

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

Proficiency testing scheme

Volatile organic compounds (VOC) with thermal desorption

April 2019

Summary of laboratory means

Sample 1

Unit	1,2,4-Trimethylbenzene		alpha-Pinene		Benzene		Cumene	
	$\mu\text{g}/\text{m}^3$	Z score	$\mu\text{g}/\text{m}^3$	Z score	$\mu\text{g}/\text{m}^3$	Z score	$\mu\text{g}/\text{m}^3$	Z score
12	15,255	-2,75 CE	65,205	1,40 C	7,365	-4,39 CE	107,505	-0,50 C
14					41,700	6,21 BE		
30	28,300	0,60	62,500	1,06	23,500	0,59	128,250	0,69
34	25,100	-0,22			20,200	-0,43	117,100	0,05
46	23,000	-0,76	50,500	-0,42	20,000	-0,49	116,000	-0,01
52	26,500	0,14	59,250	0,66	23,250	0,51	135,000	1,08
60	24,950	-0,26	103,550	6,14 BE	20,350	-0,38	129,350	0,75
68	30,700	1,22	43,900	-1,24	18,700	-0,89	129,800	0,78
105					15,150	-1,99		
107	23,550	-0,62	49,450	-0,55	18,600	-0,92	106,600	-0,55
114	17,500	-2,17 CE	46,100	-0,96	40,500	5,84 CE	96,850	-1,11
135	26,250	0,08	58,500	0,57	21,350	-0,07	115,500	-0,04
145	22,700	-0,84 C			25,250	1,13		
151	26,550	0,15	65,800	1,47	21,200	-0,12	126,950	0,62
184	25,000	-0,24	57,200	0,41	21,950	0,11	116,000	-0,01
186	22,100	-0,99	51,250	-0,33 C	24,650	0,95 C	118,200	0,11
189	26,485	0,14	55,985	0,26	20,940	-0,20	118,800	0,15
190	21,750	-1,08	51,150	-0,34	16,350	-1,62	107,000	-0,53
191	26,000	0,01	54,000	0,01	13,500	-2,50 E	112,500	-0,21
192	26,920	0,25	54,940	0,13	25,440	1,19	99,290	-0,97
199	22,250	-0,95	49,400	-0,56	25,650	1,25	116,650	0,02
206	24,350	-0,41	56,700	0,35	24,900	1,02	109,550	-0,38
207	32,500	1,68	66,500	1,56	27,000	1,67	154,500	2,20 BE
208	25,000	-0,24	48,500	-0,67	19,500	-0,65	110,000	-0,36
214	31,500	1,43	57,500	0,45	26,000	1,36	125,500	0,53
215	21,500	-1,14	46,950	-0,86	18,550	-0,94	106,950	-0,53
237	27,750	0,46	53,550	-0,04	22,550	0,30	119,700	0,20
258	22,810	-0,81	46,230	-0,95	17,605	-1,23	107,780	-0,48

	1,2,4-Trimethylbenzene	Z score	alpha-Pinene	Z score	Benzene	Z score	Cumene	Z score
261	22,200	-0,96	47,500	-0,79	17,000	-1,42	112,150	-0,23
267	35,000	2,32 E	76,500	2,80 CE	29,500	2,44 E	166,500	2,88 BE
270	22,500	-0,89	50,000	-0,48	18,700	-0,89	106,000	-0,59
503	31,150	1,34	96,850	5,31 BE	29,000	2,29 E	130,650	0,83
506	25,000	-0,24	61,500	0,94	21,000	-0,18	120,000	0,22
510					25,000	1,05		
-	-	--	-	--	-	--	-	--
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	31		29		34		30	
Mean	25,952		53,900		21,590		116,227	
Reproducibility s.d.	3,563		6,469		4,001		9,910	
Rel. reproducibility s.d.	13,73 %		12,00 %		18,53 %		8,53 %	
Reference value	22,800		49,700		20,000		101,000	
Target s.d.	3,893		8,085		3,238		17,434	
Rel. target s.d.	15,00 %		15,00 %		15,00 %		15,00 %	
Lower limit of tolerance	18,167		37,730		15,113		81,359	
Upper limit of tolerance	33,738		70,070		28,066		151,095	
Type B outliers			2		1		2	
Type C outliers	3		3		3		1	
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	28		24		30		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								

Unit	Ethyl acetate		Ethylbenzene		n-Octane		p-Xylene		Toluene	
	µg/m ³	Z score	µg/m ³	Z score	µg/m ³	Z score	µg/m ³	Z score	µg/m ³	Z score
12	22,040	-5,66 BE	61,990	-1,31	13,750	-5,37 BE	72,805	-2,20 E	27,215	-1,70 C
14			73,100	-0,35	78,350	0,70	108,100	-0,03 C	38,850	0,42
30	152,700	0,31	82,500	0,46	74,900	0,38	116,800	0,50	38,050	0,28
34	120,450	-1,16	76,450	-0,06	63,550	-0,69	107,650	-0,06	34,450	-0,38
46	145,500	-0,02	75,500	-0,15	64,500	-0,60	108,000	-0,04	32,000	-0,83
52	193,500	2,18 E	89,100	1,03	73,150	0,21	126,500	1,09	38,750	0,41
60			75,850	-0,12	71,550	0,06	97,800	-0,67	33,800	-0,50
68	117,500	-1,30	89,750	1,09	88,050	1,61	122,700	0,86	44,650	1,48
105			56,850	-1,76			40,250	-4,20 BE	27,900	-1,57
107	134,150	-0,53	75,250	-0,17	66,550	-0,41	103,300	-0,33	34,500	-0,37
114	155,500	0,44	66,850	-0,89	65,800	-0,48	82,800	-1,59	38,600	0,38 C
135	146,000	0,01	77,850	0,06	69,150	-0,16	109,000	0,02	37,650	0,21
145	133,850	-0,55	75,750	-0,12	70,750	-0,01	106,050	-0,16	65,650	5,32 BE
151	152,000	0,28	79,600	0,21	68,250	-0,25	108,400	-0,02	35,100	-0,26
184	147,000	0,05	78,500	0,11	69,800	-0,10	103,000	-0,35	36,600	0,01
186	168,700	1,04	75,950	-0,11	74,900	0,38	110,950	0,14	36,100	-0,08
189	145,450	-0,02	78,970	0,15	69,475	-0,13	111,100	0,15	41,100	0,84
190	147,000	0,05	72,850	-0,37	70,500	-0,04	85,650	-1,41	36,850	0,06
191	132,000	-0,63	86,000	0,76	65,000	-0,55	119,500	0,66	32,500	-0,73
192	149,870	0,18	88,825	1,01	87,880	1,60	126,930	1,12	42,750	1,14
199	161,750	0,73	77,100	-0,01	92,550	2,04 E	99,950	-0,53	40,800	0,78
206	152,800	0,32	73,800	-0,29 C	57,150	-1,29	108,700	0,00	34,550	-0,36
207	176,500	1,40	94,000	1,45	86,000	1,42	139,000	1,86	43,500	1,27
208	130,000	-0,72	70,000	-0,62	59,000	-1,12	100,000	-0,53	31,000	-1,01
214	142,500	-0,15	95,500	1,58	73,500	0,24	139,500	1,89	43,000	1,18
215	131,950	-0,64	69,650	-0,65	62,950	-0,75	96,950	-0,72	32,950	-0,65
237	161,650	0,72	80,950	0,33	67,450	-0,32	118,900	0,63	36,350	-0,03
258	126,470	-0,89	72,700	-0,39	61,770	-0,86	103,575	-0,31	31,530	-0,91
261	147,450	0,07	74,200	-0,26	63,900	-0,66	100,150	-0,52	32,050	-0,82
267			97,500	1,75 C	94,000	2,17 E	137,000	1,74 C	46,500	1,82
270	126,500	-0,88	71,500	-0,49	63,500	-0,70	96,000	-0,78	31,500	-0,92
503			88,850	1,01			134,600	1,59	42,850	1,16
506	135,000	-0,50	80,500	0,29	64,000	-0,65	110,000	0,08	34,000	-0,46

	Ethyl acetate	Z score	Ethylbenzene	Z score	n-Octane	Z score	p-Xylene	Z score	Toluene	Z score
510	150,000	0,19	57,500	-1,70	60,000	-1,02	102,500	-0,38	30,000	-1,19
–	–	--	–	--	–	--	–	--	–	--
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	29		34		32		34		34	
Mean	145,848		77,185		70,899		108,670		36,522	
Reproducibility s.d.	17,708		9,363		9,830		15,300		4,844	
Rel. reproducibility s.d.	12,14 %		12,13 %		13,86 %		14,08 %		13,26 %	
Reference value	134,500		66,000		59,200		94,400		30,200	
Target s.d.	21,877		11,578		10,635		16,300		5,478	
Rel. target s.d.	15,00 %		15,00 %		15,00 %		15,00 %		15,00 %	
Lower limit of tolerance	102,094		54,030		49,629		76,069		25,565	
Upper limit of tolerance	189,602		100,341		92,169		141,271		47,479	
Type B outliers	1				1		1		1	
Type C outliers			2				2		2	
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	28		32		31		31		31	

Summary of laboratory means

Sample 2

Unit	1,2,4-Trimethylbenzene		alpha-Pinene		Benzene		Cumene	
	$\mu\text{g}/\text{m}^3$	Z score	$\mu\text{g}/\text{m}^3$	Z score	$\mu\text{g}/\text{m}^3$	Z score	$\mu\text{g}/\text{m}^3$	Z score
12	64,190	-1,66 C	104,335	-1,06	55,790	-2,38 CE	39,120	-0,72 C
14					118,700	2,46 E		
30	94,300	0,68	137,950	0,75	88,650	0,15	47,650	0,58
34	83,500	-0,16			84,150	-0,20	52,650	1,34
46	79,000	-0,51	115,500	-0,46	73,000	-1,05	39,500	-0,66
52	88,650	0,24	128,000	0,21	87,850	0,09	49,500	0,86
60	86,200	0,05	246,800	6,60 BE	80,300	-0,49	50,200	0,97
68	96,000	0,82	108,050	-0,86	76,350	-0,80	50,200	0,97
105					62,350	-1,87		
107	80,200	-0,41	107,250	-0,90	73,950	-0,98	41,950	-0,28
114	59,500	-2,03 E	117,850	-0,33	152,750	5,08 CE	45,200	0,21 C
135	88,200	0,21	127,000	0,16	81,900	-0,37	45,350	0,23
145	83,350	-0,17			85,850	-0,07		
151	90,300	0,37	154,700	1,65	86,900	0,01	47,550	0,57
184	88,100	0,20	137,000	0,70	91,300	0,35	45,350	0,23
186	79,350	-0,48	129,450	0,29	92,800	0,47	40,500	-0,51
189	92,920	0,58	136,050	0,65	88,540	0,14	46,945	0,48
190	73,500	-0,94	114,500	-0,51	74,300	-0,95	35,050	-1,33
191	84,500	-0,08	119,000	-0,27	87,000	0,02	37,500	-0,96
192	91,985	0,50	127,160	0,17	100,840	1,09	37,060	-1,03
199	74,750	-0,84	104,350	-1,06	99,150	0,96	39,200	-0,70
206	78,650	-0,54	137,500	0,72	99,450	0,98	40,700	-0,47
207	108,000	1,75	152,500	1,53	104,000	1,33	55,500	1,78
208	81,000	-0,35	115,000	-0,48	81,500	-0,40	40,000	-0,58
214	111,500	2,03 E	143,500	1,05	112,000	1,94	48,500	0,71
215	78,500	-0,55	114,750	-0,50	76,350	-0,80	39,750	-0,62
237	89,450	0,31	123,150	-0,05	83,550	-0,24	40,750	-0,47
258	79,185	-0,49	120,480	-0,19	75,940	-0,83	39,650	-0,63

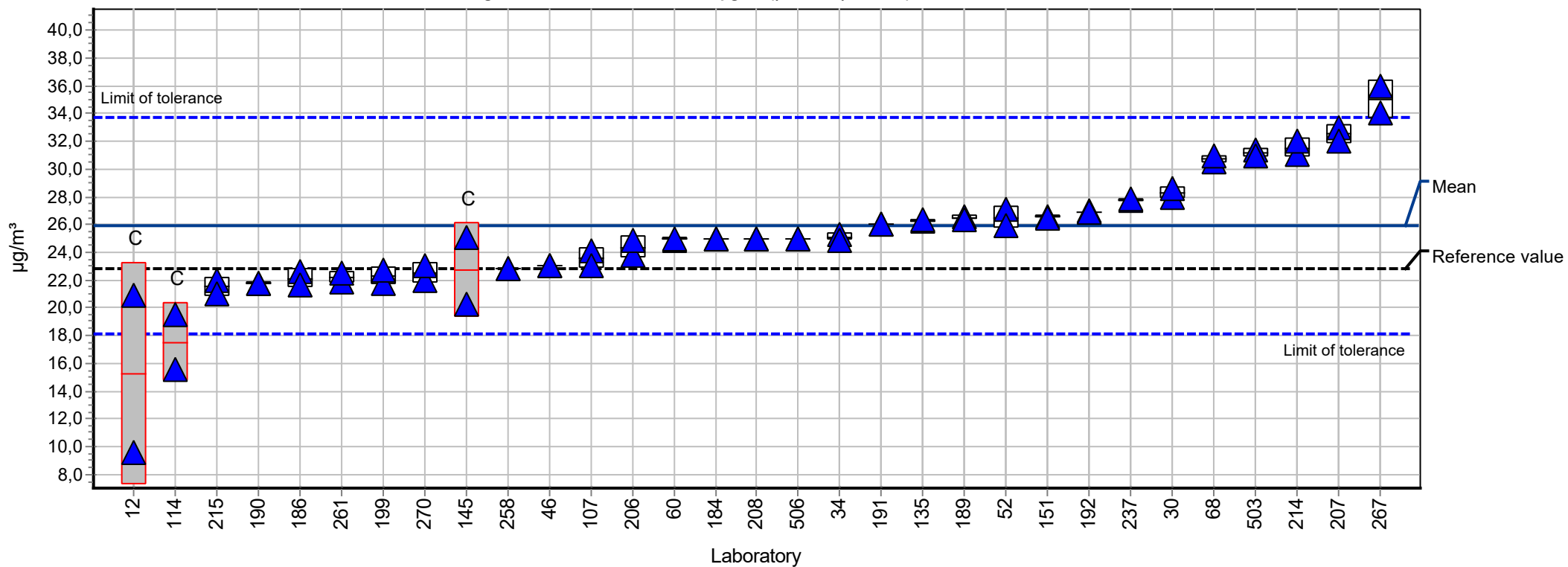
	1,2,4-Trimethylbenzene	Z score	alpha-Pinene	Z score	Benzene	Z score	Cumene	Z score
261	82,700	-0,22	117,350	-0,36	72,950	-1,06	40,400	-0,52
267	117,500	2,49 CE	161,500	2,02 CE	92,000	0,41 C	62,000	2,77 CE
270	73,000	-0,98	107,000	-0,91	74,000	-0,98	39,500	-0,66
503	104,700	1,50	228,500	5,62 BE	109,900	1,78	49,700	0,89
506	88,500	0,23	125,000	0,05	89,500	0,21	45,500	0,26
510					87,500	0,06		
-	-	--	-	--	-	--	-	--
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	31		29		34		30	
Mean	85,514		124,014		86,710		43,821	
Reproducibility s.d.	10,716		15,250		12,884		5,373	
Rel. reproducibility s.d.	12,53 %		12,30 %		14,86 %		12,26 %	
Reference value	69,400		111,500		74,500		36,500	
Target s.d.	12,827		18,602		13,006		6,573	
Rel. target s.d.	15,00 %		15,00 %		15,00 %		15,00 %	
Lower limit of tolerance	59,860		86,810		60,697		30,675	
Upper limit of tolerance	111,168		161,219		112,723		56,967	
Type B outliers			2					
Type C outliers	2		1		3		3	
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	29		26		31		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								

Unit	Ethyl acetate		Ethylbenzene		n-Octane		p-Xylene		Toluene	
	µg/m ³	Z score	µg/m ³	Z score	µg/m ³	Z score	µg/m ³	Z score	µg/m ³	Z score
12	12,785	-4,25 BE	142,070	0,05 C	14,755	-4,21 BE	39,780	-1,56 C	117,135	-0,25
14			129,250	-0,55	44,200	0,68	58,650	0,86	108,250	-0,73
30	37,200	0,38	151,800	0,51	43,000	0,48	56,600	0,60	129,900	0,45
34	26,950	-1,56	139,400	-0,07	37,300	-0,46	51,850	-0,01	118,200	-0,19
46	32,500	-0,51	136,000	-0,23	35,000	-0,85	48,000	-0,50	113,500	-0,45
52	41,500	1,19	156,500	0,74	38,600	-0,25	54,350	0,31	137,500	0,87
60			140,650	-0,01	42,500	0,40	49,150	-0,36	113,850	-0,43
68	33,000	-0,42	154,100	0,62	45,450	0,89	59,900	1,02	133,500	0,65
105			99,350	-1,97			17,950	-4,36 BE	85,200	-2,00
107	33,950	-0,24	135,400	-0,26	38,800	-0,22	51,200	-0,09	112,750	-0,49
114	12,000	-4,39 BE	134,950	-0,28	40,550	0,08	45,750	-0,79 C	144,300	1,24 C
135	36,550	0,25	142,000	0,05	40,950	0,14	52,950	0,13	123,000	0,07
145	25,300	-1,88	138,900	-0,10	37,900	-0,36 C	53,050	0,14 C	126,250	0,25
151	38,700	0,66	147,750	0,32	39,800	-0,05	53,000	0,14	121,650	0,00
184	37,450	0,42	146,000	0,24	41,450	0,23	50,700	-0,16	128,000	0,35
186	43,500	1,57	141,400	0,02	41,700	0,27	49,750	-0,28	124,400	0,15
189	37,340	0,40	148,850	0,37	43,435	0,56	57,320	0,69	136,050	0,79
190	37,650	0,46	130,500	-0,49	39,150	-0,16	34,500	-2,24 E	126,000	0,24
191	32,500	-0,51	155,500	0,69	34,500	-0,93	46,500	-0,70	129,000	0,40
192	35,790	0,11	163,120	1,05	50,305	1,70	58,670	0,87	141,985	1,12
199	31,400	-0,72	129,450	-0,54	50,850	1,79	47,900	-0,52	139,850	1,00
206	35,500	0,06	140,250	-0,03 C	34,400	-0,95	52,500	0,07 C	107,550	-0,77
207	43,000	1,48	170,000	1,37	48,500	1,40	64,500	1,61	143,500	1,20
208	30,500	-0,89	130,000	-0,52	33,500	-1,10	46,000	-0,76	110,000	-0,64
214	40,500	1,00	178,000	1,75	44,000	0,65	66,000	1,81	151,000	1,61
215	31,850	-0,64	127,750	-0,62	35,850	-0,71	45,050	-0,88	108,050	-0,74
237	39,700	0,85	155,500	0,69	38,500	-0,27	52,450	0,07	125,950	0,24
258	31,890	-0,63	134,135	-0,32	35,470	-0,77	47,395	-0,58	108,410	-0,72
261	36,400	0,23	110,050	-1,46	36,000	-0,68	46,700	-0,67	102,800	-1,03
267			164,500	1,11 C	49,500	1,56 C	57,500	0,72 C	131,500	0,54
270	34,000	-0,23	129,000	-0,56	37,000	-0,51	45,000	-0,89	101,000	-1,13
503			161,500	0,97			63,800	1,52	139,800	1,00
506	31,000	-0,80	155,000	0,67	37,000	-0,51	57,000	0,65 C	125,000	0,18

	Ethyl acetate	Z score	Ethylbenzene	Z score	n-Octane	Z score	p-Xylene	Z score	Toluene	Z score
510	35,000	-0,04	107,500	-1,58	35,000	-0,85	50,000	-0,25	102,500	-1,05
–	–	--	–	--	–	--	–	--	–	--
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	29		34		32		34		34	
Mean	35,208		140,936		40,095		51,924		121,635	
Reproducibility s.d.	4,749		17,586		4,810		6,886		14,789	
Rel. reproducibility s.d.	13,49 %		12,48 %		12,00 %		13,26 %		12,16 %	
Reference value	31,600		115,800		32,900		43,200		98,400	
Target s.d.	5,281		21,140		6,014		7,789		18,245	
Rel. target s.d.	15,00 %		15,00 %		15,00 %		15,00 %		15,00 %	
Lower limit of tolerance	24,646		98,655		28,067		36,347		85,144	
Upper limit of tolerance	45,771		183,217		52,124		67,501		158,125	
Type B outliers	2				1		1			
Type C outliers			3		2		6		1	
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	27		31		29		27		33	

Summary results

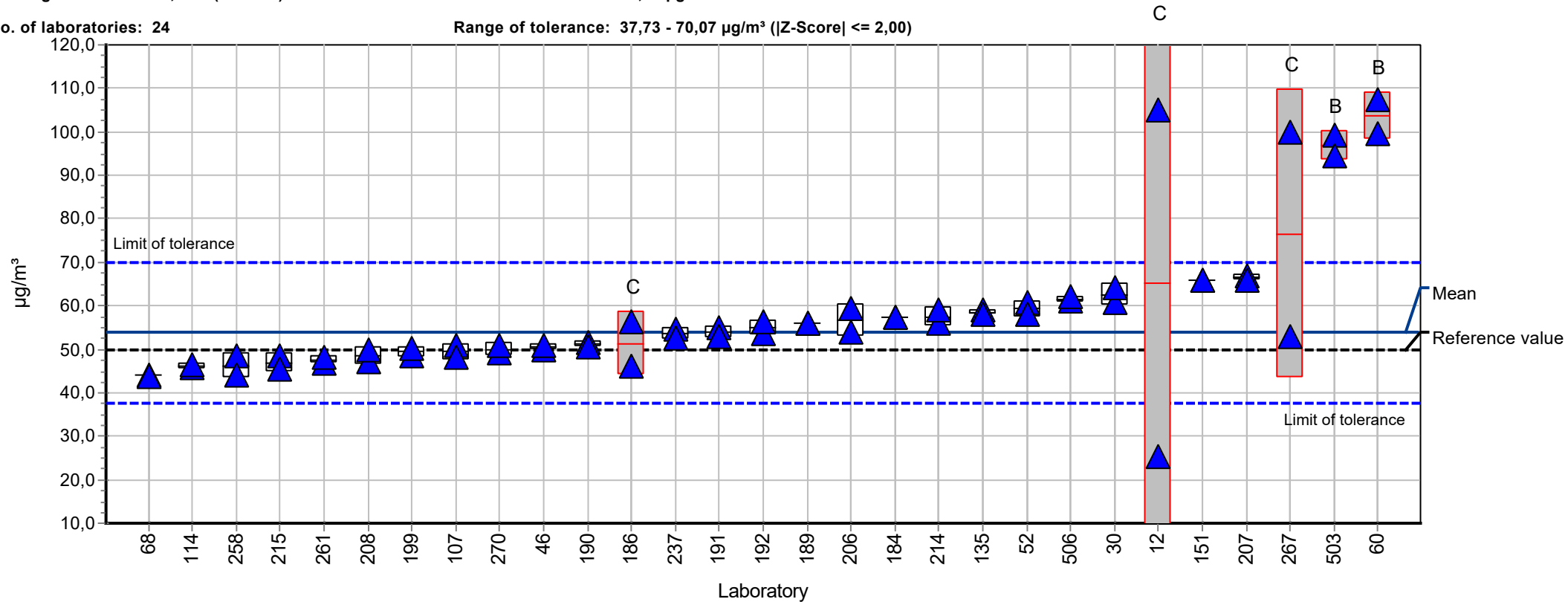
Sample:	1	Mean:	25,95 µg/m³
Measurand:	1,2,4-Trimethylbenzene	Reprod. s.d.:	3,56 µg/m³
Method:	ISO 5725-2	Rel.reprod. s.d.:	13,73%
Rel.target s.d.:	15,00% (Limited)	Reference value:	22,80 µg/m³
No. of laboratories:	28	Range of tolerance:	18,17 - 33,74 µg/m³ (Z-Score ≤ 2,00)



Summary results

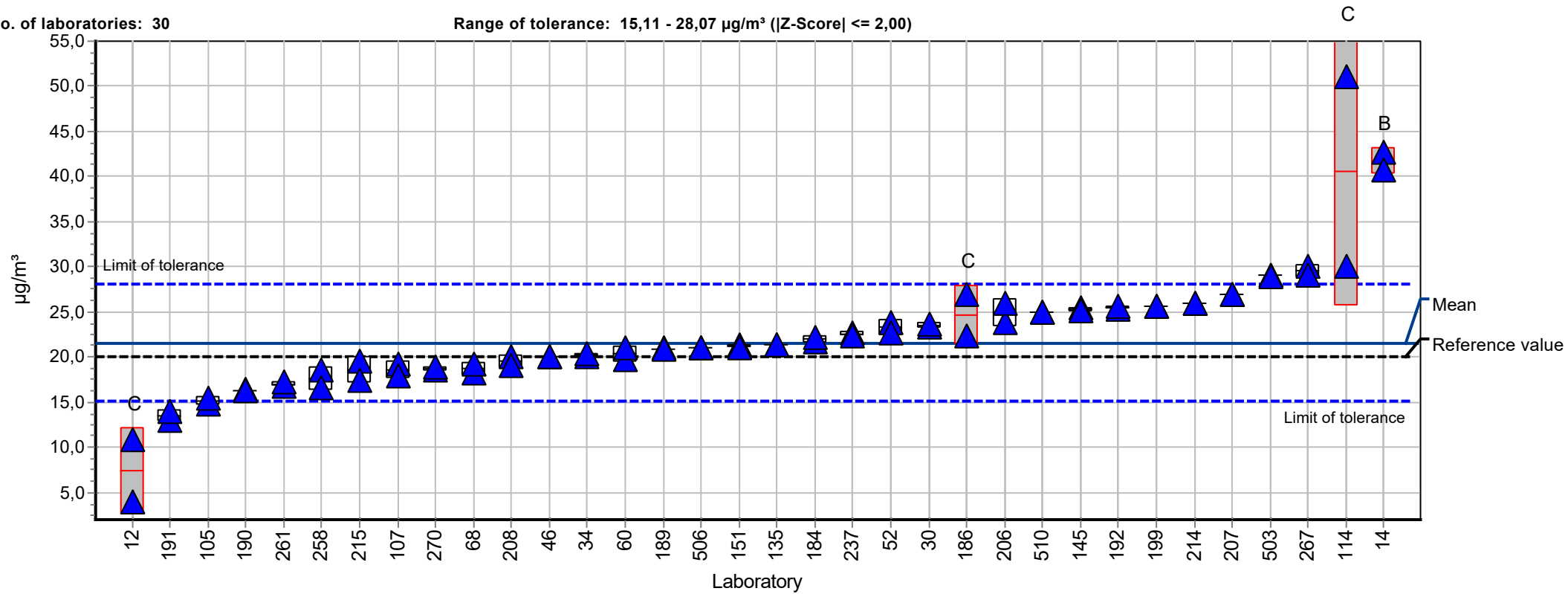
Sample: 1 **Mean:** 53,90 µg/m³
Measurand: alpha-Pinene **Reprod. s.d.:** 6,47 µg/m³
Method: ISO 5725-2 **Rel.reprod. s.d.:** 12,00%
Rel.target s.d.: 15,00% (Limited) **Reference value:** 49,70 µg/m³

No. of laboratories: 24 **Range of tolerance:** 37,73 - 70,07 µg/m³ (|Z-Score| ≤ 2,00)



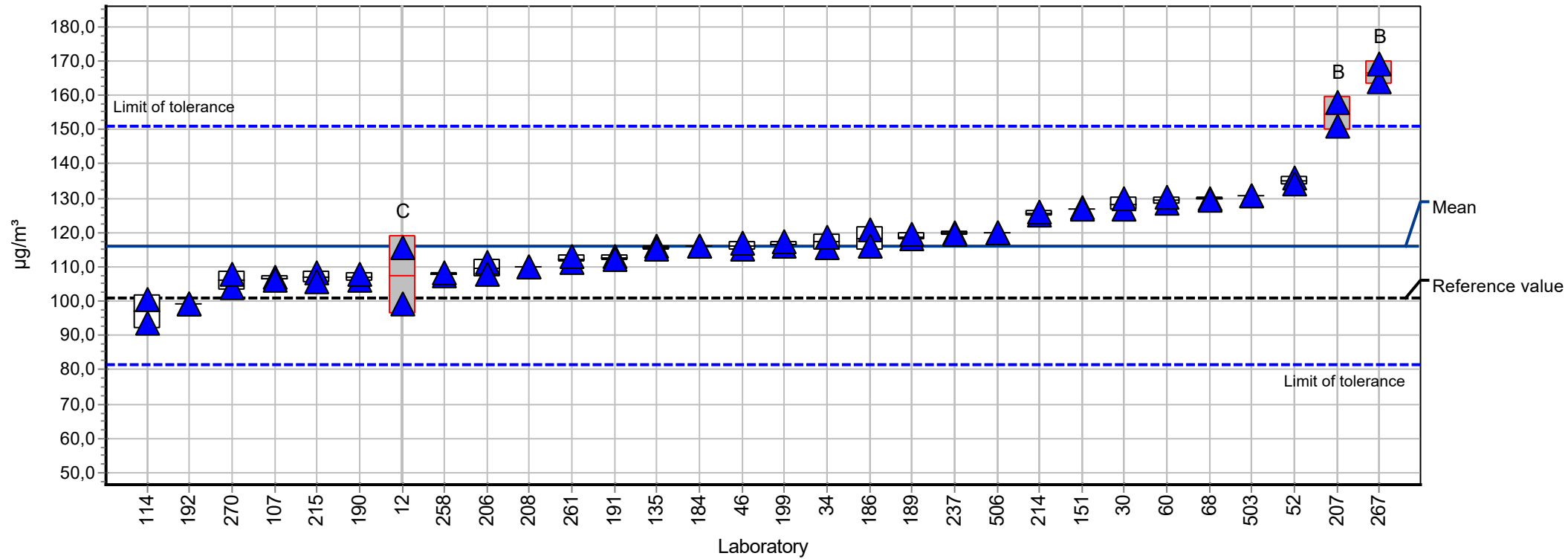
Summary results

Sample:	1	Mean:	21,59 µg/m³
Measurand:	Benzene	Reprod. s.d.:	4,00 µg/m³
Method:	ISO 5725-2	Rel.reprod. s.d.:	18,53%
Rel.target s.d.:	15,00% (Limited)	Reference value:	20,00 µg/m³
No. of laboratories:	30	Range of tolerance:	15,11 - 28,07 µg/m³ (Z-Score ≤ 2,00)



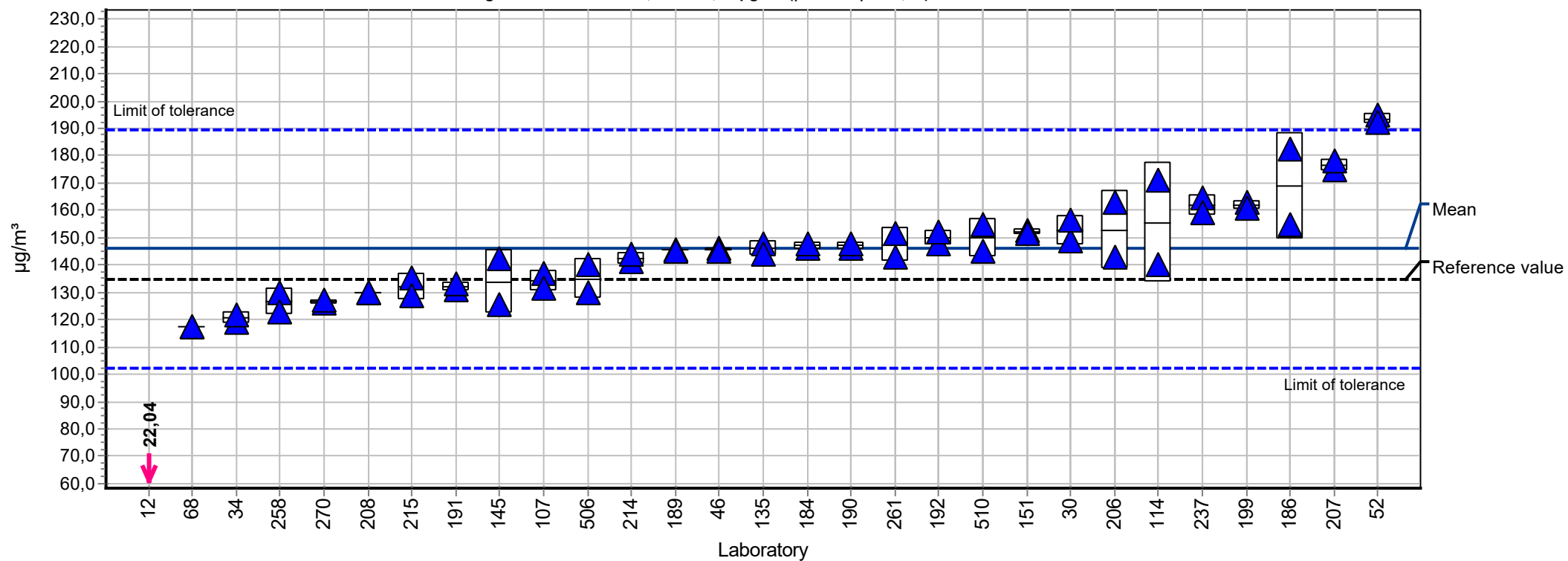
Summary results

Sample:	1	Mean:	116,23 µg/m³
Measurand:	Cumene	Reprod. s.d.:	9,91 µg/m³
Method:	ISO 5725-2	Rel.reprod. s.d.:	8,53%
Rel.target s.d.:	15,00% (Limited)	Reference value:	101,00 µg/m³
No. of laboratories:	27	Range of tolerance:	81,36 - 151,09 µg/m³ (Z-Score ≤ 2,00)



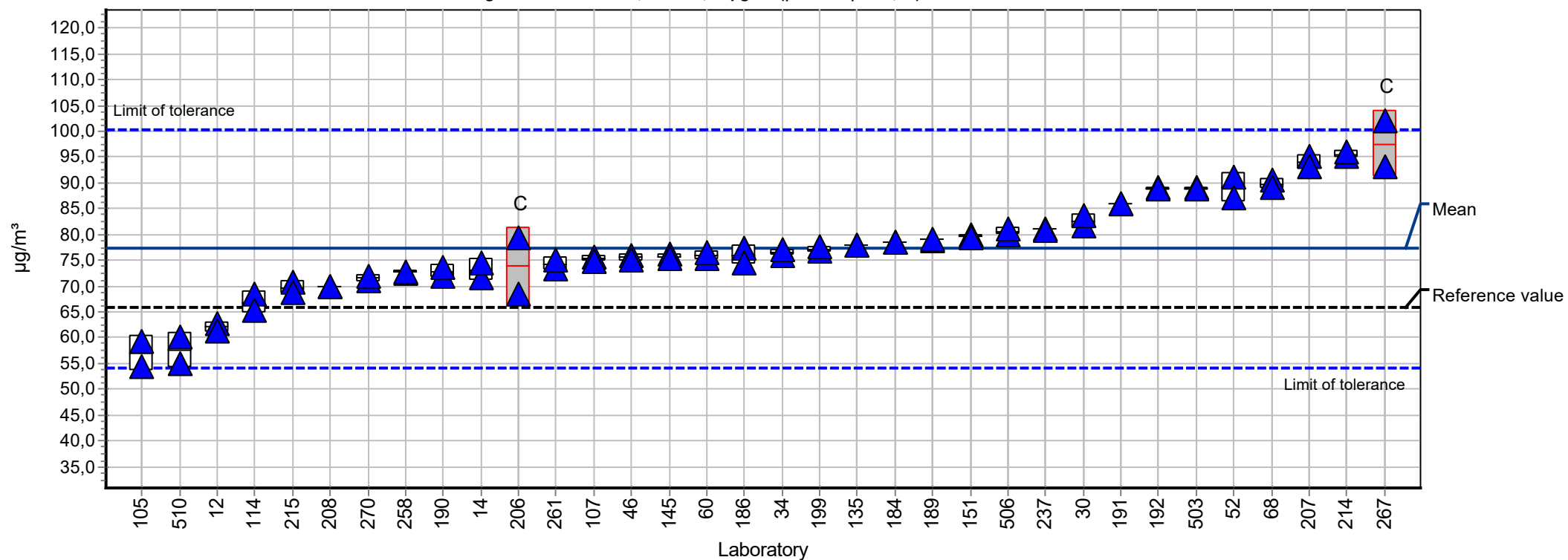
Summary results

Sample:	1	Mean:	145,85 µg/m ³
Measurand:	Ethyl acetate	Reprod. s.d.:	17,71 µg/m ³
Method:	ISO 5725-2	Rel.reprod. s.d.:	12,14%
Rel.target s.d.:	15,00% (Limited)	Reference value:	134,50 µg/m ³
No. of laboratories:	28	Range of tolerance:	102,09 - 189,60 µg/m ³ (Z-Score <= 2,00)



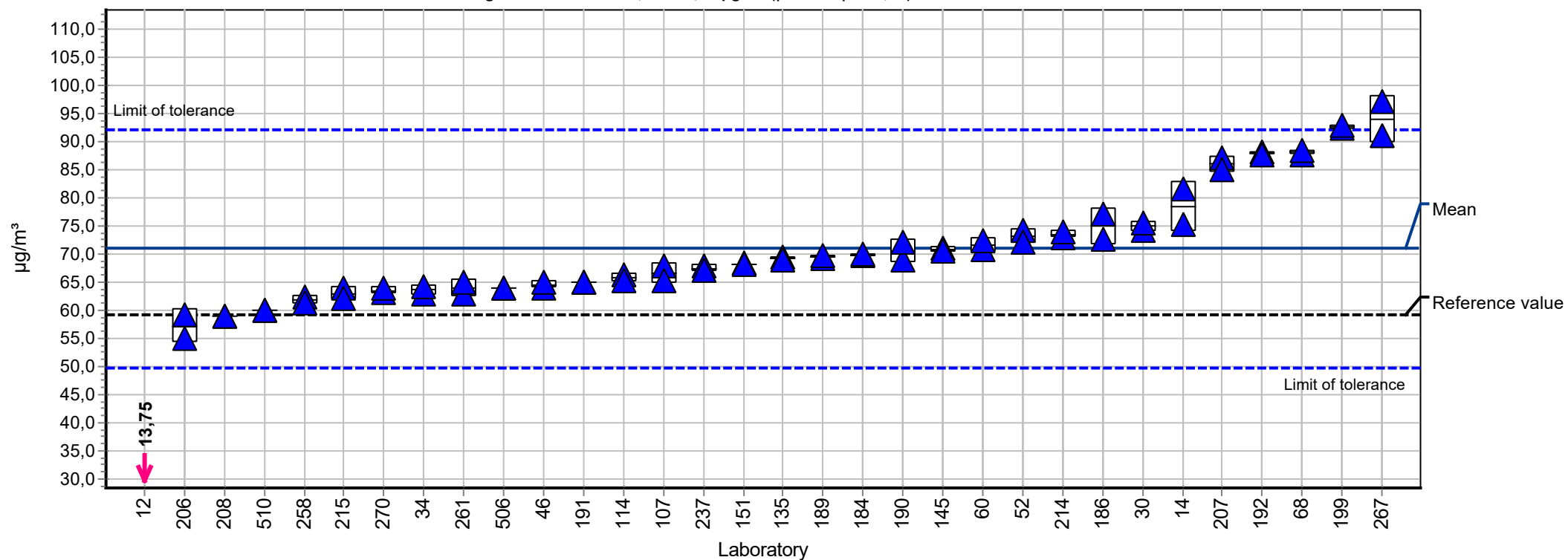
Summary results

Sample:	1	Mean:	77,19 µg/m³
Measurand:	Ethylbenzene	Reprod. s.d.:	9,36 µg/m³
Method:	ISO 5725-2	Rel.reprod. s.d.:	12,13%
Rel.target s.d.:	15,00% (Limited)	Reference value:	66,00 µg/m³
No. of laboratories:	32	Range of tolerance:	54,03 - 100,34 µg/m³ (Z-Score ≤ 2,00)



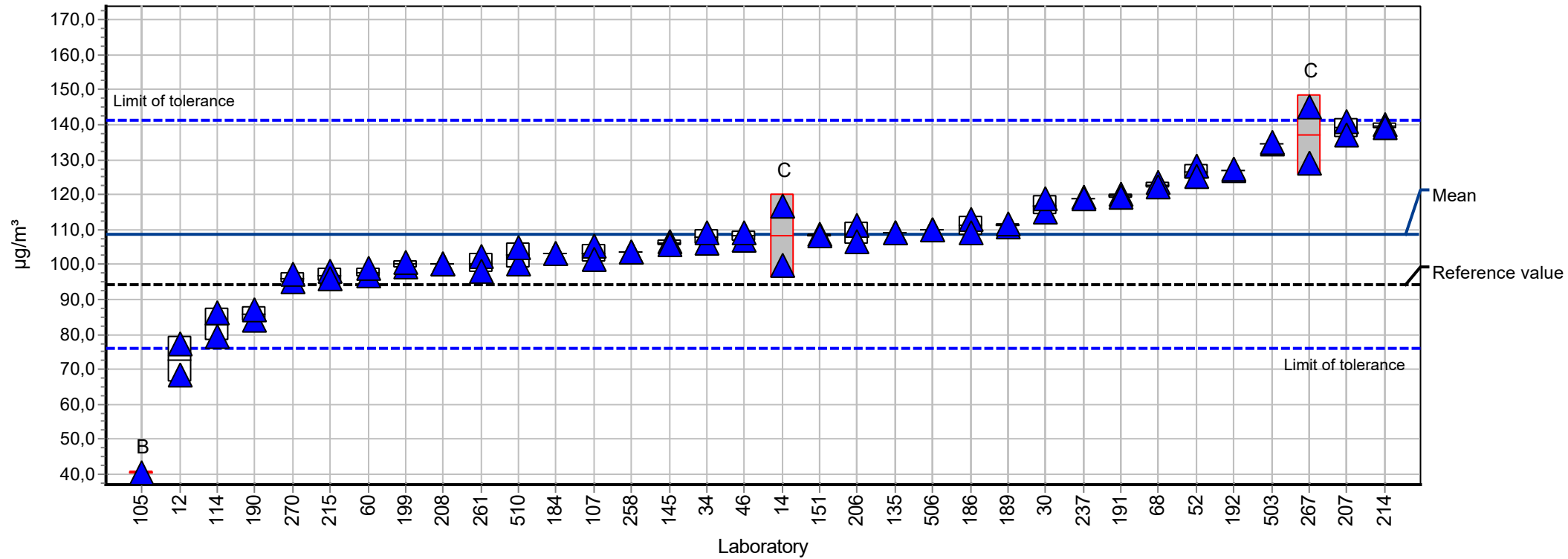
Summary results

Sample:	1	Mean:	70,90 µg/m³
Measurand:	n-Octane	Reprod. s.d.:	9,83 µg/m³
Method:	ISO 5725-2	Rel.reprod. s.d.:	13,86%
Rel.target s.d.:	15,00% (Limited)	Reference value:	59,20 µg/m³
No. of laboratories:	31	Range of tolerance:	49,63 - 92,17 µg/m³ (Z-Score <= 2,00)



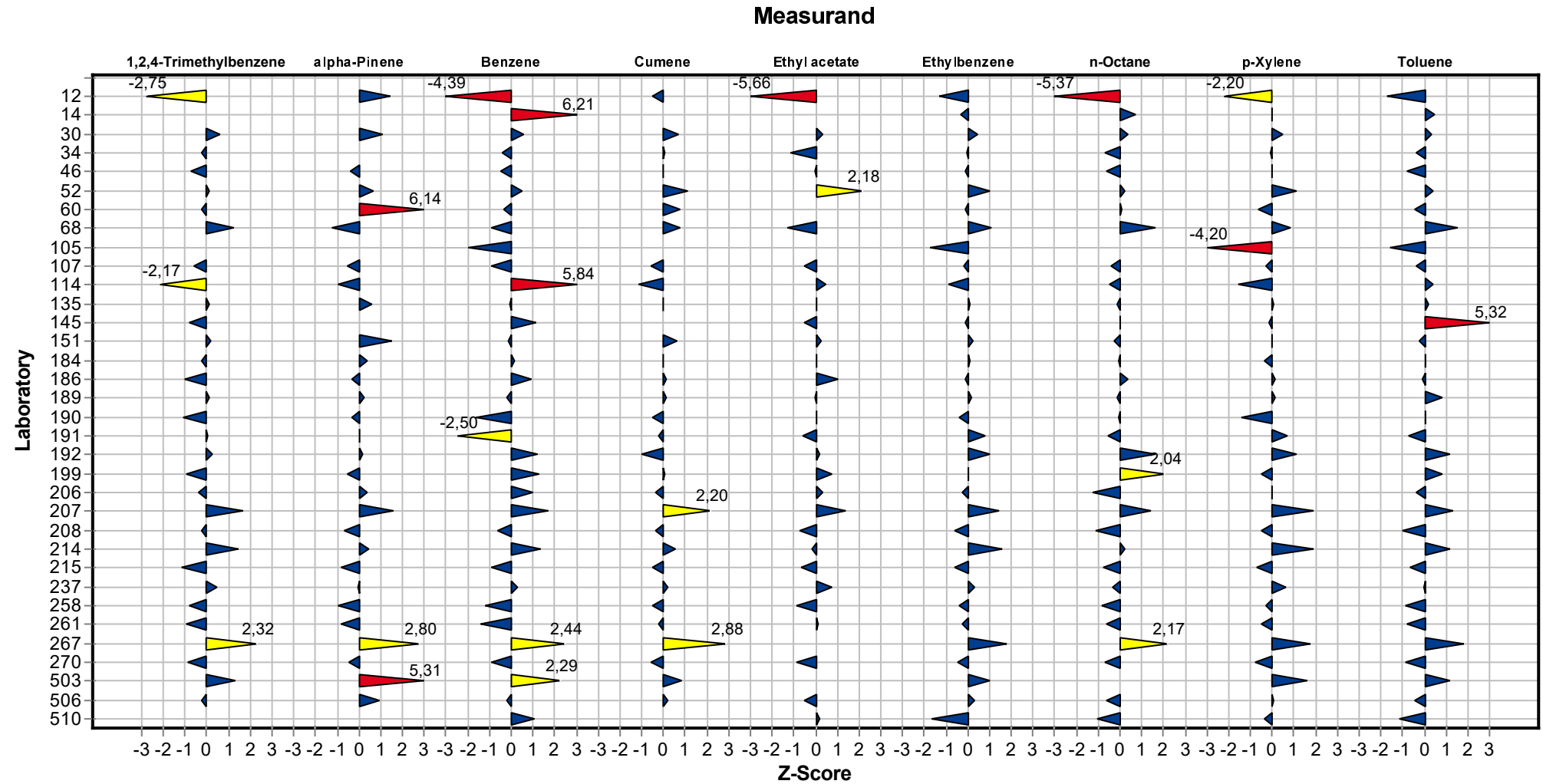
Summary results

Sample:	1	Mean:	108,67 µg/m³
Measurand:	p-Xylene	Reprod. s.d.:	15,30 µg/m³
Method:	ISO 5725-2	Rel.reprod. s.d.:	14,08%
Rel.target s.d.:	15,00% (Limited)	Reference value:	94,40 µg/m³
No. of laboratories:	31	Range of tolerance:	76,07 - 141,27 µg/m³ (Z-Score ≤ 2,00)



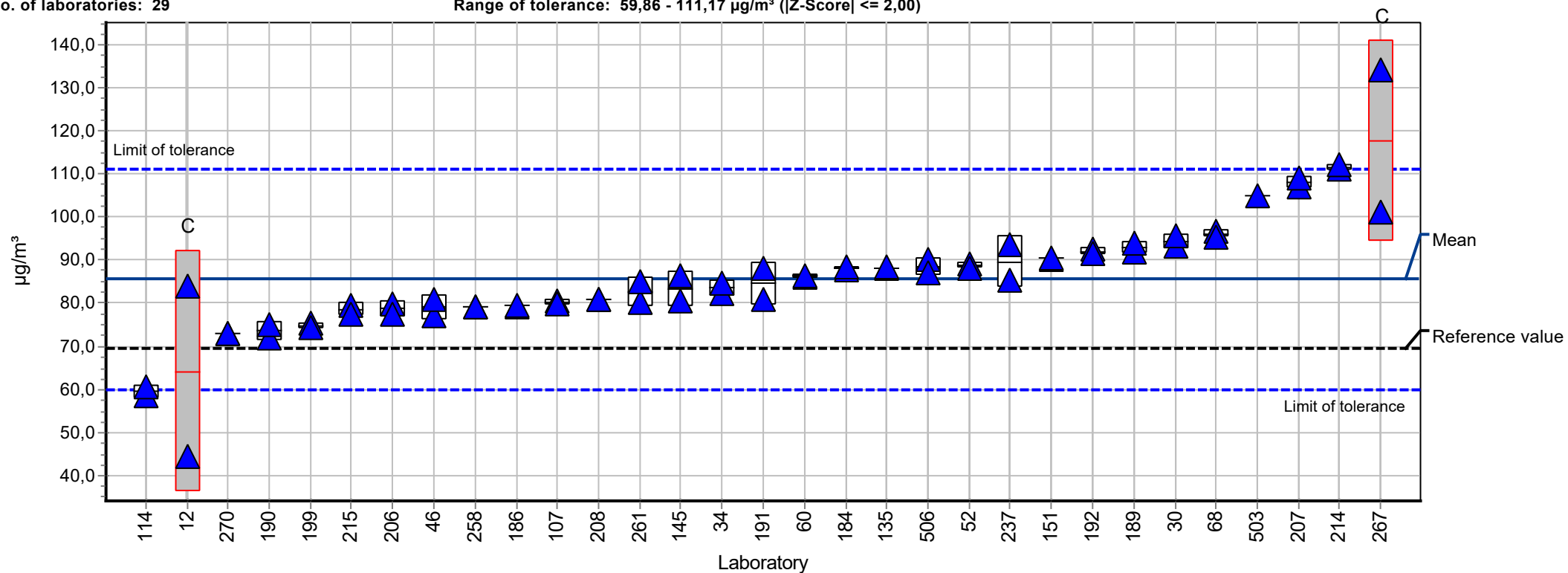
Sample chart of Z-scores

Sample 1



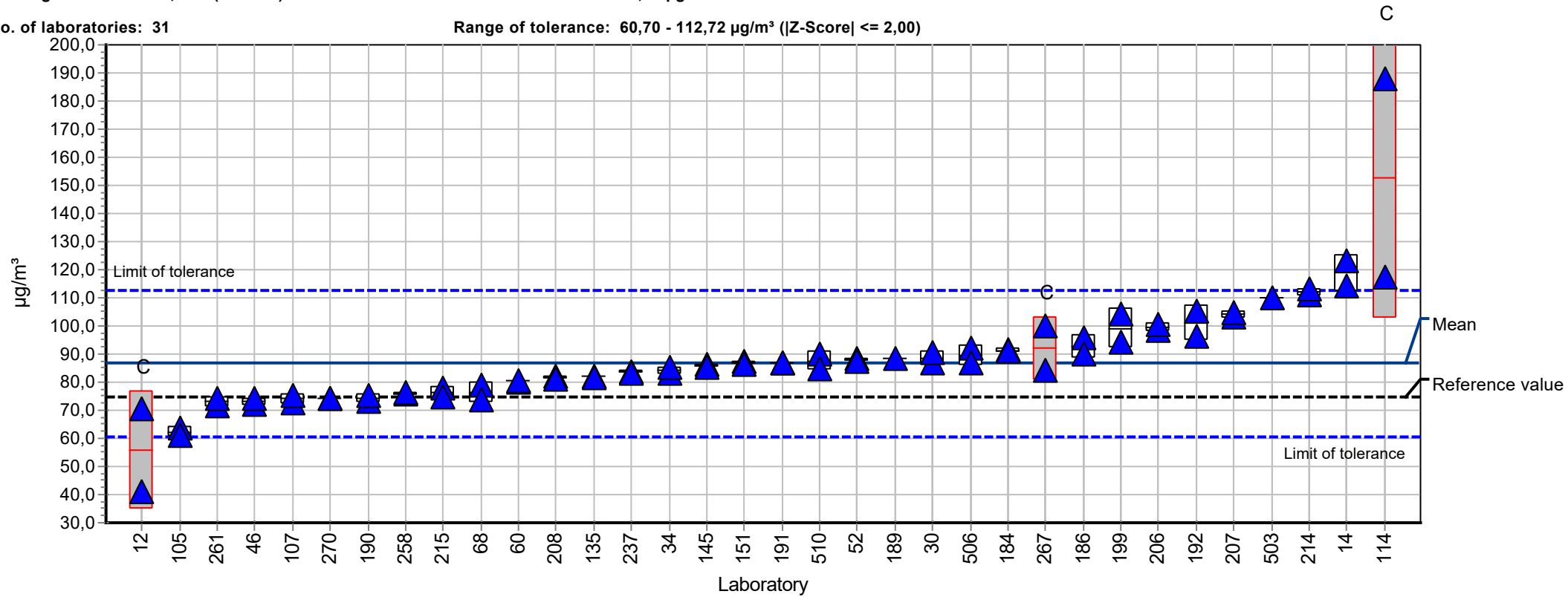
Summary results

Sample:	2	Mean:	85,51 µg/m³
Measurand:	1,2,4-Trimethylbenzene	Reprod. s.d.:	10,72 µg/m³
Method:	ISO 5725-2	Rel.reprod. s.d.:	12,53%
Rel.target s.d.:	15,00% (Limited)	Reference value:	69,40 µg/m³
No. of laboratories:	29	Range of tolerance:	59,86 - 111,17 µg/m³ (Z-Score ≤ 2,00)



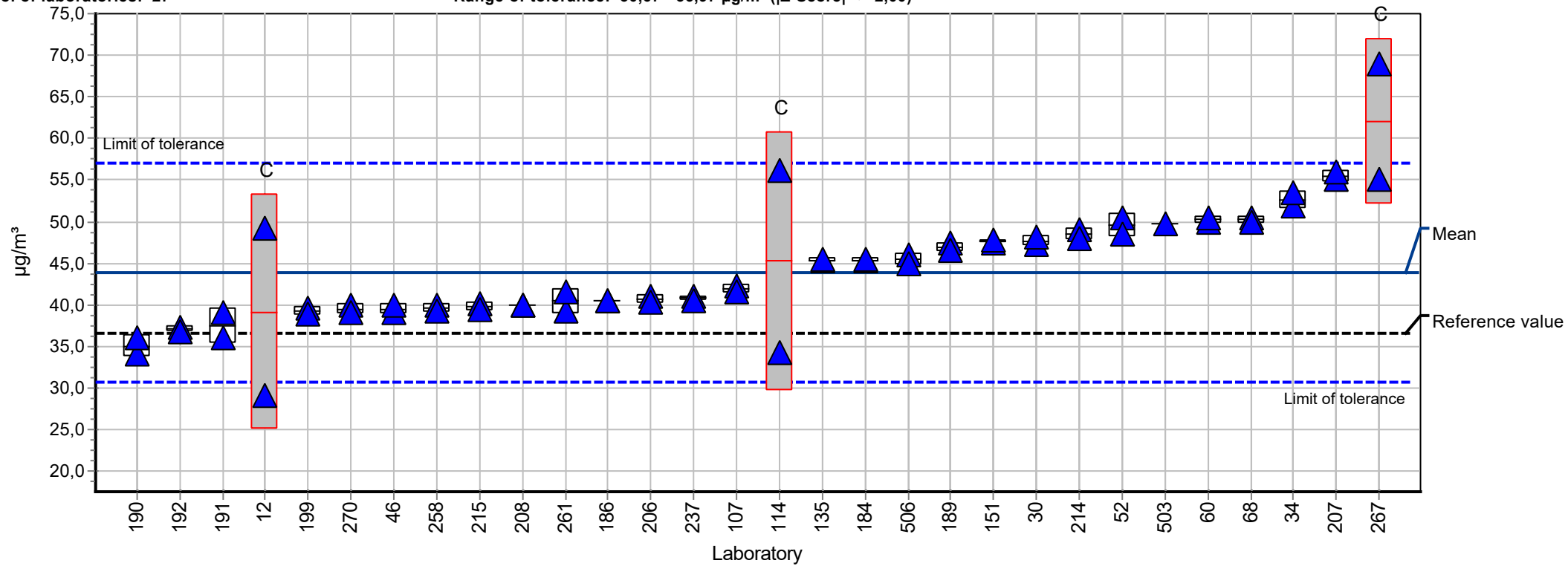
Summary results

Sample:	2	Mean:	86,71 µg/m³
Measurand:	Benzene	Reprod. s.d.:	12,88 µg/m³
Method:	ISO 5725-2	Rel.reprod. s.d.:	14,86%
Rel.target s.d.:	15,00% (Limited)	Reference value:	74,50 µg/m³
No. of laboratories:	31	Range of tolerance:	60,70 - 112,72 µg/m³ (Z-Score ≤ 2,00)



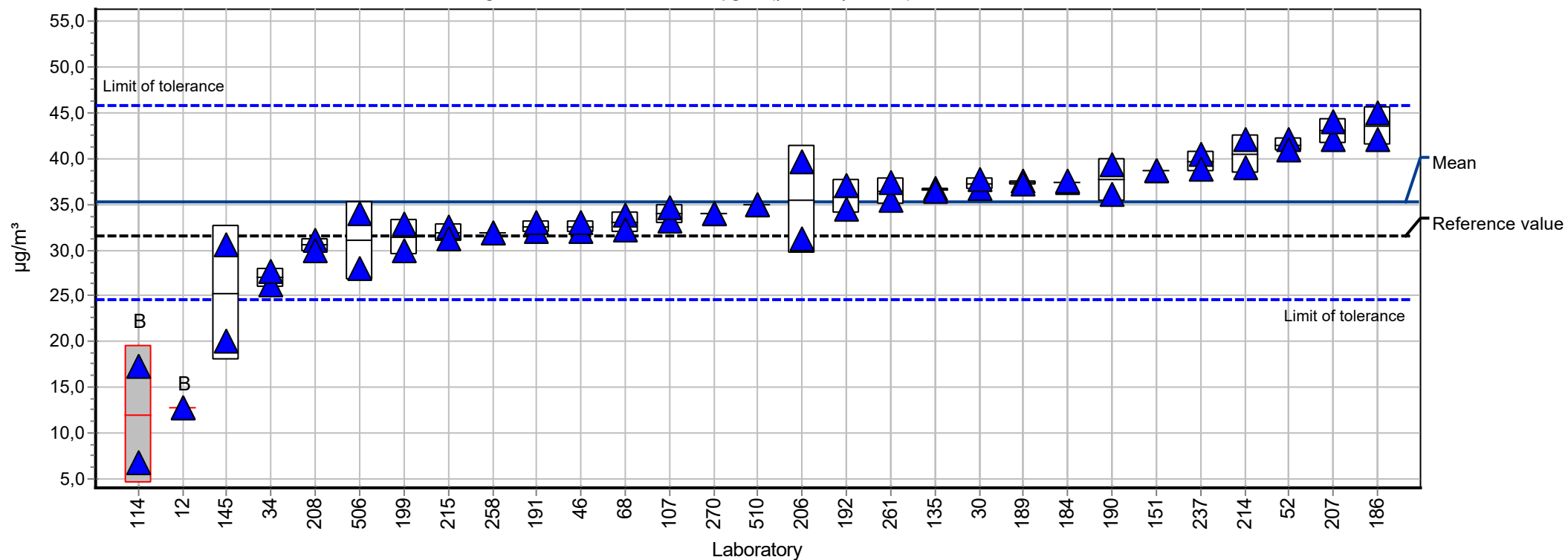
Summary results

Sample:	2	Mean:	43,82 µg/m³
Measurand:	Cumene	Reprod. s.d.:	5,37 µg/m³
Method:	ISO 5725-2	Rel.reprod. s.d.:	12,26%
Rel.target s.d.:	15,00% (Limited)	Reference value:	36,50 µg/m³
No. of laboratories:	27	Range of tolerance:	30,67 - 56,97 µg/m³ (Z-Score ≤ 2,00)



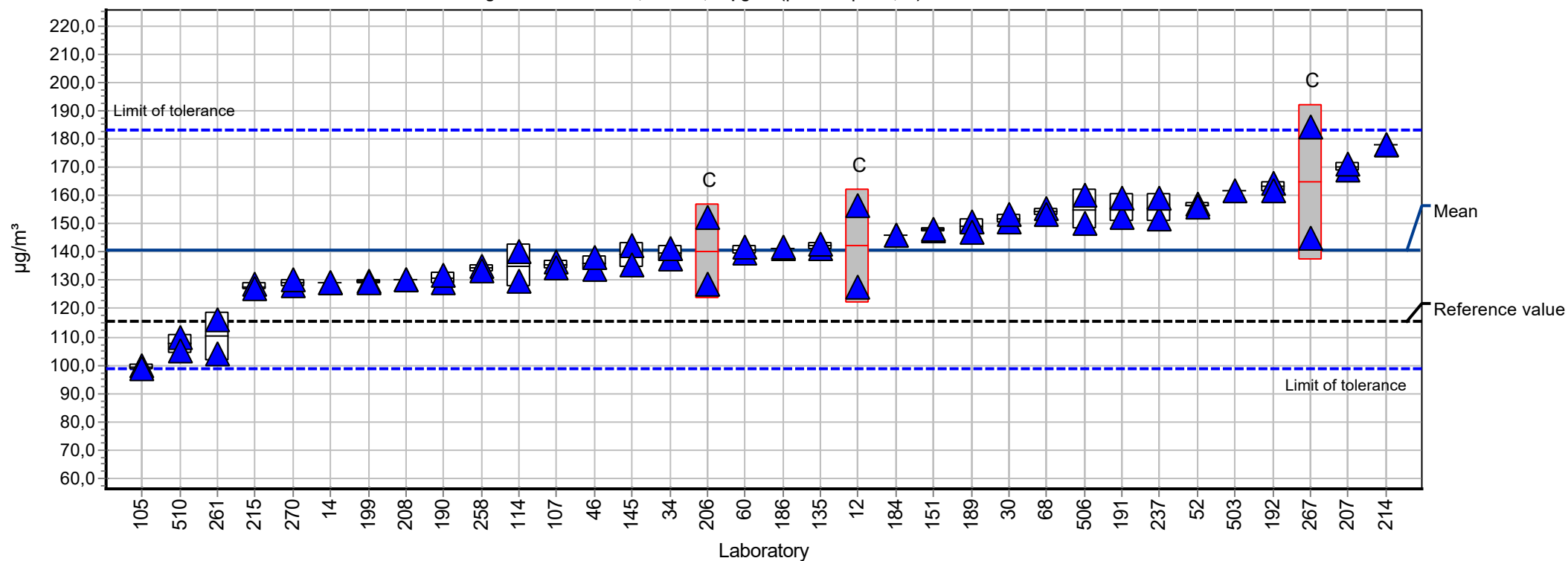
Summary results

Sample:	2	Mean:	35,21 µg/m³
Measurand:	Ethyl acetate	Reprod. s.d.:	4,75 µg/m³
Method:	ISO 5725-2	Rel.reprod. s.d.:	13,49%
Rel.target s.d.:	15,00% (Limited)	Reference value:	31,60 µg/m³
No. of laboratories:	27	Range of tolerance:	24,65 - 45,77 µg/m³ (Z-Score ≤ 2,00)



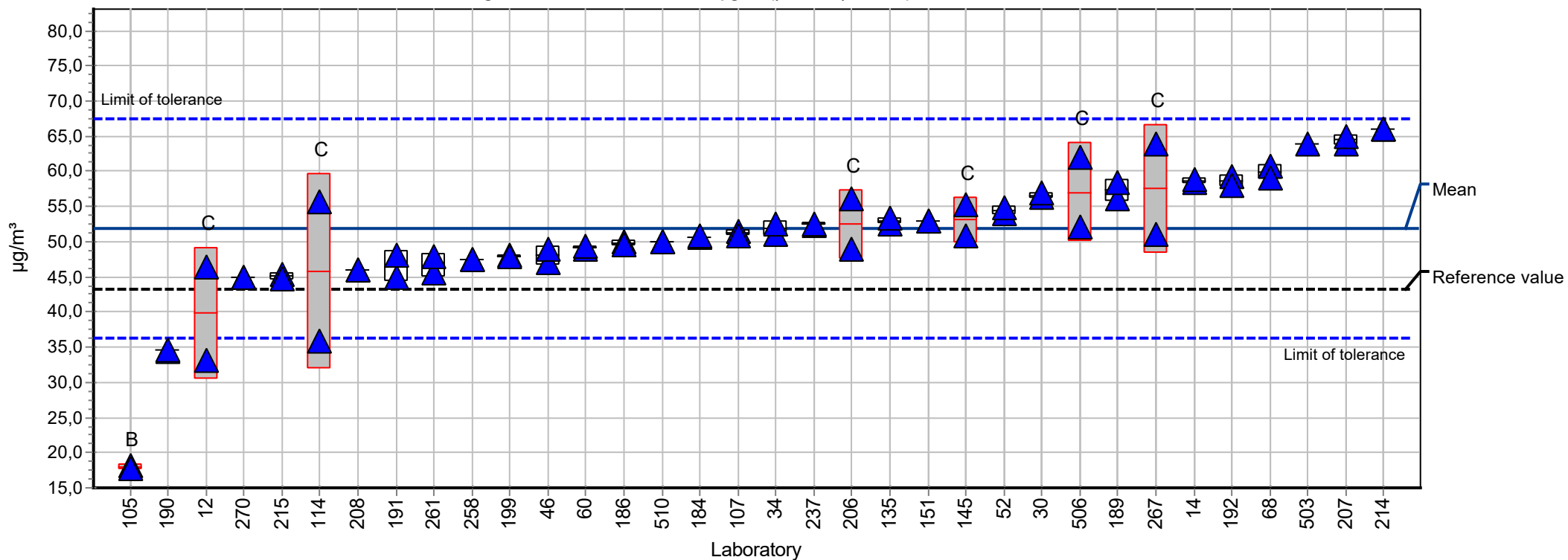
Summary results

Sample:	2	Mean:	140,94 µg/m³
Measurand:	Ethylbenzene	Reprod. s.d.:	17,59 µg/m³
Method:	ISO 5725-2	Rel.reprod. s.d.:	12,48%
Rel.target s.d.:	15,00% (Limited)	Reference value:	115,80 µg/m³
No. of laboratories:	31	Range of tolerance:	98,66 - 183,22 µg/m³ (Z-Score ≤ 2,00)



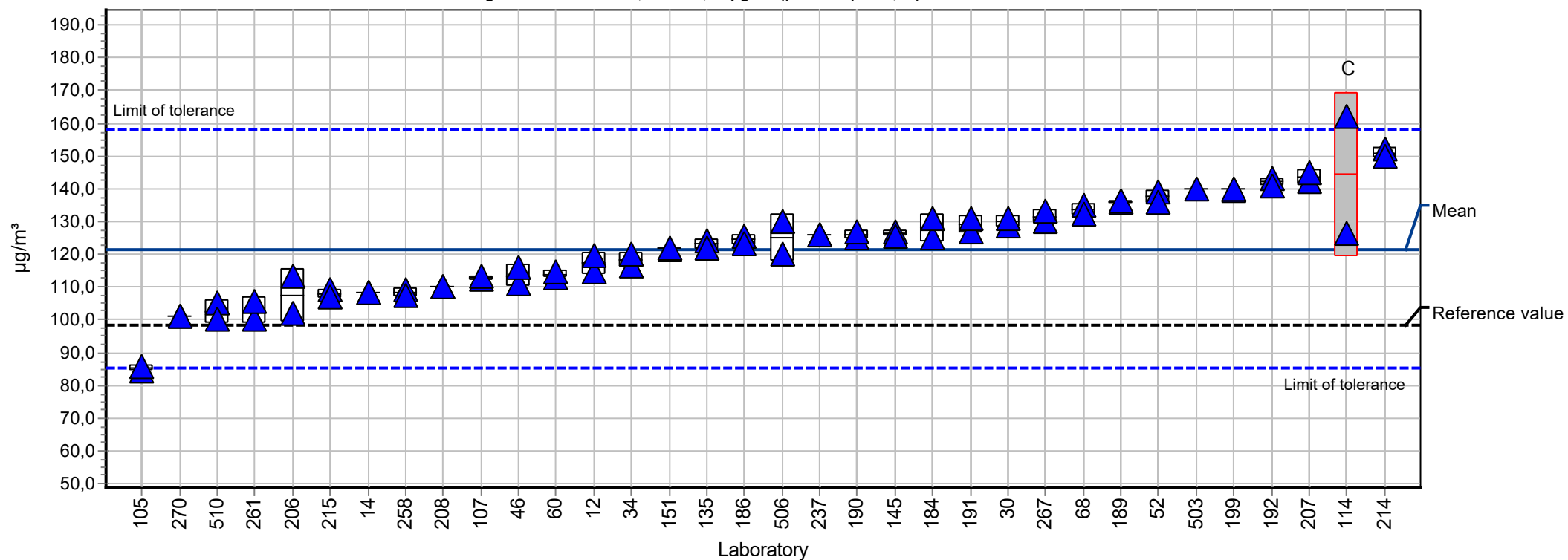
Summary results

Sample:	2	Mean:	51,92 µg/m³
Measurand:	p-Xylene	Reprod. s.d.:	6,89 µg/m³
Method:	ISO 5725-2	Rel.reprod. s.d.:	13,26%
Rel.target s.d.:	15,00% (Limited)	Reference value:	43,20 µg/m³
No. of laboratories:	27	Range of tolerance:	36,35 - 67,50 µg/m³ (Z-Score ≤ 2,00)



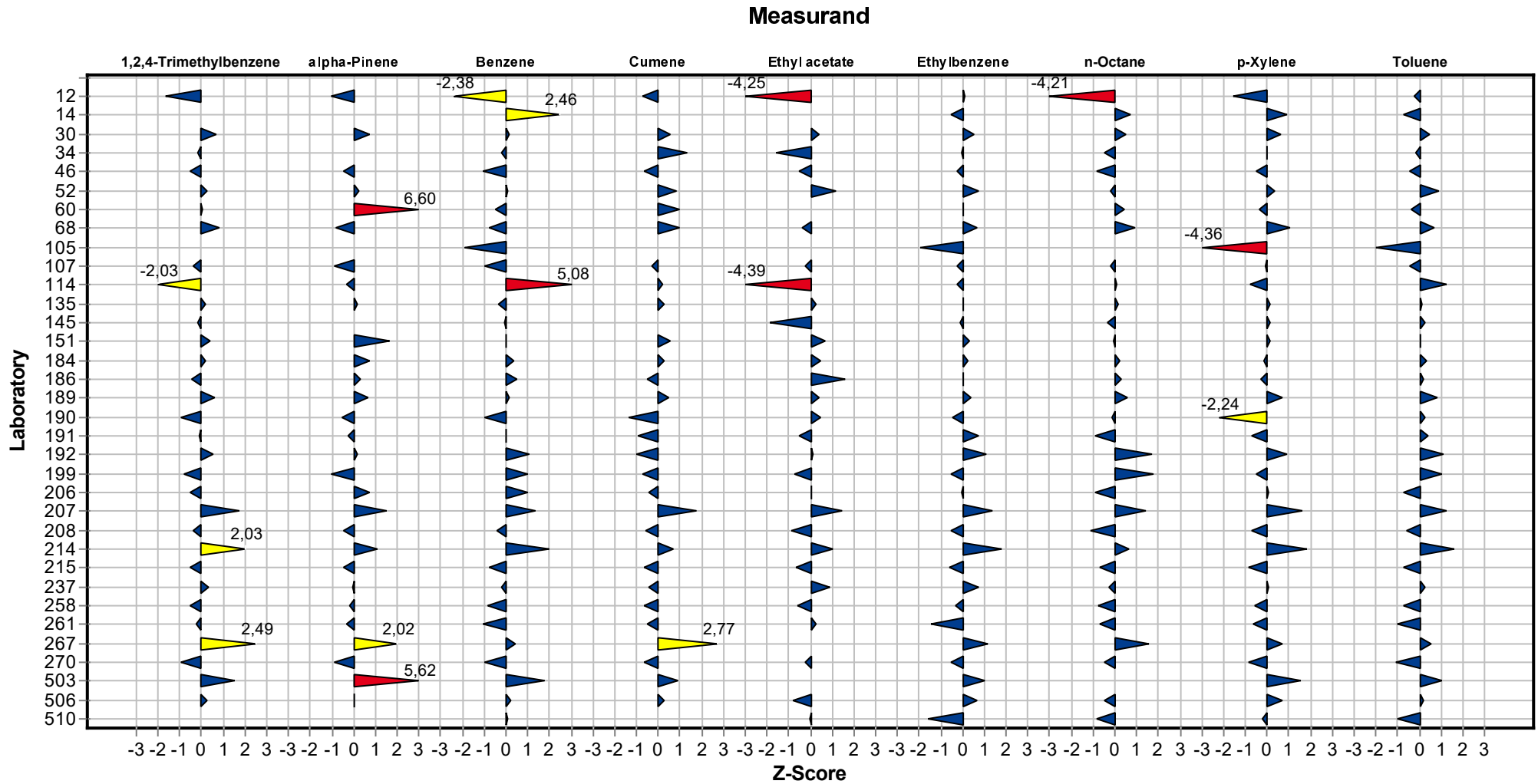
Summary results

Sample:	2	Mean:	121,63 µg/m ³
Measurand:	Toluene	Reprod. s.d.:	14,79 µg/m ³
Method:	ISO 5725-2	Rel.reprod. s.d.:	12,16%
Rel.target s.d.:	15,00% (Limited)	Reference value:	98,40 µg/m ³
No. of laboratories:	33	Range of tolerance:	85,14 - 158,13 µg/m ³ (Z-Score ≤ 2,00)



Sample chart of Z-scores

Sample 2



Summary of laboratory test results

Laboratory	1,2,4-Trimethylbenzene	alpha-Pinene	Benzene	Cumene	Ethyl acetate	Ethylbenzene	n-Octane	p-Xylene	Toluene
Unit	µg/m ³	µg/m ³	µg/m ³	µg/m ³	µg/m ³	µg/m ³	µg/m ³	µg/m ³	µg/m ³
12	0.58	0.35	0.36	0.22	0.28	0.8	0.1	0.28	0.54
14			15.1			3.1	2.1	2.8	2.6
30	< 2	< 2	1.8	< 2	< 2	< 2	< 2	< 2	< 2
34	1.1		0.6	0.3	1.8	1.2		1.1	2.9
46	1		1		2	1	1		2
52					0.4				
60	< 2.5	< 2.5	< 2.5	< 2.5		< 2.5	< 2.5	< 2.5	< 2.5
68	2.4	< 0.1	3.3	1.1	< 0.1	2.7	< 0.1	2.5	6
105						0.1			1.3
107					2.1	1.1		1.0	1.3
114			6.5						
135	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
151	0.4	0.2	0.3	0.2	0.7	0.7		0.3	0.7
184	0.5	0.2	1.3	0.1	0.5	0.6	0.3	0.2	1.5
186	4.2	0.3	3.7	0.2	1.8	0.8	0.3	0.3	1.3
189	2.61								
190	9.54	0.25	0.89	1.37	0.65	0.87	2.18	0.70	1.28
191		< 1							
192	0.23	0.08	0.43		0.29	0.54	0.26	0.62	0.93
199	0.28	0.1	0.63	0.08	0.55	0.42	0.45	0.53	0.9
206	1.3								
207	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
208	0.7		2.3			0.6		0.9	1
214	< 1	< 1	1	< 1	< 1	2	< 1	1	2
215	6.2	1.3	1.7	0.6	2.3	2.0	0.8	3.6	16.0
237			3.8						5.8
258	0.44		2.39		0.51	0.78	1.24	1.03	1.28
261	0.3	0.2	1.2	0.1	0.9	0.5	0.4	0.6	0.8
267	1		2			1	1		2
270	< 2.0	< 2.0	< 1.5	< 2.0	< 4.5	< 2.0	< 2.0	< 2.0	< 4.0
503	< 5	< 5	< 5	< 5		< 5		< 5	< 5
506	0.4		0.9			0.6		0.8	0.9
-	-	-	-	-	-	-	-	-	-
No. of laboratories that submitted results	25	18	26	17	20	26	19	23	27

Summary of laboratory test results

Laboratory	1,2,4-Trimethylbenzene	alpha-Pinene	Benzene	Cumene	Ethyl acetate	Ethylbenzene	n-Octane	p-Xylene	Toluene
Unit	µg/m ³	µg/m ³	µg/m ³	µg/m ³	µg/m ³	µg/m ³	µg/m ³	µg/m ³	µg/m ³
12	0.04	0.11	0.19	0.05	0.04	0.05	0.04	0.06	0.43
14			22.0			1.2	1.1	2.2	6.7
30	2.3	< 2	4.0	< 2	< 2	< 2	< 2	< 2	3.3
34	1.6		2.4	0.9	2.4	2.0	0.6	2.3	3.1
46	1	1	4	1	3	2	1	1	3
52	1.9	1.2	2.2	0.9	2.7	3.8	1.4	2.6	21.8
60	< 2.5	< 2.5	< 2.5	< 2.5		< 2.5	< 2.5	< 2.5	< 2.5
68	2.9	< 0.1	5.1	1.7	< 0.1	3.8	< 0.1	4	8
105						0.8			3.7
107	1.0		1.9	1.0	2.7	1.9	1.0	1.0	3.0
114			6.5						
135	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
151	0.8	0.4	0.3	0.2	1.8	1	0.5	0.5	0.7
184	0.9	0.4	3.2	0.3	1.8	1	0.5	0.6	3.2
186	2.9	0.6	5.9	0.3	2.3	1.2	0.6	0.8	3.0
189			2.89					2.62	4.11
190	6.12	0.51	3.11	6.7	2.23	2.88	4.69	5.49	3.56
192	0.63	0.31	2.36	0.21	1.22	0.87	0.14	1.1	2.64
199	0.74	0.23	2.83	0.14	1.18	0.81	0.5	1.18	2.84
207	2	< 1	4	< 1	2	1	2	< 1	4
208	1.1	0.4	3.9	0.2	2.1	1.1		1.6	2.8
214	2.5	< 1	4	2	< 1	3	< 1	3	12
215	3.3	0.5	3.5	0.8	2.4	1.6	1.1	2.1	3
258	0.92		4.48		1.86	1.29	1.26	1.87	3.40
261	0.6	0.3	2.2	0.2	2.0	0.7	0.5	1.0	2.1
267	1		4			1	1	1	4
270	< 2.0	< 2.0	2.3	< 2.0	< 4.5	< 2.0	< 2.0	< 2.0	< 4.0
503	< 5	< 5	< 5	< 5		< 5		< 5	< 5
506	1.0		2.9		1.9	1.2		1.8	3.1
-	-	-	-	-	-	-	-	-	-
No. of laboratories that submitted results	25	20	28	22	22	27	23	27	28

Questions and Answers

Participant	Sample carrier
14	Carrier is helium
30	Tenax TA
34	Glas, Air Toxics, Perkin Elmer
46	Glasröhrchen mit Tenax TA von Markes
60	manufacturer
68	Tenax TA
105	Tenax-Röhrchen TA 60/80
107	Tenax TA, Glasröhrchen, TDS3(R)-Container (Supelco)
114	CARBOGRAPH 4
135	Tenax TA
145	Gerstel Tenax-TA Carbosiev S3
151	Tenax TA
184	Perkin-Elmer, Tenax
186	Tenax TA
189	Tenax TA
190	Tenax von Supelco
191	/
192	glass, Tenax-TA, Markes
199	Tenax TA; MARKES
206	Glas, Tenax-TA, Supelco
207	Tenax, Markes-Röhrchen
208	Tenax TA-Carbograph 5 TD
214	Tenax TA
215	Glasröhrchen mit Tenax TA von Markes
237	Tenax TA, Markes
258	Tenax TA
261	Tenax TA, CAMSCO
267	Tenax TA
270	Tenax TA, Markes
503	manufacturer

Proficiency testing scheme VOC 2019_Original

Participant Sample carrier

506 Tenax TA-Carbograph 5 TD
 510 Gerstel ThermoDesorptions Tubes, Füllung TenaxTA/Carbosieve SIII

Participant Analytical method Gas chromatograph (GC)

14	DIN EN ISO 16017-1	Agilent 5977B
30	ISO 16000-6	Agilent GC 7890A MS 5975C
34	DIN EN 16017-1	Agilent GC 7890B
46	DIN16516	Shimadzu GC2010
60	DIN ISO 16000-6	Agilent 7890A
68	Auf Basis von EN ISO 16000-5 und ISO 16000-6 wurde eigene Labormethode entwickelt	Agilent 7890B Series GC Custom
105	in Haus-Methode	Agilent 7890B
107	Nein (nur in Anlehnung, nicht exakt Abweichungen insbes. Herstellung der Kalibrierlösungen)	Shimadzu GCMS2010Ultra
114	EN ISO 16000-6	GC SQ8 PERKIN ELMER
135	ISO 16000-6	Agilent 6890N
145	Interne Dow Methode	Agilent 7890B / Agilent MS5977B
151	16017-1	PE Clarus 580
184	DIN ISO 16000-6	Agilent 6890N
186	DIN ISO 16000-6	Perkin Elmer Gold
189	ISO 16000-6	Agilent Technologies, model: 7890A
190	DIN ISO 16000-6	Shimadzu GC-MS-QP 2010
191	ISO 16000-6	HP 7890A
192	ISO16000-6	7890B
199	in Anlehnung an DIN ISO 16000-6:2012-11	Agilent 7890B
206	16017-1	Agilent 7890
207	DIN ISO 16000-6	Agilent 7890
208	in house method modified from ISO16000-6	Agilent 7890/5975
214	DIN ISO 16006-6	GC 6890 Agilent
215	DIN ISO 16000-6	Agilent 6890
237	Hausmethode	PE Clarus 680
258	ISO 16000-6	Agilent 7890B
261	DIN ISO 16000-6	Perkin Elmer MS Clarus SQ8S mit Clarus 680 GC
267	Interne Methode SOP-B-25	Agilent GC 6890N

Proficiency testing scheme VOC 2019_Original

Participant	Analytical method	Gas chromatograph (GC)
270	Hausmethode in Verbindung mit DIN ISO 16000-6	GCMS Shimadzu
503	DIN ISO 16017-1	Agilent 7890A
506	in house method modified from ISO16000-6	Agilent 6890/5973
510	Interne DOW Methode	Agilent 6890 mit MS 5975C

Participant	Thermal desorber	Desorption temperature	Desorption flow	Desorption time
14	Markes Unity-xr	350	50	10
30	Perkin Elmer TD 650	260°C	50 +/- 5	15
34	Markes TD100	300°C	40ml/min	7,5min
46	Markes TD100	280 °C	50 mL/min	15 min
60	MARKES	295	100	5
68	TD100-xr (ATD) von Markes	300°C	50 ml/min	20 min
105	TDS 3C Gerstel	260 (Transfertemperatur 360)	30	58
107	Shimadzu TD-20	285	60	10
114	ATD 650 PERKIN ELMER	300	40	20
135	Perkin Elmer TurboMatrix 650	280°C	29	15
145	Gerstel ThermoDesorption TDS	20°C - 1min, 60°C/min, 260°C 16min	50mL/min	20.17
151	PE TM350	280	75	10
184	Turbomatrix ATD, Perkin-Elmer	280°C	50ml/min	10 min
186	Perkin Elmer Turbomatrix 350	280	50 mL/min	20 min
189	DANI, TD Master	260 °C	34 ml/min	10
190	PerkinElmer TurboMatrix350	280	30	15
191	TDS3 Gerstel	260 °C	/	10
192	TD-100xr	270 degC	30ml/min	10min
199	TD-100 von MARKES	250 °C	50	5
206	Perkin-Elmer T-ATD	275 °C	50 ml	3
207	Markes Unity TD 100	300	20	8
208	Markes TD100	280	50	10
214	Markes Unity / Ultra	300°C	50 ml/min	10
215	Perkin Elmer ATD	300°C	30	10
237	PE Turbomatrix	300 °C	30	10
258	Markes Ultra-xr	280°C	50	15

Proficiency testing scheme VOC 2019_Original

Participant	Thermal desorber	Desorption temperature	Desorption flow	Desorption time
261	Perkin Elmer TurboMatrix 350	270 °C	30 ml/min	15 min
267	MARKES TD100	280°C	50ml/min	15 min
270	TD-20 Shimadzu	280 °C	60	15
503	MARKES	295	100	10
506	Markes Unity2/Ultra	280	50	10
510	Gerstel ThermoDesorption TDS	20° - 1min, 60° pro min, 260° 16min	50ml/min	21.17 Minuten

Participant	Cryo trap	Carrier gas	Carrier gas flow
14	-20 end 350	Carrier is helium	1.0 ml/min
30	-30 and 280°C	He	1
34	Kühlfalle: -20°C, Heiztemperatur: 300°C	Helium	1,4ml/min
46	-10 °C / 310 °C	He	4,8 mL/min (Total Flow)
60	-10 to 300	Helium	2.5
68	-20°C / 300°C	Helium	15 ml/min
105	-150	He	2
107	-5 dann 285	He	Säulenfluss 1.17 ml/min (27.5 cm/s linear vel constant)
114	-30°C/310°C	HELIUM	1
135	-20°C ... 300°C	Helium	1,5
145	-150°C	Helium	2.1
151	-30 to 300	helium	1.0
184	-30°C auf 290°C	Helium	1ml/min
186	-30°C to 280°C at 45°C/sec	Helium	2mL/min
189	cryo temperature=-35, heating temperature=300°C	helium	0,44 ml/min
190	-25 und 300	Helium	2
191	-150 /	He	0.8 mL/min
192	cryo trap at 5degC and desorb at 280 degC	Helium	1.3ml/min
199	25-300 °C	Helium	0,7
206	-30 °C	Helium	1
207	-25	Helium	1,2
208	-20 300	He	1
214	10°C bis 300°C	He	1 ml/min
215	0°C	Helium	4,6

Proficiency testing scheme VOC 2019_Original

Participant	Cryo trap	Carrier gas	Carrier gas flow
237	-20°C/ +270°C	Helium	0,5
258	-30°C; 300°C	Helium	1.3
261	-8 / 275 °C	Helium	1,6 ml/min
267	0°C - 300°C	He	1,5 ml/min
270	-18 °C, 280 °C	TD:N2, GC:He	
503	20 - 300	Helium	2.7
506	-20 300	He	1
510	-150° Celsius	Helium	2ml/min

Participant	Analytical column	Detector
14	Zebtron ZB-624 plus 60 mt 0.32 mm 1.80 µm	Mass spectrometer
30	Rxi-5ms 55 m x 0.25 µm	FID / MS
34	DB625 60m x 250µm x 1,4µm	Agilent MSD 5977A
46	Rxi (R) - 5Sil MS (60 m, 0,25 mmID, 1 µm df)	MS
60	HP-5MS	MS
68	Vocol von Supelco	7000D Quadrupol MS/MS von Agilent
105	Agilent 122-1364 (DB-624)	FID
107	MN Optima 5MS Accent 60Meter 1µm Filmdicke	MS
114	ELITE 5 MS 60M 0.25MM	MASS SPECTROMETRY
135	RTX-200	MSD
145	CP-Select 624 CB, 60m, 0.25mm, 1,4µm	FID / MS
151	RXi5	FID
184	Restek RTX-200	MSD
186	Elite 5MS	MS
189	HP-5MS - 50m×0,20mm×0,33µm	Agilent Technologies, model: 5975C
190	RXI-5ms5 60 m Lang	MS
191	Rxi-5MS	MSD 5975C Triple a (G3172A)
192	Inert Cap-1(60cm length, 0.25mm daim, 1.5um film)	5977B MSD
199	DB-5.625MS	Massendetektor (5977A MSD)
206	Restek Rtx-5	Leco-TOF
207	DB 5	MS Agilent 5977
208	HP-5	MSD

Proficiency testing scheme VOC 2019_Original

Participant	Analytical column	Detector
214	Agilent CP 9013	MSD
215	Agilent VF-5MS (60m x 0,32mm x 1.0µm)	FID & MS
237	Varian XMS VF	MSD
258	Agilent HP-Ultra 2	Agilent 5977B MS
261	Elite-VMS 30m, PE	MSD Clarus SQ8 von Perkin Elmer
267	HP INNOWAX 60m x 0.32mm x 0.5µm	MSD Agilent 5973 inert
270	Testel RXI5sil-ms	MS
503	HP-5MS	MS
506	HP-5	MSD
510	DB 624, 60m 0.25mm - 1.4µm	FID + MS

Participant	Data evaluation
14	24/04/2019
30	Identification by MS / Calibration by FID
34	Masshunter
46	Im SCAN-Modus wurden die Areas des TICs integriert und mit einer substanzspezifischen Kalibrierung die Konzentrationen bestimmt
68	Identifikation mit MS; Quantifizierung mit entspr. Berechnung in einem Excelfile
105	Quantifiziert mit FID, identifiziert mit MS
107	Identifizierung durch Ret-Zeit-Fenster und SIM-mz und Referenzionenverhältnis; Quantifizierung anhand mz-Fläche, Kalibrierung extern, jede Substanz einzeln d.h. nicht als Toluoläquivalent
135	externer Standard; Massenspektren- und Retentionszeitvergleich
145	Quantifiziert mittels FID / Qualifiziert mittels MS
151	external standards
184	Kalibrierung mit internem Standard
186	External calibration
189	Identification by MSD and quantification using daily specific response factor 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 where was used ion extraction (ion 78) and n-octane where was used ion extraction (ion 71).
190	Quantifizierung: Kalibration und ohne internen Standard; Identifizierung über Massenspektren
191	specific quantification & identification
199	externe Standards mit Korrektur über interne Standards
206	ext. Standard
207	EIC Originalreferenzen, eigene und kommerzielle Bibliotheken

Proficiency testing scheme VOC 2019_Original

Participant	Data evaluation
208	quantification and identification done with pure reference compounds
214	externe Kalibrierung, ident mit Standard,
215	Quantifizierung FID, Identifizierung MS
237	externe Kalibration mit IS
258	External standards, mass spectra and SIM
261	Interner Standard, 5 Punkt Eichung
267	NeinQuantifizierung mittels spezifischer Massenfragmente, Identifizierung mittels NIST Bibliothek
270	Interne Standards mit RRF zu externen Standards, externe Standards
506	quantification and identification done with pure reference compounds
510	quantifiziert mittels FID, qualifiziert mittels MS

Participant	Recovery rate	Date of analysis
14	Yes	22/04/2019
30	no	09 and 15/04/2019
34	Nein	21.03.2019
46	nein	28/03/2019
60	No	21/03/2019
68	Nein	15./16.4.2019
105	nein	26.3.19
107	Nein	28. und 29.03.2019
114	NO	19/04/2019
135	nein	08.04.2019
145		25.03.2019
151	No	03/04/19
184	nein	03.04.2018-10.04.2018
186	No	18/04/2019
189	No	22/04/2019, 23/04/2019 and 24/04/2019
190	nein	09.04.2019
191	no	03/29/2019
192		16 April 2019
199	nein	05.04.2019/17.04.2019
206	ja	26. und 29.03.2019

Proficiency testing scheme VOC 2019_Original

Participant	Recovery rate	Date of analysis
--------------------	----------------------	-------------------------

207		27.03.2019
-----	--	------------

208	no	30.3.2019
-----	----	-----------

214	nein	8.4.2019
-----	------	----------

215	nein	25./26.03.2019
-----	------	----------------

237	nein	02.05.2019
-----	------	------------

258	No	April 18, 2019
-----	----	----------------

261	nein	02.04.2019
-----	------	------------

267	Nein	05/04/2019
-----	------	------------

270	ja	28.03.19
-----	----	----------

503	No	28/03/2019
-----	----	------------

506	no	8.4.2019
-----	----	----------

510		26.03.2019
-----	--	------------