

## Novel Drill Bits Break New Ground, Improve Well Economics

Continuous improvements in drill bit design and performance are driving an ongoing revolution in drilling efficiency in horizontal resource plays. Oil and gas companies are setting rate of penetration records while drilling in single runs sections that very recently required multiple bits and trips. Combined with pad drilling and advances in rigs and other downhole technologies, the net result is that operators are drilling longer-lateral wells in half the time and at half the cost.

Bit designers say their latest solutions will continue to move the drilling efficiency needle and improve well construction structural costs. The latest systems include PDC bits that automatically adjust depth of cut, steel body PDCs for

abrasive formations, and hybrid designs that offer a roller cone's steerability with a PDC's speed. Meanwhile, new cutter shapes and layouts are enabling bits to drill faster and farther.

### Extreme Parameters

During the past three years, the demands placed on bits have increased dramatically, says Ben Phillips, a senior marketing specialist at Ulterra Drilling Technologies LP. "As operators have looked for ways to drill economic wells at lower oil prices, they have increased every drilling parameter," he reports. "In some cases, they are doubling their pump pressures, flow rates, WOB and torque."

Those extreme parameters have de-

livered 100 percent increases in ROP, but to withstand them, mud pumps, motors and other drill string components have had to be re-engineered. Aron Deen, Ulterra's director of marketing and innovation, says bits must follow suit.

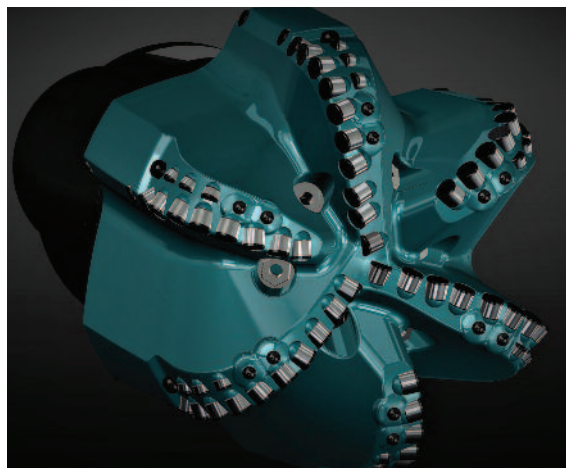
"With so much energy going through the bit, it can become the weakest link in the BHA," he warns. "If not accounted for in design, that can manifest as severely damaged cutters and failures in the pocket geometry, all the way to catastrophic material failures such as bits cracking and separating."

To prevent such failures, Deen urges operators to insist on recent designs. "When operators have tried to run bits that were designed or even built two or three years ago at today's parameters, they have had whole blades break off," he says.

To ensure it continues to meet operators' needs, Deen says Ulterra is developing bits for extreme parameters. "Operators will continue to push bits harder and harder, and we want to stay ahead so they never have to worry about a bit causing a failure," he says.

In the process, Ulterra is refining its bit manufacturing techniques. "We are paying attention to fine details that may increase our costs, but significantly improve strength, durability and consistency," Deen says.

Because PDC cutters play a vital role in bit success, the company is using the most robust cutters ever developed for



Ulterra's upcoming XtremeParameter™ drill bits are designed to endure the high pump pressure, weight on bit, and torque levels operators are adopting to accelerate well construction. The company credits the bits' reliability in early field trials to careful cutter selection, advanced materials, and more robust bit geometries.



extreme parameters, according to William Dubose, Ulterra's manager of PDC cutter and materials development. "Of course, deep leached cutters are our standard, but we have learned to pay attention to every part of the cutter recipe," he says. "When the cutters see this much energy, leaching profile, depth, grain size gradient, interface—everything has to be scrutinized."

Dubose adds, "Lab tests alone have proven inadequate, so Ulterra bases all cutter selection decisions on empirical data from real drilling applications."

Deen says the company also is improving bit geometries. "We are adding

support structures to the primary cutting structure to help convey energy from the core to the cutters," he details. "We also are fortifying and supporting secondary features such as depth of cut and load limiters."

Ulterra is reinforcing the blades as well, Deen relates. "Instead of attaching the blades to the body after it is made, we are taking an integrated, holistic approach where the blades extend organically from the bit's core," he outlines. "New blade materials are less likely to fatigue, crack and break in corrosive and extreme parameter environments."

In early field tests, these changes have doubled blade strength, improved pocket integrity, and kept cutters sharp throughout runs, even at twice the WOB.

"We are planning to launch the XtremeParameter™ PDCs in the second quarter," Deen says. "Toward that end, we are working with operators in the Permian and Delaware basins. We also are doing tests in Mid-Continent applications where the standard WOB has gone from 25,000-40,000 pounds to 50,000-100,000 pounds. The parameters there should push the bits to their limits." □