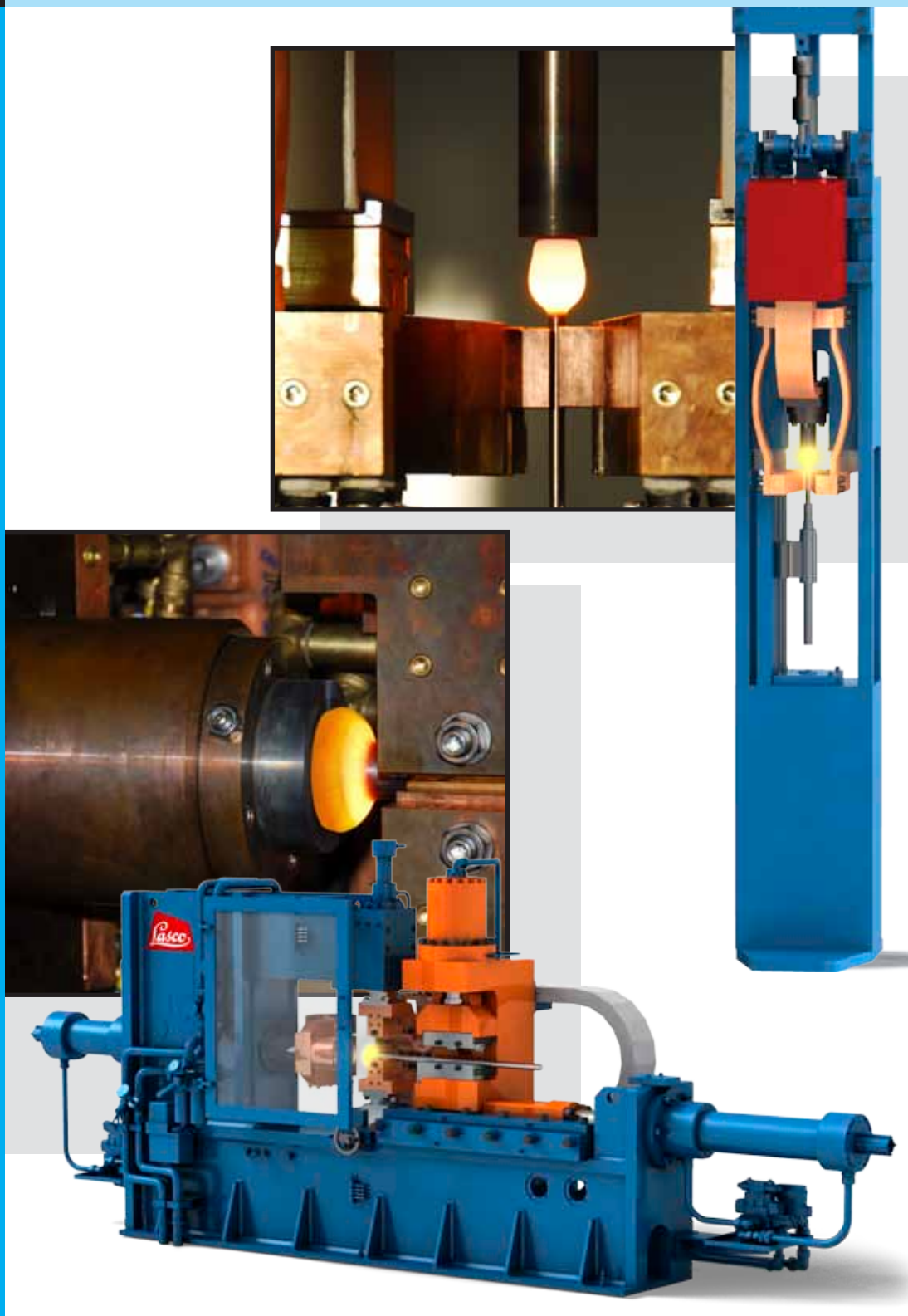
Units for
Forming Technology

Electro-upsetting



LASCO UMFORMTECHNIK
WERKZEUGMASCHINENFABRIK

Electro-upsetting

In electro-upsetting a high electric current at low frequency is passed through a bar section which is limited by contact electrodes of different potential and heated due to high current density and ohmic resistance. Axial force applied by a hydraulic piston simultaneously causes the gathering of volume which results in an increasing distance between the electrodes. At the same time the anvil electrode must retreat to allow space for the increasing volume.

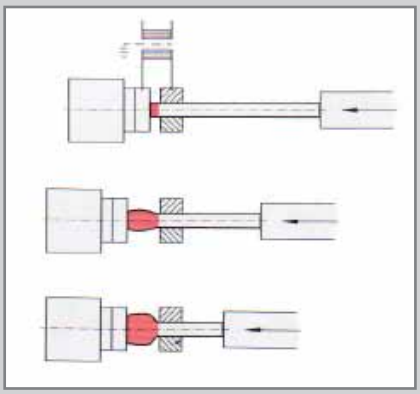
Apart from free and form upsetting at the bar end material can be gathered at any position along the bar length.

To some extent, special shapes with changes in cross-section are possible, too.

Shoulder on front or bar side

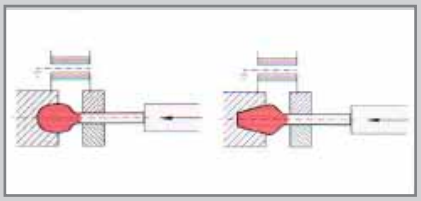
There are two basic methods of electro-upsetting:

Free upsetting



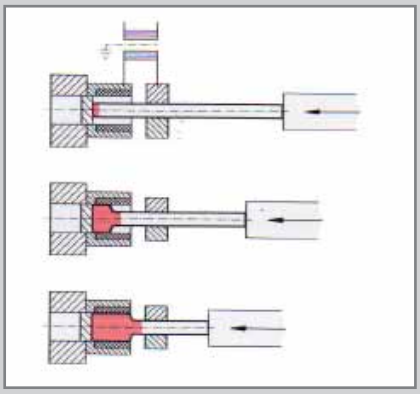
A combination of free and form upsetting is the semi-open die upsetting.

Die upsetting



All standard steels and non-ferrous metals as well as high-temperature nickel alloys can be electro-upset. Special conditions apply when using copper and highly conductive materials. Some aluminium alloys require upsetting tests

Form upsetting



Further shape varieties are possible.

The process is not limited to certain cross-sections, though mainly round material is used.

On certain conditions free and form upsetting of tubes are also possible.

Process limits

The shape of a free upset can be controlled to a certain degree, but usually at the cost of reduced upsetting velocity.

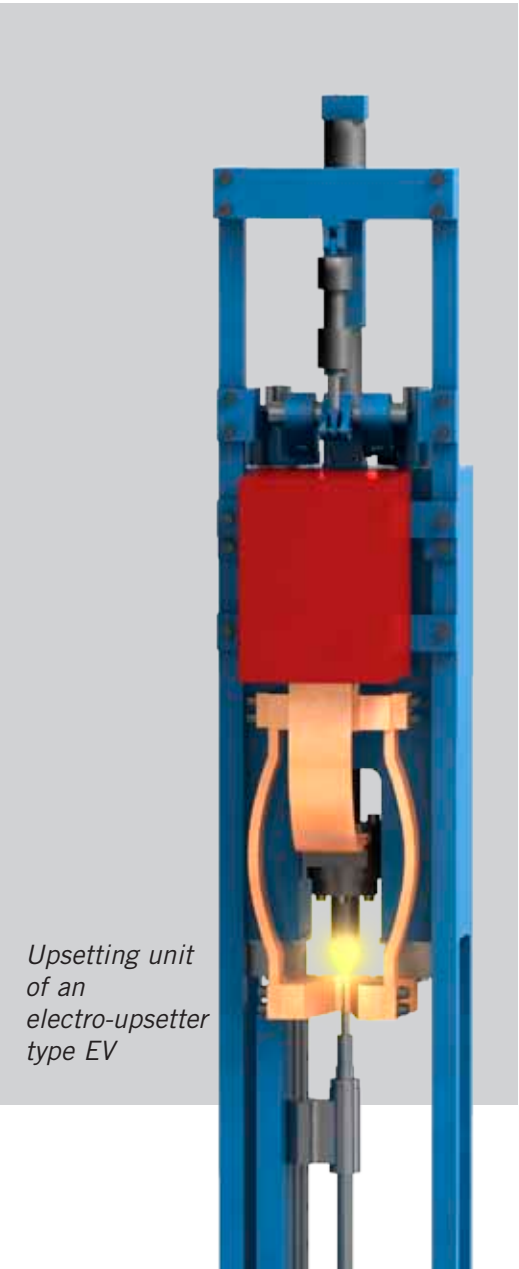
Form and die upsets are usually too cold for subsequent forging.

Preconditions and advantages of electro-upsetting

A conductive surface is necessary for an optimum upsetting and heating rate. Appropriate surface quality can be reached by drawing, centerless grinding and peeling.

Milled, sand-blasted or reeled surfaces have a negative effect on the lifetime of the contact tools and the working speed.

A preferably rectangular end face is a precondition for faultless material gathering. In certain cases chamfering is advisable. Depending on the bar diameter suitable end faces can be reached by shearing or sawing.

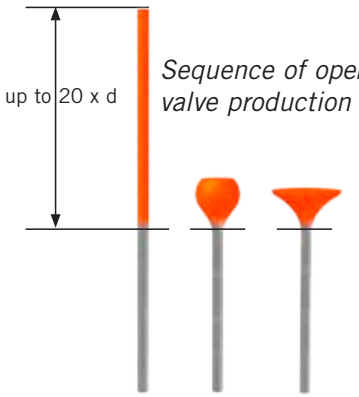


Upsetting unit of an electro-upsetter type EV

Advantages

By using electro-upsetting some of the well-known technical limitations and disadvantages of mechanical upsetters can be eliminated and the operating efficiency can be increased.

- Simultaneous heating and upsetting in one machine.
- Almost no restrictions of length in one operation.
- The mechanical upsetting limit of approximately 3 x diameter in one operation can be exceeded considerably. Automotive engine valves e.g. often have an upset length of up to 20 x diameter, and even parts with lengths of up to 40 x diameter may be upset electrically.



Sequence of operations: valve production

- The flash formed at the split line on e.g. horizontal forging machines is eliminated.
- Further processing at forging temperature. Free upsets can be finish-forged without reheating.
- Drastically reduced scale formation. The dies for subsequent finish-forging reach a long operating life.
- The volume of the upset may be controlled precisely to permit subsequent flashless forging in closed dies.
- Suitable grain flow and faultless surface. The grain flow is optimally adapted to the shape of the work-piece. A good electro-upset is free from overlapping and wrinkling; the cold shaft remains intact.
- Always ready for operation, no pre-heating necessary.
- Very efficient energy consumption, demanding 0.35 – 0.40 kWh/kg of heated material.
- Constant heating temperature due to steplessly adjustable and thyristor-controlled heating current.
- No waste of energy and material. Only the section to be upset is heated. The undeformed shaft stays cold.
- No environmental pollution by radiant heat, smoke or other emissions.
- Electro-upsetters need no foundation.

LASCO electro-upsetter

LASCO builds electro-upsetters in horizontal and vertical arrangement as well as special designs.

EH = horizontal electro-upsetter
EV = vertical electro-upsetter

Another feature of this machine type is the nominal capacity of the transformer.

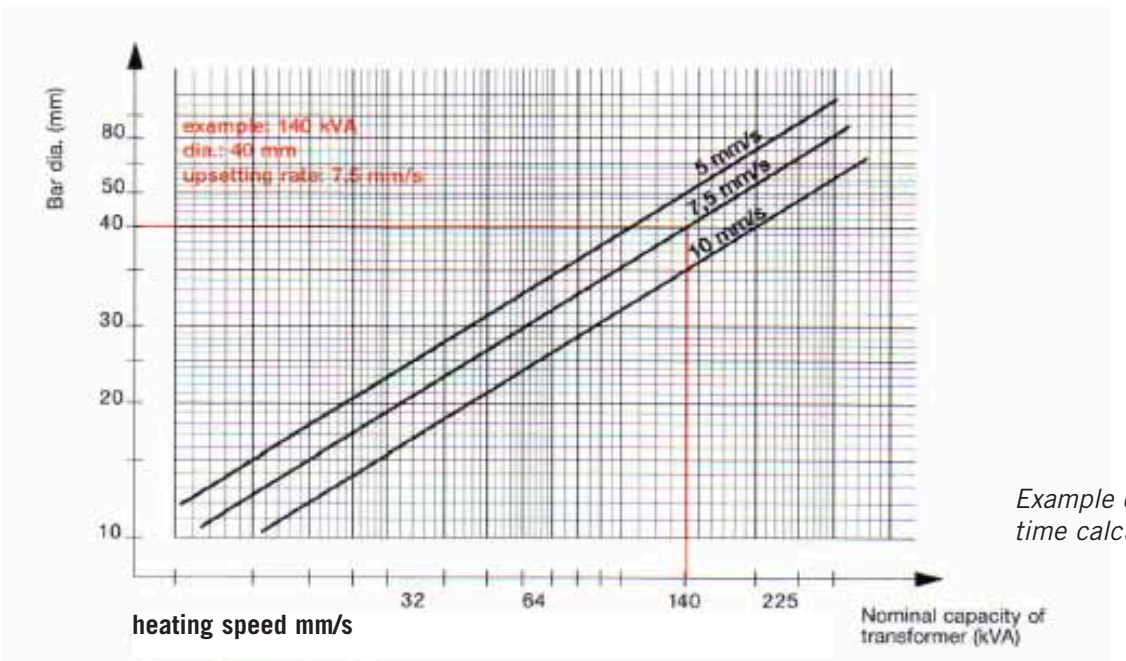
EH 63 = horizontal electro-upsetter with a nominal transformer capacity of 63 kVA

Determination of output rates

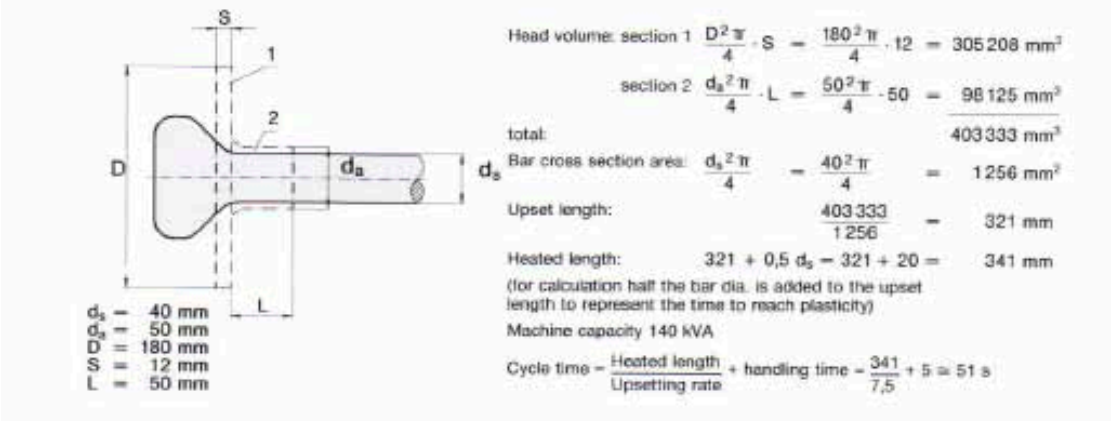
The upsetting velocity is the decisive factor influencing cycle time or output rate. Alloying components, bar diameters, surface condition of the bar, upset shape and nominal capacity of the transformer are other criteria.

LASCO designs electro-upsetters to suit special applications and customer requirements rather than fixed standard ranges.

The following graph and formula show an example of the calculation of a cycle time.



Example of a cycle time calculation.



Operating features and control

After the bar has been placed between the clamping electrodes and the foot switch has been actuated an automatic operating cycle starts.

The clamping electrodes close, the upsetting piston pushes the bar against the anvil plate and the heating current begins to flow when sufficient contact pressure has been reached.

The parameters upsetting and retraction speed as well as heating current are controlled by a servo drive and programmable control independently. Both the upsetting and the retraction stroke of the anvil electrode are divided into various variable sections. The upsetting process can be adapted optimally to the technical requirements.

When the program has finished the work-piece is released.

Operator panel with screen

The programmable logic control system offers the following operating features:

- Operator guidance via colour screen.
- Input and display of process data and functions via foil keyboard.
- Display of operational status and preconditions for start of production.
- Fault messages displayed on a special diagnostic screen.
- Fault warning in clear text.
- System for the acquisition of working data with shift, charge and countdown batch counter. Additionally production and interruption periods are indicated.
- Filing of process data under product numbers.
- Overview of product numbers.
- Availability and modification of product numbers in similar forging processes.
- Profibus-system with diagnostics capability.

Options

- Automatic loading, unloading and transfer devices.
- Temperature monitoring of the upset head.
- Statistical Process Control (SPC) and storage of working and production data.
- Interface for data transfer to master computer.

Projected and realised applications

1. Upsetting and forging lines for engine valves

The demand for higher power output and – at the same time – lower fuel consumption and car exhaust emission necessitates the design of combustion engines with powerful inlet and outlet valves.

LASCO responded to this challenge by supplying combined upsetting and forging lines.

Six to eight vertical electro-upsetters and a screw press produce approx. 1000 valves/hour in fully automatic operation, an output that can still be increased depending on the valve shape and material.

Raw material cut to length is taken from the two bar magazines and fed to the electro-upsetter.

Valve gear of a diesel engine

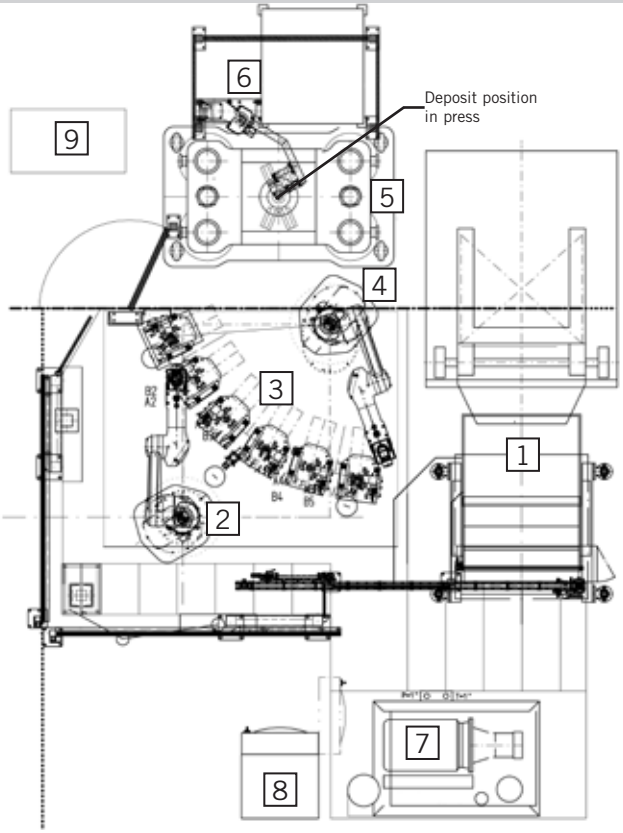
Incorrectly positioned bars for bi-metal valves are singled out or turned around.

By the use of modern servo drive and control technology the upsetting speed, retraction speed and heating current can be varied independently of each other. Upsetting and retraction strokes are divided into several variable sections without limit switches or adjustable stops. In these sections the heating current and heating speed are optimally adjusted to the technology of the upsetting process.

After rough upsetting the valve preforms are finish-forged on a screw press at forging temperature. Adjustable dead stops and short dwell times of the stroke-independent screw press are the preconditions for tight tolerances and long die life.

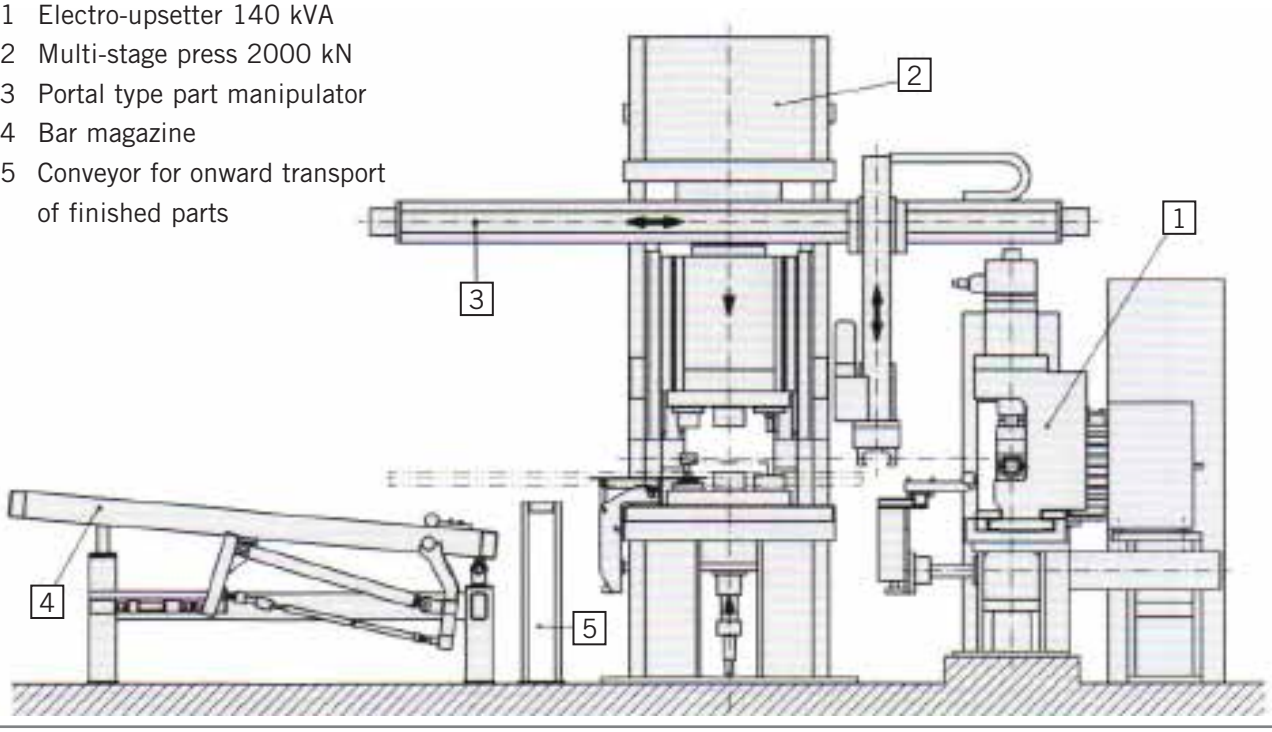
Electro-upsetting line EV 16 with 6 upsetting units

1 Magazine for bars with separating device
2 Loading robot
3 Electro-upsetters
4 Unloading robot
5 Screw press with direct drive
6 Unloading device
7 Hydraulic power unit
8 Switch cabinets for robots
9 Switch cabinet for screw press



2. Production line for stabilizers

1 Electro-upsetter 140 kVA
2 Multi-stage press 2000 kN
3 Portal type part manipulator
4 Bar magazine
5 Conveyor for onward transport of finished parts



Projected and realised applications

High safety requirements for stabilizers used in trucks, busses and railway wagons made LASCO design and supply this flexible production line:

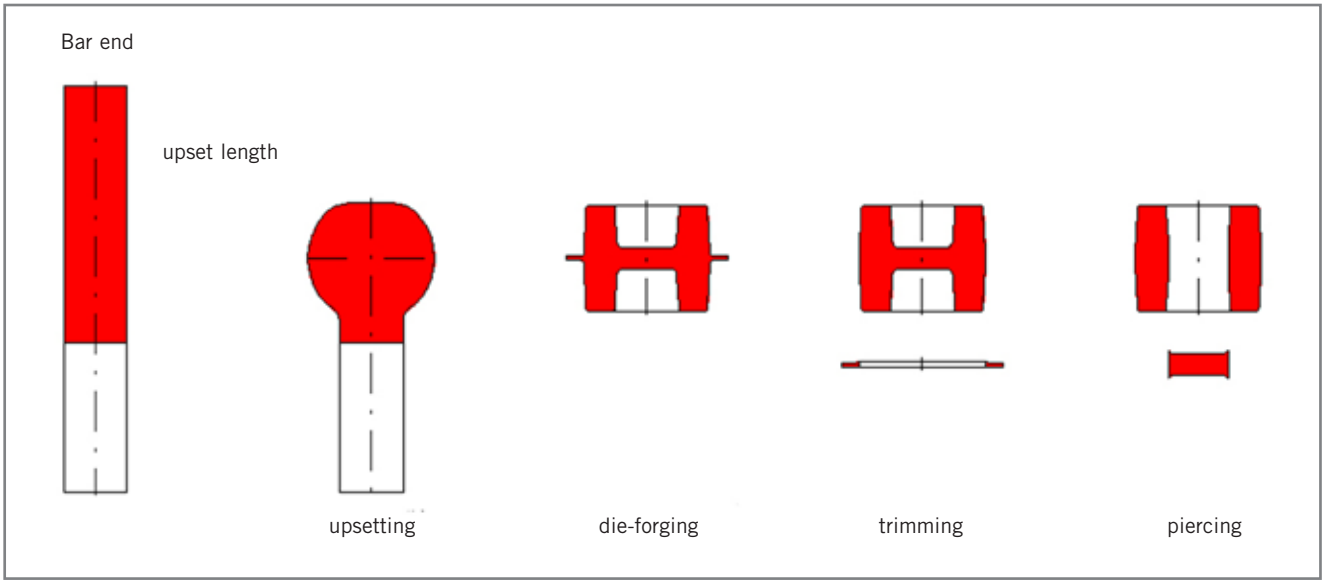
For the production of a stabiliser with upset and finish-forged bar ends the portal manipulator takes a bar from the magazine and transports it to the part feeder of the electro-upsetter. Once the upsetting process is finished the portal manipulator moves the roughly upset work-piece to the multiple-die press and through the three stations. When one end is finish-forged the bar is rotated by 180° and positioned into the part feeder of the electro-upsetter again. Overlapped by the movements of the portal manipulator the part feeder has positioned a work-piece into the electro-upsetter and started the upsetting and heating operation in the meantime.

A stabilizer with two finish-forged ends is positioned on the conveyor belt for removal.

A cycle time of approx. 30 – 40 s can be achieved by overlapping of the pressing, trimming and piercing operations and the upsetting operation.

The line is designed for processing bar diameters of 28 – 70 mm and bar lengths of 1200 – 2500 mm.

Production sequence



Finish-forged stabilizer

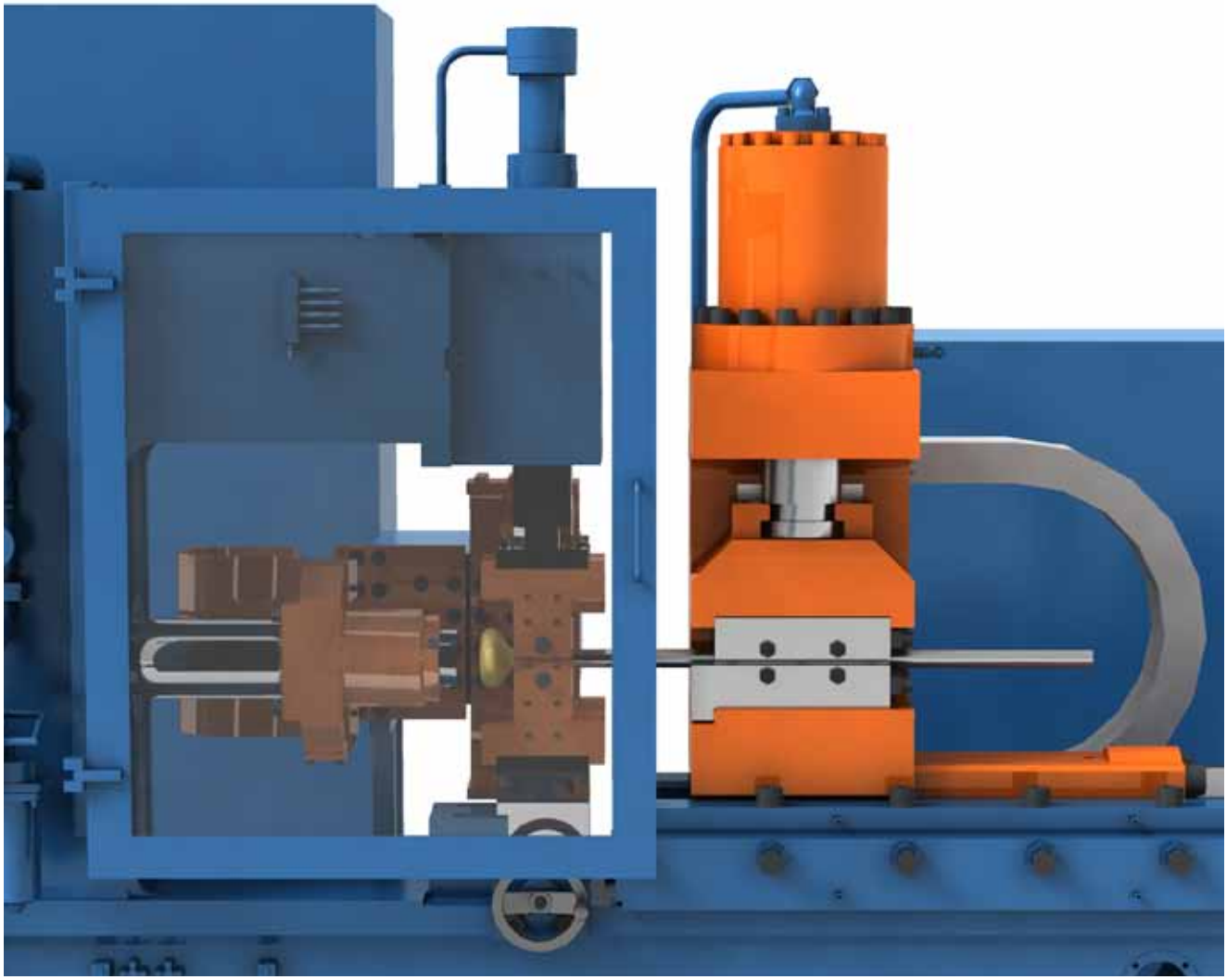
3. Production of torsion bars

The chassis of passenger cars is often equipped with torsion bars, and parts with similar geometries are used in steering systems and drive lines.

A relatively long shaft that is not formed is upset at both ends mostly cylindrically. Work-pieces of this kind are ideally suited for electro-upsetting.

Torsion bar

3D model of electro-upsetter EH



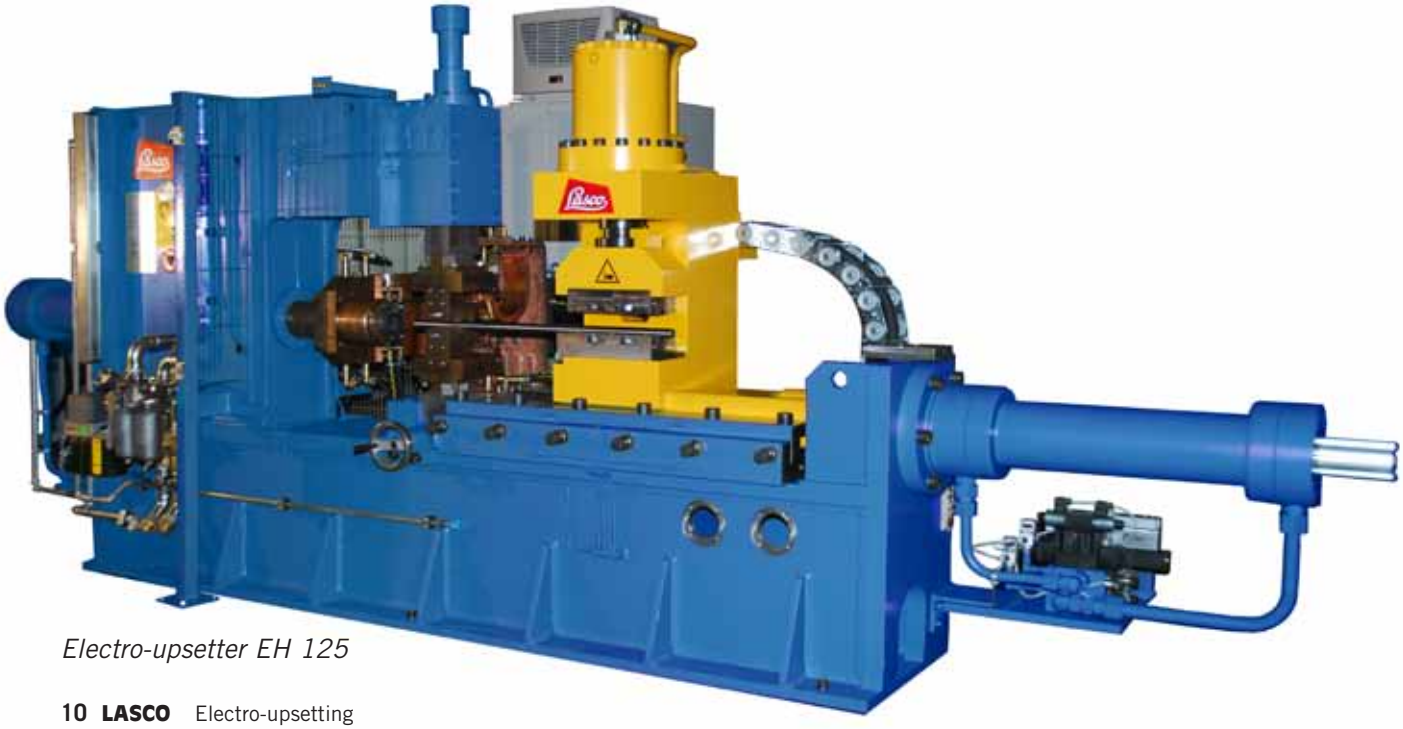
Projected and realised applications

Upsetting on EH (above) and EV (below)

4. Other realised electro-upsetters

- Semi-automatic vertical electro-upsetting line for steering parts.
- Vertical electro-upsetting line loaded manually for hand tool applications.
- Electro-upsetting line for marine diesel engine valves.

Electro-upsetter EV 50

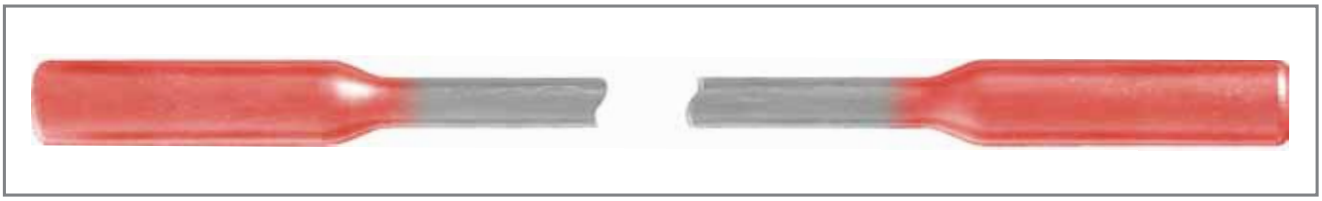


Electro-upsetter EH 125

Typical applications of electro-upsetting

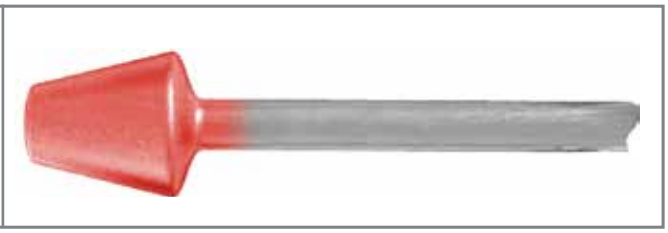
1. Rear axle shaft with spline end

2. Torsion bar



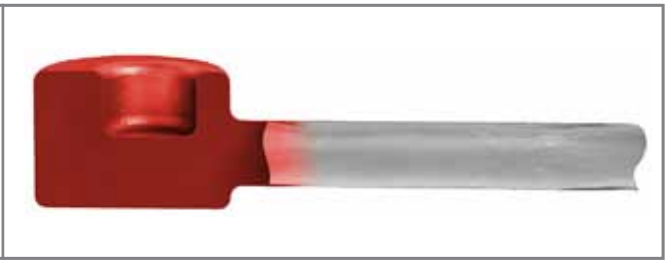
3. Engine valve

4. Bevel gear

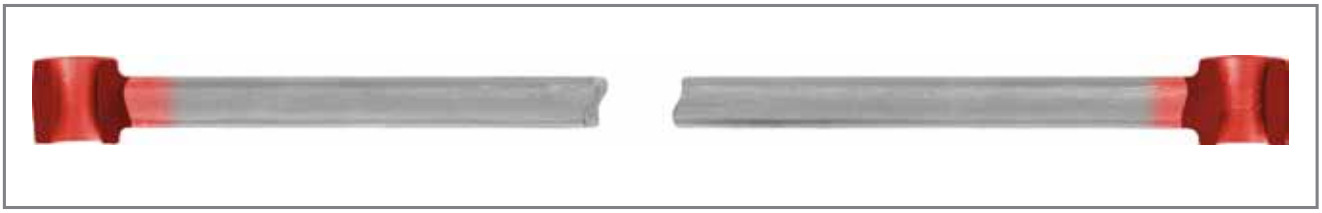


5. Tie rod end

6. Gear shift fork



7. Stabilizer



October 2012

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