IFA
Institut für Arbeitsschutz der
Deutschen Gesetzlichen Unfallversicherung

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

Proficiency testing scheme Metals on filters

July/August 2022

Institute for Occupationial Safety and Health of the
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Summary of laboratory test results

Sample 1

	Chromium	Z score	Cobalt	Z score	Copper	Z score	Indium	Z score	Lead	Z score
Unit	µg absolute		µg absolute		µg absolute		µg absolute		µg absolute	
5	0,800	-0,6	0,230	0,0	1,400	5,3 FE	0,240	0,3	35,0	0,6
13	0,801	-0,6	0,236	0,3	0,902	-0,1	0,252	0,8	33,6	0,2
40	6,700	68,9 BE	0,224	-0,2	0,898	-0,2	2,290	88,1 BE	31,7	-0,4
41	0,500	-4,1 BE	0,250	0,9	0,530	-4,2 FE			31,6	-0,4
64	0,920	0,8	0,230	0,0	0,980	0,7	0,240	0,3	33,1	0,0
68	0,900	0,6	0,300	3,1 BE	0,900	-0,2			36,2	1,0
70	0,805	-0,5	0,238	0,4	0,885	-0,3			33,5	0,1
71	0,956	1,3	0,215	-0,6	1,058	1,6			37,6	1,4
75	0,900	0,6	0,240	0,5	0,960	0,5	0,254	0,9	33,2	0,0
80	0,703	-1,7	0,209	-0,9	0,757	-1,7	0,188	-1,9	30,4	-0,8
90	0,810	-0,5	0,240	0,5	0,910	0,0	0,250	0,7	34,7	0,5
106	0,786	-0,7	0,234	0,2	0,959	0,5	0,241	0,3	32,5	-0,2
129	0,810	-0,5	0,100	-5,6 BE	3,030	23,1 BE			32,4	-0,2
138	0,860	0,1	0,200	-1,3	0,880	-0,4	0,200	-1,4	32,8	-0,1
177	1,400	6,5 BE	0,240	0,5	2,000	11,9 BE	0,250	0,7	30,1	-0,9
206	0,860	0,1	0,220	-0,4	0,910	0,0	0,220	-0,6	29,9	-0,9
231	0,971	1,4	0,242	0,6	0,930	0,2	0,247	0,6	35,0	0,6
252			0,220	-0,4	0,870	-0,5	0,220	-0,6	31,6	-0,4
–	–	– –	–	– –	–	– –	–	– –	–	– –
Method	ISO 5725-2		ISO 5725-2		ISO 5725-2		ISO 5725-2		ISO 5725-2	
Assessment	|Z|<=2,0		|Z|<=2,0		|Z|<=2,0		|Z|<=2,0		|Z|<=2,0	
No. of laboratories that submitted results	17		18		18		13		18	
Mean	0,849		0,229		0,914		0,234		33,0	
Reprod. s.d.	0,074		0,014		0,067		0,022		2,1	
Rel. reproducibility s.d.	8,76 %		5,91 %		7,35 %		9,30 %		6,29 %	
Reference value	0,870		0,240		0,860		0,220		34,3	
Target s.d.	0,085		0,023		0,091		0,023		3,3	
Rel. target s.d.	10,00 %		10,00 %		10,00 %		10,00 %		10,00 %	

	Chromium	Z score	Cobalt	Z score	Copper	Z score	Indium	Z score	Lead	Z score
Low er limit of tolerance	0,679		0,183		0,731		0,187		26,4	
Upper limit of tolerance	1,018		0,275		1,097		0,280		39,7	
Type B outliers	3		2		2		1			
Type F outliers					2					
No. of laboratories after elimination of outliers type A-D and F (w ithout laboratories that only gave states but no measured values)	14		16		14		12		18	

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	

	Manganese	Z score	Nickel	Z score	Zinc	Z score
Unit	µg absolute		µg absolute		µg absolute	
5	3,80	0,0	1,80	1,4	22,0	-0,2
13	3,84	0,1	1,57	0,0	23,0	0,3
40	3,59	-0,6	1,40	-1,1	21,2	-0,5
41	4,28	1,2	1,34	-1,5	19,0	-1,5
64	3,87	0,1	1,62	0,3	23,4	0,5
68	4,10	0,7	1,80	1,4	25,1	1,2
70	3,67	-0,4	1,50	-0,5	22,1	-0,1
71	4,36	1,4	4,44	18,2 BE	27,2	2,2 E
75	3,95	0,3	1,72	0,9	24,5	1,0
80	3,38	-1,1	1,42	-1,0	19,8	-1,1
90	3,89	0,2	1,59	0,1	21,9	-0,2
106	3,79	-0,1	1,58	0,0	21,1	-0,6
129	3,80	0,0	1,56	-0,1	20,8	-0,7

	Manganese	Z score	Nickel	Z score	Zinc	Z score
138	3,41	-1,1	1,46	-0,7	19,2	-1,4
177	3,80	0,0	3,70	13,5 BE	22,5	0,1
206	3,57	-0,7	1,60	0,2	21,5	-0,4
231	4,02	0,5	1,74	1,0	24,8	1,1
252	3,61	-0,5	1,51	-0,4	23,0	0,3
–	–	– –	–	– –	–	– –
Method	ISO 5725-2		ISO 5725-2		ISO 5725-2	
Assessment	|Z|<=2,0		|Z|<=2,0		|Z|<=2,0	
No. of laboratories that submitted results	18		18		18	
Mean	3,82		1,58		22,3	
Reprod. s.d.	0,26		0,14		2,1	
Rel. reproducibility s.d.	6,93 %		8,75 %		9,56 %	
Reference value	3,90		1,60		22,7	
Target s.d.	0,38		0,16		2,2	
Rel. target s.d.	10,00 %		10,00 %		10,00 %	
Low er limit of tolerance	3,05		1,26		17,9	
Upper limit of tolerance	4,58		1,89		26,8	
Type B outliers			2			
No. of laboratories after elimination of outliers type A-D and F (w ithout laboratories that only gave states but no measured values)	18		16		18	

Summary of laboratory test results

Sample 2

	Cobalt	Z score	Copper	Z score	Indium	Z score	Lead	Z score	Manganese	Z score
Unit	µg absolute		µg absolute		µg absolute		µg absolute		µg absolute	
5	3,15	-0,3	2,60	1,5	0,680	0,1	37,0	0,2	3,60	-0,1
13	3,14	-0,4	2,20	-0,3	0,710	0,6	36,0	0,0	3,59	-0,2
40	3,10	-0,5	2,34	0,4	6,810	91,4 BE	36,8	0,2	3,59	-0,2
41	3,08	-0,5	1,72	-2,4 E			31,5	-1,3	3,48	-0,5
64	3,07	-0,6	2,23	-0,1	0,670	0,0	35,6	-0,2	3,61	-0,1
68	3,30	0,1	2,30	0,2			38,4	0,6	3,80	0,4
70	3,28	0,1	2,31	0,2			37,8	0,5	3,64	0,0
71	3,43	0,5	2,37	0,5			37,2	0,3	3,89	0,7
75	3,47	0,7	2,48	1,0	0,747	1,1	36,9	0,2	4,00	1,0
80	3,51	0,8	2,39	0,6	0,724	0,8	40,4	1,2	3,94	0,8
90	3,12	-0,4	2,18	-0,4	0,670	0,0	36,0	0,0	3,51	-0,4
106	3,13	-0,4	2,31	0,2	0,669	0,0	35,1	-0,3	3,55	-0,3
129	3,37	0,4	1,98	-1,2			37,7	0,4	3,82	0,5
138	3,38	0,4	2,29	0,1	0,570	-1,5	38,9	0,8	3,47	-0,5
177	3,70	1,4	3,90	7,3 BE	0,400	-4,0 BE	32,2	-1,1	3,50	-0,4
206	2,87	-1,2	2,14	-0,5	0,610	-0,9	30,6	-1,5	3,27	-1,0
231	3,19	-0,2	2,23	-0,1	0,649	-0,3	34,9	-0,3	3,66	0,0
252	3,32	0,2	2,37	0,5	0,690	0,3	37,9	0,5	3,73	0,2
–	–	– –	–	– –	–	– –	–	– –	–	– –
Method	ISO 5725-2		ISO 5725-2		ISO 5725-2		ISO 5725-2		ISO 5725-2	
Assessment	|Z|<=2,0		|Z|<=2,0		|Z|<=2,0		|Z|<=2,0		|Z|<=2,0	
No. of laboratories that submitted results	18		18		13		18		18	
Mean	3,26		2,26		0,672		36,2		3,65	
Reprod. s.d.	0,20		0,20		0,050		2,6		0,19	
Rel. reproducibility s.d.	6,13 %		8,66 %		7,44 %		7,13 %		5,12 %	
Reference value	3,13		2,23		0,672		37,3		3,56	
Target s.d.	0,33		0,23		0,067		3,6		0,36	
Rel. target s.d.	10,00 %		10,00 %		10,00 %		10,00 %		10,00 %	

	Cobalt	Z score	Copper	Z score	Indium	Z score	Lead	Z score	Manganese	Z score
Low er limit of tolerance	2,60		1,81		0,537		28,9		2,92	
Upper limit of tolerance	3,91		2,71		0,806		43,4		4,38	
Type B outliers			1		2					
No. of laboratories after elimination of outliers type A-D and F (w ithout laboratories that only gave states but no measured values)	18		17		11		18		18	
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										

	Nickel	Z score	Zinc	Z score
Unit	µg absolute		µg absolute	
5	4,90	-0,4	18,0	-0,2
13	4,97	-0,2	18,6	0,2
40	4,71	-0,7	18,2	-0,1
41	4,69	-0,8	15,5	-1,5
64	4,70	-0,8	18,3	0,0
68	5,30	0,4	19,6	0,7
70	5,26	0,3	18,4	0,0
71	5,01	-0,2	19,8	0,8
75	5,55	0,9	19,5	0,6
80	5,51	0,8	19,6	0,7
90	4,69	-0,8	16,9	-0,8
106	5,35	0,5	16,4	-1,0
129	5,12	0,1	18,8	0,2
138	4,76	-0,6	16,5	-1,0

	Nickel	Z score	Zinc	Z score
177	6,30	2,4 E	19,5	0,6
206	4,68	-0,8	16,9	-0,8
231	4,94	-0,3	18,5	0,1
252	5,10	0,0	20,7	1,3
–	–	– –	–	– –
Method	ISO 5725-2		ISO 5725-2	
Assessment	|Z|<=2,0		|Z|<=2,0	
No. of laboratories that submitted results	18		18	
Mean	5,09		18,3	
Reprod. s.d.	0,42		1,4	
Rel. reproducibility s.d.	8,21 %		7,66 %	
Reference value	4,87		17,2	
Target s.d.	0,51		1,8	
Rel. target s.d.	10,00 %		10,00 %	
Low er limit of tolerance	4,07		14,7	
Upper limit of tolerance	6,10		22,0	
No. of laboratories after elimination of outliers type A-D and F (w ithout laboratories that only gave states but no measured values)	18		18	

Summary of laboratory test results

Sample 3

	Cobalt	Z score	Copper	Z score	Indium	Z score	Lead	Z score	Manganese	Z score
Unit	µg absolute		µg absolute		µg absolute		µg absolute		µg absolute	
5	0,410	-0,4	5,60	-0,8	0,140	-0,2	27,0	-0,1	13,0	-0,9
13	0,419	-0,2	6,07	-0,1	0,151	0,6	26,3	-0,4	14,1	-0,1
40	0,428	0,0	6,11	0,0	1,530	96,9 BE	27,2	0,0	13,8	-0,4
41	0,410	-0,4	5,78	-0,5			25,3	-0,7	14,7	0,3
64	0,410	-0,4	5,87	-0,4	0,150	0,5	26,0	-0,5	13,9	-0,3
68	0,500	1,7	6,30	0,3			28,6	0,5	14,8	0,3
70	0,456	0,7	6,26	0,3			28,4	0,4	14,4	0,1
71	0,401	-0,6	6,21	0,2			29,8	0,9	14,6	0,2
75	0,457	0,7	6,48	0,6	0,167	1,7	29,8	0,9	15,8	1,0
80	0,465	0,9	6,53	0,7	0,101	-2,9 E	29,5	0,8	15,0	0,5
90	0,430	0,1	6,02	-0,1	0,150	0,5	27,5	0,1	13,9	-0,2
106	0,435	0,2	6,30	0,3	0,151	0,6	26,6	-0,3	13,9	-0,3
129	0,260	-3,9 BE	7,55	2,4 BE			29,3	0,7	14,8	0,3
138	0,380	-1,1	5,89	-0,4	0,130	-0,9	29,1	0,7	15,6	0,9
177	0,430	0,1	10,50	7,2 BE	0,080	-4,4 FE	23,1	-1,5	13,6	-0,5
206	0,390	-0,9	5,94	-0,3	0,140	-0,2	23,1	-1,5	13,1	-0,8
231	0,422	-0,1	5,98	-0,2	0,144	0,1	27,6	0,1	14,0	-0,2
252	0,430	0,1	6,36	0,4	0,150	0,5	27,4	0,0	14,5	0,1
–	–	– –	–	– –	–	– –	–	– –	–	– –
Method	ISO 5725-2		ISO 5725-2		ISO 5725-2		ISO 5725-2		ISO 5725-2	
Assessment	|Z|<=2,0		|Z|<=2,0		|Z|<=2,0		|Z|<=2,0		|Z|<=2,0	
No. of laboratories that submitted results	18		18		13		18		18	
Mean	0,428		6,11		0,143		27,3		14,3	
Reprod. s.d.	0,029		0,26		0,017		2,0		0,7	
Rel. reproducibility s.d.	6,87 %		4,25 %		11,70 %		7,43 %		5,21 %	
Reference value	0,411		5,83		0,148		28,6		13,5	
Target s.d.	0,043		0,61		0,014		2,7		1,4	
Rel. target s.d.	10,00 %		10,00 %		10,00 %		10,00 %		10,00 %	

	Cobalt	Z score	Copper	Z score	Indium	Z score	Lead	Z score	Manganese	Z score
Low er limit of tolerance	0,342		4,88		0,114		21,8		11,4	
Upper limit of tolerance	0,513		7,33		0,172		32,8		17,2	
Type B outliers	1		2		1					
Type F outliers					1					
No. of laboratories after elimination of outliers type A-D and F (w ithout laboratories that only gave states but no measured values)	17		16		11		18		18	

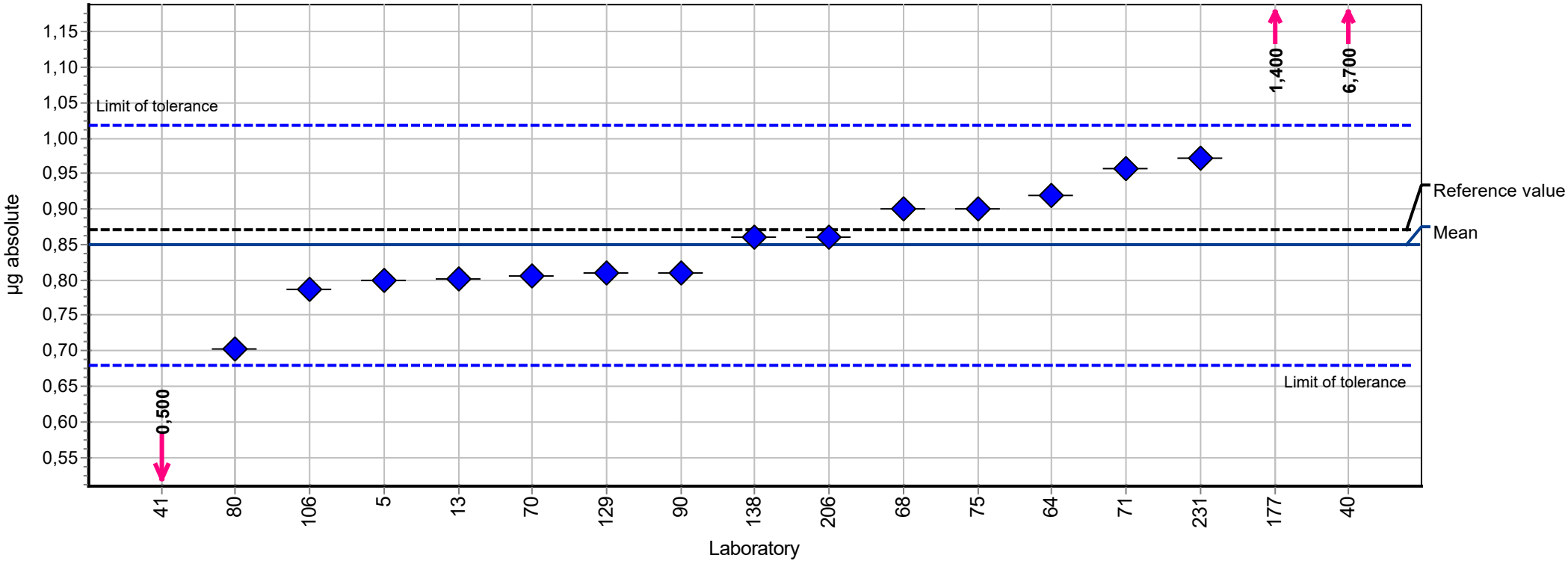
Explanation of outlier types	
A: Single outlier	Grubbs
B: Differing laboratory mean	Grubbs
C: Excessive laboratory s.d.	Cochran
D: Excluded manually	
E: mean outside tolerance limits	
F: |Z-Score|>3,5	

	Nickel	Z score		Zinc	Z score
Unit	µg absolute			µg absolute	
5	4,30	-0,4		26,0	-0,8
13	4,39	-0,2		27,8	-0,1
40	4,24	-0,5		27,6	-0,2
41	4,13	-0,7		27,5	-0,2
64	4,25	-0,5		30,5	0,8
68	4,80	0,8		30,7	0,9
70	4,70	0,5		28,1	0,0
71	2,02	-5,5	BE	30,9	1,0
75	4,90	1,0		32,3	1,5
80	4,86	0,9		29,2	0,4
90	4,34	-0,3		26,6	-0,5
106	4,52	0,1		26,8	-0,5
129	4,63	0,4		25,2	-1,0

	Nickel	Z score	Zinc	Z score
138	4,17	-0,6	24,6	-1,3
177	7,50	6,8 BE	27,5	-0,2
206	4,28	-0,4	26,3	-0,7
231	4,34	-0,3	28,2	0,0
252	4,47	0,0	31,3	1,1
–	–	– –	–	– –
Method	ISO 5725-2		ISO 5725-2	
Assessment	|Z|<=2,0		|Z|<=2,0	
No. of laboratories that submitted results	18		18	
Mean	4,46		28,2	
Reprod. s.d.	0,25		2,2	
Rel. reproducibility s.d.	5,60 %		7,79 %	
Reference value	4,34		26,3	
Target s.d.	0,45		2,8	
Rel. target s.d.	10,00 %		10,00 %	
Low er limit of tolerance	3,57		22,5	
Upper limit of tolerance	5,35		33,8	
Type B outliers	2			
No. of laboratories after elimination of outliers type A-D and F (w ithout laboratories that only gave states but no measured values)	16		18	

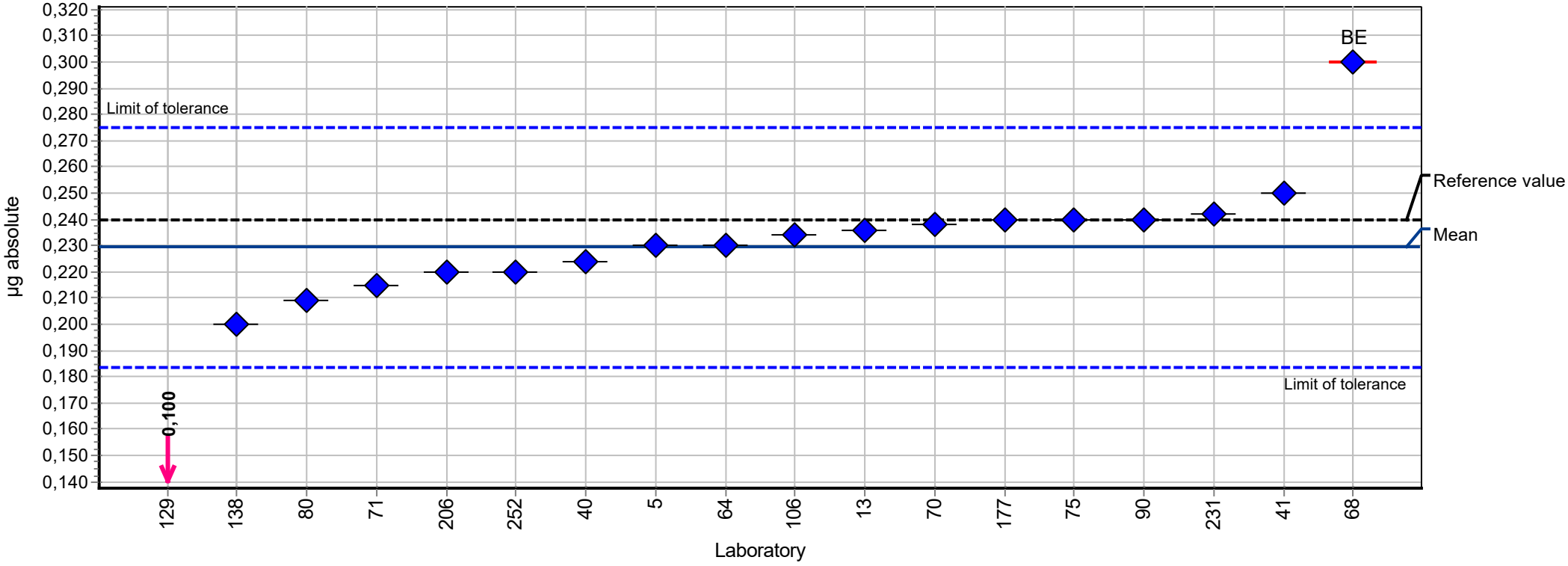
Summary results

Measurand:	**Chromium**	**Mean:**	**0,849 µg absolute**
Sample:	**1**	**Reprod. s.d.:**	**0,074 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**8,76%**
Rel.target s.d.:	**10,00% (Limited)**	**Reference value:**	**0,870 µg absolute**
Number of laboratories in calculation + outliers:	**17**	**Range of tolerance:**	**0,679 - 1,018 µg absolute (|Z-Score| <= 2,0)**



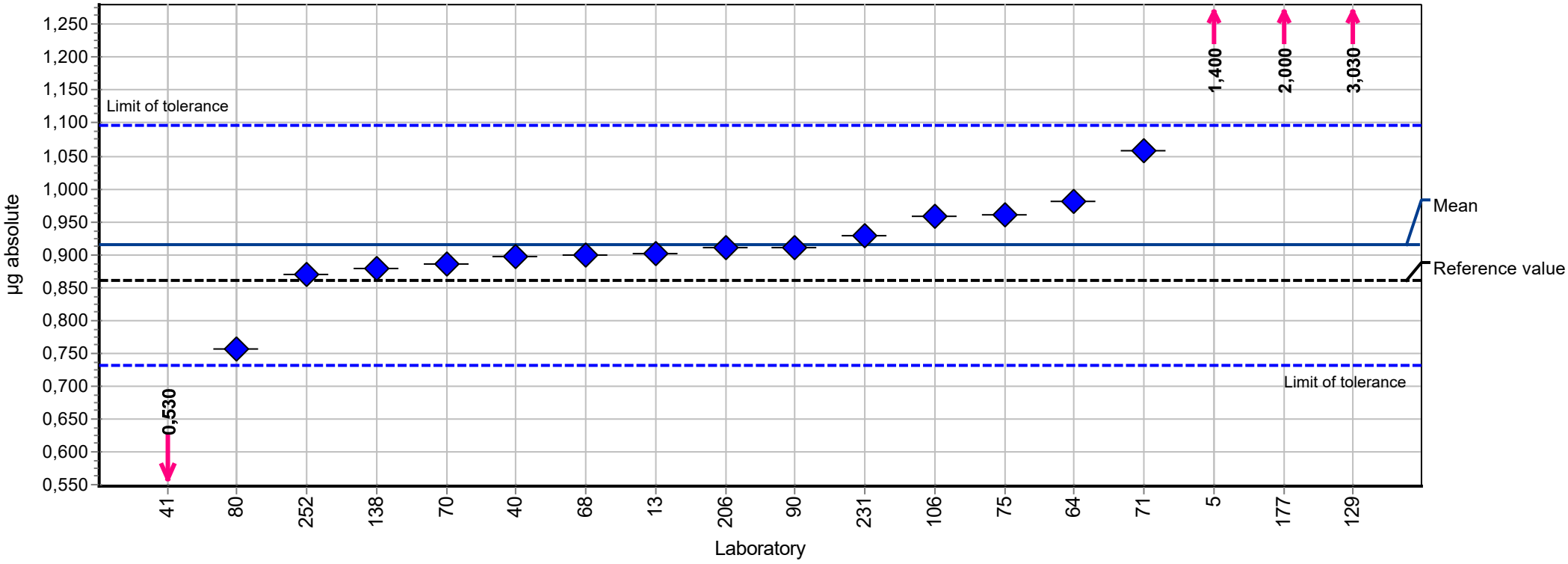
Summary results

Measurand:	**Cobalt**	**Mean:**	**0,229 µg absolute**
Sample:	**1**	**Reprod. s.d.:**	**0,014 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**5,91%**
Rel.target s.d.:	**10,00% (Limited)**	**Reference value:**	**0,240 µg absolute**
Number of laboratories in calculation + outliers:	**18**	**Range of tolerance:**	**0,183 - 0,275 µg absolute (|Z-Score| <= 2,0)**



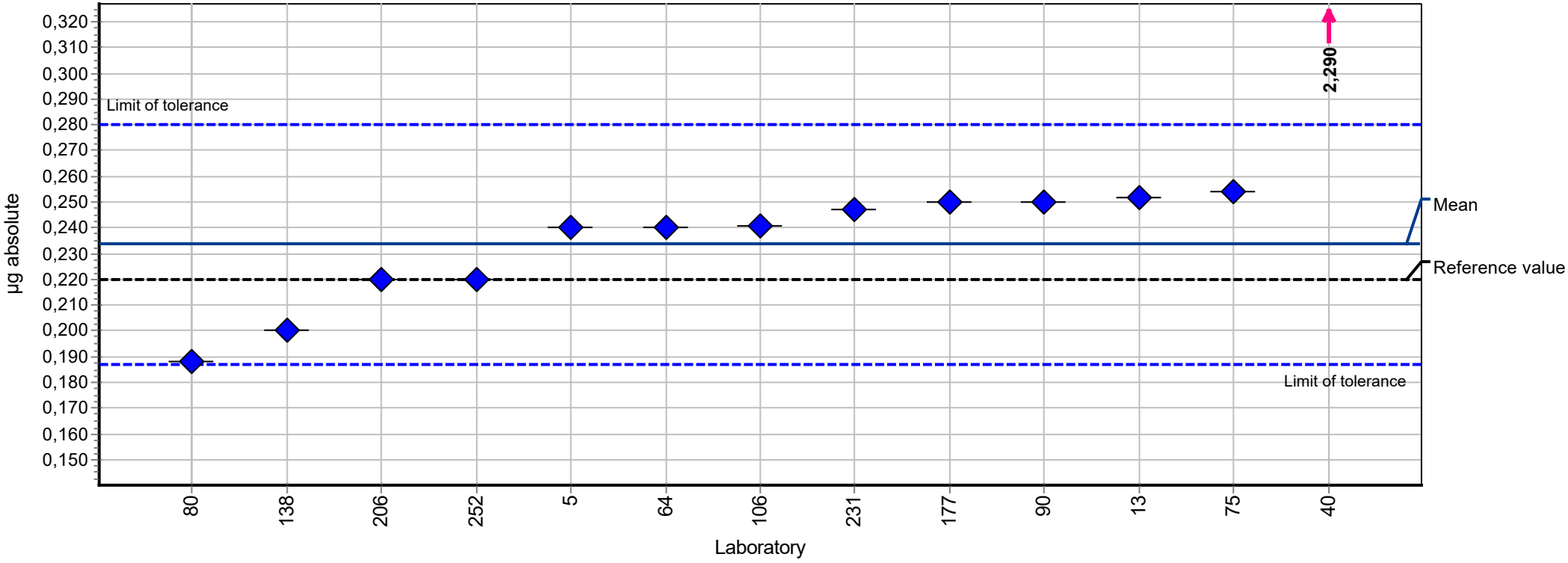
Summary results

Measurand:	**Copper**	**Mean:**	**0,914 µg absolute**
Sample:	**1**	**Reprod. s.d.:**	**0,067 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**7,35%**
Rel.target s.d.:	**10,00% (Limited)**	**Reference value:**	**0,860 µg absolute**
Number of laboratories in calculation + outliers:	**16**	**Range of tolerance:**	**0,731 - 1,097 µg absolute (|Z-Score| <= 2,0)**



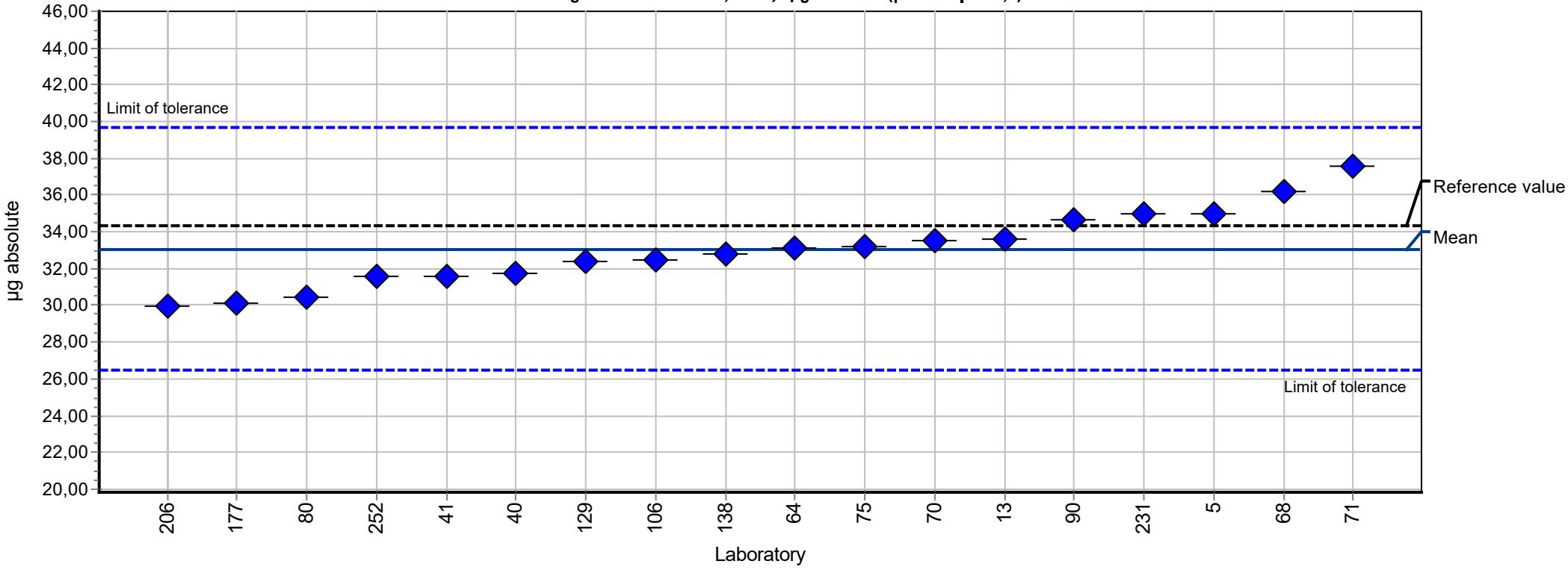
Summary results

Measurand:	**Indium**	**Mean:**	**0,234 µg absolute**
Sample:	**1**	**Reprod. s.d.:**	**0,022 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**9,30%**
Rel.target s.d.:	**10,00% (Limited)**	**Reference value:**	**0,220 µg absolute**
Number of laboratories in calculation + outliers:	**13**	**Range of tolerance:**	**0,187 - 0,280 µg absolute (|Z-Score| <= 2,0)**



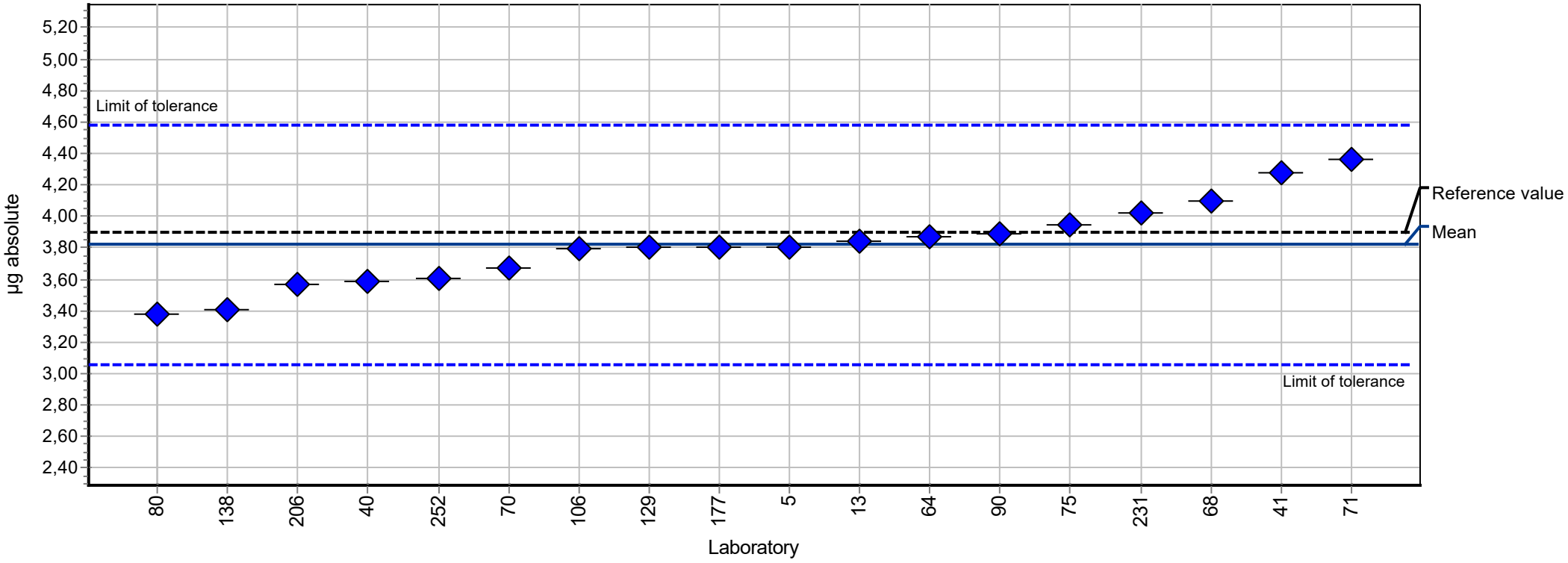
Summary results

Measurand:	**Lead**	**Mean:**	**33,0 µg absolute**
Sample:	**1**	**Reprod. s.d.:**	**2,1 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**6,29%**
Rel.target s.d.:	**10,00% (Limited)**	**Reference value:**	**34,3 µg absolute**
Number of laboratories in calculation:	**18**	**Range of tolerance:**	**26,4 - 39,7 µg absolute (|Z-Score| <= 2,0)**



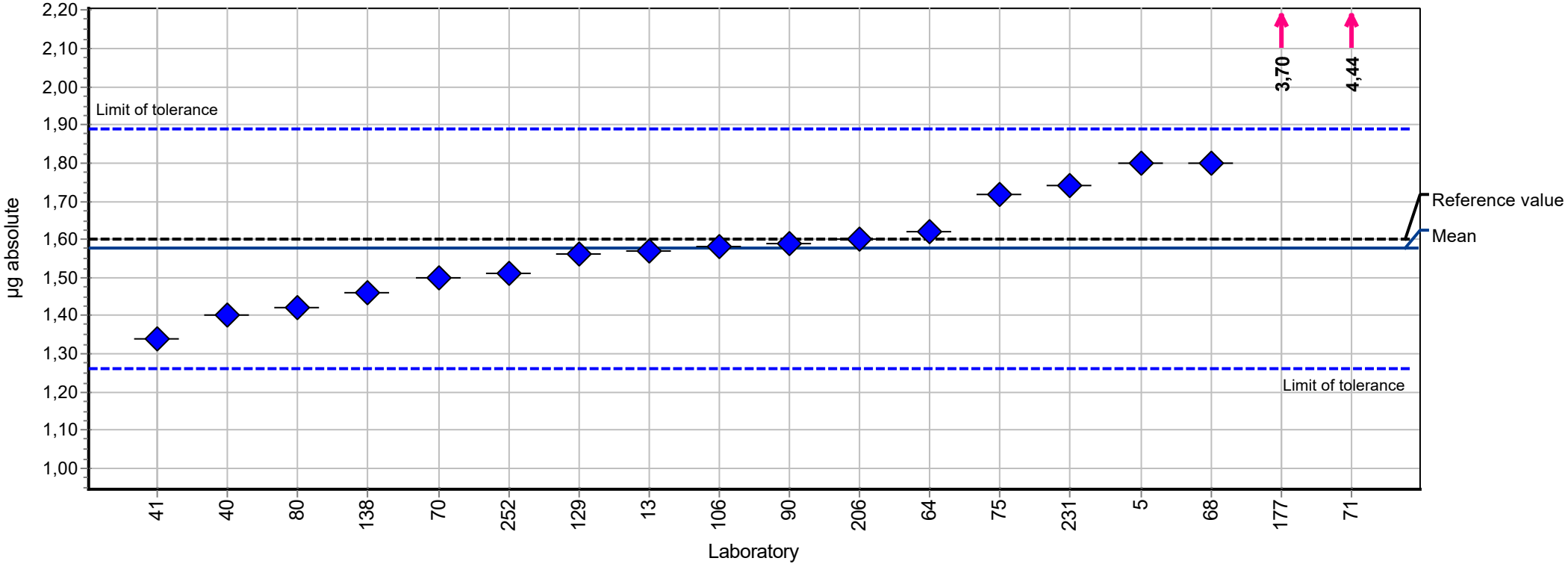
Summary results

Measurand:	**Manganese**	**Mean:**	**3,82 µg absolute**
Sample:	**1**	**Reprod. s.d.:**	**0,26 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**6,93%**
Rel.target s.d.:	**10,00% (Limited)**	**Reference value:**	**3,90 µg absolute**
Number of laboratories in calculation:	**18**	**Range of tolerance:**	**3,05 - 4,58 µg absolute (|Z-Score| <= 2,0)**



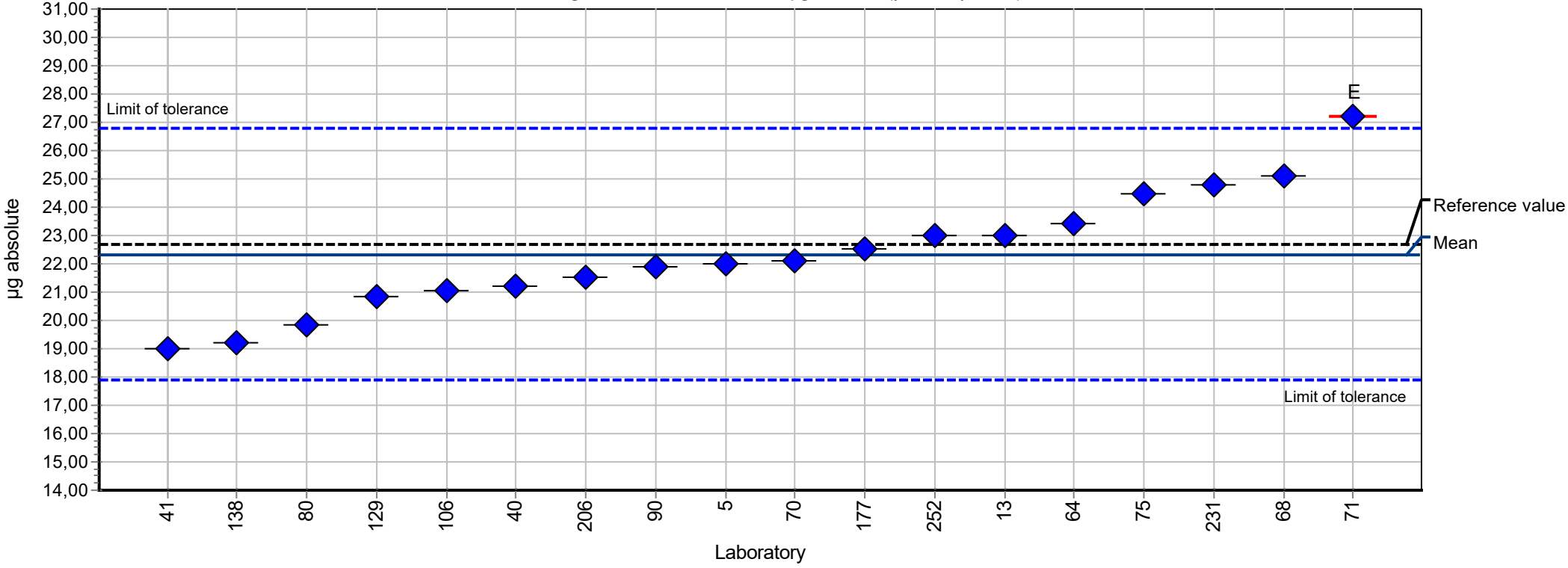
Summary results

Measurand:	**Nickel**	**Mean:**	**1,58 µg absolute**
Sample:	**1**	**Reprod. s.d.:**	**0,14 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**8,75%**
Rel.target s.d.:	**10,00% (Limited)**	**Reference value:**	**1,60 µg absolute**
Number of laboratories in calculation + outliers:	**18**	**Range of tolerance:**	**1,26 - 1,89 µg absolute (|Z-Score| <= 2,0)**



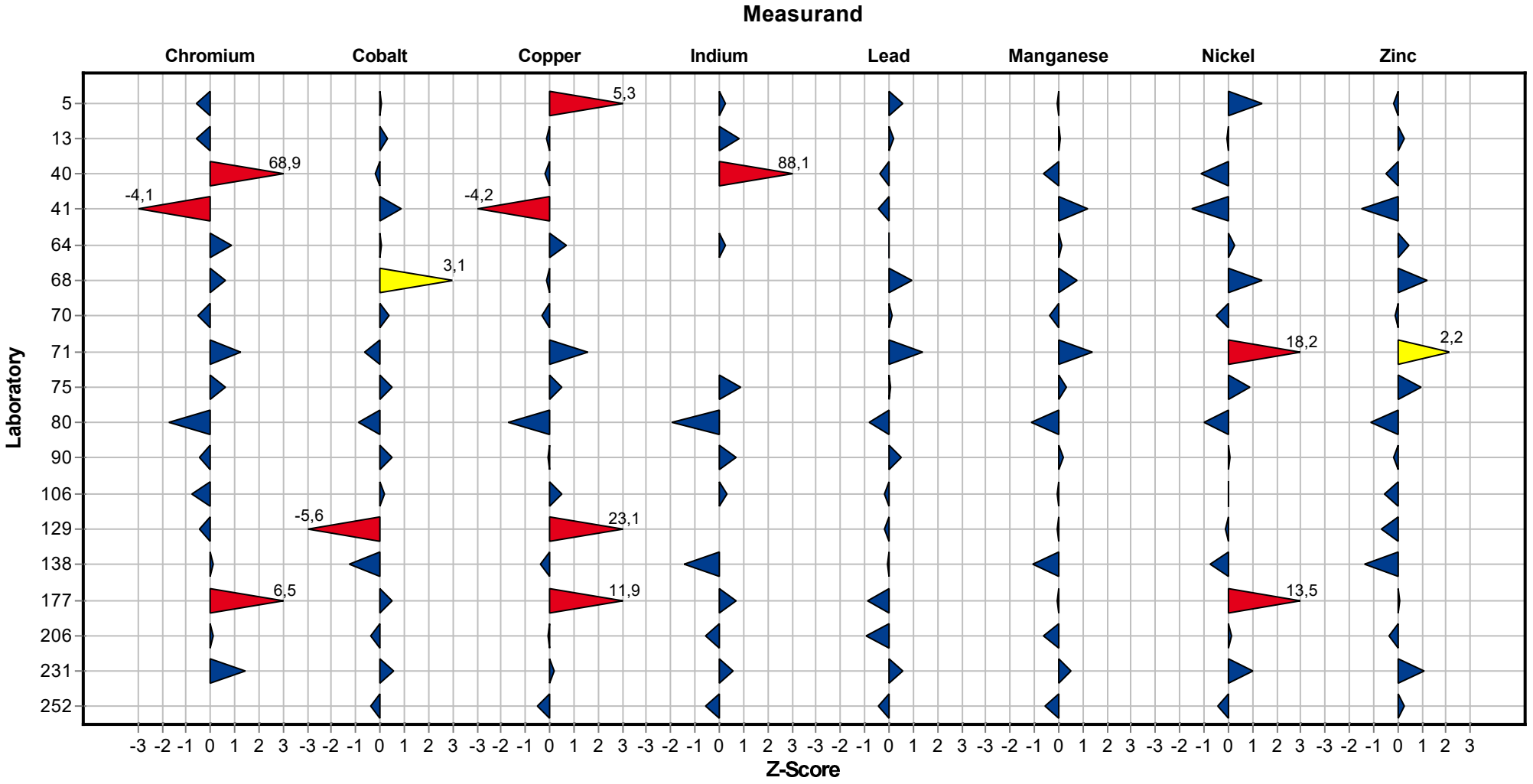
Summary results

Measurand:	**Zinc**	**Mean:**	**22,3 µg absolute**
Sample:	**1**	**Reprod. s.d.:**	**2,1 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**9,56%**
Rel.target s.d.:	**10,00% (Limited)**	**Reference value:**	**22,7 µg absolute**
Number of laboratories in calculation:	**18**	**Range of tolerance:**	**17,9 - 26,8 µg absolute (|Z-Score| <= 2,0)**



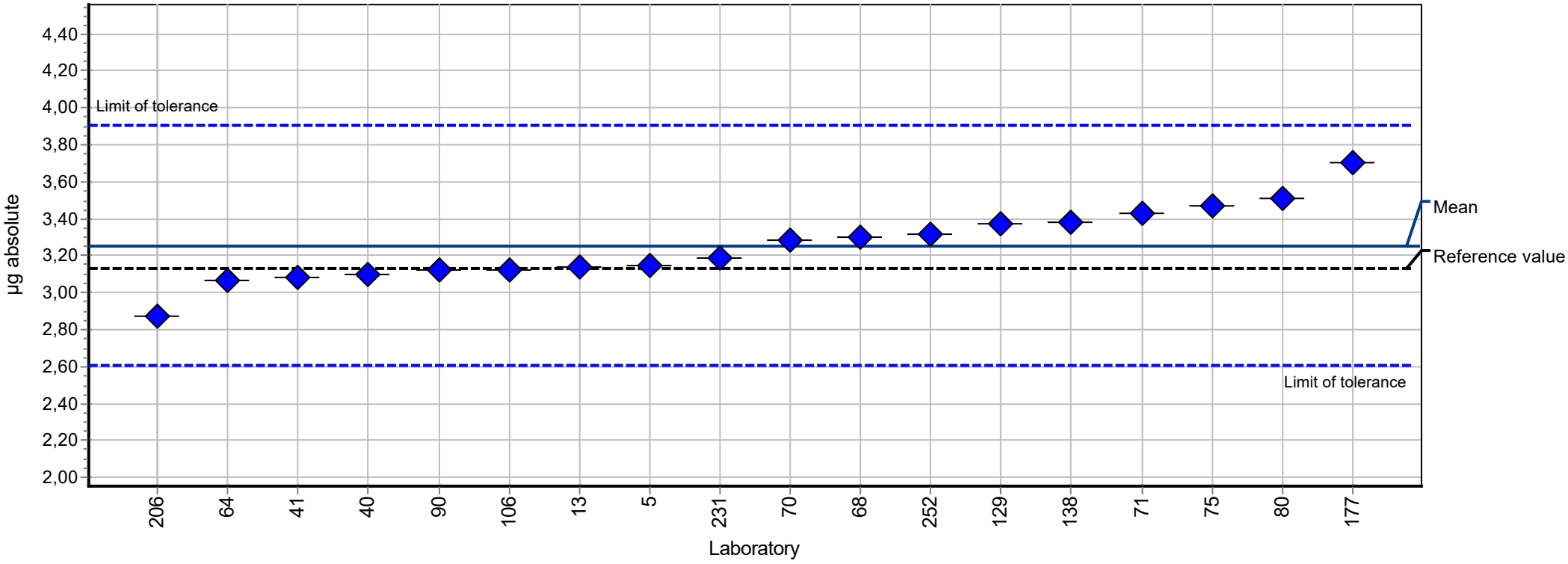
Sample chart of Z-scores

Sample 1



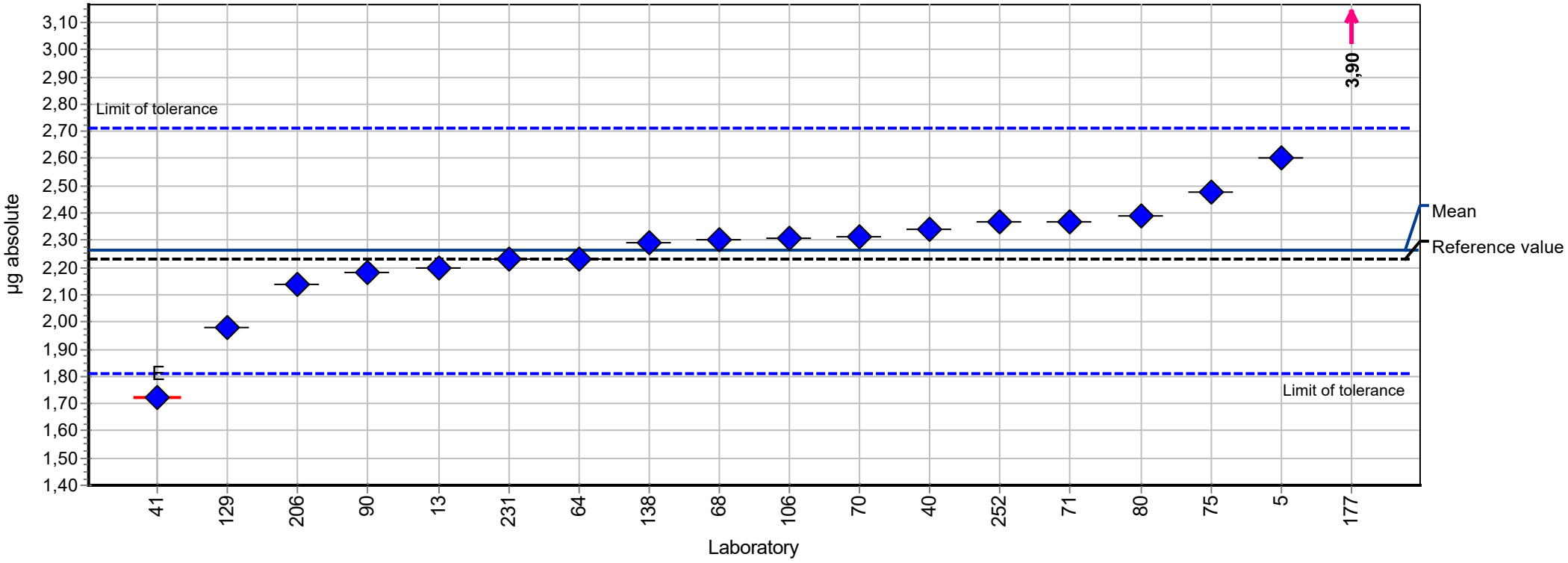
Summary results

Measurand:	**Cobalt**	**Mean:**	**3,26 µg absolute**
Sample:	**2**	**Reprod. s.d.:**	**0,20 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**6,13%**
Rel.target s.d.:	**10,00% (Limited)**	**Reference value:**	**3,13 µg absolute**
Number of laboratories in calculation:	**18**	**Range of tolerance:**	**2,60 - 3,91 µg absolute (|Z-Score| <= 2,0)**



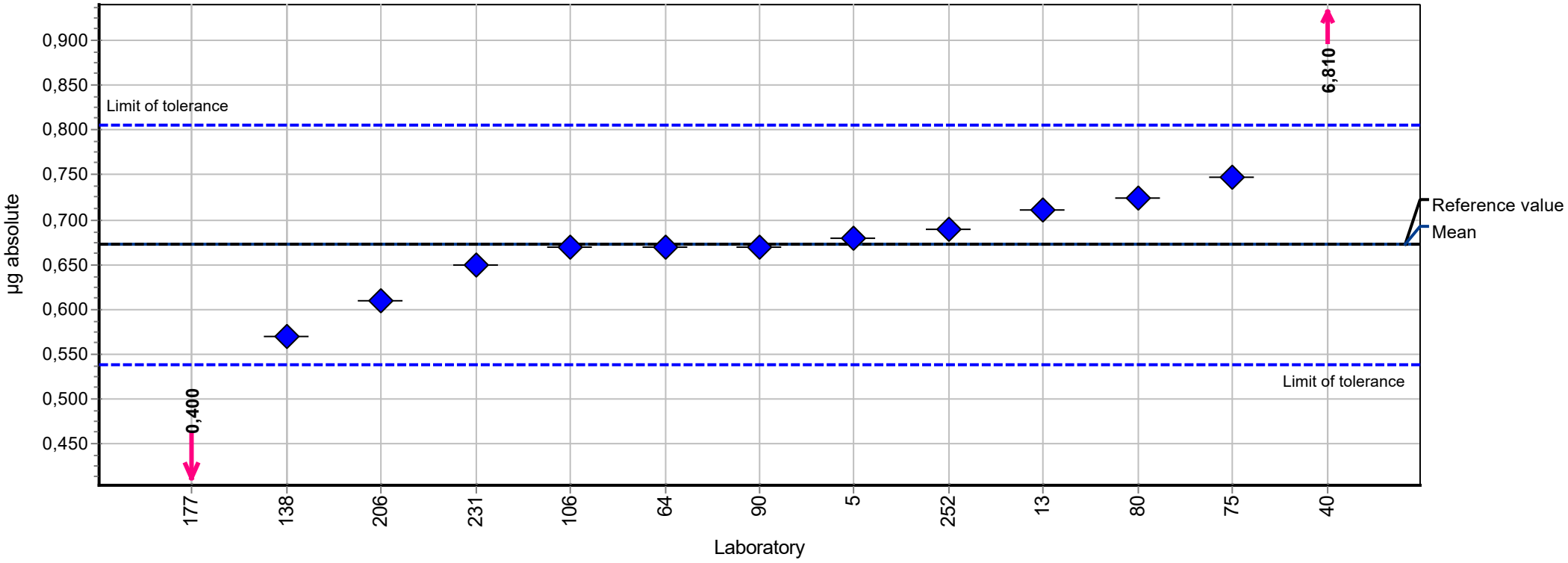
Summary results

Measurand:	**Copper**	**Mean:**	**2,26 µg absolute**
Sample:	**2**	**Reprod. s.d.:**	**0,20 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**8,66%**
Rel.target s.d.:	**10,00% (Limited)**	**Reference value:**	**2,23 µg absolute**
Number of laboratories in calculation + outliers:	**18**	**Range of tolerance:**	**1,81 - 2,71 µg absolute (|Z-Score| <= 2,0)**



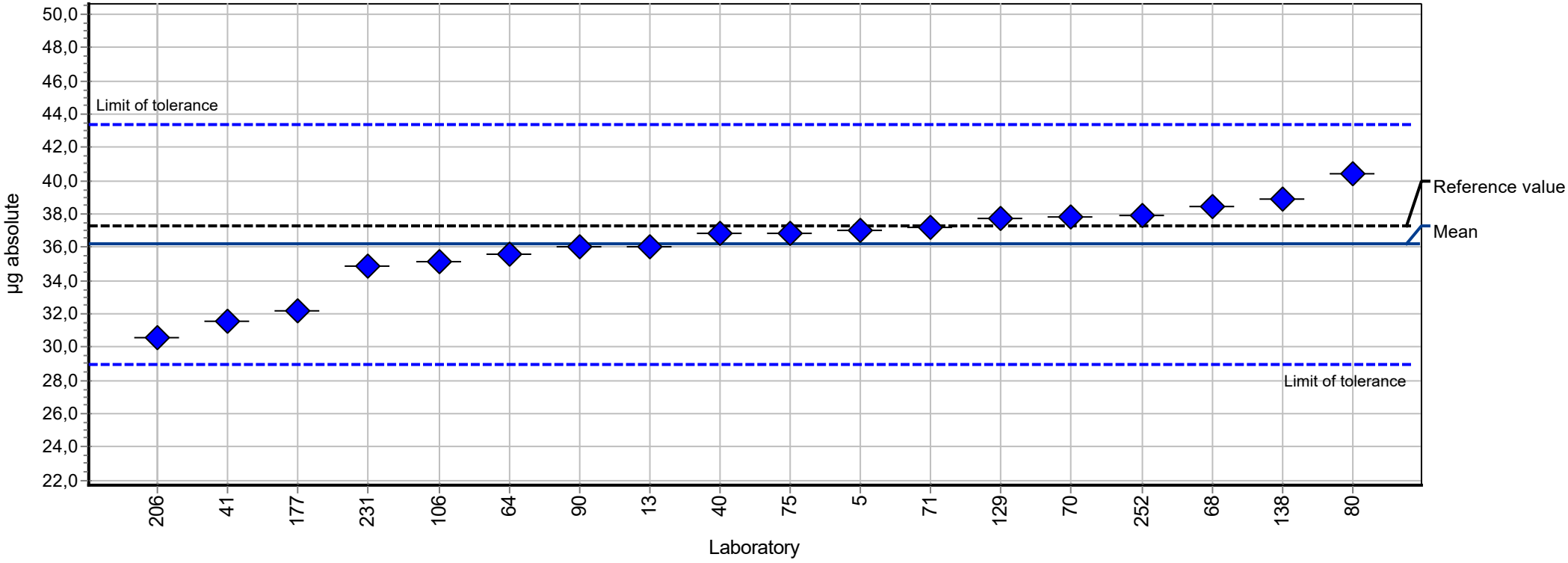
Summary results

Measurand:	**Indium**	**Mean:**	**0,672 µg absolute**
Sample:	**2**	**Reprod. s.d.:**	**0,050 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**7,44%**
Rel.target s.d.:	**10,00% (Limited)**	**Reference value:**	**0,672 µg absolute**
Number of laboratories in calculation + outliers:	**13**	**Range of tolerance:**	**0,537 - 0,806 µg absolute (|Z-Score| <= 2,0)**



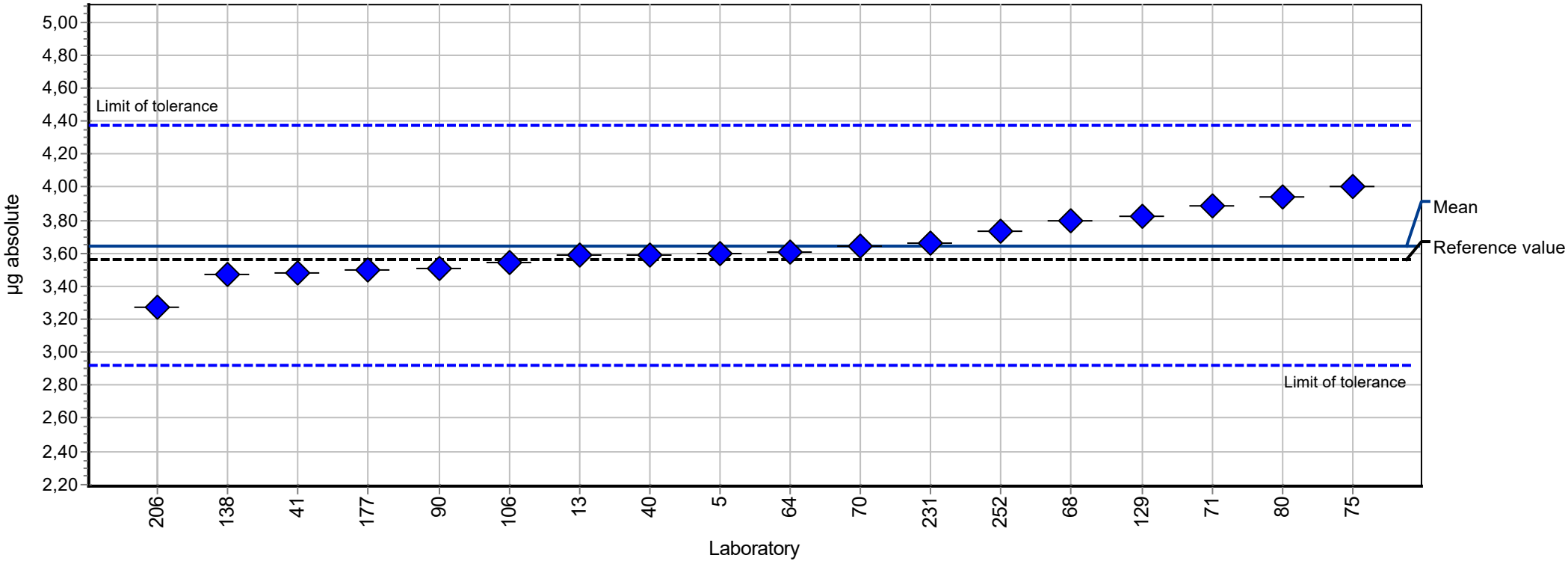
Summary results

Measurand:	**Lead**	**Mean:**	**36,2 µg absolute**
Sample:	**2**	**Reprod. s.d.:**	**2,6 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**7,13%**
Rel.target s.d.:	**10,00% (Limited)**	**Reference value:**	**37,3 µg absolute**
Number of laboratories in calculation:	**18**	**Range of tolerance:**	**28,9 - 43,4 µg absolute (|Z-Score| <= 2,0)**



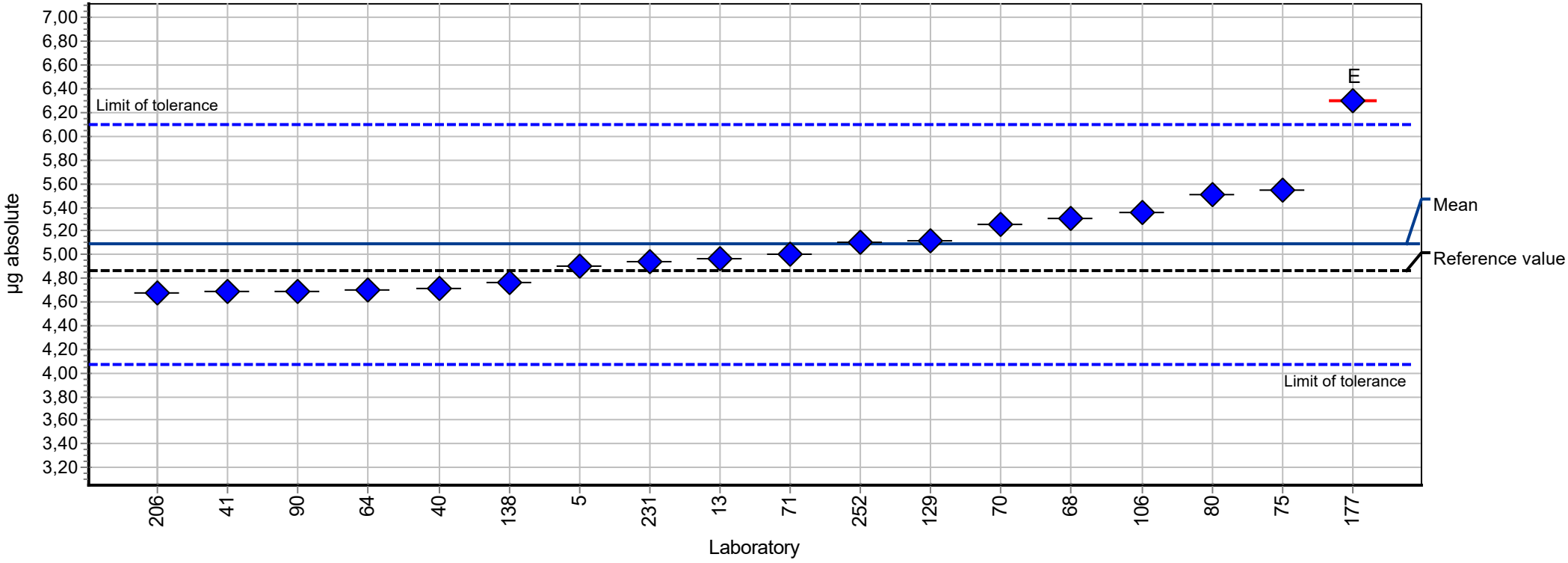
Summary results

Measurand:	**Manganese**	**Mean:**	**3,65 µg absolute**
Sample:	**2**	**Reprod. s.d.:**	**0,19 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**5,12%**
Rel.target s.d.:	**10,00% (Limited)**	**Reference value:**	**3,56 µg absolute**
Number of laboratories in calculation:	**18**	**Range of tolerance:**	**2,92 - 4,38 µg absolute (|Z-Score| <= 2,0)**



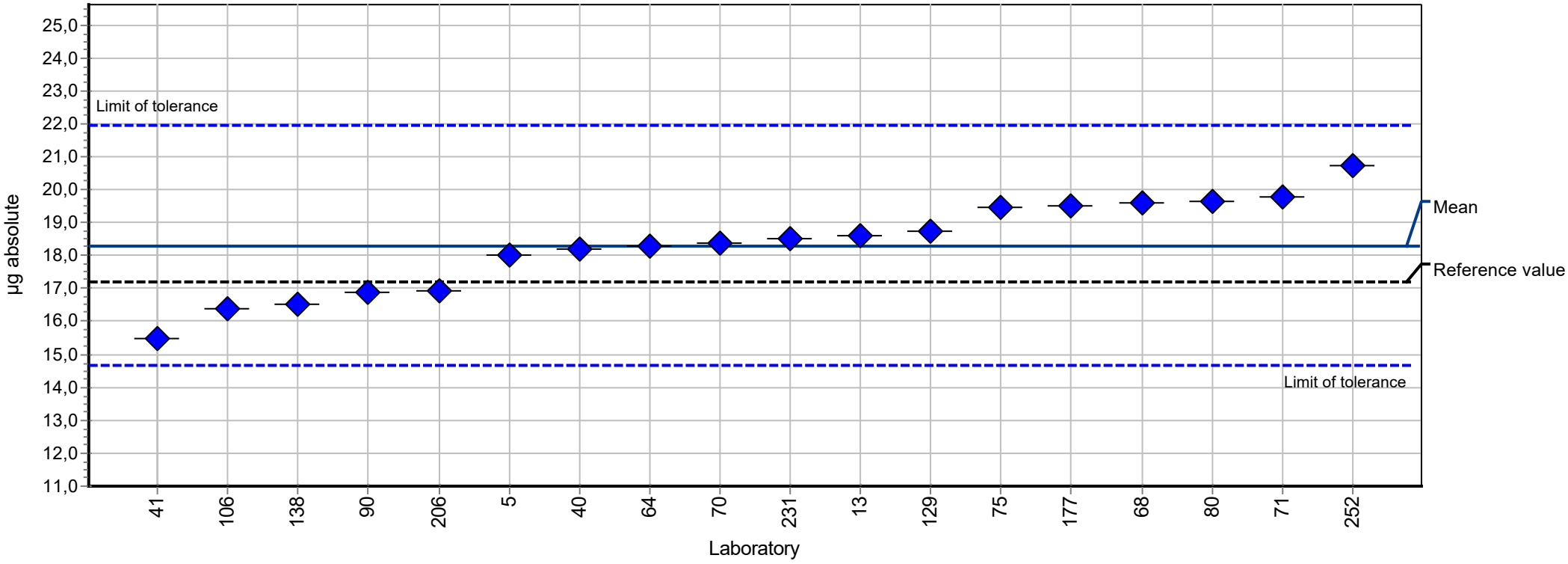
Summary results

Measurand:	**Nickel**	**Mean:**	**5,09 µg absolute**
Sample:	**2**	**Reprod. s.d.:**	**0,42 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**8,21%**
Rel.target s.d.:	**10,00% (Limited)**	**Reference value:**	**4,87 µg absolute**
Number of laboratories in calculation:	**18**	**Range of tolerance:**	**4,07 - 6,10 µg absolute (|Z-Score| <= 2,0)**



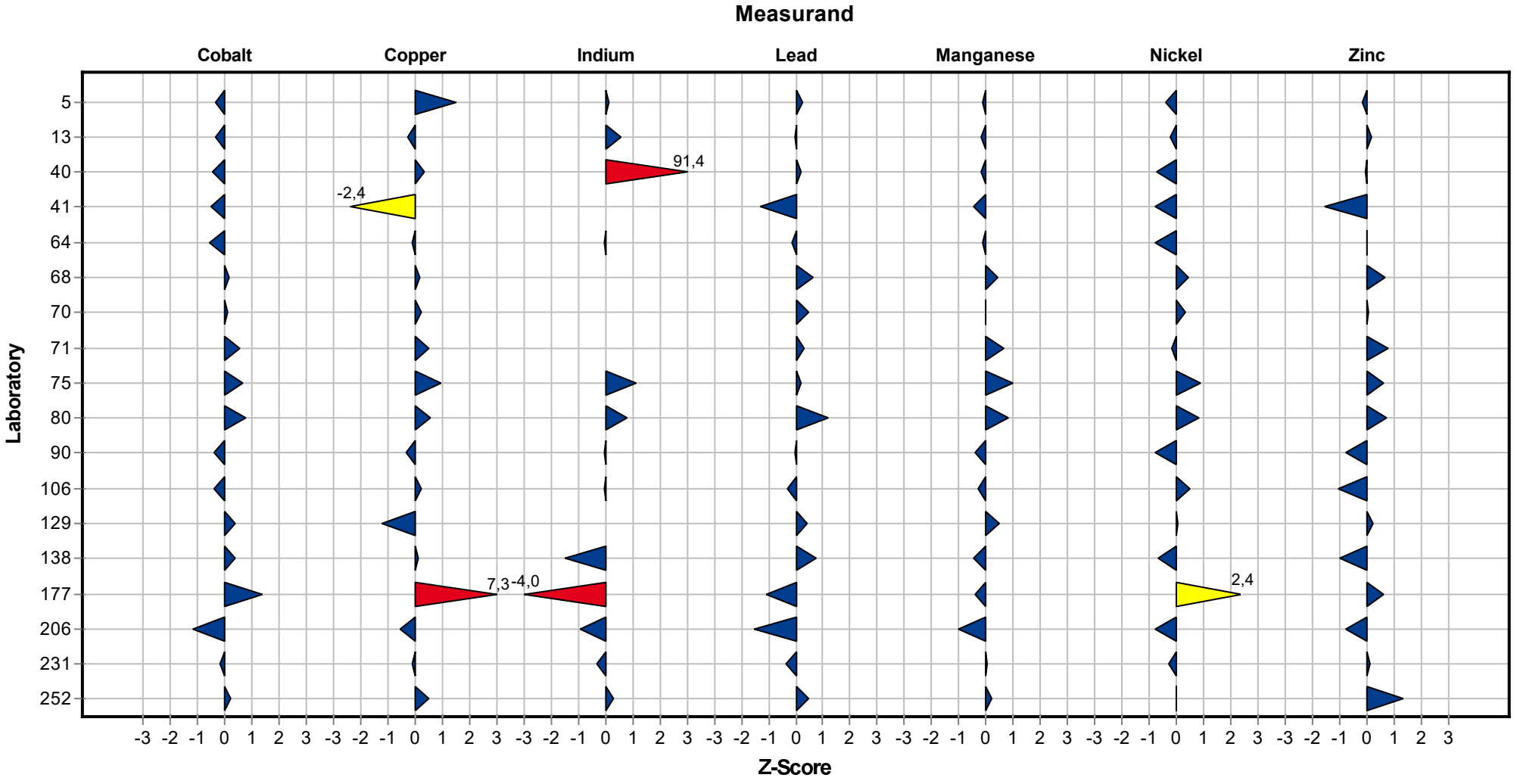
Summary results

Measurand:	**Zinc**	**Mean:**	**18,3 µg absolute**
Sample:	**2**	**Reprod. s.d.:**	**1,4 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**7,66%**
Rel.target s.d.:	**10,00% (Limited)**	**Reference value:**	**17,2 µg absolute**
Number of laboratories in calculation:	**18**	**Range of tolerance:**	**14,7 - 22,0 µg absolute (|Z-Score| <= 2,0)**



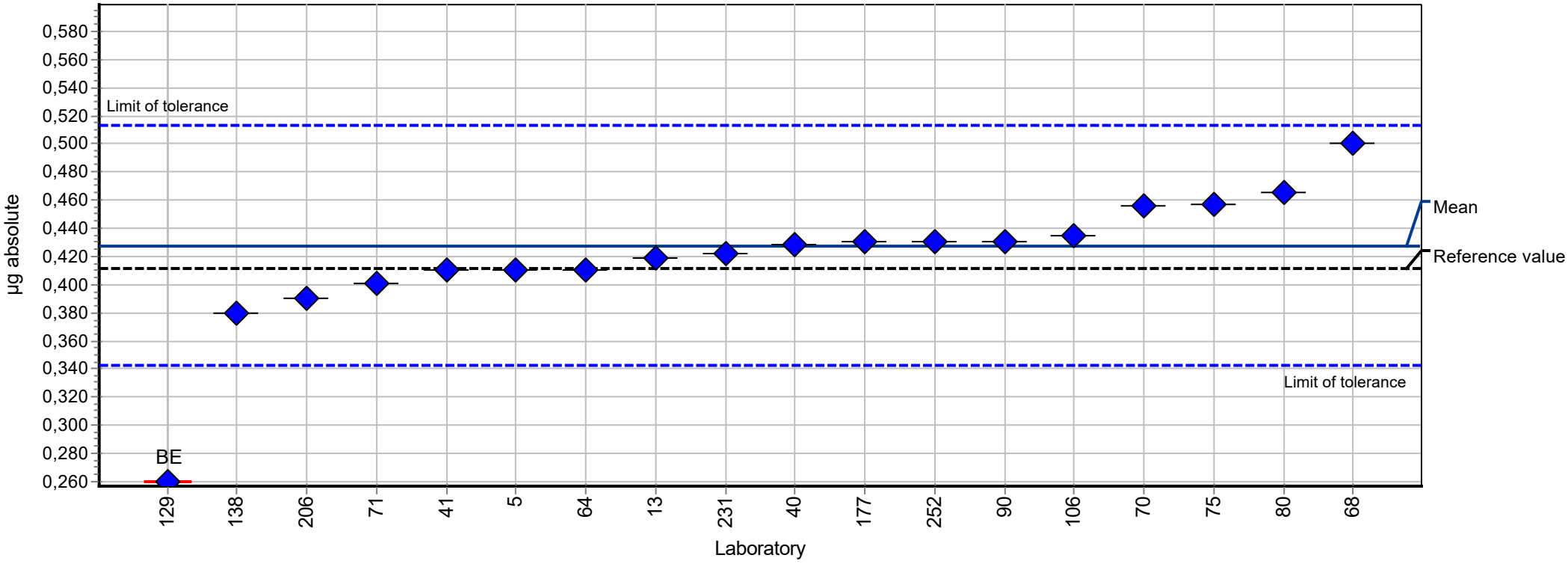
Sample chart of Z-scores

Sample 2



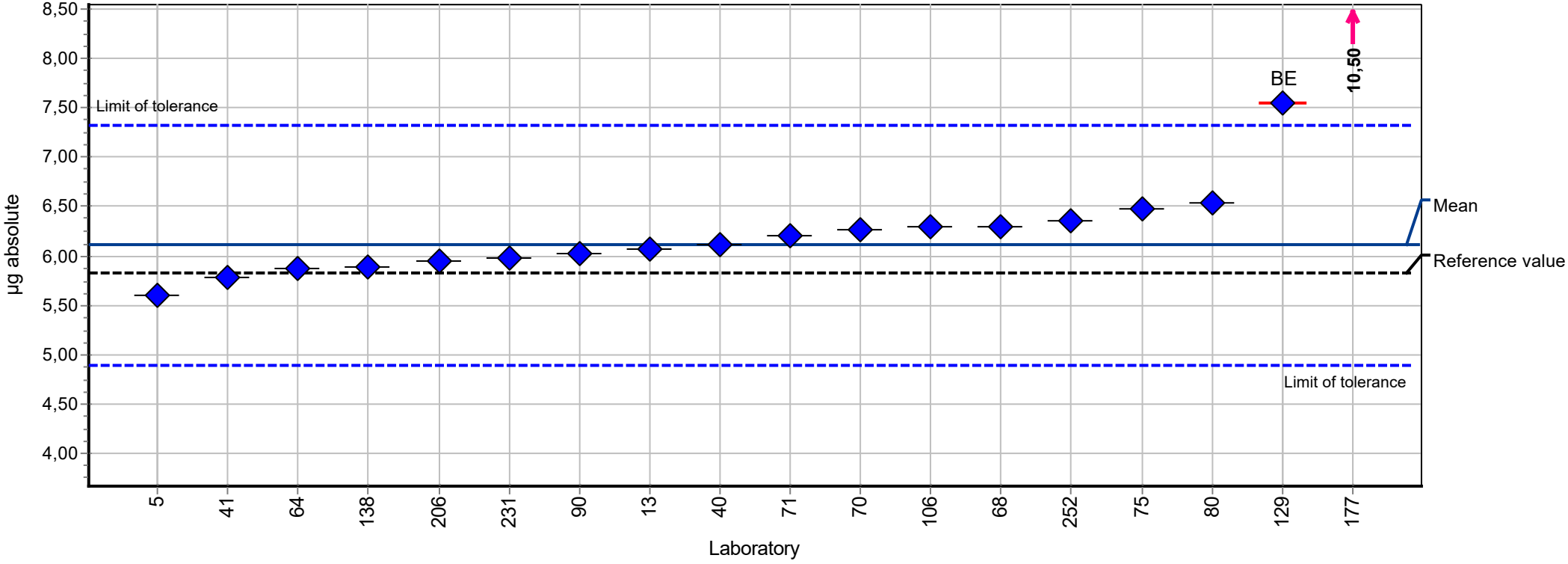
Summary results

Measurand:	**Cobalt**	**Mean:**	**0,428 µg absolute**
Sample:	**3**	**Reprod. s.d.:**	**0,029 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**6,87%**
Rel.target s.d.:	**10,00% (Limited)**	**Reference value:**	**0,411 µg absolute**
Number of laboratories in calculation + outliers:	**18**	**Range of tolerance:**	**0,342 - 0,513 µg absolute (|Z-Score| <= 2,0)**



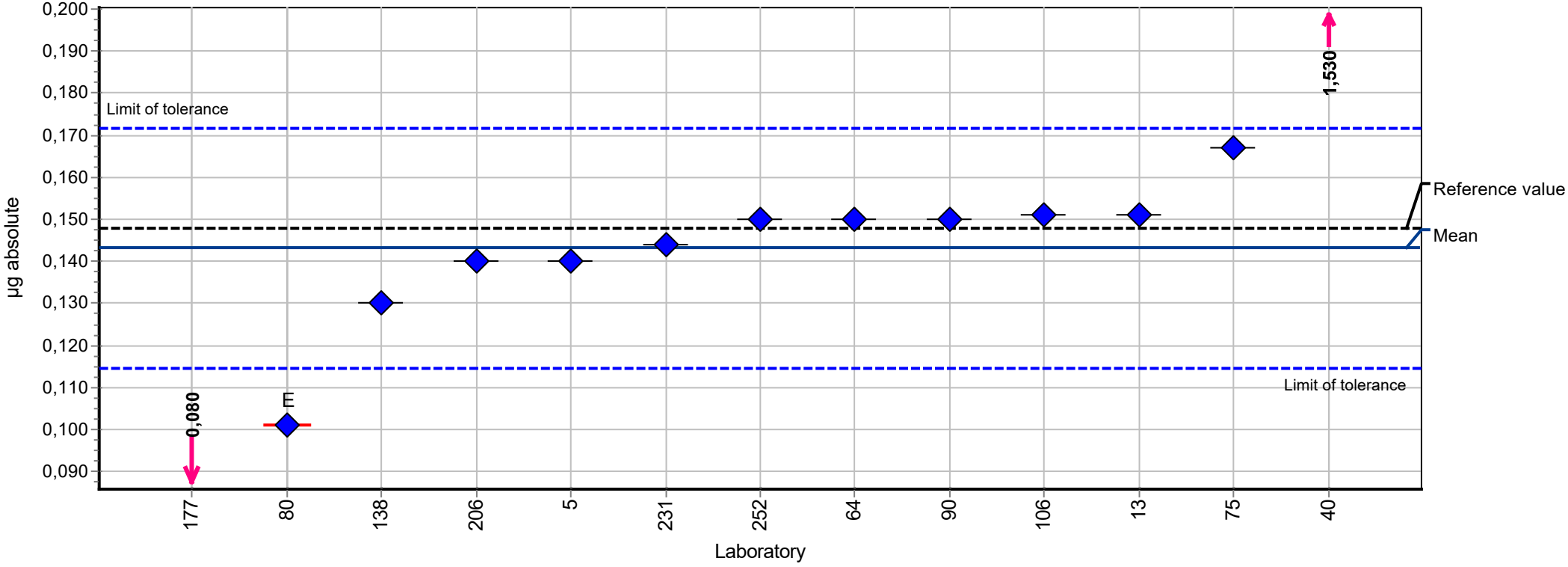
Summary results

Measurand:	**Copper**	**Mean:**	**6,11 µg absolute**
Sample:	**3**	**Reprod. s.d.:**	**0,26 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**4,25%**
Rel.target s.d.:	**10,00% (Limited)**	**Reference value:**	**5,83 µg absolute**
Number of laboratories in calculation + outliers:	**18**	**Range of tolerance:**	**4,88 - 7,33 µg absolute (|Z-Score| <= 2,0)**



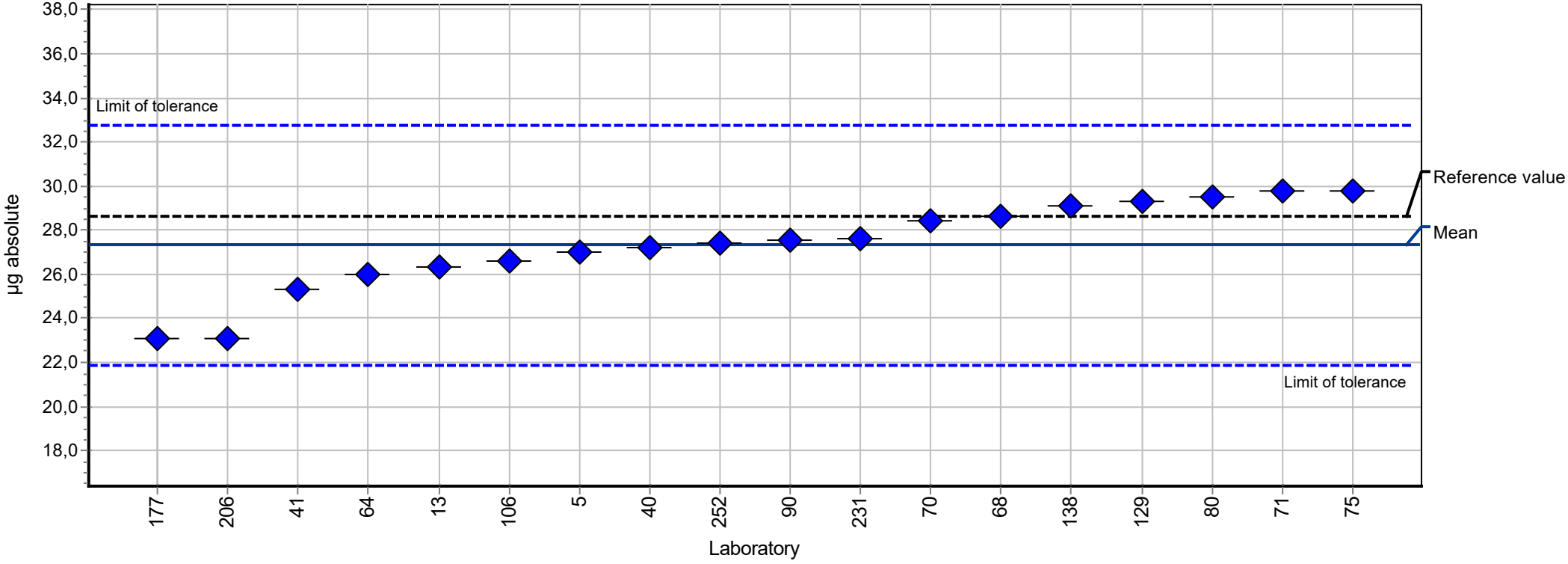
Summary results

Measurand:	**Indium**	**Mean:**	**0,143 µg absolute**
Sample:	**3**	**Reprod. s.d.:**	**0,017 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**11,70%**
Rel.target s.d.:	**10,00% (Limited)**	**Reference value:**	**0,148 µg absolute**
Number of laboratories in calculation + outliers:	**12**	**Range of tolerance:**	**0,114 - 0,172 µg absolute (|Z-Score| <= 2,0)**



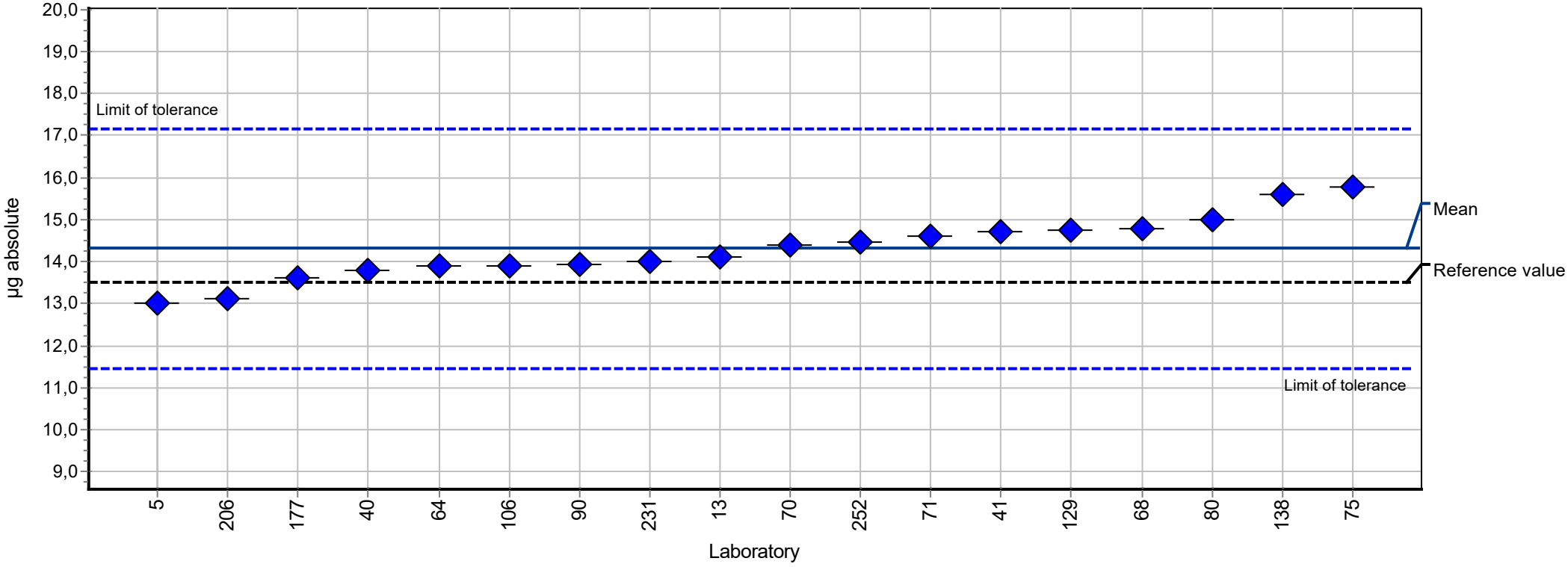
Summary results

Measurand:	**Lead**	**Mean:**	**27,3 µg absolute**
Sample:	**3**	**Reprod. s.d.:**	**2,0 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**7,43%**
Rel.target s.d.:	**10,00% (Limited)**	**Reference value:**	**28,6 µg absolute**
Number of laboratories in calculation:	**18**	**Range of tolerance:**	**21,8 - 32,8 µg absolute (|Z-Score| <= 2,0)**



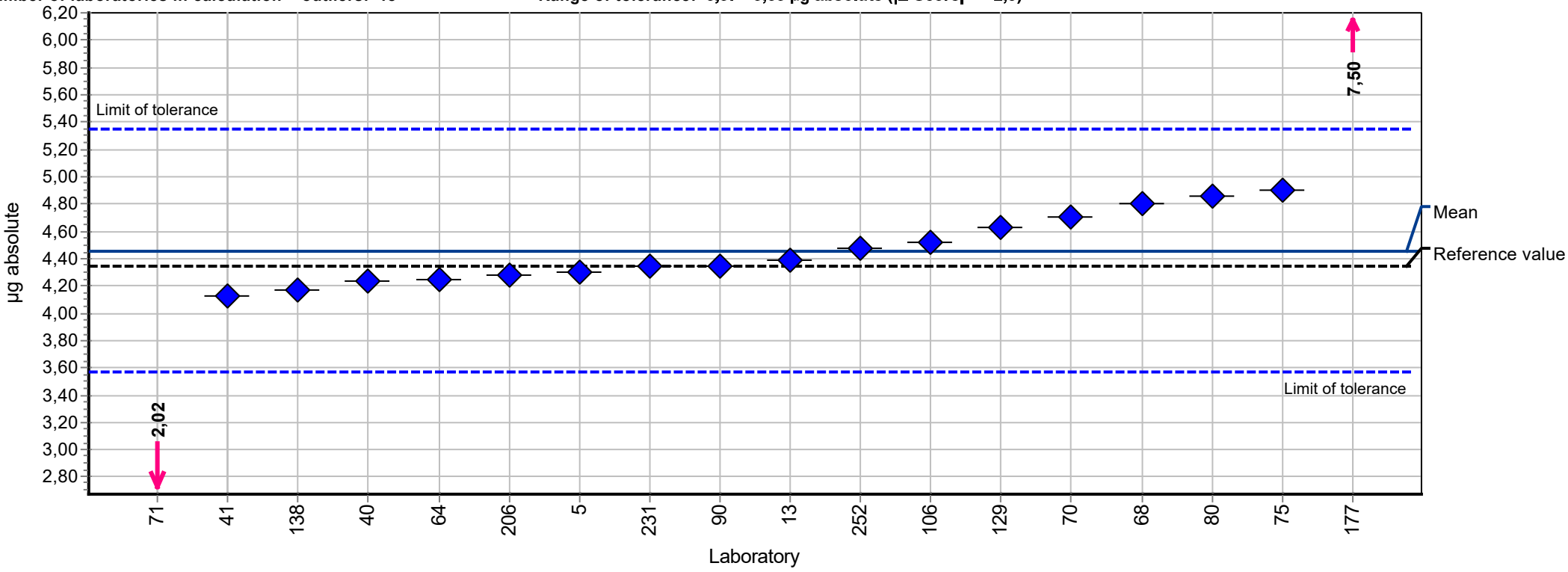
Summary results

Measurand:	**Manganese**	**Mean:**	**14,3 µg absolute**
Sample:	**3**	**Reprod. s.d.:**	**0,7 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**5,21%**
Rel.target s.d.:	**10,00% (Limited)**	**Reference value:**	**13,5 µg absolute**
Number of laboratories in calculation:	**18**	**Range of tolerance:**	**11,4 - 17,2 µg absolute (|Z-Score| <= 2,0)**



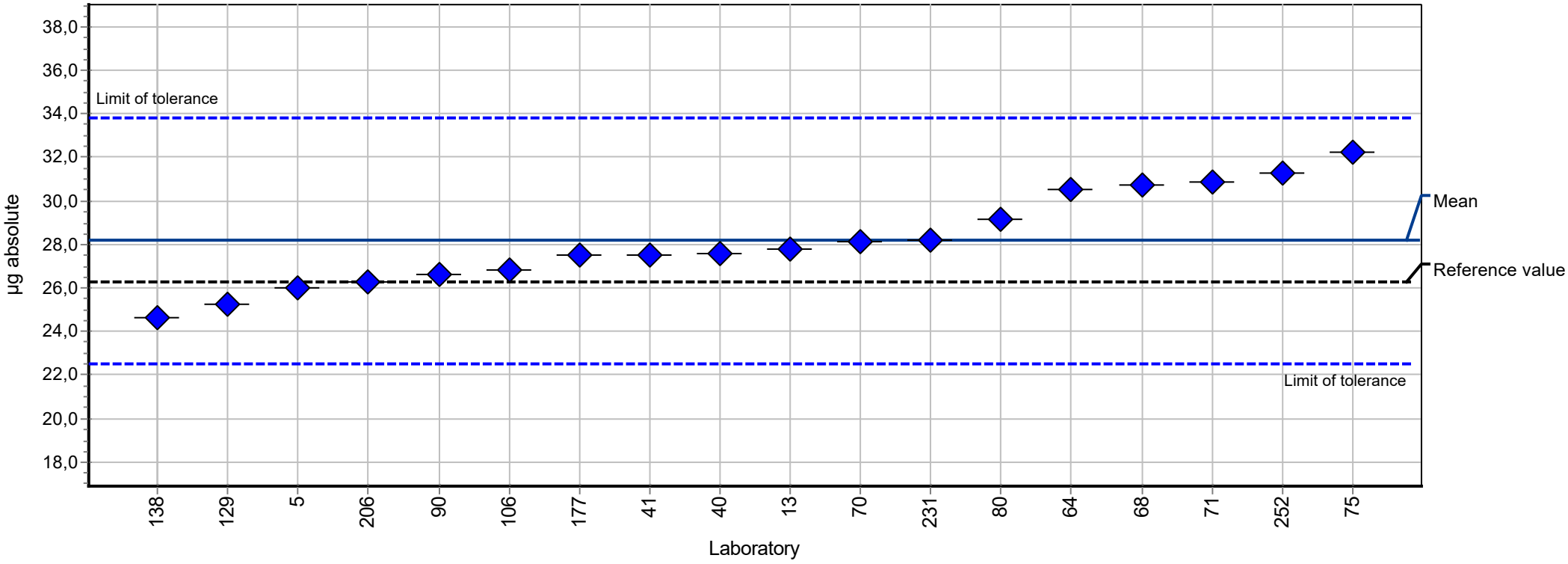
Summary results

Measurand:	**Nickel**	**Mean:**	**4,46 µg absolute**
Sample:	**3**	**Reprod. s.d.:**	**0,25 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**5,60%**
Rel.target s.d.:	**10,00% (Limited)**	**Reference value:**	**4,34 µg absolute**
Number of laboratories in calculation + outliers:	**18**	**Range of tolerance:**	**3,57 - 5,35 µg absolute (|Z-Score| <= 2,0)**



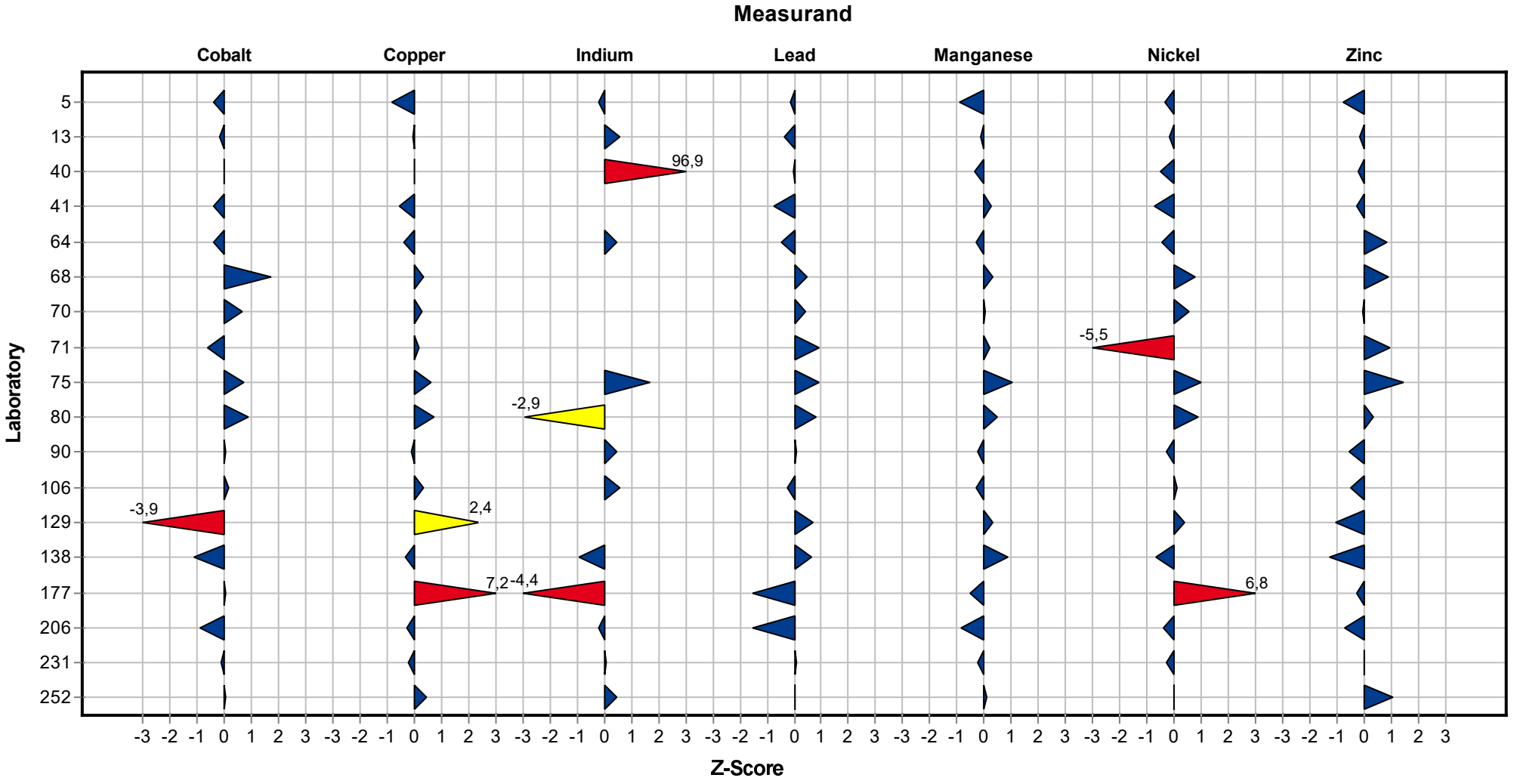
Summary results

Measurand:	**Zinc**	**Mean:**	**28,2 µg absolute**
Sample:	**3**	**Reprod. s.d.:**	**2,2 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**7,79%**
Rel.target s.d.:	**10,00% (Limited)**	**Reference value:**	**26,3 µg absolute**
Number of laboratories in calculation:	**18**	**Range of tolerance:**	**22,5 - 33,8 µg absolute (|Z-Score| <= 2,0)**



Sample chart of Z-scores

Sample 3



Questions and Answers

Participant	Pulping method	Acid concentration
5	Mikrow ellendruckaufschluss mit Salpetersäure	-
13	Hotplate digestion w ith nitric acid	67% nitric acid
40	Standard-Mikrow ellenaufschluss nach IFA-Arbeitsmappe	Salpetersäure, konz. 65-69%
41	Currenta-Hausmethode	Salpetersäure 67 - 69 %; Salzsäure 32 - 35 %
64	IFA-Arbeitsmappe, Blatt 6015, Mikrow elle	HNO3 69%, HCl 35%
68		HCl (37%) / HNO3 (65%)
70	Standard-Mikrow ellenaufschluss nach IFA-Arbeitsmappe, Blatt 6015	65%ige Salpetersäure
71	IFA-Arbeitsmappe, Blatt 6015	HNO3 65%ig ; HCL 30%ig
75	Modifizierter Aufschluss nach IFA-Arbeitsmappe, Blatt 6015	65% HNO3
80	Standard-Mikrow ellenaufschluss nach IFA-Arbeitsmappe (Blatt 6015)	10 ml Sapetersäure suprapur (>=65%)
90	Microw ave digestion method (sheet 6015)	Digestion w ith 10ml HNO3 65%
106	Lösung in 65 % Salpetersäure	65 % Salpetersäure
129	IFA- Arbeitsmappe, Blatt 6015	Salpetersäure 65%; Salzsäure 30%
138	Mikrow ellenaufschluss nach BGIA 6015	HNO3 65 % / HCl 25 %
177	IFA-Arbeitsmappe, Blatt 6015	HNO3 69% / HCl 37%
206	Eigen	HCl 32%, HNO3 65%, H2O2 30%
231	IFA 6015	10 ml HNO3 Supra
252	Angelehnt an IFA-Arbeitsmappe (Blatt 6015) - Standard-Mikrow ellendruckaufschluss	entsprechend IFA-Arbeitsmappe

Participant	Mixing ratio	Time of pulping
5	-	-
13	5ml nitric acid and 5ml milliQ	2 hours
40	10 mL : 25 mL MEV	1
41	5:1	3
64	7 ml HNO3 und 3 ml HCl	1 Std.
68	1:2	2
70	10 ml HNO^3 in 25ml	
71	6,5 mL HNO3 : 3,3 mL HCL	2 h
75	1:1 HNO3:MilliQ-H2O	45 min Ramp, 60 min Hold bei 190°C und 900 Watt

Participant	Mixing ratio	Time of pulping
80	100% Salpetersäure	Aufschlussdauer 60 Minuten
90		Digestion filters during 90 min
106	0,5 ml 65 % Salpetersäure	2 h
129	2:1	2
138	2 / 1	0,25
177	2:1	2
206	HNO3, HCl, H2O2, H2O (1:1:1:1)	45 Min
231		Aufschluss 1,5 h
252	10 ml HNO3	1 h

Participant	Reagent volume	Equipment	Method for Cobalt
5	-	-	ICP-MS
13	25ml	Closed, no reflux	ICP-MS
40	25 mL	geschlossen	ICP-MS
41	20	geschlossener Mikrow ellenaufschluss	AAS/Graphit
64	50 ml	Mikrow ellenaufschluss	ICP-MS
68	50	geschlossen	ICP-OES
70	25ml	geschlossen	ICP/OES
71	25 mL	offen	ICP-OES
75	20 mL	Geschlossen	ICP-MS DIN EN ISO 17294-2 von 2017
80	25 ml	geschlossen	ICP-OES
90	50	Closed system digestion	ICP-MS (mass 52 mode He)
106	16,25 ml	geschlossen	ICP-MS
129	20	offen unter Rückfluss	AAS/Flamme
138	50	geschlossen	ICP AES
177	25	unter Rückfluss	AAS-Graphitrohr
206	Aufschluss (10 ml) mit internem Standard, direkt 1:50 und 1:10 gemessen	Mikrow ellendruckaufschluss	ICP-MS
231	50	Geschlossen, Mikrow elle	ICP-MS
252	50 ml	Mikrow ellendruckaufschluss	ICP-MS

Participant	Method for Lead	Method for Zinc	Method for Copper
5	ICP-MS	ICP-MS	ICP-MS
13	ICP-OES	ICP-OES	ICP-MS
40	ICP-MS	ICP-MS	ICP-MS
41	AAS/Graphit	AAS/Flamme	AAS/Graphit
64	ICP-MS	ICP-MS	ICP-MS
68	ICP-OES	ICP-OES	ICP-OES
70	ICP/OES	ICP/OES	ICP/OES
71	ICP-OES	ICP-OES	ICP-OES
75	ICP-MS DIN EN ISO 17294-2 von 2017	ICP-MS DIN EN ISO 17294-2 von 2017	ICP-MS DIN EN ISO 17294-2 von 2017
80	ICP-OES	ICP-OES	ICP-OES
90	ICP-MS (mass 208 mode no gaz)	ICP-MS (mass 66 mode He)	ICP-MS (mass 63 mode He)
106	ICP-MS	ICP-MS	ICP-MS
129	AAS/Flamme	AAS/Flamme	AAS/Flamme
138	ICP AES	ICP AES	ICP AES
177	ICP-OES	ICP-OES	AAS-Graphitrohr
206	ICP-MS	ICP-MS	ICP-MS
231	ICP-MS	ICP-MS	ICP-MS
252	ICP-MS	ICP-MS	ICP-MS

Participant	Method for Nickel	Method for Indium	Method for Manganese
5	ICP-MS	ICP-MS	ICP-MS
13	ICP-MS	ICP-MS	ICP-MS
40	ICP-MS	ICP-MS	ICP-MS
41	AAS/Graphit		AAS/Graphit
64	ICP-MS	ICP-MS	ICP-MS
68	ICP-OES		ICP-OES
70	ICP/OES		ICP/OES
71	ICP-OES		ICP-OES
75	ICP-MS DIN EN ISO 17294-2 von 2017	ICP-MS DIN EN ISO 17294-2 von 2017	ICP-MS DIN EN ISO 17294-2 von 2017
80	ICP-OES	ICP-OES	ICP-OES
90	ICP-MS (mass 60 mode He)	ICP-MS (mass 115 mode no gaz)	ICP-MS (mass 55 mode He)
106	ICP-MS	ICP-MS	ICP-MS

Participant	Method for Nickel	Method for Indium	Method for Manganese
129	AAS/Flamme		AAS/Flamme
138	ICP AES	ICP AES	ICP AES
177	ICP-OES	AAS-Graphitrohr	ICP-OES
206	ICP-MS	ICP-MS	ICP-MS
231	ICP-MS	ICP-MS	ICP-MS
252	ICP-MS	ICP-MS	ICP-MS

Participant	Method for Chromium
5	ICP-MS
13	ICP-MS
40	ICP-MS
41	AAS/Graphit
64	ICP-MS
68	ICP-OES
70	ICP/OES
71	ICP-OES
75	ICP-MS DIN EN ISO 17294-2 von 2017
80	ICP-OES
90	ICP-MS (mass 52 mode He)
106	ICP-MS
129	AAS/Flamme
138	ICP AES
177	AAS-Graphitrohr
206	ICP-MS
231	ICP-MS
252	ICP-MS