

# CRAFTSMAN'S CRIBSHEET

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  Technical
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## Leaded Steels: What You Should Know

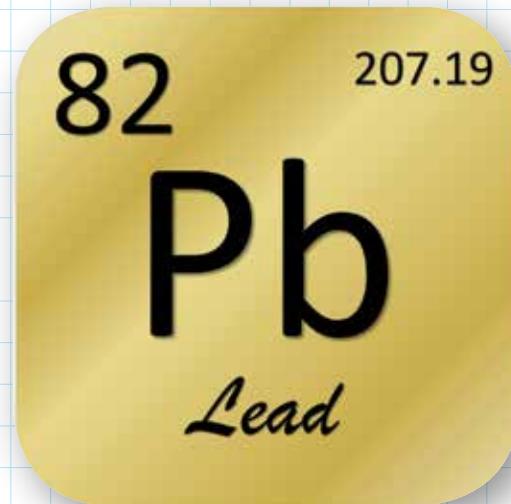
Lead is not banned by the European Union's "End of Life Vehicles Regulations" for machining purposes in steel, aluminum and brass. Lead is not banned by the European Union's "Restriction of Hazardous Substances (RoHS) Directive."

The exemption reads, "Lead as an alloying element in steel containing up to 0.35 percent lead by weight, aluminum containing up to 0.4 percent lead by weight, and as a copper alloy containing up to 4 percent by weight." This exemption is located in article 4.2 and Annex, line 6.

**If even the European Union recognizes the additions of lead in materials for machining is worthy of exemption, lead must provide some significant benefits, such as:**

- "Boosts machinability 25 percent at lower cost," says Pat Wannell, La Salle Steel, April 1994, quoted in "Modern Metals Magazine."
- "Cutting speeds can normally be increased from 15 to 25 percent above those employed for the standard grade." - Monarch Turning Manual
- "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 microcracks and, possibly, by causing some liquid metal embrittlement, it reduces the deformation stress." "American Machinist" Special Report 790.
- In our experience, we have found leaded steels to lower cutting temperatures and reduce wear rates on tools, resulting in higher uptime. Surface finish on leaded materials is superior to those on non-leaded equivalents.

Increasing speeds and production, reducing power needed (and, thus, greenhouse gas emissions) and improving surface finish are some powerful advantages that are provided by the addition of lead to materials for precision machining.



### What's the downside?

1. 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.
2. Lead has a higher density than iron. This means it will tend to segregate while the metal is liquid, given enough time.
3. Lead has a relatively low melting point (liquidus) compared with steel. This can mean that, as processing temperatures for heat treatment, leaded steel parts can exude lead.

These three factors mean that if you absolutely must have parts that are free from possible segregation, parts that will not have potential hollows or porosity after being exposed to high temperatures and absolutely no visible indications of a separate phase in the steel (that is, "lead stringers"), you probably ought to forego the leaded grade.

And forego the 25 to 30 percent savings that it gives you on the part machining cost. So, take your pick.

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