Taking the Guesswork Out of Hydraulic Hoses

Eaton's LifeSense hose technology designed to provide real-time monitoring of hose condition, alerts equipment operators when failure is imminent.

By Mike Brezonick

Knowing when a component on a piece of engine-powered equipment is going to fail remains for the most part a guess. In many cases, it's an educated guess — manufacturers have spent thousands of hours and millions of dollars on life-cycle studies and failure analyses to determine how long components will last. But in the end, because of the vagrancies of each application, the environment or conditions a machine may find itself in, the dedication (or lack thereof) of maintenance personnel and myriad other factors, knowing when a failure is about to occur remains pretty much a guess.

In at least one case, however, the Hydraulics Group at Eaton Corp., working with Purdue University, has developed a product designed to take the guesswork out of the when-to-replace equation. Eaton's new LifeSense hose technology is essentially a heavy-duty hydraulic hose that provides continuous real-time condition monitoring and will warn the machine operator when hose failure is imminent.

The LifeSense hose is currently available in -8, -12 and -16 two-wire hose assemblies. Eaton said the hose offers performance equal to industry-standard 2SN pressure-rated hose and is certified to the same specifications as conventional hydraulic hose products.

The key to the LifeSense hose is that it incorporates wire layers — similar to those used in conventional high-pressure hose designs — as a conduit through which an electrical signal is passed. "It's very similar in construction to our current hoses," said Doug Jahnke, Eaton product marketing manager. "We had to tweak the materials that we use a little, so it is a unique construction. The fittings also are unique — not terrifically different from what we build every day — and the performances are to standard pressures."

The electrical signals are continuously passed to a monitor that can be mounted in a machine's cab or operator compartment. When it detects a specific change in condition that indicates a hose failure is imminent, it alerts the machine operator. A single monitoring unit is designed to handle input from multiple hose assemblies.

"It's kind of like a temperature gauge in a car," Jahnke said. "It's measuring the entire length of the hose circumferential using an electrical signal. While the equipment is on, the monitor is in constant contact with the full length of the hose. When the hose starts to degrade or the material on the hose starts to degrade, it sends a signal that is detected by the monitor."

"There is a consistent pattern of events that happens leading to failure in every hose. So it's not looking at just a single point or several points in the hose, it's looking at the entire hose. Any place there is a weak spot, it is picked up by the monitor."

Like so many other technological advancements, the evolution of the LifeSense hose concept began two years ago during the course of some normal hose research.

"One of our hose engineers was in the lab doing some testing and he noticed some very consistent results prior to failure in the feedback he was getting from the hoses that he was testing," Jahnke said. "He was getting the same feedback whenever a hose was about to fail. So we started a project working with Purdue University to..."
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try and expand on what he learned to confirm those consistencies.”

It was clear from the outset what the potential for bringing real-time predictability could potentially bring to the mobile fluid power market, Jahnke added.

“Until now, there has not been a system out there that could accurately tell someone that a hose is approaching the end of its useful life,” he said. “So you either wait until it fails and then you replace it — in which case you have oil in the ground, you’ve got failed equipment, downtime and possibly safety issues and environmental concerns. Or every so often you just replace the hoses.”

That, Jahnke said, could also be a costly proposition. “I was at a gold mine and we went into the shop,” he said. “They had a mobile drill rig that had probably about 150 hydraulic hoses on it. It had been underground for about seven months and they brought it up for their preventive maintenance. The maintenance mechanic said they were probably going to replace most, if not all, of the hydraulic hoses on that piece of equipment — even though it had only been underground for seven months — because they didn’t want the possibility of a hose failure underground stopping production, where it’s immediately hundreds and hundreds of dollars lost.

“That same mentality applies to underground coal mines. We’ve seen that time and again, they just bring equipment up every year and just strip all the hoses off and put new hoses on because downtime is extremely expensive. On oil and gas rigs out in the ocean, the cost of downtime can be more than $500,000 a day if a rig has to shut down and they can’t produce oil.”

The LifeSense hose, he said, would mean that downtime could be minimized, along with the cost of replacing hoses that still have service life in them.

“Our estimate is that in general, users who use a time-based replacement process would get 50% or more — and sometimes far more — life out of their hoses with LifeSense,” Jahnke said. “Typically in our testing, the failure is detected within 5% of the end of the useful life of the hose. It’s usually between 1 and 2%. But 1 and 2% is usually weeks or months. It’s not something where you find out minutes or even hours that failure is imminent.

“That means that preventive maintenance becomes more of a routine process, and when they do have a hose that’s been identified as going to fail, they can do it during the preventive maintenance time or they can just stop the piece of equipment and replace it without having downtime out of the blue.”

The LifeSense technology is currently available with factory-made assemblies including straight JIC swivel fittings, Eaton said. dp
The addition of the quick disconnect coupling products, technologies and manufacturing facilities of Hansen couplings and Coupleurs Gromelle has enhanced Eaton’s ability to serve a range of hydraulic and pneumatic markets. Additions to the product line include the TH-Series quick-disconnect hydraulic couplings that target oil and gas and mobile applications, along with the FF series couplings suitable for contamination-sensitive applications in mobile machinery and oil and gas equipment.

They incorporate a ball-locking mechanism and a low pressure drop, Eaton said, and are available in RoHS-compliant zinc-plated steel and 316 stainless steel with stainless-steel springs, balls and retaining rings, and standard Buna-N or option-al fluorocarbon seals. They are rated for working pressures to 6500 psi and are available in four sizes from 0.25 to 1.0 in., the company said. dp