Craftsman's Cribsheet

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Miles Free – Director of Industry Research and Technology [X] Technical [ ] Regulatory [ ] Quality [ ] Management

5 Ways Fine Austenitic Grain Size Affects a Machine Shop

While austenitic grain size is a result of chemistry, the changes it evokes in our processes are a result of material structure and properties, not just the chemical ingredients.

Steel that is fully deoxidized with refined grain is less susceptible to cracking and distorting and more easily controlled in heat treat. Using steel like this is well worth it when it comes to final performance, compared with the machinist's increased tooling costs.

Here are five ways fine austenitic grain size affects your machine shop. Compared with coarse-grained steels, using fine austenitic grain sizes results in:

1. **Poor machinability.** The hard oxides and nitrides resulting from deoxidation and grain refinement abrade the edge of tools and coatings. This is one of the reasons shops go through more tooling on fine-grained steels.

2. **Poor plastic forming.**

3. **Less distortion in heat treating.**

4. **High ductility.**

5. **Shallow hardenability.**

Fine austenitic grain size is a result of deliberately adding grain refining elements to a heat of steel. Because these grain refining elements have been added, the steel has a fine austenitic grain size.

In order to make steels with this austenitic fine grained structure, the steel is first deoxidized, usually with silicon. Then aluminum, vanadium or niobium is added. Aluminum, vanadium and niobium are called grain refiners.

After the silicon has scavenged most of the oxygen out of the molten steel, the grain refiner is added. Using aluminum as an example, the added aluminum reacts with nitrogen in the molten steel to form aluminum nitride particles. These tiny particles precipitate along the boundaries of the austenite, as well as within the austenite grains. This restricts the growth of the grains.

Because the deoxidation and grain refinement create hard, abrasive oxide and nitride particles, they machine and process differently than coarse-grained steels.

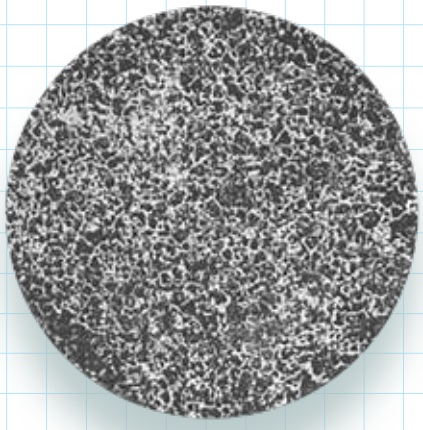
Fine austenitic grain size appears on the material test report as an ASTM value of five or more. Values of five, six, seven, eight or "five and finer" indicate the material is austenitic fine grained. Typically, seven or eight was reported for the aluminum fine grain steels I certified.

Alloy steels are always made to fine austenitic grain size.

Most free machining steels, those that are re-sulfurized (11XX), resulfurized and rephosphorized (12L14, 1215) and leaded (12L14, 11L37, 11L44) are generally made to a coarse grain practice.

Fine grain steels will not machine nor have the extended tool life we expect from the coarse-grained free machining steels we prefer to machine.

The methods for determining austenitic grain size are detailed in "ASTM Standard E112, Standard Test Methods for Determining Average Grain Size."



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