IFA
Institut für Arbeitsschutz der
Deutschen Gesetzlichen Unfallversicherung

Round-robin tests for

in-house measuring laboratories

Institut für Arbeitsschutz der Deutschen Gesetzlichen Unfallversicherung (IFA)
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Results and Evaluation

Round-robin test

Organic substances with thermodesorption 2016 (VOC)

Summary of laboratory means

Sample 1

	n-Butyl acetate	Z score		n-Heptane	Z score		Toluene	Z score		n-Octane	Z score		p-Xylene	Z score		Ethylbenzene	Z score	
Unit	µg/m³			µg/m³			µg/m³			µg/m³			µg/m³			µg/m³		
22	105,85	0,71		76,70	0,16		89,55	0,34		101,90	0,15		88,85	0,41		56,25	0,00	
30	93,45	-0,55		71,75	-0,49		83,20	-0,39		100,30	-0,01		80,85	-0,52		51,75	-0,80	
44	87,42	-1,16		78,31	0,38		91,43	0,56		107,25	0,68		97,35	1,41		60,33	0,73	
60	96,05	-0,28		74,45	-0,13		85,15	-0,16		102,15	0,18		81,10	-0,50		57,90	0,29	
68	99,50	0,07		77,20	0,23		86,40	-0,02		110,55	1,01		84,10	-0,14		57,80	0,28	
94	95,00	-0,39		76,50	0,14		93,00	0,74		98,00	-0,24		87,50	0,25		57,00	0,13	
97	105,00	0,62		75,85	0,05		78,15	-0,97		91,70	-0,87		79,90	-0,64		53,00	-0,58	
104	101,50	0,27		72,55	-0,39		85,65	-0,11		100,70	0,03		82,65	-0,31		53,65	-0,46	
121	105,85	0,71		76,70	0,16		89,55	0,34		101,90	0,15		88,85	0,41		56,25	0,00	
126	88,90	-1,01		65,75	-1,29		80,55	-0,70		88,25	-1,21		81,05	-0,50		56,90	0,12	
135	101,50	0,27		68,90	-0,87		84,50	-0,24		98,40	-0,20		85,15	-0,02		54,65	-0,28	
151	98,10	-0,08		74,35	-0,15		83,00	-0,41		99,60	-0,08		81,50	-0,45		52,80	-0,61	
155	99,50	0,07		74,50	-0,13		86,50	-0,01		101,50	0,11		84,50	-0,10		55,50	-0,13	
184	106,00	0,72		80,50	0,67		93,50	0,80		107,00	0,66		92,00	0,78		61,00	0,84	
186	93,75	-0,52		80,05	0,61		88,65	0,24		108,95	0,85		92,10	0,79		58,35	0,37	
192	97,85	-0,10		88,10	1,68		87,75	0,14		113,00	1,26		87,50	0,25		55,20	-0,19	
194	51,00	-4,84	BE	61,50	-1,85		78,50	-0,93		86,50	-1,38		77,00	-0,98		51,00	-0,93	
198	166,75	6,87	BE				185,50	11,43	CE				162,25	9,02	BE	100,25	7,82	BE
206	20,50	-7,93	BE	38,00	-4,96	BE	20,50	-7,63	BE	24,00	-7,61	BE	17,00	-8,01	BE	12,00	-7,87	BE
207	126,50	2,80	E	88,50	1,73		113,00	3,05	E	132,50	3,20	BE	108,00	2,66	BE	72,00	2,80	E
208	89,00	-1,00		67,50	-1,05		76,50	-1,16		90,50	-0,98		76,00	-1,09		50,00	-1,11	
214	131,00	3,25	BE	79,00	0,47		85,50	-0,12		95,50	-0,49		79,50	-0,68		56,00	-0,04	
237	101,05	0,22		64,58	-1,44		82,78	-0,44		99,30	-0,11		86,66	0,16		56,85	0,11	
240	86,25	-1,27					72,90	-1,58					80,95	-0,51		50,30	-1,06	
254	105,00	0,62		80,50	0,67		87,50	0,11		99,50	-0,09		84,50	-0,10		56,00	-0,04	
261	106,05	0,73		76,20	0,10		87,60	0,12		107,70	0,73		88,15	0,33		55,80	-0,08	
267	100,00	0,12		84,50	1,20		87,50	0,11		108,00	0,76		86,00	0,08		56,50	0,04	
273	89,00	-1,00		77,00	0,20		87,50	0,11		100,00	-0,04		88,00	0,31		57,00	0,13	

	n-Butyl acetate	Z score	n-Heptane	Z score	Toluene	Z score	n-Octane	Z score	p-Xylene	Z score	Ethylbenzene	Z score
274	93,00	-0,59	70,50	-0,66	81,00	-0,64	91,50	-0,89	82,00	-0,39	54,50	-0,31
503					97,10	1,22			100,05	1,73	60,70	0,79
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Method	ISO 5725-2		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		|Z|<=2,00	
Mean	98,84		75,46		86,57		100,39		85,32		56,25	
Reproducibility s.d.	8,96		6,96		7,76		7,41		5,92		4,41	
Rel. reproducibility s.d.	9,06 %		9,22 %		8,96 %		7,38 %		6,94 %		7,85 %	
Reference value	92,40		70,80		82,40		91,80		84,70		55,70	
Target s.d.	9,88		7,55		8,66		10,04		8,53		5,62	
Repeatability s.d.	3,73		3,26		3,19		3,44		2,42		1,89	
Rel. target s.d.	10,00 %		10,00 %		10,00 %		10,00 %		10,00 %		10,00 %	
Lower limit of tolerance	79,07		60,37		69,25		80,31		68,26		45,00	
Upper limit of tolerance	118,61		90,55		103,88		120,46		102,39		67,50	
Type B outliers	4		1		1		2		3		2	
Number of laboratories with replicates outside of tolerance limits	5		3		3		2		3		3	
Type F outliers												
No. of laboratories that submitted results	29		27		30		27		30		30	
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	25		26		28		25		27		28	

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

	1,2,4-Trimethylbenzene	Z score		4-Methyl-2-Pentanone	Z score		Cumene	Z score	
Unit	µg/m³			µg/m³			µg/m³		
22	58,10	0,04		92,05	0,82		56,20	-0,15	
30	54,90	-0,52		82,75	-0,28		52,55	-0,79	
44	64,92	1,21		87,54	0,29		63,12	1,06	
60	66,90	1,56		60,65	-2,87	E	105,30	8,45	CE
68	58,75	0,15		87,00	0,22		54,20	-0,50	
94	56,50	-0,24		85,50	0,05		59,00	0,34	
97	58,80	0,16		78,65	-0,76		57,55	0,08	
104	53,25	-0,80		87,45	0,27		58,40	0,23	
121	58,10	0,04		92,05	0,82		56,20	-0,15	
126	53,65	-0,73		78,25	-0,81		122,15	11,40	CE
135	62,70	0,83		84,50	-0,07		59,95	0,50	
151	55,15	-0,47		86,70	0,19		57,35	0,05	
155	56,50	-0,24		85,00	-0,01		55,00	-0,36	
184	61,50	0,62		93,00	0,93		61,50	0,78	
186	62,50	0,80		85,65	0,06		56,75	-0,06	
192	55,60	-0,40		87,10	0,23		85,05	4,90	BE
194	50,00	-1,36		54,50	-3,60	FE	51,00	-1,06	
198				180,00	11,15	CE			
206	17,00	-7,06	BE	25,50	-7,00	BE	15,00	-7,37	BE
207	68,00	1,75		107,00	2,57	E	79,00	3,84	CE
208	53,50	-0,76		77,50	-0,89		55,00	-0,36	
214	56,00	-0,33		116,50	3,69	FE	78,50	3,76	BE
237	57,99	0,02		82,81	-0,27		57,45	0,07	
240	53,65	-0,73		71,15	-1,64				
254	50,50	-1,28		92,50	0,87		52,50	-0,80	
261	62,45	0,79		92,45	0,86		61,15	0,72	
267	58,50	0,10		87,00	0,22		53,50	-0,63	
273	58,00	0,02		83,50	-0,19		58,50	0,25	
274	60,50	0,45		80,00	-0,60		60,00	0,51	
503	58,65	0,13					58,65	0,28	
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Method	ISO 5725-2			ISO 5725-2			ISO 5725-2		
Assessment	|Z|<=2,00			|Z|<=2,00			|Z|<=2,00		

	1,2,4-Trimethylbenzene	Z score	4-Methyl-2-Pentanone	Z score	Cumene	Z score
Mean	57,90		85,11		57,07	
Reproducibility s.d.	4,53		8,71		3,30	
Rel. reproducibility s.d.	7,82 %		10,23 %		5,79 %	
Reference value	53,80		82,20		52,80	
Target s.d.	5,79		8,51		5,71	
Repeatability s.d.	1,78		2,40		1,36	
Rel. target s.d.	10,00 %		10,00 %		10,00 %	
Lower limit of tolerance	46,32		68,09		45,66	
Upper limit of tolerance	69,47		102,13		68,48	
Type B outliers	1		1		3	
Number of laboratories with replicates outside of tolerance limits	2		6		6	
Type F outliers			2			
No. of laboratories that submitted results	29		29		28	
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	28		25		22	

Summary of laboratory means

Sample 2

	n-Butyl acetate	Z score		n-Heptane	Z score		Toluene	Z score		n-Octane	Z score		p-Xylene	Z score		Ethylbenzene	Z score	
Unit	µg/m³			µg/m³			µg/m³			µg/m³			µg/m³			µg/m³		
22	124,75	0,75		93,95	0,14		63,45	0,23		91,65	0,25		116,70	0,03		91,05	0,37	
30	109,65	-0,55		90,10	-0,27		58,90	-0,50		86,25	-0,35		109,95	-0,55		80,20	-0,87	
44	107,53	-0,74		100,72	0,88		67,97	0,96		99,27	1,10		131,18	1,28		96,20	0,96	
60	99,20	-1,45		83,80	-0,95		57,15	-0,78		87,10	-0,26		100,45	-1,36		81,25	-0,75	
68	115,90	-0,02		97,05	0,48		60,00	-0,32		98,65	1,03		111,90	-0,38		89,75	0,22	
94	112,50	-0,31		94,50	0,20		69,00	1,13		88,00	-0,16		117,00	0,06		88,00	0,02	
97	135,50	1,67		113,50	2,26	E	74,20	1,97		103,50	1,58		139,50	1,99		107,00	2,19	E
104	118,50	0,21		85,85	-0,73		58,95	-0,49		82,55	-0,77		109,00	-0,63		80,60	-0,82	
121	124,75	0,75		93,95	0,14		63,45	0,23		91,65	0,25		116,70	0,03		91,05	0,37	
126	106,20	-0,85		78,45	-1,53		58,70	-0,53		80,40	-1,01		116,35	0,00		92,85	0,58	
135	118,20	0,18		86,40	-0,67		60,65	-0,22		86,30	-0,35		115,20	-0,10		84,80	-0,34	
151	111,40	-0,40		90,65	-0,21		58,85	-0,51		82,85	-0,73		107,45	-0,76		80,60	-0,82	
155	123,00	0,60		96,00	0,37		65,50	0,56		92,50	0,35		122,00	0,49		91,50	0,42	
184	128,50	1,07		101,00	0,91		70,00	1,29		98,00	0,96		130,00	1,18		97,50	1,11	
186	106,70	-0,81		90,90	-0,19		60,30	-0,28		89,40	0,00		117,35	0,09		86,00	-0,20	
192	112,50	-0,31		103,00	1,12		62,50	0,08		96,75	0,82		114,50	-0,16		83,10	-0,53	
194	58,00	-5,00	BE	73,50	-2,06	E	54,50	-1,21		75,00	-1,61		103,00	-1,14		77,50	-1,17	
198	184,75	5,92	CE				141,80	12,87	CE				210,15	8,07	CE	149,35	7,01	CE
206	107,50	-0,74		81,50	-1,20		59,50	-0,40		76,50	-1,44		104,50	-1,02		87,50	-0,03	
207	148,00	2,75	E	103,00	1,12		81,00	3,06	BE	114,00	2,75	E	144,50	2,42	E	111,00	2,64	E
208	100,00	-1,38		83,00	-1,04		54,50	-1,21		78,50	-1,22		100,00	-1,40		75,00	-1,46	
214	159,50	3,74	BE	105,50	1,39		63,00	0,16		84,50	-0,55		113,00	-0,28		90,50	0,31	
237	124,68	0,74		86,96	-0,61		63,89	0,30		88,47	-0,10		121,90	0,48		91,16	0,38	
240	102,60	-1,16					53,95	-1,30					109,60	-0,58		78,45	-1,06	
254	126,50	0,90		98,50	0,64		63,50	0,24		88,50	-0,10		114,50	-0,16		86,50	-0,15	
261	121,40	0,46		91,30	-0,14		61,70	-0,05		93,10	0,41		114,60	-0,15		85,15	-0,30	
267	115,50	-0,05		103,50	1,18		62,00	0,00		94,50	0,57		116,50	0,02		87,00	-0,09	
273	107,00	-0,78		90,50	-0,23		61,50	-0,08		86,00	-0,38		113,50	-0,24		83,00	-0,55	

	n-Butyl acetate	Z score	n-Heptane	Z score	Toluene	Z score	n-Octane	Z score	p-Xylene	Z score	Ethylbenzene	Z score
274	110,00	-0,52	83,50	-0,98	60,50	-0,24	80,00	-1,05	109,00	-0,63	79,00	-1,00
503					68,05	0,97			133,20	1,45	92,90	0,58
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Method	ISO 5725-2		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		|Z|<=2,00	
Mean	116,08		92,61		62,01		89,40		116,31		87,80	
Reproducibility s.d.	11,67		9,44		4,93		8,92		11,01		8,42	
Rel. reproducibility s.d.	10,06 %		10,19 %		7,94 %		9,98 %		9,47 %		9,59 %	
Reference value	110,10		88,80		59,50		81,90		117,40		87,60	
Target s.d.	11,61		9,26		6,20		8,94		11,63		8,78	
Repeatability s.d.	3,69		2,68		1,71		2,45		3,25		2,67	
Rel. target s.d.	10,00 %		10,00 %		10,00 %		10,00 %		10,00 %		10,00 %	
Lower limit of tolerance	92,86		74,09		49,60		71,52		93,05		70,24	
Upper limit of tolerance	139,29		111,14		74,41		107,28		139,57		105,36	
Type B outliers	2				1							
Number of laboratories with replicates outside of tolerance limits	4		2		3		1		3		3	
Type F outliers												
No. of laboratories that submitted results	29		27		30		27		30		30	
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	26		27		28		27		29		29	

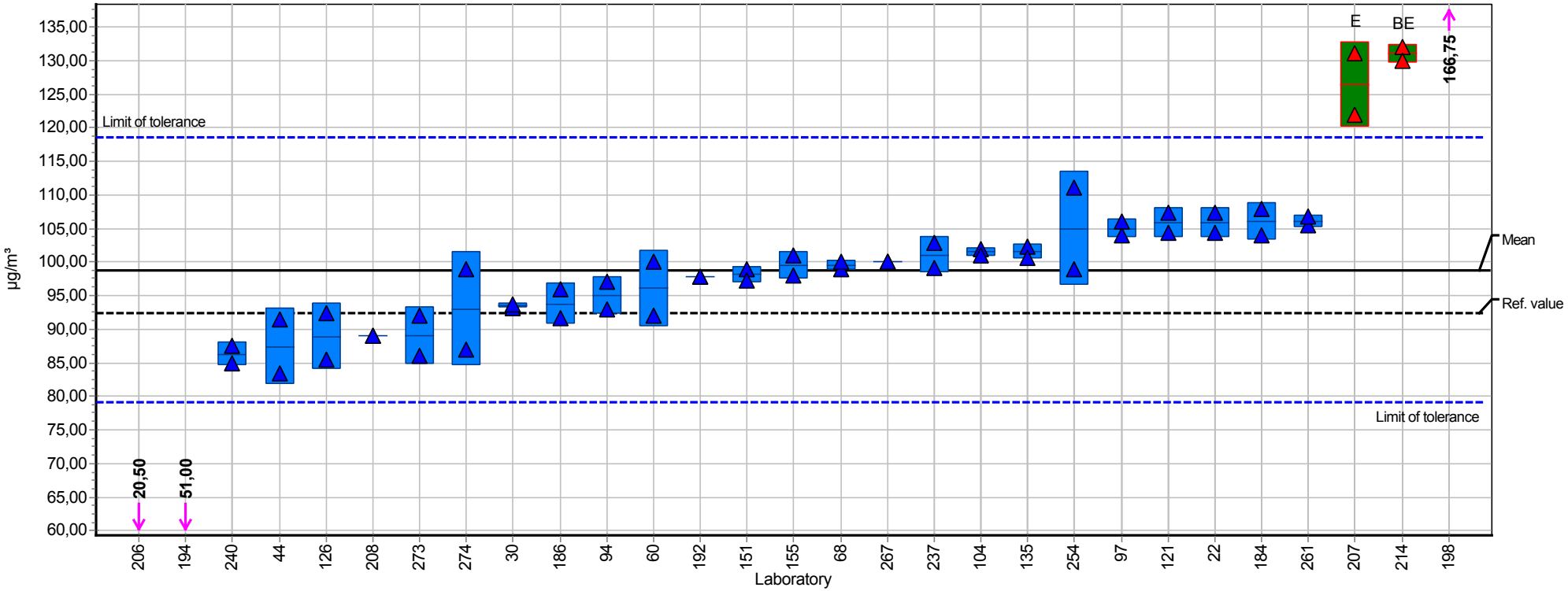
Explanation of outlier types	
A: Single outlier	Grubbs
B: Differing laboratory mean	Grubbs
C: Excessive laboratory s.d.	Cochran
D: Excluded manually	
E: mean outside tolerance limits	
F: |Z-Score|>3,5	
L: Differing laboratory mean (Grubbs II)	Grubbs für 2

	1,2,4-Trimethylbenzene	Z score		4-Methyl-2-Pentanone	Z score		Cumene	Z score	
Unit	µg/m³			µg/m³			µg/m³		
22	59,30	0,08		110,35	0,52		99,90	0,25	
30	54,85	-0,68		101,00	-0,37		94,15	-0,34	
44	65,25	1,09		110,84	0,57		108,41	1,12	
60	59,15	0,05		69,50	-3,37	E	162,25	6,64	BE
68	57,40	-0,24		104,45	-0,04		94,45	-0,31	
94	55,50	-0,57		105,00	0,01		98,00	0,05	
97	88,10	4,97	E	126,00	2,01	E	153,00	5,70	CE
104	52,95	-1,00		103,00	-0,18		99,40	0,20	
121	59,30	0,08		110,35	0,52		99,90	0,25	
126	55,50	-0,57		97,75	-0,68		212,95	11,85	BE
135	62,90	0,69		103,35	-0,15		101,80	0,44	
151	54,20	-0,79		103,90	-0,09		97,25	-0,02	
155	61,00	0,37		109,00	0,39		102,50	0,52	
184	63,50	0,79		115,00	0,96		107,50	1,03	
186	54,45	-0,75		101,20	-0,35		94,15	-0,34	
192	55,75	-0,52		105,50	0,06		142,00	4,57	BE
194	50,50	-1,42		63,00	-3,99	FE	85,00	-1,28	
198				207,65	9,80	CE			
206	57,00	-0,31		84,00	-1,99		93,50	-0,41	
207	67,00	1,39		128,00	2,20	E	133,50	3,70	CE
208	54,50	-0,74		92,50	-1,18		93,00	-0,46	
214	59,00	0,03		132,00	2,59	E	133,50	3,70	BE
237	58,69	-0,03		104,84	0,00		99,94	0,25	
240	53,65	-0,88		89,70	-1,45				
254	51,50	-1,25		117,50	1,20		91,00	-0,66	
261	60,70	0,32		109,55	0,45		99,20	0,18	
267	58,50	-0,06		105,50	0,06		91,50	-0,61	
273	58,00	-0,14		96,00	-0,85		97,50	0,00	
274	60,50	0,28		96,00	-0,85		99,00	0,16	
503	57,60	-0,21					97,45	0,00	
–	–	– –		–	– –		–	– –	
Method	ISO 5725-2			ISO 5725-2			ISO 5725-2		
Assessment	|Z|<=2,00			|Z|<=2,00			|Z|<=2,00		

	1,2,4-Trimethylbenzene	Z score	4-Methyl-2-Pentanone	Z score	Cumene	Z score
Mean	58,84		104,88		97,48	
Reproducibility s.d.	6,97		13,33		5,46	
Rel. reproducibility s.d.	11,84 %		12,71 %		5,60 %	
Reference value	55,00		100,90		92,20	
Target s.d.	5,88		10,49		9,75	
Repeatability s.d.	1,80		3,83		1,81	
Rel. target s.d.	10,00 %		10,00 %		10,00 %	
Lower limit of tolerance	47,07		83,90		77,98	
Upper limit of tolerance	70,60		125,86		116,97	
Type B outliers					4	
Number of laboratories with replicates outside of tolerance limits	1		7		6	
Type F outliers			1			
No. of laboratories that submitted results	29		29		28	
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	29		27		22	

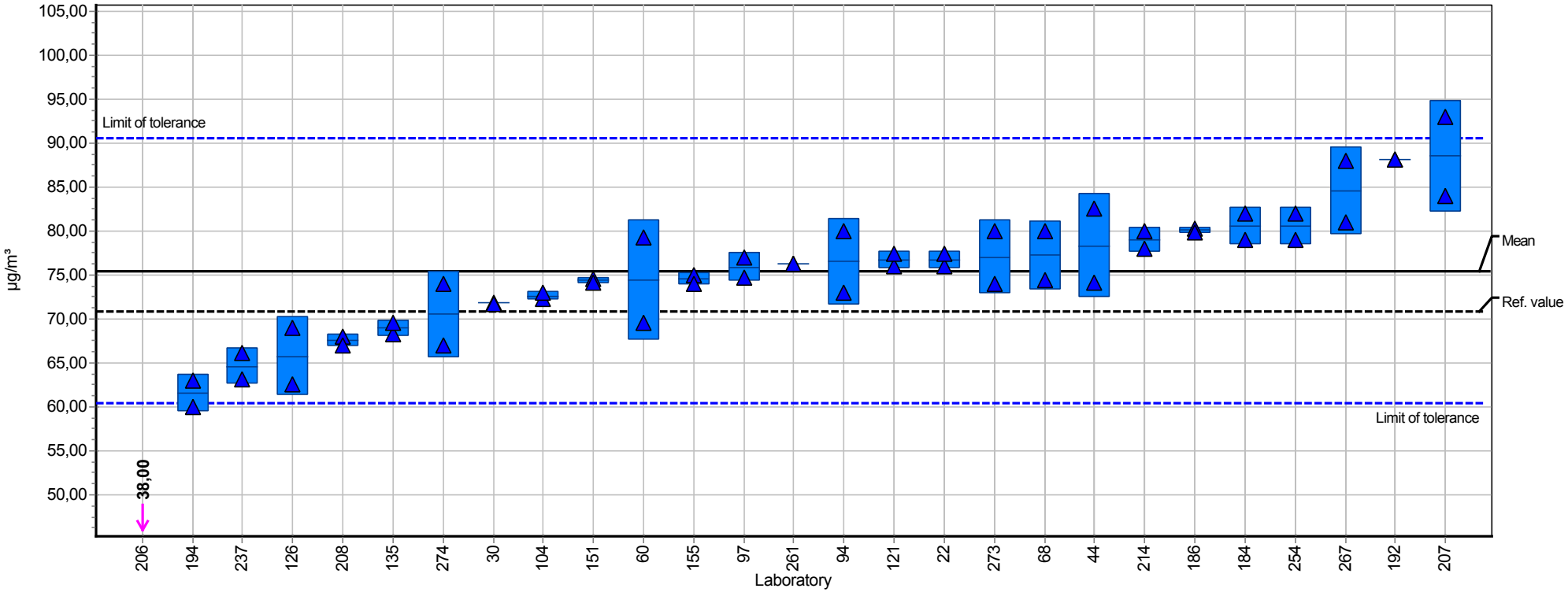
Summary results

Measurand:	**n-Butyl acetate**	**Mean:**	**98,84 µg/m³**
Sample:	**1**	**Reproducibility s.d.:**	**8,96 µg/m³**
Method:	**ISO 5725-2**	**Relative reproducibility s.d.:**	**9,06%**
Relative target s.d.:	**10,00% (Limited)**	**Reference value:**	**92,40 µg/m³**
No. of laboratories:	**25**	**Range of tolerance:**	**79,07 - 118,61 µg/m³ (|Z-Score| <= 2,00)**



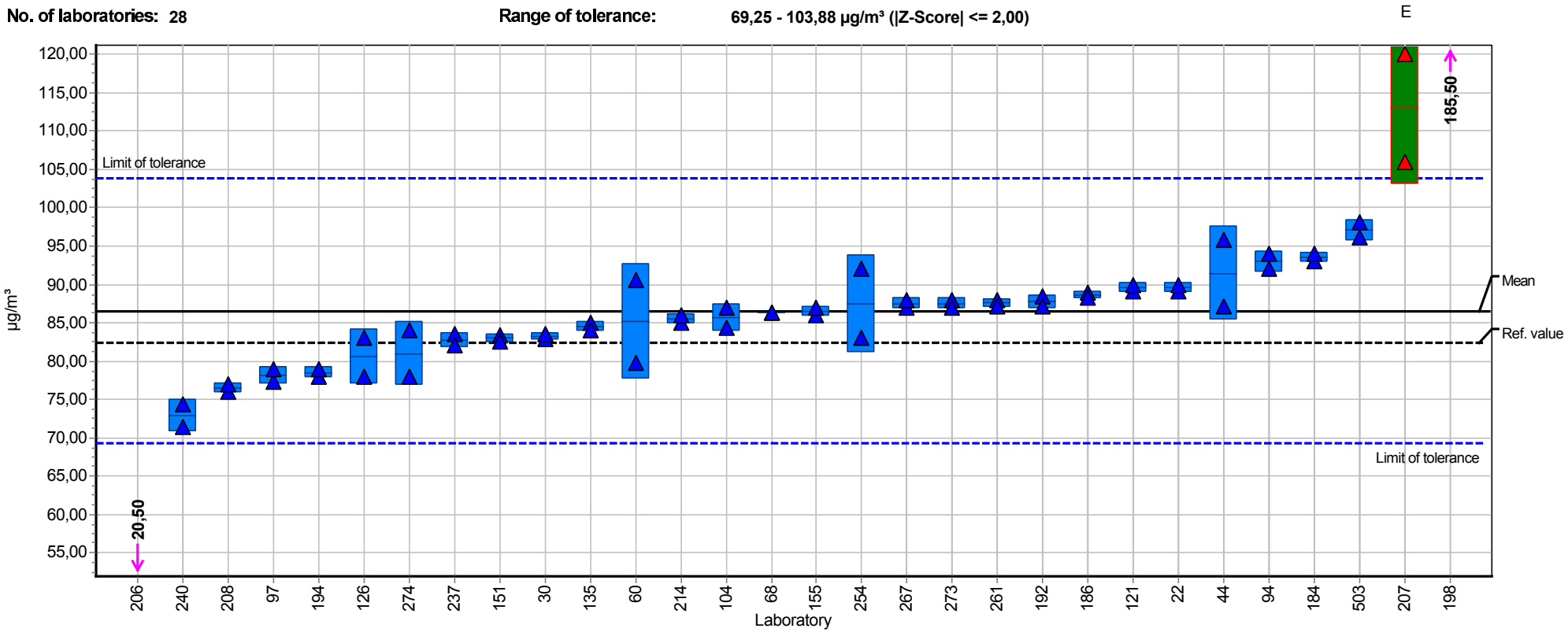
Summary results

Measurand:	**n-Heptane**	**Mean:**	**75,46 µg/m³**
Sample:	**1**	**Reproducibility s.d.:**	**6,96 µg/m³**
Method:	**ISO 5725-2**	**Relative reproducibility s.d.:**	**9,22%**
Relative target s.d.:	**10,00% (Limited)**	**Reference value:**	**70,80 µg/m³**
No. of laboratories:	**26**	**Range of tolerance:**	**60,37 - 90,55 µg/m³ (|Z-Score| <= 2,00)**



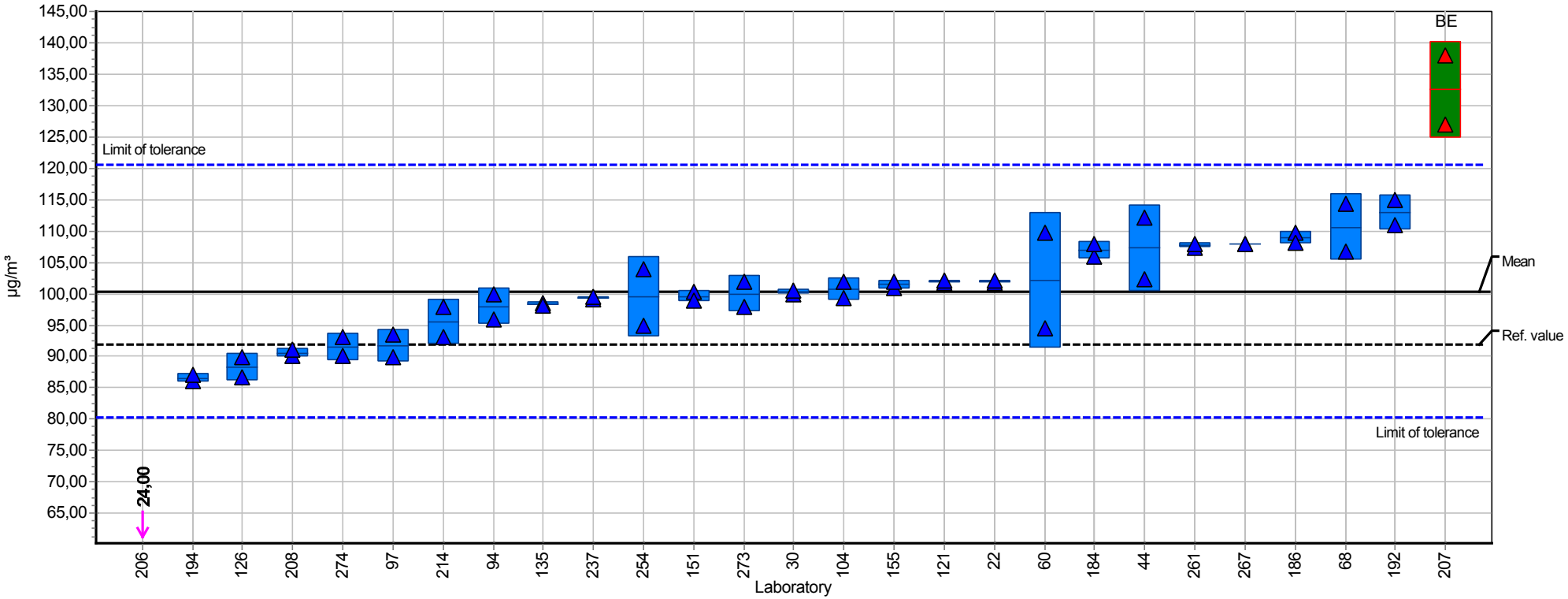
Summary results

Measurand:	**Toluene**	**Mean:**	**86,57 µg/m³**
Sample:	**1**	**Reproducibility s.d.:**	**7,76 µg/m³**
Method:	**ISO 5725-2**	**Relative reproducibility s.d.:**	**8,96%**
Relative target s.d.:	**10,00% (Limited)**	**Reference value:**	**82,40 µg/m³**
No. of laboratories:	**28**	**Range of tolerance:**	**69,25 - 103,88 µg/m³ (|Z-Score| <= 2,00)**



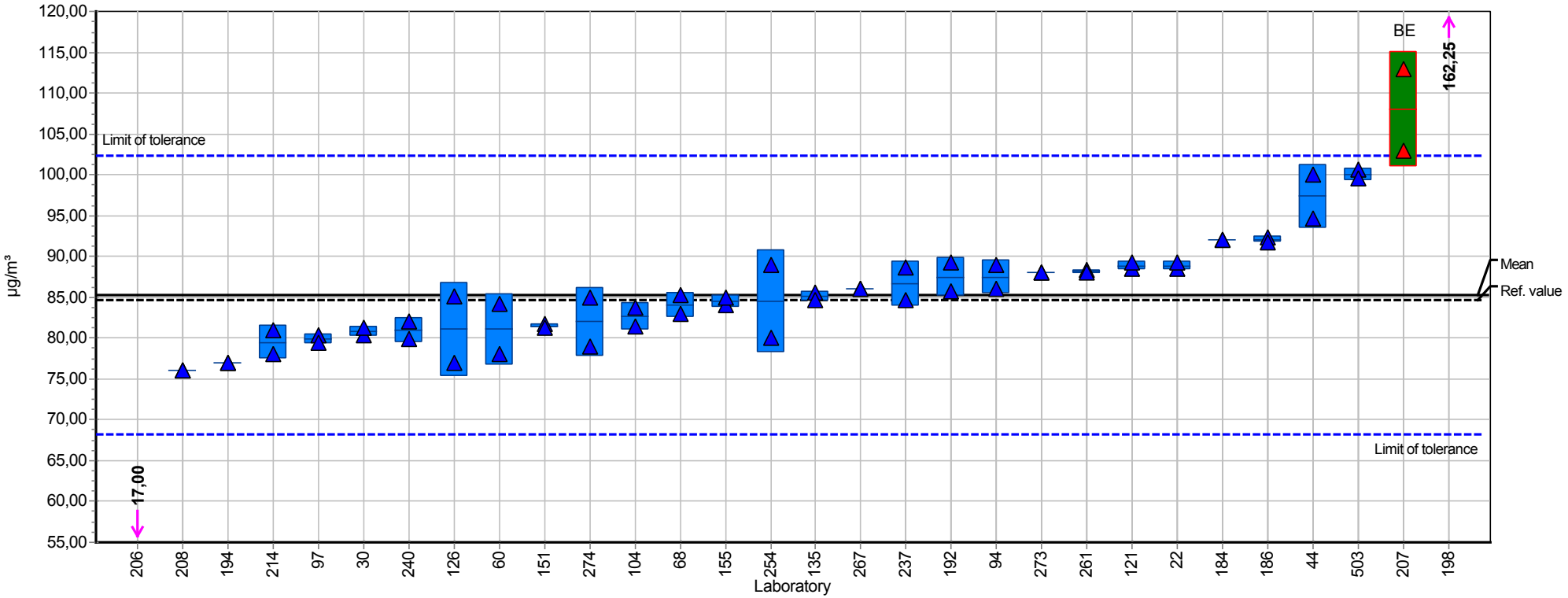
Summary results

Measurand:	n-Octane	**Mean:**	100,39 µg/m³
Sample:	1	**Reproducibility s.d.:**	7,41 µg/m³
Method:	ISO 5725-2	**Relative reproducibility s.d.:**	7,38%
Relative target s.d.:	10,00% (Limited)	**Reference value:**	91,80 µg/m³
No. of laboratories:	25	**Range of tolerance:**	80,31 - 120,46 µg/m³ (|Z-Score| <= 2,00)



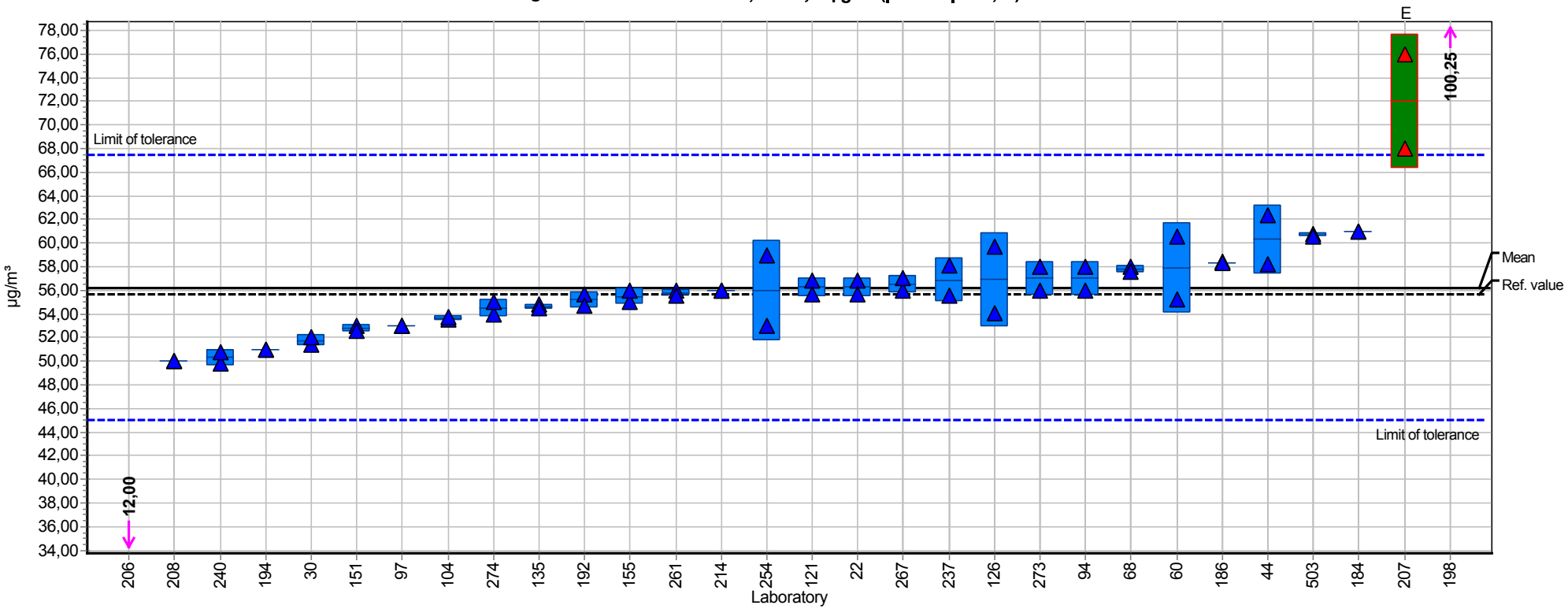
Summary results

Measurand:	**p-Xylene**	**Mean:**	**85,32 µg/m³**
Sample:	**1**	**Reproducibility s.d.:**	**5,92 µg/m³**
Method:	**ISO 5725-2**	**Relative reproducibility s.d.:**	**6,94%**
Relative target s.d.:	**10,00% (Limited)**	**Reference value:**	**84,70 µg/m³**
No. of laboratories:	**27**	**Range of tolerance:**	**68,26 - 102,39 µg/m³ (|Z-Score| <= 2,00)**



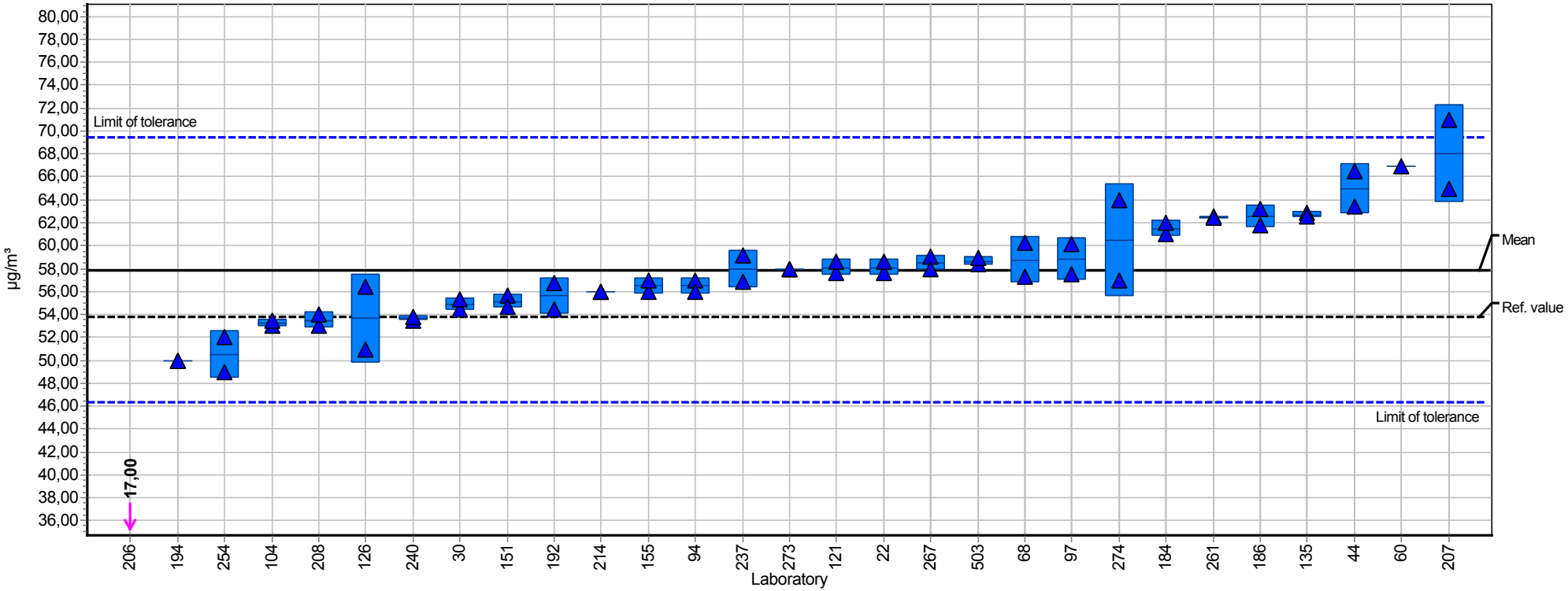
Summary results

Measurand:	**Ethylbenzene**	**Mean:**	**56,25 µg/m³**
Sample:	**1**	**Reproducibility s.d.:**	**4,41 µg/m³**
Method:	**ISO 5725-2**	**Relative reproducibility s.d.:**	**7,85%**
Relative target s.d.:	**10,00% (Limited)**	**Reference value:**	**55,70 µg/m³**
No. of laboratories:	**28**	**Range of tolerance:**	**45,00 - 67,50 µg/m³ (|Z-Score| <= 2,00)**



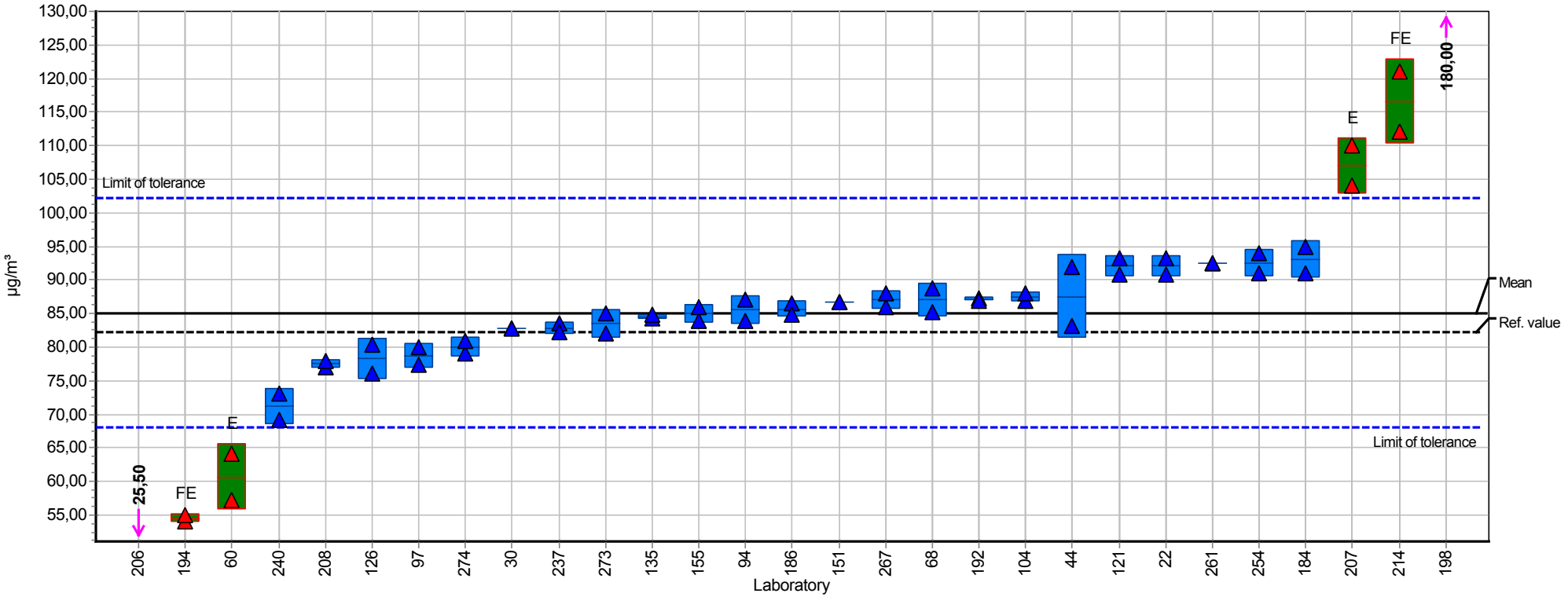
Summary results

Measurand:	1,2,4-Trimethylbenzene	**Mean:**	57,90 µg/m³
Sample:	1	**Reproducibility s.d.:**	4,53 µg/m³
Method:	ISO 5725-2	**Relative reproducibility s.d.:**	7,82%
Relative target s.d.:	10,00% (Limited)	**Reference value:**	53,80 µg/m³
No. of laboratories:	28	**Range of tolerance:**	46,32 - 69,47 µg/m³ (|Z-Score| <= 2,00)



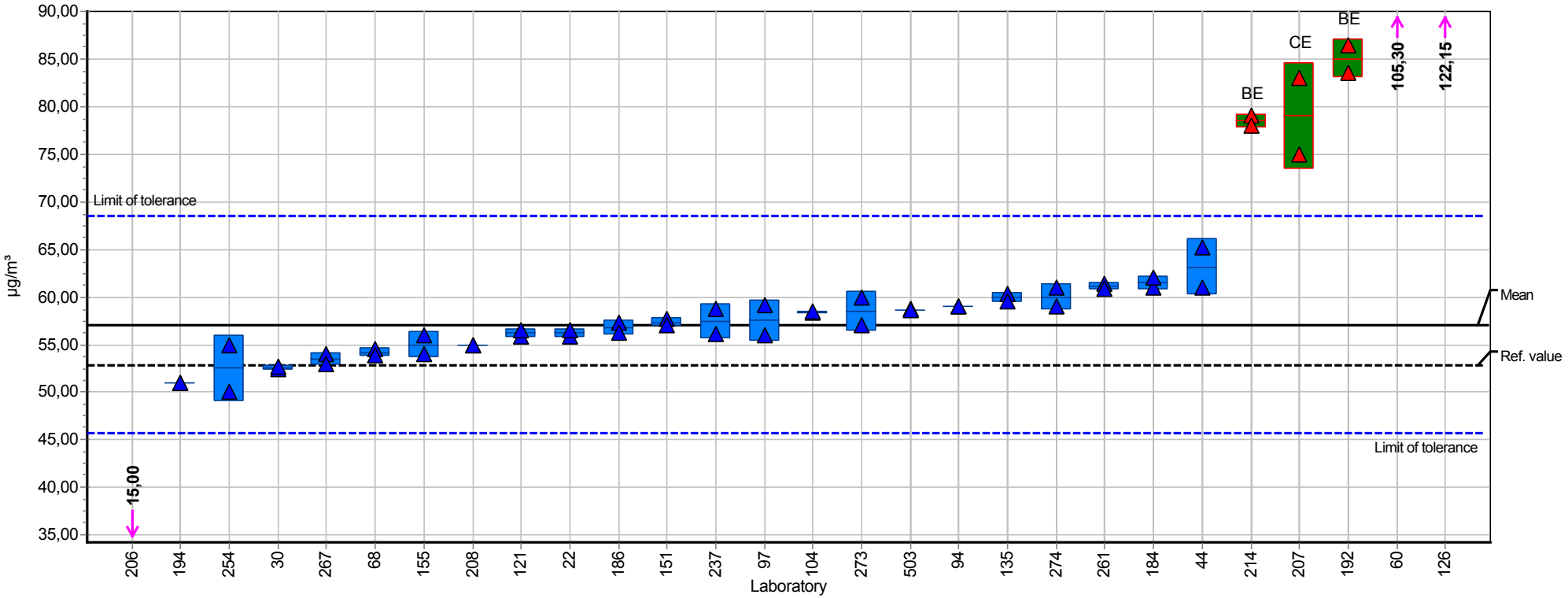
Summary results

Measurand:	**4-Methyl-2-Pentanone**	**Mean:**	**85,11 µg/m³**
Sample:	**1**	**Reproducibility s.d.:**	**8,71 µg/m³**
Method:	**ISO 5725-2**	**Relative reproducibility s.d.:**	**10,23%**
Relative target s.d.:	**10,00% (Limited)**	**Reference value:**	**82,20 µg/m³**
No. of laboratories:	**25**	**Range of tolerance:**	**68,09 - 102,13 µg/m³ (|Z-Score| <= 2,00)**



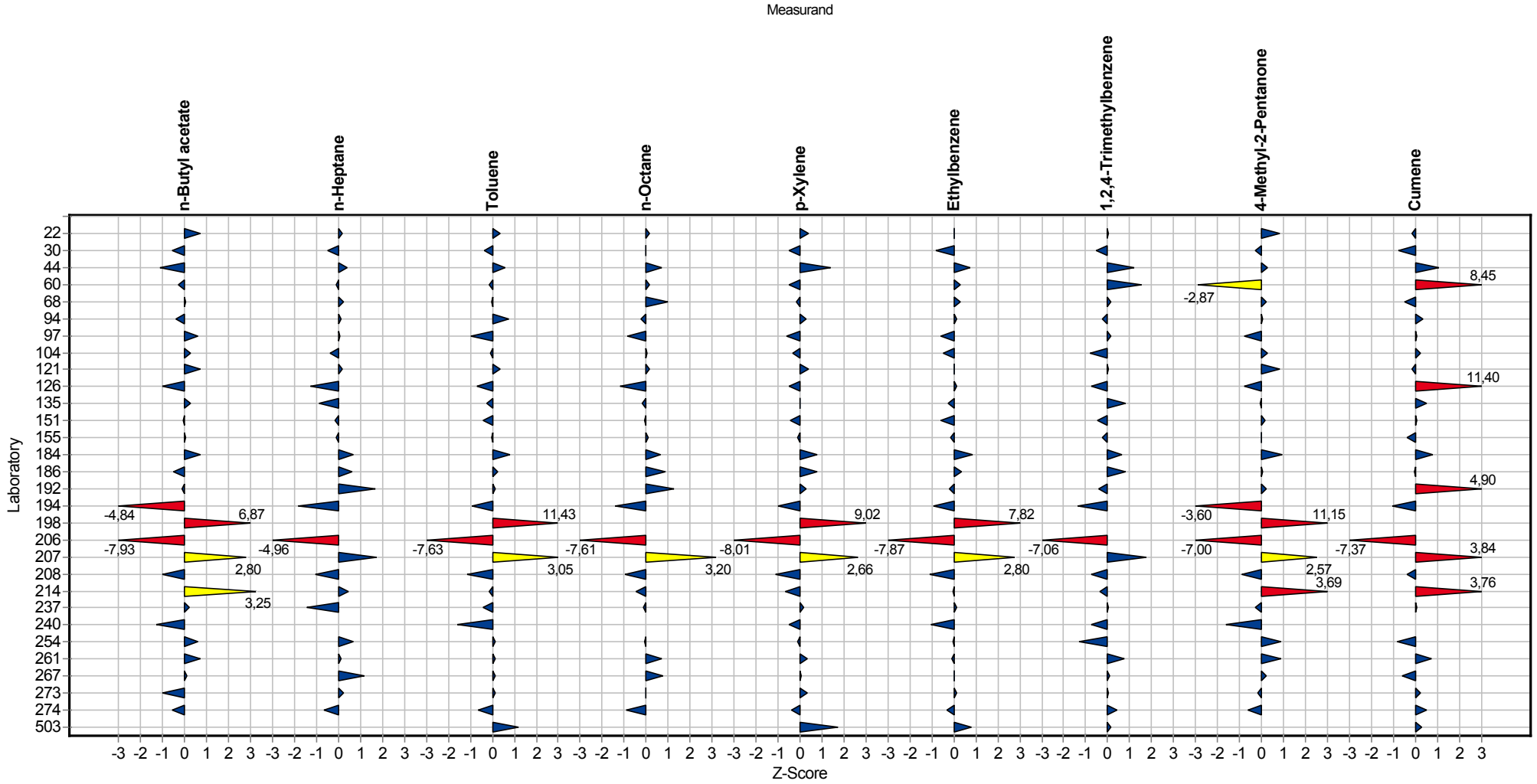
Summary results

Measurand:	**Cumene**	**Mean:**	**57,07 µg/m³**
Sample:	**1**	**Reproducibility s.d.:**	**3,30 µg/m³**
Method:	**ISO 5725-2**	**Relative reproducibility s.d.:**	**5,79%**
Relative target s.d.:	**10,00% (Limited)**	**Reference value:**	**52,80 µg/m³**
No. of laboratories:	**22**	**Range of tolerance:**	**45,66 - 68,48 µg/m³ (|Z-Score| <= 2,00)**



Sample chart of Z-scores

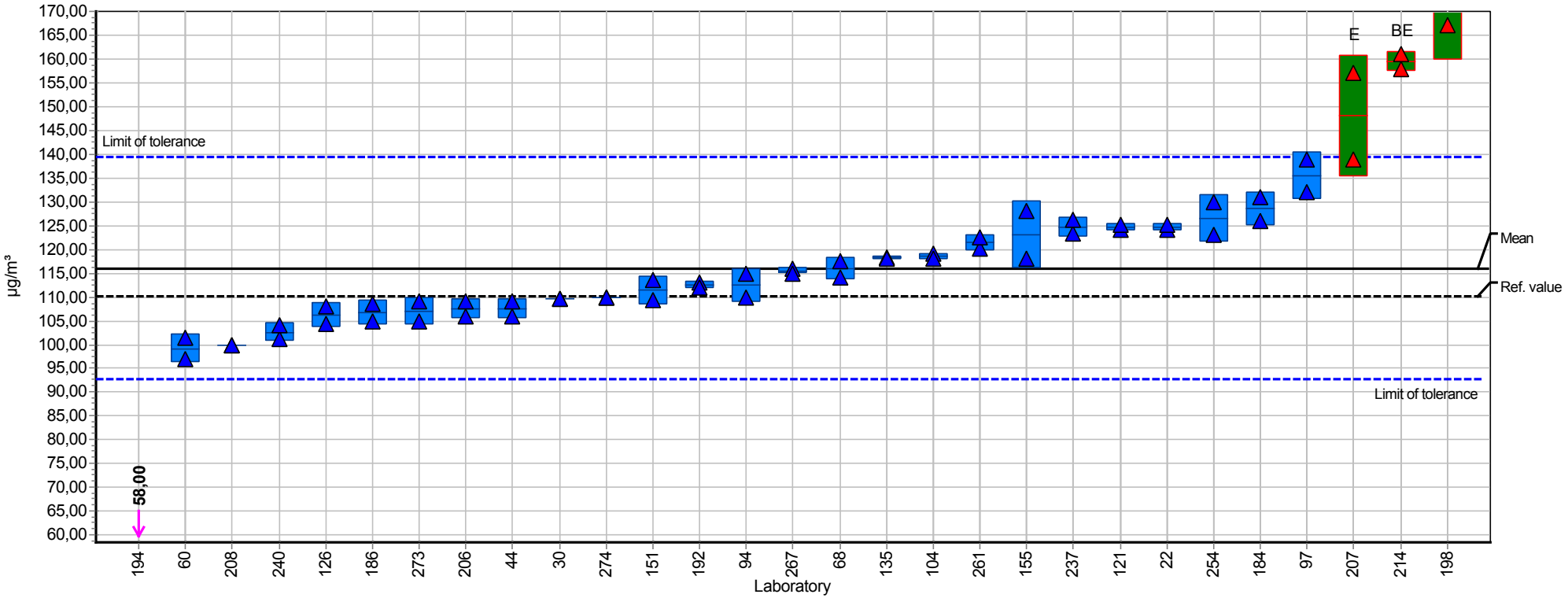
Sample 1



Summary results

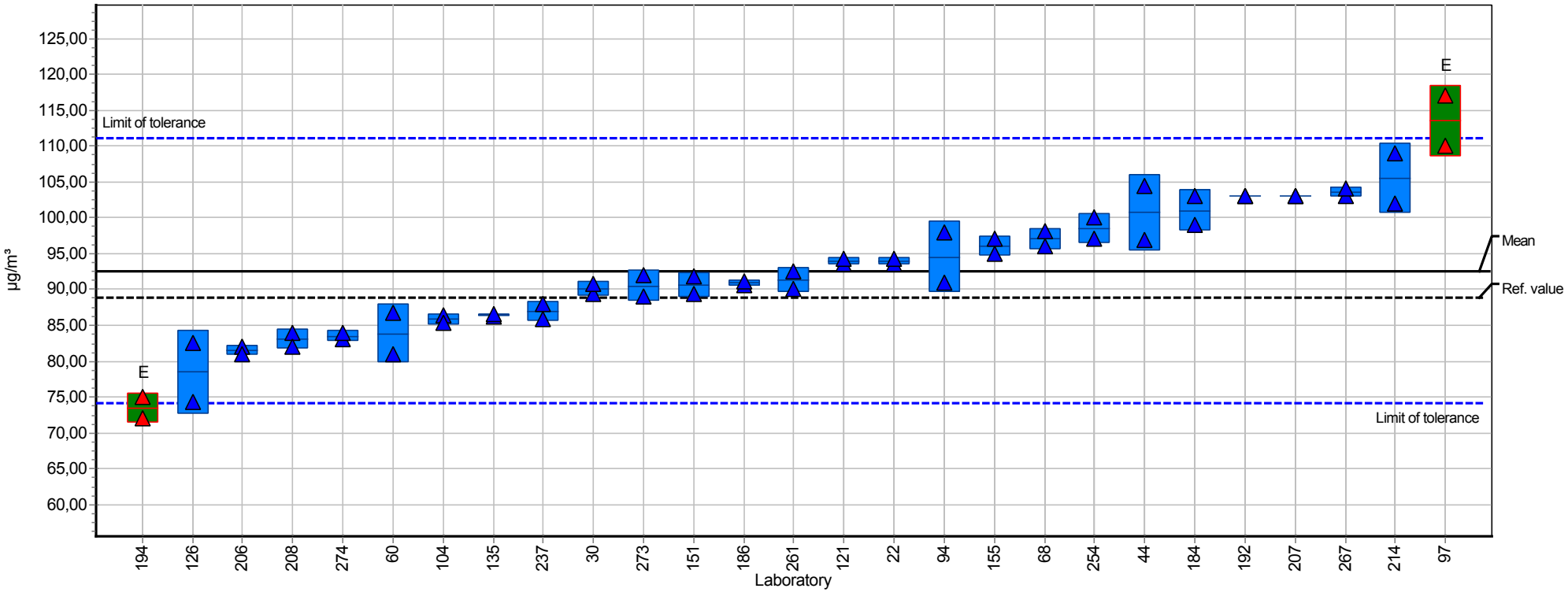
CE

Measurand:	**n-Butyl acetate**	**Mean:**	**116,08 µg/m³**
Sample:	**2**	**Reproducibility s.d.:**	**11,67 µg/m³**
Method:	**ISO 5725-2**	**Relative reproducibility s.d.:**	**10,06%**
Relative target s.d.:	**10,00% (Limited)**	**Reference value:**	**110,10 µg/m³**
No. of laboratories:	**26**	**Range of tolerance:**	**92,86 - 139,29 µg/m³ (|Z-Score| <= 2,00)**



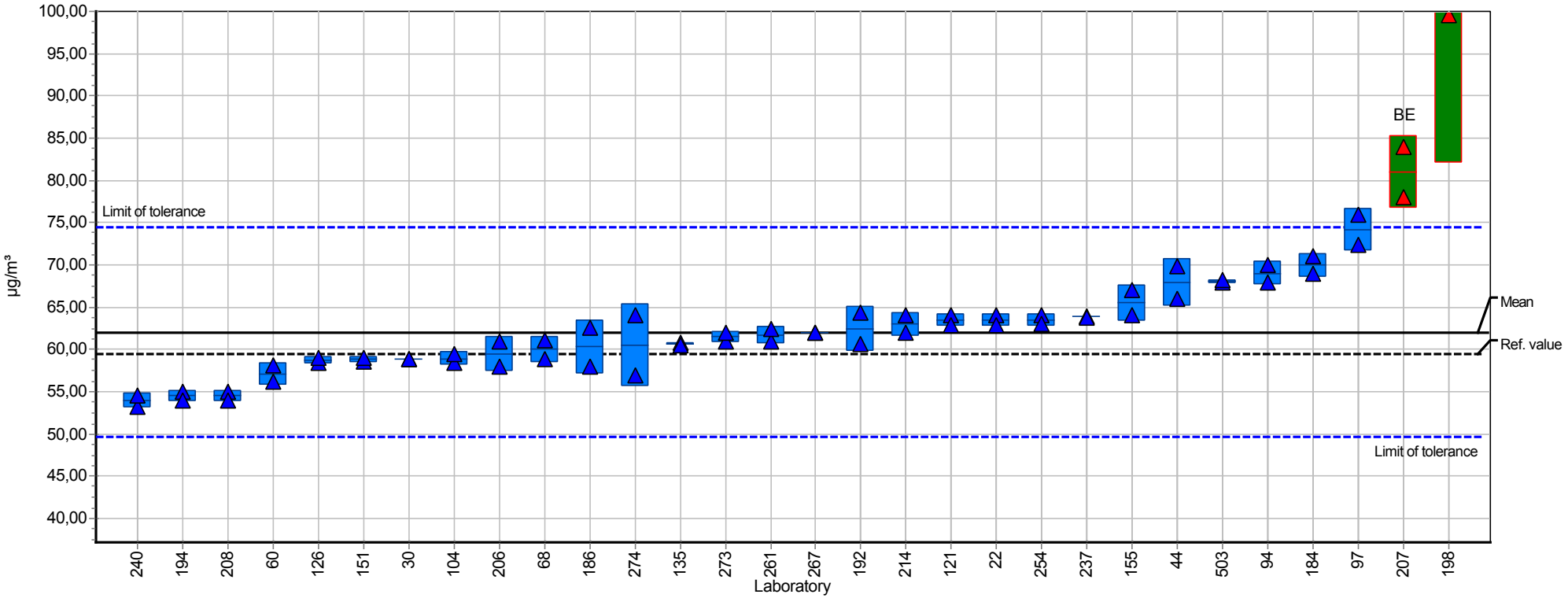
Summary results

Measurand:	n-Heptane	**Mean:**	92,61 µg/m³
Sample:	2	**Reproducibility s.d.:**	9,44 µg/m³
Method:	ISO 5725-2	**Relative reproducibility s.d.:**	10,19%
Relative target s.d.:	10,00% (Limited)	**Reference value:**	88,80 µg/m³
No. of laboratories:	27	**Range of tolerance:**	74,09 - 111,14 µg/m³ (|Z-Score| <= 2,00)



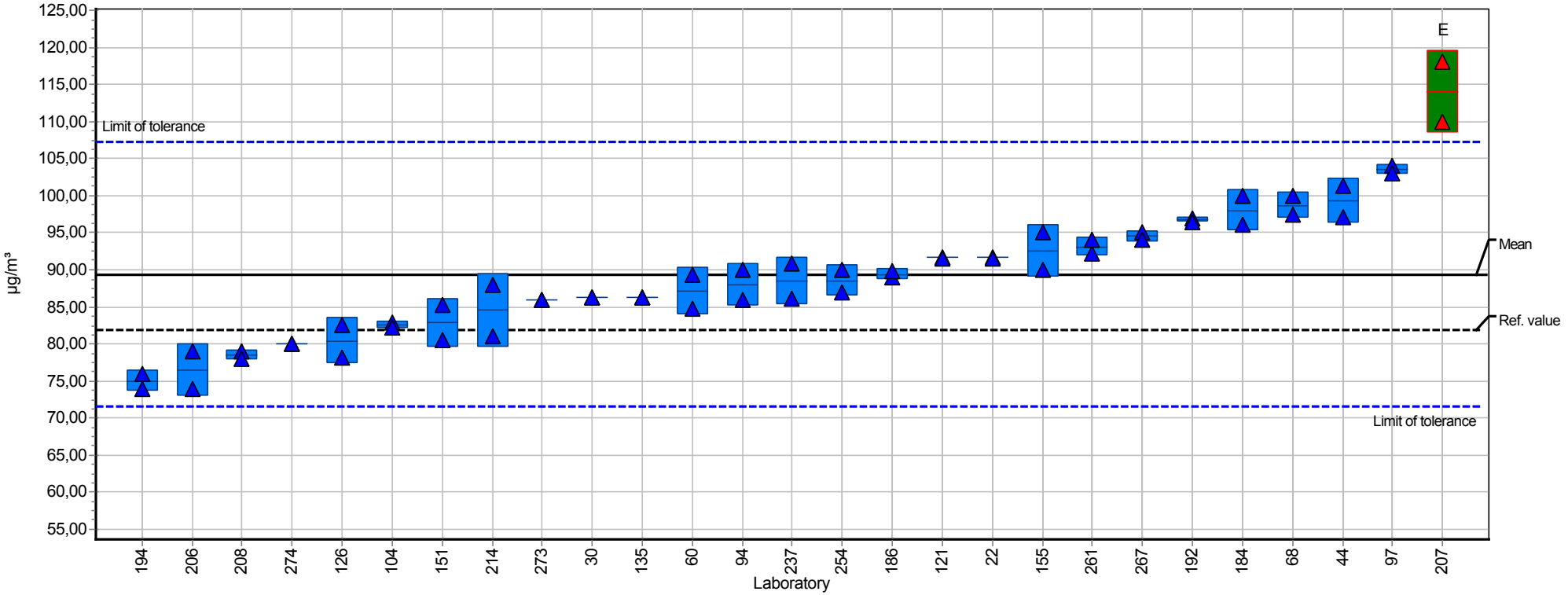
Summary results

Measurand:	**Toluene**	**Mean:**	**62,01 µg/m³**
Sample:	**2**	**Reproducibility s.d.:**	**4,93 µg/m³**
Method:	**ISO 5725-2**	**Relative reproducibility s.d.:**	**7,94%**
Relative target s.d.:	**10,00% (Limited)**	**Reference value:**	**59,50 µg/m³**
No. of laboratories:	**28**	**Range of tolerance:**	**49,60 - 74,41 µg/m³ (|Z-Score| <= 2,00)**



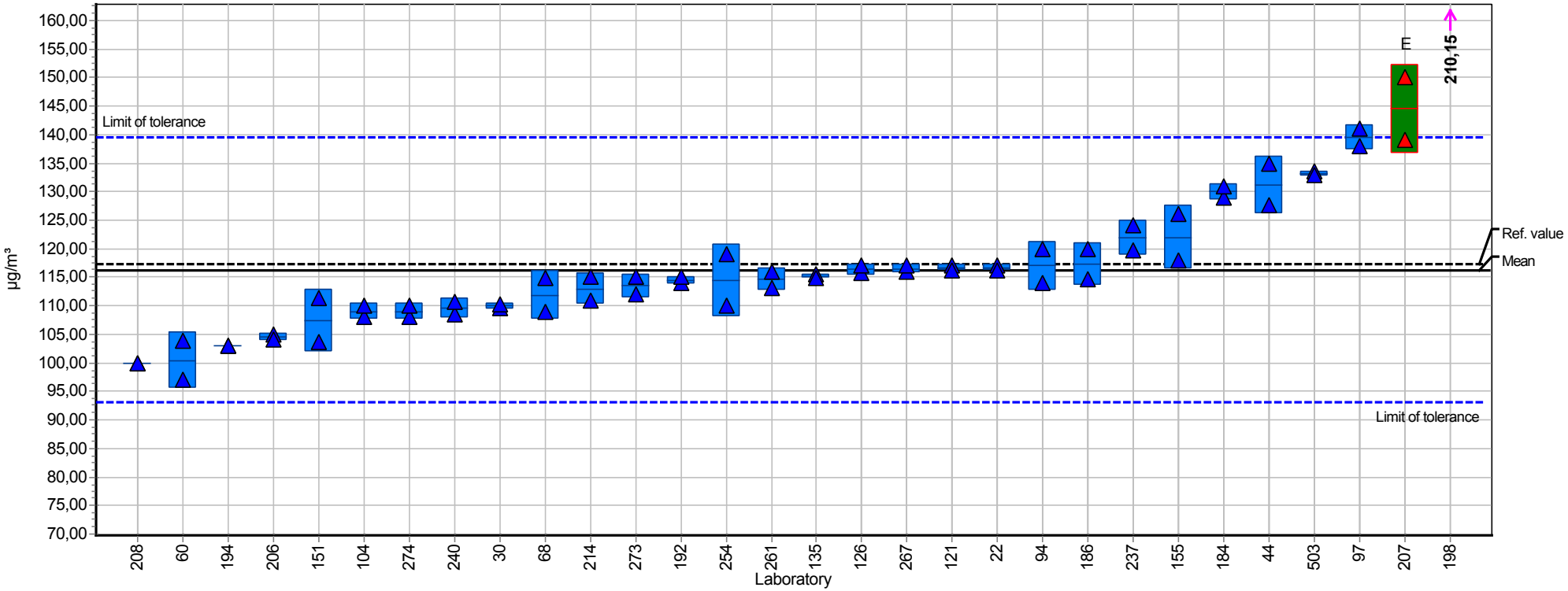
Summary results

Measurand:	n-Octane	**Mean:**	89,40 µg/m³
Sample:	2	**Reproducibility s.d.:**	8,92 µg/m³
Method:	ISO 5725-2	**Relative reproducibility s.d.:**	9,98%
Relative target s.d.:	10,00% (Limited)	**Reference value:**	81,90 µg/m³
No. of laboratories:	27	**Range of tolerance:**	71,52 - 107,28 µg/m³ (|Z-Score| <= 2,00)



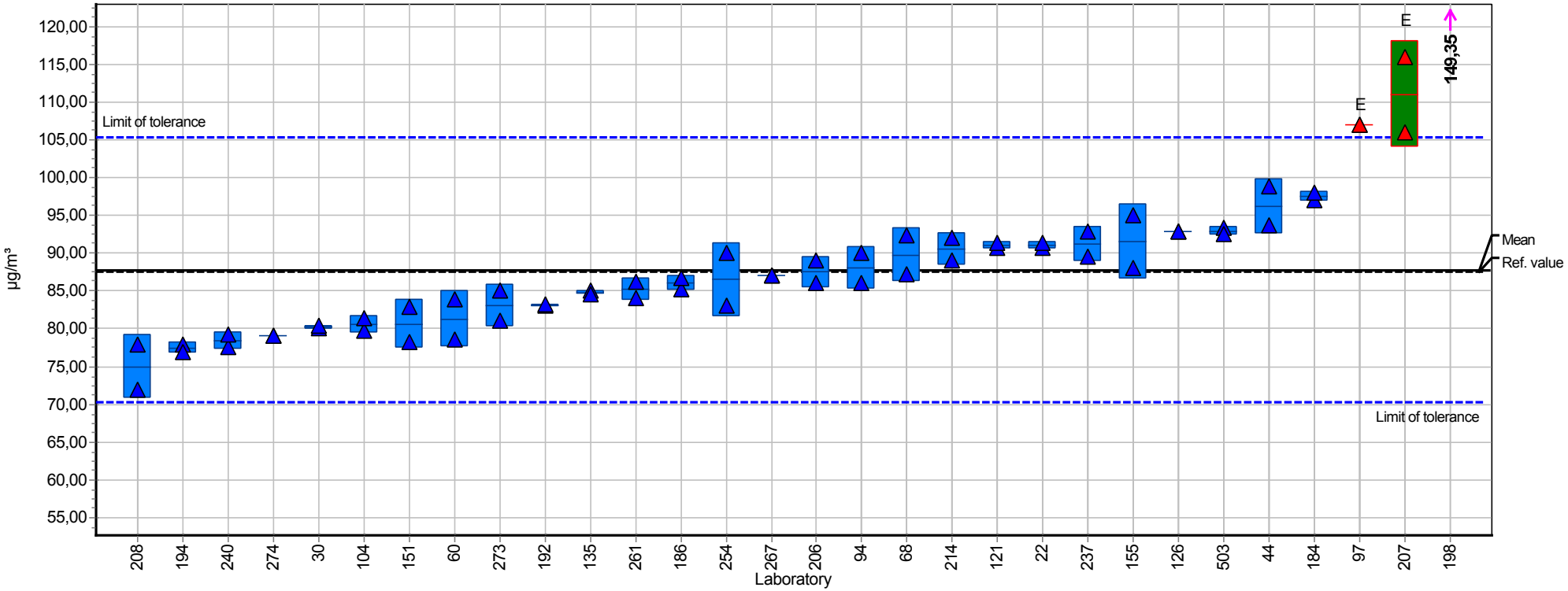
Summary results

Measurand:	**p-Xylene**	**Mean:**	**116,31 µg/m³**
Sample:	**2**	**Reproducibility s.d.:**	**11,01 µg/m³**
Method:	**ISO 5725-2**	**Relative reproducibility s.d.:**	**9,47%**
Relative target s.d.:	**10,00% (Limited)**	**Reference value:**	**117,40 µg/m³**
No. of laboratories:	**29**	**Range of tolerance:**	**93,05 - 139,57 µg/m³ (|Z-Score| <= 2,00)**



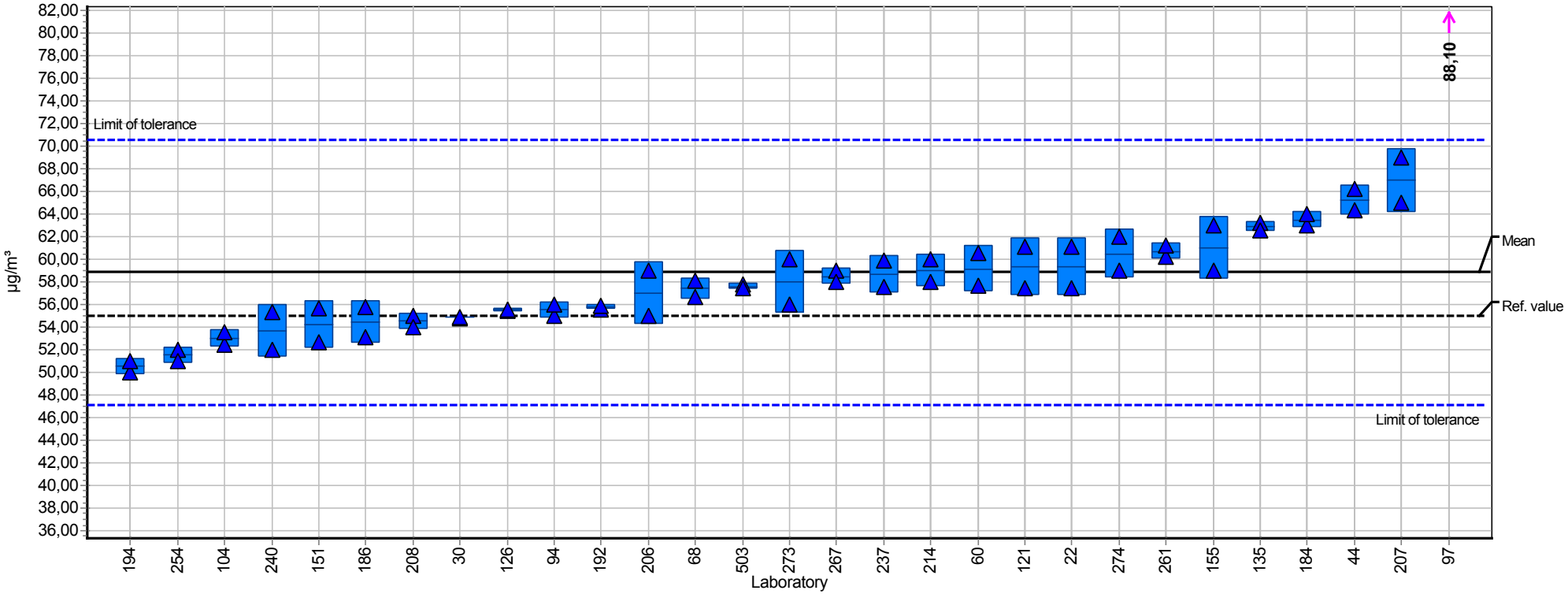
Summary results

Measurand:	**Ethylbenzene**	**Mean:**	**87,80 µg/m³**
Sample:	**2**	**Reproducibility s.d.:**	**8,42 µg/m³**
Method:	**ISO 5725-2**	**Relative reproducibility s.d.:**	**9,59%**
Relative target s.d.:	**10,00% (Limited)**	**Reference value:**	**87,60 µg/m³**
No. of laboratories:	**29**	**Range of tolerance:**	**70,24 - 105,36 µg/m³ (|Z-Score| <= 2,00)**



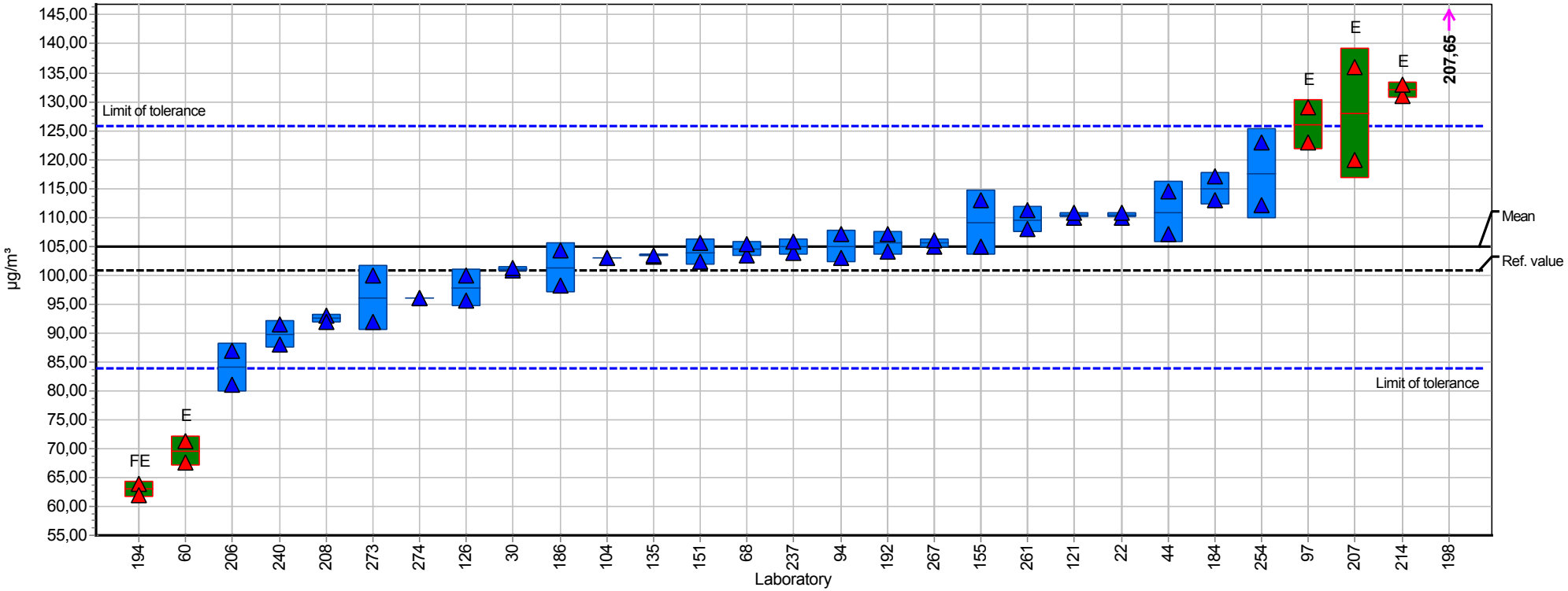
Summary results

Measurand:	1,2,4-Trimethylbenzene	**Mean:**	58,84 µg/m³
Sample:	2	**Reproducibility s.d.:**	6,97 µg/m³
Method:	ISO 5725-2	**Relative reproducibility s.d.:**	11,84%
Relative target s.d.:	10,00% (Limited)	**Reference value:**	55,00 µg/m³
No. of laboratories:	29	**Range of tolerance:**	47,07 - 70,60 µg/m³ (|Z-Score| <= 2,00)



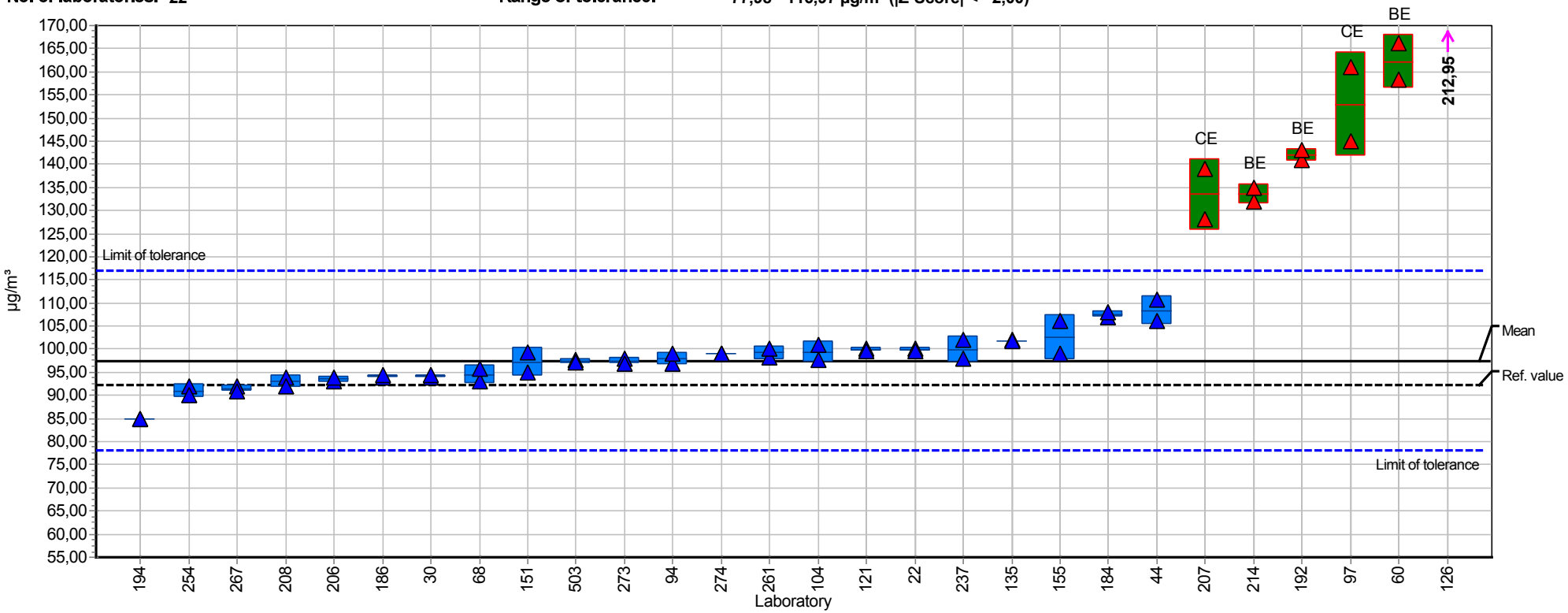
Summary results

Measurand:	**4-Methyl-2-Pentanone**	**Mean:**	**104,88 µg/m³**
Sample:	**2**	**Reproducibility s.d.:**	**13,33 µg/m³**
Method:	**ISO 5725-2**	**Relative reproducibility s.d.:**	**12,71%**
Relative target s.d.:	**10,00% (Limited)**	**Reference value:**	**100,90 µg/m³**
No. of laboratories:	**27**	**Range of tolerance:**	**83,90 - 125,86 µg/m³ (|Z-Score| <= 2,00)**



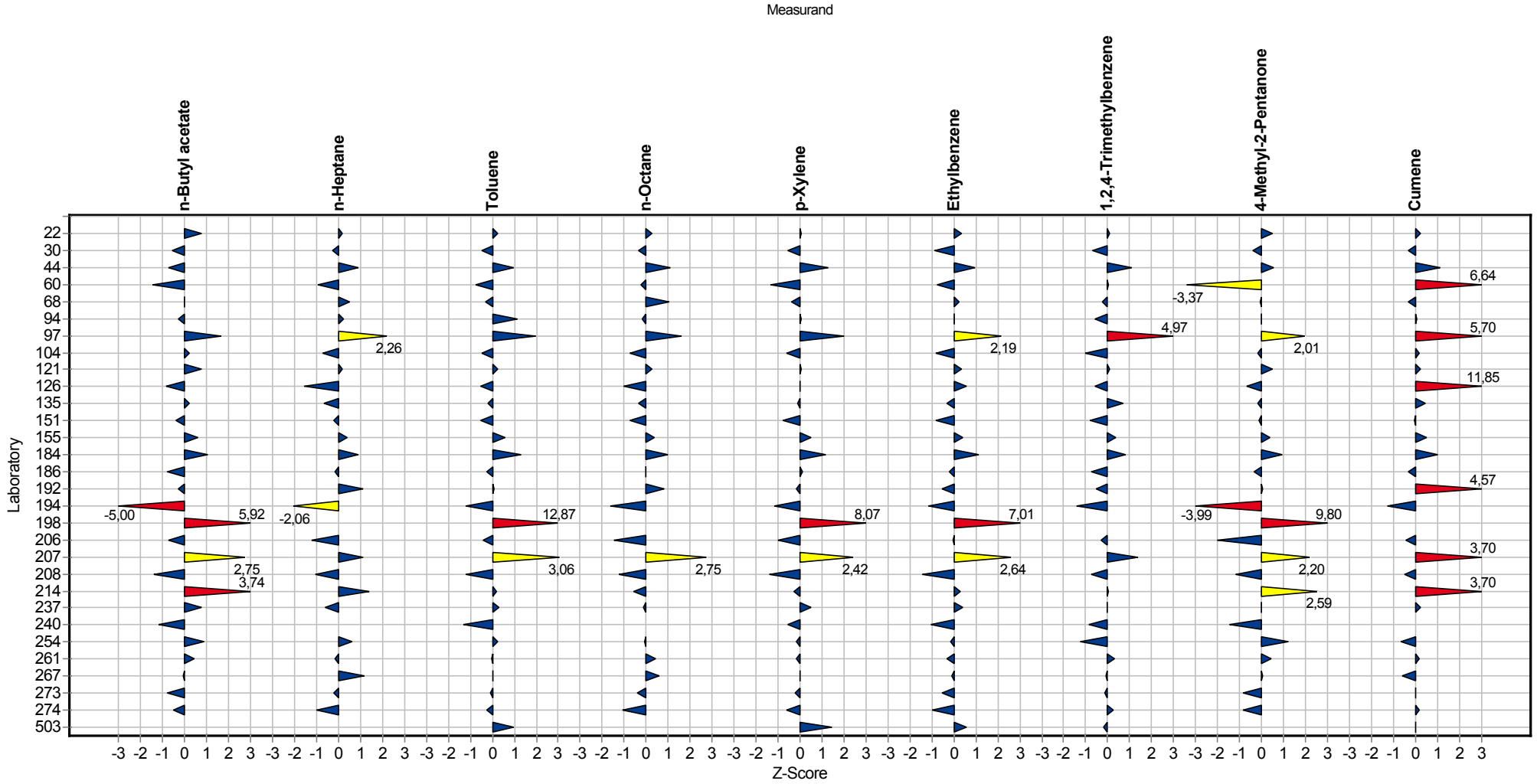
Summary results

Measurand:	**Cumene**	**Mean:**	**97,48 µg/m³**
Sample:	**2**	**Reproducibility s.d.:**	**5,46 µg/m³**
Method:	**ISO 5725-2**	**Relative reproducibility s.d.:**	**5,60%**
Relative target s.d.:	**10,00% (Limited)**	**Reference value:**	**92,20 µg/m³**
No. of laboratories:	**22**	**Range of tolerance:**	**77,98 - 116,97 µg/m³ (|Z-Score| <= 2,00)**



Sample chart of Z-scores

Sample 2



Questions and Answers

Participant	Kind of tube	Analytical method
22	Tenax TA	GC/MS gemäß ISO 16000-6
30	tenax TA	ISO 16000-6
44	Tenax TA	ISO 16000-6
60	Tenax, multi couche	DIN ISO 16000-6
68	Tenax TA	Auf Basis von EN ISO 16000-5 und ISO 16000-6 wurde eigenen Labormethode entwickelt
94	Tenax TA	ISO 16000-6
97	Tenax TA (CAMCO)	DIN ISO 16000-6
104	Tenax TA	DIN ISO 16000-6
121	Tenax TA	DIN ISO 1600-6 und DIN EN ISO 16017-1
126	Tenax TA	DIN ISO 16000-6
135	Tenax TA	16000-6
151	Tenax TA	16000-6
155	Tenax TA	DIN ISO 16000-6
184	Perkin-Elmer, Tenax	16000-6
186	TENAX TA	Yes
192	Tenax TA	ISO 16000-6
194	Tenax TA 60-80mesh	ISO-16017-1 Thermodesorption GC/FID/MS
198	Carbotrap 300 (Carbotrap C, Carbotrap B, Carbosieve SIII)	UNI EN ISO 16017-1:2002
206	Tenax TA	DIN EN ISO 16017-1
207	Tenax	DIN ISO 16000-6
208	Tenax TA /Carbograph 5TD	in house method modified from ISO 16000-6
214	Tenax TA	16000-6
237	Tenax TA	Nein
240	Tenax TA	DIN ISO 16000-6
254	Tenax TA	ISO 16000-6
261	Tenax TA	DIN ISO 16000-6
267	TENAX	Nein, Interne Methode SOP-B-25
273	Tenax TA	DIN ISO 16000-6
274	Tenax TA	DIN ISO 16000-6
503	Carbotrap B 20/40, Carbotrap C 20/40, Carbosieve SIII 60/80	16017-1

Participant	Thermodesorber	Desorption temperature	Desorption flow	Desorption time	Cyro trap
22	Markes Unity - Thermodesorber mit Autosampler Ultra TA	280 °C	10 ml/min	5 min	5 min bei 3 °C, dann 300 °C
30	Turbo Matrix 650 Perkin Elmer	260	50	15	-30°C to 280 °C
44	PE ATD650	280	50	5	-30 degree to 290 degree
60	markes	295	100	5	-10
68	Turbomatrix ATD von PerkinElmer	340°C	50 ml/min	20 min	-20°C / 340°C
94	Gerstel TDS	260 °C		5 min	-50 °C, 12 °C/min
97	Shimadzu TD20 mit Cryofocussierung	240°C	60	7	-15°C/ 240°C
104	Gerstel TDS 3	10°C, 2min, 30°C/min, 260°C, 2 min	splittless	12,3 min	-150°C, 1min, 8°C/s, 250°C, 10°C/min, 300°C, 6min
121	Turbomatrix 650 ATD	280 °C	50 ml /min	15 min	-20°C / 290°C
126	Turbomatrix ATD	250 °C	35 ml / Min	5 Min	- 30 °C
135	Perkin Elmer TurboMatrix 650	280°C	29	15	-20°C/300°C
151	PE TD650	280	90	10	-30 & 300
155	Gerster TDS II	305 °C	40	12	minus 150 °C
184	Turbomatrix ATD, Perkin-Elmer	280°C	50 ml/min	10 min	-30°C auf 290°C
186	TurboMatrix 650	280	50	20	-30°C to 280°C at 45°C/sec
192	TurboMatrix ATD(PerkinElmerInc.)	260degC	30mL/min	10min	Cyro trap at 5degC and desorb at 280degC
194	Markes TD-100	250°C	30 ml/min	5 min	-20°C
198	Shimadzu TD20	260°C	60	8 minutes	-20°C/250
206	Perkin Elmer Turbomatrix ATD	260°	50 ml/min	3 min	-30°C/260°C/99K/s
207	Markes Unity TD 100	300	20	8	-25
208	Markes TD-100	280	50	10	-20 max. 300
214	Unity / Ultra von Markes	300°C	50 ml/min	10 min	0°C - 300°C
237	PE Turbomatrix	300 °C	30	10	-20°C/ +270 °C
240	Markes Unity TD	270	50 mL/min	10 min	-10
254	TD MARKES	280°C	30	10	-25 °C - +300 °C
261	Perkin Elmer ATD350	260 °C	30 ml/min	10 min	-8 / 270 °C
267	MARKES TD100	280°C	50ml/min	15min.	-5°C
273	Perkin Elmer ATD 650, Direct desportion	280	35	20	cooling temperature during desorption :-20, heating; 310
274	Perkin Elmer ATD 650,Direct desportion	280	35	20	cooling temperature during desorption:-20, heating:310
503	Markes	295	100	10	20

Participant	Carrier gas	Flow rate	Analytical column

Participant	Carrier gas	Flow rate	Analytical column
22	Helium	2,9 ml/min	Phenomenex Zebron ZB-5MSi - 5% Phenyl - 95 % Dimethylpolysiloxan, 60 m; 0,25 mm I.D.; 0,25 µm Filmdicke
30	helium	1	Rxi-5ms 60 m x 0.25 mm - 0.25 µm
44	Helium	1.5	DB-5 MS
60	helium	1	HP-1MS
68	Helium	15 ml/min	Vocol von Supelco
94	Helium	1.2 ml/min	DB5-ms, 60 m
97	Helium	41 ml/min (Total flow); 1ml/min	ZB5 60m; 0,25mm; 1µm Film (Hersteller Phenomenex)
104	Helium		Restek Rtx-502.2, l=105m, di=0,32mm, df=1,8µm
121	Helium	1 ml /min	Varian Vf 624ms 60 m x 0,25 mmId x Df 1,4 um
126	Helium		Rxi-624 Sil MS 60 mtr x 0,25 mm, 1,4µm Filmdicke
135	Helium	1,5	RTX-200
151	Helium	1.1	50m BP1
155	Helium Qualität ECD	1 ml/min constant Flow	DB 5 60m 0,25mm 0,25µm
184	Helium	1 ml/min	HP5 MS, Agilent
186	Helium	2	Perkin Elite 5MS
192	Helium	3mL/min	HP-VOC(60m lemgth,0.32mm diam.,1.8um film
194	He	2 ml/min	Zebron 5 MS
198	helium	1	Rxi-624Sil MS 30m 0,25mm ID 1,4um film
206	Helium	1 ml/min	60m; 0,25ID; 0,25µmdf
207	Helium	1,2	DB 5
208	He	1 mL/min	HP-5MS
214	Helium	1,0 ml /min	Agilent CP 9013
237	He	0,5 ml/ min	Varian Xms VF
240	Helium	2 mL/min	HP-5
254	Nitrogen	1	HP-5 MS
261	Helium	1,6 ml/min	Elite-VMS 30m PE
267	Helium	1.5ml/min.	HP INNOWAX 60m x 0.32mm x 0.5µm
273	Helium	1	Rtx 200
274	Helium	1	Rtx200
503	helium	1	RTX-VMS

Participant	Detector

Participant	Detector
22	Triple- Quat MS
30	FID and MS
44	MSD
60	MS
68	MS
94	MS (Agilent 5790)
97	MS
104	HP MSD 5972
121	MSD
126	DSQ II, Fa. Thermo
135	MSD
151	FID
155	Agilent MSD 5977 A
184	MSD
186	FID for quantification MS for identification
192	MSD
194	FID
198	MS single quadrupole
206	TOF
207	MS
208	MSD
214	MSD
237	MSD
240	MSD
254	MS
261	PE Clarus SQ8 S MS
267	MSD
273	5975C with triple axis
274	5975C with triple axis
503	MS

Participant	Data evaluation

Participant	Data evaluation
22	Identifikation über Fragmentionen und Retentionszeit sowie Vergleich mit Spektrendatenbanken; Quantifizierung: substanzspezifische Kalibration mit internem Standard Cyclodekan
30	FID for quantification and MS for identication
44	internal standard method
60	SIM
68	Identifikation mit MS; Quantifizierung mit entspr. Berechnung in einem Excelfile
94	externe Kalibration, Identifikation durch Massenspektrum
97	Interne Standard Quantifizierung, Identifizierung über Retentionszeit und SIM
104	Mehrpunktkalibirerung, diagnostische Massen
121	externe Kalibrierung, Identifikation erfolgte über Spektrenvergleich (NIST) und Retentionszeit.
126	Quant: über SIM Ident: Massenspektrum und Retentionszeit
135	externer Standard, Retentionszeit- und Massenspektren-Vergleich
151	twin column FID
155	MIS, Vergelich Massenspekten mit Spektrenbibliothek
184	Kalibrierung mit internem Standard
186	External calibration
192	Cumene was calculated by using toluene(TIC) response factor,and others were calculated by using their individual response.
194	xcalibur
198	Acquisition Scan/SIM Quantification SIM
206	Externer Standard
207	EIC Originalreferenzen, eigene + kommerzielle Bibliotheken
208	substance specific
214	manuell, über MS
237	externe Kalibration mit IS und MSD
240	external std
254	CALIBRATION CURVE TARGET
261	Interner Standard, 5 Punkt Eichung
267	Quantifizierung mittels spezifischer Massenfragmente, Indentifizierung mittels NIST Bibliothek
273	scan mode and library search
274	Scan mode and library search

Participant	Recovery rate	Date of analysis
22	nein	28.04.2016

Participant	Recovery rate	Date of analysis
30	no	10/05/16
44	No	20160524
60	non	22/04
68	Nein	25./26.4.2016
94	nein	28.04.2016
97	keine Berücksichtigung notwendig , da Wiederfindung	30.04.2016
104		02.05.2016
121	Nein	25.04.2016
126	Nein	28.04.2016
135	nicht erforderlich	9. 5. 2016
151	No	11 May 2016
155	nein	29.04.2016
184	nein	27.04.2016-29.04.2016
186	No	11/05/2016
192	No	28 Apr 2016
194	nein	25.04.2016
198	No	22/04/2016
206	Ja	27.4.16
207		03.05.2016
208	no	24.4.2016
214	nein	22.04.2016
237	Nein	04.05.2016
240	no	11.5.2016
254	NO	11/5/2016
261	nein	29.04.2016
267	Nein	24.05.2016
273	No	2016-05-07
274	No	2016-05-14
503	no	06/05/2016

Blank values RRT VOC 2016

blank 1 (µg/m³)

Lab	1,2,4-Trimethyl-benzene	4-Methyl -2-pentanone	Cumene	Ethyl-benzene	n-Butyl acetate	n-Heptane	n-Octane	p-Xylene	Toluene
22	< 2,50	< 2,50	< 2,50	< 1,50	< 3,00	< 1,50	< 1,50	< 2,50	< 1,50
30	3,8	0	0	0	0	1,9	0	1	2,2
44	0	0	0	0	0	0	0	0	0
60	< 2,50	< 2,50	< 2,50	< 2,50	< 2,50	< 2,50	< 2,50	< 2,50	< 2,50
68	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.
94	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.
97	< 0,5	< 0,5	< 0,5	< 0,5	< 0,5	< 0,5	< 0,5	< 0,5	< 0,5
104	< 10,00	< 10,00	< 10,00	< 10,00	< 10,00	< 10,00	< 10,00	< 10,00	< 10,00
121	< 2,50	< 2,50	< 2,50	< 1,50	< 3,00	< 1,50	< 1,50	< 2,50	< 1,50
126	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.
135	< 1,00	< 1,00	< 1,00	< 1,00	1,1	< 1,00	< 1,00	< 1,00	1,8
151	0,7	0	0	0	0	0,2	0,2	0	0
155	0	0	0	0	0	0	0	2,00	0
184	0,5	0,7	0	0,4	0,5	1,8	0,3	1	5,6
186	0	0	0	0	0	0	0	0	0,6
192	0	0	0	0,4	0	0	0	0,5	2
194	0	0	0	0	k.A.	1	0	0	0
198	k.A.	7,1	k.A.	<	<	k.A.	k.A.	5,1	17,3
206	6	0	2	3	0	0	0	2	0
207	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00
208	0,2	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	0,4	0,5
214	0	0	0	0	0	0	0	0	0
237	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	1,9
240	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.
254	0	0	0	0	0	1	0	1	0
261	0,4	0,1	0	1,3	0,9	0,1	0,1	1,3	0,9
267	0	1	0	0	0	0	0	0	0
273	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	1
274	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	1
503	< 5,00	< 5,00	< 5,00	< 5,00	< 5,00	< 5,00	< 5,00	< 5,00	< 5,00
IFA	< 5,0	< 10,00	< 10,00	< 5,0	< 5,0	< 5,0	< 5,0	< 5,0	< 5,0

VOC blank 2 (µg/m³)

Lab	1,2,4-Trimethyl-benzene	4-Methyl -2-pentanone	Cumene	Ethyl-benzene	n-Butyl-acetate	n-Heptane	n-Octane	p-Xylene	Toluene
22	< 2,50	< 2,50	< 2,50	< 1,50	< 3,00	< 1,50	< 1,50	< 2,50	< 1,50
30	0,9	0	0	0	0	0	0	0	0,6
44	0	0	0	0	0	0	0	0	0
60	< 2,50	< 2,50	< 2,50	< 2,50	< 2,50	< 2,50	< 2,50	< 2,50	< 2,50
68	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	5,7
94	3,2	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.
97	< 0,5	< 0,5	< 0,5	< 0,5	< 0,5	< 0,5	< 0,5	< 0,5	< 0,5
104	< 10,00	< 10,00	< 10,00	< 10,00	< 10,00	< 10,00	< 10,00	< 10,00	< 10,00
121	< 2,50	< 2,50	< 2,50	< 1,50	< 3,00	< 1,50	< 1,50	< 2,50	< 1,50
126	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.
135	< 1,00	1,1	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00
151	0,9	0,2	0	0	0	0,2	0,1	0	0
155	3	5	3	3	5	0	5	5	5
184	0,6	0,6	0,1	0,5	0,4	6,1	0,4	1,6	6,5
186	0	0	0	0	0	0	0	0	0,5
192	0	0	0	0	0	0	0	0	0,3
194	0	0	0	0	0	1	0	0	0
198	k.A.	<		<	<	k.A.	k.A.	<	<
206	6	0	2	3	0	0	0	2	0
207	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00
208	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	0,2	0,3
214	0	0	0	0	0	0	0	0	0
237	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.
240	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.
254	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.	k.A.
261	0,3	0,2	0,1	1,2	1,7	0,1	0,1	1,2	0,8
267	0	0	0	0	1	0	0	0	0
273	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	4,0
274	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	3,0
503	< 5,00	< 5,00	< 5,00	< 5,00	< 5,00	< 5,00	< 5,00	< 5,00	< 5,00
IFA	< 5,0	< 10,00	< 10,00	< 5,0	< 5,0	< 5,0	< 5,0	< 5,0	< 5,0