THE AMERICAN OIL & GAS REPORTER®
APRIL 2011
The "Better Business" Publication Serving the Exploration / Drilling / Production Industry

New Drill Bit Designs Maximize Performance In Horizontal Shale Wells

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Drill bit designers and engineers are equipping operators with new bit capabilities that are eliminating trips, cutting costs and allowing oil and gas companies to stretch dollars in the hunt for new reserves, driving a resurgence in drilling activity and arresting a decades-long decline in U.S. oil output.

With oil topping $100 a barrel, the focus on exploiting oil and liquids-rich natural gas acreage continues to drive domestic drilling activity. In fact, the number of oil wells drilled last year in the United States outnumbered gas wells for the first time since 1996. The rig count is up 27 percent over the past 12 months and 57 percent over the past two years, signaling a healthy recovery from the 2008-09 downturn. Moreover, industry data show that the total estimated footage drilled in January was up 63 percent year-to-year, reaching the highest levels since late 2008.

But while all the activity trend lines are up, new drill bit technology and innovations to existing bit systems are enabling operators to maximize efficiencies and hold the line on drilling costs. With operators focused on drilling long-lateral horizontal shale and tight sands wells, many of the advances in bit design are engineered specifically for these demanding applications, including bits capable of drilling steep curves and extending laterals all the way to total depth without requiring a trip.

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New PDC Bit

Operators looking to succeed by leveraging experience and technology face the same economic reality worldwide: higher operating costs that require constant innovation of drilling programs targeting complex formations such as shales, notes Sean Gillis, product development manager at Drilformance.

Mindful of operator cost concerns and demands in challenging drilling environments, Drilformance has developed a PDC drill bit "from the ground up" to offer drillers tangible operational advantages, he says. "Drilling success begins at the bit," Gillis comments. "We seek to consistently deliver best-in-class penetration rates in North American shale plays and tough drilling environments."

Developing a bit that provides both stability and directional responsiveness has been the key, he says. "Our multifaceted, proprietary design elements provide directional stability," Gillis remarks. "Meanwhile, the geometry of the blades maximizes junk slot area, permitting rapid evacuation of cutting materials, which is an essential design pattern for shale plays."

In order to achieve high rate of penetration, the PDC cutter angle profile is relatively aggressive compared with similar offerings, Gillis notes. Traditionally, such designs might be unsuitable for build sections or intervals where stability is a priority, but he says Drilformance engineers have two patent pending technologies that work in tandem to compensate: the Heli Path™ stability system and ShadowPath™ work management system.

Using 3-D modeling and bit balancing systems, the company has developed a design for shale plays that demands the entire team understands the importance of accurate manufacturing processes, emphasizes Kevin Christenson, Drilformance manufacturing manager. "We are extremely aware of the importance of our manufacturing process," he says. "Our staff understands bits, and they understand the tolerances of our components. Our manufacturing is extremely precise."

For Drilformance, the industry's shift to horizontal drilling in shale plays puts the performance focus not only on efficiently drilling the curve and lateral sections, but also on achieving a high-quality bore hole, says General Manager Bill Hoy.

"Feedback from the field is overwhelmingly positive. Some of our customers describe our products as the best directional bits they ever have used," claims Hoy. "Well bore quality in the long horizontal sections of these wells is very important. Our clients are achieving time savings in the drilling phase, and the resulting smooth well bore helps the completions phase during fracturing."

Drilformance PDC bits feature compact designs with Cryo Edge™ cutters for improved thermal stability and depth of cut, Heli Path™ radial bit face structures for directional control and stability with extended PDC intervals, and Rhino Armor™ hard facing. The Shadow Path™ work sharing system adds diamond volume to key locations on the bit shoulder for tough build and transitional sections.

According to Hoy, excellent hole quality is achieved by the unique PDC cutter configuration on the bit shoulder. This larger diamond volume increases the depth of cut for each pass, contributing to the overall efficiency of the bit.

Durability is very important when targeting shale and conglomerate formations with high compressive strength, Hoy goes on. To meet the requirements, Drilformance developed Rhino Armor™ proprietary hard-facing materials and process to protect the critical surfaces of the bit during drilling.

"The hard-facing procedure is specific in its application of materials and temperatures, requiring technicians to adhere to strict protocols during the pivotal phase of manufacturing," Christenson comments. "One of our greatest strengths is gauge protection. Many of the dull-grades are surprising to even the most seasoned industry veterans. They will trip for the BHA and expect to see wear and damage to the bit. Instead, they pull a clean bit and realize it can be run again."

Rusty Petree, chairman and chief executive officer, says Drilformance plans to build on its success by expanding its PDC product line, introduce new drilling technology, and further expand service capabilities across North America. "Field results have been outstanding, with our solutions consistently delivering top performance for operators in key resource plays from the Montney and Cardium shales in Canada, to the Wolfberry and Eagle Ford Shale in Texas," Petree states. ❐