



A carefully planned, phased process of upgrading key hydraulic components keeps the press operating at peak efficiency.

**CASE STUDY**

# Smart move: Extrusion press hydraulics upgrade uses phased approach to improve results

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## Challenge:

Leading U.S. aluminum extrusion producer needed to develop a comprehensive and cost-effective plan to upgrade key hydraulics and controls on the company's main extrusion press, to improve press performance and reduce or eliminate maintenance issues associated with hydraulic fluid leaks.

## Solution:

Bosch Rexroth worked with GEI to develop a multi-phased approach to upgrading and replacing legacy hydraulic systems with new equipment including state-of-the-art Rexroth hydraulic pumps, manifolds and control valves, as well as supporting GEI in planning and implementing the entire project. The major upgrade phases included:

- Upgrade of the hydraulic fluid conditioning system
- Replacement of spool valves with Rexroth hydraulic manifolds and LC-LFA cartridge control valves
- Two new Rexroth AA4VSO 355 axial piston variable hydraulic pumps installed
- Replacement of key piping elements
- Modernization of hydraulics controls (on-going project)

## Results:

- Improved hydraulic fluid cleanliness
- Significant reduction/near elimination of hydraulic fluid leaks and associated maintenance downtime and costs
- Reduction in system shock due to manifolds and control valves
- Reduced dead cycle time by three seconds, resulting in approximately 200 additional annual production hours
- New pumps increased pump output by 30 percent, improving extrusion efficiency
- New vertical installation of pumps led to space savings of 20 to 25 percent

## Overview

The extrusion press is one of today's most valuable and hardworking systems. Productive and long-lasting, many presses operate for decades with the proper maintenance and life-cycle management.

For hydraulically driven extrusion presses, the hydraulics components – pumps, spool valves and other elements – undergo significant wear and tear. One U.S. aluminum extrusion company, after assessing the performance of the drive and control of their aluminum extrusion press, undertook a carefully planned, phased process of upgrading key hydraulic and electronic control components. The goal: Ensure that the company could continue to supply the high-quality aluminum extrusions to their customers.

### Planning the hydraulics upgrade

General Extrusions, Inc., of Youngstown, Ohio ([www.genext.com](http://www.genext.com)), is a third-generation, family-owned leading manufacturer of aluminum extrusions. The company provides products to customers in industry segments including automotive, transportation, consumer durables and machinery and equipment.

The 7-inch, 1,675-ton aluminum extrusion press at GEI's Youngstown plant that has been in operation since 1967 and is the company's primary extrusion press. It runs on three shifts in order to make certain GEI's customers get the parts they need when they need them.

"This press is at the heart of our manufacturing process," said Jason Andre, General Manager at GEI. "We generally produce between 12 and 15 million pounds of product a year, so keeping the press healthy and operating at peak efficiency and productivity is crucial to our business and keeping customers satisfied."

In recent years, the leadership at GEI began an organized assessment of the performance of the press hydraulics and controls. This strategic planning and management review evaluated the risks associated with maintenance downtime on the press, as well as reduced extruding efficiency and output due to the aging of the legacy hydraulics.

"The wear and tear on the older hydraulic components led to an increase in fluid leaks," Andre said.

The system's legacy spool valves were an older technology, making it difficult to find replacement parts for repairs. In addition, the system's original design meant that there was a higher level of inherent shock in operating the press, forcing GEI to deal with fluid leaks on a weekly, and sometimes daily, basis.

"Once these factors started adding up, we made the decision that it was in the best interest to move forward with newer, modern hydraulic systems," Andre said.

The company recognized the need to carefully plan the upgrade process. The goal: modernize the extrusion press over time to better manage the capital expenditures and make it easier for the company to "pay as you go" instead of one large, expensive project. Equally important, GEI wanted to identify how to sequence the upgrades during regularly scheduled outages, instead of taking the press out of production for a multi-week shutdown.



The image shows the space savings of the new pump configurations: the right side of the photo shows the legacy, horizontally installed pump and power unit, the left side shows the vertically installed new power unit; the pump itself is installed in the reservoir.

## Designing a phased approach

After considering the product offerings and capabilities of several industrial hydraulic technology suppliers, GEI chose the drive and control experts at Bosch Rexroth as their partners. According to Andre, Bosch Rexroth supported conducting a step-by-step upgrade program and helped GEI define the key elements of each phase.

“One of the things that Bosch Rexroth brought to the table, besides their hydraulic technology, was the concept of doing this project in stages,” he said. “Their ability to come in, work through with our team here so that we could lay out the project in a manner that was more doable in a shorter time frame was a real positive.”

Michael Kramer, Press Application Engineer at Bosch Rexroth, was the lead point of contact for the upgrade project. According to Kramer, after assessing the legacy hydraulics at GEI and working with the company to understand their goals, Bosch Rexroth assisted with or worked on the following project phases:

- Upgrade the hydraulic fluid conditioning system
- Replace the line-mounted spool valves with a hydraulic manifold system
- Replace key piping elements
- Install new state-of-the-art hydraulic pumps
- Modernize the control system

To-date, several of these phases are complete or are ongoing, while others are being planned.

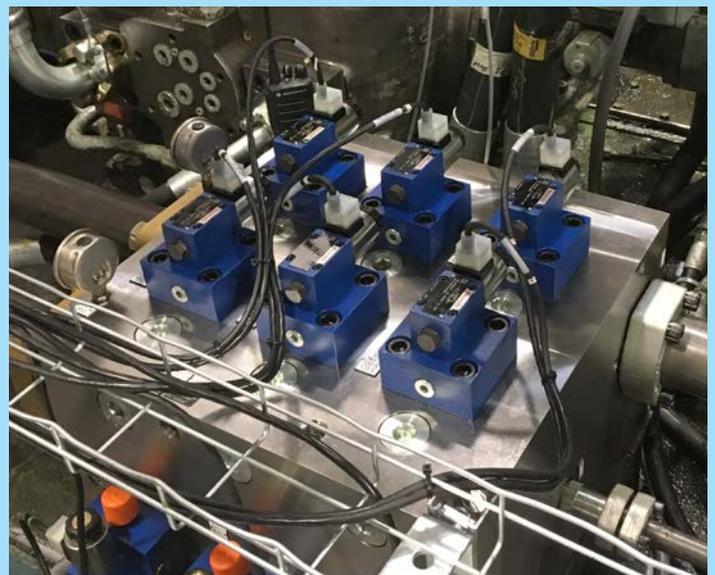
Bosch Rexroth recommended the hydraulic fluid conditioning system upgrade as a first step to ensure that the new hydraulic pumps and other equipment would be able to operate with peak efficiency and quality. GEI has replaced their cleanliness system’s pumps, filters and heat exchangers to meet ISO cleanliness targets and ensure trouble-free startup of the new components as they are introduced.

## Replacing spool valves with custom manifolds

One of the major elements of the upgrade project was to replace the line mounted spool valves controlling the hydraulic fluid flow throughout the press with a state-of-the-art manifold system. The existing, decades-old spool valves were obsolete, difficult to replace or repair and were inefficient, wasting energy through excessive leakage.

According to Kramer, a manifold system reduces the number of potential leak points in a hydraulic system. The modern logic valves that are part of the manifold system can be independently tuned to reduce hydraulic shock while speeding up machine cycle times. This can help improve productivity due to faster actuation times, and their leak-free design also offers greater pressurization rates of the main ram.

Bosch Rexroth supplies hydraulic manifolds for a wide range of industrial applications. Using proprietary software and a state-of-the-art production facility, Rexroth manifolds are designed, manufactured, assembled, and tested to ensure reliable, efficient performance that satisfies specific press requirements.



Leak-prone, obsolete legacy spool valves (left) were replaced with a custom manifold system supplied by Bosch Rexroth (right). The new manifold system helps reduce dead cycle time by three seconds, as well as reducing system shock and hydraulic fluid leakage.

According to GEI's Andre, Kramer and his Rexroth team provided a detailed explanation why a custom-engineered manifold solution would provide a dramatic improvement for the press.

“Initially, we were mainly interested in how using manifolds to replace the spool valves would reduce our leakage issues and some of the issues related to shock,” he said. “A real bonus was how the manifolds helped improve our dead cycle time: we have documented roughly a three-second reduction, and that translates into approximately 200 additional production hours on an annual basis, giving us increased capacity to fill customer orders.”

The manifolds incorporate Rexroth LC-LFA cartridge control valves. These valves can be independently controlled to open in sequences that maximize efficiency and help minimize system shock – capabilities that the spool valves could not support. And, since they are readily available off the shelf from Rexroth, the risk associated with the obsolete spool valves is eliminated.

The manifold system helped significantly reduce hydraulic shock, which is a huge benefit to the entire press, according to Andre, resulting in fewer failures and problems with mechanical elements such as tie rods and other press components.

The installation of the manifolds also gave GEI the opportunity to upgrade piping in the system, going from a welded network of pipes to a weldless system. This can also help absorb shock better and reduces potential leak points compared to the older piping.

### New generation of pumps

Once the manifold installation and piping upgrade was complete, upgrading the two hydraulic pumps powering the press was next.

The legacy pumps were difficult and expensive to repair and were significantly less efficient than modern pumps. They also required approximately 30 to 40 percent more energy to operate, as well as generating greater heat which then must be removed.

“Not only would new pumps be easier and less costly to operate and maintain,” Kramer said, “pump replacement offered us the opportunity to increase the hydraulic flow rate and power input to the press to increase productivity.”



Part of the upgrade included replacing a tangle of welded piping with a simpler arrangement of weldless steel piping, another step taken to eliminate potential points of fluid leakage.

The team selected the Rexroth AA4VSO 355 axial piston variable pump for high-pressure industrial applications. The AA4VSO 355 is a 355-cubic-centimeters (CC) pump that can operate at 1800 revolutions per minute (RPM). According to Andre, the existing pumps were producing approximately 108 gallons per minute, whereas the new AA4VSO pumps will increase pump output by 30 percent.

“In hydraulics, volume is directly related to the speed you can run your press at,” he said. “By going to a higher volume, the new pumps will help reduce dead cycle time on top of the improvements we’ve seen with the new manifold, once the new pumps are installed.”

By performing the manifold upgrade first, the legacy pumps, originally designed and installed with two pressure ports requiring a complex valve arrangement, were converted to “one way” operation. The manifold design completely changed the hydraulic circuit, setting the system up for easier installation of the new pumps.

When the time came for the pump upgrade, it was virtually a “drop-in” operation performed over a weekend shutdown. In addition, planning the project in this way allowed GEI to replace one pump at a time, spreading their capital investments out and improving their cash flow position.

A well-organized upgrade process enabled GEI to implement improvements cost-effectively and with minimal downtime.

The new pumps also provide significant space savings: the old pumps and their motors were mounted horizontally on top of the press, with suction lines feeding the pump. The new Rexroth pumps are vertically mounted and submerged in the tank, providing major space savings, as well as making it easier to install and service the system.

“That space savings lets us open up 20 percent, 25 percent of that space, and from a maintenance standpoint, everything is housed in a very compact, localized space,” he said. “Plus, installation time is very short – it’s taking about four hours to remove the legacy pump and install the new Rexroth pumps, keeping our downtime to a minimum.”

He added that the new pumps also provide Industry 4.0 performance information that they did not have with the older pumps, giving GEI more predictability and insight into their hydraulics performance.

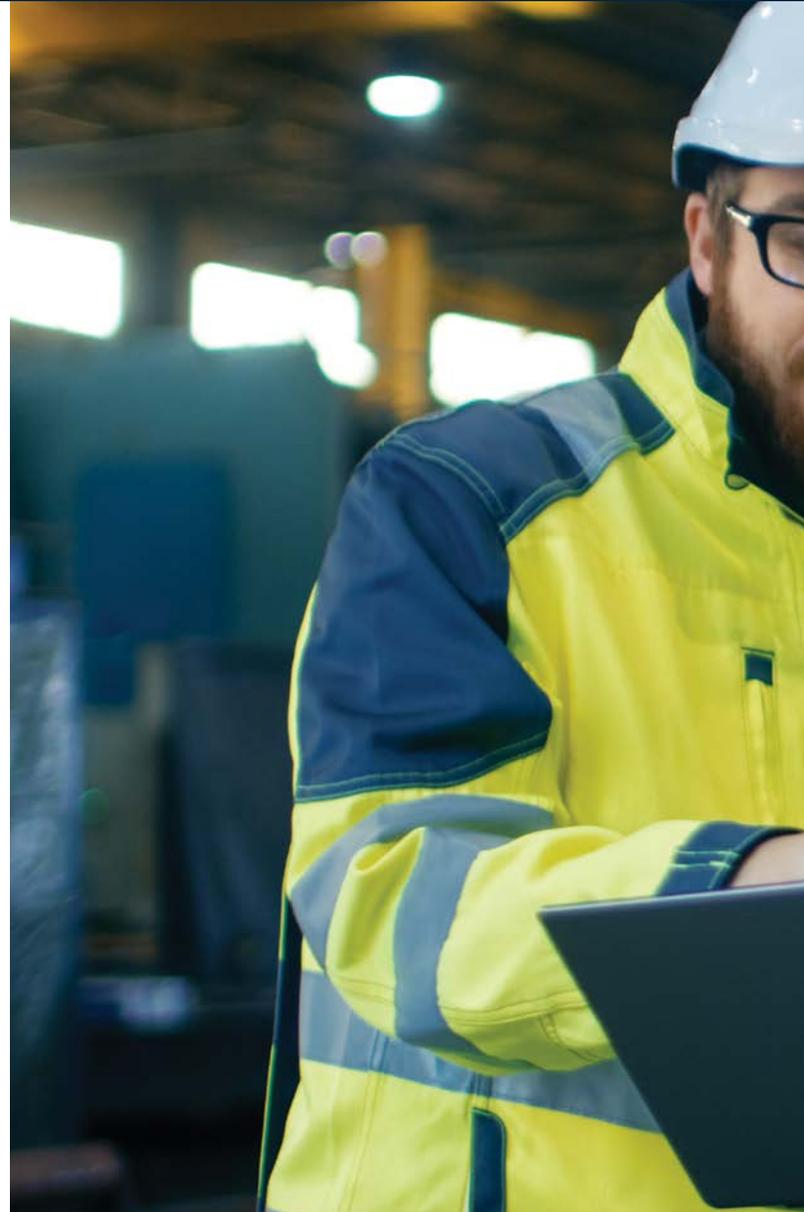
**“Pump replacement offered us the opportunity to increase the hydraulic flow rate and power input to the press to increase productivity.”**

**- Mike Kramer, Press Application Engineer, Bosch Rexroth**

#### **Successful approach to upgrade project**

Upon completion of the pump upgrades, GEI’s next major step will be to upgrade the press controls platform. Bosch Rexroth is proposing a controls upgrade solution that leverages the company’s extensive experience with extrusion press hydraulic controls. Rexroth’s platform is capable of highly dynamic control of press force and velocity and can perform power-limiting to ensure the press utilizes all available power to maximize production.

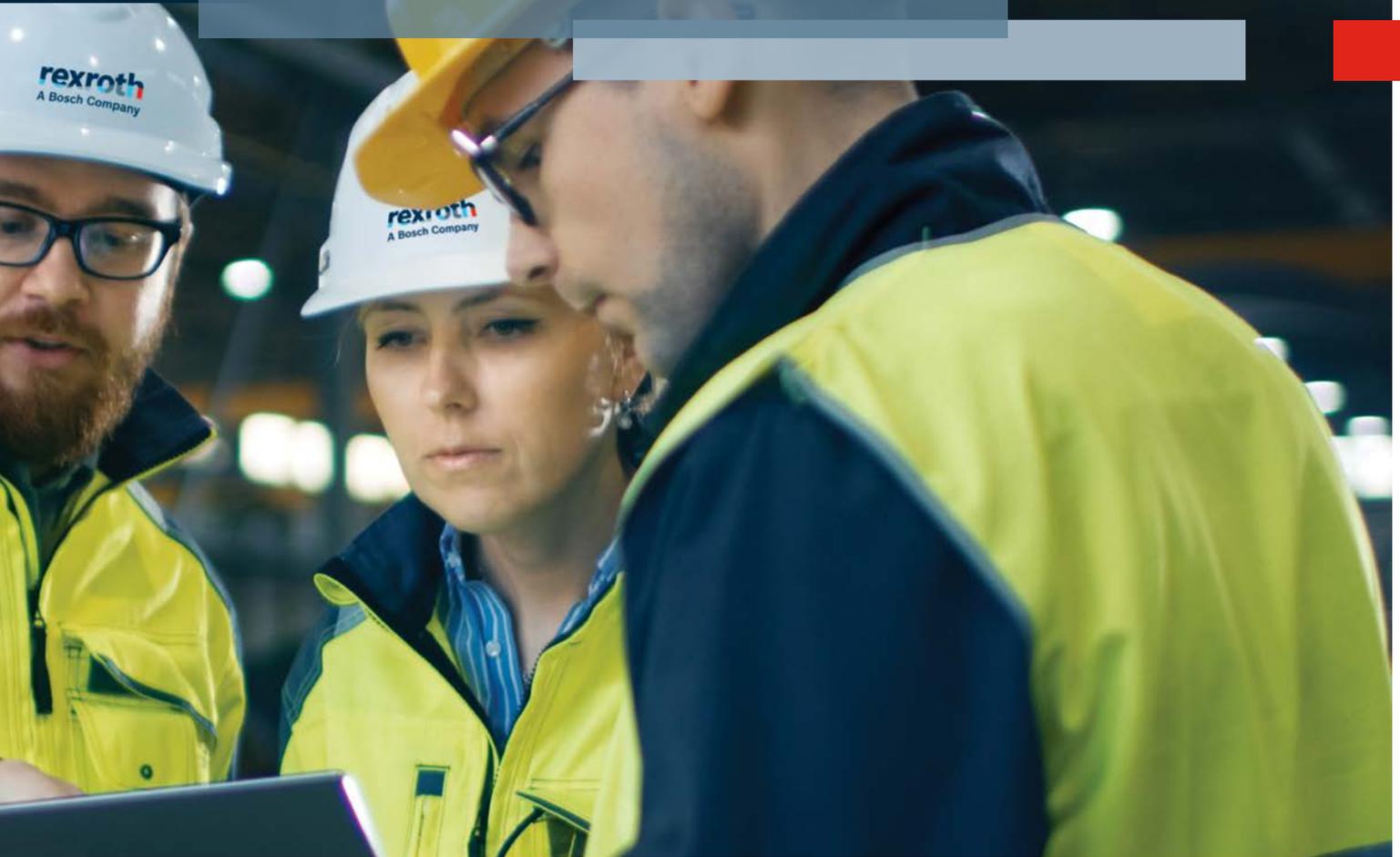
The velocity control function provides extremely accurate speed control during extrusion, including during the critical breakthrough period, helping improve product quality and



reduces scrap rates. The pressure control function is always active, limiting maximum tonnage even during breakthrough, which offers the added benefits of reducing stress on the press and extending die life.

In addition, a new control system offers the opportunity to improve press availability and maintainability through fast and flexible Ethernet I/P communications, I4.0 data collection and analysis (including predictive maintenance), and custom diagnostics to assist in troubleshooting. GEI is currently in the process of assessing the potential costs and time-frame for this project.

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## Conclusion

Throughout the project, the teamwork between GEI and Bosch Rexroth has helped make sure that the right technology and engineering design decisions provided the best solutions. From the beginning, GEI was confident that Bosch Rexroth had the right combination of drive and control technology and extrusion press expertise for this project.

“Mike and his team were able to come in and show us how this project could be split into phases that would minimize any downtime we might have to face,” Andre said. “That, combined with the history of the company within the aluminum extrusion business, their reputation within the industry, their size and ability to meet our needs – so we could continue to meet our customers’ needs – really gave us the confidence that this would be a success.”

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