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A New Dimension in Innovation

ONE OF THE OUTCOMES OF OUR shared pandemic experience is that we don't see too many people in three dimensions these days. With our time together limited and at a distance, we've resorted to business video calls to keep touch with those we work with—and many times with those we love.

Even in our free time, we're not able to experience much beyond a screen. Our halting return to sports is viewed solely on television—complete with cutout fan images in the otherwise empty seats. We've binge-watched streaming series and relived some classics, but it all remains a 2D world for the most part.

It's ironic (if there actually is any irony left in the world) because we have worked so hard over the last decade to add real dimension to our work. From 3D visions of manufacturing plants and the products they produce to the additive manufacturing of printed products from those visions, we have transformed the way we create and build products and systems. From idea to reality, the 3D processes we've created have helped us bring better products to our customers in less time and with less waste.

We have used that technology effectively during the pandemic to keep the fires of innovation burning. Perhaps our greatest achievement in the last year is that amid all the turmoil, we have adapted and continued to grow. Technology has enabled that adaptive spirit, but so has the nimble minds that take that technology and spin it into solutions.

Hydraulics & Pneumatics will celebrate that innovative spirit with our new IDEA! Awards, which are being launched this year. New products from around the world will be nominated to receive the IDEA! Awards, and then we will present the nominees to our engineering experts—you—to select the best of these solutions to receive the prizes.

The award luncheon will take place at the IDEA! Conference Nov. 10 in Cleveland, and that will be the end of the process. But that process doesn't start with the nominations, which are open now, or with the announcement of our finalists in 14 categories, or with the reader voting that will select the winners.

Innovation begin with one person's idea and the imagination and talent to turn that idea into something that serves others. The great ideas are multi-faceted and, of course, multi-dimensional. We haven't lost the dimension of innovation in the past year, and all of us at *Hydraulics & Pneumatics* are excited to showcase it with the IDEA! Awards. hp


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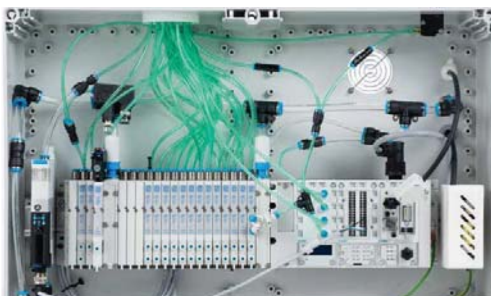
Pneumatics Makes Prostate Biopsies More Accurate

Remote controls in an MRI scanner lets the surgeon better monitor a probe's position inside the patient.

The RCM robot system from Soteria Medical is used inside MRI machines to take biopsies of tumor tissue in a patient's prostate gland. To make the robot free of any metal that would disturb the MRI machine, it uses pneumatic actuators and controls from Festo.



The valve terminal type MPA from Festo controls a medical robot's pneumatic cylinders.

Prostate cancer is one of the most common cancers and the second leading cause of cancer-related death in men in the U.S. The American Cancer Society estimates there were 192,000 new cases last year and about 33,000 of them will die from it. The group also predicts that about 1 in 9 men will be diagnosed with prostate cancer sometime in their life. The key to surviving the diagnosis is to get it early in the disease's progression. Early treatment is usually the most effective, with the fewest side-effects and the lowest cost.

Currently, surgeons rely on ultrasound to image the prostate when taking biopsies, but it lacks the resolution to reveal tumor sites. Only MRI can detect and target the most aggressive part of the lesions on the prostate. So, urologists make randomized systematic biopsies using ultrasound which consists of 12 to 16 samples taken from different portions of the prostate. This means the new robotic procedure is quicker and less problematic for patients. Less time also means lower costs and more efficient and effective use of the MRI machine.

To make diagnosing prostate cancer more accurate and easier on the patient, a team of engineers at Soteria Medical BV, a Dutch company, went to work designing a Remote-Controlled Manipulator (RCM) that contains five motors. The team wanted a surgeon-controlled robot that would precisely position the biopsy probe to sample suspicious areas of the prostate. The procedure takes place inside an MRI machine, so the surgeon can see real-time imaging of the prostrate and probe, which helps when guiding the probe to its target.

But this meant the robot could not contain metal, as that would interfere with the MRI. The robot would also have to be compact enough to fit inside the MRI machine along with the patient.

To keep the RCM metal-free, the design team partnered with Festo on pneumatic power to move and position the probe using plastic pneumatic stepper motors controlled by a Festo valve terminal type MPA. The entire RCM is made of MRI-compatible, high-quality plastics. The robotic probe is connected by more than 20 feet of pneumatic tubing to a control unit. This lets the controller be placed in the MRI control room.

For this application, the high-speed MPA valves use a CPX control interface, and the entire unit comes pre-assembled and pre-tested in a ready-to-install control box. It can hold enough valves to control the five different motors in the robot. The CPX interface on the valve uses serial communication for all the solenoid coils and electrical input and output functions. This single network handles end-to-end internal diagnostics and reduces internal connections, ensuring a reliable product.

The compact CPX/MPA combination saves valuable space, while the ready-to-install package saves time and reduces inventory. The valves give the robot a high cycle life, repeatable speeds and well-documented reliability.

Partial automation by the RCM makes the biopsy less stressful for the patient. Plus, the robot's precision and the MRI imaging lets the machine take one or two samples from any suspicious area. ■

IDEA! AWARDS

AWARDS TO CELEBRATE INNOVATION

Readers will have the chance to select winners in 14 categories.

To recognize the outstanding innovations in product design and function for the manufacturing sector, *Hydraulics & Pneumatics* and *Machine Design* and will present the 2021 IDEA! Awards.

IDEA! Award winners will be chosen by the top industry experts on innovation—the readers of *Hydraulics & Pneumatics* and *Machine Design*, who will cast their votes online from entries in 14 categories:

- 3D Printing
- Motors & Drives
- Robotics
- Motion Control
- Electrical Components
- Fastening and Joining
- Fluid Power Components
- Automation
- Design Software
- Sensors
- Machine Tools
- Mechanical Components
- Fluid Power
- Cloud and Computing

"We developed the IDEA! Awards to celebrate the tremendous progress in product development that has taken place in the last year," said Bob Vavra, senior content director. "Despite the pandemic, we have seen great new ideas continue to be presented to solve problems faced by our readers. The IDEA! Awards are a way to bring all of those great new products together, and to recognize those our audience believes provide the most important solutions."

> "We developed the IDEA! Awards to celebrate the tremendous progress in product development that has taken place in the last year,"
>
> —Bob Vavra, senior content director.

The IDEA! Awards will be presented at a Nov. 10 luncheon as part of the Industrial Design, Engineering & Automation (IDEA!) Conference, to be held Nov. 9-12 in Cleveland. The IDEA! Conference will be part of the larger Manufacturing & Technology Conference, presented by Endeavor Business Media.

Gold, Silver and Bronze trophies will be presented to the products that receive the highest percentage of votes in each category. In addition, the product that receives the most votes among all categories will be presented with the BIG IDEA! Award.

This is a contest for new products. All products must have been introduced for the first time within a 12-month period beginning Oct. 1, 2020 and ending Sept. 30, 2021. The entry fee is $500, and there is no limit to the number of new products submitted by any company. Entry deadline is July 9, 2021.

Finalists will be featured in the Mid-Year report of *Hydraulics & Pneumatics* and the August issue of *Machine Design*. Finalists also will be featured online, and voting will begin Aug. 1. Winners will be notified in mid-September and invited to attend the awards luncheon in November.

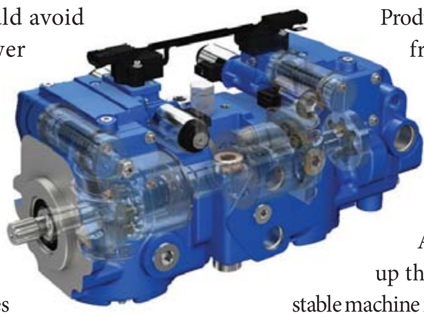
Submissions are now being accepted at https://machinedesignproductaward.secure-platform.com/a/solicitations/93/home or at the link on the home pages for *Machine Design* and *Hydraulics & Pneumatics*. ■

BRENT SCHENK | Eaton Corp.

The Benefits of Back-to-Back HYDRAULIC PUMPS

Back-to-back pumps let engineers improve machine efficiency, precision and repeatability.

The trend toward smaller machines is ushering in a host of new benefits, but it's also bringing challenges. Operators are trying to shrink the size of their machines to improve dynamics involving weight and efficiency, but in doing so, they should avoid sacrificing the power needed to get the job done.



In short, machine designers must find ways to fit the required components with the right power into tight spaces to satisfy demands for smaller, more powerful equipment. Here are a few considerations concerning hydraulic pumps that might help engineers strike the right balance.

EFFICIENCY AND BEYOND

Many industries have been affected by the drive for smaller machinery, but it seems construction and agriculture are at the forefront. Skid loaders, windrowers and other equipment common in these industries have been getting smaller for years, driven primarily by a need for more efficiency. Whether that efficiency is needed to meet regulatory standards or simply to lower operational or overall costs, machine size is a factor designers must consider.

Of course, as efficiency demands increase, so have productivity demands. An efficient machine that makes the jobsite inefficient helps no one; the machinery must maintain power and maneuverability despite a smaller and smaller size.

Productive jobsites are not just about the cost of buying and operating a machine, however. A growing shortage of qualified machine operators is starting to force design changes as well. Operators need equipment that is easier to operate, allowing for shorter training cycles, which helps get new operators into the field quicker.

Productivity gains also flow from smoother, more precise machine operations—more effectively placing concrete or moving equipment from A to B without tearing up the ground. A smooth, stable machine is also easier to operate.

THE RIGHT PUMP

Back-to-back pumps let operators improve machine efficiency. They come in more useful sizes and offer precision and efficiency. They can also improve precision and repeatability.

Hysteresis, for example, plagues many who rely on fluid power on industrial and mobile equipment. Hysteresis refers to an error based on past input, a variation caused by friction and drag in a control loop's various interfaces. In hydraulics, these interfaces are in servo valves, control pistons, swash plates and rotating pumps, mechanical feedback links and swash feedback valves.

Measured as a percentage of error against the pump's peak flow, hysteresis ranges from 4 to 11%, with 5% typical of today's pumps. Though 5% hysteresis sounds small, it means a 100-cc pump commanded to half displacement could produce 50 or 55 cc, depending on the previously commanded position. That's enough to change the output flow and require the operator to compensate by changing the input command to get the desired flow.

Though hysteresis has historically been seen as a mere nuisance that must be accepted, it is often costly in terms of lost production time, efficiency and reliability. It can greatly degrade a machine's precision, making it more difficult to operate, particularly for less-skilled drivers. As these factors become more important for operators, many have adjusted their machine design requirements to improve their bottom line.

Today's back-to-back pumps can help designers reduce hysteresis (and compatibility with programmable controllers that make it easy to manage every system function) by providing current to the solenoid valves that forces the controller to minimize the difference between the desired position and existing positions via a swash feedback sensor in the pump. This sensor can bypass the source of mechanical friction and let the controller dynamically adjust solenoid valve current based on working conditions.

When paired with a cartridge motor, the pump and controls can also create a compact propel solution with better control accuracy. As a machine designer looks to solve customer concerns, using software to customize machines makes it easier to design and build intelligent, compact equipment.

Back-to-back pumps can be equipped with roller bearings rather than the standard journal bearings. Swash roller bearings further reduce hysteresis reduction and wear-and-tear on the machine. This cuts down on the need for maintenance, allowing for longer uninterrupted machine use and more productivity. hp

BRENT SCHENK is global product manager for medium-duty, closed-circuit piston pumps at Eaton Corp. (www.eaton.com).

PAT PHILIPS | AutomationDirect

4 Basic Pneumatic Circuits

Here are four simple circuits of pneumatic components that can be used alone or as building blocks in larger systems.

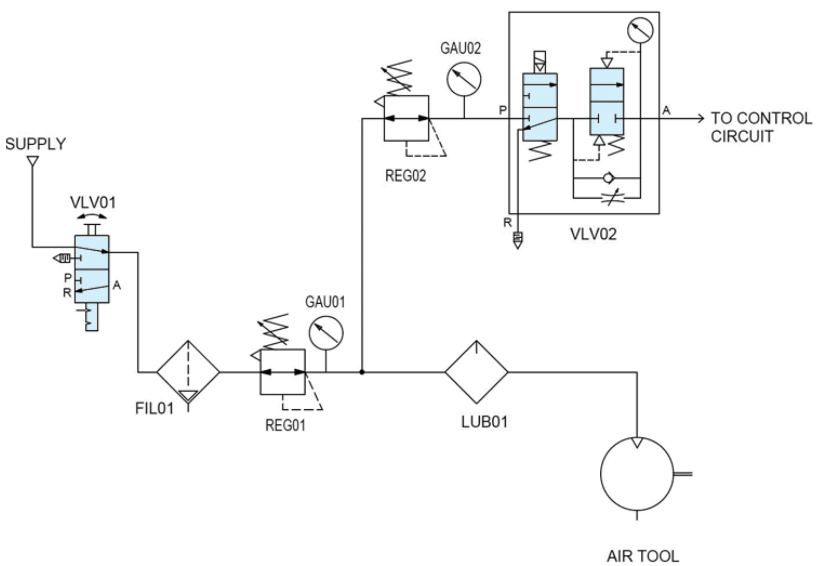
The following four pneumatic circuits can be used for air preparation, double-acting cylinders, continuous cycling and hand control applications. They can also be subsystems in larger circuits.

AIR PREPARATION

Before compressed air is used in a pneumatic device, it must be properly prepared so that it does not damage components. Here is a schematic (below) for a pneumatic device that prepares compressed air coming from a single source.

Putting the manual shut-off valve or pneumatic isolation/lockout valve first makes it easier to maintain the FRL and it protects downstream equipment when depressurizing the system for maintenance. For safety, operators should be able to lock the valve in the off position. If it is necessary to have clean, dry air flowing through the valve, the valve can be mounted after the FRL.

In the diagram, the filter (FIL01) is just downstream from the shut-off valve (VLV01) to remove particulates and moisture. The triangle at the bottom of the symbol indicates that this filter has a liquid drain, which can be manual, semi-automatic or automatic. Although the regulator (REG01) is downstream of the filter, the two could be a single unit, indicated by a dashed-line box around both filter and regulator. Although not shown in this diagram, it is good practice to note the machine's working and maximum pressures. A tag with this information is often located close to the regulator.

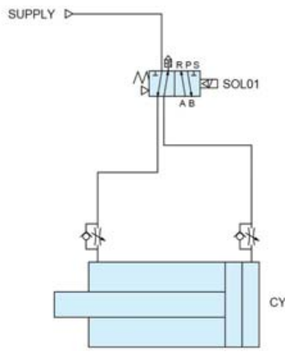


This circuit has all the pneumatic components needed to make an air-preparation system for compressed air. It includes a manual shut-off relief valve (VLV01); filter (FIL01); regulator and gauge (REG01 and GAU01); pneumatic distribution block (not shown); soft-start/dump valve (VLV02); and a lubricator, if needed (LUB01). A filter, regulator and lubricator may also be combined (FRL).

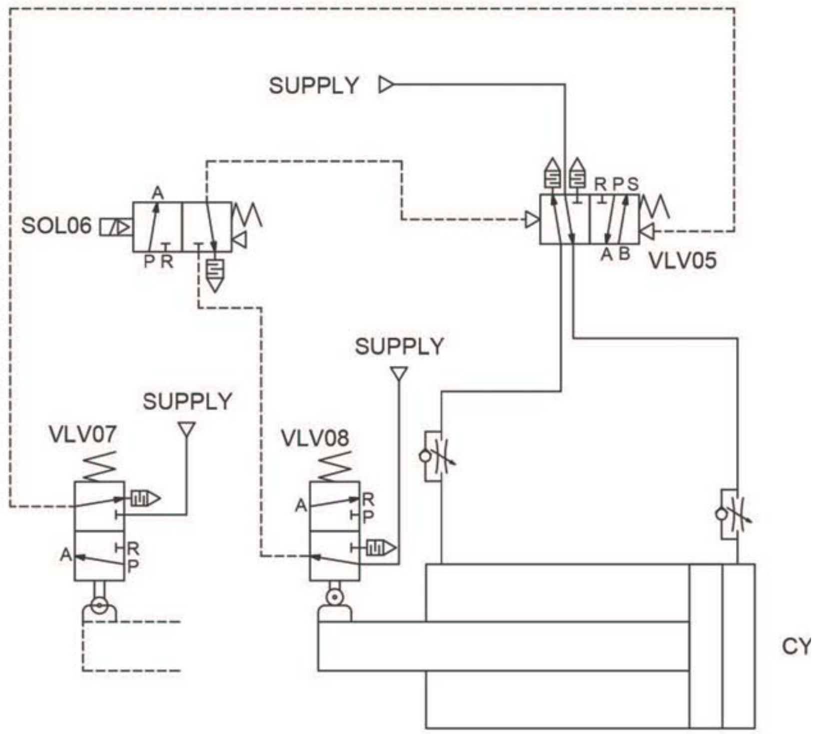
This total air prep (TAP) unit contains all the major components and controls for air preparation.

A pressure gauge (GAU01) should always be included with a regulator, whether built-in or threaded into the regulator's pressure port. Although not shown in this schematic, a pressure switch can be installed just downstream of the regulator to monitor pressure. This switch's output typically gets routed to a programmable logic controller or some other machine controller.

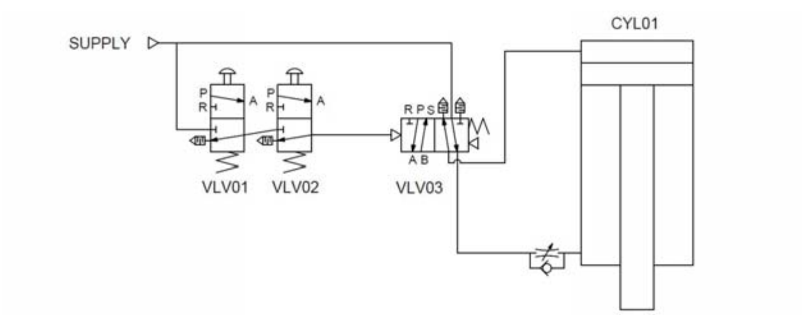
A regulator can offer relief, reducing output air when either the regulator is adjusted to a lower pressure or to remove downstream pressure when upstream air is exhausted. Triangles at the upper left corners of the regulator symbols (REG01 and REG02) show they are the relieving type. The exit air regulator (REG01) provides clean, dry and filtered air that can be split through a T fitting or pneumatic distribution block.



Double-acting cylinder circuits are common on PLC-controlled machines.



A continuously cycling circuit provides automatic cylinder cycling when 3-way solenoid valve is energized and continues until it is turned off.



This circuit requires two-hand control to safely operate a press.

One line then provides lubricated air and the other provides non-lubricated air. The non-lubricated line feeds a second regulator that supplies the electrically operated soft-start/dump valve (VLV02). This valve typically acts as a safety device by relieving pressure from motion-causing pneumatic devices, such as cylinders and actuators, when an emergency stop is pressed.

For applications such as pneumatic tools and motors which need to be lubricated, that lubrication should consist of light oiling to prevent clogging these devices.

Installing circuits such as this can be simplified by using a device that contains all the air-preparation components and controls (page 12). It also includes a clogged filter indicator, adjustable pressure switch with indicator LEDs and port sizes that adjust to match the need flow rate needed.

DOUBLE-ACTING CYLINDER

The schematic above shows a common automation application: using a 4-way solenoid valve (SOL01) to extend and retract a double-acting cylinder (CYL01). Triangles at each side of the symbol indicate it is a pilot-activated, single-solenoid, spring-return valve.

Filtered air feeds the solenoid valve, which is usually energized by a 24 V dc PLC output. This activates the valve and lets air leave through port B and flow freely through the flow control to extend the cylinder rod and plunger to the left. Air on the left side of the cylinder is forced out through its flow control to the valve's port A, and then goes to port R and exits through a muffler to reduce exhaust noise.

Pilot valves need only a small amount of air to efficiently move a large valve spool. However, valves require a minimum operating pressure, typically about 20 psi, to move the spool. A spring on the left side pushes the valve spool to the right to maintain its normal off or resting state. With the valve off, air flows out of port A and freely through the adjustable flow control to the left side of the cylinder (CYL01), making it retract.

As the cylinder retracts, air on the right side leaves through an adjustable

continued on p. 24

TRAVIS GILMER | Thomson Industries

The Case for Electro-Hydraulic Actuators

In short, they can handle heavy loads in tight spaces.

An electro-hydraulic actuator like this Thomson H-Track is about the same size as a conventional electric actuator but delivers substantially more power. (Courtesy: Thomson Industries)

Hydraulic cylinders have long been engineers' first choice for handling loads higher than 3,000 lb. But if space is tight, hydraulic cylinders and all their ancillary equipment can be difficult to shoehorn into a design, despite their power advantages. A more compact alternative are electro-hydraulic actuators. They can handle loads up to 4,800 lb and move them at up to 4 ips (inches per second). They are clean, versatile and have relatively low lifecycle costs. They also match hydraulic actuators in terms of handling loads and shocks. Electro-hydraulics are now used in a range of heavy load-handling applications in outdoor equipment, marine, military, aerospace and many other fields.

Hydraulic cylinders that convert electrical energy into motion require an assembly of oil reservoirs, electric motors, pumps, oil filters, relief valves and directional valves. The size of the pump and all the other components are determined by the target speed and cylinder size. So as speed requirements increase, the cost of whole set-up and its footprint also increase.

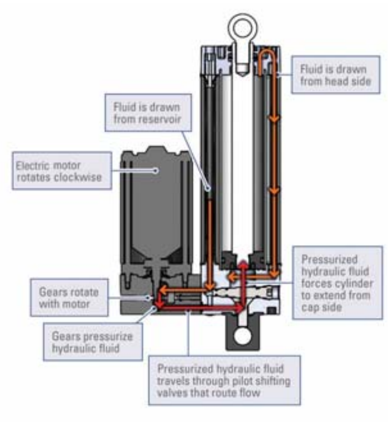
In an electro-hydraulic actuator an electric motor rotates clockwise, turning gears that pressurize the hydraulic fluid. Valves open to draw fluid from the reservoir and head side and also control delivery to extend the rod. For retraction, the motor runs counterclockwise, reversing the operation and returning fluid to the reservoir and the opposite side of the piston.

Although electro-hydraulic actuators and hydraulic cylinders may be similar in size, hydraulic cylinders require significantly more components. This gives electro-hydraulic designs a distinct advantage in power density.

Electro-hydraulic actuators also hold an advantage in cleanliness and safety. Hydraulic cylinders and their components can develop leaks at pipe and hose fittings due to vibration and other factors, pushing oil and fumes into the plant with every stroke. This pollutes the air and possibly creates slip hazards. Meanwhile leaks in the pump, pressure controls, directional valves, and cylinder convert pressure and flow to heat or wasted energy, which reduces actuator speed.

Self-contained electro-hydraulic actuators require no maintenance. Hydraulic cylinders, on the other hand, require constant fluid servicing. And as they age, they begin to wear and leak around the piston. Pumps and other components also wear over time and develop internal leaks and pressure losses.

Engineers have more design flexibility when positioning electro-hydraulic actuators. They do not need elaborate support systems, so they can be more easily placed so that control is closer to the point of application and accessibility is also improved.



An H-Track actuator from Thomson Industries in its extended position. (Courtesy: Thomson Industries)

For example, it's easier to run elec-

	Hydraulic Cylinder-Based Systems	Electro-Hydraulic Actuators
Max Load Capacity	>21 kN (4,800 lbs.)	21 kN (4,800 lbs.)
Power Density	High	Highest
Cleanliness & Safety	Low	High
Additional Maintenance	High	None
Location Versatility	Low	High
Shock Handling	High	High
Cost - Initial	High	Low
Cost - Expanding Existing Unit	Low	Low
Cost - Lifecycle	High	Low

For loads up to 4,800 lb, a compact electro-hydraulic actuator has the advantage over hydraulic cylinders in terms of power density, maintenance, location versatility, cleanliness and cost, while still handling comparable shock loading. (Courtesy: Thomson Industries)

trical wire than hydraulic lines up the boom of a cherry picker or run an electric cable from a tractor to a towed planter to control seed depth instead of hydraulic lines. In both cases, overall system size is reduced along with the risk of leaks.

Hydraulic cylinders are adept at handling sudden shocks, such as when a cylinder-guided plow hits a snow-covered barrier or a mower deck runs into a large rock. They absorb sudden energy spikes instantly by redistributing fluids throughout their internal valves and pump housing. Electro-hydraulic actuator shock resistance is on par with that of hydraulic cylinders.

Conventional hydraulic systems can be most cost effective when adding extra cylinders to a design that already contains other hydraulic elements. Otherwise, the cost of incorporating the necessary support system must be considered. Electro-hydraulic actuators eliminate fluid handling and storage, leak and spill management, and the additional maintenance costs of identifying and repairing leaks, which reduces lifecycle costs for end-users and provide benefits that OEMs can market to their customers. hp

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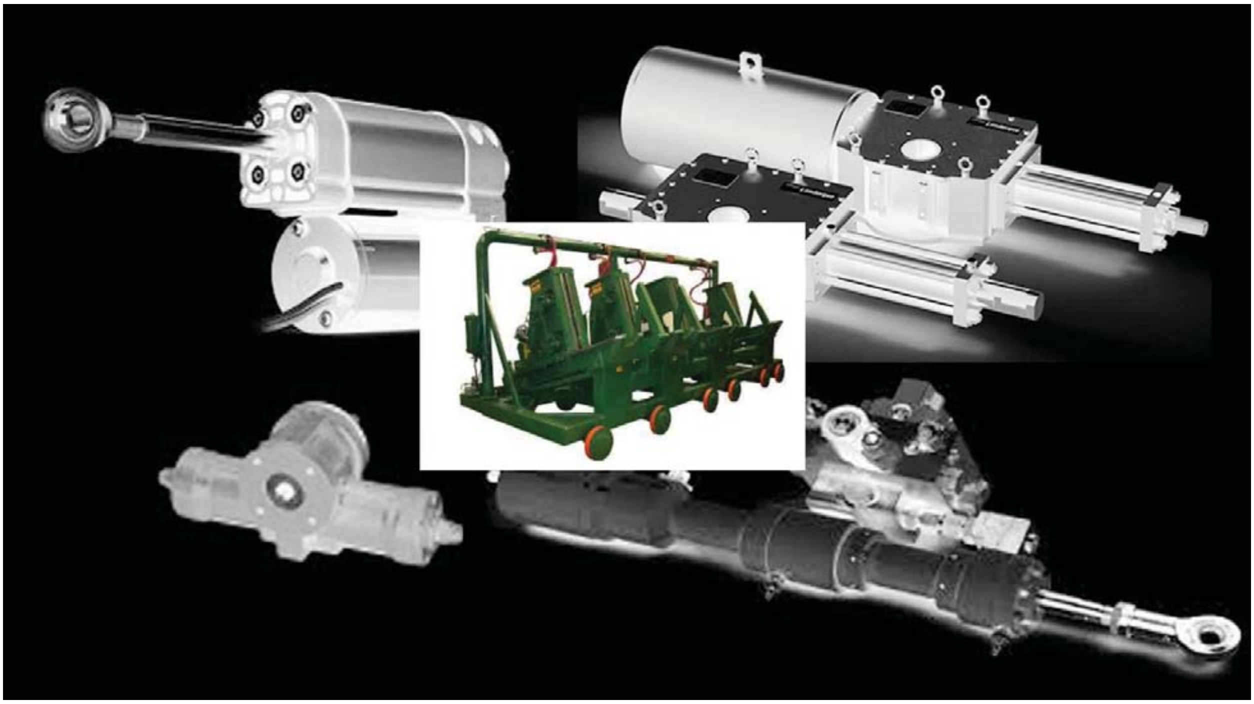
TRAVIS GILMER is a product line specialist for Thomson Industries, Inc.'s (https://www.thomsonlinear.com/en/products/linear-actuators/h-track linear actuators.

PETER NACHTWEY | Delta Computer Systems Inc.

Controlling Two or More HYDRAULIC ACTUATORS

There are several methods for coordinating the motion of two or more actuators.



Some hydraulic applications require coordinating the motion of two or more actuators. A common example is moving two or more actuators at the same time, at the same speed and to the same position. There are a couple of ways in which this can be approached.

In the past, it was common to gear one actuator to another with one of them being the master. The other actuator(s) would try to follow the master's actual position.

There are a couple of problems with this. It is difficult to calculate the master's velocity due to noise and feedback resolution. Also, if a slave cannot keep up, there must be some way to slow the master. Finally, slave actuators always lag the master. A better approach is to generate the same virtual master for each axis. If there are following errors, they should be the same for all the actuators. Then the virtual master for all slaves can be slowed down.

Nowadays, modern motion controllers generate a target motion profile for each actuator it controls. The target motion profile includes the target position, velocity and acceleration. Sometimes the target jerk or derivative of acceleration is also calculated.

The advantage of following a target or virtual master is that the virtual master is noise-free, so it can generate the same target velocities and accelerations for all the slaves. The slaves can then use this information to generate velocity and acceleration feed forwards. This greatly reduces following errors.

Feed forwards estimate or predict the control output needed by the actuator to move at any target velocity and acceleration. If this estimate is within 5% of the actual value, the PID only needs to correct for 5% of the error instead all of it.

Generating a target position, velocity and acceleration for all the slaves lets operators generate different motion profiles for all actuators and execute them as a function of time. Sometimes actuators must move to different positions while going different distances and velocities but still arrive at the same time. This is easily done by setting the actuator that needs to move the farthest as the master actuator.

Next, for each slave actuator, find the ratio of that slave's distance to the master's distance and multiply the master's speed, acceleration and deceleration by that ratio to get the slave's speed, acceleration, and deceleration. So, if a slave needs to move half the master's distance, the slave's target speed, acceleration and deceleration will be half the master's target speed, acceleration and deceleration.

An example of this is a sawmill headrig application. Logs are not perfect cylinders; they are slightly tapered or conical. To get the most usable wood from a log, the headrig's knees need to move different distances to get the log into the best position for cutting. But it is important that all the knees move synchronously and to their final position at the same time, so they don't bend the log.

There are applications where actuators move using independent functions as a function of time. An X and Y actuator could cut a pattern out of a piece of material. So, each actuator then needs to execute its motion profile as a function of time. If an X and Y actuator were to execute the same function, they would just move back and forth in a straight line. This is not helpful; the X and Y motion profiles must be different.

One way of doing this is to use cam tables or cubic splines. Cam tables let operators indicate a set of positions as a function of a set of times. Each actuator can have its own set of positions, but they should share the same set of times. This ensures the X and Y actuator can be at designated x,y coordinates at a designated time. This technique can be expanded to more than two actuators if required.

The most sophisticated version of this occurs when several actuators

In general, engineers should not gear to the feedback of an actuator that isn't controlled by the motion controller.

use cam tables/cubic splines executed as a function of an external master or encoder. An example of this from the sawmill industry involves the feed chain that moves logs through chipper heads and saws. In this case, an encoder attached to the feed chain computes the chain's speed.

When a log breaks a photo-eye, the encoder resets to 0. The encoder's counts, or position, are used to index each actuator's cam table/cubic spine to its position. The advantage of this is that if the chain changes speed, all the geared actuators change speed accordingly. This requires some complicated math, but it is done inside the motion controller.

In practice, the cam tables' set of positions is downloaded while the previous log is being cut. Each log is different, so a different set of positions is always being downloaded for each log.

The difficulty with this method is that the actuators are now geared to the feed chain encoder. It is easy to read the counts and scale that to position. However, it is harder to compute an accurate velocity when there is a lot of jitter in the feed chain encoder as each link in the chain goes over a sprocket. This makes calculating the feed chain velocity and acceleration difficult, but it is needed for using the feed forward gains.

The feed chain should run at a constant speed, so the acceleration calculation may not be important. But the chain's velocity is important because it is used to compute the slave actuators' target velocities. If an accurate target velocity and acceleration can be computed for the slave actuators, they can be used to calculate feed forwards and improve tracking. Filtering can reduce the encoder noise due to the sprockets and improve estimates of velocity.

In general, engineers should not gear to the feedback of an actuator that isn't controlled by the motion controller. If the motion controller controls the actuator, the target position, velocity and acceleration should be used rather than the feedback or actual position, velocity and acceleration. Always try to follow a computer-generated target position, velocity and acceleration because these are usually high-precision, floating-point values rather than noisy and quantized positions. hp

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Open Versus Closed-Circuit Filtration for Hydraulics Performance

Selecting the appropriate filtration system contributes to longer service life.

AT A GLANCE:

- Know the basics of open- and closed-circuit filtration designs.
- Factors to consider when specifying a return line filter system.

Selecting the appropriate filtration system when designing a hydraulic circuit is critical for maintaining fluid cleanliness and preventing premature wear, both of which contributes to optimal system operation and service life.

Contamination of the hydraulic system can occur during assembly and during operation. Contamination can come in many forms, including water or other fluids, air, solid particles, or corrosive agents and heat.

Dirt is the greatest enemy of hydraulic systems, since it generates wear that results in shortened service life of components. The cleaner the system, the higher its service life expectancy. Therefore, it is imperative that only clean fluid enter the circuit. In addition, a filter capable of maintaining fluid cleanliness to ISO 4406 class 22/18/13 or better, under normal operating circumstances, is recommended.

Between open- and closed-circuit filtration designs, there are additional factors to consider as well.

CLOSED-CIRCUIT DESIGNS

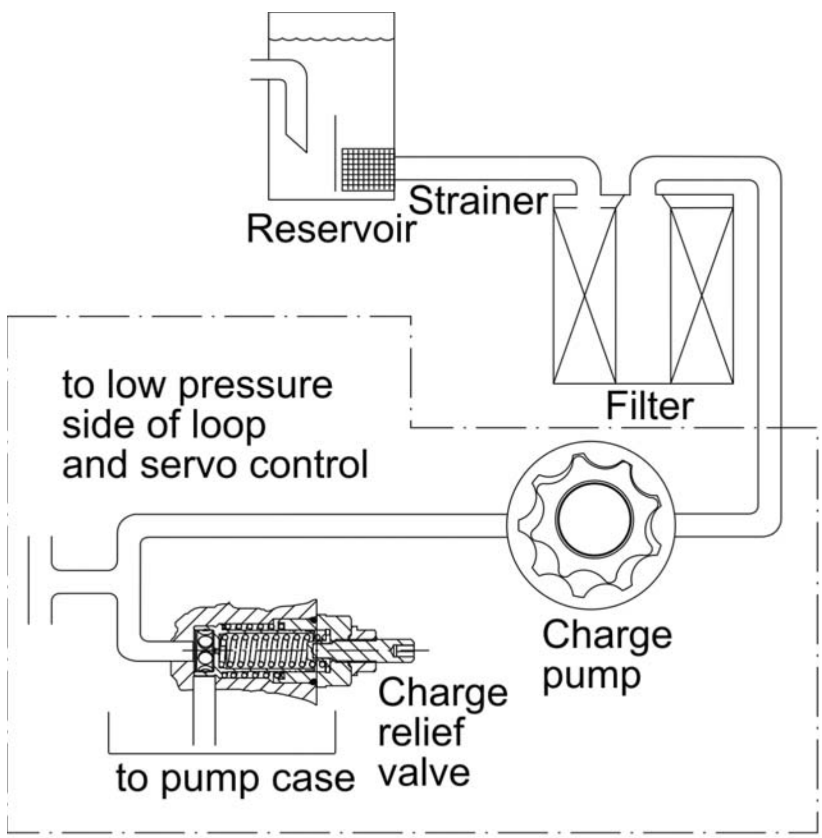
A closed-circuit filtration design will typically follow into either suction line filtration or charge pressure filtration (both partial- and full-flow).

In suction line filtration, a filter is placed in the circuit between the fluid reservoir and the inlet to the closed-circuit pump. Follow the manufacturer's recommendations for bypass versus non-bypass filter in the suction line. A vacuum gauge can be used to show when the inlet pressure exceeds the manufacturer's requirements. A contamination monitor will indicate when a filter change is needed, once a maximum vacuum level is reached.

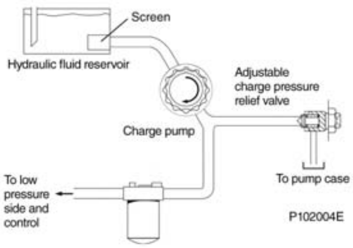
Examinations have revealed that a filter in the suction line with a $\beta35 - \beta45 = 75$ ($\beta10 \geq 2$) at a differential pressure of 0.25bar achieves the required cleanliness of 18/13 under normal operating conditions. In some applications even better cleanliness levels are achieved.

In charge pressure filtration, the filter is designed into the charge circuit of the closed-circuit pump. Placing the filter in the charge circuit can mitigate high inlet vacuum during cold start-up conditions. Fluid filtration is provided immediately ahead of a pump's control and the hydraulic loop.

Examinations here, too, have shown that filter elements with a $\beta15 - \beta20 = 75$ ($\beta10 \geq 10$) at the differential pressure occurring in



The suction filter is placed in the circuit between the reservoir and the inlet to the charge pump. Credit: Danfoss



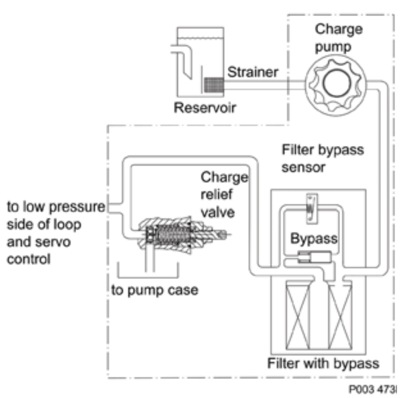
Partial flow charge filtration.
Credit: Danfoss

the application are recommended. A strainer with a mesh of 100 µm – 125 µm must be used to protect the charge pump against course contamination. However, the actual filtering is done by the filter in the charge circuit.

PARTIAL VERSUS FULL FLOW CHARGE FILTRATION

The charge pressure filtration design can be further broken down into either partial flow or full flow.

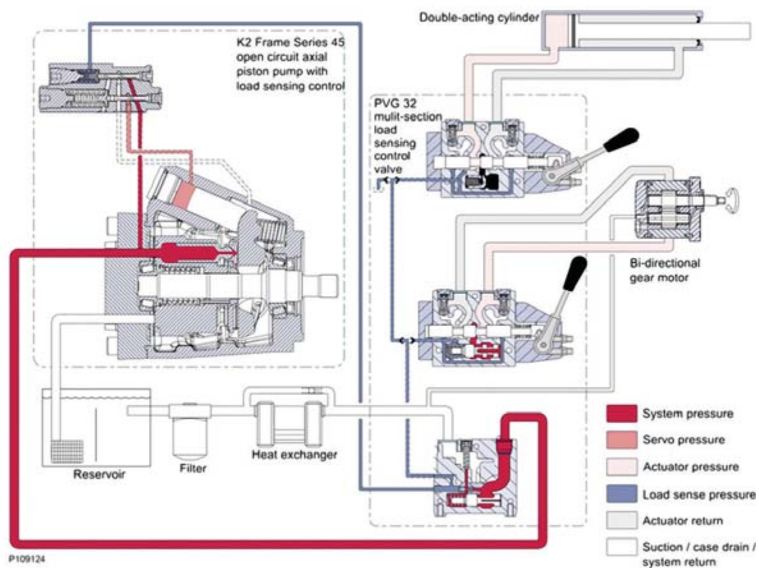
Partial flow filtration refers to the charge pressure relief valve located upstream of the filtration. A portion of the charge



Integral charge pressure filtration, full flow.
Credit: Danfoss

pump oil flows through the filter while the rest flows over the charge pressure relief valve back to the reservoir. Only the fluid needed by the closed loop system and the pump control is filtered.

Carefully consider whether to use a non-bypass or bypass filter, as excessive pressure drops can occur that may lead to charge pump damage as well as con-



Return line filtration.

taminants being forced through the filter media. A "loop flushing" valve in the circuit increases the volume of "dirty" fluid being removed from the system and, consequently, increases the volume of fluid passing through the filter.

Full flow filtration has the charge pressure relief valve downstream of the filter element. All the charge pump flow is passed through the filter increasing the filter efficiency compared to suction filtration.

With full flow filtration, a bypass valve can prevent filter damage and contaminants from being forced through the filter media by high pressure differentials across the filter. Fluid will bypass the filter with a high pressure drop or cold start-up condition. Operating the system with an open bypass should be avoided, and a means of contamination indication is recommended.

OPEN-CIRCUIT DESIGNS

In contrast to closed-circuit hydraulic systems, suction filtration is not a recommended filtration method with open-circuit pumps. This is due to the potential for high inlet vacuum to occur. Instead, a screen is recommended in the reservoir covering the pump inlet. A 125 µm (150 mesh) screen protects the pump from course particle ingression.

Return line filtration, with the filter in the return line to the reservoir, is often the preferred method in open-circuit systems. All the fluid in the system passes through the filter as it returns to the reservoir.

Factors to consider when specifying a return line filter system are:

- Cleanliness specification
- Contaminant ingression rates
- Flow capacity
- Desired maintenance interval

Typically, a filter with a $\beta 10 \geq 10$ is adequate.

MAINTAINING A FILTRATION SYSTEM

As this article serves only as a guideline, it is imperative to work closely with the filter manufacturer when selecting a filter. Every open- and closed-circuit hydraulic system is unique, and the filtration requirements and performance must be determined by test.

It is essential that monitoring of prototype systems and evaluation of components and performance throughout the test program be the final criteria for judging the adequacy of the filtration system. hp

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MAURICE ASHMORE | Eaton Corp.

Designing and Troubleshooting with Screw-in Cartridge Valves

Knowing more about the application ensures the right valves will be used.

SiCVs include solenoid-proportional and motion-control valves such as these from Eaton Corp.

AT A GLANCE:

- **Here's what** engineers should know when designing or troubleshooting screw-in control valves applications, along with some case histories to illustrate why.
- **Before specifying** valves and other components, engineers should understand where and how they will operate.
- **Sometimes the** perfect valve has been specified for an application, but something goes wrong during installation or testing.

Screw-in cartridge valves (SiCVs) are widely used, but they occasionally cause problems. In some cases, the valves do not operate properly. In others, interactions between SiCVs and other components cause the problems. And sometimes the cause of problems is installation or user errors. But often the issue is a lack of comprehensive application information on the part of the engineer or designer. So, here's what engineers should know when designing or troubleshooting SiCV applications, along with some case histories to illustrate why.

UNDERSTAND THE APPLICATION

To ensure that the correct and most cost-effective valve is used, OEMs must share—and system designers must push for—in-depth application information. That includes:

PRESSURE. Maximum system pressure is an obvious starting point, but it's not enough. Pressures vary throughout the system—and can even be higher than maximum pressure—so engineers need to consider where the valve will be located. They should also be aware of intensification in the circuit, motors in series and gear flow dividers. There might also be shock pressures caused by machine operation. For example, digging, crushing, chopping and momentum can cause unexpected surges or spike pressures.

In one instance I personally witnessed (as with the other examples mentioned throughout this article), the valve location of a gantry crane at a port resulted in the brakes not coming on fast enough. The operators took great delight in showing me the issue; they accelerated the machine towards the end of the wharf and released the joystick. The crane kept moving towards the end of the wharf, approaching the edge and a dunking far too quickly for my liking. The solution was to mount pressure-reducing valves closer to the motors so that pressure did not have to build up along the entire hose run before the brakes were applied.

FLOW. Another (perhaps obvious) application parameter needed is the system flow, which lets engineers size the valves properly. Flow varies depending on the type of actuator being used. Flow from cylinders can be multiples of the inlet flow. Flows may also be split so that smaller valves will suffice, or regenerative systems can amplify the flow.

In one case, a customer was fitting a cover to a skip truck with extendable rotary arms. The customer complained that the spool-type flow dividers we supplied were not accurate enough. When the arms reached their resting point, one bottomed out before the other by a small amount. With ±10% accuracy for this kind of product, we explained that the valves were working as they should. The customer then told us that another supplier's product had been used and was working fine. On closer examination, we discovered that the minimum flow rating for the other valve was much higher than the flow in the system. In essence, the valve was doing nothing. To demonstrate, I took the spools out of our valve and the cover functioned in the same way as on the other supplier's. We explained that, without the valve, or with a non-functioning valve, the flimsy framework would twist if one side of the cover gets snagged.

ENVIRONMENT. Imagine an olive tree shaker. To harvest the olives, the machine grabs the tree's trunk and shakes, making olives fall onto a tarpaulin encircling the tree. Pilot check valves are mounted on the shaker cylinders, which vibrates fiercely. Many valves, including most of ours, are rated to last at least 1 million cycles, which is typical for SiCVs. Depending on the application, valves can last much longer or break down quickly. In this case, it took only two months for our valve to fail. Not good enough. As a result, the customer switched to another supplier's valves. It also failed within a month. They tried yet another supplier's valves and got the same results. They then called our company for help.

After some study, we determined the valve went through 1.25 million cycles per month with unknown pressure spikes. We decided to go with an older valve design with a pilot piston pushing against a poppet check. The valve, typically used in industrial applications, had been tested to 10 million cycles.

The point of this incident is that before specifying valves and other components, engineers should understand where and how they will operate. Environmental factors and ambient temperatures might be beyond the safe working limits of the valve or its electrical components. The answers to questions such as these will help design teams seriously consider safety and service life impacts:

- What is the valve's duty cycle?
- How often does the solenoid operate?
- How frequently does the relief valve open?
- Could the valve be exposed to water, salt or acid?
- Is the environment dirty or dusty?

- Will the valve be used in dangerous areas?
- Is there a risk of fire or explosion?
- Can the valve be mistreated? For example, could it be used as a footrest for a heavy boot?

UNDERSTAND THE PRODUCT

Once the design team thoroughly understands the application, it can begin to narrow down the contenders and evaluate potential valves. This entails understanding the function and operation of each type of valve, as well as how it works with other circuit valves and components.

FUNCTION. Engineers must understand how each valve operates if they are to choose the best one for their design. Engineers should not be limited by the name of a valve. If they understand its operation, they can use it in brand-new ways. For instance, sequence valves can be used as a logic element, a flow compensator or a pilot-to-close valve in applications such as regenerative systems, spreaders and tool take-off circuits.

Engineers who do not completely understand a valve's function and only look at the circuit can wind up making errors. In one case, an engineer mistakenly used standard over-center valves on bucket cylinders, causing them to bend. The engineer had assumed that relief valves in series would protect the cylinder. They didn't. The standard valve was replaced with a part-balanced valve in which the relief remains open despite back pressure.

Understanding a valve's operation also allows design teams to account for interaction between valves; such interactions are often why a system is not performing up to snuff. In one case, a client had four relief valves fitted in parallel in a high-flow application. Each valve fighting for flow created a loud, unsettling noise. To silence the noise, we changed the valves' settings so that there was 50-psi between each.

PERFORMANCE. Before specifying a valve, designers must understand what is expected throughout the machine's life, the safety requirements,and the OEM standards that must be met. Important data points include the valve's leakage, hysteresis, accuracy and response time. Some of these can change over a valve's service life. For example, a valve's leakage may change depending on the viscosity, oil cleanliness, erosion and whether aggressive fluids are used.

Installation and use. Sometimes the perfect valve has been specified for an application, but something goes wrong during installation or testing. Perhaps they weren't torqued correctly or a technician did not know how to properly adjust them.

In one unfortunate example, a customer managed to bend a 20-foot-long pallet stacking cylinder. The valves had a dampening device that could be adjusted to prevent the compensator spool from moving too far. The customer saw a bit of instability and adjusted one of the dampening screws, only to close it off completely. This resulted in a container being lowered on one cylinder while the other bent like a coat hanger. We worked with the customer to ensure everyone who went near the hydraulics on this machine knew how the valves functioned and what could go wrong.

Boiling down SiCV design and troubleshooting into knowing the application and product is perhaps a vast oversimplification. Understanding the valves is easier said than done. Eaton, for example, offers 12 types of control valves. There are 177 different functions; five sizes, in most cases; and an array of pressure settings, flow settings, manual overrides, adjusters, solenoid voltages and terminations, seals, and line body options. That provides more than 200,000 options from which to choose. With so many valves, it can be difficult to understand the nuances behind all of them.

So, what's a designer to do?

There are many ways to learn. The best way, undoubtedly, is through experience. Beyond that, attend training. Look into virtual sessions and in-person classes (the latter, if pandemic conditions allow). These courses go into great depths on the function, operation and application of each valve. Also inquire as to what materials suppliers have so you can learn on your own time. Eaton, for example, offers several articles in its SiCV catalog that explain valves.

OEMs, for their part, generally know the endgame and want the most cost-effective valves. Partner with a supplier or integrator that can help. These firms understand the intricacies of valves and will work closely with you to explore and understand the application, then develop a solution, normally in the form of a hydraulic integrated circuit (HIC).

Gone are the days when only SiCVs were considered for these applications. Suppliers have access to a broad range of hydraulic components to ensure they will likely have the right one. They can have industrial valves that are simple to incorporate given their standard mounting patterns, as well as mobile valves which can be mounted to manifolds. Filters and accumulators can be added to the package, and the manifold can be attached to the pump or motor, depending on the customer's preference.

The keys to a successful outcome are a close partnership at every stage of the design cycle, a full understanding of all requirements upfront and the flexibility to provide the performance needed while addressing clients' preferences. hp

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continued from p. 13

flow-control device. As the device's check-valve closes, air in the flow section can be adjusted to throttle the cylinder retraction. The flow-controlled air then goes through the valve's port B and leaves at port S through a muffler.

Before compressed air is used in a pneumatic device, it must be properly prepared so that it does not damage components.

CONTINUOUS CYCLING CYLINDER

Pneumatic components can be combined to cycle automatically without external controls (see schematic on page 13, top). It shows compressed air controlled by three valves (VLV05, VLV07 and VLV08). And when the solenoid (SOL06) is energized while the cylinder (CYL03) is retracted, the system starts cycling to extend and retract the cylinder.

Supply air flowing through VLV08 and SOL06 provides pilot air to the directional control valve (VLV05). The air supplied through this valve makes the cylinder extend and retract (cycle) in a similar fashion to the double-acting cylinder in the circuit above. To control cycle speed, flow control valves adjust the flow of air from the cylinder.

As the cylinder extends, it operates the 3-way, 2-position spring-returned valve (VLV07). which supplies pilot air to VLV05. The pilot air changes the valve spool's position, which reverses the cylinder's direction and retracts it. With the cylinder retracted, VLV08 is actuated, supplying pilot air to the other side of VLV05 and making the cylinder reverse direction and extend. The cycle repeats until the solenoid is de-energized, which ends the cycle once the cylinder retracts.

The 4-way, air-piloted, directional control valve (VLV05) and the two 3-way roller-actuated valves (VLV07 and VLV08) are this circuit's key pneumatic logic components. Unlike electrical solenoids, they use air to control the 4-way valve's spool position and are configured like limit switches with a mechanical arm. The valves are actuated by cams or flags on the cylinder and,

For safety, it is necessary to ensure both buttons are released after each cycle and that both buttons are pressed at the same time before supplying pilot air to the direction valve.

when not activated, the valves spring-return to their normal position.

TWO-HAND CONTROL

The circuit for a two-hand safety control system for a press application (see schematic on p. 13, bottom) features two pneumatic buttons (VLV01 and VLV02) configured as 3-way valves. They feed pilot air to a 4-way valve (VLV03). Both buttons must be pressed simultaneously to route pilot air to this valve, where it switches the valve spool and makes the double-acting press cylinder (CYL01) extend. When either button is released, the 4-way valve's spring return function puts the spool back to its normal position, supplying air to retract the press cylinder.

For safety, it is necessary to ensure both buttons are released after each cycle and that both buttons are pressed at the same time before supplying pilot air to the direction valve. The press cylinder will retract when only one button is released, but pressing a single button could make it extend if the other one is tied or clamped in the closed position.

As in the previous circuit, a 1-way flow-control valve controls the cylinder's travel speed by throttling its exiting air. Only the extend speed is controlled in this circuit. Adding a second valve could control the retract speed. To eliminate the possibility of a fast cycle if an emergency stop or idle air leaks use up all the air available, the air flow into the cylinder could be controlled instead.

Other upgrades could be added to this circuit as well, such as a pressure regulator to control the cylinder's extend pressure (force) or a pressure switch to sense and signal to a PLC when minimum press pressure is met. hp

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BETH FIGLIULO & MICHAEL COOK | Trelleborg Sealing Solutions

The Right Seal Reduces Contamination in Hydraulic Systems

Learn what causes contamination and how to choose seals that protect against it.

MIGUEL ANGEL PALLARDO DEL RIO | DREAMSTIME

Hydraulic equipment of all kinds benefits from eliminating contamination in the hydraulic fluid.

Contamination is estimated by hydraulic experts to cause 65% to 90% of all hydraulic system failures, making it a major cause for concern for fluid power engineers. And although filters have improved, oil can still become contaminated and cut short the life of hydraulic equipment.

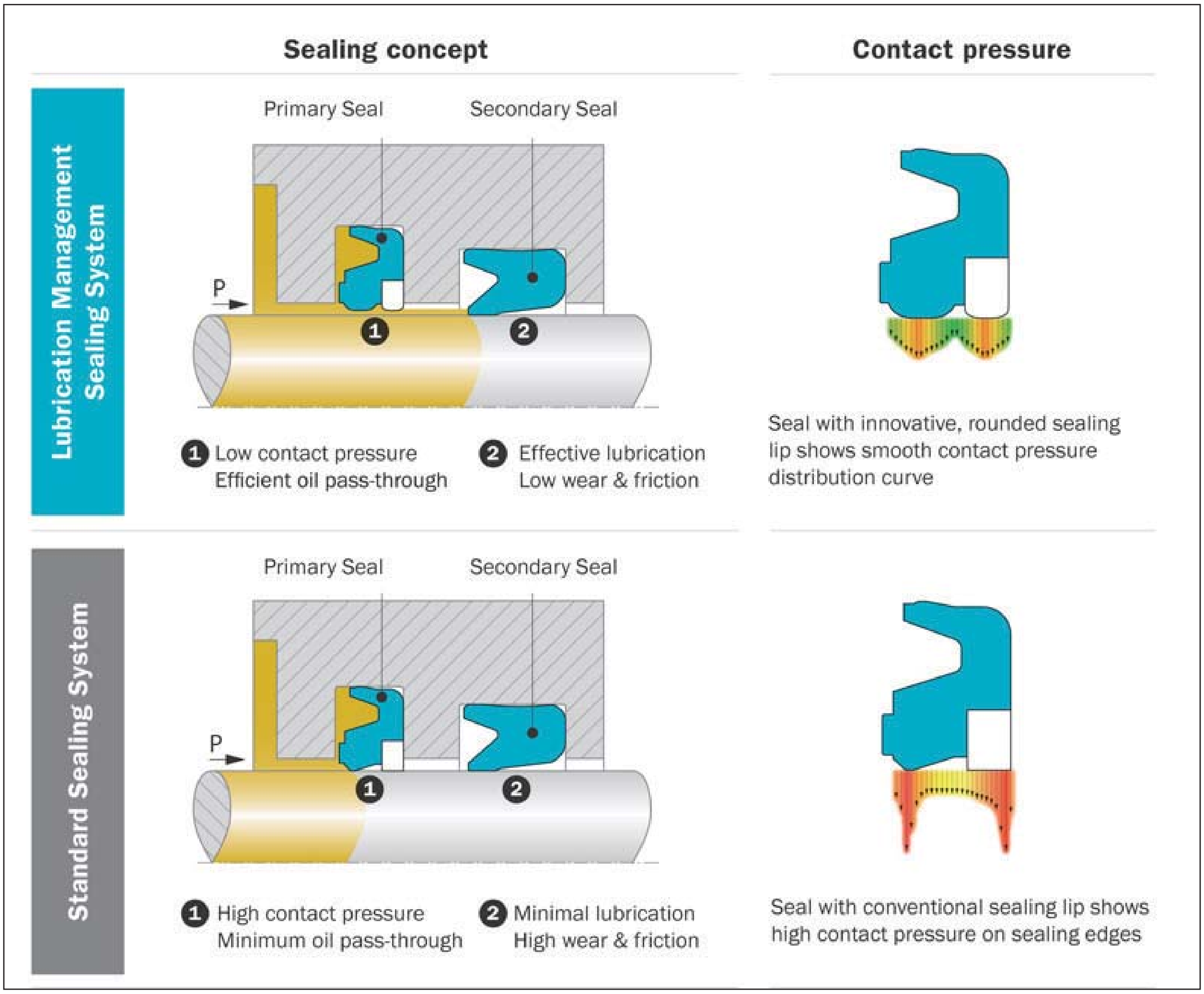
CAUSES OF CONTAMINATION

There are four main causes of contamination in hydraulic systems: particles left in the system during manufacturing; oil that is not properly filtered before it enters the system; particles and condensing water that get into the hydraulics through an opening or by bypassing the seals; and particles created by wear on one or more components.

Component wear, in turn, is caused by:

- Abrasion when lubricated surfaces contact one another, or clearance-sized particles damage a lubricated surface.
- Adhesive wear (or friction welding) that removes material from one surface through erosion.
- Fatigue, or point loading, that elastically deforms a component's surface.
- Erosion caused when silt-sized particles in a fluid form an abrasive slurry that erodes surfaces.
- Cavitation caused by vapor or air bubbles collapsing under pressure, which erodes metal parts.
- Corrosion caused by chemical byproducts, such as acids, that attack some metals when hydraulic oil is degraded by water or heat

Regardless of how wear occurs, contamination by particles inside the system (internal) or that mange to get inside (ingress) can be mitigated or prevented with the appropriate seals.



Lubrication management reduces heat and minimizes wear between primary and secondary seals.

SEALS TO THE RESCUE

Seals can be separated into four categories: hydraulic, wiper and static seals, along with wear rings.

Hydraulic seals primarily prevent leaks. They can also help limit internal contamination through Lubrication Management, an approach that uses specially engineered seals to regulate lubrication between primary and secondary seals. This reduces heat generation and minimizes wear, increasing the components' service lives. Less heat also lets hydraulic fluid last longer and not degrade, while reduced wear lowers the amount of particulates generated from the seals and their counter surfaces.

Wiper seals feature an outer scraping lip designed to prevent ingress of contamination. They are placed facing the external environment on dynamic surfaces where they are exposed to a variety of debris—such as water, dust and mud—common in hydraulic applications.

Wipers must exert the right amount of scraping force to ensure contaminants stuck to external portions of a rod are dislodged on each stroke. In many cases, a bi-directional wiper is used for additional oil film control.

Poorly regulated oil films can appear to be leaks and may let debris stick to the rod. Ensuring the wiper is correctly specified avoids this and lowers the likelihood of contamination.

Wear rings are parts of most hydraulic sealing configurations. They absorb transverse forces and prevent metal-to-metal contact, a common source of internal contamination.

Misaligned parts rubbing together can create and release metal particles into a hydraulic system. These particles become caught in the hydraulic fluid and carried throughout the system, causing wear on components and clogging fluid passages. Proper wear ring arrangements based on expected loads can prevent this.

Static seals are used throughout hydraulic systems and are often the last line of defense against internal leaks and outside debris getting into the hydraulics. They are typically located near threaded components. Therefore, it's critical to avoid damaging them during installation. In higher pressure applications, hardware can sometimes balloon, increasing the space between metal components. In these situations, it's important to specify the proper squeeze to ensure the seal retains enough sealing force to function.

CONSIDERING MATERIALS

Selecting materials for the seal components is important and often complex. The first and most obvious consideration is chemical compatibility with the hydraulic fluid and other media. For example, components made of ethylene propylene (EPM) and ethylene propylene diene monomer (EPDM)-based materials resist acids, ketones and alcohols, but are not recommended for petroleum oils or mineral oils. Similarly, nitrile rubber (NBR) is recommended for hydraulic fluids, but not for systems containing chlorinated hydrocarbons or ketones.

Temperature is also a factor. To get the longest optimized seal life, sealing materials must be matched to the hydraulics' maximum and minimum operating temperatures. For dynamic seals, frictional heat must also be considered because it can cause the temperature at the seal interface to be higher than the bulk fluid temperature.

System pressure is also important as high pressures can lead to the seal's material flowing into gaps in the hardware and potentially breaking off. This can be prevented if the hardware is designed with tighter gaps.

If heavy internal contamination or ingress is a risk, a durable, abrasion-resistant seal material can limit damage and extend system life. Working with a knowledgeable seal supplier at the beginning of a project can help ensure all elements within the seal are properly selected based on specific working conditions.

STORING SEALS

Some seals stored for extended periods or that are improperly stored can harden, soften or crack. Sealing suppliers can provide recommendations for storing elastomers and the shelf-life limits for specific materials so they can be used before they degrade. Seals should not be used after they pass their shelf-life date.

In general, elastomer seals should be stored in individual sealed envelopes or corrugated boxes at temperatures below 77°F with relative humidity less than 70%. The sealed envelope helps protect them from light and ozone-generating equipment, both of which can breakdown seal materials. The envelope also keeps seals away from contact with liquids, metals and dusting powders that can weaken them.

INSTALLATION

Seal suppliers typically provide instructions for installing standard seals. For custom seals, they prescribe application-specific installation methods. At the same time seals are designed, engineers should consider the installation process that will prevent damage to the seals. For instance, sharp edges should be avoided.

Generally, to prevent seal damage during installation, technicians should:

1. Maintain a clean, tidy and well-lit assembly area.
2. Make sure all necessary installation tools, fixtures and materials are readily available.
3. Remove machining residues, such as chips, dirt and other foreign particles.
4. Deburr and chamfer sharp edges.
5. Cover the tips of screw threads.
6. Ensure installation tools do not have sharp edges.
7. Make sure cylinder bores and rods have correct lead-in chamfers or use a calibration sleeve.

Because hydraulic systems rely on fluids to transfer and amplify power, as well as lubricate vital components, it's best to understand and counteract potential contamination and wear issues during the design of seals for hydraulics systems.

Understanding the four causes of contamination in hydraulic systems—as well as chemical compatibility, temperature, system pressure, and proper storage and installation—can help engineers choose the right seal, prevent contamination, avoid costly hydraulic failures and extend system life. hp

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ITT ENGINEERED VALVES www.engvalves.com

Intelligent Pneumatic Agitator Control

A SOLUTION FOR pneumatic pumps and agitators, Intelligent Paint Kitchen (IPK) control extends remote management to industrial paint supply and circulation systems with all types of finishing equipment. The Intelligent Paint Kitchen is a smart set of sensors, actuators and control modules that communicate with each other to optimize factory paint circulation and supply. It allows pump control (pressure and flow rates), tank control (tank levels and agitator speeds), and overall (remote) control. In addition to Graco E-Flo DC electric pumps, the Intelligent Paint Kitchen (IPK) now delivers closed-loop pressure, flow mode and a new hybrid mode to these Graco pneumatic pumps: Endura-Flo, Glutton and High-Flo (with NXT/XL motor). IPK can manage both electric and pneumatic equipment at the same time.

GRACO INC www.graco.com

Air Chuck System

NORTHFIELD'S BRAND-NEW CHUCKING system requires no air tubes or hoses. This Pressure-Lok air chuck is charged with air by a special handle and holds air pressure for more than two weeks. These chucks can be mounted to rotary tables with no thru-hole, tombstones, pallets, transfer systems, etc. The Pressure-Lok air chuck is useful in any machining operation that does not have an air tube near the machine.

NORTHFIELD PRECISION Instrument CORP
www.northfield.com

Filtration System

THE KFA 1500 is a highly efficient, low-maintenance ultra-fine filtration system for grinding carbide and HSS materials with a filtration capacity of 1,500 l/min. (397 Gal./Min.). The KFA 1500 keeps the cleaned coolant in the system for extremely long periods and does so in an energy-efficient manner, even with handling large tool batches. The tank system consists of the dirty oil inlet tank, the clean oil tank and the disposal unit. The tank volume is 10,000 liters (2,645 Gal.). Modern, low-maintenance and user-friendly technology ensures energy-efficient full-flow filtration, in which clean and dirty oil are separated 100%. Modern, high-performance pre-coat filters filter to NAS 7 for a very long time. This corresponds to 3 to 5 µm.

VOMAT www.oelheld.com

Medical and Life Science Brochure

KOGANEI'S MEDICAL AND life science brochure provides an overview of the company's core products, collaborative design process and OEM-centered service. It also highlights specific application challenges and solutions, such as how KOGANEI engineers resolved a difficult issue for a customer by designing a 5.9-mm wide solenoid valve small and light enough to be mounted and plumbed directly on a PCB. The company offers miniaturized solutions, designing valves, cylinders, actuators and desktop robots used in next-generation healthcare and research applications.

KOGANEI International AMERICA, INC.
www.koganeiusa.com

Valve Series

THIS SERIES INCLUDES inert gas/spring-operated valves to control high-purity, aggressive and corrosive liquid chemicals while allowing a superior flow rate. Each APVS Valve can be configured to meet critical user requirements with ordering options that include various port sizes, diaphragm seal materials, pilot options and valve function. In addition, an optional magnetic piston is available for end-of-stroke position sensing and can be combined with a magnetic position sensor to maintain positive feedback. Every Spartan Scientific and Canfield Industries valve is manufactured in the U.S. to ISO 9001:2015 standards and passes through extensive testing to ensure adherence to NSI FCI 70-2 Class VI.

SPARTAN SCIENTIFIC www.spartanscientific.com

Limit Switches

HIGH-TEMPERATURE PRECISION LIMIT switches provide a 10-micron accuracy and are rated for temperatures of up to 200°C. New high-vacuum resistance limit switches are high precision with an accuracy of 10 microns and are designed to be used in a high-vacuum environment. High-vacuum resistance precision limit switches come in stroke lengths from 0.8 to 5 mm and are available in M5x0.5, M14x1 and 16x1 mm threaded barrel diameters.

AUTOMATION DIRECT www.automationdirect.com

Flow Control Valves

A SOLENOID-OPERATED, 3-WAY proportional flow control valve is part of the expanding line of FLeX Series valves. The new patent-pending, compact FREP combines an electro-proportional adjustable orifice and pressure compensator in one valve and can provide a constant priority flow rate independent of load pressures. It's well-suited for situations where constant actuator speed needs to be maintained regardless of the load on the actuator, and it provides excellent variable flow control when using a fixed-displacement pump. The FREP valve brings precise control to orbital motors on conveyors, spinners or fans for equipment like salt spreaders, agricultural spreaders and seeders. Equipment designers and operators can control material output directly, avoiding excess application of material, saving money, optimizing yield and protecting the environment.

SUN HYDRAULICS www.sunhydraulics.com

Angle Encoders

SMARTER AND FASTER versions of the RCN absolute angle encoders series are used in machine tools requiring high speed, accuracy and contamination resistance. The new models RCN 2001, 5001 and 8001 are especially useful with fast rotating axes and direct-drive motors because the permissible speeds are up to three times higher than older established RCN encoders. When paired with an EIB 5211 sensor box, these new RCN encoders will transfer the temperature of the encoder and a direct-drive motor to the control in use. This gives the user the ability to push the system to its thermal load limits, which in turn increases production and cost efficiency.

HEIDENHAIN www.heidenhain.com

Vacuum Dehydrator

THE NORTH AMERICAN Vacuum Dehydrator (NAV) now can be shipped within five days as part of the QuickDelivery program. The NAV employs a low-maintenance, dry-running claw vacuum pump to remove 100% of free and over 90% of dissolved water and gas from oil. In addition, the NAV also removes particulate contaminants using premium, high-dirt-holding filter elements available in 3- to 25-micron ratings. Gauges located at eye level provide a visual indication of operating conditions. A state-of-the-art, user-friendly HMI enables user-defined system shutdowns and provides additional details on operating conditions, maintenance and troubleshooting solutions.

SCHROEDER INDUSTRIES
www.schroederindustries.com

Advertisers Index

"We All Must Meet Customers Where They Are"

FPDA president Kevin Kampe talks about the lessons of 2020 and the outlook for 2021.

After a year of turmoil and transition in 2020, the fluid power industry faces new challenges—and opportunities—in the new calendar year. A new federal administration is touting both a rollout of a COVID-19 vaccine and a bipartisan effort to pass a large infrastructure bill.

How those events and other might affect the fluid power industry were part of a *Hydraulics & Pneumatics* discussion with Kevin Kampe, president of Womack Machine Supply Co., in Dallas and current president of the Fluid Power Distributors Association (FPDA).

H&P: **Coming off a year no one really wants to look back on, what are your members looking forward to in 2021?**

Kampe: I think most are looking forward to a year of growth. Most members have been significantly impacted by the pandemic and are looking forward to bookings growth in Q1.

H&P: **Among the first things the new Congress and administration will take up is a long-discussed infrastructure bill. Talk about the impact this bill will have on your industry. What are the benefits and potential challenges in such an effort?**

Kampe: I think it largely depends on your customer base. Those that have OEMs of heavy equipment will certainly benefit from market demands. Contractor and other partners will need additional repairs and services to keep fleets up and running. Depending on the timing of the bill, many customers and suppliers may struggle to meet lead time and delivery demands.

H&P: **At a time when unemployment is still impacted by the pandemic, there still is a need for skilled workers in the fluid power industry. What steps has the industry already taken to address the worker shortage? How do we effectively recruit more people to the industry?**

Kampe: The biggest impact that industry has had comes from providing education—both on the technology of the industry as well as the roles and jobs available. Industry must continue to invest in high school, vocational and higher education programs to inspire students to pursue opportunities in fluid power and industrial automation.

H&P: **Many companies had to adopt new technology and work practices on the fly in 2020. What are some of the lessons from 2020 that you think will carry forward after the pandemic is over?**

Kampe: The ability to work from home is by far the biggest lesson learned in 2020. Companies have deployed remote technology that have enabled their employees to be as efficient—and in many cases, more efficient—than they were in the office. I believe all our members have learned how valuable virtual selling is in this new reality. We all must meet customers where they are and continue to drive business forward.

H&P: **What technology advanced should we look for in 2021? What will the next generation of tools and systems include?**

Kampe: I think everyone should be on the lookout for new virtual reality and augmented reality tools. These tools can create unique virtual environments to engage with customers. The speed of communication will also increase at a rapid rate in 2021. Making sure that you are ready to consume and communicate rapidly with your customer will be key. hp

Hydraulics & Pneumatics

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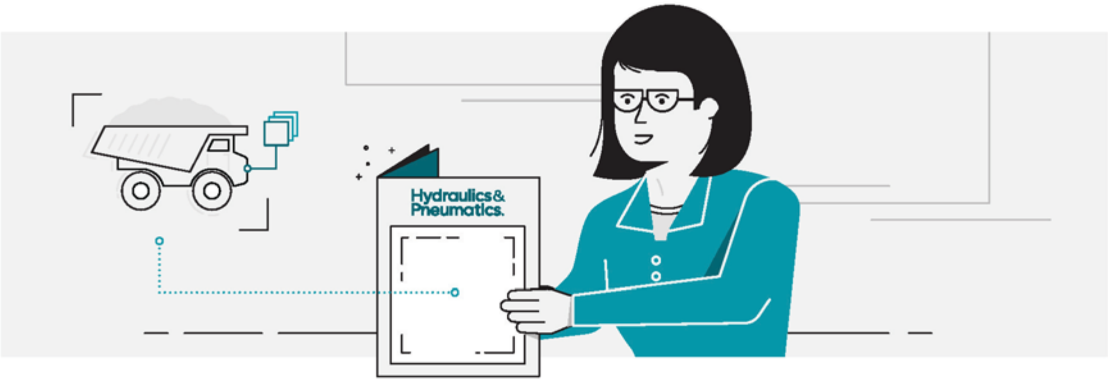

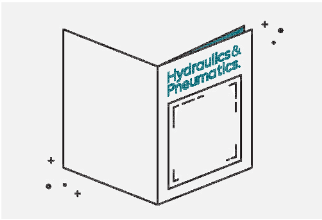

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People Who Care

Bob Vavra
Senior Content Director, *Hydraulics & Pneumatics*

After a long career in the newspaper industry, Bob has been an editorial team leader for more than 20 years. During that time, he covered the global transition of the plant floor and its systems and managed several international automation conferences. Bob is also a sought-after Webcast moderator and event emcee, and has presided over events in the U.S., Germany and China.

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