

This month's column is the fourth installment of six on bevel gearing. This series began by discussing the possible failures determined through vibration and will end with new finished products.

Regardless of type or style, when bevel gears need to be replaced and manufacturing drawings are no longer available, your gear can still be reproduced or manufactured through reverse/inverse engineering by supplying your samples no matter whether they're worn, damaged, or broken. Upon receipt of the sample gear set, the first item to be checked is the grade of material to be used. Most bevel gears are produced from low carbon alloy steels that have been carburized and tempered to the proper hardness. The surface hardness can be checked on an area of the sample gear that has not been damaged. This is done by using a variety of hardness checkers, and in some cases "destructive testing"—removing a section of a gear tooth—is required to determine core hardness and effective case depth.

Once the grade of material and heat treatment method has been determined, the geometry of the gears via the reverse/inverse engineering process begins with the determination of the following:

- Number teeth (N) of the driven component (gear) divided by the number teeth (n) on the drive component (pinion) equals ratio = (N/n). Example: 9T drive pinion mated to a 63T driven gear = 7.0:1.0 ratio which is a speed reducer and a 32T drive pinion mated to a 28T driven gear = .875:1.0 ratio which is a speed increaser.

Diametral pitch (DP) is calculated by checking the outside diameters of both gear and


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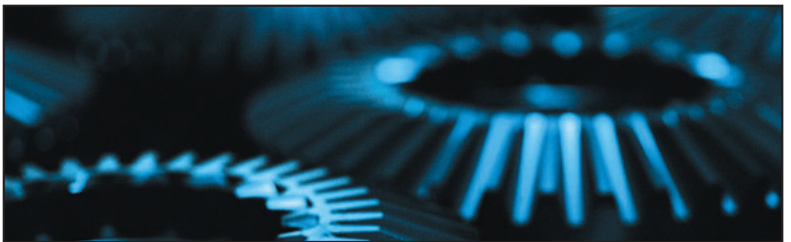
pinion. When there are an odd number of teeth in either a gear or a pinion, there is an arc that must be part of your calculations to determine exact OD.

Once the DP is determined, engineer(s) must decide the pressure angle (PA°) to incorporate into the design, which changes with load factors. If the samples are spiral

bevel gears, a spiral angle must be calculated through to coincide with horsepower, load, and the service factors required. Bore sizes, keyways, bearing fits, seal diameters, threads, shaft/step lengths, hub diameters, bolt circles, set screws, overall lengths, etc., are a few more characteristics that must be duplicated from the samples submitted. If for any reason one of these variables is questionable, verification by the end user is extremely important.

It is common practice for a mechanical engineer to produce a hand sketch and then run a computer generated "gear summary" to ensure that the dimensions coincide with samples. If all were consistent, the engineer would proceed to produce a finished computer generated drawing for approval by the end user for manufacturing purposes.

All above-mentioned criteria apply only after the customer has accepted the initial quotation and has issued a purchase order for the gear(s) or gear set(s) to be manufactured. Be sure to read my next installment on lapping and contact patterns of bevel gears. 



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