



**Copper Development
Association Inc.**
Copper Alliance

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High-Speed Machining with Brass: A New Benchmark in Productivity

Introduction

Machine shops and manufacturing companies may overlook brass as a first-choice production material under the misguided assumption that brass should be machined at conventional speeds. This belief typically traces back to handbooks that cite overly conservative machining recommendations based on outdated information and equipment. As a result, many shops continue to underestimate the productivity of brass by up to 85 percent and miss out on the profits they could achieve through high-speed machining.

In reality, brass supports high-speed production on today's advanced manufacturing equipment, often with little if any tool wear even after long periods of operation. With a few judicious machine adjustments, and with care taken to abide by simple best practices, even older machining equipment can achieve better results with brass. However, achieving truly dramatic production speeds with brass relies on today's high-speed machine tool technology.

Brass holds an additional profitability advantage over other metals, one that also carries an environmental affirmative. Residual scrap value and recycling efficiency are significantly higher for brass than for steel and aluminum. Unlike brass, steel and aluminum machining scrap is worth only a fraction of its raw material value and can require additional processing steps before it returns to the material loop. Conversely, brass rod is made almost entirely from recycled material. Most post-processing brass scrap holds 75 percent to 90 percent of its original value, allowing shops to recoup costs while contributing to global sustainable development goals.

Faster Cuts and Longer Tool Life Equal Better Profitability

The marketplace cost of metal parts draws on a combination of factors, including materials, design and production. Even after machine shops seek out best prices for raw stock and find ways to reduce the cost of creating part designs, they are

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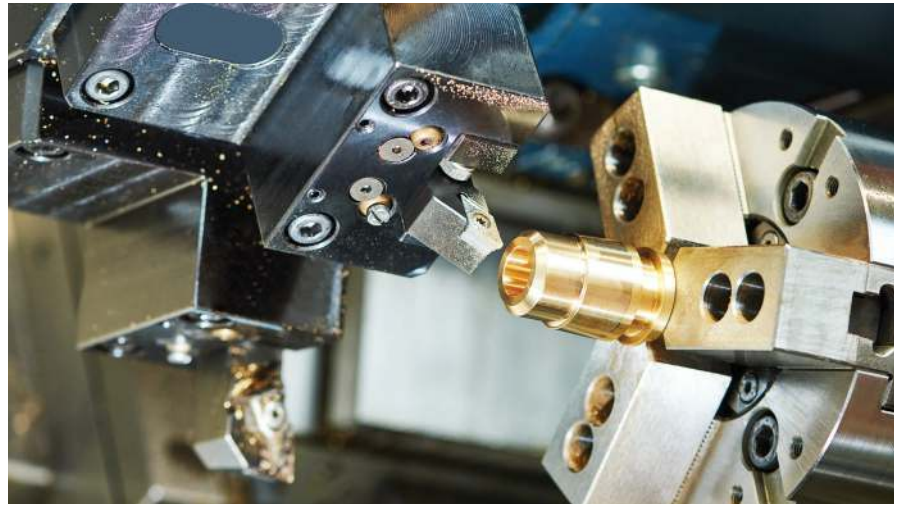
left to contemplate machine time as if it were a fixed cost. Faster cuts mean higher throughput, increased production capacity and lower costs, but unless the material tolerates the speed, the cuts remain slow.

Contrary to conventional wisdom, brass can and should be run at the maximum speeds and feeds safely permitted by each machine tool. For precision parts, brass offers sustainability and cost effectiveness, and it machines at the high speeds necessary for the production volume that yields lower costs per part. Compared to steel and stainless steel, brass costs dramatically less per cubic inch of material removed because brass runs faster, decreases downtime for tool changes and requires less machining power.

With the maximum machinability rating of 100, brass sets the standard for other metals. Consider the compelling results of a battery of tests conducted under real production conditions to determine the high-speed potential of brass, and the impact of aggressive material removal rates on tool life, power efficiency, surface finish and chip formation in comparison to other metals.

- **High-speed turning, end milling and drilling** – Brass rod alloys: With carbide tools and a 20,000-RPM spindle on a modern machining center, five brass alloys (C36000, C38500, C27450, C69240 and NBM 3) ran two-hour shifts at 4,000, 2,500 and 2,000 Surface Feet per Minute (SFM) for the respective operations with little or no evidence of tool wear, no chatter, good surface finishes and excellent chip control.
- **Machine time cost** – Brass vs. steels: Per cubic inch of material removed through turning at optimized speeds, brass (C36000) cost 86 percent less than stainless steel (304L) and 79 percent less than steel (12L14). In a drilling test at optimized speeds, brass cost 87 percent less than stainless steel and 59 percent less than steel per 1,000 holes drilled.

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- **High-speed vs. conventional-speed production** – Brass: High-speed Swiss CNC production of brass hose couplings produced 63 percent more parts than conventional speeds in a continuous eight-hour shift with no quantifiable tool wear, reducing machine time costs by 38.5 percent per part while maintaining tight tolerances throughout.
- **High-speed turning** – Brass vs. steels: With carbide tools, brass ran for four hours at speeds of 3,000 and 4,000 SFM, surpassing 16,500 RPM and yielding eight times longer tool life at more than three times the speed, compared with stainless steel (304L) or steel (12L14). Material removal rates for brass were 4.8 times greater than steel and 7.1 times greater than stainless steel. From an efficiency standpoint, brass required less than half the power per material removal rate than both steels.
- **High-speed drilling** – Brass vs. steels: Brass drilled faster than stainless steel (304L) and steel (12L14), reaching 2,000 SFM, and completing 1,000 holes eight times faster than stainless steel and 2.5 times faster than steel. Brass also required less machining power than either steel.

Brass: The Value Propositions

Brass offers superior machinability, especially at high speeds, producing advantages worth exploring as machine shops and manufacturers plan for expanded production and greater profits. The value propositions that propel brass to higher desirability as a machinable metal center around specific parameters for equally specific audiences and markets.

Machine shop owners and managers: Despite the longevity of machine shop equipment, all machines eventually become candidates for replacement. In these

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situations, shop owners and management increasingly gravitate toward new technologies as replacements or for use in new shops. They do so because of the overwhelming numbers of new high-speed machine models on the market and the compelling advantages and benefits such machines offer. At the same time, state-of-the-art equipment immediately accommodates the tested, proven high-speed machinability of brass, making this cost-effective metal a viable choice for expanded production on advanced technology. Moreover, the high value of brass swarf improves control over operation costing when the amount of scrap produced is considered in the production and sales revenues.

Part designers: From a manufacturing perspective, two parameters combine to influence cost per part: the number of steps and machines required to produce the part, and how quickly the equipment can complete the task. Today's machining technologies that perform multiple processes within single-machine platforms reduce the two factors of the first parameter in many cases. The machinability of brass enables the shop to ramp up production speed and reduce the second parameter. For design engineers, specifying brass for parts while keeping advanced production capabilities in mind is an effective cost-optimization strategy that can increase profitability.

Ancillary audiences: Examining the value proposition of brass from the perspective of those who work with it as a production material yields a limited view. Even as shop owners, managers and designers profit from their investments in new and advanced technologies, brass also offers value to the companies that create and distribute machine tools because it helps drive sales of their equipment. When **machine tool builders** share their industry and material expertise with their customers, they create a customer-centered reputation that in turn increases the likelihood that those customers will spend their equipment dollars with them. Even

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customers who plan to retain older equipment can benefit from manufacturer expertise in adjusting, rebuilding or retrofitting their machines to make the best use of brass. At the same time, **cutting tool manufacturers** benefit from increased use of brass because of the desirability of specific types of tools – for example, carbide and PCD inserts – to take advantage of high-speed equipment.

Summary

Production testing under real-world conditions amply demonstrates how productively, efficiently and profitably today's machine shops and manufacturers can run brass, setting aside outdated conservative machining speeds and limits imposed by older equipment. New machine tools include faster and more powerful spindles that can machine brass at the high speeds it tolerates with ease. Adjustments to methods and setups allow older machines to run brass more productively as well. The net result of these findings shows that brass can make a valuable contribution to virtually any shop's roster of go-to materials. Along with its direct value to the companies that use brass in production, brass also helps drive sales of advanced machine tools to shops that wish to take advantage of its high-speed capabilities.

About the Copper Development Association

Copper Development Association Inc. (CDA) is a U.S.-based, not-for-profit association of the North American copper industry, influencing the use of copper and copper alloys through research, development and education, as well as technical and end-user support. CDA is committed to promoting the proper use of copper materials in sustainable, efficient applications for business, industry and the home.