Eaton and Purdue have patented a new hydraulic hose technology, Eaton LifeSense™. LifeSense monitors the health of hydraulic hose assemblies, detects events that have been shown to be symptomatic of the hose beginning to fail, and notifies the user prior to failure with enough time to replace the hose before it fails.

Hydraulic hose has a finite life that ultimately ends in failure. Since the cost of failure in terms of unscheduled equipment downtime, environmental spills, equipment damage, and safety can be, and usually is, very high, it is common practice to replace hoses on a regular schedule before they reach the end of their useful lives.

Predictive, or time-based, replacement has been industry practice simply because there was no reliable way to determine the actual condition of a hose while it was in service. Post-mortem examinations of hoses from the field can identify the mechanisms of failure, and these mechanisms have been known for a long time. What has been lacking, however, is a technology to monitor the status of those failure mechanisms while the hose is in service and reliably alert the operator when an end-of-life event is imminent.

Some hose manufacturers have attempted to support this approach with various predictive formulae that consider time, pressure, temperature, the number of flex cycles, and other factors to produce an approximation of expected hose life. This approach causes millions of feet of good hose to be discarded every year, often long before the end of its service life.

Finding A Better Way

As a major global supplier of hydraulic hose, Eaton’s Hydraulics Group initiated a research project in partnership with Purdue University to address this issue. Purdue is a member of the Center for Compact and Efficient Fluid Power (CCEFP), an
Hydraulic Hose That Tells You When It’s About to Fail

True Condition Monitoring

Eaton has an exclusive license for this technology, which is used in its recently introduced LifeSense hose. The system includes a new hose incorporating at least one conductor in its construction, a special end fitting that serves as both a hydraulic and an electrical connector, and a diagnostic unit containing the monitoring electronics and operator notification interface. The hose is offered initially only in factory assemblies with straight JIC swivel fittings in the widely-used -8, -12 and -16 sizes.

The hose offers performance equal to industry standard EN853 2SN rated hose and, while a unique construction, is certified to the same industry specifications as conventional hydraulic hose products qualified to the 2SN specification. Additional sizes and fitting configurations are planned for future product line expansions.

The unique construction of both hose and fittings is required to allow the sensing capability. Although the specifics of construction and monitoring technology are proprietary, the system is based on the fact that certain electrical properties of the hose change as the hose approaches failure. Comparing periodic samples of these properties to a baseline value gives a highly reliable indicator of imminent hose failure with sufficient warning time for an operator to complete an operation, or in most cases a shift, before the equipment needs to be shut down for hose replacement.

The diagnostic unit contains the electronics necessary to implement the sampling schedule and store enough data to support the necessary comparisons, a proprietary algorithm to detect the relevant changes, and a simple LED output to notify the operator of hose condition. One diagnostic unit can monitor inputs from up to 11 hose assemblies.

Bottom Line Benefits

During the laboratory testing phase of the hose development, it was discovered that most of the hoses replaced on a time-based schedule of estimated useful life had actually reached less than half of their safe useful lives in the test protocol. In other words, the ability to detect imminent failure accurately can extend the useful service life of these hoses by over 50% on average.

Extrapolating that number to the millions of feet of hose being replaced on-schedule today indicates a significant savings for end users of all kinds of hydraulic systems. Of course, not every hose that is replaced on-schedule is a candidate for the technology at this point, but the potential for cost reduction is significant across the industry.

The amount of downtime required for hose replacement is also an important factor in operating cost. The LifeSense technology can significantly
reduce unscheduled downtime related to hose failure, saving anywhere from hundreds of dollars per hour on construction equipment to hundreds of thousands of dollars per day on an offshore drilling or production platform.

Another major financial impact of technology will be a significant reduction in the number of hydraulic fluid spills caused by hose failure. Laboratory and field testing shows conclusively that a LifeSense hose provides sufficient warning of imminent failure to make spills from that source a very rare occurrence.

Hoses will continue to be improperly applied and compromised by mechanical damage from external sources, as in the case of a hose being snagged by a tree limb and ripped off of a piece of forestry equipment. So the technology will not prevent all spills. But it clearly can dramatically reduce the number of normal hose failures.

The hose has the ability to monitor itself, detect unhealthy symptoms, and warn the user of imminent failure. As the technology behind it expands and matures, it really is possible to envision a time when hydraulic hose failures will no longer be a major concern for equipment operators.

For more information, visit www.eaton.com.