



Converting to P/M Gears

To facilitate the conversion of gears from other forming technologies to P/M, we've developed criteria to guide engineers in identifying potential candidates. Our technologists are quick to note, however, that while these guidelines are useful for a majority of applications, with state-of-the-art tooling, large presses and robust secondary operations, the "P/M envelope" can certainly be expanded. Answering "yes" to the following criteria indicates that the gear in question is more likely to be a good candidate for P/M conversion.

- ◆ **Size** – Does the gear have a projected surface area equal to or less than 40 sq. in., and a height typically less than 3 in.?
- ◆ **Shape** – Does the gear have a wall thickness greater than 0.060 in. and an aspect ratio (defined as the height-to-wall thickness ratio) less than 12?
- ◆ **Material** – Is the gear made of low-carbon or low-alloy steel, bronze, brass, aluminum, or stainless steel? Is a theoretical density of between 80% and 92% acceptable for the application? (However, irrespective of application, there are materials and a P/M process that will meet or exceed the operating requirements currently met by wrought gears.)
- ◆ **Tolerances** – Does the application require precise tolerances (i.e., +/-0.0015 per in. of diameter in the lateral direction (die-controlled), which applies to ODs, IDs and other features, and +/-0.003 per in. in the height direction (press controlled)? Naturally, requirements for gears with less demanding tolerances can be met as well.
- ◆ **Production Volume** – Is your annual estimated volume 50,000 pieces or more?

Some of the more common reasons for converting a gear to P/M include the following:

- ◆ The prospective P/M user has a complex gear that requires extensive (and costly) machining. Conversion to P/M may eliminate some or all of the machining operations.
- ◆ Through P/M joining and other related process technologies, individual parts may be combined into an assembly.
- ◆ The OEM or supplier (with a directive from the OEM) is looking to take weight out of a gear or assembly.
- ◆ The OEM or supplier (again, with a directive from the OEM) is looking to add features with minimal cost implications.
- ◆ There is a need to localize strength in a particular area of the gear.
- ◆ The prospective P/M user is looking for options that have the potential for lowering cost.

In order to make a part *P/M friendly*, certain design considerations are recommended: 1) chamfers of 30° to horizontal; 2) radii of 0.010 in. at a minimum; 3) hole sizes of 0.060 in. at a minimum; and 4) up to 150,000 psi tensile/compressive strength.



Powder metal is a suitable, and often preferable, alternative to conventional wrought gears.

For further information on using P/M Technologies for your gear applications, call 1-248-371-0800
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