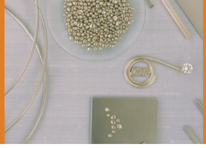
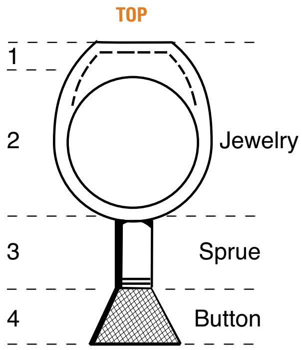


Progressive Solidification as Taught at GIA (Gemological Institute of America)

- Two words define casting success: *progressive solidification.* The molten metal cast in a pre-heated flask should solidify and cool in a progressive manner, in this order:
- **Area 1:** the top area of the item should cool first, then
- **Area 2:** the next heaviest area of the item, next to the sprue
- **Area 3:** The sprue
- **Area 4:** The button, which is attached to the sprue and which provides molten metal for the sprue to draw from. After cooling, the top of the button should be flat. If it is concave, the metal was too hot. If it is convex, the metal was too cold.



Wax to Metal

Take the weight of the wax (with the sprue) times the multiplication factor and add 5-10 dwts. for the button.

Metal	Factor
Brass, Bronze, Copper	9.00
Sterling Silver	10.40
Fine Silver	10.60
10K Gold	11.60
14K Gold	13.40
18K Gold	15.50
22K Gold	17.30
Fine Gold	19.30
Platinum	21.40
Palladium	12.20

Gold & Silver Investment

In Gold and Silver jewelry casting, gypsum-bonded investment is normally used. The investment powder consists of fine-grained mineral powder as the main component and a binder. The binder gives strength and can be added as a solid directly to the dry mineral powder or as a liquid together with the water in preparing the slurry, as is the case with phosphate bonded investment. The mixture consists of Gypsum (Calcium Sulphate Hemihydrate) and Silica (Quartz and B-cristobalite). It is convenient to handle and relatively cheap. However, the instability of calcium sulphate is the cause for many casting defects. When mixing the investment wear a protective mask for protection against inhaling the dust from the powder.

Gold & Silver Wax Burnout Cycles

Hour	6 Hours	8 Hours	12 Hours
1	350	350	350
2	700	700	350
3	1000	1000	700
4	1350	1350	800
5	1350	1350	900
6	850	1350	1000
7		1200	1350
8		850	1350
9			1350
10			1350
11			1200
12			850

Platinum Investment

In Platinum casting, phosphate investments are used. Phosphate bonded investments are best used for metals with a high melting temperature. In this investment, phosphate compounds are used as the binder (in combination with magnesia) in place of gypsum. It is not as easy to handle when compared to Gypsum bonded investment and is more expensive. Its thermal and chemical stability in jewelry casting is excellent, but the subsequent removal of this investment from the casting can be difficult.

Platinum* Wax Burnout Cycles

Hour	10 Hours	Hour	10 Hours
1	250° F	7	800° F
2	250° F	8	1000° F
3	300° F	9	1200° F
4	400° F	10	1600° F
5	600° F		
6	600° F		

Adjust temperature to the casting temperature of the metal.

*Phosphate Bonded Investment
Flasks may vary according to desired results.
These temperatures and procedures are for reference only.

Platinum Wax Burnout (by Jewelry Type)

Men's Heavy Rings: 1300°–1480°F
Medium Weight Rings/Mountings: 1600°– 1700°F
Heavy Weight Findings: 1800°F
Light Weight Rings and Findings: 1800°–1850°F

Quenching Times

Metal	Annealing Temperature °F	Quench
Fine Silver	950	Cool by quenching from red heat, natural air cool, or air cool to black heat then quench in water.
Sterling Silver	1200	Air cool to black heat and then quench in water.
10K Yellow	1200	Air cool to black heat and then quench in water.
10K White	1300	Air cool to black heat and then quench in water.
10K Red	1300	Cool by quenching from red heat, natural air cool, or air cool to black heat then quench in water.
10K Green	1200	Cool by quenching from red heat, natural air cool, or air cool to black heat then quench in water.
14K Yellow	1300	Air cool to black heat and then quench in water.
14K White	1400	Air cool to black heat and then quench in water.
14K Red	1400	Water quench from red heat.
14K Green	1300	Cool by quenching from red heat, natural air cool, or air cool to black heat then quench in water.
14K Yellow Spring	1200	Water quench from red heat.
14K Palladium White	1400	Air cool to black heat and then quench in water.
18K Yellow	1300	Air cool to black heat and then quench in water.
18K White	1400	Air cool to black heat and then quench in water.
18K Red	1400	Water quench from red heat.
18K Green	1300	Cool by quenching from red heat, natural air cool, or air cool to black heat then quench in water.
18K Palladium White	1400	Air cool to black heat and then quench in water.
22K Yellow	1300	Cool by quenching from red heat, natural air cool, or air cool to black heat then quench in water.
22K Red	1400	Water quench from red heat.
10% Ir/Pt	1800	Cool by quenching from red heat, natural air cool, or air cool to black heat then quench in water.
5% Ir/Pt	1800	Cool by quenching from red heat, natural air cool, or air cool to black heat then quench in water.
5% Ru/Pt	1800	Cool by quenching from red heat, natural air cool, or air cool to black heat then quench in water.

Common Casting Problems and Causes

Porosity is a catch-all word for casting trouble and comes in many forms. The most common porosity is very small bubbles on or just under the surface. Sometimes they will wait until the final polish to make their appearance. A few common causes of this type of porosity are:

Model Design: This cause of porosity can be related to the intricacy of the piece. Make sure you avoid the following: sharp and acute angles, alternating thick and thin cross sections, points as well as thin edges and fine wires, and sections of the model that will cross over each other.

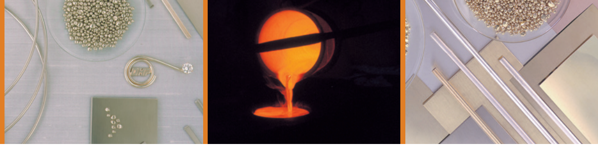
Improper Spruing: This cause of porosity can be related mostly to the size of the piece and it's placement. Make sure of the following: the number of pieces are spaced apart from one another, the light and heavy pieces are separated, the type of pieces are in the proper position, the angle of the piece(s) are correct, the sprue size is adequate, and the gate size and connection are adequate.

Investment: This cause of porosity can be related to the mixing procedure for the investment being used. Make sure the following is correct: the water temperature, the investment temperature, the investment storage, the ratio of investment to water, the mixing of the investment, the turbulence when filling the flask, the vacuum on the investment, the vibration on the investment, the time for the investment to set, the cure time after the investment.

Molten Metal Turbulence: This cause of porosity can be related to the melted metal as it flows through the investment cavity. Make sure the model design and the gate placement are properly done.

Incomplete Burnout: This cause of porosity can be related to the removal of wax from the flask and the hardening of the investment. Make sure to follow the burn-out instructions that are provided by the investment manufacturer.

Copper Oxide: To protect sterling during melting and casting, use an inert gas or reducing flame to cover the melt. For vacuum assist casters that hand pour, keep a reducing flame on the metal during the pouring and on the flask from the time the vacuum is started until casting is complete.



Casting Checklist *compliments of Kerr Casting Products*

Casting Defect	Potential Causes
"Fins" for Flash on Casting	Incorrect water/powder ratio causing weak investment mold Investing improperly stored Investing extended past work time, or flasks disturbed while investment was setting Flask dropped or otherwise mishandled Flask placed in furnace with insufficient setting time (Bench set for a minimum of one hour) Flask heated too rapidly Flask allowed to dry and not re-moistened before burnout Flask burned out and allowed to cool NOTE: Cast higher flask temperature pieces first, then lower temperature flasks. Once temperature is reduced, do not raise to higher temperature.
"Non-fills" for Incomplete Castings	Pattern improperly sprued (sprues too thin, too long, or too few) Incomplete wax burnout Mold too cool when cast Metal too cool when cast Insufficient metal by weight
Shiny Castings Before Pickling (without use of deoxidizing investment)	Incomplete elimination of wax. Carbon residue deoxidizes cast metal.
Darkened Rough Castings Which Resist Deoxidizing in Pickling Solution	Burnout temperature too high, exceeding 1450°F / 788°C
Porous Casting (Dispersion of fine cavities in metal)	Pattern improperly sprued Incomplete burnout Metal overheated Mold too hot Too much "old" metal in cast (never use more than 50%) Metal insufficiently fluxed Too much flux added to metal
Foreign Particle Inclusions in Castings	Sharp corners and bends in sprue system Flask placed in furnace with insufficient setting time Flask heated too rapidly Sprue hold not checked for particles after sprue base is removed Molten metal contained foreign particles Flask contained rust or is unclean from prior cast Crucible old and disintegrated or insufficiently fluxed NOTE: Graphite has a tendency to absorb moisture and break down if not properly dried before melt.
Spauling (portion of investment moves within the mold)	Sharp corners and bends in sprue system Flask placed in furnace at insufficient setting Flask heated too rapidly Investment handled past work time
Bubbles or Nodules on Castings	Wax patterns not painted with wetting agent Investment slurry and/or invested flasks not sufficiently mixed, vibrated, or vacuumed
Rough-surfaced Castings Other Than Bubbles or Nodules	Roughness on pattern (polish original model before vulcanizing) Pattern improperly sprued Incorrect water/powder ratio Flask placed in furnace with insufficient setting time Flask heated too rapidly Pattern material trapped in mold and boiled against mold surface Too much "old" metal in cast (never use more than 50%)
Watermarks on Casting (Grainy Surface)	Investing too rapidly

NOTE: A colder temperature will extend the work time (temperature should be 70°F/ 21°C to 75°F / 24°C).
A warmer temperature will shorten the work time. For best results, work time should be kept within the specified time of 9 to 10 minutes.