

Better Together: Getting the Lead Out of Steel

How PMPA members worked together to solve the end of lead in steel.



For generations we have been hearing about the no-lead transition. My grandfather was hearing about this back in the 70's and 80's. My predecessor Miles Free, who spent a lifetime in the steel industry, thought the end of lead was not feasible until he wrote last year that he finally felt technology had reached a point where we could see lead-free in the future. To-date, no equivalent to lead has been found to give the cycle time benefits and surface finish of leaded materials.

However, I was recently invited to participate in machining trials for a new material that is leading the way in the lead-free revolution.

The Study

In the spirit of PMPA's Better Together, PMPA member, Nucor, invited a group of fellow Technical members to test

NuCut 1215. Eastern Oil Company, Horn USA, TajMac-USA, and Dr. Julius Schoop from the University of Kentucky met at the TajMac-USA facility in Indianapolis to work on a blind study to find how NuCut performs against various free machining materials on the market. Although Dr. Schoop will be providing a detailed report on the results of this study, I want to share my first impressions.

At TajMac parts ran on a Mori-Say 8-32 cam-controlled machine. Using a cam-based machine allows the study to represent a sizable portion of the industry which still uses legacy cam machines for high volume runs. The pool of experts on site was vast. Everything from cam multi-spindle

and CNC multi-spindle to Swiss CNC and Brown and Sharpe. Having all the experts in one room allowed discussions to develop rapidly. Sharing experiments in real-time to develop a process.

When I analyze material, I compare to my old notes on feeds and speeds. I find that older data is extremely accurate for maximizing the cycle time to uptime ratio. In the initial run utilizing Horn tooling, the feeds were pushed between

150% - 300% more than I would typically use in 12L14 with about 30% lower SFM. After running approximately 1,500 pieces, very limited wear was visible on tooling under a microscope. The stressed tool—which was a smaller diameter drill running 300% feeds—had almost no wear. On the second test speeds were pushed to

100% of 12L14 SFM while maintaining the elevated feeds. I did not get to see the tooling on the second run before my departure, but parts were holding good tolerance and surface finish was consistent at around 1,000 pieces. The parts were running at 30% reduced cycle time compared to 12L14. You read that right this material was outperforming 12L14 when compared to my layout of the part being run.

The reduced cycle time was achieved utilizing tooling I would call middle of the road. The tooling did not include super expensive coatings or geometries. Not only that, chips were consistent with 12L14. I will say that 12L14 chips better. The chips from NuCut were totally manageable and were



(Left to Right) Jeremy Rose (Tajmac USA), David Wynn (PMPA), Bruce (TajMac USA), Levi Wynn (PMPA), Dr. Julius Schoop (University of Kentucky), Brandon (TajMac USA), Tony Skuratovich (Eastern Oil Company), Johnny Freeze (Horn USA), and Derek Nordby (Nucor).

only about 30% larger in size when compared to 12L14. No build up on tooling was detected. No bird nests. (Note: chipping can be a direct result of tooling choices and I did not have a 12L14 sample to test in this same setup to compare.)

For years, as a machinist, I thought we would have to settle



for a slightly reduced cycle time and tool life but at least we would be machining no lead materials. Now we have the opportunity to have a better material over all. Collaborations that bring together members to benefit the industry is one of PMPA's strengths.

Why Finding a Lead-Free Alternative is Important

Getting the lead out has been a complex problem for years. Lead is used as an additive for machinability in various metals including brass, aluminum and steel. In steel, lead is added between 0.15 – 0.35 weight percent. Leaded steel has approximately a 30% cycle time savings versus non-leaded steel varieties. Lead also generates better surface finishes for longer times between tool changes than comparable non-leaded steel varieties. Studies have shown that lead also reduces total energy consumption by 25% in reduced machining time and machining load.

Regulatory challenges for lead are ever increasing. The Safe Drinking Water Act mandated “lead-free” brass plumbing fixtures which limited lead content to 0.25%. Free machining brass (360) has a lead content of 2.5 – 3.0%. RoHS in Europe has been pushing to remove the exemptions for lead for machinability in steel since 2014. As technology has come to enable companies to machine products effectively, exemptions have started to drop off. In December of 2025 RoHS removed lead from aluminum for machinability in

new applications with a complete phase out in 2027. The committee found that there was sufficient technological gain in the machinability of alternatives to eliminate lead from aluminum products. With continued public focus, removal of lead will continue to be a top priority of regulators.

In the U.S. we face an additional challenge for leaded steel. No steel mills in the United States currently produces leaded steel. In August 2023, Republic Steel facilities in Canton and Lackawanna closed and were the last two steel mills in the U.S. with EPA lead permits. In great irony, most of our leaded steel is imported from Europe which is pushing lead-free through RoHS regulations. Recent supply chain issues, including import tariffs, have driven the cost of leaded steel dramatically higher. It also creates a national security risk having no domestic supply. It is critical to find a solution to the supply of leaded steel alternatives that meet the needs of our shops.

Generations of Collaboration

Finding alternatives for leaded steel has been a challenge that steel mills have taken on for decades. Alternative additives have been tried. Various

techniques in manufacturing have been tested. One of the greatest takeaways from this trip was seeing members from various backgrounds and ages collaborating to solve a problem. My 11 year-old son joined me on this journey. He loves machining and it was a great experience for him to see members working together to solve the no lead issue. In the end, it is the collaboration between the various elements of the supply chain and generations of participants that will find the solution. Our group spanned ages from 11 – 62. That is four generations represented: expertise from steel mill Nucor, tooling suppliers at Horn USA, cutting fluid suppliers Eastern Oil Company, scientific study of machining from Dr. Julius Schoop, machining expertise from TajMac-USA, and my son and me. We saw the best opportunity our industry has had in my lifetime to get the lead out. With all the experts in the room and generations of expertise, we witnessed innovative ideas being applied to solve an old problem. All made possible by PMPA members working through generations of collaboration. 

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