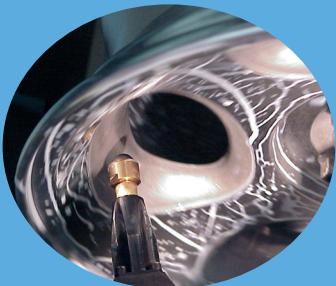




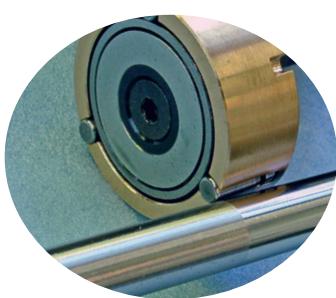
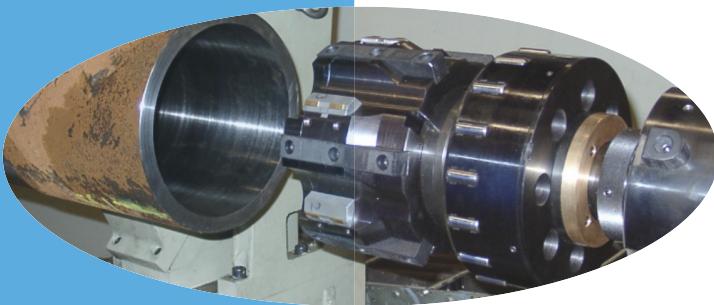
Tools & Solutions

for

Metal Surface Improvement



**Roller burnishing,
Deep rolling,
Combined skive-burnishing**



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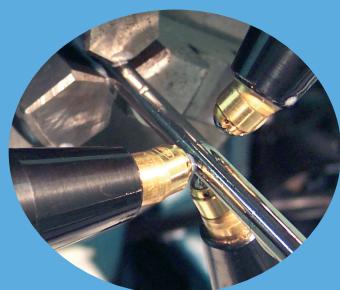
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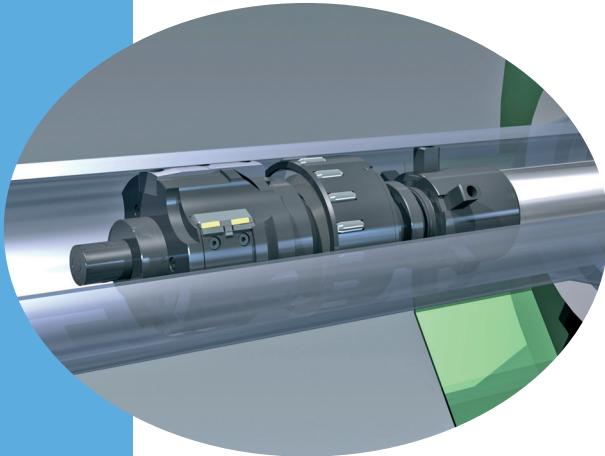
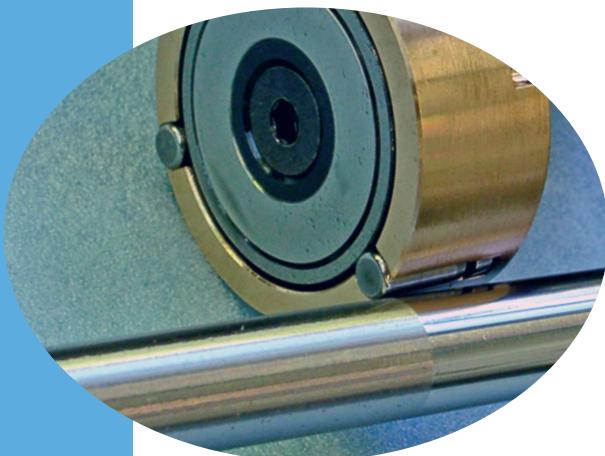
... for a smooth operation

ECOROLL AG Werkzeugtechnik & ECOROLL Corporation

We design, manufacture and sell high quality tools and machines for improving metal surfaces and components.

ECOROLL tools and solutions can be applied across a wide range of industries:

- Automotive, aircraft and aerospace industries
- Machine and engine construction
- Power generation industry
- Oil and gas industry
- Medical technology



Roller burnishing

- Produces mirror-finish surfaces
- Achieves a high surface bearing ratio
- Increases hardness, decreases friction and wear
- Short cycle, complete processing in one setting

Deep rolling

- Increases service life and fatigue strength
- Induces residual compressive stresses and work hardening in the surface layer
- Prevents or hinders stress corrosion crack formation or growth
- Produces mirror-finish surfaces
- Can process a wide variety of components
- Short cycle, complete processing in one setting

Combined skive-burnishing

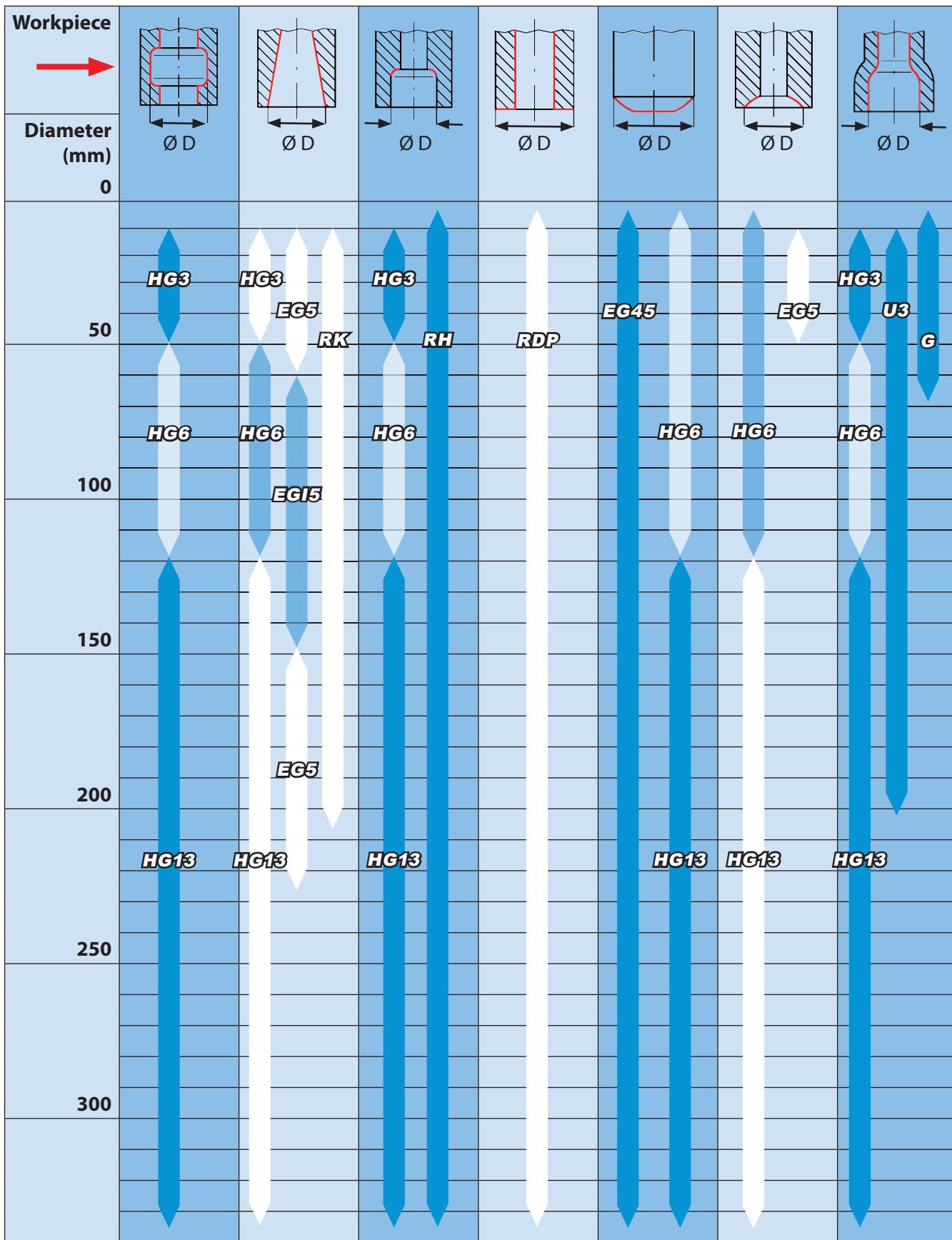
- For hydraulic and pneumatic cylinders
- Mirror-finish surfaces decrease friction and wear
- Decreases irregularities in circular form
- Enhanced cutting speed up to 300 m per minute
- Feed rates of 3–6 mm per revolution

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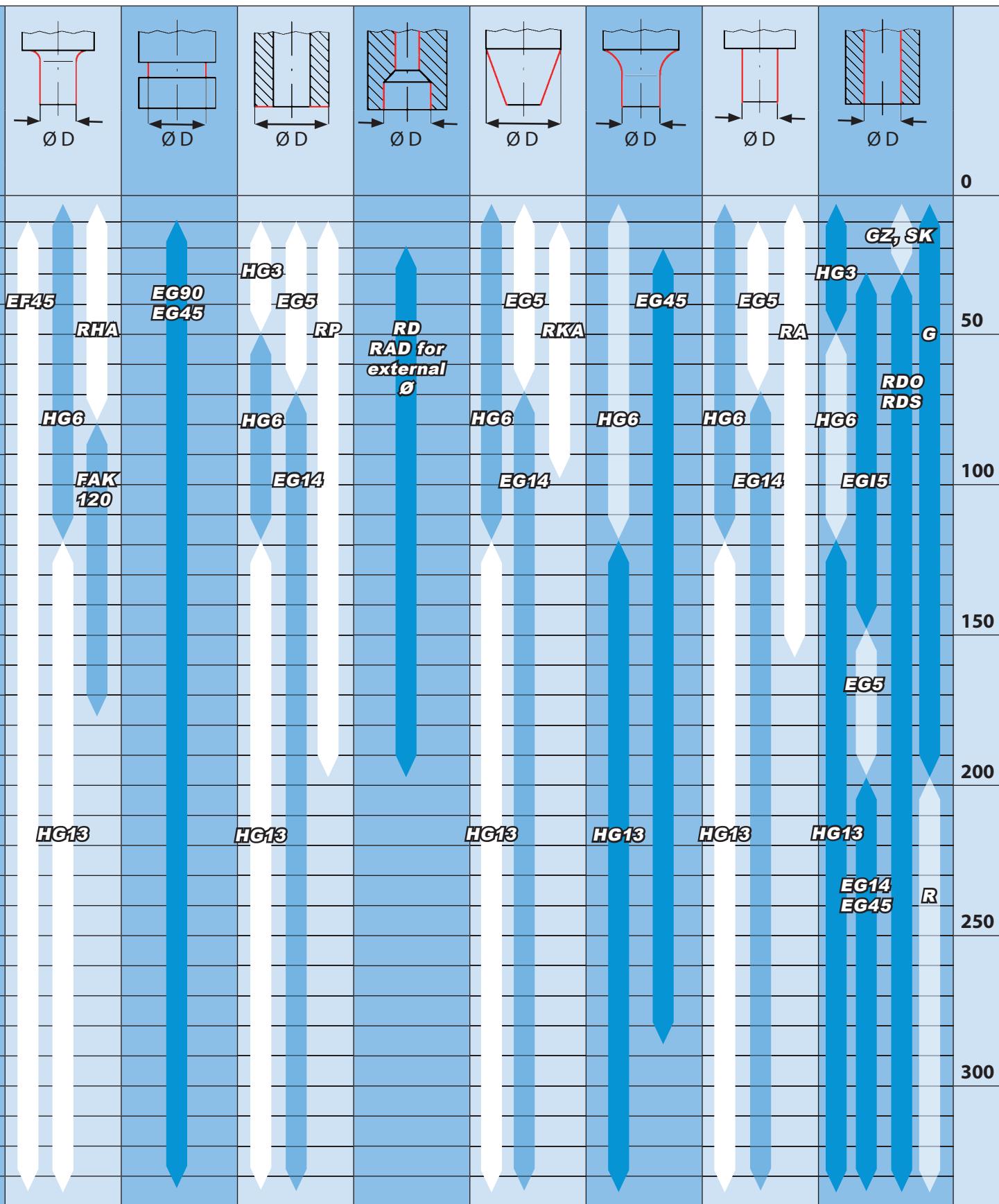
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Product & Process Overview

ECOROLL Product Selection



Section 1 – Product Overview



Product & Process Overview

ECOROLL Tooling Technology

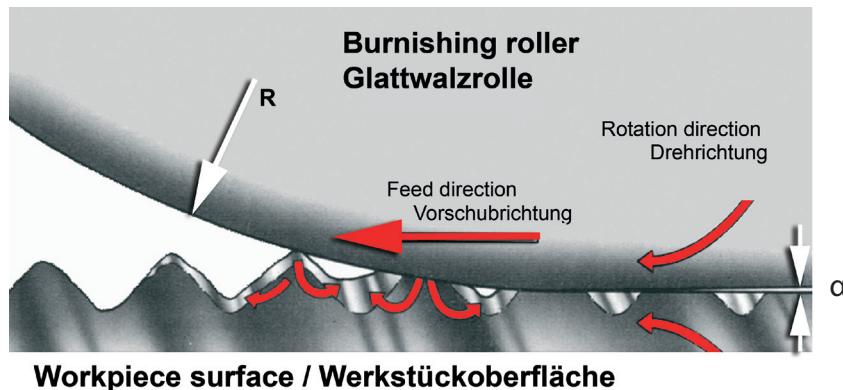
Based in Celle, Germany, ECOROLL AG Werkzeugtechnik is a mid-size company that designs, manufactures and sells tools and machines for improving the qualities of metal surfaces. These tools are used for roller burnishing, deep rolling and combined skive-burnishing applications (the latter developed especially for cylinder tubes). ECOROLL AG's presence is world-wide, including a subsidiary in the U.S. (ECOROLL Corporation in Milford, Ohio) and representatives in Korea, Japan, South Africa, Brazil, and many European countries.

The technology developed at ECOROLL AG can be applied across a broad spectrum of industries, including medical technology, the automotive industry, aircraft and aerospace, energy technology (wind turbines and the oil industry), and anywhere metal parts must be improved to increase service life or to facilitate better function.

Roller burnishing and deep rolling

ECOROLL is an industry leader in developing fundamental roller burnishing and deep rolling technology. In both processes one or more rollers or balls are pressed against the surface of a workpiece, plasticizing the material's top layer. At the contact point, the deep rolling force generates Hertzian contact stresses in the material's edge zone. If this stress is higher than the material's yield strength, the material near the surface starts to flow. As the ball or roller moves across the workpiece surface, the elastically deformed material springs back, pushing the now plastically deformed zone into compression. As long as the tool or the workpiece continues to rotate, this forming process continues over the entire workpiece surface.

By plastically deforming the workpiece's surface layer, both roller burnishing and deep rolling achieve a very smooth surface finish. The surface's peaks are pressed down, almost vertically, into the surface and the material then flows into the valleys between the peaks. The resulting smooth surface occurs not because the peaks are bent into the surface (a widely held, but false assumption), but because the material at the workpiece surface is plastically deformed — in other words, the material flows — and thus eliminates surface roughness.



The curved arrows pictured at the material's surface demonstrate how the material is displaced into the valleys between the peaks. Plastic deformation increases the roller's contact with the surface in that the applied rolling pressure (or burnishing force) affects the peaks that lie ahead of the roller's current position while causing the peaks at the point of contact to flow. The region found between the arrows labelled "rotation direction" in the figure above demonstrates how the material's surface is shaped during the roller burnishing or deep rolling process. The roller suppresses the plasticised material, preventing it from flowing backwards against the feed direction, while clearance angle α ensures that the surface is not over-burnished.

Both roller burnishing and deep rolling can take place right after an initial cutting process — such as turning, boring, reaming, milling or broaching — in the same setting. ECOROLL tools are compatible with conventional and CNC-controlled lathes, drills, milling machines and other machining centers. Moreover, these tools can process both regular (turned and bored) and irregular (milled or pressed) components. Special machines in mass production settings can also be set up to work with ECOROLL tools.

How does roller burnishing differ from deep rolling?

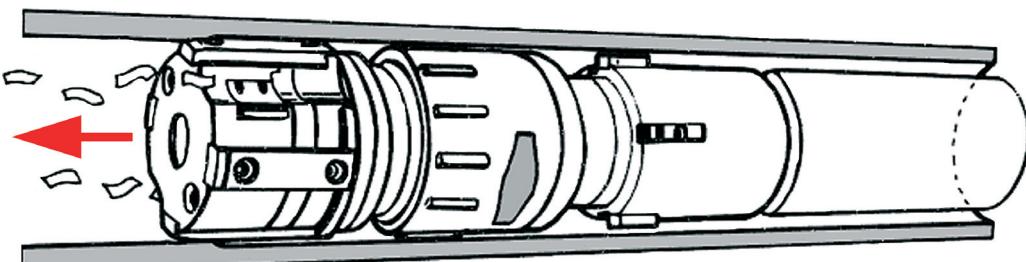
Some use the term "roller burnishing" to refer to both processes. To clarify for our customers the unique advantages of both processes, ECOROLL prefers to differentiate deep rolling from roller burnishing. Although the technological means are similar, the goals and results as well as the tools used for each process differ. When the application goal is to improve surface finish and/or increase bearing contact area, ECOROLL recommends roller burnishing. Deep rolling, on the other hand, offers a reliable process for increasing fatigue strength. That deep rolling simultaneously improves other surface qualities is, of course, beneficial but not as important in this case.

Deep rolling is similar to roller burnishing, but only this process combines burnishing, cold working and the generation of compressive stresses in the edge zone. Together, these three physical effects increase fatigue strength and reduce or even prevent stress corrosion cracking. As previously explained, rollers or balls appropriate for the particular task are pressed against the workpiece surface, plasticizing the material in the edge zone. When this plastic deformation takes place at or below room temperature, it is called "cold working." This process changes the surface's microstructure. The material characteristics achieved depend on the amount of cold work and the material's properties. Simultaneously, the deep rolling process induces compressive residual stresses. By precisely controlling the rolling pressure (or burnishing force), ECOROLL tools can produce the specific stress characteristics required for a given workpiece.

Combined skive-burnishing

The tools in ECOROLL's innovative OMEGA line combine skiving and roller burnishing to eliminate irregularities in circular form, such as rippling, that occur in the manufacture of hydraulic cylinders and other tubes. Although there are established processes for machining cylinders, the combination of skiving and roller burnishing offers an especially economical alternative. The OMEGA tools have proven effective for machining cylinders with diameters from 60 mm to 455 mm in lengths up to 10 m.

While the skiving head cuts the tube's inner surface to the exact size and form required, the roller head burnishes it. Several rollers positioned on the tool's circumference are pressed into the cylinder's inner wall.



This process smoothes and forms the surface profile generated by skiving. The forming process increases hardness and enhances the wear and fatigue resistance of surfaces subject to dynamic load.

Multiple Roller Tools

Mechanical Multiple Roller Tools

ECOROLL's multiple roller tools (types G, R, RD, RAD, RA) are specially designed to machine cylindrical bores (both through and blind holes), stepped bores and internal and external cylinder surfaces.

The RP, RDP, RK and RKA tools process similar non-cylindrical surfaces.



Type G roller burnishing tool on a CNC-controlled lathe.



These versatile tools feature convenient diameter adjustment and reliable, high-precision performance.

Type G roller burnishing tool with internal coolant.

The tools can be applied with CNC-controlled lathes, drills, milling machines and machining centers as well as with manually controlled machines.



Machining a connecting rod with a Type G tool.



Machining a three-section stepped bore with a Type RD tool.

In addition, the tools require minimal lubrication and the wear parts are easy to change.

Simple maintenance together with the short work cycle add up to considerable time-savings.



Machining a universal joint shaft with a Type RA tool.

Multiple Roller Tools

Type G Tool Application: Cylindrical bores

Through holes, diameters 4 – 200 mm

Blind holes, diameters 6 – 200 mm

Features

- For bore tolerances up to class IT8
- Type GE for bore tolerances up to class IT11, Ø 50 mm and larger
- Suitable for metals with tensile strength up to 1400 N/mm² and maximum hardness HRC ≤ 45
- Achieves a surface quality of $R_z < 1 \mu\text{m}$ ($R_a \leq 0.2 \mu\text{m}$)
- For use on CNC-controlled lathes, drills, mills, and machining centers as well as manual machines
- Right hand rotation

Basic tool design

- Type G tools consist of a tool body and roller head.
- Tool body includes shank and burnishing diameter adjustment assembly with an adjustment increment of 1 μm .
- Tool shanks are Morse taper or cylindrical Weldon design. Specialized shanks also available.
- Roller head consists of cone, cage and rollers.
- Roller heads interchangeable within tool body diameter range. Optional self-feeding cages also available.

Parameters

- Circumferential speed: up to 250 m/min.
- Feed rate: 0.05 - 0.3 mm/rev./roller
- Rolling length: when the workpiece diameter is 36 mm or larger, the tool allows for unlimited rolling length. For smaller diameters, tools with standard rolling length are available.

Specially designed versions available by request.



Tool body	Diameter range D (all measurements in mm)	Tool shank: Morse taper or cylindrical shank Ø e x f	a	b	c ¹⁾	d max.	i	I	Rolling length	
G1.1	≥ 4 < 17	MK2 Ø 20h6 x 50	35	52	1.5	70	80	89	Standard rolling length: 50 mm + 8 mm	
	≥ 17 < 21				2					
G1.2	≥ 21 < 33	MK2 Ø 20h6 x 50 Ø 25h6 x 56			3	74	80	89	Unlimited rolling length	
G1.3	≥ 33 < 36									
	≥ 36 < 50									
G2	≥ 50 < 100	MK3 Ø 25h6 x 56	49	68	93	99	79			
G3	≥ 100 < 201 ²⁾	MK4 Ø 32h6 x 60	71	84			100			

NOTE: 1) All measurements in mm. Measurement c does not apply for blind hole tools.

2) For workpieces with diameters larger than 201 mm, please see ECOROLL Type R tools.



Advantages

- Reliable, high precision performance
- Short cycle time
- Convenient diameter adjustment
- Minimal lubrication required (oil or emulsion)
- Tool automatically collapses when retracted to prevent surface damage
- Easy to change wear parts

Tool body **G1.2-25.00-1-50-MK** Shank
 Diameter Design Rolling length

How to order:

1. Specify the tool body type and machining diameter (see following table).
- NOTE:** Depending on the application, blind hole tools may allow a larger range of settings than shown in the table.
2. Specify the design version:
 - 1: through holes with non-feeding cage
 - 2: through holes with self-feeding cage
 - 3: blind holes with non-feeding cage
3. Specify the rolling length in mm: 100, 150, 200, 250, 300 (other lengths by request).
4. Specify the shank type:
 - MK: Morse taper
 - ZS: Cylindrical Weldon shank

Tool body	Diameter D	Setting range through hole blind hole ³⁾	Number of rollers ⁴⁾	Roller diameter Ø g x h	Roller radius r	Rolling length	
						mm	
G1.1 ≥ 4 < 21	4	- 0.05 / + 0.2	3	1 x 4	0.5	50	
	5	no blind hole		1.5 x 6	1		
	6-7	- 0.05 / + 0.3		2 x 6			
	8-9	- 0.05 / + 0.1	4	2 x 10 ³⁾			
	10	- 0.05 / + 0.4		3 x 9	1.5		
	11-16	- 0.05 / + 0.1	5				
	17-20	- 0.05 / + 0.6		5 x 16			
G1.2 ≥ 21 < 33	21-24	- 0.05 / + 0.1	6				
	25,26,28,30,32						
G1.3 ≥ 33 < 50	33-35	- 0.05 / + 0.8	8			75	
	36						
	38	- 0.05 / + 0.1					
	40,42,44-48						
G2 ≥ 50 < 100	50,52,55,58, 60,62,63,65,68, 70,72,75,78,80,85		12			unlimited	
	90,95						
	100,110,115,120,125 130,140,150,160		16	14 x 35	4		
	170,180,190,200						

NOTE: 3) Depending on the application, blind hole tools may allow a larger range of settings than shown in the table.

4) Please exchange only complete sets of rollers. When ordering rollers, specify through or blind hole.

Multiple Roller Tools

Type R Tool Application: Cylindrical bores

Through holes, diameters 201 – 450 mm

Blind holes, diameters 201 – 450 mm

Features

- For bore tolerances up to class IT8
- Suitable for metals with tensile strength up to 1400 N/mm² and maximum hardness HRC ≤ 45
- Tools achieve a surface quality of $R_z < 1 \mu\text{m}$ ($R_a \leq 0.2 \mu\text{m}$)
- For use on CNC-controlled lathes, drills, mills, and machining centers as well as manual machines
- Right hand rotation

Advantages

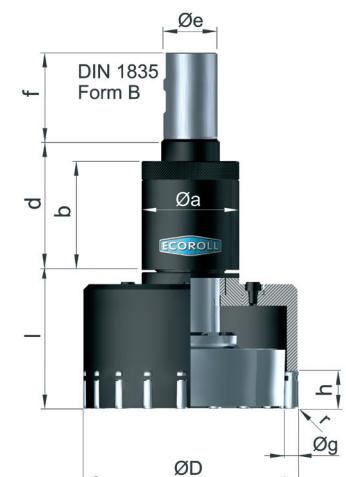
- Short cycle time
- Convenient diameter adjustment
- Minimal lubrication required (oil or emulsion)
- Tool automatically collapses when retracted to prevent surface damage
- Easy to change wear parts

Basic tool design

- Type R tools consist of a tool body and roller head.
- Tool body includes shank and diameter adjustment assembly.
- Adjustment assembly accommodates any size within the setting range.
- Specially designed rollers for bores with wide ring grooves or with cross holes. These rollers guarantee smooth tool operation and retraction.

Parameters

- Circumferential speed: up to 250 m/min.
- Feed rate: 0.10 - 0.4 mm/rev./roller



Tool body	Diameter range D	Setting range through blind hole ¹⁾	Tool shank: Morse taper or cylindrical shank Ø e x f	Number of rollers ²⁾	Roller diameter Ø g x h	Roller radius r	a	b	c	d	i	l
							mm	- / + mm	mm	mm	mm	mm
R5	≥ 201 < 255	-0.05 / +0.8	MK5 Ø 50 h6 x 80	16	14 x 35	4	90	100	5	125	156	134
	≥ 255 < 320	-0.05 / +0.1		20								
	≥ 320 < 450			28								

NOTE: 1) Depending on the application, blind hole tools may allow a larger range of settings than shown in the table.

2) Please exchange only complete sets of rollers. When ordering rollers, specify through or blind hole.

Type RD and RAD Tool Applications:

Stepped bores and stepped shafts



Features

- For bore tolerances up to class IT8
- Suitable for metals with tensile strength up to 1400 N/mm² and maximum hardness HRC ≤ 45
- Tools achieve a surface quality of $R_z < 1 \mu\text{m}$ ($R_a = 0.2 \mu\text{m}$)
- For use on CNC-controlled lathes, drills, mills, and machining centers as well as manual machines
- Right hand rotation

Advantages

- Short cycle time
- Eliminates the need for a second tool
- Convenient diameter adjustment
- Minimal lubrication required (oil or emulsion)
- Tool automatically collapses when retracted to prevent surface damage
- Easy to change wear parts



Basic tool design

- Type RD and RAD tools consist of a tool body and roller head.
- Tool body includes shank and two diameter adjustment assemblies for independent adjustment.
- Roller head consists of two external or internal cones, one double cage, and two sets of rollers.
- Standard for Type RD tools are Morse taper shanks; Type RAD has cylindrical shanks.
- Roller head is designed for specific workpiece dimensions.

Parameters

- Circumferential speed: up to 250 m/min.
- Feed rate: 0.10 - 0.4 mm/rev./roller
- Rolling length: the rolling length h as well as the step increment g is designed for specific workpiece dimensions. To avoid using more than one tool to process one workpiece, these tools can be equipped with very small step increments and up to three steps.

Tool body	Diameter range D	Setting range through blind hole	Tool shank: Morse taper or cylindrical shank Ø e x f	a	b	c ³⁾	d min.		k	i
							mm	mm		
RD1	≥ 16 < 50	-0.05 / +0.6 -0.05 / +0.1	MK3 Ø 25 h6 x 60	53	110	3	12 and/or 0.6 x D	125	99	
RD2	≥ 50 < 100	-0.05 / +0.8 -0.05 / +0.1					30			
RD3	≥ 100 < 201		MK4 Ø 32 h6 x 60	75	150			168	124	
		Setting range (through hole)	Tool shank Ø e x f	a1	a2	b min.	c min.	d min.	g min.	h min.
RAD1	≥ 12 < 25	-0.1 / +0.4	Ø 25 h6 x 56	96	65	130	30	0.8 x D	depends on the work-piece	
RAD2	≥ 25 < 51	-0.1 / +0.6	Ø 32 h6 x 60	140	105	160				

NOTE: 3) No dimension c on blind hole tools.

Multiple Roller Tools

Type RA Tool Application: Cylindrical outer surfaces

Diameters 3 – 160 mm

Features

- For bore tolerances up to class IT8
- Type RAP with compensating roller head for bore tolerances up to class IT11
- Suitable for metals with tensile strength up to 1400 N/mm² and maximum hardness HRC ≤ 45
- Achieves a surface quality of $R_z < 1 \mu\text{m}$ ($R_a \leq 0.2 \mu\text{m}$)
- For use on CNC-controlled lathes, drills, mills, and machining centers as well as manual machines
- Right hand rotation

Basic tool design

- Type RA roller burnishing tools consist of a tool body and roller head.
- Tool body includes shank and diameter adjustment assembly.
- Cylindrical shanks standard (Morse taper shanks also available).
- Roller head consists of the external cone, cage, and rollers.
- Roller heads interchangeable within the diameter range for the tool body size.



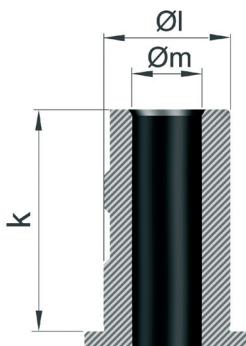
Parameters

- Circumferential speed: up to 250 m/min.
- Feed rate: 0.05 - 0.3 mm/rev./roller
- Rolling length: when equipped with a standard shank, the tool's rolling length is limited (see the following table).

For longer workpieces ECOROLL® can supply roller burnishing tools for unlimited rolling length. These tools are equipped with a hollow, reinforced cylindrical shank.

Tool body	Diameter range D	Tool shank: Morse taper or cylindrical shank Ø e x f	a	b	c ¹⁾	d	i
			mm	mm	mm	mm	
RA1	≥ 3 < 12	Ø 20 h6 x 50 (MK2)	Ø 25 h6 x 60 x 15	55	45	21	81
RA2	≥ 12 < 25	Ø 25 h6 x 56 (MK3)	Ø 40 h6 x 70 x 28	73	65		99
RA3	≥ 25 < 55	Ø 40 h6 x 70 (MK4)	Ø 80 h6 x 90 x 57	114	105	28	108
RA4	≥ 55 < 85		Ø 110 h6 x 110 x 88	152	140		124
RA5	≥ 85 < 110	Ø 50 h6 x 80 (MK5)	Ø 150 h6 x 120 x 113	190	180	35	130
RA6	≥ 110 < 160		Ø 190 h6 x 150 x 150 ¹⁾	238	225		156

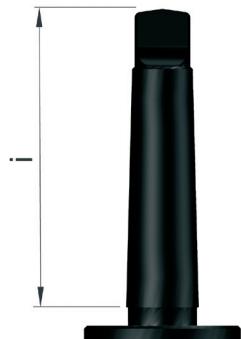
NOTE: 1) Maximum diameter for unlimited rolling length is 145 mm.



Advantages

- Reliable, high precision performance
- Short cycle time
- Convenient diameter adjustment
- Minimal lubrication required (oil or emulsion)
- Tool automatically collapses when retracted to prevent surface damage
- Easy to change wear parts

Tool RA3-25.00-3-MK Shank
body Diameter Design



How to order:

1. Specify the tool body type and machining diameter (see following table).

NOTE: Non-standard diameters are available by request.

2. Specify the design version:
 - 3: with non-feeding cage
 - 4: with self-feeding cage
3. Specify the shank type:
 - MK: Morse taper
 - ZS: Cylindrical shank (limited rolling length)
 - ZU: Hollow cylindrical shank (unlimited rolling length)

Tool body	Diameter D	Setting range	Number of Rollers	Roller diameter	Roller radius r	Rolling length				
				Ø g x h	mm	mm				
RA1 ≥ 3 < 12	3 and 5	- 0.2 / + 0.05	3	5 x 16 S	1.5	85				
	6-7	- 0.4 / + 0.1								
	8-10									
RA2 ≥ 12 < 25	12,14-16	- 0.6 / + 0.1	5	8 x 25 S	2.5	110				
	17,18,20,22,24									
RA3 ≥ 25 < 55	25,28,30,32,35	- 0.6 / + 0.1	7	8 x 25 S	2.5	110				
	40,45,50									
RA4 ≥ 55 < 85	55,60,63,65,70,75,80	- 0.6 / + 0.1	9	14 x 35 S	4	135				
RA5 ≥ 85 < 110	85,90,95,100,105									
RA6 ≥ 110 ≤ 160	110,115,120,125, 130,140,150,160	- 0.6 / + 0.1	11	14 x 35 S	4	135				

NOTE: 2) Please exchange only complete sets of rollers.

Multiple Roller Tools

Type RP, RDP, RK, RKA Tool Applications: Non-cylindrical surfaces

Features

The RP, RDP, RK and RKA roller burnishing tools achieve outstanding results on non-cylindrical surfaces such as plane faces and internal and external tapered surfaces.

These tools work under axial load and can be used with almost any type of machine. Either the tool or the workpiece can rotate.

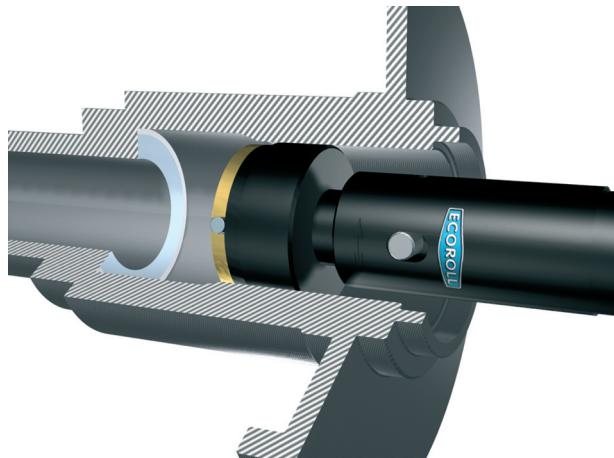
A flexible disc spring assembly transfers the axially directed rolling force from the machine to the roller head. The tools can be used to machine all metals with tensile strength up to 1400 N/mm^2 and maximum hardness of 45 HRC.



Machining a steering lever with a Type RK tool.

Advantages

- Reliable, high precision performance
- Wide variety of applications
- Extremely short processing time
- Disc spring assembly facilitates consistent, high quality results
- Suitable for use with many different machines
- Standard tool shanks available: Morse taper, cylindrical, and VDI tool shanks
- Easy to change wear parts



Machining a gear housing with a Type RP tool.

Basic tool design

Type RP, RDP, RK, and RKA roller burnishing tools consist of a tool body and roller head.

Tool bodies for the RP, RDP, RK and RKA tools come in four sizes: S1 to S4.

The tools are equipped with Morse taper shanks, but cylindrical shanks, shank DIN 69880 (VDI-shank) and shanks for other clamping systems are also available. In addition, the tool body includes a disc spring assembly specifically designed and arranged for each individual machining task.

Roller heads are produced according to the specific workpiece dimensions. The roller head unit is mounted onto the tool body and determines the tool's type.

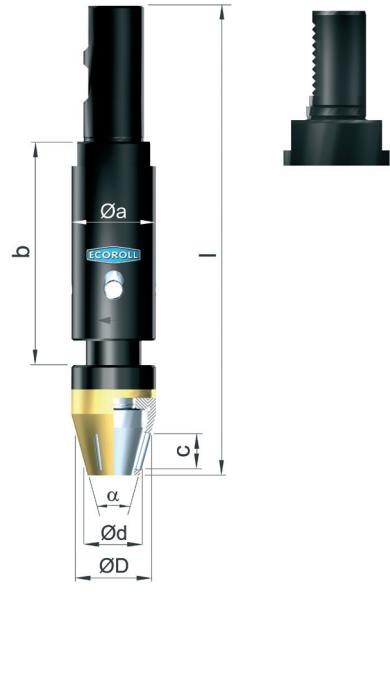
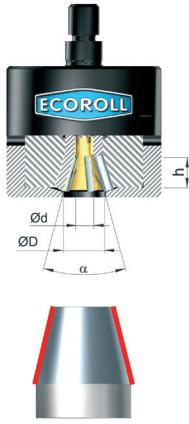
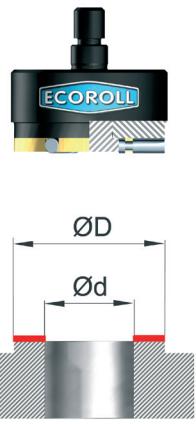
The illustrations on the following page demonstrate both the modular system and the wide variety of combinations available.

Tool Design and Specifications

Available shanks:

Morse taper
DIN 228
MK Cylindrical shank
DIN 1835 B, Form B
ZS Cylindrical shank
DIN 69880
VDI

Available roller heads:



Tool application:

RP
Plane faces

RDP
Plane faces and
cylindrical bores

RKA
External tapered
surfaces

RK
Tapered bore
holes

How to order:

The following table lists the standard dimensions for the tool bodies. Roller head dimensions and suitable tool body size depend on the workpiece dimensions and the material yield strength.

To ensure optimal tool design, please provide a drawing of the workpiece, including material specifications. If drawings are not available, provide the dimensions of the desired roller head and the material yield strength of the part to be burnished.

Tool type **RK-60.6-45.0-30°-S3-MK** Shank
 Diameter **D** Diameter **d** Angle **α** (only for RK, RKA) Tool body

Tool body	a	b	Maximum force	Standard shank
S1	26	66	3.9	MK1
S2	35	92	13.5	MK2
S3	45	107	21.6	MK3
S4	65	135	40.5	MK4

Single Roller Tools

Mechanical Single Roller Tools

ECOROLL's mechanical single roller tools are designed to machine a wide variety of irregular surfaces, including specific contours, fillets, and grooves as well as cylindrical and tapered external surfaces and bores.

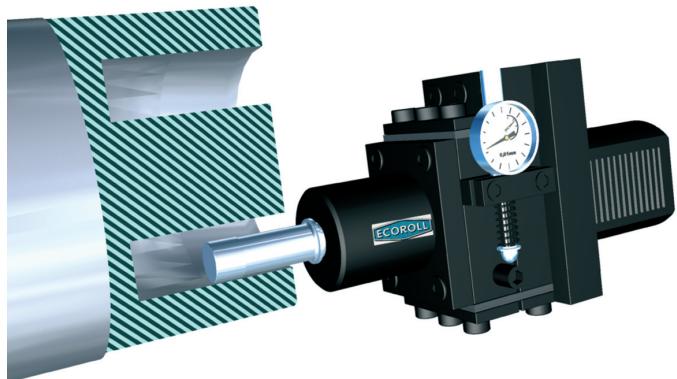
This group of tools includes types EG5, EG14 and EG45.

EG5

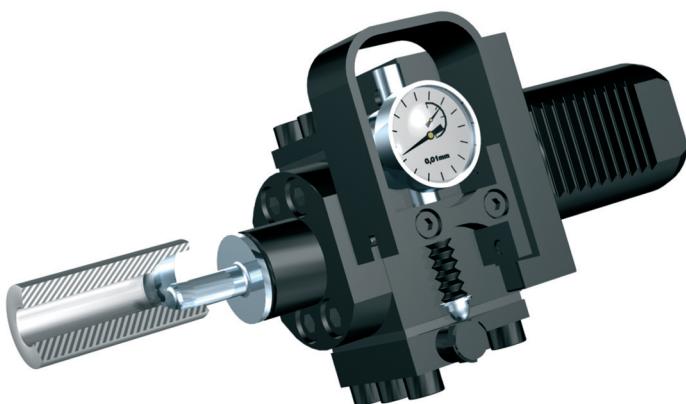


Machining a cylinder rod with a Type EG5 tool.

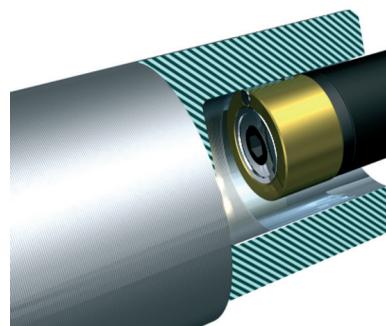
The EG tools consist of a tool body equipped with a tool shank, a spring assembly that allows the head to move with no play and very little friction, and an indicator that indirectly measures the burnishing force.



Machining a circular ring area with an EG5-xxF tool.

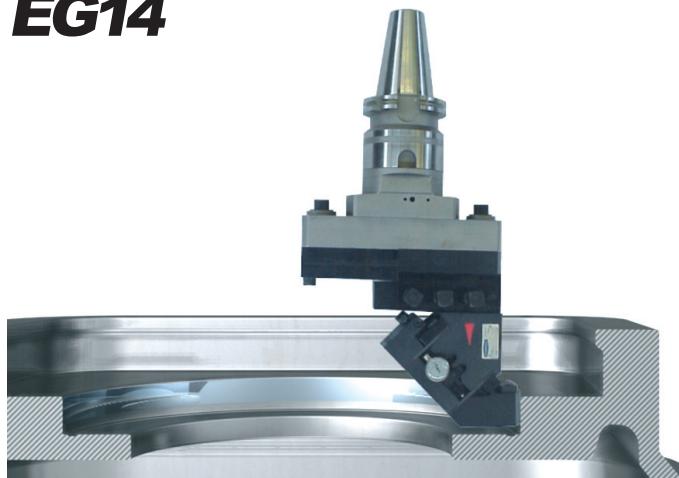


Machining a spherical surface with an EG5-08 tool.



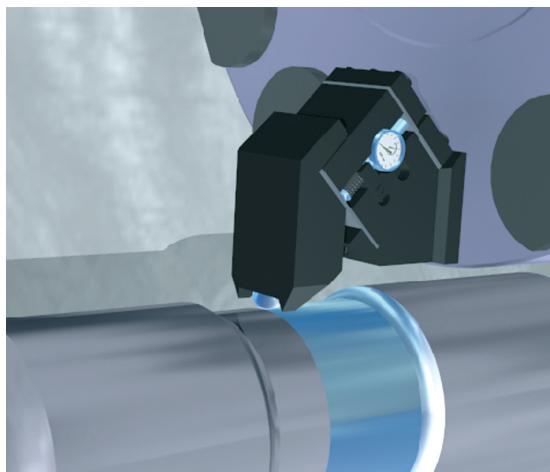
Machining a bore with an EGI-32 tool.

EG14

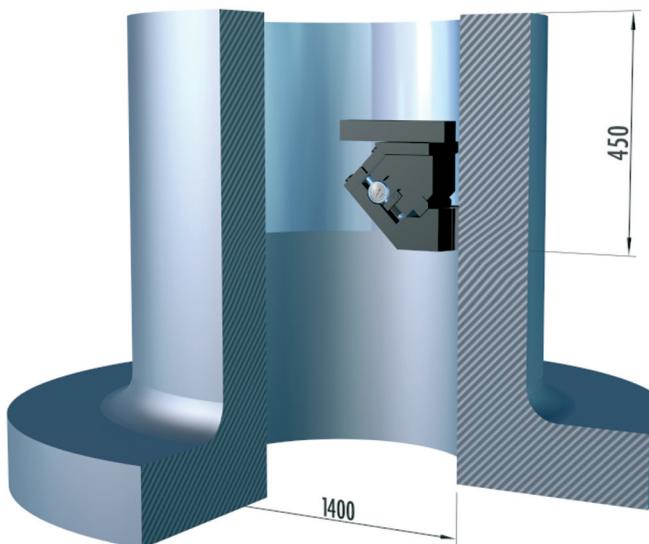


Machining a housing

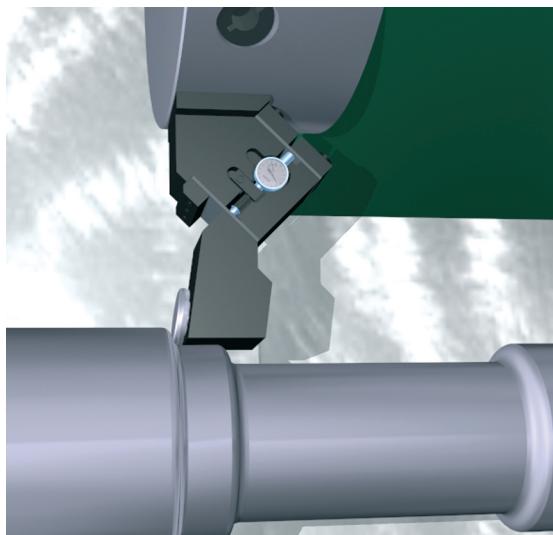
EG45



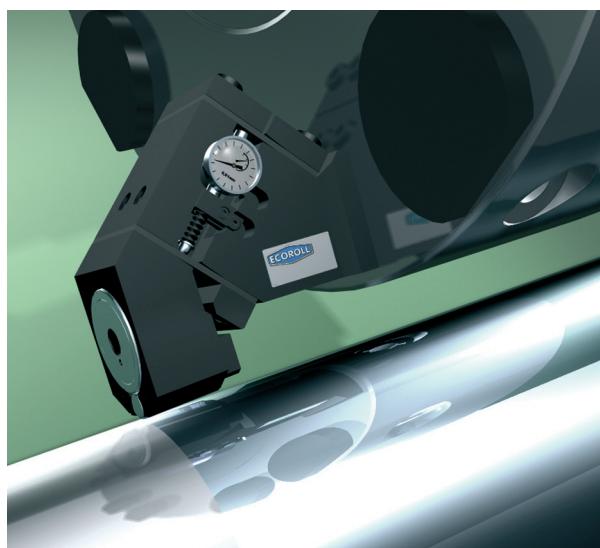
Machining a train axle with an EG45-40M tool.



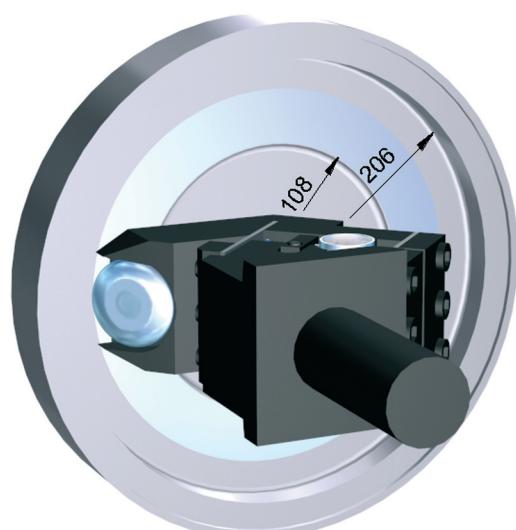
Machining a bearing housing



Machining a train axle with an EG45-45T tool.



Machining a cylinder rod



Machining a flywheel with an EG45-40M tool.

Single Roller Tools

Type EG5 Tool Applications: Cylinders, faces, tapers and bores

Diameters 55 mm and larger

Features

- Roller burnishing of cylindrical and tapered external surfaces, external or internal faces, and cylindrical and tapered bores (specially designed models available for tapers)
- For use with either CNC-controlled or conventional lathes
- Complete processing in one setting
- Achievable surface quality: $R_z < 1 \mu\text{m}$ ($R_a \leq 0.2 \mu\text{m}$)
- Suitable for metals with tensile strength up to 1400 N/mm^2 and maximum hardness $\text{HRC} \leq 45$
- Symmetrical construction allows either right or left hand operation
- Feed in the direction of the arrow label on the tool
- Roller can rotate in either direction

Advantages

- Short cycle time
- Eliminates set-up and auxiliary processing time
- For use with either CNC-controlled or conventional lathes
- No dust or grinding residue
- Minimal lubrication required (oil or emulsion)
- Variable burnishing force dependent on spring deflection
- Accurately measured burnishing force ensures consistent, high quality results
- Unrestricted roller face for roller burnishing shoulders and other edges
- Spring assembly allows roller head to move with no play and very low friction
- Modular construction allows these tools to be used in several configurations
- Easy to change wear parts
- Tool design includes fixed roller clearance angle α

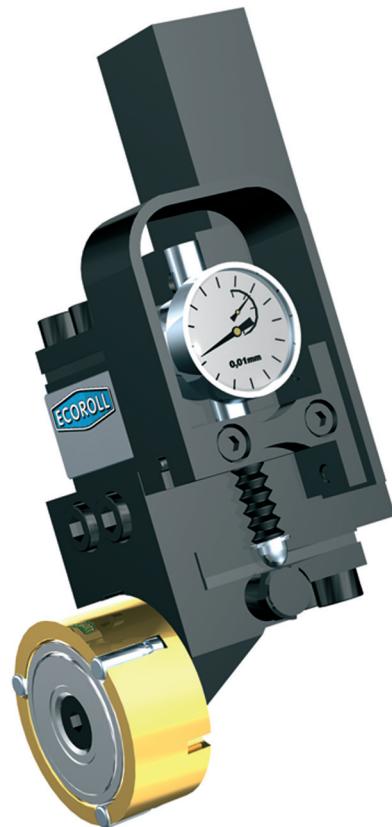
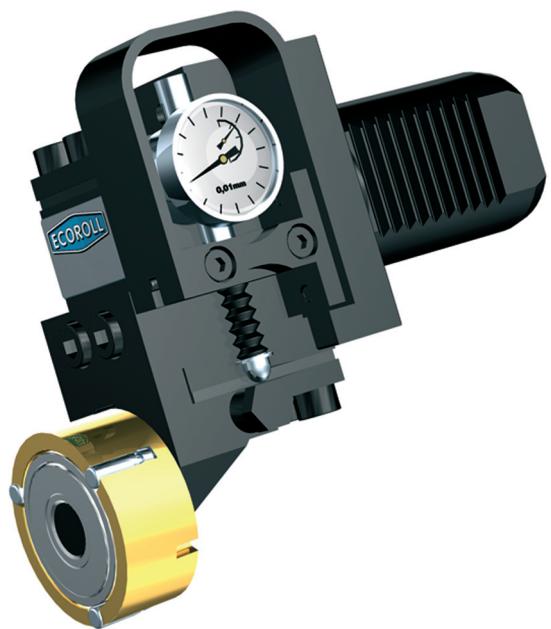
Parameters

- Maximum circumferential speed: 150 m/min.
- Maximum feed rate: 0.6 mm/rev.
- Maximum burnishing force: 3000 N

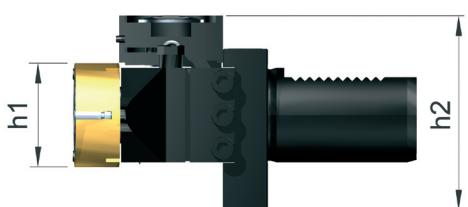
Bore Application

with Design Version 1 (see illustrations, following page)

Bore depth (mm)	≤ 16	> 66
Smallest bore diameter (mm)	55	140



Tool Design and Specifications



Basic tool design

Type EG5 single roller burnishing tools consist of a tool body equipped with a tool shank, a spring assembly that allows the roller head to move with no play and very low friction, and a gauge that indicates the burnishing force as measured by spring deflection. An optional device transmits the values by cable or wireless signal to an external indicator.

The roller head is attached to the flexible, spring-loaded section of the tool body. The roller head consists of a cage, which contains and guides the burnishing roller, and a support roller with a large-scale needle bearing. The cage also contains two spare rollers.

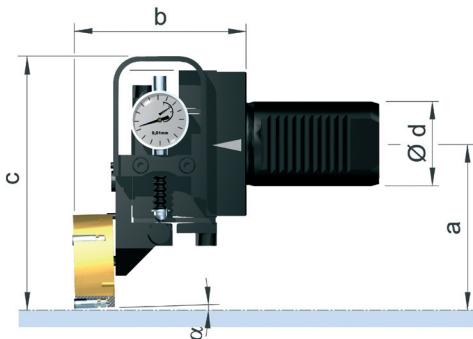
How to order:

Four versions of this tool are available.

Please refer to the following illustrations and table.

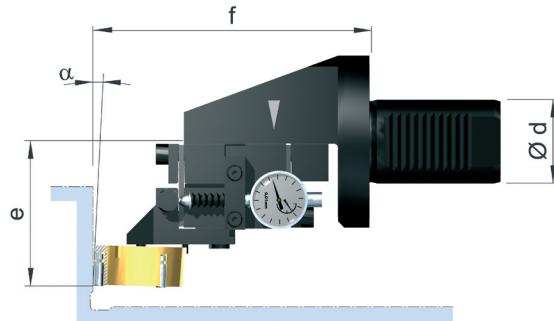
Tool type **EG5-3-VDI30** Shank:
VDI = DIN 69880
SL = square shank

Design version: See illustrations.
Specially designed tools for machining tapers by request.



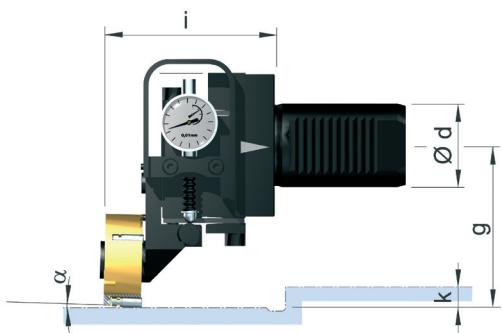
EG5, Design 1

Cylindrical surfaces



EG5, Design 2

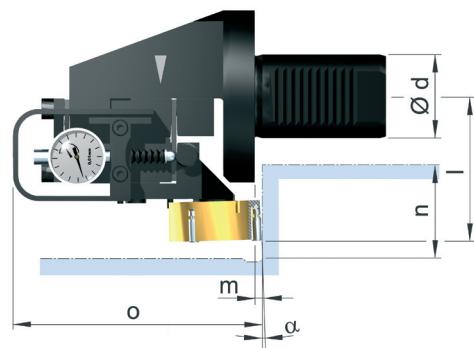
Faces on the chuck side



EG5, Design 3

Cylindrical surfaces

Feed direction: toward tailstock



EG5, Design 4

Faces on the tailstock side

Tool type	VDI shank Ø d ¹⁾ (mm)	Height (mm)		Square shank (mm)	Variable dimensions per design version (mm)								
		a	b		e	f	g	i	k	l	m	n	o
EG5	20	45	67	16	78	82	120	64	111	78	84	10	84
	30		77	20				69				3	44
	40		82	25				112				120	

NOTE: 1) Optional sizes

Single Roller Tools

Type EG5 Tool Applications: Contours, fillets, groove flanks, short bores

Diameters 8.5 mm and larger

Features

- For use with either CNC-controlled or conventional lathes
- Complete processing in one setting
- Achievable surface quality: $R_z < 1 \mu\text{m}$ ($R_a = 0.2 \mu\text{m}$)
- Suitable for metals with tensile strength up to 1400 N/mm² and maximum hardness HRC ≤ 45
- Modular construction allows these tools to be used in several configurations
- Symmetrical construction allows either right- or left-hand operation
- Rotates in either direction

Advantages

- Short cycle time
- Eliminates set-up and auxiliary processing time
- No dust or grinding residue
- Minimal lubrication required (oil or emulsion)
- Accurately measured burnishing force ensures consistent, high quality results
- Unrestricted roller face makes roller burnishing of shoulders and other edges possible
- Easy to change wear parts

Basic tool design

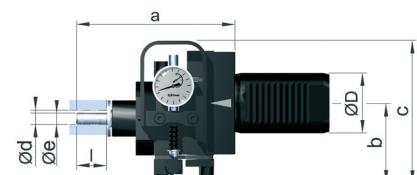
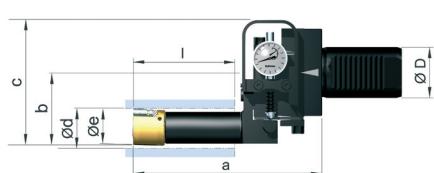
- Tool body equipped with a tool shank, a spring assembly that allows the roller head to move with no play and very low friction
- Gauge that indicates the burnishing force
- Variable burnishing force dependent on spring deflection
- Feed in the direction of the arrow label on the tool
- Tool design includes fixed roller clearance angle α

Parameters

Tool	Circumferential speed	Feed rate
EG5-08F	80-100 m/min.	0.1-0.4 mm/ rev.
EGI5-32	80-150 m/min.	0.1-0.6 mm/rev.
EGI5		
EG5-40M	100-200 m/min.	0.1-0.8 mm/rev.
EG5-40M-45°		

EG5-08F

- Roller burnishes groove flanks on the face or circumference and bores with diameters of 8.5 mm and larger
- Max. rolling depth: 20 mm for diameters of 8.5 mm and larger (EG5-08F)
- Max. rolling depth: 30 mm for diameters of 11.5 mm and larger (EG5-11F)
- Tool body's spring assembly positioned parallel to workpiece surface
- Floating roller head attached to the tool body's flexible, spring-loaded section



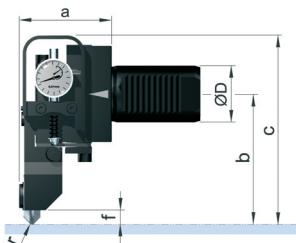
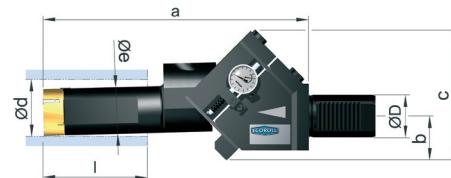
EGI5-32

- Roller burnishes bores with diameters of 32 mm and larger
- Maximum rolling length: 80 mm
- Tool body's spring assembly positioned parallel to workpiece surface
- Roller head attached to the tool body's flexible, spring-loaded section
- Roller head consists of a cage that guides the burnishing roller and a support roller with a large-scale needle bearing

Tool Design and Specifications

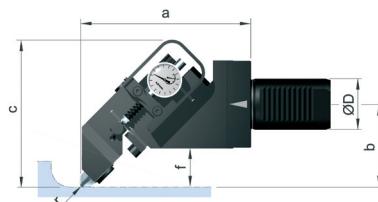
EGI5

- Roller burnishes bores with diameters of 55 mm and larger
- Maximum rolling length: 105 mm
- Tool body's spring assembly positioned at a 45° angle to workpiece surface
- Roller head attached to the tool body's flexible, spring-loaded section
- Roller head consists of a cage that guides the burnishing roller and a support roller with a large-scale needle bearing
- Cage also contains two spare rollers



EG5-40M

- Roller burnishes contoured external surfaces
- For low and mid-level strength materials
- Tool body's spring assembly positioned parallel to workpiece surface
- Roller head attached to the tool body's flexible, spring-loaded section
- Extremely narrow roller with an integrated four-point bearing



EG5-40M-45°

- Roller burnishes cylindrical surfaces with connecting fillet radii up to the workpiece face
- For low and mid-level strength materials
- Tool body's spring assembly positioned at a 45° angle to workpiece surface
- Roller head attached to the tool body's flexible, spring-loaded section
- Extremely narrow roller with an integrated four-point bearing



Tool type	VDI shank Ø D (mm)	Height (mm)		Square shank (mm)	Basic dimensions (mm)						
		h ₁	h ₂		a	b	c	d	e	f	
EG5-08F	20,30,40	40	67-91	20 25 32	106	53	95	8.5/11.5	8/11	20/30	
	50				117						
EGI5-32	20,30,40				150	58	99	32	24	80	
	50				161						
EGI5	30, 40	63	81-90	252	41	122	55	44	100		
	50									f	
EG5-40M	20,30,40	50	67-91		66	92	134			10	
	50				77						
EG5-40M-45°	20,30,40			136 147	65	115				30	
	50										

Single Roller Tools

Type EG14 Tool Applications: External surfaces and bores, cylindrical and tapered

Diameters 120 mm and larger

Features

- Machines cylindrical and tapered external surfaces, external or internal faces, and cylindrical and tapered bores (specially designed models available for tapers)
- For use with either CNC-controlled or conventional lathes
- Complete processing in one setting
- Achievable surface quality: $R_z < 1 \mu\text{m}$ ($R_a \leq 0.2 \mu\text{m}$)
- Suitable for metals with tensile strength up to 1400 N/mm² and maximum hardness HRC ≤ 45
- Modular construction allows these tools to be used in several configurations
- Symmetrical construction allows either right- or left-hand operation
- Rotates in either direction
- Tool design includes fixed roller clearance angle α



Advantages

- Short cycle time
- No auxiliary processing time necessary
- No dust or grinding residue
- Minimal lubrication required (oil or emulsion)
- Infinitely variable burnishing force
- Accurately measured burnishing force ensures consistent, high quality results
- Unrestricted roller face makes roller burnishing of shoulders and other edges possible
- Easy to change wear parts



Parameters

- Maximum circumferential speed: 200 m/min.
- Maximum feed rate: 1 mm/rev.

NOTE: Feed in the direction of the arrow label on the tool (see tools, following page)

- Maximum burnishing force: 10,000 N

Bore Application

with Design Version 1 (see illustrations, following page)

Bore depth (mm)	≤ 25	≤ 50	> 50
Smallest bore diameter (mm)	120	150	180

Tool Design and Specifications



Basic tool design

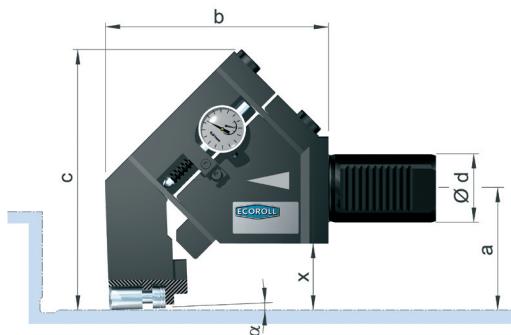
Type EG14 single roller burnishing tools consist of a tool body equipped with a tool shank, a spring assembly that allows the roller head to move with no play and very low friction, and a gauge that indicates the burnishing force as measured by spring deflection. An optional device transmits the values by cable or wireless signal to an external indicator.

The roller head is attached to the flexible, spring-loaded section of the tool body. The roller head consists of a cage, which contains and guides the burnishing roller, and a support roller with a large-scale needle bearing.

How to order:

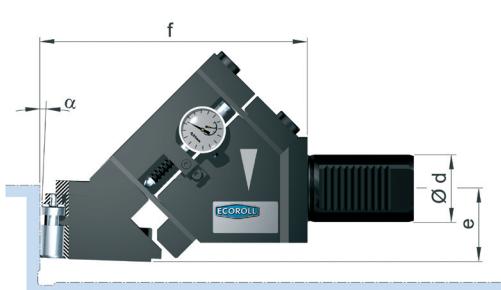
Four versions of this tool are available. Please refer to the following illustrations and table.

Tool type **EG14-1-VDI50** Shank:
VDI = DIN 69880, double toothed
SL = square shank
Specially designed shanks by request



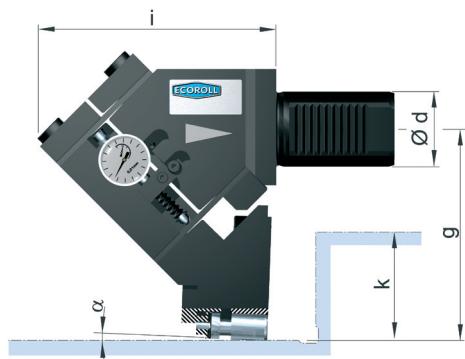
EG14, Design 1

Cylindrical surfaces



EG14, Design 2

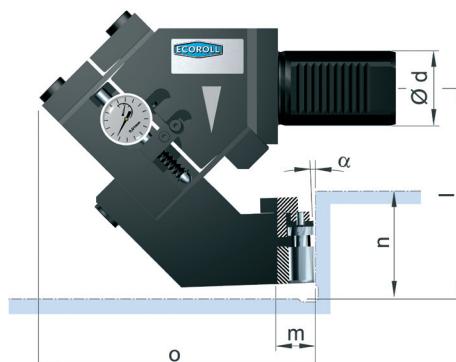
Faces on the chuck side



EG14, Design 3

Cylindrical surfaces

Feed direction: toward tailstock



EG14, Design 4

Faces on the tailstock side

Tool type	VDI shank Ø d ¹⁾ (mm)	Height (mm)		Square shank (mm)	Variable dimensions per design version (mm)											
		a	b		c	x	e	f	g	i	k	l	m	n	o	
EG14	40	63	81	25 or 32	71	131	152	43	40	159	113	127	50	106	20	147
	50		90						45							
	60		110						50	166		124		13		

NOTE: 1) Optional sizes

Single Roller Tools

Type EG45 Tool Applications: Filletts and contours

Features

- For use with either CNC-controlled or conventional lathes that can copy contours
- Complete processing in one setting
- Suitable for metals with tensile strength up to 1400 N/mm^2 and maximum hardness HRC ≤ 45
- Achievable surface quality: $R_z < 1 \mu\text{m}$ ($R_a = 0.2 \mu\text{m}$)

EG45-40M

- Roller burnishes cylindrical surfaces with connecting fillet radii up to the workpiece face
- For materials with low to mid-level strength

EG45-45T

- Roller burnishes cylinders and faces in addition to connecting fillets up to a 75° inclination
- High burnishing force can machine high-strength materials

EG45-45F

- Roller burnishes convex and concave forms with a floating roller head specially adapted to the workpiece
- Operates in plunge-in or feed mode

Advantages

- Simultaneously eliminates micro-notches and induces residual compressive stresses through cold working
- Short cycle time
- Eliminates set-up and auxiliary processing time
- No dust or grinding residue
- Minimal lubrication required (oil or emulsion)
- Infinitely variable burnishing force
- Accurately measured burnishing force ensures consistent, high quality results
- Easy to change wear parts

Parameters

- Maximum circumferential speed: 300 m/min.
- Maximum feed rate: 1 mm/rev.

Radius Application

Tool type	Workpiece radius R to be burnished with roller radius r (mm)					
	0.8	1.2	1.6	2.5	4	6.3
EG45-40M	0.8 - 3	1.2 - 5	2.5 - 8	4 - 12	6 - 40	
EG45-45T	0.8 - 3	1.2 - 5	2-8	3 - 12	5 - 20	8 - 63
EG45-45F	Rollers specially designed according to workpiece shape.					

Tool Application Ranges

Yield strength $R_p 0.2 \text{ N/mm}^2$	≤ 160	≤ 250	≤ 400	≤ 630	≤ 1000
Workpiece $\varnothing \leq 25 \text{ mm}$	EG45-45T EG45-45F EG45-40M				EG45-45T EG45-45F
Workpiece $\varnothing \leq 100 \text{ mm}$	EG45-45T EG45-45F EG45-40M			EG45-45T EG45-45F	
Workpiece $\varnothing \leq 160 \text{ mm}$	EG45-45T EG45-45F EG45-40M		EG45-45T EG45-45F		
Workpiece $\varnothing \leq 250 \text{ mm}$	EG45-45T EG45-45F EG45-40M	EG45-45T EG45-45F			



EG45-40M



EG45-45T

Tool Design and Specifications



Basic tool design

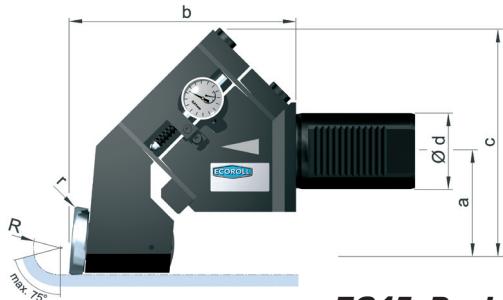
Type EG45 single roller burnishing tools consist of a tool body equipped with a tool shank, a spring assembly that allows the roller head to move with no play and very low friction, and a dial indicator that indirectly measures the burnishing force.

The roller head is attached to the flexible, spring-loaded section of the tool body. EG45-45T and -45F are equipped with floating rollers, and EG45-40M comes with a smaller roller. Because of its structure, EG45-40M has a lower load capacity.

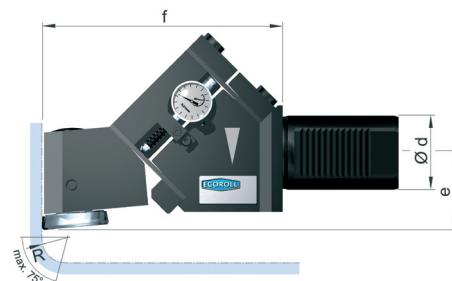
How to order:

Four versions of this tool are available. Please refer to the following illustrations and table.

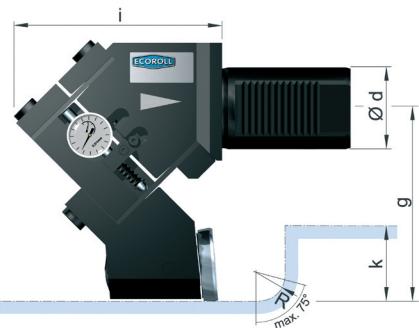
Tool type: Single roller burnishing tool with a spring system loaded at a 45° angle
EG45-1-40M-R2.5-VDI50
 Design version: see illustrations Shank VDI 50,
 SL=square shank
 Roller diameter and design Roller with radius of 2.5 mm



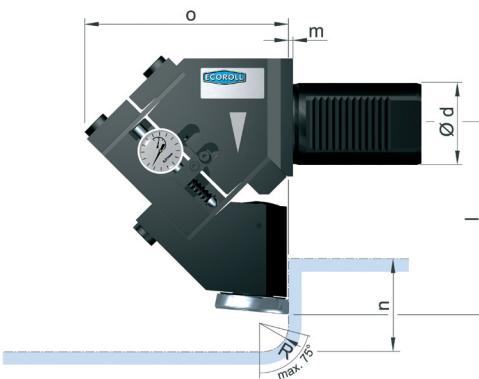
EG45, Design 1
Cylindrical surfaces, including adjacent fillets



EG45, Design 2
Faces on the chuck side, including adjacent fillets



EG45, Design 3
Cylindrical surfaces, including adjacent fillets
Feed direction: toward tailstock



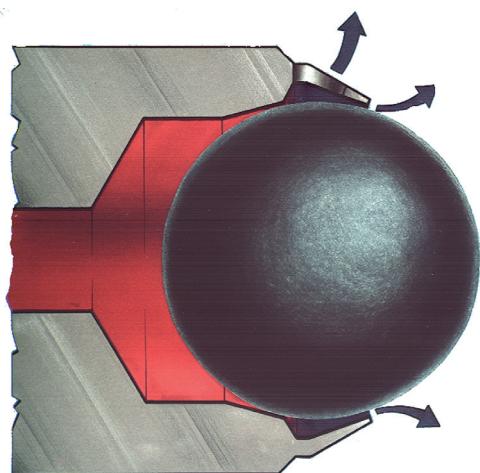
EG45, Design 4
Faces on the tailstock side, including adjacent fillets

Tool type	VDI shank Ø d (mm)	Height (mm)		Square shank (mm)	Variable dimensions per design version (mm)											
					1		2		3		4					
		h ₁	h ₂		a	b	c	e	f	g	i	k	l	m	n	o
EG45-45T	40,50	63	81-110	25 or 32	81	149	162	52	163	118	127	48	116	3	72	124
	60					156			170		134					
EG45-40M	40,50	69	129	150						108	126	134				
	60				136											

Hydrostatic Tools

Hydrostatic Tools

ECOROLL's hydrostatic HG tools can roller burnish and deep roll even the most complex contours and free-form surfaces. The HG tools can be applied with CNC-controlled lathes, drills, milling machines and machining centers as well as with manually controlled machines. HG tools can process materials up to a hardness of 65 HRC.



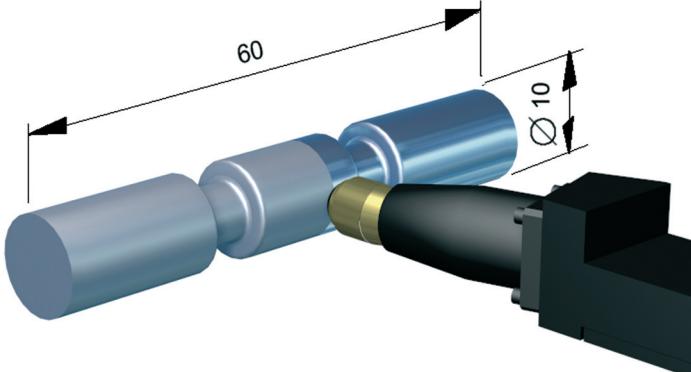
HG burnishing ball and ball retainer;
arrows signify direction of fluid leakage

This group of tools includes types HG2 – HG25.

The unique HG tool design is based on a burnishing ball made of an especially hard material. This ball is hydrostatically suspended by pressurized liquid, either water soluble coolant or oil. The ECOROLL HGP line of pumps supply the tools with a consistent, controllable source of operating pressure. This pressure generates the burnishing force that is applied as the ball rotates against the workpiece surface.



Deep rolling a valve with an HG6 tool
to improve its fatigue strength.



Machining a control valve piston with an HG6 tool to optimize sliding performance.



Machining a ball stud with an HG6 tool.

Type HG Tool Applications: Complex contours and deep rolling



Machining a hard, contoured mandrel with an HG6 tool eliminates manual polishing.

The hydrostatic bearing maintains a supporting fluid film between the ball and the ball seat, independent of the distance between the tool and the workpiece.

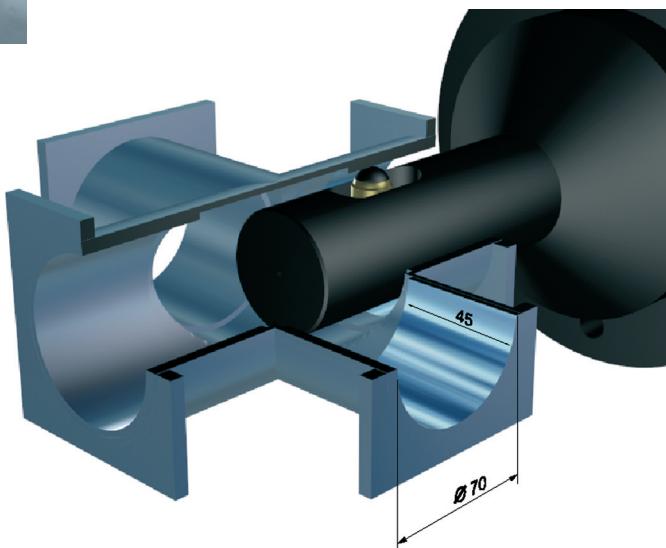
The HG tool's unique following system enables the burnishing ball to follow the workpiece contour while maintaining a constant burnishing force.



Roller burnishing a torque converter housing with an HG13 tool to improve its sliding properties.

The ECOROLL HG tools can often machine complex shapes that standard roller burnishing tools cannot.

The hydrostatically loaded ball can freely rotate in any direction within the ball retainer, even at high speed.



Machining a valve housing with an HG13 tool.

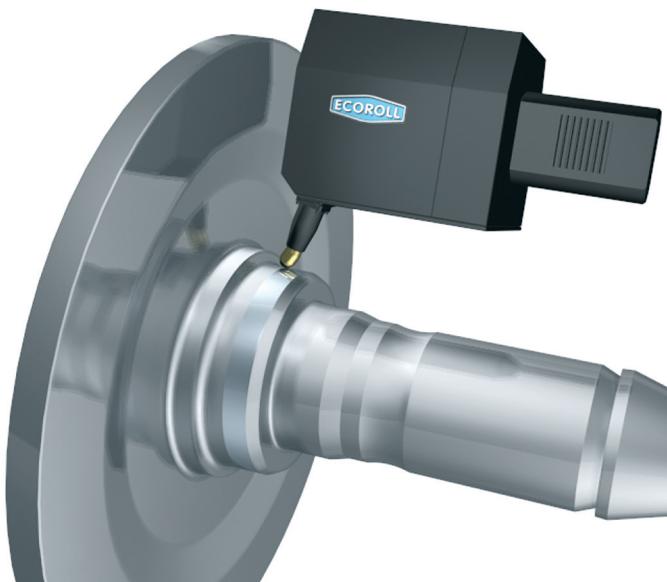
Deep rolling with HG tools dramatically increases the fatigue strength and operating life of dynamically loaded parts and components constructed of lightweight materials.

The process induces residual compressive stresses in the component's surface layer and simultaneously improves the material's strength and surface finish through plastic deformation, or cold working.

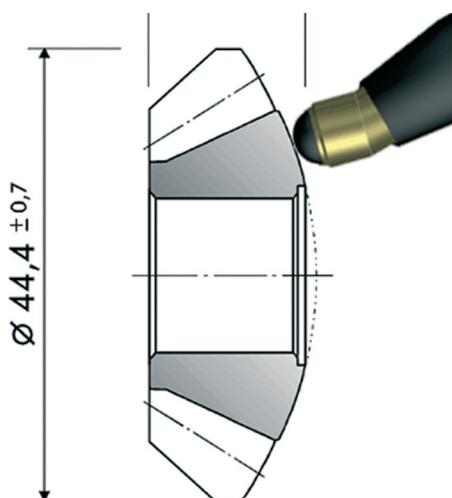
Hydrostatic Tools

Type HG Tool Applications: Hard roller burnishing

With the exception of HG2 and HG25, the entire HG tool line can burnish hardened steel and other alloys with hardnesses up to 65 HRC.

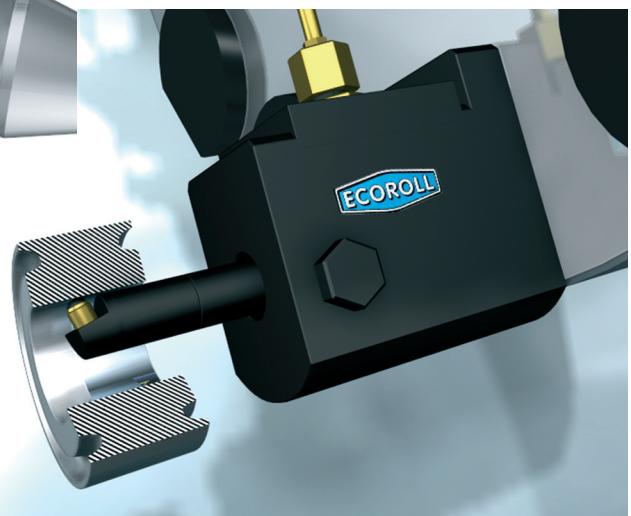


Deep rolling the fillet radius of an axle shaft to increase fatigue strength.



Machining a bevel gear with an HG6 tool.

Using the HG line of tools reduces overall machining costs. One HG tool can be used for multiple applications.



Hard rolling a roller rocker arm with an HG6 tool eliminates an extra lapping operation.

How to order:

HG tools are available in a wide variety of versions. Please refer to the information on page 35 and the naming conventions listed on the following page.

Tool type and ball size	HG13-9-L-15°-SLK-25
Design version	L = left-handed R = right-handed
Setting angle α	VDI = VDI shank SL = square shank SLK = short square shank (tool holder DIN 89880)
Shank size	

Tool type and ball size	HG6-5-E-90°-VDI20-Sauter
Design version	E = one burnishing element Z = two burnishing elements
Setting angle α	VDI = VDI shank SL = square shank SLK = short square shank (tool holder DIN 89880)
Turret head manufacturer (only HGx-5 and HGx-6)	

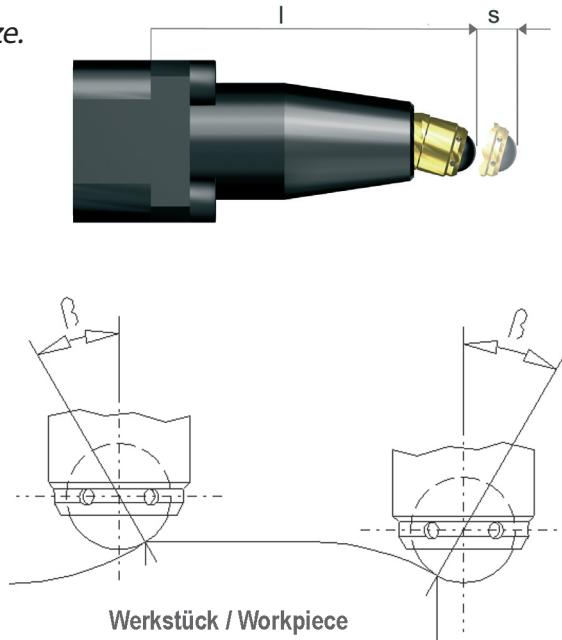
Hydrostatic Tool Design and Specifications

Ball size

The HG line features tools in a wide range of sizes with burnishing balls from 2 – 25 mm in diameter. The tools are classified according to approximate ball size. For example, the diameter of a ball in an HG6 tool is in the 6 mm range. To maximize the level of compressive residual stresses, use the tool with the largest possible ball diameter.

NOTE: Workpiece contours ultimately determine ball size.

HG ball size	Max. burnishing force	Max. angle range (β)	Stroke (s)	Length (l)
HG2	90N	$\pm 22.5^\circ$	2 mm	35 mm
HG3	250N	$\pm 22.5^\circ$	4 mm	42 mm
HG4	500N	$\pm 30^\circ$	5 mm	50 mm
HG6	1000N	$\pm 30^\circ$	6 mm	50 mm
HG13	4000N	$\pm 35^\circ$	8.5 mm	69 mm
HG25	4000N	$\pm 30^\circ$	8.5 mm	82 mm



Design version

Because HG tools can be used across a wide spectrum of applications, many different design versions are available. HG tools are classified by design version in addition to ball size. For example, an HG6-2 tool has a ball with a 6 mm diameter and is used for burnishing inner diameters. The following table lists the design versions and their related applications.

NOTE: The tools are listed as follows: HGx-y, where **x** indicates the ball size and **y** the design version.

HG design version	Application
HGx-1	internal diameters (cylindrical and tapered bores)
HGx-2	internal diameters (cylindrical bores)
HGx-4	internal diameters (narrow cylindrical bores)
HGx-5	complex contours (cylinders, tapers, faces, fillets, spheres)
HGx-6	spherical contours
HGx-7	faces and free-form surfaces
HGx-9	rotationally symmetrical surfaces (cylinders, tapers, faces, fillets, spheres)
HGx-10	spherical contours
HGx-11	special tool design versions (e.g. internal diameters – narrow cylindrical bores)
HGx-19	rotationally symmetrical surfaces (cylinders, tapers, faces, radii, slanted faces and other outer and inner contours)
HGx-20	3-point tool (3 burnishing balls), outer diameters of narrow cylinders
HGx-23	Complex external surfaces (such as transition area near steering knuckle radius)
HGx-29	2-point tool (2 burnishing balls), treats both sides of disc-like and thin-walled components (such as turbine blades) in one pass

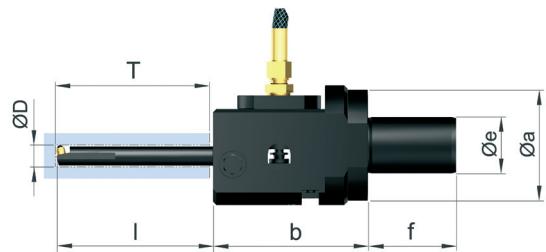
Hydrostatic Tools

Design Versions HGx-1, HGx-2, HGx-4, HGx-11

Application: Internal diameters

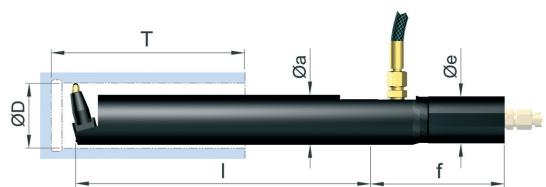
HGx-1

- For bore sizes ≥ 19 mm
- Available with burnishing balls up to 6 mm in diameter
- For use with lathes, boring mills and machining centers
- Available with rotating union DD for rotating applications (see page 37)
- Ball insert, mounted at the end of a lever, operated by the tool body's tracking system
- Initial diameter setting: adjust machine slide into approximate radial position
- Tracking system automatically fine-tunes diameter setting



HGx-2

- For bore sizes ≥ 70 mm (HG6-2) and ≥ 125 mm (HG13-2)
- Similar to previous tools, but shank diameter = 50 mm
- Rigid shank allows rolling lengths of up to 800 mm
- Equipped with standard burnishing elements



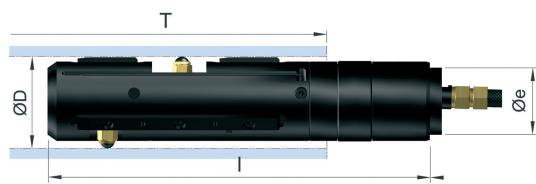
HGx-2P

- Available only with 6mm burnishing balls (HG6)
- For internal roller burnishing of narrow bores (similar to a boring bar)
- For use with boring bar holders on both conventional and CNC-controlled lathes
- Shank includes two clamping faces
- Maximum rolling length: 350 mm



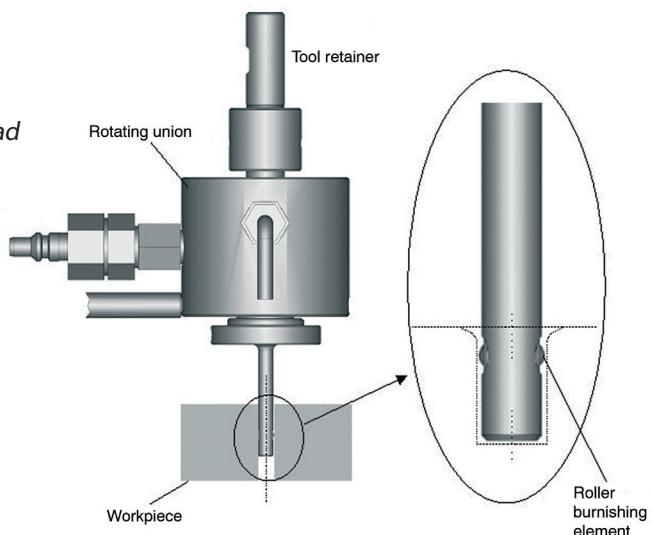
HGx-4

- For bore sizes 50 - 150 mm
- For use with deep hole boring machines
- Mounted on boring bar with standard BTA thread connection
- Unlimited rolling length
- Guide pads center the tool in the bore (approximate position)
- Allowable bore size variation: 2 mm



HGx-11 (Special version)

- For internal diameters (holes)
- Diameter sizes 6 - 33 mm
- Each diameter size requires a customized rolling head



How to order:

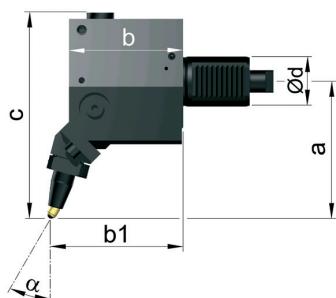
HG tools are available in many versions.

Please refer to the the information on page 35 and the following naming conventions.

Tool type and ball size	HG13-9-L-15°-SLK-25		
Design version	L = left-handed	Setting angle α	Shank size
R = right-handed	VDI = VDI shank	SL = square shank	SLK = short square shank (tool holder DIN 89880)
K = ball (HGx-6)			
H = fillet (HGx-6)			

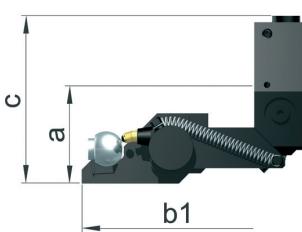
Design Versions HGx-5, HGx-6, HGx-9, HGx-10, HGx-19

Applications: Rotationally symmetrical surfaces and complex contours



HGX-5

- Applied on CNC-controlled lathes equipped with tool drive systems
- Integrated high pressure pump eliminates the need for external pressure supply
- Simply insert the tool into the turret head and it is ready for operation
- Can be equipped with VDI-shanks (with diameters of 20 - 80 mm) for all conventional drive systems
- Symmetrical design and double-toothed shank allows right- or left-handed use



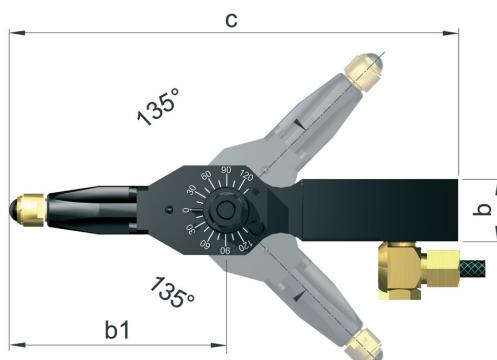
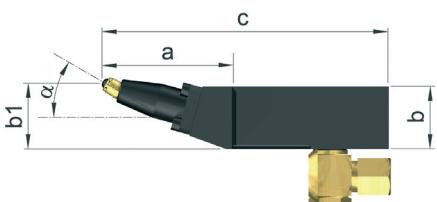
HGX-6

- Similar to HGx-5, but with swiveling burnishing element for burnishing balls and rounded surfaces
- Integrated high pressure pump eliminates the need for external pressure supply
- HG13-6R roller burnishes fillets



HGX-9

- For use with conventional and CNC-controlled lathes
- Shank heights from 20 - 32 mm
- Both right- and left-handed tools available
- Setting angle range: 0 - 90° in 15° increments
- Pressure supplied through the shank either from the side or the rear
- HG2-9 for deep rolling only, comes with an integrated square shank, but adapters for mounting with standard square shanks are available



HGX-10

- Recommended for use with conventional and CNC-controlled lathes
- Designed to roller burnish spherical contours and fillets
- Swivelling device permits continuous adjustment of the inclination during the process
- Both right- and left-handed tools available with standardized square shank heights for standard tool-holding fixtures



HGX-19

- For roller burnishing and deep rolling hard materials up to 65 HRC
- Can machine all rotationally symmetrical and free-form surfaces
- Hydraulically generated burnishing force can be accurately measured and controlled, ensuring consistent, high quality results
- Equipped with VDI shank, cylindrical shank, HSK shank or Capto shank



Hydrostatic Tools

Design Versions HGx-7, HGx-20, HGx-23, HGx-29 Applications: Faces, free-form surfaces and outer diameters

HGx-7

- For roller burnishing and deep rolling faces and free form surfaces on machining centres and milling machines
- For materials up to 65 HRC
- Complex shapes that cannot be machined with conventional roller burnishing tools can be treated with hydrostatic tools
- Integrated high pressure pump eliminates the need for external pressure supply



HG4-7



Free form surface

HGx-20

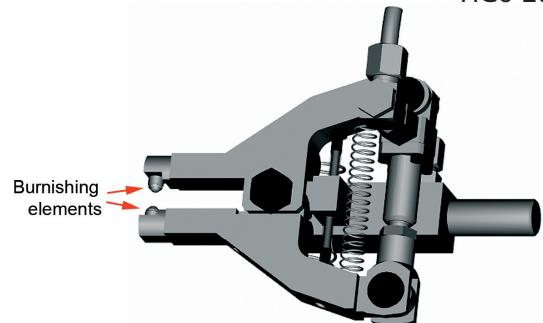
- For roller burnishing and deep rolling the outer surfaces of thin cylinders (with diameters ≥ 0.5 mm)
- Integrated supports and two fixed burnishing elements prevent the workpiece from bending, while a third burnishing element deep rolls the surface
- Consistent product quality is ensured: the burnishing force depends on an outside pressure source that can be closely measured and monitored
- Equipped with three hydrostatically loaded roller burnishing balls
- Tool comes with a square shank, but other tool shanks are available



HG6-20

HGx-23 (not pictured)

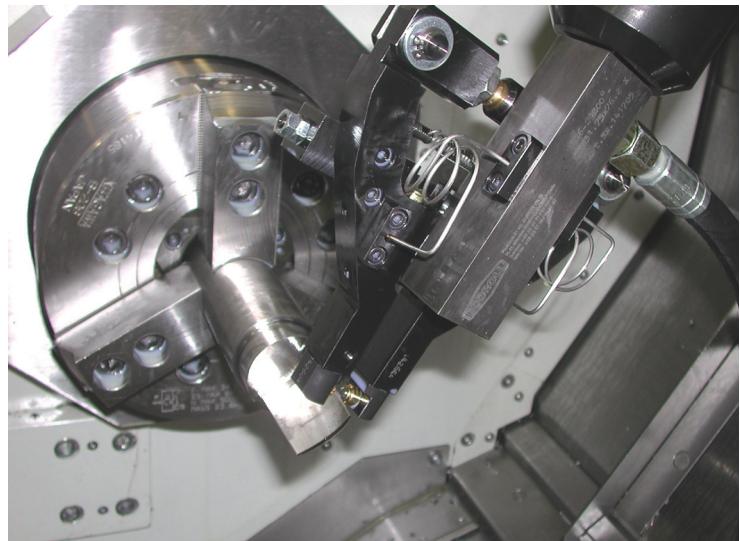
- Specially designed to machine the outer contours of axles
- The workpiece remains static while the burnishing element rotates
- For materials up to 65 HRC
- Consistent product quality is ensured: the burnishing force depends on an outside pressure source that can be closely measured and monitored



HG6-29

HGx-29

- Designed to treat both sides of disc-like and thin-walled components such as turbine blades in one pass
- Can be used with both conventional and CNC-controlled machine tools
- Processes hardened materials up to a hardness of 65 HRC
- Consistent product quality is ensured: the burnishing force depends on an outside pressure source that can be closely measured and monitored
- Equipped with a cylindrical shank, but other standard tool shanks are available



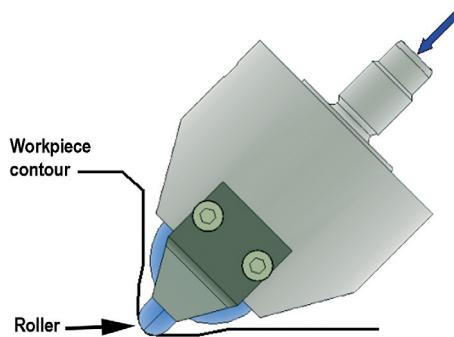
Festwalzen mit HG6-20

Design Version HG with HFR Roller Application: Deep rolling fillets



Features

- Deep rolls small, hard-to-reach fillets ($R < 2.5$ mm)
- Deep rolls hardened workpieces up to 65 HRC
- Deep rolls in a plunge-in process with rolling forces up to 15 kN
- Operating pressure: 200 - 1500 bar



Advantages

- Noticeable increase in fatigue strength
- Improved surface quality
- Machining can be completed in one setting
- Extra hardening process unnecessary

How to order HG tools

The tools are listed as follows: HGx-y, where **x** indicates the ball size and **y** the design version. See also the naming conventions on pages 30 and 31. The lettered dimensions refer to the diagrams pictured with the respective tools.

Tool	Diameter range D	Rolling length T	a	b	$\varnothing e$	f	I
HG6-1	≥ 19	50/80/125	106	131/161/206	40 ¹⁾	136	60/90/135
HG6-2	≥ 70	200/400/600/800	53		50	145	T+40
HG6-2P	≥ 40	200/300	38		40	120	200/350
HG13-2	≥ 125	800	60		63	90	1000
HG13-4	≥ 50	unlimited	49		BTA boring bar thread lead per order		260

NOTES: 1) With design version DD (rotating union) maximum shank $\varnothing = 32$ mm

Tool	Ball D	Fillet R	a	b ²⁾	b ₁ ²⁾	c	d	h	Contact angle α
HG2-9E45°-SL		> 2.5	57	32	61	205		20	45°
HG2-9V70°-SL			68		72	216		25	10° or 80°
HG3-9E45°-SL		> 4	69		73	217		32	45°
HG3-9V70°-SL			80		84	228			10° or 80°
HG6-9_-SL(K)		> 5	66		33	216(148)			30 ³⁾
HG13-9_-SL(K)		> 10	80		96	228(160)			adjust in 15° increments
HG6-9E270-SL(K)		> 5			90	276(208)			
HG13-9E270-SL(K)		> 10			111	298(230)			
HG6-5_-VDI		> 5	100		89	142	20 or 30	50	30 ³⁾
HG6-5_-VDI		> 5	109		91	109	40 or 50	85 or 100	
HG13-5_-VDI		> 10	128			162	60 or 80	125 or 160	
HG6-6_-VDI	8-25			by request		20 or 30	50	infinitely variable	
HG6-6_-VDI40		8-70			40	85			
HG13-6_-VDI		50-250	20-80		40/50/60	by request			

NOTES: 2) For operation without VDI shank other values apply. Please ask ECOROLL.

3) Adapters can be converted to accommodate setting angles of 0°, 60° and 90°. Please request modified dimensions.

Hydrostatic Tools

Accessories for Type HG Tools: Type HGP High Pressure Pumps

HGP hydraulic pump units provide pressure to the HG "ballpoint" type hydrostatic tools or to other tools without integrated pumps.

Using the pump unit can prevent rounded workpiece edges in the areas where burnishing begins or ends. The unit gradually increases and decreases the rolling pressure. During deep rolling the unit can be used to create smooth transitions to unburnished areas.

- Can be used with conventional lathes, machining centers, and CNC-controlled lathes without tool drives
- Portable or fixed versions available
- The pump runs with a standard three-phase motor; single phase motors available by request
- On CNC-controlled lathes the M-function can activate the pump and control pressure supplied to the tool

How to order:

Pump type: see below

HGP3.0 — Pump design: see below



HGP 3.0



HGP 3.7

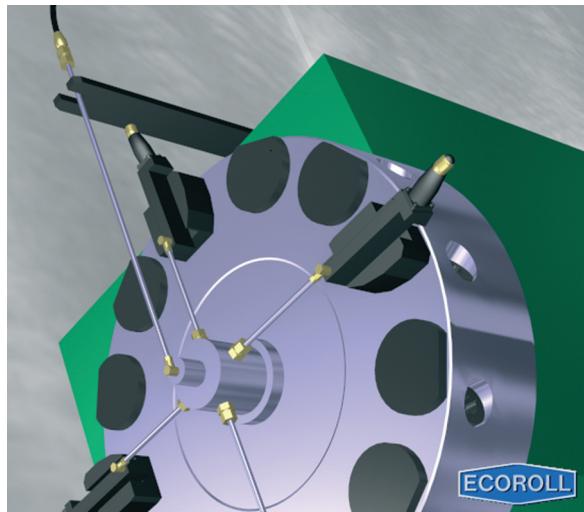
Pump type	Maximum Pressure (bar)	Maximum burnishing elements (HG tool)				
		HG2	HG3	HG6	HG13	HG25
HGP3	200	12	10	8	6	6
HGP4	400	5	4	3	2	2

Pump Design	Description
.0	Portable (by hand), direct start/stop controls, pressure build-up without delay, no switch box
.2	Portable (on a cart), roller burnishing and deep rolling with pressure accumulator(s) and solenoid valve, CNC control with M-function or with manual control cable, includes switch box
.3	Integrated into the machine's coolant tank, roller burnishing and deep rolling without pressure accumulator, CNC control with M-function, no switch box
.4	Integrated into the machine's coolant tank, roller burnishing and deep rolling with pressure accumulator(s) and solenoid valve, CNC control with M-function, no switch box
.5	Portable (on a cart), roller burnishing and deep rolling with pressure accumulators and solenoid valve, CNC control with M-function or with manual control cable, includes switch box
.7	Portable (on a cart), roller burnishing and deep rolling without pressure accumulator, CNC control with M-function or with manual control cable, no switch box

Accessories for Type HG Tools: Integrated High Pressure Pump

- Standard for HGx-5, HGx-6, HGx-7
- For use with CNC-controlled lathes equipped with tool drive systems and standard DIN 69880 tool mounts (VDI shank) with diameters of 20 - 80 mm
- Coolant (under low pressure) supplied through the turret head
- Tool drive system activates the pump
- Clockwise or counter-clockwise rotation
- Maximum speed of 3000 rpm
- Built-in pressure relief valve limits the maximum pressure to 400 bar
- Available pressure gauge for adjusting buffing force
- **The machine tool must be equipped with a filter for the coolant lubricant (nominal mesh size $\leq 40 \mu\text{m}$).**

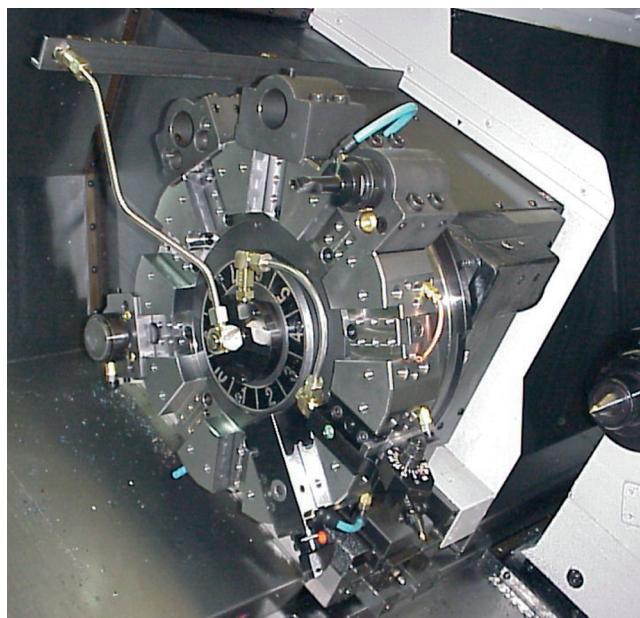
Accessories for Type HG Tools: DD Rotating Unions



DD/DS Rotating Union

On a CNC-controlled lathe without a tool drive system, the DS rotating union can supply up to four tools with high pressure emulsion.

This rotating union is centrally mounted on the face side of the turret. Fixed pressure lines run from the coupling's rotor to the tool(s). The coolant supply is connected to the rotating union's stator and to an external hydraulic pump unit (via a high pressure hose).



DD/DE Rotating Union

The DE rotating union supplies high pressure emulsion to just one tool.

Deep Rolling Tooling Technology

Advantages of deep rolling

Deep rolling significantly improves the surface layer characteristics of metal components subject to dynamic loading. This proven mechanical process has been successfully used for decades across a wide variety of industries to increase fatigue strength and service life. The process is especially well suited for treating rotationally symmetrical parts; however, with modern tooling technology the process can be used to treat free-form surfaces and thin-walled components as well.

Deep rolling can be used to treat:

- material fatigue due to dynamic loading (e.g. rotating bending or torsion)
- stress concentration or notch effect due to sharp-edged transition zones, scoring or grooves from prior processing, pitting or fretting corrosion
- low fatigue strength due to residual tensile stress left by prior processing (e.g. welding or machining)
- stress corrosion cracking
- fatigue due to rolling contact

Deep rolling is the only metal improvement process that induces residual compressive stresses and cold work while burnishing the workpiece's surface to a high quality finish. The deep rolling process combines these three effects to dramatically increase fatigue strength.

In deep rolling, one or more rollers or balls are pressed against the workpiece surface. When the pressure in the contact zone exceeds the material's yield point, the material in the surface layer is plasticized and formed. The resulting comparison stress depth profile according to Hertz demonstrates a maximum value just below the surface layer and reaches nearly zero deep in the workpiece. While the surface layer is plastically formed, at deeper levels only elastic formation occurs. The profile of the resulting compressive stresses always cycles toward a minimum value just at or below the workpiece surface where the greatest compressive stresses are induced.

During the process, the rollers subject the surface roughness peaks to the greatest load. As these peaks are pressed down, the material flows to the sides, filling the valleys and raising the valley level. The assumption that this process leads to surface compression is true only for porous materials. Depending on the application, deep rolling changes the workpiece diameter or dimensions only within the μ -range. Allowances can be made in the pre-machining stage to accommodate these slight variations.

Because the plastic deformation takes place below the material's recrystallization temperature, cold working is induced. The plastic forming process introduces disruptions into the material's lattice structure. The increased density caused by this structural change increases the surface layer's strength and can also prevent cracks or delay crack growth.

Deep rolling process

In its kinematics, the deep rolling process is similar to turning or milling. As shown in the illustrations on the next page, deep rolling can be performed as a plunge-in process with in-feed (for small radii), with linear feed, or with a special feed motion to accommodate free-form surfaces. To avoid the formation of steep inclines at the workpiece surface, the deep rolling force and pressure is built up slowly. This gradual increase prevents stress concentration.

Because the kinematics are relatively simple, the process can be applied on conventional machine tools. Deep rolling tools — including the hydrostatic HG "ballpoint" line — can also be used with CNC-controlled lathes and milling machines. On standard machines and machine tools, the components can be deep rolled right after cutting in the same setting. Specialized machines can be used to deep roll components such as crankshafts and piston rods in large series production.

Section 5 – Deep Rolling Tools

Deep rolling: plunge-in process

The profile rollers used in this process are specially designed for the radius of the fillet to be treated. The roller(s) are positioned such that the deep rolling force is concentrated on the area that experiences the highest tension or material fatigue under operating load.

The adjustable rollers incline automatically to match the workpiece form (the fillet radius in this example). As a result, the process distributes residual compressive stresses exactly as desired.

The plunge-in process requires two movements:

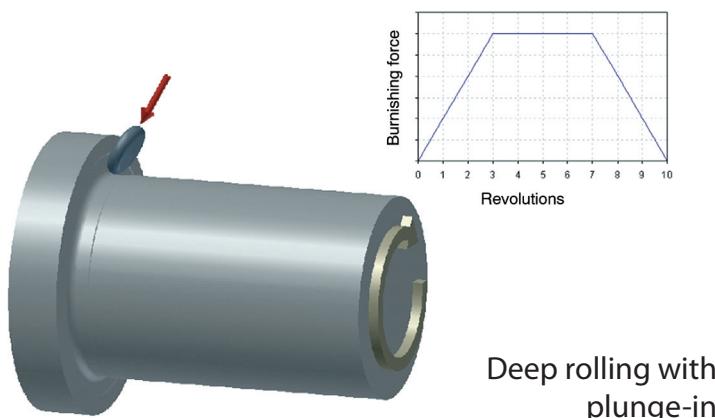
- rotation (either the tool or workpiece rotates, depending on machine and workpiece type)
- in-feed (in the axial direction for multi-roller tools; in the direction of the deep rolling force for single roller tools)

This process works well for narrow, hard-to-reach areas, such as screw threads or fillets with radii $R < 4$ mm.

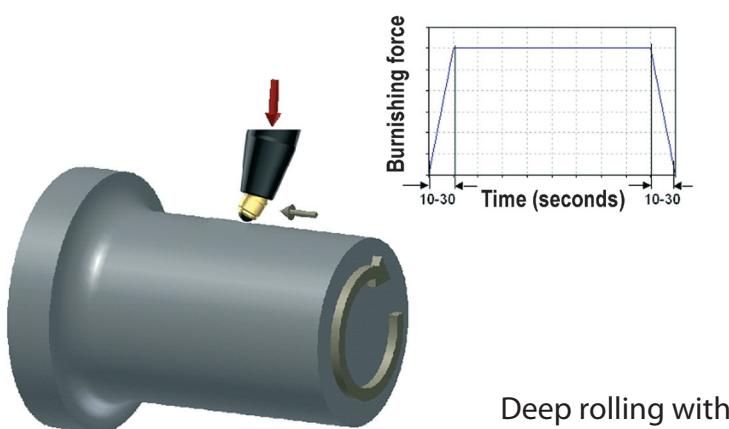
Deep rolling: feed process

This process works well for machining larger surfaces. The rotation and in-feed movements required for the plunge-in process are supplemented here by a simultaneous linear feed.

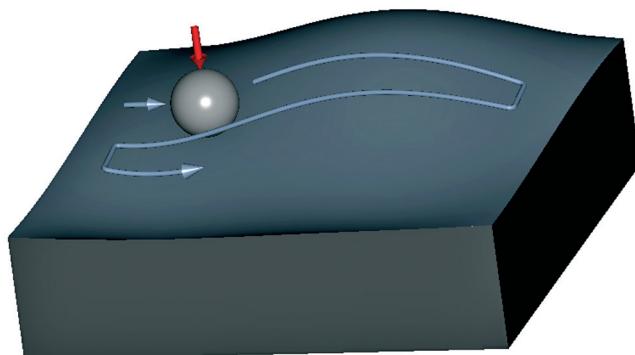
Both mechanical and hydrostatic tools can be used for this process.



Deep rolling with
plunge-in



Deep rolling with
feed



Deep rolling a free-form surface

Deep rolling with hydrostatic tools

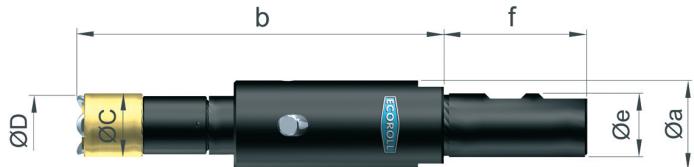
Hydrostatic "ballpoint" tools can deep roll not only rotationally symmetrical surfaces, but also flat and curved surfaces or free-form surfaces. The tool moves over the surface such that it creates parallel traces in the shape most advantageous for the particular component — for example, in a spiral or in nested squares. The hydrostatic bearing allows movement in all directions, so the feed direction can be changed even when the tool is fully engaged.

Monitoring and controlling the deep rolling force

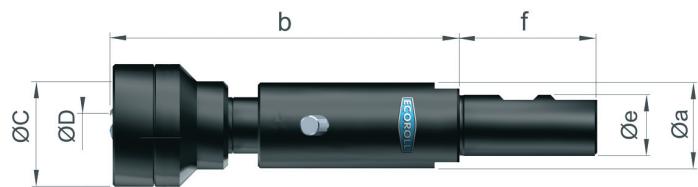
The most important parameter in the process is the deep rolling force. With mechanical tools, this force is determined by measuring and monitoring spring deflection. Each tool has an individual spring characteristic. A gauge or a sensor records and measures the related spring deflection and thus the force. For tools that operate with a hydraulic system, the deep rolling force can be monitored by measuring the pressure.

Deep Rolling Tools

Type RH Tool Applications: Internal surfaces (fillets)



Type RHA Tool Applications: External surfaces (chamfers)



Features

- Deep rolling with the plunge-in process
- For use with CNC-controlled or conventional lathes
- Complete processing in one setting
- Either right- or left-hand operation
- Rotates in either direction
- Suspended rollers for even force distribution independent of production tolerances

Advantages

Deep rolling combines the following three physical effects:

- Induces deep residual compressive stresses which increase a component's fatigue strength (especially important during cyclic loading)
- Increases the surface layer's material strength through controlled cold working
- Improves surface finish, thus greatly reducing surface flaws where cracks can initiate

Further advantages:

- Cost effective: deep rolling can take place in one setting on a standard machining tool right after the cutting process.
- No set up time, just tool change
- No transport costs
- Low energy consumption

Basic tool design

Type RH and RHA deep rolling tools consist of a tool body and roller head.

Tool body

- Four different sizes available (S1 through S4)
- Standard shank: Morse taper or cylindrical shank, other mounting systems by request
- Equipped with a disc spring assembly
- Spring layers specifically designed and arranged for each machining task

Roller head

- Specially designed per workpiece dimensions
- Mounted onto the tool body

Parameters

- Maximum rolling force: 40 kN
- Maximum machining radius: 4.0 mm
- Maximum yield strength: 1400 N/mm²
- Machining diameter (RH): > 17 mm
- Machining diameter (RHA): > 4 mm

Main dimensions (mm)					Shank $\varnothing d$ (mm)
a	b	c	b_1	x	
26-65	depends upon workpiece				≥ 25

Type RHA Deep Rolling Machine

The ECOROLL Deep Rolling Machine, Type RHA, is designed to deep roll the transition radii on bolt and screw heads. Finished components are used in **aerospace, power generation and high performance automobile applications**. Deep rolling increases cycles-to-failure so that treated components can function under high load conditions.

Deep rolling increases the material's tensile strength to 1400 N/mm² or its yield strength to 1200 N/mm².

The diameter to length ratio on standard machine tools makes deep rolling these parts difficult, if not impossible. But due to its design and size, the RHA Deep Rolling Machine can be easily integrated into the production line. The standard RHA machine is designed for manual operation, but applications for automated production are available by request.

The RHA machine deep rolls bolts and screws with various head types in a diameter range of 5–20 mm. The deep rolling head can be easily exchanged to accommodate various diameters. The maximum possible component length is 100 mm.



Deep Rolling Tools

Type EF Tool Applications: Internal and external fillets

Features

- For use with CNC-controlled or conventional lathes
- Complete processing in one setting
- Symmetrical construction allows either right- or left-hand operation
- Rotates in either direction

EF45

- Deep rolling with the plunge-in process
- One suspended roller
- Rolling force monitored by a dial gauge or sensor

EF90

- Deep rolls external thread root radii
- Deep rolls within the machine's thread cycle
- Axial floating roller compensates for marginal positioning errors
- Automatic roller angle alignment
- No conversion necessary to machine either right- or left-handed threads
- Roller made to fit component's thread root radius
- Integrated pre-loading mechanism, no further X-axis adjustment necessary

Basic tool design

Type EF deep rolling tools consist of a tool body equipped with a shank, a spring assembly that allows the roller head to move with no play and very low friction, and a dial gauge that indicates the burnishing force as measured by spring deflection. An optional device transmits the values by cable or wireless signal to an external indicator.

The roller head is attached to the flexible, spring-loaded section of the tool body. The flexible roller retainer moves in response to the radial or axial rolling forces on either side of the tool.

EF45

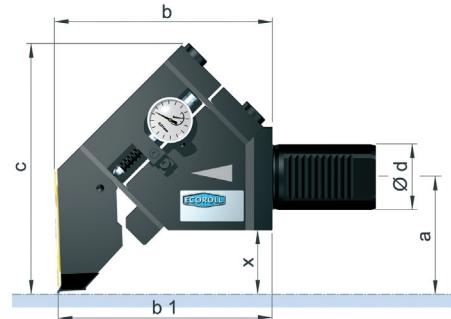
The roller is guided by a cage and supported by a support body with large-scale needle bearings.

EF90

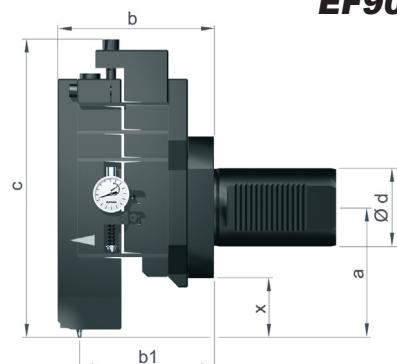
The roller is suspended within the roller retainer with a slide bearing bolt. In addition, the roller mount swings such that the roller automatically adjusts to the thread pitch. A set screw limits the roller's pivoting angle.



EF45



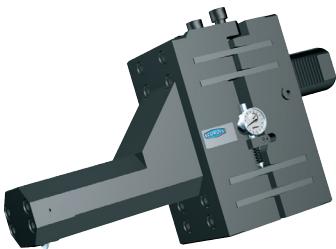
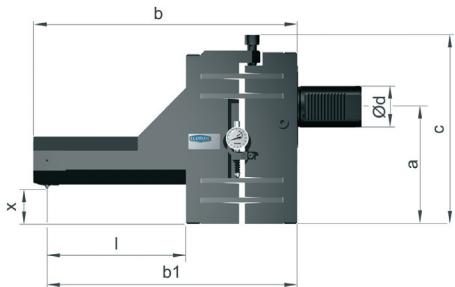
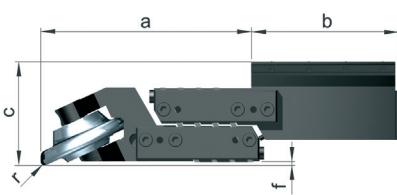
EF90



Tool type	Max. rolling force	Max. machining radius	Max. yield strength	Machining diameter	Main dimensions (mm)					Shank Ø d (mm)
					a	b	c	b ₁	x	
EF45-17	10	1.2	1400	10-250	71	133	152	130	38	≥ VDI 40
EF45-21	20	4.0		≥ 40	100	120	228	103	45	
EF90		1.6								

Type FAK Tool Applications:

Internal and external fillets

**FAK025****FAK120**

Features

- For use with CNC-controlled or conventional lathes
- Complete processing in one setting
- Symmetrical construction allows either right- or left-hand operation
- Rotates in either direction

FAK025

- Deep rolls internal thread root radii
- Deep rolls within the machine's thread cycle
- Axial floating roller compensates for marginal positioning errors
- Automatic roller angle alignment
- No conversion necessary to machine either right- or left-handed threads
- Roller made to fit component's thread root radius
- Integrated pre-loading mechanism, no further X-axis adjustment necessary

FAK120

- Deep rolls fillets with the plunge-in process
- Deep rolls contours or large fillets with the in-feed process
- Roller unit includes axial/radial bearings for the in-feed process
- Rolling force monitored by a dial gauge or sensor

Basic tool design

Type FAK deep rolling tools consist of a tool body equipped with a shank, a spring assembly that allows the roller head to move with no play and very low friction, and a dial gauge that indicates the burnishing force as measured by spring deflection. An optional device transmits the values by cable or wireless signal to an external indicator.

The roller head is attached to the flexible, spring-loaded section of the tool body. The flexible roller holder moves in response to the radial or axial rolling forces on either side of the tool.

FAK025

The roller is suspended within the roller retainer with a slide bearing bolt. In addition, the roller mount swings such that the roller automatically adjusts to the thread pitch. A set screw limits the roller's pivoting angle.

FAK120

The roller holder contains a finely machined, hardened roller with two tapered roller bearings.

Tool type	Max. rolling force	Max. machining radius	Max. yield strength	Machining diameter	Main dimensions (mm)					Shank Ø d (mm)
					a	b	c	b ₁	x	
FAK025	20	1.6	1400	≥ 80	142	324	229	307	42	≥ VDI 40
FAK120	35	4.0			256	179	126			depends upon machine

Processing Cylinders

Tools for Processing Cylinders

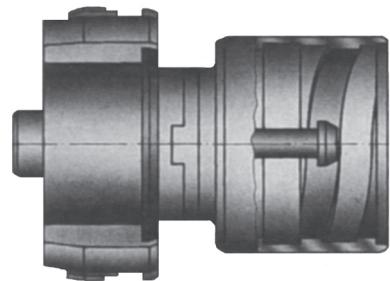
Type SK skiving heads work together with the Type GZ roller burnishing tools to process both seamless and welded precision steel cylinders. On the first pass, the SK skiving head skives the cylinder; on the second pass the GZ tool roller burnishes the surface.

Depending on the cylinder, the process can achieve a diameter tolerance of IT8 or IT9 and a surface finish of $R_z = 15\text{--}30 \mu\text{m}$.

Most often the tools are used with cylinder processing machine centers or trepanning machines with BTA systems. The quick, cost-effective process is environmentally sensitive as well: no dust, no residue.

Type SK Skiving Heads

- All SK type skiving heads produce surfaces ideal for roller burnishing
- Adjustable knives float radially
- Cutting inserts easy to exchange
- Type SK-R skiving heads come with the RETRAC® system that prevents tool retraction marks
- Type SK1R skiving head for blind holes available upon request



Basic design SK skiving head



Type SK3 skiving head

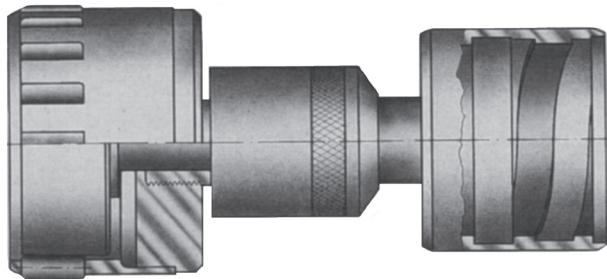


Type SK3 skiving head



Type SK1R skiving head

Type GZ Roller Burnishing Tools



Basic design GZ roller burnishing tool



Type GZ roller burnishing tool
for blind hole cylinders



Basic Type GZ roller burnishing tool

Type GZ roller burnishing tools work together with the Type SK skiving heads to process both seamless and welded precision steel cylinders.

- *Applied with cylinder processing machine centers or trepanning machines with BTA systems*
- *Achieves a diameter tolerance of IT8 or IT9 and a surface finish of $R_z < 1 \mu\text{m}$*
- *Tool feed in either direction*
- *Quick, cost-effective work cycle*
- *Simple diameter adjustment*
- *Reliable, high precision operation*
- *Wear parts are easy to exchange*
- *Roller head automatically collapses at the end of the process, preventing tool retraction marks*

Processing Cylinders

Combined Skive-Burnishing Tools

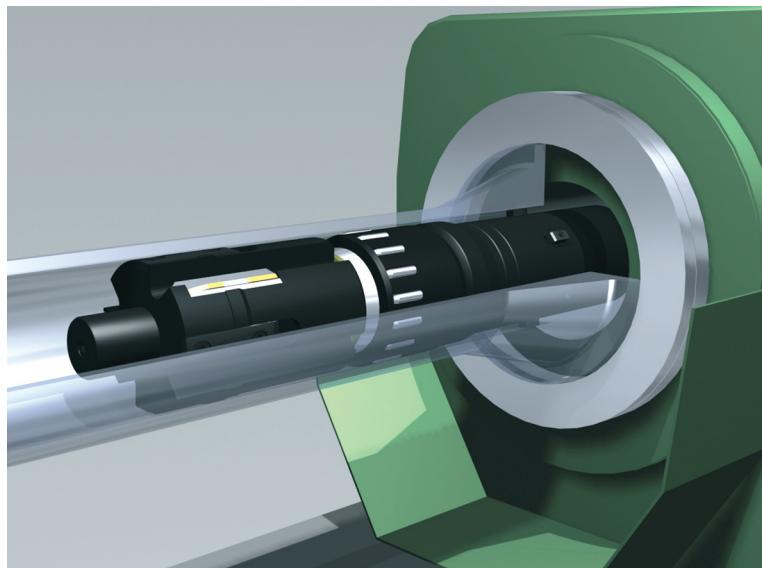
ECOROLL's combined skive-burnishing tools provide a cost-efficient and environmentally sensitive method for machining the inner surfaces of cylinders in just one step. This line of tools includes types RDS and RDO as well as the innovative Omega skiving head system.

The combined skive-burnishing tools are designed to finish seamless or welded cold drawn precision tubes after counter boring (including welded and drawn DOM tubes, seamless cold drawn DIN EN 10305-1 tubes, or hot rolled steel tubes).

The skiving head cuts the tube's inner surface to the exact size and form required, while the roller head burnishes it. This simultaneous skiving and burnishing results in a short overall process time.



Type RDS tool



Type RDSE tool

Through cold working, this forming process achieves a large surface contact area, low surface roughness and increased hardness. Thus, in contrast to honed tubes, the burnished cylinder surface has better sliding and wear properties.

ECOROLL skive-burnishing tools can be used with specially designed cylinder processing machines or trepanning machines with BTA boring systems. In addition, special versions are available for use with alternative thread connections, including Sandvik or Sierra.

NOTE: The machine tool supplies the working pressure to the tool via a high pressure hose with a quick coupling connection. When the process is complete, the pressure is released, and the skiving knives and the rolling head collapse. The tool can be quickly retracted without damaging the finished surface.

Type RDS Tool Application: Cylinders, inner surfaces

Diameters 38 – 60 mm

The RDS tool equipped with the RETRAC® system is designed to machine short cylinders up to 6 m long (depending upon the cylinder's diameter and the stiffness of the boring bar). The work cycle is extremely short because skiving and burnishing take place in one pass.

RDS tools feature the following advantages:

- Floating skiving knife with two reversible, high performance cutting inserts
- Knife adjusts easily by replacing the wedges
- Automatic coupling and separation with hydraulic RETRAC® cylinder incorporated in the boring bar
- Manual roller head diameter adjustment
- Patented choke disc concentrates the coolant-lubricant in the chip chambers
- Hydraulic RETRAC® device retracts knife and roller head when the process is finished, preventing damage to the finished workpiece

Design versions

NOTE: To order combined skive-burnishing tools, please consult the table on page 51.

1. **RDS:** standard skive-burnishing tool for diameters 38 – 60 mm
2. **RDSS:** offers increased cutting performance with two skiving knives arranged at a 90° offset
3. **RDSQ:** equipped with extended knives and support pads for skiving cylinders with cross holes
4. **RDSE:** high performance tool with flexible roller head
 - Roller head diameter self-adjusts to compensate for variable cylinder elasticity and diameter tolerances
 - Maintains constant burnishing force for even surface quality
 - Burnishing force adjusted hydraulically with RETRAC® system
 - Adapts easily and with reproducible results to a variety of material strengths and surface condition requirements
 - Unique flex-joint compensates for possible boring bar misalignment

Processing Cylinders

Type RDO "Omega" Tool Application: Cylinders, inner surfaces

Diameters 60 – 455 mm

A long-standing problem in this diameter range increases with diameter size: large diameter tubes with relatively low wall thickness exhibit greater irregularities in their circular form due to cold drawing or the straightening process. Conventional skiving heads can correct these irregularities only in certain circumstances. After such a conventional machining process, spiral-shaped waves may appear along the entire length of the cylinder's inner surface, creating a so-called rippling effect.

The RDO skive-burnishing tools equipped with the OMEGA skiving head offer an innovative solution to this problem. The following trial demonstrates the tools' effectiveness.

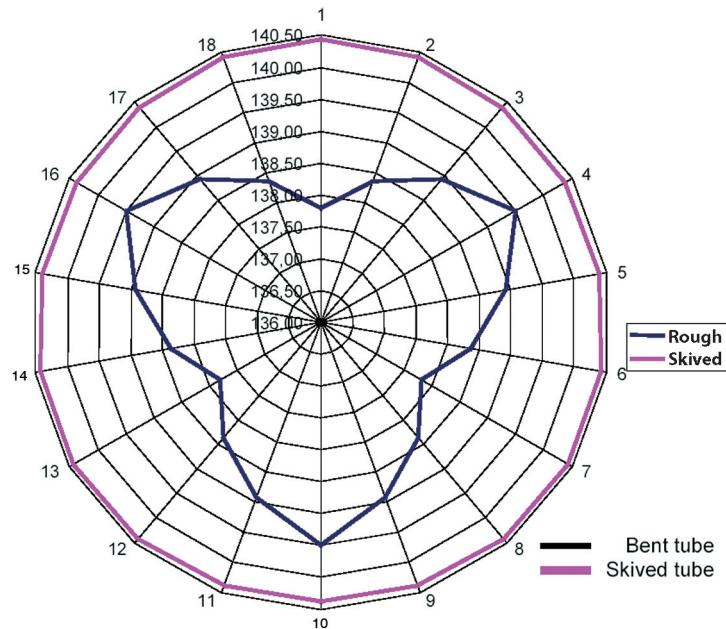
Cylinder tubes with dimensions 156 mm x 8.5 mm were bent on the in-feed end into a polygonal shape with roughly three sides, in which the diameter varied in a range from 1 – 1.7 mm.

Summary of the trial results:

After bending, the tubes exhibited irregularities in circular form of up to 1.7 mm. After skiving with an RDO tool, the infeed end of the tubes demonstrated a maximum irregularity of just 0.07 mm. At 150 mm from the infeed end (6 mm from the tube's opposite end) the maximum circular form irregularity measured just 0.02 mm. Positive results in production continue to confirm these trial results.



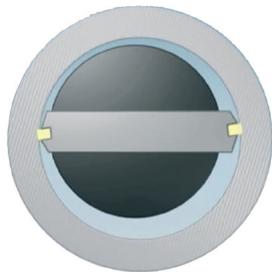
Cylinder with rippling problem



Improving the cylinder's circular form

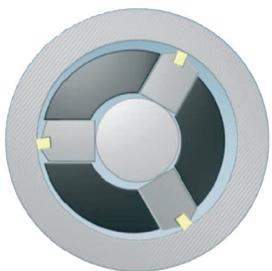
“Omega” Skiving Head

While the OMEGA skiving head cuts the cylinder's inner surface to the exact size and form required, the roller head burnishes it. The simultaneous skiving and burnishing process, together with increased cutting performance (cutting speeds up to 300 m per minute and feeds of 3 – 6 mm per revolution), result in substantial cost savings. The OMEGA skiving head is equipped with two, three or six floating knives arranged to work in concert.



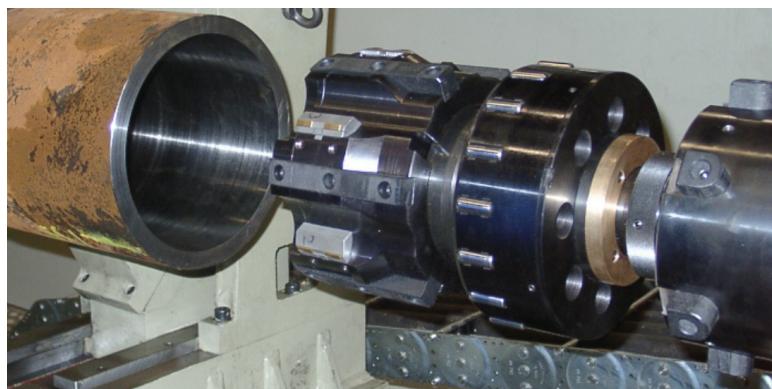
For simple applications with no rippling:

*an economical version with **2 knives***



For applications with moderate rippling in a diameter range of 60 – 400 mm:

*a version with **2 – 3 knives***



For difficult applications that require substantial form correction in a diameter range of 205 – 400 mm :

*a version with **6 knives***

The knives center themselves automatically so that each removes chips of nearly the same thickness regardless of cylinder form deviation. Thus, RDO tools with OMEGA skiving heads skive the tube clean without removing large amounts of material. This innovative knife arrangement markedly improves the tube's circular form while preventing the formation of ripples and polygon-shaped bores.

“Omega” skiving knife design versions

The skiving knives are available in two versions. The standard design, Version M, has two cutting inserts arranged one behind the other. With a cutting insert in front and a support insert behind, Version Q works especially well for cross holes.

Converting from Version M to Q is easy: simply replace the cutting insert with a support insert.

The support inserts improve the cylinder's form by:

- Guiding the knives at the beginning of the skiving process
- Limiting the oscillation of the knives, thereby reducing rippling along the length of the cylinder
- Supporting the knives over the cross holes

A precisely scaled central adjusting screw allows the knives to be adjusted even when they are already mounted in the tool. The knives no longer need to be pre-adjusted. (**NOTE:** the 6-knife OMEGA skiving head occasionally requires pre-adjustment.) The only reason for disassembling the knives is to turn them (to expose the other cutting edge) or to exchange them.

Advantages:

- Less machine down time due to central adjusting screw
- Quicker mounting and disassembly of the skiving knives

The skiving head and the rolling head are connected through a new interface. The complete skiving head can be removed by unscrewing two set screws even while the RDO tool is still mounted in the machine.

Advantages:

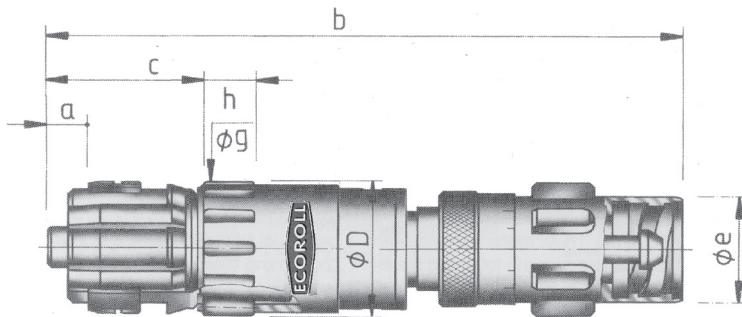
- Less time required to exchange rollers and cage
- Machine down time reduced

Combined Skive-Burnishing Tools

Technical Data

NOTE:

- The tool retainer is a BTA thread or an S-thread with a compressed air connection.
- Separate skiving and roller burnishing operations are recommended for diameters larger than 455 mm. Separate skiving heads are available in this range to improve circular form and/or machining allowance to less than 3 mm.
- All dimensions in mm**



Tool type	Diameter range D	BTA boring bar Ø e	Skiving knives		Roller head			Main dimensions		
			Diameter Range	Cross-section	Range	Number of rollers	Roller Ø g x h	a	b	c
RDS11	≥ 38 < 44	33	Nominal Ø ± 0.04	20 x 14	-0.05/-0.2	8	6 x 20	12	275	67
RDS21.1	≥ 44 < 50	36		18 x 18	-0.05/+0.3			304	86	
RDS21.2	≥ 50 < 55	43	Nominal Ø ± 0.04	20 x 18	-0.05/+0.2	16	301	301	81	
	≥ 55 < 60			18 x 18	-0.05/+0.3			275	67	
RDSQ11	≥ 38 < 44	33	Nominal Ø ± 0.04	20 x 18	-0.05/+0.2	12	8 x 25	304	86	
RDSQ21.1	≥ 44 < 50	36		18 x 18	-0.05/+0.3			275	67	
RDSQ21.2	≥ 50 < 55	43	Nominal Ø ± 0.04	20 x 18	-0.05/+0.2	16	110	301	81	
	≥ 55 < 60			18 x 18	-0.05/+0.3			437	207	
RDO34.1	≥ 60 < 70	47	≥ 60 < 63	50 x 17	-0.05/+0.3	12	8 x 25	430	200	
			≥ 63 < 70		-0.05/+0.5			120	482	
RDO34.2	≥ 70 < 80	56	≥ 70 < 80	50 x 18	-0.05/+0.5	14 x 35	121	540	241	
	≥ 80 < 100	68	≥ 80 < 100					125	609	282
RDO44.1	≥ 100 < 120	82	≥ 100 < 120	60 x 24	-0.05/+0.5	20	136	641	326	
RDO44.2	≥ 120 < 140	106	≥ 120 < 140							
RDO54.1	≥ 140 < 170	118	≥ 140 < 170	60 x 32	-0.05/+0.5	16	120	482		
RDO54.2	≥ 170 < 205	142	≥ 170 < 205					540	241	
RDO64.1	≥ 205 < 255	178	≥ 205 < 255	60 x 32	-0.05/+0.5	20	125	609	282	
	≥ 255 < 305		≥ 255 < 305					641	326	
RDO64.2	≥ 305 < 455	226	≥ 305 < 325	60 x 32	-0.05/+0.5	20	136	641	326	
			*							

* Depends on existing boring bar

Recommend operating parameters

Tool type	Diameter range mm	Rippling problem?	Cutting speed m/min.	Feed mm/rev.	Motor capacity kW
RDSR / RDSQ	≥ 38 < 60	none	180	2	20
RDO2 (2 knives)	≥ 60 < 400		300	3	30 - 50
RDO3 (3 knives)	≥ 60 < 400	moderate		4	
RDO6 (6 knives)	≥ 205 < 455	substantial		6	75

Customized Tools

Type FA Deep Rolling Tools Application: Large thread root radii

For deep rolling dynamically loaded parts, such as the large external threads as used in the oil industry, to increase fatigue strength

The deep rolling process significantly increases the amount of load cycles a component can endure without fracturing. The fatigue strength is dramatically improved. Only deep rolling combines the following three advantageous physical effects:

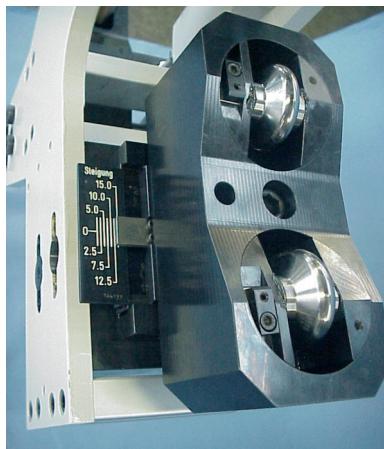
Deep rolling

- smoothes the surface (prevents micro-notches and cracking),
- generates cold work hardening (increases material strength)
- and induces compressive residual stresses in the surface edge layer.

Features

Under normal operating conditions, the highest tension is concentrated in the thread root. The deep rolling process focuses on the thread root radius.

- Even conical threads can be processed with the tool's automatic adjustment mechanism.
- FA tools are designed to be applied with CNC-controlled lathes.
- No deep rolling force is transferred from an FA tool to the machine tool. The C-bracket form allows the tool to accommodate all of the forces.
- Deep rolling forces up to 60 kN are possible.
- Deep rolling is suitable for metals with tensile strength up to 1400 N/mm² or a yield strength up to 1200 N/mm².
- An hydraulic cylinder transfers the deep rolling force to the tool. An external hydraulic unit is activated to build up pressure in the hydraulic cylinder. The hydraulic pressure and thus the deep rolling force remain constant and can compensate for workpiece tolerances and machine positioning errors.
- The FA tool rollers are positioned at an offset relative to the thread and are seated such that they can move freely. During the application, the rollers are always properly positioned in the thread root without sideways tension.



Roller position



Applying the FA deep rolling tool

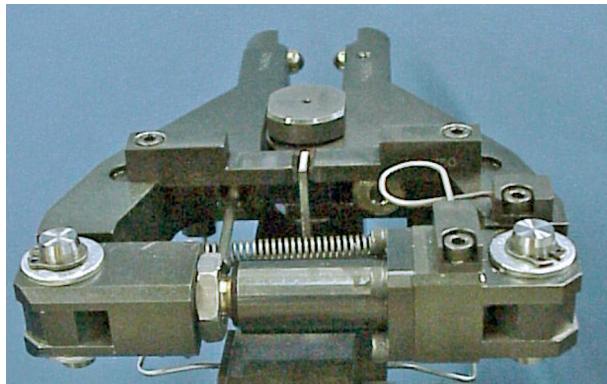


FA deep rolling tool

Type HGx-29 Hydrostatic Deep Rolling Tool

Applications: Disc-like and thin-walled components

Economical method for increasing the fatigue strength of thin-walled, complex components and free-form surfaces, such as turbine blades



Tool version HG6-29Z

Based on the proven hydrostatic HG tool design, this tool is equipped with two burnishing elements mounted in a pliers-shaped arrangement. This design allows the burnishing force to balance out on both sides of the workpiece such that no force is transferred to the machine tool.

In addition, because the burnishing elements can move and rotate freely, the workpiece cannot shift into an unstable or undesirable position.

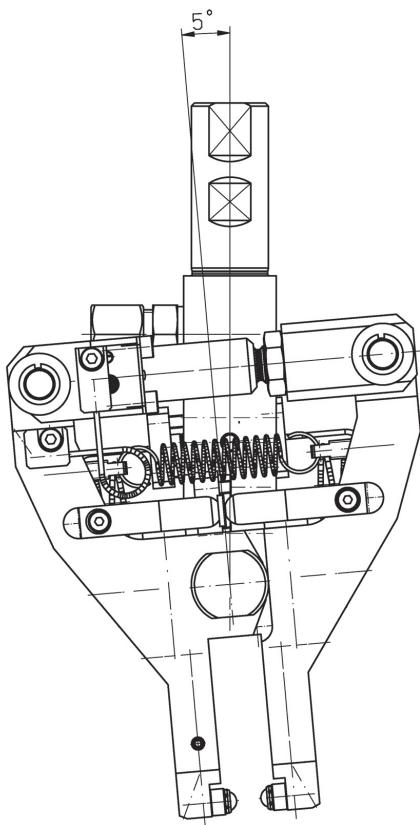
The tool guides the roller burnishing balls in parallel traces over the workpiece. Either a specifically defined area or the entire workpiece can be treated.

Features

- Deep rolling substantially increases fatigue strength
- Can be applied on both conventional and CNC-controlled lathes
- Eliminates protruding peaks to generate smooth surfaces with favorable tribomechanical properties
- Operates with a pressure-dependent burnishing force — the process is easy to control and reproduce
- Features rotating burnishing elements that adjust to complex shapes with a compensation stroke of up to 8.5 mm

Tool Function

- An external hydraulic pump unit supplies the working pressure to the tool via a high pressure hose.
- When the hydraulic pump unit is activated, the ball inserts move toward each other until they contact the workpiece surface. The working pressure (as set on the hydraulic pump unit) slowly builds up.
- During the process, both ball inserts follow the workpiece surface within a deviation of 5° right or left.
- In addition to the 8.5 mm compensation stroke, the HGx-29 is designed to pivot on its axis (or "float") in order to compensate for positioning errors and to process free form contours. This extra freedom of movement makes it possible to treat complex free-form surfaces such as turbine blades.



Both ball inserts follow the workpiece surface.

Customized Tools

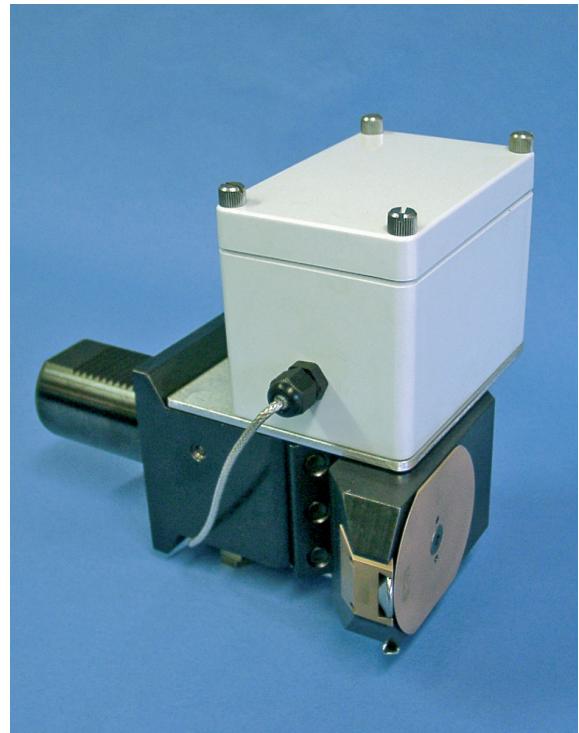
Force Monitoring Systems for EF and HG Deep Rolling Tools

In deep rolling, the operating parameters significantly influence the improvement in the workpiece's fatigue strength and service life. That's why ECOROLL continues to work toward a solution for directly monitoring deep rolling parameters during the process.

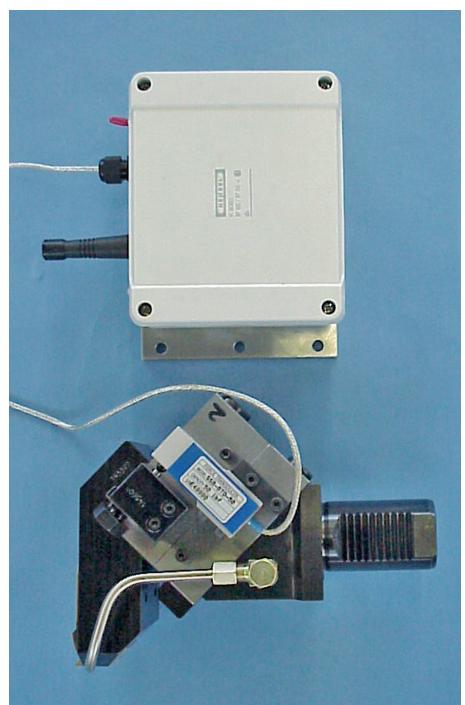
The most important parameter is the burnishing force. On ECOROLLEF tools, this force can already be determined by measuring the deformation of the springs that supply the force. This value is displayed on a gauge and can be converted into a burnishing force value by using a spring deflection diagram.

Recently ECOROLL has developed a wireless telemetry unit that transmits burnishing force data from the deep rolling tool to an external display. With this unit, operators can monitor and control the burnishing force during the process.

Future developments include a force monitoring system for all ECOROLL deep rolling tools in the EF and HG lines. This unit will display and analyze the progressive development of the burnishing force during the process. This unit will dramatically improve process reliability while reducing the output of defective parts.



Telemetry unit transmitter shown mounted on an EF tool



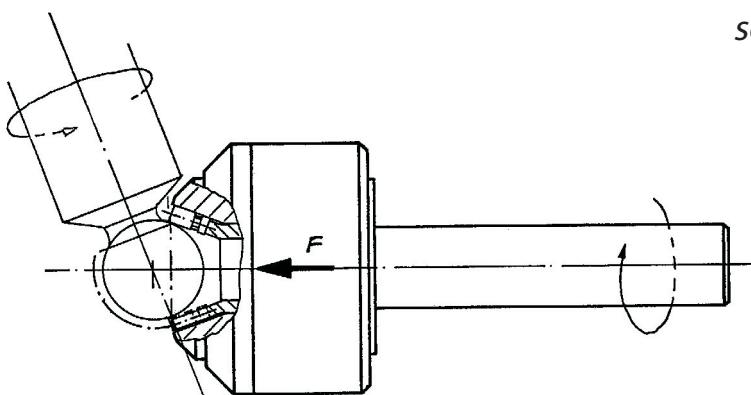
Connecting the transmitter to the deep rolling tool

Type RKAK Roller Burnishing Tool

Application: Spherical surfaces



RKAK tool in operation



How the RKAK tool works

How it works

During the roller burnishing process, the rollers are pressed against the spherical workpiece surface. This movement applies the required burnishing force (F), which is generated by the springs. The workpiece's rotational speed determines the feed rate.

Features

- Can be applied on almost all machine tools with rotating components
- All ductile metals up to a hardness of 45 HRC and a tensile strength of 1400 N/mm^2 can be treated
- On pre-machined surfaces, a surface quality of $R_z < 1 \mu\text{m}$ ($R_a \leq 0.2 \mu\text{m}$) can be achieved in one pass

Advantages

- Can be applied on CNC-controlled and conventional lathes
- Complete processing in one setting
 - Short work cycle
 - Extraneous set-up and auxilliary processing time eliminated
 - No dust or grinding residue
 - Minimal lubrication required (Oil or emulsion)

Operating parameters

- Circumferential speed: 100 m/min.
- Feed rate: 0.05 – 0.20 mm per roller

Application Examples

Application Examples: Table of Contents

Anwendungsbereich <i>Application process</i>	Werkzeug, Anwendung <i>Tool, Application</i>	Nr. <i>No.</i>
Glattwalzen mit mehrrolligen Werkzeugen <i>Roller burnishing with multiple roller tools</i>	RP Fahrwerksgetriebe / Gear box RA Schutzrohr für Thermofühler / Protector for sensor RP Ventilsitz / Valve seat RK Lenkhebel / Steering lever G Längslenker / Rear wheel carrier G Pleuel / Connecting rod RD Armaturengehäuse / Valve body G Hydraulikzylinder / Hydraulic cylinder RA Gelenkwelle / Drive shaft HG Dichtsitz / Seal insert	201 202 203 204 205 206 208 209 210 301
Glattwalzen mit einrolligen Werkzeugen <i>Roller burnishing with single roller tools</i>	HG Schaufelschwenklager / Swivel bearing EG Lagergehäuse / Bearing housing HG Dichtkegel / Seal cone EG Ringzylinder / Ring cylinder HG Kegelrad / Bevel gear HG Steuerkolben / Control valve piston HG Servokolben / Servo piston HG Kegelbolzen / Taper bolt EG Kolbenstange / Piston rod EG Dichtbuchse / Seal bushing EG Großkurbelwelle / Crank shaft HG Führungsrohr / Guide tube HG Kaltwalzen für Breitbandstraßen / Steel mill roller HG Düsenkern / Extrusion tool core HG Radialwellendichtring-Lauffläche / Rotary seal surface EG Schwungrad / Fly wheel HG Kugelbolzen / Ball stud HG Bremskolben / Brake piston HG Nockenwelle / Cam shaft	302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320



Section 8 – Application Examples

Anwendungsbereich	Werkzeug, Anwendung		Nr.
Application process	Tool, Application		No.
Glattwalzen mit einrolligen Werkzeugen	HG	Ventilkappe / Valve cap	321
Roller burnishing with single roller tools	HG	Wandlergehäuse / Torque converter housing	322
	HG	Ventil / Valve	323
	HG	Kupplungsscheibe / Clutch disc	324
	EG	Wanne / Half pipe	325
	HG	Ventilgehäuse / Valve housing	326
	HG	Bremstrommel / Brake drum	327
	HG	Glasform / Glass forming mandrel	330
	HG	Rolle / Roller for rocker arm	331
	HG	Schneckenwelle / Helix shaft	332
	HG	Formdorn / Mandrel for injection mold	333
	HG	Pressdorn / Punch	334
	HG	Steuerkolben / Control piston	335
	HG	Achswelle / Getriebewelle Axe shaft / Gear shaft	336
Festwalzen / Deep Rolling	HG	Schaftkegelrad / Angle gear shaft	337
	HG	Turbinenscheibe / Turbine wheel	501
	HG	Sicherungsbohrung / Securing bore	502
	HG	Kegelstiftbohrung / Taper pin hole	503
	HG	Dehnschraube / Tension bolt	504
	HG	Biegewelle / Flexible shaft	505
	EF	API-Kegelgewinde / API thread pin	506
	HG	Zugtraverse / Tie bar	507
	HG	Kurbelwelle / Crank shaft	508
	EF	Zylinderbuchse / Cylinder liner	509
	HG	Radflansch / Wheel flange	510
	EF	Hochfeste Schraube / High strength screw	511
	HG	Hohlwelle / Hollow shaft	512
	EF	Flugzeugfelge / Aircraft wheel rim	513
	HG	Flugzeugfederbein / Aircraft shock strut	514



ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE

201

Fahrwerksgetriebe / Gear box

WERKSTÜCK

Fahrwerksgetriebe

Teil von

Schienenfahrzeug

Forderung

 $R_z < 1 \mu\text{m}$

Material

C45

Festigkeit

680 N/mm²

WERKZEUG

**mehrrolliges
Planflächenwerkzeug RP**

Maschine

Bohrwerk

DREHZAHL

80 min⁻¹

Hauptzeit

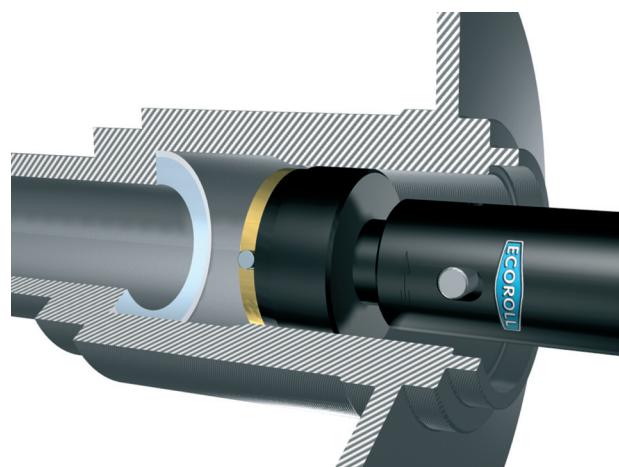
12 Sekunden

AUFGABE

- Rautiefe konnte bei spanender Bearbeitung nicht eingehalten werden*

ERGEBNISSE/VORTEILE

- verbesserte Produktqualität*
- kurze Bearbeitungszeit*



WORKPIECE

Gear box

Part of

Rail vehicle engine

Required finish

 $R_z < 1 \mu\text{m}$

Material

C45

Tensile strength

680 N/mm²

TOOL

Multiple roller face tool RP

Machine

Milling center

Rotation speed (RPM)

80

Process time

12 seconds

MACHINING TASK

- Achieve surface specification not attainable by cutting*

RESULTS/ADVANTAGES

- Improved product quality*
- Shorter process time*

**Schutzrohr für Thermofühler /
Protector for sensor**

WERKSTÜCK

Schutzrohr für Thermofühler

Teil von

Industriewaschmaschine

Material

Edelstahl 1.4301

WERKZEUG

RA

Maschine

DrehmaschineGeschwindigkeit
(m/min.) **4**

Drehzahl

180 min⁻¹

Vorschub (mm/U)

0,3

HAUPTZEIT

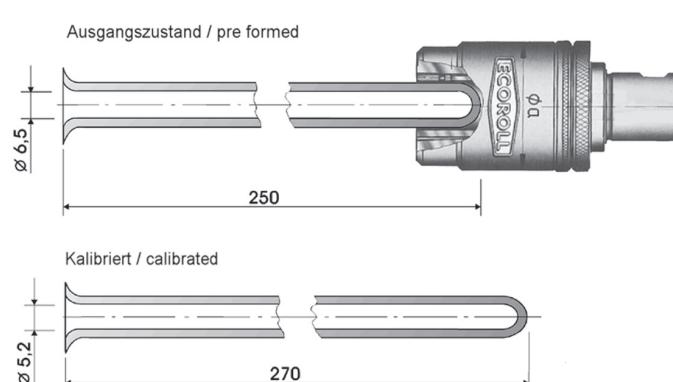
4,4 Minuten

AUFGABE

- Durch Walzen des Außendurchmessers soll der Innendurchmesser passend zum Thermofühler kalibriert werden um Wärmeübergang zu verbessern*
- Reduzierung des Innendurchmessers von 6,5 auf 5,2 mm*

ERGEBNISSE/VORTEILE

- Verbesserung der Messgenauigkeit und Ansprechgeschwindigkeit*

ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE

202

WORKPIECE

Temperature sensor protector

Part of

Industrial washing machine

Material

Stainless steel 1.4301

TOOL

RA

Machine

Conventional lathe

Speed (m/min.)

4

Rotation speed (RPM)

180

Feed rate (mm/rev.)

0,3

Process time

4.4 minutes

MACHINING TASK

- Improve heat transmission by reducing inner diameter from 6.5 to 5.2 mm*

RESULTS/ADVANTAGES

- Improved accuracy and sensitivity*

Ventilsitz / Valve seat**WERKSTÜCK****Ventilsitz**

Teil von

Ventilgehäuse

Forderung

 $R_z < 1 \mu\text{m}$

Material

X12CrMoS17

Festigkeit

 $700-800 \text{ N/mm}^2$ **WERKZEUG****RP-30.00-25.00-MK**

Maschine

CNC-Drehmaschine

Drehzahl

60 min⁻¹

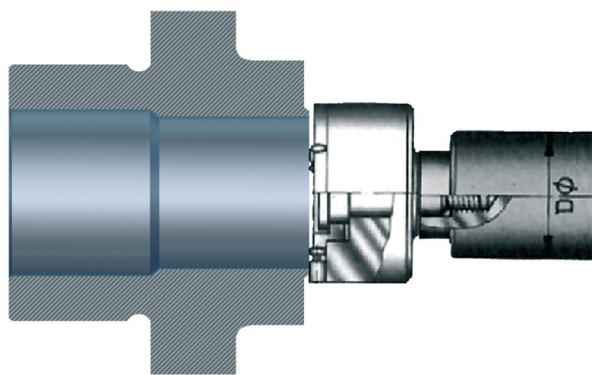
Walzkraft

400 N

Hauptzeit

10 Sekunden**AUFGABE****Planseitige Dichtfläche wird in einer Aufspannung nach dem Drehen fertigbearbeitet****ERGEBNISSE/VORTEILE**

- $R_z < 0,5 \mu\text{m}$
- Polieren entfällt

**ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE****203****WORKPIECE****Valve seat**

Part of

Valve housing

Required finish

 $R_z < 1 \mu\text{m}$

Material

Stainless steel

Tensile strength

 $700-800 \text{ N/mm}^2$ **TOOL****RP-30.00-25.00-Mk**

Machine

CNC lathe

Rotation speed (RPM)

60

Burnishing force

400 N

Process time

10 seconds**MACHINING TASK****Finish the seal face in one setting after turning****RESULTS/ADVANTAGES**

- $R_z < 0,5 \mu\text{m}$
- Polishing operation eliminated

Lenkhebel / Steering lever**WERKSTÜCK****Lenkhebel**

Teil von

Pkw-Vorderachse

Forderung

 $R_z < 2 \mu\text{m}$

Material

geschmiedeter Stahl

Festigkeit

 1100 N/mm^2 **WERKZEUG****RK**

Maschine

Transfermaschine

Drehzahl

300 min⁻¹

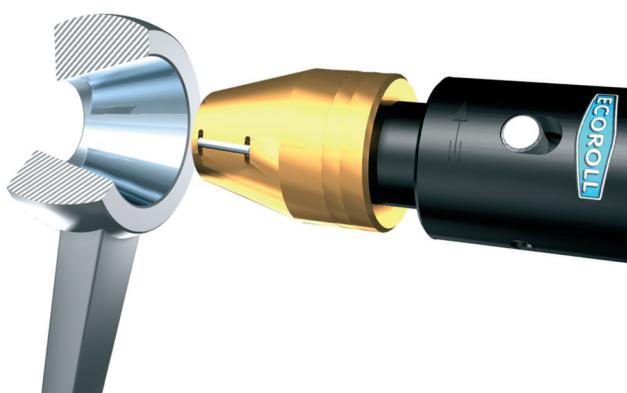
Vorschub (mm/U)

0,4

Walzkraft (N)

700

Hauptzeit

3 Sekunden**AUFGABE****Bohrung nach dem Reiben glattwalzen****ERGEBNISSE/VORTEILE**

- $R_z < 1,5 \mu\text{m}$ und hoher Materialtraganteil für festen Sitz und gute Kraftübertragung
- kurze Bearbeitungszeit

**ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE****204****WORKPIECE****Steering lever**

Part of

Front axle, passenger car

Required finish

 $R_z < 2 \mu\text{m}$

Material

Forged steel

Tensile strength

 1100 N/mm^2 **TOOL****RK**

Machine

Transfer machine

Rotation speed (RPM)

300

Feed rate (mm/rev.)

0,4

Load (N)

700

Process time

3 seconds**MACHINING TASK****Roller burnish the hole after reaming****RESULTS/ADVANTAGES**

- $R_z < 1,5 \mu\text{m}$ and high load bearing surface ratio for tight fit and good load transmission
- Short process time

Längslenker / Rear wheel carrier**WERKSTÜCK****Längslenker**

Teil von

Pkw-Hinterachse

Forderung

 $R_z < 6 \mu\text{m}$

Material

GGG 40

Festigkeit

400 N/mm²**WERKZEUG****G2-70.00-1-ZS25**

Maschine

Transfermaschine

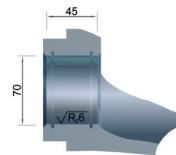
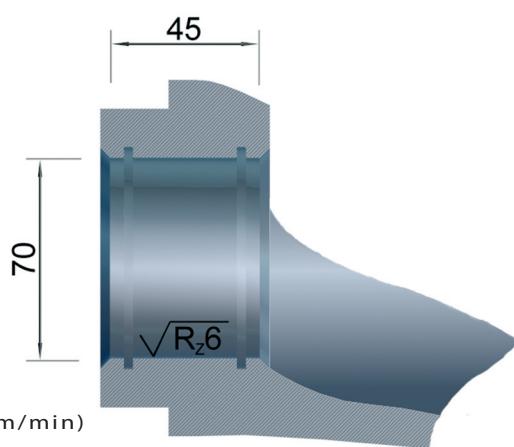
Geschwindigkeit (m/min)

150

Drehzahl 680 min⁻¹

Vorschub (mm/U) 1,6

Hauptzeit 2,5 Sekunden

**AUFGABE**

- $R_z < 4 \mu\text{m}$ ist zur Sicherung des Prozesses in der Serienproduktion gefordert
- Diese Rautiefe kann bei der Zerspanung nicht gewährleistet werden

ERGEBNISSE/VORTEILE

- Das Glattwalzen erfüllt die obige Forderung mit geringem Zeitaufwand
- Vorbearbeitungszeit durch höheren Vorschub verringert

Pleuel / Connecting rod**WERKSTÜCK****Pleuel**

Teil von

Otto-Motor

Forderung

 $R_z < 2 \mu\text{m}$

Material

Stahl bzw. Cu-Legierung**WERKZEUG****G1.3-42.00**

Geschwindigkeit (m/min) 160

Drehzahl 1200 min⁻¹

Vorschub (mm/U) 0,8

G1.2-22.00

Geschwindigkeit (m/min) 110

Drehzahl 1600 min⁻¹

Vorschub (mm/U) 0,6

Hauptzeit

1,3 Sekunden

AUFGABE**Glattwalzen des kleinen und großen Pleuelauges****ERGEBNISSE/VORTEILE****Verbesserung des Fügesitzes der Buchse - kleines Auge****ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE****205****WORKPIECE****Rear wheel carrier**

Part of

Rear axle, passenger car

Required finish

 $R_z < 6 \mu\text{m}$

Material

Nodular cast iron

Tensile strength

400 N/mm²**TOOL****G2-70.00-1-ZS25**

Machine

Transfer machine

Speed (m/min.) 150

Rotation speed (RPM) 680

Feed rate (mm/rev.) 1,6

Process time 2.5 seconds

MACHINING TASK

- Cutting alone cannot guarantee the $R_z < 4 \mu\text{m}$ finish required for series production

RESULTS/ADVANTAGES

- Roller burnishing achieves surface requirement with a short process time
- Higher feed rate facilitates quicker pre-machining process

**ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE****206****WORKPIECE****Connection rod**

Part of

Combustion engine

Required finish

 $R_z < 2 \mu\text{m}$

Material

Forged steel or bearing alloy**TOOL****G1.3-42.00**

Speed (m/min.) 160

Rotation speed (RPM) 1200

Feed rate (mm/rev.) 0,8

G1.2-22.00

Speed (m/min.) 110

Rotation speed (RPM) 1600

Feed rate (mm/rev.) 0,6

Process time

1,3 seconds

MACHINING TASK**Roller burnish both bores****RESULTS/ADVANTAGES**

- Optimal bore surface
- Improved fit of bearing bush in small eye

Armaturengehäuse / Valve body**WERKSTÜCK****Armaturengehäuse**

Teil von

Regelarmatur

Forderung

 $R_z < 2 \mu\text{m}$

Material

rostfreier Edelstahl

Festigkeit

 400 N/mm^2 **WERKZEUG****RD Sonderwerkzeug mit 3-stufigem Durchmesser****44 / 45 / 46 mm**

Maschine

CNC-Drehmaschine

Geschwindigkeit

(m/min) **150**Drehzahl **1060 min⁻¹**Vorschub (mm/U) **0,5**

Hauptzeit

1,7 Sekunden**ERGEBNISSE/VORTEILE**

- Einsparung von 2 Arbeitsgängen und 2 Werkzeugwechseln**
- Zeiteinsparung von 20 Sekunden pro Teil**

Hydraulikzylinder / Hydraulic cylinder**WERKSTÜCK****Hydraulikzylinder**

Teil von

Rotorblattverstellung für Hubschrauber

Forderung

 $R_z < 2 \mu\text{m}$

Material

Stahl

Härte

40 HRC

Festigkeit

 1000 N/mm^2 **WERKZEUG****G**

Maschine

CNC-Drehmaschine

Geschwindigkeit

(m/min) **150**Drehzahl **1000 min⁻¹**Vorschub (mm/U) **0,5**

Hauptzeit

42 Sekunden**ERGEBNISSE/VORTEILE****Reduzierung von Reibung und Dichtungsverschleiß****ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE****208****WORKPIECE****Valve body**

Part of

Control armature

Required finish

 $R_z < 2 \mu\text{m}$

Material

Stainless steel

Tensile strength

 400 N/mm^2 **TOOL****RD special version with 3-step diameter****44 / 45 / 46 mm**

Machine

CNC latheSpeed (m/min.) **150**

Rotation speed

(RPM) **1060**

Feed rate

(mm/rev.) **0.5**

Process time

1.7 seconds**RESULTS/ADVANTAGES**

- 2 operations and 2 tool changes eliminated**
- Time saved: about 20 seconds per part**

**ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE****209****WORKPIECE****Hydraulic cylinder**

Part of

Rotor blade adjustment for helicopter

Required finish

 $R_z < 2 \mu\text{m}$

Material

Steel

Hardness

40 HRC

Tensile strength

 1000 N/mm^2 **TOOL****G**

Machine

CNC latheSpeed (m/min.) **150**

Rotation speed

(RPM) **1000**Feed rate (mm/rev.) **0.5**

Process time

42 seconds**RESULTS/ADVANTAGES****Reduced friction and wear on seal**

Gelenkwelle / Drive shaft**WERKSTÜCK***Gelenkwelle*

Teil von

Hydraulikmotor

Forderung

 $R_z < 1 \mu\text{m}$ Material *Stahl*Härte *40 HRC*

Festigkeit

 1000 N/mm^2 **WERKZEUG***mehrrolliges**Glattwalzwerkzeug RA*

Maschine

Bearbeitungszentrum

Geschwindigkeit

(m/min) *150*Drehzahl *2800 min⁻¹*Vorschub (mm/U) *0,3*

Hauptzeit

1,2 Sekunden pro Zapfen**AUFGABE***Hoher Profiltraganteil wird zur Kraftübertragung benötigt***ERGEBNISSE/VORTEILE**

- *verbesserte Produktqualität*
- *kurze Bearbeitungszeit*

ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE**210****WORKPIECE***Drive shaft*

Part of

Hydraulic motor

Required finish

 $R_z < 1 \mu\text{m}$ Material *Steel*Hardness *40 HRC*

Tensile strength

 1000 N/mm^2 **TOOL***Multiple roller**burnishing tool RA*

Machine

*Milling center*Speed (m/min.) *150*

Rotation speed

(RPM) *2800*Feed rate (mm/rev.) *0.3*

Process time

*1.2 seconds per end***MACHINING TASK***High load bearing surface ratio required for good load transmission***RESULTS/ADVANTAGES**

- *Improved product quality*
- *Shorter process time*

Dichtsitz / Seal insert**WERKSTÜCK***Dichtsitz*

Teil von

Ventil

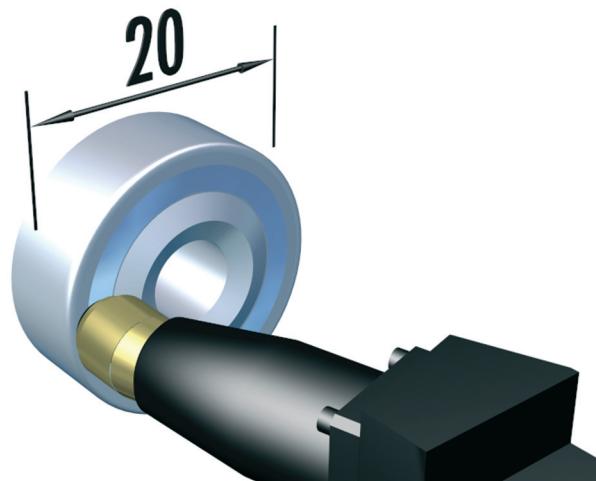
Forderung

 $R_z < 1 \mu\text{m}$

Material

1.4301

Festigkeit

 $500-750 \text{ N/mm}^2$ **WERKZEUG***HG6-9Loo°-SL25*

Maschine

*Mehrspindelautomat*Drehzahl *950 min⁻¹*Vorschub (mm/U) *0,1*Druck (bar) *60*

Hauptzeit

*2,5 Sekunden***AUFGABE***Planseitige Dichtfläche wird in einer Aufspannung nach dem Drehen glattgewalzt***ERGEBNISSE/VORTEILE***Einsparung von manueller Polierarbeit***ANWENDUNGSBEISPIEL**
APPLICATION EXAMPLE**301****WORKPIECE***Seal insert*

Part of

Valve

Required finish

 $R_z < 1 \mu\text{m}$

Material

Stainless steel

Tensile strength

 $500-750 \text{ N/mm}^2$ **TOOL***HG6-9Loo°-SL25*

Machine

Multi-spindle lathe

Rotation speed

(RPM) *950*

Feed rate

(mm/rev.) *0.1*Pressure (bar) *60*

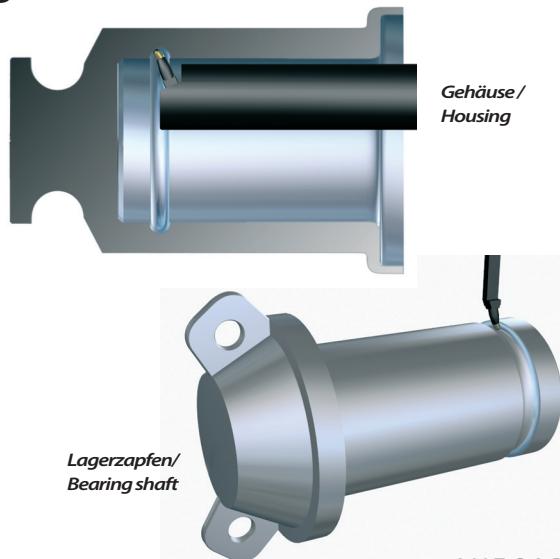
Process time

*2.5 seconds***MACHINING TASK***Roller burnish profiled seal face after turning***RESULTS/ADVANTAGES***Hand polishing eliminated*

Schaufelschwenklager / Swivel bearing

WERKSTÜCK
Schaufelschwenklager
Teil von
Bagger
Forderung
 $R_z < 2 \mu\text{m}$
Material GGG
Härte 58-62 HRC

WERKZEUG
HG6-2 und HG6-9
Maschine
CNC-Drehmaschine
Geschwindigkeit
(m/min.) 100
Drehzahl 220 min⁻¹
Vorschub (mm/U) 0,1
Druck (bar) 300
Hauptzeit 53 Sekunden



AUFGABE

- Die halbrunden Einstiche in Gehäuse und Lagerzapfen werden beim Zusammenbau mit Stahlkugeln gefüllt und bilden so ein VierpunktLAGER.
- Die Laufbahnen werden hartgedreht und hartglattgewalzt

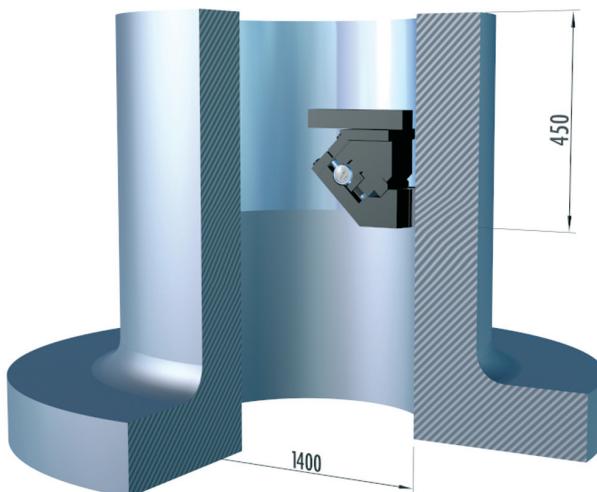
ERGEBNISSE/VORTEILE

- Zeitersparung
- Erhöhung der Tragfähigkeit

Lagergehäuse / Bearing housing

WERKSTÜCK
Lagergehäuse
Teil von *Walzenpresse*
Forderung $R_z < 3 \mu\text{m}$
Material GGG 40
Härte 170 HRB

WERKZEUG
EG14
Maschine
Karussell-Drehmaschine
Geschwindigkeit
(m/min.) 80
Drehzahl 18 min⁻¹
Vorschub (mm/U)
0,4
Messuhranzeige
(mm) 0,5
Hauptzeit 62 Minuten



AUFGABE

- Die geforderte Rautiefe war durch Schleifen nicht prozesssicher zu erreichen
- Zeitweilig setzte sich die Schleifscheibe zu, dies führte zu uneinheitlicher Oberflächengüte
- EG14 wird nach dem Drehen an Bohrstange (nicht dargestellt) befestigt

ERGEBNISSE/VORTEILE

- sichere Einhaltung der Rautiefe
- vergleichsweise kurze Bearbeitungszeit
- Einsparung von 3-5 Stunden Polierzeit

ANWENDUNGSBEISPIEL APPLICATION EXAMPLE

302

WORKPIECE
Swivel bearing
Part of
Excavator shovel
Required finish
 $R_z < 2 \mu\text{m}$
Material
Nodular cast iron
Hardness 58-62 HRC

TOOL
HG6-2 and HG6-9
Machine *CNC lathe*
Speed (m/min.) 100
Rotation speed
(RPM) 220
Feed rate (mm/rev.) 0,1
Pressure (bar) 300
Process time 53 seconds

AUFGABE

- In the assembled part, the grooves in the housing and the shaft form a race filled with steel balls to create a four-point bearing
- The task is to hard turn and hard roller burnish the ball races

RESULTS/ADVANTAGES

- Improved bearing capacity
- Shorter process time

ANWENDUNGSBEISPIEL APPLICATION EXAMPLE

303

WORKPIECE
Bearing housing
Part of *Roller press*
Required finish $R_z < 3 \mu\text{m}$
Material
Nodular cast iron
Hardness 170 HRB

TOOL
EG14
Machine
Vertical lathe
Speed (m/min.) 80
Rotation speed (RPM) 18
Feed rate (mm/rev.) 0,4
Dial gauge indication
(mm) 0,5
Process time 62 minutes

MACHINING TASK

- Required surface quality cannot be guaranteed by other processes such as grinding
- The grinding wheel clogs and causes inconsistent surface quality
- The EG14 tool replaces the cutting chisel after turning and is held by the boring bar (not shown)

RESULTS/ADVANTAGES

- Reliable, reproducible process
- Short process time
- Elimination of 3-5 hours polishing time

ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE

304

Dichtkegel / Seal cone

WERKSTÜCK

Dichtkegel

Teil von

Flüssigkeitsventil

Forderung

 $R_z < 1 \mu\text{m}$

Material

rostfreier Stahl

Streckgrenze

 240 N/mm^2

WERKZEUG

HG6-9E30°-SL25

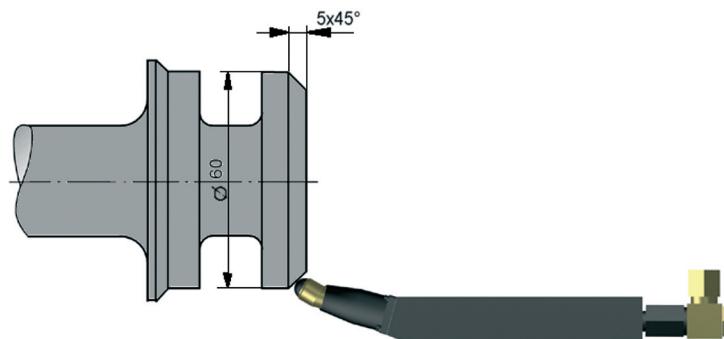
Maschine

CNC-Drehmaschine

Geschwindigkeit

(m/min) **180**Drehzahl **950 min⁻¹**Vorschub (mm/U) **1**Druck (bar) **80**

Hauptzeit

5,3 Sekunden

AUFGABE

HG wurde gewählt, da eine leichte Verrundung der Kanten erwünscht ist

ERGEBNISSE/VORTEILE

Einsparung der bisherigen separaten Polieroperation

WORKPIECE

Seal cone

Part of

Fluid valve

Required finish

 $R_z < 1 \mu\text{m}$

Material

Stainless steel

Yield strength

 240 N/mm^2

TOOL

HG6-9E30°-SL25

Machine

*CNC lathe*Speed (m/min.) **180**

Rotation speed

(RPM) **950**Feed rate (mm/rev.) **1**Pressure (bar) **80**

Process time

5.3 seconds

MACHINING TASK

HG is the best choice for rounding corners

RESULTS/ADVANTAGES

Eliminates a separate polishing operation

Ringzylinder / Ring cylinder

WERKSTÜCK

Ringzylinder

Teil von

Hydraulikkupplung

Forderung

 $R_z < 2 \mu\text{m}$ Material *Ck60*

Festigkeit

 740 N/mm^2

WERKZEUG

EG5-12F-VDI40

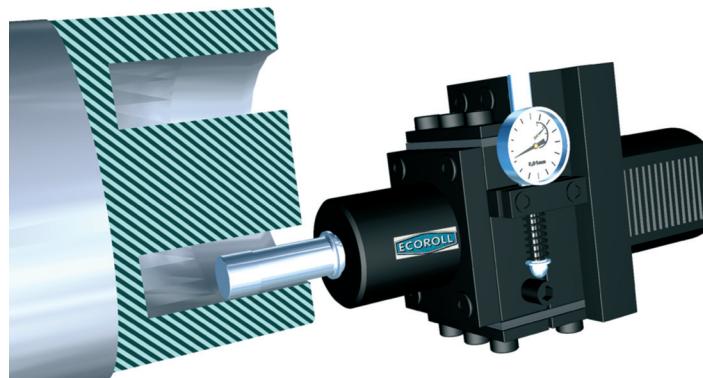
Maschine

CNC-Drehmaschine

Geschwindigkeit

(m/min) **80**Drehzahl **210 min⁻¹**Vorschub (mm/U) **0,2**Meßuhranzeige (mm) **1,0**

Hauptzeit

57 Sekunden pro Fläche

AUFGABE

- Innen- und Außendurchmesser des Ringzylinders werden mit dem selben Werkzeug in einer Aufspannung, jedoch nacheinander, bearbeitet*
- Werkzeug ist für einen großen Durchmesserbereich einsetzbar*

ERGEBNISSE/VORTEILE

- Prozesssicherheit*
- Ausschuß vermieden*
- Polievorgang eingespart*

ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE

305

WORKPIECE

Ring cylinder

Part of

Hydraulic clutch

Required finish

 $R_z < 2 \mu\text{m}$ Material *Ck60*

Tensile strength

 740 N/mm^2

TOOL

EG5-12F-VDI40

Machine

*CNC lathe*Speed (m/min.) **80**Rotation speed (RPM) **210**Feed rate (mm/rev.) **0,2**

Dial gauge indication

(mm) **1,0**

Process time

57 seconds per surface

MACHINING TASK

- Roller burnish inner and outer diameters of the ring cylinder in succession with the same tool in one setting*
- This tool can be used for many different diameter sizes*

RESULTS/ADVANTAGES

- Reliable process*
- Reduces part rejects*
- Polishing operation no longer necessary*

Kegelrad / Bevel gear**WERKSTÜCK****Kegelrad**

Teil von

Pkw-DifferentialForderung $R_z < 2 \mu\text{m}$

Material 16CD4

Härte 42 HRC

Festigkeit 1000 N/mm²**WERKZEUG****HG6 Glattwalzelement
an Spezialhalter**

Maschine

**Mehrspindel-
Drehmaschine MS50
(Index)**Geschwindigkeit
(m/min) 150Drehzahl 1500 min⁻¹

Vorschub (mm/U) 0,1

Druck (bar) 150

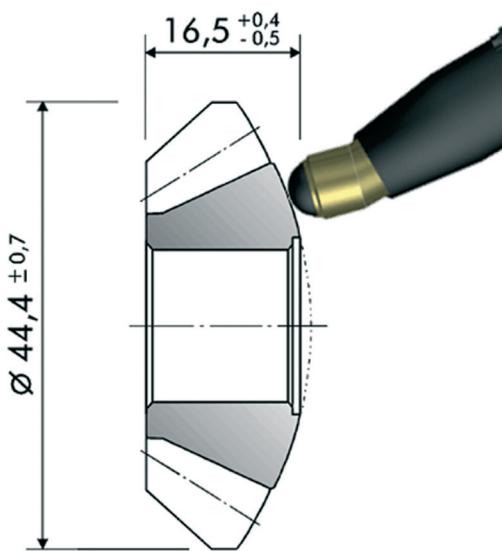
Hauptzeit 4 Sekunden

AUFGABE

- walzt die Kugelzone ohne axialen Vorschub
- Werkzeug folgt der Kontur automatisch

ERGEBNISSE/VORTEILE

- Teile werden in einer Aufspannung
einbaufertig bearbeitet

**ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE****306****WORKPIECE****Bevel gear**

Part of

Passenger car, differential gearRequired finish $R_z < 2 \mu\text{m}$

Material 16CD4

Hardness 42 HRC

Tensile strength 1000 N/mm²**TOOL****HG6 burnishing element
on a special tool holder**

Machine

**Multi-spindle lathe
(index MS50)**

Speed (m/min) 150

Rotation speed (RPM) 1500

Feed rate (mm/rev.) 0,1

Pressure (bar) 150

Process time 4 seconds

MACHINING TASK

- Roller burnish the spherical zone without axial feed
- Tool automatically follows the contour

RESULTS/ADVANTAGES

- Gear comes back from processing ready for use

**Steuerkolben /
Control valve piston****WERKSTÜCK****Steuerkolben**

Teil von

Druckluft-Wegeventil

Forderung

 $R_z < 1 \mu\text{m}$

Material C-Stahl

Festigkeit 1000 N/mm²**WERKZEUG****HG6-9Eoo°-SL20**

Maschine

CNC-DrehmaschineGeschwindigkeit
(m/min) 94

Drehzahl

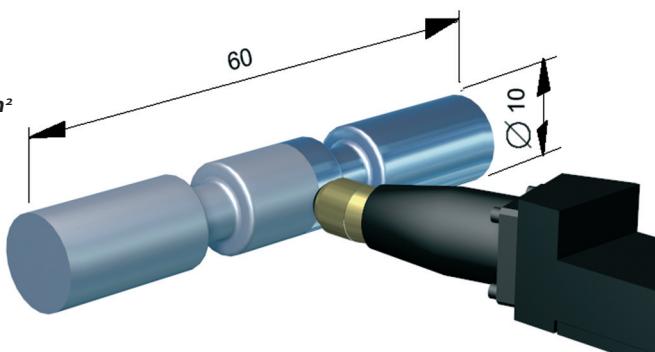
3000 min⁻¹

Vorschub (mm/U)

0,1

Druck (bar) 100

Hauptzeit 12 Sekunden

**AUFGABE**

Kolben gleitet während des Schaltens durch O-Ringen, daher sollen Radien ebenfalls geglättet werden

ERGEBNISSE/VORTEILE

- in einer Aufspannung einbaufertig bearbeitet
- bessere Funktion und Zuverlässigkeit

**ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE****307****WORKPIECE****Control valve piston**

Part of

**Compressed air
control valve**

Required finish

 $R_z < 1 \mu\text{m}$

Material C-Steel

Tensile strength

1000 N/mm²**TOOL****HG6-9Eoo°-SL20**

Machine

CNC lathe

Speed (m/min.) 94

Rotation speed

(RPM) 3000

Feed rate (mm/rev.) 0,1

Pressure (bar) 100

Process time 12 seconds

MACHINING TASK

Machine the surface to ensure optimum performance when piston slides through O-rings

RESULTS/ADVANTAGES

- Component completely finished in one setting
- Roller burnished surfaces facilitate better, more reliable function

ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE

308

Servokolben / Servo piston

WERKSTÜCK

Servokolben

Teil von

ABS-Bremssystem

Forderung

 $R_a \leq 0,3 \mu\text{m}$

Material

C-Stahl

Festigkeit

 600 N/mm^2

WERKZEUG

HG6-9Eoo°-SL25

Maschine

Mehrspindelautomat

Geschwindigkeit

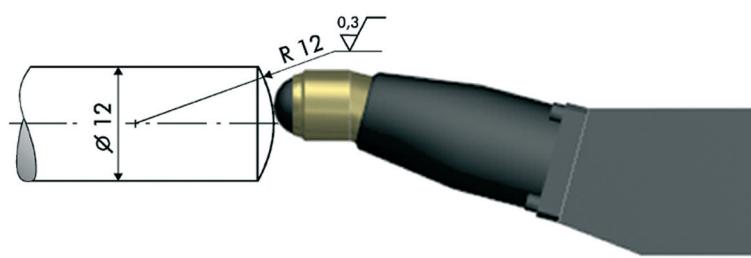
(m/min) 230

Drehzahl 6000 min⁻¹

Vorschub (mm/U) 0,1

Druck (bar) 120

Hauptzeit 0,6 Sekunden



AUFGABE

Gesamte Kuppe einschließlich des Zentrums wird glattgewalzt

ERGEBNISSE/VORTEILE

Einsparung der bisherigen separaten Polieroperation

Kegelbolzen / Taper bolt

WERKSTÜCK

Kegelbolzen

Teil von

rostfreie Metalldübel

Forderung

 $R_z < 1,5 \mu\text{m}$

Material

rostfreier Stahl

Härte 300 HV

WERKZEUG

HG6-11.2 (rotierend) mit 6-8 Walzelementen

Maschine

Rundtisch-Drehautomat

Geschwindigkeit

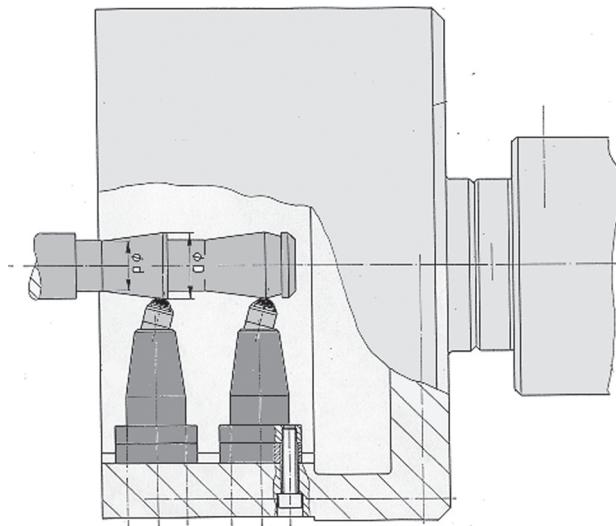
(m/min) 40-60

Drehzahl 1000 min⁻¹

Vorschub (mm/U) 0,3

Druck (bar) 120

Hauptzeit 3-4 Sekunden



AUFGABE

- Bauartzulassung rostfreier Metalldübel nur mit glattgewalzter Kegeloberfläche*
- Grund: Fressen der Spreizsegmente beim Anzug vermeiden*

ERGEBNISSE/VORTEILE

- sicheres Produkt*
- kurze Bearbeitungszeit*

ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE

309

WORKPIECE

Taper bolt

Part of

High strength tap bolt

Required finish

 $R_z < 1,5 \mu\text{m}$ to avoid galling

Material

Stainless steel

Hardness 300 HV

TOOL

HG6-11.2 (rotating) with 6-8 burnishing elements

Machine

Round table lathe

Speed (m/min.) 40-60

Rotational speed (RPM) 1000

Feed rate (mm/rev.) 0,3

Pressure (bar) 120

Process time 3-4 seconds

MACHINING TASK

In order for tap bolts to be approved for use, the taper must be roller burnished

RESULTS/ADVANTAGES

- Galling prevented*
- Reliable product at lower cost*

Kolbenstange / Piston rod

WERKSTÜCK
Kolbenstange

Teil von
Hydraulikzylinder
Forderung
 $R_z < 1,5 \mu\text{m}$
Material C60V
Härte 40 HRC
Festigkeit
 1000 N/mm^2

WERKZEUG

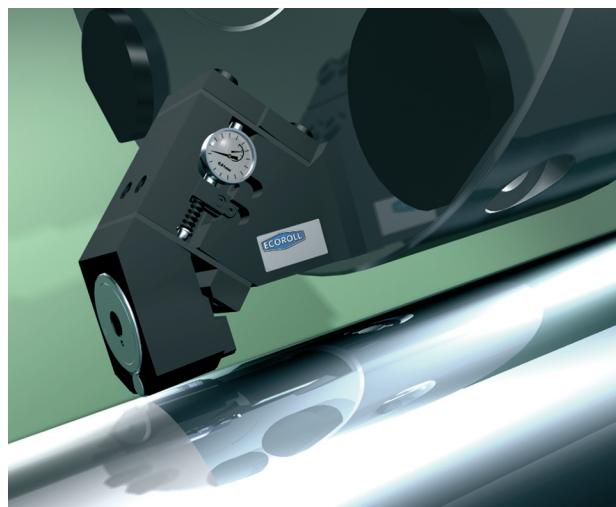
EG14-1-VDI50
Maschine
CNC-Drehmaschine
Geschwindigkeit
(m/min) 135
Drehzahl 500 min^{-1}
Vorschub (mm/U) 0,2
Meßuhranzeige (mm) 0,7
Hauptzeit 7,1 Minuten

AUFGABE

Die glattgewalzte Oberfläche wird maßverchromt und ist nach dem Schwabbeln einbaufertig

ERGEBNISSE/VORTEILE

- geringer Verbrauch von Chrom
- Schleifen vor und nach dem Verchromen entfällt
- glattgewalzte Oberfläche weist bessere Gleit- und Dichtungseigenschaften auf



Beispiel / Example:
Durchmesser/Diameter = 85 mm
Länge/Length = 715 mm

ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE

310

WORKPIECE

Piston rod
Part of
Hydraulic cylinder
Required finish
 $R_z < 1.5 \mu\text{m}$
Material C60V
Hardness 40 HRC
Tensile strength
 1000 N/mm^2

TOOL

EG14-1-VDI50
Machine **CNC lathe**
Speed (m/min.) 135
Rotational speed
(RPM) 500
Feed rate (mm/rev.) 0.2
Dial gauge indication
(mm) 0.7
Process time 7.1 minutes

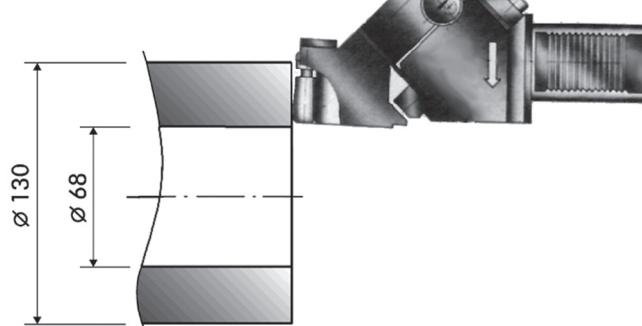
Dichtbuchse / Seal bushing

WERKSTÜCK
Dichtbuchse

Teil von
Ventil
Forderung $R_z < 1 \mu\text{m}$
Material
Aluminium-Legierung
Festigkeit
 300 N/mm^2

WERKZEUG
EG14-2-VDI40
Maschine
CNC-Drehmaschine
Geschwindigkeit
(m/min)
 100 (konstant)

Drehzahl
 $250-470 \text{ min}^{-1}$
Vorschub (mm/U) 0,2
Meßuhranzeige (mm) 0,5
Hauptzeit 29 Sekunden



ERGEBNISSE/VORTEILE

- Zeiteinsparung
- verbesserte Dichtung

ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE

311

WORKPIECE

Seal bushing
Part of
Valve
Required finish
 $R_z < 1 \mu\text{m}$
Material **Aluminum alloy**
Tensile strength
 300 N/mm^2

TOOL

EG14-2-VDI40
Machine
CNC lathe
Speed (m/min)
 100 (constant)
Rotational speed (RPM)
 $250-470$
Feed rate (mm/rev.) 0.2
Dial gauge indication
(mm) 0.5
Process time 29 seconds

RESULTS/ADVANTAGES

- Improved seal quality
- Shorter process time

Großkurbelwelle / Crank shaft

WERKSTÜCK

Großkurbelwelle

Teil von

Kolbenpumpe für

Bohrspülung

Forderung $R_z < 4 \mu\text{m}$

Material

Vergütungsstahl

Härte 42 HRC

Festigkeit 1100 N/mm²

WERKZEUG

EG14-1-SL32

Maschine

CNC-Drehmaschine

Geschwindigkeit

(m/min.) 19

Drehzahl 20 min⁻¹

Vorschub (mm/U) 0,8

Meßuhrranzeige (mm) 1,1

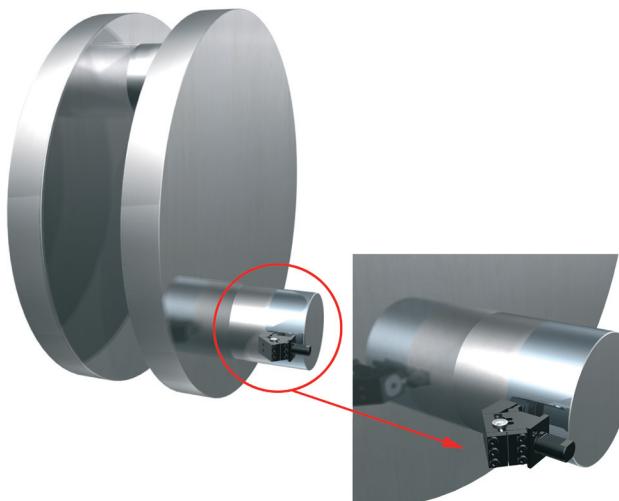
Hauptzeit 18 Minuten, 40 Sekunden

AUFGABE

Unwucht lässt nur niedrige Drehzahl zu, daher ist Oberflächengüte nicht durch Drehen erreichbar

ERGEBNISSE/VORTEILE

- *Fertigbearbeitung auf der Drehmaschine anstelle des manuellen Polierens*
- *Einsparung von 12 Stunden pro Teil*



ANWENDUNGSBEISPIEL APPLICATION EXAMPLE

312

WORKPIECE

Crank shaft

Part of

Piston pump for drilling in mud

Required finish $R_z < 4 \mu\text{m}$

Material *Heat treated steel*

Hardness 42 HRC

Tensile strength

1100 N/mm²

TOOL

EG14-1-SL32

Machine

CNC lathe

Speed (m/min.) 19

Rotation speed (RPM) 20

Feed rate (mm/rev.) 0.8

Dial gauge indication (mm) 1.1

Process time

18 minutes, 40 seconds

MACHINING TASK

Because the eccentric mass requires a slow machining speed, turning alone cannot produce the required finish

RESULTS/ADVANTAGES

- *EG14 makes it possible to finish the part on the lathe instead of hand polishing*
- *12 hours saved per part*

Führungsrohr / Guide tube

WERKSTÜCK

Führungsrohr

Teil von

Fahrzeugehebebühne

Forderung

$R_z < 2 \mu\text{m}$

Material *Stahl (St 52)*

Festigkeit

600 N/mm²

WERKZEUG

HG13-9R15°-SL25

Maschine

konventionelle Drehmaschine

Geschwindigkeit

(m/min.) 240

Drehzahl 300 min⁻¹

Vorschub (mm/U) 0,5

Druck (bar) 120

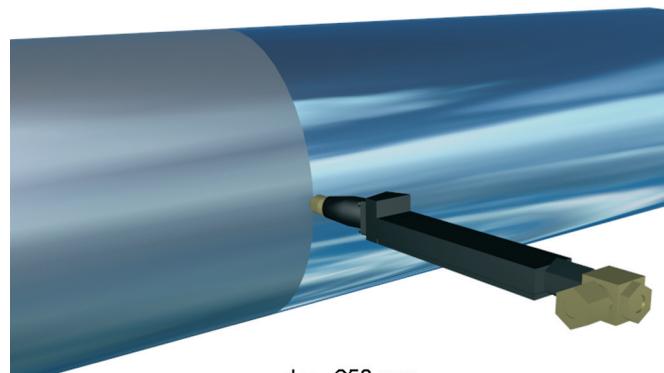
Hauptzeit 17 Minuten

AUFGABE

gezogene Präzisionsstahlrohre werden vor dem Glattwalzen spitzenlos geschliffen

ERGEBNISSE/VORTEILE

Drehen als Vorbearbeitung nicht mehr erforderlich, da HG Werkzeug Rundheitsfehler und Durchmessertoleranzen automatisch kompensiert



ANWENDUNGSBEISPIEL APPLICATION EXAMPLE

313

WORKPIECE

Guide tube

Part of

Hydraulic car lift

Required finish

$R_z < 2 \mu\text{m}$

Material *Steel (St 52)*

Tensile strength

600 N/mm²

TOOL

HG13-9R15°-SL25

Machine

Conventional lathe

Speed (m/min.) 240

Rotation speed (RPM) 300

Feed rate (mm/rev.) 0.5

Pressure (bar) 120

Process time 17 minutes

MACHINING TASK

Roller burnish cold drawn precision tubes after performing centerless grinding

RESULTS/ADVANTAGES

No pre-process turning necessary because the hydrostatic tool compensates for the tube's diameter tolerances

Kaltwalzen für Breitbandstraßen / Steel mill roller

WERKSTÜCK

Kaltwalzen für Breitbandstraßen

Teil von

Walzwerk

Forderung

Härtesteigerung

Material *Hartguss*

Härte *65 Shore B*

WERKZEUG

HG13-9R15°-SL32 mit

Hydraulikaggregat HGP1.8

mit Kühlsmierstoff-Tank

Maschine

Walzen-Drehmaschine

Geschwindigkeit

(m/min) *250*

Drehzahl *93 min⁻¹*

Vorschub (mm/U) *0,25*

Druck (bar) *250*

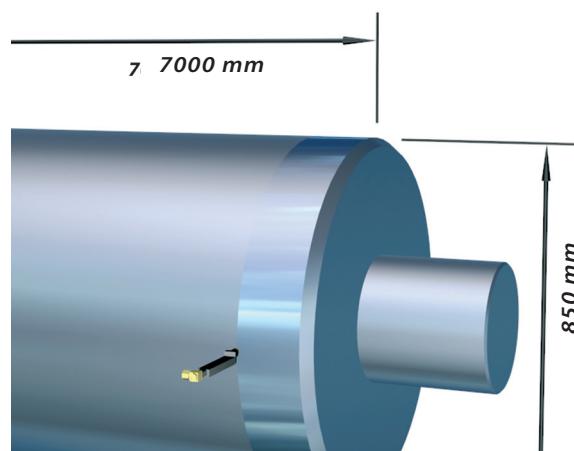
Hauptzeit *5 Stunden*

AUFGABE

Erhöhung der Härte zur Steigerung der Standzeit gefordert

ERGEBNISSE/VORTEILE

Härte > 70 Shore, Sollwert erreicht



ANWENDUNGSBEISPIEL APPLICATION EXAMPLE

314

WORKPIECE

Steel mill roller

Part of

Sheet metal mill

Required finish

Increased hardness

Material *Chilled cast iron*

Härte *65 Shore B*

TOOL

HG13-9R15°-SL32 with

hydraulic pump HGP1.8

with coolant-lubricant tank

Maschine

Roller lathe

Speed (m/min) *250*

Rotation speed (RPM) *93*

Feed rate (mm/rev.) *0.25*

Pressure (bar) *250*

Process time *5 hours*

MACHINING TASK

Increase hardness to improve fatigue strength and service life

RESULTS/ADVANTAGES

Hardness increased to 70 Shore

Düsenkern / Extrusion tool core

WERKSTÜCK

Düsenkern

Teil von

Extrusionswerkzeug

für Kunststoffrohre

Forderung $R_z < 1 \mu\text{m}$

Material

rostfreier Stahl

Festigkeit

750 N/mm^2

WERKZEUG

HG13-9R90°-SL25

Maschine

CNC-Drehmaschine

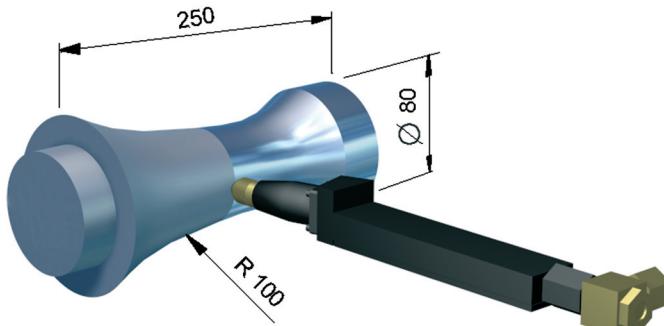
Geschwindigkeit

(m/min) *200*

Vorschub (mm/U) *0,1*

Druck (bar) *90*

Hauptzeit *3 Minuten*



AUFGABE

Glattwalzen, da glattgewalzte Oberflächen für Extrusionswerkzeuge bestens geeignet sind

ERGEBNISSE/VORTEILE

- *Zeiteinsparung von 1,5 Stunden pro Teil*
- *manuelle Polierarbeit entfällt*

ANWENDUNGSBEISPIEL APPLICATION EXAMPLE

315

WORKPIECE

Extrusion tool core

Part of

Plastic tube extrusion tool

Required finish

$R_z < 1 \mu\text{m}$

Material

Stainless steel

Tensile strength

750 N/mm^2

TOOL

HG13-9R90°-SL25

Maschine

CNC lathe

Speed (m/min.) *200*

Feed rate (mm/rev.) *0.1*

Pressure (bar) *90*

Process time *3 minutes*

MACHINING TASK

Roller burnish surface to better facilitate the plastic extrusion process

RESULTS/ADVANTAGES

- *Shorter process: 1.5 hours saved per part*
- *No hand polishing required*

ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE

316

**Radialwellendichtring - Lauffläche /
Rotary seal surface**

WERKSTÜCK

Radialwellendichtring - Lauffläche
 Teil von Wandlergetriebe
 Forderung
 $R_a = 0,2 - 0,4 \mu\text{m}$
 Material **Einsatzstahl**
 Härte 58-60 HRC

WERKZEUG

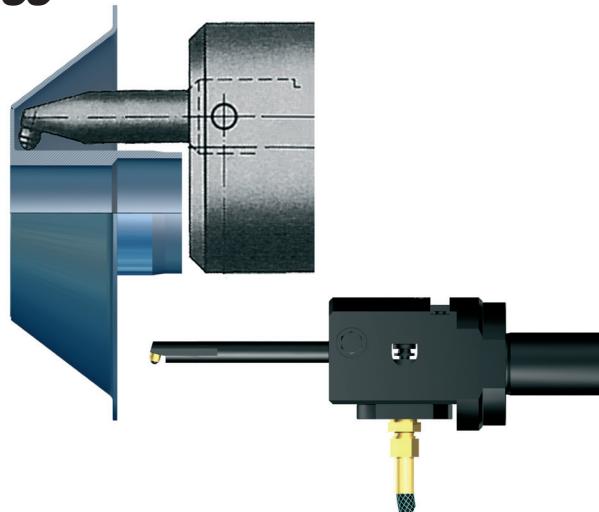
HG6-1E15°-ZS40
 Maschine
CNC-Drehmaschine
 Geschwindigkeit
 (m/min) 150
 Drehzahl 1060 min⁻¹
 Vorschub (mm/U) 0,1
 Druck (bar) 400
 Hauptzeit 25 Sekunden

AUFGABE

- Die Lauffläche des Radialwellendichtringes ist zum Schleifen nur schwer zugänglich
- Lauffläche wird hartgedreht und anschließend in einer Aufspannung hartglattgewalzt

ERGEBNISSE/VORTEILE

- kurze Bearbeitungszeit
- günstige Oberflächenstruktur: Plateaus ohne Spitzen, flache Restrauigkeit für ausreichende Schmierung jedoch ohne Ölförderwirkung

**Schwungrad / Fly wheel**

WERKSTÜCK

Schwungrad
 Teil von
 Pkw
 Forderung $R_z < 6 \mu\text{m}$
 (Produktionstoleranz)
 Material GGG 40
 Festigkeit 400 N/mm²

WERKZEUG

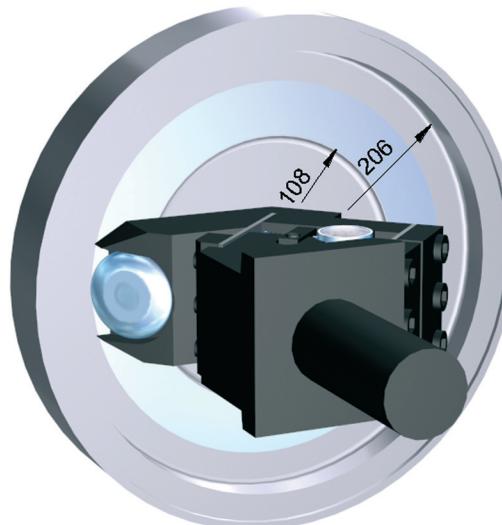
EG45-1-40M-VDI40
 Maschine
CNC-Drehmaschine
 Geschwindigkeit
 (m/min) 150
 Drehzahl 300 min⁻¹
 Vorschub (mm/U) 0,5
 Messuhrranzeige (mm) 0,4
 Hauptzeit 19 Sekunden

AUFGABE

- Forderung laut Zeichnung ($R_z < 12 \mu\text{m}$) sollte durch Drehen erreicht werden
- Etwa 10% der Teile waren Ausschuß wegen Überschreitung der Rautiefe
- Nacharbeit war nicht möglich, da Tiefe eng toleriert

ERGEBNISSE/VORTEILE

- Ausschuß vermieden
- Prozesssicherheit hergestellt

ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE

317

WERKPIECE

Fly wheel
 Part of
 Passenger car
 Required finish $R_z < 6 \mu\text{m}$
 (Production tolerance)
 Material **Nodular cast iron**
 Tensile strength 400 N/mm²

TOOL

EG45-1-40M-VDI40
 Machine
CNC lathe
 Speed (m/min.) 150
 Rotation speed (RPM) 300
 Feed rate (mm/rev.) 0,5
 Dial gauge indication
 (mm) 0,4
 Process time 19 seconds

MACHINING TASK

- Technical drawing specified a finish of $R_z < 12 \mu\text{m}$ to be achieved by turning alone
- About 10% of the parts were rejected because they were too rough and could not be reworked due to tight tolerance

RESULTS/ADVANTAGES

- Reliable process eliminates excess roughness and reduces part reject rate

Kugelbolzen / Ball stud**WERKSTÜCK****Kugelbolzen**

Teil von

Pkw

Forderung

 $R_z < 2 \mu\text{m}$

Material

geschmiedeter Stahl

Festigkeit

 1000 N/mm^2 **WERKZEUG****HG6-6K22-VDI40**

Maschine

CNC-Drehmaschine

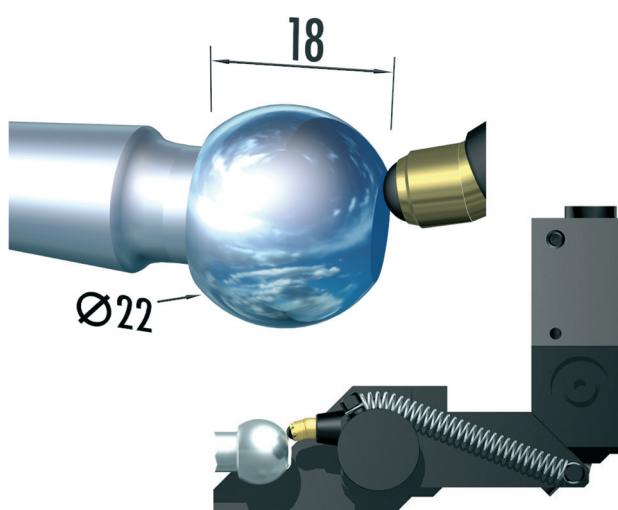
Geschwindigkeit

(m/min) **250 (konstant)**Drehzahl **variabel**Vorschub (mm/U) **0,1**Druck (bar) **160**Hauptzeit **3,8 Sekunden****AUFGABE**

- Das Werkzeug führt eine programmierte bogenförmige Bewegung um den Kugelmittelpunkt aus
- Der Hebel des Walzelements liegt am Anschlagbolzen hinter der Kugel an, dadurch schwenkt das Walzelement um die Kugel

ERGEBNISSE/VORTEILE

- $R_z < 1,6 \mu\text{m}$ erreicht

**ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE****318****WORKPIECE****Ball stud**

Part of

Passenger car

Required finish

 $R_z < 2 \mu\text{m}$

Material

Forged steel

Tensile strength

 1000 N/mm^2 **TOOL****HG6-6K22-VDI40**Machine **CNC lathe**

Speed (m/min.)

250 (constant)

Rotation speed (RPM)

variableFeed rate (mm/rev.) **0,1**Pressure (bar) **160**Process time **3.8 seconds****Bremskolben / Brake piston****WERKSTÜCK****Bremskolben**

Teil von

Schienenfahrzeug-BremseForderung $R_z < 2 \mu\text{m}$ **(Hartglattwalzen)**

Material

Cr-Ni StahlHärte **58-60 HRC****WERKZEUG****HG6-5Eoo°-VDI40**

Maschine

CNC-Drehmaschine

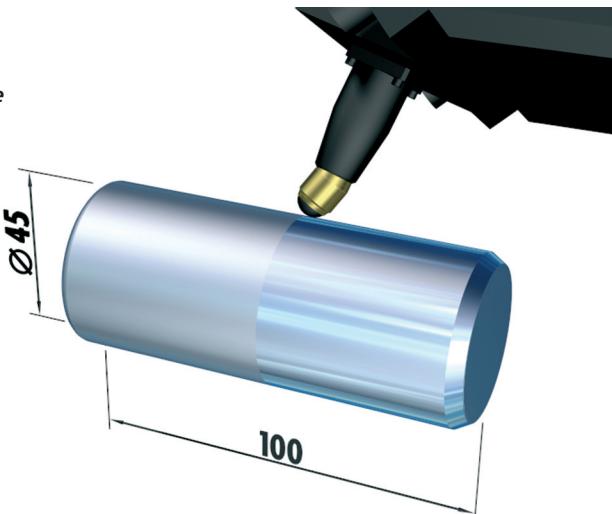
Geschwindigkeit

(m/min) **100**Drehzahl **720 min⁻¹**Vorschub (mm/U) **0,08**Druck (bar) **400**Hauptzeit **1,7 Minuten****AUFGABE**

- Die Rautiefe wird auf der gesamten Oberfläche gemessen
- Weil Überschreitung an keiner Stelle zulässig ist, gibt es eine Ausschussquote bei geschliffenen Kolben von 5 - 10%

ERGEBNISSE/VORTEILE

- höhere Produktionssicherheit
- kurze Bearbeitungszeit
- kein Umspannen
- einfache Glättung der Einführschräge

**ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE****319****WORKPIECE****Brake piston**

Part of

Rail vehicle brakesRequired finish $R_z < 2 \mu\text{m}$ **(Hard roller burnishing)**

Material

Cr-Ni SteelHardness **58-60 HRC****TOOL****HG6-5Eoo°-VDI40**

Machine

CNC latheSpeed (m/min.) **100**

Rotation speed

(RPM) **720**Feed rate (mm/rev.) **0,08**Pressure (bar) **400**Process time **1,7 minutes****MACHINING TASK**

- Final surface roughness is measured over the entire surface
- Part rejection rate of 5 - 10% because parts are rejected when just one section is too rough

RESULTS/ADVANTAGES

- Higher process reliability
- Shorter process time
- No resetting necessary
- Lead-in chamfers are easily burnished

ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE

320

Nockenwelle / Cam shaft

WERKSTÜCK

Nockenwelle

Teil von

Pkw-Motor

Forderung

 $R_z < 2 \mu\text{m}$

(Reibwert reduzieren)

Material

Schalenhartguss

Härte 55 HRC

WERKZEUG

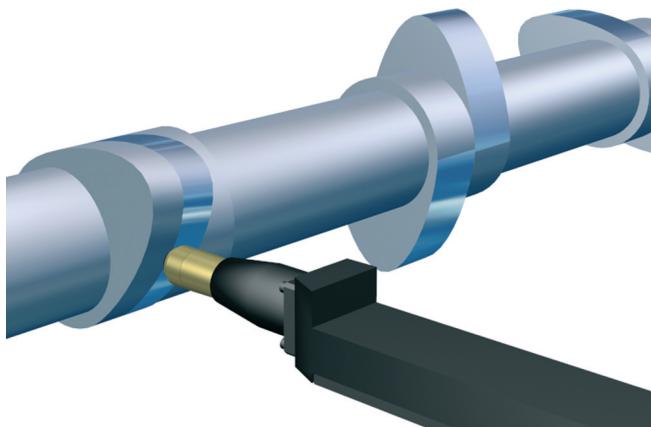
HG6-9 Sonderausführung mit verlängertem Hub

Maschine

DrehmaschineDrehzahl 40 min⁻¹

Vorschub (mm/U) 0,1

Druck (bar) 200



WORKPIECE

Cam shaft

Part of

Passenger car engine

Required finish

 $R_z < 2 \mu\text{m}$

(Reduce friction)

Material

Chilled cast iron

Hardness 55 HRC

TOOL

HG6-9 special version with extended stroke

Machine

Lathe

Rotation speed (RPM) 40

Feed rate (mm/rev.) 0.1

Pressure (bar) 200

AUFGABE

Durch Hartglattwalzen soll Reibungskoeffizient verringert und Verschleißfestigkeit erhöht werden

ERGEBNISSE/VORTEILE

- Reibung ca. 20% reduziert
- Härte 6% gesteigert

MACHINING TASK

Hard roller burnishing to reduce coefficient of friction and increase wear resistance

RESULTS/ADVANTAGES

- Friction reduced by 20%
- Hardness increased by 6%

Ventilkappe / Valve cap

WERKSTÜCK

Ventilkappe

Teil von

Pkw-Motor

Forderung

 $R_z < 2 \mu\text{m}$

Material Hartguss

Härte 58 HRC

WERKZEUG

HG6-9Roo°-SL25

Maschine

konventionelle Drehmaschine

Geschwindigkeit

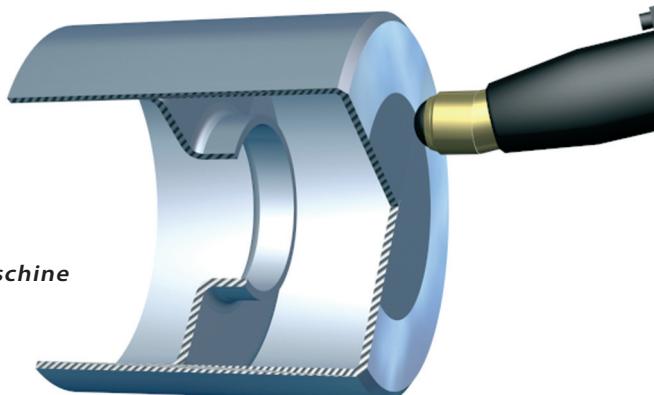
(m/min.) 100

Vorschub

(mm/U) 0,08

Druck (bar) 250

Hauptzeit 16 Sekunden



AUFGABE

Härtesteigerung und längere Lebensdauer erwartet

ERGEBNISSE/VORTEILE

Lebensdauer im gefeuerten Motor 50% länger, jedoch nicht im Komponenten-Teststand

ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE

321

WORKPIECE

Valve cap

Part of

Passenger car engine

Required finish

 $R_z < 2 \mu\text{m}$

Material

Chilled cast iron

Härte 58 HRC

TOOL

HG6-9Roo°-SL25

Machine

Conventional lathe

Speed (m/min.) 100

Feed rate

(mm/rev.) 0.08

Pressure (bar) 250

Process time 16 seconds

MACHINING TASK

Increase hardness and service life

RESULTS/ADVANTAGES

Service life increased 50% in actual engine, though these results were not repeated in the engine test stand

Wandlergehäuse / Torque converter housing

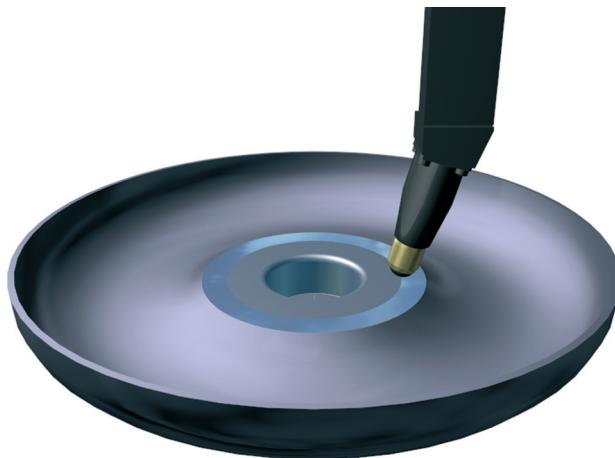
WERKSTÜCK
Wandlergehäuse
Teil von
Automatik-Getriebe
Forderung
 $R_z < 4 \mu\text{m}$
Material
Stahl (St 35)
Festigkeit
450 N/mm²

WERKZEUG
HG13-9L15°-SL25
Maschine
Vertikal-Drehmaschine
Geschwindigkeit
(m/min) **200**
Drehzahl **1270 min⁻¹**
Vorschub (mm/U) **0,25**
Druck (bar) **80**
Hauptzeit **36 Sekunden**

AUFGABE
Oberfläche soll gute Gleiteigenschaften aufweisen

ERGEBNISSE/VORTEILE

- Rautiefe $R_z < 2 \mu\text{m}$ erreicht (besser als gefordert)
- kurze Bearbeitungszeit



ANWENDUNGSBEISPIEL APPLICATION EXAMPLE

322

WORKPIECE
Torque converter housing
Part of
Automatic gear for passenger car
Required finish
 $R_z < 4 \mu\text{m}$
Material
Steel (St 35)
Tensile strength
450 N/mm²

TOOL
HG13-9L15°-SL25
Machine
Vertical lathe
Speed (m/min.) **200**
Rotation speed (RPM) **1270**
Feed rate (mm/rev.) **0.25**
Pressure (bar) **80**
Process time **36 seconds**

Ventil / Valve

WERKSTÜCK
Ventil
Teil von
Dieselmotor
Forderung
erhöhte Dauerfestigkeit
Material **Stahl**
Härte 55 HRC

WERKZEUG
HG13-9E270°-SL25
Maschine
CNC-Drehmaschine
Geschwindigkeit (m/min) **150**
Drehzahl **1200 min⁻¹**
Vorschub (mm/U) **0,25**
Druck (bar) **250**
Hauptzeit
2,5 Minuten

AUFGABE
Festwalzen von unterem Schaftteil, Radius und Teller in 2 Zonen

ERGEBNISSE/VORTEILE
verbesserte Produktqualität: Erhöhung der Dauerfestigkeit auf 250%



ANWENDUNGSBEISPIEL APPLICATION EXAMPLE

323

WORKPIECE
Valve
Part of
Diesel engine
Required finish
Increased fatigue strength
Material **Steel**
Hardness 55 HRC

TOOL
HG13-9E270°-SL25
Machine
CNC lathe
Speed (m/min.) **150**
Rotation speed (RPM) **1200**
Feed rate (mm/rev.) **0.25**
Pressure (bar) **250**
Process time
2.5 minutes

MACHINING TASK
Deep rolling of lower shaft, radius and disc in 2 zones

RESULTS/ADVANTAGES
Improved product quality: fatigue strength increased 250%

ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE

324

Kupplungsscheibe / Clutch disc

WERKSTÜCK

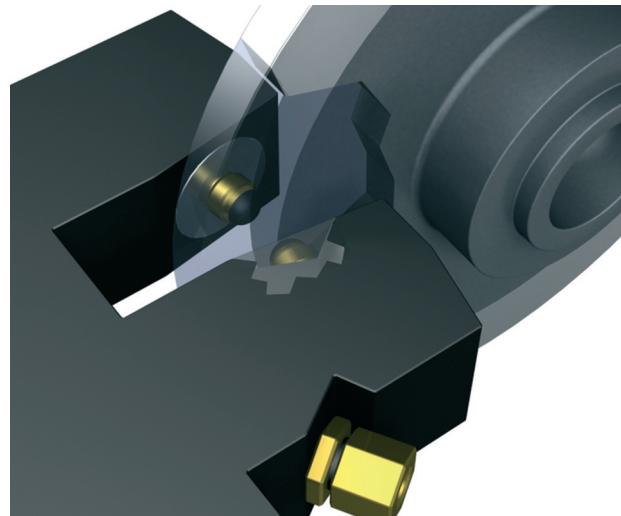
**Kupplungsscheibe /
Bremsscheibe**
Teil von

Nutzfahrzeug

Forderung $R_z < 4 \mu\text{m}$
Material Sphäroguss
Festigkeit 600 N/mm 2

WERKZEUG

**HG13-11.3P mit
2 gegenüberliegenden
Walzelementen**
Maschine
2-Spindel
CNC-Drehmaschine
Geschwindigkeit
(m/min) 250
Drehzahl 470 min $^{-1}$
Vorschub (mm/U) 0,2
Druck (bar) 120
Hauptzeit 32 Sekunden



AUFGABE

beidseitige, gleichzeitige Bearbeitung

ERGEBNISSE/VORTEILE

wesentliche Kostensenkung durch

- **größeren Vorschub beim Drehen**
- **längere Schneidenstandzeit**
- **weniger Werkzeugwechsel**

ANWENDUNGSBEISPIEL

APPLICATION EXAMPLE

324

WORKPIECE

Clutch disc /Brake disc

Part of

Truck drive train

Required finish

 $R_z < 4 \mu\text{m}$ Material **Modular iron**

Tensile strength

600 N/mm 2

TOOL

**HG13-11.3P with
2 burnishing elements**
Machine
Double spindle
CNC lathe
Speed (m/min.) 250
Rotation speed (RPM)
470
Feed rate (mm/rev.) 0.2
Pressure (bar) 120
Process time 32 seconds

MACHINING TASK

To machine both sides simultaneously

RESULTS/ADVANTAGES

Significant cost reduction due to

- greater feed rate during turning
- longer cutting insert service life
- fewer tool changes

Wanne / Half pipe

WERKSTÜCK

Wanne

Teil von

Industrie-HeißmangelForderung $R_z < 3 \mu\text{m}$

Material 1.4401

Streckgrenze

200 N/mm 2

WERKZEUG

**4 x EG14-1-SL00
an 4-Flügel-
Werkzeugträger**
Maschine

Spezial-Fräsmaschine

Geschwindigkeit

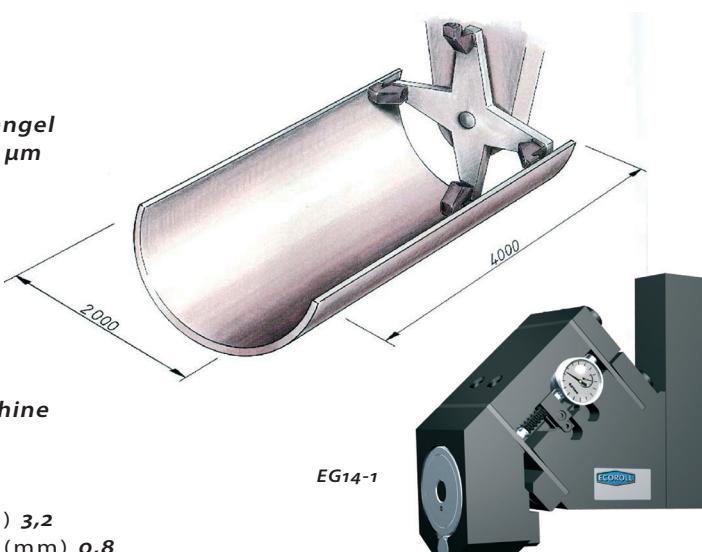
(m/min) 50

Drehzahl 7 min $^{-1}$

Vorschub (mm/U) 3,2

Messuhranzeige (mm) 0,8

Hauptzeit 157 Minuten



AUFGABE

- **Glattwalzen erfolgt in einer Aufspannung nach dem Ausspindeln**
- **Glattwalzwerkzeuge werden gegen Drehmeißel ausgetauscht**

ERGEBNISSE/VORTEILE

- **Einsparung von Bandschleifen und nachfolgendes Handpolieren**

ANWENDUNGSBEISPIEL

APPLICATION EXAMPLE

325

WORKPIECE

Half pipe

Part of

Industrial rotary ironRequired finish $R_z < 3 \mu\text{m}$ Material **Stainless steel**

Yield strength

200 N/mm 2

TOOL

**4 x EG14-1-SL00
on a 4 wing tool carrier**
Machine
Special milling machine
Speed (m/min.) 50
Rotation speed (RPM) 7
Feed rate (mm/rev.) 3,2
Dial gauge indication
(mm) 0,8
Process time
157 minutes

MACHINING TASK

- **Roller burnishing after cutting in one setting**
- **EG tools replace lathe cutting tools**

RESULTS/ADVANTAGES

- **Shorter process time: no grinding and subsequent hand polishing required**

Ventilgehäuse / Valve housing**WERKSTÜCK****Ventilgehäuse**

Teil von

ArmaturForderung $R_z < 1 \mu\text{m}$

Material

rostfreier Stahl

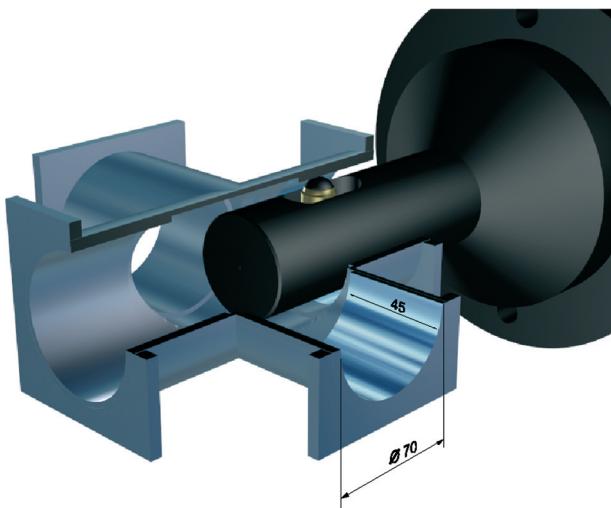
Festigkeit

 400 N/mm^2 **WERKZEUG****HG13-4X**

Maschine

Spezialmaschine

Geschwindigkeit

(m/min) **200**Drehzahl **900 min⁻¹**Vorschub (mm/U) **0,2**Druck (bar) **100**Hauptzeit **15 Sekunden****AUFGABE**

- Vormontierte Auskleidungsbuchsen werden glattgewalzt und gleichzeitig aufgeweitet*
- Die geringe Wandstärke und die große Bohrungstoleranz ($\varnothing 70^{+0,2} \text{ mm}$) erfordern eine automatische Ø-Anpassung und eine vom Ist-Ø unabhängige konstante Walzkraft*

ERGEBNISSE/VORTEILE

- Prozesszeit um 20 Minuten verkürzt*
- Glattgewalzt auf die geforderte Rautiefe*
- Verbesserter Sitz der Auskleidungsbuchsen*

ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE**326****WORKPIECE****Valve housing**

Part of

Armature

Required finish

 $R_z < 1 \mu\text{m}$ Material **Stainless steel**

Tensile strength

 400 N/mm^2 **TOOL****HG13-4X**

Machine

Special machineSpeed (m/min.) **200**Rotation speed (RPM) **900**Feed rate (mm/rev.) **0.2**Pressure (bar) **100**Process time **15 seconds****MACHINING TASK**

- Roller burnish and expand liners*
- Low wall thickness and large bore tolerance ($\varnothing 70^{+0,2} \text{ mm}$) require a tool with automatic adjustment and constant burnishing force independent of actual diameter size*

RESULTS/ADVANTAGES

- Process is 20 minutes shorter*
- Required surface finish achieved*
- Liner fit improved*

Bremstrommel / Brake drum**WERKSTÜCK****Bremstrommel**

Teil von

Motorrad

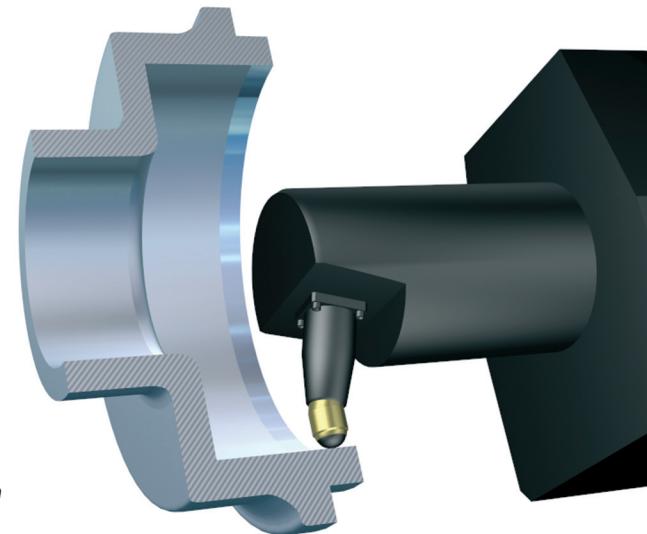
Forderung

 $R_z < 4 \mu\text{m}$ Material **GGG****WERKZEUG****HG6-2**

Maschine

CNC-Drehmaschine

Geschwindigkeit

(m/min) **180**Drehzahl **380 min⁻¹**Vorschub (mm/U) **0,2**Druck (bar) **100**Hauptzeit **40 Sekunden****AUFGABE**

- Die Bremsfläche wird glattgewalzt, damit sich das einlaufen erleichtert und die Brems-eigenschaften sich nicht mehr verändern*
- Die Fertigungstoleranzen erfordern eine automatische Ø-Anpassung und eine vom Ist-Ø unabhängige konstante Walzkraft*

ERGEBNISSE/VORTEILE

- weniger Verschleiß*
- höhere Sicherheit*

ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE**327****WORKPIECE****Brake drum**

Part of

Motorcycle

Required finish

 $R_z < 4 \mu\text{m}$ Material **Nodular cast iron****TOOL****HG6-2**

Machine

CNC latheSpeed (m/min.) **180**Rotation speed (RPM) **380**Feed rate (mm/rev.) **0.2**Pressure (bar) **100**Process time **40 seconds****MACHINING TASK**

- Roller burnish brake surfaces to reduce the effect of wear on brake quality*
- To achieve the required finish, the tool must have automatic diameter adjustment and provide constant burnishing force, independent of diameter size*

RESULTS/ADVANTAGES

- Less wear*
- Better part reliability*

Glasform / Glass forming mandrel

WERKSTÜCK

Glasform

Teil von
Werkzeug für
Glasflaschen

Forderung

$R_z < 2 \mu\text{m}$

Material **Stahl**

Härte **55 HRC**

mittlerer Ø (mm) **35**

mittlere Länge (mm) **135**

WERKZEUG

HG6-9L65°-SLK20

HG6-9L15°-SLK20

Maschine

CNC-Drehmaschine

Geschwindigkeit (m/min) **200**

Drehzahl **1800 min⁻¹**

Vorschub (mm/U) **0,1**

Druck (bar) **300**

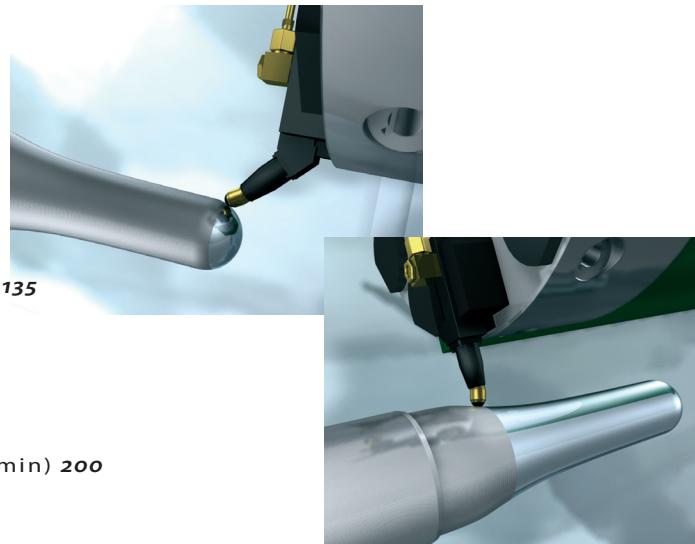
Hauptzeit **45 Sekunden**

AUFGABE

- Die Bearbeitung erfolgt in einer Aufspannung nach dem Drehen der Kontur
- Die Fläche ist in 2 Zonen aufgeteilt:
 - Kuppe vom Zentrum aus bis ca. 60°
 - restliche Kontur

ERGEBNISSE/VORTEILE

- Zeiteinsparung: Handpolieren ersetzt
- Härtezunahme
- gleichmäßige Qualität



ANWENDUNGSBEISPIEL APPLICATION EXAMPLE

330

WORKPIECE

Glass forming mandrel

Part of

Form for glass bottles

Required finish

$R_z < 2 \mu\text{m}$

Material **Steel**

Hardness **55 HRC**

Average Ø (mm) **35**

Average length (mm) **135**

TOOL

HG6-9L65°-SLK20

HG6-9L15°-SLK20

Machine

CNC lathe

Speed (m/min.) **200**

Rotation speed (RPM) **1800**

Feed rate (mm/rev.) **0,1**

Pressure (bar) **300**

Process time **45 seconds**

MACHINING TASK

- Roller burnish the surface in one setting after turning
- The surface is split into 2 zones:
 - Rounded end from its center to about 60°
 - Remaining contour

RESULTS/ADVANTAGES

- Process is shortened: no hand polishing required
- Increased surface hardness
- Consistent quality

Rolle / Roller for rocker arm

WERKSTÜCK

Rolle

Teil von

Dieselmotor

Forderung

$R_{max.} < 1 \mu\text{m}$

Material

Einsatzstahl

Härte **59-63 HRC**

Bohrungsdurchmesser

(mm) **45**

Länge (mm) **50**

WERKZEUG

HG6-1-VDI40

Maschine

CNC-Drehmaschine

Geschwindigkeit

(m/min) **125**

Drehzahl **900 min⁻¹**

Vorschub (mm/U) **0,08**

Druck (bar) **400**

Hauptzeit **43 Sekunden**

AUFGABE

Hartglattwalzen in einer Aufspannung nach dem Hartdrehen

ERGEBNISSE/VORTEILE

Einsparung des separaten Läppvorganges



ANWENDUNGSBEISPIEL APPLICATION EXAMPLE

331

WORKPIECE

Roller for rocker arm

Part of

Diesel engine

Required finish

$R_{max.} < 1 \mu\text{m}$

Material

Case-hardened steel

Hardness **59-63 HRC**

Bore diameter (mm) **45**

Length (mm) **50**

TOOL

HG6-1-VDI40

Machine

CNC lathe

Speed (m/min.) **125**

Rotation speed (RPM) **900**

Feed rate (mm/rev.) **0,08**

Pressure (bar) **400**

Process time **43 seconds**

MACHINING TASK

Roller burnishing in one setting after hard turning

RESULTS/ADVANTAGES

Process time saved: no separate lapping operation required

Schneckenwelle / Helix shaft**WERKSTÜCK****Schneckenwelle**

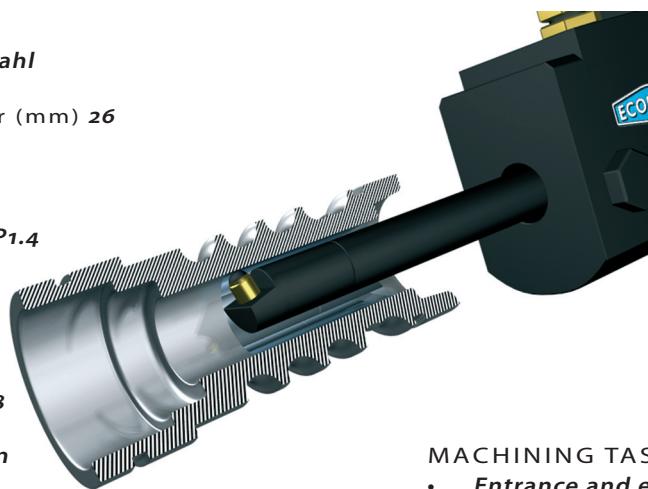
Teil von

SpritzgussmaschineForderung $R_z < 1 \mu\text{m}$ Material **Vergütungsstahl**Härte **55 HRC**Bohrungsdurchmesser (mm) **26**Länge (mm) **80****WERKZEUG****HG6-1-VDI40 mit****Hydraulikaggregat HGP1.4**

Maschine

CNC-Drehmaschine

Geschwindigkeit

(m/min.) **73**Drehzahl **900 min⁻¹**Vorschub (mm/U) **0,08**Druck (bar) **300**Hauptzeit **67 Sekunden****AUFGABE**

- Kanten an Ein- und Austrittsseite bleiben scharfkantig durch verzögerten Druckauf- und abbau
- Planflächen werden nach dem Glattwalzen abgeplant
- Das Hydraulikaggregat wird über M-Funktion der Maschine gesteuert

ERGEBNISSE/VORTEILE

- Einsparung des separaten Honens
- hoher Materialtraganteil und Härtezunahme

ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE**332****WORKPIECE****Helix shaft**

Part of

Injection molding machineRequired finish $R_z < 1 \mu\text{m}$ Material **Heat treated steel**Hardness **55 HRC**Bore diameter (mm) **26**Length (mm) **80****TOOL****HG6-1-VDI40 with hydraulic pump unit HGP1.4**

Machine

CNC latheSpeed (m/min.) **73**Rotation speed (RPM) **900**Feed rate (mm/rev.) **0.08**Pressure (bar) **300**Process time **67 seconds****MACHINING TASK**

- Entrance and exit side edges remain sharp due to controlled build-up and release of pressure
- Both faces are finished by turning after the bore is roller burnished
- The machine's M-function controls the hydraulic unit for precise start and stop

RESULTS/ADVANTAGES

- Process time saved: no separate honing operation required
- Higher bearing ratio and increased hardness

Formdorn / Mandrel for injection mold**WERKSTÜCK****Formdorn**

Teil von

SpritzgussformForderung $R_z < 1 \mu\text{m}$

Material

WerkzeugstahlHärte **48-52 HRC**mittlerer Ø (mm) **45**Länge (mm) **250****WERKZEUG****HG6-11Eoo°-VDI20 mit****Hydraulikaggregat HGP1.3**

Maschine

CNC-Drehmaschine

Geschwindigkeit

(m/min.) **180**

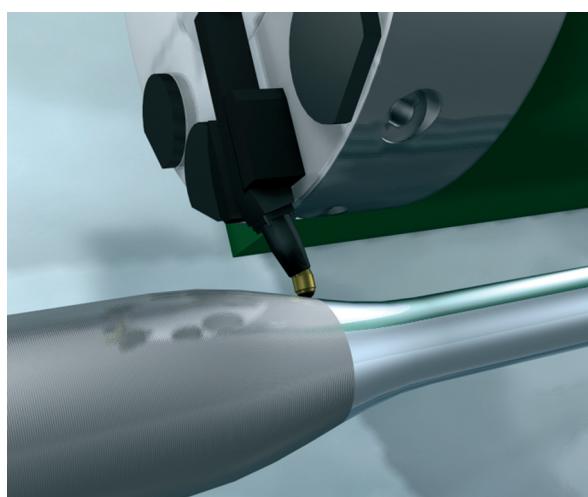
mittlere Drehzahl

1280 min⁻¹Vorschub (mm/U) **0,1**Druck (bar) **250**Hauptzeit **120 Sekunden****AUFGABE**

- Die Kontur wird nach dem Hartdrehen in einer Aufspannung glattgewalzt
- Das Werkzeug wird programmgesteuert parallel zur Kontur verfahren und hält dabei die Walzkraft durch sein integriertes Nachführsystem konstant

ERGEBNISSE/VORTEILE

- Einsparung des manuellen Polievorganges

**ANWENDUNGSBEISPIEL**
APPLICATION EXAMPLE**333****WORKPIECE****Mandrel for injection mold**

Part of

Plastic injection mold

Required finish

 $R_z < 1 \mu\text{m}$ Material **Tool steel**Hardness **48-52 HRC**Average Ø (mm) **45**Length (mm) **250****TOOL****HG6-11Eoo°-VDI20 with hydraulic pump unit HGP1.3**Machine **CNC lathe**Speed (m/min.) **180**Average rotation speed (RPM) **1280**Feed rate (mm/rev.) **0.1**Pressure (bar) **250**Process time **120 seconds****MACHINING TASK**

- Hard roller burnish the contour in one setting after hard turning
- Controlled by the machine's program, the tool moves parallel to the contour
- The integrated following system allows the tool to maintain consistent burnishing force

RESULTS/ADVANTAGES

- No manual polishing required

Pressdorn / Punch**WERKSTÜCK****Pressdorn**

Teil von

Prägewerkzeug

Forderung

 $R_a < 0,1 \mu\text{m}$

Material

Werkzeugstahl

Härte 64 +1 HRC

Durchmesser (mm) 15

WERKZEUG**HG6-9Eoo°-SL25 mit****Hydraulikaggregat HGP1.3**

Maschine

CNC-Drehmaschine

Geschwindigkeit (m/min) 40

mittlere Drehzahl 640 min⁻¹

Vorschub (mm/U) 0,08

Druck (bar) 400

Hauptzeit 18 Sekunden

AUFGABE**Hartglattwalzen der Kuppe über das Zentrum und die Signierung****ERGEBNISSE/VORTEILE****Zeiteinsparung durch Wegfall einer separaten Arbeitsganges****ANWENDUNGSBEISPIEL**
APPLICATION EXAMPLE**334****WORKPIECE****Punch**

Part of

Forming tool

Required finish

 $R_a < 0,1 \mu\text{m}$ Material **Tool steel**

Hardness 64 +1 HRC

Diameter (mm) 15

TOOL**HG6-9Eoo°-SL25 with hydraulic pump unit HGP1.3**

Machine

CNC lathe

Speed (m/min.) 40

Average rotation speed

(RPM) 640

Feed rate (mm/rev.) 0.08

Pressure (bar) 400

Process time 18 seconds

MACHINING TASK**Hard roller burnish the entire rounded end, including the center and engraved lettering****RESULTS/ADVANTAGES****Process time saved: no hand polishing required****Steuerkolben / Control piston****WERKSTÜCK****Steuerkolben**

Teil von

HydraulikventilForderung $R_z < 1 \mu\text{m}$

Material

Stahl, vakuumgehärtet

Härte 52 HRC

Durchmesser (mm) 25

Länge (mm) 80

WERKZEUG**HG6-9Eoo°-SL25**

Maschine

CNC-Drehmaschine

Geschwindigkeit

(m/min) 120

Drehzahl 1530 min⁻¹

Vorschub (mm/U) 0,08

Druck (bar) 320

Hauptzeit 39 Sekunden

**ANWENDUNGSBEISPIEL**
APPLICATION EXAMPLE**335****WORKPIECE****Control piston**

Part of

Hydraulic valve

Required finish

 $R_z < 1 \mu\text{m}$

Material

Vacuum hardened steel

Hardness 52 HRC

Diameter (mm) 25

Length (mm) 80

TOOL**HG6-9Eoo°-SL25**Machine **CNC lathe**

Speed (m/min.) 120

Rotation speed

(RPM) 1530

Feed rate (mm/rev.) 0.08

Pressure (bar) 320

Process time 39 seconds

MACHINING TASK**Roller burnishing takes place in one setting after hard turning****RESULTS/ADVANTAGES****Process time saved: no subsequent honing or grinding necessary**

ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE

336

Achswelle / Getriebewelle
Axle shaft / Gear shaft

WERKSTÜCK

Achswelle / GetriebewelleTeil von **Ackerschlepper**Forderung $R_z < 0,8 - 2,5 \mu\text{m}$ Material **Einsatzstahl**Härte **58-60 HRC**

WERKZEUG

angetriebenes Werkzeug**HG6-5E30°-VDI40**

Maschine

CNC-Drehmaschine

Geschwindigkeit

(m/min) **150**

Drehzahl (Teil 1)

1600 min⁻¹

Drehzahl (Teil 2)

530 min⁻¹

Vorschub

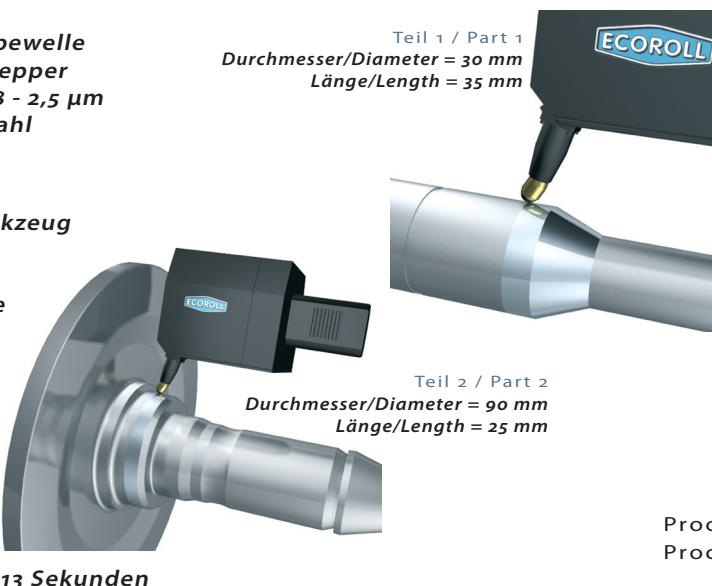
(mm/U) **0,1**Druck (bar) **400**Hauptzeit (Teil 1) **13 Sekunden**Hauptzeit (Teil 2) **28 Sekunden**

AUFGABE

- Glattwalzen der Flächen für Radialwellendichtringe und Wälzlager nach dem Hartdrehen
- Bei Teil 2 wird zusätzlich die Hohlkehle festgewalzt

ERGEBNISSE/VORTEILE

- Zeiteinsparung durch Wegfall des Schleifens
- verbesserte Produktqualität, erhöhte Betriebsfestigkeit



WORKPIECE

Axle shaft / Gear shaftPart of **Tractor**

Required finish

 $R_z < 0,8 - 2,5 \mu\text{m}$ Material **Case hardened steel**Hardness **58-60 HRC**

TOOL

Driven tool HG6-5E30°-VDI40 with integrated pumpMachine **CNC lathe**Speed (m/min.) **150**Rotation speed (Part 1)
(RPM) **1600**Rotation speed (Part 2)
(RPM) **530**Feed rate (mm/rev.) **0,1**Pressure (bar) **400**Process time (Part 1) **13 seconds**Process time (Part 2) **28 seconds**

MACHINING TASK

- Roller burnish rotary seal surfaces and needle bearings after hard turning
- Deep roll the fillet radius on Part 2 to increase fatigue strength

RESULTS/ADVANTAGES

- Shorter process time: no grinding required
- Improved product quality and service life

Schaftkegelrad / Angle gear shaft

WERKSTÜCK

Schaftkegelrad

mit diversen Durchmessern

Teil von

Fahrzeuggtriebe

Forderung

 $R_z < 1 \mu\text{m}$

Material

EinsatzstahlHärte **60-62 HRC**

WERKZEUG

HG6-9

Maschine

CNC-Drehmaschine

Geschwindigkeit

(m/min) **150**Vorschub (mm/U) **0,2**Druck (bar) **400**

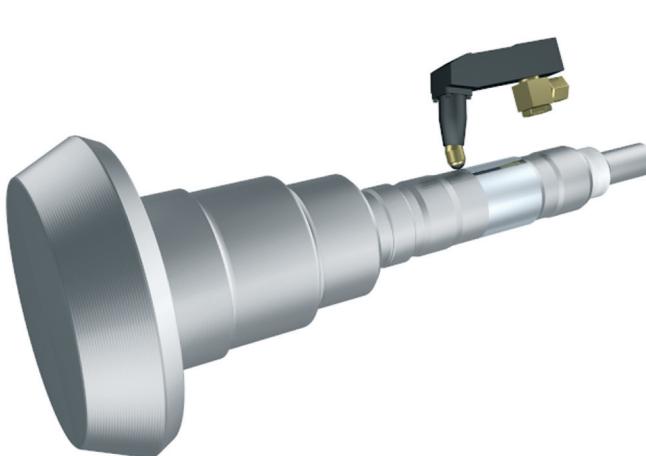
Hauptzeit

3 Sekunden

AUFGABE

Hartglattwalzen von Dichtungs- und Lagerauflächen nach dem Hartdrehen

ERGEBNISSE/VORTEILE

Einsparung des SchleifensANWENDUNGSBEISPIEL
APPLICATION EXAMPLE

337

WORKPIECE

Gear shaft with various diameters

Part of

Automotive gear

Required finish

 $R_z < 1 \mu\text{m}$

Material

Case hardened steelHardness **60-62 HRC**

TOOL

HG6-9

Machine

CNC latheSpeed (m/min.) **150**Feed rate (mm/rev.) **0,2**Pressure (bar) **400**

Process time

3 seconds

MACHINING TASK

Hard roller burnish the seal and bearing seats after hard turning

RESULTS/ADVANTAGES

Shorter process time: no grinding required

ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE

501

Turbinenscheibe / Turbine wheel**WERKSTÜCK**
Turbinenscheibe

Teil von
Dampfturbine
Forderung
Spannungsrissskorrosion vermeiden
Material
Vergütungsstahl
Härte 45 HRC
Festigkeit
1200 N/mm²

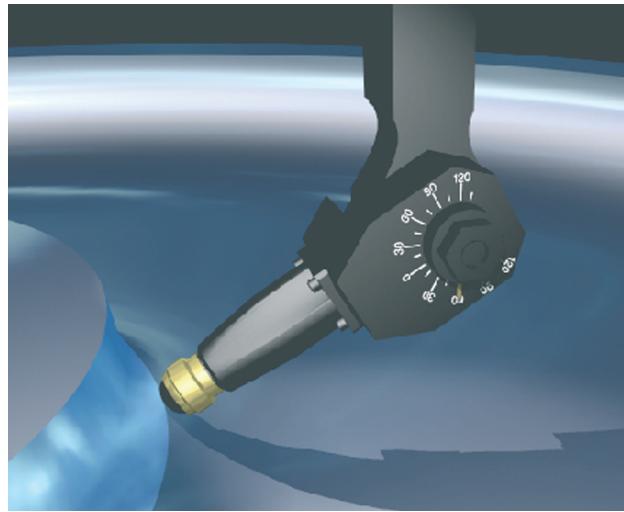
WERKZEUG
HG13-9E270°-SL32
Maschine
Karusselldrehmaschine
Geschwindigkeit
(m/min.) 100
Drehzahl 25-40 min⁻¹
Vorschub (mm/U) 0,44
Druck (bar) 200
Hauptzeit 60 Minuten

AUFGABE

- Die zu bearbeitende Werkstückpartie wird in mehrere Zonen aufgeteilt, die mit einer der Kontur entsprechenden Werkzeugneigung glattgewalzt werden

ERGEBNISSE/VORTEILE

- Druckeigenspannungen in einer Aufspannung nach dem Drehen eingebracht



WORKPIECE
Turbine wheel
Part of
Steam turbine
Required finish
Eliminate stress corrosion cracking
Material
Heat treated steel
Hardness 45 HRC
Tensile strength
1200 N/mm²

TOOL
HG13-9E270°-SL32
Machine
Vertical lathe
Speed (m/min.) 100
Rotation speed
(RPM) 25-40
Feed rate (mm/rev.) 0.44
Pressure (bar) 200
Process time 60 minutes

MACHINING TASK

- Deep roll the curved area between the hub and outer rim
- The workpiece is divided into zones, each machined with a unique tool angle that corresponds to the average local surface inclination

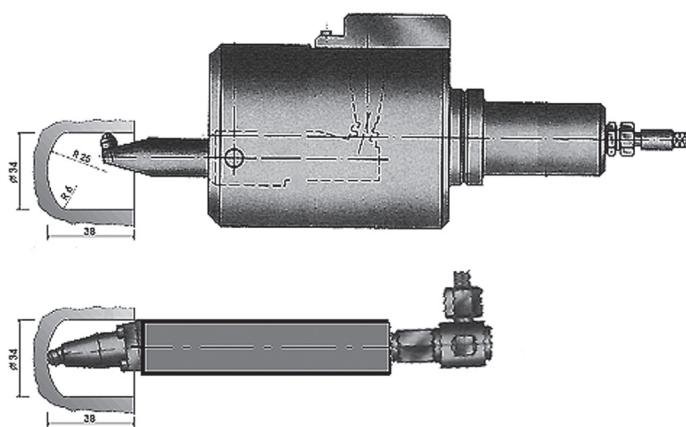
RESULTS/ADVANTAGES

- Compressive residual stresses generated in one setting after turning

Sicherungsbohrung / Securing bore**WERKSTÜCK**
Sicherungsbohrung

Teil von
Turbinenscheibe für Dampfturbine
Material
Vergütungsstahl
Härte 45 HRC
Festigkeit
1300 N/mm²

WERKZEUG
HG6-1E15°ZS40DD
HG6-1E20°ZS40DD
Maschine
Bearbeitungszentrum
Drehzahl 90 min⁻¹
Vorschub
(mm/U) 0,25
Druck (bar) 250
Hauptzeit 15 Minuten

**WORKPIECE**
Securing bore

Part of
Steam turbine wheel disc
Material
Heat treated steel
Hardness 45 HRC
Tensile strength
1300 N/mm²

TOOL
HG6-1E15°ZS40DD
HG6-1E20°ZS40DD
Machine
Milling center
Rotation speed
(RPM) 90
Feed rate
(mm/rev.) 0.25
Pressure (bar) 250
Process time 15 minutes

AUFGABE

- Zylindrischer Bereich und Boden einschließlich Zentrum festwalzen

ERGEBNISSE/VORTEILE

- Ermöglicht erstmalig Verfestigung dieser kritischen Stelle
- mit anderen Verfahren nicht möglich

MACHINING TASK

- Deep roll the cylindrical section and underside, including the center

RESULTS/ADVANTAGES

- For the first time improving the fatigue life of this critical section is possible
- No other known process achieves these results

Kegelstiftbohrung / Taper pin holeANWENDUNGSBEISPIEL
APPLICATION EXAMPLE

503

WERKSTÜCK**Kegelstiftbohrung**

Teil von

Turbinenscheibe für Dampfturbine

Material

Vergütungsstahl

Härte 45 HRC

Festigkeit

1300 N/mm²**WERKZEUG****HG3-11**

Maschine

Radialbohrmaschine

Geschwindigkeit

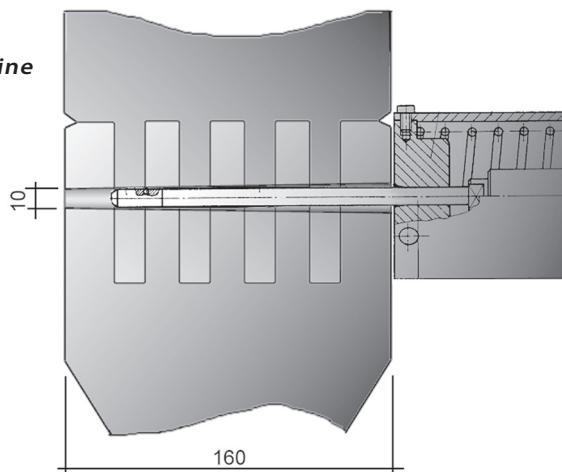
(m/min) 25

Drehzahl 660 min⁻¹

Vorschub (mm/U) 0,2

Druck (bar) 250

Hauptzeit 75 Sekunden

**AUFGABE**

- Einbringung von Druckeigenspannungen um Spannungsrisskorrosion zu beseitigen
- 2 gegenüberliegenden hydrostatischen Kugeln gewährleisten eine gleichmäßige Walzkraft entlang des Kegels

ERGEBNISSE/VORTEILE

- Kugelstrahlen wurde ersetzt

MACHINING TASK

- Eliminate stress corrosion cracking by introducing compressive residual stresses
- 2 hydrostatic burnishing balls arranged opposite each other guarantee consistent burnishing force

RESULTS/ADVANTAGES

- This operation replaces shot peening

Dehnschraube / Tension boltANWENDUNGSBEISPIEL
APPLICATION EXAMPLE

504

WERKSTÜCK**Dehnschraube**

Teil von

Flugzeug-**Triebwerksaufhängung**

Material Titan-Legierung

Festigkeit

1600 N/mm²**WERKZEUG****HG6-9Roo°-SL25**

Maschine

CNC-Drehmaschine

Geschwindigkeit

(m/min) 60

Drehzahl

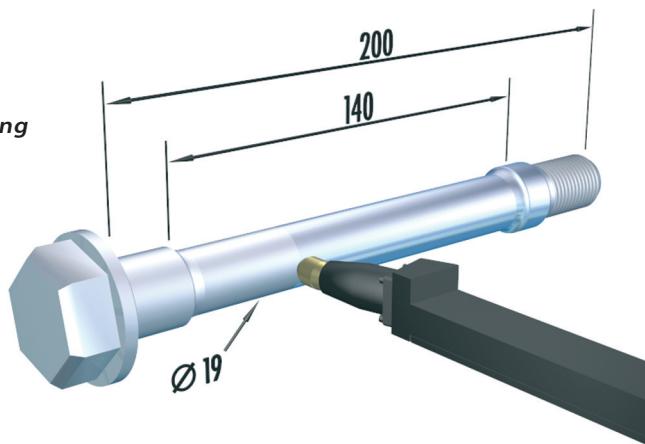
1000 min⁻¹

Vorschub (mm/U)

0,3

Druck (bar) 250

Hauptzeit 28 Sekunden

**AUFGABE****Erhöhung der Dauerfestigkeit durch Festwalzen****ERGEBNISSE/VORTEILE**

- Forderung wurde erfüllt
- Prozessfreigabe erfolgte innerhalb von ca. 10 Wochen

WORKPIECE**Tension bolt**

Part of

Aircraft engine suspension

Material Titanium alloy

Tensile strength

1600 N/mm²**TOOL****HG6-9Roo°-SL25**

Machine

CNC lathe

Speed (m/min.) 60

Rotation speed (RPM)

1000

Feed rate (mm/rev.)

0,3

Pressure (bar) 250

Process time

28 seconds

MACHINING TASK**Deep rolling to improve fatigue strength****RESULTS/ADVANTAGES**

- Required results were achieved
- The process was approved for use within about 10 weeks

Biegewelle / Flexible shaftANWENDUNGSBEISPIEL
APPLICATION EXAMPLE

505

WERKSTÜCK

Biegewelle

Teil von

Exzenterorschneckenpumpe

Material

Vergütungsstahl

Festigkeit

1600 N/mm²

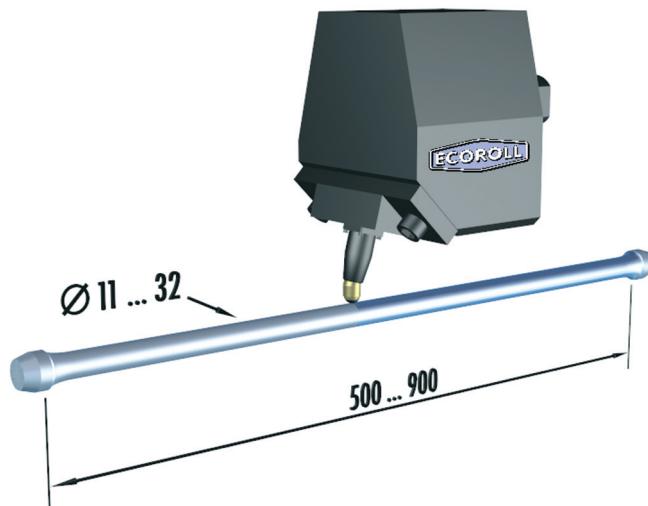
WERKZEUG

HG6-5Eoo°-VDI50

Maschine

CNC-Drehmaschine

Geschwindigkeit

(m/min) **100**Vorschub (mm/U) **0,3**Druck (bar) **350**

AUFGABE

Bei einem Teil der Anwendungen wird der gesamte eingeschnürte Bereich festgewalzt, bei anderen nur die Radien

ERGEBNISSE/VORTEILE

Erhöhung der Dauerfestigkeit um 40%

MACHINING TASK

Some of the applications required deep rolling of the entire neck length, others required deep rolling just the fillet

RESULTS/ADVANTAGES

Fatigue strength increased by 40%

API-Kegelgewinde / API thread pinANWENDUNGSBEISPIEL
APPLICATION EXAMPLE

506

WERKSTÜCK

API-Kegelgewinde

Teil von

Verbindung für Erdöltiefbohrgerät

Forderung

höhere BetriebsfestigkeitMaterial **42 CrMo 4 V**Festigkeit **1200 N/mm²**Streckgrenze **900 N/mm²**

WERKZEUG

EF90-025-Ro,8-VDI50

Maschine

CNC-Drehmaschine

Geschwindigkeit

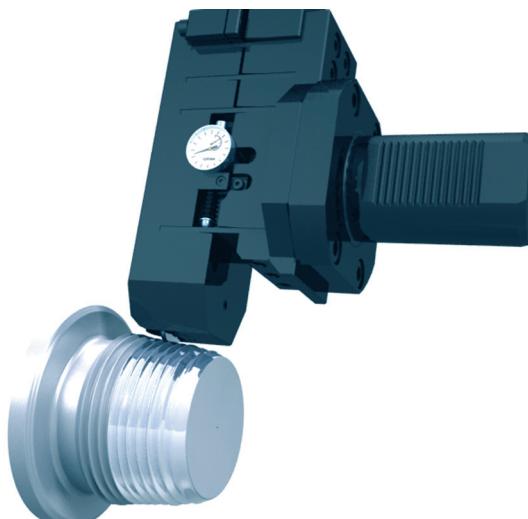
(m/min) **20**Drehzahl **53 min⁻¹**Vorschub (mm/U) **6,35**Messuhranzeige (mm) **0,9**Walzkraft (N) **8500**Hauptzeit **53 Sekunden**

AUFGABE

- Gewinde konnten bisher nicht auf CNC-Drehmaschine festgewalzt werden*
- Sie wurden mit hohem Zeitaufwand separat auf konventionellen Maschinen behandelt*

ERGEBNISSE/VORTEILE

- Prozesszeit verkürzt*
- Nebenzeiten für Transport und Umspannen entfallen*



WORKPIECE

API thread pin (tapered)

Part of

Connector for petroleum deep drilling apparatus

Required result

Greater service strengthMaterial **42 CrMo 4 V**Tensile strength **1200 N/mm²**Yield strength **900 N/mm²**

TOOL

EF90-025-Ro,8-VDI50

Machine

CNC latheSpeed (m/min.) **20**Rotation speed (RPM) **53**Feed rate (mm/rev.) **6,35**Dial gauge indication (mm) **0,9**Burnishing force (N) **8500**Process time **53 seconds**

MACHINING TASK

- Previously, threads could not be deep rolled on CNC lathes*
- Before, the time-consuming process involved a separate machining operation on conventional lathes*

RESULTS/ADVANTAGES

- Process time shortened*
- No extra time required for transportation and resetting*

Zugtraverse / Tie bar**WERKSTÜCK****Zugtraverse**

Teil von

Spritzgussmaschine**Material****Vergütungsstahl**

Härte 42 HRC

Festigkeit

1000 N/mm²

Streckgrenze

650 N/mm²

Durchmesser (mm)

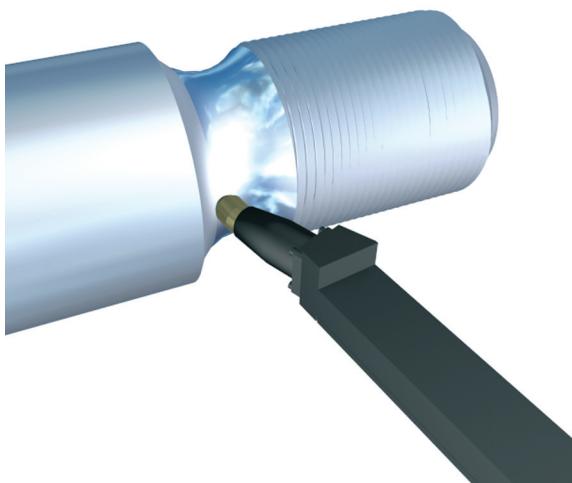
32-100

WERKZEUG**HG6-9Roo°-SL32**Drehzahl 100 min⁻¹

Vorschub (mm/U) 0,2

Druck (bar) 350

Hauptzeit 2,5 Minuten

**AUFGABE**

- Zugstangen brachen u. a. in den Gewindefreistichen durch Materialermüdung*
- Dauerfestigkeit erhöhen durch Festwalzen*

ERGEBNISSE/VORTEILE

- Im Teststand dauerfest*
- geringer Zeitaufwand, da Festwalzen in einer Aufspannung nach dem Drehen erfolgt*

ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE**507****WORKPIECE****Tie bar**

Part of

Injection molding machine**Material****Heat treated steel**

Hardness 42 HRC

Tensile strength

1000 N/mm²Yield strength 650 N/mm²

Diameter (mm) 32-100

TOOL**HG6-9Roo°-SL32**Rotation speed
(RPM) 100

Feed rate (mm/rev.) 0,2

Pressure (bar) 350

Process time 2,5 minutes

MACHINING TASK

- Components failed due to fatigue in the thread undercut*
- Deep rolling to increase fatigue strength*

RESULTS/ADVANTAGES

- In the test stand, deep rolled components withstood required stress without failing*
- Shorter process time because deep rolling can take place in one setting after turning*

Kurbelwelle / Crank shaft**WERKSTÜCK****Kurbelwelle**

Teil von

Kolbenkompressor**Material GGG 60**

Härte 55 HRC

WERKZEUG**HG13R mit Profilrolle****Maschine****CNC-Drehmaschine**Geschwindigkeit
(m/min) 8Drehzahl 60 min⁻¹

Vorschub (mm/U) 0

(Einstichverfahren)

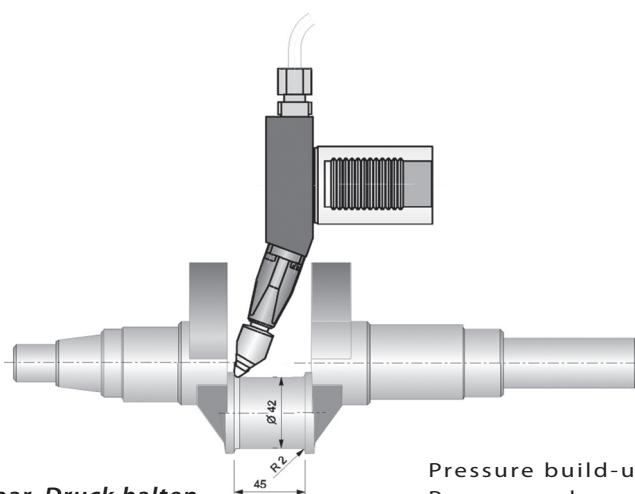
Druck (bar) 400

Druckaufbau 0->400 bar, Druck halten

Druckabbau 400->50 bar

(Auf- und Abbau jeweils 5 Sekunden)

Hauptzeit 30 Sekunden

**AUFGABE**

- Festwalzen der Hohlkehlen am Kurbelzapfen*
- Kurbelzapfen wird zentrisch gespannt*
- Die Maschine ist mit 2 Werkzeugen mit unterschiedlichen Anstellwinkeln ausgestattet*
- Die Radien werden nacheinander festgewalzt*

ERGEBNISSE/VORTEILE

- deutliche Erhöhung der Betriebsfestigkeit und der Zuverlässigkeit*

ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE**508****WORKPIECE****Crank shaft**

Part of

Piston air compressor**Material Nodular cast iron**

Hardness 55 HRC

TOOL**HG13R with profile roller****Machine****CNC lathe**

Speed (m/min.) 8

Rotation speed (RPM) 60

Feed rate (mm/rev.) 0

(plunge process)

Pressure (bar) 400

Pressure build-up 0->400 bar, hold pressure steady

Pressure release 400->50 bar

(for build-up and release allow 5 seconds each)

Process time 30 seconds

MACHINING TASK

- Deep roll crank shaft fillets*
- The crank shafts are fixed in the center for deep rolling*
- The machine is equipped with 2 tools, each arranged at a different angle*
- The fillets are deep rolled in succession*

RESULTS/ADVANTAGES

- Distinct improvement in service strength and product reliability*

Zylinderbuchse / Cylinder liner

WERKSTÜCK

Zylinderbuchse

Teil von Schiffsdiesel

Material GGG 40

Festigkeit 400 N/mm²

Außendurchmesser

(mm) ca. 300

Hohlkehle Radius (mm) 2,5

WERKZEUG

EF45-1-VDI40

Maschine

CNC-Drehmaschine

Geschwindigkeit (m/min) 50

Drehzahl 50 min⁻¹

Vorschub (mm/U) 0

(Einstichverfahren)

Festwalzkraft (kN) 10

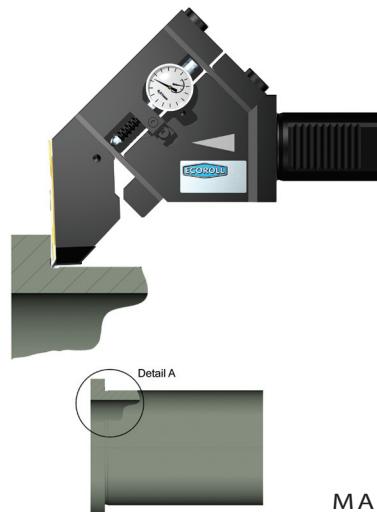
Hauptzeit 18 Sekunden

AUFGABE

- Festwalzen von Hohlkehle
- In der Hohlkehle traten durch Kerbwirkung und Wechselbiegung Ermüdungsbrüche auf
- Das Festwalzen erfolgt nach der Zerspanung in folgendem Zyklus:
 1. Kraftaufbau 0->10 kN
 2. konstante Kraft->10 kN
 3. Kraftabbau 10->0 kN
 jeweils 5 Umdrehungen

ERGEBNISSE/VORTEILE

- Dauerfestigkeit im Dauerschwingversuch verdoppelt



ANWENDUNGSBEISPIEL APPLICATION EXAMPLE

509

WORKPIECE

Cylinder liner

Part of

Marine diesel engine

Material Nodular cast iron

Tensile strength 400 N/mm²

Outer diameter (mm) ca. 300

Fillet radius (mm) 2,5

TOOL

EF45-1-VDI40

Machine CNC lathe

Speed (m/min.) 50

Rotation speed (RPM) 50

Feed rate (mm/rev.) 0

(plunge process)

Burnishing force (kN) 10

Process time 18 seconds

MACHINING TASK

- Deep roll the fillet to prevent fatigue cracks in the fillet radius due to the notch effect and cyclic bending
- Deep rolling takes place in one setting after turning using this CNC-controlled loading cycle:
 1. Build up burnishing force 0->10 kN
 2. Hold burnishing force constant (10 kN)
 3. Decrease burnishing force 10->0 kN
 Allow 5 rotations for each step

RESULTS/ADVANTAGES

- According to customer test results, fatigue strength doubled

Radflansch / Wheel flange

WERKSTÜCK

Radflansch

Teil von

Pkw-Vorderachse

Material G Stahl

Härte 40 HRC

Festigkeit 1000 N/mm²

Streckgrenze 700 N/mm²

Außendurchmesser (mm)

38 und 45

Hohlkehle Radius (mm) 5

WERKZEUG

HG6-9R30°-SLK25 und

HG6-9R60°-SLK25

Maschine

CNC-Drehmaschine

Geschwindigkeit

(m/min) 100

Drehzahl 800 min⁻¹

Vorschub (mm/U) 0,2

Druck (bar) 250

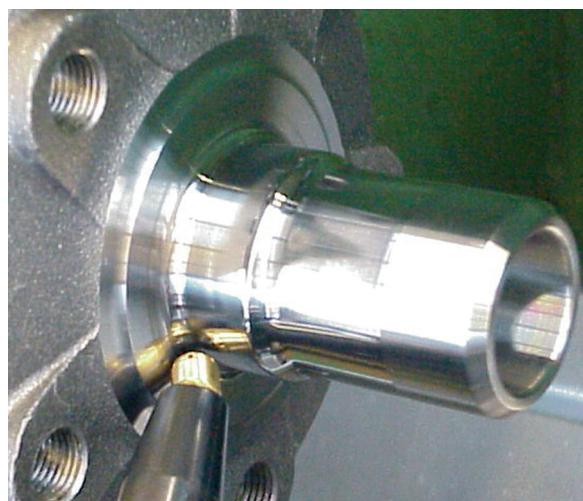
Hauptzeit 25 Sekunden

AUFGABE

- Festwalzen von Hohlkehle (beide Außendurchmesser sowie die Planfläche im gleichen Vorgang)
- Bearbeitet wird in 2 verschiedenen Zonen mit unterschiedlichen Werkzeuganstellungen

ERGEBNISSE/VORTEILE

- Teile sind unter Kunden-Testbedingungen dauerfest
- Betriebssicherheit erhöht



ANWENDUNGSBEISPIEL APPLICATION EXAMPLE

510

WORKPIECE

Wheel flange

Part of

Front axle, passenger car

Material Cast steel

Hardness 40 HRC

Tensile strength 1000 N/mm²

Yield strength 700 N/mm²

Outer diameters (mm)

38 and 45

Fillet radius (mm) 5

TOOL

HG6-9R30°-SLK25 and

HG6-9R60°-SLK25

Machine CNC lathe

Speed (m/min.) 100

Rotation speed (RPM) 800

Feed rate (mm/rev.) 0,2

Pressure (bar) 250

Process time 25 seconds

MACHINING TASK

- Deep roll fillet radii (both outer diameters and the face are machined in the same operation)
- The workpiece is divided into 2 different zones and each is processed with a different tool angle setting

RESULTS/ADVANTAGES

- According to customer test results, the components are fatigue resistant
- Greater service reliability

Hochfeste Schraube / High strength screw

WERKSTÜCK
hochfeste Schraube
Teil von
Pkw-Vorderachse
Material *Stahl*
(*Schmiederohlingen*)
Härte *48 HRC*
Festigkeit *1400 N/mm²*
Streckgrenze *1000 N/mm²*
Hohlkehlen Radius (mm) *2*

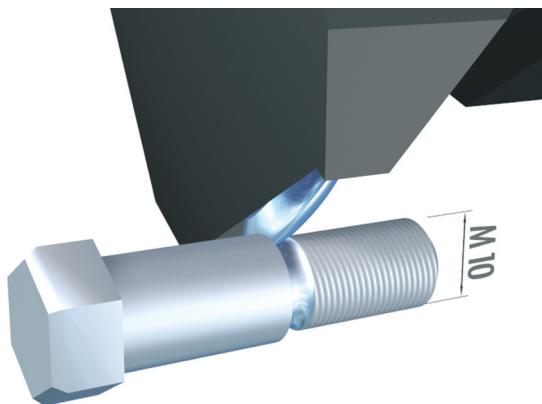
WERKZEUG
EF45
Maschine
CNC-Drehmaschine
Geschwindigkeit
(m/min.) *5*
Drehzahl *140 min⁻¹*
Hauptzeit *7 Sekunden*

AUFGABE

- Festwalzen von Hohlkehlen-Radius*
- Der Gewindefreistich ist auf Grund seiner Kerbwirkung die kritische Zone*
- Der Gewindefreistich wird in gleicher Aufspannung nach dem Drehen im Einstichverfahren festgewalzt*

ERGEBNISSE/VORTEILE

- Teile sind unter Kundentestbedingungen dauerfest*
- Betriebssicherheit erhöht*



Hohlwelle / Hollow shaft

WERKSTÜCK
Hohlwelle
Teil von
Spezialmaschine
Material *Stahl*
Festigkeit
1100 N/mm²

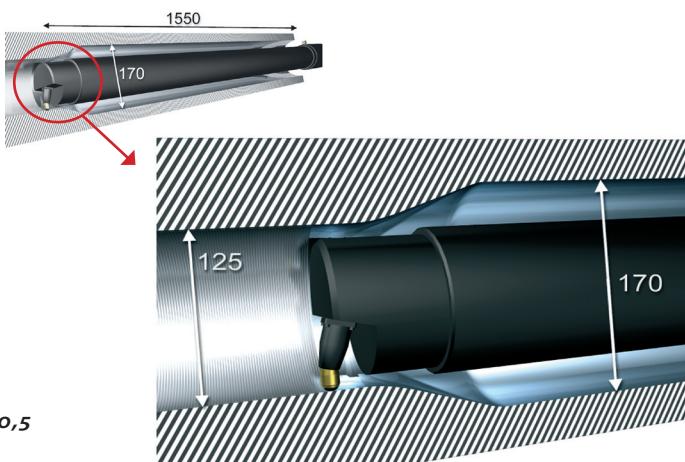
WERKZEUG
HG13-2
Maschine
CNC-Drehmaschine
Geschwindigkeit
(m/min.) *120*
Drehzahl *225 min⁻¹*
Vorschub (mm/U) *0,5*
Druck (bar) *130*
Hauptzeit *14 Minuten*

AUFGABE

- Die Stufenbohrung erzeugt Kerbwirkung, die durch Bearbeitungsriefen noch verstärkt wird*
- Festwalzen von Hohlwelle um Betriebsfestigkeit zu erhöhen*

ERGEBNISSE/VORTEILE

- Zeiteinsparung gegenüber anderen Verfestigungsverfahren*
- höhere Sicherheit*
- keine Transportkosten (Bearbeitung erfolgt in einer Aufspannung nach dem Drehen)*



ANWENDUNGSBEISPIEL APPLICATION EXAMPLE 511

WORKPIECE
High strength screw
Part of
Front axle, passenger car
Material *Steel*
(*forged blanks*)
Hardness *48 HRC*
Tensile strength
1400 N/mm²
Yield strength
1000 N/mm²
Fillet radius (mm) *2*

TOOL
EF45
Machine *CNC lathe*
Speed (m/min.) *5*
Rotation speed
(RPM) *140*
Process time *7 seconds*

MACHINING TASK

- Deep roll fillet radii*
- Due to the notch effect, the thread undercut is the critical zone*
- The thread undercut is deep rolled in one setting after turning in a plunge process*

RESULTS/ADVANTAGES

- According to customer test results, the components are fatigue resistant*
- Greater service reliability*

ANWENDUNGSBEISPIEL APPLICATION EXAMPLE 512

WORKPIECE
Hollow shaft
Part of
Special machine
Material *Steel*
Tensile strength
1100 N/mm²

TOOL
HG13-2
Machine
CNC lathe
Speed (m/min.) *120*
Rotation speed (RPM) *225*
Feed rate (mm/rev.) *0.5*
Pressure (bar) *130*
Process time *14 minutes*

MACHINING TASK

- The stepped bore suffers from the notch effect and its impact increases when grooves are produced in the surface during machining*
- Deep roll the shaft to minimize notch effect (corrosion cracking) and increase service strength*

RESULTS/ADVANTAGES

- This operation requires less time than other processes that increase hardness*
- Increased reliability*
- No transport costs (the process takes place in one setting after turning)*

Flugzeugfelge / Aircraft wheel rim

ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE

513

WERKSTÜCK

Felge

Teil von

Flugzeug

Material

Aluminium-Legierung

WERKZEUG (Teil 1)

RK

Maschine

CNC-Drehmaschine

Geschwindigkeit (m/min) 40

Drehzahl 140 min⁻¹

Hauptzeit 6 Sekunden

WERKZEUG (Teil 2)

EF90

Maschine CNC-Drehmaschine

Geschwindigkeit (m/min) 150

Drehzahl 140 min⁻¹

Vorschub (mm/U) 0,3

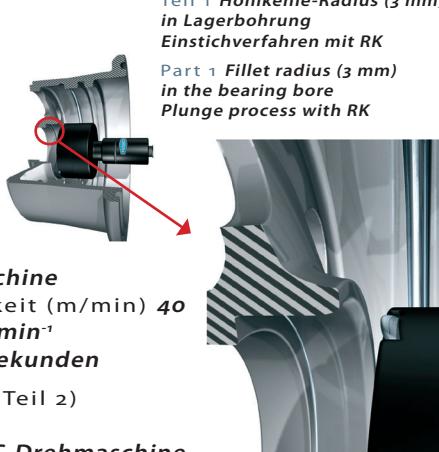
Hauptzeit 15 Sekunden

AUFGABE

- Das RK walzt den Freistich der Lagerbohrung über ca. 15 Umdrehungen im Einstichverfahren fest
- Das EF90 walzt den Radius im Radkörper im Vorschubverfahren und führt dabei eine programmgesteuerte Kurve aus

ERGEBNISSE/VORTEILE

- 5-fach Verbesserung in der Betriebsfestigkeit



Teil 1 Hohlkehle-Radius (3 mm)
in Lagerbohrung
Einstichverfahren mit RK

Part 1 Fillet radius (3 mm)
in the bearing bore
Plunge process with RK

Teil 2 Hohlkehle-Radius (6 mm)
des Felgenkörpers
Vorschubverfahren mit EF90

Part 2 Fillet radius (6 mm)
in the wheel rim body
Feed process with EF90

WORKPIECE

Wheel rim

Part of

Aircraft

Material

Aluminum alloy

TOOL (Part 1)

RK

Machine CNC lathe

Speed (m/min.) 40

Rotation speed (RPM) 140

Process time 6 seconds

WERKZEUG (Part 2)

EF90

Machine CNC lathe

Speed (m/min.) 150

Rotation speed (RPM) 140

Feed rate (mm/rev.) 0,3

Process time 15 seconds

MACHINING TASK

- The RK tool deep rolls the bearing bore's undercut in a plunge process in about 15 revolutions
- The EF90 deep rolls the fillet radius in the wheel rim body, executing a program-controlled curve

RESULTS/ADVANTAGES

- 5-fold improvement in service strength

Flugzeugfederbein / Aircraft shock strut

ANWENDUNGSBEISPIEL
APPLICATION EXAMPLE

514

WERKSTÜCK

Federbein

Teil von

Flugzeug

WERKZEUG

HG6-1

Maschine

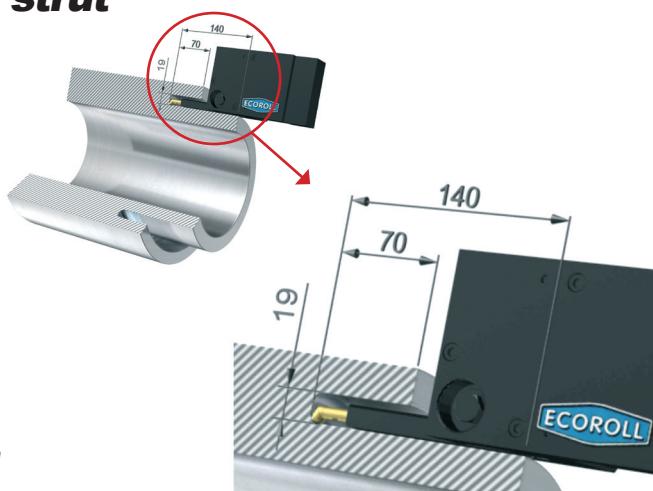
CNC-Drehmaschine

Geschwindigkeit (m/min) 100

Drehzahl 270 min⁻¹

Vorschub (mm/U) 0,3

Hauptzeit 110 Sekunden



WORKPIECE

Shock strut

Part of

Aircraft

TOOL

HG6-1

Machine

CNC lathe

Speed (m/min.) 100

Rotation speed (RPM) 270

Feed rate (mm/rev.) 0,3

Process time 110 seconds

AUFGABE

- Der Planeinstich übt auf Grund seiner geometrischen Form eine erhebliche Kerbwirkung aus, die zusätzlich durch Bearbeitungsriefen verstärkt wird
- Festwalzen von Planeinstich um beide Effekte zu beseitigen

ERGEBNISSE/VORTEILE

- Das Bauteil erfüllt die Anforderungen

MACHINING TASK

- The face cut-in suffers from the notch effect and its impact increases when grooves are produced in the surface during machining
- Deep roll the face cut-in to minimize notch effect (corrosion cracking) and increase service strength

RESULTS/ADVANTAGES

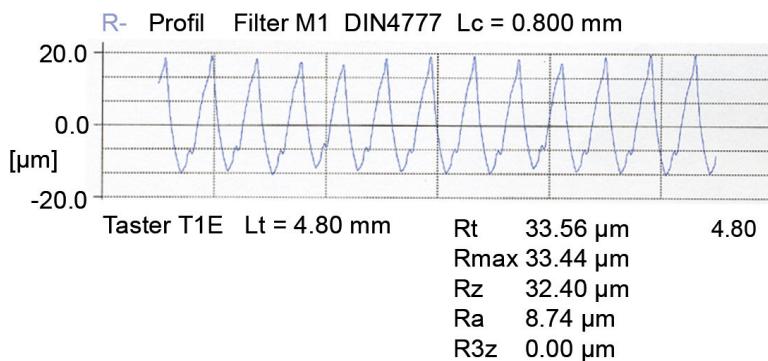
- The finished component meets requirements

After the application . . .

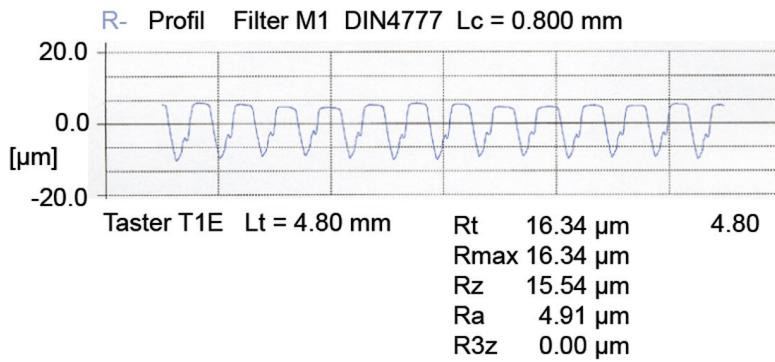
A uniquely smooth surface results when roller burnishing or deep rolling plastically deforms the surface material. After the application, the surface exhibits the following characteristics:

- Low surface roughness
- High surface contact ratio
- No pronounced peaks
- Increased hardness and wear resistance
- Remaining surface roughness accommodates lubrication

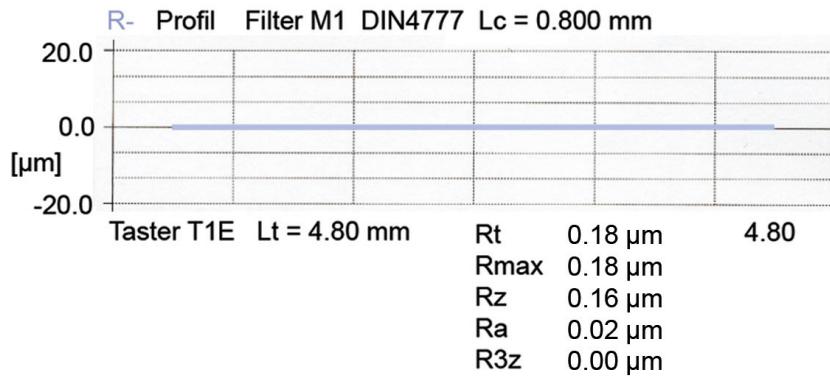
TURNED



LIGHTLY ROLLER BURNISHED



ROLLER BURNISHED



Appendix

Surface Measurement Parameters

Arithmetical mean roughness, R_a (CLA, AA)

DIN EN ISO 4287

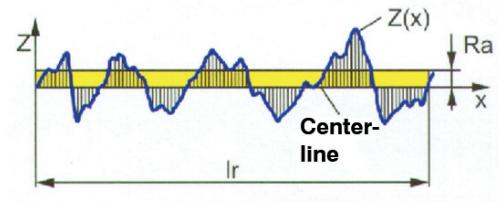
The arithmetical mean of the absolute values of the y -coordinates that correspond to the surface roughness profile.

Statistically speaking, R_a also describes the mean arithmetical deviation from the center line of the surface roughness y -coordinates.

R_a has little significance. It does not exhibit sensitivity relative to extreme profile peaks and valleys.

- R_a corresponds to measuring section l_r .
- R_a is of little statistical value.
- Individual outliers are not taken into account.
- Widespread in the USA and Europe.
- Historically, the first parameter that could be measured.

$$R_a = \frac{1}{l_r} \int_0^{l_r} |Z(x)| dx$$



Maximum roughness depth, R_z (CLA, AA)

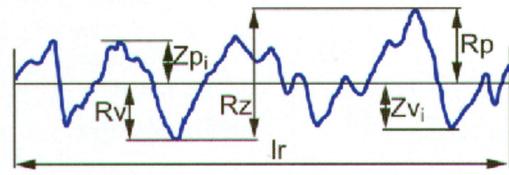
DIN EN ISO 4287

A value based on the height of the largest profile peak R_p and the depth of the deepest profile valley R_v within a given measuring section of the surface roughness profile.

R_z , or the vertical distance between the highest and the lowest points of the surface roughness profile, provides a way to measure the range of y -coordinates that correspond to surface roughness.

Because as a rule R_z is calculated as an arithmetical mean based on the maximum roughness depth of five measuring sections l_r , this parameter expresses the average roughness according to DIN 4768. R_p expresses the smoothing depth defined earlier in DIN 4762.

- R_z corresponds to measuring section l_r .
- According to DIN 4768, R_z expresses the average of five measuring sections l_r .
- Only up to a fifth of the outliers are taken into account.
- R_z can be used to measure bearing and sliding surfaces as well as press or interference fits.



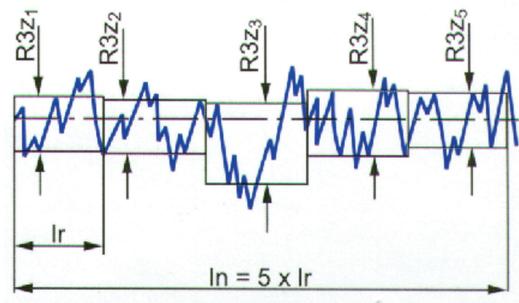
Daimler Benz Parameter, R_{3z} (Factory Standard)

Daimler Benz Factory Standard N3 1007

The arithmetical mean of five individual surface roughness values: R_{3z1} to R_{3z5} . Each surface roughness value is defined as the vertical distance between the third-largest profile peak and the third-deepest profile valley within measuring section l_r .

To measure R_{3z} both a vertical and a horizontal threshold must be set.

- R_{3z} corresponds to measuring section l_n .
- R_{3z} is the vertical distance between the third-largest profile peak and the third-deepest profile valley within measuring section l_r .
- R_{3z} can only be calculated when there are three peaks and three valleys in a given measuring section.
- R_{3z} can be used to evaluate porous or sintered surfaces.



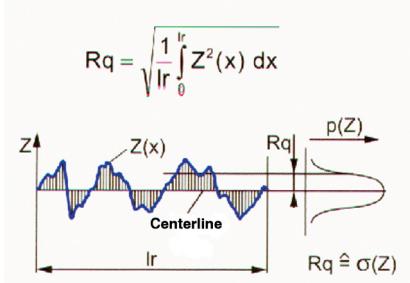
Quadratic mean roughness, R_q (RMS)

DIN EN ISO 4287

Quadratic average value of the y-coordinates that correspond to the surface roughness profile.

Because R_q , or the mean quadratic deviation from the center line of the surface profile's y-coordinates, expresses the standard deviation of the profile's ordinates, it is more statistically significant than R_a .

- R_q corresponds to measuring section l_r .
- R_q has greater statistical value than R_a (R_q ca. 1.1 $\times R_a$).
- Because R_q expresses the standard deviation of the profile peaks (and valleys) distributed over a given area, it can provide significant statistical information regarding a surface profile.



Drawing specifications according to DIN ISO 1302

a = roughness value in μm

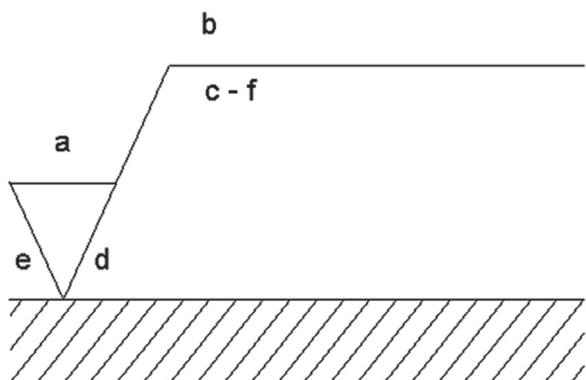
b = production process, surface treatment, coating

c = reference length

d = direction of grooves

e = machining tolerance

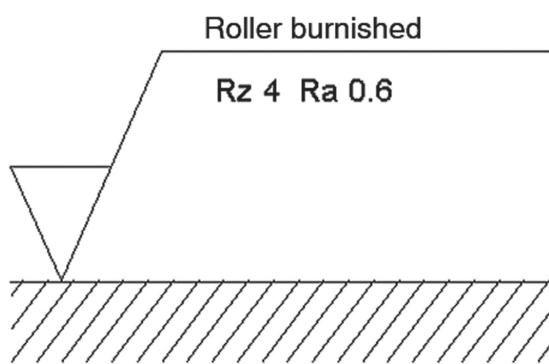
f = other roughness parameters



Drawing specifications: Examples

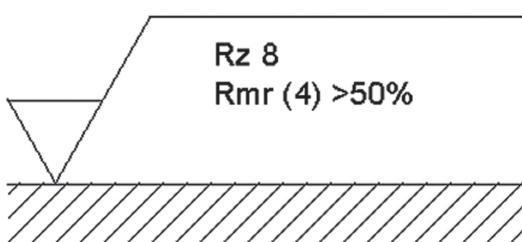
Drawing 1

- Maximum roughness up to $R_z = 4 \mu\text{m}$
- R_a value up to $0.6 \mu\text{m}$
- Machining process: roller burnishing



Drawing 2

- Maximum roughness up to $R_z = 8 \mu\text{m}$
- Percentage of material at the surface: $R_{mr} > 50\%$ measured at a cutting depth of $4 \mu\text{m}$

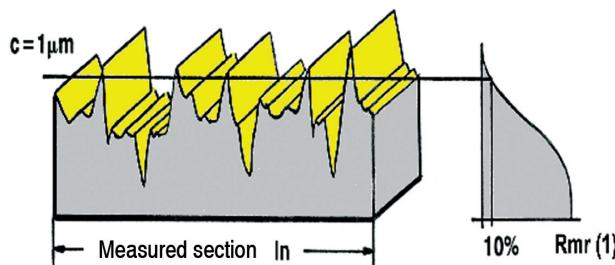


Appendix

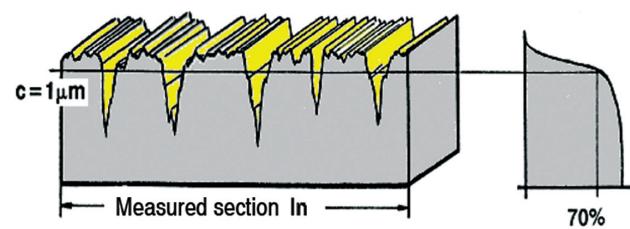
Surface Characteristics

Surface structure determines wear behavior

- A surface's structure determines its wear behavior.
- On sliding surfaces, protruding peaks can lead to increased friction and premature wear.
- Plateau-like surfaces with pronounced grooves provide good lubrication and the best sliding properties.
- The profile characteristics demonstrated by the material curve provide quick information regarding the surface structure.



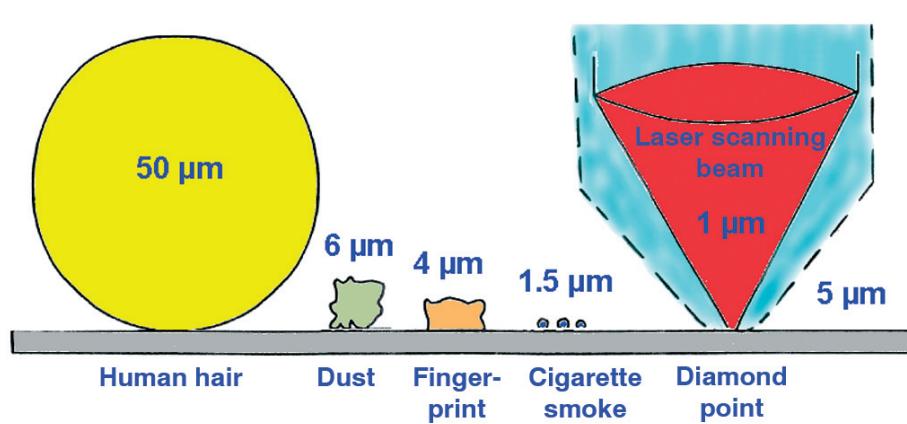
Surface profile with a low percentage of material at the surface and poor wear behavior ("Skinny" material curve)



Surface profile with a higher percentage of material at the surface and better wear behavior ("Fat" material curve)

An Overview of μ

It's easy to describe the fractional size of a μm : one, two or three places after the decimal point. This graphic presents μ in a different context.

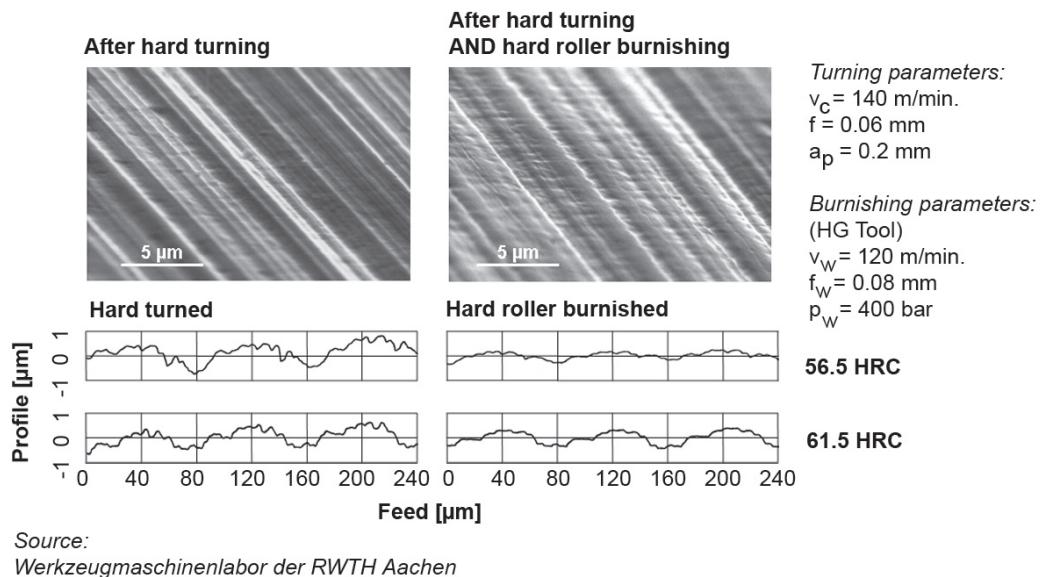


NOTE: This information presented courtesy of Hommelwerke GmbH, www.hommelwerke.de

Why use roller burnishing and deep rolling?

Improved surface and part quality

No other technology combines three advantageous physical effects to improve a metal component's edge zone. Roller burnishing and deep rolling generate a uniquely smooth surface while inducing compressive stresses and cold work in the surface layer. The compressive stresses counteract external load forces, dramatically increasing component fatigue strength. This technology saves production costs while significantly improving the treated parts.

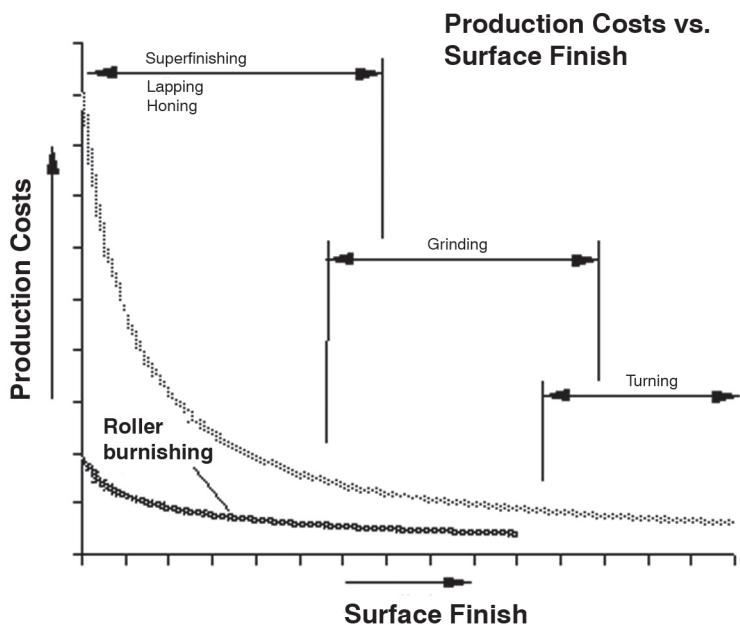


Reduce costs

Substantial cost savings are realized when expensive technologies such as grinding or honing are replaced by a more cost effective treatment. Cost savings accrue first of all because the roller burnishing and deep rolling work cycle is significantly shorter than the alternative processes.

Non-productive time is cut down dramatically because ECOROLL roller burnishing and deep rolling tools offer complete processing on one machine in one setting with no change-over. It's no longer necessary to transport the part between two or more machines.

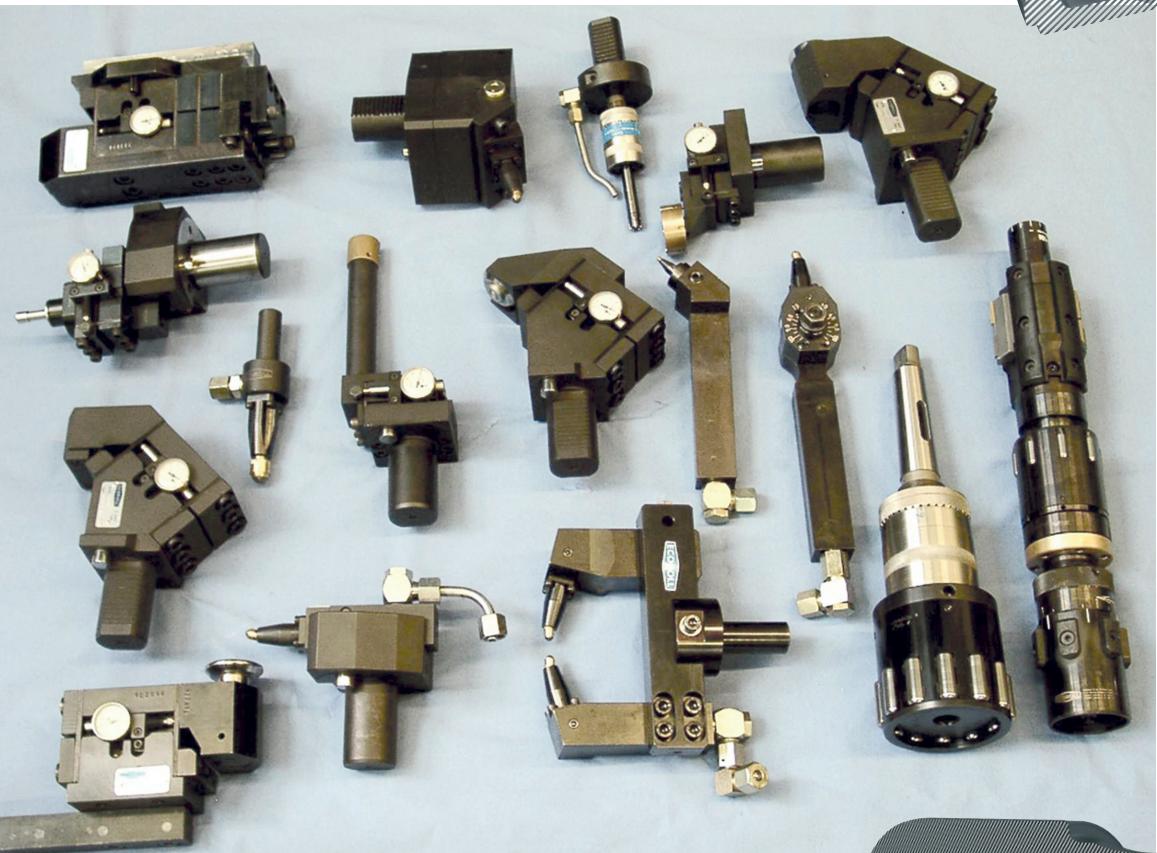
And finally, these processes produce no dust or residue, saving disposal costs.



Tools & Solutions

for

Metal Surface Improvement



***Smooth
surfaces***



... for a smooth operation

