

CRAFTSMAN'S CRIBSHEET

NUMBER
33

Miles Free – Director of Technology and Research

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Leaded Steel Refresher

Everything old is new again. Once a staple of the shop, leaded steel was out of fashion as new technologies and applications called for different materials. However, with definite savings in machinability, cutting speed and uptime, it should still be a part of your shop.

The Basics

- In the U.S., 12L14 is the predominant grade. 11SMnPb30, 11SMnPb28, 9SMnPb28 and 9SMnPb36 are German designations nominally equivalent to 12L14. The Chinese version is Y15Pb, and Japanese equivalents include SUM22L, SUM23L and SUM24L.
- Today, leaded steel is more consistent and uniform than in the past, when it was produced by the ingot process.
- There is no sacrifice in mechanical properties when adding lead to steel. Neither longitudinal nor transverse mechanical properties are affected by the addition of lead to steel.

Lead Facts

- In order to be dangerous to humans, lead must be in soluble form. The lead in steel bars is a separate solid phase. The IARC lists lead under its Group 2B category.
- Lead is not banned by the European Union's Restrictions of Hazardous Substances (RoHS) Directive. As long as it is "an alloying element in steel containing as much as 0.35 percent lead by weight, aluminum containing as much as 0.4 percent lead by weight, and as a copper alloy containing as much as 4 percent by weight."
- It is also not banned by the EU's End of Life Vehicles Regulations for machining purposes in steel, aluminum and brass.
- Lead, as well as chromium, copper, manganese, nickel and phosphorous, is required to be reported under Sara 313 (40 CFR 372.65) when above thresholds.

When to Use

- The use of leaded steel can increase machinability by as much as 25 percent, leading to lower energy and time savings.



- "Cutting speeds can normally be increased from 15-25 percent above those employed for the standard grade." – *Monarch Turning Manual*
- Leaded steels tend to lower cutting temperatures and reduce wear rates on tools, resulting in more uptime. Surface finish on leaded materials is superior to that on non-leaded equivalents as well.
- "Lead, found mainly enveloping manganese sulfide inclusions, promotes machinability in two ways, possibly three. By forming a layer of liquid lubricant at the tool chip interface, it reduces the stress required to overcome friction. By acting as an initiator of micro-cracks and, possibly, by causing some liquid metal embrittlement, it reduces the deformation stress." – *American Machinist Special Report 790*

When Not to Use

- Lead is not soluble in iron. It is therefore a separate phase in the steel, usually visible enveloping the manganese sulfides as tails, though sometimes appearing as small particles.
- Lead has a higher density than iron. Because of this, it will tend to segregate given enough time while the metal is liquid.
- Lead has a relatively low melting point (liquidus) compared with steel. This can mean that at processing temperatures for heat treatment, leaded steels can "exude" lead.
- Because of these three factors, avoid the use of leaded steel if your parts:
 - Must be free from possible segregation
 - Cannot have potential hollows or porosity after being exposed to high temperatures
 - Can have absolutely no visible indications of a separate phase in the steel (commonly referred to as "Lead Stringers")

All Craftsman's Crib sheets are available for viewing and download at short.productionmachining.com/cribsheets.