




# QOTHO PROFICIENCY TESTING SCHEME GUIDELINES


## QM-GUI-003

a SANAS Accredited Proficiency Testing Scheme Provider, No. PTS0012

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<b>Author: HdB &amp; JS</b>		<b>Authorized by: HdB</b>		
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**1. Profile:****Mission Statement:**

To add value to the Mining Industry by providing a world-class Proficiency Testing (PT) service, and to provide quality in-house Qotho Reference Materials (QRMs) for both the South African and International Markets.

**About the Company:**

Qotho Minerals specifically focuses on the design and implementation of Proficiency Testing Schemes (PTS), as well as the manufacturing and certification of Reference Materials.

Since its inception in 2013, Qotho has annually been introducing more PT Scheme within the mining industry. Participation in our schemes affords each laboratory the unique opportunity to assess the accuracy and comparability of their results with peer laboratories over time. Through the scheme, QRM's are generated, which provides an invaluable tool for further internal monitoring and instrument calibration.

Qotho Minerals is accredited to ISO 17043: PT Provider and ISO 17034: CRM Producer.

**Our Services:**

Our in-depth knowledge and experience in mining laboratories, coupled with an understanding of accreditation requirements, enables us to expertly guide customers through the many analytical challenges that arise. Qotho Minerals specializes in supporting clients in commercial or private laboratories, small businesses or multi-national corporations. You can count on our expertise, experience, products and services to meet your needs

*Our core business:*

Providing Proficiency Testing Services to laboratories to fulfill their ISO 17025 obligations. Existing PT Schemes have been established for the following locally sourced commodities: Chrome, Manganese, Nickel, Iron Ore, Cobalt, Platinum, Gold and Reductants. These schemes are rapidly expanding to meet demand from industry.

Qotho Reference Materials (QRMs): The development of customized bulk sample preparation and supply of in-house QRM's through the PT scheme.

We have published all Qotho PT schemes on the EPTIS database. Kindly inform your international referee labs and marketing teams - the direct link is <https://www.eptis.bam.de/eptis/WebSearch/view/432591>.

*Clients:*

We have expanded our capabilities and international presence and now service over 130 laboratories in sub-Saharan Africa and various International countries. Our current client base includes operations in Australia, Botswana, China, DRC, Germany, Malaysia, Mexico, Namibia, The Netherlands, Peru, Philippines, Tanzania, UK, USA, Zambia, and Zimbabwe, in addition to our well-established client base in South Africa.

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## 2. Proficiency Testing Schemes

- Proficiency testing schemes entail the organization, development and evaluation of tests (of the same item or similar items) by several laboratories, according to predefined conditions.
- It is a requirement of ISO 17025, that Laboratories participate in inter-comparisons programs and/or PT schemes.
- In addition, any laboratory that needs to demonstrate the quality of its analytical results in an independent way should participate in proficiency testing schemes, since the quality of the analytical results is directly linked to the quality of service / product, to the market credibility and brand image.
- Participation in Proficiency Testing Schemes is an essential tool to demonstrate the technical competence of the laboratory and it allows to:
  - Compare own results with those obtained by other laboratories.
  - Confirm the correct initial validation of a method.
  - Use the data obtained from participation in Proficiency Testing Schemes for validation of measurement methods.
  - Determine systematic errors.
  - Improve the test method used.
  - Learn from the methods used by other laboratories.
  - Monitor the accuracy and precision of the method.
  - Encourage collaboration between laboratories.
  - Demonstrate technical competence against third parties.


## 3. Why choose Qotho as your Proficiency Test Provider?

- We are an independent service provider, therefore no opportunity exists for biased interpretation of results, as may be the case through in-house operated schemes.
- We provide standardized method preparation of testing samples in accordance with ISO standards.
- Participation in the Qotho-run PTS provides a structured, annual PT framework and eliminates the need for laboratories to plan, organize and execute internal PTS.
- The PTS samples are typical of those tested by laboratories on a daily basis, thereby replicating the daily testing work performed by the laboratory on samples received from customers.
- Access to all general benefits that regular participation in PTS brings, including presentations and providing technical feedback on your laboratory's unique performance.

## 4. Quality Standards & Frameworks

Qotho PT schemes complies with the requirements of the following international standards:

- ISO/IEC 17043 - Conformity assessment - General requirements for proficiency testing.
- ISO/IEC 13528 - Statistical methods for use in proficiency testing by inter-laboratory comparisons.
- ISO 17034 - General requirements for the competence of reference material producers.
- IUPAC International Harmonized Protocol for the proficiency testing of analytical chemistry laboratories.
- Samples are prepared according to the ISO or other international standard & guidelines (e.g. ASTM, BSI etc.) for preparation of the particular commodity.

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**5. Scheme Framework**

**5.1 Coordination and Responsibilities**

- Responsibility and coordination of the schemes lies with Qotho Minerals.
- The PT Scheme Manager is responsible for the routine operations, monitoring & control of any subcontractors that may be used in the execution of the scheme.
- All practices and procedures are documented in our internal Quality System.

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<b>Communication</b>	<a href="mailto:admin@qotho.co.za">admin@qotho.co.za</a>	Appeals / Complaints & Comments / PT Registrations/Survey Feedback
<b>Results reporting</b>	<a href="mailto:results@qotho.co.za">results@qotho.co.za</a>	Dedicated Results email
<b>Sample delivery confirmation emails</b>	<a href="mailto:logistics@qotho.co.za">logistics@qotho.co.za</a>	Sample Tracking / Sample receipt

**5.2 Advisors & Advisory Committee**


- The technical and statistical expertise of advisors may be utilised from time to time. Where the inputs of an advisor have been used for a specific scheme or round-robin, this will be communicated in the final report of that particular round.
- An Advisory Committee, consisting of members who may or may not be participants of any particular scheme, but who have expertise on the particular commodity, is responsible for the overall direction of the scheme. The Committee will include a statistics expert.

**5.3 Type of Schemes**

- All the schemes operated by Qotho Minerals can be classed as quantitative, simultaneous schemes, where the assigned values of the test items are determined only once results have been returned by all the participants, and participants are then assessed on the difference between their result and the assigned value.
- The schemes are of a “closed” nature meaning they have a defined start and completion date. Qotho runs multiple rounds annually. All PT rounds run independent of one another.

**5.4 Scheme Framework**

- A minimum of 10 participants is required for a scheme to be initiated.

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- Participants' orders are processed and confirmed.
- Procurement/sourcing, preparation, packaging and Quality Control of test items.
- Test items dispatched to participants.
- Participants test the items and report the results and methodology used to Qotho, as instructed and within the agreed timeframe.
- Results analysed, and performance of laboratories assessed, using appropriate statistical techniques.
- Reports written and issued to participants.
- Round reviewed and requirements identified, for future rounds.
- Commencement of next round.

#### 5.5 Joining the Scheme & Scheme Costs

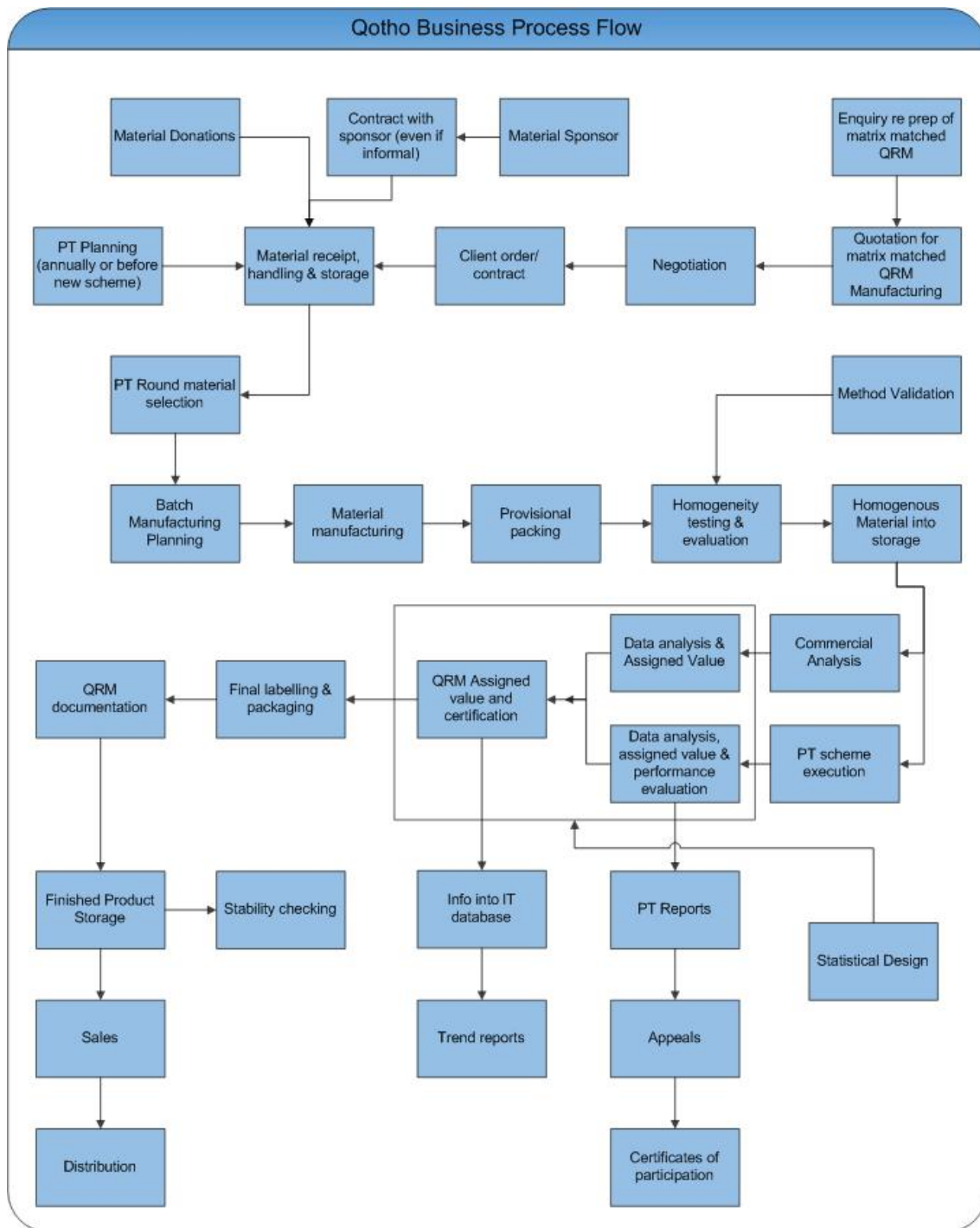
- All the currently available schemes, with details relating to types of samples and frequency, can be found on the Qotho website [www.qotho.co.za](http://www.qotho.co.za)
- An application form for the various Schemes is available. This must be completed and submitted to Qotho for processing. No applications will be processed without an official order number.
- Participants will be invoiced, pro-rata, on an annual basis (Calendar year), for the schemes and rounds that they choose to partake in. Alternatively, invoicing is done after the completion of each round.


#### 5.6 Confidentiality

- In order to ensure confidentiality, participants in the scheme are allocated a unique reference code.
- This approach enables results to be reported without linking the results to any particular laboratory.
- Each laboratory will know their unique code and is therefore able to extract their own data from the report.
- A general list of the participating laboratories to each scheme will reflect on each round being reported.

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**5.7 PT and QRM Flow Chart:**



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**6. Test Materials**

**6.1 Selection**

- Participants in the scheme will be offered the opportunity to supply the testing material for a round. This will enable participants to obtain scheme data on their own matrix and material type. Please contact the scheme administrator to obtain details of quantities required, etc. All costs related with the supply and delivery of the material to our offices in Johannesburg, will be for the particular participants' account.
- If participants do not volunteer material, it will be sourced by Qotho, at its own discretion - whilst still ensuring that the material meets the requirements and specifications of the relevant Scheme.

**6.2 Preparation & Homogeneity**

- Where relevant, samples are prepared according to the ISO standard for the preparation of the particular commodity (crush, dry, mill, screen).
- Blended samples are divided by means of a rotary splitter, until the desired subsample size is reached.
- Homogeneity tests will then be conducted, as per the criteria of the Harmonized Protocol for Proficiency Testing of Analytical Chemistry Laboratories, ISO 13528 as well as ISO Guide 35.
- If the samples pass the homogeneity test, they may be used in a PT round.
- If homogeneity is not achieved, the entire batch will be re-processed, until homogeneity is achieved.

**6.3 Delivery and Retention**

- Appropriately packaged samples are dispatched to participants.
- Once packages are delivered, the onus to maintain the integrity and stability of the material, transfers to the recipient thereof.
- Participants are requested to check the contents of the packaging upon receipt and to contact Qotho, should they consider that the integrity of the material has been jeopardised.
- The participant must retain the sample for that particular round until the final report from Qotho is issued for that round.

**6.4 Subcontracting**

- Various aspects of the proficiency testing scheme can from time to time be subcontracted. When subcontracting occurs, it is placed with a competent subcontractor and QM remains responsible for this work. QM subcontracts some homogeneity testing services to an ISO17025 accredited facility. Should there be other services which may be subcontracted, QM will inform the client in writing.

**7. Reporting of Results**

**7.1 Timing**


- In order to enable reports to be processed and issued as soon as possible after the closure of the test round, deadlines for the return of results are specified and must be adhered to. Refer to QM-GUI-004 Events Calendar 2020.
- Results received after the reporting deadline cannot be included in the report. The report is however available to all participants subscribing to the scheme, regardless of whether their results were submitted or not.

**7.2 Choice of Analytical Methods to be used**

- Unless otherwise instructed, participants may use any test method that they believe technically appropriate.
- Participants are asked to treat the test material in the same way as they would a routine sample.
- The procedures used, must be stated when reporting the results.

**7.3 Reporting Format**

- Unless otherwise instructed, results shall be reported in Excel format using the template provided by QM.
- It is recommended that results and calculations are checked thoroughly before reporting.
- The results should be reported clearly, in the format and units detailed in the scheme description.
- If calculations are used, only the final result must be reported.
- In general, results of 0 should not be reported - results should rather be reported as less than the determination limit of the procedure used.

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- Where participants use CRM’s as part of their analysis protocol, it is requested that the results of such CRM’s analysed with the sample, be reported as well.
- Results are reported as received, but where more than 3 decimal figures were reported, rounding may be done by Qotho.

**7.4 Number of Results**

- Each participant may only report two results per analyte (duplicate) or as determined in the Letter of Instructions to Participant, which is dispatched with every round.
- Where results from multiple analysts are used to derive the final number that is submitted QM, participants need to ensure that only statistically sound data processing methods are utilised. Guidelines are provided in Annexure A at the back.

**7.5 Turn Around Times**

- All assay results must be reported to Qotho by the reporting deadline. We aim to provide Laboratories 20 days for analysis.

**7.6 Collusion and Falsification of Results**

- Not returning genuine results, defeats the objective of participating in a proficiency scheme.
- Certain measures are built into the scheme to try and prevent collusion.
- Participants will be contacted directly, if collusion is expected.
- The responsibility, however, ultimately lies with each participant, to operate and conduct themselves in a professional manner.
- Proficiency testing samples may not be outsourced or subcontracted to external laboratories.

**8. Reporting of Analysed Data**

**8.1 Calculating z scores**

- Since the assigned value in our PT Schemes is a consensus value and the uncertainty requirements cannot always be guaranteed, QM - as a rule - uses (z’) scores, to evaluate participants’ performances. The statistics of a normal distribution means that 95% of data points will lie between a z’-score of -2 and +2. The z’-scores represent a measure of how far a result is from the (consensus) assigned value.
- The z’ score is calculated using the following formula:

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


Where:

- Xi = participant result
- X<sub>pt</sub> = Assigned value - computed with the Hampel estimator
- σ<sub>pt</sub> = Standard deviation for proficiency assessment (SPDA) - computed with the Q-Method
- U<sub>x<sub>pt</sub></sub> = Uncertainty of the assigned value - computed on the basis of the SDPA

The statistical evaluation of the results is performed using ProLab Plus software.

The basic performance categories and reporting formats to be used are as follows:

Score	Interpretation	Colour coding
z  ≤ 2.00	Satisfactory results	No colour
2.00 <  z  < 3.00	Questionable results	Amber
z  ≥ 3	Unsatisfactory results	Red
No score given	No result reported	Blank block

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**8.2 Report Format**

- Reports will be distributed electronically (pdf format), to all participants in the scheme. It will include details of the material tested, its composition, its assigned value, as well as graphic and tabular representation of participants' (participant codes, not actual names) results and performance. Where appropriate, comparative analysis of the various techniques used, per analyte, will also be included.

**8.3 Complaints, Advice and Feedback**

- Through continuous communication and feedback, Qotho Minerals welcomes the comments of participants to the scheme. These can be forwarded to [admin@qotho.co.za](mailto:admin@qotho.co.za). Our Complaints and Appeals Form QM-FQC-012 can also be used for this purpose and is available upon request.
- Where possible, practical and relevant, the necessary improvements will be incorporated into future rounds.

**9. Reference Materials**

- On completion of a round, analytical values will be assigned to the particular samples, based on the results of the PT round. A list of all the material available and their assigned values, will be made available to participants, upon request. This material will be on sale to laboratories, for use as Reference Materials. The reference materials will be available to the sponsor of the material, at a significantly discounted rate. Once adequate data is available, certification of the material will be done by Qotho, after which a COA will be issued.

**10. Document Approval**

This document was re-approved by Hannelie de Beer on 23 March 2020, incorporating the new company logo, document number and advanced electronic signature.

*Hannelie de Beer*

*This document has been electronically signed using an Advanced Electronic Signature (AES) in terms of the Electronic Communications and Transactions Act No. 15, 2002 (ECT Act). Any amendments to the document can be detected by reference to the Signature Panel displayed in the electronic pdf version of the document.*

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**Annexure A - Processing results from multiple analysts**

- Participants need to carefully consider raw data processing methods, when results from multiple analysts are considered. Only use protocols that are technically sound and statistically defensible. Ideally this should be captured in an internal SOP, which should ensure that the same protocol is used at all times.
- This is crucial as incorrect application methods can introduce bias into datasets, or result in values that is not considered representable of the complete dataset.
- Participants are encouraged to consult a recognised source on statistical methods for analytical chemistry.
- **Example - Data grouping & identification of outliers**
  - **Note** - Intent of example below is no way meant to be exhaustive, but rather illustrative.
  - Raw data from multiple analysts with repeat/duplicate assays are provided together with two approaches to grouping the data for evaluation.
  - Approach A segregates the analysts into two different groups, as opposed to Approach B where the complete dataset is considered. Approach A is not advisable as the grouping is subjective and could potentially introduce bias.
  - Once data is organised correctly, descriptive statistics and histogram plots can be used to evaluate information and identify outliers. It is important to consider the distribution of results. Averages should not be considered in isolation, but rather in context of dataset, and due consideration should be given to median, standard deviation, and the skewness parameters when outliers are identified within a dataset.

RAW DATA	GROUPING OF DATA																																																																																																		
<ul style="list-style-type: none"> <li>• Raw data comprising duplicate analysis from eight different analysts</li> </ul> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th></th> <th style="text-align: center;">VALUE</th> </tr> </thead> <tbody> <tr><td>Analyst A</td><td style="text-align: center;">A1</td></tr> <tr><td>Analyst A - repeat</td><td style="text-align: center;">A2</td></tr> <tr><td>Analyst B</td><td style="text-align: center;">B1</td></tr> <tr><td>Analyst B - repeat</td><td style="text-align: center;">B2</td></tr> <tr><td>Analyst C</td><td style="text-align: center;">C1</td></tr> <tr><td>Analyst C - repeat</td><td style="text-align: center;">C2</td></tr> <tr><td>Analyst D</td><td style="text-align: center;">D1</td></tr> <tr><td>Analyst D - repeat</td><td style="text-align: center;">D2</td></tr> <tr><td>Analyst E</td><td style="text-align: center;">E1</td></tr> <tr><td>Analyst E - repeat</td><td style="text-align: center;">E2</td></tr> <tr><td>Analyst F</td><td style="text-align: center;">F1</td></tr> <tr><td>Analyst F - repeat</td><td style="text-align: center;">F2</td></tr> <tr><td>Analyst G</td><td style="text-align: center;">G1</td></tr> <tr><td>Analyst G - repeat</td><td style="text-align: center;">G2</td></tr> <tr><td>Analyst H</td><td style="text-align: center;">G1</td></tr> <tr><td>Analyst H - repeat</td><td style="text-align: center;">G2</td></tr> </tbody> </table>		VALUE	Analyst A	A1	Analyst A - repeat	A2	Analyst B	B1	Analyst B - repeat	B2	Analyst C	C1	Analyst C - repeat	C2	Analyst D	D1	Analyst D - repeat	D2	Analyst E	E1	Analyst E - repeat	E2	Analyst F	F1	Analyst F - repeat	F2	Analyst G	G1	Analyst G - repeat	G2	Analyst H	G1	Analyst H - repeat	G2	<p><b>Approach A</b></p> <ul style="list-style-type: none"> <li>• Clustering results from different analysts into two different groups</li> <li>• <b>NOT ADVISABLE</b> as grouping is subjective and could potentially introduce bias</li> </ul> <table border="1" style="width: 100%; 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