P.O.P Gold Coin: Jeweler / Goldsmith Production Instructions

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Status: the coin is in the production draft phase. It has **not been made yet**. This is a planning document for a jeweler, goldsmith, die-maker or mint who is quoting or making it. Values marked **(prop.)** are *proposed* starting values from us, not published standards. The die-maker or caster must confirm them with test pieces. This is not engineering, legal or investment advice.

Drawings: `pop-coin-mold-blueprint-RevA.pdf` (die set and casting mold), `pop-mint-drawing-RevA.pdf` (coin drawing), `pop-mint-spec-sheet.pdf` (1-page quote request).

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1. The coin at a glance

Item	Value
Metal	22K (0.9167 fine) rose gold
Fine gold	**≥ 15.552 g** (exactly 1/2 troy ounce)
Gross weight	**≥ 16.966 g** (typical 16.966 to 17.07 g, +0.10 / −0.00 g, prop.)
Typical alloy	Au 91.67 % · Cu ≈ 6.83 % · Ag ≈ 1.50 % (mint/caster to confirm)
Diameter	27.00 mm ±0.05
Thickness	rim 2.15 mm ±0.05, field ≈ 1.49 mm
Rim width	1.10 mm ±0.10
Relief	up to 0.28 mm above the field
Edge	reeded, 132 reeds (pitch 0.643 mm)
Front	Red Panda tearing the panda mask, letters "P.O.P", hard-enamel color in cells between raised polished gold lines (enamel recess ≈ 0.20 mm, prop.)
Back	only "1/2 OZ" and "22KT GOLD"
Year / face value	none
Finish	proof-style: polished raised parts on a satin field
Packaging	Air-Tite H27 direct-fit capsule or equivalent (27 mm)
Tooling tolerances (prop.)	cavity / die diameter ±0.01 mm, depths ±0.01 mm

Weight check. 16.966 g × 0.9167 = 15.553 g fine gold. If the assay comes in below 916.7 ‰, raise the gross weight so that fine gold stays ≥ 15.552 g. Fine gold is the floor. Never ship a coin with less than 15.552 g of fine gold.

Reference coins for size: U.S. Mint 1/2 oz American Gold Eagle (27.00 mm, 2.15 mm, 16.966 g, 91.67 % gold) and 1/2 oz Krugerrand (27.07 mm max, 2.215 mm max, 16.965 g).

2. Two production routes

	Route A: struck with hardened steel dies	Route B: lost-wax casting
Who	mint or die-maker with a coin press	jeweler / caster, small runs
Master	engraved or EDM-cut steel dies + reeded collar	3D-printed or CNC master (resin / wax)
Quality	**recommended**: crisp relief, true reeds, flat field, repeatable weight	softer detail, some porosity risk, reeds usually finished by hand
Cost	high tooling, low cost per coin	low tooling, high cost per coin
Drawing	sheet 1 of the mold blueprint	sheet 2 of the mold blueprint

Both routes end with the same enamel, finishing, assay, QC and packaging steps (sections 5 to 8).

3. Alloy and weighing (both routes)

1. **Alloy:** gold 91.67 %, copper ≈ 6.83 %, silver ≈ 1.50 % (prop.). More copper makes the color pinker. Use a ready-made 22K rose master alloy if possible; a supplier's rose master alloy at 916 uses 0.916 gold and 0.084 master alloy.[1]
2. **Zinc:** for a coin that will be enameled, prefer a **zinc-free or very-low-zinc** alloy (under ≈ 1–2 %). Copper oxide and zinc both hurt enamel adhesion.[2]
3. **Weigh** gold, copper and silver on a 0.001 g balance. For 16.966 g of metal: gold 15.552 g, copper 1.159 g, silver 0.254 g. Weigh the charge, not the finished coin. Add sprue and button metal for Route B (≈ 4 to 6 g extra, prop.).
4. **Melt** under a protective flux or charcoal cover. The traditional order is copper at the bottom, then silver, then gold, covered with charcoal and borax; stir with a hot graphite rod before pouring.[3] Supplier data for 20K to 22K alloys quotes about **1,050 to 1,070 °C** for alloying melts.[4]
5. **Scrap:** reuse no more than about 50 % returned scrap per melt.[1]
6. **Record** the heat number, batch weights and a witness sample for assay.

4. Route A: struck coin (recommended)

A1. Dies and collar. Give the die-maker `pop-coin-mold-blueprint-RevA.pdf` sheet 1 and the art files. The dies carry the mirror image of the coin, the rim groove (1.10 wide, 0.33 deep below the field plane), relief up to 0.28 mm, and the enamel cell walls. The collar has Ø27.00 +0.02/−0.00 (prop.) bore with **132 reed grooves** about 0.10 mm deep (prop.). Dies and collar are cold-work tool steel, hardened after the impressions are cut, typically about **58 to 63 HRC**.[5][6] Keep relief walls at 10 to 15° of draft and avoid undercuts (prop.).

A2. Ingot and strip. Pour the alloy into a clean mold that has been warmed and lightly oiled, then roll in several passes.[3] Rose (copper-rich) alloy work-hardens faster than yellow: anneal after about 50 % reduction (prop.; yellow alloys can take more).[7] Roll to strip thickness a little above 2.15 mm (prop.).

A3. Blank and weigh. Punch blanks about Ø26.80 to 26.85 mm (prop.). Weigh every blank. Target 16.966 to 17.07 g gross; correct heavy or light blanks by adjusting thickness, not diameter.

A4. Anneal. Furnace-anneal blanks at about **650 °C** (suppliers quote 650 °C; a general range for karat golds is 550 to 650 °C, and a bench reference gives 677 °C for 10 minutes).[8][3][7] Hold only as long as needed for the blank to heat through, because long holds grow the grain. Use a non-oxidizing atmosphere or a boric-acid/flux coat, then **water quench**.[3][7] Pickle, rinse and dry. The U.S. Mint anneals in an oxygen-free furnace and quenches for the same reasons.[9]

A5. Upset (optional). Run the blanks through a rim-upsetting mill to raise a rim, as the U.S. Mint does for its planchets.[9]

A6. Strike. The press drives the obverse and reverse dies together with the blank inside the collar. The collar holds the diameter and forms the reeded edge.[9] A 27 mm gold coin with 0.28 mm relief usually needs more than one strike with an anneal between strikes (prop.). Press force is the mint's call; start with test pieces and check the first article against section 8.

A7. Check each coin for full rim, full reeds, no die-flow lines, flat field, weight and diameter. Reject cracked or laminated pieces.

Go to section 5 (enamel).

5. Enamel (both routes)

The front is meant to carry **hard (vitreous) enamel** in the cells. Two ways to do it:

Option 1: vitreous (hard) enamel, as specified.

- Gold is a good base for vitreous enamel because it does not form troublesome oxides, and the alloy's solidus must be well above the firing temperature.[10] Conventional jewellery enamels fire at roughly **810 to 840 °C**,[11] and typical kiln firings of 1,450 to 1,500 °F (790 to 815 °C) for about 1.5 to 2 minutes to gloss are quoted by an enamel maker.[12] A 22K rose alloy softens at about 1,000 °C and melts near 1,040 °C,[13] so standard enamels are workable. A **low-fire / lead-free enamel** is a sensible choice if the caster wants more margin. Confirm with a test plate in the real alloy.
- **Copper in rose gold is the risk.** Copper oxide hurts adhesion and color. Pickle and clean thoroughly, apply a protective flux first, and fire quickly. A first flux layer is common, and red/pink enamels on gold usually need a flux base; follow the enamel supplier's chart.[211]
- **Stress-relieve first** (about 349 °C for 1 to 2 minutes for karat golds) so the coin does not distort in the kiln.[2] Fire on a flat setter.
- **Steps:** (1) clean and pickle, (2) wet-pack the first color in its cells, dry, (3) fire to gloss, cool slowly, (4) repeat per color and layer (russet orange, white, black, dark brown, bamboo green, pink-red tongue), harder enamels first, (5) build slightly proud, (6) stone or grind flush with the gold line tops, (7) brief re-fire to gloss, (8) pickle.[212]
- **Note:** the firing heat anneals the coin (softens it). That is acceptable for a finished coin, but do not strike after enameling.

Option 2: cold enamel (fallback). Two-part epoxy or UV-cured pigmented resin in the same cells (prop.). No kiln, so no distortion and no copper-oxide problem, but it is **not** vitreous enamel, scratches more easily, and the coin should then not be described as "hard enamel". Ask the customer before substituting.

Enamel weight is negligible (under about 0.1 g), and gold content is unchanged.

6. Finishing, marking and assay (both routes)

1. **Polish:** polish the raised gold lines and rim; keep the field satin (proof-style). Remove stock evenly; leave the polished diameter at 27.00 ±0.05 and rim thickness at 2.15 ±0.05.
2. **Mark:** the reverse reads "22KT GOLD". Add the maker's mark only where the artwork leaves room (none planned on the edge).
3. **Assay:** have an independent lab check fineness by **fire assay (cupellation)**, the reference method for gold alloys (ISO 11426:2021), on a witness sample from each melt. Handheld XRF is a quick surface check only. Minimum fineness **916.7 ‰** (0.9167).

4. **Hallmarking:** in the UK, 22-carat gold uses the **916** fineness mark, and hallmarking law exempts "current coin" but not ordinary medals or tokens. A private, non-legal-tender coin may need an Assay Office mark if sold there.[14] Other countries differ. Check local rules with the mint or counsel (not legal advice).

7. Route B: lost-wax casting (small runs)

Use sheet 2 of the mold blueprint.

B1. Master. Make a 3D-printed (castable resin or wax) or CNC-machined master at **+1.35 % oversize** (prop.): Ø27.365 × 2.179 rim, 1.510 field, 1.115 rim width, 0.284 relief, 0.203 enamel recess. Gold alloys shrink roughly **1.25 to 1.65 %** on casting, and a total expansion of about 1.5 % is the traditional target;[15][16] very small printed pieces can come out as low as 0.5 % shrinkage with zero-wax-shrink printing,[13] so **test-cast and correct**. Leave about 0.03 mm per face to polish.

B2. Sprue and vents. Stand the coin **on its edge**. Attach one sprue Ø8 tapering to Ø5 at the **12 o'clock rim** (gate), and cut vent slots about 0.15 × 3 mm at 3, 6 and 9 o'clock in a split mold (prop.). For an investment flask, the same single edge gate on the wax tree applies; use vacuum or pressure assist so the metal fills the thin field.

B3. Investment and burnout. Use a phosphate- or gypsum-bonded investment suited to gold, vacuum-mix, burn out on the supplier's cycle (a long cycle, never a hot furnace load), and let the flask **hold at casting temperature for at least 1 hour** before casting.[17] Flask temperature about **550 to 650 °C**; some suppliers quote 600 to 700 °C for 22K.[11][17][18]

B4. Melt and pour. Melt about **950 to 980 °C** and pour at about **1,050 to 1,150 °C** (22K rose master alloy data).[1] Other sources for 22K give 1,000 to 1,150 °C,[18] 1,040 to 1,140 °C,[17] and 1,050 to 1,100 °C.[4] The 22K rose liquidus is about 1,040 °C,[13] so a pour near **1,050 to 1,100 °C** (prop.) with vacuum or centrifugal casting is a good starting point. Charge = coin weight + sprue/button; use pre-grained alloy.

B5. Quench and clean. Wait about 15 to 20 minutes before quenching the flask,[4] then pickle at 60 to 70 °C for 15 to 30 minutes.[1]

B6. Anneal and finish. Anneal at about 650 °C and quench (section 4, A4). Check for porosity (weigh against the target; cut-test one coin per batch). Flatten and clean the field. Cut the **132 reeds** on the edge with a reeding tool or indexed lathe if they did not cast cleanly (prop.). A **hybrid** option is to cast a plain blank and give it a light strike in the Route A dies (prop.).

B7. Continue with enamel (section 5), finishing/assay (section 6), QC and packaging (section 8).

8. Quality control and packaging

Check	Accept	Basis
Diameter	27.00 ±0.05 mm	spec
Thickness at rim	2.15 ±0.05 mm	spec
Rim width	1.10 ±0.10 mm	spec
Gross weight	16.966 to 17.07 g	spec / prop. tolerance
Fine gold	≥ 15.552 g; fineness ≥ 916.7 ‰ (fire assay on witness sample)	spec
Reeds	132, full and even around the edge	spec
Relief height	up to 0.28 mm; lines polished	spec
Enamel	fully fused, flush with line tops ±0.03 mm, no pinholes, no cracks, colors match approved sample	prop.
Surface	no scratches, porosity or die-flow marks visible at 10×	prop.
Flatness	field flat within 0.05 mm	prop.
Sampling	first article approval, then 100 % weigh and visual, dimensional check on every 10th coin	prop.

Packaging. Place each coin in an Air-Tite H27 (or equivalent 27 mm) capsule, handle with cotton gloves, and add a numbered card. Never touch the faces. Pack in a padded box and insure shipments by declared value.

9. What to ask the mint or goldsmith when quoting

1. Which route do you recommend, and what are tooling and unit prices at 25, 100 and 500 coins?
2. Can you supply 22K rose gold blanks at Au 91.67 % and confirm the copper/silver split?
3. Do you offer hard (vitreous) enamel on 22K rose gold, and what is the longest test time and cost?
4. What shrinkage / reed-cutting method do you use if casting?
5. What assay and certificate do you provide?
6. Lead time, minimums, payment and shipping terms.

Sources

Fire assay standard referenced in section 6: ISO 11426:2021, Jewellery and precious metals — Determination of gold — Cupellation method (fire assay), https://www.iso.org/standard/75771.html. Fineness and size references: U.S. Mint American Gold Eagle specifications; South African Mint Krugerrand specifications.

Notes: dimensions, enamel depth, reed depth, die clearances, weight tolerance, shrinkage factor and QC limits marked (prop.) are proposals by Proof of Panda. The sources above were read on Nov 26, 2026; supplier data are for their own alloys and may differ for yours.

1. Hygrade Casting, "22 Karat Rose Master Alloy" (916 fineness, melt 950–980 °C, cast 1,050–1,150 °C, flask 550–650 °C, pickle 60–70 °C for 15–30 min, scrap reuse ≤ 50 %). https://hygradecasting.com.au/products/hygrade-casting/casting-master-alloys/22-karat-alloys/22-karat-rose-master-alloy-detail ↩↩↩↩↩
2. S. Grice, "The Metal Underneath", Ganoksin (alloy choice, zinc and copper, stress relief ≈ 349 °C, firing ≈ 816 °C, layering and finishing). https://www.ganoksin.com/article/the-metal-underneath/ ↩↩↩↩
3. Bureau of Indian Standards, IS 2790:1999, Guidelines for manufacture of 23, 22, 21, 18, 14 and 9 carat gold alloys (melting order, ingot pouring, annealing 550–650 °C, atmosphere, quench). https://law.resource.org/pub/in/bis/S10/is.2790.1999.pdf ↩↩↩↩

4. United Precious Metal Refining, UNITED Alloy #490 data sheet (alloying melt 1,050–1,070 °C, 20K–22K casting 1,050–1,100 °C, quench after 15–20 min). https://unitedpmthailand.com/data/en/pdf/UNITED%20ALLOY%20490%20(E).pdf ↩↩↩

5. The Ike Group, "Metallurgy of Ike Dollars" (coin dies and hubs: tool steel hardened after forming, about 58–63 HRC). https://www.ikegroup.info/?page_id=840 ↩

6. "Wear Mechanisms and Service Life of PVD-Coated Collar Dies in Coin Minting", Production Engineering Archives (collar dies: cold-work tool steels, about 59–64 HRC, reeded grooves). https://doi.org/10.30657/pea.2026.32.4 ↩

7. Stuller Bench Jeweler, "Annealing Gold, Silver, and Platinum" (karat golds ≈ 677 °C for 10 min then water quench; cold work limits: yellow/green up to 60 %, red up to 50 %). https://www.stuller.com/benchjeweler/resources/bencharticles/view/annealing-gold/ ↩↩↩

8. Cookson Gold, "22ct DS Yellow Alloy Properties and Process Data" (furnace anneal 650 °C, minimal hold, water quench). https://www.cooksongold.com/downloads/files/bullion/22ctDS_properties_sheet.pdf ↩

9. U.S. Mint, "Coin Production" (blanking, annealing in oxygen-free furnace then quench, upsetting, striking with collar forming the edge). https://www.usmint.gov/learn/production-process/coin-production ↩↩↩

10. Ganoksin, "Metals Suitable for Enameling" (gold as an enameling base; solidus must be above firing temperature). https://www.ganoksin.com/article/metals-suitable-for-enameling/ ↩

11. Milton Bridge, jewellery enamel data (transparent 820–840 °C, opaque 810–830 °C; flux for gold-bearing reds and pinks). https://www.milton-bridge.co.uk/images/pdf/jewellery-enamel/milton-bridge-and-lead-free/MB-Enamel-Colour-Chart2.pdf ↩↩

12. Thompson Enamel, "Enameling Help and Information" (kiln 1,450–1,500 °F, fire to gloss in about 1.5–2 minutes, test small samples). https://thompsonenamel.com/enameling-help-and-information/ ↩↩

13. Hygrade Casting, "Casting Technical Information" (22K rose gold: density 17.08 g/cm³, softening about 1,000–1,020 °C, liquidus about 1,040 °C; small-piece casting shrinkage as low as 0.5 % with zero-shrink printed wax). https://hygradecasting.com.au/our-services/casting-info/casting-technical-information ↩↩↩

14. UK Hallmarking Act 1973, Schedules 1 and 2 (916 fineness mark for 22 ct; exemption for current coin). https://www.legislation.gov.uk/ukpga/1973/43/schedule/1 ↩

15. T. E. Moore, "Résumé of the expansion required to compensate for casting gold shrinkage", J. Prosthetic Dentistry, 1952 (about 1.5 % combined expansion needed). https://www.thejpd.org/article/0022-3913(52)90092-9/abstract ↩

16. BDS Notes, "Metal Casting Processes: Understanding Shrinkage, Expansion, and Compensation Techniques" (gold alloy casting shrinkage about 1.25–1.65 %). https://bdsnotes.com/metal-casting-processes-understanding-shrinkage-expansion-and-compensation-techniques/ ↩

17. SRS (Goodwin Refractory Services), "Burnout Guidelines & Casting Temperatures" (hold flask at casting temperature ≥ 1 hour; 22K yellow pour 1,040–1,140 °C). https://www.srs-ltd.co.uk/technical-advice/burnout/ ↩↩↩

18. Siam Casting Powders, "Casting Temperature Guide" (22ct gold: pour 1,000–1,150 °C, flask 600–700 °C). https://www.siamcasting.com/casting_temperature_guide.html ↩↩