

## Information Sheet

### Gas Stack Emission Proficiency Test (Short Version)

#### 1. Location

Hessisches Landesamt für Naturschutz, Umwelt und Geologie  
(Hessian Agency for Nature Conservation, Environment and Geology)

Dezernat I3 – Luftreinhaltung: Emissionen  
(Department I3 – Air Pollution Control: Emission)

HLNUG – I3  
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**Please note:** The sampling takes place on the 1st and 3rd floor (rooms 130 and 373). There is no lift available for transporting the equipment.

#### 2. Contact

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#### 3. Participants

We designed the short version of the gas proficiency test for measuring institutes, industrial measuring centres, manufacturers of appliances etc. who are active in the field of stack emission measurements and want to check the quality of their measurements.

**Please note:** Due to the limited space available in the measuring room, only two people per participant can take part in the sampling without consultation with the organiser.

**Note for notified measuring bodies:** The short version of the gas proficiency test does not fulfil all the requirements of the LAI specifications and is not recognised within the meaning of §16 (4) 7a of the 41st BImSchV (Federal Immission Control Ordinance). Participation in the full version of the gas proficiency test is required to obtain or maintain a notification in accordance with §29b BImSchG (Federal Immission Control Act).

## 4. Task

The proficiency test programme simulates plants with predominantly time-varying operating conditions with regard to the emitted mass concentrations, on which at least six individual measurements must be carried out in accordance with “TA Luft” (Technical Instructions on Air Quality Control).

## 5. Carrying out the measurements

### 5.1 Measuring rooms and measuring cross-sections

The measuring rooms are located on the 1st and 3rd floors of the HLNUG building (rooms 130 and 371). All sampling ports there have an inlet section (vertical, straight inflow conduit) of at least 6.5 metres. Sampling ports of the following size (according to [DIN] ISO 228) and number are available for the proficiency test:

**Table 1:** Available sampling ports.

Floor	3" internal thread (G3)	2" internal thread (G2)
1st floor	8	4
3rd floor	6	7

The assignment of the measuring rooms and sampling ports is determined by the HLNUG staff on site. The sampling probes used by the participants must be matched to the inner diameter of the system of 40 cm.

If permanently installed automatic measuring equipment inside a vehicle is to be used during the proficiency test (instead of portable measuring devices at the ESA), HLNUG must be informed in advance. A sample gas line with a length of approx. 50 metres is required from the ESA to the vehicle.

### 5.2 Gas flow conditions

The ESA is operated in fresh air mode with preheating and, if necessary, humidification of the outside air. The system parameters are kept constant - as far as possible - during a measurement day. The gas flow conditions are selected in such a way that droplet formation in the chimney is excluded. During the proficiency test, the following gas flow conditions must be measured for each measurement day in compliance with [DIN] EN 15259:

**Table 2:** Value ranges for gas flow conditions and specified rounding of measured values.

No. (k)	Component	Value range	Criterion for performance evaluation $\sigma_k$	Decimal places
R1	Volume flow	2000 - 6000 m <sup>3</sup> /h (sc, dry)	140 m <sup>3</sup> /h (sc, dry)	0
R2	Mean flow velocity	4 - 15 m/s (oc, wet)	0.30 m/s (oc, wet)	2
R3	Temperature	20 - 50 °C	0,9 °C	1
R4	Water vapour concentration	0 - 50 g/m <sup>3</sup> (sc, dry)	0.74 g/m <sup>3</sup> (sc, dry)	2
R5	Static pressure	0 - 10 hPa	0.21 hPa	2

sc, dry: standard conditions, dry; oc, wet: operating conditions, wet

When measuring the gas flow conditions, the participants must apply the measurement methods they normally use on comparable installations. The measurement of the gas flow conditions takes place on each proficiency test day under different operating conditions.

Discontinuous water vapour determination in accordance with [DIN] EN 14790 can be carried out on each measurement day during measurement no. 1, in parallel with the other sampling procedures.

#### 5.4 Carrying out the sampling

- 7 individual measurements are carried out for each component. The first measurement is carried out without dosing pollutants and is used to measure blank values. Discontinuous water vapor determination in accordance with [DIN] EN 14790 can also be carried out during this introductory measurement.
- The participants must carry out the sampling with their own measuring equipment.
- Sampling takes place simultaneously for all participants. The components are determined in accordance with [DIN] EN 15259 and the following measurement methods:

**Table 3:** Measurement methods and concentration ranges for gaseous substances.

No. (k)	Component	Compulsory method	Concentration range [mg/m <sup>3</sup> ]	Criterion for performance evaluation $\sigma_k$ in %
G1	NO <sub>x</sub> as NO <sub>2</sub>	[DIN] EN 14792	60 to 450 (relating to NO <sub>2</sub> )	3,1
G2	CO	[DIN] EN 15058	10 to 100	3,6
G3	TOC	[DIN] EN 12619	4 to 100	3,3
G4	SO <sub>2</sub>	[DIN] EN 14791	20 to 150	3,4
G5	Formaldehyde	VDI 3862 Part 2, 3, or 4	2 to 20	3,6
G6	Ethylbenzene	[DIN] CEN/TS 13649	1 to 40	4,1
G7	Toluene	[DIN] CEN/TS 13649	1 to 40	4,1
G8	Xylene (sum of isomers)	[DIN] CEN/TS 13649	1 to 40 (individual isomers and sum)	4,1

- The procedures used by the participant in the proficiency test must correspond as far as possible to the standard procedures routinely used on comparable real stacks.
- The sampling time or integration time is 30 minutes for all measurements.
- The xylene isomers (*o*-, *m*- and *p*-xylene) are determined as a sum.

#### 6. Submission of results

All measurement results for components G1-G8 must be stated in relation to standard conditions, dry (273.15 K and 1013.25 hPa). The concentrations must be stated in mg/m<sup>3</sup> and with two decimal places.

The measurement results for the gas flow conditions shall be reported in the units and rounded to the number of decimal places specified in Table 2.

The measurement results must be submitted to HLNUG no later than four weeks after the last day of the proficiency test. Results submitted later will not be considered unless HLNUG is responsible for the late receipt.

The measurement results are sent by e-mail to the following address:

pt@hlnug.hessen.de

The measured values are to be entered in an Excel file, which can be downloaded from the HLNUG website at:

<https://pt.hlnug.de>

Each participant can only submit one result per measurement and component. The measured values submitted by the participants are checked for plausibility by HLNUG using the data collected during the proficiency test. If this plausibility check raises doubts about the standard-compliant determination of measured values, the participant concerned will be asked to explain how the results were determined. If, upon request, a participant is unable to reconcile the measurement results submitted by it with other records of the proficiency test in a comprehensible and standard-compliant manner, the components concerned will be rejected and receive in deviation from point 8 the remark "not evaluated". In this case, a corresponding note will be added to the communication of results. An exchange of results among participants before the deadline for submission of the measurement results or other collusive behaviour is not permitted. In the event of a violation of this regulation, all affected components will be assessed as "not evaluated" and a corresponding note will be added to the communication of results.

## 7. Evaluation of the individual measurements

### 7.1 Basics of the calculation of results

The proficiency test is evaluated in the form of z-scores and class numbers. Before z-scores are calculated, the assigned values are rounded to the same number of decimal places as the measured values to be submitted by the participants. No rounding is performed when calculating z-scores and their mean values. However, the numerical values are rounded in results notifications and reports.

For the uncertainty  $u_k$  of the assigned values, the following condition must be met with regard to  $\sigma_k$ :

$$\sigma_k \geq 3 \cdot u_k$$

If the relative uncertainty of the assigned value in a proficiency test is greater than the permissible value, the criterion for proficiency assessment for the component concerned is adjusted in accordance with VDI 4221 Part 2. The criterion is adjusted to the next higher value with the same number of decimal places (1 for G1-G8; for R1-R5 see Table 2) that fulfils the requirements of the standard. Participants will be informed of this increase at the latest with the results notification.

To assess the results of the individual measurements for components G1-G8, a z-score value  $z_{ijk}$  is calculated for the  $i$ -th measured value of the  $j$ -th concentration level of the  $k$ -th component  $x_{ijk}$ :

$$z_{ijk} = \frac{x_{ijk} - X_{ijk}}{\sigma_k \cdot X_{ijk}}$$

Here  $X_{ijk}$  is the assigned value of the corresponding measurement and  $\sigma_k$  is the criterion for proficiency assessment. The assigned value is derived from the measurement data of the dosing system and the volume flow.

The measurement results of the two introductory measurements (the first measurement on each proficiency test day), during which no dosing takes place, are not evaluated.

## 7.2 Gas flow conditions

To evaluate the measurement results for the gas flow conditions (components R1-R5), a z-score value  $z_{ik}$  is calculated for the  $i$ -th measured value of the  $k$ -th component  $x_{ik}$ :

$$z_{ik} = \frac{x_{ik} - X_{ik}}{\sigma_k}$$

Here  $X_{ik}$  is the assigned value of the corresponding measurement and  $\sigma_k$  is the criterion for proficiency assessment. The assigned value is determined by HLNUG's continuous measurement devices.

## 7.3 Interpretation of the z-score values

The following scheme applies to the interpretation of all z-score values determined:

$ z_{ijk}  \leq 2$	satisfactory performance (no signal)
$2 <  z_{ijk}  < 3$	questionable performance (warning signal)
$ z_{ijk}  \geq 3$	unsatisfactory performance (action signal)

In general, a root cause analysis should be carried out for every result with a z-score of more than two.

## 8. Evaluation of the components

### 8.1 Gaseous components

For the evaluation of a component, the amounts of the z-scores of the  $n$  results of a concentration level (usually is  $n = 2$ ) of a component are averaged:

$$z_{jk} = \sum_{i=1}^n \frac{|z_{ijk}|}{n}$$

and, depending on this mean z-score, each concentration level is assigned a class number  $K_{jk}$  according to the following scheme:

$$\begin{array}{ll} z_{jk} \leq 2 & \text{results: } K_{jk} = 1 \\ 2 < z_{jk} < 3 & \text{results: } K_{jk} = 2 \\ z_{jk} \geq 3 & \text{results: } K_{jk} = 3 \end{array}$$

For the assignment to concentration levels, the 6 evaluated measurements are sorted according to their assigned value and 2 consecutive values are assigned to a concentration level.

In the next step, for each component  $k$ , the sum of the class numbers  $K_k$  over all  $m$  concentration levels (usually is  $m = 3$ ) is formed:

$$K_k = \sum_{j=1}^m K_{jk}$$

A component has been successfully determined if the corresponding sum of the class numbers is less than or equal to 6. In this case, the participant receives a "passed" rating for the component. If the class total exceeds the permitted value, the participant receives the grade "failed".

If only measured values for two concentration levels are submitted, the component is deemed to have "passed" if the sum of the class numbers is a maximum of 4. If only measured values for one concentration level are submitted, the component is deemed to have been "passed" if the associated class number is a maximum of 2. If no measured values are submitted, the component is marked as "no participation".

## 8.2 Gas flow conditions

For the gas flow conditions, two measured values per component are submitted and evaluated in the gas proficiency test. The interpretation of the z-score values described above applies. In the gas proficiency test, the amounts of the z-scores of the  $n$  results (usually is  $n = 2$ ) of a component are averaged:

$$z_k = \sum_{i=1}^n \frac{|z_{ik}|}{n}$$

The respective component is assessed as "passed" if the condition

$$z_k < 3$$

is fulfilled, otherwise the component is assessed as "failed". If no measured values were submitted, the component is marked as "no participation".

## 9. Overall evaluation of the proficiency test

There is no overall evaluation for this proficiency test. Please note that the short version of the gas stack emission proficiency test does not fulfil all requirements of the LAI specifications for proficiency tests (as of May 2019) and is not acclaimed according to §16 (4) 7a of

the 41st BImSchV. Participation in the full version of the gas proficiency test is required to obtain or maintain a notification in accordance with §29b BImSchG.

## 10. Notification of results

The results are communicated in the form of an overall summary no later than 6 weeks after the deadline for submission of the participants' results. The personnel involved in the measurements and sampling at the ESA will be named in the notification of results.

In addition, the results of a year's proficiency tests are summarised in a report, whereby the participants are pseudonymised.

## 11. Objections and complaints

Objections and complaints should be addressed to the organiser of the proficiency testing scheme. Various aspects of the proficiency test programme can be subcontracted on a temporary basis. In the case of subcontracting, this is done to a competent subcontractor for whose work HLNUG is responsible. The objection deadlines are regulated in the respective notifications and communications.

## 12. Costs

The participation fee (**3250 €**) is charged in accordance with the currently valid administrative cost regulations (Verwaltungskostenordnung) for the division of the Hessian Ministry of Agriculture and Environment, Viticulture, Forestry, Hunting and Community (Hessisches Ministerium für Landwirtschaft und Umwelt, Weinbau, Forsten, Jagd und Heimat; VwKostO-MLU, for the full text see: [www.rv.hessenrecht.hessen.de](http://www.rv.hessenrecht.hessen.de)). Upon confirmation of your participation, you will receive a notification of prepayment, payable before the start of the proficiency test. If a short-term cancellation of the proficiency test by HLNUG should be necessary for important reasons (e.g. facilities or personnel shortage, etc.), the prospective proficiency test participant has no claim to compensation except reimbursement of the participation fee.

### 13. Timetable

Below you can find the schedule for the proficiency test. One of the prerequisites for adherence to the specified times is that the measurements are carried out quickly and smoothly by the participants. Therefore, the organisers cannot guarantee that the times will be adhered to. Depending on the actual progress of the individual points, there may be delays in the schedule. In the event of wilful disruption of the schedule by individual participants, they may be excluded from the proficiency test.

## Timetable gas proficiency test (short version)

### Day 1

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- from 08:00** Arrival and setting up the measuring instruments
- 09:00** Pre-meeting (**room 258**, one person per measuring institute)
- 09:30** **1st floor: measurement of gas flow conditions**; 3rd floor: preparations
- 10:30** 1st floor: preparations; **3rd floor: measurement of gas flow conditions**
- 11:30** Lunch break (*can be omitted on request*)
- 12:00** Measurements 1 to 7: **SO<sub>2</sub>, TOC, organic solvents (ETX)**
- 17:30** End of the measuring day

### Day 2

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- 08:00** 1st floor: preparations; **3rd floor: measurement of gas flow conditions**
- 08:45** **1st floor: measurement of gas flow conditions**; 3rd floor: preparations
- 09:30** Measurements 1 to 4: **NO<sub>x</sub>, CO, formaldehyde**
- 12:30** Lunch break (*can be omitted on request*)
- 13:00** Measurements 5 to 7: **NO<sub>x</sub>, CO, formaldehyde**
- 15:30** Removal of the measuring instruments, departure of the participants.
- 16:30** End of the proficiency test