IFA
Institut für Arbeitsschutz der
Deutschen Gesetzlichen Unfallversicherung

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

Proficiency testing scheme “Organic solvents with own sampling”

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Institute for Occupationial Safety and Health of the
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Summary of laboratory test results

Sample 1

	1-Butanol	Z score	1-Methoxy-2-propanol	Z score	1-Propanol	Z score	2-Butanol	Z score
Unit	mg/m³		mg/m³		mg/m³		mg/m³	
5	169,35	-0,31	88,29	-1,32	63,49	0,07	79,92	0,62
20	151,83	-1,31	71,97	-2,92 E	52,30	-1,70	62,41	-1,71
26	187,85	0,75	114,75	1,28	77,50	2,29 E	87,75	1,66
37	185,00	0,59	94,10	-0,75	64,70	0,26	73,20	-0,28
66	212,63	2,17 E	121,22	1,92	66,85	0,60	89,19	1,85
72	184,28	0,55	127,33	2,52 E	64,54	0,24	85,90	1,41
76	186,00	0,64	143,00	4,06 FE	120,00	9,04 BE	110,00	4,61 BE
78	190,49	0,90	102,27	0,05	66,79	0,60	77,50	0,30
111	164,00	-0,62	97,40	-0,42	57,90	-0,82	65,20	-1,34
116	142,00	-1,87	89,20	-1,23			67,30	-1,06
138	179,00	0,24	107,00	0,52	54,80	-1,31	73,10	-0,29
150	178,00	0,19	121,00	1,90	65,20	0,34	74,80	-0,06
154	198,31	1,35	115,91	1,40	78,07	2,38 E	86,67	1,51
157	163,90	-0,62	92,70	-0,89	57,70	-0,85	73,10	-0,29
158	192,40	1,01	107,80	0,60	63,00	-0,01	85,90	1,41
212	168,52	-0,36	101,46	-0,03	60,69	-0,37	66,26	-1,20
231	149,60	-1,44	111,56	0,97	59,44	-0,57	76,32	0,14
242	171,26	-0,20	93,74	-0,78	60,64	-0,38	72,47	-0,37
244	171,15	-0,21	102,11	0,04	61,00	-0,32	76,43	0,15
252								
269	171,40	-0,19	85,70	-1,57	63,70	0,10	70,10	-0,69
271	139,10	-2,04 E	94,60	-0,70	57,90	-0,82	68,10	-0,95
516	177,37	0,15	95,95	-0,57	62,51	-0,08	70,21	-0,67
517	185,89	0,64			65,08	0,32	74,22	-0,14
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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		23	

	1-Butanol	Z score	1-Methoxy-2-propanol	Z score	1-Propanol	Z score	2-Butanol	Z score
Mean	174,75		101,72		63,04		75,27	
Reprod. s.d.	17,89		13,65		6,21		7,78	
Rel. reproducibility s.d.	10,24 %		13,42 %		9,85 %		10,34 %	
Reference value	185,30		102,40		63,50		79,90	
Target s.d.	17,48		10,17		6,30		7,53	
Rel. target s.d.	10,00 %		10,00 %		10,00 %		10,00 %	
Low er limit of tolerance	139,80		81,37		50,43		60,22	
Upper limit of tolerance	209,70		122,06		75,65		90,33	
Type B outliers					1		1	
Type F 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		21		21		22	

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	

	2-Propanol	Z score		i-Butanol	Z score	
Unit	mg/m³			mg/m³		
5	50,52	0,27		74,45	-0,68	
20	47,34	-0,37		64,69	-1,91	
26	59,25	2,05	E	92,75	1,61	
37	49,30	0,02		73,90	-0,75	
66	73,44	4,93	BE	98,41	2,31	E
72	48,74	-0,09		78,10	-0,23	
76	53,40	0,86		86,20	0,79	

	2-Propanol	Z score	i-Butanol	Z score
78	52,73	0,72	81,41	0,19
111	44,90	-0,87	72,00	-0,99
116	36,70	-2,54 E	62,40	-2,19 E
138	48,50	-0,14	78,80	-0,14
150	53,90	0,96	79,70	-0,03
154	59,05	2,01 E	90,96	1,38
157	46,40	-0,57	72,10	-0,98
158	48,40	-0,16	87,10	0,90
212	47,29	-0,39	74,44	-0,69
231	46,54	-0,54	99,77	2,48 E
242	47,53	-0,34	73,29	-0,83
244	47,09	-0,43	80,17	0,03
252	47,20	-0,40		
269	49,50	0,06	74,60	-0,67
271	48,00	-0,24	90,10	1,27
516	48,85	-0,07	74,32	-0,70
517	50,10	0,19	78,43	-0,19
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Method	ISO 5725-2		ISO 5725-2	
Assessment	|Z|<=2,00		|Z|<=2,00	
No. of laboratories that submitted results	24		23	
Mean	49,18		79,92	
Reprod. s.d.	4,59		9,74	
Rel. reproducibility s.d.	9,34 %		12,19 %	
Reference value	48,70		79,10	
Target s.d.	4,92		7,99	
Rel. target s.d.	10,00 %		10,00 %	
Low er limit of tolerance	39,35		63,93	
Upper limit of tolerance	59,02		95,90	
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		23	

Summary of laboratory test results

Sample 2

	1,2,4-Trimethylbenzene	Z score	Cumene	Z score	Ethylacetate	Z score	Ethylbenzene	Z score
Unit	mg/m³		mg/m³		mg/m³		mg/m³	
5	61,12	0,63	11,98	-0,24	69,52	-0,47	21,21	-0,20
20	62,73	0,91	11,64	-0,52	66,47	-0,88	21,60	-0,02
26	59,49	0,35	12,39	0,09	79,48	0,90	22,18	0,25
37	42,20	-2,66 E	12,20	-0,06	116,00	5,91 BE	21,30	-0,16
66	35,86	-3,76 FE	12,48	0,17	70,99	-0,26	19,59	-0,95
72	59,85	0,41	12,39	0,09	70,64	-0,31	24,04	1,11
76	62,80	0,92	12,50	0,18	77,40	0,62	23,00	0,63
78	57,35	-0,03	11,84	-0,35	77,26	0,60	19,87	-0,82
111	58,50	0,17	11,70	-0,47	65,90	-0,96	22,20	0,26
116	41,95	-2,70 E	9,65	-2,14 E	43,75	-4,00 BE	17,00	-2,15 E
138	59,50	0,35	11,90	-0,31	72,40	-0,07	21,70	0,03
150	54,10	-0,59	14,30	1,65	69,60	-0,45	22,20	0,26
154	59,65	0,37	12,43	0,13	81,65	1,20	21,70	0,03
157	64,40	1,20	14,50	1,81	72,40	-0,07	25,40	1,74
158	57,90	0,07	11,80	-0,39	80,20	1,00	22,60	0,44
212	64,34	1,19	12,14	-0,11	70,67	-0,31	23,19	0,71
231	59,69	0,38	11,57	-0,57	74,27	0,19	21,87	0,11
242	58,75	0,22	13,29	0,82	66,69	-0,85	20,70	-0,44
244	53,38	-0,72	12,78	0,41	69,68	-0,44	21,92	0,13
252					68,70	-0,58		
269	62,30	0,83	13,30	0,83	72,00	-0,13	22,00	0,17
271	51,20	-1,10	11,20	-0,88	69,30	-0,50	19,80	-0,85
283	47,90	-1,67	11,20	-0,88	85,30	1,70	20,00	-0,76
516	59,50	0,35	11,70	-0,47	73,35	0,06	21,64	0,00
517	63,94	1,12	13,73	1,19	73,11	0,03	22,72	0,50
–	–	– –	–	– –	–	– –	–	– –
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	

	1,2,4-Trimethylbenzene	Z score	Cumene	Z score	Ethylacetate	Z score	Ethylbenzene	Z score
No. of laboratories that submitted results	24		24		25		24	
Mean	57,50		12,28		72,91		21,64	
Reprod. s.d.	6,37		1,04		5,11		1,66	
Rel. reproducibility s.d.	11,08 %		8,51 %		7,01 %		7,68 %	
Reference value	63,60		11,80		68,70		22,10	
Target s.d.	5,75		1,23		7,29		2,16	
Rel. target s.d.	10,00 %		10,00 %		10,00 %		10,00 %	
Low er limit of tolerance	46,00		9,82		58,33		17,31	
Upper limit of tolerance	69,00		14,73		87,49		25,97	
Type B outliers					2			
Type F 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		24		23		24	
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								

	m-Xylene	Z score	n-Hexane	Z score	o-Octane	Z score	Toluene	Z score
Unit	mg/m³		mg/m³		mg/m³		mg/m³	
5	61,27	0,15	42,11	-0,23	159,85	-0,14	81,42	-0,26
20	62,59	0,37	43,50	0,10	156,24	-0,37	83,98	0,05
26	58,61	-0,29	47,69	1,07	179,30	1,06	89,95	0,76
37	55,50	-0,81	45,00	0,45	165,00	0,17	86,20	0,31
66	55,00	-0,89			161,09	-0,07	68,13	-1,85
72	62,15	0,29	40,78	-0,53	161,99	-0,01	84,65	0,13

	m-Xylene	Z score	n-Hexane	Z score	o-Octane	Z score	Toluene	Z score
76	65,40	0,83	45,60	0,59	180,00	1,10	92,30	1,04
78	60,32	-0,01	42,56	-0,12	166,48	0,27	84,59	0,12
111	60,00	-0,06	41,30	-0,41	157,00	-0,32	81,30	-0,27
116	44,75	-2,59 BE	19,85	-5,39 BE	138,50	-1,46	60,40	-2,77 BE
138	60,70	0,05	42,50	-0,13	173,00	0,67	84,90	0,16
150	63,20	0,47	34,80	-1,92	151,00	-0,69	70,30	-1,59
154	56,96	-0,57	45,85	0,64	180,88	1,15	88,06	0,54
157	65,00	0,77	46,00	0,68	182,00	1,22	90,10	0,78
158	60,40	0,00	47,20	0,96	164,90	0,17	89,70	0,73
212	64,11	0,62	42,89	-0,04	163,60	0,09	87,86	0,51
231	59,03	-0,22	36,95	-1,42	108,86	-3,29 E	82,02	-0,19
242	58,44	-0,32	39,05	-0,94	155,80	-0,39	80,15	-0,41
244	58,61	-0,29	40,46	-0,61	153,29	-0,55	83,23	-0,04
252							81,00	-0,31
269	63,20	0,47	43,30	0,05	169,80	0,47	86,40	0,34
271	54,30	-1,01	37,00	-1,41	120,20	-2,59 E	75,50	-0,97
283	57,90	-0,41	52,80	2,26 E	203,00	2,52 E	79,60	-0,47
516	61,48	0,18	46,38	0,77	167,34	0,32	86,28	0,32
517	64,47	0,68	44,02	0,22	173,22	0,68	88,05	0,54
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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	24		23		24		25	
Mean	60,38		43,08		162,18		83,57	
Reprod. s.d.	3,18		4,07		19,63		5,93	
Rel. reproducibility s.d.	5,27 %		9,44 %		12,10 %		7,09 %	
Reference value	63,70		42,50		165,00		87,50	
Target s.d.	6,04		4,31		16,22		8,36	
Rel. target s.d.	10,00 %		10,00 %		10,00 %		10,00 %	
Low er limit of tolerance	48,30		34,46		129,74		66,86	
Upper limit of tolerance	72,45		51,70		194,62		100,28	
Type B outliers	1		1				1	
No. of laboratories after elimination of outliers type A-D and F (w ithout	23		22		24		24	

	m-Xylene	Z score	n-Hexane	Z score	o-Octane	Z score	Toluene	Z score
laboratories that only gave states but no measured values)								

Summary of laboratory test results

Sample 3

	1,2,4-Trimethylbenzene	Z score	Cumene	Z score	Ethylacetate	Z score	Ethylbenzene	Z score
Unit	mg/m³		mg/m³		mg/m³		mg/m³	
5	30,91	0,15	21,59	-0,69	126,03	-0,40	16,26	-0,42
20	31,78	0,44	21,15	-0,88	116,00	-1,16	16,39	-0,34
26	32,75	0,75	22,34	-0,36	144,33	1,00	16,95	-0,01
37	24,00	-2,12 E	22,50	-0,29	223,00	6,99 BE	16,80	-0,10
66	18,38	-3,96 FE	22,13	-0,45	136,11	0,37	16,66	-0,18
72	31,48	0,34	22,82	-0,16	128,03	-0,24	18,69	1,01
76	34,90	1,46	23,40	0,09	153,00	1,66	18,00	0,60
78	31,24	0,26	22,11	-0,46	146,34	1,15	15,67	-0,77
111	30,30	-0,05	21,50	-0,73	128,00	-0,25	17,10	0,07
116	25,40	-1,66	20,70	-1,07	78,80	-3,99 BE	15,00	-1,16
138	29,70	-0,25	21,80	-0,60	132,00	0,06	16,60	-0,22
150	28,60	-0,61	26,40	1,39	124,00	-0,55	17,60	0,37
154	34,36	1,28	22,52	-0,29	152,39	1,61	17,16	0,11
157	33,60	1,03	24,40	0,53	131,50	0,02	19,50	1,49
158	34,50	1,33	25,10	0,83	138,60	0,56	19,00	1,19
212	33,88	1,13	22,02	-0,50	127,40	-0,29	17,85	0,52
231	31,59	0,37	26,82	1,57	113,37	-1,36	17,06	0,05
242	30,62	0,05	24,57	0,60	119,07	-0,93	16,06	-0,54
244	27,39	-1,01	23,04	-0,06	125,47	-0,44	17,32	0,20
252					122,90	-0,63		
269	31,40	0,31	24,30	0,48	126,10	-0,39	16,60	-0,22
271	27,50	-0,97	28,00	2,08 E	114,00	-1,31	16,00	-0,57
283	21,20	-3,04 E	20,20	-1,29	152,00	1,58	14,90	-1,22
516	29,95	-0,17	21,28	-0,82	128,61	-0,20	16,52	-0,27
517	33,39	0,96	25,65	1,06	132,84	0,12	17,69	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	

	1,2,4-Trimethylbenzene	Z score	Cumene	Z score	Ethylacetate	Z score	Ethylbenzene	Z score
No. of laboratories that submitted results	24		24		25		24	
Mean	30,45		23,18		131,22		16,97	
Reprod. s.d.	3,49		2,05		11,83		1,13	
Rel. reproducibility s.d.	11,46 %		8,85 %		9,02 %		6,67 %	
Reference value	32,30		21,50		121,40		16,80	
Target s.d.	3,05		2,32		13,12		1,70	
Rel. target s.d.	10,00 %		10,00 %		10,00 %		10,00 %	
Low er limit of tolerance	24,36		18,54		104,98		13,58	
Upper limit of tolerance	36,54		27,82		157,47		20,37	
Type B outliers					2			
Type F 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		24		23		24	
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								

	m-Xylene	Z score	n-Hexane	Z score	o-Octane	Z score	Toluene	Z score
Unit	mg/m³		mg/m³		mg/m³		mg/m³	
5	28,12	-0,19	28,30	-0,09	204,85	-0,08	44,98	-0,18
20	28,46	-0,07	28,86	0,10	198,03	-0,41	45,29	-0,11
26	32,84	1,46	29,65	0,38	217,83	0,55	47,86	0,45
37	26,20	-0,86	31,40	0,99	218,00	0,55	45,40	-0,09
66	26,12	-0,88			209,43	0,14	35,64	-2,22 E
72	29,54	0,31	27,28	-0,45	210,45	0,19	47,13	0,29

	m-Xylene	Z score	n-Hexane	Z score	o-Octane	Z score	Toluene	Z score
76	32,30	1,27	32,80	1,48	232,00	1,23	52,20	1,40
78	28,93	0,10	27,78	-0,28	215,78	0,45	47,32	0,33
111	28,50	-0,05	28,20	-0,13	207,00	0,02	45,90	0,02
116	24,20	-1,55	15,30	-4,64 BE	171,00	-1,72	36,80	-1,96
138	27,30	-0,47	27,60	-0,34	224,00	0,85	46,10	0,07
150	30,10	0,51	21,40	-2,51 E	185,00	-1,04	43,60	-0,48
154	28,05	-0,21	30,52	0,68	229,33	1,10	50,55	1,04
157	31,10	0,85	30,80	0,78	230,80	1,17	49,70	0,85
158	32,60	1,38	31,50	1,03	224,10	0,85	50,80	1,09
212	30,63	0,69	28,90	0,12	210,38	0,19	48,19	0,52
231	29,10	0,16	23,62	-1,73	143,69	-3,04 E	45,15	-0,14
242	27,13	-0,53	25,76	-0,98	199,89	-0,32	43,97	-0,40
244	27,72	-0,32	27,76	-0,28	194,58	-0,58	46,90	0,24
252							44,90	-0,20
269	28,40	-0,09	27,80	-0,27	213,20	0,32	46,10	0,07
271	27,60	-0,37	24,60	-1,39	146,10	-2,93 E	42,50	-0,72
283	24,60	-1,41	34,80	2,18 E	238,00	1,52	41,80	-0,87
516	28,08	-0,20	29,94	0,48	209,57	0,15	47,42	0,36
517	30,00	0,47	29,28	0,25	224,06	0,85	48,63	0,62
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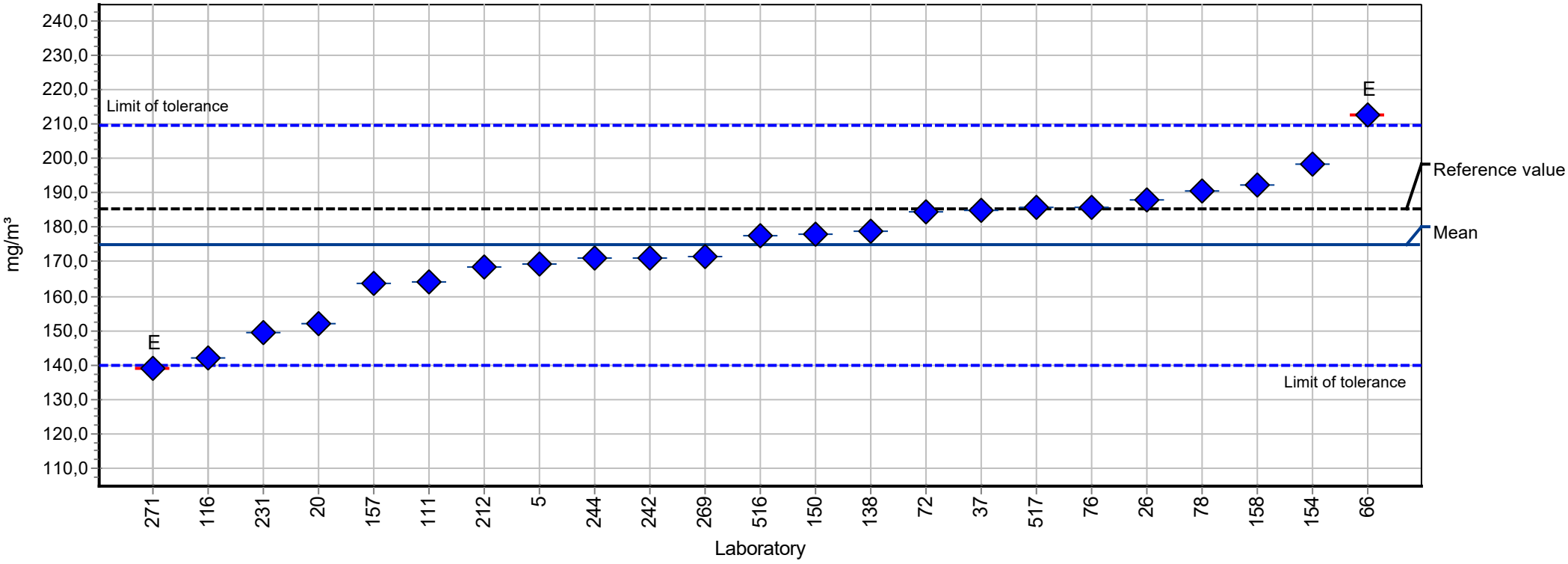
Method	ISO 5725-2		ISO 5725-2		ISO 5725-2		ISO 5725-2	
Assessment	|Z|<=2,00		|Z|<=2,00		|Z|<=2,00		|Z|<=2,00	
No. of laboratories that submitted results	24		23		24		25	
Mean	28,65		28,57		206,54		45,79	
Reprod. s.d.	2,26		3,01		24,40		3,83	
Rel. reproducibility s.d.	7,88 %		10,53 %		11,81 %		8,36 %	
Reference value	28,90		27,80		208,60		47,10	
Target s.d.	2,87		2,86		20,65		4,58	
Rel. target s.d.	10,00 %		10,00 %		10,00 %		10,00 %	
Low er limit of tolerance	22,92		22,86		165,24		36,63	
Upper limit of tolerance	34,38		34,28		247,85		54,95	
Type B outliers			1					
No. of laboratories after elimination of outliers type A-D and F (w ithout	24		22		24		25	

	m-Xylene	Z score	n-Hexane	Z score	o-Octane	Z score	Toluene	Z score
laboratories that only gave states but no measured values)								

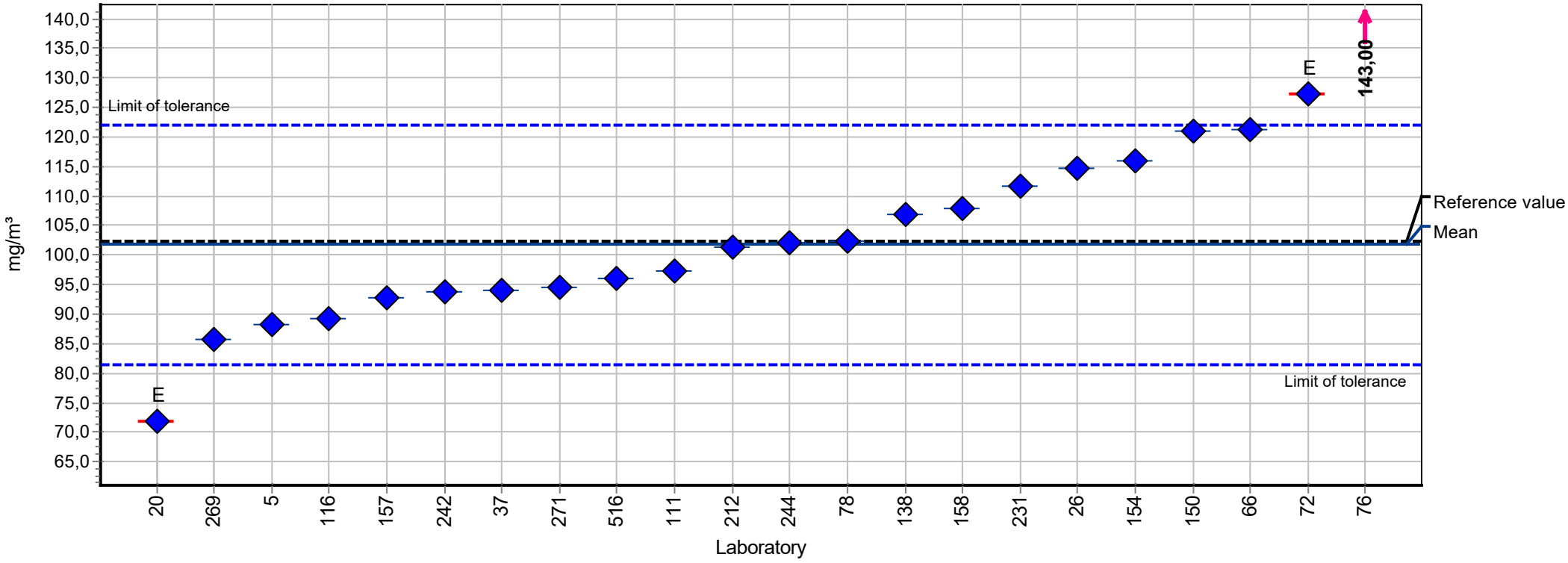
Summary results

Sample:	**1**	**Mean:**	**174,75 mg/m³**
Measurand:	**1-Butanol**	**Reprod. s.d.:**	**17,89 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**10,24%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**185,30 mg/m³**
Number of laboratories in calculation:	**23**	**Range of tolerance:**	**139,80 - 209,70 mg/m³ (|Z-Score| <= 2,00)**



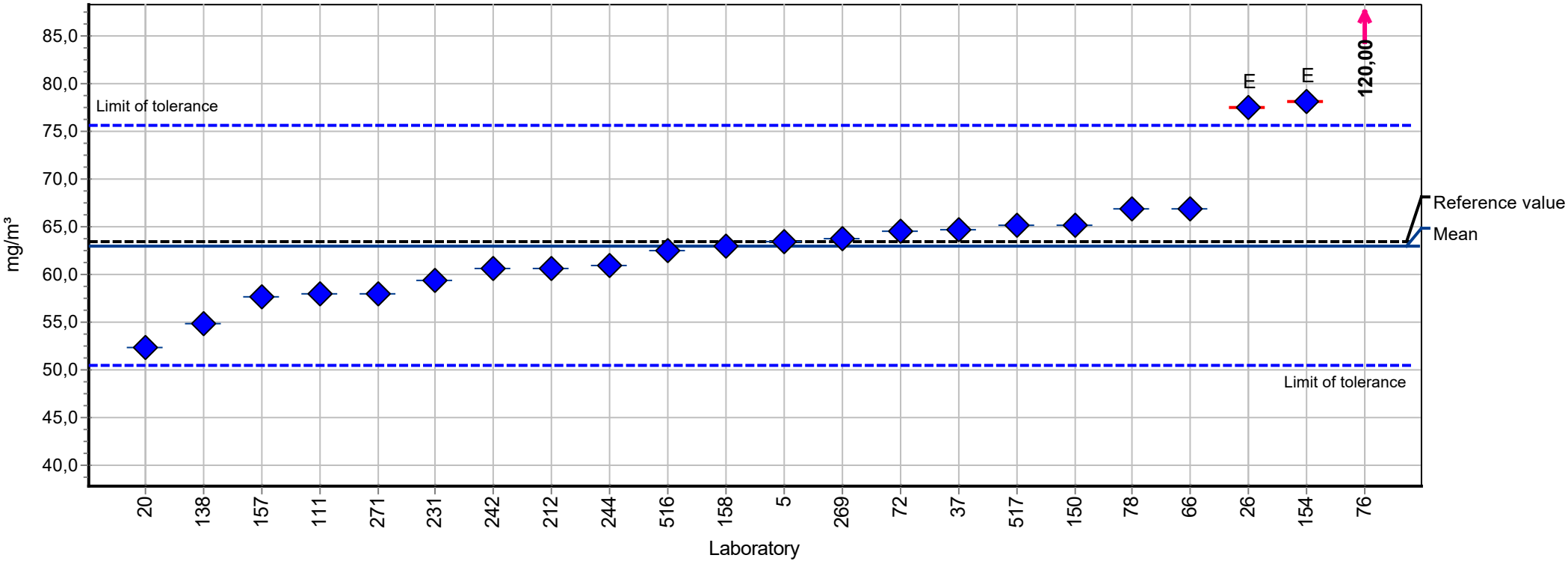
Summary results

Sample:	**1**	**Mean:**	**101,72 mg/m³**
Measurand:	**1-Methoxy-2-propanol**	**Reprod. s.d.:**	**13,65 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**13,42%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**102,40 mg/m³**
Number of laboratories in calculation:	**21**	**Range of tolerance:**	**81,37 - 122,06 mg/m³ (|Z-Score| <= 2,00)**



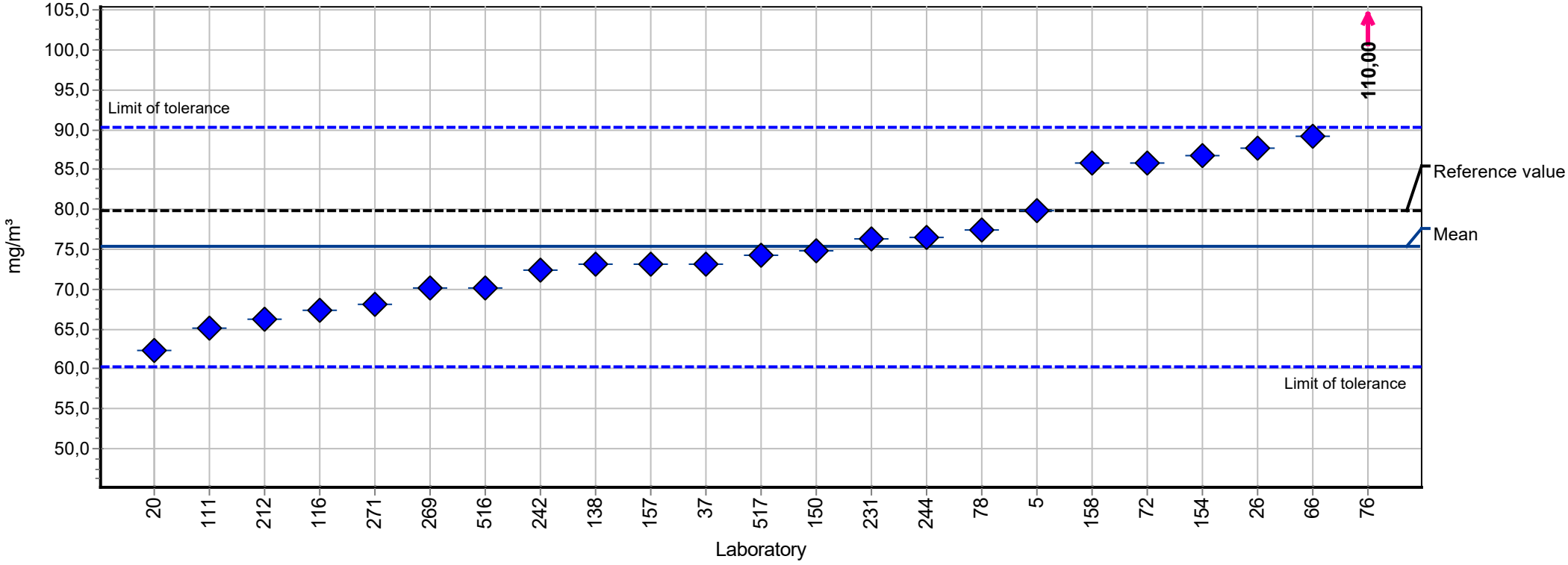
Summary results

Sample:	**1**	**Mean:**	**63,04 mg/m³**
Measurand:	**1-Propanol**	**Reprod. s.d.:**	**6,21 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**9,85%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**63,50 mg/m³**
Number of laboratories in calculation + outliers:	**22**	**Range of tolerance:**	**50,43 - 75,65 mg/m³ (|Z-Score| <= 2,00)**



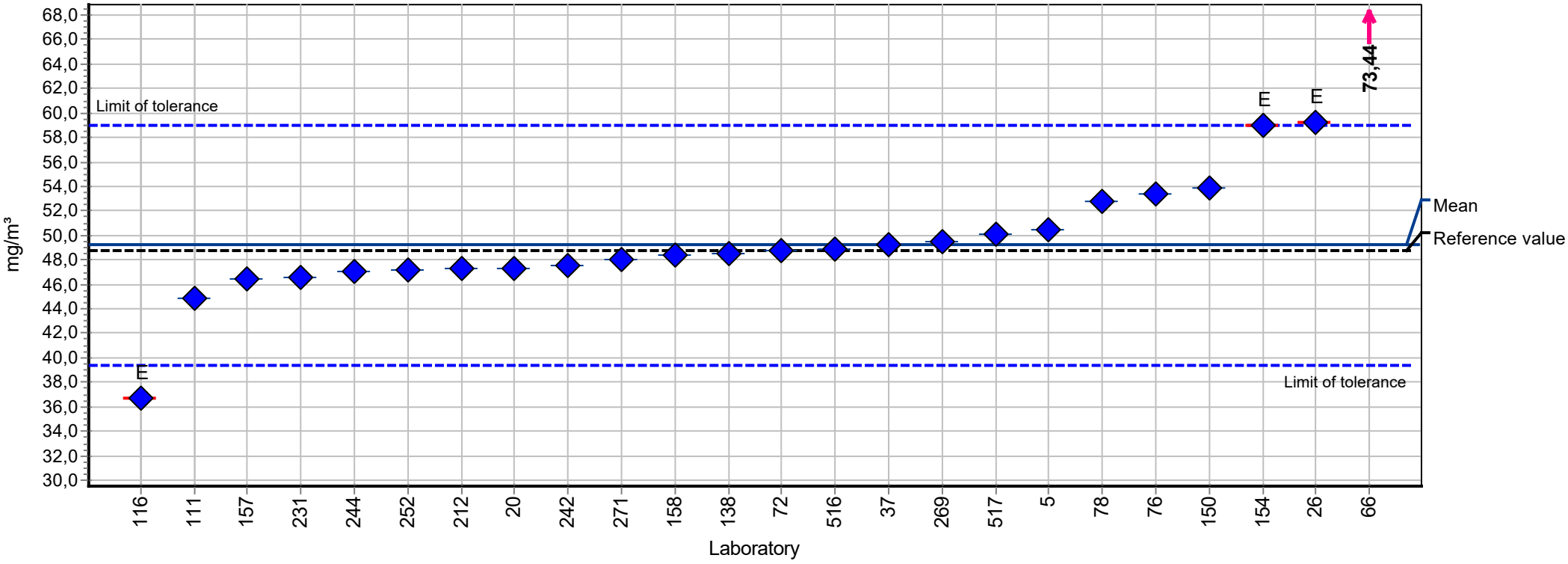
Summary results

Sample:	**1**	**Mean:**	**75,27 mg/m³**
Measurand:	**2-Butanol**	**Reprod. s.d.:**	**7,78 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**10,34%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**79,90 mg/m³**
Number of laboratories in calculation + outliers:	**23**	**Range of tolerance:**	**60,22 - 90,33 mg/m³ (|Z-Score| <= 2,00)**



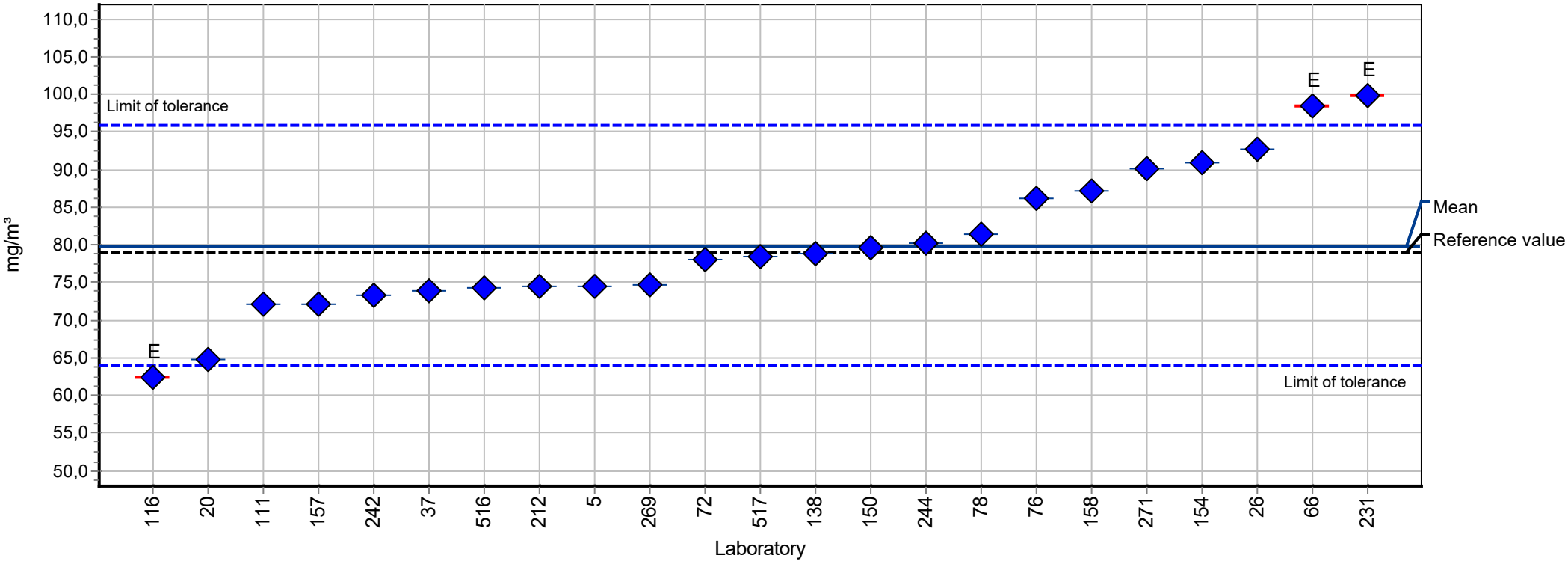
Summary results

Sample:	**1**	**Mean:**	**49,18 mg/m³**
Measurand:	**2-Propanol**	**Reprod. s.d.:**	**4,59 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**9,34%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**48,70 mg/m³**
Number of laboratories in calculation + outliers:	**24**	**Range of tolerance:**	**39,35 - 59,02 mg/m³ (|Z-Score| <= 2,00)**



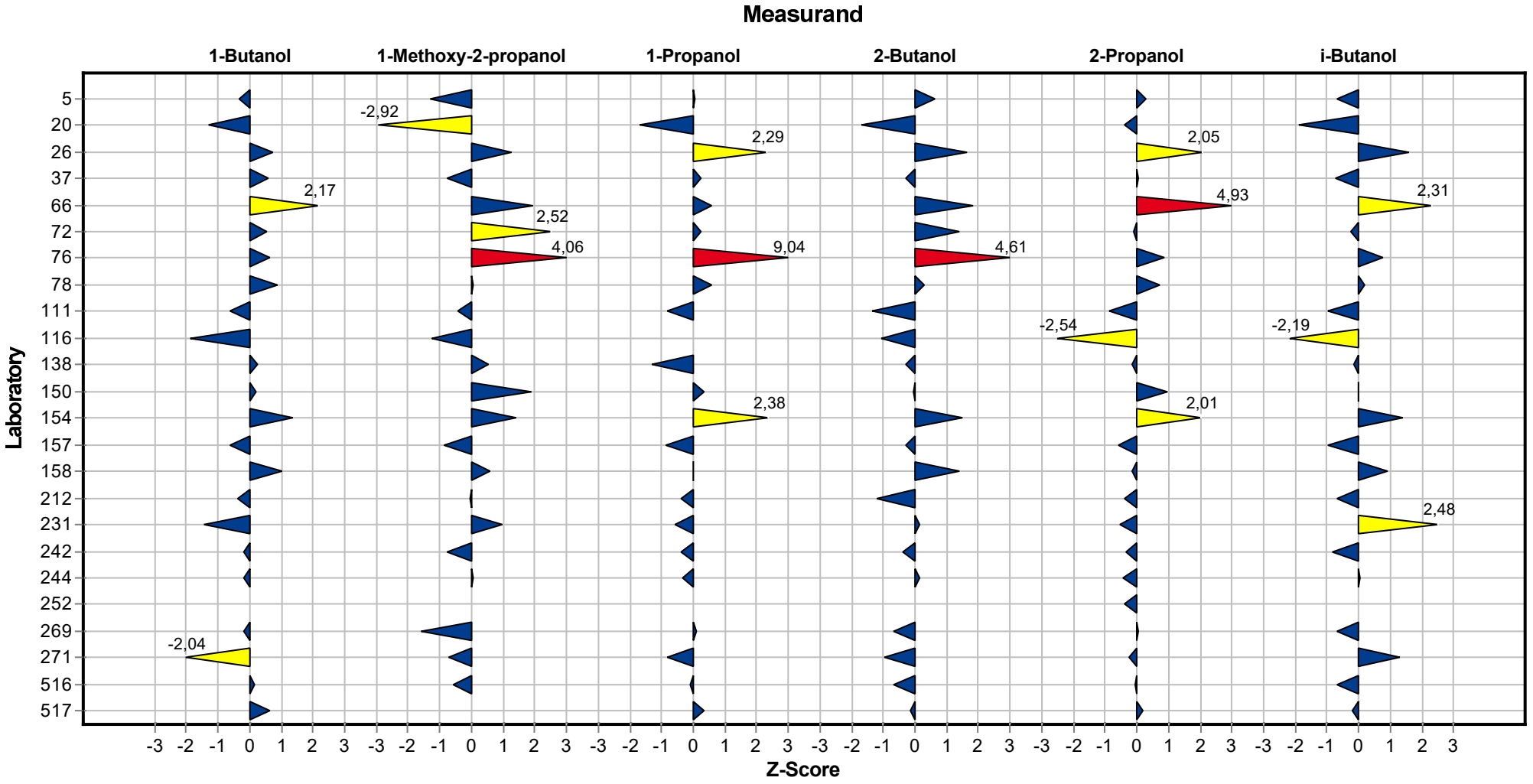
Summary results

Sample:	**1**	**Mean:**	**79,92 mg/m³**
Measurand:	**i-Butanol**	**Reprod. s.d.:**	**9,74 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**12,19%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**79,10 mg/m³**
Number of laboratories in calculation:	**23**	**Range of tolerance:**	**63,93 - 95,90 mg/m³ (|Z-Score| <= 2,00)**



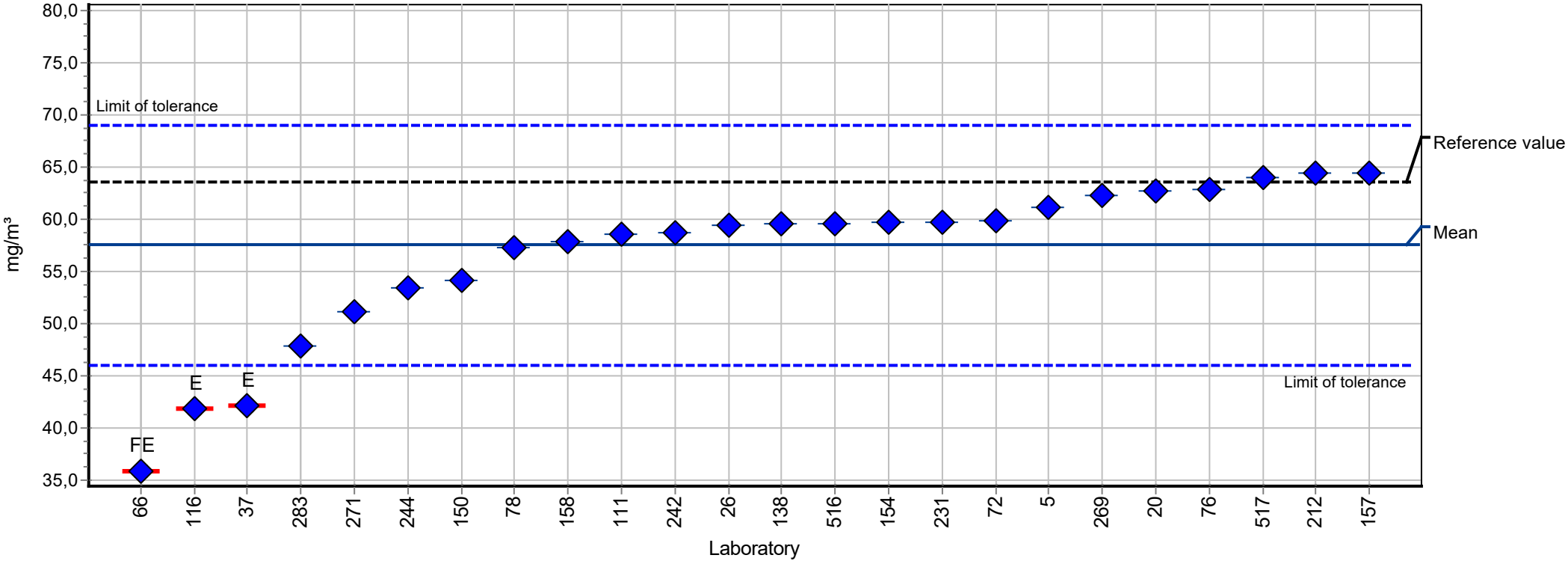
Sample chart of Z-scores

Sample 1



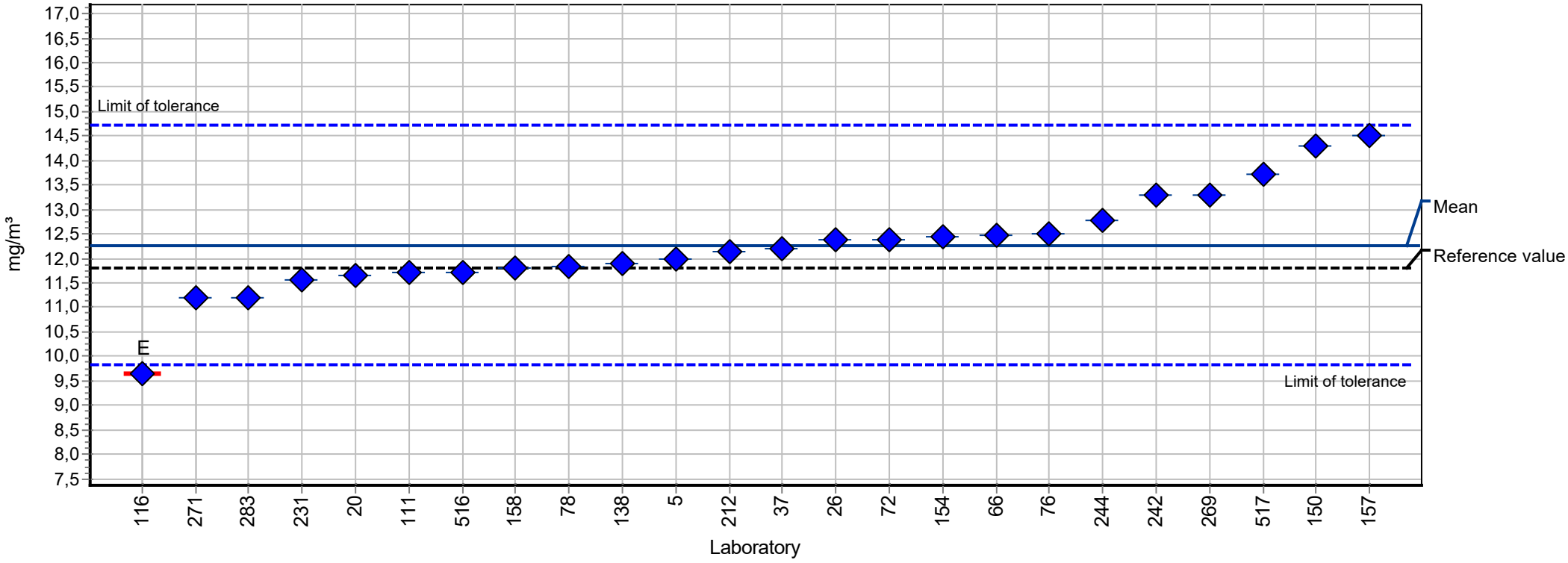
Summary results

Sample:	**2**	**Mean:**	**57,50 mg/m³**
Measurand:	**1,2,4-Trimethylbenzene**	**Reprod. s.d.:**	**6,37 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**11,08%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**63,60 mg/m³**
Number of laboratories in calculation:	**23**	**Range of tolerance:**	**46,00 - 69,00 mg/m³ (|Z-Score| <= 2,00)**



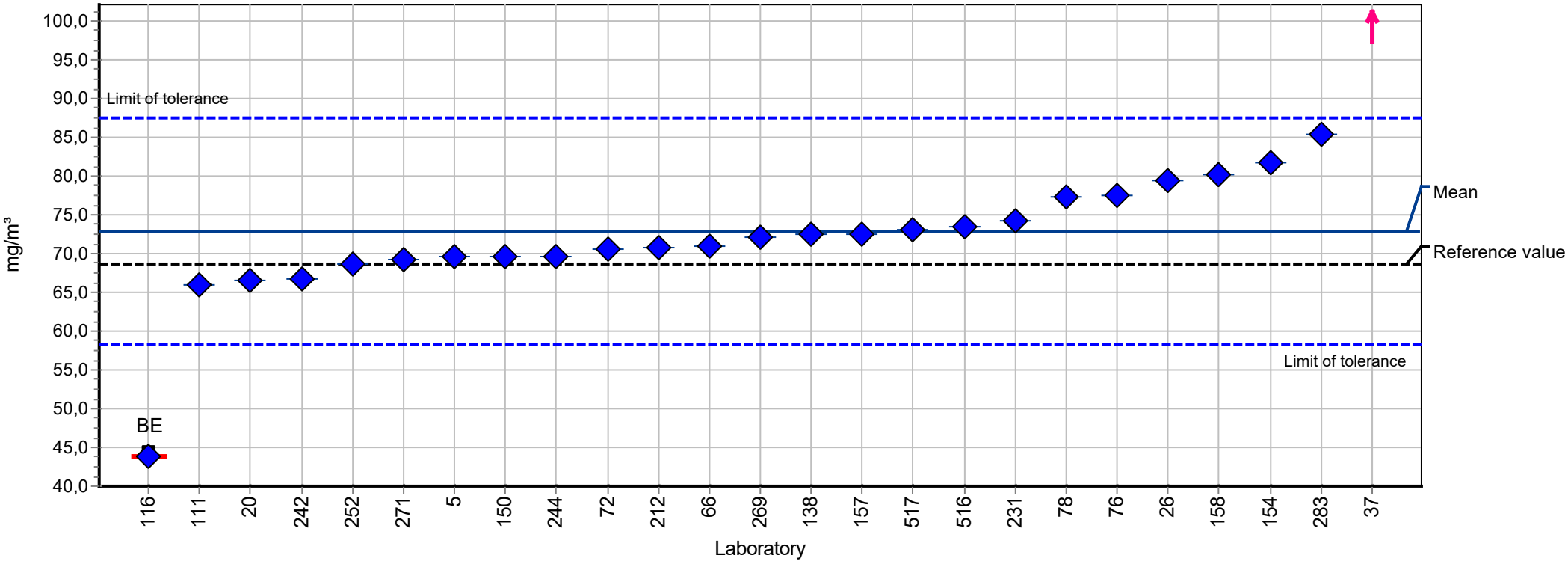
Summary results

Sample:	**2**	**Mean:**	**12,28 mg/m³**
Measurand:	**Cumene**	**Reprod. s.d.:**	**1,04 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**8,51%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**11,80 mg/m³**
Number of laboratories in calculation:	**24**	**Range of tolerance:**	**9,82 - 14,73 mg/m³ (|Z-Score| <= 2,00)**



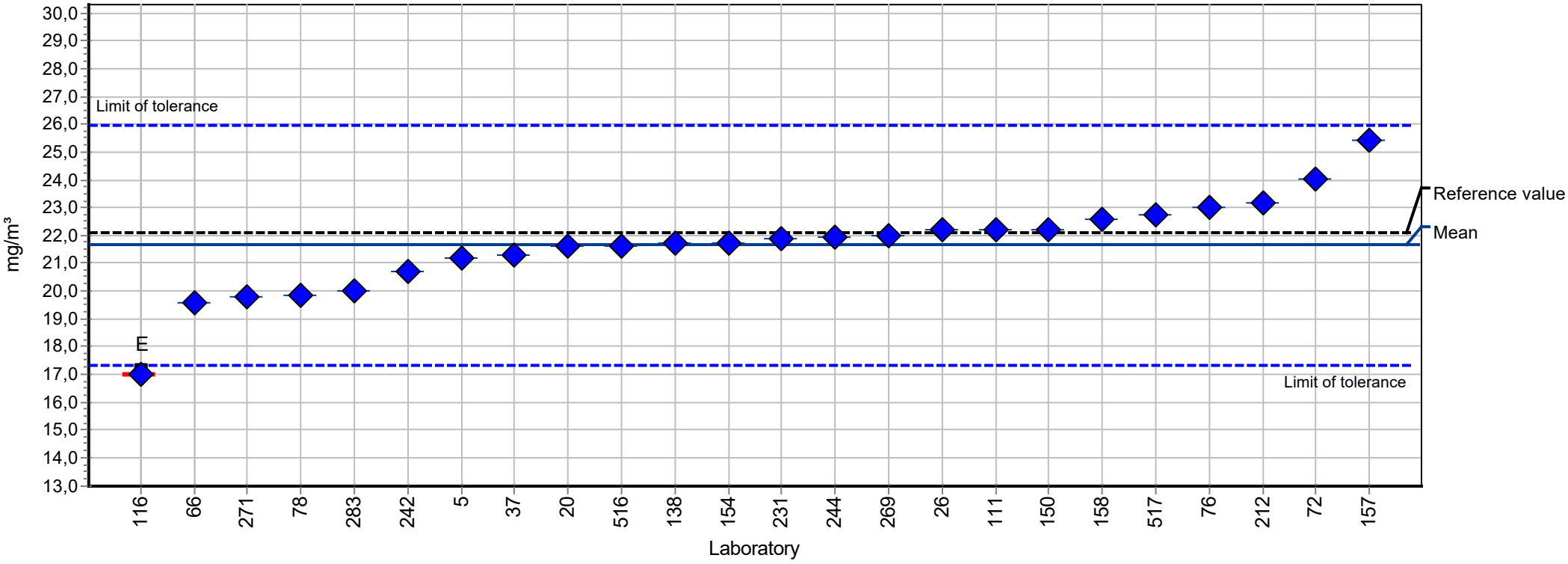
Summary results

Sample:	**2**	**Mean:**	**72,91 mg/m³**
Measurand:	**Ethylacetate**	**Reprod. s.d.:**	**5,11 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**7,01%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**68,70 mg/m³**
Number of laboratories in calculation + outliers:	**25**	**Range of tolerance:**	**58,33 - 87,49 mg/m³ (|Z-Score| <= 2,00)**



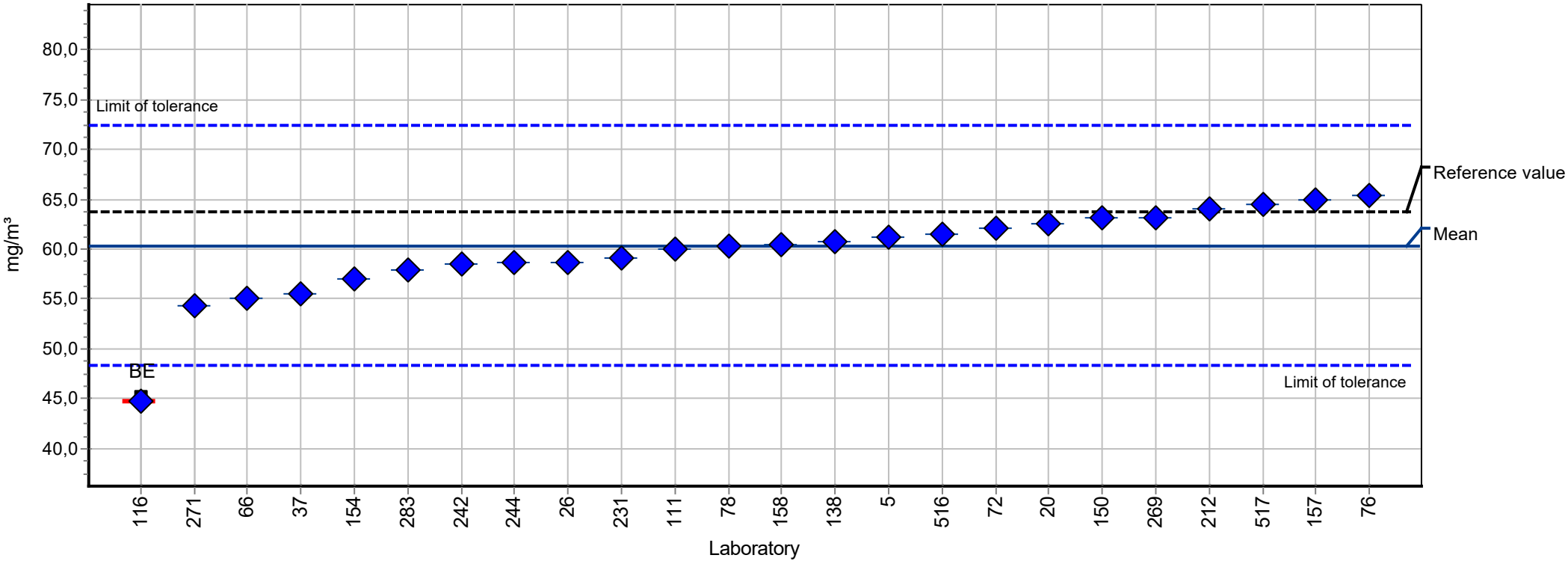
Summary results

Sample:	**2**	**Mean:**	**21,64 mg/m³**
Measurand:	**Ethylbenzene**	**Reprod. s.d.:**	**1,66 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**7,68%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**22,10 mg/m³**
Number of laboratories in calculation:	**24**	**Range of tolerance:**	**17,31 - 25,97 mg/m³ (|Z-Score| <= 2,00)**



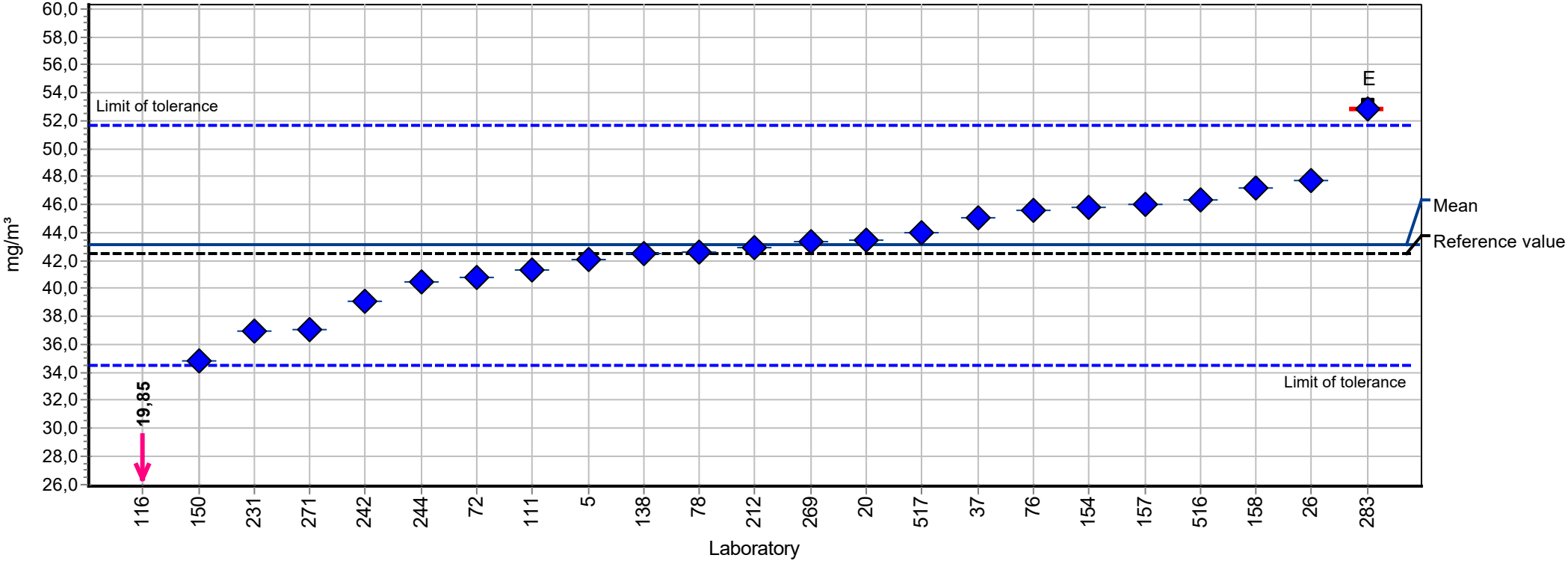
Summary results

Sample:	**2**	**Mean:**	**60,38 mg/m³**
Measurand:	**m-Xylene**	**Reprod. s.d.:**	**3,18 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**5,27%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**63,70 mg/m³**
Number of laboratories in calculation + outliers:	**24**	**Range of tolerance:**	**48,30 - 72,45 mg/m³ (|Z-Score| <= 2,00)**



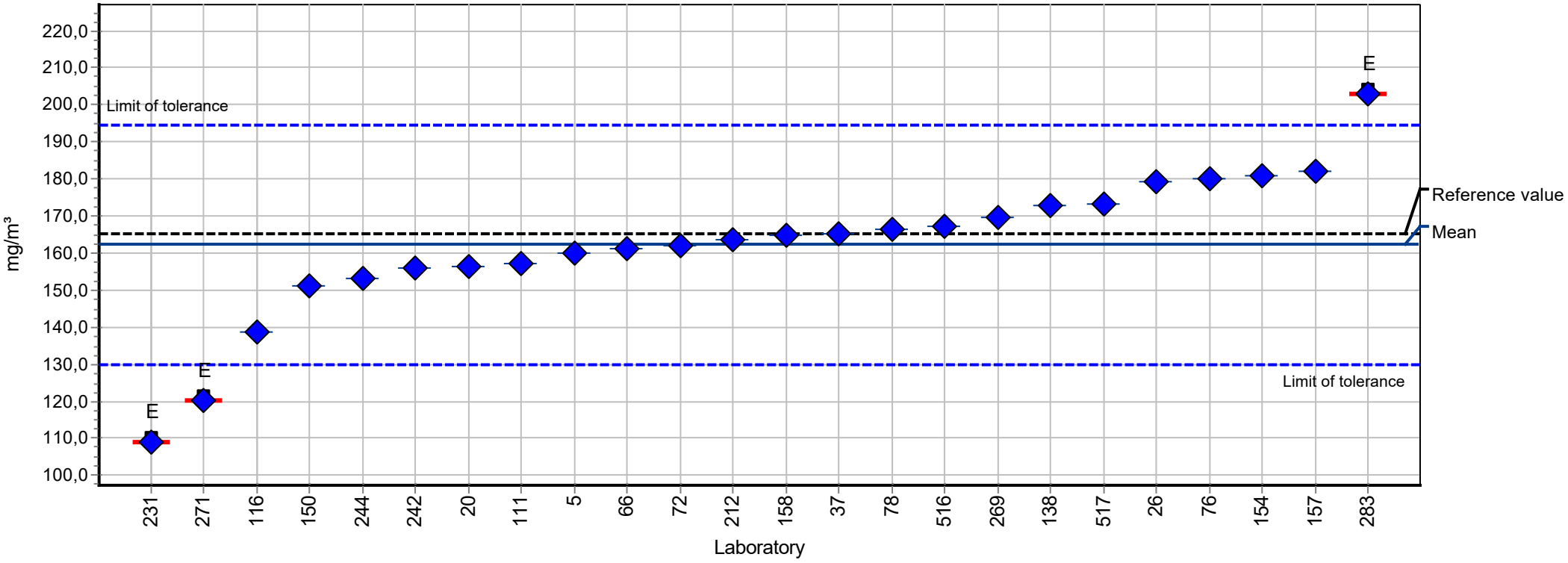
Summary results

Sample:	**2**	**Mean:**	**43,08 mg/m³**
Measurand:	**n-Hexane**	**Reprod. s.d.:**	**4,07 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**9,44%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**42,50 mg/m³**
Number of laboratories in calculation + outliers:	**23**	**Range of tolerance:**	**34,46 - 51,70 mg/m³ (|Z-Score| <= 2,00)**



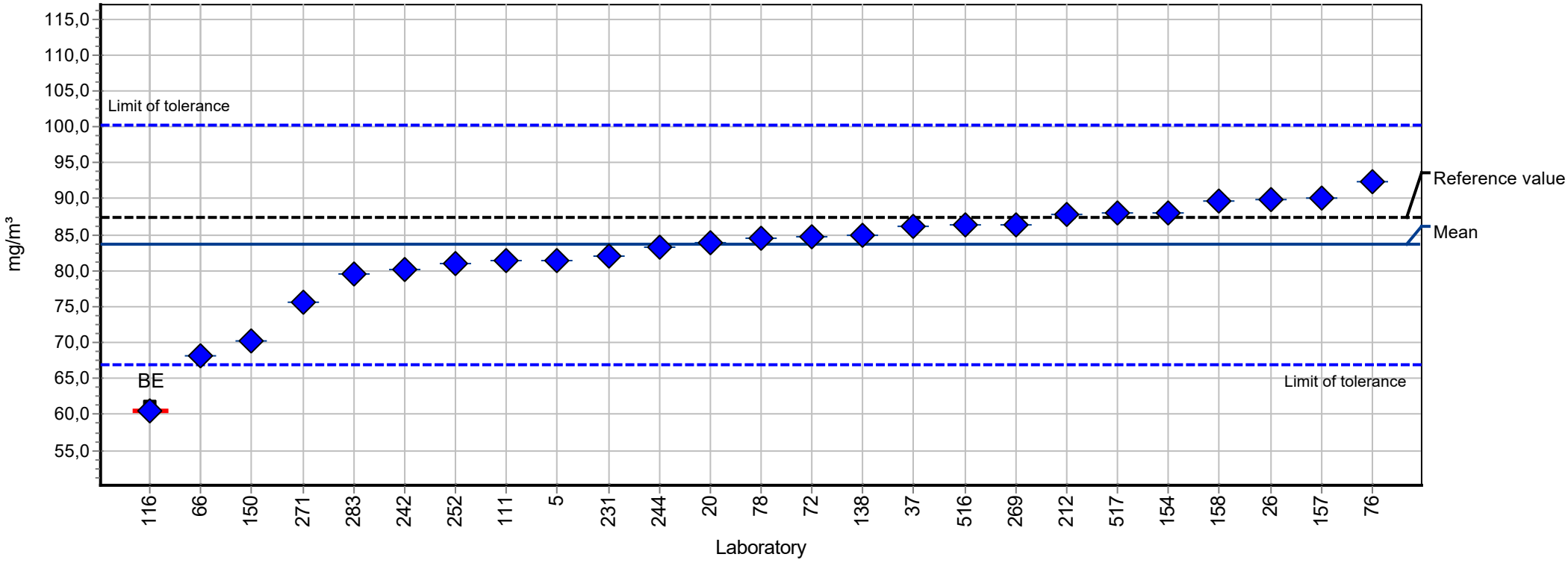
Summary results

Sample:	**2**	**Mean:**	**162,18 mg/m³**
Measurand:	**o-Octane**	**Reprod. s.d.:**	**19,63 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**12,10%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**165,00 mg/m³**
Number of laboratories in calculation:	**24**	**Range of tolerance:**	**129,74 - 194,62 mg/m³ (|Z-Score| <= 2,00)**



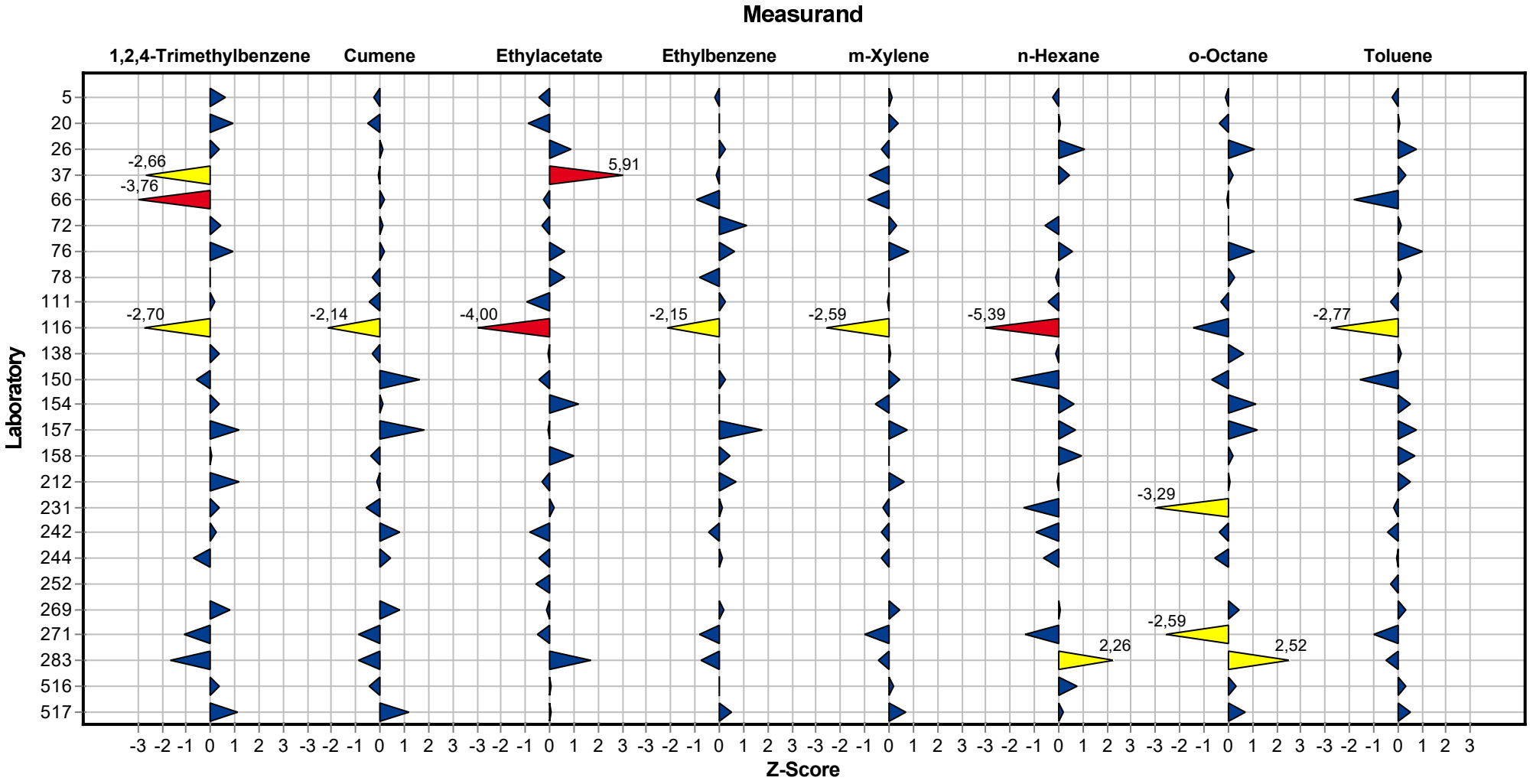
Summary results

Sample:	**2**	**Mean:**	**83,57 mg/m³**
Measurand:	**Toluene**	**Reprod. s.d.:**	**5,93 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**7,09%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**87,50 mg/m³**
Number of laboratories in calculation + outliers:	**25**	**Range of tolerance:**	**66,86 - 100,28 mg/m³ (|Z-Score| <= 2,00)**



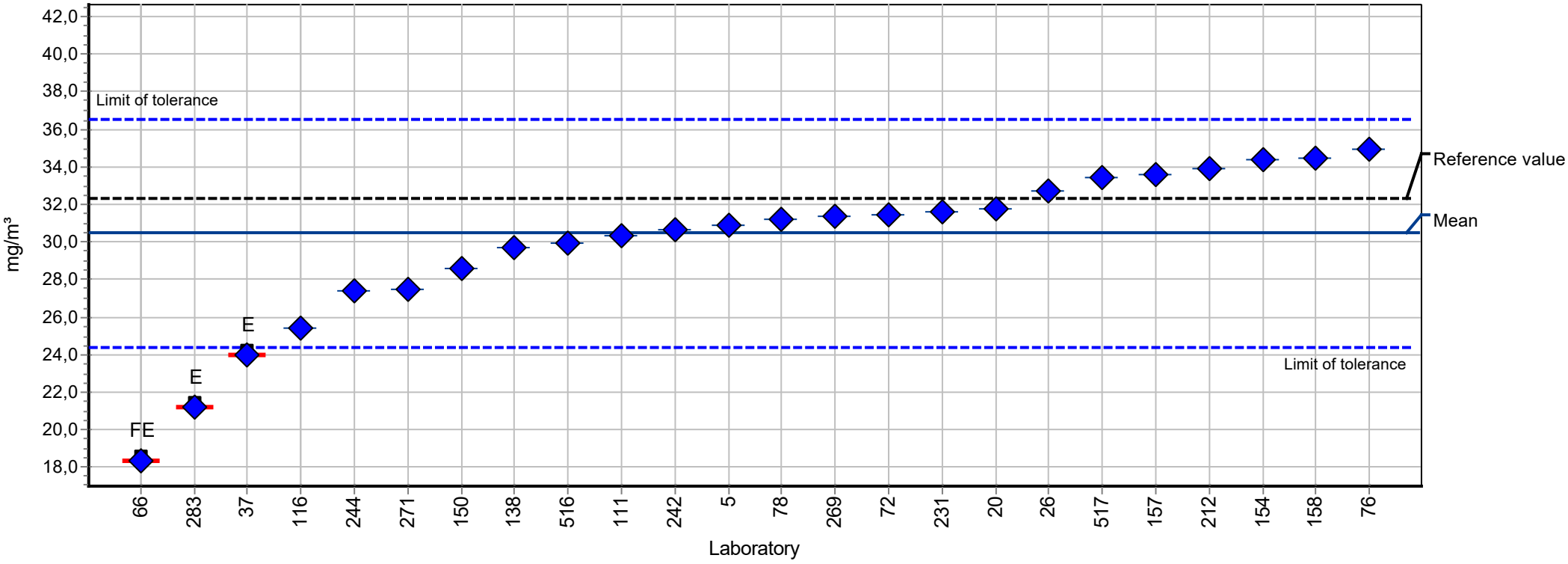
Sample chart of Z-scores

Sample 2



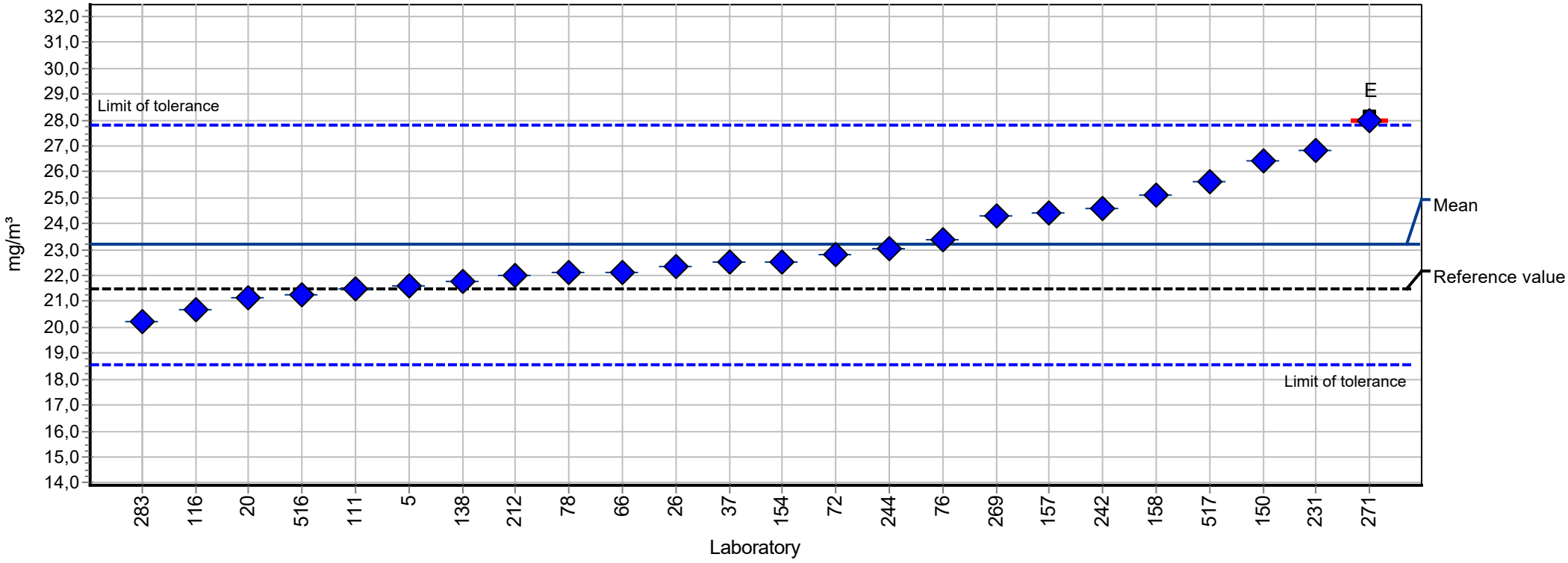
Summary results

Sample:	**3**	**Mean:**	**30,45 mg/m³**
Measurand:	**1,2,4-Trimethylbenzene**	**Reprod. s.d.:**	**3,49 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**11,46%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**32,30 mg/m³**
Number of laboratories in calculation:	**23**	**Range of tolerance:**	**24,36 - 36,54 mg/m³ (|Z-Score| <= 2,00)**



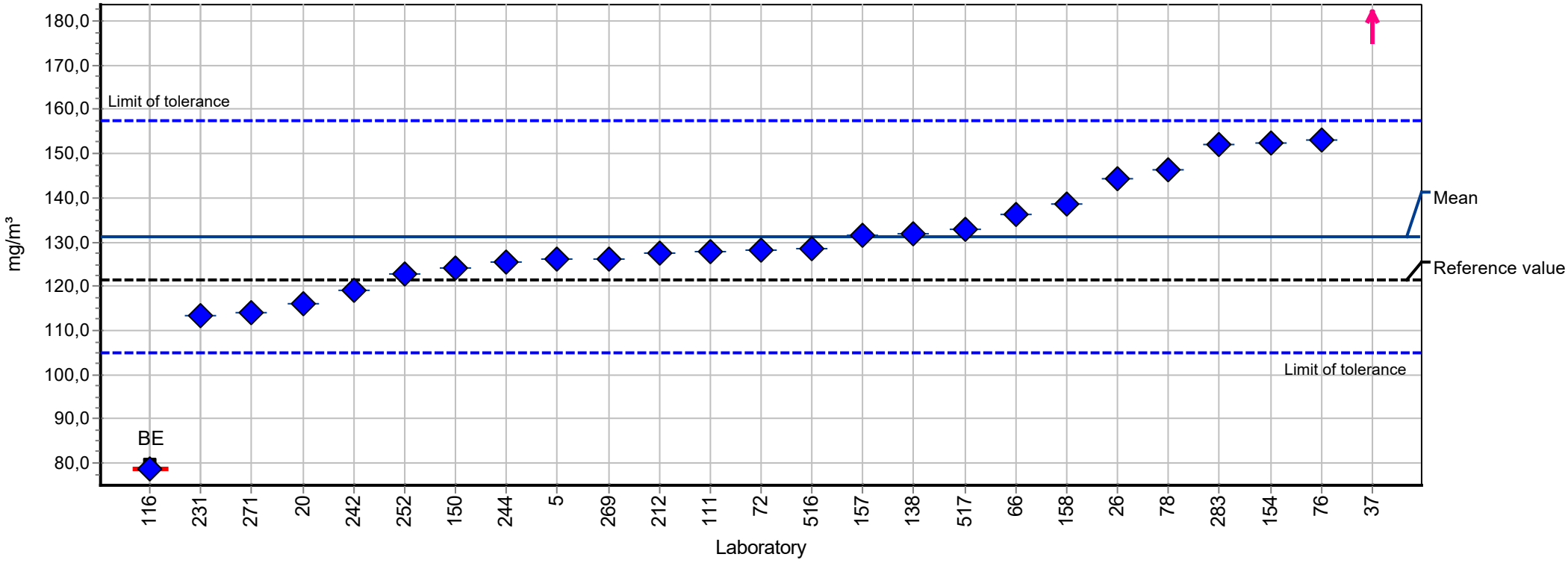
Summary results

Sample:	**3**	**Mean:**	**23,18 mg/m³**
Measurand:	**Cumene**	**Reprod. s.d.:**	**2,05 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**8,85%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**21,50 mg/m³**
Number of laboratories in calculation:	**24**	**Range of tolerance:**	**18,54 - 27,82 mg/m³ (|Z-Score| <= 2,00)**



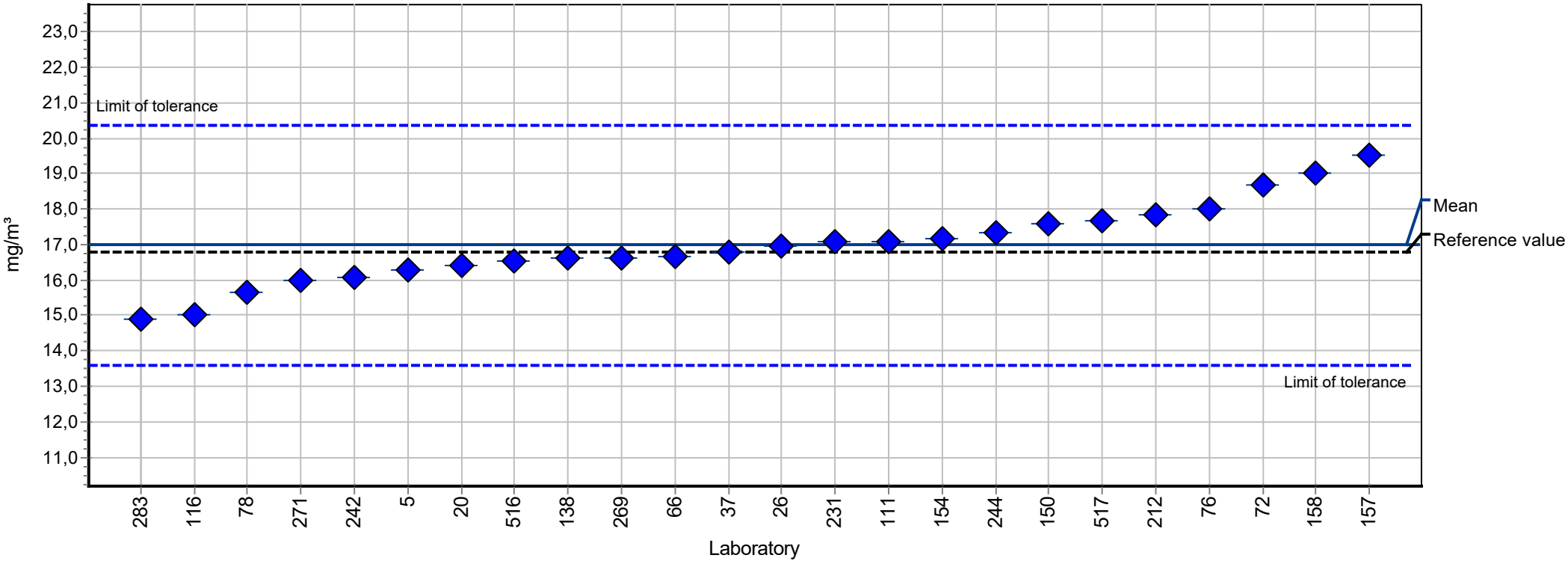
Summary results

Sample:	**3**	**Mean:**	**131,22 mg/m³**
Measurand:	**Ethylacetate**	**Reprod. s.d.:**	**11,83 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**9,02%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**121,40 mg/m³**
Number of laboratories in calculation + outliers:	**25**	**Range of tolerance:**	**104,98 - 157,47 mg/m³ (|Z-Score| <= 2,00)**



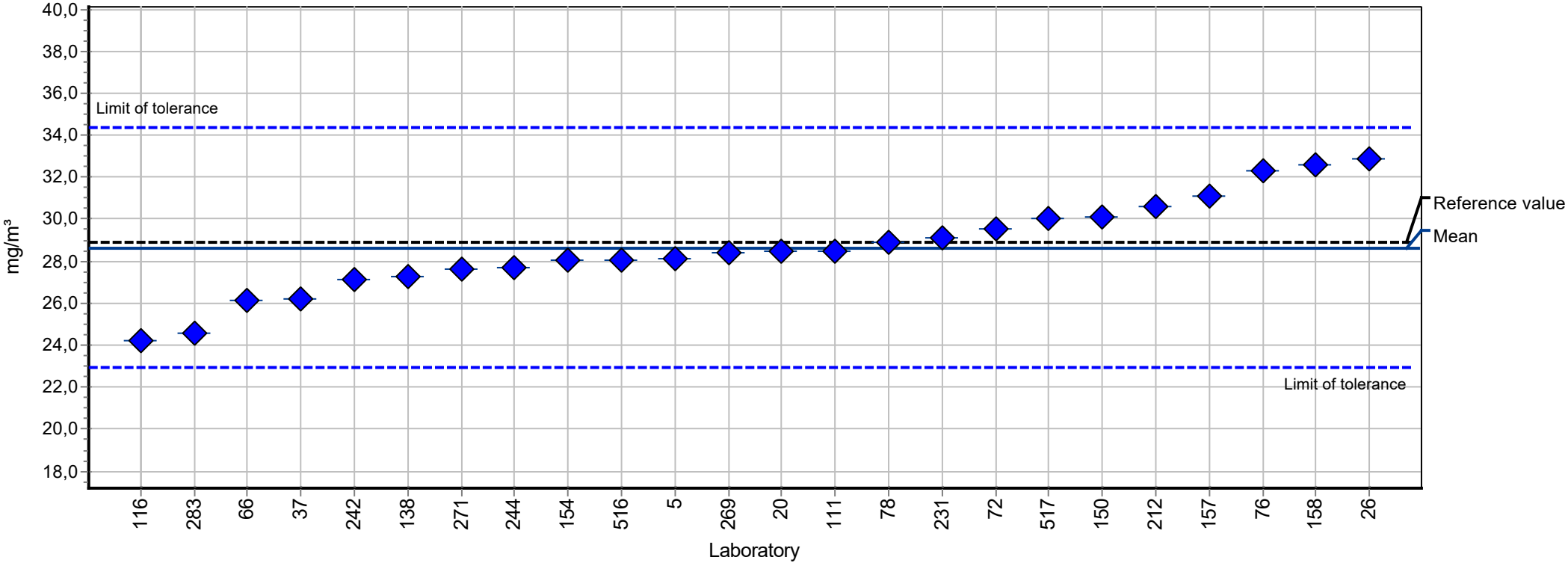
Summary results

Sample:	**3**	**Mean:**	**16,97 mg/m³**
Measurand:	**Ethylbenzene**	**Reprod. s.d.:**	**1,13 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**6,67%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**16,80 mg/m³**
Number of laboratories in calculation:	**24**	**Range of tolerance:**	**13,58 - 20,37 mg/m³ (|Z-Score| <= 2,00)**



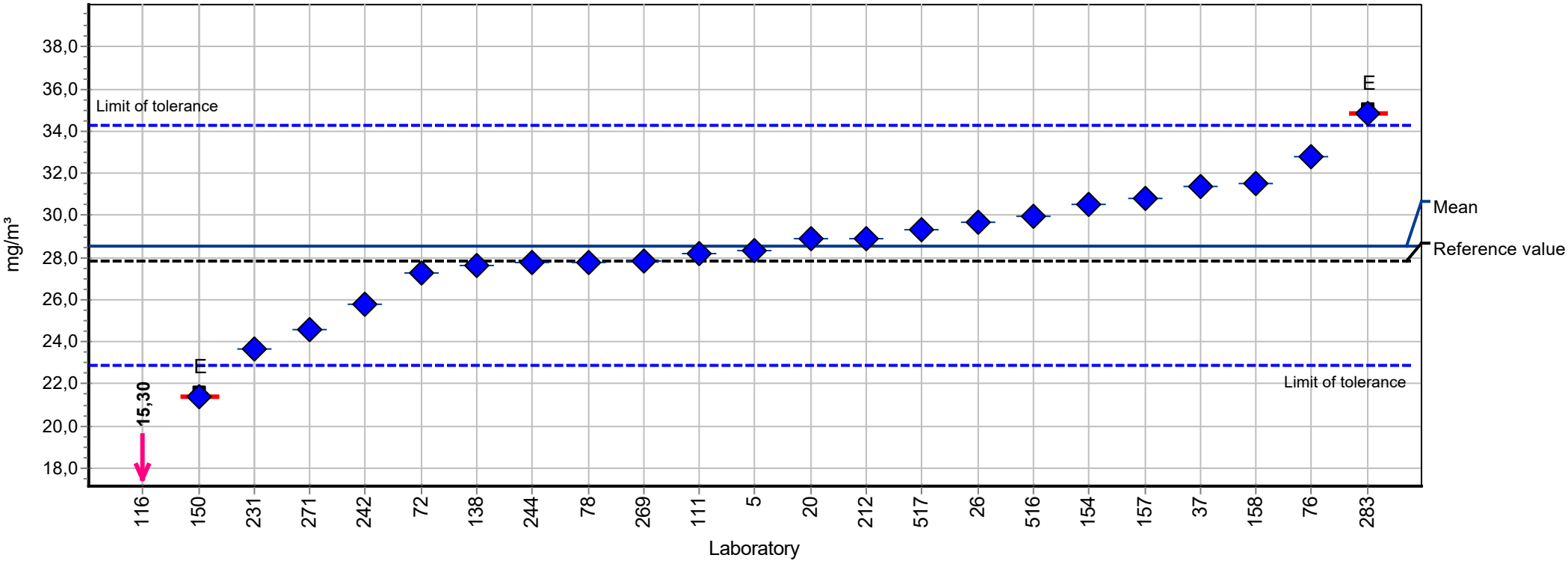
Summary results

Sample:	**3**	**Mean:**	**28,65 mg/m³**
Measurand:	**m-Xylene**	**Reprod. s.d.:**	**2,26 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**7,88%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**28,90 mg/m³**
Number of laboratories in calculation:	**24**	**Range of tolerance:**	**22,92 - 34,38 mg/m³ (|Z-Score| <= 2,00)**



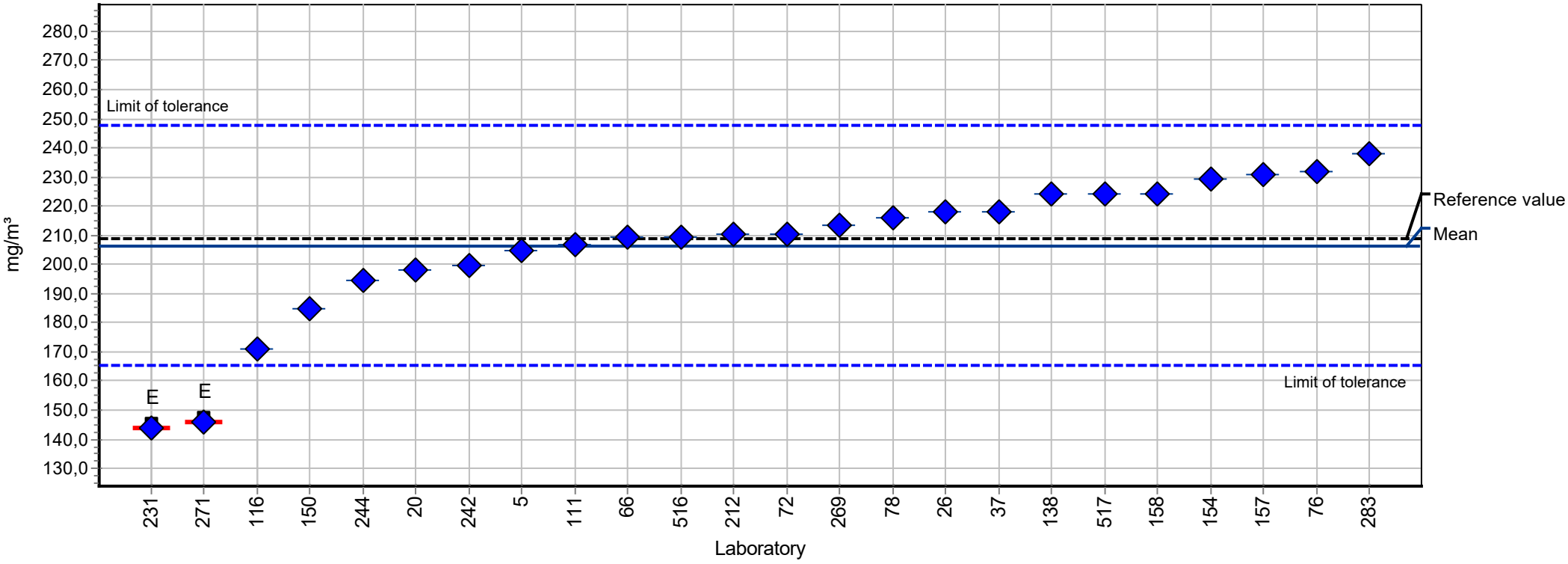
Summary results

Sample:	**3**	**Mean:**	**28,57 mg/m³**
Measurand:	**n-Hexane**	**Reprod. s.d.:**	**3,01 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**10,53%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**27,80 mg/m³**
Number of laboratories in calculation + outliers:	**23**	**Range of tolerance:**	**22,86 - 34,28 mg/m³ (|Z-Score| <= 2,00)**



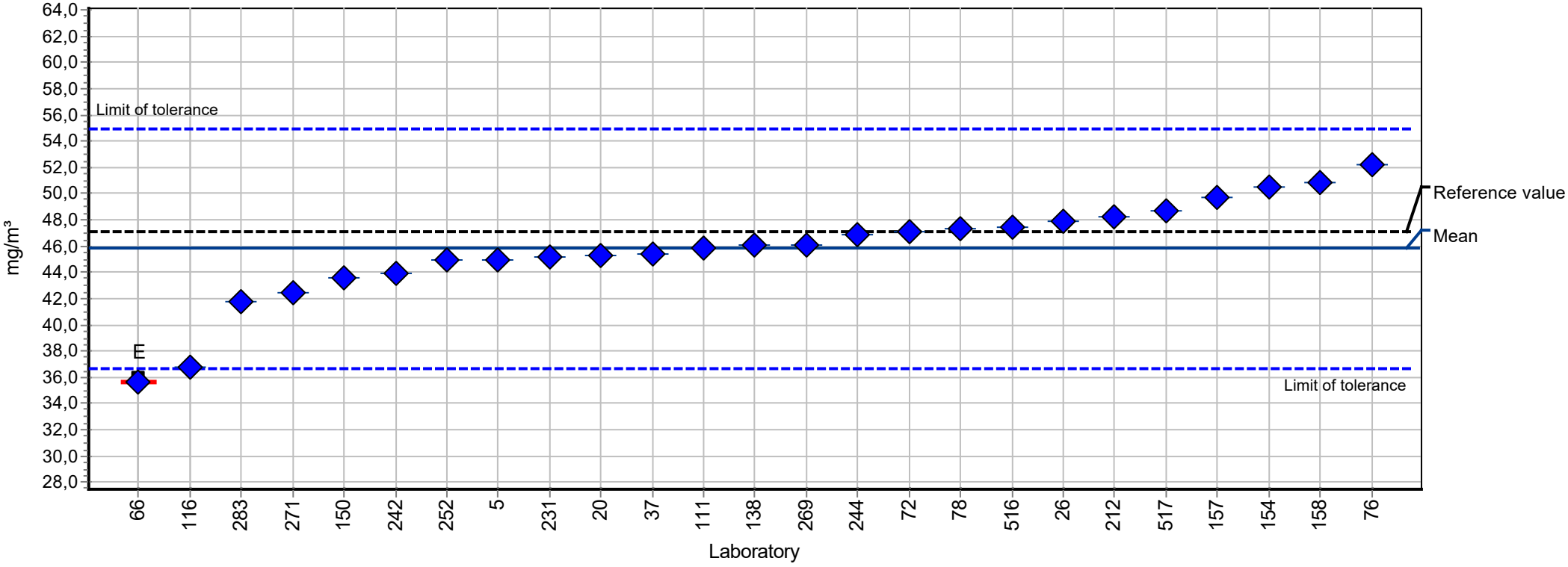
Summary results

Sample:	**3**	**Mean:**	**206,54 mg/m³**
Measurand:	**o-Octane**	**Reprod. s.d.:**	**24,40 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**11,81%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**208,60 mg/m³**
Number of laboratories in calculation:	**24**	**Range of tolerance:**	**165,24 - 247,85 mg/m³ (|Z-Score| <= 2,00)**



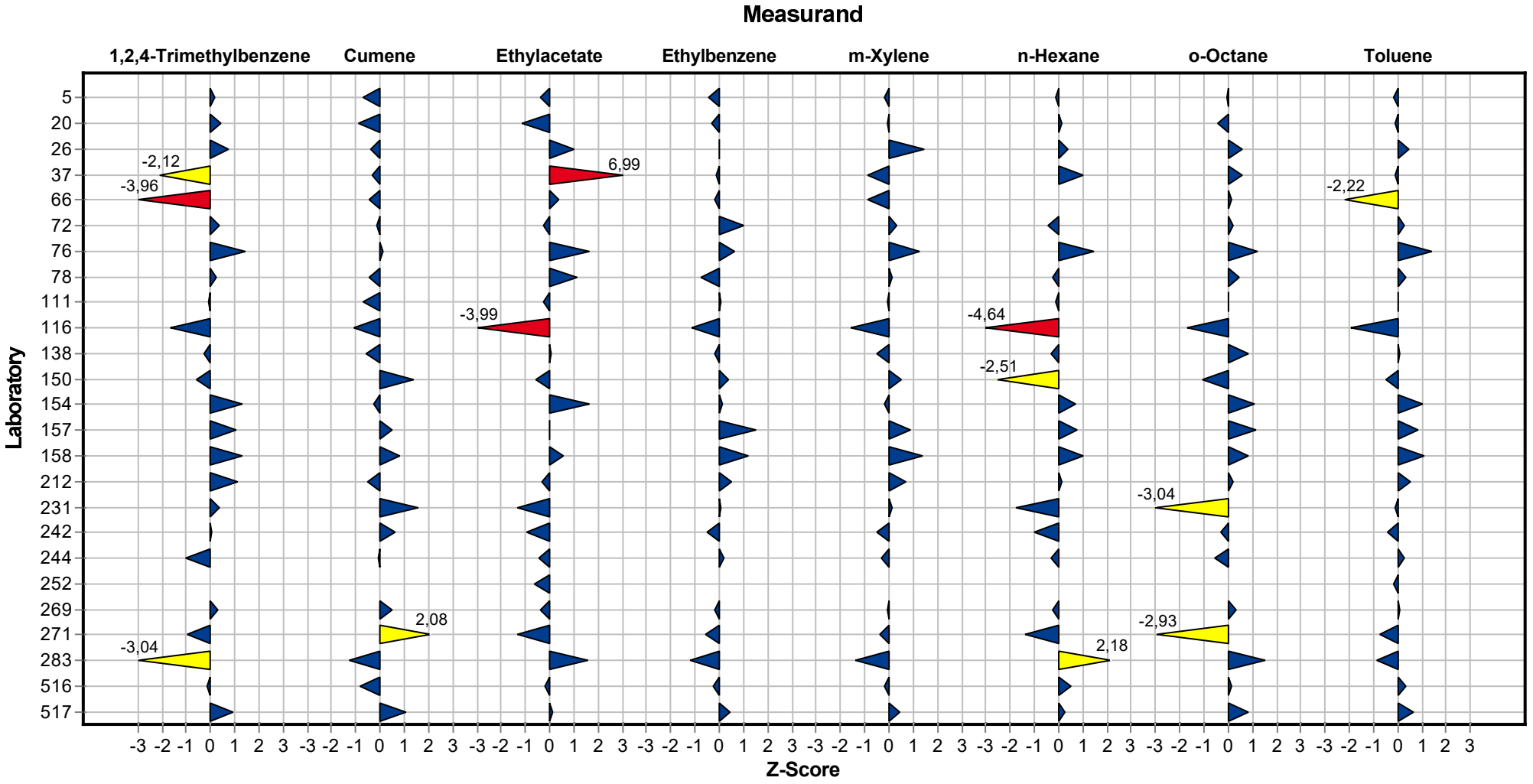
Summary results

Sample:	**3**	**Mean:**	**45,79 mg/m³**
Measurand:	**Toluene**	**Reprod. s.d.:**	**3,83 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**8,36%**
Rel.target s.d.:	**10,00%**	**Reference value:**	**47,10 mg/m³**
Number of laboratories in calculation:	**25**	**Range of tolerance:**	**36,63 - 54,95 mg/m³ (|Z-Score| <= 2,00)**



Sample chart of Z-scores

Sample 3



Questions and Answers

Participant	Sample carrier	Sampling pump	Volume flow
5	AK NIOSH	SKC, Pocket Pump	70 ml/min
20	SKC Aktivkohle NIOSH	SKC und Gilian	70 ml/min
26	Aktivkohle Typ BIA	Gilian LFS 113	0,33 l/min
37	Dräger Aktivkohleröhrchen, Typ B	Gilian LFS-113DC	ca. 0,33 l/min (20 l/h)
66	Dräger Röhrchen Aktivkohle Typ B/G	GSA 350, SKC Universal Pump Deluxe	333 ml/min
72	Aktivkohle Typ B	SG 350	333 ml/min
76	Aktivkohle Typ B/G (Dräger)	Gilian Air Plus	0,33 l/min
78	Aktivkohle Röhrchen Typ B/G	SG350ex	ca 0,33 L/min
111	Dräger Aktivkohle Typ G	Sensidyne GilAir Plus	0,33 l/min
116	Aktivkohleröhrchen Typ G	Lfs Deha	0,33 L/min
138	Aktivkohle Dräger Typ G	PCXR8, SKC und PPT, SKC	0,50 und 0,33 l/min
150	Aktivkohle-Röhrchen Typ B/G, Aktivkohle-Röhrchen Typ BIA	GSA SG 350ex; GSA SG 5100ex	333 ml/min
154	Ativkohle Typ BIA	GilAir 5 mit Low -Flow Module und GilAir PLUS	0,333 l/min
157	Aktivkohle	GilAir Plus	0,107 - 0,326 L/Min.
158	Tenax TA	Gilian LFS-113 DC Low Flow Sampler	10 ml/min
212	Draeger Aktivkohleröhrchen	GSA SG350ex	0,333 L/min
231	Dräger Aktivkohle Typ G	Gilian Air Plus	0,33 l/min
242	Aktivkohle Typ BIA	Low flow sampler LFS 113 D und LFS 113 DC	ca. 333 mL/min
244	Aktivkohle Typ NIOSH Fa. Dräger	SKC Poket Pump 210-1002MTX	50 ml/min
252	Aktivkohle Typ BIA	GilAir5, GilAir Plus, SG5200, SG5100ex	0,33 l/Min
269	Aktivkohle Typ BIA	SKC; Gilair	0,1 bis 0,3 L/min
271	Aktivkohleröhrchen BIA	GSA SG 350	0,33 l/min
283	Aktivkohle Dräger Typ B	GSA 5100	0,35 l/min
516	AK NIOSH	SKC, Pocket Pump	70 ml/min
517	Dräger Röhrchen Aktivkohle Typ B/G	SKC AirChek TOUCH	333 ml/min

Participant	Volume flow measurement	Sampling time
5	Defender	ca. 2 h
20	DryCal DC-Lite L	120 min

Participant	Volume flow measurement	Sampling time
26		120 Min
37	Mass-Flow -Meter TSI 4146	30 Minuten
66	Strömungsmesser 35812 MLWB - Analyt-MTC, ,	2 Stunden
72	Defender 520 (50-5000 ml/min)	60 min
76	read-y compact (vögtlin)	120 min
78	Gilibrator 3	120 min
111	BIOS Defender M	60 und 120 Minuten (kein Unterschied im Ergebnis)
116	Bios Defender 510	120
138	Massendurchflussmesser 35810 MLWB, Analyt-MTC	120 und 75 Minuten
150	BIOS DryCal	1 h
154	Gilibrator 3 mit Low -Flow Zelle	120 Minuten
157	TSI	30 - 45 Minuten
158	Bios Int. Corp. Defender 510-L Rev C1	10, 15 und 30 min
212	MesaLabs Defender 510	Probe 1: 120 min, , Probe 2 und 3: 60 min
231	DryCal DC Lite	120 min
242	Defender 510-L	15 min, 60 min, 120 min
244	BIOS Defender 510	120 min
252	Massflow meter 4146 TSI	120 min
269	Massenstromdurchflussmesser	
271	DryCal DC Lite	2 h
283	Massenflussmeter 0-1 l/min, SkC	50-70 min
516	Defender	ca. 2 h
517	Strömungsmesser 35812 MLWB Analyt-MTC	2 Stunden

Participant	Front- and back section
5	ja
20	ja
26	nein
37	nein
72	Ja
76	Nein
78	ja

Participant	Front- and back section
111	nein
116	ja
138	ja
150	ja
154	Nein: Sammelschicht und Kontrollschicht nicht getrennt
157	Ja
158	Ja
231	Ja
242	ja
244	ja
252	Ja
269	Ja
271	Ja
283	nein
516	ja

Participant	Analytical method
5	Hausmethode
20	Hausmethode
26	BGIA 7322 / IFA 7732 / BGIA 7733 / IFA 8414
37	Hausmethode
72	validierte eigene SOP in Anlehnung an IFA Arbeitsmappe
76	DIN CEN/TS 13649:2015-03
78	7732/7733
111	IFA 6385, IFA 7569, IFA 7322, IFA 7732, IFA 7733
116	Aliphaten: NIOSH 1500 (2003); , , Aromaten: NIOSH 1501 (2003); , , Ethylacetat: NIOSH 1450 (2003); , , 2-Propanol: NIOSH 1400 (1994); , , 1-,2-,i-Butanol: NIOSH 1401 (1994), , , 1-Methoxy-2-propanol: NIOSH 2554 (2003), ,
138	IFA- Arbeitsmappe 7322, 7732, 7733, 8414
150	IFA 7569, IFA 7733, IFA 7732, IFA 7322, IFA 8415, IFA 8414, IFA 6385, IFA 6386, IFA 6387
154	IFA-Arbeitsmappe Kennzahl 7322; Kennzahl 7732; Kennzahl 7733; Kennzahl 8414
157	DFG Luftanalysen, Band 1.: 2013-10
158	VOC in Luft mittels Thermodesorption

Participant	Analytical method
212	Probe 1: IFA 7569, IFA 8415, IFA 8414, IFA 6385, IFA 6386, , Probe 2 und 3: IFA 7732, IFA 7733, IFA 7322
231	IFA 7569; IFA 6385; IFA 6386; IFA 6387; IFA 8415; IFA 7732 // NIOSH 1501
242	IFA 7730 (PG 1) IFA 7733 (PG 2&3)
244	eigene Methode
252	Hausinterne Methode
269	IFA /NIOSH
271	IFA-Arbeitsmappe
283	IFA 7732/DFG Meth.-Nr.1 Lösem.
516	Hausmethode
517	IFA 7733, NIOSH 1400, NIOSH 1450

Participant	Desorption solution
5	Schw efelkohlenstoff
20	Schw efelkohlenstoff
26	ternäres Gemisch (CH2Cl2 : CS2 : MeOH = 60 : 35: 5)
37	Benzylalkohol
72	Benzylalkohol
76	CS2/1-Propanol (95/5) bzw . Toluol
78	Ternäres Gemisch DCM:CS2:MeOH 60:35:5
111	ternäres Gemisch (5% Methanol, 35% CS2, 60% Dichlormethan)
116	Aliphaten/Aromaten/Ethylacetat: Schw efelkohlenstoff, , 2-Propanol: Schw efelkohlenstoff + 1% 2-Butanol, , 1-,2-,i-Butanol: Schw efelkohlenstoff + 1% 2-Propanol, , 1-Methoxy-2-propanol: Dichlormethan/Methanol 85/15, ,
138	ternäres Gemisch Dichlormethan / Schw efelkohlenstoff / Methanol
150	tern. Gemisch aus methanol, Schw efelkohlenstoff und Dichlormethan
154	Ternäres Gemisch 1: Ternäres Gemisch (TG1) (CH2Cl2 : CS2 : MeOH) = 60 : 35 : 5
157	ternäre Gemisch eine Stunde bei Raumtemperatur
158	keins, da Thermodesorption
231	Ternäres Gemisch (Dichlormethan, Methanol, Schw efelkohlenstoff) int. St: Undecan // Schw efelkohlenstoff int. St.: Chlorbenzol
242	Ternäres Gemisch (CH2Cl2 : CS2 : MeOH) (60 : 35 : 5)
244	Benzylalkohol
252	DMF:CS2 (60:40)
271	Polar, Alkane: tern. Gemisch / Aromaten: Schw efelkohlenstoff

Participant	Desorption solution
283	ternäres Gemisch DCM:CS2:MeOH (60:35:5)
516	Schw efelkohlenstoff
517	Schw efelkohlenstoff

Participant	Volume of desorption solution	Gas chromatograph (GC)	Carrier gas
5	1 ml	Agilent 6890	Helium
20	1 mL	Agilent 7890B	Helium
26	5 ml	KW und Acetat mit Agilent 7890A und Alkohole mit Agilent 6890N	Helium
37	3	PE Clarus 680	Helium
72	5 ml	GC-FID HP 7890b	Helium 6.0
76	3,5	Gaschromatograph 7890A (Agilent)	Helium
78	20	Clarus590	Helium
111	10	Thermo Scientific TRACE 1310	Helium
116	Messzone: 2 ml, Durchbruchszone: 1 ml	GC 3800 (Varian)	Helium
138	10 ml	Shimadzu Nexis GC 2030	Stickstoff
150	1-2 ml	Agilent, Perkin Elmer	Helium
154	5ml Desorptionslösung	Agilent 7890A und Agilent 6890N	Helium
157	10,0 ml	Kapillar-GC/FID	Stickstoff
158	-	Agilent GC 7890	Helium
231	3	Thermo Trace 1310	Helium
242	10 mL	HP 8890 Fa. Agilent	Wasserstoff
244	1,5 ml	Shimadzu GC-2010 Plus	Helium
252	5 ml	Shimadzu GC 2010Plus	Helium
269	10 ml		
271	3 ml	Thermo Trace 1310	Helium
283	3	GCMS ShimadzuQP2020 (EI)	Helium
516	1 ml	Agilent 8860	Helium

Participant	Sample injection
5	split 1:10
20	Split

Participant	Sample injection
26	split
37	Headspace
72	split
76	Split 1:30
78	split
111	Split 1:50
116	Split/splitless
138	split
150	split
154	split
157	Split-Injektor
158	Mittels Markes TD100 im 1:4000 Splitmodus
231	split
242	Split 1:10 (PG 1) Split 1:20 (PG 2&3)
244	split
252	Split
271	split
283	split,
516	split 1:10

Participant	Analytical column
5	HP1 und FFAP
20	HP1 und FFAP
26	KW und Acetat mit VMS 60 Säule und Alkohole mit DB Wax UI 60
37	60m Rtx Volatile und 60m Stabilw ax DA
72	Phenomenex Zebron ZB-WAX,, , 30 m x 0,25 mm x 0,25 mm
76	Fused-Silica-Kapillarsäule 30 m, Innendurchmesser 0.25 mm, belegt mit DB 5, Filmdicke 0.25 µm
78	DB-1 / Stabilw ax
111	RESTEK; RXI-5ms; 60m*0,32mmID, 1,0µm Filmdicke
116	RTX Volatiles (L = 60 m, ID = 0,25 mm, FD = 1 µm)
138	Restek RCX-volatile 60 m * 0,32 mm * 1,5 µm
150	50 m CP Sil 8 CB, 0,32 mm I.D., 5 µm Film

Participant	Analytical column
154	VMS 60 Säule und DB Wax UI 60
157	Phenomenex ZB-5 (60 m x 0,32 mm x 1,0 µm), , Phenomenex ZB-624 (60 m x 0,32 mm x 1,8 µm)
158	Resteck RTX-1 60m, ID 0,25 x 1µm
231	MN - Optima 1; 30 m x 0,25 mm ID; 0,50 µm Filmdicke // Thermo TG-1301MS; 30 m x 0,25 mm ID; 1,0 µm Filmdicke
242	HP 5, 50 m x 0,32 mm; df 1,05 µm
244	Zebron ZB-5MSi 30m x 0,25mm x 0,25µm
252	Rxi-5Sil MS
271	Aromaten: Thermo TG-1301MS 30m x 0,25 mm, 1,0 µm Filmdicke, Polare und Alkane: MN Optima 1 30m x 0,25 mm, 0,50 µm Filmdicke
283	VF-5ms
516	HP1 und FFAP

Participant	Detector
5	FID
20	FID
26	MSD Agilent 5975C
37	FID / FID
72	FID
76	Massenspektrometer 5975C (Agilent)
78	FID
111	MS
116	Massenspektrometer (MS)
138	FID
150	FID, MSD
154	MSD Agilent 5975C
157	FID
158	MSD Agilent 5975C
231	MS
242	FID
244	Shimadzu GCMS-QP2020
252	FID
271	Aromaten: MS ISQ / Polare und Alkane: MS ISQ LT
283	MS

Participant	Detector
516	FID
517	FID

Participant	Data evaluation
5	ISTD
20	interner Standard
26	Quantifizierung: Durch eine Kalibrierung von Standards mit verschiedenen Stufen gegen Anw esenheit von internem Standard. (Undecan). Identifizierung: Durch die Massen von Analyten mittels Massenspektrometer
37	Externer Standard
72	externer Standard, 6 Pkt. Kalibrierung
76	Mit externen Standards und korrigiert mit IS (Chlorhexan)
78	interner Standard
111	externer Standard, Korrektur über Internen Standard
116	interner Standard
138	externer Standard
150	mit internem Wiederfindungsstandard im Desorptionsmittel gegen externe Standards
154	Durch eine Kalibrierung von Standards mit verschiedenen Stufen gegen Anw esenheit von internen Standard. (Undecan). Identifizierung: Durch die Massen von Analyten mittels Massenspektrometers.
157	Externe Mehrpunktkalibrierung aus Reinsubstanzen
158	Mittels internem Standard
231	interner Standard
242	interner Standard
244	externer Standard
252	Interner Standard
269	Externer Standard
271	Polar, Alkane: interner Standard Undecan / Aromaten: interner Standard Chlorbenzol
283	interner Standard
516	ISTD

Participant	Recovery rate	Date of analysis
5	indirekt	

Participant	Recovery rate	Date of analysis
20	ja	17.-23.03.2023
26	nein	Beginn der Analyse am 22.03.203
37	nein	14.04.2023
72	ja (0,90 bis 0,98)	29.03.2023
76	Ja	29.-30.03.2023
78	nein	21. bzw . 28.03.2023
111	nicht berücksichtigt, da Kalibrierung über Gesamtverfahren	28.03.2023, 30.03.2023
116	nein	29.03.-12.04.2023
138	nein	28.03. - 31.03.2023
150	teilw eise (2-Propanol, Alkylbenzole)	s. o.
154	nein	15.05.2023
157	Nein	22.03.-12.04.2023
158	Ja, es w urde ein Kontrollstandard eingesetzt	
212		Zw ischen 28.3.2023 and 30.3.2023.
231	teilw eise	20.03.2023
242	nein	PG 1: 25.04.2023, PG 2&3: 28.04.-02.05.2023
244	ja	03. - 05.04.2023
252	Nein	28.02.2023
269	Ja	
271	nein	21.03. - 23.03.2023
283	nein	27.3.2023
516	indirekt	