

Information Sheet

Dust 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 – Luftreinhalteung: 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 dust 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 dust 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 dust 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. To carry out the proficiency test, sampling ports conforming to [DIN] ISO 228 (3“ internal thread (G3)) are available. 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.

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 the 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 1: Value ranges for gas flow conditions and specified rounding of the measured values.

| No. (k) | Component | Value range | Criterion for performance evaluation σ_k | Decimal places |
|---------|----------------------------|---|---|----------------|
| R1 | Volume flow | 2000 – 6000 m ³ /h (sc, dry) | 140 m ³ /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 ³ (sc, dry) | 0.74 g/m ³ (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.

5.3 Carrying out the samplings

- 7 individual measurements are carried out: One introductory measurement without dust dosing (which is not evaluated), followed by six measurements at different dust mass concentrations (which are evaluated).
- The participants in the proficiency test must carry out the sampling with their own measuring equipment.

- Sampling is carried out simultaneously by all participants, in accordance with [DIN] EN 15259 and conforming to the following standards:

Table 2: Measuring methods and concentration ranges for total dust and heavy metals

| No. (k) | Component | Compulsory method | Concentration range | criterion for performance evaluation σ_k in % |
|---------|------------|--|----------------------------|--|
| P1 | Total dust | [DIN] EN 13284-1 | 1 to 15 mg/m ³ | 7.0 |
| P2 | Cadmium | | 1 to 200 µg/m ³ | 10.0 |
| P3 | Cobalt | | 1 to 200 µg/m ³ | 10.0 |
| P4 | Chromium | [DIN] EN 14385 | 1 to 200 µg/m ³ | 10.0 |
| P5 | Copper | <i>Note: In deviation from the standard, participants may execute the sampling without the use of washing bottles.</i> | 1 to 200 µg/m ³ | 10.0 |
| P6 | Manganese | | 1 to 200 µg/m ³ | 10.0 |
| P7 | Nickel | | 1 to 200 µg/m ³ | 10.0 |
| P8 | Lead | | 1 to 200 µg/m ³ | 10.0 |
| P9 | Vanadium | | 1 to 200 µg/m ³ | 10.0 |

- The procedure used by the participant in the proficiency test must correspond as far as possible to the standard procedure routinely used at comparable real plants. For organisational reasons, only the following deviations are necessary or permissible:
 - No continuous measurement of the volume flow: This is kept constant and continuously monitored by the organizer.
 - Carrying out the grid measurement using the tangential method on two measuring axes: It is generally not possible to use the general method.
 - No use of washing bottles: Only dusts made of blast furnace slag doped with heavy metals (main components: SiO₂, Al₂O₃, Fe₂O₃, CaO, amorphous iron and alumina-silicates) are used. In case of sampling in conformity with the standards, due to the grain size distribution the heavy metal portions that can pass the filter are negligible compared to the portion retained by the filter.
- The duration of the individual measurements is 30 minutes, with an interruption after 15 minutes for changing the measuring axis.

6. Submission of results

All measurement results for dust and heavy metals shall be stated in relation to standard conditions, dry (273.15 K and 1013.25 hPa). Dust concentrations must be stated in mg/m³ and heavy metal concentrations in µg/m³. All values must be given 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 1.

The measurement results must be submitted to HLNUG no later than six weeks after the 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. 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", in deviation from section 8. In this case, 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 σ_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 P1-P9; for R1-R5 see table 1) 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 the components P1-P9, 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 measurement, and σ_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 result for the introductory measurement without dust dosing is 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_k is calculated for the measured value of the k -th component, x_k :

$$z_k = \frac{x_k - X_k}{\sigma_k}$$

Here X_k is the assigned value of the corresponding measurement and σ_k is the criterion for proficiency assessment (see table 1). 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 Dust and heavy metal 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:

| | |
|------------------|-----------------------|
| $z_{jk} \leq 2$ | results: $K_{jk} = 1$ |
| $2 < z_{jk} < 3$ | results: $K_{jk} = 2$ |
| $z_{jk} \geq 3$ | results: $K_{jk} = 3$ |

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, components are assessed as "passed" if the condition

$$|z_k| < 3$$

is fulfilled, otherwise the component is assessed as "failed". If no measured value was submitted, the component is indicated as "no participation".

9. Overall evaluation of the proficiency test

There is no overall evaluation for this proficiency test programme. Please note that the short version of the dust stack emission proficiency test does not fulfil all requirements of the LAI specifications for proficiency tests (status May 2019) and is not acclaimed according to §16 (4) 7a of the 41st BImSchV. Participation in the full version of the dust 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 complains

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 (2950 €) is charged in accordance with the currently valid administrative cost regulations (Verwaltungskostenordnung) for the division of the Hessian Ministry for

the Environment, Climate Protection, Agriculture, and Consumer Protection (Hessisches Ministerium für Umwelt, Klimaschutz, Landwirtschaft und Verbraucherschutz; VwKostO-MUKLV, for the full text see: 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 dust proficiency test (short version)

| | |
|-------------------|---|
| from 08:00 | Arrival and setup of the measuring instruments |
| 08:30 | Pre-meeting (room 258 , one person per laboratory) |
| 09:00 | 1st floor: measurement of gas flow conditions; 3rd floor: preparations |
| 10:00 | 1st floor: preparations; 3rd floor: measurement of gas flow conditions |
| 11:00 | Measurements 1 to 3 |
| 13:00 | Lunch break |
| 13:40 | Measurements 4 to 7 |
| 16:20 | Removal of the measuring instruments, departure of the participants |
| 17:00 | End of the proficiency test |