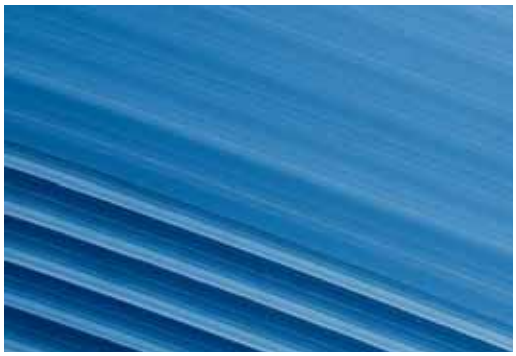
ECOROLL

surface matters

Motorenbau Engine Construction **Festwalzen Deep Rolling** Automobilindustrie Automotive Industry MMS MQL Glätten Smoothing Kaltverfestigung Strain Hardening Medizintechnik Medical Industry **Glattwalzen Roller Burnishing** Maschinenbau Engineering **Schälen Skiving** Umformen Forming Großserienfertigung Line Production Druckeigenspannung Residual Compressive Stress Druckluftwalzen Rolling with Compressed Air **Zylinderrohrbearbeitung Processing Cylinders** Segmentkäfig Segment Cage Trockenbearbeitung Dry Processing Erneuerbare Energie Renewable Energy Prozessüberwachung Process Monitoring Rollieren Rolling Ölindustrie Oil Industry **Oberflächenveredelung Metal Surface Improvement** Luftfahrt Aviation Energietechnik Power Engineering

Tool Technology for Mechanical Metal Surface Improvement

Solutions that Meet High Surface Quality Demands



Roller Burnishing

The economic alternative for producing high-quality component surfaces

- Produces mirror-finish or pre-defined surfaces.
- Can be used with any conventional or CNC-controlled machines.
- Complete processing in one setting.
- Short cycle time and elimination of set-up and auxiliary processing time.
- Increased surface hardness.
- Increased wear resistance.
- Low energy demand.
- No pollution of cooling lubricants.
- Can be used with minimum quantity lubrication.

Deep Rolling

Smoothing, cold work and induction of residual compressive stresses in a single process

- Complete processing in one setting.
- Can be used with any conventional or CNC-controlled machines.
- For a wide range of work pieces.
- Prevents or hinders stress corrosion crack formation or growth.
- Significantly increases service life and fatigue strength.
- Extraordinary increase of fatigue strength.

Processing Cylinders

Fast and efficient internal machining

- Produces surfaces with very low residual surface roughness, reduced friction and less wear.
- Notably decreases irregularities in circular form.
- Suitable for cold drawn or hot rolled tubes.
- For diameter range 28 to 800 mm.
- Possible processes: Combined boring – skiving – roller burnishing, skiving on lathes.

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Processes

Basic Principles of Roller Burnishing

Roller burnishing is a forming process used to generate high-quality, smooth surfaces or surfaces with a specific structure. One or more rollers or balls are used to plastify and form the workpiece's edge layer. This process is used when a metal component requires a high-quality surface finish or when the specified surface quality cannot be achieved reliably with a machining process. The process is described in VDI standard 2032, which also clearly explains the differences between roller burnishing and the rolling process.

In roller burnishing, when the compressive stress that occurs at the contact point between the roller burnishing tool and the workpiece surface exceeds the workpiece's yield strength, plastic deformation results. The roughness peaks are pressed down in nearly a vertical direction into the surface and as a result the material flow fills the roughness valleys from below (Fig. 1). The resulting smooth surface occurs due to the flow of the entire surface near the material's edge layer, not because the roughness peaks are bent into the surface or flattened (a widely held, but false assumption).

Roller burnishing can be used in place of any process applied to produce high-quality component surfaces (e.g. fine turning, grinding, reaming, honing, superfinishing, lap grinding, polishing, scraping). This process, proven over decades, offers great technological and economic advantages for surfaces in the roughness range $R_z < 10$ µm. Roller burnished surfaces are characterized by a unique surface structure with the following features:

- Low degree of roughness ($R_z < 1$ µm / $R_a < 0.1$ µm) or specified roughness
- Rounded surface profile
- High surface contact ratio
- Less friction
- Increased wear resistance
- Increased edge layer hardness due to cold working

The process offers the following **advantages**:

- Short cycle time
- Can be used with any conventional or CNC-controlled machines
- Complete processing in one setting
- No material removed
- Easily reproducible
- Minimal lubrication required
- Low noise emission
- Long tool life
- No change in dimensions due to tool wear

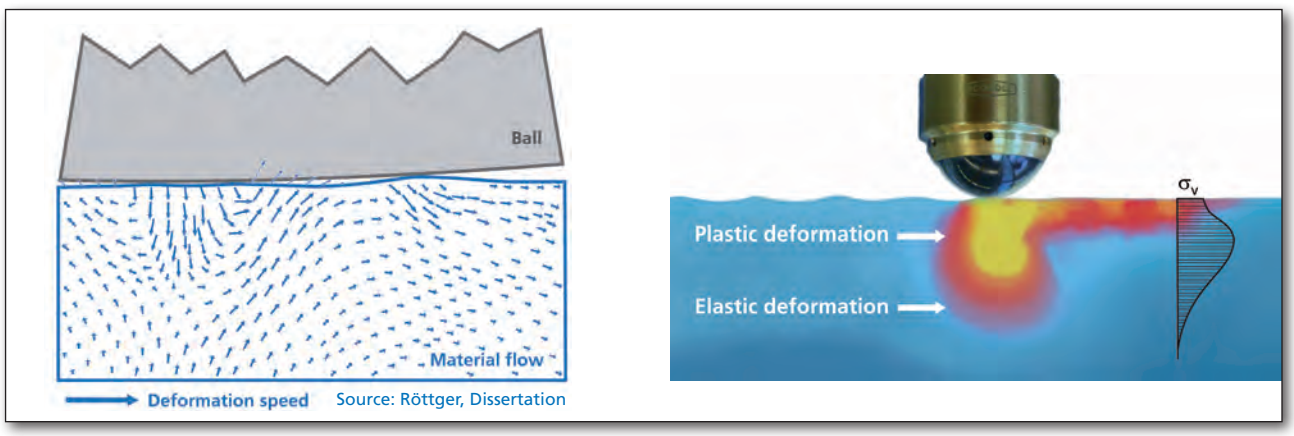


Fig. 1: Edge layer forming

Basic Principles of Deep Rolling

Deep rolling is a forming process used to effect positive change in a component's edge zone properties. The process is unique in that it is the only process for increasing component service life that combines these effects:

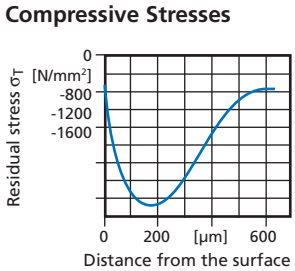
- Generation of compressive stresses
- Cold working in the edge layer
- Smoothing a component's surface, which removes micro-notches

This combination can increase fatigue strength by a factor of five, resulting in an appreciable improvement in the service life of a component. Deep rolling is particularly suitable for components subject to dynamic stress during operation that can be destroyed due to material fatigue.

Compared with alternative methods (e.g. shot peening), deep rolling is an extraordinarily cost-effective process, and its application range includes nearly the entire spectrum of metal materials. It can be easily integrated into an existing process chain and can be used on both conventional and CNC-controlled machine tools. This allows a workpiece to be deep rolled in one setting directly after machining, eliminating set-up and transportation costs. Whenever the goal is to increase the fatigue strength of metal material or implement a lightweight design, this process can be used.

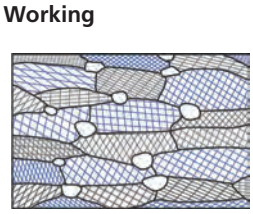
Deep rolling can be used in place of any process applied to increase the fatigue strength of a component, including mechanical processes (e.g. shot peening), thermal processes (e.g. laser hardening) and thermochemical processes (e.g. nitriding). However, because each individual application brings up new challenges or questions, please contact us so that we can consult with you directly in order to meet your needs.

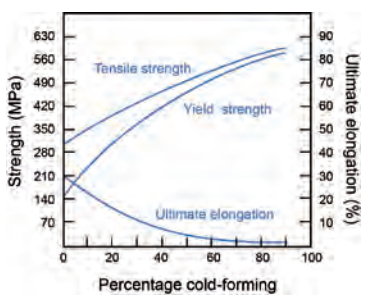
Compressive Stresses



- Reduction of crack growth
- Increased fatigue strength
- Increased service life

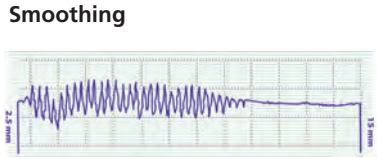
Cold Working

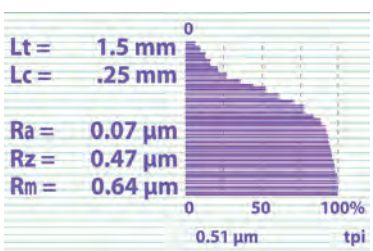




- Increased dislocation density
- Increased edge layer hardness
- Increased strength, stable under temperature change
- Delayed crack formation

Smoothing





- Improved sliding properties
- Reduction in the micro-notch effect

Fig. 2: Advantages of deep rolling

Process Similarities

The application areas for both processes extend from general mechanical engineering, automobile and aircraft manufacturing and motor construction to medical and power plant technology. Roller burnishing and deep rolling tools are suitable for use with almost any machine tool (e.g. conventional and CNC-controlled lathes, drills, machining centers, deep hole drilling machinery). This allows a workpiece to be roller burnished or deep rolled in one setting directly after machining. In certain cases where it does not make sense to tie up a complex machine tool with the process, a separate deep rolling machine is available for use during the cutting process.

Various process kinematics are possible with both processes. The simplest version is roller burnishing or deep rolling in a plunge-in process (Fig. 3). A roller or ball contacts the surface of a workpiece at an axial position. The burnishing force is built up during the initial rotations and then kept steady for several more rotations. At the end of the process, the burnishing force is reduced during the final few rotations. Building up and reducing the burnishing force is very important because otherwise stress gradients can result in the edge zone of the component, which can cause the component to fail prematurely. This kinematic process is primarily used for deep rolling, e.g. to eliminate the notch effect in the various sections of wave-shaped components.

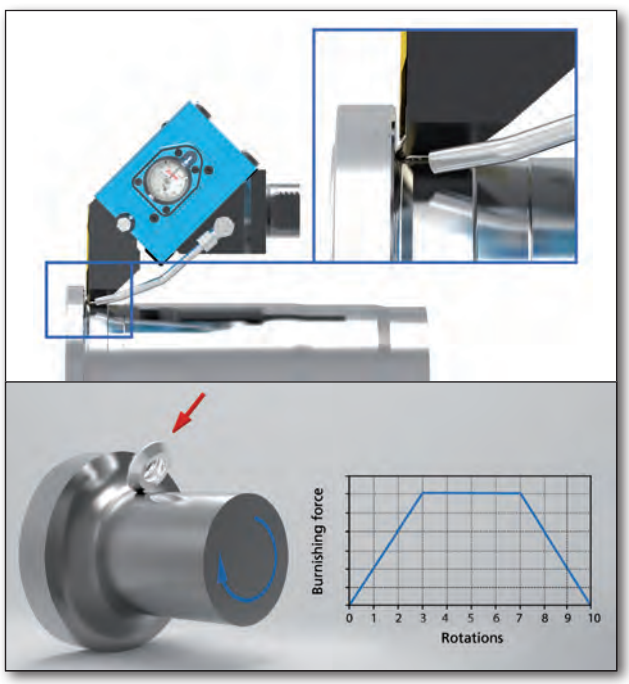


Fig. 3: Deep rolling in a plunge-in process

A feed motion can be added (Fig. 4) so that the roller burnishing or deep rolling process can be used to treat cylindrical surfaces easily and quickly, for example.

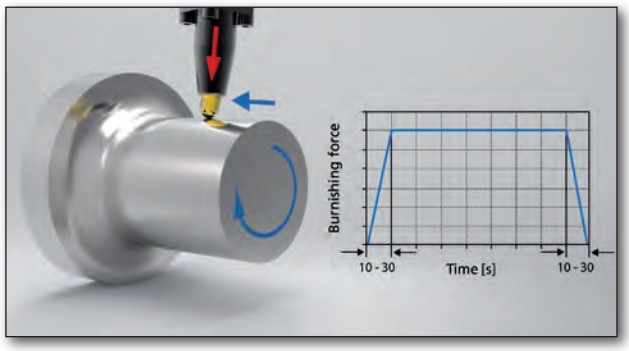


Fig. 4: Deep rolling in a feed process

Tools with hydrostatically loaded balls can also machine both flat and free-form surfaces (Fig. 5).

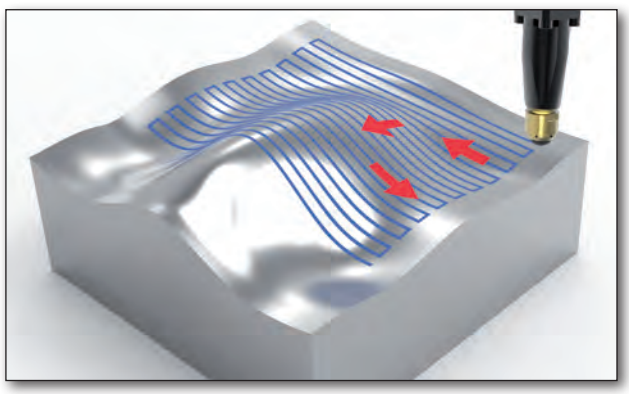


Fig. 5: 3D burnishing of free-form surfaces

The rolling elements, or balls, are guided by the tool's following system. In this way, users can compensate for a wide variety of component tolerances and machine elasticities within a specified range and still maintain a continuous, constant burnishing force at the workpiece's surface. In this way, complex geometries can be machined with a process quality that is always consistent. Particularly with components that are subject to the highest safety requirements, only force-controlled tools can be considered for roller burnishing or deep rolling.

In addition, the hydrostatic principle behind these roller burnishing and deep rolling tools allows components with a high initial hardness value to be machined. In general, tools with mechanically loaded rolling elements are only used for workpieces with initial hardnesses up to 45 HRC (Rockwell scale). Tools with hydrostatically loaded balls, however, can be used to process materials with initial hardnesses up to 65 HRC. Even under such conditions, the surface is smoothed, cold working takes place and compressive stresses are induced in the edge zone of the component.

Differences

The primary difference between roller burnishing and deep rolling is the objective of the process. While the goal of roller burnishing is to achieve a specific surface quality by attaining a determined roughness value, the main objective of deep rolling is to increase fatigue strength. Though the increase in the component's service life results in part from smoothing the surface, cold working and the induction of compressive stresses into the edge zone have a much more significant effect on improving durability.

Another difference between the two processes is in quality control. Roller burnishing simply requires a physical measurement of the surface quality. With deep rolling, however, process results can only be verified by service life testing, measurements of residual stress depth profiles, and so on, which means that the component must be destroyed. Subsequent corrections are only possible with roller burnishing; in most cases, if a specified surface value is not obtained, the process can be repeated to achieve it.

For deep rolling, quality assurance is only possible with a reliable reproduction of the parameters specified and authorized for the process. Particularly for components that are related to safety, process monitoring that records and documents the process parameters in real time is recommended.

Cost-effective Processes

There is enormous savings potential in converting other production processes to roller burnishing or deep rolling. Depending on the application, when switching from grinding, polishing or honing to roller burnishing, production costs can be reduced by much more than 50 percent. The explanation for this is that expensive reworking is no longer necessary. In addition, processing times are considerably shorter and components can be completely machined in one setting, e.g. on a lathe. This eliminates costs for additional machines and significantly reduces the time required for primary processing as well as conversion. The process does not produce chips or grinding residue, which considerably decreases environmental impact and disposal costs as well as wear on machine bearings and guideways.

In comparison with other processes, deep rolling is also an extraordinarily cost-effective process. Due to the wide variety of possible applications, however, individualized consultation is recommended.

Differences between the Rolling Process, Roller Burnishing and Deep Rolling

The rolling process is frequently equated with roller burnishing and even deep rolling, and despite the differences between the objectives of these processes, the term "rolling" is used for all. According to VDI/VDE standard 2032, the term "rolling" is defined as fine machining using tools with roughened working surfaces to improve the shape, dimensions and surface quality of a workpiece. The tool – the rolling disk (tool steel, carbide or ceramic) – is roughened in a grinding operation. The resulting surfaces are shiny, but their structure differs considerably from that of a burnished surface. ECOROLL does not sell tools for "rolling" according to this VDI/VDE definition.

Processing Cylinder Tubes

The OMEGA system by ECOROLL combines skiving and roller burnishing to manufacture hydraulic cylinders and cylinder tubes. It has almost completely replaced honing, the other production process used for these products, because this combination offers unequaled speed and cost-effectiveness. In this application area, ECOROLL tools can even offer four processes in one working cycle: pre-drilling, drilling out, skiving, roller burnishing. With the modular, building block system, the optimum tools for any tube quality or processing length can be configured.

The patented OMEGA system offers the following advantages:

- Improved precision in dimensions and form with 3 or 6 skiving knives with cutters arranged in pairs
- Quick, easy tool setting
- Quick replacement of wear parts

Complete Processing of Short Hydraulic Cylinders on CNC-controlled Lathes

Until now, cylinder tubes (L/Ø ≤ 15) have been processed in two separate steps:

1. Internal processing of the cylinder on deep hole drilling machinery
2. Final processing on a lathe

With ECOROLL tools, the entire process can take place directly on a lathe or machining center. In this process, a skiving head is first used to prepare the cylinder. Following an automated tool change, the fine machining is done with a separate roller burnishing tool. To ensure thorough chip removal and surface cleaning, both tools are equipped with an internal cooling-lubricant supply device.

Developed especially for use on CNC-controlled lathes, the combined RIOC tools can also be used. The two working cycles are combined into one in this tool. The skiving heads of these innovative tools are designed with a cutting geometry that is particularly good for removing chips and are equipped with a high-pressure flushing system with nozzles where chips collect. This ensures that chip removal functions reliably, even with the low amounts of cooling-lubricant available on CNC-controlled lathes.

This complete processing results in a significant reduction in auxiliary process time and processing on deep hole drilling machinery is no longer required. This eliminates the extremely high investment costs for deep hole drilling machinery. In this way, even operations that produce small and mid-sized series are able to manufacture cylinder tubes and entire cylinders themselves.

ECOROLL Product Overview

Tools for roller burnishing, deep rolling and machining cylinder tubes

The ECOROLL families of tools for roller burnishing, deep rolling and machining cylinder tubes have a modular design and are suitable for a wide range of workpieces and geometries. The following overview makes it easy to choose the right tool for your special application.

Cylindrical bore



G	14
ø 4 - 200	
R	17
ø 200 - ∞	
EG5	29
ø 150 - 200	
EG14	36
ø 200 - ∞	
EG45	38
ø 200 - ∞	
HG2-11	69
ø 7,5 - 15	
HG6-11	69
ø 17 - 70	
HG6-1	68
ø 19 - ∞	
HG6-2	68
ø 70 - ∞	
HGx-4	69
ø 50 - 120	
HG13-2	68
ø 125 - ∞	
SK	82
ø 25 - 750 +	
GZ	82
ø 25 - 200	
RIO/RDO	78
ø 28 - 554,99	

Cylindrical outside contour



RA	19
ø 3 - 160	
EG5	29
ø 10 - 70	
EG14	36
ø 50 - ∞	
EG45	38
ø 50 - ∞	
HG6	64
ø 5 - ∞	
HG13	64
ø 30 - ∞	

Plunge-in/ Groove



EG5	29
ø 5 - 100	
EG45	38
ø 10 - ∞	
EG90	41
ø 50 - ∞	
MZG	26
ø 20 - ∞	

Cylindrical outside diameter with transition radius



EG45	38
ø 20 - 290	
HG4	64
ø 5 - 120 (r>5)	
HG6	64
ø 5 - 120 (r>5)	
HG13	64
ø 120 - ∞ (r>10)	

Plane face

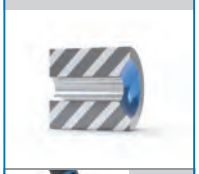
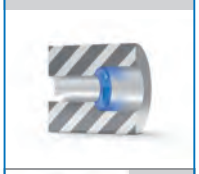


EG5	29
ø 10 - 70	
EG14	36
ø 70 - ∞	
EG45	38
ø 70 - ∞	
RP	21
ø 10 - 200	
HG3	64
ø 0 - ∞	
HG4	64
ø 0 - ∞	
HG6	64
ø 0 - ∞	
HG13	64
ø 0 - ∞	

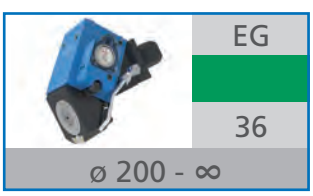
Plane face with transition radius



EG5	29
ø 5 - ∞	
EG45	38
ø 50 - ∞	
HG4	64
ø 5 - 120	
HG6	64
ø 5 - 120	
HG13	64
ø 120 - ∞	

Tapered bore	Outside taper	Inside contour	Spherical face	Fillet (internal)
				
 RK 21 ø 10 - 210	 RKA 21 ø 10 - 100	 EG5 29 ø 8 - 250	 EG5 29 ø 8 - 250	 RH 24 ø 17 - 200 + (r 0,2-2)
 EG5 29 ø 10 - 60 u. 150 - 230	 EG5 29 ø 5 - 70	 HG3 64 ø 10 - 50	 HG4 64 ø 5 - 120	 HG6 64 ø 50 - 120 (r > 5)
 HG3 64 ø 10 - 50	 HG4 64 ø 10 - 50	 HG4 64 ø 19 - 120	 HG6 64 ø 5 - 120	 HG13 64 ø 120 - ∞
 HG6 64 ø 19 - 120	 HG6 64 ø 19 - 120	 HG6 64 ø 19 - 120	 HG13 64 ø 120 - ∞	
 HG13 64 ø 125 - ∞	 HG13 64 ø 125 - ∞	 HG13 64 ø 120 - ∞		

Key



- Tool/Tool type
- Processing technology
- Page reference
- Processing diameter

- Roller burnishing
- Deep rolling
- Roller burnishing and/or deep rolling
- Skiving
- Skiving and roller burnishing

All dimensions in mm.

Note: This overview includes the most common tools for every contour.

Fillet (external)





EF45 — 43 — ø 10 - ∞ (r 0,4-3)



RHA — 24 — ø 5 - 80 (r 0,4-3)



FAK120 — 56 — ø 200 - ∞



HG6 — 64 — ø 15 - ∞ (r < 6)



HG13 — 64 — ø 120 - ∞ (r < 10)

Thread (internal)





EFI90 — 49 — ø 70 - ∞



HFI90 — 51 — ø 75 - ∞

Thread (external)





EF90 — 45 — ø 10 - 400



HF90 — 47 — ø 25 - 400



FAK90 — 54 — ø 150 - 500



FA — 53 — ø 38 - 500 +

Ball machining





RKAK — 23 — ø 15 - 50



HG6 — 64 — ø 15 - 250

Free-form surfaces





HG6 — 64

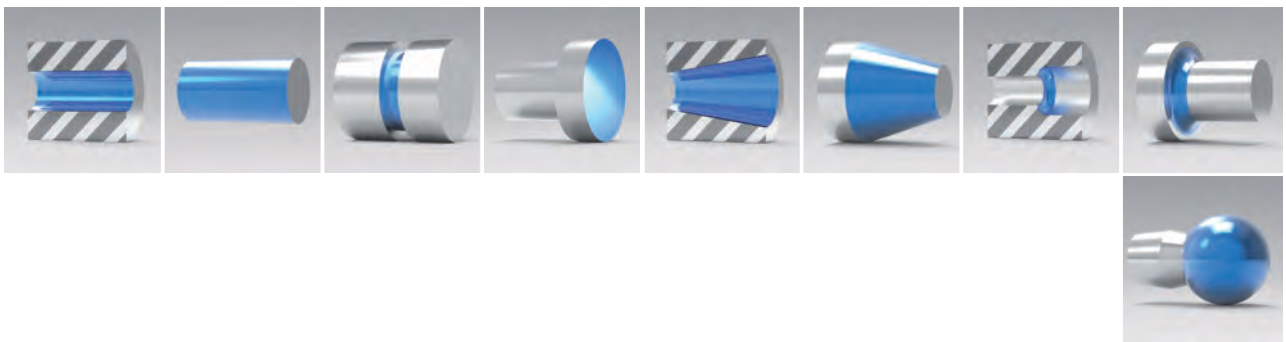


HG13 — 64



HG25 — 64

Multi-roller Mechanical Tools



ECOROLL's mechanical tools with multiple rollers are primarily used for roller burnishing. Tool types G, R and RA are used to machine cylindrical bores (both through and blind holes), stepped bores and cylindrical outside diameters. Tool types RP, RK, RKA and RKAK are intended for use with plane faces, tapers and ball-shaped areas. The MZG series includes two roller tools, which are mainly used to roller burnish sealing surfaces for shaft seals.

Both internal and external fillets can be deep rolled with tool types RH/RHA.

All of ECOROLL's multiple roller tools feature easy diameter adjustment, high precision performance and reliable function. They can be used on CNC-controlled drilling or milling machines and lathes, machining centers or conventional machine tools. The tools require just minimal lubrication and wear parts are easy to exchange. This simple maintenance and the short work cycle save a significant amount of time.



Type G tool with internal coolant

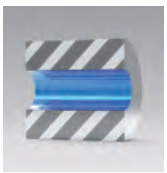


Machining a connecting rod with a type G tool



Machining a universal joint shaft with a type RA tool

Type G:
Machining cylindrical bores up to Ø 200,99 mm



Through holes: Ø 4 - 200,99 mm
Blind holes: Ø 6 - 200,99 mm

Features

- Can be used up to tolerance class IT8 (up to IT9 for thin-walled workpieces).
- Type GE up to tolerance class IT11 for Ø of 50 mm and larger.
- Machines all metal materials up to a tensile strength of 1400 N/mm² and a maximum hardness of HRC ≤ 45.
- Can achieve a surface quality of R_z < 1 µm (R_a ≤ 0.1 µm).
- For use on CNC-controlled drilling or milling machines and lathes, machining centers or conventional machine tools.
- Machining with clockwise rotation.
- Optional internal cooling-lubricant supply possible with straight shank, VDI shank, HSK, Capto, or similar shanks.

Advantages

- Reliable function, high degree of accuracy.
- Short cycle time.
- Diameter adjustment is easy and reproducible.
- Requires minimal lubrication (oil or emulsion).
- Tool automatically contracts upon retraction, preventing damage to the roller burnished surface.
- Wear parts are easy to exchange.

Design

- Type G tools consist of a basic tool body and a burnishing head.
- The tool body contains the tool shank as well as the mechanism for the infinitely variable setting of the rolling diameter in increments of 1 µm.
- Tool shanks either with Morse taper or straight shank; special designs by request.
- The burnishing head consists of the cone, cage and rollers.



- Burnishing heads are replaceable within the diameter range. By request, the tools can be equipped with self-feeding capability (recommended only for machines with manual feed (e.g. box column drilling machines)).

Parameters

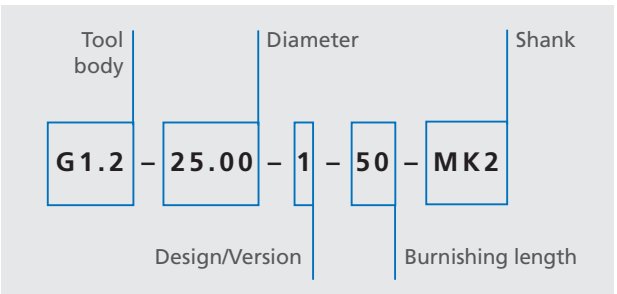
- Circumferential speeds up to 250 m/min. possible.
- Feed rate: 0.05 – 0.3 mm/rev. per roller.
- Burnishing length: The dimensions of the tool body allow for unlimited burnishing length if the workpiece diameter is 36 mm or larger. For smaller diameters, tools with standard burnishing lengths are available. Special designs available by request.

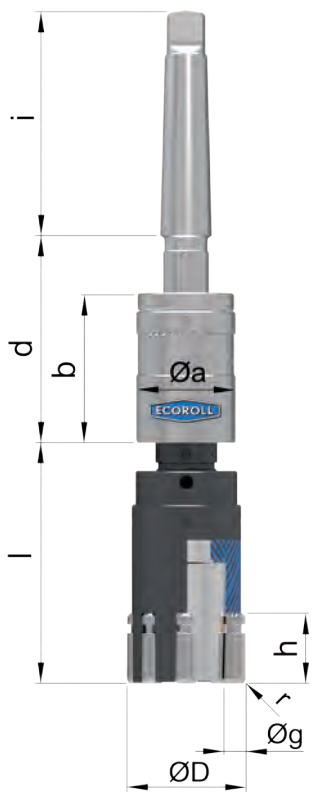
Ordering

The following information is required:

1. Workpiece diameter.
2. Bore depth = Burnishing length in mm : 50, 100, 150, 200, 250, 300 (others by request).
3. Shank type:
   MK: Morse taper
   ZS: Straight shank – in accordance with DIN 1835 B with clamping surface (Weldon)
   Special shanks, HSK, VDI, Capto available upon request.

The tool designation is generated as follows:





Tool body	Diameter range D	Tool shank: Morse taper or straight shank Ø e x f	a	b	c[1]	d max.	i	l	Burnishing length
	mm	+ / - mm	mm						
G1.1	≥ 4 < 17	MK2 Ø 20h6 x 50	35	52	1.5	70	80	Burnishing length + 8 mm	50
	≥ 17 < 21				2				
G1.2	≥ 21 < 33	MK2 Ø 20h6 x 50 Ø 25h6 x 56					80		
G1.3	≥ 33 < 36								75
	≥ 36 < 50				3	74		89	Unlimited
G2	≥ 50 < 100	MK3 Ø 25h6 x 56	49	68		93	99	79	
G3	≥ 100 < 201[2]	MK4 Ø 32h6 x 60	71	84	5	110	124	100	

Note: All dimensions are in mm.

[1] No dimension c for blind hole versions.

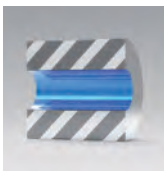
[2] ECOROLL type R roller burnishing tools are suitable for use with workpieces with diameters of 201 mm and larger.

Tool body	Diameter D	Adjustment range Through hole / Blind hole[1]	Number of rollers[2]	Roller diameter Ø g x h	Roller radius r	Burnishing length
	mm	- / + mm		mm		
G1.1 Ø ≥ 4 < 21	≥ 4 < 5	- 0.05 / + 0.15	3	1 x 4	0.5	50
	≥ 5 < 6	Blind hole unavailable		1.5 x 6	1	
	≥ 6 < 8	- 0.05 / + 0.3		2 x 6		
	≥ 8 < 10	- 0.05 / + 0.1	4	2 x 10		
	≥ 10 < 11	- 0.05 / + 0.4		3 x 9	1.5	
	≥ 11 < 17	- 0.05 / + 0.1	5			
	≥ 17 < 21	- 0.05 / + 0.6		5 x 16		
G1.2 ≥ 21 < 33	≥ 21 < 25	- 0.05 / + 0.1				
	≥ 25 < 33		6			75
G1.3 ≥ 33 < 50	≥ 33 < 36					
	≥ 36 < 38					Unlimited
	≥ 38 < 50	- 0.05 / + 0.8	8	8 x 25	2.5	
G2 ≥ 50 < 100	≥ 50 < 86	- 0.05 / + 0.1				
	≥ 86 < 100		12			
G3 Ø ≥ 100 < 201	≥ 100 < 170			14 x 35	4	
	≥ 170 < 201		16			

Note: [1] Depending on the structure of the hole outlet, blind hole tools may allow a larger range of settings than shown in the table.

[2] Replace only complete sets of rollers. When ordering replacement rollers, specify through or blind hole.

Type R:
Machining cylindrical bores Ø 201 mm and larger



Through holes: Ø 201 – 450 mm
Blind holes: Ø 201 – 450 mm

Features

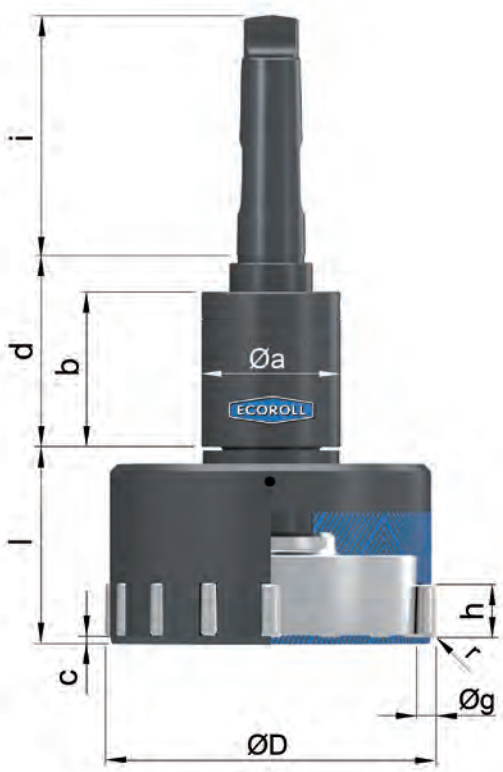
- Can be used up to tolerance class IT8.
- Machines all metal materials up to a tensile strength of 1400 N/mm² and a maximum hardness of HRC ≤ 45.
- Can achieve a surface quality of $R_z \leq 1$ µm ($R_a < 0.1$ µm).
- For use on CNC-controlled drilling or milling machines and lathes, machining centers or conventional machine tools.
- Machining with clockwise rotation.

Advantages

- Short cycle time.
- Diameter adjustment is infinite and reproducible.
- Requires minimal lubrication (oil or emulsion).
- Tool automatically contracts upon retraction, preventing damage to the roller burnished surface.
- Wear parts are easy to exchange.

Design

- Type R tools consist of a basic tool body and a burnishing head.
- The tool body contains the tool shank as well as the mechanism for the infinitely variable setting of the rolling diameter.
- For machining bores with large ring grooves or cross holes, we offer special roller burnishing tools (type Q), which ensure that interrupted surfaces can be machined (to test feasibility, please send us a drawing of the workpiece).



Parameters

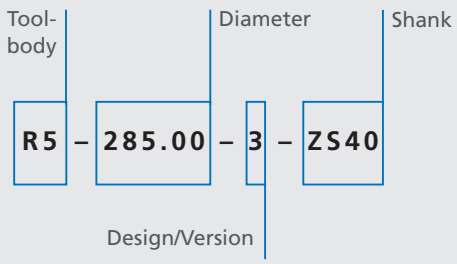
- Circumferential speeds up to 250 m/min. possible.
- Feed rate: 0.10 – 0.4 mm/rev. per roller.

Ordering

The following information is required:

1. Tool body type and workpiece diameter
   (see the following table).
2. Design/Version:
   1: For through holes
   2: For blind holes
3. Shank type:
   MK: Morse taper
   ZS: Straight shank
   Special shanks, HSK, VDI, Capto available upon request.

The tool designation is generated as follows:





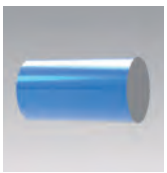
Tool body	Diameter D	Adjustment range Through hole / Blind hole[1]	Tool shank: Morse taper or Straight shank Ø e x f	Number of rollers[2]	Roller diameter Ø g x h	Roller radius r	a	b	c	d	i	l
	mm	- / + mm	mm		mm							
R5	≥ 201 < 255	- 0.05 / + 0.8 / - 0.05 / + 0.1	MK5 ø 50 h6 x 80	16	14 x 35 (Blind hole)	4	90	100	5	125	156	134
	≥ 255 < 320			20								
	≥ 320 < 355			28	20 x 45 (Through hole)							
R7	≥ 355 < 455											
R8	≥ 455											

Note: For Ø 220 mm and larger, all of the tools are available in the through hole version with a segmented cage.

[1] Depending on the structure of the hole outlet, blind hole tools may allow a larger range of settings than shown in the table.

[2] Replace only complete sets of rollers. When ordering replacement rollers, specify through or blind hole.

Typ RA:
Machining cylindrical external surfaces from diameter 1 mm



Diameter: Ø 1 – 160 mm

Multi-roller burnishing tools RA are used for economically roller burnishing of cylindrical external surfaces. The compact design of these tools takes into account the limited installation space for tools on sliding headstock lathes, Swiss-type lathes or rotary transfer machines. Based on the design these tools are made for a specific nominal diameter and offer – due to multi-roller design – high feed rates and thus high productivity in serial and mass production.



Features

- Can be used up to tolerance class IT8.
- Suitable for all metal materials up to a tensile strength of 1400 N/mm² and a maximum hardness of HRC ≤ 45.
- Can achieve a surface quality of R_z < 1 µm (R_a ≤ 0.1 µm).
- Application ideal for sliding headstock lathes, but also on CNC controlled turning, drilling or milling machines, machining centers or conventional machine tools.
- Machining in pushing motion with clockwise rotation.
- Available with different straight shanks (optional with hollow shank for very long workpieces).
- Internal coolant-lubricant supply optional.

Advantages

- Compact design for application in machines with limited workspace.
- High degree of accuracy.
- Short cycle time.
- Diameter adjustment is easy and reproducible.
- Requires minimal lubrication (oil or emulsion).
- Tool automatically contracts upon retraction, preventing damage to the roller burnished surface.
- Wear parts are easy to exchange.

Design

- Consists of a basic tool body and a burnishing head.
- The tool body contains the tool shank as well as the mechanism for the infinitely variable and reproducible setting of the rolling diameter.
- Morse taper and solid straight shanks for limited burnishing lengths. Perforated straight shanks for unlimited burnishing lengths.
- The burnishing head consists of the outer cone, cage and rollers.
- Burnishing heads are replaceable within the diameter range.



Parameter recommendation

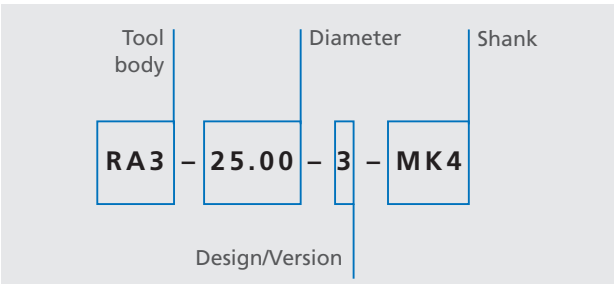
- Max rotary speed: up to 250 m/min.
- Max feed:: 0,3 mm/rev per roller.

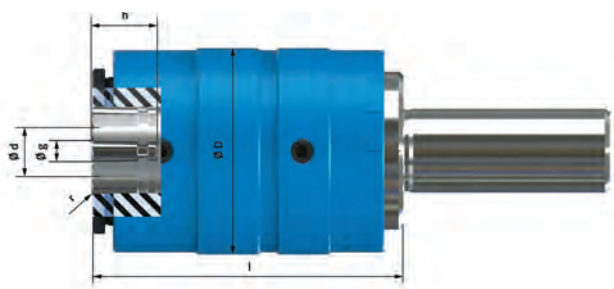
Ordering

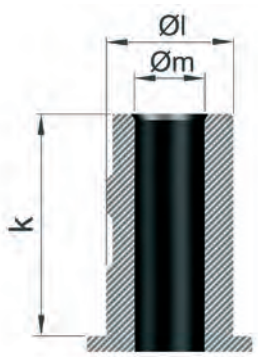
The following information is required:

1. Tool body type and workpiece diameter (see the following table).
   Note: Although other diameters are often covered by the setting range, tools with diameters and burnishing lengths of any size are available.
2. Design/Version:
   3: Without self-feeding capability
   4: With self-feeding capability (recommended only for machines with manual feed!)
3. Shank type:
   MK: Morse taper
   ZS: Straight shanks for limited burnishing lengths
   ZU: Straight shanks for unlimited burnishing lengths

The tool designation is generated as follows:





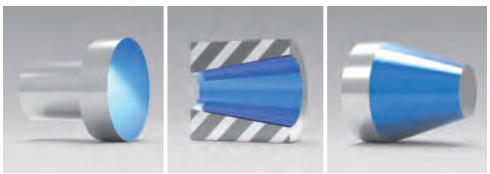




Tool body	Diameter range d	Adjustment range	Number of rollers	Roller-Ø g x h	Roller radius r	Burnishing length l	Housing diameter D	Standard tool shank l
	mm	+/- mm		mm				
RA01*	1.00 – 1.99	-0,1/+0,5	3	2 x 10 S	1,0	55	38	ZS08 DIN 1835A
	2.00 – 2.99			3 x 9 S				
RA11	3.00 – 5.99	-0,2/+0,05		5 x 16 S	0,5	85 ab ZS20 unlimited	50	ZS20 DIN 1835B (hollow shank)
	6.00 – 7.99		4					
	8.00 – 11.99		5					
RA21	12.00 – 14.99	-0,4/+0,05	6			100 ab ZS25 unlimited	66	ZS25 DIN 1835B (hollow shank)
	15.00 – 16.99					100		
	17.00 – 24.99		8					
RA31	25.00 – 35.99	-0,4/+0,05				100	89	ZS25 DIN 1835B
	36.00 – 43.99		10					
RA41	44.00 – 68.99	-0,6/+0,05	12			120	124	

* The RA01 tool body is smaller than the RA11 tool body.
Note: RA11 is the standard design.

Types RP, RK, RKA: Machining non-cylindrical surfaces



Plane faces, tapers

Features

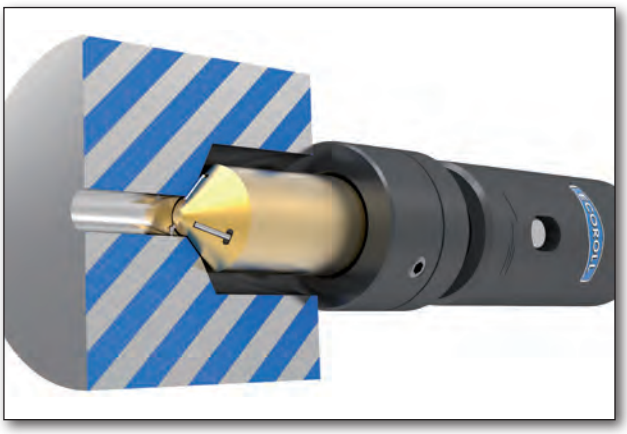
- For roller burnishing many non-cylindrical surfaces such as plane faces or tapers (internal and external).
- Tool applies force in the axial direction.
- The burnishing force applied in the axial direction is transferred elastically from the machine to the burnishing head via a disc spring assembly.
- Machines all metal materials up to a tensile strength of 1400 N/mm² and a maximum hardness of HRC ≤ 45.

Advantages

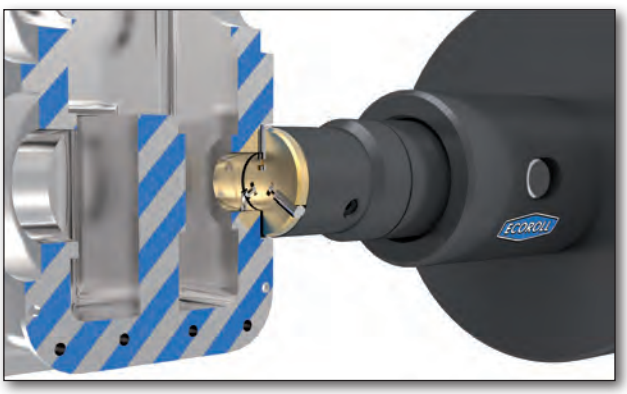
- Reliable function, high degree of accuracy.
- Wide variety of contours and diameter combinations.
- Cost-effective due to an extremely short work cycle.
- Optimized spring characteristic for consistent work result.
- Can be used with almost any type of machine. Depending on the type of machine, either the tool or the workpiece can rotate.
- Tool shanks available for any clamping system.
- Wear parts are easy to exchange.

Design

- Consists of a basic tool body and a burnishing head.
- Tool bodies are available in four different sizes (S1 to S4).
- Tools have Morse tapers, but can also be equipped with straight shanks, shanks in accordance with DIN 69880 (VDI shanks) or shanks for other clamping systems.
- Tool bodies are equipped with disc spring assemblies. The springs are arranged at ECOROLL for optimum performance with the respective machining task.



Roller burnishing an internal taper with type RK

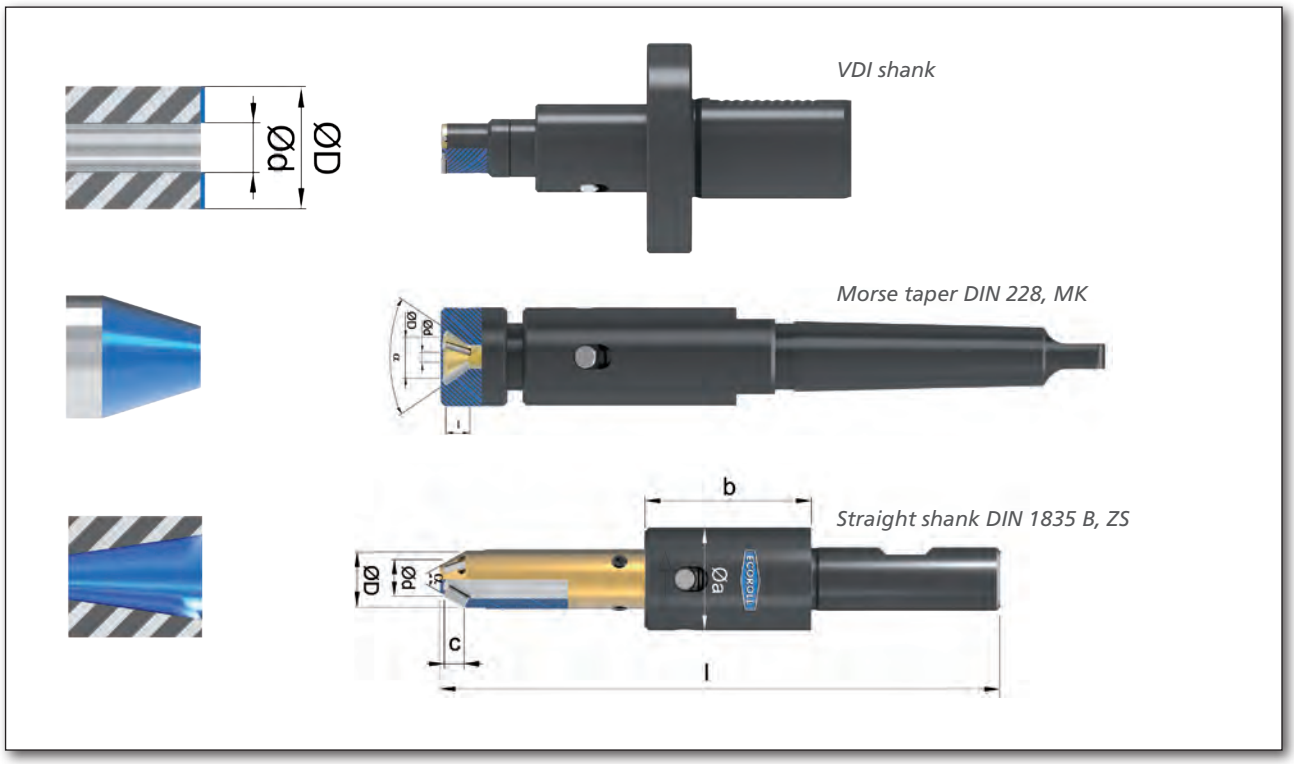


Roller burnishing an plane face of a gear housing with type RP

- During production, the burnishing head is specially adapted for the workpiece dimensions and screwed onto the tool body. It determines the tool's type designation.

Parameters

- Circumferential speeds up to 20 m/min.
- Plunge-in process: max. 15 rotations.

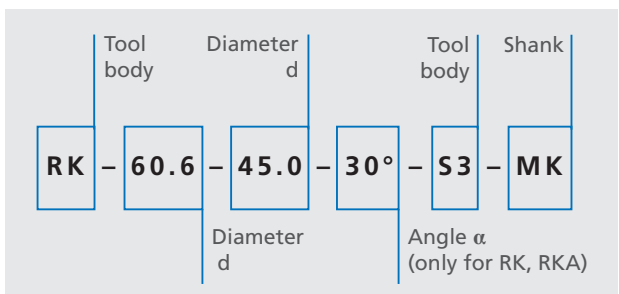


Ordering

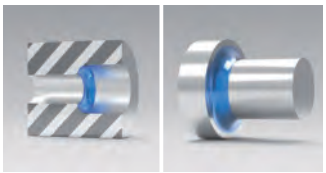
The following information is required:

- Workpiece dimensions and tensile strength (the dimensions of the burnishing heads and selection of the appropriate tool body size depend on the workpiece dimensions and material strength).
- To design the tool correctly, we generally need **workpiece drawings** and the **material designation, tensile strength, yield strength and breaking elongation**. If a drawing cannot be provided, we at least need the dimensions specified for the respective burnishing head and the tensile strength of the workpiece material.

The tool designation is generated as follows:



Types RH, RHA: Deep rolling fillets



RH: Internal machining
RHA: External machining

Features

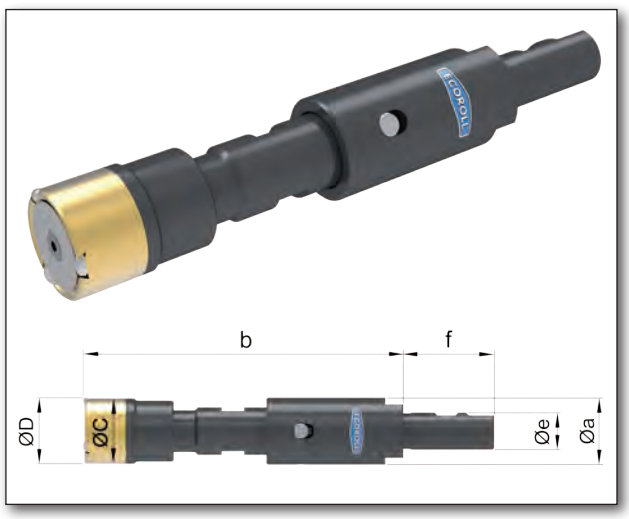
- Deep rolling in a plunge-in process.
- Can be used with conventional or CNC-controlled lathes and machining centers.
- Complete processing in one setting.
- Rotation in either direction.
- Suspended rollers for even force distribution regardless of production tolerances.

Advantages

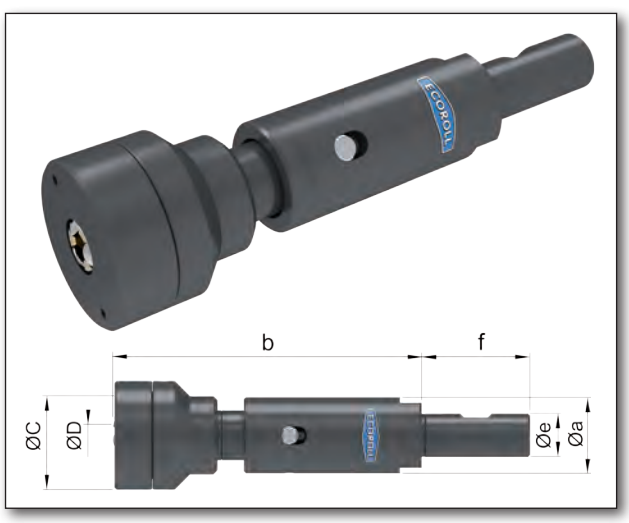
- Induces residual compressive stresses in the edge zone, which increases fatigue strength (especially important during cyclic loading).
- Increases the surface layer's material strength through controlled cold working.
- Generates a smooth surface, which eliminates micro-notches.
- Short work cycle (in one setting right after the cutting process).
- No set up time, just tool change.
- No transport costs.
- Low energy consumption.

Design

- RH and RHA tools consist of a basic tool body and a burnishing head.
- Standard shank: Morse taper or straight shank or any other clamping system by request. Equipped with disc spring assembly. Springs are arranged for optimum performance based on the machining task.
- Tool body: four different sizes available (S1 to S4).
- Burnishing head:
  – Specially adapted for the workpiece dimensions.
  – Screwed onto the tool body.



RH: Internal machining



RHA: External machining

Parameters

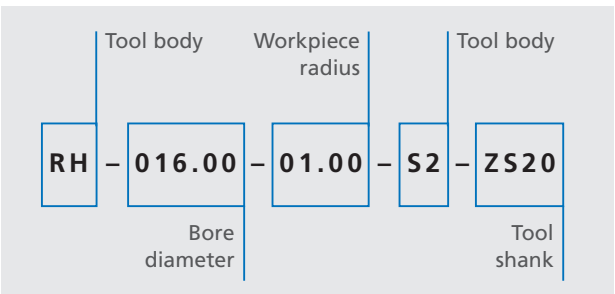
- max. burnishing force: 40 kN.
- max. machining radius: 4.0 mm.
- max. tensile strength: 1400 N/mm².
- min. machining diameter (RH): > 17 mm.
- min. machining diameter (RHA): > 4 mm.

Ordering

The following information is required:

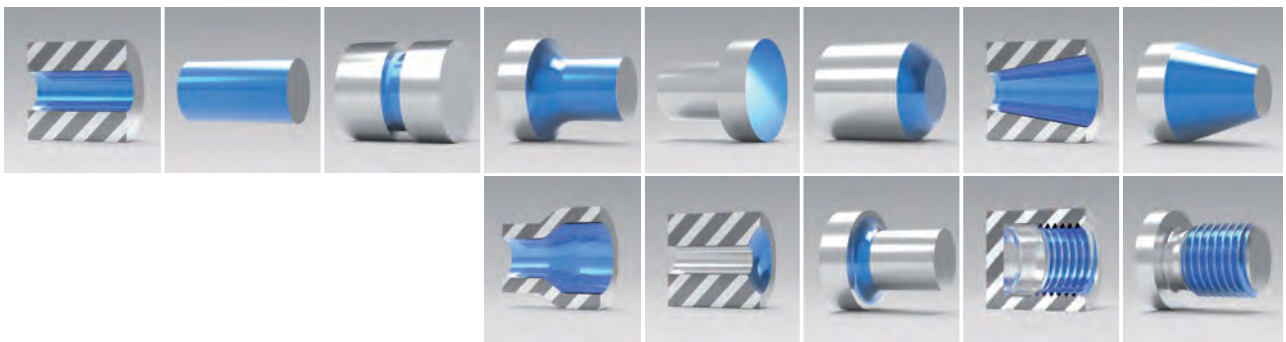
1. Workpiece dimensions
2. Shank type:
   MK: Morse taper
   ZS: Straight shank
   Other clamping system

The tool designation is generated as follows:



Main dimensions (mm)				Shank ø e (mm)
a	b	c	d	
26-65	Depending on the workpiece			≥ 25

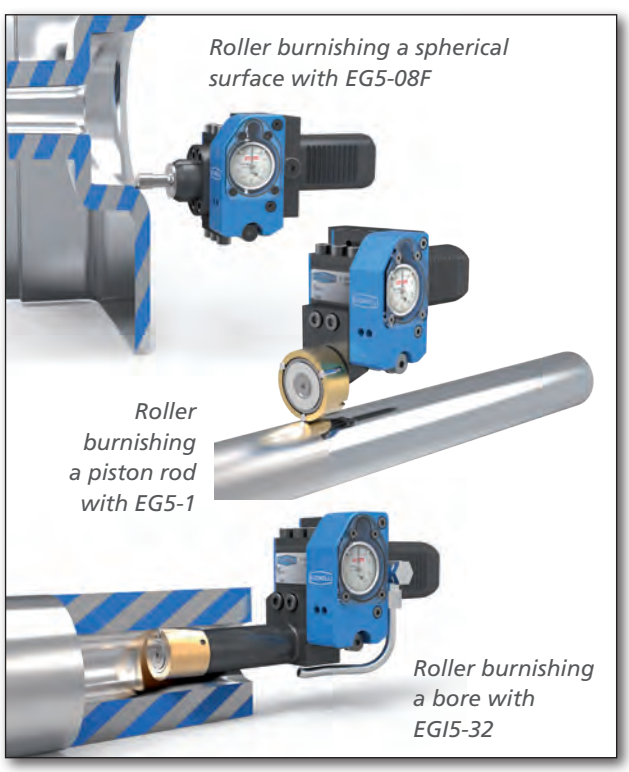
Single-roller Mechanical Tools



ECOROLL's mechanical tools with single rollers are generally used for roller burnishing. These tools can be used to machine a wide variety of complex contours, such as fillets and grooves, as well as cylindrical and tapered external surfaces or bores.

These tools are classified into three series: EG, EF and FAK. The EG series includes tool types EG5, EG14, EG45 and EG90, which are suitable for use in the machining of cylindrical outer surfaces and bores, tapered bores, plane faces and fillets. The tools in the EF and FAK series are used to deep roll fillets and thread root radii.

Single-roller tools consist of a tool body, a burnishing head and a tool shank, which is equipped with a spring assembly with no play, low friction and progressive action. In the normal version, the tool body contains a dial gauge that indirectly indicates the spring force. A measurement system for transmitting the spring force values by cable or wireless communication to an external display is available in special versions. The burnishing head is affixed to the spring-loaded section of the tool body.



EG5



EG14

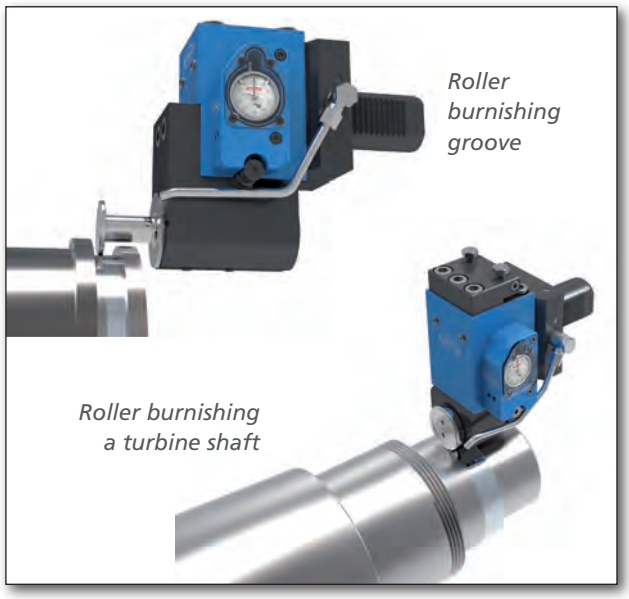


Roller burnishing the fillet of a train axle with an EG45-45T

Roller burnishing an plane face of a flywheel with EG45-40M

Roller burnishing a train axle with EG45-40M

EG45



Roller burnishing groove

Roller burnishing a turbine shaft

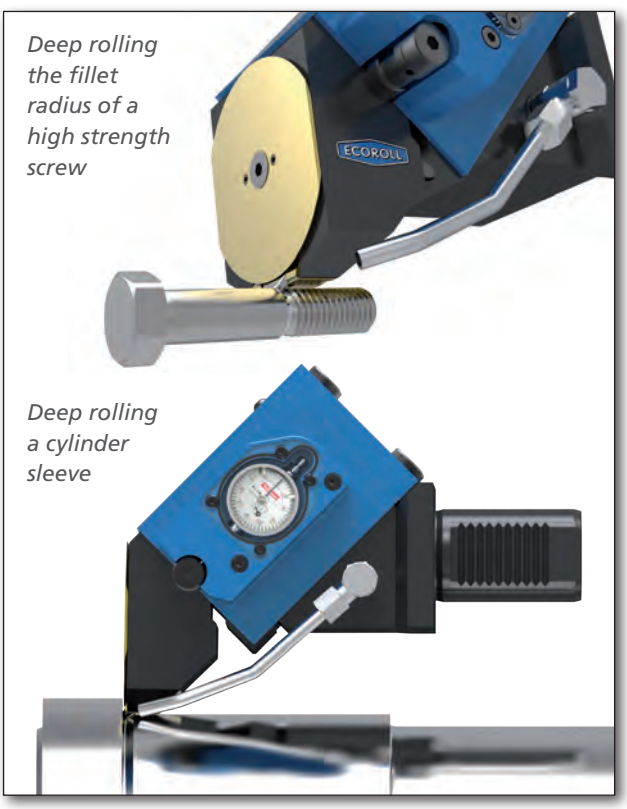
EG90



Deep rolling the thread root of internal threads

Deep rolling the thread root of external threads

EF90

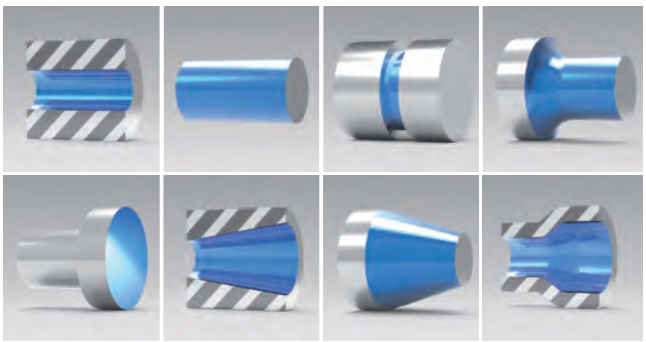


Deep rolling the fillet radius of a high strength screw

Deep rolling a cylinder sleeve

EF45

Type EG5: Modular system for universal application



- EG5: Cost-effective roller burnishing of any linear, rotationally symmetric surfaces of specified dimensions.
- For contours, transition radii and groove flanks: Ø of 8.5 mm and larger.
- For external surfaces (cylindrical or tapered), plane faces (external or internal) and bores (cylindrical or tapered): Ø of 55 mm and larger.

Burnishing heads

EG5-1



EG5-1-25.00



EGI5-32



EG5-F



EG5-40M





Example:
Standard tool
EG5-1-SL20

Tool bodies

EG5



Dial gauge/Dial gauge protector



EG5-45°
(mainly used in connection with EG5-40M)



Tool shanks

Square shank SL / SLA
20, 25 and 32 mm



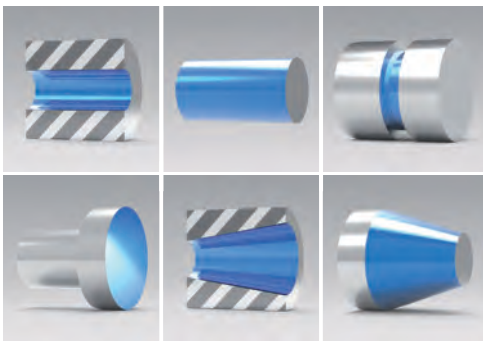
VDI DIN 69880



Capto, HSK, other special retainers



Type EG5: For external surfaces, plane faces and bores



Features

- For use on CNC-controlled or conventional lathes.
- Complete processing in one setting.
- Can achieve a surface quality of $R_z < 1$ µm ($R_a \leq 0.1$ µm).
- Machines all metal materials up to a tensile strength of 1400 N/mm² and a maximum hardness of HRC ≤ 45.
- Symmetrical tool design allows either right or left hand operation.
- Feed in the direction of the arrow label on the tool.
- Rotation in either direction.
- Included with delivery: two replacement rollers installed in the cage.

Advantages

- Short work cycle, changeover and auxiliary process time eliminated.
- No dust or residue.
- Requires minimal lubrication (oil or emulsion).
- Adjustable support positioning enables infinitely variable burnishing force.
- Measurement of burnishing force enables consistent, controlled work result.
- Unrestricted roller face for roller burnishing shoulders and other edges.
- Guided roller head moves with no play and very low friction.
- Wear parts are easy to exchange.

Design

- Tools consist of a tool body, a burnishing head and a tool shank, which is equipped with a spring assembly with no play, low friction and progressive action.
- In the normal version, the tool body contains a dial gauge that indirectly indicates the spring force. A measurement system for transmitting the spring force values by cable or wireless communication to an external display is available in special versions.
- The burnishing head is affixed to the spring-loaded section of the tool body.
- Burnishing head components: Roller (in a cage) and support roller (with large-scale needle bearing).
- Fixed roller clearance angle α.

Parameters

- Maximum circumferential speed: 150 m/min.
- Maximum feed rate: 0.3 mm/rev.
- Maximum burnishing force: 3000 N.



Ordering

The following information is required:

1. Tool holder: SLA
2. Application:

   Available in three versions (various burnishing heads).

   Special version for machining tapers by request.

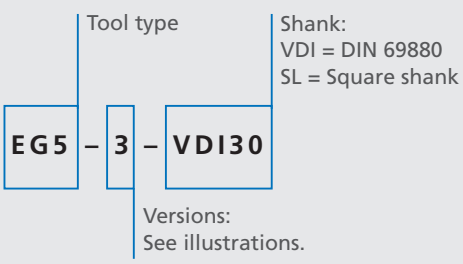
   Version 1: Machining bores and cylindrical surfaces.

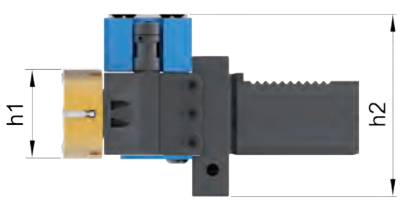
Bore depth (mm)	≤ 16	>16
Smallest bore diameter (mm)	55	140

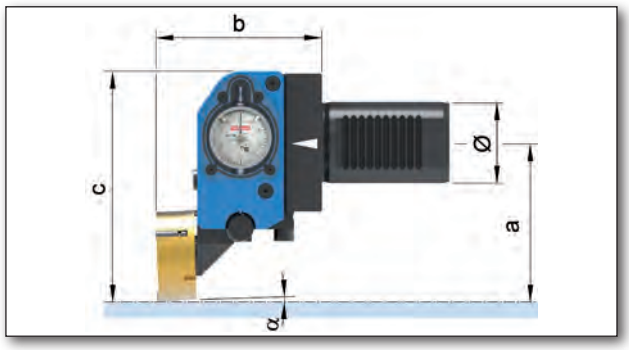
   Version 2: Machining plane faces.

   Version 3: Machining cylindrical surfaces (feed toward tailstock).

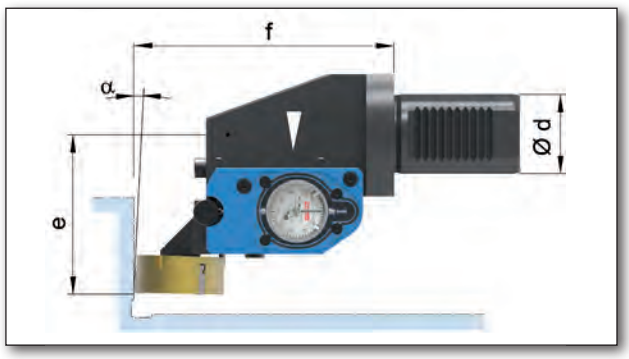
The tool designation is generated as follows:



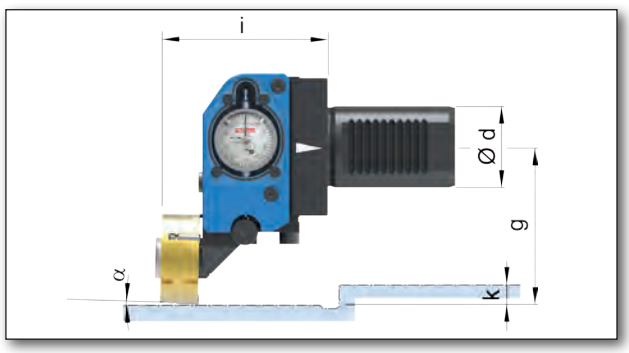




EG5, Version 1, Cylindrical surfaces



EG5, Version 2, Plane faces

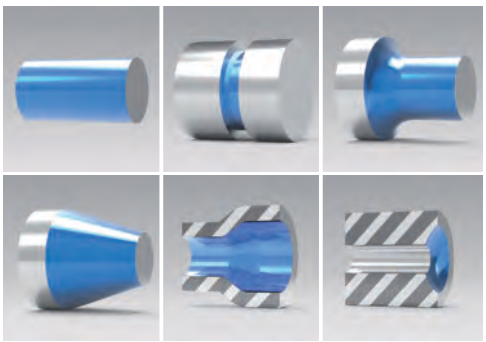


EG5, Version 3, Cylindrical surfaces, Feed toward tailstock

Tool body	VDI shank: Ø d[1] (mm)	Height (mm)		Square shank (mm)	Variable dimensions per version (mm)							
					1			2		3		
		h_1	h_2	p[1]	a	b	c	e	f	g	i	k
EG5	20	45	67	16	78	82	120	64	111	78	84	10
	30		77	20				69				
	40		82	25					112			

Note: [1] Alternative sizes.

Type EG5: For contours, transition radii and groove flanks, Ø of 8.5 mm and larger



Features

- For use on CNC-controlled or conventional lathes.
- Complete processing in one setting.
- Can achieve a surface quality of $R_z < 1$ µm ($R_a \leq 0.1$ µm).
- Machines all metal materials up to a tensile strength of 1400 N/mm² and a maximum hardness of HRC ≤ 45.
- Symmetrical tool design allows either right or left hand operation.
- Feed in the direction of the arrow label on the tool.
- Rotation in either direction.

Advantages

- Short work cycle, changeover and auxiliary process time eliminated.
- No dust or residue.
- Minimum lubrication requirements (oil, emulsion)
- Adjustable support positioning enables infinitely variable burnishing force.
- Measurement of burnishing force enables consistent, controlled work result.
- Unrestricted roller face for roller burnishing shoulders and other edges.
- Wear parts are easy to exchange.

Design

- Tools consist of a tool body, a burnishing head and a tool shank, (equipped with a spring assembly with no play, low friction and progressive action).
- The tool body contains a dial gauge that indirectly indicates the spring force. Special version: with a measurement system for transmitting the spring force values by cable or wireless communication to an external display.
- The burnishing head is affixed to the spring-loaded section of the tool body. Burnishing head components: Roller (in a cage) and support roller (with large-scale needle bearing).
- Fixed roller clearance angle α.

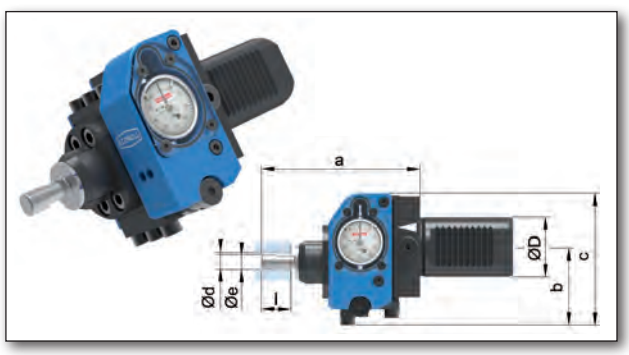
Parameters

Tool	Circumferential speed	Feed
EG5-08F	80-100 m/min.	0.1-0.3 mm/rev.
EGI5-32	80-150 m/min.	0.1-0.3 mm/rev.
EGI5		
EG5-40M	100-200 m/min.	0.1-0.5 mm/rev.
EG5-40M-45°		

Ordering

The following information is required:

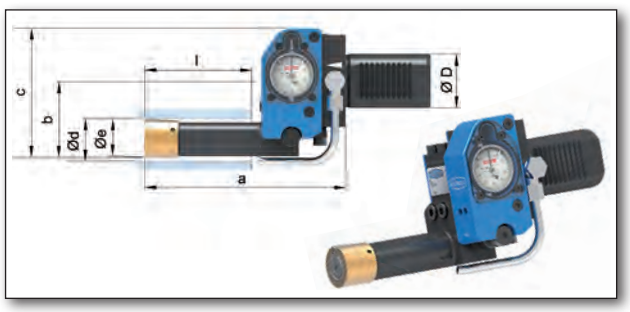
1. Shank diameter.
2. Application:
   Available in four versions (various burnishing heads).
   Version 1 (EG5-08F, EG5-11F): Groove flanks (face or circumference).
   - max. burnishing depth: 20 mm for bores of 8.5 mm and larger (EG5-08F).
   - max. burnishing depth: 30 mm for bores of 11 mm and larger (EG5-11F).
   - The tool body's spring assembly is positioned parallel to the workpiece surface.
   - Burnishing head with floating roller is affixed to the spring-loaded section of the tool body.
   - For machining bores and cylindrical surfaces.



EG5-08F and EG5-11F

Version 2 (EGI5-32): For bores of Ø 32 mm and larger.

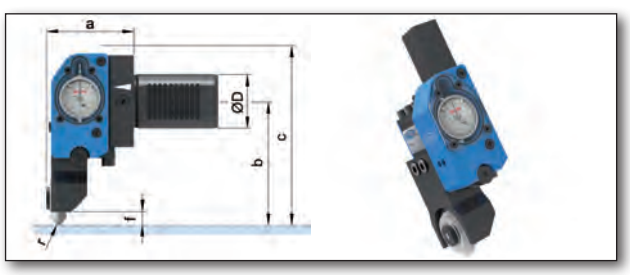
- max. burnishing length: 80 mm.
- The tool body's spring assembly is positioned parallel to the workpiece surface.
- Burnishing head is affixed to the spring-loaded section of the tool body.
- The burnishing head consists of both a cage that guides the roller and a support roller with a large-scale needle bearing.



EGI5-32

Version 3 (EG5-40M): External surfaces with contours.

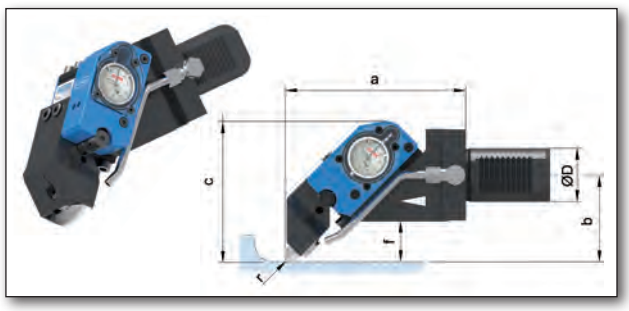
- Suitable for use with low and mid-level strength materials.
- The tool body's spring assembly is positioned parallel to the workpiece surface.
- Burnishing head with an extremely narrow roller is affixed to the spring-loaded section of the tool body.
- The roller is equipped with an integrated four-point bearing.



EG5-40M

Version 4 (EG5-40M-45°): Cylindrical surfaces with connecting radii up to the plane face.

- Suitable for use with low and mid-level strength materials.
- The tool body's spring assembly is positioned at a 45° angle to the workpiece surface.
- Burnishing head with an extremely narrow roller is affixed to the spring-loaded section of the tool body.
- The roller is equipped with an integrated four-point bearing.



EG5-40M-45°

The tool designation is generated as follows:

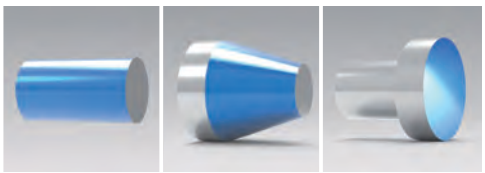
Tool type		Diameter		Tool body at 45°
EG5 –	1 –	40M –	R02.50 –	VDI40 –	45°
	Version		Radius	Shank	



Tool	VDI shank: Ø d (mm)	Height (mm)		Square shank (mm)	Main dimensions (mm)						
		h_1	h_2	p[1)]	a	b	c	d	e	f	l
EG5-08F	20, 30, 40	40	67-91	20	106	53	95	8,5 / 11,5	84		20 / 30
	50				117						
EGI5-32	20, 30, 40			25	150	58	99	32	24		80
	50				161						
EG5-40M	20, 30, 40	50	67-91	32	66	92	134			10	10
	50				77						
EG5-40M-45°	20, 30, 40				136	65	115			30	30
	50				147						

Note: [1)] Alternative sizes.

Type EG5T: Cost-effective roller burnishing of any linear, rotationally symmetric surfaces of specified dimensions



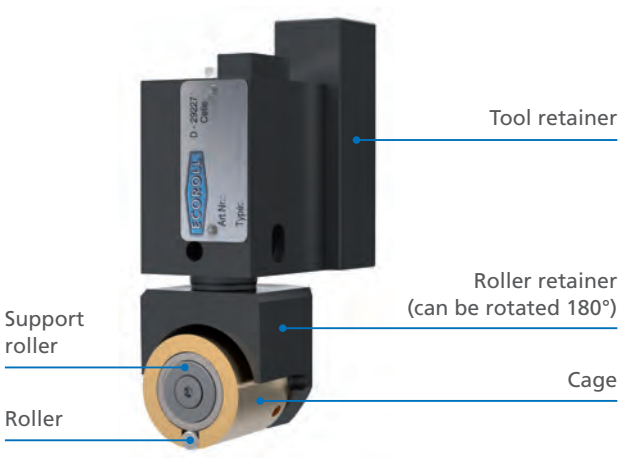
Features

- For use on CNC-controlled or conventional lathes.
- Also suitable for use on long bed lathes.
- Can achieve a surface quality of R_z < 1 µm (R_a ≤ 0.1 µm).
- Machines all metal materials up to a tensile strength of 1400 N/mm2 and a maximum hardness of HRC ≤ 45.

Advantages

- Versatile, compact, inexpensive.
- Short cycle time.
- Complete processing in one setting; changeover and auxiliary process time eliminated.

Design



Parameters

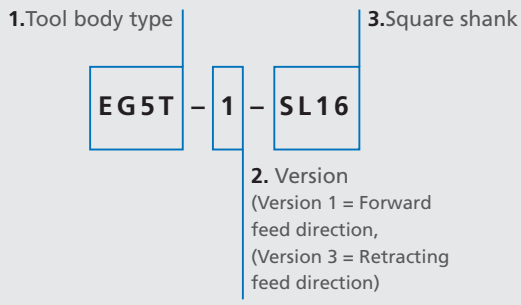
- max. circumferential speed: 150 m/min.
- max. feed rate: 0.3 mm/rev.
- max. burnishing force: 2100 N.

Ordering

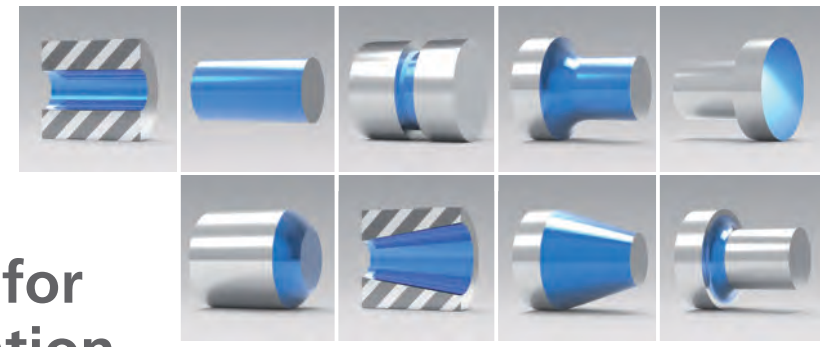
The following information is required:

1. Tool retainer.
2. Component drawing.
3. Square shank size
   (available thicknesses: 12, 16, 20 mm).

The tool designation is generated as follows:



Types EG14 and EG45: Overview



Modular system for universal application

Tool types EG14 and EG45 have the same tool body. Depending on the application, the tools are classified as EG14 or EG45; the differences between these tools include the burnishing head and the shank.

Burnishing heads

EG14

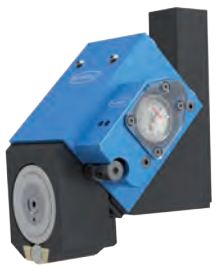


EG45-40M



EG45-55TS





Example:
Standard tool
EG14-1-SL32

Tool bodies

EG14



Dial gauge/Dial gauge protector



Tool shanks

Square shank SL / SLA
20, 25 and 32 mm



VDI DIN 69880

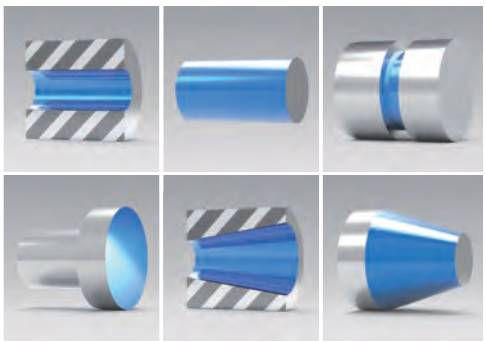


Capto, HSK, other special retainers



* Note: Depending on the burnishing head and the shank, tools are classified as EG45 or EG14. The tool body is always EG14.

Type EG14: Machining external surfaces and cylindrical and tapered bores



Features

- Machines cylindrical and tapered external surfaces, external or internal plane faces and cylindrical and tapered bores (special version required for machining tapered surfaces).
- For use on CNC-controlled or conventional lathes.
- Complete processing in one setting.
- Can achieve a surface quality of $R_z < 1$ µm ($R_a \leq 0.1$ µm).
- Machines all metal materials up to a tensile strength of 1400 N/mm² and a maximum hardness of HRC ≤ 45.
- Symmetrical tool design allows either right or left hand operation.
- Rotation in either direction.

Advantages

- Short work cycle, changeover and auxiliary process time eliminated.
- No dust or residue.
- Requires minimal lubrication (oil or emulsion).
- Adjustable support positioning enables infinitely variable burnishing force.
- Measurement of burnishing force enables consistent, controlled work result.
- Unrestricted roller face for roller burnishing shoulders and other edges.
- Wear parts are easy to exchange.

Design

- Tools consist of a tool body, a burnishing head and a tool shank, which is equipped with a spring assembly with no play, low friction and progressive action.
- In the normal version, the tool body contains a dial gauge that indirectly indicates the spring force. A measurement system for transmitting the spring force values by cable or wireless communication to an external display is available in special versions.
- The burnishing head is affixed to the spring-loaded section of the tool body.
- Fixed roller clearance angle α.



Parameters

- Maximum circumferential speed: 200 m/min.
- Maximum feed rate: 0.5 mm/rev. feed in the direction of the arrow label on the tool.
- Maximum burnishing force: 10,000 N.

Ordering

The following information is required:

1. Shank diameter.
2. Application:

   Available in three versions (various burnishing heads).

   Special version for machining tapers by request.

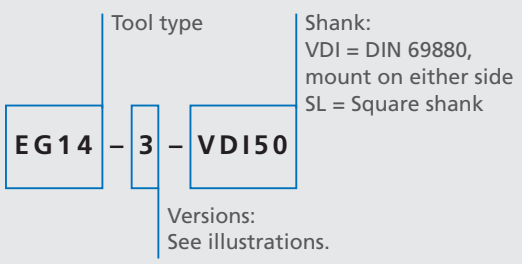
   Version 1: Machining bores and cylindrical surfaces.

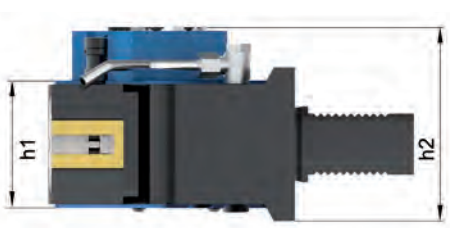
Bore depth (mm)	<– 25	<– 50	> 50
Smallest bore diameter (mm)	120	140	180

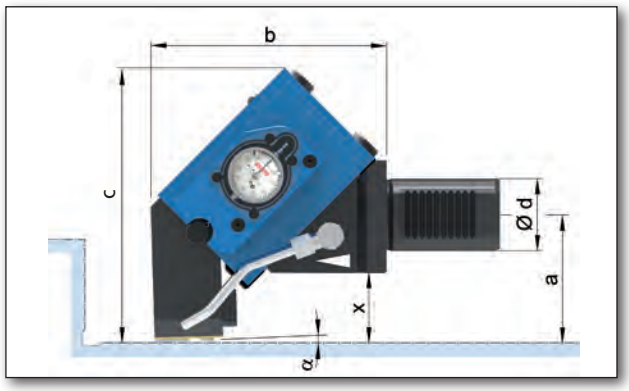
   Version 2: Machining plane faces.

   Version 3: Machining cylindrical surfaces (feed toward tailstock).

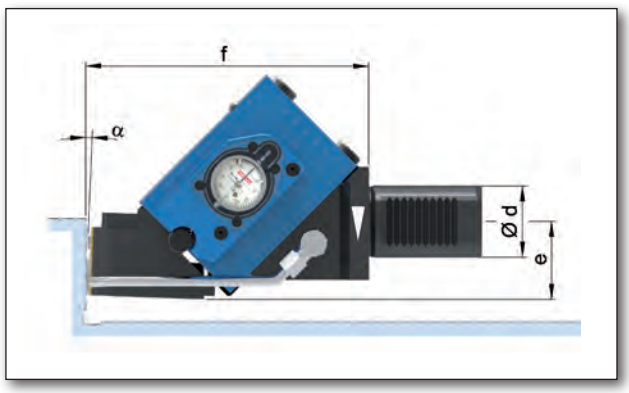
The tool designation is generated as follows:



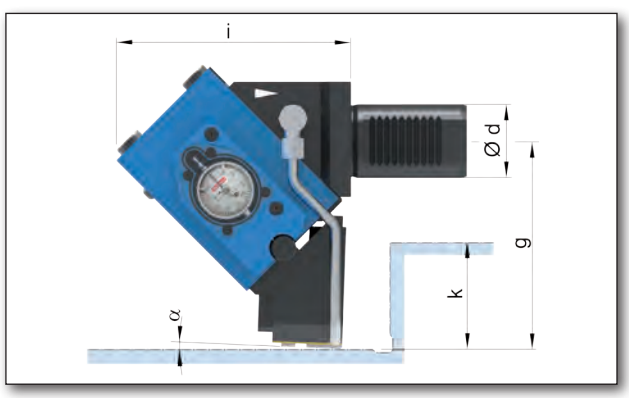




EG14, Version 1, Cylindrical surfaces



EG14, Version 2, Plane faces

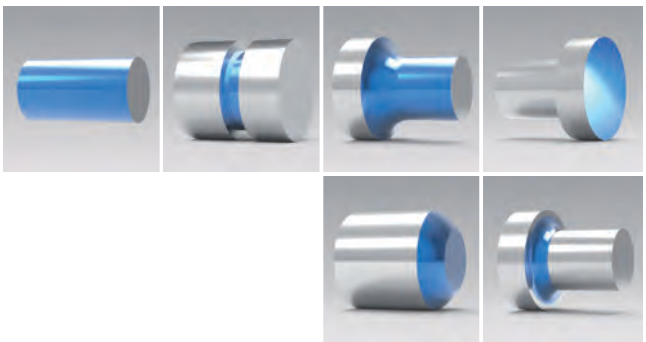


EG14, Version 3, Cylindrical surfaces, Feed toward tailstock

Tool body	VDI shank: Ø d[1] (mm)	Height (mm)		Square shank (mm)	Variable dimensions per version (mm)								
					1				2		3		
		h_1	h_2	p[1]	a	b	c	x	e	f	g	i	k
EG14	40	63	81	25 or 32	71	131	152	43	40	159	113	127	50
	50		90						45				
	60		110			150			50	166		124	

Note: [1] Alternative sizes.

Type EG45: Machining transition radii, fillets and contours



Features

- For use on CNC-controlled or conventional lathes with hydraulic duplicators.
- Complete processing in one setting.
- Machines all metal materials up to a tensile strength of 1400 N/mm² and a maximum hardness of HRC ≤ 45.
- Can achieve a surface quality of R_z < 1 µm (R_a ≤ 0.1 µm).

Advantages

- Eliminates micro-notches.
- Induces compressive stresses and cold working.
- Short work cycle, changeover and auxiliary process time eliminated.
- No dust or residue.
- Requires minimal lubrication (oil or emulsion).
- Infinitely variable burnishing force.
- Measurement of burnishing force enables consistent, controlled work result.
- Wear parts are easy to exchange.

Design

- Tools consist of a tool body, a burnishing head and a tool shank, which is equipped with a spring assembly with no play, low friction and progressive action.
- In the normal version, the tool body contains a dial gauge that indirectly indicates the spring force.
- The burnishing head is affixed to the spring-loaded section of the tool body.





Parameters

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

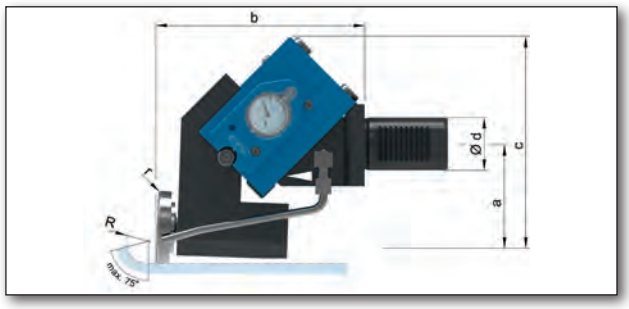
Ordering

The following information is required:

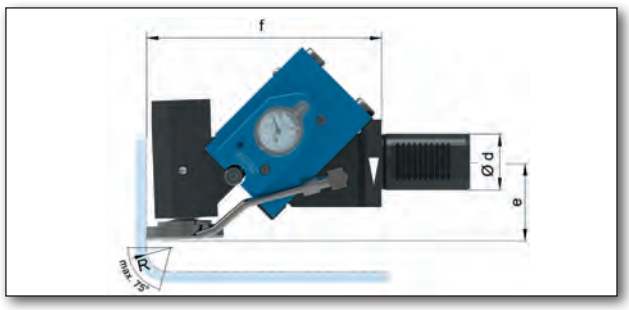
1. Shank diameter.
2. Component geometry:
   EG45-40M: Machines cylindrical surfaces with connecting radii up to the plane face.
   - Suitable for use with low and mid-level strength materials.
   - Equipped with an extremely narrow roller; due to its compact design, however, this roller bearing cannot withstand high loads.
   - Up to 4,000 N.

   EG45-55TS: Machines cylinders or plane faces with connecting transition radii up to 75°.
   - High burnishing force; suitable for high strength materials.
   - Floating rollers.

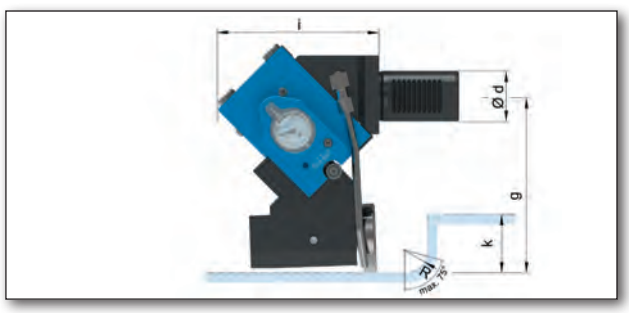
   EG45-55F: Machines convex and concave shapes in a plunge-in or feed process.
   - Special version with specially shaped, floating roller.
3. Version 3: Available in three versions (various burnishing heads).
   Version 1: Machines cylinder surfaces (including connecting fillets).
   Version 2: Machines faces on the chuck side (including connecting fillets).
   Version 3: Machines cylindrical surfaces (feed toward tailstock).



EG45, Version 1, Cylindrical surfaces



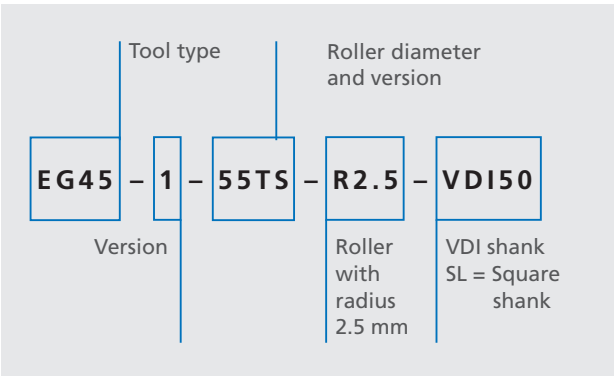
EG45, Version 2, Plane faces



EG45, Version 3, Cylindrical surfaces, Feed toward tailstock

Tool	Workpiece radius R can be machined 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	< 10
EG45-55TS	0,8 - 3	1,2 - 5	2 - 8	3 - 12	5 - 20	8 - 63
EG45-55F	Special rollers adapted for workpiece contour					

The tool designation is generated as follows:

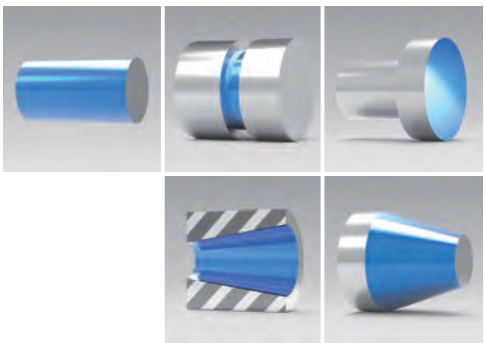




Tool	VDI shank: Ø d[1] (mm)	Height (mm)		Square shank (mm)	Variable dimensions per version (mm)						
					1			2		3	
		h_1	h_2	p[1]	a	b	c	e	f	g	i
EG45-55TS	40, 50	63	100-115	25 oder 32	91	158	172	56	167	140	134
	60					165			174		
EG45-40M	40, 50				69	129	150			108	126
	60					136					134

Note: [1] Alternative sizes.

Type EG90: Cylinders, internal and external tapers and plane faces



Features

- For machining any linear, rotationally symmetric surfaces of specified dimensions, together with connecting radii or arched radii, such as cylinders, external or internal tapers or plane faces.
- Any metal material that can be plastically formed, with a hardness up to 45 HRC, can be roller burnished.
- Starting with a finished surface, a surface roughness of $R_z < 1$ µm can be achieved in one pass.

Advantages

- Complete processing in one setting following the cutting process on a lathe or machining center.
- Short cycle time when compared with processes that remove material.
- Designed for use on CNC-controlled machine tools, but the same advantages can be achieved on conventional lathes.
- The floating burnishing roller positioned in the feed direction is particularly advantageous because it enables machining right up to shoulders and other difficult edges.

Design

- The tool body has a tool shank and a spring assembly with no play, low friction and progressive action.
- The normal version of the tool is equipped with a measuring device.
- Special versions have a position sensor.
- Other components include a roller head and roller retainer.



Parameters

- max. circumferential speed: 250 m/min.
- max. feed rate: 0.5 mm/rev.
- max. burnishing force: 10,000 N.

Ordering

The following information is required:

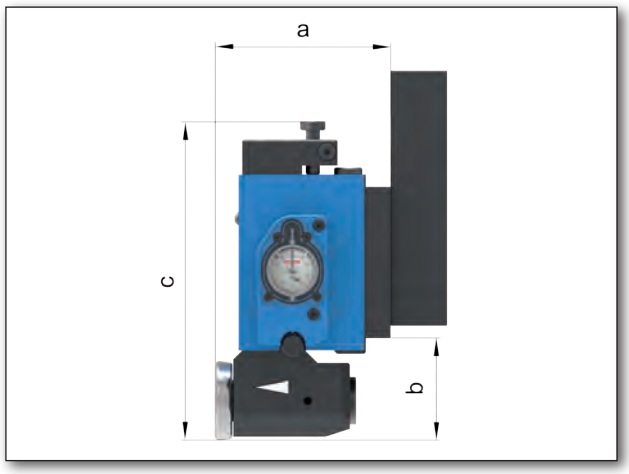
1. Type of tool retainer and machine tool.
2. Component drawing.
3. Application:

   Available in two versions (various burnishing heads).

   Special version for internal surfaces by request.

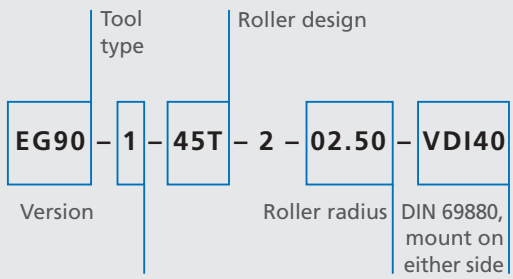
   Version 1: Machines external contours and bores with Ø 200 mm and larger (mounted on disc type turret).

   Version 2: Machines external contours and bores (mounted on disc type turret or vertical turret).

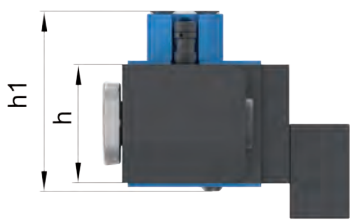


EG90-1-45T

The tool designation is generated as follows:

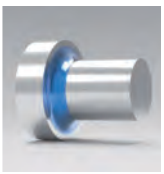


Note: SL= Square shank, special roller designs and other tool retainers available.



Tool	max. burnishing force	max. machining radius	max. tensile strength	Machining diameter	Main dimensions (mm)					Shank Ø d (mm)
	(kN)	(mm)	(N/mm²)	(mm)	a	b	c	h	h_1	
EG90	20	1.6	1400	≥ 80	99	60	181	63	98	≥ VDI 40

Type EF45:
Deep rolling fillets



Features

- For machining fillets on turned parts, such as shafts, screws, tension rods, torsion rods.
- Deep rolling in a plunge-in process.
- One floating roller.
- Burnishing force monitoring adjusted for the radius of the fillet using a dial gauge or sensor.



Advantages

- Can be used with conventional or CNC-controlled lathes.
- Complete processing in one setting.
- Allows either right or left hand operation.
- Rotation in either direction.

Design

- The tool body has a tool shank and a spring assembly with no play, low friction and progressive action.
- The normal version is equipped with a dial gauge that indirectly indicates the spring force. Special versions can include an inductive measuring system for external display of the spring force.
- Burnishing head with roller is affixed to the spring-loaded section of the tool body. The springs allow the roller retainer to move elastically when affected by radial or axial burnishing forces acting upon the tool retainer.
- A cage holds the roller, which is supported by a support body with large-scale needle bearings.

Parameters

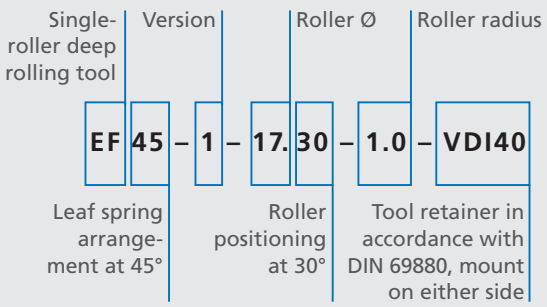
- max. circumferential speed: 20 m/min.
- max. burnishing force: 20 kN.

Ordering

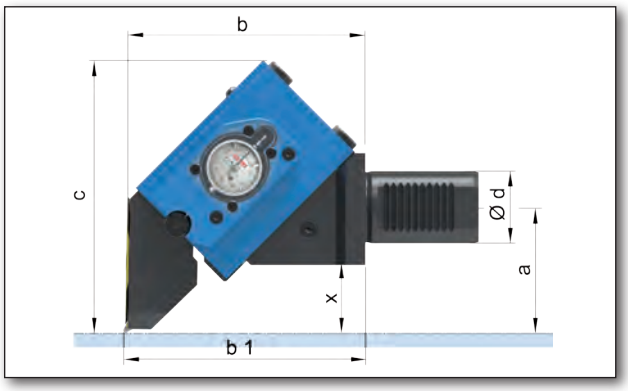
The following information is required:

1. Type of tool retainer and machine tool.
2. Component drawing.
3. Fillet radius.
4. Material properties.

The tool designation is generated as follows:



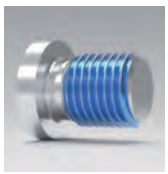
Note: SL = Square shank; special shanks by request.



EF45

Tool	max. burnishing force	max. machining radius	max. tensile strength	Machining diameter	Main dimensions (mm)					Shank Ø d (mm)
	(kN)	(mm)	(N/mm²)	(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	2.5		≥ 40						

Type EF90: Deep rolling thread root radii on external threads





Features

- Deep rolling thread root radii (external).
- Deep rolling in the machine's thread cycle.
- Axially floating rollers compensate for minor positioning errors.
- Automatic roller angle setting for various pitches.
- Machines right-hand and left-hand threads without conversion.
- Roller adapted to the thread root radius of the workpiece.
- Integrated pre-loading mechanism, no further X-axis adjustment required.

Advantages

- Can be used with conventional or CNC-controlled lathes.
- Complete processing in one setting.
- Allows either right or left hand operation.
- Rotation in either direction.

Design

- The tool body has a tool shank and a spring assembly with no play, low friction and progressive action.
- The normal version is equipped with a dial gauge that indirectly indicates the spring force. Special versions can include an inductive measuring system for external display of the spring force.
- Burnishing head with roller is affixed to the spring-loaded section of the tool body. The springs allow the roller retainer to move elastically when affected by radial or axial burnishing forces acting upon the tool retainer.
- The roller is suspended within the roller retainer with a slide bearing bolt.
- The roller mount swings such that the roller automatically adjusts to the thread pitch. A set screw limits the roller's pivoting angle.

Parameters

- max. circumferential speed: 20 m/min.
- max. burnishing force: 15 kN.

Ordering

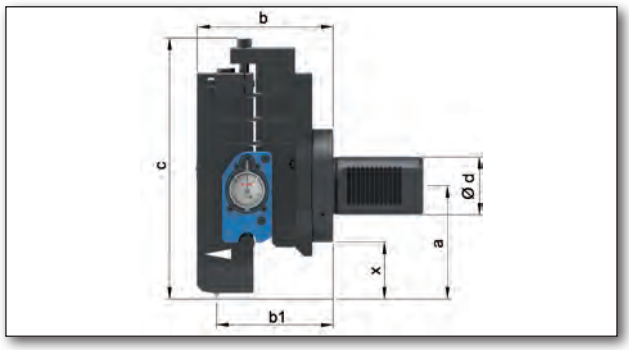
The following information is required:

1. Type of tool retainer and machine tool.
2. Component drawing.
3. Thread dimensions.
4. Thread root radius.
5. Material properties.

The tool designation is generated as follows:

Single-roller deep rolling tool	Version		Roller Ø		Thread root radius	
EF	90	– 1 –	28.00	– 1.15 –	VDI60	
	Leaf spring arrangement at 90°				Shank DIN 69880, mount on either side	

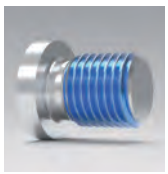
Note: SL = Square shank; special shanks by request.



EF90

Tool	max. burnishing force	max. machining radius	max. tensile strength	Machining diameter	Main dimensions (mm)					Shank Ø d (mm)
	(kN)	(mm)	(N/mm²)	(mm)	a	b	c	b_1	x	
EF90	20	1.6	1400	≥ 40	100	120	228	103	45	≥ VDI 40

Type HF90: Deep rolling thread root radii on external threads





Features

- Deep rolling of dynamically loaded external threads at the thread root (e.g. metric ISO threads or Whitworth threads).
- Hydraulic deep rolling tool (HGP series hydraulic unit available separately).
- Deep rolling in the machine's thread cycle.
- Automatic roller angle setting for various thread pitches.
- For use on CNC-controlled lathes.
- Any metal material that can be plastically formed, up to a tensile strength of 1400 N/mm² or a yield strength of 1200 N/mm² can be roller burnished.

Advantages

- Complete processing in one setting.
- Axially floating rollers compensate for minor positioning errors.

Design

- HG90 tools consist of a basic tool body with a hydraulic following system and a deep rolling head.
- Depending on the version, the tool can be delivered with any of a variety of shanks (e.g. HSK, Capto, VDI or square).

Parameters

- max. circumferential speed: 20 m/min.
- max. burnishing force: 20 kN.

Ordering

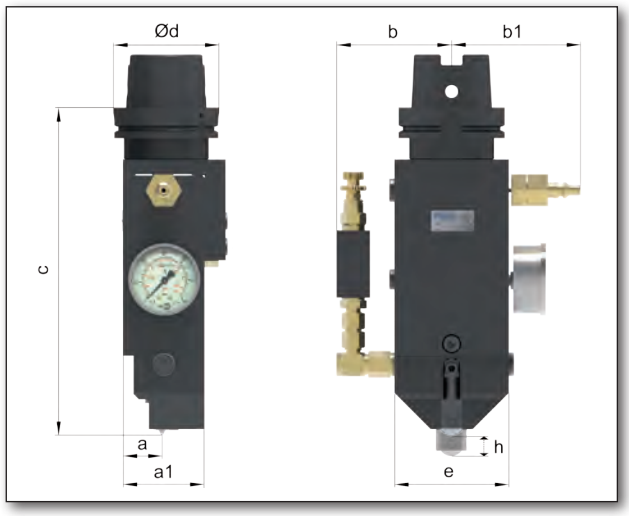
The following information is required:

1. Type of tool retainer and machine tool.
2. Component drawing.
3. Thread dimensions.
4. Thread root radius.
5. Material properties.

The tool designation is generated as follows:

Hydraulic deep rolling tool for external threads	Version	Roller Ø		Thread root radius	
HF	**90** –	**1** –	**25.00** –	**1.15** –	**VDI60**
	Series				Shank DIN 69880, mount on either side

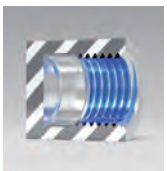
Note: SL = Square shank,
ZS = Straight shank; special shanks by request.



HF90

Tool	max. burnishing force	max. machining radius	max. tensile strength	Machining diameter	Main dimensions (mm)							Shank Ø d (mm)
	(kN)	(mm)	(N/mm²)	(mm)	a	a_1	b	b_1	c	e	h	
HF90	20	2.5	1400	≥ 40	37	77	109	122	311	108	20	≥ VDI 40

Type EFI90: Deep rolling thread root radii on internal threads



Features

- Deep rolling thread root radii (internal).
- Deep rolling in the machine's thread cycle.
- Axially floating rollers compensate for minor positioning errors.
- Automatic roller angle setting for various pitches.
- Machines right-hand and left-hand threads without conversion.
- Roller adapted to the thread root radius of the workpiece.
- Integrated pre-loading mechanism, no further X-axis adjustment required.



Advantages

- Can be used with conventional or CNC-controlled lathes.
- Complete processing in one setting.
- Allows either right or left hand operation.
- Rotation in either direction.

Parameters

- max. circumferential speed: 20 m/min.
- max. burnishing force: 15 kN.

Design

- The tool body has a tool shank and a spring assembly with no play, low friction and progressive action.
- The normal version is equipped with a dial gauge that indirectly indicates the spring force. Special versions can include an inductive measuring system for external display of the spring force.
- Burnishing head with roller is affixed to the spring-loaded section of the tool body. The springs allow the roller retainer to move elastically when affected by radial or axial burnishing forces acting upon the tool retainer.
- The roller is suspended within the roller retainer with a slide bearing bolt. The roller mount swings such that the roller automatically adjusts to the thread pitch. A set screw limits the roller's pivoting angle.

Ordering

The following information is required:

1. Type of tool retainer and machine tool.
2. Component drawing.
3. Thread dimensions.
4. Thread root radius.
5. Material properties.

The tool designation is generated as follows:

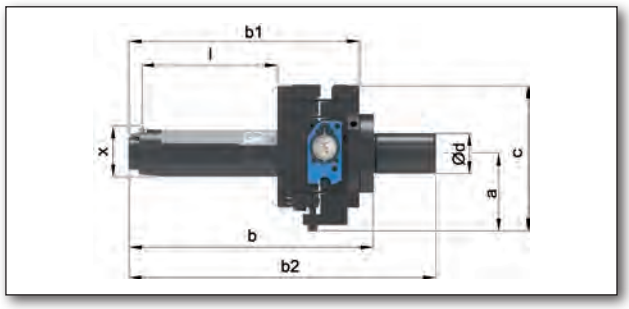
Single-roller deep rolling tool for internal threads | Roller Ø | Thread root radius

EFI 90 – 28.00 – 0.97 – VDI60

Shank DIN 69880, mount on either side

Note: SL = Square shank,

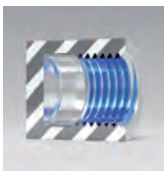
ZS = Straight shank; special shanks by request.



EFI90

Tool	max. burnishing force	max. machining radius	max. tensile strength	Machining diameter	Main dimensions (mm)						Shank Ø d (mm)
	(kN)	(mm)	(N/mm²)	(mm)	a	b	c	b_1	b_2	x	
EFI90	20	1.6	1400	≥ 80	142	324	229	307		42	≥ VDI 40

Type HFI90: Deep rolling thread root radii on internal threads





Features

- Deep rolling of dynamically loaded internal threads at the thread root (e.g. metric ISO threads, Whitworth threads or conical threads for the oil industry).
- Hydraulic deep rolling tool (HGP series hydraulic unit available separately).
- Deep rolling in the machine's thread cycle.
- The deep rolling force is determined by the hydraulic pressure. The required pressure depends on the size of the thread root radius and the material strength.
- Automatic roller angle setting for various pitches.
- For use on CNC-controlled lathes.
- Any metal material that can be plastically formed, up to a breaking strength of 1400 N/mm² or a yield strength of 1200 N/mm² can be roller burnished.

Advantages

- Complete processing in one setting.
- Axially floating rollers compensate for minor positioning errors.
- No radial force is transferred to the machine because the rollers are offset by 180°. This allows high deep rolling forces to be applied.

Design

- HFI90 tools consist of a basic tool body and a deep rolling head.
- While the tool body remains the same for all of the thread sizes to be machined, the deep rolling head is changed to adapt to the thread size and design.
- The tools are equipped with a modular interface for mounting the tool shanks required by the machine.

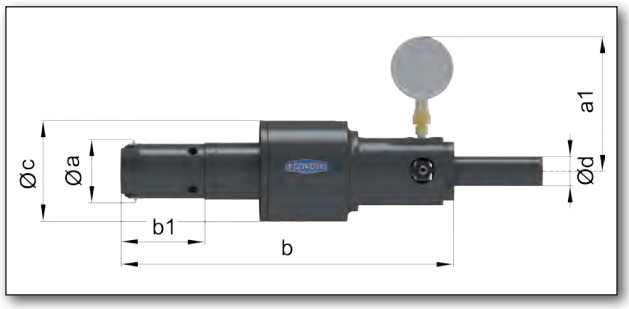
Parameters

- max. circumferential speed: 20 m/min.
- max. burnishing force: 40 kN.

Ordering

The following information is required:

1. Type of tool retainer and machine tool.
2. Component drawing.
3. Thread dimensions.
4. Thread root radius.
5. Material properties.



HFI90

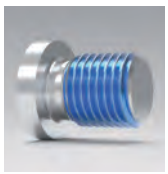
The tool designation is generated as follows:

Hydraulic deep rolling tools for internal threads	Roller Ø		Thread root radius	
HFI 90	– 25.00	– 0.1	– VDI60	
				Shank DIN 69880, mount on either side

Note: ZS = Straight shank; special shanks by request.

Tool	max. burnishing force	max. machining radius	max. tensile strength	Machining diameter	Main dimensions (mm)					Shank Ø d (mm)
	(kN)	(mm)	(N/mm²)	(mm)	a	a_1	b	b_1	c	
HFI90	20	1.6	1400	≥ 80	122	191	404	141	170	≥ VDI 40

Type FA: Deep rolling large radii in thread roots



Features

- Deep rolling of dynamically loaded external threads, such as those used in the oil industry).
- Hydraulic deep rolling tool (HGP series hydraulic unit available separately).
- The set hydraulic pressure determines the deep rolling force. The constant, consistent hydraulic pressure compensates for workpiece tolerances and machine positioning errors, while the deep rolling force remains constant.
- Available deep rolling forces up to 60 kN.
- Any metal material that can be plastically formed, up to a breaking strength of 1400 N/mm² or a yield strength of 1200 N/mm² can be roller burnished.
- Automatic roller angle setting for various pitches.
- Automatic adjustment allows conical threads to be machined as well.



Advantages

- Force-locking version: no deep rolling forces are transferred into the machine tool; due to the C-shaped design, the forces are absorbed by the tool.
- Axially floating rollers compensate for minor positioning errors.

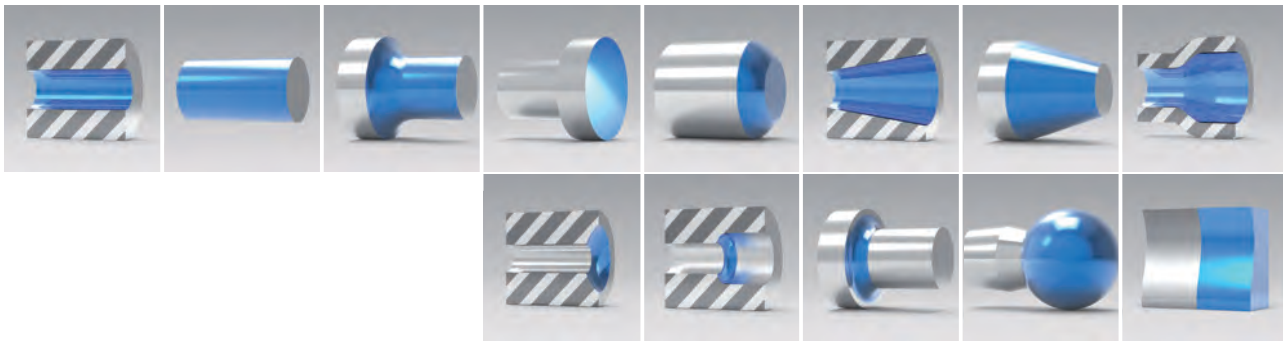
Design

- FA tools consist of a tool retainer, a hydraulic cylinder, the side parts and the lever as well as the upper and lower thread boxes.

Parameters

- max. circumferential speed: 20 m/min.
- max. burnishing force: 60 kN.

Hydrostatic Tools – HG Series: Overview

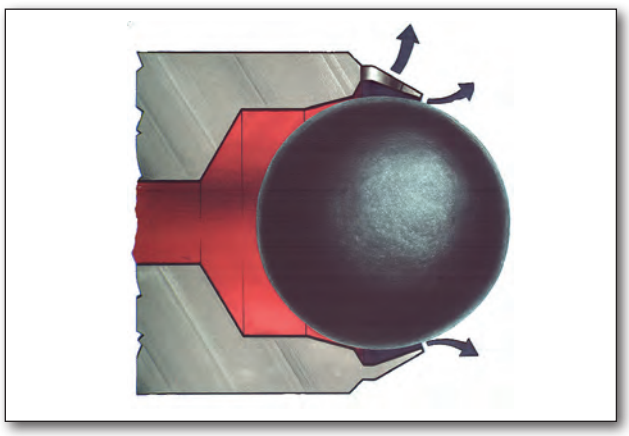


The hydrostatic tools in the ECOROLL HG series are used to roller burnish and deep roll internal and external surfaces, highly complex contours and free-form surfaces. These tools can be used on all common machine tools, e.g. CNC-controlled lathes, milling machines and drilling machines as well as machining centers and conventional machine tools. The universal tool system can be used with both rotating and stationary workpieces. Any metal material up to a hardness of 65 HRC can be machined.

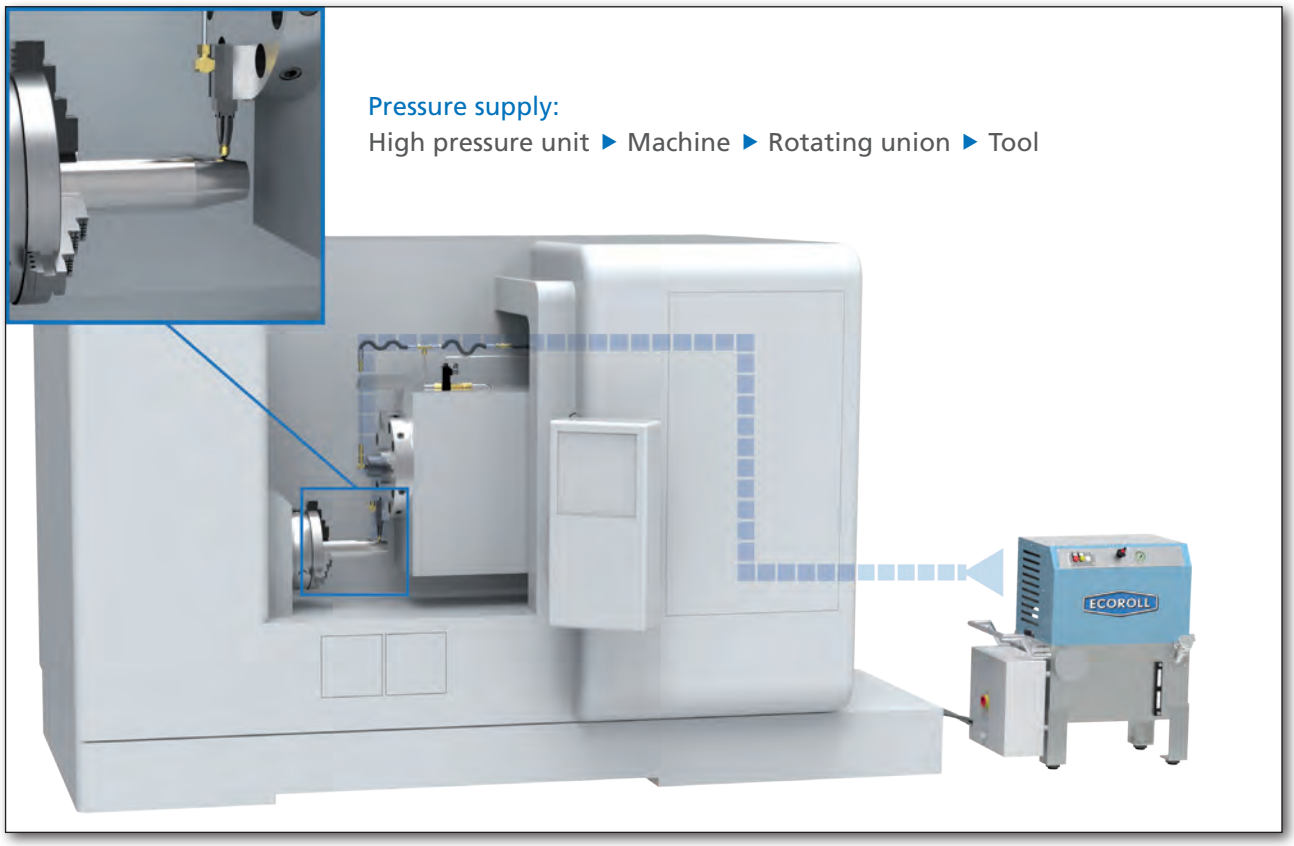
The heart of the tools in the HG series is a burnishing element that consists of a ball insert and a following system. The ball insert contains a special ball made of hard material, which functions as a rolling element when it contacts the workpiece surface. To operate the hydrostatic tools, cooling lubricant (emulsion or oil) flows into the burnishing element, which creates a hydrostatic bearing for the ball. The pressure medium is used to press the ball into the surface at a defined burnishing pressure, causing surface deformation. To generate this high pressure, ECOROLL offers either various versions of external hydraulic units (HGP) or driven tools with integrated high pressure pumps. The tools are identified and classified by the size of the balls used. Balls with diameters in a range of 1.2 - 28 mm are available, resulting in a tool series from HG1.2 to HG28. The HG6 tool, for example, has a ball with a diameter of 6 mm.



Following system

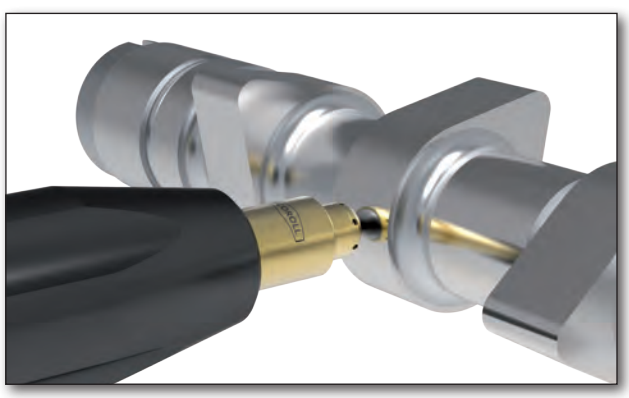


HG ball and ball retainer



Schematic of the entire process

Tools in the HG series can also be used for dry machining. In this case, a mixture of compressed air and oil is used (minimum lubrication) is used as the pressure medium. All of the tools provided with automatic following systems (series tools HG3 through HG13) do not require any conversion in order to function with emulsion, compressed air and minimum lubrication. Materials up to a hardness of 45 HRC can be machined with compressed air and minimum lubrication.



Hard roller burnishing a cam shaft

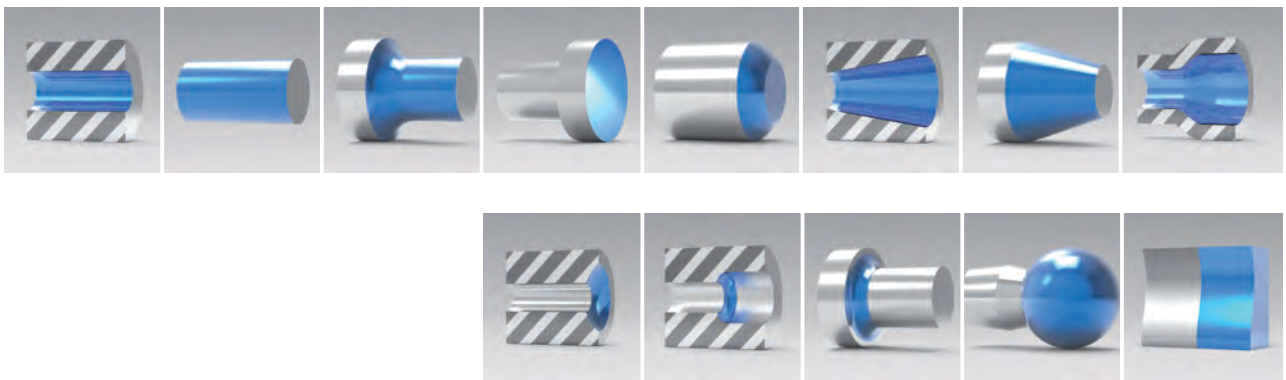


Deep rolling the lower shank section, radius and plate of a valve



Roller burnishing a ball joint

HG Series



Features

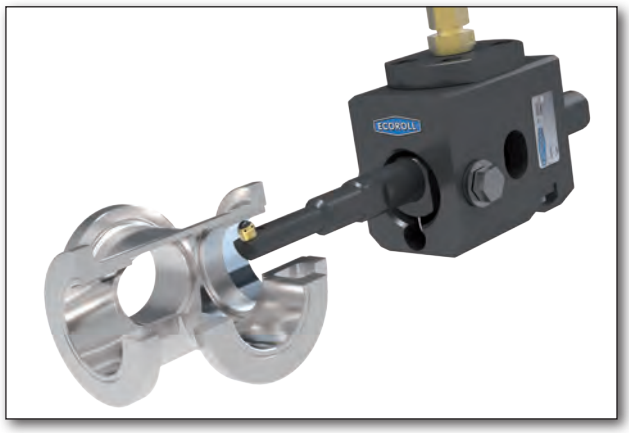
- Used to roller burnish and deep roll complex contours.
- For hard machining of workpieces made of hardened steel and other hardened alloys up to 65 HRC (except for HG1.2, HG2 and HG25).
- All of the tools provided with automatic following systems (series tools HG3 through HG13) and can be operated with compressed air and minimum lubrication.
- Depending on the process, the tool, pressure supply and machine type required for the tool can vary:

Workpiece/Process	Tool/Version	Pressure supply	Machine type
External machining			
Cylindrical contours	HGx-9; HGx-19; HGx-5; HGx-7	HGP3/HGP6 Integrated high pressure pump	Conventional/ CNC-controlled lathe
Tapered contours	HGx-9; HGx-19; HGx-5; HGx-7	HGP3/HGP6 Integrated high pressure pump	CNC-controlled lathe
Plane faces	HGx-9; HGx-19; HGx-5; HGx-7	HGP3/HGP6 Integrated high pressure pump	CNC-controlled lathe
Transition radii	HGx-9; HGx-19; HGx-5; HGx-7	HGP3/HGP6 Integrated high pressure pump	CNC-controlled lathe (Mill-turn machine)
Free-form surfaces, sealing groove	HGx-9; HGx-19; HGx-5; HGx-7	HGP3/HGP6 Integrated high pressure pump	CNC-controlled lathe, machining center
Ball machining	HGx-10 (swivelling tool)	HGP3/HGP6	CNC-controlled lathe
Narrow cylinders	HGx-20 (3-point tool)	HGP3/HGP6	Conventional/ CNC-controlled lathe
Machines thin-walled components on both sides	HGx-29 (pincer-shaped tool)	HGP3/HGP6	CNC-controlled lathe, machining center
Internal machining			
Cylindrical bores	HGx-1 / HGx-2	HGP3/HGP6	Conventional/ CNC-controlled lathe
Tapered bores, fillets, complex internal contours, cylindrical bores	HGx-2P / HGx -11	HGP3/HGP6	Conventional/ CNC-controlled lathe
Extra-long cylindrical bores	HG13-4	HGP3/HGP6	Deep hole drilling machine/ Conventional lathe

Note: In the designation HGx-y, x indicates the ball size and y the design version (details regarding the versions are found under "Ordering"). For further details regarding the HGP series, see "Accessories for the HG Series".

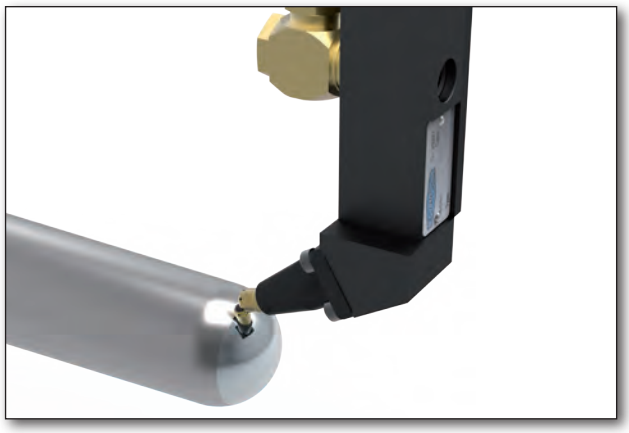
Advantages

- Increases the fatigue strength and service life of dynamically loaded components.
- Induces compressive stresses in the edge zone.
- Simultaneously smoothes the surface.
- Wide variety of application options reduces production costs.
- The hydrostatically loaded ball rotates completely without contact in all directions – even at high speeds.
- The following system in the burnishing element keeps the gap between the ball and the retainer constant, regardless of the clearance to the workpiece.
- If there is a change in position, the burnishing element follows the workpiece contour within the tool stroke without changing the burnishing force.



Internal machining with a HG6 tool. Interrupted surfaces can also be machined.

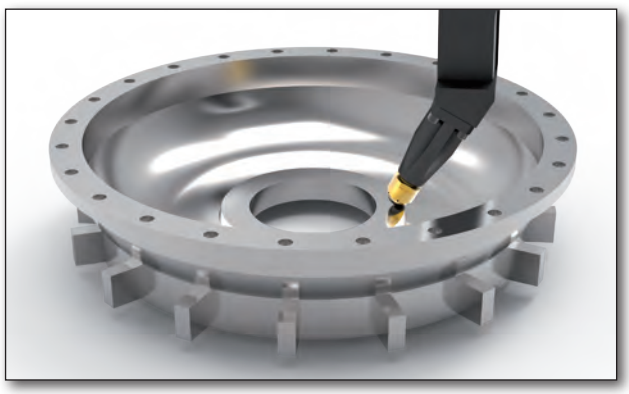
- When the compressed air system is used:
  - Environmental stresses are reduced.
  - Enormous cost saving potential:
    no costs for purchasing or disposing of lubricants.



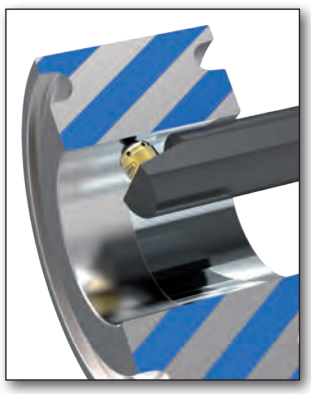
Machining a hard punch with HG6 saves time because it eliminates another process (polishing).



Deep rolling a control piston to increase its service life.



Machining a torque converter housing with HG13 to optimize sliding properties.



Hard roller burnishing the bore of a roller with HG6 eliminates an extra lapping operation.



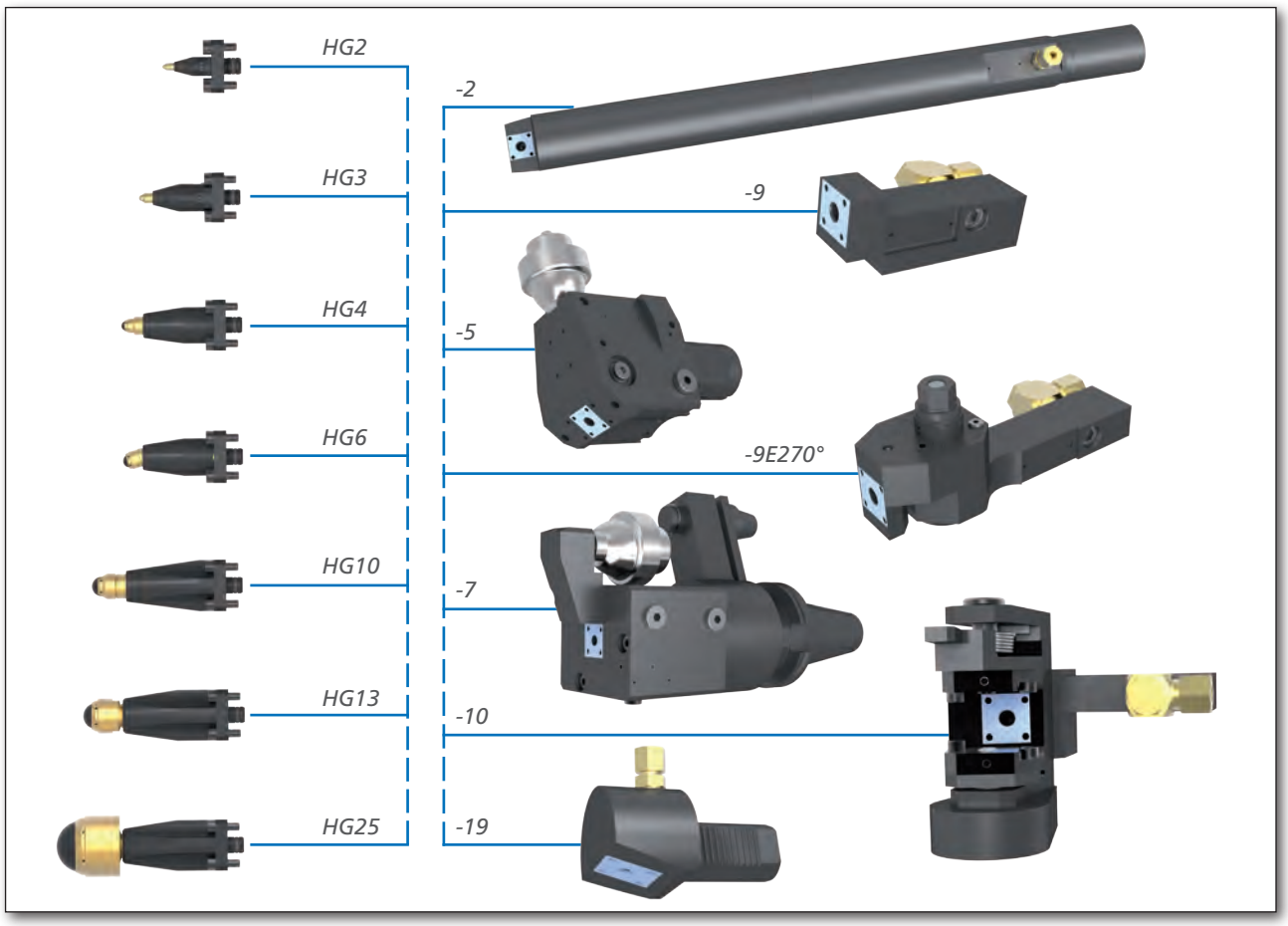
Roller burnishing the ball zone of a bevel gear.

Design

- The HG series includes many different versions with modular designs and ball diameters in a range from 2 – 25 mm:



Maximal angular change ß



- HG burnishing elements by ball size

Type	Permissible contact angle (ß) at the ball's crown point	Stroke (s) in mm	Length (l) in mm
HG2	± 22,5 °	4	37
HG3	± 22,5 °	4	42
HG4	± 30 °	5	51
HG6	± 30 °	6	50
HG10	± 30 °	8.5	65
HG13	± 35 °	8.5	72
HG19*	± 35 °	10	88
HG25	± 30 °	8.5	85

Note: In general, the workpiece contours determine the ball size. To induce the maximum level of compressive stresses by deep rolling, select the tool with the largest possible ball.

Parameters

Tool type	Max. burnishing force in N	Max. circumferential speed in m/min.	Max. feed rate in mm/rev.
HG2	90	250	0.12
HG3	250	250	0.2
HG4	550	250	0.3
HG6	1000	250	0.5
HG10	2200	250	0.7
HG13	4000	250	1
HG19*	9000	250	1.2
HG25	4000	250	1.4

Note: Circumferential speeds can, in certain circumstances, be increased substantially.

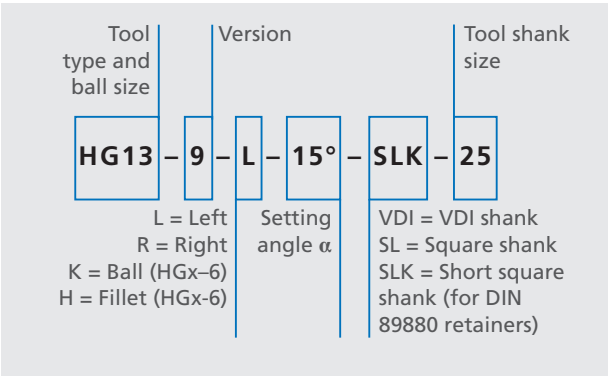
* deviating connection dimensions

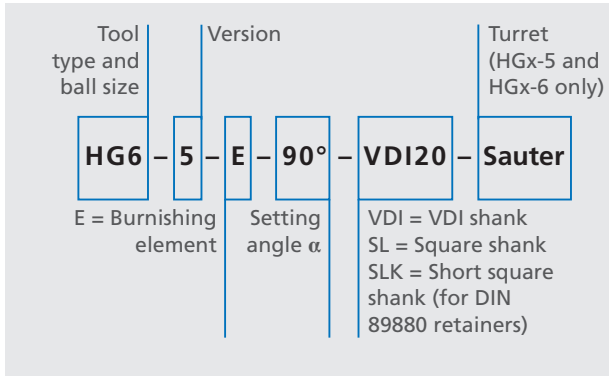
Ordering

Tool in the HG series are available in a wide variety of versions in order to cover many application areas. In addition to the ball size, the tools are classified according to version. In the designation HGx-y, x indicates the ball size and y the design version. For example, HG6-2 contains a ball with a diameter of 6 mm and is suitable for machining cylindrical bores. The following table lists the most significant design versions and their related applications (for further details regarding each version, see the following pages).

Designation	Applications
HGx-1	Inside diameters (cylindrical and tapered bores) > 19 mm
HGx-2	Internal machining > 70
HGx-4	Internal machining > 50 mm, 2-point tool for long components
HGx-5	For machining external and plane faces
HGx-6	Ball machining
HGx-7	Plane faces and free-form surfaces
HGx-9	External machining of rotationally symmetric surfaces (cylinders, tapers, plane faces, fillets, balls)
HGx-10	Ball machining
HGx-11	Internal machining of cylindrical bores > 6 mm, 2-point tool for small and long components
HGx-19	Like HGx-9, but with tool shank according customer requirements
HGx-20	3-point tool (3 balls), for narrow outside diameters
HGx-29	2-point tool (2 balls) for machining both sides of both sides of disc-like and thin-walled components (such as turbine blades) in one pass, starting at a thickness of 0.8 mm

The complete tool designation is generated as follows:

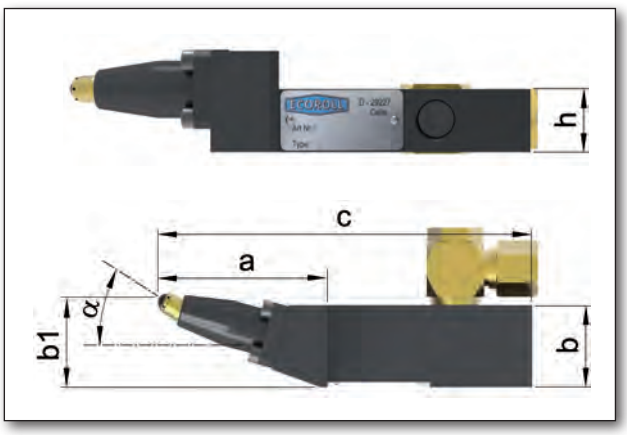




External machining

HGx-9, HGx-19:
Operation with external pressure supply

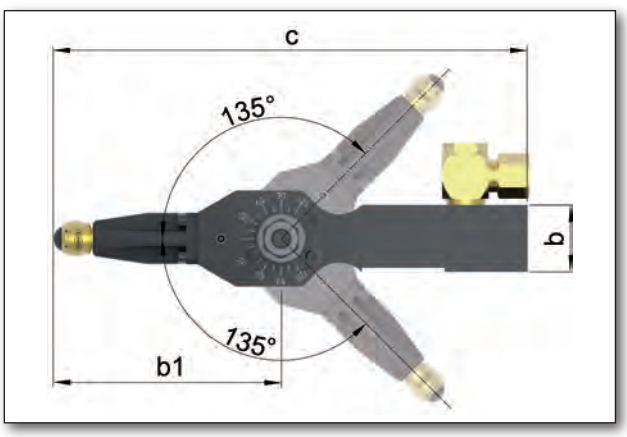
- Also required are a hydraulic unit and high pressure supply.
- For machining any rotationally symmetric component and irregular free-form surfaces.
- For roller burnishing and deep rolling any metal material or hardened material up to a hardness of 65 HRC.
- Burnishing force is pressure dependent, so the process can be monitored for consistent product quality.



HGx-9L/R

HGx-9

- Universal, standard version.
- Can be used with conventional or CNC-controlled lathes.
- Standard square shanks, 20 - 32 mm available (SL = long, SLK = short).
- Versions available for right- or left-handed use.
- Setting angle α = 0 - 90° in 15° increments available.
- Pressure is supplied from the side or rear through the square shank.
- HG2-9 only suitable for use with components with hardnesses ≤ 45 HRC. Tool is mounted on an integrated square shank, but also available with adapter for use with standard square shanks.



HGx-9E270°

Tool	Fillet R	a	b	b_1	c	h	Setting angle α
HG2-9_-SL(K)	> 2	42	32	35	190 (122)	20 25 32	0°, 15°, 30°, 45°, 60°, 75°, 90° [1]
HG3-9_-SL(K)	> 2.5	54		41	201 (133)		
HG4-9_-SL(K)	> 4	62		45	210 (142)		
HG6-9_-SL(K)	> 5	67		33	215 (147)		
HG13-9_-SL(K)	> 10	80		54	228 (160)		
HG4-9E270°-SL(K)	> 4	-		91	278 (210)		Can be adjusted in 15° increments
HG6-9E270°-SL(K)	> 5	-		90	277 (209)		
HG13-9E270°-SL(K)	> 10	-		111	298 (230)		

HGx-19

- For use on CNC-controlled lathes with turrets.
- Versions available for right- or left-handed use.
- Setting angle α = 0 - 90° in 15° increments.
- Pressure is supplied from the side at the tool body.
- Interface depends on the machine: ZS, VDI, HSK or Capto shank available.

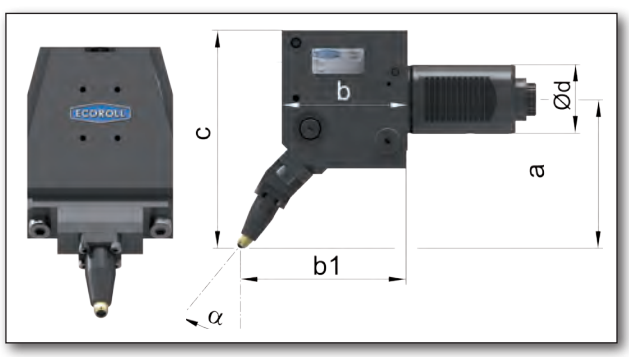


HGx-5, HGx-7: Operation with integrated high pressure pump

- Machine tool specifically for use with driven tools required.
- For machining any rotationally symmetric components.
- For roller burnishing and deep rolling any metal material or hardened material up to a hardness of 65 HRC.
- Burnishing force is pressure dependent, so the process can be monitored for consistent product quality.

HGx-5

- External machines on CNC-controlled lathes.
- Integrated high pressure pump; pressure supply installation not required.
- Ready for operation as soon as it is inserted in the turret.
- Available with VDI tool retainers (DIN 69880) for a ø range of 20 - 80 mm and all common drive systems.
- Symmetrical tool design and VDI tool retainer allow either right or left hand operation.
- A pressure measurement device is required to set up the tool.



Tool	Fillet R	a	b[1)]	b_1[1)]	c	d	h	Setting angle α
HG6-5_°-VDI	> 5	100	89	142	130	20 or 30	50	30°[2)]
HG6-5_°-VDI	> 5	109	91	109	164	40 or 50	85 or 100	
HG13-5_°-VDI	> 10	128		162	178	60 or 80	125 or 160	

Note: [1)] Other dimensions apply for drives other than the VDI shank. Please contact us.
[2)] Setting angles of 0°, 60° and 90° possible by changing the adapter (please ask about modified dimensions).

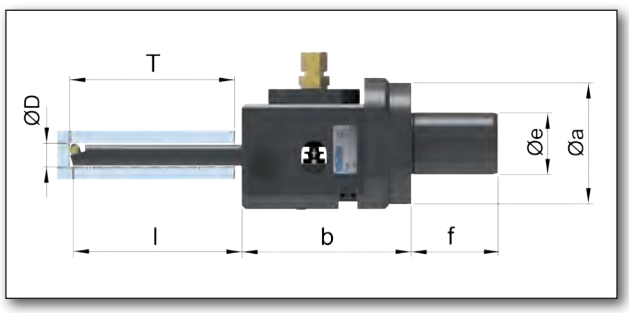
Internal machining

HGx-1, HGx-2, HGx-2P, HGx-4, HGx-11: Operation with external pressure supply

- Also required are a hydraulic unit and high pressure supply.

HGx-1

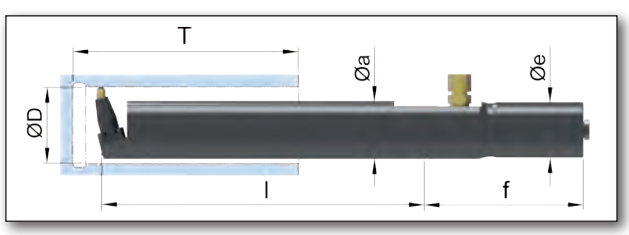
- For bores ≥ 19 mm.
- Ball diameter max. 6 mm.
- For use on lathes, boring mills and machining centers.
- Available as a rotating tool with special rotating union DD.
- The ball insert is at the end of a lever activated by the following system in the tool body.
- Initial, approximate diameter setting by positioning in the radial direction.
- Finer setting takes place automatically with the following system.



Tool	Diameter range D (all dimensions in mm)	Burnishing length T	a	b	Ø e	f	l
HG6-1	≥ 19	50/80/125	106	131/161/206	40	136	60/90/135

HGx-2

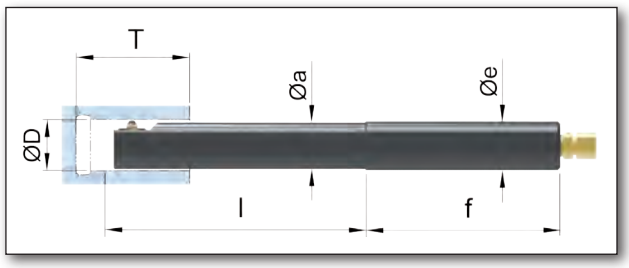
- For bores ≥ 70 mm (HG6-2) and ≥ 125 mm (HG13-2).
- Standard tool retainer, cylindrical Ø 50 mm.
- Rigid, bend-proof version, available for burnishing lengths up to 800 mm.
- Equipped with standard burnishing elements.



Tool	Diameter range D (all dimensions in mm)	Burnishing length T	a	Ø e	f	l
HG6-2	≥ 70	200/400/600/800	53	50	145	T+40

HGx-2P

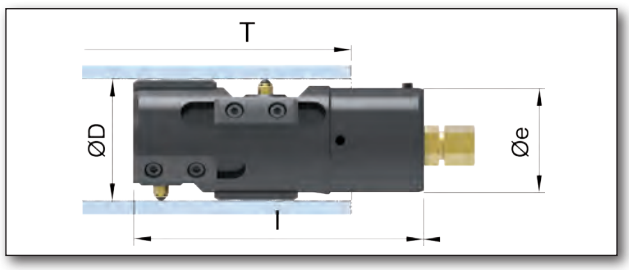
- With cartridge burnishing element HG6 (ball Ø 6 mm).
- For internal machining of narrow, cylindrical bores.
- Can be used with conventional or CNC-controlled lathes.
- Cylindrical tool retainer with clamping face.
- max. burnishing length: 350 mm.



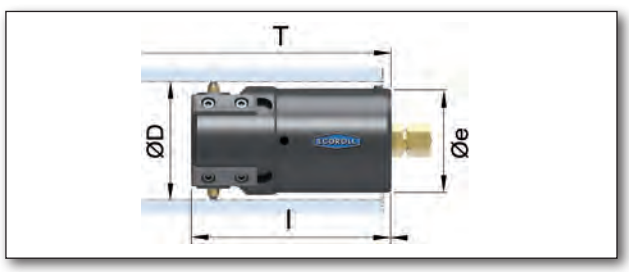
Tool	Diameter range D (all dimensions in mm)	Burnishing length T	a	Ø e	f	l
HG6-2P	≥ 40	200/300	38	40	120	200/350

HGx-4

- For extra-long (≥ 800 mm) bores in a Ø range of 50 - 150 mm (larger diameters by request).
- For use on deep hole drilling machines or conventional lathes.
- BTA boring bar connection.
- 2-point tool prevents bending for long burnishing lengths.
- Approximate centering in the bore achieved by the guide pads on the tool body.



HGx-4.0



HGx-4.3P

Tool	Smallest diameter D	Burnishing length T	Ø e	l
HG13-4.0	50,8	Unlimited	BTA connection by order	variable
HG6-4.3P	82			

HGx-11

- For roller burnishing and deep rolling small bores ≥ 6 mm.
- 2-point tool prevents bending for long burnishing lengths.
- Suitable for use with slightly trumpet-shaped bores (connecting rods).
- Available as a stationary or rotating tool with special rotating union DD.



Accessories for the HG Series: HGP hydraulic units and immersion pump units

Features

HGP hydraulic units provide a source of pressure for operating HG series tools without integrated high pressure pumps:

- For use with all machine tools without tool drives.
- Mobile or fixed versions available.
- Two series:
  - HGP3: $P_{max.}$ = 200 bar
  - HGP6: $P_{max.}$ = 400 bar
- Electric motor drive: 220V, 1 phase or 400 V, 3 phase, depending on the HGP version (motors for other voltages by request).
- Control with M-function for CNC-controlled lathes available.



HGP 6.5



HGP 6.0



Immersion pump unit

Accessories for the HG Series: Rotating Unions

Features

- ECOROLL rotating unions are required if tools with external pressure supply are used on CNC-controlled lathes with turrets. With the rotating union, the turret can function fully and uninterrupted pressure supply is ensured.
- The **DE** rotating union is used to supply a single tool.
- The **DS** rotating union can supply up to 4 tools with pressure.



Selective Rotating Unions (DS)

Processing Cylinder Tubes





Overview of the OMEGA System

The OMEGA system (RDO, RIO) by ECOROLL combines skiving and roller burnishing in one tool for the production of hydraulic cylinders and cylinder tubes. The OMEGA skiving head achieves the required dimensions and form, while the roller burnishing head smoothes the surface. This combination has almost completely replaced honing, the other production process used for these products because this combination offers unequaled speed and cost-effectiveness. With the modular OMEGA building block system, the optimum tools for any tube quality or processing length can be configured.

For various reasons, individual tubes are simply skived (without subsequent roller burnishing) or both processes are carried out separately in two passes. For this reason, all of the skiving heads in the SK series are available both as individual tools and in combination with type GZ roller burnishing tools for the internal machining of hydraulic cylinders and cylinder tubes. On the first pass, the SK skiving head skives the cylinder; on the second pass, the GZ tool roller burnishes the surface. Special blind hole skiving heads are available for cylinders with blind holes or steps.

ECOROLL tools in the SKIO and GZ series can completely process short hydraulic cylinders with a length to diameter ratio of approx. L/Ø ≤ 15 directly on a lathe. In this process, a skiving head is first used to prepare the cylinder, and following an automatic tool change, fine machining takes place with a separate roller burnishing tool. In general, this process requires two tool settings, each equipped with a boring bar.*



SKIO skiving tool



GZ roller burnishing tool

* The second boring bar is not required if the tool is equipped with a quick change interface. In this case, tools for drilling out, skiving and roller burnishing can be automatically exchanged and applied one after the other.

The OMEGA System (RDO, RIO): 2, 3 or 4 tools in one for the internal machining of hydraulic cylinders and cylinder tubes



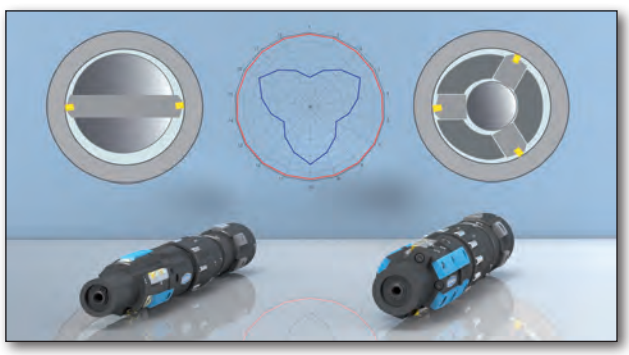
Features

- Two tools in one for skiving and roller burnishing (RDO, RIO), 3 tools in one (RIOA) for drilling out, skiving and roller burnishing, 4 tools in one (RIOA quattro) for pre-drilling, drilling out, skiving and roller burnishing in one process.
- Tubes with errors in circular form of up to 0.5 mm in the radial direction are skived into the correct shape in one pass. The remaining error in circular form is 0.01 mm. At the same time, existing ripples in the longitudinal direction are reduced.
- Diameter tolerances of IT8 or IT9; surface roughnesses R_a = 0,05 - 0.4 (R_z = 0.5 - 2 µm) can be achieved.
- In order to ensure sufficient lubrication of the sealing lips, targeting roughnesses less than R_a = 0.2 (R_z = 1.0 µm) is not recommended.
- The design of the control system (RETRAC or an international system) determines which tool series to use (RIO or RDO, see Table 1: Control systems).

	RETRAC system	International system
Control cycle	Pressureless process, retraction with approx. 20 bar hydraulic pressure	Process: 100 bar hydraulic pressure, retraction: pressureless
Area of use	Primarily Europe	Worldwide
Activation cylinder	RETRAC cylinder installed in boring bar	Integrated into tool
Quick coupling	Mechanical in the threaded connection between boring bar/tool	Hydraulic in the threaded connection Boring bar/tool
Compat-ible tools	RDO (combined skiving and roller burnishing)	RIOA, RIOF, RIOK (2, 3 or 4 tools in one: skiv-ing/roller burnishing, drilling out/skiving/roller burnishing, pre-drilling/drilling out/skiv-ing/roller burnishing)

Advantages

- Improved circular and cylindrical form; rippling is prevented or reduced.

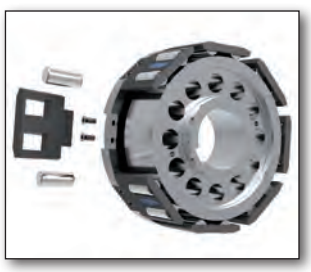


Improving circular form

- Shorter processing time due to greater speeds and feed rates.
- Tubes with greater form faults can be machined in one pass.
- Greater cutting depth possible.
- Cutters last longer.
- Less auxiliary processing time required.
- Diameter adjustment is easy.



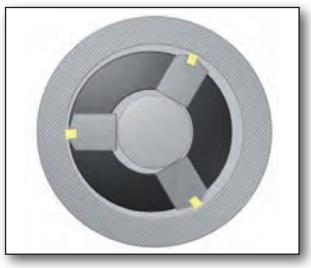
Central diameter adjust-ment



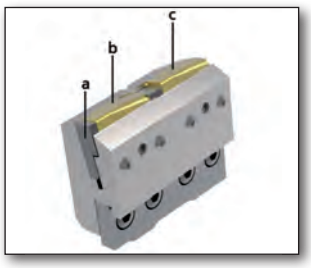
Segmented cage

- Wear parts can be easily replaced (cage, internal cone and rollers) due to quick connectors, which reduces machine down time for this maintenance.
- Segmented cages also simplify the replacement of rollers for Ø ≥ 205 mm.

Design



OMEGA principle



Skiving knife (a. Insert seats, b. finish cutter, c. pre-cutter)

- Skiving knives supported by the floating RETRAC cone.
- RETRAC cone used to activate the tool and set the skiving knife diameter. After the process, the skiving knives and burnishing rollers retract in order to avoid damaging the surface when the tool is removed from the workpiece.
- Central setting for the skiving knives with an Allen key.
- Scale on the front face of the skiving head for exact, reproducible setting.
- Quick coupling connects the skiving head with the tool body (enables easy separation with no special tool required).
- Skiving knives with two cutting inserts arranged one behind the other (b) and (c) (tandem arrangement).
- Depending on the size of the machining allowance, the pre-cutter is set deeper by 0.1, 0.2, 0.4, 0.6 or 0.8 mm than the finish cutter.
- Replaceable insert seat (a) ensures precise cutting insert positioning.
- Hydraulic tool control.

Ordering

The following information is required:

1. Control system design
2. Boring bar diameter and thread system (BTA, Sandvik, etc.).
3. Cylinder length.
4. Outside Ø and inside Ø of tubes before machining.
5. Tube version (cold or hot rolled).
6. Material.

The tool designation is generated as follows:

Type and version	Tool body size		Skiving head design			
RIOF	67.1	– 250.00	– 3M	.2	–	178
	Machining diameter	Height difference between pre-cutter and finish cutter				BTA/Tool connection*

* Other interfaces by request

Select the appropriate tool series (RDO or RIO) based on the control system design. The RIO series includes many different tool versions for a wide variety of applications.

Parameters

Tool	Ø range mm	Circumferential speed m/min.	Feed mm/rev.
RDO	38-504.99	300	3 - 5
RIOA	63-554.99	150 – 180	1.2 – 1.8
RIOF	28-554.99	300	3 - 5
RIOK			
– 4 - 10 m	50-504.99	300	3-5
– 1.5 - 4 (10*) m	38-79.99	200-300**	2-4

Note: * Available with stabilized boring bar, ** max. speed: 1200 min^{-1}

RDO series (hydraulic activation during retraction, RETRAC)

- Skiving and roller burnishing of hydraulic cylinders and cylinder tubes up to approx. 20 m long.
- Ø 38 to 500 mm.
- Tool bodies and burnishing heads are identical with those in the older RDS-R and RDZ series. Compatible conversion sets are available for changing over to the OMEGA system.



RDO series

Tubes	ø from ... to ... (mm)	Lengths from ... to ... (m)	Parameters
Cold drawn or hot rolled and drilled out	38-504.99	0.5-<20	V_c 300 m/min. f 3 - 5 mm/rev.

RIO series (hydraulic activation during the process)

- Large cutting capacity.
- Appropriate configurations available for:
  - Seamless or longitudinally welded tubes
  - Hot rolled tubes in various lengths
- Control hydraulics connected by quick coupling in the connection thread.
- Consistent activation pressure of 100 bar is recommended for all sizes.
- Pressurized in working position.
- Release pressure when the end of the tube is reached. The skiving knives and burnishing head retract.

RIOA

- 3 or 4 tools in one for pre-drilling, drilling out, skiving and roller burnishing hot rolled tubes in one process.
- Drilling head is equipped with three cutters.
- Three hard metal guide pads ensure that the drilling head moves in the radial direction with no play.
- max. center deviation: 0.5 mm/m.
- Skiving head is equipped with three skiving knives.



RIOA series

Tubes	ø from ... to ... (mm)	Lengths from ... to ... (m)	Parameters
Hot rolled	63-554.99	0.5 to 4	V_c 150 - 180 m/min. f 1.2 - 1.8 mm/rev.

RIOF

- Skiving knife mounted on the tool.
- For tube lengths ≤ 5 m.
- Can be converted to RIOA tool by exchanging the cover with a drilling head.



RIOF series

Tubes	ø from ... to ... (mm)	Lengths from ... to ... (m)	Parameters
Cold drawn	28-554.99	max. L = 25 x d (applies for d = 38 to 200; for d > 200, please contact us)	V_c to 300 m/min f 3...5 mm/U

RIOK

- Skiving head can move.
- Three guide pads.
- Required in order to machine tubes > 4 m.
- Compensates for wobbling movement, straightness and alignment errors that can affect the process depending on tube length and other circumstances.
- Prevents the formation of “black” or unmachined sections.



RIOK for long tubes

Tubes	ø from ... to ... (mm)	Lengths from ... to ... (m)	Parameters
Cold drawn	50-554.99	4.0->10	V_c 300 m/min. f 3 - 5 mm/rev.



RIOB (for small workpieces, 38-79.90 mm)

Tubes	ø from ... to ... (mm)	Lengths from ... to ... (m)	Parameters
Cold drawn	38-79.99	1.5-4.0 (10*)	V_c 200 to 300 m/min.** f 2 - 4 mm/rev.

Note: * Available with stabilized boring bar
** max. speed: 1200 min^{-1}

The OMEGA System: Segmented cage for RDO and RIO



Features

- Diameter range: 205 to 805 mm (RIO), 205 to 554,99 mm (RDO).
- Dimensions: various quantities of cage segments are used respectively for each of the three diameter ranges (205 mm – 405 mm; 405 mm – 605 mm; 605 mm – 805 mm). The distances between the segments can vary.

Advantages

- Worn burnishing rollers and cage segments can be replaced without disassembling or dismounting the tool.
- Open a "window" for a quick inspection of the cone surface.
- When converting to another diameter within the same range, now just a new segment carrier, and not the complete cage, must be replaced. Using the segments for a specific range decreases the types of spare parts to keep in stock to just one item that can be used for several tool diameters.
- Easy assembly, even in a horizontal position.
- When the roller pockets in the cage are worn, only the segments have to be replaced.
- Segments are standard parts.
- Roller diameter enlarged to 20 mm, increasing service life.
- Dramatic reduction in auxiliary processing time.
- Short delivery time for replacement segments.
- Compatible with older tool versions.

Design

- The cage consists of a number of segments screwed onto a segment carrier (Fig. 1).
- Either one or all of the segments can be removed (Fig. 2). To do so, the tool does not have to be dismounted from the machine, nor is any further disassembly necessary.



Fig. 1: Complete cage module

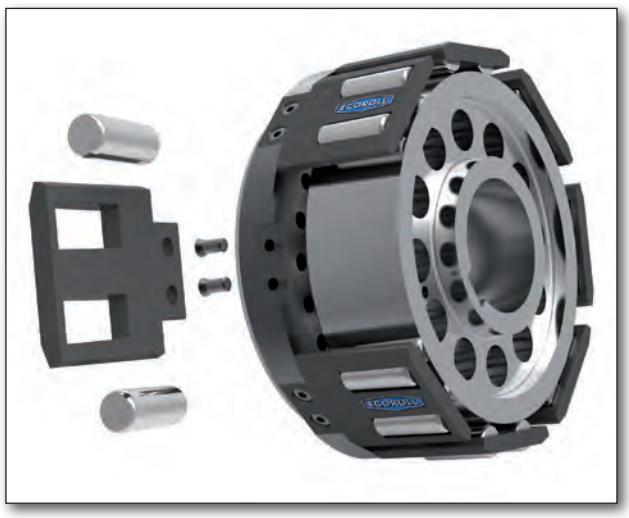


Fig. 2: A disassembled segment

Ordering

The following information is required:

1. Tool type.
2. Tool diameter.



Combined cylinder tool type RIOA Quattro with segmented cage

Types SK and GZ: Fine machining of cylinder tubes



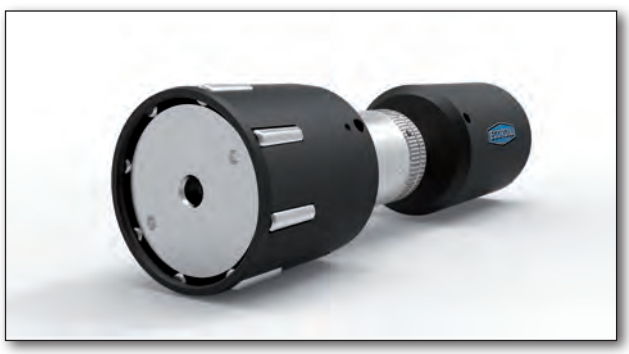
SK: Skiving heads
GZ: Internal roller burnishing tools

Features

- Skiving and roller burnishing run as separate, subsequent processes.
- Generally used on deep hole drilling machines.
- For short cylinders (L/Ø ≤ 15), complete processing with tool types SKIO and GZ on CNC-controlled lathes and machining centers possible (see the following chapter).
- Type SK:
  - For finish processing or preparation for roller burnishing.
  - High performance indexable inserts.
- Type GZ:
  - Any metal material that can be plastically formed, with hardnesses up to 42 to 45 HRC, can be roller burnished.
  - Used on deep hole drilling machines.
  - After the process, the burnishing head automatically retracts and the tool can be quickly removed without damaging the workpiece.



SK



GZ

Advantages

- Reliable function, high degree of accuracy.
- Depending on the workpiece, diameter tolerances of IT8 to IT9 are possible.
- Type SK:
  - Can achieve a surface quality of R_Z = 5 – 20 µm.
  - Radially floating skiving knife allows good adherence to the specified bore axis.
- Type GZ:
  - Can achieve a surface quality of R_Z < 1 µm.
  - Short cycle time.
  - Diameter adjustment is easy and reproducible.
  - Wear parts are easy to exchange.

Design

- Type SK:
  - Skiving head.
  - Tool retainer.
- Type GZ:
  - Burnishing head.
  - Adjusting device.
  - Tool retainer.

Parameters

Tool	Circumferential speed m/min.	Feed mm/rev.
SK	150-300	0.9-3
GZ*	Up to 250	0.05-0.3 per roller

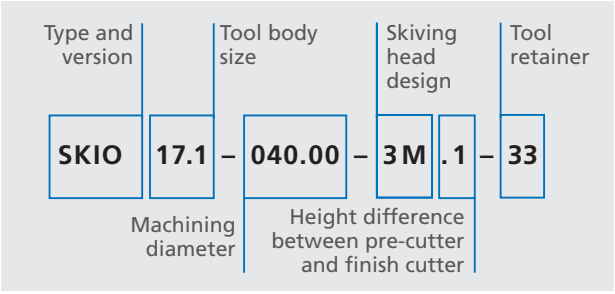
Note: * Unlimited burnishing length.

Ordering

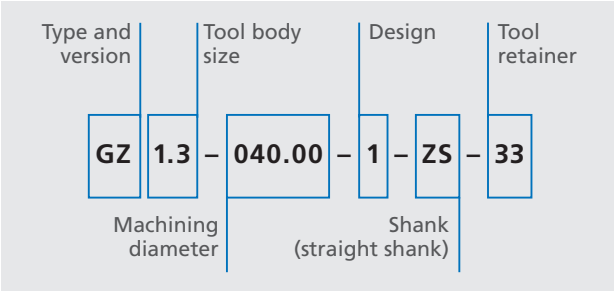
The following information is required:

1. Cylinder length.
2. Outside Ø and inside Ø of tubes before machining.
3. Tube characteristics (cold drawn or hot rolled and drilled out).
4. Material.

For type SK, the tool designation is generated as follows:



For type GZ, the tool designation is generated as follows:



Types SKIO and GZ: Complete internal machining of short cylinder tubes (L/Ø ≤ 15)



SKIO: Skiving heads
GZ: Internal roller burnishing tools

Features

- Complete processing on CNC-controlled lathes and machining centers.
- Skiving and roller burnishing are carried out in one pass before or after final processing; internal machining on a deep hole drilling machine is not necessary.
- Type GZ: In their design and function, these tools are similar to the standard, type G roller burnishing tools (see the "Multi-roller Mechanical Tools" chapter), equipped with additional internal flushing and a tool retainer that is compatible for use with a boring bar.
- Accessories: Cooling-lubricant pumps with installation service.

Advantages

- Reliable function, high degree of accuracy.
- Depending on the workpiece, diameter tolerances of IT8 to IT9 are possible.
- Short process time, no time required for changeover or transport to a deep hole drilling machine.
- Machining is concentric with respect to final processing.
- Separate, short tools.
- Purchasing a deep hole drilling machine is not necessary, so production of cylinder tubes is cost-effective.
- Type SKIO:
  - Can achieve a surface quality of R_z = 15 – 30 µm.
  - Cutting inserts can be exchanged without removing the skiving knives.
  - Central diameter adjustment with a setting screw without removing the skiving knives.
  - Cooling-lubricant pressure is used to control the skiving knives (no separate control system required).
  - Quick coupling for connection to the boring bar (ECOROLL W-connection)



Skiving tool SKIO11-40.00



Roller burnishing tool GZ1-40.00

- Type GZ:
  - Can achieve a surface quality of R_z < 1 µm.
  - Wear parts are easy to exchange.

Design

- Type SKIO:
  - Design is based on the OMEGA principle.
  - 3 floating skiving knives with cutters in a tandem arrangement.
  - Integrated into the tool shank: Control piston pressurized with cooling-lubricant. After the cooling-lubricant supply is switched on, the skiving knives automatically move into the working position; after it is switched off, they retract into the rest position. Then the tool can be removed quickly

Required cooling-lubricant amounts and pressures

Type	Ø from - to [mm]	Recommended max. cylinder tube length [mm]	Cooling-lubricant Amount [l/min.]	Pressure [bar]
SKIO 11	38 < 44	250	20 - 30	7 - 120
SKIO 21.1	44 < 50			
SKIO 21.2	50 < 70	600	30 - 45	
SKIO 31	70 < 100	900	50 - 70	
SKIO 41	100 < 140	1200		
SKIO 51	140 < 205	1800		

Note: If a lathe is not equipped with a pump with corresponding capacity, ECOROLL offers pump units for retrofitting, along with installation service.
The higher cooling-lubricant amounts apply for 70 bar cooling-lubricant pressure!

without damaging the skived surface with retraction marks.

– Cooling-lubricant nozzles spray the fluid into the cutting area at high speed, providing support for flushing the chips in the direction of feed.

- Type GZC:
  – In their design and function, these tools are similar to the standard, type G roller burnishing tools (see the “Multi-roller Mechanical Tools” chapter).
  – In addition, they are equipped with internal flushing directed toward the wall of the bore. This cleans the skived surface one more time before roller burnishing.
- Cooling-lubricant supply:
  – Through the boring bar for both tools.

Parameters

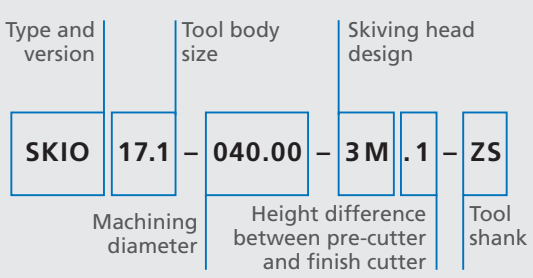
Tool	Circumferential speed m/min.	Feed mm/rev.
SKIO	250-300	2.5-5
GZ	Up to 250	0.05-0.3 per roller

Ordering

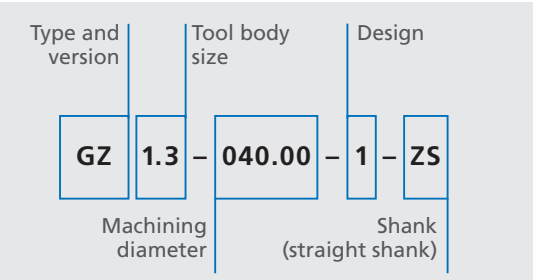
The following information is required:

1. Cylinder length.
2. Outside Ø and inside Ø of tubes before machining.
3. Tube characteristics (bright drawn or hot rolled).
4. Material.

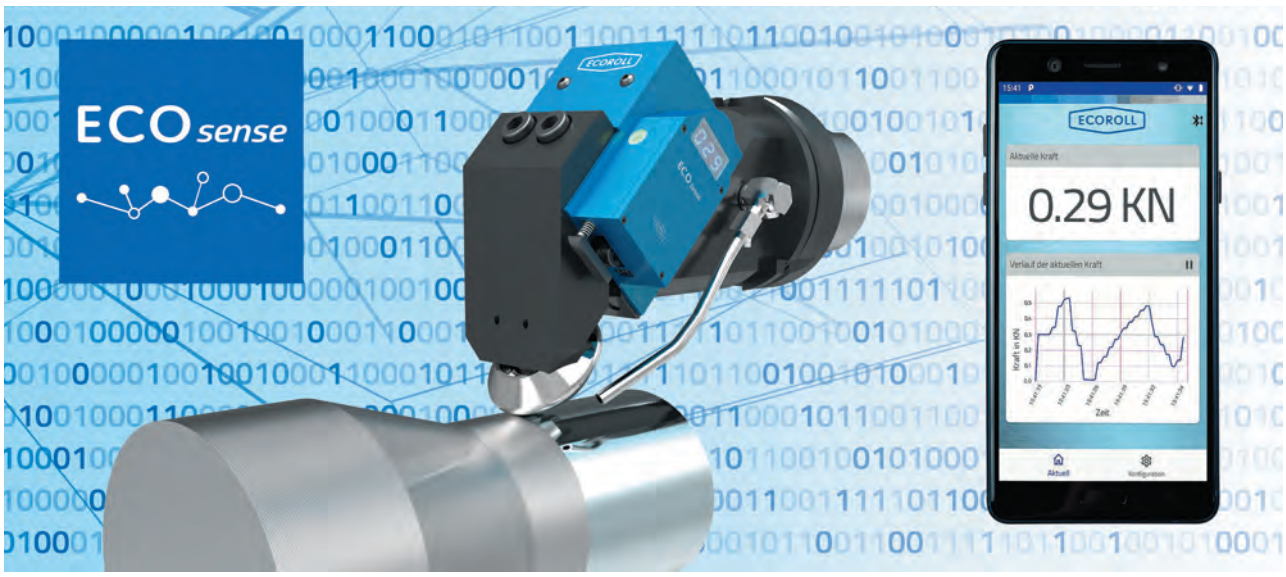
For type SKIO, the tool designation is generated as follows:



For type GZ, the tool designation is generated as follows:



ECO*sense*
Digital Dial Gauge



Functional characteristics:

ECOROLL AG has developed the ECOsense technology for mechanical roller burnishing and deep rolling tools. ECOsense monitors and documents the process rolling force with an adapted sensor technology. On the tool individual processes are detected and recorded autonomously. The force values are transmitted and copied in real time to a smart phone application via wireless connection. The critical rolling force is thus recorded for each processed workpiece..

Product characteristics and features:

- Rolling force directly indicated on the display.
- Force graph displayed on a connected smart phone.
- Measuring frequency: 10Hz.
- Battery life: approx. 2-3 weeks in continuous use (display turned off).
- Saves process data to internal storage (storage sufficient for up to 10 years of non-stop recording).
- Forces evaluated for process documentation.
- Status LED shows operating mode.
- Creates and exports measurement records after downloading the process data to the smart phone.
- Battery change without disassembling the tool (only short manufacturing interruption).
- Can replace the analog dial gauge on all mechanical tools.

Advantages:

- Simplified process set-up.
- Displays force chart on connected smart phone.
- Process force documentation for every process.

Projected enhancements:

- Process statistics across a selected time period.
- Raw data export.

ECO*sense*
Digital Dial Gauge

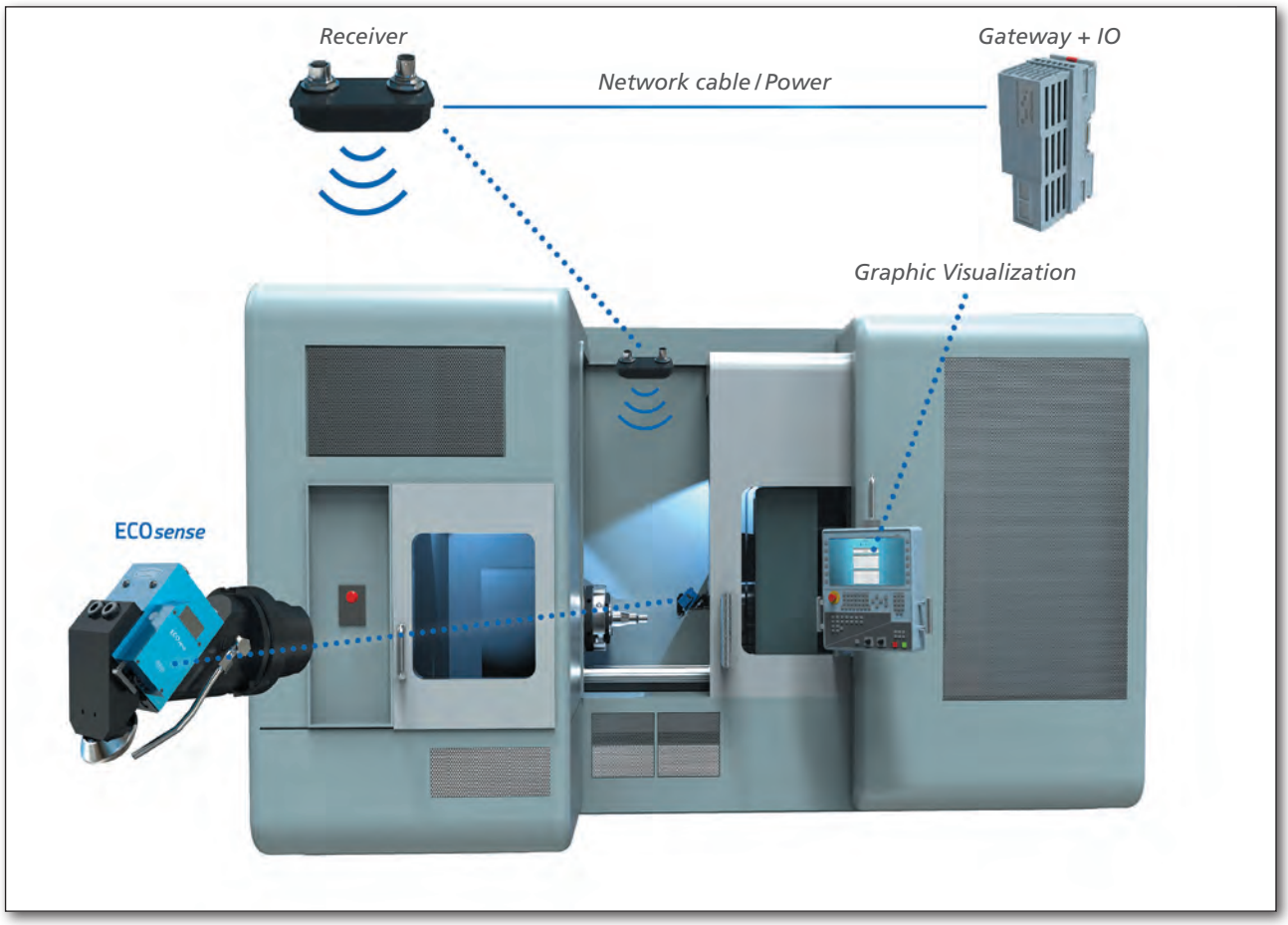


App Functions

Function	Basic	Prozess documentation
Transmits real time force values	■	■
Force graph in active window	■	■
Automatically detects overload	■	■
Controls dial gauge functions	■	■
Automatically detects processes		■
Transfers data of individual force graphs		■
Creates measurement records with process information		■
Possible to select multiple processes and create process information		■

App Functions

ECO*sense*
Digital Dial Gauge



Schematic of the machine connection

Function:

Ecoroll tools with the ECOsense module can be integrated into any machine to enable fully automated process monitoring and data logging of your burnishing process. The ECOsense module comes standard with Bluetooth connectivity that guarantees a solid and reliable connection between your Ecoroll tool and machine. The customized Interface and software solution ensures a robust communication and data export from the Ecoroll tool to your machine, personal computer, or network.

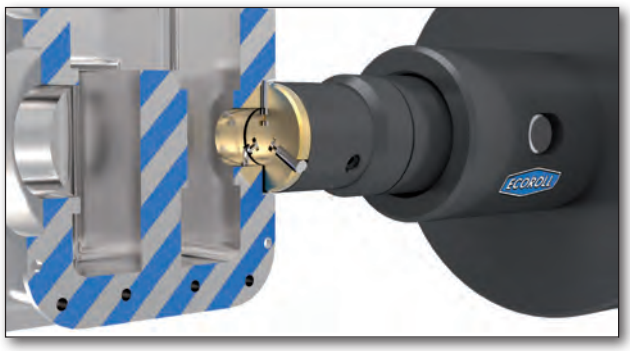
Features:

- Real Time Process Reporting.
- Available Alarms for "Out of Parameter" Process Monitoring.
- Automatic Data Transfer and Logging for Analysis of Process Data and Statistics.
- Bluetooth Enabled for Data Transfer.
- Network Integration with ECOsense.
- Connectivity to Machine / Computer / Personal Device.
- Compatible with ANY Platform Including ERP System (OPC, UA, MQTT).
- Graphic Visualization for Rolling Forces / Process Data on Machine / HMI.

Application Examples

Roller burnishing with mechanical tools

Gear box



Machining Task

- Cutting cannot guarantee required surface finish.

- **Workpiece** ..... Gear box
- **Part of** ..... Rail vehicle engine
- **Material** C45

- **Tensile strength** ..... 680 N/mm^2
- **Hardness** ..... –
- **Required finish** ..... R_z < 1 µm

Solution

- **Tool** ..... Multi-roller face tool RP
- **Rotation speed** ..... 80 min^{-1}
- **Feed rate** ..... –
- **Rolling force** ..... –
- **Process time** ..... 12 seconds

Results/Advantages

- Improved product quality.
- Short process time.

Seal Bushing



Machining Task

- Roller burnish seal face after turning in one setting.

- **Workpiece** ..... Seal Bushing
- **Part of** ..... Valve
- **Material** ..... Aluminium alloy

- **Tensile strength** ..... 300 N/mm^2
- **Hardness** ..... –
- **Required finish** ..... R_z < 1 µm

Solution

- **Tool** EG14-2
- **Rotation speed** ..... 250-470 min^{-1}
- **Feed rate** ..... 0.2 mm/rev.
- **Rolling force** ..... –
- **Process time** ..... 29 seconds

Results/Advantages

- Time saving.
- Improved seal.

Steering lever



Machining Task

- Roller burnish bore after reaming.

- **Workpiece** ..... Steering lever
- **Part of** ..... Front axle, passenger car
- **Material** ..... Forged steel

- **Tensile strength** ..... 1100 N/mm^2
- **Hardness** ..... –
- **Required finish** ..... R_z < 2 µm

Solution

- **Tool** ..... RK
- **Rotation speed** ..... 300 min^{-1}
- **Feed rate** ..... 0.4 mm/rev.
- **Rolling force** ..... 700 N
- **Process time** ..... 3 seconds

Results/Advantages

- R_z < 1.5 µm and high load bearing surface ratio for tight fit and good load transmission.
- Short process time.

Rear wheel carrier



Machining Task

- Cutting cannot guarantee the required finish of R_z < 4 µm for series production.

- **Workpiece** ..... Rear wheel carrier
- **Part of** ..... Rear axle, passenger car
- **Material** ..... GGG 40

- **Tensile strength** ..... 400 N/mm^2
- **Hardness** ..... –
- **Required finish** ..... R_z < 6 µm

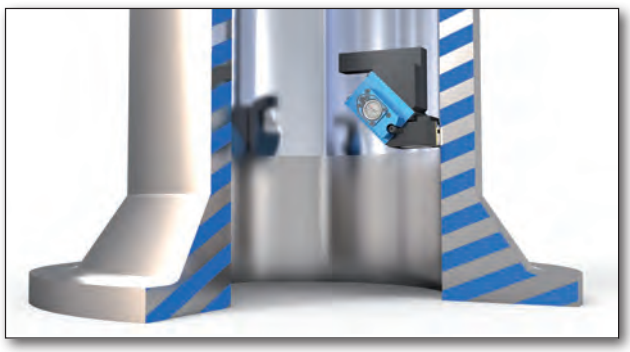
Solution

- **Tool** G2
- **Rotation speed** ..... 680 min^{-1}
- **Feed rate** ..... 1.6 mm/rev.
- **Rolling force** ..... –
- **Process time** ..... 2.5 seconds

Results/Advantages

- Roller burnishing achieves required surface finish within a short process time.
- Higher feed rate reduces pre-machining process time.

Bearing housing



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).

- **Workpiece** ..... Bearing housing
- **Part of** ..... Roller press
- **Material** ..... GGG 40
- **Tensile strength** ..... 680 N/mm^2
- **Hardness** ..... 170 HRB
- **Required finish** ..... R_z < 3 µm

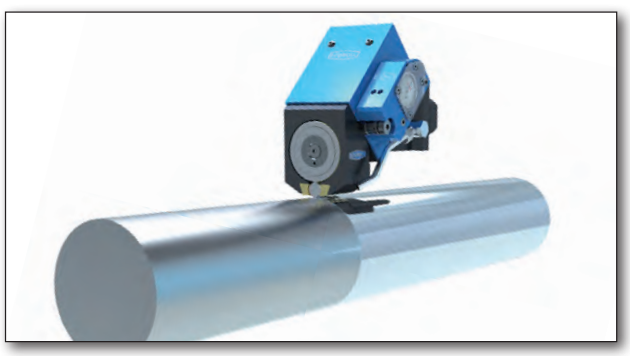
Solution

- **Tool** EG14
- **Rotation speed** ..... 18 min^{-1}
- **Feed rate** ..... 0.4 mm/rev.
- **Rolling force** ..... –
- **Process time** ..... 62 minutes

Results/Advantages

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

Piston rod



Machining Task

- Roller burnishing followed by chrome plating. After buffing, the part is ready to use.

- **Workpiece** ..... Piston rod
- **Part of** ..... Hydraulic cylinder
- **Material** ..... Forged steel

- **Tensile strength** ..... 1000 N/mm^2
- **Hardness** ..... 40 HRC
- **Required finish** ..... R_z < 1.5 µm

Solution

- **Tool** EG14-1-VDI50
- **Rotation speed** ..... 500 min^{-1}
- **Feed rate** ..... 0.2 mm/rev.
- **Rolling force** ..... –
- **Process time** ..... 7.1 minutes

Results/Advantages

- Process requires less chromium.
- No grinding necessary before and after chrome plating.
- Improved sliding and sealing properties of roller burnished surface.

Deep rolling with mechanical tools

API thread pin



Machining Task

- Until now, threads could not be deep rolled on CNC lathes.
- The time-consuming process involved a separate machining operation on conventional lathes.

- **Workpiece** ..... API thread pin (tapered)
- **Part of** ..... Connector of mineral oil deep drilling unit
- **Material** ..... 42 CrMo 4 V
- **Tensile strength** ..... 1200 N/mm^2
- **Hardness** ..... –
- **Required finish** ..... Higher operating strength

Solution

- **Tool** EF90-025-R0.8-VDI50
- **Rotation speed** ..... 53 min^{-1}
- **Feed rate** ..... 6.35 mm/rev.
- **Rolling force** ..... 8500 N
- **Process time** ..... 53 seconds

Results/Advantages

- Reduced process time.
- No extra time required for transportation and resetting.

High strength screw



Machining Task

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

- **Workpiece** ..... High strength crew
- **Part of** ..... Front axle, passenger car
- **Material** ..... Steel (forged blanks)
- **Tensile strength** ..... 1400 N/mm^2
- **Hardness** ..... 48 HRC
- **Required finish** ..... –

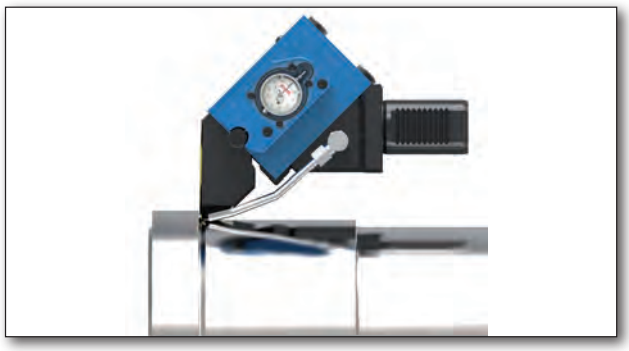
Solution

- **Tool** EF45
- **Rotation speed** ..... 140 min^{-1}
- **Feed rate** ..... 1.6 mm/rev.
- **Rolling force** ..... –
- **Process time** ..... 7 seconds

Results/Advantages

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

Cylinder liner



- **Workpiece** ..... Cylinder liner
- **Part of** ..... Marine diesel engine
- **Material** ..... GGG 40
- **Tensile strength** ..... 400 N/mm^2
- **Hardness** ..... –
- **Required finish** ..... –

Machining Task

- Deep roll fillet to prevent fatigue cracks in the fillet radius due to the notch effect and cyclic bending.
- Deep rolling in one setting after turning in the following CNC-controlled loading cycle (for each step allow for 5 rotations): 1. Build up rolling force 0 –> 10 kN
  2. Keep rolling force constant on –> 10 kN
  3. Reduce rolling force 10 –> 0 kN

Solution

- **Tool** EF45-1-VDI40
- **Rotation speed** ..... 50 min^{-1}
- **Feed rate** ..... 0 mm/rev. (plunge process)
- **Rolling force** ..... 10 kN
- **Process time** ..... 18 seconds

Results/Advantages

- Fatigue strength doubled during dynamic fatigue test.

Aircraft wheel rim

Part 1: Fillet radius (3 mm) in the bearing bore; plunge process with RK





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

- **Workpiece** ..... Wheel rim
- **Part of** ..... Aircraft
- **Material** ..... Aluminium alloy
- **Tensile strength** ..... –
- **Hardness** ..... –
- **Required finish** ..... –

Machining Task

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

Solution

	Part 1	Part 2
Tool	RK	EF90
Rotation speed	140 min^{-1}	140 min^{-1}
Feed rate	–	0.3 mm/rev.
Rolling force	–	–
Process time	6 seconds	15 seconds

Results/Advantages

- 5-fold improvement in service strength.

Roller burnishing with hydrostatic tools

Bevel gear



Machining Task

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

- **Workpiece** ..... Bevel gear
- **Part of** ..... Passenger car, differential gear
- **Material** 16CD4

- **Tensile strength** ..... 1000 N/mm^2
- **Hardness** ..... 42 HRC
- **Required finish** ..... R_z < 2 µm

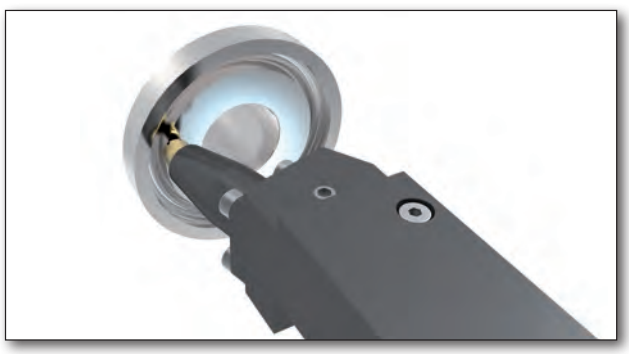
Solution

- **Tool** ..... HG6 burnishing element on a special tool holder
- **Rotation speed** ..... 1500 min^{-1}
- **Feed rate** ..... 0.1 mm/rev.
- **Rolling force** ..... –
- **Process time** ..... 4 seconds

Results/Advantages

- Ready-to-use machining of gear in one setting.

Seal insert



Machining Task

- Roller burnish seal face in one setting after turning.

- **Workpiece** ..... Seal insert
- **Part of** ..... Valve
- **Material** 1.4301

- **Tensile strength** ..... 500 - 750 N/mm^2
- **Hardness** ..... –
- **Required finish** ..... R_z < 1 µm

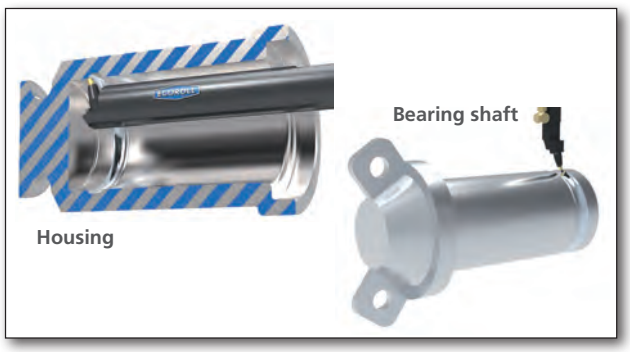
Solution

- **Tool** HG6
- **Rotation speed** ..... 950 min^{-1}
- **Feed rate** ..... 0.1 mm/rev.
- **Rolling force** ..... –
- **Process time** ..... 2.5 seconds

Results/Advantages

- Manual polishing no longer required.

Swivel bearing



Machining Task

- During assembly, semicircular grooves inside the housing and shaft are filled with steel balls to create a four-point bearing.
- Hard turning and hard roller burnishing of bearing raceways.

- **Workpiece** ..... Swivel bearing
- **Part of** ..... Excavator shovel
- **Material** ..... GGG
- **Tensile strength** ..... –
- **Hardness** ..... 58-62 HRC
- **Required finish** ..... R_z < 2 µm

Solution

- **Tool** ..... HG6-2 und HG6-9
- **Rotation speed** ..... 220 min^{-1}
- **Feed rate** ..... 0.1 mm/rev.
- **Rolling force** ..... –
- **Process time** ..... 53 seconds

Results/Advantages

- Reduced process time.
- Increased bearing capacity.

Ball stud



Machining Task

- The tool moves in a programmed curved motion around the ball's center.
- The burnishing element's lever is connected to a stop pin located behind the ball, which enables the element to swivel around the ball.

- **Workpiece** ..... Ball stud
- **Part of** ..... Passenger car
- **Material** ..... Forged steel
- **Tensile strength** ..... 1000 N/mm^2
- **Hardness** ..... –
- **Required finish** ..... R_z < 2 µm

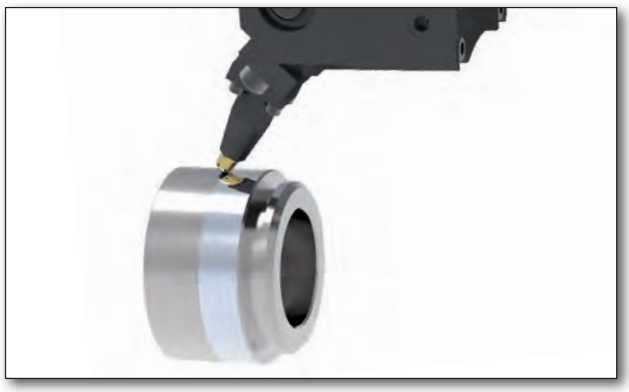
Solution

- **Tool** HG6-6K22-VDI40
- **Rotation speed** ..... variable
- **Feed rate** ..... 0.1 mm/rev.
- **Rolling force** ..... –
- **Process time** ..... 3.8 seconds

Results/Advantages

- R_z < 1.6 µm achieved.

Brake piston



Machining Task

- Surface roughness is measured across the entire surface.
- Therefore, rejection rate for ground pistons of 5 - 10% if one section exceeds the limit.

- **Workpiece** ..... Brake piston
- **Part of** ..... Rail vehicle brakes
- **Material** ..... Cr-Ni steel
- **Tensile strength** ..... –
- **Hardness** ..... 58-60 HRC
- **Required finish** ..... R_z < 2 µm (hard roller burnishing)

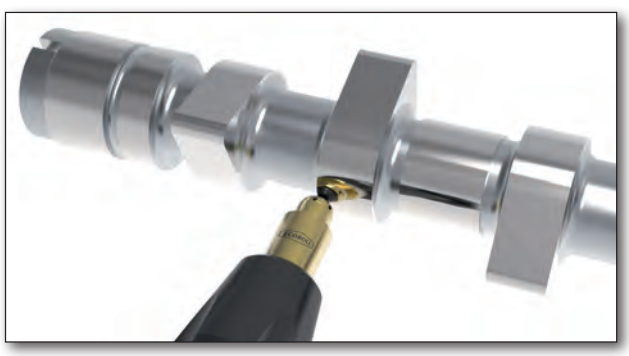
Solution

- **Tool** ..... HG6-5E00°-VDI40
- **Rotation speed** ..... 720 min^{-1}
- **Feed rate** ..... 0.08 mm/rev.
- **Rolling force** ..... –
- **Process time** ..... 1.7 minutes

Results/Advantages

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

Cam shaft



Machining Task

- Reduce friction coefficient and increase wear resistance by hard roller burnishing.

- **Workpiece** ..... Cam shaft
- **Part of** ..... Passenger car engine
- **Material** ..... Chilled cast iron
- **Tensile strength** ..... –
- **Hardness** ..... 55 HRC
- **Required finish** ..... R_z < 1.5 µm (reduce friction)

Solution

- **Tool** ..... HG6-9 special version with extended stroke
- **Rotation speed** ..... 40 min^{-1}
- **Feed rate** ..... 0.1 mm/rev.
- **Rolling force** ..... –
- **Process time** ..... –

Results/Advantages

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

Glass forming mandrel



Machining Task

- Roller burnish the surface in one setting after turning.
- The surface is subdivided into two zones:
  1. Form point's center to about 60°
  2. Remaining contour

- **Workpiece** ..... Glass forming mandrel
- **Part of** ..... Form for glass bottles

- **Material** ..... Steel
- **Tensile strength** ..... –
- **Hardness** ..... 55 HRC
- **Required finish** ..... R_z < 2 µm

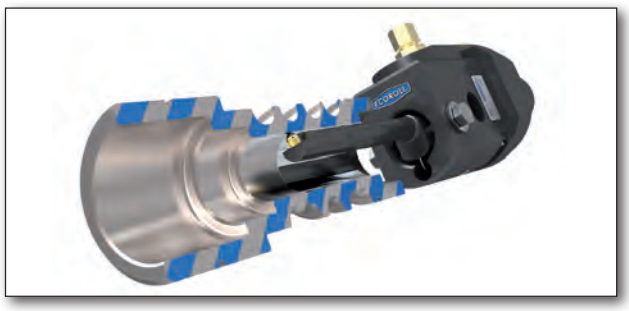
Solution

- **Tool** ..... HG6-9L65°-SLK20
  HG6-9L15°-SLK20
- **Rotation speed** ..... 1800 min^{-1}
- **Feed rate** ..... 0.1 mm/rev.
- **Rolling force** ..... –
- **Process time** ..... 45 seconds

Results/Advantages

- Reduces process time: no hand polishing required.
- Increased surface hardness.
- Consistent quality.

Helix shaft



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 roller burnishing of bore.
- The machine's M-function controls the hydraulic unit for precise start and stop.

- **Workpiece** ..... Helix shaft
- **Part of** ..... Injection molding machine

- **Material** ..... Heat treated steel
- **Tensile strength** ..... –
- **Hardness** ..... 55 HRC
- **Required finish** ..... R_z < 1 µm

Solution

- **Tool** ..... HG6-1-VDI40 with hydraulic pump unit HGP1.4
- **Rotation speed** ..... 900 min^{-1}
- **Feed rate** ..... 0.08 mm/rev.
- **Rolling force** ..... –
- **Process time** ..... 67 seconds

Results/Advantages

- Reduced process time: no separate honing required.
- Higher bearing ratio and increased hardness.

Control valve piston



Machining Task

- Machine surface of the workpiece to ensure its optimal performance while sliding through O-rings.

- **Workpiece** ..... Control valve piston
- **Part of** ..... Compressed air control valve

- **Material** ..... C-Steel
- **Tensile strength** ..... 1000 N/mm²
- **Hardness** ..... –
- **Required finish** ..... R_z < 1 µm

Solution

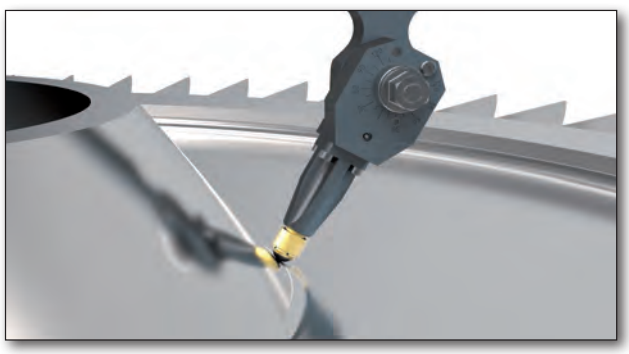
- **Tool** ..... HG6-9E00°-SL20
- **Rotation speed** ..... 3000 min^{-1}
- **Feed rate** ..... 0.1 mm/rev.
- **Rolling force** ..... –
- **Process time** ..... 12 seconds

Results/Advantages

- Complete finish in one setting.
- Improved functioning and higher reliability.

Deep rolling with hydrostatic tools

Turbine wheel



Machining Task

- Deep roll the curved area between hub and outer rim. The workpiece is subdivided into zones, each machined with a unique tool angle corresponding to the surface's inclination.

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

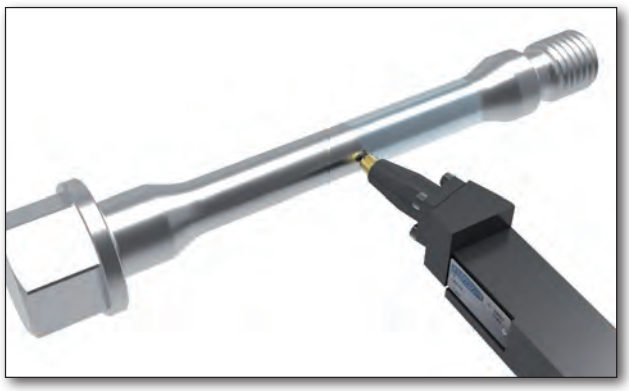
Solution

- **Tool** ..... HG13-9E270°-SL32
- **Rotation speed** ..... 25-40 min^{-1}
- **Feed rate** ..... 0.44 mm/rev.
- **Rolling force** ..... –
- **Process time** ..... 60 seconds

Results/Advantages

- Compressive residual stresses generated in one setting after turning.

Tension bolt



- **Hardness** ..... –
- **Required finish** ..... –

Solution

- **Tool** ..... HG6-9R00°-SL25
- **Rotation speed** ..... 1000 min^{-1} (average speed)
- **Feed rate** ..... 0.3 mm/rev.
- **Rolling force** ..... –
- **Process time** ..... 28 seconds

Machining Task

- Deep roll workpiece to increase fatigue strength.

- **Workpiece** ..... Tension bolt
- **Part of** ..... Aircraft engine suspension
- **Material** ..... Titanium alloy
- **Tensile strength** ..... 1600 N/mm^2

Results/Advantages

- Fatigue strength increased according to specifications.
- Process approval after only 10 weeks.

Flexible shaft



- **Tensile strength** ..... 1600 N/mm^2
- **Hardness** ..... –
- **Required finish** ..... –

Solution

- **Tool** ..... HG6-5E00°-VDI50
- **Rotation speed** ..... –
- **Feed rate** ..... 0.3 mm/rev.
- **Rolling force** ..... –
- **Process time** ..... –

Machining Task

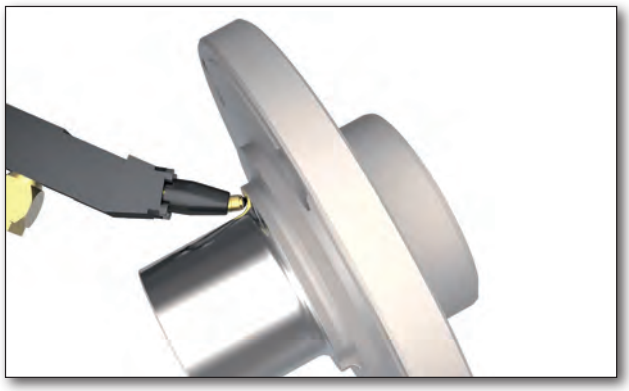
- Some applications require deep rolling of the entire neck length, others only deep rolling of the fillet.

- **Workpiece** ..... Flexible shaft
- **Part of** ..... Eccentric screw pump
- **Material** ..... Heat treated steel

Results/Advantages

- Fatigue strength increased by 40%.

Wheel flange



Machining Task

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

- **Workpiece** ..... Wheel flange
- **Part of** ..... Front axle, passenger car

- **Material** ..... Cast steel
- **Tensile strength** ..... 1000 N/mm²
- **Hardness** ..... 40 HRC
- **Required finish** ..... –

Solution

- **Tool** ..... HG6-9R30°-SLK25 and HG6-9R60°-SLK25
- **Rotation speed** ..... 800 min^{-1}
- **Feed rate** ..... 0.2 mm/rev.
- **Rolling force** ..... –
- **Process time** ..... 25 seconds

Results/Advantages

- According to customer test results, components are now fatigue resistant.
- Higher service reliability.

Hollow shaft



Machining Task

- The stepped bore suffers from the notch effect which is increased by machining grooves.
- Deep roll the shaft to minimize notch effect (corrosion cracking) and increase service strength.

- **Workpiece** ..... Hollow shaft
- **Part of** ..... Special machine

- **Material** ..... Steel
- **Tensile strength** ..... 1100 N/mm²
- **Hardness** ..... –
- **Required finish** ..... –

Solution

- **Tool** HG13-2
- **Rotation speed** ..... 225 min^{-1}
- **Feed rate** ..... 0.5 mm/rev.
- **Rolling force** ..... –
- **Process time** ..... 14 minutes

Results/Advantages

- Saving of time in comparison to other processes that increase hardness.
- Increased reliability.
- No transportation costs (one setting after turning).

Appendix

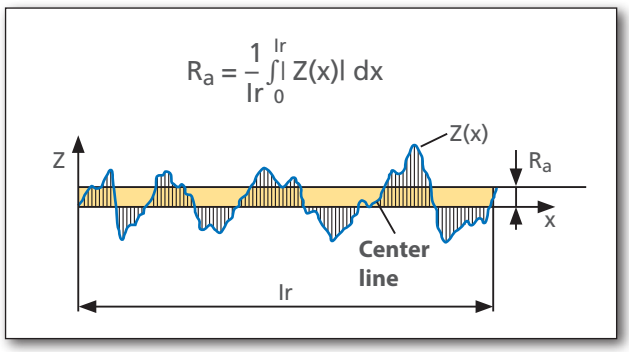
Surface measurement parameters

Arithmetical mean roughness, R_a (CLA, AA)

DIN EN ISO 4287

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 and does not exhibit sensitivity relative to extreme profile peaks and valleys.

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

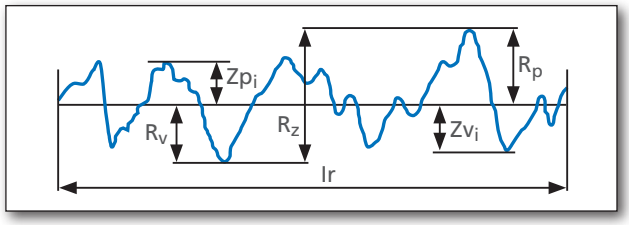


Maximum roughness depth, R_z (CLA, AA)

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 profile heights of five measuring sections lr in the surface roughness profile, 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 lr.
- According to DIN 4768, R_z expresses the average of five measuring sections lr.
- 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.

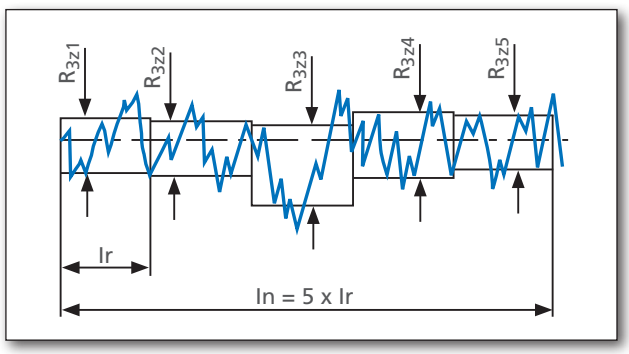


Daimler Benz Parameter, R_{3Z} (Factory Standard)

Daimler Benz Factory Standard N3 1007

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

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

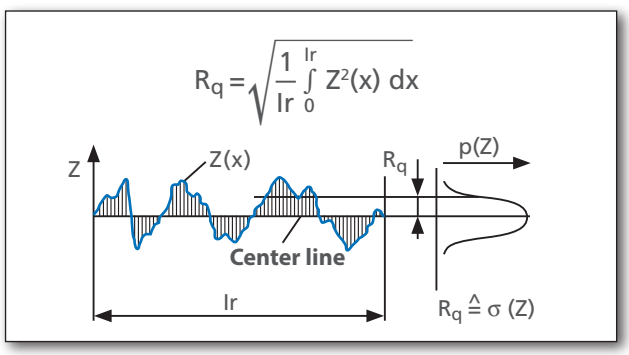


Quadratic mean roughness, R_q (RMS)

DIN EN ISO 4287

Quadratic average value of the y-coordinates that correspond to the surface roughness profile. Because R_q, 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 lr.
- R_q has greater statistical value than R_a (R_q, ca. 1.1 x R_a).
- R_q is more sensitive with regard to the individual peaks and valleys.
- R_q can be included in a statistical consideration of a profile because it expresses the standard deviation of the profile peaks (and valleys) distributed over the given profile.



Drawing specifications according to DIN ISO 1302

a = Roughness value in µm

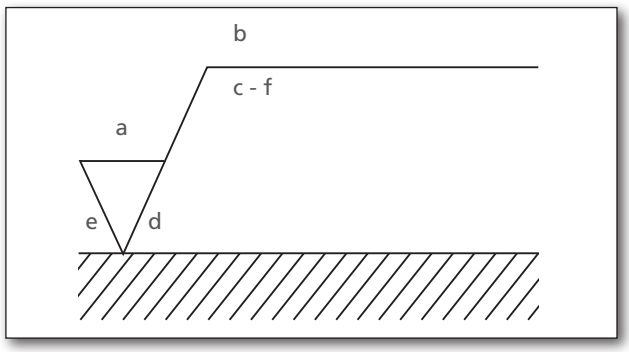
b = Production process, surface treatment, coating

c = Reference length

d = Direction of grooves

e = Machining tolerance

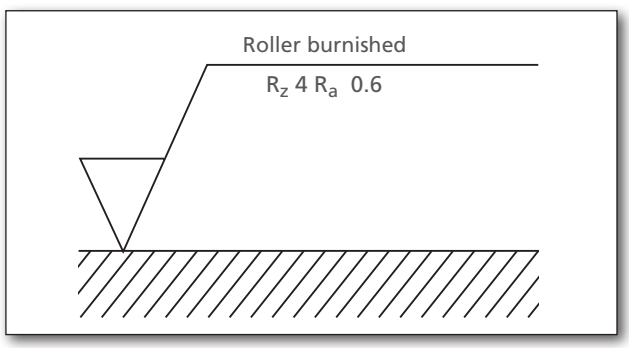
f = Other roughness parameters



Drawing specifications: Examples

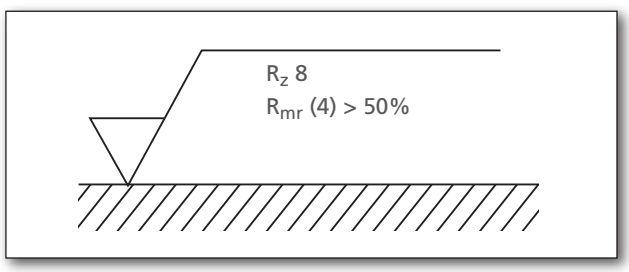
Drawing 1

- Maximum roughness up to R_z = 4 µm.
- R_a value up to a maximum of 0.6 µm.
- Machining process: roller burnishing.



Drawing 2

- Maximum roughness up to R_z = 8 µm.
- Percentage of material at the surface: R_{mr} > 50% measured at a cutting depth of 4 µm.

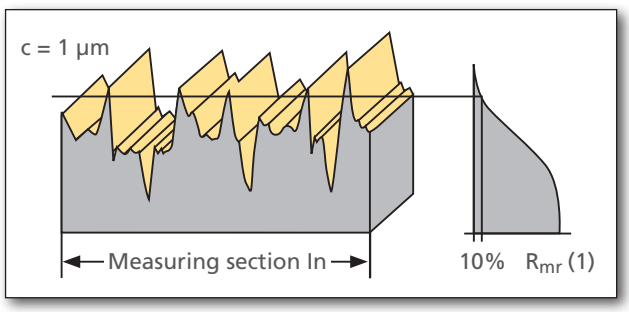


Note: This information presented courtesy of Hommelwerke GmbH, www.hommelwerke.de

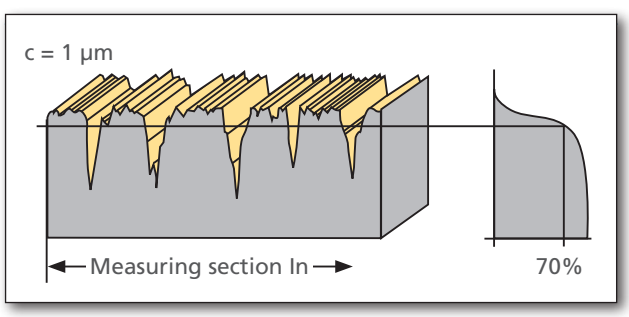
Surface Characteristics

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.



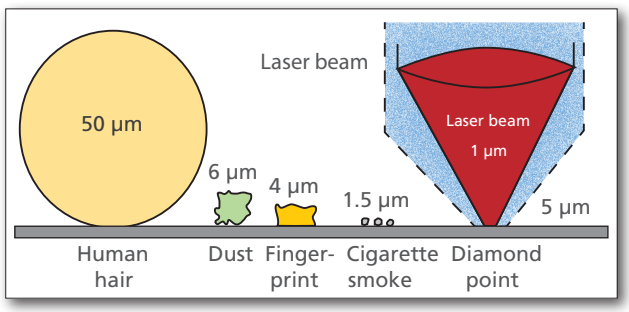
Surface profile with a low percentage of material and poor wear behavior ("skinny" material curve)



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

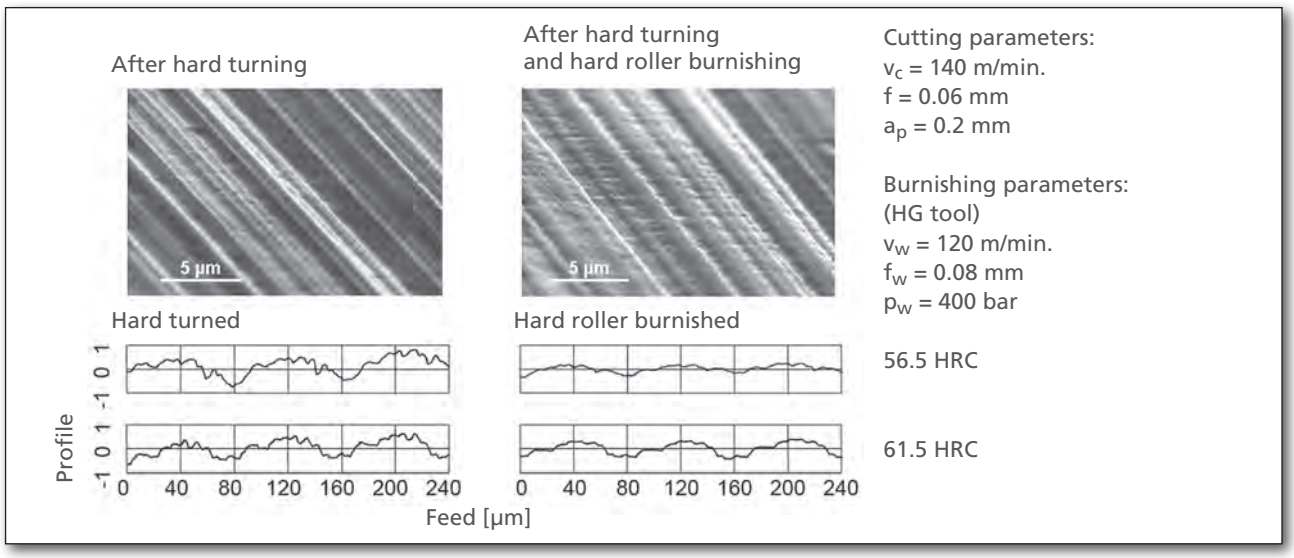
Benefits of Roller Burnishing and Deep Rolling

Improved surface and part quality

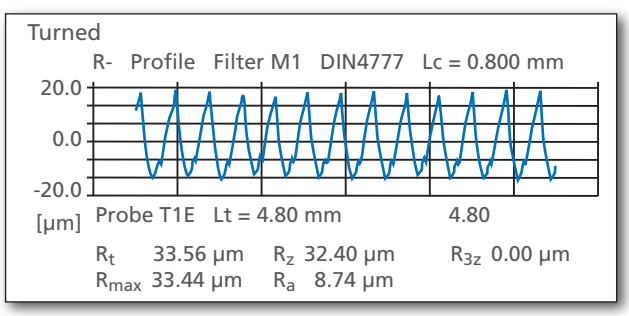
No other technology combines three advantageous physical effects to improve a metal component's edge zone. Roller burnishing and deep rolling generate a uniquely smooth surface while inducing compressive stresses and cold working in the surface layer. The compressive stresses counteract external load forces, dramatically increasing component fatigue strength. As a result, this technology not only saves production costs, but also significantly improves component quality.

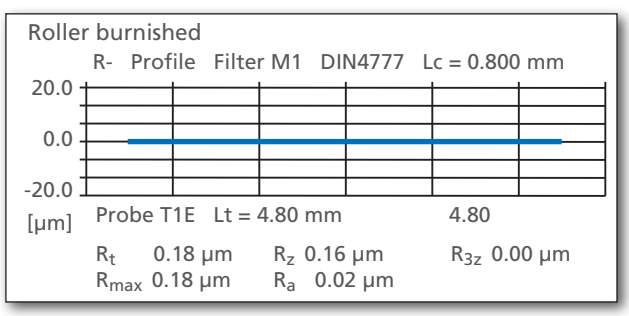
The plastic deformation of the material, together with the smoothing of the surface, generates a high quality surface with the following properties:

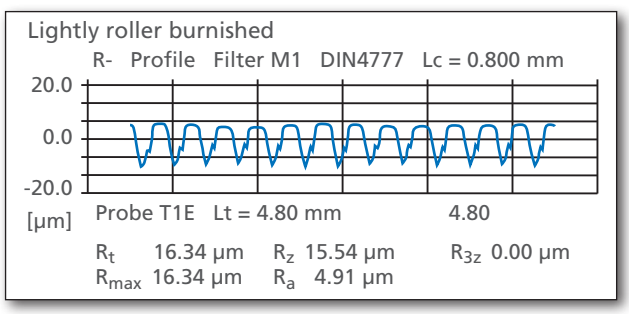
- Low surface roughness.
- High surface contact ratio.
- No remaining profile peaks.
- Increased edge layer hardness.
- Residual valleys which assist lubrication.



Source: Laboratory for Machine Tools and Production Engineering (WZL) of RWTH Aachen University



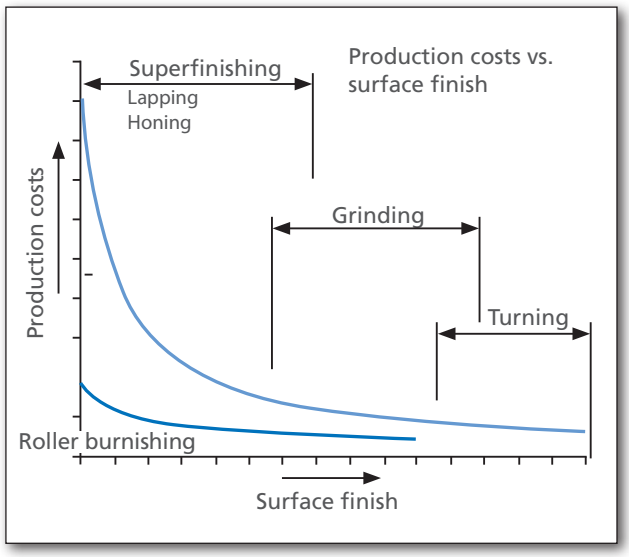




Lower costs

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. Auxiliary processing time is cut dramatically because this technology offers complete processing on the same machine where cutting is carried out. This means that it's no longer necessary to transport the workpiece.

And finally, these processes do not produce dust or residue, saving disposal costs, which continue to increase considerably.



ECOROLL AG Werkzeugtechnik – Overview

For decades, ECOROLL AG Werkzeugtechnik offers solutions for processing and finishing metal surfaces which meet high surface quality demands. Our success and innovative power is based upon close cooperation with our customers, universities and research establishments. Since 1969, ECOROLL's employees design and produce customer-oriented tools and machines for roller burnishing, deep rolling and machining cylinders in Celle, Germany.



Our Global Sales Network

ECOROLL's worldwide sales network enables individual and prompt support for our customersand prospects. In almost every industrial nation, our partners are at your disposal to developcustomized solutions for your special needs in close cooperation with you. Milford, Ohio (USA) is headquarters of ECOROLL Corporation, the subsidiary company founded in 2003.

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or send us an Email (mail@ecoroll.com).
We are looking forward to hearing from you!

ECOROLL
surface matters

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