

# Worm Gear Cutting

## THE QUESTION

I have a fairly straightforward question about a worm gear segment. But as of yet, I haven't gotten a straight answer from any of the gear job shops I've approached about this job. Is there a "traditional" gear cutting method that can produce a ~180 degree enveloping worm gear segment when a feature on the back of the part will interfere with a complete rotation of the part?

Or am I left with only the option of 4- or 5-axis surfacing with a CNC mill?

I have presented this part to several well-known gear shops in the U.S. without a straight answer on how the part can be made.

Any help you could offer would be appreciated.

### Expert Response Provided by Ernie Reiter P. Eng., President, Web Gear Services Ltd.:

The question relates to the manufacturing of a sector worm wheel which has teeth covering 180 degrees of rotation. To further clarify the question, the worm wheel also has its body extending away from the center of rotation in a manner shown in the attached figure.

Aside from CNC machining, which requires the complexity of an accurate 3-D model to create the surface profiles, the most common method of manufacturing worm gears is by hobbing, using a cutter (mounted at 90 degrees to the axis of rotation) whose profile is nearly similar to the mating worm that will mesh with the worm wheel.

Hobbing is the predominant manufacturing method since most worm gears are made of softer materials which rarely exceed 30 HRC. Materials with hardness of up to 37 HRC can be hobbled; however some manufacturers are reluctant to do it due to the increased tool wear and slow cutting speeds. Ultimately these issues are cost related. Some manufacturers may or may not be interested in taking on this higher level of hardness. Grinding of worm gear teeth is not commonly done.

The issue of finding a supplier with the capability to hob the required

gear with 180 degrees of rotation is dependent on the specific machine, the cutting tool shank and mounting on the machine, and the part design itself. It may be that the combination of these issues for your specific part severely narrows the field of suppliers that are able to produce your part. Figure 1 shows the interference zone where these issues converge.

Some design changes that may increase the manufacturing capability include modification of the extension feature of the sector gear to allow more clearance for the cutter without contacting the part; reduction of the sector to less than 180 degrees; or modification of the design to a crossed axis helical gear instead of a worm gear—which may allow for more cutting tool options to provide clearance—including using a hob tilted off 90 degrees to the axis of rotation that may clear the extension feature.

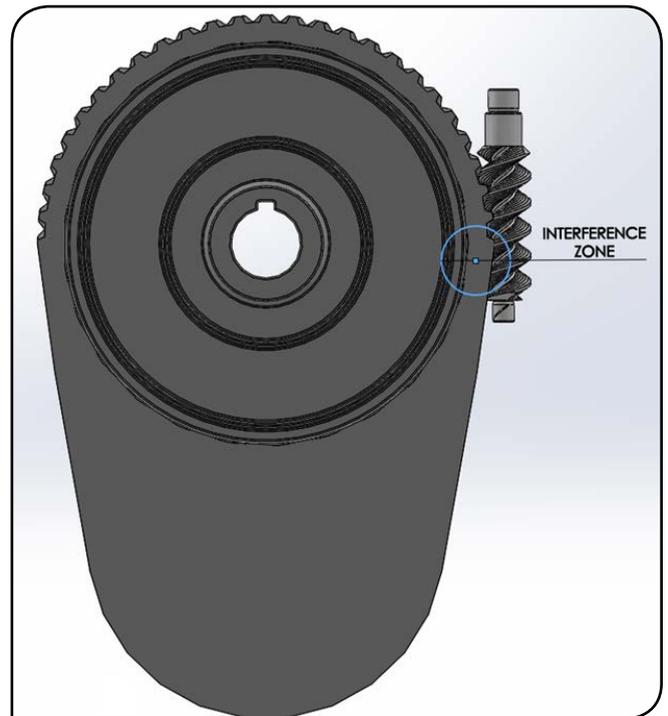


Figure 1 It may be that a combination of issues for your specific part severely narrows the field of suppliers that are able to produce it. Shown is the interference zone where these issues typically converge (Image courtesy Web Gear Services Ltd.).

**Ernie Reiter (P. Eng)** is a consultant specializing in the design of gears and geared products. He has authored modern software on gearing and other mechanical components, and provides clients with gearing-related design, consulting, software, gaging, training, and support. Since receiving his degree in mechanical engineering in 1985 from the University of Waterloo in Ontario, Canada, Reiter worked in the field of plastics part production for the automotive industry. His various responsibilities include developing tooling and directing the manufacture of molded plastic gears. As part of his engineering duties, he has acquired advanced skills in computer graphics and its application to gear geometry. He is active in five AGMA technical committees, including vice chair positions in both the Plastics and Powder Metal Gearing Committees, and is an active participant in the Fine Pitch, Gear Accuracy and Worm Gearing Committees.



**Second Expert Response provided by Fred Young, CEO Forest City Gear ([www.forestcitygear.com](http://www.forestcitygear.com)):**

(In this case) it could not be made as an enveloping worm gear due to the necessity of continual rotation to achieve full depth. There is no gear machine that can back off for sufficient distance to avoid running into the arm extension 180 degrees to the gear. This also applies to fly cutting the gear. If it was designed as a crossed axis helical, it could easily be shaped on a gear shaper and would run fine against the worm.

You can also make it as a two-piece assembly. Otherwise, this leaves milling it on a five-axis milling machine or perhaps printing it. **PTE**

**Fred Young** is owner/operator of Roscoe, IL-based Forest City Gear, [www.forestcitygear.com](http://www.forestcitygear.com).



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