

**PHYSICAL METHOD**

**Assessment of free-floating dust and abrasion particles of treated seeds as a parameter of the quality of treated seeds**

**HEUBACH TEST**

**Authors: Euroseeds CSTP Working Group Dust**  
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## PHYSICAL METHOD

### Assessment of free-floating dust and abrasion particles of treated seeds as a parameter of the quality of treated seeds

#### HEUBACH TEST

##### 1. Scope

The method described is intended to assess the amount of free-floating dust and abrasion particles of treated seeds under defined mechanical stress conditions.

##### 2. Principle

Treated seeds are mechanically stressed inside a rotating drum. A vacuum pump creates an air flow through the rotating drum, the connected glass cylinder and the attached filter unit. By the air flow, abraded dust particles are transported out of the rotating drum through the glass cylinder and subsequently through the filter unit. Coarse non-floating particles are separated and collected in the glass cylinder while floating dust particles are deposited onto a filter. The amount of floating dust collected on the filter is determined gravimetrically.

##### 3. Apparatus

**3.1** Analytical balance (accuracy 0.1 mg). As the last digit of a scale carries a larger error it is mandatory to use a 5-decimal scale to achieve an accurate reading of the 4<sup>th</sup> decimal. Use of a receptor for filter housing is recommended on balance plateau to place the filter housing in the same position (larger opening on top). Such a receptor is commercially available for some scale brands (Mettler ErgoClip basket small). Otherwise a 3D print file for such receptor can be obtained from Euroseeds Technical Manager sustainable seed technologies.

**3.2** Heubach Dustmeter device (Heubach Dustmeter Type I (DIN 55992), Heubach DUSTMETER GmbH, Löwensternstraße 4, 5411 Oberalm, Austria)

3.2.1 Metal rotating drum

3.2.2 Glass cylinder

3.3.3 Aluminum or non-electrostatic filter housing with conditioned glass fiber filter disc (Whatman GF 92 or Macherey Nagel Type MN 85/70 BF, or equivalent specification).

3.3.4 Drive & control unit with touch screen control panel

**3.3** Constant climate chamber (e.g. Binder, KBF 720)

**3.4** Paper bags (not airtight)

**3.5** Air ionizer (e.g. Sartorius, STAT-FAN YIB-01, or PRX U field ionizer from Haug GmbH, Germany, or equivalent)

**3.6** Seed Counter (e.g. Pfeuffer, Contador or GTA Sensorik, Marvin, or equivalent)

##### 4. Sample

A sample must consist of at least 500 g +/- 5% of seeds taken from the seed flow in a representative manner, at best by automatic continuous sampling. The thousand seed weight (TSW) of the seeds must be known and registered. The sample can be split in two parts of 250 g each. In general seed sampling

must follow ISTA rules (<https://sampling-calculator.seedtest.org/>) especially for seeds not being processed.

## **5. Procedure**

### **5.1 Safety Advice**

This test is designed to potentially produce significant amounts of fine dust particles which are loaded with active ingredients (a.i.'s). Therefore, before performing this test it must be ensured that all measures are taken to prevent exposure of any personnel to dust liberated during the test (incl. preparation, cleaning procedure and disposal of any material). Special care must be taken that potentially polluted exhaust air does not harm people and environment.

In addition, technical personnel must be properly trained in the safe use of all equipment and must be instructed on possible hazards resulting from the test (see also note 8.5). Adequate protective equipment must be used in order to avoid exposure to dust.

### **5.2 Laboratory Conditions**

The test has to be performed in a laboratory (separated from the treating area) at 20°C to 25°C and 30% to 70% relative humidity which is free as possible of free floating dust particles. Any other testing which could interfere with the analytical scales (electrostatics, vibrations etc.) should be avoided.

### **5.3 Calibration**

No calibration is necessary before measurement. It is recommended that the air flow rate, time of measurements and rotational settings are checked on a routine basis (every 2-3 years) by the technical service of the manufacturer or an equivalent qualified technical service. If dust has been sucked by accident through the flow meter, it must be cleaned and a new calibration may be necessary.

### **5.4 Apparatus preparation**

During initial installation of the Heubach equipment make sure that the same is horizontally levelled.

After disconnecting the vacuum tube from the filter unit, the Heubach device is stepwise disassembled: the filter unit is removed and opened, the glass cylinder removed and finally the metal drum removed and opened.

Cleaning is a key step to prevent carry-over dust to the next test. Cleaning is routinely done using a vacuum cleaner with a pointed nozzle. (see 8.1). Vacuum from less contaminated to most contaminated elements: 1 Glass bottle set vertically, vacuum from bottom and alternate side, 2 Glass-drum connector, 3 filter housing both parts (outside and then inside), 4 O seal (rubber joint from filter housing), 5 table, 6 metallic lid, 7 large rubber joint, 8 metallic drum (vacuum all deflectors sides for 20 seconds in total), 9 use wet tissue to clean vacuum cleaner nozzle, 10 Use wet tissue to clean shovel and aluminum seed tray. Then change gloves before the next test.

Note: If the drum is either used for the first time in this test or has been cleaned with alcohol there is a need to run 2 cycles with treated seeds before starting the actual measurements on your samples. This ensures a constant occupancy of the pores in the metal surface.

Switch on the main power of the Heubach device min. 30 minutes before starting any measurement in order to allow proper warm-up of the flow meter. For setting the parameters on the control panel choose the program "User Method" in which the parameters are manually set to the values given in 6.2. It is recommended to set the parameters after full assembly of the device.

## 5.5 Sample Preparation

Prior to testing, seed samples have to be stored in a constant climate chamber for at least 48 hours (2 days) at  $20^{\circ}\text{C} \pm 2^{\circ}\text{C}$  and at  $50\% \pm 10\%$  relative humidity. To allow equilibration, seeds must be kept in paper bags (not airtight) when entering the climate chamber.

For obtaining a working sample a soft method should be used to reduce the submitted sample in size to the size needed for the test. This to avoid damage to the treated seed which could lead to artificially enhanced dust levels. Examples of a soft methods are the modified halving method, the spoon method and the hand halving method described in the ISTA Rules.

## 5.6 Measurement

Place a glass fiber filter disc in the filter unit according to the description in the manual. For equilibration with the laboratory conditions, the filter discs will be stored in an open box next to the Heubach device. In order to prevent effects resulting from electrostatic charging, ensure sufficient time for use of air ionizer before introducing filter unit in the scale. The filter unit including the filter disc is weighed (weight filter assembly  $w_0$  [g]; accuracy: 0.1 mg; see note 3.1). Carry filter unit in an aluminum tray.

Carefully transfer (avoid dust)  $100 \pm 1$  grams of the conditioned seeds (weight seeds  $w_s$  [g]; accuracy: 0.01 gram) into the metal drum of the Heubach device, then correctly close and reassemble the drum and connect the glass cylinder. The system has to be leveled perfectly horizontally and no obstruction of the rotating parts and of the internal or external airflow must take place.

The time for transferring and analyzing the sample is to be kept as short as possible in order to avoid a change in its relative humidity. A contamination with non-seed dust particles must be excluded. Use aluminum tray for carrying seeds from paper bag to metal drum.

Place filter unit on the glass cylinder and connect to the vacuum tube.

On the control panel pre-select the "time" option. Start the rotation cycle by pressing "I" on the control panel. After completion of the run, the rotation must have fully stopped before any parts of the apparatus may be disassembled. Remove the filter unit including the filter disc carefully from the glass cylinder and weigh it in the same manner as described before (weight filter assembly  $w_1$  [g]; accuracy: 0.1 mg).

If significant amounts of dust have passed *through* the filter disc (by visible inspection), the test must be stopped immediately and the filter unit checked for incorrect assembly or damages. If necessary, it has to be replaced and the test has to be repeated.

The test has to be performed twice. After each measurement, the apparatus must be cleaned as described in section 5.4.

If the rotation speed (rpm) displayed on the control panel during the measurement deviates more than  $\pm 10\%$  from the pre-set value or if the total air volume sampled during the measurement deviates more than  $\pm 10\%$  from the expected volume of 40 L (20 L/min for 2 min) the measurement has to be redone.

As a back-up control for the air volume a separate flow-meter [e.g. DFM Typ SVB (Uniflux  $\frac{1}{4}$ )] from VAF-Fluid-Technik GmbH, Germany; [www.vaf-fluidtechnik.de](http://www.vaf-fluidtechnik.de)] can be inserted in the plastic air hose, as shown in Appendix 6.

## 5.7 Evaluation and Calculation of Results

The Heubach dust value is expressed in g / 100 kg of treated seeds. Depending on requirements and seed type tested, the result can be also expressed in g / 100.000 kernels, taking into account the Thousand

Seed Weight (TSW) of the tested sample.

Use the following formula to convert the measured result to the Heubach dust value:

$$\text{Heubach dust value} = \frac{(W_1 - W_0) \cdot 100.000}{W_s} \text{ [g / 100 kg]}$$

or alternatively expressed in g / 100.000 kernels:

$$\text{Heubach dust value} = \frac{(W_1 - W_0) \cdot 100 \cdot \text{TSW}}{W_s} \text{ [g / 100.000 kernels]}$$

where:

$W_1$  = weight of the loaded filter unit incl. filter disc [g]

$W_0$  = weight of the empty filter unit incl. filter disc [g]

$W_s$  = weight of the treated seeds [g]

100.000 = conversion factor a [ ]

100 = conversion factor b [ ]

TSW = Thousand Seed Weight [g / 1000 kernels]

The final result is the mean of the two measurements. If a threshold value is defined the test must be repeated if one test result is higher than 50% of the threshold value and if the two test results differ more than 20% from the higher value. In case of experimental or voluntarily purposes without a mandated threshold value (e.g. small seeded crops) the test must be repeated if the two test results differ more than 20% and at least one test result exceeds 1 g/100 kg. If both test results are below 1 g/100 kg and the two results differ more than 0.2 g the test must be repeated.

## 6. Results

### 6.1 Results from the measurement

Heubach dust value = \*\*\* [g / 100 kg] or

Heubach dust value = \*\*\* [g / 100.000 kernels]

### 6.2 Parameter settings

Rotation speed = 30 [rpm]

Rotation time = 120 [seconds]

Airflow rate = 20 [liters per minute]

Pre-Selection: set to "time"; set to "rotation speed"; set to "airflow rate".

### 6.3 Accuracy and Measurement Errors

The measurement accuracy can be strongly influenced by electrostatic charging, contamination with non-seed dust and absorption of humidity from the air. In addition, loose dust particles which are already

contained in the seed sample can strongly affect the result.

## 7. Analysis report

The minimum requirements to report in the analysis report are:

- Name and coordinates of the laboratory
- Reference number of the sample
- Date of receipt/arrival of the sample in the laboratory
- Date of analysis
- Date of issuance of the analysis report
  - condition (packaging, i.e. sample not tightly packed or damaged)
- Results as described in 6.1
- Limit of quantification and date of limit of quantification test
- Signature or electronic validation by responsible person of the laboratory

The analysis report has to be released.

## 8. Competency test (to be enforced from July 2026)

Once a year, limit of quantification test must be conducted by each laboratory as described in appendix 7. A spreadsheet is attached for automated calculation of limit of quantification. Negative weight differences and outliers according to Z-score will be removed before calculation of limit of quantification. A minimum of 12 values (without negative weight differences and outliers) is necessary to assess the limit of quantification.

From July 2026, maximum limit of quantification target is 1.5 g/100 kg seeds. 41 laboratories participated in a limit of quantification test in January 2026. All changes in the method couldn't be implemented by all laboratories. However, the interim maximum limit of quantification target of 1.5 g/100 kg is aligned with results from this first test. A second limit of quantification test will be arranged in second quarter 2026. Results from second test in 2026 will be used to set maximum acceptable limit of quantification from July 2027.

In case limit of quantification result is above maximum acceptable limit (target from July 2026 1.5 g/100 kg), more attention must be provided to cleaning steps in particular vacuum cleaner hose. Limit of quantification test could be repeated with improved cleaning. There is a further option to repeat limit of quantification but implementing an additional step. It has been demonstrated that a great improvement is obtained when a blank cycle is operated with the filter housing mounted with the new filter (filter conditioning step see appendix 8). Therefore this option requires after cleaning all parts to run a cycle without seeds and filter housing with a new filter. But the filter housing is weighed only after this run, then a blank run is conducted keeping the same filter in filter housing. Filter housing is weighed again after this blank run. However this procedure with filter conditioning cycle would need to be followed then for the full year with all samples, if only this option allows to get limit of quantification below maximum acceptable limit (target from July 2026 1.5 g/100 kg).

## 9. Notes

**9.1** The vacuum cleaner must qualify for the safe use with hazardous chemicals (especially hazardous dust particles, e.g. Kärcher Nt 30/1 Tact Te H ACD).

**9.2** The handling of the filter unit during assembly and weighing should always be done wearing laboratory gloves (e.g. nitrile type) to avoid grease depositions from hands which would affect the weight.

**9.3** Warning: the seeds you are working with are treated with active ingredients. Always wear adequate Personal Protective Equipment (PPE). Please take the necessary actions which are determined by your local laws to work with these type of products. For the disposal of the seeds and other contaminated materials check the local requirements by law.

**9.4** Method extension: In case the content of active ingredient(s) in the floating dust should be determined this is possible by appropriate extraction of the filter disc and filter housing and subsequent chemical analysis (e.g. HPLC) using an appropriate analytical method. Such analytical method(s) which has to be developed and validated in accordance with valid guidelines are specific for one or several active ingredient(s) and can not be described in frame of this method.

**9.5** Material Safety Data Sheets for each product used in the test item (treated seeds) must be available at the test location and must be consulted before any test. Furthermore, safety requirements concerning exposure to dust must be strictly observed.

## **10. LITERATURE**

Manual to the Heubach device (“Dustmeter Instruction Manual”)

## **11. APPENDICES**

Appendix 1	Heubach Dustmeter Device (Overview)
Appendix 2	Analytical Balance and receptors for filter housing
Appendix 3	Touch-screen Panel and Rotating Drum
Appendix 4	Aluminum Filter housing
Appendix 5	Examples for Deposited Abraded Dust External flow-meter
Appendix 6	External Flow meter
Appendix 7	Limit of quantification test
Appendix 8	Additional step: filter conditioning figure

## Appendix 1: Heubach Dustmeter Device (Overview)



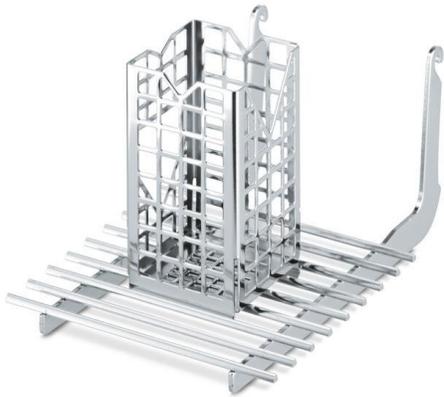
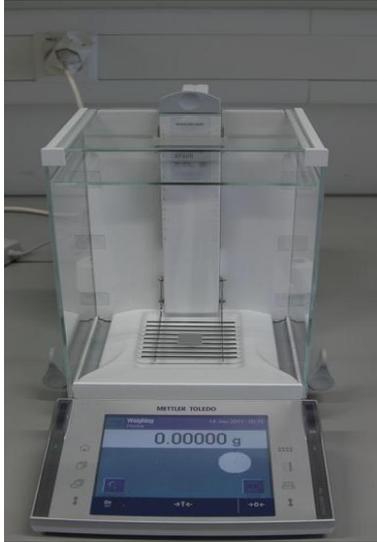
Drive & control unit

Rotating drum

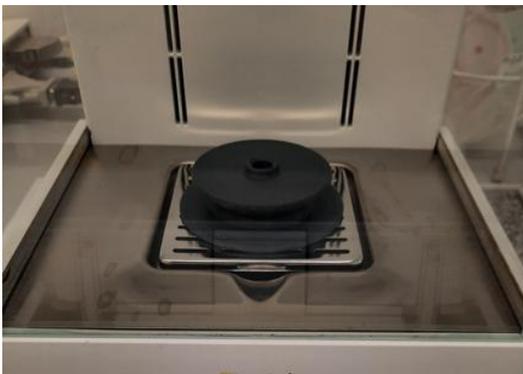
Glass cylinder

Filter unit

## Appendix 2: Analytical Balance and Receptors for filter housing



Mettler ErgoClip basket small



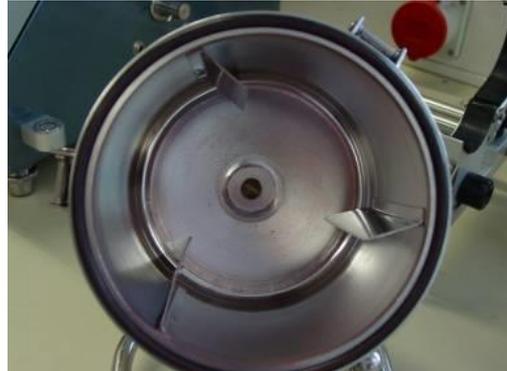
Receptor

### Appendix 3: Touch-screen Panel and Rotating Drum



Touch-screen for parameter setting:

- Rotation speed (rpm)
- Airflow (L/min)



Rotating drum for seed

#### Appendix 4: Aluminum Filter housing



Filter Unit (open, without filter disc)



Filter Unit (open, with filter disc and O-seal)

### Appendix 5: Examples for Deposited Abraded Dust

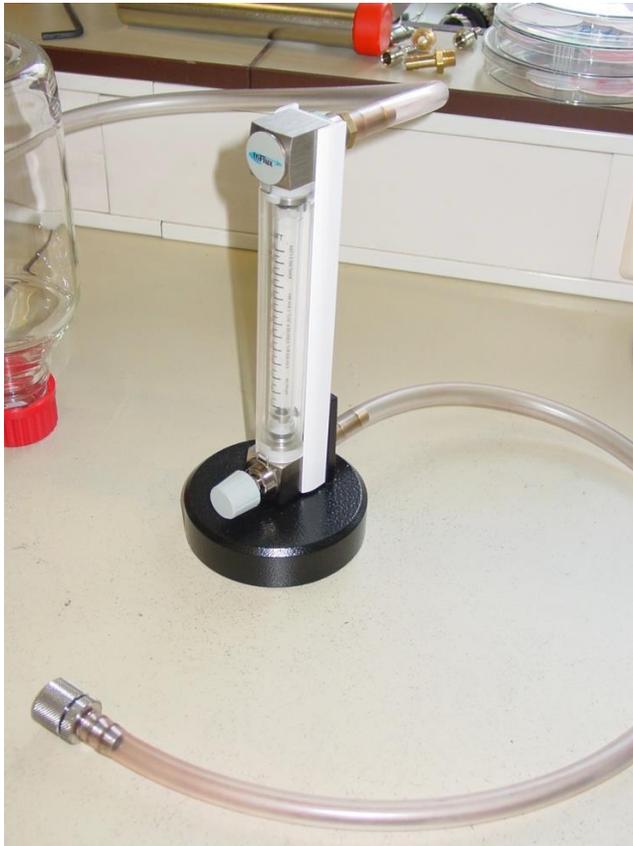


Little Dust



Higher Amount of Dust

### Appendix 6: External flow-meter



## Appendix 7: Limit of quantification test

Test will follow Blank value method according to ISO 11843.

### Sample

Take a 2 kg seed sample (any crop). Prior to testing, seed sample has to be stored in a constant climate chamber for at least 48 hours (2 days) at  $20^{\circ}\text{C} \pm 2^{\circ}\text{C}$  and at  $50\% \pm 10\%$  relative humidity. To allow equilibration, seeds must be kept in paper bags (not airtight) when entering the climate chamber.

### Procedure

If the drum is either used for the first time in this test or has been cleaned with alcohol there is a need to run 2 cycles with treated seeds before starting the actual measurements on your samples. This ensures a constant occupancy of the pores in the metal surface.

Detailed steps:

1. Assemble the clean filter housing, filter paper and rubber seal (use only one filter housing for the whole procedure; no splitting/ switching between filter housings for conditioning and sample measurements!)
2. Put the filter housing assembly on the Heubach dustmeter
3. Document room humidity and temperature
4. Fill in  $100\text{g} \pm 1\text{g}$  (document weight!) of conditioning seeds and start the normal Heubach cycle
5. If finished put the filter housing into an aluminum tray, remove seeds from the drum, Vacuum elements in the following order: 1 Glass bottle set vertically, vacuum from bottom and alternate side, 2 Glass-drum connector, 3 filter housing both parts (outside and then inside), 4 O seal (rubber joint from filter housing), 5 table, 6 metallic lid, 7 large rubber joint, 8 metallic drum (vacuum all deflectors sides for 20 seconds in total), 9 use wet tissue to clean vacuum cleaner nozzle.10 Use wet tissue to clean shovel and aluminum seed tray.
6. Fill in a second portion of  $100 \pm 1$  grams of the conditioned seeds (accuracy: 0.01 g; document weight!) into the drum and start the normal Heubach cycle
7. When finished remove the filter housing assembly from the Heubach dustmeter and take out the filter paper, remove the seeds from the drum, vacuum elements in the following order: 1 Glass bottle set vertically, vacuum from bottom and alternate side, 2 Glass-drum connector, 3 filter housing both parts (outside and then inside), 4 O seal (rubber joint from filter housing), 5 table, 6 metallic lid, 7 large rubber joint, 8 metallic drum (vacuum all deflectors sides for 20 seconds in total), 9 use wet tissue to clean vacuum cleaner nozzle.10 Use wet tissue to clean shovel and aluminum seed tray.
8. Put clean gloves on
9. Put a new filter paper in the filter housing assembly
10. Put the filter housing assembly into a new and clean aluminum tray
11. Hold the complete filter housing assembly under an ionizer for about 15 seconds
12. Tare your scale
13. Put the assembly (with filter housing dust entry side up) in the receptor placed at the center of the scale plateau and wait for stabilization

14. Document the weight value as “Empty Weight”
15. Put the filter housing assembly on the Heubach dustmeter
16. Start the normal Heubach cycle as Blank run (no more seeds inside the drum!)
17. Wait until the cycle is finished
18. Put the filter housing assembly into an aluminium tray
19. Tare your scale
20. Hold the complete filter housing assembly under an ionizer for about 15 seconds
21. Put the assembly (with filter housing dust entry side up) in the center of the scale plateau and wait for stabilization
22. Document the weight value as “Full Weight”
23. Remove the filter housing assembly from the scale, put the filter housing assembly (with the used filter paper) on the Heubach dustmeter
24. Document room humidity and temperature
25. Fill in 100g (document weight!) of conditioning seeds and start the normal Heubach cycle
26. If finished remove the filter housing assembly from the Heubach dustmeter and take out the filter paper, remove the seeds from the drum, Vacuum elements in the following order: 1 Glass bottle set vertically, vacuum from bottom and alternate side, 2 Glass-drum connector, 3 filter housing both parts (outside and then inside), 4 O seal (rubber joint from filter housing), 5 table, 6 metallic lid, 7 large rubber joint, 8 metallic drum (vacuum all deflectors sides for 20 seconds in total), 9 use wet tissue to clean vacuum cleaner nozzle.10 Use wet tissue to clean shovel and aluminum seed tray.
27. Put clean gloves on
28. Put a new filter paper in the filter housing assembly
29. Put the filter housing assembly into a new and clean aluminum tray
30. Hold the complete filter housing assembly under an ionizer for about 15 seconds
31. Tare your scale
32. Put the assembly (with filter housing dust entry side up) in the center of the scale plateau and wait for stabilization
33. Document the weight value as “Empty Weight”
34. Put the filter housing assembly on the Heubach dustmeter
35. Start the normal Heubach cycle as Blank run (no more seeds inside the drum!)
36. Wait until the cycle is finished
37. Put the filter housing assembly into an aluminum tray
38. Tare your scale
39. Hold the complete filter housing assembly under an ionizer for about 15 seconds
40. Put the assembly (with filter housing dust entry side up) in the center of the scale plateau and wait for stabilization
41. Document the weight value as “Full Weight”
42. Remove the filter housing assembly from the scale, put the filter housing assembly (with the used filter paper) on the Heubach dustmeter
43. Repeat step 24. to 42. -> 8 x times.
44. Repeat the whole procedure with the second employee or if only single employee repeat the whole procedure another day and mention in recording.

## Calculation of Limit of quantification

Report the weights in attached spreadsheet. Limit of quantification is automatically calculated. Negative weight differences as well as outliers (from Z-score) are excluded for calculation. A minimum of 12 values after exclusion of negative weight differences and outliers is necessary to calculate limit of quantification. If less than 12 values after exclusion of negative weight differences and outliers, a new serie of 20 blank tests must be conducted. It is advised to practice in advance with careful cleaning and weighing in order to get as little as possible negative weight differences. Compare weight differences in blank test with or without filter conditioning step.

## Recording

Keep recording

## Heubach Method validation range

Method validation from CSTP Dust working group involved 7 laboratories with diverse settings. All laboratories which have followed carefully cleaning and weighing steps showed a non crop specific limit of quantification. Limits of quantification ranged between 0.21 to 1.13 g/100 kg.

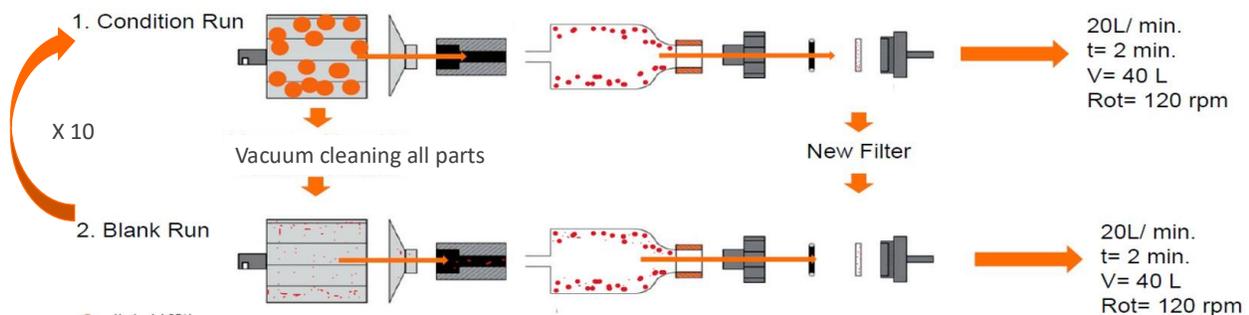
See the data publication: Weimar-Bosse, C., Immenroth, E., & Ahrens, K. (2025). *Data set: blank values from heubach dustmeter-conditioning with sugar beets and barley with a refined procedure* [Data set]. OpenAgrar Repository. <https://doi.org/10.5073/20251029-145457-0>

2025-2026 annual ring test will include limit of quantification test for all participating laboratories. Based on the results of this ring test a maximum limit of quantification will be set.

## Figure: Heubach blank ring test scheme



## Heubach Blank ring test



## Appendix 8: Additional step: filter conditioning



### Additional step: conditioning of filter

