

TERM OF REFERENCE FOR RESEARCH PROJECT

TITLE OF THE PROJECT: Study the Gravimetric (fire assay) test method for analyzing refined bullion containing gold content above 999.5 up to and including 999.9 fineness

1. BACKGROUND:

- 1.1 Gold bullion containing gold above 999.5 parts per thousand (ppt) up to and including 999.9 fineness is extensively manufactured, imported, and used in India. Currently, there is an Indian Standard, *IS 1418:2009 - Determination of Gold in Gold Bullion, Gold Alloys, and Gold Jewellery/Artefacts Cupellation Method*, which prescribes gravimetric (fire assay) test methods for determining fineness up to 999.5 ppt only.
- 1.2 For testing of gold above 999.5 purity there is an instrumental test method *IS 16901 :2022/ISO 15093:2020 Jewellery and precious metals Determination of high purity gold platinum and palladium - Difference method using ICP-OES*. However, the cost of the instrument ICP-OES is very high and there was a demand from the gold refineries and bullion exchanges to develop a gravimetric (fire assay) test method for determination of gold purity more than 999.5 fineness.
- 1.3 A need was thus felt to study, validate and include a new Gravimetric (fire assay) for testing gold purity more than 999.5 fineness in IS 1418.
- 1.4 The standards mentioned above can be accessed from <https://standardsbis.bsbedge.com/>

2. OBJECTIVE:

To study Gravimetric (fire assay) test methods available for analysis of refined bullion containing gold content above 999.5 up to and including 999.9 fineness and validate this test method.

3. SCOPE:

- 3.1 Study the available literature like National / International/ association/industry standards available, research papers, any study conducted by other organizations/institutes on the subject.
- 3.2 Identify the refineries/mint manufacturing this fineness.
- 3.3 Visit the refineries/mint to witness the testing facilities available and test methods used by them.
- 3.4 Test samples of known purity through the proposed test method and validate the test method.

3.5 Engage in discussions with the primary importers and exporters of gold bullion to gather data on the quantity of the product being imported and exported. Additionally, inquire about the technical regulations of the countries where the product is being exported. Obtain information from them regarding the methods they employ to test gold with a fineness more than 999.5 parts per thousand (ppt) purity

3.6 Identify the product users and gather data on the quantity they use, specifications used, check for the test certificates they have received, and study the fineness and test methods used.

3.7 Prepare a comprehensive analytical report of the data collected in the above.

4. METHODOLOGY:

4.1 Study the literature and analyse the available fire assay test methods for testing fineness more than 999.5 parts per thousand (ppt)

4.2 Visit the refineries/mints **engaged** in manufacturing and testing bullion **with purity** more than 999.5 parts per thousand (ppt) and

- a. Observe the manufacturing process,
- b. Examine in-process control measures,
- c. **Collect** data on the purity of the bullion they manufacture, along with the testing methods used and associated uncertainty values.
- d. Conduct focused group discussions with quality personnel regarding the methods used for testing bullions with purity more than 999.5 ppt.
- e. Make a list of test equipment's.
- f. Test samples of gold with known purity (fineness > 999.5ppt) in the refinery/mint laboratory using the proposed test method and validate this test method. Additionally, calculate the associated uncertainty. Samples of known purity are those tested and certified by the established instrumental method such as ICP-OES.

5.3 Visit the identified importers and exporters and collect data as mentioned in the scope through a questionnaire.

5.4 Visit the users of the product and collect data as mentioned in the scope through a questionnaire

5.5 Analyse the data and test reports and include the same in the project report.

5. SAMPLING PLAN

5.1 Two refineries or mint manufacturing/ testing gold bullion of purity more than 999.5 ppt shall be visited.

5.2 Three purity sample of gold content between 999.5 ppt and up to 999.9 ppt fineness needs to be tested by gravimetric analysis (Fire assay method) and the tests validated against the purity test by ICP –OES/Spark OES or any established method of requisite precision and accuracy.

5.3 Two users of the product shall be visited.

6. DELIVERABLES:

6.1 Final project report, in hard copy format as well as in soft copy, covering all aspects mentioned in the scope.

6.2 Questionnaire, discussion, visit reports, test reports to be appended with the final project report.

7. TIMELINE:

The duration of the project is 3 months from the date of award of the project. The proposed indicative timeline stage-wise is given below:

Sr No	Stage	Time from date of award of project (cumulative)
1	Literature review and identification of refinery/mint, user/user industry, and discussion with BIS for the finalization of sampling plan	1 month
2	Visit to refineries/mint, testing laboratories, users, importers and exporters and data collection	2 month
3	Preparation and submission of first draft report to BIS	2.5 month
4	Submission of final project report	3 month

8. Support from BIS will provide:

BIS will provide access to latest available editions of Indian standards and/ or international standards relevant to the project, on request.

9. Relevant sectional committee and Nodal officer from BIS

Sectional committee: MTD-10, Precious Sectional Committee

Nodal Officer:

Mr Shiv Prakash, Scientist D/ Joint Director – Member Secretary MTD 10,
Metallurgical Engineering Department; Email: mtd10@bis.gov.in