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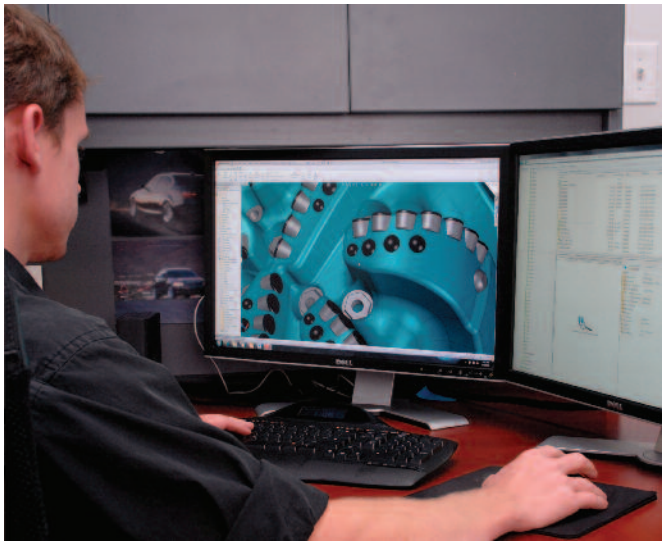
New Bit Innovations Offer Higher ROPs And Lengthy Run Times

By Colter Cookson

Drill bits have an impact that far exceeds their cost. A well-designed bit that is appropriate for the application can save thousands or even millions of dollars by reducing rig time, staying in the sweet spot, and delivering a high-quality wellbore.

Given bits' dramatic impact on well economics, it is no wonder bit designers continue to engineer new approaches to old problems. In the endless quest for faster penetration rates, longer runs and better steerability, manufacturers have introduced cutter configurations that counter vibration; bits that drill a small hole to relieve rock stress, then widen the hole to the desired diameter; and designs that turn conventional wisdom on its head by increasing ROPs with smaller cutters. Other bits leverage advanced manufacturing capabilities, application-specific designs, and ultratough seals to tackle hard, abrasive formations.

Many of these products came about because the designers looked outside the industry for inspiration. Consider Ulterra's CounterForce™ cutter configuration, which engineering project manager Aron Deen says originated from machining.



"In machining, a tool has been known for decades to improve material removal rates and reduce vibration, especially in brittle materials," he says. "We decided to see what would happen if we adapted the tool's staggered tooth concept to a drill bit. Because the tool reduces vibration, we hypothesized the bit would offer increased durability and higher penetration rates."

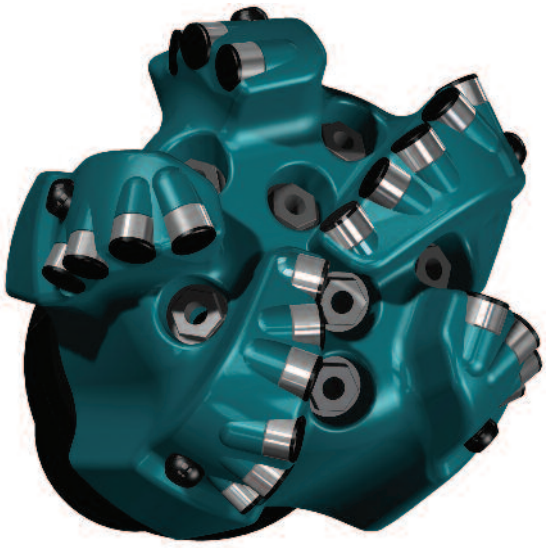
That hypothesis has proven correct, Deen says. The ROP increase varies by application, but generally falls within 10-50 percent. In the Eagle Ford, where most of the early tests took place, the company achieved 20-30 percent increases, he reports.

How does the cutter configuration increase ROP? According to Deen, the key is its ability to counter lateral forces. "In most PDC bits, the cutters on each blade are aligned, so when lateral forces push on the bit, the cutters provide almost no contradictory lateral force. They will shift sideways and allow the bit to vibrate.

"With CounterForce, the cutters are canted and disaligned to create a reactive force that keeps lateral forces from moving the bit, because the cutters are engaged in the formation in that direction. If the lateral forces from the BHA are so strong they move the bit despite the counterforce, the cutters are oriented to fail the formation in front of them. Instead of wasting the energy from the vibration, they use it to fail the formation and drill ahead."

Because it reduces vibration, the design should improve durability, Deen continues. He says that benefit has been confirmed by initial field tests, which compared 90 CounterForce wells with offsets that were within three miles, went through the same formations, and had been drilled during the past two years.

"With less vibration, we would expect to see fewer tool and motor failures," Deen notes. "That is exactly what we saw. The CounterForce runs were less than half as likely to be pulled for tool or motor failure. We not only improved bit condition, which enhances drilling efficiency and reduces the number of bits that are damaged beyond repair, but also provided greater tool reliability."



The cutters on Ulterra's CounterForce™ bits have been placed and angled carefully to negate vibration-causing lateral forces, or to use those forces to drill more efficiently. As a result, the cutters improve bit durability, tool reliability, and penetration rates.

Directional drillers have praised the bits' tool face control, he adds. "The bit provides great control because it is able to drill more efficiently with less weight on bit, and more importantly, less torque. Having consistent torque and controlling motor orientation is the main limiting factor when it comes to directional drilling, so this is allowing directional companies to keep the bit on course," Deen explains.

Ulterra has completed 1,200 runs and drilled more than 4 million feet using CounterForce bits, he reports. "We have gotten good results from Canada, the Mississippian Lime, the Marcellus Shale, the Bakken Shale, the Piceance Basin, and the Permian Basin. In many of these applications, the concept is allowing operators to use larger cutters," he says.

According to Deen, the concept can be applied to almost any application. "We are really excited about CounterForce," he enthuses. "Because it involves rearranging components rather than using experimental parts, the bit costs the same as its predecessors and the operator's risk is extremely low. In the best-case scenario, we reduce drilling risk by reducing vibration at the same time we improve penetration rates and footage drilled per run. Even the worst-case scenario entails no additional risk." ❐