

Gallery Of New Drill Bit Technology

Bits Increase ROP, Eliminate Trips

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Operators in both unconventional and conventional plays in virtually every U.S. basin are enjoying the best of both worlds when it comes to reducing exploration costs: drill bit advances and technology enhancements that reduce bit trips and set record rates of penetration for operators continuing to lead the charge toward a new energy era in North America.

With strong oil prices, the industry continues to zero in on drilling liquids-rich reserves in all types of geologic settings with more complex well bore architectures. No matter the well type or drilling plan, the objective is to drill a full-gauge, high-quality hole to the target interval in the least amount of rig time. Optimizing performance and eliminating nonproductive time begins with the bit, one of the most critical components in the drilling system.

Drill bit designers and engineers are responding to the challenge by equipping operators with cutting-edge bits and performance-enhancing technological innovations that are eliminating trips, even recording single bit runs to drill the entire vertical, curve and lateral sections of horizontal wells in some plays! The end result is improved drilling efficiencies, enabling oil and gas companies to maximize their capital dollars in the hunt for new reserves—whether drilling long-lateral horizontal wells in unconventional formations, directional wells offshore, or vertical wells in legacy oil basins where commodity prices are invigorating activity.

However, oil drilling is clearly the new driving force behind climbing domestic

drilling activity. With 16 percent more rigs "turning to the right" in early April compared with the same time in 2011, about 65 percent of them were targeting oil reserves—the mirror opposite of oil versus natural gas drilling ratios only two years ago. The American Petroleum Institute reports that 6,149 oil wells were completed in the fourth quarter of 2011—up 10 percent year-to-year.

And the ramped-up U.S. oil drilling activity is generating a production response that is reversing the trend line on total domestic oil output, positioning the industry to add millions of barrels a day in new production going forward, according to forecasters.

In addition to tailoring existing bits to overcome obstacles in tight oil plays, bit designers at the leading manufacturers also have their eyes on an additional prize: recovering activity in the Gulf of Mexico that will require even greater bit performance and durability, especially in the ultradeepwater Lower Tertiary and ultradeep Shelf play in shallow waters.

Consistent High Performance

North American unconventional resource plays demand consistent high per-

formance to deliver acceptable returns for operators as part of drilling and completions conducted as a repeatable, lean manufacturing process in which consistency and efficiency are fundamental, points out Rusty Petree, chairman and chief executive officer at Drilformance.

To be successful, drill bit providers must focus on methods and communications that are consistent with operators' real goals, he adds. Consequently, Drilformance's focus is on "understanding and achieving predictable high performance with the company's line of PDC bits." Petree points to Drilformance results compared with offset bits in 90 runs in a North American shale play.

Data from drilling that included one-trip curve and lateral runs in close proximity utilizing the same rigs, BHAs, operating parameters and mud system show a standard deviation for Drilformance PDC bits of 14 percent compared with 24 percent for the second best performer and 17 percent for the third best, Petree reports. With respect to ROP, he adds that Drilformance's mean PDC bit performance equated to 78 feet/hour, compared with 76 feet/hour for the second best performer and 69 feet/hour for the third best (Table 1).

TABLE 1

Drilling Performance Data (North American Shale Play)

Drill Bit	Avg. ROP ft/hr	Std. Devi.	% below Avg.	% above Avg.	No. of runs
Drilformance	78	14%	36%	64%	25
Manufacturer B	76	24%	51%	49%	40
Manufacturer C	69	17%	67%	33%	15
Others	72	19%	60%	40%	10
All Runs	75	21%	52%	48%	90



“It can be helpful to think of bit performance in terms of financial industry jargon highlighting performance over the course of the entire year,” Petree says. “Higher performance with lower volatility (low standard deviation) is a better investment over time.”

Noting that “alpha” is a financial term used to describe risk-adjusted performance greater than the industry average, Petree says the alpha of Drilformance’s bits for the operator in the shale play is above 4 percent, which he notes is considered significant in either manufacturing or financial terms.

“For this North American operator, already among the most efficient in the industry, 4 percent equates to more than \$10 million a year of additional cash flow from this local area alone,” he states. “Most anyone would choose the investment generating above-market return two thirds of the time with lower volatility. Predictable, high-performance generates higher returns for operators.”

Petree says Drilformance’s PDC bits are precision designed and manufactured utilizing solid steel. “We focus on the

three keys to success: consistency, durability and performance,” he relates.

In regard to consistency, he says cutting structure concentricity within 0.010 inches relative to the axis of the bit pin is maintained through machining the cutting structure while locating and holding the bit on the pin using a high precision five-axis mill and the latest tooling technology. These tolerances and consistency are well beyond the reach of legacy bit manufacturing methods, he notes. Precision-machined cutter pockets hold perfect tolerances to enable high-quality braze joints.

“In short, every Drilformance bit manufactured is exactly the same through precise manufacturing and rigorous quality control measures,” Petree holds.

Durability is enhanced through Rhino-Armor™, a proprietary process that provides maximum protection to all critical surfaces, eliminating erosion issues, he says, adding that Drilformance bits have significantly higher tensile strength and ductility to enable higher impacts and torsional loading without failure, and less vibration during operation.

The manufacturing process enables

compact designs with shorter makeup lengths, resulting in more directional control, according to Petree. “Material strength provides more design flexibility such as high blade standoff, thinner blades, larger junk slot area, bullet shaped bodies, optimal nozzle placement, more intricate cutter geometry, and host of other design elements, including proprietary Heli-Path™, Shadow-Path™, and Cryo-Edge™ technologies that combine to create top performing products,” he comments.

According to Petree, Drilformance has evolved from top performance models for directional applications to top performance models for each hole section from surface to TD, with bits continually increasing the limits of what can be achieved in terms of consistent high performance.

“The company’s next evolution seeks to achieve step-change performance in hard rock drilling and directional applications through deploying a drilling system designed to revolutionize rock destruction mechanics and eliminate unnatural BHA stress typical with legacy tools,” Petree concludes. □