

Round-robin tests for in-house and external measuring stations - results and evaluation

Round-robin test „Inorganic Acids 2017“

March 2017

Part 1: volatile acids

Summary of laboratory test results

Measurand hydrochloric acid

Unit	Sample 1 Z score		Sample 2 Z score		Sample 3 Z score	
	mg/m ³		mg/m ³		mg/m ³	
10	1,010	-0,44	1,760	-0,46	2,870	-0,38
68	1,070	0,13	1,900	0,29	2,770	-0,71
78	0,994	-0,59	1,810	-0,19	3,027	0,15
82	1,118	0,59	1,851	0,03	3,200	0,73
86	1,118	0,59	1,883	0,20	2,669	-1,05
90	1,010	-0,44	1,800	-0,25	2,990	0,03
93	1,038	-0,17	1,909	0,34	3,094	0,38
95	0,865	-1,81	1,532	-1,70	2,146	-2,80 E
99	1,010	-0,44	1,950	0,57	2,810	-0,58
100	1,080	0,23	1,790	-0,30	3,000	0,06
110	1,030	-0,25	1,830	-0,09	3,070	0,30
114	1,020	-0,34	1,890	0,24	2,957	-0,08
131	1,112	0,53	1,979	0,72	3,105	0,41
134	1,172	1,10	2,057	1,14	3,085	0,35
143	1,074	0,17	1,776	-0,38	3,223	0,81
144	1,027	-0,28	1,844	-0,01	3,150	0,56
147	1,075	0,18	1,780	-0,36	2,975	-0,02
151	1,070	0,13	1,910	0,35	3,380	1,33
174	0,966	-0,85	1,721	-0,68	2,860	-0,41
177	1,051	-0,05	1,829	-0,09	3,132	0,50
178	1,090	0,32	1,680	-0,90	2,960	-0,07
188	1,040	-0,15	1,860	0,08	3,120	0,46
195	1,230	1,65	2,120	1,49	4,040	3,55 BE
197	1,060	0,04	1,910	0,35	3,110	0,43
208	1,160	0,98	1,800	-0,25	3,320	1,13
239	1,070	0,13	1,850	0,02	3,030	0,16
242	1,035	-0,20	1,813	-0,18	3,173	0,64
264	0,975	-0,77	1,423	-2,29 BE	2,287	-2,33 E

	Sample 1 Z score	Sample 2 Z score	Sample 3 Z score
280	0,010 -9,91 BE	0,005 -9,97 BE	0,035 -9,88 BE
-	-	-	-
Method	ISO 5725-2	ISO 5725-2	ISO 5725-2
Assessment	Z <=2,00	Z <=2,00	Z <=2,00
Mean	1,056	1,846	2,982
Reproducibility s.d.	0,070	0,114	0,273
Rel. reproducibility s.d.	6,66 %	6,15 %	9,15 %
Reference value	1,080	1,870	3,150
Target s.d.	0,106	0,185	0,298
Rel. target s.d.	10,00 %	10,00 %	10,00 %
Lower limit of tolerance	0,845	1,477	2,386
Upper limit of tolerance	1,267	2,215	3,578
No. of laboratories that submitted results	29	29	29
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	28	27	27
Explanation of outlier types			
A: Single outlier	Grubbs		
B: Differing laboratory mean	Grubbs		
C: Excessive laboratory s.d.	Cochran		
D: Excluded manually			
E: mean outside tolerance limits			
F: Z-Score >3,5			
L: Differing laboratory mean (Grubbs II)	Grubbs für 2		

Summary of laboratory test results

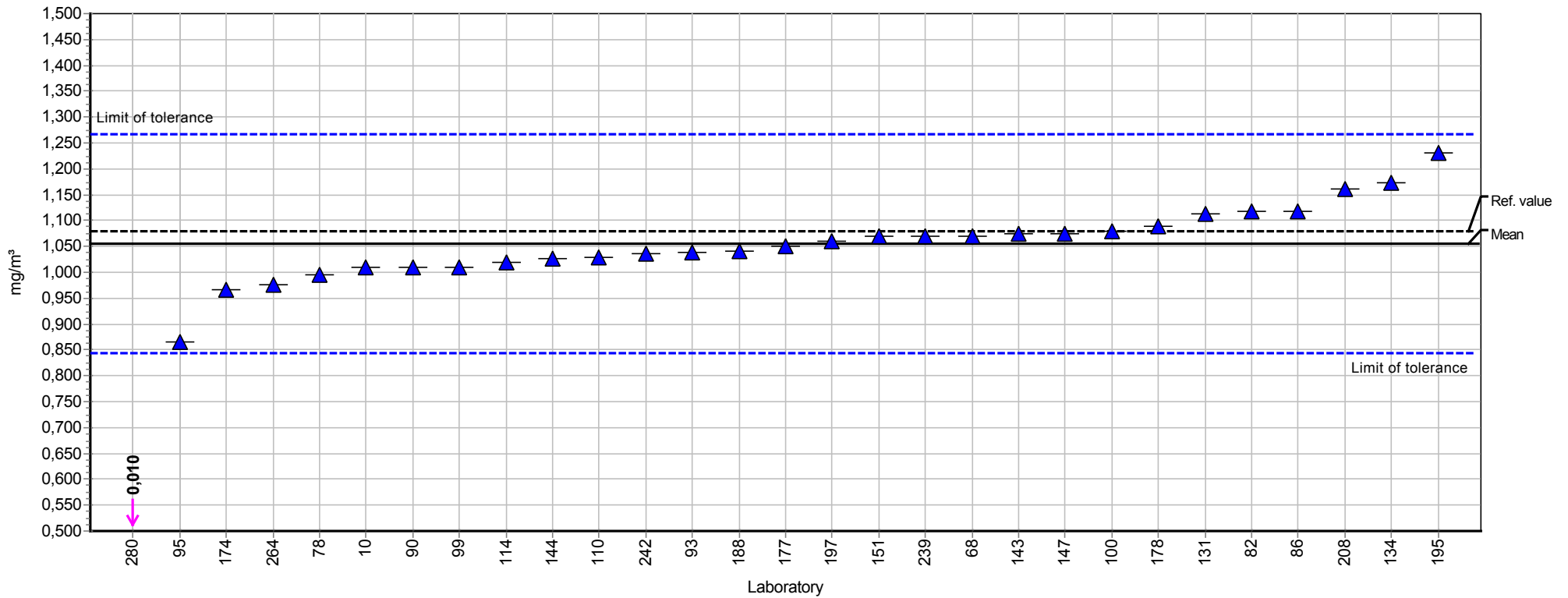
Measurand nitric acid

Unit	Sample 1 Z score		Sample 2 Z score		Sample 3 Z score	
	mg/m ³		mg/m ³		mg/m ³	
10	0,825	0,22	2,210	-0,13	2,690	-0,10
68	0,850	0,53	2,350	0,49	2,720	0,01
78	0,763	-0,55	2,206	-0,15	2,641	-0,28
82	0,813	0,07	2,229	-0,05	2,765	0,18
86	0,778	-0,36	2,152	-0,39	2,381	-1,24
90	0,790	-0,21	2,250	0,05	2,650	-0,25
93	0,805	-0,03	2,287	0,21	2,734	0,06
95	0,778	-0,36	2,031	-0,93	2,727	0,04
99	0,830	0,28	2,260	0,09	3,070	1,30
100	0,830	0,28	2,260	0,09	2,640	-0,28
110	0,820	0,16	2,220	-0,09	2,850	0,49
114	0,725	-1,02	2,146	-0,42	2,295	-1,55
131	0,829	0,27	2,372	0,59	2,848	0,48
134	0,963	1,93	2,434	0,87	2,689	-0,10
143	0,758	-0,61	2,137	-0,46	2,789	0,27
144	0,796	-0,14	2,255	0,07	2,828	0,41
147	0,856	0,60	2,370	0,58	2,573	-0,53
151	0,800	-0,09	2,300	0,27	2,800	0,31
174	0,757	-0,62	2,183	-0,25	2,461	-0,94
177	0,812	0,06	2,229	-0,05	2,785	0,25
178	0,800	-0,09	2,120	-0,53	2,500	-0,80
188	0,800	-0,09	2,280	0,18	2,820	0,38
195	0,890	1,02	2,590	1,56	2,880	0,60
197	0,840	0,40	2,360	0,54	2,940	0,82
208	0,932	1,54	2,210	-0,13	3,060	1,26
239	0,710	-1,21	1,900	-1,52	2,530	-0,69
242	0,767	-0,50	2,134	-0,47	2,682	-0,13
264	0,688	-1,48	1,530	-3,17 BE	1,710	-3,71 BE

	Sample 1 Z score	Sample 2 Z score	Sample 3 Z score
280	0,015 -9,81 BE	0,015 -9,93 BE	0,118 -9,57 BE
-	- --	- --	- --
Method	ISO 5725-2	ISO 5725-2	ISO 5725-2
Assessment	Z <=2,00	Z <=2,00	Z <=2,00
Mean	0,807	2,240	2,717
Reproducibility s.d.	0,059	0,131	0,183
Rel. reproducibility s.d.	7,36 %	5,86 %	6,75 %
Reference value	0,860	2,300	3,040
Target s.d.	0,081	0,224	0,272
Rel. target s.d.	10,00 %	10,00 %	10,00 %
Lower limit of tolerance	0,646	1,792	2,173
Upper limit of tolerance	0,969	2,688	3,260
No. of laboratories that submitted results	29	29	29
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	28	27	27
Explanation of outlier types			
A: Single outlier	Grubbs		
B: Differing laboratory mean	Grubbs		
C: Excessive laboratory s.d.	Cochran		
D: Excluded manually			
E: mean outside tolerance limits			
F: Z-Score >3,5			
L: Differing laboratory mean (Grubbs II)	Grubbs für 2		

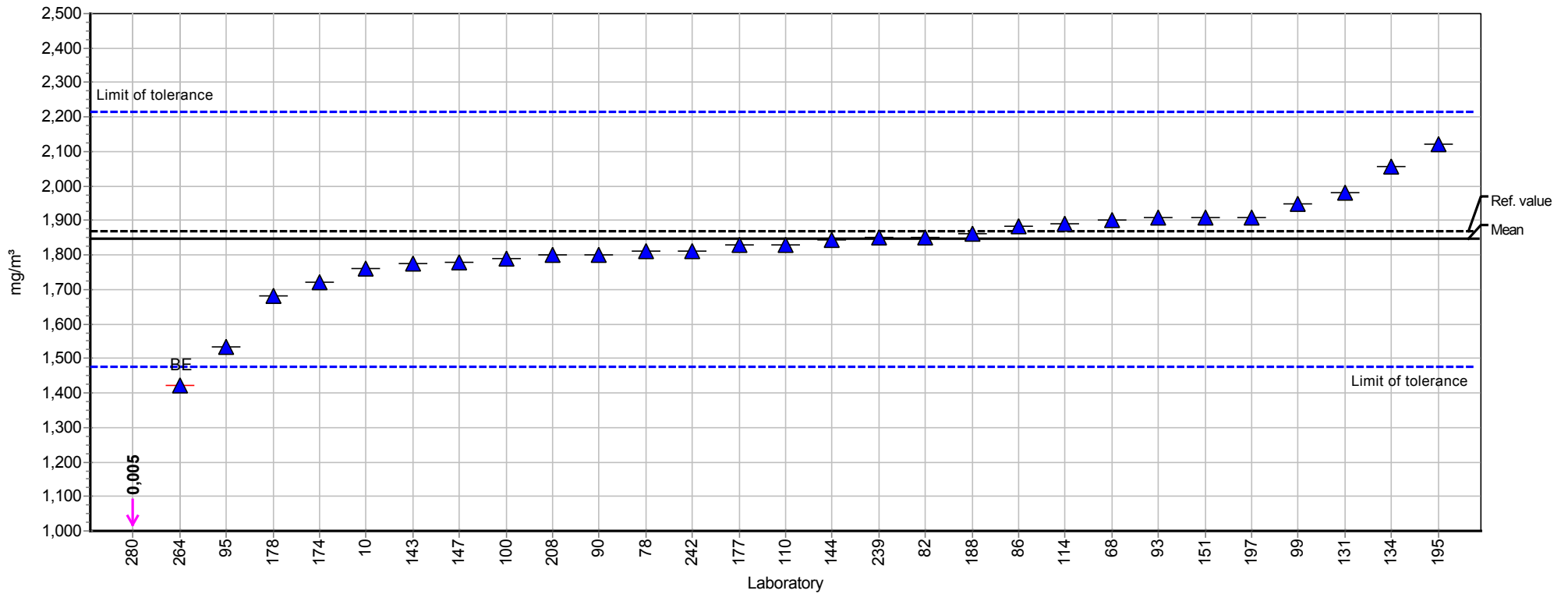
Summary results

Measurand:	hydrochloric acid	Mean:	1,056 mg/m ³
Sample:	1	Reproducibility s.d.:	0,070 mg/m ³
Method:	ISO 5725-2	Relative reproducibility s.d.:	6,66%
Relative target s.d.:	10,00% (Limited)	Reference value:	1,080 mg/m ³
No. of laboratories:	28	Range of tolerance:	0,845 - 1,267 mg/m ³ (Z-Score <= 2,00)



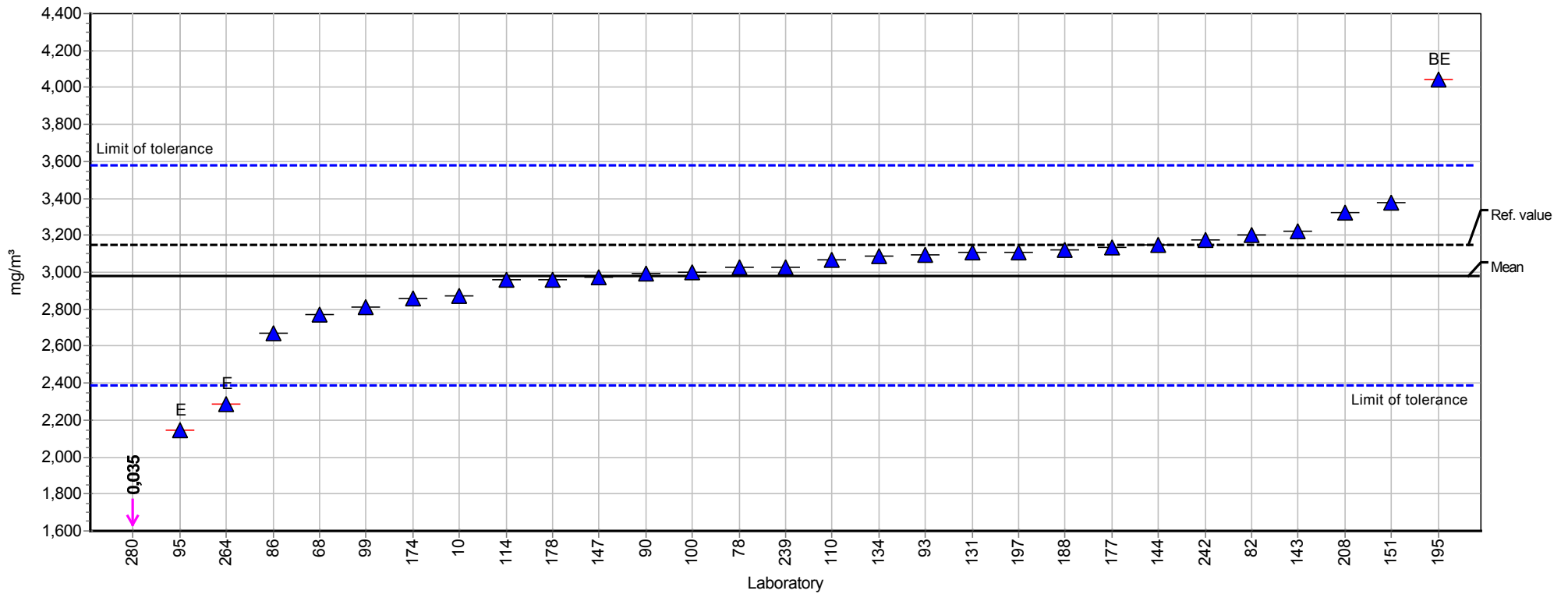
Summary results

Measurand:	hydrochloric acid	Mean:	1,846 mg/m ³
Sample:	2	Reproducibility s.d.:	0,114 mg/m ³
Method:	ISO 5725-2	Relative reproducibility s.d.:	6,15%
Relative target s.d.:	10,00% (Limited)	Reference value:	1,870 mg/m ³
No. of laboratories:	27	Range of tolerance:	1,477 - 2,215 mg/m ³ (Z-Score <= 2,00)



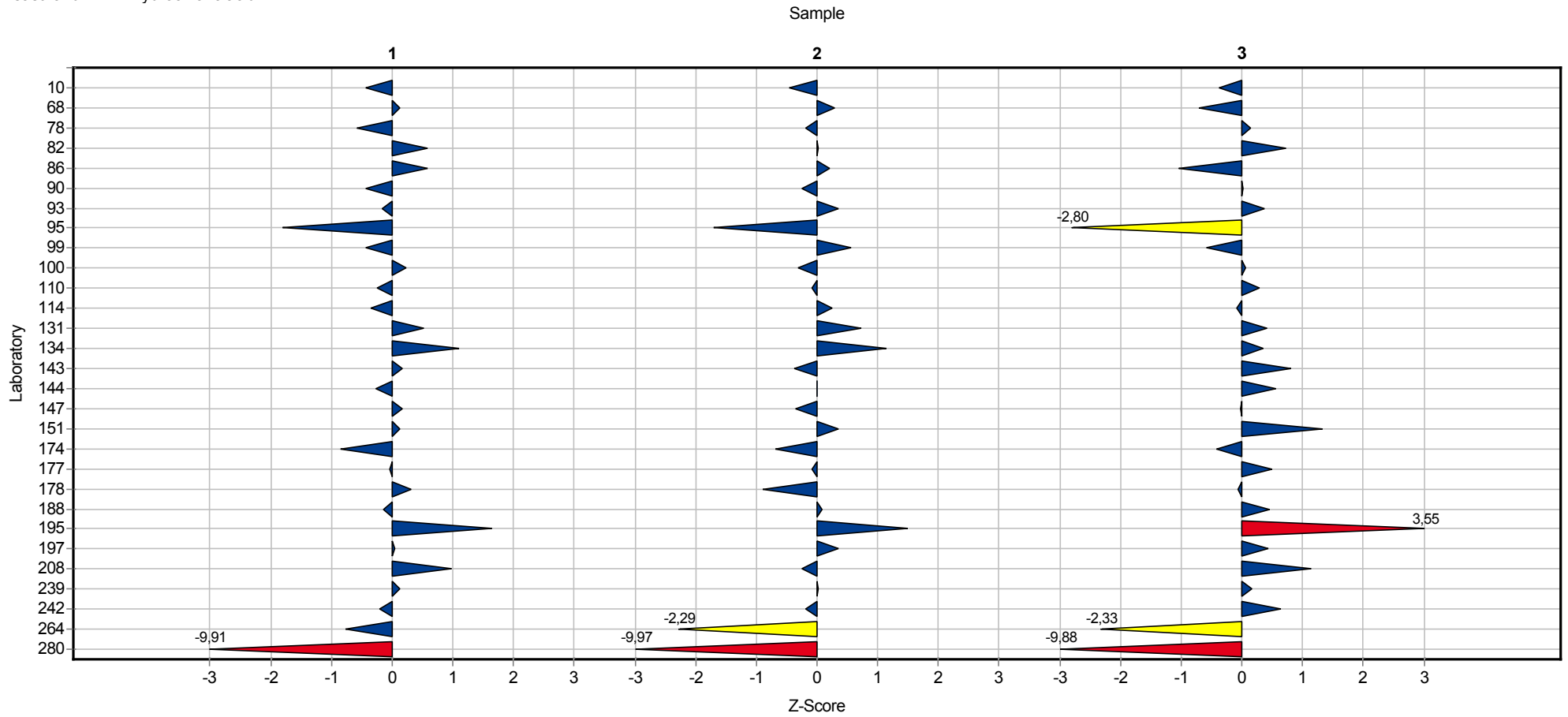
Summary results

Measurand:	hydrochloric acid	Mean:	2,982 mg/m ³
Sample:	3	Reproducibility s.d.:	0,273 mg/m ³
Method:	ISO 5725-2	Relative reproducibility s.d.:	9,15%
Relative target s.d.:	10,00% (Limited)	Reference value:	3,150 mg/m ³
No. of laboratories:	27	Range of tolerance:	2,386 - 3,578 mg/m ³ (Z-Score <= 2,00)



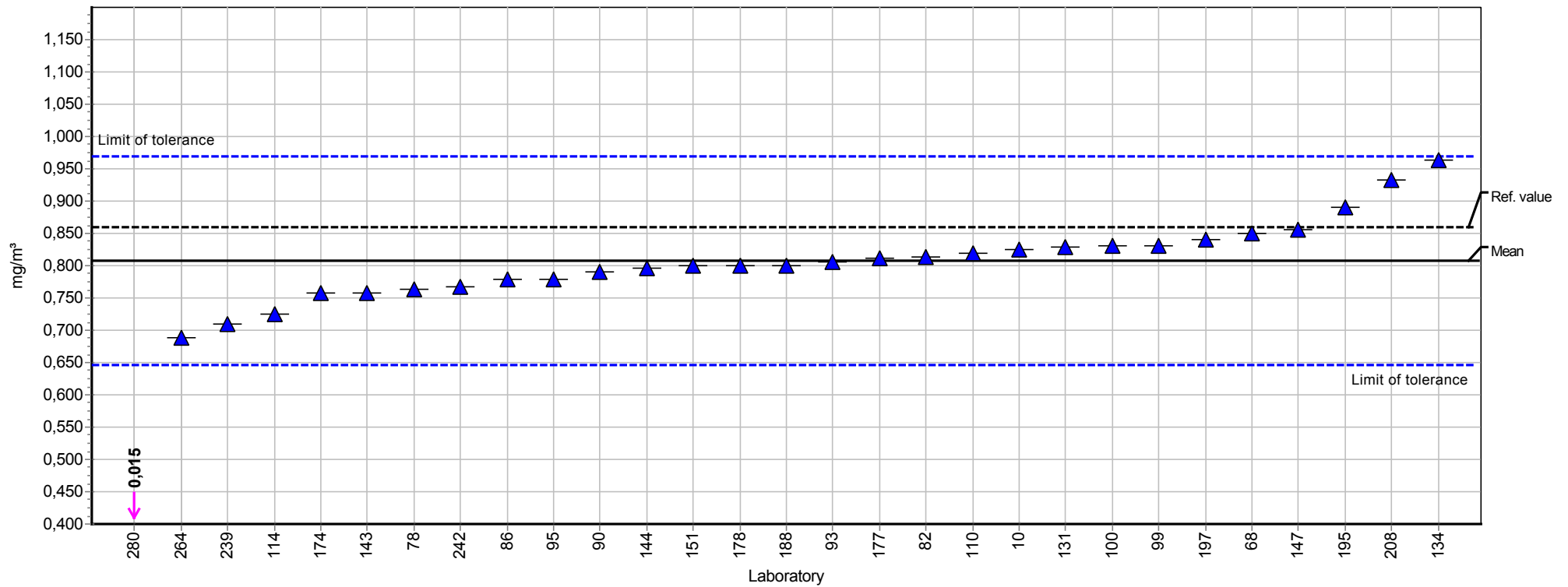
Analyte chart of Z-Scores

Measurand: hydrochloric acid



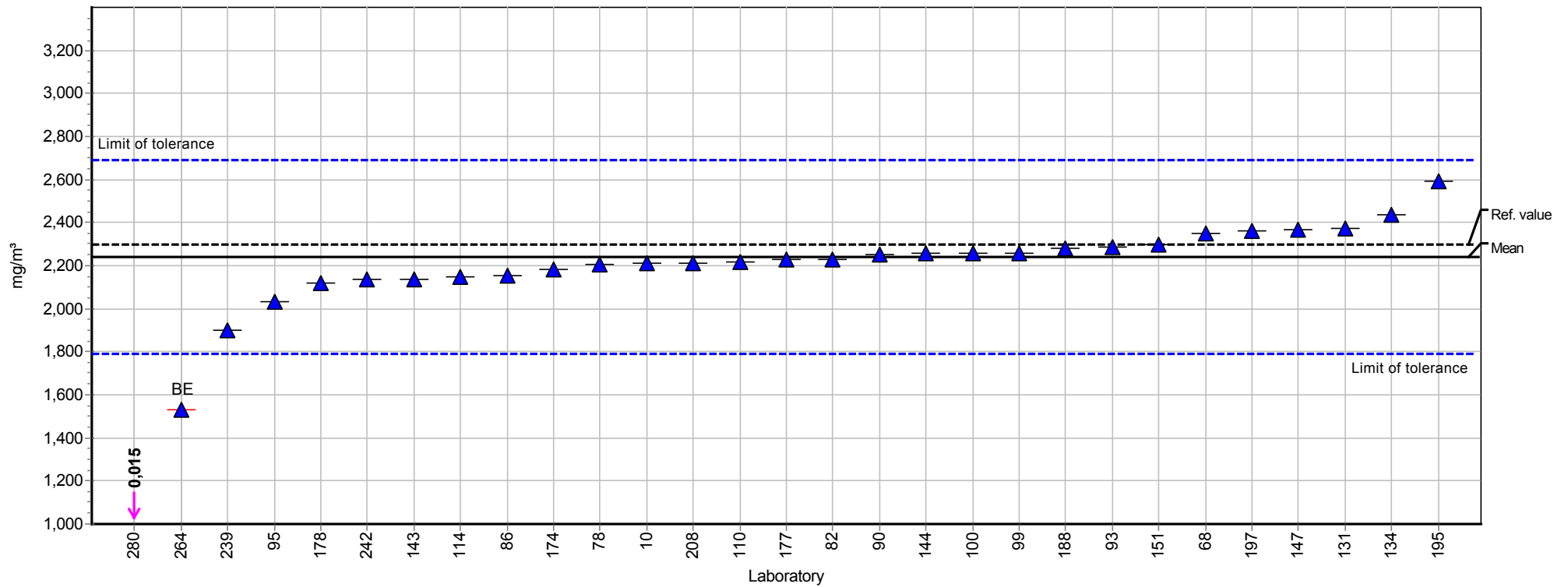
Summary results

Measurand:	nitric acid	Mean:	0,807 mg/m ³
Sample:	1	Reproducibility s.d.:	0,059 mg/m ³
Method:	ISO 5725-2	Relative reproducibility s.d.:	7,36%
Relative target s.d.:	10,00% (Limited)	Reference value:	0,860 mg/m ³
No. of laboratories:	28	Range of tolerance:	0,646 - 0,969 mg/m ³ (Z-Score ≤ 2,00)



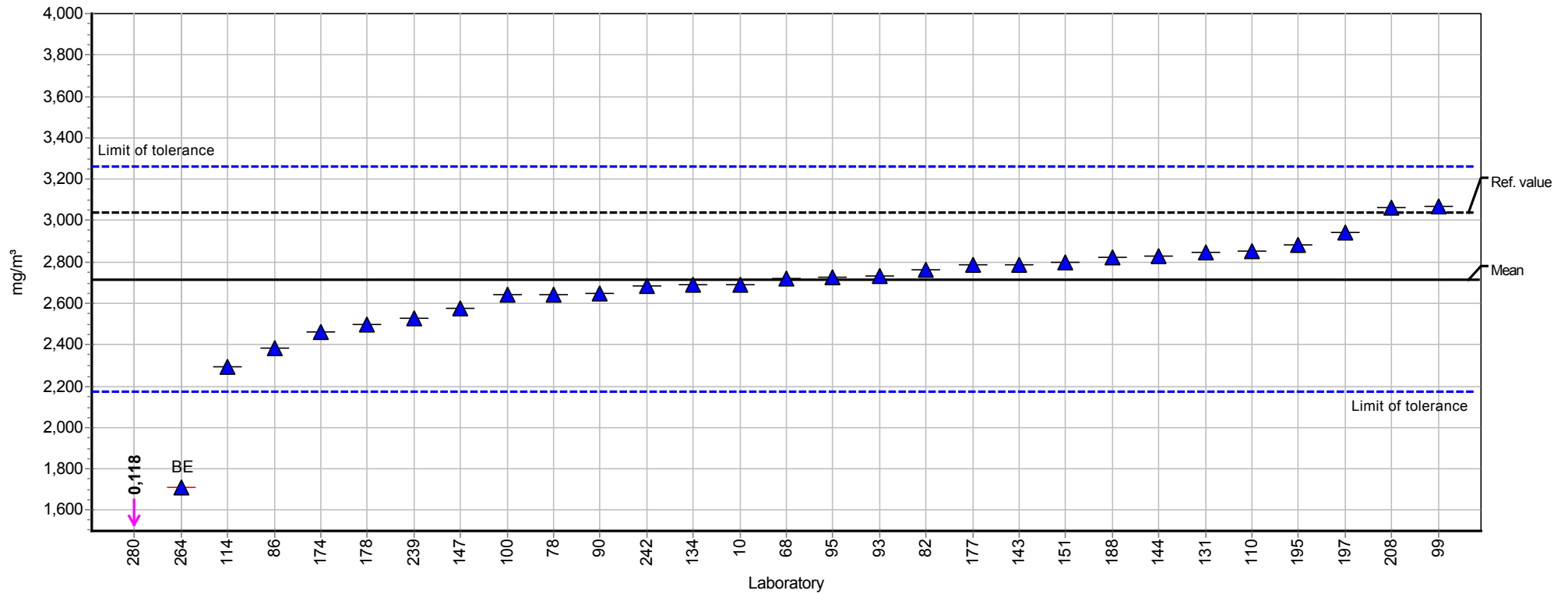
Summary results

Measurand:	nitric acid	Mean:	2,240 mg/m ³
Sample:	2	Reproducibility s.d.:	0,131 mg/m ³
Method:	ISO 5725-2	Relative reproducibility s.d.:	5,86%
Relative target s.d.:	10,00% (Limited)	Reference value:	2,300 mg/m ³
No. of laboratories:	27	Range of tolerance:	1,792 - 2,688 mg/m ³ (Z-Score <= 2,00)



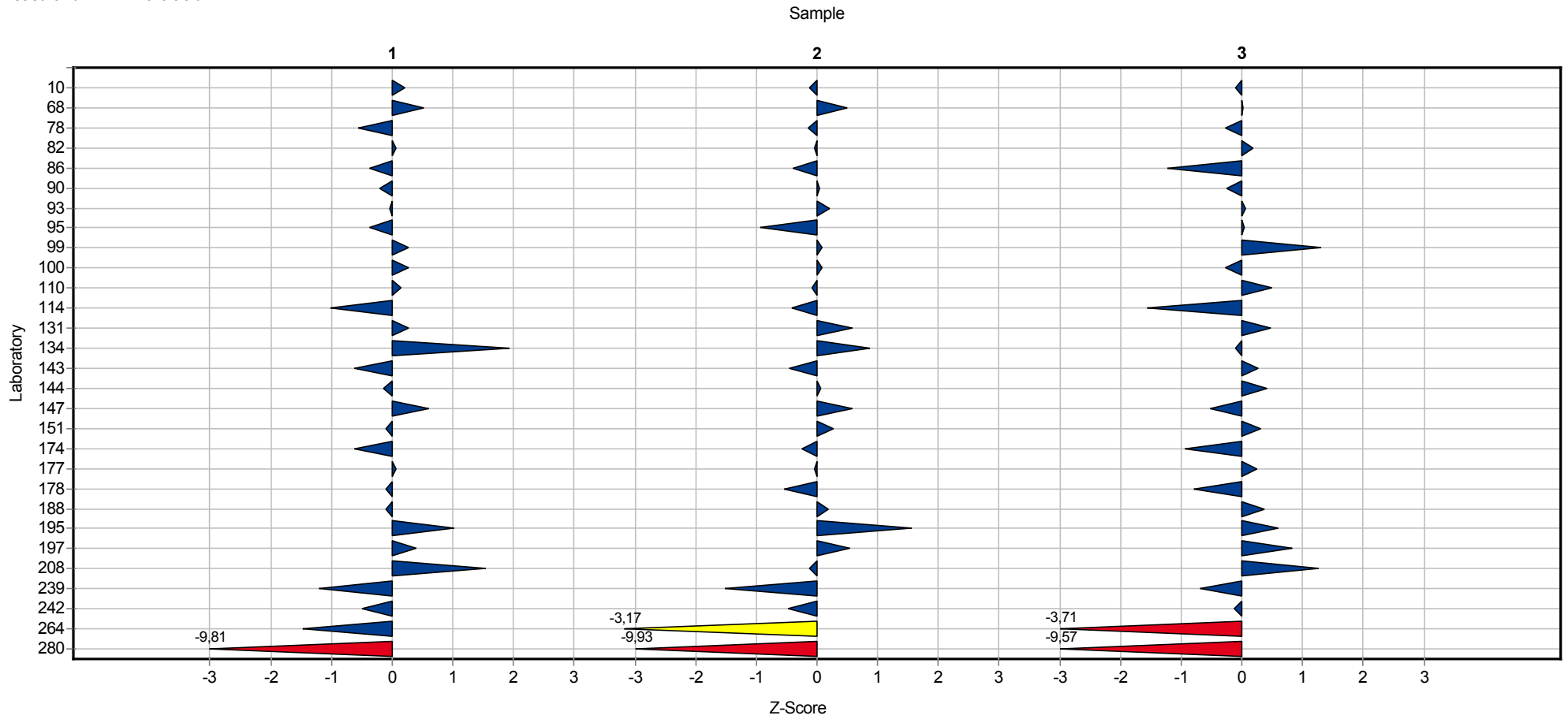
Summary results

Measurand:	nitric acid	Mean:	2,717 mg/m ³
Sample:	3	Reproducibility s.d.:	0,183 mg/m ³
Method:	ISO 5725-2	Relative reproducibility s.d.:	6,75%
Relative target s.d.:	10,00% (Limited)	Reference value:	3,040 mg/m ³
No. of laboratories:	27	Range of tolerance:	2,173 - 3,260 mg/m ³ (Z-Score <= 2,00)



Analyte chart of Z-Scores

Measurand: nitric acid



Questions and Answers

Participant	Analytical method
10	Metropol M-53
68	IFA
78	
82	IFA_Arbeitsmappe Nr. 6172 und Nr. 6173
86	Internal
90	INRS METROPOL M-53
93	INRS Metropol Method
95	IFA 6173
99	metropol M-53
100	INRS MétroPol M-53 + NF ISO 21438-1 + NF ISO 21438-2
110	nach IFA Arbeitsmappe
114	Ionic Chromatography based on NF ISO 21438-1, NF ISO 21438-02, Metropol_53
131	METROPOL - M-53
134	IFA 6172, IFA 6173
143	For H2So4 and H3PO4 parameters NIOSH 7908 method was used. For HCl and HNO3 parameters NIOSH 7907 method was used.
144	METROPOL M-53
147	International Standard ISO 21438 (volatile acids) and ISO 21438 (non volatile acids)
151	Ion chromatography
174	MétroPol anions
177	Ionenchromatographie
188	IFA-Arbeitsmappe Nr.6172 + IFA-Arbeitsmappe Nr.6173
195	MTA/MA-019/A90
197	BGIA 6172
208	In-house method, based on SFS-EN ISO 10304-1, ISO 21438-1/2/3, NIOSH, OSHA and DFG methods.
239	Ionic chromatography
242	analog IFA Arbeitsmappe
264	Ionic chromatography
266	IC-UV
280	ionic chromatography

Round-robin test Volatile inorganic acids 1/2017

Participant	Desorption solution	Volume of desorption solution
10	Water	20
68	Impr. QFF: Wasser - Desorb. QFF: 3.6 mM Natriumcarbonat-Lösung	Impr. QFF: 10 ml - Desorb, QFF: Verd. von 2 ml Desorptionslsg./10 ml
78	Eluent	10 mL
82	3,2 mmol Na ₂ CO ₃ , 1 mmol NaHCO ₃	25 mL
86	water	10
90	eau	20 ml
93	Water	10 ml (HCl/HNO ₃) - 4+2=6ml (H ₃ PO ₄ /H ₂ SO ₄)
95	bidest. Wasser	10
99	carbonate/bicarbonate de sodium	20ml
100	Ultrapure Water (G = 18,2 Megaohm cm)	20 for hydrochloric and nitric acids - 4 mL for the others
110	8,0 mmol Na ₂ CO ₃ + 1,0 mmol NaHCO ₃	50 ml
114	DI water	10
131	eau ultrapure	6
134	Reinstwasser (Bi - Dest.)	10 mL
143	Deionized water	10 ml
144	H ₂ O	20
147	Water deionized for volatile acids and solution Na ₂ CO ₃ (3.1 mmol/L)/NaHCO ₃ (0.35mmol/L) for the non volatile acids	10 mL for the volatile acids and 4 mL for the non volatiles acids
151	Water	10
174	H ₂ O	H ₃ PO ₄ - H ₂ SO ₄ : 10mL ; HCl - HNO ₃ : 4mL+2mL H ₂ O
177	Reinstwasser	20 ml bzw. 10 ml
188	A Supp 4 Standardeluent	20 ml
195	1mM NaHCO ₃ : 3.5 mM Na ₂ CO ₃	5 mL
197	NaHCO ₃ /Na ₂ CO ₃	20
208	Ultrapure water for impregnated filters.	10 ml for impregnated filters.
239	Eau	15
242	Reinstwasser	10 (HCl,HNO ₃)
264	water	10 mL
266	NaHCO ₃ 0.3mM	10mL
280	ultrapure water	25

Participant	Desorption time	Ion Chromatographic System
10	10 min in ultrasonic bath	Conductimetric detector

Round-robin test Volatile inorganic acids 1/2017

Participant	Desorption time	Ion Chromatographic System
68	15 Min. Ultraschallbad, anschl. mind. 30 Min. stehen lassen	930 Compact IC Flex von Metrohm
78	30 min Ultraschall	Handeinspritzung
82	15 Minuten	Fa. Metrohm, 930 Compact IC Flex, 944 Professional UV/VIS Detector vario, 858 Professional Sample Processor
86	60 min mecanic agitation	DX120, AS40 autosampler automatic
90	30 min agitation mécanique	Dionex ICS1000- détecteur conductimétrique - passeur AS40
93	2 h	Metrohm 850 professionn IC, conductimetric detector, 858 Sample processor
95	45 Min. Ultraschall, 1h stehen lassen	Dionex ICS1100, Leif.-Detektor, AS Waters 717plus
99	15 min us	ics thermo 1100/conductimetric detector/as-dv
100	15 min in ultasonic bath	conductimetric detector
110	15 min, ja	Dionex ICS 900 / AS-DV
114	15 min with ultrasonic bath	Thermo Scientific ICS5000, conductivity
131	30 min agitation	conductimetric
134	15 Min. Ultraschallbad & 30 Min. stehen lassen	Standard Pumpe, Leitfähigkeitsdetektor, mauelle Probeneingabe
143	30 minutes	Dionex ICS 5000+ dual isocratic pump system, electrochemical dedector ASRS_4 mm
144	Manual shaking	DINOEX ICS3000 - conductimetric detector
147	30 min in an ultrasonic bath	The dionex ICS 2100 system with eluent generation and conductivity detection. A sampler Dionex AS 40 was used.
151	2 hours, no	Thermo ICS5000+
174	15min	Dionex DX600, ED50, AS40
177	30 min Ultraschallbad	Dionex ICS 2000
188	15 Minuten	930 Compact IC Flex inkl. Online-Filtration
195	1 h orbital shaker	DIONEX ICS-3000
197	U-Bad, 15 min	Ismatec MS Reglo/LF/838 Advance SAmple Processor
208	45 min, ultrasonic bath.	Dionex/Thermo Fisher ICS5000, AS-AP, conductivity.
239	5 mn	ICS5000 Dionex
242	analog IFA 6172	IC 850 Metrohm
266	15 minutes	Dionex ICS-2000, Suppressor ASRS-300, 4mm from Dionex
280	1 hour	Metrohm

Participant	Analytical column	mobile phase	Flow rate
10	Anionic column Metrosep A supp 5 de 250 mm	3,2 mM de Na ₂ CO ₃ and 1 mM de NaHCO ₃	1
68	Metrosep C 6 - 250/4.0 von Metrohm	3.6 mM Natriumcarbonat-Lösung	0.7 ml/min.
78	Metrosep A Supp5 250 mm	3,2 mmol/L Na ₂ CO ₃ & 1,0 mmol/L NaHCO ₃	0,7 mL/min

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Participant	Analytical column	mobile phase	Flow rate
82	METROSEP A SUPP 5-250	3,2 mmol Na ₂ CO ₃ , 1 mmol NaHCO ₃	0,7 mL/min.
86	Thermo AS14A RFIC	Na ₂ CO ₃ 8mM + NaHCO ₃ 1mM	1
90	Colonne THERMO AS23 (4x250 mm) + précolonne AG23 (4x50 mm)	Na ₂ CO ₃ 4.5 mM + NaHCO ₃ 0.8 mM	1 ml/min
93	Metrohm Supp 7	Na ₂ CO ₃ - 3.4mM	0.8 ml/min
95	AS9-SC + AG9-SC	2mmol Na ₂ CO ₃ / 0,75mmol NaHCO ₃	2
99	THERMO AS23	carbonate de sodium/bicarbonate de sodium 4.5/0.8 mM	1 ml/min
100	Metrosep A Supp 16 - 250/4.0 mm	Na ₂ CO ₃ 150 mmol L-1 ; NaOH 15 mmol L-1	0.8
110	AG 14A / AS 14A	8,0 mmol Na ₂ CO ₃ + 1,0 mmol NaHCO ₃	1,10 ml/min
114	AS15	KOH 8-65 mM gradient	1.4mL/min
131	IONPAC AS 22 A	Na ₂ CO ₃ 4.5mM + NaHCO ₃ 1.4 mM	1.2 ml/min
134	Metrosep A Supp 5 - 150/4.0	3,2 mmol/L Na ₂ CO ₃ / 1,0 mmol/L NaHCO ₃	0,7 ml/min
143	Dionex Ion Pac AS19 RFIC4*250 mm analytical colomn	Dyonex EGC III KOH 17 mM	1 ml/min
144	THERMO AG23+AS23	4.5mM Na ₂ CO ₃ / 0.8mM NaHCO ₃	0.5
147	Pre-column AG15 and column AS 15 Dionex Ionpac	gradient KOH	1.2 ml/min
151	AS22 2 * 250 mm	1.4 mM NaHCO ₃ , 4.8 mM Na ₂ CO ₃	0.3
174	IonPac AG12+AS12 - supprimeur ACRS500	2.7mM Na ₂ CO ₃ + 0.31 mM NaHCO ₃	1.5mL/min
177	AS 15	KOH 12-48 mmol/l	0,3 ml/min
188	A Supp 4 250mm	A Supp 4 Standardeluent	1
195	IONPACK AS14 250 x 4 mm	1mM NaHCO ₃ : 3.5 mM Na ₂ CO ₃	1.2
197	Metrosep S Supp 5	1mmol/l NaHCO ₃ /3,2 mmol/l Na ₂ CO ₃	0,7
208	AS11HC-4 µm	KOH 1-60 mM gradient	0,015
239	Dionex ref AS11-HC 2mm	20 % NaOH 30mM / 80% H ₂ O	0.3
242	Metrohm ASupp 5 4x250 mm	4 mM Na ₂ CO ₃	0,7
264		KOH	
266	IonPac AS12A	Carbonate/Bicarbonate (mM) 2.7/0.3	1.5
280	Metrosep supp 5 250/4	Na ₂ CO ₃ + NaHCO ₃	0.7

Participant	Recovery rate	Date of analysis
10	No	05/04/2013
68	Nein	22./23.3.2017
78		28.-07.04.2017
82	nein	2017-04-07 - 2017-04-10

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Participant	Recovery rate	Date of analysis
86	no	28/03/17
90	no	4/04/2017
93	no recoverate rate	29/03/2017
95	---	23.03.2017
99	no	04/04/2017 et 06/04/2017
100	No	Already written in the tab "Measured values"
110		27.03.17 und 28.03.17
114	No	11/04/2017
131	no	17/04/17
134	IFA Wiederfindungsrate: HCL= 0,994; HNO3 = 1,006; H3PO4 = 1,006; H2SO4 = 0,975	30.03.2017 (HCl, HNO3) & 31.03.2017 (H2SO4, H3PO4)
143	No	23.03.2017-12.04.2017
144	no	28/03/2017
147	No	02 and 03 may 2017
151	No	10/04/2017
174	MétroPol Anions minéraux M-53 - données de validation	28-29/03/2017
177	nein	11.04.2017
188		03.04.17 + 04.04.17
195	no	24/03/2017 and 10/04/2017
197	-	10.4.2017
208	no	24.3.2017
239	No	07/04/17
242	nein	05.-07.04.2014
264		04/04/2017
266	n/a	27 mar 2017
280	100%	23/03/2017

Round-robin tests for in-house and external measuring stations - results and evaluation

Round-robin test „Inorganic Acids 2017“

March 2017

Part 2: non-volatile acids

Summary of laboratory test results

Measurand phosphoric acid

	Sample 1	Z score	Sample 2	Z score	Sample 3	Z score
Unit	mg/m ³		mg/m ³		mg/m ³	
5	0,214	-0,28	0,556	0,31	1,264	1,92
7	0,238	0,79	0,584	0,83	1,098	0,35
10	0,200	-0,93	0,512	-0,50	0,979	-0,77
40	0,243	1,02	0,609	1,30	1,278	2,05 E
68	0,230	0,43	0,560	0,39	1,130	0,65
76	0,180	-1,84	0,494	-0,84	0,897	-1,55
78	0,223	0,11	0,529	-0,19	1,055	-0,06
82	0,242	0,97	0,549	0,18	1,073	0,11
86	0,168	-2,38 E	0,462	-1,43	0,925	-1,28
90	0,220	-0,03	0,520	-0,35	1,050	-0,10
93	0,224	0,16	0,531	-0,15	1,060	-0,01
95	0,218	-0,12	0,524	-0,28	0,950	-1,05
99	0,210	-0,48	0,530	-0,17	1,020	-0,39
100	< 0,001		0,533	-0,11	1,110	0,46
110	0,250	1,33	0,550	0,20	1,060	-0,01
111	0,220	-0,03	0,550	0,20	1,060	-0,01
114	0,216	-0,21	0,548	0,17	1,072	0,10
131	0,234	0,61	0,558	0,35	1,113	0,49
134	0,252	1,42	0,577	0,70	1,141	0,75
143	0,207	-0,62	0,473	-1,23	0,962	-0,93
144	0,209	-0,52	0,552	0,24	1,095	0,32
147	0,201	-0,89	0,512	-0,50	0,972	-0,84
151	0,222	0,06	0,560	0,39	1,116	0,52
154	0,241	0,93	0,574	0,65	1,062	0,01
174	0,214	-0,30	0,518	-0,39	1,040	-0,20
177	0,202	-0,84	0,499	-0,74	0,963	-0,92
178	0,230	0,43	0,640	1,87	1,390	3,10 BE

	Sample 1	Z score	Sample 2	Z score	Sample 3	Z score
188	0,230	0,43	0,560	0,39	1,080	0,18
195	0,270	2,24 E	0,540	0,02	1,080	0,18
197	0,194	-1,20	0,471	-1,26	0,936	-1,18
208	0,212	-0,39	0,542	0,05	1,040	-0,20
242	0,231	0,47	0,517	-0,41	1,078	0,16
245	0,216	-0,21	0,535	-0,08	1,100	0,37
264	0,212	-0,39	0,510	-0,54	0,993	-0,64
266	0,224	0,16	0,560	0,39	1,113	0,49
269	0,253	1,47	0,589	0,93	1,110	0,46
280	0,190	-1,39	0,519	-0,37	1,120	0,56
-	-	--	-	--	-	--
Method	ISO 5725-2		ISO 5725-2		ISO 5725-2	
Assessment	Z <=2,00		Z <=2,00		Z <=2,00	
No. of laboratories that submitted results	37		37		37	
Mean	0,221		0,539		1,061	
Reproducibility s.d.	0,021		0,037		0,082	
Rel. reproducibility s.d.	9,55 %		6,80 %		7,74 %	
Reference value	0,217		0,540		1,050	
Target s.d.	0,022		0,054		0,106	
Rel. target s.d.	10,00 %		10,00 %		10,00 %	
Lower limit of tolerance	0,176		0,431		0,849	
Upper limit of tolerance	0,265		0,647		1,273	
Type B outliers					1	
Number of laboratories with replicates outside of tolerance limits	2				2	
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	36		37		36	
Explanation of outlier types						
A: Single outlier	Grubbs					

	Sample 1 Z score	Sample 2 Z score	Sample 3 Z score
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

Measurand sulphuric acid

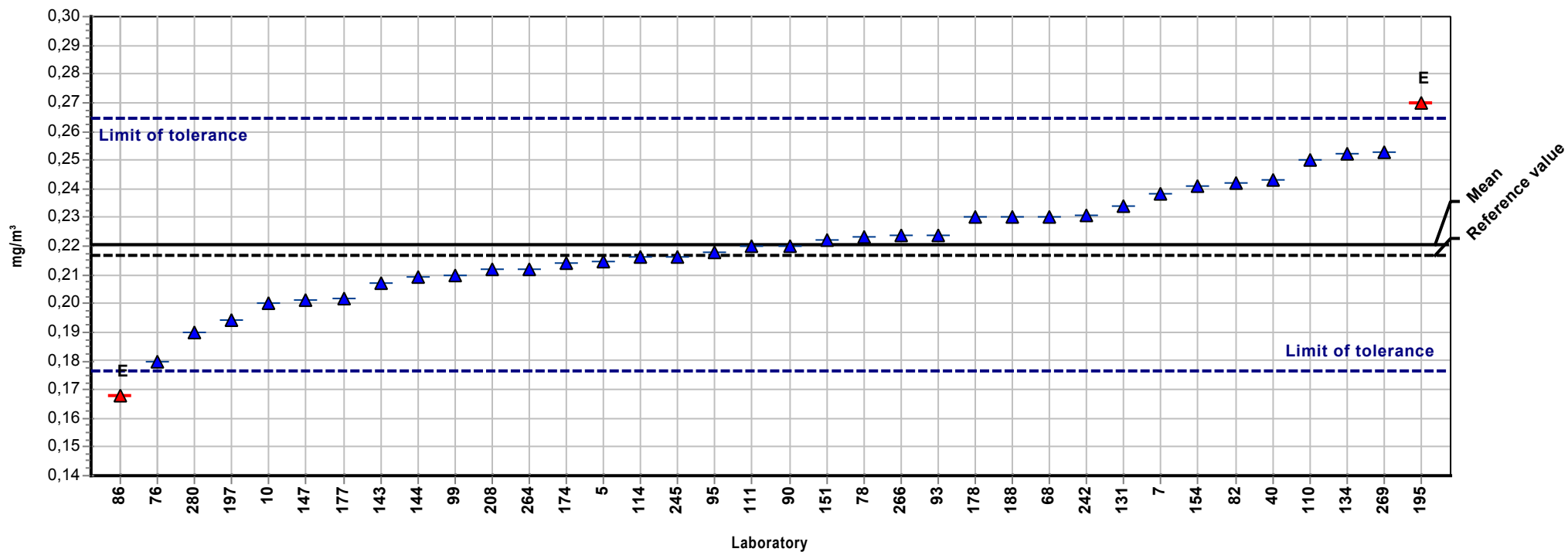
	Sample 1 Z score		Sample 2 Z score		Sample 3 Z score	
Unit	mg/m ³		mg/m ³		mg/m ³	
5	0,212	0,14	0,107	0,20	0,033	5,33 FE
7	0,225	0,78	0,113	0,76	0,022	0,13
10	0,198	-0,52	0,104	-0,10	0,022	0,36
40	0,243	1,64	0,120	1,43	0,022	0,13
68	0,220	0,54	0,120	1,43	0,030	3,81 FE
76	0,176	-1,57	0,102	-0,29	0,016	-2,64 E
78	0,220	0,54	0,104	-0,10	0,020	-0,98
82	0,227	0,87	0,111	0,57	0,022	0,13
86	0,167	-2,00 E	0,085	-1,91	0,012	-4,48 FE
90	0,210	0,06	0,090	-1,43	0,020	-0,79
93	0,216	0,35	0,102	-0,29	0,020	-0,93
95	0,210	0,06	0,104	-0,10	0,022	0,13
99	0,220	0,54	0,110	0,47	0,030	3,81 FE
100	< 0,001		0,099	-0,57	0,019	-1,25
110	0,200	-0,42	0,090	-1,43	0,010	-5,40 FE
111	0,220	0,54	0,110	0,47	0,020	-0,79
114	0,207	-0,08	0,101	-0,38	0,019	-1,25
131	0,222	0,63	0,112	0,66	0,025	1,51
134	0,252	2,07 E	0,117	1,14	0,031	4,27 E
143	0,145	-3,05 E	0,086	-1,85	0,016	-2,77 E
144	0,213	0,20	0,114	0,85	0,025	1,51
147	0,194	-0,71	0,100	-0,48	0,022	0,13
151	0,227	0,87	0,113	0,76	0,025	1,51
154	0,227	0,87	0,114	0,85	0,027	2,43 E
174	0,200	-0,42	0,100	-0,48	0,025	1,51
177	0,196	-0,61	0,102	-0,29	0,021	-0,33
178	0,220	0,54	0,100	-0,48	0,020	-0,79

	Sample 1	Z score	Sample 2	Z score	Sample 3	Z score
188	0,220	0,54	0,110	0,47	0,020	-0,79
195	0,150	-2,81 E	0,070	-3,33 BE	0,010	-5,40 FE
197	0,203	-0,28	0,106	0,09	0,019	-1,25
208	0,202	-0,32	0,100	-0,53	0,021	-0,33
239	0,210	0,06	0,100	-0,48	0,020	-0,79
242	0,204	-0,23	0,098	-0,67	0,026	1,97
245	0,225	0,78	0,107	0,19	0,023	0,59
264	0,210	0,06	0,110	0,47	0,022	0,13
266	0,212	0,16	0,107	0,15	0,021	-0,33
269	0,208	-0,04	0,098	-0,67	0,021	-0,33
280	0,213	0,20	0,121	1,52	0,032	4,73 FE
-	-	--	-	--	-	--
Method	ISO 5725-2		ISO 5725-2		ISO 5725-2	
Assessment	Z <=2,00		Z <=2,00		Z <=2,00	
No. of laboratories that submitted results	38		38		38	
Mean	0,209		0,105		0,022	
Reproducibility s.d.	0,022		0,009		0,003	
Rel. reproducibility s.d.	10,32 %		8,51 %		14,43 %	
Reference value	0,212		0,106		0,021	
Target s.d.	0,021		0,011		0,002	
Rel. target s.d.	10,00 %		10,00 %		10,00 %	
Lower limit of tolerance	0,167		0,084		0,017	
Upper limit of tolerance	0,251		0,126		0,026	
Type B outliers			1			
Type F outliers					7	
Number of laboratories with replicates outside of tolerance limits	4		1		11	
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	37		37		31	

	Sample 1 Z score	Sample 2 Z score	Sample 3 Z score
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		

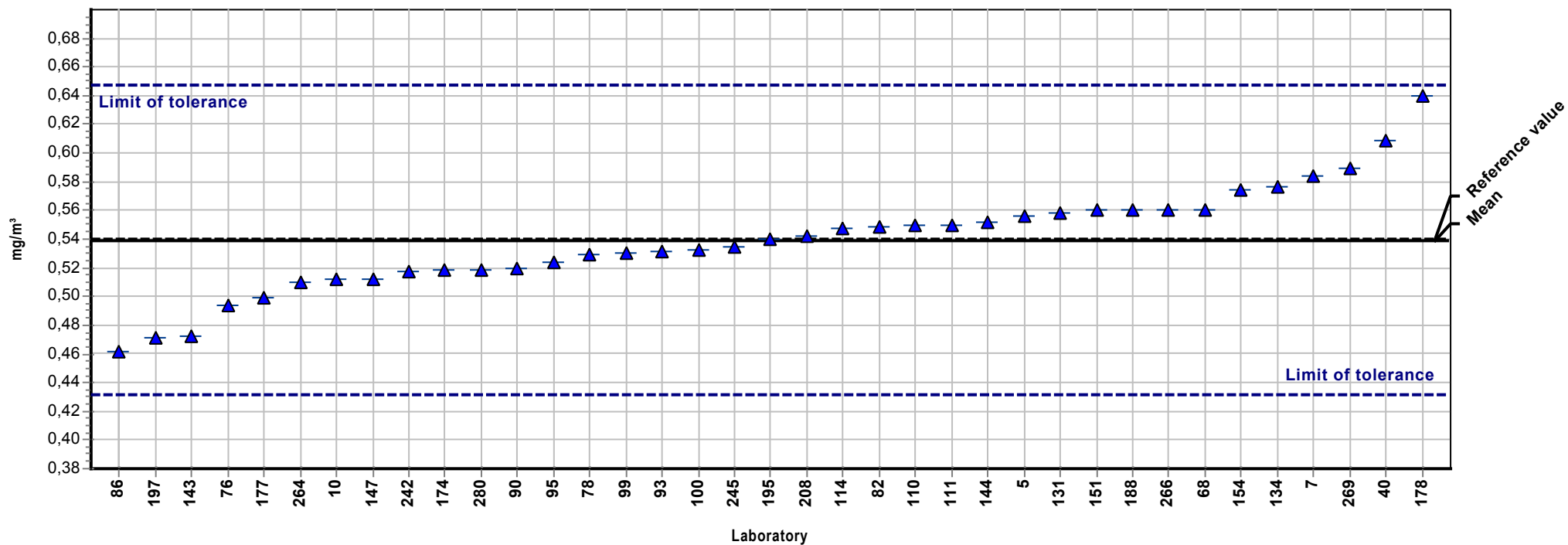
Summary results

Measurand:	phosphoric acid	Mean:	0,221 mg/m ³
Sample:	1	Reproducibility s.d.:	0,021 mg/m ³
Method:	ISO 5725-2	Rel. reproducibility s.d.:	9,55%
Rel. target s.d.:	10,00% (Limited)	Reference value:	0,217 mg/m ³
No. of laboratories:	36	Range of tolerance:	0,176 - 0,265 mg/m ³ (Z-Score <= 2,00)



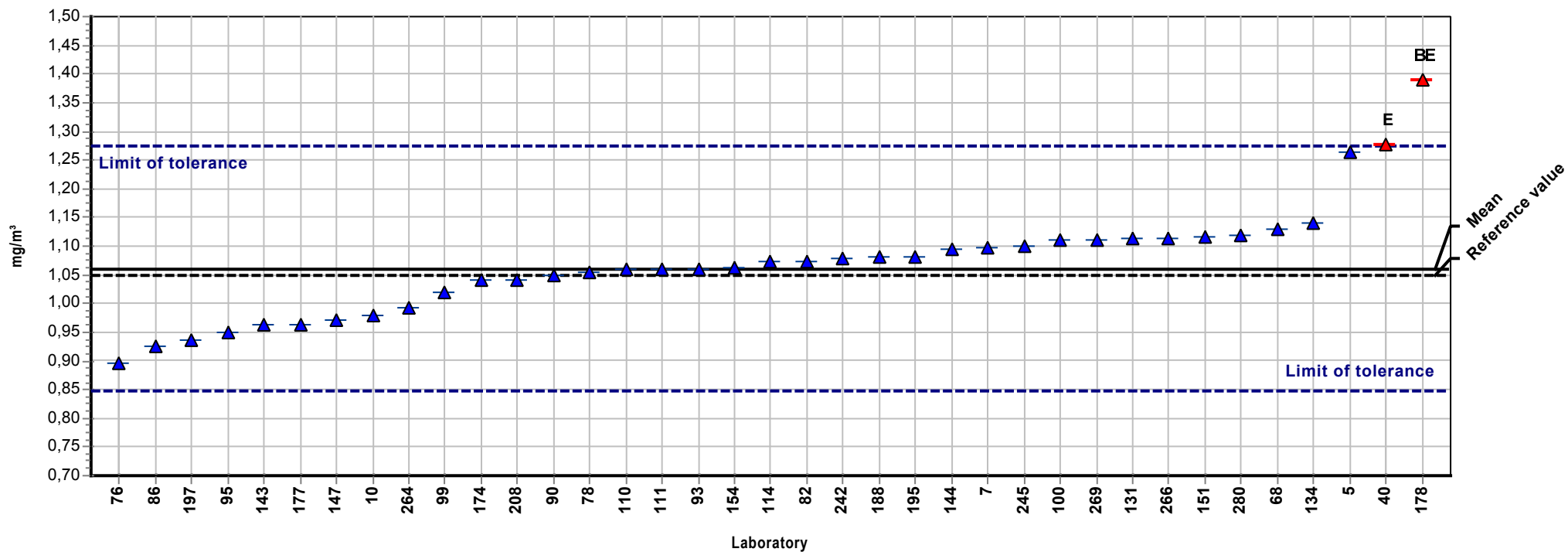
Summary results

Measurand:	phosphoric acid	Mean:	0,539 mg/m ³
Sample:	2	Reproducibility s.d.:	0,037 mg/m ³
Method:	ISO 5725-2	Rel. reproducibility s.d.:	6,80%
Rel. target s.d.:	10,00% (Limited)	Reference value:	0,540 mg/m ³
No. of laboratories:	37	Range of tolerance:	0,431 - 0,647 mg/m ³ (Z-Score <= 2,00)



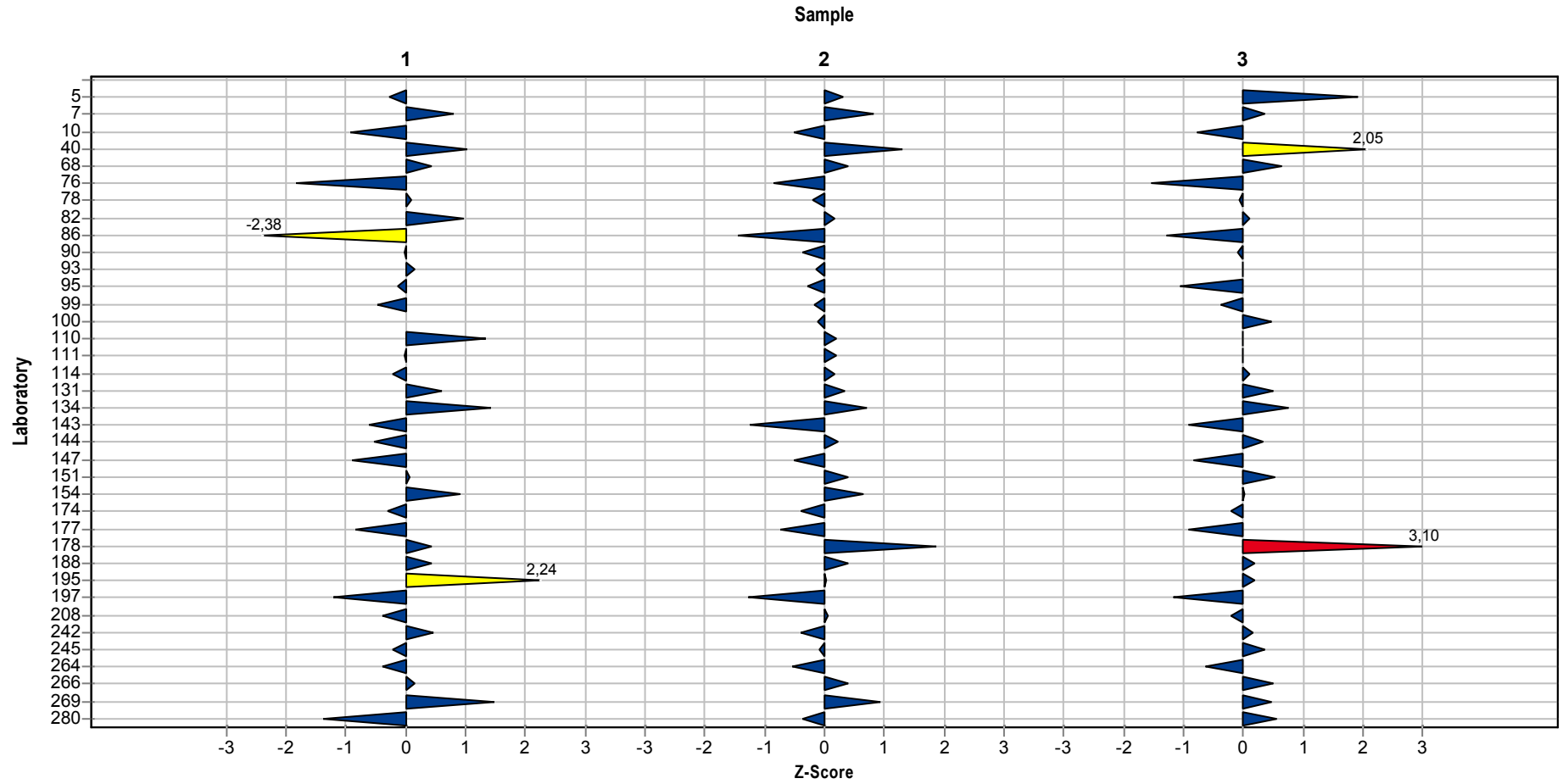
Summary results

Measurand:	phosphoric acid	Mean:	1,061 mg/m ³
Sample:	3	Reproducibility s.d.:	0,082 mg/m ³
Method:	ISO 5725-2	Rel. reproducibility s.d.:	7,74%
Rel. target s.d.:	10,00% (Limited)	Reference value:	1,050 mg/m ³
No. of laboratories:	36	Range of tolerance:	0,849 - 1,273 mg/m ³ (Z-Score <= 2,00)



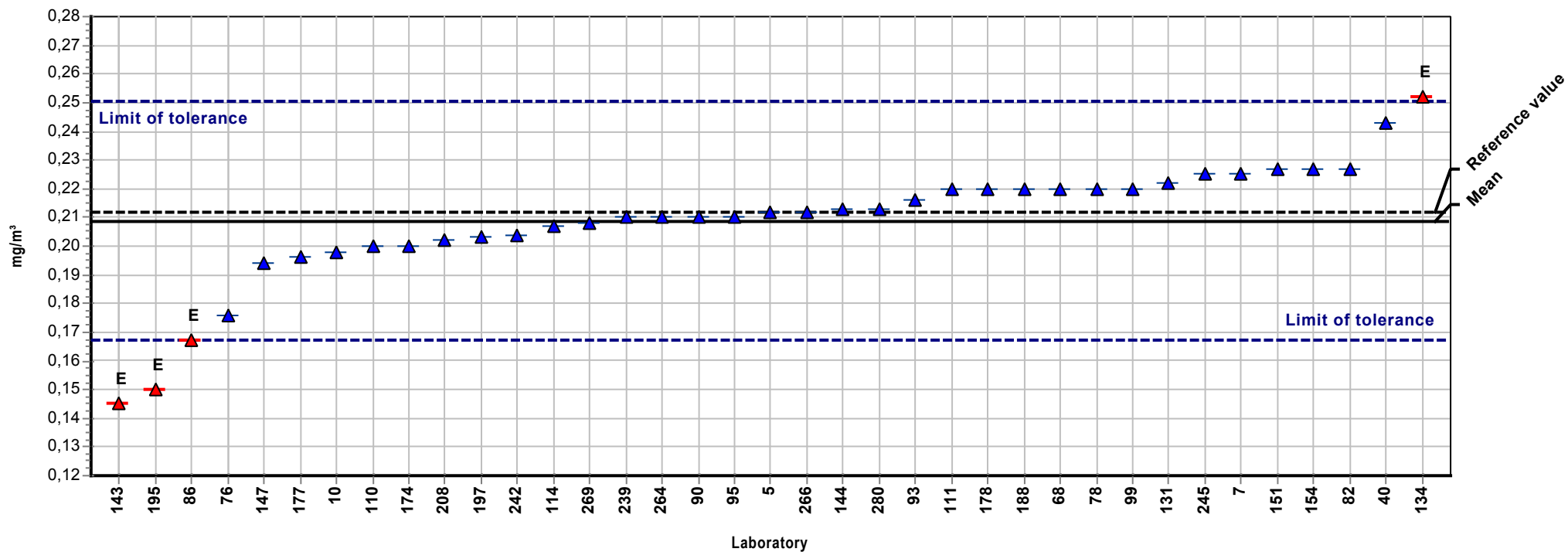
Analyte chart of Z-Scores

Measurand: phosphoric acid



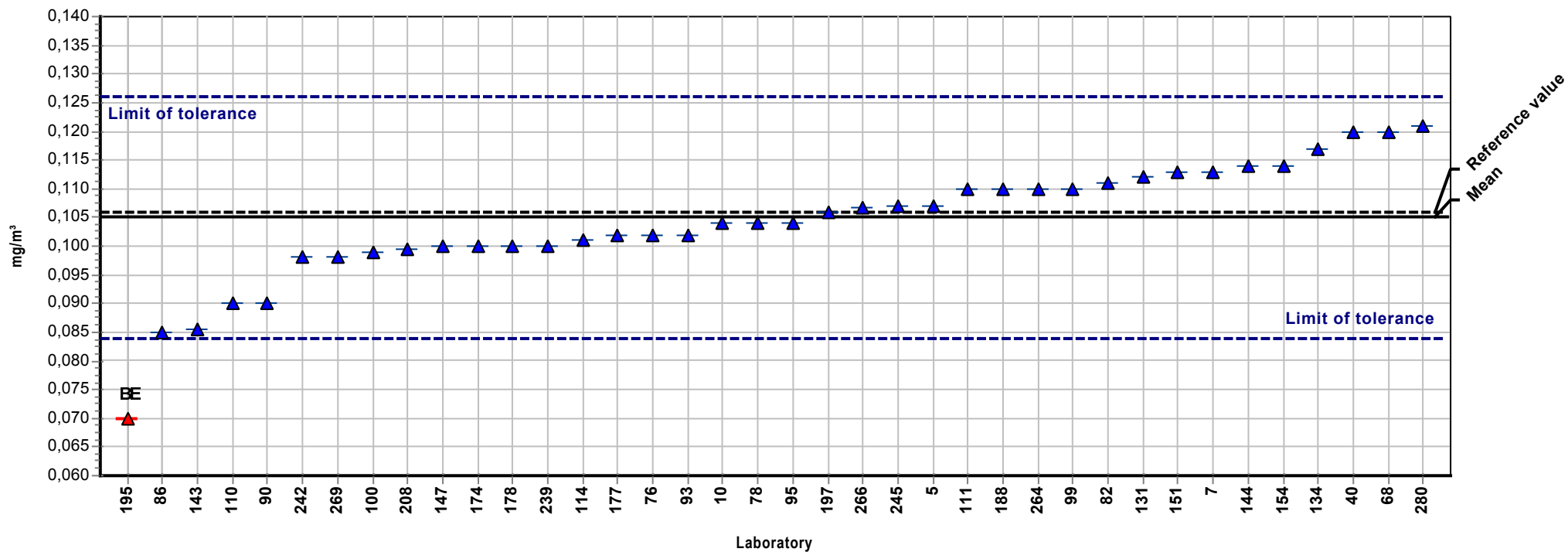
Summary results

Measurand:	sulphuric acid	Mean:	0,209 mg/m ³
Sample:	1	Reproducibility s.d.:	0,022 mg/m ³
Method:	ISO 5725-2	Rel. reproducibility s.d.:	10,32%
Rel. target s.d.:	10,00% (Limited)	Reference value:	0,212 mg/m ³
No. of laboratories:	37	Range of tolerance:	0,167 - 0,251 mg/m ³ (Z-Score <= 2,00)



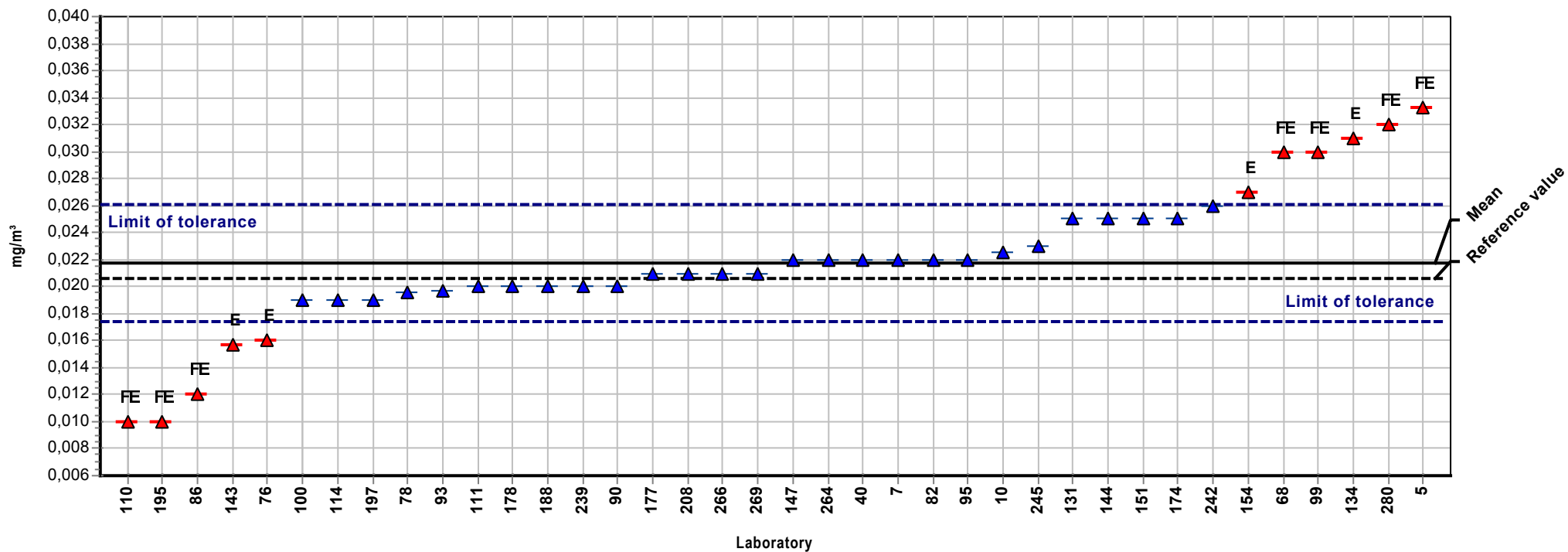
Summary results

Measurand:	sulphuric acid	Mean:	0,105 mg/m ³
Sample:	2	Reproducibility s.d.:	0,009 mg/m ³
Method:	ISO 5725-2	Rel. reproducibility s.d.:	8,51%
Rel. target s.d.:	10,00% (Limited)	Reference value:	0,106 mg/m ³
No. of laboratories:	37	Range of tolerance:	0,084 - 0,126 mg/m ³ (Z-Score <= 2,00)



Summary results

Measurand:	sulphuric acid	Mean:	0,022 mg/m ³
Sample:	3	Reproducibility s.d.:	0,003 mg/m ³
Method:	ISO 5725-2	Rel. reproducibility s.d.:	14,43%
Rel. target s.d.:	10,00% (Limited)	Reference value:	0,021 mg/m ³
No. of laboratories:	31	Range of tolerance:	0,017 - 0,026 mg/m ³ (Z-Score <= 2,00)



Analyte chart of Z-Scores

Measurand: sulphuric acid

