

**PERFECT SURFACES WORLDWIDE**



## A WELCOME FROM THE TECHNOLOGY LEADER in mass finishing



Proverbial ingenuity, coupled with German efficiency and a love of perfection, are the best qualifications for developing successful ways of creating immaculate surfaces. Driven by these attributes of German engineering, OTEC, with its innovative technologies, has grown into the industry trendsetter in just a few years.



# MARKETS



AUTOMOTIVE INDUSTRY



TOOLMAKING INDUSTRY



STAMPED, TURNED AND MILLED PARTS



AEROSPACE INDUSTRY



MEDICAL AND PHARMACEUTICAL  
INDUSTRY



CERAMIC AND PLASTIC PARTS



JEWELLERY AND WATCHMAKING  
INDUSTRY

A background image showing a collection of metal drill bits. One drill bit in the center is highlighted in a bright, golden-yellow color, while the others are in shades of grey and silver, creating a bokeh effect in the background.

## TOOLMAKING INDUSTRY

## TOOLMAKING INDUSTRY

- Increasing the quality of punching, forming and cutting tools
- Defined cutting edge rounding increases tool life of cutting tools, usually min. by a factor of 2
- Special feature of the OTEC process:
  - Cutting edges are rounded in a defined way and the flutes are smoothed out clearly
  - More stable cutting edge and better chip removal
- Reduced friction forces on workpieces with PVD and DLC coatings - longer tool life
- Reduction of wear and increase of the percentage contact area
- Polishing of forming tools with Ra-values up to 0.02  $\mu\text{m}$
- Prevent corrosion on tool holders

# FINISHING MACHINES

for the toolmaking industry

DRAG FINISHING MACHINES  
STREAM FINISHING MACHINES



## FINISHING MACHINES for the toolmaking industry



- High process reliability
- Easy automation
- Cost advantages due to the cost-effectiveness of the process compared to conventional methods



## DRAG FINISHING MACHINES





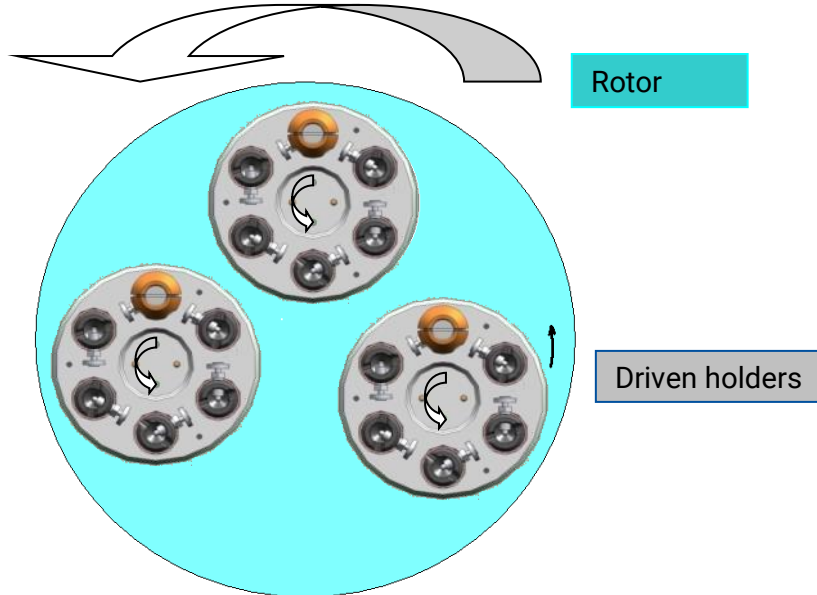
## DRAG FINISHING TECHNIQUE (DF)

- Workpieces are fixed in special holding fixtures
  - Collision of the workpieces is avoided
- These are dragged at high speed in circular motion through a container with grinding or polishing granules
- The rapid movement creates a high contact pressure between workpiece and media, which delivers an optimum result in the shortest possible time. E.g.:
  - Exact rounding of cutting edges
  - Smoothing
  - High-gloss finish
- Absolutely reliable
  - High economic efficiency
  - Perfect results
  - Short process times
- Multi-stage processes possible
  - Fine grinding and polishing
  - Hand polish quality attainable



# DRAG FINISHING MACHINES SERIES DF

Concept



# DRAG FINISHING MACHINES SERIES DF

## Properties

- Thanks to application-specific workpiece holders
  - Optimum fixing of the workpieces
  - Fast loading
  - Simple batch change-over
- More than 100 individual workpiece holders
- Thanks to a water cooling system of the process container, the temperature of the polishing granulate is kept at a constant low level
  - Extension of service life
  - Consistently high processing quality
- For dry and wet processing
- Simple change of process container



[Video](#)



## DRAG FINISHING MACHINES SERIES DF

### Quick exchange tool holder

- With this system, tools such as drills and end mills can be changed within seconds via a lever.
- Fast batch change-over



## STREAM FINISHING MACHINES



## STREAM FINISHING TECHNIQUE (SF)

- Workpieces are fixed in a holder and immersed in a rotating process container filled with grinding or polishing granulate
- Grinding effect due to the grinding and polishing media flowing around and additionally due to the also rotating workpiece
- Deburring, rounding, smoothing and polishing in one process
- Very short process times
- Easy to automate
- High process reliability

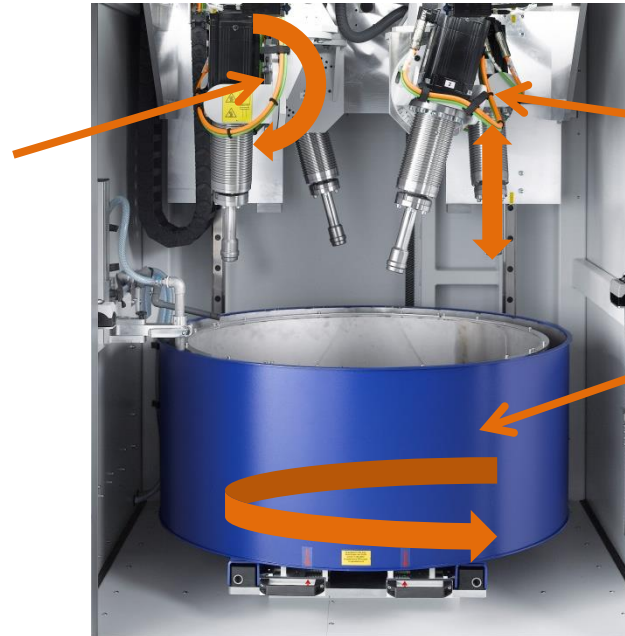




# STREAM FINISHING MACHINES SERIES SF

## Concept

Angle adjustment of  
workpiece holders



Lifting unit  
Allows automatic loading during  
the process

Rotating process container  
filled with media



# STREAM FINISHING MACHINES SERIES SF

## Properties

- The worlds fastest finishing technology
- Up to five workpiece holders
- Manual or automatic loading and clamping
- Manual or automatic angle adjustment of the workpiece holders
- Automatic change of workpiece holder possible
- For dry and wet processing
- Simple change of process container
- Simple switching between different types of workpiece possible

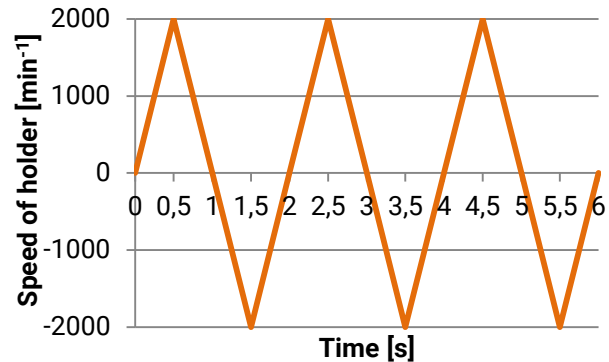


[Video](#)

# STREAM FINISHING MACHINES SERIES SF PULSFINISH

## Concept

- Alternating rotation of the workpiece up to +/- 2000 min<sup>-1</sup>
- High tangential acceleration up to 40 g
  - Strong grinding effect
  - Very short process times
- Very low R<sub>pk</sub> values (< 0.1 μm) attainable in a short time
- Processing of hard-to-reach areas





## SF 1 ILS WITH INTEGRATED LOADING SYSTEM

### Efficient tool processing

- The worlds fastest finishing technology
- Specially tailored to the requirements of the tool industry
- Compact design, space-saving and yet very powerful
- Cost advantages through automated loading
- Easy handling, no robot knowledge necessary
- Large diameter range possible without refitting
- Ideal for small batch sizes and frequently changing series



[Video](#)

# SF 1 ILS WITH INTEGRATED LOADING SYSTEM

## Efficient tool processing

- Processing of tools with:
  - Shaft diameter: from 3 mm to 18 mm
  - Total length: max. 150 mm
  - Part clamping with collet type: OTEC M 3 mm - 18 mm
  - Cycle time 116 s/part → approx. 30 tools/h at 90 s process time
  
- During the process cycle, the machining spindle can be positioned automatically in inclined position
- Loading unit with chain and gripper system
- Loading system with automatic collet chuck change to enable diameter-independent loading.
- Buffer for 5 collets with different diameters
- Process container with diameter 780 mm



## STREAM FINISHING MACHINES SF2 RLS

### Intelligent robotics for higher output

- Automatic loading by robot
- Max. workpiece diameter from 3 - 26 mm
- Max. workpiece length of 200 mm
- During the process cycle, the machining spindle can be positioned automatically in inclined position
- Especially predestined for medium quantities



[Video](#)



## STREAM FINISHING MACHINES SF3 RLS

Top model for highest volume production

- Automatic loading by robot
- Max. Workpiece diameter from 3 - 26 mm
- Max. Workpiece length of 250 mm
- Collet adapter available with HSK interface
- 3 independent lifting units
- While machining is running at two stations, a workpiece change can be carried out at the 3rd station
- During the process cycle, the machining spindle can be positioned automatically in inclined position
- Minimized change-over times and high output performance
- Ideal for high volume production



[Video](#)

## PROCESSING EXAMPLES

[FORMING TOOLS](#)

[CUTTING TOOLS](#)

# FORMING TOOLS

## Definition

- The given form of a solid body is transformed into another form while retaining its mass and substance
  
- Tools for tensile compression forming:
  - Punch
  - Mandrels
  - Dies for forming tubes and profiles
  - Can seamers and folding rollers



## FORMING TOOLS

### Concrete task

- Removal of adhering product residues
- Polishing and smoothing of surfaces
- Reduction of friction between tool and workpiece to be deformed
- Replacement of the costly and time-consuming manual processing
- Removal of droplets



## FORMING TOOLS

### Polishing and smoothing

Advantages:

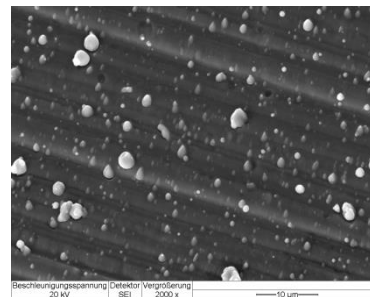
- Less force required for deformation and use of less lubricant
- The material to be processed is less susceptible to breakage
- The percentage contact area of the mould surfaces and tool edges can be increased to up to 98 percent by smoothing the roughness peaks
- Extension of tool life
- Reduction of friction between tool and workpiece to be deformed
- Surface quality of products is higher and over a longer period of use more uniform
- Increased output due to polished tools



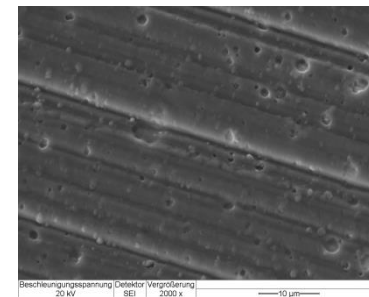
## FORMING TOOLS

### Removal of droplets

- Hard material coating to protect against wear
- Droplets are formed on the surface of the workpiece due to the coating process
- Removal of these droplets by means of the OTEC-process
- Remaining small holes and recesses absorb lubricants such as oil → improved lubricating film and longer tool life



Initial state



After drag finishing process

## FORMING TOOLS

### Example of application: Can seamers

The main functional area is the forming surface or groove, which connects the can and the lid by forming the rims.

Advantages after processing:

- Less force required for deformation
- Less lubricant required
- Fracture tendency of the material to be processed decreases,. Due to better flow properties the offset yield strength and yield tensile strength of the material are better utilized.
- Reduction of the friction coefficient
- Decreasing wear on the tool surface
- Extension of tool life

## FORMING TOOLS

### Example of application: Can seamers

- Processing in stream finishing machine SF
- Exemplary process parameters:
- Process medium: M4/300
- Processing time: 10 minutes
- Roughness before processing:  $R_a$  0.44  $\mu\text{m}$
- Roughness after processing :  $R_a$  0.05  $\mu\text{m}$



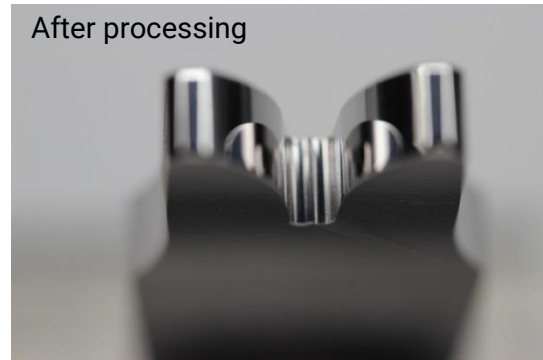
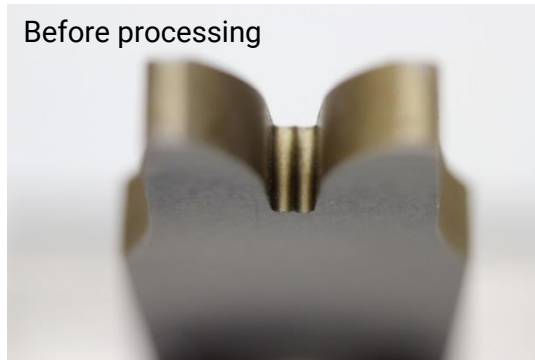
Surface before and after the OTEC process

Surface treatment with the stream finishing machine SF not only saves cost-intensive manual work, but also creates a surface of the highest quality with absolute process reliability. Polishing of the mould surfaces is carried out with minimal material removal.

## FORMING TOOLS

Example of application: Crimping tools

Process time:	10 - 20 min.
Media:	H1/500 + 5 kg M18
Speed process container:	85 min <sup>-1</sup>
Speed workpiece :	0 (fixed angle)



## FORMING TOOLS

Example of application: Polishing of forming tools



→ Process: M4/300 with approx. 5-10 minutes processing time



## FORMING TOOLS

### Example of application: Thread roll dies

Application:

- Production of external threads e. g. for spindles, screws etc.
- Thread is rolled
- No machining, but cold forming
- Edges have so far been prepared by hand
- Time and cost-intensive and not process-safe

## FORMING TOOLS

Example of application: Thread roll dies

Requirements:

- Defined edge rounding at the beginning and end of the tool
  - Less wear and tear
- Smooth surface
  - Reduced friction and high surface quality

Target:

- Increased tool life and rolling speed
- Reduction of production time



## FORMING TOOLS

Example of application: Carbide punches

Target:

The aim of polishing is to achieve a roughness well below  $R_a 0.1$ . The output quality is usually approx.  $R_a 0.2 \mu\text{m}$ .

Process time: 8-12 min.

Media: M4/300



## FORMING TOOLS

### Example of application: Dies

Initial state:

- Workpiece surface in unprocessed condition. In order to process matrices effectively, an effective flow of grinding or polishing media must be generated on the mould surface.



## FORMING TOOLS

Example of application: Dies



Step 1:

Workpiece after 60 min. drag finishing.

Grinding in HSC 1/300, clamped in special holder with 15° inclination. Adequate smoothing can be achieved even with deep-seated forming surfaces by an inclined clamping.



Step 2:

Workpiece after 20 min. drag finishing.

Polishing in H1/400 and polishing paste P 17, clamped in special holder with 15° inclination.



## CUTTING TOOLS

### Concrete task

Cutting tools such as drills, milling cutters, taps, thread formers, milling heads, etc.

Processing task:

- Rounding of the cutting edges and smoothing of the flutes
- Removal of Droplets



## CUTTING TOOLS

### Polishing and smoothing

#### Advantages:

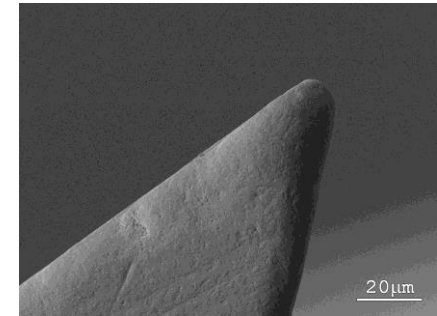
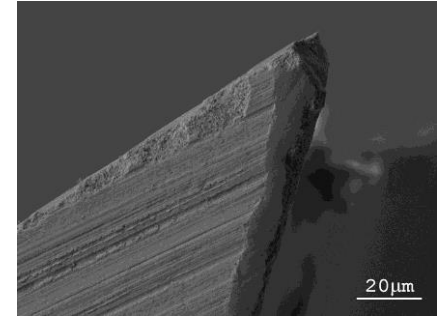
- Improvement of surface quality
- Reduction of roughness
- Improved chip removal, resulting in significantly higher tool productivity
- Fewer chipping
- Increased tool life
- Improved adhesion of coatings
- Reduction of cutting forces
- Cold welding inclination is reduced
- Increased cutting speed/feed rate possible
- Better optics for sale



# CUTTING TOOLS

## Rounding of cutting edges

- Sharpened tools usually show micro defects at the cutting edge, such as chipping, jaggedness and damage on the surface in the area on the cutting edge.
- Problem: Unstable cutting, increased wear, fluctuating tool life and decreased quality of the workpiece surface
- Solution: Targeted and precise rounding of the main and secondary cutting edges and thus
  - Optimization of the machining process by stabilization of the cutting edge
  - Reduction of roughness on the rake face and thus improved chip flow
  - Reduced thermal load due to reduced friction
  - Better cutting parameters and longer tool life



## CUTTING TOOLS

What are the benefits of rounding of cutting edges at drills?

- Increase in tool life by up to a factor of 3.5 (for steel alloys)
- Increase of the maximum feed rate by a factor of 4.5  
(comparison: rounded, coated carbide drills with not rounded, coated carbide drills)
- Reduced surface roughness of drilled holes with rounded in comparison to unrounded drills

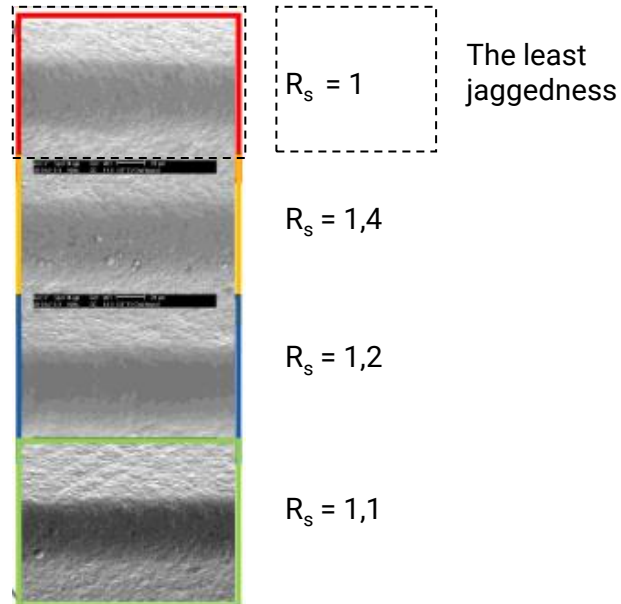


# CUTTING TOOLS

## Influence of the drag finishing process during drilling

Average jaggedness ( $R_s$ ) at Hyperlox-coating

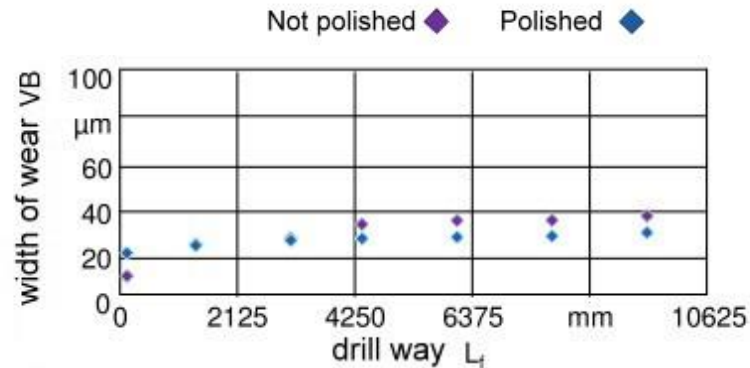
- Drag finishing
  - Dry blasting
  - Wet blasting
  - Magnetfinishing
- Edge honing 40  $\mu\text{m}$



## CUTTING TOOLS

### Influence of the drag finishing process during drilling

Influence of post-treatment on feed force and wear



→ Significant decrease of wear due to preparation of the tools

## CUTTING TOOLS

### Influence of the drag finishing process during drilling

- Drag finishing leads to an improved surface quality of the flank face and the rake face (chipping face)
- The rounding of the cutting edge influences positively the stability of the cutting edge and therefore the wear in despite of higher feed rate forces. The surface quality remains comparably.
- The wear resistance of the tools will be increased.

## CUTTING TOOLS

### Drag finishing of end mills

Advantages:

- Reliable, reproducible, with an accuracy of +/- 1  $\mu\text{m}$
- Simultaneous smoothing of the flutes and defined rounding of the cutting edge, thus better chip removal and improved layer adhesion
- Cost-effective process due to low operating and acquisition costs
- Can also be used to remove droplets after coating
- Rounding values from 4  $\mu\text{m}$  to 80  $\mu\text{m}$  can be achieved
- K-factor can be influenced by clockwise and anti-clockwise rotation
- Absolutely smooth, chipping resistant surface on the cutting edge

## CUTTING TOOLS

### What are the benefits of rounding of cutting edges at end mills?

- Serious increase in the service life of HM tools (certified by numerous studies and research projects)
- HM-end mill: Rounding of 8  $\mu\text{m}$  to 25  $\mu\text{m}$  → increase in tool life by a factor of 2 to 3 (e. g. when machining C 45)
- Increase of service life even by a factor of 4 to 5 for high-alloy steels

Conclusion:

With a rounding of 12  $\mu\text{m}$  to 25  $\mu\text{m}$  at cutting edges, 90% of all tool life problems are solved. At the same time, the adhesion of the PVD coating is significantly increased.

## CUTTING TOOLS

### Drag finishing of end mills

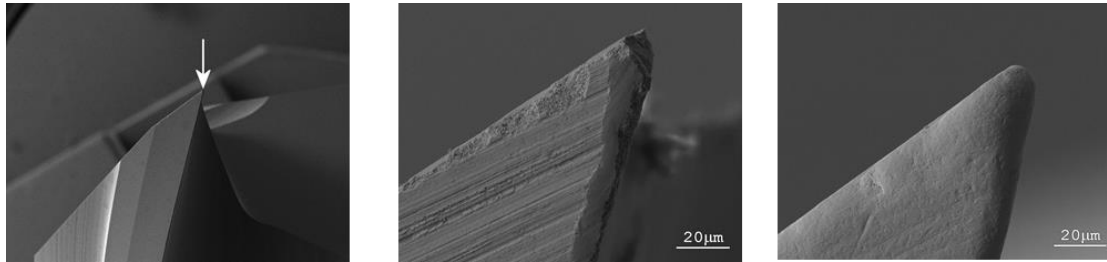


Fig. 3: HM end mill with a cutting edge roundness of approx. 15 µm, machined with HSC 1/300

Even when machining aluminium alloys, edge rounding of 8-10 µm is advantageous:

- The sharpness of the cutting edge is removed
- So-called chatter marks are avoided
- The milling machine runs much more smoothly



## CUTTING TOOLS

### Influence of drag finishing during milling

- Drag finishing leads to a selective smoothing of the surface of the coating
- Removing of the droplets as well as rounding of the cutting edges lead to a more efficient cutting process
- Best cutting results can be reached with a combination of rounding of the cutting edges, coating and polishing of the coating (droplet removal) by drag finishing

## CUTTING TOOLS

Examples before and after OTEC processing



## CUTTING TOOLS

### Example of application: Tap drills

Processing requirements:	Deburring and rounding of cutting edges at tap drills
Process time:	Max 60 s.
Angle B:	0°
Material:	HSS
Media:	HSC 1/300
Workpiece holder:	2000 min <sup>-1</sup> (1 sec. ccw, 1 sec. cw, pulse finishing in SF machine)
Speed process container :	80 min <sup>-1</sup>

→ Reliable deburring and edge rounding in one single operation!



## CUTTING TOOLS

### Example of application: Tap former

- Uniform smoothing of the entire tool surface
  - Reduces the setting of material in the form grooves
  - Reduces friction between tool and material to be deformed
  
- Depending on the requirements also specific rounding of certain functional edges

→ Deformation forces can be reduced by about 60%.



## CUTTING TOOLS

Example of application:

Processing requirements: Deburring / Polishing of tool holders



→ Process: H1/400 ca. 10 min. process time

## CUTTER BODIES

### Example of application

Drilling, milling and turning bodies are made of hardenable steel, milled, deburred, hardened and ground to size. Then either polished or provided with a coating such as e.g. hard chrome. The coating serves to prevent corrosion, but the hard chrome layer is removed relatively quickly by chips. A polished cutter body is therefore preferable, as it is much better protected against corrosion.

Main objective of the finishing process:

- Deburring after milling
- Polishing after hardening and grinding

→ Process: DS 4/4 with SC 15; process time about 150 s






## FINISHING CENTRE



- Finishing of sample workpiece with no obligation and costs
  - Individual customer advice
  - Detailed documentation
  - Finishing concept tailored to your needs

## FINISHING CENTRE

- 
- State of the art measurement technology
  - Very experienced and highly qualified staff members
  - Process research together with institutes and universities

**THANK YOU FOR YOUR ATTENTION.**