

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

## Round-robin test

## Volatile Organic Substances (VOC) with Thermodesorption

**May 2017**

## Summary of laboratory means

Sample 1

Unit	n-Heptane Z score		Toluene Z score		m-Xylene Z score		1-Butanol Z score		1,2,4-Trimethylbenzene Z score		Benzene Z score	
	$\mu\text{g}/\text{m}^3$		$\mu\text{g}/\text{m}^3$		$\mu\text{g}/\text{m}^3$		$\mu\text{g}/\text{m}^3$		$\mu\text{g}/\text{m}^3$		$\mu\text{g}/\text{m}^3$	
30	95,90	1,36	110,85	1,15	122,55	1,16	194,95	0,76	48,65	-0,19		
44	81,90	0,19	98,38	0,27	104,68	0,01	168,56	-0,24	59,61	1,27	24,63	-0,24
55	84,00	0,37	93,00	-0,11	106,50	0,13	171,50	-0,13	47,50	-0,34	25,00	-0,15
60	85,45	0,49	86,00	-0,60	89,85	-0,93			41,55	-1,13	26,10	0,14
63	57,65	-1,84	69,05	-1,80	78,50	-1,66	130,00	-1,71	36,05	-1,87	18,60	-1,82
68	59,65	-1,67	89,30	-0,37	68,50	-2,29 E	199,10	0,92	45,20	-0,65	16,35	-2,40 E
88	97,52	1,50 C	112,48	1,26	60,32	-2,82 E	128,60	-1,77	56,88	0,91 C	47,64	5,76 BE
95	69,69	-0,83	85,70	-0,62	97,03	-0,47			45,14	-0,65	22,48	-0,80
135	78,00	-0,13	95,55	0,07	111,50	0,45	167,95	-0,27	52,05	0,27	24,20	-0,35
148	90,25	0,89	96,05	0,10	110,50	0,39	185,00	0,38	56,40	0,84	27,60	0,53
151	75,90	-0,31	88,40	-0,43	101,65	-0,18	168,05	-0,26	44,50	-0,74	24,00	-0,41
153	97,00	1,46	115,50	1,48	132,00	1,76			63,00	1,72		
169	114,30	2,90 E	103,80	0,65 C	132,90	1,82	188,95	0,53	62,65	1,68	35,20	2,51 E
184	81,35	0,15	101,50	0,49	113,00	0,55	178,50	0,14	51,00	0,13	26,90	0,35
186	73,75	-0,49	96,15	0,11	109,05	0,29	192,65	0,67	51,25	0,16	25,30	-0,07
189	74,36	-0,44	92,68	-0,13	106,00	0,10	166,50	-0,32	50,39	0,04	21,79	-0,98
191	60,50	-1,60	99,50	0,35	124,50	1,28	203,00	1,07	52,00	0,26	18,00	-1,97
192	94,40	1,24	101,50	0,49	120,00	0,99	176,50	0,06	50,55	0,07	29,15	0,94
199	86,50	0,58	96,20	0,11	103,30	-0,07	187,00	0,46	45,30	-0,63	27,50	0,51
206	81,50	0,16	50,00	-3,14 BE	34,00	-4,50 BE	191,00	0,61	53,00	0,39	27,00	0,38
207	84,00	0,37	103,00	0,59	126,00	1,38	204,00	1,11	53,00	0,39	31,00	1,42
208	69,82	-0,82	85,88	-0,61	99,44	-0,32	146,71	-1,08	48,70	-0,18	24,02	-0,40
214	71,50	-0,68	109,50	1,05	129,50	1,60	154,50	-0,78	58,00	1,06	29,00	0,90
215	75,15	-0,37	85,35	-0,65	96,95	-0,48	176,80	0,07	45,60	-0,59	25,25	-0,08
237	74,59	-0,42	88,35	-0,44	110,73	0,40	170,67	-0,16	50,25	0,03	25,07	-0,13
254	86,00	0,54	102,00	0,52	115,50	0,71	223,00	1,83	56,00	0,79	34,00	2,20 E
261	71,65	-0,67	92,55	-0,14	99,85	-0,29	130,00	-1,71	47,10	-0,39	22,35	-0,84
267	91,50	1,00	103,00	0,59	105,00	0,03	205,00	1,15	51,00	0,13	33,50	2,07 E

	n-Heptane Z score		Toluene Z score		m-Xylene Z score		1- Butanol Z score		1,2,4-Trimethylbenzene Z score		Benzene Z score	
503			78,25	-1,15	73,05	-2,00 E			43,02	-0,94	27,99	0,63
506	68,49	-0,93	77,33	-1,22	90,97	-0,86	160,65	-0,54	42,25	-1,04	21,83	-0,97
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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	79,61		94,57		104,45		174,95		50,06		25,56	
Reproducibility s.d.	12,77		11,23		18,61		24,67		6,40		4,65	
Rel. reproducibility s.d.	16,04 %		11,87 %		17,81 %		14,10 %		12,79 %		18,18 %	
Reference value	85,60		94,90		114,20		169,10		50,10		29,70	
Target s.d.	11,94		14,19		15,67		26,24		7,51		3,83	
Rel. target s.d.:	15,00 %		15,00 %		15,00 %		15,00 %		15,00 %		15,00 %	
Lower limit of tolerance	55,73		66,20		73,12		122,46		35,04		17,89	
Upper limit of tolerance	103,49		122,94		135,79		227,43		65,07		33,23	
Type B outliers			1		1						1	
Type C outliers	1		1						1			
Type E outliers	3		2		7				1		9	
Type F outliers												
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	28		28		29		26		29		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											
	2-Ethoxyethyl acetate Z score		Cumene Z score		alpha-Pinene Z score							

Unit	2-Ethoxyethyl acetate Z score		Cumene Z score		alpha-Pinene Z score	
	µg/m³		µg/m³		µg/m³	
30	101,65	0,76	42,00	0,59	69,85	-0,28
44	96,66	0,40	42,58	0,69	77,68	0,43
55	84,50	-0,49	37,00	-0,27	71,50	-0,13
60	76,45	-1,08	32,75	-1,01	51,15	-1,99
63	64,30	-1,97	28,25	-1,79	52,50	-1,87
68	102,70	0,84	39,25	0,12	89,25	1,49
88	96,39	0,38 C	36,27	-0,40 C	82,78	0,90 C
95	85,93	-0,39	35,39	-0,55	63,73	-0,84
135	89,85	-0,10	40,20	0,28	68,85	-0,37
148	104,50	0,97	40,30	0,30	68,85	-0,37
151	76,05	-1,11	37,55	-0,18	77,40	0,41
153	120,00	2,10 E	45,50	1,20	91,00	1,65
169	110,55	1,41	53,40	2,56 E	93,95	1,92
184	86,40	-0,35	41,05	0,43	75,15	0,20
186	81,35	-0,72	37,15	-0,25	73,00	0,01
189	102,45	0,82	36,08	-0,43	73,00	0,00
191			36,50	-0,36	70,00	-0,27
192	37,55	-3,92 FE	58,15	3,38 BE	73,10	0,01
199	84,30	-0,51	39,80	0,21	123,50	4,62 BE
206	96,00	0,35	41,00	0,42	80,00	0,64
207	96,00	0,35	46,00	1,28	82,00	0,83
208	33,09	-4,25 FE	36,25	-0,40	69,61	-0,30
214	79,50	-0,86	33,50	-0,88	63,50	-0,86
215	88,25	-0,22	36,45	-0,37	72,40	-0,05
237	89,50	-0,13	37,43	-0,20	66,65	-0,58
254	90,50	-0,05	44,00	0,94	101,00	2,56 E
261	89,75	-0,11	38,50	-0,01	58,55	-1,32
267			37,00	-0,27	80,50	0,69
503			26,65	-2,06 CE		
506	29,38	-4,52 FE	31,09	-1,29	59,88	-1,19
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Method	ISO 5725-2		ISO 5725-2		ISO 5725-2	

	2-Ethoxyethyl acetate Z score	Cumene Z score	alpha-Pinene Z score
Assessment	Z <=2,00	Z <=2,00	Z <=2,00
Mean	91,23	38,58	72,94
Reproducibility s.d.	12,73	5,07	11,91
Rel. reproducibility s.d.	13,96 %	13,14 %	16,32 %
Reference value	85,70	38,30	72,50
Target s.d.	13,68	5,79	10,94
Rel. target s.d.:	15,00 %	15,00 %	15,00 %
Lower limit of tolerance	63,86	27,01	51,06
Upper limit of tolerance	118,59	50,15	94,83
Type B outliers		1	1
Type C outliers	1	2	1
Type E outliers	8	5	3
Type F outliers	3		
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	23	27	27

## Summary of laboratory means

Sample 2

Unit	n-Heptane Z score		Toluene Z score		m-Xylene Z score		1-Butanol Z score		1,2,4-Trimethylbenzene Z score		Benzene Z score	
	$\mu\text{g}/\text{m}^3$		$\mu\text{g}/\text{m}^3$		$\mu\text{g}/\text{m}^3$		$\mu\text{g}/\text{m}^3$		$\mu\text{g}/\text{m}^3$		$\mu\text{g}/\text{m}^3$	
30	73,85	1,40	97,65	1,26	216,80	0,90	148,50	0,61	64,85	-0,47		
44	62,30	0,14	90,50	0,68	175,70	-0,54	131,10	-0,24	80,27	1,00	40,78	0,02
55	61,50	0,05	90,00	0,64 C	205,00	0,49	128,00	-0,40	65,00	-0,46	39,00	-0,27
60	64,95	0,43	77,00	-0,42	168,00	-0,80			56,30	-1,29	40,80	0,02
63	42,75	-2,00	61,25	-1,70	142,00	-1,71	98,90	-1,82	49,20	-1,97	29,50	-1,83
68	51,30	-1,06	77,50	-0,38	47,55	-5,01 FE	164,65	1,40	59,00	-1,03	27,70	-2,13 E
88	79,97	2,07 E	97,50	1,25	121,64	-2,42 E	97,31	-1,90	85,07	1,46	75,95	5,79 BE
95	53,72	-0,80	78,94	-0,26	178,31	-0,44			63,08	-0,64	37,37	-0,54
135	58,00	-0,33	84,15	0,16	204,50	0,47	127,70	-0,41	70,50	0,07	39,15	-0,25
148	65,60	0,50	85,50	0,27	208,50	0,61	126,50	-0,47	66,85	-0,28	39,45	-0,20
151	57,20	-0,42	80,15	-0,16	197,75	0,23	126,30	-0,48	62,45	-0,70	39,00	-0,27
153	72,00	1,20	105,00	1,85	241,00	1,74			86,00	1,55		
169	91,20	3,30 E	119,25	3,01 CE	197,30	0,22	176,80	2,00	96,90	2,59 E	65,65	4,10 FE
184	60,70	-0,04	83,75	0,13	194,00	0,10	129,00	-0,35	65,10	-0,45	39,05	-0,26
186	54,65	-0,70	82,30	0,01	204,00	0,45	137,20	0,06	65,30	-0,43	40,00	-0,11
189	49,97	-1,21	81,96	-0,02	188,40	-0,09	118,15	-0,88	64,45	-0,51	31,94	-1,43
191	43,50	-1,91	88,00	0,47	251,00	2,09 E	159,50	1,15	76,00	0,59	32,00	-1,42
192	70,40	1,02	89,85	0,62	223,50	1,13	133,50	-0,13	68,40	-0,13	46,05	0,88
199	63,50	0,27	86,90	0,39	201,20	0,35	142,70	0,33	65,70	-0,39	46,80	1,01
206	64,50	0,38	47,50	-2,81 E	56,00	-4,71 FE	164,50	1,39	82,50	1,22	48,50	1,28
207	67,00	0,65	95,00	1,04	225,00	1,18	167,00	1,52	74,00	0,40	49,00	1,37
208	48,69	-1,35	76,88	-0,43	188,95	-0,07	107,86	-1,38	66,17	-0,34	35,75	-0,81
214	72,00	1,20	127,00	3,64 BE	291,50	3,51 FE	157,50	1,05	100,50	2,94 E	63,50	3,74 E
215	55,80	-0,57	77,50	-0,38	187,45	-0,13	133,25	-0,14 C	62,05	-0,74	39,30	-0,22
237	52,89	-0,89	74,78	-0,60	192,51	0,05	124,09	-0,59	65,82	-0,38	37,93	-0,45
254	71,00	1,09	95,00	1,04	207,50	0,57	177,00	2,01 E	76,50	0,64	52,00	1,86
261	53,00	-0,88	85,05	0,23	146,00	-1,57	96,10	-1,96	64,20	-0,53	35,25	-0,89
267	63,00	0,22	86,50	0,35	189,50	-0,05	159,00	1,12	67,00	-0,27	50,00	1,53

	n-Heptane Z score		Toluene Z score		m-Xylene Z score		1- Butanol Z score		1,2,4-Trimethylbenzene Z score		Benzene Z score	
503			69,73	-1,01	149,44	-1,45			62,33	-0,71	43,38	0,45
506	49,01	-1,31	71,03	-0,90	173,98	-0,60	121,52	-0,71	59,25	-1,01	36,92	-0,61
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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	61,02		82,15		191,04		136,06		69,78		40,66	
Reproducibility s.d.	11,26		12,08		30,00		24,30		11,79		7,80	
Rel. reproducibility s.d.	18,45 %		14,71 %		15,71 %		17,86 %		16,89 %		19,19 %	
Reference value	62,70		83,90		214,20		126,30		67,60		44,50	
Target s.d.	9,15		12,32		28,66		20,41		10,47		6,10	
Rel. target s.d.:	15,00 %		15,00 %		15,00 %		15,00 %		15,00 %		15,00 %	
Lower limit of tolerance	42,72		57,51		133,73		95,24		48,84		28,46	
Upper limit of tolerance	79,33		106,80		248,36		176,88		90,71		52,86	
Type B outliers			1								1	
Type C outliers			2				1					
Type E outliers	4		5		9		4		4		8	
Type F outliers					3						1	
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	29		27		27		25		30		26	
Explanation of outlier types												
A: Single outlier	Grubbs											
B: Differing laboratory mean	Grubbs											
C: Excessive laboratory s.d.	Cochran											
D: Excluded manually												
E: mean outside tolerance limits												
F:  Z-Score >3,5												
L: Differing laboratory mean (Grubbs II)	Grubbs für 2											
	2-Ethoxyethyl acetate Z score				Cumene Z score				alpha-Pinene Z score			

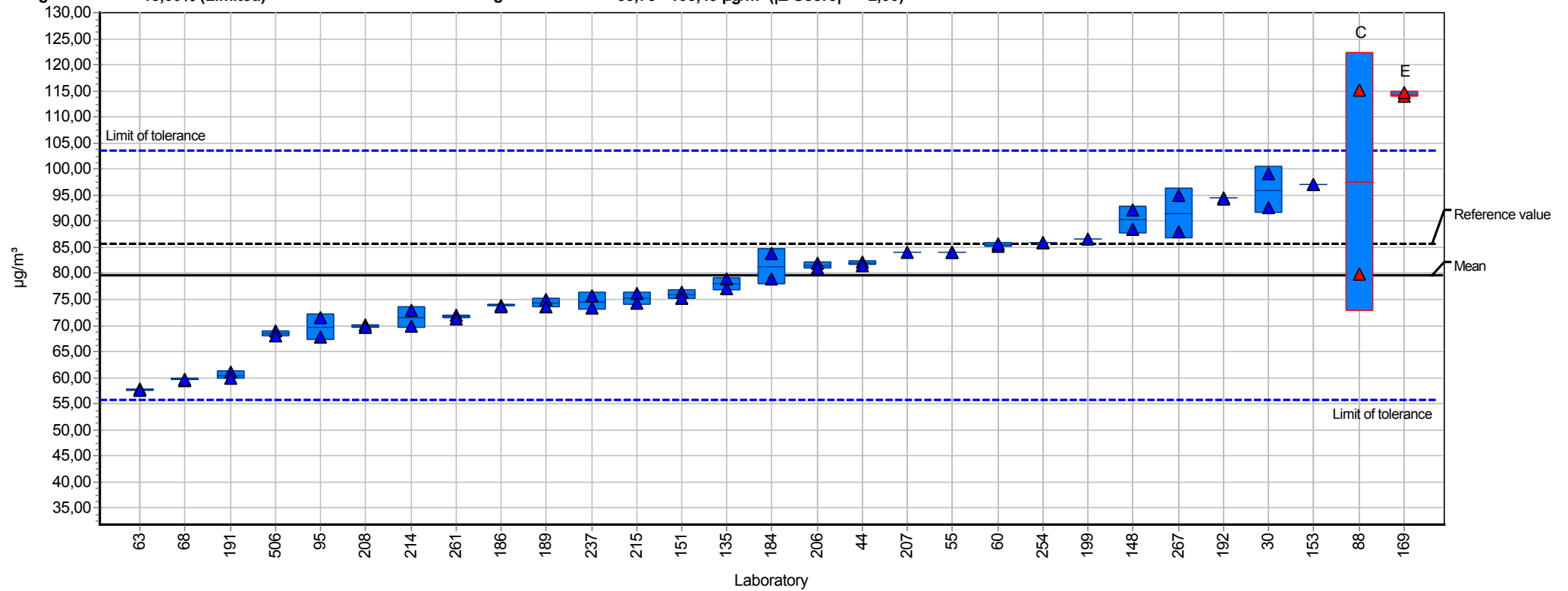
Unit	2-Ethoxyethyl acetate Z score		Cumene Z score		alpha-Pinene Z score	
	µg/m³		µg/m³		µg/m³	
30	142,35	0,59	120,20	0,45	47,60	-0,41
44	131,66	0,05	125,06	0,74	53,41	0,35
55	120,00	-0,55	108,50	-0,24	47,50	-0,42
60	108,90	-1,11	97,25	-0,91	35,45	-2,01 E
63	91,80	-1,99	81,20	-1,86	36,45	-1,88
68	190,25	3,04 FE	100,65	-0,71	122,60	9,45 BE
88	167,12	1,86	112,13	-0,03	58,99	1,09
95	125,30	-0,28	105,53	-0,42	44,98	-0,75
135	126,40	-0,22	116,20	0,21	48,95	-0,23
148	143,50	0,65	118,00	0,32	45,45	-0,69
151	113,30	-0,89	113,05	0,03	54,20	0,46
153	159,00	1,44	134,00	1,27	63,50	1,68
169	159,60	1,47	177,90	3,87 BE	69,45	2,46 E
184	116,00	-0,75	112,00	-0,04	48,05	-0,35
186	111,05	-1,00	109,20	-0,20	49,35	-0,18
189	130,50	-0,01	99,83	-0,76	49,02	-0,22
191			121,50	0,53	49,00	-0,23
192	55,45	-3,84 FE	169,50	3,37 E	48,85	-0,25
199	121,10	-0,49	127,40	0,88	83,40	4,30 FE
206	154,00	1,19	126,50	0,82	67,50	2,21 E
207	131,00	0,01	125,00	0,73	57,00	0,83
208	46,02	-4,32 FE	107,31	-0,31	44,69	-0,79
214	147,00	0,83	123,00	0,62	54,00	0,43
215	125,30	-0,28	108,90	-0,22	50,15	-0,07
237	123,27	-0,38	112,63	0,00	45,06	-0,74
254	128,00	-0,14	117,00	0,26	71,50	2,73 E
261	125,80	-0,25	98,75	-0,82	39,70	-1,45
267			104,50	-0,48	52,50	0,23
503			90,28	-1,32		
506	42,16	-4,52 FE	94,13	-1,09	40,13	-1,39
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Method	ISO 5725-2		ISO 5725-2		ISO 5725-2	



	2-Ethoxyethyl acetate Z score	Cumene Z score	alpha-Pinene Z score
Assessment	Z <=2,00	Z <=2,00	Z <=2,00
Mean	130,73	112,61	50,71
Reproducibility s.d.	19,00	16,54	9,37
Rel. reproducibility s.d.	14,54 %	14,68 %	18,47 %
Reference value	119,50	113,00	49,30
Target s.d.	19,61	16,89	7,61
Rel. target s.d.:	15,00 %	15,00 %	15,00 %
Lower limit of tolerance	91,51	78,83	35,50
Upper limit of tolerance	169,95	146,39	65,93
Type B outliers		1	1
Type E outliers	10	4	12
Type F outliers	4		1
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	23	29	27

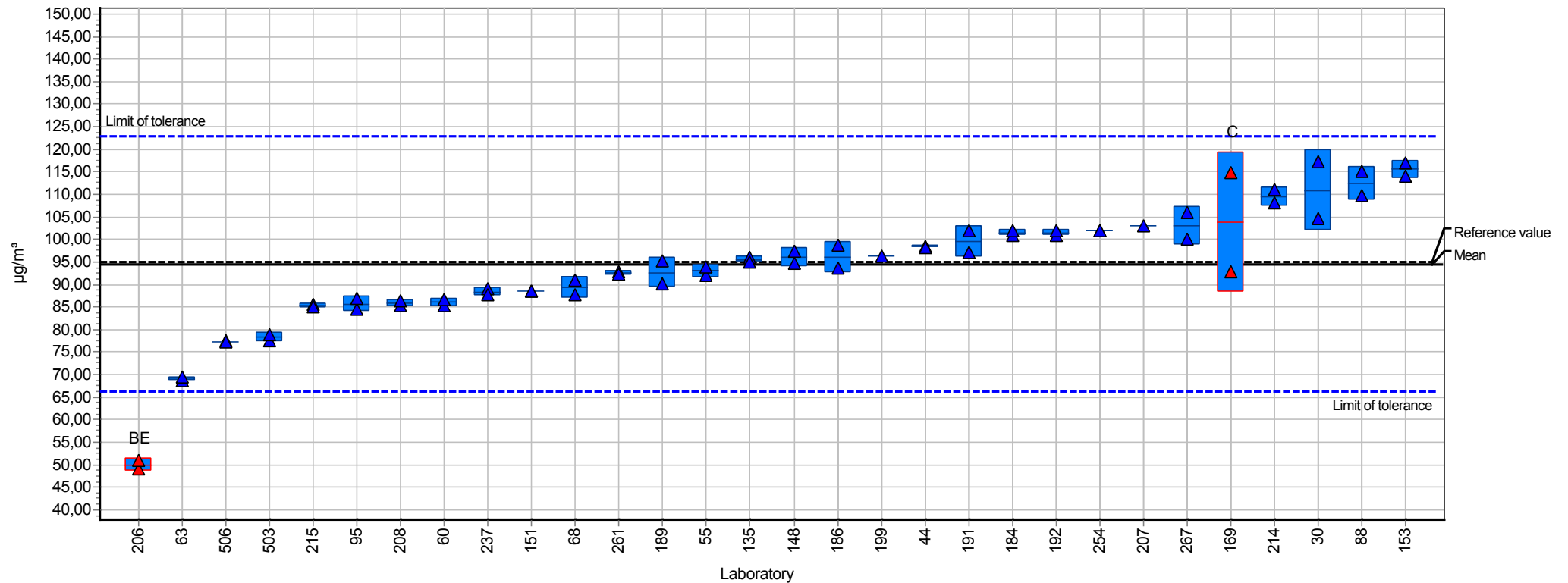
## Summary results

<b>Measurand</b>	n-Heptane	<b>Mean</b>	79,61 µg/m³
<b>Sample</b>	1	<b>Reprod. s.d.</b>	12,77 µg/m³
<b>Method</b>	ISO 5725-2	<b>Rel.reprod. s.d.</b>	16,04%
<b>No. of laboratories:</b>	28	<b>Reference value</b>	85,60 µg/m³
<b>Rel.target s.d.</b>	15,00% (Limited)	<b>Range of tolerance</b>	55,73 - 103,49 µg/m³ ( Z-Score  ≤ 2,00)



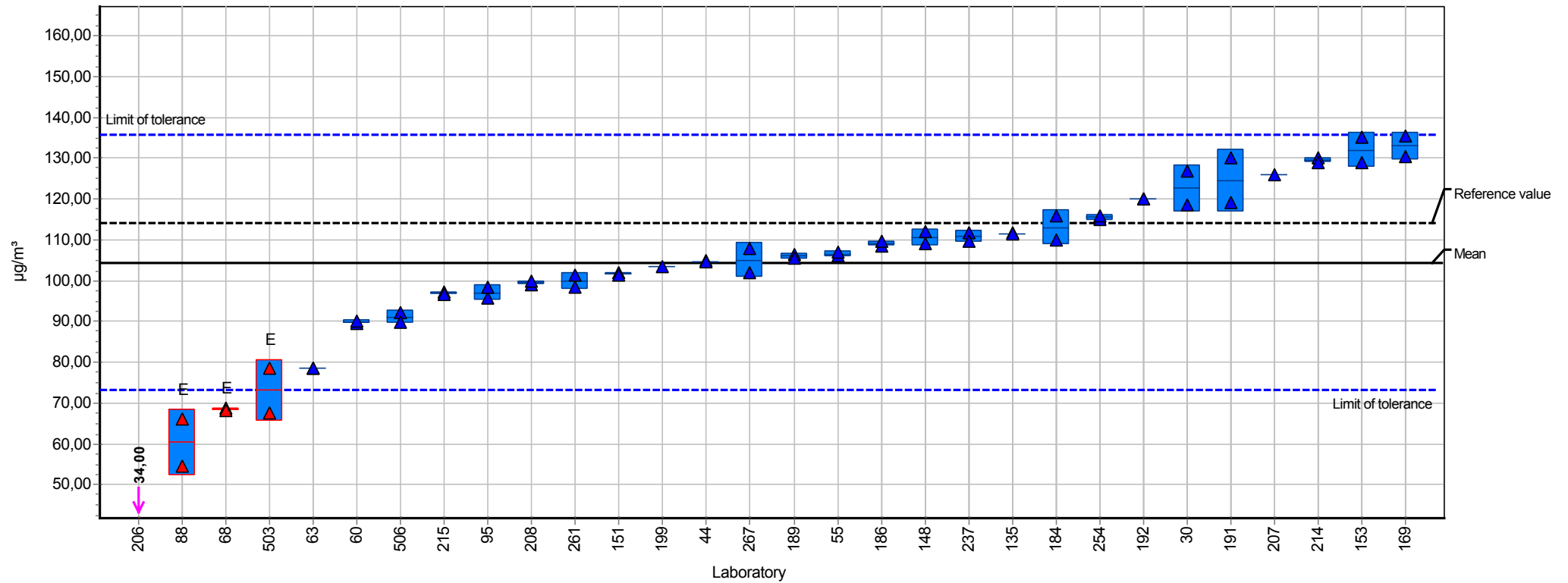
## Summary results

Measurand	Toluene	Mean	94,57 µg/m <sup>3</sup>
Sample	1	Reprod. s.d.	11,23 µg/m <sup>3</sup>
Method	ISO 5725-2	Rel.reprod. s.d.	11,87%
No. of laboratories:	28	Reference value	94,90 µg/m <sup>3</sup>
Rel.target s.d.	15,00% (Limited)	Range of tolerance	66,20 - 122,94 µg/m <sup>3</sup> ( Z-Score  ≤ 2,00)



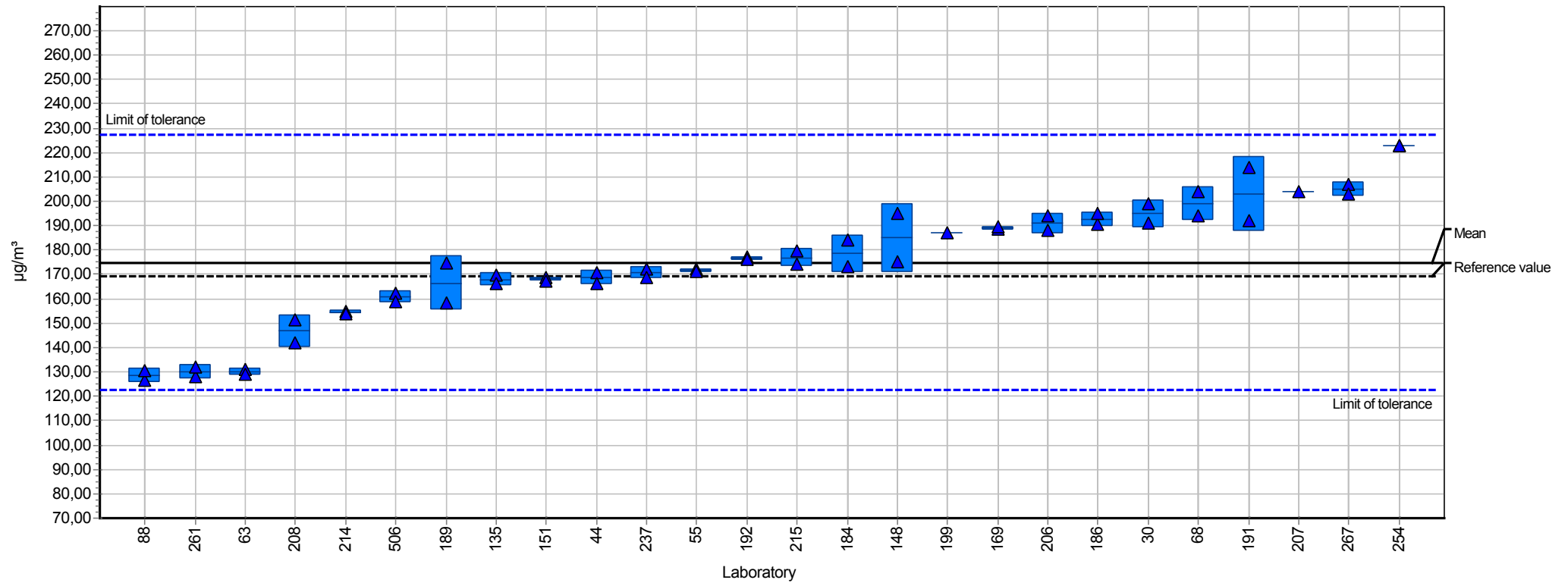
## Summary results

Measurand	m-Xylene	Mean	104,45 µg/m <sup>3</sup>
Sample	1	Reprod. s.d.	18,61 µg/m <sup>3</sup>
Method	ISO 5725-2	Rel.reprod. s.d.	17,81%
No. of laboratories:	29	Reference value	114,20 µg/m <sup>3</sup>
Rel.target s.d.	15,00% (Limited)	Range of tolerance	73,12 - 135,79 µg/m <sup>3</sup> ( Z-Score  ≤ 2,00)



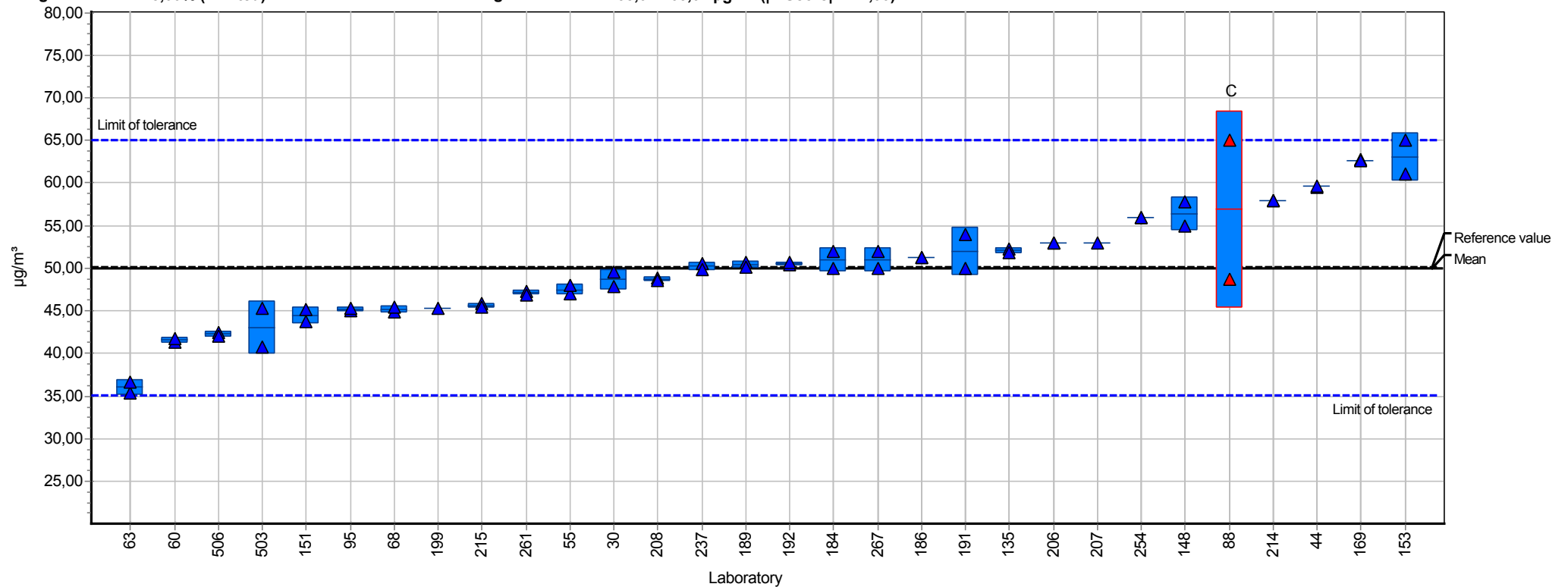
## Summary results

Measurand	1- Butanol	Mean	174,95 µg/m <sup>3</sup>
Sample	1	Reprod. s.d.	24,67 µg/m <sup>3</sup>
Method	ISO 5725-2	Rel.reprod. s.d.	14,10%
No. of laboratories:	26	Reference value	169,10 µg/m <sup>3</sup>
Rel.target s.d.	15,00% (Limited)	Range of tolerance	122,46 - 227,43 µg/m <sup>3</sup> ( Z-Score  <= 2,00)



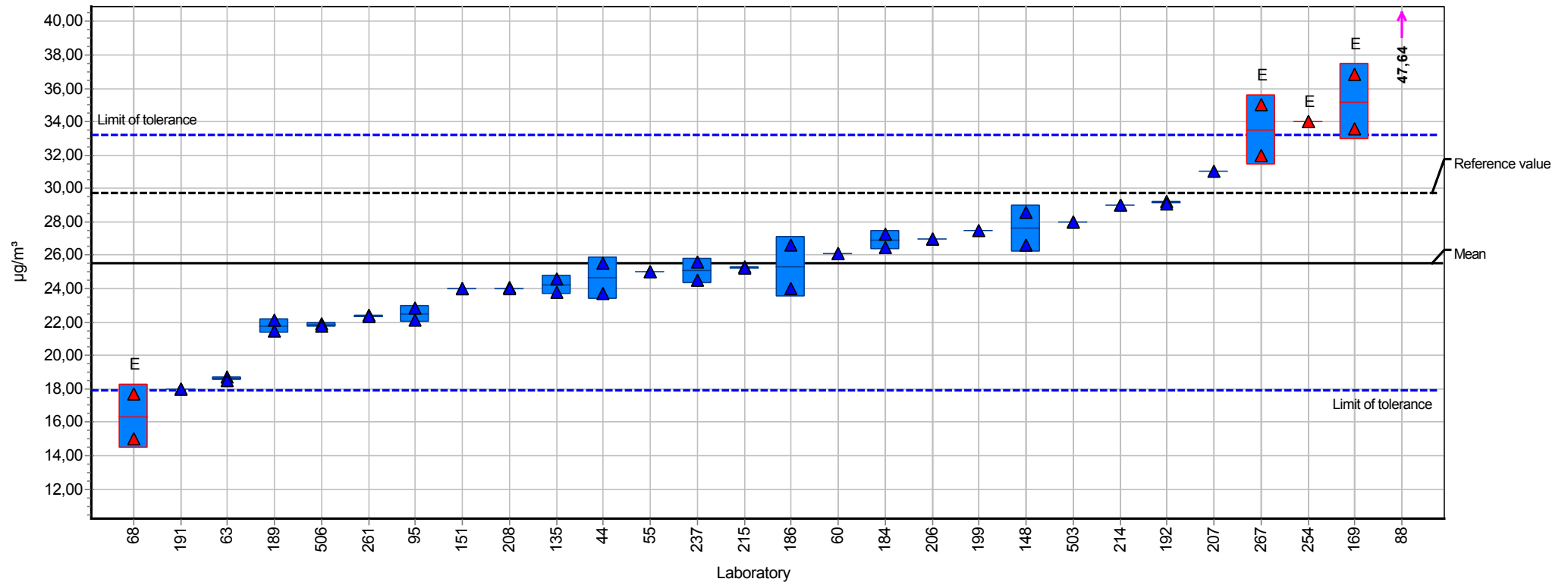
## Summary results

Measurand	1,2,4-Trimethylbenzene	Mean	50,06 µg/m³
Sample	1	Reprod. s.d.	6,40 µg/m³
Method	ISO 5725-2	Rel.reprod. s.d.	12,79%
No. of laboratories:	29	Reference value	50,10 µg/m³
Rel.target s.d.	15,00% (Limited)	Range of tolerance	35,04 - 65,07 µg/m³ ( Z-Score  <= 2,00)



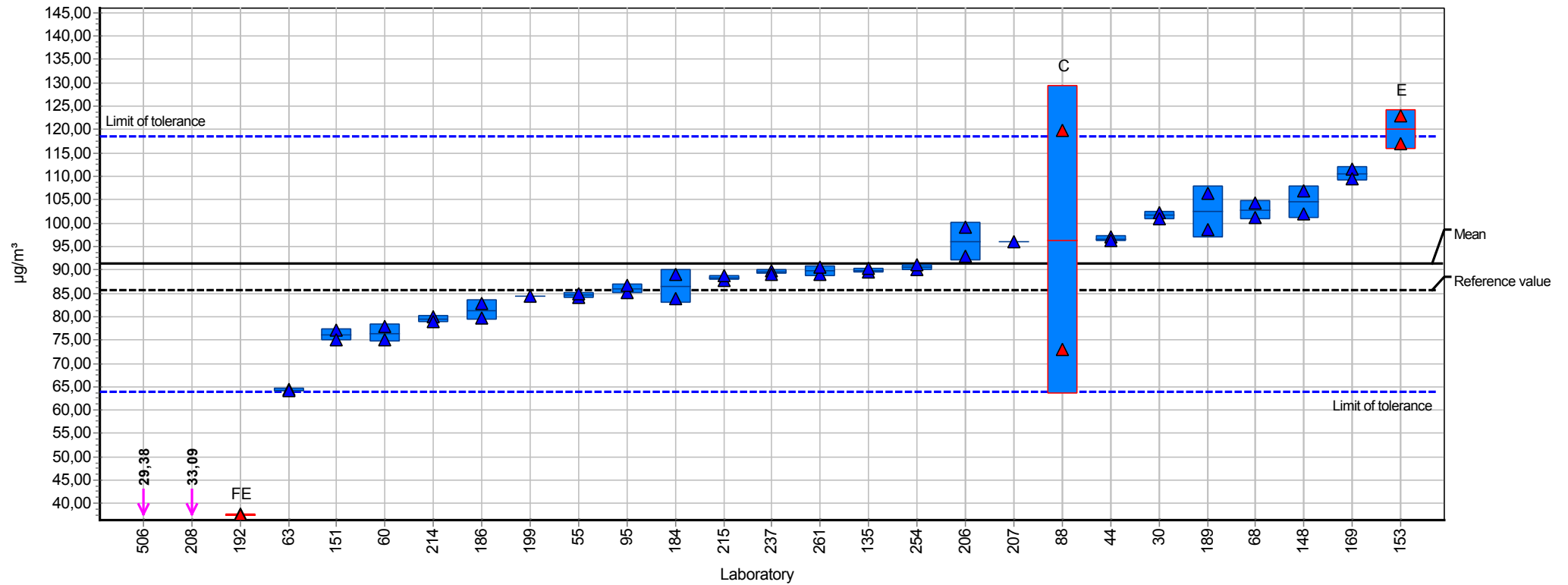
## Summary results

<b>Measurand:</b>	<b>Benzene</b>	<b>Mean:</b>	<b>25,56 µg/m³</b>
<b>Sample:</b>	<b>1</b>	<b>Reprod. s.d.:</b>	<b>4,65 µg/m³</b>
<b>Method:</b>	<b>ISO 5725-2</b>	<b>Rel.reprod. s.d.:</b>	<b>18,18%</b>
<b>No. of laboratories:</b>	<b>27</b>	<b>Reference value:</b>	<b>29,70 µg/m³</b>
<b>Rel.target s.d.:</b>	<b>15,00% (Limited)</b>	<b>Range of tolerance:</b>	<b>17,89 - 33,23 µg/m³ ( Z-Score  ≤ 2,00)</b>



## Summary results

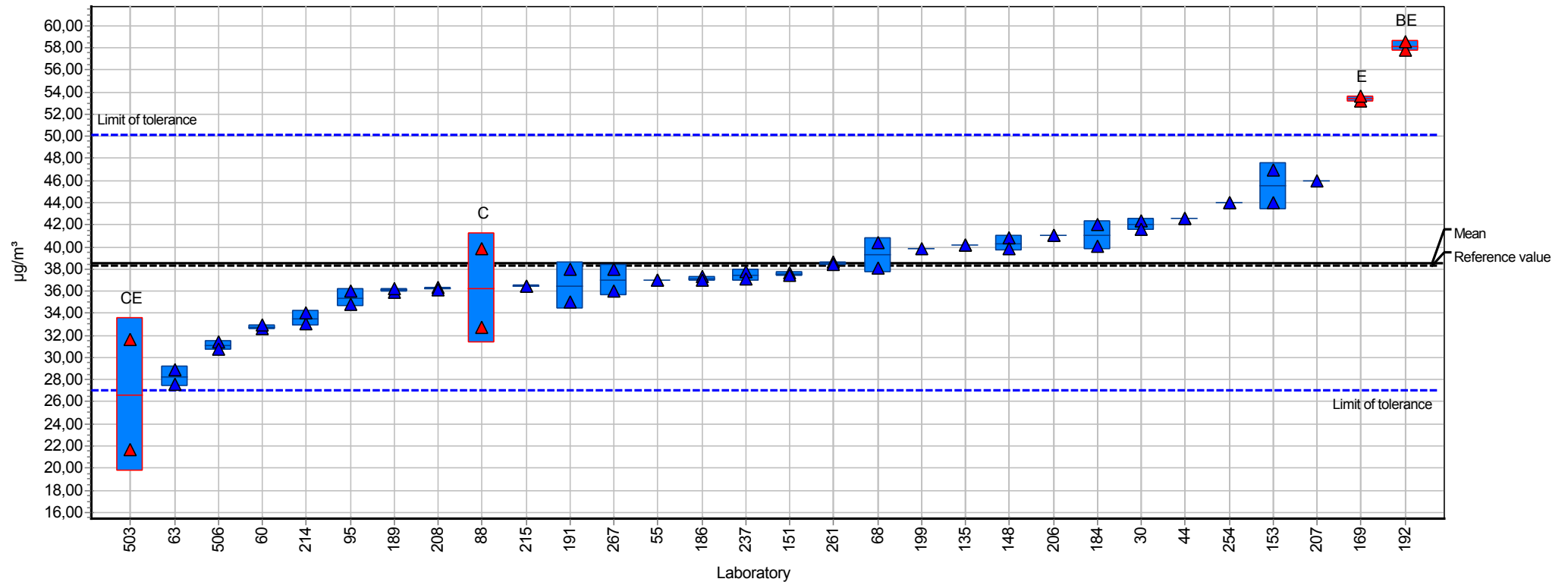
Measurand	2-Ethoxyethyl acetate	Mean	91,23 µg/m³
Sample	1	Reprod. s.d.	12,73 µg/m³
Method	ISO 5725-2	Rel.reprod. s.d.	13,96%
No. of laboratories:	23	Reference value	85,70 µg/m³
Rel.target s.d.	15,00% (Limited)	Range of tolerance	63,86 - 118,59 µg/m³ ( Z-Score  ≤ 2,00)





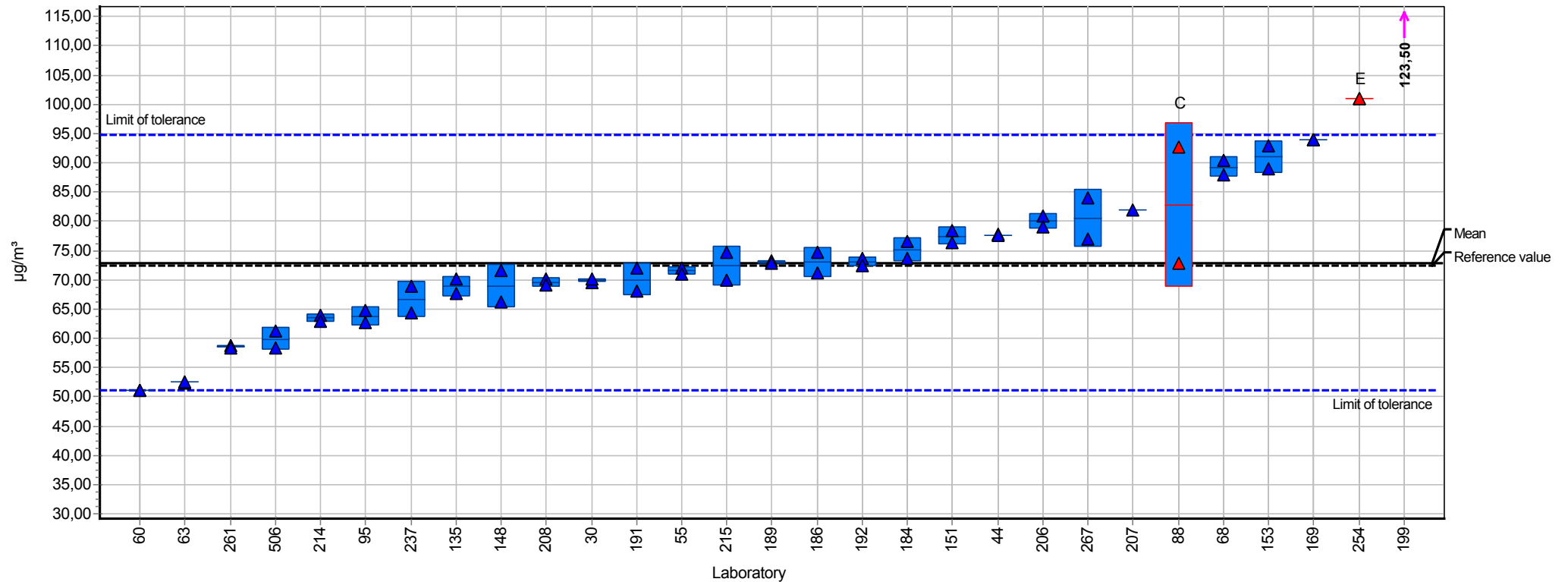
## Summary results

Measurand	Cumene	Mean	38,58 µg/m³
Sample	1	Reprod. s.d.	5,07 µg/m³
Method	ISO 5725-2	Rel.reprod. s.d.	13,14%
No. of laboratories:	27	Reference value	38,30 µg/m³
Rel.target s.d.	15,00% (Limited)	Range of tolerance	27,01 - 50,15 µg/m³ ( Z-Score  <= 2,00)



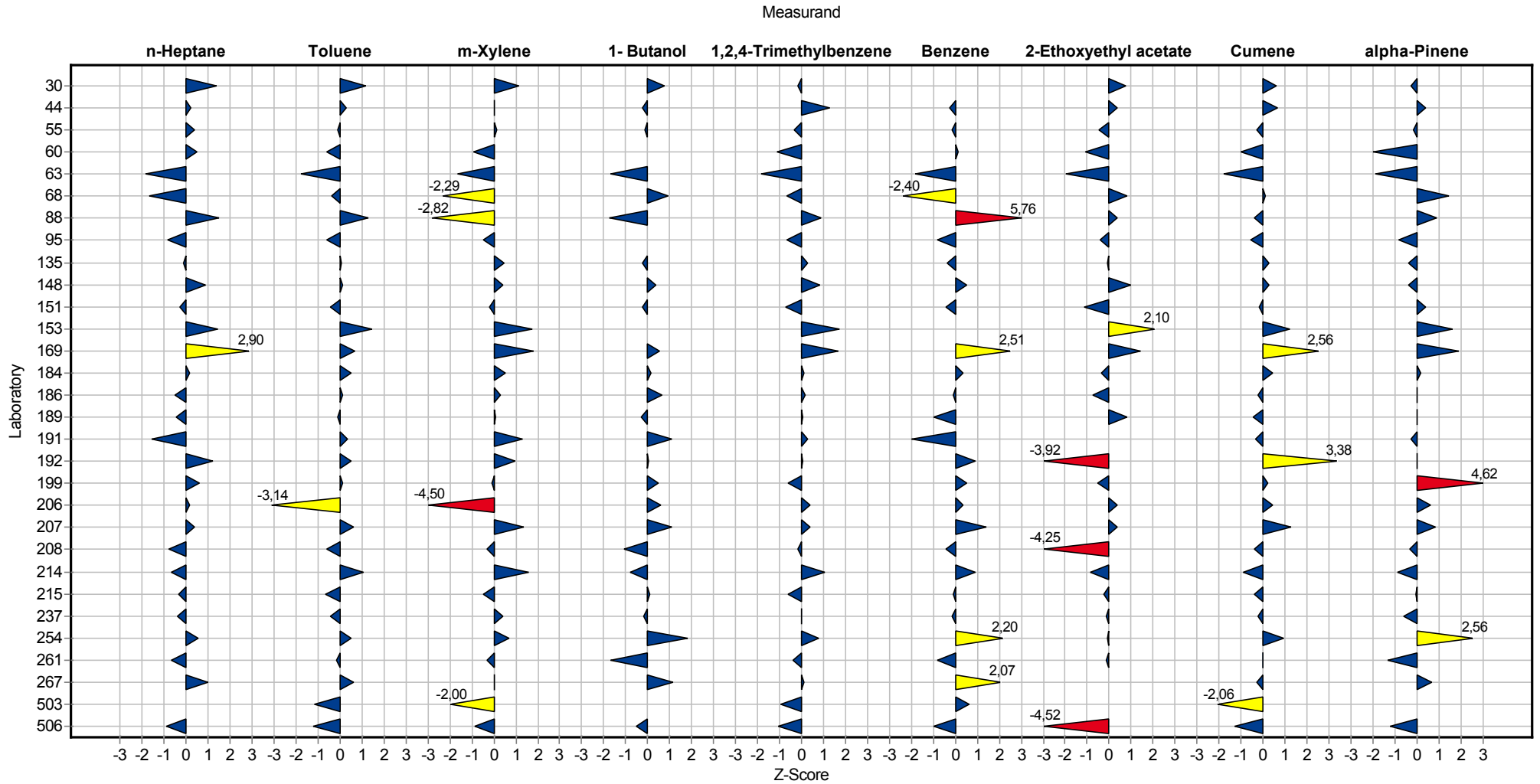
## Summary results

Measurand	alpha-Pinene	Mean	72,94 µg/m³
Sample	1	Reprod. s.d.	11,91 µg/m³
Method	ISO 5725-2	Rel.reprod. s.d.	16,32%
No. of laboratories:	27	Reference value	72,50 µg/m³
Rel.target s.d.	15,00% (Limited)	Range of tolerance	51,06 - 94,83 µg/m³ ( Z-Score  <= 2,00)



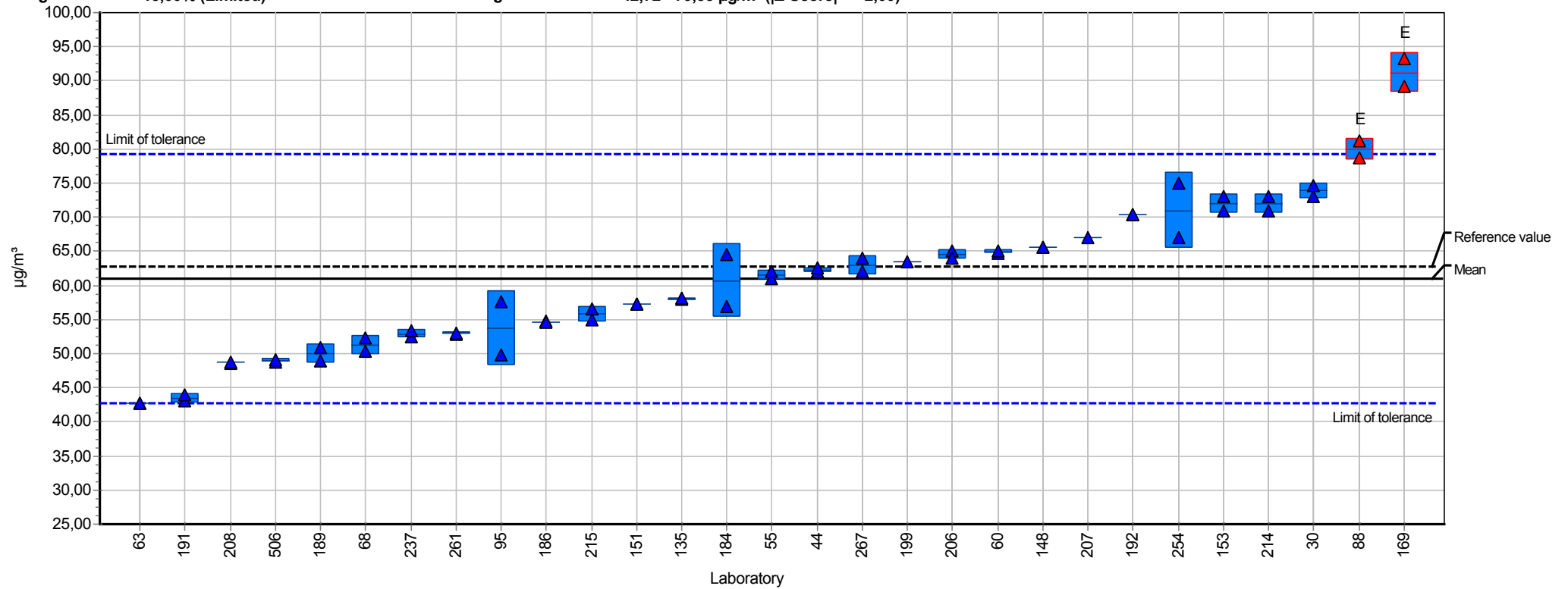
# Sample chart of Z-scores

Sample 1



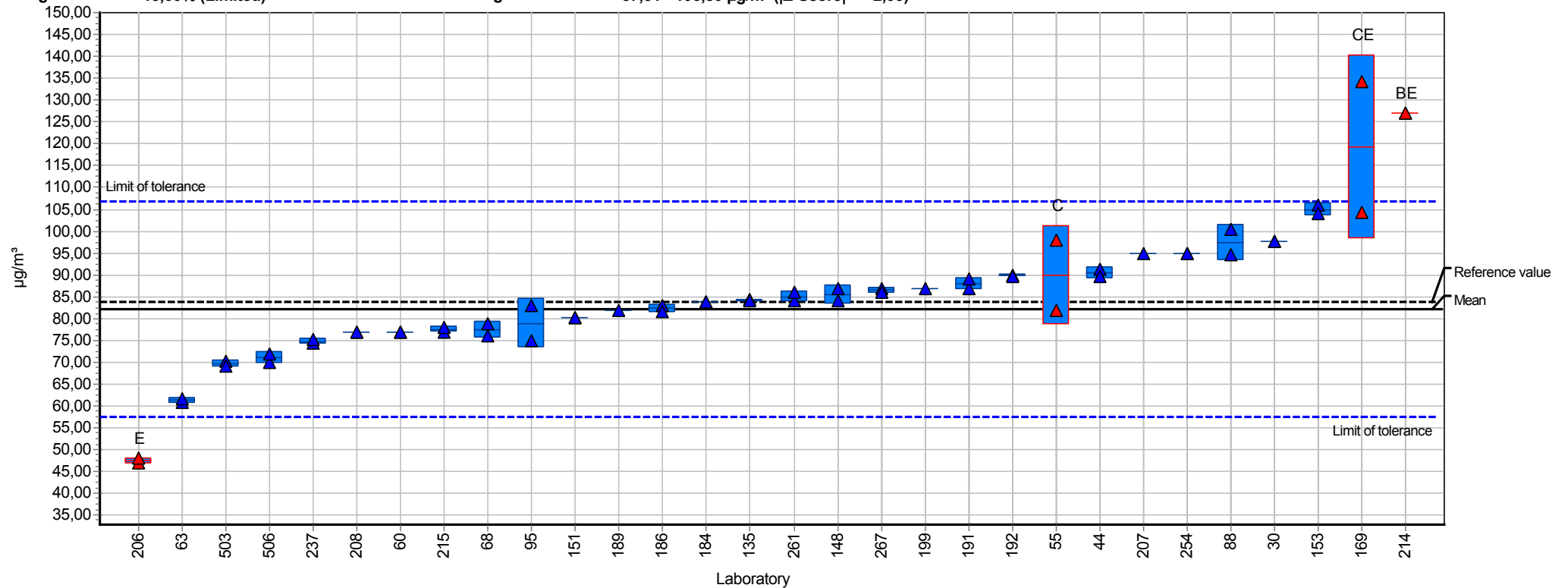
## Summary results

Measurand:	n-Heptane	Mean:	61,02 µg/m³
Sample:	2	Reprod. s.d.:	11,26 µg/m³
Method:	ISO 5725-2	Rel.reprod. s.d.:	18,45%
No. of laboratories:	29	Reference value:	62,70 µg/m³
Rel.target s.d.:	15,00% (Limited)	Range of tolerance:	42,72 - 79,33 µg/m³ ( Z-Score  <= 2,00)



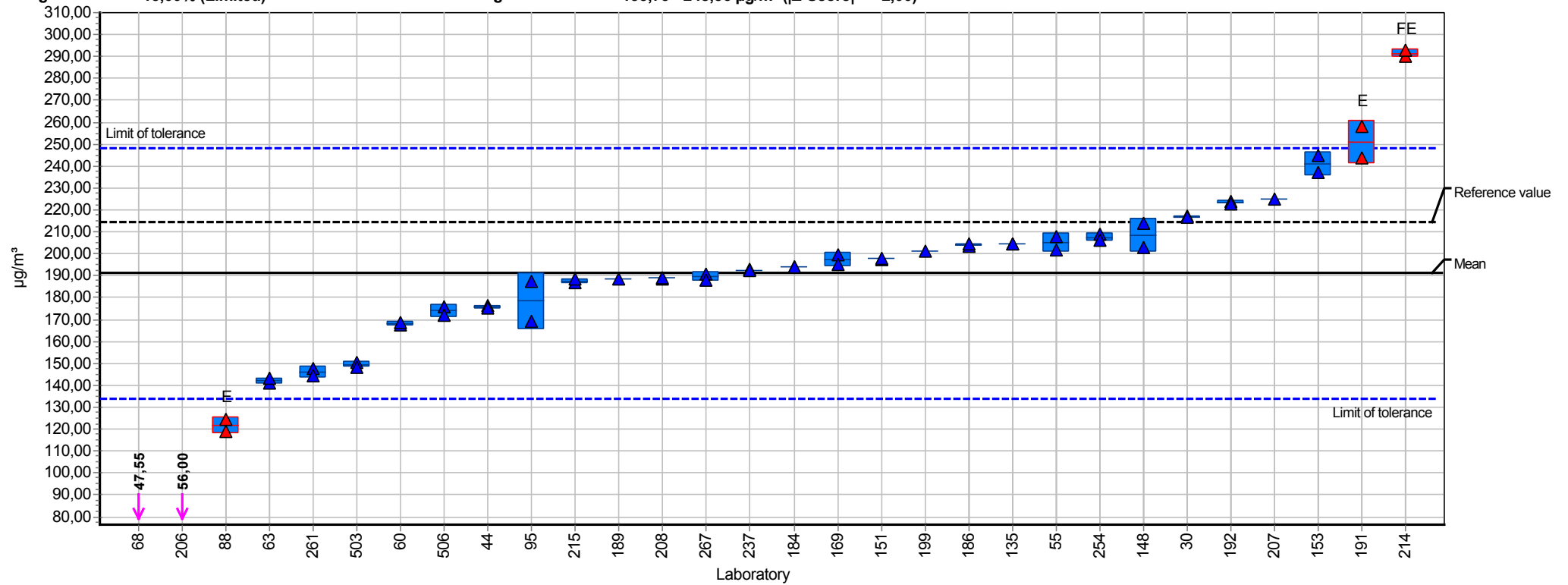
## Summary results

<b>Measurand:</b>	<b>Toluene</b>	<b>Mean:</b>	<b>82,15 µg/m³</b>
<b>Sample:</b>	<b>2</b>	<b>Reprod. s.d.:</b>	<b>12,08 µg/m³</b>
<b>Method:</b>	<b>ISO 5725-2</b>	<b>Rel.reprod. s.d.:</b>	<b>14,71%</b>
<b>No. of laboratories:</b>	<b>27</b>	<b>Reference value:</b>	<b>83,90 µg/m³</b>
<b>Rel.target s.d.:</b>	<b>15,00% (Limited)</b>	<b>Range of tolerance:</b>	<b>57,51 - 106,80 µg/m³ ( Z-Score  ≤ 2,00)</b>



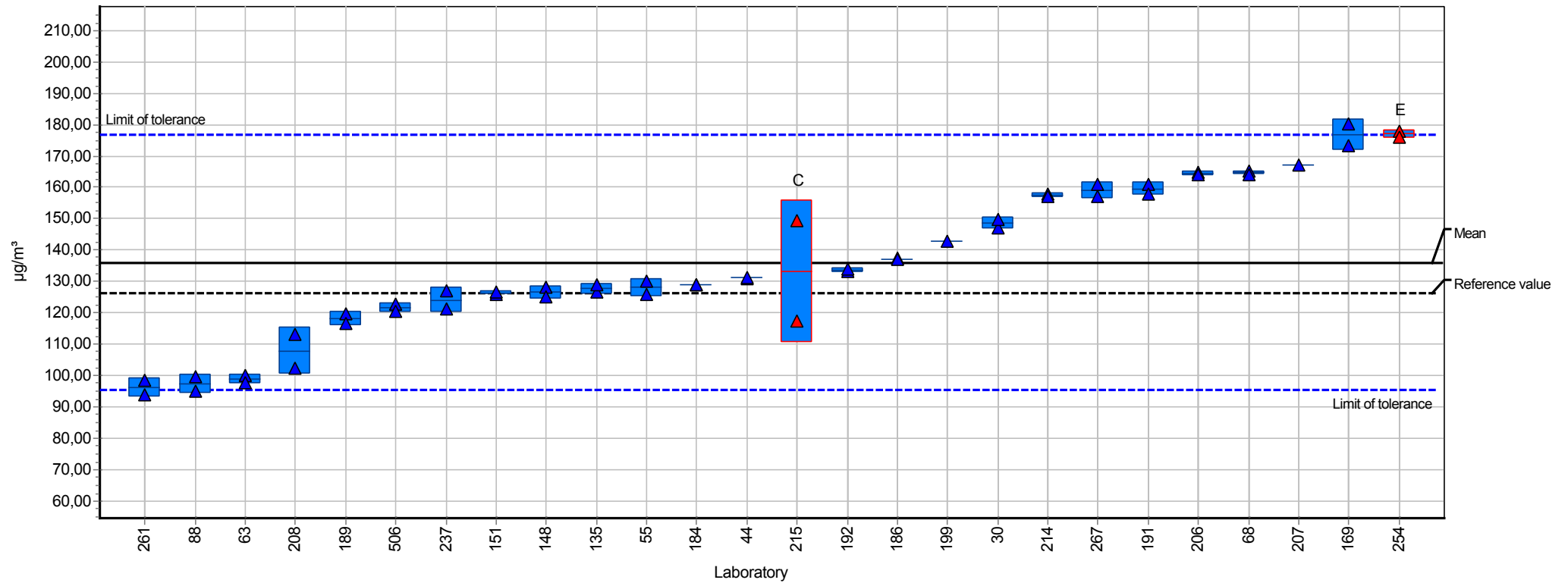
## Summary results

Measurand:	m-Xylene	Mean:	191,04 µg/m <sup>3</sup>
Sample:	2	Reprod. s.d.:	30,00 µg/m <sup>3</sup>
Method:	ISO 5725-2	Rel.reprod. s.d.:	15,71%
No. of laboratories:	27	Reference value:	214,20 µg/m <sup>3</sup>
Rel.target s.d.:	15,00% (Limited)	Range of tolerance:	133,73 - 248,36 µg/m <sup>3</sup> ( Z-Score  <= 2,00)



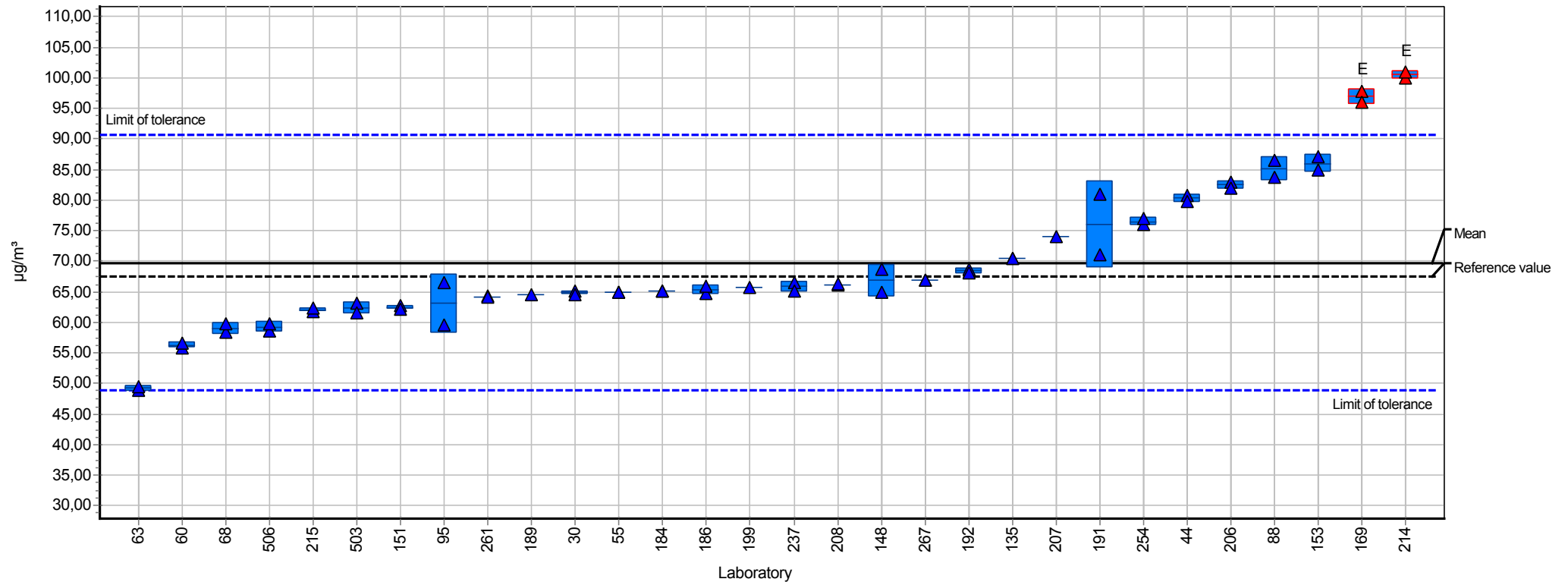
## Summary results

<b>Measurand:</b>	<b>1- Butanol</b>	<b>Mean:</b>	<b>136,06 µg/m³</b>
<b>Sample:</b>	<b>2</b>	<b>Reprod. s.d.:</b>	<b>24,30 µg/m³</b>
<b>Method:</b>	<b>ISO 5725-2</b>	<b>Rel.reprod. s.d.:</b>	<b>17,86%</b>
<b>No. of laboratories:</b>	<b>25</b>	<b>Reference value:</b>	<b>126,30 µg/m³</b>
<b>Rel.target s.d.:</b>	<b>15,00% (Limited)</b>	<b>Range of tolerance:</b>	<b>95,24 - 176,88 µg/m³ ( Z-Score  ≤ 2,00)</b>



## Summary results

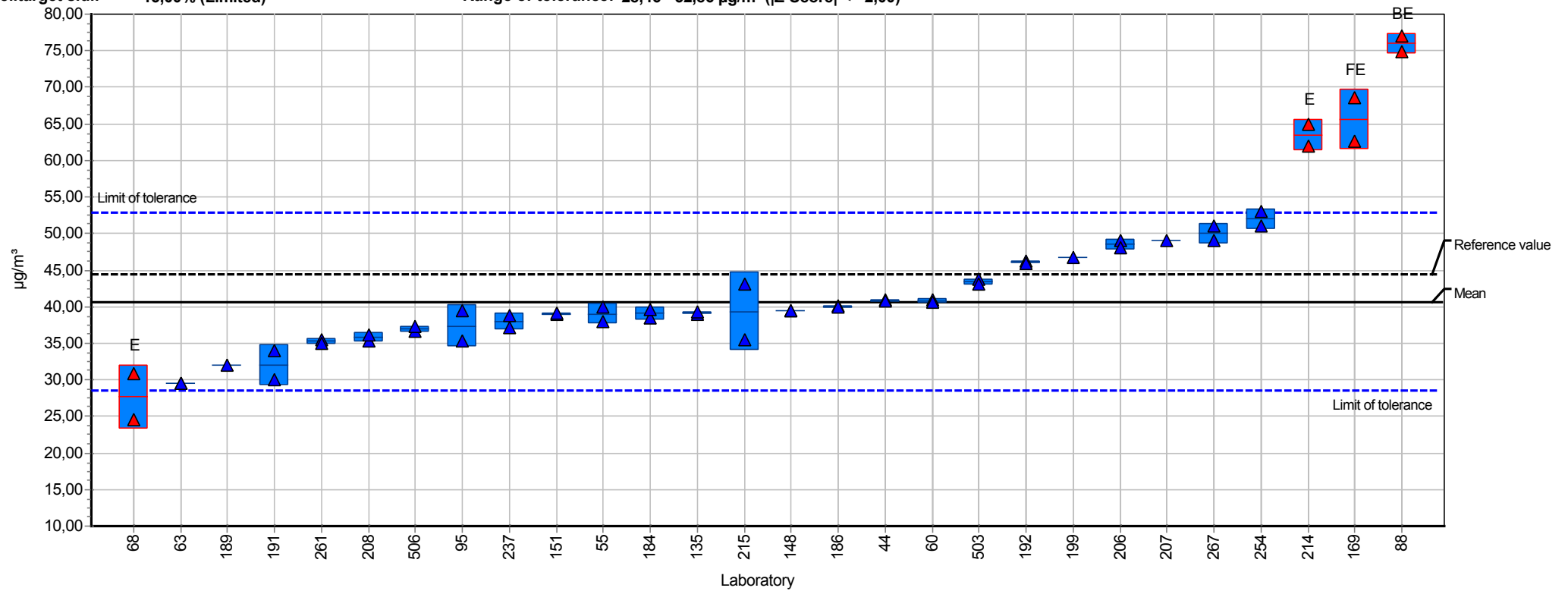
Measurand:	1,2,4-Trimethylbenzene	Mean:	69,78 µg/m³
Sample:	2	Reprod. s.d.:	11,79 µg/m³
Method:	ISO 5725-2	Rel.reprod. s.d.:	16,89%
No. of laboratories:	30	Reference value:	67,60 µg/m³
Rel.target s.d.:	15,00% (Limited)	Range of tolerance:	48,84 - 90,71 µg/m³ ( Z-Score  <= 2,00)





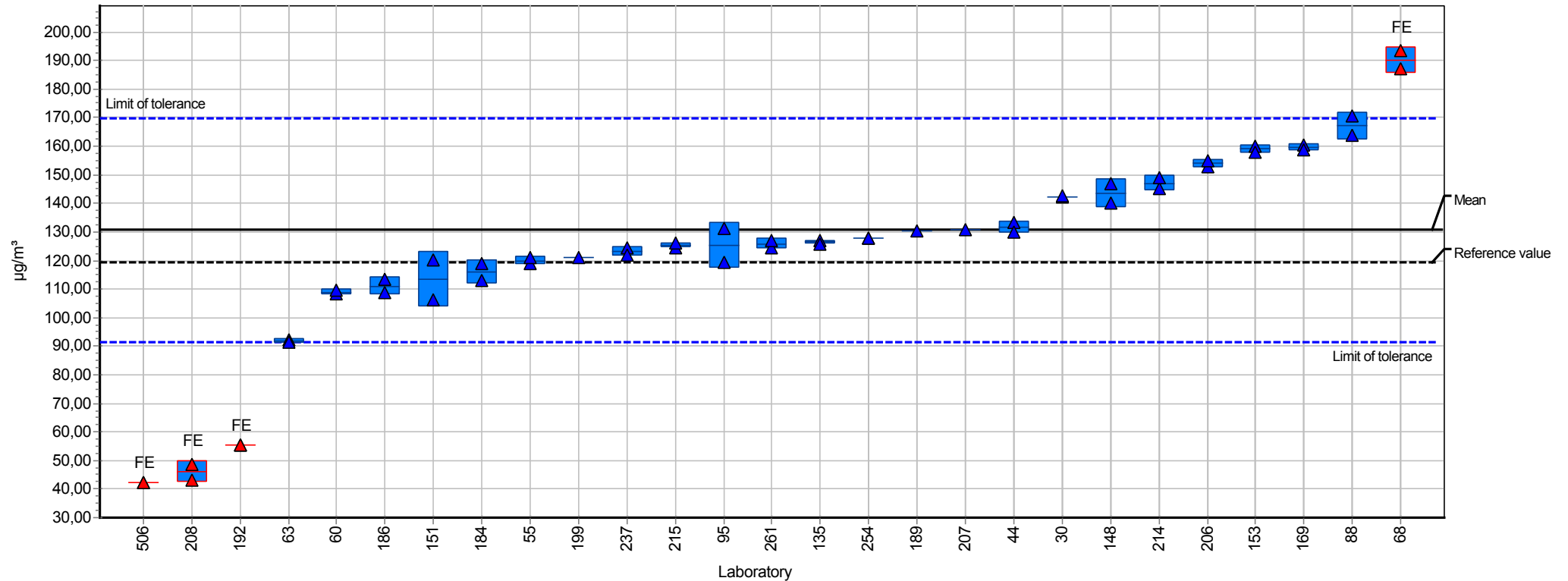
## Summary results

<b>Measurand:</b>	<b>Benzene</b>	<b>Mean:</b>	<b>40,66 µg/m³</b>
<b>Sample:</b>	<b>2</b>	<b>Reprod. s.d.:</b>	<b>7,80 µg/m³</b>
<b>Method:</b>	<b>ISO 5725-2</b>	<b>Rel.reprod. s.d.:</b>	<b>19,19%</b>
<b>No. of laboratories:</b>	<b>26</b>	<b>Reference value:</b>	<b>44,50 µg/m³</b>
<b>Rel.target s.d.:</b>	<b>15,00% (Limited)</b>	<b>Range of tolerance:</b>	<b>28,46 - 52,86 µg/m³ ( Z-Score  ≤ 2,00)</b>



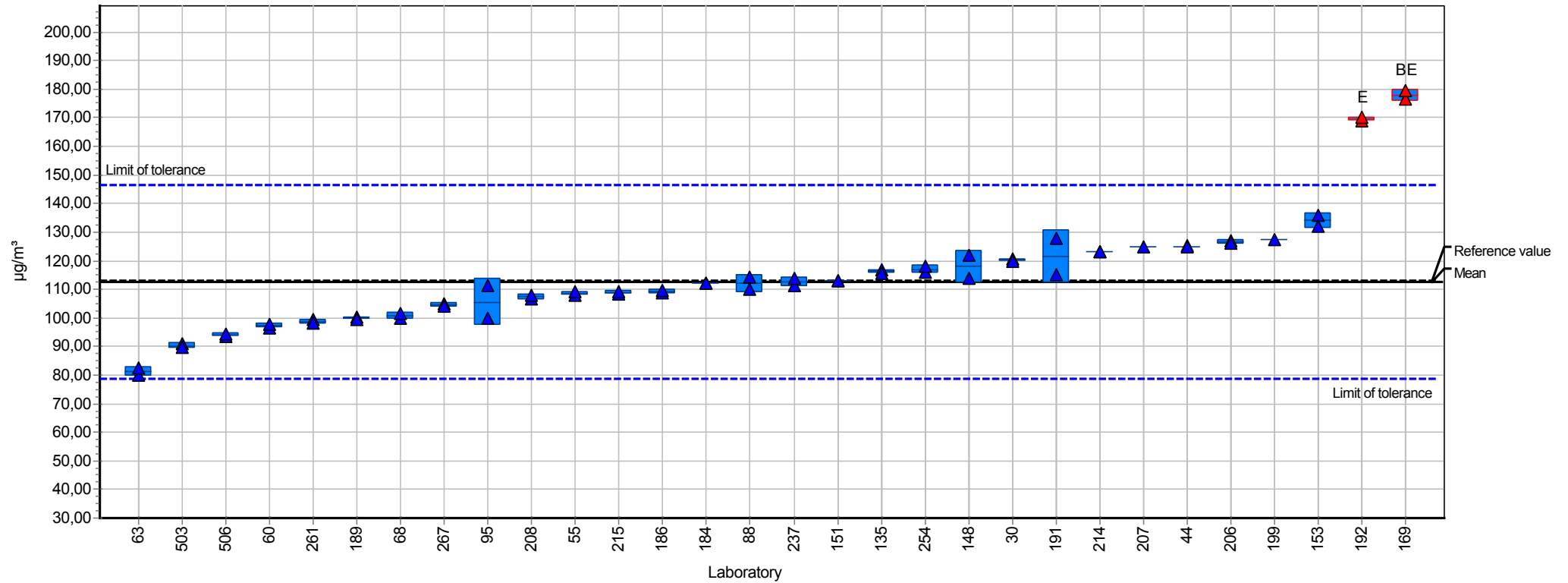
## Summary results

<b>Measurand:</b>	<b>2-Ethoxyethyl acetate</b>	<b>Mean:</b>	<b>130,73 µg/m³</b>
<b>Sample:</b>	<b>2</b>	<b>Reprod. s.d.:</b>	<b>19,00 µg/m³</b>
<b>Method:</b>	<b>ISO 5725-2</b>	<b>Rel.reprod. s.d.:</b>	<b>14,54%</b>
<b>No. of laboratories:</b>	<b>23</b>	<b>Reference value:</b>	<b>119,50 µg/m³</b>
<b>Rel.target s.d.:</b>	<b>15,00% (Limited)</b>	<b>Range of tolerance:</b>	<b>91,51 - 169,95 µg/m³ ( Z-Score  &lt;= 2,00)</b>



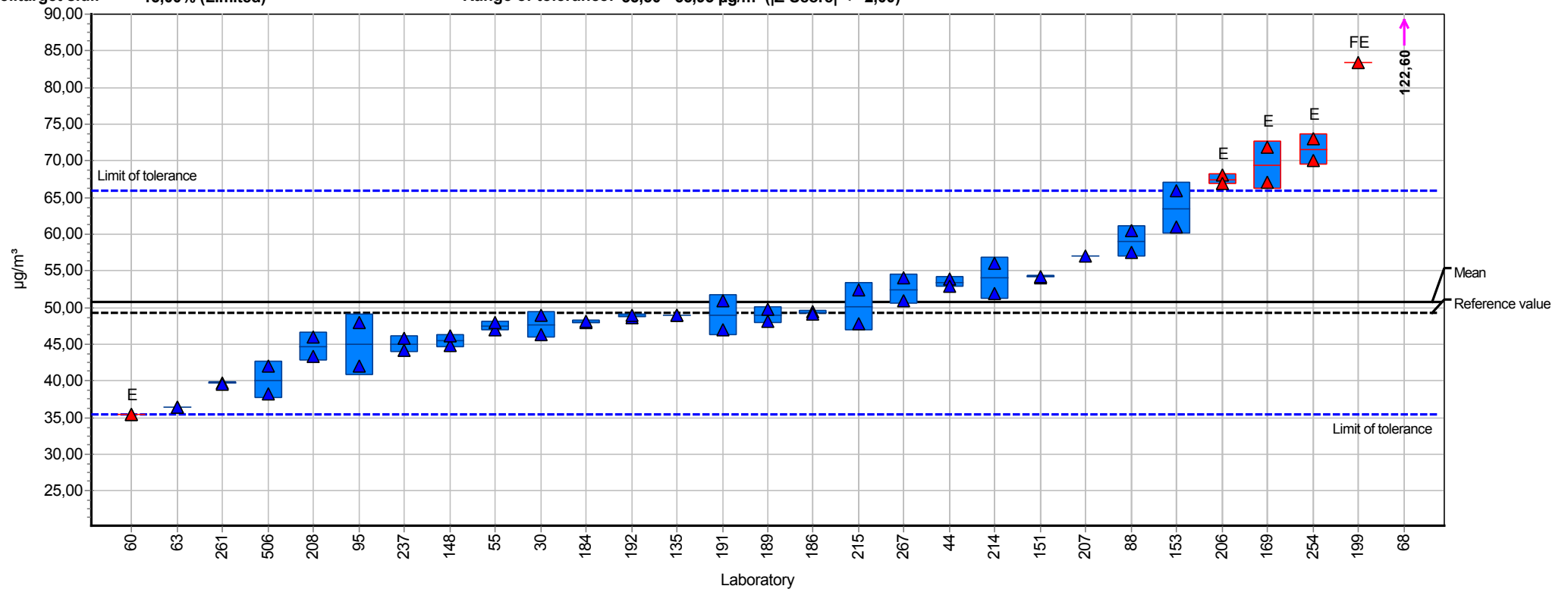
## Summary results

Measurand:	Cumene	Mean:	112,61 µg/m³
Sample:	2	Reprod. s.d.:	16,54 µg/m³
Method:	ISO 5725-2	Rel.reprod. s.d.:	14,68%
No. of laboratories:	29	Reference value:	113,00 µg/m³
Rel.target s.d.:	15,00% (Limited)	Range of tolerance:	78,83 - 146,39 µg/m³ ( Z-Score  ≤ 2,00)



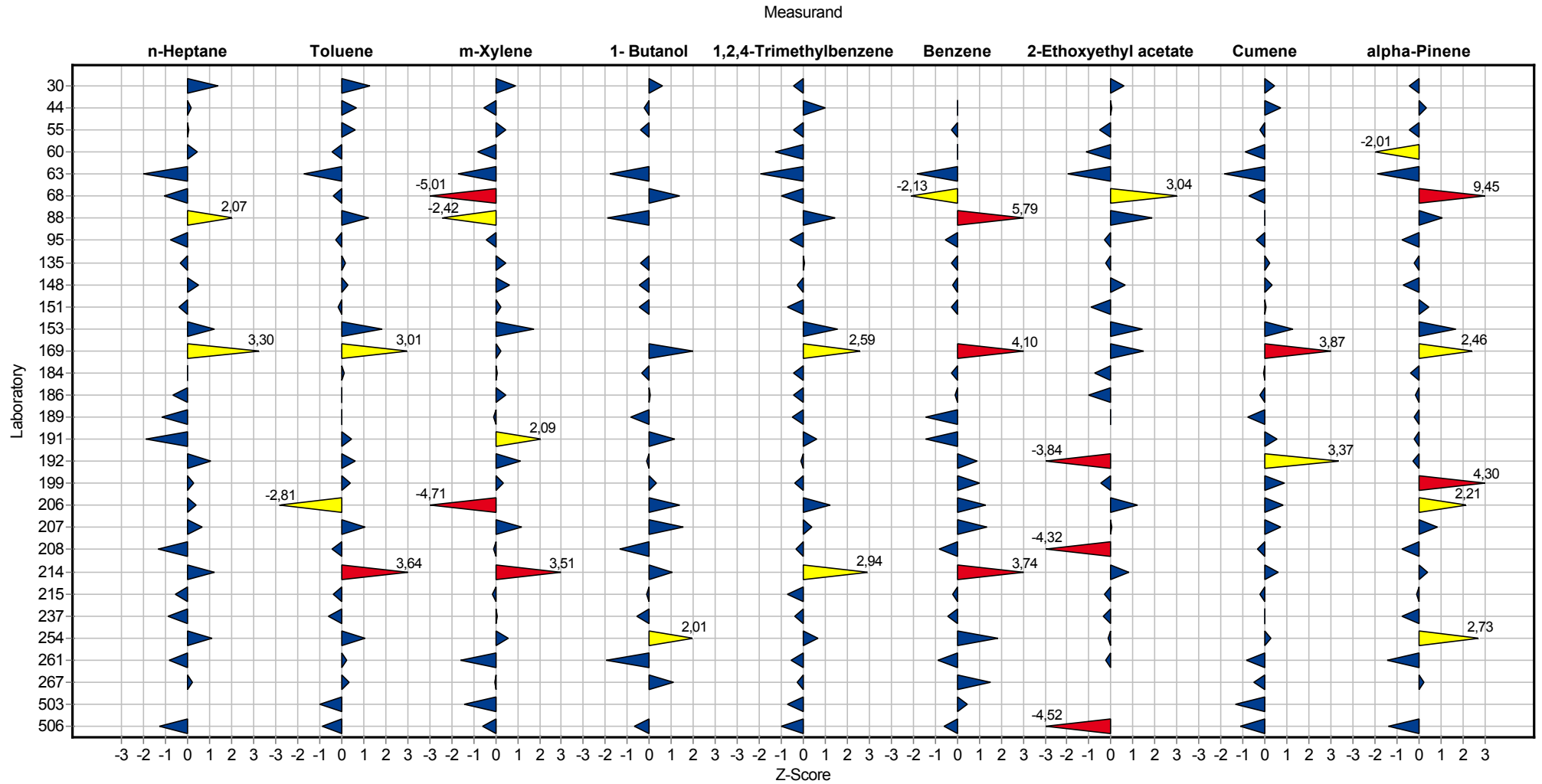
## Summary results

<b>Measurand:</b>	<b>alpha-Pinene</b>	<b>Mean:</b>	<b>50,71 µg/m³</b>
<b>Sample:</b>	<b>2</b>	<b>Reprod. s.d.:</b>	<b>9,37 µg/m³</b>
<b>Method:</b>	<b>ISO 5725-2</b>	<b>Rel.reprod. s.d.:</b>	<b>18,47%</b>
<b>No. of laboratories:</b>	<b>27</b>	<b>Reference value:</b>	<b>49,30 µg/m³</b>
<b>Rel.target s.d.:</b>	<b>15,00% (Limited)</b>	<b>Range of tolerance:</b>	<b>35,50 - 65,93 µg/m³ ( Z-Score  &lt;= 2,00)</b>



# Sample chart of Z-scores

Sample 2



## Summary of laboratory test results

Sample Blank conc.1

Unit	n-Heptane	Toluene	m-Xylene	1-Butanol	1,2,4-Trimethylbenzene	Benzene	2-Ethoxyethyl acetate	Cumene	alpha-Pinene
Unit	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
30	5,60	9,30	5,20						
44	0,99	2,89	1,65	2,85	1,44	1,10	1,20	0,63	0,95
55		3,00	2,00	2,00		2,00			
60	< 2,50	2,90	< 2,50	< 2,50	< 2,50	< 2,50	< 2,50	< 2,50	< 2,50
63	0,54	2,06	1,42	2,37	0,87	0,95	0,76	0,45	0,68
68	< 0,10	< 0,10	< 0,10	0,10	< 0,10	< 0,10	< 0,10	< 0,10	< 0,10
88		2,40	0,68	1,63				0,34	4,25
95		3,84	2,29		1,20	0,19			
135	< 1,00	3,00	1,50	2,10	1,20	< 1,00	1,10	< 1,00	< 1,00
148	< 1,00	3,10	2,60	1,70	1,50	1,10	2,50	< 1,00	1,10
151	0,80	1,90	1,20	1,40	0,80	0,60	2,20	0,50	0,80
153		7,00							
169	5,80	8,30	29,90		7,30	5,70	7,20		
184	1,70	6,90	2,10	4,80	1,80	1,30	1,60	0,80	1,20
186		3,60	1,10	4,50		3,10			
189				3,64					
191	3,00			11,00	3,00			6,00	5,00
192	0,90	3,10	2,10	1,90	1,20	1,10			0,70
199	0,85	2,70	1,55	3,65	1,25	1,30	1,25	0,70	1,80
206	1,00	6,00	2,00	4,00	1,00			2,00	
207	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00
208	1,52	3,55	1,73	3,15	1,25	13,85		2,66	0,53
214	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00
215	1,10	2,60	1,50		1,30	2,60		0,70	1,00
237		4,20		7,30		1,90			
254	2,00	3,00	3,00	5,00	1,00	2,00	< 1,00	< 1,00	< 1,00
261	0,30	2,10	1,00	0,60	0,80	0,60	0,50		0,50
267	1,00	3,00	2,00	3,00	2,00	2,00		1,00	1,00

	n-Heptane	Toluene	m-Xylene	1- Butanol	1,2,4-Trimethylbenzene	Benzene	2-Ethoxyethyl acetate	Cumene	alpha-Pinene
503	< 5,00	< 5,00	< 5,00	< 5,00	< 5,00	< 5,00	< 5,00	< 5,00	< 5,00
506		2,40	1,26	2,34	0,81	1,68		0,39	0,49
-	-	-	-	-	-	-	-	-	-
No. of laboratories that submitted results	22	28	26	25	23	24	15	20	21

# Summary of laboratory test results

Sample Blank conc.2

Unit	n-Heptane	Toluene	m-Xylene	1- Butanol	1,2,4-Trimethylbenzene	Benzene	2-Ethoxyethyl acetate	Cumene	alpha-Pinene
Unit	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
30	5,10	5,40	2,90						
44	4,50	3,38	1,29	2,91	1,13	1,27	0,67	0,38	0,94
55	4,00	6,00				2,00			
60	4,30	3,20	< 2,50	< 2,50	< 2,50	< 2,50	< 2,50	< 2,50	< 2,50
63	3,36	2,27	1,04	2,11	0,76	1,07	0,37	0,26	0,64
68	< 0,10	< 0,10	< 0,10	< 0,10	< 0,10	< 0,10	< 0,10	< 0,10	< 0,10
88		3,27	0,76	2,91				0,34	4,45
95	1,19	3,45	1,24		0,72	0,06			
135	3,90	3,30	1,10	1,70	1,10	< 1,00	< 1,00	< 1,00	< 1,00
148	4,70	3,40	1,50	< 1,00	< 1,00	1,10	1,50	< 1,00	< 1,00
151	3,80	1,90	1,00	1,00	0,70	0,50	2,00	0,30	0,80
153		7,00							
169	2,90	15,10	15,10		3,70	2,90	3,70		
184	4,30	7,50	1,40	3,40	1,50	1,30	0,90	0,40	1,00
186	2,70	3,00				1,70			
189				6,17					
191	5,00			17,00	2,00			6,00	5,00
192	5,10	3,20	1,30	1,10	0,90	1,10			0,70
199	3,20	2,70	1,10	6,90	0,90	0,90	0,55	0,40	1,35
206	1,00	6,00	2,00	4,00	1,00			1,00	
207	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00
208	3,02	2,88	1,18	1,76	0,92	1,71		0,26	0,79
214	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00	< 1,00
215	4,20	3,20	1,10		1,00	3,80		0,40	0,90
237		4,70				2,00			
254	6,00	4,00	3,00	5,00	1,00	2,00	< 1,00	< 1,00	< 1,00
261	2,30	2,30	0,80	0,70	0,70	0,70	0,30		0,60
267	5,00	8,00	2,00	5,00	1,00	3,00		1,00	1,00



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	n-Heptane	Toluene	m-Xylene	1- Butanol	1,2,4-Trimethylbenzene	Benzene	2-Ethoxyethyl acetate	Cumene	alpha-Pinene
503	< 5,00	< 5,00	< 5,00	< 5,00	< 5,00	< 5,00	< 5,00	< 5,00	< 5,00
506	2,69	2,34	0,93	1,74	0,71	1,38	0,24	0,56	
-	-	-	-	-	-	-	-	-	-
No. of laboratories that submitted results	26	28	24	22	23	24	15	20	21

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## Questions and Answers

Participant	Kind of tube	Analytical method	thermodesorber	Desorption temperature
30	Tenax TA	NF ISO 16000-6	Thermomatrix 650 Perkin Elmer	260 °C
44	Tenax	DIN ISO16000-6	PE-ATD650	280
55	Tenax	EN16516	Markes TD-100	300
60	tenax multi couche	DIN ISO 16000-6	markes	295
63	Tenax TA	DIN ISO 16000-6	Shimadzu TD 20	280 °C
68	Tenax TA	Auf Basis von EN ISO 16000-5 und ISO 16000-6 wurde eigene Labormethode entwickelt	Turbomatrix ATD von PerkinElmer	340 °C
88	Tenax TA	prEN 16516, ISO 16000-6	TD100-xr (MARKES)	280 °C
95	Chromosorb 106	DIN EN ISO 16017-1	Gerstel TDSA2	180 °C
135	Tenax TA	16000-6	Perkin Elmer TurboMatrix 650	280 °C
148	Tenax	DIN ISO 16000-6	Markes TD 100	280 °C
151	Tenax	ISO 16000-6	PE TD650	250
153	Tenax	ISO 16000-6	TD-20 SIMADZU	250 °C
169	TenaxTA	16000-6	Fa. Gerstel	280 °C
184	Perkin-Elmer, Tenax	16000-6	Turbomatrix ATD, Perkin-Elmer	280 °C
186	TENAX TA	DIN ISO 16000-6	TurboMatrix 650, Perkin-Elmer	280 °C
189	Tenax	ISO 16000-6	DANI STD 33.50	260 °C
191	tenax	ISO 16000-6	TDS Gerstel	260
192	TenaxTA	ISO 16000-6	TurboMatrix ATD (PerkinElmer Inc)	260degC
199	Tenax	in Anlehnung an DIN ISO 16000-6:2012-11	TD-100 von Markes	250 °C
206	Tenax TA	16006	T-ATD Perkin Elmer	250
207	Tenax	DIN ISO 16000-6	Markes Unity TD 100	300
208	Tenax TA/Carbograph 5 TD	in house method modified from ISO 16000-6	Markes TD100	280
214	Tenax TA	ISO 16000-6	Markes Unity / Ultra	300 °C
215	Tenax	DIN ISO 16000-6	Perkin Elmer ATD	300 °C
237	Tenax TA	Hausmethode	PE Turbomatrix	300 °C
254	tenax	ISO 16000-6	TD MARKES - Unity 2	280 °C
261	Tenax TA	DIN ISO 16000-6	Perkin Elmer ATD-350	260 °C
267	Tenax TA	Interne Methode SOP-B-25	MARKES TD100	280 °C
503	tenax multi couche	16017-1	markes	295
506	Tenax TA/Carbograph 5 TD	in house method modified from ISO 16000-6	Markes TD100	280

Round-robin test VOC 2017

Participant	Desorption flow	Desorption time	Cyros trap	Carrier gas	Flow rate
30	50 +/-5 mL/min	15 min	-30°C to 280°C	Helium	1 mL/min
44	50	5	-30---290	Helium	1.5
55	25	10	10 - 350 max heating rate	He	1.5
60	100	10	-10	helium	1
63	60	10	-6, 280	Helium	1,88
68	50 ml/min	20 min	-20°C / 340°C	Helium	15 ml/min
88	50 ml/min	15 min	5°C, heating up to 280°C	Helium	50 ml/min
95	40ml/min	8 Minuten	-145°C - 12°C/s - 300°C - 3Min.	Helium	0,91ml/min bei 40°C
135	29	15	-20°C/300°C	Helium	1,5
148	50 ml/min	10 min	-25 / 315°C	Helium	0,5 ml/min
151	70	10	-30 to 300	helium	1.2 ml/min
153	60 ml/min	5 min	(-20 oC) / (+280 oC)	helium	1,0 ml/min
169	100	5	-100°C/280°C	Helium	1 ml/min
184	50 ml/min	10 min	-30°C auf 290°C	Helium	1ml/min
186	50 mL/min	20 min	-30°C to 280°C at 45°C/sec	Helium	2 mL/min
189	10 ml/min	10	cryo temperature= -35°C , heating temperature=300°C	Helium	0.8 ml/min
191		10	-150°C	He	1.34
192	30mL/min	10min	Cryo trap at 5degC and desorb at 280degC	Helium	3mL/min
199	50 ml/min	5 min	25 bis 300°C	Helium	0,7 ml/min
206	50	3	-30 bis +260	Helium	1
207	20	8	-25	Helium	1,2
208	50	10	-20 max. 300	He	1
214	50 ml/min	10	10°C - 300 °C	Helium	1 ml/min
215	30 ml/min	10 min	0°C ; 300°C	Helium	4,5 ml/min
237	30	10	-20°C/ +270°C	Helium	0,5 mL/ min
254	30	10	-25°C ----> +300°C	Nitrogen	1
261	30 ml/min	10 min	-8 / 270 °C	Helium	1,6 ml/min
267	50ml/min	15 min	-5°C	He	1,5 ml/min
503	100	5	20	helium	1
506	50	10	-20 max. 300	He	1

Participant	Analytical column	Detector
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## Round-robin test VOC 2017

Participant	Analytical column	Detector
30	Rxi-5ms 55m x 0.25mm x 0,25µm	FID/MS
44	DB-5MS	MS
55	Rxi-5Sil-ms 60 x 0.25 x 1	Agilent MS 5973
60	HP-1MS	MS
63	RTX 5 MS	MS Shimadzu QP 2010
68	Vocol von Supelco	MS
88	Rxi_5ms (RESTEK) - 60m, 0.32mmID, 0.25 µm df - 95% dimethylpolysiloxane, 5% diphenylpolysiloxane	Massaspektrometer - ISQ LT (THERMO SCIENTIFIC)
95	Rtx-502.2, 40m x 0,18mm ID; 1µm FD	Agilent 7975 C
135	RTX-200	MSD
148	Restek Rxi-5Sil MS, 20m x 0,18 mm id x 0,36 µm df	MS, FID
151	BP1 50m	FID
153	ZB- semiVolatiles	MS
169	DB-5ms, 60m x 250 µm x 1µm	Massenspektrometer
184	RTX-200, Restek	MSD
186	Perkin Elmer - Elite 5MS	FID for quantification - MS for identification
189	HP5 (50m, 0.2mm, 0.50 µm)	MSD 5972
191	Agilent Ultra 2	MS
192	HP-VOC(60ml length, 0.32mm daim., 1.8µm film	MSD
199	DB5-5.625MS	5977A MSD
206	60m 5% 0,25 0,25	TOF-MS
207	DB 5	MS
208	HP-5MS	MSD
214	Agilent CP 9013	MSD
215	VF-5 ms, 60 m; 0,32 mm	MS (Benzol/1-Butanol) und FID (Rest)
237	Varian Xms VF	MSD
254	HP-5 MS	MSD
261	Elite-VMS 30 m PE	PE Clarus SQ8 S MS
267	HP INNOWAX 60m x 0.32mm x 0.5µm	MSD
503	RTX-VMS	MS
506	HP-5MS	MSD

Participant	Data evaluation
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## Round-robin test VOC 2017

Participant	Data evaluation
30	Identification by MS // Quantification by calibration table in FID
44	Nist laboratory, internal standard
55	identification: library + retention time; quantification: 8 points calibration curve with external standards
60	SIM
63	TIC/ SIM
68	Identifikation mit MS; Quantifizierung mit entspr. Berechnung in einem Excelfile
88	Integration of quantifier mass ion peaks extracted from TIC signal, 9-point multi level calibration with specific analytical standards, the obtained peak areas are corrected with an internal standard (o-fluorotoluene)
95	Quantifizierung über internen Standard, Identifizierung MS-Spektrum+RT
135	Externer Standard/Massenspektren- und Retentionszeitvergleich
148	Identifizierung: MS; Quantifizierung: MS, FID
151	External standard, twin column
153	standards
169	externe Kalibrierung
184	Kalibrierung mit internem Standard
186	External calibration
189	identification by MSD and confirmed by standard injection for all compounds using calibration curve with 5 levels of concentration. TIC area was used, except in the case of benzene (ion 78) and 1-butanol (ion 56) where was used ion extraction.
192	2-Ethoxy ethylacetate and Cumene were calculated by toluene(TIC) response factor, and others were calculated by using their individual response.
199	externe Kalibrierung
206	Tol-d8 + ext. Std
207	EIC Originalreferenzen, eigene und kommerzielle Bibliotheken
208	substance specific
214	manuell, NIST,
215	manuell
237	externe Kalibration mit IS und MSD
254	CALIBRATION CURVE TARGET
261	Interner Std., 5 Punkt-Eichung
267	Quantifizierung mittels spezifischer Massenfragmente, Identifizierung mittels NIST Bibliothek
503	SIM
506	substance specific

Participant	Recovery rate	Date of analysis
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## Round-robin test VOC 2017

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Participant	Recovery rate	Date of analysis
30	No	07/06/2017
44	NO	2017-6-22
55		22/05/2017
60	no	22/05/2017
63	nein	02.06.17
68	Nein	29./30.5.2017
88	no	15-17/06/2017
95	Nein	23./24. Mai 2017
135	ja	24.05.2017
148	nein	18.05.2017
151	No	19/6/17
153	No	22-06-2017
169	nein	19.05.2017
184	nein	22.05.2017-25.05.2017
186	No	08/06/2017
189	NO	20-06-2017 and 21/06/2017
191	no	07/06/2017
192	No	5,6 Jun 2017
199	nein	23.05.17
206	ja	27.05.2017
207		22.05.2017
208	no	21st May 2017
214	nein	19.05.2017
215	nein	18. bis 19.5.17
237	Nein	29.05.2017
254	NO	6/6/2017
261	nein	30.05.2017
267	Nein	01.06.2017
503	no	24/05
506	no	10th June 2017

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