

Proficiency testing for in-house and external measuring stations - results and evaluation

Proficiency testing scheme “Metals on filters”

July/August 2024

Summary of laboratory test results

Sample 1

Laboratory	Chromium	Z score	Cobalt	Z score	Copper	Z score	Indium	Z score
Unit	µg absolut		µg absolut		µg absolut		µg absolut	
13	19.8	-1.42	0.304	-1.49	17.1	-0.58	0.635	0.08
26	19.9	-1.39	0.334	-0.65	17.9	-0.14	0.573	-0.91
31	24.5	0.61	0.380	0.64	17.4	-0.41	0.590	-0.64
42	25.0	0.85	0.400	1.20	17.8	-0.21	0.650	0.31
68	23.9	0.37	0.220	-3.84 BE	24.0	3.24 BE		
70	25.1	0.87	0.344	-0.37	17.4	-0.41		
71	22.4	-0.28	0.371	0.39	18.5	0.17		
75	25.2	0.94	0.405	1.34	18.0	-0.08	0.689	0.93
82	25.0	0.83	0.380	0.64	19.0	0.47		
84	19.6	-1.51	0.294	-1.77	18.0	-0.08		
106	19.7	-1.45	0.310	-1.32	17.4	-0.44	0.620	-0.16
129	22.0	-0.48	0.390	0.92	18.6	0.25		
138	23.5	0.18	0.370	0.36	19.9	0.97	0.720	1.42
140	24.6	0.66	0.343	-0.40	20.2	1.13	0.685	0.87
188	21.7	-0.59	0.330	-0.76	18.6	0.25		
206	25.4	1.01	0.390	0.92	18.3	0.06	0.520	-1.75
218	22.1	-0.43	0.350	-0.20	17.8	-0.22		
248	22.9	-0.08	0.394	1.03	17.7	-0.25	0.565	-1.03
252	24.6	0.68	0.390	0.92	17.6	-0.27	0.650	0.31
263	25.8	1.19	0.363	0.16	18.8	0.34	0.668	0.60
267	20.7	-1.03	0.300	-1.60	17.1	-0.58		
269	21.8	-0.56	0.351	-0.17	20.2	1.13	0.617	-0.21
272	22.9	-0.08	0.321	-1.01	16.7	-0.80	0.611	-0.30
286	25.7	1.12	0.400	1.20	17.6	-0.32	0.660	0.47
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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	24		24		24		15	
Mean	23.1		0.357		18.1		0.630	

Laboratory	Chromium	Z score	Cobalt	Z score	Copper	Z score	Indium	Z score
Reproducibility s.d.	2.1		0.035		1.0		0.053	
Rel. reproducibility s.d.	9.02 %		9.87 %		5.30 %		8.44 %	
Reference value	25.4		0.390		17.5		0.610	
Target s.d.	2.3		0.036		1.8		0.063	
Rel. target s.d.	10.00 %		10.00 %		10.00 %		10.00 %	
Lower limit of tolerance	18.5		0.286		14.5		0.504	
Upper limit of tolerance	27.7		0.429		21.8		0.756	
Type B outliers			1		1			
Type E 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)	24		23		23		15	

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|>3.50

Laboratory	Lead	Z score	Manganese	Z score	Nickel	Z score	Zinc	Z score
Unit	µg absolut		µg absolut		µg absolut		µg absolut	
13	48.1	-0.44	3.00	-1.57	5.72	-1.30	11.8	-1.32
26	47.2	-0.62	3.14	-1.18	6.18	-0.60	12.3	-0.94
31	46.6	-0.74	4.00	1.24	7.00	0.64	13.9	0.22
42	49.8	-0.10	4.01	1.27	6.87	0.44	13.4	-0.13
68	54.2	0.77	3.76	0.57	9.49	4.43 BE	159.5	107.27 BE
70	52.2	0.37	2.78	-2.19 E	7.04	0.70	15.0	1.03
71	54.0	0.73	3.50	-0.17	6.64	0.10	14.3	0.55
75	50.2	-0.02	4.07	1.44	7.12	0.82	12.6	-0.74
82	53.0	0.53	3.70	0.40	6.40	-0.27	13.0	-0.44
84	49.1	-0.24	3.00	-1.57	5.66	-1.40	28.6	11.05 BE

Laboratory	Lead	Z score	Manganese	Z score	Nickel	Z score	Zinc	Z score
106	48.6	-0.35	3.02	-1.51	5.62	-1.46	12.4	-0.90
129	51.7	0.27	3.34	-0.61	6.72	0.22	13.6	0.03
138	51.9	0.31	3.48	-0.22	7.12	0.82	13.6	0.00
140	50.6	0.06	3.87	0.88	7.09	0.78	14.7	0.81
188	52.1	0.35	3.44	-0.33	6.46	-0.18	14.1	0.33
206	52.4	0.41	3.78	0.62	7.04	0.70	15.3	1.25
218	47.1	-0.64	3.49	-0.19	6.22	-0.54	11.8	-1.32
248	50.8	0.10	3.69	0.37	6.53	-0.07	14.2	0.44
252	49.1	-0.23	3.91	0.99	6.69	0.17	14.4	0.60
263	50.8	0.10	3.99	1.21	6.92	0.51	12.9	-0.51
267	46.8	-0.70	3.30	-0.73	6.00	-0.88	15.0	1.03
269	52.5	0.43	3.41	-0.42	6.67	0.14	15.1	1.10
272	48.6	-0.34	3.75	0.54	6.68	0.16	12.5	-0.81
286	50.3	0.00	3.98	1.18	6.90	0.49	13.2	-0.29
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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	24		24		24		24	
Mean	50.3		3.56		6.58		13.6	
Reproducibility s.d.	2.3		0.38		0.48		1.1	
Rel. reproducibility s.d.	4.47 %		10.59 %		7.23 %		8.02 %	
Reference value	47.6		3.99		7.35		14.8	
Target s.d.	5.0		0.36		0.66		1.4	
Rel. target s.d.	10.00 %		10.00 %		10.00 %		10.00 %	
Lower limit of tolerance	40.3		2.85		5.26		10.9	
Upper limit of tolerance	60.4		4.27		7.89		16.3	
Type B outliers					1		2	
Type E outliers			1		1		2	
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	24		24		23		22	

Summary of laboratory test results

Sample 2

Laboratory	Chromium	Z score	Cobalt	Z score	Copper	Z score	Indium	Z score
Unit	µg absolut		µg absolut		µg absolut		µg absolut	
13	3.31	-0.56	5.49	-0.63	4.62	0.04	0.619	13.45 BE
26	3.44	-0.18	6.13	0.47	4.83	0.50	0.268	0.15
31	3.50	-0.01	5.80	-0.10	4.50	-0.22	0.250	-0.53
42	3.44	-0.18	5.98	0.21	4.53	-0.15	0.260	-0.15
68	3.45	-0.16	5.71	-0.25	11.48	14.96 BE		
70	4.09	1.67	6.45	1.01	3.91	-1.50		
71	3.48	-0.06	6.19	0.57	4.65	0.10		
75	3.71	0.57	5.96	0.18	4.76	0.36	0.281	0.64
82	3.90	1.13	6.00	0.24	4.40	-0.43		
84	3.29	-0.61	5.59	-0.46	4.76	0.35		
106	3.26	-0.70	5.64	-0.37	4.53	-0.15	0.260	-0.15
129	3.38	-0.36	5.91	0.09	4.36	-0.52		
138	3.65	0.42	6.18	0.55	4.66	0.13	0.330	2.50 E
140	3.44	-0.18	5.94	0.14	3.93	-1.46	0.290	0.98
188	3.54	0.10	6.03	0.29	5.20	1.30		
206	3.66	0.44	5.83	-0.05	4.84	0.52	0.210	-2.05 E
218	3.35	-0.44	5.79	-0.11	4.77	0.37		
248	3.59	0.24	6.09	0.40	4.62	0.04	0.421	5.95 FE
252	3.48	-0.07	5.90	0.07	4.62	0.04	0.260	-0.15
263	3.04	-1.33	5.15	-1.20	4.28	-0.71	0.257	-0.27
267	3.50	-0.01	5.60	-0.44	4.70	0.22		
269	3.63	0.36	5.57	-0.49	5.38	1.70	0.404	5.30 FE
272	3.39	-0.33	5.76	-0.17	4.44	-0.35	0.252	-0.45
286	3.59	0.24	5.88	0.04	4.51	-0.20	0.250	-0.53
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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	24		24		24		15	
Mean	3.50		5.86		4.60		0.264	

Laboratory	Chromium	Z score	Cobalt	Z score	Copper	Z score	Indium	Z score
Reproducibility s.d.	0.21		0.27		0.33		0.028	
Rel. reproducibility s.d.	6.08 %		4.67 %		7.12 %		10.77 %	
Reference value	3.52		6.04		4.54		0.240	
Target s.d.	0.35		0.59		0.46		0.026	
Rel. target s.d.	10.00 %		10.00 %		10.00 %		10.00 %	
Lower limit of tolerance	2.80		4.69		3.68		0.211	
Upper limit of tolerance	4.21		7.03		5.52		0.317	
Type B outliers					1		1	
Type E outliers					1		5	
Type F outliers							2	
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	24		24		23		12	
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 >3.50								

Laboratory	Lead	Z score	Manganese	Z score	Nickel	Z score	Zinc	Z score
Unit	µg absolut		µg absolut		µg absolut		µg absolut	
13	32.5	-0.83	13.0	-0.68	3.31	-0.65	68.6	-0.14
26	36.3	0.23	13.4	-0.37	3.61	0.19	69.2	-0.05
31	32.8	-0.75	14.4	0.32	3.50	-0.12	69.1	-0.07
42	34.3	-0.33	14.1	0.09	3.41	-0.37	69.5	-0.01
68	37.5	0.59	14.4	0.32	6.35	7.93 BE	224.6	22.28 BE
70	41.4	1.68 B	14.2	0.18	4.00	1.29	80.7	1.60
71	36.2	0.22	14.2	0.16	4.10	1.58	73.0	0.49
75	34.3	-0.33	14.7	0.57	3.63	0.26	60.5	-1.30
82	38.0	0.72	13.0	-0.68	3.20	-0.97	67.0	-0.37

Laboratory	Lead	Z score	Manganese	Z score	Nickel	Z score	Zinc	Z score
84	34.4	-0.30	13.0	-0.68	3.30	-0.68	72.3	0.39
106	34.5	-0.26	13.5	-0.33	3.34	-0.57	68.5	-0.16
129	37.1	0.47	14.0	0.06	3.63	0.25	72.1	0.36
138	35.9	0.13	13.7	-0.18	3.83	0.81	75.4	0.84
140	35.0	-0.13	14.2	0.18	3.57	0.08	69.8	0.03
188	37.0	0.44	14.2	0.17	3.70	0.45	73.9	0.63
206	36.0	0.15	14.0	0.01	3.71	0.47	75.8	0.89
218	33.4	-0.59	13.9	-0.04	3.30	-0.68	59.4	-1.46
248	36.5	0.30	14.4	0.32	3.57	0.08	73.2	0.52
252	35.8	0.11	14.2	0.17	3.45	-0.26	74.3	0.68
263	36.7	0.34	12.0	-1.39 B	3.29	-0.71	56.6	-1.87
267	33.9	-0.44	13.9	-0.04	3.40	-0.40	68.3	-0.18
269	36.4	0.27	15.0	0.75	3.68	0.39	73.0	0.49
272	35.6	0.04	13.6	-0.25	3.49	-0.15	65.2	-0.63
286	35.2	-0.08	13.9	-0.06	3.44	-0.29	64.9	-0.67
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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	24		24		24		24	
Mean	35.4		14.0		3.54		69.6	
Reproducibility s.d.	1.5		0.5		0.23		5.6	
Rel. reproducibility s.d.	4.21 %		3.75 %		6.46 %		8.07 %	
Reference value	33.5		13.9		3.73		74.7	
Target s.d.	3.5		1.4		0.35		7.0	
Rel. target s.d.	10.00 %		10.00 %		10.00 %		10.00 %	
Lower limit of tolerance	28.4		11.2		2.83		55.7	
Upper limit of tolerance	42.5		16.7		4.25		83.5	
Type B outliers	1		1		1		1	
Type E 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)	23		23		23		23	

Summary of laboratory test results

Sample 3

Laboratory	Chromium	Z score	Cobalt	Z score	Copper	Z score	Indium	Z score
Unit	µg absolut		µg absolut		µg absolut		µg absolut	
13	6.65	-0.32	1.69	-0.20	15.8	-0.16	2.96	11.03 BE
26	7.16	0.43	1.87	0.85	17.2	0.69	1.38	-0.19
31	7.00	0.19	1.70	-0.14	15.6	-0.29	1.40	-0.05
42	7.01	0.21	1.78	0.32	16.4	0.18	1.48	0.52
68	7.03	0.24	1.73	0.03	17.0	0.60		
70	7.74	1.27	1.74	0.09	14.8	-0.79		
71	6.13	-1.08	2.10	2.20 BE	14.6	-0.89		
75	7.23	0.53	1.82	0.57	16.6	0.31	1.53	0.84
82	6.90	0.05	1.60	-0.72	15.0	-0.66		
84	6.88	0.02	1.75	0.15	16.2	0.08		
106	6.58	-0.42	1.69	-0.20	15.9	-0.08	1.41	0.02
129	6.65	-0.32	1.67	-0.31	16.2	0.11		
138	1.75	-7.45 BE	1.75	0.15	19.8	2.33 BE	1.36	-0.34
140	6.94	0.10	1.75	0.15	17.0	0.58	1.26	-1.05
188	7.05	0.26	1.80	0.44	17.5	0.87		
206	7.05	0.26	1.68	-0.26	16.4	0.20	1.13	-1.97 B
218	6.70	-0.24	1.72	-0.02	15.9	-0.10		
248	6.96	0.13	1.86	0.79	15.9	-0.10	1.39	-0.11
252	6.56	-0.45	1.68	-0.26	15.5	-0.35	1.39	-0.12
263	6.16	-1.03	1.57	-0.89	15.4	-0.43	1.47	0.42
267	6.90	0.05	1.70	-0.14	16.0	-0.04		
269	7.10	0.34	1.67	-0.31	18.0	1.21	1.49	0.59
272	6.43	-0.64	1.65	-0.43	14.8	-0.79	1.34	-0.48
286	7.16	0.43	1.78	0.32	15.8	-0.14	1.40	-0.05
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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	24		24		24		15	
Mean	6.87		1.72		16.1		1.41	

Laboratory	Chromium	Z score	Cobalt	Z score	Copper	Z score	Indium	Z score
Reproducibility s.d.	0.36		0.07		0.9		0.07	
Rel. reproducibility s.d.	5.20 %		4.31 %		5.44 %		5.00 %	
Reference value	7.05		1.76		15.4		1.41	
Target s.d.	0.69		0.17		1.6		0.14	
Rel. target s.d.	10.00 %		10.00 %		10.00 %		10.00 %	
Lower limit of tolerance	5.49		1.38		12.9		1.13	
Upper limit of tolerance	8.24		2.07		19.3		1.69	
Type B outliers	1		1		1		2	
Type E outliers	1		1		1		1	
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	23		23		23		13	

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

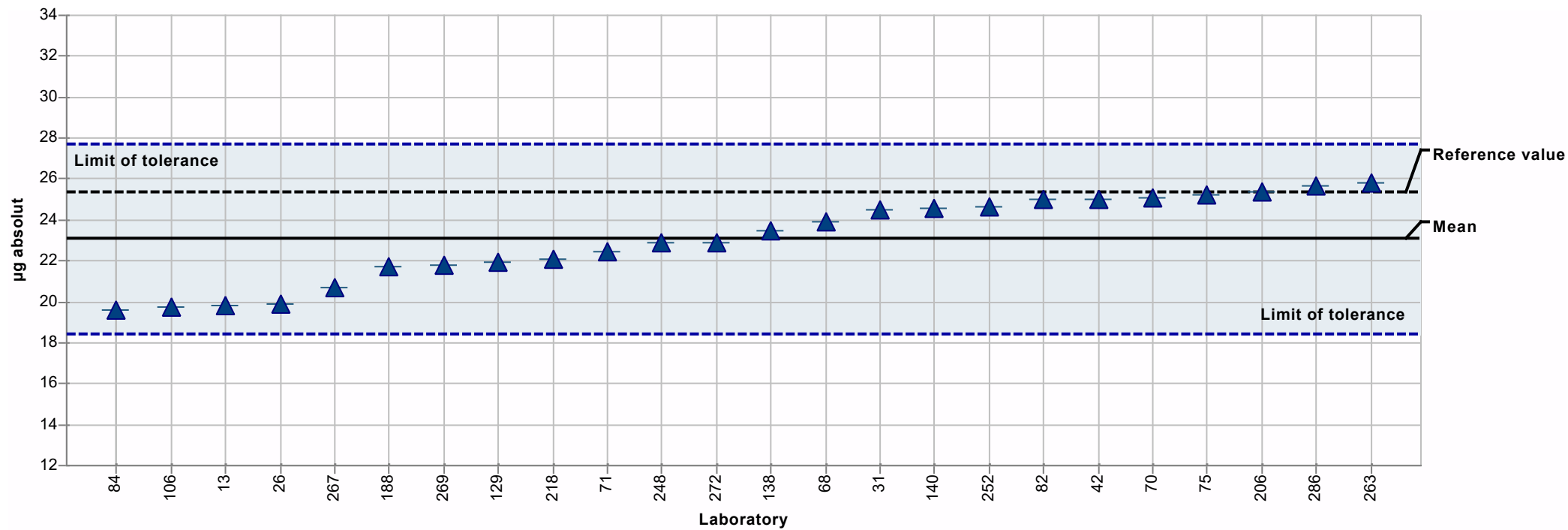
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Laboratory	Lead	Z score	Manganese	Z score	Nickel	Z score	Zinc	Z score
Unit	µg absolut		µg absolut		µg absolut		µg absolut	
13	17.0	-0.44	33.7	-0.24	6.76	-0.18	46.5	0.12
26	17.0	-0.44	34.5	0.00	7.49	0.88	47.2	0.28
31	16.4	-0.78	35.8	0.36	6.90	0.02	47.8	0.40
42	17.5	-0.15	35.9	0.39	6.90	0.02	47.0	0.24
68	19.0	0.69	36.8	0.66	7.24	0.52	50.0	0.87
70	20.1	1.30	37.2	0.77	8.22	1.94 B	54.5	1.86
71	16.5	-0.71	31.7	-0.83	6.58	-0.44	44.2	-0.38
75	17.6	-0.11	36.1	0.45	7.12	0.34	39.9	-1.32
82	20.0	1.25	33.0	-0.45	6.10	-1.14	45.0	-0.21
84	17.6	-0.10	34.0	-0.16	6.94	0.08	42.6	-0.73

Laboratory	Lead	Z score	Manganese	Z score	Nickel	Z score	Zinc	Z score
106	17.5	-0.16	34.2	-0.11	6.69	-0.28	47.0	0.24
129	17.5	-0.17	34.3	-0.07	6.95	0.09	47.5	0.34
138	18.3	0.29	35.7	0.33	6.94	0.08	44.2	-0.38
140	17.8	0.01	36.6	0.60	7.13	0.36	47.1	0.25
188	18.7	0.52	35.4	0.24	7.46	0.83	49.7	0.81
206	17.5	-0.16	34.0	-0.16	7.10	0.31	49.2	0.71
218	16.5	-0.72	33.7	-0.25	6.48	-0.59	38.9	-1.54
248	17.9	0.08	34.9	0.10	6.95	0.09	47.6	0.36
252	17.1	-0.38	32.7	-0.54	6.56	-0.47	46.5	0.12
263	18.3	0.29	31.4	-0.91	6.58	-0.45	39.7	-1.36
267	17.2	-0.33	34.4	-0.04	6.90	0.02	45.8	-0.03
269	19.5	0.97	36.6	0.60	7.15	0.38	49.8	0.84
272	16.6	-0.66	31.5	-0.88	6.59	-0.43	41.6	-0.95
286	17.7	-0.06	35.0	0.14	6.85	-0.05	43.4	-0.55
–	–	–	–	–	–	–	–	–
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	24		24		24		24	
Mean	17.8		34.5		6.89		45.9	
Reproducibility s.d.	1.0		1.7		0.32		3.7	
Rel. reproducibility s.d.	5.88 %		4.85 %		4.68 %		8.02 %	
Reference value	16.6		34.9		7.15		49.7	
Target s.d.	1.8		3.5		0.69		4.6	
Rel. target s.d.	10.00 %		10.00 %		10.00 %		10.00 %	
Lower limit of tolerance	14.2		27.6		5.51		36.8	
Upper limit of tolerance	21.3		41.5		8.26		55.1	
Type B outliers					1			
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	24		24		23		24	

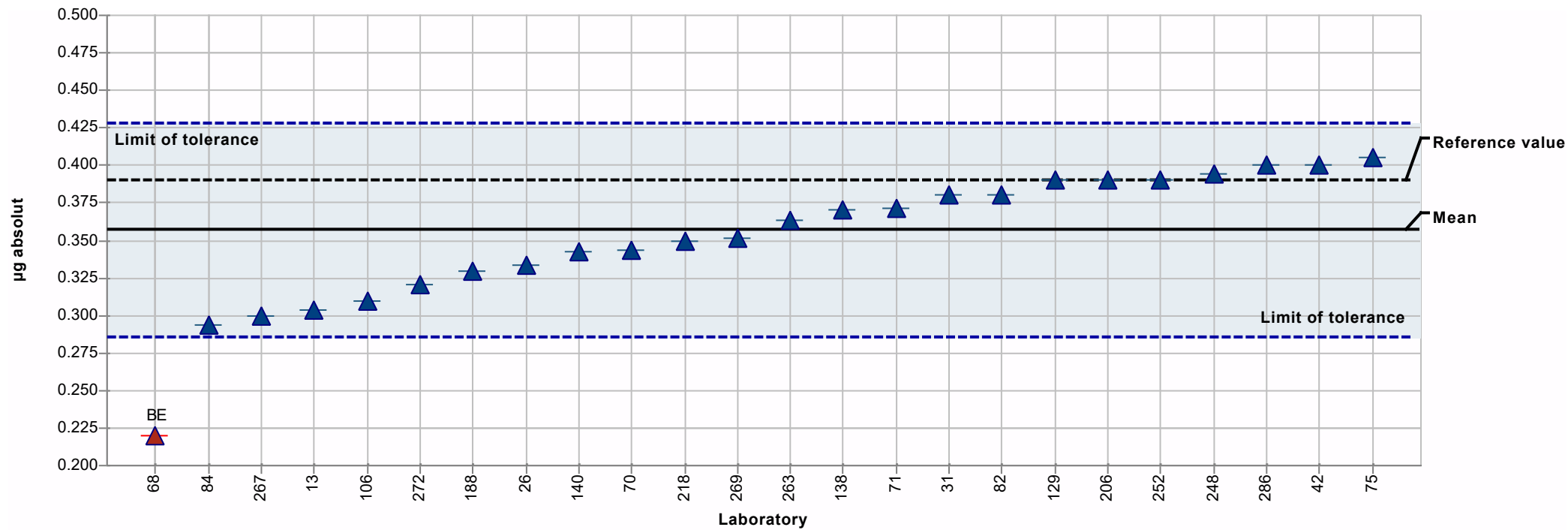
Summary results

Sample:	1	Mean:	23.1 µg absolut
Measurand:	Chromium	Reproducibility s.d.:	2.1 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	9.02%
Rel. target s.d.:	10.00%	Reference value:	25.4 µg absolut
Number of laboratories in calculation + outliers: 24		Range of tolerance:	18.5 - 27.7 µg absolut (Z-Score <= 2.00)



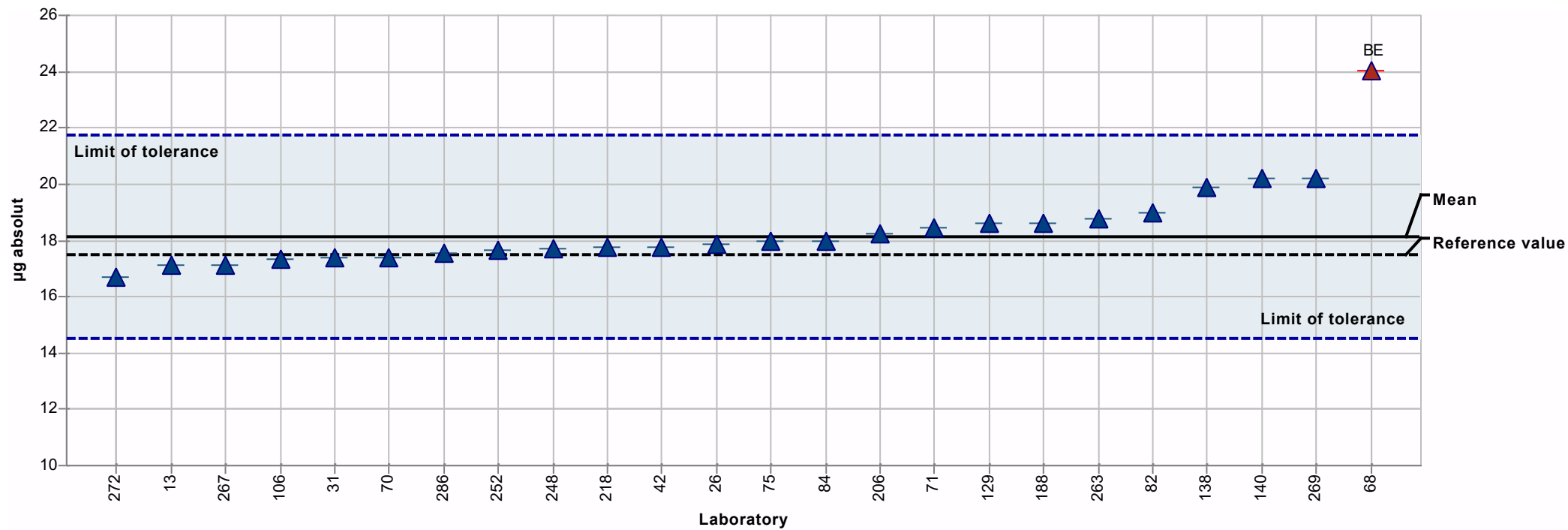
Summary results

Sample:	1	Mean:	0.357 µg absolut
Measurand:	Cobalt	Reproducibility s.d.:	0.035 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	9.87%
Rel. target s.d.:	10.00%	Reference value:	0.390 µg absolut
Number of laboratories in calculation + outliers: 24		Range of tolerance:	0.286 - 0.429 µg absolut (Z-Score <= 2.00)



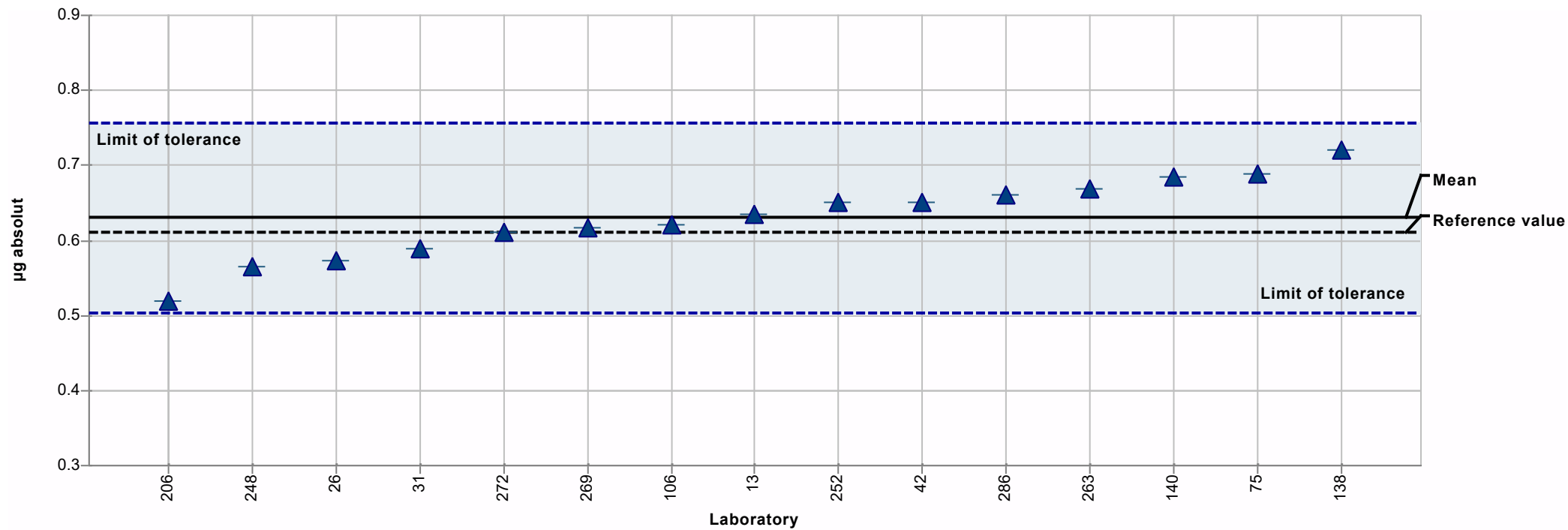
Summary results

Sample:	1	Mean:	18.1 µg absolut
Measurand:	Copper	Reproducibility s.d.:	1.0 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	5.30%
Rel. target s.d.:	10.00%	Reference value:	17.5 µg absolut
Number of laboratories in calculation + outliers: 24		Range of tolerance:	14.5 - 21.8 µg absolut (Z-Score <= 2.00)



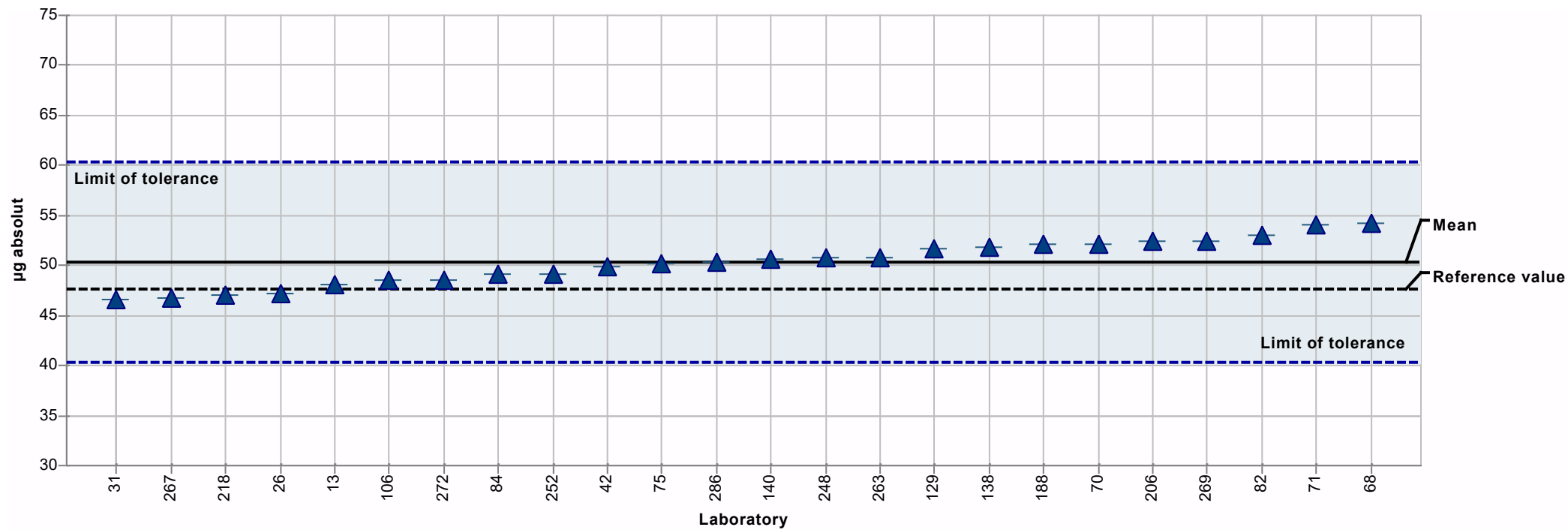
Summary results

Sample:	1	Mean:	0.630 µg absolut
Measurand:	Indium	Reproducibility s.d.:	0.053 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	8.44%
Rel. target s.d.:	10.00%	Reference value:	0.610 µg absolut
Number of laboratories in calculation + outliers: 15		Range of tolerance:	0.504 - 0.756 µg absolut ($ Z\text{-Score} \leq 2.00$)



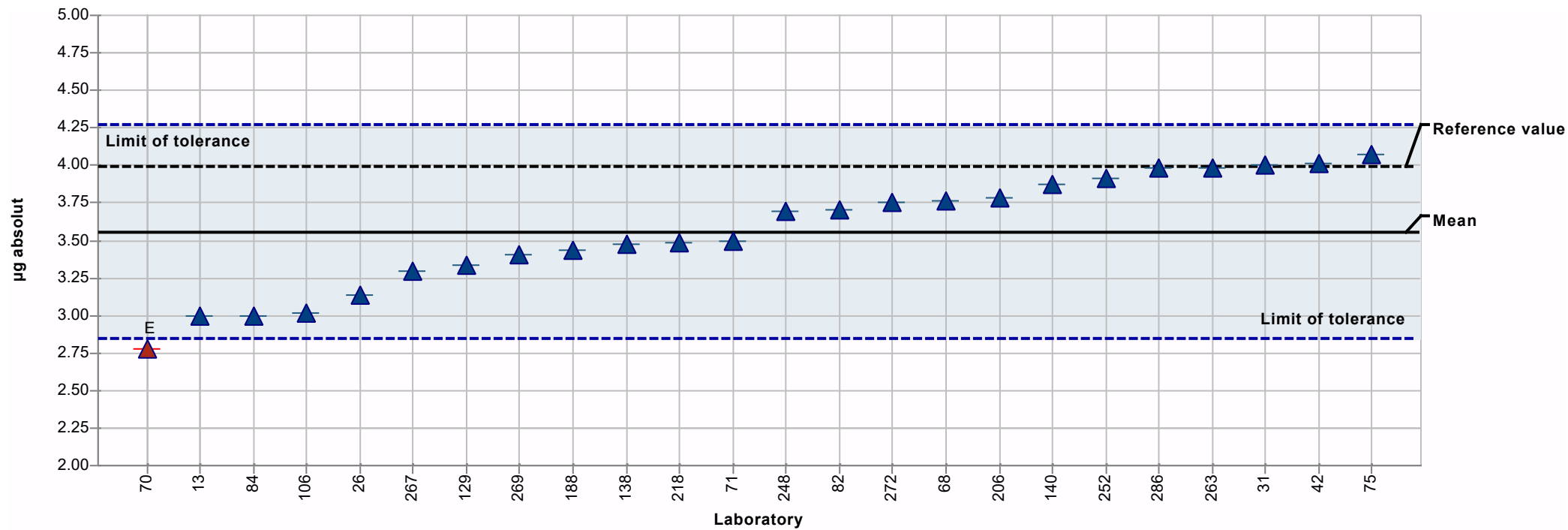
Summary results

Sample:	1	Mean:	50.3 µg absolut
Measurand:	Lead	Reproducibility s.d.:	2.3 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	4.47%
Rel. target s.d.:	10.00%	Reference value:	47.6 µg absolut
Number of laboratories in calculation + outliers: 24		Range of tolerance:	40.3 - 60.4 µg absolut (Z-Score <= 2.00)



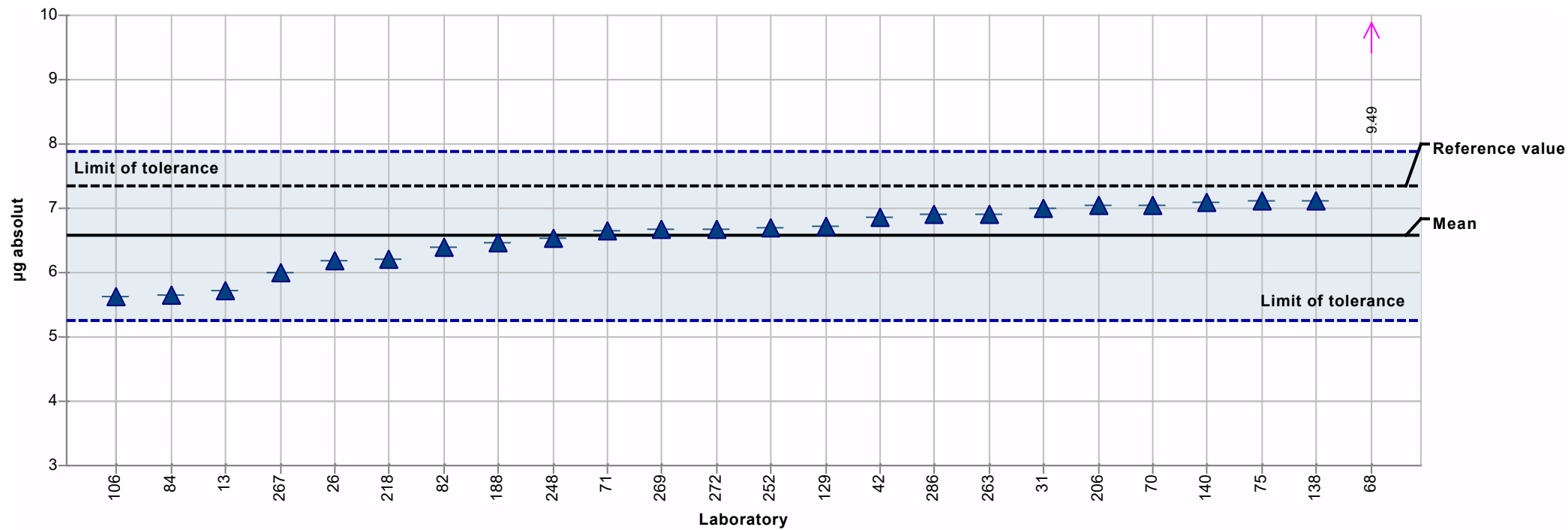
Summary results

Sample:	1	Mean:	3.56 µg absolut
Measurand:	Manganese	Reproducibility s.d.:	0.38 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	10.59%
Rel. target s.d.:	10.00%	Reference value:	3.99 µg absolut
Number of laboratories in calculation + outliers: 24		Range of tolerance:	2.85 - 4.27 µg absolut (Z-Score <= 2.00)



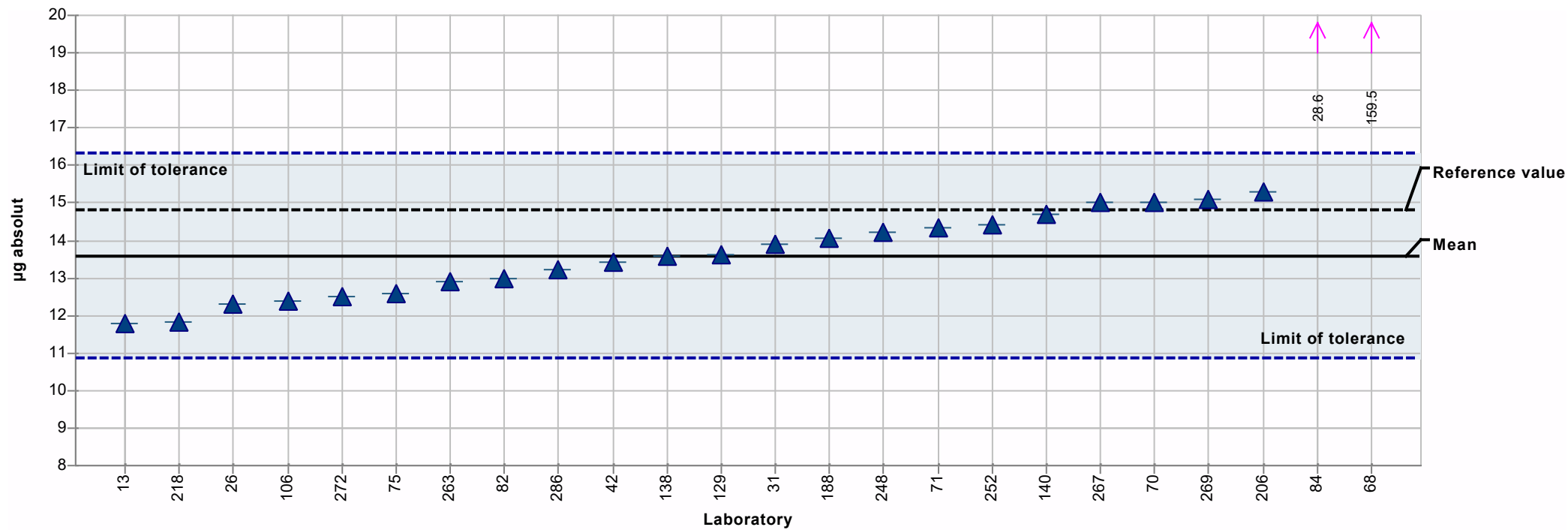
Summary results

Sample:	1	Mean:	6.58 µg absolut
Measurand:	Nickel	Reproducibility s.d.:	0.48 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	7.23%
Rel. target s.d.:	10.00%	Reference value:	7.35 µg absolut
Number of laboratories in calculation + outliers: 24		Range of tolerance:	5.26 - 7.89 µg absolut (Z-Score <= 2.00)



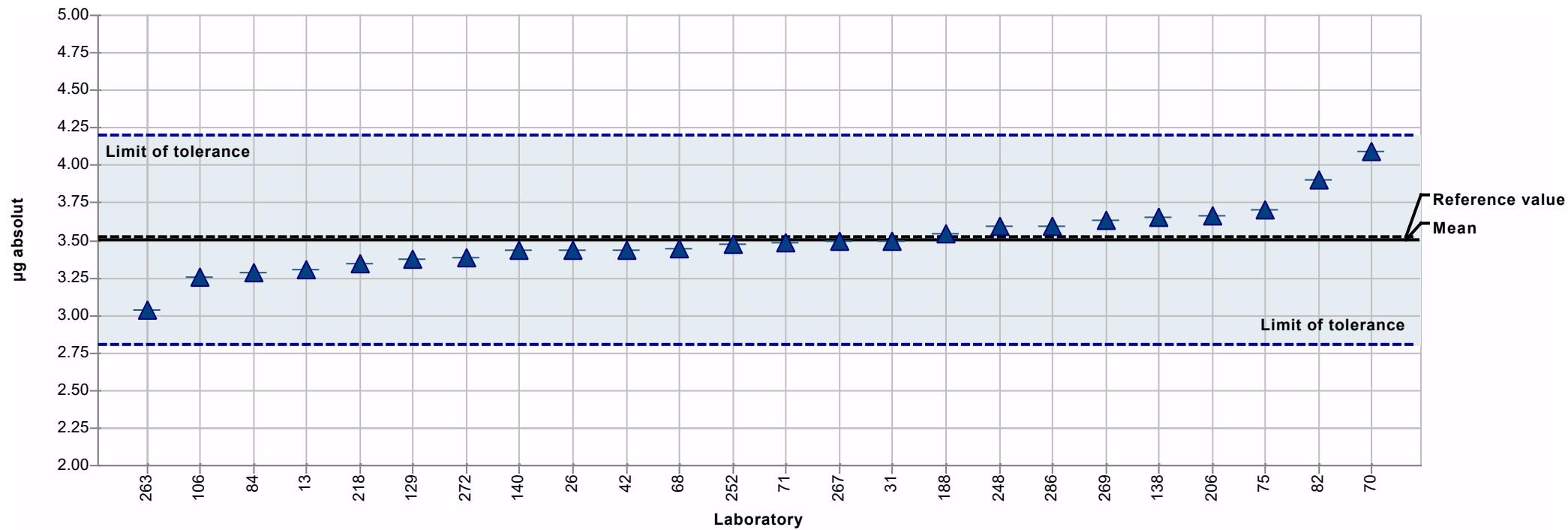
Summary results

Sample:	1	Mean:	13.6 µg absolut
Measurand:	Zinc	Reproducibility s.d.:	1.1 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	8.02%
Rel. target s.d.:	10.00%	Reference value:	14.8 µg absolut
Number of laboratories in calculation + outliers: 24		Range of tolerance:	10.9 - 16.3 µg absolut (Z-Score <= 2.00)



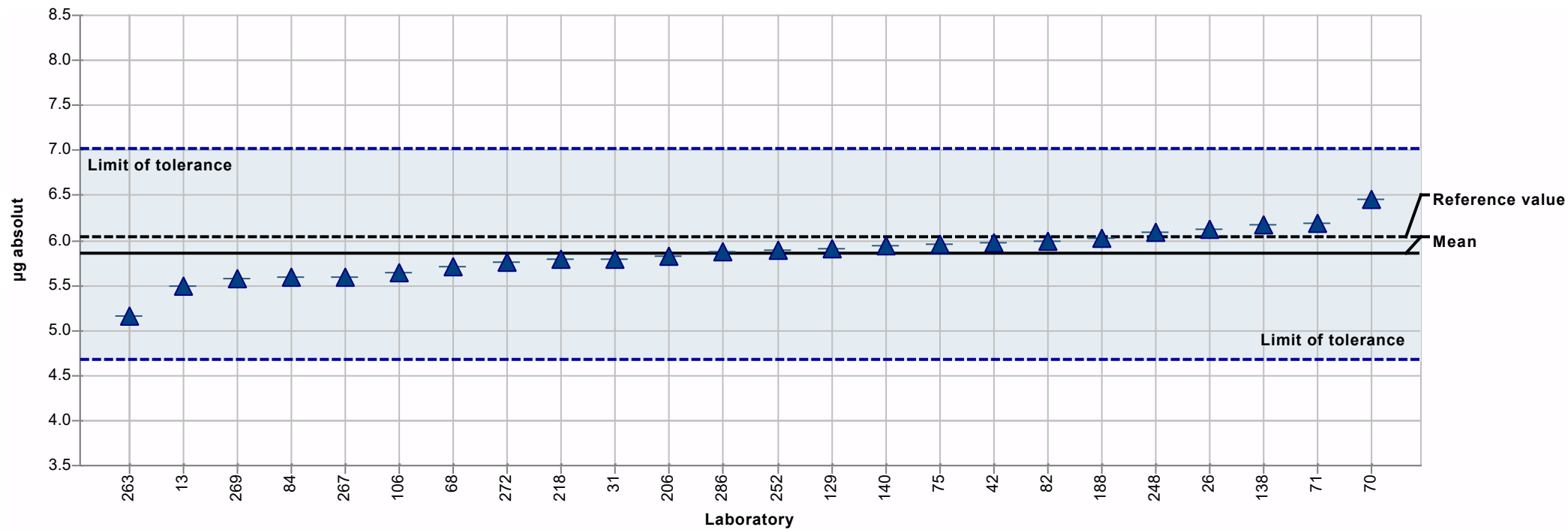
Summary results

Sample:	2	Mean:	3.50 µg absolut
Measurand:	Chromium	Reproducibility s.d.:	0.21 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	6.08%
Rel. target s.d.:	10.00%	Reference value:	3.52 µg absolut
Number of laboratories in calculation + outliers: 24		Range of tolerance:	2.80 - 4.21 µg absolut (Z-Score <= 2.00)



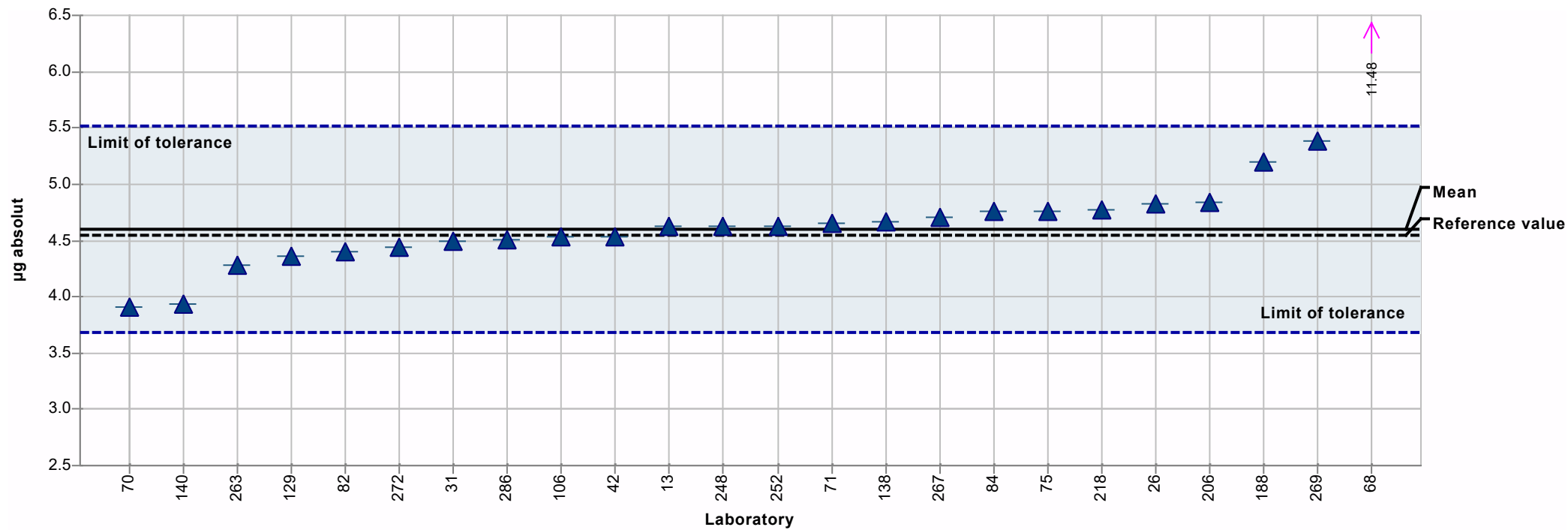
Summary results

Sample:	2	Mean:	5.86 µg absolut
Measurand:	Cobalt	Reproducibility s.d.:	0.27 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	4.67%
Rel. target s.d.:	10.00%	Reference value:	6.04 µg absolut
Number of laboratories in calculation + outliers: 24		Range of tolerance:	4.69 - 7.03 µg absolut (Z-Score <= 2.00)



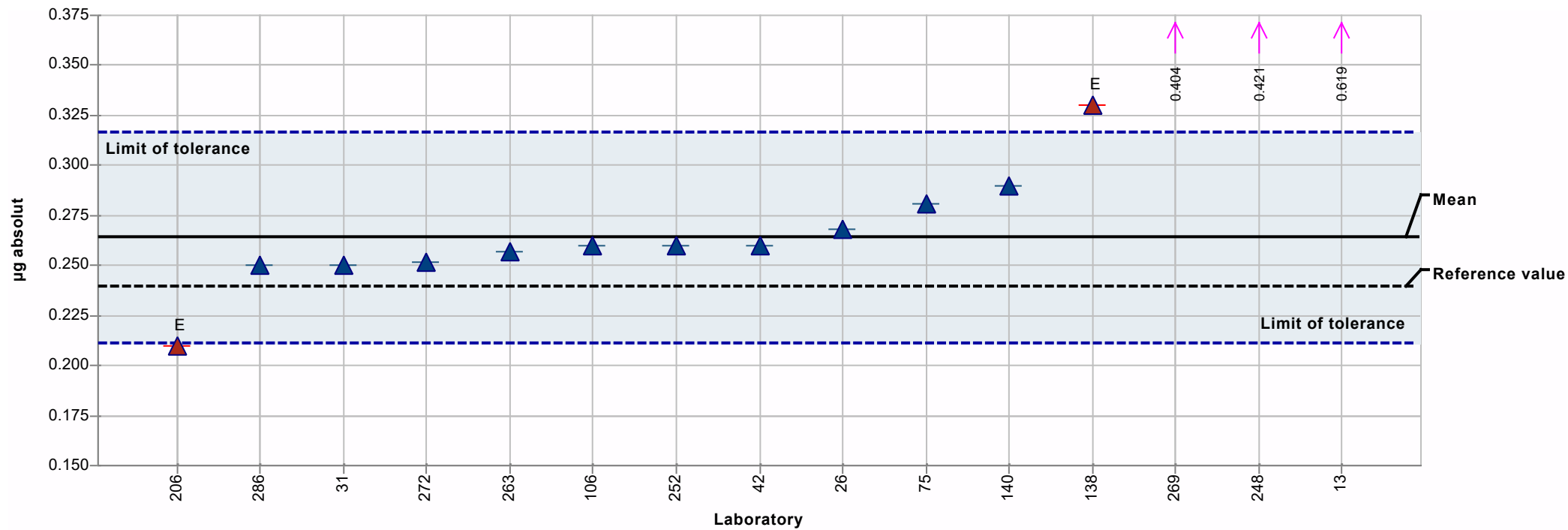
Summary results

Sample:	2	Mean:	4.60 µg absolut
Measurand:	Copper	Reproducibility s.d.:	0.33 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	7.12%
Rel. target s.d.:	10.00%	Reference value:	4.54 µg absolut
Number of laboratories in calculation + outliers: 24		Range of tolerance:	3.68 - 5.52 µg absolut (Z-Score <= 2.00)



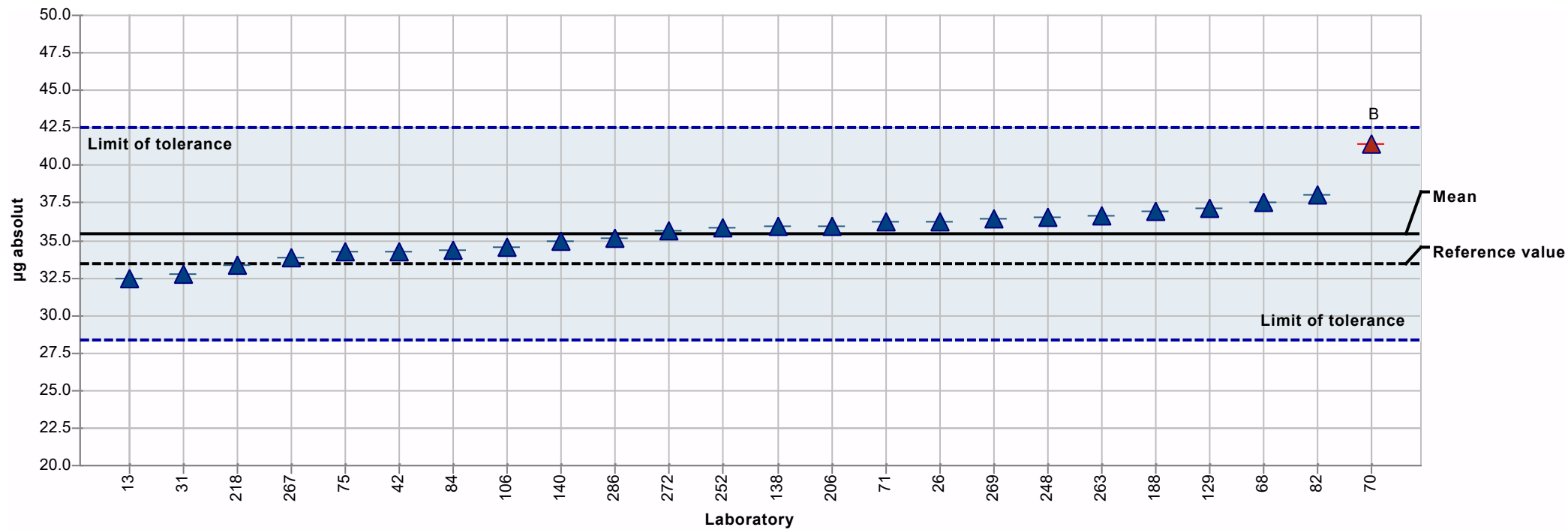
Summary results

Sample:	2	Mean:	0.264 µg absolut
Measurand:	Indium	Reproducibility s.d.:	0.028 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	10.77%
Rel. target s.d.:	10.00%	Reference value:	0.240 µg absolut
Number of laboratories in calculation + outliers: 15		Range of tolerance:	0.211 - 0.317 µg absolut ($ Z\text{-Score} \leq 2.00$)



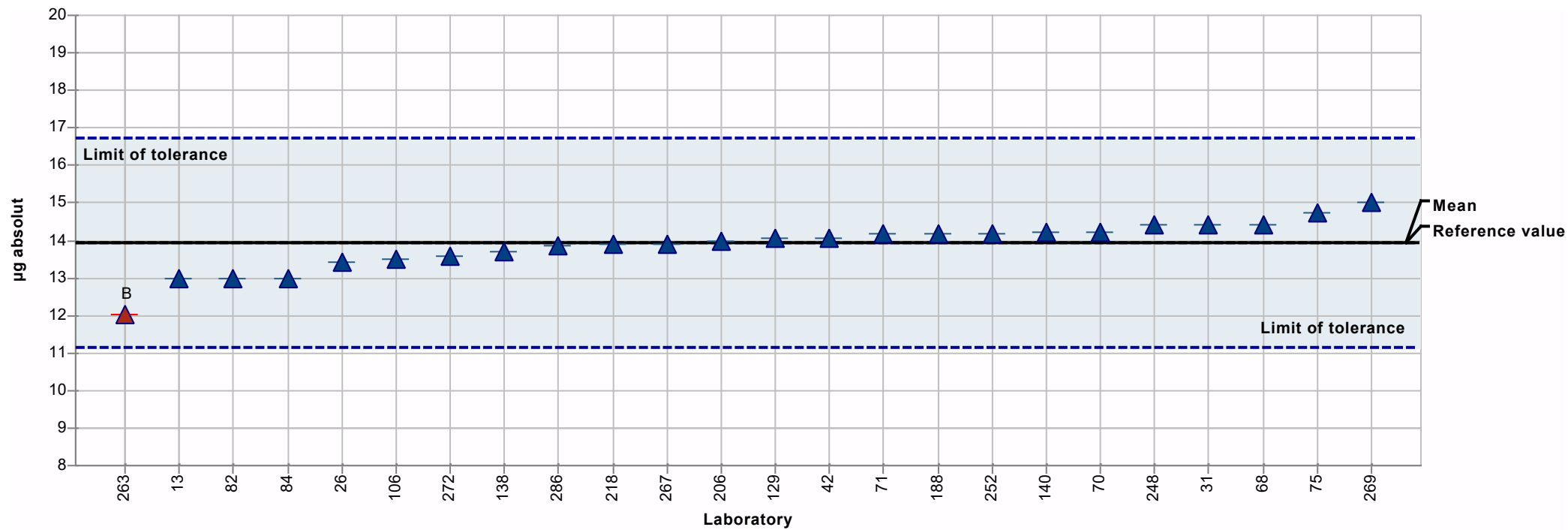
Summary results

Sample:	2	Mean:	35.4 µg absolut
Measurand:	Lead	Reproducibility s.d.:	1.5 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	4.21%
Rel. target s.d.:	10.00%	Reference value:	33.5 µg absolut
Number of laboratories in calculation + outliers: 24		Range of tolerance:	28.4 - 42.5 µg absolut (Z-Score <= 2.00)



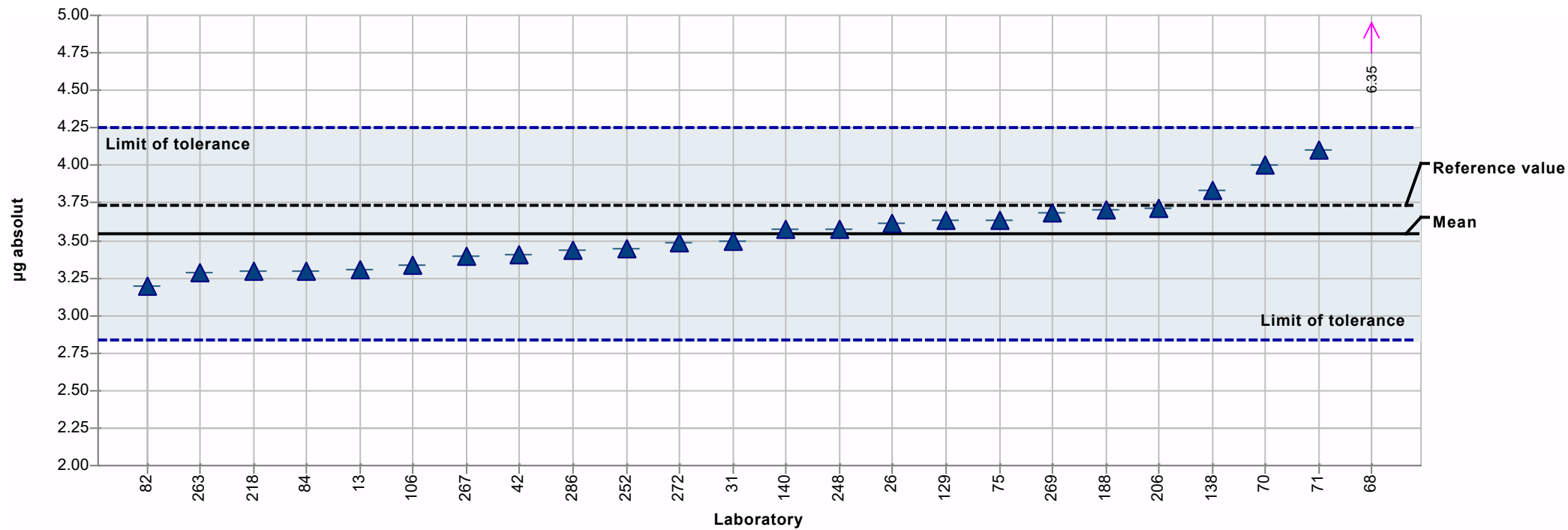
Summary results

Sample:	2	Mean:	14.0 µg absolut
Measurand:	Manganese	Reproducibility s.d.:	0.5 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	3.75%
Rel. target s.d.:	10.00%	Reference value:	13.9 µg absolut
Number of laboratories in calculation + outliers: 24		Range of tolerance:	11.2 - 16.7 µg absolut (Z-Score <= 2.00)



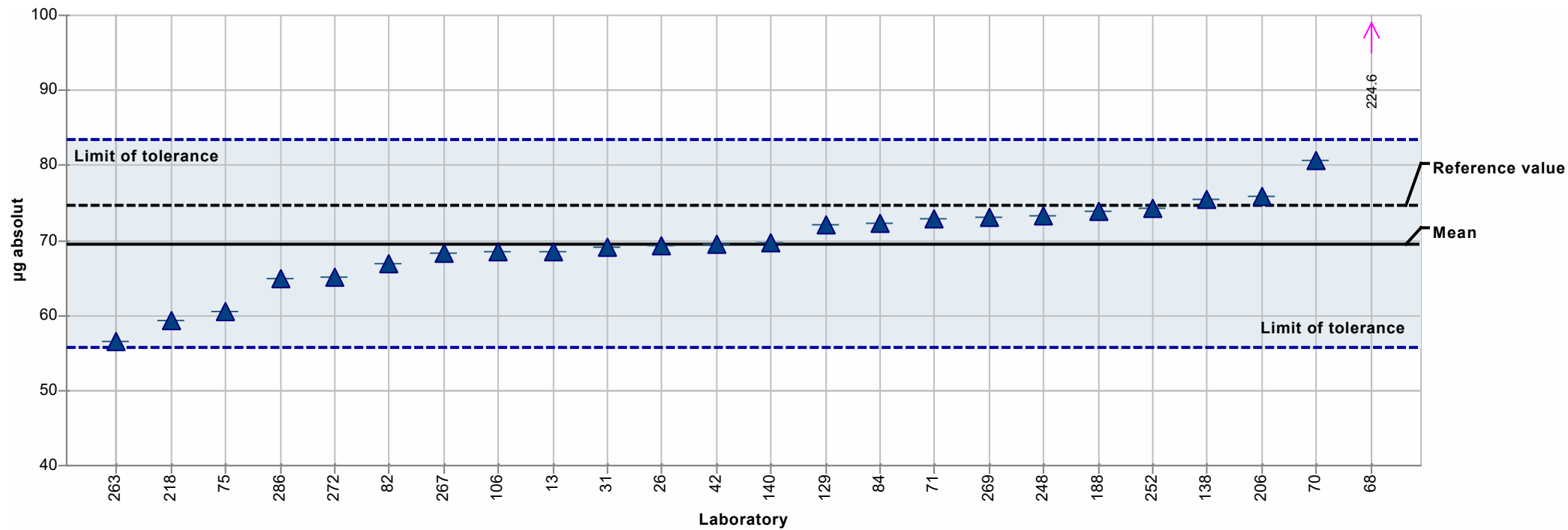
Summary results

Sample:	2	Mean:	3.54 µg absolut
Measurand:	Nickel	Reproducibility s.d.:	0.23 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	6.46%
Rel. target s.d.:	10.00%	Reference value:	3.73 µg absolut
Number of laboratories in calculation + outliers: 24		Range of tolerance:	2.83 - 4.25 µg absolut (Z-Score <= 2.00)



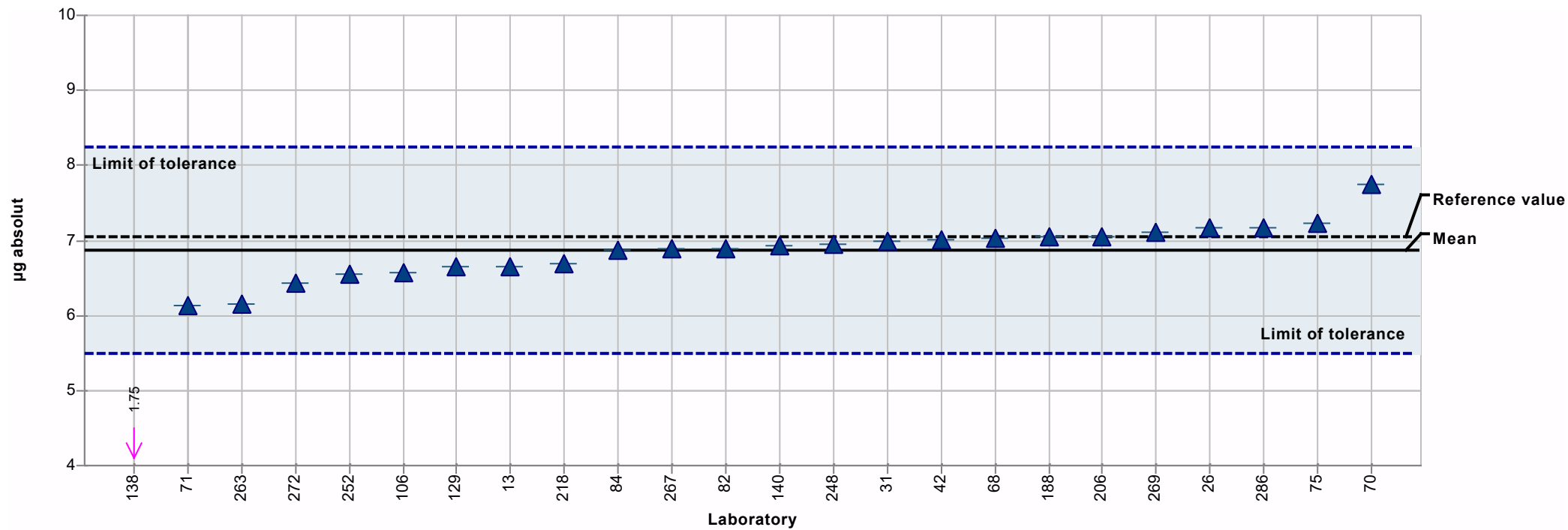
Summary results

Sample:	2	Mean:	69.6 µg absolut
Measurand:	Zinc	Reproducibility s.d.:	5.6 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	8.07%
Rel. target s.d.:	10.00%	Reference value:	74.7 µg absolut
Number of laboratories in calculation + outliers: 24		Range of tolerance:	55.7 - 83.5 µg absolut (Z-Score <= 2.00)



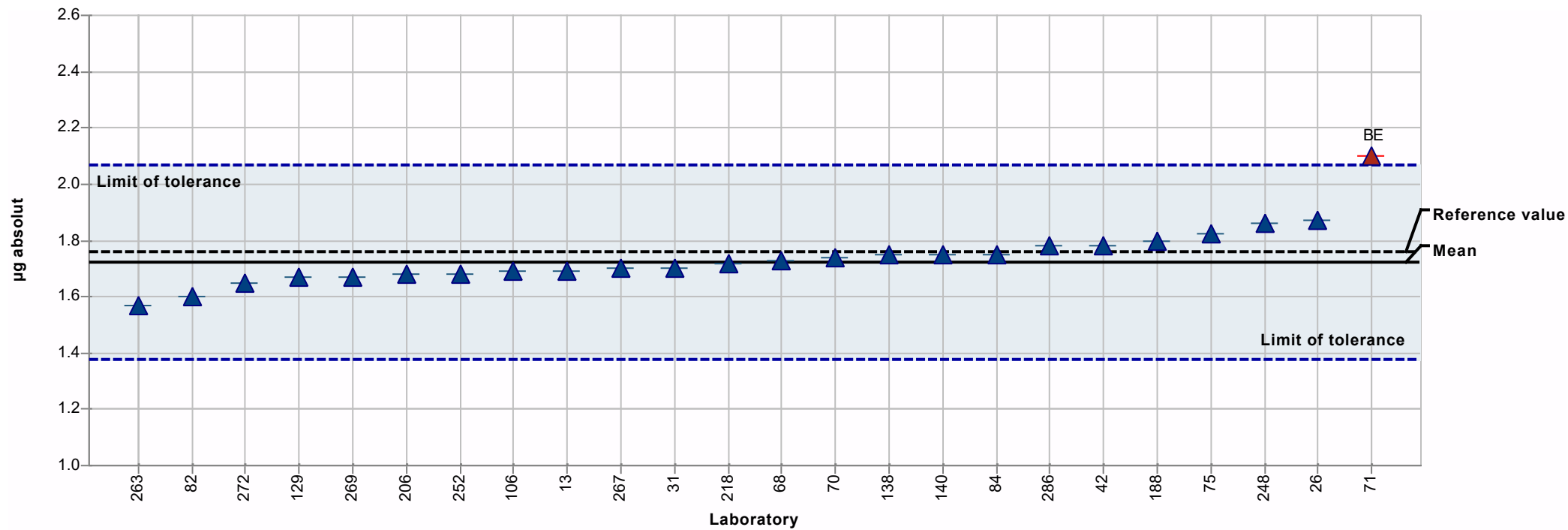
Summary results

Sample:	3	Mean:	6.87 µg absolut
Measurand:	Chromium	Reproducibility s.d.:	0.36 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	5.20%
Rel. target s.d.:	10.00%	Reference value:	7.05 µg absolut
Number of laboratories in calculation + outliers: 24		Range of tolerance:	5.49 - 8.24 µg absolut (Z-Score <= 2.00)



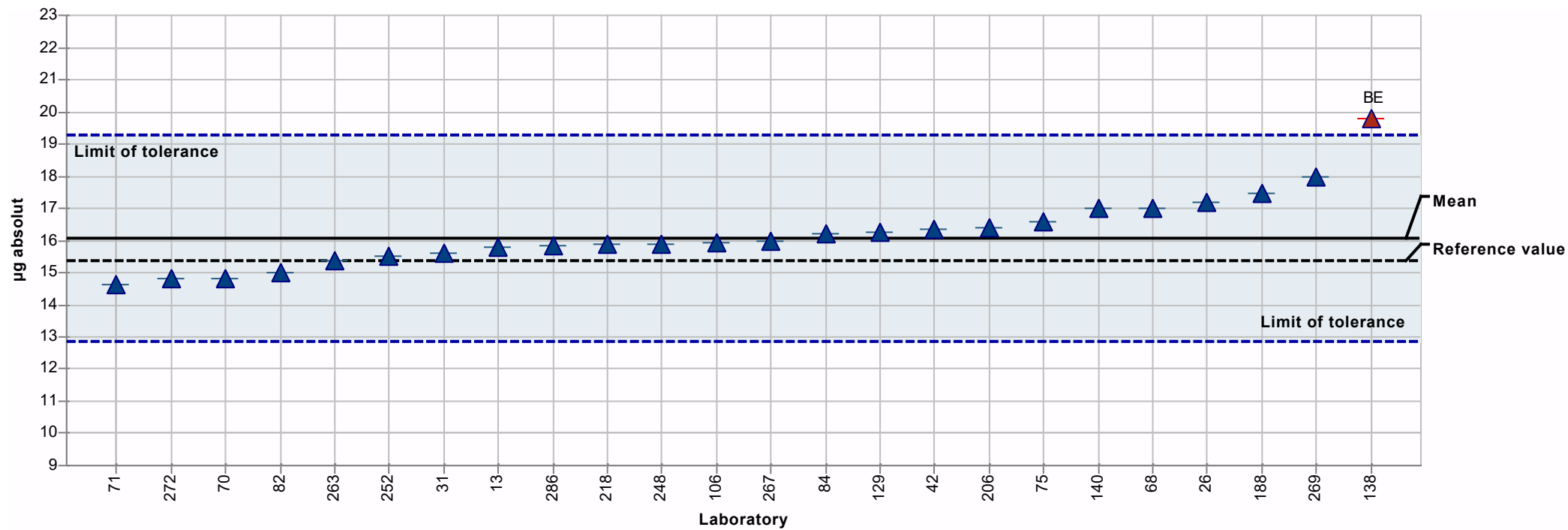
Summary results

Sample:	3	Mean:	1.72 µg absolut
Measurand:	Cobalt	Reproducibility s.d.:	0.07 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	4.31%
Rel. target s.d.:	10.00%	Reference value:	1.76 µg absolut
Number of laboratories in calculation + outliers: 24		Range of tolerance:	1.38 - 2.07 µg absolut (Z-Score <= 2.00)



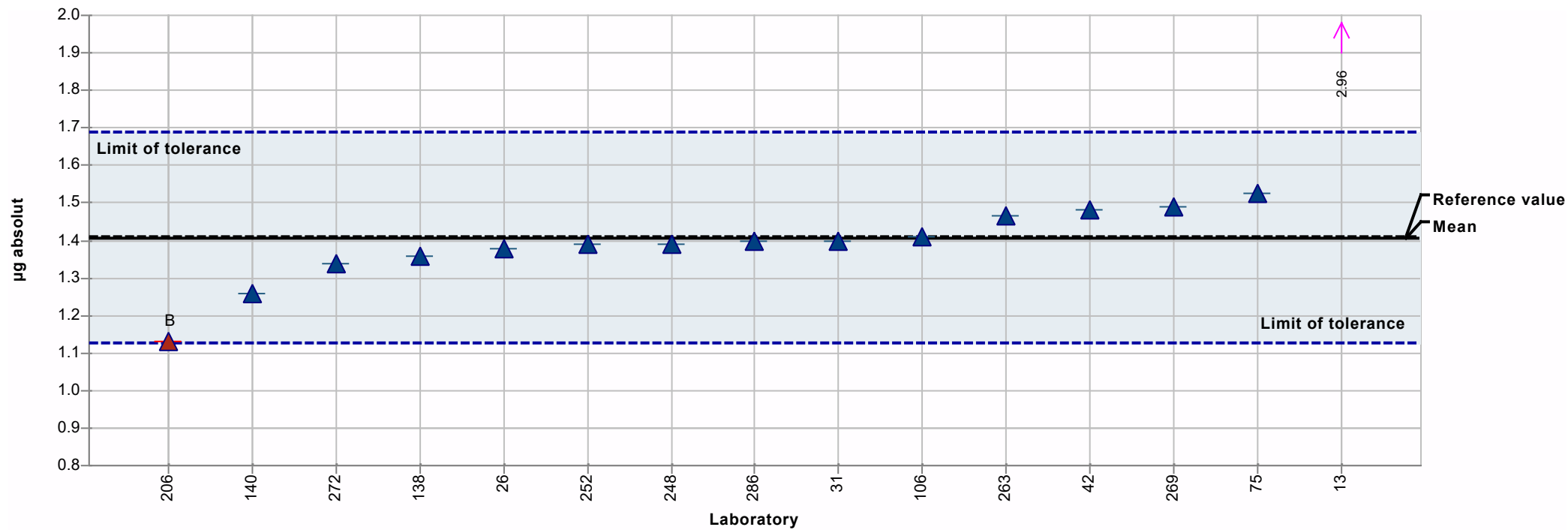
Summary results

Sample:	3	Mean:	16.1 µg absolut
Measurand:	Copper	Reproducibility s.d.:	0.9 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	5.44%
Rel. target s.d.:	10.00%	Reference value:	15.4 µg absolut
Number of laboratories in calculation + outliers: 24		Range of tolerance:	12.9 - 19.3 µg absolut (Z-Score <= 2.00)



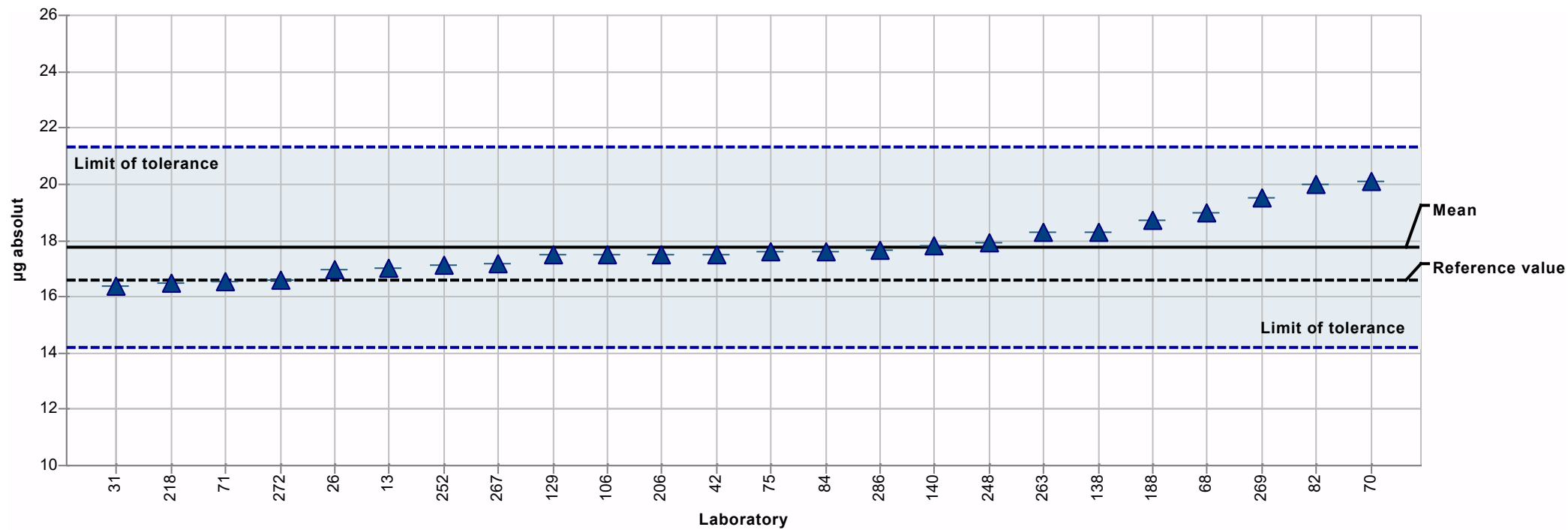
Summary results

Sample:	3	Mean:	1.41 µg absolut
Measurand:	Indium	Reproducibility s.d.:	0.07 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	5.00%
Rel. target s.d.:	10.00%	Reference value:	1.41 µg absolut
Number of laboratories in calculation + outliers: 15		Range of tolerance:	1.13 - 1.69 µg absolut (Z-Score <= 2.00)



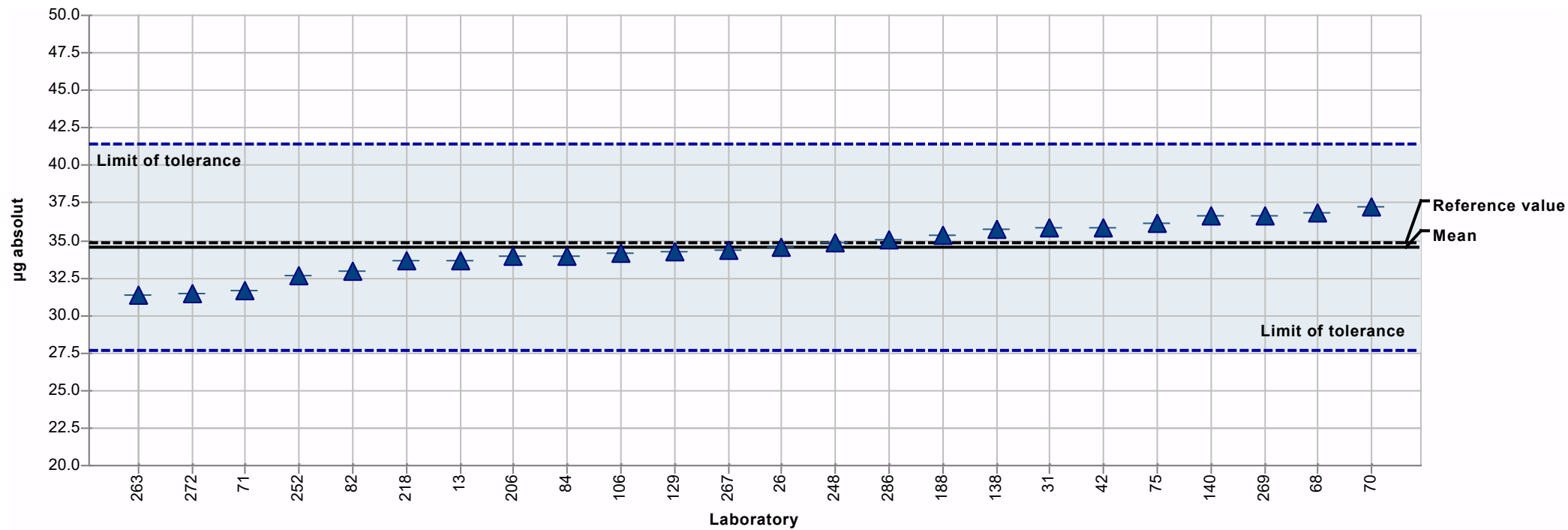
Summary results

Sample:	3	Mean:	17.8 µg absolut
Measurand:	Lead	Reproducibility s.d.:	1.0 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	5.88%
Rel. target s.d.:	10.00%	Reference value:	16.6 µg absolut
Number of laboratories in calculation + outliers: 24		Range of tolerance:	14.2 - 21.3 µg absolut (Z-Score <= 2.00)



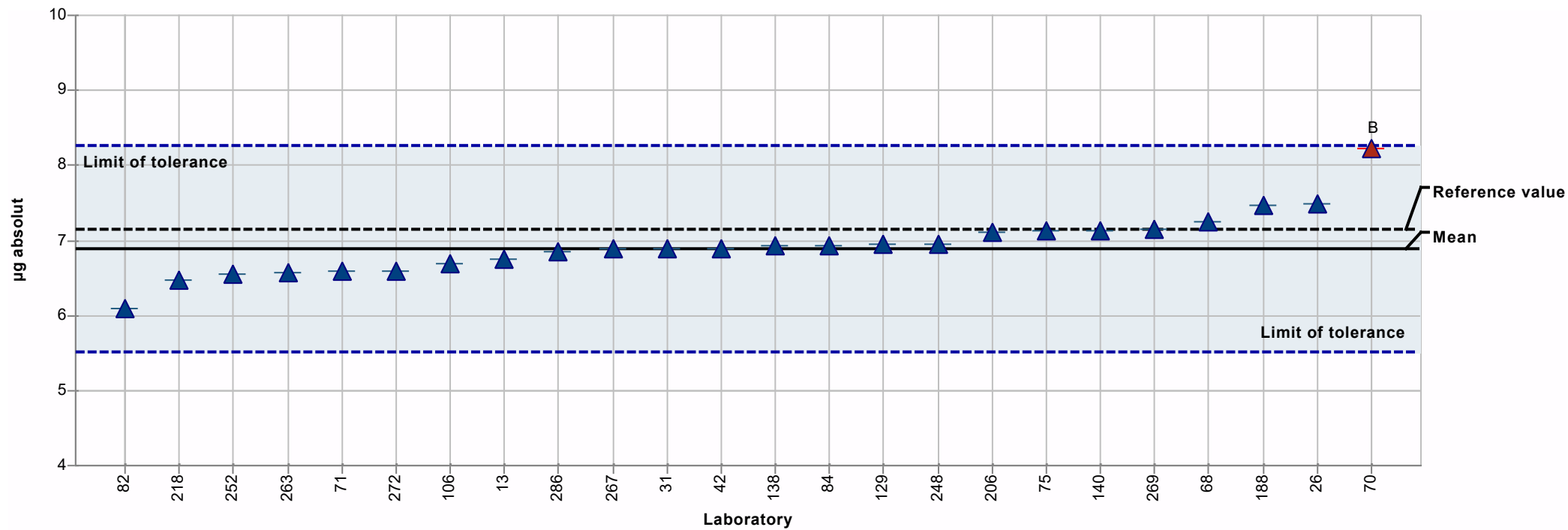
Summary results

Sample:	3	Mean:	34.5 µg absolut
Measurand:	Manganese	Reproducibility s.d.:	1.7 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	4.85%
Rel. target s.d.:	10.00%	Reference value:	34.9 µg absolut
Number of laboratories in calculation + outliers: 24		Range of tolerance:	27.6 - 41.5 µg absolut (Z-Score <= 2.00)



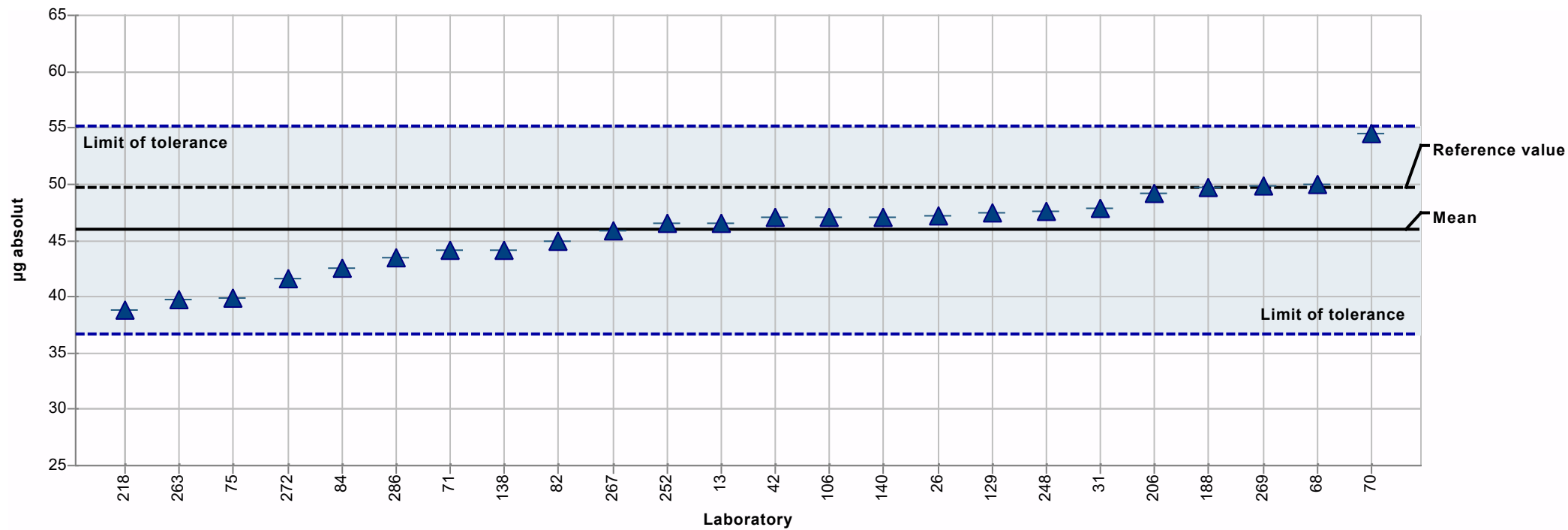
Summary results

Sample:	3	Mean:	6.89 µg absolut
Measurand:	Nickel	Reproducibility s.d.:	0.32 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	4.68%
Rel. target s.d.:	10.00%	Reference value:	7.15 µg absolut
Number of laboratories in calculation + outliers:	24	Range of tolerance:	5.51 - 8.26 µg absolut (Z-Score <= 2.00)



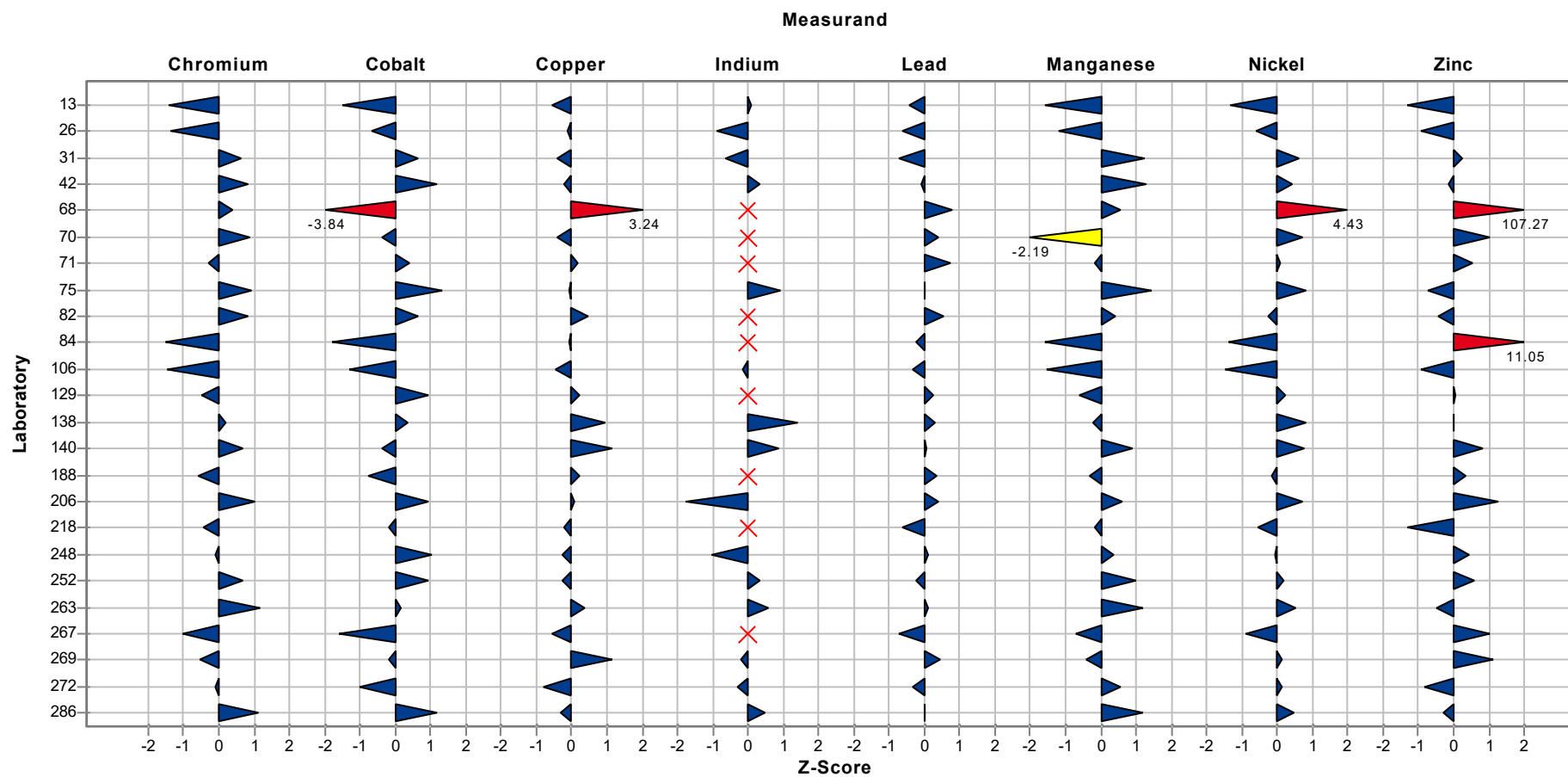
Summary results

Sample:	3	Mean:	45.9 µg absolut
Measurand:	Zinc	Reproducibility s.d.:	3.7 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	8.02%
Rel. target s.d.:	10.00%	Reference value:	49.7 µg absolut
Number of laboratories in calculation + outliers: 24		Range of tolerance:	36.8 - 55.1 µg absolut (Z-Score <= 2.00)



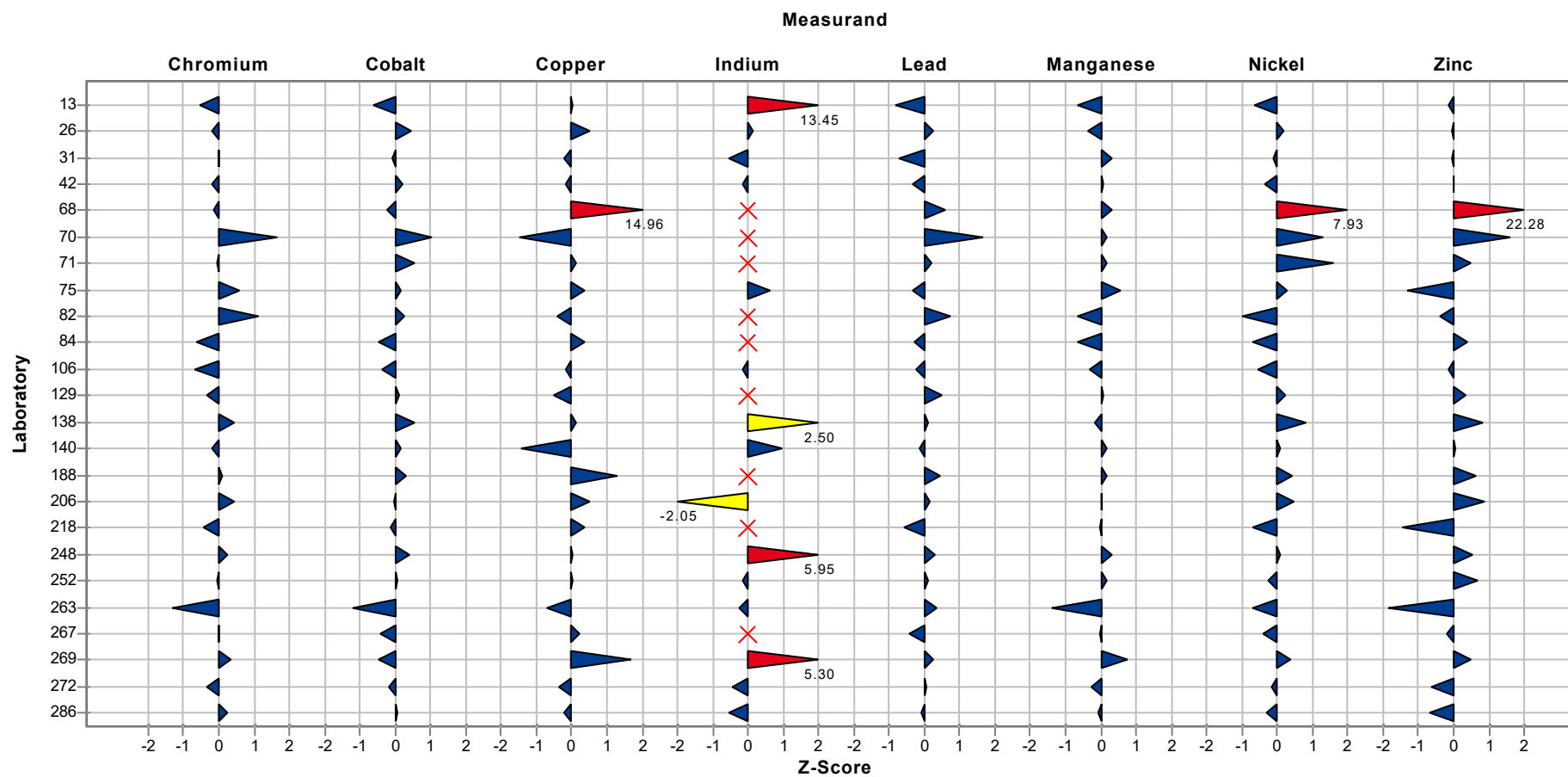
Sample chart of Z-Scores

Sample: 1



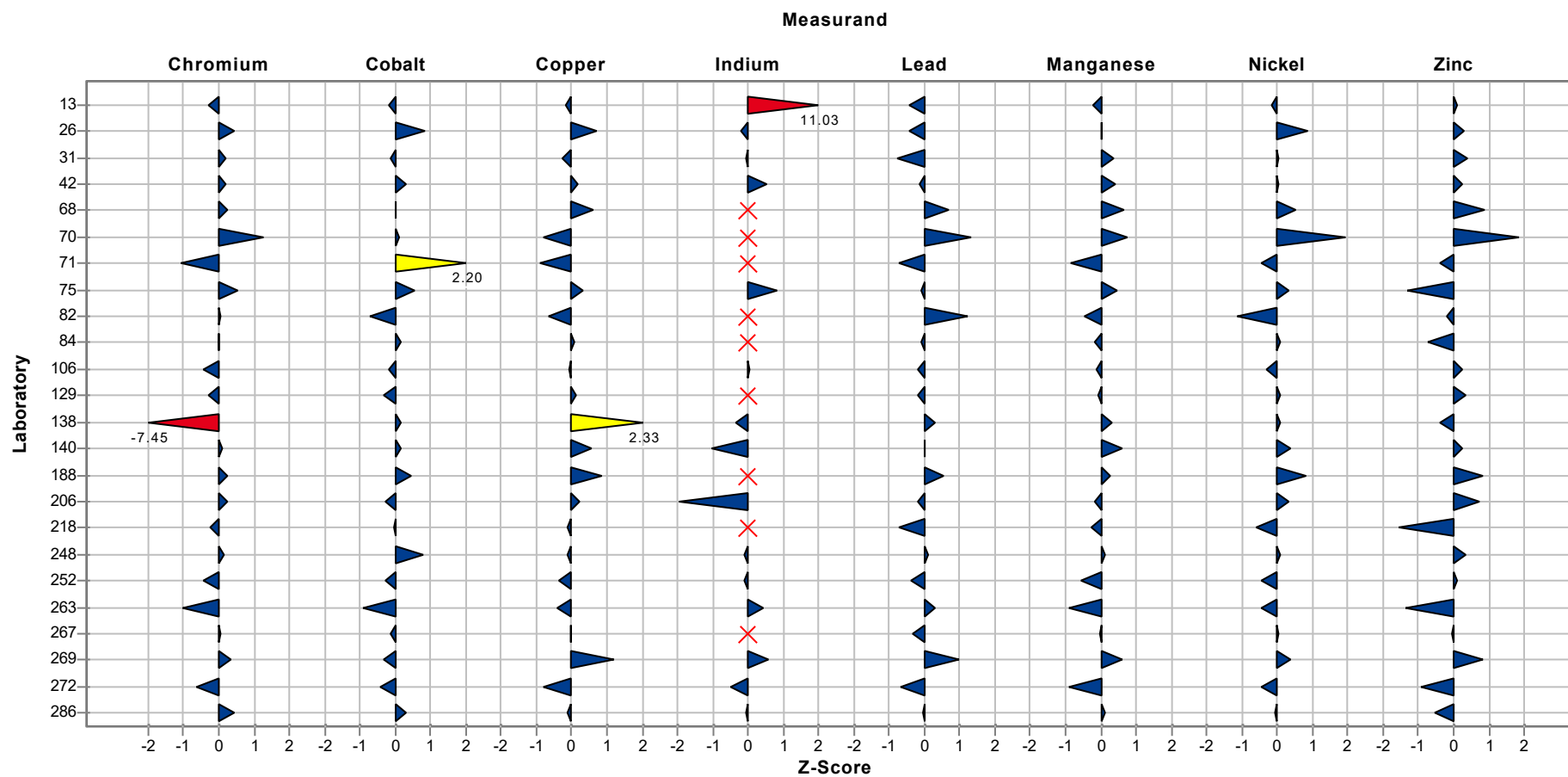
Sample chart of Z-Scores

Sample: 2



Sample chart of Z-Scores

Sample: 3



Questions and Answers

Participant	Pulping method
13	Aufschluss auf Heizplatte
26	IFA 7808 (2020-11)
31	IFA-Arbeitsmappe 6015
42	Mikrow ellendruckaufschluss nach IFA-Arbeitsmappe (Blatt 6015)
68	geschlossener Säureaufschluss
70	Mikrow ellendruckaufschluss (IFA Arbeitsmappe, Blatt 6015)
71	IFA-Arbeitsmappe Blatt 6015
75	Modifizierter Aufschluss nach IFA-Arbeitsmappe, Blatt 6015
82	IFA Arbeitsmappe Blatt 6015 Mikrow ellendruckaufschluss
84	IFA Arbeitsmappe Blatt 6015 (2018) Offener Standardaufschluss
106	Offener Aufschluss
129	Offener Standardaufschluss
138	IFA 6015
140	Standard Mikrow ellenaufschluss nach IFA Arbeitsmappe Blatt 6015
188	
206	
218	Mikrow ellendruckaufschluss
248	NIOSH 7301 und 7303
252	Angelehnt an IFA-Arbeitsmappe (Blatt 6015)-Standard-Mikrow ellendruckaufschluss
263	Mikrow ellendruckaufschluss nach IFA Arbeitsmappe (Blatt 6015)
267	Mikrow ellensäureaufschluss
269	
272	IFA 6015 - Mikrow ellendruckaufschluss
286	6015 Mikrow ellenaufschluss
Participant	Acid concentration
13	6ml konzentrierte HNO ₃ (65%)
26	65% HNO ₃ und 35% HCl
31	65% HNO ₃ ultrapur
42	69% Salpetersäure

Participant	Acid concentration
68	60% Salpetersäure
70	65%
71	HCL 30%ig , HNO3 65%ig
75	65% HNO3
82	65% Salpetersäure
84	HNO3 65%, HCl 25%
106	65% HNO3
129	Salzsäure: 30% Salpetersäure: 65%
138	HNO3: 65 %
140	Konzentrierte Salpetersäure (<= 65%)
206	HCl 32%, HNO3 65%, H2O2 30%
218	HNO3 (65 %) / H2O2 (30 %)
248	HCl 37%, HNO3 69%
252	entsprechend IFA-Arbeitsmappe
263	HNO3 65%
267	HCl 30%, HNO3 65%, H2O2 30%
272	Salpetersäure 65%
286	die Filterproben wurden mit 10 ml HNO3 (ROTIPURAN®Supra 65 %, Carl Roth) in der Mikrowelle aufgeschlossen.
Participant	Mixing ratio
13	6ml konzentrierte HNO3 und 3ml milliQ
26	2 Vol Teile HNO3 und 1 Vol Teil HCl
31	10 mL
42	10 ml HNO3
68	5mL Salpetersäure 60%
70	2,5
71	6,5 mL HNO3 : 3,3 ml HCl
75	1:1 HNO3:MilliQ-H2O
82	Filter + 10 ml Salpetersäure
84	2:1
106	rein
129	2 Volumenteile Salpetersäure / 1 Volumenteil Salzsäure
138	---

Participant	Mixing ratio
140	Konzentrierte Salpetersäure ($\leq 65\%$)
206	HNO ₃ , HCl, H ₂ O ₂ , H ₂ O (1:1:1:1)
218	10 mL HNO ₃ / 2 mL H ₂ O ₂
248	3:1
252	10 ml HNO ₃
263	-
272	nur 10 mL HNO ₃ - 65 %, keine Mischung
286	Nach dem Aufschluss wurden die Aufschlusslösungen in ein Röhrchen überführt und mit Millipore-Wasser auf 25 ml aufgefüllt. Das Mischungsverhältnis von der Säure zur Gesamtlösung beträgt 1:2,5.

Participant	Time of pulping
13	2
26	2
31	2
42	15 min auf 220°C, Haltezeit 45 min bei 220°C
68	1.2 Stunden
70	1
71	2 h
75	45 min Ramp, 60 min Hold bei 190°C und 900 Watt
82	60 min
84	2h
106	2
129	2
138	1,25 Std
140	1 Stunde
206	45 Min
218	2
248	2 h
252	1h
263	45 Minuten
272	1
286	Die Aufschlussdauer beträgt 45 min (entspricht der Aufschlussdauer bei der Endtemperatur und bei dem Enddruck). Die gesamte Dauer (Aufheizen + halten + abkühlen) liegt bei ca. 2,5 h.

Participant	Reagent volume
13	25
26	50 ml
31	20 mL
42	25
68	25mL
70	25
71	25 mL
75	20
82	25
84	20 mL
106	16,25
129	20
138	25 ml
140	25 ml
206	Aufschluss (10 ml) mit internem Standard, direkt 1:10 gemessen
218	100
248	50 ml
252	50 ml
263	25 mL
267	7 mL
272	25
286	25

Participant	Equipment	Method for lead
13	geschlossen	ICP-OES
26	offen	ICP-MS
31	MWDA gem. IFA-Arbeitsmappe 6015	ICP-MS
42	geschlossen (Mikrow elle)	ICP/MS
68	geschlossen	ICP-MS
70	geschlossen	ICP/OES
71	Offen	ICP-OES
75	geschlossen	ICP-MS DIN EN ISO 17294-2 von 2017
82	Mikrow elle geschlossen	ICP-OES
84	unter Rückfluss	ICP-MS

Participant	Equipment	Method for lead	
106	offen	ICP-MS	
129	offen unter Rückfluss	ICP/OES	
138	geschossen (Mikrow ellendruckaufschluss)	ICP/AES	
140	geschlossen	ICP-OES	
206	Mikrow ellendruckaufschluss	ICP-MS	
218	geschlossen	ICP-MS	
248	geschlossen / Mikrow elle	ICP/OES	
252	Mikrow ellendruckaufschluss	ICP-MS	
263	geschlossen	ICP-MS	
267	geschlossen	ICP-MS	
272	geschlossen	ICP/MS	
286	Die Aufschlüsse erfolgten geschlossen in einer Mikrow elle (ultraCLAVE, MLS-MWS)	ICP/MS	

Participant	Method for chromium	Method for cobalt	Method for indium
13	ICP-OES	ICP-OES	ICP-OES
26	ICP-MS	ICP-MS	ICP-MS
31	ICP-MS	ICP-MS	ICP-MS
42	ICP/MS	ICP/MS	ICP/MS
68	ICP-MS	ICP-MS	ICP-MS
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
82	ICP-OES	ICP-OES	
84	ICP-MS	ICP-MS	nicht bestimmt
106	ICP-MS	ICP-MS	ICP-MS
129	ICP/OES	ICP/OES	
138	ICP/AES	ICP/AES	ICP/AES
140	ICP-OES	ICP-OES	ICP-OES
206	ICP-MS	ICP-MS	ICP-MS
218	ICP-MS	ICP-MS	
248	ICP/OES	ICP/OES	ICP/OES
252	ICP-MS	ICP-MS	ICP-MS
263	ICP-MS	ICP-MS	ICP-MS

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Participant	Method for chromium	Method for cobalt	Method for indium
267	ICP-MS	ICP-MS	
272	ICP/MS	ICP/MS	ICP/MS
286	ICP/MS	ICP/MS	ICP/MS
Participant	Method for copper	Method for manganese	Method for nickel
13	ICP-OES	ICP-OES	ICP-OES
26	ICP-MS	ICP-MS	ICP-MS
31	ICP-MS	ICP-MS	ICP-MS
42	ICP/MS	ICP/MS	ICP/MS
68	ICP-MS	ICP-MS	ICP-MS
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
82	ICP-OES	ICP-MS	ICP-OES
84	ICP-MS	ICP-MS	ICP-MS
106	ICP-MS	ICP-MS	ICP-MS
129	ICP/OES	ICP/OES	ICP/OES
138	ICP/AES	ICP/AES	ICP/AES
140	ICP-OES	ICP-OES	ICP-OES
206	ICP-MS	ICP-MS	ICP-MS
218	ICP-MS	ICP-MS	ICP-MS
248	ICP/OES	ICP/OES	ICP/OES
252	ICP-MS	ICP-MS	ICP-MS
263	ICP-MS	ICP-MS	ICP-MS
267	ICP-MS	ICP-MS	ICP-MS
272	ICP/MS	ICP/MS	ICP/MS
286	ICP/MS	ICP/MS	ICP/MS
Participant	Method for zinc	Problems with iron matrix	
13	ICP-OES	Filter 4 zeigte bei der Analyse keine nennensw erten Interferenzen	
26	ICP-MS	keine Probleme aufgetreten	
31	ICP-MS	Nein	
42	ICP/MS	Nein	

Participant	Method for zinc	Problems with iron matrix
68	ICP-MS	Keine bekannten
70	ICP/OES	ja, bei Cobalt
71	ICP-OES	nein
75	ICP-MS DIN EN ISO 17294-2 von 2017	Nein
82	ICP-OES	Nein
84	ICP-MS	nein
106	ICP-MS	erhöhter RSD, sonst keine Probleme
129	ICP/OES	nein
138	ICP/AES	ja
140	ICP-OES	nein
206	ICP-MS	Nein
218	ICP-MS	Nein
248	ICP/OES	ja
252	ICP-MS	Nein
263	ICP-MS	nein
267	ICP-MS	
272	ICP/MS	nein
286	ICP/MS	Probe 4 musste wegen der Eisenkonzentration etw. höher verdünnt werden (1:100 gegenüber 1:50)

Proficiency testing for in-house and external measuring stations - results and evaluation

Proficiency testing scheme “Metals on filters”

July/August 2024

Evaluation of “Sample 4 – Test”

Loaded with iron interference matrix

Summary of laboratory test results

Sample 4 - Test

Laboratory	Chromium	Z score	Cobalt	Z score	Copper	Z score	Indium	Z score
Unit	µg absolut		µg absolut		µg absolut		µg absolut	
13	2.37	0.00	0.679	-0.24	2.60	-0.55	0.837	1.87
26	2.26	-0.46	0.707	0.16	2.75	0.00	0.663	-0.60
31	2.40	0.13	0.680	-0.22	2.60	-0.55	0.680	-0.36
42	2.44	0.30	0.730	0.49	2.74	-0.04	0.740	0.49
68	0.86	-6.37 BE	0.170	-7.56 BE	14.21	41.65 BE		
70	2.88	2.16 BE	0.506	-2.73 BE	2.79	0.14		
71	2.33	-0.18	0.949	3.64 BE	2.71	-0.13		
75	2.45	0.35	0.739	0.62	2.78	0.11	0.761	0.79
82	2.40	0.13	0.680	-0.22	2.60	-0.55		
84	2.28	-0.38	0.670	-0.37	3.15	1.45		
106	2.24	-0.55	0.700	0.06	2.66	-0.33	0.710	0.07
129	2.14	-0.97	0.670	-0.37	2.48	-0.99		
138	2.46	0.38	0.700	0.06	2.25	-1.82	0.750	0.64
140	2.36	-0.04	0.684	-0.17	1.72	-3.75 BE	0.619	-1.22
188	2.50	0.55	0.360	-4.82 BE	3.33	2.10 E		
206	2.51	0.59	0.710	0.21	2.87	0.43	0.590	-1.63
218	2.20	-0.71	0.670	-0.37	2.75	0.00		
248	2.51	0.59	0.857	2.32 BE	2.86	0.40	1.005	4.25 BE
252	2.27	-0.42	0.690	-0.08	2.64	-0.40	0.710	0.07
263	2.11	-1.11	0.666	-0.43	2.58	-0.63	0.740	0.49
267	2.40	0.13	0.700	0.06	2.80	0.18		
269	2.64	1.14	0.730	0.49	3.19	1.60	0.694	-0.16
272	2.41	0.17	0.701	0.08	2.64	-0.40	0.698	-0.10
286	2.45	0.34	0.710	0.21	2.75	0.00	0.680	-0.36
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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	24		24		24		15	
Mean	2.37		0.696		2.75		0.705	

Laboratory	Chromium	Z score	Cobalt	Z score	Copper	Z score	Indium	Z score
Reproducibility s.d.	0.13		0.022		0.24		0.061	
Rel. reproducibility s.d.	5.52 %		3.15 %		8.60 %		8.70 %	
Reference value	2.38		0.730		2.73		0.710	
Target s.d.	0.24		0.070		0.28		0.071	
Rel. target s.d.	10.00 %		10.00 %		10.00 %		10.00 %	
Lower limit of tolerance	1.90		0.556		2.20		0.564	
Upper limit of tolerance	2.84		0.835		3.30		0.846	
Type B outliers	2		5		2		1	
Type E outliers	2		5		3		1	
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	22		19		22		14	
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 >3.50								

Laboratory	Iron	Z score	Lead	Z score	Manganese	Z score	Nickel	Z score
Unit	µg absolut		µg absolut		µg absolut		µg absolut	
13			96	-0.40	10.9	-0.47	4.63	-0.29
26	140	-1.29	96	-0.45	10.8	-0.53	4.79	0.04
31	162	0.07	95	-0.52	11.6	0.15	4.60	-0.35
42	165	0.23	98	-0.21	11.9	0.44	4.82	0.11
68	5	-9.69 BE	45	-5.53 BE	4.7	-5.88 BE	3.69	-2.26 BE
70	141	-1.24	118	1.79 B	10.6	-0.73	4.99	0.46
71	155	-0.39	105	0.48	11.7	0.24	5.05	0.59
75	169	0.53	100	0.02	12.2	0.64	4.94	0.36
82	165	0.25	105	0.49	11.0	-0.38	4.30	-0.98
84	148	-0.80	100	-0.03	10.7	-0.64	4.58	-0.40
106	104	-3.52 BE	96	-0.39	11.1	-0.31	4.58	-0.40
129	162	0.04	101	0.12	11.4	-0.02	4.76	-0.02
138	158	-0.18	2	-9.75 BE	11.4	-0.03	4.96	0.40
140	176	0.94	104	0.39	11.6	0.15	4.82	0.11
188			107	0.67	11.9	0.41	5.02	0.53
206	178	1.07	106	0.59	11.4	0.01	5.13	0.76
218	154	-0.42	92	-0.76	11.0	-0.36	4.41	-0.75
248	166	0.31	101	0.07	11.8	0.32	4.90	0.28
252	155	-0.37	96	-0.45	11.0	-0.36	4.57	-0.42
263	160	-0.07			12.3	0.79	4.50	-0.56
267	161	0.00	98	-0.19	11.5	0.06	4.70	-0.14
269	181	1.25	107	0.69	12.4	0.85	5.18	0.86
272	160	-0.06	98	-0.26	11.2	-0.20	4.80	0.07
286	163	0.13	101	0.12	11.4	-0.04	4.65	-0.25
—	—	--	—	--	—	--	—	--
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	22		23		24		24	
Mean	161		100		11.4		4.77	
Reproducibility s.d.	11		4		0.5		0.23	
Rel. reproducibility s.d.	6.67 %		4.38 %		4.42 %		4.85 %	
Reference value	163		99		11.5		5.11	
Target s.d.	16		10		1.1		0.48	
Rel. target s.d.	10.00 %		10.00 %		10.00 %		10.00 %	

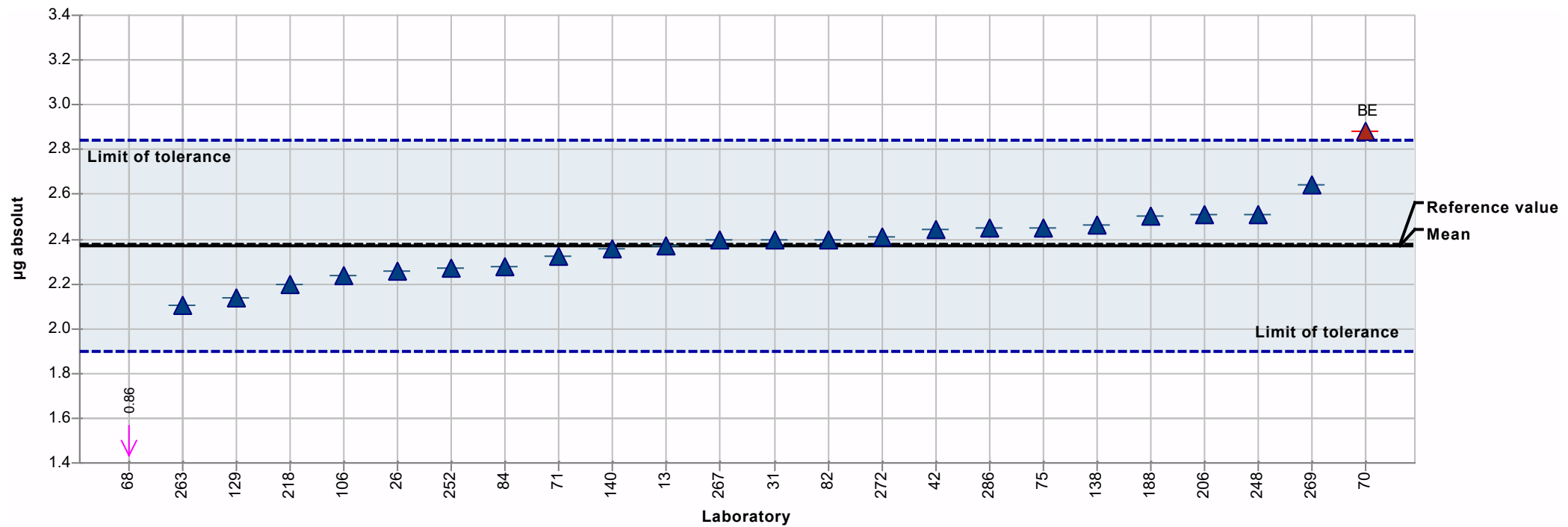
Laboratory	Iron	Z score	Lead	Z score	Manganese	Z score	Nickel	Z score
Lower limit of tolerance	129		80		9.1		3.81	
Upper limit of tolerance	193		120		13.7		5.72	
Type B outliers	2		3		1		1	
Type E outliers	2		2		1		1	
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	20		20		23		23	

Laboratory	Zinc	Z score
Unit	µg absolut	
13	67.9	-0.03
26	66.8	-0.19
31	68.9	0.12
42	67.2	-0.13
68	141.0	10.71 BE
70	70.1	0.30
71	72.0	0.58
75	52.4	-2.30 BE
82	67.0	-0.16
84	68.3	0.03
106	64.9	-0.46
129	68.7	0.10
138	71.2	0.46
140	68.1	0.00
188	73.3	0.77
206	73.8	0.84
218	56.4	-1.71
248	70.7	0.39
252	71.4	0.49
263	62.6	-0.80
267	67.0	-0.16
269	74.6	0.96
272	63.3	-0.70
286	63.3	-0.70
–	–	– –
Method	ISO 5725-2	
Assessment	Z ≤2.00	
No. of laboratories that submitted results	24	
Mean	68.1	
Reproducibility s.d.	4.2	
Rel. reproducibility s.d.	6.22 %	
Reference value	67.1	
Target s.d.	6.8	
Rel. target s.d.	10.00 %	

Laboratory	Zinc	Z score
Low er limit of tolerance	54.5	
Upper limit of tolerance	81.7	
Type B outliers	2	
Type E 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)	22	

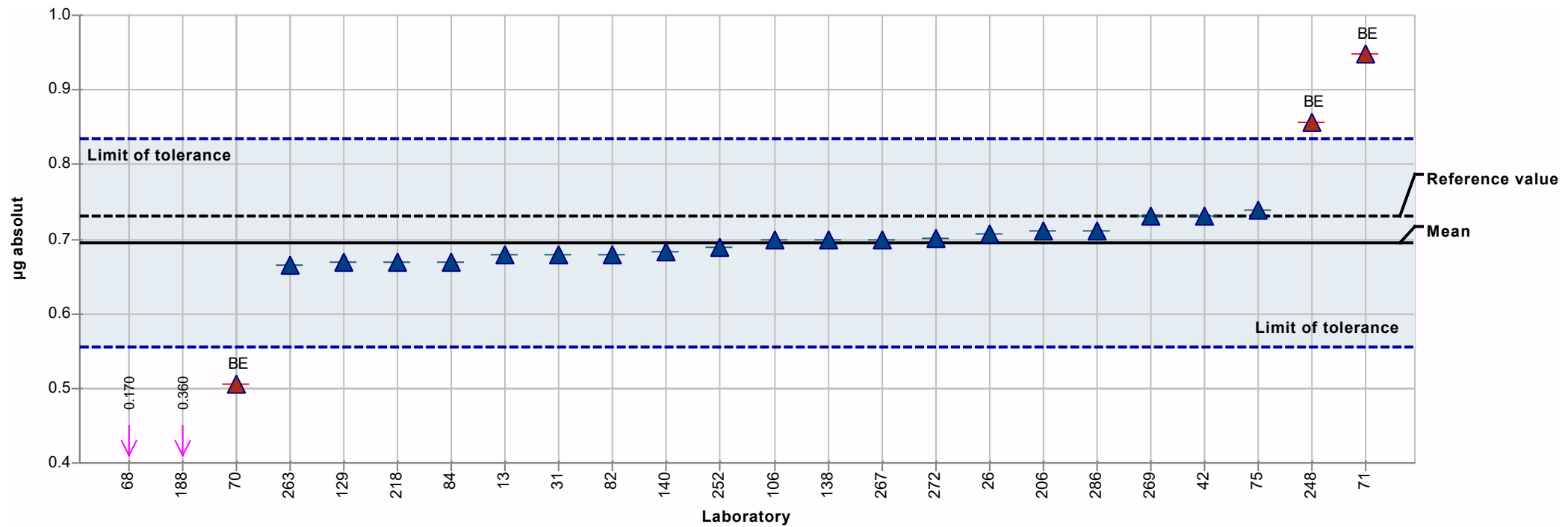
Summary results

Sample:	4 - Test	Mean:	2.37 µg absolut
Measurand:	Chromium	Reproducibility s.d.:	0.13 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	5.52%
Rel. target s.d.:	10.00%	Reference value:	2.38 µg absolut
Number of laboratories in calculation + outliers: 24		Range of tolerance:	1.90 - 2.84 µg absolut (Z-Score <= 2.00)



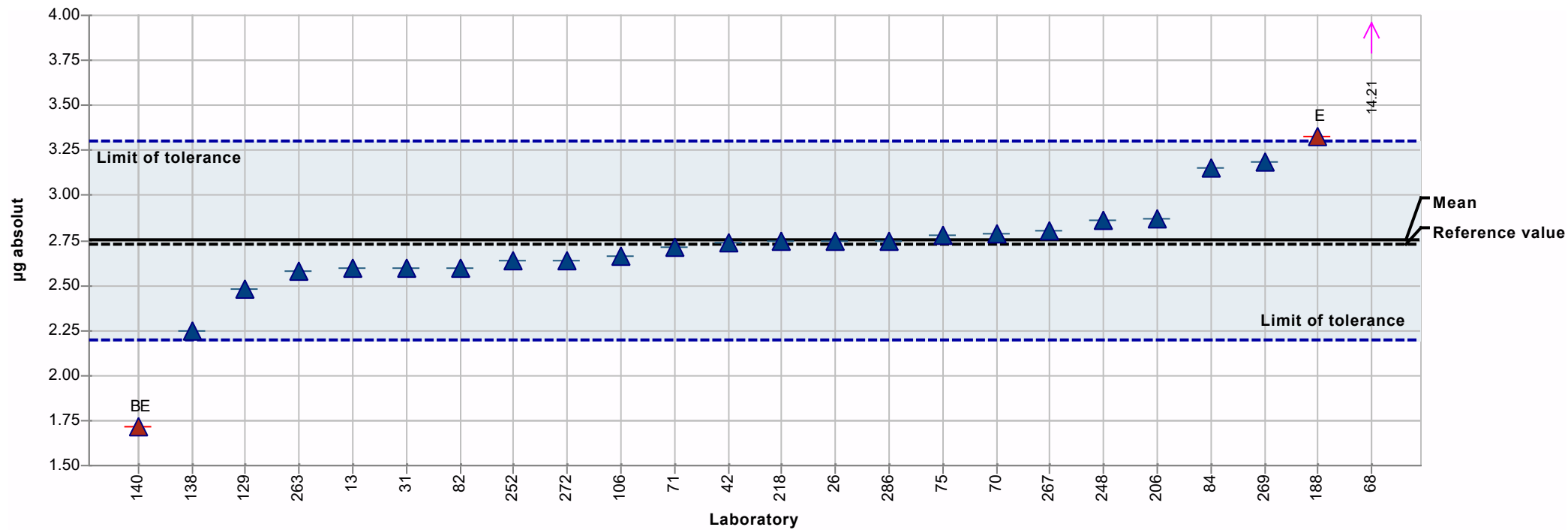
Summary results

Sample:	4 - Test	Mean:	0.696 µg absolut
Measurand:	Cobalt	Reproducibility s.d.:	0.022 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	3.15%
Rel. target s.d.:	10.00%	Reference value:	0.730 µg absolut
Number of laboratories in calculation + outliers: 24		Range of tolerance:	0.556 - 0.835 µg absolut (Z-Score <= 2.00)



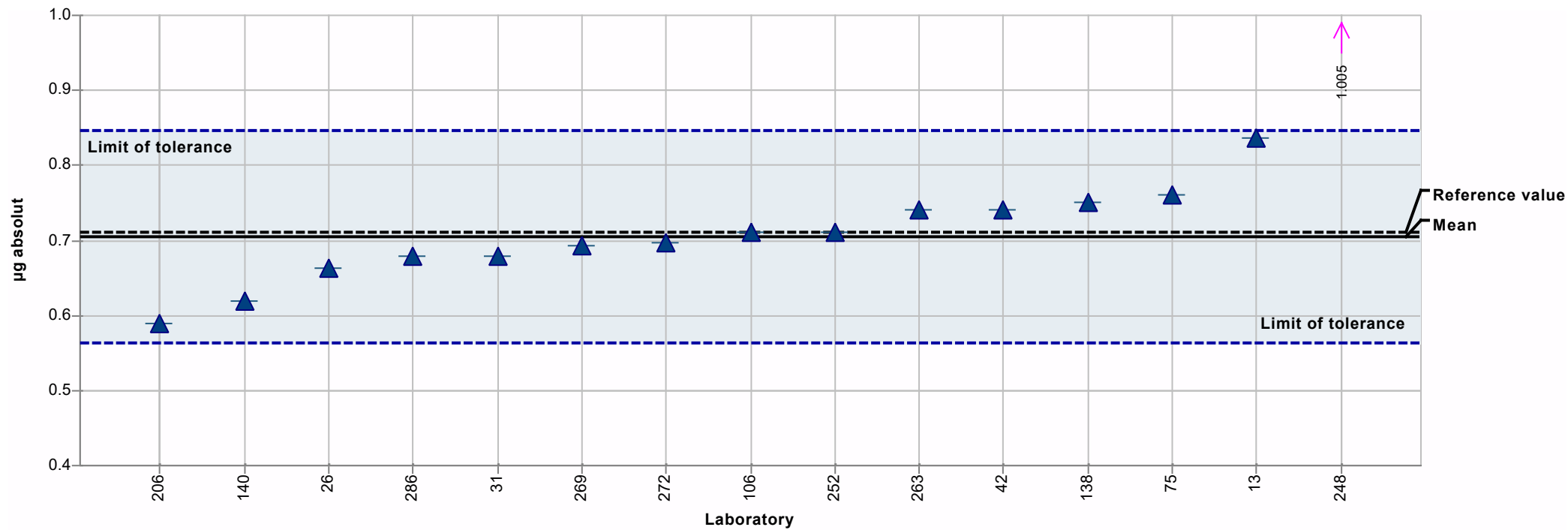
Summary results

Sample:	4 - Test	Mean:	2.75 µg absolut
Measurand:	Copper	Reproducibility s.d.:	0.24 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	8.60%
Rel. target s.d.:	10.00%	Reference value:	2.73 µg absolut
Number of laboratories in calculation + outliers: 24		Range of tolerance:	2.20 - 3.30 µg absolut (Z-Score <= 2.00)



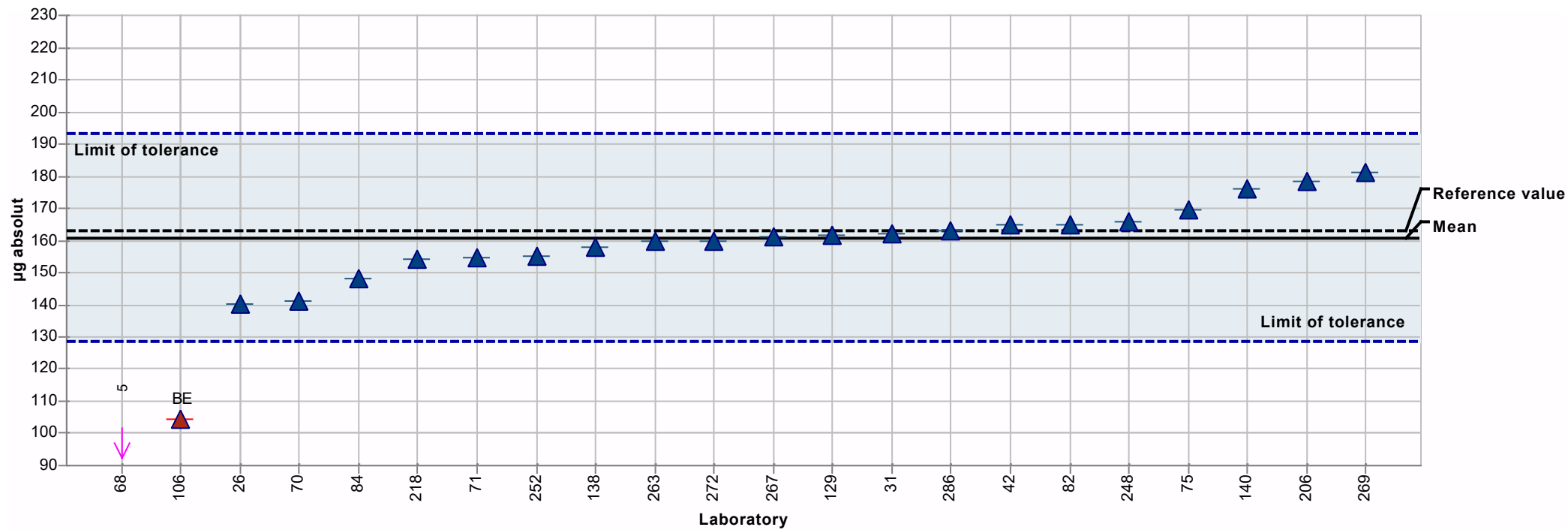
Summary results

Sample:	4 - Test	Mean:	0.705 µg absolut
Measurand:	Indium	Reproducibility s.d.:	0.061 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	8.70%
Rel. target s.d.:	10.00%	Reference value:	0.710 µg absolut
Number of laboratories in calculation + outliers: 15		Range of tolerance:	0.564 - 0.846 µg absolut (Z-Score <= 2.00)



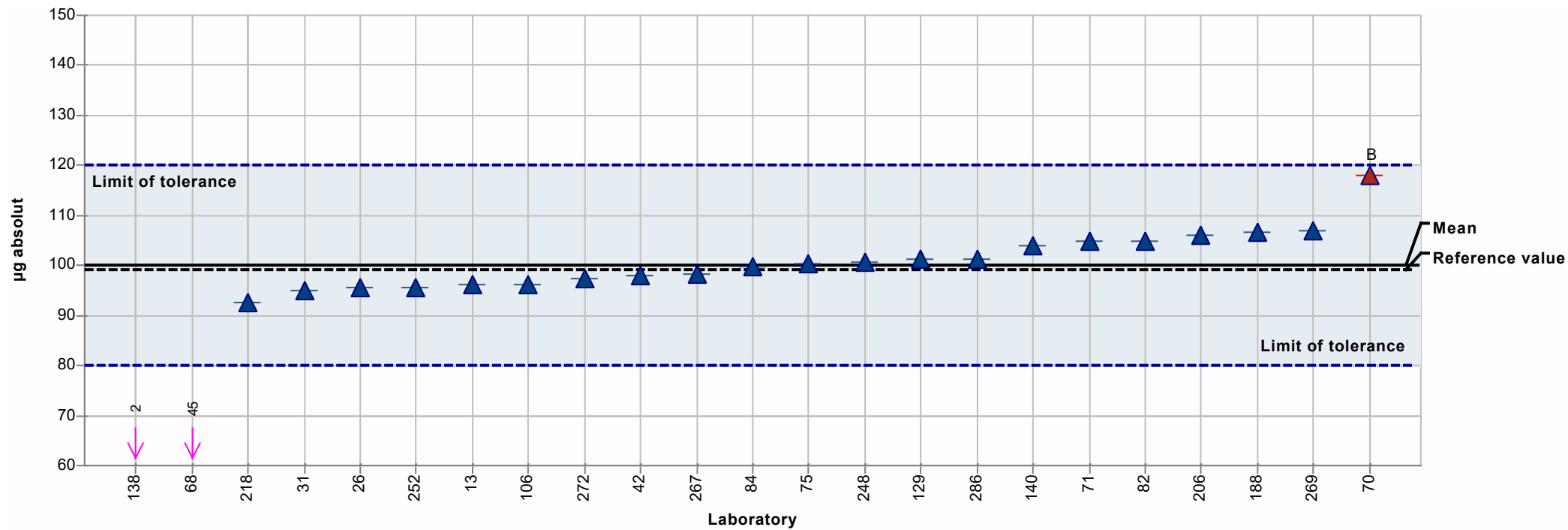
Summary results

Sample:	4 - Test	Mean:	161 µg absolut
Measurand:	Iron	Reproducibility s.d.:	11 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	6.67%
Rel. target s.d.:	10.00%	Reference value:	163 µg absolut
Number of laboratories in calculation + outliers: 22		Range of tolerance:	129 - 193 µg absolut (Z-Score <= 2.00)



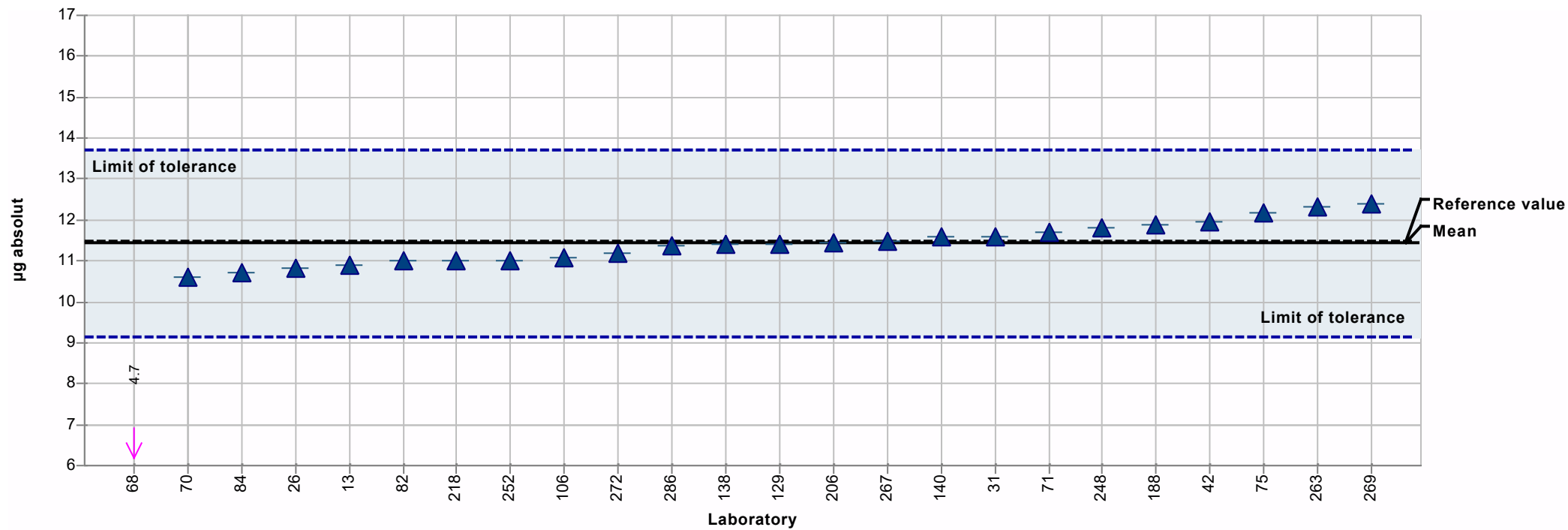
Summary results

Sample:	4 - Test	Mean:	100 µg absolut
Measurand:	Lead	Reproducibility s.d.:	4 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	4.38%
Rel. target s.d.:	10.00%	Reference value:	99 µg absolut
Number of laboratories in calculation + outliers: 23		Range of tolerance:	80 - 120 µg absolut (Z-Score <= 2.00)



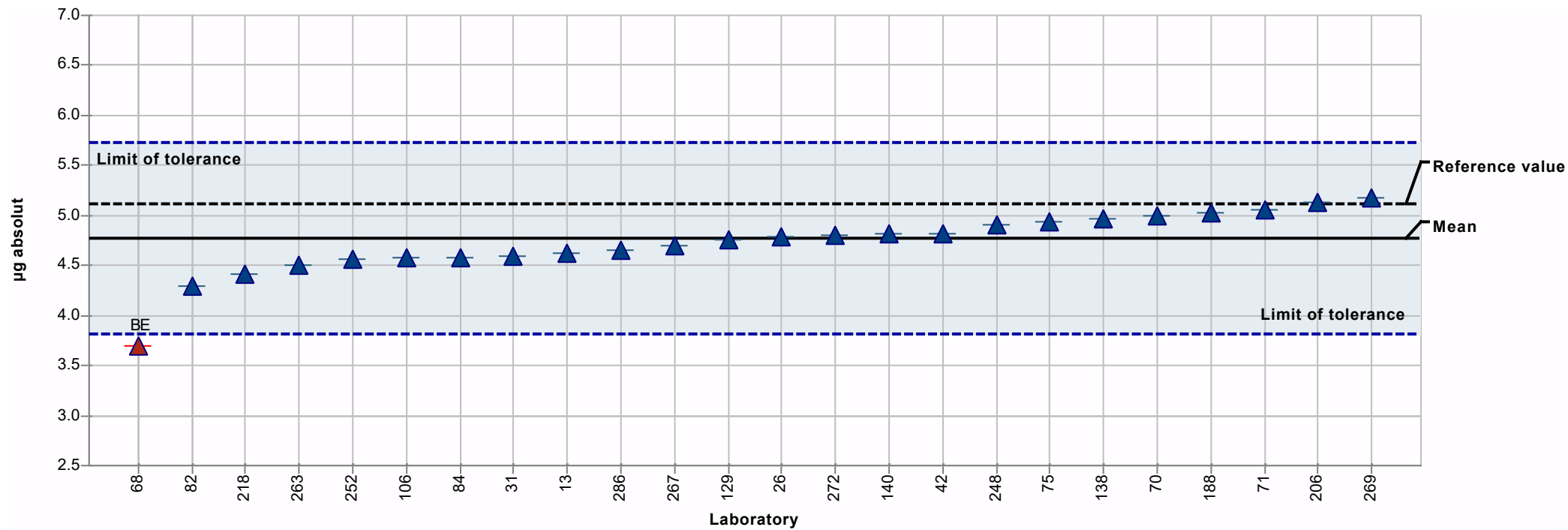
Summary results

Sample:	4 - Test	Mean:	11.4 µg absolut
Measurand:	Manganese	Reproducibility s.d.:	0.5 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	4.42%
Rel. target s.d.:	10.00%	Reference value:	11.5 µg absolut
Number of laboratories in calculation + outliers: 24		Range of tolerance:	9.1 - 13.7 µg absolut ($ Z\text{-Score} \leq 2.00$)



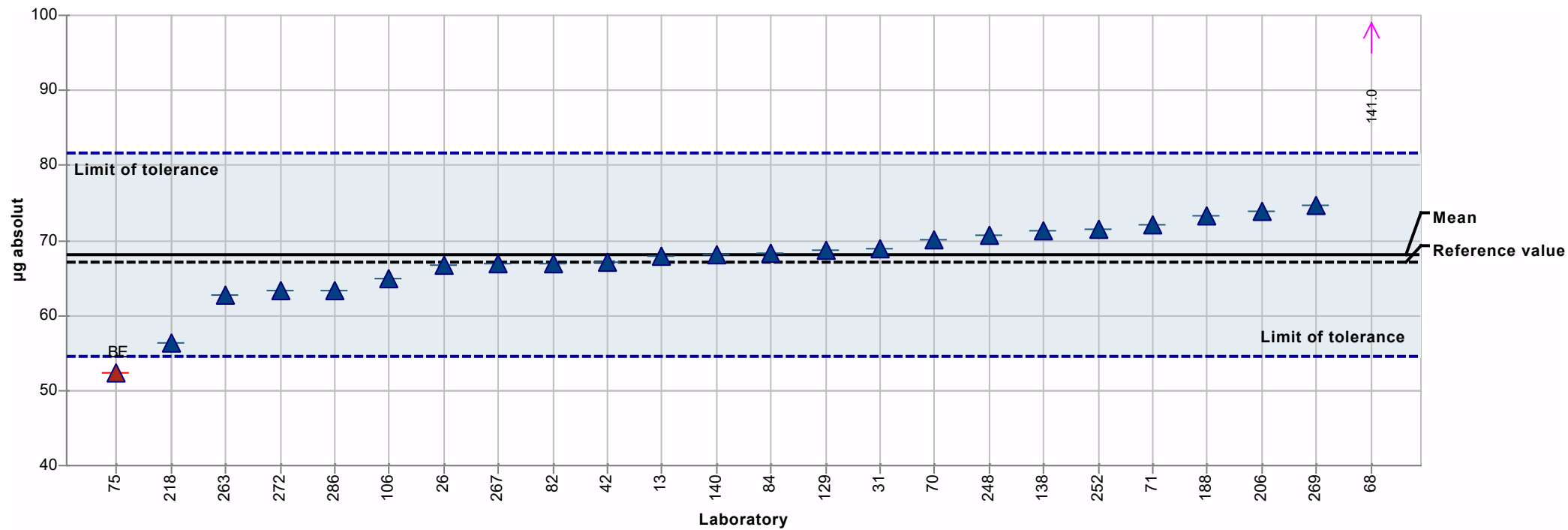
Summary results

Sample:	4 - Test	Mean:	4.77 µg absolut
Measurand:	Nickel	Reproducibility s.d.:	0.23 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	4.85%
Rel. target s.d.:	10.00%	Reference value:	5.11 µg absolut
Number of laboratories in calculation + outliers: 24		Range of tolerance:	3.81 - 5.72 µg absolut (Z-Score <= 2.00)



Summary results

Sample:	4 - Test	Mean:	68.1 µg absolut
Measurand:	Zinc	Reproducibility s.d.:	4.2 µg absolut
Method:	ISO 5725-2	Rel. reproducibility s.d.:	6.22%
Rel. target s.d.:	10.00%	Reference value:	67.1 µg absolut
Number of laboratories in calculation + outliers: 24		Range of tolerance:	54.5 - 81.7 µg absolut (Z-Score <= 2.00)



Sample chart of Z-Scores

Sample: 4 - Test

