**Processing lead-free brass**

Demand for geometrically exact surfaces of brass components, extending to a high polish for high quality fittings and parts for ‘design’ applications, the automotive and electronics industry, and flawless reflective surfaces in, for example, astrophysics, are increasing noticeably. In addition, use of lead-free copper materials, especially as antibacterial material alternatives with high mechanical strength and increased oxidization resistance for the food, drinking water and sanitation areas, is increasing in importance due to the new EU Drinking Water Directive.

In order to improve the machining capability, copper materials like brass have always been alloyed with lead. However, changed legislation points toward a broad prohibition of the use of lead. However, by dispensing with lead, the machining capability of these materials is significantly impaired. Increased tool wear due to adhesion and material smearing, the formation of long band and snarl chips, and reductions in process reliability and productivity are the consequence.

A series of lead-free or low lead copper materials has been developed in recent years to fulfil the new legal conditions. A well-known representative is the CuZn21Si3P brass alloy marketed under the brand name "Ecobrass" or "Cuphin", or other special brasses, like the wrought alloy CuZn10Si4, the cast variant CuZn10Si4-C and many others.

The general rule applies that higher specific cutting forces and tool temperatures are determined for lead-free brass materials. On average they are double or three times those of the usual automatic system brass CuZn39Pb3. Strong material pick-up on the chip surface and on the open surface, especially when processing CuCr1Zn, result in the tearing out of TIAlN layers and expose the hard metal substrate. Sharp-edged and coated edges are also subject to types of wear such as initial wear as a consequence of micro-chunking caused by the strong tendency toward adhesion of the lead-free Cu materials and the strong machining forces.

In comparison to TiAlN coatings, diamond coatings or diamond cutting substances give rise to a significantly smoother surface, a lower friction value, the lowest tendency toward adhesion and significantly higher heat conductivity. In addition to this, diamond coatings or diamond edges possess exceptionally abrasive wear resistance due to their high degree of hardness, so that they are also ideally suited for dry processing. The cutting speeds are many times those of TiAlN-coated edges. With their high level of heat conductivity, they also reduce the entry of heat into the work piece, which improves the precision of the dimensions and the shape, especially with small and geometrically sophisticated components. Increased entry of heat into the component, for example, when processing CuZn39Pb3, was previously prevented by its friction-reducing lead film, and today needs to be prevented by other cutting substances with other properties.

While ceramic cutting substances are unsuitable due to their high tendency toward adhesion and their low heat conductivity, diamond coated edges and cutting substances like PKD, CVD-diamond and MKD have proven themselves with an even better performance profile. The latter is unsurpassed in the creation of highly precise reflective polished surfaces. Depending upon the Cu material or type of processing, PKD or CVD-diamond prove to be the cutting substance of choice. The various PKD types with cutting geometries to be ground individually thereby fulfil the respective requirement profiles in a tailored fashion. CVD-diamond edges offer the highest degree of hardness, precision-lasered, highly sharp cutting and lasered formed chip breakers also ensure secure chip breakage for dry processing even with a reduced chip thickness providing, highly precise surfaces and low burr formation.

With these cutting substances optimally adapted to the processing task, a significant increase in the tool service life, the geometric precision, the surface quality, the time chipping volume, the productivity and especially the process reliability is achieved. The tool specialist HORN in Tübingen has long since reacted to the requirements of the processors of lead-free copper alloys and, with its extensive cutting substance programme, offers them individual, productive, safe and economical solutions.

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**Image caption:**



**Image 1:** Tools with mono-crystalline diamonds are used for the high polish processing of (lead-free) brass.

**Image credit:** Paul Horn GmbH, Nico Sauermann

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