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PROFICIENCY TESTING PROGRAM

No CCB/PT/C.1

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PROFICIENCY TESTING ORGANIZER ACCREDITED BY PCA

No PT 014

Developed:	Approved:
Agata Dziubek *Statistician* **Brygida Augustyniok** *Technical Manager*	**Brygida Augustyniok** *Coordinator* 24.03.2026 Brygida Jadwiga Augustyniok Elektronicznie podpisany przez Brygida Jadwiga Augustyniok Data: 2026.03.24 12:35:47 +01'00' *Date and signature*

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1. Proficiency Testing Organizer

Centrum Certyfikacji BARG Sp. z o.o.
Proficiency Testing Department
street Delfina 4B, 03-194 Warszawa, POLAND
e-mail: badania.bieglosci@barg.pl
Tax Identification Number: 524-29-36-340

In the scope of these proficiency tests, the PT Organizer undertakes to maintain confidentiality of all information provided by Participants, including, among others, test results and the identities of individual Participants, and to ensure impartiality in evaluating their actions. The Organizer also commits to securing documentation related to the tests against unauthorized access.

This proficiency testing program is conducted in accordance with the requirements of the PN-EN ISO/IEC 17043:2023-10 (EN ISO/IEC 17043:2023) standard. The PT Organiser is accredited by the PCA with regard to facilities and properties in accordance with the scope presented in point 6 by this PT program - Accreditation Scope No. PT 014, available on the PT Organiser's website www.ccbarg.pl and on the PCA website www.pca.gov.pl.

2. Individuals involved in the design and operation of the proficiency testing program.

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3. Purpose of the program

The aim of the proficiency testing program is:

- assessment of the Participant's ability to conduct specific tests
- providing evidence to confirm the validity of results and demonstrate the competence of conformity assessment bodies
- enabling the Participant to identify areas for improvement through proficiency testing
- providing customers with additional information to enhance trust

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4. External service providers

During the implementation of this proficiency testing program, the PT Organizer will use external service providers to perform tests to assess homogeneity and stability.

The above activities will be carried out by the accredited laboratories:

- BARG Południe Sp. z o.o. based in Siemianowice Śląskie, Accreditation Scope No. AB 804,
- Centrum Technologiczne Betotech Sp. z o.o. based in Dąbrowa Górnicza, Accreditation Scope No. AB 829.

If, during the program, it becomes necessary to use external service providers in another area, the PT Organizer shall immediately inform the Participants in writing about the services that it intends to subcontract additionally.

The proficiency testing organizer does not subcontract the design and planning of the proficiency testing program, assessment of performance results, or the development and authorization of the PT report.

5. Criteria for Participation in Proficiency Testing

Participation in proficiency testing is possible after acceptance of the participation conditions specified in this program, which occurs upon submission of the dedicated Registration Form for a particular round, within the deadline indicated in the Schedule of the PT program, to the email address badania.bieglosci@barg.pl.

The proficiency testing format is open and is carried out cyclically. Participation is open to both accredited and non-accredited laboratories, as well as other interested parties involved in conformity assessment activities. The minimum number of Participants for each method is 5, while the maximum is 30. In case of too few submissions, the PT Organizer may extend the submission period (which may affect the deadlines indicated in the Schedule of the program for a given round) or cancel the proficiency testing for a specific property, and Participants will be promptly informed. In case of exceeding the number of Participants, the order of submissions will determine participation. In the event of an overwhelming number of interested parties, the PT Organizer may announce additional rounds under this program. A Participant may take part in proficiency testing for selected properties. Tests should be conducted by the Participant using the testing methods specified by the PT Organizer.

In the proficiency test, for a given method, no more than:

- 2 Participants from one entity, where the total number of Participants is 10 and below,
- 3 Participants from one entity, where the total number of Participants is more than 10.

A Participant without accreditation for a specific test is also required to conduct the test using supervised equipment, ensuring measurement consistency, in accordance with DA-06 (ILAC-P10).

Details of the proficiency testing program implementation are described in the Instruction developed for each program round. Participants should follow the requirements of the Instruction.

Results from Participants should be provided with expanded measurement uncertainty, with the same accuracy and in the same unit as the test result, at a specified expansion factor k and expansion probability p, following ILAC-G17.

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Results from Participants that do not meet program requirements and/or instructions for Participants, including results obtained using a different testing method, failure to meet requirements for measurement consistency, or reported without measurement uncertainty, will not be used to determine the values of x_{pt} and σ_{pt}.

Participation in proficiency testing is subject to a fee. Participation costs are presented in the Registration Form. They do not include the cost of delivering proficiency testing objects to the Participant. Transport of samples is carried out through a shipping company, and the cost is borne by the Participant. After registering for participation, the PT Organizer sends an invoice with a 14-day payment term to the Participant. The proficiency testing report can be provided to the Participant after settling the payment for participation. Failure to provide proficiency testing results by the Participant does not exempt them from the obligation to pay according to the scope of the reported participation.

A Participant has the right to withdraw from participation in proficiency testing free of charge, which requires submitting a written withdrawal to the email address badania.bieglosci@barg.pl within 14 days from the end of sending the applications.

6. Scope of Organized Proficiency Testing

Ord.	Measured quantity/property	Reference document
1.	Compressive strength [A]	PN-EN 196-1:2016-07 (EN 196-1:2016)
2.	Flexural strength [A]	PN-EN 196-1:2016-07 (EN 196-1:2016)
3.	Standard consistency [A]	PN-EN 196-3:2016-12 (EN 196-3:2016)
4.	Setting time [A] (initial and final of setting time)	PN-EN 196-3:2016-12 (EN 196-3:2016)
5.	Soundness [A]	PN-EN 196-3:2016-12 (EN 196-3:2016)
6.	Loss of ignition [NA]	PN-EN 196-2:2013-11 (EN 196-2:2013)
7.	Sulphate content SO_3 [NA]	PN-EN 196-2:2013-11 (EN 196-2:2013)
8.	Chloride content Cl [NA]	PN-EN 196-2:2013-11 (EN 196-2:2013)
9.	Residue insoluble [NA]	PN-EN 196-2:2013-11 (EN 196-2:2013)
10.	Carbon dioxide content CO_2 [NA]	PN-EN 196-2:2013-11 (EN 196-2:2013)
11.	Density [NA]	PN-EN 196-6:2019-01 (EN 196-6:2018)
12.	Fineness of grind by Blaine method [NA]	PN-EN 196-6:2019-01 (EN 196-6:2018)
13.	Water-soluble chromium Cr (VI) content [NA]	PN-EN 196-10:2016-07 (EN 196-10:2016)

[A] measured quantity/property covered by the scope of accreditation

[NA] measured quantity/property not covered by the scope of accreditation

The scope of measured quantities/properties is specified in the Registration Form and defined within successive rounds of the program in accordance with the Schedule of the PT program for a given calendar year.

Detailed information on what needs to be identified, measured, or tested is provided in the Instruction and Test Result Sheets. Instructions and Test Result Cards are made available to Participants no later than the day of transferring samples for proficiency testing.

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The range of expected values and/or properties for proficiency testing objects is indicated in the Registration Form and/or Instruction for a specific round.

7. Potential sources of errors

- Incorrect handling of test objects
- Occurrence of collusion among Participants
- Equipment that does not meet the requirements of the reference document
- Malfunctioning equipment during the test
- Influence of environmental conditions during the test
- Small number of Participants
- Use of a different method by the Participant than required in the proficiency testing program
- Non-compliance with the PT Organizer's guidelines
- Non-compliance with the guidelines included in the testing methods
- Period and method of storage of the proficiency test object

8. Arrangements to prevent collusion between Participants

Each Participant, by signing the registration form, commits to maintaining confidentiality of obtained test results in relation to other Participants and securing proficiency testing documentation from unauthorized access.

Participants are obligated to conduct tests and submit the results to the Proficiency Testing Department (DBB) of the PT Organizer, without consulting with other Participants, whose participation in each program is known to them from other sources. In the event of collusion detection, Participants will be disqualified from participating in the specific round and will bear the total costs of participation in the proficiency testing program. It should be noted, however, that avoiding collusion and falsifying results is the responsibility of each Participant.

9. Production, storage and distribution of research objects and instructions for Participants

The proficiency test objects are manufactured in such a way as to ensure a high degree of homogeneity by obtaining bulk or bagged material from a single manufacturer from production representing the same batch of cement.

The storage of proficiency test objects shall take place under conditions compatible with the requirements of the test methods, preventing external influences from affecting their properties, in such a way as to maintain adequate stability.

The method of packing proficiency testing objects, for the purpose of their transfer to Participants, is designed to ensure that the type and timing of transport do not negatively impact their condition and properties.

The proficiency test objects are delivered to the Participants via a shipping company. During delivery (in the presence of the courier) the Participant is obliged to check the condition of the shipment. The Proficiency Testing Coordinator must be informed immediately of any damage to the delivered sample.

In the case of loss or damage to the proficiency testing objects, if possible, the Coordinator sends the Participant a reserve sample from the pool of archival samples.

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All information related to the implementation of the proficiency testing programme is described in this Programme, the PT Programme Schedule or is provided to the Participant in the form of Instructions to Participants.

The Instruction for Participants contains detailed information related to the execution of the tests, such as the type, size, and/or quantity of samples to be tested, methods of preparing and storing objects, deadlines for completing individual stages of the test, properties of the object necessary for conducting the test, accuracy in reporting test results and measurement uncertainty, etc.

10. Checking the homogeneity and stability of proficiency testing objects

10.1. Homogeneity

Homogeneity is assessed according to the algorithm presented in Figure 1. Test samples will be randomly selected from the prepared proficiency testing objects for a given round of the program, in quantities specified in Table 1. Two portions (m) will be prepared from each series. The tests will be conducted under repeatability conditions as soon as possible after the material is produced and samples are prepared.

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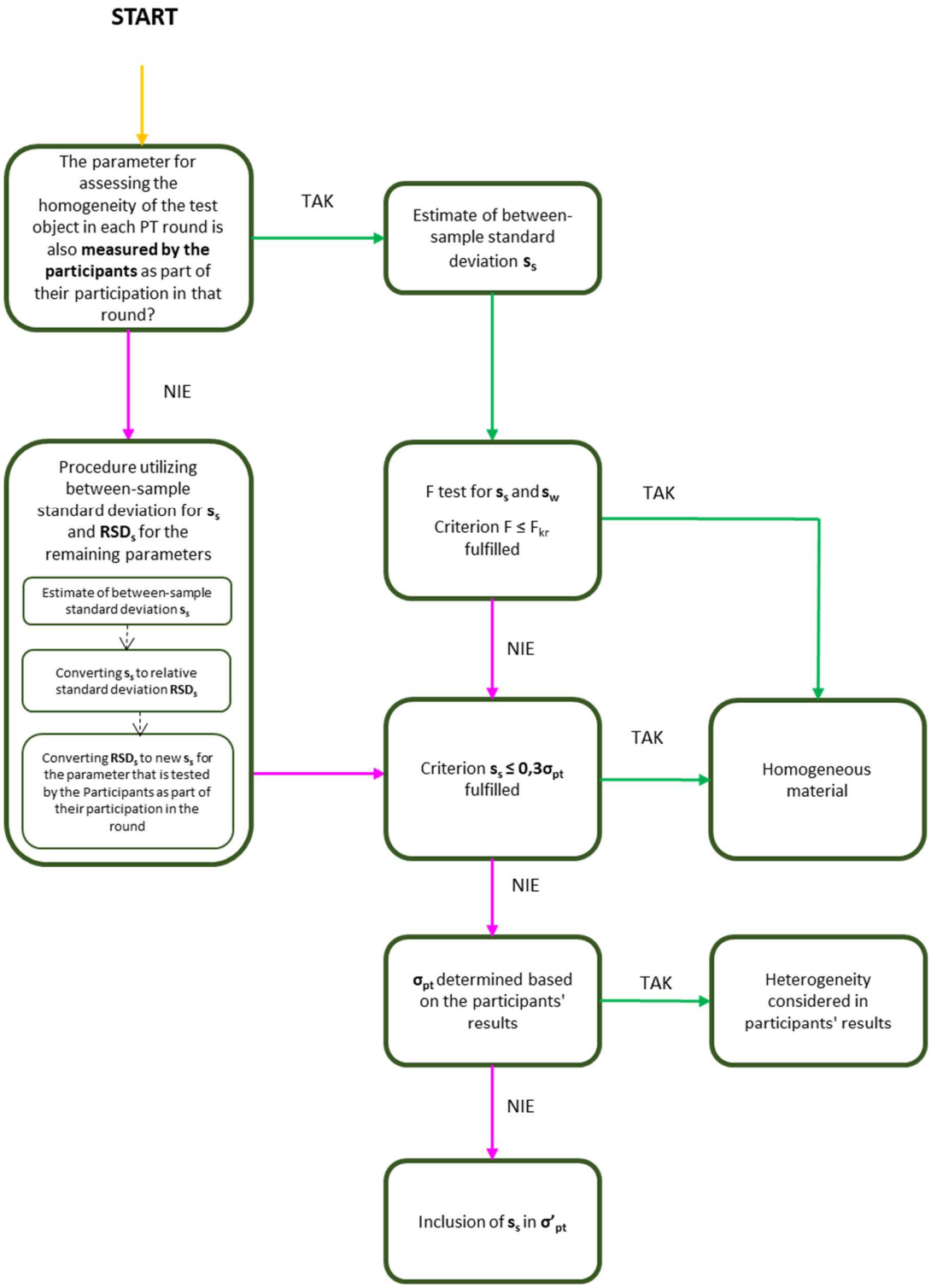

Fig. 1. Homogeneity assessment algorithm in proficiency testing

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Table 1. List of values verifying homogeneity for individual values measured as part of proficiency tests

Measured quantity/property	**Number of samples**	**A quantity verifying homogeneity**
Compressive strength **PN-EN 196-1:2016-07 (EN 196-1:2016)**	6	Compressive strength **PN-EN 196-1:2016-07 (EN 196-1:2016)**
Flexural strength **PN-EN 196-1:2016-07 (EN 196-2:2013)**	6	Compressive strength **PN-EN 196-1:2016-07 (EN 196-1:2016)**
Standard consistency **PN-EN 196-3:2016-12 (EN 196-3:2016)**	6	Compressive strength **PN-EN 196-1:2016-07 (EN 196-1:2016)**
Setting time (initial and final of setting time) **PN-EN 196-3:2016-12 (EN 196-3:2016)**	6	Compressive strength **PN-EN 196-1:2016-07 (EN 196-1:2016)**
Soundness **PN-EN 196-3:2016-12 (EN 196-3:2016)**	6	Compressive strength **PN-EN 196-1:2016-07 (EN 196-1:2016)**
Loss of ignition **PN-EN 196-2:2013-11 (EN 196-2:2013)**	6	Loss of ignition **PN-EN 196-2:2013-11 (EN 196-2:2013**)
Sulphate content SO_3 **PN-EN 196-2:2013-11 (EN 196-2:2013)**	6	Loss of ignition **PN-EN 196-2:2013-11 (EN 196-2:2013**)
Chloride content Cl **PN-EN 196-2:2013-11 (EN 196-2:2013)**	6	Loss of ignition **PN-EN 196-2:2013-11 (EN 196-2:2013**)
Residue insoluble **PN-EN 196-2:2013-11 (EN 196-2:2013)**	6	Loss of ignition **PN-EN 196-2:2013-11 (EN 196-2:2013**)
Carbon dioxide content CO_2 **PN-EN 196-2:2013-11 (EN 196-2:2013)**	6	Loss of ignition **PN-EN 196-2:2013-11 (EN 196-2:2013**)
Density **PN-EN 196-6:2019-01 (EN 196-6:2018)**	6	Loss of ignition **PN-EN 196-2:2013-11 (EN 196-2:2013**)
Fineness of grind by Blaine method **PN-EN 196-6:2019-01 (EN 196-6:2018)**	6	Loss of ignition **PN-EN 196-2:2013-11 (EN 196-2:2013**)
Water-soluble chromium Cr (VI) content **PN-EN 196-10:2016-07 (EN 196-10:2016)**	6	Loss of ignition **PN-EN 196-2:2013-11 (EN 196-2:2013**)

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Estimate of between-sample standard deviation (according to ISO 13528:2022-08 Annex B.3), homogeneity is verified by calculating the standard deviation between samples:

If m=2

$$s_s = \sqrt{max(0,\ s_{\bar{x}}^2 - s_w^2 / 2)}$$

$$s_{\bar{x}} = \sqrt{\sum_{t=1}^{g} (\bar{x}_t - \bar{\bar{x}})^2/(g-1)}$$

$$s_w = \sqrt{\sum_{t=1}^{g} w_t^2/(2g)}$$

If m≠2

$$s_s^2 = s_{s,w}^2 - s_w^2 = \frac{1}{(g-1)}\sum_{t=1}^{g} (\bar{x}_t - \bar{\bar{x}})^2 - \frac{1}{m}\, s_w^2$$

$$s_x^2 = \frac{1}{(g-1)}\sum_{t=1}^{g} (\bar{x}_t - \bar{\bar{x}})^2$$

$$s_w^2 = \frac{1}{g}\sum_{t=1}^{g} s_t^2$$

$$s_{s,w}^2 = \frac{1}{(g-1)}\sum_{t=1}^{g} (\bar{x}_t - \bar{\bar{x}})^2 + \left(1 - \frac{1}{m}\right) s_w^2 = s_s^2 + s_w^2$$

where:
s_s – estimate of between-sample standard deviation
$s_{\bar{x}}$ – standard deviation of sample averages
s_w – ithin-sample or within-laboratory standard deviation
$s_{s,w}$ – combined variance value of s_s and s_w
$\bar{x}_t$ – mean for the t-th sample (t=1, …, g)
$\bar{\bar{x}}$ – overall mean
w_t – between-test-portion range
g – number of proficiency test items tested in a homogeneity check
m – number of portions

Test samples will be deemed homogeneous if the condition is satisfied according to the algorithm presented in Figure 1:

$$F \leq F_{kr}$$

or

$$s_s \leq 0{,}3\ \sigma_{pt}$$

where:

$$F = \frac{s_{\bar{x}}^2}{s_w^2}$$

$F_{kr\ unilateral}$ (P = 95%; g-1; g·(m-1))

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10.2. Stability

Stability will be assessed according to the algorithm presented in Figure 2. Test samples will be randomly selected from the prepared proficiency testing objects for a given round of the program, in quantities specified in Table 2. Two portions will be prepared from each series. The first group of samples will be tested before the planned distribution date, the second group at the same time as the samples tested by the Participants. All samples are tested under repeatability conditions. The pre-distribution test may be skipped if there is an opportunity to use the test results obtained in the homogeneity assessment.

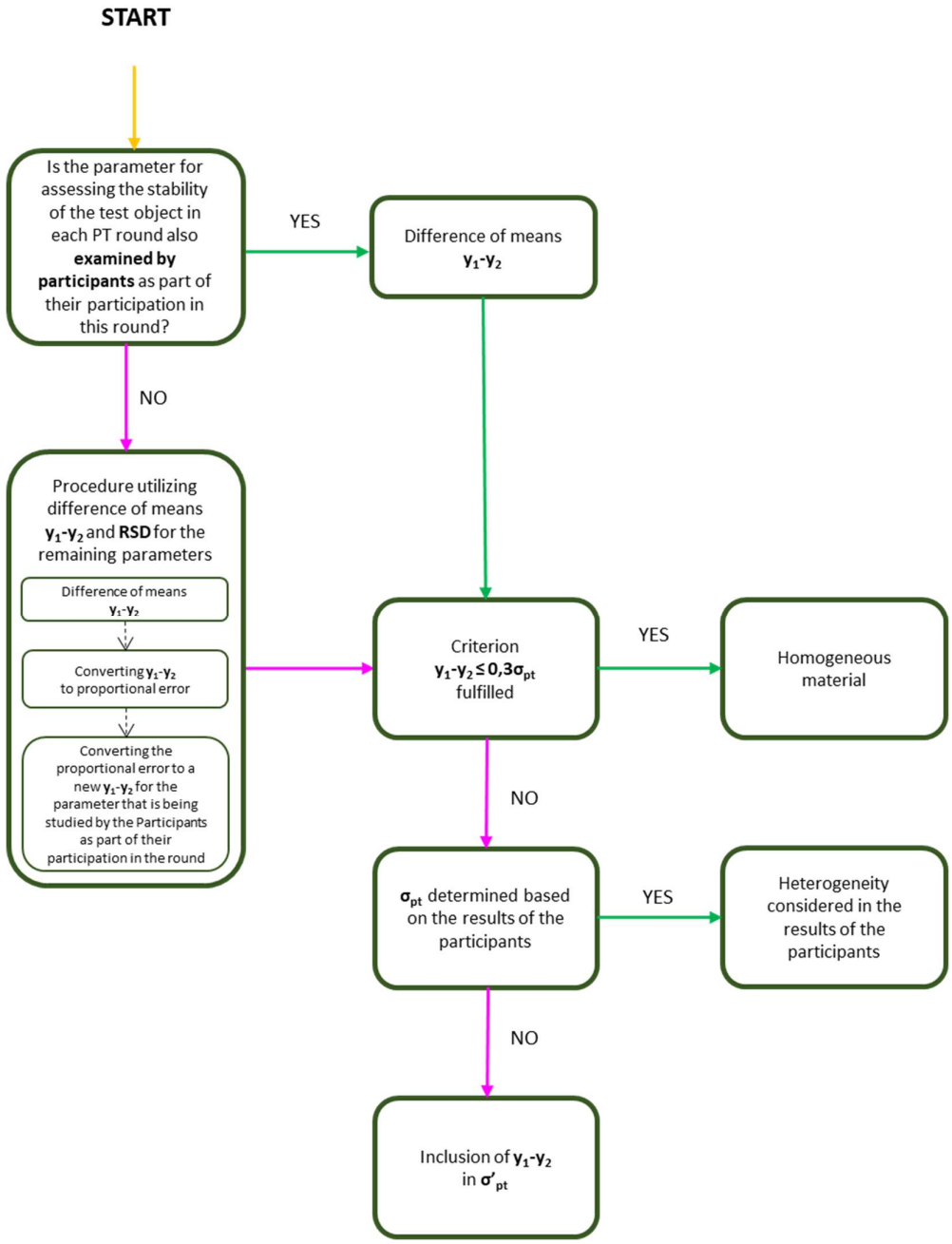

Fig. 2. Algorithm for assessing stability in proficiency testing

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Table 2. List of values verifying stability for individual values measured as part of proficiency tests

Measured quantity/property	**Number of samples**	**A quantity verifying stability**
Compressive strength **PN-EN 196-1:2016-07 (EN 196-1:2016)**	2	Compressive strength **PN-EN 196-1:2016-07 (EN 196-1:2016)**
Flexural strength **PN-EN 196-1:2016-07 (EN 196-2:2013)**	2	Compressive strength **PN-EN 196-1:2016-07 (EN 196-1:2016)**
Standard consistency **PN-EN 196-3:2016-12 (EN 196-3:2016)**	2	Compressive strength **PN-EN 196-1:2016-07 (EN 196-1:2016)**
Setting time (beginning and end of setting time) **PN-EN 196-3:2016-12 (EN 196-3:2016)**	2	Compressive strength **PN-EN 196-1:2016-07 (EN 196-1:2016)**
Soundness **PN-EN 196-3:2016-12 (EN 196-3:2016)**	2	Compressive strength **PN-EN 196-1:2016-07 (EN 196-1:2016)**
Loss of ignition **PN-EN 196-2:2013-11 (EN 196-2:2013)**	2	Loss of ignition **PN-EN 196-2:2013-11 (EN 196-2:2013**)
Sulphate content SO_3 **PN-EN 196-2:2013-11 (EN 196-2:2013)**	2	Loss of ignition **PN-EN 196-2:2013-11 (EN 196-2:2013**)
Chloride content Cl **PN-EN 196-2:2013-11 (EN 196-2:2013)**	2	Loss of ignition **PN-EN 196-2:2013-11 (EN 196-2:2013**)
Residue insoluble **PN-EN 196-2:2013-11 (EN 196-2:2013)**	2	Loss of ignition **PN-EN 196-2:2013-11 (EN 196-2:2013**)
Carbon dioxide content CO_2 **PN-EN 196-2:2013-11 (EN 196-2:2013)**	2	Loss of ignition **PN-EN 196-2:2013-11 (EN 196-2:2013**)
Density **PN-EN 196-6:2019-01 (EN 196-6:2018)**	2	Loss of ignition **PN-EN 196-2:2013-11 (EN 196-2:2013**)
Fineness of grind by Blaine method **PN-EN 196-6:2019-01 (EN 196-6:2018)**	2	Loss of ignition **PN-EN 196-2:2013-11 (EN 196-2:2013**)
Water-soluble chromium Cr (VI) content **PN-EN 196-10:2016-07 (EN 196-10:2016)**	2	Loss of ignition **PN-EN 196-2:2013-11 (EN 196-2:2013**)

Stability is verified by comparing the overall means obtained at various stages of the control (according to ISO 13528:2022-08 Annex B.4):

$$|\bar{y}_1 - \bar{y}_2| \leq 0{,}3\ \sigma_{pt}$$

where:

$\bar{y}_1$ - overall mean of results obtained before the start of the round

$\bar{y}_2$ - overall mean of results obtained after the completion of the round

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10.3. Procedure in case of inhomogeneity and instability (according to ISO 13528:2022-08 Annex B.2.5, B.5)

10.3.1. Inhomogeneity

If the criterion for sufficient homogeneity is not met, one of the following options is considered:

a. Option I

Rehomogenization and portioning of objects, followed by retesting for homogeneity.

b. Option II

Incorporating the deviation between samples s_s into data analysis by using:

- σ'_{pt} determined by the formula

$$\sigma'_{\mathrm{pt}} = \sqrt{\sigma_{pt}^2 + s_s^2}$$

- lub z' specified by the formula

$$z_i' = \frac{x_i - x_{pt}}{\sqrt{\sigma_{pt}^2 + s_s^2}}$$

c. Option III

Not assessing the results of participants' activities.

10.3.2. Instability

If the criterion for sufficient stability is not met, the first step involves checking the impact of measurement uncertainty on precision. For this purpose, the acceptance criterion is expanded according to the formula:

$$|\bar{y}_1 - \bar{y}_2| \leq 0{,}3\sigma_{\mathrm{pt}} + 2\sqrt{u^2(\bar{y}_1) + u^2(\bar{y}_2)}$$

In the event that the expanded criterion is also not met, one of the following options is considered:

a. Option I

Incorporating the difference between overall means obtained at various stages of the control $\bar{y}_1 - \bar{y}_2$ into σ_{pt}

b. Option II

Not assessing the results of participants' activities.

11. Method and Evaluation Criteria

After receiving proficiency testing results from all participants, a preliminary data analysis will be conducted to verify whether the provided results meet the requirements set by the PT Organizer as specified in the program and instructions for participants. This data analysis may involve verification of measurement consistency, application of the appropriate research method, or presentation of the test result (correct unit, required precision, result with expanded measurement uncertainty), etc.

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Participants' results obtained in a given round of the program will be verified for distribution before statistical analysis of the data.

Results from participants that do not meet the program and/or instruction requirements, including results obtained using a different research method, failure to meet consistency requirements, or presented without measurement uncertainty, will not be used to determine the values x_{pt} and σ_{pt}.

In cases where analyses other than robust ones are applied to determine the values x_{pt} or σ_{pt}, a Grubbs' test will be conducted (according to PN-ISO 5725-2:2002 (ISO 5725-2:1994)) to detect outlier values.

The Grubbs' test will be used to check whether the dataset contains data affected by gross errors.

One observed outlier

For this purpose, the obtained values are ranked in ascending order, and then the parameters G_1 and G_p are determined according to the formulas:

$$G_1 = \frac{\bar{x} - x_1}{s}$$

$$G_p = \frac{x_p - \bar{x}}{s}$$

$$\bar{x} = \frac{1}{p}\sum_{i=1}^{P} x_i$$

$$s = \sqrt{\frac{1}{p-1}\sum_{i=1}^{P}(x_i - \bar{x})^2}$$

where:
$\bar{x}$ – mean value
x_1 – smallest value in the result set
x_p – largest value in the result set
s – standard deviation

The obtained values will be compared with the critical value at a confidence level of 95%. If G_1 or G_p exceeds the critical value, the corresponding result will be considered as an outlier and will be excluded from the dataset used for further calculations.

Two observed outliers

For this purpose, the obtained values are ranked in ascending order, and then the G parameters are determined according to the formulas:

For the two largest values

$$G = \frac{s^2_{p-1,p}}{s_0^2}$$

For the two smallest values

$$G = \frac{s^2_{1,2}}{s_0^2}$$

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$$s_0^2 = \sum_{i=1}^{p} (x_i - \bar{x})^2 \qquad s_{1,2}^2 = \sum_{i=3}^{p} (x_i - \bar{x}_{1,2})^2$$

$$s_{p-1,p}^2 = \sum_{i=1}^{p-2} (x_i - \bar{x}_{p-1,p})^2 \qquad \bar{x}_{1,2} = \frac{1}{p-2} \sum_{i=3}^{p} x_i$$

$$\bar{x}_{p-1,p} = \frac{1}{p-2} \sum_{i=1}^{p-2} x_i$$

where:

$\bar{x}$ – mean value
x_1 – smallest value in the result set
x_p – largest value in the result set
s – standard deviation

The values obtained will be compared with the critical value at a confidence level of 95%. If G is not within the range determined by the critical value, the corresponding result is considered an outlier and will be rejected from the data set used for further calculations.

For quantitative research, the general statistical model used in proficiency testing at Centrum Certyfikacji BARG Sp. z o.o. is presented in Figure No. 3 - Algorithm of the PT Statistical Model. Methods for determining the assigned value, σ_{pt} value, δ_E value, and the indicators used for the purposes of this proficiency testing program are described in the following subpoints.

After receiving the result cards, the PT Organizer, due to the justification for applying a different approach, reserves the right to choose a different statistical path than presented in the following subpoints.

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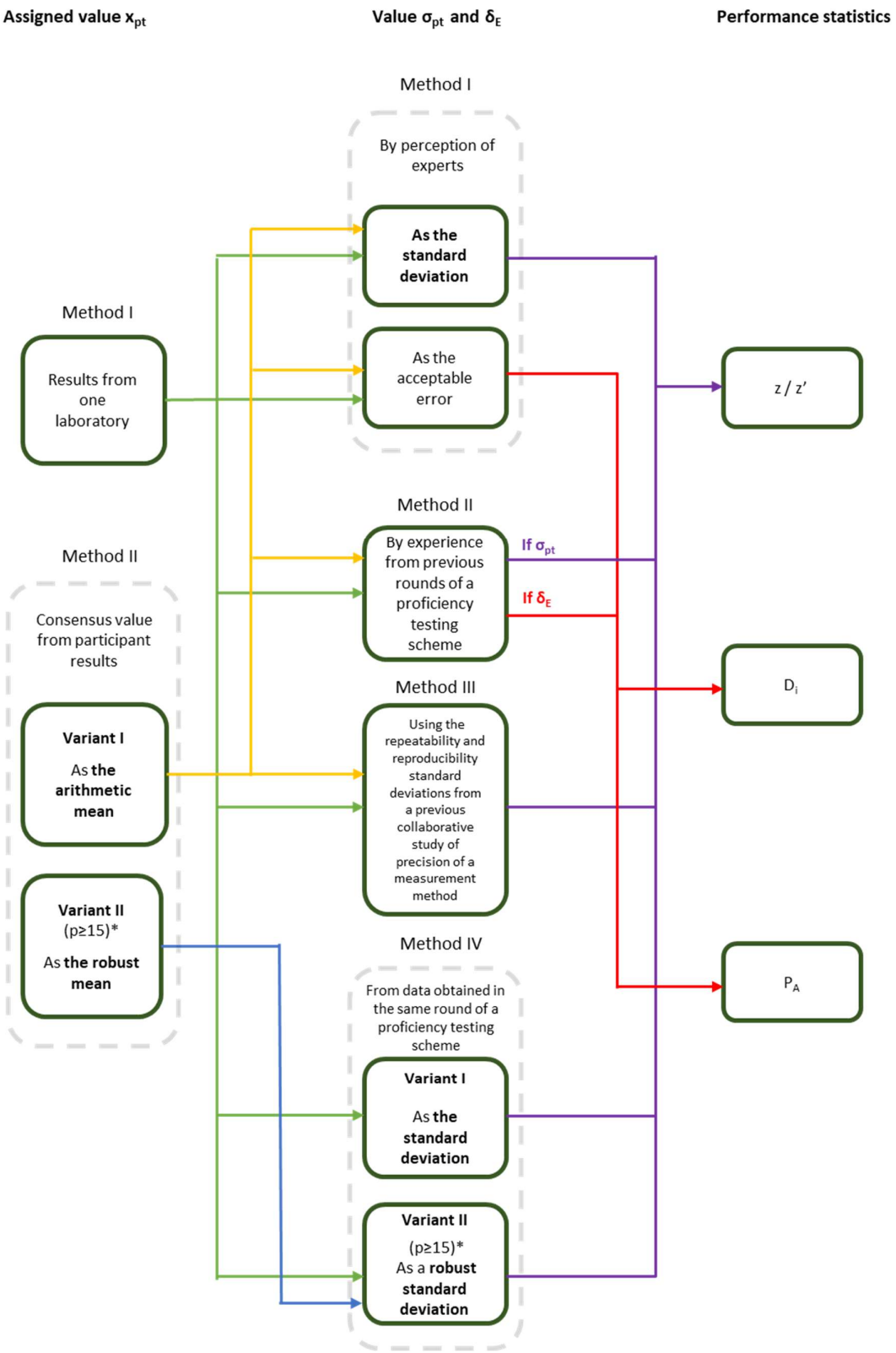

* in justified cases, it is allowed to use: p ≥ 12

Fig. 3. Statistical model algorithm in proficiency testing - quantitative research

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11.1. Determination of the assigned value

The assigned value x_{pt} will be determined according to Method II of the statistical model algorithm (Fig. 3) based on the results obtained in the current round using the arithmetic mean or Algorithm A described in Annex C of ISO 13528:2022-08, Variant I or II below.

11.1.1. Method II Consensus value from participant results (according to ISO 13528:2022-08, point 7.7)

Variant I

The assigned value x_{pt} as the arithmetic mean:

$$x_{pt} = \overline{x}$$

where:

$\overline{x}$ – arithmetic mean of results provided by participants in each round after excluding outliers

The uncertainty $u(x_{pt})$ is estimated using the formula:

$$u(x_{pt}) = \frac{s}{\sqrt{p}}$$

where:

s – standard deviation after excluding outliers

p – number of results after excluding outliers

Variant II

The assigned value x_{pt} as the robust mean when the number of Participants is 15 or more (p≥15):

$$x_{pt} = x*$$

where:

$x*$ - the robust mean calculated using algorithm A

The uncertainty $u(x_{pt})$ is estimated using the formula:

$$u(x_{pt}) = \frac{1{,}25}{\sqrt{p}} \cdot s^*$$

where:

s^* - the robust standard deviation determined using algorithm A

p – the number of provided results

Limitation of the uncertainty of the assigned value

If the condition is met:

$$u(x_{pt}) \leq 0{,}3\sigma_{pt}$$

where:

σ_{pt} – standard deviation for assessing proficiency testing

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in that case, the uncertainty of the assigned value is considered insignificant and will not be taken into account in the interpretation of proficiency testing round results.

Otherwise, the uncertainty of the assigned value will be included in the calculations.

11.2. Determination of the σ_{pt} Value

The σ_{pt} value will be determined according to Method I, III, or IV of the statistical model algorithm (Fig. 3) respectively as the standard deviation, required based on the precision of the measurement method or data obtained in the specific round.

11.2.1. Method I By perception of experts (according to ISO 13528:2022-08 point 8.2)

The standard deviation for assessing proficiency testing will be established by the expert panel based on experience derived from the application of the method.

11.2.2. Method III Using the repeatability and reproducibility standard deviations from a previous collaborative study of precision of a measurement method (according to ISO 13528:2022-08 point 8.5)

For measured quantities for which information on the repeatability (σ_r) and reproducibility (σ_R) of the method is available, the standard deviation for assessing proficiency testing (σ_{pt}) will be calculated based on this information as follows:

$$\sigma_{pt} = \sqrt{\sigma_R^2 - \sigma_r^2\left(1 - \frac{1}{m}\right)}$$

where:

σ_R – reproducibility standard deviation

σ_r – repeatability standard deviation

m – number of repeated measurements made by each laboratory in a given PT round; if m = 1, then $\sigma_{pt} = \sigma_R$

11.2.3. Method IV From data obtained in the same round of a proficiency testing scheme (according to ISO 13528:2022 point 8.6)

Variant II (according to ISO 13528:2022 Annex C.3.1)

Standard deviation for assessing proficiency testing **as a robust deviation** when the number of Participants is 15 or more (p≥15):

$$\sigma_{pt} = s^*$$

where:

s^* – Robust estimate of the participant standard deviation using algorithm A (without rejecting outliers)

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11.3. Criteria used for proficiency assessment

The z score or z' score will be used to assess the results of participants' performance.

The z score (according to ISO 13528:2022-08 point 9.4)

The z score is applicable when the condition is met $u(x_{pt}) \leq 0{,}3\sigma_{pt}$

$$z_i = \frac{(x_i - x_{pt})}{\sigma_{pt}}$$

where:

x_i – the result obtained by the Participant
x_{pt} – assigned value
σ_{pt} – standard deviation for proficiency testing evaluation

Criterion:

$\lvert z \rvert \leq 2{,}0$	acceptable result
$2{,}0 < \lvert z \rvert < 3{,}0$	warning signal result
$\lvert z \rvert \geq 3{,}0$	unacceptable result

The z' score (according to ISO 13528:2022-08 point 9.5)

The z' indicator is applicable when the condition is not met $(x_{pt}) \leq 0{,}3\sigma_{pt}$

$$z_i' = \frac{x_i - x_{pt}}{\sqrt{\sigma_{pt}^2 + u^2(x_{pt})}}$$

where:

x_i – the result obtained by the Participant
x_{pt} – assigned value
σ_{pt} – standard deviation for proficiency testing
$u(x_{pt})$ – uncertainty of the assigned value

Criterion:

$\lvert z' \rvert \leq 2{,}0$	acceptable result
$2{,}0 < \lvert z' \rvert < 3{,}0$	warning signal result
$\lvert z' \rvert \geq 3{,}0$	unacceptable result

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12. PT Report

The PT organizer, upon receiving all results and conducting statistical analyses, will prepare a report that includes:

- Name and contact details of the Proficiency Testing (PT) study organizer
- Name and contact details of the PT study coordinator
- Name, position, and signature of the person authorizing the PT report
- Dates of issuance and status of the report (e.g., preliminary, intermediate, or final)
- Report number and unambiguous identification of the report and proficiency testing program
- Indication of which activities were performed by an external supplier, if they affect production, characterization of PT facilities, or provision of services
- unambiguous identification ensuring that all its elements are recognized as part of the complete PT report, and number of pages and clear identification of the end of the report
- Detailed description of the objects used in the proficiency testing, including necessary details regarding the production of proficiency testing objects and the assessment of homogeneity and stability
- Results of participants, including reporting of measurement uncertainty
- Statistical data and summary, including assigned values and the range of acceptable results, along with graphical presentation
- Procedures used to determine each assigned value
- Details regarding measurement consistency and uncertainty for each assigned value
- Procedures used to determine the standard deviation for proficiency assessment or other evaluation criteria
- Assigned values and their uncertainties, statistical summaries for the testing methods/procedures used by each participant group (if different participant groups used different research methods)
- Procedures used for statistical data analysis
- Comments from the PT study organizer regarding the participants' results
- Guidance on interpreting the statistical analysis, along with comments and recommendations resulting from the proficiency testing round's outcomes
- Statement regarding the confidentiality of proficiency testing results.

Information regarding the results obtained by specific Participants will be encoded and known only to the PT Organizer. Each Participant will receive information about the assigned code along with the Report.

All results, tabular summaries, participants' performance analyses presented in the proficiency testing report will be displayed according to the Participant's code.

PT reports will be sent to Participants via email in PDF format within the specified schedule.

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Participants are required to inform the PT Organizer of any comments on the report affecting the Participant's final assessment or any other errors found in the proficiency testing report within 14 days of receiving it. The PT Organizer is obligated to promptly correct any errors in the report and inform all Participants about it. Comments on the PT report, if expressed dissatisfaction by a Participant, may be treated by the PT Organizer as a complaint and handled in accordance with point 13 of this program.

13. Complaints and Appeals

Participants have the right to submit complaints and/or appeals within 14 days of receiving the report to the email address: badania.bieglosci@barg.pl. The PT Organizer will review them within 30 days of receiving the complaint and/or appeal and provide feedback to the designated contact person, if the complaint and/or appeal concerns his activities in the area of PT. The DBB policy is to fairly address all complaints and appeals received from Participants, customers, or other parties. The procedure for conducting explanations and maintaining records regarding complaints and appeals is described in DSZ – section PT-7.6 “Complaint Handling” and PT-7.7 “Appeal Handling” and is available upon request.

14. Contact with the Participant

DBB provides participants with all information regarding the implementation of the program, including each individual round. All documents and necessary forms are communicated to participants electronically, through courier services, or collected in person with confirmation of sample receipt.

The coordinator publishes the current schedule of the PT program with planned proficiency testing rounds and participation criteria on the website.

DBB provides participants in the proficiency testing program with:

• PT Program Schedule (4/PT-7.2)

• Registration Form (6/PT-7.2)

• Participant Instructions (5/PT-7.2) – provided before the start of each program round

• Test Result Cards (8/PT-7.2)

• Proficiency Testing Report – provided to participants after the completion of each program round

• Customer Evaluation Survey about the level of services provided by the PT Organizer (1/PT-8.6)

Participants in proficiency testing can contact the PT Organizer regarding any uncertainties, matters requiring clarification or justification, and any other issues contributing to the improvement of the proficiency testing organization.

15. Reference Documents

- EN 196-1:2016 Method of testing cement- Part 1: Determination of strength
- EN 196-2:2013 Method of testing cement- Part 2: Chemical analysis of cement
- EN 196-3:2016 Method of testing cement- Part 3: Determination of setting times and soundness
- EN 196-6:2018 Method of testing cement- Part 3: Determination of fineness

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- EN 196-10:2016 Method of testing cement- Part 3: Determination of the water-soluble chromium (VI) content of cement
- PN-EN ISO/IEC 17025:2018-02 (EN ISO/IEC 17025:2017) General requirements for the competence of testing and calibration laboratories
- PN-EN ISO/IEC 17043:2023-10 (EN ISO/IEC 17043:2023) Conformity assessment – General requirements for the competence of proficiency testing providers
- PN-ISO 2854:1994 (ISO 2854:1976) Statistical interpretation of data — Techniques of estimation and tests relating to means and variances
- PN-ISO 5725-1:2002 (ISO 5725-1:1994) Accuracy (trueness and precision) of measurement methods and results — Part 1: General principles and definitions
- PN-ISO 5725-2:2002 (ISO 5725-2:1994) Accuracy (trueness and precision) of measurement methods and results — Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method
- ISO 13528:2022-08 Statistical methods for use in proficiency testing by interlaboratory comparisons
- DA-05 Policy on participation in proficiency testing or interlaboratory comparisons other than proficiency testing (ILAC-P9)
- DA-06 Measurement Consistency Policy (ILAC-P10)
- ILAC-G17 ILAC Guidelanes for Measurements Uncertainty in Testing

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