Gear-Shaping Machines
LFS and LSE 200 - 500

LIEBHERR
The Machine Concept

The Liebherr gear shaping machines are optimally tailored for universal use. The machine’s movable shaping head design allows manufacturing of a variety of parts with minimal setup times. With the variable height of the cutting head, it is also possible to cut multiple gears in one setup.

The machine concept is based on a modular platform system, with component groups that are also used for the Liebherr hobbing and grinding machines. This permits cost effective manufacturing of individual components. The machine concept is suitable for wet processing as well as dry processing in equal measure.

The Table Drive

Achieving the highest gear quality requires a completely backlash free table drive. Additional to the gear driven tables, highly dynamic direct drives are available that meet all requirements regarding speed and accuracy.

The axes

X1 – Radial travel main column
Y1 – Column offset
Z1 – Stroke position adjustment
Z2 – Stroke length adjustment
Z3 – Stroke travel tool
Z4 – Vertical travel tailstock arm
Z6 – NC-lift station
B4 – Tool relief motion
B5 – Column swivel axis
C1 – Rotary motion tool
C2 – Rotary motion work piece
C3 – Rotary motion ring loader
The moving cutting head slide facilitates the universal and flexible manufacture of cluster gears as well as internal and external splines in one set-up. In conjunction with an electronically controlled guide, it is possible to cut straight teeth and helical teeth. Time-consuming retooling of the angled spindle guide is no longer necessary. The ability to set the position of the direct guide for the cutter spindle height – aside from the greater freedom - allows corrections to be made to the workpiece helical angle down to a few thousandths of a degree as well as corrections in the face width.

### The Shaping Heads

<table>
<thead>
<tr>
<th>Shaping head</th>
<th>SK 1.70</th>
<th>SKE 120</th>
<th>SKE 240</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. module (mm)</td>
<td>5</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>Stroke speed (min⁻¹)</td>
<td>1,500</td>
<td>1,200</td>
<td>1,000</td>
</tr>
<tr>
<td>Stroke length (mm)</td>
<td>70</td>
<td>120</td>
<td>240</td>
</tr>
<tr>
<td>Drive power (kW)</td>
<td>17</td>
<td>35</td>
<td>55</td>
</tr>
<tr>
<td>Accelerated return stroke</td>
<td>no</td>
<td>optional</td>
<td>optional</td>
</tr>
<tr>
<td>Guide concept</td>
<td>Change guide mechanical</td>
<td>Straight/helical · electronic controlled</td>
<td>Straight/helical · electronic controlled</td>
</tr>
</tbody>
</table>

SK 1.70 SKE 120 SKE 240
SGA Method (Gear Shaping with Crossed Axes)
Thanks to the SGA cutting method developed by Liebherr, the use of cylindrical cutters without clearance angles makes it possible to keep the material costs per workpiece down to a very low level. The clearance angles required for cutting are facilitated by the column tilt angle. A special cam is used to ensure that the tooth root of the sprocket runs straight despite crossed axes.

SSM (Shuttle Stroke Method)
With this method, oversize face widths can be shaped, which are larger than the maximum working area of the machine. The desired face width is split into several increments with corresponding stroke lengths. With the relevant setting, these incremental lengths are processed one-by-one until the overall face width is cut to size.

Wafer Tools
Tool setups are a significant part of the overall production costs. This cost portion can be reduced with the use of wafer cutters with their constant diameter. With water tools, several workpieces can be processed at the same time, which helps to assure the highest output.

Deburring
In the Liebherr gear shaping machines, it is possible to perform coarse deburring measures in the working area. As additional options, simultaneous pressure deburring and centrifuging in the 90° position of the ring loader are possible.
**Technical Data**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>LFS 200/300/380/500</th>
<th>LSE 200/300/380/500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal module</td>
<td>mm</td>
<td>5</td>
</tr>
<tr>
<td>Max. cutting diameter</td>
<td>mm</td>
<td>200/300/380/500</td>
</tr>
<tr>
<td>Stroke length</td>
<td>mm</td>
<td>70</td>
</tr>
<tr>
<td>Centre distance cutter spindle / work table</td>
<td>mm</td>
<td>-50 ... +450</td>
</tr>
<tr>
<td>Axis angle cutter spindle / work table</td>
<td>deg.</td>
<td>± 0.28</td>
</tr>
<tr>
<td>Column swivel axis</td>
<td>-1 ... +12</td>
<td>-1 ... +12</td>
</tr>
<tr>
<td>Stroke position range cutter head slide</td>
<td>mm</td>
<td>400</td>
</tr>
<tr>
<td>Stroke speeds infinitely variable as standard</td>
<td>DS/min.</td>
<td>1,500</td>
</tr>
<tr>
<td>Feed rotary axis cutter</td>
<td>mm/min.</td>
<td>3,750</td>
</tr>
<tr>
<td>Total weight</td>
<td>approx. kg</td>
<td>18,000 - 19,000</td>
</tr>
</tbody>
</table>
Internal Automation Possibilities

Ring loader
The ring loader makes simultaneous loading and unloading possible. The average loading time is 0.1 min. Gripper versions are fitted as parallel (e.g. gears) and swivel grippers (e.g. shafts). No tools are required for the gripper quick change feature. The ring loader can be loaded up to 100 kg in weight.

Lift/Tilt Loader
The lift/tilt loader is suitable for larger and heavier workpieces weighing in excess of 70 kg. Since the unmachined parts are set-up on a carrier plate simultaneously, the machine is not idle during the process. Changing from unmachined to machined parts is performed within 15 seconds.

Tool Changer
The tool changer is a storage magazine for preset tools. Changing of the tools is an automated process. The advantages of this, for example, are in the processing of cluster teeth as well as in the automated exchange of roughing tools (e.g. HM-WSP cutting wheels) to finishing tools. With this tool delivery system, a high turnaround can be achieved. Replacement of a measuring sensor is possible as an option.
External Automation Possibilities

**Palletizing Cell (LPC)**
Standardized transport containers with basket technology facilitate a uniform approach to logistics as well as flexible future-oriented production.

**Plastic Chain Conveyor (KKB)**
The plastic chain conveyor is available in the standard version for workpieces up to 20 kg in weight and in the heavy duty version for workpieces up to 180 kg in weight, and is designed to transport any number of irregularly shaped workpieces without them coming into contact with each other.

**Robot Cell (LRC)**
Hook-ready robot solution in modular design replaces complex sorting systems, increases productivity, and alleviates burden on personnel.

**Drag Frame Conveyor (SRB)**
Drag frame conveyors serve to transport parts with a flat surface, e.g. bore-type gears, hubs or rings. The workpieces are dragged by a frame that is connected to a chain.

**Hinged Chain Conveyor (SKB)**
With the aid of hinged chain conveyors, it is possible to transport workpieces with a flat surface, e.g. bore-type gears. Depending on the scenario, multi-track versions are also possible.
Machine Tools and Automation Systems from Liebherr

With over sixty years of industrial experience, Liebherr is one of the world’s leading manufacturers of CNC gear cutting machines, gear cutting tools and automation systems. The company’s innovative products are the result of pioneering ideas, highly qualified staff and state-of-the-art manufacturing systems at each of their locations. They are characterised by economy, ease of use, quality and reliability in combination with a high degree of flexibility.

High Quality Gear Cutting Tools
Liebherr manufactures high quality, precision tools for the soft and hard machining of gears and all Liebherr gear cutting machines are fitted with Liebherr tools. The range also includes Lorenz shaping tools and products customised for specific customer applications.

Automation Systems for a Broad Range of Applications
Liebherr has a wide range of products for linear robots, pallet-handling systems, conveying systems and robot integration for projects in all areas of production and can provide above-average availability of systems.

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If required, experienced and highly qualified application specialists can convey their expertise within the course of a technology mentoring session directly on the machine and tailored to the specific production process.

Liebherr gear cutting machines have been designed, developed and built for the highest level of production quality and reliability. In order that you as a customer can fully benefit from these properties, your personnel must be suitably qualified and trained. Liebherr therefore offers a comprehensive range of training courses and seminars.

**We offer mentoring in the following areas**
- Quality optimization of workpieces and gears/splines
- Determination and optimization of technology parameters
- Use of suitable tools for different applications
- Increase in cutting speeds, reduction in tool downtimes etc.
- Shortening of processing times
- Utilization of all resources from the machine software

**Training Courses**
- User training for machine configuration and machine operation
- Electrician training for servicing and repair
- Mechanic training for servicing and repair

**Seminars**
- Outline courses • Fundamentals of gear cutting
- Basic courses
- Advanced courses
- Theory & practical courses
- PC training, time calculation
Application Examples and Software

Software Support
The WinKolli program is used to check the suitability of the shaping cutters for specific gear applications.

Tooth Analysis
This program can be used to detect collisions between the shaping cutter and gear workpiece before previously the machining process and to prevent collisions by varying the tooth parameters.

Your Advantages
- Integrated database of the Liebherr shaping cutters
- Free database for customer-specific gear workpieces and shaping cutters
- Pairing calculations of gear workpiece and shaping cutter
- Visualization of gear workpiece and shaping cutter when engaged
- Rolling the shaping cutter with selectable immersion depth and feeds
- Calculation of the actual profile offset for shaping cutter and gear workpiece, optionally with the roll dimension, tooth width or tooth thickness
- Logical test routines for checking input errors
- User-friendly Windows interface
Service and Spare Parts

Liebherr customer service means being a reliable and competent partner for customers around the world. With a whole range of different services, Liebherr assists customers in assuring the productivity and cost-effectiveness of Liebherr machines.

Your Benefits

• Support with malfunction messages via remote diagnosis /repair
• Spare parts service with professional advice
• Customer service centres in Europe, America and Asia guarantee first class and trouble-free service with short reaction times in order to avoid unscheduled downtimes
• Supported production
• Individual service contracts
• Repairs
• Long service intervals

Tool Service

Liebherr’s after sales department offers a sharpening and coating service for gear cutting tools as well as a recoating service for CBN grinding tools.

Sharpening and Coating of Gear Cutting Tools

• Comprehensive quality control for high tool quality
• Short delivery times
• Reduction in costs
• Inspection protocol for quality control
• Sharpening of gear cutting tools is carried out according to the same high standards of quality as for new tools and guarantees original manufacturer quality

Recoating of CBN Grinding Tools

• Recoating of grinding tools in our in-house electroplating plant
• Quality control in all steps of the process ensures a constant high level of quality
• Goods-in check to determine the extent of recoating