

## Drag finishing improves the quality of forming and stamping tools

22.03.2007 | Author: Helmut Gegenheimer

**In the manufacture and regrinding of forming and stamping tools, the drag finishing process not only eliminates extensive manual polishing with oil stones but also improves the quality of the cutting edges and surfaces. This has a distinctly beneficial effect on the life of the tools themselves and on the quality of the workpieces. And there is absolutely no risk of any damage to tool parts occurring from the edge rounding process.**



In order to design machines for the drag finishing of tool parts, precise details concerning the dimensions of the required edge rounding are needed.  
Photo: Otec

Forming and stamping tools are used to bend, cut, press and deep draw sheet metal. These processes are therefore used mainly in the automotive, furniture and electrical industries, in which tool edges and surfaces are subject to regular wear. This is especially true in the case of tool parts such as punches, forming dies and cutting dies. Wear caused by friction, pressure welding and diffusion shorten tool life and are detrimental to the results obtained.

Regular regrinding makes these tools usable again. In this process the edges are resharpened, contact surfaces of dies, punches, ejectors and material infeed edges are smoothed in order to obtain the best flow characteristics for the forming materials. As a rule, the cutting edges are treated with an oilstone.

However, this manual form of processing guarantees neither adequate reliability nor reproducible quality. Studies have shown that automated micro-rounding of cutting edges offers a variety of significant advantages.

## **Tool-related down time is reduced**

Rounded edges in the micrometer range improve edge stability, prevent the formation of built-up edges and generate less frictional heat during the forming process. This gives increased tool life and at the same time improves the technical quality and the appearance of the product. This is made possible by means of the drag finishing process: a form of vibratory grinding which has its origins at least partly in the jewellery industry.

Otec's drag finishing process was developed in the jewellery industry for the purpose of processing heavy workpieces with complex geometries such as heavy jewellery rings and watch cases. During processing the workpieces are clamped in special holders and dragged at a high speed through a container filled with a processing medium of special granulate. The main advantage of this is that bur-free, smoothed or polished surfaces are generated in a very short time with no danger of the workpieces being damaged through colliding with one another.

## **Drag finishing is suitable for many applications**

Because it provides reliable and accurate processing of delicate and intricate workpieces, this process has now conquered the market for even more applications. In particular, smoothing the surfaces of tool parts with complex shapes is as a rule very time-consuming and must be carried out by highly skilled staff. The drag finishing process on the other hand is not only easier and faster but also improves the quality of the tool surface.

The process that gives the finishing touch to precious jewellery raises the quality of tools to new heights. Because forming dies can be comparatively big and heavy, drag finishing machines of a suitable size need to be used. As far as possible, smaller tool components can be clamped in rotating holders, while best results are obtained with larger ones by clamping them in fixed holders. The controlled movement of the fixed workpieces eliminates all risk of damage to the workpieces as a result of them colliding during the processing cycle. Clamping the tools at the correct angle ensures the best flow of media at the tool surface (Fig. 1).



**Fig. 1: To process moulding dies effectively in drag finishing machines it is necessary to produce the best flow of media at the tool surface.**

(moulding die before and after processing)

#### Roughness measurements before and after processing in a drag finishing machine

##### Example 1: moulding die

Before: Ra: 2.04 Rz: 10.9

After: Ra: 1.00 Rz: 4.1

##### Example 2: embossing tool

Before: Ra: 0.45 Rz: 2.6

After: Ra: 0.13 Rz: 0.8

The measurements speak for themselves. In only two processing stages, the surface structure has improved from Ra 0.4 to Ra 0.06.

The secret of successful processing lies in the ideal combination of media, speed of rotation and the clamping angle of the tool. In the case of punches, it is important that the cutting edge is not rounded too much - as a rule a maximum of 8 to 10  $\mu\text{m}$ . Even in professional circles such a delicate and precise machine finishing process is considered to be a major innovation. Even key international customers are impressed by the results that can be obtained by the drag finishing process.

For example, the production manager of a world wide electronics group admits that such accuracy in the micrometer range would previously not have been thought possible.

#### Optimised surfaces improve product quality

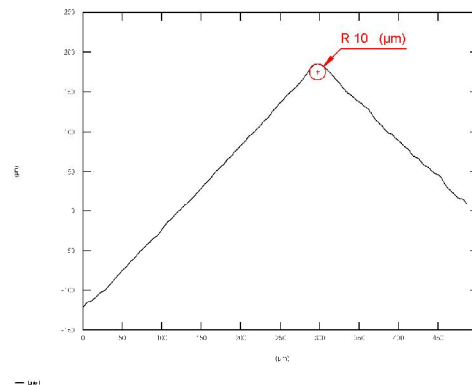
Detailed studies of the surface and structures of tools and workpieces show the effect that the drag finishing of shaping tools has on the manufacturing process:

- The roughness peaks of the tools are smoothed or the peaks are rounded (as shown in the table). This means that less force is required for the forming process. There is less tendency of the workpiece material to break since improved flow properties during forming lead to a more efficient exploitation of the yield point and elastic limit of the material;
- The percentage contact area of the tool edges can be increased to as much as 95% by smoothing the roughness peaks.
- Lowering the coefficient of friction reduces wear at the tool surface and increases tool life. In many cases tool life can be doubled.

- Reducing the roughness also lowers the risk of cold welding between the workpiece and the tool. For example, less force is required for ejecting or stripping and this reduces the rate of rejects from accidental bending.
- The grain structure of the material is not adversely affected by rough, untreated surfaces.
- The surface quality of the machined products is improved by the drag finishing process (Fig. 2). The quality remains constant for a longer period of the useful life of the product.

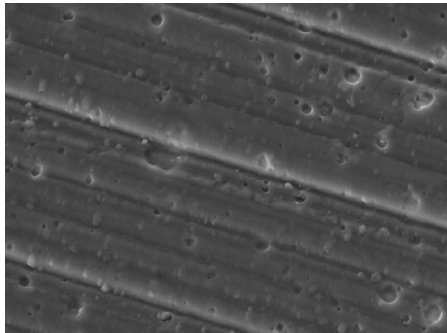


**Fig. 2:** stamping tool



In addition there are cost benefits resulting from the more economical drag finishing process when compared to conventional processes such as abrasive flow machining or manual grinding. Processing in a drag finishing machine is considerably more cost-effective and much faster. The required processing times range from a few seconds, for example for the edge rounding of thin tungsten carbide punches, to a maximum of two hours for forming tools with a relatively high degree of initial roughness. In short, this means that there is less down time for maintenance work and therefore a greater capacity usage of the production line accompanied by a better surface quality in the workpieces processed.

Stamping and forming dies are often coated with tungsten carbide to reduce wear. During this process, so-called droplets form on the surface of the workpiece. These are in fact congealed globules of the coating material. The drag finishing process removes these droplets. The minute cavities and depressions which they leave behind can serve to retain lubricants such as oil during the forming process. The result is a better film of lubricant and a considerable increase in tool life. This effect can be observed in both forming and stamping tools. (Fig. 3).



Beschleunigungsspannung 20 kV | Detektor SEI | Vergrößerung 2000 x | —10 µm—

**Fig.3 :** The drag finishing process has removed the droplets without roughening the surface. The resultant cavities and depressions can absorb coolant and thereby increase tool life.

### **Pockets of lubricant are created by removing droplets**

In addition to the process parameters already discussed, the choice of the correct processing medium plays an important part. SIX granulates are suitable for preparing (levelling) coarse surfaces prior to polishing, for example for the deburring and edge rounding of tungsten carbide tools and tool steels. For less coarse surfaces the harder HSC granulates are to be recommended for the same purpose.

Walnut shell granulates are used for the smoothing, polishing and gentle rounding of unhardened tool steels, for polishing tungsten carbide tools and hardened tool steels after the surfaces have been prepared with SIX and HSC granulates. Field tests have shown that good results are obtained by using a mixture of H 1/100 and H 1/400 (approx. 30% volume H 1/400) and polishing paste P 17.

There are virtually no limits to the applications of drag finishing for the processing of tools (Fig. 4). Generally speaking, all clampable workpieces up to 250 mm in length and 200 mm in diameter can be processed. The process minimizes the friction on tools used for the forming or cutting of metals or plastics, those which are subject to mechanical wear and those which have received or are due to receive a protective coating. For operational components such as gear wheels and components for motor racing vehicles and for the aerospace industry, drag finishing offers an affordable and effective method of optimizing surfaces.

### **Unlike the use of oilstones, drag finishing fulfils the requirements of ISO/TS**

Stamping tools have a much longer useful life if their edges are accurately rounded because this considerably improves the stability of the edge. In addition the uniform precision and quality of the cutting edge surface also gives a much higher quality of cutting edge at the workpiece. The traditional manual preparation of cutting edges with an oilstone can not be considered reliable in the sense of ISO/TS 16949. This is because no constant and reproducible processing quality as set out in the standard can be detected.

Even partly automated processes such as sandblasting, brushing or abrasive flow machining are – like manual finishing – highly cost-intensive and similarly do not produce optimized and reproducible results. Drag finishing on the other hand produces the best results at a relatively low cost. The process offers distinct advantages,

especially for large production runs. It enables the cutting edges of stamping and forming tools to be rounded with precision with a minimal staff requirement and at low cost. This means better product quality and lower unit costs. The result is a considerable increase in productivity and lower per unit costs.



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