The New Age of Bronze

Supply chain constraints and fast-rising commodity prices are taking their toll. Here's how one Midwest producer of bronze gear blanks is helping gear manufacturers "re-shore" — and shorten the distance from bronze blank to finished gear.

Eric Blickley, vice president, R&D and technology deployment, Fisher Barton

There's a container on-board with your name on it, loaded with thousands of the bronze gear blanks you've been waiting months for. To add insult to injury, you probably paid 3–4 times what this container and its contents would have cost you pre-pandemic. And that new solar energy customer that needs thousands of bronze worm gears for its panel tracking drives? Seems they've moved on.

What if there was a better way? What if you could place an order now and get those bronze gear blanks on your shop floor, ready for hobbing, while that other shipment is still in transit? Better yet, what if your supplier could offer you a worm gear blank designed to reduce material costs by 10–30 percent? And finally, what if your supplier then offered a buyback program for those hundreds of pounds of bronze chips that you're practically giving away to your scrap recycler?

Fisher Barton's Accurate Specialties division, a Waukesha, WI–based manufacturer in bronze worm gear blanks, is making a compelling case to gear manufacturers who have seen their bronze worm gear business grow significantly in recent years. Gear engineers have long prized bronze for its unique mechanical and chemical properties. Since it's made from a nonferrous material, a bronze worm gear won't 'scavenge' molecules from its steel mating pinion or drive worm, thus greatly reducing galling and abnormal or premature gear wear as compared to a steel-on-steel solution.

You'll find bronze worm gears wherever maintenance-free, corrosion-resistant, reliable operation is required: for the tracking systems used to position solar panels in a hostile desert environment along the Dead Sea; on boat lifts and cable and winch systems in highly corrosive marine environments; on shop

Fisher Barton uses a Zeiss scanning electron microscope to perform a very sophisticated analysis of fracture surfaces and microstructures, or a Keyence laser scanning microscope to analyze the material in 3D.

floors in the indexing and rotary tables of machine tools where an unscheduled maintenance event can cost thousands of dollars.

Cutting Material Costs

Today, this increased demand, combined with soaring copper and aluminum prices, are putting pressure on bronze alloy cost and delivery. That's why, for many manufacturers who see the benefits of bronze worm gears for their application, *composite* bronze worm gear blanks make economic sense.

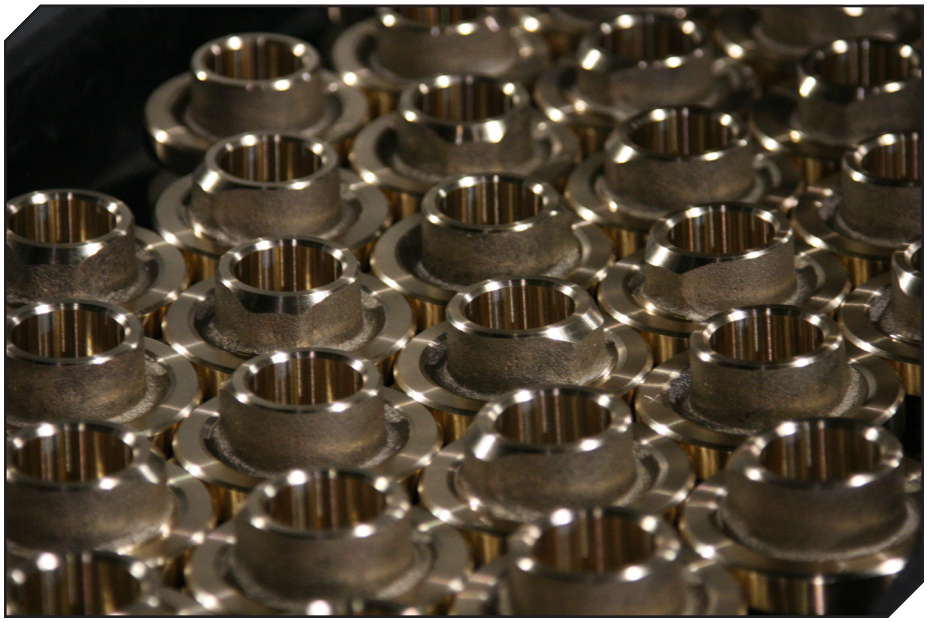
For many gear blank applications, with OD diameters from as small as 3 in. to as large as 24 in., up to 75 percent of the bronze alloy can actually be replaced through a composite solution. In most worm gear applications, the bronze rim portion is all that's needed to achieve the desired wear results; the hub portion that mounts to the mating shaft can generally be made from a much less costly, but highly functional alternative material such as ductile or grey iron. Since the per-pound cost of bronze alloy today is five to seven times more than that of iron, cost savings can be truly significant, particularly as volumes go up.

In addition to greatly reducing material costs, this composite solution offers significant benefits versus worm gear assemblies, where a steel hub is turned from bar stock and assembled with screws to a bronze rim. This approach adds many more components to the supply chain, inventory, and time-consuming and costly machining and assembly process steps. Instead, a composite solution uses a cast iron hub with a bronze alloy rim poured around the hub. The process eliminates multiple turning, sweating and assembly process steps. This, combined with the reduction in material costs, can lead to a per piece reduction of anywhere from 10

to 30 percent on average. The savings, particularly as volumes increase, easily offsets the casting die and pattern investment. This cost is further minimized with the ability to produce these dies to the most precise dimensions and tolerances in-house.

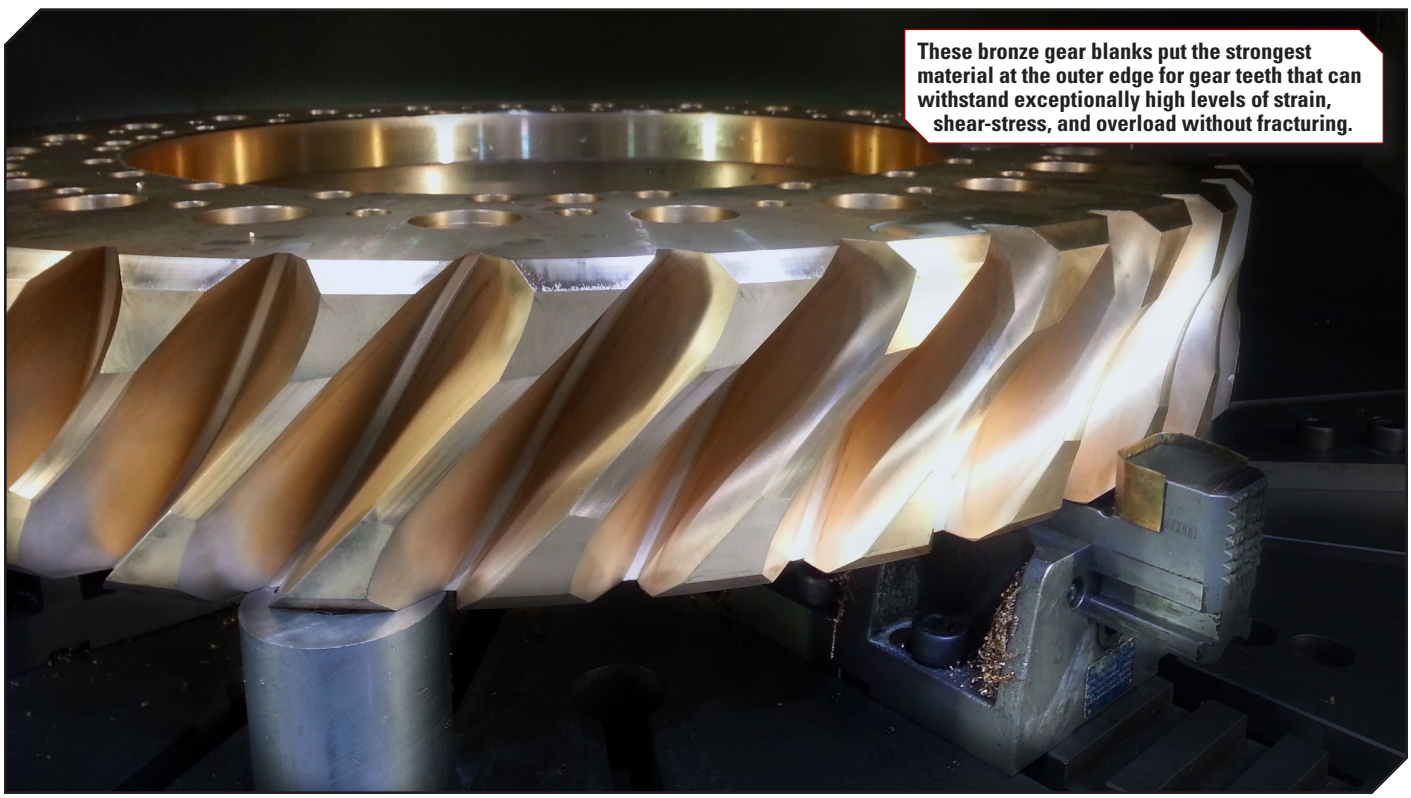
Most importantly, the composite gear blank is considerably more robust and reliable than its assembled equivalent. This results from the cooling bronze after casting. As it solidifies, the bronze alloy rim shrinks slightly, forming a compressive mechanical bond around the iron hub. The hub also has lugs configured into the area over which the bronze rim is poured, assuring a much stronger bond than possible with screws under torque — and eliminating the possibility of assembly screws becoming loose and resulting in gear maintenance, repair, or failure downstream. Furthermore, where a keyway is required, the cast iron hub is an inherently stronger solution than the bronze alloy equivalent.

Of course, composite gear blanks are not a one-size-fits-all solution. The iron (or, in some cases, steel) hub and bronze alloy must be carefully designed so that the compressive load created by the shrinking bronze doesn't crack the iron hub. This will vary depending on the bronze alloy used. Tin bronze, for example, works particularly well, while aluminum and manganese bronze alloys are more challenging. The provider should have a deep understanding of metallurgical properties and proprietary pre-melting and pour management techniques are critical to optimizing performance. It also beneficial if you can machine the gear blanks in-house so they arrive ready-to-hob.



To meet the increase in gear blank demands, Fisher Barton has added six new 36 in. centrifugal casting machines, eight advanced Doosan CNC machining lathes, a versatile new Haas vertical milling center — and a new clean room for machining.

For worm gear applications where a composite solution isn't desirable, there are a variety of other bronze gear blank solutions to accommodate a wide range of application requirements. These include:



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- **Centrifugal casting** ensures uniform purity, weight, density, and quality throughout the gear blank. These bronze gear blanks put the strongest material at the outer edge for gear teeth that can withstand exceptionally high levels of strain, shear-stress, and overload without fracturing. Sizes range from 2 to 50 in. dia., up to 5,000 lbs.; one-off or in quantities in the thousands.
- **Chilled casting** produces a bronze gear blank with fine grain structure and outstanding uniformity throughout. This produces chill cast bronze gear blanks at near-net-shape.
- **Continuous cast bar blanks** are made with an alternative casting method that is particularly competitive when applied to simple, low feature gear blank designs. The continuous cast process allows for part-specific casting, where simple features can be continuous cast into the raw material, thus providing a "near net" shape. High-speed in-house production flow is equipped to cut bars into pucks, then lathe-turn them into gear blanks or shafts at the speeds needed to meet higher volume requirements and Just in Time turn-around.
- **Shaft manufacturing**, from any standard ferrous and nonferrous material, with ODs to 6.875 in. and lengths to 19 in., for gear shafts, propeller shafts, drive shafts and countless other applications. Cut lengths and complete machining all done in-house with late-model, highly productive CNC turning and machining centers. Advanced wear resistant materials, including hard metals, carbides, and metal oxide ceramics are engineered into highly resistant coatings for critical shaft sealing locations.

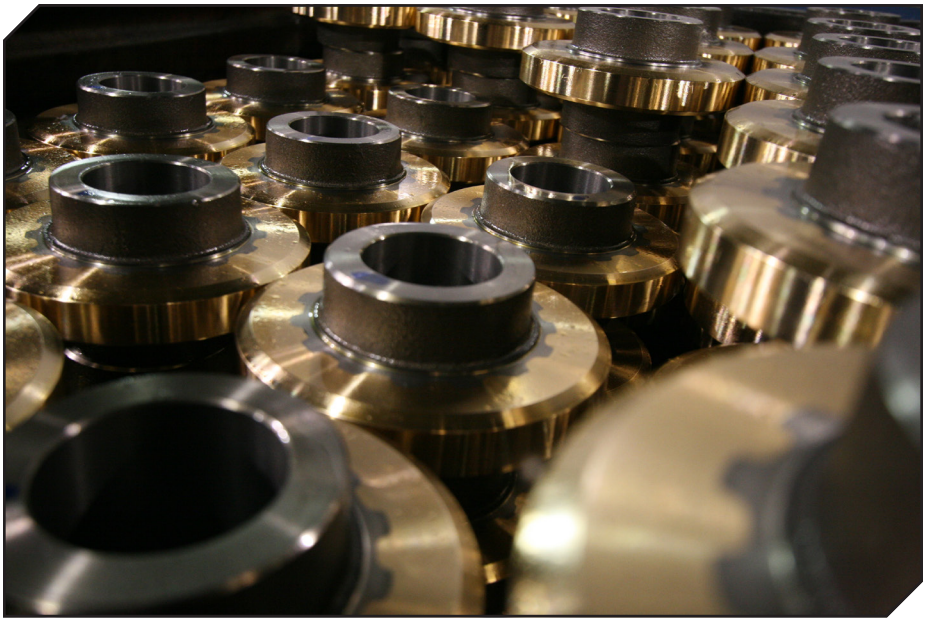
Alloy Chip Credit Program

As bronze has become more valuable as a commodity, so too has its scrap value, in the form of the volumes of chips produced during hobbing, shaping and other machining. Yet, the prices that gear manufacturers receive from their traditional metal scrap recyclers doesn't reflect its true value.

Accurate Specialties' Chip Credit Program offers a strong incentive to instead direct this 'waste stream' of chips back to us. We pay customers 90 percent of the market value of the alloy as a credit to their account. We then clean the chips of grease and oil and return them directly to the foundry for melting and re-use as blanks. The program is today accounting for approximately 20 tons of recycled bronze alloy per year. Our customers also benefit from the savings that result from our inventory management programs, all designed to reduce their raw material and machining costs.

Sourcing Blanks

Fisher Barton is a metallurgical innovation partner for high wear and cutting components. Engineers understand the behavior of material and the application of proprietary heat treating and surface engineering solutions that reimagine a component's lifespan beyond the core manufacturing capabilities of stamping, bending, forming, cutting, welding, machining and casting. These capabilities offer more than just a foundry and machine shop.



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