

# waveform roughing

## Maximum Material Removal

Waveform roughing strategy is a high speed machining technique that maintains a constant tool cutting load by ensuring the tool engagement into the material is consistent. The tool path moves in a smooth path to avoid sharp changes in direction which maintains the machine tool's velocity.

**Benefits include :**  
Reduces cycle time

Tool life maximised

Full flute of tool utilised

Minimum tool vibration

Constant chip load

Intelligent toolpath linking

Cuts deeper and faster

### Constant Engagement

Although the Concentric pattern looks much simpler at the first glance the problem is that the tool "digs" into each corner causing the tool to overload, leading to reduced tool life or tool breakage. In reality the machine tool operator may have to reduce the cycle feed rate to compensate and thus, increase manufacturing time.

As Waveform maintains a constant engagement with the material, the feed rate can remain at the optimal value throughout the cycle. This will improve the tool life and greatly reduce the risk of tool breakage - it is very simple to switch from traditional roughing to Waveform to see the toolpath pattern.

### The Waveform Pattern

To maintain a constant chip load the cycle uses the philosophy that we machine from "Stock to part". This reduces the amount of intermittent cuts, particularly on external regions, which means the tool is engaged with the material for longer without lifting clear. Traditionally, cycles generally offset the component until they meet the stock. This can lead to the generation of sharp corners and discontinuous tool paths.

For pocket regions the tool will helical in to depth at the centre and open the pocket up so that it can create a continuous spiral cut until the edge of the pocket is reached. Any remaining corners are then removed. Waveform automatically detects open areas and uses them for tool entry, rather than cutting an open region like a closed region.

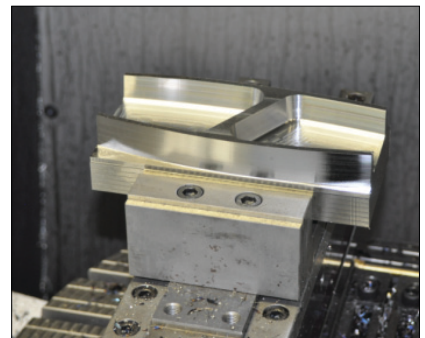
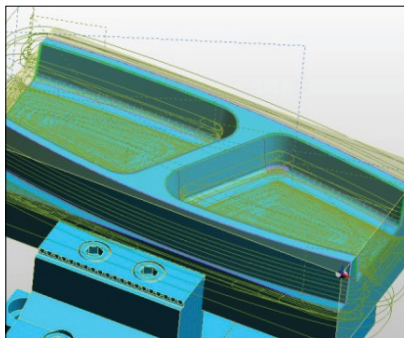
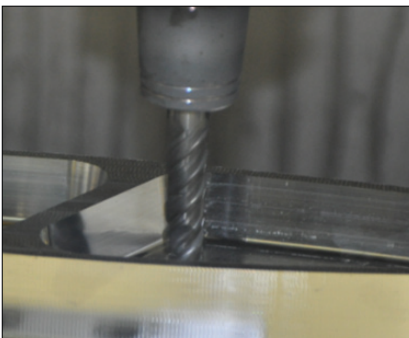
### Adjusted Tool Engagement

To maintain the tool engagement and the chip load the tool path is automatically adjusted to compensate. When cutting into a concave area tool engagement is increased. The cycle adjusts the step over between the passes to compensate and maintain the desired engagement.

When cutting a convex area the opposite affect occurs. As the material falls away the tool path step over is increased to maintain the desired engagement.

### Intelligent Linking

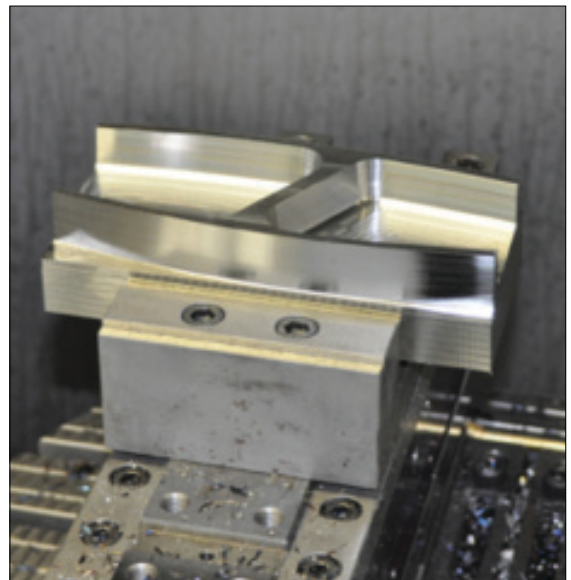
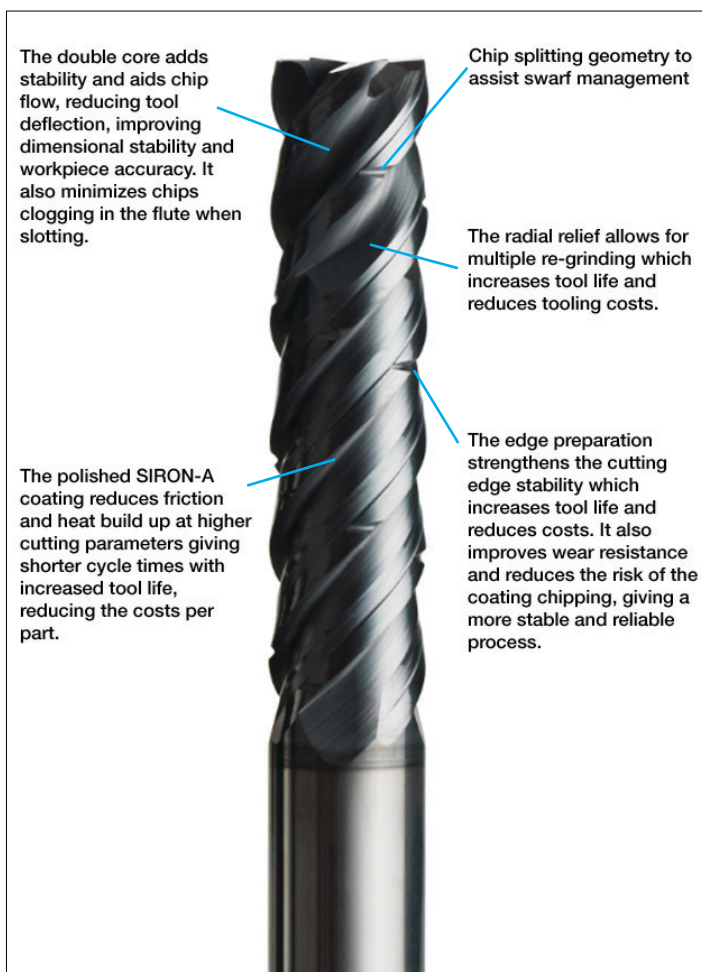
To improve cycle efficiency, Waveform provides the ability to stay at depth whilst moving between milling areas or go up and over and stepping off the component.



# waveform

Waveform Roughing greatly improves standard roughing cycles by removing a constant volume of material.

Cutting along as much of the flute length as possible distributes wear evenly along the entire flute length, rather than just the tip, massively reducing tool vibration. The radial cut depth is also reduced to ensure a consistent cutting force, allowing cut material to escape from the flutes. Tool life is further extended as most of the heat is removed in the chip.



Strategy	Waveform	5 Axis
Tool Details	12mm Vari Mill	16mm Ball R3.1
Machine	Agie Charmilles Mikron HMP600 U	
Material	EN19T (Group 5)	
Speed (RPM)	8,000	3,180
Feed (mm/min)	8,000	1,200
Ap (mm)	25	-
Ae (mm)	8.3%	-
Entry Strategy	Z Depth - Open Pocket	-
MRR (cm³)	200	-

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