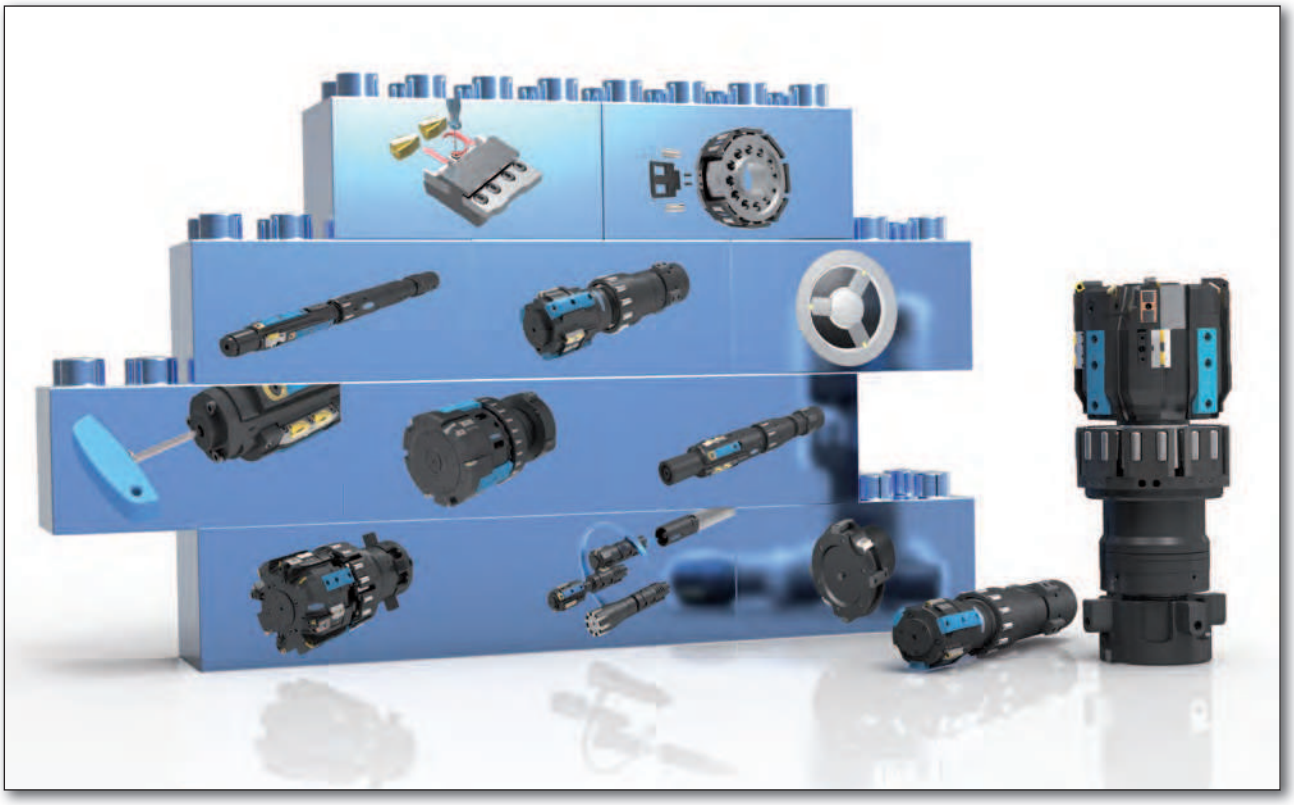
Processing Cylinder Tubes



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

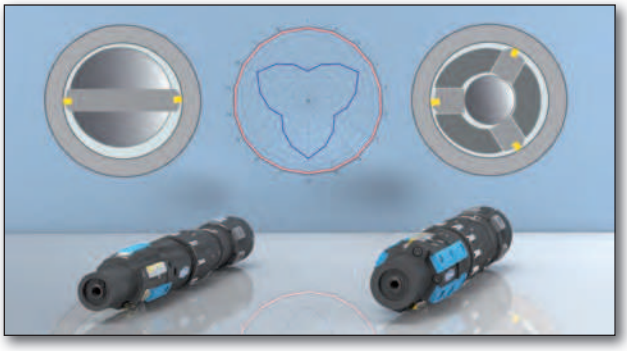
Features

- 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

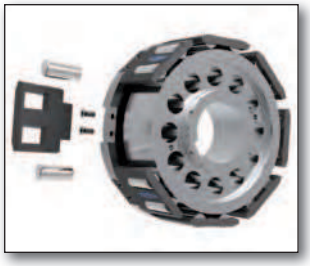
- Improved circular and cylindrical form; rippling is prevented or reduced.



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 > 4.5 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	50-504.99	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 end faces

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

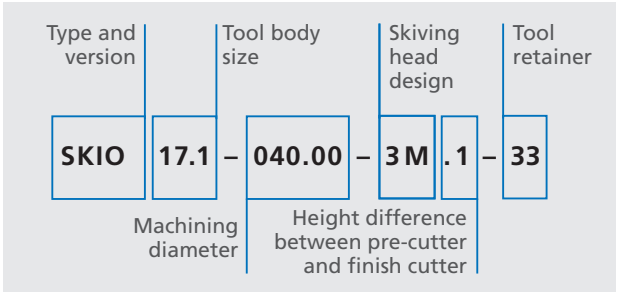
Note: * Unlimited burnishing length.

Ordering

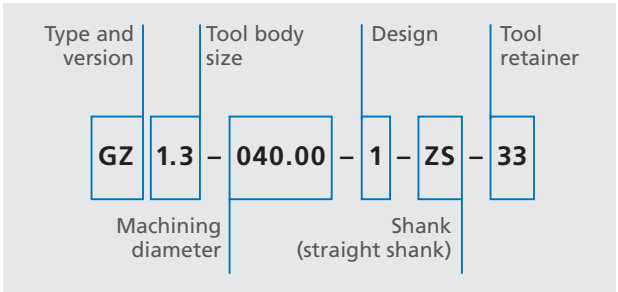
The following information is required:

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