IFA
Institut für Arbeitsschutz der
Deutschen Gesetzlichen Unfallversicherung

Round-robin tests for in-house measuring laboratories – Results and Evaluation

Round-robin test Metals on filters

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Summary of laboratory test results

Sample 1

	copper	Z score		nickel	Z score		lead	Z score	zinc	Z score		cobalt	Z score	
Unit	µg absolute			µg absolute			µg absolute		µg absolute			µg absolute		
6	7,53	1,08		13,13	0,98		39,09	1,61	110,40	1,16		5,81	0,87	
33	6,79	-0,01		11,80	-0,14		31,80	-0,55	98,10	-0,09		5,34	-0,01	
38	6,47	-0,48		11,49	-0,39		34,24	0,17	96,34	-0,26		5,20	-0,28	
68	6,85	0,08		12,50	0,45		34,00	0,10	99,90	0,10		5,55	0,38	
70	7,02	0,33		12,22	0,22		34,06	0,12	99,44	0,05		5,46	0,22	
71	6,55	-0,37		10,81	-0,97		33,07	-0,17	99,39	0,04		5,07	-0,51	
74	6,30	-0,73		11,00	-0,80		30,80	-0,85	92,80	-0,62		4,90	-0,84	
82	6,70	-0,14		12,00	0,03		33,00	-0,19	99,00	0,01		4,90	-0,84	
84	6,86	0,09		12,00	0,03		31,90	-0,52	95,80	-0,32		5,40	0,10	
90	6,16	-0,94		11,03	-0,78		31,77	-0,56	92,82	-0,62		4,87	-0,89	
91	7,56	1,12		29,58	14,73	BE	35,08	0,42	96,52	-0,25		5,47	0,23	
95	6,79	-0,01		11,70	-0,22		33,50	-0,05	91,60	-0,74		5,37	0,04	
110	6,56	-0,35		11,10	-0,72		32,50	-0,34	99,40	0,05		5,22	-0,24	
111	6,77	-0,04		12,40	0,37		32,80	-0,25	96,30	-0,27		5,38	0,06	
112	7,07	0,40		12,60	0,53		36,60	0,87	104,00	0,51		5,69	0,64	
113	7,33	0,78		11,20	-0,64		34,10	0,13	68,20	-3,11	BE	4,83	-0,97	
116	7,25	0,67		12,45	0,41		36,30	0,79	104,90	0,60		5,64	0,55	
126	7,39	0,87		13,16	1,00		37,29	1,08	116,60	1,78		5,90	1,03	
129	7,11	0,46		12,62	0,55		32,31	-0,40	87,75	-1,13		5,69	0,64	
131	6,70	-0,14		12,10	0,12		34,40	0,22	96,80	-0,22		5,50	0,29	
134	6,70	-0,14		11,30	-0,55		30,20	-1,03	83,90	-1,52		5,10	-0,46	
138	6,97	0,25		15,30	2,79	BE	33,70	0,01	107,00	0,81		5,26	-0,16	
147	6,69	-0,16		12,12	0,13		33,62	-0,01	103,46	0,46		5,37	0,04	
177	4,67	-3,13	BE	13,34	1,15		35,99	0,69	108,36	0,95		5,57	0,42	
188	6,81	0,02		12,01	0,04		33,50	-0,05	99,88	0,09		5,36	0,02	
197	6,26	-0,79		11,20	-0,64		31,50	-0,64	94,40	-0,46		5,07	-0,52	
206	6,59	-0,30		11,30	-0,55		33,00	-0,19	79,50	-1,97		5,12	-0,42	
210	6,96	0,24		12,79	0,69		36,03	0,71	102,30	0,34		5,69	0,64	

	copper	Z score	nickel	Z score	lead	Z score	zinc	Z score	cobalt	Z score
212	6,70	-0,14	11,80	-0,14	35,80	0,64	108,30	0,94	5,20	-0,28
232	6,60	-0,29	12,29	0,27	32,05	-0,48	118,25	1,95	5,70	0,66
242	6,60	-0,29	12,00	0,03	32,60	-0,31	98,60	-0,04	5,30	-0,09
245	6,20	-0,88	11,00	-0,80	31,00	-0,79	88,00	-1,11	5,10	-0,46
252	6,43	-0,54	11,72	-0,20	32,20	-0,43	93,55	-0,55	5,22	-0,24
282	7,05	0,37	12,60	0,53	34,50	0,25	102,00	0,31	5,55	0,38
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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	
Mean	6,80		11,96		33,66		98,95		5,35	
Reproducibility s.d.	0,36		0,69		1,99		8,34		0,28	
Rel. reproducibility s.d.	5,29 %		5,78 %		5,92 %		8,43 %		5,22 %	
Reference value	6,53		11,55		33,01		98,27		5,03	
Target s.d.	0,68		1,20		3,37		9,90		0,53	
Rel. target s.d.:	10,00 %		10,00 %		10,00 %		10,00 %		10,00 %	
Lower limit of tolerance	5,44		9,57		26,92		79,16		4,28	
Upper limit of tolerance	8,16		14,35		40,39		118,74		6,42	
Type B outliers	1		2				1			
Type E 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)	33		32		34		33		34	

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	
L: Differing laboratory mean (Grubbs II)	Grubbs für 2

Summary of laboratory test results

Sample 2

	copper	Z score	nickel	Z score	lead	Z score	zinc	Z score	cobalt	Z score
Unit	µg absolute		µg absolute		µg absolute		µg absolute		µg absolute	
6	14,81	1,07	7,28	0,85	164,40	1,23	43,84	0,95	2,92	0,81
33	13,40	0,02	6,64	-0,11	137,00	-0,64	39,60	-0,11	2,72	0,07
38	13,14	-0,17	6,99	0,41	142,91	-0,24	40,58	0,14	2,67	-0,12
68	13,70	0,24	7,05	0,50	149,00	0,18	40,80	0,19	2,83	0,48
70	14,22	0,63	7,57	1,27	149,06	0,18	43,65	0,90	2,81	0,42
71	12,86	-0,38	5,36	-2,02 E	144,74	-0,11	38,48	-0,39	2,67	-0,11
74	13,20	-0,13	6,20	-0,77	139,70	-0,45	38,30	-0,43	2,50	-0,75
82	13,00	-0,28	6,30	-0,62	148,00	0,11	41,00	0,24	2,50	-0,75
84	13,70	0,24	6,86	0,22	140,00	-0,43	38,60	-0,36	2,84	0,51
90	13,06	-0,23	6,24	-0,71	141,40	-0,34	36,37	-0,92	2,49	-0,78
91	13,62	0,18	7,12	0,60	151,35	0,34	37,14	-0,72	2,70	-0,01
95	13,30	-0,06	6,49	-0,33	149,00	0,18	35,70	-1,08	2,60	-0,38
110	13,10	-0,20	6,00	-1,06	146,00	-0,02	39,20	-0,21	2,72	0,07
111	13,30	-0,06	6,88	0,25	140,00	-0,43	37,70	-0,58	2,69	-0,04
112	14,40	0,77	7,11	0,59	161,00	1,00	42,00	0,49	2,89	0,70
113	13,30	-0,06	6,20	-0,77	148,40	0,14	27,30	-3,18 BE	2,40	-1,12
116	14,69	0,98	7,12	0,60	156,20	0,67	43,00	0,74	2,88	0,66
126	14,64	0,95	7,69	1,45	155,10	0,60	48,73	2,17 E	2,84	0,51
129	13,55	0,13	6,63	-0,13	146,56	0,01	37,65	-0,60	2,85	0,56
131	13,00	-0,28	7,30	0,87	147,30	0,06	39,40	-0,16	2,80	0,37
134	13,70	0,24	6,40	-0,47	135,50	-0,74	34,90	-1,28	2,60	-0,38
138	13,80	0,32	9,38	3,97 BE	150,00	0,25	41,30	0,32	2,70	-0,01
147	13,25	-0,09	6,74	0,04	147,87	0,10	41,93	0,47	2,69	-0,06
177	11,24	-1,60	7,16	0,66	154,55	0,56	43,89	0,96	2,87	0,62
188	13,49	0,09	6,62	-0,14	143,97	-0,16	39,41	-0,16	2,62	-0,30
197	12,20	-0,88	6,23	-0,72	137,00	-0,64	35,10	-1,23	2,54	-0,60
206	13,00	-0,28	6,46	-0,38	123,00	-1,60	36,60	-0,86	2,58	-0,45
210	14,12	0,56	7,26	0,81	159,80	0,92	43,08	0,76	2,91	0,77

	copper	Z score	nickel	Z score	lead	Z score	zinc	Z score	cobalt	Z score
212	12,70	-0,50	6,50	-0,32	148,10	0,12	43,20	0,79	2,60	-0,38
232	12,80	-0,43	6,37	-0,51	138,35	-0,55	44,76	1,18	2,67	-0,11
242	13,40	0,02	6,80	0,13	142,80	-0,24	40,50	0,12	2,70	-0,01
245	12,00	-1,03	6,30	-0,62	138,00	-0,57	35,00	-1,26	2,60	-0,38
252	13,23	-0,11	6,57	-0,22	150,01	0,25	38,29	-0,44	2,64	-0,23
282	13,80	0,32	7,15	0,65	150,00	0,25	41,50	0,37	2,80	0,37
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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	
Mean	13,37		6,71		146,35		40,04		2,70	
Reproducibility s.d.	0,74		0,50		8,19		3,23		0,14	
Rel. reproducibility s.d.	5,54 %		7,38 %		5,60 %		8,06 %		5,03 %	
Reference value	13,09		6,48		143,56		39,56		2,56	
Target s.d.	1,34		0,67		14,64		4,00		0,27	
Rel. target s.d.:	10,00 %		10,00 %		10,00 %		10,00 %		10,00 %	
Lower limit of tolerance	10,70		5,37		117,08		32,03		2,16	
Upper limit of tolerance	16,05		8,06		175,63		48,04		3,24	
Type B outliers			1				1			
Type E outliers			2				2			
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	34		33		34		33		34	

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	
L: Differing laboratory mean (Grubbs II)	Grubbs für 2

Summary of laboratory test results

Sample 3

	copper	Z score	nickel	Z score	lead	Z score	zinc	Z score	cobalt	Z score
Unit	µg absolute		µg absolute		µg absolute		µg absolute		µg absolute	
6	18,56	1,42	15,03	1,19	62,89	1,56	91,47	1,46	10,45	1,10
33	16,00	-0,15	12,80	-0,47	49,90	-0,83	77,40	-0,30	9,26	-0,17
38	15,68	-0,35	12,78	-0,48	53,46	-0,17	77,34	-0,31	9,00	-0,44
68	16,50	0,15	13,90	0,35	54,20	-0,04	80,10	0,04	9,68	0,28
70	17,64	0,85	17,27	2,86 E	55,31	0,17	83,09	0,41	9,68	0,27
71	15,51	-0,45	11,79	-1,22	53,69	-0,13	78,84	-0,12	8,86	-0,59
74	15,70	-0,34	12,40	-0,77	51,20	-0,59	76,20	-0,45	8,70	-0,76
82	16,00	-0,15	13,00	-0,32	54,00	-0,07	79,00	-0,10	8,60	-0,87
84	16,40	0,09	13,30	-0,10	50,80	-0,66	76,40	-0,42	9,47	0,06
90	15,57	-0,42	12,33	-0,82	51,42	-0,55	76,74	-0,38	8,99	-0,45
91	16,37	0,07	9,91	-2,62 E	55,72	0,24	71,38	-1,05	9,63	0,23
95	16,50	0,15	13,20	-0,17	53,80	-0,11	72,90	-0,86	9,58	0,17
110	15,60	-0,40	12,40	-0,77	52,90	-0,28	81,40	0,20	9,28	-0,14
111	16,40	0,09	13,70	0,20	54,30	-0,02	85,40	0,70	9,54	0,13
112	16,80	0,34	14,10	0,50	58,00	0,66	82,60	0,35	9,90	0,51
113	15,50	-0,46	12,60	-0,62	55,40	0,18	55,10	-3,09 BE	8,63	-0,84
116	17,54	0,79	14,30	0,65	58,73	0,79	85,44	0,71	10,06	0,68
126	17,97	1,06	14,73	0,97	60,63	1,14	95,91	2,02 E	10,01	0,63
129	16,24	-0,01	14,12	0,51	54,24	-0,03	71,05	-1,09	9,75	0,36
131	15,90	-0,22	13,40	-0,02	54,40	0,00	77,90	-0,24	9,60	0,19
134	16,40	0,09	12,80	-0,47	49,80	-0,85	68,90	-1,36	9,20	-0,23
138	16,60	0,22	15,60	1,62	53,90	-0,09	81,80	0,25	4,60	-5,11 BE
147	16,35	0,06	13,44	0,01	54,70	0,05	83,65	0,48	9,43	0,01
177	14,74	-0,93	14,93	1,12	59,24	0,89	90,97	1,40	10,17	0,80
188	16,22	-0,02	13,39	-0,03	53,87	-0,10	79,85	0,01	9,48	0,07
197	15,00	-0,77	12,50	-0,69	51,80	-0,48	75,80	-0,50	8,97	-0,47
206	15,90	-0,22	12,80	-0,47	49,80	-0,85	67,10	-1,59	9,01	-0,43
210	17,34	0,67	15,04	1,20	58,10	0,68	83,38	0,45	10,06	0,68

	copper	Z score	nickel	Z score	lead	Z score	zinc	Z score	cobalt	Z score
212	15,80	-0,28	13,10	-0,25	57,10	0,49	85,20	0,68	9,20	-0,23
232	15,77	-0,30	12,81	-0,46	53,72	-0,13	83,60	0,48	8,98	-0,46
242	16,10	-0,09	13,50	0,05	53,30	-0,20	81,30	0,19	9,50	0,09
245	15,00	-0,77	12,00	-1,06	49,00	-0,99	69,00	-1,35	8,90	-0,55
252	16,06	-0,12	13,52	0,07	54,84	0,08	78,80	-0,12	9,42	0,00
282	16,85	0,37	14,10	0,50	55,70	0,24	83,00	0,40	9,75	0,35
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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	
Mean	16,25		13,43		54,41		79,79		9,42	
Reproducibility s.d.	0,83		1,30		3,16		6,50		0,47	
Rel. reproducibility s.d.	5,13 %		9,65 %		5,81 %		8,15 %		4,95 %	
Reference value	15,91		13,06		53,33		81,82		9,12	
Target s.d.	1,63		1,34		5,44		7,98		0,94	
Rel. target s.d.:	10,00 %		10,00 %		10,00 %		10,00 %		10,00 %	
Lower limit of tolerance	13,00		10,74		43,53		63,83		7,53	
Upper limit of tolerance	19,50		16,11		65,29		95,74		11,30	
Type B outliers							1		1	
Type E outliers			2				2		1	
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	34		34		34		33		33	

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	
L: Differing laboratory mean (Grubbs II)	Grubbs für 2

Summary of laboratory test results

Sample reference solution

	copper Score	nickel Score	lead Score	zinc Score	cobalt Score
Unit	µg absolute	µg absolute	µg absolute	µg absolute	µg absolute
6	10,31	10,16	77,53	69,85	5,08
33	10,30	10,40	78,70	70,00	5,12
38	10,19	10,26	78,73	68,42	5,10
68	9,83	10,10	76,00	69,50	5,03
70	10,37	10,41	80,36	70,58	5,14
71	10,13	10,08	79,16	71,23	4,91
74	9,70	9,50	72,50	65,20	4,60
82	9,90	9,90	79,00	75,00	5,00
84	10,80	10,60	78,70	70,40	5,29
90	9,82	9,99	75,60	69,31	4,84
91	10,43	9,81	78,62	63,67	5,06
95	10,70	10,15	81,42	64,50	5,27
110	9,70	9,50	74,70	69,30	4,90
111	10,20	10,30	77,70	69,70	5,04
112	10,00	10,00	80,20	70,30	5,03
113	8,95	8,93	76,30	47,90	4,33
116	10,24	10,05	80,90	73,76	4,99
126	10,09	10,26	77,99	76,98	5,08
129	9,72	10,52	76,19	65,13	5,35
131	10,80	7,90	82,70	71,20	5,30
134	9,30	8,60	62,80	53,40	4,40
138	9,80	9,87	78,10	69,80	4,86
147	9,44	9,50	73,11	67,89	4,70
177	7,64	10,13	75,22	75,16	5,13
188	10,21	10,08	78,09	70,28	4,99
197	10,10	10,20	80,60	71,80	5,20
206	9,60	9,85	60,10	80,60	4,62
210	9,90	9,94	77,04	66,68	4,96

	copper	Score	nickel	Score	lead	Score	zinc	Score	cobalt	Score
212	9,95		10,43		76,55		82,15		5,08	
232	11,07		10,97		86,37		75,50		5,23	
242	9,70		9,80		75,10		69,30		4,80	
245	9,50		9,80		75,00		63,00		4,80	
252	9,75		9,90		78,56		67,11		4,85	
282	10,25		10,30		78,70		70,00		5,05	
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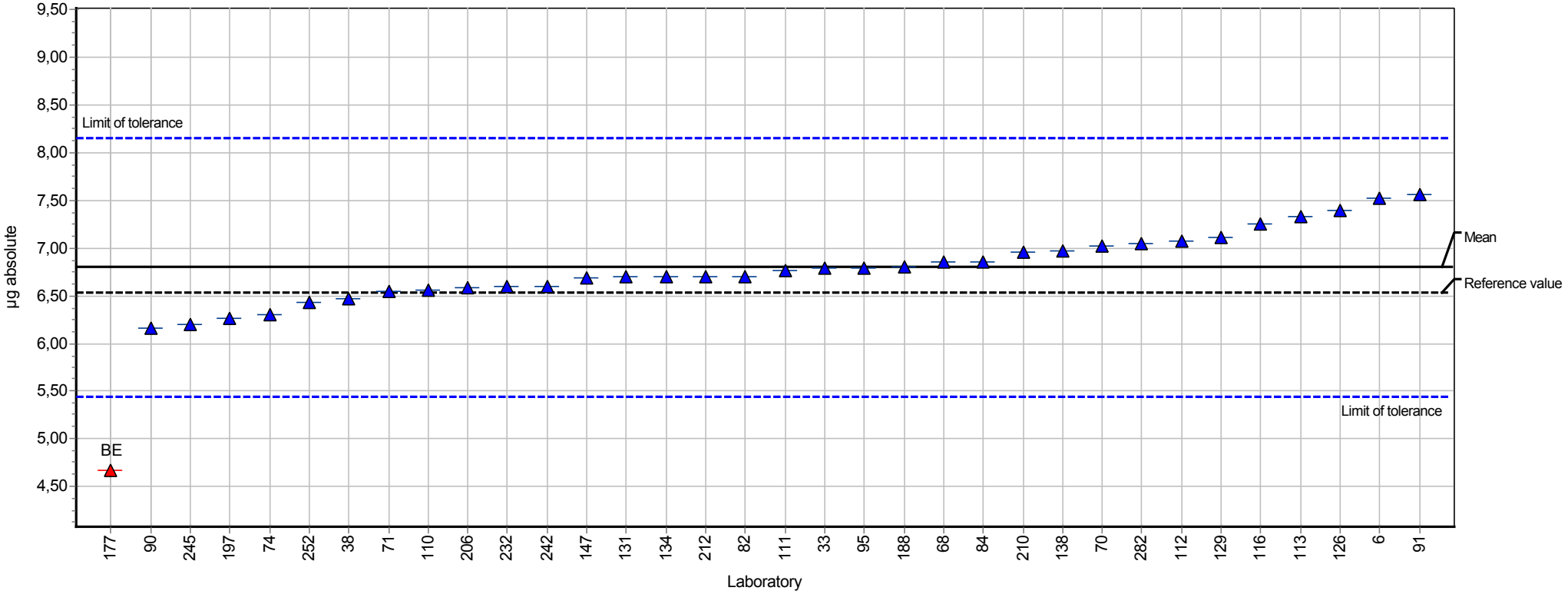
Method	ISO 5725-2		ISO 5725-2		ISO 5725-2		ISO 5725-2		ISO 5725-2	
Assessment	unknown		unknown		unknown		unknown		unknown	
Mean	9,95		9,95		77,01		69,25		4,97	
Reproducibility s.d.	0,60		0,57		4,81		6,40		0,24	
Rel. reproducibility s.d.	6,07 %		5,77 %		6,24 %		9,24 %		4,83 %	
Reference value	9,60		9,50		74,10		66,50		4,80	
Target s.d.	1,00		0,99		7,70		6,93		0,50	
Rel. target s.d.:	10,00 %		10,00 %		10,00 %		10,00 %		10,00 %	
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	34		34		34		34		34	

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	
L: Differing laboratory mean (Grubbs II)	Grubbs für 2

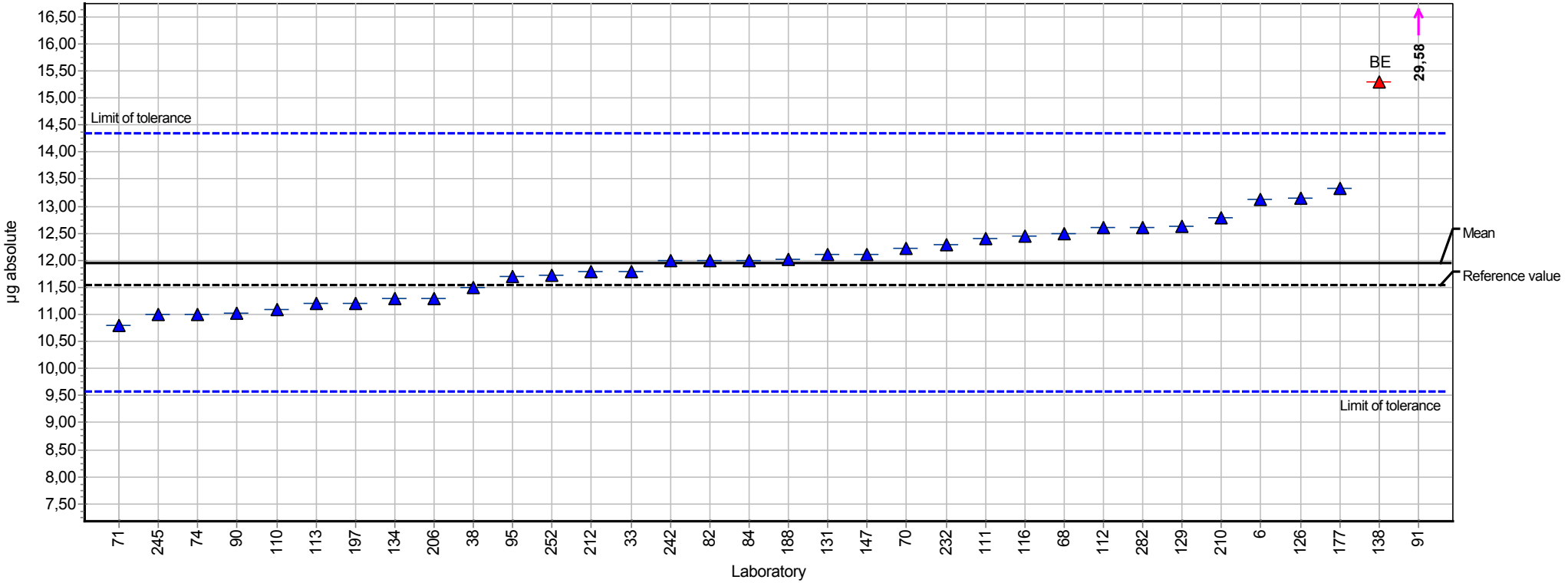
Summary results

Measurand:	**copper**	**Mean:**	**6,80 µg absolute**
Sample:	**1**	**Reprod. s.d.:**	**0,36 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**5,29%**
No. of laboratories:	**33**	**Reference value:**	**6,53 µg absolute**
Rel.target s.d.:	**10,00% (Limited)**	**Range of tolerance:**	**5,44 - 8,16 µg absolute (|Z-Score| <= 2,00)**



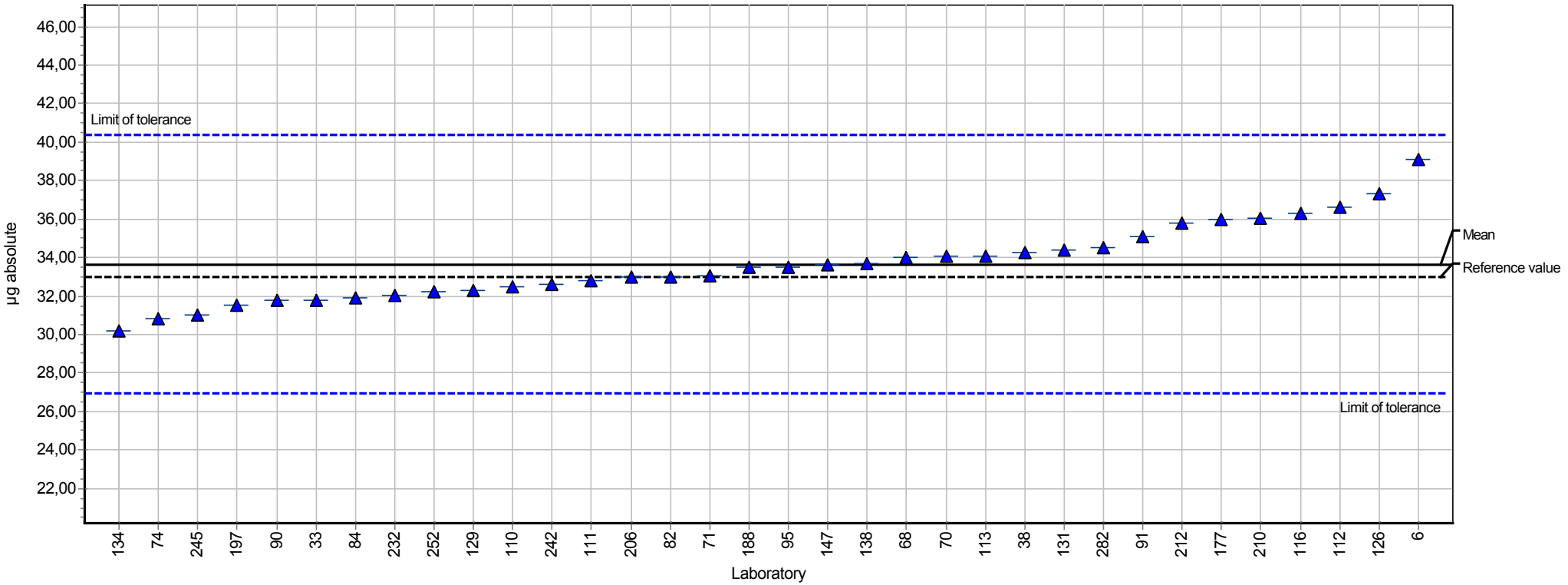
Summary results

Measurand:	**nickel**	**Mean:**	**11,96 µg absolute**
Sample:	**1**	**Reprod. s.d.:**	**0,69 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**5,78%**
No. of laboratories:	**32**	**Reference value:**	**11,55 µg absolute**
Rel.target s.d.:	**10,00% (Limited)**	**Range of tolerance:**	**9,57 - 14,35 µg absolute (|Z-Score| <= 2,00)**



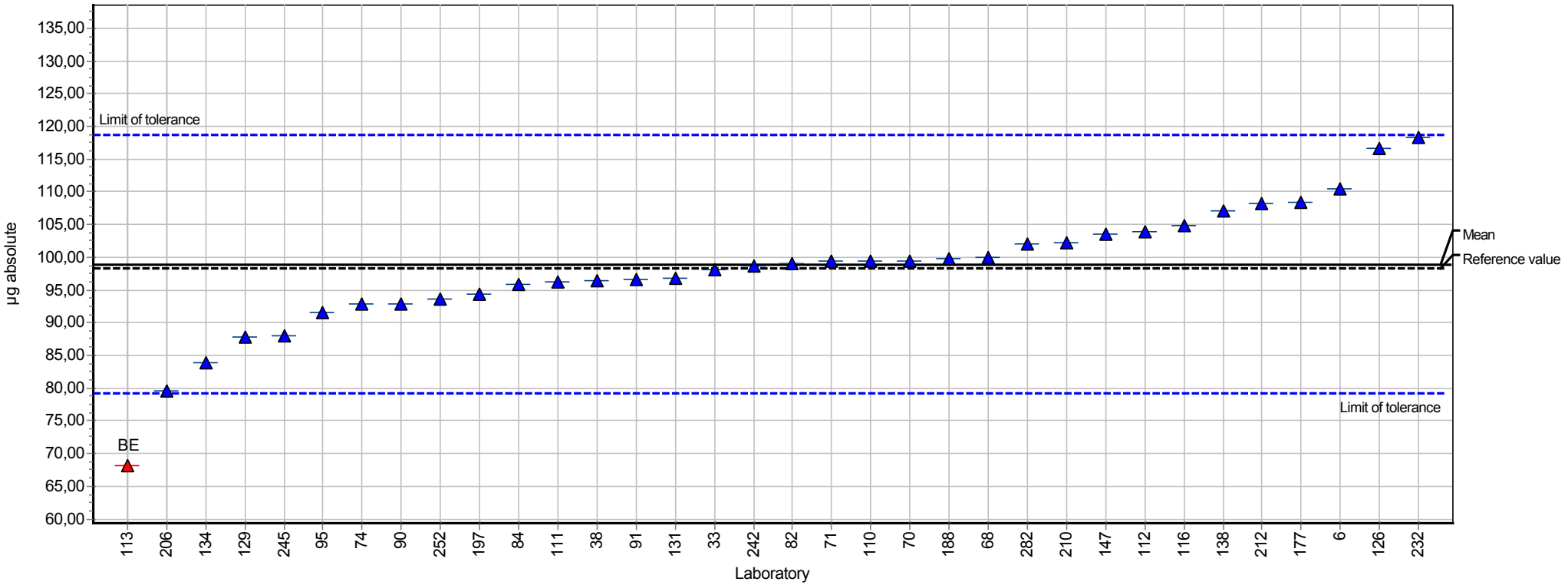
Summary results

Measurand:	**lead**	**Mean:**	**33,66 µg absolute**
Sample:	**1**	**Reprod. s.d.:**	**1,99 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**5,92%**
No. of laboratories:	**34**	**Reference value:**	**33,01 µg absolute**
Rel.target s.d.:	**10,00% (Limited)**	**Range of tolerance:**	**26,92 - 40,39 µg absolute (|Z-Score| <= 2,00)**



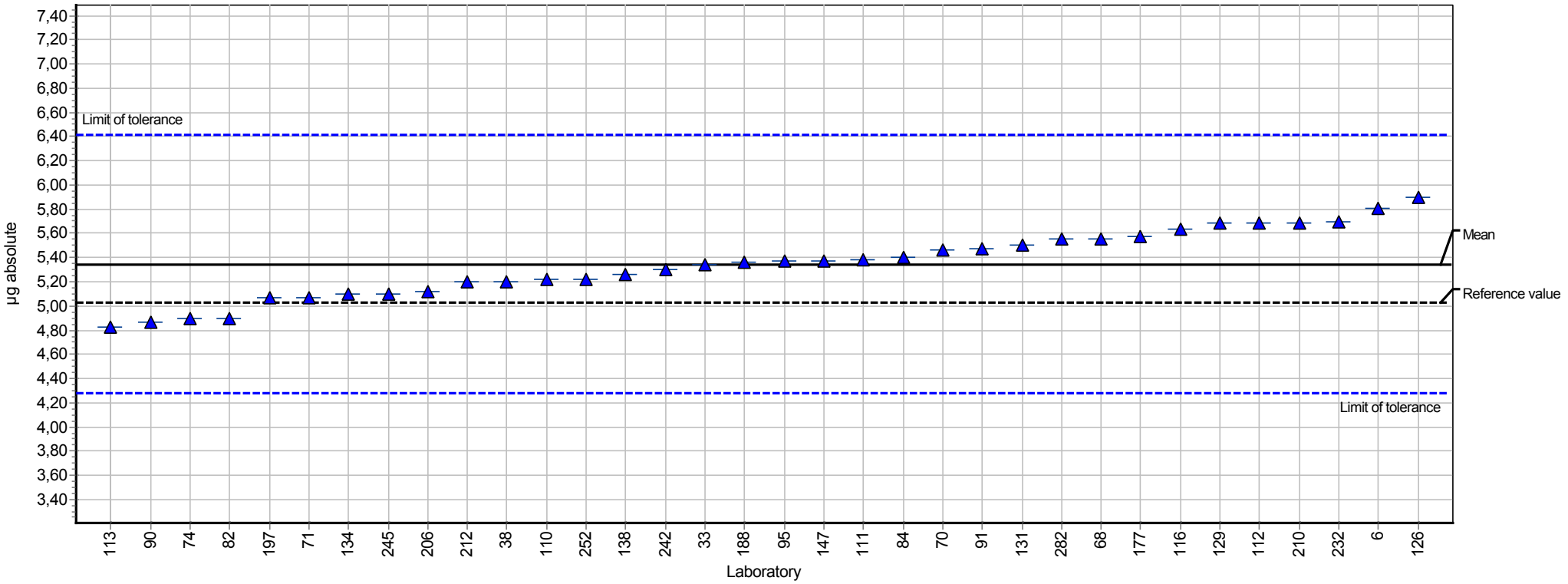
Summary results

Measurand:	**zinc**	**Mean:**	**98,95 µg absolute**
Sample:	**1**	**Reprod. s.d.:**	**8,34 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**8,43%**
No. of laboratories:	**33**	**Reference value:**	**98,27 µg absolute**
Rel.target s.d.:	**10,00% (Limited)**	**Range of tolerance:**	**79,16 - 118,74 µg absolute (|Z-Score| <= 2,00)**



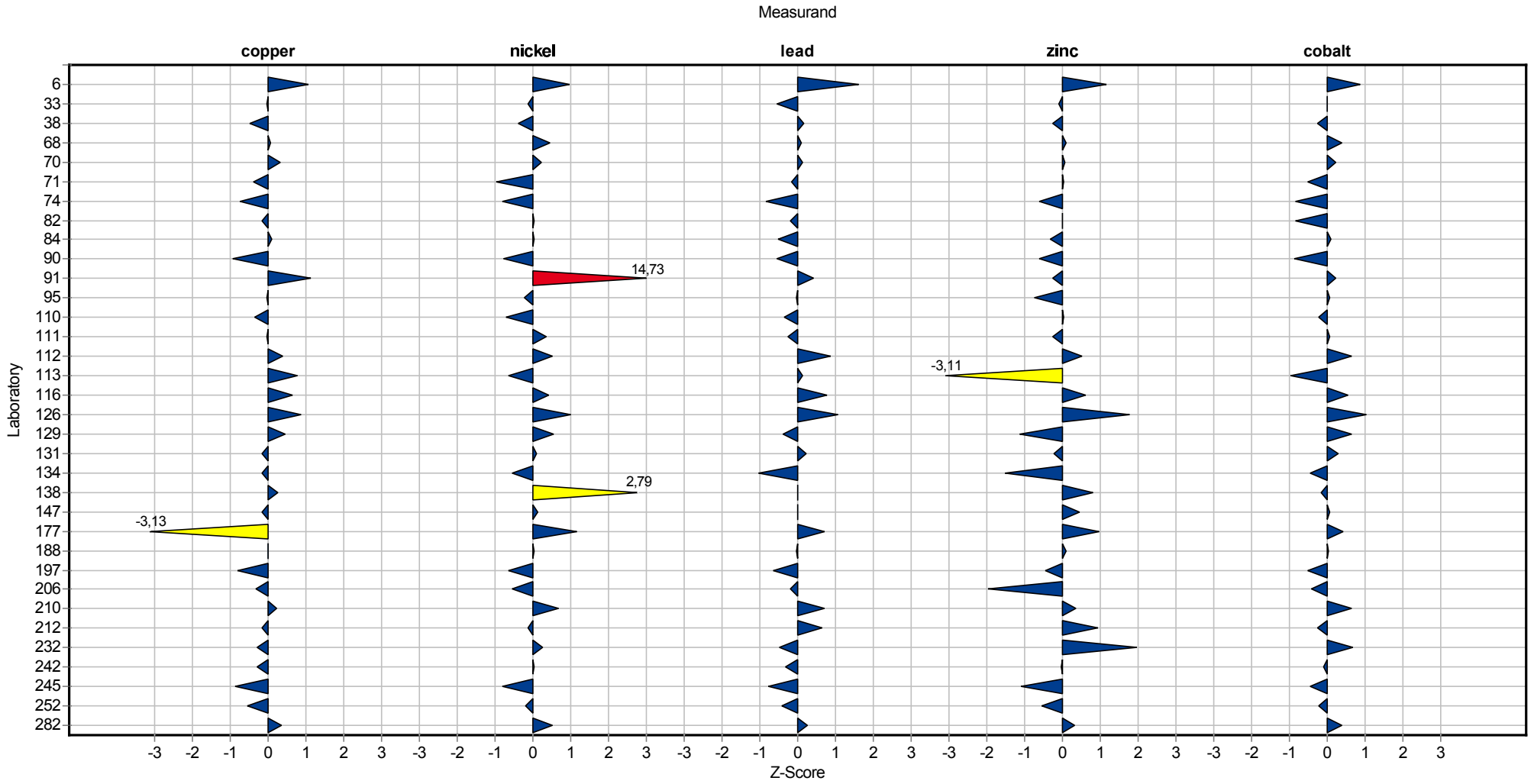
Summary results

Measurand:	**cobalt**	**Mean:**	**5,35 µg absolute**
Sample:	**1**	**Reprod. s.d.:**	**0,28 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**5,22%**
No. of laboratories:	**34**	**Reference value:**	**5,03 µg absolute**
Rel.target s.d.:	**10,00% (Limited)**	**Range of tolerance:**	**4,28 - 6,42 µg absolute (|Z-Score| <= 2,00)**



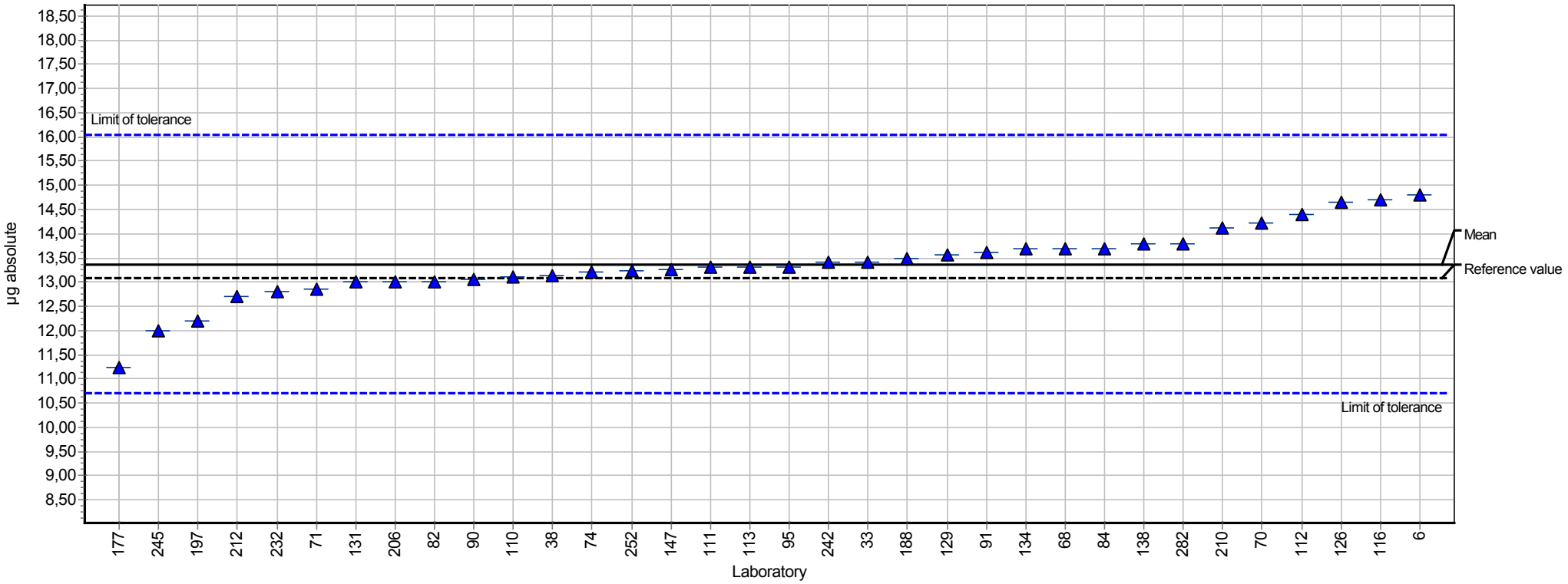
Sample chart of Z-scores

Sample 1



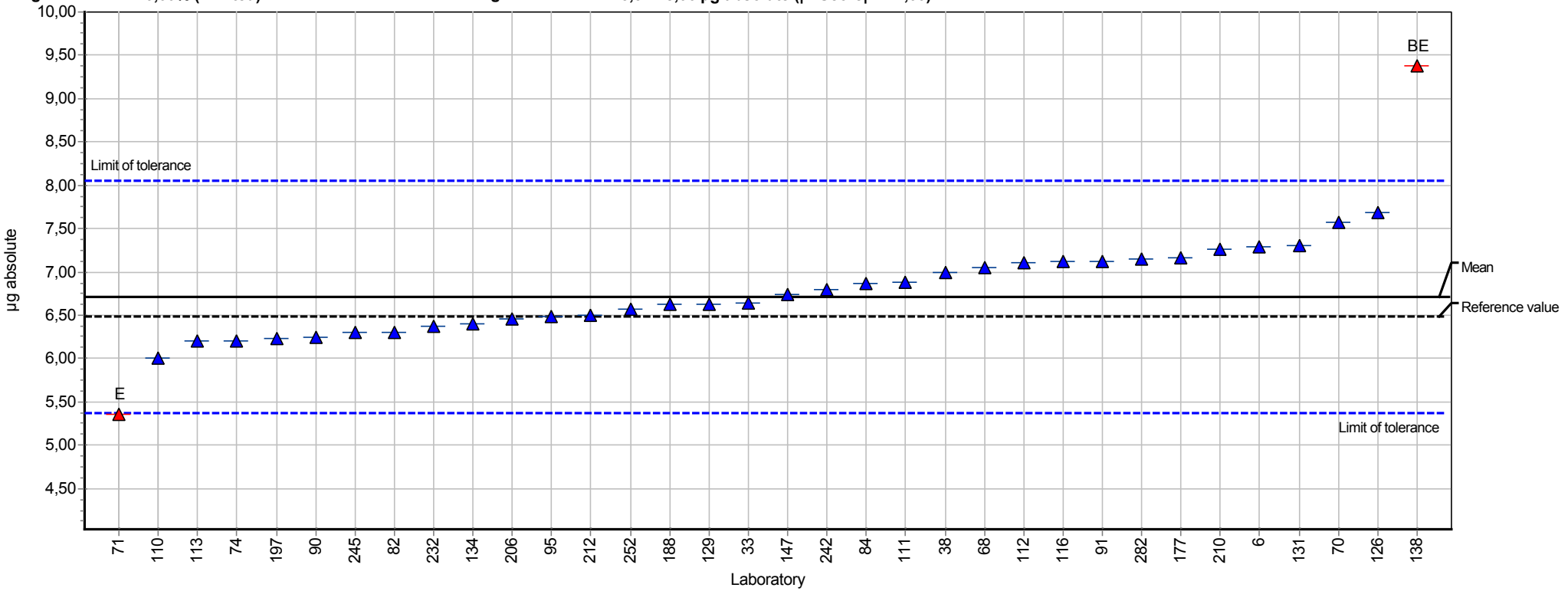
Summary results

Measurand:	**copper**	**Mean:**	**13,37 µg absolute**
Sample:	**2**	**Reprod. s.d.:**	**0,74 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**5,54%**
No. of laboratories:	**34**	**Reference value:**	**13,09 µg absolute**
Rel.target s.d.:	**10,00% (Limited)**	**Range of tolerance:**	**10,70 - 16,05 µg absolute (|Z-Score| <= 2,00)**



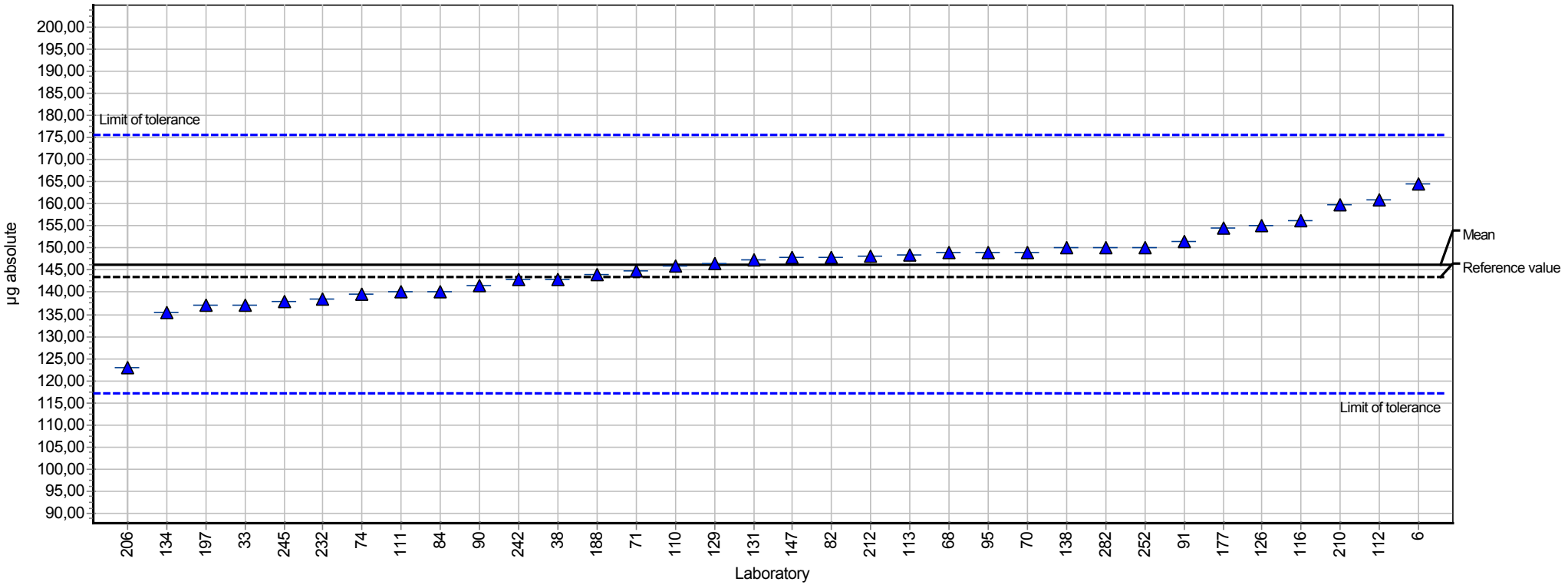
Summary results

Measurand:	**nickel**	**Mean:**	**6,71 µg absolute**
Sample:	**2**	**Reprod. s.d.:**	**0,50 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**7,38%**
No. of laboratories:	**33**	**Reference value:**	**6,48 µg absolute**
Rel.target s.d.:	**10,00% (Limited)**	**Range of tolerance:**	**5,37 - 8,06 µg absolute (|Z-Score| <= 2,00)**



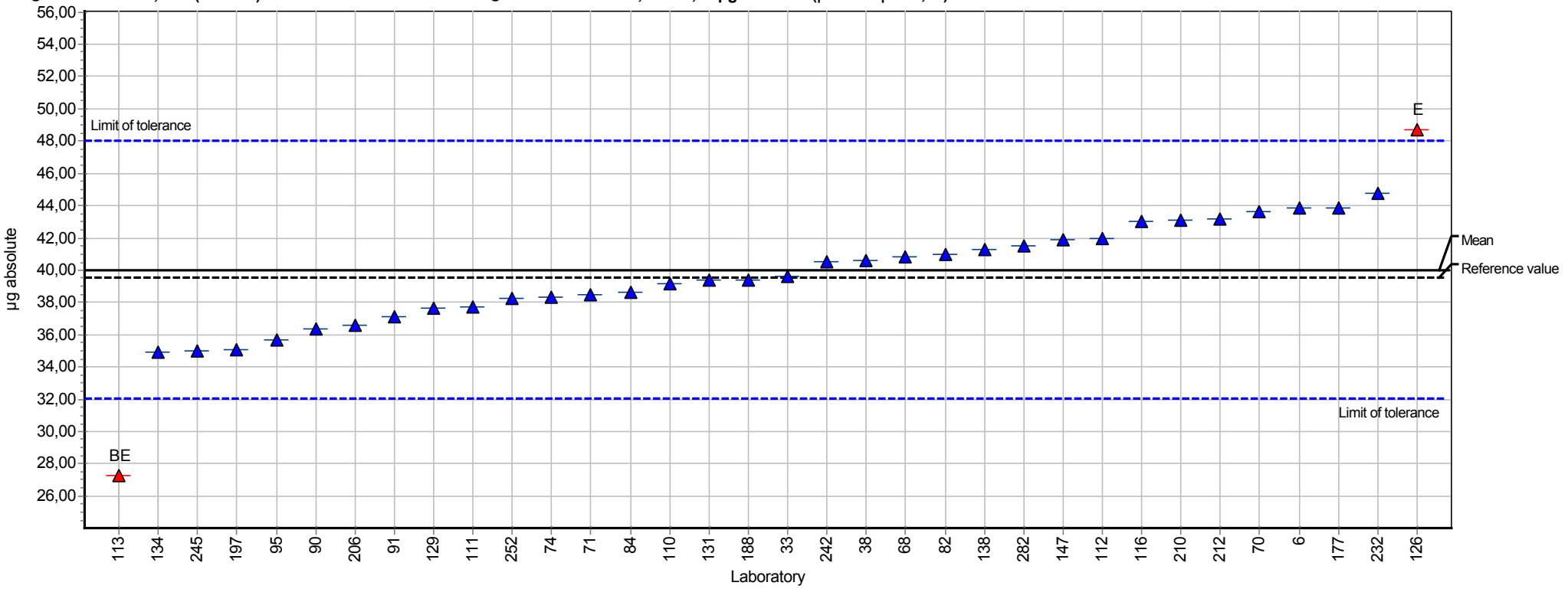
Summary results

Measurand:	**lead**	**Mean:**	**146,35 µg absolute**
Sample:	**2**	**Reprod. s.d.:**	**8,19 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**5,60%**
No. of laboratories:	**34**	**Reference value:**	**143,56 µg absolute**
Rel.target s.d.:	**10,00% (Limited)**	**Range of tolerance:**	**117,08 - 175,63 µg absolute (|Z-Score| <= 2,00)**



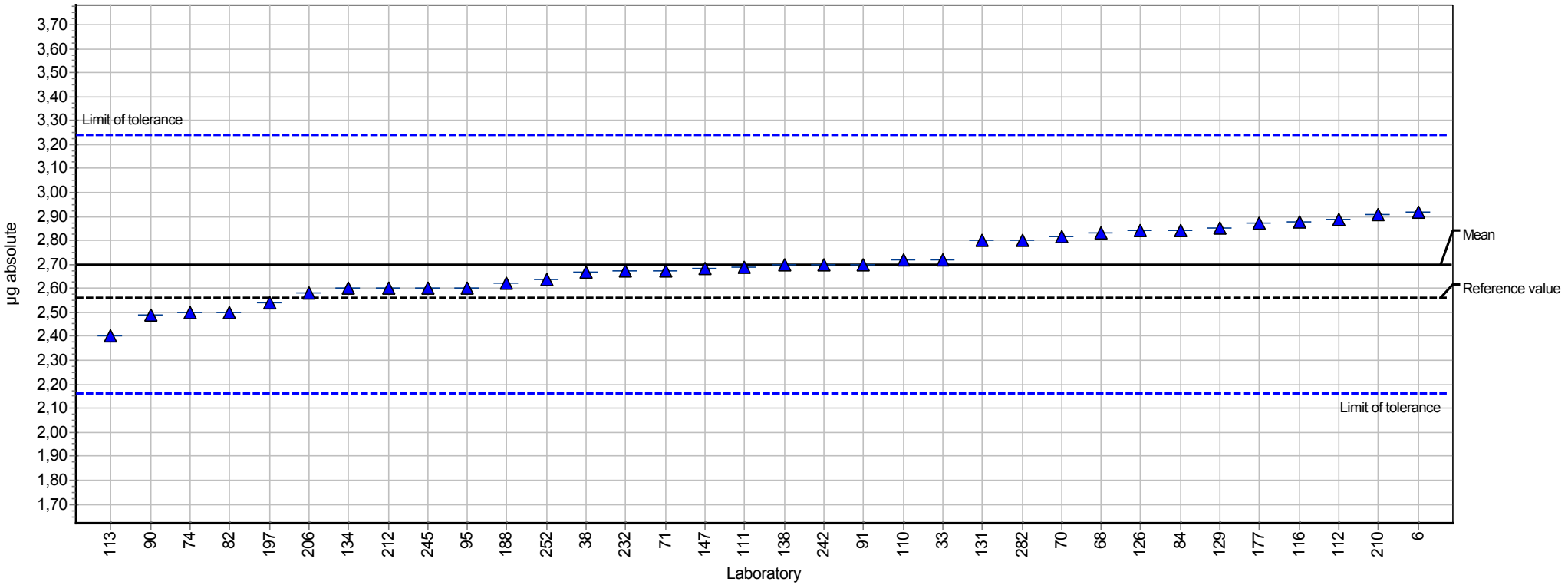
Summary results

Measurand:	**zinc**	**Mean:**	**40,04 µg absolute**
Sample:	**2**	**Reprod. s.d.:**	**3,23 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**8,06%**
No. of laboratories:	**33**	**Reference value:**	**39,56 µg absolute**
Rel.target s.d.:	**10,00% (Limited)**	**Range of tolerance:**	**32,03 - 48,04 µg absolute (|Z-Score| <= 2,00)**



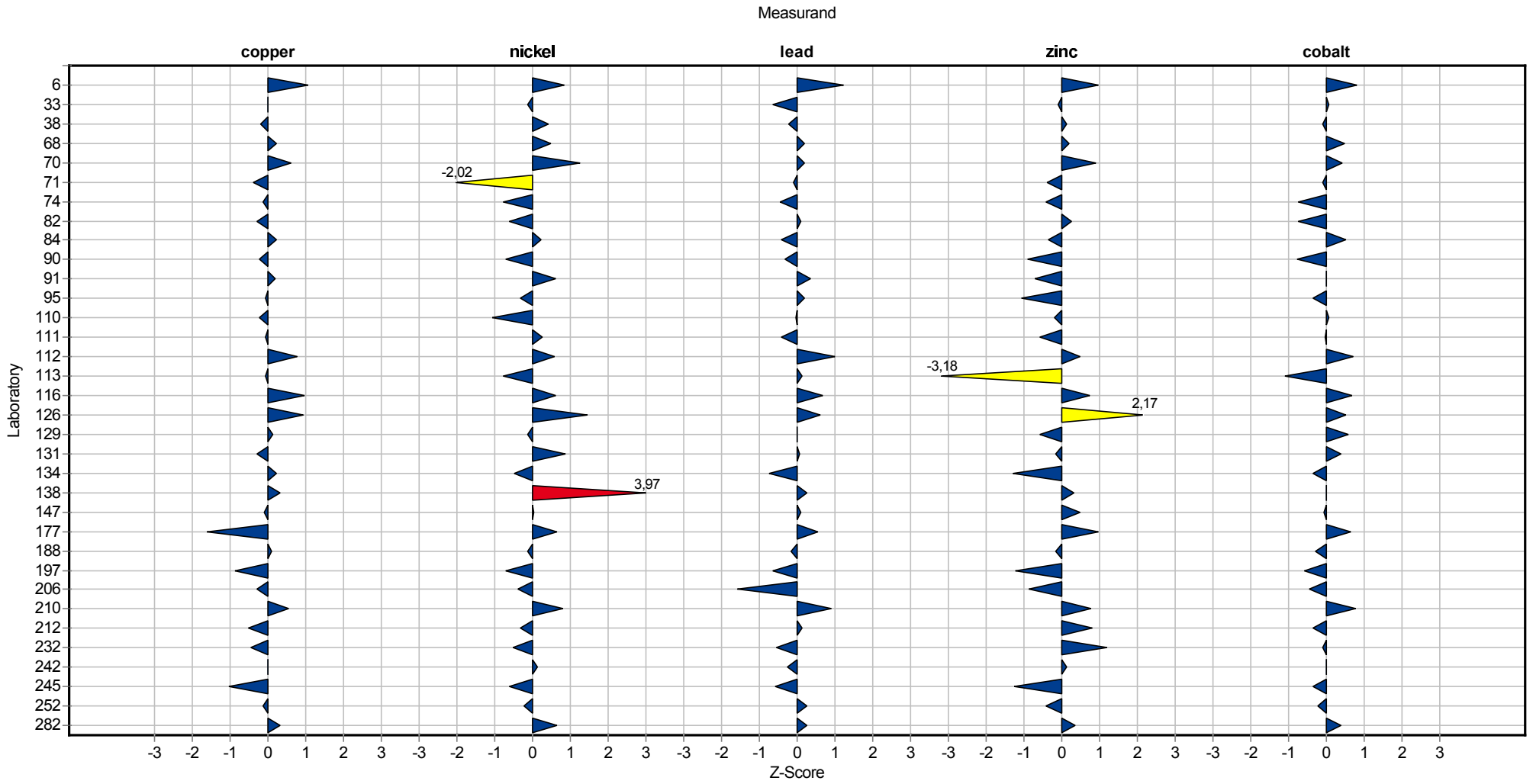
Summary results

Measurand:	**cobalt**	**Mean:**	**2,70 µg absolute**
Sample:	**2**	**Reprod. s.d.:**	**0,14 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**5,03%**
No. of laboratories:	**34**	**Reference value:**	**2,56 µg absolute**
Rel.target s.d.:	**10,00% (Limited)**	**Range of tolerance:**	**2,16 - 3,24 µg absolute (|Z-Score| <= 2,00)**



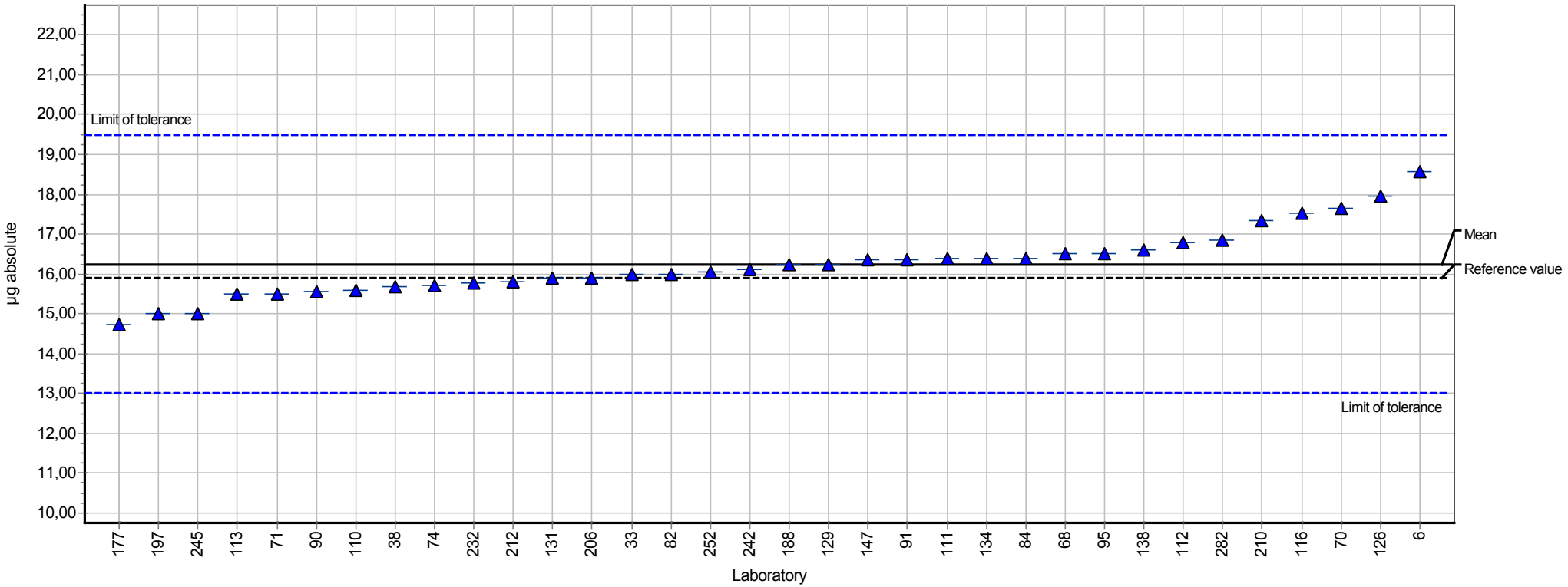
Sample chart of Z-scores

Sample 2



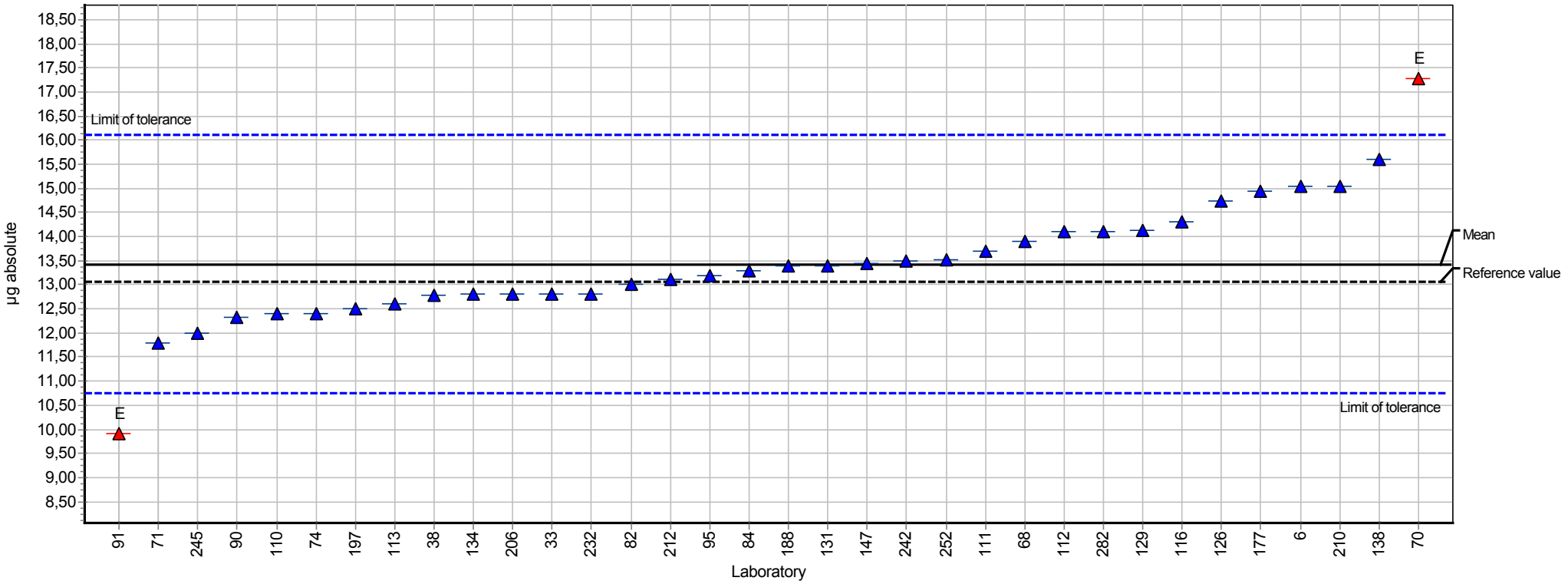
Summary results

Measurand:	**copper**	**Mean:**	**16,25 µg absolute**
Sample:	**3**	**Reprod. s.d.:**	**0,83 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**5,13%**
No. of laboratories:	**34**	**Reference value:**	**15,91 µg absolute**
Rel.target s.d.:	**10,00% (Limited)**	**Range of tolerance:**	**13,00 - 19,50 µg absolute (|Z-Score| <= 2,00)**



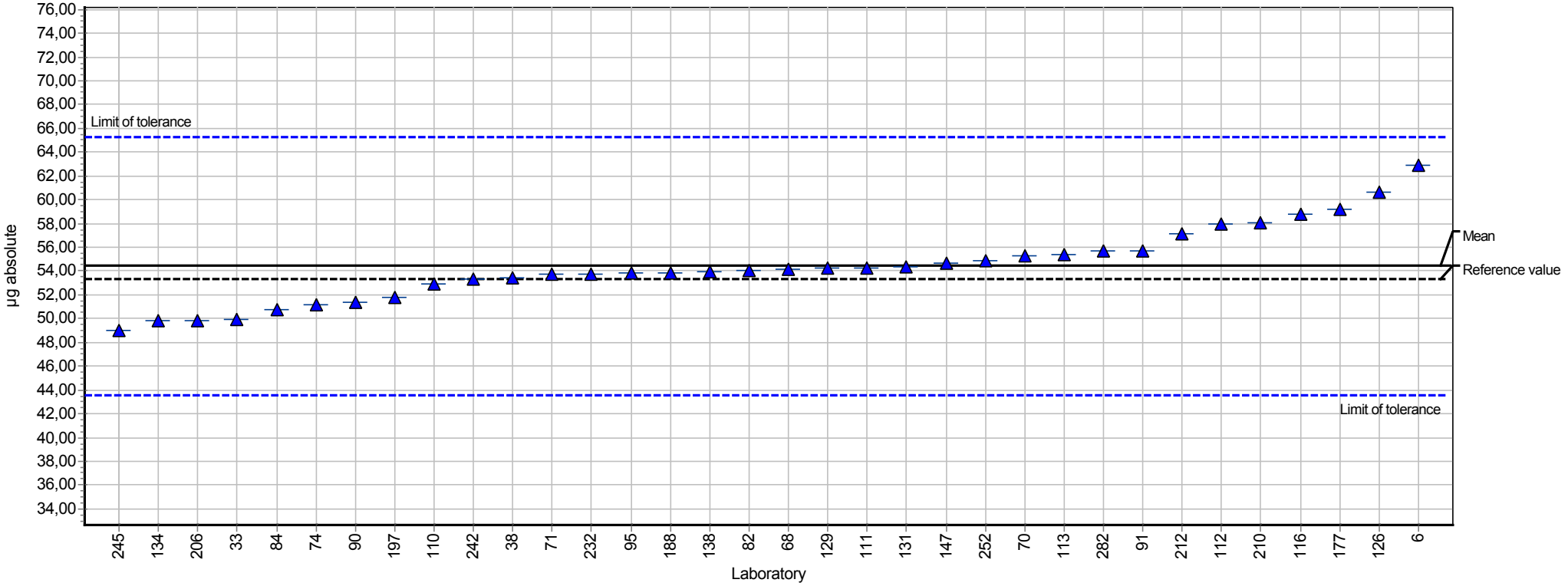
Summary results

Measurand:	**nickel**	**Mean:**	**13,43 µg absolute**
Sample:	**3**	**Reprod. s.d.:**	**1,30 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**9,65%**
No. of laboratories:	**34**	**Reference value:**	**13,06 µg absolute**
Rel.target s.d.:	**10,00% (Limited)**	**Range of tolerance:**	**10,74 - 16,11 µg absolute (|Z-Score| <= 2,00)**



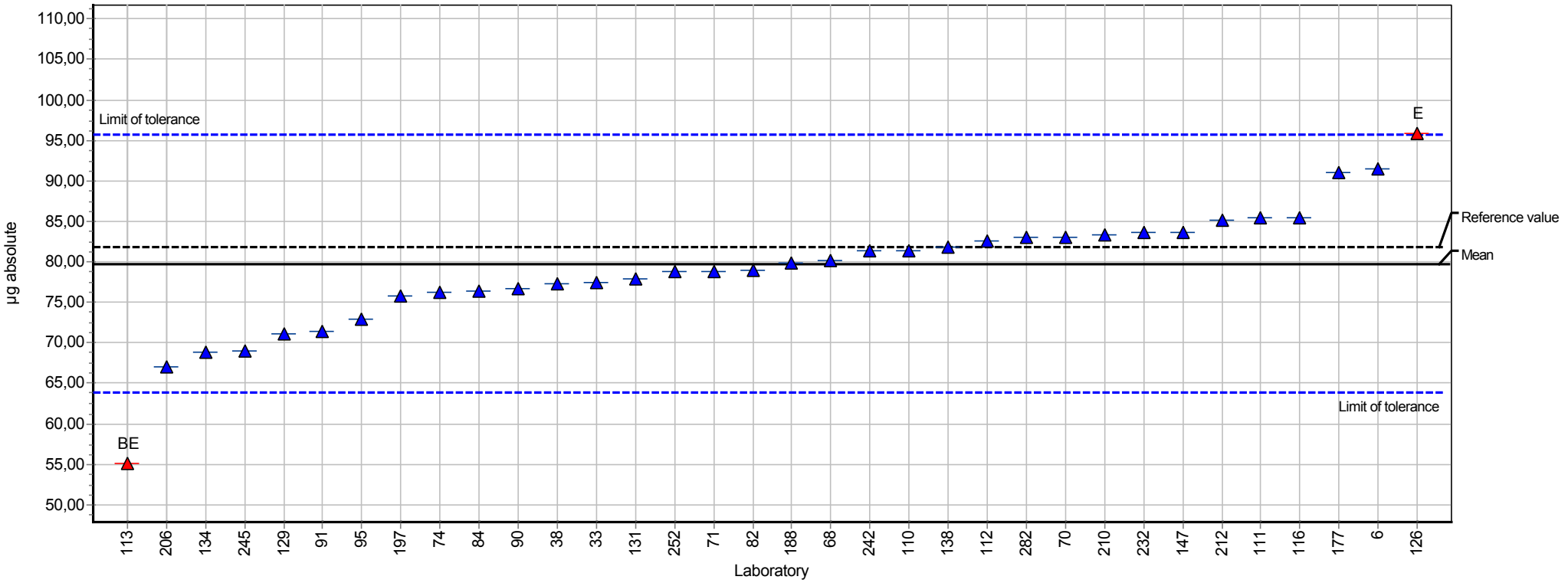
Summary results

Measurand:	**lead**	**Mean:**	**54,41 µg absolute**
Sample:	**3**	**Reprod. s.d.:**	**3,16 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**5,81%**
No. of laboratories:	**34**	**Reference value:**	**53,33 µg absolute**
Rel.target s.d.:	**10,00% (Limited)**	**Range of tolerance:**	**43,53 - 65,29 µg absolute (|Z-Score| <= 2,00)**



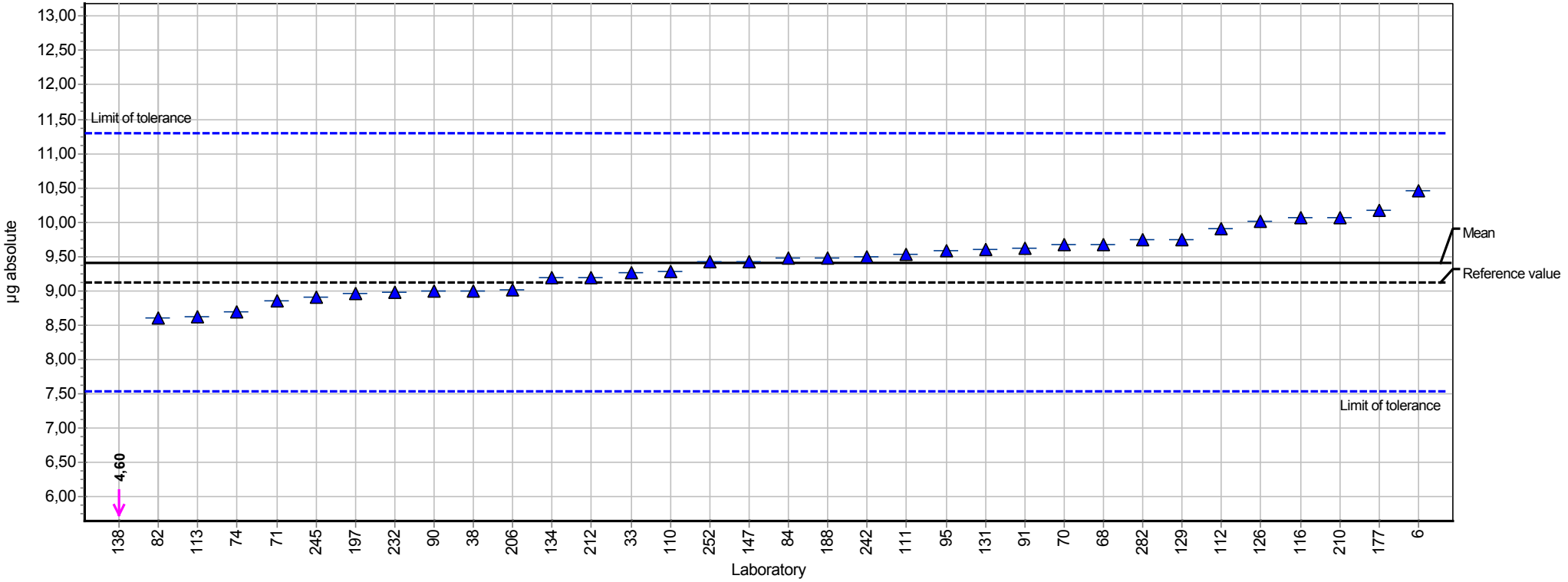
Summary results

Measurand:	**zinc**	**Mean:**	**79,79 µg absolute**
Sample:	**3**	**Reprod. s.d.:**	**6,50 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**8,15%**
No. of laboratories:	**33**	**Reference value:**	**81,82 µg absolute**
Rel.target s.d.:	**10,00% (Limited)**	**Range of tolerance:**	**63,83 - 95,74 µg absolute (|Z-Score| <= 2,00)**



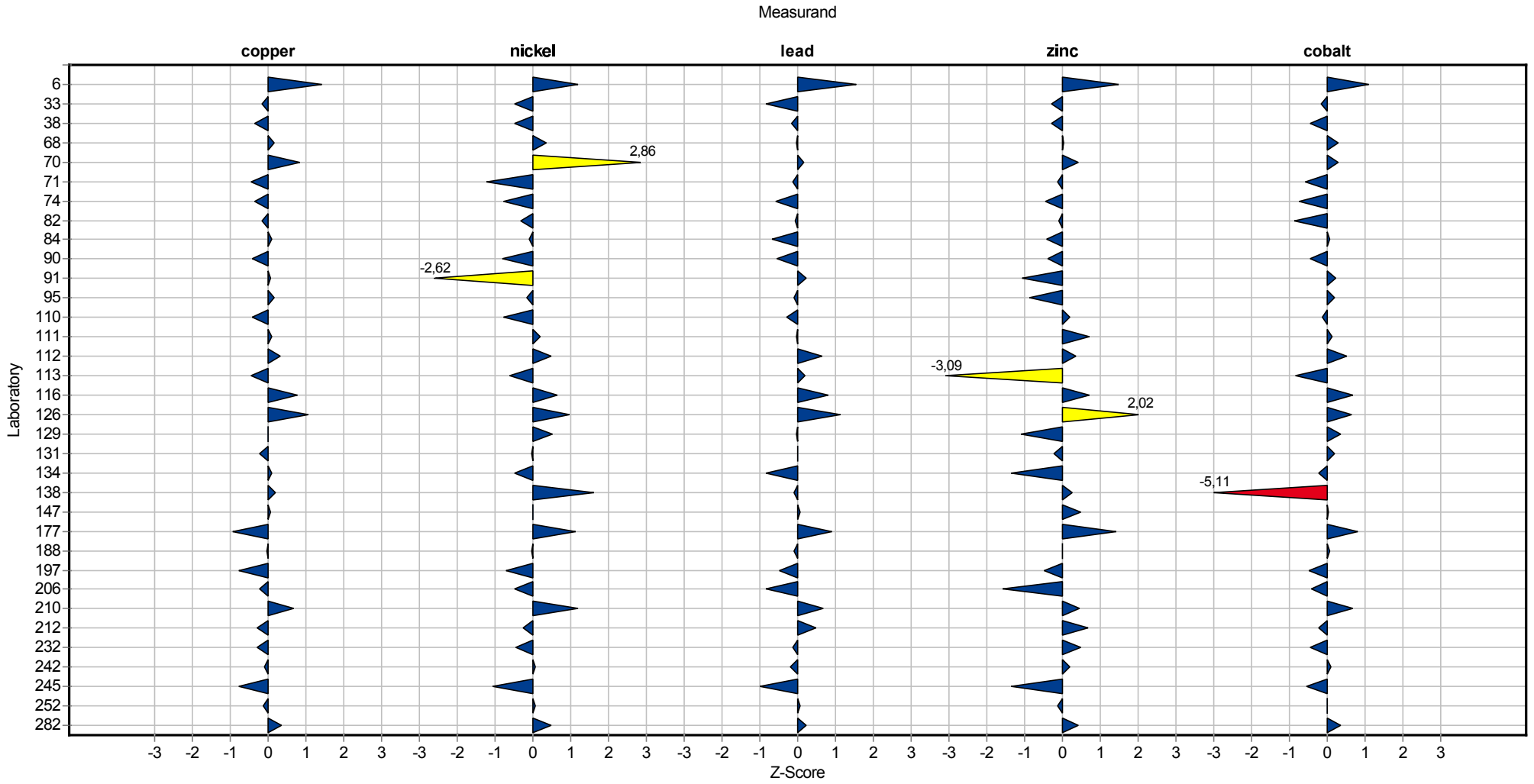
Summary results

Measurand:	**cobalt**	**Mean:**	**9,42 µg absolute**
Sample:	**3**	**Reprod. s.d.:**	**0,47 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**4,95%**
No. of laboratories:	**33**	**Reference value:**	**9,12 µg absolute**
Rel.target s.d.:	**10,00% (Limited)**	**Range of tolerance:**	**7,53 - 11,30 µg absolute (|Z-Score| <= 2,00)**



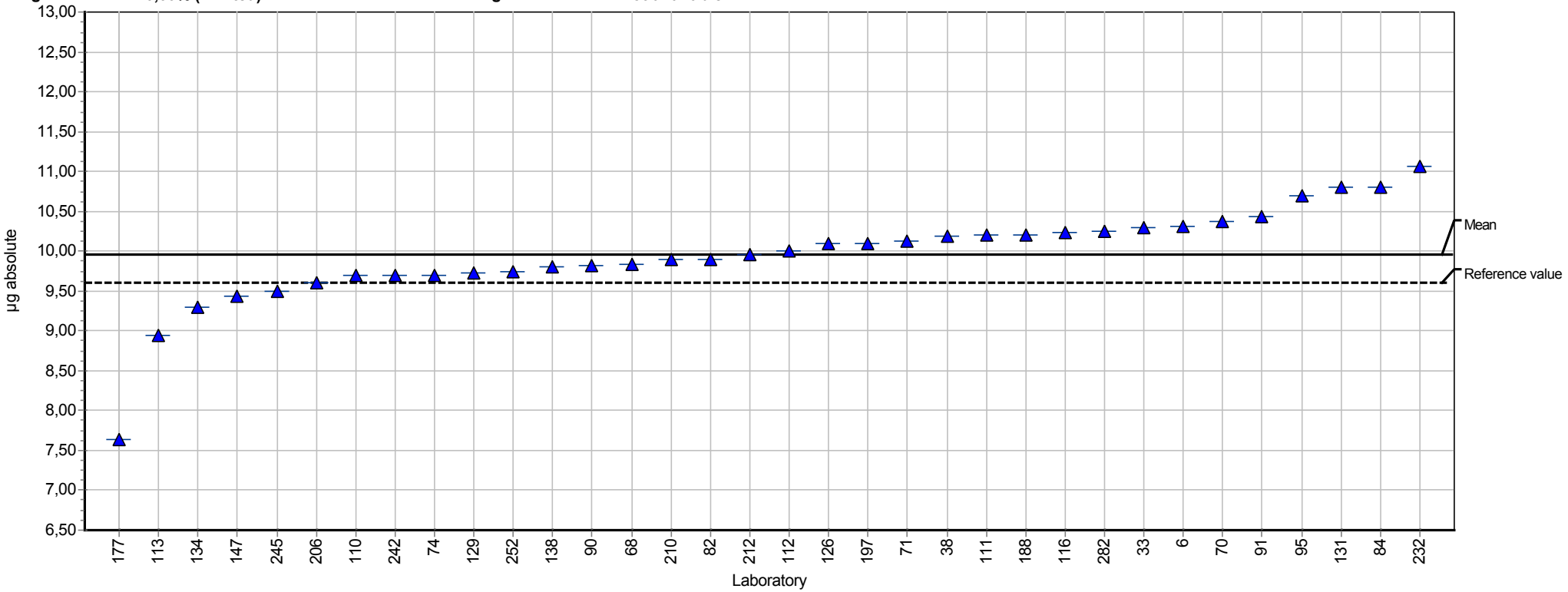
Sample chart of Z-scores

Sample 3



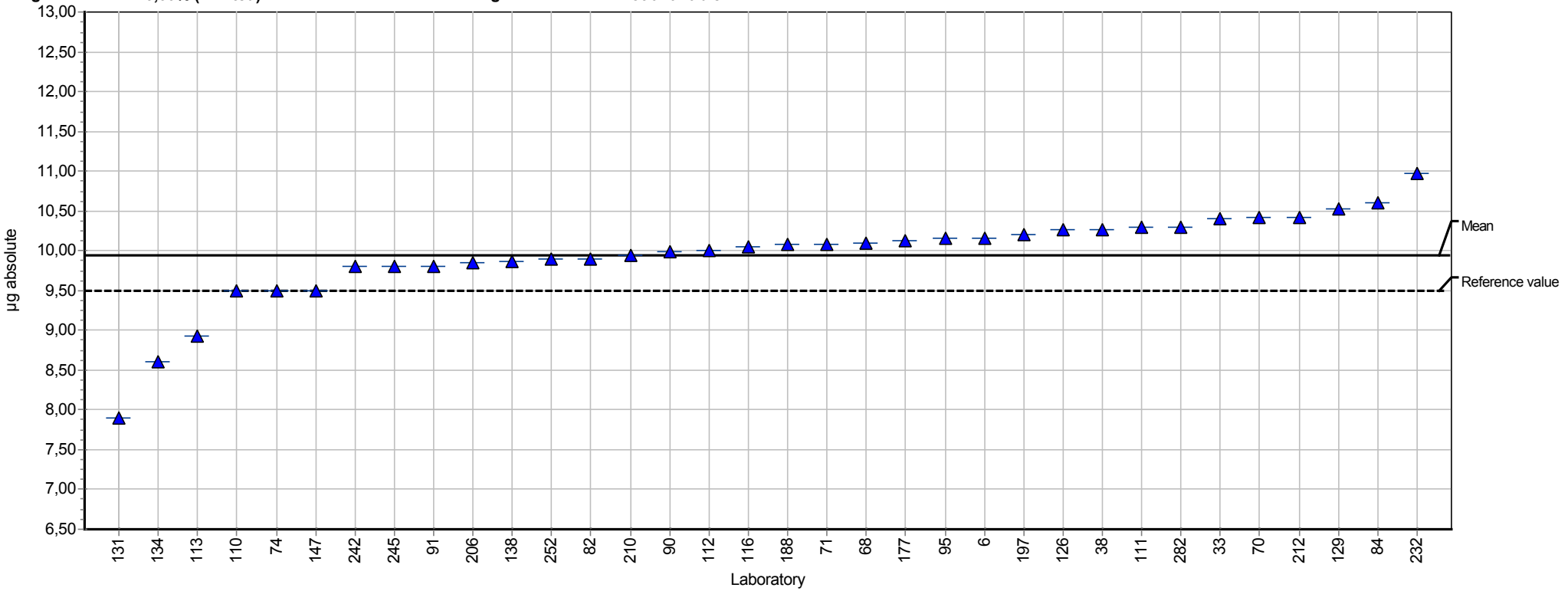
Summary results

Measurand:	**copper**	**Mean:**	**9,95 µg absolute**
Sample:	**reference solution**	**Reprod. s.d.:**	**0,60 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**6,07%**
No. of laboratories:	**34**	**Reference value:**	**9,60 µg absolute**
Rel.target s.d.:	**10,00% (Limited)**	**Range of tolerance:**	**not available**



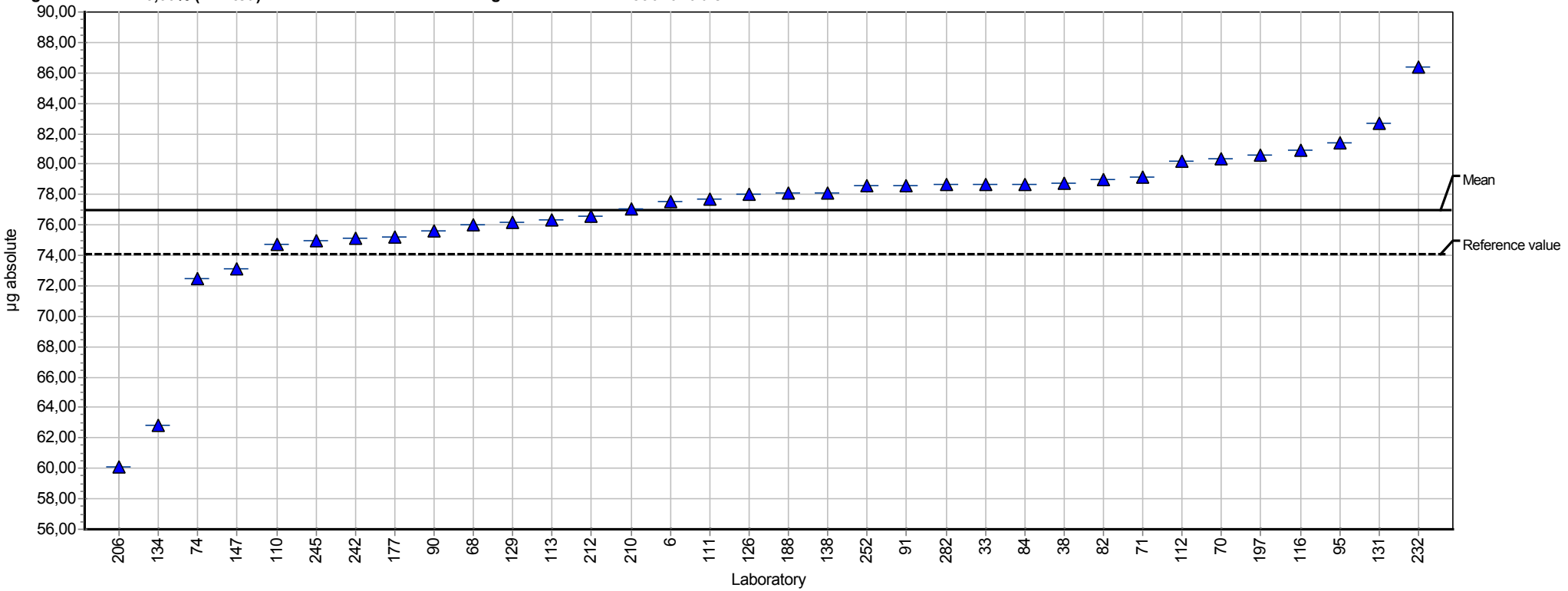
Summary results

Measurand:	**nickel**	**Mean:**	**9,95 µg absolute**
Sample:	**reference solution**	**Reprod. s.d.:**	**0,57 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**5,77%**
No. of laboratories:	**34**	**Reference value:**	**9,50 µg absolute**
Rel.target s.d.:	**10,00% (Limited)**	**Range of tolerance:**	**not available**



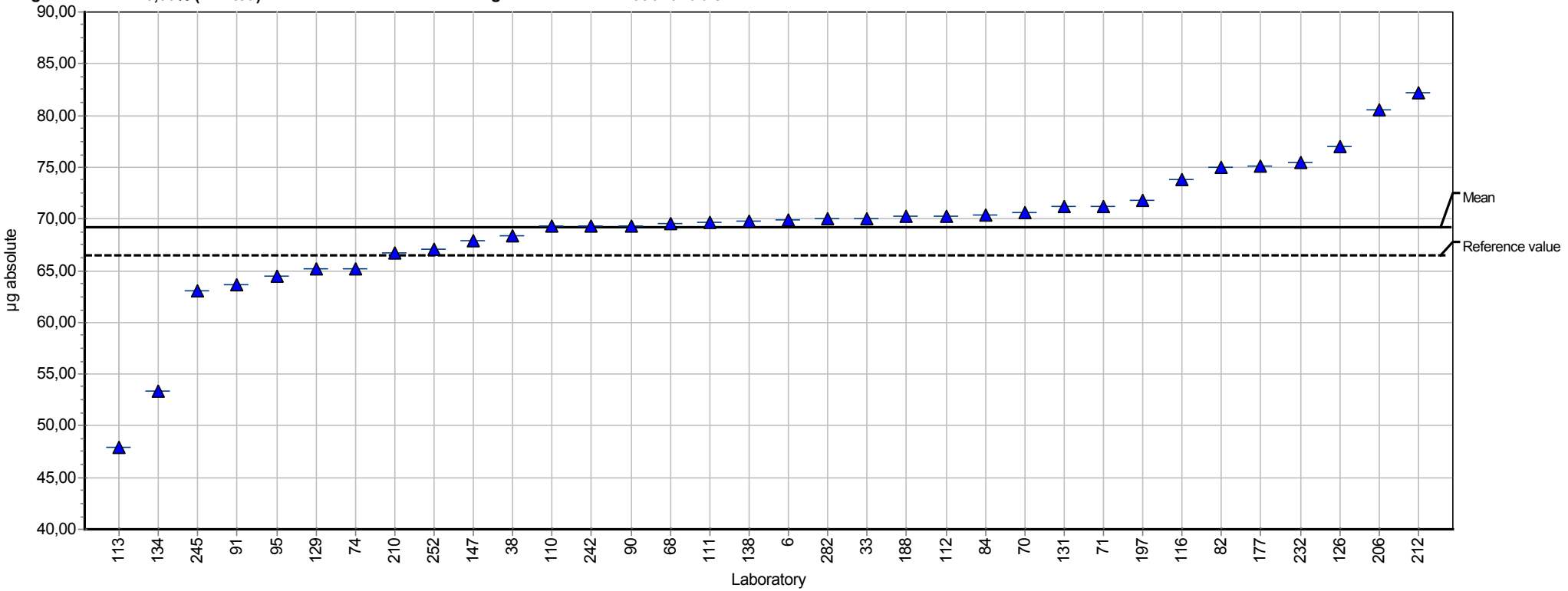
Summary results

Measurand:	**lead**	**Mean:**	**77,01 µg absolute**
Sample:	**reference solution**	**Reprod. s.d.:**	**4,81 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**6,24%**
No. of laboratories:	**34**	**Reference value:**	**74,10 µg absolute**
Rel.target s.d.:	**10,00% (Limited)**	**Range of tolerance:**	**not available**



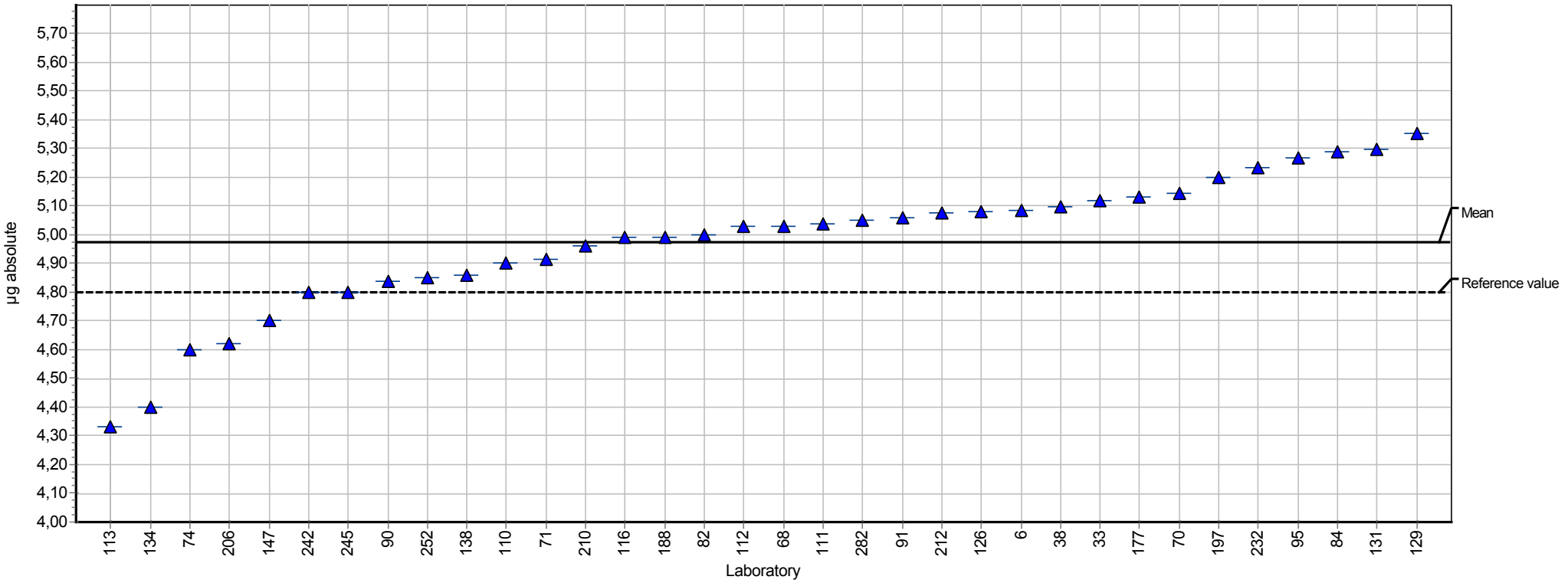
Summary results

Measurand:	**zinc**	**Mean:**	**69,25 µg absolute**
Sample:	**reference solution**	**Reprod. s.d.:**	**6,40 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**9,24%**
No. of laboratories:	**34**	**Reference value:**	**66,50 µg absolute**
Rel.target s.d.:	**10,00% (Limited)**	**Range of tolerance:**	**not available**



Summary results

Measurand:	**cobalt**	**Mean:**	**4,97 µg absolute**
Sample:	**reference solution**	**Reprod. s.d.:**	**0,24 µg absolute**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**4,83%**
No. of laboratories:	**34**	**Reference value:**	**4,80 µg absolute**
Rel.target s.d.:	**10,00% (Limited)**	**Range of tolerance:**	**not available**



Questions and Answers

Participant	pulping method	Säurekonzentration	mixing ratio	time of pulping
6	IFA-Arbeitsmappe, Blatt 6015	HNO3 65%, HCl 25%	2:1	2
33	Hausmethode-SOP M1	HCl 36%, HNO3 65%	5ml HNO3 (1+1), 5ml HCl	0,5
38	nach IFA-Arbeitsblatt, Blatt 6015	HNO3 69% suprapur, HCL 30% suprapur	2/1	2 h
68	IFA-Arbeitsmappe	HNO3 65% und HCl 37%	2:1	2 Std.
70	analog IFA-Arbeitsmappe, Blatt 6015	Salpetersäure: 65%ig; Salzsäure: 30%ig	2:1	2
71	nach IFA-Arbeitsmappe	HNO3 65%ig ; HCL 30%ig	2:1	2
74	IFA-Arbeitsmappe, Blatt 6015	Salpetersäure 65%, Salzsäure 25%	2 Volumenteile HNO3, 1 Volumenteil HCl	2
82	IFA Arbeitsmappe (Blatt 6015)	HCl 30%, HNO3 65%	2 VT HNO3, 1 VT HCl	2 Stunden
84	BGIA 6015	HNO3 65%, HCl 25%	2:1	2h
90	microwave digestion	HNO3 65% / HCL 25%	HNO3 2 vol / HCL 1 vol	0h55
91	nach Blatt 6015	lt. Blatt 6015	lt. Blatt 6015	lt. Blatt 6015
95	IFA-Arbeitsmappe, Blatt 6015	HNO3: 65%, HCl: 30%	6:3	0,5
110	IFA-Arbeitsmappe Blatt 6015	HNO3 65% , HCl 25%	2 Teile HNO3 & 1 Teil HCl	2h
111	IFA 6015	HNO3 65%, HCl 25%	2:1	2
112	IFA-Arbeitsmappe, Blatt 6015	HNO3 65%, HCl 25%	2 VT HNO3, 1 VT HCl	2
113	IFA Methode 6015	65%HNO3 und 32%HCl	2 Vol. : 1 Vol.	2
116	IFA-Arbeitsmappe, Blatt 6015	HCl: 30 % (Suprapur), HNO3: 65% (Suprapur)	2 HNO3 : 1HCl	2h
126	IFA-Arbeitsmappe (Blatt 6015)	w(HCl)=25%, w(HNO3)=65%	1 VolTeil HCL, 2 VolTeile HNO3	2
129	IFA- Arbeitsmappe, Blatt 6015	HNO3: 65% / HCL: 30%	2:1	2
131	Acid digestion	HNO3 65% et HCl 25%	HNO3 / HCL --> 2/1	2
134	IFA-Arbeitsmappe, Blatt 6015	HCl (25%), HNO3 (65%)	1 Volumen-Teil HCl, 2 Volumen-Teile HNO3	2 Stunden
138	BGIA 6015	HNO3 65 % / HCl 25 %	2 / 4	2 Std.
147	IFA-working folder (sheet 6015)	HNO3 65 % and HCL 25 %	2 volumes of acid nitric and 1 volume of hydrochloric acid	2 h
177	IFA-Arbeitsmappe, Blatt 6015	HNO3 69% / HCl 37%	2:1	2 h
188	IFA-Arbeitsmappe, Blatt 6015	HNO3 65 %, HCL 25 %	2 HNO3 : 1 HCL	1 Stunde
197	BIA 6015	65% HNO3/25% HCl	2/1	2h
206	wie angegeben	wie angegeben	wie angegeben	0,75
210	BIA 6015	HNO3 65%; HCl 25%	2 Teile HNHO3 + 1 Teil HCl	2
212	IFA 6015	HNO3 65%, HCl 25%	2:1	2h
242	in Anlehnung an DIN EN ISO 15587-1	HNO3 70%; HCL 37%	1 mL HNO3 / 3 mL HCl	2/3 h
245	IFA Arbeitsmappe, Blatt 6015	65% HNO3; 30% HCl (beide suprapur)	2 Teile HNO3; 1 Teil HCl	2

Participant	pulping method	Säurekonzentration	mixing ratio	time of pulping
252	IFA 6015	IFA 6015	IFA 6015	1
282	IFA-Arbeitsmappe, Blatt 6015	HNO3 65%, HCl 25%	2:1	2 h

Participant	reagent volume	equipment	method for lead	method for copper	method for zinc	method for cobalt	method for nickel
6	50 ml	unter Rückfluss	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS
33	25	offen	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS
38	50	geschlossen unter Rückfluss	ICPMS	ICPMS	ICPMS	ICPMS	ICPMS
68	25 ml	geschlossen	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES
70	20	offen	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES
71	25	geschlossen	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES
74	50	geschlossen unter Rückfluss	ICP	ICP	ICP	ICP	ICP
82	20 mL	unter Rückfluss	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS
84	20 ml	unter RÜCKFLUSS	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS
90	10 ml	closed	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS
91	lt. Blatt 6015	lt. Blatt 6015	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS
95	50	geschlossen, Mikrowelle	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS
110	20 ml	unter Rückfuss	ICP/OES	ICP/OES	ICP/OES	ICP/OES	ICP/OES
111	20	offen	ICP/MS	ICP/MS	ICP/MS	ICP/MS	ICP/MS
112	25	unter Rückfluss	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES
113	25	offen	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES
116	20 ml	unter Rückfluss	ICP/OES	ICP/OES	ICP/OES	ICP/OES	ICP/OES
126	25 mL	Rückfluss	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES
129	20	offen	AAS/Flamme	AAS/Flamme	AAS/Flamme	AAS/Flamme	AAS/Flamme
131	25	closed	ICP/OES	ICP/OES	ICP/OES	ICP/OES	ICP/OES
134	20 mL	Heizblock mit Aufschlusscap´s und Rückflusskappe	ICP/OES	ICP/OES	ICP/OES	ICP/OES	ICP/OES
138	50 ml	offen	ICP AES	ICP AES	ICP AES	ICP AES	ICP AES
147	10 mL mixture of HNO3/HCl in 20 mL	Hotplate (160 °C), beaker with watch glass	ICP/OES	ICP/OES	ICP/OES	ICP/OES	ICP/OES
177	20	offen	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES
188	25 ml	offen	ICP/OES	ICP/OES	ICP/OES	ICP/OES	ICP/OES
197	20	geschlossen, digiprep	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS
206	Aufschlusslösung 1:10 verdünnt	Mikrowellendruckaufschluss	ICP/MS	ICP/MS	ICP/MS	ICP/MS	ICP/MS
210	20	Rückfluss	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES

Participant	reagent volume	equipment	method for lead	method for copper	method for zinc	method for cobalt	method for nickel
212	10	under reflux	ICP OES	ICP OES	ICP OES	ICP OES	ICP OES
242	25 mL	geschlossener Mikrowellenaufschluss (Turbowave)	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES
245	25	Unter Rückfluss	ICP-MS	ICP-MS	ICP-MS	ICP-MS	ICP-MS
252	50	offen	ICP/OES	ICP/OES	ICP/OES	ICP/OES	ICP/OES
282	20 mL	offen	ICP-OES	ICP-OES	ICP-OES	ICP-OES	ICP-OES