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

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Summary of laboratory test results

Sample 1

	1- Butanol	Z score	1-Propanol	Z score	2-Butanol	Z score	2-Propanol	Z score	Ethanol	Z score
Unit	mg/m³		mg/m³		mg/m³		mg/m³		mg/m³	
5	74.84	1.59	139.69	0.68	34.74	1.32	135.36	1.98	285.04	1.03
10	34.30	-4.69 BE	108.00	-1.74	18.50	-3.97 BE				
37	70.50	0.92	123.00	-0.60	33.20	0.82	118.00	0.44	269.00	0.59
42	67.00	0.38	146.00	1.16	31.00	0.10	113.00	0.00	239.00	-0.22
66	73.78	1.43	141.38	0.81	33.50	0.91	147.24	3.03 E	309.90	1.70
68	53.67	-1.69	104.00	-2.05 E	26.67	-1.31	85.33	-2.45 E	160.92	-2.32 E
73	66.92	0.36	131.10	0.02	31.39	0.23	105.00	-0.71	230.90	-0.43
82	59.00	-0.86			28.00	-0.88	81.00	-2.83 E	255.00	0.22
100	70.10	0.86	139.00	0.62	33.80	1.01	123.00	0.88	250.00	0.08
114	64.10	-0.07			27.70	-0.98	145.20	2.85 E	204.50	-1.15
116	66.30	0.27	145.00	1.08	31.70	0.33	105.00	-0.71	262.00	0.41
118	60.33	-0.66	124.43	-0.49	28.73	-0.64	103.96	-0.80	220.47	-0.72
135	61.20	-0.52	127.00	-0.29	26.30	-1.43	102.00	-0.97	198.00	-1.32
146	71.90	1.14	158.00	2.08 E	33.00	0.75	120.00	0.62	297.00	1.35
162	65.80	0.19	150.70	1.52	32.30	0.52	123.70	0.95	286.70	1.07
167	67.96	0.53	130.60	-0.02	31.12	0.14	104.10	-0.79	195.80	-1.38
190	56.00	-1.33	113.00	-1.36	34.70	1.30	91.10	-1.94	288.00	1.11
208	66.44	0.29	133.92	0.24	31.08	0.13	110.30	-0.24	231.73	-0.41
210	58.00	-1.02			32.00	0.42	147.00	3.01 E	289.00	1.13
238	55.00	-1.48	110.00	-1.59	27.00	-1.20	96.00	-1.50	235.00	-0.32
252							119.68	0.59	254.85	0.21
256	66.70	0.33	131.90	0.08	27.10	-1.17	103.10	-0.88		
263	60.40	-0.65	129.00	-0.14	29.60	-0.36	107.00	-0.53	224.00	-0.62
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Method	ISO 5725-2		ISO 5725-2		ISO 5725-2		ISO 5725-2		ISO 5725-2	
Assessment	|Z|<=2.00		|Z|<=2.00		|Z|<=2.00		|Z|<=2.00		|Z|<=2.00	
No. of laboratories that submitted results	22		19		22		22		21	
Mean	64.57		130.83		30.70		113.00		246.99	

	1- Butanol	Z score	1-Propanol	Z score	2-Butanol	Z score	2-Propanol	Z score	Ethanol	Z score
Reproducibility s.d.	6.12		14.80		2.75		18.65		38.69	
Rel. reproducibility s.d.	9.49 %		11.31 %		8.95 %		16.51 %		15.66 %	
Reference value	71.80		144.60		35.20		116.80		248.50	
Target s.d.	6.46		13.08		3.07		11.30		37.05	
Rel. target s.d.	10.00 %		10.00 %		10.00 %		10.00 %		15.00 %	
Low er limit of tolerance	51.65		104.66		24.56		90.40		172.89	
Upper limit of tolerance	77.48		156.99		36.84		135.60		321.09	
Type B outliers	1				1					
No. of laboratories after elimination of outliers type A-D and F (w ithout laboratories that only gave states but no measured values)	21		19		21		22		21	

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	

	i-Butanol	Z score	
Unit	mg/m³		
5	97.74	1.36	
10	53.30	-3.80	BE
37	93.40	0.86	
42	86.50	0.06	
66	93.04	0.82	
68	76.58	-1.10	
73	87.59	0.18	
82	75.00	-1.28	
100	94.50	0.99	

	i-Butanol	Z score
114	92.00	0.69
116	87.10	0.12
118	80.39	-0.66
135	81.80	-0.49
146	92.00	0.69
162	91.20	0.60
167	89.18	0.37
190	69.60	-1.91
208	87.60	0.18
210	89.00	0.35
238	78.00	-0.93
256	79.40	-0.77
263	84.90	-0.13
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Method	ISO 5725-2	
Assessment	|Z|<=2.00	
No. of laboratories that submitted results	22	
Mean	86.02	
Reproducibility s.d.	7.33	
Rel. reproducibility s.d.	8.52 %	
Reference value	93.00	
Target s.d.	8.60	
Rel. target s.d.	10.00 %	
Low er limit of tolerance	68.82	
Upper limit of tolerance	103.23	
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)	21	

Summary of laboratory test results

Sample 2

	Cyclohexane	Z score	Methylcyclohexane	Z score	n-Decane	Z score	n-Hexane	Z score
Unit	mg/m³		mg/m³		mg/m³		mg/m³	
5	113.72	-0.27	105.94	-0.01	63.65	0.02	23.41	0.62
10	115.00	-0.16	103.00	-0.28	59.60	-0.62	21.40	-0.29
37	124.00	0.61	110.00	0.38	70.00	1.02	25.70	1.66
42	112.00	-0.42	101.00	-0.47	62.30	-0.19	21.10	-0.43
55	147.00	2.58 E			70.40	1.08	27.60	2.52 E
66	145.77	2.47 E	124.49	1.74	73.82	1.62	29.41	3.34 E
68	112.05	-0.41	104.41	-0.15	63.59	0.01	21.11	-0.42
73	111.00	-0.50	103.00	-0.28	70.15	1.04	21.33	-0.33
82	125.00	0.70	115.00	0.85	70.00	1.02	25.00	1.34
100	99.20	-1.51	113.00	0.66	61.20	-0.37	20.70	-0.61
114	146.10	2.50 E	124.40	1.73	60.50	-0.48	21.20	-0.39
116	112.00	-0.42	102.00	-0.38	59.00	-0.71	21.20	-0.39
118	100.63	-1.39	92.47	-1.28	56.63	-1.09	19.13	-1.32
135	103.00	-1.19	96.20	-0.93	57.30	-0.98	19.10	-1.34
146	104.00	-1.10	95.70	-0.97	56.20	-1.15	19.60	-1.11
162	108.60	-0.71	100.70	-0.50	57.80	-0.90	17.50	-2.06 E
167	134.80	1.53	119.50	1.27	78.54	2.36 E	24.58	1.15
190	134.00	1.47	111.00	0.47	53.90	-1.51	50.60	12.95 BE
208	104.83	-1.03	100.65	-0.51	61.56	-0.31	21.15	-0.41
210	111.00	-0.50	114.00	0.75	72.00	1.33	22.00	-0.02
238	113.00	-0.33	104.00	-0.19	60.00	-0.55	22.00	-0.02
256	110.20	-0.57	97.90	-0.77	62.20	-0.21		
263	101.00	-1.36	94.00	-1.13	60.70	-0.44	18.80	-1.47
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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		23		22	
Mean	116.87		106.02		63.52		22.05	

	Cyclohexane	Z score	Methylcyclohexane	Z score	n-Decane	Z score	n-Hexane	Z score
Reproducibility s.d.	14.99		9.30		6.47		2.97	
Rel. reproducibility s.d.	12.82 %		8.77 %		10.19 %		13.47 %	
Reference value	116.20		106.70		63.90		20.30	
Target s.d.	11.69		10.60		6.35		2.20	
Rel. target s.d.	10.00 %		10.00 %		10.00 %		10.00 %	
Low er limit of tolerance	93.49		84.81		50.82		17.64	
Upper limit of tolerance	140.24		127.22		76.23		26.46	
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		22		23		21	

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	

	n-Nonane	Z score	
Unit	mg/m³		
5	244.15	-0.02	
10	249.00	0.18	
37	316.00	2.91	BE
42	239.00	-0.23	
55	277.00	1.32	
66	233.46	-0.46	
68	242.23	-0.10	
73	247.20	0.10	
82	274.00	1.20	

	n-Nonane	Z score
100	232.00	-0.52
114	247.90	0.13
116	255.00	0.42
118	218.64	-1.06
135	235.00	-0.40
146	242.00	-0.11
162	254.80	0.41
167	291.70	1.92
190	210.00	-1.42
208	235.16	-0.39
210	252.00	0.30
238	232.00	-0.52
256	253.70	0.37
263	217.00	-1.13
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Method	ISO 5725-2	
Assessment	|Z|<=2.00	
No. of laboratories that submitted results	23	
Mean	244.68	
Reproducibility s.d.	19.30	
Rel. reproducibility s.d.	7.89 %	
Reference value	259.80	
Target s.d.	24.47	
Rel. target s.d.	10.00 %	
Low er limit of tolerance	195.74	
Upper limit of tolerance	293.62	
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)	22	

Summary of laboratory test results

Sample 3

	1,2,4-Trimethylbenzene	Z score	Cumene	Z score	Ethyl acetate	Z score	Ethylbenzene	Z score
Unit	mg/m³		mg/m³		mg/m³		mg/m³	
5	91.32	0.64	9.22	0.21	193.09	0.76	69.39	0.59
10	90.50	0.54	9.25	0.24	181.00	0.09	64.90	-0.09
27								
37	78.80	-0.82	10.00	1.07	182.00	0.15	66.00	0.08
42	88.40	0.30	9.04	0.01	174.00	-0.30	63.90	-0.24
55	85.50	-0.04	9.03	0.00			68.70	0.49
66	78.01	-0.91	11.42	2.64 E	155.57	-1.33	68.29	0.43
68	50.59	-4.11 BE	5.11	-4.34 FE	169.76	-0.54	96.40	4.72 BE
73	95.50	1.12	9.12	0.10	170.30	-0.51	64.74	-0.12
82			9.80	0.85	182.00	0.15	71.00	0.84
100	83.00	-0.33	7.75	-1.42	187.00	0.42	59.10	-0.98
114	73.60	-1.43	7.50	-1.70	160.90	-1.03	54.00	-1.76
116	91.50	0.66	8.71	-0.36	212.00	1.82	65.00	-0.08
118	78.20	-0.89	8.25	-0.87	165.47	-0.78	59.09	-0.98
133	84.20	-0.19	11.20	2.40 E			75.30	1.50
135	81.10	-0.55	9.55	0.57	174.00	-0.30	61.40	-0.63
146	91.40	0.64	8.76	-0.30	206.00	1.48	66.10	0.09
162	83.30	-0.30	6.30	-3.03 E	183.20	0.21	58.00	-1.14
167	104.00	2.11 E	10.08	1.16	347.70	9.38 BE	74.94	1.44
190	81.00	-0.57	7.99	-1.16	196.00	0.93	54.70	-1.65
208	88.35	0.29	9.70	0.74	177.47	-0.11	63.86	-0.25
210	95.00	1.06	10.00	1.07	192.00	0.70	80.00	2.21 E
238	80.00	-0.68	8.20	-0.92	163.00	-0.91	74.00	1.30
252					184.36	0.28		
256	83.50	-0.28	8.80	-0.26	167.20	-0.68	64.70	-0.12
263	82.80	-0.36	8.10	-1.03	170.00	-0.52	59.30	-0.95
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Method	ISO 5725-2		ISO 5725-2		ISO 5725-2		ISO 5725-2	

	1,2,4-Trimethylbenzene	Z score	Cumene	Z score	Ethyl acetate	Z score	Ethylbenzene	Z score
Assessment	|Z|<=2.00		|Z|<=2.00		|Z|<=2.00		|Z|<=2.00	
No. of laboratories that submitted results	23		24		23		24	
Mean	85.86		9.03		179.38		65.50	
Reproducibility s.d.	7.12		1.16		14.40		6.68	
Rel. reproducibility s.d.	8.30 %		12.87 %		8.03 %		10.20 %	
Reference value	100.70		9.20		189.40		67.40	
Target s.d.	8.59		0.90		17.94		6.55	
Rel. target s.d.	10.00 %		10.00 %		10.00 %		10.00 %	
Low er limit of tolerance	68.69		7.23		143.50		52.40	
Upper limit of tolerance	103.04		10.84		215.25		78.60	
Type B outliers	1				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)	22		23		22		23	

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	

	m-Xylene	Z score	Toluene	Z score
Unit	mg/m³		mg/m³	
5	61.77	0.21	44.76	0.44
10	59.60	-0.15	43.10	0.05
27	59.62	-0.15		
37	60.60	0.02	45.30	0.56
42	59.80	-0.12	41.90	-0.23

	m-Xylene	Z score		Toluene	Z score	
55	65.80	0.87		41.30	-0.37	
66	58.34	-0.36		41.36	-0.36	
68	37.86	-3.74	BE	36.18	-1.56	
73	62.20	0.28		41.57	-0.31	
82	64.00	0.58		46.00	0.73	
100	56.80	-0.61		41.30	-0.37	
114	51.20	-1.54		35.60	-1.70	
116	59.50	-0.17		42.10	-0.18	
118	55.28	-0.86		39.69	-0.74	
133	67.63	1.18		51.28	1.96	
135	56.00	-0.75		41.20	-0.39	
146	60.30	-0.03		42.60	-0.07	
162	52.90	-1.26		36.60	-1.47	
167	66.39	0.97		49.04	1.44	
190	51.50	-1.49		35.60	-1.70	
208	59.48	-0.17		42.85	-0.01	
210	75.00	2.39	E	52.00	2.13	E
238	67.00	1.07		47.00	0.96	
252				43.29	0.09	
256	65.60	0.84		49.90	1.64	
263	55.90	-0.76		40.60	-0.53	
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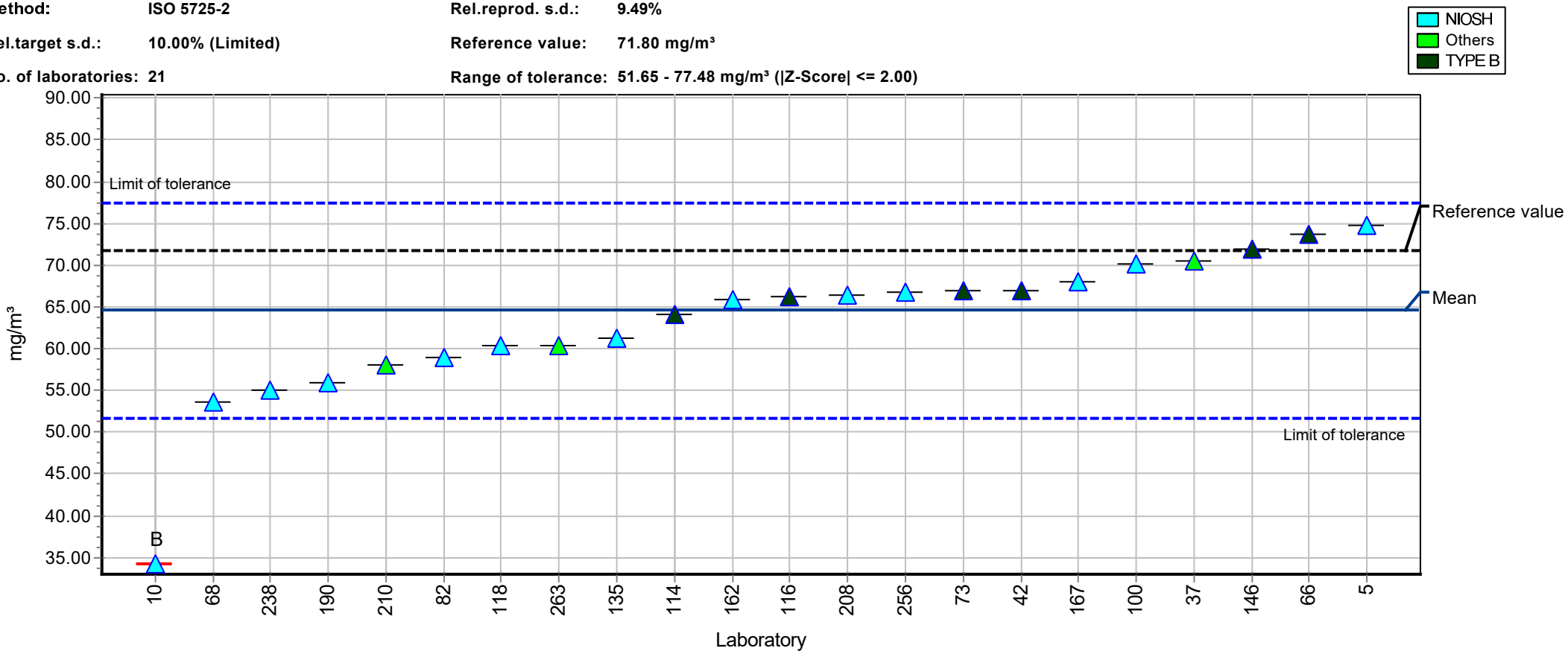
Method	ISO 5725-2			ISO 5725-2		
Assessment	|Z|<=2.00			|Z|<=2.00		
No. of laboratories that submitted results	25			25		
Mean	60.51			42.88		
Reproducibility s.d.	5.62			4.55		
Rel. reproducibility s.d.	9.28 %			10.61 %		
Reference value	64.10			46.00		
Target s.d.	6.05			4.29		
Rel. target s.d.	10.00 %			10.00 %		
Low er limit of tolerance	48.41			34.31		
Upper limit of tolerance	72.61			51.46		

	m-Xylene	Z score	Toluene	Z score
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)	24		25	

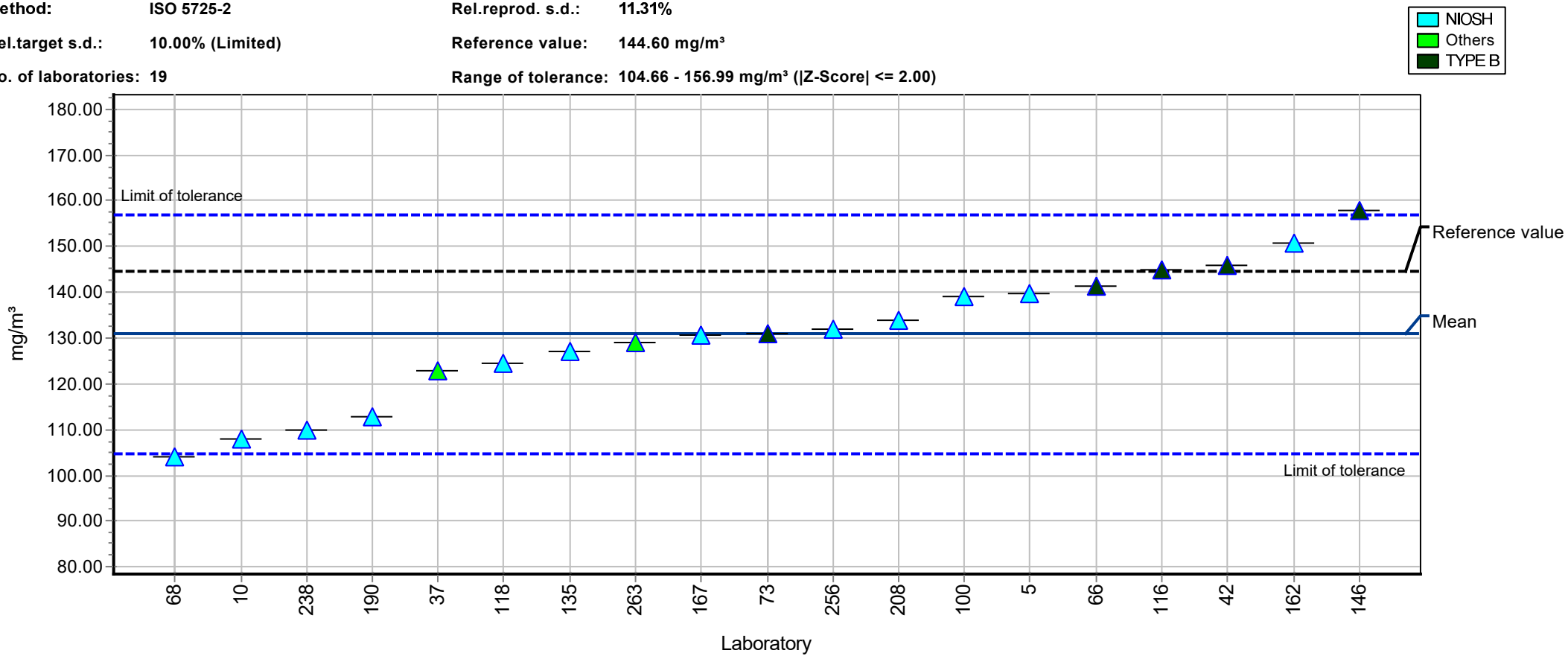
Summary results

Sample:	**1**	**Mean:**	**64.57 mg/m³**
Measurand:	**1- Butanol**	**Reprod. s.d.:**	**6.12 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**9.49%**
Rel.target s.d.:	**10.00% (Limited)**	**Reference value:**	**71.80 mg/m³**
No. of laboratories:	**21**	**Range of tolerance:**	**51.65 - 77.48 mg/m³ (|Z-Score| <= 2.00)**



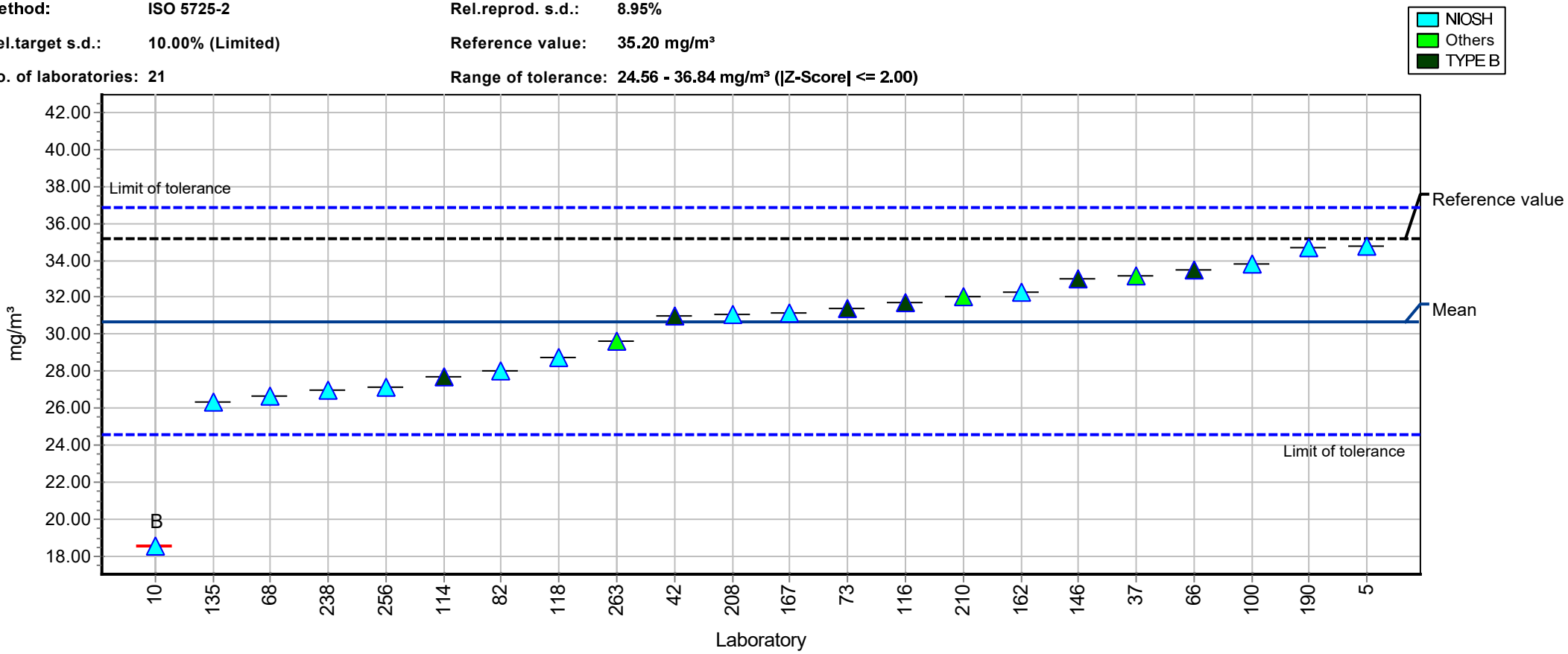
Summary results

Sample:	**1**	**Mean:**	**130.83 mg/m³**
Measurand:	**1-Propanol**	**Reprod. s.d.:**	**14.80 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**11.31%**
Rel.target s.d.:	**10.00% (Limited)**	**Reference value:**	**144.60 mg/m³**
No. of laboratories:	**19**	**Range of tolerance:**	**104.66 - 156.99 mg/m³ (|Z-Score| <= 2.00)**



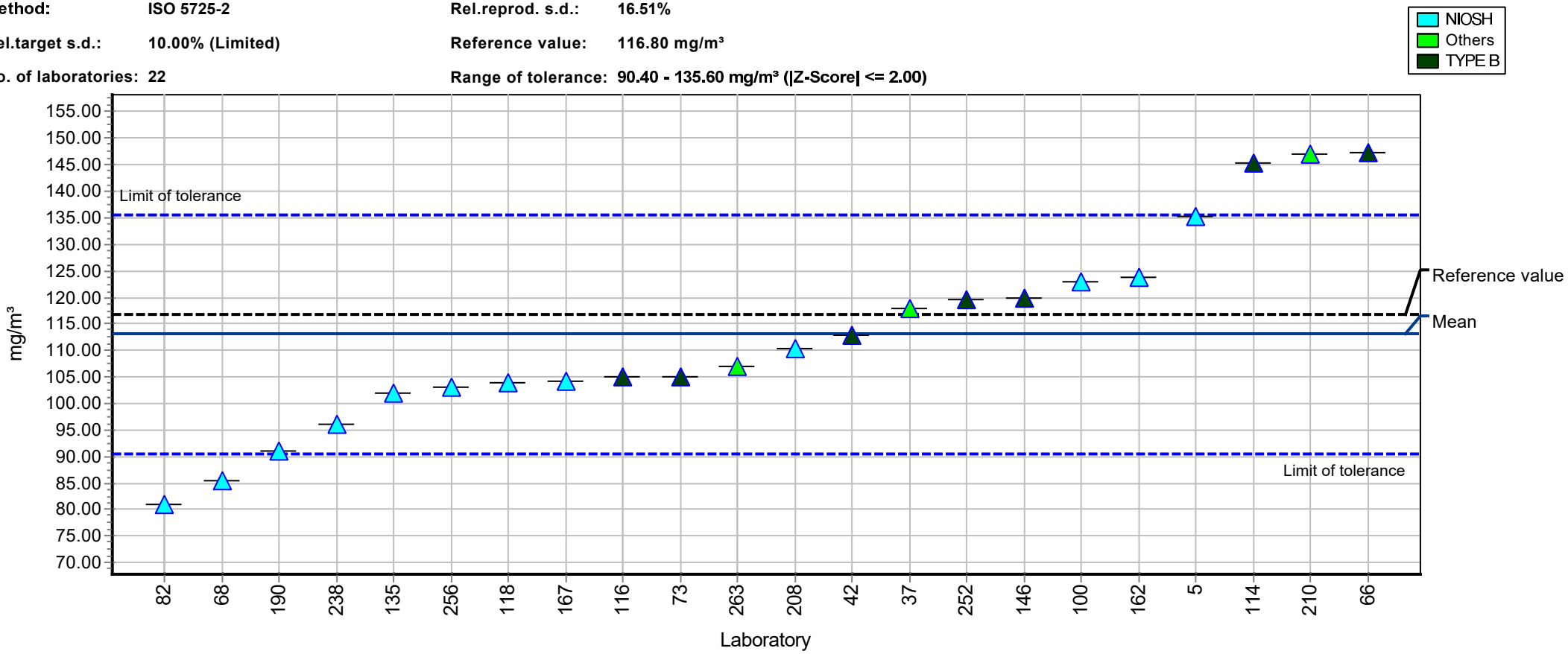
Summary results

Sample:	**1**	**Mean:**	**30.70 mg/m³**
Measurand:	**2-Butanol**	**Reprod. s.d.:**	**2.75 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**8.95%**
Rel.target s.d.:	**10.00% (Limited)**	**Reference value:**	**35.20 mg/m³**
No. of laboratories:	**21**	**Range of tolerance:**	**24.56 - 36.84 mg/m³ (|Z-Score| <= 2.00)**



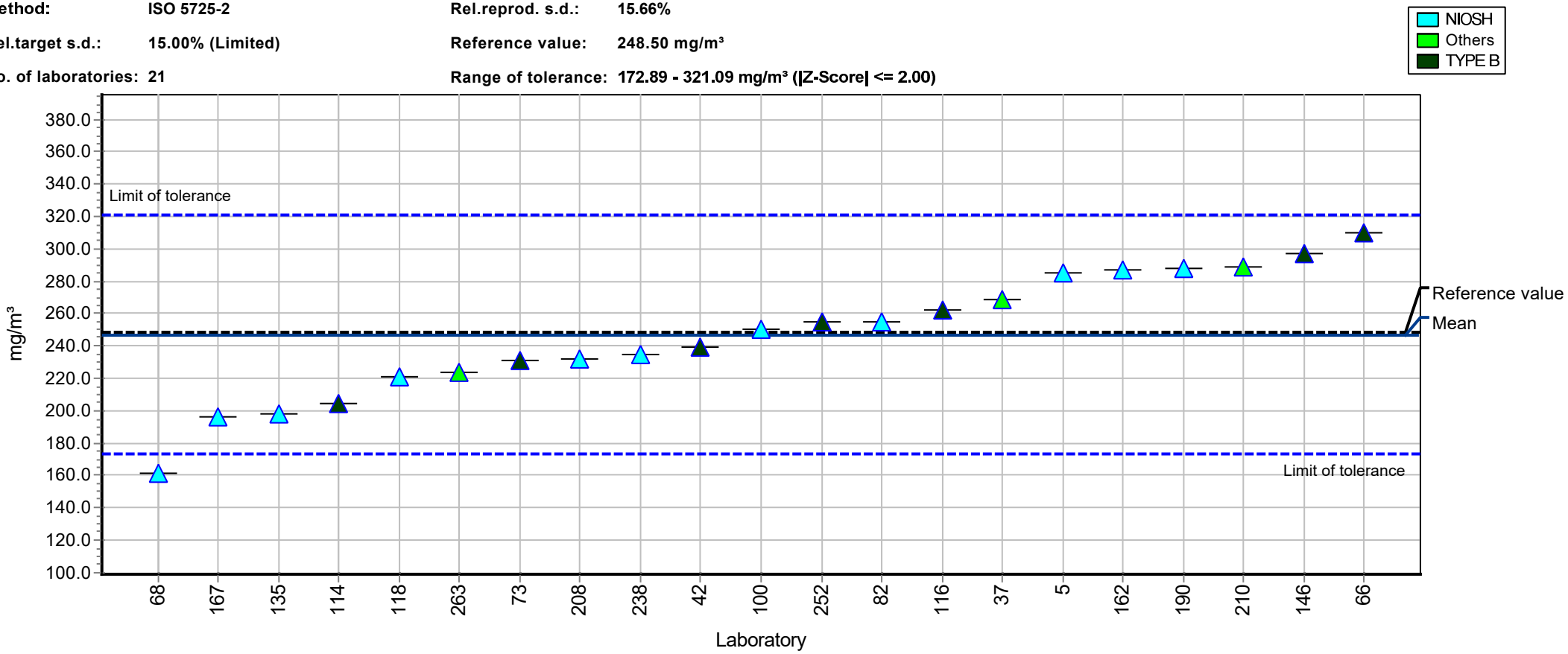
Summary results

Sample:	**1**	**Mean:**	**113.00 mg/m³**
Measurand:	**2-Propanol**	**Reprod. s.d.:**	**18.65 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**16.51%**
Rel.target s.d.:	**10.00% (Limited)**	**Reference value:**	**116.80 mg/m³**
No. of laboratories:	**22**	**Range of tolerance:**	**90.40 - 135.60 mg/m³ (|Z-Score| <= 2.00)**



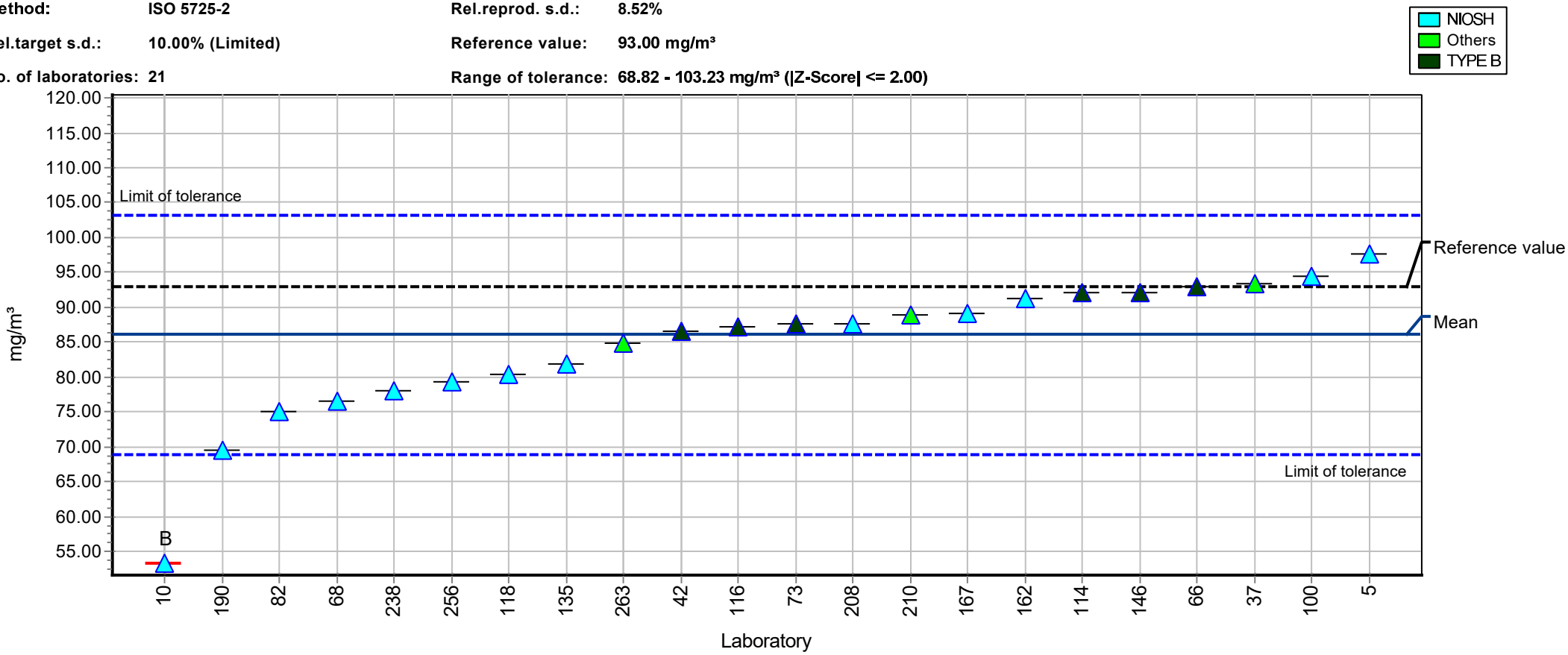
Summary results

Sample:	**1**	**Mean:**	**246.99 mg/m³**
Measurand:	**Ethanol**	**Reprod. s.d.:**	**38.69 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**15.66%**
Rel.target s.d.:	**15.00% (Limited)**	**Reference value:**	**248.50 mg/m³**
No. of laboratories:	**21**	**Range of tolerance:**	**172.89 - 321.09 mg/m³ (|Z-Score| <= 2.00)**



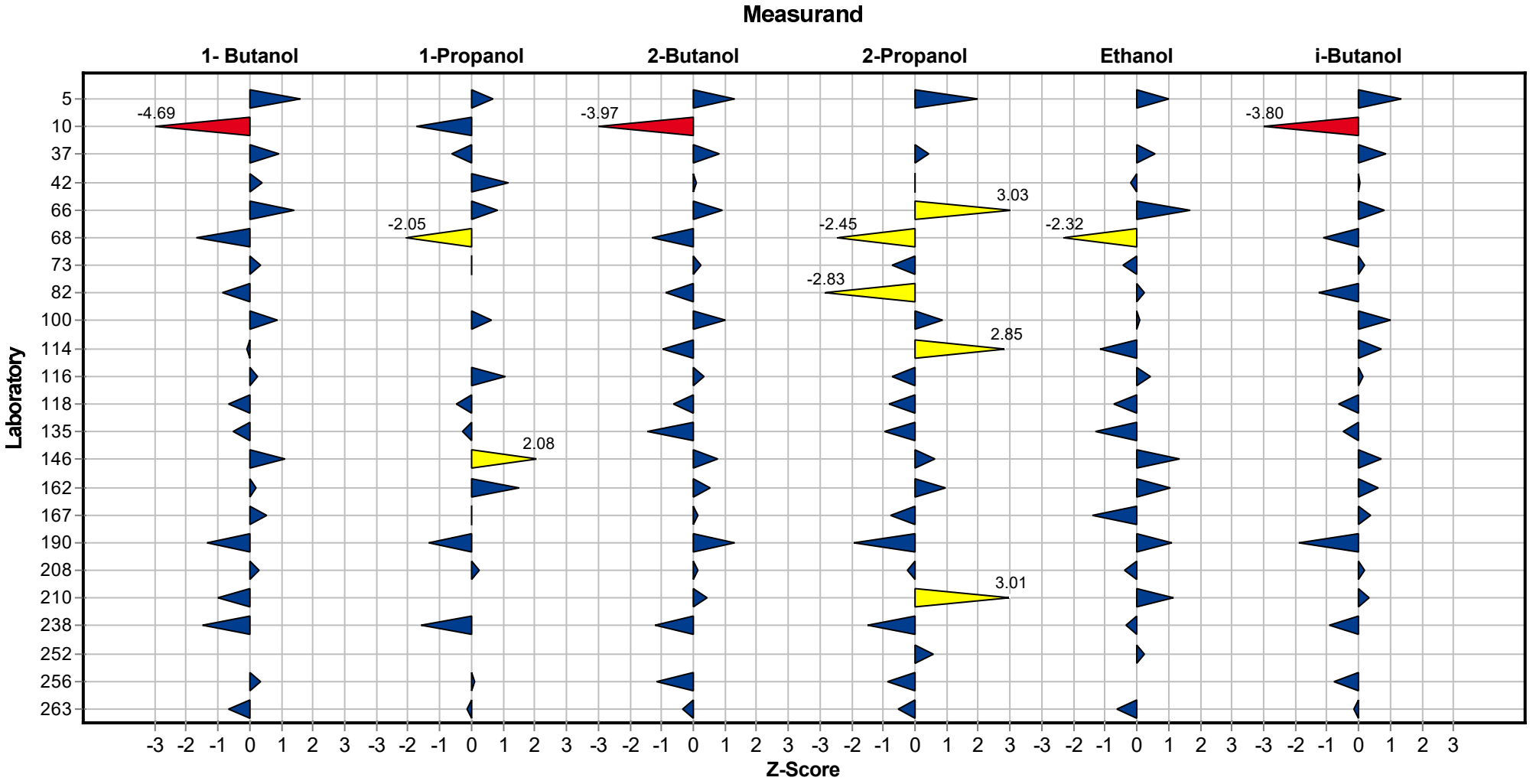
Summary results

Sample:	**1**	**Mean:**	**86.02 mg/m³**
Measurand:	**i-Butanol**	**Reprod. s.d.:**	**7.33 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**8.52%**
Rel.target s.d.:	**10.00% (Limited)**	**Reference value:**	**93.00 mg/m³**
No. of laboratories:	**21**	**Range of tolerance:**	**68.82 - 103.23 mg/m³ (|Z-Score| <= 2.00)**



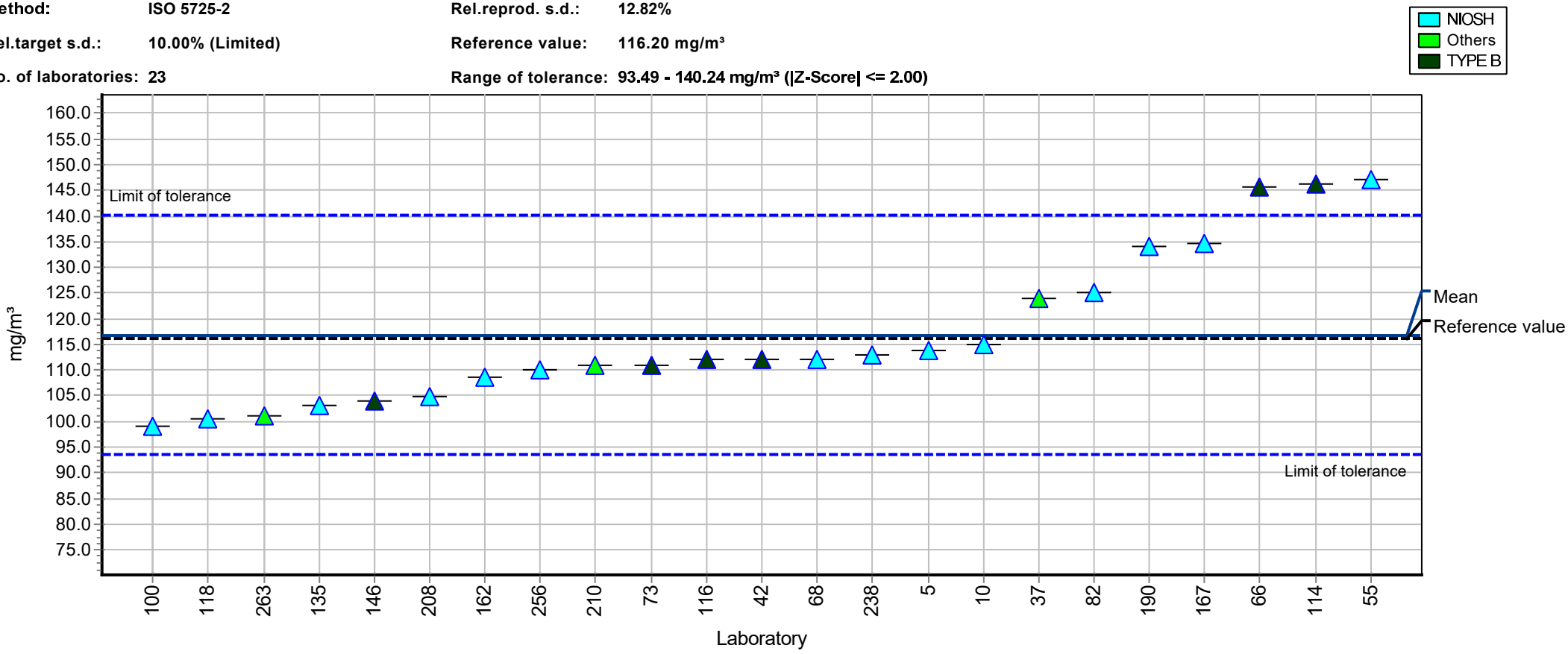
Sample chart of Z-scores

Sample 1



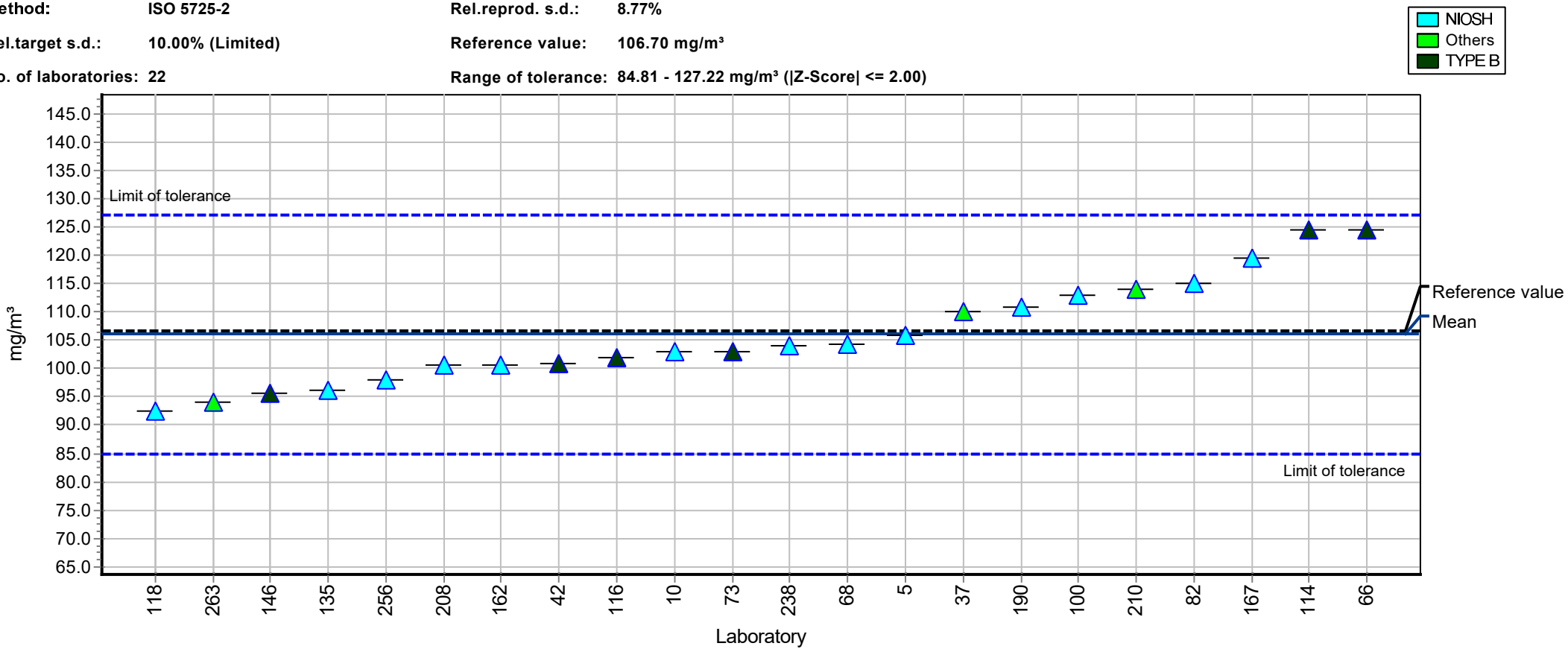
Summary results

Sample:	**2**	**Mean:**	**116.87 mg/m³**
Measurand:	**Cyclohexane**	**Reprod. s.d.:**	**14.99 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**12.82%**
Rel.target s.d.:	**10.00% (Limited)**	**Reference value:**	**116.20 mg/m³**
No. of laboratories:	**23**	**Range of tolerance:**	**93.49 - 140.24 mg/m³ (|Z-Score| <= 2.00)**



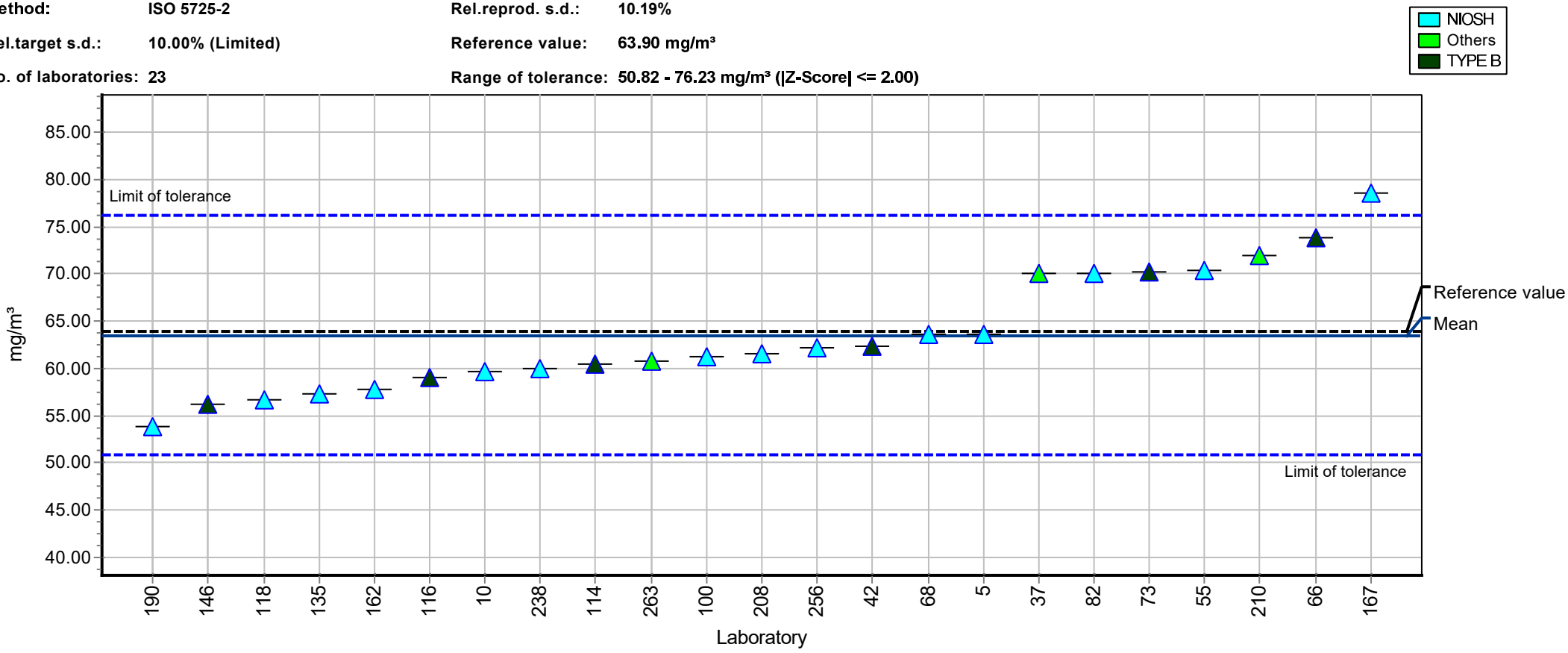
Summary results

Sample:	**2**	**Mean:**	**106.02 mg/m³**
Measurand:	**Methylcyclohexane**	**Reprod. s.d.:**	**9.30 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**8.77%**
Rel.target s.d.:	**10.00% (Limited)**	**Reference value:**	**106.70 mg/m³**
No. of laboratories:	**22**	**Range of tolerance:**	**84.81 - 127.22 mg/m³ (|Z-Score| <= 2.00)**



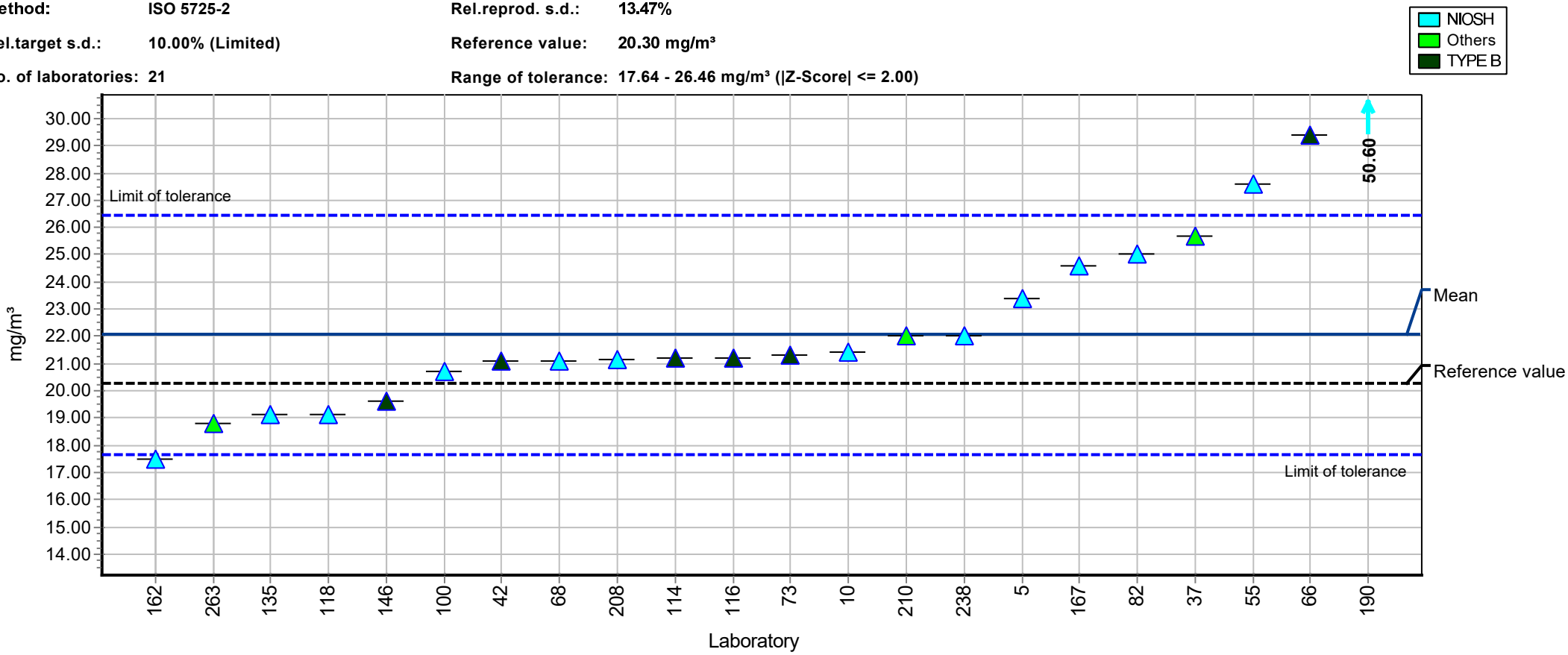
Summary results

Sample:	**2**	**Mean:**	**63.52 mg/m³**
Measurand:	**n-Decane**	**Reprod. s.d.:**	**6.47 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**10.19%**
Rel.target s.d.:	**10.00% (Limited)**	**Reference value:**	**63.90 mg/m³**
No. of laboratories:	**23**	**Range of tolerance:**	**50.82 - 76.23 mg/m³ (|Z-Score| <= 2.00)**



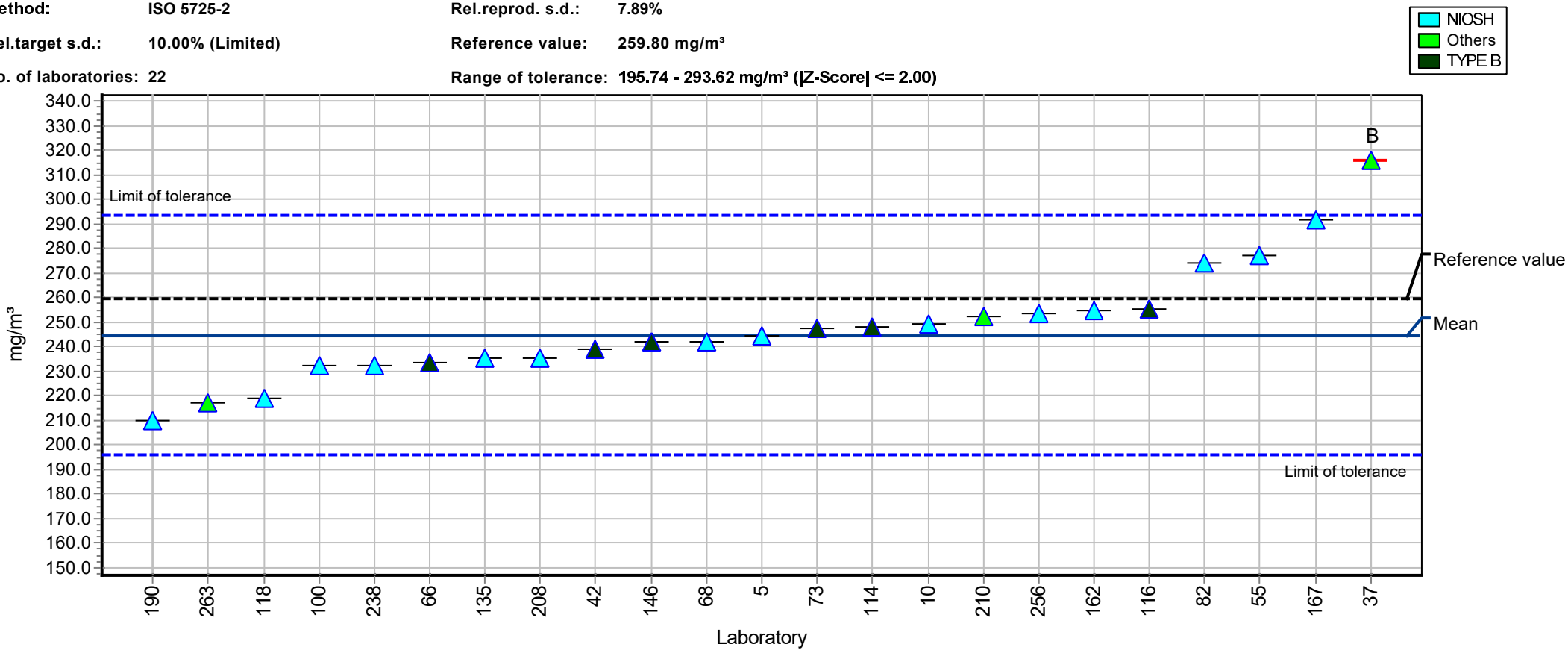
Summary results

Sample:	**2**	**Mean:**	**22.05 mg/m³**
Measurand:	**n-Hexane**	**Reprod. s.d.:**	**2.97 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**13.47%**
Rel.target s.d.:	**10.00% (Limited)**	**Reference value:**	**20.30 mg/m³**
No. of laboratories:	**21**	**Range of tolerance:**	**17.64 - 26.46 mg/m³ (|Z-Score| <= 2.00)**



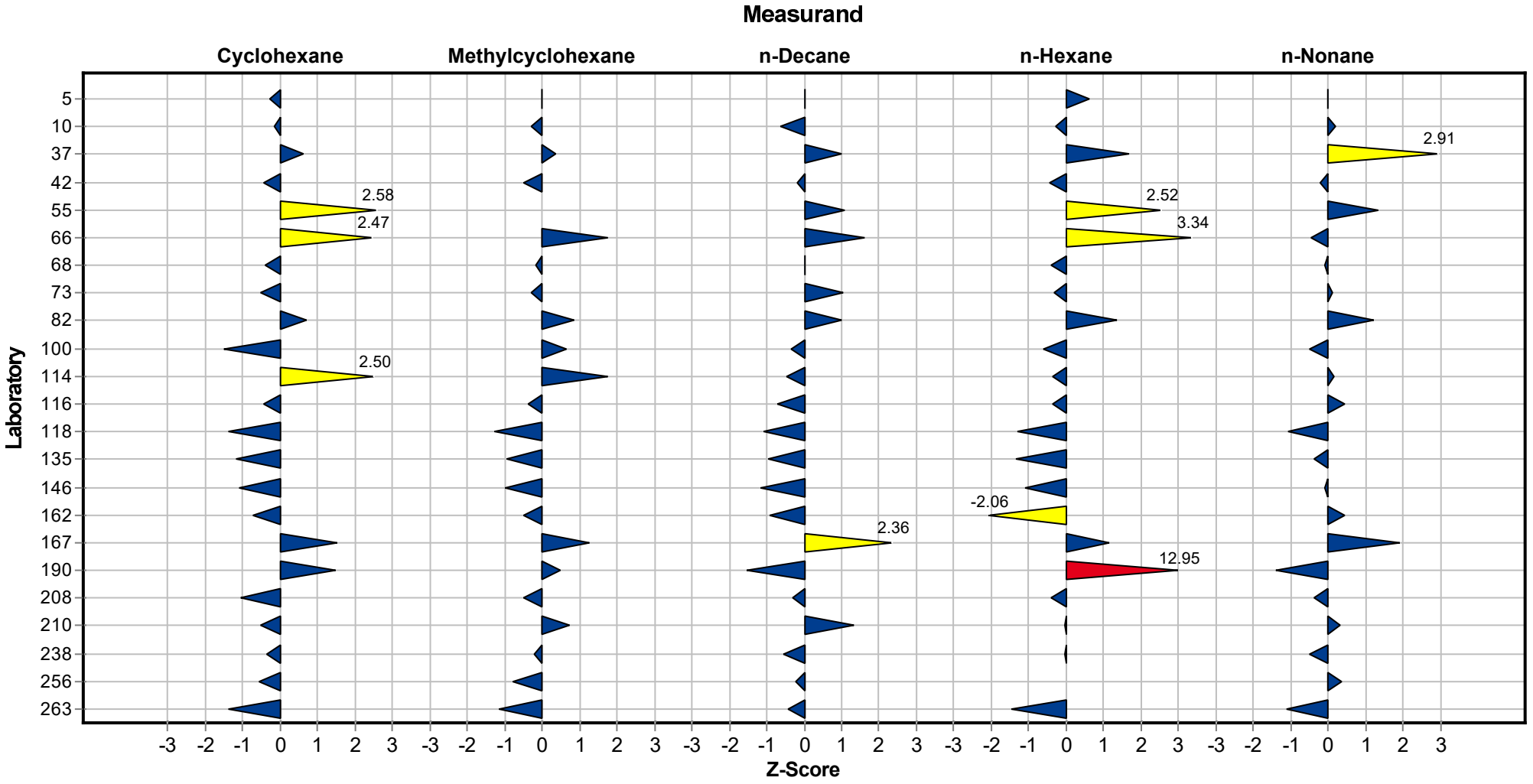
Summary results

Sample:	**2**	**Mean:**	**244.68 mg/m³**
Measurand:	**n-Nonane**	**Reprod. s.d.:**	**19.30 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**7.89%**
Rel.target s.d.:	**10.00% (Limited)**	**Reference value:**	**259.80 mg/m³**
No. of laboratories:	**22**	**Range of tolerance:**	**195.74 - 293.62 mg/m³ (|Z-Score| <= 2.00)**



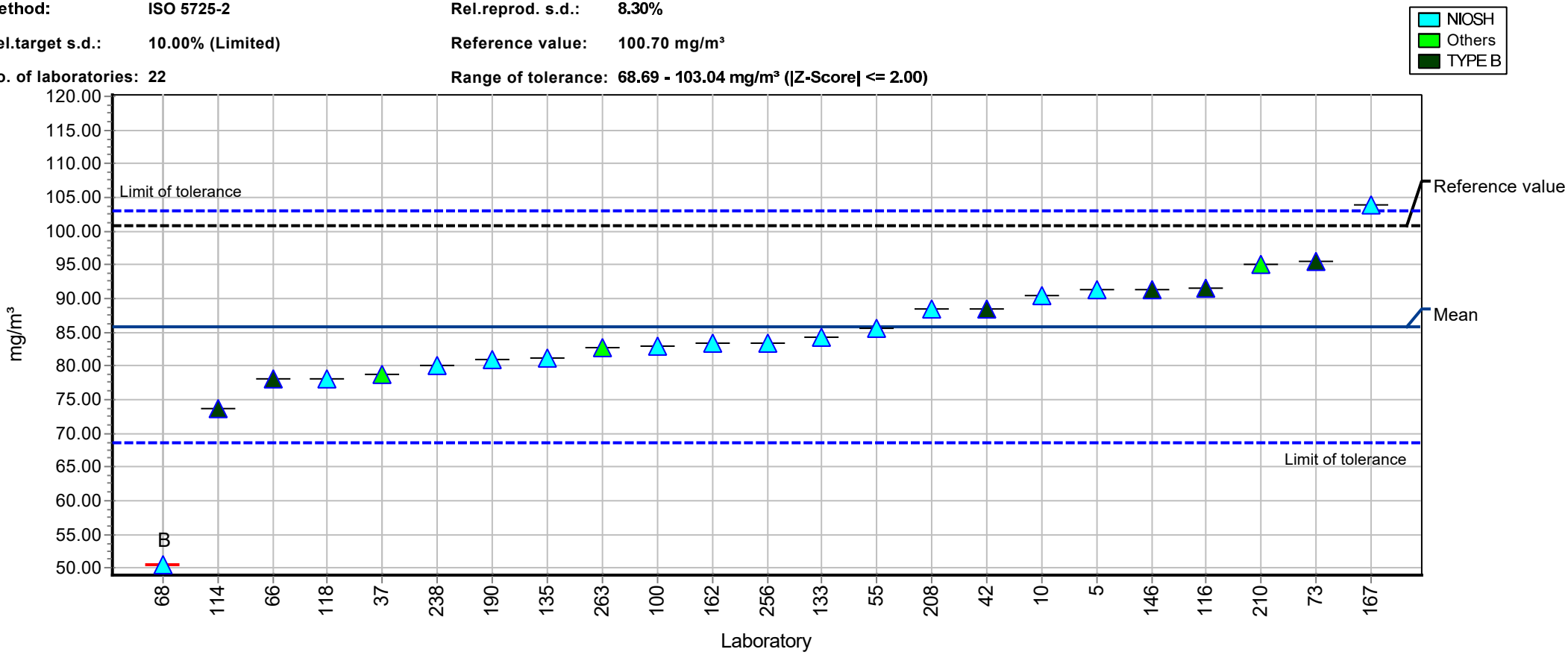
Sample chart of Z-scores

Sample 2



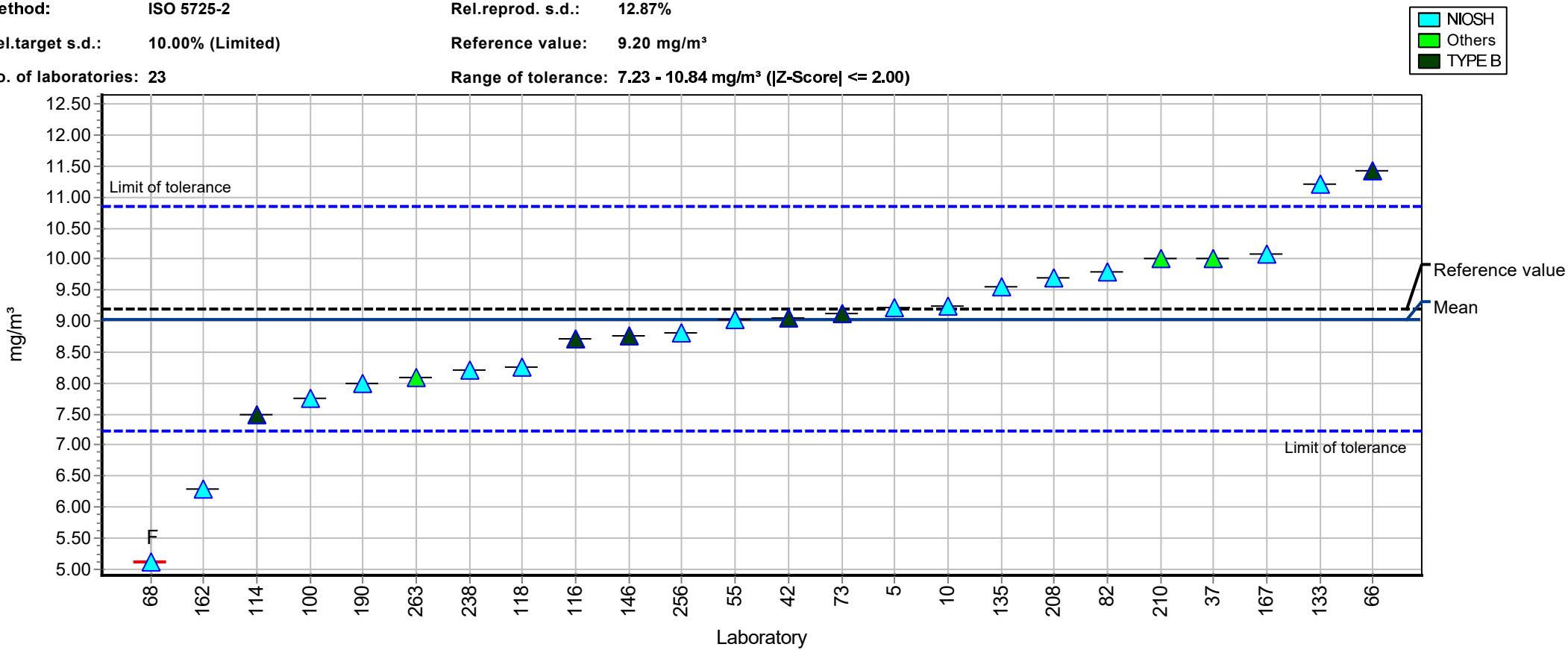
Summary results

Sample:	**3**	**Mean:**	**85.86 mg/m³**
Measurand:	**1,2,4-Trimethylbenzene**	**Reprod. s.d.:**	**7.12 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**8.30%**
Rel.target s.d.:	**10.00% (Limited)**	**Reference value:**	**100.70 mg/m³**
No. of laboratories:	**22**	**Range of tolerance:**	**68.69 - 103.04 mg/m³ (|Z-Score| <= 2.00)**



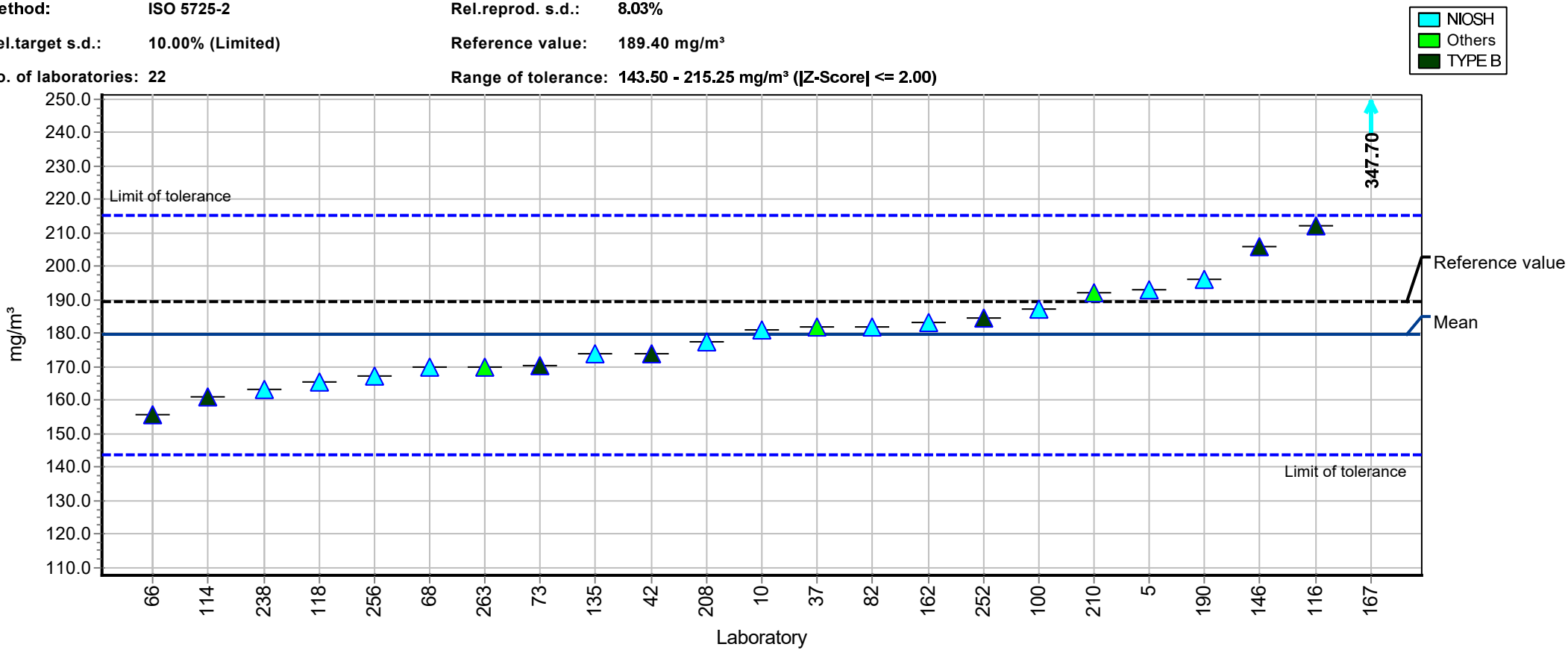
Summary results

Sample:	**3**	**Mean:**	**9.03 mg/m³**
Measurand:	**Cumene**	**Reprod. s.d.:**	**1.16 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**12.87%**
Rel.target s.d.:	**10.00% (Limited)**	**Reference value:**	**9.20 mg/m³**
No. of laboratories:	**23**	**Range of tolerance:**	**7.23 - 10.84 mg/m³ (|Z-Score| <= 2.00)**



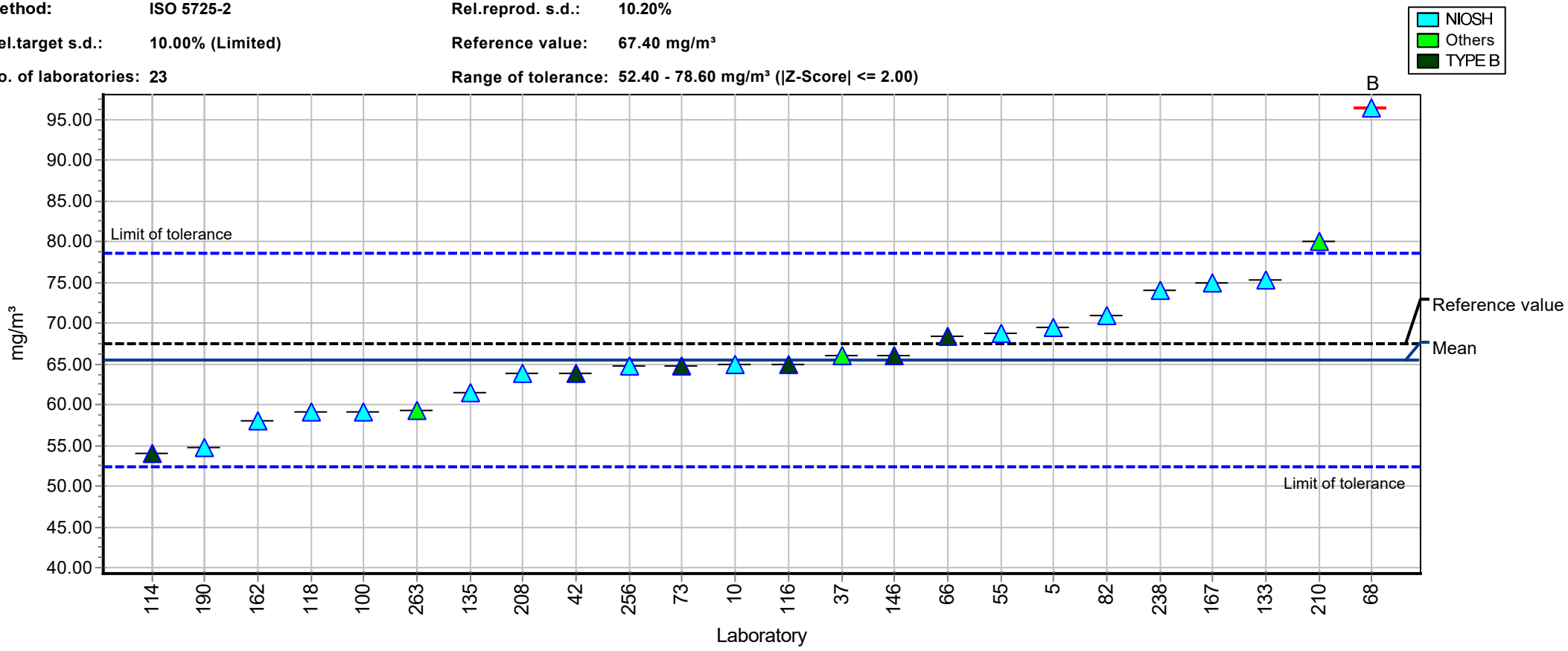
Summary results

Sample:	**3**	**Mean:**	**179.38 mg/m³**
Measurand:	**Ethyl acetate**	**Reprod. s.d.:**	**14.40 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**8.03%**
Rel.target s.d.:	**10.00% (Limited)**	**Reference value:**	**189.40 mg/m³**
No. of laboratories:	**22**	**Range of tolerance:**	**143.50 - 215.25 mg/m³ (|Z-Score| <= 2.00)**



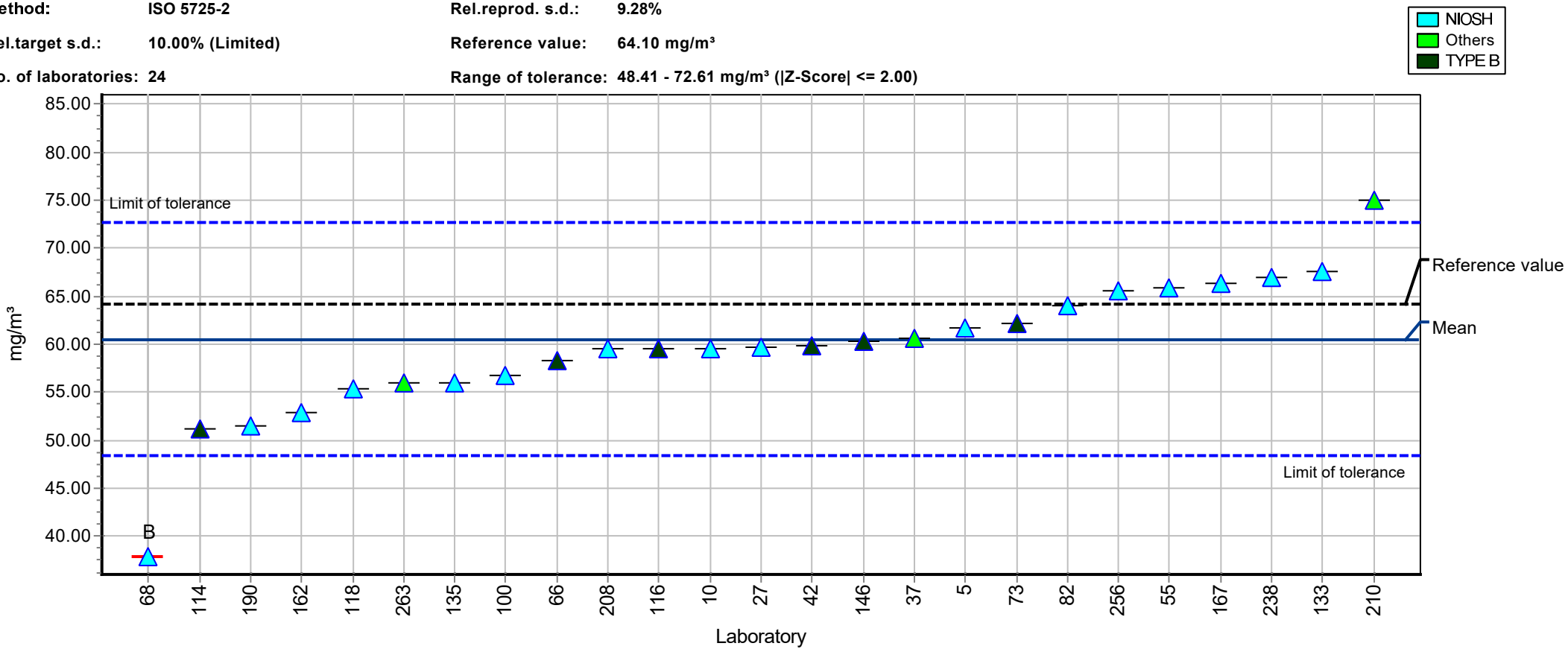
Summary results

Sample:	**3**	**Mean:**	**65.50 mg/m³**
Measurand:	**Ethylbenzene**	**Reprod. s.d.:**	**6.68 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**10.20%**
Rel.target s.d.:	**10.00% (Limited)**	**Reference value:**	**67.40 mg/m³**
No. of laboratories:	**23**	**Range of tolerance:**	**52.40 - 78.60 mg/m³ (|Z-Score| <= 2.00)**



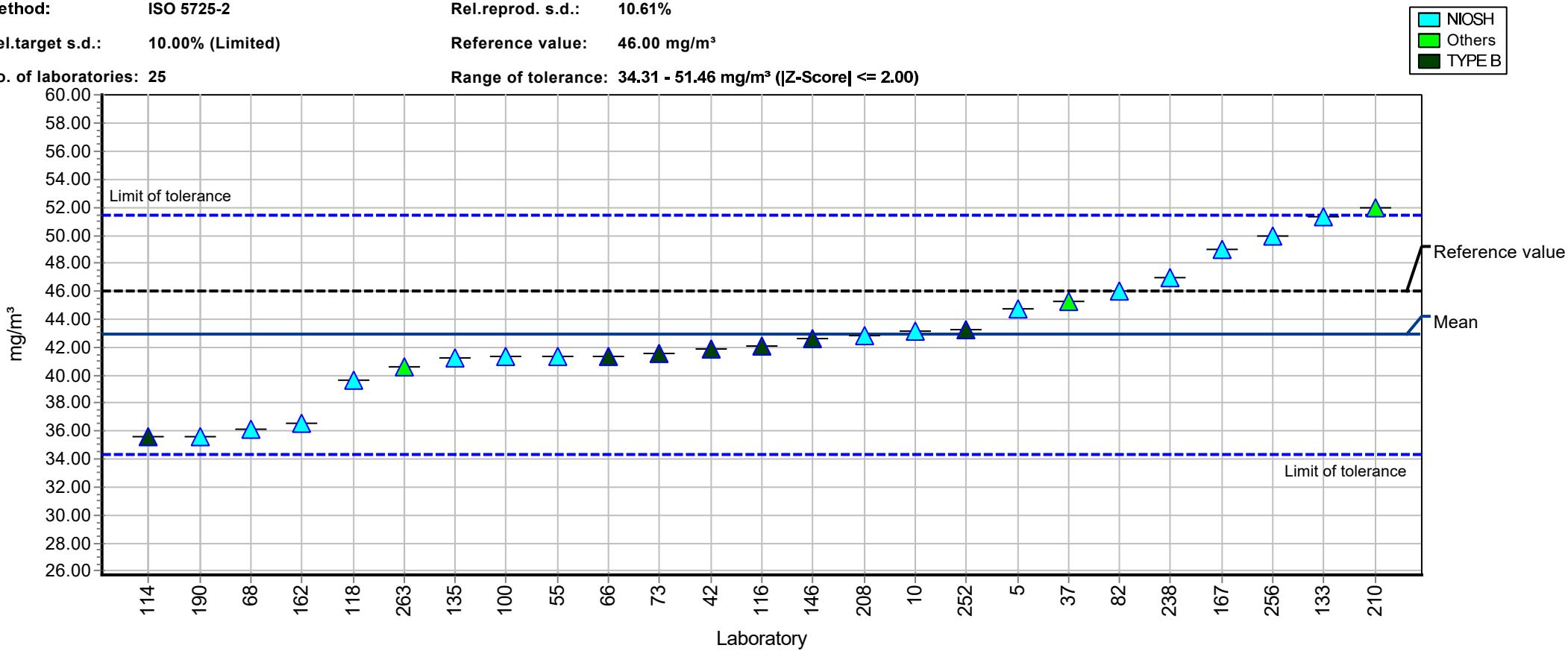
Summary results

Sample:	**3**	**Mean:**	**60.51 mg/m³**
Measurand:	**m-Xylene**	**Reprod. s.d.:**	**5.62 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**9.28%**
Rel.target s.d.:	**10.00% (Limited)**	**Reference value:**	**64.10 mg/m³**
No. of laboratories:	**24**	**Range of tolerance:**	**48.41 - 72.61 mg/m³ (|Z-Score| <= 2.00)**



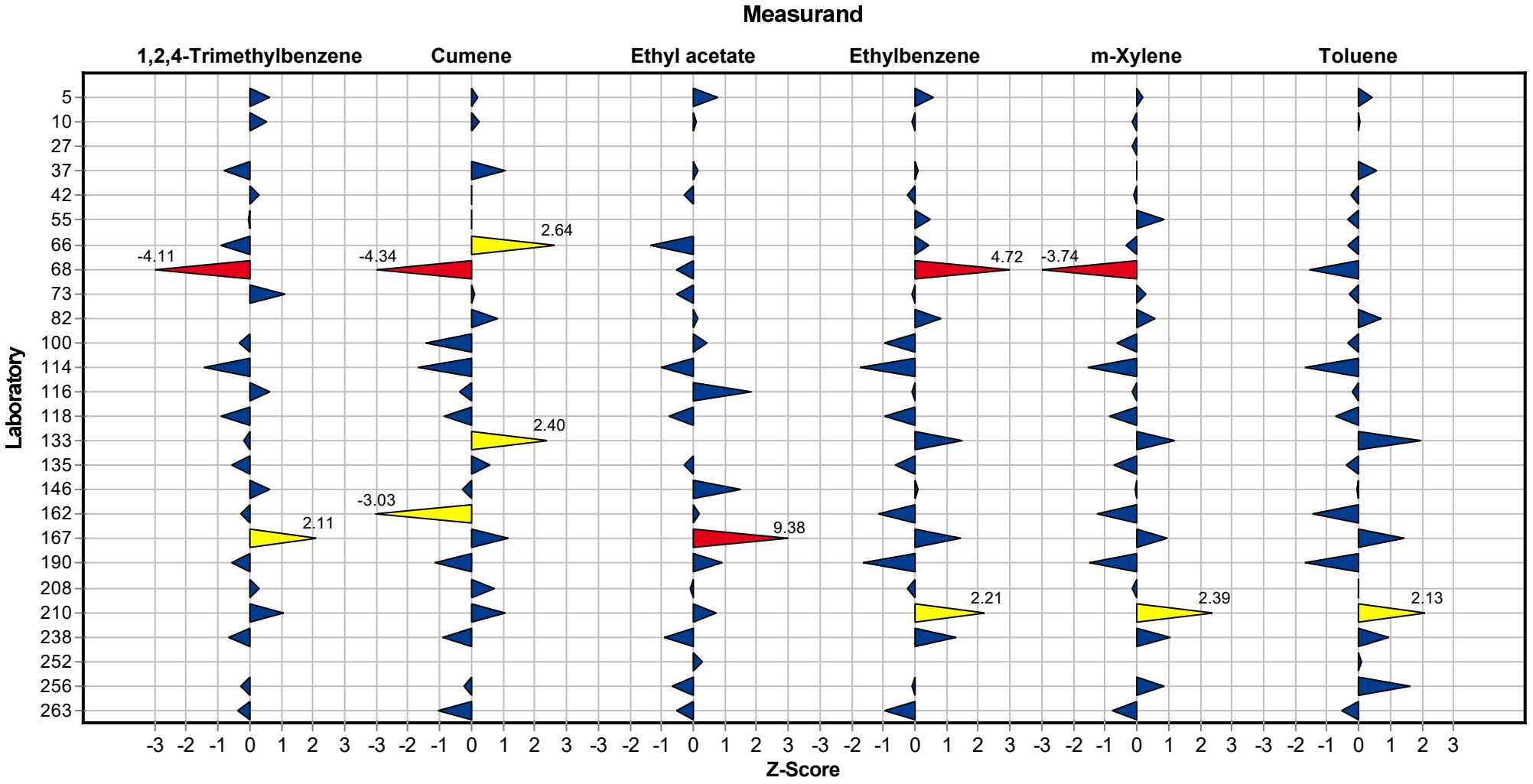
Summary results

Sample:	**3**	**Mean:**	**42.88 mg/m³**
Measurand:	**Toluene**	**Reprod. s.d.:**	**4.55 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**10.61%**
Rel.target s.d.:	**10.00% (Limited)**	**Reference value:**	**46.00 mg/m³**
No. of laboratories:	**25**	**Range of tolerance:**	**34.31 - 51.46 mg/m³ (|Z-Score| <= 2.00)**



Sample chart of Z-scores

Sample 3



Questions and Answers

Participant	Analytical method
5	Hausmethode
10	iso 16200-1 or NFX 43-267
37	Hausmethode
42	IFA-Arbeitsmappe
55	GC-MS
66	Hausmethode in Anlehnung an VDI 2100 Blatt 2
68	Weder DFG noch IFA-Arbeitsmappe
73	In Anlehnung IFA-Arbeitsmappe: 7732, 7733 und 7322
82	Hauseigene Methode
100	NF X-43-267, metropol
114	NFX 43-267
116	DFG Nr6 1997; IFA 7732 2011; IFA 7733 2005; NIOSH 1450 2003
118	inhouse-Methode in Anlehnung an IFA-Arbeitsmappen
135	NIOSH 140X/150X
146	DFG NR. 6 1997, IFA 7732 2011, IFA 7733 2005, NIOSH 1450 2003
162	Hausmethode, angelehnt an Methoden aus IFA-Arbeitsmappe
167	Capillary Gas Chromatography
190	IFA 7732, 7733 und 7322
208	Ow n, based on NIOSH and OSHA-methods
210	Nach NIOSH-Normen (1400: Ethanol, 2-Propanol; 1401: 1-Butanol, 2-Butanol, i-Butanol; 1500: Aliphaten;1501: Aromaten; 1450: Ethylacetat)
238	Metropol INRS
252	hausinterne Methode
256	VDI 2100 Blatt2
263	IFA 7732, 7733, 7322 und QMA

Participant	Front- and back section	Desorption solution
5	ja	Schw efelkohlenstoff
10	yes	CS2 or CS2/isopropanol
37	nein	Benzylalkohol

Participant	Front- and back section	Desorption solution
42	nein	Ternäres Gemisch (60% Dichlormethan, 35% Schw efelkohlenstoff, 5% Methanol)
55	yes	CS2
66	nein	PG1: BA; PG2+3: DCM/CS2/MeOH
68	ja	CS2
73	Ja	ternäres Gemisch (60% Dichlormethan; 35% Schw efelkohlenstoff; 5% Methanol)
82	ja	CS2
100	yes	CS2 (sample2-3), CS2/Methylene Chloride(50/50) (sample 1)
114	ja	CS2
116	ja	Schw efelkohlenstoff
118	nein, zusammen	ternäres Gemisch (CH2CL2:CS2:MeOH) = 60:35:5
135	nein	Schw efelkohlenstoff/Phenoxyethanol (95/5)
162	getrennt	Schw efelkohlenstoff
167	Yes	Carbon disulphide
190	Nein	Dichlormethan/Schw efelkohlenstoff/Methanol
208	Yes	2% DMF in CS2
210	nein	PG 1: je nach Vorgabe der NIOSH; PG2 + PG 3: nach Vorgabe der NIOSH's mit Schw efelkohlenstoff
238	yes	disulfide carbon
252	Ja	DMF/CS2 (60:40)
256	Nein	Diethylether und CS2
263	ja	PG1: ternäres Gemisch; PG2: ternäres Gemisch; PG3: PG3 CS2 und ternäres Gemisch

Participant	Volume of desorption solution	Gas chromatograph (GC)	Carrier gas
5	1	Agilent 6890	Helium
10	1	Clarus 680	He
37	3ml	Clarus 680 von PE	Helium 5.0
42	10ml	GC 7890A (Agilent)	Helium
55	2 ml	agilent	helium
66	PG1: 5mL; PG 2+3: 10 mL	PG1: Agilent 7697A; PG2+3: Agilent 6890N	Helium
68	1 ml	GC/FID: HP 5890 Series II	Helium
73	Sammelschicht mit ~1ml / Kontrollschicht mit ~2 ml	Agilent 7890B	Helium
82	1 mL	Agilent 7890A	Stickstoff
100	2ml	GC 6890 agilent	He

Participant	Volume of desorption solution	Gas chromatograph (GC)	Carrier gas
114	5ml	GC PERKIN ELMER	He
116	10ml	Agilent 78 90 B	Stickstoff
118	10mL	Agilent 7890A	Stickstoff
135	5ml	Agilent 7890	Helium
162	1.5 ml	Shimadzu GC-2010	Wasserstoff
167	1,5 mL	1. Agilent Technologies 7890A / 2. Agilent Technologies 6890N	1. He / 2. N2
190	10 mL	Shimadzu	Helium
208	1,5 ml	GC-FID	Helium
210	je nach Röhrchengröße: 1ml/ 3ml	Agilent GC 7890A gekoppelt mit Varian MS-220	Helium
238	2 ml	GCMS and GCFID	helium
252	5 ml	Shimadzu GC 2010 Plus	Helium
256	5 mL und 5 mL	Agilent Technologies 7890B	He
263	5 mL	GC-doppel FID, Autosystem Perkin Elmer	Stickstoff

Participant	Sample injection	Data evaluation
5	split 1:10	ISTD
10	split	ESTD
37	Turbomatrix 40, Headspace bei 100°C mit Split,	quant. mit externem Standard, Identifizierung über Retentionszeit(en) auf beiden Säulen.
42	1µl, Split 1:10	Interner Standard
55	split	internal standard
66	PG1: Split Ratio 10:1; PG2+3: splitless	externe Standards mit Korrektur über interne Standards
68	split	interner Standard
73	Split	Interner Standard
82	Split	Quantifizierung über internen Standard, Identifikation über Retentionszeiten der Bezugssubstanzen
100	split	internal
114	SPLIT	beide
116	split	Kalibriert auf angegebenen Stoff und dann über die Retentionszeit
118	on column	interner Standard
135	Split	externer Standard
162	split	Interner Standard
167	Splitless	Internal standard, chlorobenzene
190	split	interner Standard

Participant	Sample injection	Data evaluation
208	Split	External standard
210	splitless	interner Standard; TIC
238	splitless	internal
252	split	interner Standard
256	splitless	Interner Standard
263	split	externe Kalibrierung, Verw endung interner Standard, Identifizierung und Absicherung über Säule 2

Participant	Analytical column
5	HP1 und FFAP
10	Rxi 5 MS and stabilw ax
37	60m Rtx Volatile 0,32mmID, 1,5µm df und 60m Stabilw ax DA 0,32mmID, 0,25µm df
42	HP-FFAP / HP-ULTRA2 (je 50m; 0,32mm; 0,52µm)
55	RTX 502.2
66	PG1: DB-5.625; PG2+3: DB-5.625MS
68	Vocol von Supelco
73	DB-5 MS / 60 m
82	HP5 30m, 0,32mm x 0,25 µm
100	DB624
114	ELITE 5MS
116	Optima und Wax
118	CP Sil 5 CB/CB-WAX 57 CB
135	Carbow ax / DB1
162	CP Sil PONA CB, 40 m x 0.1 mm ID x 0.2 µm und Restek RTX 502.2, 60 m x 0.1 mm ID x 1.4 µm
167	Samples #2 & #3: Agilent Technologies DB-5 MS + DG, 30 m x 0,25 mm, 0,25 µm film thickness, Sample #1 + hexane, ethylacetate: Agilent Technologies DB-624 UI, 30 m x 0,25 mm, 1,4 µm film thickness, ethanol & 2-propanol: Restek PP PS 80/100, 2 m x 2,0 mm
190	Agilent DV VRX
208	Agilent HP5 and HP-Innow ax
210	Restek RXi-5ms
238	RTX624
252	RXi - 5Sil MS
256	RTx-624, 40 m, 0.18 mm ID, 1um Film
263	Säule 1: Fused Silica-Kapillarsäule 007-5-50-2.5F (5% Phenyl Methyl Silicon), Quadrex; Säule 2: Fused Silica-Kapillarsäule 007-1701-50W-1.OF,

Participant	Detector	Recovery rate	Date of analysis	Sample carrier
5	FID	ja	26.02-01.03.2019	AK NIOSH
10	FID	no	2019 march 2nd	
37	2 x FID	nein	14.03.2019	Aktivkohle Dräger Typ B und Tenax TA
42	FID / FID	Ja	20. 02. 2019	
55	MS	yes	27/02/2019	
66	Massendetektor	nein	26.2.-12.3.2019	Aktivkohle Typ B
68	FID	Nein	26./27.2.2019	
73	FID	Nein	25.02.2019	
82	FID	ja	2019-03-15	
100	MS (5975 agilent)	no	3/7/19 (sample1), 3/13/19 (sample 1-2)	
114	FID	nein	01/03/2019	
116	FID	ja	19.03.2019	Aktivkohleröhrchen Dräger Typ B
118	FID		07.03.2019	
135	Agilent 5975C MSD	ja	25./26.02.2019	
146				A-Kohle BIA
162	FID	Ja	27.02.2019	
167	FID	Yes	Weeks 11 - 12	
190	MS	nein	10.03.2019	
208	FID	No	20.2.2019	
210	MS	nein	KW 11	BIA-Aktivkohleröhrchen und Anasorb CSC Röhrchen
238	GCMS and GCFID	no	23/02/2019	
252	FID	Nein	21.02.2019	Dräger-Röhrchen Typ BIA
256	MS	Ja	28.02.2019	
263	FID	nein	13.032019 bis 22.03.2019	Aktivkohle Typ G von Dräger

Participant	Sampling pump	Flow rate
5	SKC, PocketPump	70/200 ml/min
37	Gilian PP1-Ex LFS-113 DC	330 - 340 ml/min (A-Kohle) / 50-60 ml/min (Tenax)
66	SKC Universal, GSA SG-350, GilAir plus	333 ml/min
116	Lfs 113	ca 0,333
146	Gil Air 5	0,33 L/min.
210	GSA SG 350	0,08 l/min; 0,33 - 0,37 l/min

Participant	Sampling pump	Flow rate
252	GilAir 5 (low flow module) und GSA SG 5200	330 ml/min
263	GilAir plus von Sensidyne	ca. 0,33 l/min

Participant	Flow rate measurement	Sampling time
5	SKC, Primärkalibrator, Defender	60-120 min
37	Analyt MTC Massenflussmesser GFM-17 / Messbereich 0-500 ml/min / kalibriert auf Luft	30 Minuten
66	Analyt-MTC 35809 MLW	2 h
116	BIOS Defender Seriennummer: 133 137	zwischen 120 und 140 Minuten
146	Gilibrator	PG 1 40 Min., PG 2 40 Min., PG3 60 Min.
210	TSI 4146	12 - 60 Minuten
252	Massflow meter 4146 TSI	ca. 2 h
263	Massflow meter 4140 von TSI	Probenahmedauern: 6 / 15 / 45 Minuten