



THIRD WAVE SYSTEMS

MODELING TECHNOLOGY · MACHINING SOLUTIONS

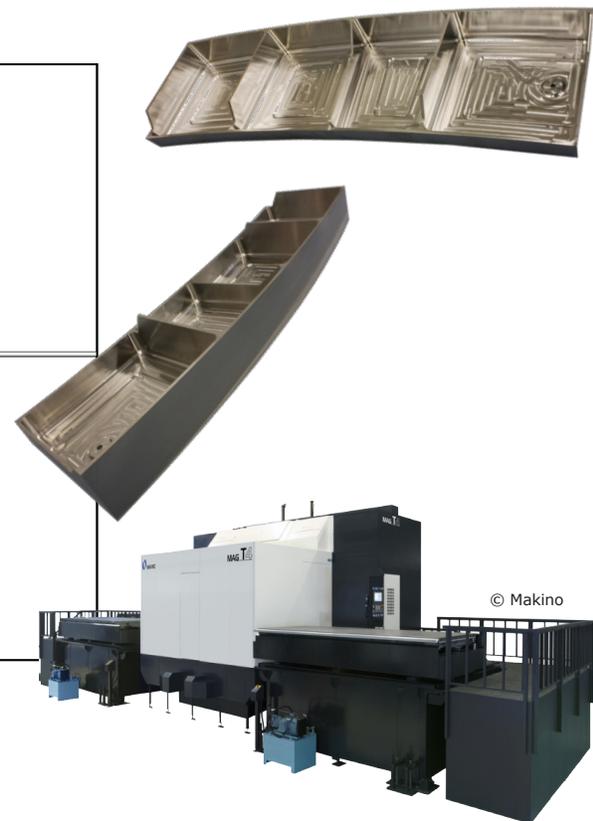
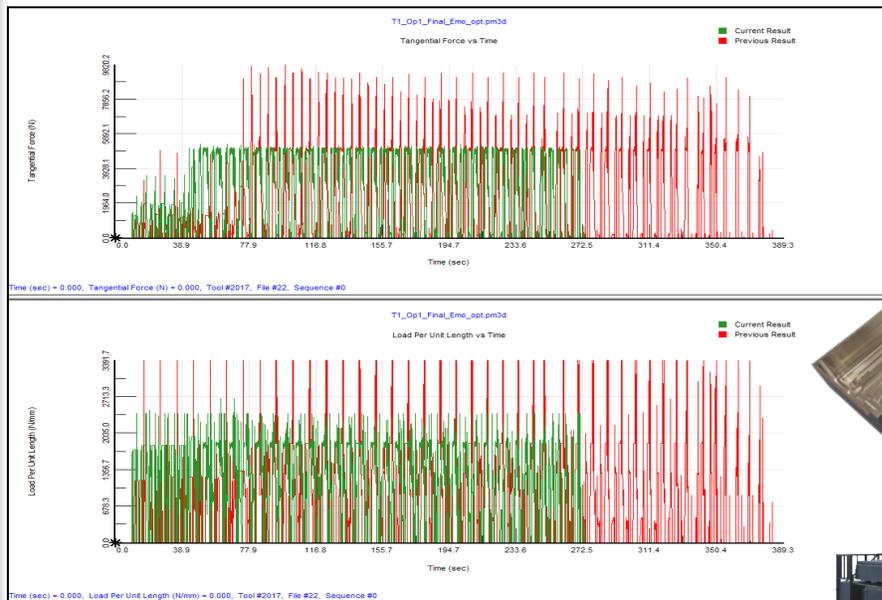
CASE STUDY: Aerospace Structure



As one of the world's largest machine tool manufacturers, Makino is proud to partner with customers to build and sustain a metal-cutting business that thrives by making the parts that matter for the customers that matter the most. As part of this partnership, Makino frequently machines sample parts for potential customers to demonstrate the advantages of Makino milling machines. The company is always on the lookout for technologies and tools that help machine the sample parts more efficiently, not only to prove the benefits of Makino machines, but also to promote better machining practices and tools to their customer community for a worldwide impact.

Software:

Third Wave Systems NC optimization product, Production Module



Results

Makino engineers used Production Module to optimize a 5-axis pocket operation on a customer-provided test part similar to a landing gear link. The 900 mm test part is machined from Ti-5-5-5-3, and Makino engineers wanted to identify the 5-axis toolpath that would achieve balanced loads. Tangential force limits were set at 7806.3 N within Production Module, and the toolpath was then optimized line by line to balance forces on the cutting tool.

Third Wave Systems is the premier provider of validated material physics-based modeling solutions and services. The physics-based machining simulation software products and services are used to optimize machining processes, giving engineers access to more information than trial-and-error tests and allowing them to make better decisions. Third Wave Systems' modeling products and services are used by progressive companies to dramatically reduce costs of machined components, accelerate design cycles, improve part quality and get to market faster.

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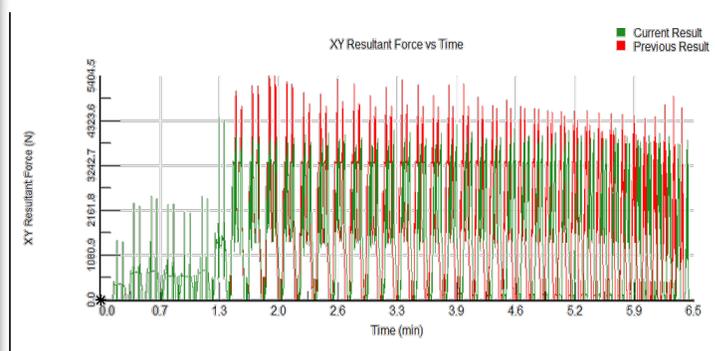
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One of the benefits Makino receives from utilizing Third Wave Systems product, Production Module, is the force calculation when the insert geometry is irregular. This example shows a HFM cutter with three edged inserts. The orientation and geometry of such inserts makes challenging the manual estimation of cutting forces. For this particular tool is important to keep the cutting forces below the maximum allowed by the bending moment limit.

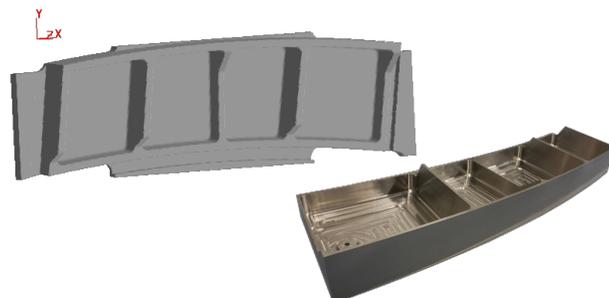
Analysis of bending moment for long reach tools

- » HSK 100 with 45000 N of clamping force
- » 1250 Nm of allowable bending moment
- » Maximum side load on tool = 1250 [Nm]/GL [m]



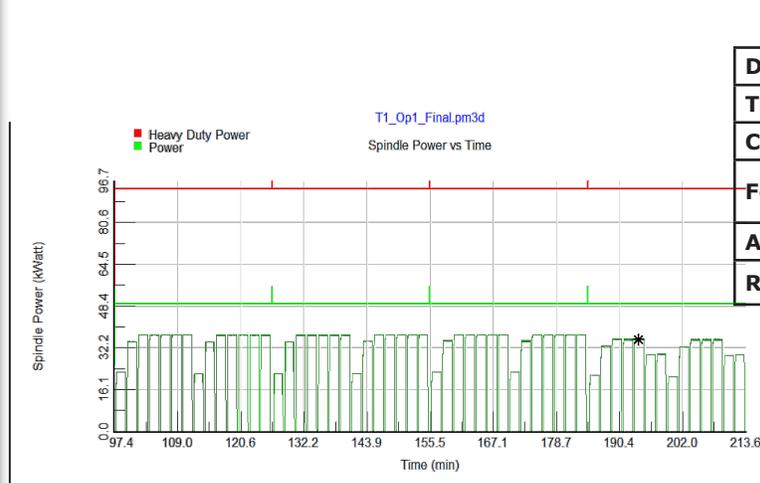
Tool allows 4032 N of side load

		Metric	Inch
Diameter	D _c	63.000 mm	2.480"
Teeth	Z _n	5	
Cutting Speed	V _c	200.0 m/min	656.2 sfm
Feed/tooth	f _z	0.600 mm/tooth	0.0236"/tooth
Axial Immersion	a _p	1.500 mm	0.059"
Radial Immersion	a _e	63.000 mm	2.480"

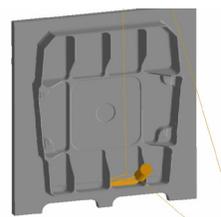


Utilization of spindle capability for heavy roughing

Production Module uses physics to simulate the machining process. In this case, it displayed heavy roughing on the fluid-end removing about 42.5 cubic inches a minute (a little less than 3/4 of a liter of steel per minute). Production Module helps Makino visualize spindle usage by calculating the power demand and illustrating how close this demand is to the continuous operating specification.



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