

**PERFECT SURFACES WORLDWIDE**



## A WELCOME FROM THE TECHNOLOGY LEADER in mass finishing



Proverbial ingenuity, coupled with 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**



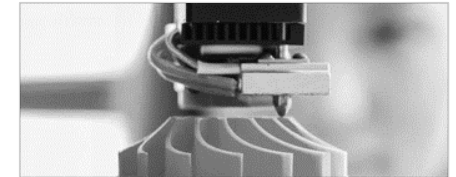
**MEDICAL AND PHARMACEUTICAL  
INDUSTRY**



**CERAMIC AND PLASTIC PARTS**



**JEWELLERY AND WATCHMAKING  
INDUSTRY**



**ADDITIVE MANUFACTURING**

A 3D rendered illustration of a human knee joint with a metallic prosthetic implant. The joint is shown in a side profile, with the femur and tibia bones visible. The prosthetic is a long, cylindrical metal rod with a textured end. The background is a gradient of blue and black.

**MEDICAL TECHNOLOGY**

## MEDICAL TECHNOLOGY

Co-Cr alloys, titanium or ceramics - Precise processing on all materials

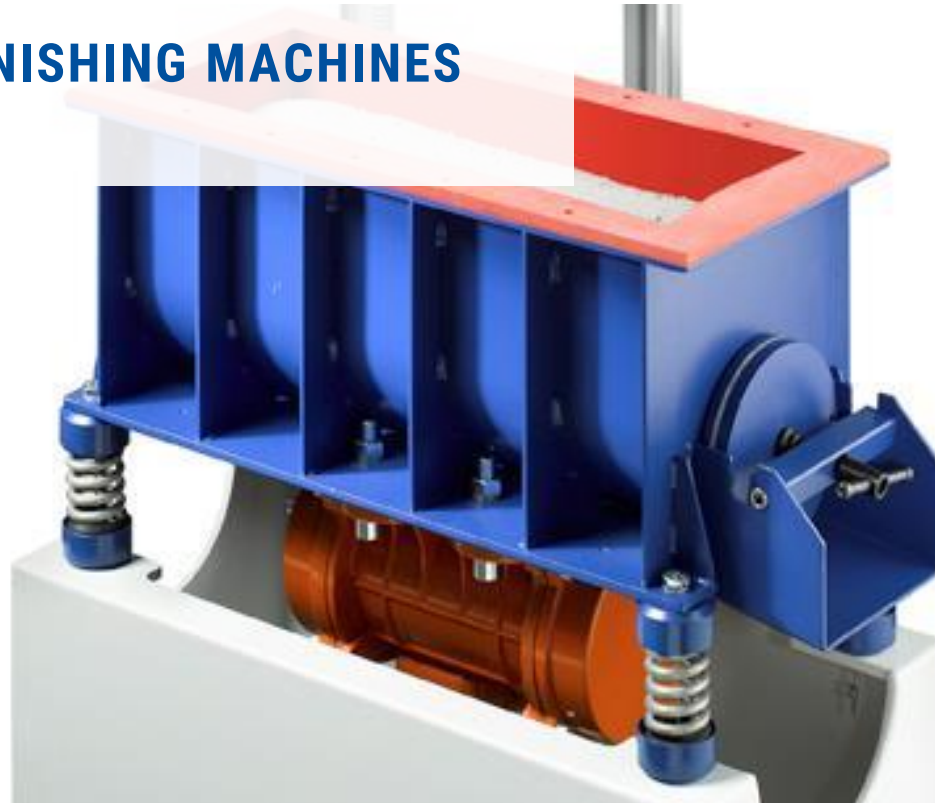
- Special process parameters for medical technology:
  - Constantly high quality
  - In a short time
  - Workpieces with different shape and weight
  - Precise deburring, grinding, smoothing and polishing
- Prostheses
- Implants
- Medical equipment
- Special features of the OTEC process:
  - Process reliability
  - Best surface quality

# MASS FINISHING

for medical technology

VIBRATORY FINISHING MACHINES  
DISC FINISHING MACHINES  
DRAG FINISHING MACHINES

## VIBRATORY FINISHING MACHINES



# VIBRATORY FINISHING MACHINES

## Method of application

- Vibrators consist of spring-mounted containers with unbalanced motors
- Generation of vibrations
- Processing of heavy or large workpieces possible
- Movement in a horizontal screw-like movement
- The abrasion takes place mainly by the different masses between the grinding or polishing media and the work piece



# VIBRATORY FINISHING MACHINES

## Series HV 20

- Processing of bone nails (bone pins) and bone plates
- Particularly intensive processing
- Significantly shorter process times than conventional bowl vibrators
  
- Advantages:
  - Reverse acceleration 20 g for significantly shorter processing times than comparable systems
  - Noise protection and speed control
  - Centrifugal force 1000 kg, drive power 1.3 kW
  - Processing of internal surfaces
  - Continuous water flow
  - Suitable for dry and wet processing and for steel-ball polishing



## MASS FINISHING TECHNOLOGY

### Disc- and drag finishing machines

- For disc finishing techniques (CF) and drag finishing techniques (DF):
  - OTEC guarantees for both finishing methods perfect surfaces of workpieces in medical and dental technology by means of high-quality machines
  - Up to 10 times more effective than e.g. conventional methods
- Machines in various sizes
  - Table top machines for small-scale commercial production as well as machines for large-scale industrial production
- Suitable polishing and grinding media for optimum results

## MASS FINISHING TECHNOLOGY

### Disc- and drag finishing machines

- Ideal for a wide range of applications:
  - Bone plates and bone screws
  - Joint implants
  - Dental implants and teeth
  - Dental tools and orthodontic products
  - Earpieces



## MASS FINISHING TECHNOLOGY

### Disc- and drag finishing machines

#### Advantages:

- Economical for small- and large-scale batch processing
- Process reliability
- Homogeneous surface treatment often better than hand polishing
- Up to 10 times higher efficiency
- Specially tailored to medical technology



A large industrial disc finishing machine with a rotating disc covered in a fine, blue-tinted abrasive material. A hand is holding a small pile of finished metal parts, including a chain link and several small rectangular pieces, in front of the machine.

## DISC FINISHING MACHINES

## DISC FINISHING TECHNOLOGY (CF)

- Processing in an open drum (the process container) with a base plate in the form of turntable or disc
- Workpieces, together with a suitable polishing or grinding media, are set in motion by the rotation of the disc to create a toroidal stream inside the stationary drum
- Contact between the workpieces and the media generates a very intense finishing effect
  - up to 20 times more efficient than with systems such as conventional vibrators
- In the wet finishing process, a water/compound mixture is continuously added and drains off, taking with it the residues of the material removed
- Highlights:
  - Fast, absolutely reliable and reproducible results
  - Extremely cost-effective finishing, even for very small parts (e.g. turned parts 0.5 mm Ø, material thickness 0.08 mm)
  - Simple handling
  - Wide range of applications, from deburring to mirror-finish polishing



## DISC FINISHING TECHNOLOGY (CF)

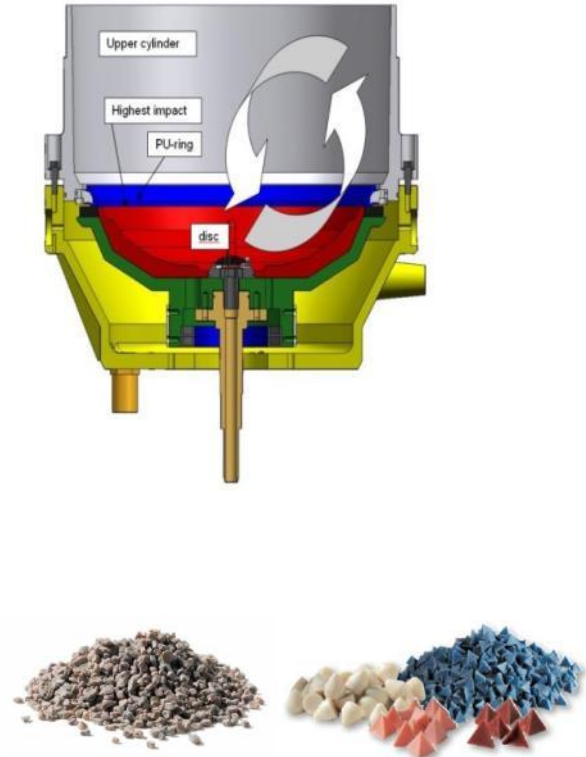
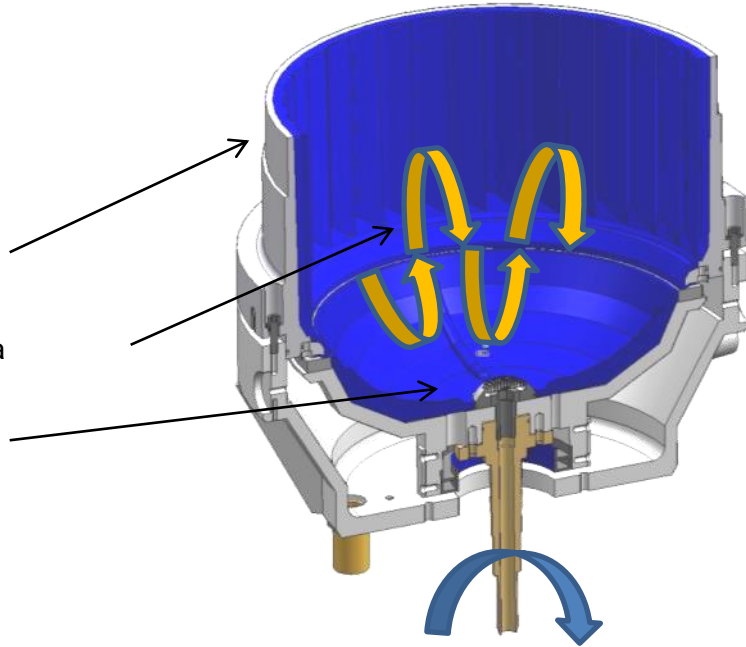
- CF Series are available with the right gap system between the disc and the upper cylinder for all processing techniques:
- Zero gap system:
  - For the wet finishing of very fine workpieces, the gap is reduced to zero
  - Benefit: It is possible to use very fine microfinishing media, no workpieces can get lodged in the gap
- Ceramic gap system:
  - With this system, the gap can be set to a precision of 0.05 mm
  - Benefit: use of very fine polishing granulates for best polishing results
- Ceramic/polyurethane gap system:
  - OTEC's standard system
  - suitable for the most common wet finishing applications
  - Benefit: prevents anything from lodging in the gap and blocking the disc, ensuring a high degree of process reliability, low maintenance requirement



# DISC FINISHING UNITS

## Principle

- Stationary cylinder
- Movement of media
- Rotating disc





## DISC FINISHING UNITS SERIES CF

### Properties

- Modular concept - up to 6 process containers
- For dry and wet finishing process
- Process drums with hot moulded PU lining
- Aluminium profile chassis - easy to add on optional equipment
- Chassis of anodized aluminium profile (resistant to corrosion)
- Speed control via frequency inverter
- PLC touch screen control unit with digital display of:
  - processing time, speed, rinse cycle, dosing and other key process parameters
  - storage for up to 200 different finishing programs



[Video](#)

## DRAG FINISHING MACHINES



# DRAG FINISHING MACHINES (DF)

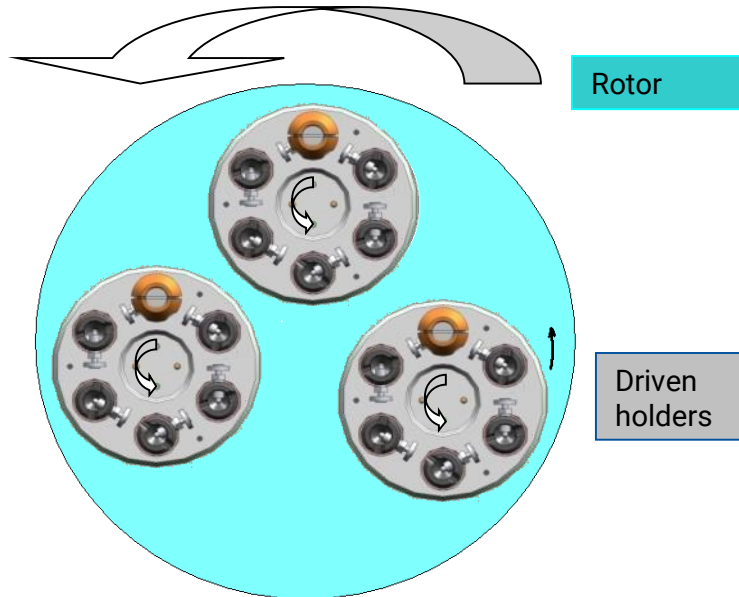
## Process

- Workpieces are clamped in specially designed holders
  - Prevents collision of the workpieces
- These holders are dragged in a circular motion through a process drum containing grinding or polishing granulate
- This high-speed motion generates high contact pressure between the workpiece and the media, which in a very short time produces perfect results:
  - High-precision edge rounding
  - Smoothing
  - Mirror finish
- Absolute reliability
- Maximum cost-effectiveness
- Perfect finishing results
- Short processing times
- Realisation of multi-stage processes
  - Fine grinding and polishing
  - Quality equivalent to that obtained by manual polishing



# DRAG FINISHING MACHINE SERIES DF

## Principle



# DRAG FINISHING MACHINES SERIES DF

## Properties

- Custom-designed workpiece holders ensure that the workpieces are mounted as quickly and efficiently as possible and considerably simplify batch processing
- Over 100 different types of holder
- Water cooling system keeps the polishing granulate at a constantly low temperature
  - Extends the life of the process medium
  - Constant process quality
- Fast and easy change of the process container
- For dry and wet finishing process



[Video](#)

## DRAG FINISHING MACHINES SERIES DF

### Holder

- Special fixtures for work pieces in the field of medical application



# DRAG FINISHING MACHINES SERIES PHARMACEUTICAL

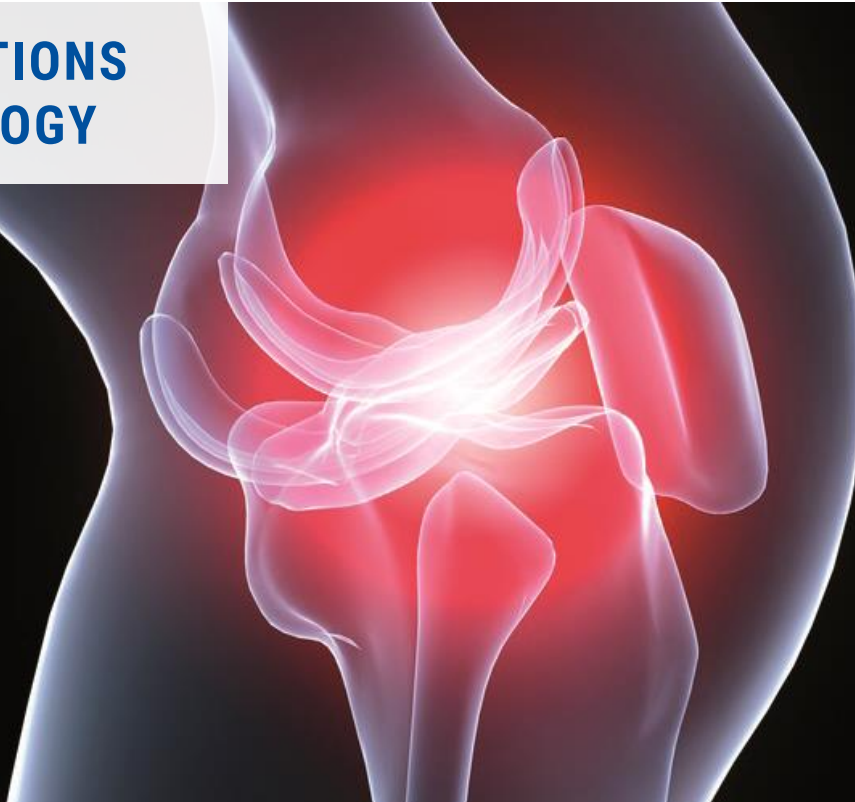
## Properties

- Stainless steel components and components with heavy duty paint
  - For surface treatment in the pharmaceutical and food industry
- Versions
  - Series DF 40 for processing of up to 36 work pieces
  - Series DF 80 for processing of up to 60 work pieces
- Application-specific work piece holders
  - Optimum fixing of the work pieces
  - Fast assembly
  - Easy batch change
- Thanks to the water cooling system of the process container constant low level of the temperature of the polishing granules
  - Extension life-time
  - Consistently high processing quality
- Advantages:
  - Absolutely reliable
  - High profitability
  - Perfect processing results
  - Short process times
  - From the market leader and inventor of the process



[Video](#)

**FIELD OF APPLICATIONS  
MEDICAL TECHNOLOGY**





## BONE PLATES

### Disc finishing and vibratory machines

- Ideal for smooth, highly rounded and homogeneous surfaces of bone plates
- Task: very strong edge rounding
  
- OTEC machines are the perfect solution for both small and large bone implants
  - High-performance vibrator HV 20 for large work pieces
  - CF machines for smaller work pieces up to 100 mm
  - For removal of punch- and cutting traces after machining
  - Very short processing time
  
- Result:
  - High-quality, precise surfaces
  - Smooth and homogeneous
  - Bone plates of any size



## VIBRATORY FINISHING MACHINES

For big bone plates (up to 400 mm length)

- HV 20 produces perfect surfaces
  - By a homogeneous removal
  - Up to 65% faster than comparable machines
  - Tuned for workpieces and media, it vibrates with precisely defined oscillations, which results in an abrasive effect
- Depending on the machine geometry, bone plates up to 400 mm in length can be processed
- Advantages:
  - Especially for large bone plates up to 400 mm in length
  - Up to 65% faster than comparable machines on the market
  - Several processing steps in one: from deburring to wet polishing with a high-gloss surface area of  $R_a < 0.04 \mu\text{m}$



## DISC FINISHING MACHINES

For small bone plates (0 – 100 mm length)

- The machines of the CF series are especially suitable for processing of implants
  - Stainless steel
  - Titanium alloys
  - Plastic
  - Ceramic
- Reliable deburring and rounding
- Special process for smoothing the surfaces with subsequent polishing in the  $\mu\text{m}$  range
  - In just one processing step
  - $R_a$  values of  $0.02 \mu\text{m}$  are possible
  - For wet and dry processing



## DISC FINISHING MACHINES

For small bone screws and plates (0 – 80 mm length)

- Powerful disc finishing machine CF-T in a compact desktop design
- Unique, patented gap system
  - Precisely adjustable gap size to 0.05 mm
- Dry processing possible
- For processing of very thin work pieces
- Use of very fine grain polishing granules
- For best polishing results
- With a convincing price- / performance ratio
  
- Advantages:
  - Especially small bone screws and plates (for sizes of up to 80 mm)
  - Especially for small quantities
  - Compact desktop design construction
  - Machines from the global market leader



## DISC FINISHING MACHINES

For small bone screws and plates (0 – 100 mm length)

- Powerful disc finishing machine CF-SP for surgical implants
- Advantages:
  - Especially for smaller bone plates (up to 100 mm in size)
  - Processing of very thin work pieces
  - Patented gap system for the use of high-quality polishing media
  - Precisely adjustable gap to 0.05 mm or to even zero mm (zero gap system)
  - Water flow, compound concentration, speed profile directly controllable / preselectable
  - Wet grinding and polishing in one operation without retooling, media change, screening
  - High efficiency
  - Designed for industrial large-scale productions
  - Process reliable
  - For best polishing results
  - With a convincing price / performance ratio



# SEPARATION MACHINES FOR BONE PLATES

## Series UNISEPA

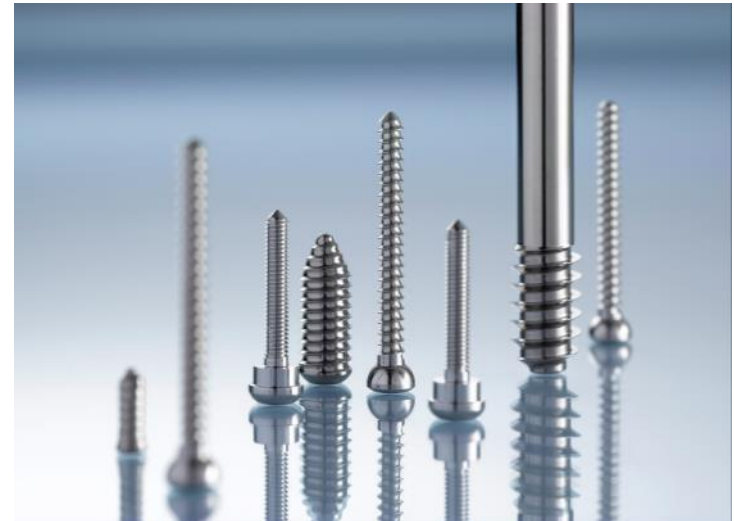
- Especially for the separation of bone plates
  - With a size of 40 - 100 mm in length
- For bone plates of different sizes
- Replacement for up to now extensive manual work
- Procedure:
  - The abrasive workpiece mixture flows out of the bunker and is transported by vibration over the perforated plate
  - Media fall through the screen
  - Workpieces adhering to the workpieces are rinsed off by a spraying device
  - Additional screen for second separation step
  - Separated media will be collected
  - Perforated bottom ensures water drainage
- Result:
  - 98% separation



## BONE SCREWS

### Disc finishing and drag finishing machines

- Especially for processing of bone screws
  - Co-Cr alloys
  - Titanium alloys
- For a tight fit, edges which are not rounded but without burrs are necessary
- A smooth, polished surface allows easy insertion and removal
- Reliable deburring, without appreciable edge rounding for bone screws
- All three requirements in one operation
  
- Result
  - Workpieces bright, immaculate and clearly higher quality optics
  - In just one operation
  - $R_a$  values of  $0.03 \mu\text{m}$  can be achieved



## DRAG FINISHING MACHINES

For large bone screws (up to 100 mm length)

- Deburring, smoothing and polishing in one operation
- A mirror finish but with precise edges





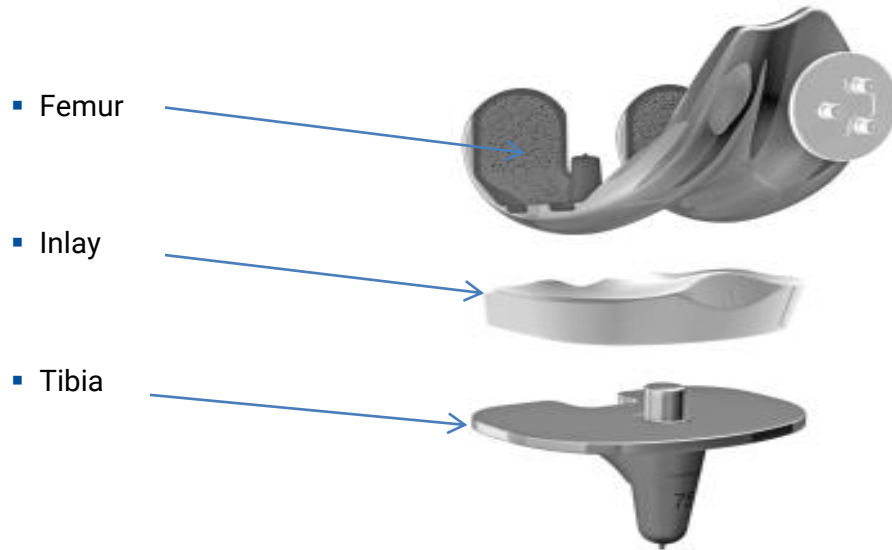
## KNEE JOINTS

### Drag finishing machines

- Especially suitable for processing of knee joints
  - Co-Cr alloys
  - Titanium alloys
  - Ceramic
- Perfect, highly polished surfaces, not the smallest scratches can be found and roughness of  $R_a < 0,03 \mu\text{m}$  with absolute process reliability, even in very complex free-form surfaces
- Maximum surface quality
- Uniform material removal
  
- Result
  - Workpieces bright, immaculate and clearly higher quality optics
  - $R_a$  values of  $0.03 \mu\text{m}$  can be achieved



# KNEE JOINTS Assembly



# KNEE JOINTS

## Sizes

- 10 different sizes
  - Size 6 72.99 mm x 65.684 mm
  - Size 7 76.987mm x 69.646 mm
  - Size 8 79.502 mm x 74.904 mm
  - Size 9 80.01 mm x 75.006 mm
  - Size 10 81.991 mm x 78.994 mm
- Each right and left
- Different versions e.g.
  - With box
  - Without box

# KNEE JOINTS

## Versions

With box

Without box



# KNEE JOINTS

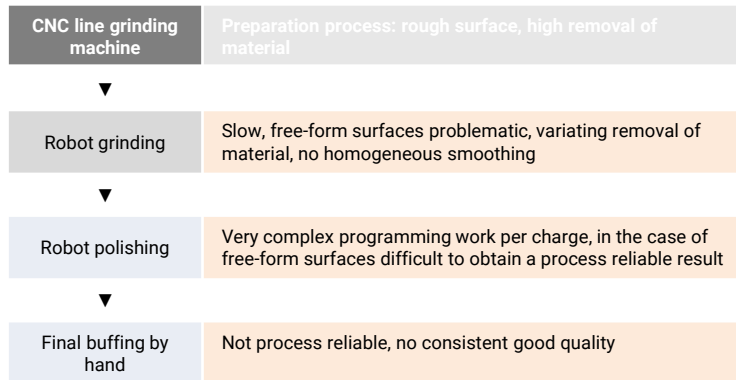
## Conventional processing

- Machining process after the manufacturing process
  - Machining - mounting of threaded holes + machining of the box with milling cutter
  - CNC line grinding machine. This is used to process the tread and to specify the shape
    - Roughness after: ca.  $R_a$  1.6  $\mu\text{m}$
  - Robot grinding
    - The robot has up to 4 grinding belts available in different grades
    - Processing time 2-5 min
  - Robot polishing
    - The robot has up to 4 polishing belts available
    - Processing time 2-5 min
- Final buffing by hand

# KNEE JOINTS

## Conventional processing

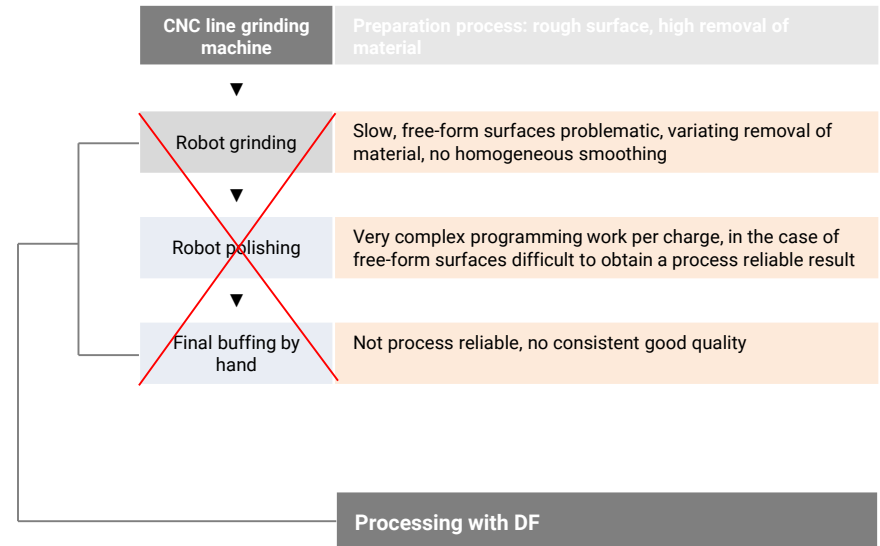
- Processing with robots is complex and expensive
  - Acquisition and maintenance costs (grinding belts etc.)
- Programming costs for a new component can be up to one week
- Due to wear, the contact pressure has to adjust permanently, which leads in practice to high quality fluctuations



# KNEE JOINTS– FEMURS

## OTEC processing

- Machining in drag finishing machines
  - Pretty easy
  - Absolutely reliable
  - Easy handling
  - Very low programming effort



## DRAG FINISHING MACHINES

### For femurs

- Due to fast movement, high contact pressures arise between the work piece and media optimal processing results in the form of smooth surfaces or a high-gloss finish in the quality of a handpolish result
- Wet and dry processes
- Available in a wide variety of dimensions and sizes - adapted to the work pieces to be processed
- Particularities:
  - In the multi-stage DF machines, the change from wet to dry processing takes place automatically, without interruption of the process
  - Angled, driven holders ensure a treatment right down to the smallest corner





# DRAG FINISHING MACHINES

For femurs

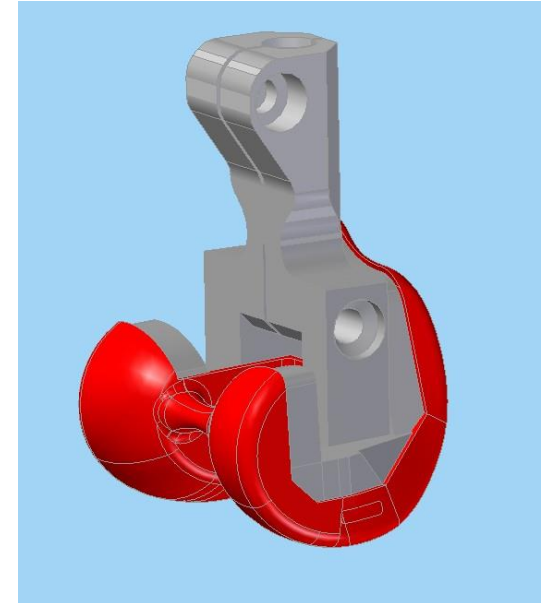
- Advantages:
  - Surfaces  $< R_a 0.02 \mu\text{m}$  in extremely short processing time
  - High profitability
  - Automatic change of wet and dry processing possible
  - Very compact design with high output
  - Process reliability
  - Easy handling
  - Defect-free surfaces



## DRAG FINISHING MACHINES SERIES DF

### Covers for femurs

- Sandblasting the femur is necessary before grinding and polishing
- To protect the sand-blasted surface during grinding and polishing process
  - Cover
  - At the same time used for fixing the holders



## DRAG FINISHING MACHINES SERIES DF

### Elastic base for best surface quality

- Due to the static pressure, the processing intensity increases with the immersion depth
  - Strongest and therefore shortest processing takes place on the bottom of the process container
  - When grinding the implants, ceramic- or plastic-bonded chips are used
    - Risk of grinding of the chips
  
- Solution:
  - Elastic base
  - Base yields when pressure is high
  - To avoid impact on the workpiece surface
  - No punctual compacting
  
- Avoiding pimples and so-called orange skin



## DRAG FINISHING MACHINES SERIES DF

Device to blow off work pieces after wet grinding

For the reliable prevention of carry-over of abrasive particles into the polishing process

- Device to blow off work pieces
  - Workpiece holders move to a certain position
  - Blowing off takes place
  - Time setting individually possible



## **KNEE JOINTS– FEMURS WITHOUT BOX**

### OTEC processing

- Typical processing of femurs without box
  - E.g. DF-3 Tools
  - Holding in a driven holder for 3 work pieces with a screw eventually including a cover in case the customer wants to sand-blast the back of the femur before
  
- Possibility of assembly:
  - DF 3 - 9 work pieces
  - DF 5 - 15 work pieces
  - DF 8 - 24 work pieces

## KNEE JOINTS– FEMURS WITHOUT BOX

### OTEC process

- Initial roughness approx.  $R_a$  1.6  $\mu\text{m}$  (2 steps)
- 1<sup>st</sup> step wet grinding with plastic chips KM 10
  - Process time 2-3 hrs
  - Roughness  $R_a$  0.05 - 0.07  $\mu\text{m}$
- 2<sup>nd</sup> step dry polishing with M 5/300
  - Process time 0.5 hrs
  - Roughness  $R_a$  0.01 - 0.02  $\mu\text{m}$
- Output roughness  $> R_a$  1.6  $\mu\text{m}$  (3 steps)
- 1<sup>st</sup> step wet grinding with ceramic chips DBS 6/6
  - Process time 1-2 hours
  - Roughness value approx.  $R_a$  0.18  $\mu\text{m}$
- 2<sup>nd</sup> step wet grinding with plastic chips KM 10
  - Process time 0.5 hrs
  - Roughness  $R_a$  0.05 - 0.07  $\mu\text{m}$
- 3<sup>rd</sup> step dry polishing with M 5/300
  - Process time 0.5 hrs
  - Roughness  $R_a$  0.01 - 0.02  $\mu\text{m}$

## KNEE JOINTS– FEMURS WITH BOX

### OTEC process

- Finishing of the box only manually possible
- It is milled or eroded and then finished by hand
- Finishing of the box is often as expensive as finishing of the free-form surface
- Machining the femur with box in drag finishing machines:
  - Driven holders
    - Workpieces also rotate around their own axis
  - Inclined position of the holder
    - Significantly better finish of the faces of the work pieces
- Advantages of driven holders
  - Improved finishing in the center for hip joints
  - More uniform finishing of femurs
  - Better finishing of the box of femurs
  - Optimal finishing of the faces of tibias



## KNEE JOINTS– FEMURS WITH BOX

### OTEC process

- 1<sup>st</sup> step wet grinding with ceramic chips DBS 6/6
  - Process time 1 hour
  - Roughness value approx.  $R_a$  0.18  $\mu\text{m}$
- 2<sup>nd</sup> step wet grinding with plastic chips KM 10
  - Process time 1 hour
  - Roughness  $R_a$  0.05 - 0.07  $\mu\text{m}$
- 3<sup>rd</sup> step dry polishing with M 5/300
  - Process time 1 hour
  - Roughness  $R_a$  0.01 - 0.02  $\mu\text{m}$



# KNEE JOINTS

## Advantage OTEC process

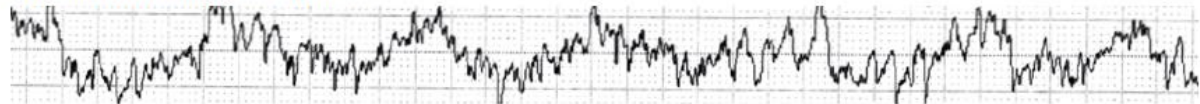
- Absolutely reliable
- Scratch-free, very smooth, high-gloss surfaces
- Easy handling
- Parts can be processed without preparation in a CNC grinding machine → uniform removal between 60-80 µm
  - Provided the sprue has been removed nicely before and the casting quality is high

Surface after machining with CNC line grinding machine

Oberfläche auf CNC-Schleifmaschine bearbeitet

Ra: 1,23 µm

Rz: 7,9 µm



Surface after processing with OTEC DF-machine

Ra: 0,01 µm

Rz: 0,1 µm



125 times enlarged

## EXAMPLE OF USE

Femur - before / after



Femur after (left) and before (right) processing

## EXAMPLE OF USE

### Processing of CoCr- cast alloy knee joints

- Material: CoCr
- Manufacturing method: milled work pieces

#### Task definition

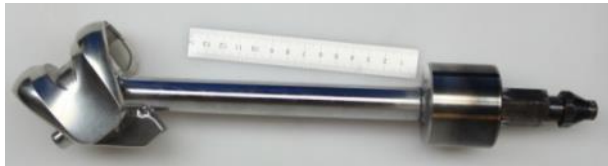
- Flattening the milling structure
- Preparation of a polishable surface
- Polishing of the functional surfaces  $R_a < 0.03 \mu\text{m}$



# TEST SETUP

## DF HD

- Drag finishing machine for wet- and dry processing
- Workpiece holder: custom made holder for femurs



Custom made holder



## PROCESS

### Processing in three steps

- Total process time: 3 Std. 10 min.
- Process steps:
  1. Wet grinding with ceramic chips: 1.5 hours.
  2. Wet grinding with plastic chips: 1 hour
  3. Dry polishing with granules and powder: 40 min.



## EXAMPLE OF USE

Femur – before / after



Before processing

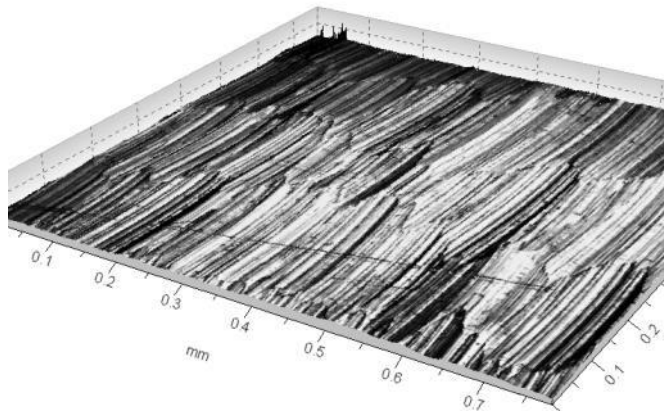


After processing

# TECHNIQUE

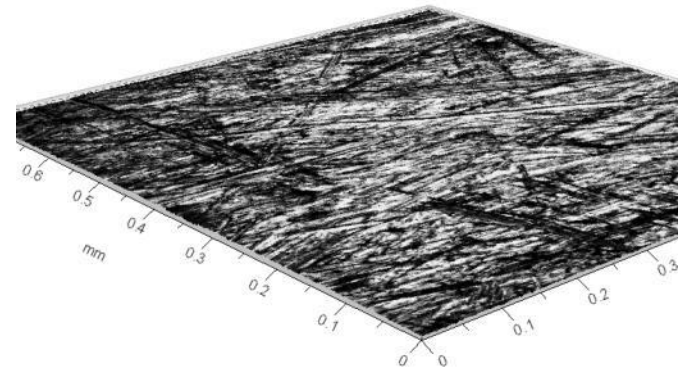
## Surface

Measuring the surface (with: Nanofocus 3D Topometrie)



Milled surface unprocessed

$R_a$  0.54  $\mu\text{m}$



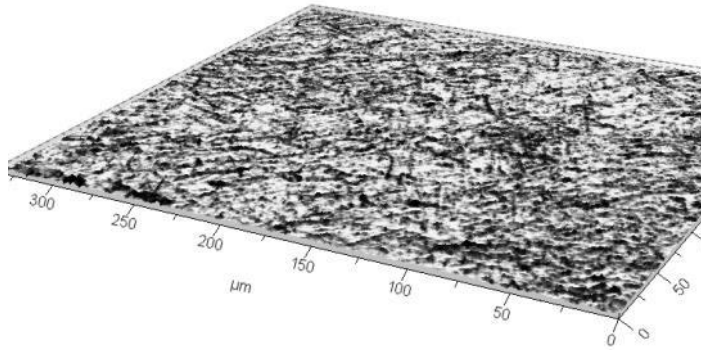
Surface after first processing step with ceramic chips

$R_a$  0.18  $\mu\text{m}$

# TECHNIQUE

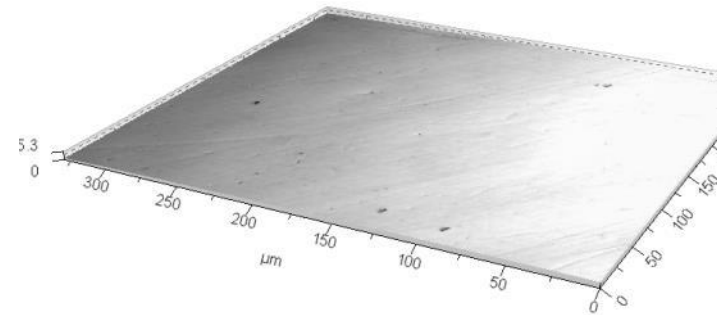
## Surface

Measuring the surface (with: Nanofocus 3D Topometrie)



Surface after processing with plastic chips

$R_a$  0.054  $\mu\text{m}$



Surface after the final polishing step with granules

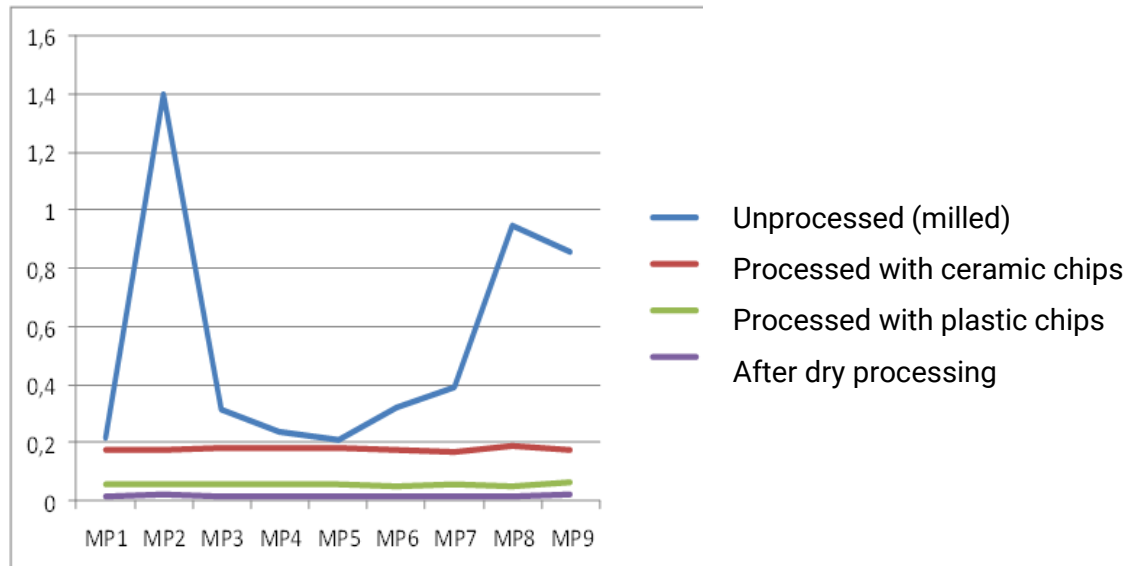
$R_a$  0.016  $\mu\text{m}$



# TECHNIQUE

## Surface development

The roughness has been measured at 6 femurs at various measurement points ( $R_a$  in  $\mu\text{m}$ )



# TEETH

## Disc finishing machines

- Deburring and creating smooth surfaces are the A and O in dental medicine
- Task:
  - Smoothing and polishing of fine and soft surfaces (e.g. ceramic or plastic)
  - Without appreciable edge rounding
  - Perfect up to the  $\mu\text{m}$  range
- CF SP und CF-T
  - $R_a$  values of  $0.03 \mu\text{m}$
  - In just a single operation
  - In small- and large-scale productions



# ORTHODONTIC AND DENTAL TOOLS

## Disc finishing machines

- The right method for every workpiece:
  - Brackets
  - Bows
  - Orthodontic and dental tools
- Whether sharp-edged or edge-rounded, pointed or blunt
- Complex, filigree geometries
  
- CF SP
  - Hand polishing quality achievable
  - Use of the appropriate abrasive and polishing agent
  - In a short time
  - For large and small workpieces



# EARMOULD

## Disc finishing machines

- Fitting accuracy and wearing comfort are the focus
  - Earmoulds for hearing aids or ear protection are produced from specific plastics by means of a rapid manufacturing process
    - Too rough to use straight after manufacturing process
  - Task:
    - Finishing in disc finishing machines for grinding and polishing the plastic surfaces
    - The special design of the machine allows a very high-quality smoothing of the surface with gentle processing of the work piece
    - Even delicate workpieces are processed without damage
    - Gentle and absolutely process reliable processing
    - In no time
- Reduction of complex and difficult hand grinding



## FURTHER FIELDS OF APPLICATIONS

Stems



## FURTHER FIELDS OF APPLICATIONS

Spheres and hemispheres



## FURTHER FIELDS OF APPLICATIONS

Hip joints



## FURTHER FIELDS OF APPLICATIONS

Tibia





## FURTHER FIELDS OF APPLICATIONS

Hip sockets



## FURTHER FIELDS OF APPLICATIONS

Implants



# FINISHING MACHINES FOR MEDICAL AND PHARMACEUTICAL TECHNOLOGY

## Overview

	CF	CF-T	CF SP	DF-Series „dry/wet“	HV
Application	Surgical implants: for industrial serial production	Surgical implants:	Surgical implants: smaller dimensions / geometries	Endoscopy Femurs Orthodontic tools Surgical implants such as tibia, hip joints, heart valves etc..	Surgical implants: large dimensions
	Earmoulds				
	Dental implants industrial series	Dental implants smaller numbers	Dental implants		Bone nails (bone pins)
	Orthodontic and dental tools small to medium size	Medical technology in general			
Characteristics	Patented gap system, absolute process reliability, highly efficient for serial processing, easy operation	Compact and small, processing and machine quality of the "big". As table type format, easy operation	Further development of CF technology, grinding and polishing without changing containers and media, easy operation water and compound feed can be adjusted via touch panel -> high process reliability	Thanks to angled holder optimal surfaces even with complex geometries	Gentle treatment

## FINISHING CENTRE

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

## FINISHING CENTRE



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



**THANK YOU FOR YOUR ATTENTION.**