

Drilling Services

Quick Reference Guide

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Motors

DuraMax

Navi-Drill Ultra-HP Series

Navi-Drill X-treme Series

MOTORS

DuraMax

High-performance drilling motors

The Baker Hughes **DuraMax™ high-performance drilling motors** are the next step in delivering and achieving maximum rates of penetration (ROPs) and reduce the number of runs per well, to achieve a lower cost-per-foot drilling program. The completely re-engineered motor design enables drilling capabilities unattainable with conventional motor technologies, providing higher levels of torque and power for performance drilling and harsh environments.

Applications

- Shale gas
- Onshore, offshore, and deepwater
- Conventional and unconventional
- Geothermal
- Vertical and directional drilling
- Performance drilling
- Hard/abrasive formations and high-temperature environments

Features and benefits

- Internally developed and newly designed DuraMax Ultra Series power section
 - Increased ability to achieve a higher rate of penetration (ROP), extended run length, while delivering higher torque and power at the bit
- Titanium flex shaft
 - Increased mean time between failures
 - Reduced nonproductive time (NPT), including twist-off and drive-train failures downhole
- Optimized connections
 - Increased motor reliability improving drilling performance by preventing downhole back-off in harsh drilling environments
- High-temperature elastomer
 - Improved reliability in temperatures up to 320°F (160°C)
- High weight-on-bit (WOB) bearing assembly
 - Optimized performance in hard formations
- Adjustable kickoff (AKO) sub
 - Improved steering to optimize wellbore placement
- Increased flex design
 - Aids in in meeting high dogleg directional plan
- Increased flow rate
 - Increased power & torque, while improve hole cleaning capabilities

DuraMax

Number of lobes (rotor)

Power section

D100-5130C

Revolutions per Gallon (rpg)

Number of stages



Conventional Specifications

Tool size	5/8-in. to 7/8-in. (130 mm to 180 mm)
Hole size	5/8-in. to 9/8-in. (150 mm to 250 mm)
Tool weight	1,455 lb to 3,880 lb (660 kg to 1760 kg)
Tool length	31.2 ft to 41 ft (9.5 m to 12.5 m)
Maximum temperature*	300°F (150°C)
Speed range*	25 rpm to 303 rpm
Flow range*	106 gpm to 760 gpm (401 lpm to 2877 lpm)
Operational differential pressure range*	825 psi to 2,067 psi (57 bar to 143 bar)
Operational torque range*	6,385 ft-lb to 20,093 ft-lb (8657 Nm to 27242 Nm)
Power output range*	82 hp to 574 hp (61 kW to 428 kW)

Pre-contoured Specifications

Tool size	5/8-in. (130 mm)
Hole size	5/8-in. (150 mm)
Tool weight	1,455 lb (660 kg)
Tool length	31.2 (9.5 m)
Maximum temperature*	320°F (160°C)
Speed range*	55 rpm to 370 rpm
Flow range*	106 gpm to 360 gpm (401 lpm to 1363 lpm)
Operational differential pressure range*	1,790 psi to 3,570 psi (124 bar to 246 bar)
Operational torque range*	7,690 ft-lb to 7,740 ft-lb (10426 Nm to 10494 Nm)
Power output range*	203 hp to 405 hp (151 kW to 302 kW)

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

MOTORS

Navi-Drill Ultra-HP Series

High-performance drilling motors

The Baker Hughes **Navi-Drill™ Ultra-HP™ series drilling motors** deliver increased power at the bit for longer, faster drilling runs. Integrated with the Baker Hughes DuraMax™ high-performance elastomer, the motors provide 50% more torque and power downhole. Operators realize reduced overall drilling costs through improved rates of penetration (ROPs), no unnecessary trips, and minimized nonproductive time (NPT).

Applications

- Shale gas
- Onshore and conventional/unconventional
- Vertical and directional drilling
- Performance drilling
- Underbalanced drilling
- Hard/abrasive formations

Features and benefits

- DuraMax high-performance elastomer technology
 - Maximizes rate of penetration (ROP) in extended runs with all fluid types by delivering 50% higher torque and power
 - Improves durability and reduces risk of tripping for motor failure
- Titanium flex shaft improves reliability compared to universal joint
 - Increases mean time between failures
 - Reduces nonproductive time (NPT), including twist-off and drive-train failures downhole
- Optimized connections increase motor reliability
 - Improves drilling performance by preventing downhole back-off in harsh drilling environments
- Adjustable kickoff (AKO) sub
 - Improves steering to optimize wellbore placement
 - Increases flexibility in meeting directional plan by adjusting deflection angle on the surface



Tool Specifications

Tool size	6 1/2-in. to 11 1/4-in. (165 mm to 286 mm)
Hole size	7 7/8-in. to 44-in. (200 mm to 1118 mm)
Tool weight	1,765 lb to 9,285 lb (800 kg to 4212 kg)
Tool length	31.7 ft to 42.88 ft (9.66 m to 13.07 m)
Maximum temperature*	266°F (130°C)
Speed range*	30 rpm to 1,100 rpm
Flow range*	265 gpm to 1,500 gpm (1003 lpm. to 5678 lpm.)
Operational differential pressure range*	580 psi to 2,600 psi (40 bar to 179 bar)
Operational torque range*	450 ft-lb to 28,500 ft-lb (610 Nm to 38640 Nm)
Power output range*	82 hp to 1,100 hp (61 kW to 820 kW)

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

MOTORS

Navi-Drill X-treme Series

High-performance drilling motors

The Baker Hughes **Navi-Drill™ X-treme™ Series drilling motors** deliver maximum rates of penetration (ROPs) and reduce the number of runs for lower cost-per-foot performance drilling. The re-engineered motor design enables drilling capabilities unattainable with conventional motor technologies, providing higher levels of torque and power for performance drilling and harsh environments.

Applications

- Shale gas
- Onshore, offshore, and deepwater
- Conventional and unconventional
- Geothermal
- Vertical and directional drilling
- Performance drilling
- Re-entry and slimhole drilling
- Hard/abrasive formations and high-temperature environments

Features and benefits

- Internally developed and newly designed X-treme precontoured power section
 - Maximizes rate of penetration (ROP) in extended runs with all fluid types by delivering up to 100% higher torque and power
- Titanium flex shaft
 - Increases mean time between failures
 - Reduces nonproductive time (NPT), including twist-off and drive-train failures downhole
- Optimized connections increase motor reliability
 - Improves drilling performance by preventing downhole back-off in harsh drilling environments
- High-temperature elastomer
 - Improves reliability in temperatures up to 374°F (190°C)
- High weight-on-bit (WOB) bearing assembly
 - Optimizes performance in hard formations
- Adjustable kickoff (AKO) sub
 - Improves steering to optimize wellbore placement
 - Increases flexibility in meeting directional plan by adjusting deflection angle on the surface



Tool Specifications	
Tool size	2 ³ / ₈ -in. (60 mm) 2 ⁷ / ₈ -in. (73 mm) 11 ³ / ₄ -in. (299 mm) 12 ³ / ₄ -in. (324 mm)
Hole size	2 ³ / ₄ -in. to 44-in. (70 mm to 1118 mm)
Tool weight*	100 lb to 9,945 lb (45 kg to 4511 kg)
Tool length*	8.4 ft to 35.73 ft (2.6 m to 10.9 m)
Maximum temperature*	320°F (160°C) with standard elastomer 375°F (190°C) with high temperature elastomer
Speed range*	105 rpm to 190 rpm
Flow range*	25 gpm to 1,750 gpm (95 lpm. to 6600 lpm.)
Operational differential pressure range*	905 psi to 1,600 psi (63 bar to 110 bar)
Operational torque range*	365 ft-lb to 37,000 ft-lb (495 Nm to 50165 Nm)
Power output range*	24 hp to 850 hp (18 kW to 634 kW)

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

Rotary Steerable Systems

Lucida

AutoTrak eXact Pro

AutoTrak eXact

AutoTrak Curve Pro

AutoTrak Curve

AutoTrak X-treme

AutoTrak G3

ROTARY STEERABLE SYSTEMS

Lucida

Advanced rotary steerable service

Baker Hughes has integrated hardware, software, automation, and remote connectivity to deliver the **Lucida™ advanced rotary steerable service**—a new way to achieve exceptional drilling performance, exact well placement, and superior wellbore quality.

The Lucida service delivers a new way to achieve exceptional drilling performance with a robust integrated bottomhole assembly that features a fully customized drill bit, real-time dynamics sensors, and multi-chip module electronics. The Lucida advanced rotary steerable service delivers new levels of drilling precision, letting you hit geological targets the first time, with no sidetracks. High-quality, 16-sector gamma-ray sensors, situated very close to the bit, provide real-time formation data that enable quick decisions to geosteer or geo-stop.

The Lucida service enables superior wellbore quality with a new combination of automated wellpath trajectory control and continuous proportional steering that automatically corrects wellbore trajectory for any formation trends. The integration and automation in these systems reduces wellbore tortuosity, providing a corresponding reduction in torque and drag, to drill better curve sections and longer and faster lateral sections.

The Lucida advanced rotary steerable service is fully enabled for Baker Hughes Remote Operations services. With experience from thousands of wells, our drilling and evaluation experts use proprietary systems and advanced technology to execute remote drilling operations and deliver consistent results—everywhere.

Applications

- Wells that require high buildup rates
- Simple or complex 3D wellbore profiles
- Single-run vertical, curve, and lateral
- Extended-reach wells
- Pad or batch drilling
- Onshore, shelf, or deepwater

Features and benefits

- Integrated drill bit
 - Customized for each application to deliver exceptional performance
- Automated wellpath trajectory control system
 - Delivers exact well placement
- Continuous proportional steering
 - Provides superior hole quality, longer laterals, and faster rate of penetration (ROP)
- Near-bit directional measurements
 - Precise directional control
- Near-bit and azimuthal gamma-ray measurements
 - Precise reservoir navigation
- Multi-chip module (MCM) electronics
 - Increased reliability and operating range
- Real-time dynamics measurements
 - Mitigate drilling dysfunctions for exceptional drilling performance



Tool Specifications

Tool size	4¼-in. (121 mm)
Hole size*	5⅞-in. to 6¾-in. (149 mm to 171 mm)
Tool weight*	661 lb (300 kg)
Tool length*	13.22 ft (4.03m)
Maximum temperature*	347°F (175°C)
Maximum pressure*	30,000 psi (2070 bar)
Maximum RPM	400 rpm
Flow range	120 gpm to 350gpm (454 lpm to 1325 lpm)
Max. buildup rate*	15°/100 ft (30 m)

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

ROTARY STEERABLE SYSTEMS

AutoTrak eXact Pro

High-performance rotary steerable system with LWD

The **AutoTrak™ eXact Pro high-performance rotary steerable system (RSS) with logging while drilling (LWD)** delivers smooth, precise, and fast drilling in your high-build rate directional drilling applications while gathering critical LWD data. Efficiently drilling a smooth wellbore and precisely placing it in the most productive zone helps to keep your costs down. The AutoTrak eXact Pro RSS is fully compatible with the Baker Hughes suite of advanced LWD services. This enables you to obtain accurate and comprehensive formation evaluation and reservoir data to geosteer wells to target, maximize production, and minimize the risk and cost of development.

The AutoTrak eXact Pro RSS incorporates an advanced wellpath trajectory control system as the next step in rotary closed-loop drilling automation. The wellpath trajectory control system combines azimuthal hold, inclination hold, multi-chip module (MCM) electronics, and firmware to automatically correct the wellbore trajectory for any formation trends. The automated system will reduce wellbore tortuosity along with a corresponding reduction in torque and drag to drill better curve sections and longer and faster lateral sections. It also reduces the number of downlinks, resulting in more on-bottom time and increased overall rate of penetration (ROP).

Applications

- Simple or complex 3D wellbore profiles
- Higher temperature wells up to 330°F (165°C)
- Extended-reach wells
- Geosteering with advanced LWD services
- Onshore, offshore, and deepwater

Features and benefits

- Wellpath trajectory control system
 - Reduces well tortuosity and provides precise well placement
- Near-bit directional measurements
 - Precise reservoir navigation and well placement
- MCM electronics
 - Increase ruggedness and temperature resistance for increased reliability
- The 4 $\frac{3}{4}$ -in. tool has WOB capability up to 35,000 lb (15 875 kg)
 - Significantly increases ROP
- High-resolution vibration and stick slip (VSS) measurements
 - Mitigates vibration and maximizes ROP and run length
- Continuous proportional steering
 - Delivers superior hole quality, longer laterals, and faster ROP
- Compatible with Baker Hughes suite of advanced LWD services
 - Real-time formation evaluation
 - Advanced reservoir navigation



Tool Specifications

Tool size	4 ³ / ₄ -in. (121 mm) 6 ³ / ₄ -in. (171 mm)
Hole size	5 ⁷ / ₈ to 10 ⁵ / ₈ -in. (149 to 270 mm)
Tool weight	2,786 to 8,492 lb (1264 kg to 3852 kg)
Tool length	48.0 to 60.8 ft (14.6 to 18.5 m)
Maximum temperature*	4 ³ / ₄ -in. 330°F (165°C) 6 ³ / ₄ -in. 302°F (150°C)
Maximum RPM*	400 rpm
Flow range*	125 to 1,600 gpm (473 to 6056 lpm)
Maximum pressure*	Standard 20,000 psi (1380 bar) Optional 25,000 to 30,000 psi (1724 to 2070 bar)
Max. buildup rate*	4 ³ / ₄ -in. 10°/100 ft (30 m) 6 ³ / ₄ -in. 12°/100 ft (30 m)

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

ROTARY STEERABLE SYSTEMS

AutoTrak eXact

High-performance rotary steerable system

The Baker Hughes **AutoTrak™ eXact high-performance rotary steerable system** offers comprehensive formation evaluation while achieving high buildup rate (BUR) curves, effectively reducing time on well. The system optimizes wellbore placement and reservoir exposure through real-time, near-bit inclination and complete logging while drilling (LWD) measurements. Operators achieve faster and safer well delivery with consistent target intersection.

Applications

- Onshore, offshore, and deepwater
- Real-time reservoir navigation, integrating multiple measurement-while-drilling (MWD)/LWD measurements
- Multilateral, extended-reach, or complex 3D designer wells
- Conventional and unconventional development drilling

Features and benefits

- Reaches high buildup rates, up to 12°/100 ft
 - Shorter curve section
 - Improves drilling efficiency through deeper kickoff and more responsive steering
 - Maximizes reservoir exposure
- Automated steering mechanism creates a continuous steer force with continuous drillstring rotation
 - Increases drilling efficiency and improves rate of penetration (ROP)
 - Eliminates the need for correction runs or sliding time associated with mud motors
 - Provides superior hole quality for smooth completion operations
- Fully modular system, additional LWD measurements as required
 - Optimizes wellbore navigation and placement
 - Complete understanding of drilling environment
- Integrated bottomhole assembly (BHA) with short-spaced, advanced MWD/LWD sensors
 - Detects formation changes early
 - Maximizes drilling performance by changing directional targets without drilling process interruptions
- Steering mechanism independent of hydraulic parameters such as flow rate, bit pressure drop, and mud properties
 - Reduces total time on well by optimizing hydraulic parameters for improving ROP



Tool Specifications

Tool size	4 ³ / ₄ -in. (121 mm) 6 ³ / ₄ -in. (171 mm)
Hole size	5 ⁷ / ₈ to 10 ⁵ / ₈ -in. (149 to 270 mm)
Tool weight	2,786 to 8,492 lb (1264 kg to 3852 kg)
Tool length	48.0 to 60.8 ft (14.6 to 18.5 m)
Maximum temperature*	4 ³ / ₄ -in. 330°F (165°C) 6 ³ / ₄ -in. 302°F (150°C)
Maximum RPM*	400 rpm
Flow range*	125 to 1,600 gpm (473 to 6056 lpm)
Maximum pressure*	Standard 20,000 psi (1380 bar) Optional 25,000 to 30,000 psi (1724 to 2070 bar)
Maximum buildup rate*	4 ³ / ₄ -in. 10°/100 ft (30 m) 6 ³ / ₄ -in. 12°/100 ft (30 m)

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

ROTARY STEERABLE SYSTEMS

AutoTrak Curve Pro

High build-up rate rotary steerable system

The **AutoTrak™ Curve Pro high build-up rate rotary steerable system (RSS)** delivers smooth, precise, and fast drilling in your high build-up rate directional drilling applications. Efficiently drilling a smooth wellbore and precisely placing it in the most productive zone keeps your directional drilling costs down while maximizing production.

The AutoTrak Curve Pro RSS incorporates an advanced wellpath trajectory control system as the next step in rotary closed-loop drilling automation. The wellpath trajectory control system combines azimuthal hold, inclination hold, new electronics, and firmware to automatically correct the wellbore trajectory for any formation trends. This automated system will reduce wellbore tortuosity along with a corresponding reduction in torque and drag to drill better curve sections and longer and faster lateral sections. It also reduces the number of downlinks, resulting in more on-bottom time and increased overall rate of penetration (ROP).

Applications

- Wells that require high build up rates
- Simple or complex 3D wellbore profiles
- Single-run vertical, curve, and lateral
- Extended-reach wells
- Pad or batch drilling
- Onshore, offshore, and deepwater
- Conventional and unconventional development drilling

Features and benefits

- Automated wellpath trajectory control system
 - Decreases wellbore tortuosity and downlinks
 - More onbottom time to increase overall ROP
- Continuous proportional steering
 - Provides superior hole quality, longer laterals, and faster ROP
- Internal hydraulics independent of pressure drop
 - Enables hydraulics optimization for drilling performance
- Near-bit directional and azimuthal gamma-ray measurements
 - Provide precise reservoir navigation and well placement
- Flow-off directional surveys
 - Combines accurate wellbore positioning with optimal drilling efficiency
- High-resolution vibration and stick slip (VSS) measurements
 - Mitigate drilling dysfunctions for maximum ROP and run length



Tool Specifications

Tool size	6¼-in. (171 mm)
Hole size*	8 ³ / ₈ -in. to 10 ⁵ / ₈ -in. (213 mm to 270 mm)
Tool weight*	3,090 lb (1400 kg)
Tool length*	37.8 ft (11.5 m)
Maximum temperature*	302°F (150°C)
Maximum pressure*	20,000 psi (1380 bar)
Maximum RPM	400 rpm
Flow range	350 gpm to 700 gpm (1325 lpm to 2650 lpm)
Maximum buildup rate*	15°/100 ft (30 m)
Power output range*	14 hp to 430 hp (10 kW to 320 kW)

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

ROTARY STEERABLE SYSTEMS

AutoTrak Curve

High-build-rate rotary steerable system

The Baker Hughes **AutoTrak™ Curve high-build-rate rotary steerable system** reduces time on well in one smooth, fast run. The system optimizes wellbore placement and reservoir exposure through real-time, near-bit inclination and gamma ray measurements. Operators achieve faster and safer well delivery with exact placement.

Applications

- Conventional and unconventional hydrocarbon development drilling
- Vertical, horizontal, and 3D directional drilling
- Pad drilling applications with tight wellbore spacing
- Well factory applications in high-volume drilling environments

Features and benefits

- Reaches high buildup rates, up to 15°/100 ft
 - Maximizes reservoir exposure in small leases
 - Improves drilling efficiency through deeper kickoff and more responsive steering
- Uses automated 3D steering adjustments while drilling ahead
 - Eliminates bottomhole assembly (BHA) trips, drilling curve, and lateral sections in one run
- Measures real-time, azimuthal gamma ray at short distance to bit
 - Enables reservoir navigation for optimum wellbore placement
- Drills straight, smooth wellbores with automatic inclination hold function
 - Promotes faster completions and production
- Optimized, rugged system design with single piece BHA
 - Reduces setup time and maximizes productivity in high-volume applications
- Optional downhole motor
 - Improves drilling performance and reach



Tool Specifications

Tool size	6¼-in. (171 mm)
Hole size*	8 ³ / ₈ -in. to 10 ⁵ / ₈ -in. (213 mm to 270 mm)
Tool weight*	3,090 lb (1400 kg)
Tool length*	37.8 ft (11.5 m)
Maximum temperature*	302°F (150°C)
Maximum pressure*	20,000 psi (1380 bar)
Maximum RPM	400 rpm
Flow range	350 gpm to 700 gpm (1325 lpm to 2650 lpm)
Max. buildup rate*	15°/100 ft (30 m)

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

ROTARY STEERABLE SYSTEMS

AutoTrak X-treme

Motor-powered rotary steerable system

The Baker Hughes **AutoTrak™ X-treme motor- powered rotary steerable system** integrates the precontoured mud motor with hard-wired communication functionality, delivering additional power and RPM directly at the bit. This technology enhances penetration rates and increases horizontal intervals, allowing operators to reach inaccessible, trapped reserves and maximize hydrocarbon recovery.

Applications

- Horizontal extended-reach wells
- Complex 3D directional profiles
- Onshore, offshore, and deepwater environments
- Performance drilling applications

Features and benefits

- Automated steering mechanism creates a continuous steer force with continuous drillstring rotation
 - Increases drilling efficiency and improves rate of penetration (ROP)
 - Eliminates the need for correction runs or sliding time associated with mud motors
 - Provides superior hole quality for smooth completion operations
- Integrated bottomhole assembly (BHA) with short-spaced, advanced MWD/LWD sensors
 - Detects formation changes early
 - Maximizes drilling performance by changing directional targets without drilling process interruptions
- Precontoured X-treme mud motor
 - Increases ROP
 - Extends horizontal section in 3D well profiles
 - Reduces drillstring wear
- Wired motor technology
 - Improves reliability of communications with motor positioned close to the bit
- Fully modular system, additional LWD measurements as required
 - Optimizes wellbore navigation and placement
 - Provides complete understanding of drilling environment
- Optimized, real-time bidirectional communication
 - Minimizes drilling interruptions and improves drilling performance by sending commands from the surface
- Continuous near-bit inclination measurement with closed-loop downhole controls
 - Maximizes drilling efficiency and wellbore placement



Tool Specifications

Tool size	4¼-in. (121 mm) 6¾-in. (171 mm) 9½-in. (241 mm)
Hole size*	5⅞-in. to 28-in. (146 mm to 711 mm)
Tool weight*	3,439 lb to 11,820 lb (1560 kg to 5360 kg)
Tool length*	73.5 ft to 95 ft (22.4 m to 29 m)
Maximum temperature*	302°F (150°C)
Maximum pressure*	Standard: 20,000 psi (1380 bar) Optional high pressure: 25,000 psi to 30,000 psi (1725 bar to 2070 bar)
Maximum RPM	4¼-in., 6¾-in. Maximum 400 rpm 9½-in. Maximum 300 rpm
Flow range	125 gpm to 1,600 gpm (473 lpm to 6056 lpm)
Max. buildup rate*	4¼-in. 10°/100 ft. 6¾-in. 6.5°/100 ft. 9½-in. 6.5°/100 ft.

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

ROTARY STEERABLE SYSTEMS

AutoTrak G3

Advanced rotary steerable system

The Baker Hughes **AutoTrak™ G3 advanced rotary steerable system** integrates the Baker Hughes **OnTrak™ MWD/LWD technology** with a complete formation evaluation package. The system provides reliable and precise steering response in a wide range of formation types, drilling conditions, and well profiles. Operators in deepwater and onshore environments can optimize production with efficient, consistent target intersection.

Applications

- Onshore, offshore, and deepwater
- Multilateral, extended-reach, or complex 3D designer wells
- Real-time reservoir navigation, integrating multiple MWD/LWD measurements
- Weak sediments or hard rock formations
- Conventional and unconventional drilling applications

Features and benefits

- Automated steering mechanism creates a continuous steer force with continuous drillstring rotation
 - Increases drilling efficiency and improves rate of penetration (ROP)
 - Eliminates the need for correction runs or sliding time associated with mud motors
 - Provides superior hole quality for smooth completion operations
- Fully modular system, additional LWD measurements as required
 - Optimizes wellbore navigation and placement
 - Provides complete understanding of drilling environment
- Integrated bottomhole assembly (BHA) with short-spaced, advanced MWD/LWD sensors
 - Detects formation changes early
 - Maximizes drilling performance by changing directional targets without drilling process interruptions
- Optimized, real-time bidirectional communication
 - Minimizes drilling interruptions and improves drilling performance by sending commands from the surface while drilling
- Steering mechanism independent of hydraulic parameters such as flow rate, bit pressure drop, and mud properties
 - Reduces total time on well by optimizing hydraulic parameters for improving ROP



Tool Specifications

Tool size	9½-in. (241 mm)
Hole size*	12-in. to 18⅞-in. (304 mm to 464 mm)
Tool weight*	15,200 lb (6,895 kg)
Tool length*	58.1 ft (17.7 m)
Maximum temperature*	302°F (150°C)
Maximum pressure*	20,000 psi (1380 bar)
Maximum RPM	300 rpm
Flow range	1,600 gpm (6056 lpm)
Maximum buildup rate*	6.5°/100 ft

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

Liner Drilling Systems

SureTrak

LINER DRILLING SYSTEMS

SureTrak

Steerable drilling liner service

The Baker Hughes **SureTrak™ service** integrates proven **AutoTrak™ rotary steerable technology** to drill through the most challenging environments. The system allows for automated closed-loop directional drilling and LWD formation evaluation while simultaneously installing the liner in a single run to TD. Application of the system reduces operational risks associated with drilling through difficult zones while minimizing drilling risks including lost circulation, stuck pipe, and additional wiper trips and in the event if the liner cannot be set due to time sensitive formations. Using SureTrak, operators can drill, log, and set the liner in one run, reaching reserves that were out of reach before and reducing their nonproductive time.

Applications

- Onshore or offshore environments
- Interbedded formations
- Wellbore instability issues, including swelling shale and weak sediments
- Lost circulation

Features and benefits

- Exchangeable inner string including bottom hole assembly (BHA) without the need for tripping the liner.
 - Optimizes efficiency and reduces time at rigsite
 - Improves well stability with liner in place
- BHA design tailored to well requirements
 - Maximizes production in a variety of drilling environments
- Uses AutoTrak system with modular MWD/LWD services
 - Optimizes wellbore placement through geo-steering and formation evaluation data
 - Reduces the number of additional runs
- Incorporates X-treme motor technology
 - Maximizes rate of penetration
 - Improves drilling efficiency
- Liner shoe with decoupled reamer bit separates BHA drilling dynamics from the liner
 - Improves borehole quality
 - Maintains wellbore stability
 - Reduces wear on the liner
- Improved HS&E due to less tripping and handling of tubulars
 - Reduces risk to rig site personnel by the reduction of number of trips
 - No rig modifications required



Tool Specifications

Tool size	4¼-in. with 7-in. liner 6¾-in. with 9 ⁵ / ₈ -in. liner
Hole size*	8½-in. to 12¼-in. (216 mm to 311 mm)
Tool weight*	Varies according to customer's specifications
Tool length*	Varies according to customer's specifications
Maximum temperature*	302°F (150°C)
Maximum pressure*	25,000 psi (1725 bar)
Max. buildup rate*	3.0°/100 ft (limited by liner threads)
Connections upper/lower	Inner string NC38 Box / 3½-in. API reg box Outer string depends on inner/outer drillpipe and liner threads

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

For improved hole quality and reduced length of the pilot BHA, several components—including the motor, smart battery sub (SBS), bidirectional communication and power module (BCPM), reamer driver sub (RDS), and thruster—are located inside the liner. Additional LWD and drilling optimization subs may be added upon request.

Drilling Engineering Solutions

CoPilot 2.0 / Copilot UHD

Drilling Engineering Solutions Levels

DRILLING ENGINEERING SOLUTIONS

CoPilot 2.0 / CoPilot UHD

Real-time drilling optimization service

The **CoPilot™ drilling performance sub** is a short modular sensor sub that can be integrated into a Baker Hughes bottom hole assembly (BHA). As the most advanced, versatile downhole data acquisition and processing system in the industry, it offers real-time downhole pressure and dynamics information including static tool data, weight and torque on bit, bending moment, bending orientation, annular and bore pressure.

Placement of the sub can be optimized for client-specific applications, yielding important insights into the effects of downhole mechanics. This technical solution is complemented with real-time engineering expertise to optimize overall drilling efficiency, reduce nonproductive time, and enhance the design of drilling systems and processes over the course of a drilling campaign.

Applications

- Onshore, offshore, and deepwater
- Extended-reach drilling
- Challenging interbedded or complex well formations with stringers
- Conventional or unconventional oil and gas
- Salt drilling
- Shale gas drilling

Features and benefits

- Real-time data transmission and expert interpretation
 - Reduces operational risk and maximizes drilling efficiency and performance
 - Enable quick, informed decisions
- Bending moment and bending orientation
 - Provides closer-to-the-bit steering control to optimize wellbore placement
 - Reduces risk of exceeding bottomhole assembly (BHA) bending limits
 - Offers continuous high local dog-leg identification, severity, and direction
 - Identifies hole spiraling attitude and severity
- Accurate downhole weight and torque
 - Initiates timely reaming to overcome weight-transfer problems
 - Shows how much weight actually reaches the bit and thus helps to achieve optimum performance
 - The closer CoPilot is positioned to the bit, then the better downhole torque correlates with bit torque – thus indicating how good a fixed cutter bit bites
- Downhole dynamics measurements, including whirl
 - Provides advanced understanding of downhole motions
 - Resolves whirl situations, avoiding trips for failed equipment (fishing, twist-offs)



Tool Specifications

Tool size	4½-in. Copilot / UHD	(121 mm)
	6½-in. Copilot / UHD	(171 mm)
	8½-in. Copilot	(210 mm)
	9½-in. Copilot / UHD	(241 mm)
Hole size*	5¼-in. to 26-in. (146 mm to 660 mm)	
Tool weight*	540 lb to 1,561 lb (245 kg to 708 kg)	
Tool length*	7.09 ft to 8.92 ft (2.16 m to 2.72 m)	
Maximum temperature*	302°F (150°C)	
Flow range*	No limits are specified for maximum flow rates. The limit is determined by the design constraints of other components in the BHA or drilling system	
Maximum pressure	25,000 psi (1725 bar)	
Data acquisition	Copilot Sample Rate: 14 Channels @ 1000Hz	
	Copilot UHD Sample Rate: 16 Channels @ 2500Hz	

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

DRILLING ENGINEERING SOLUTIONS

Drilling Engineering Solutions

Drilling Engineering Solutions are supporting customer's requirements in safe and reliable placement of the wellbore while maximizing recovery from the reservoir. Drilling Engineering Solutions can be utilized for all operators in a variety of downhole conditions across the extensive portfolio of Engineering Services. These services are provided by highly skilled and experienced subject matter experts.

Geometric and Geological Wellbore Positioning

Geometric and Geological Wellbore Positioning solution is the group of services that help customers to plan, place, measure and optimize the geometric location and geological position of a wellbore. These services reduce drilling costs and risk through minimizing wellbore placement uncertainty.

Geometric Wellbore Positioning is a series of processes used to drill a well, positioned in real-time within the planned objectives. It includes the design of a planned well path to meet those objectives and uses final positioning data to ensure that the objectives are met. Optimizing wellbore positioning is highly impacting the production rate over reservoir life.

The application of Geological Wellbore Positioning, such as advanced reservoir navigation and proactive geo-steering techniques, enable operators to drill and complete complex horizontal and multi-lateral wells successfully with increased confidence. Geological Wellbore Positioning will significantly reduce unnecessary course corrections, decrease hole tortuosity and improve penetration rates. By maximizing reservoir contact and accurately reaching well targets, Geological Wellbore Positioning offer an efficient, cost-effective solution to operational needs.

Wellbore Stability and Integrity

Wellbore Stability and Integrity solution is the range of services that help customers to apply the technical, operational and organizational solutions to reduce the risk of uncontrolled release of formation fluids throughout the life cycle of a well as well as to reduce risk associated to the hole diameter being markedly different from

the bit size (over- or under gauged hole). Wellbore integrity services define the upper and lower wellbore pressure limits and identify the optimum mud weight window. They describe causes of wellbore instability problems; wellbore stability before, during, and after drilling wells; symptoms of the problems while drilling; discuss practical, preventive, and remedial actions for wellbore instability. These services reduce drilling costs and risks associated with unwanted fracturing of the formation or hole collapse. Increased ROP, extension of the possible target depth and optimization or elimination of the casing points are additional benefits of the Wellbore Stability and Integrity Solution.

Hydraulics Management

Hydraulics Management solutions focuses on optimization of borehole cleaning and maintaining annular pressures within pressure boundaries while drilling. This solution includes managing the flow rates, drilling mud properties and operational procedures. Operational and organizational side of the solution include trip in/out best practices as well as the optimization of hole cleaning with specially defined cleanup cycles and suitable pressures of the circulating system.

Services, included in the solution, reduce drilling cost and risks associated with inefficient hole cleaning, causing stuck drill string, and with not suitable ESD/ECD, causing possible kick or unwanted formation fracturing. Problems with hydraulics management can lead to a wrong estimation of the surface pump capability which could impact or even prevent drilling with given BHA. In addition, a properly managed hydraulic system is capable to improve ROP and optimize tripping in/out time performance.

Well Cost Reduction (NPT reduction)

Geometric and Geological Wellbore Positioning

Base:	Base Directional Planning and Surveying
Plus:	Advance Wellbore Positioning with 2-D RNS
Advanced:	Wellbore Positioning SME Supervision with all levels of RNS

Wellbore Stability and Integrity

Base:	ESD/ECD trend monitoring and SLS data acquisition
Plus:	Modeling and real-time monitoring PP & WBS.
Advanced:	Pre-drill Geomechanics Modeling and Analysis, PP Measurements, Geomechanics Model Calibration

Hydraulics Management

Base:	Basic surface pressure and downhole hydraulics
Plus:	Hole Cleaning, Hydraulics and Temperature Management
Advanced:	Hydraulics Optimization SME supervision

Drillstring/BHA Integrity

Base:	Stress and Vibration Mitigation Planning
Plus:	Real-time Stress and Vibration Monitoring
Advanced:	Real-time Stress, Vibration, Force and Mud Optimization

Drillstring/BHA Integrity

Drillstring/BHA Integrity solution is the group of services designed to address the prevention of mechanical overload, and thus protect from fatigue and excessive vibration.

During the job planning, every BHA and drillstring is modeled with utilization of special software and on the basis of existing information about the well and customer requirements to the drillstring and BHA. During the job the BHA vibration sensors provide information about the level of vibration downhole. On basis of this and additional drilling dynamic information (ROP, RPM etc.) the vibration mitigation actions are evaluated and applied while drilling.

Formation evaluation data provide additional information, utilized to reduce damaging vibration and improve drilling performance. Post-job analyses including documentation of the “lessons learned” ensure continues improvement in BHA and drillstring design.

Services, included in the solution, reduce drilling cost and risks associated with excessive vibration, causing downhole tools to stop working, and with mechanical overload and fatigue, causing mechanical disintegration of the drillstring and BHA components. From another side, proper managed vibrations and mechanical loads enable the improvement of ROP, overall reliability and hole quality.

Drilling Performance Optimization

The Drilling Performance Optimization solution is the group of services to address all processes that utilize downhole and surface sensors, software and experienced personnel to reduce NPT and increase drilling efficiency. This solution contains different aspects such as integrity of the drillstring, hydraulic pressure, borehole cleaning and pressure limits of the open hole. SME utilize the software, surface sensors and workflows to optimize performance and minimize risk associated with the drilling process. SMEs will also provide solution for the situation when NPT or failures occur to prevent further such events.

The Drilling Performance Optimization solution provides reduced drilling costs as well as significant risk reduction associated with mechanical, hydraulic and pressure aspects of the BHA in open hole, thus reducing NPT.

Reservoir Geomechanics

Baker Hughes expertise in subsurface geomechanics, pore-pressure analysis, and pressure management optimizes drilling performance by contributing to wellbore stability while operating within a safe pressure window. Fracture properties, stimulation, sand control, and subsidence prediction through geomechanical studies support well-completion design.

Since 1996, Baker Hughes has repeatedly demonstrated that comprehensive, robust geomechanical models for the reservoir and overlying formations help alleviate problems related to drilling, completion, and production over the entire life of a field.

Baker Hughes combines geomechanics expertise with proprietary software to generate highly robust geomechanical models that evaluate the potential risk of wellbore instability. A comprehensive modeling approach will help better understand the link between wellbore instability and geomechanics, while providing recommendations on specific operational practices that can reduce

costs and optimize drilling parameters. Improved wellbore stability is achieved by utilizing accurate geomechanical modeling and detailed model calibration prior to constructing the geomechanical model. Baker Hughes performs a comprehensive review of available data acquired in existing offset wells. Data, from drilling reports and well logs to surface and downhole measurements, is extensively reviewed and analyzed by expert consultants to extract the most meaningful geomechanical information available. Mud weights, ROP, and intervals where drilling problems occurred (kicks, lost circulation, excessive caving) are combined with log-derived rock properties and stress and pressure data to build a complete understanding of the geomechanical properties of the field. Baker Hughes uses advanced proprietary software packages to analyze the parameters that control wellbore instability and determine the operational practices that mitigate risks.

Wellbore Quality

Wellbore Quality solution is the group of services that help customers to plan and achieve a straight, smooth, round gauge, clean, integral and fit for purpose borehole. These services maximize production by ensuring the borehole has minimal tortuosity or hole spiraling, reduced wellbore break-out or ledging, no wash-outs or residual cuttings beds, and is without leakage or formation damage.

Achievement of the first-class Wellbore Quality is possible by optimizing operating parameters (WOB, RPM, Flow Rate), connection practices, hole cleaning practices, mud weight management, managing pack-offs, vibration management and ECD management. All those aspects will be carefully evaluated and solution will be implemented by wellbore quality SMEs.

Wellbore Quality solution reduces the risk of having a wellbore which will be difficult to complete and which will produce less than the expected amount of hydrocarbons.

Well Cost Reduction (NPT reduction)

Drilling Performance Optimization

Base: Base Drillstring/BHA, Hydraulics, Well Planning and Analysis

Plus: Base Drillstring/BHA, Hydraulics, Well, WBS/I Monitoring

Advanced: Base Drillstring/BHA, Hydraulics, Well, WBS/I Monitoring, Calibration & Optimization

Increasing Production and Recovery Maximization (NPV increase)

Reservoir Geomechanics

Plus: Well-centric geomechanics Evaluation and well positioning optimization

Advanced: Field-centric geomechanics Evaluation and well positioning optimization

Wellbore Quality

Base: Straight and smooth wellbore through Drilling Practices

Plus: Drilling Practices, Clean hole, Caliper, Invasion Monitoring

Advanced: Optimization of Drilling and Hydraulic Parameters for Wellbore Quality

Digital and Automation

Remote Operations Services
i-Trak Automated Trajectory Drilling
i-Trak Dynamics Management
i-Trak Wellbore Hydraulics
WellLink RT
WellLink Advisor
WellLink Assurance
WellLink Performance
Cadence
Solus
RiskGuard

DIGITAL AND AUTOMATION

Remote Operations Services

Operate from anywhere

Since the early 2000's, Baker Hughes has solidified its offering in terms of remote operations as a means to improve HS&E performance, expand on service delivery capabilities as well as provide customers with experienced talent pool for their operations regardless while managing the workforce efficiently. Today we see increasing demand for automation and remote operations to meet the challenges that face us both as an industry and as humanity.

For delivery to be sustainable and well founded in Baker Hughes and customer organizations, thorough pre-work including common risk assessments, roles and responsibility studies have been conducted. Transformation from standard operations to remote requires redistribution of work tasks and processes between site and town personnel. Adjusted field positions tailored for the remaining tasks onsite and implementation of new positions in the remote operations service center (ROS) is a key success factor to enable reduction of personnel on board.

Through ROS Centres across the globe, Baker Hughes brings a new level of information technology to the wellsite that helps customers monitor reservoir performance, manage remote operations, and collaborate in the quickest, most direct way possible.

Applications

All drilling environments

Features and benefits

- Reduced HSE risk:
 - Travel risks
 - Onsite risks
- Carbon emissions reduction
- Increased collaboration
 - Real-time access to subject matter experts for better faster decisions
- Maximized efficiency
 - Accelerated learnings to lower NPT and trim rig days
 - Reduced footprint and the rigsite
 - Efficient resource management
- Realtime access to subject matter experts for better and faster decision making
- Predictable reliable performance:
 - Record setting performance
 - Precise well placement
 - Increased traceability and oversight

DIGITAL AND AUTOMATION

i-Trak Automation Service

Automated trajectory drilling

The **i-Trak™ Automated Trajectory Drilling service** is a software application running on a dedicated server on the rigsite. This software solution generates steering parameters based on the comparison of the planned well trajectory with actual survey measurements.

Using hole quality KPI's such as minimum added dog-leg severity and optimized number of downlinks it enables to maintain the well close to the planned trajectory and to drill a high quality well within a pre-planned drilling corridor.

Applications

- Onshore, offshore, and deepwater
- Directional Drilling with AutoTrak G3
- Conventional and unconventional

Features

- Software application capable of predicting the wellbore trajectory, deriving steering proposals to follow the planned trajectory closely or steer back to plan, and submitting those steering parameters automatically per downlink
- Automate survey transfer to well-planning system and trigger automated clearance scanning
- Real-time calculation of distance from plan at survey position, bit and every meter down to 30m ahead of the bit
- Automated alarms

Benefits

- Unburdens the directional driller by automatically generating steering parameters as advice or automated downlink
- Facilitates remote operations
- Enables Directional Driller to focus on exception handling, not routine events
- Automated downlink

DIGITAL AND AUTOMATION

i-Trak Automation Service

Dynamics management

The **i-Trak™ Dynamics application** is using CoPilot data to detect hard stringers in the drilled formation and provides computer assisted guidance how to drill such stringers minimizing the wellpath deviation or equipment damage caused by these stringers.

Applications

- All Drilling Environments
- Drilling Formations with interbedded Hard Stringers

Features

Constant monitoring of drilling dynamics measurements from CoPilot and rig surface sensors to detect and mitigate NPT impact of hitting hard stringers in the formation. These interbedded hard formations typically lead to problems maintaining the planned trajectory, introduce local doglegs damaging the BHA or directly damage the bit.

Benefits

- Earliest detection of a stringer allows to react according to established procedures and to mitigate potential NPT from such event.
- i-Trak Drilling Advisor provides the required workflow and operational procedures in real-time to the user. It is automatically triggered as soon as a stringer is detected.

DIGITAL AND AUTOMATION

i-Trak Automation Service

Wellbore hydraulics services

The **i-Trak™ Wellbore Hydraulics service** application is focused on protecting the wellbore from pressure or flow related impacts. Using the Jewel Suite Drilling Engineering software with real time data feeds, including mud properties it provides ECD/ESD, trip speed limit, Torque and Drag and flow-in/out calculations in real time. If connected with a rig control system such as NOVOS, it is capable to control trip speed limits

Applications

Conventional onshore and offshore drilling environments except for MPD operations

Features and benefits

- i-Trak Wellbore Hydraulics Tripping Advisor
 - Calculates the tripping speed limitations based on real-time data and continuously run updates to prevent swab/surge events (NPT). Improved capabilities for visualization and real-time data usage helps to minimize ILT during tripping
- i-Trak Automated Torque & Drag
 - Continuously and automatically sample pick-up, rotating-off-bottom, slack-off and break-over weights & torque for trend monitoring and comparison to theoretical parameters delivers early alarms for increasing friction and overpull
- i-Trak Borehole Pressure
 - ECD and ESD monitoring are automatically plotting the calculated data in real-time along with the theoretical data. Includes OnTrak™ pressure while drilling calibration.
 - Theoretical data are consciously being calculated based on the hydraulic model and automatically incorporates AFM data if available
- i-Trak Hole Cleaning Advisor
 - Continuously monitors and calculates the theoretical deposition and erosion of cutting bed in real-time. Data are visualized on illustrative curtain section view of wellbore. Delivers continuously advises for surface flowrate in order to minimize risk of stuck pipe.
 - Will be expanded to include hole cleaning advisor by the end of 2020.

DIGITAL AND AUTOMATION

WellLink RT

Real-time data visualization and analysis

The **WellLink™ RT service** optimizes web-based delivery of advanced visualization and analysis capabilities for real-time data regardless of the data density acquired.

WellLink RT is a vendor neutral data aggregation and visualization solution, supporting industry standard data types such as WITSML and OPC. The web-based interface is easy to use and configure, graphically integrating any type of WITSML data from diverse sources such as MWD/LWD, MudLogging, Wireline, Casing, Cementing, Pressure Pumping, Drilling Instrumentation.

WellLink RT is backed by a globally integrated environment that features load-balanced and geographically redundant systems enabling collaboration with clients, support of enterprise well site operations, and real-time decision-making by entitled professionals regardless of their disciplinary or geographic borders.

Applications

- Aggregation of real-time data at any wellsite from multiple sources – including LWD, MWD, Drilling, Mudlogging and Testing
- Deliver data in real-time to any authorized global user
- Deliver data in WITSML format from any location or operation

Features and benefits

- Remote data visualization
 - Vendor agnostic
 - Extensive library of display formats
 - Detachable displays
 - Flow back fingerprinting
 - 2D/3D cross plots
 - Smart scaling
 - Reservoir navigation displays
- Data analysis
 - Smart agents
 - Flow back fingerprinting
 - Activity break down
 - Alarms
 - Offset well view
- Mobile iOS app
- Security assurance
 - Data compression and encryption
 - Versatile entitlement management
- Data management
 - Industry standard data formats
 - Import / export of various file types
 - Built-in data validation
 - Quality assurance and control alarms
- Well construction expertise
 - 24 x 7 technical support
 - 3 global support hubs
 - Regional support centers

DIGITAL AND AUTOMATION

WellLink Advisor

Real-time well engineering

WellLink™ Advisor is a decision support application which integrates data with predictive tools and processes. With WellLink Advisor, operators and drilling contractors can reduce their non-productive time (NPT) during well construction by enhancing operational integrity and efficiency.

WellLink Advisor delivers the right information to the right place at the right time allowing for more informed decisions.

WellLink Advisor application integrates raw information and analytical results into standardized consoles. These consoles are designed around best practices workflows. The consoles allow teams to understand critical data better, improve efficiency and minimize HS&E and operational risks.

Applications

- Rate of penetration optimization
- Stuck pipe mitigation
- Geological correlation and risk management
- Fluids management

Features and benefits

- Rate of penetration console
 - Drilling efficiency qualification
 - Real-time correlation to geological model
 - Depth based risks proactive alerts
 - Bit life optimization
 - Vibration analysis
 - Offset well correlation
- Drilling operations console
 - Hole quality analysis
 - Hole cleaning advisory
 - Real-time torque and drag analysis
 - Real-time Torque and weight on bit analysis
- Tripping and casing console
 - Downhole static friction proactive alarms
 - Real-time tripping speed comparison against modelled trip curves
 - Connection time KPI's
 - Hookload analysis
 - Automated activity detection
- No drilling surprises console
 - Lithographical columns correlation
 - Visual representation of pre-drill analysis including risk objects
 - Real-time operations summary with offset data correlation

DIGITAL AND AUTOMATION

WellLink Assurance

Remote management by exception

WellLink™ Assurance is a real-time, advanced drilling surveillance and alarm management system that monitors and measures the execution of well construction projects to detect potential drilling hazards at an early stage.

With WellLink Assurance, operators and drilling contractors can proactively address problematic trends and identify opportunities for optimization. Complex multi-well drilling operations can be monitored remotely and with fewer personnel using exception-based management and workflow management (SPE 179368). WellLink Assurance is scalable from a single well to support multiple wells easily without the need to add many personnel.

Unlike simple high-low alarms, WellLink Assurance evaluates multiple inputs and functions per alarm to indicate abnormal drilling behaviors such as kicks, influx, washout, drilling break events and hole cleaning or unexpected trend changes.

Applications

- Performance optimization
- Kick and circulation losses detection
- Early hazard warning
- Remote operations management

Features and benefits

- Management by exception
 - Customizable alarms
 - Rules and filters for each operations phase
 - Email, auditory, visual and SMS alarm delivery
- Alarm center
 - User defined alarms groups
 - Single click acknowledgement
 - Quick data visualization
- Alarm formula management
 - Rule based alarms
 - Boundary based alarms
 - Data quality validation
- Audit trail
 - Alarms activity logging
 - Rules modifications
 - Audit reports

DIGITAL AND AUTOMATION

WellLink Performance

Real-time performance analytics

WellLink™ Performance is a web-based application providing drilling key performance indicator (KPI) monitoring, analytics, and reporting. Real-time data is analyzed, combined with contextual data and compared with plan/benchmark/offset data.

WellLink Performance facilitates proactive identification of performance gaps, allowing the decision-making teams to address performance barriers and associated causes of non-productive time (NPT) or invisible lost time (ILT) in a timely manner.

Applications

- Multi-well project performance management
- Multi-rig operations management

Features and benefits

- Dashboards
 - Configurable multi-well dashboard
 - Map display
- Real-time displays
 - Time depth analysis
 - Activity analysis
 - KPI monitor
 - Flat time display
 - DDR KPI monitor
- Key performance indicators
 - Off bottom time
 - Weight to weight
 - Weight to slips
 - Days ahead/behind plan
 - Flat time
 - Over 34 additional KPI's
- Reporting
 - Customizable section and end-of-well reports

DIGITAL AND AUTOMATION

Cadence

Surface acquisition software

Cadence™ surface acquisition software is a scalable wellsite data acquisition, processing, and interpretation software for Baker Hughes Drilling Services. Cadence offers a universal interface based on the tasks associated with well operations: job setup, pre-run, real-time data acquisition, post-run, deliverables, and tracking. With a common database and universal well data input for all user roles,

Cadence avoids the duplication of data entry; and with a single report application allows an integrated analysis, data collection and data sharing between Product Lines in the Global Market.

Applications

- Baker Hughes Drilling Services operations worldwide
- Integrated services with SLS
- WITSML service operations

Features and benefits

- Simple workflow
 - Reduction in the required training
 - Allows FSE to focus on Answers While Drilling™
 - Improve user experience
 - Enhance productivity
- Single reporting application
 - One button deliverables for report and logs
 - QC validation on deliverable packages
 - Direct communication with MaPS for reliability data analysis
- Built-in dynamic help
 - Reduce troubleshooting time
 - Minimize transactional errors
 - Incorporate tools and procedures within BHOS to assist our employees
- Reliable Architecture
 - Allows remote operations capability
 - Increase efficiency for software updates and security
- Enhanced Graphics
 - Visual validation of input data
 - User configurable screens for RT visualization

DIGITAL AND AUTOMATION

Solus

Surface acquisition hardware

Solus™ surface acquisition hardware is the surface equipment used to acquire sensor data on surface and communicate to Baker Hughes downhole drilling and LWD tools.

Solus is the latest generation hardware highlighting globally certified “plug-n-play” digital sensors with field-bus digital connections, fiber optic Ethernet cabin interface, and advanced digital signal processing which ensures safe, reliable, accurate and highly efficient operations under zone-rated conditions.



Applications

- Baker Hughes Drilling services operations worldwide
- Remote Operation scenarios

Features and benefits

- Plug & Play capabilities
 - Reduces rig up/rig down time and steps
 - Minimize trouble shooting
 - Reduces training needs
 - Self-diagnostic sensors reduces NPT
- Wireless connection
 - Reduces number of cables between rig and cabin
 - Provide a simpler system with less components
- Versatile around the world
 - It complies with all current Global regulations
 - Can be used for multiple service levels and different applications
 - Fiber optics communication from cabin to rig floor where necessary

DIGITAL AND AUTOMATION

RiskGuard

Analysis and risk management solutions

While drilling a well, operators continually observe and react to a complex interaction of geologic, hydraulic, mechanical, and human factors. When one or more of these factors misalign, the results may be hazardous, time-consuming, and costly. Nonproductive time (NPT), which is related to wellbore problems and equipment failures, can account for up to 25% of an operator's budget. Invisible lost time (ILT), which is related to operational efficiencies, such as time to make a connection or to trip pipe, can add up to an additional 25% of operating costs.

Pre-well modelling uses offset and target well data to identify and diagnose potential problems, then develop an action plan to address them. In real-time engineers provide 24-hour interpretation of data trends and provide solutions when necessary. Real-time data is integrated into the pre-well models to observe deviations if any.

Finally, a post-well or section review will be made to note lessons learned and recommend ways to reduce NPT/ILT further.

Applications

All drilling environments

Features and benefits

- Pre-well analysis of NPT/ILT factors
 - Identifies potential wellbore issues
 - Defines target times for rig operations
- Focused real-time trend surveillance
 - 24-hour monitoring and analysis
 - Identifies leading indicators to avoid NPT
 - Analyzes rig efficiency compared to target
 - Identifies time-saving opportunities (ILT)
- Collaborative wellsite and remote interaction
 - Provides rapid problem evaluation
 - Comprehensive answers while drilling
 - Develops and reports best practices
- Structured workflow and communication protocols
 - Ensures all personnel follow the same workflow
 - Rapid and accurate recognition of anomalies
 - Informs the right person at the right time
- Post-well service analysis
 - Evaluates the well against target times
 - Identifies areas for improvement
 - Records lessons learned for future jobs

Measurement While Drilling (MWD)

aXcelerate PLUS Mud-Pulse Telemetry

Wired-Pipe Telemetry

GyroTrak

NaviTrak MP

NaviTrak LCP

NaviTrak HR

NaviTrak EM

NaviTrak UT

OnTrak

AccuFIT

MEASUREMENT WHILE DRILLING

aXcelerate PLUS

Mud-pulse telemetry

The **aXcelerate™ PLUS mud-pulse telemetry service** delivers downhole data, fast. This allows informed real-time decisions for:

- Drilling optimization services based on higher-resolution drilling performance data to minimize drilling risks and improve drilling efficiency
- Reservoir navigation services based on enhanced geological and petrophysical understanding, along with optimized wellbore placement.

The aXcelerate PLUS mud-pulse telemetry service comprises an advanced surface software suite and a BCPM2™ turbine-powered communication module. The combination of downhole adjustable, oscillating shear valve, and sophisticated signal processing means reliable data transmission in the toughest drilling conditions, including high-lost-circulation-material (high-LCM) and high-drilling-noise environments.

Applications

- Critical wells
- Geosteering and optimized wellbore placement
- Extended-reach and complex 3D wells
- Performance drilling
- Required for extended formation evaluation bottomhole assemblies (BHAs)

Features and benefits

- Downhole adjustable pulser setup via downlink
 - Maximizes achievable data rates in changing drilling environments and conditions without pulling out of hole
- Real-time formation evaluation data for reservoir navigation
 - Maximizes production through optimized wellbore placement
 - Improves decision making and reduces uncertainty
- High-resolution downhole drilling dynamics data
 - Optimizes drilling efficiency and improves hole quality
- Bandwidth up to 40 bits per second physical and up to 256 bits per second compressed
 - Delivers more real-time data for informed decision making and reduced risk
 - Increases rate of penetration (ROP) without sacrificing log density



Tool Specifications

Tool size	4½-in. (121 mm) 6½-in. (172 mm)
Hole size*	5½-in. to 10⅝-in. (146 mm to 270 mm)
Tool weight*	922 lb to 1,764 lb (455 kg to 800 kg)
Tool length*	16.0 ft to 17.5 ft (4.9 m to 5.33 m)
Maximum temperature	302°F (150°C)
Maximum pressure	25,000 psi (1,725 bar)
Flow range*	147 gpm to 900 gpm (556 lpm to 3407 lpm)
Maximum data rate	40 bps

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

MEASUREMENT WHILE DRILLING

Wired-Pipe Telemetry

High-speed data transmission

The **wired-pipe telemetry service** provides downhole data at the highest speed currently available in the industry. With memory quality data available in real time, this allows informed decisions based on:

- Highest-resolution drilling performance data of the BHA and optional along-string measurements for drilling optimization services to minimize drilling risks and improve drilling efficiency
- Enhanced geological and petrophysical understanding for reservoir navigation services, along with optimized wellbore placement
- Data delivery from environments previously undrillable using mud-pulse telemetry

The wired-pipe service combines the IntelliServ* wired-pipe network and the BHA to deliver the most detailed, real-time picture of the downhole environment to make informed decisions while optimizing wellbore placement and managing wellbore stability simultaneously.

Applications

- Extended-reach wells
- Underbalanced drilling

Features and benefits

- Real-time formation evaluation memory quality data for reservoir navigation
 - Maximizes production through optimized wellbore placement
 - Improves decision making and reduces uncertainty
 - Enables high-quality images and logs for specific LWD services
- Bandwidth up to 57,600 bits per second
 - Delivers more real-time data for informed decision making and reduced risk
 - Increases rate of penetration (ROP) without sacrificing log density
 - Significantly reduces downlink times for optimized wellbore placement and reservoir navigation
- High-resolution downhole drilling dynamics data of the BHA and optional along the string
 - Optimizes drilling efficiency and improves hole quality
- Drilling in environments where data transmission was not possible with mud pulse telemetry

*IntelliServ is a trademark of National Oilwell Varco Inc.



Tool Specifications	
Tool size	4½-in. (121 mm) 6-in. (171 mm) 8¼-in. (210 mm) 9½-in. (241 mm)
Hole size*	5½-in. to 26-in. (146 mm to 660 mm)
Tool weight*	459 lb to 1,540 lb (208 kg to 700 kg)
Tool length*	8.5 ft to 9.11 ft (2.60 m to 2.77 m)
Maximum temperature	302°F (150°C)
Maximum pressure	25,000 psi (1,725 bar)
Flow range*	147 gpm to 1,600 gpm (556 lpm to 6050 lpm)

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

MEASUREMENT WHILE DRILLING

GyroTrak

Gyroscopic MWD service

The Baker Hughes **GyroTrak™ gyro while drilling service** offers accurate measurements of azimuth, inclination, and true-north toolface in situations where operators encounter high magnetic interference. When drilling from crowded platforms or pads, these measurements increase the certainty of directional surveys. This allows operators to save rig time and drill ahead without wireline gyro surveys while minimizing the risk of collision with a nearby well.

Applications

- Nearby well casing interference
- Kickoff below a casing shoe

Features and benefits

- Robust gyroscopic measurements
 - Increases certainty of directional surveys



Tool Specifications

Tool size	2 ³ / ₈ -in. to 12 ³ / ₄ -in. (60 mm to 313 mm)
Hole size	2 ¹ / ₄ -in. to 44-in. (70 mm to 1,118 mm)
Tool weight	187 lb to 8,600 lb (85 kg to 3900 kg)
Tool length	10.66 ft to 36.09 ft (3.25 m to 11 m)
Maximum temperature*	266°F (130°C) with standard elastomer 320°F (160°C) with high-temperature elastomer
Speed range*	28 rpm to 1,250 rpm
Flow range*	25 gpm to 1,500 gpm (95 lpm to 5700 lpm)
Operational differential pressure range*	Maximum 290 psi to 1,800 psi (20 bar to 125 bar)
Operational torque range*	Maximum 275 ft-lb to 18,000 ft-lb (370 Nm to 24500 Nm)
Power output range*	14 hp to 430 hp (10 kW to 320 kW)

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

MEASUREMENT WHILE DRILLING

NaviTrak MP

Directional and gamma MWD service

The Baker Hughes **NaviTrak™ MP directional and gamma MWD service** delivers real-time directional information, including hole inclination, azimuth, and toolface orientation. The mud-pulse telemetry system transmits downhole measurements quickly to the surface, reducing risk and enabling precise wellbore positioning. With modular sensor modules and a wide range of collar sizes, this service can be tailored to the client's drilling specifications.

Applications

- Unconventional shale plays
- Onshore development drilling
- Factory drilling

Features and benefits

- Real-time directional information
 - Allows accurate wellbore placement
 - Meets regulatory survey requirements
- Downlink capability
 - Improves telemetry rates and optimizes performance
- Real-time gamma ray logs
 - Identifies formations for lithology correlation
 - Determines casing and core point selection
- Optional flow-off logging
 - Provides downhole information during connections



Tool Specifications

Tool size	31/8-in. (79.4 mm)
	41/4-in. (120.7 mm)
	63/4-in. (171.5 mm)
	81/4-in. (209.6 mm)
	91/2-in. (241.3 mm)
Maximum data rate*	6 bps
Probe diameter	13/4-in. (45 mm)
Hole size*	37/8-in. to 171/2-in. (98 mm to 445 mm)
Tool weight*	1,920 lb to 5,950 lb (870 kg to 1870 kg)
Tool length*	29 ft (8.84 m)
Maximum temperature	302°F (150°C)
Maximum pressure	20,000 psi (1380 bar)
Flow range*	75 gpm to 1,600 gpm (285 lpm to 6130 lpm)
Gamma ray range	0 to 200 API
Inclination accuracy	±0.2°
Azimuth accuracy	±1.0°

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

MEASUREMENT WHILE DRILLING

NaviTrak LCP

LCM-resistant MWD service

The Baker Hughes **NaviTrak™ LCP MWD** delivers downhole information to the surface through a mud pulser that operates under high volumes of lost circulation material (LCM) and in mud systems contaminated with magnetic particles. This service is LCM-resistant, and delivers directional surveys, gamma ray, vibration, stick slip, and pressure measurements, while minimizing nonproductive time (NPT) and reducing drilling risks.

Applications

- High-LCM environments
- Unconventional shale plays
- Onshore development drilling
- Factory drilling

Features and benefits

- Proven tolerance to high solids and LCM concentrations
 - Minimizes or eliminates NPT through reduced plugging risks of MWD system
- Real-time directional information, including hole inclination, azimuth, and toolface orientation
 - Optimizes wellbore placement
- Downlink capability improves telemetry rates
 - Reduces unnecessary trips
- Single-turbine/restrictor configuration
 - Adapts to a wide range of flow rates and conditions
- Real-time gamma ray logs
 - Identifies formations for lithology correlation
 - Determines casing and core point selection



Tool Specifications

Tool size	4 $\frac{1}{2}$ -in. (121 mm) 6 $\frac{1}{2}$ -in. (165 mm) 6 $\frac{3}{4}$ -in. (172 mm)
Maximum data rate*	4 bps
Hole size*	5 $\frac{7}{8}$ -in. to 9 $\frac{7}{8}$ -in. (149 mm to 250 mm)
Tool weight*	2,250 lb to 3,991 lb (1020 kg to 1810 kg)
Tool length*	20.20 ft to 23.0 ft 6.2 m to 7.0 m
Maximum temperature	302°F (150°C)
Maximum pressure	25,000 psi (1725 bar)
Flow range*	120 gpm to 750 gpm (454 lpm to 2650 lpm)
Gamma ray range	0 to 200 API
Inclination accuracy	±0.2°
Azimuth accuracy	±1.0°
Toolface accuracy	±1.5°

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

MEASUREMENT WHILE DRILLING

NaviTrak HR

High reliability MWD service

The Baker Hughes **NaviTrak™ HR directional and gamma MWD service** delivers real-time directional information, including hole inclination, azimuth, and toolface orientation. The mud-pulse telemetry system transmits downhole measurements quickly to the surface, reducing risk and enabling precise wellbore positioning. With the latest technology upgrade for Directional and Memory, NaviTrak HR allows us to reduce drilling time with Flow off survey, continuous inclination and continuous azimuth.

Applications

- Unconventional shale plays
- Onshore development drilling
- Factory drilling

Features and benefits

- Upgraded Directional and Memory
 - High Reliability MWD service
- Real-time continuous inclination and azimuth
 - Allows continuous accurate wellbore steering and landing
- Flow off survey
 - Reduce rig time by taking survey during making up connections
- Optional gamma-ray measurement
 - Quickly identifies formation tops, allows for log correlation, and select casing points.



Tool Specifications	
Tool size	3/8-in. (79.4 mm) 3 3/8-in (85.7 mm) 4 1/4-in. (120.7 mm) 6 3/4-in. (171.5 mm) 8 1/4-in. (209.6 mm) 9 1/2-in. (241.3 mm)
Maximum data rate*	6bps
Probe diameter	1 1/4-in. (45 mm)
Hole size*	3 7/8-in. to 17 1/2-in. (98 mm to 445 mm)
Tool weight*	452 lb to 6,945 lb (205 kg to 3150 kg)
Tool length*	29 ft (8.84 m)
Maximum temperature	302°F (150°C)
Maximum pressure	20,000 psi (1380 bar)
Flow range*	75 gpm to 1,600 gpm (285 lpm to 6130 lpm)
Gamma ray range	0 to 200 API
Inclination accuracy	±0.2°
Azimuth accuracy	±1.0°
Continuous Inclination accuracy	±0.4°
Continuous Azimuth accuracy	±2.0°
Toolface accuracy	±1.5°

*Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.

MEASUREMENT WHILE DRILLING

NaviTrak EM

Electromagnetic Telemetry MWD service

The Baker Hughes **NaviTrak™ EM directional and gamma MWD service** delivers real-time directional information, including hole inclination, azimuth, and toolface orientation through Electromagnetic (EM) telemetry channel. The EM telemetry system transmits downhole measurements quickly to the surface, reducing risk and enabling precise wellbore positioning, especially under high LCM environment.

Applications

- High to extremely high LCM
- Unconventional shale plays
- Onshore development drilling
- Factory drilling

Features and benefits

- EM Telemetry
 - Unlimited LCM allows flexible well planning
- Flow off survey:
 - Reduce rig time from taking survey during connection
- Downlink capability
 - Optimizes telemetry speed and power usage to avoid unnecessary trips.
- Anulus Pressure
 - Allow for drilling optimization
- Optional gamma-ray measurement
 - Quickly identifies formation tops, allows for log correlation, and select casing points.



Tool Specifications

Tool size	4¾-in. (120.7 mm)
	6½-in. (165.1 mm)
	8-in. (203.2 mm)
Maximum data rate*	5 bps
Probe ID	1.88-in. (47.8 mm)
Hole size*	6 ⅞-in. to 17 ½-in. (156 mm to 445 mm)
Gap Sub length*	68-in (1.7m)
Maximum temperature	302°F (150°C)
Inclination accuracy	±0.2°
Azimuth accuracy	±2.0°
Toolface accuracy	±1.5°

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

MEASUREMENT WHILE DRILLING

NaviTrak UT

Unified Telemetry MWD service

The Baker Hughes **NaviTrak™ UT directional and gamma MWD service** delivers real-time directional information, including hole inclination, azimuth, and toolface orientation through Electromagnetic (EM) and/ or Mud Pulse (MP) telemetry channels at the same time. The Unified telemetry system transmits downhole measurements quickly and reliably to the surface, reducing risk and enabling precise wellbore positioning, especially under high LCM environment.

Applications

- High to extremely high LCM
- Unconventional shale plays
- Onshore development drilling
- Factory drilling

Features and benefits

- Unified Telemetry combining EM 16bps and MP
 - Improve drilling ROP with fast telemetry rate and high reliability from using both Pulsers
- Real-time continuous inclination and azimuth
 - Allows continuous accurate wellbore steering and landing
- Flow off survey
 - Reduce rig time from taking survey during connection
- Downlink capability
 - Reduce rig time with short downlink and uplink time
- Optional gamma-ray measurement
 - Quickly identifies formation tops, allows for log correlation, and select casing points.



Tool Specifications

Tool size	4 $\frac{1}{2}$ -in. (120.7 mm) 6 $\frac{1}{2}$ -in. (165.1 mm) 8-in. (203.2 mm)
Maximum data rate*	16 bps by EM, 1 bps by MP
Probe diameter	2.54-in. (64.5 mm)
Hole size*	6 $\frac{1}{8}$ -in. to 12 $\frac{1}{4}$ -in. (156 mm to 311 mm)
Tool weight*	775 lb to 1,840 lb (352 kg to 835 kg)
Tool length*	15ft-15.8ft (4.58m-4.83m)
Maximum temperature	302°F (150°C)
Maximum pressure	20,000 psi (1380 bar)
Flow range (Mud Pulse)*	300 gpm to 1,300 gpm (1,136 lpm to 4,921 lpm)
Gamma ray range	0 to 750 API
Inclination accuracy	±0.2°
Azimuth accuracy	±1.0°
Toolface accuracy	±1.5°

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

MEASUREMENT WHILE DRILLING

OnTrak

Integrated MWD and LWD service

The Baker Hughes **OnTrak™ integrated measurement-while-drilling (MWD) and logging-while-drilling (LWD) service** delivers a suite of directional and formation evaluation measurements. Along with pressure and drilling dynamics monitoring, the service provides operators with the most accurate propagation resistivity in the industry. The integrated design offers increased reliability, fewer connections, and optimized sensor-to-bit spacing to complement a suite of real-time downhole measurements. Power and mud-pulse telemetry are provided by the BCPM module. The OnTrak module serves as a platform for advanced rotary steerable and formation evaluation services.

Applications

- Onshore, offshore, and deepwater
- Complex directional targets
- Geosteering
- Leak Off and Formation Integrity Testing

Features and benefits

- Real-time directional information
 - Allows accurate wellbore placement
 - Meets regulatory survey requirements
- Azimuthal gamma ray with imaging capability
 - Identifies bed boundaries and orientation
- High-frequency phase resistivity
 - Increases vertical resolution
 - Identifies thin beds and fluid contacts
- Low-frequency attenuation resistivity
 - Increases depth of investigation
 - Estimate Rt with a greater immunity to environmental effects
- Fast two-way communication between the surface and downhole
 - Reduces drilling risk, using real-time downhole information
 - Minimizes nonproductive time through optimized drilling parameters



Tool Specifications

Tool size	4½-in. (121 mm) 6¾-in. (172 mm) 8¼-in. (210 mm) 9½-in. (241.3 mm)	
Hole size*	5¾-in. to 26-in. (146 mm to 669 mm)	
Tool weight*	2200 lb to 7275 lb 998 kg to 3300 kg	
Tool length*	27.7 ft to 31.3 ft (8.4 m to 9.6 m)	
Maximum temperature	302°F (150°C)	
Maximum pressure*	25,000 psi to 30,000 psi (1725 bar to 2068 bar)	
Flow range*	125 gmp to 1,600 gpm (475 lpm to 6050 lpm)	
Azimuthal gamma ray range	0 to 500 API	
Inclination accuracy	±0.1°	
Resistivity range	2MHz Phase difference: 0.1 to 3,000 ohm-m 2MHz Attenuation: 0.1 to 500 ohm-m 400 kHz Phase difference: 0.1 to 1,000 ohm-m 400 kHz Attenuation: 0.1 to 200 ohm-m	
Azimuth accuracy	±1.0°	
Toolface accuracy	±1.5°	

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

MEASUREMENT WHILE DRILLING

AccuFIT

Real-time flow-off annular pressure service

AccuFIT™ Real-time flow-off annular pressure service quickly and reliably transmits high-resolution downhole flow-off pressure data to surface in real time, enabling operators to make well-informed decisions during drilling operations.

The AccuFIT service delivers high-quality data acquired during Leak Off and Formation Integrity Tests. Because information about LOT or FIT is no longer limited by surface measurements, the knowledge about real downhole pressure is improved. Technologies such as flexible resolution modes with downlink command, intelligent data compression, default sending of the downhole data after start of normal flow resumes and automatic switching to the high-resolution mode without downlink command, ensure optimal decisions for the drilling mud program, evaluation of the cement strength around casing shoe, and provision of input for pore pressure analysis, while minimizing nonproductive time.

Additionally, the AccuFIT service provides flow-off pressure information which could be used for understanding the downhole pressure changes during connections, evaluation of swab and surge downhole pressure variations to optimize tripping speeds, determination of tight spots, and downhole verification of pressure balance during Managed Pressure Drilling operations.

Applications

- Wells with narrow pressure window
- Extended-reach wells
- Deepwater exploration wells

Features and benefits

- High-resolution flow off pressure curve in real-time
 - Provide detailed information about FIT/LOT
 - Enable understanding of the downhole pressure changes during connections
 - Allow evaluation of the swab and surge downhole pressure variations
 - Defines position of the tight spot in the sticky hole
 - Verifies Managed Pressure Drilling measurements
- Downlink configurable resolution of the transmitted pressure curve
 - Ensures optimal data transmission
- Automatic provision of data after every flow-off event without dedicated downlink
- Automatic switch to the high-resolution mode without dedicated downlink
 - Eliminates need for special downlink-saves rig time
- State-of-the-art data processing and compression algorithms

Formation Evaluation

OnTrak

LithoTrak

MagTrak

SoundTrak

FORMATION EVALUATION

OnTrak

Gamma and multiple-propagation resistivity service

The **Baker Hughes OnTrak™ integrated measurement-while-drilling (MWD) and logging-while-drilling (LWD) service** delivers a suite of directional and formation evaluation measurements. Along with pressure and drilling dynamics monitoring, the service provides operators with the most accurate propagation resistivity in the industry. The integrated design offers increased reliability, fewer connections, and optimized sensor-to-bit spacing to complement a suite of real-time downhole measurements.

Power and mud-pulse telemetry are provided by the BCPM module. The OnTrak module serves as a platform for advanced rotary steerable and formation evaluation services.

Applications

- Onshore, offshore, and deepwater
- Complex directional targets
- Geosteering

Features and benefits

- Azimuthal gamma ray with imaging capability
 - Identifies bed boundaries and orientation
- High-frequency phase resistivity
 - Increases vertical resolution
 - Identifies thin beds and fluid contacts
- Low-frequency attenuation resistivity
 - Increases depth of investigation
 - Estimate R_t with a greater immunity to environmental effects
- Fast two-way communication between the surface and downhole
 - Reduces drilling risk, using real-time downhole information
 - Minimizes nonproductive time through optimized drilling parameters



Tool Specifications

Tool size	4¼-in. (121 mm)	
	6¼-in. (172 mm)	
	8¼-in. (210 mm)	
	9½-in. (241.3 mm)	
Hole size*	5¼-in. to 26-in. (146 mm to 669 mm)	
Tool weight*	2200 lb to 7275 lb 998 kg to 3300 kg	
Tool length*	27.7 ft to 31.3 ft (8.4 m to 9.6 m)	
Maximum temperature	302°F (150°C)	
Maximum pressure*	25,000 psi to 30,000 psi (1725 bar to 2068 bar)	
Flow range*	125 gmp to 1,600 gpm (475 lpm to 6050 lpm)	
Azimuthal gamma ray range	0 to 500 API	
Inclination accuracy	±0.1°	
Resistivity range	2MHz Phase difference:	0.1 to 3,000 ohm-m
	2MHz Attenuation:	0.1 to 500 ohm-m
	400 kHz Phase difference:	0.1 to 1,000 ohm-m
	400 kHz Attenuation:	0.1 to 200 ohm-m
Azimuth accuracy	±1.0°	
Toolface accuracy	±1.5°	

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

FORMATION EVALUATION

LithoTrak

Density and porosity service

The Baker Hughes **LithoTrak™ logging-while-drilling (LWD) density and porosity service** delivers accurate and reliable neutron porosity and formation density logs. The service also provides operators with real-time images for enhanced reservoir navigation and wellbore stability. A proprietary binning technique gathers accurate density measurements, regardless of borehole quality, vibrations, and hole cleaning. The service eliminates the need for additional wireline runs and reduces nonproductive time, allowing operators to update drilling plans in real time and avoid drilling hazards.

Applications

- Formation and reservoir evaluation in all well profiles
- Acquires data, using straight-hole rotary steerable motors, or rotary steerable drilling systems
- Reservoir navigation
- Wellbore stability monitoring

Features and benefits

- Compensated density and P_e measurements collected through standoff binning
 - Eliminates need for additional wireline runs with accurate density measurements in drilling environments
 - Reduces wellsite nonproductive time
- Real-time borehole density images and caliper measurements in all mud types
 - Facilitates accurate reservoir navigation for optimal wellbore placement
 - Increases safety by avoiding drilling hazards
- Accurate identification of fluid contacts and hydrocarbon typing
 - Optimizes wellbore placement
 - Improves hydrocarbon recovery
- Azimuthal borehole caliper and real-time, short-spaced borehole images
 - Improves wellbore stability through breakout detection and borehole profiling



Tool Specifications

Tool size	4¼-in. (121 mm) 6¼-in. (171 mm) 8¼-in. (241 mm)
Hole size*	5⅞-in. to 12¼-in. (149 mm to 311 mm)
Tool weight*	1,100 lb to 3,265 lb (499 kg to 1481 kg)
Tool length*	16.1 ft to 18.2 ft (4.91 m to 5.55 m)
Maximum temperature*	302°F (150°C)
Maximum pressure*	30,000 psi (2070 bar)
Flow range*	Refer to applicable flow ranges for BCPM tool

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

FORMATION EVALUATION

MagTrak

Magnetic resonance service

The Baker Hughes **MagTrak™ magnetic-resonance-while-drilling service** offers precise, dependable answers to critical questions regarding fluid properties, total and effective porosity, and permeability estimations in production zones. Measurements are lithology independent, and the tool does not utilize radioactive sources. Unlike other while-drilling magnetic resonance services, operators can rely on the system's real-time answers because the tool principle and design minimize the risk of drilling vibration effects on the data. Operators gain a comprehensive understanding of the reservoir quality to optimize a well's productivity throughout its life cycle.

Applications

- Sourceless petrophysical characterization
- Accurate reserves estimates in complex lithologies
- Continuous permeability
- Fluid sampling optimization
- Fluid typing
- Wellbore placement
- Drilling efficiency
- Completions optimization

Features and benefits

- Accurate T_2 magnetic resonance logs
 - Improves real-time and post-well decisions on reserve estimates, petrophysical characterization, fluid typing, and wellbore placement
- Eliminates motion effects on measurements induced by drilling vibration
 - Delivers accurate T_2 magnetic resonance logs
 - Optimizes reservoir drainage strategies with dependable fluid volume estimates
- Sourceless porosity
 - Reduces lost-in-hole risk by accurately measuring porosity without using a radioactive source
- Real-time T_2 spectrum transmitted to surface
 - Improves real-time quality control and fluid typing



Tool Specifications	
Tool size	4¼-in. (121 mm) 6¼-in. (172 mm) 8¼-in. (211 mm)
Hole size*	5¼-in. to 12¼-in. (146 mm to 314 mm)
Tool weight*	1,580 lb to 3,197 lb (716 kg to 1,450 kg) sensor sub with lower stabilizer
Tool length*	22.5 ft to 24.2 ft (6.85 m to 7.4 m) sensor sub with lower stabilizer
Maximum temperature*	302°F (150°C)
Maximum pressure*	25,000 psi (1725 bar)
Flow range*	Normal: 180 gpm to 660 gpm (680 lpm to 2500 lpm) Low: 145 gpm to 446 gpm (550 lpm to 1680 lpm) High: 238 gpm to 406 gpm (900 lpm to 1450 lpm)
Inter-echo time (TE)	Standard: 0.6 ms
Number of echoes	1,000

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

FORMATION EVALUATION

SoundTrak

Acoustic service

The Baker Hughes **SoundTrak™ acoustic logging-while-drilling (LWD) service** provides compressional and shear wave travel time in all formations, delivering accurate and reliable logging performance in challenging drilling environments. Using quadrupole technology, this service allows operators real-time access to critical formation information that maximizes drilling efficiency and enhances wellbore stability even in larger holes and slow formations.

Applications

- Pore-pressure predictions
- Measuring compressional and shear slowness in larger holes and slow formations
- Real-time geomechanical rock properties measured for wellbore stability
- Seismic ties
- Porosity estimates

Features and benefits

- Salinity-independent measurements for real-time pore-pressure prediction using compressional slowness measurements
 - Prevents blowouts and wellbore collapse
 - Optimizes drilling efficiency by maintaining safe, low mud weights
 - Reduces stuck pipe incidents
- Seismic time-depth ties
 - Maximizes hydrocarbon recovery through precise wellbore placement
- Rock mechanical properties
 - Improves safety through early identification of sanding potential and wellbore stability issues
- Early detection of shallow gas, using acoustic light-hydrocarbon indicator
 - Reduces the number of conductor pipe sections required
 - Improves drilling safety in offshore environments
- Acoustic porosity evaluation
 - Reduces need for radioactive or chemical sources to determine sourceless porosity



Tool Specifications

Tool size	6¼-in. (172 mm) 8¼-in. (210 mm) 9½-in. (241 mm)
Hole size*	8 ³ / ₈ -in. to 26-in. (212 mm to 660 mm)
Tool weight*	3,750 lb to 6,800 lb (1701 kg to 3084 kg)
Tool length*	32.8 ft (10 m)
Maximum temperature*	302°F (150°C)
Maximum pressure*	25,000 psi (1725 bar) With upgrade – 30,000 psi (2069 bar)
Flow range*	Refer to applicable flow ranges for BCPM tool
Compressional velocity slowness range*	40 µsec/ft to 220 µsec/ft (131 µsec/m to 722 µsec/m)
Shear velocity slowness range*	60 µsec/ft to 600 µsec/ft (197 µsec/m to 1968 µsec/m)

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

Reservoir Fluid Characterization

TesTrak

FASTrak PRISM

RESERVOIR FLUID CHARACTERIZATION

TesTrak

Formation pressure service

The Baker Hughes **TesTrak™ formation-pressure-while-drilling service** offers precise, answers to critical questions on downhole formation pressure and mobility. Gathering pressure data while drilling allows operators to monitor real-time downhole conditions while improving rigsite safety, drilling efficiency, and wellbore placement decisions; besides standard reservoir and petrophysical analysis related to pressure gradients, fluid contacts, reservoir compartmentalization and others.

Applications

- Onshore, offshore, and deepwater
- Drilling hazard mitigation
- Reservoir characterization

Features and benefits

- **SmartTest™ intelligent testing**
 - Measures reservoir pressure and provides fluid mobility data
 - Improves testing efficiency and saves rig time
- **SmartPad™ closed-loop sealing**
 - Maintains undisturbed pressure communication between the tool and formation
 - Minimizes time-consuming interactions from the surface
 - Improves testing efficiency and saves time
- Real-time pore pressure measurements
 - Reduces nonproductive time by mitigating drilling hazards
 - Minimizes impact to the drilling process
 - Reduces differential sticking risks
 - Optimizes rate of penetration (ROP) and casing point selection
- Real-time gradient analysis to identify fluids and contacts
 - Increases hydrocarbon recovery through efficient reservoir navigation
- Real-time formation mobility
 - Improves accuracy of formation evaluation by identifying and retesting in low-permeability formations



Tool Specifications

Tool size	4¼-in. (121 mm) 6¼-in. (171 mm) 8¼-in. (210 mm)
Hole size*	5¼-in. to 17½-in. (146 mm to 445 mm)
Tool weight*	1,257 lb to 4,080 lb (570 kg to 1854 kg)
Tool length*	24.3 ft to 24.4 ft (7.40 m to 7.45 m)
Maximum temperature*	302°F (150°C)
Maximum pressure*	30,000 psi (2070 bar)
Sensor resolution	0.012 psi (0.0008 bar)
Draw down pressure range	Variable—maximum 8,700 psi (600 bar)
Draw down rate	Variable—up to 10 cm/s (3.94 in.)

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

RESERVOIR FLUID CHARACTERIZATION

FASTrak Prism

Fluid analysis, sampling, and pressure testing service

The Baker Hughes **FASTrak™ logging-while drilling (LWD) fluid analysis, sampling, and testing service** provides key petrophysical information to determine reservoir volume, fluid producibility, type and composition of the movable fluids. It combines the accurate pressure testing functionality of Baker Hughes TesTrak™ service, while addressing the growing need of real-time fluid identification and acquisition of representative fluid samples while drilling, resulting in significant cost savings.

The FASTrak Prism service is the latest generation of FASTrak. It includes all the features and benefits of its predecessor with the addition of VIS-NIR optical absorbance spectroscopy measurements for improved fluid characterization.

Applications

- Onshore, offshore and Deepwater
- Highly deviated, extended-reach and horizontal wells

Features and benefits

- SmartTest™ intelligent testing system
 - Provides optimized parameters that reduce BHA stationary time and ensures valid data
 - Multiple drawdowns per test station
- Calculates mobility in real time
 - Identifies formation mobility for estimation of producibility
- SmartPad™ closed-loop sealing system
 - Increases seal efficiency during sampling and testing
- Real-Time Fluid Analysis
 - VIS/NIR Optical absorbance and UV fluorescence spectroscopy
 - Enhances critical decision making based on fluid identification and fluid typing during sampling
- Direct measurement of density, refractive index, and sound speed
 - Enhances estimation of producible
- reserves and direct calculation of gas/oil ratio (GOR)
- Sampling and pressure testing while circulating
 - Reduces risk of differential sticking of BHA
- High-accuracy pump control
 - Increases efficiency during pump through and cleanup operations
- Compressibility and drawdown mobility
 - Provides accurate measurements in immiscible fluids for cleanup detection
- Capture of up to 16 single-phase samples
 - Maximizes fluid volume recovered in a single run
- Multiple samples per pressure station
 - Reduces pump-out time for consecutive samples and possible sample validations
- Chemical-resistant metallurgy
 - Reduces pump-out time for consecutive samples and possible sample validations
 - Collects representative fluid samples for geochemical analysis
- Single-phase sample tank technology
 - Avoids asphaltene and wax precipitation during sample retrieval at surface
- JewelSuite Software
 - Full Real-Time analysis and Post Job Deliverables



Tool Specifications

Tool size	6¼-in. (172 mm)
Hole size*	8½-in. to 11¼-in. (216 mm to 298 mm)
Tool weight*	Tool Weight without Tank Carrier: 4,881 lb (2214 kg)
Tool length*	without Tank Carrier 42.7 ft (13 m) with one Tank Carrier 57.4 ft (17.5 m) with 4 Tank Carrier 101.7 ft (31 m)
Maximum temperature*	300°F (150°C)
Maximum Pressure*	25,000 psi to 30,000 psi (1725 bar to 2068 bar)
Flow range*	370–900 gpm (1400–3400 lpm)

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

Geo-stopping

ZoneTrak R

ZoneTrak G

GEO-STOPPING

ZoneTrak R

At bit resistivity service

The Baker Hughes **ZoneTrak R™ at bit resistivity service** provides practical, real-time answers to detect formation changes as quickly as possible. The service is ideal for all geo-stopping applications in formations with high-resistivity contrasts, and accurately identifies the top of the reservoir. By increasing the reservoir exposure, operators maximize coring section intervals and ultimately reservoir production.

Applications

- Onshore, offshore, and deepwater
- High-resistivity contrast formations
- Casing and coring point selection
- Salt exit detection
- Real-time pressure management

Features and benefits

- Identifies top of reservoir
 - Increases reservoir exposure by reducing cased-off intervals
 - Minimizes loss of coring section intervals
- Detects formation changes early to adjust drilling fluid parameters
 - Enhances wellbore stability and safety
- Includes forward-response modeling
 - Eliminates nonproductive time (NPT) by accurately predicting tool response
- Deployable in water- and oil-based muds
 - Increases use in a variety of formations where water- and oil-based muds are typically used
- Real-time data transmitted through Baker Hughes WellLink™ service
 - Increases efficiency by monitoring data from Baker Hughes BEACON centers and customers' offices



Tool Specifications

Tool size	6¼-in. (172 mm) 9½-in. (241 mm)
Hole size*	8 ³ / ₈ -in. to 18¼-in. (213 mm to 464 mm), dependent upon mud type
Tool weight*	772 lb to 1,272 lb (350 kg to 577 kg)
Tool length*	5.7 ft to 6.8 ft (1.73 m to 2.06 m)
Maximum temperature*	302°F (150°C)
Maximum pressure*	30,000 psi (2070 bar)
Maximum RPM*	400 rpm
Flow range*	200 gpm to 1,600 gpm (757 lpm to 6057 lpm)
Maximum build-up rate*	According to BHA setup using BHASYS PRO

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

GEO-STOPPING

ZoneTrak G

Near-bit gamma service

The Baker Hughes **ZoneTrak G™ near-bit gamma service** provides early formation identification, geo-stopping, and geosteering capabilities while drilling when a gamma ray measurement contrast exists. This enables rapid identification of geological targets, allowing early confirmation of the zone of interest. Used with either conventional rotary systems or AutoTrak™ rotary steerable systems, the near-bit sub gathers formation gamma ray measurements directly behind the bit, and it can operate in either oil-based or water-based drilling fluids, minimizing exposure to troublesome formations.

Applications

- Conventional and unconventional
- Geo-stopping service
- Geosteering service

Features and benefits

- Includes two gamma sensors for early detection of target production zone
 - Eliminates need for additional runs with redundancy and accuracy of measurements
 - Reduces nonproductive time (NPT)
- True azimuthal gamma ray measurements above the bit with imaging capabilities in up to 16 sectors
 - Optimizes wellbore placement in the target zone
 - Maximizes productive reservoir length through precise casing point selection
 - Minimizes loss of coring section interval through precise core point selection
- Deployable in water- and oil-based muds
 - Increases use in a variety of formations where water- and oil-based muds are typically used
- Real-time gamma data can be displayed through the Baker Hughes WellLink™ service
 - Increases efficiency by monitoring data from the Baker Hughes BEACON center or operator's facility
 - Reduces NPT by using data to make decisions and drilling adjustments from remote locations



Tool Specifications	
Tool size	4½-in. (121 mm) 6½-in. (172 mm) 9½-in. (241 mm)
Hole size*	5½-in. to 18¼-in. (146 mm to 464 mm)
Tool weight*	1,012 lb to 1,060 lb (459 kg to 481 kg)
Tool length*	4.79 ft to 5.35 ft (1.46 m to 1.63 m)
Maximum temperature*	302°F (150°C) 125°C for 6½" toolsize
Maximum pressure*	25,000 psi to 30,000 psi (1725 bar to 2070 bar)
Maximum RPM*	4½-in. 400 rpm 6½-in. 400 rpm 9½-in. 300 rpm
Flow range*	125 gpm to 1,600 gpm (475 lpm to 6050 lpm)
Max build-up rate*	According to BHA setup using BHASYS PRO

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

Reservoir Navigation

AziTrak

VisiTrak

RESERVOIR NAVIGATION

AziTrak

Deep azimuthal resistivity service

The Baker Hughes **AziTrak™ deep azimuthal resistivity tool** is a fully integrated, measurement-while-drilling (MWD) and logging-while-drilling (LWD) tool. It provides real-time, directional, azimuthal gamma ray, multiple-propagation resistivity (MPR™), deep-reading azimuthal resistivity measurements, and downhole pressure and vibration measurements from a single sub. These measurements allow operators to deliver optimal wellbore placement and increase production in high-angle and horizontal wells.

Applications

- Onshore, offshore, and deepwater
- High-angle and horizontal wells
- Brownfield production enhancement
- Field development through infill drilling
- Leak Off and Formation Integrity Testing
- Geosteering

Features and benefits

- Compact, fully integrated sub featuring close-to-the-bit measurements
 - Allows early decisions on optimal wellbore placement through close-to-the-bit measurements
- Close-to-the-bit, deep-reading azimuthal resistivity allows early detection of remote conductive boundaries
 - Optimizes wellbore placement in the zone of interest
 - Reduces nonproductive time (NPT) and alleviates expensive sidetracks
- Intuitive, dynamic, real-time display of reservoir boundaries
 - Improves operating efficiency through identifying bed boundaries using immediately available data



Tool Specifications

Tool size	4¼-in. (121 mm) 6¼-in. (172 mm)
Hole size*	5¼-in. to 10 ⁵ / ₈ -in. (146 mm to 270 mm)
Tool weight*	2,094 lb to 2,866 lb (950 kg to 1300 kg)
Tool length*	22.1 ft to 23.5 ft (6.72 m to 7.16 m)
Maximum temperature*	302°F (150°C)
Maximum pressure*	30,000 psi (2070 bar)
Flow range*	125 gpm to 350 gpm (475 lpm to 1325 lpm)
Depth of bed detection	Up to 17 ft (5.20 m)
Resistivity range*	0.1 to 3,000 ohm-m
Gamma Ray range	0 to 500 api

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

RESERVOIR NAVIGATION

VisiTrak

Geospatial navigation and analysis service

The Baker Hughes **VisiTrak™ extra deep azimuthal resistivity** is an evolutionary leap forward based on a decade of reservoir navigation experience using both omnidirectional and azimuthal resistivity technologies. The tool operates at two frequencies: 20 and 50 KHz. It is composed of two modules, a non-azimuthal transmitter sub and a receiver sub which also contains a dedicated azimuthal transmitter device. As with any conductive seeking tool, VisiTrak response is dependent on formation resistivity contrast. In ideal conditions, remote boundaries can be detected up to 150 ft (45.72 m) from the borehole with azimuthal sensitivity.

This depth of detection provides a reservoir scale view, opening a new frontier in real-time well bore placement and reservoir mapping by bringing reservoir navigation interpretation from bore hole to seismic scale. VisiTrak adds significant value by increasing production through optimized reservoir placement and improving ultimate recovery through better understanding of reservoir architecture. It delivers efficiency through reduction in costly pilot holes and non-planned geological sidetracks, as well as increasing drilling efficiency with no ROP limitations.

Applications

- Onshore, offshore, and deepwater
- Conventional oil and gas reservoirs
- High angle and horizontal wells

Features and benefits

- Mechanics of the service
 - Utilizes low frequency measurements (electromagnetic signals) for extra deep investigation
 - Utilizes cross component antenna technology allowing azimuthal sensitivity
 - Utilizes proprietary multi-component inversion techniques in real time to provide informed answers while drilling
- Well Placement
 - Pre-well modeling service based on client offset data to predict possible responses and possible decision points
 - Reservoir navigation SMEs utilize the next generation of proprietary navigation software to deliver a full interpretation in complex geological scenarios
 - Delivers R_v , R_h properties independently for each layer
- Reservoir Mapping
 - Provides 1D optimum earth model in real time delivering thicknesses and dip for each layer detected
 - Real-time 3D visualization for better visual and spatial understanding
 - Provides 2D grids designed for geological model update



Tool Specifications

Tool size	6¾-in. (172 mm) 9½-in. (242 mm)
Hole size*	8½-in. to 9¾-in. (216 mm to 251 mm) 12¼-in. (312 mm)
Tool weight*	6¾: Transmitter 1,102 lb (500 kg) Receiver 3,986 lb (1,800 kg) 9½: Transmitter 1,873 lb (850 kg) Receiver 6,285 lb (2,850 kg)
Tool length*	Transmitter 8.9 ft (2.7 m) Receiver 28.9 ft (8.8 m), 29.2 ft (8.9 m) in 9½-in.
Maximum temperature*	302°F (150°C)
Maximum pressure*	30,000 psi (2070 bar)
Flow range*	6¾ 200 gpm to 900 gpm (760 lpm to 3400 lpm) 9½ 290 gpm to 1600 gpm (1,100-6,050 lpm)
Depth of bed detection	Up to 150 ft (45.72 m)

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

Wellbore Imaging

StarTrak

ImageTrak

WELLBORE IMAGING

StarTrak

Electrical imaging service

The Baker Hughes **StarTrak™ logging-while-drilling (LWD)** electrical imaging service acquires microresistivity measurements around the circumference of the borehole during rotation of the bottomhole assembly. The imaging service features the industry's highest resolution (0.25-in. by 0.25-in.) with azimuthal measurements acquired in 120 separate sectors. The high resolution shows the sedimentological formation details and correlates with the conventional core. A detailed fracture analysis can be created, which is critical to maximize production of horizontal wells in unconventional plays.

Applications

- Complex or thin-bedded reservoirs
- Shale gas plays
- Geosteering
- Wellbore stability

Features and benefits

- Acquires high-resolution images at penetration rates up to 150 ft/hr
 - Delivers a highly detailed view of the formation
 - Provides complete fault and fracture identification
- Very tolerant of moderate levels of stick/slip
 - Provides early indication of wellbore stability problems
- Real-time images displayed through Baker Hughes **WellLink™ service**
 - Enables geosteering decisions
- Detailed fracture analysis
 - Optimizes stimulation program in horizontal wells and in wells located in unconventional shale plays



Tool Specifications

Tool size	4½-in. (121 mm) 6½-in. (172 mm)
Hole size*	5½-in. to 9½-in. (146 mm to 241 mm)
Tool weight*	639 lb to 1,014 lb (290 kg to 460 kg)
Tool length*	8.3 ft to 9.8 ft (2.53 m to 2.99 m)
Maximum temperature*	302°F (150°C)
Maximum pressure*	25,000 psi (1725 bar)
RPM*	Maximum 150 rpm
Flow range*	Function of OnTrak™ MWD service
Max. buildup rate*	According to BHA setup using BHASYS PRO

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

WELLBORE IMAGING

ImageTrak

High Resolution ultrasonic borehole imaging service

The Baker Hughes **ImageTrak™ service** provides high-resolution borehole images while drilling in any type of drilling fluid, it offers high resolution borehole imaging both in conductive and non-conductive medium.

Borehole imaging has been used for several decades to calculate borehole caliper, stress, breakout orientation, and stratigraphic and geologic structure imaging in conventional wells. Borehole wall images are now commonly used for fracture characterization during well planning to optimize hydraulic stimulation and maximize the possible return from a reservoir.

The ImageTrak service is currently delivered by a 6^{3/4}-in. ORD version 2.8 sub which can at the same time provide the standard LithoTrak service or could be standalone. The service is only available in memory mode while drilling and not real-time.

Applications

- Fracture characterization
- Borehole breakouts and geomechanics
- Borehole geometry evaluation
- Thin-bed identification
- Structural dip determination
- Lithology and porosity variations
- Secondary porosity identification
- Sedimentary features identification

Features and benefits

- High quality ultrasonic acoustic transducer
 - Measures both Amplitude and Travel Time to obtain fully sampled images of the borehole surface.
- 3D Borehole image visualization
 - Enables client to evaluate borehole quality
- High sampling rate
 - Enables a 256 sector circumferential resolution (1.4°) which is sufficient to fully sample the borehole wall in the typical ROP and RPM ranges experienced while drilling



Tool Specifications

Tool size	6 ³ / ₄ -in.(172 mm)
Hole size	8 ³ / ₈ -10-in. (213 mm-254 mm)
Tool weight	825 lb (375 kg)
Tool length	8.8 ft (2.68 m)
Max temperature	302°F (150°C)
Max Pressure	25,000 psi (1,725 bar)
Flow range	See OnTrak BCPM specification
Logging speed	Up to 400 ft/hr
Max buildup rate*	Application specific
Mud Type	OBM WBM
Max mud weight	16 ppg
Azimuthal sectors	256

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

Multi-propagation Resistivity

Ultraslim MPR

MULTI-PROPAGATION RESISTIVITY

Ultraslim MPR

Ultra-slimhole resistivity service

The Baker Hughes **Ultraslim MPR™ resistivity service** delivers real-time formation evaluation services and geosteering capabilities to optimize wellbore placement in slimhole applications. The service provides accurate, reliable data for a variety of drilling environments, including vertical resolution for defining thin beds and deeper formation evaluation for precise reservoir navigation. The two Ultraslim MPR sizes can be integrated with the Baker Hughes CoilTrak™ coiled-tubing re-entry drilling system, the NaviTrak™ MWD system, or the Advanced Slim MWD system.

Applications

- Coiled-tubing drilling
- Through-tubing rotary drilling
- Conventional oil and gas
- Deep water
- Onshore and offshore

Features and benefits

- Slim design with 2³/₈-in. or 3¹/₈-in. tool outside diameter (OD)
 - Increases hydrocarbon recovery in slimhole re-entry and/or through-tubing well construction applications
- 2-MHz and 400-kHz transmitted frequencies collect resistivity measurements in all mud types
 - Improves recovery by measuring hydrocarbon volumes in target zones
- Rugged antenna design and fully digital electronics on board
 - Enhances reservoir navigation services for precise wellbore placement
 - Provides reliable formation evaluation (FE) measurements in higher-buildup-rate environments
- Real-time data transmitted to surface through e-line or mud-pulse telemetry system
 - Optimizes wellbore placement through geosteering service



Tool Specifications

Tool size	2 ³ / ₈ -in. (60 mm) 3 ¹ / ₈ -in. (80 mm)
Hole size*	3-in. to 5 ⁷ / ₈ -in. (76 mm to 149 mm)
Tool weight*	121 lbs to 256 lbs (55 kg to 116 kg)
Tool length*	9.5 ft to 12.85 ft (2.9 m to 3.92 m)
Maximum temperature*	302°F (150°C)
Maximum pressure*	14,500 psi to 20,000 psi (1000 bar to 1380 bar)
RPM*	3 ¹ / ₈ -in.: Maximum 400 rpm (depends on BHA system)
Flow range*	80 gpm to 160 gpm (300 lpm to 600 lpm)
Max. buildup rate*	According to BHA setup and application

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

Baker Hughes 

Seismic

SeismicTrak

SEISMIC

SeismicTrak

Seismic service

The Baker Hughes **SeismicTrak™ seismic service** provides real-time, first-arrival seismic and waveform data to reduce formation depth uncertainty, allowing operators to hit their reservoir targets under a variety of complex conditions. Operators can use the seismic-while-drilling data to update surface seismic models without impeding overall drilling operations. This results in immediate and better-quality information on the reservoir, leading to improved production and recovery.

Applications

- Onshore, offshore, and deepwater
- Highly deviated, horizontal, or extended-reach wells
- Determining casing and coring points
- Reducing seismic uncertainty
- Identifying over-pressured zones below the bit

Features and benefits

- Measurements acquired during natural breaks in the drilling process
 - Reduces downtime, improving rigsite efficiency
- Reduces overall cost of logging program
 - Saves rig time and costs associated with wireline runs in complex wells
- Employs precise clock mechanisms for highly accurate checkshot time-depth pairs
 - Keeps accurate measurements even when down hole for extended periods of time
- Immediate data-capture feedback during drilling process
 - Enhances wellbore placement
 - Reduces depth uncertainty and risk
 - Enables setting of optimal casing point
 - Aids in detecting pressure changes
- Rugged design with redundant sensors and large memory
 - Improves reliability for deepwater conditions
 - Allows for continual or longer runs without stops



Tool Specifications

Tool size	6¼-in. (171 mm) 9½-in. (241 mm)
Hole size*	8¾-in. to 26-in. (213 mm to 660 mm)
Nominal hole size*	8½-in. to 12¼-in. (216 mm to 311.2 mm)
Tool length*	10.73 ft to 11.35 ft (3.27 m to 3.46 m)
Tool weight*	1,300 lb to 2,843 lb (590 kg to 1290 kg)
Maximum temperature*	257°F (125°C)
Maximum pressure*	25,000 psi (1725 bar)

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

Coiled Tubing and Re-entry

CoilTrak

CoilTrak HT

Advanced Slim MWD System (TTRD)

COILED TUBING AND RE-ENTRY

CoilTrak

Coiled-tubing drilling system

The Baker Hughes **CoilTrak™ coiled-tubing drilling (CTD) system** delivers high-end drilling services for challenging coiled-tubing re-entry applications, including underbalanced and H₂S applications. The modular, coiled-tubing drilling system integrates selectable steering control, aligned downhole sensors, and geosteering capability to reduce drilling time, optimize wellbore placement, and minimize formation damage for improved production.

Applications

- Coiled-tubing re-entry drilling
- Slimhole drilling
- Conventional oil and gas
- Underbalanced drilling

Features and benefits

- Fully integrated and modular CTD system with flexible setup
 - Reduces nonproductive time (NPT) through on-location, customized bottomhole assembly (BHA) adjustments
- Data transmission and communication through single wireline conductor
 - Improves efficiency through high-density, real-time data
 - Reduces formation damage and optimizes recovery rates by underbalanced capability
- Selectable directional system with automated, closed-loop steering control and near-bit inclination sensors
 - Optimizes wellbore placement through precise directional control
 - Maximizes reservoir access
 - Minimizes drilling time
- Resistivity and gamma LWD service
 - Improves reservoir contact and production through geosteering
- Provides real-time data for weight on bit (WOB), bore and annular pressure, and vibration
 - Increases rate of penetration (ROP) and efficiency through optimized drilling parameters
 - Mitigates risk through reliable and precise ECD control and management



Tool Specifications

Tool size	2 ³ / ₈ -in. (60 mm) 3-in. (76 mm)
Hole size*	2 ³ / ₄ -in. to 4 ³ / ₄ -in. (70 mm to 121 mm)
Tool weight*	478 lb to 950 lb (217 kg to 431 kg)
Tool length*	49.58 ft to 55.61 ft (15.11 m to 16.95 m)
Maximum temperature*	302°F (150°C)
Maximum pressure*	14,500 psi (1000 bar)
Flow range*	2 ³ / ₈ -in. up to 80 gpm (300 lpm) 3-in. up to 210 gpm (800 lpm)
Max. buildup rate*	2 ³ / ₈ -in. 50°/100 ft 3-in. 45°/100 ft

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

Hydraulic orienter

Rib-steered motor

COILED TUBING AND RE-ENTRY

CoilTrak HT

Coiled tubing drilling BHA

The **CoilTrak™ HT coiled tubing drilling (CTD) bottomhole assembly** provides specialized BHA services for slimhole directional CTD applications. The BHA performs in temperatures up to 175°C (347°F) in all types of formations, including hard and abrasive.

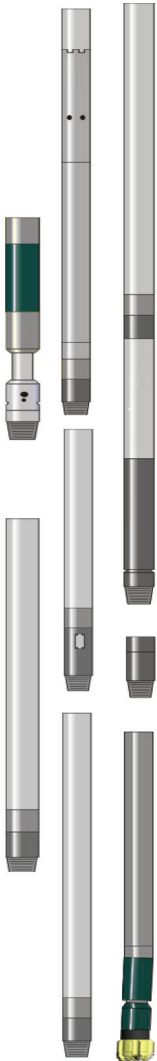
The CoilTrak HT service is the latest generation of the Baker Hughes directional CTD BHA which enables the economic access of bypassed reserves in maturing fields using coiled tubing in existing wellbores.

Applications

- Coiled tubing drilling
- Re-entry and preset well application
- Slimhole drilling
- Underbalanced drilling

Features and benefits

- Performs in downhole temperatures up to 175°C
- Passes easily through existing completion for economic access to bypassed reserves
- Reaches target zone faster because of high build-up rate capability
- Handles underbalanced conditions with compressible drilling fluids and gas injections through the drill string or production while drilling
- Enables BHA deployment into pressurized/live wellheads, and allows BHA setup variations depending on customer needs and application requirements



Tool Specifications

Tool size	3-in. (76 mm)
Hole size	3½-in. to 4¾-in. (89 mm to 121 mm)
Tool weight	950 lb (431 kg)
Tool length	55.61 ft (16.95 m)
Maximum temperature*	347°F (175°C)
Maximum pressure*	14,500 psi (1000 bar)
Flow range*	3-in. up to 210 gpm (800 lpm)
Max. buildup rate*	3-in. 45°/100 ft

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

COILED TUBING AND RE-ENTRY

Advanced Slim MWD System (TTRD)

Slimhole through-tubing rotary drilling

The Baker Hughes **Advanced Slim MWD system** accesses bypassed reserves in mature reservoirs faster and more efficiently. Operators can optimize drilling performance in challenging through-tubing rotary drilling (TTRD) or slimhole applications through an industry-exclusive downhole drilling service. The real-time formation data and proven well-path control improves reservoir contact and increases production from the new wellbore.

Applications

- Through-tubing rotary drilling
- Slimhole drilling
- Conventional oil and gas

Features and benefits

- Integrated and modular slim MWD/ LWD system for TTRD and slimhole applications
 - Increases hydrocarbon recovery in mature fields through re-entry technology
- Drilling performance sub provides real-time downhole operating parameters
 - Improves drilling efficiency and penetration rates
 - Mitigates and manages risk through precise equivalent circulating density (ECD) measurements
- Geosteering capability based on gamma and resistivity measurements
 - Optimizes wellbore placement, using real-time formation data and well-path control
- Flow-off services
 - Minimizes nonproductive time (NPT) with logging-while-tripping or flow-off surveys



Tool Specifications

Tool size	3 1/8-in. (79 mm)
Hole size*	3 3/4-in. to 4 1/4-in. (95 mm to 121 mm)
Tool weight*	637 lb (289 kg)
Tool length*	34.45 ft (10.5 m)
Maximum temperature*	302°F (150°C)
Maximum pressure*	20,000 psi (1380 bar)
Flow range*	79 gpm to 180 gpm (300 lpm to 680 lpm)
Max. buildup rate*	Sliding: 50°/100 ft

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

*Advanced slim
directional gamma sub*

Advanced slim BCPM

Hole Enlargement

GaugePro Echo
GaugePro XPR/XPS

HOLE ENLARGEMENT

GaugePro Echo

On-Command digital concentric expandable tools

The **GaugePro™ Echo on-command digital reamer**— advance reaming capability for better economics, enabling real-time downhole tool control by the operator.

Through proprietary technology, unknowns are known, limitations are removed, and nonproductive time (NPT) is reduced. Deployment flexibility and controlled operation enable the combination of borehole enlargement, stabilization and rathole drilling in one BHA.

Applications

- Onshore, offshore, and deepwater
- High cost-per-foot drilling applications
- Salt and unconsolidated formation drilling
- Rathole drilling

Features and benefits

- Direct digital reamer control via downlink and telemetry service
 - Provides limitless activation and deactivation cycles independent of pump flow rates
 - Improves activation time to less than four minutes
 - Reduces operational risk with the availability of real-time reamer status and parameter information
- Modular integration within the BHA
 - Eliminates a separate rathole trip when run as a near-bit reamer
 - Capability to install and independent control of up to three reamers in the BHA
- Failsafe functionality
 - Provides assurance that the reamer blades will always retract when required
- Latest StaySharp™ and Stabilis™ cutter and StayTough™ hardfacing technology
 - Enables faster, longer, and more stable drilling operations
 - Amplifies cutter durability and improves torsional stability



Tool Specifications

Series 6	6-in. x 7 ¹ / ₂ -in.
Series 8	8 ¹ / ₂ -in. x 9 ⁷ / ₈ -in.
Series 10	10 ⁵ / ₈ -in. x 12 ¹ / ₄ -in.
Series 12	12 ¹ / ₄ -in. x 14 ³ / ₄ -in.
Series 14	14 ¹ / ₂ -in. x 17 ³ / ₄ -in.
Series 16	16 ¹ / ₂ -in. x 22-in.

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

HOLE ENLARGEMENT

GaugePro XPR/XPS

Concentric expandable tools

The Baker Hughes **GaugePro™ concentric expandable reamers and stabilizers**—premium hole-enlargement tools with best-in-class reliability—provide stability, increased durability, and reduced costs in a wide range of applications, from the simplest well to the most complex deepwater project. The GaugePro tools, when synchronized with the pilot bit in an optimized drilling assembly, prevent downhole tool damage and ultimately provide longer runs and fewer days in well.

Applications

- Rotary steerable and rotary operations
- Onshore, offshore, and deepwater
- Wellbore enlargement
- Unconsolidated formations
- Salt drilling

Features and benefits

- Latest **StaySharp™** and **Stabilis™** **cutter** and **StayTough™** **hardfacing technology**
 - Enables faster, longer, and more stable drilling operations
 - Amplifies cutter durability and improves torsional stability
- Active blade retraction
 - Prevents drilling system damage by using an internal spring to retract blades when pumps are off
- Application-specific cutter blades
 - Improve cutting structure performance and durability
 - Balance bit and reamer cutter forces to maintain consistent rate of penetration
 - Available back-reaming for ledge removal and improved casing running operations



“Pass Thru Size” x “Max Hole Size”

Series 6	6-in. x 7-in.
Series 6.5	6½-in. 7½-in.
Series 8	8½-in. x 9 ⁷ / ₈ -in.
Series 9	9½-in. x 11 ³ / ₄ -in.
Series 10	10 ⁵ / ₈ -in. x 12½-in.
Series 12	12¼-in. x 14 ³ / ₄ -in.
Series 13	13½-in. x 16-in.
Series 14	14½-in. x 17½-in.
Series 16	16½-in. x 20-in.
Series 18	18 ⁷ / ₈ -in. x 22-in.

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

Surface Logging Services and Data Solutions

Fe Vision

STRATA-Vision

HC-Vision

TRU-Vision

SIGNALS Surveillance

SIGNALS Defense

SIGNALS Optime

SURFACE LOGGING SERVICES

FE-Vision

Geological evaluation

Geology remains the foundation of the oil industry and of Surface Logging Services. Drilled cuttings are collected, prepared, and examined under the microscope for lithological type and under ultraviolet light for oil show indications. The data is used for stratigraphic correlation, reservoir indication, and recognition of problematic formations.

Knowing the geology is essential for well control, drilling efficiency, and formation evaluation. Nowadays advanced cuttings evaluation techniques help identify reservoir quality to maximize recovery in unconventional environment.

Applications

All drilling environments

Features and benefits

- First-look formation evaluation
 - Stratigraphic correlation
 - Identification of trouble-zone geology
 - Shale compaction indication
 - Pressured formation indication
 - Reservoir indication
 - Sample preservation for advanced analyses
- Cavings analysis
 - Pressured formation indication
 - Wellbore instability indication
 - Hole cleaning management
 - Stuck-pipe mitigation
 - Improved drilling efficiency
 - NPT reduction
- Shale density measurement
 - Pressured formation indication
 - Shale compaction indication
 - Stuck-pipe and NPT prevention
- Calcimetry measurement
 - Formation calcite/dolomite percentage
 - Stratigraphic correlation
 - Aids matrix correction for porosity logs
 - Improves reservoir calculations
- Cuttings volume measurement
 - Hole cleaning efficiency
 - Wellbore instability indication
 - Stuck-pipe and NPT prevention

SURFACE LOGGING SERVICES

FE-Vision

C1- C5 gas monitoring and analysis

Surface Logging Services offers fit-for-purpose gas monitoring and analysis. The range of service options allows the choice of basic monitoring for safety and reservoir identification through to qualitative measurement of hydrocarbon gases by quantitative high-speed gas chromatographs for more in-depth reservoir evaluation.

Different combinations of gas extraction and measurement equipment will ensure that the right solution is provided for different drilling environment whether the focus is on safety and well control or enhanced formation evaluation.

Applications

- All drilling environments
- Manage pressure drilling

Features and benefits

- No need for additional cabins
- Reduced CO₂ emissions and environmental impact
- Total gas measurement
 - Frequency of analysis every 1second
 - Explosive gas level warnings
 - Abnormal pressure indication
 - Enhanced well safety
- C1-C5 chromatography
 - 45 second cycle time for maximum data density
 - 45 second cycle time for optimum C1/C2 separation
 - Able to recalibrate data post run
 - Automated gas ratio calculations
 - Quick-look reservoir indication
- Fit-for-purpose gas trap technology
 - QGM type—for rigs with limited space
 - CV-QGM—constant volume, constant flow for advanced services

SURFACE LOGGING SERVICES

STRATA-Vision

Advanced cutting analysis

The STRATA-Vision advanced cuttings evaluation service uses the latest technologies to provide near real-time elemental, mineralogical, organic, and petrophysical analysis of your cuttings. This service enables you to make better drilling decisions while drilling by providing advanced formation evaluation data in any drilling environment.

The STRATA-Vision service utilizes X-Ray diffraction (XRD), X-Ray fluorescence (XRF), high-resolution digital microscopy, and pyrolysis help improve understanding of the well's depositional environment and hydrocarbon maturity to make more informed completion decisions while avoiding unproductive completion stages.

STRATA-Vision can be operated with the pre-existing surface logging cabin. The analysis can be performed post-well for wells already drilled with cuttings collected at the time the well was drilled. This rapid turn-around allows customers to make rapid, informed decisions for drilling, testing and completing their wells. In unconventional shale plays, where LWD or wireline information is sparse, the elemental and mineralogical data provided by advanced cuttings evaluation is of extreme importance in understanding the reservoir quality, completion quality and geohazards.

Applications

- Onshore, offshore, and deepwater
- Conventional onshore and offshore drilling environments
- Unconventional drilling environments
- High-pressure/high-temperature environments
- Wells with limited LWD/Wireline formation evaluation options
- Managed pressure drilling

Features and benefits

- X-ray fluorescence (XRF)
 - A field portable device with automated calibration
 - Used for elemental analysis and chemostratigraphy
 - Trace metal elements provide a TOC proxy
 - Radioactive elements give a geochemical gamma ray
- X-ray diffraction (XRD)
 - Field portable device with BHI created mineral database
 - Used for mineralogical analysis
 - Mineralogy allows brittleness determination
 - Combination of XRF and XRD allows cross-referencing
- Pyrolysis with kinetics (HAWK™)
 - Field portable pyrolysis equipment
 - Used to identify type and maturity of kerogen
- Will determine a formation's production potential
- Also measures TOC and inorganic carbon content
- High-resolution digital microscopy
 - Used to visualize and create images of sedimentological features and grain morphologies
 - Enables comprehensive measurements and analyses (such as grain size)
 - Remote visualization capabilities
- Formation evaluation log correlation with other FE datasets
- Identification of productive zones
- Chemostratigraphic profile and surface spectral - gamma
- Near real-time formation and kerogen geochemical analysis

SURFACE LOGGING SERVICES

HC-Vision

Reservoir characterization service

The **HC-Vision™ reservoir characterization service** provides critical indicators of wellbore hydrocarbon volumetrics, saturations, porosity, and permeability. These indicators deliver answers about a reservoir's fluid type, productive or non-productive zones, potential fluid contacts, reservoir connectivity, and natural fractures. Mapping these properties across the well's profile will help determine areas of greatest interest and potential hazards.

The HC-Vision service can be utilized for wells already drilled using C1-C5 gas data collected by any standard mud-logging services at the time the well was drilled.

In some settings, such as in unconventional reservoirs, hydrocarbon concentrations may be the only geochemical data collected during surface logging. The new HC-Vision reservoir characterization service uses hydrocarbon gas input to produce well logs for reservoir evaluation and interpretation.

The HC-Vision service efficiently processes gas data in real-time and delivers easy-to-interpret outputs that identify hydrocarbon sweet spots. Additionally, gas data previously collected by other service providers, or data that have never been analyzed, can be incorporated and analyzed by the HC-Vision service. This is particularly important where gas data are the only formation evaluation information collected, as is the case for many unconventional plays.

Applications

All drilling environments

Features and benefits

- Optimized reservoir characterization
 - Identifies fluid composition
 - Identifies fluid contacts
 - Identifies hydrocarbon sweet-spots
- Provides visual reservoir interpretation logs
 - Provides indications of hydrocarbon porosity, permeability, volumetrics, saturations, geohazards and fluid compartmentalization
- Legacy data processing
 - Allows re-investigation of wells and fields
 - Allows pre-well analysis for correlations
 - Allows review of fracture- stage placement
- Data integration with other FE services
 - LWD/Wireline
 - SLS Advanced Cuttings Evaluation
 - Able to use third-party gas data
- Cost effective and simple to implement

SURFACE LOGGING SERVICES

TRU-Vision

Quantitative gas measurement and analysis

Surface Logging Services offers fit-for-purpose gas monitoring and analysis. The range of service options allows the choice of basic monitoring for safety and reservoir identification through to qualitative measurement of hydrocarbon gases by quantitative high-speed gas chromatographs for more in-depth reservoir evaluation. Different combinations of gas extraction and measurement equipment will ensure that the right solution is provided for different drilling environment whether the focus is on safety and well control or enhanced formation evaluation.

Applications

- All drilling environments
- Manage pressure drilling

Features and benefits

- No need for additional cabins
- Reduced CO₂ emissions and environmental impact
- Fully automated for remote control
- Multiple sensors for safety purposes
- Automatic safety shutdown
- Total gas measurement
 - 25Hz sampling frequency
 - Explosive gas level warnings
 - Abnormal pressure indication
 - Enhanced well safety
- C1-C5 chromatography
 - 45 second cycle time for maximum data density
 - 45 second cycle time for optimum C1/C2 separation
 - Ethene and Propene (drill bit metamorphism) components identification
 - Able to recalibrate data post run
 - Automated gas ratio calculations
 - Quick-look reservoir indication
- Inorganic gas detection (He, He, O₂, CO₂)
 - In-line and remote sensors
 - Fully alarmed for timely warning
 - Maintain a safe drilling environment
 - Aid in protecting drillstring
- Fit-for-purpose gas trap technology
 - QGM type-for rigs with limited space
 - CV-QGM-constant volume, constant flow for advanced services
- Heated mud gas extraction
 - Enhanced gas extraction
 - Reduced analytical uncertainty
 - Used in combination with CV-QGM gas traps
 - Continuous quantification and visualization of mud density
- C6+ chromatography
 - Quantitative measurement of C6 to C8 hydrocarbons
 - 45 second cycle time for C6-7 with complete isomers separation
 - 180 second cycle time for C8 to ensure complete detection and separation of three unique ethane isomers
 - Enhanced real-time formation evaluation
- Automated and continuous gas extraction efficiency

SURFACE LOGGING SERVICES

SIGNALS Surveillance

Fluid monitoring

SIGNAL Surveillance combines well operations monitoring and well safety. This service enable our clients on gathering from the well all the parameters through surface sensors.

As a critical service in well control, Surface Logging Services (SLS) provides the fluids monitoring that is crucial for the safe completion of any well.

A range of offerings for accurate pit and flow monitoring are available to mitigate major well-control issues, wellbore stability problems, and errors in surface-pit mud movement.

Real-time software alarms, smart flowback fingerprinting applications, and rig site and remote surveillance capabilities ensure improved safety and reduction of nonproductive time (NPT).

Applications

All drilling environments

Features and benefits

- Operations monitoring
- Well activity monitoring through surface sensors
 - During drilling
 - Completion
 - Production
 - Workovers
- Pit level monitoring
 - Enhanced well safety
 - Timely kick detection
 - Timely lost-circulation detection
 - Detection of pit transfer errors
 - Reduction of NPT
- Qualitative return flow monitoring
 - Industry standard paddle and sonic sensors
 - Enhanced well safety
 - Timely kick detection
 - Timely lost-circulation detection
 - Reduction of NPT
- Quantitative flow and mud density measurement
 - Innovative wedge flowmeter and density sensor array
 - Large internal passageways eliminate blockage
 - Less intrusive than Coriolis type sensors for flow-out
 - Measures actual flow-in not calculated value
 - Accurate with high gas and cuttings load
 - Proprietary EKD software
- Smart flowback fingerprinting
 - Early kick detection on connections
 - Smart, automatic alarm setpoints
 - Increased rig and personnel safety

SURFACE LOGGING SERVICES

SIGNALS Surveillance

Operations monitoring

SIGNALS Surveillance helps reduce incidents and nonproductive time while at the same time optimizing drilling performance. SLS personnel continually monitor, record and analyze data using a suite of independent rig sensors. Whether drilling, tripping, circulating or engaged in any other operation, data will be recorded and displayed for timely decision making with drilling trends being evaluated for events such as pipe washouts, twist-offs, and swab- surge incidents along with comprehensive trend comparison for the prevention of pore pressure and stuck pipe incidents.

Applications

All drilling environments

Features and benefits

- Depth tracking and penetration rate
 - Accurate stratigraphic placement
 - Mitigation of wellbore problems
 - Enhanced drilling performance
 - Reduced NPT
- Drilling parameter measurement
 - Enhanced drilling performance
 - Wellbore problem mitigation
 - Enhanced well control
 - Reduced NPT
- Trip parameter measurement
 - Real-time drag and slack-off measurement
 - Stuck-pipe prevention
 - Mitigation of swab-surge problems
 - Reduced NPT
- Pore pressure trend monitoring
 - Enhanced real-time well control
 - Enhanced drilling performance
 - Increased safety
 - Reduced NPT
- Formation pressure and wellbore stability evaluation
 - Rigsite or remote pore pressure engineers
 - Pre-well studies from RDS pore pressure experts
 - Real-time or batch formation pressure calculation
 - Proactive wellbore pressure and stability solutions
 - Enhanced safety and drilling performance
 - Reduced NPT

SURFACE LOGGING SERVICES

SIGNALS Defense

Advanced well operations monitoring

SIGNAL Defense advanced well operations monitoring combines the Baker Hughes Surface Logging Personnel expertise with highly innovative automated algorithms to maximise well safety and deliver a more efficient time solution to our clients.

Whether drilling, tripping, circulating or engaged in any other operation, data will be recorded and displayed for timely decision making with drilling trends being evaluated for events such as pipe washouts, twist-offs, and swab- surge incidents along with comprehensive trend comparison for the prevention of pore pressure and stuck pipe incidents.

Applications

All drilling environments

Features and benefits

- Depth tracking and penetration rate
 - Mitigation of wellbore problems
 - Enhanced drilling performance
 - Reduced NPT and ILT
- Drilling parameter measurement
 - Enhanced drilling performance
 - Wellbore problem mitigation
 - Enhanced well control
 - Reduced NPT
- Trip parameter measurement
 - Real-time drag and slack-off measurement
 - Stuck-pipe prevention
 - Mitigation of swab-surge problems
 - Reduced NPT
- Automated early kick detection
- Hole cleaning conditions
- Formation pressure and wellbore stability evaluation
 - Rigsite or remote pore pressure engineers
 - Pre-well studies from RDS pore pressure experts
 - Real-time or batch formation pressure calculation
 - Proactive wellbore pressure and stability solutions
 - Enhanced safety and drilling performance
 - Reduced NPT

SURFACE LOGGING SERVICES

SIGNALS Optime

Drilling advisor system

While drilling a well, operators continually observe and react to a complex interaction of geologic, hydraulic, mechanical, and human factors. When one or more of these factors misalign, the results may be hazardous, time-consuming, and costly.

Nonproductive time (NPT), which is related to wellbore problems and equipment failures, can account for up to 25% of an operator's budget. Invisible lost time (ILT), which is related to operational efficiencies, such as time to make a connection or to trip pipe, can add up to an additional 25% of operating costs.

The **SIGNALS™ drilling advisory service** uses a combination of reliable sensor systems, smart visualization, complex alarm software, and competent personnel to identify leading indicators that will provide opportunities to substantially reduce the amount of NPT and ILT while drilling a well.

Pre-well modelling uses offset and target well data to identify and diagnose potential problems, then develop an action plan to address them. In real-time engineers provide 24-hour interpretation of data trends and provide solutions when necessary. Real-time data is integrated into the pre-well models to observe deviations if any. Finally, a post-well or section review will be made to note lessons learned and recommend ways to reduce NPT/ILT further.

Applications

All drilling environments

Features and benefits

- Pre-well analysis of NPT/ILT factors
 - Identifies potential wellbore issues
 - Defines target times for rig operations
- Focused real-time trend surveillance
 - 24-hour monitoring and analysis
 - Identifies leading indicators to avoid NPT
 - Analyzes rig efficiency compared to target
 - Identifies time-saving opportunities (ILT)
- Collaborative wellsite and remote interaction
 - Provides rapid problem evaluation
 - Comprehensive answers while drilling
 - Develops and reports best practices
- Structured workflow and communication protocols
 - Ensures all personnel follow the same workflow
 - Rapid and accurate recognition of anomalies
 - Informs the right person at the right time
- Post-well service analysis
 - Evaluates the well against target times
 - Identifies areas for improvement
 - Records lessons learned for future jobs

High-temperature Directional Drilling and Measurement While Drilling

DuraMax

Navi-Drill Ultra Series

Navi-Drill X-treme Series

High-Temperature AutoTrak eXact

High-Temperature AutoTrak X-treme

High-Temperature AutoTrak V

High-Temperature AutoTrak G3

High-Temperature OnTrak

High Temperature LithoTrak

HT DIRECTIONAL DRILLING & MWD

DuraMax

High-performance drilling motors

The Baker Hughes **DuraMax™ high-performance drilling motors** are the next step in delivering and achieving maximum rates of penetration (ROPs) and reduce the number of runs per well, to achieve a lower cost-per-foot drilling program. The completely re-engineered motor design enables drilling capabilities unattainable with conventional motor technologies, providing higher levels of torque and power for performance drilling and harsh environments.

Applications

- Shale gas
- Onshore, offshore, and deepwater
- Conventional and unconventional
- Geothermal
- Vertical and directional drilling
- Performance drilling
- Hard/abrasive formations and high-temperature environments

Features and benefits

- Internally developed and newly designed DuraMax Ultra Series power section
 - Increased ability to achieve a higher rate of penetration (ROP), extended run length, while delivering higher torque and power at the bit
- Titanium flex shaft
 - Increased mean time between failures
 - Reduced nonproductive time (NPT), including twist-off and drive-train failures downhole
- Optimized connections
 - Increased motor reliability improving drilling performance by preventing downhole back-off in harsh drilling environments
- High-temperature elastomer
 - Improved reliability in temperatures up to 320°F (160°C)
- High weight-on-bit (WOB) bearing assembly
 - Optimized performance in hard formations
- Adjustable kickoff (AKO) sub
 - Improved steering to optimize wellbore placement
- Increased flex design
 - Aids in in meeting high dogleg directional plan
- Increased flow rate
 - Increased power & torque, while improve hole cleaning capabilities

DuraMax

Number of lobes (rotor)

Power section

D100-5130C

Revolutions per Gallon (rpg)

Number of stages



Conventional Specifications

Tool size	5/8-in. to 7/8-in. (130 mm to 180 mm)
Hole size	5/8-in. to 9/8-in. (150 mm to 250 mm)
Tool weight	1,455 lb to 3,880 lb (660 kg to 1760 kg)
Tool length	31.2 ft to 41 ft (9.5 m to 12.5 m)
Maximum temperature*	300°F (150°C)
Speed range*	25 rpm to 303 rpm
Flow range*	106 gpm to 760 gpm (401 lpm to 2877 lpm)
Operational differential pressure range*	825 psi to 2,067 psi (57 bar to 143 bar)
Operational torque range*	6,385 ft-lb to 20,093 ft-lb (8657 Nm to 27242 Nm)
Power output range*	82 hp to 574 hp (61 kW to 428 kW)

Pre-contoured Specifications

Tool size	5/8-in. (130 mm)
Hole size	5/8-in. (150 mm)
Tool weight	1,455 lb (660 kg)
Tool length	31.2 (9.5 m)
Maximum temperature*	320°F (160°C)
Speed range*	55 rpm to 370 rpm
Flow range*	106 gpm to 360 gpm (401 lpm to 1363 lpm)
Operational differential pressure range*	1,790 psi to 3,570 psi (124 bar to 246 bar)
Operational torque range*	7,690 ft-lb to 7,740 ft-lb (10426 Nm to 10494 Nm)
Power output range*	203 hp to 405 hp (151 kW to 302 kW)

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

HT DIRECTIONAL DRILLING & MWD

Navi-Drill Ultra Series

Directional drilling motors

In the most challenging environments, the Baker Hughes **Navi-Drill™ Ultra™ Series directional drilling motors** deliver accurate steering and precise wellbore placement in a range of applications. Used for directional and high-performance drilling, these motors provide reliability, including for use in high-temperature and abrasive formations. Designed to stay downhole for extended periods of time, the motors provide longer drilling runs and casing-to-casing performance, resulting in better hole quality, improved penetration rates, and increased recovery from directional wells.

Applications

- Shale gas and onshore
- Conventional and unconventional
- Vertical and directional drilling
- Performance drilling
- Underbalanced drilling
- Re-entry and slimhole drilling
- Hard/abrasive formations and high-temperature environments

Features and benefits

- Titanium flex shaft improves reliability compared to universal joint
 - Increases mean time between failures
 - Reduces nonproductive time (NPT), including twist-off and drive-train failures downhole
- Optimized connections increase motor reliability
 - Improves drilling performance by preventing downhole back-off in harsh drilling environments
- High-temperature elastomer
 - Improves reliability in temperatures up to 320°F (160°C)
- Extended length of the power section (Ultra™ XL)
 - Maximizes rate of penetration (ROP) through higher torque and power output
 - Reduces NPT
- Adjustable kickoff (AKO) sub
 - Improves steering to optimize wellbore placement
 - Increases flexibility in meeting directional plan by adjusting deflecting angle on the surface



Tool Specifications

Tool size	2 $\frac{3}{4}$ -in. to 12 $\frac{3}{4}$ -in. (60 mm to 313 mm)
Hole size	2 $\frac{1}{4}$ -in. to 44-in. (70 mm to 1118 mm)
Tool weight	187 lb. to 8,600 lb. (85 kg to 3900 kg)
Tool length	10.66 ft. to 36.09 ft. (3.25 m to 11 m)
Maximum temperature*	320°F (160°C) with high-temperature elastomer
Speed range*	28 rpm to 1,250 rpm
Flow range*	25 gpm to 1,500 gpm (95 lpm. to 5700 lpm.)
Operational differential pressure range*	Maximum 290 psi to 1,800 psi (20 bar to 125 bar)
Operational torque range*	Maximum 275 ft-lb to 18,000 ft-lb (370 Nm to 24500 Nm)
Power output range*	14 hp. to 430 hp. (10 kW to 320 kW)

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

HT DIRECTIONAL DRILLING & MWD

Navi-Drill X-treme Series

High-performance drilling motors

The Baker Hughes **Navi-Drill™ X-treme™ Series drilling motors** deliver maximum rates of penetration (ROP) and reduce the number of runs for lower cost-per-foot performance drilling. The reengineered motor design ensures drilling capabilities unattainable with conventional motor technologies, providing higher levels of torque and power for high-temperature environments.

Applications

- Shale gas
- Onshore, offshore, and deepwater
- Geothermal
- Vertical and directional drilling
- Performance drilling
- Re-entry and slim-hole drilling
- Hard/abrasive formations and high-temperature environments

Features and benefits

- Internally developed and newly designed X-treme™ precontoured power section
 - Maximizes ROP in extended runs with all fluid types by delivering up to 100% higher torque and power
- Titanium flex shaft
 - Increases mean time between failures
 - Reduces nonproductive time (NPT), including twist-off and drive-train failures downhole
- Optimized connections increase motor reliability
 - Improves drilling performance by preventing downhole back-off in harsh drilling environments
- High-temperature elastomer
 - Improves reliability in temperatures up to 375°F (190°C)
- High weight-on-bit (WOB) bearing assembly
 - Optimizes performance in hard formations
- Adjustable kickoff (AKO) sub
 - Improves steering to optimize wellbore placement
 - Increases flexibility in meeting directional plan by adjusting deflection angle on the surface



Tool Specifications

Tool size	2 $\frac{3}{8}$ -in. to 12 $\frac{1}{4}$ -in. (60 mm to 313 mm)
Hole size	2 $\frac{1}{4}$ -in. to 44-in. (70 mm to 1118 mm)
Tool weight	100 lb. to 10,600 lb. (45 kg to 4800 kg)
Tool length	8.4 ft. to 37.7 ft. (2.6 m to 11.5 m)
Maximum temperature*	320°F (160°C) with standard elastomer 375°F (190°C) with high temperature elastomer
Speed range*	40 rpm to 1,200 rpm
Flow range*	25 gpm to 1,750 gpm (95 lpm. to 6600 lpm.)
Operational differential pressure range*	Maximum 580 psi to 2,050 psi (40 bar to 145 bar)
Operational torque range*	Maximum 290 ft-lb to 29,500 ft-lb (395 Nm to 40000 Nm)
Power output range*	24 hp. to 1,100 hp. (18 kW to 810 kW)

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

HT DIRECTIONAL DRILLING & MWD

High-Temperature AutoTrak eXact

Advanced high-performance rotary steerable system

The Baker Hughes **High-Temperature AutoTrak™ eXact advanced high-performance rotary steerable system** offers comprehensive formation evaluation while achieving high buildup rate (BUR) curves, effectively reducing time on well. The system optimizes wellbore placement and reservoir exposure through real-time, near-bit inclination and complete logging while drilling (LWD) measurements. Operators achieve faster and safer well delivery with consistent target intersection.

Applications

- Onshore and offshore
- Real-time reservoir navigation, integrating multiple measurement-while-drilling (MWD)/LWD measurements
- Multilateral, extended-reach, or complex 3D designer wells
- Conventional and unconventional development drilling

Features and benefits

- Reaches high buildup rates, up to 10°/100 ft
 - Shorter curve section
 - Improves drilling efficiency through deeper kickoff and more responsive steering
 - Maximizes reservoir exposure
- Automated steering mechanism creates a continuous steer force with continuous drillstring rotation
 - Increases drilling efficiency and improves rate of penetration (ROP)
 - Eliminates the need for correction runs or sliding time associated with mud motors
 - Provides superior hole quality for smooth completion operations
- Fully modular system, additional LWD measurements as required
 - Optimizes wellbore navigation and placement
 - Complete understanding of drilling environment
- Integrated bottomhole assembly (BHA) with short-spaced, advanced MWD/LWD sensors
 - Detects formation changes early
 - Maximizes drilling performance by changing directional targets without drilling process interruptions
- Steering mechanism independent of hydraulic parameters such as flow rate, bit pressure drop, and mud properties
 - Reduces total time on well by optimizing hydraulic parameters for improving ROP
- Optimized, real-time bidirectional communication
 - Minimizes drilling interruptions and improves drilling performance by sending commands from the surface while drilling
- Operating temperature up to 325°F (165°C)
 - Allows operators to reach reservoir targets with minimal risk in high-temperature environments



Tool Specifications

Tool size	4 ³ / ₄ -in. (149 mm)
Hole size	5 ⁷ / ₈ to 6 ³ / ₄ -in. (149 to 171 mm)
Tool weight	2,786 lb (1264 kg)
Tool length	48.0 ft (14.6 m)
Maximum temperature*	325° F (165 °C)
RPM*	Maximum 400 rpm
Flow range*	125 to 350 gpm (473 to 1325 lpm)
Maximum pressure*	Standard 20,000 psi (1380 bar) Optional 25,000 to 30,000 psi (1724 to 2070 bar)
Max. buildup rate*	10 ⁰ /100 ft (30 m)

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

HT DIRECTIONAL DRILLING & MWD

High-Temperature AutoTrak X-treme

High-temperature motor-powered rotary steerable system

In the most challenging High-temperature environment, the Baker Hughes **High-temperature AutoTrak™ X-treme motor-powered rotary steerable system** integrates the precontoured mud motor with hard-wired communication functionality, delivering additional power and RPM directly at the bit. This technology enhances penetration rates and increases horizontal intervals, allowing operators to reach inaccessible, trapped reserves and maximize hydrocarbon recovery.

Applications

- Horizontal extended-reach wells
- Complex 3D directional profiles
- Onshore, offshore, and deepwater environments
- Performance drilling applications

Features and benefits

- Operating temperature up to 347°F (175°C)
 - Allows operators to reach targets with minimal risk in high-temperature environments
- Automated steering mechanism creates a continuous steer force with continuous drillstring rotation
 - Increases drilling efficiency and improves rate of penetration (ROP)
 - Eliminates the need for correction runs or sliding time associated with mud motors
 - Provides superior hole quality for smooth completion operations
- Integrated BHA with short-spaced, advanced MWD/LWD sensors
 - Detects formation changes early
 - Maximizes drilling performance by changing directional targets without drilling process interruptions
- Precontoured X-treme mud motor
 - Increases ROP
 - Extends horizontal section in 3D well profiles
 - Reduces drillstring wear
- Wired motor technology
 - Improves reliability of communications with motor positioned close to the bit
- Fully modular system, with additional LWD measurements as required
 - Optimizes wellbore navigation and placement
 - Provides complete understanding of drilling environment
- Optimized, real-time bidirectional communication
 - Minimizes drilling interruptions and improves drilling performance by sending commands from the surface
- Continuous near-bit inclination measurement with closed-loop downhole controls
 - Maximizes drilling efficiency and wellbore placement



Tool Specifications

Tool size	6¼-in. (171 mm) 9½-in. (241 mm)
Hole size	8 ³ / ₈ -in. to 28-in. (213 mm to 711 mm)
Tool weight	11,820 lb (5360 kg)
Tool length	95 ft (29 m)
Maximum temperature*	347°F (175°C)
RPM*	6¼-in. Maximum 400 rpm
Flow range*	200 gpm to 1,600 gpm (757 lpm to 6056 lpm)
Maximum pressure*	25,000 psi to 30,000 psi (1725 bar to 2070 bar)
Max. buildup rate*	6¼-in. 6.5°/100 ft.

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

HT DIRECTIONAL DRILLING & MWD

High-Temperature AutoTrak V

High-temperature vertical-seeking rotary steerable system

In the most challenging High-temperature environment, the Baker Hughes **High-Temperature AutoTrak™ V vertical-seeking rotary steerable system** maximizes the overall rate of penetration (ROP) and drills a straight, vertical hole in environments where deviation control is problematic or when it is required to drill a precise, vertical interval to intersect a target. The system eliminates correction runs often required with conventional drilling systems. Operators are able to efficiently drill vertical intervals with excellent borehole quality and with little, if any, surface intervention.

Applications

- Conventional and unconventional drilling applications
- Onshore and offshore drilling
- Areas with high formation dips and deviation tendencies

Features and benefits

- Operating temperature up to 347°F (175°C)
 - Allows operator to reach targets with minimal risk in high-temperature environments
- Automated steering mechanism creates a continuous steer force
 - Increases drilling efficiency and improves ROP
 - Eliminates the need for correction runs or sliding time associated with mud motors
 - Provides superior hole quality for smooth completion operations
- Real-time, continuous inclination updates
 - Confirms verticality of the wellbore
- Continuous near-bit inclination measurement with closed-loop downhole controls
 - Eliminates need for MWD, reducing total drilling costs
- Simple deployment with minimal surface interaction
 - Saves drilling hours by reducing setup time
- Steering mechanism independent of hydraulic parameters such as flow rate, bit nozzles, and mud properties
 - Reduces total time on well by optimizing hydraulic parameters for improving ROP
- Optional downhole motor
 - Improves drilling performance and reach



Tool Specifications

Tool size	6¼-in. (171 mm) 9½-in. (241 mm)
Hole size*	8¾-in. to 28-in. (213 mm to 711 mm)
Tool weight*	2,105 lb to 6,100 lb (650 kg to 2767 kg)
Tool length*	19.7 ft to 23.1 ft (6.0 m to 7.0 m)
Maximum temperature*	347°F (175°C)
Maximum pressure*	25,000 psi to 30,000 psi
RPM	6¼-in. Maximum 400 rpm
Flow range	200 gpm to 1,600 gpm (757 lpm to 6056 lpm)
Near-bit inclination sensor distance from bottom	6¼-in. 3.1 ft (0.95 m) 9½-in. 3.9 ft (1.19 m)

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

HT DIRECTIONAL DRILLING & MWD

High-Temperature AutoTrak G3

High-temperature advanced rotary steerable system

The Baker Hughes **High-Temperature AutoTrak™ G3 advanced rotary steerable system** integrates the Baker Hughes OnTrak™ MWD/LWD technology with a complete formation evaluation package. The system provides reliable and precise steering response in the most challenging High-temperature environment, in a wide range of formation types, drilling conditions, and well profiles. Operators in deepwater and onshore environments can optimize production with efficient, consistent target intersection.

Applications

- Onshore, offshore, and deepwater environments
- Multilateral, extended-reach, or complex 3D designer wells

Features and benefits

- Operating temperature up to 347°F (175°C)
 - Allows operator to reach reservoir targets with minimal risk in high-temperature environments
- Automated steering mechanism creates a continuous steer force with continuous drillstring rotation
 - Increases drilling efficiency and improves rate of penetration (ROP)
 - Eliminates the need for correction runs or sliding time associated with mud motors
 - Provides superior hole quality for smooth completion operations
- Fully modular system, with additional LWD measurements as required
 - Optimizes wellbore navigation and placement
 - Provided complete understanding of drilling environment
- Integrated BHA with short-spaced, advanced MWD/LWD sensors
 - Detects formation changes early
 - Maximizes drilling performance by changing directional targets without drilling process interruptions
- Optimized, real-time bidirectional communication
 - Minimizes drilling interruptions and improves drilling performance by sending commands from the surface while drilling
- Steering mechanism independent of hydraulic parameters such as flow rate, bit nozzles, and mud properties
 - Reduces total time on well by optimizing hydraulic parameters for improving ROP
- Optional downhole motor (AutoTrak™ X-treme)
 - Improves drilling performance and reach



Tool Specifications

Tool size	6¼-in. (171 mm) 9½-in. (241 mm)
Hole size*	8¾-in. to 28-in. (213 mm to 711 mm)
Tool weight*	2,798 lb to 15,200 lb (1270 kg to 6895 kg)
Tool length*	49.9 ft to 58.1 ft (14.7 m to 17.7 m)
Maximum temperature*	347°F (175°C)
Maximum pressure*	25,000 psi to 30,000 psi (1725 bar to 2070 bar)
RPM	6¼-in. Maximum 400 rpm
Flow range	200 gpm to 1,600 gpm (757 lpm to 6056 lpm)
Max. buildup rate*	6¼-in. 6.5°/100 ft 9½-in. 6.5°/100 ft

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

HT DIRECTIONAL DRILLING & MWD

High-Temperature OnTrak

High-temperature integrated MWD and LWD service

The Baker Hughes **OnTrak™ integrated measurement-while-drilling (MWD) and logging-while-drilling (LWD) service** delivers a suite of directional and formation evaluation measurements. In the most challenging High-temperature environment, along with pressure and drilling dynamics monitoring, the service provides operators with the most accurate propagation resistivity in the industry. The integrated design offers increased reliability, fewer connections, and optimized sensor-to-bit spacing to complement a suite of real-time downhole measurements. Power and mud-pulse telemetry are provided by the High Temperature BCPM module. The High-Temperature OnTrak module serves as a platform for advanced rotary steerable and formation evaluation services.

Applications

- Offshore exploration and development
- Complex directional targets
- Geosteering

Features and benefits

- Operating temperature up to 347°F (175°C)
 - Allows operators to reach reservoir targets with minimal risk in high-temperature environments
- Real-time directional information
 - Allows accurate wellbore placement
 - Meets regulatory survey requirements
- Azimuthal gamma ray with imaging capability
 - Identifies bed boundaries and orientation
- High-frequency phase resistivity
 - Increases vertical resolution
 - Identifies thin beds and fluid contacts
- Low-frequency attenuation resistivity
 - Increases depth of investigation
 - Estimate Rt with a greater immunity to environmental effects
- Fast two-way communication between the surface and down hole
 - Reduces drilling risk, using real-time downhole information
 - Minimizes nonproductive time (NPT) through optimized drilling parameters



Tool Specifications

Tool size	43/4-in. (121 mm)
	63/4-in. (172 mm)
	91/2-in. (241 mm)
Hole size*	57/8-in. to 26-in. (146 mm to 669 mm)
Tool weight*	2200 lb to 7275 lb
Tool length*	20.20 ft to 23.0 ft
Maximum	347°F (175°C)
Maximum	25,000 psi to 30,000 psi
Flow range*	125 gmp to 1,600 gpm
Azimuthal gamma	0 to 500 API
Inclination accuracy	±0.1°
Resistivity range	2MHz Phase difference: 0.1 to 3,000 ohm-m
	2MHz Attenuation: 01. to 500 ohm-m
	400 kHz Phase difference: 0.1 to 1,000 ohm-m
	0.1 to 200 ohm-m
Azimuth accuracy	±1.0°
Toolface accuracy	±1.5°

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

HT DIRECTIONAL DRILLING & MWD

High Temperature LithoTrak

High-temperature density service

The Baker Hughes **High-Temperature LithoTrak Logging-while-drilling (LWD) density and caliper service** delivers accurate and reliable formation density and caliper logs. The service also provides operators with real-time images for enhanced reservoir navigation and wellbore stability. A proprietary binning technique gathers accurate density measurements, regardless of borehole quality, vibrations and hole cleaning. The service eliminates the need for additional wireline runs and reduces nonproductive time, allowing operators to update drilling plans in real time to avoid drilling hazards.

Applications

- Formation and reservoir evaluation in all well profiles
- Acquires data, using straight-hole rotary steerable motors, or rotary steerable drilling systems
- Reservoir navigation
- Wellbore stability monitoring

Features and benefits

- Compensated density and P_e measurements collected through standoff binning
 - Eliminates need for additional wireline runs with accurate density measurements in drilling environments
 - Reduces wellsite nonproductive time
- Real-time borehole density images and caliper measurements in all mud types
 - Facilitates accurate reservoir navigation for optimal wellbore placement
 - Increases safety by avoiding drilling hazards
- Accurate identification of fluid contacts and hydrocarbon typing
 - Optimizes wellbore placement
 - Improves hydrocarbon recovery
- Azimuthal borehole caliper and real-time, short-spaced borehole images
 - Improves wellbore stability through breakout detection and borehole profiling



Tool Specifications

Tool size	6 ³ / ₄ -in. (171 mm)
Hole size*	8 ¹ / ₂ -in. to 9 ⁷ / ₈ -in. (216 mm to 251 mm)
Tool weight*	800 lb (362 kg)
Tool length*	8.5 ft to 9.6 ft (2.59 m to 2.92 m)
Maximum temperature*	325°F (165°C)
Maximum pressure*	30,000 psi (2070 bar)
Flow range*	Refer to applicable flow ranges for BCPM tool

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

Coring Services

Conventional Coring

HydroLift

JamBuster

LaserCut

SOR Sponge Liner Coring System

Core Handling

Core Bits

CORING SERVICES

Conventional Coring

Acquisition and recovery services

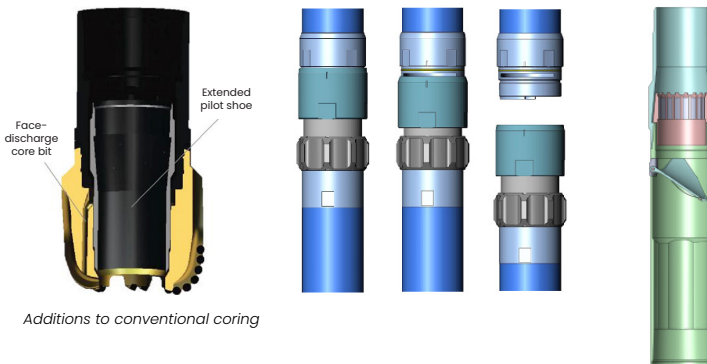
Baker Hughes **Coring Services** perform the acquisition and recovery to surface of a continuous column of reservoir formation material (a core), using a special drillstring with inner and outer barrels. Coring is a key component of Formation evaluation, providing the actual formation material needed for hands-on laboratory testing and geological evaluation to determine formation properties, verify reserves, and calibrate logs.

Applications

- Onshore, offshore, and deepwater
- Conventional and unconventional formations
- High-pressure/high-temperature formations
- Shale gas drilling
- Horizontal and deviated drilling
- Geothermal drilling
- Enhanced oil recovery projects
- Consolidated and unconsolidated formations

Features and benefits

- **HT-Series™ (heavy duty, high torque) Core barrels**
 - Risk mitigation
 - Coring efficiency
 - High-torque connections
- Flapper Catchers backup catcher system
 - Provides cost efficient catcher solution in unconsolidated formations
 - Minimizes operational risk
- **CoreGard™ Low-invasion Technology**
 - Involves minimal fluid invasion
 - Improves core quality
 - Comes as standard feature
- Disposable, vented Inner barrels
 - Improves core quality
 - Minimizes health, safety, and environment (HSE) concerns
- Non-rotating inner-tube stabilizers (NRITS)
 - Improves core quality
 - Coring efficiency
 - Minimizes HSE concerns



Additions to conventional coring



Tool Specifications

Tool size	HT10: 4¾-in. (120.6 mm) HT12: 5⅛-in. (130.2 mm) 250P: 5½-in. (139.7 mm) 250P: 6¼-in. (158.7 mm) HT30: 6¾-in. (171 mm) HT30 Max: 7¼-in. (184.2 mm) HT40: 8-in. (203.2 mm) HT60: 9½-in. (241.3 mm)
Hole size*	5¼-in. to 17½-in. (146.0 - 444.5 mm)
Tool length*	30 ft (9.14 m) sections 30 ft. - 810 ft. (9.14m - 246.89m)
Maximum temperature*	660°F (348°C) (based on use of disposable Steel Inner Barrels)
Flow range*	0 to 700 gpm (0 to 2650 lpm)
Make up torque range*	HT10: 10,000 ft-lb (13558Nm) HT12: 12,000 ft-lb (16270Nm) 5½-in. 250P: 7,000 ft-lb (9500Nm) 6¼-in. 250P: 9,400 ft-lb (12750Nm) HT30 & HT30 Max: 30,000 ft-lb (40675Nm) HT40: 40,000 ft-lb (54233Nm) HT60: 60,000 ft-lb (81349Nm)

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

CORING SERVICES

HydroLift

Full-closure catcher system

The **HydroLift™ was the first full-closure system** introduced to the coring market and is employed on **HT Series™ core barrels**. It is designed to completely seal the inner barrel so that unconsolidated formation material can be recovered to the surface intact.

Applications

- The HydroLift system is utilized when coring unconsolidated or friable formations where recovery of core would not be possible without a full-closure catcher system.
- HydroLift is available for the HT30 and HT60 core barrels, cutting 4- and 5¼-in. diameter core samples, respectively.
- The system also can be used to core in fractured formations where there is a potential to jam in the throat of the bit, as the slick-entry feature prevents the fractured core from catching or jamming into the catcher.

Features and benefits

- Full-closure catcher completely seals the inner barrel
 - Enables complete recovery of unconsolidated formation core material
 - Ensures coring recovery and quality; undisturbed unconsolidated formation material will be recovered
- Slick, unobstructed core entry
 - Prevents jamming in the throat of the bit
 - Mitigates risk by reducing unnecessary trips out of hole, and improving coring efficiency with more core recoveries per run
- Backup conventional core catcher
 - Captures hard formation material that cannot be penetrated by the full-closure mechanism
 - Improves coring efficiency, with more recoveries per run if hard stringers are encountered



Tool Specifications

Tool size	HT30: 6¼-in. (171.4 mm) HT60: 9½-in. (241.3 mm)
Hole size*	8½-in. to 17½-in. (146.0 - 444.5 mm)
Tool length*	30 ft (9.14 m) 30 ft. to 120 ft. (dependent on derrick height)
Maximum temperature*	660°F (348°C) Based on the use of disposable steel innertues

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

CORING SERVICES

JamBuster

Jam mitigation system

The **JamBuster™ anti-jamming system** was introduced in 1997 as an inner-core barrel system that allows continuous coring after the onset of core jamming. Two or three telescoping inner barrel sleeves allow three to four core jams to occur inside the inner barrel during one coring run before having to trip out of hole. The tool is designed for use in a wide range of hole sizes with all of the Baker Hughes HT Series™ core barrels.

Applications

- Onshore, offshore, and deepwater
- Conventional and unconventional formations
- High-pressure / high-temperature formations
- Shale gas drilling
- Horizontal and deviated drilling
- Geothermal drilling
- Enhanced oil recovery projects
- Consolidated and fractured formations

Features and benefits

- Telescoping sleeves allow continuous coring after jamming inside inner barrel
 - Saves rig time and cost
 - Risk mitigation, reduces number of trips during core jam-prone formations
- Modular coring system
 - Provides compatibility with all **HT Series™ conventional coring systems**
 - Helps control cost by reducing mobilization and standby costs



Tool Specifications

Tool size	HT10: 4¼-in. (120.6mm) HT12: 5⅞-in. (130.2 mm) HT30: 6¾-in. (171.4 mm) HT30 Max: 7¼-in. (184.2 mm) 250P: 6¼-in. (158.7mm) HT40: 8-in. (203.2 mm) HT60: 9½-in. (241.3 mm)
Hole size*	5¾-in. to 17½-in. (146.0 mm to 444.5 mm)
Tool length*	30 ft (9.14 m) sections 60 ft. – 330 ft. (9.14 m to 100.58 m)
Maximum temperature*	347°F (175°C)
Flow range*	0 to 700 gpm (0 to 2650 lpm)

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

CORING SERVICES

LaserCut

Aluminum split liner system

The **LaserCut™ liner system** is a one-piece aluminum inner barrel liner system that protects and containerizes core material during coring operations with conventional and wireline core barrels. The system offers enhanced safety features, improved core handling on the rig floor, and easy opening at the surface for rapid examination and sub-sampling of the core material.

Applications

- Onshore, offshore, and deepwater
- Conventional and unconventional formations
- Shale gas drilling
- Horizontal and deviated drilling
- Geothermal drilling

Features and benefits

- Integral, one-piece aluminum liners along length of inner barrel
 - Improves risk mitigation
 - Reduces risk of liner jamming inside inner barrels due to integral design of LaserCut liners
- Rapid access on surface
 - Liner can be easily opened
 - Enables quick observation of core for rapid decision making
- Modular coring system:
 - No specialized core barrel needed
 - Helps control cost by reducing mobilization and standby cost



Tool Specifications

Tool size	HT12: 5 1/8-in. (130.2 mm) HT30: 6 3/4-in. (171.4 mm) HT30 Max: 7 1/4-in. (184.2 mm)
Hole size*	6-in. to 12 1/4-in. (152.4mm to 311.2mm)
Tool length*	30 ft (9.14 m) 30 ft. to 180 ft. (9.14 m to 54.86 m)
Maximum temperature*	347°F (175°C)
Flow range*	0 to 395 gpm (0 to 1500 lpm)

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

CORING SERVICES

SOr Sponge Liner Coring System

Oil saturation coring

The Baker Hughes **SOr™ (saturation oil remaining) sponge liner coring system** enables accurate analysis and measurement of fluid types and oil saturation levels in cores. This information helps determine if conventional and unconventional oil formations have sufficient reserves to continue field development and production.

Applications

- Specialized Coring operations
- Onshore, offshore, and deepwater
- Conventional and unconventional formations
- Horizontal and deviated drilling
- Enhanced oil recovery projects
- Consolidated formations

Features and benefits

- Molded, oil-absorptive sponge liner
 - Improve the accuracy of the analysis by holding the oil adjacent to its corresponding core depth
- Custom designed coring bit and liner provides controlled core and foam interaction
 - Minimizes eccentricity helps ensure that a precisely sized core is cut for entry into the sponge liner
 - Minimizes drilling fluid invasion and captures the expelled oil while tripping out of hole
- Foam reinforced webbing
 - Mitigates risk, preventing the core from damaging the foam material and helps assure the quality of the core
- LaserCut aluminum liner system—Improves core efficiency by allowing easy access to the core sample inside the liner
- Proprietary pressure-compensating piston design
 - Improves core quality by keeping the foam clean until the core enters the liner



Tool Specifications

Tool size	HT30: 6 ³ / ₄ -in. (171.4 mm)
Hole size*	8-in. to 12 ¹ / ₄ -in. (203.2 mm to 311.2 mm)
Tool length	30 ft (9.14 m)
Maximum temperature*	194°F (90°C)
Flow range*	0 to 395 gpm (0 to 1495 lpm)

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

CORING SERVICES

Core Handling

Maintain core quality

With the high focus that Baker Hughes Coring Services has on the core quality during a downhole coring operation, a natural extension of these services is to include the core handling at the rigsite, along with the transportation of the core back to the customer's chosen core laboratory. The extended core handling services will be planned depending on the geographical area and will be delivered according to the customer's coring program.

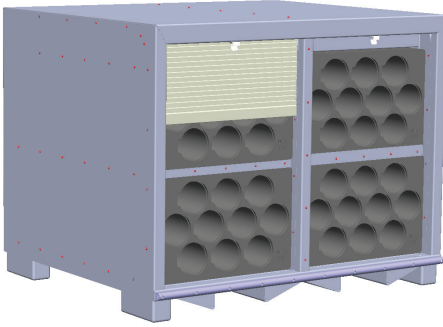
Applications

- Onshore, offshore, and deepwater
- Conventional and unconventional formations
- High-pressure / high-temperature formations
- Shale gas drilling
- Horizontal and deviated drilling
- Geothermal drilling
- Enhanced oil recovery projects
- Consolidated and unconsolidated formations

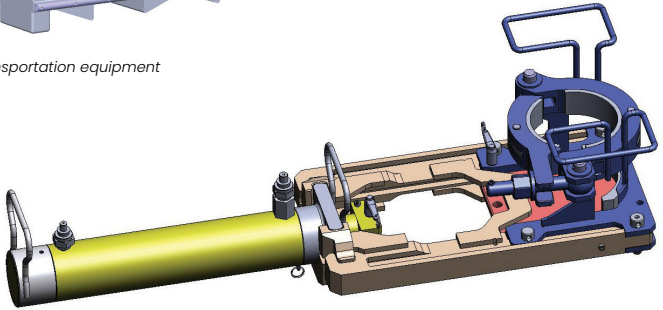
Features and benefits

- Laydown operation
 - Less manual handling
 - Equipment and services focus on health, safety, and environment (HSE) and core quality.
- **CoreCare™ core transportation**
 - Includes special core transportation, equipment monitoring, and reporting
 - Provides increased focus on HSE
 - Improves core quality
 - Improves chain of custody
- Core preservation and onsite handling
 - Offers a variety of services that are customized according to the customer's core analysis plans
 - Plugging
 - Preservation
 - Stabilization
 - Improves core quality
 - Significantly reduces handling-induced damage to the core

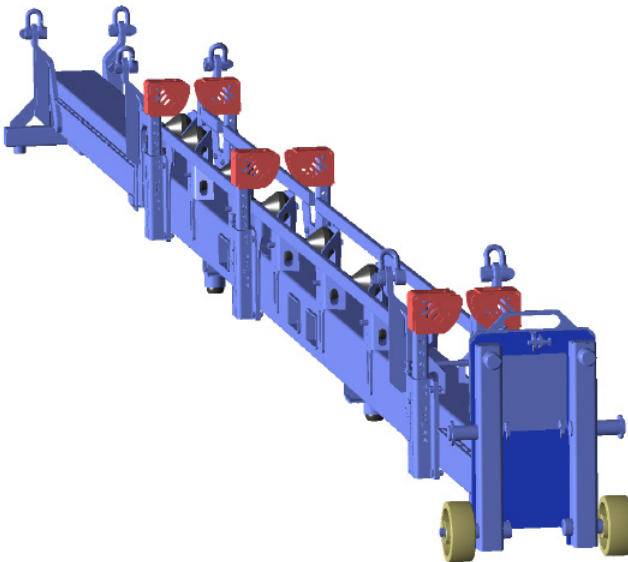
Baker Hughes core handling services include the services and equipment needed to get the core safely retrieved at the drill floor, along with core laydown and processing at the rigsite and transportation to the customer's chosen core laboratory. These services are all focused on giving the customer the highest possible core quality delivered to the laboratory in order to minimize the uncertainty of the core analysis results. All equipment and procedures that are used in these processes have also been designed with a high health, safety, and environment (HSE) focus to ensure a safe working environment for the core-handling personnel.



CoreCare Transportation equipment



Hydraulic core splitter



CORING SERVICES

Core Bits

Advanced bit technology

Baker Hughes coring services include access to the newest and most advanced bit technology in the world. Working with the Baker Hughes Drill Bits team, the Coring Services group provides customers with the most advanced technology for both PDC and impregnated bits, along with a portfolio of core bits that covers nearly any application and hole size.

The Coring Services team operates globally wherever oil and gas fields are being developed. The team customizes its services to correspond with the customer's core analysis plans and deliver the highest-possible core quality.

Applications

- Specialized Coring operations
- Onshore, offshore, and deepwater
- Conventional and unconventional formations
- Horizontal and deviated drilling
- Enhanced oil recovery projects
- Consolidated formations

Features and benefits

- **Talon™ Core series** of polycrystalline diamond compact (PDC) core bits
 - **StaySharp™ cutters** are tailored to improve abrasion and impact resistance as well as diamond degradation mitigation
 - Provides tapered gauge design, which improves cleaning, and reduces balling and torque fluctuations
 - Complete junk slot mapping, improved hydraulic efficiency in low-HSI applications and maximized cuttings evacuation
 - Optimized short blade profile improves drilling dynamics and efficiency
- **Genesis™ series** of PDC core bits (BHC)
 - Offers a wide variety of formation types from unconsolidated to hard, abrasive, and interbedded formations
 - Includes time-tested, stable designs that reduce vibration to improve cutter durability and extend bit life
 - Provides a range of application-specific PDC cutters that are fracture- and abrasive-resistant
- **IRev™ impregnated core bits**
 - Provides diamond-impregnated post for increased durability and higher rate of rock removal
 - Offers aggressive design and optimized profile, enabling higher torque output to deliver a greater rate of penetration (ROP) and to better balance workloads with extended bit life
 - Features improved hydraulics for more effective cleaning in hard sections that are interbedded with stickier, softer shales and siltstones
- Natural diamond core bits
 - Features time-proven, applicant-specific designs and profiles
 - Provides a core bit of last resort for extremely hard, abrasive formations



Tool Specifications

Tool size	Available for all Baker Hughes Coring Systems
Hole size*	5½-in. to 17½-in. (146.0 mm to 444.50 mm)
Speed range*	See appropriate Core Bit Technical Data Sheet
Flow range*	See appropriate Core Bit Technical Data Sheet
Max. weight on bit*	See appropriate Core Bit Technical Data Sheet

**Specifications and ranges applicable to multiple tool sizes. Final specifications are dependent upon bottomhole assembly (BHA) configuration. Please contact your Baker Hughes representative for more detailed technical information.*

Baker Hughes 

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