

Information sheet

Dust and gas stack emission proficiency tests (pandemic 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 of the HLNUG building.
A lift is not available.

2. Contact

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3. Participants

The pandemic version of the stack emission proficiency tests was designed for bodies according to §29b of the Federal Immission Control Act (BImSchG), as well as for applicants in the notification procedure according to BImSchG or 41st BImSchV (41st Federal Immission Control Ordinance).

A maximum of 2 laboratories can take part in the pandemic version of the dust and gas proficiency test at the same time. There is no limit to the number of persons per laboratory.

4. Task

The proficiency test programme simulates plants with predominantly time-varying operating conditions with regard to the emitted mass concentrations. The aim is to determine the mass concentrations of total dust and the heavy metals listed in Table 3, as

well as the gaseous substances in emissions listed in Table 4, using the overall procedure of sampling and analysis. Compared to the regular stack emission proficiency tests of the HLNUG, the following points were changed for the pandemic version:

- The hygiene concept of the HLNUG must be observed when carrying out the proficiency tests.
- Only two laboratories can take part in each proficiency test day, and each laboratory has its own measuring and common room.
- The limit on the number of persons per laboratory is waived.
- The number of measurements per component has been reduced to 3, all measurements take place on a single day for each participant.
- The measurements for the dust proficiency test are carried out in the morning and the measurements for the gas proficiency test in the afternoon.
- The component formaldehyde is not offered.
- Due to the numerous deviations from the LAI specifications, there is no overall evaluation of the results in relation to the 41st BImSchV.
- The theory test does not take place.
- No verification of the span gases is offered.
- No preliminary or final discussion takes place.

5. Performance of the measurements

During the entire proficiency test, the hygiene concept of the HLNUG (see information sheet "Hygiene concept proficiency tests") must be observed. Each participant will be allocated a separate sampling room with an associated common room for sole use during the proficiency test. The rooms of the other participant may not be entered.

5.1 Sampling rooms and sampling ports

The measurements take place on the 1st and the 3rd floor of the HLNUG building (room 130, and 371, respectively), approx. 5.0 and 12.5 m, respectively, above ground level and at the end of a 6.5/14 m long vertical flue duct. To carry out the proficiency test, sampling ports conforming to standard (DIN) ISO 228 are available in the following sizes:

Table 1: Available sampling ports.

floor	3" internal thread (G3)	2" internal thread (G2)
1 st floor	8	5
3 rd floor	6	7

The assignment of the sampling rooms is determined by the HLNUG staff. The sampling probes used by the participants must correspond to the inner diameter of the duct of 40 cm. During the proficiency test, the system operates with a flue gas velocity of > 4 m/s. If automatic measuring devices permanently installed in a measuring vehicle are used during the proficiency test, a measuring gas line with a length of approx. 50 m is required from the sampling port to the measuring vehicle.

5.2 Measurement of gas flow conditions

The ESA is operated in fresh air mode with preheating and, if necessary, humidification of the outside air. The volume flow is set in a range between 2000 and 6000 m³/h (standard conditions, dry). The gas flow conditions are selected in such a way that droplet formation in the stack is prevented. During the proficiency test, the following gas flow conditions are to be measured in compliance with (DIN) EN 15259:

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

No. (k)	component	value range	decimal places
R1	volume flow	2000 – 6000 m ³ /h (standard conditions, dry)	0
R2	mean flow velocity	4 – 15 m/s (operating conditions, wet)	2
R3	temperature	20 – 50 °C	1
R4	water vapour concentration	0 – 50 g/m ³ (standard conditions, dry)	2
R5	static pressure	0 – 10 hPa	2

When measuring the gas flow conditions, the participants shall apply the measurement procedures they normally use at comparable plants.

5.3 Performance of sampling: Dust

- Each participant shall determine the mass concentrations of particulate matter in accordance with (DIN) EN 15259 and the standards listed in Table 3. For the application of other sampling or analysis methods for participations in connection with the 41st BImSchV, proof of equivalence according to (DIN) EN 14793 must be provided.
- The participants in the proficiency test must carry out the sampling with their own measuring equipment.
- The sampling set-up shall be designed in such a way that sampling of flue gases with high water vapour contents is also possible.
- Three individual measurements are carried out at different dust mass concentrations.
- The duration of the individual measurements is 30 minutes, with an interruption after 15 minutes to change axes.

- Sampling takes place simultaneously for both participants. The following components are determined using the following measuring methods:

Table 3: Measurement methods and concentration ranges for total dust and heavy metals.

No. (k)	component	measuring method to be used	concentration range
P1	total dust	(DIN) EN 13284-1	1 - 15 mg/m ³
P2	Cadmium		1 - 200 µg/m ³
P3	Cobalt		1 - 200 µg/m ³
P4	Chromium	(DIN) EN 14385	1 - 200 µg/m ³
P5	Copper	<i>Note: In deviation from the standard, sampling can be performed without the use of wash bottles.</i>	1 - 200 µg/m ³
P6	Manganese		1 - 200 µg/m ³
P7	Nickel		1 - 200 µg/m ³
P8	Lead		1 - 200 µg/m ³
P9	Vanadium		1 - 200 µg/m ³

- The procedure used by the participant in the proficiency test must correspond as far as possible to the standard procedure used on comparable real plants. For organisational reasons, only the following deviations are necessary or permissible:
 - Waiver of continuous measurement of the volume flow: This is kept constant and continuously monitored by the organiser.
 - Carrying out the net measurement according to the tangential method on two measurement axes: The use of the general method is generally not possible.
 - Omission of wash bottles: Only dusts from blast furnace slag doped with heavy metals (main constituents: SiO₂, Al₂O₃, Fe₂O₃, CaO, amorphous iron and aluminosilicates) are used. Due to the particle size distribution, the filterable heavy metal fractions are negligible compared to the fraction retained by the filter when sampling is performed in conformity with the standard.

5.4 Performance of sampling: Gas

- Each participant shall carry out the determination of mass concentrations of gaseous substances in accordance with (DIN) EN 15259 and the standards and guidelines listed in Table 4. For the application of other sampling or analysis procedures in proficiency test participations in connection with the 41st BImSchV, proof of equivalence according to (DIN) EN 14793 must be provided.
- The participants in the proficiency test must carry out the sampling with their own measuring equipment.
- The sampling time or integration time for all measurements is 30 minutes.
- For each component, 3 measurements are carried out at different concentrations.

- Sampling takes place simultaneously for both participants. The following components are determined using the following measuring methods:

Table 4: Measurement methods and concentration ranges for gaseous components.

No. (k)	component	measuring method to be used	concentration range [mg/m ³]
G1	NO _x as NO ₂	(DIN) EN 14792	60 - 450 (referring to NO ₂)
G2	CO	(DIN) EN 15058	10 - 100
G3	TOC	(DIN) EN 12619	4 - 100
G4	SO ₂	(DIN) EN 14791	20 - 150
G5	(n/a)		
G6	ethyl benzene	(DIN) CEN/TS 13649	1 - 40
G7	toluene	(DIN) CEN/TS 13649	1 - 40
G8	xylene (sum of isomers)	(DIN) CEN/TS 13649	1 - 40 (applies to individual isomers and sum)

- The procedures used by the participant in the proficiency test must correspond as far as possible to the standard procedures used in comparable real plants.
- The xylene isomers (*o*-, *m*-, and *p*-xylene) are determined as a sum.

6. Result submission

All measurement results shall be reported referring to standard conditions, dry (273.15 K and 1013.25 hPa). Heavy metal concentrations shall be reported in µg/m³ and all other measurement results in mg/m³. All measured values for components P1-P9 and G1-G8 shall be indicated with two decimal places. The measurement results for the gas flow conditions R1-R5 shall be reported in the units specified in Table 2 and rounded to the number of decimal places specified therein.

The results of the proficiency test shall be sent by e-mail to the following address:

pt@hlnug.hessen.de

For this purpose, the measured values are to be entered into an Excel file, which is available for download on the HLNUG website under:

www.hlnug.de/?id=13375

Each participant may submit only one result per measurement and component. An exchange of results between the participants before the deadline for the submission of the measurement results is not permitted. In case of a violation of this rule, all components concerned will be assessed as "not evaluated" and the communication of assessment results will be marked accordingly.

All participants must submit their results to the HLNUG no later than six weeks after the respective proficiency test day. Results submitted later will not be considered for the

evaluation and the concerned components will be assessed as “failed” - unless HLNUG is responsible for the late receipt.

7. Assessment of the individual measurements

7.1 Basics of the calculation of assessment results

The performance of participants in the proficiency tests is assessed in terms of z-scores and class numbers. The assigned values are rounded to the same number of decimal places as the measurement values to be submitted by the participants. No rounding is performed when calculating z-scores and their mean values. However, in results communications and reports, the numerical values are presented rounded.

For the uncertainty u_k of the assigned values, the following condition must be fulfilled with regard to the criterion for proficiency assessment, σ_k :

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

If, in a proficiency test, the relative uncertainty of the assigned value is greater than the permissible value, the criterion for proficiency assessment for the component concerned shall be adjusted in accordance with guideline VDI 4221 part 2. In doing so, the criterion for proficiency assessment for components P1-P9 and G1-G8 is raised to the next higher value with one decimal place that meets the requirement of the standard. For component R1, the next higher integer value that meets the requirement of the guideline is chosen. The participants will be informed about this increase at the latest with the communication of assessment results.

To assess the results of the individual measurements for components P1-P9 and G1-G8, a z-score value z_{jk} is determined for the j^{th} measured value of the k^{th} component, x_{jk} :

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

Here X_{jk} is the assigned value of the corresponding 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.

7.2 Total dust and heavy metals

The criteria for proficiency assessment for total dust and the heavy metal components are as follows, provided that the uncertainty of the assigned value meets the above conditions:

Table 5: Assessment criteria for total dust and heavy metals.

No. (<i>k</i>)	component	criterion for proficiency assessment σ_k in %
P1	total dust	7.0
P2	Cadmium	10.0
P3	Cobalt	10.0
P4	Chromium	10.0
P5	Copper	10.0
P6	Manganese	10.0
P7	Nickel	10.0
P8	Lead	10.0
P9	Vanadium	10.0

7.3 Gaseous components

The criteria for proficiency assessment for gaseous components are as follows, provided that the uncertainty of the assigned value meets the above conditions:

Table 6: Assessment criteria for gaseous components.

No. (<i>k</i>)	component	criterion for proficiency assessment σ_k in %
G1	NO _x as NO ₂	3.1
G2	CO	3.6
G3	TOC	3.3
G4	SO ₂	3.4
G5	(<i>n/a</i>)	
G6	ethyl benzene	4.1
G7	toluene	4.1
G8	xylene (sum of isomers)	4.1

7.4 Gas flow conditions

A z-score value z_k is determined for the assessment of the measurement results for the volume flow (component R1):

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

Here, X_k is the assigned value of the measurement and σ_k is the criterion for proficiency assessment. The assigned value is determined by the continuous measurement devices of HLNUG. The criterion for proficiency assessment for component R1 is 140 m³/h (referring to standard conditions, dry), provided that the uncertainty of the assigned value meets the above conditions. No z-scores are calculated for components R2 to R5. Here, instead, the deviations of the participants' measured values from the assigned values are compared informatively with the usual standard deviation for these measurements. For this purpose, the quotient of the deviation of the participants' measurement values from the assigned values and the usual standard deviation for the measurement variable in question is calculated. The corresponding comparative values can be found in Table 7.

Table 7: Usual standard deviations for gas flow conditions.

No. (k)	component	usual standard deviation
R2	mean flow velocity	0.30 m/s (operating conditions, wet)
R3	temperature	0.9 °C
R4	water vapour concentration	0.74 g/m ³ (standard conditions, dry)
R5	static pressure	0.21 hPa

7.5 Interpretation of z-score values

After normalisation to the criteria for proficiency assessment, the following scheme applies to the interpretation of all z-score values determined:

$ z_{jk} \leq 2$	“satisfactory” performance
$2 < z_{jk} < 3$	“questionable” performance
$ z_{jk} \geq 3$	“unsatisfactory” performance

In general, any result with a z-score of more than two should have a root cause analysis.

8. Assessment of the components

8.1 Total dust and heavy metals as well as gaseous components

For the assessment of a component, the amounts of the z-scores of the 3 measurements are calculated and, depending on these amounts, class numbers K_{jk} are assigned according to the following scheme:

$ z_{jk} \leq 2$	yields: $K_{jk} = 1$
$2 < z_{jk} < 3$	yields: $K_{jk} = 2$
$ z_{jk} \geq 3$	yields: $K_{jk} = 3$

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

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

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 the assessment "passed" for the component. If the class sum exceeds the permissible value, the participant receives the assessment "failed".

If only measured values for two measurements are submitted, the component is considered "passed" if the sum of the class numbers is a maximum of 4. If only one measurement value is submitted, the component is considered "passed" if the class number obtained is a maximum of 2. If sampling or measurements have been carried out for a component, but no measured value has been submitted, the component is assessed as "failed". If the participant has completely refrained from sampling or measuring a component in the proficiency test, the respective component will be marked "no participation".

8.2 Gas flow conditions

For the gas flow conditions, only one measured value per component is submitted and assessed. The interpretation of the z-score values described above applies. The amount of the z-score is calculated. The component volume flow is 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 assessment of the proficiency test

There will be no overall assessment for the pandemic version of the stack emission proficiency tests. However, measuring bodies notified according to the German Federal Immission Control Act (§29b BImSchG) are obliged to report the results of the proficiency test to the respective competent federal state authority and to take appropriate quality assurance measures in the event of insufficient results. In this context, reference is made to §16 (4) No. 7a of the 41st BImSchV.

10. Communication of the assessment results

The communication of the assessment results to the participants in the proficiency test takes place in the form of an overall summary at the latest 6 weeks after the deadline for the submission of the participants' results. In this communication, the names of the personnel involved in the measurements and sampling at the ESA are mentioned. Reference is made to the obligation of the notified measuring bodies to directly inform the authority responsible for their notification of the proficiency test result (§16 (4) No. 7 of the 41st BImSchV).

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

11. Theory test

There is no written test in the pandemic version of the dust and gas stack emission proficiency tests.

12. Appeals and complaints

Appeals and complaints should be addressed to the organiser of the proficiency test if they relate to the invitation, the conduct of the proficiency test, the communication of the assessment results and the assessment results themselves. Various aspects of the proficiency testing scheme may be temporarily subcontracted. In case of subcontracting, this is done to a competent subcontractor for whose work HLNUG is responsible.

Objections and complaints must be addressed to the authority responsible for the notification under federal state law, provided they relate to measures derived from the assessment results (e.g. a request for repetition, revocation of notification, etc.).

The time limits for appeal are regulated in the respective notices and communications.

13. Costs

The participation fee is charged in accordance with the currently valid administrative costs regulations for the business area of the Hessian Ministry for the Environment, Climate Protection, Agriculture and Consumer Protection (HMUKLV, Hessisches Ministerium für Umwelt, Klimaschutz, Landwirtschaft und Verbraucherschutz).

14. Time schedule

On the following page you will find the time schedule for the proficiency test. A prerequisite for the adherence to the stated times is, among other things, a quick and smooth performance of the measurements by the participants in the proficiency test. Therefore, the organiser cannot guarantee that the times will be observed. Depending on the actual course of the performance of the individual items, there may be shifts in the schedule. In the event of wilful disruptions of the procedure by individual participants, they may be excluded from the proficiency test.

Time schedule stack emission proficiency tests dust and gas

(Pandemic version)

- From 08:00** Arrival of participants and set-up of measuring equipment
- 10:00** Start of the **dust proficiency test**: measurement of gas flow conditions.
(Note: The gas flow conditions will be kept constant throughout the day.)
- 10:30** Measurement of the components **total dust, Cd, Co, Cr, Cu, Mn, Ni, Pb** and **V**:
– **three** measurements (30 min each)
- 13:00** End of the dust proficiency test, lunch break
- 14:00** Start of the **gas proficiency test**: measurement of the components **SO₂, TOC, toluene, ethyl benzene, xylene, CO** and **NO_x**:
– **three** measurements (30 min each)
- 16:30** Removal of the measuring equipment, departure of the participants
- 18:00** End of the gas proficiency test