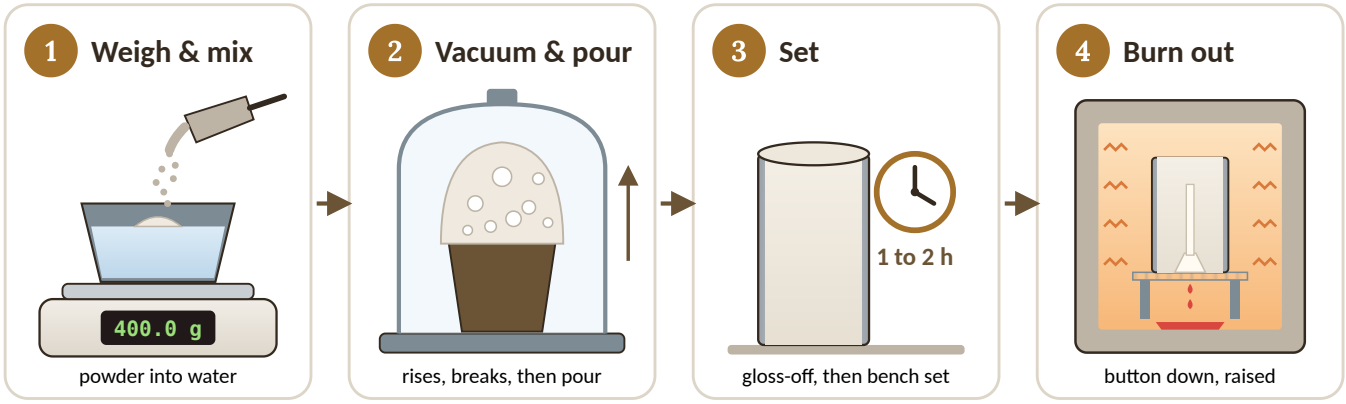
INVESTING AND BURNOUT GUIDE

From a wax tree to a clean, hot mould.

Your tree is built and weighed. Next it is set in a flask of investment, and the kiln melts and burns out the wax to leave a mould ready for metal. This guide explains how each step works and what to check in your investment maker's instructions. Their numbers always come first, because every powder is a little different.



THE NUMBERS AT A GLANCE

38 to 40
g of water per 100 g of powder, as your maker specifies

8 to 10 min
typical working time, from powder into water to the vacuumed flask

1 to 2 h
typical bench set before burnout, longer for big flasks

About 730°C
top of a standard gypsum investment cycle. Never above your maker's maximum

1 h min
at casting temperature before you cast, longer for big flasks

WHAT YOU NEED

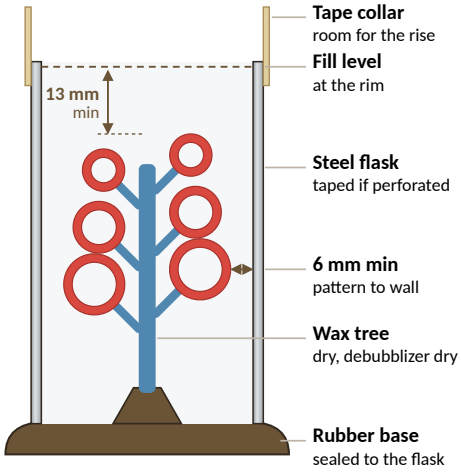
- **Investment powder** — fresh, sealed, stored dry
- **Digital scale** — for powder and water
- **Distilled water** — and a thermometer
- **Mixing bowl and mixer** — or a spatula
- **Vacuum investing unit** — bell jar and pump
- **Flasks and tape** — collar and perforated tape
- **Burnout kiln** — programmable, vented
- **Flask tongs** — plus heat resistant gloves
- **P2 respirator** — fit tested, for the powder

Before you start

- **Read your powder's instructions.** Ratio, mixing time, bench set and cycle all differ between powders.
- **Get everything ready first.** Once powder meets water, the clock is running.
- **Fresh, dry powder.** Investment absorbs moisture, so keep it sealed and off the floor.

1 Prepare the flask

- **Check the fit.** At least 6 mm from any pattern to the flask wall, and at least 13 mm of investment above the highest pattern, as in our casting tree guide.
- **Solid or perforated.** Perforated flasks are used for vacuum casting, where the vacuum pulls through the flask wall. Cover the holes with perforated flask tape before investing. The tape burns off in the kiln or peels off once the investment has set.
- **Add a tape collar.** A band standing about 25 mm above the rim holds the mix as it rises when you vacuum the flask. Seat the flask firmly on the rubber base so nothing leaks at the join.
- **Debubblizer.** As in the tree guide: it helps stop air bubbles clinging to the wax. Recommended with a bell jar setup like this one, optional only if an investing machine mixes and pours under vacuum. Let it dry completely.

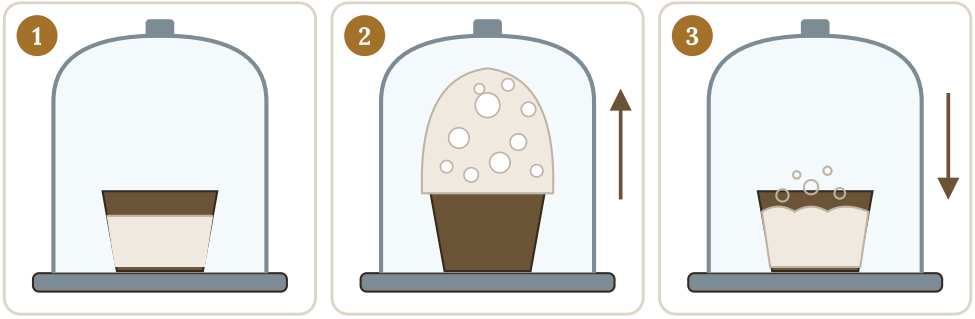


2 Weigh and mix

- **Weigh the water as well as the powder.** 1 ml of water weighs 1 g, so the scale beats a jug. Take the amounts for your flask size from the maker's chart.
- **Common ratios are 38 to 40 g of water per 100 g of powder:** less water for heavy pieces, a little more for fine filigree, as your maker advises. Be exact. A 5% error in the water can shift the setting time by 30 to 45 seconds.
- **Distilled or deionised water at about 21 to 24°C.** Warmer water shortens the working time, colder lengthens it.
- **Powder into water, never the other way round.** Start the timer, wet the powder out within about 30 seconds, then mix for your maker's time, typically 3 to 5 minutes.

3 Vacuum the mix

- **Vacuum the bowl** until the mix rises, breaks and starts to boil, then only as long as your maker says past the boil (Kerr about 20 seconds, Prestige 1.5 minutes). Keep it short: R&R's Ultra-Vest sheet says no more than 2 minutes in all.



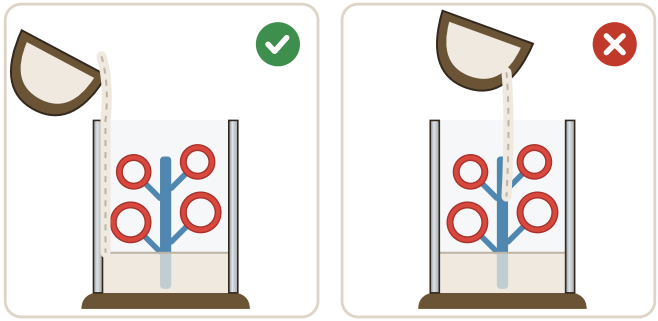
Vacuum on
the pump draws the air out

It rises
air expands out of it

It breaks and boils
then stop, per your maker

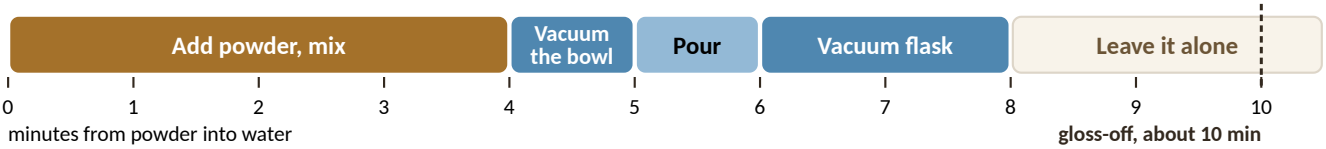
4 Pour and vacuum the flask

- **Pour down the side of the flask,** never over the patterns. The slurry fills from the bottom up and pushes the air out ahead of it.
- **Vacuum the filled flask** for about 1 to 2 minutes, as your maker specifies. The collar catches the rise.
- **Finish inside the working time,** usually about 8 to 10 minutes from powder into water. Slurry handled after it starts to thicken gives fins, water marks and loose investment in the casting.



Down the side
fills from the bottom up

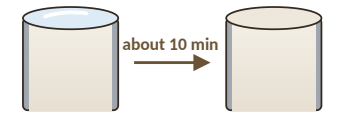
Onto the patterns
can break fine wax, traps air



Example: Goldstar's hand mix sequence for Omega+ and XL, 8 minutes in total. Gloss-off time from Stuller. Other powders and machine mixing differ.

5 Let it set

- **Watch for gloss-off.** Around 10 minutes after the powder went in, sometimes a little later, the shine turns matt. Do not move or knock the flask while it sets.
- **Bench set for your maker's time,** commonly 1 to 2 hours: Goldstar Omega+ 90 minutes, Goldstar XL, Kerr and R&R 2 hours. Too soon in the kiln and the mould can crack or shed investment into the casting.
- **Keep it moist.** Flasks go into the kiln moist, not dried out: the steam helps push the wax out. If they must wait, for example overnight, follow your maker. R&R's Bandust sheet says past 6 hours, rewet, cover with a wet cloth and seal in a bag.
- **Before loading,** remove the base and collar, and clear loose investment from the sprue opening.

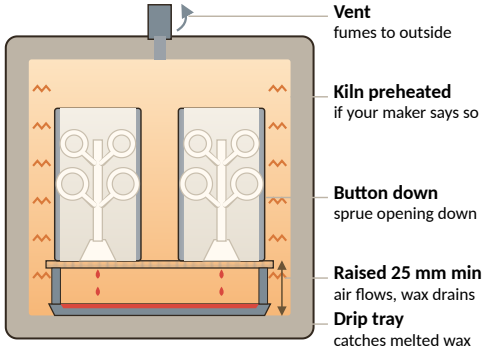


Printed wax: what to expect in the kiln

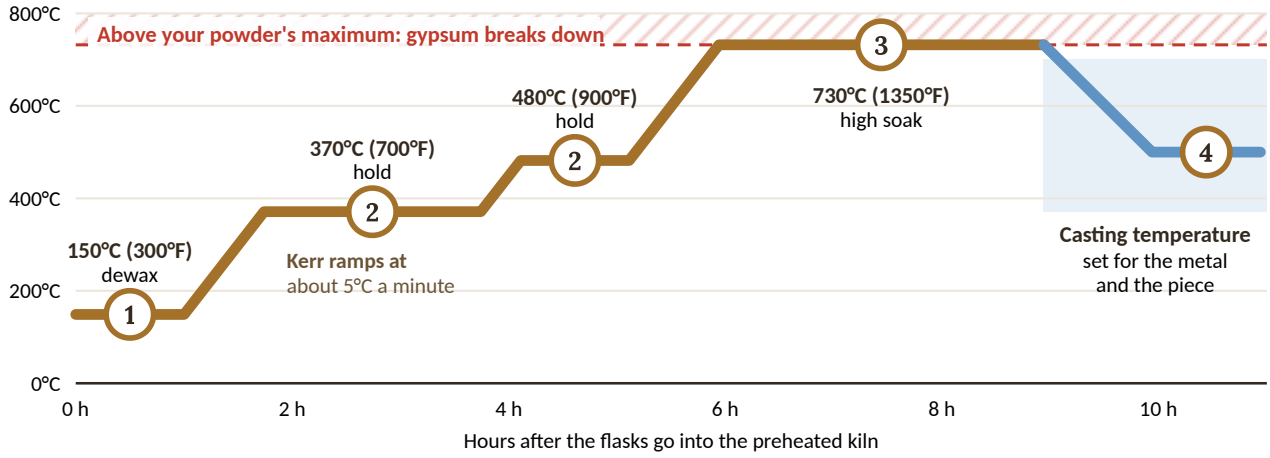
- **It melts early.** The WaxJet's red model wax melts at 68°C, so it softens and drains in the dewax stage, before the flask sees casting heat.
- **It pushes on the mould first.** Wax expands as it warms. In a 2024 lab test, a solid sample of one FDM printing wax pushed about twice as hard as an injection wax, though its porous printed parts did better. The WaxJet's wax was not tested, so use a good investment, the full bench set and your maker's ramps.
- **It still has a carbon stage.** Ash is under 0.01%, but keep the full high soak. Use your powder's cycle for wax patterns, not a resin cycle.

6 Load the kiln and burn out

- **Button down, raised.** Load the flasks sprue opening down, on a mesh or stand at least 25 mm above the floor, so air circulates and the wax drains. Preheat the kiln only if your maker says so.
- **Leave space around each flask.** The carbon left by the wax needs air to burn off.
- **Bigger flasks need longer cycles.** R&R's Ultra-Vest cycle runs 10 hours for flasks up to 2.5 x 5 inches, 14 hours up to 4 x 6 and 18 hours up to 6 x 12. A full kiln needs more time too.



HOW A BURNOUT CYCLE WORKS



The shape of a typical cycle, not a schedule to copy. Use your investment maker's schedule. Drawn from Kerr's Satin Cast 20 eight hour cycle for a 3.5 x 4 inch flask (holds of 1, 2, 1, 3 and 1 hours), with Kerr's ramps of about 5°C a minute. Cycles for standard gypsum powders such as R&R Ultra-Vest, Kerr Satin Cast 20 and Goldstar XL peak at about 730°C (1350°F). A few powders are rated higher, such as Goldstar Omega+ at up to 850°C.

1 **Dewax, about 150°C.** The wax melts and drains. Steam from the moist investment helps carry it out.

2 **Slow ramps and holds.** The last water leaves and the silica goes through its steepest expansion. Rushing cracks moulds. Stuller suggests about 2°C (4°F) a minute.

3 **High soak, about 730°C.** Burns the wax's carbon out of the mould and cures the investment. Above your powder's maximum, the gypsum breaks down and gives off sulphur gases: stained metal and gas porosity.

4 **Down to casting temperature, then hold.** The core of the flask lags behind the kiln display, so hold at least 1 hour. Stuller waits 2 hours for a tall flask 100 mm (4 inches) across.

SAFETY

- **Silica dust.** Investment contains crystalline silica, which causes silicosis. Wear at least a P2 respirator, fit tested, when handling powder, and use local extraction where you weigh and mix.
- **Clean up wet.** Never dry sweep or use compressed air. Wet wipe, mop, or use an M or H class HEPA vacuum.
- **Kiln fumes and hot flasks.** Burning wax gives off irritating fumes, including acrolein and formaldehyde, so vent the kiln to outside. Use non-slip flask tongs, heat resistant gloves, protective clothing and eye protection, and shade 2 or darker glasses to look into a glowing kiln.

FLASK TEMPERATURE FOR CASTING

PIECE	KERR SATIN CAST 20	STULLER, CARAT GOLD
Heavy, plain pieces such as men's rings	370 to 480°C (700 to 900°F)	425 to 540°C (800 to 1000°F)
Fine, detailed pieces such as filigree and findings	480 to 540°C (900 to 1000°F)	590 to 700°C (1100 to 1300°F)

- **Your alloy maker's data sheet wins.** These are typical starting ranges from two sources, and they differ. White gold usually runs at the high end, and a mixed tree is set closer to what its lightest pieces need.
- **Platinum is different.** It needs a platinum investment, such as a phosphate-bonded one, with its own cycle, not a gypsum powder.

TROUBLESHOOTING

WHAT YOU SEE	LIKELY CAUSE	WHAT TO DO
Fins or flash on the casting	Cracked mould: wrong water ratio, slurry worked past its working time, flask moved too soon, or heated too fast	Weigh water and powder, finish in time, full bench set, follow the maker's ramps
Small metal balls (nodules)	Air bubbles on the wax: no debubblizer, mix not vacuumed enough, or a weak vacuum pump	Debubblizer, vacuum the bowl and the flask fully, service the pump
Water marks or a rough surface	Investing too fast, wrong water ratio, slurry handled past its working time, or a rough pattern	Pour steadily down the side, weigh accurately, stay in time, smooth patterns
Investment inside the casting	Sharp corners on the sprues, flask into the kiln too soon, or heated too fast	Fillet every join, full bench set, slow ramps
Incomplete fill	Sprues too thin or too few, burnout not finished, mould or metal too cool, or not enough metal	Check the sprues, full cycle, correct flask temperature, weigh the metal
Gas porosity or a dark, stained surface	Carbon left in the mould, flask or metal too hot, or investment taken above its maximum	Full high soak with air around the flasks, never above the maximum, correct temperatures

BEFORE YOU CAST: CHECKLIST

- [ ] Flask taped, collared and sealed on its base
- [ ] Flask left alone through gloss-off and bench set
- [ ] Water and powder weighed, water 21 to 24°C
- [ ] Button down on a raised stand, kiln loaded as your maker says
- [ ] Mix and flask vacuumed inside the working time
- [ ] Maker's cycle programmed, never above its maximum

Keep a burnout log

Write down the powder, ratio, water temperature, bench set, cycle and flask temperature for every flask. When a casting goes wrong, the log shows what changed. Change one thing at a time, within your makers' ranges.

3D WERK

Local Flashforge WaxJet support in Sydney

Questions about your wax patterns?

support@3dwerk.com.au

3dwerk.com.au