COLD FORMING MACHINE C6/C9/C9T
ERNST GROB AG
Cold forming machines
Slotting machines
Rohrgasse 9, P.O. Box 830
CH-8708 Männedorf
Switzerland
Phone +41 44 922 77 00
Fax +41 44 922 77 88
info@ernst-grob.com
www.ernst-grob.com

Products and Services

Cold forming machines
ERNST GROB AG develops, designs and builds cold forming machines; from basic, manually loaded units to fully automated production lines. The primary fields of application for the sheet metal and solid components produced by cold forming are to be found in the automotive industry. Our machines, however, are also operational wherever efficiency and quality are key considerations.

Slotting machines
Sheet metal parts that have been splined on GROB cold forming machines can be transferred to our slotting machines for secondary operations, thereby ideally complementing the cold forming process. Non-splined workpieces can also be slotted. The design concept of our equipment is modular and can be optimally tailored to suit the specific requirements of the application involved.

Tools
All tools used on GROB machines are developed and manufactured in GROB’s in-house tool shop in accordance with the specific requirements of the materials and applications involved. An in-depth expertise, plus state-of-the-art toolmaking equipment combined with continuous research and development allows ERNST GROB AG to provide optimal tooling delivered in the shortest possible delivery times.

Subcontracting
At our subcontract facility we use our own cold forming and slotting machines to produce components to customer order. We can take on your production needs for individual components or small pilot runs. To overcome production bottlenecks, we also process full-scale mass volumes. Our Quality Management System is certified to ISO/TS 16949.

Engineering
A cornerstone of our success is the relentless search for optimal solutions to specific engineering challenges. Our development department is key in this objective, as this is where years of in-depth experience and the latest technological expertise are merged. Close collaboration with our business partners invariably succeeds in generating innovative results that our test department rapidly converts into prototype components, which are already close to mass-production maturity.
## Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company profile</td>
<td>2</td>
</tr>
<tr>
<td>Industries, products, process description</td>
<td>4</td>
</tr>
<tr>
<td>GROB Cold forming machines</td>
<td>6</td>
</tr>
<tr>
<td>Cold forming machine C6</td>
<td>10</td>
</tr>
<tr>
<td>Cold forming machine C9</td>
<td>12</td>
</tr>
<tr>
<td>Cold forming machine C9T</td>
<td>14</td>
</tr>
<tr>
<td>Installation, operation, service</td>
<td>16</td>
</tr>
</tbody>
</table>
**Company profile**

**Competencies**
ERNST GROB AG develops, designs and builds precision machines dedicated to the cold forming of splined and non-splined workpieces. The manufacture of slotting machines for secondary and finishing operations on cold formed workpieces is yet another core competence of the company. From the initial idea through to its development, and right up to the industrial application—the entire concept is available from a single partner. ERNST GROB AG provides customer specific solutions, from manually loaded single machines to fully automated production lines.

**GROB slotting machines**
GROB slotting machines are employed to finish cold formed splined or non-splined hollow components. Diverse slotting and coining operations are undertaken at various stations. Separate stations for dedicated applications can also be integrated.

**Diversity of finished products**
Applications for GROB-Machines are highly flexible, for example, when producing:
- Clutch disc carriers
- Splined shafts
- Gearbox shafts
- Drive shafts
- Steering system parts
- Pump shafts
- Extruder shafts
- Splined shafts for:
  - Printers
  - Medical instruments
  - Communal vehicles
  - Helicopters
  - Food processing equipment
  - Torsion bars and progressive coil springs

**GROB cold forming machines**
GROB cold forming machines are based on the principle of the cold roll forming in planetary type movement process. The technology provides a solution for the cost-effective production of splined or reduction type cylindrical workpieces. The founder of our company, Ernst Grob, further developed and refined the principle (see infobox «The GROB story»).

**Machines for the automotive industry**
GROB machines are primarily used in the automotive industry. Typical components are clutch disc carriers in automatic transmissions and other splined components within the power train.

**Diversity of finished products**
Applications for GROB-Machines are highly flexible, for example, when producing:
- Clutch disc carriers
- Splined shafts
- Gearbox shafts
- Drive shafts
- Steering system parts
- Pump shafts
- Extruder shafts
- Splined shafts for:
  - Printers
  - Medical instruments
  - Communal vehicles
  - Helicopters
  - Food processing equipment
  - Torsion bars and progressive coil springs
Dedicated partnerships

At ERNST GROB AG the development department is intensely focused on the refinement of existing technologies, plus the development of new processes and applications. In close cooperation with customers and other interested parties, solutions are generated that permit economic production of accurate finished parts. When required, ERNST GROB AG offers customer support throughout the entire service life of machines installed by our company.

Success factor employees

The key success factor of ERNST GROB AG is the professional competence and dedication of its employees. A team of highly qualified and experienced specialists is the best guarantee for meeting the most demanding challenges. An innovative spirit coupled with an inherent flair for technical solutions are the foundation on which innumerable and unique developments are based.

Locations

ERNST GROB AG plants are located in Switzerland’s greater Zurich conurbation where the company is able to benefit from an outstanding infrastructure with excellent transport facilities.

Headquarters in Maennendorf

Subsidiary in Oetwil am See

The GROB story

up to 1961

Dr. h.c. Ernst Grob develops cold forming machines at the machine tool works he founded in Munich in 1926.

1962

1962 Dr. h.c. Ernst Grob founds a company making cold rolling machines in Maennendorf and delivers the first one to Sulzer, Zuchwil, Switzerland.

1963

Further machine deliveries to Germany, Italy and Japan. Subsequent set-up of global sales and marketing network.

1979

Introduction of PLC technology and establishment of in-house electrical department.

1984

Introduction of multiple axis CNC technology.

1985

Following death of Dr. h.c. Ernst Grob: establishment of ERNST GROB AG. Business continued and expanded by his grandson and current owner, Mr. Daniel Dériaz.

1991

Acquisition and expansion of a subsidiary plant of ERNST GROB AG in Oetwil am See, Switzerland.

1999

Quality Management Certification to ISO 9001.

2001

Expansion of product portfolio with type S8 slotting machine for hollow parts and delivery of first slotting machine to General Motors Strasbourg.

2005

Start-up of production at the newly constructed workshop in Oetwil am See.

2006

Certification of subcontracting facility in Oetwil am See to ISO/TS 16949.

2007

Introduction of torque drive technology (NCT).

2008

Modern centralised office building in Maennendorf is occupied.

2009

Market roll-out of newly developed stroke-stamping process.

2012

Opening of our own Beijing representative office.

50 years jubilee of ERNST GROB AG.
Industries, products, process description

**Industries**
Machinery from ERNST GROB AG is installed primarily in the automotive and vehicles industries. The majority of OEM’s and their suppliers use GROB technology to produce splined parts for gearboxes, steering systems and numerous other applications. Splined components are also produced by other sectors, for example, the plastics and papermaking industries.

**Large-scale and small volume production**
Whereas ERNST GROB AG machine customers essentially use their equipment for mass production, the situation for smaller volumes is different: components for a wide range of applications are frequently subcontracted direct and produced by ERNST GROB AG.

**Finished products**
In the vehicles industry, splines are mainly required on half-shafts, gearbox shafts, universal joints, clutch- and steering shafts. In all these applications, high precision and surface finish are essential.

The GROB cold forming process is also highly suited to challenging components, such as shafts for pump construction or extrusion machinery. Here, even specifications for extremely long and highly accurate splines of up to 10 metres in length or more can be met.

**Materials and geometries**
In the majority of applications, steel is the specified workpiece material. Also steels for case-hardening, steels for heat treatment and stainless steels are suitable. However, other alternatives such as titanium, non-ferrous metals and light alloys can be processed by GROB cold forming technology. Both cylindrical thick-walled hollow shafts and solid ones are suitable for cold forming. The profile geometry of the spline gap is virtually identical to the profile of the rolling tool. Hence, all common standard profiles and almost any desired tooth geometry, e.g. parallel flanks, involutes (including those with undercuts), linear ball bearing or buttress tooth profiles are feasible.
Process description

In the GROB cold forming process, the entire forming sequence is broken down into numerous individual steps. This procedure allows high degrees of accuracy and surface finish to be achieved with relatively low force levels. The tooling consists of two opposing rolling tools carried in roller heads.

During operation, the tools rotate in a planetary motion within the roller heads and act on the workpiece which is turning about its own axis. At the same time, the workpiece moves in axial direction, thereby generating the spline geometry along its length. This process produces extremely precise components with all the familiar benefits of chipless forming, e.g.: cold work hardening, enhanced material microstructure, material savings.

Example of involute spline
Example of spline with parallel flanks
Example of linear ball bearing profile
Calibrating of tooth tips
Forming splines with chamfered tips
Example of buttress tooth geometry
Applications
Machines of the C-series have been designed specifically for forming precision splines in solid material, tubular blanks and hollow shafts. Typical applications are splines required on forked and universal joint shaft, wheel hubs and flanges.

Cold forming machine C9T

Internal views of C9 cold forming machine

Chuck for yoke shaft and actuated blow-off device
Key benefits of the C6/C9/C9T at a glance

- Chipless production process
- Flexibility
- Rapid changeovers
- Short cycle times
- Simple machine operation
- Minimal maintenance costs
- Low tooling costs
- High accuracy, Class 5–7 to DIN 3960/3962
- Consistent maintaining of tolerances in production, thanks to absence of wear on rolling tools
- Improved microstructure as grain flow follows the workpiece profile, allowing higher loads on the splines
- Increased strength through work hardening effect
- Surface finish Ra 0.4 (<0.001mm)

Control panel
All functions can be input and accessed via the logically arranged control panel.
Drive and axis functions

For the majority of applications, a C6 or a C9 equipped with conventional drive can be used. Special splines, e.g. those with parallel flanks or very long splines, call for the use of a torque motor. This direct drive system is free of backlash and operates at high peak-, nominal- and standstill torque rating.

The machines are equipped with an automatic lubrication and cooling system that supplies the individual machine assemblies such as the gearbox, carriage and lead screws, plus the roller heads. Contaminated oil is collected in a tank where it is subsequently centrifuged to remove debris and abrasive residues. All connection points are electronically monitored. An air-cooled heat exchanger completes the system. All other lubrication points are supplied by permanent grease or oil circuits.

The clamping system is operated hydraulically. The countercenter and the blow-off device are actuated pneumatically.

Legend

C C axis: Workpiece rotation drive
Z Z axis: Workpiece feed
X X axis: Roller head depth movement
B B axis: Roller head rotation drive
A A axis: Swivelling angle adjustment
**Options**

**Cooling and heating unit**
Where technical or climatic conditions dictate, a compressor type chiller with heating circuit and pump can be installed. This system can be integrated into the machine controls from where it is regulated and monitored via timer, thermostat and pressure switch.

**Actuated blow-off device**
Coolant that lubricates the workpiece during the forming operation is subsequently blown off by compressed air. Generally, a two-piece nozzle ring is used. Its pneumatically actuated approach and retraction movements are synchronized with the production cycle.

**Loading system**
Applications specific automatic loaders and unloaders are available for handling workpieces within the installation.
Cold forming machine C6

C6

The compact C6 is an economic and universal solution offering a high degree of applications flexibility and occupying a minimum of space.

Characteristics of the C6

- Suitable for manufacturing of splines up to approx. module 2.3
- Low space requirement
- High level of flexibility
- Rapid changeover procedure, short cycle times
- Forming in continuous pitch mode
- Optional shifting for maximum three different spline geometries in one clamping
- Simple machine operation
- Machine completely encapsulated in sound damping cabin, transportable in one piece

Technical specifications of the C6

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roller head speed (min⁻¹)</td>
<td>0–3000</td>
</tr>
<tr>
<td>Carriage rapid traverse (mm/min)</td>
<td>30 000</td>
</tr>
<tr>
<td>Space between spindle nose and roller head carrier (LW, in mm)</td>
<td>135–1390</td>
</tr>
<tr>
<td>Max. spline length (LZ, in mm)</td>
<td>1100² ²) ³)–90</td>
</tr>
<tr>
<td>Roller head diameter (DR, in mm)</td>
<td>63² ³)–80/63³)–90</td>
</tr>
<tr>
<td>Workpiece diameter range (DA, in mm)</td>
<td>8–72/16–80⁴)</td>
</tr>
<tr>
<td>Workpiece and chuck diameter (D(max), in mm)</td>
<td>315</td>
</tr>
<tr>
<td>Possible number of splines</td>
<td>freely programmable</td>
</tr>
<tr>
<td>Maximum approx. module</td>
<td>2.3</td>
</tr>
<tr>
<td>Power consumption (kW)</td>
<td>9–12</td>
</tr>
<tr>
<td>Compressed air (bar)</td>
<td>6</td>
</tr>
<tr>
<td>Length L, width B, height H (mm)</td>
<td>4500, 1950, 2200</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>8 000</td>
</tr>
</tbody>
</table>

¹) As GROB machine concepts undergo continuous development refinement, all technical specifications are subject to change without notice.
²) Greater lengths possible with extended machine beds or follow-up reclamping.
³) Only feasible with one roller per roller head.
⁴) Workpiece or workpiece specific accessories can affect this dimension.
Cold forming machine C9

C9

Compared to the C6, longer workpieces with larger diameters and modules up to approx. 3.5 can be processed on the C9.

Characteristics of the C9

- Suitable for manufacturing of splines up to approx. module 3.5
- Low space requirement
- High level of flexibility
- Rapid changeover procedure, short cycle times
- Forming in continuous pitch mode
- Optional shifting for maximum three different spline geometries in one clamping
- Much shorter processing times thanks to multiple rolling tools per roller head
- Simple machine operation
- Machine completely encapsulated in sound damping cabin, transportable in one piece

Technical specifications of the C9

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roller head speed (min⁻¹)</td>
<td>0–3000</td>
</tr>
<tr>
<td>Carriage rapid traverse (mm/min)</td>
<td>30 000</td>
</tr>
<tr>
<td>Space between spindle nose and roller head carrier (LW, in mm)</td>
<td>240–2025</td>
</tr>
<tr>
<td>Max. spline length (LZ, in mm)</td>
<td>1650 (² ⁴)</td>
</tr>
<tr>
<td>Roller head diameter (DR, in mm)</td>
<td>80³–110</td>
</tr>
<tr>
<td>Workpiece diameter range (DA, in mm)</td>
<td>20–120 (⁴)</td>
</tr>
<tr>
<td>Workpiece and chuck diameter (Fₘₐₓ in mm)</td>
<td>400</td>
</tr>
<tr>
<td>Possible number of splines</td>
<td>freely programmable</td>
</tr>
<tr>
<td>Maximum approx. module</td>
<td>3.5</td>
</tr>
<tr>
<td>Power consumption (kW)</td>
<td>11–15</td>
</tr>
<tr>
<td>Compressed air (bar)</td>
<td>6</td>
</tr>
<tr>
<td>Length L, width B, height H (mm)</td>
<td>5150, 2215, 2000</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>10 000</td>
</tr>
</tbody>
</table>

1) As GROB machine concepts undergo continuous development refinement, all technical specifications are subject to change without notice.
2) Greater lengths possible with extended machine beds or follow-up reclamping.
3) Only feasible with one roller per roller head.
4) Workpiece or workpiece specific accessories can affect this dimension.
Cold forming machine C9T

**C9T**

The C9T is the most universal machine type of the C-series. Unlike the classic C9, the use of torque technology (electrical pitch mode) in this model allows difficult spline geometries such as parallel flanked profiles with limited numbers of teeth to be produced without difficulty. With the intermittent rolling process, significantly higher speeds can be achieved than in conventional mechanical pitch mode. Moreover, any desired number of splines can be generated without the need to change conversion elements.

**Characteristics of the C9T**

- Suitable for manufacturing of splines up to approx. module 3.5
- Forming in continuous and indexed pitch mode possible without conversion elements thanks to torque motor
- Economic production of special spline geometries such as parallel flanked profiles with limited numbers of teeth
- Optional shifting for maximum three different geometries in one clamping
- Much shorter processing times thanks to multiple rolling tools per roller head
- Flexibility, rapid changeover procedure, short cycle times
- Simple machine operation
- Machine completely encapsulated in sound damping cabin, transportable in one piece

**Technical specifications of the C9T**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Roller head speed (min⁻¹)</td>
<td>0–3000</td>
</tr>
<tr>
<td>Carriage rapid traverse (mm/min)</td>
<td>30 000</td>
</tr>
<tr>
<td>Space between spindle nose and roller head carrier (LW, in mm)</td>
<td>120–1845</td>
</tr>
<tr>
<td>Max. spline length (LZ, in mm)</td>
<td>1450³)</td>
</tr>
<tr>
<td>Roller head diameter (DR, in mm)</td>
<td>80³)–110</td>
</tr>
<tr>
<td>Workpiece diameter range (DA, in mm)</td>
<td>20–120³)</td>
</tr>
<tr>
<td>Workpiece and chuck diameter (Fₘₐₓ in mm)</td>
<td>400</td>
</tr>
<tr>
<td>Possible number of splines in continuous pitch mode</td>
<td>freely programmable</td>
</tr>
<tr>
<td>Possible number of splines in indexed mode</td>
<td>freely programmable</td>
</tr>
<tr>
<td>Maximum approx. module</td>
<td>3.5</td>
</tr>
<tr>
<td>Power consumption (kW)</td>
<td>12–60</td>
</tr>
<tr>
<td>Compressed air (bar)</td>
<td>6</td>
</tr>
<tr>
<td>Length L, width B, height H (mm)</td>
<td>6000, 2215, 2500</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>12 500</td>
</tr>
</tbody>
</table>

1) As GROB machine concepts undergo continuous development refinement, all technical specifications are subject to change without notice.
2) Greater lengths possible with extended machine beds or follow-up reclamping.
3) Only feasible with one roller per roller head.
4) Workpiece or workpiece specific accessories can affect this dimension.
Installation, Operation, Service

**Up to transfer to enduser**
Customized installations are built and set up at the GROB facility by a team of specialists. Our experienced service engineers participate in every preliminary acceptance procedure together with the customer. Following delivery to the customer’s plant, they ensure seamless installation and handover of the equipment.

The cold forming machine stands on anti-vibration pads and can be installed without the need for foundations.

**Operation and service**
GROB machines are renowned for their durability under full production conditions. Virtually all machines produced since 1962 are still fully operational across the globe.

ERNST GROB AG offers its customers competent, prompt and comprehensive repair and spare parts services during the entire lifetime of the machine.