"Insert Tooling Solutions for No Lead Brass"

"Let us take things as we find them: let us not attempt to distort them into what they are not. We cannot make facts. All our wishing cannot change them. We must use them."
<u>John Henry Cardinal Newman</u> (1801 - 1890)

The amalgamation of the elements copper and zinc yields brass. Lead is added to brass to improve its machinability. This paper has been developed to assist you in working through the problems created by the elimination of lead from brass. The world's market places are moving toward "No Lead" (Pb<.25) because of health and environmental concerns. This initiative has resulted in increasingly stringent legislation both here in the US and internationally. Like it or not unleaded brass is here to stay and we, the manufacturing sector, must develop a new playbook in order to tackle this new challenger.

The place Peterson Tool Company has within the industry, affords us a unique perspective on the changing playing field from leaded to unleaded brass. The common obstacles that can emerge with almost every project are: chatter, chips, burrs, heat, tool life, part failure and reduced cycle times. It must be pointed out at the beginning of this discussion that there is no "silver bullet" in solving these problems. Each application has required its own idiosyncratic solution however the purpose of this paper is to highlight the treads that are emerging as it relates to insert tooling.

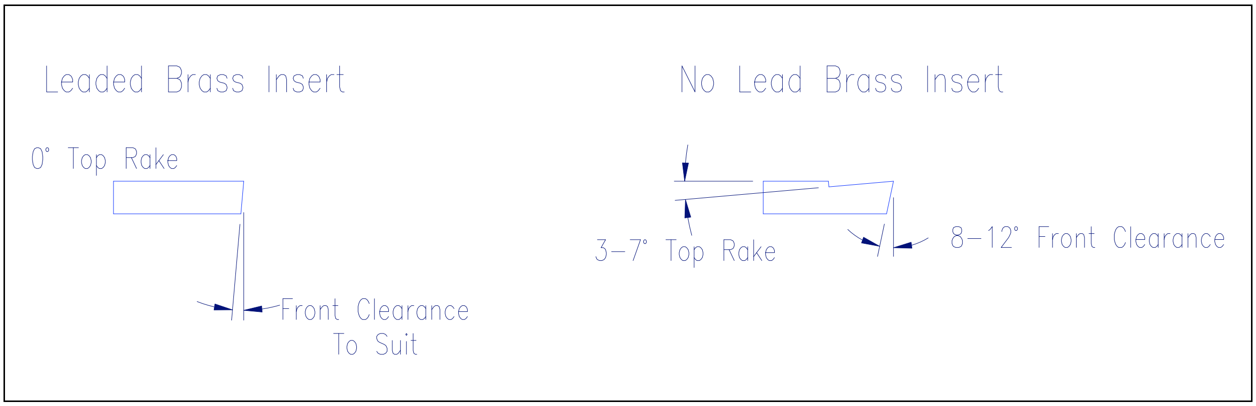
Mark G. Charleton

There are two main camps in the no lead brass supply chain. Copper to zinc ratios vary by product line, but it's the addition of silicon that differentiates the two groups. Silicon, one of the most abundant elements on earth, is substituted for lead in an effort to improve machinability. It must be noted that the chips and waste materials from the brass containing silicon can not be contaminated with traditional leaded brass swarf. No lead brass without silicon does not have this restriction and is recyclable with traditional leaded brass. Both products have their pluses and minuses, but as it concerns insert form and shave tooling the differences are marginal, therefore, the ongoing discussion applies to both groups.

The typical scenario for conversion to no lead production is simply a switch in material. Its' brass isn't it? Existing tools struggle to keep up with the increased tooling pressures and generated heat. Once stable and profitable processes can become troublesome resulting in reduced production and unfortunately reduced margins. Solutions can vary from part to part, some part profiles will only be slightly affected but the more material removed, the greater the loss of lead is missed.

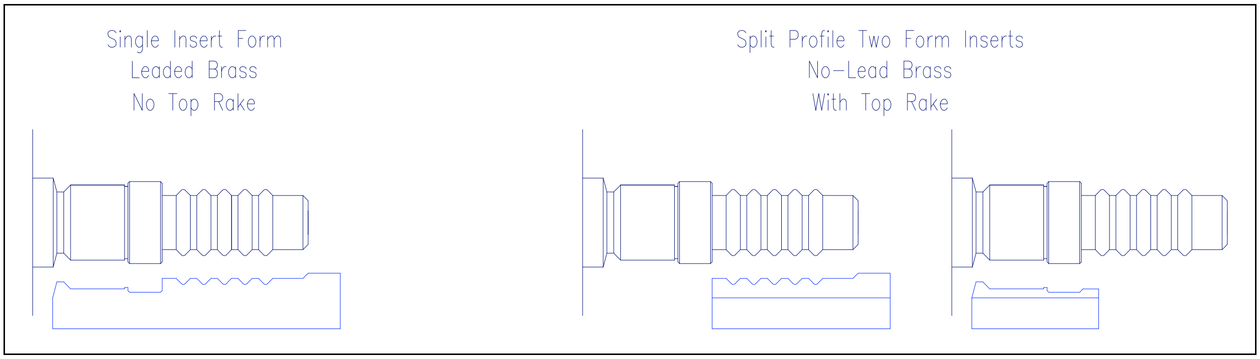
Insert tools for leaded free cutting brass have minimal geometry, typically, little or no top rake and the least amount clearance required. This increases tool pressure, inhibiting chatter and preventing tools from diving into the work. Without lead, brass's machinability drops. Many in the industry are finding that tooling schemes which could be forgiven by the very nature of free cutting brass must now be re-thought. The decreased machinability is forcing change.

The first solution in *managing* the increased cutting force is additional geometry. Chatter, the two headed snake, (Too free or too severe cutting) is now tamed with top rake and increased clearance. The geometry now can resemble a stainless or steel insert tool with 5-7° top rake and 8-12° clearance for form inserts. Shave tools can require an extra degree of top rake (0 - 1.5° total). Geometries may be affected by the nature of the cut and the existing fixturing. Solid fixturing (Supports and Tool holders: Form and Shave) can play a vital role in settling chatter. As the tool begins its' work heat increases, and carbide (Micrograin or C-2) coated (TiN or AlCrN) tools are required to maintain the cutting edge and provide lubricity to the point of contact which was lead's former function.



Chatter and heat are the first hurtles to be crossed. Conditions are improved with carbide tooling, altered geometry, fixturing and added coating but reductions in surface feet per minute (SFM) will most likely be required. Feed rates are additionally regulated to settle persistent chatter, regain lost cycle time and/or control chips. The trend is reduced RPM's and increased feed rates. Tool life is diminished with heat. Insert tool life for leaded brass can be counted in days, weeks and/or months. Unleaded brass changes the tool life parameters to hours and/or shifts.

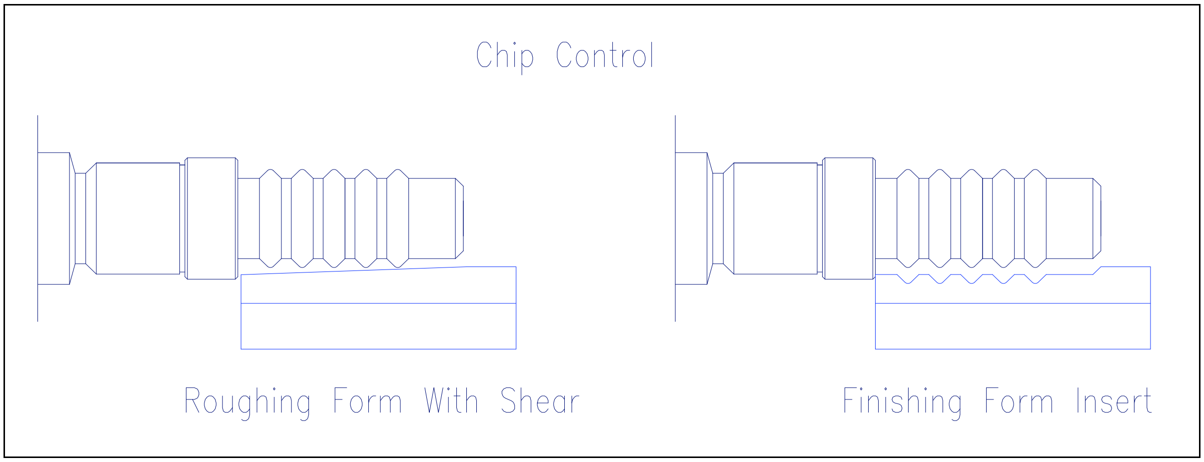
Continuing in the vein of heat and its management, it is not uncommon for the sequence of operations to change. Formerly empty stations may be worth their weight in gold as reprocessing alternatives are considered. Wide tools or tools with large depths of cuts may have to be divided into smaller increments which will increase the number of tools in the set up. Turning and drilling can allow heat to run toward the collet and may result in discoloring the material's patina.



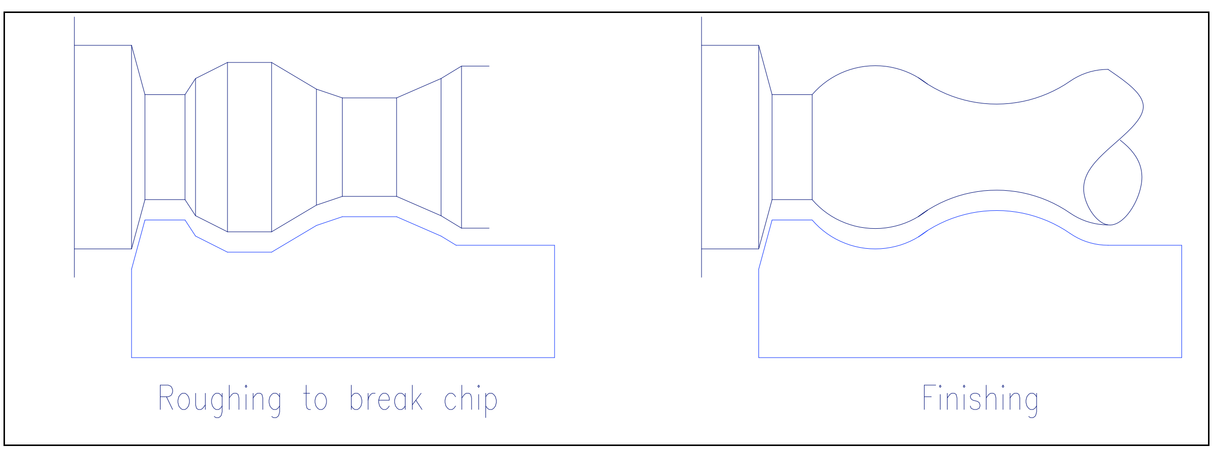
Specifically addressing the barbed fittings common to brass parts, caution is warranted when thin walls are produced in simultaneous drilling and forming operations. The combined heat may cause part cracking. Staggering operations can provide time for cooling the part. Voluminous as well as high pressure coolant can assist in heat dissipation and chip issues.

The normal slivering chips of leaded brass will become more continuous and may tax chip handling systems. Clogged work zones can be improved with interrupted feed rates which can be provided by special camming or program dwells. Chip breaking cams are a must. Top rakes and profiled form clamps may help to direct chips in manageable spirals and directions.

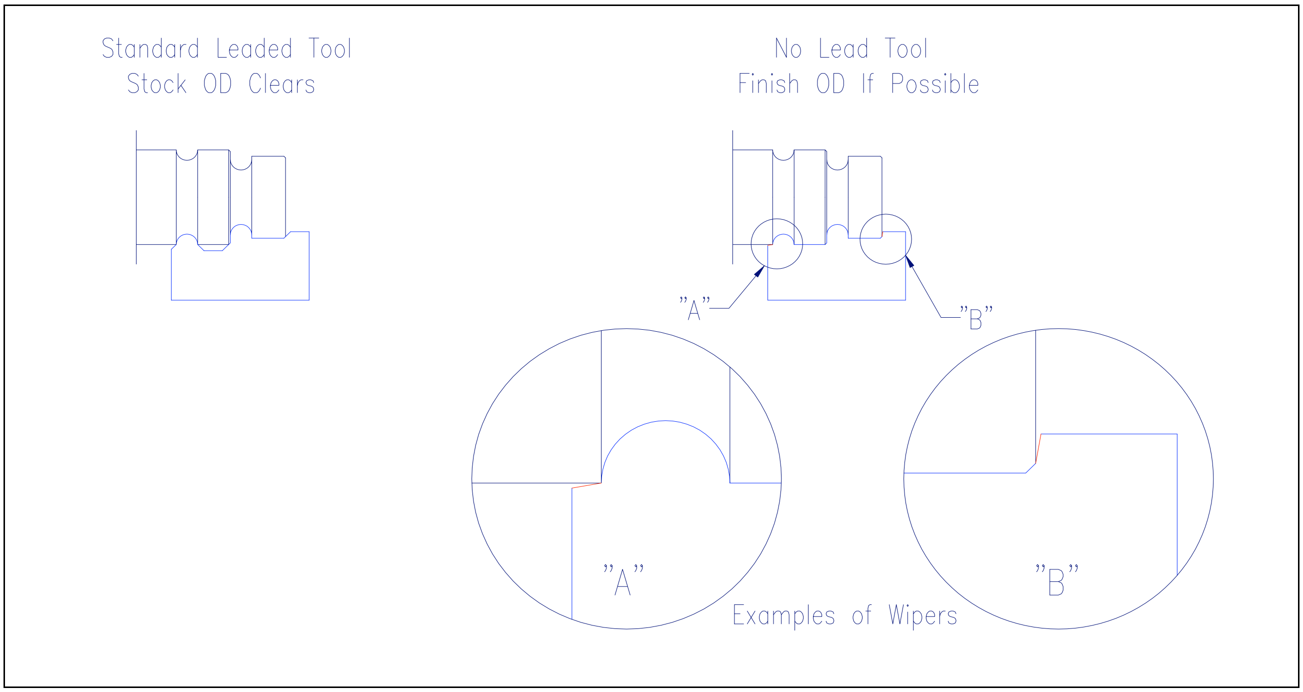
As with heat, tooling sequences for chip issues can also be developed. Flat straight cuts which can produce wrap-around chips may be preceded by shear angled tools. This will remove excess material before final forming, minimizing chip wrap potential.



Common to the plumbing industry are many radius styled parts. Radiuses can increase cutting forces and may produce obstinate chip formations. Roughing form inserts can simulate the ball profile with conjoining angles; this reduces the cutting forces and part deflection. The sharp points of the intersections also produce edges which can break or fold the chip rather than allowing the formation of a jumbled ribbon chip wad. Finishing form inserts can then easily complete the spherical configuration.



Burr issues can plague lead-free brass parts. This is problematic especially when it concerns o-ring grooves, sliding, sealing and aesthetic parts. If the outside diameter of the part is stock O.D. and even though the part is chamfered, a burr can still cling to the transition area. If it is possible, clean the O.D. of the part with the profile of the insert be it shaving or forming. If that is not possible a secondary angle of 5-10° may help wipe a burr off at the transition of the chamfer and the bar stock. Concentricity issues limit this method and post process burr removal may be required.



Obviously "business as usual" with the least expensive tool to simply get the job out is no longer a long-term option. Companies that use this paradigm shift as an opportunity to modernize their tooling systems and fixturing will be in the best position to remain competitive. Problems with no lead brass are being overcome. As a manufacturing community we aren't out of the woods, but there is light at the end of the tunnel…. or…. clear lead free water at the end of the spigot.