

Leading the Way in Lead Crown Correction and Inspection

Forest City Gear applies advanced gear shaping and inspection technologies to help solve difficult lead crown correction challenges half a world away. But these solutions can also benefit customers much closer to home, the company says. Here's how...

Bring it on, says Forest City Gear's Fred Young.

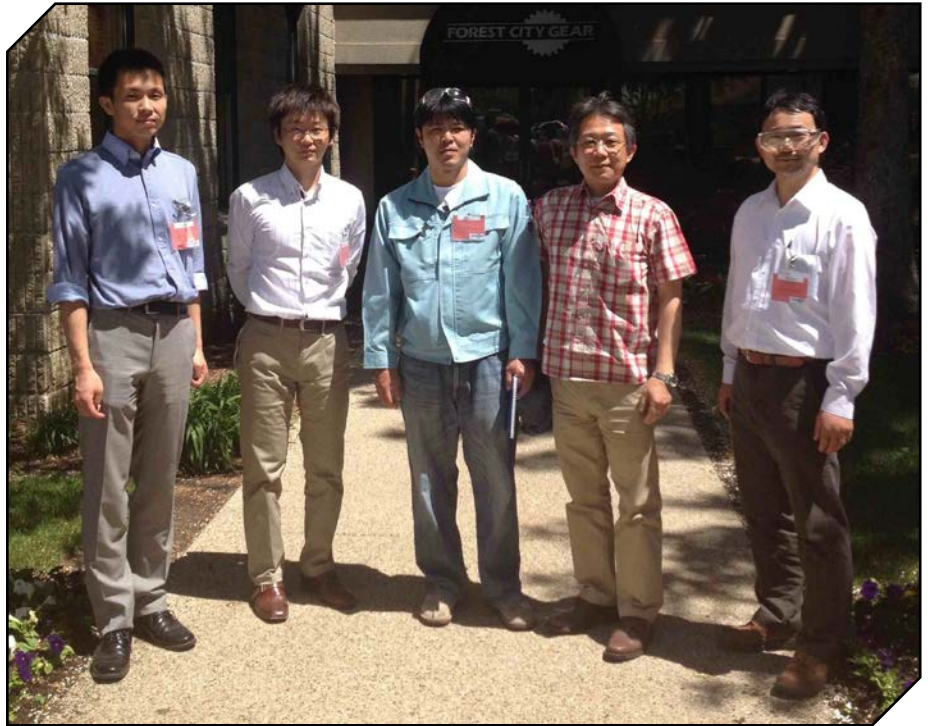
Some might think it unusual that Gleason Asia and its customer, a Japanese aerospace parts manufacturer, would travel thousands of miles to contract with Roscoe, IL's Forest City Gear to produce prototypes of a titanium turbine part for an aerospace application. But for Young, it's all in a day's work. "We have a good reputation amongst many Japanese manufacturers as a 'can do' company," Young says. "And we're not averse to taking on challenges — even when it's something this exotic."

'Exotic' might be an understatement.

This particular aerospace turbine part has an external gear with a design that calls for crowning 70 teeth. Unlike most crowns, which are generally produced on both flanks and are relatively easy to produce since they're centered symmetrically right at the mid point of the face width, this crown is asymmetrical, and with an allowable lead tolerance of just two microns (.002 mm, .000080") at the 'knee' of the crown. (Note that the crown is unusual in that it resembles an involute K chart.)

Ultimately, this Japanese manufacturer will produce these gears and perform the crowning on a new Gleason P 600 ES Gear Shaper with ES electronic guide capability, but until that machine arrives later this year, they're relying on Forest City Gear to carry the load.

Not coincidentally, Forest City Gear has years of experience running Gleason P 300 ES and P 500 ES Gear Shapers, and has long been an advocate of crowning as a highly effective way to reduce noise, and minimize misalignment problems that might exist in housings, shafts, gearboxes or bearing journals. Gears sometimes have a load differential on



Gleason Asia Co., Ltd.'s T. Utsugi, on the far left with Forest City Gear's special guests from Japan.

the two flanks as well, requiring a modification of the involute to compensate. Crowning also reduces lead problems in the gears themselves, which, over time, can cause the gears to wear unevenly and even bind because of eccentricities and position errors. (The crowning or barreling of the teeth naturally localizes contact bearing in the center of the teeth rather than toward the edge where the teeth would be more subject to stress.) While gear manufacturers have known about the benefits of crowning for some time and have often created the desired crown while hobbing or, more commonly, post-hobbing (or shaping) with a *shaving* operation, Forest City Gear has championed the use of its Gleason ES Shapers for this work, because both the crowning and cutting can be done simultaneously, thus eliminating the time and cost of an additional shaving operation.

And there are other benefits as well. According to Gleason Senior Product Manager John Lange, who is well versed in gear shaping technology, there might be only one or two gear jobbers in the world that could perform this partic-

ular operation, meet these accuracy requirements, and verify the results in its own gear inspection lab right on-site. "Crowning both flanks simultaneously is relatively common and can be done even on shapers that rely on a traditional modified back-off cam to create the desired shape," says Lange. "But these cams can cost upwards of \$5,000 and take 4-6 weeks to design and produce." Furthermore, Lange says, the asymmetrical nature of this crown and the required accuracies would make it virtually impossible to produce unless the machine has an electronic guide such as the one equipped on the Gleason ES Shaper.

Gleason's ES electronic guide technology uses software and CNC programming to replace mechanical components like a special crown modified backoff cam.

The cutter's rotational motion can be programmed, as the cutter passes through the part, to make a left-hand helix angle, and then a right-hand helix angle, which together create the desired crown shape along the face width of the


tooth flank. Both teeth are cut simultaneously without a crowned surface, but on the flank requiring the crown enough stock is left to then finish just the crowned flank in a final pass. (Note in the pictured lead chart that the left flank is not modified — only the right flank.)

As one might imagine, the project was not without its challenges, recalls Young. “We realized early on that we hadn’t asked for enough parts to dial in the machine without running the risk of scrapping a \$20,000 or \$30,000 titanium part, so we made our own test parts out of softer, less expensive steel to use before we cut the actual titanium parts,” he says. “Our gear inspection lab was also challenged with the inspection criteria — 70 teeth, 100 percent evaluation of the two micron tolerance band on the crowned lead — and many process variables such as the two different material types and even the effects of removing the coating from the shaper cutter at some point to improve quality.”

Where quality takes shape. “When I show others the crowning inspection results and ask them how we achieved this two-micron tolerance, they naturally conclude that the teeth have been finish

ground,” Gleason’s Lange says. “They’re amazed when they find out it’s all done on the ES Gear Shaper.”

Credit Forest City Gear’s Quality Manager Amy Sovina and her team for their role in employing Forest City Gear’s gear inspection assets to help make the project a success. According to Sovina, Forest City Gear’s Klingelnberg P65 CNC Analytical Gear Checker was key to speeding the complete evaluation of this part and its particularly challenging lead crown.

As far as tackling the most challenging gear production jobs, Young wouldn’t change a thing. “It stretches us as a company, and makes all of us better, each and every time we take on a project like this that we’ve never seen before,” concludes Young. “More companies should be doing lead crown correction like this. We know just the place.” 

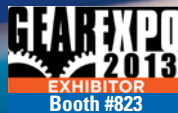
For more information:
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Forest City Gear’s investment in analytical gear inspection equipment played a critical role in the success of this particularly challenging lead crown correction project

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