Elevated RPM with increased ROP

Application-specific roller cone bits equipped to withstand higher energy inputs can deliver better performance in critical applications.

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Operators continue to demand increased energy inputs on drill bits through greater weight on bit (WOB) combined with higher RPM for faster drilling. This increased energy causes additional stress to the internal components of the drill bit and impacts downhole longevity. Drill bit technology is evolving to meet the increasing operational requirements demanded by the drilling industry.

Varel International reviewed the entire bearing/seal system and produced a series that can reliably withstand high-energy inputs, meeting drillers' increased performance expectations.

High-energy bearing

The company set out to develop a bearing to support a combination of higher WOB and increased RPM. First, a mathematical model was developed to evaluate the bearing capacity. Then, known bearings were evaluated and performance was compared to calculated predictions. Using this knowledge, the team developed a new bearing package for high-energy applications.

This solution incorporates a more robust journal bearing to support heavier loads and tighter bearing assembly tolerances. The bearing package consists of a fixed silver-plated journal bushing and a floating silver-plated thrust washer. The bearing grease was reviewed and upgraded to a new premium rock bit bearing grease, reducing wear and frictional heat generation.

To complement the new bearing, a new seal package was developed, which includes two new patent pending features. A reliable O-ring seal is installed in a conical recess to resist mud packing and seal wear. Additionally, the seal is protected from bearing-generated heat by a heat shield located between the bearing and elastomer seal.

These enhancements work together to extend bit life and improve reliability in demanding, high-energy applications.

Stability and steerability

Maintaining stability and steerability in directional applications is paramount to the success of the operation. Due to the aggressive behavior of polycrystalline diamond compact (PDC) bits, they tend to be ineffective tools when drilling in highly interbedded lithologies. Poor toolface control of PDC bits can lead to a variety of issues including lower rate of penetration (ROP) and instances of stick-slip resulting in harmful vibrations.

Roller cone bits built for increased energy inputs have successfully achieved build rates in horizontal drilling applications while maintaining stability. (Image courtesy of Varel International)

This scenario is especially true for the horizontal drilling environment in the Barnett shale.

High-energy bits allow operators to drill at elevated RPM, resulting in increased ROP. The roller cone bits also drill through the changing lithologies while limiting harmful vibrations and reducing torque generation.

The bits are field-proven and in many instances have drilled an entire interval in just one run, in areas normally requiring two bit intervals.

In the Wilkinson field, a major operator used 8¾-in. high-energy series roller cone bits to drill the curve in multiple directional applications. The bits were designed to provide the necessary stabilization in the curve while allowing a directional company to complete the desired build. In these applications, the bits averaged a run length of 681.8 ft (208 m) with an average ROP of 34.5 ft/hr (10.5 m/hr). The operator realized a 29% improvement in ROP when compared to local offsets, an indication of asset and time savings.

Additionally, an operator drilling in the Johnson County, Texas, area of the Barnett Shale recently completed an 8¾-in. interval in one run, compared to the normal two bits required in the interval. The operator was able to maintain stability while completing the curve, drilling a total of 848 ft (259 m) with an average ROP of 23.56 ft/hr (7.2 m/hr). Similar offset runs averaged just 611 ft (186 m) at a ROP of 21 ft/hr (6.4 m/hr). In addition to the material savings, the operator reduced operational costs and safety risks by completing the section without tripping.

Using application-specific roller cone bits equipped to withstand higher energy inputs has been proven to deliver better performance and outcomes in critical applications. E&P