



THE COMPANY

Founded in 1996, OTEC has quickly established itself as the market's technology leader by developing new machine concepts, inventions and improvements. OTEC supplies machines which are carefully tailored to the needs of specific industries and which are truly impressive in terms of cost-effectiveness, handling and precision and which are far superior to conventional systems. Some 100 members of staff are employed at the company's headquarters in Southern Germany. A global sales network ensures that excellent worldwide service and top-quality finishing are always guaranteed.



Perfect surfaces. Worldwide.
Perfect surfaces. Worldwide.

SF Stream Finishing



Product range:

- OTEC DF SERIES:
Drag finishing unit for
finishing workpieces
in up to 10 jigs.



- OTEC CF SERIES:
For precision
engineered workpieces
and bulk goods.



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Better and Faster with Stream Finishing

A new process for perfect surfaces

SF (stream finishing) technology is the basis of an innovative new generation of drag finishing machines. The differences to previous concepts are as follows:

1. The tremendous processing power of the machine
2. Deburring, rounding and smoothing (e.g. from Ra 0.4 to 0.1 μm) in a single operation

In this new process one or more workpieces are clamped in a holder and immersed in the rotating process drum filled with grinding or polishing media. The actual processing motion is the result of the grinding or polishing media flowing around the workpiece combined with the rotation of the workpiece itself. This enables extremely fine surfaces with roughness values of $R_a < 0.01$ to be obtained, even in the tiniest of flutes. With the SF process, finishing times are very short and the machine is easy to automate, whilst at the same time ensuring extremely reliable finishing.

THE PROCESS

Highlights:

- Deburring, rounding and smoothing in a single operation and in just a few seconds
- Ideal for in-line production since processing cycles are short
- Easy to automate
- Much greater contact area than with conventional processes

Wide range of processing applications

The SF enables several stages of processing to be carried out very quickly in a single operation. For example, a workpiece can be successively deburred, edge-rounded, smoothed and polished in one operation.

Path-controlled sequence of movements

The path-controlled movement sequence enables individual parts of a workpiece to receive intensive selective finishing. In order to ensure uniform material removal over the whole of the workpiece surface, this movement is carried out parallel to the "regular" finishing and is automatically monitored.

The special design of the machine enables the angle of incidence of the grinding or polishing medium to be adjusted, thus regulating the amount of material removed right down to the μm level.

High processing forces

SF (stream finishing) technology harnesses the power of high-speed streams of grinding and polishing media. This generates powerful forces which enable even the smallest and least accessible surfaces and recesses (e.g. flutes and grooves) to be finished with the utmost precision. This is achieved through the high contact forces pressing the fine-grain polishing medium into even the very tiniest of recesses and polishing the surfaces there. This makes surface qualities of $R_a < 0.01 \mu\text{m}$ a reality (see the examples on page 7).

Extremely short finishing times

A high degree of automation, fast tool change on the fly and powerful processing forces result in extremely fast and economical finishing of the workpieces.

SF – Mass Finishing Reinvented

SF machines are available in a wide variety of models, which means that almost all workpiece requirements can be accommodated. For example, the machines are available with five basic drum sizes:

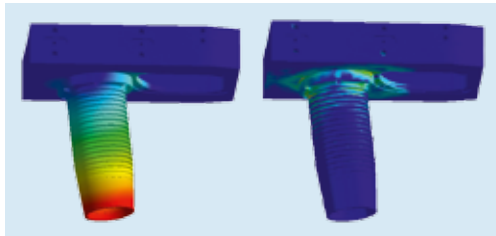
- ▶ 330 mm for up to 1 workpiece holder, for workpieces measuring Ø 6 x 60 mm max.
- ▶ 780 mm for up to 2 workpiece holders, for workpieces measuring 100 x 200 mm max.
- ▶ 1050 mm for up to 5 workpiece holders 400 x 400 mm
- ▶ 1450 mm for up to 6 workpiece holders 400 x 400 mm
- ▶ 2000 mm for up to 6 workpiece holders 200 x 200 mm max.



INNOVATIVE DETAILS

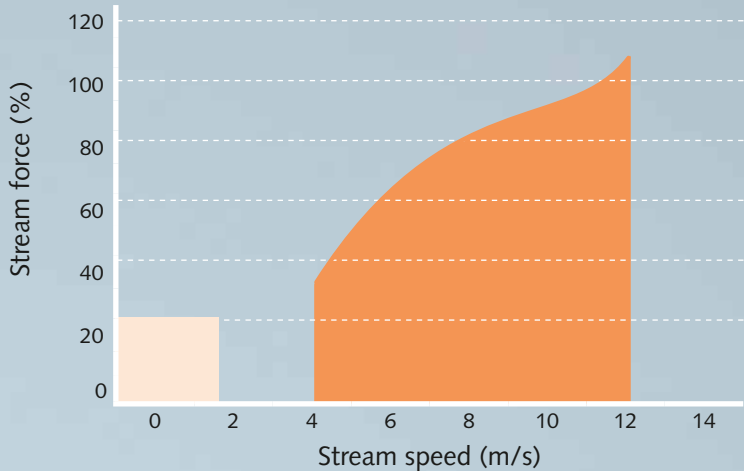
Design Principle

Drum diameters of up to 2 meters and rotary speeds of 15 m/s generate powerful forces. Design and calculation using the finite element method (FEM) enable real conditions to be simulated and the geometries of the machine and its housing to be optimized.



Deformation
Pulse drive under load

Effect of forces acting on material
Pulse drive under load



- OTEC SF units
- Conventional drag finishing units

The graph shows the operating range of the SF machine. This clearly shows that the SF process can be run at considerably higher speeds in order to achieve higher stream forces. The result is processing times which are many times shorter than with conventional drag finishing machines.

ADVANCED TEHNOLOGY



▶ 4

There are two basic versions of the machine types SF 780, SF 1050 and SF 1450.

Version 1

With a decentralized lift unit which immerses all holders/workpieces at the same time. This version is usually used for manual loading and unloading.

Multi-head attachment

This attachment enables each workpiece holder to finish up to six workpieces at the same time and features a quick release mechanism. The workpieces rotate around their own axis and also describe a planetary motion so that a perfectly uniform finish is guaranteed.

Typical application:
Workpieces with a length of 150 mm and a diameter of 50 mm.



▶ 5

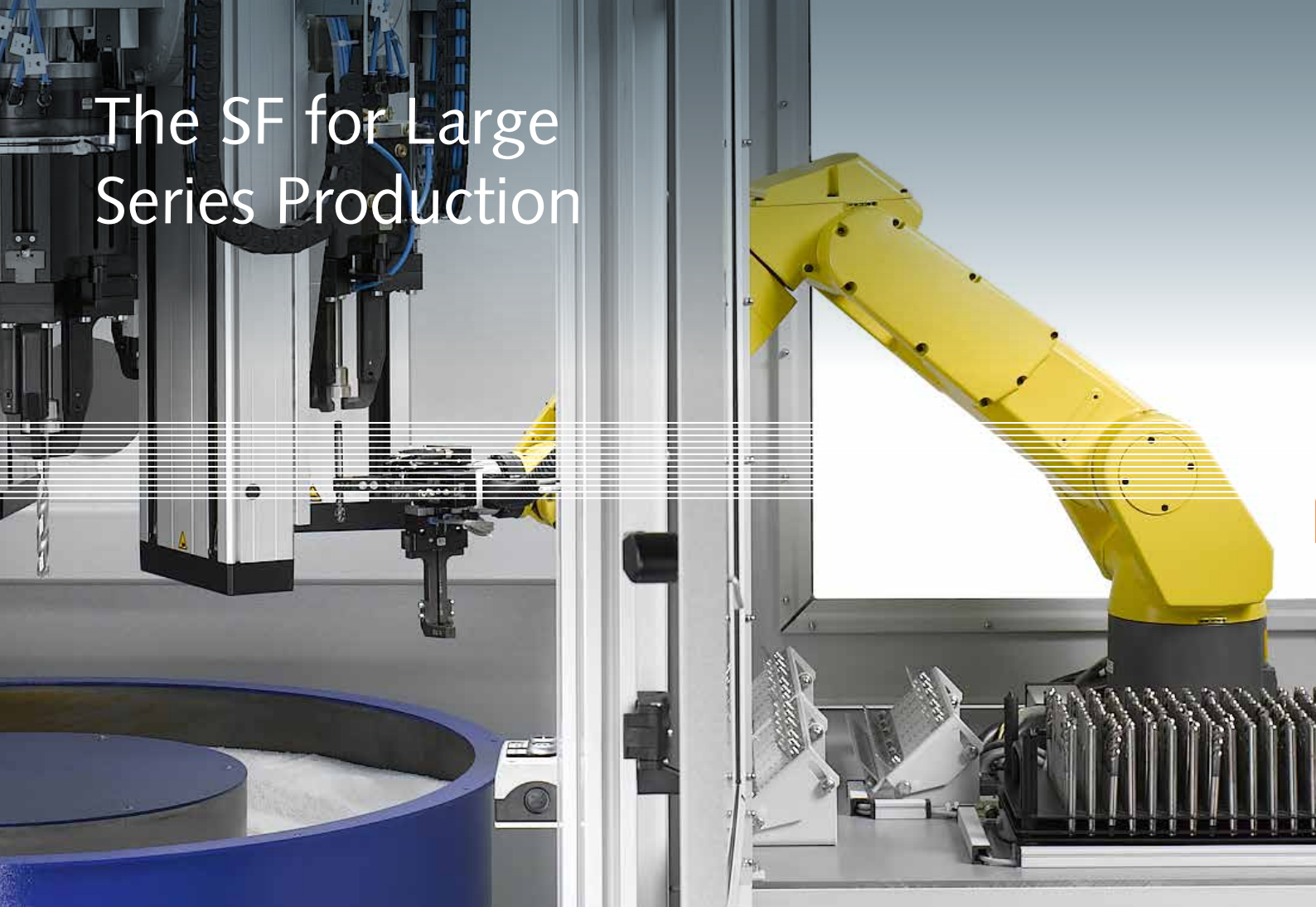
Fast drum change

Fast drum change without tools. Simply pull on two levers and the drum is already released and can easily be transported via rollers onto a trolley.

Version 2

With one lift unit per holder and workpiece. This enables each workpiece to be removed individually whilst the other workpieces are still being processed. Only the workpiece that needs changing is moved to the changing position, so there is very little machine down time.

The SF for Large Series Production



NEW TECHNOLOGY

The SF 3/105 was specially designed for the requirements of in-line production in the automotive industry or modern tool making industry. The machine features the innovative new pulse drive known as PULSFINISH®. This enables the extremely stringent requirements of large in-line production in terms of reliability, production speed and processing quality to be consistently fulfilled.

- Deburring, rounding up to 200 µm, smoothing from e.g. Ra 0.4 to <0.1; Rpk 0.1 in just a few minutes
- The contours of the workpiece remain very intact

Areas of application

Wherever extremely high demands are made in terms of precision in the deburring and smoothing of components, e.g.

- Automotive industry
- Tool making industry
- Hydraulic components
- Complex geometries such as thread cutting taps and fuel injector systems

Extremely cost-effective

The SF 3/105 is equipped with three workpiece holders so that three workpieces can be finished at the same time and can also be changed on the fly. These three workpiece grippers can be programmed and controlled independently of one another. This enables the machine to debur, round, smooth or polish workpieces in a matter of seconds.

Modular design

The SF 3/105 can easily be integrated into a production line. Depending on the peripherals and the cycle time, the workpiece holders can be loaded in a fully automatic or manual process. The modular design of the machine enables it to easily be adjusted to a cycle time of just a few seconds.

The New Process: PULSFINISH®

The principle of the newly developed pulse finishing system is based on the precisely defined and rapidly repeating relative movement between media and workpiece.

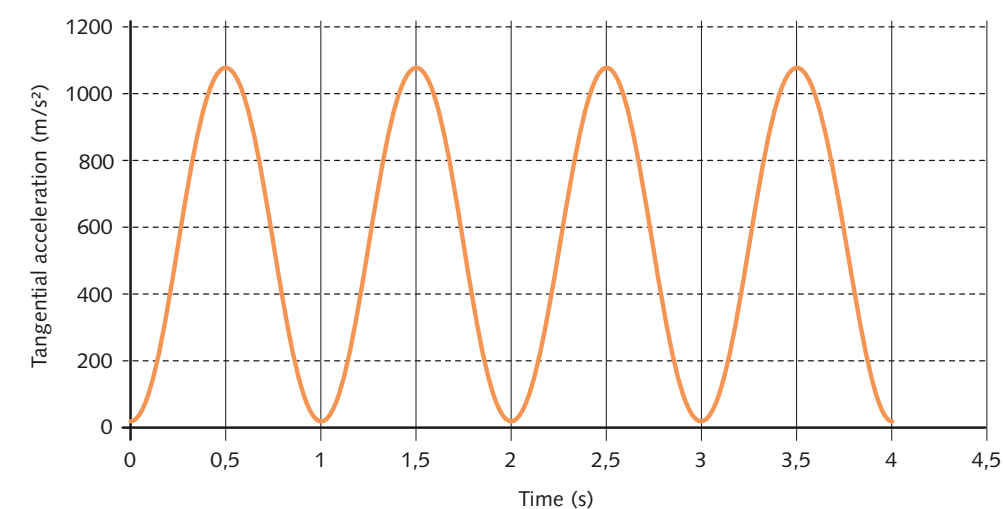


Here the clamped workpiece is immersed in the media stream of the rotating drum where it is quickly accelerated to a speed of over 2,000 rpm. Then it is decelerated again and accelerated once more. The differing speeds resulting from the inertia of the media in the drum and the rapid change of workpiece speed give rise to an extremely intense and precisely controllable abrasive effect. During this process, relative velocities of up to 100G are attained!



PULSFINISH®

Acceleration at the circumference of a workpiece with a diameter of 50 mm during pulse drive operation (to 2,000 rpm in 0.5 seconds)



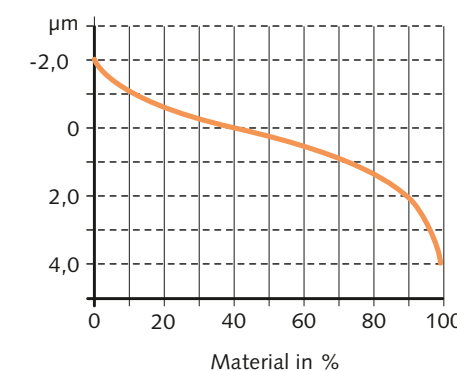
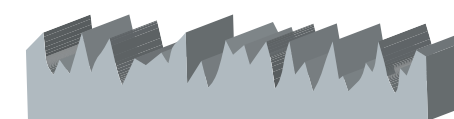
The graph alongside illustrates the pulsating effect of the PULSFINISH process. The workpiece immersed in the media is accelerated to maximum tangential acceleration inside 30 seconds and then decelerated to zero.

 Pulsfinish

Camshaft measurement

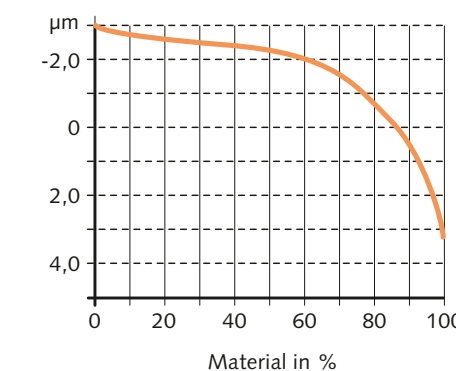
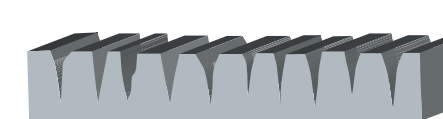
Conventionally ground

$R_a = 2,0 \mu m$ $R_{pk} = 1,8 \mu m$



With PULSFINISH®

$R_a = 0,1 \mu m$ $R_{pk} = 0,1 \mu m$



SF 3/200: Dry Grinding/ Polishing with V_{max}

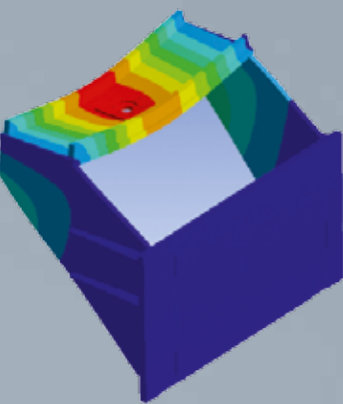
The new SF 3/200 can grind and polish workpieces in a single dry finishing stage. The tremendous speeds of the grinding and polishing media of up to 16 m/s enable high-precision finishing in angles, recesses, grooves, etc. And all this can be achieved in extremely short processing times of between 20 seconds and a maximum of 3 minutes.

Operating principle

In this high-speed stream finish machine, the workpieces are clamped in place and immersed in a fast-flowing stream of grinding or polishing medium. During the process, the workpiece can be rotated or moved along an angular path. This delivers considerable benefits:

- ▶ Thorough surface finishing, even in inaccessible areas
- ▶ The amount of material removed from the workpiece can be selectively controlled

Deformation of a central
lift unit under load



THE GIANT

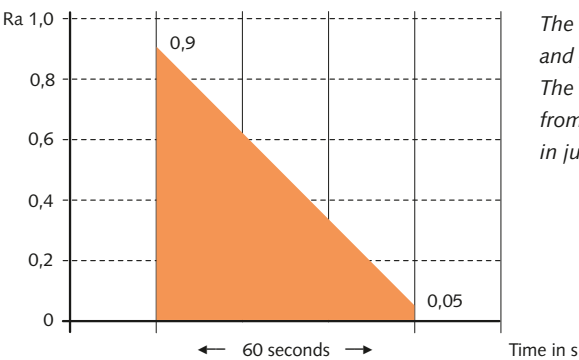
Because of the tremendous forces released, the SF 3-200 has an especially solid construction. Encapsulating the media drum prevents highly accelerated media from escaping during the process.



The new SF 3-200 immersion polishing unit from OTEC has the following features:

- ▶ Very robust and stable construction
- ▶ Powerful 50 KW main drive
- ▶ Drum speed: up to 150 rpm with a drum diameter of 2 meters
- ▶ Three workstations; workpieces are clamped by e.g. a pneumatic system
- ▶ Only for dry finishing
- ▶ Extremely short processing times
- ▶ Automatic process
- ▶ Can be loaded by robot

Surface/time graph, aluminum material



The workpiece can be ground and polished in a single process. The surface roughness is reduced from Ra 0.0 μ m to Ra 0.05 μ m - in just 60 seconds!

Typical part finished in the SF 3-200



DETAILS



Overview of SF Machines

Technical Specifications

SF MACHINES	SF 1/1-78	SF 2/2-78	SF 3/1-105	SF 4/1-105	SF 5/1-105
L x w x h in mm	1620x1210x2100	1620x1210x2100	1870x1520x2600	1870x1520x2600	1870x1520x2600
Weight	600 kg	730 kg	1300 kg	1400 kg	1500 kg
Mains voltage	400 V	400 V	400 V	400 V	400 V
Output in KVA	16 A	16 A	32 A	32 A	32 A
Holder positions	4,2	5,5	11,4	11,6	11,8
Process drum Ø in mm	1	2	3	4	5
Max. workpiece length for 600 mm lift	680 mm	680 mm	1050 mm	1050 mm	1050 mm
Maximum workpiece weight, including holder, approx.	400 mm	400 mm	400 mm	400 mm	400 mm
Max. workpiece length with a drum height of 350 mm	12 kg	12 kg	12 kg	12 kg	12 kg
Max. workpiece length with a drum height of 500 mm	250 mm	250 mm	250 mm	250 mm	250 mm
Max. diameter	-	-	400 mm	400 mm	400 mm
Clamping Ø of collet chuck	100 mm	100 mm	400 mm	400 mm	300 mm
Clamping Ø of three-jaw chuck	max. 13 mm	max. 13 mm	max. 13 mm	max. 13 mm	max. 13 mm
Spann-Ø Backenfutter	max. 50 mm	max. 50 mm	max. 50 mm	max. 50 mm	max. 50 mm

Standard equipment

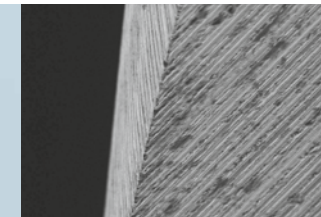
- ▶ Process drum for dry finishing, in steel, painted exterior with stripper brush
- ▶ Process drum for wet finishing, in steel, panted
- ▶ Manual clamping of workpieces
- ▶ Workpiece angle adjustable up to 35°
- ▶ Electromechanical immersion by means of lift system
- ▶ Touch screen operation via Siemens S7-1200 control system
- ▶ Rotary speed infinitely adjustable via frequency converter
- ▶ Automated process control
- ▶ Direction of rotation can be preset with automatic reversal of direction

Optional extras

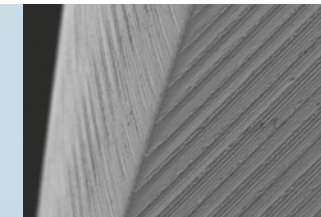
- ▶ Additional process drum for wet or dry finishing
- ▶ Trolley for changing process drums
- ▶ Collet chuck with workpiece diameter of 1.5 – 13 mm
- ▶ Three-jaw chuck d=4-50 mm
- ▶ Holder for chucks d max. = 28 mm, for d = 3-28 mm, also suitable for air purging
- ▶ Holder for chucks d max. = 45 mm, for d = 20-45 mm, also suitable for air purging
- ▶ Indexing function for workpiece drive for the selective finishing of specific surfaces and continuous movement with adjustable angle areas and speeds
- ▶ Workpiece immersion angle can be adjusted automatically by the control system, from 0-35° (not for SF 4 and SF 5)
- ▶ PROFI BUS interface for automatic loading
- ▶ Dosing unit for automatic water/compound change in programmable cycles
- ▶ PULSFINISH® for shorter processing times, even in areas which are normally inaccessible

Typical Applications

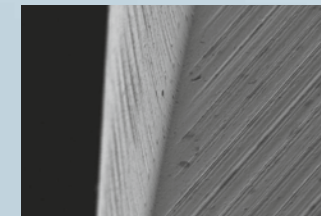
Photos: Fraunhofer Institute for Production Systems and Design Technology



Circumferential cutting edge, ground



Circumferential cutting edge, slightly rounded 3 µm



Circumferential cutting edge rounded 5 µm



Drill with coolant holes



Camshaft before finishing



Camshaft after finishing

Result:

Deburring, rounding and smoothing in approx. 60 seconds. Ra before finishing 0.4 µm, after finishing 0.09 µm (RPK ≤ 0.05 µm), whilst at the same time deburring and rounding to 120 µm.



Tooth flank before finishing



Tooth flank after finishing

Result:

Short finishing times of just under two minutes. Since up to five workpieces can be processed at the same time and work can be inserted and removed on the fly, the effective throughput time is only 24 seconds per workpiece. The roughness at the tooth flanks was reduced from Rz 1.5 µm to 0.04 µm.

Cutting edges of cutting and stamping tools

Task:

Selective rounding of the cutting edges of tools in order to obtain a considerable increase in tool life.

Finishing process:

The workpiece (e.g. a carbide drill) is clamped in a holder and immersed in the streaming media. Processing is usually complete in just a few seconds. Optionally, the air can be purged to keep the coolant holes free of media during finishing. The main advantages of this technique is the ease with which the process can be automated; in addition it is a highly reliable process and can achieve very smooth surfaces at the cutting edge (e.g. R 0.05 µm).

Camshaft for automotive applications

Task:

To achieve a high-quality surface with maximum contact area – for large in-line production and in less than 60 seconds.

Finishing process: PULSFINISH®

Result:

- ▶ Less wear, giving longer service life
- ▶ Less friction through lower Rpk values (≤ 0.5 µm) and consequently greater energy efficiency
- ▶ Much less heat generation
- ▶ Less metal deposited in the oil, giving longer intervals between oil changes

Cog wheels: deburring, rounding and smoothing tooth flanks

Task:

Various finishing stages (deburring, rounding, smoothing tooth flanks) in a single process, reduction of processing times whilst at the same time ensuring best possible surface quality.

Finishing process:

The tools are clamped onto an angled holder. During the process, the workpiece rotates around its own axis in a pre-programmed sequence (e.g. 30 seconds clockwise, then 30 seconds counter-clockwise).

Other typical applications:

- ▶ Finishing gearbox and engine parts
- ▶ Finishing aerospace engine components, blisks, etc.
- ▶ Polishing ceramic workpieces