

Cutting tool lifetime increased by 400%

Dorman Machine Tools has been appointed as the sole UK distributors for the Magnetfinish range of machines that have been designed to finish all types of cutting tools to vastly improve tool lifetime and performance under heavy cutting conditions.

Magnetfinish has supplied many machines to specialist tool manufacturers and regrinding companies who are using this new technology to offer end users within the aerospace and mould and die industries premium solutions whereby the finest and most highly precise milling cutters, drills and taps are required for arduous machining tasks.

After being produced by a grinding process; cutting tools of all types can suffer from having jagged and sometimes very sharp cutting edges as well as micro sized burrs. These impact heavily upon the lifetime of cutting tools and can also affect their performance during heavy cutting and this often means that tools cannot be used at optimum speeds and feeds. When milling, drilling or tapping at extreme speeds the resulting high temperatures that develop at the cutting edges are the main source for such problems because the tool becomes highly susceptible to wear and even fracture. Deformed hot chips, which may even weld to the tool surface and form built-up edges, also greatly impair high-speed machining. The subsequent jamming of chips or even more minor impairment to chip flow that results from this quickly brings about a premature end to tool life. The patented Magnetfinish technology that has been developed by Dr Wolfgang Thiel of Magnetfinish addresses this problem.

The Magnetfinish process polishes the flutes on all types of HSS and Carbide rotary tools such as endmills, form cutters and drills, provides the perfect conditioning or "edge honing" of the cutting edges (micron rounding of the edge) and is also used to polish profiles on taps and coated cutters. Other applications lie in the fields of the fuel-injection and pump industries whereby burr free parts are considered to be a critical necessity.

The Magnetfinish polishing process of the flutes results in a superior chip flow leading to the increased productivity of the tool. The surface finishes on the tool flutes that are generated by the Magnetfinish process are of



Above: Magnetfinish MF61 Manually Loaded machine

the order of just 0.02µm Ra. Tests have shown that these fine finishes ensure that the subsequent friction caused by chips running through the cutting tool flutes can be reduced by 50% thus resulting in faster and smoother chip evacuation that allows faster feeds to be used resulting in faster cycle times during milling and drilling operations. If the swarf or chips created during end machining are not removed as fast as they are produced, the

flutes can tend to clog up and prevent the tool from cutting efficiently and this causes vibration leading to early tool wear and overheating. Cutting tools with polished flutes for superior chip evacuation are also very important when machining dry without coolant to help chip flow and to reduce heat build up.

The tools primary cutting edges are machined to allow a defined and reproducible

radius of between $3\mu\text{m}$ and $50\mu\text{m}$ to be created. This edge preparation process can increase the lifetime of tools such as ball nosed end mills by a factor of 4 and also allows more consistent machining results to be achieved as from using the tools for the very first time.

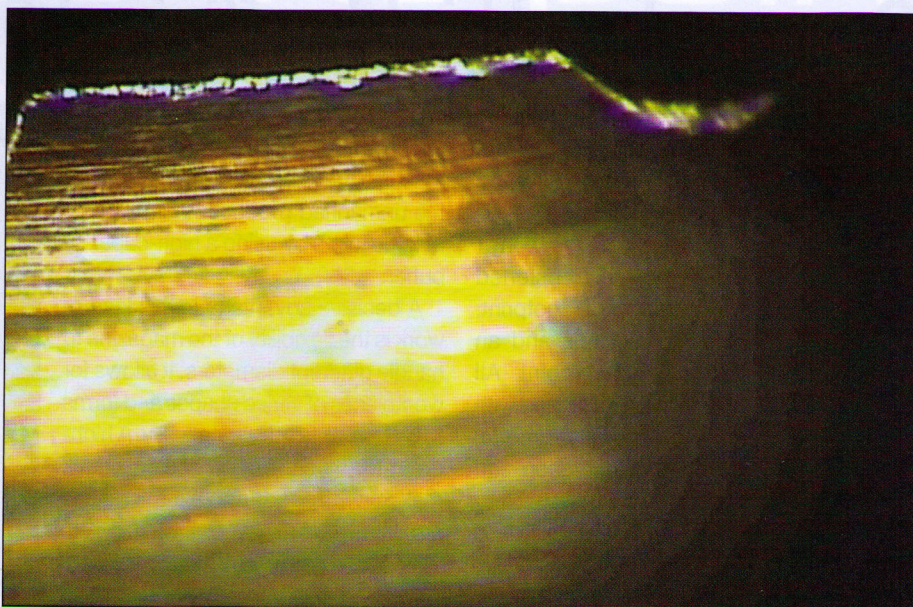
The patented Magnetfinish process is based around two rotating magnetic heads between which a layer of processing powder is placed. The powder is made up of magnetic and abrasive compounds. The magnetic compound is used to hold the abrasive compound within the magnetic field that is generated by the rotating magnetic heads and then the abrasive compound itself performs the cutting function to the surface of the cutting tool.

The thickness of the processing powder is between 5-7mm and this allows 50 layers of powder grains to contact the surface to generate the fine surface finishes and radius edge forms that are required onto the cutting tool. Because the powder is constantly refreshed during the Magnetfinish process 100% reproducible results across large batches of tools can be guaranteed.

The processing times for cutting tools are extremely fast and, for example, a typical deep hole carbide drill of 6mm dia x 180mm in length can be machined in just 20 seconds with the average machining time for smaller tools being in the region of 5 to 10 seconds.

Magnetfinished milling cutters are especially effective when used for "hard milling" applications such as those used for producing very fine milled finishes on moulds that then require little or no hand polishing. Hard milling is an offshoot of high speed machining techniques initially pioneered within the aerospace industry whereby a series of many light cuts are taken with very closely spaced stepovers. For the cutting tool to achieve an effective chip load the associated feed rates and spindle speeds must be much higher than those normally applied in traditional milling. The higher feed rates also make it possible to complete a much larger number of passes across the workpiece more quickly than with traditional methods. Hard milling takes the concept of high speed machining one step further and the combination of light cuts at very high feed rates makes it possible to remove steel in the hardened state with the utmost efficiency with small diameter, fine radiused tools that generate surfaces that approach the quality of those that are often finished polished by hand.

Hard milling solutions typically use two-flute ball nose cutters for final finishing and



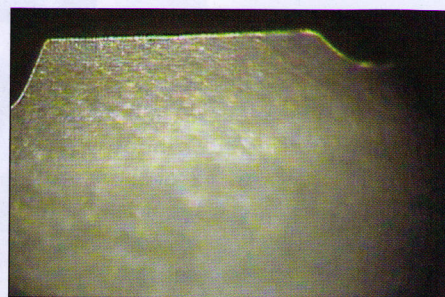
Above: The tooth of an M12 Tap under 80 x magnification after production grinding and before Magnetfinishing

these need a highly precise radius and perfectly edge honed cutting edges. The accuracy of the radius has to be extremely tight so that a high or low flute does not cause uneven metal removal, thus affecting part geometry, surface quality and also cutting tool life. The cutting edges of the flutes must have no jagged edges, chips, cracks or other surface irregularities. The presence of these defects would otherwise mean that the cutter edges would be subject to very early wear as soon as they contact the workpiece for the first time and would also lead to a rougher surface finish being created and a shortened tool life.

A variety of Magnetfinish machines are available from small and cost-effective manually loaded machines for low batch production through to large automated cells with a capacity to automatically load cutting tools for processing from 240 station magazines.

The entry level manually loaded MF61 machine has a general capacity for cutting tools from 0.1 to 20mm in diameter and for tool lengths of up to 300mm and is equipped with a simple laser based safety curtain to allow for parts to be manually exchanged at ease without the need to constantly open and close a door. Tools are manually loaded and unloaded to a centrally positioned pneumatic gripper unit that will accept cutters of various diameters and lengths.

This machine in the automated MF61A version can be specified with an optional 45 position automatic part loader. Both machine versions are operated by a simple to use



Above: The same tooth after undergoing a 10 second Magnetfinishing process.

touch panel operator control screen and all tool data can be stored for subsequent recall. Furthermore it is possible to mix different types and sizes of cutters within the optional auto-loader with the entire batch of cutting tools then being processed without any operator involvement. Both variants are very compact machines requiring the minimum of floor space for installation near to adjacent cutter grinding cells.

Dorman Machine Tools can arrange for sample cutters to be Magnetfinished and returned to customers for their inspection in order that improvements in tool lifetime and performance can be established and any tool manufacturers, regrinding shops or end users can contact Dorman.

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