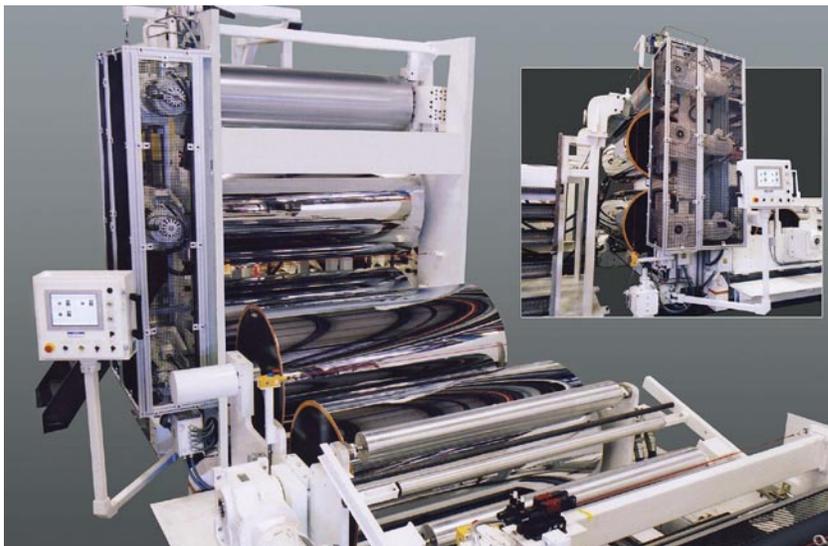


# Drive & Control profile

## Rexroth intelligent hydraulics makes plastics sheet extrusion faster, simpler, safer—and smarter



Using a Rexroth electrohydraulic system, the XP Express offers hands-free gap control with substantial advantages over the mechanical gap control on traditional rollstack machines.

Rexroth electrohydraulics make extrusion gap setting and control a smooth, rapid and highly accurate process so manufacturers can meet the most demanding specs

Davis-Standard LLC, ([www.davis-standard.com](http://www.davis-standard.com)) builds equipment for the plastics industry and has a long history of producing quality machines for foam, flexible and rigid sheet plastics extrusion. Their fully-integrated extrusion solutions are

at work in packaging, automotive, building trade, medical, and many other industries. Thanks to the combined efforts of [Rexroth \(www.boschrexroth-us.com\)](http://www.boschrexroth-us.com) and its local distributor [Airline Hydraulics, Inc, \(www.airlinehyd.com\)](http://www.airlinehyd.com),

### Challenge:

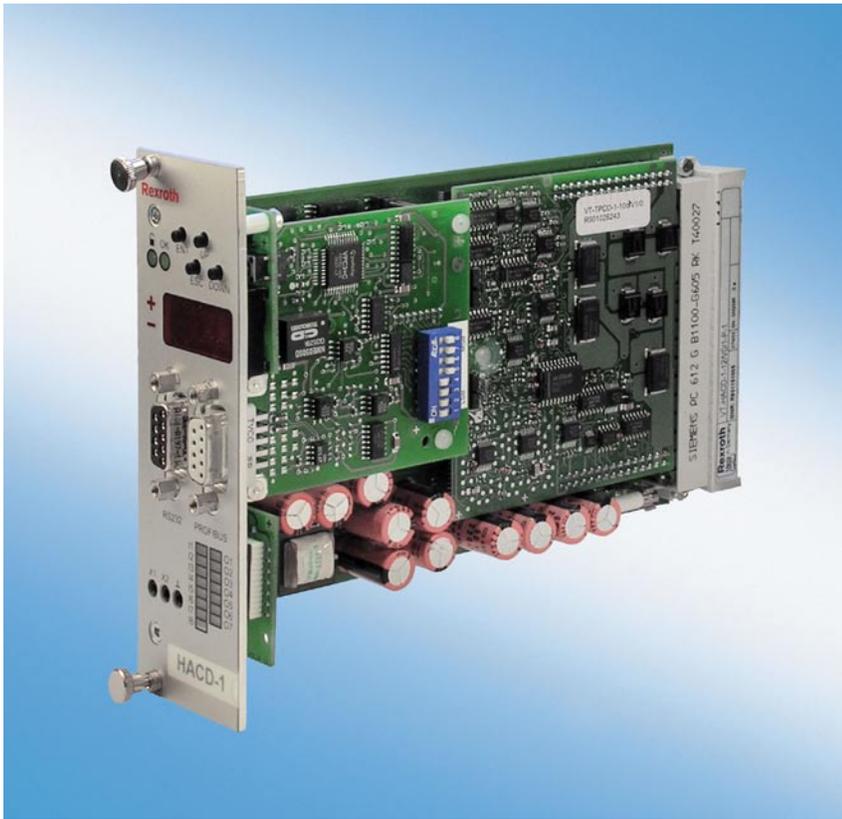
Eliminate mechanical gap control and improve precision with electrohydraulics for sheet plastics extrusion machine.

### Rexroth Solution:

- HACD electrohydraulic controllers
- Servo solenoid proportional valves
- CST4 hydraulic cylinders
- Linear guide rails
- Applications engineering

### Results:

- Hands-free gap control for both position and force
- Elimination of mechanical components for gap adjustment
- On-the-fly adjustments reduces changeover time
- Positioning to .0001 inch
- Minimal waste from product changeovers
- Electronic precision, smooth mechanical motion



With Rexroth's HACD controller\*, gap changes for the rolls can be made through the system while the machine is in operation, usually in seconds.

Davis-Standard can offer its customers a leap forward in precise gap control technology. Airline and Rexroth provided an alternate system solution to replace Davis-Standard's existing hydraulic "hands-free" gap control system for the plastics extrusion industry.

Hands-free gap control has substantial advantages over mechanical gap control found on traditional rollstack machines. In plastics production, a rollstack machine draws raw polymer material between heavy rollers, which cools the material and gives the plastic sheet its desired surface finish and thickness. Thicknesses range between .008 inches (0.2 mm) to over one

inch (25 mm) depending on the application, which often include pharmaceutical containers, consumer products packaging, arts and crafts products, film and much more. Producing plastics for these applications requires precise control of the distance between rollers to control thickness, which is exactly what Davis-Standard wanted to provide: precise gap settings that can be changed in a matter of seconds.

Traditional gap setting and control methods are based on mechanical devices such as lever arms and pancake cylinders which are nudged to the desired position according to the given product on the production line. Operators

must also enter the nip area (where heavy nip rolls pull material out of the machine) and perform manual calibration using feeler gauges. Not only is this a potential safety hazard, it can be more difficult or time consuming to change gap or force requirements for different products. Once set, the gap can also be difficult to monitor using traditional feedback methods because machine frames can flex under heavy loads, causing slight discrepancies in positioning. In addition, the use of numerous mechanical components can cause maintenance and inventory issues.

To help customers become more flexible in their manufacturing, Davis-Standard addressed these challenges on its [XP Express™](#) roll stand system using [Rexroth industrial hydraulics](#) components to provide the intelligent control that allows customers hands-free flexibility for quick and smooth gap or force changes.

The key to the XP Express hands-free system is electronic control of the hydraulic cylinders that actuate the chill rollers, including digital position feedback to monitor cylinder positioning at any time. The chill rollers measure 36-inches in diameter by 80-inches wide, weigh about 5,000 pounds each, and can process more than 7,000 pounds of material per hour. Rexroth's [electrohydraulic](#) components allow positioning to be maintained at specifications down to .0001 inch.

"The gap setting is the key to producing the finish customers

\*Customer specific, and or customized firm-ware may have been developed and incorporated to fulfill this application requirement.

want for their plastics products,” said Larry Mellow, project manager at Davis-Standard. “We recognized that we could design a machine that would let electronic signals and transducers, not mechanical parts, control the gap settings and force. Now we have a way to adjust those settings almost instantly for more flexibility in product runs.”

Davis-Standard worked with Airline Hydraulics, who recommended the Rexroth intelligent system — specifically, four [Rexroth HACD digital controllers](#), each one commanding a [Rexroth CST4 hydraulic cylinder](#) with a 3.25-inch bore and a stroke between five and 12 inches. There are two hydraulic cylinders per roller (one at each end) with each cylinder controlled independently. That allows the operator to change settings or “float” either end of the roll separately if necessary. The HACD controllers communicate digitally to a third-party PLC via DeviceNet or Profibus and receive signals from both digital SSI linear position feedback and analog pressure transducers. The digital position feedback enables one-micron resolution. The pressure transducers allow force to be limited if desired. The force can be monitored and used for feedback for the overall process. The controllers also supply command signals to Rexroth [4WRPEH servo solenoid proportional valves](#) which ensure smooth control of the up and down roll motion. Rexroth servo valves and pressure transducers come fully assembled on the hydraulic cylinders and require no assembly time. The

hydraulic pressure in the system generally ranges between 2,000 and 2,500 psi, but can go as high as 3,000 psi for larger sheet products.

Airline Hydraulics also specified Rexroth mechanical components in the form of [linear guide rails](#) for carrying the bearing blocks associated with the rollers. The rails are 35 to 45 mm wide and range in length from 396 to 575 mm. Airline recommended Rexroth linear motion components because they were the ideal choice for translating electronic precision into accurate mechanical motion.



Rexroth servo valves and pressure transducers come fully assembled on the hydraulic cylinders and require no assembly time.

The final element of the hands-free gap control system was a custom Airline Hydraulics manifold containing the components needed for emergency retraction of the chill rolls if necessary.

According to Mellow, the XP-Express with hands-free roll gap control has proven to be everything Davis-Standard had hoped for.

“The hands-free system allows the customer to set the exact gap or force that’s needed to make a sheet

product to any specification,” said Mellow. “What’s more, the system offers operators the choice of position control or force control.”

In position control, which can be changed by the operator during the process, Mellow said the chill roll gap is keyed into the system along with the production recipe (including melt temperature, chill temperature, nip pressure, line speed, etc.). With linear transducers handling the position sensing, the roll gap is held constant. Gap changes can be made through the system while in operation, usually in seconds. If force control is chosen, hydraulic force expressed as nip roll pounds-per-linear inch is keyed in and force is maintained by the computer’s digital feedback system. Force changes, too, can be made “on the fly.”

Many products such as embossed plastic or those with a high-gloss finish run best by running a primary nip in position (gap) control mode with a secondary nip in force control mode. That allows the operator to use the chill roll “float” capability to impart a final polish to the sheet. When operating in either force or position modes, the alternate mode is displayed as a reference. All information is digitally stored and recorded.

The [electrohydraulic](#) system also makes it easy to set force limits for extra protection measures. “Operators can input a low force setting for the second chill roll, which they couldn’t do before,” Mellow explained. “If the nip

detects a force change from foreign matter passing through, it can be set to open automatically. This helps reduce the risk of damage to the roll or plastic sheet.”

Airline Hydraulics and Rexroth engineers also worked to solve the tricky problem of frame flexing. Recognizing that some flexing was inevitable if the machine was to have high-load capabilities, they changed the position feedback system so that key feedback components were not on the hydraulic cylinders. Instead, the feedback components are placed on the bearing blocks at the end of the rolls, where a magnetic sensing system allows excellent position monitoring.

For plastics manufacturers who want the versatility of specialized finishes down the thousandths of an inch, the XP-Express with hands-free control delivers. Changeovers for different production requirements can be made in seconds without shutting down an entire line. Rexroth’s HACD system reduces the need for operators to interpret feeler gauge readings and use trial-and-error methods to determine the right settings. That, in turn, minimizes wasted material caused by improper settings, or settings that become invalid due to flexing



Rexroth proportional valves ensure smooth control of the up and down roll motion.

or vibration. Once the recipe is keyed in, the intelligent hydraulics immediately begin controlling material output exactly as customers demand.

“The more changeovers a customer has, the greater the gain in productivity from using a hands-free system,” Mellow concluded. “It also maximizes operator safety, virtually eliminating the need to enter the nip area to make adjustments and changes. This can help users to produce a wider variety of plastics products and increase return on investment even more,” he said.

**Rexroth**  
Bosch Group