



Hughes Christensen
DRILL BIT CATALOG



Hughes Christensen

Total Value Package

For 100 years, Hughes Christensen, a Baker Hughes Product Center, has been on the leading edge of drilling technology and innovation. And although it's true we deliver the best bit in the industry, that's only part of the total solution we provide. We constantly search for new ways to provide our customers value that will enhance their business. Unique programs like our Drilling, Application Review Teams (DART) bring a multifunctional perspective to our customers' specific challenges. State-of-the-art facilities like our full-scale research rig and downhole simulator ensure new ideas like Vanguard and Quantec bits are optimized for our customers' applications. You get a total value package from Hughes Christensen. Every product comes with the comprehensive knowledge and informed recommendations of our experts, delivering maximum advantage and value.



Hughes Two-Cone Drill Bit designated a Historic Mechanical Engineering Landmark by The American Society of Mechanical Engineers.

A Century of Innovation

After a century of innovation and engineering excellence, we're barely getting started. You won't believe what the next century has in store.



1909

First Two-Cone Bit

Howard Robard Hughes, Sr., invents the first two-cone drill bit, allowing drillers to tap vast reservoirs of oil deep below the surface. The US Patent Office issues a patent, dated August 10, 1909. The Hughes Tool Company is incorporated in 1915.

1933

First Three-Cone Bit

Hughes Tool Company introduces the first three-cone drill bit with interfitting teeth. The bit is branded Tricone™, which, with numerous improvements, remains the industry standard.

1947

First Diamond in Oil Field

Christensen Diamond Products introduces the first surface-set natural diamond core bit in the Rangely field, Rangely, Colorado. The smooth abrasive cutting action captures a greater amount of softer rock.

1951

First Tungsten Carbide Insert Bit

Hughes Tool Company introduces the Hugheset bit for hard, abrasive formations, the world's first tungsten carbide insert bit. The R-1 drills these tough formations faster than conventional Tricone bits with 3 to 10 times the footage.

1952

First Natural Diamond Drill Bit

Christensen Diamond Products introduces the first noncoring surface-set natural diamond bit for the oilfield. A proprietary erosion-resistant matrix with a unique infiltration-powder metallurgy process enables this step change in drill bit technology, including enhanced hydraulics.

1970

First Tricone Bit with O-ring Sealed Journal Bearings

Hughes Tool Company introduces the first three-cone bit with an O-ring-sealed journal bearing, dramatically improving bit life. The longer-lasting bearing with special alloy inlays now matches the more durable cutting structure for greater wear resistance.



The right bit for the right application.

Hughes Christensen has always prided itself in offering the greatest value to our customer through a combination of product performance and service. To better deliver the right drilling solution for our customers' specific applications we offer three levels of product line, each tailored to a combination of a well's complexity, cost and customer expectations. Our goal is to provide a wide range of drill bit technologies and services that deliver the best value across the full market spectrum of customer needs.

- Platinum Line** Superior performance in difficult applications
- Classic Line** Field proven, competitive technology
- Standard Line** Economic performance in less challenging conditions

	Platinum Line	Classic Line	Standard Line
Application Difficulty	Difficult	Normal	Low
Drilling Cost	High	Average	Low
Customer Expectations	Superior Perf.	Competitive	Adequate
Service Level	Highest	High	Minimum

Contents

2	Application Engineering
2	Application Engineering
2	Oasis Certification
2	Drill Bit Optimization
3	Drillability Analyses
3	Knowledge Management
4	Innovation and Technology
4	Solid Modeling Design
4	FEA Finite Element Analysis
4	Materials Research
5	Drilling Technology Laboratory
5	BETA Baker Hughes Experimental Test Area
5	Product Evaluation Laboratory
6	Diamond Products
7	Product Line - Nomenclature
8	Platinum Bits
10	Classic Bits
12	Standard Bits
13	Specialty Products
18	Specifications
19	Diamond Optional Features
20	Tricone Products
21	Product Line
22	Platinum Bits
24	Classic Bits
26	Standard Bits
27	Special Application Bits
28	Technical Data - Nomenclature
29	Size and Weight
30	IADC Bit Classification
32	Technical Data
33	Tricone Optional Features
34	Sales and Terms
34	Sales Offices
36	Terms and Conditions

1976

First Commercially Successful PDC Bit

Christensen introduces the first polycrystalline diamond compact (PDC) drill bit with a successful cutter mounting system.

1987

First Metal-Sealed-Bearing

Hughes Tool Company introduces ATM, the first metal-seal roller cone bit for highspeed, high-temperature applications. All sliding wear occurs between the lowfriction surfaces of the seal ring, enhancing bit life in tough drilling conditions.

2000

First Ream While Drilling Tool

First device allowing operators to drill out cement, then continue to drill and ream the formation interval in one run.

2003

Depth-of-Cut Control Technology for PDC Bits

Hughes Christensen introduces EZSteer which improves toolface control in directional drilling applications, tempering aggressiveness when steering and preserving ROP while rotating.

2005

First Steel Casing Bit System

Hughes Christensen introduces a new casing bit system that gets casing/liners to bottom by reaming through tight spots and extending open hole intervals faster.

Application Engineering

For 100 years Hughes Christensen has been in the forefront providing customers engineering services which improve drilling performance and lower drilling costs.

With the introduction of OASIS premier engineering and consulting services ten years ago, Hughes Christensen again set the industry standard for applying detailed analysis of the entire drilling system, offset data and down hole conditions to help identify opportunities to further improve drilling performance. Today, our Application Engineering Services continue a tradition of continuous improvement. We are committed to deliver consistent results through the precise application of expertise and technology at a level none of our competitors can match.



OASIS Certification

With considerable investments of time, resources, and capital at stake, our customers rightly insist on a level of service that inspires confidence. They demand engineers who can speak intelligently about the drilling process from end to end, contribute valid and valuable knowledge on demand, and communicate comfortably with the on-site team.

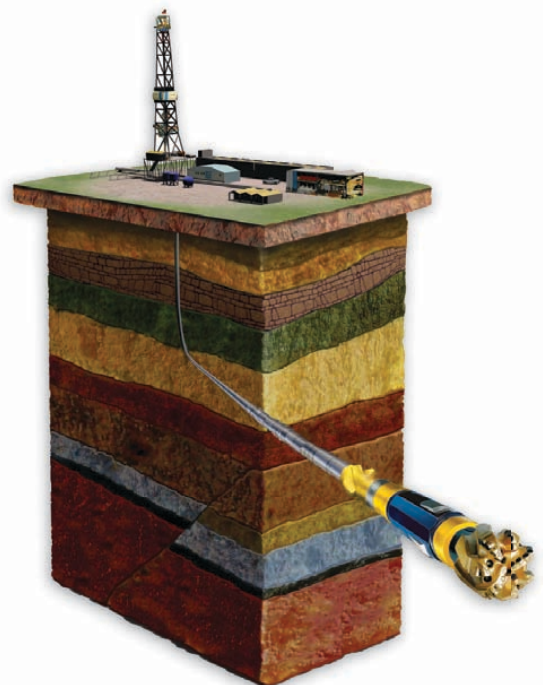
Comprehensive competency and skill mapping combined with mentored training ensures that OASIS certified engineers provide the most consistent, reliable engineering service to our customers around the world.

Drill Bit Optimization

Ultimately, this process comes down to matching the right drill bit to the environment and drilling system. Optimum bit performance demands a complete understanding of the drilling environment and the principles at work.

Engineers specializing in Drill Bit Optimization possess the analytical skill to evaluate drilling problems in a methodical fashion, carefully considering the larger context of the drilling process. Engineers examine the drilling operation from every angle to identify factors that might influence bit performance. By understanding the symptoms and accurately diagnosing the root causes, drilling problems are corrected at the source.

Armed with a complete picture of the drilling environment, the drill bit optimization engineer can match ideal drilling and bit technologies to customer specific applications and objectives.



Drillability Analyses

As drilling tools and methods grow more varied and complex, engineers require better and more sophisticated tools to help them distill all of the variables into a more accessible, more easily understandable range of options.

Webits: An accumulated data base of bit performance records. It captures a wealth of basic well information useful in project planning.

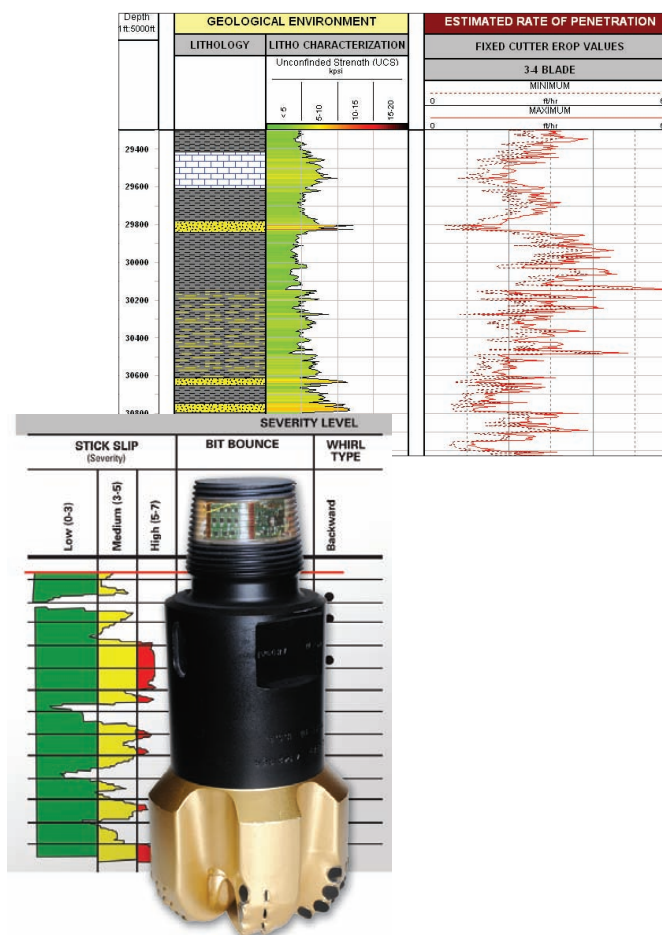
Rocky: This rock mechanics software package evaluates the lithology of a drilling environment, calculates formation strengths and estimates drilling efficiency.

Estimate ROP (EROP): This proprietary analytical tool predicts rates of penetration based on lithology, formation strength and drilling parameters that can be used to make drilling performance decisions.

Drill Bit Advisor (DBA): The industry's leading rule-based expert system uses complex decision trees that analyze raw drilling and well log data to recommend the ideal bit design.

BHASYS Pro: This BHA modeling software performs complex static and dynamic calculations to construct an ideal bottom-hole assembly for any given drilling environment.

DataBit: An exclusive drilling dysfunction identification module, is an in-bit recording device for detecting performance-killing vibration. It delivers decision support for optimized performance, system reliability and improved economics.



DataBit in-bit recording device

Knowledge Management

A knowledge base of practical field experience, lessons learned, and best practices helps our application engineers bring proven solutions and global perspective to our customers' specific applications.

Application Knowledge Store (AKS): This proprietary resource captures and retains case-specific product performance data, practical lessons learned and detailed information on applied technology that is accessible worldwide for optimizing performance solutions.

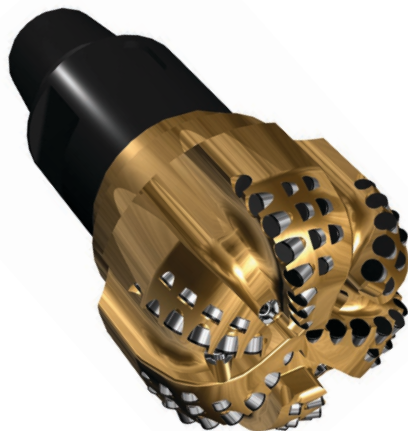
Drilling Performance Guidelines (DPG): A dynamic, highly structured knowledge base of universal best practices is used daily by our drilling personnel in the provision of best drilling performance.



World Oil magazine Data Management award

Innovation and Technology

Since we introduced the first rotary rock bit, our research and development programs have been responsible for the systematic advancement of drill bit technology. Over 1200 patents awarded the company over the last 100 years accounts for our products being recognized around the world as the industry standard. Today, our culture is based on a philosophy of continuous improvement. We are constantly searching for more effective ways to provide our customers the highest quality products and value added service.

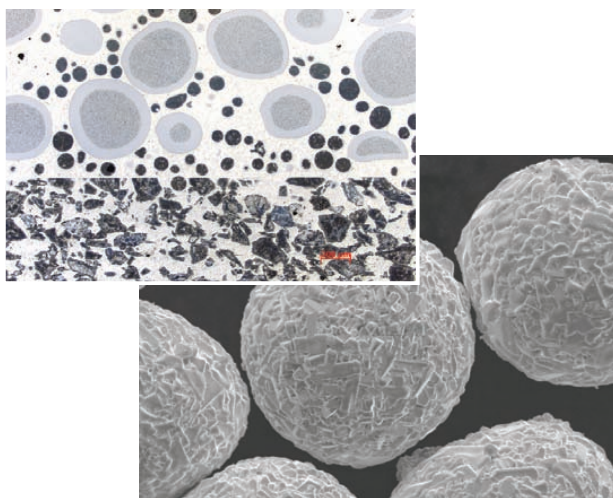
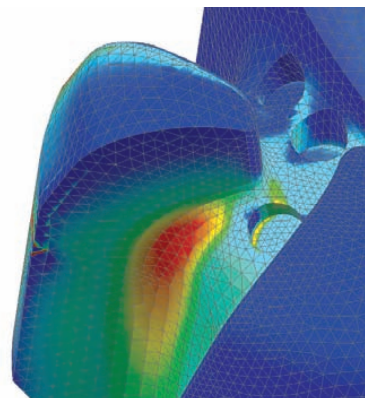


Solid modeling design

Our PDC and Tricone bits begin life on our engineering teams' desktops. Customized 3D solid-modeling CAD systems enable us to refine each design iteration through visual inspection. We seamlessly transfer the product model to customized analysis tools that further enhance development. The CAD system then generates drawings for production from the final product model. Using CAM technology, numerically controlled programs are generated from the solid model to drive the machine tools. Computerized simulations continuously check the programs to ensure error-free information reaches the shop floor.

Finite Element Analysis (FEA)

Our engineers use FEA to model stress and strain in hard metals, elastomers, and rock-like materials for greater bit durability. We can predict cutting structure failures so you receive a continuously improved product. In Tricone bits, FEA enables understanding of bearing contact stress for new bearing geometries, carbide tooth stress for more durable tungsten carbide inserts, and carbide grade differences for better materials. In PDC bits, FEA enables us to move harmful residual stress away from the PDC cutters' edge, significantly increasing cutter life.



Materials research

We continuously monitor the strength and fracture toughness of our Tricone and PDC drill bit materials to lower your cost-per-foot drilled while improving durability and longevity. This work has enabled us to introduce improved grease, bearings, and seals for Tricone bits and improved matrix body materials and PDC cutters for diamond bits. Analytical tools, including acoustic, electron, and optical microscopes are part of our phase and fracture-surface studies.



Drilling Technology Laboratory

Many of Hughes Christensen's advances in improving penetration rate and fine-tuning performance features of drill bits are tested and evaluated at our high-pressure drilling test facility. With our full-scale drilling simulator, where we bring the field to the laboratory, the research and development cycle that once took months in the field has been reduced to days. The drilling simulator, which is capable of testing bits up to 12 1/4-in. diameter, reproduces the harsh downhole environment to enable our researchers to accurately assess and compare the performance of new designs, as well as standard products.

Baker Hughes Experimental Test Area (BETA)

Located in an oil field near Tulsa, Oklahoma, BETA brings field-proven technology to your operations faster while reducing the risk of using unproven tools in your well. This is a unique resource for testing in a range of geological formations a variety of drilling, completion, and production tools on a full-scale rig. All of the real-time data and information, including a rig floor video, are available on the Baker Hughes intranet for immediate analysis.



Product Evaluation Laboratory

In this laboratory, we diagnose product wear and failure modes to determine the causes for the various dull bit conditions and to identify opportunities for performance-enhancing features and design improvements. Our engineers literally "autopsy" bits, conducting top to bottom forensic examinations of cutting structures, bearings, seals, and other bit elements. The laboratory closes the loop of our total commitment to your drilling success.

PDC Diamond Drill Bits

PLATINUM | CLASSIC | STANDARD

Hughes Christensen line of PDC bits with advanced technology and a revolutionary design process achieves maximum performance in a defined application.



Product Lines

Platinum Drill Bits

Quantec™ PDC (Q) Our most advanced bits utilize diamond volume management (DVM), superior cutters, optimized hydraulics and a unique stability technology.

Quantec Force™ PDC (QF) A new generation of cutter and stabilization technology delivers supreme performance in a wide range of environments.

Classic Drill Bits

Genesis ZX™ (HC-ZX) The ZX product line adds Zenith-series cutters and secondary cutting elements to the Genesis product to help you drill further, faster.

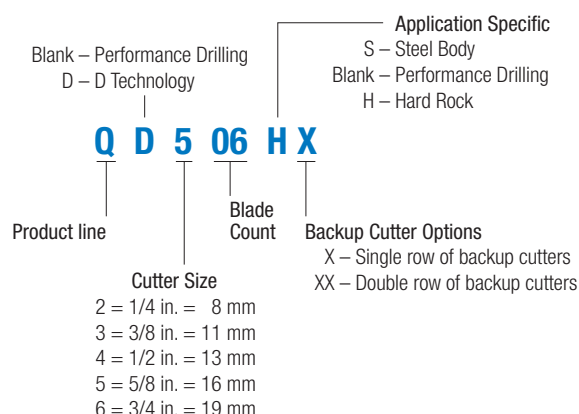
Genesis XT™ (HC-Z) PDC bits with advanced abrasion-resistant Zenith-series cutters advance PDC bits into interbedded formations.

Genesis™ (HC) A premium line of PDC bits that utilize advanced technology and a revolutionary design process to achieve maximum performance in a defined application.

Standard Drill Bits

Triton™ PDC (FC) Our modestly priced bit delivers reliable performance and a quality bore hole.

Nomenclature



Product Line Prefix

- Q** Quantec
- HC** Genesis Technology
- FC** Triton

Product Line Suffix

- F** Force Series of Quantec
- Z** Zenith Series Cutters

Specialty Products

GaugePro™ (XPR) A expandable, concentric hole-opening system that drills and reams simultaneously with minimal vibration and superior hole quality.

EZCase™ (Ezc) A line of PDC bits designed to ream and drill new formations on liner or casing.

EZReam™ (EZR) The industry's only steel reaming shoe that is PDC drillable.

RWD2™ (RWD2) The line of ream-while-drilling tools is designed for specific hole-opening applications at a fraction of the cost and without the risks associated with bicenter bits and conventional underreamers.

HedgeHog (HH) A full line of impregnated diamond bits designed to drill the hardest and most abrasive drilling formations.

Natural Diamond (D, T) Surface set with natural diamonds of various grades and concentrations to drill a variety of harder, more abrasive formations.

BallaSet (S) Utilizes thermally stable polycrystalline diamond cutters to drill medium-to-hard formations.

SideTrack (ST) Line of PDC and natural diamond bits designed for sidetracking in soft formations. Performs well in rotary and downhole motor applications.

Speed Mill (DSM) Natural diamond bits designed for drilling casing windows.

Options

G3 Step Gauge	G8 Longer Gauge Than Standard	M1 ChipMaster Hydraulics	X Backup Cutters
G5 In-Gauge PDC Trimmers	G9 Extended Sleeve	NSS Nonstandard Shank	XX Double Row of Backup Cutters
G6 Spiral Gauge	G12 Active Gauge Cutters	U1 Natural Diamond Updrill	XDO EZCase Drillout
G7 TSP Diamond Gauge	K3 TCI Wear Knots	U3 PDC Updrill (3/8-in.)	Y Box-Up Connection
		U4 PDC Updrill (1/2-in.)	

Platinum PDC Drill Bits

Quantec

Our best PDC bits are designed to drill further and faster through the toughest and most abrasive formations. These new generation PDC bits are now drilling hard and abrasive hole sections historically saved for TCI bits. As a result, operators are drilling these intervals faster, with less bits and at a lower cost-per-foot.



Diamond Volume Management

DVM places the right amount of diamond at the right location on the bit. DVM provides higher ROP, greater stability and longer runs with significantly reduced cutter or BHA damage.



Quantec cutters

Application-specific cutters offer a step change in abrasion resistance with less potential for chipping or fragmenting. Bits drill with “like new cutters” longer. Customers enjoy longer and faster runs.



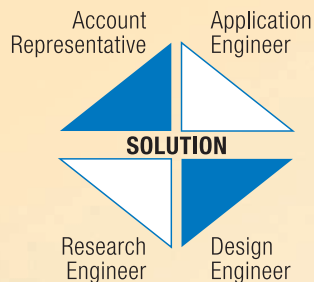
Enhanced gauge protection

Thermally stable polycrystalline inserts ensure maximum gauge-holding ability in the most abrasive drilling environments.



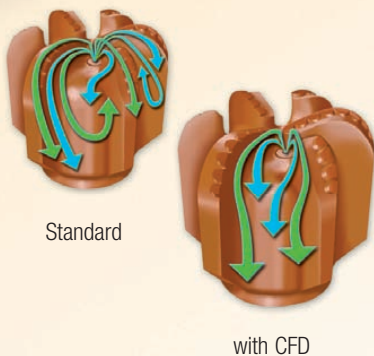
Drilling Application Review Process (DART)

Each new PDC design project receives the personal attention of an integrated, multifunctional team comprising design, research and applications engineers and a field sales representative. The team conducts an in-depth analysis from each specialized perspective. This DART process improves communication with the customer; reduces costly, time consuming iterations; and maximizes your ultimate solution.



SmoothCut™ depth-of-cut control technology

Patented technology provides a low-vibration, stable drill bit that reduces premature cutter wear. Bit stability increases footage drilled and improves ROP by eliminating impact damage. Cutters retain their initial, sharp-edge geometry.



Optimized hydraulics

Computational fluid dynamics provide an optimized balance of fluid flow, cutter cooling and erosion resistance.



Quantec D PDC bits

These premium PDC bits utilize directional technologies that place the well where reservoir production is optimized. Our patented depth-of-cut control technology delivers exceptional tool face control on rotary and motor steerable systems. These precise bits are exposing more reservoir than ever before in days instead of weeks. That same technology reduces bit vibration, resulting in a smoother well bore and less downhole tool damage. A smooth well bore improves logging quality, allowing better measurement in the horizontal sections and pay zones. A smooth well bore prevents ledges, kinks and casing problems which can affect completion and production for the life of the well.



Quantec Force PDC Bit

Our newest generation PDC bit pushes the envelope of bit stability and drilling efficiency. Unprecedented built-in vibration control enables our designers to utilize more aggressive and efficient cutting structures. Q-Force bits are drilling intervals with "like new" cutters longer and faster. In addition to improved efficiency, Q-Force bits utilize a new series of PDC cutters with improved wear resistance and thermal stability for faster, longer runs.

Classic PDC Drill Bits

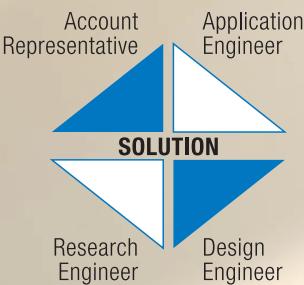
Genesis

Extremely reliable bits that combine advanced technology and a revolutionary design process to achieve excellent performance and consistency in defined applications.



Genesis Cutters

Continuous research in diamond interface design, diamond table thickness and diamond-edge geometry has provided cutters with greater impact and abrasion resistance. With a vast array of cutters to choose from, our engineers can custom design each bit's cutting structure with the ideal combination of aggressiveness and durability for the application.



Drilling Application Review Process (DART)

Each new PDC design project receives the personal attention of an integrated, multifunctional team comprising design, research and applications engineers and a field sales representative. The team conducts an in-depth analysis from each specialized perspective. This DART process improves communication with the customer; reduces costly, time consuming iterations; and maximizes your ultimate solution.



SmoothCut Technology

Patented, depth-of-cut control technology, ensures cutter damaging peak loads are minimized by balancing the workload over more cutters. SmoothCut technology limits bit reactive torque response without limiting bit aggressiveness and ROP.



Standard



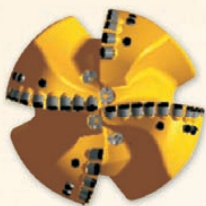
Genesis

Lateral Movement Mitigator™ (LMM)

Patented LMM reduces vibration severity and protects shoulder cutters from impact loads.



Standard



Genesis

Chordal Drop

Innovative design concepts allow greater borehole coverage. Combined with LMM, chordal drop delivers enhanced bit stability.



Genesis XT PDC bit

XT bits drill at a lower cost-per-foot with tough abrasion-resistant Z cutters. These tough bits have advanced PDC drilling into interbedded formations typically drilled by roller cone bits.



Zenith-Series Cutters

Innovative diamond-cutter technology enables Z series cutters to maintain a sharp, efficient cutting edge when drilling through a wide variety of formations in extreme downhole conditions.



Genesis D PDC bit

Designed for both motor and rotary steerable applications, the Genesis D bits enhance a system's ability to deliver a quality hole precisely on target.

Its patented depth-of-cut control technology uses engineered bearing surfaces to lower the bit's torque response to additional weight. The results - improved toolface control without sacrificing ROP.

Standard PDC Drill Bits

Triton

Designed for simple, highly drillable formations, these field proven, cost-effective bits deliver the performance you need. Engineered cutter placement offers the required aggressiveness and durability to reach the target at good ROP.



H1 cutters

Tough, sharp cutters with residual stress management offer consistent performance in PDC-drillable formations.

Cutter layout

Time tested designs deliver a stable drilling platform and a quality borehole.

Standard gauge protection

Flush set tungsten carbide inserts working in tandem with PDC gauge cutters offer extra protection and maximum gauge holding.

Hydraulic efficiency

Computational fluid dynamics maximizes cuttings removal for reduced balling.

Specialty Products

GaugePro XPR / XPS

On a drilling assembly, our GaugePro XPR expandable reamer drills and reams simultaneously with minimal vibration and superior hole quality. The reamer remains closed until triggered, opens on command, reams an in-gauge hole, closes and comes out of the hole problem free. With the pilot bit design synchronized to the expandable reamer in a fit-for-purpose drilling assembly, operators are achieving an exceptional downhole operating environment.

The GaugePro XPS expandable stabilizer increases drilling efficiency by providing BHA stabilization in the enlarged wellbore. The stabilizer, when run in combination with the expandable reamer, significantly reduces upper BHA whirl, thus reducing BHA damage and further enhancing the downhole operating environment and drilling performance.

- First patented drop-ball method to trigger an expandable reamer, which eliminates premature triggering independent of WOB, flow, or BHA pressure.
- First documented, significant vibration reduction by limiting aggressiveness of the pilot bit without reducing ROP using patented EZSteer depth-of-cut control technology.
- First documented use of the GaugePro XPS expandable stabilizer above a reamer to significantly increase drilling efficiency by eliminating collar whirl for higher ROP with lower weight on bit.



XPR

XPS



Open



Closed

Specialty Products



RWD

RWD2 ream-while-drilling technology

Regardless of the drilling assembly or application, the RWD2 enables you to drill out cement, float equipment, and drill and ream the remaining interval in one continuous operation. Our fixed-blade eccentric reamer tackles hole-opening applications in the most demanding wellbore geometries.

Depth-Adjusted Cutters

With our patented approach, individual cutter exposure is carefully adjusted to balance the load, reducing vibration and improving cutter durability.

Hole-Opening Blade

Our patented blade design delivers smoother drilling in the transition from pass-through to drill size.

Optimized Hydraulics

Computational fluid dynamics optimizes nozzle positioning, maximizing cuttings removal and cutting structure cooling.

Pilot Bit Flexibility

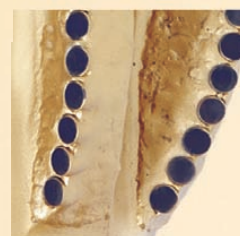
Use Tricone or PDC pilot bits, depending upon the application requirements.*

Application Versatility

RWD2 for straight-hole rotary applications. Significantly reduces the cost of conventional drilling and reaming with an ideal combination of pilot bit and BHA selected to optimize drilling efficiency.

RWD2S™ for motor steerable or rotary steerable applications. With zero moving parts, this tool significantly reduces the cost of underreaming while eliminating the mechanical risks.

RWD2ST™/2X significantly reduces the risk of mechanical failure in tight wellbores with a one-piece pilot bit/reamer design that offers maximum hole clearance.



RWD2



RWD2S



RWD2ST / 2X

* 2ST & 2X are one piece tools

EZCase casing bit system



EZCase

Reduce NPT by combining drilling and casing in one run with the industry's only steel casing bit system. You can complete a well that traditional technology could not complete because of severe losses or unstable formations, including rubble zones, lost circulation zones, depleted reservoirs, and underground blowouts. Genesis PDC bit drillout ensures additional milling operations are unnecessary.

- Drill problematic wells including rubble zones, lost circulation zones, depleted reservoirs and underground blowouts. With EZCase you can complete a well that may not have been possible using traditional technology.
- Drill out float equipment, the EZCase bit and drill the new hole size with roller cone and PDC drillout bits.
- Optimized hydraulics are realized from computational fluid dynamic analysis which maximizes the bit's cooling, cleaning and cuttings ejection.



EZReam Lite

EZReam

EZReam Heavy Duty

EZReam casing/liner shoe

Reduce drilling cost with fewer trips using the industry's most robust casing/liner shoe. This is the only steel reaming shoe that is PDC drillable. With a tungsten carbide and PDC cutting structure, enhanced durability enables you to ream longer intervals through the most challenging barriers and get to TD in a severely compromised borehole.

- Faster drillout—EZReam technology is drillable with a standard PDC or roller cone in onshore and offshore applications.
- Reduced drillout risk—EZReam concave profile drills out from the center to the shoulder, eliminating the risk of leaving an undrilled portion downhole.
- Fail-safe circulation—The industry's only casing/line shoe to offer a secondary bypass port, which allows normal circulation or cementing to continue in the event of nozzle plugging.

Specialty Products

Kymera™ hybrid drilling technology

- Higher overall ROP: Maintains PDC-equivalent ROP in soft formations while increasing ROP in harder formations that are typically drilled by roller cone bits.
- Lower vibration: The unique design of Kymera bits provides an extremely stable drilling platform that mitigates vibration present in roller cone and PDC environments.
- Better toolface control: Superior directional bit for motor or rotary applications with better toolface control and steerability than a PDC.
- Improved torque control: Kymera bits offer unrivaled torque management in the toughest formations; even in transition zones torque is controlled with smooth and fast drilling.



Special Applications

HedgeHog

The HedgeHog impreg bit has an aggressive, balling-resistant cutting structure with optimized hydraulics and advanced matrix material. The optimized blade configuration enables more formation removal.

Interrupted Cutting Structure

Increased drilling efficiency without any uncut bottom because of staggered, overlapped posts that allow shale to flow through. Twenty-five percent more diamond volume in the cone area than standard impreg bits with post-over-blade design. Optimal sand and shale drilling with maximized blade count.



Enhanced Hydraulics

Impact-force directed where balling occurs with unique ported design. Enhanced ROP with deep junk slots that optimize cuttings removal and limit hole swabbing during trips.

Matrix Flexibility

The matrix wears slightly faster than the diamond to ensure the most efficient cutting structure. Each matrix formulation is matched to the lithology, achieving the optimal rate of fresh, sharp diamonds for enhanced ROP.



Natural Diamond

We have a variety of natural diamond styles for rotary and motor drilling in hard or abrasive formations. There are various sizes, grades and concentrations of natural diamond in these bits for your specific application. The crown profiles are designed for optimum performance.



Natural Diamond

SideTrack

Our SideTrack line of PDC and natural diamond bits is designed for sidetracking using rotary or motor. A tungsten carbide matrix body construction ensures erosion resistance; there's natural diamond protection on the gauge. There are shallow cone profiles for minimal resistance to directional changes. The short shoulder radius enhances the lateral cut when side forces are applied for successful kickoff.



SideTrack

Speed Mill

These natural diamond bits enable you to drill casing windows. The flat profile with short shoulder radius offers the greatest surface area in direct contact with the casing. This design ensures durability with an aggressive edge. The smaller, less-exposed diamonds have high impact resistance to prevent breakage when drilling steel casing.



Speed Mill

Ballaset

Custom designed for your application, our BallaSet bits have thermally stable polycrystalline diamond cutters to drill medium-to-hard formations. The crown profiles optimize penetration rates and bit life when running on rotary or motor.



Ballaset

Specifications

API Diameter | Tolerances | Nozzles | Make-up Torques

API Diamond Bit Tolerances

Nominal Bit Size OD	OD Tolerance	
<i>inch</i>	<i>inch</i>	<i>mm*</i>
Up to 6 3/4, incl.	+0. - 0.015	+0. - 0.38
6 25/32 to 9, incl.	+0. - 0.020	+0. - 0.51
9 1/32 to 13 3/4, incl.	+0. - 0.030	+0. - 0.76
13 25/32 and larger	+0. - 0.045	+0. - 1.14

* Converted from inches

TFA Values of Common Nozzle Sizes

Nozzle Size*	Number of Nozzles									
	1	2	3	4	5	6	7	8	9	10
7	.0376	.0752	.1127	.1503	.1877	.2255	.2631	.3007	.3382	.375
8	.0491	.0982	.1473	.1963	.2454	.2945	.3435	.3927	.4418	.4909
9	.0621	.1242	.1864	.2485	.3106	.3728	.4249	.4970	.5591	.6213
10	.0767	.1534	.2301	.3060	.3835	.4602	.5369	.6136	.6903	.7670
11	.0928	.1856	.2784	.3712	.4640	.5568	.6496	.7424	.8353	.9281
12	.1104	.2209	.3313	.4418	.5522	.6627	.7731	.8836	.9940	1.045
13	.1296	.2592	.3889	.5185	.6481	.7777	.9073	1.0370	1.1666	1.2962
14	.1503	.3007	.4510	.6013	.7517	.9020	1.0523	1.2026	1.3530	1.5033
15	.1726	.3451	.5177	.6903	.8629	1.0354	1.2080	1.3806	1.5532	1.7258
16	.1963	.3927	.5890	.7854	.9817	1.1781	1.3744	1.5708	1.7671	1.9634
18	.2485	.4970	.7455	.9940	1.2425	1.4910	1.7395	1.9880	2.2365	2.4850
20	.3068	.6136	.9204	1.2272	1.5340	1.8408	2.1476	2.4544	2.7612	3.0680
22	.3712	.7424	1.1137	1.4849	1.8561	2.2273	2.5986	2.9698	3.3410	3.7122

* (Nozzle size in 32nds of an inch.)

API Connection Chart / Recommended Makeup Torque

Bit OD (inches)	Connection	"Bit Sub OD" (inches)	"Recommended Make-up Torque"	
			(kNm)	(1000 ft-lb)
3 1/2 - 4 1/2	2-3/8 REG	3	2.4 - 2.7	1.8 - 2.0
		3 1/8	3.3 - 3.6	2.4 - 2.7
		3 1/4	4.2 - 4.6	3.1 - 3.4
4 17/32 - 5	2-7/8 REG	3 1/2	4.2 - 4.6	3.1 - 3.4
		3 3/4 and larger	6.3 - 6.9	4.6 - 5.1
5 1/32 - 7 3/8	3-1/2 REG	4 1/8	7.0 - 7.7	5.2 - 5.7
		4 1/4	8.6 - 9.4	6.3 - 6.9
		4 1/2	10.3 - 11.4	7.6 - 8.4
7 13/32 - 9 3/8	4-1/2 REG	5 1/2	16.9 - 18.6	12.5 - 13.7
		5 3/4	22.4 - 24.6	16.5 - 18.1
		6 and larger	27.6 - 30.3	20.3 - 22.4
9 13/32 - 14 1/2	6-5/8 REG	7 1/2	50.3 - 55.4	37.1 - 40.8
		7 3/4 and larger	57.9 - 63.6	42.7 - 46.9
14 9/16 and larger	7-5/8 REG	8 1/2	65.5 - 72.1	48.3 - 53.2
		8 3/4	78.3 - 86.1	57.7 - 63.5
		9	91.6 - 100.8	67.6 - 74.3
		9 1/4 and larger	96.1 - 105.7	70.9 - 78.0

* (Converted from ft-lb)

(Nozzle size in 32nds of an inch.)

*(In some cases, 6 5/8" reg is used.)

++(In some cases, 7 5/8" reg is used. Use appropriate torques for API connection, not bit size, in these cases.)

Diamond Optional Features



In-Gauge PDC Trimmers (G5)

Additional PDC cutters are flush mounted on the leading edge of the gauge pads. They provide extra durability on the bit gauge pads for applications that prematurely wear a conventional TCI/ND gauge.



Extended Sleeve (G9)

For greater bit stability when drilling with high rotational speeds, an optional gauge sleeve may be added.

Box-Up Connection (Y)

Some directional drilling applications utilizing turbines require the smallest possible distance between the bit face and the lower bearing stabilizer. This can be achieved by using a pin-down connection on the turbine.



Spiral Gauge (G6)

Maximizes borehole coverage for enhanced stability. The spiral gauge option is one of many chordal drop management tools that reduces vibration severity.



XX Backup Cutters (XX)

Two or more rows of backup cutters.



TCI Wear Knots (K3)

TCI wear knots minimize large torque variations and provide cutters additional protection from impact damage.



Longer Gauge Than Standard (G8)

The G8 option is any gauge length that is longer than the standard gauge length for a given bit size. In some high-rotation speed applications, such as when using turbines, maximum bit stabilization and durability are required. Therefore, gauge length is increased to meet specific application requirements.

G3	Step Gauge
G5	In-Gauge PDC Trimmers
G6	Spiral Gauge
G7	TSP Diamond Gauge
G8	Longer Gauge Than Standard
G9	Extended Sleeve
G12	Active Gauge PDC Cutters
K3	TCI Wear Knots
NSS	Nonstandard Shank
M1	ChipMaster Hydraulics
U1	Natural Diamond Updrill
U3	PDC Updrill (3/8-in.)
U4	PDC Updrill (1/2-in.)
X	Single Row of Backup Cutters
XX	Two or More Rows of Backup Cutters
XD0	EZ Case Drillout
Y	Box-Up Connection



X Backup Cutters (X)

Single row of backup cutters.



EZCase Drillout (XD0)

Added to standard PDC bit designs, this technology enables PDC bits to drill through EZCase casing bits.



Natural Diamond Updrill (U1)

The updrill feature drills the formation when the bit is rotated while tripping out of the hole. This reduces the risk of problems in tight holes, unstable formations or salt sections.



PDC Updrill (3/8-inch) (U3)

PDC Updrill (1/2-inch) (U4)

The updrill feature drills the formation when the bit is rotated while tripping out of the hole. This reduces the risk of problems in tight holes, unstable formations or salt sections.

Tricone Drill Bits

PLATINUM | CLASSIC | STANDARD

Hughes Christensen line of Tricone bits with advanced technology and a revolutionary design process achieves maximum performance in a defined application.



Product Lines

Platinum

Vanguard—Premium Tricone bits designed for superior performance in challenging applications. Next generation advancements in bearings, carbide, hydraulics and shirttail protection provide the flexibility to design the right bit for virtually any Tricone application.

VM—Metal-to-metal sealing system

VG—High Aspect Ratio (HAR) elastomer seal

Classic

MX—A very reliable, long-life steel tooth and TCI motor bit Tricone line designed for demanding applications. Their metal-seal bearing package has set new standards of reliability in tough drilling environments.

GX—Field-proven elastomer-sealed Tricone bits that utilize highly efficient components to consistently deliver longer runs at maximum penetration rates in either rotary or motor applications.

Standard

Triton—These roller-cone bits feature an O-ring sealed journal bearing.

Their time tested cutting structures deliver a quality borehole and high penetration rates.

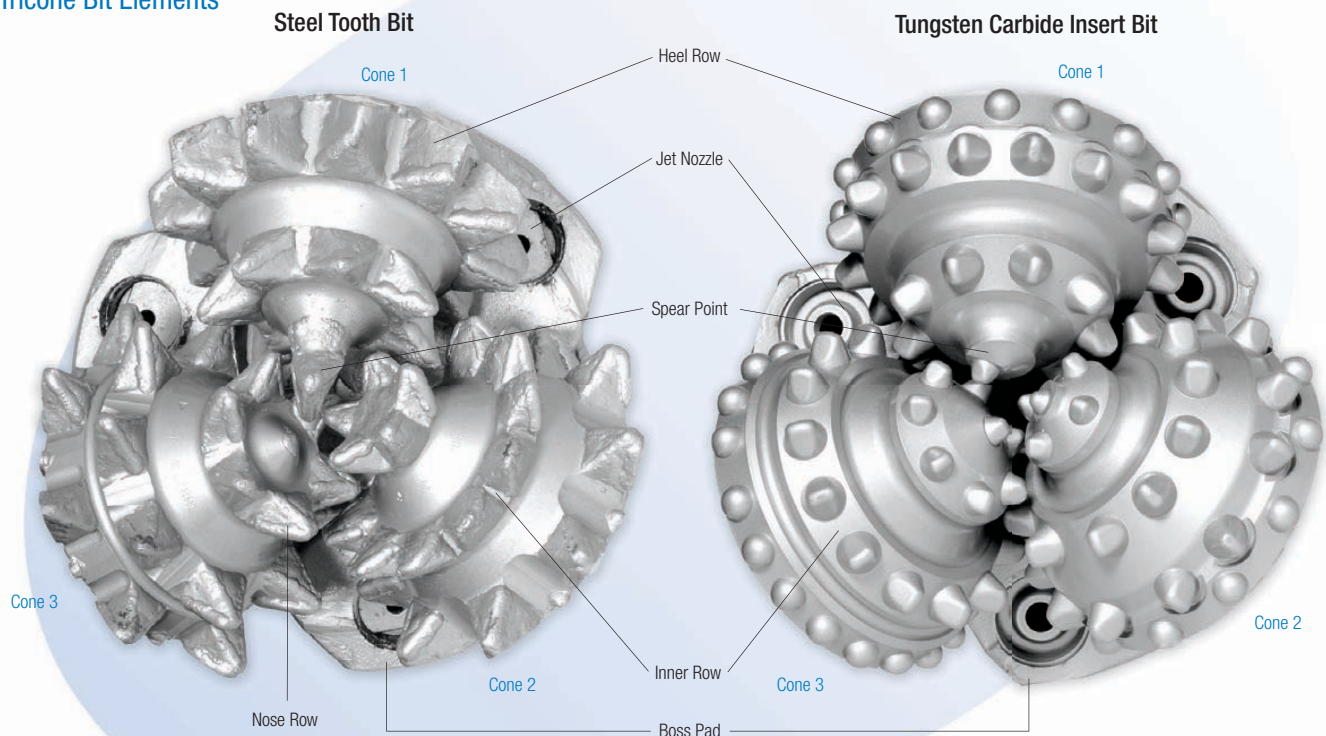
Features and Options

- A** Air Journal Bearing, Air Nozzles
- C** Center Jet
- C** Conical-Shape Insert
- C3** Three-Directed Center Jets
- DDX** DSE Diamond Gauge (33%) / Diamond Trimmers (50%)
- DDT** DSE Diamond Gauge (33%) / Diamond Trimmers (100%)
- DH** Diamond Heel Compacts (100%)
- DH1** Diamond Heel Compacts (50%)
- DP** Diamond-Enhanced Stabilization Pad
- DS** Diamond-Enhanced Shirttail Compacts
- DT** Diamond Gauge Trimmers (100%)

- DT1** Diamond Gauge Trimmers (50%)
- DX** DSE Diamond Gauge Compacts (33%)
- DX0** DSE Diamond Gauge Compacts (20%)
- DX1** DSE Diamond Gauge Compacts (50%)
- DX2** DSE Diamond Gauge Compacts (100%)
- DX3** DSE Diamond Gauge Compacts - 1st Row (33%), 2nd (100%)
- DVH** Diamond Vanguard Heel
- DVHX0** Diamond Heel +20% Gauge
- DVHX** Diamond Heel +33% Gauge
- DVHX1** Diamond Heel +50% Gauge
- DVHX2** Diamond Heel +100% Gauge
- G** Enhanced Gauge - Wear Resistant

- H** Enhanced Gauge - Breakage Resistant
- M** Motor Hardfacing
- M** M Technology
- P** Leg Stabilization Wear Pad
- R** Spray-Coat Cones
- S** Shirttail Compacts
- STL** Shirttail & Leg Hardfacing
- T** Highflow Nozzles (2 Highflow)
- T1** Highflow Nozzles (1 Highflow)
- T3** Highflow Nozzles (3 Highflow)

Tricone Bit Elements



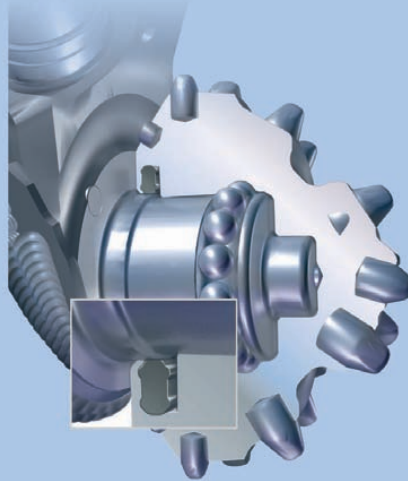
Platinum Tricone Drill Bits

Vanguard

Our premium Tricone line utilizes next generation technology to create the most efficient and durable Tricone bits. Vanguard bits are custom designed to meet the individual requirements of specific applications. From tough carbonate drilling in the Middle East to delivering a quality hole in directional applications, Vanguard bits are setting new standards of performance and reliability.

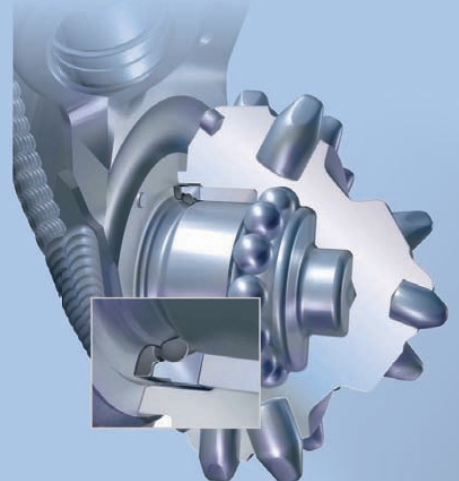


*Vanguard TCI
with BOSS Feature*



Vanguard VG bits

VG bits rely on a High Aspect Ratio (HAR) elastomer seal. Its unique geometry provides enhanced stabilization as it maintains optimum sealing position within the bearing.



Vanguard VM bits

VM bits utilize the industry's most reliable bearing package. Its unique metal-to-metal sealing system performs long hours under the most challenging conditions.

High-Capacity Grease

New, high viscosity, and high thermal stability grease formulation increases the bearing load carry capacity and ensures long bearing life.

Application matched cutter arrangements

Computer modeling software is used to statistically improve resistance to tracking. Pitch and distance between inserts are configured to eliminate bit tracking, reduce cutter wear and improve penetration rate.



Engineered compacts

Tougher, wear resistant teeth with custom carbide grades allow our engineers to match aggressive tooth shapes with specific formations and drilling applications.



BOSS



Standard

STL Shirttail packages

Patented STL shirttail and leg hardfacing packages are customized to minimize severe leg wear in directional applications and ensures superior bearing and seal protection in difficult applications.



Vanguard TCI



Vanguard ST

Vanguard Geothermal bits

Bits designed for the extreme temperature zones. Their unique metal-to-metal sealing system, with new elastomer components made from high temperature resistant compounds, makes the Vanguard Geothermal bits an ideal choice for hot-hole applications.

Vanguard Directional bits

Designed for high ROP and reliable build rates, these bits minimize potential roller cone directional challenges such as unreliable bearing performance, excessive OD wear, and high cyclic loading failure.

Vanguard Arabia bits

These bits are designed for the nonabrasive Middle-Eastern carbonate markets. Arabia bits utilize carbide grades specially developed for carbonate formations with innovative cutting structures for higher ROP and sustained durability.

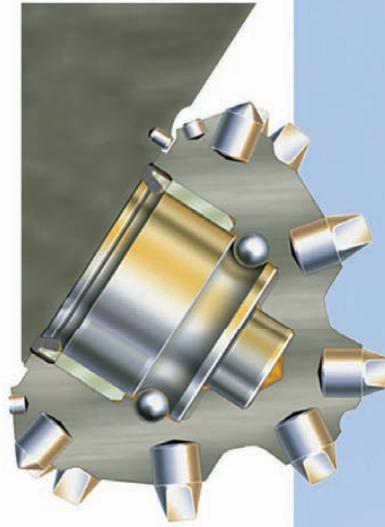
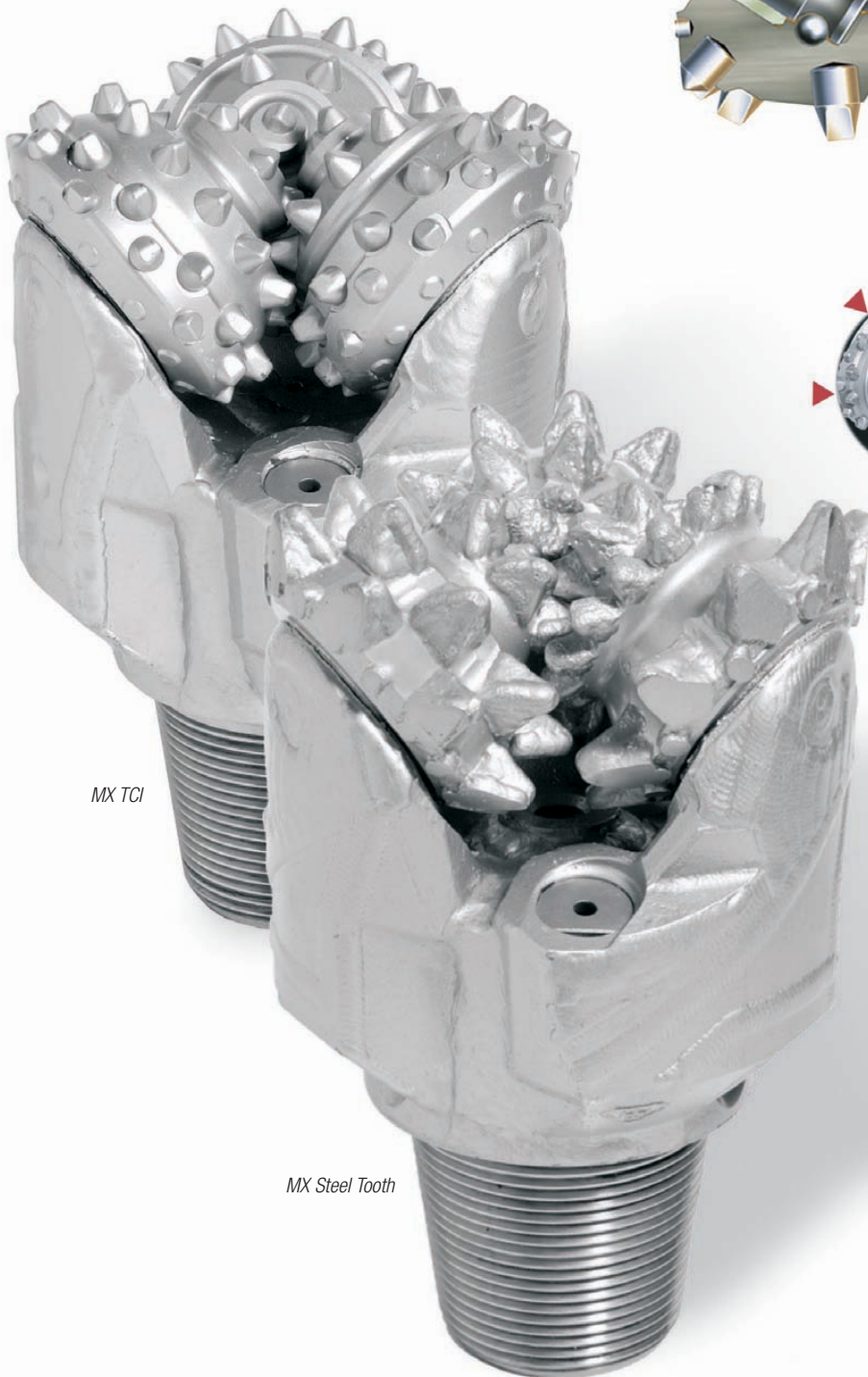
Vanguard Steel Tooth bits

These bits are designed for durability and speed. Vanguard steel tooth bits deliver the fastest drilling achievable in a range of soft formations as well as exceptional durability in the more demanding and extremely abrasive high-wear applications.

Classic Tricone Drill Bits

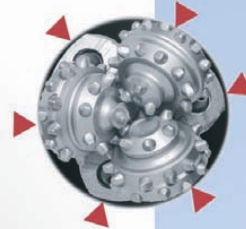
MX

MX bits are field proven and designed specifically for the rigors of high-speed rotary and motors, high temperatures and other demanding applications. The patented single-energizer metal-seal bearing package is unequalled by competitors, setting new standards in long life and reliability.



SEM Bearing Package

- Metal bearing seal where all relative rotary motion occurs between two lubricated metal surfaces. Metal seals provide a superior alternative to elastomer sealed bearing designs when operating in high-speed, high-temperature and abrasive conditions.
- Excluder package with strategically positioned backup ring is one of a group of features targeted specifically at preventing the detrimental effects of mud packing.
- Equalizer package features a proven compensation system and customized grease with a lower coefficient of friction.



BOSS Feature

The BOSS system delivers near six-point contact with the borehole wall for unequalled bit stability that protects the cutting structure from damaging lateral blows.



Motor Hardfacing

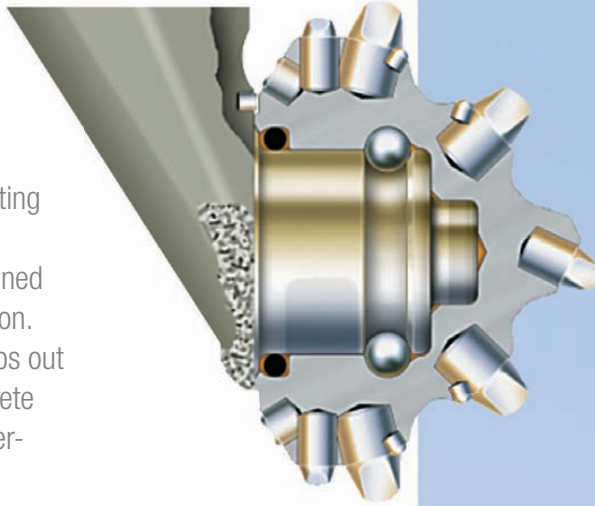
Tungsten carbide particle hardfacing is liberally applied to the shirttail and up the leading edge of the leg for additional protection in high-speed, directional or abrasive applications.

MX Hydraulics

MX bits offer both biased and unbiased hydraulic configurations that are fine tuned for specific applications.

GX

GX bits deliver proven bearing, hydraulic configurations and cutting structure technology. The key to faster, longer runs are bits designed for virtually any Tricone application. Fewer bits per section, fewer trips out of the hole, fewer days to complete the well result in a lower cost-per-foot for our customers.



G3 Bearing

- Silver-plated cone bearing—solid lubricant coating transfers heat away from load surfaces.
- Hard-metal alloy wear pad—reduces friction and retards wear for better coupling between pin and cone.
- Custom grease formulation—temperature-resistant grease reduces friction and increases load-carrying capacity.
- Enhanced elastomer material—proprietary elastomer material resists abrasion and thermal degradation under highly adverse conditions.

Engineered Compact Shapes

Aggressive, durable shapes are the result of research into individual compact attributes which are now fine tuned to match specific formations and applications.



GX Hydraulics

GX bits offer both biased and unbiased hydraulic configurations that are fine tuned for specific applications.

Unbiased:

- Conventional—Standard nozzle configuration directs fluid between the cones toward the corner of the borehole wall.



Biased:

- Clean Sweep—Nozzles are positioned so that the fluid stream cleans the heel and adjacent heel teeth.
- XStream—Nozzles are positioned so that multiple rows of the cutting structure are cleaned.



GX TCI

Standard Tricone Drill Bits

Triton

Triton bits are time tested technology that deliver consistent performance and a quality borehole at a modest price.



Triton ST



Triton TCI

Reliable Bearing

A reliable bearing package incorporating field proven elastomer and lubricant research, bearing geometry and metallurgy.

High Efficiency Drilling

Triton bits bring relieved cone steel, aggressive tooth pitches and active shear-cutting gauge compacts to deliver a low-cost performance solution.

Hydraulic Flexibility

A wide range of available nozzle or jet sizes helps optimize bit hydraulics for adequate cutting removal and fast ROP.

Special Application Bits

Star2

Star2 steel tooth and TCI slimhole bits offer remarkable bearing reliability, carbide grades and bit stability which allow you to drill faster and stay in the hole longer. Thermal-resistant grease and proprietary hardfacing add to this proven technology. In directional and highly abrasive applications, a full line of diamond gauge options are available.



Precision Bearing / Synthetic Grease

Lower friction forces reduce bearing wear and increase bearing-load capacity.



Shirttail Compacts

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

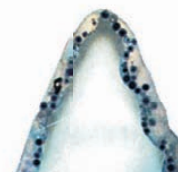
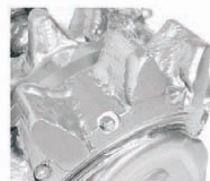


Enhanced Hydraulics

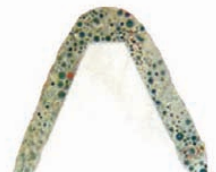
- Nozzle configuration cleans areas susceptible to balling.
- Superior return flow for better chip removal.

Steel Tooth Endura Hardfacing

Proprietary hardfacing technology is applied to the inner teeth and gauge surfaces to withstand wear.



Conventional



Endura



AirXL bits

AirXL Tricone bits are specifically designed for demanding air applications. Specialized synthetic grease plus an application-specific bearing and seal geometry reduce wear, improve reliability and increase seal efficiency in harsh air-drilling applications.

Stronger Gauge and Heel Rows

Better carbide grades, compact shapes and cone profiles improve gauge-holding, resist compact breakage, reduce vibration and enhance ROP.

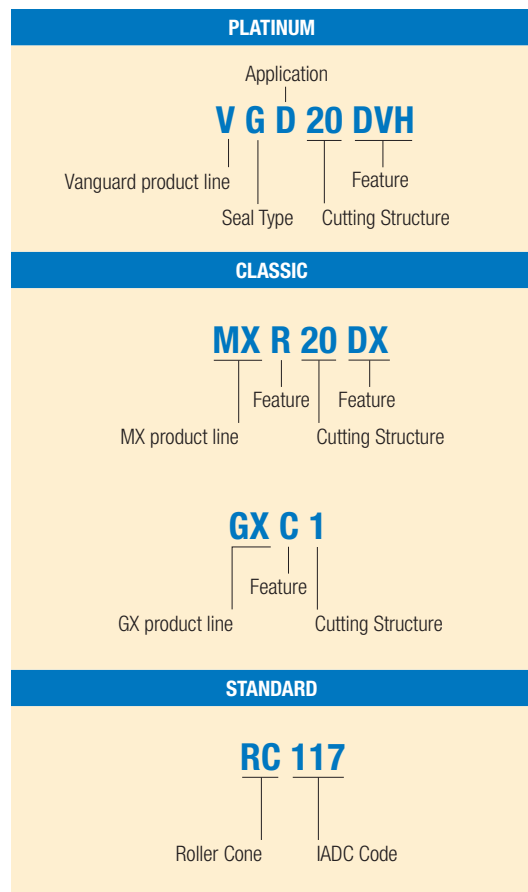
Unique Center Bore

This unique AirXL technology directs the air flow to the center of the hole bottom, increasing hole cleaning while optimizing ROP.

Technical Data

Nomenclature | Bearing Packages | Features

Nomenclature



API Roller Cone Bit Tolerances

Nominal Bit Size OD	OD Tolerance	
	inch	mm*
3 3/8" - 13 3/4", incl.	-0. + .0313 (1/32)	-0. + .794
14" - 17 1/2", incl.	-0. + .0625 (1/16)	-0. + 1.588
17 5/8" and larger	-0. +0938 (3/32)	-0. + 2.381

* Converted from ft-lb

Product Features and Enhancements

Code	Description	Example
A	Air Journal Bearing, Air Nozzles	XL-40A
C (Prefix)	Center Jet	GX-C18
C (Suffix)	Conical-Shape Insert	GX-18C
C3	Three-Directed Center Jets	MX-C31
DDX	DSE Diamond Gauge (33%) / Diamond Trimmers (50%)	MX-09DDX
DDT	DSE Diamond Gauge (33%) / Diamond Trimmers (100%)	MX-09DDT
DH	Diamond Heel Compacts (100%)	STX50DH
DH1	Diamond Heel Compacts (50%)	STX50DH1
DP	Diamond-Enhanced Stabilization Pad	GX-DP66
DS	Diamond-Enhanced Shirttail Compacts	GX-DS20
DT	Diamond Gauge Trimmers (100%)	MX-09DT
DT1	Diamond Gauge Trimmers (50%)	MX-1DT1
DX	DSE Diamond Gauge Compacts (33%)	MX-09DX
DX0	DSE Diamond Gauge Compacts (20%)	MX-09DX0
DX1	DSE Diamond Gauge Compacts (50%)	MX-09DX1
DX2	DSE Diamond Gauge Compacts (100%)	MX-09DX2
DX3	DSE Diamond Gauge Compacts - 1st Row (33%), 2nd (100%)	MX-09DX3
DVH	Diamond Vanguard Heel	VG-20DVH
DVHX0	Diamond Vanguard Heel +20% Gauge	VG-20DVHX0
DVHX	Diamond Vanguard Heel +33% Gauge	VG-20DVHX
DVHX1	Diamond Vanguard Heel +50% Gauge	VG-20DVHX1
DVHX2	Diamond Vanguard Heel + 100% Gauge	VG-20DVHX2
G	Enhanced Gauge - Wear Resistant	MX-20G
H	Enhanced Gauge - Breakage Resistant	GTX-11H
M (Prefix)	Motor Hardfacing	GTX-M1
M (Suffix)	M Technology	GX-20M
P (Prefix)	Leg Stabilization Wear Pad	HR-P66
R	Spray-Coat Cones	MX-R09
S	Shirttail Compacts	MX-S20
T	Highflow Nozzles (2 Highflow)	MX-T03
T1	Highflow Nozzle (1 Highflow)	MX-T103
T3	Highflow Nozzle (3 Highflow)	MX-T303
P (Suffix)	Pyramid Compacts	VGA-10P

Bearing and Performance Packages

	Vanguard			UltraMax (MX)	GX	STAR2 (STX)	GTX	Triton
	VXG	VM	VG					
Journal Bearing		•	•	•	•	•		•
Ball & Roller Bearing	•	•	•	•			•	•
Metal Seal		•		•				
Elastomer Seal			•		•	•	•	•
GT Performance Package				•	•	•	•	
High Temp. Package	•	•						
Directional Package	•	•	•					
Unsealed	•							

Tungsten Carbide Product Line

Bit Size		API	Approximate Weight	
<i>inch</i>	<i>mm</i>	<i>Pin</i>	<i>lb</i>	<i>kg</i>
3 3/4	95.3	2 3/8	14	6.4
3 7/8	98.4	2 3/8	14	6.4
4 1/8	104.8	2 3/8	16	7.3
4 1/2	114.3	2 3/8	20	9.0
4 5/8	117.5	2 7/8	20	9.0
4 3/4	120.3	2 7/8	22	10.0
4 7/8	123.8	2 7/8	22	10.0
5	127.0	2 7/8	21	9.5
5 1/4	133.4	2 7/8	25	11.4
5 1/2	139.7	3 1/2	29	13.2
5 5/8	142.9	3 1/2	29	13.2
5 3/4	146.1	3 1/2	35	15.9
5 7/8	149.2	3 1/2	39	17.7
6	152.4	3 1/2	40	18.1
6 1/8	155.6	3 1/2	40	18.1
6 1/4	158.8	3 1/2	41	18.6
6 1/2	165.1	3 1/2	48	21.8
6 5/8	168.3	3 1/2	49	22.2
6 3/4	171.4	3 1/2	50	22.7
7 1/2	190.5	4 1/2	76	34.5
7 5/8	193.7	4 1/2	78	35.4
7 7/8	200.0	4 1/2	80	36.3
8 1/4	209.6	4 1/2	90	40.8
8 3/8	212.7	4 1/2	92	41.7
8 1/2	215.9	4 1/2	94	42.6
8 5/8	219.1	4 1/2	95	43.1
8 3/4	222.2	4 1/2	96	43.5
8 7/8	225.4	4 1/2	96	43.5
9	228.6	4 1/2	110	49.9
9 1/4	235.0	6 5/8	125	56.7
9 1/2	241.3	6 5/8	145	65.8
9 7/8	250.8	6 5/8	155	70.3
10 1/2	266.7	6 5/8	175	79.4
10 5/8	269.9	6 5/8	175	79.4
11	279.4	6 5/8	180	81.6
11 5/8	295.3	6 5/8	193	87.7
11 7/8	301.6	6 5/8	234	106.1
12	304.8	6 5/8	235	106.6
12 1/8	308.0	6 5/8	240	108.9
12 1/4	311.1	6 5/8	245	111.1
12 1/2	317.5	6 5/8	250	113.4
13 1/2	342.9	6 5/8	296	134.5
14	355.6	6 5/8	300	136.1
14 3/4	374.6	7 5/8	345	156.5
15 1/2	393.7	7 5/8	400	181.4
16	406.4	7 5/8	510	231.3
17	431.6	7 5/8	541	245.9
17 1/2	444.5	7 5/8	560	254.0
18 1/2	469.9	7 5/8	600	272.2
19	482.6	8 5/8	778	353.6
20	508.0	7 5/8	780	354.0
21	533.4	7 5/8	1056	480.0
21 1/2	546.1	7 5/8	1185	537.5
22	558.8	7 5/8	1185	537.5
22 3/8	568.3	7 5/8	1190	539.8
23	584.2	7 5/8	1195	542.0
23 1/2	569.9	7 5/8	1287	585.0
24	609.6	7 5/8	1195	542.0
26	660.4	7 5/8	1425	646.4
28	711.2	8 5/8	1490	676.0
30	762.0	8 5/8	1490	676.0

Steel Tooth Product Line

Bit Size		API	Approximate Weight	
<i>inch</i>	<i>mm</i>	<i>Pin</i>	<i>lb</i>	<i>kg</i>
3 5/8	92.1	2 3/8	12	5.4
3 3/4	95.2	2 3/8	12	5.4
3 7/8	98.4	2 3/8	12	5.4
4 1/8	104.8	2 3/8	14	6.4
4 1/2	114.3	2 3/8	18	8.2
4 5/8	117.5	2 7/8	18	8.2
4 3/4	120.6	2 7/8	20	9.1
4 7/8	123.8	2 7/8	22	10.0
5	127.0	2 7/8	25	11.3
5 5/8	142.9	3 1/2	29	13.2
5 3/4	146.1	3 1/2	37	16.8
5 7/8	149.2	3 1/2	37	16.8
6	152.4	3 1/2	38	17.3
6 1/8	155.6	3 1/2	38	17.3
6 1/4	158.7	3 1/2	39	17.8
6 1/2	165.1	3 1/2	44	20.0
6 5/8	168.3	3 1/2	45	20.4
6 3/4	171.4	3 1/2	46	21.0
7 5/8	193.7	4 1/2	69	31.3
7 7/8	200.0	4 1/2	73	33.1
8 3/8	212.7	4 1/2	88	40.0
8 1/2	215.9	4 1/2	90	40.9
8 3/4	222.2	4 1/2	92	41.7
9 1/2	241.3	6 5/8	140	63.5
9 5/8	244.5	6 5/8	142	64.4
9 7/8	250.8	6 5/8	145	65.8
10 5/8	269.9	6 5/8	168	76.2
11	279.4	6 5/8	175	79.4
12 1/4	311.1	6 5/8	225	102.0
13 1/2	342.9	6 5/8	255	115.7
13 3/4	349.3	6 5/8	265	120.2
14 1/2	368.3	7 5/8	300	136.0
14 3/4	374.6	7 5/8	315	143.0
15 1/2	393.7	7 5/8	395	179.5
16	406.4	7 5/8	450	204.1
17	431.8	7 5/8	465	210.9
17 1/2	444.5	7 5/8	515	233.6
20	508.0	7 5/8	705	320.0
22	558.8	7 5/8	1125	510.3
23	584.2	7 5/8	1145	519.4
24	609.6	7 5/8	1145	519.4
26	660.4	7 5/8	1300	590.0
28	711.2	8 5/8	1380	626.0
30	762.0	8 5/8	1380	626.0

IADC Bit Classification

Series	Formations	T y p e	1	4	5		6	7				
			Standard Roller Bearing	Sealed Roller Bearing	Sealed Roller Bearing Gauge Protection		Sealed Friction Bearing	Sealed Friction/Gauge Protection			Sealed Geothermal	
					Elastomer	Metal		Elastomer	Air	Elastomer		Metal
Steel Tooth	1	Soft	1	RC111	GTX-1, RC114	VG-1, GTX-G1, RC115	VM-1, MX-1			VG-1, STX-1, RC117	VM-1, MX-1	
			2	RC121	RC124	RC125				RC127		
			3	RC131	GTX-3	VG-3, RC135	VM-3, MX-3	RC136	STX-3	VG-3, RC137	VM-3, MX-3, MXB-3	
			4									
	2	Medium	1	RC211		RC215		RC216		RC217		
			2									
			3			RC235		RC236		RC237		
			4									
	3	Hard	1									
			2	RC321								
			3									
			4							RC347		

Tungsten Carbide Tooth	4	Soft	1			VG-03, VG-03M, VGA-02, VGA-02M, GTX-00, GTX-00H, GTX-00M, GTX-03, GTX-03H, RC415	VMA-02, VMA-02M, MX-00, MX-03, MX-05H	RC416		VGA-03, GX-00, GX-03, GX-03H, RC417	VMA-03, MXB-00, MX-03, MXB-03, MX-05		
			2										
			3			VGA-10, VGA-10G, VGA-10M, VGA-11M, GTX-09, GTX-09H, GTX-11H, RC435	VM-11HM, VMA-10M, VMA-11MH, MX-09, MX-09G, MX-09H, MX-11H			GX-09, STX-09, GX-09C, STX-09C, GX-09H, STX-09H, GX-09M, GX-11, GX-11C, GX-11M, RC437	VMA-09, VMD-11, VMD-11G, MX-09, MXB-09, MX-09G, MX-09H, MXB-09H, MX-09C, MX-09CG, MX-11		
			4			GTX-11C, GTX-11CH, GTX-12H, GTX-18H, GTX-18CH	MX-11CH, MX-18, MX-18H, MX-18CH			VGA-18, GX-18, STX-18, GX-18H, STX-18H, GX-18C	VM-18, VMA-18, VMD-18H, MX-18, MXB-18, MX-18H, MX-18C, MXB-18C, MX-18CH		
	5	Soft Medium	1			VG-22, GTX-20, GTX-20H, GTX-22, RC515	MX-20, MX-20G, MX-20H			VG-20M, VG-22S, VGD-20, VGD-21S, VGD-22S, GX-20, STX-20, STX-20G, GX-20H, STX-20H, GX-20M, GX-22, GX-22M, GX-22S, GX-23, GX-25, RC517	VM-20, VMA-20, VMA-20M, VMD-20, VMD-22S, MX-20, MXB-20, MX-20G, MX-20H, MX-22		
			2			GTX-28	MX-20C, MC-28			VG-28, VGD-25, VGD-25S, VGD-26, VGD-28, GX-20C, STX-20C, GX-20CH, GX-28, GX-28C, RC527	VMD-25, VMD26, VMD-28, VMD-29, MX-20CH, MXB-20CH, MX-28, MXB-28, MX-28G		
			3			VG-30, VG-30HM, GTX-30, GTX-30H, GTX-33, RC535	MX-30H			VG-30, VG-30M, VGD-30M, VG-35M, VGA-30, VGD-30, VGD-30S, VGD-33, VGD-34, VGD-35, GX-30, STX-30, STX-30H, GX-30M, GX-30S, RC537	VMD-33, MX-30, MXB-30, MX-30G, MXB-30G, MX-30H	VMG-30	
			4			GTX-30C, GTX-33CG, RC545	MX-33CG			VG-38, VG-38CH, VGD-30C, VGD-36, VGD-38CH, GX-30C, STX-30C, STX-30CG, GX-33, GX-35, STX-35, GX-38C, GX-38CM, GX-38CH, RC547	VMD-38C, MXB-30C, MXB-30CH, MX-35, MX-35CG, MXB-35CG, MX-38C	VMG-35C	
	6	Medium	1							VG-40, VG-44G, VGD-40, VGD-44, VGD-44G, STX-40, GX-44, GX-44G	MX-40, MX-40G	VXG-44	
			2			GTX-40C, GTX-44C, RC615	MX-44CG			VG-44C, STX-40C, GX-44C, STX-44C, GX-45, RC617	VM-44C, MX-40C, MX-40CG, MXB-40CG, MX-44C, MX-44CH	VMG-44C, VXG-44C	
			3				MX-55			VG-50, VG-55M, VGD-50RG, STX-50, STX-50R, GX-55, STX-55, GX-55RG	VMD-55, MX-50, MX-50R, MX-50RG, MX-55	VMG-55	
			4							VG-66, VGD-66, GX-66, STX-66, GX-68	VM-66, MX-66, MX-68, MXB-68	VMG-68	
	7	Hard	1										
			2										
			3							VG-70M, VGD-70, STX-70, STX-77			
			4										
	8	Extra Hard	1							STX-88			
			2							GX-89			
			3							VG-90M, STX-90, GX-95, GX-98M, STX-99			
			4										

API Casing Data

Casing Specifications					Recommended Max. Bit Size	
Casing Size OD (inches)	Casing Coupling OD (inches)	Nominal Weight lb/ft	Inside Diameter ID (inches)	API Drift ID (inches)	Roller Cone Bit Size OD (inches)	Fixed Cutter Bit Size OD (inches)
4.500	5.000	9.50	4.090	3.965	3 7/8	3 7/8
4.500	5.000	10.50	4.052	3.927	3 7/8	3 7/8
4.500	5.000	11.60	4.000	3.875	3 7/8	3 7/8
4.500	5.000	13.50	3.920	3.795	3 3/4	3 3/4
5.000	5.563	11.50	4.560	4.435	4 1/8	4 3/8
5.000	5.563	13.00	4.494	4.369	4 1/8	4 1/8
5.000	5.563	15.00	4.408	4.283	4 1/8	4
5.000	5.563	18.00	4.276	4.151	4 1/8	4
5.500	6.050	14.00	5.012	4.887	4 7/8	4 3/4
5.500	6.050	15.50	4.950	4.825	4 3/4	4 3/4
5.500	6.050	17.00	4.892	4.767	4 3/4	4 3/4
5.500	6.050	20.00	4.778	4.653	4 5/8	4 5/8
5.500	6.050	23.00	4.670	4.545	4 1/2	4 1/2
6.625	7.390	20.00	6.049	5.924	5 7/8	5 7/8
6.625	7.390	24.00	5.921	5.796	5 3/4	5 3/4
6.625	7.390	28.00	5.791	5.666	5 5/8	5 5/8
6.625	7.390	32.00	5.675	5.550	5 1/2	5 1/2
7.000	7.656	17.00	6.538	6.413	6 1/4	6 1/4
7.000	7.656	20.00	6.456	6.331	6 1/4	6 1/4
7.000	7.656	23.00	6.366	6.241	6 1/8	6 1/8
7.000	7.656	26.00	6.276	6.151	6 1/8	6 1/8
7.000	7.656	29.00	6.184	6.059	6	6
7.000	7.656	32.00	6.094	5.969	5 7/8	5 7/8
7.000	7.656	35.00	6.004	5.879	5 7/8	5 7/8
7.000	7.656	38.00	5.920	5.795	5 3/4	5 3/4
7.625	8.500	20.00	7.125	7.000	6 3/4	6 3/4
7.625	8.500	24.00	7.025	6.900	6 3/4	6 3/4
7.625	8.500	26.40	6.969	6.844	6 3/4	6 3/4
7.625	8.500	29.70	6.875	6.750	6 3/4	6 3/4
7.625	8.500	33.70	6.765	6.640	6 1/2	6 1/2
7.625	8.500	39.00	6.625	6.500	6 1/2	6 1/2
8.625	9.625	24.00	8.097	7.972	7 7/8	7 7/8
8.625	9.625	28.00	8.017	7.892	7 7/8	7 7/8
8.625	9.625	32.00	7.921	7.796	7 5/8	7 5/8
8.625	9.625	36.00	7.825	7.700	7 5/8	7 5/8
8.625	9.625	40.00	7.725	7.600	6 3/4	7 1/2
8.625	9.625	44.00	7.625	7.500	6 3/4	7 1/2
8.625	9.625	49.00	7.511	7.386	6 3/4	7 3/8
9.625	10.625	29.30	9.063	8.907	8 7/8	8 3/4
9.625	10.625	32.30	9.001	8.845	8 3/4	8 3/4
9.625	10.625	36.00	8.921	8.765	8 3/4	8 3/4
9.625	10.625	40.00	8.835	8.679	8 1/2	8 1/2
9.625	10.625	43.50	8.755	8.599	8 1/2	8 1/2
9.625	10.625	47.00	8.681	8.525	8 1/2	8 1/2
9.625	10.625	53.50	8.535	8.379	8 3/8	8 3/8
10.750	11.750	32.75	10.192	10.036	9 7/8	9 7/8
10.750	11.750	40.50	10.050	9.894	9 7/8	9 7/8
10.750	11.750	45.50	9.950	9.794	9 5/8	9 5/8
10.750	11.750	51.00	9.850	9.694	9 5/8	9 5/8
10.750	11.750	55.50	9.760	9.604	9 1/2	9 1/2
10.750	11.750	60.70	9.660	9.504	9 1/2	9 1/2
10.750	11.750	65.70	9.560	9.404	9 1/4	9 1/4
11.750	12.750	42.00	11.084	10.928	10 5/8	10 5/8
11.750	12.750	47.00	11.000	10.844	10 5/8	10 5/8
11.750	12.750	54.00	10.880	10.724	10 5/8	10 5/8
11.750	12.750	60.00	10.772	10.616	10 1/2	9 7/8
13.375	14.375	48.00	12.715	12.559	12 1/4	12 1/4
13.375	14.375	54.50	12.615	12.459	12 1/4	12 1/4
13.375	14.375	61.00	12.515	12.359	12 1/4	12 1/4
13.375	14.375	68.00	12.415	12.259	12 1/4	12 1/4
13.375	14.375	72.00	12.347	12.191	12	12
16.000	17.000	65.00	15.250	15.062	14 3/4	14 3/4
16.000	17.000	75.00	15.124	14.936	14 3/4	14 3/4
16.000	17.000	84.00	15.010	14.822	14 3/4	14 3/4
18.625	20.000	87.50	17.755	17.567	17 1/2	17 1/2
20.000	21.000	94.00	19.124	18.936	18 1/2	18
20.000	21.000	106.50	19.000	18.812	18 1/2	18
20.000	21.000	133.00	18.730	18.542	18 1/2	18
20.000	21.000	169.00	18.376	18.188	18	18

Technical Data

Breakout Plates | Nozzles | Make-up Torque

Nozzles

Bit Size	Standard Nozzle	Mini-Extended Nozzle	HighFlow Extended Nozzle	Center Jet Nozzle
3 1/2" - 3 3/4"	AA			
3 7/8" - 4 1/8"	FA			
4 1/2" - 4 3/4"	FB			
5 5/8" - 6 3/4"	FF	LF		
7 5/8" - 7 7/8"	FH	LH		FF / VF
8 3/8" - 9 7/8"	FK	LK		FF / VF
9 7/8" - 13 1/2"	FK	LK		
10 5/8" - 14"	FK	LK	FK / LK	FK / VK
14" - 22"	FL	LL	FL / LL	FK / VK
19" - 30"	FL	LL		FK / VK

Nozzle Availability

Standard								Mini-Extended				Vortex		C3	Air
Size	AA	FA	FB	FF	FH	FK	FL	LFB	LHB	LKB	LLB	VF	VK		
00	●	●	●	●	●	●	●								●
06	●	●													
08	●	●	●	●	●	●	●	●					●		
09			●	●	●	●	●	●	●	●					
10	●	●	●	●	●	●	●	●	●	●		●	●		
11			●	●	●	●	●	●	●	●					
12	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
13			●	●	●	●	●	●	●	●					
14		●	●	●	●	●	●		●	●	●		●	●	
15			●	●	●	●	●		●	●					
16		●	●	●	●	●	●		●	●	●			●	●
18			●	●	●	●	●			●	●				●
20			●	●	●	●	●			●	●				●
22					●	●	●				●				
24					●	●	●								
26							●								
28					●	●	●								

Make-up Torque Recommended for Rock Bit Shanks

Shank Size	Recommended Torque	
	ft-lb	mm*
2 3/8"	3,000 - 3,500	4,100 - 4,700
2 7/8"	4,500 - 5,500	6,100 - 7,500
3 1/2"	7,000 - 9,000	9,500 - 12,200
4 1/2"	12,000 - 16,000	16,300 - 21,700
6 5/8"	28,000 - 32,000	38,000 - 43,400
7 5/8"	34,000 - 40,000	46,100 - 54,200
8 5/8"	40,000 - 60,000	54,200 - 81,300

* Converted from ft-lb

Breakout Plates

(To fit standard API rotary table Adapter)

Bit Size Range	Part Number
3 3/8" - 3 3/4"	033036
3 7/8" - 4 1/8"	037041
4 1/4" - 4 3/8"	042043
4 1/2" - 4 7/8"	044047
5 1/4" - 5 1/2"	052054B
5 5/8" - 5 7/8"	055057B
5 5/8" - 5 7/8"	060062B
5 5/8" - 5 7/8"	064066B
7 5/8" - 7 7/8"	075077B
8 3/8" - 8 5/8"	083085B
8 3/4" - 9"	086090B
9 1/2"	094000B
9 7/8"	097000B
10 5/8" - 11"	105110B
11 5/8"	115000B
12" - 12 1/4"	120122B
12 1/2"	124124B
13 1/2" - 13 3/4"	134136
13 1/2" - 13 3/4"	134136X
14 1/2" - 14 3/4"	144146
15 1/2"	154000
16"	160000
17 1/2"	174000
18 1/2"	184000
20"	200000
22"	220220
23"	230000
24" - 26"	240260
24" - 26"	240240X
28"	280000
30"	300000
31 1/2"	314000

Breakout Plates for Extended Nozzles

Bit Size Range	Part Number
5 5/8" - 5 7/8"	055057
6" - 6 1/4"	060062
6 1/2" - 6 3/4"	064066
7 5/8" - 7 7/8"	075077
8 3/8" - 9"	083090
9 7/8"	097000EN
12 1/4"	122000EN
14 3/4"	146001EN
16"	160001EN
17 1/2"	174001EN
18 1/2"	184000EN
22"	220220X
22"	220TPR
23"	230001

Tricone Optional Features



EnGauge Diamond Inserts (DX)

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



Spray-Coated Cones (R)

For additional wear resistance when drilling directional or abrasive applications, we offer a tungsten carbide spray coating for our cones.



Gauge Enhancement Package (G)

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



Breakage-Resistant Heels (H)

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



Diamond Gauge Trimmers (DT)

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



Diamond Heel Compacts (DH)

Every heel compact is diamond-enhanced.



Diamond Gauge / Diamond Trimmers (DDT)

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



Wear/Stabilization Pad (P)

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



STL Hardfacing

Patent-pending STL hardfacing is the industry's leading technology to strengthen the legs and shirrtails.



Diamond-Enhanced Wear Pad (DP)

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



Motor Hardfacing (M)

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



Shirrtail Compacts (S)

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



Diamond Shirrtail Compacts (DS)

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



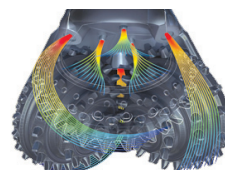
HighFlow Extended Nozzles (T)

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



Center Jet (C)

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



Three-Port Center Jet (C3)

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

Sales Offices

COMPANY HEADQUARTERS

9110 Grogan's Mill Road
The Woodlands, TX 77380-3615
Mailing Address:
P. O. Box 2539
Houston, TX 77252-2539
Delivery Address:
9175 Six Pines Drive
The Woodlands, TX 77380-1130
TEL: 281 363 6000
FAX: 281 363 6009

ABU DHABI

Arab Tower, 2nd Floor
Sheikh Hamdan Street
Abu Dhabi, U.A.E.
TEL: 9712 677 3200
FAX: 9712 676 3498

ALGERIA

BP 527 Route D'El Borma
Hassi-Messaoud 30500
Wilaya de Ouargla
Algeria
TEL: 213 29 739134
FAX: 213 29 739130

ANGOLA

Molongo Terminal 392 646
Cabinda
Angola
TEL: 44 171 487 8100 X 2391
FAX: 44 171 487 8100 X 2701

Sonils Base 488
Porto de Luanda
Republica de Angola
TEL: 244 2 311 747
FAX: 244 2 311 762

ARGENTINA

ARGENTINA / BAKER HUGHES
ARGENTINA SRL / HCC
Dr. Tomás de Anchorena 454
C1170ACH - Buenos Aires,
Argentina
TEL: 54 11 4378 6400
FAX: 54 11 4378 6460

Ruta 3, N° 3396
9000 Comodoro Rivadavia
Chubut, Argentina
TEL: 54 297 448 4666
FAX: 54 297 448 3555

Ruta 7, Km 3.5
Q8301XAC Neuquen
Argentina
TEL: 54 299 441 3378
FAX: 54 299 441 3384

Ruta 34, Km 1427
A4560CJA Gral Mosconi, Salta
Argentina
TEL: 54 3875 481958
FAX: 54 3875 481964

AUSTRALIA

Lvl 24, Santos House
91 King William Street
Adelaide 5000
South Australia
TEL: 61 88233 5821
FAX: 61 88233 5995

Lvl 23 HWT Tower
40 City Road
Southbank, Melbourne, 3006
Victoria, Australia
TEL: 61 39674 7140
FAX: 61 39674 7240

Level 7
256 St. Georges Terrace
Perth, 6000
Australia
TEL: 61 8 9217 7100
FAX: 61 8 9217 7101

AZERBAIJAN

ISR Plaza
69 Nizami Street, 6th Floor
Baku, Abseron AZ 1005
TEL: 994 12 4973026
FAX: 994 12 4973004

BOLIVIA

BOLIVIA / HCC
Km 7½ Carretera Antigua a
Cochabamba
Santa Cruz, Bolivia
TEL: 591 3 355 3910
FAX: 591 3 355 3912

BRAZIL

BAKER HUGHES DO BRAZIL LTDA.
Estrada de Imboassica,
s/n-Granja das Garças
Macaé - RJ - 27920-340 Brazil
TEL: 55 24 2773 6514
FAX: 55 24 2773 6559

BRAZIL HUGHES DO BRAZIL LTDA.
Rua Dezenove de Fevereiro, 30
CEP 22280-030-Botafogo
Rio de Janeiro
TEL: 55 21 2266 8400
FAX: 55 21 2266 8496

BRUNEI

Lot 49-50-63-64,
Tapak Perindustrian Pekan
Jalan Setia Di-Raja, Kuala Belait,
KA3131
Negara Brunei Darussalam
TEL: 673 3222 042
FAX: 673 3222 184

CANADA

1000, 401 - 9th Avenue SW
Calgary, Alberta T2P 3C5
TEL: 403 537 3400
FAX: 403 537 3905

5119 - 67th Avenue
Edmonton, Alberta T6B 2R8
TEL: 780 434 8800
FAX: 780 437 5706

10415 - 89th Avenue
Fort St. John, BC V1J 5P8
TEL: 250 785 3309
FAX: 250 785 3600

9509 - 110th Street
Grande Prairie, Alberta T8V 4Z2
TEL: 780 532 2942
FAX: 780 539 3529

5525 - 3rd Avenue
Edson, Alberta T7E 1L8
TEL: 780 723 5622
FAX: 780 723 6332

Box 3654
Vermilion, AB T9X 2B6
TEL: 780 581 8522
FAX: 780 853 7367

2, 6761 - 67th Avenue
Red Deer, Alberta T4P 1K3
TEL: 403 346 4765
FAX: 403 341 6330

27, 4948 - 126th Avenue SE
Calgary, Alberta T2Z 0X9
TEL: 403 250 2111
FAX: 403 250 1221

83 Devonian Street
Estevan, Saskatchewan S4A 2L7
TEL: 306 636 1656
FAX: 306 636 1650

215 Water Street
St. John's, NL A1C 6C9
TEL: 709 748 4900
FAX: 709 738 8624

141B Joseph Zatzman Drive
Dartmouth, Nova Scotia B3B 1M7
TEL: 902 481 0808
FAX: 902 481 0810

CHILE

CHILE / HUGHES TOOL CO.
CHILE LTDA.
While relocating to new facilities in
Chile, please contact our offices in
Buenos Aires, Argentina during this
transition period.
Argentina / Baker Hughes Argentina
SRL / HCC
Dr. Tomás de Anchorena 454,
C1170ACH - Buenos Aires,
Argentina
TEL: 54 11 4378 6400
FAX: 54 11 4378 6460

CHINA

6th floor, Tower C, The Fifth Square
No 7, Chaoyangmen Avenue,
Dongcheng District
Beijing, 100010
TEL: 86 10 8400 7888
FAX: 84 10 8400 7922

7th Floor, Chiwan Building
Shekou 518068, Shenzhen, GD
People's Republic of China
TEL: 86 755 2681 5577
FAX: 86 755 2669 3852

COLOMBIA

Calle 67 No. 7-35 Of 1108
Bogota D.C.
TEL: 57 1 7421600
FAX: 57 1 7421780

CONGO

Baker Hughes INTEQ Congo SARL
B.P. 357
Pointe-Noire
Congo
TEL: 242 2945861
FAX: 242 2942818

ECUADOR

Av. Amazonas 1014 & Av. Naciones
Unidas
La Previsora Building
Tower A, 5th Floor, Office 501
Quito, Ecuador
TEL: 593 2 2271 881
FAX: 593 2 2469 940

EGYPT

14, Road 280 New Maadi
Cairo, Egypt
TEL: 202 27545316
FAX: 202 27545315

EQUATORIAL GUINEA

Arptdo #713, Cocoteros Calle
Abilio Balboa No. 4
Malabo, Equatorial Guinea
TEL: 240 9 2781
FAX: 240 9 4398

FRANCE

Avenue Thimonnier
Lons, Aquitaine 64140
TEL: 33 5 59 92 77 09
FAX: 33 5 59 92 89 20

GABON

BP 587
Port Gentil
Gabon
TEL: 241 55 36 12
FAX: 241 55 09 28

GERMANY

Baker-Hughes-Strasse 1
Celle, Niedersachsen 29221
TEL: 49 5141 203 149
FAX: 49 5141 203 144

HUNGARY

Lovag Street 8, Vth Floor, No 13th
Vith District
Budapest
TEL/FAX: 36 30 6262 926

INDIA

BAKER HUGHES SINGAPORE PTE
15th Floor, Platinum Plaza, Platinum
TechnoPark
Plot 17-18, Sector 30-A, Vashi
Navi Mumbai, Maharashtra 400703
TEL: 91 22 6154 8500
FAX: 91 22 6154 8510

INDONESIA

PT Baker Hughes Indonesia
Jl. Mulawarman KM 16
RT. 15 RW. 03 No. 63 Batakan
Balikpapan, Kalimantan Timur
Indonesia 76116
TEL: 62 542 764 579
FAX: 62 542 764 319

6th Floor, The Garden Centre
Cilandak Commercial Estate
Jl. Cilandak K.K.O.
Jakarta 12560, Indonesia
TEL: 62 21 780 0737
FAX: 62 21 780 1682

ITALY

Via della Catalana 3
Ravenna, Ravenna 48100
TEL: 0039 0544424907
FAX: 0039 0854972054

Via Angelo, Moro 109
Centro Commerciale L'incontro
San Donato Milanese, Milano
20097
TEL: 39 02 51640503
FAX: 39 02 557 00 630

S S 602 Contrada da Calcasacco di
Villanova, Km 52+000
Cepagatti, Pescara 65012
TEL: 39 085 497501
FAX: 39 085 4972054

KAZAKHSTAN

154 A, Nauryzbai Str
BC Kablan, 4th floor
Almaty 050013
TEL: 8 7273 30 08 00
FAX: 8 7273 30 08 40

2 Azattyk Avr
Atyrau 060012
TEL: 8 7122 90 91 00
FAX: 8 7122 90 91 92

8 Microdistrict
Build 39
Aktau, Mangistau 130000
TEL: 8 7292 57 30 53

Office 101, 46 Bld
46 Moldagulova Avenue
Aktobe 030000
TEL: 8 7132 55 70 44
FAX: 8 7132 55 70 25

28 Aiteke Bi Street
Kyzylorda 120014
TEL: 8 7242 26 19 29
FAX: 8 7242 26 19 51

KUWAIT

Bldg. No. 13, 14, 15, & 16
Opp. Al-Rasai
Glass Manufacturing
Area 6, East Ahmadi
Kuwait
TEL: 965 398 0720
FAX: 965 398 0751

LIBYA

T4 F1 Dat Elmad Towers
PO. Box 91357
Tripoli
TEL: 00218 21 336 0089 93
FAX: 00218 21 335 0014

MALAYSIA

Common Warehouse Phase II
Kemaman Supply Base, Kemaman
24007
Trellanganu, Malaysia
TEL: 609 8623544
FAX: 609 8634568

BAKER HUGHES MALAYSIA SDN
BHD
25th Floor, Manara Tan & Tan
207, Jalan Tun Razak
50450 Kuala Lumpur
West Malaysia
TEL: 60 3 2164 7888
FAX: 60 3 2163 2034

BAKER HUGHES MALAYSIA SDN
BHD
A17, Block A
Manmohan's Warehouse
Jalan Patau-Patau
PO Box 81722
87027 Labuan FT, Malaysia
TEL: 60 87 411 718
FAX: 60 87 412 675

HCC BITS MALAYSIA SDN BHD
Lot 31, Block 3
2nd Floor, Naba Building
Plassau Industrial Estate
98000 Miri, Sarawak
East Malaysia
TEL: 6 085 658 833
FAX: 6 085 659 944

MEXICO

BAKER HUGHES DE MEXICO
Carretera estatal No2 Km. 23.5 s/n
Col Ej. Miguel Hidalgo.
CP 21705
Mexicali BC
TEL/FAX: 52 686 523 09 55

BAKER HUGHES DE MEXICO
Blv. Manuel Ávila Camacho No. 138
5° Piso, Col. Lomas de Chapultepec
CP 11560 México DF
TEL: 52 55 8525 4440
FAX: 52 55 8535 4466

BAKER HUGHES DE MEXICO
AV. Occidental 1919
Col. Ampliación Rodríguez
CP 88630 Reynosa, Tamaulipas
TEL/FAX: 52 899 925 02 03

BAKER HUGHES DE MEXICO
Ezequiel Ordóñez #105 Col. Palmas
CP 93230 Poza Rica, Veracruz
TEL: 52 782 111 1735 / 1736

BAKER HUGHES DE MEXICO
Juan Barragán # 530
Entre 1 de Mayo y Gómez Farias
Col. Flores Magon
CP 91900 Veracruz
TEL/FAX: 52 229 931 74 96

BAKER HUGHES DE MEXICO
Edificio Ceiba
Calle Ceiba s/n entre calle Alpes y
calle Pirineos
Fraccionamiento Lisboa
Colonia 1ro. De Mayo
CP 86190 Villahermosa, Tabasco
TEL: 52 993 187 98 00
FAX: 52 993 187 98 31

BAKER HUGHES DE MEXICO
Km 9 + 200 Carretera Federal 180
Carmen Puerto Real
Av. Edzna del Fracc. Mundo Maya
Parque Ind. Laguna de Términos
CP 24190 Cuidad del Carmen
Campeche
TEL: 52 938 381 07 70
FAX: 52 938 38 1 07 70
ext. 2191

THE NETHERLANDS

Wijkmeerweg 7A
Velsen-Noord, Noord-Holland
1951 AH
TEL: 31 251 260500
FAX: 31 251 260555

NEW ZEALAND

177 Courtenay Street
New Plymouth 4310
New Zealand
TEL: 64 6 7580797
FAX: 64 6 7699289

NIGERIA

10B Club Road Ikoyi
Ikoyi
Lagos, Nigeria
TEL: 234 1 271 8402

BAKER HUGHES NIGERIA LIMITED
175 Trans Amadi Ind Layout
Port Harcourt, Nigeria
TEL: 234 84 238 884
FAX: 234 84 236 086

NORWAY

Kokstadveien 31a
N-5061 Kokstad
Norway
TEL: 47 55 986 660
FAX: 47 55 227 697

Ekofiskveien 1
4056 Tananger
Norway
TEL: 47 51 717 900
FAX: 47 51 717 901

OMAN

Al Raid House
Opposite Sabco Commercial Center
2nd Floor, Qurum
Sultante of Oman
TEL: 968 571 029
FAX: 968 561 856

PAKISTAN

Plot No. 193 Street-1
Sector I-10/3
Islamabad
TEL: 92 51 4430791
FAX: 92 51 4430796

Sales Offices

PERU

BAKER HUGHES ARGENTINA S.R.L.
Sucursal del Peru
Av. Republica De Panama 3055
Piso 9, San Isidro
Lima 27, Perú
TEL: 51 1 441 42 42
FAX: 51 1 442 09 30

BAKER HUGHES ARGENTINA S.R.L.
Sucursal del Peru
Av. H 55 - "A"
Talara - Perú
TEL: 51 74 382955
FAX: 51 74 381167

PHILIPPINES

Unit 4, 4th Floor RB Building
No.1 Don Jesus Boulevard
Corner West Service Road
Alabang Hills, Cupang
Muntinlupa City 1771
Philippines
TEL: 632 842 4081
FAX: 632 842 4194

QATAR

AAB Toyota Tower 2nd Floor
'C' Ring Road
Doha, Qatar
TEL: 974 436 5109
FAX: 974 442 2936

ROMANIA

Parc Industrial Ploiesti, Soseaua
Ploiesti-Targoviste km 8, 10
Conului St
Ploiesti, Prahova
TEL: 40 244 436 111 /2 /3 /4 /5
FAX: 40 0 244 436 117

RUSSIA

BAKER HUGHES
Fourth Floor, Building 9
37 Leningradsky Prospect
Moscow, 125167 Russia
TEL: 7 495 771 7240
FAX: 7 495 771 7246

SAUDI ARABIA

2nd Industrial City
Abqaiq Highway
Dammam, Saudi Arabia
TEL: 966 3 812 1838
FAX: 966 3 812 2057

SINGAPORE

273 Jalan Ahmad Ibrahim
Jurong, Singapore 629150
TEL: 65 6864 1512
FAX: 65 6863 3800

SOUTH AFRICA

BAKER HUGHES SA
Block B, Silverwood,
Steenberg Estate, Steenberg
Cape Town, 7945
TEL: 27 (0)21 702 8100
FAX: 27 (0)21 701 1110

SPAIN

Calle Caleruega, 81
Madrid, Madrid 28033
TEL: 34 91 515 51 18
FAX: 34 914 672 161

THAILAND

15/F Q House Asoke Room 1515
66 Sukhumvit 21 Road
Bangkok 10110, Thailand
TEL: 66 2 264 2211
FAX: 66 2 264 2210

BAKER HUGHES (THAILAND)
CO., LTD.
428 Khoyor Road, Tambol Phawong
Amphur Muang, Songkhla
90100 Thailand
TEL: 6674 333977 / 8
FAX: 6674 333979

TRINIDAD & TOBAGO

Maple House, 3rd Floor
3 & 3A Sweet Briar Road
St Clair, Port of Spain,
Trinidad and Tobago, W.I.
TEL: 868 622 3962
FAX: 868 622 3993

TUNISIA

Rue Okba Ibn Nafaa B.P. 115
B.P. 115
30018 Sfax
Tunisia
TEL: 216 74 497 027
FAX: 216 74 497 029

Immeuble Fajr
App. No. 203, 2eme Etage
Rue Du Lac Lockness
Les Berges Du Lac
1053 Tunis, Tunisia
TEL: 216 71 515
FAX: 216 71 963 005

UNITED ARAB EMIRATES

BAKER HUGHES EHO LIMITED
Hughes Christensen Division
Block - B18
Oilfield Supply Centre Ltd. (Opposite
DPC)
Jebel Ali Free Zone - Dubai, U.A.E.
TEL: 971 4 808 2200
FAX: 971 4 883 6487

UNITED KINGDOM

Baker Hughes Building
Stoneywood Park North
Dyce,
Aberdeen, Aberdeenshire AB21 7EA
United Kingdom
TEL: 44 1 224 720 000
FAX: 44 1 224 720 008

UNITED STATES

REGION HEADQUARTERS
17015 Aldine Westfield
Houston, TX 77073
TEL: 713 625 6654
FAX: 713 625 6655

ALASKA

7260 Homer Drive
Anchorage, AK 99518-2309
TEL: 907 267 6600
FAX: 907 267 6623

Pouch 340004
Prudhoe Bay, AK 99734
TEL: 907 659 2362
FAX: 907 659 2464

CENTRAL US

6290 Heber Springs Rd. West
Quitman, AR 72131
TEL: 501 589 3330
FAX: 501 589 2995

2007 West Third Street
Liberal, KS 67901
TEL: 620 655 8892
FAX: 620 624 5390

3000 North Hemlock Circle
Broken Arrow, OK 74012
TEL: 918 455 3000
FAX: 918 259 2046

202 S. Swallow Drive
McAlester, OK 74501
TEL: 918 426 6585
FAX: 918 426 6596

3030 NW Expressway, Suite 300
Oklahoma City, OK 73112
TEL: 405 917 6700
FAX: 405 917 6740

1124 E. Reno
Oklahoma City, OK 73117
TEL: 405 290 7162
FAX: 405 278 7336

219 South 8th Street
Weatherford, OK 73096
TEL: 580 772 2310
FAX: 580 772 3718

AGENT
1421 34th Street
Woodward, OK 73801
TEL: 580 256 3872
FAX: 580-254-5200

500 W. 7th. Suite 1729 Unit 42
Ft. Worth, TX 76102
TEL: 817 348 8105
FAX: 817 348 8192

2525 Wann Perkins Circle
Granbury, TX 76049
TEL: 817 579 6014
FAX: 817 579 6865

940 South Blue Mound Road
Saginaw, TX 76131
TEL: 817 232 7018
FAX: 817 232 3154

126 S. Houston
Pampa, TX 79065
TEL: 806 665 5022
FAX: 806 665 5026

EASTERN US

1461 Hawn Avenue
Shreveport, LA 71107
TEL: 318 222 9553
FAX: 318 221 8558

2410 Moose Drive
Laurel, MS 39440
TEL: 601 649 7400
FAX: 601 649 1005

1409 S. Adams
Carthage, TX 75633
TEL: 903 694 2611
FAX: 903 694 2992

7584 Hwy 79 South
Palestine, TX 75801
TEL: 903 538 2095
FAX: 903 538 2566

4556 FM2813
Flint, TX 75762
TEL: 903 871 2900
FAX: 903 839 2174

4080 Washington Blvd, Suite 4
Beaumont, TX 77705
TEL: 409 840 9475
FAX: 409 840 9662

AGENT
5580 Venture Way
Mt Pleasant, MI 44858
TEL: 989 775 6608
FAX: 989 775 6909

315 South State Street
Crossville, IL 62827
TEL: 304 993 3125
FAX: 724 695 2266

1807 Allen Ave SE, Bldg #19
Canton, OH 47707
TEL: 330 455 2140
FAX: 330 455 2151

14 Industrial Dr., Ste 1
Dubois, PA 15801
TEL: 814 375 9209
FAX: 814 375 9203

400 Imperial Industrial Park
Bldg 400
P.O. Box 134
Imperial, PA 15126
TEL: 724 695 2266
FAX: 724 695 2295

1150 Crestwood Rd.
Mountain Top, PA 18707
TEL: 570 403 5600
FAX: 570 403 5610

4998B Elk River Rd S
Elkview, WV 25071
TEL: 304 965 5800
FAX: 304 965 3715

GULF COAST

136 Equity Blvd.
Houma, LA 70360
TEL: 985 223 7600
FAX: 985 718 4442

118 South Park
Lafayette, LA 70508
TEL: 337 837 1414
FAX: 337 837 1022

1515 Poydras, Suite 2400
New Orleans, LA 70112
TEL: 504 561 8826
FAX: 504 561 8829

17015 Aldine Westfield
Houston, Texas 77073
TEL: 713 625 6654
FAX: 713 625 6655

SOUTHERN US

401 S. Park Street
Brenham, TX 77833
TEL: 979 421 9775
FAX: 979 421 9776

800 North Shoreline Blvd.
Suite 700 N. Tower
Corpus Christi, TX 78401
TEL: 361 880 4063
FAX: 361 880 4071

430 Navigation Blvd.
Corpus Christi, TX 78408
TEL: 361 883 0241
FAX: 361 887 0487

129 Ranch Road / 6086 B Highway
359 East
Laredo, TX 78043
TEL: 956 723 5434
FAX: 956 723 5962

5510 North Cage
Building M
Pharr, TX 78577
TEL: 956 702 9912
FAX: 956 283 7408

12950 Country Parkway, Ste 120
San Antonio, TX 78216-2004
TEL: 210 491 9058
FAX: 210 491 9624

13003 Murphy Road, Ste M-13
Stafford, TX 77477
TEL: 281 498 4442
FAX: 281 498 2318

2604-A East Rio Grande
Victoria, TX 77901
TEL: 361 575 0594
FAX: 361 578 6498

WEST TEXAS/NEW MEXICO

3237 Industrial Drive
Hobbs, NM 88240
TEL: 505 392 1284
FAX: 505 392 1474

409 N. Nelson Street
Ft. Stockton, TX 79735
TEL: 432 336 0255
FAX: 432 336 0265

2105 Market Street
Midland, TX 79703
TEL: 432 681 7800
FAX: 432 495 7200

3300 N. A Street
Midland TX 79705-5469
TEL: 432 570 1050
FAX: 432 683 7209

AGENT
27 Southridge
San Angelo, TX 76904
TEL: 325 650 4557
FAX: 325 949 4759

AGENT
5005 Tabosa
San Angelo, TX 76904
TEL: 325 944 4999
FAX: 325 944 7199

WESTERN US

1675 Broadway Suite 1500
Denver, CO 80202
TEL: 303 573 8606
FAX: 303 825 5706
303 825 5707

5151 Reserve Drive
Evansville, WY 82636
TEL: 307 472 0001
FAX: 307 472 0161

1700 East 1586 South
Vernal, UT 84078
TEL: 435 789 3413
FAX: 435 789 2815

554 25 Road, Unit 6
Grand Junction, CO 81505
TEL: 970 241 7934
FAX: 970 241 7956

2721 Killpecker Drive
Rock Springs, WY 82901
TEL: 307 362 6844
FAX: 307 362 6735

125 48th Ave S.W.
Dickinson, ND 58601
TEL: 701 483 6512
FAX: 701 483 6513

2916 1st Avenue West
Williston, ND 58801
TEL: 701 774 0375
FAX: 701 572 8669

AGENT
5773 U.S. Hwy 64
Farmington, NM 87401
TEL: 505 632 1452
FAX: 505 632 0438

AGENT
449 Industrial Drive
Ft. Collins, CO 80524
TEL: 970 493 3018
FAX: 970 493 3037

5010 Lisa Marie Court
Bakersfield, CA 93313
TEL: 661 837 9711
FAX: 661 837 9601

AGENT
2150 DeAnn Drive
Carson City, NV 89701
TEL: 775 882 7983
FAX: 775 882 8387

AGENT
430 Douglas Lane
Woodland, CA 95776
TEL: 530 666 2119
FAX: 530 666 4726

VENEZUELA

Avenida Intercomunal Sector Las
Morochas
Via Terminales Maracaibo,
Al lado de la Escuela
Las Morochas, Ciudad Ojeda
Estado Zulia, Venezuela
TEL: 58 265 4002 555
FAX: 58 265 4002 576

Av. 66. Nº 62-609. 1º Etapa
Zona Industrial Maracaibo - Edo.
Zulia
Venezuela
TEL: 58 261 7363 244
FAX: 58 261 7362 660

Av. Alirio Ugarte Pelayo
Edif. Harvest Vincicler - Piso 1
Maturin - Estado Monagas
TEL: 58 291 3003000
FAX: 50 291 6430959

VIETNAM

BAKER HUGHES
c/o BITEKCO Office Building,
2nd / 17th floor
19-25 Nguyen Hue Blvd, District 1
Ho Chi Minh City, S.R. Vietnam
TEL: 84 8 3 821 3732/3742
FAX: 84 8 3 821 1401

BAKER HUGHES
Petro Vietnam Towers,
5th Floor, Suite 520
No. 8 Hoang Dieu
Vung Tau, S.R. Vietnam
TEL: 84 64 351 0425
FAX: 84 64 351 0426

YEMEN

Villa #6 Off Street No. 24
Sanaa, Yemen
TEL: 967 1 414 462
FAX: 967 1 417 888

Terms and Conditions / Worldwide

Note: this agreement contains provisions which indemnify and/or release the indemnified and/or released party from the consequences of its own negligence and other legal fault.

Orders for rental equipment ("Equipment"), services ("Services"), and the supply or sale of products or equipment ("Products") to be provided by BAKER HUGHES INCORPORATED, or its operating divisions, or its direct or indirect wholly-owned subsidiaries (in each case as applicable referred to herein as "BHI") to its customers (each a "CUSTOMER") are subject to acceptance by BHI, and any orders so accepted will be governed by the terms and conditions stated herein and any additional terms proposed or agreed to in writing by an authorized representative of BHI (these terms and conditions and any such additional terms collectively referred to herein as the "Agreement"). Any additions to or modifications of these terms and conditions, or any terms and conditions contained in CUSTOMER's order inconsistent herewith, shall not bind BHI unless accepted in writing by an authorized representative of BHI.

1. PAYMENT TERMS

Unless alternate payment terms are specified or approved by the BHI Credit Department, all charges, including applicable packing and transportation costs, billed by BHI are payable within thirty (30) days of the date of invoice. At BHI's option, interest may be charged at the rate of ten percent (10%) per annum unless such rate contravenes local law in which case the interest charged will be the maximum allowed by law. Operating, production or well conditions which prevent satisfactory operation of Equipment, Services or Products do not relieve CUSTOMER of its payment responsibility.

2. CANCELLATION

Products: Orders for Products which are subject to cancellation after acceptance by BHI will be subject to a restocking charge of at least twenty-five percent (25%), plus any actual packing and transportation costs. Products specially built or manufactured to CUSTOMER specifications, or orders for substantial quantities manufactured specially for CUSTOMER, may only be canceled subject to either (i) payment of a cancellation fee by CUSTOMER, or (ii) a return credit against future purchases, to be determined solely by BHI. Credit for unused Products will be issued for the quantity returned at the original purchase price, less restocking or cancellation charges, provided the returned Products are in reusable condition. No credit will be given for shipping charges incurred by CUSTOMER. In no event will credit be allowed for Products returned without prior written authorization by BHI. Equipment/Services: In the event CUSTOMER cancels an order for Services or Equipment, CUSTOMER shall be liable for all costs incurred by BHI in the mobilization/demobilization related thereto, and any other reasonable costs incurred by BHI incident to such cancellation. In addition, a restocking charge of at least twenty-five percent (25%) of the original order may be applied at BHI's sole discretion.

3. THIRD-PARTY CHARGES, TAXES

CUSTOMER shall pay all third-party charges, in compliance with BHI's current price list, and any sales, use, rental or other taxes that may be applicable to transactions hereunder. CUSTOMER shall pay all applicable customs, excise, import and other duties unless otherwise agreed to in writing by an authorized representative of BHI. CUSTOMER shall provide necessary import licenses and extensions thereof.

4. RISK OF LOSS AND TITLE

For Product sales within the United States of America, title and risk of loss shall pass to CUSTOMER as soon as the Products depart BHI's point of origin. For Product sales outside the United States of America, unless otherwise agreed to in writing between BHI and CUSTOMER, INCOTERM "CPT" shall apply with the following exception: TITLE AND RISK OF LOSS REMAIN WITH BHI UNTIL THE PRODUCTS REACH THE PORT OF ENTRY.

5. LIABILITIES, RELEASES AND INDEMNIFICATION:

A. In this Agreement, "Claims" shall mean all claims, demands, causes of action, liabilities, damages, judgments, fines, penalties, awards, losses, costs, expenses (including, without limitation, attorneys' fees and costs of litigation) of any kind or character arising out of, or related to, the performance of or subject matter of this Agreement (including, without limitation, real or personal property loss, damage or destruction, personal or bodily injury, illness, sickness, disease or death, loss of services or wages, or loss of consortium or society).

B. BHI shall release, indemnify, defend and hold CUSTOMER, its parent, subsidiary and affiliated or related companies, and the officers, directors, employees, consultants and agents of all of the foregoing (referred to in this Agreement as "CUSTOMER INDEMNITEES") harmless from and against any and all Claims asserted by or in favor of any member of BHI INDEMNITEES (as defined in paragraph C. below) or BHI INDEMNITEES' subcontractors at any tier or their employees, agents, or invitees.

C. CUSTOMER shall release, indemnify, defend and hold BHI, its parent, subsidiary and affiliated or related companies, and the officers, directors, employees, consultants and agents of all of the foregoing (referred to in this Agreement as "BHI INDEMNITEES") harmless from and against any and all Claims asserted by or in favor of any member of CUSTOMER INDEMNITEES or CUSTOMER INDEMNITEES' contractors at any tier (except BHI INDEMNITEES or BHI INDEMNITEES' subcontractors) or their employees, agents or invitees.

D. Notwithstanding paragraph B. above, should any of BHI INDEMNITEES' or BHI INDEMNITEES' subcontractors' instruments, equipment or tools ("Tools") become lost or damaged in the well when performing or attempting to perform the Services hereunder, it is understood that CUSTOMER shall make every effort to recover the lost or damaged Tools. CUSTOMER shall assume the entire responsibility for such fishing operations in the recovery or attempted recovery of any such lost or damaged Tools. None of BHI's employees are authorized to do anything whatsoever, nor shall any of BHI's employees be required by CUSTOMER to do anything, other than consult in an advisory capacity with CUSTOMER in connection with such fishing operations. Should CUSTOMER fail to recover such Tools lost in the well, or should such Tools become damaged in the well, or damaged during recovery, CUSTOMER shall reimburse BHI the replacement value of such lost Tools or for the cost of repairing any Tools so damaged. Further, all risks associated with loss of or damage to property of BHI INDEMNITEES or BHI INDEMNITEES' subcontractors while in the custody and control of CUSTOMER or during transportation arranged by or controlled by CUSTOMER, shall be borne by CUSTOMER.

E. Notwithstanding anything contained in this Agreement to the contrary, CUSTOMER, to the maximum extent permitted under applicable law, shall release, indemnify, defend and hold BHI INDEMNITEES and BHI INDEMNITEES' subcontractors harmless from and against any and all Claims asserted by or in favor of any person or party, including BHI INDEMNITEES, CUSTOMER INDEMNITEES or any other person or party, resulting from: (i) loss of or damage to any well or hole (including but not limited to the costs of re-drill), (ii) blowout, fire, explosion, cratering or any uncontrolled well condition (including but not limited to the costs to control a wild well and the removal of debris), (iii) damage to any reservoir, geological formation or underground strata or the loss of oil, water or gas therefrom, (iv) the use of BHI INDEMNITEES' or BHI INDEMNITEES' subcontractors' radioactive tools or any contamination resulting therefrom (including but not limited to retrieval or containment and clean-up), (v) pollution or contamination of any kind (other than surface spillage of fuels, lubricants, rig sewage or garbage, to the extent attributable to the negligence of BHI INDEMNITEES) including but not limited to the cost of control, removal and clean-up, or (vi) damage to, or escape of any substance from, any pipeline, vessel or storage facility.

F. Neither party shall be liable to the other for any indirect, special, punitive, exemplary or consequential damages or losses (whether foreseeable or not at the date of this Agreement), including without limitation damages for lost production, lost revenue, lost product, lost profit, lost business or lost business opportunities.

G. In the event this Agreement is subject to the indemnity or release limitations in Chapter 127 of the Texas Civil Practices and Remedies Code (or any successor statute), and so long as such limitations are in force, each party covenants and agrees to support the mutual indemnity and release obligations contained in paragraphs

B. and C. above by carrying equal amounts of insurance (or qualified selfinsurance) in an amount not less than U.S. \$5,000,000.00.

H. THE EXCLUSIONS OF LIABILITY, RELEASES AND INDEMNITIES SET FORTH IN PARAGRAPHS B. THROUGH F. OF THIS ARTICLE 5. SHALL APPLY TO ANY CLAIM(S), LOSSES OR DAMAGES WITHOUT REGARD TO THE CAUSE(S) THEREOF INCLUDING BUT NOT LIMITED TO PRE-EXISTING CONDITIONS, WHETHER SUCH CONDITIONS BE PATENT OR LATENT, THE UNSEAWORTHINESS OF ANY VESSEL OR VESSELS, IMPERFECTION OF MATERIAL, DEFECT OR FAILURE OF PRODUCTS OR EQUIPMENT, BREACH OF REPRESENTATION OR WARRANTY (EXPRESS OR IMPLIED), ULTRAHAZARDOUS ACTIVITY, STRICT LIABILITY, TORT, BREACH OF CONTRACT, BREACH OF DUTY (STATUTORY OR OTHERWISE), BREACH OF ANY SAFETY REQUIREMENT OR REGULATION, OR THE NEGLIGENCE OR OTHER LEGAL FAULT OR RESPONSIBILITY OF ANY PERSON (INCLUDING THE INDEMNIFIED OR RELEASED PARTY), WHETHER SUCH NEGLIGENCE BE SOLE, JOINT OR CONCURRENT, ACTIVE OR PASSIVE.

I. REDRESS UNDER THE INDEMNITY PROVISIONS SET FORTH IN THIS ARTICLE 5. SHALL BE THE EXCLUSIVE REMEDY(-IES) AVAILABLE TO THE PARTIES HERETO FOR THE MATTERS, CLAIMS, DAMAGES AND LOSSES COVERED BY SUCH PROVISIONS.

6. DIRECTIONAL DRILLING

CUSTOMER shall release, defend, indemnify and hold BHI INDEMNITEES harmless from and against any Claims arising out of, or related to, subsurface trespass arising out of directional drilling operations or other operations performed by BHI or its employees, CUSTOMER or its employees, or other contractors or their employees. CUSTOMER shall furnish BHI with a well location plan (certified by CUSTOMER as correct) setting out the surface location of the well, the lease, license, or property boundary lines, and the bottom hole location of CUSTOMER's directionally drilled well. If in the course of drilling the well, it becomes evident to BHI that the certified plan is in error, BHI shall at once notify CUSTOMER of the error, and CUSTOMER shall be responsible to regulate all directional drilling factors so that CUSTOMER's well bottom hole location will be situated on CUSTOMER's property, license, or leasehold at total depth of the well being drilled.

7. CUSTOMER WARRANTY/BINDING AUTHORITY

If CUSTOMER is not the sole owner of the mineral interests, the well or the field, CUSTOMER's request for Services, Equipment or Products shall constitute CUSTOMER's warranty that CUSTOMER is the duly constituted agent of each and every owner and has full authority to represent the interests of the same with respect to all decisions taken throughout the provision of any Services, Equipment or Products hereunder. CUSTOMER will defend, release, indemnify and hold BHI INDEMNITEES harmless from and against all Claims resulting from the allegation by any person that CUSTOMER has misrepresented or lacked sufficient authority to represent such person as warranted by CUSTOMER in this Article.

8. ACCESS TO WELL AND STORAGE

With respect to onshore and offshore operations, CUSTOMER shall provide at its expense adequate means of transportation required for Equipment, Products and BHI personnel to gain access to or return from a well site, and shall obtain at CUSTOMER's sole cost and expense all permits, licenses or other authorization required for BHI to enter upon work areas for the purposes contemplated. When necessary to repair roads or bridges, or to provide transportation to move Equipment, Products or BHI personnel, such shall be arranged and paid for by CUSTOMER.

CUSTOMER shall provide safe transportation and proper storage space at the well site, meeting all applicable safety and security requirements and consistent with good industry practices, for the Equipment and Products, including without limitation, all explosive and radioactive materials.

9. RADIOACTIVE SOURCES

Radioactive sources which may be used in BHI's Services are potentially dangerous. CUSTOMER agrees to comply with all applicable governmental regulations governing the use and handling of radioactive sources. In the event a radioactive source becomes stuck in a well, CUSTOMER, at

CUSTOMER's sole risk and expense will (i) use special precautions to prevent damaging the source during recovery operations, or (ii) if the source cannot be recovered, isolate the radioactive material by cementing it in place or by other means consistent with applicable regulations.

10. WARRANTY

A. Services: BHI warrants that the Services to be provided by BHI pursuant to this Agreement shall conform to the material aspects of the specifications set forth in the relevant scope of work document agreed to in writing by BHI and CUSTOMER. In the event that the Services fail to conform with such specifications, BHI shall re-perform that part of the non-conforming Services, provided BHI is notified thereof by CUSTOMER prior to BHI's departure from the work site.

B. Equipment: BHI warrants that the Equipment will be of the types specified by CUSTOMER and will be in good operating condition. Liability for loss or damage to Equipment is set forth in Article 5.

C. Products: (EXCLUDING DRILL BITS, ELECTRIC SUBMERSIBLE PUMPS AND ASSOCIATED CABLE AND SURFACE EQUIPMENT, SPECIALTY CHEMICAL PRODUCTS AND SPECIALTY PRODUCTS): BHI warrants that the Products to be provided by BHI pursuant to this Agreement shall conform to BHI's published specifications or the specifications agreed to in writing by BHI and CUSTOMER. If any of the Products fail to conform with such specifications upon inspection by BHI, BHI, at its option, shall repair or replace the non-conforming Products with the type originally furnished or issue credit to the CUSTOMER, provided BHI is notified thereof in writing within thirty (30) days after delivery of the particular Products.

D. Drill Bits: BHI warrants that the drill bits to be provided by BHI pursuant to this Agreement shall conform to BHI's published specifications. If any of the drill bits fail to conform to such specifications upon inspection by BHI, BHI, at its option, shall repair or replace the non-conforming drill bits with the type originally furnished or issue credit to the CUSTOMER, provided BHI is notified thereof in writing within ninety (90) days from the date of shipment.

E. Electric Submersible Pumps and Associated Cable and Surface Equipment: BHI warrants that the electrical submersible pumps and associated cable and surface equipment to be provided by BHI pursuant to this Agreement shall conform to BHI's published specifications. If any of the electric submersible pumps or associated cable or surface equipment fail to conform with such specifications upon inspection by BHI, BHI, at its option, shall repair or replace the non-conforming electric submersible pumps or associated cable or surface equipment with the type originally furnished, provided BHI is notified thereof in writing within the earlier of twelve (12) months from the date of installation or eighteen (18) months from the date of shipment. Warranty claims by CUSTOMER must be submitted to BHI within sixty (60) days after the later of the pulling date or failure date of the electric submersible pumps or associated cable or surface equipment.

F. Specialty Chemical Products: BHI warrants that the specialty chemical products to be provided by BHI pursuant to this Agreement shall, upon its departure from BHI's point of origin, conform to the published physical and chemical specifications established by BHI for each such product. If any of the specialty chemical products fail to conform to such specifications, BHI, at its option, shall replace the non-conforming specialty chemical products with the type originally furnished or issue credit to the CUSTOMER, provided BHI is notified thereof in writing within thirty (30) days after the specialty chemical products depart BHI's point of origin.

G. Specialty Products: In the event BHI is to provide Products to CUSTOMER based upon CUSTOMER's specific request that BHI develop, manufacture, test or put to use Products that are intended to satisfy a unique need identified by CUSTOMER and are not "standard" Products of BHI ("Specialty Products"), CUSTOMER hereby recognizes and agrees that the Specialty Products being provided do not, necessarily, have or contain the same or similar characteristics as BHI's "standard" Products,

including, but not limited to, a historical performance against which future performance can be measured. In developing, manufacturing, testing and putting to use any Specialty Products, BHI will be relying upon information and specifications provided by CUSTOMER relating to the unique needs to CUSTOMER. As such, BHI shall have no responsibility for the design, manufacture or engineering of any such Specialty Products, even though BHI may have participated in the development and manufacture of the Specialty Products, or for any CUSTOMER-furnished materials, information and specifications. If any of the Specialty Products fail to meet the specifications provided by CUSTOMER upon inspection by BHI, BHI shall, at its option, repair or replace the non-conforming Specialty Products with (i) the type originally furnished to CUSTOMER, or (ii) substituted Products having BHI's "standard" specifications and qualifications.

BHI's warranty obligations hereunder shall not apply if the nonconformity was caused by (i) CUSTOMER's failure to properly store or maintain the Products or Equipment, (ii) abnormal well conditions, abrasive materials, corrosion due to aggressive fluids or incorrect specifications provided by CUSTOMER, (iii) unauthorized alteration or repair of the Products or Equipment by CUSTOMER (iv) the Products or Equipment are lost or damaged while on CUSTOMER's site due to CUSTOMER's or any third party's negligence, vandalism or force majeure (including, but not limited to, lightning), or (v) use or handling of the Products or Equipment by CUSTOMER in a manner inconsistent with BHI's recommendations. Further, BHI's warranty obligations under this Article 10 shall terminate if (i) CUSTOMER fails to perform its obligations under this or any other Agreement between the parties, or (ii) CUSTOMER fails to pay any charges due BHI.

All non-conforming Products shall be delivered to the service facility designated by BHI. All transportation charges related to the repair or replacement of non-conforming Products shall be borne by CUSTOMER. Any parts for which BHI provides replacement under this warranty shall become the property of BHI. With regard to materials or equipment furnished by third party vendors and/or suppliers, BHI's liability therefor shall be limited to the assignment of such third party vendor's or supplier's warranty to CUSTOMER, to the extent such warranties are assignable.

Interpretations, research, analysis, recommendations, advice or interpretational data ("Interpretations and/or Recommendations") furnished by BHI hereunder are opinions based upon inferences from measurements, empirical relationships and assumptions, and industry practice, which inferences, assumptions and practices are not infallible, and with respect to which professional geologists, engineers, drilling consultants, and analysts may differ. Accordingly, BHI does not warrant the accuracy, correctness, or completeness of any such Interpretations and/or Recommendations, or that CUSTOMER's reliance on any third party's reliance on such Interpretations and/or Recommendations will accomplish any particular results. CUSTOMER assumes full responsibility for the use of such Interpretations and/or Recommendations and for all decisions based thereon (including without limitation decisions based on any oil and gas evaluations, production forecasts and reserve estimates, furnished by BHI to CUSTOMER hereunder), and CUSTOMER hereby agrees to release, defend and indemnify BHI from any Claims arising out of the use of such Interpretations and/or Recommendations.

BHI will endeavor to transmit data to CUSTOMER as accurately and securely as practicable in accordance with current industry practice. Notwithstanding the foregoing, BHI does not warrant the accuracy of data transmitted by electronic processes and will not be responsible to CUSTOMER for accidental or intentional interception of such data by others.

THIS ARTICLE 10 SETS FORTH CUSTOMER'S SOLE REMEDY AND BHI'S ONLY OBLIGATION WITH REGARD TO NON-CONFORMING SERVICES, EQUIPMENT OR PRODUCTS. EXCEPT AS IS OTHERWISE EXPRESSLY PROVIDED PURSUANT TO THE PROVISIONS OF THIS ARTICLE 10, BHI MAKES NO WARRANTY OR GUARANTEE OF ANY KIND, EXPRESS OR

IMPLIED, INCLUDING NO IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, REGARDING ANY SERVICES PERFORMED OR EQUIPMENT OR PRODUCTS SUPPLIED BY BHI HEREUNDER.

11. LOST-IN-HOLE COVERAGE

In some locations, lost-in-hole coverage is available for some Equipment. Such coverage must be purchased by CUSTOMER prior to the Equipment leaving BHI's point of origin for the coverage to take effect. BHI reserves the right not to offer coverage at its sole discretion.

12. INSURANCE

Upon written request, each party shall furnish to the other party certificates of insurance evidencing the fact that adequate insurance to support each party's obligations hereunder has been secured. To the extent of each party's release and indemnity obligations hereunder, each party agrees that all such insurance policies shall (i) be primary to the other party's insurance, (ii) include the other party, its parent, subsidiary and affiliated or related companies, and its and their respective officers, directors, employees, consultants and agents as additional insured, and (iii) be endorsed to waive subrogation against the other party, its parent, subsidiary and affiliated or related companies, and its and their respective officers, directors, employees, consultants and agents.

13. CHANGE OF DESIGN

BHI expressly reserves the right to change or modify the design and construction of any of its Products without obligation to furnish or install such changes or modifications on Products previously or subsequently sold.

14. PATENTS

BHI warrants that the use or sale of Equipment or Products hereunder will not infringe patents of others by reason of the use or sale of such Equipment or Products per se, and hereby agrees to hold CUSTOMER harmless against judgment for damages for infringement of any such patent, provided that CUSTOMER shall promptly notify BHI in writing upon receipt of any claim for infringement, or upon the filing of any such suit for infringement, whichever first occurs, and shall afford BHI full opportunity, at BHI's option of suit and expense, to answer such claim or threat of suit, assume the control of the defense of such suit, and settle or compromise same in any way BHI sees fit. BHI does not warrant that such Equipment or Products: (a) will not infringe any such patent when not of BHI's manufacture, or specially made, in whole or in part, to the CUSTOMER's design specifications; or (b) if used or sold in combination with other materials or apparatus or used in the practice of processes, will not, as a result of such combination or use, infringe any such patent, and BHI shall not be liable and does not indemnify CUSTOMER for damages or losses of any nature whatsoever resulting from actual or alleged patent infringement arising pursuant to (a) and (b) above. THIS PARAGRAPH STATES THE ENTIRE RESPONSIBILITY OF BHI CONCERNING PATENT INFRINGEMENT.

15. CONFIDENTIALITY

Each party shall maintain all data and information obtained from the other party in strict confidence, subject only to disclosure required by law or legal process. In the event that BHI owns copyrights to, patents to, or has filed patent applications on, any technology related to the Services, Products or Equipment furnished by BHI hereunder, and if BHI makes any improvements on such technology, then such improvements shall not fall within the confidentiality obligations included herein, and BHI shall own all such improvements, including drawings, specifications, calculations and other documents. The design, construction, application and operation of BHI's Services, Equipment and Products embody proprietary and confidential information. CUSTOMER shall maintain this information in strict confidence and shall not disclose it to others, subject only to disclosure required by law or legal process.

16. LIENS, ATTACHMENTS AND ENCUMBRANCES

Should CUSTOMER commit a material breach of any terms and conditions of this Agreement, become bankrupt, insolvent, go into receivership or should any creditor or other person attach or levy Customer's property or equipment, BHI shall immediately have the right, without notice and without liability for trespass or damages, to retake and remove any of its Products or Equipment wherever it may be found. CUSTOMER shall release, defend, indemnify and hold BHI Indemnitees

harmless from any and all liens and encumbrances against Products or Equipment furnished hereunder and shall return same promptly to BHI free of any liens or encumbrances.

17. FORCE MAJEURE

If either party is unable by reason of Force Majeure to carry out any of its obligations under this Agreement, other than obligations to pay money, then on such party giving notice and particulars in writing to the other party within a reasonable time after the occurrence of the cause relied upon, such obligations shall be suspended. "Force Majeure" shall include acts of God, laws and regulations, government action, war, civil disturbances, strikes and labor problems, delays of vendors or carriers, lightning, fire, flood, washout, storm, breakage or accident to equipment or machinery, shortage of raw materials, and any other causes that are not reasonably within the control of the party so affected.

18. INDEPENDENT CONTRACTOR

It is expressly understood that BHI is an independent contractor, and that neither BHI nor its principals, partners, employees or subcontractors are servants, agents or employees of CUSTOMER. In all cases where BHI's employees (defined to include BHI's and its subcontractors' direct, borrowed, special, or statutory employees) are covered by the Louisiana Workers' Compensation Act, La. R.S. 23:102 et seq., BHI and CUSTOMER agree that all Services, Products and Equipment provided by BHI and BHI's employees pursuant to this Agreement are an integral part of and are essential to the ability of CUSTOMER to generate CUSTOMER's goods, products, and services for the purpose of La. R.S. 23:106 (A) (1). Furthermore, BHI and CUSTOMER agree that CUSTOMER is the statutory employer of BHI's employees for purposes of La. R.S. 23:1061 (A) (3).

19. LAWS, RULES AND REGULATIONS

BHI and CUSTOMER agree to be subject to all laws, rules, regulations and decrees of any governmental or regulatory body having jurisdiction over the Services, Equipment or Products to be provided by BHI or the work site or that may otherwise be applicable to BHI's or CUSTOMER's performance under this Agreement.

20. GOVERNING LAW

NOT WITH STANDING ARTICLE 19:

A. Except for Services, Equipment or Products provided, or to be provided, by BHI in North or South America (the "AMERICAS"), THIS AGREEMENT SHALL BE GOVERNED BY AND INTERPRETED IN ACCORDANCE WITH ENGLISH LAW, EXCLUDING CONFLICTS OF LAW AND CHOICE OF LAW PRINCIPLES.

B. For Services, Equipment or Products provided, or to be provided, by BHI in the AMERICAS, THIS AGREEMENT SHALL BE GOVERNED BY AND INTERPRETED IN ACCORDANCE WITH THE SUBSTANTIVE LAWS OF OKLAHOMA, EXCLUDING CONFLICTS OF LAW AND CHOICE OF LAW PRINCIPLES.

21. MEDIATION/ARBITRATION

A. Except for a dispute, controversy, or claim (a "Dispute") arising out of this Agreement from Services, Equipment or Products provided, or to be provided, by BHI in the AMERICAS, the parties will attempt to resolve any Dispute between them which results from this Agreement in a spirit of cooperation. Accordingly, the parties agree to engage in good faith negotiations to reach a rapid and equitable solution. If the parties are unable to resolve a dispute through direct negotiation, they will use the services of a mediator. The rules of the Centre for Dispute Resolution (CEDR) will apply to the mediation. Each party will bear its own expenses and an equal share of the costs of the mediators and the body administering the mediation. If the negotiation or mediation fails to reach an equitable solution to the Dispute within 45 days after the request by either party to submit the Dispute to negotiation or mediation, then the Dispute shall be referred to and finally resolved by the English Courts which shall have exclusive jurisdiction. Notwithstanding the provisions of this paragraph, the parties accept that they may take proceedings for injunctive or similar relief in the courts of any jurisdiction to restrain or prevent any breach of this Agreement.

B. Any Dispute arising out of or in connection with this Agreement from Services, Equipment or Products provided, or to be provided, by BHI in the AMERICAS shall be referred to and determined by binding arbitration, as the sole and exclusive remedy of the parties as to the Dispute, conducted in accordance with the American Arbitration Association ("AAA") arbitration rules for commercial disputes, as in effect on the date hereof (the "Rules"), which are deemed to be incorporated by reference, and the Federal Arbitration Act (Title 9 of the United States Code), except that in the event of any conflict between those Rules and the arbitration provisions set forth below, the provisions set forth below shall govern and control. The arbitral tribunal (the "Tribunal") shall use the substantive laws of Oklahoma, excluding conflicts laws and choice of law principles, in construing and interpreting this Agreement, and direct the Tribunal to respect the parties' selection of the law governing the interpretation of this Agreement. The Tribunal shall be composed of three arbitrators, with each party appointing one arbitrator, and the two arbitrators so appointed appointing the third arbitrator who shall act as Chairman of the Tribunal. Should any arbitrator fail to be appointed, as aforesaid, then such arbitrator shall be appointed by the AAA in accordance with the Rules. Should a vacancy in the Tribunal arise because any arbitrator dies, resigns, refuses to act, or becomes incapable of performing his functions, the vacancy shall be filled by the method by which that arbitrator was originally appointed. The language of the arbitration, the submission of all writings, the decision of the Tribunal, and the reasons supporting such decision, shall be in English. The arbitration shall be in Houston, Texas, and the proceedings shall be conducted and concluded as soon as reasonably practicable, based upon the schedule established by the Tribunal, but in any event the decision of the Tribunal shall be rendered within one hundred twenty (120) days following the selection of the Chairman of the Tribunal. Any decision of the Tribunal shall be made by the majority of the arbitrators comprising the Tribunal. No award shall be made for punitive, special, exemplary, indirect or consequential damages or losses, including loss of profits or loss of business opportunity. Any monetary award shall be made in U.S. Dollars, free of any tax or other deduction. The decision of the Tribunal pursuant hereto shall be final and binding upon the parties and shall be enforceable in accordance with The New York Convention on the Recognition and Enforcement of Foreign Arbitral Awards (1958). It is the desire of the parties that any Dispute be resolved quickly and at the lowest possible cost, and the Tribunal shall act in a manner consistent with these intentions, including limiting discovery to only that which is absolutely necessary to enable the Tribunal to render a fair decision which reflects the parties' intent set forth in this Agreement.

22. ASSIGNMENT

BHI shall have the right to assign this Agreement to any of its subsidiaries, affiliated or related companies without the consent of CUSTOMER.

23. GENERAL

Failure of CUSTOMER or BHI to enforce any of the terms and conditions of this Agreement shall not prevent a subsequent enforcement of such terms and conditions or be deemed a waiver of any subsequent breach. Should any provision of this Agreement, or a portion thereof, be unenforceable or in conflict with governing country, state, province, or local laws, then the validity of the remaining provisions, and portions thereof, shall not be affected by such unenforceability or conflict, and this Agreement shall be construed as if such provisions, or portion thereof, were not contained herein. This Agreement contains all representations of the parties and supersedes all prior oral or written agreements or representations. CUSTOMER acknowledges that it has not relied on any representations other than those contained in this Agreement. This Agreement shall not be varied, supplemented, qualified, or interpreted by any prior course of dealing between the parties or by any usage of trade and may only be amended by an agreement executed by both parties.



9110 Grogan's Mill Road
The Woodlands, Texas 77380-3615
U.S.A.
Tel 713 363 6000

www.bakerhughes.com

©2009 Baker Hughes Incorporated. All Rights Reserved. HCC-09-27390