

Gear Skiving Machines

LK 300 / 500



LIEBHERR

Skiving³: Machine, tool, and process all from a single source



Increased efficiency thanks to gear skiving

Customers are seeking alternative processes that are more productive and cost-effective than the gear shaping method and more flexible than broaching.

Successful skiving requires the following:

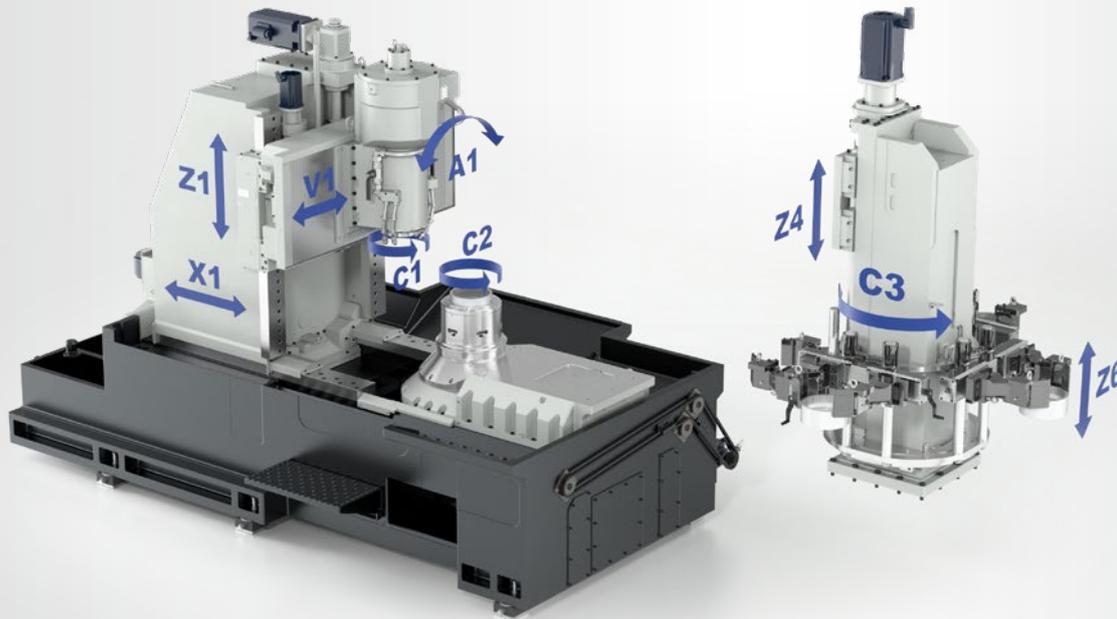
- Machine
- Tool
- Process

The foundation is the rigidity by the machine: The cast iron machine bed absorbs resulting process forces. The use of flat guides in all important linear axes provides additional damping. A high spindle rigidity is attained in the machining head using a special bearing concept, in which longer tool holders can be used – this is particularly important for machining internal gears.

In addition to the machine, the appropriate tool is crucial for a stable process. With its in-house tool development and manufacturing, Liebherr can design the optimal tool for every workpiece.

The planned process must be taken into account when designing tools. Thanks to intensive technological development and extensive tests with customers, Liebherr understands the interaction between machine and tool and is in a position to be able to offer a skiving machine, tools, and to provide the Skiving³ process.

The machine design



Axes

X1 - Radial movement of machine column
V1 - Tangential movement of tool
Z1 - Axial movement of skiver head

C1 - Rotary movement of tool
C2 - Rotary movement of workpiece
A1 - Swivel movement of tool

Z4 - Vertical movement of tailstock
C3 - Rotary movement of ringloader
Z6 - Vertical movement of the NC lifting station



Automatic part change

The Liebherr ring loader design provides for a quick and automatic part change. Shafts and wheels with a maximum workpiece weight of up to 100 kg can be loaded and unloaded fully automatically using this tried-and-tested automation method.

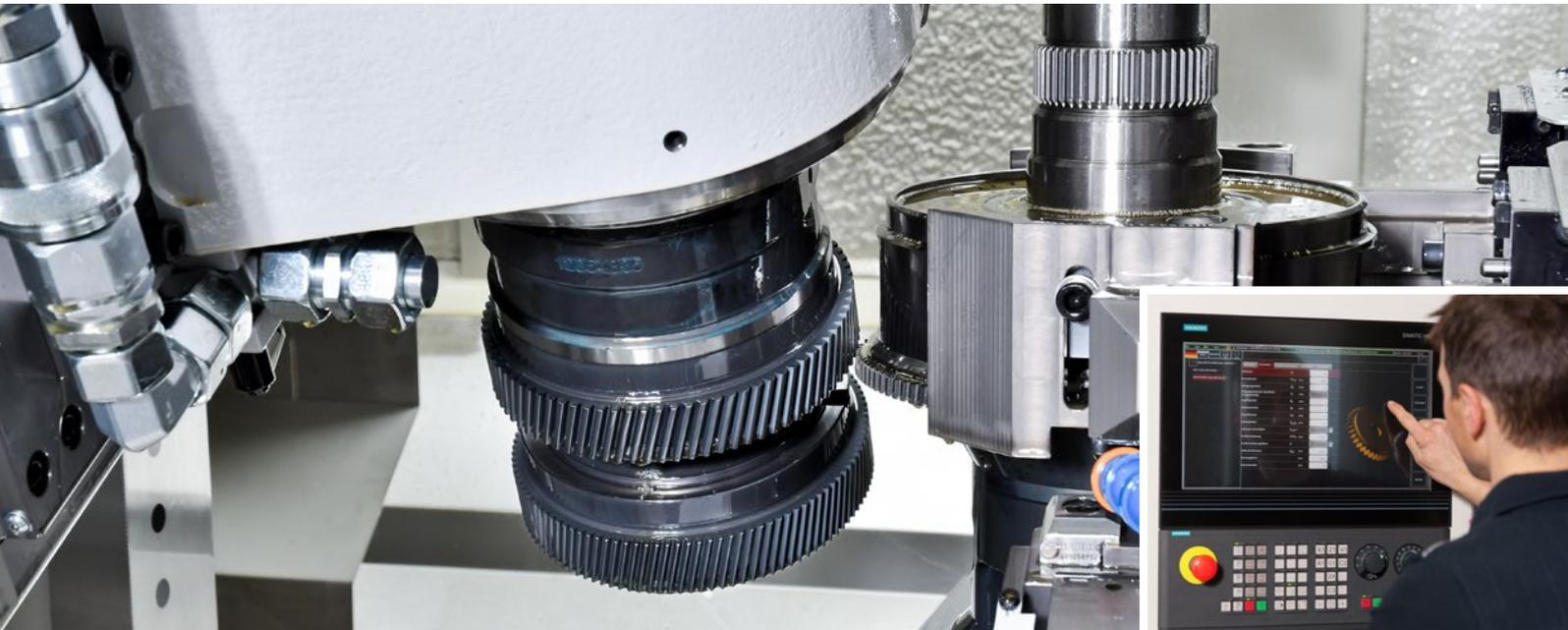
For matching external automation, Liebherr offers additional customized solutions such as robot loading or workpiece guidance using plastic chain or hinged chain conveyors.



Automatic tool change

Various tools can be exchanged in almost no time by means of an optional tool changer. This gives you the option to use various tools, provided that the machining of cluster gears in a clamping fixture is necessary. Furthermore, similar tools can be held in the tool changer so that when the end of tool life is reached, a new tool is automatically exchanged.

Tool design and production



Interaction of tool, technology and machine: Skiving³

Field tests have clearly shown that the mathematical mastery of the process and the coordination thereof to tool and machine is the key to success. This was proven during customer trials.

Optimal tool design

- Technologically ideal design for each gear
- Profile calculation taking into account the crossed-axis angle and offset cutting face
- Observation of collision avoidance – especially for internal gears
- Optimal cutting and relief angles for the entire process



Liebherr's in-house tool production



Tool design and production at locations in Ettlingen, Germany (left) and at the Liebherr-Utensili S.r.l. in Collegno, Italy (right).

Materials for tool production

1. Tools made from powder-metallurgical steels (PM-HSS) have a lower invest, but are subject to increased wear.
2. Tools made from carbide metal have higher production and material cost due to more expensive raw materials and manufacturing, as well as higher grinding times and greater grinding material usage. Because they cost three times as much as PM-HSS tools, it is only worth while to use them with high production output.



Conical tools

They are more complex in production, but on the other hand they are easier to adjust in the gear skiving machine. They result in a more robust process design and are thus better suited for technologically demanding processes.

Conical and cylindrical tools

With conical and cylindrical tools, the axis arrangement is different: A conical skiving tool maintains a constructive relief angle and is usually centered, while a cylindrical skiving tool requires additional tilting or an off-centered position. The control system of the Liebherr machines controls both process variations.



Cylindrical tools

Due to their uniform profile, they are much easier to manufacture. However, the kinematics required in the gear skiving machine are somewhat more complicated and compromises must be made. Therefore, the requirements for process control are higher.

Additional functions



Wet machining

With internal gears, wet machining is advantageous because the meshed blades are cooled and lubricated so that no thermal damage occurs to the tool. Another reason is that chips that form are perfectly removed, which prevents them from being drawn into the running process. Optimal chip removal considerably increases process reliability.

Plug-in coolant nozzle design

With its innovative coolant nozzle design, Liebherr provides customers with the unique ability to have a specific coolant nozzle available for each workpiece. This way, complex adjustment work during the set-process can be significantly reduced and the process is more stable. The coolant nozzle is changed using a quick-change clamping fixture.

Deburring

As with every machining process, sharp edges and burrs result from tool runout. To remove these quickly and cost-effectively, Liebherr offers an adaptable lathe tool on the gear skiving head. Using the lathe tool and the corresponding software, these burrs can be removed easily.

Meshing a gear

An alignment process is required for using finishing tools and for soft and hard machining. For this, Liebherr offers a simple solution by means of a meshing sensor on the gear skiving head. Customized solutions can be developed as needed.



Skiving³: Advantages and specifications



Machine

- Rigid machine design
- Direct drive for spindle and table for implementation of the highest dynamic rigidity
- State-of-the-art user interface with LH Geartec
- Wet machining (internal gearing) and dry machining possible (external gearing)
- Proven ringloader concept for workpiece changing and various automation options
- Integrated deburring
- Optional chamfering during the machining process
- Optional with fully automatic tool changer (up to 12 tools)

Tool

- Design and production of conical and cylindrical skiving wheels
- Process optimized tool design
- Tools in PM-HSS & carbide metal design

Process

- Process analysis and simulation for optimal cutting conditions
- Use of technology applications for optimal customer support
- Collision analysis with calculation software

LK 300/500

Maximum module	mm	5
Maximum gear diameter	mm	300/500
Maximum workpiece external diameter	mm	500
Maximum table speed	min	3,000/1,500
Maximum tool diameter	mm	250
Maximum tool speed	min	2,700
Maximum spindle output	kW	32

Your solution provider



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