GLOBAL SOLUTIONS

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TAKING THE "WAIT" OFF AEROSPACE GEARS

Arrow Gear Company uses Gleason computerized closed-loop system to produce spiral bevel gears for aerospace applications in a fraction of the time it takes conventionally.

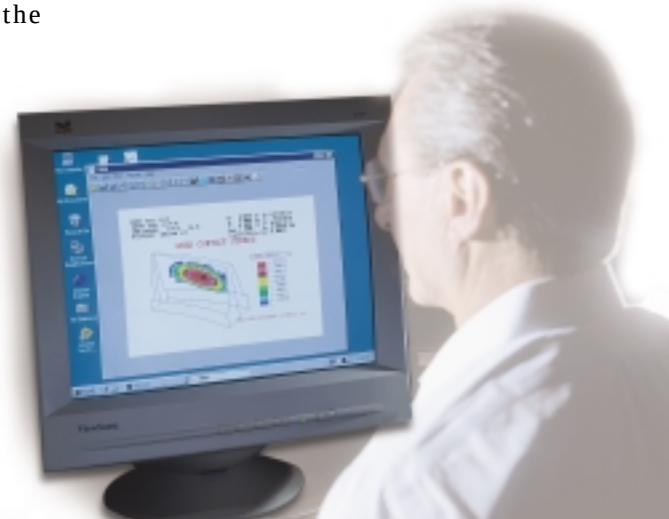
The world's aerospace leaders are applying new manufacturing technology and production methods on a scale not seen since the dawn of the jet age. So too are aerospace suppliers like Arrow Gear Company, Downers Grove, IL, a company that has succeeded in shaving literally months — and thousands of dollars — off the production of the spiral bevel gear sets that go into aerospace gear boxes.

Gleason's proprietary CAGE™, G-AGE™, loaded TCA™ (Tooth Contact Analysis) and Finite Element Analysis software, working in conjunction with Gleason Phoenix® CNC Bevel Gear Cutting and Grinding Machines and a CNC Gear Inspection System hold the key to eliminating months of costly trial and error, says Arrow Gear President Joseph Arvin. "We can now design and produce a spiral bevel gear with the optimum contact pattern in one or two tries," he says.

Gleason CAGE design software program enables Arrow Gear to design spiral bevel gears with an optimum contact pattern, cutting typical gear development trial and error time from many months to just weeks.

This isn't the case at many aerospace gear shops, where the process for identifying the size and position of the gear's contact pattern — a primary design consideration — is time consuming and very expensive. For a gear to perform properly under the significant loads placed on most lightweight aerospace gearboxes, the contact pattern (where gear teeth engage and disengage during rotation) must be a very precise shape and size. The ideal contact pattern, for example, will be almost 100% of the tooth area, but without running off the edges. The typical process starts with an engineer making a first pass at the gear tooth geometry to provide a correct contact pattern.

Gear and mating pinion are produced, run on a tester and, more often than not, found to have an incorrect contact pattern. This 'hit or miss' process is repeated many times. Even after a gear is thought to have the correct contact pattern, testing under load usually reveals that still further refinement is required. It is this costly and time-consuming process that Arrow has succeeded in improving upon.



Taking the guesswork out of gears. "Fantastic! It's great to work with," says Arrow's Chief Gear Designer Tom Mifflin when asked how he likes Gleason's CAGE design software. And no wonder. The power takeoff gear Mr. Mifflin is designing for the Airbus A380's powerful new engines has some 28 different load displacement conditions that must be factored in to determine the correct contact pattern. But rather than taking an educated guess, Mr. Mifflin simply uses the Gleason Finite Element software tool to perform a loaded Tooth Contact Analysis (TCA), which takes into account displacement conditions and recommends a contact pattern for Arrow's consideration. The Finite Element Analysis is also used to predict real stress on the tooth surface and root fillet. Mr. Mifflin can then use these tools to help verify whether there is a potential for failure resulting from excessive or non-uniform pressures anywhere along the line of engagement of the gear tooth.

Once Arrow has performed the TCA and FEA studies, and determined the ideal contact pattern size and location, the CAGE software creates the summary machine parameter settings required by Arrow's Gleason Phoenix® Bevel Gear Grinders to finish the parts. At the same time, Gleason's G-AGE software program is used to generate an inspection file for Arrow's CNC inspection machine, which ultimately performs an electronic digital topographical plot of the finished tooth surface. G-AGE then automatically changes the machine settings to match the computerized tooth shape desired, thus 'closing the loop' on the entire process. Through a hard-wired connection, both the summary settings and the inspection file are downloaded to the machines. In all, the development process for the new Airbus engine gear will take around 40 hours, says Mr. Mifflin, as compared to anywhere from six months to a year using conventional methods.

'Closing the loop' on quality.

"Our success rate is 100% using this Gleason closed-loop system," adds Mr. Mifflin. "We recently used it to cut initial development time on a bevel gear set for a Pratt & Whitney PW6000 jet engine from six months to just one week, and the manufacture of the new gearing from 22 weeks to just 12. And did it work? After 75 hours of qualification testing the contact patterns were exactly as we predicted they would be."

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