

Gear Teeth as Bearing Surfaces

Email your question—along with your name, job title and company name (if you wish to remain anonymous, no problem) to: jmcguinn@geartechnology.com; or submit your question by visiting geartechnology.com.

QUESTION

I am wondering about gears where the tops of the teeth are the bearing surface, e.g.—as used in spur gear differentials. Do these (require) any special construction or processing? Thanks!

Expert Response Provided by Chuck Schultz.

Designers frequently have to mount bearing inner races on surfaces that are interrupted by gear or spline teeth or the “runout” area of the cutters used to make those teeth. Bearing manufacturers have their own policies on how much support a particular bearing needs so your best information will come from them. Unfortunately, the bearing company you want to reach is probably busy helping other customers, so here are a few of the design rules I try to follow. I say “try” because with apologies to Yoda, some situations will not quite comply with the rules.

The tolerance of the bearing mounting surface **MUST** comply with the bearing manufacturer’s requirement. Having a bearing “slip” is disastrous under normal circumstances; doubly so when the teeth can act like milling cutters on the bearing bore. You may have to adjust gear geometry to achieve the required fit diameter, as is commonly done with metric spline standards such as DIN 5480.

Some bearings, such as needle roller bearings with thin inner races, will require testing or a bearing manufacturer “sign-off” to be mounted in this way. If the bearing company says NO, you would be wise to listen.

If the total area at the bearing mounting surface is less than 45%, you will want to consider using a larger-bore bearing with a sleeve fitted to the shaft.

All runout and finish requirements of the bearing fit diameter apply to these interrupted surfaces. That means it will have to be ground or hard turned after heat treating if the part is surface hardened.

All abutment dimensions still apply; the adjacent shoulder, roller clearance zone, and corner radii must be held.

As DIN5480’s popularity shows, mounting bearings on surfaces interrupted by teeth and cutter is not an unusual requirement. Clever engineers like Leo Goosen (*see Addendum p. 88, 1926 Miller front wheel drive gearbox*) find ways to avoid it, but many successful power transmission products have made it work.

Chuck Schultz is a licensed engineer, Gear Technology Blogger (geartechnology.com) and Technical Editor, and Chief Engineer for Beyta Gear Service (gearmanx52@gmail.com).



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