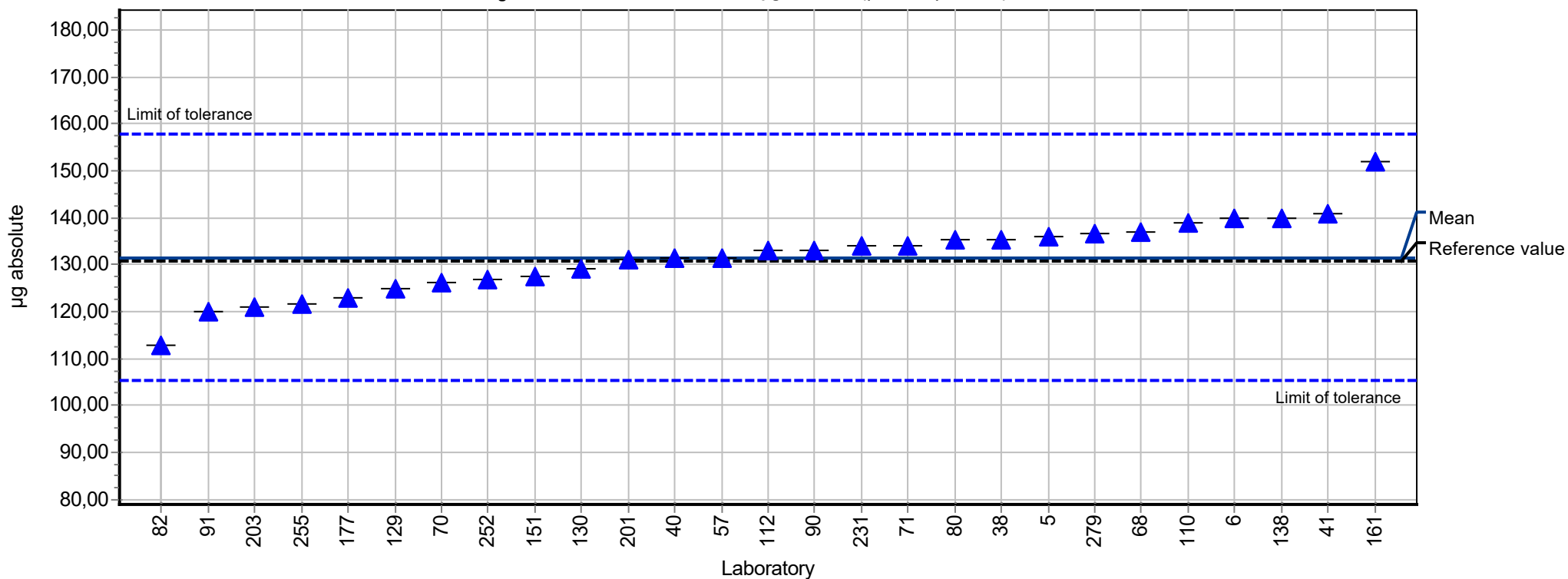
Summary results

Measurand:	nickel	Mean:	10,61 µg absolute
Sample:	1	Reprod. s.d.:	0,74 µg absolute
Method:	ISO 5725-2	Rel.reprod. s.d.:	6,94%
Rel.target s.d.:	10,00% (Limited)	Reference value:	10,52 µg absolute
No. of laboratories:	27	Range of tolerance:	8,49 - 12,73 µg absolute ($ Z\text{-Score} \leq 2,00$)



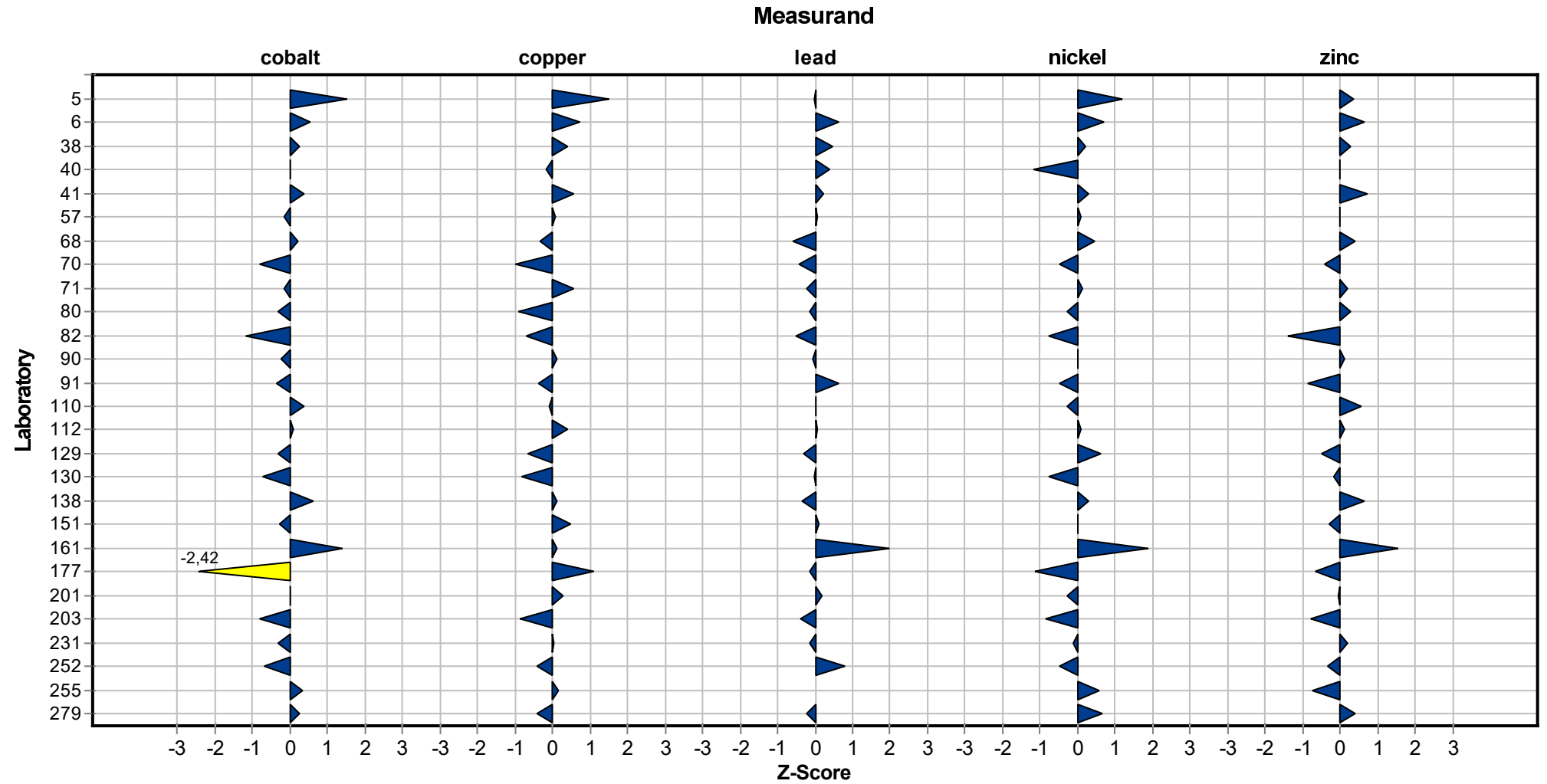
Summary results

Measurand:	zinc	Mean:	131,59 µg absolute
Sample:	1	Reprod. s.d.:	8,09 µg absolute
Method:	ISO 5725-2	Rel.reprod. s.d.:	6,15%
Rel.target s.d.:	10,00% (Limited)	Reference value:	130,92 µg absolute
No. of laboratories:	27	Range of tolerance:	105,27 - 157,91 µg absolute (Z-Score ≤ 2,00)



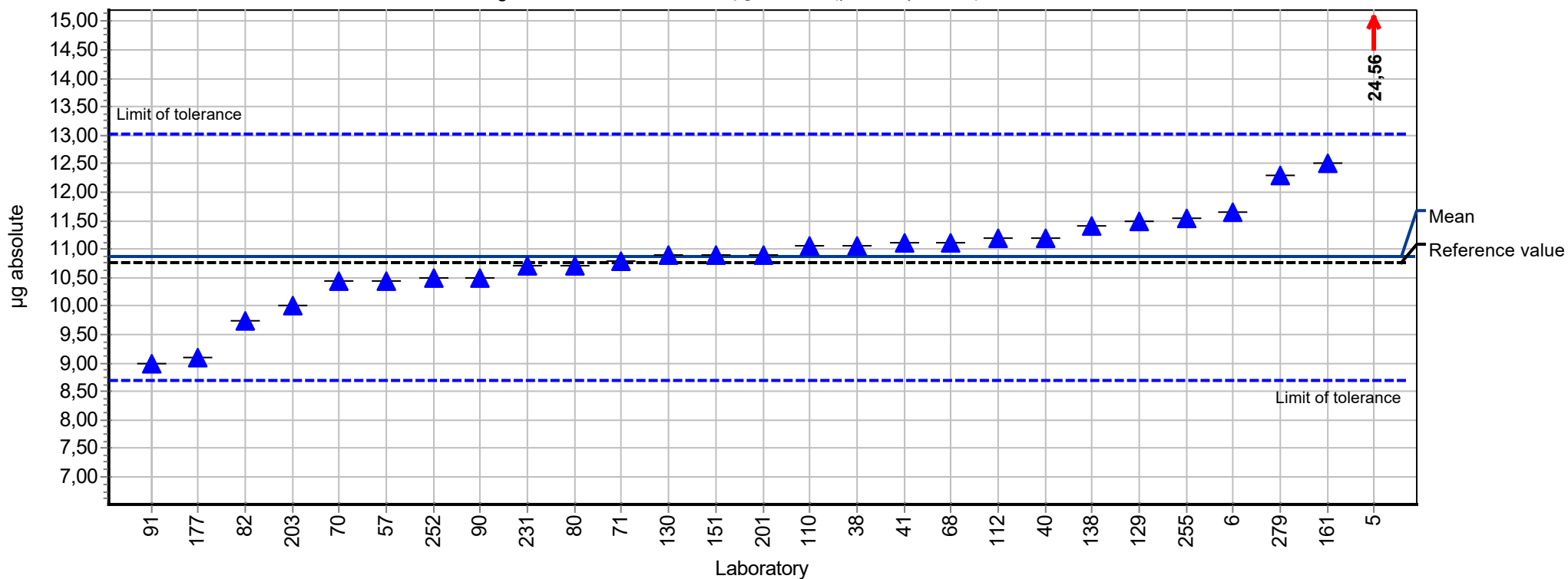
Sample chart of Z-scores

Sample 1



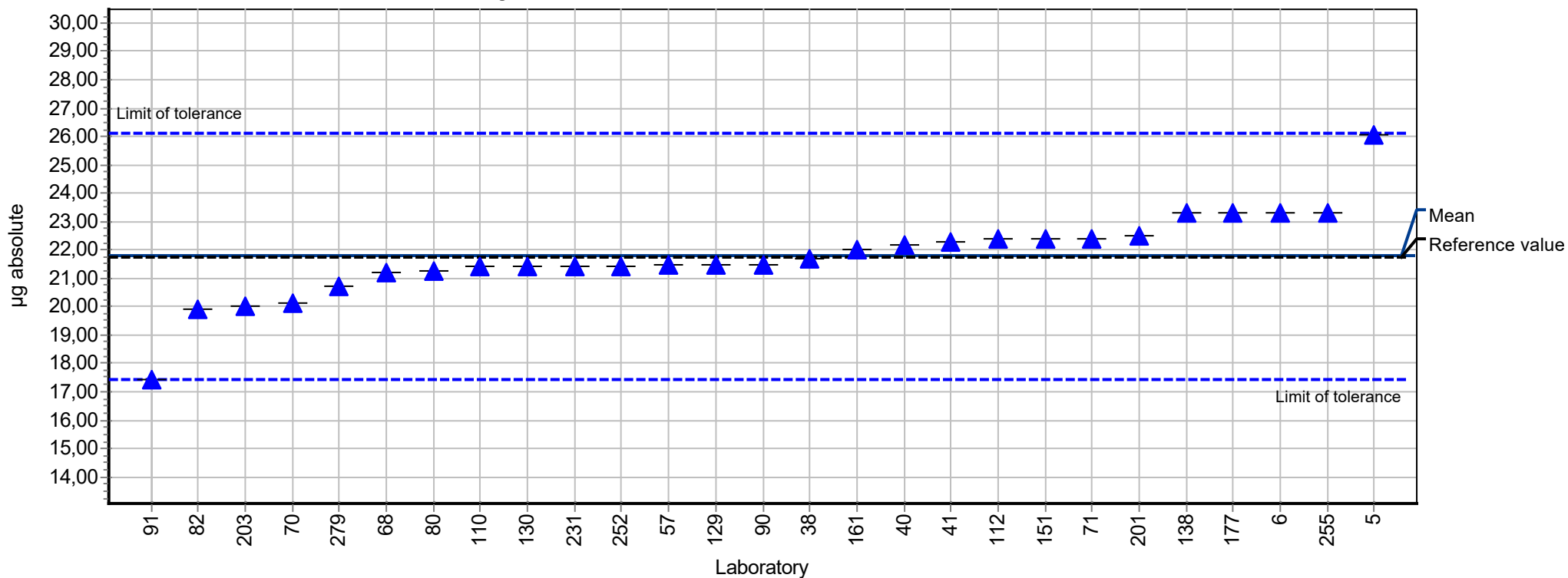
Summary results

Measurand:	cobalt	Mean:	10,86 µg absolute
Sample:	2	Reprod. s.d.:	0,81 µg absolute
Method:	ISO 5725-2	Rel.reprod. s.d.:	7,42%
Rel.target s.d.:	10,00% (Limited)	Reference value:	10,76 µg absolute
No. of laboratories:	26	Range of tolerance:	8,68 - 13,03 µg absolute (Z-Score <= 2,00)



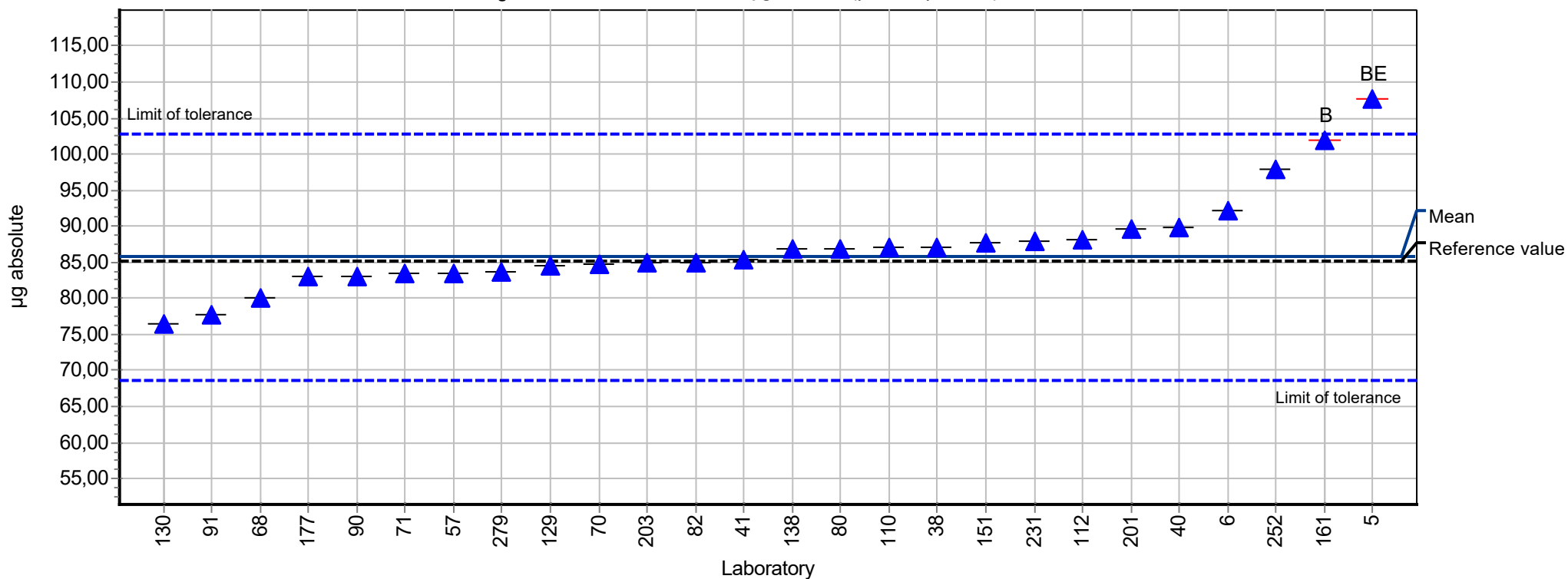
Summary results

Measurand:	copper	Mean:	21,77 µg absolute
Sample:	2	Reprod. s.d.:	1,53 µg absolute
Method:	ISO 5725-2	Rel.reprod. s.d.:	7,03%
Rel.target s.d.:	10,00% (Limited)	Reference value:	21,75 µg absolute
No. of laboratories:	27	Range of tolerance:	17,42 - 26,13 µg absolute ($ Z\text{-Score} \leq 2,00$)



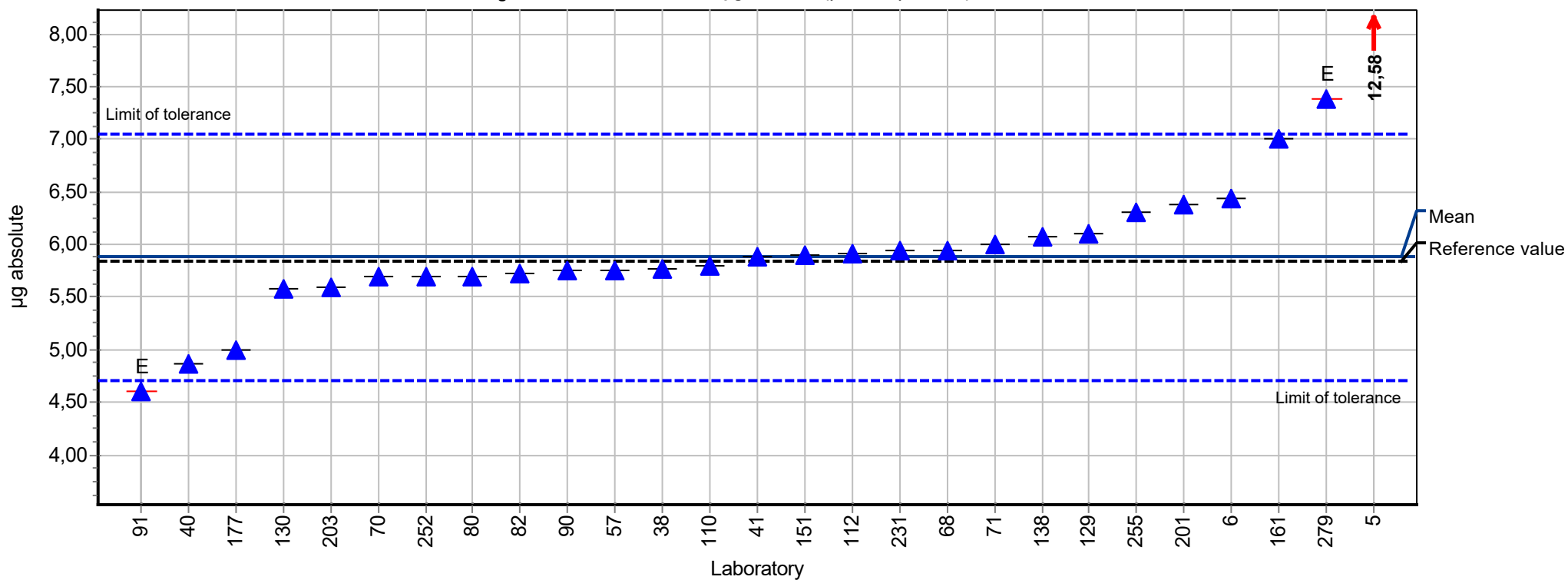
Summary results

Measurand:	lead	Mean:	85,69 µg absolute
Sample:	2	Reprod. s.d.:	4,46 µg absolute
Method:	ISO 5725-2	Rel.reprod. s.d.:	5,20%
Rel.target s.d.:	10,00% (Limited)	Reference value:	85,22 µg absolute
No. of laboratories:	24	Range of tolerance:	68,55 - 102,83 µg absolute ($ Z\text{-Score} \leq 2,00$)



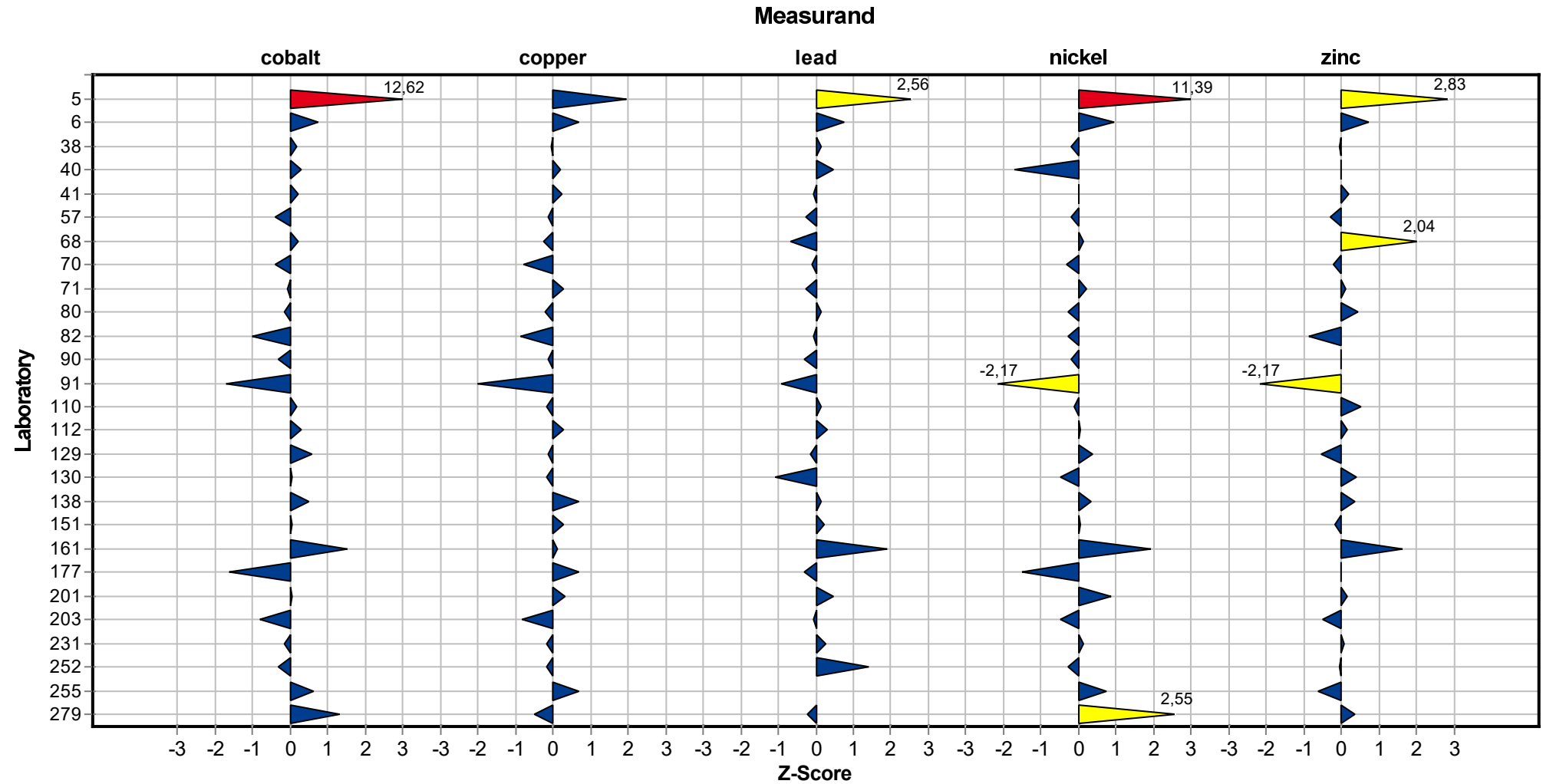
Summary results

Measurand:	nickel	Mean:	5,88 µg absolute
Sample:	2	Reprod. s.d.:	0,57 µg absolute
Method:	ISO 5725-2	Rel.reprod. s.d.:	9,72%
Rel.target s.d.:	10,00% (Limited)	Reference value:	5,84 µg absolute
No. of laboratories:	26	Range of tolerance:	4,70 - 7,05 µg absolute ($ Z\text{-Score} \leq 2,00$)



Sample chart of Z-scores

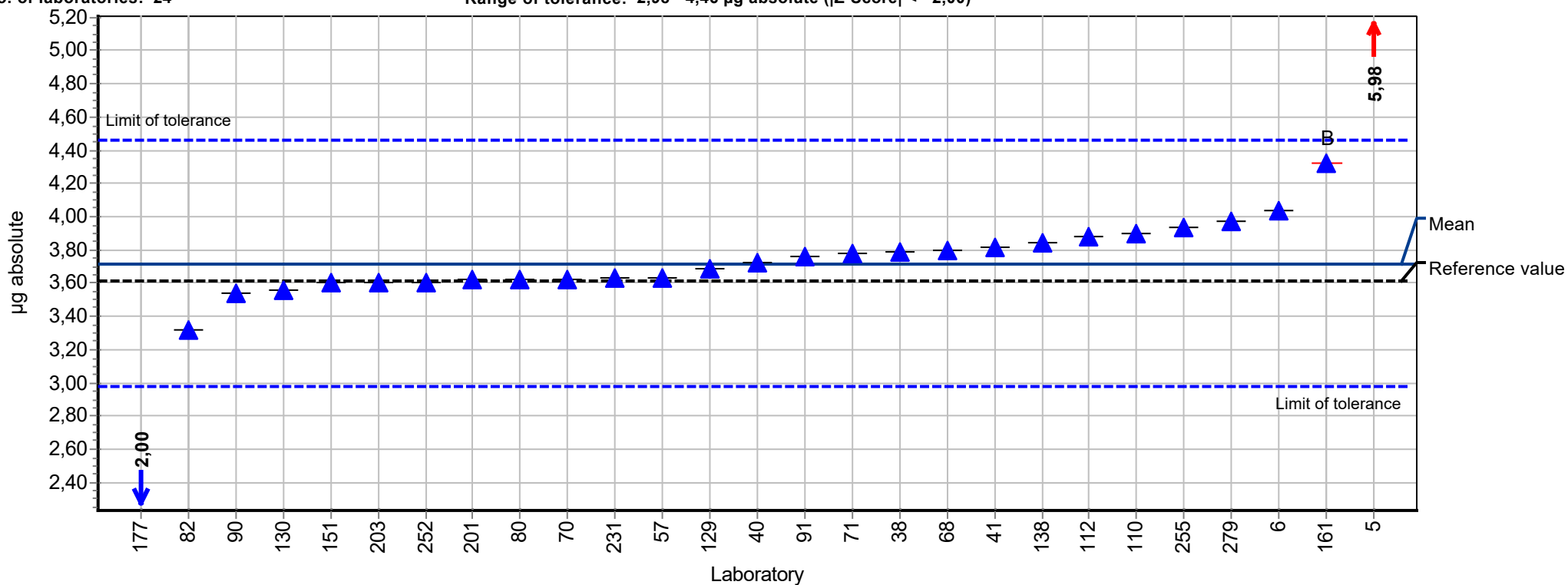
Sample 2



Summary results

Measurand: cobalt **Mean:** 3,72 µg absolute
Sample: 3 **Reprod. s.d.:** 0,16 µg absolute
Method: ISO 5725-2 **Rel.reprod. s.d.:** 4,40%
Rel.target s.d.: 10,00% (Limited) **Reference value:** 3,61 µg absolute

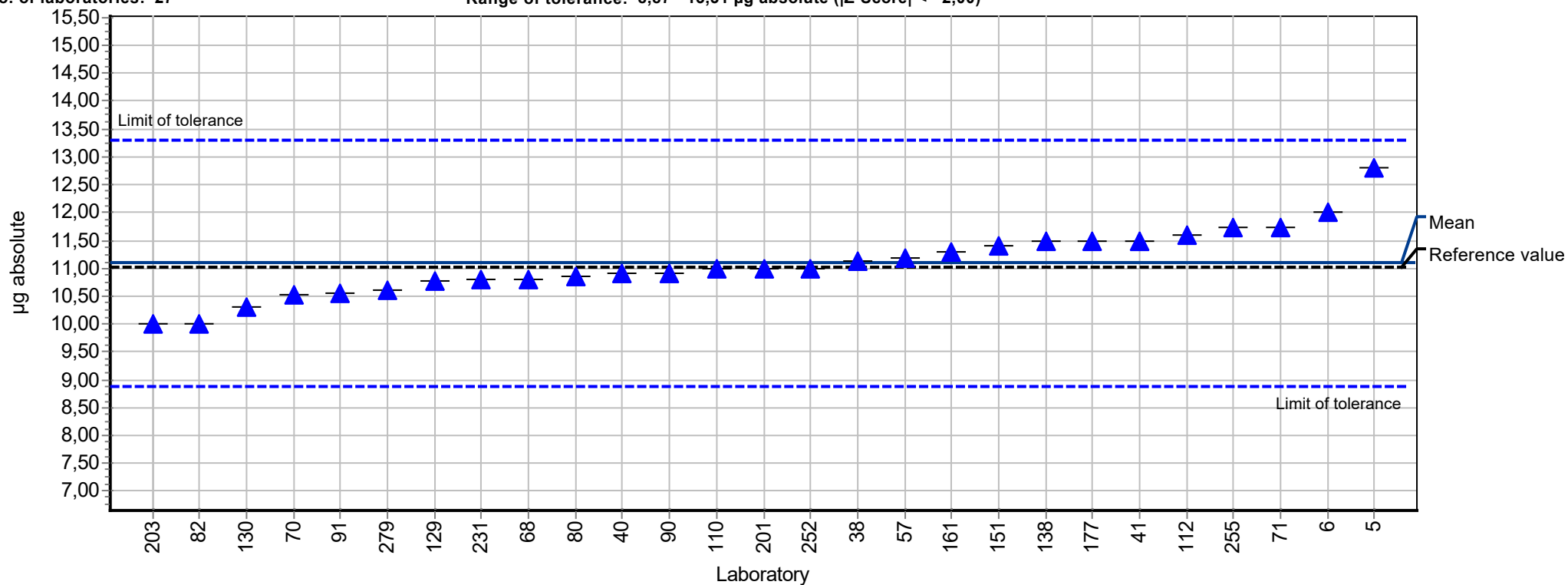
No. of laboratories: 24 **Range of tolerance:** 2,98 - 4,46 µg absolute ($|Z\text{-Score}| \leq 2,00$)



Summary results

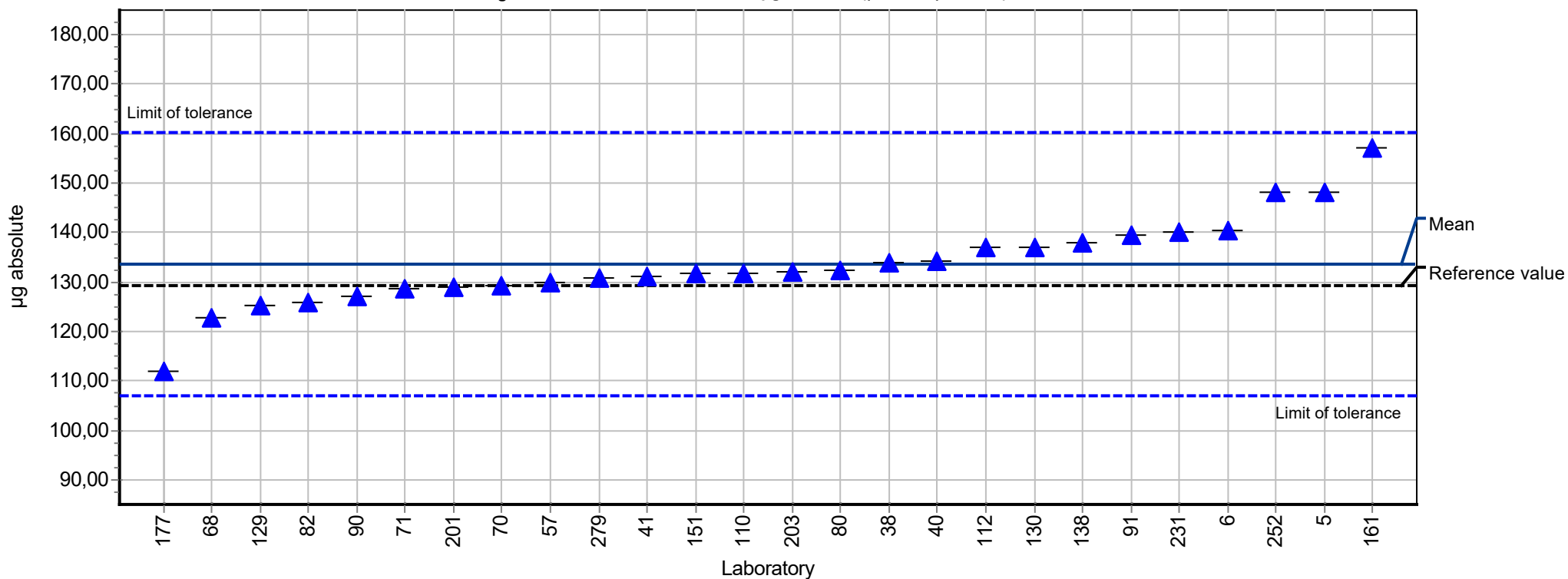
Measurand:	copper	Mean:	11,09 µg absolute
Sample:	3	Reprod. s.d.:	0,61 µg absolute
Method:	ISO 5725-2	Rel.reprod. s.d.:	5,54%
Rel.target s.d.:	10,00% (Limited)	Reference value:	11,03 µg absolute

No. of laboratories: 27 Range of tolerance: 8,87 - 13,31 µg absolute ($|Z\text{-Score}| \leq 2,00$)



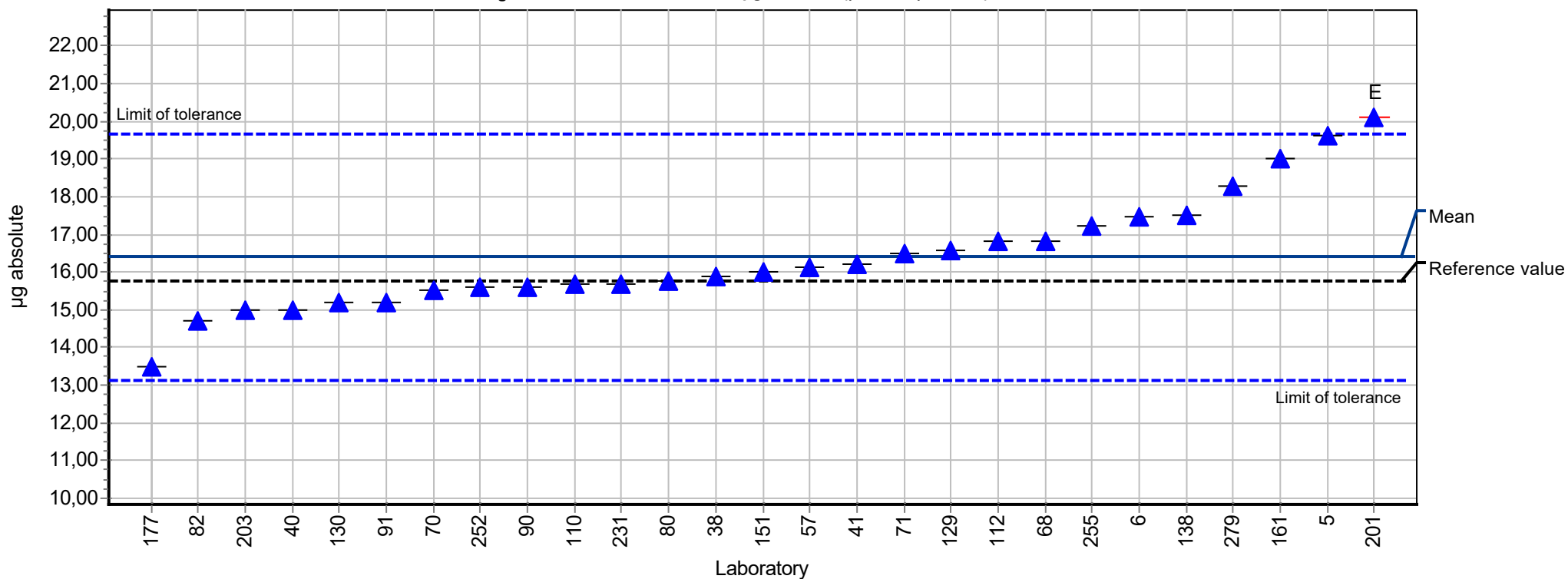
Summary results

Measurand:	lead	Mean:	133,58 µg absolute
Sample:	3	Reprod. s.d.:	8,93 µg absolute
Method:	ISO 5725-2	Rel.reprod. s.d.:	6,69%
Rel.target s.d.:	10,00% (Limited)	Reference value:	129,42 µg absolute
No. of laboratories:	26	Range of tolerance:	106,86 - 160,29 µg absolute ($ Z\text{-Score} \leq 2,00$)



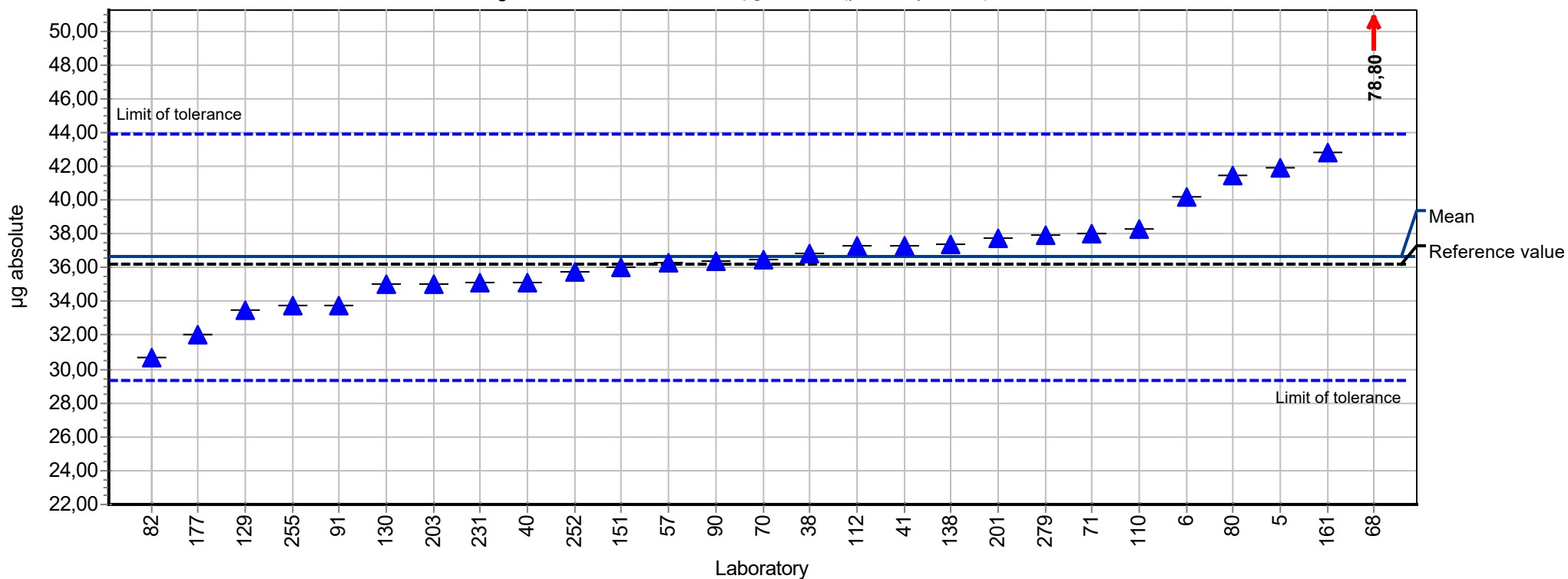
Summary results

Measurand:	nickel	Mean:	16,39 µg absolute
Sample:	3	Reprod. s.d.:	1,52 µg absolute
Method:	ISO 5725-2	Rel.reprod. s.d.:	9,27%
Rel.target s.d.:	10,00% (Limited)	Reference value:	15,77 µg absolute
No. of laboratories:	27	Range of tolerance:	13,11 - 19,67 µg absolute ($ Z\text{-Score} \leq 2,00$)



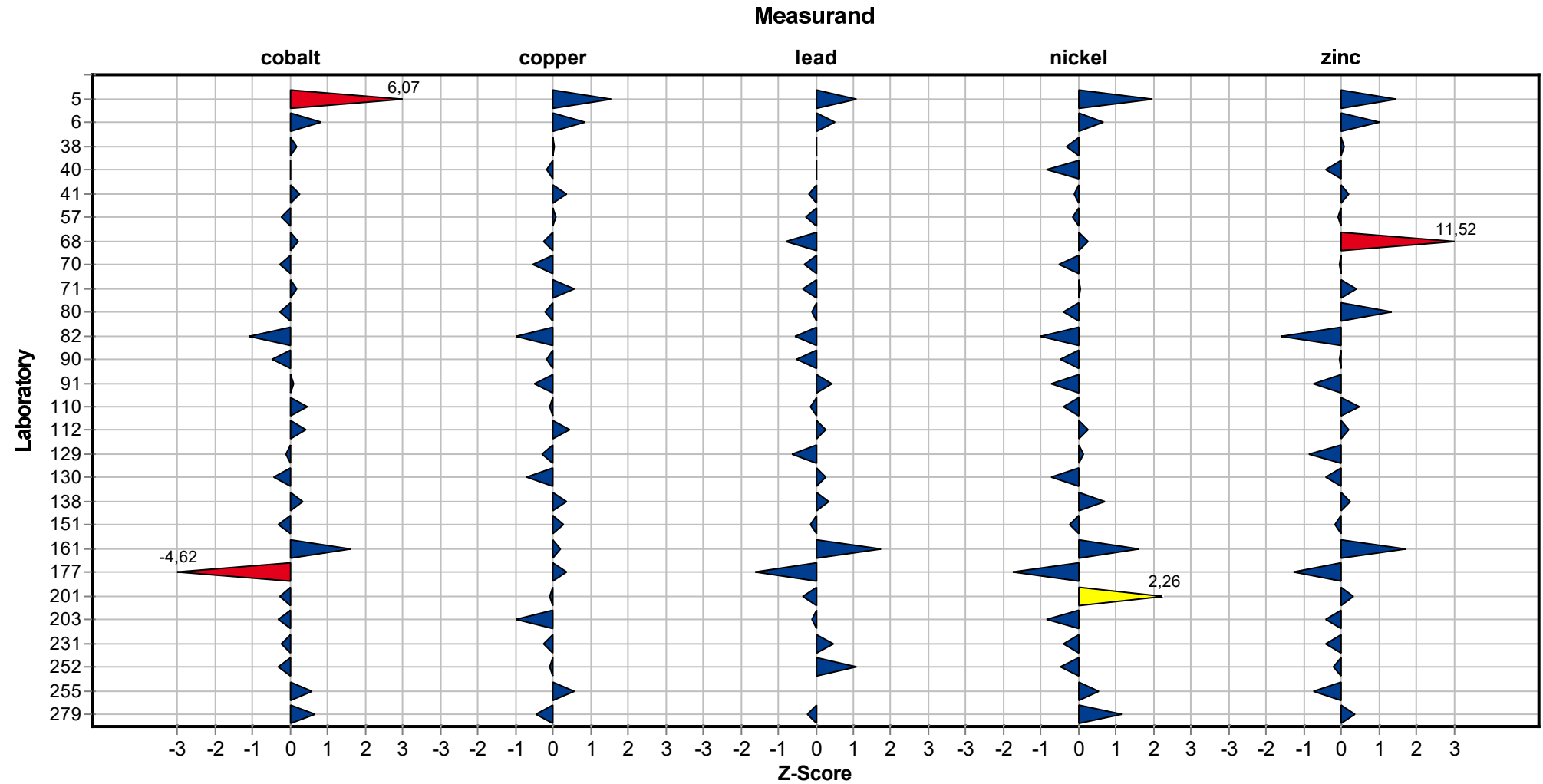
Summary results

Measurand:	zinc	Mean:	36,62 µg absolute
Sample:	3	Reprod. s.d.:	2,87 µg absolute
Method:	ISO 5725-2	Rel.reprod. s.d.:	7,83%
Rel.target s.d.:	10,00% (Limited)	Reference value:	36,23 µg absolute
No. of laboratories:	26	Range of tolerance:	29,30 - 43,95 µg absolute (Z-Score ≤ 2,00)



Sample chart of Z-scores

Sample 3



Questions and Answers

Participant	pulping method	acid concentration
6	IFA-Arbeitsmappe, Blatt 6015	HNO3 65%, HCl 25%
38	IFA-Arbeitsmappe, Blatt 6015	HNO3 69%, HCl 30%
40	Aufschluss nach IFA Arbeitsmappe (Blatt 6015)	HNO3 (conc.) , HCl (25%)
41	IFA Mikrow ellendruckaufschluss	67-69% (konzentrierte Salpetersäure)
57	IFA-Arbeitsmappe, Blatt 6015	HNO3 65%, HCl 25%
68	IFA-Arbeitsmappe	HCl 37 % / HNO3 65 %
70	IFA-Mikrow ellendruckaufschluss	65%ige Salpetersäure
71	Mikrow ellenaufschluss	65%ige Salpetersäure
80	IFA Mikrow ellenaufschluss	10 ml Salpetersäure 65%ig
82	in Anlehnung an IFA-Arbeitsmappe Blatt 6015	HNO3 65%, HCl 30%
90	Methode METROPOL M-124	HClO4 60% - HNO3 65% - HCl 37%
91	IFA Mikrow ellendruckaufschluss	65%
110	IFA-Arbeitsmappe 6015	HNO3 65%, HCl 25%
112	Standardaufschluss nach IFA Blatt 6015	HNO3 65% und HCl 25%
129	IFA- Arbeitsmappe, Blatt 6015	HNO3: 65% // HCl: 30%
138	Mikrow ellenaufschluss	HNO3, 65 %ig
151	Ja	25% HCl, 65% HNO3
161	in Anlehnung an Blatt 6015	konz.
177	IFA-Arbeitsmappe, Blatt 6015	HNO3 69% / HCl 37%
201	IFA 6015	HNO3 69 %; HCl 25 %
203	IFA Mikrow ellendruckaufw schluss	HNO3 65 %
231	IFA Mikrow ellendruckaufschluss	69 %; Supra Qualität
252	IFA 6015	IFA 6015
255	IFA 6015	Gemäß IFA 6015
279	Aufschluss nach IFA-Arbeitsmappe, Blatt 6015	Salpetersäure: 65 % Salzsäure: 25%

Participant	mixing ratio	time of pulping
6	2:1	2

Proficiency testing scheme Metals 2018

Participant	mixing ratio	time of pulping
38	2/1	2
40	2 Volumenteile HNO ₃ , 1 Volumenteil HCl	2 Stunden
41	10 mL Säure und anschließend auf 20 mL mit Reinstw asser aufgefüllt	Mit Abkühlphase 3 Stunden
57	2 : 1	2
68	1:2	2 Std.
70	10 ml Salpetersäure	in 15 min auf 220°C, in 5 min auf 240°C, 45 min halten --> 65 min
71	10 mL HNO ₃	laut Vorschrift
80	pur	1
82	17 mL HNO ₃ + 7 mL HCl	2
90	0,5 ml HClO ₄ + 2 ml HNO ₃ /HCl (2vol/1vol)	0h40min
91	5mLHNO ₃ auf 20mL mit H ₂ O	Programm lt. IFA
110	2 Teile HNO ₃ & 1 Teil HCl	2h
112	2 VT HNO ₃ und 1 VT HCl	2 Stunden
129	2:1	2
138	---	15 / 45 Minuten
151	1:2	2
161	1:3	2
177	2:1	2
201	2:1	2
203		1
231	nur 10 ml Salpetersäure	Rampe 45 min auf 240°C; 45 min halten bei 240°C
252	IFA 6015	0,5 h
255	Gemäß IFA 6015	2
279	HNO ₃ : HCl = 2 : 1	2

Participant	reagent volume	equipment	method for lead	method for copper	method for zinc
6	50 ml	unter Rückfluss	ICP-MS	ICP-MS	ICP-MS
38	50	unter Rückfluss	ICP-MS	ICP-MS	ICP-MS
40	50 ml	unter Rückfluss	ICP-MS	ICP-MS	ICP-MS
41	auf 20 mL	Mikrow elle Ultraclave	ICP-MS	ICP-MS	ICP-MS
57	25	offen	ICP-OES	ICP-OES	ICP-OES

Proficiency testing scheme Metals 2018

Participant	reagent volume	equipment	method for lead	method for copper	method for zinc
68	50	geschlossen	ICP-OES	ICP-OES	ICP-OES
70	aufgefüllt auf 20 ml	mikrow ellenassistierter Druckaufschluss	ICP-OES	ICP-OES	ICP-OES
71	25 ml	geschlossen	ICP-OES	ICP-OES	ICP-OES
80	50	geschlossen	ICP-OES	ICP-OES	ICP-OES
82	50 mL	unter Rückfluss	ICP-MS	ICP-MS	ICP MS
90	2,5 ml	offen	ICP MS	ICP MS	ICP MS
91	20	Mikrow ellendruckaufschluss	ICP MS	ICP MS	ICP MS
110	20ml	unter Rückfluss	ICP/OES	ICP/OES	ICP/OES
112	25ml	Rückfluss	ICP-OES	ICP-OES	ICP-OES
129	25	offen unter Rückfluss	AAS /Flamme	AAS/Flamme	AAS/Flamme
138	25	geschlossen	ICP AES	ICP AES	ICP AES
151	10	reflux	ICP/OES	ICP/OES	ICP/OES
161	50	offen	ICP/OES	ICP/OES	ICP/OES
177	20	offen	ICP-OES	ICP-OES	ICP-OES
201	25 ml	offen unter Rückfluss	AAS/Flamme	ET-AAS	AAS/Flamme
203	50	geschlossen	ICP-MS	ICP-MS	ICP-MS
231	25	geschlossen, Mikrow elle	ICP-OES	ICP-OES	ICP-OES
252	50 ml	offen	ICP/OES	ICP/OES	ICP/OES
255	20 ml	Rückfluss	-	AAS	AAS
279	25	offen unter Rückfluss	AAS-Flamme	AAS-Flamme	AAS-Flamme

Participant	method for cobalt	method for nickel
6	ICP-MS	ICP-MS
38	ICP-MS	ICP-MS
40	ICP-MS	ICP-MS
41	ICP-MS	ICP-MS
57	ICP-OES	ICP-OES
68	ICP-OES	ICP-OES
70	ICP-OES	ICP-OES
71	ICP-OES	ICP-OES
80	ICP-OES	ICP-OES

Proficiency testing scheme Metals 2018

Participant	method for cobalt	method for nickel
82	ICP-MS	ICP MS
90	ICP MS	ICP MS
91	ICP MS	ICP MS
110	ICP/OES	ICP/OES
112	ICP-OES	ICP-OES
129	AAS/Flamme	AAS/Flamme
138	ICP AES	ICP AES
151	ICP/OES	ICP/OES
161	ICP/OES	ICP/OES
177	ICP-OES	ICP-OES
201	ET-AAS	ET-AAS
203	ICP-MS	ICP-MS
231	ICP-OES	ICP-OES
252	ICP/OES	ICP/OES
255	AAS	AAS
279	AAS-Graphitrohrtechnik	AAS-Graphitrohrtechnik
