

# Durability, ROP are key to advanced drilling methods

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**MEETING DEMANDS FOR** increased durability and penetration rates requires bit designs that incorporate a full range of technologies, from bit dynamic mathematical modeling to materials, components and bit body configuration. Singularly and in combination, these design advances are resulting in bits that have the wear life and effectiveness not only to support new drilling methods but also set the performance standards on which emerging technologies may be built.

The complexity and costs of drilling modern wellbores constantly challenge the design of roller cone and fixed cutter drill bits. Durability and penetration rates continue to be key areas of focus as the means to improve drilling economics and performance. Achieving these fundamental objectives requires continuous improvements that keep pace or lead advancing capabilities in drilling technology.

Recent challenges include rotary steering systems that place greater wear loads on the side of the bit and complex drilling applications where high durability is required. Bit technology must also address the economics of costly drilling operations that place increasingly high premiums on speed, reducing risk and minimizing non-productive time.

Building on decades of experience, ReedHycalog, a new member of the Grant Pridco family, is advancing new roller cone designs that provide impressive durability in the most difficult applications. New fixed cutter designs benefit from significant materials advances that keep the bit sharper, longer.

## ROLLER CONE ADVANCES

Drilling large diameter holes at high RPM and in directional applications can be very challenging and expensive. This is especially true in deeper sections. In these cases, bit durability and aggressiveness are key considerations in reducing costs.

To improve bit life and penetration rates, the company has engineered the Titan™ roller bearing product line in tooth and insert designs ranging in size from 12 1/4-in. to 26-in. This large-diameter

bit family features the Precision Logarithmic Roller bearing and many new durability-enhancing cutting structure features. The large, rugged roller bearing is much more durable than other elastomer-sealed designs, especially in high RPM motor and turbine applications. This bearing design is responsible for many records for length of run and hours on bottom.



**Highly durable roller bearings and an array of cutting structure enhancements available in the ReedHycalog Titan bit line improve drilling performance in large diameter holes.**

The PLR bearing was used to set the 17-in. world record for drilling 148 hours in Saudi Arabia. In Oman, this bearing was used to complete 12,010 ft over multiple wells for a cumulative total of 231.5 hrs. More important, however, is the consistent performance that has been achieved with this bearing. In a particular sample of over 55 runs in the ASAB field in Abu Dhabi, no PLR bearing failures occurred. A mix of 32 competitor runs exhibited a 27% bearing failure rate in the same field.

Cutting structures on Titan bits feature GageGuard™ inserts, TuffGage™ heel-pacs and MegaKPR™ shirttail protection to enhance gauge durability. Cutting structure durability is further improved with the MatchFit™ insert retention system and SuperTuff™ inserts. The cutting structure and the

formation are cleaned using Mudpick™ hydraulics to eliminate balling, enhance cuttings removal and increase ROP.

Increased durability is the major bit objective in many high energy drilling applications. To maximize drilling time and reduce rig costs, ReedHycalog has engineered the TuffDuty™ line of journal bearing bits. Available in sizes ranging from 7 7/8-in. to 12 1/4-in., the bit series offers many unique design features, including a tougher bearing system, improved cone and insert retention technology, advanced hydraulics, enhanced gauge durability and new high-performance hard-facing for tooth bits.

## FIXED CUTTER ADVANCES

ReedHycalog fixed cutter advances include the introduction of a unique PDC cutter material and a PDC bit designed specifically to handle the rigors of rotary steerable drilling.

TReX™ cutters are a new generation of polycrystalline diamond compact (PDC) that feature a super-hard, wear-resistant layer on the leading edge of the diamond table. In laboratory tests, the material is four times more abrasion resistant than standard cutters. This wear resistance is achieved without any reduction in impact resistance, which has been the industry's traditional trade-off in PDC cutter design.

Because TReX cutters are more abrasion resistant and maintain a sharp cutting edge during drilling, they enhance bit performance by drilling for longer intervals at higher penetration rates. This capability saves rig time and reduces risk in many ways. The higher penetration rate decreases the time required to drill an interval. A more durable, longer lasting bit results in less time spent tripping and a reduction in drilling costs. Less non-productive trip time also reduces cost and risk.

The new cutters provide superior performance in any PDC application with no downside performance risk. The most significant increase in performance is achieved in conditions where abrasive wear limits bit life. Bits equipped with TReX cutters significantly extend the bit life and footage drilled.

## TREX CASE HISTORIES

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The use of TReX cutters has resulted in significant improvements in bit life and ROP in a wide range of global applications.

In Freestone County, Texas, an 8 3/4-in. DSX107D bit fitted with TReX cutters drilled a total of 1,561 ft of the Travis Peak for Anadarko Petroleum Co. on the Betty Jean Ivy #5 well. The bit drilled the entire Travis Peak interval for the most footage ever drilled by a PDC bit in this very abrasive application. Compared to average offsets this run replaced 3 or 4 insert bits and eliminated multiple trips.

Footage drilled increased by 38% when using TReX cutters in Australia's Cooper Basin (Hutton Formation), allowing the operator to complete an entire section in one run. The challenge was to complete 3,800 ft of the easily drilled claystone (<30 Kpsi), and then survive

300-400 ft of the Hutton formation. TReX-equipped bits have drilled more Hutton formation than any other PDC bit.

BP has used TReX cutters to set and then re-set the world record for the longest 7 7/8-in. PDC run. The latest record was 10,463 ft on Lost Cabin 19-1 in Sweetwater County, Wyoming.

## ROTARY STEERABLE BIT DESIGN

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Fast-growing rotary steerable drilling technology offers a significant savings to operators but requires a very specific engineered solution to be most effective. ReedHycalog rotary steerable (RS) PDC Bits are designed for the unique requirements and loads associated with push-the-bit rotary steerable systems. The bits have a low aspect ratio resulting in a reduced length between the bit face and steering pads. This reduction increases steering responsiveness and allows tighter turns to be made. Also, RS

bits have very short, aggressive gauges which make it easier for the steerable rotary system to push the bit laterally and deviate the wellbore.

Designed to complete the interval even in very complex wellbore trajectories, rotary steerable products require an engineered solution. One consideration in engineering a RS bit solution is the selection of an appropriate gauge design. For instance, the Active Gage design has aggressive cutters on the gauge of the bit to allow it to drill laterally. Dual Action Gage (DAG) provides a similar response in the build section but is not aggressive on a tangent section, eliminating gauge side-cutting and reducing any dropping tendency. A lateral stability-enhancing ring provides the advantages of the DAG with the additional benefits of increasing lateral stability and reducing or eliminating bit-whirl. ■