

Press Release

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Perfect Surfaces of Metal Cutting Tools

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Rounding of cutting edges with a drag finishing process

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The rounding of cutting edges at cutting tools is coming more and more into the focus of experts. It is already well known, that the condition of the cutting edge has an enormous influence over the tool life-time and possible cutting characteristics. An interesting alternative to well known processes, like brushing or blasting, has been established.

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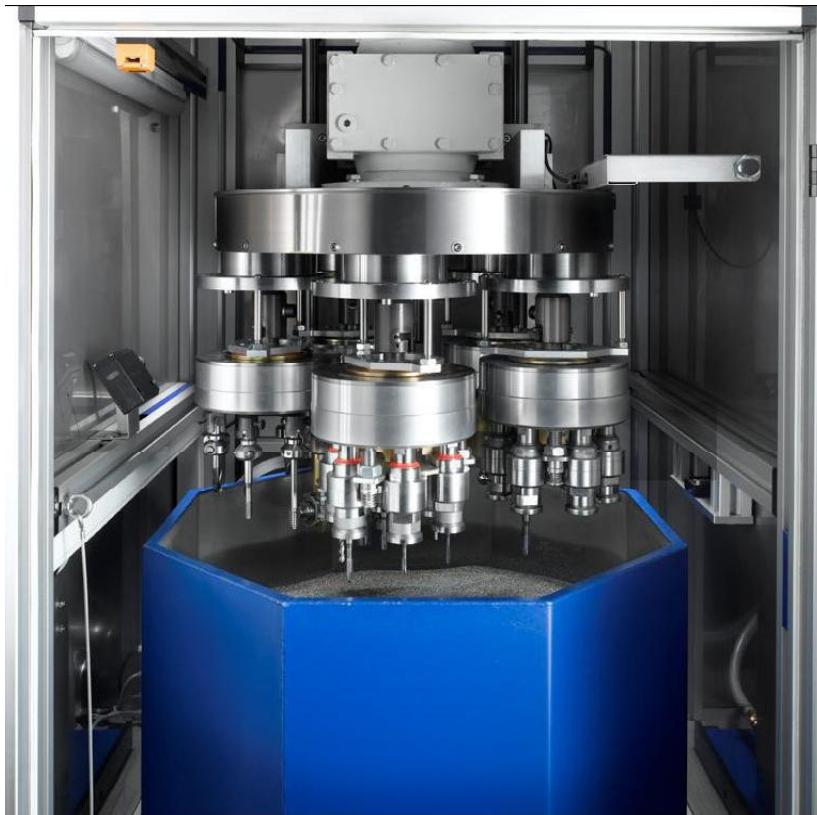


Figure 1: Drag finishing machine with planetary driven multiple tool holder for efficient and perfect processing

Picture: OTEC GmbH

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Drag Finishing:

In drag finishing, tools are fixed in holders and dragged through abrasive media, while they are additionally rotating on their own axis. The tools follow a planetary like path; this ensures a uniform contact of all areas at the tools to the media. Also complex geometries can be processed the same way. Primarily the process time, speed, immersion depth of the tools and the abrasive media itself determine the size of the edge rounding and the surface finish. These parameters which influence the result can all be clearly defined and guarantee a high process reliability. This is a clear advantage of the drag finishing process, and where it differs from other conventional processes.

The following are the main influential parameters:

a) Immersion depth of the tool into the abrasive media:

The heavier the grain of the media, the higher will be the static pressure. This will result in bigger cutting edge radiuses and respectively in better smoothing ability. The immersion depth can be chosen via the SPC.

b) Speed:

The speed influences the rounding of the cutting edges as well. It can be adjusted continuously variable.

c) Process time:

The process time may vary from as little as a few seconds for removal of droplets from coatings up to 20 minutes to achieve a 70µm radius at carbide tools.

d) Abrasive media:

The media has influence on surface quality at the cutting edge as well as in the flute, and also on the size of the radius at the cutting edge.

e) Right-/ left rotation of the tool holders:

Different results will be achieved, depending on the direction of rotation of the tool.

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Drag finishing is suitable for:

- Tungsten carbide mills and drills
- Tap drills and tap forming tools
- CBN-PCD tools
- Inserts
- Thread rolling tools
- Stamping dies and forming tools

Leaving theory and going to practice:

Deburring, edge finishing of tap drills

During production of tap drills, small burrs in between tap profile and flute are generated due to the grinding process.

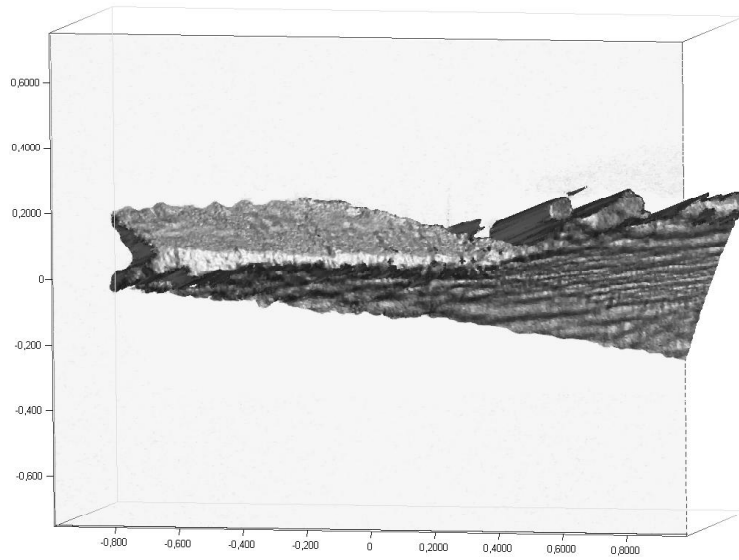
Grinding free of burr is not possible, costly finishing treatment is therefore obligatory.

In case tap drills would not be deburred, the burr would negatively influence the cutting edge geometry. Moreover, at uncoated tools the burr could get bent over the cutting edge during machining, could chip off and damage the cutting edge.

This would end up in shortened tool life-time, reduced surface finish and less dimensional accuracy.

Furthermore, a tool completely free of burr is, for a modern tool-coating, absolutely essential. And, on top of that, surface finish has to be at its best to ensure good chip flow.

Nowadays it is well known, that a cutting edge radius of 10 to 15 μm can lead to extended tool life-time.



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Figure 2: Cutting edge of a tap drill with burr.

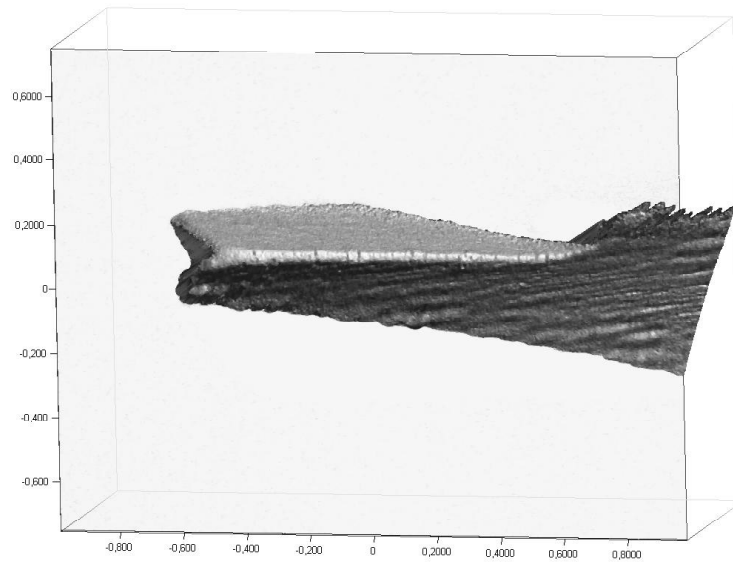
Picture: OTEC GmbH

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Figure 2 shows a typical cutting edge of a HSS tap drill after a production process. Average jaggedness here has a value of 2.7 μm . On the left you can see a larger burr.

Average process time of tap drills in a drag finishing is around 8 minutes. Up to 60 tools can be processed at the same time.



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Figure 3: Cutting edge of a tap drill after an 8 min. treatment in a drag finishing machine of the series DF.

Picture: OTEC GmbH

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The cutting edge after the drag finishing has an average edge radius of 12.5 μm . This matches the nowadays required edge preparation of a radius with around 10 to 15 μm . The average jaggedness was decreased from 2.7 μm down to 1.1 μm and the burr was removed completely.

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Cutting edge preparation and polishing of tungsten carbide mills.

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After an end mill is manufactured in a grinding process, the cutting edge is not really sharp-edged. It has a high jaggedness. Micro chipping between 2 to 6 μm with a high notching effect is usual. At untreated cutting edges you can measure radiuses between 2 to 6 μm .

Cutting edge preparation has been practised for several years. Often the cutting edge is just bevelled. This is problematic, because now two new cutting edges are created, which can lead again to micro chipping. Additionally tools with bevels instead of a radius generate higher forces. Another advantage of rounded cutting edges is that when the feed rate increases, processing forces increase less than with a tool which is bevelled. Also the adhesion of the coating on a rounded cutting edge is considerably better as at a cutting edge without preparation.

Due to cutting edge preparation with a radius, the tool life-time of e.g. end mills can be increased up to 10 times longer for cutting hardened steel.

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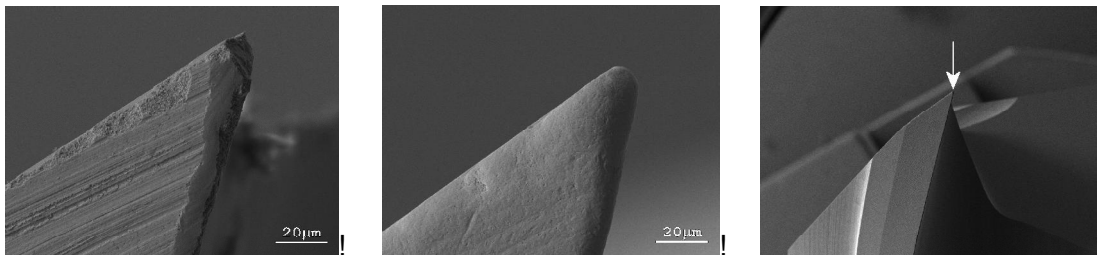


Figure 4: Tungsten carbide end mill with bevel (left) and rounded (middle).

Picture: OTEC GmbH

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During drag finishing in certain media, a considerable smoothing of the tools can be achieved. (See sequence 5) During this process the Ra value can usually be halved. Typically, reductions from Ra 0.8 to Ra 0.4 can be achieved.

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The required radius of the cutting edge depends significantly on the material which needs to be cut. With aluminium alloys the aim is a homogenisation of the cutting edge with maximum surface finish at the same time. This corresponds to a cutting edge radius of 10 to 15 μm and a surface finish of Ra 0.2 to 0.4.

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Figure 5: Tungsten carbide end mill before and after drag finishing

Picture: OTEC GmbH

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The end mills in figure 5 were treated in a special media, which is especially suitable for polishing of tungsten carbide. Process time here is around 10 to 15 minutes.

When larger radiuses are required, different media will be used, with which radiuses of 30 μm or more can be achieved. Average processing time is around 2 to 6 minutes.

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Removal of droplets after PVD coating

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After most PVD coating processes so called “droplets” are generated on the tools. They increase the roughness of the tools and therefore influence seriously the flow of the chips. During drag finishing these droplets will be consistently removed. Process time for removal is just 2 to 3 minutes.

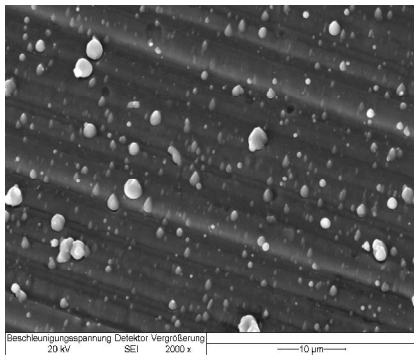


Figure 6a: Coating before drag finishing.

Droplets clearly visible

Picture: OTEC GmbH

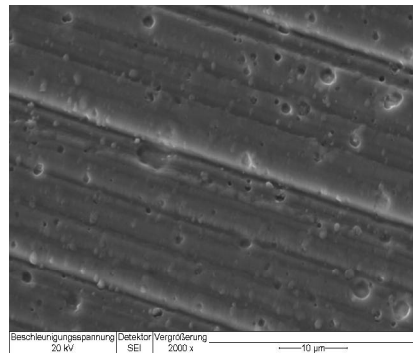


Figure 6b: Coating after drag finishing.

Droplets are removed

Picture: OTEC GmbH

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The company:

OTEC is a medium-sized manufacturer of drag finishing and disc finishing machines. Founded in 1996 by Helmut Gegenheimer, the company has successively established itself on the market through new machine concepts and numerous patented processes - first in the jewellery industry then increasingly in the tool making, pharmaceuticals and automotive industries as well as in medical and CNC processing technology. The key has always been new, better solutions which were superior to the surface treatment processes previously in use. Today OTEC is the technological leader in many markets and maintains a worldwide presence with branches of its own.

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