

# drive&control

The Magazine for Rexroth Customers

All-Rounder:

## The Flexible Orbital Grinder

2004

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**Rexroth**  
Bosch Group

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## 2|2004



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For its high-performance grinding machine Italian company Berco has opted for drive and motion components from Rexroth's entire technological spectrum.



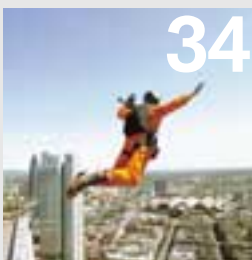
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## Imprint

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Flexible LYNX 2000 Orbital Grinding Machine from Berco:

# All-Rounder: The Flexible Orbital Grinder

Camshafts and crankshafts control the valves and pistons of petrol and diesel engines. Even the slightest deviations from the ideal form can adversely affect the performance and service life of the engine. Therefore, when it comes to machining these components, extreme precision is maximum priority and, as a result, requirements are all the more demanding in relation to the technology used. One example of a high-performance solution of this kind is the LYNX 2000 orbital grinding machine from Berco SpA. The Italian company has opted for drive and motion components covering the entire technological spectrum from the Rexroth Drive & Control modular system.



General view of the LYNX 2000 orbital grinding machine from Berco SpA for maximum precision shaft machining.

Berco, a company which is part of ThyssenKrupp Technologies, has, in the shape of the LYNX 2000 orbital grinding machine, succeeded in implementing an innovative machine concept for machining cam- and crankshafts. Because of its flexibility, the machine is suitable for various types of production, in particular for small and medium scale manufacture, construction samples, research and development as well as for series production. This versatile grinding machine features a large number of intelligent drive solutions which reduce change-over times to an appreciable extent, thus achieving increased availability in mixed operation.

Machining of the shaft proceeds in a similar manner to the subsequent operation, where the crankshaft rotates and so raises the pistons several thousand times per minute. The grinding wheel on the machine moves along a precisely calculated path on the rotating component – but employing the whole of its machining force. Whereas with other concepts the shafts are constantly being re-mounted over a number of machining cycles and individual points are machined, the LYNX 2000 carries out the machining

of crank pins, journals, dogs and mounting flanges on the flywheel within a single set-up operation. The shaft is not, as is otherwise the norm, mounted eccentrically (an expensive exercise) but centrally instead. In addition, the LYNX 2000 makes it possible to grind concave and convex camshafts without the need to use master templates.

If precise machining results are to be achieved, the shaft must be held during machining using precisely applied forces. If the clamping force is too low the workpiece will sag whilst, if the force applied is too high, deformations may result. Berco is able to achieve hydraulic control of the clamping force at the tailstock right down to 1 kg. In addition, the company uses the 4 WRSR valve, which has been further developed, in conjunction with the PVPQ control card from Rexroth.





A view of the work area on the LYNX 2000.



Hydraulic precision control to tailstock right down 1 kg.

## Decentralized intelligence synchronized in real time

While the workpiece is turning, the rotating grinding wheel is constantly moving rapidly in minimal linear increments in relation to the shaft and removing the material at the corresponding points. This complex machining process (elliptical cam profile) calls for a spread of intelligence in order to precisely co-ordinate the movements in real-time quality. To achieve this for the axis movements Berco has opted for the intelligent, high-dynamic response servo drives of the DIAX04 series. This permits high contouring accuracies at the same time as high path speeds within a cycle time of 250 ms, due to fine interpolation and bearing control within the drive providing freedom from contouring errors. Berco uses both rotary and linear motors here.

### High-precision orbital grinding of a camshaft.



Both the Rexroth DIAX04 intelligent servo drives and the Rexroth Refudrive frequency converter are controlled via the SERCOS drive interface.





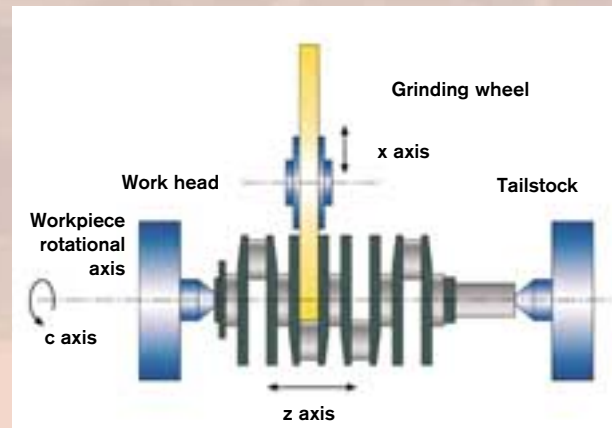
Complete machining in one clamping operation:  
in the LYNX 2000 ground crankshaft.

Mechanical probe during measurement of the crankshaft.

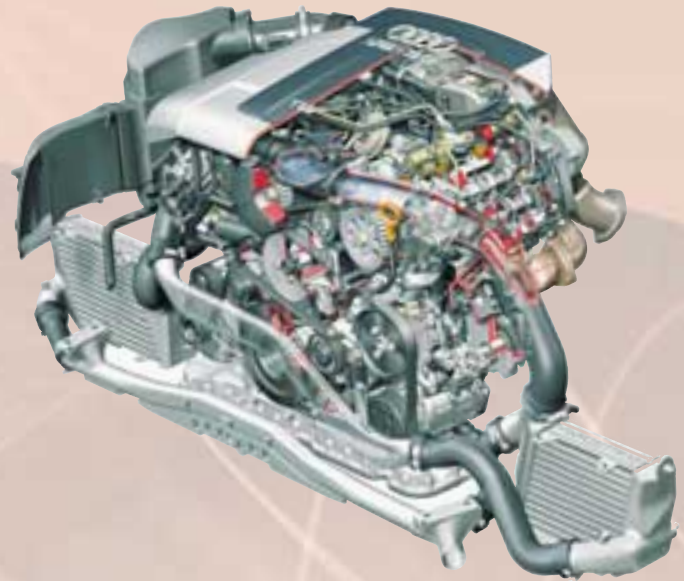


The intelligent servo drives constantly monitor the basic response parameters for the axis, such as contour variations, locating torque and feedback value for the controlled speed. This data is evaluated in-process. The potential for storing a number of sets of configuration parameters for the axes and for loading these in the individual application phases of the operating cycle means that it is possible to carry out sophisticated movements precisely and with a high degree of flexibility.

A RefuSpeed RS51 spindle drive moves the grinding wheel. This frequency converter, which is capable of handling a velocity range of up to 180 000 rpm, features the optimized VFSC (voltage frequency synchro control) process and an integrated sinusoidal filter. This means improved efficiency at the same time as extremely low rotor heating – pre-conditions for long life and maximum machining precision. Both the frequency converter and the servo drives are controlled and synchronized via the SERCOS open drive interface, the only one of its kind to enjoy worldwide recognition.



*Due to its flexibility, the machine is suitable for different types of production and in particular for small and medium-scale manufacture ...*



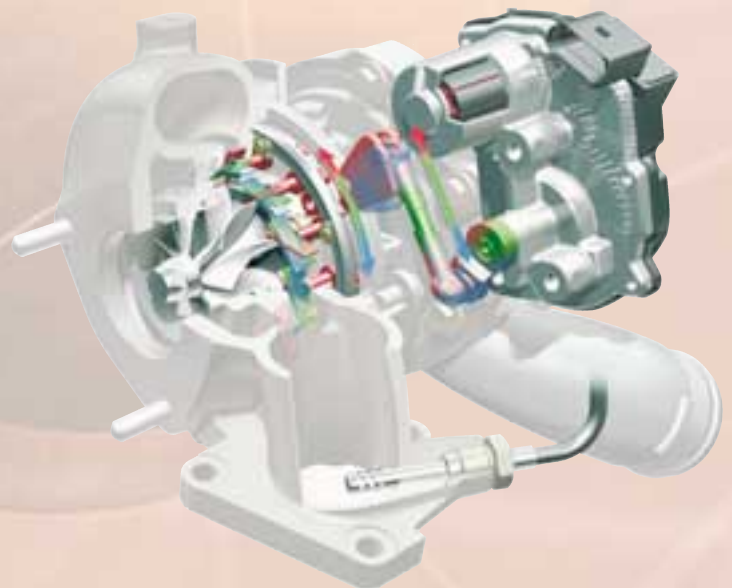
### Consistent alignment of components to standards

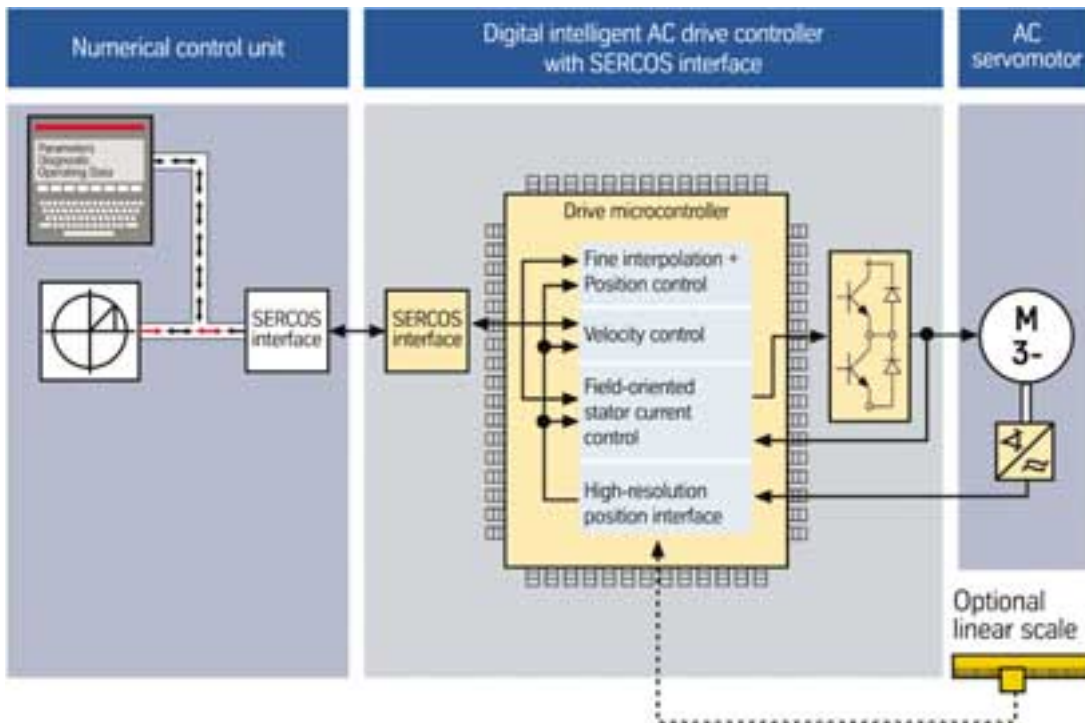
The movement of the grinding wheel in relation to the workpiece takes place with the aid of high dynamic response linear motors running on ball bearing rail guides with a 0.1 mm motor resolution. The high-resolution glass scales used in conjunction with this are cleaned using pneumatic components from Rexroth. The grinding head consists of a motor with a capacity of 15 or 25 kW, depending on the application, which is directly coupled to the headstock. Fitted with an automatic dynamic compensator and vibration absorber, the LYNX 2000 operates with its grinding wheel constantly counterbalanced. The internal hatches for protecting the grinding wheels are, in the same way as other automation components, moved by means of pneumatic components including type ISO 581 solenoid valves and cylinders. With a special electric spindle from Rexroth for use on grinding wheels up to 45 mm thick and for machining concave cams, especially for the Common Rail diesel engines which are currently much in demand, the LYNX 2000 demonstrates its versatility.

A high level of machine rigidity is the basic mechanical pre-condition for accurate results. Thanks to the Rexroth ball bearing rail guides a high level of precision can be achieved when the workpiece is clamped in position. The linear guides, which are designed to cope with high machining forces, feature a high degree of load capability in all four load directions. An important design characteristic of the guide carriages is the robust metal plates to both end faces. Integrated polydirectional lubrication connections with metal threads are very well suited to the sometimes harsh environmental influences in the metal processing industry. Lubrication reservoirs in the guide carriages ensure lengthy re-lubrication intervals.

The valves and pistons on petrol and diesel engines are controlled by cam- and crankshafts.

*During machining, the shaft has to be held in place by means of accurately applied forces ...*



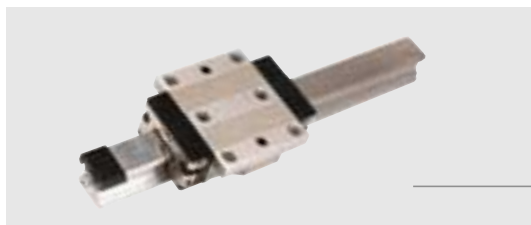


*One particular feature of Rexroth guides: The rail profile has been consistently maintained right from the start.*



One particular feature of Rexroth guides: the rail profile has been consistently maintained right from the start. This means that the new generation of guide carriages can still be mounted on a guide rail dating back to 1985 without any problems. The result is shorter delivery times and simplified spare parts logistics.

With the LYNX 200 Berco has developed a highly flexible orbital grinding machine, opting without exception for Rexroth drive and motion technology. Due to consistent observance of standards and maintenance of open interfaces, the components fit ideally into the open loop control architecture of the machine. The distribution of intelligence not only ensures accurate results but also promotes the flexible and economic production of small series items: a single machine for all crankshafts and camshafts. ■



Rexroth ball rail guides are characterised by their extreme rigidity and high load capacity.



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