IFA
Institut für Arbeitsschutz der
Deutschen Gesetzlichen Unfallversicherung

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

Proficiency testing scheme

Aldehydes 2025 with own sampling 1

11 – 12 November 2025

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Summary of laboratory test results

Sample 1

Laboratory	Butyraldehyde	Z score	Formaldehyde	Z score	Propionaldehyde	Z score
Unit	mg/m³		mg/m³		mg/m³	
1	1.218	0.63	0.124	0.07	0.237	0.73
23	1.080	-0.57	0.131	0.64	0.233	0.55
33	1.273	1.11	0.146	1.86	0.233	0.55
39	1.088	-0.50	0.111	-0.99	0.212	-0.40
40	1.100	-0.40	0.110	-1.07	0.230	0.42
76	1.102	-0.38	0.133	0.79	0.217	-0.19
97	1.143	-0.02	0.123	-0.01	0.204	-0.76
107	1.223	0.68	0.115	-0.66	0.225	0.19
116	1.187	0.36	0.117	-0.50	0.239	0.82
120	1.240	0.83	0.118	-0.42	0.206	-0.67
149	1.100	-0.40	0.125	0.15	0.200	-0.94
152	1.256	0.97	0.138	1.21	0.243	1.01
171	1.150	0.04	0.165	3.40 BE	0.224	0.15
209	1.137	-0.07	0.120	-0.25	0.204	-0.76
212	1.070	-0.66	0.133	0.80	0.210	-0.49
233	1.188	0.37	0.122	-0.09	0.227	0.28
245	1.080	-0.57	0.110	-1.07	0.210	-0.49
265	1.028	-1.02	0.118	-0.42	0.204	-0.76
269	1.224	0.69	0.126	0.23	0.237	0.73
289	1.080	-0.57	0.115	-0.66	0.215	-0.26
315	1.160	0.13	0.131	0.64	0.238	0.78
316	1.070	-0.66	0.120	-0.25	0.210	-0.49
–	–	– –	–	– –	–	– –
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	22		22		22	
Mean	1.145		0.123		0.221	
Reproducibility s.d.	0.071		0.010		0.014	
Rel. reproducibility s.d.	6.21 %		7.72 %		6.31 %	
Reference value	1.139		0.115		0.223	
Target s.d.	0.115		0.012		0.022	
Rel. target s.d.	10.00 %		10.00 %		10.00 %	
Lower limit of tolerance	0.916		0.099		0.177	
Upper limit of tolerance	1.374		0.148		0.265	
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)	22		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						

Summary of laboratory test results

Sample 2

Laboratory	Formaldehyde	Z score	Propionaldehyde	Z score
Unit	mg/m³		mg/m³	
1	0.243	-0.02	1.318	0.27
23	0.266	0.93	1.360	0.59
33	0.266	0.93	1.378	0.73
39	0.223	-0.84	1.236	-0.37
40	0.210	-1.37	1.300	0.13
76	0.259	0.63	1.232	-0.40
97	0.245	0.06	1.186	-0.76
107	0.233	-0.43	1.321	0.29
116	0.233	-0.43	1.333	0.38
120	0.236	-0.31	1.194	-0.70
149	0.210	-1.37	0.935	-2.72 BE
152	0.273	1.21	1.428	1.12
171	0.277	1.38	1.280	-0.03
209	0.233	-0.43	1.167	-0.91
212	0.264	0.84	1.220	-0.50
233	0.246	0.10	1.344	0.47
245	0.220	-0.96	1.250	-0.26
265	0.237	-0.26	1.207	-0.60
269	0.256	0.52	1.388	0.81
289	0.224	-0.80	1.300	0.13
315	0.262	0.76	1.310	0.20
316	0.240	-0.14	1.210	-0.58
–	–	– –	–	– –
Method	ISO 5725-2		ISO 5725-2	
Assessment	|Z|<=2.00		|Z|<=2.00	
No. of laboratories that submitted results	22		22	
Mean	0.243		1.284	
Reproducibility s.d.	0.020		0.074	
Rel. reproducibility s.d.	8.12 %		5.75 %	
Reference value	0.221		1.288	
Target s.d.	0.024		0.128	
Rel. target s.d.	10.00 %		10.00 %	
Lower limit of tolerance	0.195		1.027	
Upper limit of tolerance	0.292		1.541	
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)	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|>3.50				

Summary of laboratory test results

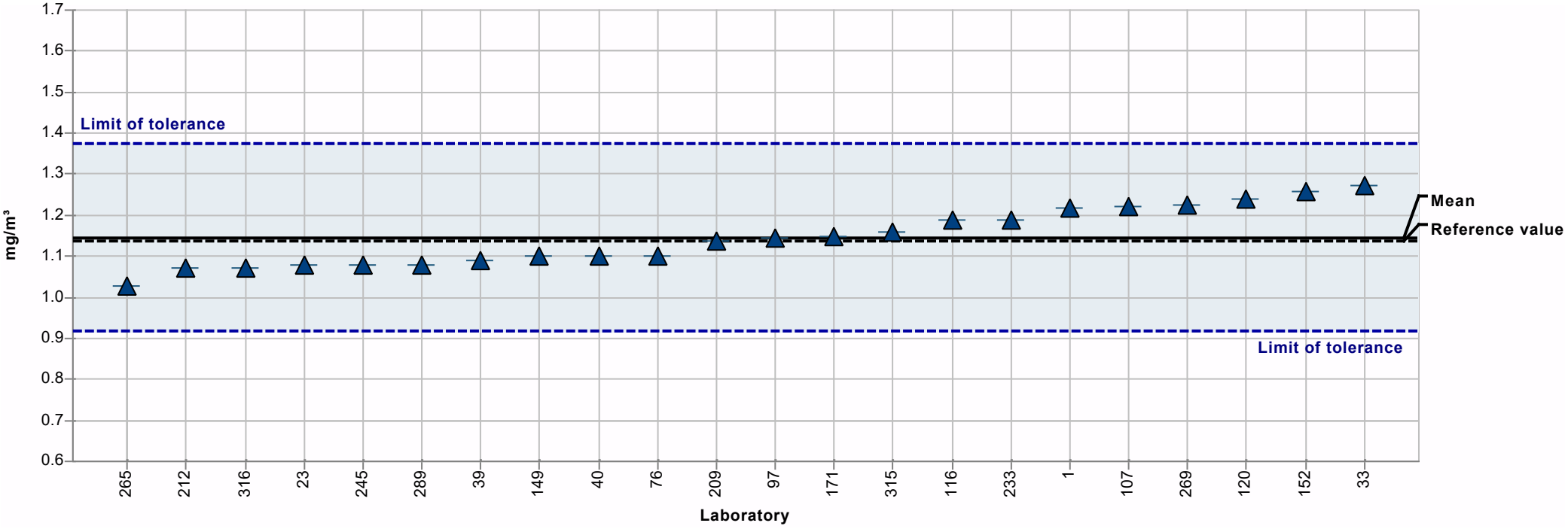
Sample 3

Laboratory	Butyraldehyde	Z score	Formaldehyde	Z score
Unit	mg/m³		mg/m³	
1	0.194	0.76	0.300	0.15
23	0.170	-0.57	0.321	0.86
33	0.194	0.76	0.318	0.76
39	0.175	-0.29	0.273	-0.76
40	0.180	-0.02	0.260	-1.20
76	0.170	-0.58	0.310	0.48
97	0.178	-0.13	0.298	0.09
107	0.201	1.15	0.289	-0.22
116	0.189	0.48	0.282	-0.46
120	0.192	0.65	0.289	-0.22
149	0.140	-2.24 E	0.240	-1.88
152	0.200	1.09	0.333	1.27
171	0.189	0.48	0.331	1.20
209	0.179	-0.07	0.285	-0.35
212	0.169	-0.63	0.326	1.02
233	0.188	0.43	0.303	0.25
245	0.170	-0.57	0.270	-0.86
265	0.160	-1.13	0.290	-0.19
269	0.195	0.81	0.312	0.56
289	0.177	-0.18	0.271	-0.83
315	0.197	0.93	0.320	0.83
316	0.160	-1.13	0.280	-0.52
–	–	– –	–	– –
Method	ISO 5725-2		ISO 5725-2	
Assessment	|Z|<=2.00		|Z|<=2.00	
No. of laboratories that submitted results	22		22	
Mean	0.180		0.295	
Reproducibility s.d.	0.015		0.025	
Rel. reproducibility s.d.	8.54 %		8.30 %	
Reference value	0.181		0.272	
Target s.d.	0.018		0.030	
Rel. target s.d.	10.00 %		10.00 %	
Lower limit of tolerance	0.144		0.236	
Upper limit of tolerance	0.216		0.355	
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	22		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	

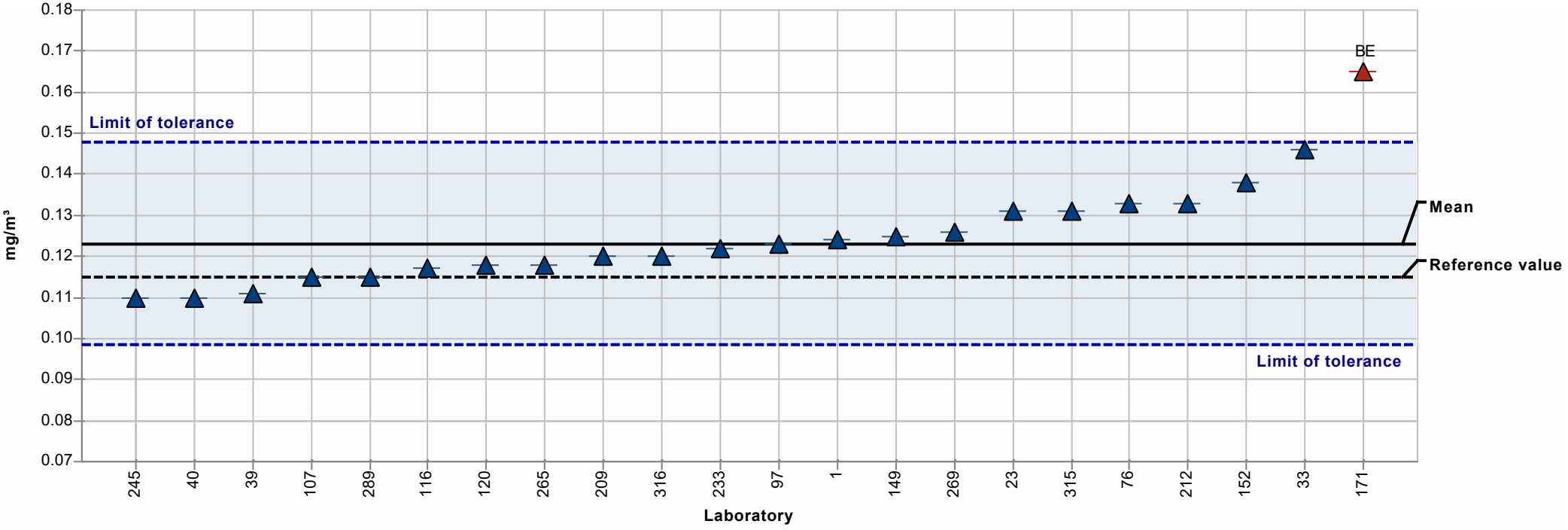
Summary results

Sample:	**1**	**Mean:**	**1.145 mg/m³**
Measurand:	**Butyraldehyde**	**Reproducibility s.d.:**	**0.071 mg/m³**
Method:	**ISO 5725-2**	**Rel. reproducibility s.d.:**	**6.21%**
Rel. target s.d.:	**10.00%**	**Reference value:**	**1.139 mg/m³**
Number of laboratories in calculation:	**22**	**Range of tolerance:**	**0.916 - 1.374 mg/m³ (|Z-Score| <= 2.00)**
No. of outlier values:	**0**		



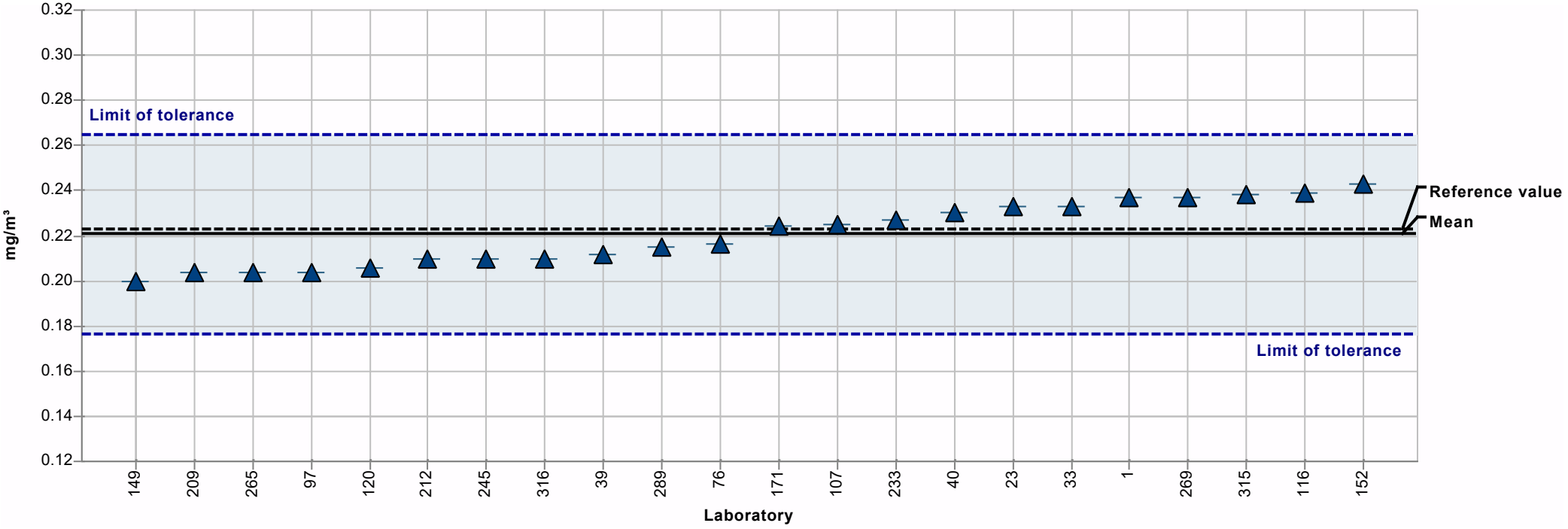
Summary results

Sample:	**1**	**Mean:**	**0.123 mg/m³**
Measurand:	**Formaldehyde**	**Reproducibility s.d.:**	**0.010 mg/m³**
Method:	**ISO 5725-2**	**Rel. reproducibility s.d.:**	**7.72%**
Rel. target s.d.:	**10.00%**	**Reference value:**	**0.115 mg/m³**
Number of laboratories in calculation:	**22**	**Range of tolerance:**	**0.099 - 0.148 mg/m³ (|Z-Score| <= 2.00)**
No. of outlier values:	**1**		



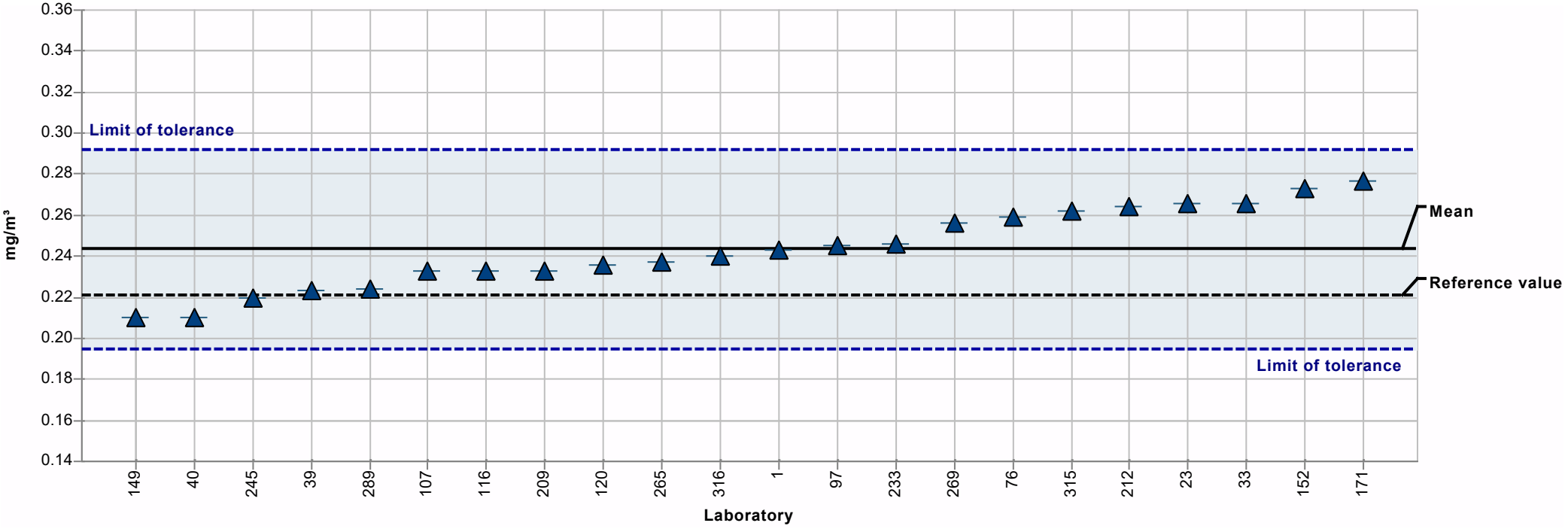
Summary results

Sample:	**1**	**Mean:**	**0.221 mg/m³**
Measurand:	**Propionaldehyde**	**Reproducibility s.d.:**	**0.014 mg/m³**
Method:	**ISO 5725-2**	**Rel. reproducibility s.d.:**	**6.31%**
Rel. target s.d.:	**10.00%**	**Reference value:**	**0.223 mg/m³**
Number of laboratories in calculation:	**22**	**Range of tolerance:**	**0.177 - 0.265 mg/m³ (|Z-Score| <= 2.00)**
No. of outlier values:	**0**		



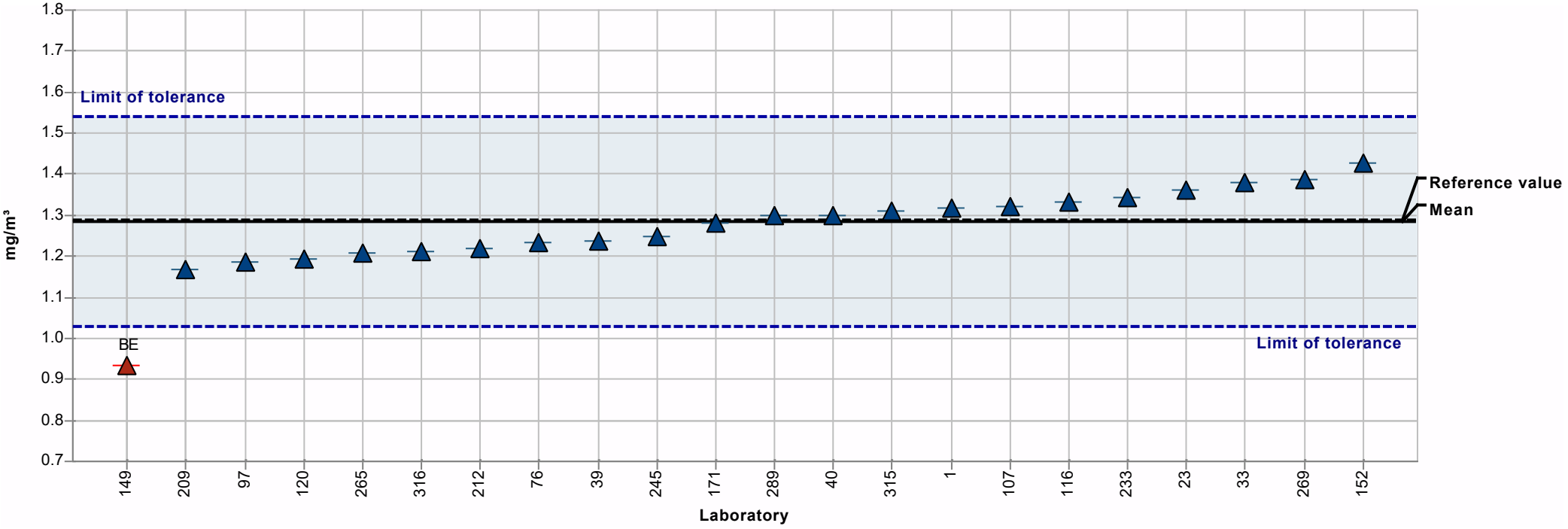
Summary results

Sample:	**2**	**Mean:**	**0.243 mg/m³**
Measurand:	**Formaldehyde**	**Reproducibility s.d.:**	**0.020 mg/m³**
Method:	**ISO 5725-2**	**Rel. reproducibility s.d.:**	**8.12%**
Rel. target s.d.:	**10.00%**	**Reference value:**	**0.221 mg/m³**
Number of laboratories in calculation:	**22**	**Range of tolerance:**	**0.195 - 0.292 mg/m³ (|Z-Score| <= 2.00)**
No. of outlier values:	**0**		



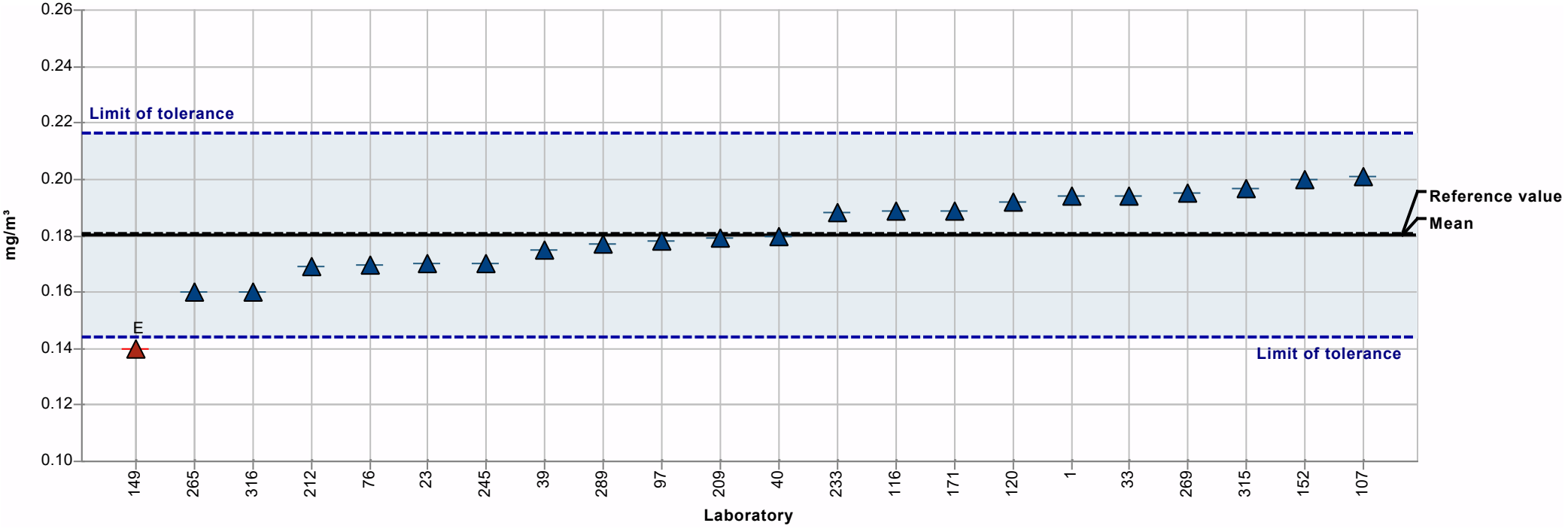
Summary results

Sample:	**2**	**Mean:**	**1.284 mg/m³**
Measurand:	**Propionaldehyde**	**Reproducibility s.d.:**	**0.074 mg/m³**
Method:	**ISO 5725-2**	**Rel. reproducibility s.d.:**	**5.75%**
Rel. target s.d.:	**10.00%**	**Reference value:**	**1.288 mg/m³**
Number of laboratories in calculation:	**22**	**Range of tolerance:**	**1.027 - 1.541 mg/m³ (|Z-Score| <= 2.00)**
No. of outlier values:	**1**		



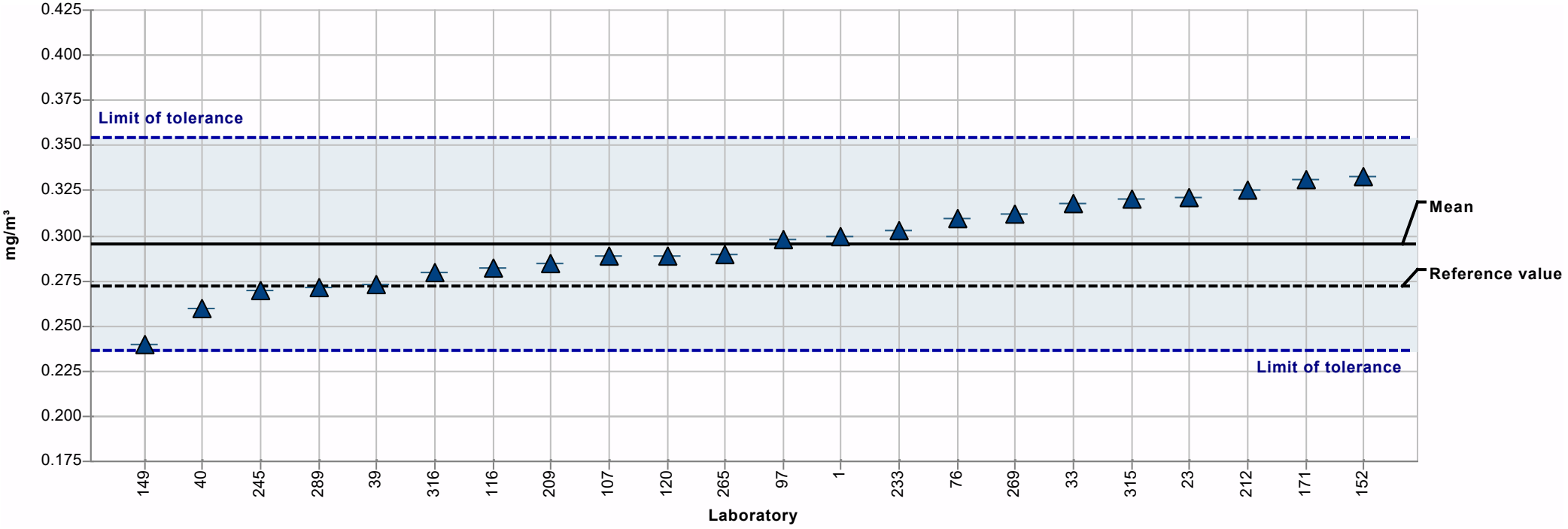
Summary results

Sample:	**3**	**Mean:**	**0.180 mg/m³**
Measurand:	**Butyraldehyde**	**Reproducibility s.d.:**	**0.015 mg/m³**
Method:	**ISO 5725-2**	**Rel. reproducibility s.d.:**	**8.54%**
Rel. target s.d.:	**10.00%**	**Reference value:**	**0.181 mg/m³**
Number of laboratories in calculation:	**22**	**Range of tolerance:**	**0.144 - 0.216 mg/m³ (|Z-Score| <= 2.00)**
No. of outlier values:	**0**		



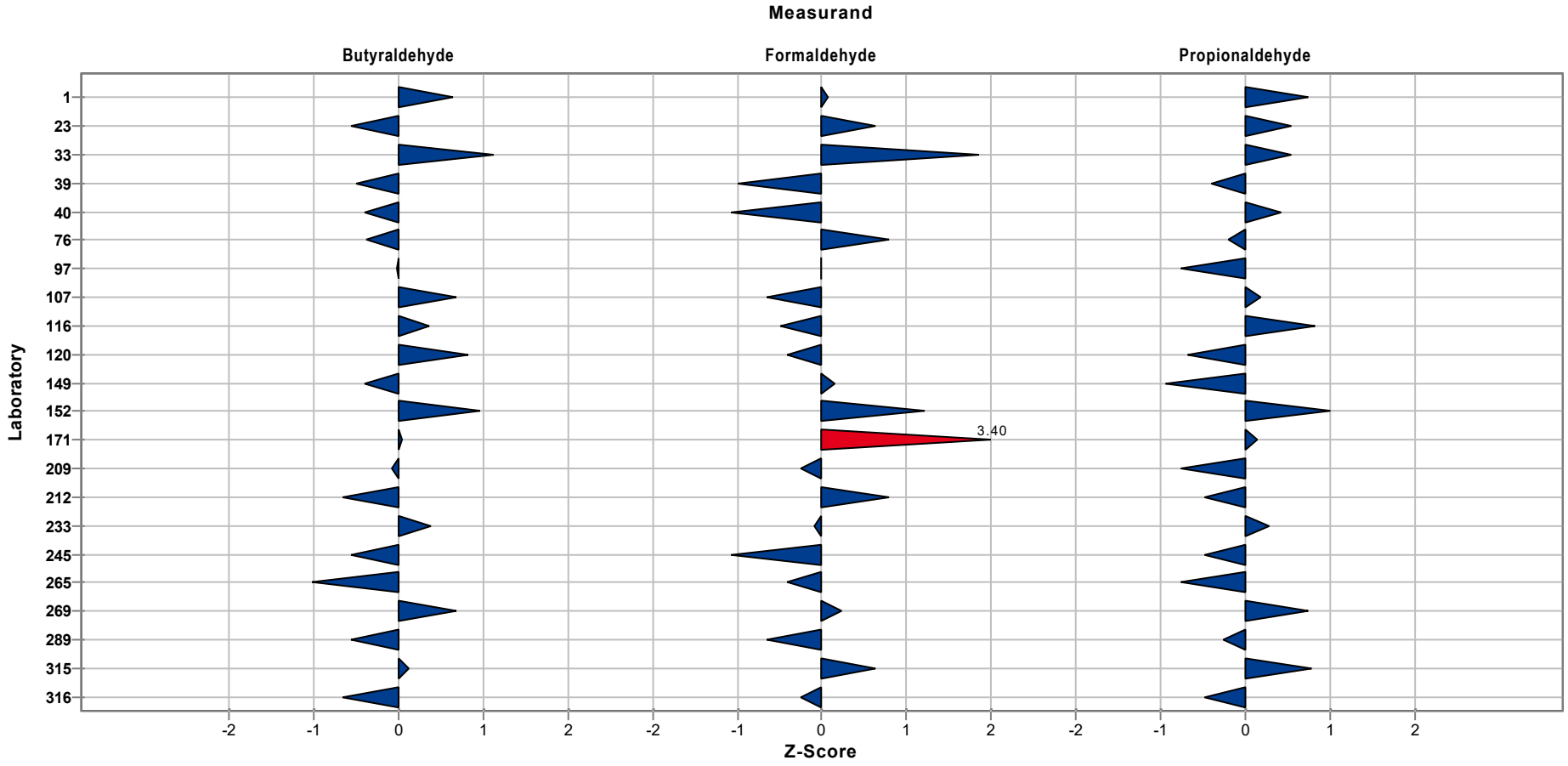
Summary results

Sample:	**3**	**Mean:**	**0.295 mg/m³**
Measurand:	**Formaldehyde**	**Reproducibility s.d.:**	**0.025 mg/m³**
Method:	**ISO 5725-2**	**Rel. reproducibility s.d.:**	**8.30%**
Rel. target s.d.:	**10.00%**	**Reference value:**	**0.272 mg/m³**
Number of laboratories in calculation:	**22**	**Range of tolerance:**	**0.236 - 0.355 mg/m³ (|Z-Score| <= 2.00)**
No. of outlier values:	**0**		



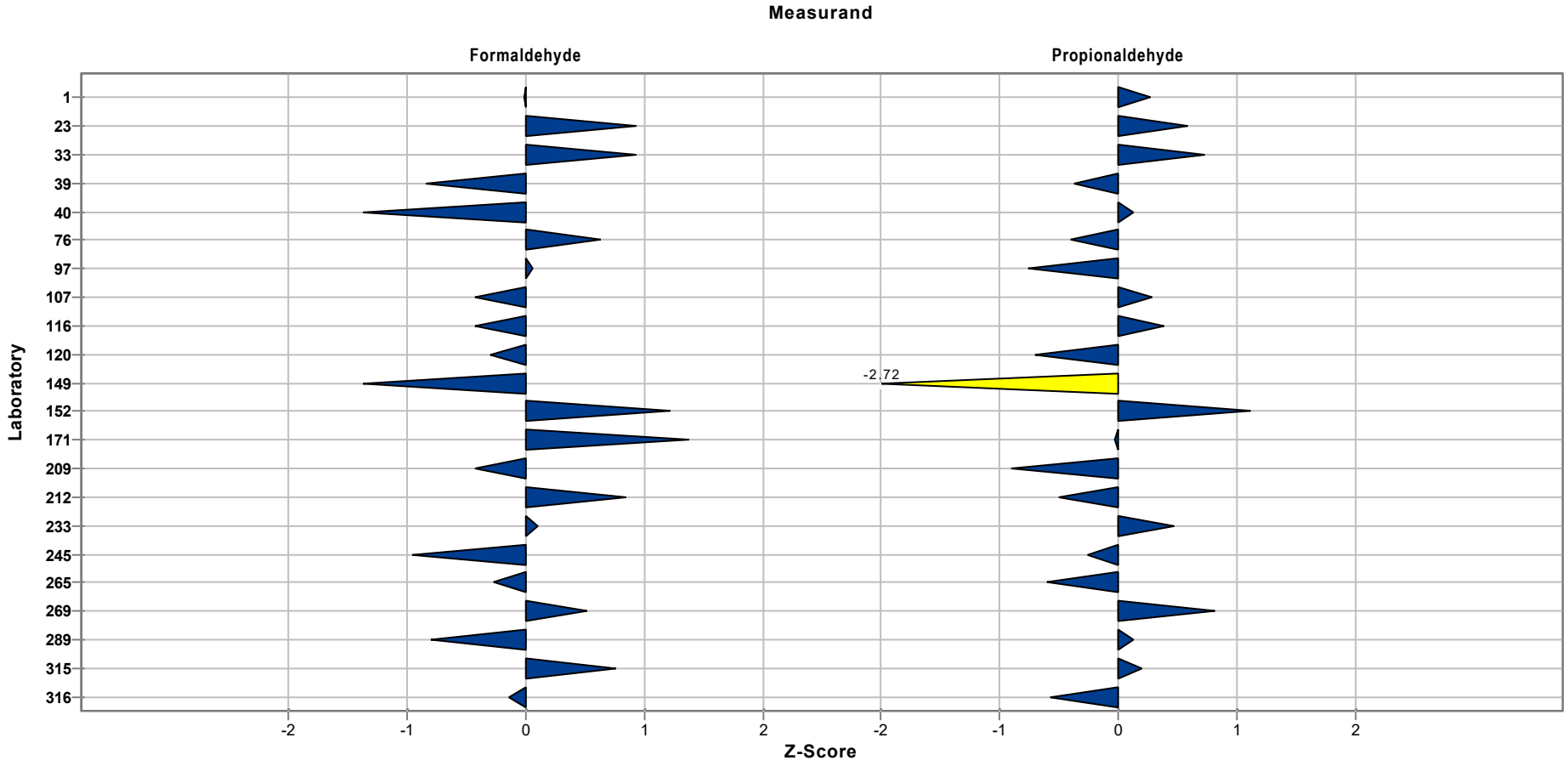
Sample chart of *Z-Scores*

Sample: 1



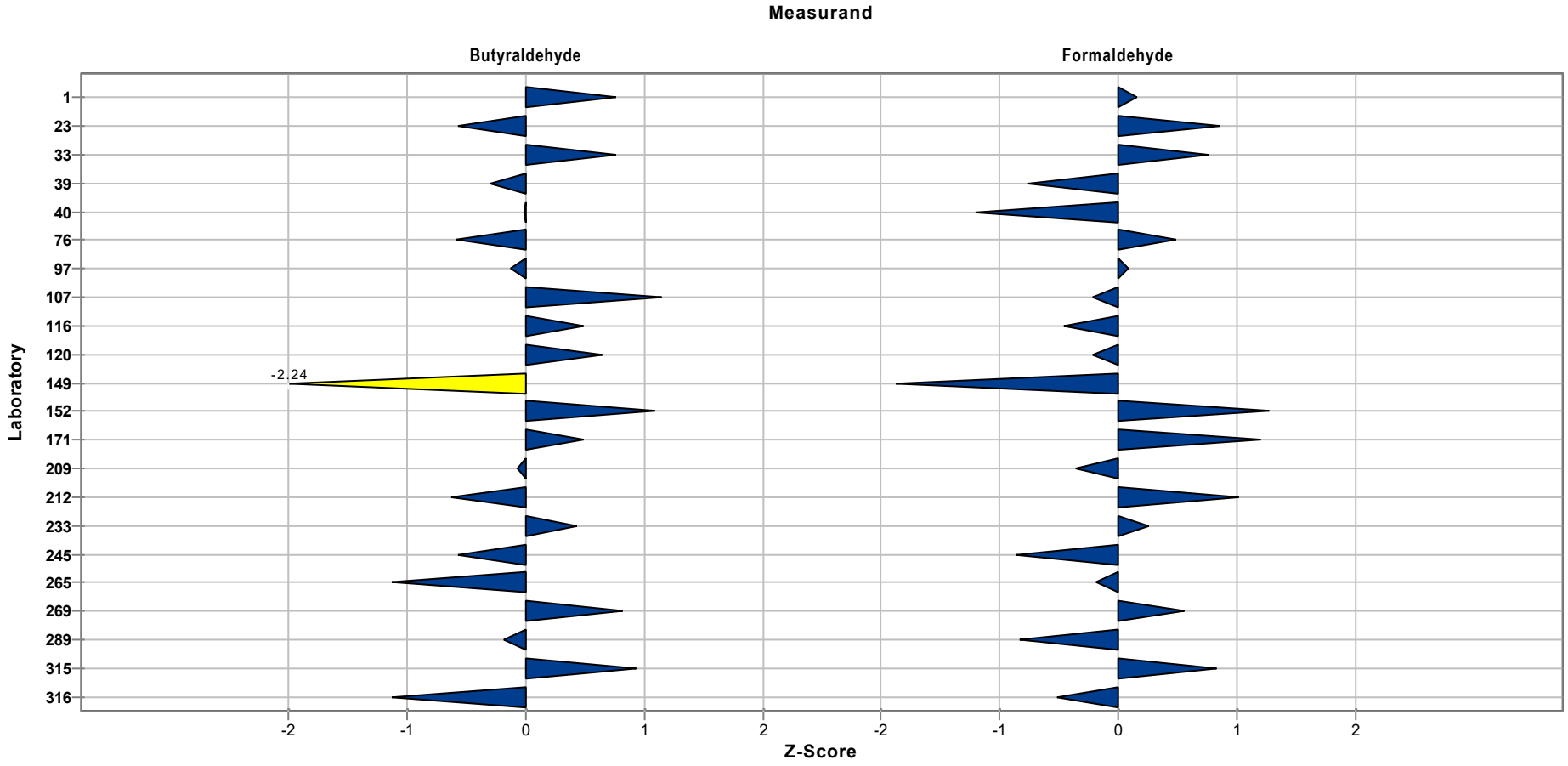
Sample chart of *Z-Scores*

Sample: **2**



Sample chart of *Z-Scores*

Sample: 3



Questions and Answers

Participant	Type of sample carrier	Sampling pump	Flow rate	Flow rate measurement
1	LpDNPH S 10 Kartusche Supelco (Merk)	AirChek XR5000 (SKC) / SG350ex (GSA)	1,2 l/min / 0,33 l/min	Massflowmeter Model 4140 (TSI)
23	Supelco DNPH Kartuschen	Bivoc 2	800 ml /min	BIOS Definer
33	Waters DNPH Silicagel WAT 039550	SKC Personal Air Sampler 224PCMTX8	0,18 L/min	BIOS Defender 510
39	Waters Sep-Pak XPoSure	Gilian Gilair Plus	500 ml/min	Mesa Labs Defender 520
40	Waters DNPH-Kartusche	Gilian LF 113	200 ml/min	Drycal Defender
76	DNPH imprägnierter Probenträger	GilAir plus und SKC PocketPumpTOUCH	0,3 l/min	Vögtlin Redy GSM-A9TS-BN00
97	Supelco LpDNPH S10 Cartridge	GSA SG5100ex, Biomess BPP 4-8	1,0 l/min	Defender 510H
107	DNPH Kartusche, H10, Fa. Supelco,	GilAir PLUS, SG5200	0,5 l/min und 1,0 l/min	Mesa Labs Definer 220
116	DNPH-Kartuschen	Gillian Lfs	0,33	Defender
120	DNPH-S10 (Supelco)	Gilian GilAir Plus	0,15 L / Min	Bios Defender 530-L
149	Supelco LpDNPH S10	Gilian GilAir Plus	1 L/min	MesaLabs Defender 520M
152	DNPH	DESAGA GS301	0,5 l/min	intern
171	LpDNPH S10x	Gilian GilAir plus	1 L/min	TSI 4100 Series
209	LpDNPH S10 Supelco	Gilian GilairPlus	1 L/min	TSI Typ 4146
212	Waters Sep-Pak Xposure	GSA SG350ex	0,333	Defender 510 L
233	Supelco Lp DNPH S10	GSA SG2500, Gilian GilAirPlus	1,5 L/min	Aalborg GFM17
245	Supelco Lp DNPH H10 Catridge	Gillian GilAir Plus	0,333 L/min	Mass Flow Meter 4140 von TSI
265	Supelco LpDNPH S10L	BiVOC2 (V2)	1,0 L/min	Bronkhorst Massenflussmesser
269	LpDNPH S10 Supelco	Gilair, SKC	0,3 -1,0 l/min	Massendurchflussmesser
289	DNPH Probenträger	Sensidyne GilAir Plus	1 L / min	Gilibrator 2
315	Supelco, LpDNPH S10 Cartridgeg, 3mL, 350mg SPE	BiVOC2	1,2	BiVOC2 / TSI 5200 Series
316	Supelco LpDNPH S10 Cartridge	GilAir Plus	0,5	SENSIDYNE Calibrator

Participant	Sampling time	Analytical method	Date start sample preparation
1	50 min / 120 min	BGIA 6045 / DIN ISO 16000-3	18.11.2025
23	125 min	DIN EN ISO 16000-3:2023-12	13.11.2025
33	120 min	IFA 6045	13.11.2025
39	120 Min.	CAM-0691101-24D	17.11.2025

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Participant	Sampling time	Analytical method	Date start sample preparation
40	120	HPLC-UV	17.11.2025
76	120 min	IFA 6045:2024-12	17.11.2025
97	45 Minuten	DIN EN ISO 16000-3:2023-12	19.11.2025
107	0,5 h und 1,0 h	Hausmethode in Anlehnung an DIN ISO 16000-3 und DFG - Band 1	13.11.2025
116	120 Minuten	DIN ISO 16000-3	24.11.2025
120	120 Min (2 h)	IFA 6045:2024-12 - Aldehyde	17-11-2025
149	100 Minuten	DIN ISO 16000-3: 2013-01	17.11.2025
152	30 Minuten	DIN-ISO-16000-3	
171	60 Min	DIN ISO 16000-3 (2023-12)	20.11.2025
209	32 Minuten	DIN EN ISO 16000-3:2023-12	20.11.2025
212	2h	IFA 6045	
233	30 Minuten	DIN ISO 16000-3	25.11.2025
245	2 Stunden	IFA 6045 (12/2024)	25.11.2025
265	20 min	DIN ISO 16000-3	14.11.2025
269	15 - 110 min	IFA 6045 Stand 2023	14.11.2025
289	30 min	NF ISO 16000-3	21.11.2025
315	Probe 1, 41 min 52 s Probe 2, 41 min 45 s Probe 3, 41 min 43 s	Analyse nach DIN ISO 16000-3, Ausgabestand: 12-2023	04.12.2025
316	2h	IFA 6045 XII/23	11.11.2025

Participant	Storage time after desorption
1	7 Tage im Kühlschrank
23	1 Tag im Kühlschrank
33	im Kühlschrank bei 7 °C
39	Lagerung nach Eingang (14.11.2025) im Labor im Kühlschrank.
40	Probe 1 und 2 = 6 Tage / Probe 3 = 5 Tage - Kühlschrank
76	Kühlschrank
97	Lagerung nach Desorption einen Tag im Kühlschrank. Nach Analyse werden die Proben 4 Wochen als Rückstellproben im Kühlschrank gelagert
107	Ja, Gefrierschrank.
116	ja, im Kühlschrank
120	Nein, direkte Messung
149	für eventuelle Nachmessungen (bei RT)

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Participant	Storage time after desorption
152	Kühlschrank
171	Kühltaschen mit Kühlelementen (8 Stunden), dann 1 Nacht im Kühlschrank, dann Übernahme durch Labor.
209	Kühlschrank nach Posteingang
233	keine Desorption; nach Aufarbeitung mit Acetonitril sofortige Analyse, vorher und nachher Aufbewahrung im Kühlschrank
245	3 Stunden bei Raumtemperatur
265	nein
269	Direkt vermessen
289	Keine Lagerung, direkt gemessen
315	Kühlschrank vom 11.11. bis 02.12.
316	1-2 Tage im Kühlschrank

Participant	Date of analysis	Desorption solution
1	19.11.2025	Acetonitril
23	13.11.2025	Acetonitril HPLC
33	18.11.2025 -22.12.2025	Acetonitril
39	18.11.2025	Acetonitril
40	17.11.2025	Acetonitril
76	25.11.2025 (Fertigstellung)	AcCN
97	20.11.2025	ACN
107	24.11.2025	Acetonitril eluiert und vor dem Messung 1zu 2 verdünnt.
116	28.11.2025	
120	18-11-2025	Acetonitril (anschließend angesäuert mit 0,5 molare H2SO4)
149	19.11.25	Acetonitril
152	1.12.2025	Acetonitril
171	Untersuchungsbeginn 20.11.2025 und Untersuchungsende 02.12.2025	
209	20.11.2025	Acetonitril
233	November und Dezember 2025	Acetonitril
245	3 Stunden nach Aufarbeitung	Acetonitril
265	14.11.2025	Acetonitril
269	Nach der Desorption	Acetonitril
289	21.11.2025	Acetonitril

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Participant	Date of analysis	Desorption solution
315	04.12-18.12.	-
316	21.11. - 13.12.25	

Participant	Volume of desorption solution
1	Kartusche 2ml
23	5 ml
33	5 ml
39	3 ml
40	2 ml
76	5
97	2,5 - 2,8 ml
107	Mit 5 ml ACN eluiert, anschließend 1 zu 2 mit Wasser verdünnt. Insgesamt 10 ml.
120	5
149	2 mL
152	5 ml
209	5 ml
233	5
245	5 mL
265	2
269	5 ml
289	3 mL
315	-

Participant	Chromatography system
1	HPLC Dionex U-3000 Aldehyde
23	HPLC / DAD 20a Shimadzu System
33	HP binäre Pumpe G1312A, DAD G1315A, Autosampler G1313A
39	Agilent
40	Agilent 1260 infinity

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Participant	Chromatography system
76	DAD-Einkanal365 nm
97	Shimadzu LC40
107	Pumpe: VC-P10-A, Detektor: DV-D50-A, Autosampler: VC-A12-A ; Fa. Thermo
120	Agilent HPLC 1224 mit quaternärer Pumpe, DAD
149	VWR Hitachi ; Pumpe: 5160 ; Detektor: 5430 ; Autosampler: 5260
152	Thermo Fisher Scientific, Vanquish Horizon UPLC mit UV-Detektor
209	Agilent 1200: 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
233	G7112B 1260 Infinity II Binäre Pumpe, G7117C 1260 Infinity II Diodenarray-Detektor, G7129A 1260 Infinity Automatischer Probengeber
245	Shimadzu Nexera LC-20AD XR Pumpen, Shimadzu SPD-40 UV-VIS Detektor, Shimadzu Nexera SIL-20AC XR Autosampler
265	Shimadzu LC 20
269	Ultimate 3000, Thermofisher Scientific
315	-

Participant	Refrigerated autosampler	Analytical column
1	nein	Restek Allure 5µm, 200 x 4,6mm
23	nein	Synergie 4µm Hydro- RP 80A, 250 x 4,6 mm
33	nein, Raumtemperatur	Dr. Maisch Reprosil pur 120 C18-AQ 150 x 4 mm
39	Ja, 18 °C	VDSpher Nucleosil 120 C18
40	Kein Autosampler	Agilent Poroshell 120, EC C18 2,7 µm ; 4,6 * 100 mm
76		Gemini-NX 3u C18 110A, 150 x 3.00 mm, Phenomenex
97	ja, 15 °C	C18
107	ja, 8 °C	Luna Omega, C18, 1,6 µm, 100 x 2,1 mm, Fa. Phenomenex
120	20 °C	ProntoSil (120-5-C18-ace-EPS 5µm)
149	nein	Macherey-Nagel Nucleodur Gravity C18 SB (150 x 3mm; 3 µm)
152	Ja, 20 °C	Dr.Maisch Grace Grom-Sil ods-5 (200 x 3.0 mm, 3.0 µm) Art. GSOD50312s2003
209	20°C	Restek Allure AK 5µm, 200x4,6 mm
233	ja, 10 °C	C18
245	15°C	Kinetex 5 µm C18, 100 x 4,6 mm mit Vorsäule
265	ja, 15 °C	Agilent Zorbax RRHD Eclipse Plus C18 2,1x150 mm, 1,8 µm
269	Nein	Lichrospher 100, RP-18 (5µm) 250-4

Aldehydes 2025 with own sampling 1

Participant	Refrigerated autosampler	Analytical column
289		C18
315	-	

Participant	Mobile phase	Flow rate HPLC	Wavelength	Column temperature
1	Acetonitril/ Wasser (Gradientenprogramm)	1,5ml/min	360nm	30°C
23	A : Wasser B: Acetonitril mit 5% Wasser (V/V) Gradient	1 ml / min	360 nm	25 Grad Celsius
33	Acetonitril/Wasser	1,2 ml/min	365 nm	Raumtemperatur
39	Wasser / Acetonitril	1 ml/min	365 nm	40 °C
40	Acetonitril/Wasser	1,0 mL/min	363 nm	40°C
76	Wasser / Acetonitril:THF (80:20)	0,9	200 - 450 nm	32°C
97	ACN/H2O/THF	0,7 ml/min	substanzspezifisch	40 °C
107	A: Acetonitril/Wasser 50/50 v/V, B: Acetonitril	0,2 ml/min	360 nm	30 °C
120	ACN / Wasser im Gradienten	1,5	365 nm	25°C
149	ACN/H2O	1,3 mL	365 nm	30 °C
152	A: 60 % Acetonitril / 40 % Wasser (v/v) B: 95 % Acetonitril / 5 % Wasser (v/v) mit Gradient	0.5 ml/min	360 nm	40°C
209	Acetonitril / Wasser, Gradient (60 bis max. 95% Acetonitril)	1,4 ml/min	360 nm	30°C
233	Acetonitril und Wasser	1	360 nm	25 °C
245	A: Tetrahydrofuran p.a. (10 %) : Reinstwasser (90 %), B: Acetonitril p.a.	1,4 mL/min	365 nm	40°C
265	Acetonitril / Wasser 45:55	0,25 ml/min	356 nm	45 °C
269	Aetonitril / Wasser, Gradientenelution	1 ml / min	365 nm	20C°
289		1 mL/min	360 nm	
315	-	-	-	-

Participant	Recovery rate
1	nein
23	ja
33	nein
39	Nein
40	Ja

Aldehydes 2025 with own sampling 1

Participant	Recovery rate
76	ja
97	nein
107	nein
120	Ja
149	Nein – Referenzstd. zu Kal im Bereich zw. 91 und 106 % - ohne Berücks.
152	Nicht anwendbar, da keine Wiederfindungsproben möglich über Kartuschen.
209	Nein
233	nein
245	Nein
265	nein
269	Ja
315	-

Summary of laboratory test results

Measurand Acetaldehyde

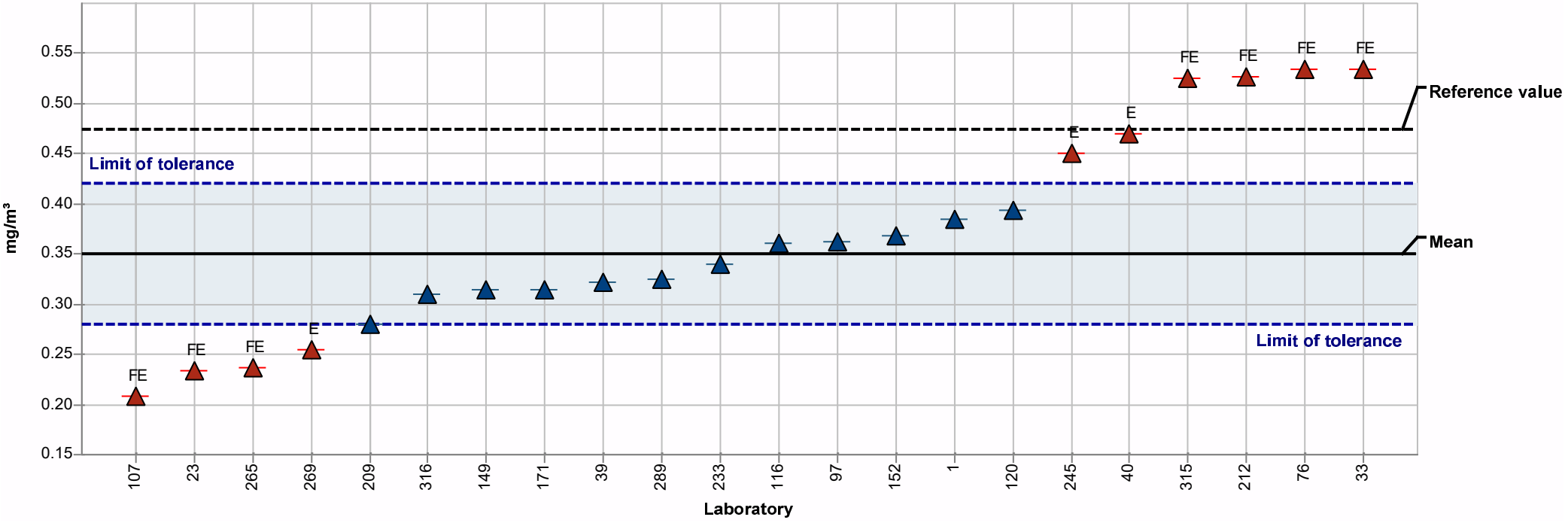
Laboratory	Sample 1	Z score	Sample 2	Z score	Sample 3	Z score
Unit	mg/m³		mg/m³		mg/m³	
1	0.384	0.97	0.549	0.66	1.127	0.11
23	0.233	-3.34 FE	0.346	-3.28 FE	0.714	-3.59 FE
33	0.534	5.26 FE	0.767	4.89 FE	1.712	5.36 FE
39	0.322	-0.80	0.499	-0.31	1.057	-0.52
40	0.470	3.43 E	0.680	3.20 E	1.500	3.46 E
76	0.533	5.24 FE	0.777	5.08 FE	1.715	5.39 FE
97	0.362	0.34	0.515	0.00	1.069	-0.41
107	0.208	-4.06 FE	0.311	-3.96 FE	0.673	-3.96 FE
116	0.361	0.31	0.523	0.15	1.190	0.68
120	0.393	1.23	0.586	1.38	1.292	1.59
149	0.315	-1.00	0.395	-2.33 E	0.840	-2.46 E
152	0.368	0.51	0.544	0.56	1.200	0.77
171	0.315	-1.00	0.468	-0.91	1.050	-0.58
209	0.280	-2.00	0.409	-2.06 E	0.881	-2.09 E
212	0.527	5.06 FE	0.780	5.14 FE	1.720	5.43 FE
233	0.340	-0.29	0.499	-0.31	1.146	0.28
245	0.450	2.86 E	0.670	3.01 E	1.360	2.20 E
265	0.236	-3.26 FE	0.308	-4.02 FE	0.612	-4.51 FE
269	0.255	-2.71 E	0.378	-2.66 E	0.810	-2.73 E
289	0.325	-0.71	0.522	0.13	1.155	0.36
315	0.525	5.00 FE	0.791	5.36 FE	1.890	6.96 FE
316	0.310	-1.14	0.490	-0.49	1.040	-0.67
–	–	– –	–	– –	–	– –
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	22		22		22	
Mean	0.350		0.515		1.114	
Reproducibility s.d.	0.058		0.087		0.188	
Rel. reproducibility s.d.	16.64 %		16.90 %		16.85 %	
Reference value	0.474		0.716		1.613	
Target s.d.	0.035		0.052		0.111	
Rel. target s.d.	10.00 %		10.00 %		10.00 %	
Lower limit of tolerance	0.280		0.412		0.892	
Upper limit of tolerance	0.420		0.618		1.337	
Type F outliers	7		7		7	
No. of laboratories after elimination of outliers type A-D and F (without laboratories that only gave states but no measured values)	15		15		15	

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	

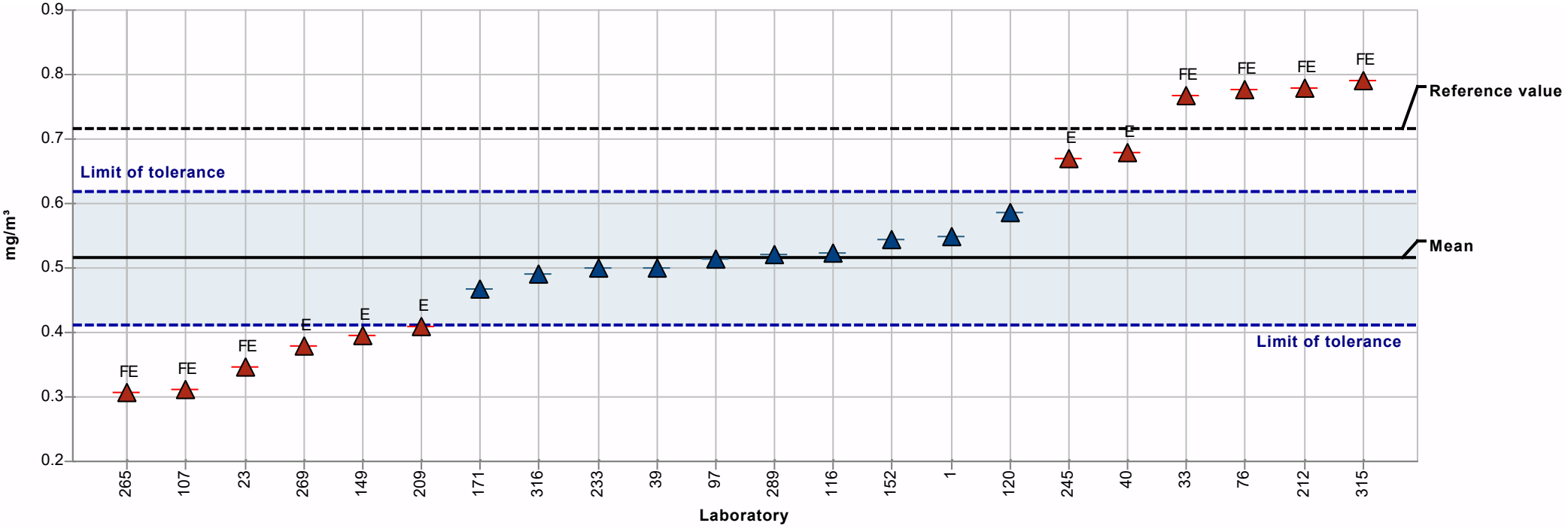
Summary results

Sample:	1	**Mean:**	0.350 mg/m³
Measurand:	Acetaldehyde	**Reproducibility s.d.:**	0.058 mg/m³
Method:	ISO 5725-2	**Rel. reproducibility s.d.:**	16.64%
Rel. target s.d.:	10.00%	**Reference value:**	0.474 mg/m³
Number of laboratories in calculation:	15	**Range of tolerance:**	0.280 - 0.420 mg/m³ (|Z-Score| <= 2.00)
No. of outlier values:	7		



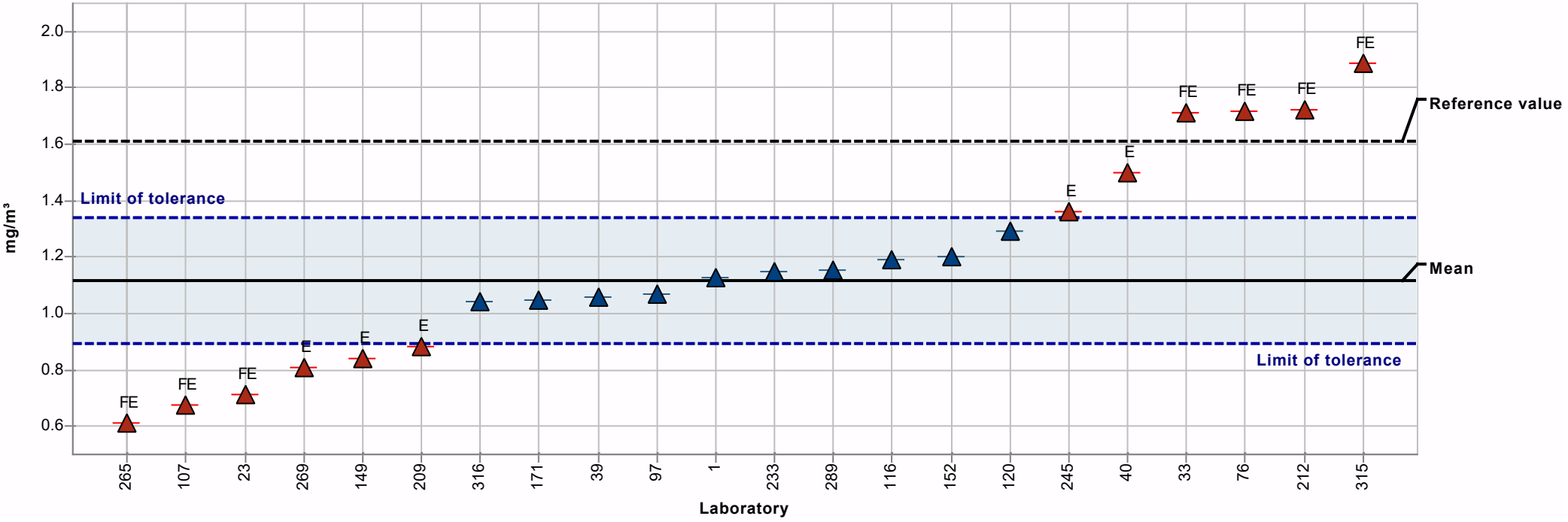
Summary results

Sample:	2	**Mean:**	0.515 mg/m³
Measurand:	Acetaldehyde	**Reproducibility s.d.:**	0.087 mg/m³
Method:	ISO 5725-2	**Rel. reproducibility s.d.:**	16.90%
Rel. target s.d.:	10.00%	**Reference value:**	0.716 mg/m³
Number of laboratories in calculation:	15	**Range of tolerance:**	0.412 - 0.618 mg/m³ (|Z-Score| <= 2.00)
No. of outlier values:	7		



Summary results

Sample:	3	**Mean:**	1.114 mg/m³
Measurand:	Acetaldehyde	**Reproducibility s.d.:**	0.188 mg/m³
Method:	ISO 5725-2	**Rel. reproducibility s.d.:**	16.85%
Rel. target s.d.:	10.00%	**Reference value:**	1.613 mg/m³
Number of laboratories in calculation:	15	**Range of tolerance:**	0.892 - 1.337 mg/m³ (|Z-Score| <= 2.00)
No. of outlier values:	7		



Homogeneity test

Overview of statistical values and results

Sample description	Measurand description	Unit	Mean	s(analytical) [%]	s(sample) [%]	Mode for SDPA	SDPA [%]	Replicates	Test items
1	Acetaldehyde	mg/m³	0.474	0.58	1.49	Manual	10.00	2	10
1	Butyraldehyde	mg/m³	1.139	0.46	1.45	Manual	10.00	2	10
1	Formaldehyde	mg/m³	0.115	0.58	1.63	Manual	10.00	2	10
1	Propionaldehyde	mg/m³	0.223	0.83	1.26	Manual	10.00	2	10
2	Acetaldehyde	mg/m³	0.716	0.62	1.32	Manual	10.00	2	10
2	Formaldehyde	mg/m³	0.221	0.70	1.23	Manual	10.00	2	10
2	Propionaldehyde	mg/m³	1.288	0.63	1.07	Manual	10.00	2	10
3	Acetaldehyde	mg/m³	1.613	0.79	1.18	Manual	10.00	2	10
3	Butyraldehyde	mg/m³	0.181	0.28	1.30	Manual	10.00	2	10
3	Formaldehyde	mg/m³	0.272	0.76	1.35	Manual	10.00	2	10

Sample description	Measurand description	ISO 13528:2022 - test for adequate homogeneity
1	Acetaldehyde	Ok
1	Butyraldehyde	Ok
1	Formaldehyde	Ok
1	Propionaldehyde	Ok
2	Acetaldehyde	Ok
2	Formaldehyde	Ok
2	Propionaldehyde	Ok
3	Acetaldehyde	Ok
3	Butyraldehyde	Ok
3	Formaldehyde	Ok