IFA
Institut für Arbeitsschutz der
Deutschen Gesetzlichen Unfallversicherung

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

Proficiency testing scheme aldehydes with own sampling

24 - 25 October 2023

Institute for Occupationial Safety and Health of the
German Social Accident Insurance (IFA)
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Summary of laboratory test results

Sample 1

	Acetaldehyde	Z score	Butyraldehyde	Z score	Formaldehyde	Z score	Propionaldehyd	Z score
Unit	mg/m³		mg/m³		mg/m³		mg/m³	
35	0.207	-1.31	0.538	-2.17 E	0.092	-0.96	0.398	-1.93
44	0.258	0.83	0.779	1.34	0.119	1.73	0.558	1.31
72	0.208	-1.27	0.604	-1.21	0.078	-2.31 E	0.429	-1.30
95	0.270	1.33	0.790	1.50	0.110	0.85	0.560	1.35
107	0.253	0.62	0.712	0.37	0.106	0.45	0.528	0.70
109	0.259	0.87	0.770	1.21	0.110	0.85	0.532	0.78
116	0.238	-0.01	0.740	0.77	0.110	0.85	0.530	0.74
126	0.230	-0.35			0.092	-0.93		
130	0.230	-0.35	0.641	-0.67	0.097	-0.44	0.301	-3.90 FE
143	0.230	-0.34	0.779	1.34	0.100	-0.15	0.506	0.25
147	0.243	0.19			0.104	0.28		
175	0.250	0.49	0.760	1.06	0.100	-0.14	0.520	0.54
202	0.228	-0.42	0.536	-2.20 E	0.091	-1.01	0.402	-1.85
233	0.223	-0.64	0.657	-0.44	0.100	-0.14	0.496	0.05
242	0.233	-0.22	0.754	0.98	0.097	-0.44	0.504	0.22
265	0.241	0.11	0.607	-1.16	0.104	0.25	0.475	-0.37
272	0.250	0.49	0.637	-0.73	0.114	1.24	0.469	-0.49
–	–	– –	–	– –	–	– –	–	– –
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	17		15		17		15	
Mean	0.238		0.687		0.101		0.493	
Reprod. s.d.	0.017		0.089		0.010		0.053	
Rel. reproducibility s.d.	7.27 %		12.99 %		9.88 %		10.68 %	
Reference value	0.229		0.670		0.098		0.499	
Target s.d.	0.024		0.069		0.010		0.049	
Rel. target s.d.	10.00 %		10.00 %		10.00 %		10.00 %	
Low er limit of tolerance	0.191		0.550		0.081		0.395	

	Acetaldehyde	Z score	Butyraldehyde	Z score	Formaldehyde	Z score	Propionaldehyd	Z score
Upper limit of tolerance	0.286		0.824		0.122		0.592	
Type F outliers							1	
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	17		15		17		14	

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	

Summary of laboratory test results

Sample 2

	Acetaldehyde	Z score	Formaldehyde	Z score	Propionaldehyd	Z score
Unit	mg/m³		mg/m³		mg/m³	
35	0.070	-1.45	0.146	-1.64	0.264	-2.02 E
44	0.090	1.04	0.203	1.60	0.386	1.66
72	0.073	-1.04	0.149	-1.48	0.293	-1.15
95	0.100	2.27 E	0.200	1.43	0.380	1.48
107	0.085	0.43	0.177	0.12	0.343	0.36
109	0.086	0.55	0.190	0.86	0.358	0.81
116	0.080	-0.18	0.186	0.63	0.350	0.57
126	0.073	-1.04	0.167	-0.45		
130	0.076	-0.67	0.166	-0.51	0.203	-3.87 BE
143	0.078	-0.48	0.164	-0.63	0.320	-0.32
147			0.171	-0.20		
175	0.080	-0.18	0.160	-0.85	0.330	-0.03
202	0.095	1.62	0.182	0.42	0.304	-0.81
233	0.075	-0.80	0.172	-0.17	0.334	0.09
242	0.076	-0.67	0.165	-0.57	0.334	0.09
265	0.084	0.31	0.183	0.46	0.326	-0.15
272	0.084	0.31	0.192	0.98	0.312	-0.58
–	–	– –	–	– –	–	– –
Method	ISO 5725-2		ISO 5725-2		ISO 5725-2	
Assessment	|Z|<=2.00		|Z|<=2.00		|Z|<=2.00	
No. of laboratories that submitted results	16		17		15	
Mean	0.082		0.175		0.331	
Reprod. s.d.	0.008		0.016		0.033	
Rel. reproducibility s.d.	10.22 %		9.35 %		9.84 %	
Reference value	0.078		0.169		0.334	
Target s.d.	0.008		0.017		0.033	
Rel. target s.d.	10.00 %		10.00 %		10.00 %	
Low er limit of tolerance	0.065		0.140		0.265	

	Acetaldehyde	Z score	Formaldehyde	Z score	Propionaldehyd	Z score
Upper limit of tolerance	0.098		0.210		0.397	
Type B outliers					1	
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	16		17		14	

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	

Summary of laboratory test results

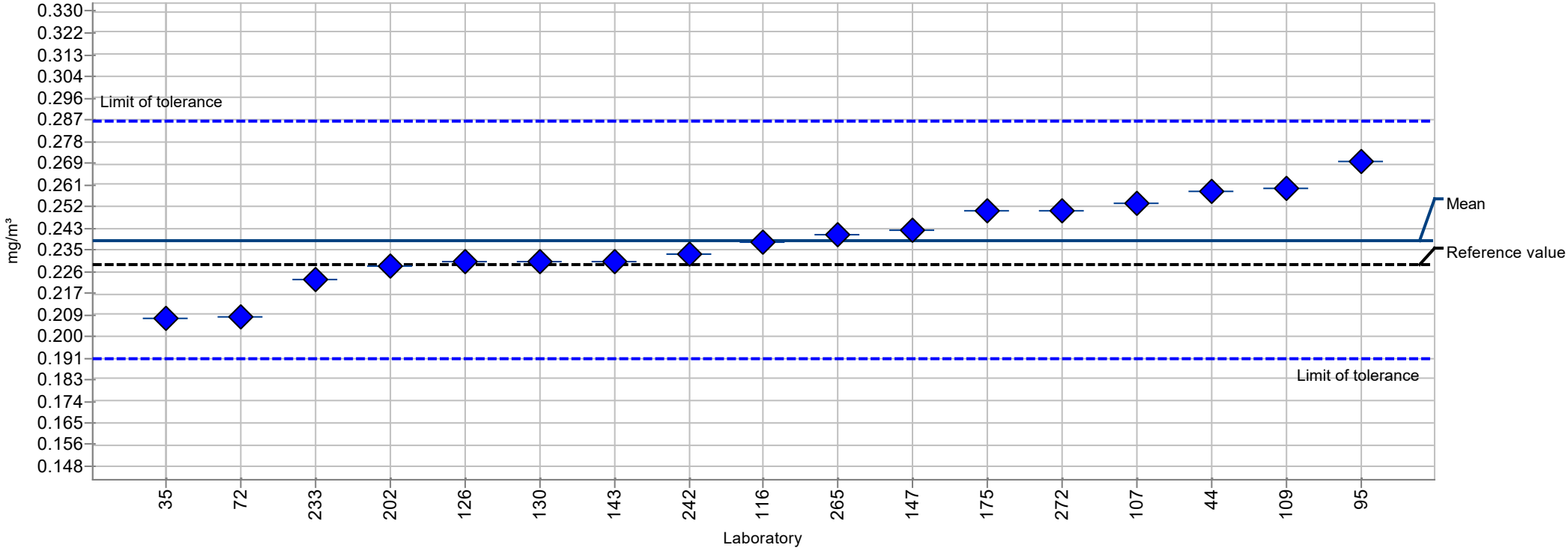
Sample 3

	Acetaldehyde	Z score	Butyraldehyde	Z score	Formaldehyde	Z score
Unit	mg/m³		mg/m³		mg/m³	
35	0.115	-1.81	0.734	-2.49 E	0.181	-1.75
44	0.158	1.25	1.141	1.68	0.258	1.74
72	0.123	-1.24	0.851	-1.29	0.189	-1.40
95	0.160	1.39	1.150	1.77	0.250	1.38
107	0.145	0.32	0.982	0.05	0.220	0.01
109	0.150	0.68	1.075	1.00	0.236	0.74
116	0.140	-0.03	1.050	0.75	0.235	0.70
126	0.131	-0.67			0.212	-0.35
130	0.133	-0.53	0.926	-0.52	0.205	-0.67
143	0.137	-0.22	1.064	0.89	0.211	-0.40
147	0.143	0.17			0.214	-0.25
175	0.150	0.68	1.100	1.26	0.210	-0.44
202	0.144	0.28	0.784	-1.98	0.210	-0.44
233	0.133	-0.53	0.958	-0.20	0.223	0.15
242	0.134	-0.46	1.070	0.95	0.210	-0.44
265	0.145	0.32	0.877	-1.02	0.229	0.42
272	0.146	0.40	0.896	-0.83	0.241	0.97
–	–	– –	–	– –	–	– –
Method	ISO 5725-2		ISO 5725-2		ISO 5725-2	
Assessment	|Z|<=2.00		|Z|<=2.00		|Z|<=2.00	
No. of laboratories that submitted results	17		15		17	
Mean	0.140		0.977		0.220	
Reprod. s.d.	0.012		0.130		0.020	
Rel. reproducibility s.d.	8.29 %		13.26 %		9.19 %	
Reference value	0.134		0.948		0.208	
Target s.d.	0.014		0.098		0.022	
Rel. target s.d.	10.00 %		10.00 %		10.00 %	
Low er limit of tolerance	0.112		0.782		0.176	

	Acetaldehyde	Z score	Butyraldehyde	Z score	Formaldehyde	Z score
Upper limit of tolerance	0.169		1.173		0.264	
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	17		15		17	
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						

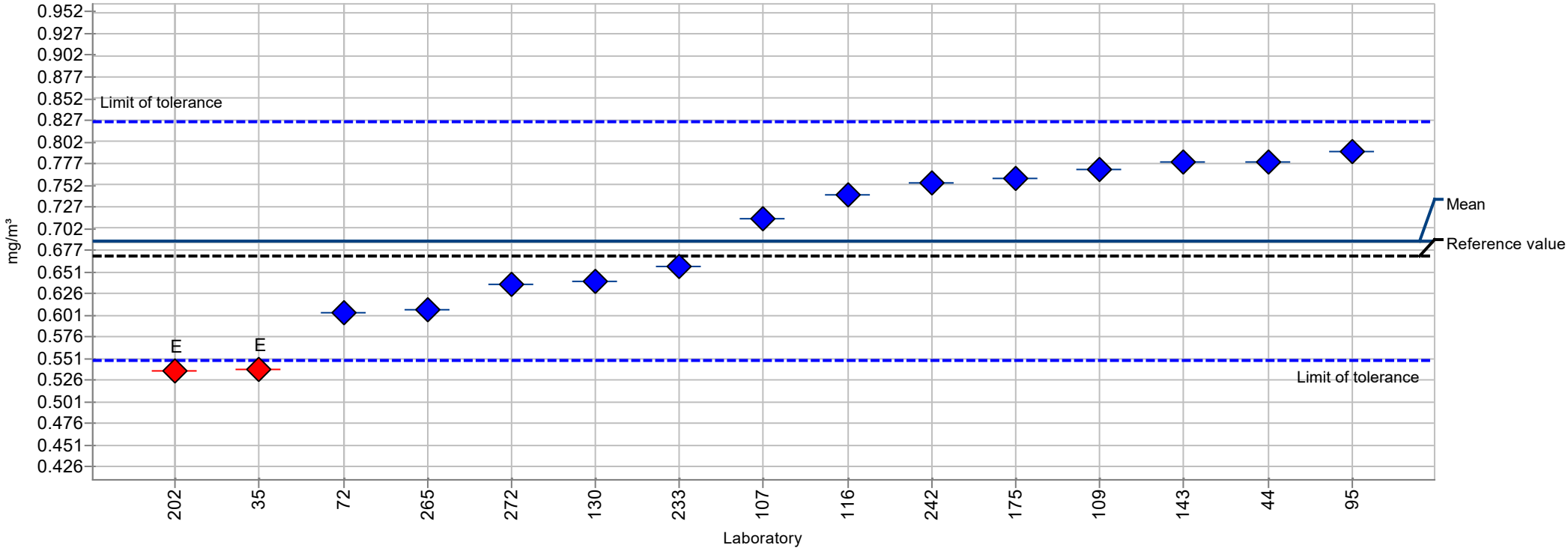
Summary results

Measurand:	**Acetaldehyde**	**Mean:**	**0.238 mg/m³**
Sample:	**Sample 1**	**Reprod. s.d.:**	**0.017 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**7.27%**
Rel.target s.d.:	**10.00%**	**Reference value:**	**0.229 mg/m³**
Number of laboratories in calculation:	**17**	**Range of tolerance:**	**0.191 - 0.286 mg/m³ (|Z-Score| <= 2.00)**



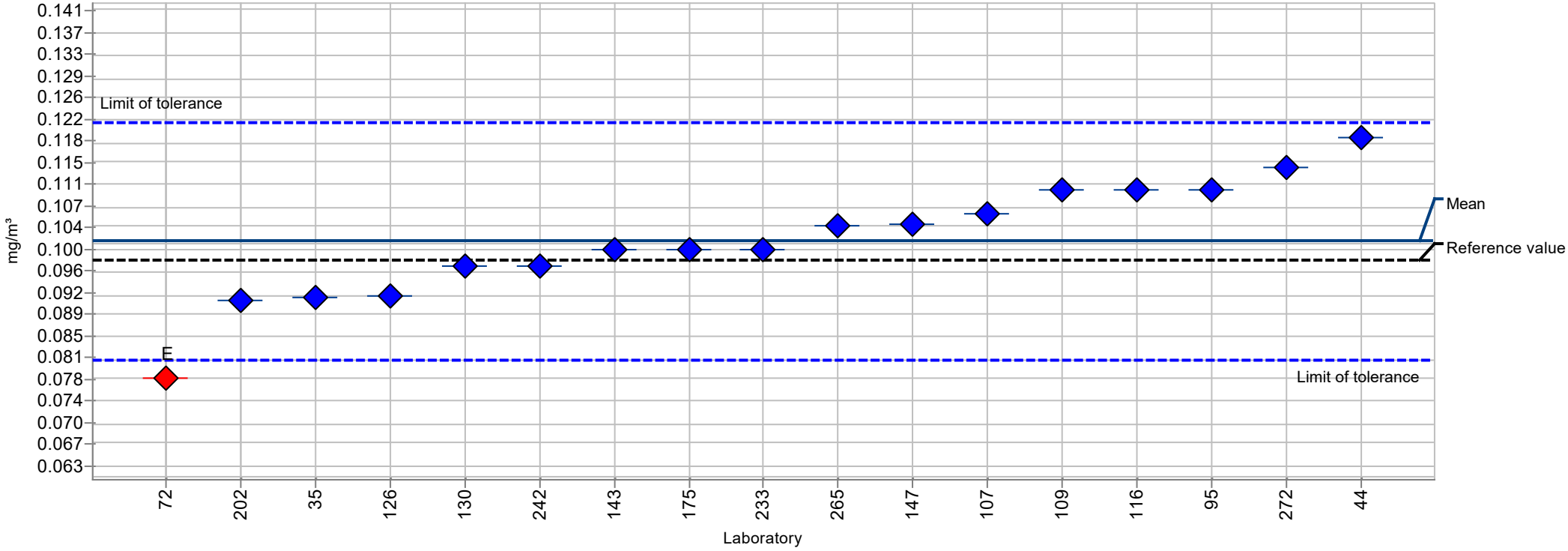
Summary results

Measurand:	**Butyraldehyde**	**Mean:**	**0.687 mg/m³**
Sample:	**Sample 1**	**Reprod. s.d.:**	**0.089 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**12.99%**
Rel.target s.d.:	**10.00%**	**Reference value:**	**0.670 mg/m³**
Number of laboratories in calculation:	**15**	**Range of tolerance:**	**0.550 - 0.824 mg/m³ (|Z-Score| <= 2.00)**



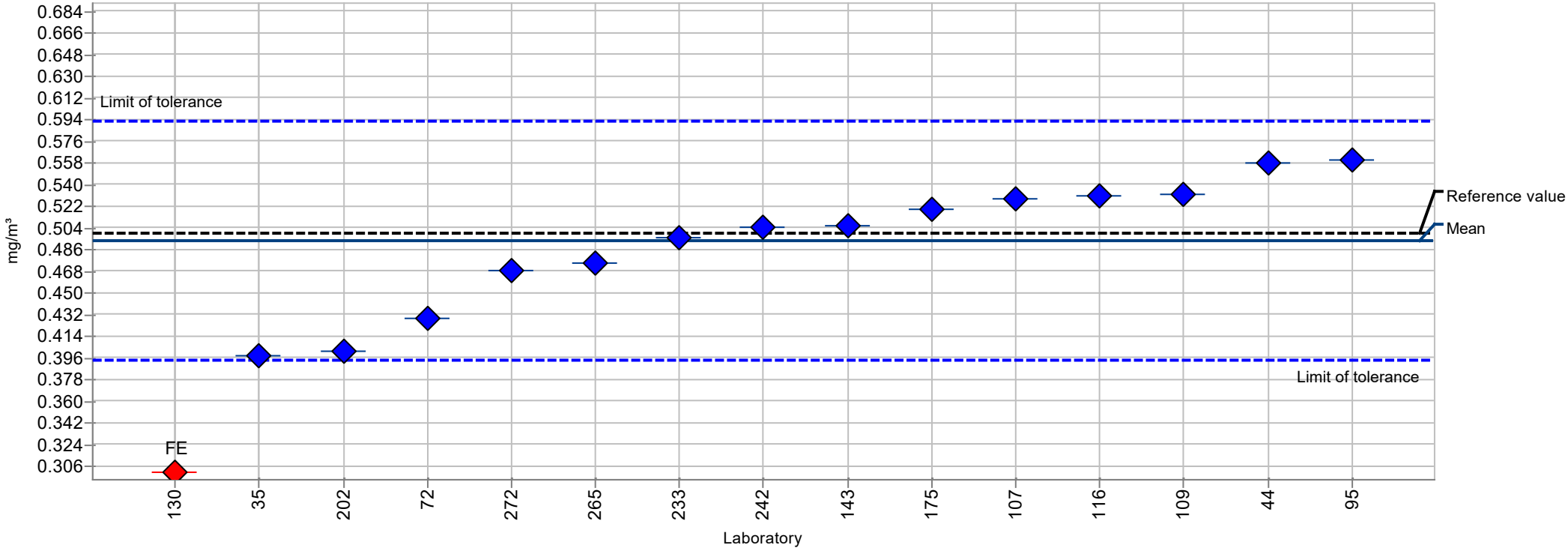
Summary results

Measurand:	**Formaldehyde**	**Mean:**	**0.101 mg/m³**
Sample:	**Sample 1**	**Reprod. s.d.:**	**0.010 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**9.88%**
Rel.target s.d.:	**10.00%**	**Reference value:**	**0.098 mg/m³**
Number of laboratories in calculation:	**17**	**Range of tolerance:**	**0.081 - 0.122 mg/m³ (|Z-Score| <= 2.00)**



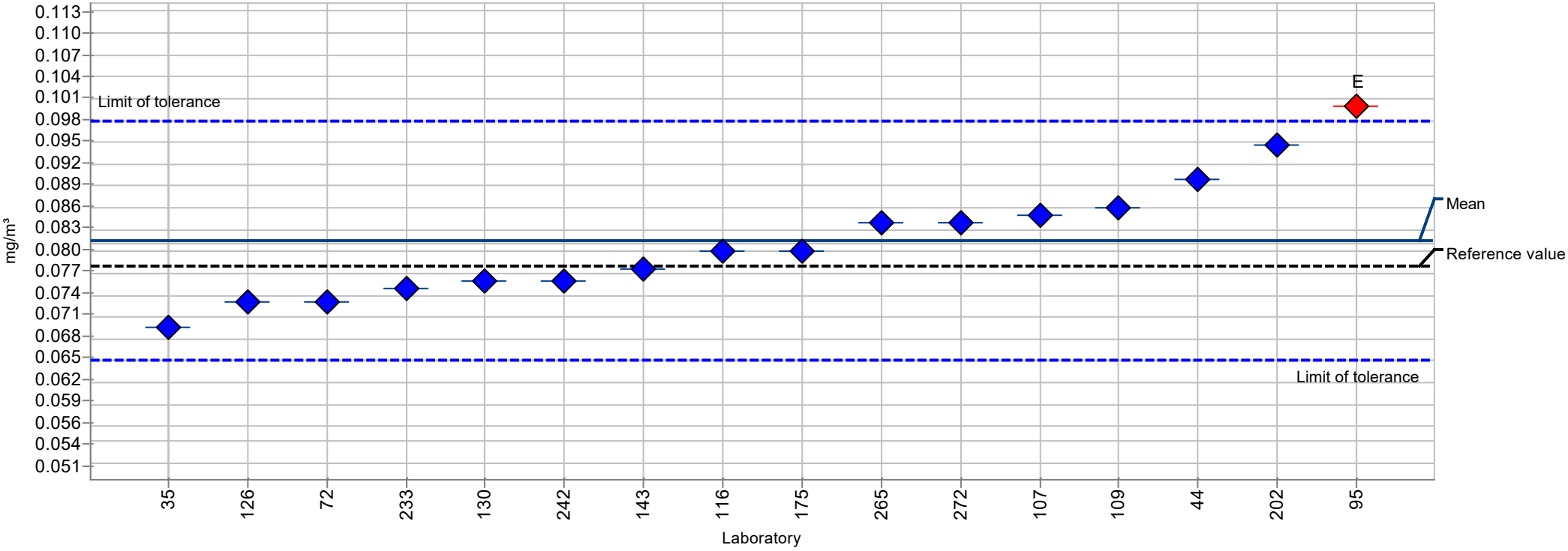
Summary results

Measurand:	**Propionaldehyd**	**Mean:**	**0.493 mg/m³**
Sample:	**Sample 1**	**Reprod. s.d.:**	**0.053 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**10.68%**
Rel.target s.d.:	**10.00%**	**Reference value:**	**0.499 mg/m³**
Number of laboratories in calculation:	**14**	**Range of tolerance:**	**0.395 - 0.592 mg/m³ (|Z-Score| <= 2.00)**



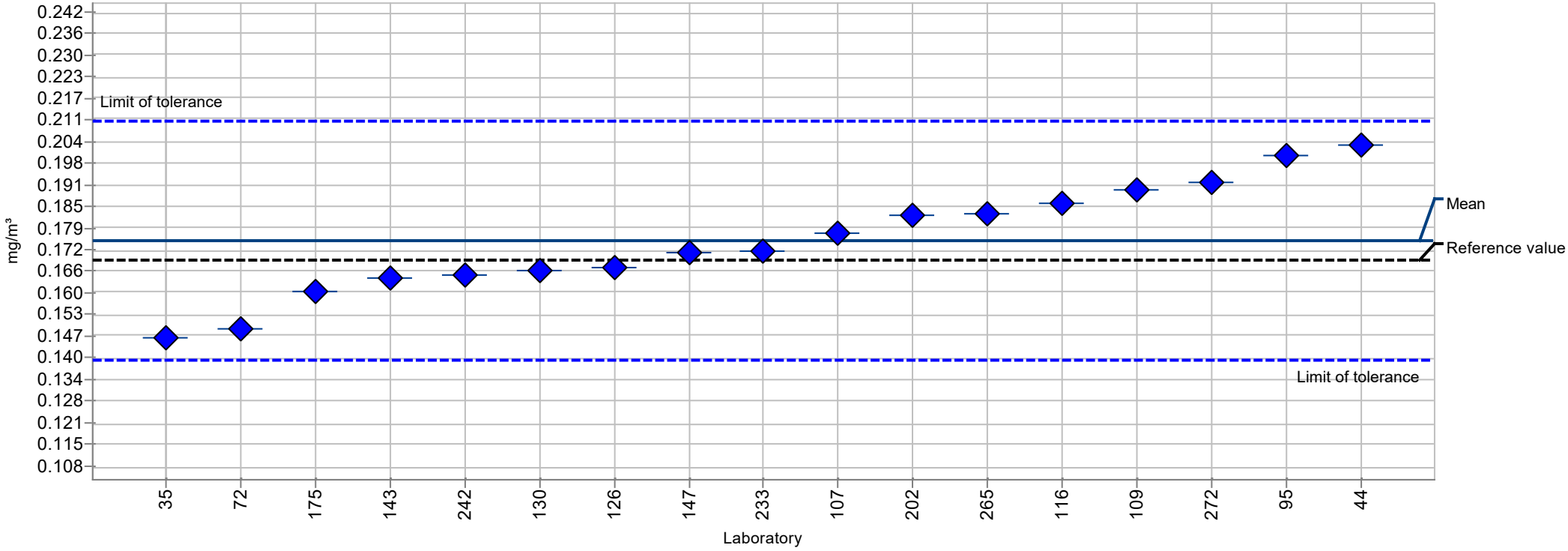
Summary results

Measurand:	**Acetaldehyde**	**Mean:**	**0.082 mg/m³**
Sample:	**Sample 2**	**Reprod. s.d.:**	**0.008 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**10.22%**
Rel.target s.d.:	**10.00%**	**Reference value:**	**0.078 mg/m³**
Number of laboratories in calculation:	**16**	**Range of tolerance:**	**0.065 - 0.098 mg/m³ (|Z-Score| <= 2.00)**



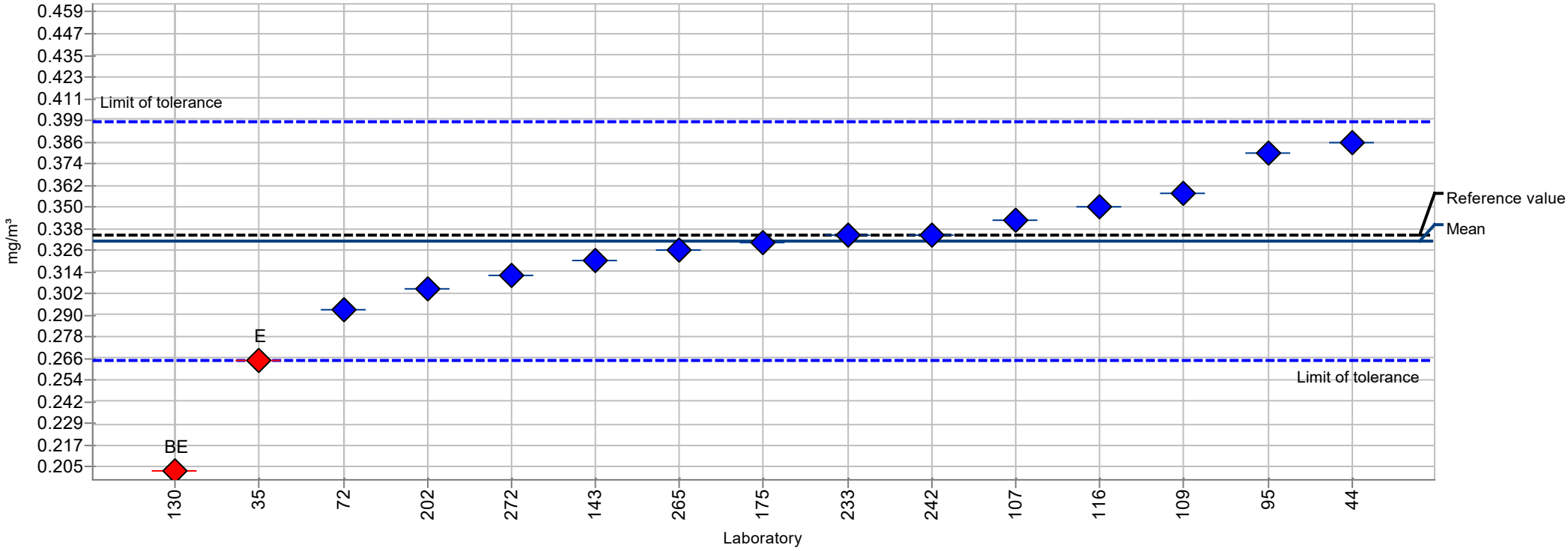
Summary results

Measurand:	**Formaldehyde**	**Mean:**	**0.175 mg/m³**
Sample:	**Sample 2**	**Reprod. s.d.:**	**0.016 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**9.35%**
Rel.target s.d.:	**10.00%**	**Reference value:**	**0.169 mg/m³**
Number of laboratories in calculation:	**17**	**Range of tolerance:**	**0.140 - 0.210 mg/m³ (|Z-Score| <= 2.00)**



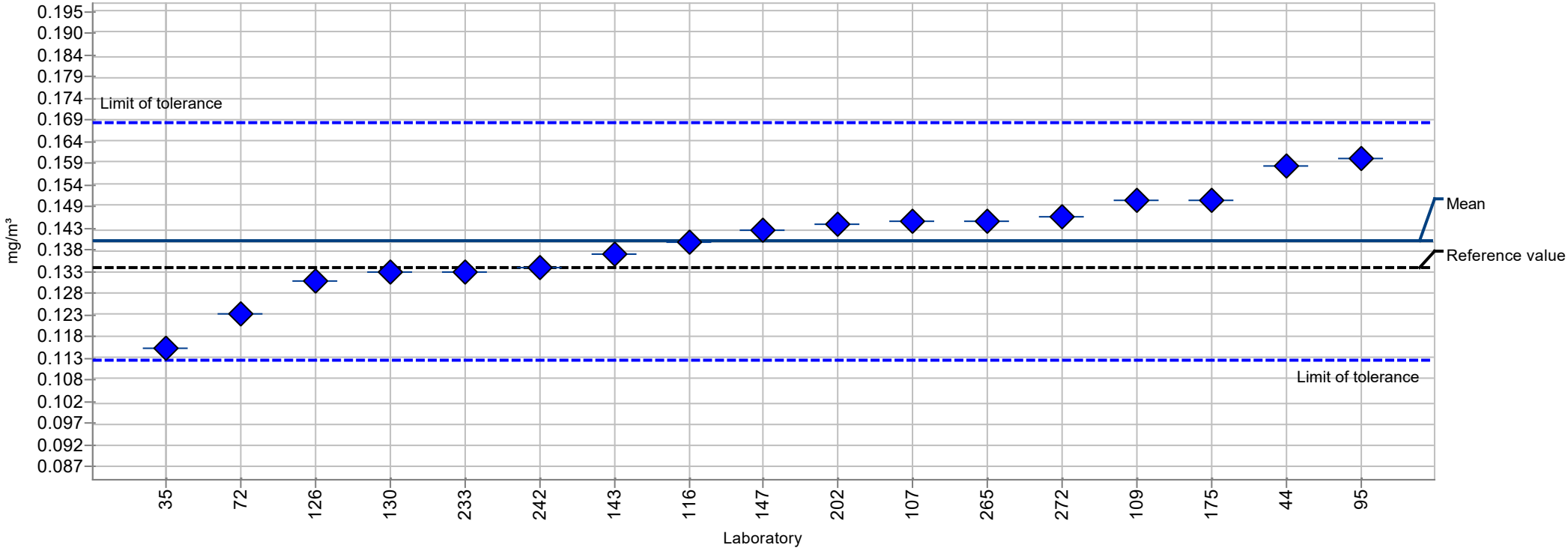
Summary results

Measurand:	**Propionaldehyd**	**Mean:**	**0.331 mg/m³**
Sample:	**Sample 2**	**Reprod. s.d.:**	**0.033 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**9.84%**
Rel.target s.d.:	**10.00%**	**Reference value:**	**0.334 mg/m³**
Number of laboratories in calculation:	**15**	**Range of tolerance:**	**0.265 - 0.397 mg/m³ (|Z-Score| <= 2.00)**



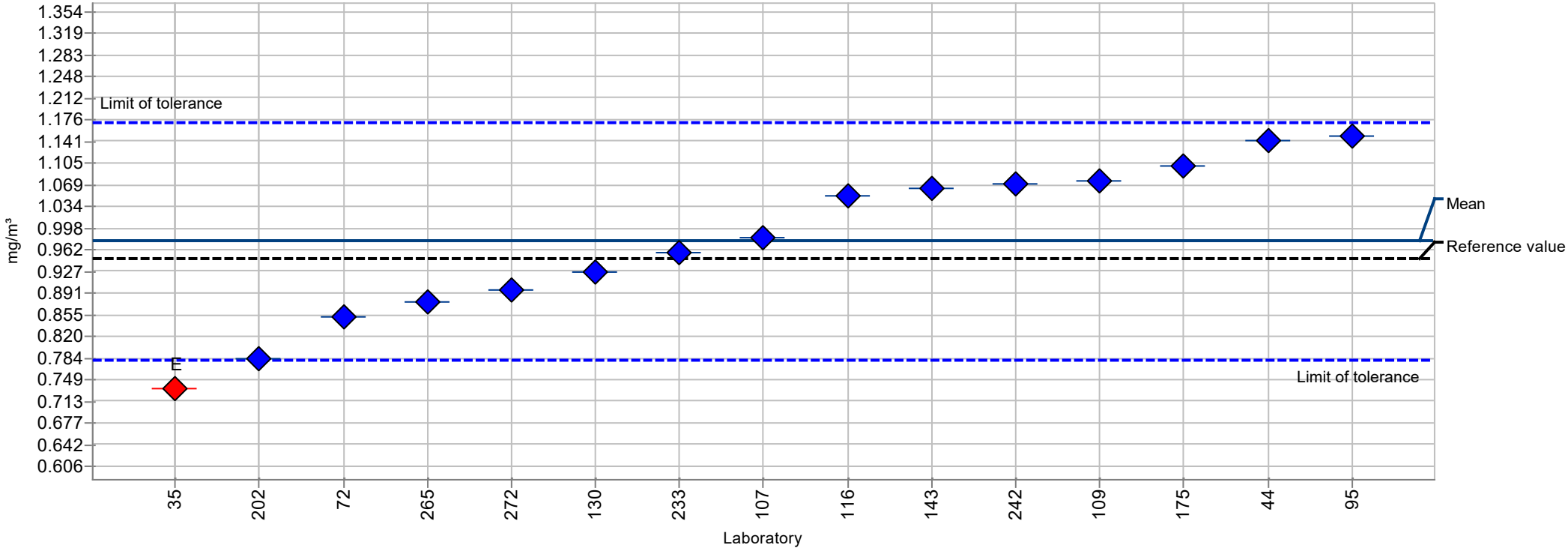
Summary results

Measurand:	**Acetaldehyde**	**Mean:**	**0.140 mg/m³**
Sample:	**Sample 3**	**Reprod. s.d.:**	**0.012 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**8.29%**
Rel.target s.d.:	**10.00%**	**Reference value:**	**0.134 mg/m³**
Number of laboratories in calculation:	**17**	**Range of tolerance:**	**0.112 - 0.169 mg/m³ (|Z-Score| <= 2.00)**



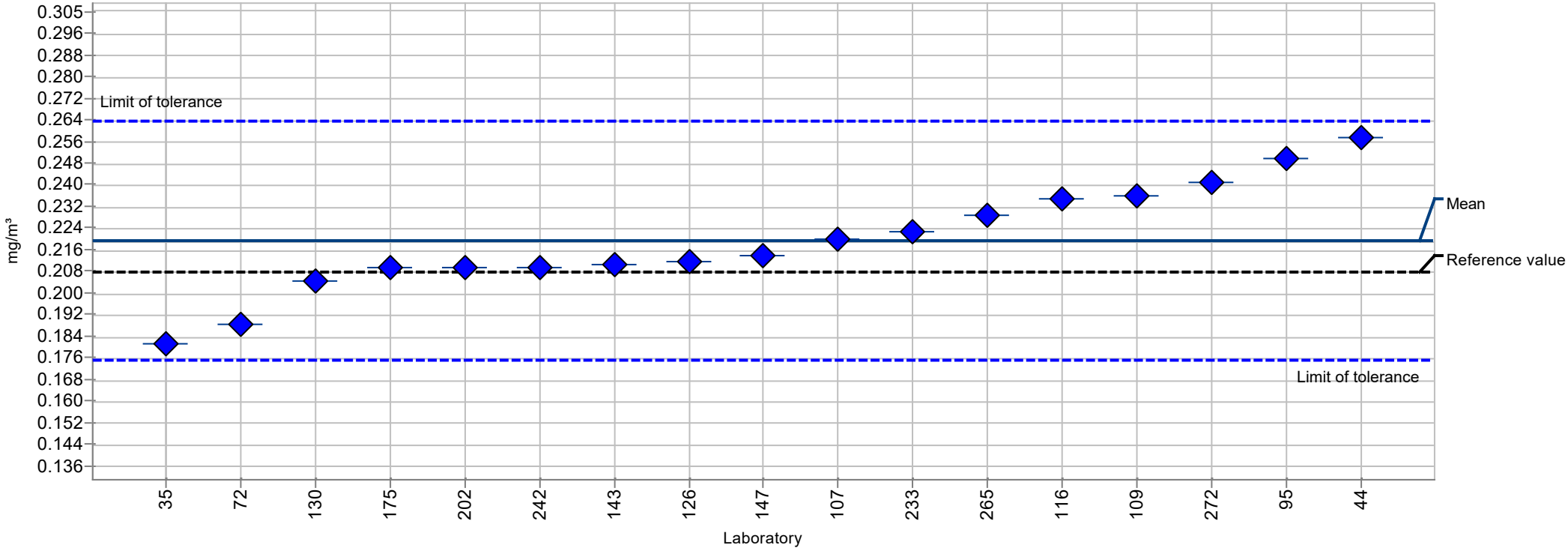
Summary results

Measurand:	**Butyraldehyde**	**Mean:**	**0.977 mg/m³**
Sample:	**Sample 3**	**Reprod. s.d.:**	**0.130 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**13.26%**
Rel.target s.d.:	**10.00%**	**Reference value:**	**0.948 mg/m³**
Number of laboratories in calculation:	**15**	**Range of tolerance:**	**0.782 - 1.173 mg/m³ (|Z-Score| <= 2.00)**



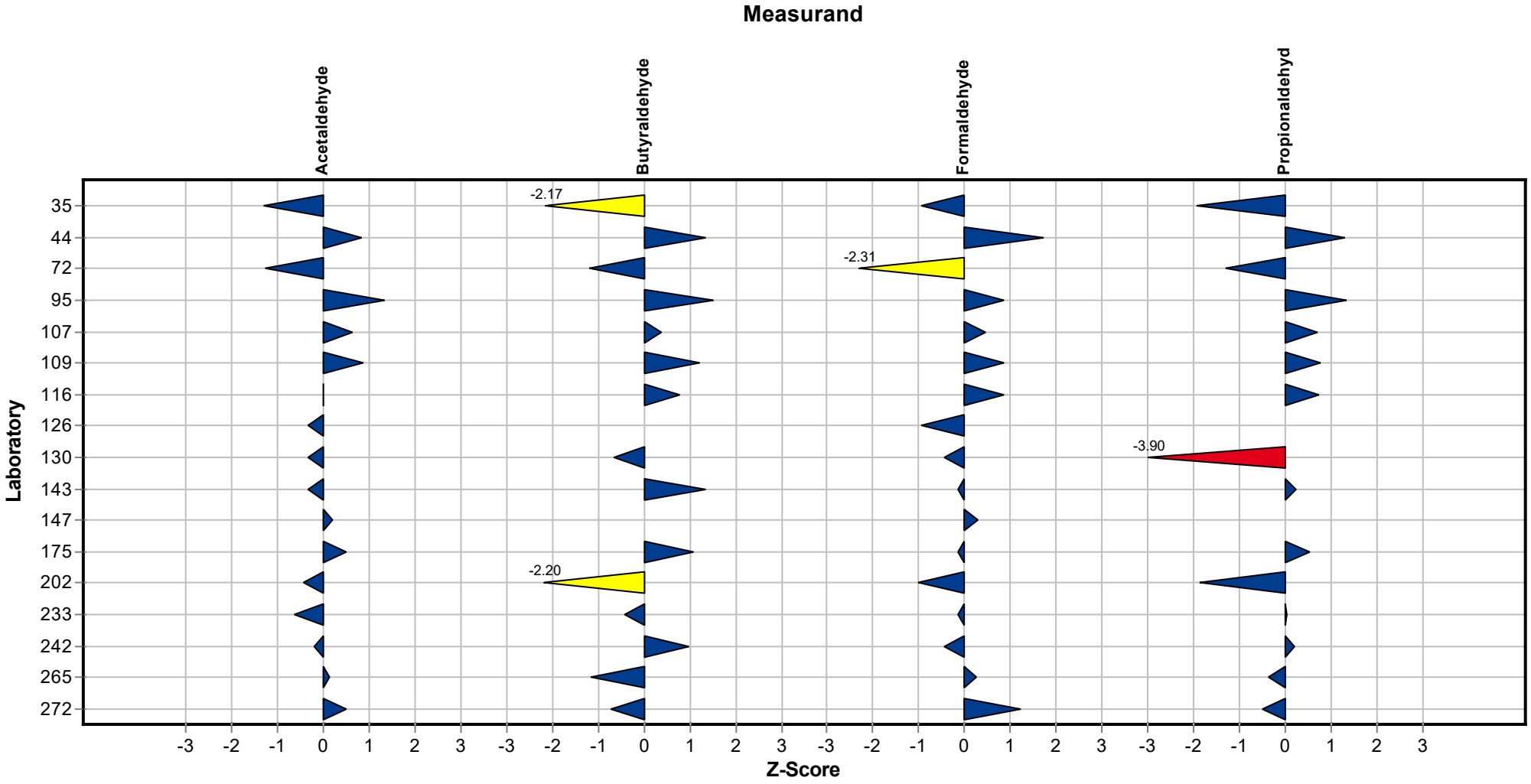
Summary results

Measurand:	**Formaldehyde**	**Mean:**	**0.220 mg/m³**
Sample:	**Sample 3**	**Reprod. s.d.:**	**0.020 mg/m³**
Method:	**ISO 5725-2**	**Rel.reprod. s.d.:**	**9.19%**
Rel.target s.d.:	**10.00%**	**Reference value:**	**0.208 mg/m³**
Number of laboratories in calculation:	**17**	**Range of tolerance:**	**0.176 - 0.264 mg/m³ (|Z-Score| <= 2.00)**



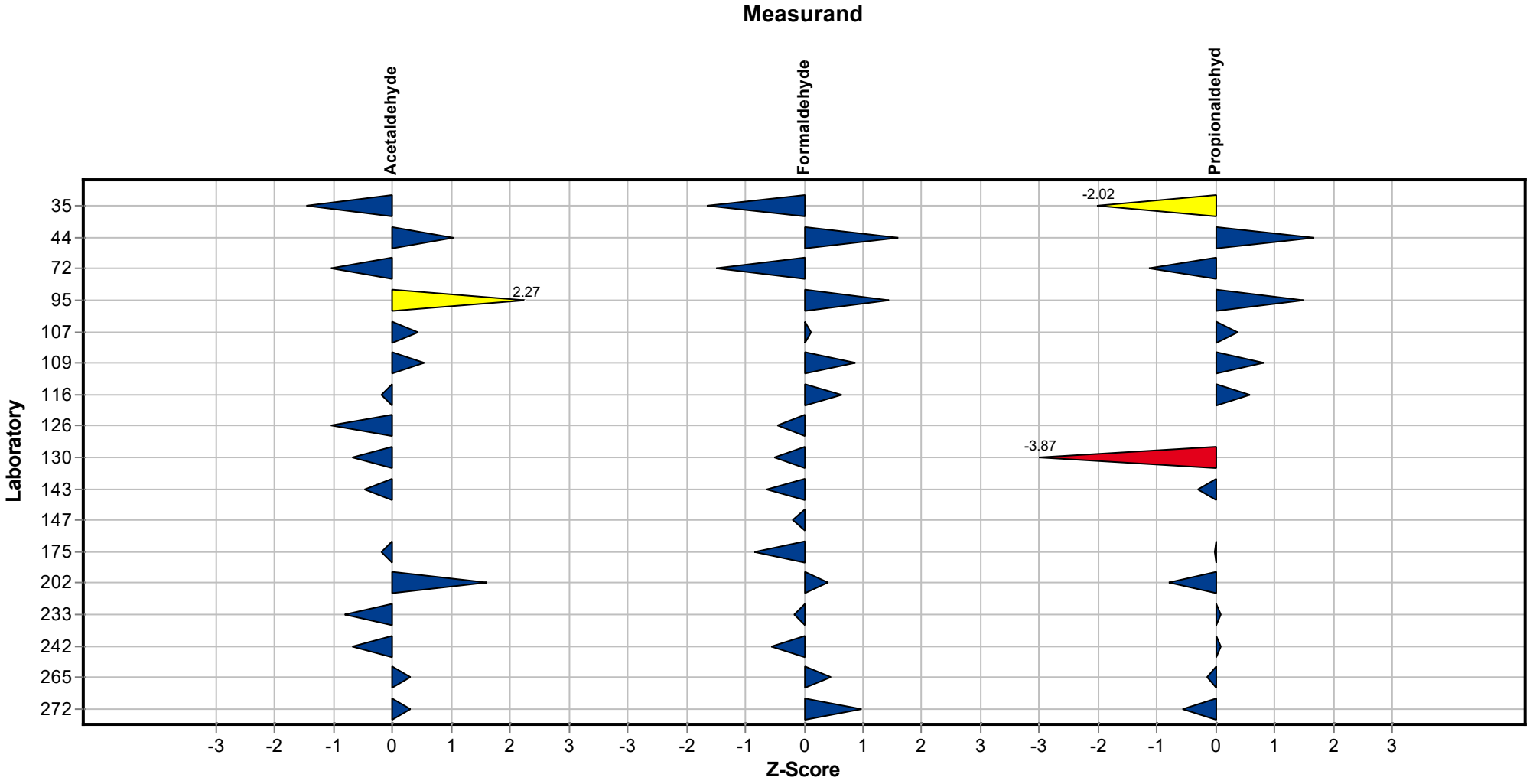
Sample chart of Z-scores

Sample **Sample 1**



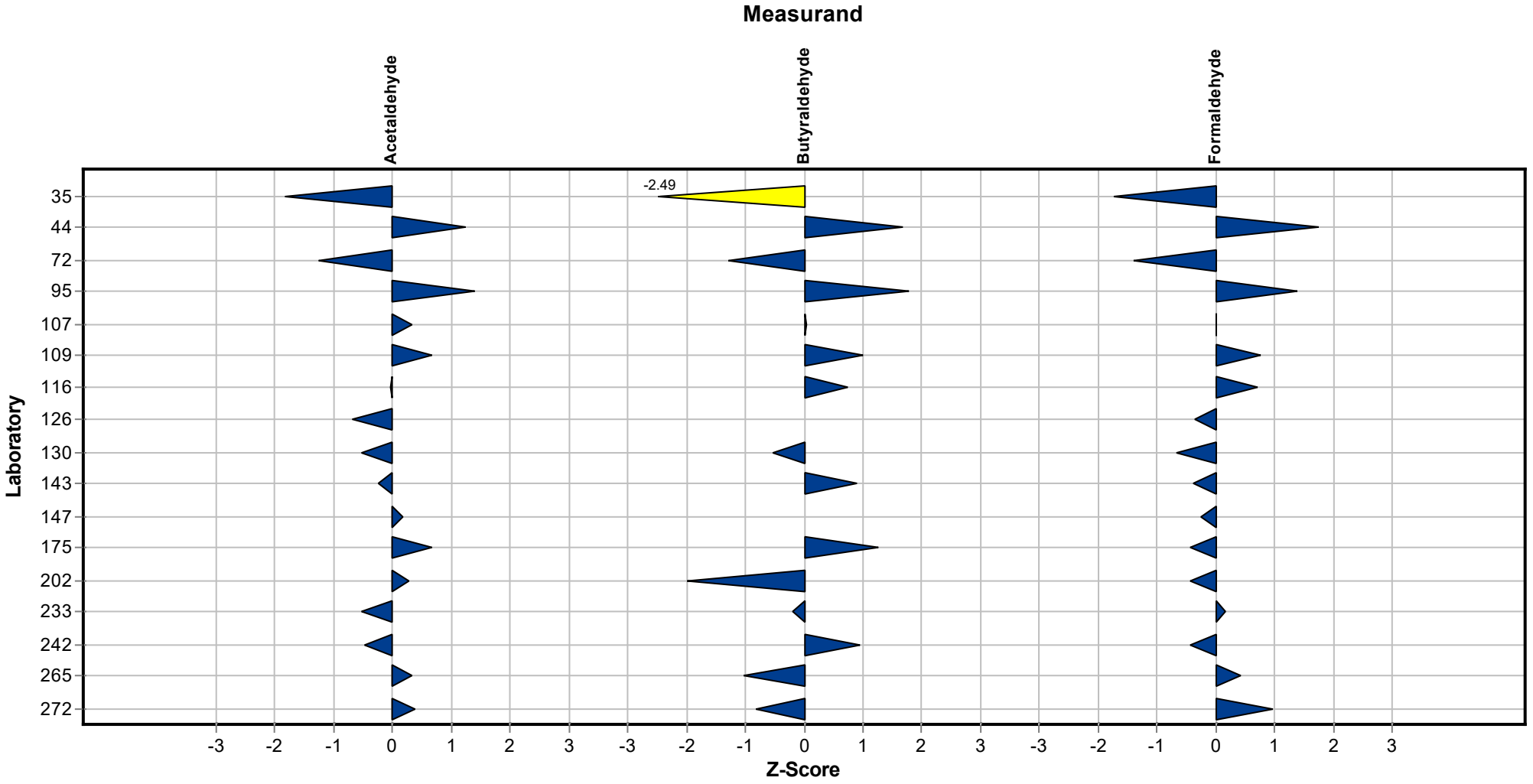
Sample chart of Z-scores

Sample **Sample 2**



Sample chart of Z-scores

Sample **Sample 3**



Questions and Answers

Participant	Type of sample carrier	Sampling pump
35	Supelco DNPH-Kartuschen	Sensidyne GilAir Plus
44	Supelco DNPH	BiVOC2/ Tw inVOC (Holbach GmbH)
72	DNPH Kartuschen XPosure Aldehyde Sampler, Fa. Waters	SG 350
95	Supelco LpDNPH S10	GSA SG 4000ex
107	DNPH Kartusche Supelco	Dionex-Ultimate 3000
109	Supelco LpDNPH S10	Gillian Gilair Plus
116	DNPH-Kartuschen	Lfs-113
126	DNPH-Kartuschen, S10, Fa. Supelco	SG 5200, Fa. GSA
130	SKC-Röhrchen No. 226-119	Gilian LFS-113
143	DNPH-Kartusche	GilAir plus
147	DNPh	GilAir plus
175	Waters Sep Pak XPosure	Casella VAPex IS and Casella Apex2 Plus IS
202	Waters Sep-Pak Kartusche	GilAirPlus/GSA SG 5100
233	Supelco Lp DNPH S10	GSA SG 2500, GSA SG 5200, Gilian GilAir Plus
242	Orbo-DNPH Tubes	Gilian LFS 113 D bzw . Gilian LFS 113 DC
265	Waters DNPH Kartuschen Shortbody	BiVOC2(V2)
272	SepPak-Kartusche	GSA SG 350

Participant	Volume flow	Volume flow measurement
35	1000 mL/min	TSI 4100
44	1L/min.	automatische Volumenstromregelung in der Pumpe
72	333 ml/min	Defender
95	0,6 L/min	DryCal DC-Lite
107	0,8 ml/min	MesLabsDefiner
109	0,4 L/min	MesaLab Defender 530
116	0,33 L/min	Kolbenhubkalibrator
126	300 bzw . 500 mL/min	Defender 510
130	0,3 l/min	Gilibrator
143	0,5 l/min	Analyt MTC 35810MLWB

Participant	Volume flow	Volume flow measurement
147	500 ml/min	BIOS Defender
175	0,1 L/min; 1,0 L/min and 1,5 L/min	TSI Mass Flow Meter 4100
202	0,33 l/min	TSI 4100
233	1,5 L/min	Aalborg GFM17
242	Mehrfachprobenahme mit unterschiedlichen Volumenströmen im Bereich 50 - 200 mL/min	Defender 510-L Fa. MesaLabs
265	1,0 L/min	Bronkhorst Massenflussmesser
272	0,333 l/min	Defender 510-H

Participant	Sampling time
35	60 Minuten
44	30 min.
72	60 min
95	30 min, 45 min bzw . 60 min
107	40 min
109	113 Minuten
116	60 - 120 Minuten
126	60 bzw . 120 Minuten
130	120 Minuten und 60 Minuten
143	120 min
147	14 min
175	Both 2h and 15 min
202	ca 90 min
233	30 Minuten
242	Mehrfachprobenahme 15, 30, 60 und 120 min
265	10 min
272	120 minuten

Participant	Analytical method
35	DIN EN ISO 16000-3:2013-01
44	DIN ISO 16000-3: 2013-01
72	LC1

Participant	Analytical method
95	DIN ISO 16000-3
107	Hausmethode in Anlehnung an DIN ISO 16000-3
109	Hausmethode in Anlehnung an IFA Arbeitsmappe 6045
116	DIN ISO 16000-3
126	DFG-Luftanalysen, Aldehyde Methode Nr. 2 bzw . DIN ISO 16000-3: Innenraumluftverunreinigungen – Teil 3: Messen von Formaldehyd und anderen Carbonylverbindungen, Probenahme mit einer Pumpe
130	IFA-Arbeitsmappe Nr. 6045
143	DIN ISO 16000-3
147	ISO 16000 - 6
175	SS-ISO 16000-3:2022
202	IFA 6045
233	HPLC-MS
242	IFA 6045
265	DIN ISO 16000-3
272	IFA 6045:2007-11

Participant	Date start sample preparation	Storage time after desorption
35	10.11.2023, 15.11.2023 und 24.11.2023	Nein
44	02.11.2023	ja für evtl. Nachmessung (RT)
72	01.11.2023	nein
95	01.11.2023	Nein
107	27.10.2023	Ja, ca. 3 Wochen im Gefrierschrank (-20 C)
109	14.11.2023	1Tag im Kühlschrank
116	27.10.2023	
126	26.10.2023	Ja, ca. 2 Wochen im Kühlschrank
130	03.11.2023	Nein
143	2.11.23	ja/Kühlzelle
147	1st test 10:10; 2nd test 14:12; 3rd test 10:25 on 25/10/2023	13 days refrigerated
175	2023-11-01	7-8 days in refridgerator
202	09.11.2023	48 h
233	26.10.2023	sofortige Analyse, dann Aufbew ahrung im Kühlschrank
242	26.10.2023	"Lagern" Im Autosampler bei RT bis zur Analyse

Participant	Date start sample preparation	Storage time after desorption
265	26.10.2023	nein
272	30.10.2023	Kühlschrank, Von Eingang 30.10. bis Messung 6.11.

Participant	Date of analysis	Desorption solution	Volume of desorption solution
35	10.11.2023, 15.11.2023 und 24.11.2023	Acetonitril	5 mL
44	02.11.2023	Acetonitril	2 ml
72	01.11.2023	Acetonitril	Es w urde mit 5 ml eluiert und dann auf 5 ml aufgefüllt
95	02.11.2023	Acetonitril	5 mL
107	24.11.2023	Acetonitril	5 ml
109	16.11.2023	Acetonitril	10 ml
126	14.11.2023	Acetonitril	10 mL
130	04.11.2023	Acetonitril	4
143	2.11.2023/7.11.23	Acetonitril	5
147	06/11/2023		
175	2023-11-01	Acetonitrile	2 mL
202	13.11.2023		10 ml
233	26.10.-13.11.2023	Acetonitril	5
242	Proben w urden am 27.10.23 zw ischen 6 und 23 Uhr analysiert.	Acetonitril	3
265	26.10.2023	Acetonitirl	2
272	06.11.2023	Eluiert mit Acetonitril	10 ml

Participant	Chromatography system
35	Pumpe: 1200 Binary Pump G1312-64015-RNC Autosampler: 1200 Standard Autosampler G1329-64010-RNC Säulenofen: 1200 TCC SCV Säulenofen G1316-64011-RNC Detektor: 1200 Diode Array Detector G1315-64013-RNC
44	VWR Hitachi ?Pumpe: 5160 ; Detektor: 5430 ; Autosampler: 5260
72	Waters 2695 mit Waters 996 DAD
95	Waters Acquity Ultra Performance mit PDA Detektor
107	Dionex Ultimate 3000, AS-3000, UV-DAD -3000
109	Pumpe: Shimadzu LC20-AD, Detektor: SPD-M30A (DAD)
126	System Ultimate 3000, Fa. Thermo Fisher
130	Shimadzu HPLC Prominence i LC 2030C 3D, PDA-Detektor LC-2030/2040

Participant	Chromatography system
143	LC-20ADxR, SPD-M20A(PDA), SIL-30AC
175	Thermo Scientific Vanquich
202	Agilent Technologies: 1260 Bin Pump – G1312B | 1260 DAD – G4212B | 1260 ALS – G1329A
233	G7112B 1260 Infinity II Binäre Pumpe, G7117C 1260 Infinity II Diodenarray-Detektor, G7129A 1260 Infinity Automatischer Probengeber.
242	1260 Agilent
265	Shimadzu LC 20
272	Agilent 1200 SL (Bin Pump G1312B, DAD G1315C, ALS G1329B)

Participant	Refrigerated autosampler	Analytical column
35	20°C	Restek Allure AK 5µm, 200x4,6 mm
44	Nein	Macherey-Nagel Nucleodur Gravity C18 SB (150x3mm; 3µm)
72	nein (Raumtemperatur)	Phenomenex, Synergi 4µm Max-RP 80A, 250x4,6mm
95	Nein	Raptor ARC-18; 1,8 µm 100x2,1 mm (Restek)
107	ja, 8 °C	Supelcosil LC18, 250 x 4,6 mm
109	Nein	Shim-Pack GIST C18 2µm 75mm
126	Nein, RT	RP18, 5µm, 150 mm
130	Nein	Hypersil ODS 5 µm 250 x 3 mm
143		VP-ODS 1502x4,6 9032973
175	Yes, 10 °C	Thermo Scientific Syncronis C18, 100 mm x 2,1 mm, 1,7 µm
202	Nein	Kinetex 2.6u EVO C18 100 A, 50x3.0 mm, Phenomenex
233	Ja, 10°C	C18
242	nein	Zorbax Eclipse XDB-C18 4,6 mm x 250 mm / 5,0 µm
265	ja, 15 °C	Agilent Zorbax RRHD Eclipse Plus C18 2,1x150 mm, 1,8 µm
272	Nein, bei RT.	C18, 3u, 110A, 150x3mm, Phenomenex

Participant	Mobile phase	Flow rate HPLC
35	Acetonitril / Wasser, Gradient (60 bis max. 95% Acetonitril)	1,4 ml/min
44	ACN/H2O	1,3 ml
72	Gradientenmethode aus Acetonitril und Wasser Gradientenmethode aus Acetonitril und Wasser	1,0 ml/min
95	Gradient aus Laufmittel A: Acetonitril/Wasser/THF bzw . B: Acetonitril/Wasser	0,6 mL/min
107	Wasser/Acetonitril	0,6 ml/min

Participant	Mobile phase	Flow rate HPLC
109	Acetonitril/Wasser 45/55	0,4
126	Acetonitril/Wasser : 60/40	0,5 mL/min
130	Laufmittel A: 20 % THF mit 80 % Wasser, dann Laufmittel B: Acetronitril	0,8 bis 1,3
143	THF/H2O/ACN	1,8
175	Gradient w ater/acetonitrile	0,3 mL/min
202	A:VE-Wasser B: Acetonitril/Methanol/Tetrahydrofuran 45/45/10	0.8 ml/min
233	Acetonitril und Wasser	1
242	Gradient, A: Wasser: Methanol 1:1, B: Methanol : THF : Ethylacetat 1:1:2	Gradient 1 ml/min bis 1,5 ml/min
265	Acetonitril / Wasser 45:55	0,25
272	A: Wasser, B: Acetonitril/THF (80:20), mit Gradientenprogramm	0,9 ml/min

Participant	Wavelength	Column temperature
35	360 nm	30°C
44	365 nm	30°C
72	250-600 nm, extracted channel 365 nm	25
95	360 nm	50°C
107	365 nm	30 °C
109	360	40
126	365 nm	50°C
130	365 nm	30 °C
143	370 nm	50°C
175	360 nm	20 °C
202	365 nm	40 °C
233	360 nm	25°C
242	365 nm	40 °C
265	356 nm	45 °C
272	365 nm	32 °C

Participant	Calibration standard
35	Carbonyl-DNPH Mix 1, Supelco
44	Einzelstandard- und Mix-Lösung, Neochema

Participant	Calibration standard
72	Carb Carbonyl DNPH-Mix 1 + Aldehyde/Ketone DNPH Stock Standard-13 von Sigma Aldrich
95	SigmaAldrich CARB-Carbonyl DNPH-Mix 1
107	Einzelne Standards und Mix 1 von Supelco
109	Mix: Supelco Aldehyde/Ketone-DNPH Stock Standard-13
126	Aus Einzelstandards hergestellt, Fa. Supelco
130	Accu Standard Mix 10 S-102593, Lot: 223081455
143	Einzelstandards LGC
175	CRM47651, Sigma-aldrich
202	Fertiger Mix: T011/IP-6-A (Supelco Katalognummer CRM4M7285)
233	als fertiger Mix gekauft, Hersteller Sigma-Aldrich
242	Einzelstandards von Supelco
265	fertiger Mix von Restek
272	Formaldehyd-DNPH (Sigma) als Einzelstandard. Die anderen Aldehyde mittels Mix (Aldehyde/Ketone-DNPH-Stock („ERA-mix“) von Sigma).

Participant	Recovery rate
35	Nein
44	ja
72	ja
95	Nein
107	nein
109	Nein
126	Nein
130	Nein
143	ja
175	No
202	Nein
233	nein
242	nein
265	nein
272	Nein.