IFA
Institut für Arbeitsschutz der
Deutschen Gesetzlichen Unfallversicherung

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

Proficiency testing scheme

Volatile organic compounds (VOC) with thermal desorption with own sampling

12 September 2023

Institute for Occupationial Safety and Health of the
German Social Accident Insurance (IFA)
B. Maybaum, K. Gusbeth, R. Schustkowski, F. Nürnberger, K. Pitzke
Alte Heerstraße 111, 53757 Sankt Augustin, Germany
Phone.: +49 30 13001 3299
Email: proficiency-testing@dguv.de

Summary of laboratory test results

Sample 1

	1,2,3-Trimethylbenzene	Z score	4-Methyl-2-pentanone	Z score	alpha-Pinene	Z score	Benzaldehyde	Z score
Unit	µg/m³		µg/m³		µg/m³		µg/m³	
1	50,1	1,80	151,0	0,52	49,4	0,38	45,1	1,66
23	50,0	1,78	155,0	0,80	41,0	-1,38	49,0	2,67 E
24	40,0	-0,59	146,1	0,18	39,3	-1,75	44,4	1,48
26	42,4	-0,01	140,0	-0,25	44,8	-0,59	37,7	-0,25
39	52,5	2,36 CE	144,5	0,07	46,4	-0,26	37,4	-0,33
44	28,1	-3,37 FE	94,8	-3,40 E	24,0	-4,95 FE	33,7	-1,29
66	42,7	0,06	159,0	1,08	47,1	-0,10	43,5	1,25
95	39,7	-0,65	128,9	-1,02	52,3	0,99	30,4	-2,13 E
126	32,1	-2,43 E	131,9	-0,81	96,5	10,29 BE	32,3	-1,65
147								
152	50,5	1,90	165,2	1,51	52,4	1,01	39,0	0,09
180	41,0	-0,34	115,0	-1,99	25,5	-4,64 FE	29,5	-2,37 E
206	63,7	5,01 FE	191,0	3,30 E	80,9	7,01 BE	54,4	4,07 FE
209	41,0	-0,34	146,0	0,17	48,0	0,09	38,0	-0,17
213	40,0	-0,58	127,9	-1,09	38,7	-1,86	33,7	-1,28
228	42,6	0,05						
230	42,0	-0,11	150,0	0,45	59,0	2,40 E	44,5	1,51
233	44,5	0,49	147,1	0,25	51,9	0,90		
235	32,0	-2,46 E	82,0	-4,29 FE	24,0	-4,96 FE	15,0	-6,12 BE
242	45,3	0,67	140,4	-0,22	46,2	-0,29	49,2	2,73 E
265	43,0	0,13	139,0	-0,32	46,0	-0,33	40,0	0,35
284	48,5	1,43	157,7	0,98	49,9	0,49	37,8	-0,22
289	33,3	-2,17 CE	127,5	-1,12	40,7	-1,46	38,3	-0,09
517	51,1	2,04 E	168,0	1,70	52,0	0,93	41,1	0,63
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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	23		22		22		21	

	1,2,3-Trimethylbenzene	Z score	4-Methyl-2-pentanone	Z score	alpha-Pinene	Z score	Benzaldehyde	Z score
Mean	42,5		143,6		47,6		38,7	
Reprod. s.d.	5,3		20,9		5,7		6,2	
Rel. reproducibility s.d.	12,50 %		14,58 %		12,00 %		15,94 %	
Reference value	42,3		136,8		43,0		36,2	
Target s.d.	4,2		14,4		4,8		3,9	
Rel. target s.d.	10,00 %		10,00 %		10,00 %		10,00 %	
Low er limit of tolerance	34,0		114,8		38,1		30,9	
Upper limit of tolerance	50,9		172,3		57,1		46,4	
Type B outliers					2		1	
Type C outliers	2							
Type F outliers	2		1		3		1	
No. of laboratories after elimination of outliers type A-D and F (w ithout laboratories that only gave states but no measured values)	19		21		17		19	
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								

	Benzene	Z score	Cumene	Z score	n-Decane	Z score	n-Heptane	Z score	p-Xylene	Z score
Unit	µg/m³		µg/m³		µg/m³		µg/m³		µg/m³	
1	39,5	-0,27	69,0	0,72	136,0	0,56	39,6	0,06	36,1	1,04
23	36,0	-1,13	74,0	1,49	150,0	1,65	41,0	0,41	39,0	1,92
24	41,2	0,16	61,1	-0,52	133,0	0,33	48,4	2,30 E	31,5	-0,38
26	37,4	-0,79	62,7	-0,26	124,5	-0,33	35,8	-0,92	32,5	-0,05
39	41,5	0,23	62,1	-0,35	111,5	-1,34	40,9	0,38	34,3	0,47
44	24,7	-3,91 FE	35,3	-4,51 BE	75,1	-4,17 FE	14,6	-6,30 FE	12,0	-6,32 BE

	Benzene	Z score	Cumene	Z score	n-Decane	Z score	n-Heptane	Z score	p-Xylene	Z score
66	36,6	-0,99	76,3	1,85	134,6	0,45	37,2	-0,55	31,9	-0,25
95	49,5	2,19 E	56,3	-1,25	124,8	-0,31	44,2	1,23	27,7	-1,52
126	28,3	-3,03 E	67,0	0,40	113,6	-1,18	30,8	-2,19 E	25,4	-2,23 E
147	40,0	-0,15					45,5	1,56	35,5	0,85
152	43,2	0,64	65,6	0,19	136,6	0,61	38,5	-0,22	36,6	1,19
180	22,0	-4,58 FE	62,0	-0,37	115,0	-1,07	29,5	-2,51 E	25,5	-2,20 E
206	58,9	4,49 FE	92,8	4,41 BE	170,9	3,28 E	64,4	6,36 FE	28,4	-1,33
209	37,0	-0,89	63,0	-0,22	122,0	-0,53	38,0	-0,35	34,0	0,40
213	35,3	-1,32	60,5	-0,60	137,7	0,70	39,1	-0,06	31,2	-0,46
228	51,9	2,78 E	72,0	1,18	144,8	1,25	63,3	6,08 FE	37,3	1,39
230	47,5	1,70	60,5	-0,60	122,5	-0,49	52,5	3,34 E	38,5	1,77
233	41,4	0,20	65,7	0,21	132,5	0,29	41,4	0,53	34,7	0,61
235	13,0	-6,80 FE	61,0	-0,53	87,0	-3,24 E	21,0	-4,67 FE	20,0	-3,88 FE
242	39,5	-0,28	65,8	0,22	131,9	0,24	37,3	-0,54	31,8	-0,28
265	38,0	-0,64	62,0	-0,37	138,0	0,72	38,0	-0,35	36,0	1,01
284	41,5	0,22	63,1	-0,20	128,0	-0,06	36,7	-0,68	35,0	0,70
289	36,0	-1,15	63,9	-0,08	113,0	-1,22	40,0	0,16 C	29,4	-1,00 C
517	44,2	0,89	65,9	0,23	140,0	0,87	38,5	-0,22	37,0	1,31
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Method	ISO 5725-2		ISO 5725-2		ISO 5725-2		ISO 5725-2		ISO 5725-2	
Assessment	|Z|<=2,00		|Z|<=2,00		|Z|<=2,00		|Z|<=2,00		|Z|<=2,00	
No. of laboratories that submitted results	24		23		23		24		24	
Mean	40,6		64,4		128,8		39,4		32,7	
Reprod. s.d.	6,2		4,9		17,3		6,2		4,3	
Rel. reproducibility s.d.	15,22 %		7,64 %		13,47 %		15,74 %		13,28 %	
Reference value	34,5		60,0		128,8		33,9		29,8	
Target s.d.	4,1		6,4		12,9		3,9		3,3	
Rel. target s.d.	10,00 %		10,00 %		10,00 %		10,00 %		10,00 %	
Low er limit of tolerance	32,5		51,5		103,0		31,5		26,2	
Upper limit of tolerance	48,7		77,3		154,5		47,2		39,2	
Type B outliers			2						1	
Type C outliers							1		1	
Type F outliers	4				1		4		1	
No. of laboratories after elimination of	20		21		22		19		21	

	Benzene	Z score	Cumene	Z score	n-Decane	Z score	n-Heptane	Z score	p-Xylene	Z score
outliers type A-D and F (without laboratories that only gave states but no measured values)										

	Toluene	Z score	
Unit	µg/m³		
1	31,6	1,04	
23	32,0	1,18	
24	27,4	-0,41	
26	27,0	-0,57	
39	30,5	0,67	
44	11,0	-6,15	BE
66	27,7	-0,33	
95	23,5	-1,78	
126	19,7	-3,11	E
147	31,0	0,83	
152	31,1	0,86	
180	24,0	-1,62	
206	36,0	2,56	E
209	26,0	-0,92	
213	27,0	-0,57	
228	33,0	1,54	
230	36,5	2,75	E
233	29,5	0,31	
235	21,0	-2,67	E
242	26,1	-0,90	
265	30,0	0,48	
284	29,5	0,30	
289	28,5	-0,05	
517	31,2	0,90	
–	–	– –	
Method	ISO 5725-2		

	Toluene	Z score
Assessment	|Z|<=2,00	
No. of laboratories that submitted results	24	
Mean	28,6	
Reprod. s.d.	4,6	
Rel. reproducibility s.d.	16,20 %	
Reference value	24,5	
Target s.d.	2,9	
Rel. target s.d.	10,00 %	
Low er limit of tolerance	22,9	
Upper limit of tolerance	34,4	
Type B outliers	1	
No. of laboratories after elimination of outliers type A-D and F (w ithout laboratories that only gave states but no measured values)	23	

Summary of laboratory test results

Sample 2

	1,2,3-Trimethylbenzene	Z score	4-Methyl-2-pentanone	Z score	alpha-Pinene	Z score	Benzaldehyde	Z score
Unit	µg/m³		µg/m³		µg/m³		µg/m³	
1	92,0	1,07	43,7	1,15	89,8	0,40	31,8	1,88
23	99,0	1,91	41,0	0,46	97,0	1,23	34,0	2,70 E
24	77,0	-0,73	37,9	-0,32	78,5	-0,92	28,2	0,53
26	78,4	-0,57	39,2	0,01	83,8	-0,29	26,0	-0,29
39	89,0	0,71	42,6	0,87	61,5	-2,88 E	30,6	1,43
44	85,7	0,32	36,7	-0,62	89,4	0,35	34,7	2,96 E
66	78,8	-0,52	42,3	0,80	86,5	0,01	28,9	0,79
95	80,4	-0,33	34,3	-1,25	97,2	1,26	21,2	-2,10 E
126	74,2	-1,07 C	34,5	-1,20	153,2	7,73 FE	21,3	-2,06 E
147								
152	87,9	0,58	41,3	0,54	89,2	0,33	26,4	-0,14
180	80,5	-0,31	35,5	-0,94	44,0	-4,91 FE	21,5	-1,97
206	122,7	4,77 BE	47,9	2,21 E	156,6	8,13 FE	39,8	4,84 FE
209	75,0	-0,97	42,0	0,72	86,0	-0,04	25,0	-0,66
213	75,8	-0,88	35,5	-0,93	74,3	-1,40	22,3	-1,69
228	92,7	1,16						
230	75,5	-0,91	41,5	0,59	106,5	2,33 E	28,5	0,64
233	80,6	-0,30	41,5	0,59	88,1	0,20		
235	54,5	-3,44 BE	22,5	-4,26 BE	43,0	-5,02 FE	7,3	-7,26 BE
242	83,4	0,04	38,6	-0,13	85,8	-0,07	33,0	2,30 E
265	78,0	-0,61	39,0	-0,05	87,0	0,07	27,0	0,08
284	87,9	0,58	41,2	0,52	89,7	0,38	26,9	0,05
289	60,2	-2,76 CE	33,1	-1,54	66,6	-2,29 E	24,9	-0,70
517	88,8	0,69	42,2	0,77	89,8	0,40	27,9	0,42
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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	23		22		22		21	

	1,2,3-Trimethylbenzene	Z score	4-Methyl-2-pentanone	Z score	alpha-Pinene	Z score	Benzaldehyde	Z score
Mean	83,1		39,2		86,4		26,8	
Reprod. s.d.	6,7		4,2		11,5		4,4	
Rel. reproducibility s.d.	8,12 %		10,62 %		13,30 %		16,34 %	
Reference value	86,1		36,8		80,1		24,3	
Target s.d.	8,3		3,9		8,6		2,7	
Rel. target s.d.	10,00 %		10,00 %		10,00 %		10,00 %	
Low er limit of tolerance	66,5		31,3		69,1		21,4	
Upper limit of tolerance	99,7		47,0		103,7		32,1	
Type B outliers	2		1				1	
Type C outliers	2							
Type F outliers					4		1	
No. of laboratories after elimination of outliers type A-D and F (w ithout laboratories that only gave states but no measured values)	19		21		18		19	
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								

	Benzene	Z score	Cumene	Z score	n-Decane	Z score	n-Heptane	Z score	p-Xylene	Z score
Unit	µg/m³		µg/m³		µg/m³		µg/m³		µg/m³	
1	86,9	0,46	53,7	0,43	85,9	1,09	77,2	0,55	64,0	0,85
23	101,0	2,16 E	63,0	2,23 E	97,0	2,52 E	92,0	2,57 E	74,0	2,55 E
24	92,7	1,17	47,1	-0,86	79,7	0,28	95,1	2,99 E	57,9	-0,19
26	84,3	0,15	49,5	-0,39	77,3	-0,02	70,5	-0,36	59,9	0,16
39	65,3	-2,14 E	51,2	-0,06	71,0	-0,84	71,8	-0,19	61,6	0,44
44	67,6	-1,86	63,1	2,26 E	63,0	-1,87	62,7	-1,43	50,7	-1,40

	Benzene	Z score	Cumene	Z score	n-Decane	Z score	n-Heptane	Z score	p-Xylene	Z score
66	90,6	0,91	58,5	1,36	76,4	-0,14	73,0	-0,02	59,2	0,04
95	90,3	0,88	43,1	-1,64	73,9	-0,46	82,1	1,22	51,9	-1,21
126	64,1	-2,28 E	58,8	1,42	70,2	-0,94	59,9	-1,82	50,8	-1,38
147	63,0	-2,41 E					65,0	-1,12	65,0	1,02
152	88,7	0,68	52,7	0,23	78,2	0,09	73,8	0,09	62,7	0,63
180	49,5	-4,04 FE	52,5	0,19	76,0	-0,19	60,5	-1,73	49,0	-1,69
206	131,1	5,78 FE	71,9	3,96 BE	100,5	2,98 E	130,4	7,83 FE	52,8	-1,06
209	79,0	-0,49	49,0	-0,49	75,0	-0,32	74,0	0,11	61,0	0,34
213	78,3	-0,57	48,1	-0,67	83,8	0,81	79,3	0,84	58,3	-0,12
228	97,3	1,72	53,8	0,45	84,9	0,96	109,3	4,93 FE	61,6	0,45
230	117,5	4,15 FE	48,5	-0,58	76,5	-0,13	118,5	6,20 FE	72,5	2,29 E
233	89,7	0,81	52,2	0,13	85,0	0,96	80,0	0,94	62,1	0,53
235	31,0	-6,27 FE	47,5	-0,78	52,0	-3,29 E	45,5	-3,78 FE	37,0	-3,73 FE
242	83,2	0,01	50,9	-0,12	78,5	0,13	70,6	-0,35	58,5	-0,08
265	84,0	0,12	48,0	-0,68	85,0	0,97	76,0	0,39	64,0	0,85
284	89,9	0,83	52,6	0,21	78,2	0,09	74,0	0,11	62,6	0,61
289	76,3	-0,82	47,7	-0,74	69,4	-1,04	75,9	0,37 C	53,5	-0,93
517	91,5	1,02	52,9	0,27	80,2	0,35	74,9	0,24	63,3	0,73
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Method	ISO 5725-2		ISO 5725-2		ISO 5725-2		ISO 5725-2		ISO 5725-2	
Assessment	|Z|<=2,00		|Z|<=2,00		|Z|<=2,00		|Z|<=2,00		|Z|<=2,00	
No. of laboratories that submitted results	24		23		23		24		24	
Mean	83,0		51,5		77,5		73,2		59,0	
Reprod. s.d.	11,4		5,1		10,9		9,6		6,9	
Rel. reproducibility s.d.	13,78 %		9,97 %		14,02 %		13,09 %		11,70 %	
Reference value	82,7		47,6		79,4		70,6		59,2	
Target s.d.	8,3		5,2		7,7		7,3		5,9	
Rel. target s.d.	10,00 %		10,00 %		10,00 %		10,00 %		10,00 %	
Low er limit of tolerance	66,4		41,2		62,0		58,5		47,2	
Upper limit of tolerance	99,6		61,8		93,0		87,8		70,8	
Type B outliers			1							
Type C outliers							1			
Type F outliers	4						4		1	
No. of laboratories after elimination of	20		22		23		19		23	

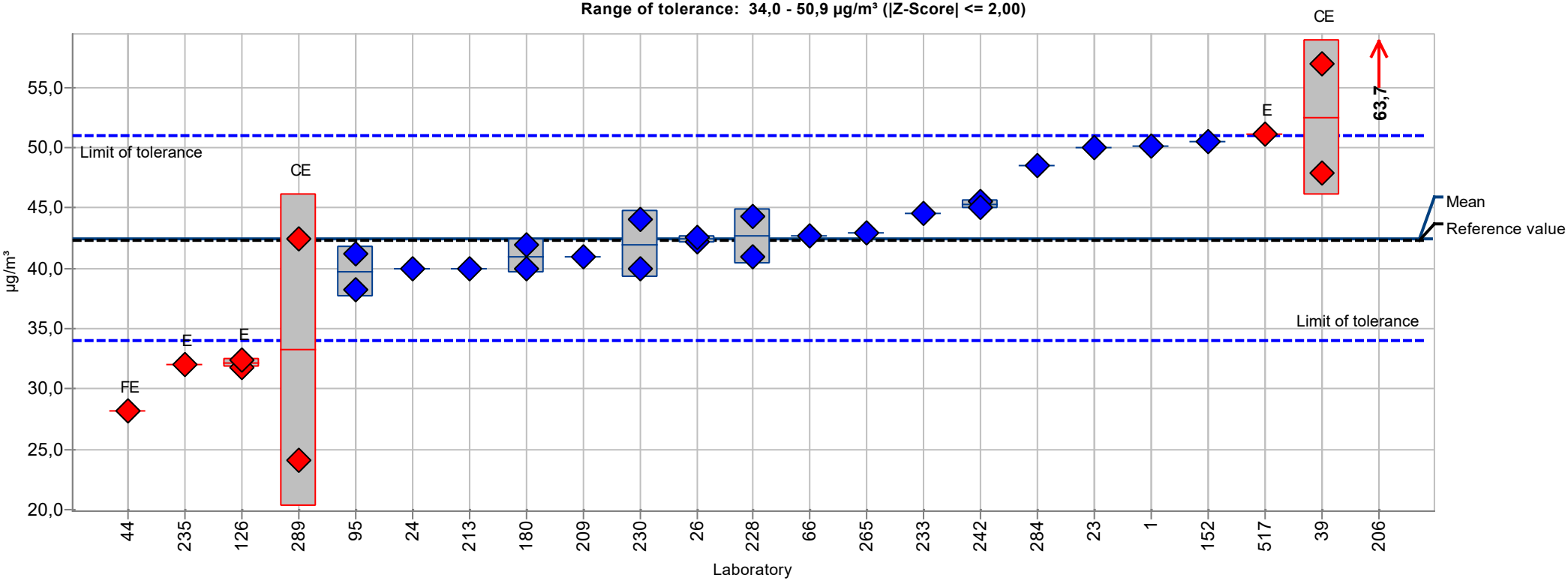
	Benzene	Z score	Cumene	Z score	n-Decane	Z score	n-Heptane	Z score	p-Xylene	Z score
outliers type A-D and F (without laboratories that only gave states but no measured values)										

	Toluene	Z score	
Unit	µg/m³		
1	52,3	0,71	
23	56,0	1,46	
24	48,6	-0,04	
26	48,6	-0,04	
39	52,4	0,73	
44	41,2	-1,57	
66	50,4	0,32	
95	42,1	-1,39	
126	36,9	-2,44	E
147	38,0	-2,22	E
152	53,0	0,85	
180	46,0	-0,58	
206	60,8	2,45	E
209	46,0	-0,58	
213	49,8	0,20	
228	51,8	0,60	
230	65,0	3,31	E
233	52,1	0,66	
235	36,0	-2,63	E
242	45,0	-0,78	
265	53,0	0,85	
284	52,7	0,79	
289	48,5	-0,06	
517	53,6	0,97	
–	–	– –	
Method	ISO 5725-2		

	Toluene	Z score
Assessment	|Z|<=2,00	
No. of laboratories that submitted results	24	
Mean	48,8	
Reprod. s.d.	7,8	
Rel. reproducibility s.d.	15,97 %	
Reference value	47,6	
Target s.d.	4,9	
Rel. target s.d.	10,00 %	
Low er limit of tolerance	39,1	
Upper limit of tolerance	58,6	
No. of laboratories after elimination of outliers type A-D and F (w ithout laboratories that only gave states but no measured values)	24	

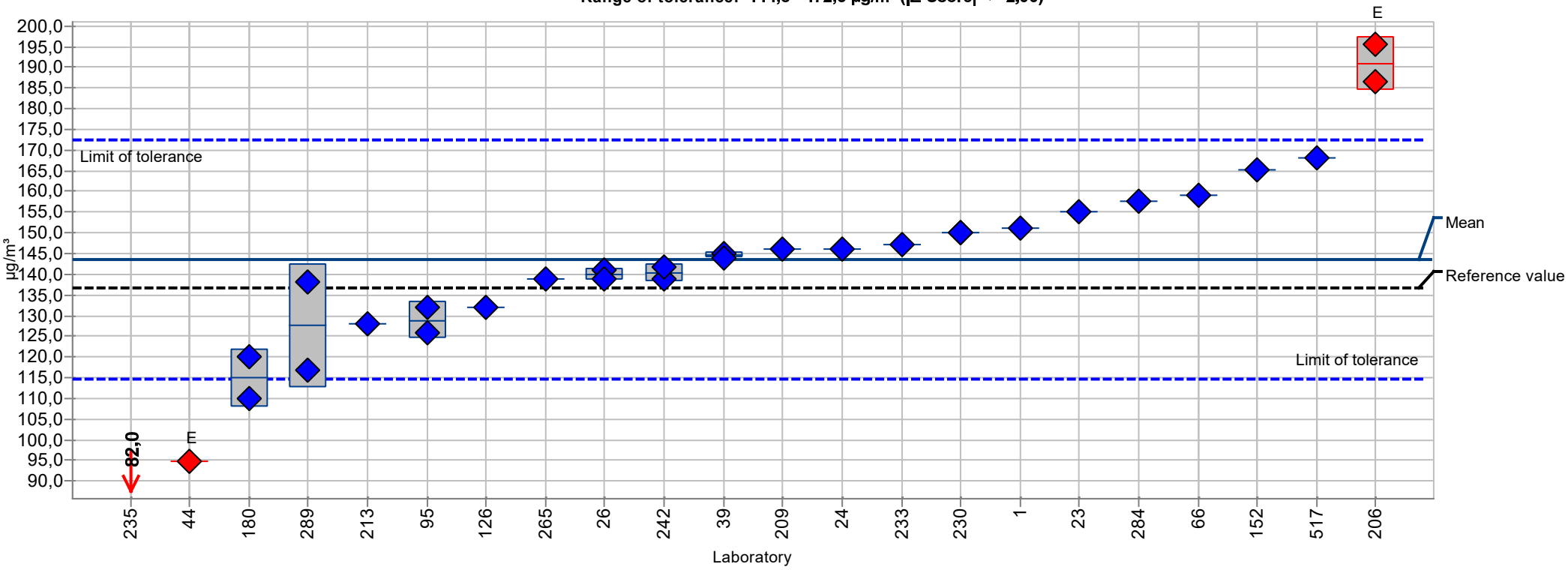
Summary results

Measurand:	**1,2,3-Trimethylbenzene**	**Mean:**	**42,5 µg/m³**
Sample:	**1**	**Reprod. s.d.:**	**5,3 µg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**12,50%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**42,3 µg/m³**
		Range of tolerance:	**34,0 - 50,9 µg/m³ (|Z-Score| <= 2,00)**



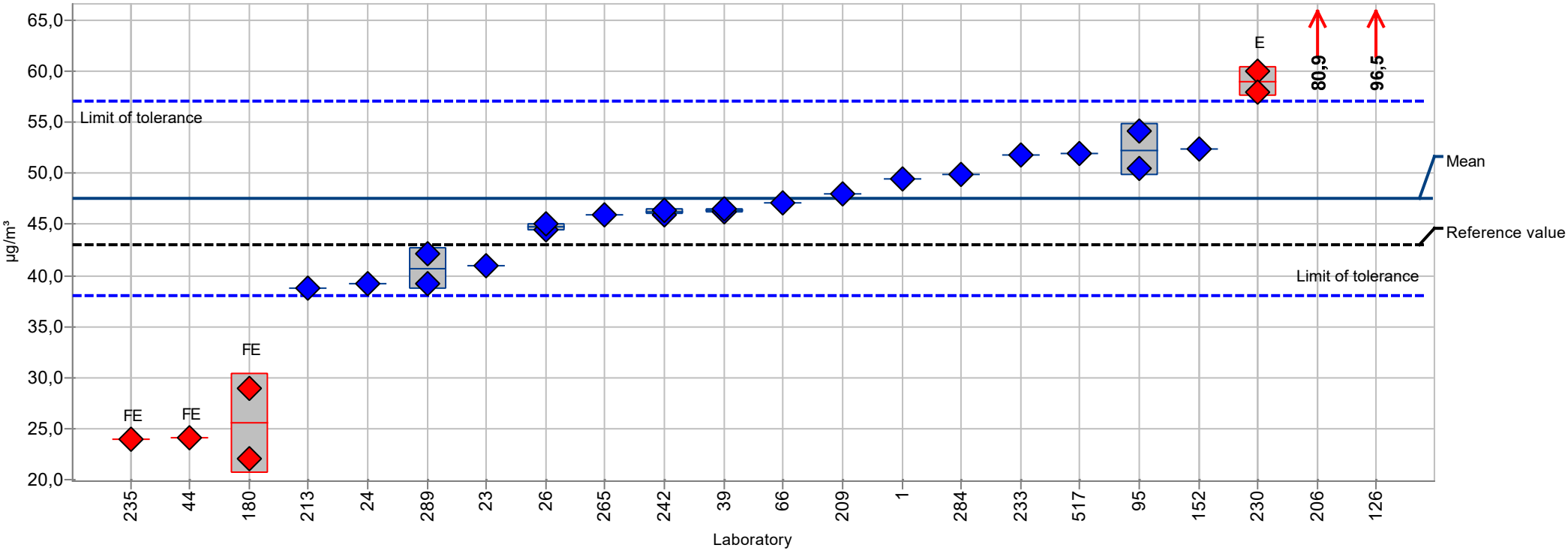
Summary results

Measurand:	**4-Methyl-2-pentanone**	**Mean:**	**143,6 µg/m³**
Sample:	**1**	**Reprod. s.d.:**	**20,9 µg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**14,58%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**136,8 µg/m³**
:		**Range of tolerance:**	**114,8 - 172,3 µg/m³ (|Z-Score| <= 2,00)**



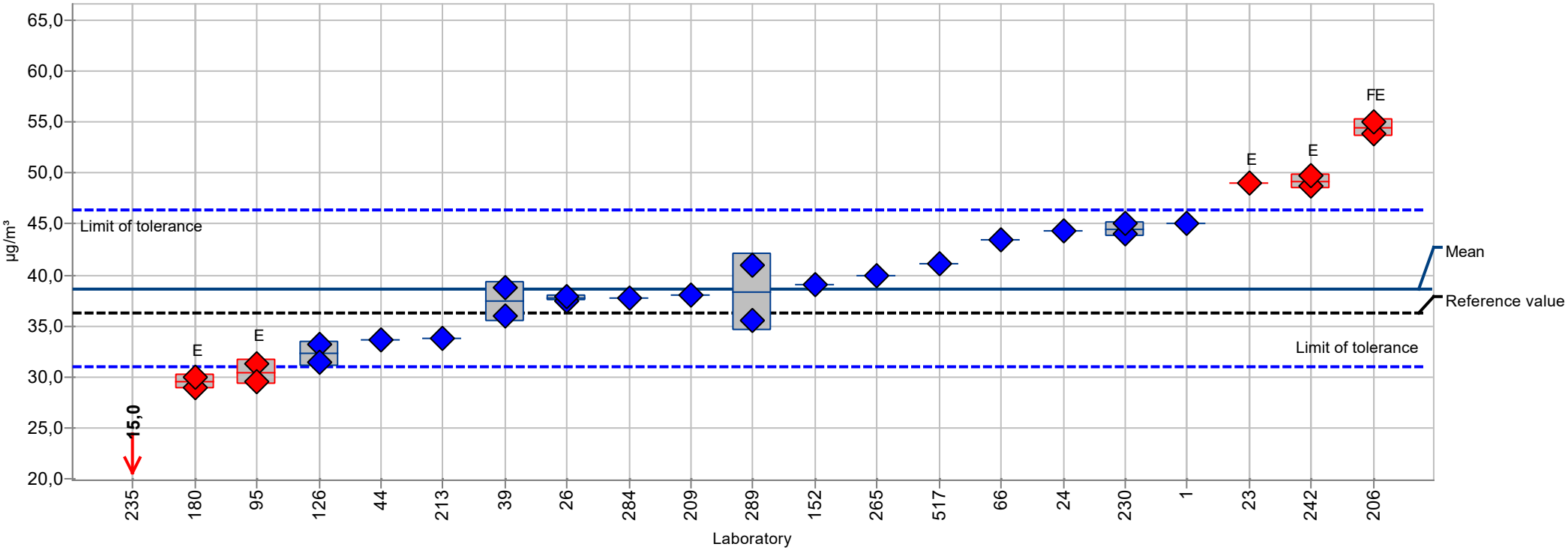
Summary results

Measurand:	**alpha-Pinene**	**Mean:**	**47,6 µg/m³**
Sample:	**1**	**Reprod. s.d.:**	**5,7 µg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**12,00%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**43,0 µg/m³**
		Range of tolerance:	**38,1 - 57,1 µg/m³ (|Z-Score| <= 2,00)**



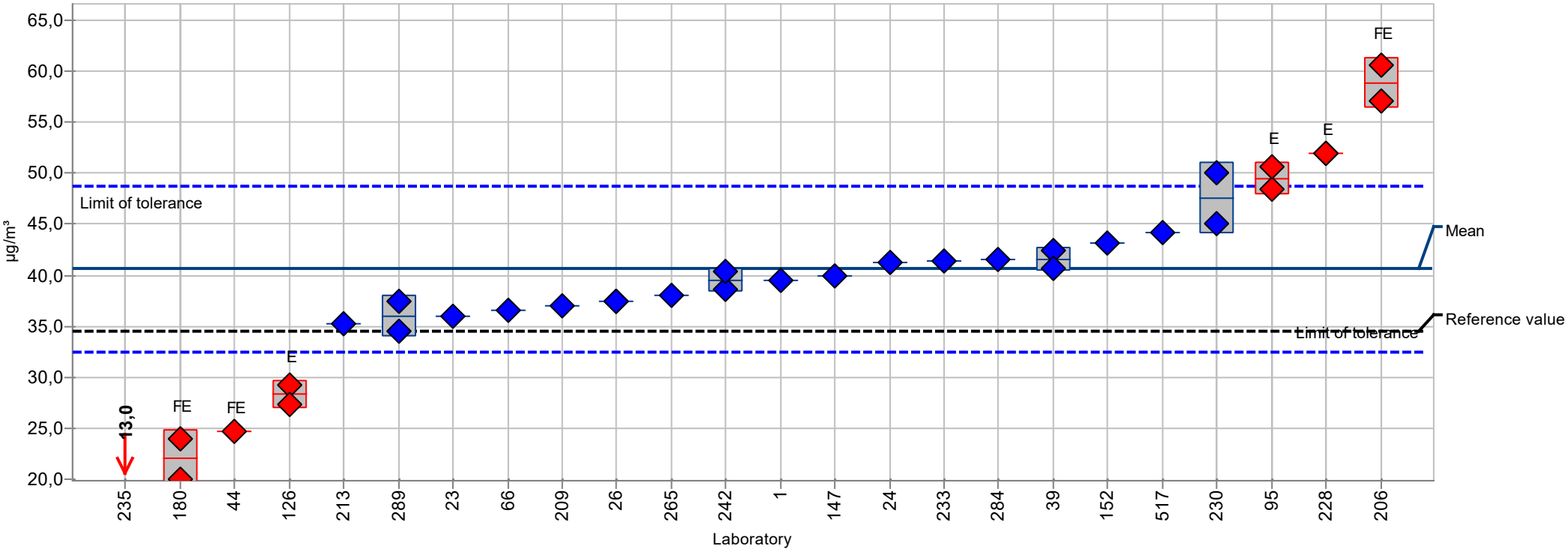
Summary results

Measurand:	**Benzaldehyde**	**Mean:**	**38,7 µg/m³**
Sample:	**1**	**Reprod. s.d.:**	**6,2 µg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**15,94%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**36,2 µg/m³**
		Range of tolerance:	**30,9 - 46,4 µg/m³ (|Z-Score| <= 2,00)**



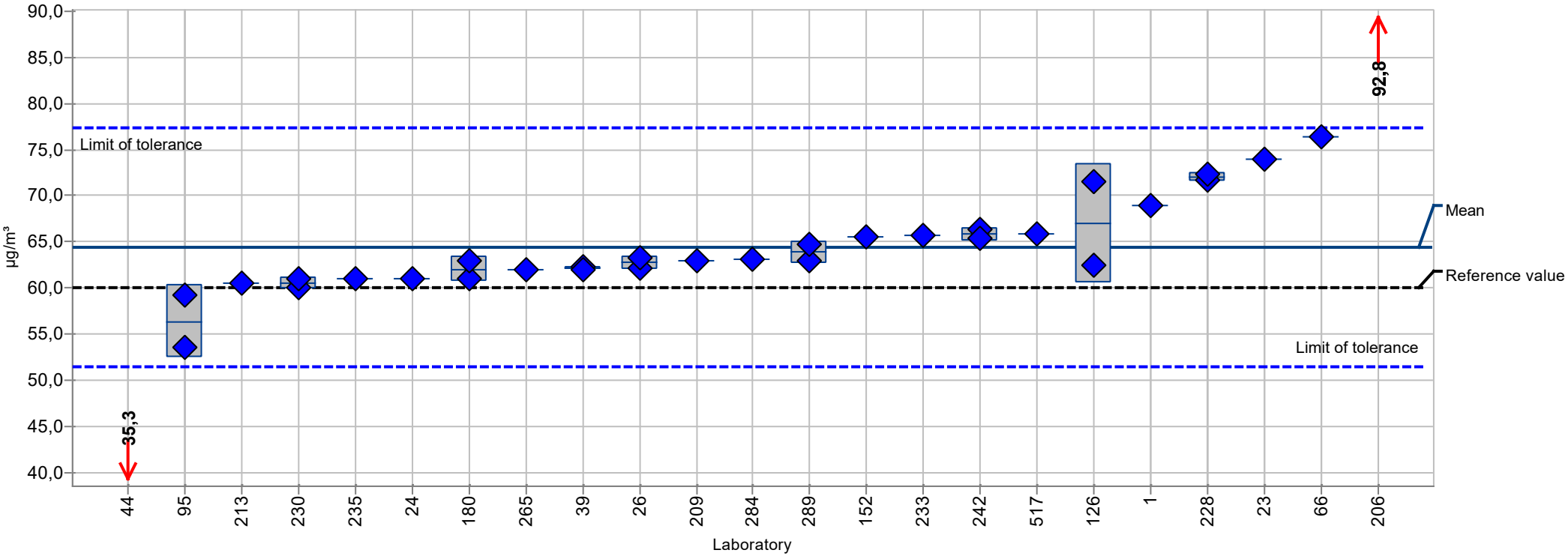
Summary results

Measurand:	**Benzene**	**Mean:**	**40,6 µg/m³**
Sample:	**1**	**Reprod. s.d.:**	**6,2 µg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**15,22%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**34,5 µg/m³**
		Range of tolerance:	**32,5 - 48,7 µg/m³ (|Z-Score| <= 2,00)**



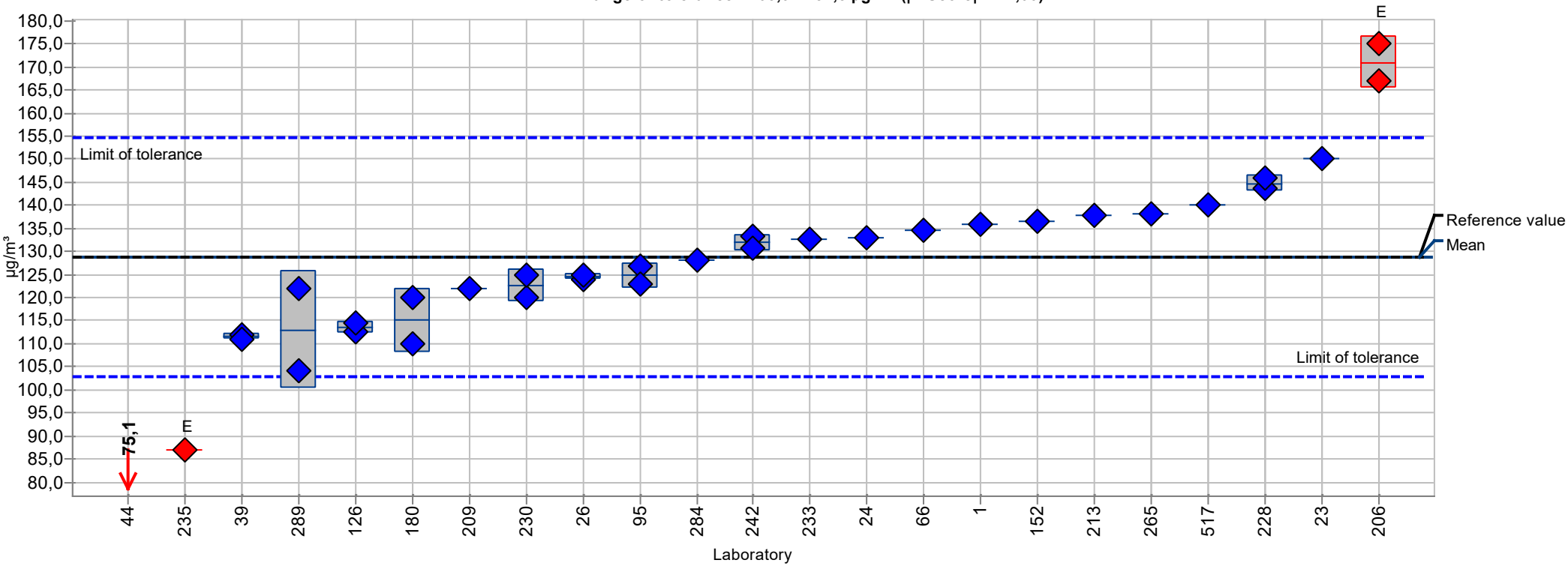
Summary results

Measurand:	**Cumene**	**Mean:**	**64,4 µg/m³**
Sample:	**1**	**Reprod. s.d.:**	**4,9 µg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**7,64%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**60,0 µg/m³**
		Range of tolerance:	**51,5 - 77,3 µg/m³ (|Z-Score| <= 2,00)**



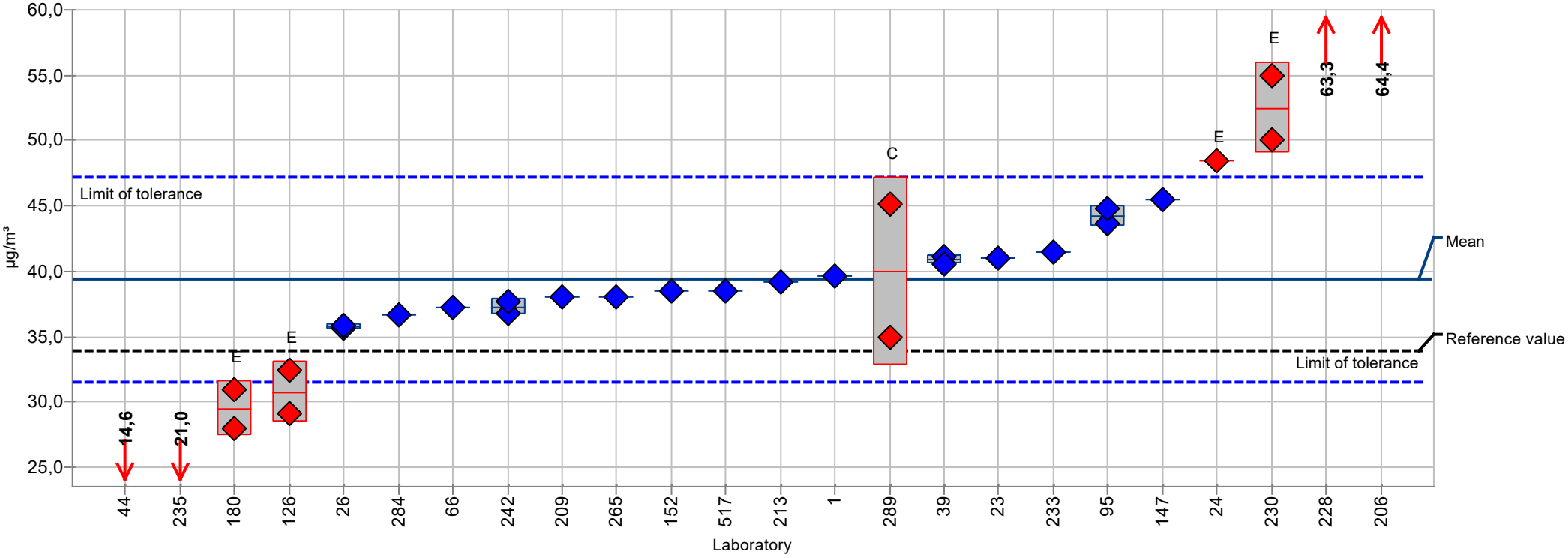
Summary results

Measurand:	**n-Decane**	**Mean:**	**128,8 µg/m³**
Sample:	**1**	**Reprod. s.d.:**	**17,3 µg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**13,47%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**128,8 µg/m³**
:		**Range of tolerance:**	**103,0 - 154,5 µg/m³ (|Z-Score| <= 2,00)**



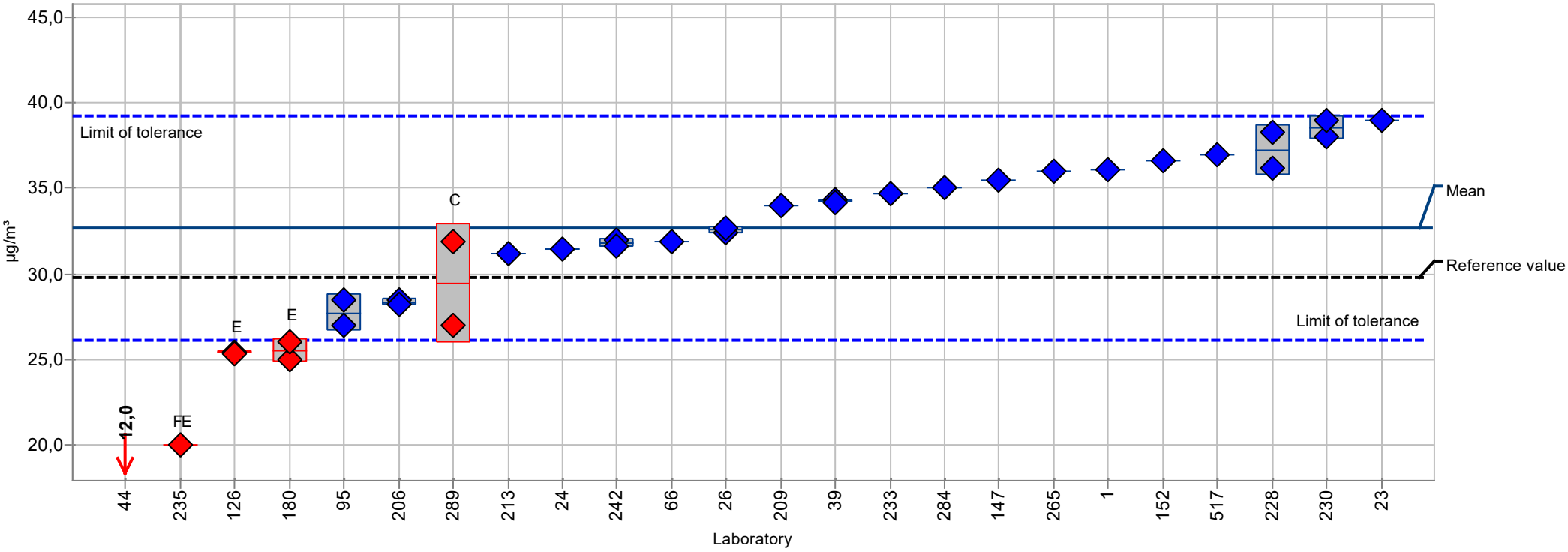
Summary results

Measurand:	**n-Heptane**	**Mean:**	**39,4 µg/m³**
Sample:	**1**	**Reprod. s.d.:**	**6,2 µg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**15,74%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**33,9 µg/m³**
:		**Range of tolerance:**	**31,5 - 47,2 µg/m³ (|Z-Score| <= 2,00)**



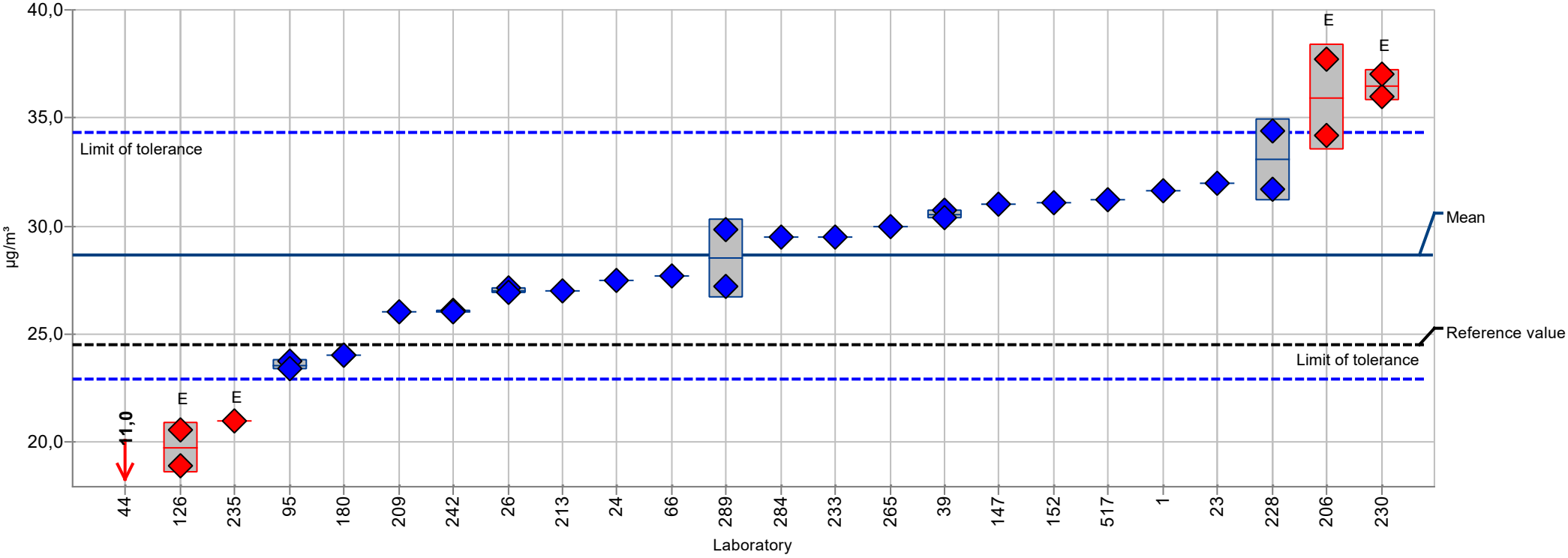
Summary results

Measurand:	**p-Xylene**	**Mean:**	**32,7 µg/m³**
Sample:	**1**	**Reprod. s.d.:**	**4,3 µg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**13,28%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**29,8 µg/m³**
		Range of tolerance:	**26,2 - 39,2 µg/m³ (|Z-Score| <= 2,00)**



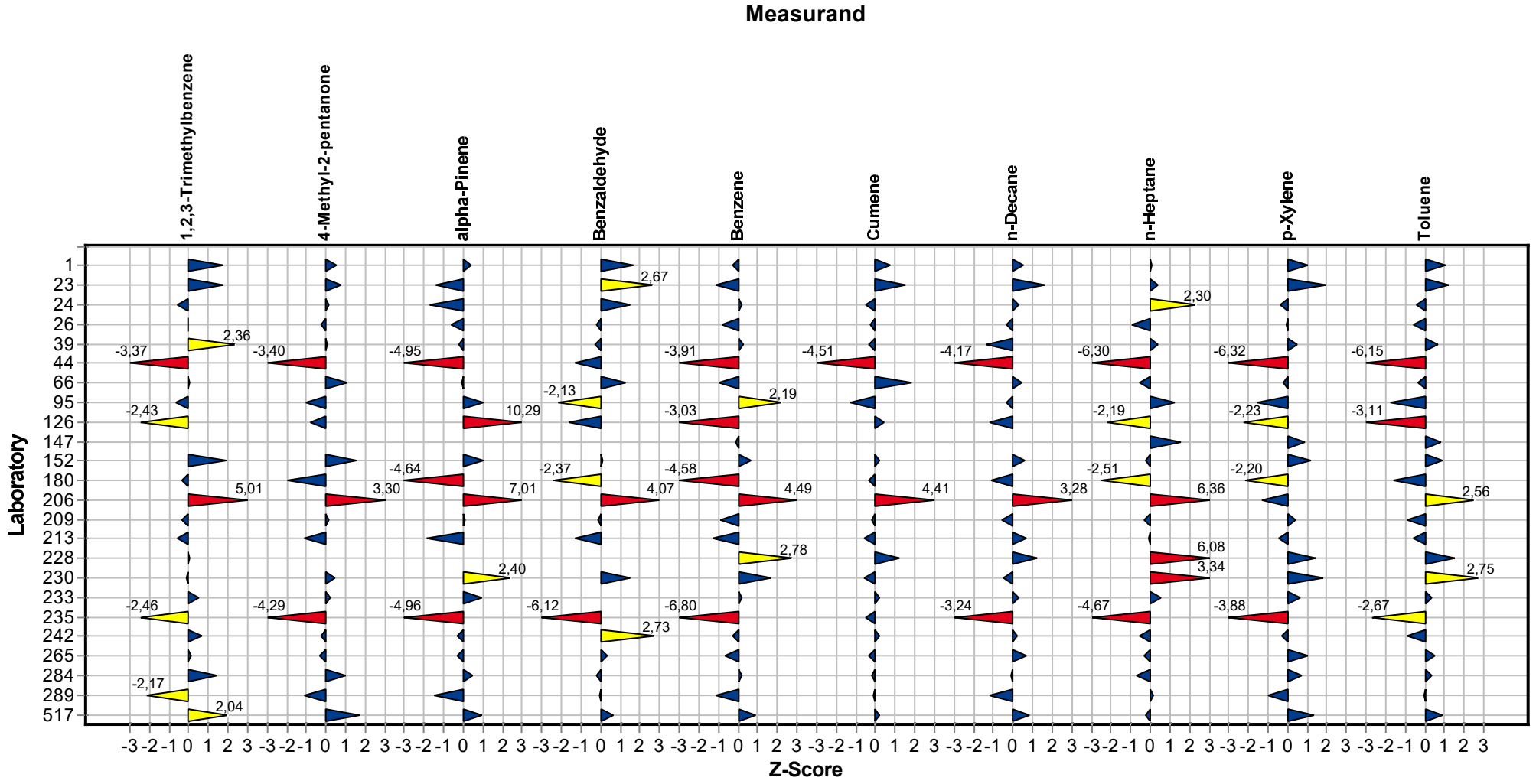
Summary results

Measurand:	**Toluene**	**Mean:**	**28,6 µg/m³**
Sample:	**1**	**Reprod. s.d.:**	**4,6 µg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**16,20%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**24,5 µg/m³**
		Range of tolerance:	**22,9 - 34,4 µg/m³ (|Z-Score| <= 2,00)**



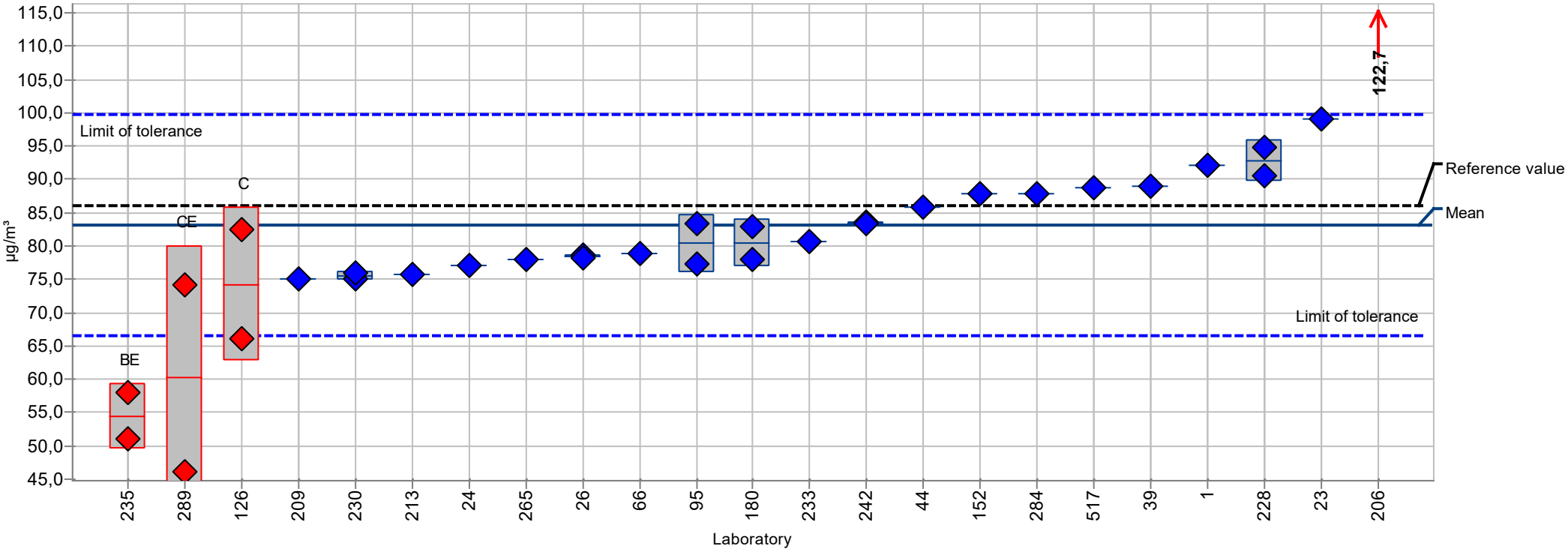
Sample chart of Z-scores

Sample 1



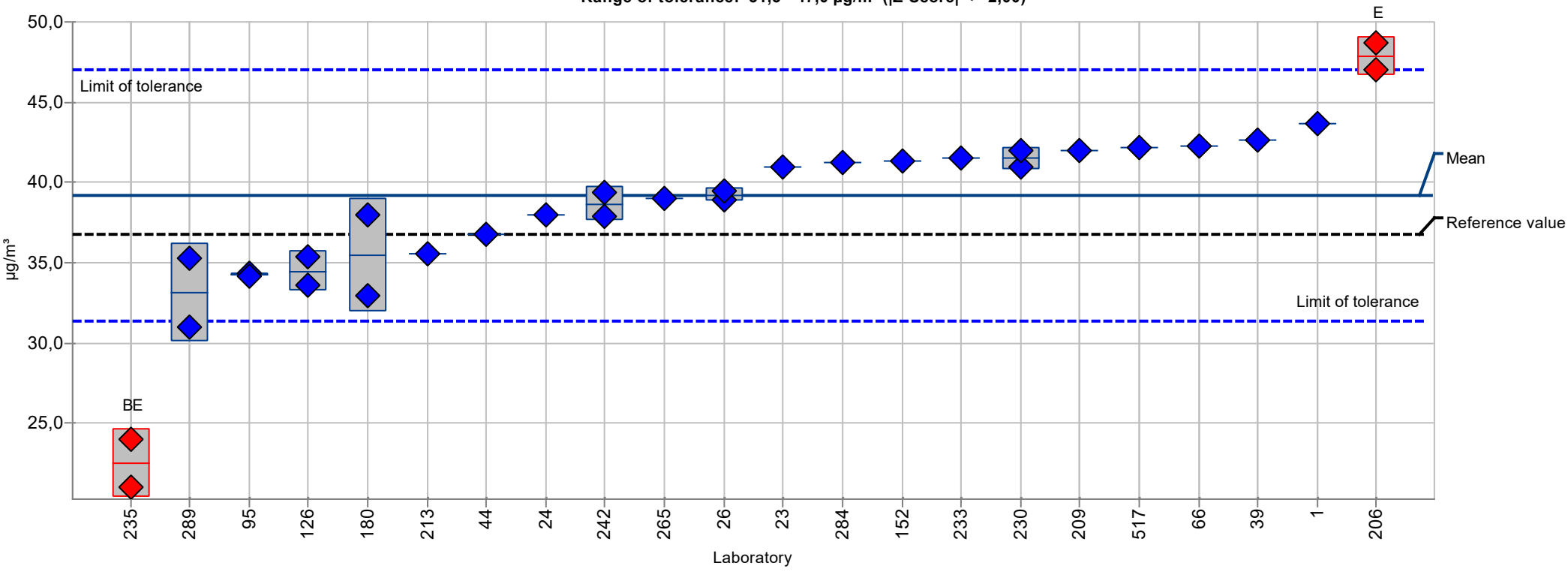
Summary results

Measurand:	**1,2,3-Trimethylbenzene**	**Mean:**	**83,1 µg/m³**
Sample:	**2**	**Reprod. s.d.:**	**6,7 µg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**8,12%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**86,1 µg/m³**
		Range of tolerance:	**66,5 - 99,7 µg/m³ (|Z-Score| <= 2,00)**



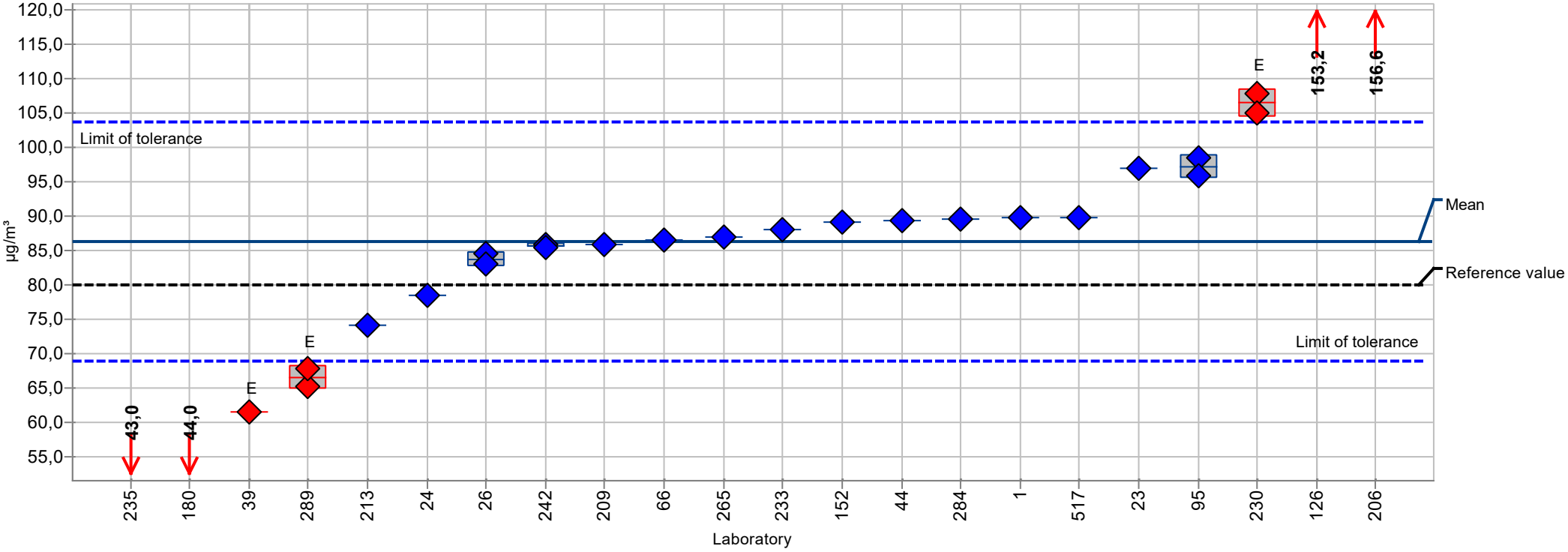
Summary results

Measurand:	**4-Methyl-2-pentanone**	**Mean:**	**39,2 µg/m³**
Sample:	**2**	**Reprod. s.d.:**	**4,2 µg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**10,62%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**36,8 µg/m³**
		Range of tolerance:	**31,3 - 47,0 µg/m³ (|Z-Score| <= 2,00)**



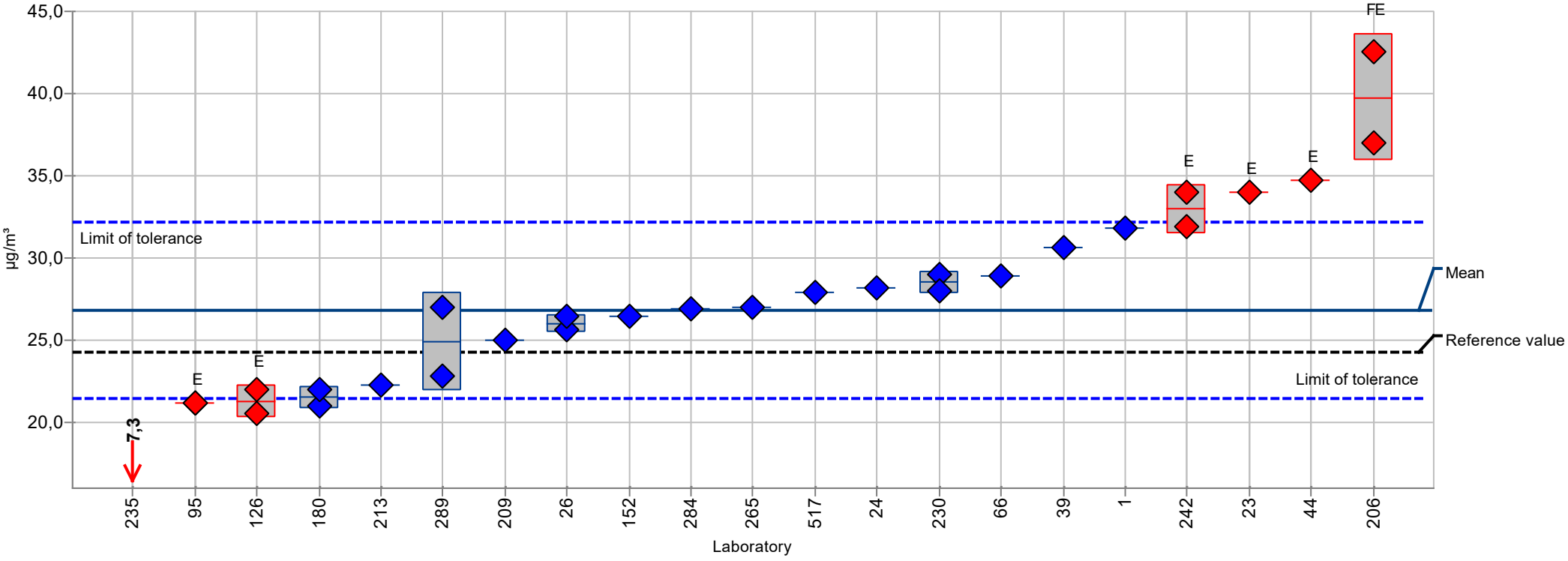
Summary results

Measurand:	**alpha-Pinene**	**Mean:**	**86,4 µg/m³**
Sample:	**2**	**Reprod. s.d.:**	**11,5 µg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**13,30%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**80,1 µg/m³**
		Range of tolerance:	**69,1 - 103,7 µg/m³ (|Z-Score| <= 2,00)**



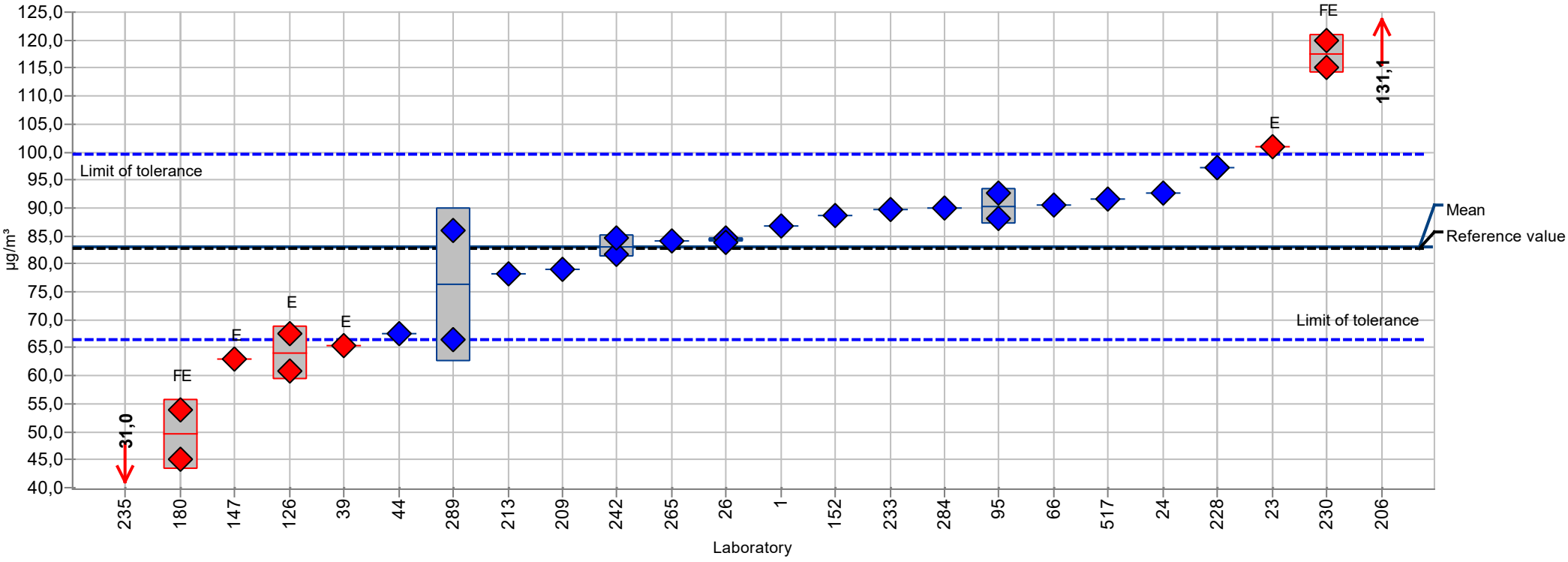
Summary results

Measurand:	**Benzaldehyde**	**Mean:**	**26,8 µg/m³**
Sample:	**2**	**Reprod. s.d.:**	**4,4 µg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**16,34%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**24,3 µg/m³**
		Range of tolerance:	**21,4 - 32,1 µg/m³ (|Z-Score| <= 2,00)**



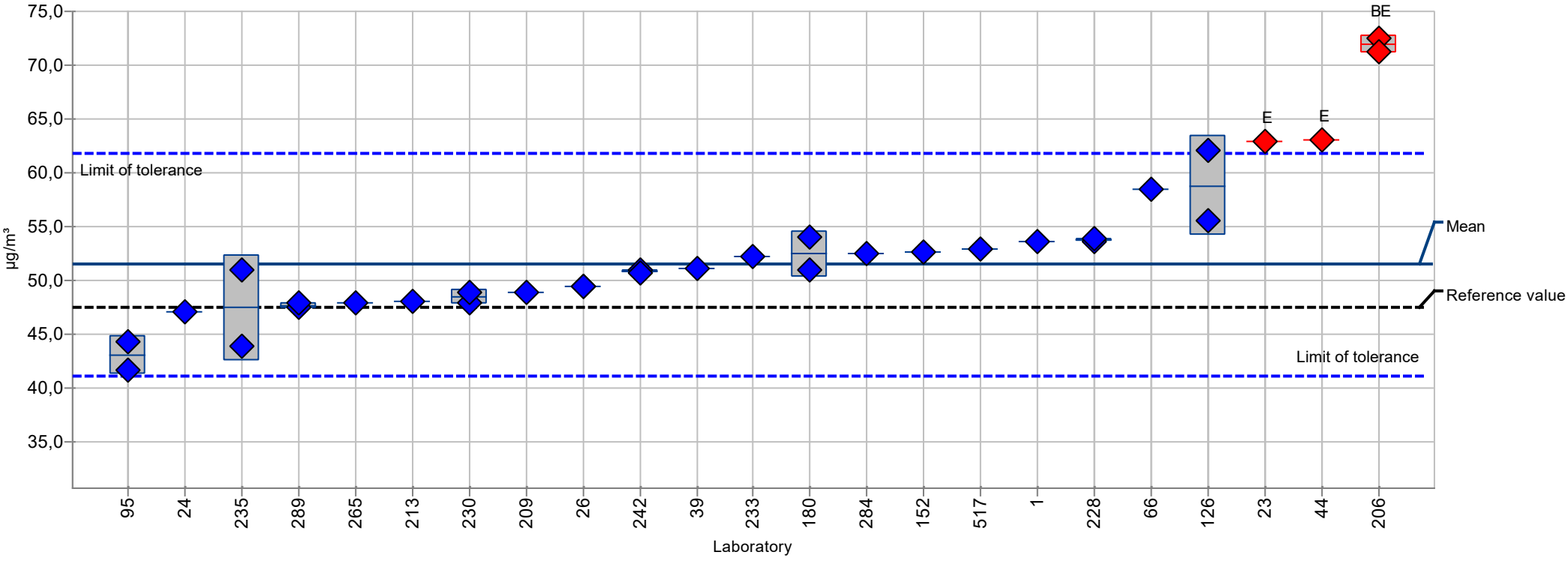
Summary results

Measurand:	**Benzene**	**Mean:**	**83,0 µg/m³**
Sample:	**2**	**Reprod. s.d.:**	**11,4 µg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**13,78%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**82,7 µg/m³**
		Range of tolerance:	**66,4 - 99,6 µg/m³ (|Z-Score| <= 2,00)**



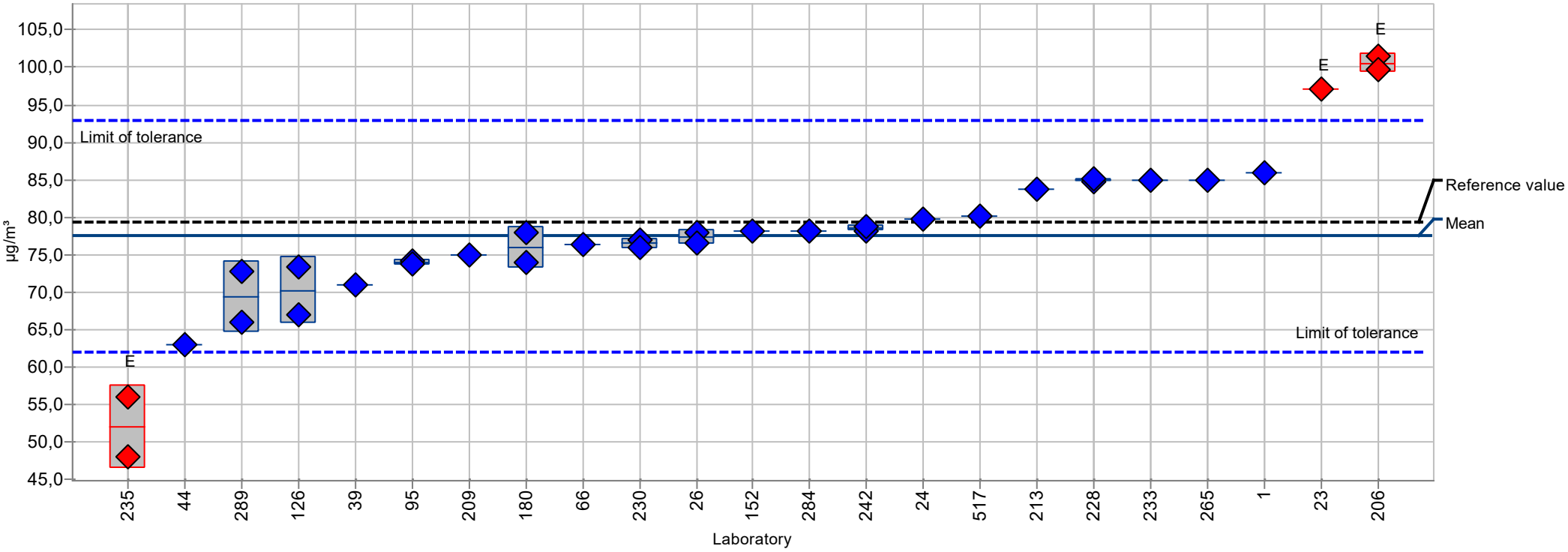
Summary results

Measurand:	**Cumene**	**Mean:**	**51,5 µg/m³**
Sample:	**2**	**Reprod. s.d.:**	**5,1 µg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**9,97%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**47,6 µg/m³**
		Range of tolerance:	**41,2 - 61,8 µg/m³ (|Z-Score| <= 2,00)**



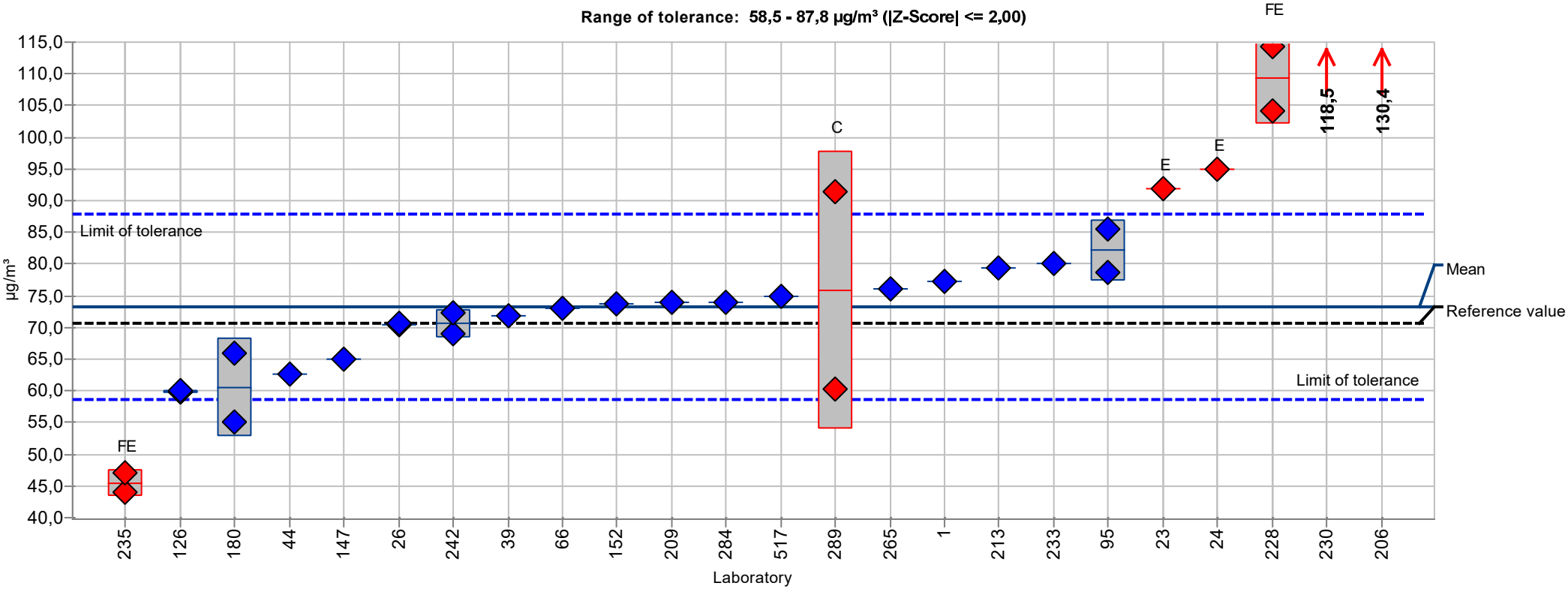
Summary results

Measurand:	**n-Decane**	**Mean:**	**77,5 µg/m³**
Sample:	**2**	**Reprod. s.d.:**	**10,9 µg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**14,02%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**79,4 µg/m³**
		Range of tolerance:	**62,0 - 93,0 µg/m³ (|Z-Score| <= 2,00)**



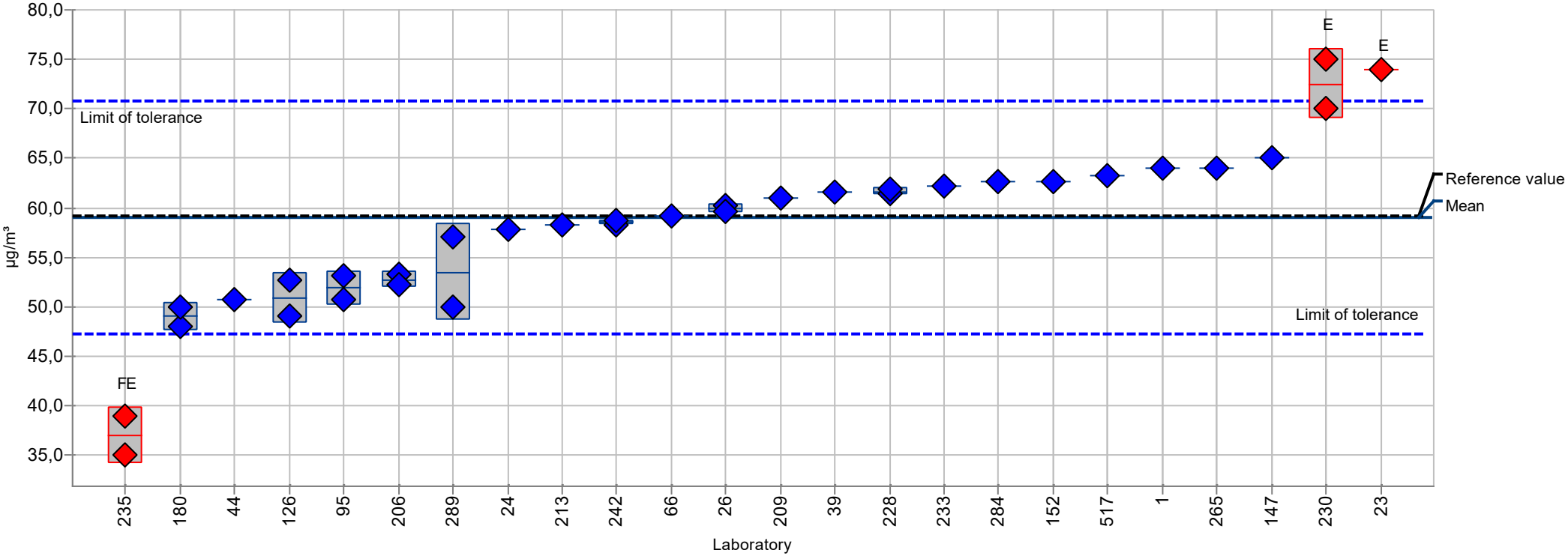
Summary results

Measurand:	**n-Heptane**	**Mean:**	**73,2 µg/m³**
Sample:	**2**	**Reprod. s.d.:**	**9,6 µg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**13,09%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**70,6 µg/m³**
		Range of tolerance:	**58,5 - 87,8 µg/m³ (|Z-Score| <= 2,00)**



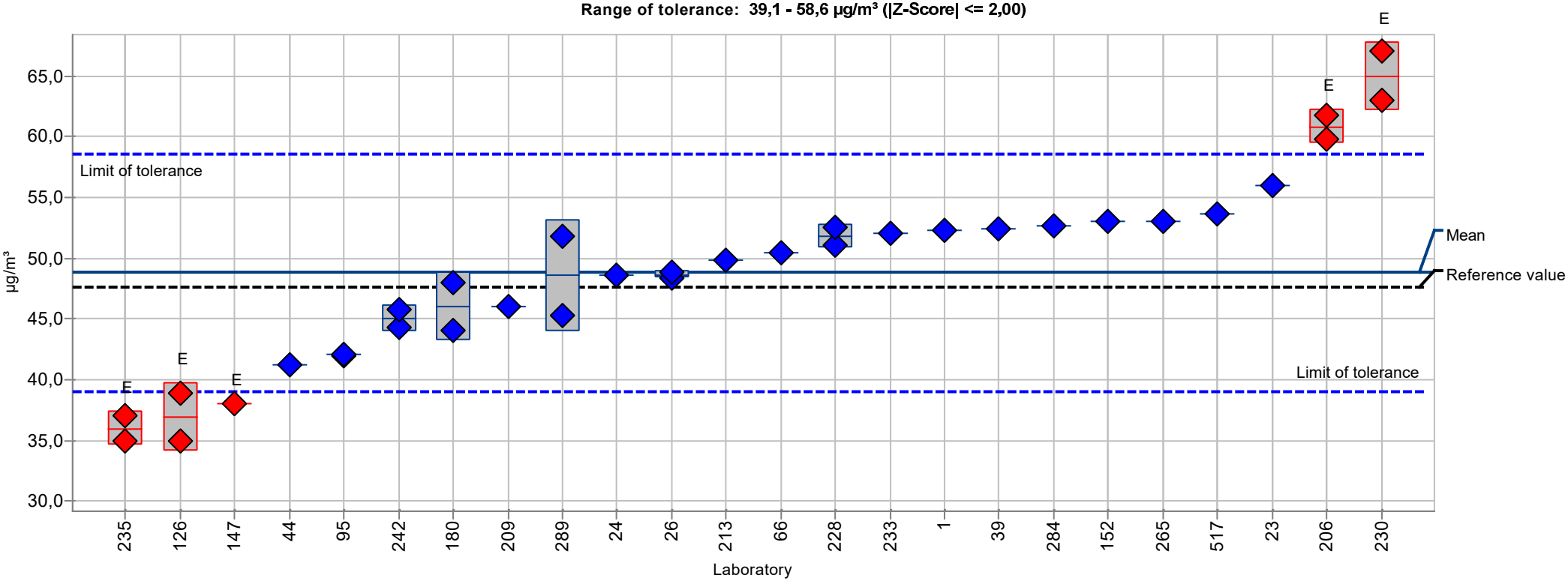
Summary results

Measurand:	**p-Xylene**	**Mean:**	**59,0 µg/m³**
Sample:	**2**	**Reprod. s.d.:**	**6,9 µg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**11,70%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**59,2 µg/m³**
		Range of tolerance:	**47,2 - 70,8 µg/m³ (|Z-Score| <= 2,00)**



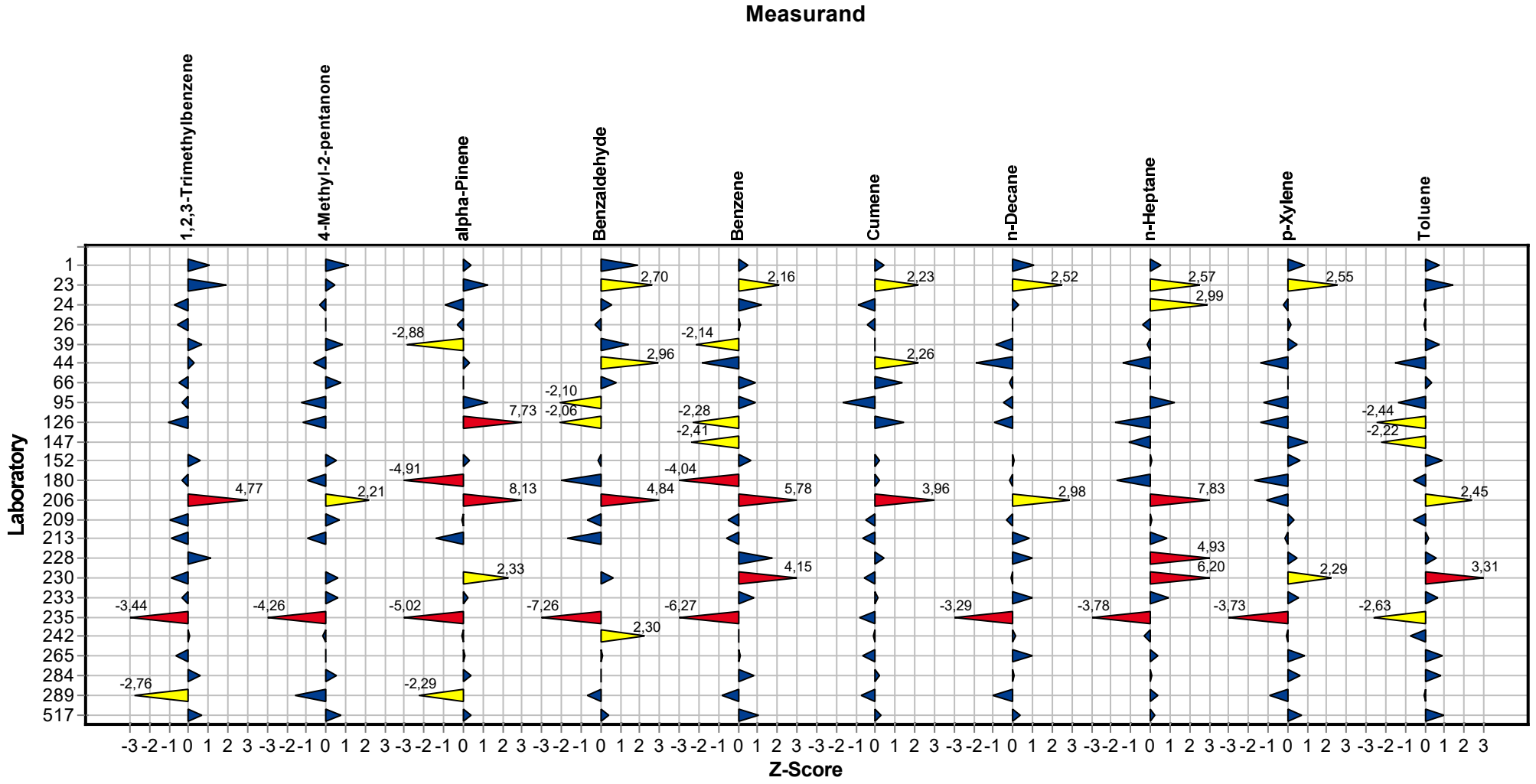
Summary results

Measurand:	**Toluene**	**Mean:**	**48,8 µg/m³**
Sample:	**2**	**Reprod. s.d.:**	**7,8 µg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**15,97%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**47,6 µg/m³**
		Range of tolerance:	**39,1 - 58,6 µg/m³ (|Z-Score| <= 2,00)**



Sample chart of Z-scores

Sample 2



Summary of laboratory test results

Laboratory	1.2,3-Trimethylbenzene	4-Methyl-2-pentanone	alpha-Pinene	Benzaldehyde	Benzene	Cumene	n-Decane
Unit	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
1	< 0.50	< 0.50	< 0.50	< 2.00	< 0.50	< 0.50	< 0.50
24	1.12	0.00	0.67	5.90	0.00	0.64	0.32
26	0.20	0.20	0.15	0.50	0.60	0.07	0.30
39	< 0.50	< 0.50	1.85	4.05	< 0.50	< 0.50	1.90
44	0.17	0.00	0.15	2.17	1.90	0.05	0.00
66	< 1.00	< 2.00	< 1.00	2.20	< 0.50	< 1.00	< 1.00
95	0.60	3.05	0.07	2.03	0.00	0.48	0.50
147	0.00	0.00	0.00	0.00	0.00	0.00	0.00
152	0.00	0.00	0.00	0.00	0.00	0.00	0.00
180	0.00	0.00	0.00	0.00	0.00	0.00	0.00
209	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00
213				2.52			
228	< 1.00				2.50	< 1.00	< 1.00
230	< 1.00	< 2.00	< 2.00	< 2.00	< 1.00	< 1.00	< 2.00
235	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
242	0.00	0.00	0.00	0.00	0.00	0.00	0.00
265	0.00	0.00	0.00	0.00	0.00	0.00	0.00
284	0.00	0.00	0.00	0.00	0.00	0.00	0.00
289	0.09	< 2.00	0.02	0.31	0.12	0.04	0.12
517	< 10.00	< 10.00	< 10.00	< 10.00	< 10.00	< 10.00	< 10.00
–	– –	– –	– –	– –	– –	– –	– –
No. of laboratories that submitted results	19	18	18	19	19	19	19

Laboratory	n-Heptane	p-Xylene	Toluene
Unit	µg/m³	µg/m³	µg/m³
1	< 0.50	< 0.50	< 0.50
24	0.00	0.52	0.28
26	0.40	1.10	2.95
39	< 0.50	1.30	1.30
44	0.22	0.13	0.75
66	< 1.00	5.70	< 0.50
95	0.00	0.59	0.78
147	0.00	0.00	0.00
152	0.00	0.00	0.00
180	0.00	0.00	0.00
209	< 1.00	< 1.00	< 1.00
228	< 1.00	1.00	1.50
230	< 2.00	< 1.00	3.00
235	< 0.10	< 0.10	< 0.10
242	0.00	0.00	0.00
265	0.00	0.00	0.00
284	0.00	0.00	0.00
289	< 2.00	0.07	0.03
517	< 10.00	< 10.00	< 10.00
–	– –	– –	– –
No. of laboratories that submitted results	19	19	19

Questions and Answers

Participant	Sample carrier
1	Tenax TA
23	Tenax Rohre von Markes
24	Gerstel Tenax TA
26	Tenax TA (Markes)
39	Tenax-Röhrchen (Vom Labor)
44	Tenax Markes
66	Tenaxröhrchen
95	Tenax GR
126	Tenax TA
147	Carbotrap 349
152	Tenax TA v. Fa. Supelco
180	TENAX
206	Tenax TA CAMSCO
209	Thermodesorptionsröhrchen auf Mehrbettsystem (Tenax TA und Carbopack X)
213	TDU Röhrchen mit TENAX Ta, Hersteller:- Markes
228	Tenax
230	Tenax TA, Fa. Gerstel
233	Edelstahlröhrchen mit Tenax TA von Markes
235	stainless steel TD tube, O.D. × L 1/4 in. × 3 1/2 in., 60-80 mesh, Tenax TA, Supelco (https://w w w .sigmaaldrich.com/DE/de/product/supelco/30133u)
242	Tenax TA, Fa. Gerstel
265	Tenax TA
284	Tenax TA v. Fa. Supelco
289	Tenax TA
517	Tenax TA (Fa. Supelco)

Participant	Sampling pump	Flow rate	Flow rate measurement	Sampling time
1	SKC PCXR8, AirChek2000, GSA 350ex	ca. 0,1 l/min	Massflow meter TSI 4100	10 und 30 min
23	Bivoc	100 ml/min		50 min
24	BiVOC2V2	0,1-0,2 L/min	BiVOC2V2	10-40min

Participant	Sampling pump	Flow rate	Flow rate measurement	Sampling time
26	Gilian LFS-113 DC	0,067 - 0,070 l/min	Gilibrator 3	30
39	Gilian Air Plus	0,1L/min	Gilian Gilibrator 3	30
44	BIVOC2, Fa. Holbach	0,15 L/min.	In der Pumpe integriert	20
66	SKC AirChek TOUCH	50 ml/min	Analyt-MTC	60
95	GSA SG350ex	0,1 L/min	DryCal DC-Lite	30 min, 45 min, 60 min
126	Aircon 2	M1: 200 mL/min; M2: 100 mL/min	DryCal Defender 530	30
147	GilAir plus	250 ml/min	Bios Defender	80 min
152	Turzer	0.2 l/min	interner Massflow controller	15
180	KNF Laboport Mini-Laborpumpen	0.15 l/min	red-y compact series by vögtlin	81-90 min
206	SKC 224-PCEX8	100 ml/Min.	Defender 510 BIOS	30 Minuten
209	GilAir Plus Personal Air Sampling Pump	190 mL/Min	TSI 4100	15
213	BIVOC2	0,2ml/min	BIVOC2	25min
228	Hersteller Holbach Model BiVOC2	0,2 l/min	Hersteller Holbach Model BiVOC2	Ca. 25 min
230	BiVOC, Fa. Holbach	0,15 ml/ml	TSI 4140 F	20
233	DESAGA GS301 und Gilian GilAir Plus	0,1 L/min	Aalborg GFM17	20
235	GSA Messgerätebau, GSA 350ex	167 ml/min (BW, M1); 100ml/min (M2)	GSA Messgerätebau, GSA 350ex	BW 45; M1 60 Min; M2 30 Min
242	LFS-113 DC	100ml/min	Defender 510	20
265	BiVOC V2	0,1 L/min	Massenflussmesser von Bronkhorst	20
284	GilAir	200 ml/min	Gilibrator	15 Minuten
289	Gilair Plus	6 L	Gilibrator	60
517	SKC Universal	50 ml/min	Strömungsmesser Analyt	60

Participant	Analytical method	Gas chromatograph (GC)
1	DIN ISO 16000-6 (03-2022)	Shimadzu QP-2020
23	16000-6	GC Shimadzu 2010 Plus
24	DIN ISO 16000-6	Agilent GC 7890 B
26	DIN ISO 16000-6, DIN EN 16516	Agilent GC 7890B
39	DIN ISO 16000-6 (03-2022)	Shimadzu QP-2020
44	DIN ISO16000-6, DIN EN ISO 16017-1, EPA to 17	HPGC MS D-13 GC-System Argelent 8890+ 5977B GC MSD
95	DIN EN ISO 16017-1	Agilent 8890
126	DIN EN ISO 16000-6	ThermoFisher Trace GC Ultra
147	ISO 16000-6	

Participant	Analytical method	Gas chromatograph (GC)
152	DIN ISO 16000-6	Agilent 7890B
180	DIN 16000-6:2022-03	Shimadzu GC-MS QP 2010 Ultra bzw . Shimadzu GC-MS-QP2020, 60 m Säule
206	DIN ISO 16000-6	AGILENT 7890 A
209	DIN EN ISO 16000-6	-
213	ISO 16000-6	Agilent 8890 GC System
228	DIN ISO 16000-6	Agilent
230	DIN ISO 16000-6	Thermo Scientific GC Trace 1610 + ISQ 7610
233	DIN ISO 16000-6	Agilent GC 7890A
235	ISO 16017-1	PerkinElmer: GC: Clarus 600; MS: Clarus SQ8
242	nein	Agilent GC 8890
265	DIN ISO 16000-6	Shimadzu QP2020
284	DIN ISO 16000-6	Agilent 7890B
289	DIN ISO 16000-6, DIN EN 16516	Agilent GC 7890B
517	DIN ISO 16000-6	Agilent 7890B

Participant	Thermal desorber	Desorption temperature	Cryo trap	Carrier gas
1	Shimadzu TD-30R	220°C	- 30 °C auf 220°C	Helium
23	Shimadzu TD30-R	250 C°	-20 bid 250 C°	Helium
24	Gerstel TDS 3	260°C	-150°C / 280°C	Helium
26	Markes TD100	280° C	-20 / 315° C	Helium
39	Shimadzu TD-30R	220°C	-30°C auf 220°C	Helium
44	Turbo Matrix 650 Perkin Elmer	280°C	-20°C, 40°C/sek.	Helium
95	Gerstel TD3.5+	270°C	-145°C - 12°C/sec - 300°C - 3 min	Helium
126	Markes TD100XR	250°C	-20°C; Heiztemperatur: 250°C	Helium
152	Gerstel TD 3.5.+	265°C	-30°C / 270°C	Helium
180	Markes TD100-xr			
206	PERKIN-ELMER TurboMatrix 650	275°C	-30°C bis 280°C	Helium
209	Shimadzu TD-20	240	-18 °C / +260 °C	He
213	Markes TD100-xr	260°C	-30°C, 300°C	Helium
228	Markes Unit 2	280°C	5°C / 60°C / min auf 280°C	Helium
230	TDS 3, Fa. Gerstel	40°C-260°C	-30°C bis 260°C	Helium
233	Markes TD100-xr	280°C	-10°C auf 320°	Helium

Participant	Thermal desorber	Desorption temperature	Cryo trap	Carrier gas
235	ATD: Turbomatrix 650	280°C	-30°C	Helium 5.0, zusätzlich Aktivkohle-filtriert
242	TDS 3	280°C	-150°C; 60°C/s	Helium
265	Shimadzu TD30	290 °C	-17 °C / 290 °C	Helium
284	Gerstel TD 3.5.+	265°C	-30°C / 270°C	Helium
289	Markes TD100	280°C	-20 / 315	Helium
517	Gerstel TD 3.5.+	265 °C	-30 °C / 270 °C	Helium

Participant	Carrier gas flow	Analytical column	Detector
1	1,2 ml/min	Restek RTX-5ms	MS und FID
23	Column Flow : 2,42 ml/min, Total Flow : 33,1 ml/min	Rxi 5 Sil ms	MS Shimadzu QP-2020 /Quadropol-MS
24	1,3ml/min	Agilent Ultra 2	Agilent MSD 5977B
26	0,5	Restek Rxi-5Sil MS, 20m x 0,18mm id x 0,36µm df	MS
39	1,2ml/min	Restek RTX-5ms	MS und FID
44	3,1 ml/min über Thermodesorber	RTX 502.2 60m x 250 µm x 1,4 µm	Massenspektrometer
95	0,8 mL/min	Rtx-502.2; 40m x 0,18mm ID; 1µmFD	Agilent 5975C MSD
126	1 mL/min	Rxi-624 Sil MS 60 m x 0,25 mm, 1,4 µm Filmdicke	MSD ISQ 7000
152	1,2ml/min		MSD 5977 B, Agilent
206	1,5 ml/Min.	RESTEK Rtx-5Sil MS	LECO Pegasus 4 D
209	45 ml/min	DB-5MS 60 m - 0,25 µm - 0,25 mm (Agilent)	MS QP2010 Ultra, Shimadzu
213	1.3ml/min	ULTRA HP	Agilent 5977B GC/MSD
228	1.3 ml/min	HP Ultra 2	Agilent MS
230	06 ml/min	Restek Rxi 1 MS, 60 m	MS
233	1,5 mL/min	HP-5ms 5% Phenyl (30 m; ID: 0,25 mm, Filmdicke 0,25 µm)	Agilent 5975C MSD
235	1 ml/min	PerkinElmer Elite 5-MS, l = 60 m, ID = 0,25 mm, film = 0,25 µm	MS: Clarus SQ8
242	1,3ml/min	HP-5 Ultra 2	Massenspektrometer 5977C
265	2,46	Agilent VF-5MS	MS
284	1,2ml/min	MSD 5977 B, Agilent	MSD 5977 B, Agilent
289	0.5		
517	1,2		MSD 5977 B, Agilent

Participant	Data evaluation
1	Identifizierung: Retentionszeit + Massenspektrum; Quantifizierung: MS interne Standardmethode, FID externe Standardmethode
23	Quantifizierung über Vergleichstandards (substanzspezifisch)
24	2-Punktkalibrierung externer Standards, Identifikation via Spektrum
26	Identifizierung und Quantifizierung mittels GC-MSD und Toluol d8 als interner Standard, 12 Punkt Kalibrierung aller Analyten (1-500 ng abs.)
39	Identifizierung: Retentionszeit + Massenspektrum; Quantifizierung: MS interne Standardmethode, FID externe Standardmethode
44	externe Kalibrierung (Fläche)
95	Quantifizierung über internen Standard, Identifizierung über MS-Spektrum und RT
126	Quantifizierung über TIC; Ausnahme alpha-Pinen: quan via m/z 93 und ident via m/z 91
152	Identifizierung: stoffspezifisch, Vergleichsspektrum+Retentionszeit
206	externer Standard
209	Quantifizierung: Substanzspezifisch mittels ext. Kalibrierreihe (5-Punkt- Kalibrierung), Identifizierung: Referenzmassenspektrum und Retentionszeit
213	Quantifizierung der spezifischen Substanzen mit Drei-Punkt-Kalibrierung, Identifizierung mit Retentionszeit und Ionenfragmenten
228	Einzelausw ertung mit spezifischen Massen
230	Referenzstands, eigene Belegung, Retentionszeit, MS
233	externe 6-Punkt-Kalibrierung mit ISTD (Cyclooctan)
235	Quantifizierung über Toluene-D8 internen Standard (100ng); Identifikation über MS-NIST Datenbank und Standardsubstanzen (Supelco P/N 49148-U, P/N 28220, Sigma-Aldrich P/N B1334)
242	Quantifizierung über externe Mehrpunktkalibration der Einzelsubstanzen, Identifikation über Massenspektrometrie
265	über stoffspezifische Kalibration
284	stoffspezifisch, Vergleichsspektrum + Retentionszeit
289	GC-MSD and Toluol d8 as internal standard, 12 point calibration of all analytes (1-500ng abs.)
517	stoffspezifisch, Vergleichsspektrum und Retentionszeit

Participant	Recovery rate	Date of analysis
1	nein	22.09.2023
23	nein	12.09.2023+ 22.09.2023
24	nein	16.-17.10.2023
26	nein	13.09.2023
39	nein	22.09.2023
44	nein	15.09.2023
66		21.09.2023
95	nein	21.09.2023
126	Nein	19.09.2023 bis 13.10.2023

Participant	Recovery rate	Date of analysis
152	nein	21.9.23
180		25.09.-16.10.2023
206	ja	02.10.2023
209	Nein	18.09. - 04-10.2023
213	nein	10.10.2023 & 12.10.2023
228	Nein	18.09.2023
230	nein	ab dem 15.09.2023
233	nein	13.09.-16.10.2023
235	nein	2 bzw . 6 Tage nach Probenahme
242	Nein	14.09.2023
265	nein	18.09.2023
284	nein	21.9.23
289	no	19.09.2023
517	nein	21.09.2023