Drive & Control profile

Technical Article

Modern hydraulics: six advanced capabilities for stamping presses

Advanced hydraulics and intelligent drive systems are now available to provide greater precision and can improve stamping press productivity and product quality.

By virtue of its speed, force and power density hydraulics technology has long been utilized as a core drive technology in stamping presses. Yet stamping press technology is "under pressure" to deliver more sophisticated performance. Operators need presses that can provide greater precision, produce more complex shapes and parts, and operate with increased productivity, cost control and energy efficiency. Many machine designers may not be aware how the latest electrohydraulic control technology has significantly advanced the performance and intelligence of modern hydraulics to achieve those objectives.

Two areas in particular are driving the demand for improved hydraulics technology in stamping presses. One

Capabilities at a glance

Here are six key capabilities of hydraulic drive technology:

Micrometer precision—a higher level of control over motion sequence parameters such as speed, velocity and force can be achieved for greater control of the part being produced.

Compact and powerful—power generation is decentralized in the hydraulic power unit and is connected to the actuator via lines or pipes so machines can generate high forces in minimal space.

On-demand energy efficiency—variable-speed hydraulic pump drive systems can reduce energy consumption by up to 80 percent.

Balanced drive physics—advanced control software is tailored to the unique demands of hydraulic systems.

Open and easily integrated—modern motion controls for hydraulic drives support all common machine communication protocols.

Plug and play modularity—many hydraulic axes are now available as complete self-contained systems that allow engineers to simply connect power and communication cables for assembly and start-up.

Ready-to-install servo-hydraulic axes have an integrated fluid loop and are driven by the same servo drives as the electromechanical versions.

is the need to improve precision for increasingly complex shapes produced by stamping presses. For example, in the automotive industry, doors, quarter panels, fenders and other components feature complex, rounded surfaces that require sophisticated hydraulics and controls to achieve accurate and high-volume fabrication.

There is also a movement to use higher grades of steel, steel alloys and aluminum to fabricate parts. These materials react differently to forming processes, which in turn require better hydraulic control to handle the formability.

Advanced hydraulics and intelligent drive systems are now available to provide greater precision and can improve stamping press productivity and product quality. Here are six capabilities of this versatile drive technology, which may come as a surprise for many:

Micrometer precision
Electrohydraulic axis controllers close the control loop decentrally, similar to electric servo drives, and harmonize the target/actual position in real time within milliseconds. The precision of the movement solely depends on the respective utilized measuring system. In tool and plastic machines, as well as stamping presses, hydraulic drives can reliably position axes to within a few micrometers of precision.

This level of control has not traditionally been associated with hydraulics, or stamping presses for that matter. But with consumers and manufacturers demanding extremely tight tolerances in the way parts are shaped and fitted, stamping press technology must meet these demands.

One way to achieve this precision is through the use of more powerful and accurate measuring system technology. Transducer electronics technology has been dramatically improved, with digital transducers being free of electrical noise interference present in older analog devices. Combined with the right digital hydraulic controller, a much higher level of control over motion sequence parameters such as speed, velocity and force can be achieved and sustained, which equals much greater control over the quality and precision of the part being produced.

Compact and powerful
It is often difficult to place electromechanical drives with sufficient performance in tight machine spaces. Unlike hydraulic drives they also generate significant heat. This is one of the key advantages that hydraulics continues to provide for stamping presses. Since power generation is decentralized in the hydraulic power unit and is connected to the actuator via lines or pipes, machines can generate high forces even with minimal construction space.

For older model stamping presses, dramatic improvements in power density can also be achieved by retrofitting with modern electrohydraulic technology, which is more compact and delivers hydraulic pressure up to 5,000 pounds per square inch.

This kind of retrofitting can also add a level of sophistication to stamping press cushioning functions. Synchronizing the speed/velocity/force parameters of the cylinders driving the cushioning axis can now be more sophisticated for shaping a non-symmetrical part, enabling older presses retrofitted with the latest hydraulics technology to produce higher quality, higher value products.

On-demand energy efficiency
Some of the most important advances in hydraulic stamping presses involve technologies that operate more intelligently, such as variable-speed hydraulic pump drive systems. In Rexroth's Sytronix system for example, software combines the best characteristics from electronic and hydraulic systems. The decentralized intelligence in the electronic control device coordinates the rotational speed of the hydraulic pump drive on-demand as the stamping press requires power, or lowers it to zero to save energy in idle mode.

In comparison to traditional constant speed drive systems, energy consumption of hydraulic power units is reduced by up to 80 percent. This can offer significant savings for older facilities and stamping presses, extending their service life while

reducing energy consumption; those savings can help justify the investment in a hydraulic system controls upgrade, as well as enabling existing systems to produce higher-value pieces requiring greater precision.

Balanced drive physics

Fluid technology is not always inherently linear. Drive software for hydraulic actuators takes these characteristics into consideration and harmonizes them automatically. Pre-programmed hydraulic function blocks, e.g., synchronization or position-dependent braking, provide the software foundation for efficient hydraulic controller programming. There are hydraulic motion control components such as Rexroth's HACD, HNC, IAC-R and IndraMotion MLC-H that are specifically engineered to take full advantage of modern electrohydraulics and variable-speed pump drives. They provide intelligent, high-performance control for variable-speed pump systems as well as systems controlled with traditional proportional valves.

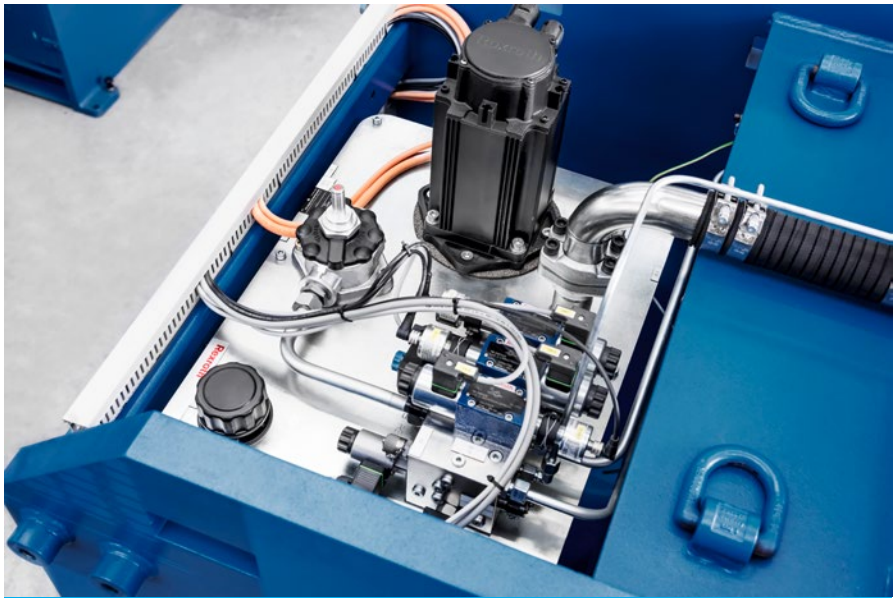
They typically feature advanced control software packages tailored to the unique demands of hydraulic system properties. This includes software compensation for factors such as fluid compressibility and non-linear system dynamics. Hydraulic-specific algorithms for proportional valves and variable-speed pump drives allow for smooth transitions between position control and force control, the generation of smooth motion trajectories, and multi-axis synchronization. This reduces system shock and impact on tooling, while providing improved dynamics and accuracy as well as increased energy efficiency and productivity of the press.

The Bosch Rexroth Sytronix system uses decentralized intelligence in the electronic control device to adjust the rotational speed of the hydraulic pump drive on-demand as needed, to achieve energy savings.

Open and easily integrated

Real-time Ethernet protocols are used more and more in modern machines to integrate all actuators and peripherals together. This trend also includes stamping press operations. One key driver in this area is quality control and process data capture for both diagnostic purposes, and to document quality processes for end-user parts customers. Hydraulic controls platforms not only need to tell a valve what to do, but also need to capture data such as "what position did the valve achieve?" or "what force did the cylinder deliver?" and then communicate that information up from the press to higher-level management and quality control systems.

Modern motion controls for hydraulic drives support all common protocols such as Sercos, EtherCAT, Ethernet IP, PROFINET RT, Powerlink and Varan. Their software is also based on open standards including IEC 61131-3 and PLCopen. With this they are an ideal match for the increasingly integrated and technology-overlapping infrastructure of modern production environments, and provide stamping press operators with competitive advantages as they work with customers who need high-level "smart factory" machine-to-machine communication and data sharing. This is especially important as machines incorporate Industrial Internet of Things and Industry 4.0 concepts.



A benefit of modern hydraulics is that power generation is decentralized, so high forces can still be created using minimal space.

Plug and play modularity

Ready-to-install servo-hydraulic axes have an integrated fluid loop and are driven by the same electric servo drives as electromechanical versions. Many hydraulic axes are now available as complete self-contained systems, where engineers can simply connect power and communication cables for assembly and start-up. Everything else (for example, the parameterization values determined from simulations) is already stored in the drive software and support the “plug and play” philosophy.

For stamping press operations, a modular self-contained hydraulic axis—containing cylinder, motor, pump and manifold built in—could provide an efficient and easy-to-incorporate solution for upgrading secondary systems, such as tooling used to punch holes on parts that are being simultaneously formed. It could also provide a cost-effective solution for handling systems that move source metal into presses or remove finished parts.

Modern hydraulics: versatile and scalable

A final characteristic of today’s hydraulics and controls technology sums up all six advantages discussed here: hydraulics are scalable. It is a proven technology that has the flexibility to be as sophisticated as possible—or as simple as needed—to perform the required task.

Today’s sophisticated controllers feature hydraulic-specific algorithms for proportional valve and variable-speed pump control, allowing for smooth transitions between position and force, the generation of smooth motion trajectories, and multi-axis synchronization.

There are many stamping operations that are relatively straightforward, and can draw on a proven portfolio of drives, cylinders, pumps and other hydraulic components to satisfy specific precision and cost requirements. But when higher levels of performance are called for—extremely tight tolerances, advanced data tracking, efficient production of complex shapes, and working with new types of steel and aluminum alloys—hydraulics provides the drive and control technology solutions that stamping press operators and end-user customers require.

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Contact Susan Strauss: 610-694-8352
susan.strauss@boschrexroth-us.com

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Bosch Rexroth Corporation
14001 South Lakes Drive
Charlotte, NC 28273-6791
Telephone (800) 739-7684
www.boschrexroth-us.com