Drill Bits catalog

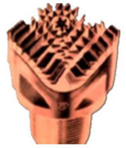
Drill Bits

History of innovation

1909
Sharp-Hughes Tool Company forms with the creation of the first rotary rock bit

1915
Sharp-Hughes Tool Company is renamed to Hughes Tool Company

1933
Introduction of the Tricone drill bit design



1944
Christensen Diamond Products Co. founded in Salt Lake City, Utah

1976
Introduction of synthetic PDC bits

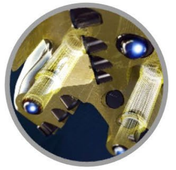
1986
Baker International acquires Hughes Tool Company to form Baker Hughes

1990
Baker Hughes acquires Christensen to form Hughes Christensen, a Baker Hughes company

1997
Introduction of in-bit measurement

2010
Introduction of the hybrid drill bit

2017
Introduction of the adaptive drill bit



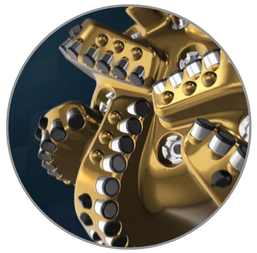
2018
Introduction of AntiWalk technology

2021
Introduction of Apex & Prism shaped cutters

2024
Introduction of Kymera Mach 6, PermaFORCE, CryoCut, and Lancer shaped cutters

Delivering the best drill bit technology in the industry

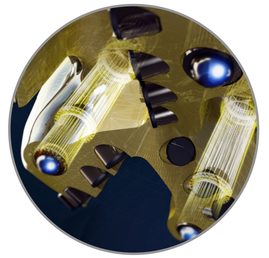
Talon™ Strike
pdc drill bit



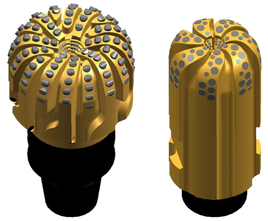
Dynamus™
extended-life drill bit

PermaFORCE™
elite PDC drill bit

Shaped-Cutter
technology

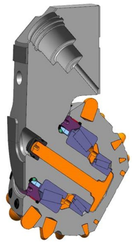


TerrAdapt™
adaptive drill bit



IRev™
impregnated diamond drill bit

Vanguard™
premium tricone drill bit



Metal Face Seal
Tapered Roller Bearing

Kymera™ Mach 6
hybrid drill bit

EZCase™
casing bit system

EZReam™
casing and liner reaming shoe

MultiSense™
dynamics mapping system

Drill Bits AMO facilities

WESTERN HEMISPHERE

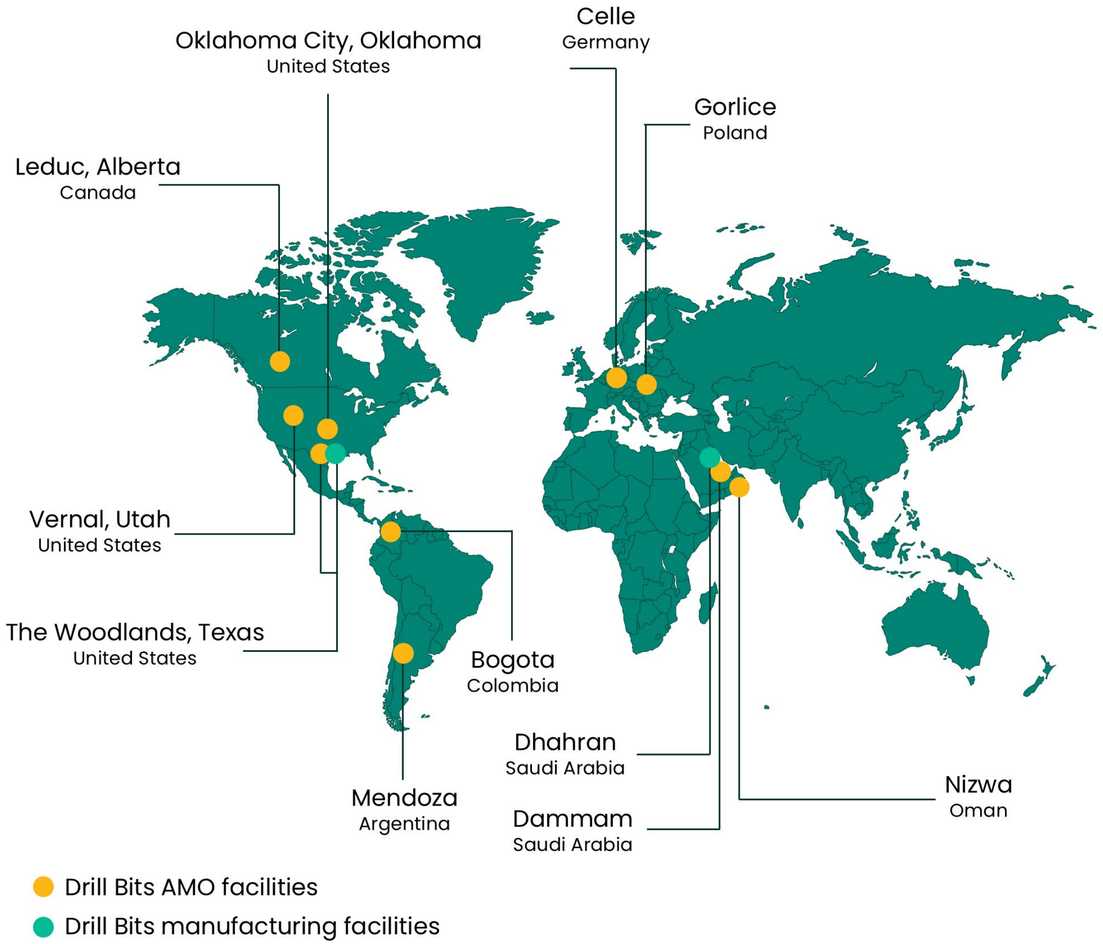
- The Woodlands, Texas, USA
- Oklahoma City, Oklahoma, USA
- Vernal, Utah, USA
- Leduc, Alberta, Canada
- Mendoza, Argentina
- Bogota, Colombia

EASTERN HEMISPHERE

- Dammam, Saudi Arabia
- Celle, Germany
- Nizwa, Oman
- Gorlice, Poland

Drill Bits manufacturing facilities

- The Woodlands, Texas, USA
- Dhahran, Saudi Arabia



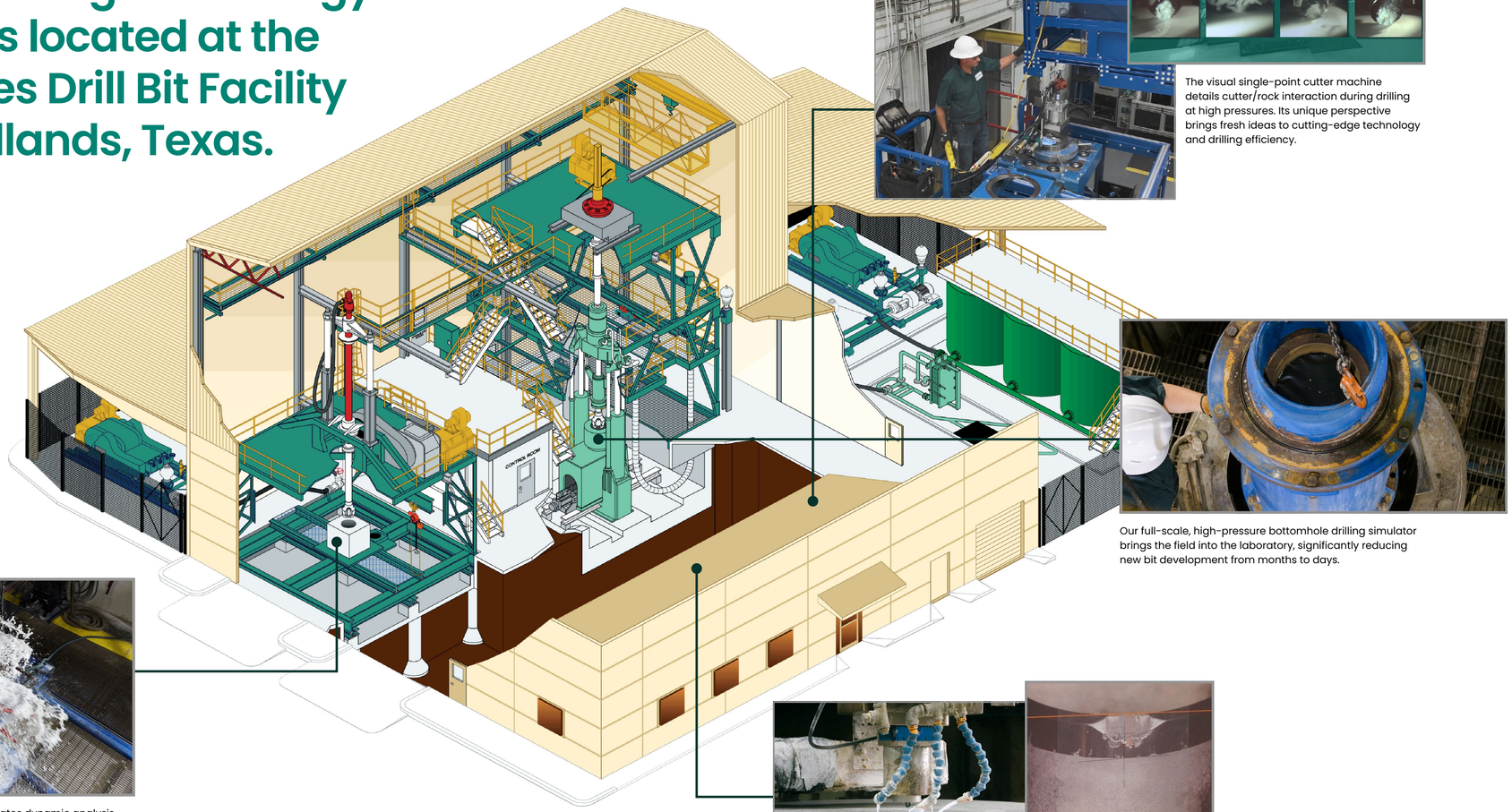
Drill Bit Technology Laboratory

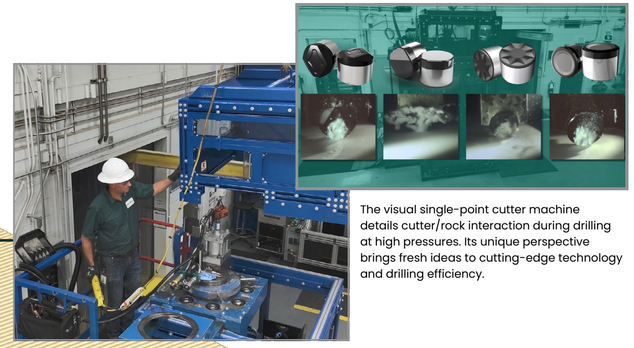
Shorten the lead-time between concept and product introduction

This state-of-the-art laboratory, employing the drilling industry's most sophisticated high-pressure downhole simulator, reflects Baker Hughes commitment to lead the way in developing innovative, cost-saving technologies. This laboratory allows Baker Hughes' engineers to capture bit behavior under strict laboratory controls and rapidly optimize performance. These capabilities dramatically shorten the lead-time between concept and product introduction.

The Drill Bit Technology Laboratory further allows us to tackle customer challenges ranging in scope and complexity. We can set up the rock and fluid for customer's specific application, and optimize drilling performance. We provide test solutions for customers to select the drill-out equipment, drill bit and drilling procedure for their operation. We also work on technical collaborations in which we innovate and iterate on novel pathways to tackle problems that shape the future of drilling.

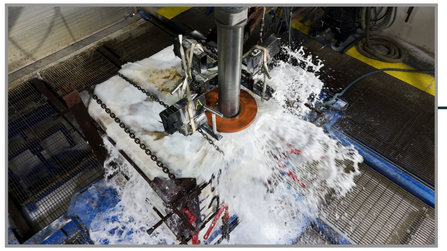
The industry's most advanced Drilling Technology Laboratory is located at the Baker Hughes Drill Bit Facility in The Woodlands, Texas.



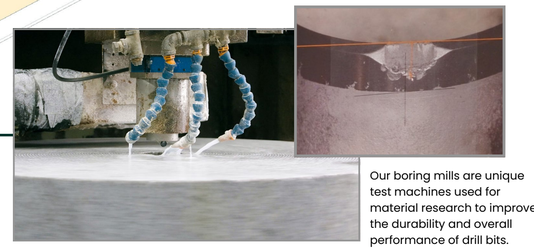


The visual single-point cutter machine details cutter/rock interaction during drilling at high pressures. Its unique perspective brings fresh ideas to cutting-edge technology and drilling efficiency.

Our full-scale, high-pressure bottomhole drilling simulator brings the field into the laboratory, significantly reducing new bit development from months to days.



Our full-scale atmospheric pressure test rig facilitates dynamic analysis of all types of drill bits.



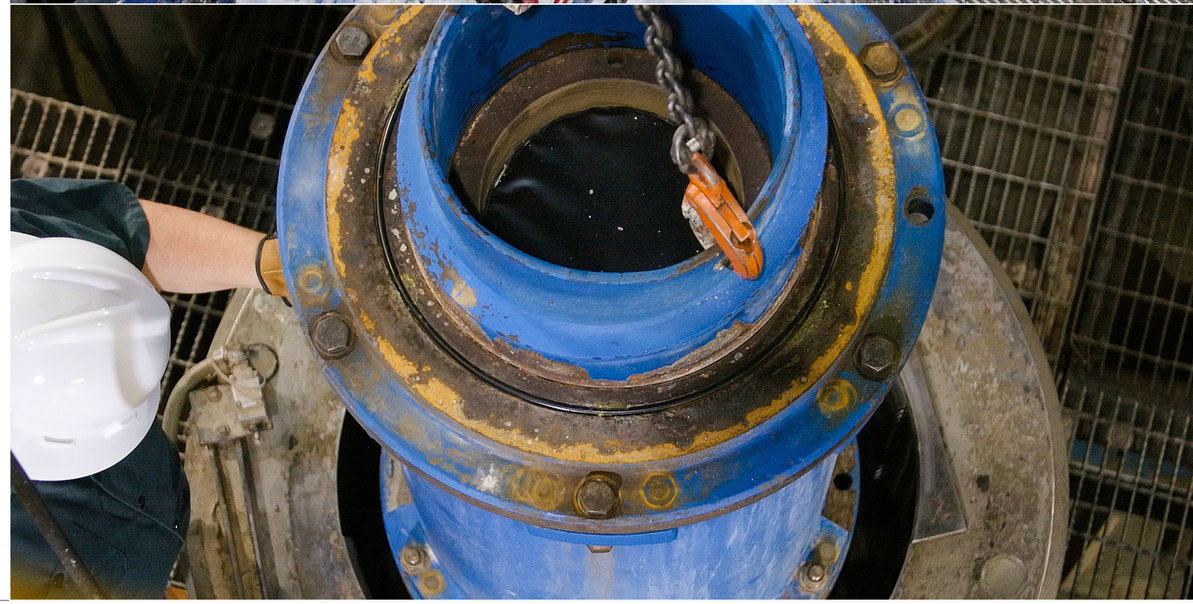
Our boring mills are unique test machines used for material research to improve the durability and overall performance of drill bits.

Surface rig and downhole simulator

In the Surface Rig lab, our experts can drill both formations and cased equipment cemented in the rock using drill bits as large as 28-in. in diameter. Laser sensors, along with accelerometers on the drillstring, enable accurate bit motion sensing and stability testing. Teams can design specific drilling parameters to develop optimized drilling programs and validate them by evaluating the drilled cuttings and borehole. The lab can even drill under side loads that mimic rotary steerable drilling and assess bit steerability in these applications.

The lab's Downhole Simulator can drill a wide selection of formations by applying confining pressures that match downhole conditions of up to 30,000 feet with 9.5 ppg. mud. In this device, experts can assess stability in bits up to 12¼-in. across a wide range of operating conditions with in-bit and BHA sensors.

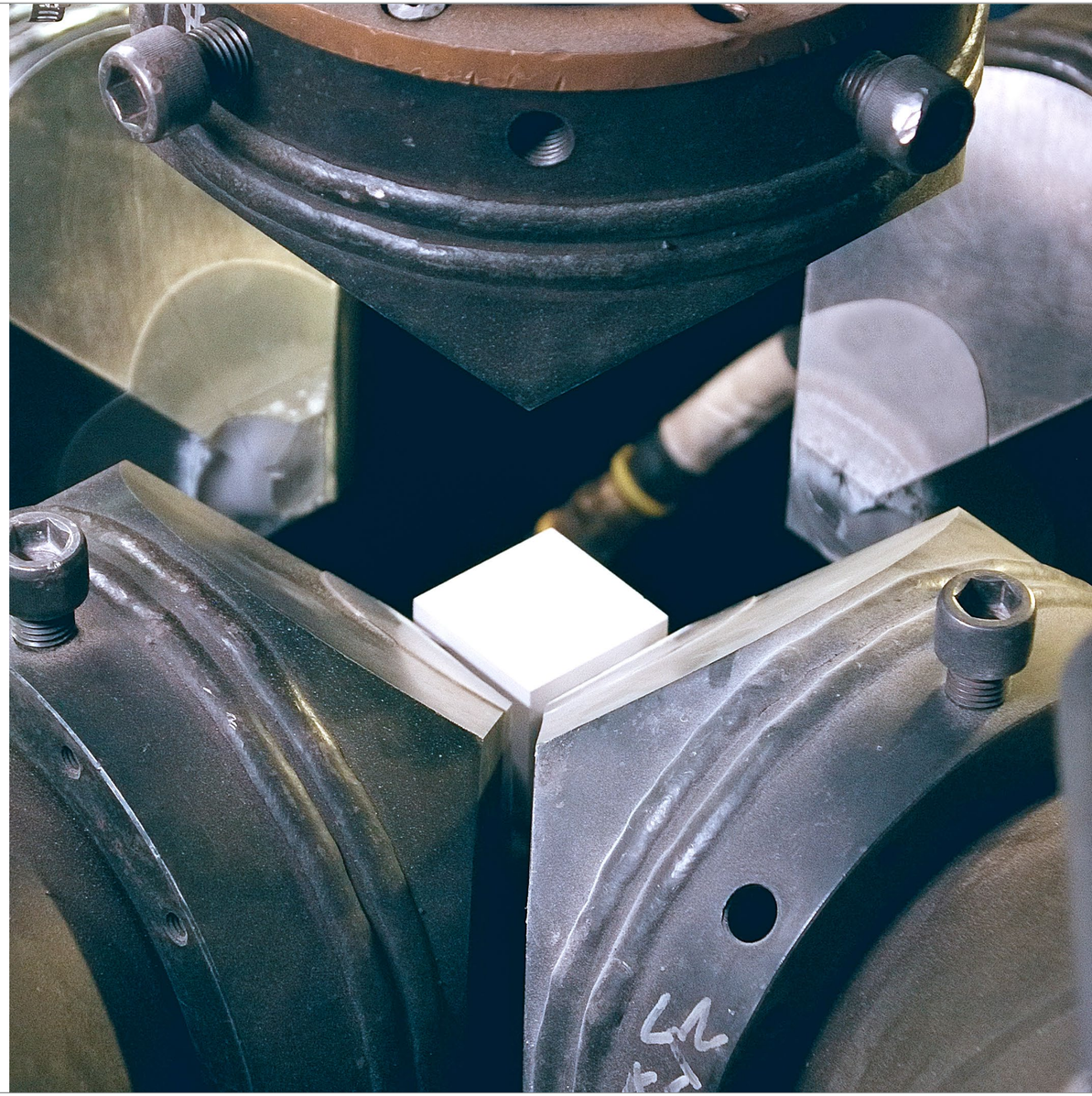
In addition to controlling and monitoring data in real time, further insights can be gained by post-drilling analysis of the bit and formation core.



Diamond press

In-house cutter R&D

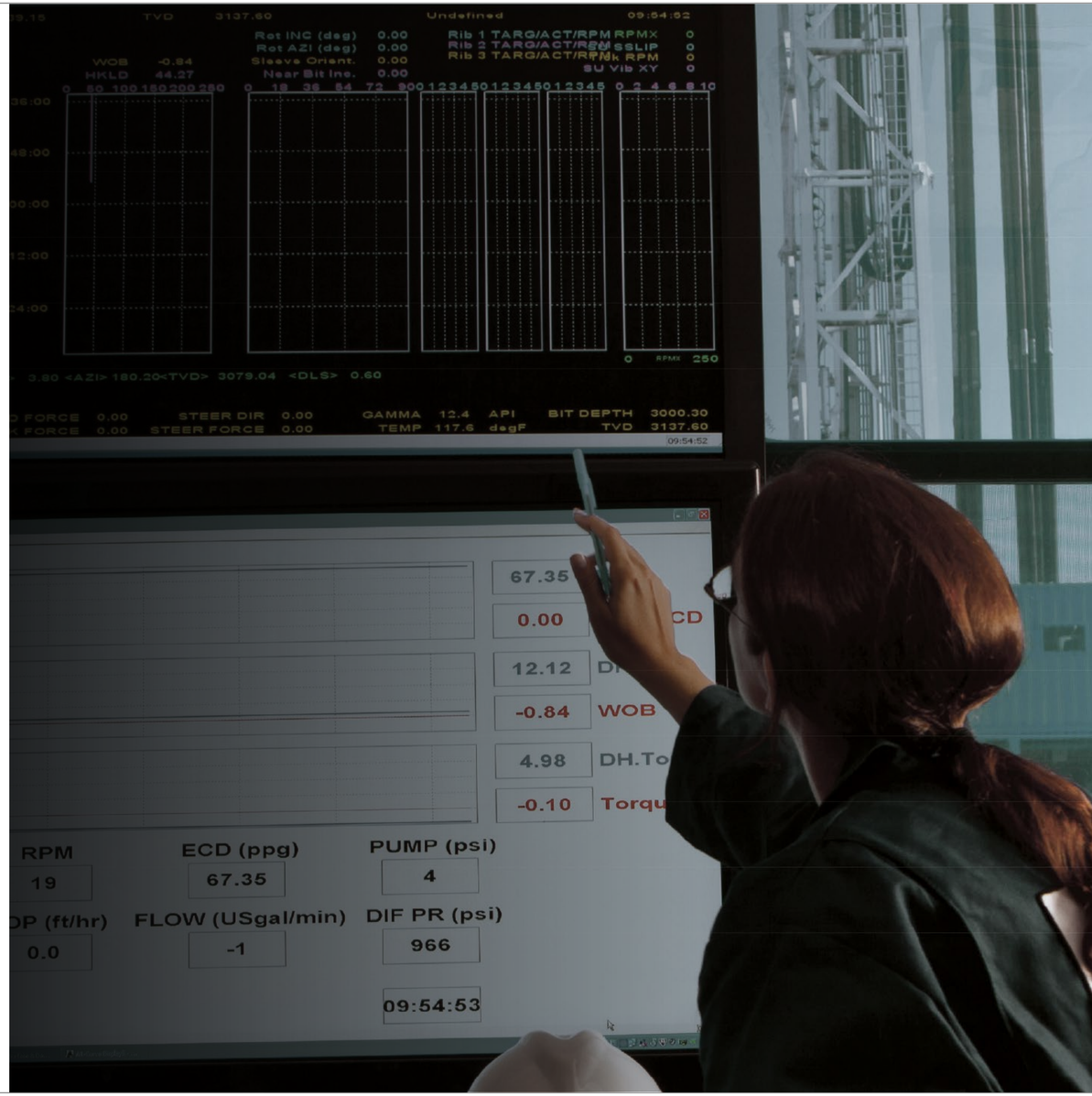
Baker Hughes provides our own custom PDC cutter research and collaborates with PDC manufacturers to bring you premium cutter and compact technology. Our diamond laboratory houses a 4,100 ton multi-axis anvil press that can achieve pressures and temperatures greater than 1 million psi and 2700°F (1482°C), respectively. Baker Hughes can synthesis, process, and finish small-scale PDC cutter and compacts fit for drilling and cutting tests. These capabilities, with our drilling laboratory, help our Baker Hughes researchers and collaborators rapidly develop novel cutting technology.



Experimental test facility (BETA)

Redefine drilling performance with an advanced knowledge of drilling environments

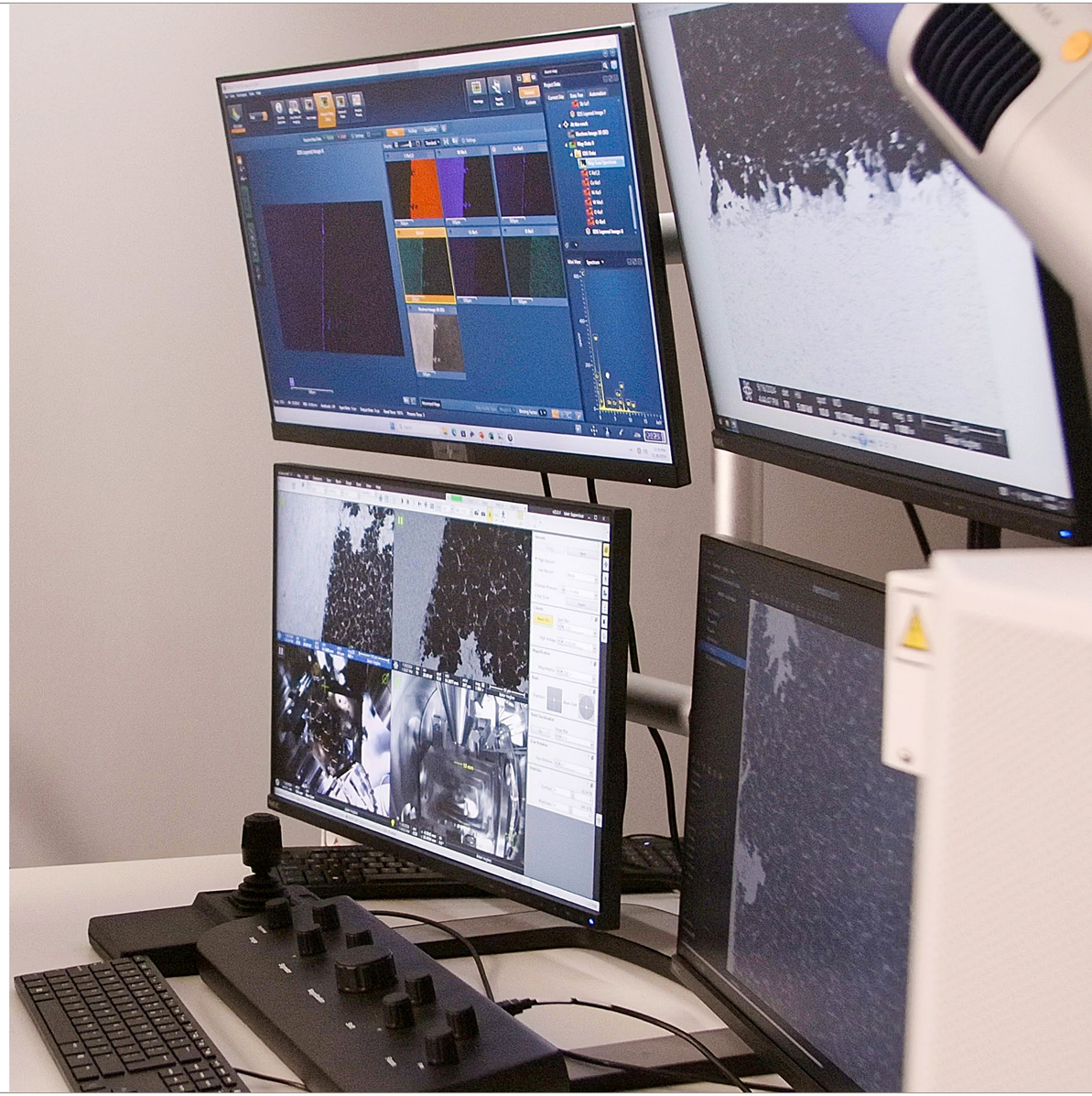
The Baker Hughes BETA experimental test facility enables drilling, completion, and production solutions to be tested on a full-scale rig while simulating a range of geological formations. This unique resource brings field-proven technology to the field faster while reducing the risk of using unproven tools. All real-time data and information, including a rig-floor video, are available for immediate analysis.



Materials research

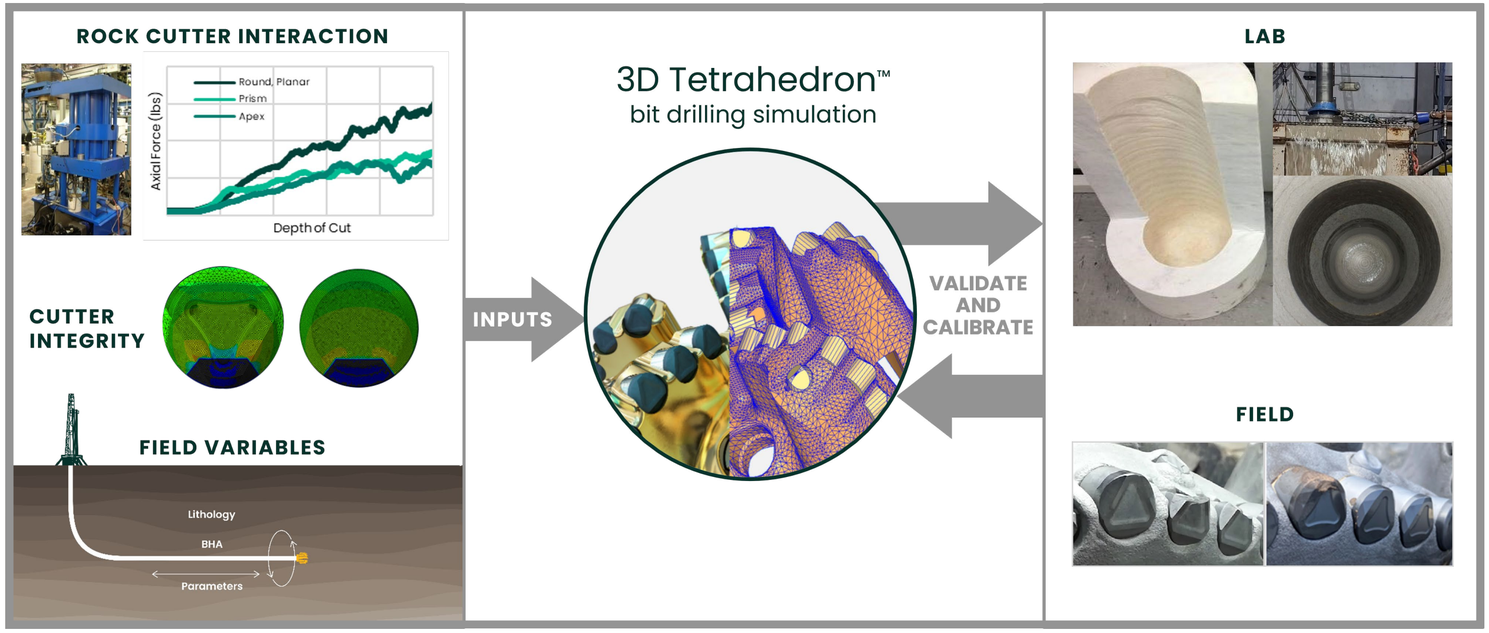
Improve drill bit durability and longevity

To lower the cost-per-foot-drilled while improving durability and product effectiveness, Baker Hughes continuously monitors the strength and fracture durability of Hybrid and PDC drill bit materials. The world class materials laboratories house material synthesis, mechanical and wear testing, characterization, and prototype machining capabilities. Baker Hughes scientists and engineers routinely use these capabilities to unite the ***molecular structure*** with ***drilling performance.*** This attention to detail improves the effectiveness of bearing and seals, compact and PDC cutters, and hardfacing and bit body materials to realize performance enhancements.

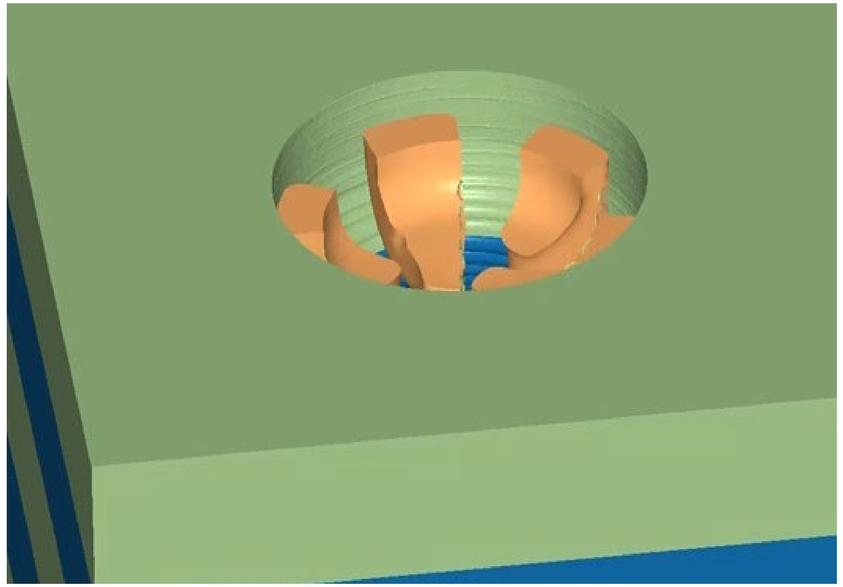


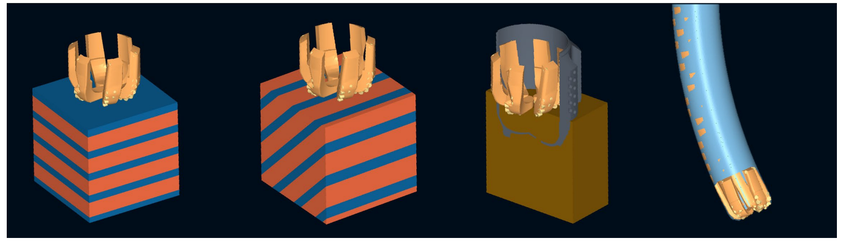
3D Tetrahedron™ bit drilling simulation software

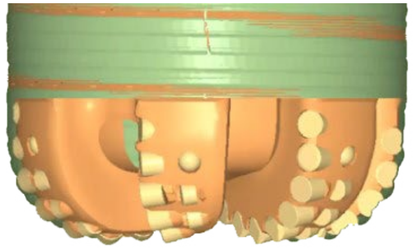
3D Tetrahedron™ bit drilling simulation software is a proprietary bit drilling simulator, that allows designers and application engineers to design with confidence, reduce iterations, and deliver the solution faster for challenging applications. A digital twin of the bit and the drilling environment is created. We can simulate vertical, deviated, extended reach well geometry with interbedded formations. The cutting action of the bit with shaped PDC cutters, rubbing elements, the dual-cutting mechanism of Kymera bits or reamer blades visualized in three-dimensions with BHA types of rotary, bent motor or RSS. Additionally, the rock-bit interaction forces, work rate, and thermomechanical wear rate are accurately captured, from being validated both on a cutter-rock scale and on full scale bit drilling technology laboratory and field data. As a result, the bits deliver faster ROP, vibration control, steerability, durability, and performance without compromise.

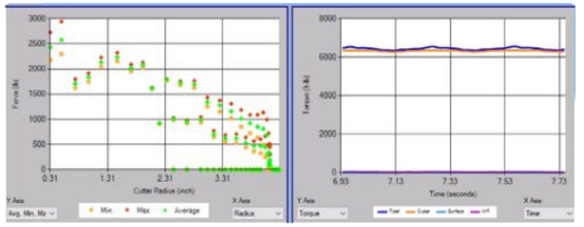


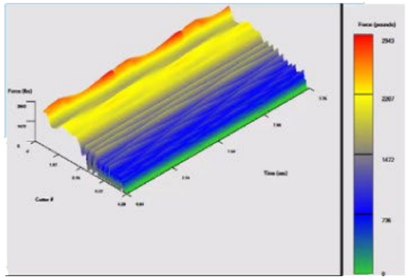
3D Tetrahedron™ bit drilling simulation software











PermaFORCE elite PDC drill bit

Performance without compromise

PermaFORCE™ elite PDC drill bits are designed to enhance rate of penetration (ROP) for faster drilling, while maintaining durability to complete the interval. These bits reduce well construction costs by improving drilling performance in applications where traditional PDC designs compromise performance for durability.

PermaFORCE elite PDC drill bits:

- Deliver both enhanced stability and durability—improving drilling performance in complex intervals and challenging formation transitions.
- Drill faster through different formations and destroy challenging rock types more efficiently than traditional PDC bits.
- Perform reliably under extreme operating conditions and can be run confidently in the most challenging applications.

This is accomplished with a rich technology toolbox featuring a new advanced PDC cutter and body materials, new shaped-cutter technology, and versatile cutting structures enabled by Baker Hughes 3D Tetrahedron™ bit drilling simulation software.

Examples of optimized PermaFORCE PDC designs using the 3D Tetrahedron simulation software

Optimized for heavily interbedded formations

Optimized for fast ROP in interbedded sections

Optimized for hard, abrasive applications

APPLICATIONS

- Complex drilling environments, complex directional profiles, and lithologies
- More powerful BHAs and rigs with increased energy demands
- Extended-length laterals
- Formations causing lower ROP or multiple bit runs

BENEFITS

- Enhanced performance in complex intervals
- Expanded operating envelopes
- Improved stability with less vibrations and smoother torque responses
- Increased ROP and improved hydraulic efficiency
- Predictable, reliable performance

TerrAdapt adaptive drill bit

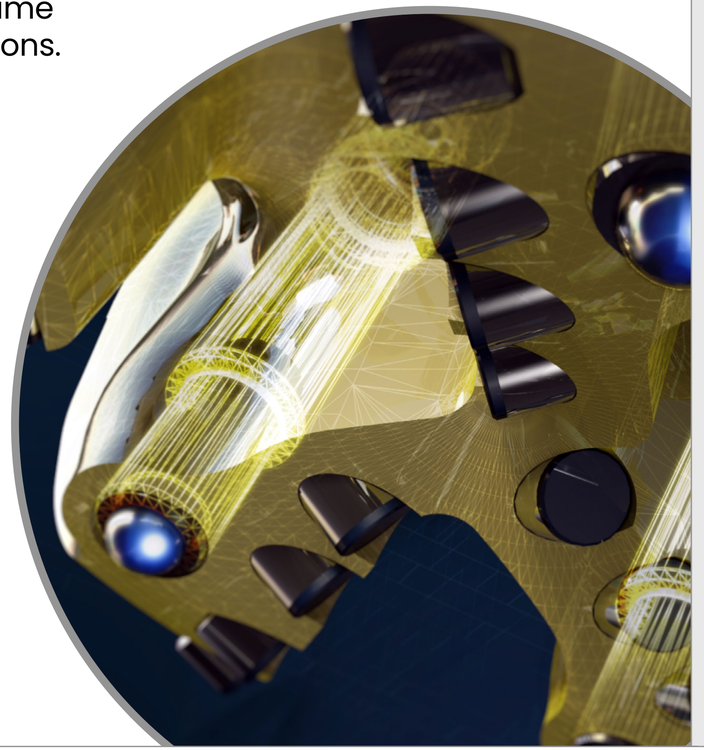
Work Smarter. Not Harder.

With yesterday's PDC technology, once you trip in hole, that bit's behavior is what you have for your entire well. If rock strength changes, or stringers are encountered, that bit is no longer optimized to drill efficiently. The TerrAdapt™ adaptive drill bit solves that issue-it is the first and only smart bit that can adjust depth of cut control downhole, in real-time to optimize efficiency for those loading conditions.

The TerrAdapt bit's autonomous depth of cut control adjustment:

- Mitigates stick-slip, an often silent torsional dysfunction that can lead to erratic bit performance and inconsistent bit/BHA life.
- Absorbs impact loads - prolong cutting structure life and ensuring your goals will be met.

The TerrAdapt technology optimizes bit response to deliver the best performance real-time, increasing efficiency and reducing NPT.



APPLICATIONS

- Rotary steerable and bent motor applications
- Performance limited by stick-slip and torsional vibrations
- Reamer applications

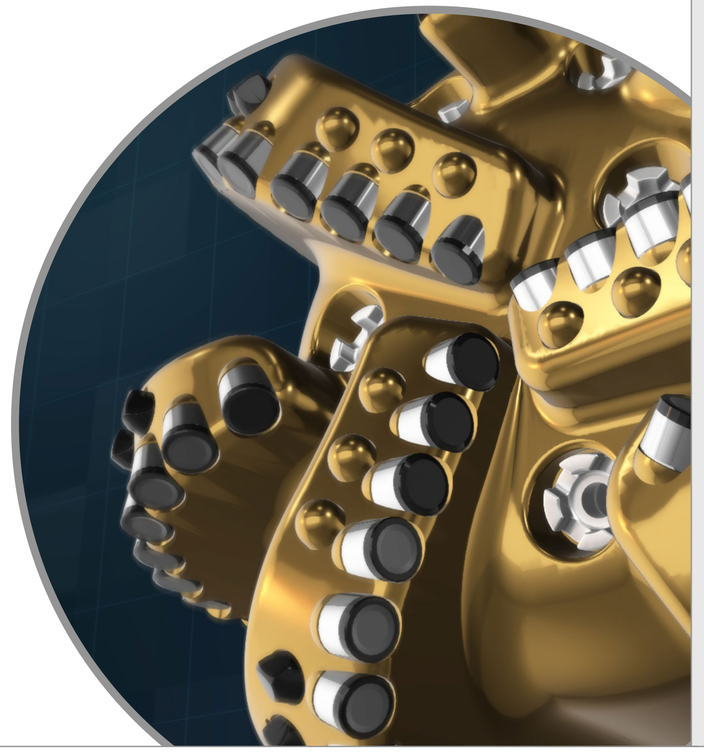
BENEFITS

- Mitigate stick-slip
- Real-time depth of cut control
- Eliminate surface intervention
- Optimize bit response
- Reduce bit-reamer matching issues

Dynamus PDC drill bit platform

Fast. Rugged. Reliable.

The Dynamus™ extended-life drill bit platform is a reliable PDC technology to meet performance targets in challenging applications. Directional features reduce slide and steering time for increased rate of penetration (ROP). Durable cutter technology provides efficient cutting edge to maintain drilling performance in applications with moderately hard formations.



APPLICATIONS

- Soft to medium-hard formations
- Interbedded lithologies
- Performance drilling applications
- Directional applications (RSS and conventional)

BENEFITS

- Customized designs to meet application needs
- Higher ROP and longer bit life
- Vibration mitigation
- Enhanced directional control
- Reduce drilling cost

Talon Strike PDC drill bit portfolio

Performance delivered

The Talon™ Strike PDC drill bit portfolio from Baker Hughes delivers consistent performance, and competitive pricing in soft to medium competitive pricing, in soft to medium-hard formation toughness, and moderate application complexity.

Talon Strike combines application engineering expertise, proven bit technology and a comprehensive feature set to deliver the right bit at the right price, when and where it's needed.

APPLICATIONS

- Soft to medium-hard rock
- Fast-drilling applications
- Top hole applications
- Directional applications (RSS and conventional)
- Development drilling campaigns

BENEFITS

- Comprehensive application engineering expertise
- Superior directional control and bit stability
- Reliable, consistent performance

CTD and TTRD drill bits

Maximize Coil Tubing Drilling (CTD) and Through Tubing Rotary Drilling (TTRD) operations with drill bits designed for the job

Aging fields and declining production are common problems that can be addressed using CTD or TTRD operations. Drilling in these super slimhole environments requires expertise in drill bit design and materials to accomplish all well objectives safely and effectively.

Baker Hughes offers a full suite of drill bits specifically designed for the operations and challenges associated with CTD and TTRD.

- PermaFORCE™ elite PDC drill bit: for performance drilling in all environments
- RWD2ST: Reaming-while-drilling to enlarge the production hole size
- Natural diamond mills and PathMAKER™ formation mill: cut casing windows cleanly and efficiently

APPLICATIONS

- Production enhancement through increased producing formation contact using existing wellbores
- High performance drilling
- Directional drilling with bent motor or RSS
- Hole enlargement while drilling
- Casing exits

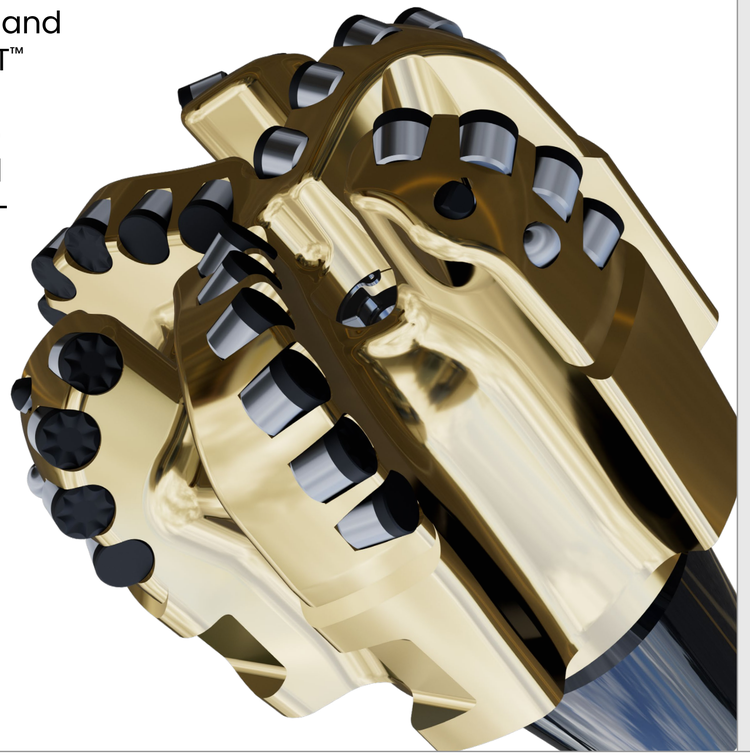
BENEFITS

- Highly durable cutting structures to stay in the hole longer
- Hole enlargement creates more borehole surface area to increase production or ease production equipment installation
- Fast and clean window milling

DirectKNCT shankless PDC drill bit

Gain uncompromising directional response with a shorter, more stable PDC drill bit design

Traditional methods for improving directional response while drilling focused on shortening bit designs by reducing gauge length. This approach could lead to lateral instability and borehole quality issues that limit the BHA's durability and performance. The Baker Hughes DirectKNCT™ shankless PDC drill bit technology takes an alternative approach. By reducing makeup length, DirectKNCT bits enhance directional control of bent motor and RSS assemblies—without compromising stability or borehole quality.



APPLICATIONS

- Directional drilling
- Bent-motor bottom hole assemblies (BHAs)
- Rotary steerable assemblies (RSS)

BENEFITS

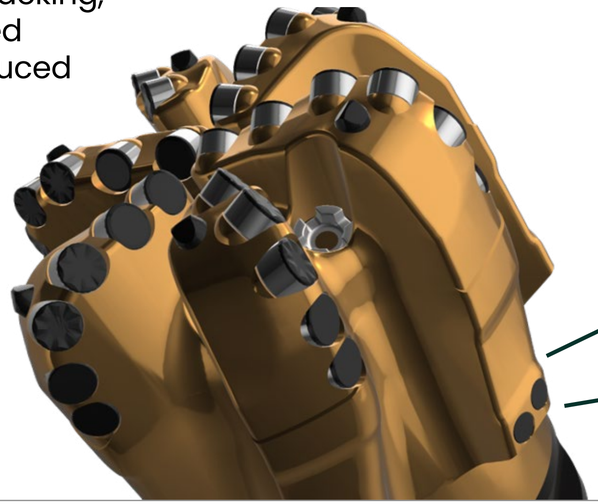
- Allows higher doglegs and facilitates steering
- Reduces the force required to steer and achieve buildup rates
- Maintains bit durability and wellbore quality in the lateral with an optimal gauge length
- Affords interchangeability at the rig site, with breaker slots moved into the gauge pads
- Available in pin-up or box-up configurations to match BHA requirements to the application

AntiWalk drill bit technology

Drill on time. Drill on target.

AntiWalk drill bit technology reduces slide time to increase rate of penetration (ROP), lower overall drilling time, and improve wellbore placement. It also optimizes wellbore quality and enables greater flexibility in BHA design.

Slides on conventional motor assemblies often account for up to 50% of drilling time, yet only 10 -15% of the distance drilled. AntiWalk technology tracks better to stay on target in all hole sections and reduce the time spent sliding for corrections. This enables you to spend your time optimizing ROP rather than correcting the wellbore trajectory. A unique stripe on the gauge pad limits depth of side cutting against the borehole wall while drilling ahead for reliable tracking, resulting in increased overall ROP and reduced dogleg severity.



RELIEF
Allows for planned BUR

STRIPE
Limits DOC against borehole wall at low side loads

APPLICATIONS

- Unconventional oil and gas wells
- Motor directional assemblies
- Wells prone to unplanned deviations
- Vertical, curve, and lateral sections

BENEFITS

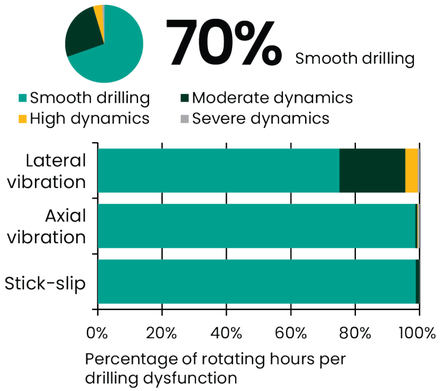
- Optimizes section ROP for reduced drilling time and costs
- Tracks to stay on target in rotate mode
- Reduces number and severity of slides for trajectory corrections
- Improves wellbore quality with reduced dogleg severity

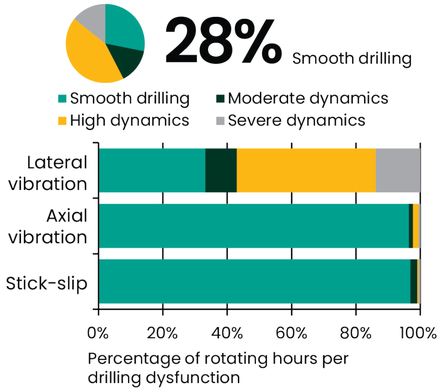
StayTrue shaped diamond elements

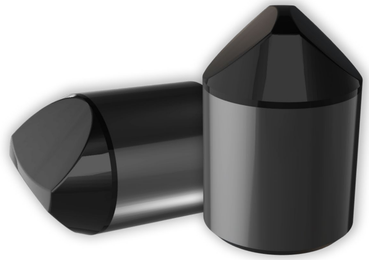
Get longer, faster runs consistently and without compromise

StayTrue™ shaped diamond element technology delivers improved speed and durability in hard and interbedded formations by enabling more efficient bit designs that expand the smooth drilling window.

The StayTrue shaped technology leverages a unique chisel shape and engineered placement so you don't have to choose between bit life and speed. Instead, it minimizes downhole dysfunctions and delivers longer, faster runs— and reduced cost per foot—consistently and without compromise.







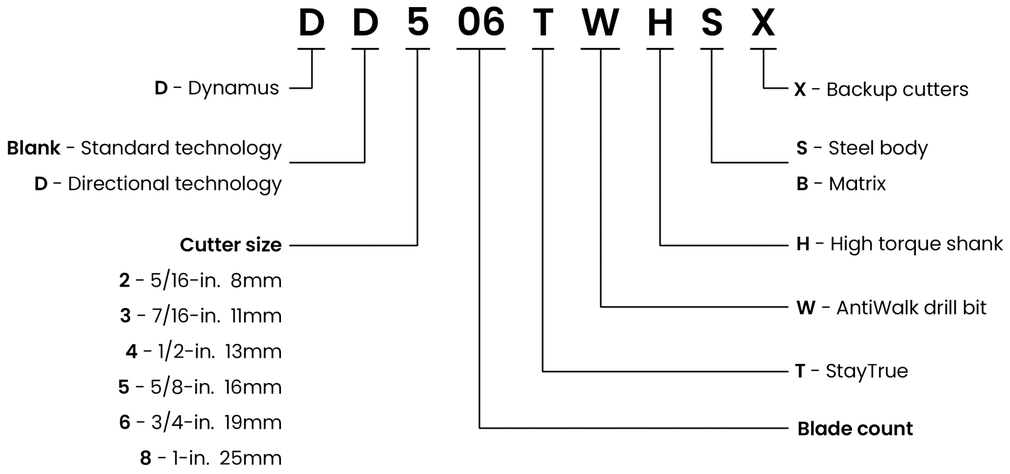
APPLICATIONS

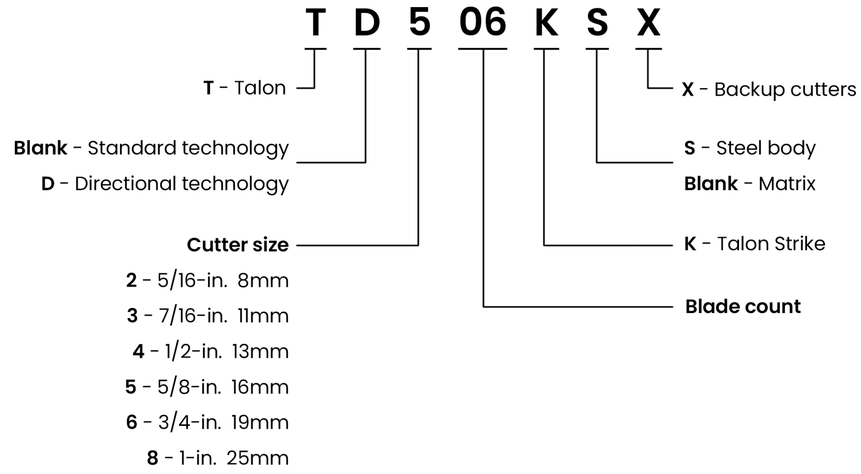
- Hard and interbedded formations
- Where downhole vibrations/bit whirl are causing tool damage/poor bit performance

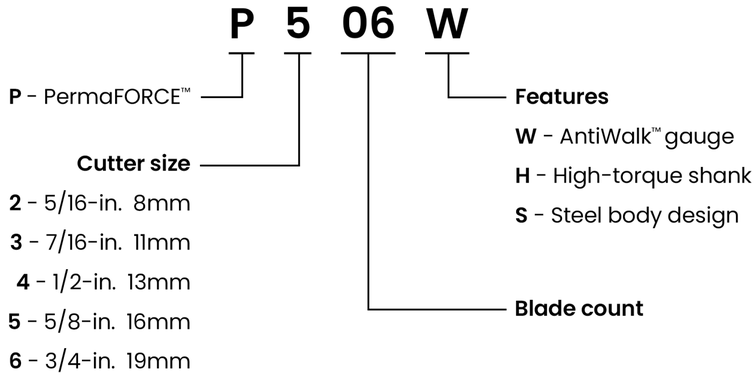
BENEFITS

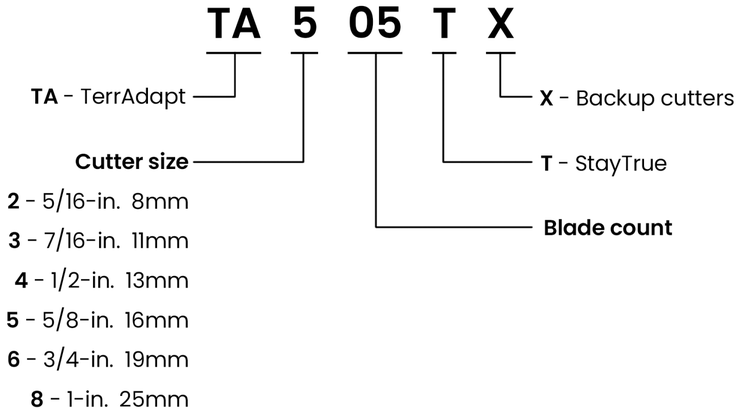
- Creates a stabilizing effect to reduce lateral vibrations
- Mitigates bit whirl
- Optimizes bit response
- Provides increased durability over standard PDC cutters
- Improves energy efficiency
- Minimizes damage to primary cutting structure
- Increases durability and longevity
- Prevents chipping
- Reduces drag
- Improves cutting performance
- Improves ROP

PDC drill bit nomenclature





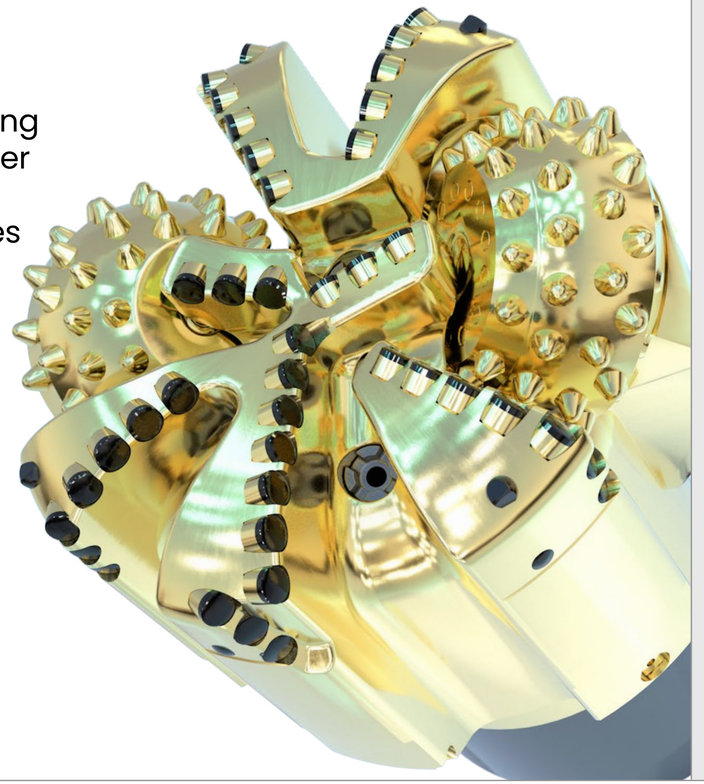




Kymera hybrid drill bits

Improve drilling performance in complex applications

Kymera™ hybrid drill bit technology combines the cutting elements of both roller cone and PDC bits into a single, patented design to reduce drilling time and trips in the most complex applications. Kymera is designed to take advantage of the best attributes of both bit types – a dual cutting mechanism with the crushing action of a roller cone and the shearing action of a PDC. Kymera drills faster than a roller cone and drills smoother with less torque and vibration than a PDC. This technology increases ROP, reduces drilling vibrations, improves directional control, and improves durability in challenging formations.



APPLICATIONS

- Minimizing vibrations
- Improving directional control
- Excessive bit damage
- Low ROP with roller cone
- Inconsistent drilling performance

BENEFITS

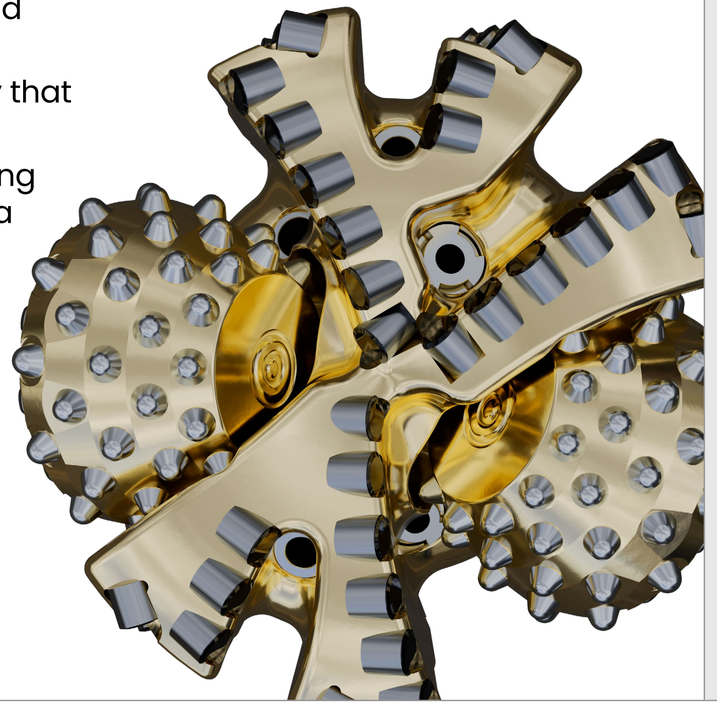
- Smooth drilling and low vibrations
- Superior tool face control and build rate capability
- Higher ROP
- Improved bit durability
- Improved downhole tool reliability
- Lower cost per foot

Kymera Mach 6 hybrid drill bit

Conquer challenging drilling applications

Kymera™ Mach 6 is the next-generation hybrid drill bit technology for the world's most challenging applications. It is designed to drill the toughest rock, minimize vibrations, improve directional control, and reduce cost-per-foot in complex applications. Kymera Mach 6 delivers this with:

- New bit design strategies combined with new cutting materials that improve durability and increase drilling efficiency
- Enhancements to leg and shoulder integrity that make Kymera built for tougher drilling
- Optimization using 3D Tetrahedron™ bit drilling simulation software that models the Kymera dual-cutting mechanism to optimize for any application



APPLICATIONS

- Tough formations, such as hard or interbedded rock
- Complex directional profiles on bent motor or rotary steerable assemblies
- Applications needing to minimize drilling vibrations
- Sections where conventional bit types show inconsistent or low drilling performance

BENEFITS

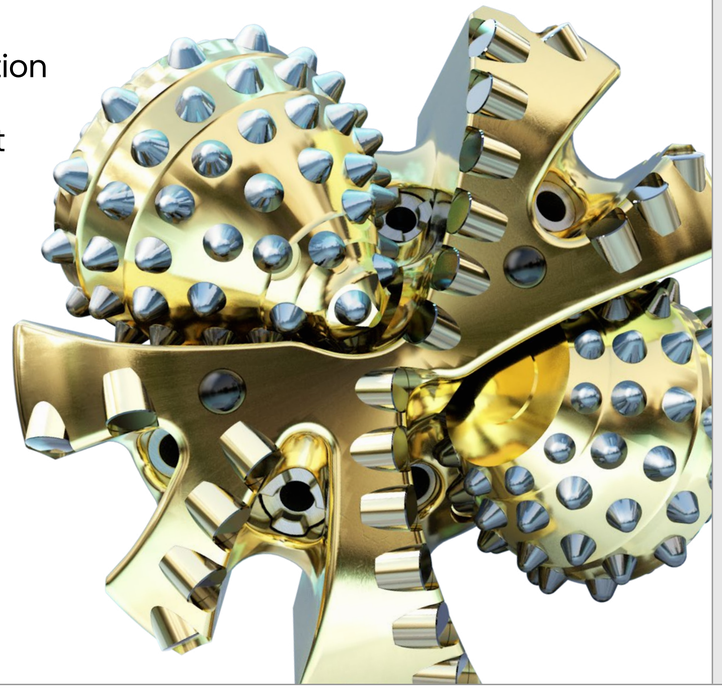
- Improves drilling performance in the most challenging applications
- Extends run lengths, increases drilling efficiency, and improves dull conditions
- Optimizes the hybrid bit design specifically for the application
- Delivers better consistency and reduced NPT risk
- Reduces total well costs with fewer bits per interval

Kymera Mach 5 hybrid drill bit

Unleash the power. Extend the limit.

The drive to improve penetration rates has seen the introduction of high torque motors and higher weight on bit, making it increasingly challenging to find the right bit for this tougher operating environment. Steering issues make it difficult to land in the desired target and compromise overall penetration rates. Bit durability has been limited in harder formations and intervals with interbedded hard streaks.

The Kymera™ Mach 5 hybrid drill bit from Baker Hughes extends the hybrid bit application range, increases rate of penetration (ROP), improves steerability, and provides longer bit life in high energy drilling environments.



APPLICATIONS

- Challenging carbonates
- Hard interbedded formations
- Vertical and/or curve sections
- Directional drilling with motors or rotary steerable systems (RSS)
- High-energy drilling environments

BENEFITS

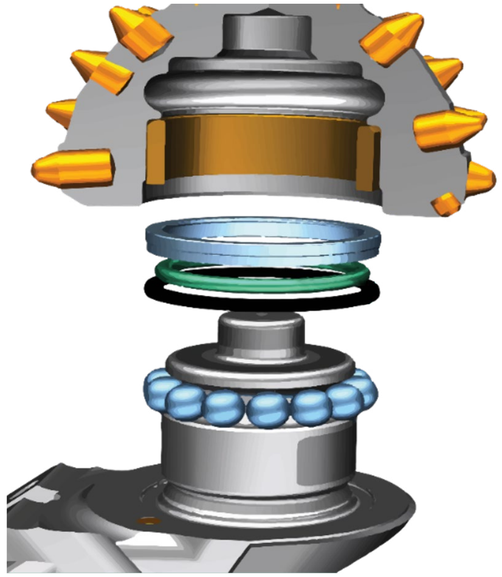
- Increased application range
- Higher penetration rates
- Improved steerability
- Longer bit life
- Reduced drilling cost

Kymera bearing and seal technology

Extended bit life and improved KREV limits

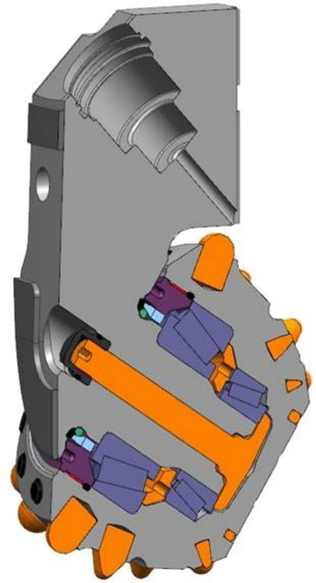
Metal Face Seal

- Metal-to-metal seal extends bit life with higher krev limits
- Improves seal wear resistance vs. elastomer seals
- Enables higher rotation speeds and higher temperature limits

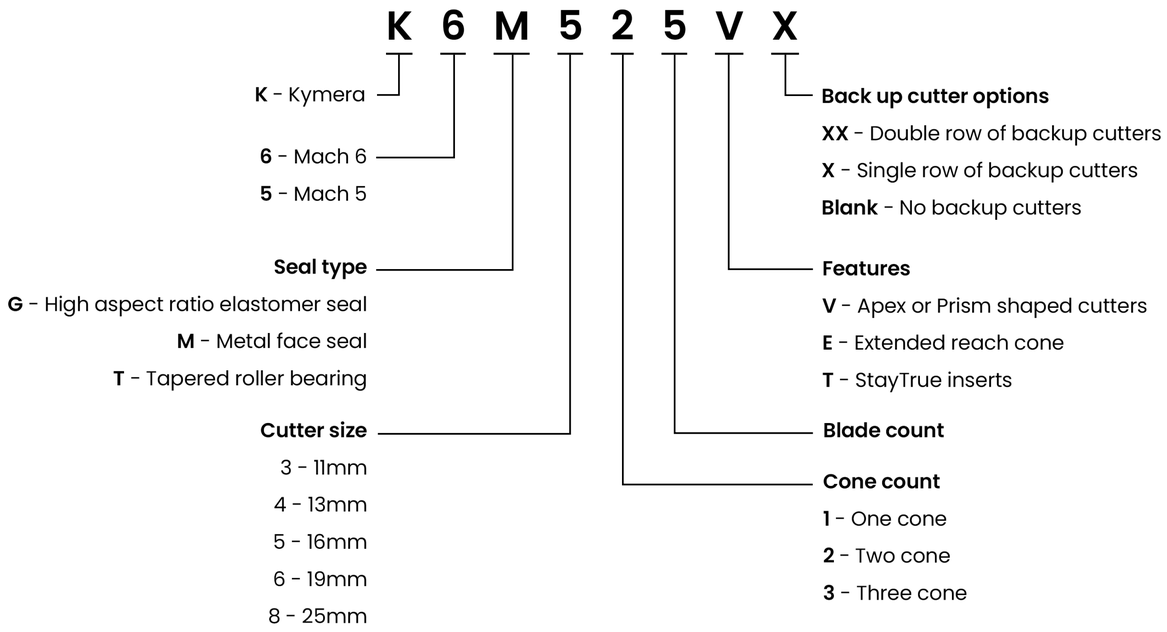


Tapered Roller Bearing

- Eliminates axial and radial play in traditional rock bit bearings
- Reduces bearing wear and extends seal life
- For extended run length applications



Kymera hybrid drill bit nomenclature

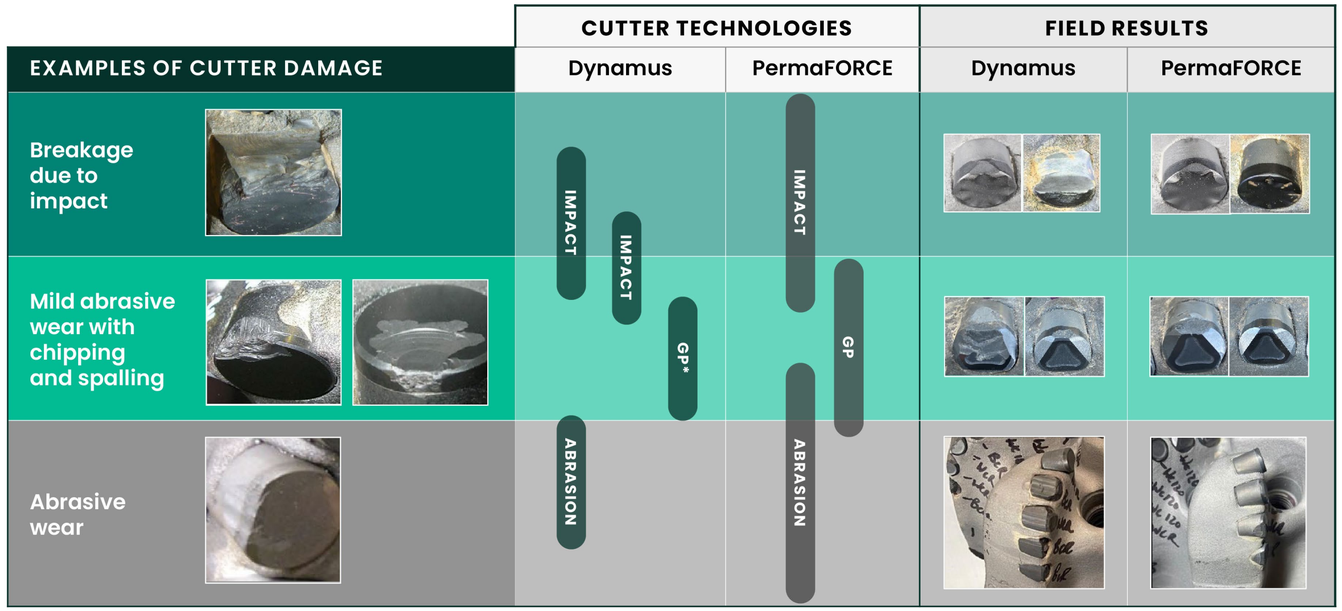


Application specific cutter technologies

Cutter characteristics and application targeting

Baker Hughes' application specific cutter technologies are designed to address specific applications challenges to maintain a sharp cutting structure and improve overall drilling performance.

Total upgrade to our cutter portfolio



*General purpose

APPLICATIONS

- Impact
- General purpose
- Abrasive

BENEFITS

- Reduces breakage to maintain ROP
- Prevents wear and chipping/ spalling to facilitate higher ROP and longer runs
- Improves abrasion resistance and thermal stability to prevent the cutters from wearing prematurely

Shaped-cutter technology

Our shaped-cutter technologies provide different options to fine-tune drilling performance to the specific application so you can maximize durability or ROP potential regardless of application type.

Avoid heavy-impact damage in—and extend runs through—tough, interbedded formations.

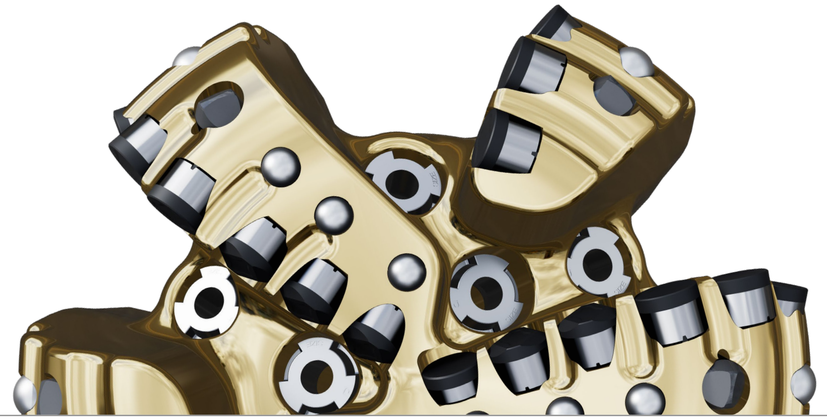
Lower friction to prevent thermal damage or chipping in interbedded geology.

Improve cutting life on hard, abrasive formations.

Reduce friction and point loading while driving ROP at lower WOB.

Enhance efficiency in tough to drill formations.

Maximize efficiency in tough, ductile formations at high mud weights or restricted WOB.



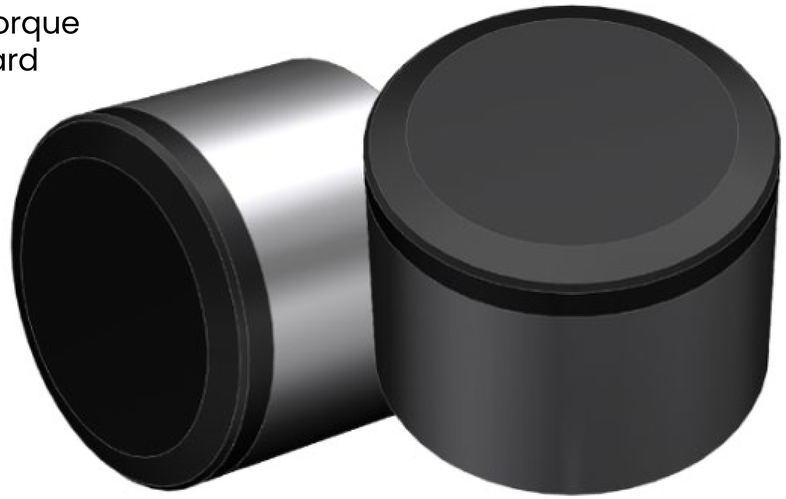
StabilisX shaped-cutter technology

Drill farther in challenging applications

The StabilisX™ shaped-cutter technology from Baker Hughes amplifies cutter durability and delivers longer runs in challenging formations. Where traditional PDC cutters fail, the StabilisX cutter's novel geometrical design protects the cutters while improving performance.

StabilisX cutters introduce a secondary chamfer on the diamond face of the cutter that enables a higher loading to be applied without breakage. Compared to traditional cutter geometry, StabilisX cutters have nearly triple the impact strength.

StabilisX cutters also generate less torque fluctuations compared to the standard geometry. For changing cut depths, StabilisX cutters have a consistent coefficient of friction, whereas standard cutters have a fluctuating torque response. Controlling these oscillations leads to smoother, more stable drilling resulting in higher rates of penetration (ROP) and improved overall run performance.



APPLICATIONS

- Wide range of challenging formations where PDC cutter breakage is a concern
- Interbedded or directional intervals where improved torsional stability is required

BENEFITS

- Protect the cutter for increased durability and longer run life
- Reduce spalling and chipping of the diamond face
- Generate less torque fluctuations with a consistent response across changing cut depths
- Decrease friction on the cutter face to reduce heat buildup
- Reduce cuttings size for easier transport to surface and improved borehole quality

ShockWave shaped-cutter technology

Drill faster. Drill farther.

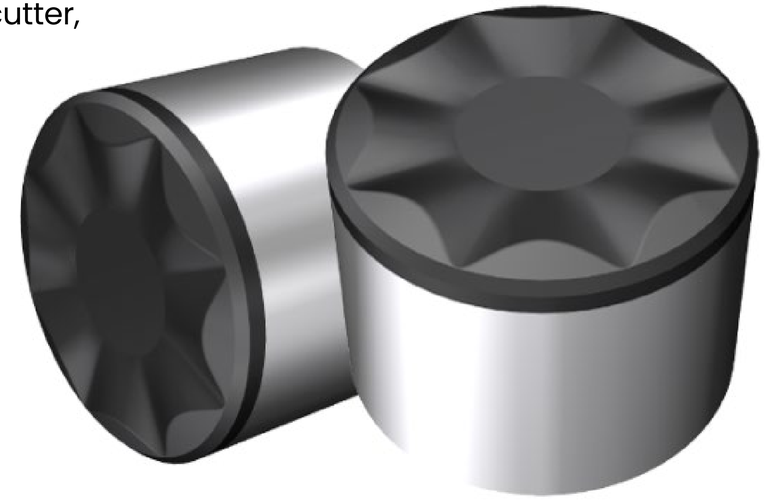
The ShockWave™ shaped-cutter technology from Baker Hughes saves time and money by extending cutter life to enable your drill bit to drill faster and farther. Designed for the Dynamus™ extended-life drill bit platform, novel ShockWave geometry improves cutter-rock interaction for efficient drilling and increased durability in all applications.

DRILL FASTER

The ShockWave cutter geometry increases stress on the rock, enabling the rock to fracture with less energy. The result is a cutter that drills like a single chamfer cutter with the impact resistance of a dual chamfer cutter, resulting in increased ROP for a given weight on bit (WOB).

DRILL FARTHER

Heat on the face of a cutter causes it to wear and chip faster. The unique shape moves the rock up the trough and breaks it as it hits the ShockWave feature. Cuttings are projected away from the face of the cutter resulting in lower heat on the diamond table. Less heat on the diamond table results in longer cutter life.



APPLICATIONS

- Conventional and unconventional oil and gas wells
- Abrasive and interbedded formations

BENEFITS

- Lowers WOB requirement for a given ROP
- Reduces friction on diamond table
- Lowers heat generation at cutter/rock interface
- Breaks up rock cuttings to improve efficiency
- Enables faster drilling and longer runs

CryoCut shaped-cutter technology

Maintain your edge to drill faster and farther

CryoCut™ shaped-cutter technology from Baker Hughes, helps beat the drilling day curve and reduce drilling costs by minimizing friction on the cutter face, improving rates of penetration (ROP), and drilling more efficiently. CryoCut shaped cutters use unique non-planar diamond table geometry and polished cutter base technology to enhance performance in key applications.

In more challenging environments, like interbedded sandstones and carbonates, bit performance is directly related to cutters and their ability to withstand heat. CryoCut technology reduces heat generation at the cutter/ rock interface. This lengthens the life of the cutter, which leads to extended runs, fewer bit trips, and reduced overall time to reach total depth (TD).

APPLICATIONS

- Intervals with abrasive formations combined with other types of rock that could introduce impact loading
- Conventional BHA's and RSS with motors

BENEFITS

- Reduces friction between formation and cutter
- Lowers heat generation at cutter/rock interface to maximize thermal stability
- Improved face geometry reduces stresses and improves durability to reduce breakage and chipping
- Increase durability and consistency
- Maintains sharper edge for more efficient drilling over life of run

Prism shaped-cutter technology

Drill challenging formations with efficient cutting action and durability

The Prism™ shaped-cutter technology from Baker Hughes provides strategically placed point loading in the cutting structure to deliver peak penetration rates in tough, ductile formations interbedded with hard formations without sacrificing durability. The Prism shaped cutter provides point loading by distributing more weight to a smaller portion of the rock, and the unique three-dimensional shape also improves strength over traditional point loading cutters to increase cutter efficiency without reducing durability. This allows a drill bit modified with this shaped-cutter technology to generate maximum rate of penetration in challenging applications with ductile formations.

Baker Hughes has also incorporated elements of the CryoCut™ shaped-cutter technology into the Prism shaped-cutter design to improve durability in hard abrasive applications. The integration of the CryoCut technology reduces heat generation at the cutter/rock interface with an exceptionally wear-resistant working surface, maintaining a sharper cutting edge to maximize drilling efficiency.

APPLICATIONS

- Carbonates, anhydrites, salts, and pressured shales
- High mud weight applications
- Challenging intervals with tough, ductile formations and high interfacial severity

BENEFITS

- Penetrate ductile formations more effectively and optimize drilling efficiency
- Reduce friction to lower heat generation at rock/ cutter interface
- Improve durability in applications with high cutter forces and higher impact
- Increase ROP
- Prolong cutter life and maintain sharper edge

Lancer shaped-cutter technology

Increase efficiency to drill faster with confidence

Lancer™ shaped-cutter technology from Baker Hughes provides an efficient point loading effect to improve rate of penetration (ROP) in applications where soft formations are combined with tough, ductile formations with moderate levels of interfacial severity. By incorporating the CryoCut shaped-cutter technology, Lancer shaped cutters provide a sharp point loading edge that focuses more weight to a smaller area of the rock, and the unique three dimensional shape balances efficiency, thermal stability, and durability.

Lancer's efficient cutting action and durability allows for a higher ROP potential while mitigating the risk of tangential failure, which can be a limiting factor in shoe-to-shoe runs. This allows a drill bit equipped with Lancer shaped cutters to maximize ROP in applications with ductile formations mixed with other lithologies like shale and sandstone.

APPLICATIONS

- Carbonates, anhydrites, salts, and pressured shales
- High mud weight applications
- Intervals with soft formations combined with tough, ductile formations with moderate levels of interfacial severity and abrasiveness

BENEFITS

- Penetrate ductile formations more effectively and optimize drilling efficiency
- Reduce friction to lower heat generation at rock/ cutter interface
- Improve durability in applications with high cutter forces and moderate impact
- Increase ROP
- Prolong cutter life and maintain sharper edge

Apex shaped-cutter technology

Drill tough formations with efficient cutting action

The Apex™ shaped-cutter technology from Baker Hughes provides strategically placed point loading in the cutting structure to deliver peak penetration rates in tough, ductile formations without sacrificing durability. The Apex shaped cutter provides a traditional point-loading approach by distributing more weight to a smaller portion of the rock. This allows the cutter to penetrate ductile formations and generate maximum rate of penetration (ROP). Baker Hughes has fine tuned the Apex geometry to maximize penetration rates and durability through difficult interbedded formations.

APPLICATIONS

- Carbonates, anhydrites, salts, and pressured shales
- High mud weight applications

BENEFITS

- Penetrate ductile formations more effectively and optimize drilling efficiency
- Increase ROP
- Prolong cutter life and maintain sharper edge

Vanguard premium tricone drill bits

Drilling excellence in extreme environments

Vanguard tricone drill bits continue the legacy of drilling excellence that has made Baker Hughes the industry's leading drill bit provider for more than 100 years. Vanguard bits are custom designed to maximize drilling effectiveness and improve reliability, steerability, and performance—no matter the application.

Vanguard tricones feature:

- Engineered cutting structures for maximum efficiency and durability
- Advanced seal technology for superior reliability
- Advanced carbide insert technology with superior wear resistance and fracture toughness
- Robust STL shirttail and leg hardfacing for improved OD protection
- Optional diamond enhancement

APPLICATIONS

- Challenging formations, hard rock
- Directional drilling
- Extended section lengths
- High temperature drilling (greater than 275°F/135°C)

BENEFITS

- Reliable and consistent drilling performance
- Higher ROP and run length, better dull conditions
- Improved OD protection, minimize risk of under gage bits
- Extended bit life and krev limits

Vanguard Arabia tricone drill bit

Optimize drilling efficiency in carbonate formations

The Baker Hughes Vanguard™ Arabia tricone drill bits reliably drill hard carbonate formations, offering unprecedented cutting aggressiveness. The bit's next-generation family of carbide grades and geometry deliver unsurpassed penetration rates and durability in these drilling applications.

Vanguard Arabia bits are designed using enhanced engineering methods, which calculate the optimum tungsten carbide insert spacing on each row to further improve drilling efficiency and minimize the risk of tracking, allowing higher rates of penetration (ROP) over longer distances in carbonate sections.

APPLICATIONS

- Performance drilling in carbonate formations
- Rotary, RSS, and motor applications

BENEFITS

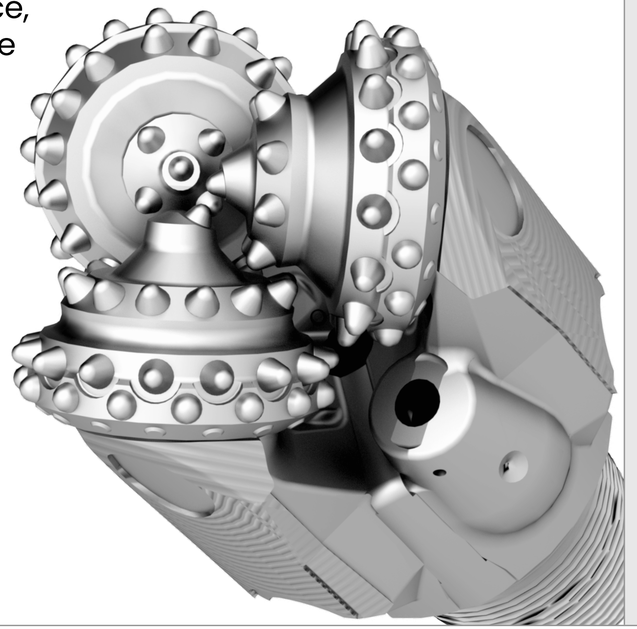
- Provides exceptional ROP
- Improves reliability for longer drilling hours downhole
- Increases bit life in carbonate drilling environments

Vanguard air tricone drill bit

Drill faster with increased reliability

The Vanguard™ air performance tricone drill bit, from Baker Hughes combines extra-hard tungsten carbide alloys with a customized insert layout to maximize penetration rates and downhole rock destruction in air-drilling applications.

The tricone bit's uniformly applied tungsten carbide hardfacing protects the body from damaging rock formations and debris, enhancing wear resistance while extending the life of bearing and grease compensator seals. Further optimizing performance, the bit features a unique seal and bearing package engineered to improve bit life and reliability.



APPLICATIONS

Air-drilling operations

BENEFITS

- Provides exceptional ROP
- Increases bit life in abrasive and impact drilling environments
- Better hole cleaning for greater ROP and reduced risk of bit erosion
- Improves reliability

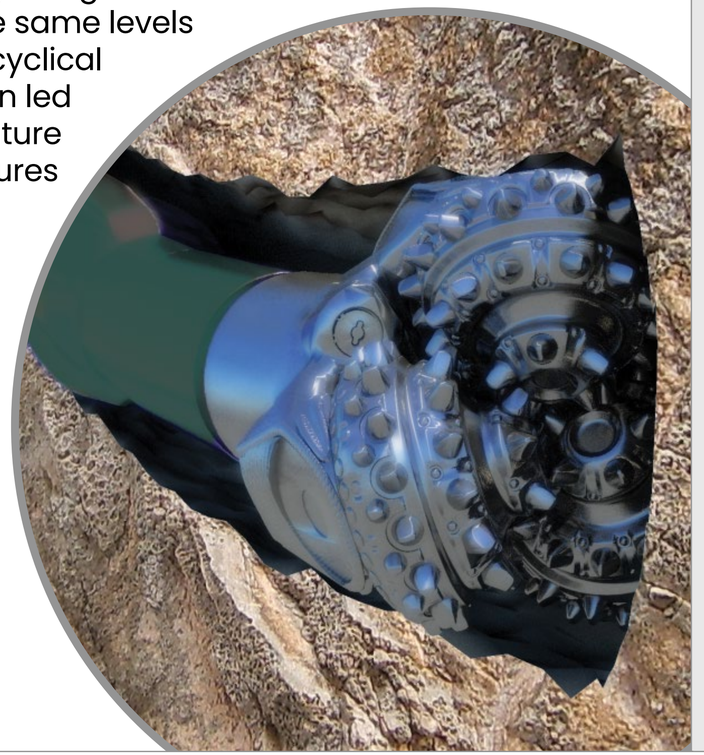
Vanguard directional tricone drill bit

The new benchmark for drilling directional intervals

Increasing dependence on directional drilling has resulted in a higher demand for quality drill bits that provide high levels of reliability, steerability, and performance. Baker Hughes has addressed these needs with our Vanguard™ directional rollercone drill bits.

Because traditional roller cones were originally designed to drill vertically, the bits did not perform at the same levels in diverse drilling environments. For example, cyclical side loading intrinsic to directional drilling often led to leg damages and early seal failures, premature heel-rounding also gave way to early seal failures and reduced penetration rates, and back reaming damaged bit compensator systems and increased torque and drag.

Baker Hughes has invested more than a decade of continuous improvement efforts in directional drilling technology, including analyzing the root cause of failures and drilling inefficiencies.



APPLICATIONS

- Non-vertical drilling
- Rotary, motor, and other directional system applications

BENEFITS

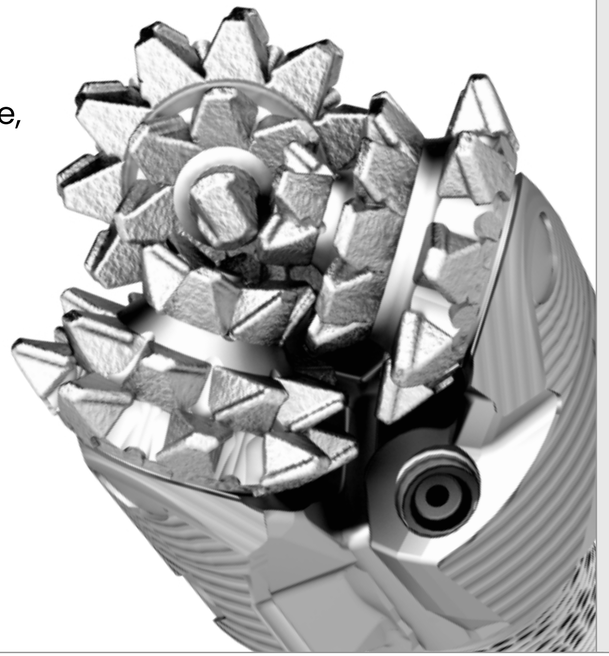
- Achieving longer curve drilling hours
- Maximizing average ROP with specific cutting structures
- Improves seal reliability and bit dull conditions
- Decreasing directional drilling cost-per-foot

Vanguard steel-tooth tricone drill bit

Unsurpassed performance, reliability, and economics in a range of soft formations

Vanguard™ steel-tooth tricone bits from Baker Hughes address the primary issues associated with steel-tooth applications and the need for enhanced durability and speed.

An optimized high-count row minimizes bit tracking and improves drilling efficiency, allowing higher rates of penetration (ROP) over longer distances. Superior reliability in a wide range of applications is achieved with patented high-aspect-ratio and metal-face seal technologies, while shirttail and leg hardfacing (STL) protects the bit body, increases wear resistance, and extends bearing and grease-compensator seal life.



APPLICATIONS

- Performance drilling operations in soft formations
- Rotary and motor applications

BENEFITS

- Deliver maximum rock destruction and improved ROP in a full range of formations and applications
- Improve reliability for longer drilling hours downhole
- Increases bit life in abrasive drilling environments

Vanguard plug drillout bit

Smooth, fast drillout for expedited operations

Designed to do more than simply drill through composite bridge plugs (CBPs), the Vanguard™ plug drillout roller cone bit, from Baker Hughes consistently delivers a cleaner, more reliable drillout operation.

The unique cutting structure of the Vanguard plug drillout bit uses a higher tooth count and self-sharpening teeth to tackle the specific challenges of plug drillouts. This cutting structure directs the limited available weight on bit (WOB) to destroy cast iron and tungsten carbide CBPs, crushing them into smaller cuttings. Production is then allowed to flow more smoothly and cleanly with less debris.

APPLICATIONS

- Bridge plug drillouts
- Fracturing ball and sleeve system drillouts
- Coiled tubing
- Motor, rotary, and directional drilling
- Low weight on bit; low available torque

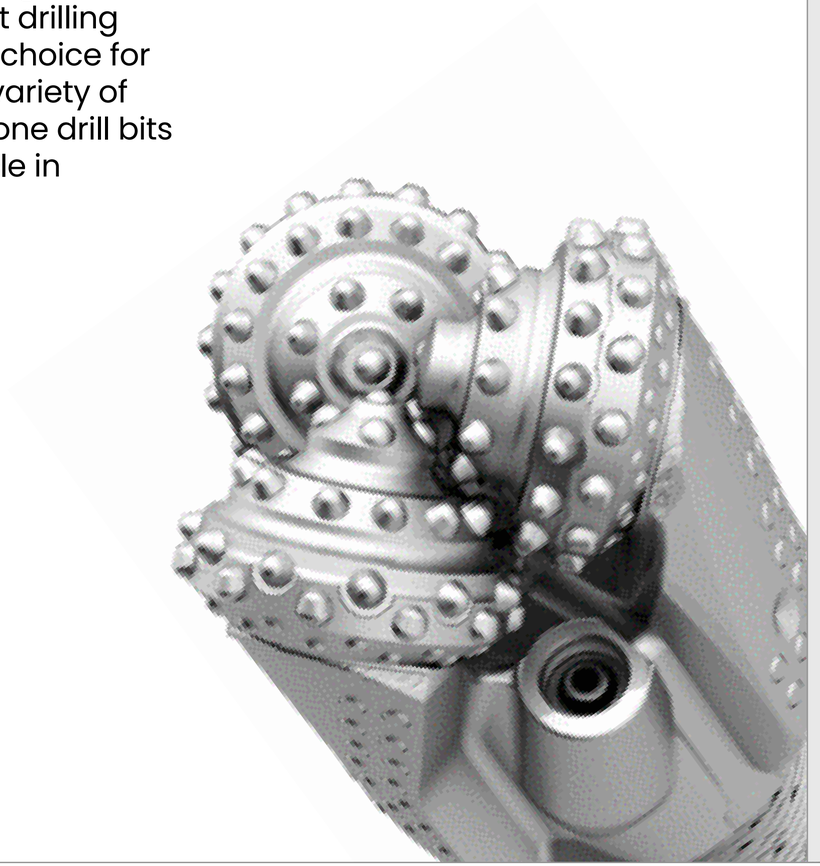
BENEFITS

- Improves drilling efficiency in low WOB applications
- Reduces wear in the bearing
- Extends bearing life
- Protects the bearing and seal for increased durability and performance
- Protects the compensator
- Assists the drilling operation when backreaming is required
- Provides longer bit life in rotary, motor, and directional applications

GTX, GX, and STX tricone drill bits

Achieve consistent, reliable drilling performance in a broad range of applications

The family of GTX™, GX™, and STX™ tricone drill bits from Baker Hughes has accumulated significant field experience with reliable and consistent drilling performance, becoming the drill bit of choice for many operators and contractors in a variety of applications. The GTX, GX, and STX tricone drill bits are elastomer-sealed and are available in diameters from 3.875 to 30 in.



APPLICATIONS

- Conventional drilling applications
- Rotary and motor applications

BENEFITS

- Efficient operational costs
- Provide reliable and consistent drilling performance
- Offers flexibility when choosing the right bit for a wide range of applications

Tricone drill bit optional features

Tricone drill bits

Diamond inserts (DX)

For directional and highly abrasive applications, diamond inserts deliver unmatched gauge-holding ability. Every third insert has a thicker diamond table and generous chamfer for remarkable resistance to breakage.

Diamond gauge trimmers (DT)

For abrasive applications where rounded gauge is a problem, every gauge trimmer is diamond.

Shirttail and leg hardfacing

STL™ hardfacing is the industry's leading technology to strengthen legs and shirttails.

Diamond shirttail compacts (DS)

For additional leg protection in abrasive applications, flat diamond compacts can be inserted on the leg of the bit.

Spray-coated cones (R)

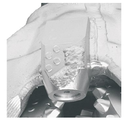
For additional wear resistance when drilling directional or abrasive applications, a tungsten carbide spray coating can be applied to cones.

Diamond heel compacts (DH)

Every heel compact is diamond enhanced.

Diamond-enhanced wear pad (DP)

For additional leg protection in abrasive applications, flat diamond compacts can be added to the leading edge of the leg pad.



High-flow extended nozzles (T)

High-flow extended nozzles are added to maximize penetration rates in hard and soft formations. These nozzles are much sturdier and provide greater flow capacity than conventional extended nozzles.

Gauge enhancement package (G)

For directional and highly abrasive applications, tough ovoid-shaped inserts are added on the heel row and a generous amount of carbide inserts are added on the gauge.

Diamond gauge/diamond trimmers (DDT)

For maximum gauge and heel-area protection, every third gauge compact and every gauge trimmer is diamond.

Motor hardfacing (M)

For additional protection in high-speed, directional, or abrasive applications, motor hardfacing can be applied. Tungsten carbide particle hardfacing is applied liberally along the shirttail and extended up the leading edge of the bit leg.

Center jet (C)

A fourth jet may be positioned in the center of the bit. Center jets are primarily used to prevent bit balling and the associated reduction in penetration rate. Center jets are available in bit sizes 7 7/8-in. and larger.

Breakage-resistant heels (H)

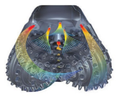
A breakage-resistance package for tough drilling applications where friction tends to heat-check the heel compacts.

Wear/stabilization pad (P)

Wear/stabilization pads are a steel block containing flush-mounted carbide inserts added to the outer diameter of a bit to minimize wear on the bit leg or body.

Shirttail compacts (S)

Tungsten carbide compacts are added to the shirttail to reduce leg wear in abrasive formations and deviated or horizontal wellbores.



Three-port center jet (C3)

For bit sizes 16-in. and larger where severe balling conditions may occur, three fixed ports can be positioned in the bit center.

Tricone drill bit nomenclature

V G D - 20

V - Vanguard

Seal type

G - Elastomer

M - Metal face

X - Non-sealed

Application

A - Arabia (Carbonate)

D - Directional

G - Geothermal

Blank - No specific sub line or steel tooth

Cutting structure

Options and nomenclature similar to existing product lines

STX - 20

Product series

STX - Elastomer seal (slimhole)

GX/GTX - Elastomer seal

Cutting structure

Options and nomenclature similar to existing product lines

Vulcanix geothermal drill bits

Tackle challenging formations, high temperatures, and harsh well conditions to make your geothermal projects economic–and successful

Baker Hughes offers a full portfolio of Vulcanix™ geothermal drill bit solutions.

The portfolio includes the Vulcanix™ geothermal tricone bit, the Vulcanix™ geothermal PDC bit, and the proprietary Vulcanix™ geothermal Kymera™ hybrid drill bit.

Our application engineers can select the optimal bit to deliver superior performance in a specific formation or address the most demanding drilling challenges. For example, in Indonesia our Vulcanix Kymera bit is the go-to choice to reliably drill tough, igneous lithologies. And in a US Department of Energy project in Utah, our Vulcanix Geothermal PDC set a drilling performance record with unmatched ROP.

APPLICATIONS

- Hard igneous and/or metamorphic lithology with rock strength above 25 KPSI unconfined compressive strength (UCS)
- Non-homogeneous and/or interbedded volcanic formations
- Abrasive formations

BENEFITS

- Wide application range: Address challenging rock formations, high temperatures and harsh well conditions.
- Superior reliability: High temperature components enable the bit to operate reliably for extended runs in circulating temperatures upwards of 400°F (204°C).
- Longer runs: Built on technologies and procedures tested and refined in hard and abrasive applications, these bits offer proven capabilities for reaching TD reliably in the most challenging and complex geothermal drilling environments

Vulcanix geothermal Kymera hybrid drill bit

Maximize drilling efficiencies to total depth with the hybrid solution for geothermal

The Vulcanix™ geothermal Kymera™ hybrid drill bit delivers value to your geothermal operations by drilling deeper and longer in hotter environments. With their unique combination of polycrystalline diamond compact (PDC) and roller cone cutting structures, our hybrid bits help increase your rates of penetration (ROPs), improve borehole quality, and accurately place your well to total depth—with greater efficiency than PDCs or roller cones could achieve alone.

Working with Baker Hughes, you'll find the optimal hybrid bit design for your geothermal application, based on proven processes and technologies honed in hard and abrasive formations worldwide.

APPLICATIONS

- Hard igneous and/or metamorphic lithology with rock strength above 25 KPSI unconfined compressive strength (UCS)
- Non-homogeneous and/or interbedded volcanic formations
- Abrasive formations

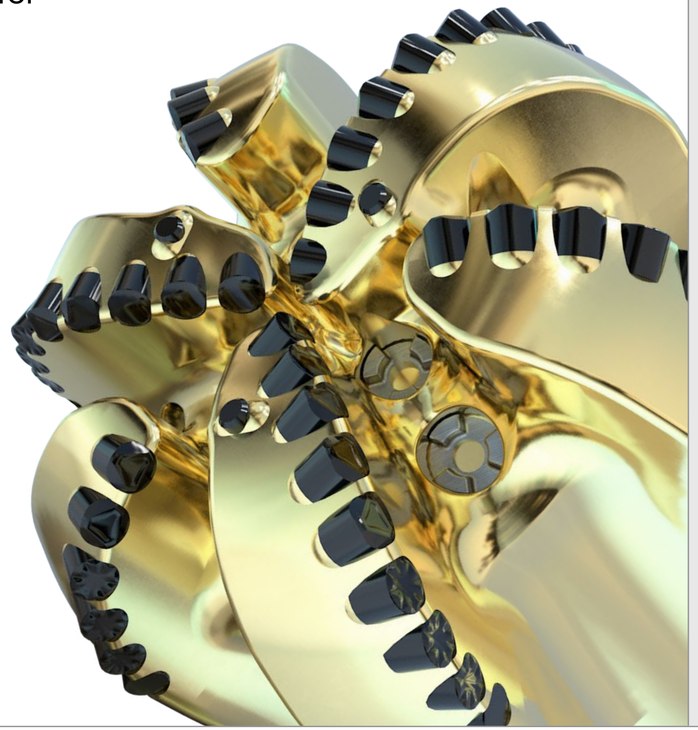
BENEFITS

- Delivers optimal bit designs through collaboration, advanced simulation, and testing
- Withstands high temperatures and challenging lithologies to drill farther without replacement
- Drills effectively through hard formations at lower costs and time compared to conventional PDC bits
- Increases ROP while minimizing vibrations and maintaining excellent toolface control to target

Vulcanix geothermal PDC drill bit

Optimize high temperature drilling with a PDC solution built for geothermal

The Vulcanix™ geothermal polycrystalline diamond compact (PDC) drill bit delivers value to your geothermal wells by drilling deeper and longer in hotter environments. Built on technologies and procedures honed in hard and abrasive applications around the world, Vulcanix bits offer proven capabilities to help you reliably reach total depth.



APPLICATIONS

- Hard igneous and/or metamorphic lithology with rock strength above 25 KPSI unconfined compressive strength (UCS)
- Non-homogenous and/or interbedded volcanic formations
- Abrasive formations

BENEFITS

- Delivers optimal bit designs through collaboration, advanced simulation, and testing
- Withstands high temperatures and challenging lithologies to drill farther without replacement
- Improves drilling efficiency and increases ROP, even through formation transitions

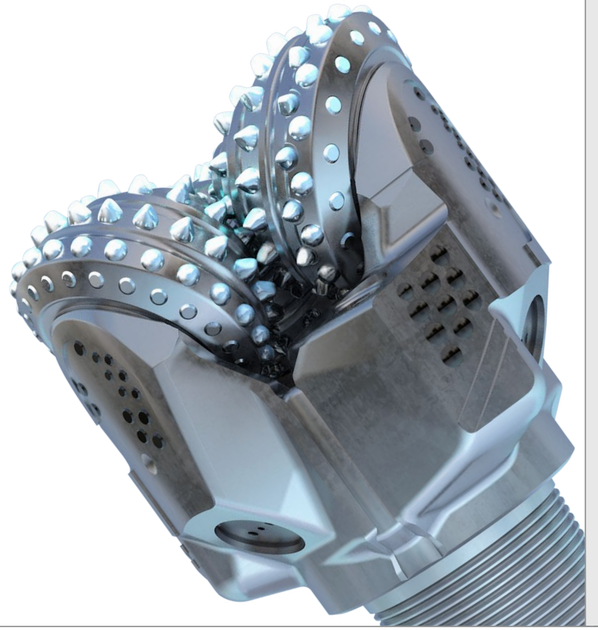
Vulcanix geothermal tricone drill bit

High-temperature performance

The Baker Hughes Vulcanix™ geothermal tricone bit line introduces application specific bearing packages that deliver unsurpassed reliability for a variety of high-temperature ranges.

For circulating temperatures up to 350°F (177°C), the Baker Hughes Vulcanix Metal Face Seal is ideal. A patented, metal-to-metal sealing system provides unmatched reliability in temperatures beyond the capabilities of ordinary, elastomer-based designs.

For even higher temperatures, the Vulcanix Geothermal Metal Face Seal has a sealed-bearing package designed specifically for drilling in circulating temperatures of 275°F to 400°F (177°C to 204°C). This new sealed-bearing system further enhances the high-performance advantages of the Metal Face Seal system by replacing all of its elastomer components with specially formulated, high-temperature compounds that are more resistant to thermal degradation and compression set.



APPLICATIONS

- Geothermal drilling
- High-temperature environments
- Rotary and motor applications
- Air drilling applications

BENEFITS

- Bit types and bearing/seal packages to address a range of high-temperatures
- Patented Metal Face Seal technology
- Anti-tracking cutting structures
- Advanced STL™ shirttail and leg hardfacing
- BOSS stabilization design
- Optional diamond enhancement packages that may include, Vulcanix diamond heels, diamond gauge, and diamond bar trimmers

Vulcanix geothermal drill bit nomenclature

VULCANIX GEOTHERMAL PDC DRILL BIT

VX 5 06

VX - Vulcanix geothermal PDC

Blade count

Cutter size

3 - 7/16-in. 11mm

4 - 1/2-in. 13mm

5 - 5/8-in. 16mm

6 - 3/4-in. 19mm

VULCANIX GEOTHERMAL KYMERA HYBRID DRILL BIT

VX 4 2 5

VX - Vulcanix geothermal Kymera hybrid

Blade count

Cone count

1 - One count

2 - Two count

3 - Three count

Cutter size

3 - 11mm

4 - 13mm

5 - 16mm

6 - 19mm

8 - 25mm

VULCANIX GEOTHERMAL TRICONE DRILL BIT

VX - 20

VX - Vulcanix geothermal tricone

Hardness type

00 to 99 - Tungsten carbide

Baker Hughes

EZCase casing bit system

Optimize casing and liner operations

The Baker Hughes EZCase™ casing bit system enables casing or liner systems to be successfully drilled down to total depth. By combining drilling and casing in one run, the system reduces flat time and provides additional options for problematic wells that cannot be completed through traditional drilling techniques. This non-retrievable casing bit system incorporates numerous exclusive features to enable drilling and reaming over longer intervals, in the most demanding applications, and in a full range of formations.

APPLICATIONS

- Casing and liner drilling or reaming operations
- Drilling and completing problematic wells, including rubble zones, lost circulation zones, depleted reservoirs, and underground blowouts

BENEFITS

- Steel construction maximizes integrity, durability, and efficiency
- Robust crown cutting structure enables casing bit to match performance of standard PDC bits
- Drillable body with patented internal profile reduces drillout time and costs
- Optimized hydraulic efficiency and easy change nozzles to adjust TFA's in the field
- Patented secondary bypass port to mitigate plugged nozzles

EZReam casing and liner reaming shoe

Reduce drilling cost with fewer trips

The Baker Hughes EZReam™ casing and liner reaming shoe reduces drilling costs by reaming faster through long, challenging intervals while ensuring casing and liner systems successfully reach total depth on the first attempt. This robust steel-body reaming shoe incorporates a unique design for efficient reaming and faster drillout. It is the industry's only steel reaming shoe that is drillable with a standard PDC bit.

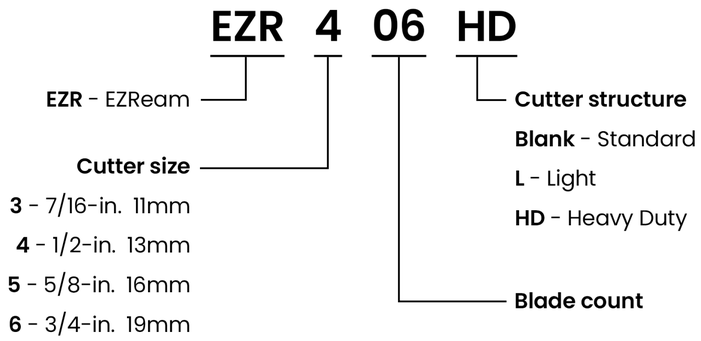
APPLICATIONS

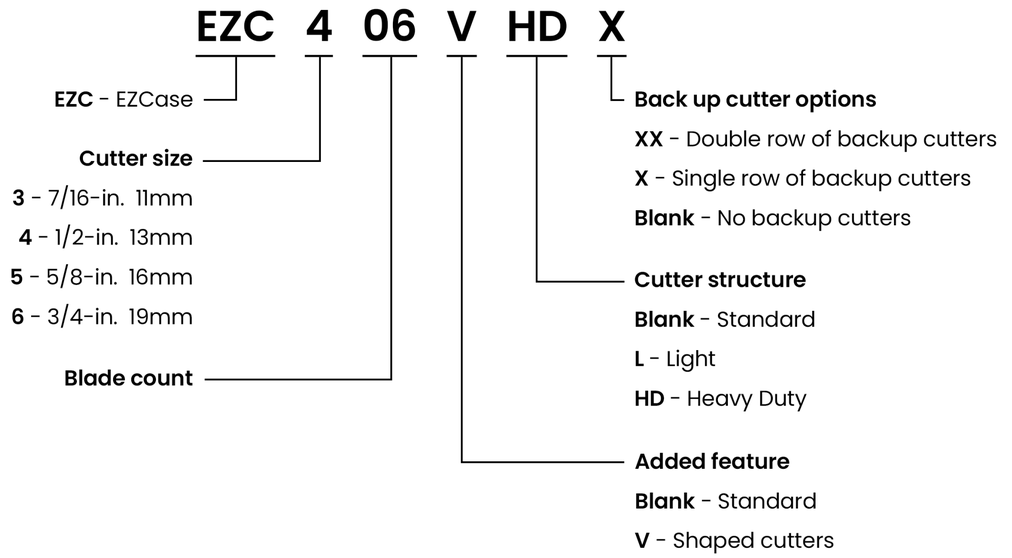
- Casing reaming operations
- Liner reaming operations

BENEFITS

- Steel construction increases ROP and maximizes durability
- Optimized profile and heavy duty cutting structure to eliminate obstructions, improve borehole quality, and allow completion equipment to pass through
- Combined tungsten carbide hardfacing and PDC cutting structure to open up tight spots and wipe away low-side cutting beds
- Patented concave profile reduces total drillout time and costs
- 360° spiral gauge increases stability when rotating and improves reaming efficiency
- Patented secondary bypass port to mitigate plugged nozzles

Casing bit nomenclature



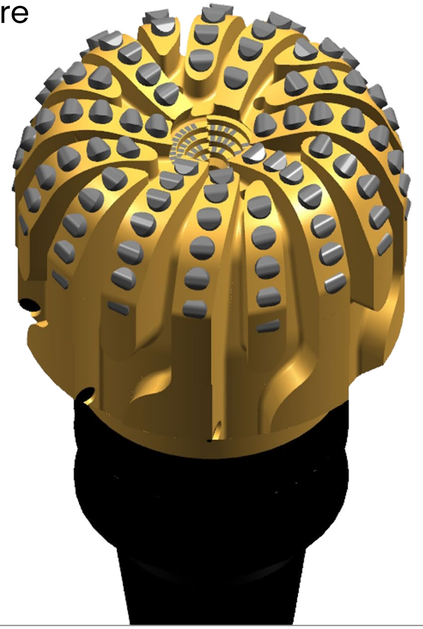


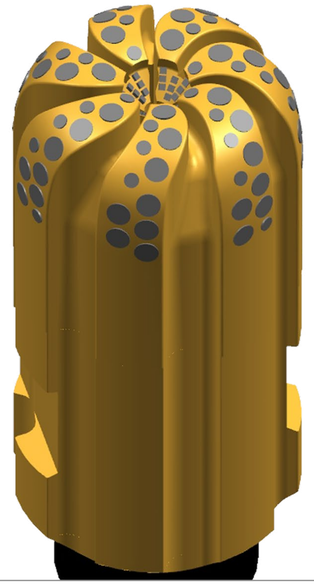
IRev impregnated drill bit

Maximize drilling performance in even the most difficult and abrasive environments

The IRev™ infinite revolution impregnated bit from Baker Hughes improves run life, while minimizing trips and the number of bits required when drilling in hard and abrasive intervals, including sandstones, or complex sections interbedded with softer shales.

IRev technology features a completely new cutting structure including diamond impregnated posts that allow a more aggressive rate of rock removal, enabling the bit to drill in places where PDC bits typically cannot perform. As diamonds wear away, new diamonds are exposed to enhance performance and further extend bit life.





APPLICATIONS

- Extremely hard and abrasive intervals
- Hard sections interbedded with soft shales and siltstones
- Enhanced coring operations

BENEFITS

- Diamond impregnated posts increase durability, performance, and footage drilled
- More aggressive design enables higher torque output to deliver greater ROP
- Application-specific diamond grits and body matrix provides optimal performance by matching technology to application for best performance
- Optimized profile better balances workloads and extends bit life

LedgeX reaming tools

Eliminate dedicated wiper trips, save time and money by wiping out ledges while drilling

The Baker Hughes LedgeX™ eccentric reaming tools eliminate the need for dedicated wiper trips and enable completion systems to be run to total depth on the first attempt, saving rig time and lowering cost per foot.

By incorporating LedgeX in the drill string, wellbores can be conditioned during normal drilling operations without sacrificing directional control or bottomhole assembly (BHA) integrity. This fixed-blade PDC reamer improves overall borehole quality by clearing ledges and micro-doglegs created by steerable motor assemblies, and it agitates low-side cuttings beds while drilling high-angle and extended lateral sections. The ability of LedgeX reamers to enhance hole cleaning and conditioning can help reduce torque and drag, improving weight transfer to the bit for increased rate of penetration performance.

APPLICATIONS

- Steerable motor and rotary steerable applications
- Curve, lateral, and other directional drilling applications
- Swelling formations

BENEFITS

- Eccentric blade configuration maintains a smaller pass-through diameter and ensures full hole cleaning / ledge removal
- Reduce torque and drag and risk of hanging up while sliding
- Parabolic blade profile improves reaming efficiency and allows for drilling and back-reaming
- PDC cutters actively engage ledges and provide full-gauge hole conditions while BHA rotates
- Leading and trailing hardfacing pads manage torque and extend PDC cutter life

RWD2 ream-while-drilling tools

Enlarge and ream boreholes in one run with eccentric, concentric, and bicenter tools

The Baker Hughes RWD2™ fixed-blade eccentric ream while drilling tools are capable of drilling out cement and float equipment, as well as drilling and reaming the remaining interval in one continuous operation. The tool blade design and depth-adjusted cutters increase efficiency and reduce cost per foot. RWD2 tools also provide bottomhole assembly (BHA) flexibility for any motor, rotary, or rotary steerable application.

APPLICATIONS

Rotary and rotary steerable applications

BENEFITS

- Active stabilization pad decreases vibrations for increased drilling efficiency and improved borehole quality
- Depth-adjusted cutters eliminate premature wear and improve balance and durability
- Casing drillout protection with one-run capability
- Optimized nozzle positioning to maximize cuttings removal and cutting structure cooling
- Meets profile needs of a given well with pendulum, packed, or directional assemblies

RWD2 ream-while-drilling tools

RWD2S™ MOTOR STEERABLE FIXED-BLADE ECCENTRIC REAM WHILE DRILLING TOOLS

APPLICATIONS

- Directional motor applications
- Hard rock drilling applications

BENEFITS

- Interchangeable pilot bit allows the selection for an application specific pilot bit and the ability to change bits at the rigsite
- Short tool body provides greater directional performance and control with additional features for BHA flexibility, durability, and stability without the length of traditional eccentric tools

RWD2X™ DIRECTIONAL BICENTER REAM WHILE DRILLING TOOLS

APPLICATIONS

- Directional motor applications
- Balling-prone operations

BENEFITS

- Directional technology manages pilot bit aggressiveness to allow for better tool face control in directional applications
- Pilot and reamer blade alignment optimizes fluid paths for improved cutter removal, increased cutter durability, and better rates of penetration

RWD2C™ ROTARY FIXED-BLADE CONCENTRIC REAM WHILE DRILLING TOOLS

APPLICATIONS

- Rotary and rotary steerable applications
- Pilot hole enlargement operations
- Pre-drilled wellbore enlargement operations

BENEFITS

- Variable profile features increase stability and improve hydraulic efficiency

RWD2ST™ SLIMHOLE BICENTER REAM WHILE DRILLING TOOLS

APPLICATIONS

- Coiled tubing operations
- Re-entry and sidetrack operations

BENEFITS

- Customized pilot bit design increases performance and durability in specific applications
- One-piece construction with shorter tool body enhances potential build-up rates

Impregnated drill bit and RWD2 nomenclature

IR C 2 13 E

- **IR** - IRev
- **Style**
  - **Blank** - Standard
  - **C** - Core bit
- **Application type**
  - **1** - Medium
  - **2** - Medium to hard
  - **3** - Hard to abrasive
  - **4** - Extremely hard and abrasive
- **Blade count**
- **Posts**
  - **E** - Exposed
  - **Blank** - Tapered

12.250 RWD2 | RWD2S 4 04 10.625

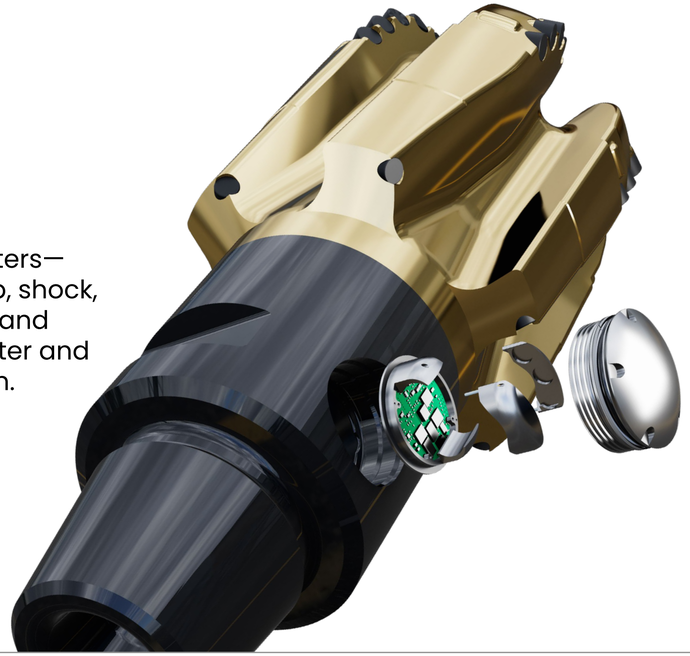
- Hole size
- Product
- Cutter size
- Pilot bit style
- Pass-through diameter

MultiSense dynamics mapping system

Deliver more efficient and consistent drilling performance

The MultiSense™ dynamics mapping system is an advanced in-bit sensing technology that provides a deeper understanding of drilling dynamics at the rock face.

As an add-on service for most bits, the MultiSense system delivers continuous, high-frequency measurements of parameters at the bit for smarter insights that guide design decisions and improve formation characterization. The system helps maximize drilling performance at a lower cost-per-foot in several ways.



The module's in-bit sensors measure a range of parameters—including vibrations, stick/slip, shock, and revolutions per minute—and identify any inaccuracies faster and more precisely than a human.

APPLICATIONS

- Single and multiple wells with hole sizes of 5 in. (127 mm) and greater
- Wells with a risk of drilling vibrations
- Identifying performance limiters
- Root cause and failure analysis
- Benchmarking and building parameter road maps

BENEFITS

- Leverages continuous, high-resolution measurements at the bit
- Streamlines data acquisition and processing to accelerate insights for faster decisions
- Helps optimize bits and BHAs for extended runs
- Maintains consistent BHA length above the bit

Diamond drill bits: API bit tolerance

API bit tolerances		
Nominal bit size OD	OD tolerance	
In.	In.	mm
Up–6 3/4 incl.	+0.–0.015	+0.–0.38
6 25/32–9 incl.	+0.–0.020	+0.–0.51
9 1/32–13 3/4 incl.	+0.–0.030	+0.–0.76
13 25/32–17½ incl.	+0.–0.045	+0.–1.14
17 17/32 and larger	+0.–0.063	+0.–1.60

Diamond drill bits: TFA values

TFA values of common nozzle sizes

Nozzle size*	Number of nozzles									
	1	2	3	4	5	6	7	8	9	10
7	.0376	.0752	.1127	.1503	.1879	.2255	.2631	.3007	.3382	.3758
8	.0491	.0982	.1473	.1963	.2454	.2945	.3436	.3927	.4418	.4909
9	.0621	.1243	.1864	.2485	.3106	.3728	.4349	.4970	.5591	.6213
10	.0767	.1534	.2301	.3068	.3835	.4602	.5369	.6136	.6903	.7670
11	.0928	.1856	.2784	.3712	.4640	.5568	.6496	.7424	.8353	.9281
12	.1104	.2209	.3313	.4418	.5522	.6627	.7731	.8836	.9940	1.1045
13	.1296	.2592	.3889	.5185	.6481	.7777	.9073	1.0370	1.1666	1.2962
14	.1503	.3007	.4510	.6013	.7517	.9020	1.0523	1.2026	1.3530	1.5033
15	.1726	.3451	.5177	.6903	.8629	1.0354	1.2080	1.3806	1.5532	1.7257
16	.1963	.3927	.5890	.7854	.9817	1.1781	1.3744	1.5708	1.7671	1.9635
18	.2485	.4970	.7455	.9940	1.2425	1.4910	1.7395	1.9880	2.2365	2.4850
20	.3068	.6136	.9204	1.2272	1.5340	1.8408	2.1476	2.4544	2.7612	3.0680
22	.3712	.7424	1.1137	1.4849	1.8561	2.2273	2.5986	2.9698	3.3410	3.7122

*Nozzle size in 32nds of an in.

Diamond drill bits: API connection / makeup

API connection chart / makeup torque

Connection	Bit size	Makeup torque	
		kft-lb	kN-m
1 REG	1.75-2.24	0.40-0.44	.55-.60
1-1/2 REG	2.25-3.49	0.87-0.96	1.2-1.3
2-3/8 REG	3.5-4.5	3.1-3.4	4.2-4.6
2-7/8 REG	>4.5-5	4.6-5.1	6.3-6.9
3-1/2 REG	>5-7.375	9.1-10.0	12-13.5
4-1/2 REG REG	>7.375-9.375	24-26	32-35
6-5/8 REG	>9.375-18.5	48-53	65-72
7-5/8 REG	>14.5	71-78	96-106
8-5/8 REG	>18.5	100-110	135-150

Note: Specific bits may have different makeup torque recommendations. Please reference the style sheet for bit specific recommendations.

Tricone drill bits: API bit tolerance

API bit tolerances		
Nominal bit size OD	OD tolerance	
In.	In.	mm
$1\frac{3}{4}$–$13\frac{3}{4}$ incl.	+0.0313 / -0. ($\frac{1}{32}$)	+0.8 / -0.
14-$17\frac{1}{2}$ incl.	+0.0625 / -0. ($\frac{1}{16}$)	+1.6 / -0.
$17\frac{5}{8}$ and larger	+0.0938 / -0. ($\frac{3}{32}$)	+2.4 -0.

Tricone drill bits: TFA values

TFA common values

Nozzle size	Number of nozzles			
	1	2	3	4
6	0.0276	0.0552	0.0828	0.1104
8	0.0491	0.0982	0.1473	0.1963
9	0.0621	0.1243	0.1864	0.2485
10	0.0767	0.1534	0.2301	0.3068
11	0.0928	0.1856	0.2784	0.3712
12	0.1104	0.2209	0.3313	0.4418
13	0.1296	0.2592	0.3889	0.5185
14	0.1503	0.3007	0.4510	0.6013
15	0.1726	0.3451	0.5177	0.6903
16	0.1963	0.3927	0.5890	0.7854
18	0.2485	0.4970	0.7455	0.9940
20	0.3068	0.6136	0.9204	1.2272
22	0.3712	0.7424	1.1137	1.4849
24	0.4418	0.8836	1.3254	1.7671
26	0.5185	1.0370	1.5555	2.0739
28	0.6013	1.2026	1.8040	2.4053

Tricone drill bits: Makeup torque recommendations

Makeup torque recommended for roller cone bit shanks		
Shank size	Recommended torque	
in.	kft-lb	kN-m
$2^{3}/_{8}$	3-3.5	4.1-4.7
$2^{7}/_{8}$	4.5-5.5	6.1-7.5
3½	7-9	9.5-12.2
4½	12-16	16.3-21.7
$6^{5}/_{8}$	28-32	38-43.4
$7^{5}/_{8}$	34-40	46.1-54.2
$8^{5}/_{8}$	40-60	54.2-81.3

Tricone drill bits: Nozzles

Nozzles				
Bit size (in.)	Standard nozzle	Mini-extended nozzle	High-flow extended nozzle	Center jet nozzle
3½–3¾	AA			
$3^{7}/_{8}$–$4^{1}/_{8}$	FA			
4½–4¾	FB			
$5^{5}/_{8}$–6¾	FF	LF		
$7^{5}/_{8}$–$7^{7}/_{8}$	FH	LH		FF
$8^{3}/_{8}$–$9^{7}/_{8}$	FK	LK		FF
10½–14	FK	LK	FK / LK	FK
14½–18½	FL	LL	FL / LL	FK
19–30	FL	LL		FK

Tricone drill bits: Bearing performance packages

Bearing and performance packages

	Vanguard			GX	STX	GTX	Triton
	VXG	VM	VG				
Journal bearing		●	●	●	●		●
Ball and roller bearing	●	●	●			●	●
Metal seal		●					
Elastomer seal			●	●	●	●	●
GT performance package				●	●	●	
High-temperature package	●	●					
Directional package	●	●	●				
Unsealed	●						●

Tricone drill bits: Product features and enhancements

Product features and enhancements

Code	Description	Example	Code	Description	Example
A	Air journal bearing, air nozzles	VG-40A	DX3	DSE diamond gauge compacts / 1st row (33%), 2nd row (100%)	VM-09DX3
C (prefix)	Center jet	GX-C18	DVH	Diamond Vanguard bit heel	VGD-20DVH
C (suffix)	Conical-shape insert	GX-18C	DVHX0	Diamond Vanguard bit heel +20% gauge	VGD-20DVHX0
C3	Three-directed center jets	VM-C31	DVHX	Diamond Vanguard bit heel +33% gauge	VGD-20DVHX
DDX	DSE diamond gauge (33%) / diamond trimmers (50%)	VM-09DDX	DVHX1	Diamond Vanguard bit heel +50% gauge	VGD-20DVHX1
DDT	DSE diamond gauge (33%) / diamond trimmers (100%)	VM-09DDT	DVHX2	Diamond Vanguard bit heel +100% gauge	VGD-20DVHX2
DH	Diamond heel compacts (100%)	STX-50DH	G	Enhanced gauge wear resistant	VM-20G
DH1	Diamond heel compacts (50%)	STX-50DH1	H	Enhanced gauge breakage resistant	GTX-11H
DP	Diamond-enhanced stabilization pad	GX-DP66	M (prefix)	Motor hardfacing	GTX-M1
DS	Diamond-enhanced shirttail compacts	GX-DS20	M (suffix)	M technology	GX-20M
DT	Diamond gauge trimmers (100%)	VM-09DT	P (prefix)	Leg stabilization wear pad	GX-P35
DT1	Diamond gauge trimmers (50%)	VM-1DT1	R	Spray-coat cones	VM-R09
DX	DSE diamond gauge compacts (33%)	VM-09DX	S	Shirttail compacts	VM-S20
DX0	DSE diamond gauge compacts (20%)	VM-09DX0	T	High-flow nozzles (two)	VM-T03
DX1	DSE diamond gauge compacts (50%)	VM-09DX1	T1	High-flow nozzle (one)	VM-T103
DX2	DSE diamond gauge compacts (100%)	VM-09DX2	T3	High-flow nozzles (three)	VM-T303

Ream-while-drilling tools: Effective ID and nozzle type

Effective ID and nozzle type

Tool size (in.)	Nozzle type	Inlet ID (in.)
7	A	.300
7½	A	.300
8	A	.300
9 7/8	B	.850
12¼	B	.850
13¾	B	.850
14	B	.850
15	B	.850
17	C	1.850
18	C	1.850
20	C	1.850

Ream-while-drilling tools: Tool nozzle parts

Tool nozzle parts			
Tool size (in.)	RWD2 a	RWD2 b	RWD2 c
9	123-204-434	-	-
10	015-226-932	015-226-942	015-226-952
11	015-226-933	015-226-943	015-226-953
12	015-226-934	015-226-944	015-226-954
13	015-226-935	015-226-945	015-226-955
14	015-226-936	015-226-946	015-226-956
15	015-226-937	015-226-947	015-226-957
16	015-226-938	015-226-948	015-226-958
18	015-226-939	015-226-949	015-226-959
20	015-226-940	015-226-950	015-226-960
22	015-226-941	015-226-951	015-226-961

Ream-while-drilling tools: Makeup torque

Makeup Torque

Connection			Minimum makeup torque (ft/lb)‡							
			Bore of drill collar (in.)							
Size (in.)	Type	OD (in.)	1¾	2	2¼	2½	$2^{13}/_{16}$	3	3¼	3½	3¾
3½	API IF	4¾	*9,986	*9,986	*9,986	*9,986	8,315				
API	NC38	5	*13,949	*13,949	12,907	10,977	8,315				
3½	H-90†	4¾	*8,786	*8,786	*8,786	*8,786	*8,786				
		5	*12,794	*12,794	*12,794	*12,794	10,408				
		5¼	*17,094	16,929	15,137	13,151	10,408				
		5½	18,522	16,929	15,137	13,151	10,408				
4½	H-90†	5¼	*12,590	*12,590	*12,590	*12,590	*12,590				
		5½	*17,401	*17,401	*17,401	*17,401	16,536				
		5¾	*22,531	*22,531	21,714	19,543	16,536				
		6	25,408	23,671	21,714	19,543	16,536				
		6¼	25,408	23,671	21,714	19,543	16,536				
4½	API Reg	5½	*15,576	*15,576	*15,576	*15,576	*15,576				
		5¾	*20,609	*20,609	*20,609	19,601	16,629				
		6	25,407	23,686	21,749	19,601	16,629				
		6¼	25,407	23,686	21,749	19,601	16,629				
API	NC44	5¾	*20,895	*20,895	*20,895	*20,895	18,161				
		6	*26,453	25,510	23,493	21,257	18,161				
		6¼	27,300	25,510	23,493	21,257	18,161				
		6½	27,300	25,510	23,493	21,257	18,161				
4½	API full hole	5½		*12,973	*12,973	*12,973	*12,973	*12,973			
		5¾		*18,119	*18,119	*18,119	*18,119	17,900			
		6		*23,605	*23,605	*23,028	19,921	17,900			
		6¼		27,294	25,272	22,028	19,921	17,900			
		6½		27,294	25,272	22,028	19,921	17,900			

Makeup Torque (continued)

Connection			Minimum makeup torque (ft/lb)‡							
			Bore of drill collar (in.)							
Size (in.)	Type	OD (in.)	1¾	2	2¼	2½	$2^{13}/_{16}$	3	3¼	3½	3¾
4½	API IF	6¼			*23,004	*23,004	*23,004	*23,004	*23,004		
API	NC50	6½			*29,679	*29,679	*29,679	*29,679	26,675		
$6^{5}/_{8}$	API REG	7½				*46,399	*46,399	*46,399	*46,399		
		7¾				*55,627	53,346	50,704	46,936		
		8				57,393	53,346	50,704	46,936		
		8¼				57,393	53,346	50,704	46,936		
		8½				*60,402	*60,402	*60,402	*60,402	*60,402	*60,402
		8¾				*72,169	*72,169	*72,169	*72,169	*72,169	*72,169
		9				*84,442	*84,442	*84,442	84,221	79,536	74,529
		9¼				96,301	91,633	88,580	84,221	79,536	74,529
		9½				96,301	91,633	88,580	84,221	79,536	74,529

*Notes

1. Torque figures preceded by an asterisk indicate the weaker member for the corresponding outside diameter (OD) and bore is the BOX. For all other torque values, the weaker member is the PIN.

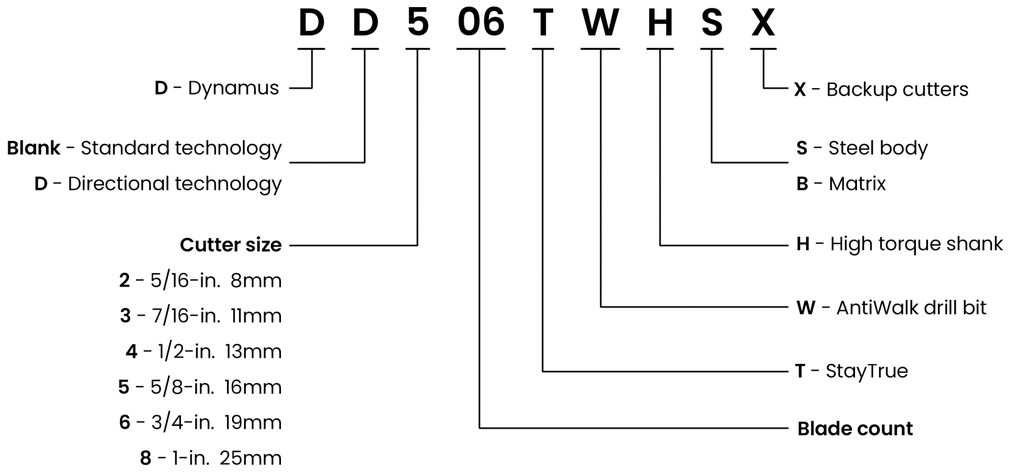
2. In each connection size and type group, torque values apply to all connection types in the group, when used with the same drill collar outside diameter and bore, i.e., $2^{3}/_{8}$-in. API IF, API NC 26, and $2^{7}/_{8}$-in. slimhole connections used with 3½ in. x 1¼ in. drill collars all have the same minimum makeup torque of 4,600 ft/lb, and the BOX is the weaker number.

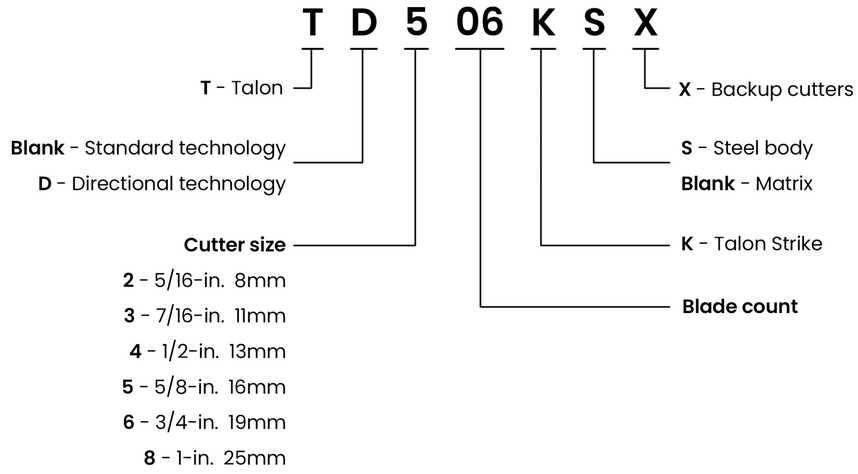
3. Stress-relief features are disregarded for makeup torque.

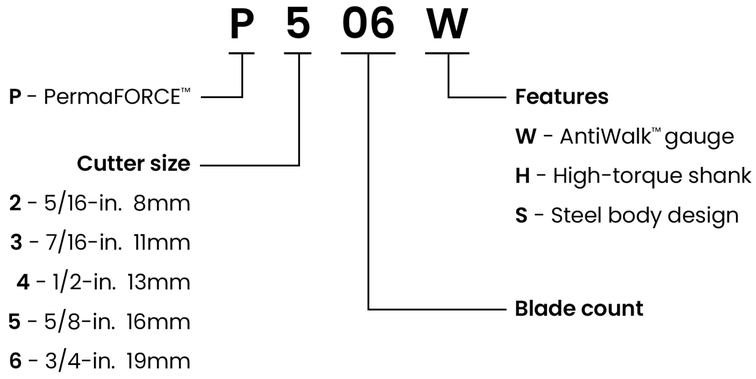
‡ Basis of recommended maximum torque values are from API Specification 7.

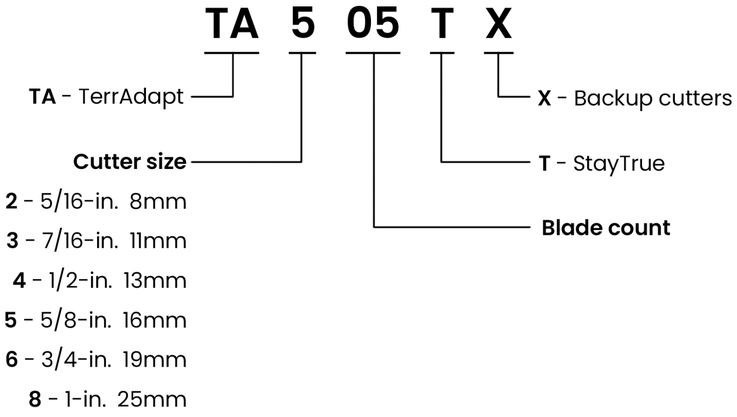
† Basis of calculation for recommended makeup torque assumed the use of a thread compound containing 40-60 by weight of finely powdered metallic zinc or 60 by weight of finely powdered lead, with not more than 0.3 total active sulfur (reference the caution regarding the use of hazardous materials in Appendix F of Specification 7) applied thoroughly to all threads and shoulders and using the modified Screw Jack formula in Appendix A, paragraph A.8, and a unit stress of 62,500 psi in the BOX or PIN, whichever is weaker.

PDC drill bit nomenclature

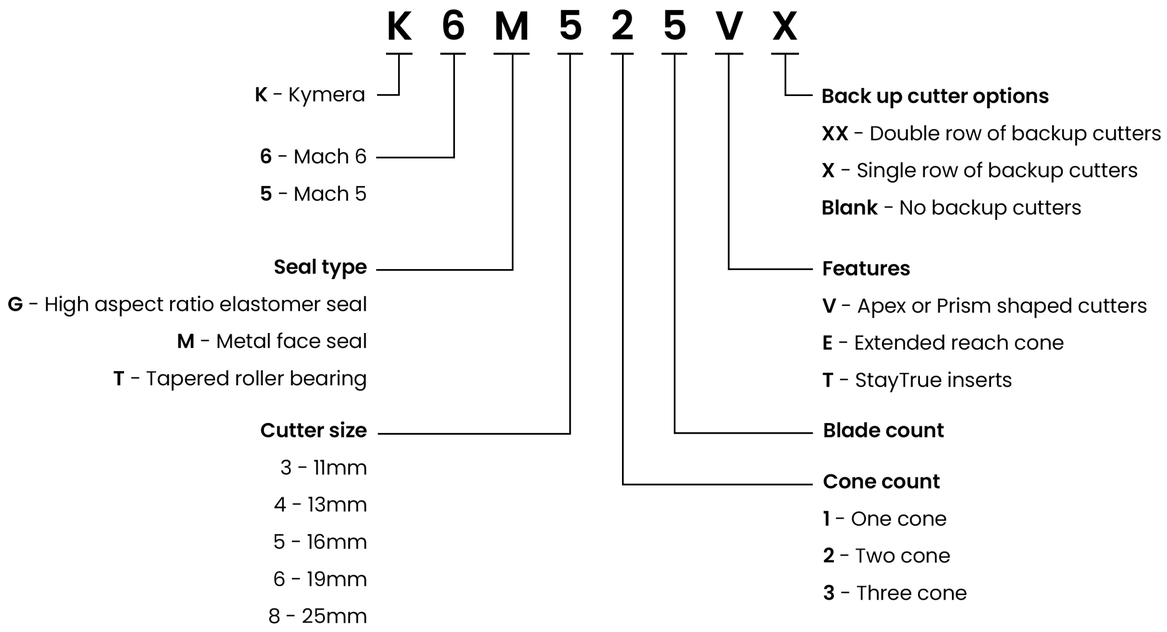








Kymera hybrid drill bit nomenclature



Tricone drill bit nomenclature

V G D - 20

V - Vanguard

Seal type

G - Elastomer

M - Metal face

X - Non-sealed

Application

A - Arabia (Carbonate)

D - Directional

G - Geothermal

Blank - No specific sub line or steel tooth

Cutting structure

Options and nomenclature similar to existing product lines

STX - 20

Product series

STX - Elastomer seal (slimhole)

GX/GTX - Elastomer seal

Cutting structure

Options and nomenclature similar to existing product lines

Vulcanix geothermal drill bit nomenclature

VULCANIX GEOTHERMAL PDC DRILL BIT

VX 5 06

VX - Vulcanix geothermal PDC

Cutter size

3 - 7/16-in. 11mm

4 - 1/2-in. 13mm

5 - 5/8-in. 16mm

6 - 3/4-in. 19mm

Blade count

VULCANIX GEOTHERMAL KYMERA HYBRID DRILL BIT

VX 4 2 5

VX - Vulcanix geothermal Kymera hybrid

Cutter size

3 - 11mm

4 - 13mm

5 - 16mm

6 - 19mm

8 - 25mm

Blade count

Cone count

1 - One count

2 - Two count

3 - Three count

VULCANIX GEOTHERMAL TRICONE DRILL BIT

VX - 20

VX - Vulcanix geothermal tricone

Hardness type

00 to 99 - Tungsten carbide

Casing bit nomenclature

EZR 4 06 HD

EZR - EZReam

Cutter size

3 - 7/16-in. 11mm

4 - 1/2-in. 13mm

5 - 5/8-in. 16mm

6 - 3/4-in. 19mm

Blade count

Cutter structure

Blank - Standard

L - Light

HD - Heavy Duty

EZC 4 06 V HD X

EZC - EZCase

Cutter size

3 - 7/16-in. 11mm

4 - 1/2-in. 13mm

5 - 5/8-in. 16mm

6 - 3/4-in. 19mm

Blade count

Back up cutter options

XX - Double row of backup cutters

X - Single row of backup cutters

Blank - No backup cutters

Cutter structure

Blank - Standard

L - Light

HD - Heavy Duty

Added feature

Blank - Standard

V - Shaped cutters

Impregnated drill bit and RWD2 nomenclature