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Standard Specification for Refined Gold[1]

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1. Scope

1.1 This specification covers refined gold in cast bar form (Note 1).

1.1.1 *Grade 99.5*—Gold having a minimum fineness of 995.

1.1.2 *Grade 99.95*— Gold having a minimum fineness of 999.5.

1.1.3 *Grade 99.99*— Gold having a minimum fineness of 999.9.

1.1.4 *Grade 99.995*— Gold having a minimum fineness of 999.95.

NOTE 1—Other forms of unfabricated gold of commerce are not to be excluded under this specification.

1.2 The values stated in inch-pound units are to be regarded as the standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications[2]

E 1446 Test Method for Chemical Analysis of Refined Gold by Direct Current Plasma Emission Spectroscopy[3]

3. Materials and Manufacture

3.1 The metal may be produced by any process that yields a product capable of meeting the requirements of this specification. The purchaser, upon request, shall be informed of the refining process used.

3.2 The bars shall be of a quality generally acceptable to the trade.

4. Chemical Composition

4.1 The refined gold shall conform to the chemical composition prescribed in Table 1.

NOTE 2—For purposes of determining conformance with this specification, an observed value obtained from analysis shall be rounded to the nearest unit in the last right-hand place of figures used in expressing the limiting value, in accordance with the rounding method of Practice E 29.

5. Sampling

5.1 On agreement between the manufacturer and the purchaser, a sample may be taken from the melt before pouring (Note 3). The sample shall be in the form of shot or pins (Note 4 and Note 5).

NOTE 3—A single melt or bar(s) cast from a single melt shall constitute a lot for sampling.

NOTE 4—Pins of ⅜ in. (9.5 mm) or other suitable diameter may be cast into graphite molds or drawn into evacuated glass tubes. In some cases it may be necessary to draw the glass tube pins through 60-grit emery paper before acid leaching to remove adhering glass particles.

NOTE 5—In order to avoid surface contamination, the sample, irrespective of its nature, is to be leached in hot 1 + 1 HCl for 5 min, washed in water, rinsed twice in alcohol or acetone, and dried in a muffle at 110°C before portions are taken for analysis.

5.2 On agreement between manufacturer and purchaser an alternative sampling procedure may be used.

5.3 The amount of sample taken shall be sufficient to supply three portions for analysis; the mass of each portion shall be sufficient to permit the determination of its composition as set forth in Table 1.

5.4 After mixing thoroughly, the sample shall be divided into three parts, each placed in a package and sealed; one for the manufacturer, one for the purchaser, and one for the umpire.

5.5 All tools required are to be reserved exclusively for this work.

6. Method of Analysis

6.1 Chemical composition of the materials set forth in this specification shall be determined, in case of disagreement, in accordance with Test Method E 1446. The selection of test methods for the determination of elements not covered by that

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[2] *Annual Book of ASTM Standards*, Vol 14.02.

[3] *Annual Book of ASTM Standards*, Vol. 03.06.

TABLE 1 Chemical Requirements

Element[A]	Composition,%			
	Grade 99.5	Grade 99.95	Grade 99.99	Grade 99.995
Gold, min	99.5	...	...	...
Gold, min (by difference)	...	99.95	99.99	99.995
Silver + copper, max	...	0.04	...	...
Silver, max	...	0.035	0.009	0.001
Copper, max	...	0.02	0.005	0.001
Palladium, max	...	0.02	0.005	0.001
Iron, max	...	0.005	0.002	0.001
Lead, max	...	0.005	0.002	0.001
Silicon, max	...	...	0.005	0.001
Magnesium, max	...	...	0.003	0.001
Arsenic, max	...	...	0.003	...
Bismuth, max	...	...	0.002	0.001
Tin, max	...	...	0.001	0.001
Chromium, max	...	...	0.0003	0.0003
Nickel, max	...	...	0.0003	...
Manganese, max	...	...	0.0003	0.0003

[A]By agreement between manufacturer and purchaser analyses may be required and limits established for elements not specified in this table.

test method shall be a matter of agreement between the manufacturer and the purchaser.

6.2 Chemical composition of materials required for Grade 99.5 refined gold shall be determined by a test method similar to the fire assay test method listed in the appendix.

7. Rejection and Rehearing

7.1 *Rejection*:

7.1.1 Claims to be considered shall be made to the manufacturer in writing within 30 days of receipt of the material at the purchaser's plant, and the results of tests made by the purchaser shall accompany such claims. The manufacturer shall be given one week from the date of receipt of the complaint to investigate his records, and shall then agree either to satisfy the claim or to submit samples to an umpire. No claim shall be considered unless a portion of the original gold bars can be shown to the representative of the manufacturer.

7.1.2 Where the gold satisfies the requirements of this specification, it shall not be condemned for defects in the products in which it is used.

7.2 *Investigation of Claims*—In a question of chemical composition, a sample shall be drawn by representatives of both parties in accordance with Section 5. The sample shall be suitably separated into three parts, each of which shall be placed in a sealed package, one for the manufacturer, one for the purchaser, and one for an umpire, if necessary. The manufacturer and the purchaser shall each make an analysis, and if the results do not establish or dismiss the claim to the satisfaction of both parties, the third sample shall be submitted to a mutually agreeable umpire, who shall determine the question of fact, and whose determination shall be final.

8. Settlement of Claims

8.1 The expenses of the manufacturer's representative and of the umpire shall be paid by the loser or divided in proportion to the concession made in case of compromise. In the case of rejection being established, the damages shall be limited to the payment of transportation charges both ways by the manufacturer for substitution of an equivalent weight of gold conforming to this specification.

9. Product Marking

9.1 The brand by which the manufacturer can be identified shall be cast or otherwise legibly marked upon each bar. The bar shall be marked with the fineness together with the melt number, bar number, and weight to the nearest 0.001 troy oz (0.03 g).

10. Keywords

10.1 gold; refined gold

APPENDIX

(Nonmandatory Information)

X1. TEST METHOD FOR CHEMICAL ANALYSIS OF REFINED GOLD BY CUPELLATION FIRE ASSAY

X1.1 Scope

X1.1.1 This test method covers the cupellation analysis of Grade 99.5 refined gold for gold content.

X1.2 Summary of Test Method

X1.2.1 The weighed sample along with required silver, copper, and lead is cupelled until all base metal is absorbed and only the precious metals remain. The silver is then removed by dissolution with nitric acid. The remaining gold is dried, annealed, and weighed. Synthetic proof samples of known amounts of gold are also assayed and the sample is corrected for gains or losses in the proof sample.

X1.3 Interferences

X1.3.1 The presence of the following elemental concentrations will lead to erroneous results.

Element	Max. %
Nickel, Iron, Tin	2.0
Tungsten	0.5
Paladium, Platinum	0.01
Iridium, Rhodium, Ruthenium, Osmium	0.01

X1.4 Apparatus

X1.4.1 *Muffle furnace*, capable of maintaining 1250°C and having adjustable air flow control.

X1.4.2 *Analytical balance*, capable of weighing ±0.002 mg.

X1.4.3 *Rolling mill*.

X1.4.4 *Platinum basket*.

X1.5 Reagents and Materials

X1.5.1 *Nitric acid*, 22° Baumé, 1.169 ± 0.01 specific gravity by hydrometer.

X1.5.2 *Nitric acid*, 32° Baumé, 1.285 ± 0.01 specific gravity by hydrometer.

X1.5.3 *Lead foil*.

X1.5.4 *Silver wire*, 99.99 % (<0.001 ppt Au)

X1.5.5 *Copper disks*, 25 mg

X1.5.6 *Proof gold wire*, 99.999 %

X1.6 Procedure

X1.6.1 *Sample Preparation*—Wire brush chill pin samples to remove glass particles from surface, then cut and roll. After rolling, inspect the sample for inclusions or other signs of segregation. Drillings and grain samples are as is.

X1.6.2 Weigh samples in triplicate at 0.50____ g and place in 2.5-g lead cornucopias, along with 1.25 g of fine silver and 1/2 disk of copper.

X1.6.3 Prepare two proofs per sample. Weigh fine gold at 0.4975 ± 0.00050 g. Add silver at 1.25 g, along with 1/2 disk of copper.

X1.6.4 Close lead cornucopias and compress with pliers into spheres to fit cupels. Place in numbered tray compartments.

X1.6.5 Load a set of 15 (three rows of five) 1 in. magnesite cupels into the muffle furnace (no air flow) at approximately 1225°C and allow to dry for 30 min. Calibrate the temperature of the furnace by noting the temperature necessary to melt pure gold.

X1.6.6 Carefully place each lead wrapped sample in a cupel, starting with the next to the front row, as follows:

B	B	B	B	B
3A	P	3B	P	3C
2A	P	2B	P	2C
1A	P	1B	P	1C
B	B	B	B	B

where:

B = blank cupel, and

P = proof.

Close the door and wait 2 to 3 min until all samples become molten. Open the draft and adjust after 1 min for sufficient draft (fumes visibly rising off cupels and flowing back to vent in rear of furnace).

X1.6.7 After 8 to 10 min the samples will appear silvery but not solidified. At this point remove the cupels from the furnace one at a time and place in front of the furnace door, where the samples will immediately solidify and blink.

X1.6.8 Once cooled, remove beads from cupels with flat pliers and place in dimpled porcelain trays.

X1.6.9 Clean beads by squeezing bead with flat plier and brushing away adhering bone ash.

X1.6.10 Flatten beads with one middle blow and several end blows. Roll beads to about 0.040 in. by passing twice through hand roller, and anneal at 1550°F (843.3°C) for 7 min.

X1.6.11 Roll beads to a thickness of 0.015 in. by passing twice through hand roller, and anneal again at 1550°F (843.3°C) for 7 min. Finally roll beads to 0.012 in., and anneal one final time at 1550°F (843.3°C) for 7 min. The edges of the rolled bead must be smooth and have no roughness. It is important that all fillets of each row are the same size and thickness.

X1.6.12 Coil fillets into “coronets” or spirals using thin-nose pliers or rolling tool.

X1.6.13 Place coronets in a platinum basket in a definite pattern so as not to mix each coronet.

X1.6.14 Place the basket in 22° Baumé nitric acid at 105°C (boil gently) for 45 min, for full basket.

X1.6.15 Remove the basket, rinse with hot deionized water and place in 32° Baumé nitric acid at 110°C (boil gently) for 45 min, for full basket.

X1.6.16 Rinse the basket first in hot deionized water, then a hot 5 % ammonium hydroxide solution rinse, and three more hot deionized water rinses.

X1.6.17 Place the basket (still containing coronets) on the hot plate and dry.

X1.6.18 Place the basket in an annealing furnace at 1550°F (843.3°C) for 7 min.

X1.6.19 Cool gold coronets and weigh.

X1.7 Calculation

X1.7.1 *Gold Concentration*:

$$\text{Gold concentration in parts per thousand} = \frac{A \times B \times 1000}{C}$$

where:

A = Final gold weight, g,
B = Average of two proof factors, and

$$\text{Proof factor} = \frac{\text{Initial proof gold weight, g}}{\text{Final proof gold weight, g}}$$

C = Initial sample weight, g.