
SMITH BITS
A Schlumberger Company
AxeBlade
Ridged diamond element bit

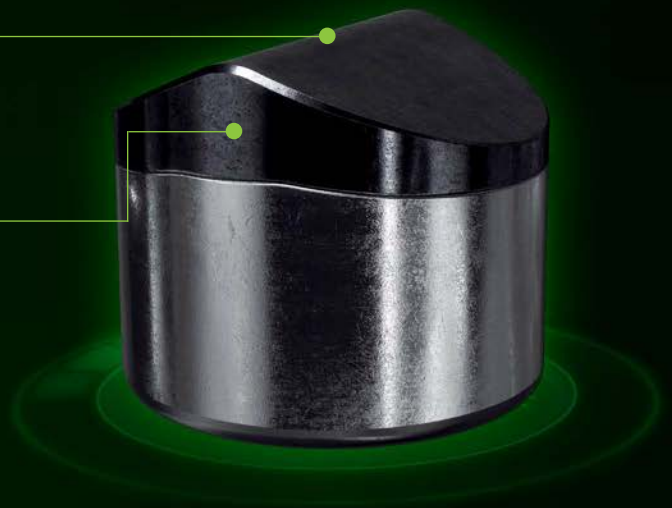
Instantaneous ROP Improvement. Better Steerability.

The AxeBlade* ridged diamond element bit positions Axe* elements along the bit face to achieve increased ROP and steerability in a wide range of applications through increased cutting efficiency and superior impact resistance.

The new-generation 3D cutter geometry of the Axe ridged diamond element combines the shearing action of a conventional PDC cutter with the crushing action of a tungsten carbide insert (TCI).

Ridge geometry combines shearing and cutting actions to cut rock more effectively while generating less overall torque with fewer reactive torque fluctuations.

Thicker diamond table on cutter ridge increases cutter durability and ensures high ROP throughout the run.

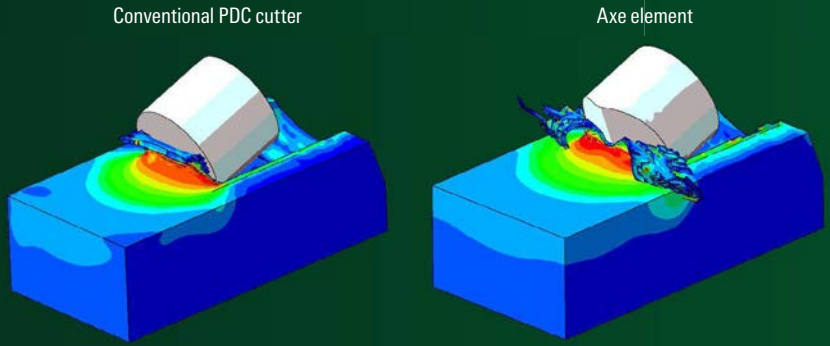


Increased cutting efficiency

Axe elements employ a unique ridge-shaped geometry that enables a PDC bit to cut rock in a new way—a combination of shearing and crushing. This cutting method achieves at least 22% deeper penetration and removes more formation to provide higher instantaneous ROP using the same weight on bit and rpm applied to conventional PDC cutters.

Because Axe elements can be used in many bit designs, the AxeBlade bit can be deployed in a variety of applications in which enhanced ROP is needed to reduce drilling costs.

The AxeBlade bit has demonstrated up to 29% improvement in ROP compared with bits using conventional PDC cutters, resulting in rig time and cost savings for operators.



Finite-element analysis (FEA) testing showed that the Axe element achieves at least 22% deeper penetration under the same drilling conditions and parameters.

Thicker diamond table on cutter ridge

The new ridged design of the Axe element enables more efficient heat dissipation and better impact resistance, which is achieved through a proprietary blend of polycrystalline diamond grain sizes.

The thicker diamond layer gives Axe elements the ability to withstand a higher concentration of stress at the ridge. When placed along the bit face to form the AxeBlade bit, the ridge cutters exhibit greater durability in formations that damage conventional cutters.

Higher ROP throughout runs

In laboratory testing, a conventional PDC cutter and Axe element impacted a hardened steel block at 7,000 lbf to simulate drilling into a hard limestone formation at 60 ft/h.

The results demonstrate that the diamond layer on the cutter ridge, which is 70% thicker than that of a conventional cutter, gives the Axe element increased impact resistance to enable the AxeBlade bit to sustain high ROP throughout the run.

Conventional PDC cutter

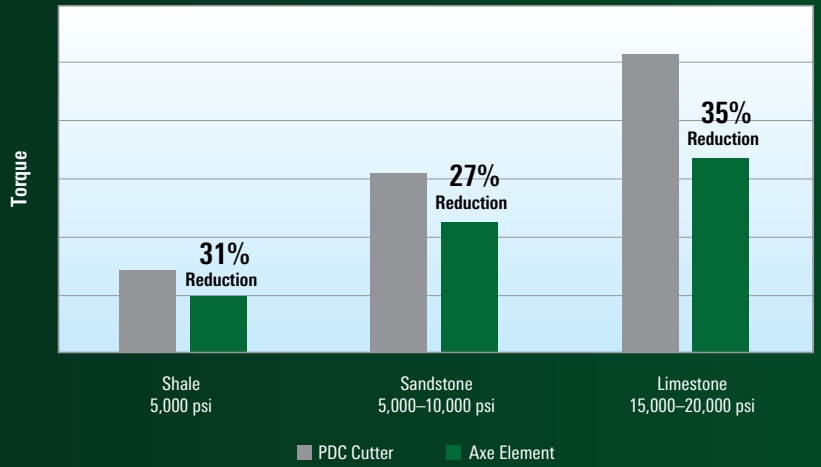
Axe element

Enhanced control in directional applications

The AxeBlade bit enables better trajectory control in directional applications by reducing torque at the bit, which is achieved by the more-aggressive geometry of the Axe element.

This advantage helps operators achieve better build rates with fewer reactive torque fluctuations while delivering higher overall ROP. The AxeBlade bit maximizes production zone exposure and minimizes NPT by delivering better steering and well placement and completing directional objectives in less time.

Torque Comparison: Conventional PDC Cutter vs. Axe Element

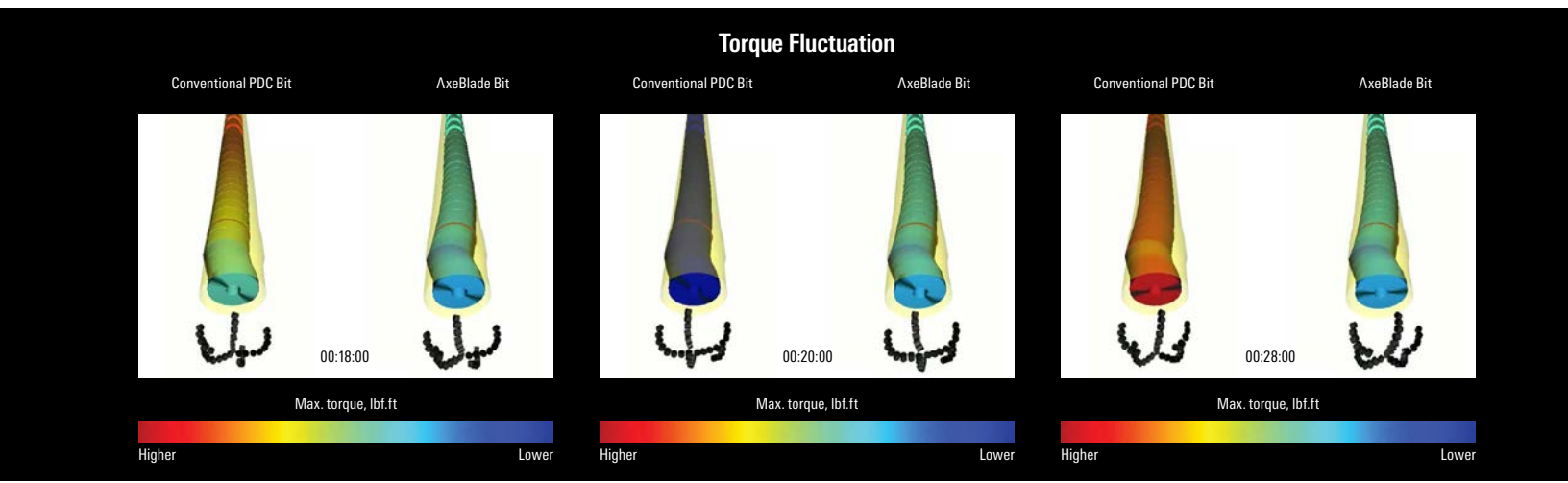


Results from lab testing show that the ridged shape of the Axe element (green) enables the AxeBlade bit to generate less torque than conventional PDC bits in a variety of formations.

Demonstrated torque and ROP improvement

The IDEAS* integrated dynamic design and analysis platform was used to perform a finite element analysis comparing an AxeBlade bit with a conventional PDC bit. In a simulation of rotating and sliding through a shale–carbonate transition with an unconfined compressive strength of 10,000 to 20,000 psi, the AxeBlade bit exhibited better toolface control and steerability with less overall torque and less torque fluctuation.

Testing at the Schlumberger Gould Research Center (SGR) near Cambridge, England, employed a large atmospheric drilling machine (LAM) to compare the drilling performance of the AxeBlade bit with a conventional PDC bit. Drilling through roughly 40 ft of 22,000-psi limestone, the AxeBlade bit enabled significantly higher ROP and required less torque to achieve these ROP gains. Data from a vibration monitoring sub indicated that the bit also reduced lateral vibrations for better borehole quality.



Screenshots of the IDEAS platform simulations: Analysis revealed that the AxeBlade bit (right) generated fewer torque fluctuations and less overall torque compared with a conventional PDC bit.

Case Study

Unit Petroleum Company Boosts ROP 27% in Intermediate Section Targeting the Granite Wash

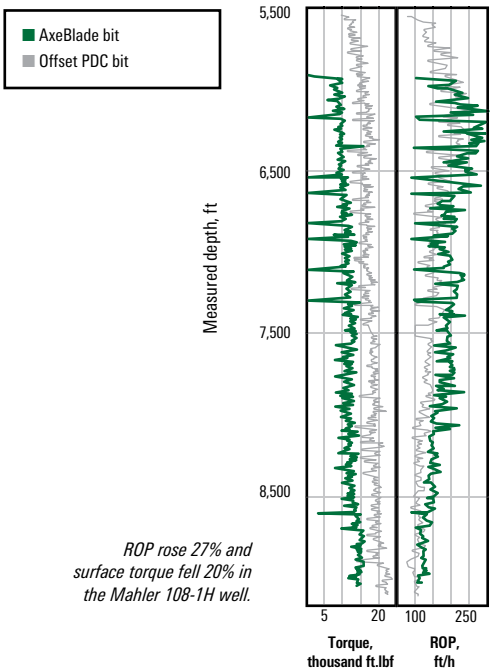
AxeBlade bit enabled drilling with 20% less torque through interbedded shale, sand, and limestone formation onshore Texas

Challenge

Improve ROP and reduce torque while drilling through interbedded formations of shale, sand, and limestone above the Granite Wash in the Anadarko basin.

Results

Drilled the entire interval at 27% higher ROP and generated 20% less torque.



ROP rose 27% and surface torque fell 20% in the Mahler 108-1H well.

Case Study

AxeBlade Bit Increases ROP 29% and Improves Directional Control in Eagle Ford Shale Interval

"I was impressed with how well the bit held tool face and built angle compared with the baseline bit with standard cutters. The reactive torque was reduced significantly compared to bits we used in the past."

Directional driller
Eagle Ford Shale drilling operation

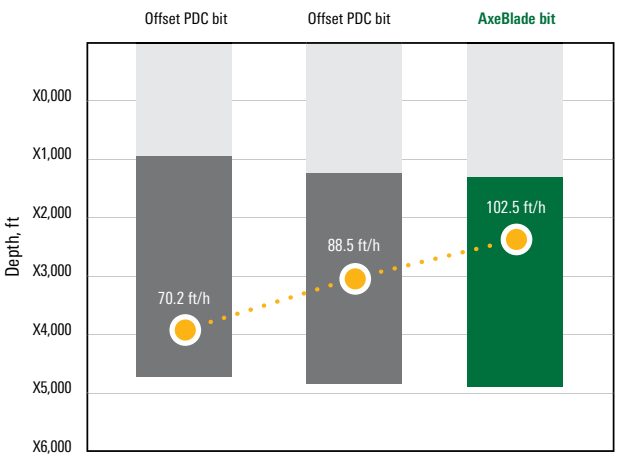
Ridged diamond element bit improves drilling rates while enhancing steerability with reduced reactive torque

Challenge

Achieve high instantaneous ROP and enhance toolface control while drilling with a high differential pressure motor in limestone and shale formations, Eagle Ford Shale.

Results

- Drilled 3,586-ft [1,093-m] interval in 35 hours for an ROP of 102.5 ft/h [31.2 m/h], an improvement of 29% compared with ROP of previous wells.
- Held toolface, built angle, and reduced reactive torque compared with baseline bits.



The AxeBlade bit drilled the same interval as offsets with significantly higher ROP.

Case Study

ROP Improves 42% to Establish New Benchmark Using AxeBlade Bit in a Single Run, Oman

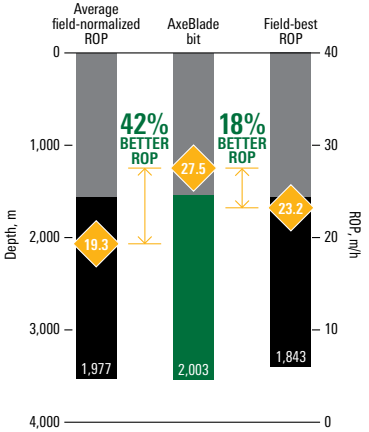
Six-bladed bit design successfully drills 12¼-in section through highly abrasive formation and sets new ROP records

Challenge

Maintain cutter sharpness to drill a historically challenging 12¼-in hole section in a single bit run while improving the benchmark ROP in a deep gas field.

Results

Drilled the section in a single bit run while breaking multiple field records for ROP.



The AxeBlade bit drilled the section in one run at an ROP of 27.5 m/h. This represents an improvement of 42% over the normalized ROP for the field and 18% over the existing field-best ROP.

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