

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

## Proficiency testing scheme aldehydes with own sampling

**16 - 17 November 2021**

## Summary of laboratory test results

Sample 1

|  | Acetaldehyde      | Z score | Formaldehyde      | Z score | Propionaldehyd    | Z score |
|--|-------------------|---------|-------------------|---------|-------------------|---------|
| Unit                                       | mg/m <sup>3</sup> |         | mg/m <sup>3</sup> |         | mg/m <sup>3</sup> |         |
| 19   | 0,344             | -0,14   | 0,153             | -0,40   | 0,536             | 0,18    |
| 49   | 0,335             | -0,39   | 0,150             | -0,58   | 0,486             | -0,77   |
| 66   | 0,385             | 1,04    | 0,179             | 1,24    | 0,575             | 0,92    |
| 76   | 0,386             | 1,07    | 0,170             | 0,67    | 0,514             | -0,23   |
| 109  | 0,379             | 0,87    | 0,169             | 0,61    | 0,573             | 0,89    |
| 115  | 0,358             | 0,27    | 0,158             | -0,08   | 0,551             | 0,47    |
| 116  | 0,330             | -0,54   | 0,150             | -0,58   | 0,490             | -0,69   |
| 122  | 0,372             | 0,67    | 0,160             | 0,04    | 0,573             | 0,89    |
| 158  | 0,352             | 0,09    | 0,160             | 0,04    | 0,543             | 0,32    |
| 176  | 0,349             | 0,01    | 0,159             | -0,02   | 0,545             | 0,35    |
| 209  | 0,279             | -2,00   | 0,166             | 0,42    | 0,481             | -0,86   |
| 211  | 0,315             | -0,97   | 0,171             | 0,73    | 0,487             | -0,75   |
| 236  | 0,362             | 0,38    | 0,148             | -0,71   | 0,760             | 4,44 BE |
| 245  | 0,320             | -0,82   | 0,150             | -0,58   | 0,510             | -0,31   |
| 246  | 0,351             | 0,08    | 0,161             | 0,11    | 0,504             | -0,42   |
| 259  | 0,336             | -0,36   | 0,143             | -1,02   | 0,517             | -0,18   |
| 265  | 0,365             | 0,47    | 0,161             | 0,11    | 0,510             | -0,31   |
| 269  | 0,359             | 0,29    | 0,164             | 0,30    | 0,495             | -0,60   |
| 284  | 0,341             | -0,22   | 0,154             | -0,33   | 0,531             | 0,09    |
| 289  | 0,356             | 0,21    | 0,160             | 0,04    | 0,580             | 1,02    |
|  | -                 | --      | -                 | --      | -                 | --      |
| 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 | 20                |         | 20                |         | 20                |         |
| Mean                                       | 0,349             |         | 0,159             |         | 0,526             |         |
| Reprod. s.d.                               | 0,026             |         | 0,009             |         | 0,033             |         |
| Rel. reproducibility s.d.                  | 7,35 %            |         | 5,63 %            |         | 6,29 %            |         |
| Reference value                            | 0,358             |         | 0,155             |         | 0,559             |         |

|  | Acetaldehyde | Z score | Formaldehyde | Z score | Propionaldehyd | Z score |
|--|--------------|---------|--------------|---------|----------------|---------|
| Target s.d.  | 0,035        |         | 0,016        |         | 0,053          |         |
| Rel. target s.d.   | 10,00 %      |         | 10,00 %      |         | 10,00 %        |         |
| Lower limit of tolerance   | 0,279        |         | 0,127        |         | 0,421          |         |
| Upper limit of tolerance   | 0,418        |         | 0,191        |         | 0,632          |         |
| 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) | 20           |         | 20           |         | 19             |         |
| 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   |              |         |              |         |                |         |

## Summary of laboratory test results

Sample 2

|  | Acetaldehyde      | Z score | Butyraldehyde     | Z score | Formaldehyde      | Z score |
|--|-------------------|---------|-------------------|---------|-------------------|---------|
| Unit                                       | mg/m <sup>3</sup> |         | mg/m <sup>3</sup> |         | mg/m <sup>3</sup> |         |
| 19   | 0,966             | 0,47    | 0,310             | 1,26    | 0,109             | 0,02    |
| 49   | 0,897             | -0,28   | 0,257             | -0,67   | 0,103             | -0,53   |
| 66   | 1,100             | 1,92    | 0,410             | 4,89 BE | 0,131             | 2,04 E  |
| 76   | 1,010             | 0,95    | 0,276             | 0,02    | 0,117             | 0,76    |
| 109  | 0,978             | 0,60    | 0,252             | -0,85   | 0,112             | 0,30    |
| 115  | 0,924             | 0,01    | 0,282             | 0,24    | 0,107             | -0,16   |
| 116  | 0,840             | -0,90   | 0,270             | -0,19   | 0,100             | -0,81   |
| 122  | 0,950             | 0,30    | 0,297             | 0,79    | 0,108             | -0,07   |
| 158  | 0,946             | 0,25    | 0,291             | 0,57    | 0,110             | 0,11    |
| 176  | 0,905             | -0,19   | 0,266             | -0,34   | 0,109             | 0,02    |
| 209  | 0,716             | -2,24 E | 0,243             | -1,17   | 0,105             | -0,35   |
| 211  | 0,943             | 0,22    | 0,264             | -0,41   | 0,130             | 1,95    |
| 236  | 0,984             | 0,66    | 0,317             | 1,51    | 0,097             | -1,09   |
| 245  | 0,850             | -0,79   | 0,270             | -0,19   | 0,100             | -0,81   |
| 246  | 0,923             | 0,00    | 0,253             | -0,83   | 0,110             | 0,07    |
| 259  | 0,884             | -0,42   | 0,312             | 1,33    | 0,100             | -0,81   |
| 265  | 0,937             | 0,15    | 0,258             | -0,63   | 0,107             | -0,16   |
| 269  | 0,951             | 0,31    | 0,266             | -0,34   | 0,112             | 0,30    |
| 284  | 0,843             | -0,86   | 0,248             | -0,99   | 0,101             | -0,71   |
| 289  | 0,908             | -0,16   | 0,300             | 0,90    | 0,108             | -0,07   |
|  | -                 | --      | -                 | --      | -                 | --      |
| 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 | 20                |         | 20                |         | 20                |         |
| Mean                                       | 0,923             |         | 0,275             |         | 0,109             |         |
| Reprod. s.d.                               | 0,078             |         | 0,023             |         | 0,009             |         |
| Rel. reproducibility s.d.                  | 8,41 %            |         | 8,35 %            |         | 8,23 %            |         |
| Reference value                            | 0,936             |         | 0,274             |         | 0,105             |         |

|  | Acetaldehyde | Z score | Butyraldehyde | Z score | Formaldehyde | Z score |
|--|--------------|---------|---------------|---------|--------------|---------|
| Target s.d.  | 0,092        |         | 0,028         |         | 0,011        |         |
| Rel. target s.d.   | 10,00 %      |         | 10,00 %       |         | 10,00 %      |         |
| Lower limit of tolerance   | 0,738        |         | 0,220         |         | 0,087        |         |
| Upper limit of tolerance   | 1,107        |         | 0,330         |         | 0,131        |         |
| 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) | 20           |         | 19            |         | 20           |         |
| 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\text{-Score}  > 3,5$  |              |         |               |         |              |         |

## Summary of laboratory test results

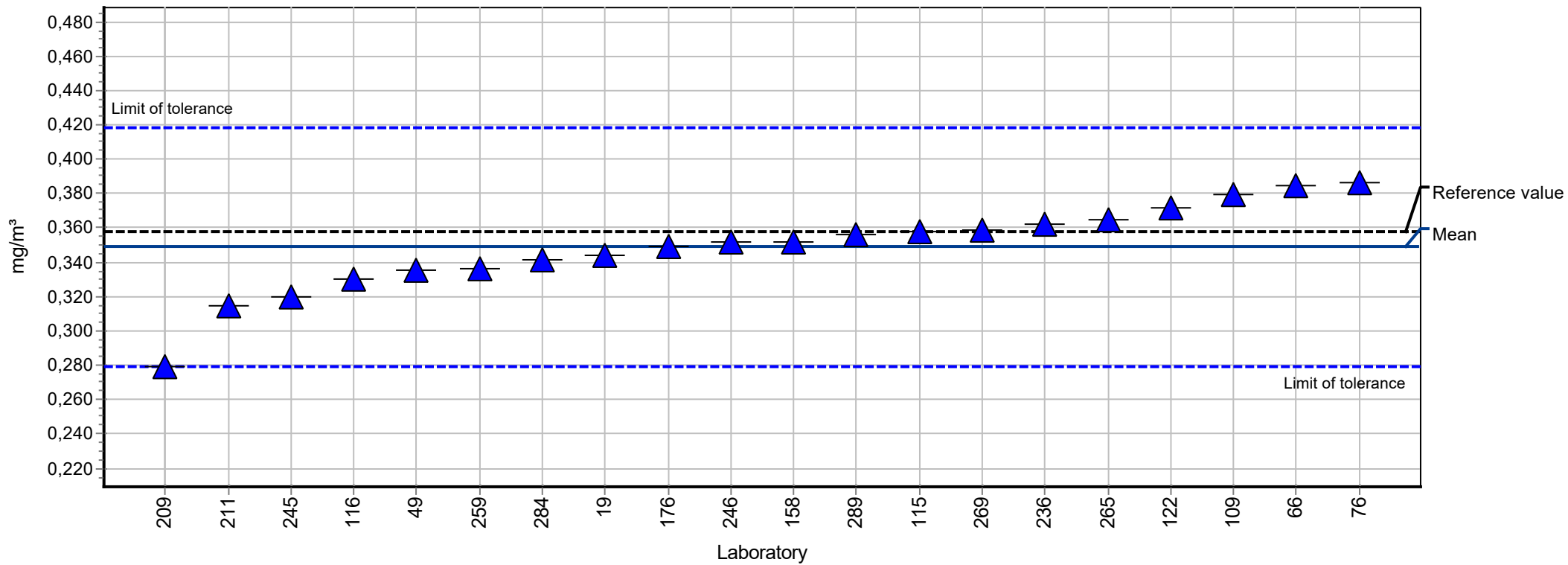
Sample 3

|  | Acetaldehyde      | Z score | Butyraldehyde     | Z score  | Formaldehyde      | Z score | Propionaldehyd    | Z score  |
|--|-------------------|---------|-------------------|----------|-------------------|---------|-------------------|----------|
| Unit                                       | mg/m <sup>3</sup> |         | mg/m <sup>3</sup> |          | mg/m <sup>3</sup> |         | mg/m <sup>3</sup> |          |
| 19   | 0,247             | -0,13   | 0,573             | 0,73     | 0,064             | -0,49   | 0,279             | 0,20     |
| 49   | 0,246             | -0,17   | 0,503             | -0,58    | 0,064             | -0,49   | 0,258             | -0,57    |
| 66   | 0,300             | 1,99    | 0,828             | 5,50 BE  | 0,087             | 2,93 E  | 0,372             | 3,60 BE  |
| 76   | 0,274             | 0,95    | 0,521             | -0,25    | 0,075             | 1,15    | 0,274             | 0,01     |
| 109  | 0,275             | 0,99    | 0,554             | 0,37     | 0,073             | 0,85    | 0,305             | 1,15     |
| 115  | 0,255             | 0,19    | 0,570             | 0,67     | 0,070             | 0,41    | 0,286             | 0,45     |
| 116  | 0,250             | -0,01   | 0,570             | 0,67     | 0,070             | 0,41    | 0,280             | 0,23     |
| 122  | 0,259             | 0,35    | 0,577             | 0,80     | 0,067             | -0,11   | 0,290             | 0,60     |
| 158  | 0,250             | -0,01   | 0,559             | 0,46     | 0,068             | 0,11    | 0,282             | 0,31     |
| 176  | 0,249             | -0,05   | 0,518             | -0,30    | 0,068             | 0,11    | 0,284             | 0,38     |
| 209  | 0,198             | -2,09 E | 0,474             | -1,13    | 0,063             | -0,63   | 0,251             | -0,83    |
| 211  | 0,232             | -0,73   | 0,505             | -0,55    | 0,097             | 4,42 FE | 0,262             | -0,42    |
| 236  | 0,248             | -0,09   | 0,335             | -3,73 BE | 0,052             | -2,27 E | 0,605             | 12,11 BE |
| 245  | 0,240             | -0,41   | 0,530             | -0,08    | 0,060             | -1,08   | 0,260             | -0,50    |
| 246  | 0,244             | -0,25   | 0,478             | -1,04    | 0,067             | -0,11   | 0,254             | -0,72    |
| 259  | 0,238             | -0,49   | 0,591             | 1,06     | 0,063             | -0,63   | 0,269             | -0,17    |
| 265  | 0,259             | 0,35    | 0,512             | -0,42    | 0,067             | -0,04   | 0,263             | -0,39    |
| 269  | 0,255             | 0,19    | 0,515             | -0,36    | 0,070             | 0,41    | 0,261             | -0,46    |
| 284  | 0,230             | -0,81   | 0,476             | -1,09    | 0,062             | -0,78   | 0,260             | -0,50    |
| 289  | 0,257             | 0,27    | 0,589             | 1,03     | 0,069             | 0,26    | 0,307             | 1,22     |
|  | -                 | --      | -                 | --       | -                 | --      | -                 | --       |
| 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 | 20                |         | 20                |          | 20                |         | 20                |          |
| Mean                                       | 0,250             |         | 0,534             |          | 0,067             |         | 0,274             |          |
| Reprod. s.d.                               | 0,020             |         | 0,039             |          | 0,007             |         | 0,017             |          |
| Rel. reproducibility s.d.                  | 8,04 %            |         | 7,38 %            |          | 10,40 %           |         | 6,08 %            |          |
| Reference value                            | 0,256             |         | 0,550             |          | 0,066             |         | 0,290             |          |

|  | Acetaldehyde | Z score | Butyraldehyde | Z score | Formaldehyde | Z score | Propionaldehyd | Z score |
|--|--------------|---------|---------------|---------|--------------|---------|----------------|---------|
| Target s.d.  | 0,025        |         | 0,053         |         | 0,007        |         | 0,027          |         |
| Rel. target s.d.   | 10,00 %      |         | 10,00 %       |         | 10,00 %      |         | 10,00 %        |         |
| Lower limit of tolerance   | 0,200        |         | 0,427         |         | 0,054        |         | 0,219          |         |
| Upper limit of tolerance   | 0,300        |         | 0,641         |         | 0,081        |         | 0,328          |         |
| Type B outliers  |              |         | 2             |         |              |         | 2              |         |
| 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) | 20           |         | 18            |         | 19           |         | 18             |         |
| 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\text{-Score}  > 3,5$  |              |         |               |         |              |         |                |         |

## Summary results

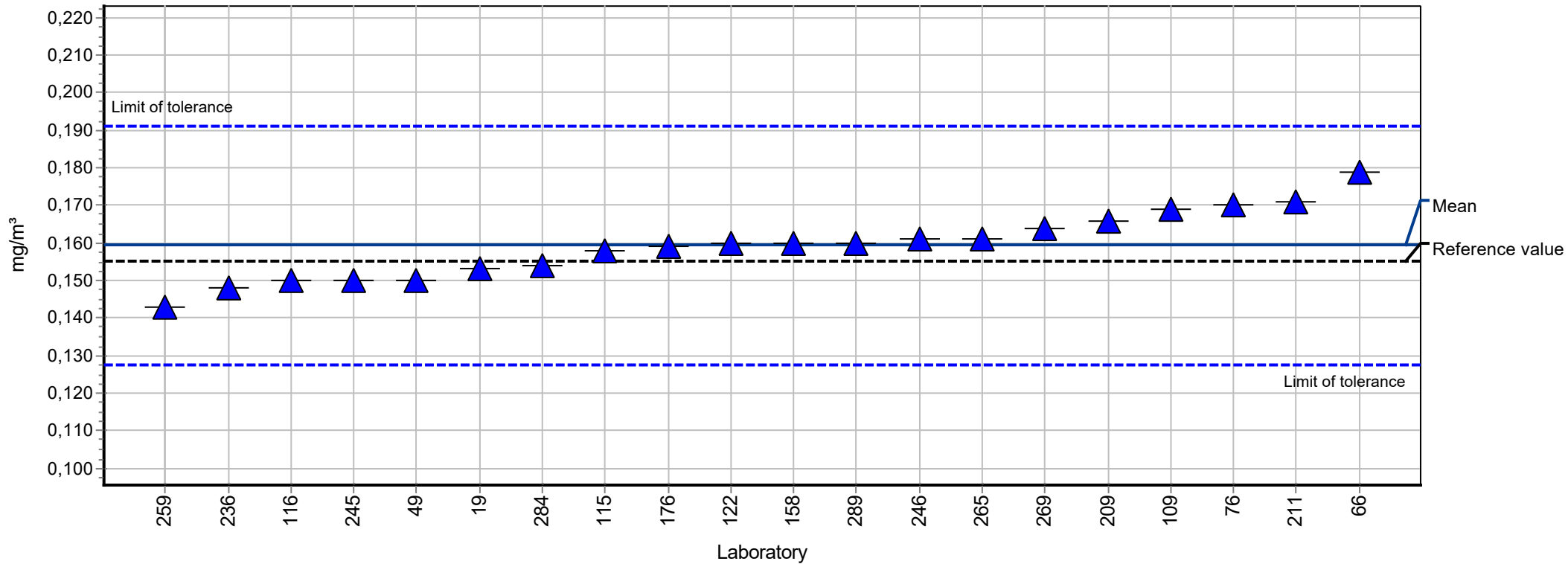
Measurand: Acetaldehyde      Mean: 0,349 mg/m<sup>3</sup>  
Sample: 1      Reprod. s.d.: 0,026 mg/m<sup>3</sup>  
Method: ISO 5725-2      Rel.reprod. s.d.: 7,35%  
Rel.target s.d.: 10,00% (Limited)      Reference value: 0,358 mg/m<sup>3</sup>  
Number of laboratories in calculation: 20      Range of tolerance: 0,279 - 0,418 mg/m<sup>3</sup> (|Z-Score| <= 2,00)





## Summary results

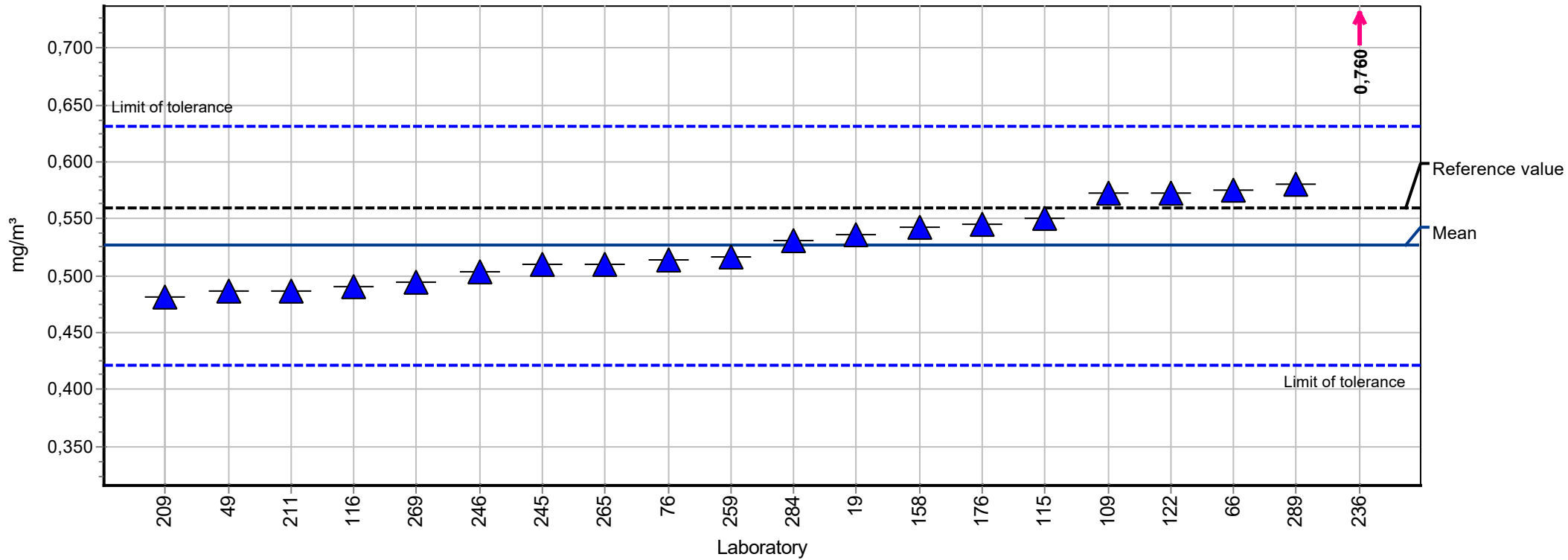
|   |                  |   |                         |
|---|------------------|---|-------------------------|
| Measurand:                                | Formaldehyde     | Mean:   | 0,159 mg/m <sup>3</sup> |
| Sample:                                   | 1                | Reprod. s.d.:   | 0,009 mg/m <sup>3</sup> |
| Method:                                   | ISO 5725-2       | Rel.reprod. s.d.:   | 5,63%                   |
| Rel.target s.d.:                          | 10,00% (Limited) | Reference value:  | 0,155 mg/m <sup>3</sup> |
| Number of laboratories in calculation: 20 |                  | Range of tolerance: 0,127 - 0,191 mg/m <sup>3</sup> ( Z-Score  <= 2,00) |                         |



## Summary results

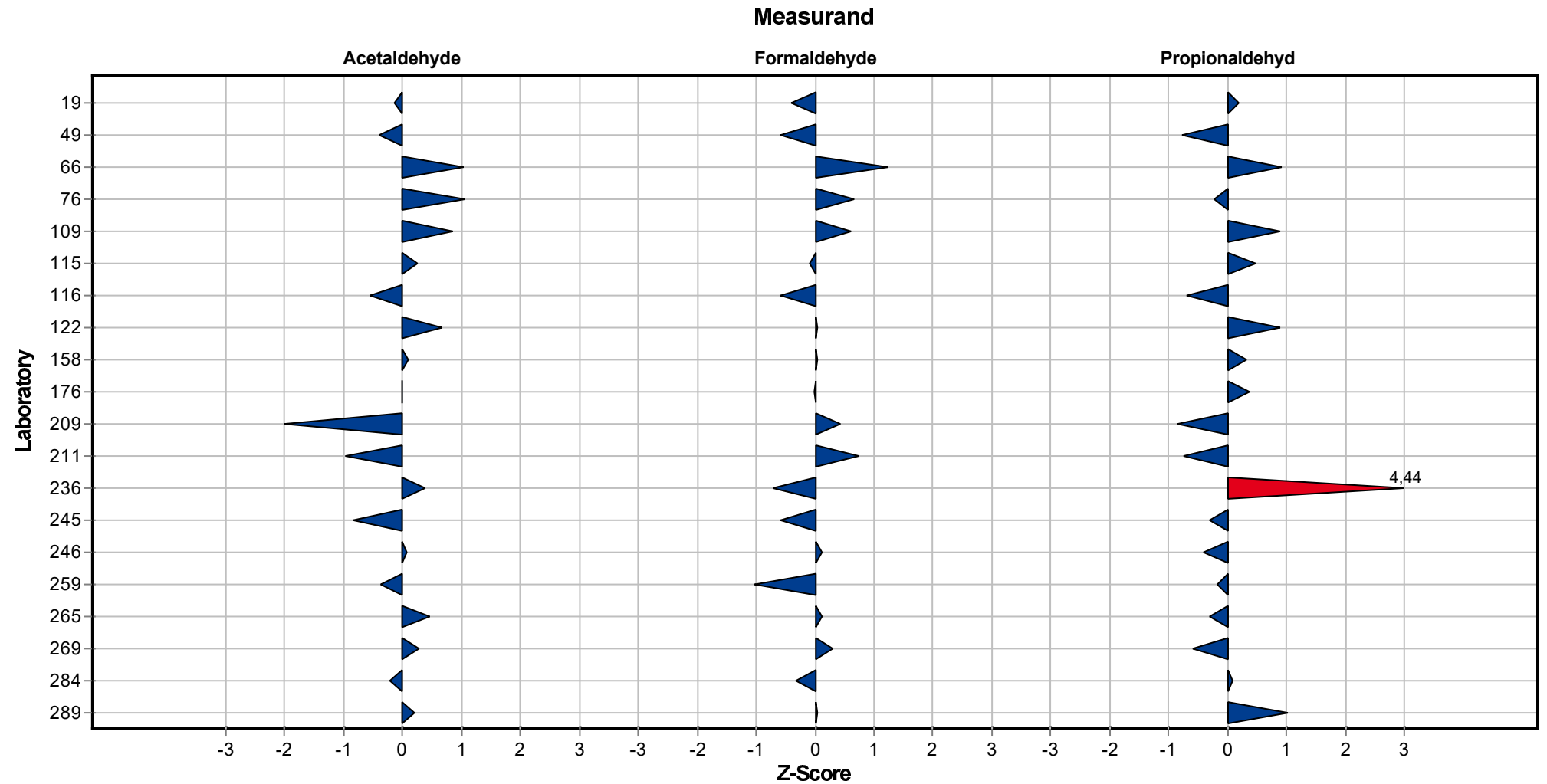
|                  |                  |                   |                         |
|------------------|------------------|-------------------|-------------------------|
| Measurand:       | Propionaldehyd   | Mean:             | 0,526 mg/m <sup>3</sup> |
| Sample:          | 1                | Reprod. s.d.:     | 0,033 mg/m <sup>3</sup> |
| Method:          | ISO 5725-2       | Rel.reprod. s.d.: | 6,29%                   |
| Rel.target s.d.: | 10,00% (Limited) | Reference value:  | 0,559 mg/m <sup>3</sup> |

Number of laboratories in calculation + outliers: 20      Range of tolerance: 0,421 - 0,632 mg/m<sup>3</sup> (|Z-Score| <= 2,00)



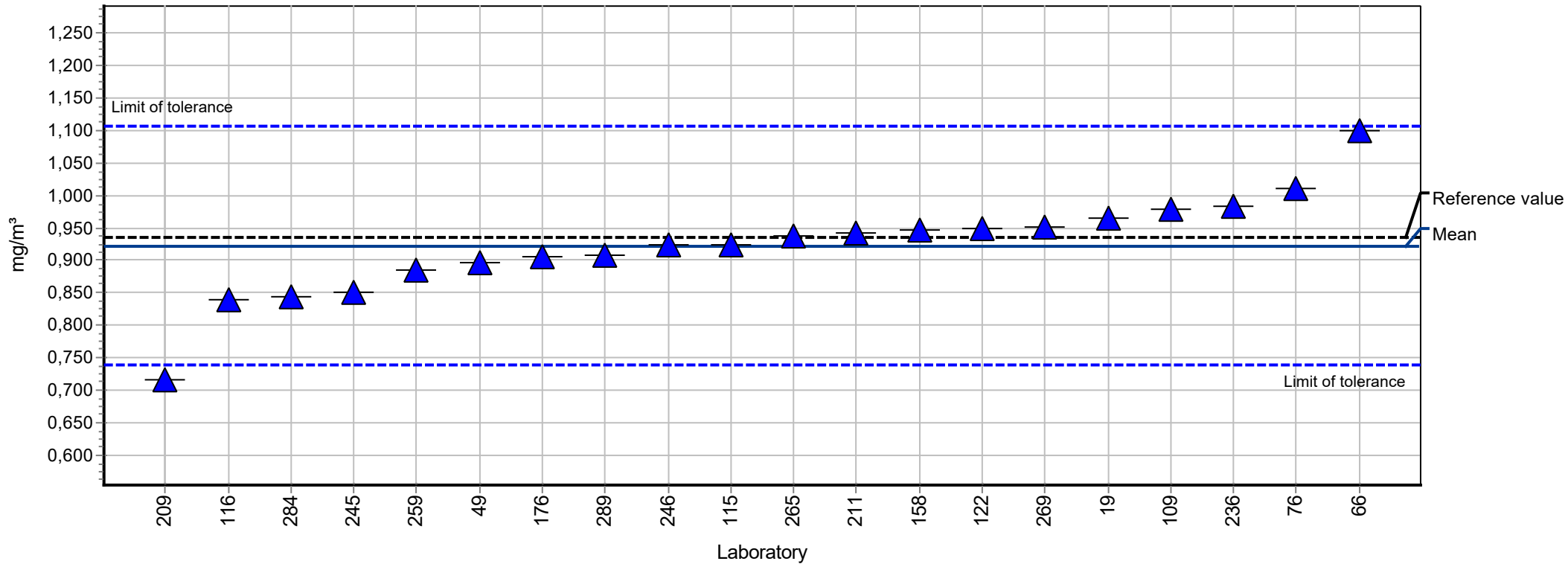
# Sample chart of Z-scores

Sample 1



## Summary results

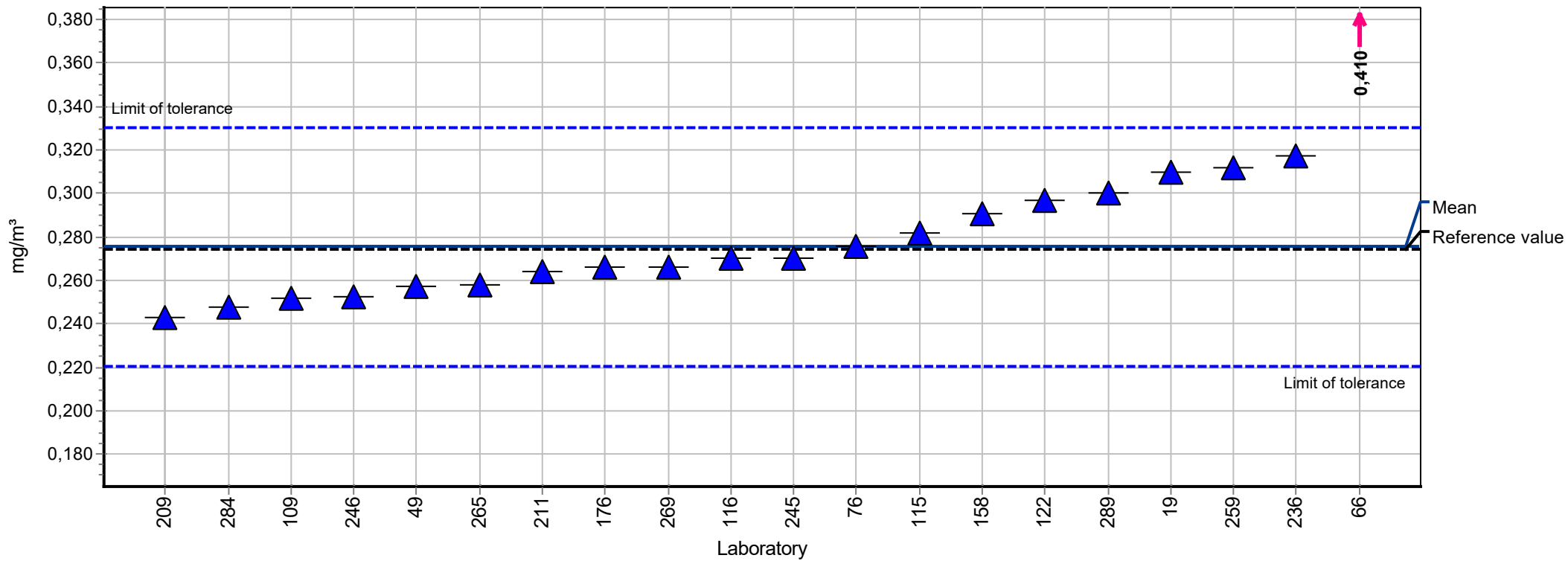
|   |                  |   |                         |
|---|------------------|---|-------------------------|
| Measurand:                                | Acetaldehyde     | Mean:   | 0,923 mg/m <sup>3</sup> |
| Sample:                                   | 2                | Reprod. s.d.:   | 0,078 mg/m <sup>3</sup> |
| Method:                                   | ISO 5725-2       | Rel.reprod. s.d.:   | 8,41%                   |
| Rel.target s.d.:                          | 10,00% (Limited) | Reference value:  | 0,936 mg/m <sup>3</sup> |
| Number of laboratories in calculation: 20 |                  | Range of tolerance: 0,738 - 1,107 mg/m <sup>3</sup> ( Z-Score  <= 2,00) |                         |



## Summary results

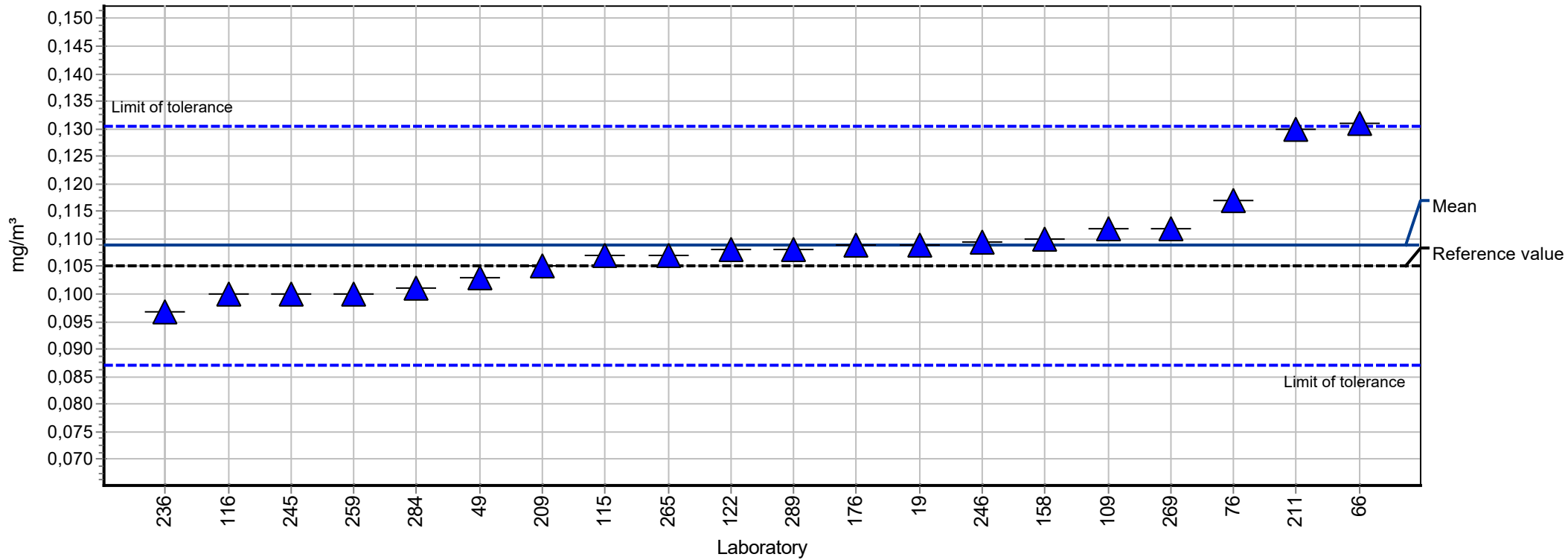
**Measurand:** Butyraldehyde    **Mean:** 0,275 mg/m<sup>3</sup>  
**Sample:** 2    **Reprod. s.d.:** 0,023 mg/m<sup>3</sup>  
**Method:** ISO 5725-2    **Rel.reprod. s.d.:** 8,35%  
**Rel.target s.d.:** 10,00% (Limited)    **Reference value:** 0,274 mg/m<sup>3</sup>

**Number of laboratories in calculation + outliers:** 20    **Range of tolerance:** 0,220 - 0,330 mg/m<sup>3</sup> (|Z-Score| <= 2,00)



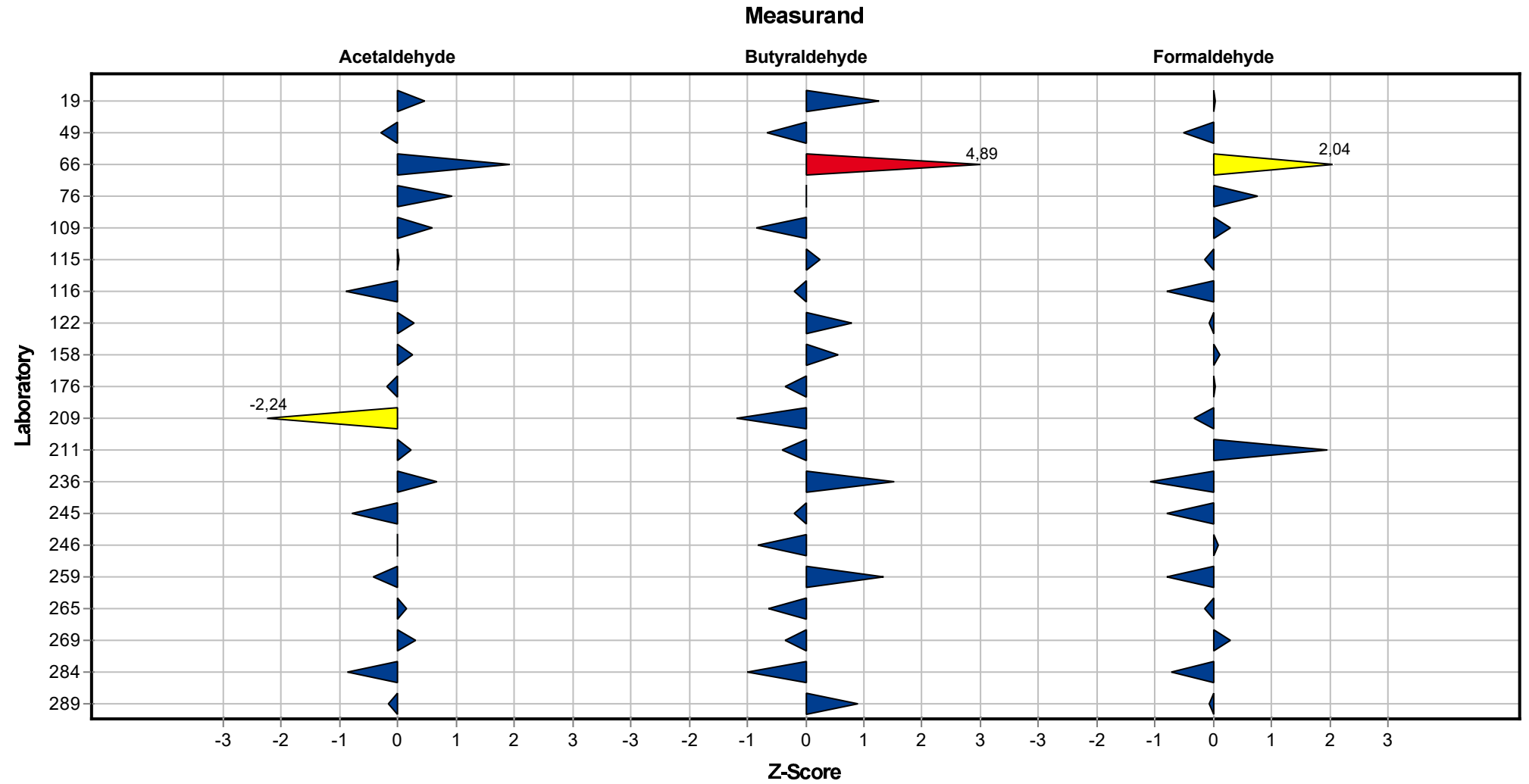
## Summary results

|   |                  |   |                         |
|---|------------------|---|-------------------------|
| Measurand:                                | Formaldehyde     | Mean:   | 0,109 mg/m <sup>3</sup> |
| Sample:                                   | 2                | Reprod. s.d.:   | 0,009 mg/m <sup>3</sup> |
| Method:                                   | ISO 5725-2       | Rel.reprod. s.d.:   | 8,23%                   |
| Rel.target s.d.:                          | 10,00% (Limited) | Reference value:  | 0,105 mg/m <sup>3</sup> |
| Number of laboratories in calculation: 20 |                  | Range of tolerance: 0,087 - 0,131 mg/m <sup>3</sup> ( Z-Score  <= 2,00) |                         |



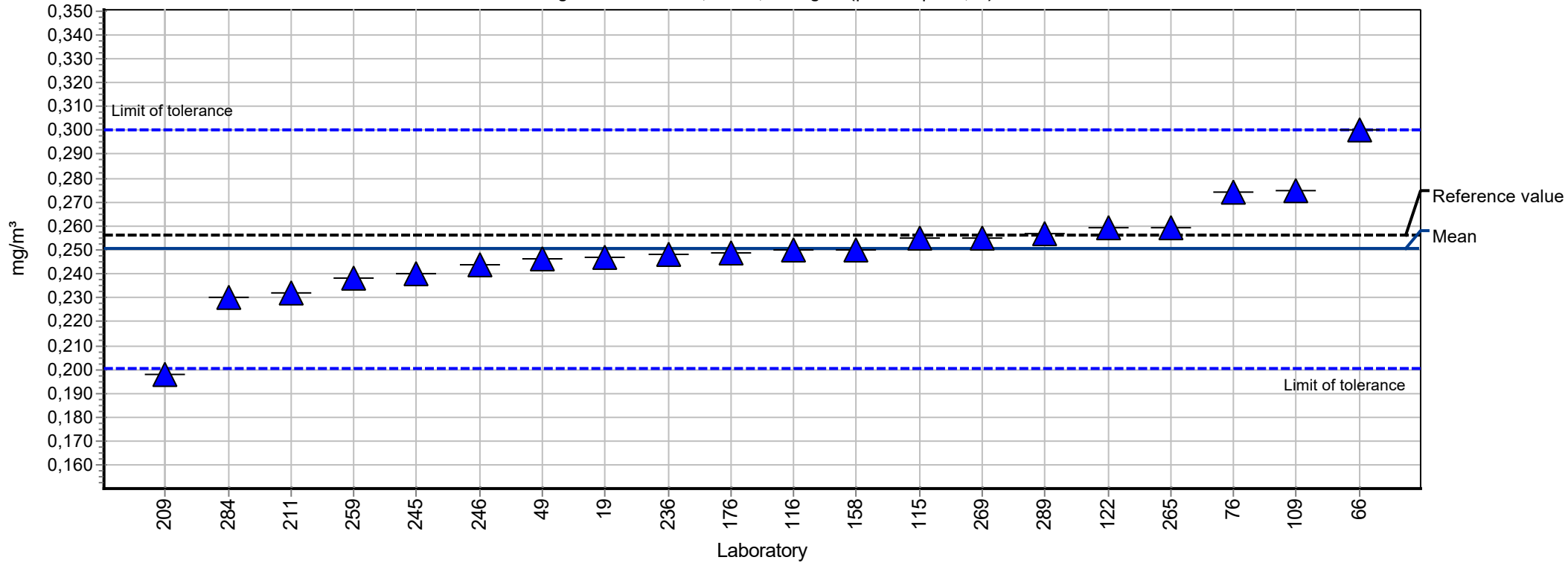
# Sample chart of Z-scores

Sample 2



## Summary results

|   |                  |   |                         |
|---|------------------|---|-------------------------|
| Measurand:                                | Acetaldehyde     | Mean:   | 0,250 mg/m <sup>3</sup> |
| Sample:                                   | 3                | Reprod. s.d.:   | 0,020 mg/m <sup>3</sup> |
| Method:                                   | ISO 5725-2       | Rel.reprod. s.d.:   | 8,04%                   |
| Rel.target s.d.:                          | 10,00% (Limited) | Reference value:  | 0,256 mg/m <sup>3</sup> |
| Number of laboratories in calculation: 20 |                  | Range of tolerance: 0,200 - 0,300 mg/m <sup>3</sup> ( Z-Score  <= 2,00) |                         |

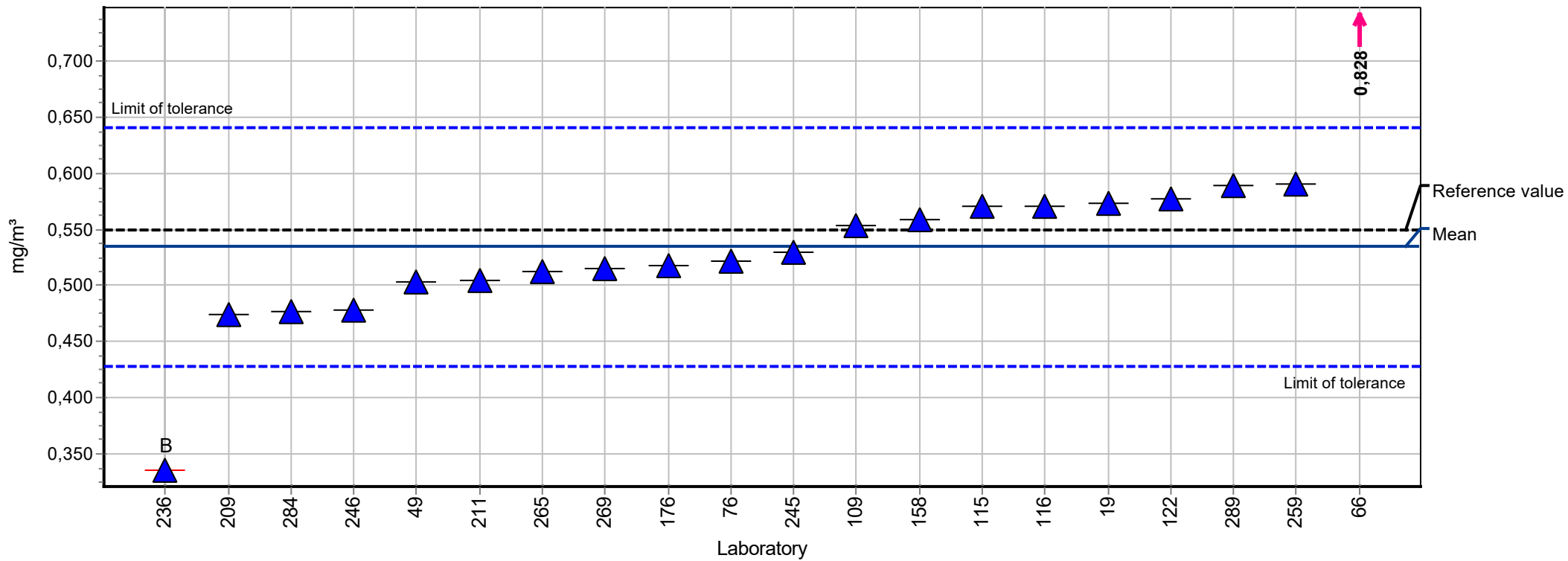




## Summary results

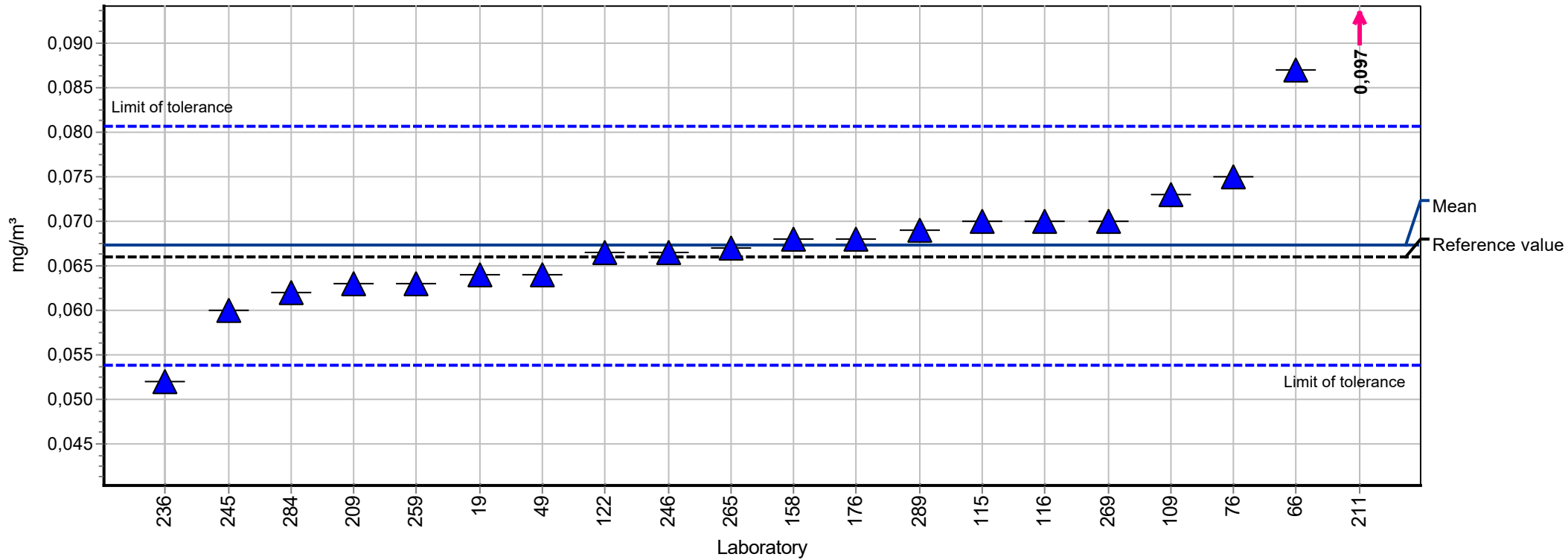
**Measurand:** Butyraldehyde    **Mean:** 0,534 mg/m<sup>3</sup>  
**Sample:** 3    **Reprod. s.d.:** 0,039 mg/m<sup>3</sup>  
**Method:** ISO 5725-2    **Rel.reprod. s.d.:** 7,38%  
**Rel.target s.d.:** 10,00% (Limited)    **Reference value:** 0,550 mg/m<sup>3</sup>

**Number of laboratories in calculation + outliers:** 20    **Range of tolerance:** 0,427 - 0,641 mg/m<sup>3</sup> (|Z-Score| <= 2,00)



## Summary results

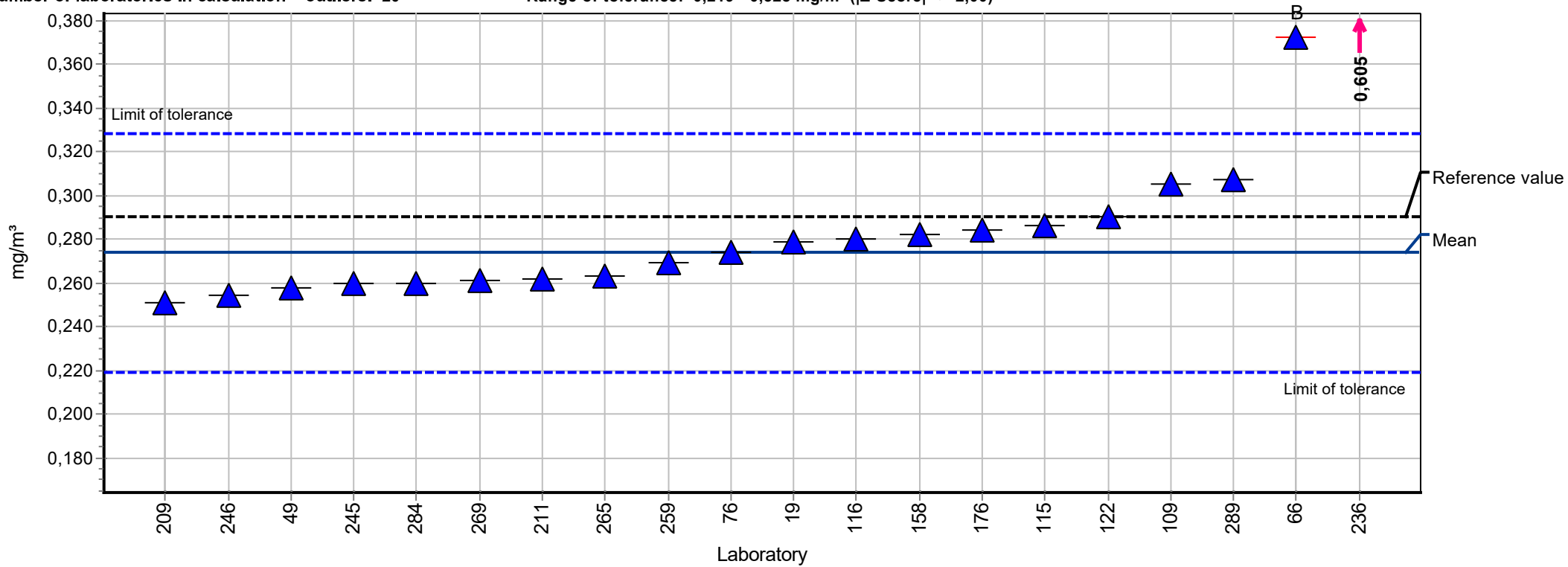
|   |                  |   |                         |
|---|------------------|---|-------------------------|
| Measurand:                                | Formaldehyde     | Mean:   | 0,067 mg/m <sup>3</sup> |
| Sample:                                   | 3                | Reprod. s.d.:   | 0,007 mg/m <sup>3</sup> |
| Method:                                   | ISO 5725-2       | Rel.reprod. s.d.:   | 10,40%                  |
| Rel.target s.d.:                          | 10,00% (Limited) | Reference value:  | 0,066 mg/m <sup>3</sup> |
| Number of laboratories in calculation: 19 |                  | Range of tolerance: 0,054 - 0,081 mg/m <sup>3</sup> ( Z-Score  <= 2,00) |                         |



## Summary results

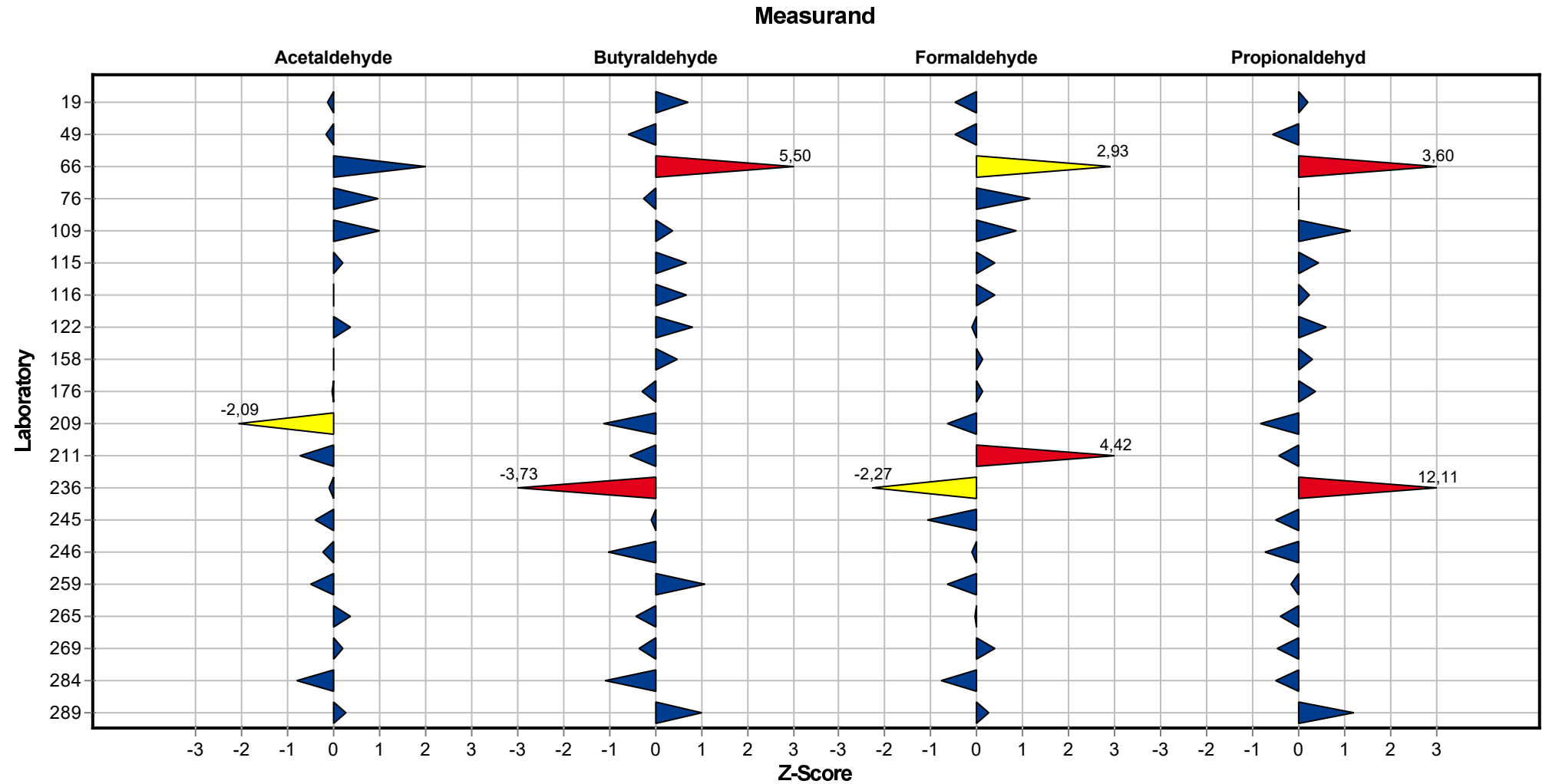
|                  |                  |                   |                         |
|------------------|------------------|-------------------|-------------------------|
| Measurand:       | Propionaldehyd   | Mean:             | 0,274 mg/m <sup>3</sup> |
| Sample:          | 3                | Reprod. s.d.:     | 0,017 mg/m <sup>3</sup> |
| Method:          | ISO 5725-2       | Rel.reprod. s.d.: | 6,08%                   |
| Rel.target s.d.: | 10,00% (Limited) | Reference value:  | 0,290 mg/m <sup>3</sup> |

Number of laboratories in calculation + outliers: 20      Range of tolerance: 0,219 - 0,328 mg/m<sup>3</sup> (|Z-Score| <= 2,00)



# Sample chart of Z-scores

Sample 3



## Questions and Answers

| Participant | Type of sample carrier            | Sampling pump                          | Volume flow                     |
|-------------|-----------------------------------|--|---------------------------------|
| 19          |                                   |  |                                 |
| 49          | Supelco LpDNPH S10 Cartridge 3 ml | DuPont P2500B                          | ca. 1,2 l/min und ca. 1,4 l/min |
| 66          |                                   |  |                                 |
| 76          | DNPH-Kartuschen Waters Sep-Pak    | Gilian LFS 113                         | 0,25 l/min bzw . 0,1 l/min      |
| 109         | Supelco LpDNPH S10                | Gilian Gilair Plus                     | 0,4 Liter/Minute                |
| 115         | S10X LpDNPH                       | Gil Air Plus                           | 330 ml/min                      |
| 116         |                                   | Lfs                                    | 0,33 L/min                      |
| 122         |                                   | GilAirPlus                             | 1.2l und 1l                     |
| 158         | Supelco LpDNPH S10 und H10        | GSA SG 4000 und GilAir Plus STP        | 0,5 l/min                       |
| 176         | Supelco LpDMPH S 10 Kartuschen    | KNF Laboport Mini-Laborpumpen N86KN.18 | 1.2 L/min                       |
| 209         | LpDNPH (Supelco)                  | Sensidyne GilAir Plus                  | ca. 1 L/Min                     |
| 211         | DNPH-Kartuschen (Fa. Supelco)     | Vacuum gas pump (Fa. VWR)              | 50 ml/min                       |
| 236         |                                   |  |                                 |
| 245         | Supelco Lp DNPH H10               | Gilian GilAir Plus                     | 0,333 l/min                     |
| 246         | Supelco LpDNPH S10                | KNF                                    | 1l/min                          |
| 259         | LpDNPH S10 Cartridge              | Gilian 5000, GilAir Plus               |                                 |
| 265         | Waters DNPH Kartuschen Shortbody  | BiVOC2V2                               | 1,0 L/min                       |
| 269         | LpDNPH S10 Supelco                | Dräger -x-act                          | 1 L/ min                        |
| 284         | Supelco LpDNPH S10                | Desaga GS 312                          | 1.0 L/Min                       |
| 289         | DNPH                              | Gilair Plus                            | 1 L/min                         |

| Participant | Volume flow measurement   | Sampling time     |
|-------------|---|-------------------|
| 49          | Thermisches Massendurchflussgerät GCM-B9EA-PN00, externer Druckminderer (Vögtlin) |                   |
| 76          | DryCal DC-Lite  | 120 - 127         |
| 109         | MesaLab Defender 530  | 113 Minuten       |
| 115         | TSI   | Laufzeit: 120 min |
| 116         | Bios Defender   |                   |
| 122         | Defender 520 M  | 60 min und 50 min |
| 158         | BIOS Defender 510   | 20 Min und 40 Min |

**Proficiency testing scheme Aldehydes with sampling 2/2021**

| Participant | Volume flow measurement                 | Sampling time         |
|-------------|---|-----------------------|
| 176         | Vögtlin Durchflussmesser GCM-B9SA-BN00  | 36 Min                |
| 209         | TSI Typ 4146                            | 32 Min                |
| 211         | Massendurchflussmesser (Fa. Analyt-MTC) | 10, 20, 30 Minuten    |
| 245         | TSI Model 4146                          |                       |
| 246         | Kalibrierte Gasuhr                      | 30 Minuten Probenahme |
| 265         | Gilian Gilibrator                       | 20 min                |
| 269         | Massenstromdurchflussmesser (Vögtlin)   | 30 min                |
| 284         | keines                                  | 30 min.               |
| 289         | Gilibrator                              | 60 bis 75 min.        |

| Participant | Analytical method  |
|-------------|--|
| 19          | IFA 6045:2007-11   |
| 49          | DIN ISO 16000-3: 2013-01   |
| 76          | IFA 6045   |
| 109         | IFA Arbeitsmappe 6045  |
| 115         | ISO 16000-3  |
| 116         | DIN ISO 16000-3  |
| 158         | Bestimmung als Derivate von 2,4-Dinitrophenylhydrazin (2,4-DNPH) mittels Hochleistungs Flüssigkeits-Chromatographie (HPLC) und UV-Absorption |
| 176         | ISO 16000-3, HPLC-UV   |
| 209         | Analog DIN ISO 16 000 – 3 : 2013-01.   |
| 211         | Hausprüfverfahren PV 250 Bestimmung der Konzentration an Formaldehyd und anderen Carbonyl-Verbindungen in Luftproben (HPLC)                  |
| 236         | interne SOP 81.40 angelehnt an NIOSH-Methode 2016  |
| 245         | in Anlehnung an IFA 6045   |
| 246         | DIN EN ISO 16000-3:2013-01   |
| 259         | DIN ISO 16000-3  |
| 265         | DIN ISO 16000-3  |
| 269         | IFA 7520   |
| 284         | DIN ISO 16000-3  |
| 289         | 16000-3  |

**Proficiency testing scheme Aldehydes with sampling 2/2021**

| Participant | Date start sample preparation | Storage time after desorption                | Date of analysis                |
|-------------|-------------------------------|--|---------------------------------|
| 19          |                               | Nein   | 19.11.2021                      |
| 49          | 19.11.2021                    | nein   | 19.11.2021                      |
| 76          | 25.11.2021                    | nein   | 25.11.2021                      |
| 109         | 22.11.2021                    | 4 Tage im Kühlschrank                        | 23.11.2021                      |
| 115         | 22.11.2021                    | Ja, ein Tag im Kühlschrank bei 4°C           | 29.11.2021                      |
| 116         | 22.11.2021                    |  |                                 |
| 122         |                               | ja, mittels Kühlelementen und im Kühlschrank | 08.12.2021 (Datum Laborbericht) |
| 158         | 18.11.2021                    | 1 Tag, Kühlzelle (4-7°C)                     | 19.11.2021                      |
| 176         | 19.11.2021                    |  | 19.11.2021                      |
| 209         | 26.11.2021                    | Kühlschrank, anschl. Expressversand          | 27.11.2021                      |
| 211         | 14.12.21                      | Nein   | 14.12.21                        |
| 236         |                               | ja, 5 Tage im Kühlschrank                    | 23.11.2021                      |
| 245         | 25.11.2021                    | 24h, Tiefkühlschrank, -26°C                  | 26.11.2021                      |
| 246         | 23.11.2021                    | Wurden direkt im Anschluss gemessen.         | 23.11.2021                      |
| 259         | 23.11.2021                    | nein   | 23.11.2021                      |
| 265         | 18.11.2021                    | Nein   | 18.11.2021                      |
| 269         | 23.11.2021                    | ja/ 6 Tage im Kühlschrank                    | 23.11.2021                      |
| 284         | 16.11.2021                    | Ja, gekühlt in der Kühlbox bis 24.11.2021    | 24.11.2021                      |
| 289         | 22.11.2021                    | 4h / 20°C                                    | 22.11.2021                      |

| Participant | Desorption solution                               | Volume of desorption solution |
|-------------|---|-------------------------------|
| 19          | Acetonitril                                       | 4,5                           |
| 49          | Acetonitril                                       | 3 ml                          |
| 76          | Acetonitril                                       | 10                            |
| 109         | Acetonitril                                       | 10                            |
| 115         | Mit Acetonitril eluiert, verdünnt mit DNPH-Lösung | 1 ml                          |
| 158         | Acetonitril                                       | auf 5 ml und auf 10 ml        |
| 176         | Acetonitril                                       | 5.0 mL                        |
| 209         | Acetonitril                                       | Keine Angaben vom Labor       |
| 211         | Acetonitril                                       | 10                            |
| 236         | Acetonitril                                       | 3 ml                          |
| 245         | Acetonitril                                       | 5                             |

**Proficiency testing scheme Aldehydes with sampling 2/2021**

| Participant | Desorption solution | Volume of desorption solution |
|-------------|---------------------|-------------------------------|
| 246         | Acetonitril         |                               |
| 259         | Acetonitril         | 2-10 ml                       |
| 265         | ACN                 | 2                             |
| 269         | ACN                 | 5                             |
| 284         | Acetonitril         | 5.0 mL                        |
| 289         | AcN                 | 3mL                           |

| Participant | Chromatography system   |
|-------------|---|
| 19          | HPLC-Pumpe Thermo Fischer LPG-3400SD, UV-Detektor mit Diodenarray Thermo Fischer DAD 3000, Fluoreszenz-Detektor, Thermo Fischer F |
| 49          | Agilent   |
| 76          | Agilent HPLC-System 1200SL (Bin Pump SL, DAD-SL, ALS-SL)  |
| 109         | Schimadzu LC20-AD, SPD-M20A   |
| 115         | Binäre Pumpe, DAD, HiP-Sampler alles von Agilent  |
| 158         | Agilent HPLC mit DAD-UV Detektor  |
| 176         | Thermo Fisher Scientific, Vanquish Horizon UPLC mit UV-Detektor   |
| 209         | Keine Angaben vom Labor   |
| 236         | Agilent Technologies Infinity 1260 mit DAD Detektor   |
| 245         | LC 2030 Pump, LC 2030/2040 PDA, LC 2050 Autosampler   |
| 259         | HP1090 DAD  |
| 265         | Shimadzu LC 20  |
| 284         | Thermo Fisher Scientific, Vanquish Horizon UPLC mit UV-Detektor   |
| 289         | DAD   |

| Participant | Refrigerated autosampler               | Analytical column                                      |
|-------------|--|--|
| 19          | HPLC Autosampler Thermo Fischer 3000SL | Trennsäule: Acclaim RSLC Carbonyl 2.1 x 100 mm, 2,2 µm |
| 49          | nein                                   | C 18, 150 x 4,6 mm, 5 mikro m                          |
| 76          | nein                                   | Gemini-NX 3µm C18, 150 x 3,00 mm Phenomenex            |
| 109         | ungekühlt                              | Kinetex RP18 5µm 100Å 250*4,6mm                        |
| 115         | nein                                   | Nucleodur C18 Isis 3 micrometer                        |
| 158         | nein                                   | Hypersil ODS 4.0 x 250 mm 5 Micron                     |



**Proficiency testing scheme Aldehydes with sampling 2/2021**

| Participant | Refrigerated autosampler      | Analytical column   |
|-------------|-------------------------------|---|
| 176         | ja, 20 °C                     | Dr.Maisch Grace Grom-Sil ods-5 (200 x 3.0 mm, 3.0 µm) Art. GSOD50312s2003 |
| 209         | Keine Angaben vom Labor       | Keine Angaben vom Labor   |
| 211         | Die Temperatur liegt bei 10°C | Acclaim Carbonyl C18 ThermoFisher Scientific                              |
| 236         | nein                          | Pursuit C18 100x2,0 mm 3µm  |
| 245         | 15°C                          | Hypersil ODS C18 5µm 250x3,0mm  |
| 259         | nein                          | Nucleosil 100-5 C18 AB 250 mm x 3.0 mm, 5µm                               |
| 265         | ja, 15 °C                     | Agilent Zorbax RRHD Eclipse Plus C18, 2,1x150 mm, 1,8 µm                  |
| 269         | nein                          |   |
| 284         | Ja 20°C                       | Dr.Maisch Grace Grom-Sil ods-5 (200 x 3.0 mm, 3.0 µm) Art. GSOD50312s2003 |
| 289         | nein                          | C18 reverse phase   |

| Participant | Mobile phase   | Flow rate HPLC          | Wavelength              |
|-------------|--|-------------------------|-------------------------|
| 19          | k. A.  | 1,0                     | 360                     |
| 49          | Wasser / Acetonitril   | 0,8 ml/min              | 370 nm                  |
| 76          | A: H2O B: Acetonitril : THF (80 : 20)  | 0,9                     | 365 nm                  |
| 109         | Acetonitril / Wasser (60:40)   | 1,00                    | 365 nm                  |
| 115         |  | 0.5 ml/min              | Sig = 365.4 Ref= 590.10 |
| 158         | von 60% Acetonitril bis 100% Acetonitril in 30 Min                             | 1,000 ml/min            | 360 nm                  |
| 176         |  | 0.500 mL/min            | 360.0 nm                |
| 209         | Keine Angaben vom Labor  | Keine Angaben vom Labor | Keine Angaben vom Labor |
| 211         | Wasser/Acetonitril   | 0,6 mL/min              | 360                     |
| 236         | Wasser/Acetonitril 40:60   | 0,2 ml/min              | 360 nm                  |
| 245         |  | 0,7                     | 365                     |
| 259         | Eluent A 100 % ACN, Eluent B 15%THF in Wasser, Gradient                        | 0,9 ml/min              | 365                     |
| 265         | Acetonitril / Wasser 45:55   | 0,25                    | 356 nm                  |
| 269         | Gradient (Wasser + ACN)  | 1ml / min               | 365                     |
| 284         | A: 60 % Acetonitril / 40 % Wasser (v/v) B: 95 % Acetonitril / 5 % Wasser (v/v) | 0.500 mL/min            | 360.0 nm                |
| 289         | AcN / H2O  | 1mL/min                 | 360 nm                  |

| Participant | Column temperature |
|-------------|--------------------|
|-------------|--------------------|

**Proficiency testing scheme Aldehydes with sampling 2/2021****Participant      Column temperature**

|     |                         |
|-----|-------------------------|
| 19  | k. A.                   |
| 49  | 30°C                    |
| 76  | 32 °C                   |
| 109 | 40 °C                   |
| 115 | 30°C                    |
| 158 | 30 °C                   |
| 176 | 40.0 °C                 |
| 209 | Keine Angaben vom Labor |
| 211 | 28°C                    |
| 236 | 33 Grad                 |
| 245 | 30°C                    |
| 259 | 42 °C                   |
| 265 | 45 °C                   |
| 269 | 20°C                    |
| 284 | 40.0 °C                 |
| 289 | 25°C                    |

**Participant      Calibration standard**

|     |  |
|-----|--|
| 19  | Einzelstandards  |
| 49  | Einzelstandards + Carbonyl - DNPH-MIX, Sigma-Aldrich CRM47672  |
| 76  | ERA-Mix, Lot FN01062011 (Cerilliant)   |
| 109 | Einzelstandards von SIGMA-ALDRICH  |
| 115 | Fertiger Mix Kalibration Accu Standard, Ktr Supelco  |
| 158 | NEOCHEM Fertiglösung, DNPH-Mix 13  |
| 176 | Fertiger Mix, Sigma-Aldrich, Art. CRM47285   |
| 209 | Fertiger Mix   |
| 211 | TO11/IP-6A Aldehyde/Ketone-DNPH Mix von Sigma Aldrich  |
| 236 | Standards w urden einzeln hergestellt.   |
| 245 | Kalibrierstandard: CAR-DNPH Accu STD LOT:219101001 Ex: 03,2029 Kontrollstandard: CARB Carbonyl-DNPH Mix 1 Lot: LRAC7522 Ex: 09,2 |
| 259 | Einzelsubstanzen   |
| 265 | Zugekaufter Standard von Restek  |
| 284 | Fertiger Mix, Sigma-Aldrich, Art. CRM47285   |

## Proficiency testing scheme Aldehydes with sampling 2/2021

---

| Participant | Calibration standard |
|-------------|----------------------|
|-------------|----------------------|

---

|     |  |
|-----|--|
| 289 | Standard für derivatisierte Carbonylverbindungen DNPH, TechLab, M-8315-R2-DNPH |
|-----|--|

---

| Participant | Recovery rate |
|-------------|---------------|
|-------------|---------------|

---

|     |   |
|-----|---|
| 19  | Ja  |
| 49  | nein  |
| 76  | nein  |
| 109 | nein  |
| 115 | nein  |
| 158 | Es wurden unabhängige Kontrollstandards verwendet.                      |
| 176 | Nicht anwendbar, da keine Wiederfindungsproben möglich über Kartuschen. |
| 209 | Keine Angaben vom Labor   |
| 211 | Nein  |
| 236 | nein  |
| 245 | Nein  |
| 259 | nein  |
| 265 | nein  |
| 269 | Ja  |
| 284 | Nicht anwendbar, da keine Wiederfindungsproben möglich über Kartuschen. |
| 289 | nein  |

---

| Participant | Comments |
|-------------|----------|
|-------------|----------|

---

|    |  |
|----|--|
| 49 | Vielen Dank für Ihre Hilfsbereitschaft, das Ausleihen der Schläuche und das nette uns sachliche Klima bei den Versuchen! |
| 76 | -  |

---