Flexibility in Fluid Power

Latest Sealing Technologies Offer Optimum Wear and Frictional Characteristics.

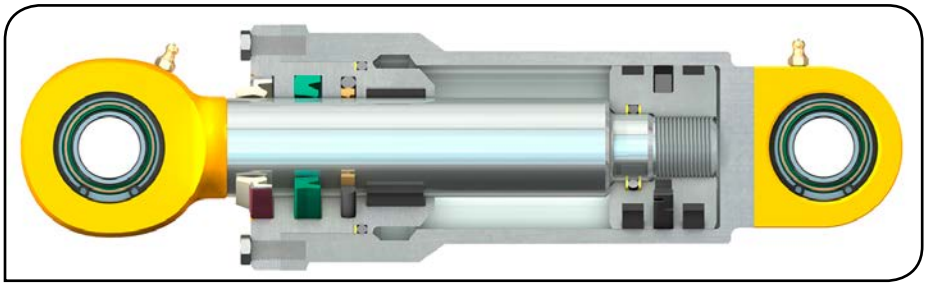
Matthew Jaster, Senior Editor

The selection of seal materials greatly depends on factors such as operating temperature, pressure rating, fluid type and the chemical compatibility of fluid. While the most common seals are manufactured with materials like PTFE, rubber or polyurethane, the fluid power industry is always looking for unique sealing solutions that work hand-in-hand with the most difficult applications.

With manufacturing capabilities changing rapidly, organizations like SKF and Freudenberg Sealing Technologies need to create dependable products for fluid power applications—and a little flexibility and creativity goes a long way in meeting customer's increased demands.

"Customers are seeking increased power density, along with changes in hydraulic fluids, rod surface coatings, and longer equipment life expectancy," said Scott Barth, business development manager for hydraulic seals at SKF. "Developing new materials, seal designs and sealing systems is necessary to meet these increasing market demands."

"We are seeing trends toward much higher pressures, higher loading, wider temperature ranges (higher and lower), more use of biodegradable & synthetic-based oils, and longer life. These lead to the need for more durable & robust sealing technologies," said Norbert Frank, global segment director, fluid technologies at Freudenberg Sealing Technologies.



This photo shows a hydraulic cylinder integrating seals between various components in the hydraulic cylinder (photo courtesy of SKF).

SKF Focuses on Expanding Material and Seal Capabilities

How do you meet the sealing requirements of a several different fluid power applications? It starts with broadening your product portfolio. SKF has several new and innovative sealing technologies including:

Hydrolysis-resistant urethanes for use in high temperature water applications or hot and high humidity ambient environments; internally lubricated urethanes for lower friction and improved wear resistance on ceramic coated shafts; bonding urethane to PTFE and other rigid plastics for improved performance at high pressures, temperatures and speeds; bonding thermoset materials to PTFE and other plastics for improved sealing and longer service life and more.

"Creating seal assemblies with materials from multiple manufacturing capabilities allows SKF to offer unique sealing products that address some of the most difficult fluid power sealing applications," Barth said. Additionally, creating seal packages that promote effective fluid sealing and improve the device efficiency by reducing loses due to seal friction."

Harsh and demanding applications really force these companies to find new and innovative ways to produce seals. For example, OEs are using more biodegradable fluids today which are more susceptible to entrained water. Most seal-grade urethanes fail from hydrolysis when exposed to high temperature, water or humidity. These hydrolysis-resistant urethanes offer a solution and performance upgrade to OE's using biodegradable or even some water-based fluids.

"As OE's move away from Chrome plated shafts to other options, such as Nitride or ceramic coatings, seal wear and service life become a concern. SKF is developing new urethanes with better wear and frictional characteristics to extend seal life on these new and more aggressive surface coatings," Barth added.

There are also some unique fluid power applications with high speed (rotary or reciprocating) and high pressures, which lead to high friction and increased wear which tends to reduce seal life. Incorporating PTFE or Nylon in to their seal design in critical locations, allows SKF seals to operate at lower temperatures, which can reduce seal wear and prolong service life.

Premium urethane, PTFE, PEEK, Nylon, Hytrel, NBR, HNBR, FKM… There are several material combinations SKF uses to enhance seal performance to meet a customer's application requirements. And the company will continue to look for new materials that will enhance their product offerings in the future.

Another area that is often addressed is how to make fluid power components more energy efficient. Utilizing materials with improved frictional properties in seal designs—that also reduce operating friction—can improve the efficiency of the fluid power being converted into a force for doing work.

"Also, designing sealing systems that reduce the pressure loading of

individual seals can lead to a reduced overall friction loss from the seal package, which also improves the efficiency of the fluid power being converted into a force for doing work," Barth said.

The end result hopefully is creating a product the both improves reliability and reduces environmental impact. Using more capable seal materials and optimized seal designs, as well as sealing components designed to work together as a sealing system, result in a more reliable sealing package, with longer service life and less likelihood that a fluid leak could occur and result in a spill into the environment.

Fluid power OE's are seeking to increase the power density on their equipment, which can lead to higher temperatures, pressures and dynamic velocities. From a seal perspective these increased system parameters can lead to noise, increased friction and heat generation that accelerate seal wear and material performance decay.

How will these sealing technologies evolve in the future?

Barth said they will need to keep up with increases in operating pressures, wider temperature ranges, more aggressive system fluids, and longer expected service life. This will be accomplished through the development of more capable seal materials, and improved seal geometries. R&D at SKF is actively working on expanding material and seal capabilities to meet these increasing customer demands.

Freudenberg Touts Latest Fluid Power Technology

Freudenberg Sealing Technologies has supported the fluid power industry for decades with highly innovative products that help customers tackle challenges such as rising demands for longevity, leak tightness and friction control. Four recent innovations illustrate the company's success.

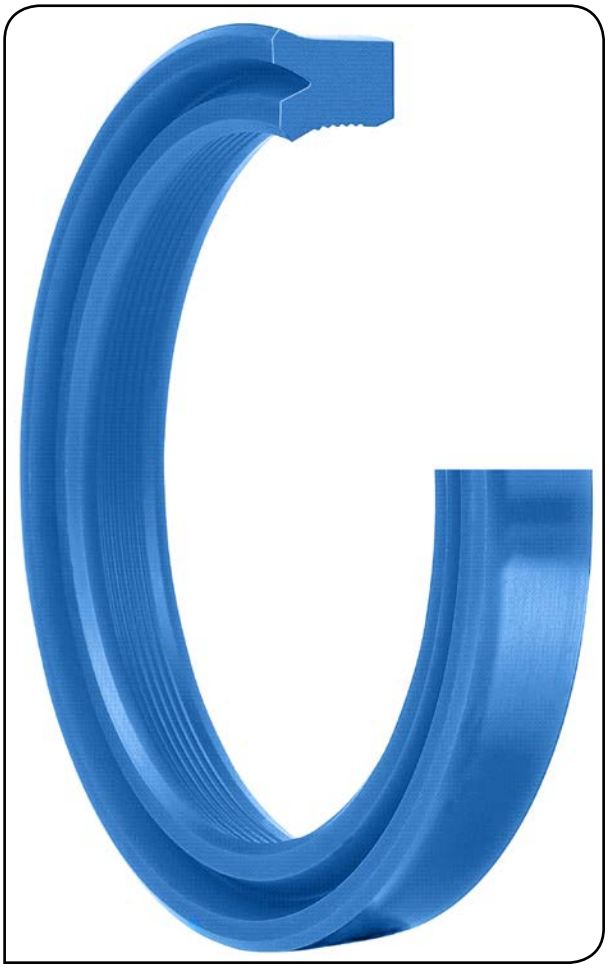
One of its newest materials, polyurethane 94 AU 30000, is setting new standards that meet fluid power requirements while ensuring a broader range of use. This innovation is complemented by the hydraulic wiper DMRW2, which is made of 94 AU 30000 and sheet metal. It features an integrated pressure relief function, a wiper lip and an additional sealing lip, which improves the sealing effect.

Another product Freudenberg is offering to the fluid power market is the BlueSeal, a patented Simmerring shaft seal that offers a weight savings of 40 percent compared to a conventional seal and requires only half as much installation space. This technology features a low-friction polytetrafluoroethylene power-optimized (POP) lip design that was developed to mechanically resist high pressures and stand up to aggressive substances.

Finally, the company's HDP330 High Pressure Piston Seals allow for optimum sealing performance in fluid power applications while enabling customers to save on mating component machining costs. HDP330 pistons seals consist of a step cut polyamide sealing cap and an elastomer energizer. The step cut cap is molded with unique molding processes to allow for a very flat sealing surface to prevent cylinder drift in the applications. The step cut design allows for easy assembly into the piston gland.

Until recently, manufacturers often had to keep different hydraulic cylinder seals in reserve, depending on the region of the world where the machine would be used and the medium that the hydraulic system would employ. But construction machinery today is developed for worldwide use and seals must be able to do their job reliably for years in the arctic or in the desert.

"The new generation of polyurethane (PU) seals delivers on this by extending maintenance intervals, increasing uptime and reducing costs, making them especially well-suited for construction and agricultural machinery, as well as materials handling technology. 94 AU 30000, for example, is more resistant to water and synthetic hydraulic fluids and withstands major temperature fluctuations better than other existing polyurethane materials. The material offers excellent performance in heat and cold and can be used in mineral hydraulic fluids at temperatures ranging from –31°F (–35°C)



Besides seal design, friction reduction can also be achieved by special Reduced Friction Nanotechnology (RFN) coatings or by grooving sealing surfaces (photo courtesy of Freudenberg).

up to 248°F (120°C)," Frank said.

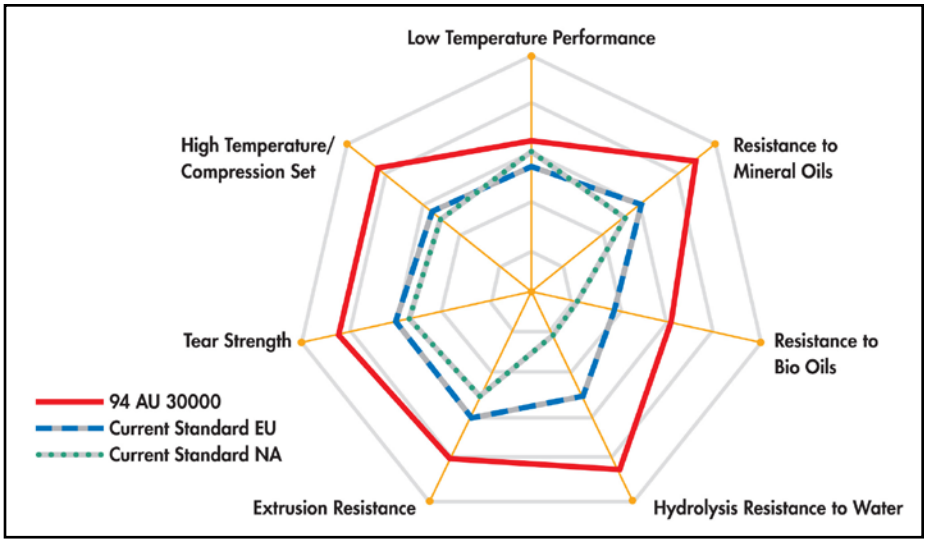
The main materials at Freudenberg Sealing Technologies are polyurethane, polyamide and polytetrafluoroethylene (PTFE). The requirements for materials in this market include high values for tensile strength and elongation at break, resistance to oils and ozone, high elasticity and abrasion resistance. "We develop and manufacture our own materials which allows us to custom tailor the blend or additives to give very specific advantages based upon the application," Frank added.

For example, while polyurethane meets basic industry requirements very well they are also subject to severe wear and manufacturers are increasingly looking for universal solutions to cover broader ranges of applications. Materials like 94 AU 30000 are being developed to provide such universal solutions.

"At the same time, we continue to work on development of new elastomers that offer even better performance and longevity, which will lengthen maintenance cycles and reduce downtime," Frank said.

These include products like BlueSeal that help reduce friction and strongly improve the energy efficiency of a system. Besides seal design friction reduction can also be achieved by special Reduced Friction Nanotechnology (RFN) coatings or by grooving sealing surfaces. Freudenberg can also use FEA simulations as physical testing to customize the sealing-tightness-to-friction ratio.

Reduced friction means reduced temperatures and reduced wear in the seal. If a seal causes less friction it will perform longer and thus prevent oil and other fluid leakage. Hydraulic fluid leaks are an unmistakable sign of imminent seal demise. But the early effects of material failure are not directly visible in most cases.



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There is an increase in a vehicle's CO_2 emissions if slight disturbances in the frictional torque of a crankshaft seal occur. The triggers are often aggressive media and extreme loads.

Additionally, fluid leaks in some industries can have dire consequences. Fluid leaks in agricultural equipment could lead to soil, water and crop contamination.

"Increasing longevity, leak tightness and friction demands on seals have led to new applications for both existing and new Freudenberg products such as certain Simmerring shaft seals and hydraulic cylinder seals. Our expertise allows us to choose specific material and design combinations that best address the challenges at hand," Frank said.

Agriculture machinery is becoming smaller and lighter to achieve cost reductions and to meet CO_2 emission restrictions. The installation of additional components like filters into this machinery helps achieve CO_2 reductions, but also leaves less installation space for other components.

"Therefore, our products need to become smaller which in turn increases physical influences like power density. This means our products have to withstand higher pressure and temperatures," Frank added.

Freudenberg Sealing Technologies step cut design allows for easy assembly into the piston gland and the robust design and material allow for the use of DOM (drawn-over-mandrel) cylinder tuning rather than honed. This can vastly reduce the cost of the cylinder assembly.

The seals in a hydraulic cylinder also have so-called guide elements in the form of rod and piston seals that are designed to prevent contact with the cylinder housing. The challenge here is a trade-off between absorbing high transverse forces and keeping frictional losses as low as possible. This is a complex issue especially for long-stroke cylinders, due to the insufficient lubrication during short strokes and the sagging of the long piston rod.

Freudenberg introduced high-performance guides, the patented piston and rod guides Guivex KBK and SBK, more than 10 years ago. The company's patented profiling of the guide rings from a fabric-based laminate greatly facilitates the entry of the lubricant into the area between the guide and the counter-surface. Shear forces that occur are evenly distributed.

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The need to do more work within a given space typically means higher pressures for hydraulic systems. In addition to high-performance guides, Guivex KBK and SBK, Freudenberg's material offerings like 94 Au 30000 and HDP330 piston seals help address these challenges.

"We are seeing some major trends that influence fluid power applications, including strong commoditization of sealing solutions and an increased demand in mid-level quality products. Customers are no longer willing to pay high prices if there are 'good enough' products on the markets, even if these products lack longevity or reliability. Freudenberg is well prepared to handle this trend thanks to our special sourcing teams that can provide such products from proven and certified partners," Frank said.

Another trend is increasing demand for energy efficiency, according to Frank. "Given rising prices for energy and strict legal requirements that govern the use of energy, our customers are demanding more energy efficient components, especially for pumps and motors or for cylinder coatings (like ceramics). Energy efficiency is also an important factor for air compressors for pneumatics."

And with green efforts across the globe, sustainability remains an important focal point. Seal design can play a significant role in making sure green manufacturing initiatives are being met.

"There is a rising demand to reduce environmental impact of products and recyclability. The use of ecological lubricants or biodegradable oils has a certain impact on sealing materials. And we have norms and regulations like REACH that are banning materials like chromium plating," Frank said. **PTE**

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