

Forget the idea that purity is paramount — in the jewelry world,

# The Metallurgical *Balancing* Act

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## the right alloy can improve color, workability, and strength of precious metals.

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◆ Metal workers, you'll want to check out two **STEP**by**STEP** projects this month — "Silver Pendant," by Jack Berry, page 64, and "Silver and Glass Slide," by Tom and Kay Benham, page 68.

n everyday speech, alloys get a bum rap. Look in a dictionary, and it sounds positively disdainful. These "substance[s] composed of two or more metals" (all right so far) are also defined as "anything added that serves to reduce quality or purity . . . to debase, impair . . . adulterate." Yet the alloying of metals often creates properties in the alloy that are *more* desirable than the properties of the metals alone. While soft copper and tin are pure, their alloy bronze, tougher and more durable than either, ushered in a new age in the history of humankind. Iron alone was an improvement over bronze, but alloyed with carbon, iron became steel, allowing us to build car chassis and skyscrapers.

Precious metals — gold, silver and platinum — need their alloys, too. Precious metals are so called because they are rare, chemically stable, and resistant to oxidation and corrosion from acids. However, in their pure, or fine, state, they may be too soft for everyday jewelry wear. By adding base metals, such as copper, nickel, and zinc, refiners can change the physical properties of precious metals to make them more workable, more durable, and give them more variety. "Color, hardness, malleability, and tensile strength, or how strong it is when you pull it — those are the four characteristics you have to keep in mind when alloying metals," says Torry Hoover of Hoover & Strong. Melting temperature and fluidity during casting also are important considerations.

Refiners begin experimenting with new alloys for a variety of reasons: a search for a particular color or property, a special request from a customer, a desire to match a product brought out by a competitor.

Not everything can be successful. The two most commonly requested jewelry metals are blue and purple gold, says Hoover. Metallurgists know that adding iron to gold turns it blue and adding aluminum to gold makes purple. However, like oil and water, the iron and the aluminum just don't mix with the gold to make a malleable, workable gold. "You can't just put them in a pot and mix them together, even if you know the technique." Hoover has samples of the two colors in his office. "If you throw them against the wall, they'll shatter," he says. "That's why you don't see it on the market." Designer Steve Kretchmer uses purple



**Above:** Keith Hale's brooch of sterling and reticulation silver and garnets. Reticulation silver has a higher level of copper, and is used to create very specific effects when brought to red heat. Photo: Tony J. Masters.

**Opposite page, top:** Christine MacKellar used sterling silver, 22K and 18K yellow gold, and 14K pink gold for her Diving pin. Pink gold has a higher percentage of copper than other gold alloys. Stones used are tourmaline, beryl, and ruby. Photo: Ralph Gabriner.

**Opposite page, main:** Cala Lily landscape, by Stephen Greenstein, uses 18K gold and sterling silver. Sterling is 92.5% fine silver alloyed with 7.5% copper, which makes the silver harder, tougher, and more fusible. Photo: F. Jaulmes.

# THERE IS NO ONE PERFECT METAL THAT IS GOOD FOR ALL PURPOSES.

gold in some of his pieces, says Hoover, but he doesn't work the metal. Instead, Kretchmer casts a block of the purple gold into a shape, then inlays the metal into the surface of gold or platinum like he might inlay a gemstone.

**SILVER.** There are two silver alloys used for jewelry: sterling (92.5 percent silver and 7.5 percent copper) and reticulation silver (80 percent silver and 20 percent copper). Adding copper to fine silver makes the metal harder, tougher, and more fusible. Reticulation silver, with its higher level of copper, is used to create a very specific effect when brought to red heat (see "Reticulated Bracelet," *LJ*, May and June 1997; "Ridges and Ripples," *American Jewelry Manufacturer*, June 1999).

Although the copper in the alloy means that sterling and reticulation silver oxidize or tarnish — something fine silver doesn't do — fine silver alone would be too soft to stand up to the abuse of jewelry wear. And those who love sterling often love the soft patina that comes from wear, a combination of surface scratches and oxidation. Copper's tendency to oxidize, to combine with sulfur in the air in the presence of moisture, is, in fact, used by jewelers to "antique" copper-containing alloys with various solutions, quite often with liquid liver of sulfur.

**GOLD.** Gold, probably the most popular jewelry metal, has a history of more sophisticated alloys. Most refiners use the same basic combination of elements to alloy karat gold — gold, copper, silver, nickel, and zinc — but they may also contain pinches and dashes of proprietary ingredients that contribute to color, hardness, fluidity, malleability and so on. For example, Hoover & Strong's 18-karat Royal Yellow contains more silver than its standard 18-karat yellow. The silver gives the metal a richer, more European color. But the



Earrings by Raoul and Star Sosa, in yellow, green, and white 14K gold and set with green tourmaline, natural pearls, and diamonds. Carving by John Wade. Green gold has a higher percentage of silver; white gold owes its color to nickel. Photo: Jerry Anthony Photography.

silver also makes the metal softer than standard 18 karat. While customers loved the color, they complained that the alloy scratched and nicked more often — they wanted more durability. "So we tweaked the alloy and added a small amount of an element that is very hard, so now it is comparable to our standard 18-karat yellow," says Hoover.

The karat tells you how much gold is in the alloy; this is an amount fixed by Federal regulation. 18-karat gold contains 75 percent gold; 14 karat contains 53.5 percent gold; and 10 karat contains 42 percent gold. All the alchemy that creates variation in the properties of the alloys takes place in the remaining percentage of metals.

As it is in sterling silver, copper is the primary hardening agent in yellow golds. The more copper in the gold, the redder it is. Rose, or pink, gold has a higher percentage of copper compared to other elements in the alloy. But too much copper in the alloy can make it hard and difficult to work. So refiners balance the copper with silver, which makes the gold softer. (It also makes the gold greener.) A little zinc in the alloy makes it more fluid and easier to cast.

White gold, which first appeared during World War II when platinum was declared a strategic metal and became unavailable for jewelry use, was created by adding nickel to gold; compared to platinum, white gold still has the yellowish tint of gold. Jewelers pretty uniformly dislike working with white gold because the nickel in the metal makes it hard and brittle. This has always



Rings of 18K gold and 18K white palladium, with natural fancy colored diamonds, by John Rink and Thomas Ballard. Palladium, a platinum family metal, makes a white gold that is more workable than nickel-based white gold. Photo courtesy Palladium Inc.