
Developing the Ideal Hydraulic Fluid

By Eaton Hydraulics Division

It started out as

one of those questions that are frequently posed when a group of colleagues get together: “What would you include in the design of the ideal hydraulic fluid?” The question was posed by a fluid supplier and might have been dismissed as small talk, except that it was directed to Thelma Marougy, one of a very small group of people with the knowledge and experience to answer it authoritatively.



“Thelma is recognized and respected throughout the industry,” said Doug Jahnke, product marketing manager. “When she speaks, everyone listens because nobody knows more about hydraulic fluids than Thelma. After more than 20 years, she’s seen it all, and more important, she knows what to do about the problems she finds.” Marougy is based at the company’s R&D center in Southfield, Mich.

Intrigued by the question, Marougy set about developing a set of specifications for an “ideal” hydraulic fluid based on her experience. But to her this was no academic exercise, and when she brought the concept to Jahnke, he immediately recognized the commercial value of what she had done.

The concept behind the commercialization of the project was simple: develop a premium hydraulic fluid that would extend the life of the company’s pumps, motors and valves to deliver even greater value to customers who depend on them. While there were a few “premium” fluids on the market, none of them was developed by a company that also produces hydraulic components.

According to Marougy, Eaton is uniquely positioned to undertake this project because the company manufactures a full range of pump and motor technologies. “Piston pumps and motors are different from vane pumps and motors, and are different from gerotor pumps and motors and geroller pumps and motors,” she said. “They all have their idiosyncrasies and they all have their operating niches. We were tasked with designing a premium fluid that performed equally well in all of them, as well as in valves and other hydraulic system components. It certainly was not a simple challenge, but it was one I was confident we could achieve.”

Virtually any liquid can be used in a hydraulic system, including water, motor oil, tractor oil, vegetable oils, food-grade oils, non-staining oils and a variety of specialized products. But the mere fact that a specific liquid can be used does not make it a good choice.

“Unless the customer is meeting some specific requirement, like using a food-grade oil in a food processing plant, the best choice is almost always a petroleum base stock combined with an engineered package of additives,” Marougy said. “But, not all base stocks are equal and all additive packages certainly are not equal. What we find is that most fluid suppliers sell two grades of fluid – one is low grade and the other is a little better. A few also sell what they call a ‘premium fluid’ that is a little better than their ‘little better’ product.”

She added, “Hydraulic components have certain very consistent appetites when it comes to fluids. Once you understand that, the challenge is to select the appropriate base stocks and then design the proper additive package to achieve the desired results. In this project, we worked with the leading additive manufacturer to develop the package and partnered with Valvoline to provide the blending capabilities and help with product distribution through their network.”

The additive package includes more zinc dithio-phosphates (Super ZDDP) than conventional hydraulic fluids, plus other proprietary additives. According to Marougy, low-quality ZDDP will form corrosive and insoluble by-products that can plug filters, stick valves, and attack and corrode yellow metals such as bronze and brass. “This premium formulation effectively eliminates those problems and delivers outstanding performance.”

The fluid uses a standard base stock rather than an expensive synthetic base because a standard base provides all of the performance required in nearly all industrial applications – as long as it is blended with the right additive package. According to the company, the product will improve the efficiency and maximize the service life of the equipment it’s used in.

“Once the base was selected and the additive package designed, the prototype fluid was rigorously tested,” Marougy noted, “and fluid testing is something we know a lot about.”

The candidate fluid was subjected to extreme bench testing that far exceeded industry standards, plus a special severe extended Vickers® 35VQ25 pump test to demonstrate its ability to withstand long-term use in the most demanding application environments. While currently available “premium” fluids typically begin to fail at 800 hours, the new formula was tested to 1,400 hours before any signs of degradation were noted.

These tests conformed to the company’s standard ATS-373 protocol and the industry standard ASTM D-6973 series. The candidate fluid was also tested extensively for compatibility with various hose compounds and with protocols other than the Vickers 35VQ25 pump test. Among these were tests for leakage and swelling, as well as hydraulic impulse testing. Both premium and standard hoses were included in the testing.

“We were designing a premium fluid,” Jahnke said, “and that meant it had to meet performance requirements for all system components, not just pump and motor wear. It’s unusual to test compatibility with hose compounds when developing a hydraulic fluid, but (it) is an unusually good product.”

“We settled on three standard viscosities,” Marougy noted, “AW 32, AW 46 and AW 68. These meet the needs of the broadest selection of our customers while offering choices for those with special requirements. The heavy AW 68 fluid is often chosen for sensitive applications where its increased viscosity reduces leakage; however, it would be at the price of a small reduction in overall system efficiency. The other two, AW 32 and AW 46, meet nearly all stationary system requirements. AW46 and 68 meet most mobile application requirements.”

Figure Identification:

1. Thelma Marougy
2. Eaton 35VQ25 pump

For more information, contact Eaton Hydraulic Operations at www.eaton.com/hydraulics.com.

Figure 1



Figure 2

