# SERVO VALVE CONTROLS BAR STOP IN HOT PRESS WITH THE PRECISION OF A SWISS CLOCKWORK

## Servo valve from Moog Böblingen controls bar stop in Hatebur hot press

**Swiss machine builder Hatebur Umformmaschinen AG, a manufacturer of high-end horizontal multi-stage presses, recently completed the development of its innovative servo-hydraulic bar stop. The bar stop optimizes the shearing process for hot presses, and increases the quality of cut-offs to the extent that the reworking process has now been rendered largely unnecessary. It has also significantly reduced the consumption of materials. Moog's D636 Servo Valve is the central motion control element of the bar stop. Thanks to its robust design and highly dynamic digital control, the valve offers the best solution for use on this demanding application.**

*Servo hydraulic bar stop with Moog servo valve D636*
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## Shearing process has decisive influence on part quality and production costs

Hatebur is one of the market leaders in hot and cold forging. On Hatebur's largest hot forging press, the HOT*matic* HM 75 XL series, wheel flanges, gear wheels, parking lock wheels or rolling bearing rings are produced by way of an automated process involving several forming stages, and with a pressing force of up to 2000 t directly from the bar.

Steel bars of up to 90 mm in diameter are induction heated to a temperature of up to 1250 °C, and automatically forwarded to the shearing process. Here, red hot rods are sheared as accurately as possible during the machine's cycle (50 to 80 parts/min). This shearing process, which lasts 50 to 60 milliseconds, has a decisive influence on parts quality and thus on the resulting rework effort, on materials consumption and ultimately on production costs.

The decisive factor shaping the quality of each section weighing up to 7.5 kg is the quality of the front surfaces. This depends heavily on how well the steel rod is held in position during shearing. Until recently, mechanical bar stop systems were widely regarded as state of the art technology given the advantages offered by their robustness, comparatively simple construction and their reliability once optimally adjusted. However, the stops also have numerous disadvantages. For example, it is not possible to adjust the shear gap or the angle of the bar stop head during the production process. To do so, the machine must be at standstill, which incurs additional costs to the manufacturer. At the same time, these mechanical bar stops are not able to react to, or compensate for, positional deviations or changing conditions such as the deterioration of the shearing blades.

Previously, the slight tilting that affected this part of the process was unavoidable, and led to tearing toward the end of shearing. This tearing caused surface damage on up to 20% of the shearing surface in the form of breakouts, shingles and wrinkles and led to uneven surfaces. Consequently, the finished forged surface required further machining, and the machine operator was forced to allow for wastage on the blank. This increased both manufacturing time and costs.

## Faster than a blink of an eye – servo hydraulics regulates bar stop

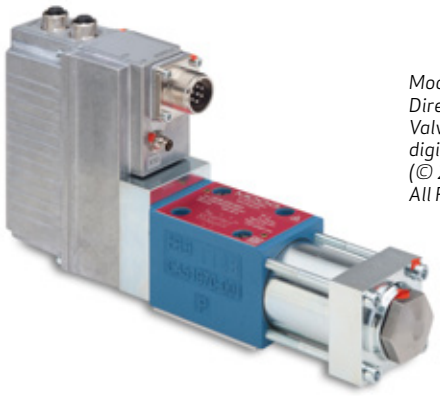
Hatebur decided that a key requirement of the new bar stop was that the system should not only be applied to new machines, but should also be easy to retrofit on its existing applications. Hatebur presses are normally in use for a number of years, and therefore many of their existing machines would benefit from successful new technology.

The company assessed the power density required by the limited installation space available. Hatebur also analyzed the heavy load on the bar stop system generated by the forces that had to be absorbed, the vibrations and high temperatures. Following this assessment, the use of a hydraulic axis to replace the existing mechanical one seemed the most promising solution for driving the bar stop.

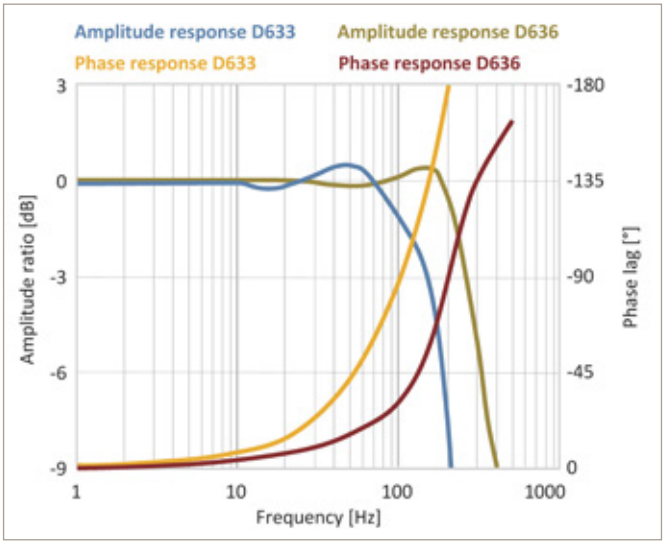
A team of experts led by Dr Mihai Vulcan designed and tested the hydraulic bar stop under simulated manufacturing conditions at Hatebur. 'With up to 80 strokes or shearing operations per minute, it quickly became clear that only a highly dynamic and robust servo valve could be considered as the central actuator of the servo-hydraulic bar stop', explains Vulcan. Eventually, Hatebur opted for a Moog D636 Series Direct Controlled Valve (DCV), which had enjoyed over 10 years' success on the industrial market and had been under continuous development by Moog. Thanks to the digital controller structure and the powerful short-stroke linear motor, the valve achieved the high dynamic characteristics required for the shearing process.

Compared to Moog's counterpart valve - the D633 Series with analog controller – the digital D636 Series offers twice the bandwidth within the small-signal range. The integrated vibration decoupling also protects electronics from shock and vibration loads. The wear-resistant spool in bushing unit with precise null cut is driven by a short-stroke linear motor. This Moog Valve therefore ensures that every machine cycle can be reproduced, and that consistent parts quality is achieved even when machinery is in constant use.

## Dynamic against breakouts



*Moog's D636 Series Direct Operated Servo Valve with integrated digital electronics (© 2019 Moog All Rights Reserved)*




*Frequency response (+/-5 % signal) D633 with analog controller compared with D636 with digital controller (© 2019 Moog All Rights Reserved)*

During the shearing process, Moog's D636 with integrated digital electronics ensures that any deviation from the target position is corrected within a few milliseconds by force control (Δp control) with position monitoring. The distance between blade and bar stop is thus kept constant and precise throughout the entire shearing process, and tensile stresses are virtually eliminated. The measurement technology integrated in the bar stop provides the necessary data. The valve operating time (0 to 100 %) of less than 8 milliseconds is almost fully utilized on this demanding application.

The machine operator can easily control the displacement force time profile within certain limits. It is now possible to make adjustments from the control panel without interrupting production, and the servo hydraulics implement these adjustments directly. This makes it easy to compensate for shear blade wear and other factors influencing shear quality, such as the material, temperature or tension in the cutting zone.

In order to exploit the advantages of digital technology, Hatebur used a real-time EtherCAT Fieldbus. This means that the company is well equipped for the future, as the D636 is Industry 4.0 capable.

## Testing under three-shift operational conditions

Since 2017, Hatebur has tested the servo hydraulic bar stop extensively on its HOTmatic HM 75 XL application in partnership with a leading automotive parts supplier, and under a wide variety of operating conditions using various materials. The simulation results from the development phase matched the real drive behavior of the servo hydraulic bar stop. The results were impressive, even after the application had manufactured several million parts.

The primary objective of the new development, to achieve a significant improvement in the quality of shearing surfaces, was clearly met. The servo hydraulic bar stop ensures an excellent shear pattern due to the Moog Servo Valve's sensitive and dynamic control capability. The shearing surfaces are now almost parallel, and the breakouts and shingles are frequently reduced from 20% to an average of 1%.

*Work pieces sheared off with a mechanical bar stop: in the lower area breakouts and shingles are clearly visible, on the right work piece the characteristic known as „Dali's moustache" is clearly visible." (© 2019 Hatebur All Rights Reserved)*

*Work piece front surface without breakout, produced with servo-hydraulic bar stop (© 2019 Hatebur All Rights Reserved)*

Reworking is no longer such a necessity, and material consumption is now lower, as the quantity of material required can be significantly reduced. Since less material has to be heated, energy costs are also reduced as are overall handling costs. Machine downtime is now less frequent as the bar stop can be readjusted during production if necessary. Both process reliability and the quality of the finished forged parts have increased. All these advantages, which are only slightly noticeable for the individual part, but multiplied by the approx. 14 to 30 million parts that are usually produced annually on the hot presses, the cost and time savings add up to a significant amount.

## Savings in all fields

Hatebur's new servo hydraulic bar stop system generates significantly lower throughput times and production costs due to an optimized shearing process. It is available for new machines, but can be easily retrofitted to existing systems by the company's worldwide customer service.

## Moog and Hatebur

As has been the case for many years, Hatebur and Moog continue to work closely together on innovative development projects. Moog's products help Hatebur stay ahead of the competition.

At Moog, a new version of the D636 Series Valve will shortly to go into production. Thanks to a new linear motor and new digital electronics, it will offer even higher dynamics and thus even faster response times. This could lead to further savings, especially on Hatebur's smaller hot presses which have high cycle rates.

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