

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

## Round-robin test Metals on filters

**July/August 2016**

## Summary of laboratory test results

Sample 1

Unit	copper Z score		nickel Z score		lead Z score		zinc Z score		cobalt Z score	
	µg absolute		µg absolute		µg absolute		µg absolute		µg absolute	
6	9,046	1,22	14,551	1,18	36,899	1,43	106,890	1,44	6,060	1,36
38	7,950	-0,14	12,750	-0,20	31,620	-0,20	91,800	-0,18	5,300	-0,07
48	7,380	-0,84	11,610	-1,08	26,950	-1,65	87,360	-0,65	4,770	-1,06
68	7,880	-0,22	12,900	-0,09	28,500	-1,17	92,200	-0,13	5,380	0,08
70	8,065	0,01	13,000	-0,01	31,570	-0,22	94,170	0,08	5,395	0,11
71	6,950	-1,38	11,420	-1,23	28,900	-1,05	86,000	-0,80	5,280	-0,10
82	8,080	0,02	13,400	0,29	31,700	-0,18	95,000	0,17	5,470	0,25
90	7,070	-1,23	11,290	-1,33	28,840	-1,07	80,750	-1,36	4,690	-1,21
91	7,196	-1,07	11,005	-1,55	29,456	-0,87	77,902	-1,66	4,798	-1,01
93	8,320	0,32	13,300	0,22	33,300	0,32	96,100	0,28	5,510	0,33
110	8,520	0,57	13,400	0,29	32,900	0,19	100,000	0,70	5,520	0,35
111	7,960	-0,13	12,400	-0,47	31,200	-0,33	95,500	0,22	5,280	-0,10
129	8,083	0,03	13,858	0,65	32,817	0,17	86,500	-0,74	5,767	0,81
131	7,690	-0,46	12,730	-0,22	31,390	-0,28	96,300	0,31	5,360	0,05
138	7,690	-0,46	16,200	2,45 E	29,800	-0,77	97,600	0,45	5,320	-0,03
147	8,050	-0,01	12,830	-0,14	32,100	-0,06	95,000	0,17	5,330	-0,01
177	7,200	-1,07	14,000	0,76	39,000	2,08 E	95,000	0,17	5,400	0,12
201	8,250	0,23	12,700	-0,24	33,400	0,35	82,600	-1,16	4,300	-1,94
206	7,400	-0,82	10,800	-1,70	< 0,200		85,500	-0,85	5,000	-0,63
231	8,040	-0,03	13,100	0,06	31,500	-0,24	91,800	-0,18	5,300	-0,07
232	10,252	2,72 E	14,965	1,50	37,600	1,65	104,664	1,20	6,264	1,74
252	7,700	-0,45	12,500	-0,40	32,600	0,10	93,200	-0,03	5,300	-0,07
263	10,300	2,78 E	14,300	0,99	37,400	1,59	107,000	1,45	6,100	1,43
269	8,340	0,35	13,400	0,29	32,300	0,01	99,100	0,61	5,070	-0,50
282	8,110	0,06	13,000	-0,01	32,970	0,21	98,030	0,49	5,430	0,18
-	-	--	-	--	-	--	-	--	-	--
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	

	copper Z score	nickel Z score	lead Z score	zinc Z score	cobalt Z score
No. of laboratories that submitted results	25	25	25	25	25
Mean	8,061	13,016	32,280	93,439	5,336
Reproducibility s.d.	0,823	1,251	3,011	7,533	0,435
Rel. reproducibility s.d.	10,21 %	9,61 %	9,33 %	8,06 %	8,16 %
Reference value	7,690	11,940	30,910	95,170	5,070
Target s.d.	0,806	1,302	3,228	9,344	0,534
Rel. target s.d.	10,00 %	10,00 %	10,00 %	10,00 %	10,00 %
Lower limit of tolerance	6,449	10,413	25,824	74,751	4,269
Upper limit of tolerance	9,673	15,620	38,736	112,126	6,403
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	25	25	24	25	25
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\text{-Score}  > 3,5$					
L: Differing laboratory mean (Grubbs II)	Grubbs für 2				

## Summary of laboratory test results

Sample 2

Unit	copper Z score		nickel Z score		lead Z score		zinc Z score		cobalt Z score	
	µg absolute		µg absolute		µg absolute		µg absolute		µg absolute	
6	18,464	1,19	12,506	0,94	126,750	1,40	36,659	1,06	3,089	1,14
38	16,820	0,19	11,160	-0,24	109,610	-0,14	32,500	-0,20	2,820	0,17
48	14,550	-1,18	9,930	-1,31	94,210	-1,53	27,850	-1,60	2,340	-1,56
68	16,400	-0,06	11,200	-0,20	99,700	-1,03	33,600	0,14	2,850	0,28
70	15,130	-0,83	10,590	-0,73	103,300	-0,71	32,560	-0,18	2,592	-0,65
71	16,950	0,27	10,920	-0,45	109,200	-0,18	33,800	0,20	2,990	0,78
82	16,700	0,12	11,500	0,06	108,000	-0,29	32,000	-0,35	2,820	0,17
90	16,490	-0,01	11,520	0,08	107,800	-0,31	30,520	-0,79	2,670	-0,37
91	14,193	-1,40	8,822	-2,28 BE	97,645	-1,22	26,371	-2,04 E	2,375	-1,44
93	17,200	0,42	11,900	0,41	119,000	0,70	35,400	0,68	2,950	0,64
110	17,200	0,42	11,600	0,15	113,000	0,16	36,100	0,89	2,820	0,17
111	16,900	0,24	11,100	-0,29	111,000	-0,02	34,900	0,53	2,860	0,31
129	16,392	-0,07	11,317	-0,10	108,392	-0,25	28,583	-1,38	2,550	-0,81
131	15,950	-0,33	11,160	-0,24	109,170	-0,18	34,510	0,41	2,870	0,35
138	16,800	0,18	19,100	6,71 BE	110,000	-0,11	36,300	0,95	2,930	0,56
147	17,380	0,53	11,620	0,17	115,120	0,35	34,280	0,34	2,910	0,49
177	16,500	0,00	12,300	0,76	121,000	0,88	33,000	-0,04	3,000	0,82
201	17,200	0,42	11,300	-0,11	108,000	-0,29	28,800	-1,31	2,460	-1,13
206	14,100	-1,45	7,700	-3,26 BE	< 0,200		26,100	-2,13 E	2,400	-1,35
217	16,600	0,06	11,030	-0,35	103,730	-0,67	31,610	-0,46	2,760	-0,05
231	16,800	0,18	11,300	-0,11	111,000	-0,02	32,700	-0,14	2,780	0,02
232	20,536	2,45 BE	13,079	1,44	128,325	1,54	36,504	1,01	3,256	1,74
252	16,500	0,00	11,200	-0,20	113,500	0,21	33,700	0,17	2,800	0,10
263	16,900	0,24	15,900	3,91 BE	124,000	1,15	43,200	3,03 E	2,660	-0,41
269	17,300	0,48	11,700	0,24	112,000	0,07	35,400	0,68	2,650	-0,45
282	17,100	0,36	11,510	0,07	116,460	0,47	34,890	0,53	2,910	0,49
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Method	ISO 5725-2		ISO 5725-2		ISO 5725-2		ISO 5725-2		ISO 5725-2	

	copper Z score	nickel Z score	lead Z score	zinc Z score	cobalt Z score
Assessment	Z <=2,00	Z <=2,00	Z <=2,00	Z <=2,00	Z <=2,00
No. of laboratories that submitted results	26	26	26	26	26
Mean	16,501	11,429	111,196	33,148	2,774
Reproducibility s.d.	1,022	0,647	8,374	3,680	0,225
Rel. reproducibility s.d.	6,19 %	5,66 %	7,53 %	11,10 %	8,09 %
Reference value	16,160	10,600	108,180	32,830	2,620
Target s.d.	1,650	1,143	11,120	3,315	0,277
Rel. target s.d.	10,00 %	10,00 %	10,00 %	10,00 %	10,00 %
Lower limit of tolerance	13,201	9,143	88,957	26,518	2,219
Upper limit of tolerance	19,801	13,715	133,436	39,777	3,328
Type B outliers	1	4			
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	25	22	25	26	26
Explanation of outlier types					
A: Single outlier	Grubbs				
B: Differing laboratory mean	Grubbs				
C: Excessive laboratory s.d.	Cochran				
D: Excluded manually					
E: mean outside tolerance limits					
F:  Z-Score >3,5					
L: Differing laboratory mean (Grubbs II)	Grubbs für 2				

## Summary of laboratory test results

Sample 3

Unit	copper Z score		nickel Z score		lead Z score		zinc Z score		cobalt Z score	
	µg absolute		µg absolute		µg absolute		µg absolute		µg absolute	
6	12,156	1,60	7,255	1,43	61,908	1,56	87,038	1,32	7,152	1,34
38	10,560	0,08	6,400	0,08	53,170	-0,07	74,510	-0,31	6,350	0,07
48	10,600	0,12	6,150	-0,31	50,700	-0,53	76,470	-0,06	6,230	-0,12
68	10,600	0,12	6,480	0,21	47,900	-1,05	76,600	-0,04	6,450	0,23
70	10,760	0,27	6,483	0,22	54,480	0,17	79,980	0,40	6,596	0,46
71	8,550	-1,84	5,120	-1,93	44,200	-1,75	65,200	-1,52	6,200	-0,17
82	11,100	0,59	6,850	0,79	53,300	-0,05	81,200	0,56	6,490	0,29
90	10,330	-0,14	6,370	0,04	52,910	-0,12	73,410	-0,45	6,150	-0,25
91	9,831	-0,62	5,391	-1,51	53,496	-0,01	68,774	-1,06	5,908	-0,63
93	9,910	-0,54	5,970	-0,59	50,900	-0,49	71,600	-0,69	6,030	-0,44
110	12,000	1,45	7,000	1,03	57,700	0,78	87,800	1,42	6,880	0,91
111	10,900	0,40	6,460	0,18	53,500	-0,01	81,100	0,55	6,500	0,31
129	10,100	-0,36	6,525	0,28	52,200	-0,25	70,250	-0,86	6,550	0,39
131	10,210	-0,26	6,450	0,16	52,390	-0,22	80,620	0,48	6,490	0,29
138	10,800	0,31	8,780	3,84 FE	53,300	-0,05	83,300	0,83	6,610	0,48
147	11,430	0,91	6,870	0,83	57,210	0,68	85,220	1,08	6,750	0,71
177	7,600	-2,75 E	14,700	13,16 BE	59,000	1,02	84,000	0,92	9,000	4,27 BE
201	12,600	2,02 E	6,130	-0,34	54,900	0,25	81,800	0,64	5,190	-1,77
206	10,000	-0,46	5,000	-2,12 E	< 0,200		69,100	-1,01	6,200	-0,17
217	10,510	0,03	6,160	-0,29	50,120	-0,64	73,480	-0,44	6,150	-0,25
231	10,600	0,12	6,330	-0,03	52,100	-0,27	75,400	-0,19	6,280	-0,04
232	14,624	3,96 BE	8,238	2,98 E	66,850	2,48 E	93,749	2,19 E	7,995	2,68 E
252	10,500	0,02	6,500	0,24	55,300	0,33	78,800	0,25	6,500	0,31
263	10,800	0,31	12,700	10,01 BE	54,300	0,14	54,200	-2,95 E	4,760	-2,45 E
269	11,100	0,59	6,750	0,64	53,800	0,05	82,300	0,70	6,180	-0,20
282	8,420	-1,96	5,080	-2,00	43,060	-1,96	63,400	-1,76	5,040	-2,01 E
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Method	ISO 5725-2		ISO 5725-2		ISO 5725-2		ISO 5725-2		ISO 5725-2	

	copper Z score	nickel Z score	lead Z score	zinc Z score	cobalt Z score
Assessment	Z <=2,00	Z <=2,00	Z <=2,00	Z <=2,00	Z <=2,00
No. of laboratories that submitted results	26	26	26	26	26
Mean	10,479	6,346	53,548	76,896	6,305
Reproducibility s.d.	1,104	0,730	4,898	8,598	0,647
Rel. reproducibility s.d.	10,54 %	11,51 %	9,15 %	11,18 %	10,27 %
Reference value	10,540	6,090	52,200	80,380	6,160
Target s.d.	1,048	0,635	5,355	7,690	0,631
Rel. target s.d.	10,00 %	10,00 %	10,00 %	10,00 %	10,00 %
Lower limit of tolerance	8,383	5,077	42,838	61,517	5,044
Upper limit of tolerance	12,574	7,615	64,257	92,275	7,566
Type B outliers	1	2			1
Type F outliers		1			
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	25	23	25	26	25
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

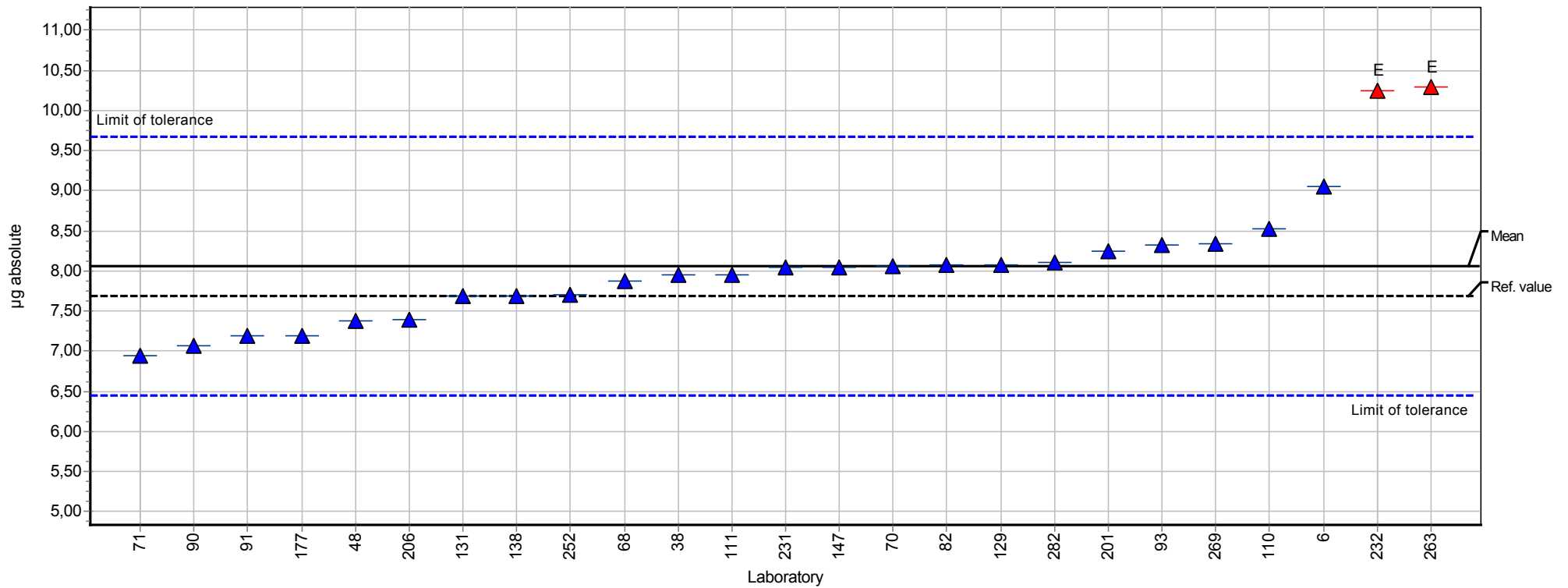
	copper Score	nickel Score	lead Score	zinc Score	cobalt Score	
Unit	µg absolute	µg absolute	µg absolute	µg absolute	µg absolute	
6	10,089	9,961	49,805	48,208	5,013	
38	10,560	10,760	51,250	53,720	5,340	
48	9,580	9,310	47,660	45,410	4,860	
68	9,700	10,100	44,400	50,000	5,050	
70	10,020	9,981	49,610	49,770	5,012	
71	10,040	10,110	50,500	49,500	5,240	
82	10,000	10,000	50,000	50,000	5,000	
90	10,390	9,960	49,910	46,190	4,890	
91	9,413	8,702	49,981	43,753	4,746	
93	9,720	9,130	46,200	43,500	4,610	
110	10,200	10,100	50,900	50,800	5,080	
111	10,600	10,400	52,000	52,700	5,250	
129	10,058	10,033	48,925	48,167	5,558	
131	10,050	10,020	49,560	48,060	5,050	
138	9,560	10,050	55,040	53,720	4,940	
147	10,520	10,040	49,700	49,300	5,000	
177	12,000	10,700	54,000	52,000	5,400	
201	11,000	10,100	56,200	53,400	5,000	
206	10,300	9,500	< 0,010	47,810	5,130	
217	9,710	9,690	47,600	49,080	4,770	
231	9,130	9,960	50,500	45,700	4,980	
232	12,034	11,515	57,300	53,986	5,822	B
252	10,400	10,700	54,900	52,200	5,300	
263	10,400	11,500	52,500	45,800	5,000	
269	9,990	10,100	48,900	51,300	4,990	
282	10,080	10,200	51,740	51,330	5,070	
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Method	ISO 5725-2	ISO 5725-2	ISO 5725-2	ISO 5725-2	ISO 5725-2	



	copper Score	nickel Score	lead Score	zinc Score	cobalt Score
Assessment	unknown	unknown	unknown	unknown	unknown
No. of laboratories that submitted results	26	26	26	26	26
Mean	10,213	10,101	50,763	49,439	5,051
Reproducibility s.d.	0,671	0,612	3,018	3,079	0,211
Rel. reproducibility s.d.	6,57 %	6,06 %	5,95 %	6,23 %	4,18 %
Reference value	10,000	10,000	50,000	50,000	5,000
Target s.d.	0,671	0,612	3,018	3,079	0,211
Rel. target s.d.	6,57 %	6,06 %	5,95 %	6,23 %	4,18 %
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)	26	26	25	26	25
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\text{-Score}  > 3,5$					
L: Differing laboratory mean (Grubbs II)	Grubbs für 2				

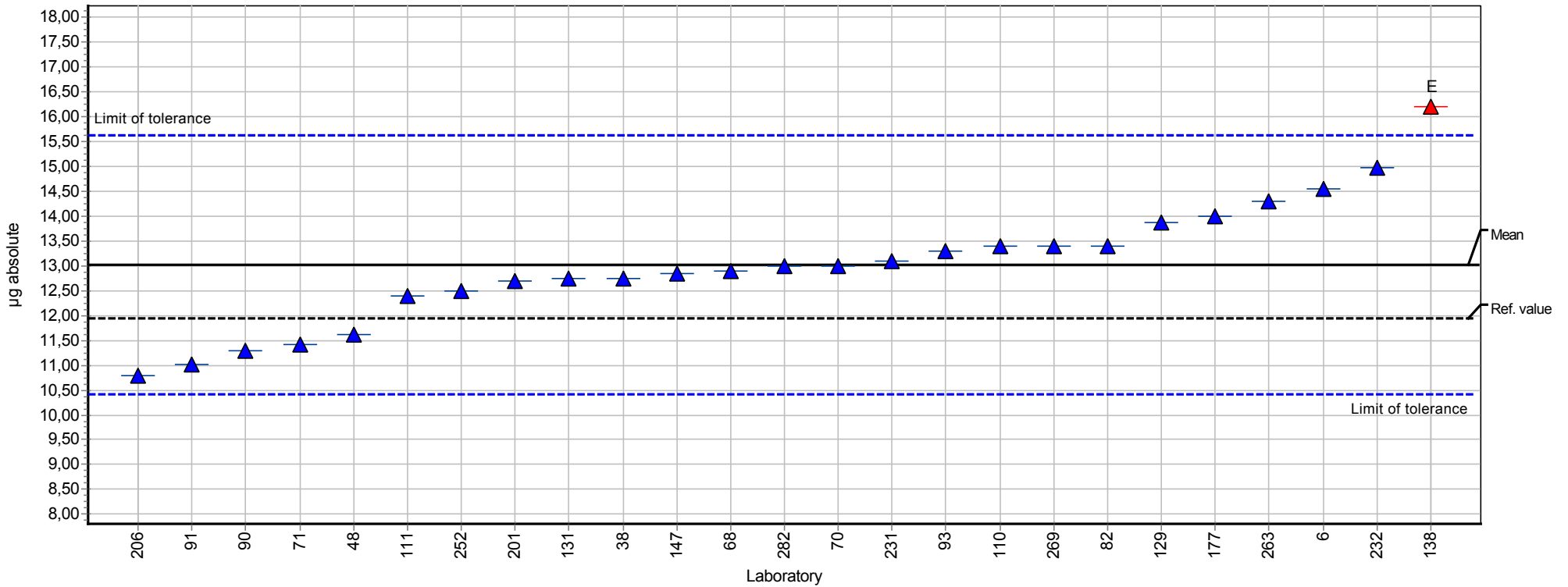
## Summary results

<b>Measurand:</b>	copper	<b>Mean:</b>	8,061 µg absolute
<b>Sample:</b>	1	<b>Reproducibility s.d.:</b>	0,823 µg absolute
<b>Method:</b>	ISO 5725-2	<b>Relative reproducibility s.d.:</b>	10,21%
<b>Relative target s.d.:</b>	10,00% (Limited)	<b>Reference value:</b>	7,690 µg absolute
<b>No. of laboratories:</b>	25	<b>Range of tolerance:</b>	6,449 - 9,673 µg absolute ( $ Z\text{-Score}  \leq 2,00$ )



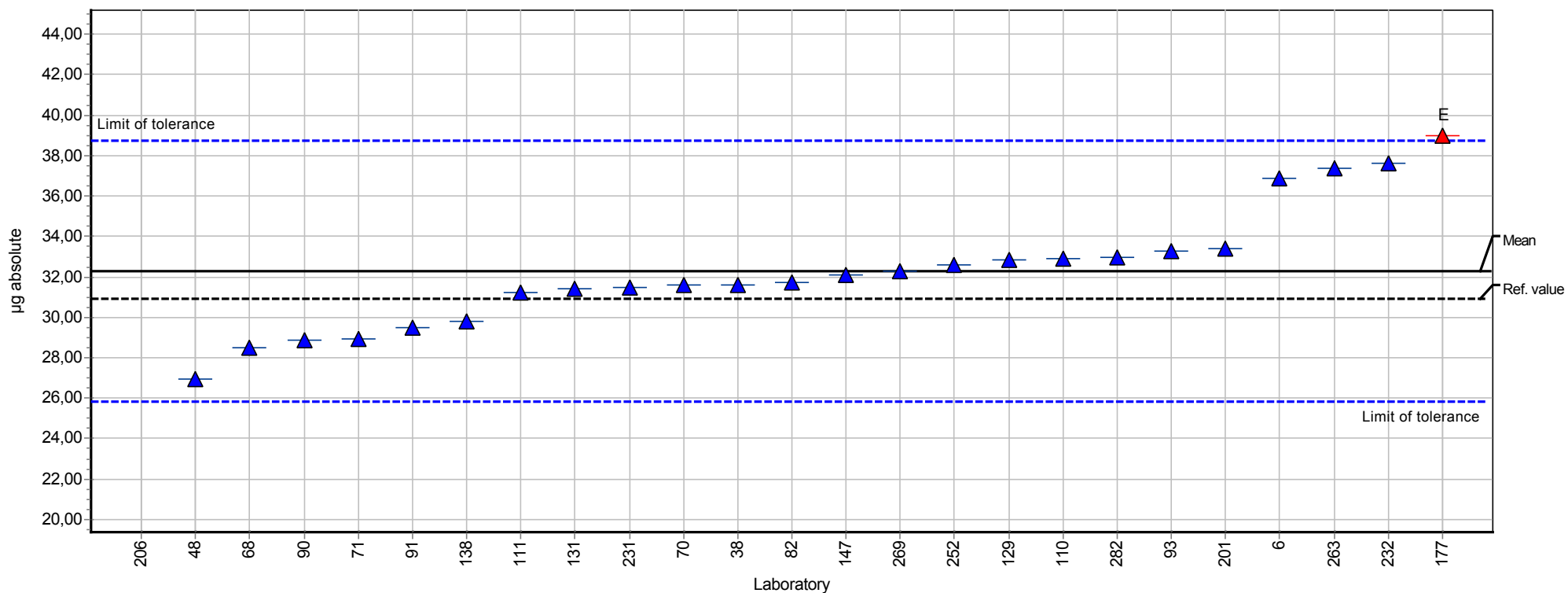
## Summary results

<b>Measurand:</b>	nickel	<b>Mean:</b>	13,016 µg absolute
<b>Sample:</b>	1	<b>Reproducibility s.d.:</b>	1,251 µg absolute
<b>Method:</b>	ISO 5725-2	<b>Relative reproducibility s.d.:</b>	9,61%
<b>Relative target s.d.:</b>	10,00% (Limited)	<b>Reference value:</b>	11,940 µg absolute
<b>No. of laboratories:</b>	25	<b>Range of tolerance:</b>	10,413 - 15,620 µg absolute ( $ Z\text{-Score}  \leq 2,00$ )



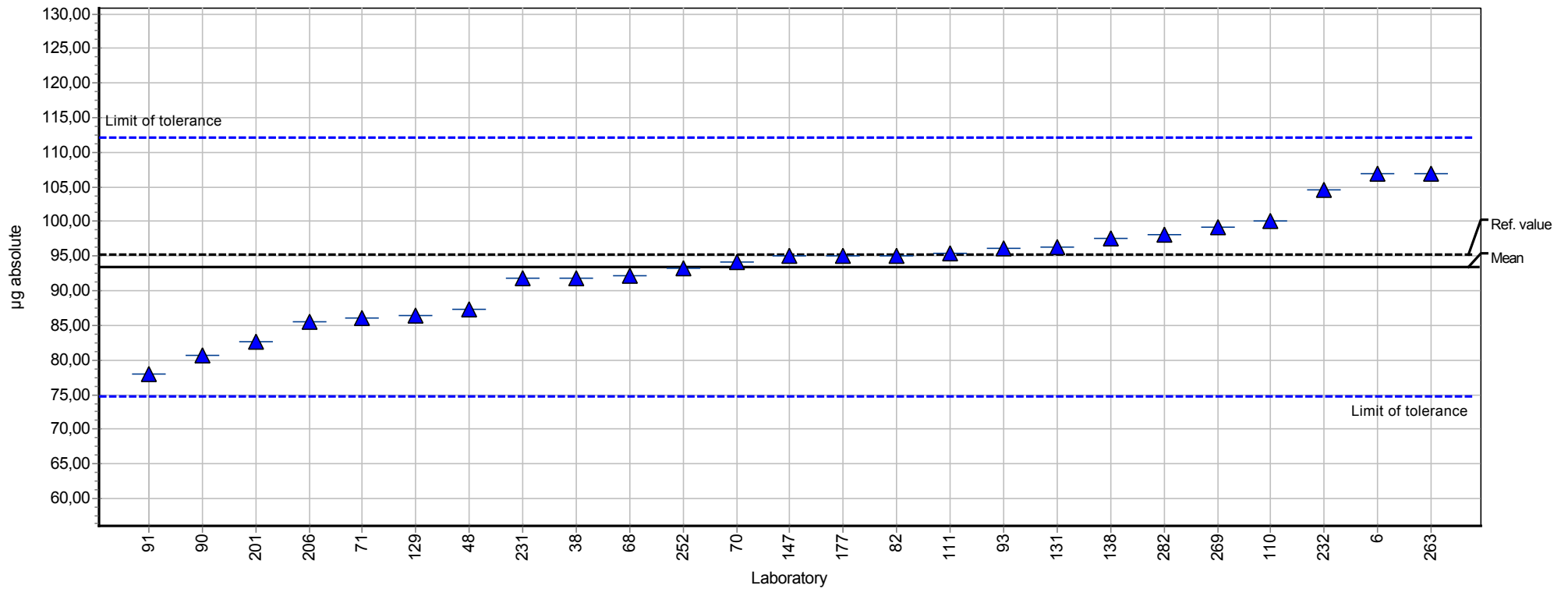
## Summary results

<b>Measurand:</b>	lead	<b>Mean:</b>	32,280 µg absolute
<b>Sample:</b>	1	<b>Reproducibility s.d.:</b>	3,011 µg absolute
<b>Method:</b>	ISO 5725-2	<b>Relative reproducibility s.d.:</b>	9,33%
<b>Relative target s.d.:</b>	10,00% (Limited)	<b>Reference value:</b>	30,910 µg absolute
<b>No. of laboratories:</b>	24	<b>Range of tolerance:</b>	25,824 - 38,736 µg absolute ( Z-Score  <= 2,00)



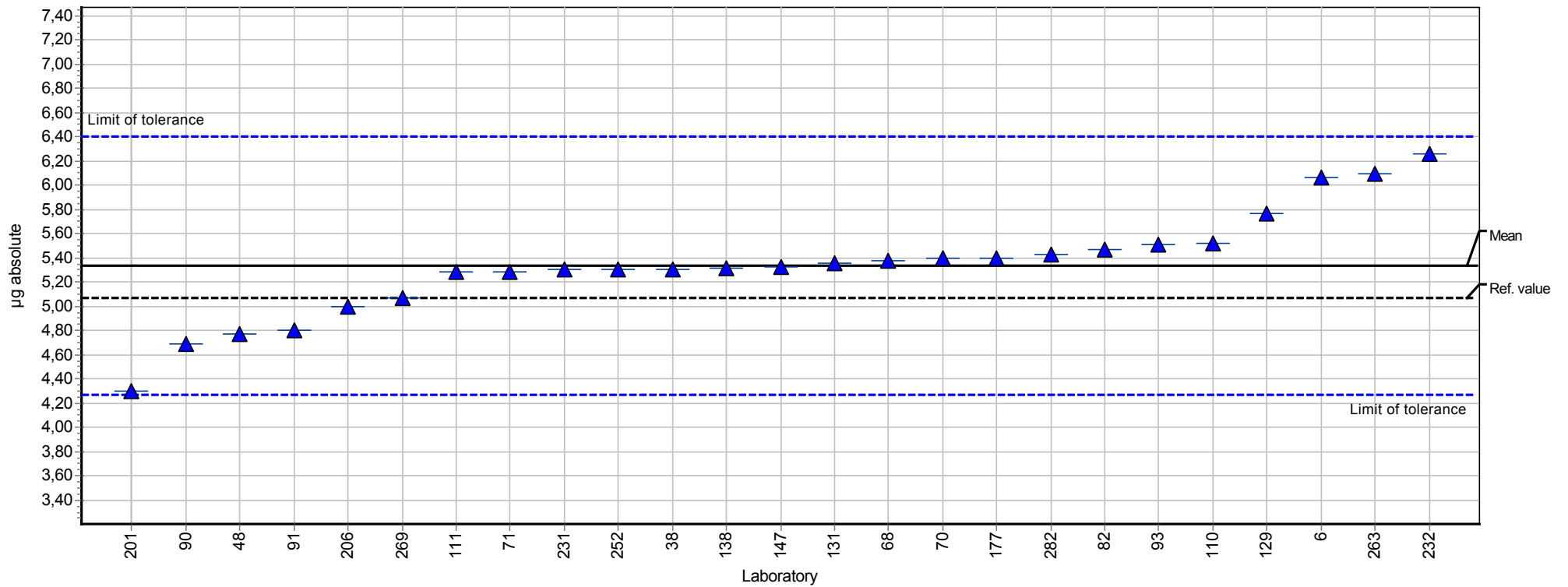
## Summary results

<b>Measurand:</b>	<b>zinc</b>	<b>Mean:</b>	<b>93,439 µg absolute</b>
<b>Sample:</b>	<b>1</b>	<b>Reproducibility s.d.:</b>	<b>7,533 µg absolute</b>
<b>Method:</b>	<b>ISO 5725-2</b>	<b>Relative reproducibility s.d.:</b>	<b>8,06%</b>
<b>Relative target s.d.:</b>	<b>10,00% (Limited)</b>	<b>Reference value:</b>	<b>95,170 µg absolute</b>
<b>No. of laboratories:</b>	<b>25</b>	<b>Range of tolerance:</b>	<b>74,751 - 112,126 µg absolute ( Z-Score  &lt;= 2,00)</b>



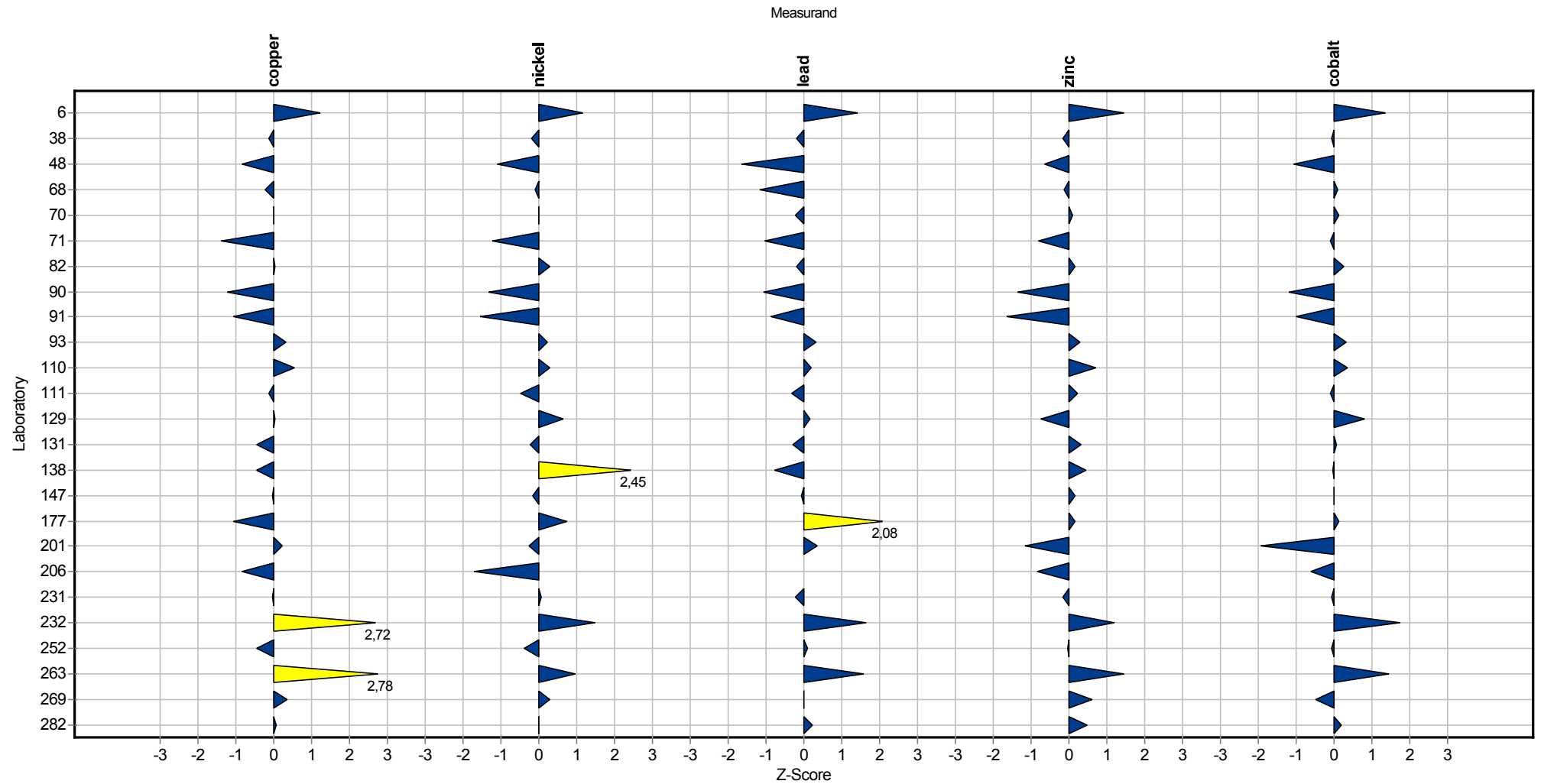
## Summary results

<b>Measurand:</b>	cobalt	<b>Mean:</b>	5,336 µg absolute
<b>Sample:</b>	1	<b>Reproducibility s.d.:</b>	0,435 µg absolute
<b>Method:</b>	ISO 5725-2	<b>Relative reproducibility s.d.:</b>	8,16%
<b>Relative target s.d.:</b>	10,00% (Limited)	<b>Reference value:</b>	5,070 µg absolute
<b>No. of laboratories:</b>	25	<b>Range of tolerance:</b>	4,269 - 6,403 µg absolute ( $ Z\text{-Score}  \leq 2,00$ )



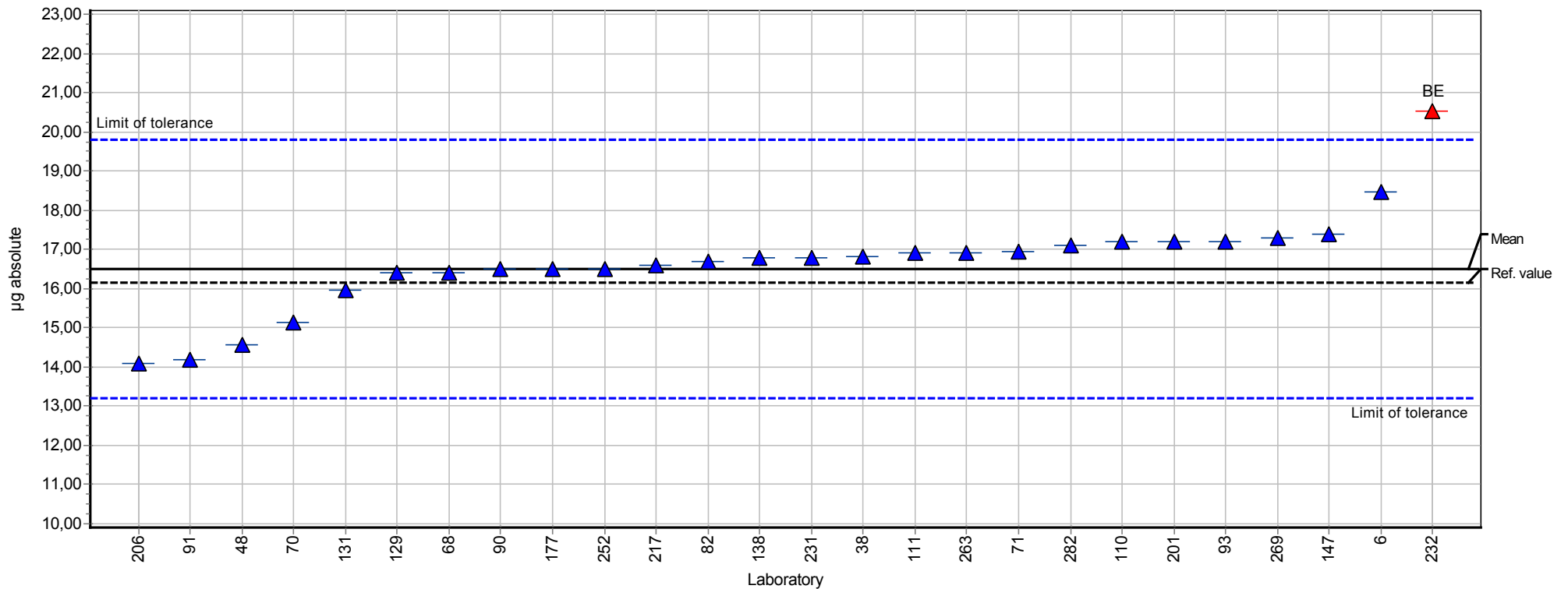
# Sample chart of Z-scores

Sample 1



## Summary results

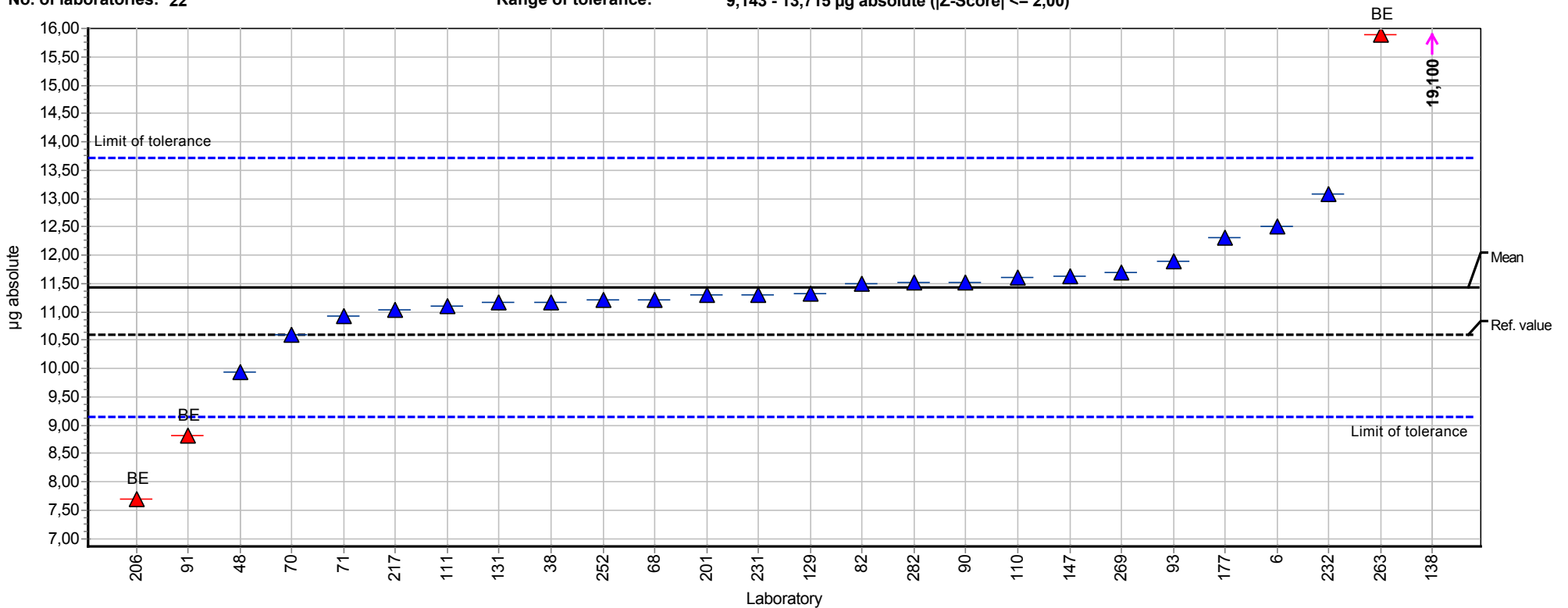
<b>Measurand:</b>	copper	<b>Mean:</b>	16,501 µg absolute
<b>Sample:</b>	2	<b>Reproducibility s.d.:</b>	1,022 µg absolute
<b>Method:</b>	ISO 5725-2	<b>Relative reproducibility s.d.:</b>	6,19%
<b>Relative target s.d.:</b>	10,00% (Limited)	<b>Reference value:</b>	16,160 µg absolute
<b>No. of laboratories:</b>	25	<b>Range of tolerance:</b>	13,201 - 19,801 µg absolute ( $ Z\text{-Score}  \leq 2,00$ )





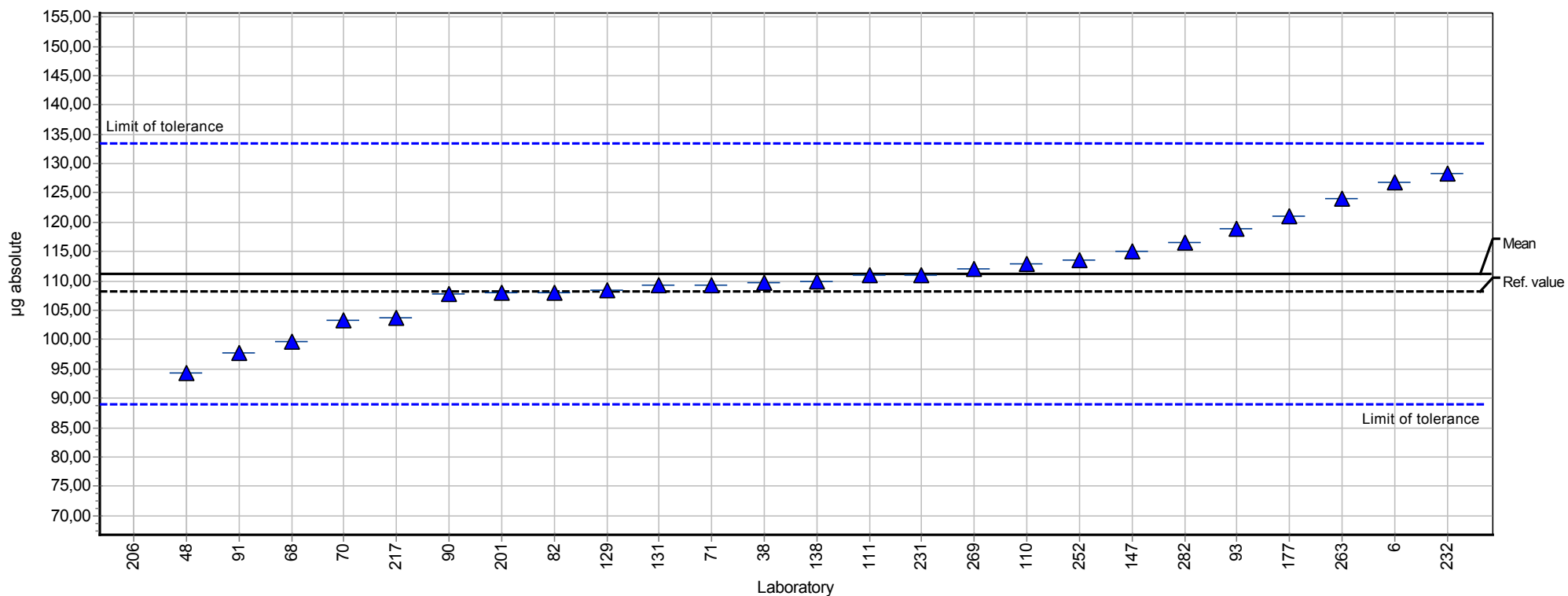
## Summary results

<b>Measurand:</b>	nickel	<b>Mean:</b>	11,429 µg absolute
<b>Sample:</b>	2	<b>Reproducibility s.d.:</b>	0,647 µg absolute
<b>Method:</b>	ISO 5725-2	<b>Relative reproducibility s.d.:</b>	5,66%
<b>Relative target s.d.:</b>	10,00% (Limited)	<b>Reference value:</b>	10,600 µg absolute
<b>No. of laboratories:</b>	22	<b>Range of tolerance:</b>	9,143 - 13,715 µg absolute ( Z-Score  <= 2,00)



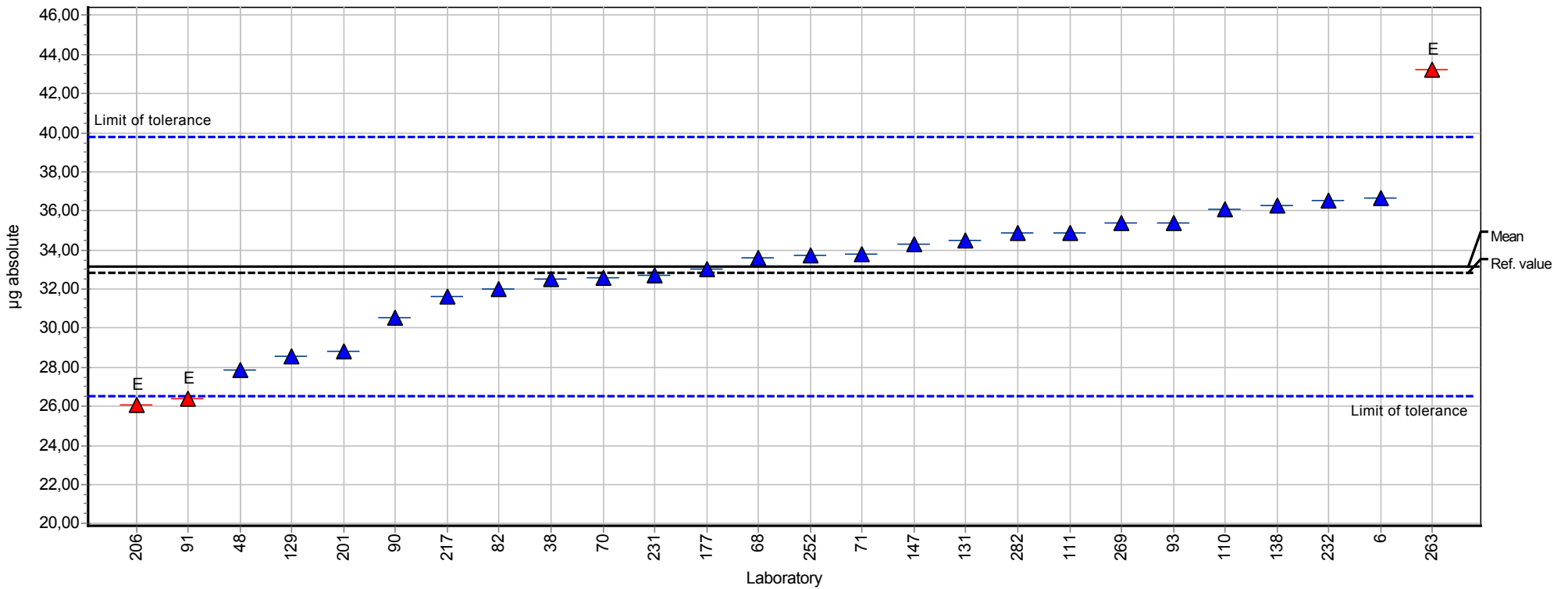
## Summary results

<b>Measurand:</b>	lead	<b>Mean:</b>	111,196 µg absolute
<b>Sample:</b>	2	<b>Reproducibility s.d.:</b>	8,374 µg absolute
<b>Method:</b>	ISO 5725-2	<b>Relative reproducibility s.d.:</b>	7,53%
<b>Relative target s.d.:</b>	10,00% (Limited)	<b>Reference value:</b>	108,180 µg absolute
<b>No. of laboratories:</b>	25	<b>Range of tolerance:</b>	88,957 - 133,436 µg absolute ( $ Z\text{-Score}  \leq 2,00$ )



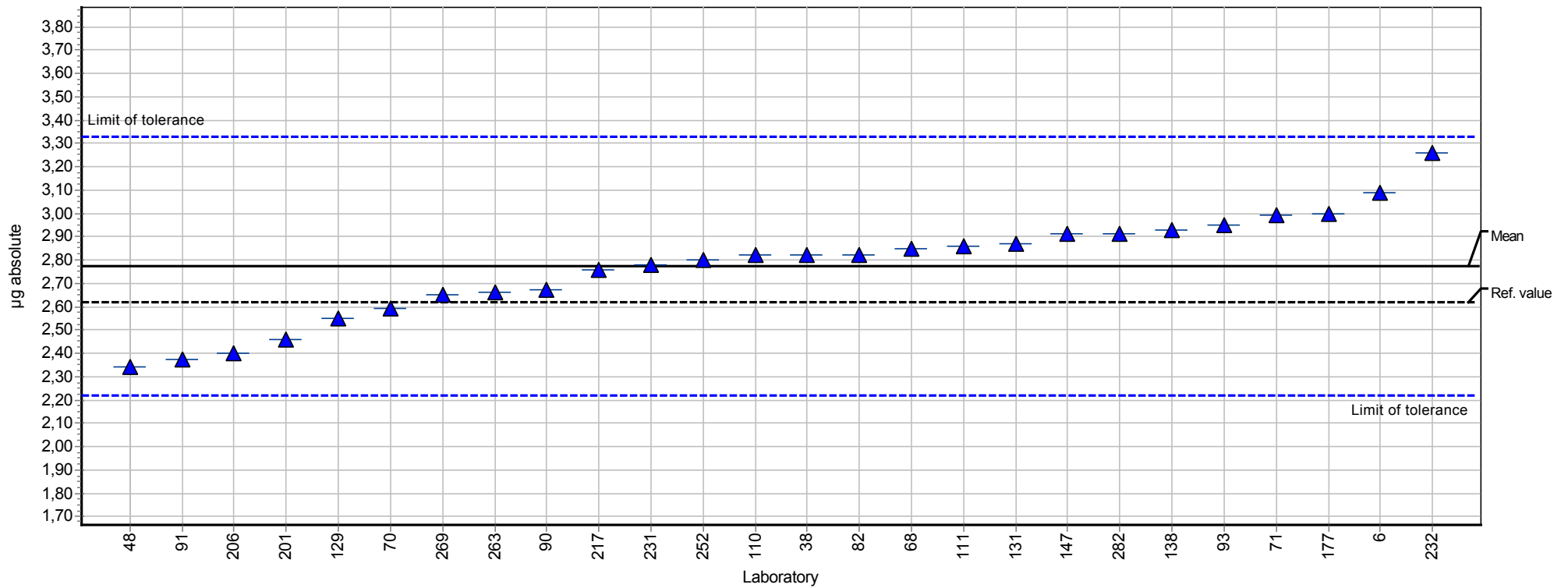
## Summary results

<b>Measurand:</b>	<b>zinc</b>	<b>Mean:</b>	<b>33,148 µg absolute</b>
<b>Sample:</b>	<b>2</b>	<b>Reproducibility s.d.:</b>	<b>3,680 µg absolute</b>
<b>Method:</b>	<b>ISO 5725-2</b>	<b>Relative reproducibility s.d.:</b>	<b>11,10%</b>
<b>Relative target s.d.:</b>	<b>10,00% (Limited)</b>	<b>Reference value:</b>	<b>32,830 µg absolute</b>
<b>No. of laboratories:</b>	<b>26</b>	<b>Range of tolerance:</b>	<b>26,518 - 39,777 µg absolute ( Z-Score  &lt;= 2,00)</b>



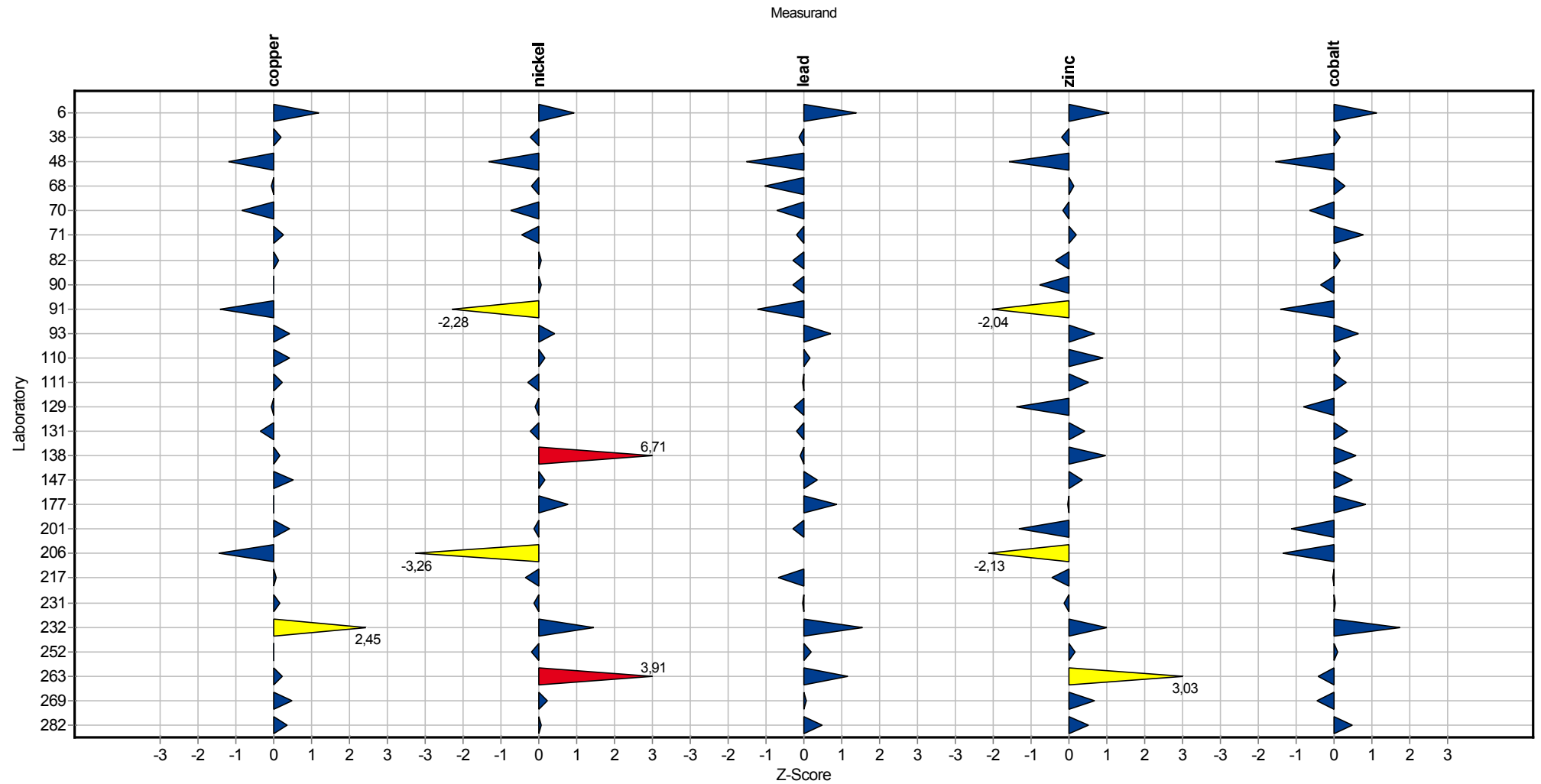
## Summary results

<b>Measurand:</b>	cobalt	<b>Mean:</b>	2,774 µg absolute
<b>Sample:</b>	2	<b>Reproducibility s.d.:</b>	0,225 µg absolute
<b>Method:</b>	ISO 5725-2	<b>Relative reproducibility s.d.:</b>	8,09%
<b>Relative target s.d.:</b>	10,00% (Limited)	<b>Reference value:</b>	2,620 µg absolute
<b>No. of laboratories:</b>	26	<b>Range of tolerance:</b>	2,219 - 3,328 µg absolute ( $ Z\text{-Score}  \leq 2,00$ )



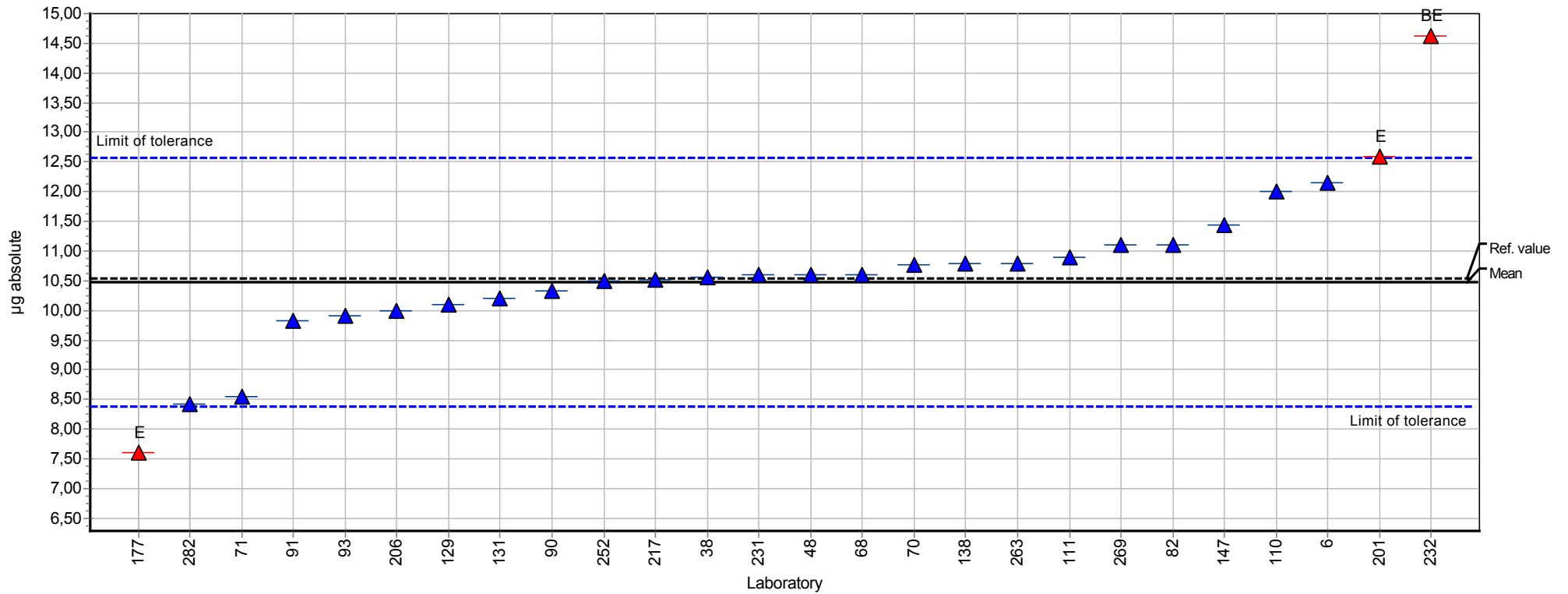
# Sample chart of Z-scores

Sample 2



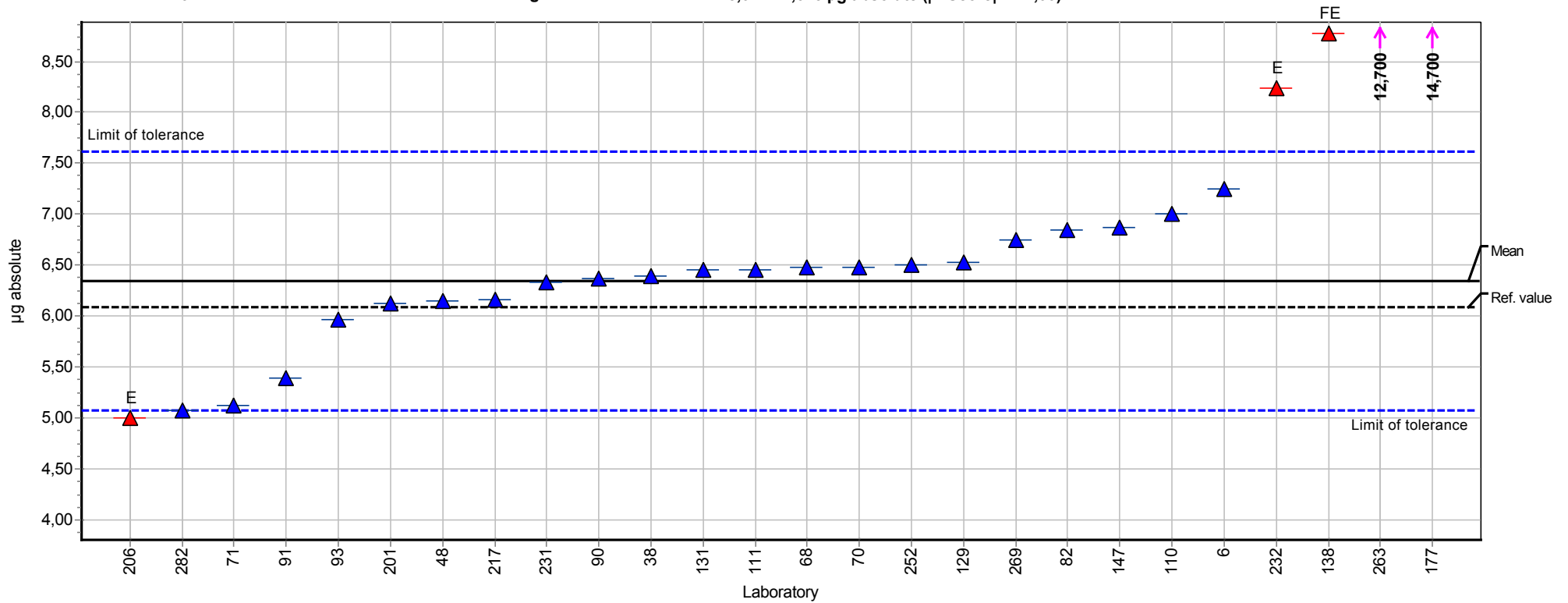
## Summary results

<b>Measurand:</b>	copper	<b>Mean:</b>	10,479 µg absolute
<b>Sample:</b>	3	<b>Reproducibility s.d.:</b>	1,104 µg absolute
<b>Method:</b>	ISO 5725-2	<b>Relative reproducibility s.d.:</b>	10,54%
<b>Relative target s.d.:</b>	10,00% (Limited)	<b>Reference value:</b>	10,540 µg absolute
<b>No. of laboratories:</b>	25	<b>Range of tolerance:</b>	8,383 - 12,574 µg absolute ( Z-Score  <= 2,00)



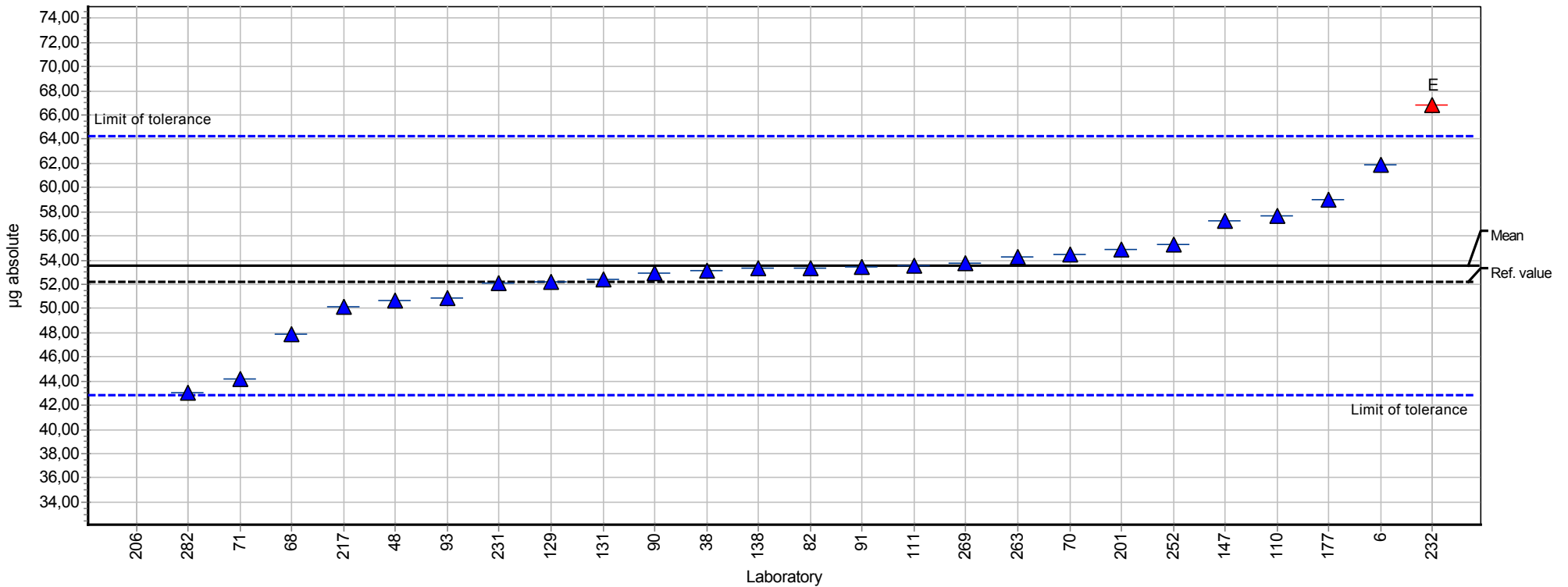
## Summary results

<b>Measurand:</b>	nickel	<b>Mean:</b>	6,346 µg absolute
<b>Sample:</b>	3	<b>Reproducibility s.d.:</b>	0,730 µg absolute
<b>Method:</b>	ISO 5725-2	<b>Relative reproducibility s.d.:</b>	11,51%
<b>Relative target s.d.:</b>	10,00% (Limited)	<b>Reference value:</b>	6,090 µg absolute
<b>No. of laboratories:</b>	23	<b>Range of tolerance:</b>	5,077 - 7,615 µg absolute ( Z-Score  <= 2,00)



## Summary results

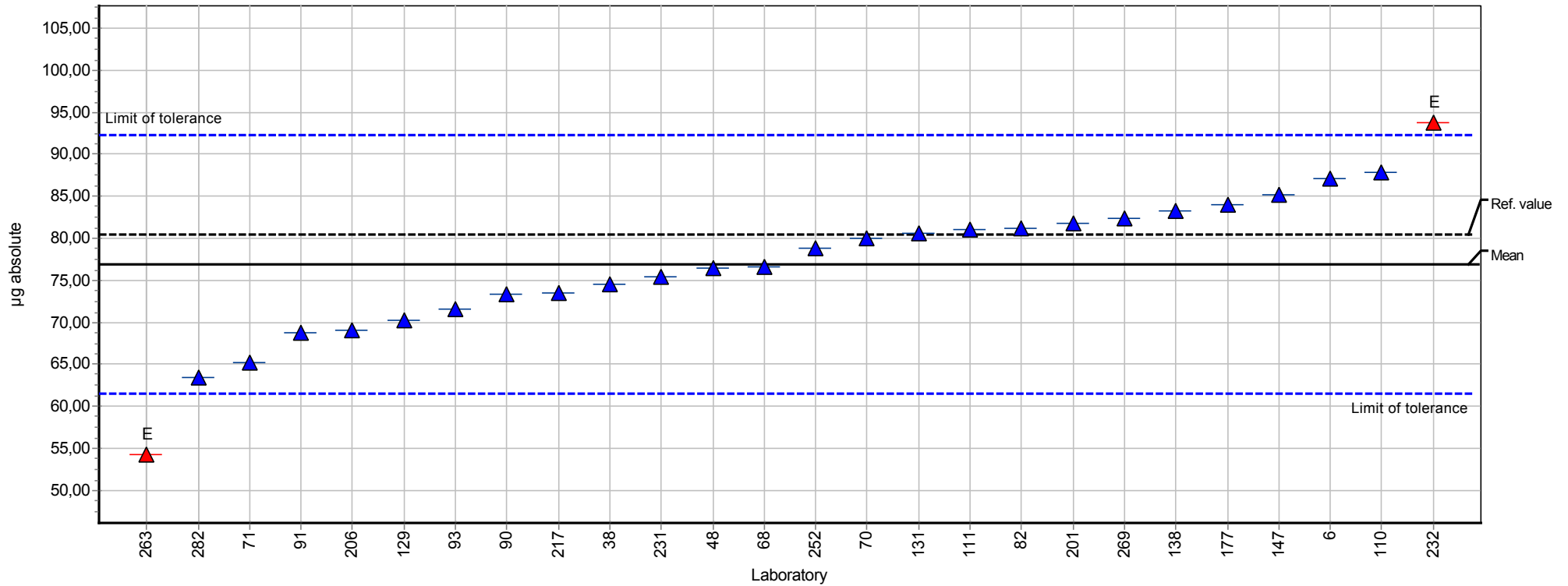
<b>Measurand:</b>	lead	<b>Mean:</b>	53,548 µg absolute
<b>Sample:</b>	3	<b>Reproducibility s.d.:</b>	4,898 µg absolute
<b>Method:</b>	ISO 5725-2	<b>Relative reproducibility s.d.:</b>	9,15%
<b>Relative target s.d.:</b>	10,00% (Limited)	<b>Reference value:</b>	52,200 µg absolute
<b>No. of laboratories:</b>	25	<b>Range of tolerance:</b>	42,838 - 64,257 µg absolute ( $ Z\text{-Score}  \leq 2,00$ )





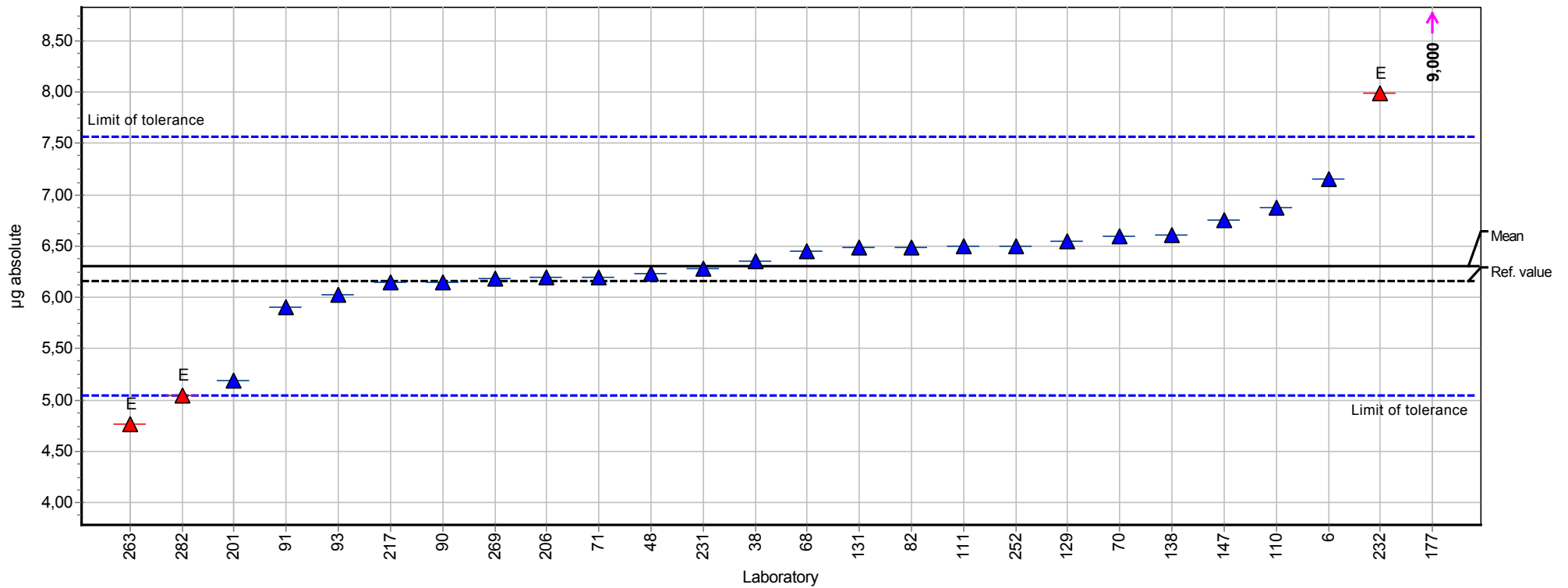
## Summary results

<b>Measurand:</b>	<b>zinc</b>	<b>Mean:</b>	<b>76,896 µg absolute</b>
<b>Sample:</b>	<b>3</b>	<b>Reproducibility s.d.:</b>	<b>8,598 µg absolute</b>
<b>Method:</b>	<b>ISO 5725-2</b>	<b>Relative reproducibility s.d.:</b>	<b>11,18%</b>
<b>Relative target s.d.:</b>	<b>10,00% (Limited)</b>	<b>Reference value:</b>	<b>80,380 µg absolute</b>
<b>No. of laboratories:</b>	<b>26</b>	<b>Range of tolerance:</b>	<b>61,517 - 92,275 µg absolute ( Z-Score  &lt;= 2,00)</b>



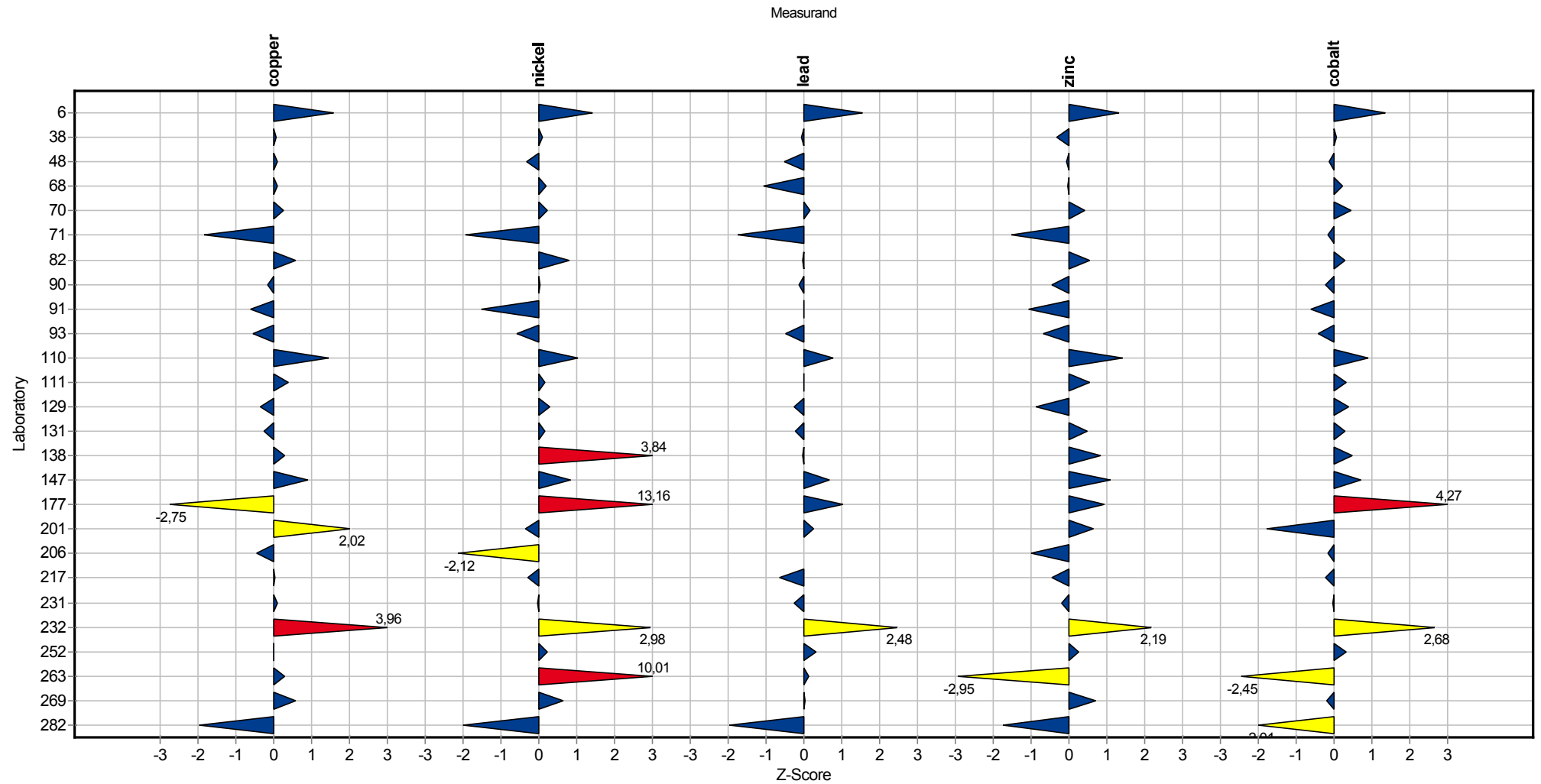
## Summary results

<b>Measurand:</b>	cobalt	<b>Mean:</b>	6,305 µg absolute
<b>Sample:</b>	3	<b>Reproducibility s.d.:</b>	0,647 µg absolute
<b>Method:</b>	ISO 5725-2	<b>Relative reproducibility s.d.:</b>	10,27%
<b>Relative target s.d.:</b>	10,00% (Limited)	<b>Reference value:</b>	6,160 µg absolute
<b>No. of laboratories:</b>	25	<b>Range of tolerance:</b>	5,044 - 7,566 µg absolute ( $ Z\text{-Score}  \leq 2,00$ )



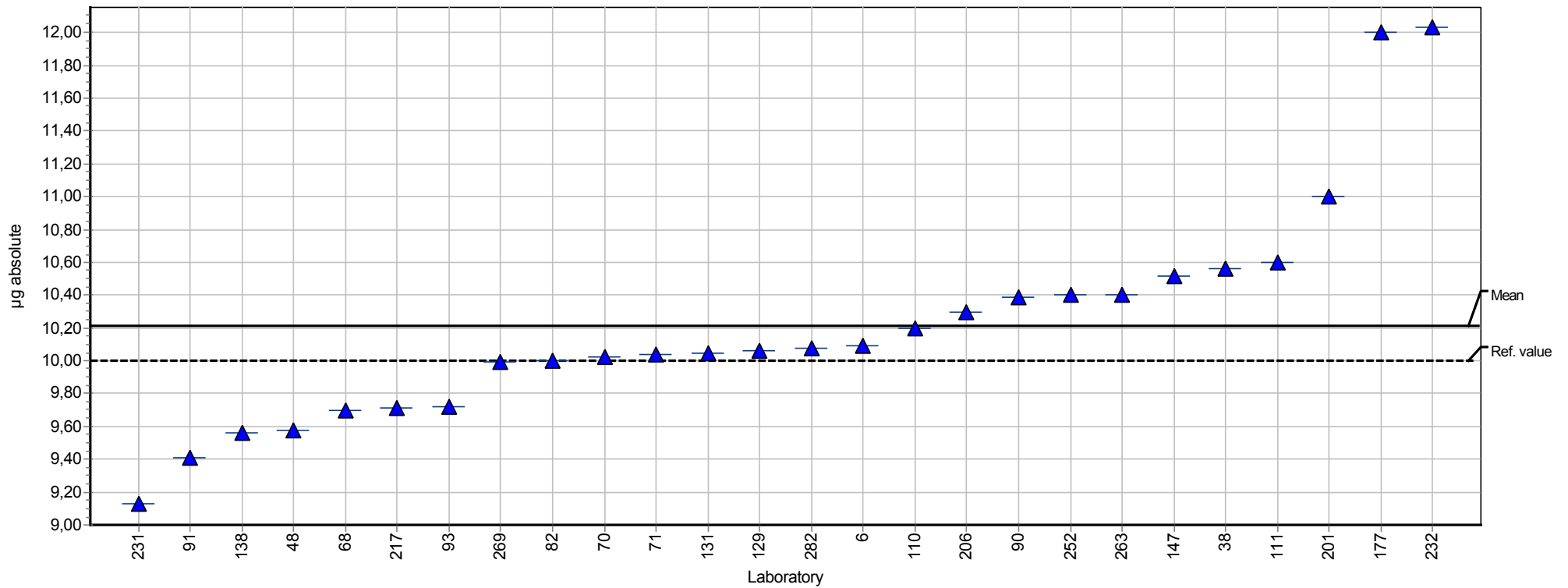
# Sample chart of Z-scores

Sample 3



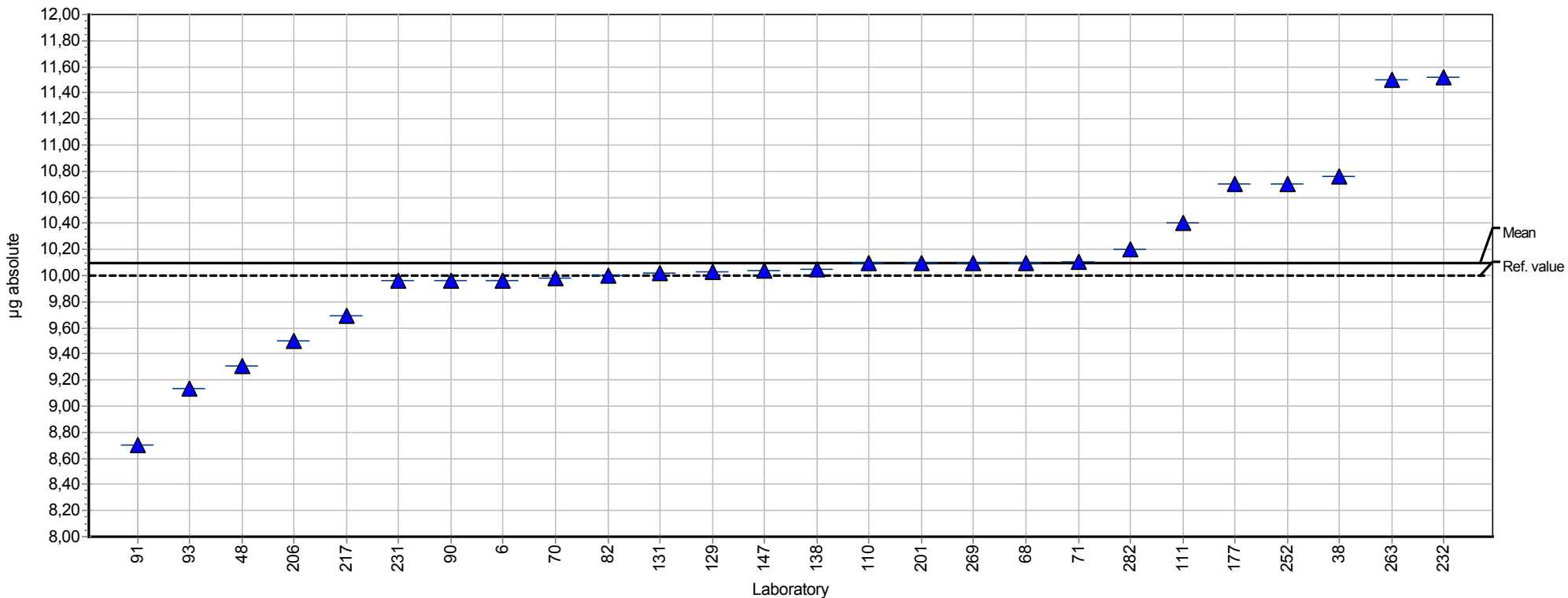
## Summary results

<b>Measurand:</b>	copper	<b>Mean:</b>	10,213 µg absolute
<b>Sample:</b>	reference solution	<b>Reproducibility s.d.:</b>	0,671 µg absolute
<b>Method:</b>	ISO 5725-2	<b>Relative reproducibility s.d.:</b>	6,57%
<b>Relative target s.d.:</b>	6,57% (Empirical value)	<b>Reference value:</b>	10,000 µg absolute
<b>No. of laboratories:</b>	26	<b>Range of tolerance:</b>	not available



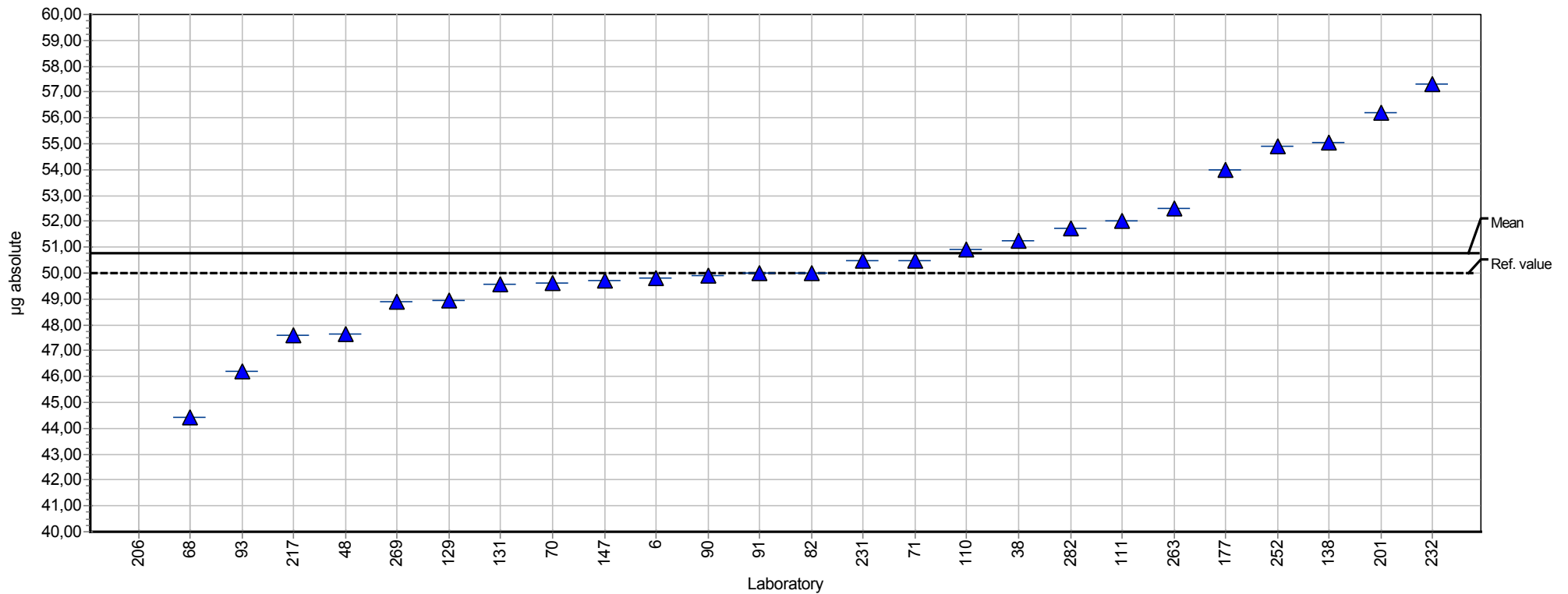
## Summary results

<b>Measurand:</b>	nickel	<b>Mean:</b>	10,101 µg absolute
<b>Sample:</b>	reference solution	<b>Reproducibility s.d.:</b>	0,612 µg absolute
<b>Method:</b>	ISO 5725-2	<b>Relative reproducibility s.d.:</b>	6,06%
<b>Relative target s.d.:</b>	6,06% (Empirical value)	<b>Reference value:</b>	10,000 µg absolute
<b>No. of laboratories:</b>	26	<b>Range of tolerance:</b>	not available



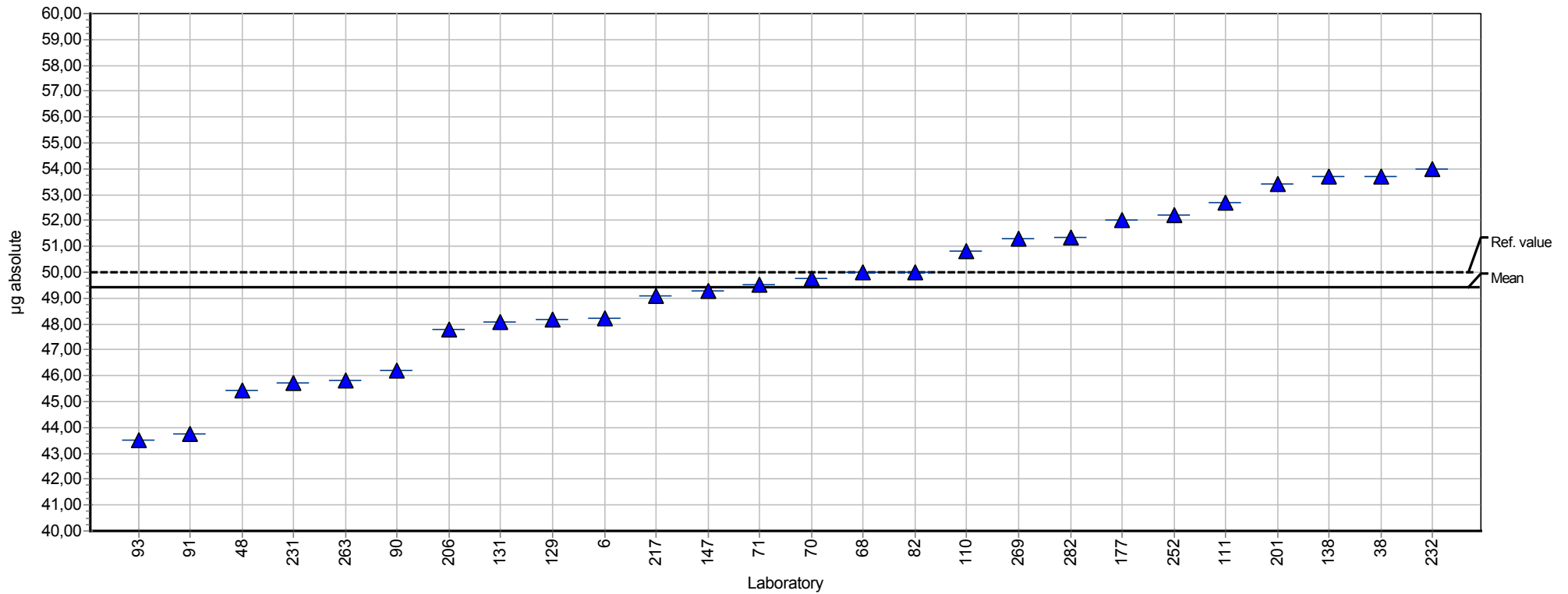
## Summary results

<b>Measurand:</b>	lead	<b>Mean:</b>	50,763 µg absolute
<b>Sample:</b>	reference solution	<b>Reproducibility s.d.:</b>	3,018 µg absolute
<b>Method:</b>	ISO 5725-2	<b>Relative reproducibility s.d.:</b>	5,95%
<b>Relative target s.d.:</b>	5,95% (Empirical value)	<b>Reference value:</b>	50,000 µg absolute
<b>No. of laboratories:</b>	25	<b>Range of tolerance:</b>	not available



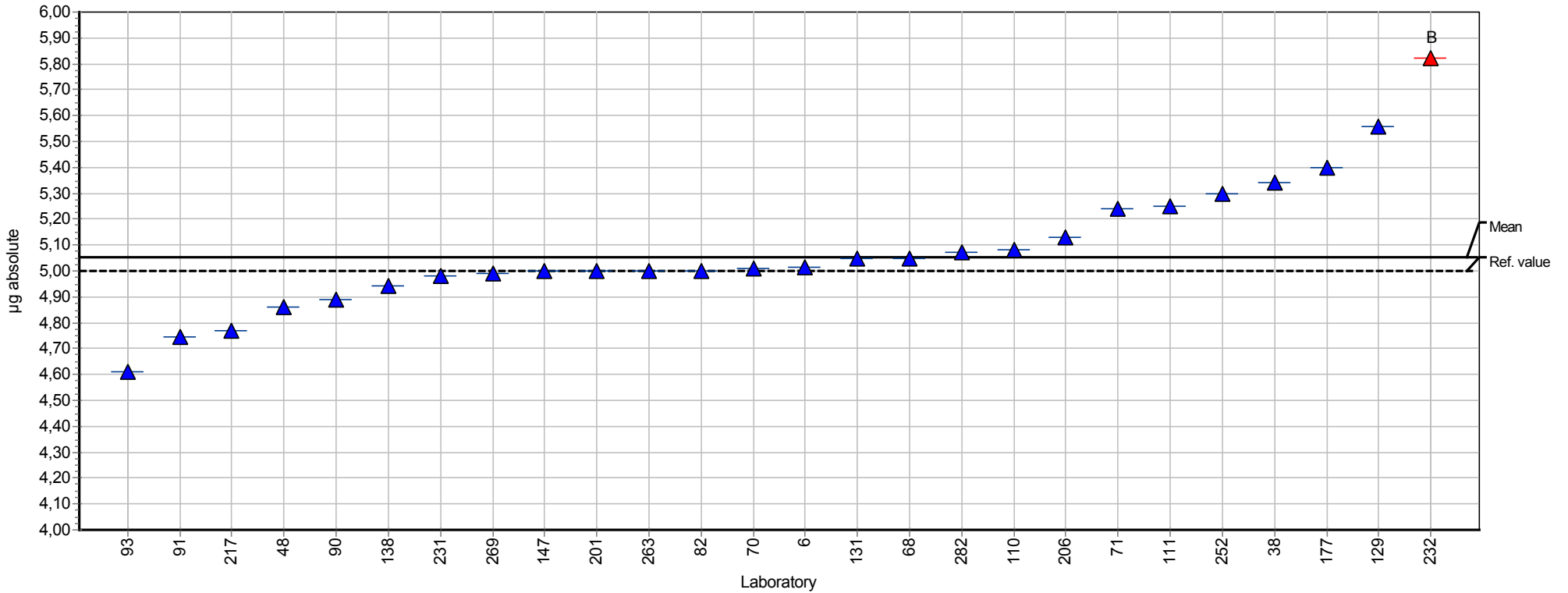
## Summary results

<b>Measurand:</b>	<b>zinc</b>	<b>Mean:</b>	<b>49,439 µg absolute</b>
<b>Sample:</b>	<b>reference solution</b>	<b>Reproducibility s.d.:</b>	<b>3,079 µg absolute</b>
<b>Method:</b>	<b>ISO 5725-2</b>	<b>Relative reproducibility s.d.:</b>	<b>6,23%</b>
<b>Relative target s.d.:</b>	<b>6,23% (Empirical value)</b>	<b>Reference value:</b>	<b>50,000 µg absolute</b>
<b>No. of laboratories:</b>	<b>26</b>	<b>Range of tolerance:</b>	<b>not available</b>



## Summary results

<b>Measurand:</b>	cobalt	<b>Mean:</b>	5,051 µg absolute
<b>Sample:</b>	reference solution	<b>Reproducibility s.d.:</b>	0,211 µg absolute
<b>Method:</b>	ISO 5725-2	<b>Relative reproducibility s.d.:</b>	4,18%
<b>Relative target s.d.:</b>	4,18% (Empirical value)	<b>Reference value:</b>	5,000 µg absolute
<b>No. of laboratories:</b>	25	<b>Range of tolerance:</b>	not available





## Questions and Answers

Participant	pulping method
6	IFA-Arbeitsmappe,Blatt 6015
38	Standardaufschluss nach IFA-Arbeitsmappe (Blatt 6015)
48	IFA-working folder sheet 6015
68	IFA-Arbeitsmappe
70	analog IFA-Arbeitsmappe, Blatt 6015
71	IFA , Blatt 6015
82	in Anlehnung an IFA-Arbeitsmappe Blatt 6015
90	microwave digestion
91	IFA Blatt 6015
93	reflux for 2 hours on a hot plate with mixture of 2 vol nitric acid +1vol hydrochloric acid( as described in the IFA paper)
110	nach IFA-Arbeitsmappe, Blatt 6015
111	IFA 6015
129	IFA Arbeitsmappe (Blatt 6015)
131	Hot block 90°C without reflux
138	BGIA 6015
147	IFA-working folder (sheet 6015)
177	Standardaufschluss nach IFA-Arbeitsmappe (Blatt 6015)
201	IFA 6015
206	Frage 1 - 3 & 5: 9 ml Mischung (2 Teile HNO <sub>3</sub> , 1 Teil HCl) + 1ml IS (1mg Rh / L), dann 1:10 mit VE-Wasser, im Anschluss ICP-MS-Messung
217	microwave digestion
231	DIN EN 14385 Vollaufschluss
232	6015
252	IFA 6015
263	IFA-Arbeitsmappe Blatt 6015
269	IFA-Arbeitsmappe Blatt 6015
282	IFA-Arbeitsmappe, Blatt 6015

Participant	Säurekonzentration	mixing ratio	time of pulping
6	HNO <sub>3</sub> 65% HCl 25%	2:1	2

Round-robin test metals 2016

Participant	Säurekonzentration	mixing ratio	time of pulping
38	Salpetersäure 69%, Salzsäure 30%, suprapur	2:1	2
48	%65 HNO3+%30HCl	2:1	2
68	HNO3 65% und HCl 37%	2:1	2 Std.
70	Salpetersäure: 65%ig; Salzsäure: 30%ig	2:1	2
71	60 % HNO3 ; 30 % HCL	2:1	2
82	HNO3 65% , HCl 30%	17 mL HNO3 + 7 mL HCl	2
90	HNO3 65% / HCl 25%	2 vol HNO3 / 1 vol HCl	1h40
91	lt. IFA Blatt 6015	lt. IFA Blatt 6015	lt. IFA Blatt 6015
93	HNO3 69% HCl 25%	2 vol HNO3/1volHCl	2 hours
110	HNO3 65% , HCl 25%	2 Teile HNO3 , 1 Teil HCl	2h
111	HNO3 65%, HCl 25%	2:1	2
129	HCL: 30%; HNO3: 65%	HCL:HNO3 = 1:2	2
131	HCl >37% and HNO3 > 65%	-	2 hours
138	HNO3 65 % , HCl 25 %	HNO3 2 Teile, HCl 1 Teil	2
147	HNO3 65 % , HCl 25%	2 volumes of acid nitric and 1 volume of hydrochloric acis	1h40
177	HNO3 69% / HCl 37%	2 Volumentteile HNO3 : 1 Volumentteil HCL	2 Stunden
201	65/25 %	2:1	2
206			2
217	65% HNO3 + 25% HCl	2 volumes 65% HNO3 : 1 volume 25% HCl	1 h
231	3ml HNO3 65%ig+2ml HF conc.+15 ml Borsäure gesättigt/Wasser Verhältniss 2:1		40 min
232	wie angegeben	wie angegeben	2
252	IFA 6015	IFA 6015	1
263	HNO3 65%, HCl 35%	2:1 HNO3:HCL	2 Stunden
269	2 Teile (V) HNO3 (65 %) + 1 Teil (V) HCl (25%)	Aufschluss mit 12,5 ml des Gemisches nach 2	2 h siedend
282	HNO3 65%; HCl 25 %	2:1	2 h

Participant	reagent volume	equipment	method for lead	method for copper	method for zinc
6	50	unter Rückfluss	ICP/MS	ICP/MS	ICP/MS
38	50	mit Rückfluss	ICPMS	ICPMS	ICPMS
48	10	open	ICP/MS	ICP/MS	ICP/MS
68	25 ml	geschlossen	ICP-OES	ICP-OES	ICP-OES
70	20	offen	ICP/OES	ICP/OES	ICP/OES

Round-robin test metals 2016

Participant	reagent volume	equipment	method for lead	method for copper	method for zinc
71	25 mL	geschlossen	ICP-OES	ICP-OES	ICP-OES
82	50 mL	geschlossen unter Rückfluss	ICP-OES	ICP-OES	ICP-OES
90	10 ml	closed	ICP/MS	ICP/MS	ICP/MS
91	lt. IFA Blatt 6015	lt. IFA Blatt 6015	ICP-MS	ICP-MS	ICP-MS
93	20ml	in an open conical flask	ICP/OES	ICP/OES	ICP/OES
110	20 ml	offen	ICP-OES	ICP-OES	ICP-OES
111	20	offen	ICP/MS	ICP/MS	ICP/MS
129	25	offen	AAS/Flamme	AAS/Flamme	AAS/Flamme
131	filters: 25mL and reference solution: 20mL	-	ICP/OES	ICP/OES	ICP/OES
138	50	offen	ICP-AES	ICP-AES	ICP-AES
147		hotplate (160°C), beaker with a watch glass	ICP/OES	ICP/OES	ICP/OES
177	20 ml	offen	ICP-OES	ICP-OES	ICP-OES
201	20 ml	offen	AAS/Flamme	AAS/Graphit	AAS/Flamme
206		Mikrowellendruckaufschluss	ICP-MS	ICP-MS	ICP-MS
217	5 mL	high pressure microwave digestion system	ICP MS	ICP MS	ICP MS
231	25	geschlossen, Mikrowelle	ICP-OES	ICP-OES	ICP-OES
232	20		ICPOES DIN ISO 11885	s.o.	s.o.
252	50	offen	ICP/OES	ICP/OES	ICP/OES
263	50 mL	offen	ICP-MS	ICP-MS	ICP-MS
269	auf 25 ml mit Reinstwasser	offen unter Rückfluss	DIN EN ISO 11885 (ICP-OES)	DIN EN ISO 11885 (ICP-OES)	DIN EN ISO 11885 (ICP-OES)
282	20 mL	offen	ICP-OES	ICP-OES	ICP-OES

Participant	method for cobalt	method for nickel
6	ICP/MS	ICP/MS
38	ICPMS	ICPMS
48	ICP/MS	ICP/MS
68	ICP-OES	ICP-OES
70	ICP/OES	ICP/OES
71	ICP-OES	ICP-OES
82	ICP-OES	ICP-OES
90	ICP/MS	ICP/MS
91	ICP-MS	ICP-MS

## Round-robin test metals 2016

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Participant	method for cobalt	method for nickel
93	ICP/OES	ICP/OES
110	ICP-OES	ICP-OES
111	ICP/MS	ICP/MS
129	AAS/Flamme	AAS/Flamme
131	ICP/OES	ICP/OES
138	ICP-AES	ICP-AES
147	ICP/OES	ICP/OES
177	ICP-OES	ICP-OES
201	AAS/Graphit	AAS/Graphit
206	ICP-MS	ICP-MS
217	ICP MS	ICP MS
231	ICP-OES	ICP-OES
232	s.o.	s.o.
252	ICP/OES	ICP/OES
263	ICP-MS	ICP-MS
269	DIN EN ISO 11885 (ICP-OES)	DIN EN ISO 11885 (ICP-OES)
282	ICP-OES	ICP-OES

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