Closed-Loop Gear Machining
A Mazak/Dontyne Systems Collaboration

Mazak and Dontyne Systems have agreed to an exclusive collaboration to develop and market a flexible gear machining solution that combines the Multi-Tasking capabilities of Mazak's precision 5-axis CNC Multi-Tasking machine tools with Dontyne Systems' gear production software solutions. Dontyne is a gear software developer based in the UK with sales support in Cincinnati, OH, which is located near the Mazak USA Headquarters in Florence, KY. Mazak and Dontyne employees were introduced to each other at Gear Expo 2013 in Indianapolis, IN, and have since developed their joint Closed-Loop Gear Machining solution with the help of Renishaw and Advanced Industrial Measurement Systems (AIMS). They've exhibited at Gear Expo 2015 (Detroit, MI); Mazak's DISCOVER 2015 (Florence, KY); PRI 2015 (Indianapolis, IN); and AeroDef 2016 (Long Beach, CA). They have also presented to Mazak's West Coast sales team in Gardena, CA and held a customer focused "Lunch & Learn" at the same location.

This flexible gear machining solution combines the Multi-Tasking capabilities of Mazak's precision 5-axis CNC Multi-Tasking machine tools with Dontyne Systems' gear production software solutions.

Dontyne Systems | Mazak

HOW DOES THIS SOLUTION WORK?

The Closed-Loop Gear Machining solution enables customers to use Mazak's INTEGREX Series Multi-Tasking CNC machine tools to accurately cut gears (new or "reverse engineer" existing ones) that have been designed using Dontyne's software. The software functions include powerfully integrated graphics and industry standard (AGMA) engineering reports that enable a gear manufacturer to simulate how gear sets make contact (conjugate) for different industry applications. Gear designers are particularly interested in the "contact marking pattern" of gear sets — something Mazak & Dontyne have taken from theory to reality in a validated closed-loop process using Renishaw and AIMS products. Dontyne's software sits offline and all design, analysis, simulation and marking pattern definitions are made prior to the G-Code being posted to the machine. The process is suitable for manufacturing spur and helical, bevel or spline gears using either standard (i.e. end mills) or custom tooling (i.e. hobs).

Process Steps:

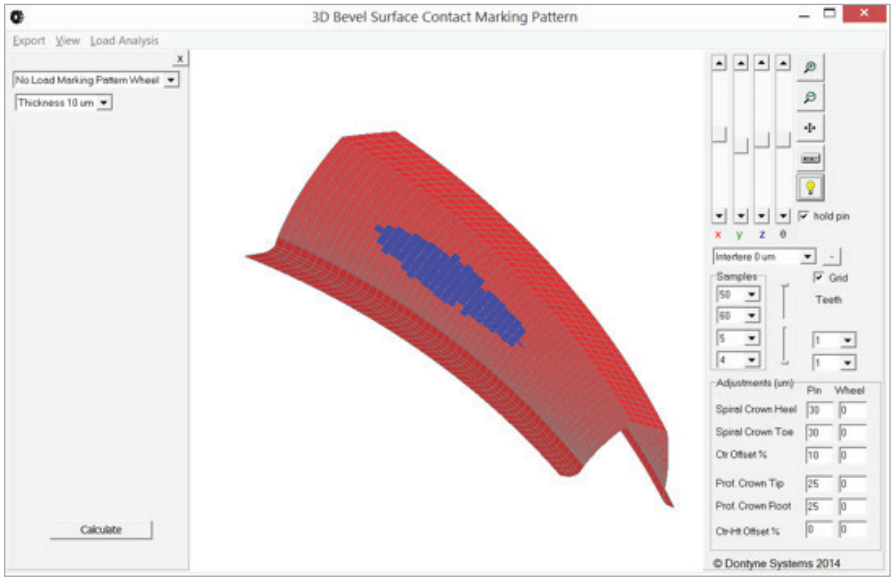
1. Gear design (create a new design or import an existing one), analysis, optimization, simulation, and tool design (if hobbing using Dontyne's offline software).
2. Export IGES/DXF tooth surface designs to a CAD/CAM system to create a solid model and G-Code or post G-Code directly from Dontyne to the Mazak.
3. Machine the part.
4. Inspect/measure the part using an accurate CMM.
5. Import measured data back to Dontyne software for comparative analysis — software can "invert" minor errors, if necessary.
6. Post NEW G-Code and machine corrected part.

Examples of gears machined using this software solution.

Mike Finn, Mazak Senior Applications Development Engineer

KEY CUSTOMER FEATURES & BENEFITS

- Single flexible CNC machine
- Rapid product mix changeover, which is responsive to demand fluctuations
- Lower overall machine and software costs coupled with dedicated gear equipment
- Smaller machine footprint
- No additional machine operator skills required
- Standard tooling can be used, which results in reduced lead times (custom hob tools can also be used)
- Suitable for spur and helical, bevel gears and splines
- Cycle time may be comparable to dedicated equipment (given part movement and finish required, heat treat, etc.)
- Ideal for companies with small batch, prototype and variable product mix jobs with floor space limitations
- Cut with confidence with a proven closed-loop solution that is supported by Mazak and Dontyne
- Compatible with any CMM and any CAD/CAM
- Cutting up to Rockwell 62



Example of Dontyne interface.

FREQUENTLY ASKED QUESTIONS

Q. We've tried to cut gears using a CNC before and cannot get the gears to mesh accurately. How can this solution help us?

A. Dontyne's gear software can accurately simulate the desired marking pattern. As long as the machine is set up correctly, parts can be precision made to match the design using a Mazak INTEGREX Multi-Tasking CNC machine tool.

Q. Will this solution be slower than using dedicated gear equipment?

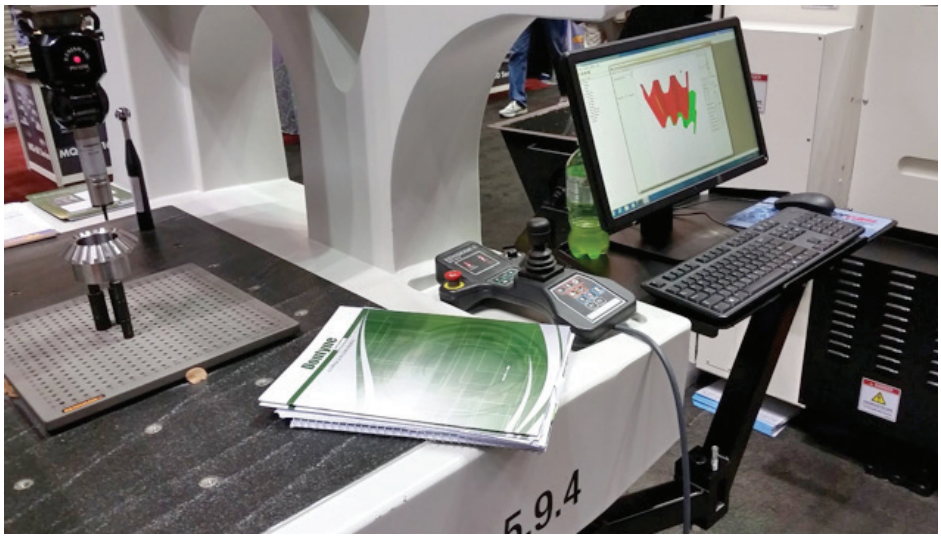
A. The closed-loop gear machining solution is not suited for very high volume gear production but, when the total process cycle time is considered, customers have identified advantages to using this solution to make finished parts in a single machining process.

Q. We already have dedicated gear equipment. Why should we explore this solution?

A. When the time comes to maintain, update or replace your equipment, we welcome the opportunity to demonstrate a viable alternative that costs less and offers greater overall flexibility.

Q. We design gears but outsource manufacturing. Is this a good solution for us?

A. More and more customers are bringing work back in-house to reduce part costs, reduce lead times and improve quality through tighter supply chain control.



Mazak/Dontyne Closed-Loop Gear machining solution.

FREQUENTLY ASKED QUESTIONS

Q. We are a job shop. We don't design gears, we just make what the customer wants. How would this work for us?

A. Using a Mazak INTEGREX and Dontyne gear software will improve accuracy, reduce waste, improve flexibility, reduce tooling costs, increase overall speed and enhance your supply relationships.

Q. Our operators don't have gear cutting knowledge. Will that be a problem?

A. As long as the design, analysis and G-code is controlled offline in the hands of a qualified person, the operator simply needs to focus on running the machine. Cutting gears is like cutting any other part from a machining perspective. The gear-specific design elements are determined at the front-end using Dontyne software.

Mazak and Dontyne team members exhibiting at PRI 2015.

For more information on Closed-Loop Gear Machining, contact Mike Finn at mfinn@mazakcorp.com or (859) 342-1891, or Rich Easley at reasley@dontynesystems.com or (513) 679-0313.