



DRILL BITS AND SERVICES

Solutions Catalog

HALLIBURTON
Drill Bits and Services

Solving challenges.™

Table of Contents

Health, Safety, Environment, and Service Quality Excellence	4
DatCI SM Process	5
Fixed Cutter Drill Bits	13
Roller Cone Drill Bits	29
Coring Services	39
Hole Enlargement Tools	45
Resources	53
Local Representatives	61





As a public company with nearly 70,000 employees in approximately 80 countries, Halliburton's number one priority is to offer safe and superior products and services. We promote safety and environmental principles by working together to protect our employees, stakeholders, communities, and environment from harm.

Halliburton believes safety is everyone's business. That is why every person at every worldwide Halliburton location makes safety awareness the number one priority. Every member of every Halliburton team is tasked with taking personal ownership of his or her own safety and the safety of others.

Our goal is to keep our people (and the environments in which they work) safe and healthy. For this reason, we put policies and procedures in place to make sure that adherence to proper safety practices is a 24/7 commitment on everyone's part.

OSHA VPP Star Worksite

The Halliburton Drill Bits & Services manufacturing and technology facility in Conroe, Texas takes Halliburton safety fundamentals to

another level by being recognized as a Star Worksite by the U.S. Occupational Safety Health Administration (OSHA). OSHA's Voluntary Protection Programs (VPP) recognize and partner with businesses and worksites that show excellence in occupational safety and health. While all U.S. companies must comply with OSHA regulations, the Star Program is designed for exemplary worksites with comprehensive, successful safety and health management systems. Our facility was recertified as a VPP Star Worksite in 2012, an honor the facility has held since its first certification in 2004.

Becoming an OSHA Star Worksite is not an easy accomplishment. It takes much more than a single audit or visit by OSHA personnel. Less than 1% of companies have been certified as OSHA VPP Star Worksites, and Halliburton is the only drill bit manufacturer in the United States to receive this award. This repeated recognition demonstrates that safety is top priority for Halliburton Drill Bits & Services.



DatCISM Process

SPARTATM Software

**Direction by Design[®]
Software**

Precise Bit Reamer (PBR)

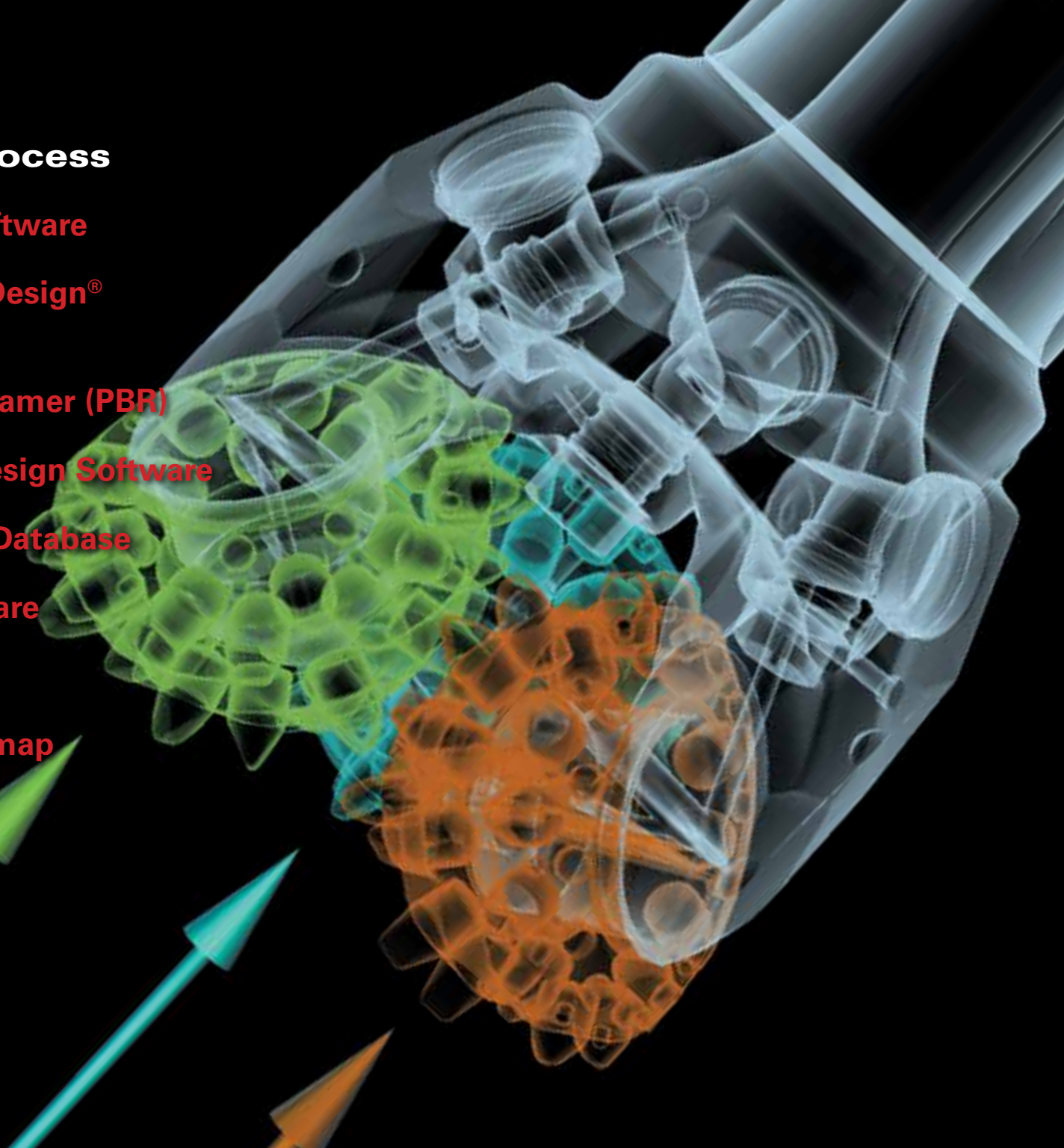
MaxBHATM Design Software

Performance Database

IBitSTM Software

CFD Analysis

Drilling Roadmap





Design at the Customer Interface (DatCISM) Process

Customized Drill Bits and Services Engineered for Optimal Efficiency and Performance

With different applications around the world, there is no one-size-fits-all solution. Our unique DatCISM process takes that into account. Rather than centralizing design for drill bits, coring services, or downhole tools, Halliburton Drill Bits & Services has highly trained Application Design Evaluation (ADESM) service specialists in locations around the globe. This enables us to work directly with customers to design application-specific solutions.

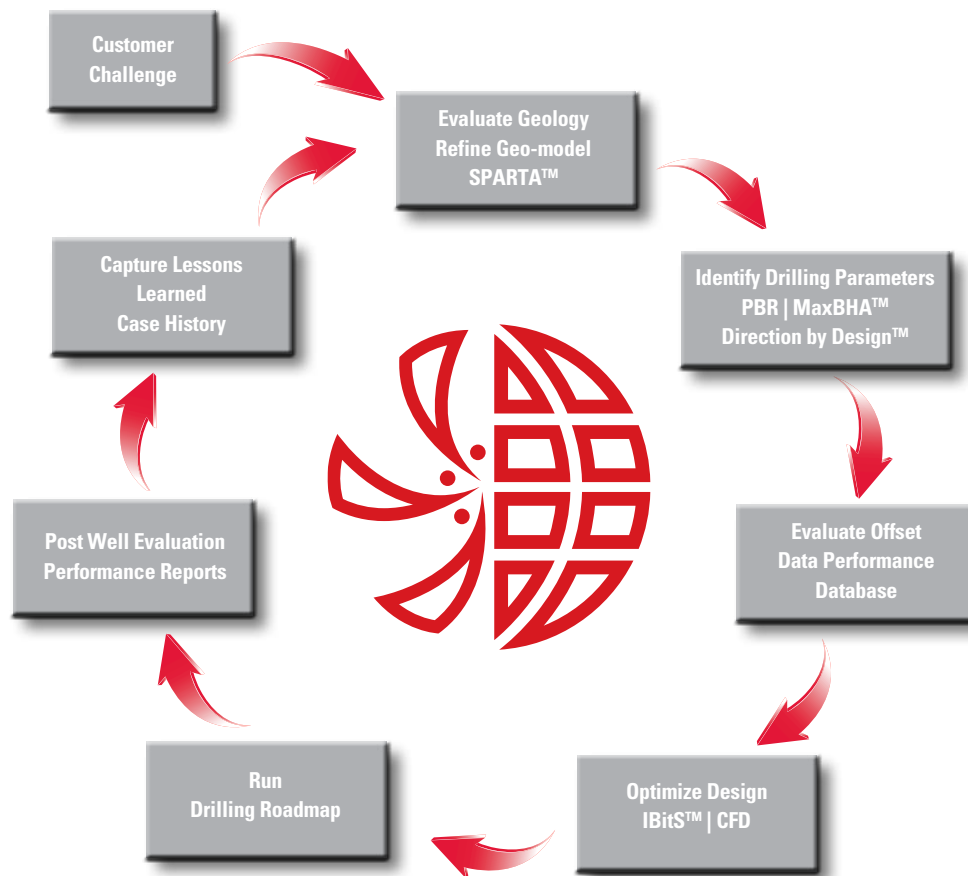
These deployed specialists integrate local knowledge with some of the industry's most powerful software, working with customers to design drill bits and tools. When designs are complete, they are sent directly to manufacturing, where drill bits are rapidly produced with industry-best cycle times. DatCI process has helped Halliburton become the North American market leader in drill bits.



Powerful Software-Application Specific Solutions

The DatCISM process is a continuous improvement loop employed by our on-location ADESM (Application Design Evaluation) service specialists to define application-specific drill bit solutions via well planning. This bit optimization process uses the industry's most

powerful proprietary software tools and enables our specialists to predict bit performance and design the optimal bit for your specific objectives. We analyze formation properties to precisely define the application and then match the design to that application.

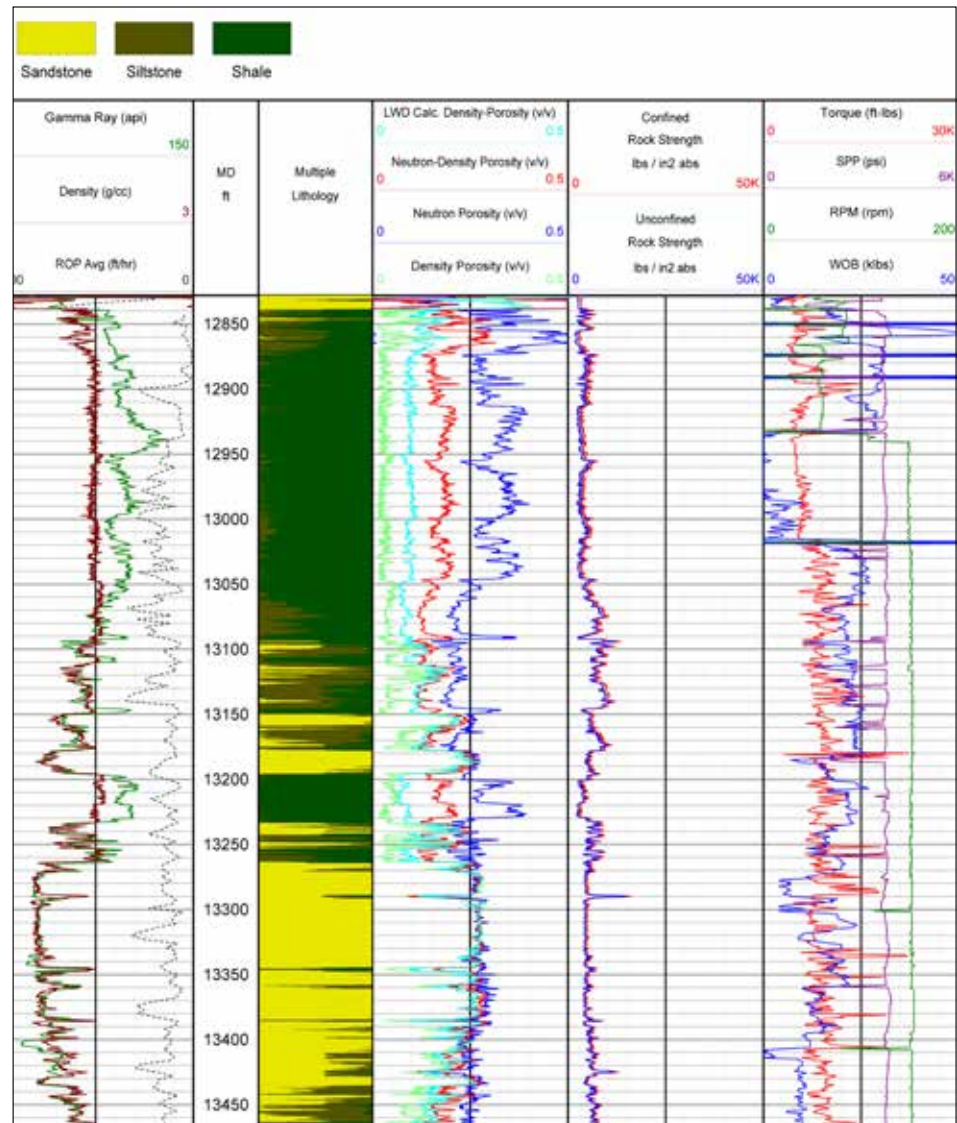




SPARTATM Software

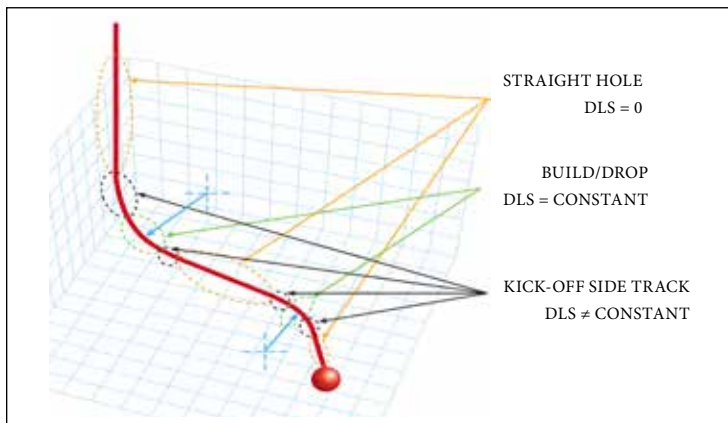
Scientific Planning and Real Time Applications

SPARTA software delivers advanced rock-strength analysis and modeling, providing clear and concise information to optimize drill bit selection and drilling parameters. SPARTA software helps to generate a map of anticipated geology including hard stringers, abrasive zones, and shales. This map can assist in optimizing drilling parameters to predict and evaluate run performance when plotted against offset wells. It can also be utilized for post-run evaluation to identify future bit selection and operating parameters. In a multi-well drilling program, SPARTA software enhances the DatCI process through reducing cycle times and overall drilling costs.



Direction by Design® Software

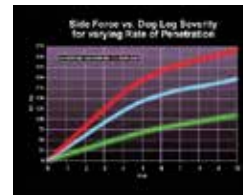
Halliburton's Direction by Design® software provides advanced bit design engineering to optimize directional performance. Evaluating directional drill bit behavior depends greatly on understanding both the drive/steer mechanism and bit/formation interaction. Application Design Evaluation (ADESM) specialists use a wide variety of inputs such as applicable BHA configuration, operating parameters, hole geometry, and formation characteristics to model bits for customer-specific applications. Direction by Design software also enables Halliburton designers to define the connection between specific bit design features and their full impact on directional deliverables, enabling them to provide the ideal combination of steerability, stability, and aggressiveness for the application. Either used as an application-specific bit selection tool or in conjunction with the DatCI process, this software is a powerful means to optimize matched bit design for the specific directional application and drive system. The result is fast, responsive directional drilling.



The ADESM specialist can isolate performance zones in each part of the directional trajectory, to focus on directional deliverables that are important in each zone.

Outputs

For a given bit under given drilling conditions, Direction by Design software determines the effects of bit geometry on steerability and walk rate, and calculates bit torque variance during directional drilling to account for different bit behaviors during kick-off, build, and hold drilling modes.



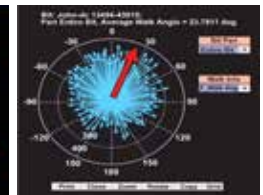
Side Force Output

Designers simulate a range of bit actions and quantify the effect on steerability.



Bit Face Control Output

Analysis of torque variance between different areas of the bit design enables maximum aggressiveness without over-engagement that can contribute to damaging vibration.



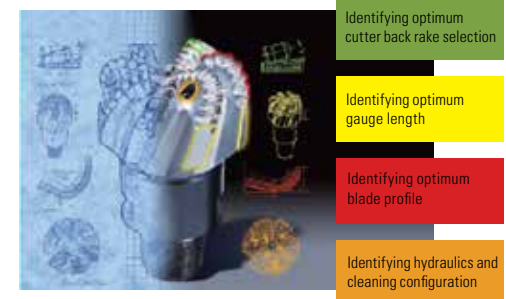
Bit Walk Tendency Output

In this application, the bit is designed with a right-hand walk to offset a tendency toward undesired left-hand walk and remain centered on the well path.

Performance Evolution

The three Direction by Design software outputs are used to select and optimize bit features and dimensions to continuously drive enhanced performance in your unique directional application.

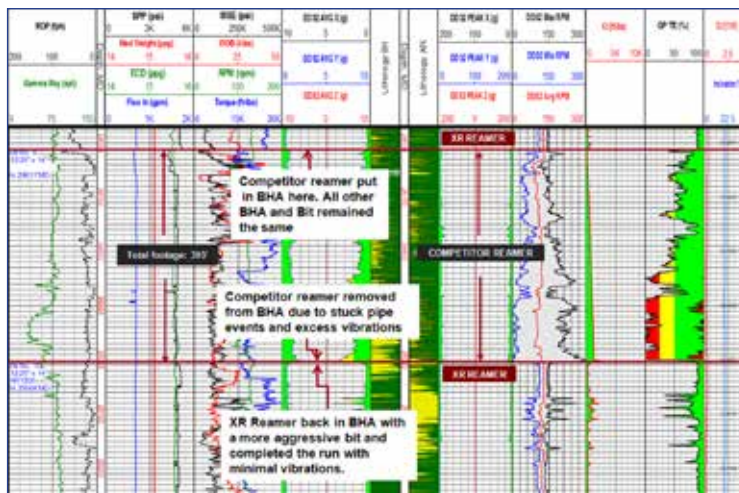
This continuous evolution replaces the traditional "trial and error" approach.





Precise Bit Reamer (PBR)

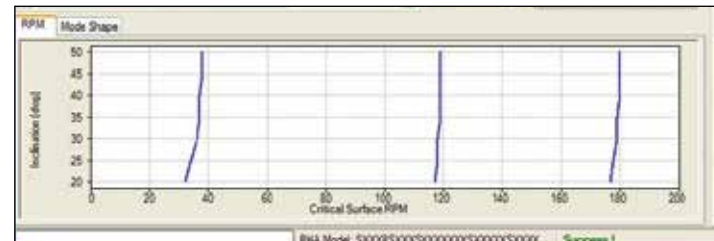
PBR software accurately simulates the interactions of bits, reamers, BHA, and formation combinations. PBR produces a simulation of drilling efficiency for each bit and reamer configuration, showing the optimal combination. This capability supports both well planning and real-time decision making while drilling. PBR helps operators reduce non-productive time (NPT) and increase overall rate of penetration (ROP) when reaming while drilling.



Bit Beamer Log – The actual log excerpt from PBR (left) predicted that using a competitor reamer would produce excess vibrations, a prediction validated during the actual drilling.

MaxBHA™ Design Software

MaxBHA™ integrated BHA modeling and drilling optimization software offers a wide range of applications including directional drilling, vibration reduction, survey improvement, and tool design optimization. It can also be used for well planning, real-time optimization, and post-run analysis.



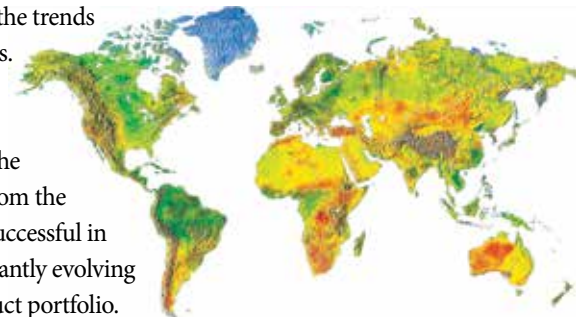
MaxBHA™ application window

Application Design Evaluation (ADE) service specialists run MaxBHA software with drill bit and reamer designs to gain insight on bending forces and to pinpoint critical rotary speeds for the BHA. The simulation software extends bit and reamer life by providing ADE service specialists with optimal run parameters that will minimize vibration and increase tool reliability.

Performance Database

The Performance Database is a global software system used to capture and analyze bit performance data. It provides accurate, valuable, and fast information to aid sales, product development, and product management. The application enables Halliburton DBS field personnel to quickly and efficiently analyze bit performance data and provide our customers with tailored reports. As the system is constantly updated with new runs, Halliburton has the ability to understand the unique challenges presented by each play and see the trends of successful products.

This gives our technology and product development teams the real-time feedback from the field required to be successful in developing our constantly evolving and improving product portfolio.



IBitSM Software

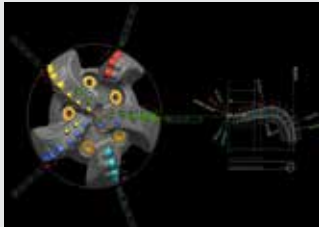
Interactive Bit Solutions

IBitSM software tool is used by ADE service specialists to optimize bit selection or design a new bit for specific applications. It enables Halliburton DBS to design the highest performing bits by simulating the forces that the bit will be exposed to under specific drilling parameters. IBit software calculates the torsional, axial, and lateral forces of each cutting element depending on the cutting structure, geometry, and space position on the bit face. The sum of these forces

(total bit force imbalance) is displayed as an output to indicate how the bit will perform in the application.

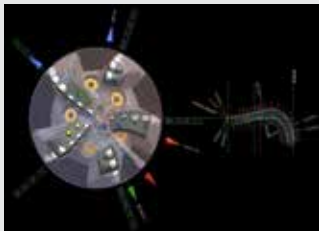
IBit software can be used to rapidly design a drill bit in 3D. The ADE service specialists can collaborate in a customer's office or at the rig site. Both the bit design and the manufacturing processes are generated simultaneously. This process enables Halliburton DBS to achieve industry-best cycle times and manufacturing precision, which leads to best-in-class performance.

Fixed Cutter Application Outputs



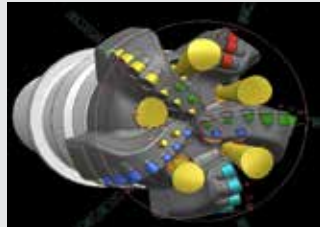
Cutter Layout

A cutter tip profile shows a two dimensional representation of cutter spacing. Also, profile zones, attached to the cutter tip profile, depict how spacing, back rake, side rake, and degree of spiral are applied to the cutters along the profile.



Force/Energy Balancing

On the left, force balancing with radial and drag vectors. On the right, wear analysis factoring volume and footage drilled.



Hydraulics

Optimal hydraulic configurations determined through unique modeling techniques in conjunction with Computational Fluid Dynamics (CFD).



Manufacturing

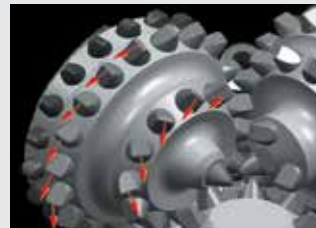
IBit software is used to create the manufacturing components and machining programs as well as the bit design.

Roller Cone Application Outputs



Tooth Angles

Tooth angles are designed for roller cone bits with Energy Balanced[®] bit technology.



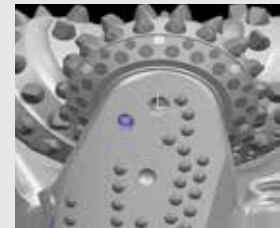
Energy Balanced[®] Bits

IBit Software shows orientation of compacts for Energy Balanced[®] roller cone bit.



Insert Placement

The IBit Software roller cone design shows bottom hole pattern (left), clearances between inserts (center) and insert spacing (right three).



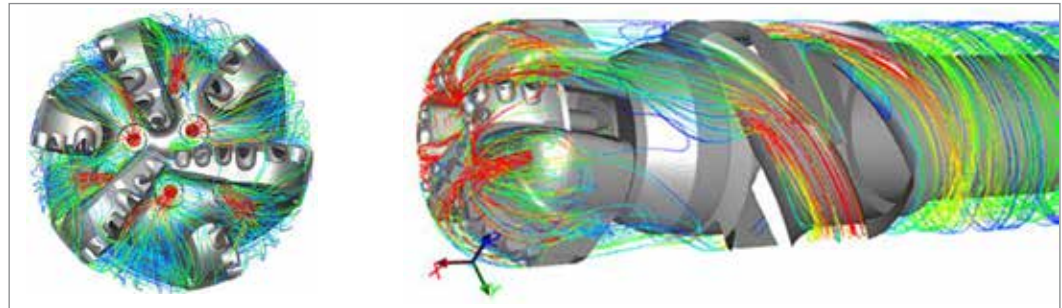
Side Wall Protection

IBit Software can be used to design arms and side wall protection for particular applications for roller cone bits.



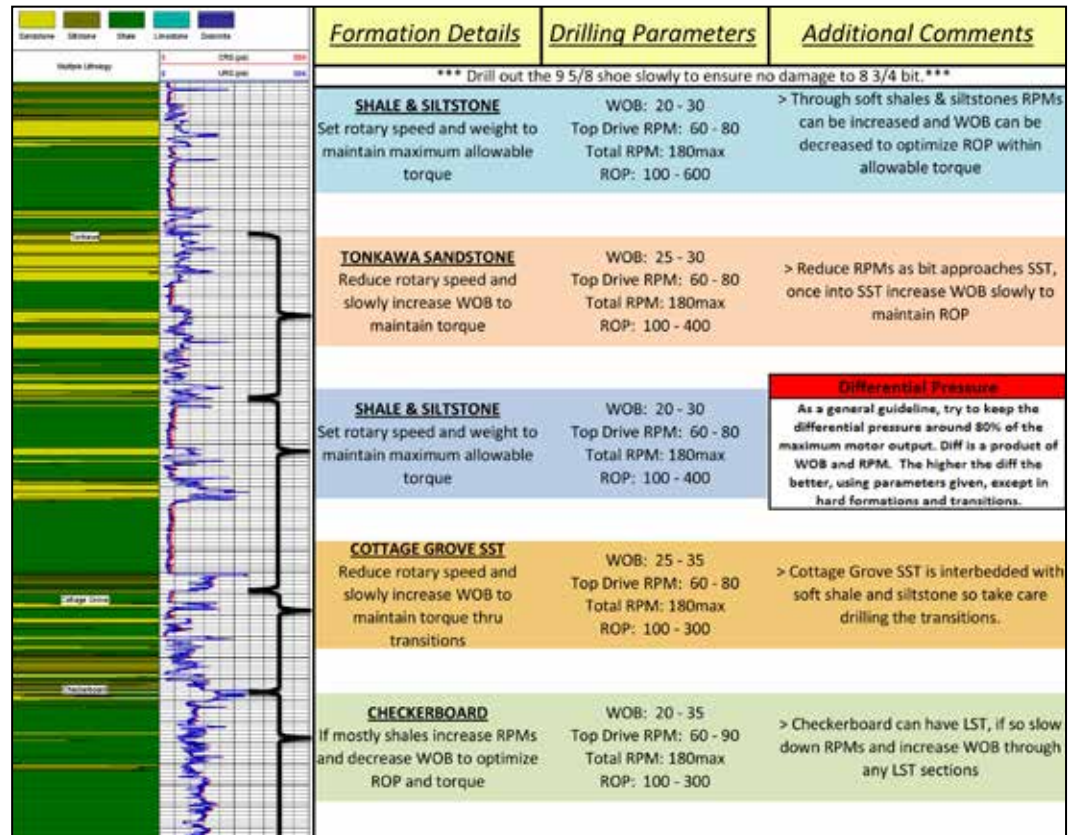
Computational Fluid Dynamics (CFD) Analysis

CFD analysis enables the designer to optimize nozzle placement and blade design for effective removal of cuttings. This reduces bit balling and erosion—thus maximizing bit life and ROP.



Drilling Roadmap

As part of the DatCI process, the drilling roadmap displays expected formations and provides bit and parameter recommendations as formations change. This translates into optimized ROP and extended life.



A detailed, close-up photograph of a drill bit's cutting edge. The bit is made of a dark, metallic material, likely cobalt or high-speed steel, and features several sharp, rounded cutting edges. The background is blurred, showing more of the drill bit's structure.

Fixed Cutter Drill Bits

Premium Line

GeoTech™ Drill Bits

MegaForce™ Drill Bits

SteelForce™ Drill Bits

TurboForce™ Drill Bits

Performance Line

FX Series™ Drill Bits



Premium Technologies

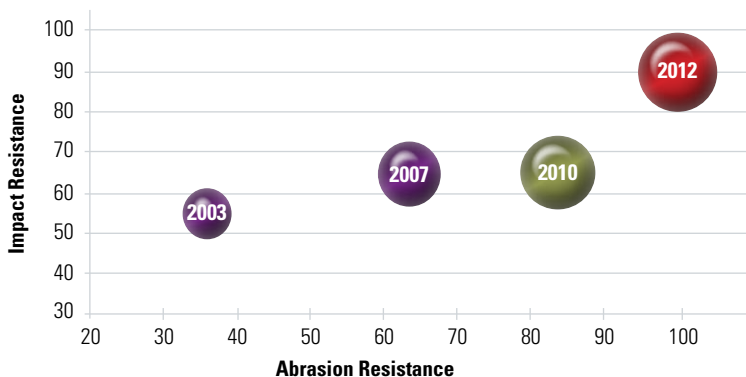
Featured in our premium line of fixed cutter drill bits, our premium technologies incorporate all of the latest engineering advancements from our research and development labs.

SelectCutter™ PDC Technology

Proprietary technology development has produced the new thermally stable and highly abrasion-resistant SelectCutter™ PDC technology, available exclusively in the premium drill bit product line from Halliburton. SelectCutter PDC technology is suited to drill the most challenging formations by providing the highest level of abrasion resistance, impact resistance, and Thermal Mechanical Integrity (TMI) available.

Abrasion Resistance measures the capability of a cutter to shear formation and minimize the loss of diamond. Improvements in diamond abrasion resistance maintains the sharp cutting edge longer.

Impact Resistance measures the ability of a cutter to withstand a dynamic force without chipping or breaking, enabling the cutter to retain a sharp drilling edge for maximum rate of penetration.



TMI is the performance measure of a cutter's capacity to endure frictional heat generated during the drilling process. Improving TMI means the cutters will wear slower because the diamond-to-diamond bonds can survive elevated temperatures prior to separating.

Multi-Level Force Balancing

By optimizing cutter placement through Multi-Level Force Balancing, Halliburton premium bits provide the maximum bit stability and cutting structure efficiency during transitional drilling.

Standard Force Balanced



High Imbalance Force

created by uneven distribution of cutting force as bit enters formation transition

Multi-Level Force Balanced



Low Imbalance Force

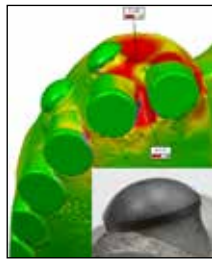
created by even distribution of cutting force as bit enters formation transition

Premium Tungsten Carbide Matrix Material

Halliburton's premium tungsten carbide matrix material offers a 20% improvement in erosion and wear resistance over our performance matrix material. This translates into maximum ROP by reducing the amount of cutting structure loss and enabling longer intervals to be drilled by preventing bit body damage.



New Matrix Material
Green=Zero Material Loss



Previous Matrix Material
Red=Material Loss (Erosion)

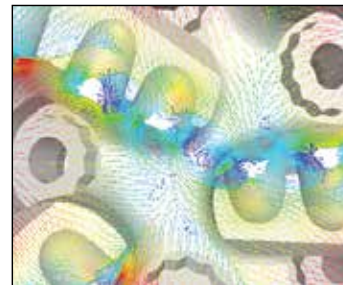
Hydro-Dynamic Bridges

With the new hydro-dynamic bridges, not only is the strength and durability of the bit increased, but fluid flow is improved as well. TurboForce™ hydro-dynamic bridges improve fluid flow across bottom hole and results in better cleaning and cooling.

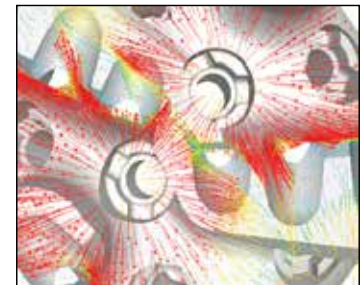


Enhanced Hydraulics

The use of targeted, directional micro nozzles in our premium line of drill bits optimizes fluid flow across the bit face. Micro nozzles permit significant increases in junk slot volume to improve cleaning at high ROP, reduce chances of bit balling, and offer additional design flexibility for minimizing erosion and optimizing total flow area (TFA).



Standard Nozzles



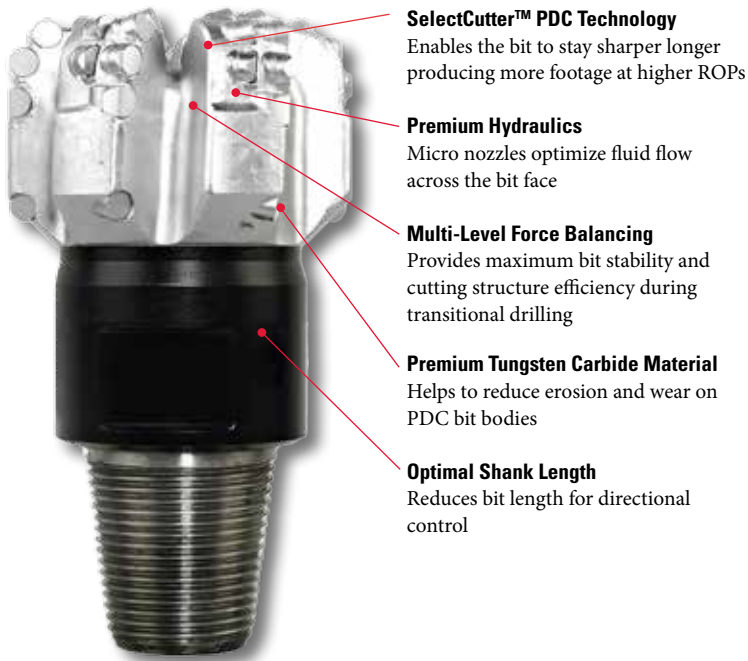
Micro Nozzles



MegaForce™ Drill Bit

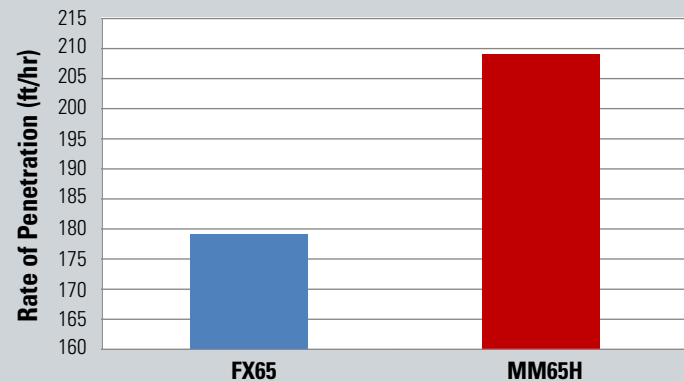
Industry's Most Robust Matrix Body

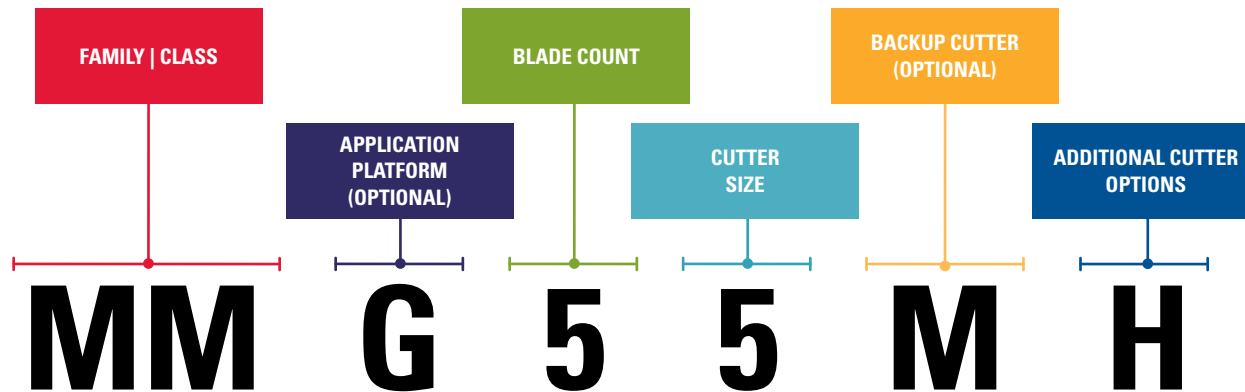
The Halliburton MegaForce™ bit features advanced SelectCutter™ PDC technology, ultra-efficient cutter layout force balancing, improved erosion resistant material, and enhanced hydraulics. Designed for an operator's specific application by one of our Application Design Evaluation (ADESM) service specialists using our industry-unique Design at the Customer Interface (DatCISM) process, the result is a matrix bit with a combination of higher ROP and longer intervals drilled than any other bit.



Rockies: 20% Faster ROP and increased interval drilled

- Halliburton DBS 7 7/8" MM65H vs FX65
- Uintah County, Utah
- Drilled 31% more footage at a 20% increase in ROP over the same section



**FAMILY | CLASS**

MegaForce™ Drill Bits

APPLICATION PLATFORM (OPTIONAL)

D = Directional (all other directional systems)
 G = Geo-Pilot® Rotary Steerable
 E = Geo-Pilot® EDL Rotary Steerable
 T = Turbine High Rotational Speed

BLADE COUNT

The blade count indicates the number of blades on the bit.

3 = Three Blades
 4 = Four Blades
 5 = Five Blades
 6 = Six Blades
 7 = Seven Blades
 8 = Eight Blades
 9 = Nine Blades

CUTTER SIZE

The cutter size digit describes the size of the PDC cutters on the bit. On bits with multiple cutter sizes, the predominant size is indicated.

2 = 8 mm (3/8 in.)
 3 = 10.5 mm (13/32 in.)
 4 = 13 mm (1/2 in.)
 5 = 16 mm (5/8 in.)
 6 = 19 mm (3/4 in.)
 8 = 25 mm (1 in.)

BACKUP CUTTER (OPTIONAL)

D = Dual Row Backup
 M = Modified Diamond Round
 R = R1™ Backup Cutters
 I = Impreg Backup Discs
 C = Carbide Impact Arrestor

ADDITIONAL CUTTER OPTIONS

H = Highly abrasive wear

OPTIONAL FEATURES

Not listed in nomenclature but found on marketing spec sheet. For more information, please contact your local Halliburton Drill Bits representative.

b = Back Reaming
 c = Carbide Reinforcement
 e = SE - Highly Spiraled
 f = Full PDC Gauge Trimmers
 k = Kerfing - Scribe Cutters
 p = PDC Gauge Reinforcement
 u = Updrill



GeoTechTM Drill Bit

Industry's Most Robust Matrix Body

Halliburton's new GeoTechTM series of fixed cutter PDC bits blends design theory with practical application-specific knowledge to produce custom -engineered matrix and steel body bits for optimal efficiency and performance—delivering you a truly optimized bit design.

Each GeoTech bit incorporates specific application experience with expert design science, including:

- Our rock-interaction analysis tool for predicting load and motion of a drill bit for multiple scenarios including rock chipping, bent motor, whirl, and more.
- Depth of cut control optimally positions cutting structure elements to smooth torque fluctuations, while a two-step cutter layout position improves performance when primary cutters wear or when drilling parameters change.
- GeoTech PDC cutter technology can significantly increase the amount of rock removed with less wear for higher average ROP and up to four times the footage of previous products.
- Improved hydraulics simulation leads to optimum hydraulic design, directing flow with little recirculation and eliminating stagnant zones to optimize bit cleaning and minimize erosion.



The DatCISM process of developing GeoTechTM bits brings together differentiating bit design features needed for any given application.

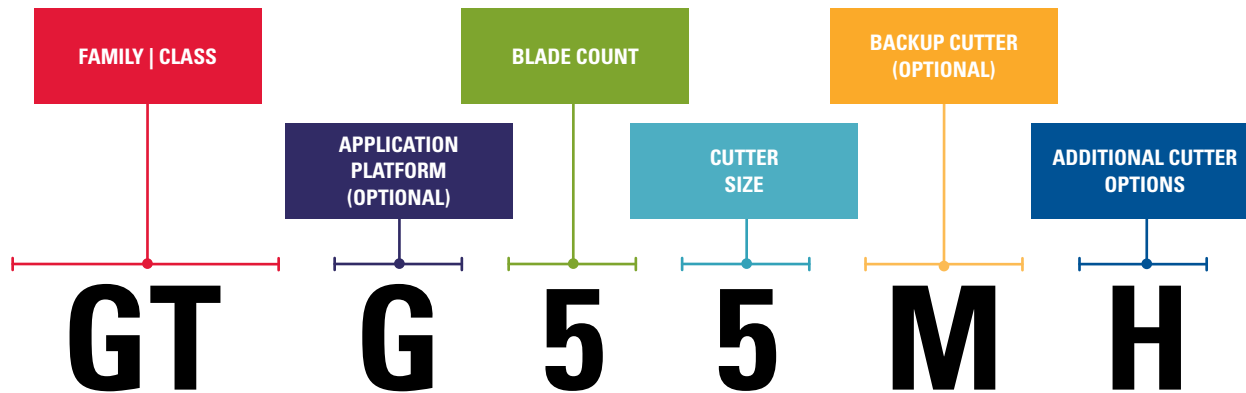
- Advanced materials include new matrix/binder materials, which increase durability and erosion resistance, enabling innovative steel-blade geometries and aggressive matrix body design.

DatCISM Process: The Most Effective Drill Bit Optimization Solution

Combining powerful design and simulation tools, and a global network of technical resources, the DatCI service platform uses direct customer input to rapidly optimize each GeoTech bit. Our global network of application design and evaluation (ADE) service specialists work directly with the customer to define specific bit solutions, drawing from a toolbox of the industry's most sophisticated software systems for comprehensive planning, modeling and engineering—with real-time performance optimization capabilities.

That toolbox includes:

- IBitS[™] patented and proprietary system for creating 3D bit designs anywhere using the latest bit dynamics modeling, including upgrades that better simulate cutting structures for specific applications.
- Enhanced hydraulics modeling that provides a more accurate bottom-hole pattern and allows quantitative analysis on cutter faces and through junk slots to minimize erosion.
- SPARTA[™] drilling optimization software with an advanced rock mechanics module to analyze formation properties and precisely define the drilling application.
- DrillingXpert simulation model that allows application and evaluation service specialist to quantify the impact of changes, recommend the best drill bit for the application and optimize bottom-hole assembly parameters to minimize vibration and enhance performance.

**FAMILY | CLASS**

GeoTech™ Drill Bits

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SteelForce™ Drill Bit

Industry's Most Advanced Steel Body Drill Bit

Highest penetration rates. Lowest cost per foot. Application-specific designs. With the Halliburton SteelForce™ bit, slow ROP due to bit cleaning is history. Taking drill bit design to a higher level, the SteelForce bit features a large flow area, anti-balling treatment, premium hardfacing, and micro nozzles to get the right flow to the right place on the bit face. Coupled with our industry-unique DatCISM process performed by one of our ADESM service specialists, our application-specific SteelForce bits are the best performing steel body bits to overcome your specific drilling challenges.



Premium Hardfacing

K1 hardfacing is 100% more abrasion resistant, 30% more erosion resistant and includes tough carbide pellets making it virtually fracture proof

Higher Blade Standoff

Increases face volume for improved cuttings evacuation and higher rate of penetration

SelectCutter™ PDC Technology

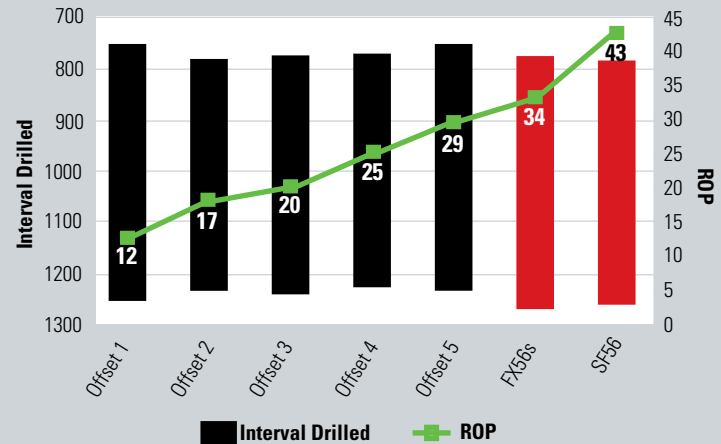
Provides the highest level of abrasion resistance, impact resistance, and Thermal Mechanical Integrity available

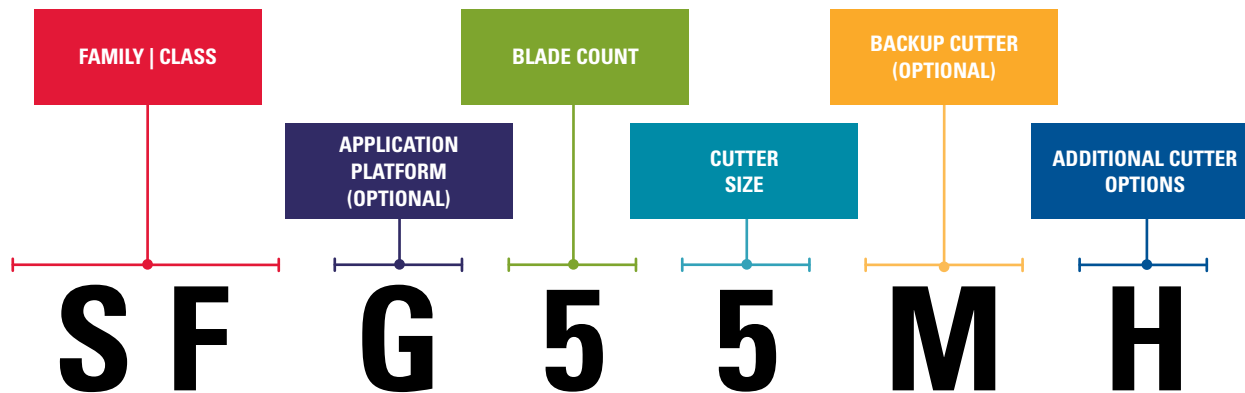
Anti-Balling Coating

Helps keep shale cuttings from balling and sticking to the bit by producing an electronegative charge, which repels the negative ions in shale cuttings

Oman: 87% Faster ROP Over Field Average

- Halliburton Drill Bits and Services 12 1/4" SF56
- Drilled entire section with 87% faster ROP over the field average
- Dull Condition 1-1-WT



**FAMILY | CLASS**

SteelForce™ Drill Bits

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TurboForce™ Drill Bit

When applications become too abrasive for PDCs, TurboForce™ bits take over. TurboForce diamond-impregnated drill bits feature an improved bit stability through mass distribution, a new bridge design, increased diamond volume, and a proprietary wear indicator. These advanced features result in longer intervals drilled, enhanced versatility and reliability, plus a lower cost per foot. Using our industry-unique DatCISM process performed by one of our ADESM service specialists, our application-specific TurboForce diamond-impregnated bits are the best to overcome your specific drilling challenges.



Wear Indicator

Precisely determines the bit condition, optimizing decisions for product usage

Hydro-Dynamic Bridges

Redirects fluid and boosts the cleaning and cooling of the cutting structure

Mass Balancing

Mass distribution calculation and balancing methods improve bit stability and negate underbalanced centrifugal forces

Continuous Shoulder

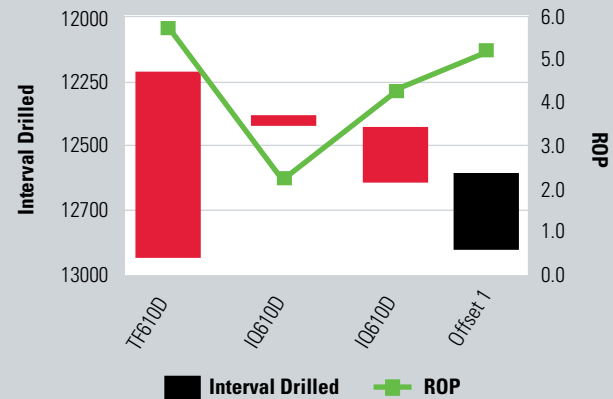
Increased diamond content further promotes bit stability and enables greater run length

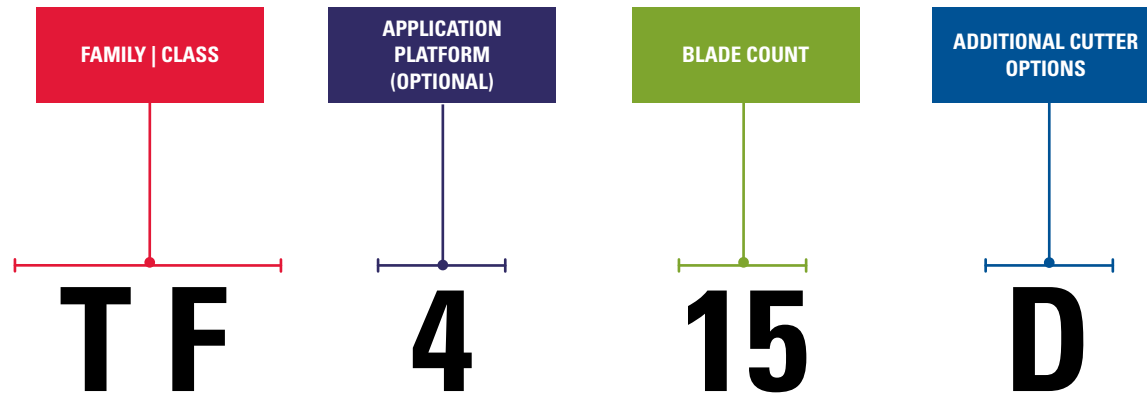
Advanced Active Gauge Geometry

Reduces differential sticking, improving overall drilling efficiency

Mid-Con: First bit to complete the Bromide interval

- DBS 8 1/2" TF610D
- Saved 31.1% per foot
- Dull Condition 2-4WT-A-X-I-NO-TD





FAMILY | CLASS

TurboForce™ Drill Bits

APPLICATION PLATFORM

1-3 = Soft
4-6 = Medium
7-9 = Hard & Abrasive

BLADE COUNT

The blade count describes the number of blades on the bit.

06 = Six Blades
08 = Eight Blades
09 = Nine Blades
10 = Ten Blades
11 = Eleven Blades
12 = Twelve Blades
14 = Fourteen Blades
15 = Fifteen Blades

ADDITIONAL CUTTER (OPTIONAL)

S = Scribe Blocks
D = Drill Out Feature

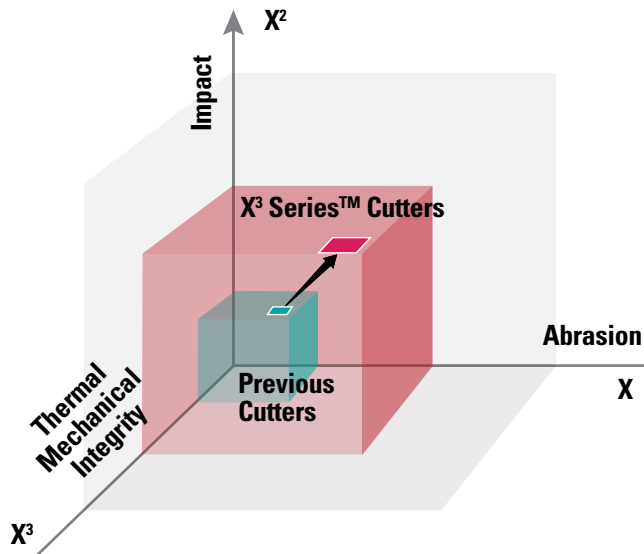


Performance Technologies

Featured in our performance line of fixed cutter drill bits, our performance technologies deliver proven value worldwide.

X³ Series™ PDC Technology

Since 2008, X³ Series™ cutters have proven themselves over and over again as being high-performing, long-lasting cutters with high abrasion and impact resistance. Manufactured with new press technology, the X³ Series cutters have a high TMI value and can withstand the frictional heat generated during the drilling process while limiting heat build-up.



Refined Blade Geometry

To design the right bit for your application, our specialists utilize the DatCISM process and Halliburton's proprietary software to optimize cutter placement and hydraulic nozzles, and define blade geometry. The FX Series bits are more efficient at removing cuttings from underneath the bit through advances in manufacturing and design technology. These bits are created from a milled mold, enabling the FX Series Bits to have improved consistency and smoother drilling over hand formed molds used in previous generations of drill bits.



Previous
Hand-formed mold



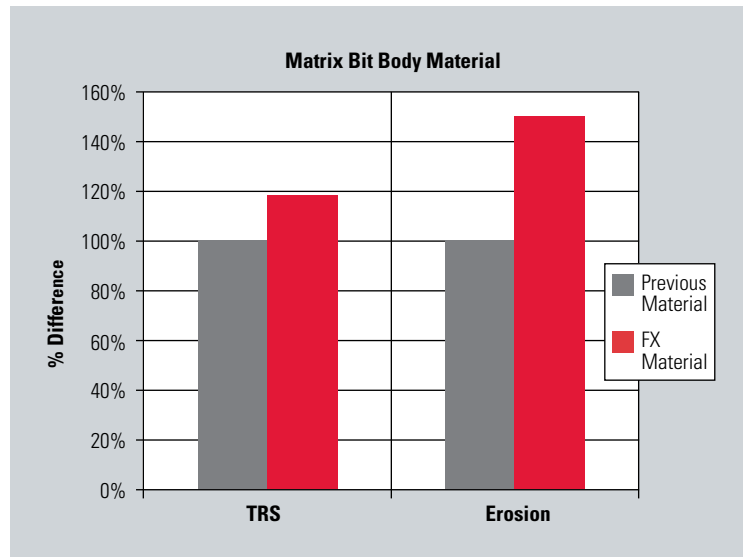
Current
Computer-milled mold

Performance Tungsten Carbide Matrix Material

With reduced bit body erosion, tungsten carbide matrix material increases the life of the bit.

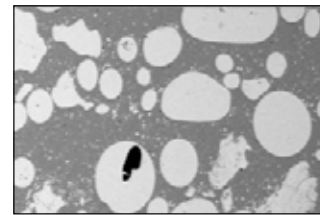
Transverse Rupture Strength (TRS) is 18% higher in the current material as compared to the previous material.

The current carbide matrix material offers 50% more erosion resistance as compared to the previous material.

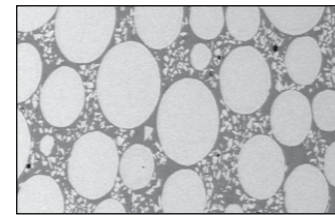


Premium Tungsten Carbide Matrix Material

Halliburton's premium tungsten carbide matrix material offers a 20% improvement in erosion and wear resistance over our performance matrix material. This translates into maximum ROP by reducing the amount of cutting structure loss and enabling longer intervals to be drilled by preventing bit body damage.



Current Hardfacing

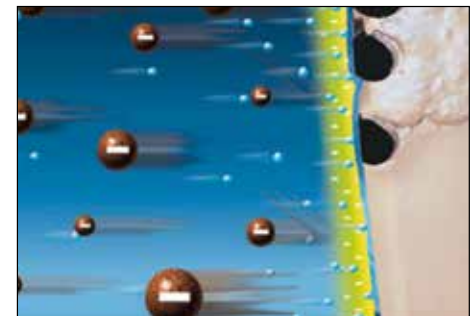


K1 Hardfacing

Anti-Balling Technology

The SteelForce™ premium line features anti-balling technology, enabling for efficient drilling by maximizing the amount of cuttings removal. This patented anti-balling nitriding treatment creates a lubricating water barrier between the bit body and the drilling mud.

The nitriding treatment creates a negative electrical potential in the surface of the steel, repelling the negative ions in the mud and creating a lubricating water barrier.





FX Series™ Drill Bits

Proven Performers with over 100 Million Feet Drilled Worldwide

FX Series™ drill bits are custom designed to overcome tough drilling challenges in even the harshest environments. If reducing trip time is important to you, then an FX Series drill bit is the answer. Halliburton's X³ Series™ cutter technology delivers a cutter that stays sharper, longer on a more erosion-resistant bit body. Ultimately, this means more footage drilled per bit and fewer trips for the operator.



X³ Series™ Cutter Technology

Enables the bit to drill farther and faster, because the cutters stay sharper, longer and are more durable under extreme drilling conditions

Refined Blade Geometry

Provides added stability

Performance Hydraulics

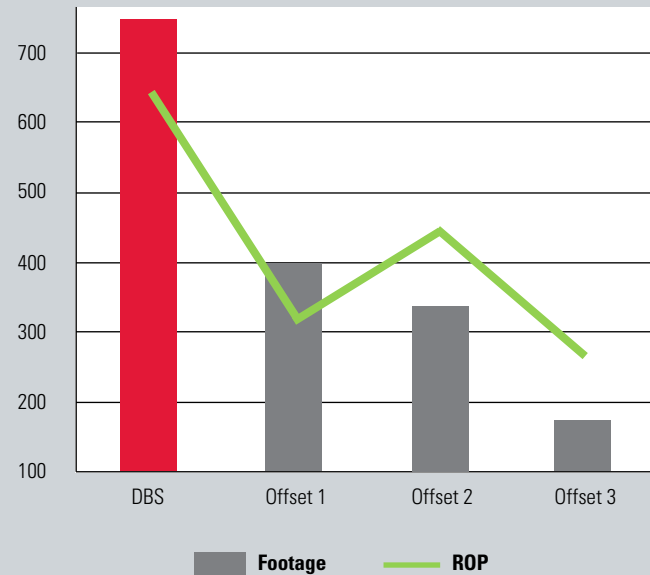
Improves cuttings removal and enables more efficient cooling

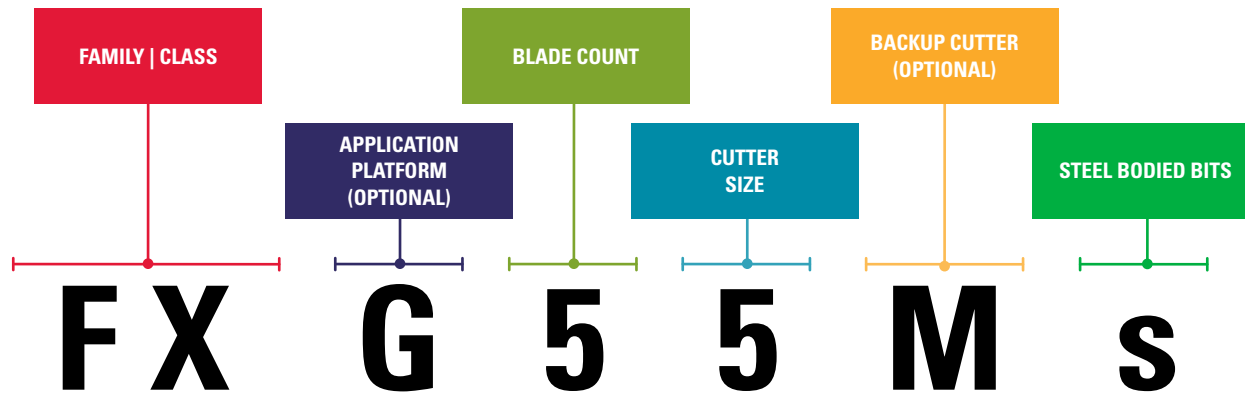
Superior Bit Body Hydraulics

Reduces bit body erosion, increasing the life of the bit

Brazil: Interbedded hard rock in Carauari formation

- Halliburton DBS 8 1/2" FXD74D drill bit
- Single Run on 740 m (2,828 ft)
- Average ROP of 5.8 m/hr (19 ft/hr)
- Outperformed all offsets in terms of both footage drilled and penetration rate



**FAMILY | CLASS**

SteelForce™ Drill Bits

APPLICATION PLATFORM (OPTIONAL)

D = Directional (all other directional systems)
 G = Geo-Pilot® Rotary Steerable
 E = Geo-Pilot® EDL Rotary Steerable
 T = Turbine High Rotational Speed

CUTTER SIZE

The cutter size digit describes the size of the PDC cutters on the bit. On bits with multiple cutter sizes, the predominant size is indicated.

2 = 8 mm (3/8 in.)
 3 = 10.5 mm (13/32 in.)
 4 = 13 mm (1/2 in.)
 5 = 16 mm (5/8 in.)
 6 = 19 mm (3/4 in.)
 8 = 25 mm (1 in.)

OPTIONAL FEATURES

Not listed in nomenclature but found on marketing spec sheet. For more information, please contact your local Halliburton Drill Bits representative.

b = Back Reaming
 c = Carbide Reinforcement
 e = SE - Highly Spiraled
 f = Full PDC Gauge Trimmers
 k = Kerfing - Scribe Cutters
 p = PDC Gauge Reinforcement
 u = Updrill

BLADE COUNT

The blade count indicates the number of blades on the bit.

3 = Three Blades
 4 = Four Blades
 5 = Five Blades
 6 = Six Blades
 7 = Seven Blades
 8 = Eight Blades
 9 = Nine Blades

BACKUP CUTTER (OPTIONAL)

D = Dual Row Backup
 M = Modified Diamond Round
 R = R1™ Backup Cutters
 C = Carbide Impact Arrestor

STEEL BODIED BITS

s = Steel Bodied



Fixed Cutter Bit Features

Combining sophisticated design capabilities with the most advanced cutter technology, Halliburton Drill Bits & Services has created a series of PDC bit features to capture the benefits of durability and stability that are needed for any challenging application.

APPLICATION PLATFORM



Geo-Pilot® PDC Bit Design (G)

The Geo-Pilot® PDC bit uses a Modified Extended Gauge (MEG) sleeve to give the box connection and fulcrum point necessary for the Geo-Pilot® rotary steerable tool. The MEG sleeve gives consistent fulcrum point locations while maintaining a flow area from bit face to sleeve.



Turbine PDC Bit Design (T)

The Turbine PDC bit uses special cutter layouts and optimized Depth of Cut to give maximum ROP in high RPM applications. Bits can utilize sleeves and extended gauges for stability or specialized gauge designs for directional application.



Directional PDC Bit Design (D)

The Directional PDC bit uses different gauge and cutting structure geometries calculated from Direction by Design® software to help ensure that adequate DLS and tool face can be achieved without sacrificing bit performance or life.



Geo-Pilot® EDL Bit Design (E)

The Geo-Pilot® EDL PDC bit uses a standard point-the-bit cutting structure with a unique gauge design to enable high doglegs to be achieved.

BACKUP CUTTER**Dual Row Backup Cutters (D)**

Use dual row SelectCutter™ or X³ Series™ cutters in highly abrasive conditions. Shows even wear.

**Modified Diamond Reinforcement (M)**

Modified diamond reinforcement (MDR) cutters can be used as a diamond “wear resistant” axial arrestor or to replace the R1 backup cutter to minimize cutter pocket wear and mitigate the progression of ring out.

**Backup R1™ Cutters (R)**

Use backup R1™ cutters when the application is highly interbedded with formations of significantly different rock strengths. Dull condition shows signs of cutter chippage in the nose and shoulder with surrounding cutters often having little to no wear.

**Impreg Backup discs (i)**

Use the “i” (synthetic diamond) backup cutter as a secondary cutter, enabling a dual-cutting action with PDC and as a reinforcement to extend bit life. Typical applications are intermediate hard/abrasive formations (interbedded or not), high RPM applications, and exploration wells.

ADDITIONAL CUTTER OPTIONS**Highly Abrasive Wear (H)**

Use this feature to help ensure that highly abrasive formations can be delivered at the maximum ROP and can achieve the longest run.

Available on MegaForce™ and SteelForce™ bits only.

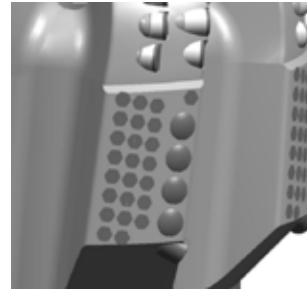


OPTIONAL FEATURES



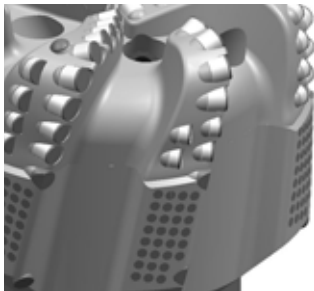
Impact Arrestor and Carbide Impact Arrestor (C)

Use Impact arrestors and Carbide Impact Arrestors (CIA) when little wear is expected but impact damage is observed. Ensure DOC guidelines are used.



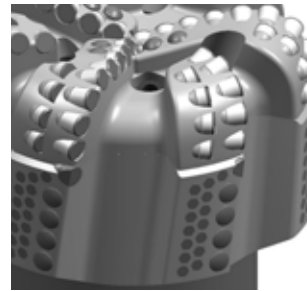
Gauge Reinforcement (p) (Hex TSP, TSP, Dome PDC)

Use TSP gauge elements in all applications except where gauge pad wear is observed. When extreme wear is observed, use Hex TSP or Dome PDCs.



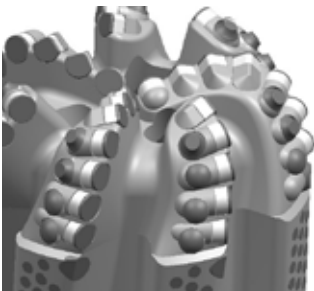
Back Reaming Feature (Updrill, Back Reaming, Hybrid)

Use back reaming cutters when hole conditioning is needed and the top of the gauge pad has wear. When key seats or cave-ins are observed then, use updrill cutters. When a combination of these events take place then, use a hybrid set of back reaming and updrill cutters.



Directional Gauge Features (Drop-In, Full PDC Round, Stepped)

The standard is one drop-in cutter per gauge pad. Based on Direction by Design® software, a more aggressive gauge might be required to achieve the DLS. In this case, increasingly use more drop-in cutters per gauge pad, full PDC round cutters along the gauge pad, or go to a stepped or undercut gauge pad as needed.



Kerfing – Scribe Cutters (k)

The scribe cutter is a unique shaped PDC cutter that puts a maximum energy point load into the formation where crushing and fracturing the formation is more advantageous than shearing. This shape ensures that maximum ROP and rock removal can be achieved.

A high-contrast, black and white close-up photograph of a roller cone drill bit. The image shows the intricate details of the bit's teeth, which are arranged in a circular pattern around a central point. The teeth are sharp and pointed, designed for drilling into hard materials. The lighting creates strong highlights and shadows, emphasizing the metallic texture and the complex geometry of the drill bit. The background is dark and out of focus, making the drill bit the central focus of the image.

Roller Cone Drill Bits

QuadPack® Plus Drill Bits

X Series™ Drill Bits



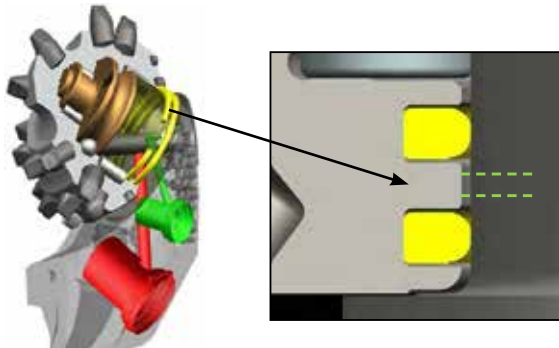
Roller Cone Technologies

Whether offshore drilling a 28-in. section or a slim hole application on land to reach TD, roller cone drill bits from Halliburton Drill Bits & Services provide solutions to customers globally. Whatever the drilling challenge: hard rock, highly interbedded, high chert content, high abrasion or high build rates, Halliburton DBS roller cone bits are designed to offer the best performance in the industry through coupling of the DatCISM process.

Premium Bearing System

8 1/2 to 28 in.

Available in sizes 8 1/2 to 28 in., the premium bearing uses two primary seals with a patented dual compensation system to extend bearing life. This dual system is a superior method for extending the life of the inner primary seal and reducing wear by preventing the intrusion of formation cuttings. Each primary seal has a dedicated reservoir to equalize pressure between them for maximum performance and life.



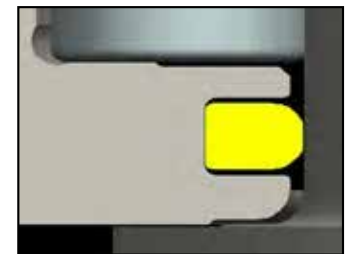
Performance Bearings

14 1/4 to 28 in.

Available in two configurations for 14 1/4 to 28 in. The performance bearing uses a primary seal along with an axial secondary seal as its bearing sealing system. The secondary seal works to protect the primary inner seal from cuttings debris and enables for pressure relief between the inner and axial seals. The premium bearing functions with a dedicated pressure compensation system.

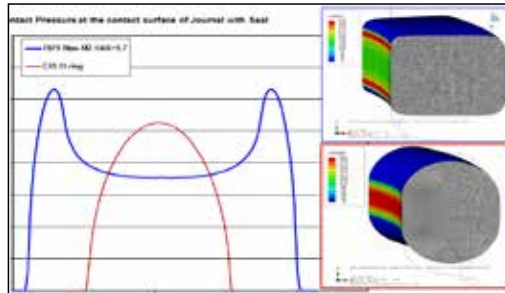
4 3/8 to 13 3/4 in.

For bit sizes 4 3/8 to 13 3/4 in. the performance bearing uses a primary seal that exhibits greater thermal properties and wear resistance over its predecessor. The seal makes the performance bearing more effective in preventing contamination which extends bit life, resulting in better performance. A dedicated pressure compensation system which helps achieve pressure equalization across the bit is also used.



Optimized Contact Pressure Seal

By re-engineering the seal shape, we were able to deliver a 53% increase in seal reliability, a 24% reduction in torque friction, and a 16% decrease in temperature endured by the seal over the previous design. These achievements were accomplished by moving the highest contact pressures to the edge of the sealing interface where it is needed most. In turn, the lower contact pressures at the center of the sealing face reduce wear and frictional torque.



Mechanical Pressure Compensator (MPC)

The patented MPC is now available on all roller cone drill bits. The rubber diaphragm quickly equalizes the pressure on the inside and outside of the seals. This equalization greatly enhances the durability of the bearing and seal system by all reducing the seal stress.



Energy Balanced® Bit Technology

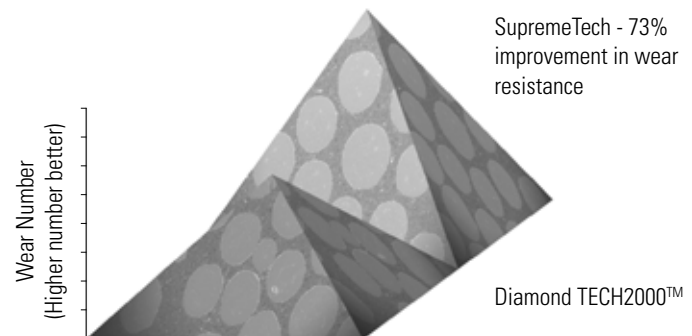
Only Halliburton DBS offers this patented feature, a cutting structure, which is balanced to equalized load and rock removal among all three cones. This is accomplished by optimizing cutter placement and analyzing the depth of cut on adjacent cutters. The result minimizes vibration which enhances the service life of sensitive instrumentation and equipment while increasing ROP and durability.



At left, some cones bear more load than others, causing imbalance. At right, the load is balanced equally among all cones through use of Energy Balanced Bit Technology.

SupremeTech™ Hardfacing

Our patented SupremeTech™ Hardfacing treatment produces a material that is 73% more abrasion resistant compared to conventional hardfacing treatments. This abrasion resistance is achieved by using a novel low-binder, sintered-hipped tungsten carbide pellets. This helps maintain their super dense microstructure and superior roundness when compared to conventional hardfacing using high-binder, sintered tungsten carbide pellets.

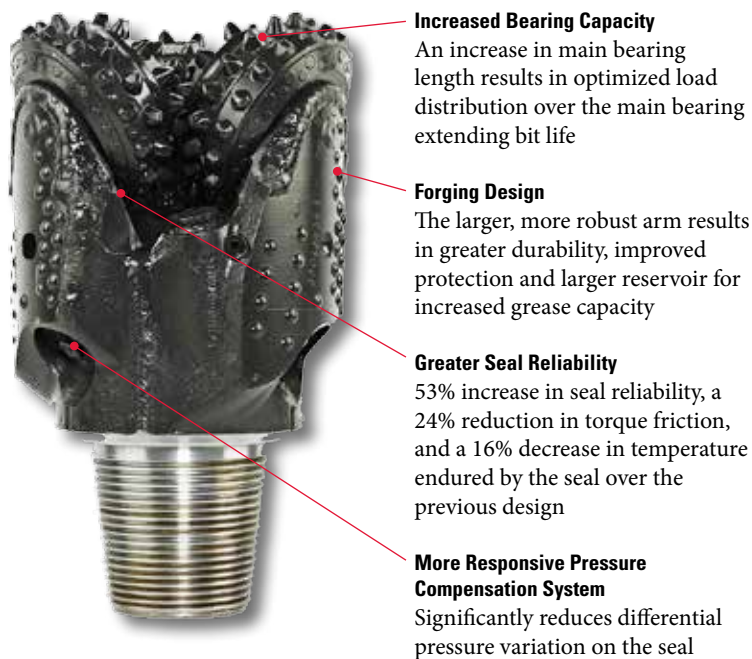


QuadPack® Plus Engineered Hydraulic Bits

With the complexities and challenges of drilling in today's environment, Halliburton Drill Bits & Services has developed a line of roller cone bits well suited for these applications. Through better durability and performance QuadPack® Plus drill bits are lowering operators cost per foot globally through increased durability and performance.

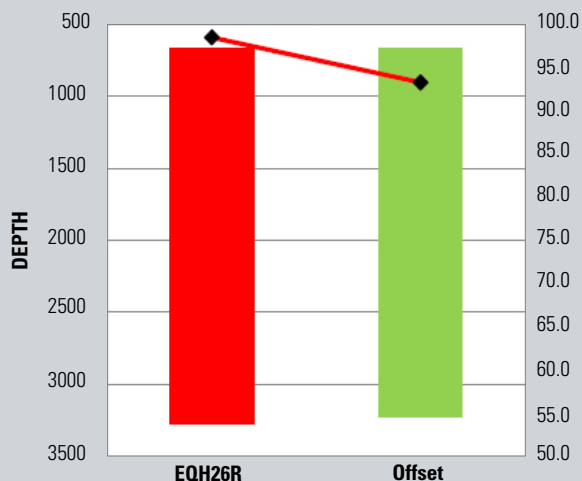
The QuadPack Plus design profile is focused on removing cuttings from crucial areas of the cutting structure and wellbore, accomplished

by changing the arm geometry and directing the nozzles towards to the leading edge of the cutting structure. This geometry change produces higher ROP and extends the bit life when compared to traditional arm profiles. QuadPack Plus bits are available in sizes 4 1/2 to 13 3/4 in.

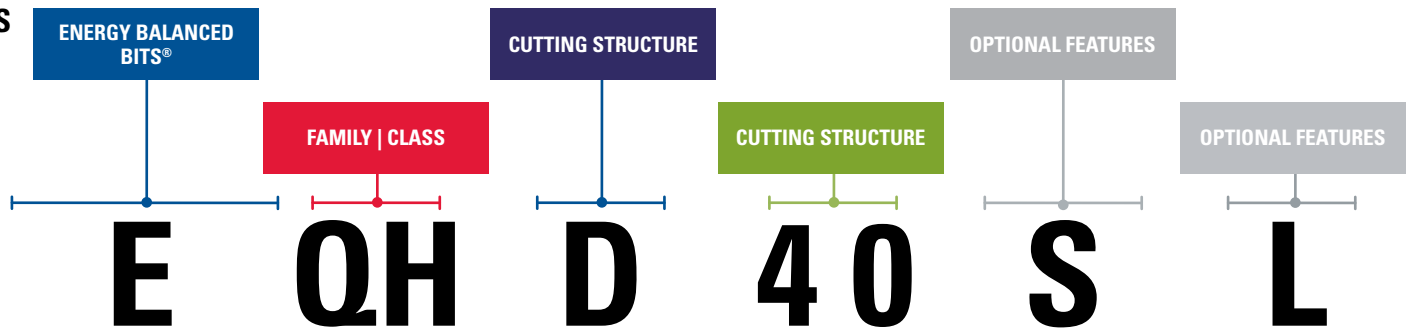


Ohio: Fastest ROP and lowest cost per foot

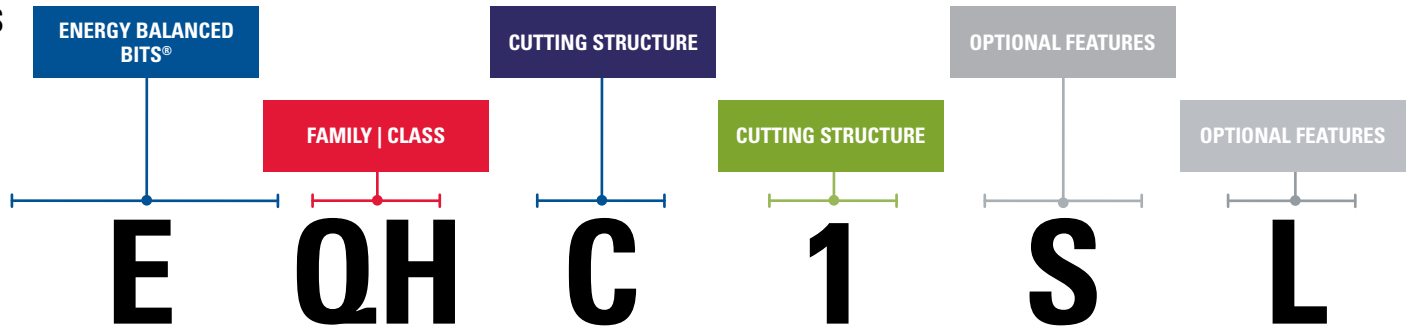
- Halliburton DBS 12 1/4 in. EQH26R drill bit
- Drilled 2,610 ft (795 m) in 26.5 hr
- ROP of 98.5 ft/hr (30 m/hr)
- Outdrilled the competitor on the same pad (20 ft away) in both footage and ROP



INSERT BITS



TOOTH BITS



ENERGY BALANCED® BITS

E = Energy Balanced® Bits

FAMILY | CLASS

QH = QuadPack® Plus Engineered Hydraulics Bits
(4 1/2 through 13-1/2 in.)

CUTTING STRUCTURE (PREFIX)

C = After Class Alpha for Claw Tooth on Steel Tooth Model
D = For Gauge/Face Diamond Insert on Insert Model

CUTTING STRUCTURE

For Tooth Bits Single Numeric Variant From 1 to 7
For Insert Bits Dual Numeric Variant From 00 to 99

OPTIONAL FEATURES

For more information, please contact your local Halliburton Drill Bits representative.

A = Air Application

C = Center Jet

D = Diamond Surf Row (33%)

D2 = Diamond Surf Row (50%)

D3 = Diamond Surf Row (100%)

G = Non-Standard Gauge Row

L = Lug Pads

LD = Diamond Insert Lug Pads

P = Protective Carbide Coating

R = Raised Enhanced Shirttail / Arm Protection

S = Enhanced Shirttail Protection

SD = Shirttail Diamond – Enhanced Protection

RD = Shirttail Diamond – Raised Protection



X Series™ Drill Bits

Our line of X Series™ roller cone bits include non-sealed and sealed roller bearing bits, typically in sizes larger than 13 1/2 in. Featuring greater seal reliability, these bits ensure maximum performance to meet challenging applications.



Increased Bearing Capacity

New bearing has increased load capacity with larger cross section seals for increased compression while maintaining similar contact pressure

Greater Seal Reliability

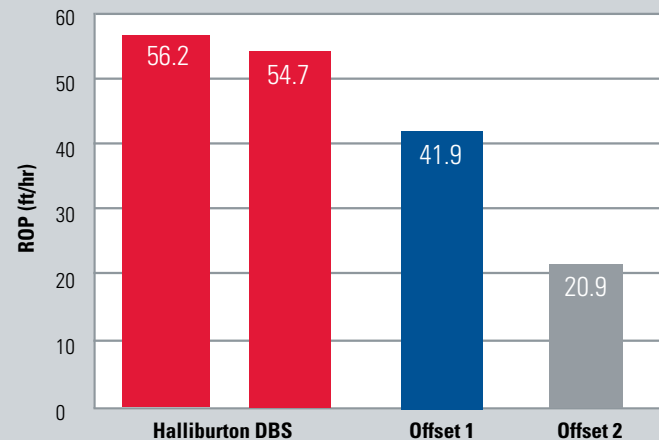
53% increase in seal reliability, a 24% reduction in torque friction, and a 16% decrease in temperature endured by the seal over the previous design

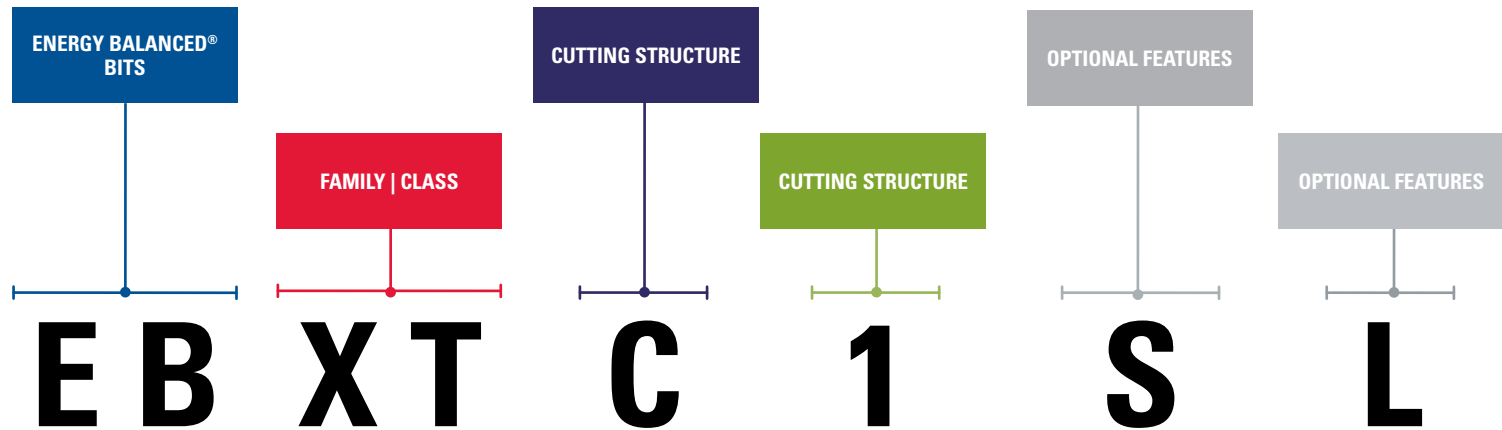
More Responsive Pressure Compensation System

Significantly reduces differential pressure variation on the seal

Saudi Arabia: Record ROP and Cost Per Foot

- Halliburton DBS 22" EBXT02S
- Drilled 1,855 ft (795 m) in 33 hr
- ROP of 53.2 ft/hr (30 m/hr)
- 25.4% improvement in ROP and reduction in cost per foot of 8% over the best competitor offset in the Shedgum field





ENERGY BALANCED® BITS

EB = Energy Balanced® Bits

FAMILY | CLASS

XN = Non Sealed Bearing

XT = Sealed Roller Bearing

CUTTING STRUCTURE (PREFIX)

C = After Class Alpha for Claw Tooth on Steel Tooth Model

D = For Gauge/Face Diamond Insert on Insert Model

CUTTING STRUCTURE

For Tooth Bits Single Numeric Variant From 1 to 7

For Insert Bits Dual Numeric Variant From 00 to 99

OPTIONAL FEATURES

For more information, please contact your local Halliburton Drill Bits representative.

A = Air Application

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D = Diamond Surf Row (33%)

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L = Lug Pads

LD = Diamond Insert Lug Pads

P = Protective Carbide Coating

R = Raised Enhanced Shirttail / Arm Protection

S = Enhanced Shirttail Protection

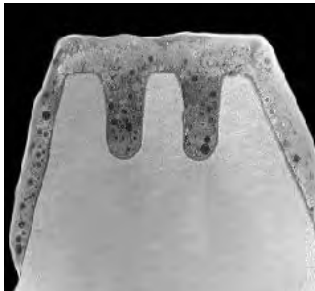
SD = Shirttail Diamond – Enhanced Protection

RD = Shirttail Diamond – Raised Protection



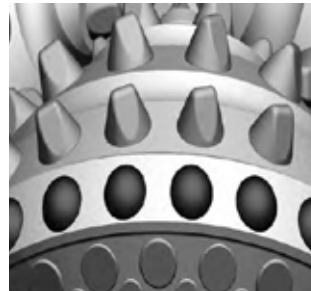
Roller Cone Bit Features

CUTTING STRUCTURE



After Class Alpha for Claw Tooth on Steel Tooth Bits (C)

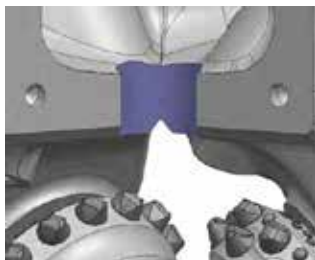
The patented claw feature delays the typical wear pattern of the tooth, leaving a longer, sharper tooth for improved ROP and cutting structure life. Utilization of the “claw” increases the aggressiveness of the bit as the teeth wear.



For Gauge/Face Diamond Insert on Insert Bits (D)

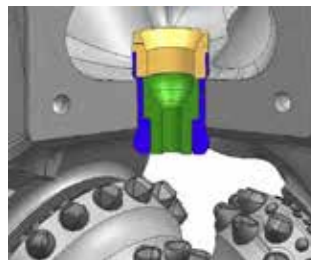
Diamond enhanced gauge row insert protection for reduced gauge wear, high-quality wellbore and improved cutting structure performance.

OPTIONAL FEATURES



Air Application (A)

Center bore in bit for air drilling applications, which helps minimize the volume of drilling fluids needed for the full well and reduces the time that fluids are held in reserve pits.



Center Jet (C)

Center jet feature to enhance cone cleaning and hydraulic flow patterns, which helps prevent bit balling.



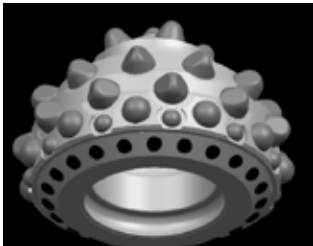
Diamond Surf Row 33% (D)

33% diamond surf protection improves resistance to impact damage and abrasive wear, which results in more protection for the bearing seal, extending bit life.



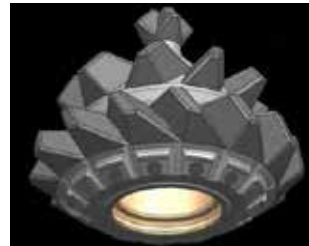
Diamond Surf Row 50% (D2)

50% diamond surf protection improves resistance to impact damage and abrasive wear, which results in more protection for the bearing seal, extending bit life.



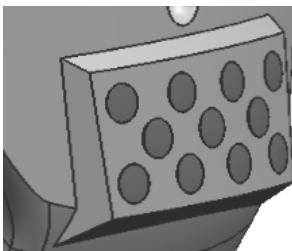
Diamond Surf Row 100% (D3)

100% diamond surf protection improves resistance to impact damage and abrasive wear, which results in more protection for the bearing seal, extending bit life.



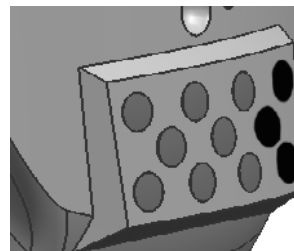
Non-Standard Gauge Row (G)

Tungsten carbide “surf” inserts in gauge teeth for added gauge protection.



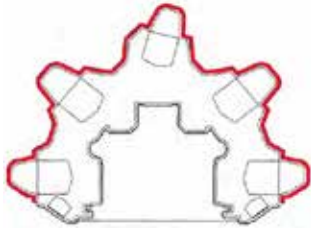
Lug Pads (L)

Integral stabilizer pads for improved directional performance on steerable assemblies.



Diamond Insert Lug Pads (LD)

Diamond integral stabilizer pads for improved directional performance on steerable assemblies.



X-Gun® is a registered trademark of GS Manufacturing

Protective Carbide Coating (P)

Thermal spray process (HVOF), using the X-Gun® sprayer, produces hard, dense tungsten carbide coatings for cutting structures that are resistant to abrasive wear and erosion.



Raised Enhanced Shirttail/Arm Protection (R)

Raised tungsten carbide inserts and proprietary hardfacing provides maximum arm protection in abrasive and directional applications.



Enhanced Shirttail/Arm Protection (S)

Shirttails protected with proprietary hardfacing and tungsten carbide inserts for maximum abrasion resistance.



Shirttail Diamond – Enhanced Protection (SD)

Diamond-enhanced inserts and tungsten carbide inserts protect shirttail for maximum abrasion resistance.



Shirttail Diamond – Raised Protection (RD)

Raised diamond-enhanced inserts and tungsten carbide inserts protect shirttail for maximum abrasion resistance.

Coring Services

RockSwift™ System

Core Barrel Features

**Preservation and
Stabilization Services**





Coring Technologies

Halliburton offers a full range of coring services from unconsolidated to ultrahard abrasive formations. With proven global performance of over 400 jobs performed each year, we have a 94% core recovery rate. We offer best-in-class core bit technology to maximize ROP and extend bit life.

Our on-site Design at the Customer Interface (DatCISM) process provides custom solutions to maximize core recovery. MaxBHATM software analysis is performed for the coring BHA to provide additional information on drilling performance. We provide superior coring service quality to more than 170 customers in 47 countries to meet your coring objectives.

Applications	Solutions
Tendency to Jam from Fractured Reservoir	RockStrong TM Coring System, Full Closure System, MaxBHA
Soft Friable or Unconsolidated Expensive Rig Time	RockStrong, RockSwift TM Coring System, MaxBHA
Horizontal or High Angle	RockStrong, MaxBHA
High Pressure/High Temperature	RockStrong, RockSwift, MaxBHA



PDC Core Head
For Soft Formations



TSP Core Head
For Medium to Hard Formations



Diamond Impregnated Core Head
For Hard/Abrasive Formations

RockStrongTM Coring System

Designed specifically for high pressure, high temperature (HPHT) environments and hard, abrasive rock, the RockStrongTM coring system incorporates best-in-class corehead technology, anti-jamming design, and engineered vibration mitigation.

The RockStrong coring system features a unique swivel assembly, making it the most robust coring tool on the market. To date, it is the only system specifically designed for extreme wellbore environments. It is field proven to deliver high-quality core samples in the harshest conditions. The system was built to overcome ultra-deepwater coring issues and high vibration levels encountered in tight multi-layer formations.

Tool Size				
	4-3/4 in. x 2-5/8 in.	5-1/2 in. x 3-1/4 in.	6-3/4 in. x 4 in.	8 in. x 5 1/4 in.
Hole Size Compatibility	5-7/8 in. x 7 in.	6 in. x 8-1/2 in.	8 in. x 9 in.	10 7/8 in. x 12 1/4 in.
Core Barrel Size	4-3/4 in.	5-1/2 in.	6-3/4 in.	6-3/4 in.
Core Size	2-5/8 in.	3-1/4 in.	4 in.	4 in.

Ultra Stable Double Bearing Assembly

Ensures smooth core entry and reduces risk of damage to the core

Anti-Jamming Features

Included a top spacer assembly which acts like a preloaded spring to absorb axial vibrations along the inner assembly

Increased Space-Out Capacity

Withstands HPHT conditions

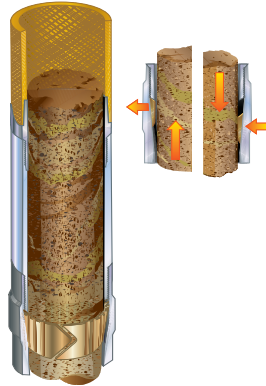
Pre-Loaded Adjustment System

Reduces fatigue effects and extends the vibration level that can be sustained by the core barrel



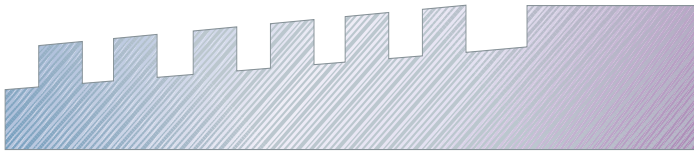
Heavy Duty Core Catcher

Designed for coring medium-hard, hard-fractured, or interbedded formations. The spring catcher (*shown at right*) opens as the core enters. When the core barrel is lifted off the bottom, the spring catcher closes to break off the formation and retains it within the inner tube.



Heavy Duty Threadform (patented)

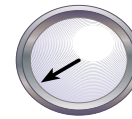
The Heavy Duty Threadform reduces thread damage and costly delays. It adds reliability in horizontal applications and enables longer core barrels to save trips and valuable rig time. The heavy duty buttress threads are double shouldered and flush internally and externally. They greatly increase tensile strength, flex capacity, torsional strength, and fatigue life compared with conventional threads. Its fatigue life is ten times greater than conventional types.



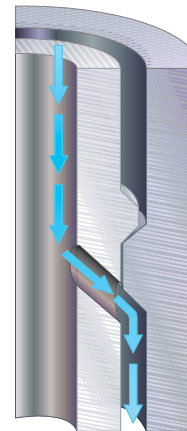
The Hydro-Seal Barrel (HSB™) System

The Hydro-Seal Barrel (HSB™) System, an optional feature, provides a clear and instantaneous indication on the rig floor if core jamming occurs. The floating, flexible barrel (*shown below*) is hydraulically seated, which means much less stress on the core at entry. Jamming lifts the inner barrel restricting mud flow, and increases the pressure reading at the surface.

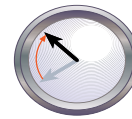
Stand Pipe Pressure



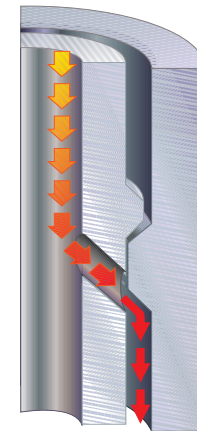
Coring



Stand Pipe Pressure



Jamming





RockSwift™ Coring System

The RockSwift™ wireline coring system enables operations to pull the core out of the hole by a wire while the core barrel remains downhole. The inner assembly containing the core is pulled, and as soon as the core is retrieved, an empty tube is dropped in and hydraulically kept inside the bore barrel, ready to complete the next core cut.

A drill plug can alternatively replace the removable tube to fill the corehead with a cutting structure to drill towards the next core point.

RockSwift™ coring system comes in a variety of tool sizes with different hole size capabilities to.

	Latch Les™ 4-3/4 in. x 1.713 in.	Latch Les™ Triple Tube 6-3/4 in. x 2.02 in.	RockSwift 6-3/4 in. x 3 in.
Hole Size Capabilities	5-7/8 in. - 7 in.	8 in. - 9 in.	8 in. - 9 in.
Core Size	1.713 in.	2.02 in.	3 in.
Recommended Drill String Drift Diameter	2-1/4 in.	2-13/16 in.	4-1/8 in.



RockSwift™ Coring System in the La Luna Shale in Colombia.

Poland: Fast Recovery for Accurate Gas-in-Place Measurement

- Halliburton DBS 3-in. RockSwift™ wireline coring system with 8-1/2 in. x 3 in. FC3643 PDC core head
- Cut 820 ft (250 m) in 29 runs with a single core head
- 100% core recovery

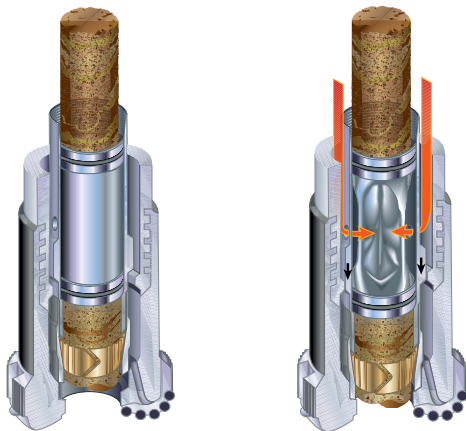
Core Barrel Features

FCS™ (Full Closure System)

FCS™ system is ideal for soft, unconsolidated formations. A hydraulic collapsing sleeve minimizes mechanical parts and increases reliability.

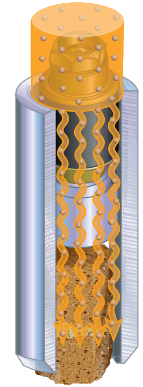
Full Closure System is a parallel concept of core catcher that enables an efficient recovery of soft to highly unconsolidated cores. The FCS system is available as a conversion kit to the Conventional Barrel and consists of two main assemblies: the FCS Inner Tube Plug that is assembled to the Conventional Swivel and the FCS Collapsing Shoe that is fitted located at the top of the conventional lower half shoe containing the core catcher. An additional Activation Sub is finally fitted around the FCS Collapsing Shoe to create a TFA restriction upon request which will bring the latter to collapse around the core foot.

The FCS is hydraulically activated by a drop ball and is fully compatible with Halliburton DBS Conventional Coring equipment.



Glider™ System

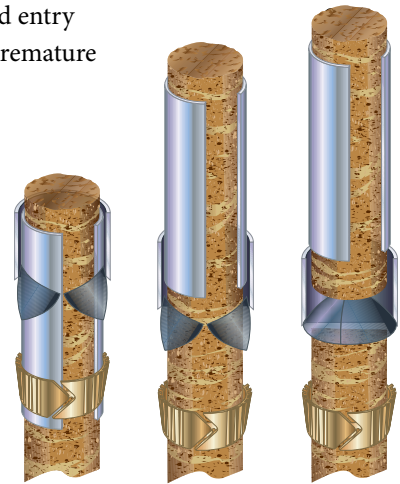
The Glider™ system provides a layer of lubricating non-reactive fluid between the core and inner tube to prevent jamming and protect the core from the drilling mud.



PosiClose™ System

The PosiClose™ system also maximizes core recovery in soft formations. Unrestricted entry eliminates jamming from premature catcher/core contact.

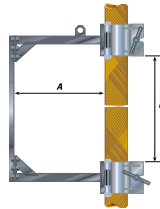
The catcher system fully closes to ensure complete retention throughout retrieval.



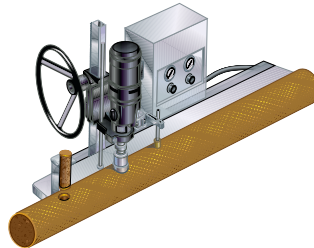


Preservation and Stabilization Services

Inner Tube Alignment Device prevents core damage from rotating and flexing of inner tubes, while separating the inner tubes prior to laydown.



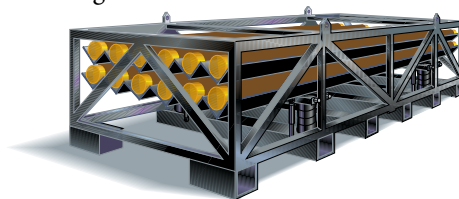
Plug Taker cuts core samples to aid on-site operating decisions or to ship them to the laboratory for further analysis. Operators can also take plugs at the surface to prevent further diffusion, and with trimming, provide the laboratory an inner plug untouched by drilling fluids, which prevents alternation.



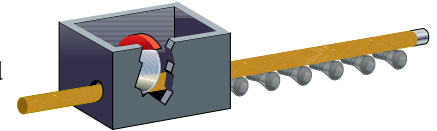
Foam Coring Preservation provides complete core stabilization in a fast and reliable system that ensures sample integrity while facilitating ease of handling. Cores are immediately protected and preserved in-situ, eliminating potential damage and ensuring quality analysis.



Special Shipping Baskets can be spring-loaded to protect cores during transport. The basket can ship full length cores, the preference of some laboratories.



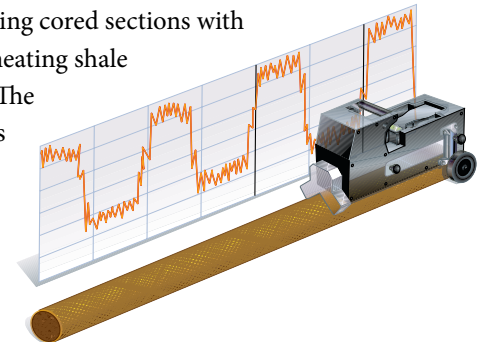
Power Saw cuts fiberglass or aluminum inner tubes into three foot sections, if requested by the customer. The blade is normally diamond tipped, and the saw pneumatic depending on the rig location. The box's safety housing offers an open top for access.



Lay-down Cradle protects against bending and impact damage. The cradle is equipped with rollers.



Core Gamma Logger (CGL) provides on-site analysis for gamma ray logs. It enables real-time decisions on further coring, testing, or completions by correlating cored sections with anticipated lithology, delineating shale from non-shale sections. The CGL is portable and works vertically on the rig floor or horizontally on the catwalk.



Hole Enlargement Tools

XR™ Reamer

TDReam™ Tool

NBR® Near Bit Reamer

UR™ UnderReamer

Single Piece Hole Opener





Hole Enlargement Technologies

Halliburton DBS offers high-performance downhole tools for hole enlargement, torque reduction, and drag resistance improvement needs.

Halliburton's hole enlargement solutions can help solve your challenges whether you are using a rotary steerable BHA, a steerable motor BHA, or a conventional rotary drilling system. We offer innovative drilling technologies to mitigate drillstring vibration during hole enlargement.

Halliburton's hole enlargement tools operate efficiently, improving circulation, reducing the risk for fracturing formations to overcome your hole enlargement challenges.

Challenges	Solutions
Rotary Steerable BHA	XR™, TDReam™, SPHO
Steerable Motor BHA	NBR®
Conventional Rotary BHA	XR™, NBR®, UR™, SPHO

Cutting Structures

TDReam™ and NBR® Pistons

The NBR® tool features dome PDC cutters, which help prevent cutters from damaging the casing if pistons are released inadvertently within the casing shoe.



Standard arms for soft applications have a single row of PDC cutters on our hole enlargement tools.



Two rows of PDC cutters are used for medium to hard applications.

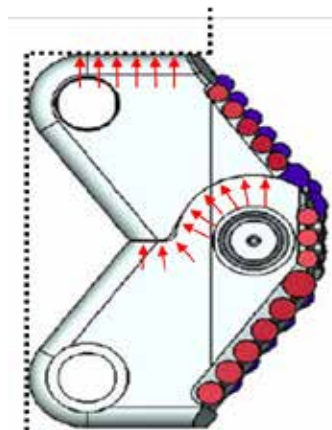


Three rows of PDC cutters are for hard/abrasive applications, made with reinforced hardfacing.

XR™ Reamer Arms

With dedicated cutter arm sets for each hole opening size, the XR™ Reamer can increase hole size up to 1.5 times the pilot hole diameter.

Drilling loads are broadly distributed across the body and arm geometries so that vibrations are greatly reduced. The XR Reamer autoblocking technology assures the arms are open at all times while WOB is applied.



UR™ Tool Arms

The largest in the market in terms of enlargement capability, the tool is specifically designed for gravel packing, and coalbed methane and gas storage applications where enlarged hole size is critical for optimizing well production.



For standard applications, PDC cutters are used.



For medium to hard formations, interbedded with hard layers, the cutter structure is comprised of PDC cutters backed up with diamond impregnated disks.



For hard/abrasive formations, a fully diamond impregnated cutting structure is used.

Single Piece Hole Opener (SPHO)

The SPHO cutting structure is designed, using force and torque balancing technology.

The cutting structure can be customized as needed to fit the application.



Operating Principles

XR™ Reamer

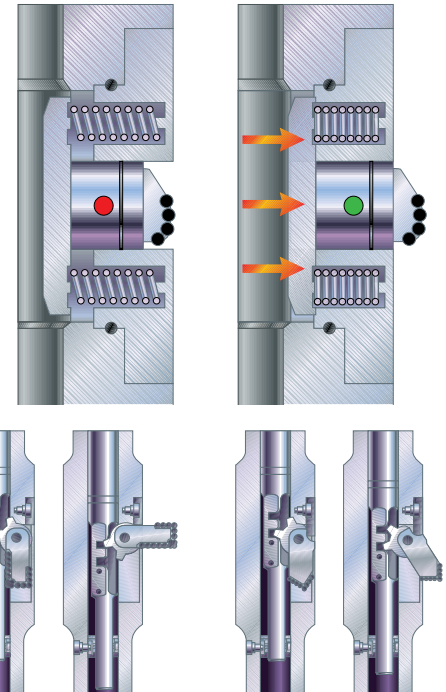
XR Reamer is ball-drop activated. When the ball seats, a pressure differential is seen at the shear pin, and the arms are activated. This pressure differential can be seen at surface, indicating that the tool has moved into the active state. A second ball is then dropped to deactivate the arms.

NBR® Tool

The NBR® tool operates solely on hydraulic bore pressure (*shown below, top*). A minimal increase in internal pressure acts on the flanges, breaks the shear pin, and then forces the pistons to move radially. Return springs close the pistons when flow decreases.

UR™ Tool Arms

Hydraulic force activates the cutter arms on the UR™ tool (*shown right, bottom*). With the pumps off, a return spring closes the arms. There is no locking device. A rack-and-pinion mechanism transmits the drive rod motion to open the arms, and then stop blocks enable two different arm opening angles, 90° and 35°.





XR™ Reamer Hole Enlargement Tool

Quality Hole Enlargement While Drilling

The XR™ Reamer is the only tool capable of enlargement up to 1.5 times the pilot hole or drift diameter. The tool provides dependable hole enlargement while minimizing BHA vibration. The XR Reamer is proven in high-angle, extended-reach applications where it minimizes downhole vibration resulting in reliable performance, even in challenging environments.

A self-stabilized body is one of many technological features embedded in the XR Reamer. Besides minimizing BHA whirl, the technology produces a quality enlarged wellbore and extends drill string component life.

The XR Reamer autoblocking technology uses the dynamic and fully automated blocking to assure the arms are open at all times while WOB is applied. This mechanism has been chosen, because in expandable enlargement applications any physical locking open feature may expose the customer to the risk of losing the entire BHA due to the mechanical lock's failure to disengage. This feature provides improved service quality for the customer.

Reliable Autoblocking System

Enables the use of optimum WOB while drilling as all the loads are transferred to the reamer body rather than on internal components

Large Flow Area

For efficient cuttings removal

Articulated Arm Deployment

For tool reliability, durability, and hole quality

Self Stabilizing Body

Minimizes BHA whirl, making the hole enlargement operation more efficient



Norway: World Record in Reservoir Section

- Halliburton XR800 tool with 9-in. arms
- Successful reaming to a total depth of 6353 m (20,876 ft)
- The 4297-m (14,098-ft) long section was opened in one run
- The XR800 set a world record for the longest expandable hole enlargement run in a reservoir section.

TDRream™ Tool

In a traditional reaming-while-drilling BHA, the reamer is placed above the RSS and LWD tools, creating a long rathole and requiring an extra trip to enlarge the hole to total depth (TD). Challenged to design a tool to increase efficiency, Halliburton has responded with a solution that has the

added benefits of reducing operational risk in addition to saving time and money. Run in conjunction with the XR™ Reamer, the TDRream™ tool is Halliburton's newest downhole innovation designed to significantly reduce rathole length and reach TD in one run.

No Locking Devices

To prevent pistons from inadvertently locking in the open position, the return springs close the arms when the flow decreases.

Shear Pin

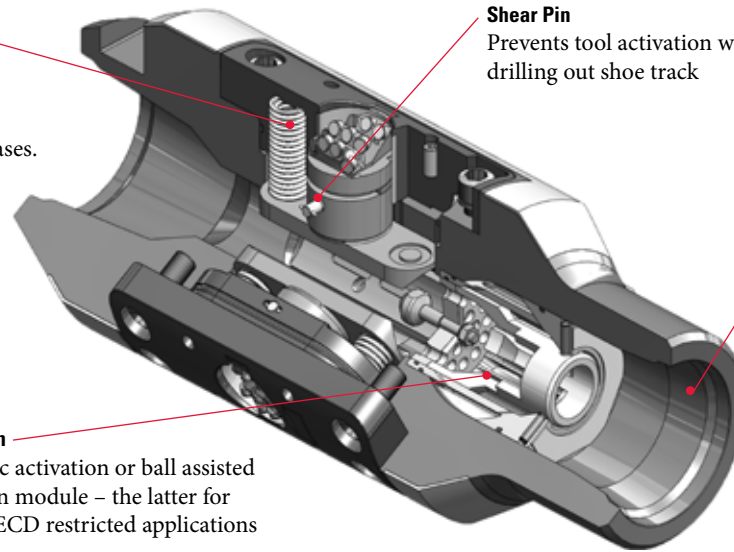
Prevents tool activation while drilling out shoe track

Selectable Activation

Selectable hydraulic activation or ball assisted hydraulic activation module – the latter for pump pressure or ECD restricted applications

Balanced Concentric Design

Substantially reduces BHA vibration compared with eccentric tools of bi-center bits, improving steerability and stability



Norway: Successfully enlarged wellbore from 12 1/4 in. to 13 1/2 in.

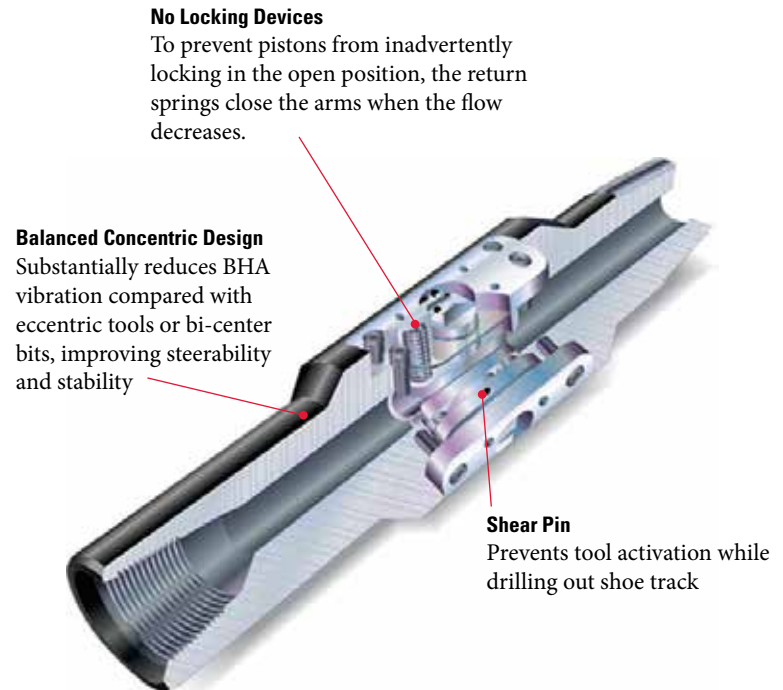
- Halliburton TDR1200 tool in combination with the XR™ Reamer delivers a one-trip solution for borehole enlargement to TD.
- Successfully enlarged the rathole to enable the running of a 10 3/4-in. casing to TD
- Estimated cost savings of \$300,000 in rig time alone for the operator



NBR® (Near Bit Reamer) Tool

The NBR® tool has borehole enlargement capabilities up to 1.2 times the pilot hole diameter. The tool is a concentric expandable reamer, which is engineered to run between the downhole motor and above the drill bit. Due to its robustness and limited moving parts, the NBR tool is the most reliable tool on the market.

The NBR tool's concentric technology substantially reduces BHA vibration compared to eccentric tools or bi-center bits, improving steerability and stability. The greater stability of the NBR tool helps ensure a gauged hole.



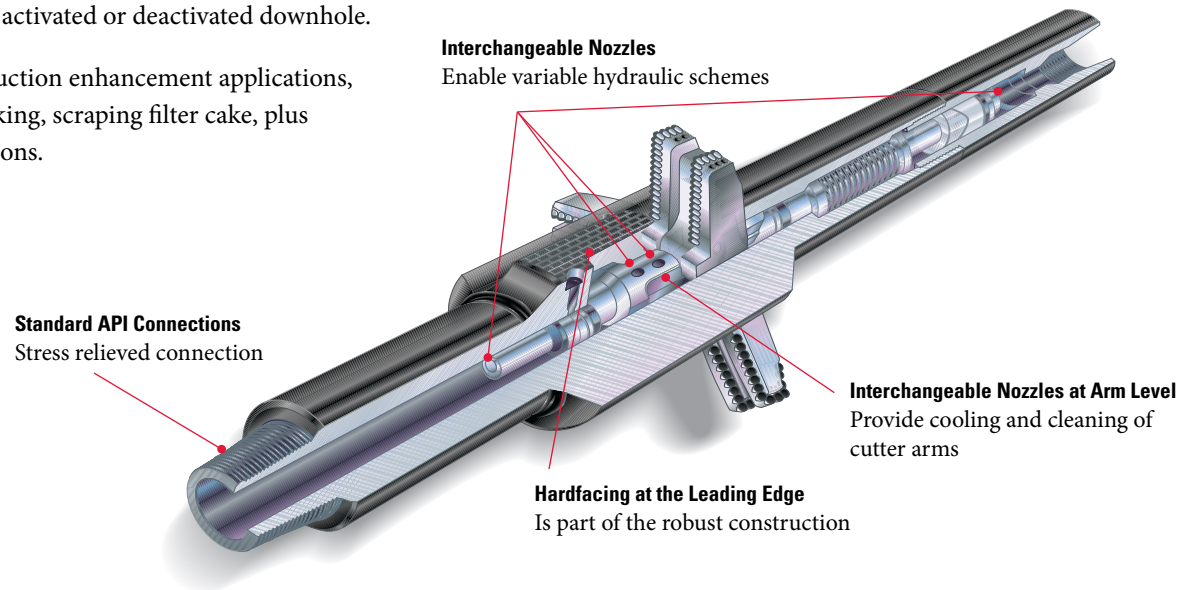
Gulf of Mexico: Outstanding Product Performance

- Halliburton NBR 800 tool
- Successfully enlarged the entire section of the well in a single run with excellent directional control
- Estimated cost savings of \$59,000 in rig time alone for the customer, by eliminating a trip to pick up a second enlargement tool

UR™ (UnderReamer) Tool

The UR™ tool is a heavy-duty tool for enlarging the borehole up to two times the pilot hole diameter. It offers a variety of completion options, since it can be selectively activated or deactivated downhole.

The UR tool can be used for production enhancement applications, expanding the hole for gravel packing, scraping filter cake, plus underground gas storage applications.



Australia: Successful under reaming of 450 m (1,476 ft) of coal

- Halliburton UR 800 tool
- Reaming of the 8 3/4-in. pilot hole to 12 1/4 in. was successfully conducted to 1100 m
- Rate of penetration of 40 m/hr
- The UR 800 tool successfully under reams 450 m (1,476 ft) of coal in a Coal Seam Gas well.



Single Piece Hole Opener (SPHO)

The SPHO is an enhanced version of a PDC concentric hole opener. During or after drilling, the SPHO enlarges the pilot hole. The SPHO features an optimized cutting structure, single piece construction, a self-stabilized body, and interchangeable nozzles.

Optimized Cutting Structure

Designed using force and torque balancing technology

Self-Body Stabilization

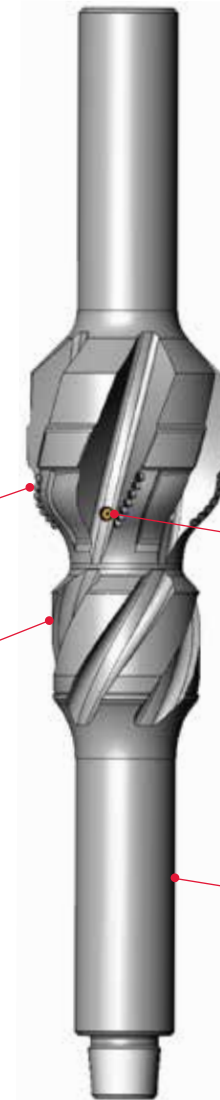
Is integrated with the tool so that no extra stabilization is required when the SPHO is added to the BHA

Interchangeable Nozzles at Arm Level

Provide cooling and cleaning of cutter arms

Single Piece Structure

Milled from a single steel bar-heat treatment is used to make sure the material has proper hardness and structural integrity



Resources

API Casing Dimensions

Recommended
Make-Up Torque

API Tolerances and
TFA Values

IADC Dull Grading

Roller Cone Ring
Gauging

Local Representatives





API CASING DIMENSIONS								
CASING SIZE O.D. IN.	CASING COUPLING O.D. IN.	NORMAL WEIGHT LBS/FT.	INSIDE DIAMETER I.D. IN.	API DRIFT I.D. IN.	ROLLER CONE BIT SIZE O.D.		FIXED CUTTER BIT SIZE O.D.	
					IN.	DEC.	IN.	DEC.
4-1/2*	5.000	9.50	4.090	3.965	3-7/8	3.875	3-7/8	3.875
4.500*	5.000	10.50	4.052	3.927	3-7/8	3.875	3-7/8	3.875
	5.000	11.60	4.000	3.875	3-7/8	3.875	3-7/8	3.875
	5.000	13.50	3.920	3.795	3-3/4	3.750	3-3/4	3.750
	5.563	11.50	4.560	4.435	3-7/8	4.375	3-7/8	4.375
5	5.563	13.00	4.494	4.369	3-7/8	4.250	3-7/8	4.250
	5.563	15.00	4.408	4.283	3-7/8	4.250	3-7/8	4.250
	5.563	18.00	4.276	4.151	3-7/8	4.125	3-7/8	4.125
	6.050	14.00	5.012	4.887	4-3/4	4.750	4-3/4	4.750
5-1/2	6.050	15.50	4.950	4.825	4-3/4	4.750	4-3/4	4.750
	6.050	1700	4.892	4.767	4-3/4	4.750	4-3/4	4.750
	6.050	20.00	4.778	4.653	3-7/8	4.500	3-7/8	4.500
	6.050	23.00	4.670	4.545	3-7/8	4.500	3-7/8	4.500
6-5/8	7.390	20.00	6.049	5.924	5-7/8	5.875	5-7/8	5.875
	7.390	24.00	5.921	5.796	4-3/4	4.750	4-3/4	4.750
	7.390	28.00	5.791	5.666	4-3/4	4.750	4-3/4	4.750
	7.390	32.00	5.675	5.550	4-3/4	4.750	4-3/4	4.750
7	7.656	17.00	6.538	6.413	6-1/4	6.250	6-1/4	6.250
	7.656	20.00	6.456	6.331	6-1/4	6.250	6-1/4	6.250
	7.656	23.00	6.366	6.241	6-1/8	6.125	6-1/8	6.125
	7.656	26.00	6.276	6.151	6-1/8	6.125	6-1/8	6.125
7.000	7.656	29.00	6.184	6.059	6	6.000	6	6.000
	7.656	32.00	6.094	5.969	5-7/8	5.875	5-7/8	5.875
	7.656	35.00	6.004	5.879	5-7/8	5.875	5-7/8	5.875
	7.656	38.00	5.920	5.795	4-3/4	4.750	4-3/4	4.750
	8.500	20.00	7.125	7.000	6-3/4	6.750	6-3/4	6.750
	8.500	24.00	7.025	6.900	6-3/4	6.750	6-3/4	6.750
	8.500	26.40	6.969	6.844	6-3/4	6.750	6-3/4	6.750
	8.500	29.70	6.875	6.750	6-3/4	6.750	6-3/4	6.750
7-5/8	8.500	33.70	6.765	6.640	6-1/2	6.500	6-1/2	6.500
	8.500	39.00	6.625	6.500	6-1/2	6.500	6-1/2	6.500
	9.625	24.00	8.097	7.972	7-7/8	7.875	7-7/8	7.875
	9.625	38.00	8.017	7.892	7-7/8	7.875	7-7/8	7.875
8-5/8	9.625	32.00	7.921	7.796	6-3/4	6.750	6-3/4	6.750
	9.625	36.00	7.825	7.700	6-3/4	6.750	6-3/4	6.750
	9.625	40.00	7.725	7.600	6-3/4	6.750	6-3/4	6.750

NOTE: For API casing data regarding the above information, refer to Toolpusher's Manual or specific manufacturer's specifications. * Roller Cone bits are not currently available for this casing size

API CASING DIMENSIONS								
CASING SIZE O.D. IN.	CASING COUPLING O.D. IN.	NORMAL WEIGHT LBS/FT.	INSIDE DIAMETER I.D. IN.	API DRIFT I.D. IN.	ROLLER CONE BIT SIZE O.D.		FIXED CUTTER BIT SIZE O.D.	
					IN.	DEC.	IN.	DEC.
9-5/8	9.625	44.00	7.625	7.500	6-3/4	6.750	6-3/4	6.750
	9.625	49.00	7.511	7.386	6-3/4	6.750	6-3/4	6.750
9-5/8	10.625	29.30	9.063	8.907	8-3/4	8.750	8-3/4	8.750
9.625	10.625	32.30	9.001	8.845	8-3/4	8.750	8-3/4	8.750
	10.625	36.00	8.921	8.765	8-3/4	8.750	8-3/4	8.750
	10.625	40.00	8.835	8.679	8-1/2	8.500	8-1/2	8.500
	10.625	43.50	8.755	8.599	8-1/2	8.500	8-1/2	8.500
	10.625	47.00	8.681	8.525	8-1/2	8.500	8-1/2	8.500
	10.625	53.50	8.535	8.379	8-3/8	8.375	8-3/8	8.375
10-3/4	11.750	32.75	10.192	10.036	9-7/8	9.875	9-7/8	9.875
10.750	11.750	40.50	10.050	9.984	9-7/8	9.875	9-7/8	9.875
	11.750	45.50	9.950	9.794	9-1/2	9.500	9-1/2	9.500
	11.750	51.00	9.850	9.694	9-1/2	9.500	9-1/2	9.500
	11.750	55.50	9.760	9.604	9-1/2	9.500	9-1/2	9.500
	11.750	60.70	9.660	9.504	9-1/2	9.500	9-1/2	9.500
	11.750	65.70	9.560	9.404	8-3/4	7.750	8-3/4	7.750
11-3/4	12.750	42.00	11.084	10.928	10-5/8	10.625	10-5/8	10.625
11.750	12.750	47.00	11.000	10.844	10-5/8	10.625	10-5/8	10.625
	12.750	54.00	10.880	10.724	10-5/8	10.625	10-5/8	10.625
	12.750	60.00	10.772	10.616	9-7/8	9.875	9-7/8	9.875
13-3/8	14.375	48.00	12.715	12.559	12-1/4	12.250	12-1/4	12.250
13.375	14.375	54.50	12.615	12.459	12-1/4	12.250	12-1/4	12.250
	14.375	61.00	12.515	12.359	12-1/4	12.250	12-1/4	12.250
	14.375	68.00	12.415	12.259	12-1/4	12.250	12-1/4	12.250
	14.375	72.00	12.347	12.191	11	11.000	11	11.000
16	17.000	65.00	15.250	15.062	14-3/4	14.750	14-3/4	14.750
16.000	17.000	75.00	15.124	14.936	14-3/4	14.750	14-3/4	14.750
	17.000	84.00	15.015	14.822	14-3/4	14.750	14-3/4	14.750
18-5/8	20.000	87.50	17.755	17.567	17-1/2	17.500	17-1/2	17.500
18.625	-	-	-	-	-	-	-	-
20	21.000	94.00	19.124	18.936	17-1/2	17.500	17-1/2	17.500
20.000	21.000	106.50	19.000	18.812	17-1/2	17.500	17-1/2	17.500
	21.000	133.00	18.730	18.542	17-1/2	17.500	17-1/2	17.500
	21.000	169.00	18.376	18.188	17-1/2	17.500	17-1/2	17.500

NOTE: For API casing data regarding the above information, refer to Toolpusher's Manual or specific manufacturer's specifications. * *Roller Cone bits are not currently available for this casing size*

RECOMMENDED MAKE-UP TORQUE—FIXED CUTTER BITS

CONNECTION IN.	MAX. PIN I.D. IN.	BIT SUB O.D. IN.	MIN. MAKE-UP TORQUE	CONNECTION IN.	MAX. PIN I.D. IN.	BIT SUB O.D. IN.	MIN. MAKE-UP TORQUE
2-3/8 (API Reg.)	1	3	1,793*	6-5/8 (API Reg.)	3	8-1/4	43,525
		3-1/8	2,422*			7-1/2	37,119*
		3-1/4	3,069*			7-3/4	40,753
2-7/8 (API Reg.)	1-1/4	3-1/2	3,071*			8	41,114
		3-3/4	4,620			8-1/4	41,114
		3-7/8	4,662	7-5/8 (API Reg.)	3-1/4	8-1/2	41,474
3-1/2 (API Reg.)	1-1/2	4-1/8	5,173*			8-3/4	48,321*
		4-1/4	6,309*			9	57,735
		4-1/2	7,665			9-1/4	67,386
		5-1/2	12,461*			9-1/2	67,908
4-1/2 (API Reg.)	2-1/4	5-3/4	16,488*	7-5/8 (API Reg.)	3-1/2	8-1/2	68,431
		6	17,560			8-3/4	48,321*
		6-1/4	17,766			9	57,735*
4-1/2 (I.F. Box)	2-1/4	6-1/2	23,743*			9-1/4	63,824
		7	30,941			9-1/2	64,318
		8	32,169	8-5/8 (API Reg.)	3-1/2	9-3/4	64,813
6-5/8 (API Reg.)	2-13/16	7-1/2	37,119*			10	97,229
		7-3/4	42,769			10-1/4	98,012
		8	43,147			10-1/2	98,725
							99,437

RECOMMEND MAKE-UP TORQUE—ROLLER CONE BITS*

BIT SIZE IN.	TOOL-JOINT TYPE IN.	RECOMMENDED TORQUE FT/LBS	RECOMMENDED TORQUE JOULES
4-3/4	2-7/8	4500/5500	6102/7458
5-7/8 to 7-3/8	3-1/2	7000/9000	9492/12204
7-5/8 to 8-3/4	4-1/2	12000/16000	16272/21696
9-1/2 to 13-3/4	6-5/8	28000/32000	37968/43392
14-3/4 to 28	7-5/8	34000/40000	46104/54240

NOTE: The tool joint type for the 14-3/4 to 17-1/2 in. rock bit range is either 6-5/8 or 7-5/8 in. per API Reg.

*Calculations based on recommendations from API and tool joint manufacturers.

API Tolerances and TFA Values

API STANDARD ROLLER CONE BIT TOLERANCES	
BIT SIZE (IN.)	O.D. TOLERANCE (IN.)
6-3/4 and smaller	-0.0 to +1/32
6-25/32 to 9	-0.0 to +1/32
9-1/32 to 13-3/4	-0.0 to +1/32
13-25/32 to 17-1/2	-0.0 to +1/16
17-17/32 and larger	-0.0 to +3/32

API STANDARD FIXED CUTTER BIT TOLERANCES	
BIT SIZE (IN.)	O.D. TOLERANCE (IN.)
6-3/4 and smaller	-0.015 to +0.00
6-25/32 to 9	-0.020 to +0.00
9-1/32 to 13-3/4	-0.030 to +0.00
13-25/32 to 17-1/2	-0.045 to +0.00
17-17/32 and larger	-0.063 to +0.00

TFA VALUES OF COMMON NOZZLE SIZES										
NOZZLE SIZE IN.	NUMBER OF NOZZLES									
	1	2	3	4	5	6	7	8	9	10
7/32	0.0376	0.0752	0.1128	0.1504	0.1880	0.2256	0.2632	0.3007	0.3382	0.3758
8/32	0.0491	0.0982	0.1473	0.1964	0.2455	0.2946	0.3437	0.3927	0.4418	0.4909
9/32	0.0621	0.1242	0.1863	0.2484	0.3105	0.3728	0.4349	0.4970	0.5591	0.6213
10/32	0.0767	0.1534	0.2301	0.3068	0.3835	0.4602	0.5369	0.6136	0.6903	0.7670
11/32	0.0928	0.1856	0.2784	0.3712	0.4640	0.5568	0.6496	0.7424	0.8353	0.9281
12/32	0.1104	0.2208	0.3312	0.4418	0.5522	0.6627	0.7731	0.8836	0.9940	1.1045
13/32	0.1296	0.2592	0.3888	0.5184	0.6480	0.7776	0.9072	1.0370	1.1666	1.2962
14/32	0.1503	0.3006	0.4509	0.6012	0.7515	0.9020	1.0523	1.2026	1.3530	1.5033
15/32	0.1726	0.3452	0.5178	0.6904	0.8630	1.0354	1.2080	1.3806	1.5532	1.7257
16/32	0.1963	0.3926	0.5889	0.7854	0.9817	1.1781	1.3744	1.5708	1.7671	1.9635
17/32	0.2217	0.4433	0.6650	0.8866	1.1083	1.3300	1.5516	1.7733	1.9949	2.2166
18/32	0.2485	0.4970	0.7455	0.9940	1.2425	1.4910	1.7395	1.9880	2.2365	2.4850
19/32	0.2769	0.5538	0.8307	1.1076	1.3845	1.6614	1.9382	2.2151	2.4920	2.7688
20/32	0.3068	0.6136	0.9204	1.2272	1.5340	1.8408	2.1476	2.4544	2.7612	3.0680
21/32	0.3382	0.6764	1.0115	1.3530	1.6912	2.0295	2.3677	2.7059	3.0442	3.3824
22/32	0.3712	0.7424	1.1136	1.4848	1.8560	2.2272	2.5986	2.9698	3.3410	3.7122
24/32	0.4418	0.8836	1.3254	1.7671	2.2089	2.6507	3.0925	3.5343	3.9761	4.4179
26/32	0.5185	1.0370	1.5555	2.0739	2.5924	3.1109	3.294	4.1479	4.6664	5.1849
28/32	0.6013	1.2026	1.8040	2.4053	3.0066	3.6079	4.2092	4.8106	5.4119	6.0132



IADC Dull Grading

CUTTING STRUCTURE							
INNER ROWS	OUTER ROWS	DULL CHAR.	LOCATION	BEARINGS/SEALS	GAUGE	OTHER DULL CHAR.	REASON PULLED
1	2	3	4	X	6	7	8

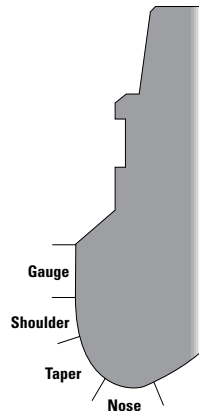
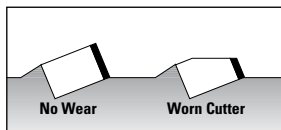
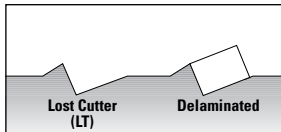
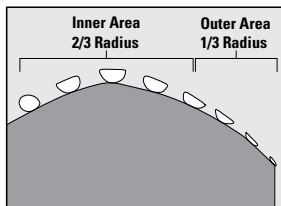
1 INNER CUTTING STRUCTURE

2 OUTER CUTTING STRUCTURE

A measure of lost, worn, and/or broken cutting structure.

Linear Scale: 0-8

- 0 - No lost, worn and/or broken cutting structure
- 8 - All of cutting structure lost, worn and/or broken



3 DULL CHARACTERISTICS

- BF - Bond Failure
- BT - Broken Cutters
- BU - Balled Up
- CR - Cored
- CT - Chipped Cutters
- DL - Delaminated Cutters
- ER - Erosion
- HC - Heat Checking
- JD - Junk Damage
- LM - Lost Matrix
- LN - Lost Nozzle
- LT - Lost Cutters
- NO - No Dull Characteristics
- NR - Not Rerunnable
- PN - Plugged Nozzle/Flow Passage
- RO - Ring Out
- RR - Rerunnable
- WO - Washed Out
- WT - Worn Cutters

4 LOCATION

- C - Cone
- S - Shoulder
- N - Nose
- G - Gauge
- T - Taper
- A - All Areas

5 BEARINGS/SEALS

N/A

6 GAUGE

- I - In Gauge
- 1 - 1/16" Out of Gauge
- 2 - 1/8" Out of Gauge
- 4 - 1/4" Out of Gauge

7 OTHER DULL CHARACTERISTICS

(Refer to column 3 codes)

8 REASON PULLED OR RUN TERMINATED

- BHA - Change Bottom Hole Assembly
- CM - Condition Mud
- CP - Core Point
- DMF - Downhole Motor Failure
- DP - Drill Plug
- DSF - Drill String Failure
- DST - Drill Stem Test
- DTF - Down Hole Tool Failure
- FM - Formation Change
- HP - Hole Problems
- HR - Hours on Bit
- LH - Left in Hole
- LOG - Run Logs
- PP - Pump Pressure
- PR - Penetration Rate
- RIG - Rig Repair
- TD - Total Depth/Casing Depth
- TQ - Torque
- TW - Twist Off
- WC - Weather Conditions
- WO - Washout in Drill String

Halliburton's fixed cutter bits are tip ground to exacting tolerances at gauge O.D. per API spec 7. Depending on the specific design and application, as much as .080 of an inch of the cutter diameter may be ground flat. This can be mistaken for gauge wear if unfamiliar with our products. Please ensure that the dull bits are in gauge with a calibrated No Go ring gauge.

IADC Dull Grading

CUTTING STRUCTURE							
INNER ROWS	OUTER ROWS	DULL CHAR.	LOCATION	BEARINGS/SEALS	GAUGE	OTHER DULL CHAR.	REASON PULLED
1	2	3	4	X	6	7	8

1 INNER CUTTING STRUCTURE

All inner rows

2 OUTER CUTTING STRUCTURE

(Gauge row only)

In columns 1 and 2, a linear scale from 0 to 8 is used to describe the condition of the cutting structure according to the following:

Steel Tooth Bits

A measure of lost tooth height due to abrasion and/or damage.

0 - No loss of tooth height

8 - Total loss of tooth height

Insert Bits

A measure of total cutting structure reduction due to lost, worn and/or broken inserts.

0 - No lost, worn and/or broken inserts

8 - All inserts lost, worn and/or broken

3 DULL CHARACTERISTICS

(Use only cutting structure related codes)

BC - Broken Cone*	LT - Lost Teeth
BT - Broken Teeth	NO - No Dull Characteristic
BU - Balled Up	NR - Not Rerunnable
CC - Cracked Cone*	OC - Off Center Wear
CD - Cone Dragged*	PB - Pinched Bit
CI - Cone Interference	PN - Plugged Nozzle/Flow Passage
CR - Cored	RG - Rounded Gauge
CT - Chipped Teeth	RO - Ring Out
ER - Erosion	RR - Rerunnable
FC - Flat Crested Wear	SD - Shirttail Damage
HC - Heat Checking	SS - Self-Sharpening Wear
JD - Junk Damage	TR - Tracking
LC - Lost Cone*	WO - Washed Out Bit
LN - Lost Nozzle	WT - Worn Teeth

4 LOCATION

- C - Cone
- S - Shoulder
- N - Nose
- G - Gauge
- T - Taper
- A - All Areas

5 BEARINGS/SEALS

Non-Sealed Bearings

A linear scale estimating bearing life used.

0 - No life used

8 - All life used, i.e. no bearing life remaining

Sealed Bearings

E - Seals Effective

F - Seals Failed

N - Not Able To Grade

6 GAUGE

(Measure in fractions of an inch)

I - In Gauge

1 - 1/16" Out of Gauge

2 - 1/8" Out of Gauge

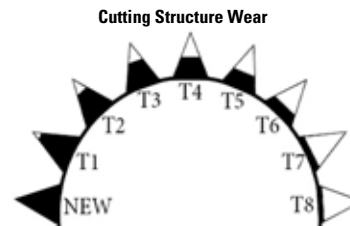
4 - 1/4" Out of Gauge

7 OTHER DULL CHARACTERISTICS

(Refer to Column 3 codes)

8 REASON PULLED OR RUN TERMINATED

- BHA - Change Bottom Hole Assembly
- CM - Condition Mud
- CP - Core Point
- DMF - Downhole Motor Failure
- DP - Drill Plug
- DSF - Drill String Failure
- DST - Drill Stem Test
- DTF - Downhole Tool Failure
- FM - Formation Change
- HP - Hole Problems
- HR - Hours on Bit
- LIH - Left In Hole
- LOG - Run Logs
- PP - Pump Pressure
- PR - Penetration Rate
- RIG - Rig Repair
- TD - Total Depth/Casing Depth
- TQ - Torque
- TW - Twist Off
- WC - Weather Conditions
- WO - Washout in Drill String



* Show cone # or #'s under location 4.

Cone numbers are identified as follows:

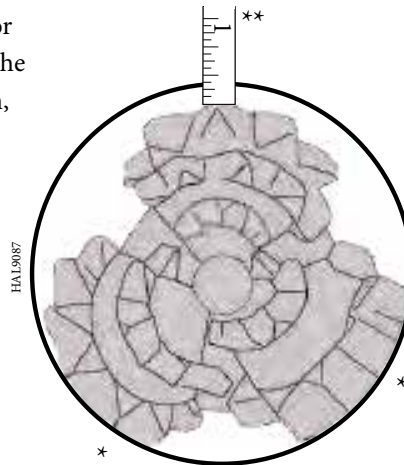
- The number one cone contains the center most cutting element.
- Cones two and three follow in a clockwise orientation as viewed looking down at the cutting structure with the bit sitting on the pin.



Roller Cone Ring Gauging

Dull Three Cone Bits

- ❶ Obtain a nominal size ring gauge. A nominal ring gauge is one that is exact in size. For example, a 12-1/4-in. ring gauge is 12-1/4-in. exactly.
- ❷ Rotate all cones so that one of the gauge teeth on each cone is at the maximum gauge point.* (Remember, soft formation bits with large offsets have the maximum gauge points on each cone located towards the leading side of the cone).
- ❸ Place the ring gauge over the bit and locate it at the maximum gauge point.
- ❹ Pull the ring gauge tight against the gauge points of two cones as shown.
- ❺ Measure the gap between the third cone's gauge point and the ring gauge.**
- ❻ Multiply this measurement by 2/3 for accuracy. This result is the amount the bit is under gauge. In the illustration, for example, measurement shows 3/8-in., while the bit is actually 1/4-in. out of gauge.
- ❼ Report this amount to the nearest 1/16th of an inch.



Sharp Bits

- ❶ When ring gauging a sharp (new) roller cone bit, a nominal ring gauge might not fit over the cones due to the “plus” tolerances. Obtain the appropriate Go and No Go gauges for each bit size.
- ❷ The Go gauge is manufactured to the maximum roller cone bit tolerance (see API Standard Roller Cone Rock Bit Tolerances) plus its own tolerance +.003 to -0 in. for clearance.
- ❸ The No Go gauge is manufactured to the minimum roller cone bit tolerance, which is nominal bit diameter, plus its own tolerance +0- to -.003-in.

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