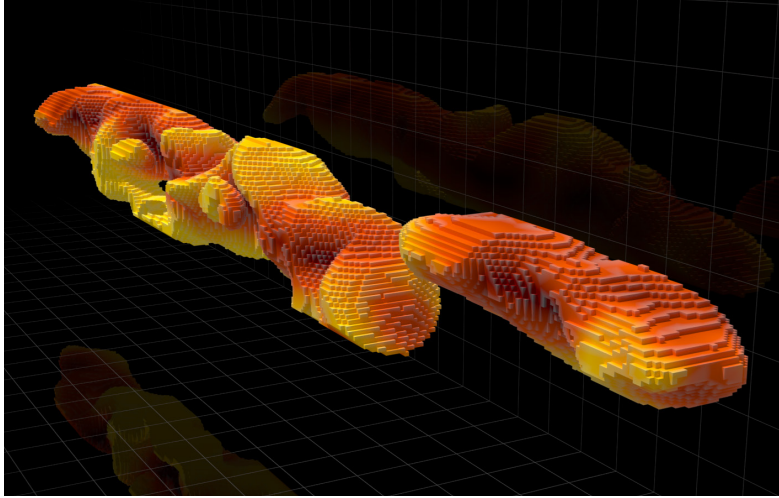


iStar® Intelligent Drilling and Logging Platform

BUILT FOR TODAY. DESIGNED FOR TOMORROW.

HALLIBURTON

iStar® Intelligent Drilling and Logging Platform

INDUSTRY-LEADING SUBSURFACE INSIGHT, SUPERIOR DRILLING PERFORMANCE, AND CONSISTENT WELL DELIVERY

The iStar® platform from Halliburton Sperry Drilling is built for today yet designed for tomorrow, delivering industry-leading subsurface insight, superior drilling performance, and consistent well delivery.

Fully digital and web-enabled, the iStar platform allows you to monitor and control your drilling and logging operations from anywhere. The digital architecture supports automation, machine learning, and artificial intelligence, so your drilling and logging platform can help you stay one step ahead. The rugged, compact design includes more sensors in fewer tools and delivers high-definition measurements closer to the bit.

iStar® Platform

Industry-Leading Subsurface Insight

Superior Drilling Performance

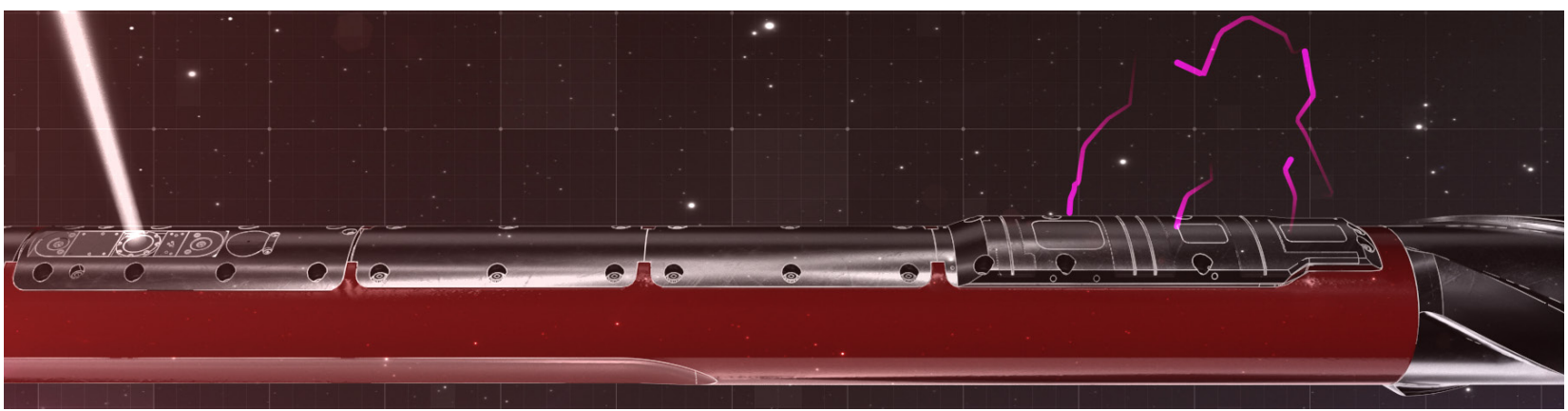
Consistent Well Delivery

Industry-Leading Subsurface Insight

The iStar platform delivers high-definition measurements closer to the bit and deeper into the formation to provide industry-leading subsurface insight. This platform provides unprecedented real-time visibility of the type and quantity of fluids present in your reservoir. Advanced data science techniques further enhance reservoir understanding to optimize reserves calculations and well placement.

FEATURES

- Comprehensive logging measurements closer to the bit for deep subsurface insight
- Better quality measurements with improved accuracy and resolution for improved reserves calculations
- Enhanced reservoir understanding using machine learning and artificial intelligence
- Improved measurements to drive automated intelligent geosteering
- Improved wellbore stability and optimized completions

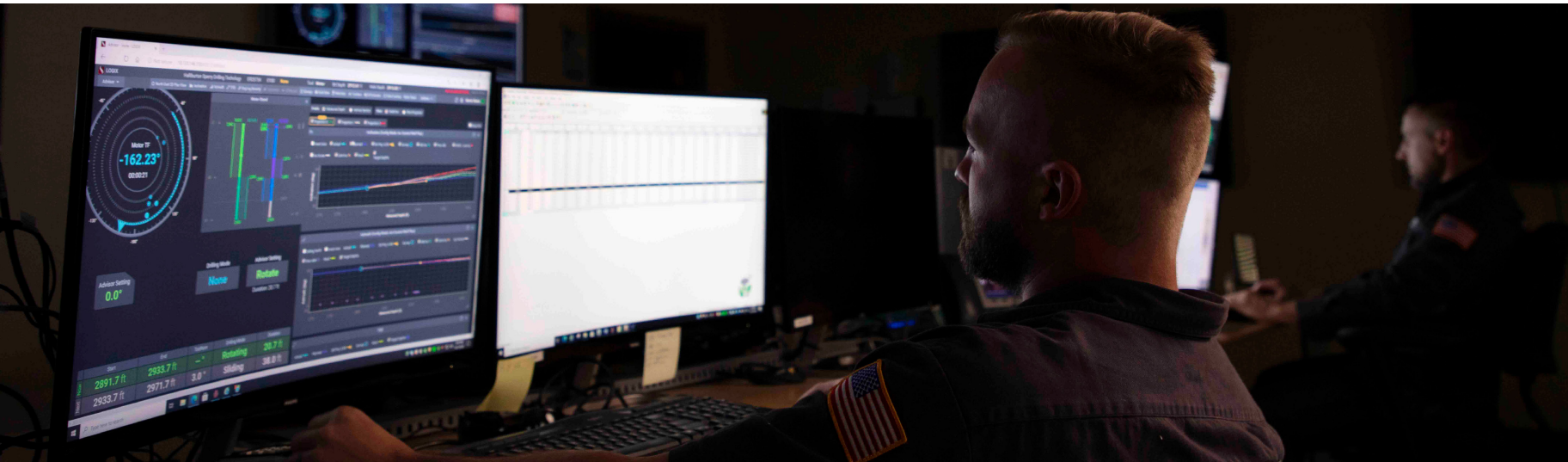


Superior Drilling Performance

Built for a wide range of drilling parameters, including high rotary speed and high torque, the iStar platform helps maximize the rate of penetration and minimize flat time. Integrated drilling dynamics combined with continuous well positioning measurements support drilling automation to drill safely, quickly, and on target, reducing well time.

FEATURES

- Optimized performance and reduced well time
- Comprehensive drilling measurements for improved well delivery
- Integrated drilling dynamics to support automated drilling
- Operation across a wide range of drilling parameters, including high RPM and high torque
- Consistent shoe-to-shoe delivery

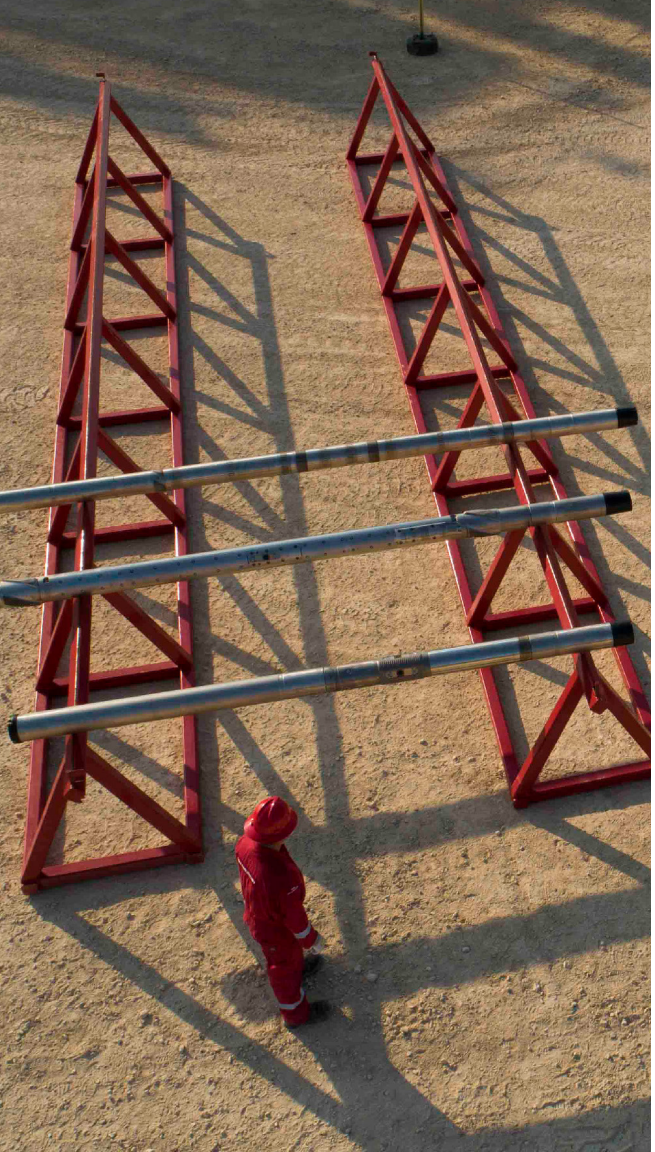


Consistent Well Delivery

The rugged iStar platform provides more sensors in fewer collars, significantly reducing the bottom hole assembly (BHA) length and decreasing the number of connections, to improve reliability and for efficient handling on the rig floor. The compact footprint allows easy handling and quicker pickup with fewer people at the rig site, reducing health, safety, and environment (HSE) risks and environmental impact. Intuitive, user-friendly diagnostics support smart tracking and predictive maintenance, reducing uncertainty and providing consistent shoe-to-shoe delivery.

FEATURES

- Fully digital and web-enabled to monitor and control drilling from anywhere
- Smart tracking and preventive maintenance for high service quality
- Reduced physical footprint for easy management and quicker pickup at the rig site with fewer people on board
- Safer operations with fewer tools to handle and reduce HSE exposure
- Rugged, compact design with fewer rig floor connections
- Reduced critical path with intuitive, user-friendly diagnostics



ISTAR® PLATFORM FAMILY OF SERVICES

From accurate and comprehensive reservoir evaluation, to safe, fast, and efficient drilling, and a predictability that helps minimize cost and maximize value, the iStar platform and its family of services can help take your next well to the next level.

The iStar platform is launching with the following services, and will continue to grow with additional services to further enhance your asset value.

- **PulseStar™** service streams high-resolution, real-time drilling and subsurface data at increased depths to ensure efficient and consistent well delivery.
- **BaseStar®** service integrates critical measurements for wellbore placement, drilling performance optimization, and borehole quality.
- **ResiStar®** service provides accurate resistivity from multi-frequency compensated measurements to determine reservoir fluids.
- **StrataStar®** service provides deep azimuthal resistivity measurements to precisely place wellbores in thin laminated reservoirs without impacting drilling performance.
- **EarthStar®** service provides ultra-deep resistivity to illuminate and map reservoir and fluid boundaries up to 225 feet (68 meters) from the wellbore and offers the industry's only 3D inversion capability.
- **EarthStar® X** service unlocks reservoir potential with near-bit, ultra-deep boundary mapping.

- **BrightStar®** service provides reservoir structure and fluid boundaries ahead of the bottom hole assembly (BHA).
- **LithoStar®** service provides high-precision formation density and neutron porosity measurements for improved petrophysical interpretations and accurate reserves calculations.
- **PixStar™** service provides high-resolution acoustic images that capture more of the wellbore to show borehole size and shape and enhance reservoir understanding in all mud types.
- **GuideStar™** service provides continuous definitive survey measurements using high resolution sampling for precise wellbore positioning.

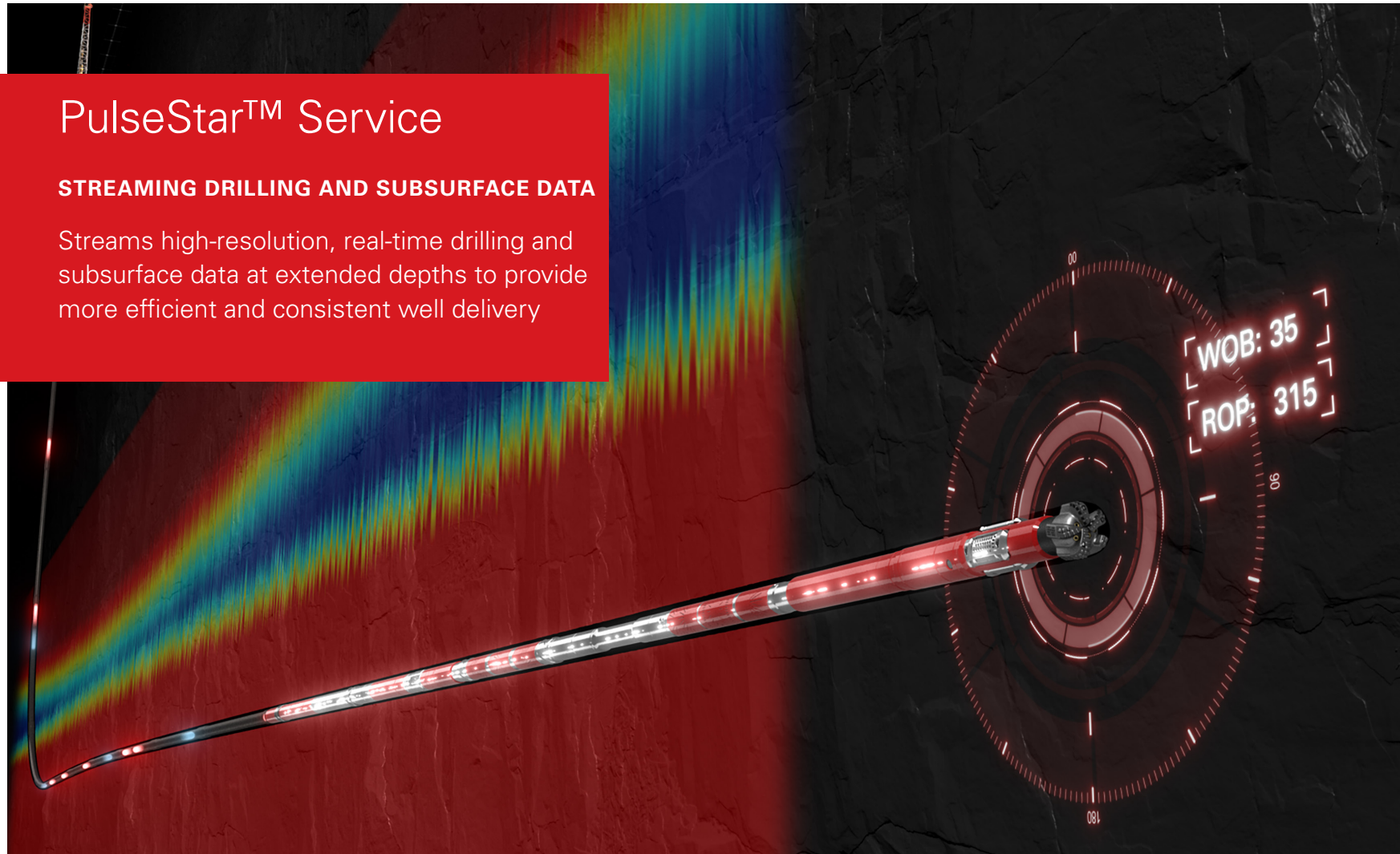
The iStar intelligent drilling and logging platform services are designed to match the mechanical specifications of the iCruise® intelligent rotary steerable system (RSS) from Halliburton Sperry Drilling. When run with the iCruise RSS, drilling performance and consistent well delivery are enhanced with the inclusion of additional data and advanced automation capabilities.

All of the services share these common mechanical specifications and operating limits. Parameters for each service are found within the information for the specific service.

PulseStar™ Service

STREAMING DRILLING AND SUBSURFACE DATA

Streams high-resolution, real-time drilling and subsurface data at extended depths to provide more efficient and consistent well delivery



The PulseStar™ intelligent, high-speed telemetry service streams high-resolution, real-time drilling and subsurface data at extended depths to provide more efficient and consistent well delivery. The automated mud-pulse telemetry system is designed to consistently deliver high-speed data at extended depths for enhanced subsurface insight and higher ROP. In critical operations, the PulseStar service is designed to be compatible with other telemetry systems, and can withstand higher specifications to provide solutions that improve run length.

Consistent, High-Speed Telemetry At Extended Depths

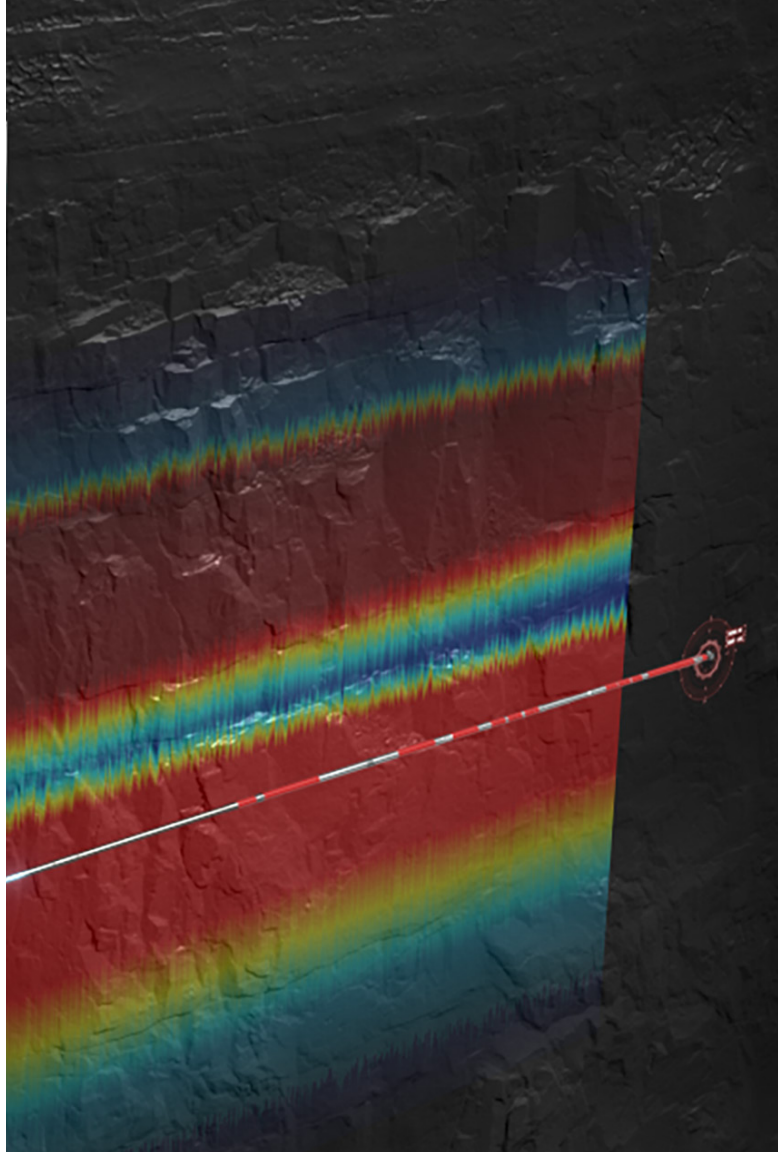
The PulseStar service provides consistent high data rates at increased depths. Its unique pulse mechanism enables high-speed transmission in deeper depths across the reservoir, where detailed characterization and drilling optimization is required.

Automated Telemetry System

The PulseStar service minimizes human interaction with telemetry for remote operations and increases on-bottom drilling time. The service automatically adapts to environmental changes for optimal data rate and detection. Advanced signal processing also allows downlinks for two-way communication while drilling.

Optimized For Critical Operations

The PulseStar service has high LCM tolerance with a wider flow envelope, providing advanced wellbore management options during unpredictable events. In critical operations, the PulseStar service's compatibility with other telemetry systems provides more solutions to increase run length.



PULSESTAR™ BENEFITS AND FEATURES

BENEFITS

» High-speed data streaming for rapid and accurate drilling decisions and enhanced subsurface insights

» Consistent and reliable real-time data even in challenging environments

» Increased on-bottom time through automated telemetry and signal processing with A.I.

» Reduced uncertainties from unpredicted well conditions

FEATURES

» High-speed real-time data transmission across wide depth ranges

» Automated telemetry operations and troubleshooting system

» Optional tandem telemetry capability

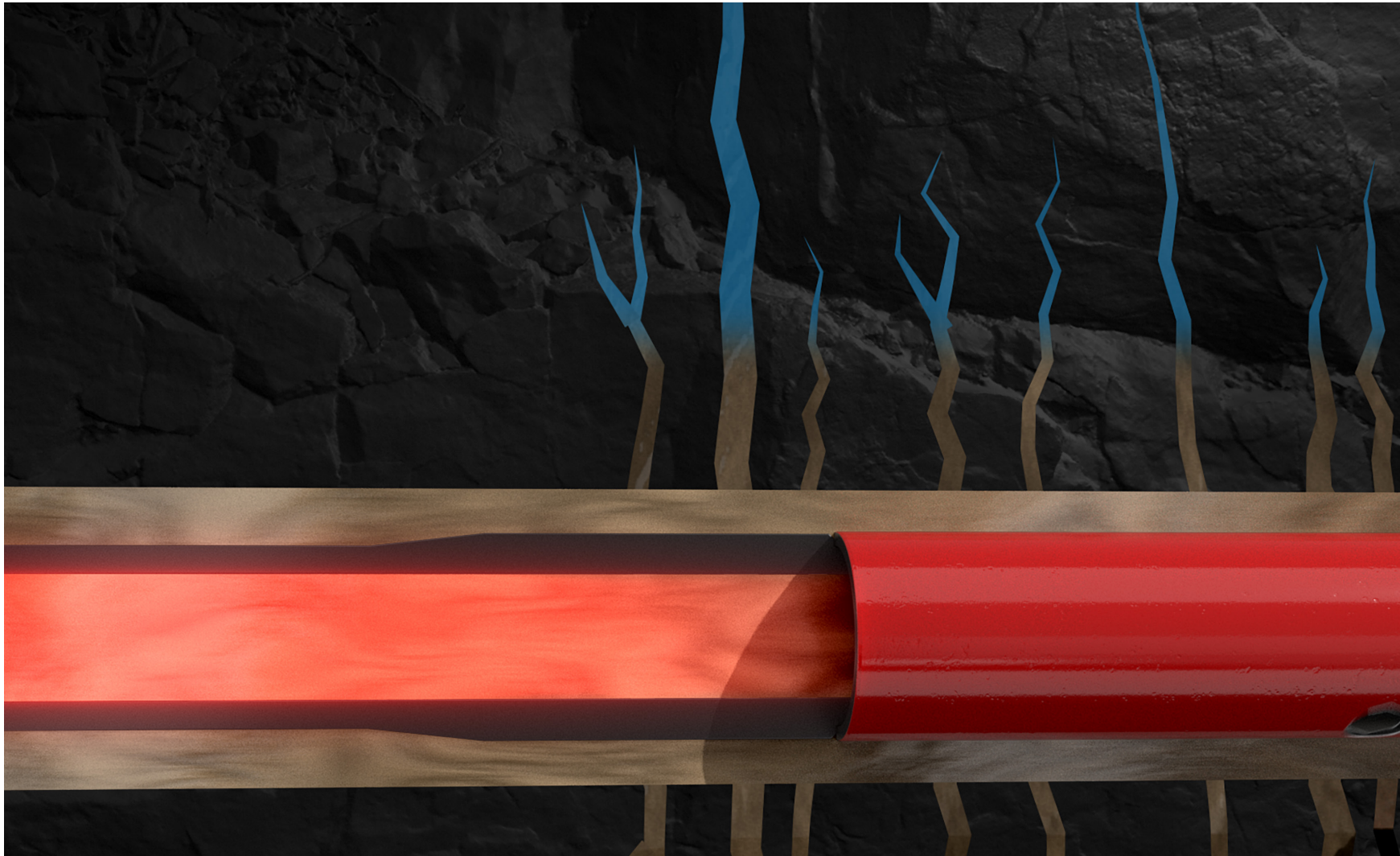
» High LCM tolerance

» Operational robustness with wide flow range

PulseStar® Service Technical Specifications

Mechanical Specifications	4.75 in.	6.75 in.
Hole Size Range	5.875 to 6.75 in. (149 to 171 mm)	7.875 to 9.875 in. (200 to 251 mm)
Length	8.66 ft (2.64 m)	8.66 ft (2.64 m)
Maximum Body OD	5.25 in. (133.35 mm)	6.75 in. (171.45 mm)
Top Collar Connection Bottom Collar Connection	HAL40 Box HAL44 Pin	HAL50 Box HAL50 Pin
Maximum Operating Torque	12,000 lbf-ft (1626 daN.m)	35,000 lbf-ft (4745 daN.m)
Maximum Dog Leg Severity - Rotating	14°/100 ft	10°/100 ft
Maximum Dog Leg Severity - Sliding	30°/100 ft	21°/100 ft
Maximum Make-Up Torque	14,000 lbf-ft (1898 daN.m)	35,000 lbf-ft (4745 daN.m)
Maximum Overpull	340,000 lbf (151 240 daN.m)	820,000 lbf (364 754 daN.m)
Maximum WOB	25,000 lbf (11 121 daN)	65,000 lbf (28 913 daN)

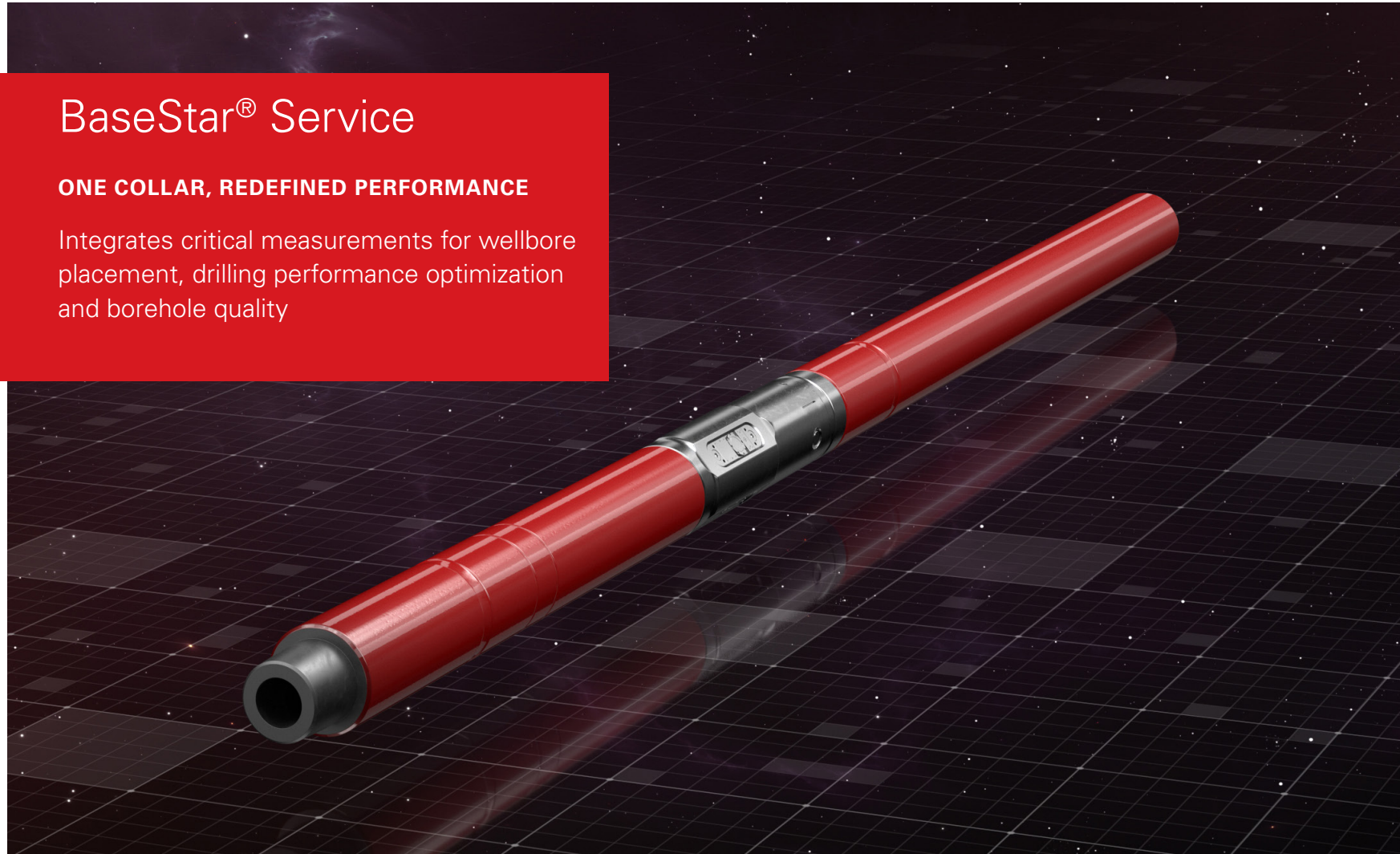
Operating Limits		
Average mechanical RPM limit	400 RPM	
Temperature Range	32 to 302°F (0° to 150°C)	
Maximum Pressure	25,000 psi (172 Mpa)	
Mass Flow Rate	5,000 lbs/min (2270 kg/min)	10,000 lbs/min (4540 kg/min)
Flow Range	150 to 350 gpm	250 to 750 gpm
LCM Tolerance	85 lbm/bbl WAL-NUTT® Medium	
Maximum Sand Content	2%	
Vibration	Refer to Sperry Drilling Downhole Tools Technical Specifications. (Available on request.)	



BaseStar® Service

ONE COLLAR, REDEFINED PERFORMANCE

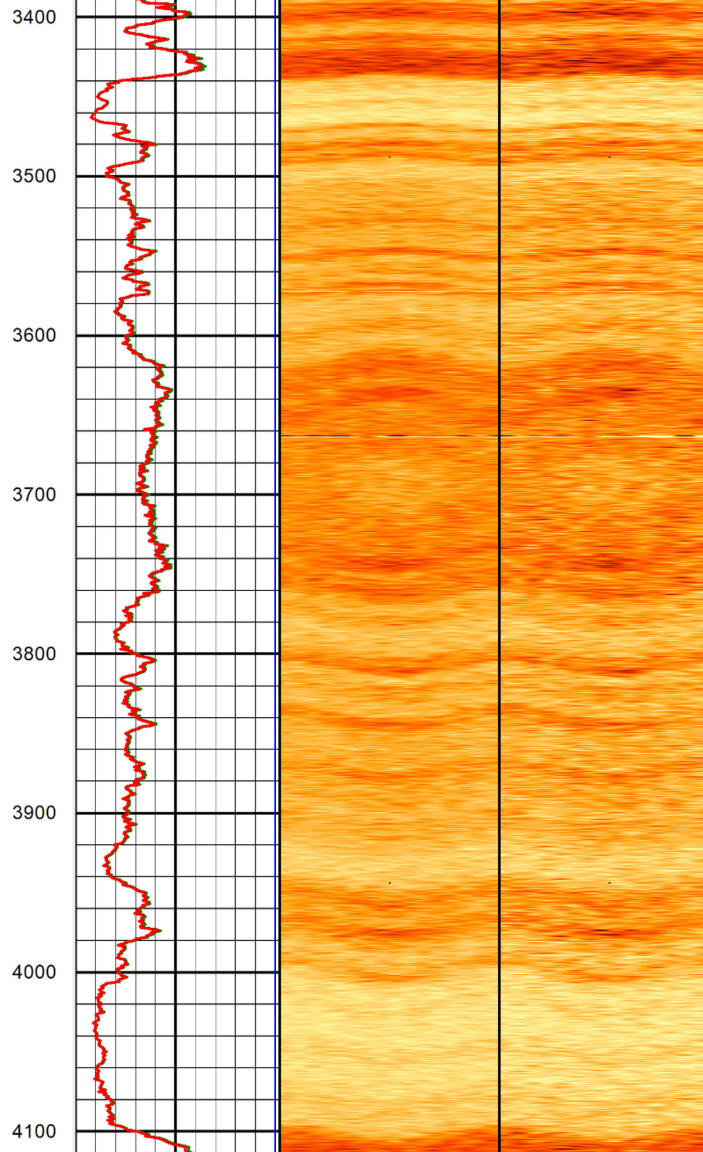
Integrates critical measurements for wellbore placement, drilling performance optimization and borehole quality

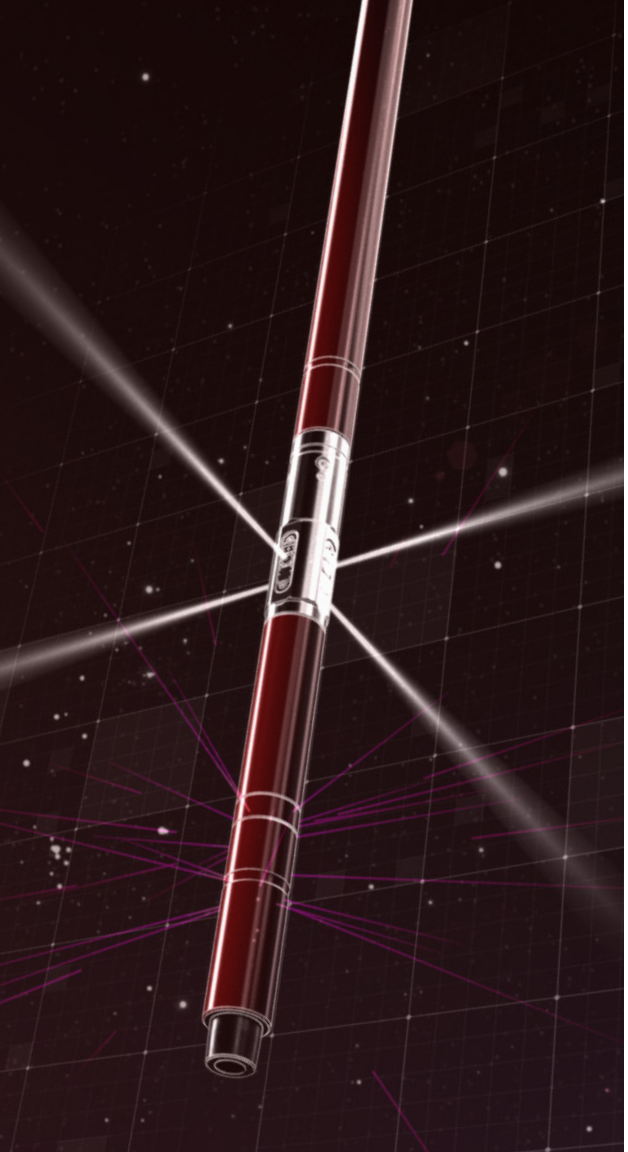


In today's challenging drilling environments, operators need to fully understand the BHA position and dynamics to optimize drilling performance and well placement. The BaseStar® service from Halliburton Sperry Drilling is an integrated measurement-while-drilling (MWD) service that provides the information you need to understand drillstring dynamics, manage wellbore trajectory, and safely deliver your well on target and on time. The compact footprint of this complete package moves critical measurements closer to the bit, reduces the length of pilot holes, and drives quicker decisions.

Continuous Directional Data, Precise Positioning

The BaseStar service takes pumps-off static surveys for reduced well time and accurate geometric wellbore positioning. High-frequency, continuous inclination and azimuth measurements enable the automated drilling service from Halliburton Sperry Drilling to adapt to downhole uncertainty and accurately place the well. The BaseStar service provides high-resolution gamma-ray logs for correlation between wells, and gamma-ray borehole images to enhance well placement and further reduce the geological uncertainty of your reservoir. Directional data from the BaseStar service supports Halliburton Sperry Drilling survey management services that can increase the accuracy of the survey measurements by correcting for localized environmental influences. These methods help reduce inherent uncertainties when calculating the wellbore trajectory and increase the accuracy of the wellbore position.





BASESTAR® SERVICE CONTINUED

Reduced Well Time

Downhole torque, weight, and vibration measurements drive real-time decisions for improved drilling efficiency and optimized performance. This comprehensive sensor package allows you to mitigate the risk of tool damage, monitor and efficiently transfer weight and torque along the drillstring, minimize wasted energy transfer, and manage drilling dysfunction, which minimizes non-productive time and reduces well time. Real-time bore and annular pressure measurements allow equivalent circulating density monitoring and rapid decision-making to adjust drilling and drilling-fluid parameters and operating procedures to improve hole cleaning efficiency and avoid pack-offs.

Wellbore Stability

Real-time hole shape and annular pressure measurements allow ongoing evaluation of wellbore stability and effective control of the mud program to protect formation integrity and mitigate hole problems. In the pumps-off mode, the service measures the minimum, maximum, and average pressures during non-circulating periods and transmits the results to the surface when circulation resumes. These measurements help to avoid lost circulation and detect flow or kicks immediately. The BaseStar service also reduces the risk of problems caused by unexpected fracture or collapse. On extended-reach wells, real-time information helps to maintain wellbore pressures within safe operating limits.

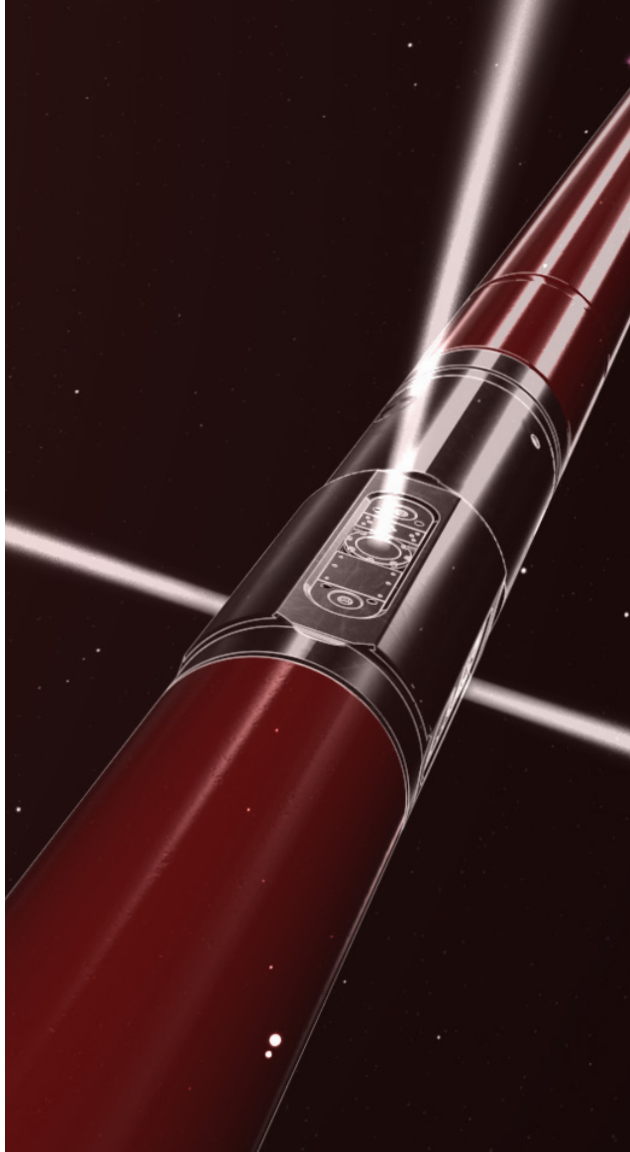
BASESTAR® SERVICE BENEFITS AND FEATURES

BENEFITS

- Improve accuracy of geometric well placement and understanding of borehole tortuosity
- Acquire correlation, geosteering, and structural dip measurements
- Identify casing or coring points and determine accurate shale volumes
- Improve drilling efficiency and reduce well time
- Monitor hole cleaning and wellbore stability, and maintain wellbore pressures on extended-reach wells in real time
- Detect well flows and kicks immediately to maintain well control
- Reduce the risk of unexpected fracture or collapse

FEATURES

- Compact 13-ft (4-m) collar design moves critical measurements closer to the bit
- Definitive pumps-off surveys complemented by continuous inclination and azimuth measurements
- Comprehensive drilling dynamics from weight on bit, torque on bit, pressure, and vibration measurements
- High detector sensitivity provides precise gamma-ray measurements and clear borehole images
- Hole shape and size measurements



BaseStar® Service Technical Specifications

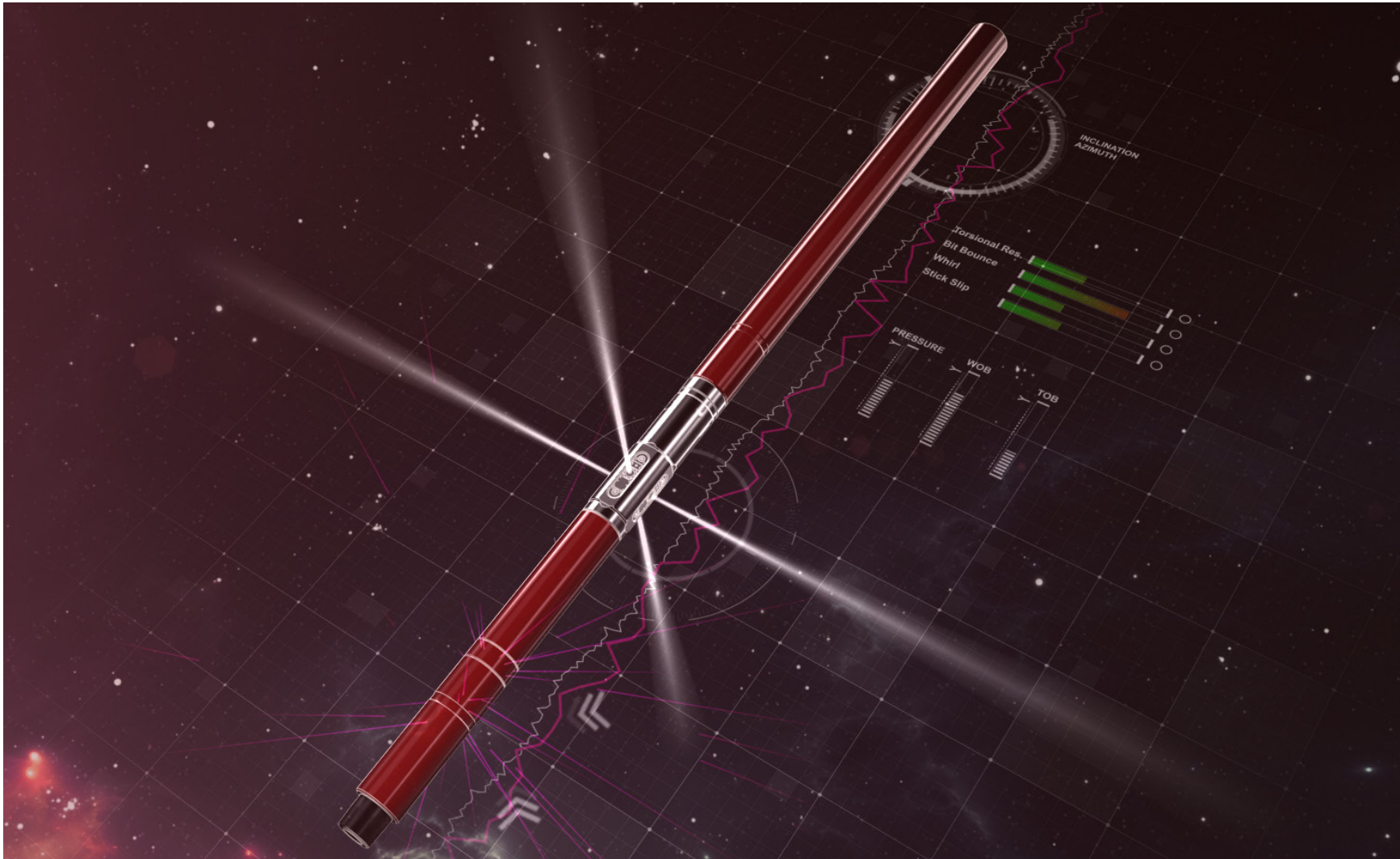
Mechanical Specifications	4.75 in.	6.75 in.	8 in.
Nominal Tool OD	4.75 in. (121 mm)	6.75 in. (171 mm)	8.00 in. (203 mm)
Maximum Body OD	5.25 in. (133 mm)	7.125 in. (181 mm)	9.00 in. (229 mm)
Hole Size Range	5.875 to 6.75 in. (149 to 171 mm)	7.875 to 9.875 in. (200 to 251 mm)	10.50 to 14.75 in. (267 to 374 mm)
Collar ID	1.25 in. (32 mm)	2.00 in. (51 mm)	2.36 in. (60 mm)
Effective Collar ID*	1.25 in. (32 mm)	1.82 in. (46 mm)	2.37 in. (60 mm)
Length	13.40 ft (4.08 m)		13.88 ft (4.23 m)
Weight	735 lbm (333 kg)	1,227 lbm (557 kg)	1,822 lbm (827 kg)
Connections	HAL40 (box up x pin down)	HAL50 (box up x pin down)	HAL56 (box up x pin down)
Make-Up Torque	14,000 ft·lbf (1900 daN·m)	35,000 ft·lbf (4750 daN·m)	50,000 ft·lbf (6780 daN·m)
Maximum Dog Leg Severity - Rotating	14°/100 ft (14°/30 m)	10°/100 ft (10°/30 m)	8°/100 ft (8°/30 m)
Maximum Dog Leg Severity - Sliding	30°/100 ft (30°/30 m)	21°/100 ft (21°/30 m)	14°/100 ft (14°/30 m)
Maximum Drilling or Operating Rotary Torque	12,000 ft·lbf (1630 daN·m)	35,000 ft·lbf (4750 daN·m)	50,000 ft·lbf (6780 daN·m)
Operating Limits			
Temperature Range	32 to 302˚F (0 to 150˚C)		
Maximum Pressure	25,000 psi (172 MPa)		
Maximum Mass Flow Rate	5,000 lbm/min (2,270 kg/min)	10,000 lbm/min (4,540 kg/min)	20,000 lbm/min (9070 kg/min)
Maximum Sand Content	2%		

* For hydraulics calculations.

Mechanical Specifications	4.75 in.	6.75 in.	8 in.
Maximum Rotary Speed	400 RPM		
Maximum WOB	25,000 lbf (11 000 daN)	65,000 lbf (29 000 daN)	85,000 lbf (38 000 daN)
Vibration	Refer to Sperry Drilling Downhole Tools Technical Specifications (Available on Request)		
Measurement Specifications			
Gamma Ray			
Detector Type	Scintillation Crystal (x2)		
Measurement Range	0 to 1,000 API		
Measurement Precision**	±1.8 API @ 100 API	±2.4 API @ 100 API	
Real-Time Gamma Image	4 or 16 (compressed) sectors		
Recorded Gamma Image	16 sectors		
Measure Point from Bottom of Tool	2.69 ft (0.82 m)		2.99 ft (0.91 m)
WOB/TOB			
Weight Operating Range	30,000 lbf (13 300 daN)	65,000 lbf (29 000 daN)	85,000 lbf (38,000 daN)
Weight Resolution	1,000 lbf (444.82 daN)		
Torque Operating Range	10,000 lbf·ft (1360 daN·m)	35,000 lbf·ft (4750 daN·m)	50,000 lbf·ft (6780 daN·m)
Torque Resolution	200 lbf·ft (27 daN·m)		
Measure Point from Bottom of Tool	5.70 ft (1.74 m)		6.12 ft (1.87 m)

** Specifications are for a 30-second interval.

Measurement Specifications	4.75 in.	6.75 in.	8 in.
Pressure While Drilling			
Detector Type	Quartzdyne Transducer		
Measurement Range	0 to 30,000 psi (0 to 206.8 MPa)		
Measurement Accuracy	0.1% at Full Scale		
Measure Point from Bottom of Tool	8.03 ft (2.45 m)		8.51 ft (2.59 m)
Vibration			
Peak Accelerations	0–105 g (3 axis)		
Average Accelerations	0–25 g (3 axis)		
Burst Data Sampling Rate	1,000 Hz		
Rotary Speed	±0–500 RPM		
Measure Point from Bottom of Tool	9.13 ft (2.78 m)		9.61 ft (2.93 m)
Directional			
Azimuth Accuracy	±1°		
Inclination Accuracy	±0.1°		
Toolface Resolution	±2.8°		
Measure Point from Bottom of Tool	10.28 ft (3.13 m)		10.76 ft (3.28 m)


INCLINATION
AZIMUTH
Torsional Res.
Bit Bounce
Whirl
Stick Slip
PRESSURE
WOB
TOB

ResiStar® Service

FLUID UNDERSTANDING IN EVERY RESERVOIR

Accurate resistivity from multi-frequency compensated measurements

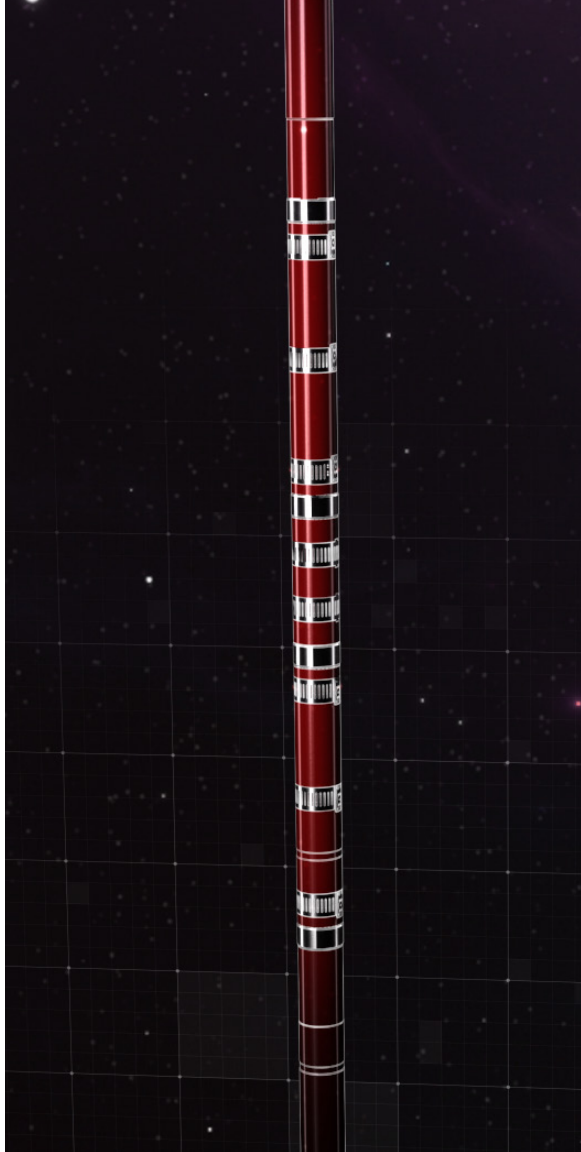
Placing your wells in the most productive zone requires understanding the fluids in your reservoir. The ResiStar® service from Halliburton Sperry Drilling provides multi-frequency, compensated measurements with downhole environmental corrections for accurate resistivity in all drilling environments.

Halliburton Sperry Drilling provides industry-leading resistivity measurements, building on the latest generation of downhole electronics and novel antenna designs used across our comprehensive range of resistivity services such as the EarthStar® Ultra-Deep Resistivity Service.

The ResiStar service complements the EarthStar service by delivering highly accurate conventional resistivity measurements and enabling precise reserves evaluation, detailed formation delineation, and improved reservoir understanding.

Enhanced Resistivity Measurements in Every Drilling Environment

The ResiStar service measures resistivity using two frequencies (2 MHz, 500 kHz) and three geometrically distributed spacings. Multiple operating frequencies along with physically compensated antennas reduce borehole rugosity effects on the measurement quality. Digitization of the signal at the receiver along with advanced electronics isolation significantly reduce noise to further improve both precision and accuracy. Downhole measurement of mud resistivity, combined with borehole size information from the BaseStar service, allows for complete environmental corrections. These features combine to deliver accurate measurements in all operating environments to cover the widest possible range of formations and provide input to advanced petrophysical analyses.



RESISTAR® SERVICE BENEFITS AND FEATURES

BENEFITS

» Receive accurate resistivity measurements across a wide range of R_t and R_m

» Improve understanding of reservoir fluids

» Obtain multiple depths of investigation, minimizing borehole effects in large boreholes

» Acquire robust measurements in any downhole environment

FEATURES

» Phase and attenuation resistivities from three spacings and two frequencies

» Low-noise electronics

» Ruggedized antenna design

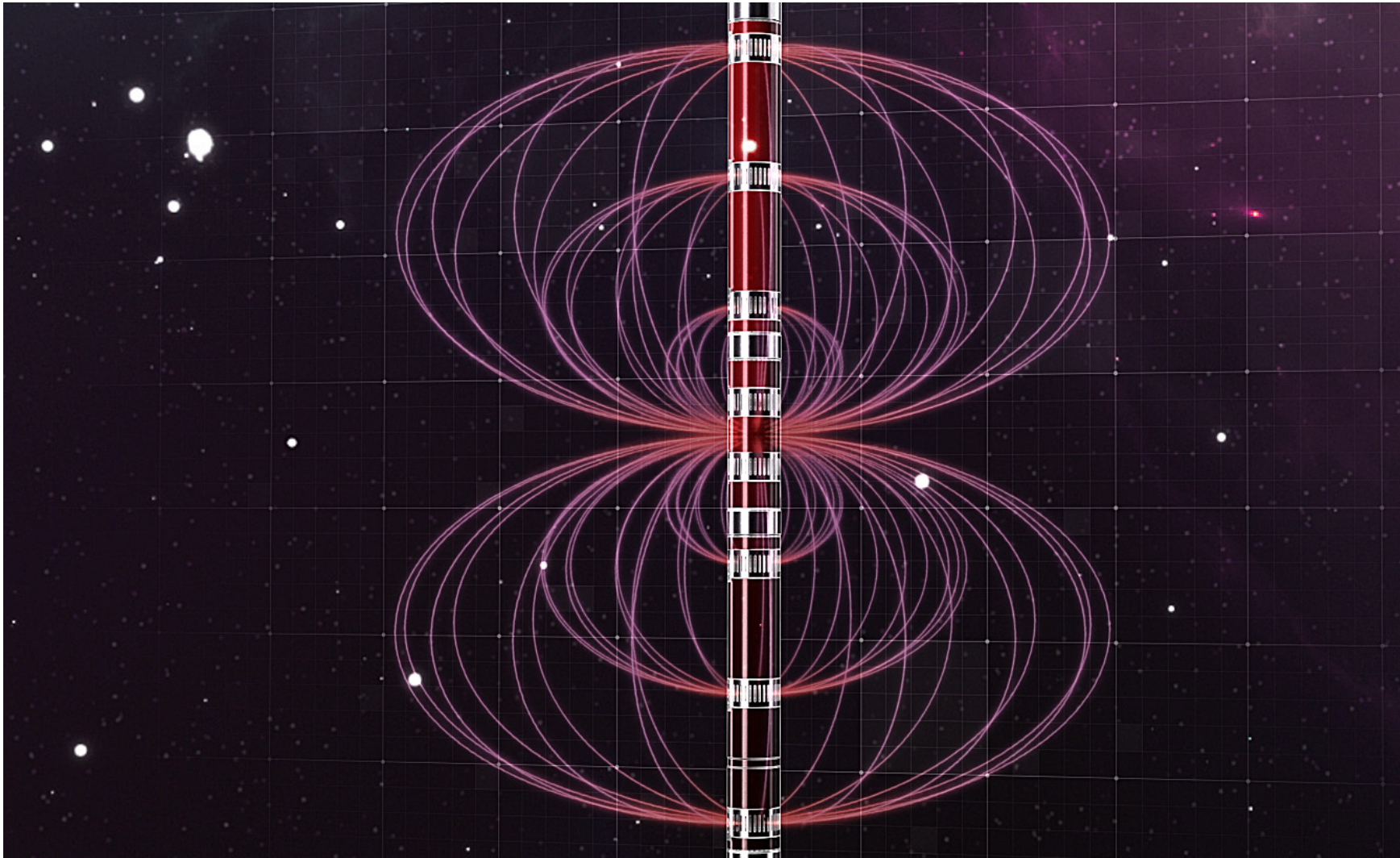
» Comprehensive environmental corrections

» Downhole mud resistivity measurement

ResiStar® Service Technical Specifications

Mechanical Specifications	4.75 in.	6.75 in.	8 in.
Nominal Tool OD	4.75 in. (121 mm)	6.75 in. (171 mm)	8 in. (203 mm)
Maximum Body OD	5.38 in. (133 mm)	6.93 in. (176 mm)	8.15 in. (206.4 mm)
Hole Size Range	5.875 to 6.75 in. (149 to 171 mm)	7.875 to 9.875 in. (200 to 251 mm)	10.50 to 14.75 in.(267 to 374 mm)
Collar ID	1.25 in. (32 mm)	2.00 in. (51 mm)	2.36 in. (60 mm)
Length	18.38 ft (5.60 m)	17.64 ft (5.38 m)	17.95 ft (5.47 m)
Weight	1,147 lbm (520 kg)	1,888 lbm (856 kg)	2,555 lbm (1159 kg)
Connections	HAL40 (box up x pin down)	HAL50 (box up x pin down)	HAL56 (box up x pin down)
Make-Up Torque	14,000 ft·lbf (1900 daN·m)	35,000 ft·lbf (4750 daN·m)	50,000 ft·lbf (6780 daN·m)
Maximum Dog Leg Severity - Rotating	14°/100 ft (14°/30 m)	10°/100 ft (10°/30 m)	8°/100 ft (8°/30 m)
Maximum Dog Leg Severity - Sliding	30°/100 ft (30°/30 m)	21°/100 ft (21°/30 m)	14°/100 ft (14°/30 m)
Maximum Drilling or Operating Rotary Torque	12,000 ft·lbf (1630 daN·m)	35,000 ft·lbf (4750 daN·m)	50,000 ft·lbf (6780 daN·m)
Operating Limits			
Temperature Range		32 to 302˚F (0 to 150˚C)	
Maximum Pressure		25,000 psi (172 MPa)	
Maximum Mass Flow Rate	5,000 lbm/min (2,270 kg/min)	10,000 lbm/min (4,540 kg/min)	20,000 lbm/min (9070 kg/min)
Maximum Sand Content		2%	
Maximum Rotary Speed		400 RPM	

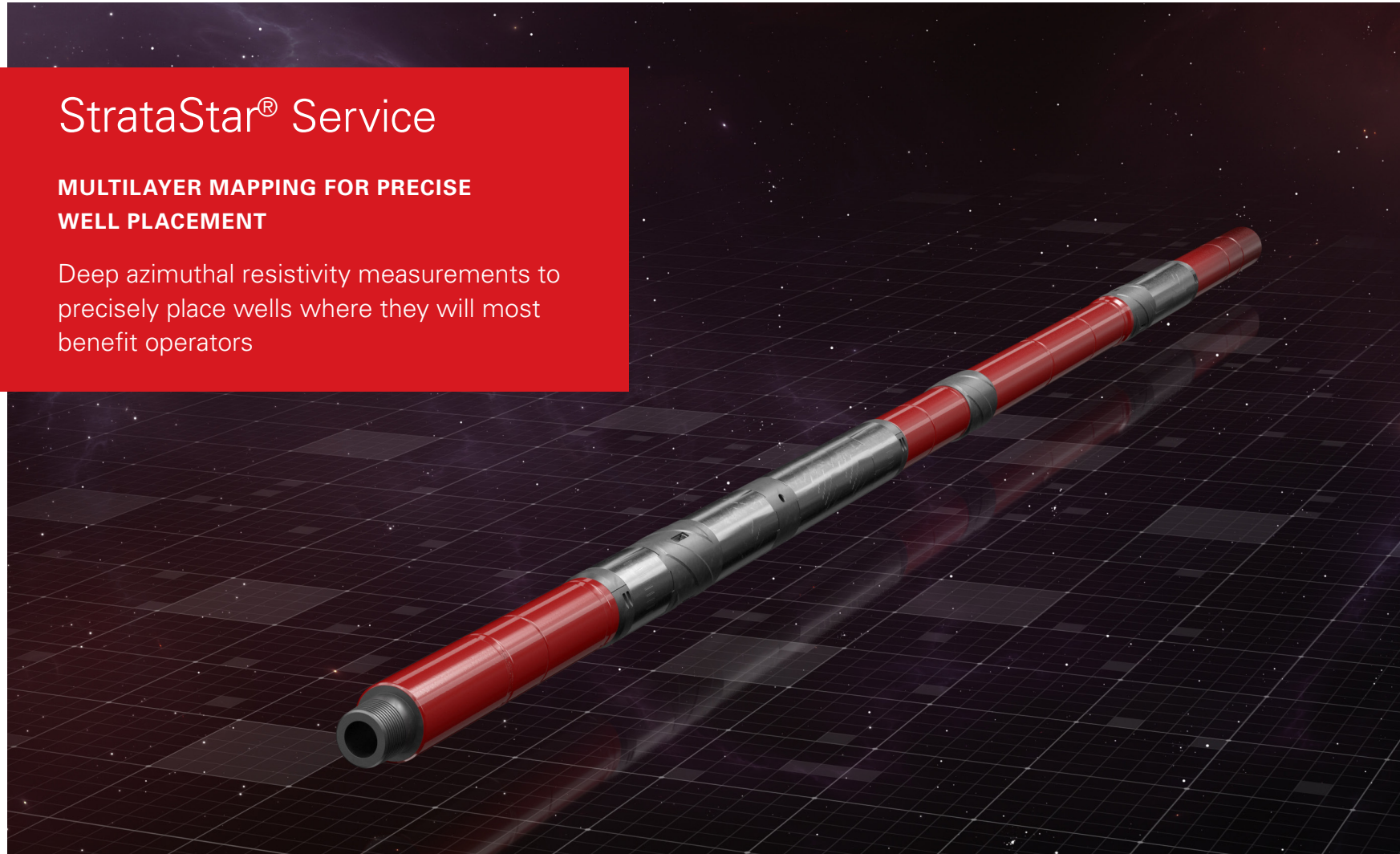
Mechanical Specifications	4.75 in.	6.75 in.	8 in.
Maximum WOB	25,000 lbf (11 000 daN)	65,000 lbf (29 000 daN)	85,000 lbf (38 000 daN)
Vibration	Refer to Sperry Drilling Downhole Tools Technical Specifications (Available on Request)		
Resistivity			
Measurement Type	Electromagnetic Wave Propagation		
Measurement Range	Phase-Shift Resistivity: 0.05 to 2,000 Ω·m Attenuation Resistivity: 0.1 to 100 Ω·m		
Measurement Accuracy (2 MHz, 48-in. spacing)	1 Ω·m ± 0.12% 10 Ω·m ± 0.3% 100 Ω·m ± 1.5% 1,000 Ω·m ± 8%		
Measure Point from Bottom of Collar	7.48 ft (2.28 m)	7.36 ft (2.24 m)	7.56 ft (2.30 m)
Mud Resistivity			
Mud Resistivity Operating Range	0.01 to 10 Ω·m 0.1 to 100 S/m		



StrataStar® Service

MULTILAYER MAPPING FOR PRECISE WELL PLACEMENT

Deep azimuthal resistivity measurements to precisely place wells where they will most benefit operators



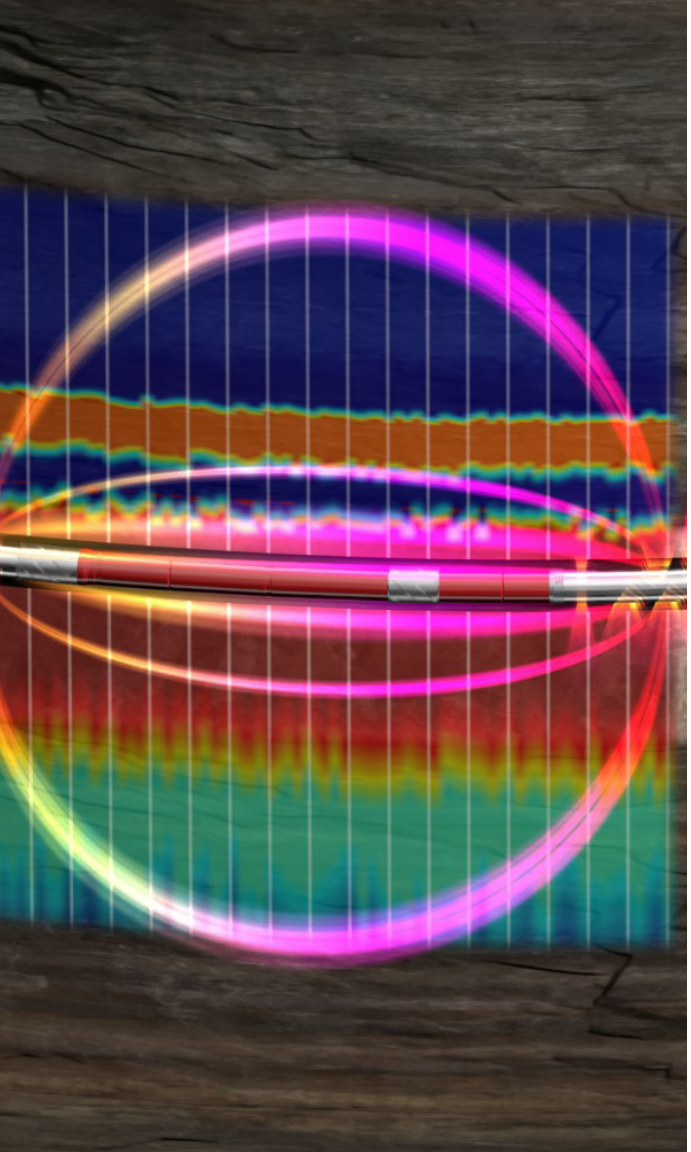
Regardless of the nature or complexity of the reservoir, wells accurately placed in the most productive zones help operators maximize asset value. The StrataStar® deep azimuthal resistivity service from Halliburton Sperry Drilling delivers advanced measurements and processing to improve real-time reserves evaluation while optimizing borehole placement to increase well production. Encompassing the robust, compact design of the iStar® intelligent drilling and logging platform, the StrataStar service embodies innovation by combining a novel antenna, mounted on a modular tool, with a suite of advanced inversion techniques. This service provides better data interpretation, widens the volume investigated, and increases the amount of information collected in real time to precisely steer wells where they will most benefit operators.

Stay within Thin Layer Boundaries

The StrataStar service makes deep azimuthal measurements up to 30-feet around the wellbore. A sophisticated processing algorithm inverts the data and maps the positions, thicknesses, and resistivities of interbedded rock and fluid layers. Real-time visualization of the surrounding geology and fluids provides key information required to precisely place the well and maximize reservoir contact.

Better Reservoir Characterization with Real-Time Anisotropy

The StrataStar service also provides shallower multi-frequency measurements over four spacings to deliver a comprehensive understanding of resistivity across the widest range of fluids and rocks. The innovative design of the proprietary crossed-transmitter antenna enables the computation of anisotropy in real time, enhancing formation characterization. Real-time access to R_v and R_h in a relatively undisturbed environment drives a more accurate calculation of the water saturation, further supporting advanced petrophysical analysis of the reservoir.



STRATASTAR® BENEFITS AND FEATURES

BENEFITS

» Adjust the well path to maintain desired distance from multiple bed boundaries

» Detect water zones at distance and avoid penetration

» Map formation structures and fluid distributions

» Acquire accurate formation resistivity for detailed formation and fluid characterization

» Obtain anisotropy for improved reserve evaluation

» React earlier to unforeseen geological changes and stay within the productive zone

FEATURES

» Visualizes reservoir structure 30 ft (±9 m) above and below the well

» Provides phase shift and attenuation compensated resistivity from four spacings at two frequencies

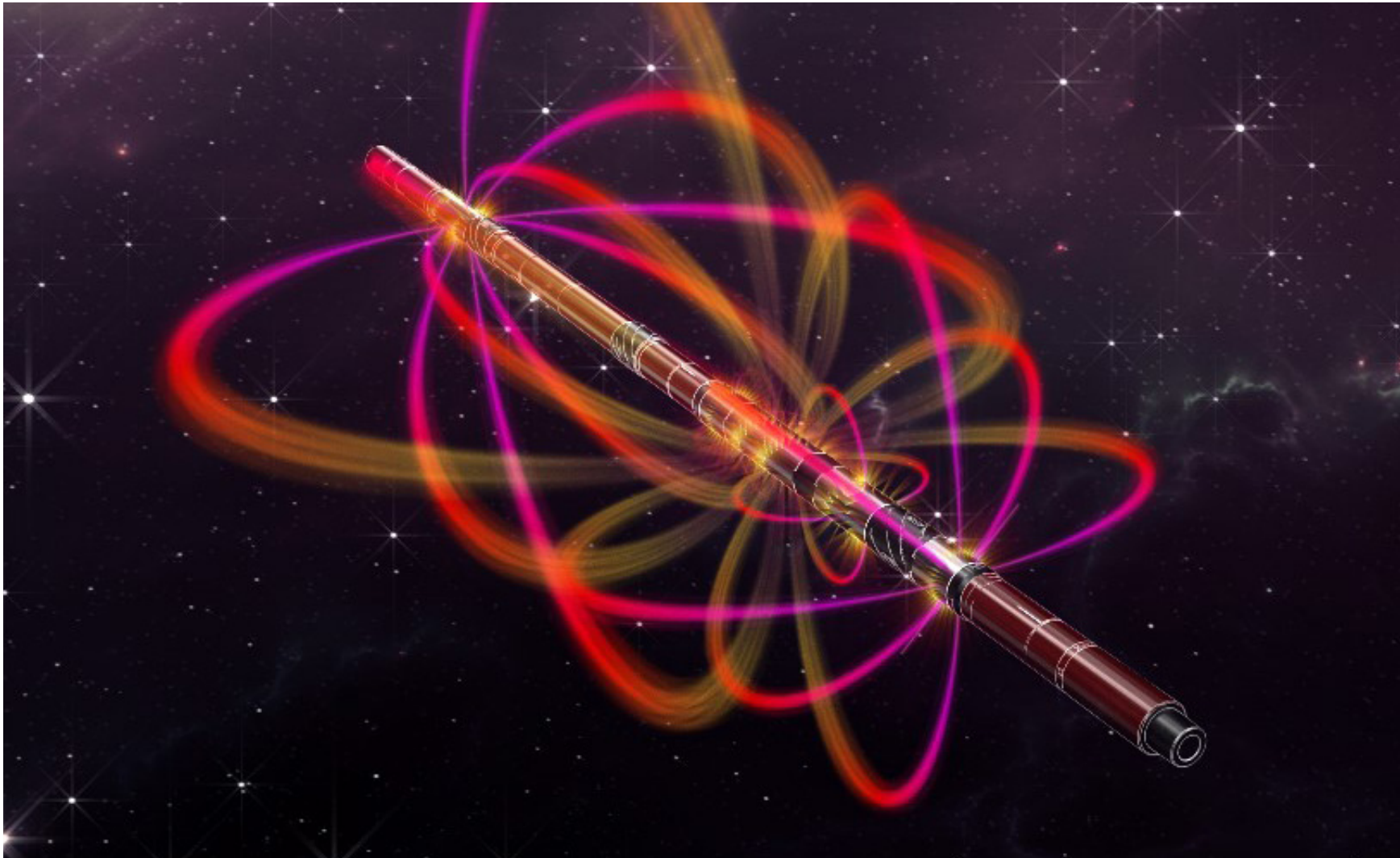
» Acquires high-resolution azimuthal resistivity images

» Calculates R_v, R_h, and relative dip at any hole angle

StrataStar® Service Technical Specifications

Mechanical Specifications	4.75 in.	6.75 in.
Nominal Tool OD	4.75 in. (121 mm)	6.75 in. (171 mm)
Maximum Body OD	5.62 in. (143 mm)	7.42 in. (188 mm)
Hole Size Range	5.875 to 6.75 in. (149 to 171 mm)	7.875 to 9.875 in. (200 to 251 mm)
Collar ID	1.25 in. (32 mm)	2.00 in. (51 mm)
Length - Base Array only	14.20 ft (4.33 m)	15.90 ft (4.85 m)
Length - Deep Array configuration	23.60 ft (7.19 m)	24.50 ft (7.47 m)
Weight	1,450 lbm (660 kg)	1,888 lbm (856 kg)
Connections	HAL40 (box up x pin down)	HAL50 (box up x pin down)
Make-Up Torque	14,000 ft·lbf (1900 daN·m)	35,000 ft·lbf (4750 daN·m)
Maximum Dog Leg Severity - Rotating	14°/100 ft (14°/30 m)	10°/100 ft (10°/30 m)
Maximum Dog Leg Severity - Sliding	30°/100 ft (30°/30 m)	21°/100 ft (21°/30 m)
Maximum Drilling or Operating Rotary Torque	12,000 ft·lbf (1630 daN·m)	35,000 ft·lbf (4750 daN·m)

Operating Limits	4.75 in.	6.75 in.
Temperature Range	32 to 302˚F (0 to 150˚C)	
Maximum Pressure	25,000 psi (172 MPa)	
Maximum Mass Flow Rate	5,000 lbm/min (2270 kg/min)	10,000 lbm/min (4540 kg/min)
Maximum Sand Content	2%	
Maximum Rotary Speed	400 RPM	
Maximum WOB	25,000 lbf (11 000 daN)	65,000 lbf (29 000 daN)
Vibration	Refer to Sperry Drilling Downhole Tools Technical Specifications (Available on Request)	
Measurement Type	Electromagnetic Wave Propagation	
Measurement Range	0.05 to 2000 Ω·m	
Measurement Accuracy (2 MHz, 48-in. spacing)	1 Ω·m ± 0.12% 10 Ω·m ± 0.3% 100 Ω·m ± 1% 1000 Ω·m ± 66%	
Depths of Investigation	Base Array configuration: 8 in. to 10 ft (3 cm to 3 m) Deep Array configuration: 8 in. to 30 ft (3 cm to 9 m)	
Azimuthal Bins	32	
Measure Point from Bottom of Collar	7.53 ft (2.30 m)	



EarthStar® Service

ILLUMINATE YOUR RESERVOIR

Ultra-deep resistivity for unparalleled visualization of the true reservoir structure

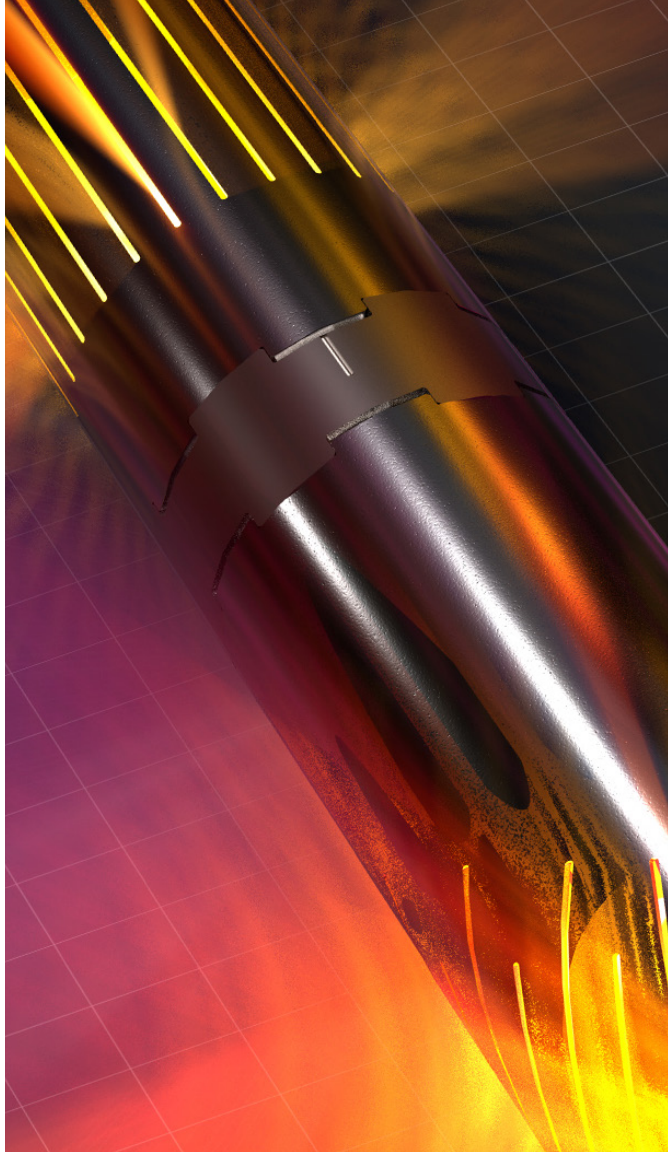
The EarthStar® ultra-deep resistivity service is proven to illuminate and map reservoir and fluid boundaries up to 225 feet (68 meters) from the wellbore. It also offers the industry's only 3D inversion capability, providing unparalleled visualization of the true reservoir structure. In deepwater and mature fields, this technology helps operators to maximize asset value and plan for future field developments by mapping hydrocarbon- bearing zones, allowing for real-time steering decisions, and eliminating costly pilot holes and sidetracks.

The EarthStar service extends the sensitive range up to 10 times farther from the wellbore than was previously possible. It combines very-deep-reading resistivity measurements with azimuthal sensitivity and advanced inversion processing to provide estimates of the position, resistivity, and orientation of formation layers around the wellbore, along with the position of reservoir fluids within them. This information allows for improved evaluation of reserves and more efficient field development.

Applications to Help Maximize Asset Value

Geostopping – Reduce well time and cost per barrel of oil equivalent (BOE) by eliminating costly pilot holes and avoiding drilling hazards. Detect target zones early and land the production lateral in a single drilling run. Drill precisely and confidently to casing points immediately above critical reservoir boundaries, such as over-pressured zones, to minimize well-control risks.

Geosteering – Drill to produce by positioning the well optimally in the sweet spot to maximize production, avoid unwanted reservoir exits, and minimize nonproductive intervals. Make well-placement decisions early while drilling, and steer confidently within large and complex wellbore structures.



EARTHSTAR® SERVICE CONTINUED

Geomapping – Enhance reservoir understanding by mapping surrounding formation boundaries in three dimensions and estimating the volume of hydrocarbons in place. Identify bypassed pay zones to gain more reserves and facilitate future well planning. In mature fields, improve understanding of fluid movements due to production or water injection.

Industry-Leading Engineered Drilling Solution

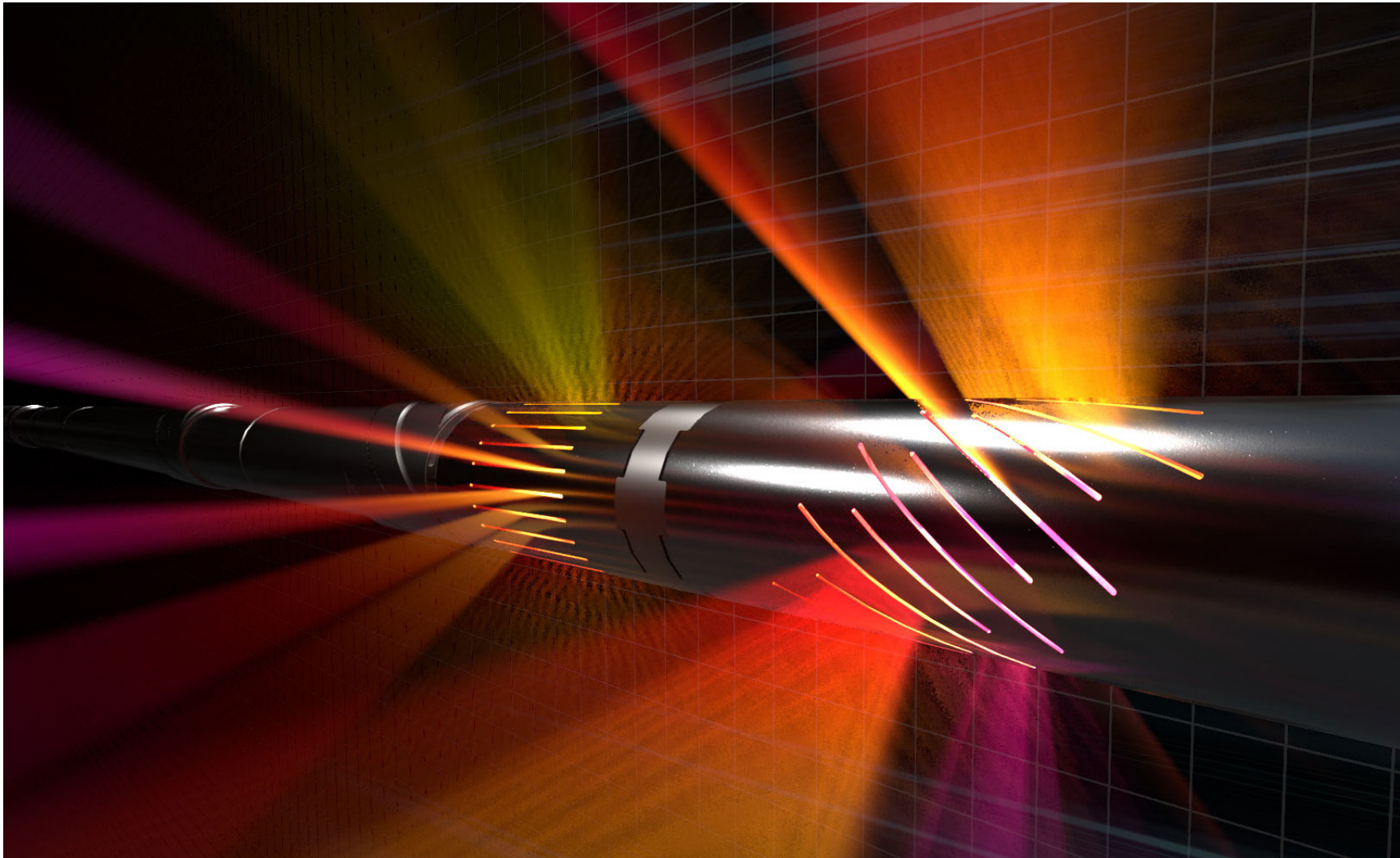
- The industry's greatest depth of detection, proven at up to 225 feet (68 meters), combined with advanced 3D inversion and visualization techniques delivers a comprehensive and realistic visualization of the reservoir.
- High-quality, ultra-deep azimuthal resistivity and geosignal images enable improved geosteering decision-making in three dimensions.
- Low system noise allows for clear delineation of geological features such as faults and low-contrast or transitional boundaries.
- Formation measurements from the EarthStar service are integrated into the proprietary RoxC® real-time geosteering software, which features fast calculation speeds and a real-time visualization of the reservoir structure. Sperry Drilling geosteering experts use RoxC software to help optimize well placement, reduce wellbore tortuosity, maximize reservoir contact, and plan for future field development.

EarthStar® Service Technical Specifications

Mechanical Specifications	4.75 in.	6.75 in.	8 in.
Nominal Tool Outside Diameter (OD)	4.75 in. (121 mm)	6.75 in. (171 mm)	8.00 in. (203 mm)
Maximum Body Outside Diameter (OD)	5.36 in. (136 mm)	7.45 in. (189 mm)	8.62 in. (219 mm)
Hole Size Range	5.875–7.25 in. (149–178 mm)	8.375 to 10.625 in. (213 to 270 mm)	10.625 to 16 in. (270 to 406 mm)
Collar Inside Diameter (ID)	1.25 in. (31.7 mm)	1.92 in. (48.8 mm)	2.38 in. (60.5 mm)
Length - Transmitter*	19.61 ft (5.98 m)	18.98 ft (5.79 m)	19.40 ft (5.91 m)
Length - Receiver	19.38 ft (5.91 m)	18.86 ft (5.75 m)	19.29 ft (5.88 m)
Weight - Transmitter*	954 lbm (433 kg)	1837 lbm (834 kg)	2790 lbm (1267 kg)
Weight - Receiver	980 lbm (445 kg)	1840 lbm (835 kg)	2865 lbm (1301 kg)
Connections	NC 38 (3.5 IF) box x box	4.5 IF (NC 50) box x box	6.625 REG box x box
Makeup Torque	9,940 to 10,900 lbf·ft (1350 to 1480 daN·m)	30,000 to 33,000 lbf·ft (4070 to 4470 daN·m)	53,000 to 58,000 lbf·ft (7200 to 7800 daN·m)
Maximum Dogleg Severity - Rotating	14°/100 ft (14°/30 m)	10°/100 ft (10°/30 m)	8°/100 ft (8°/30 m)
Maximum Dogleg Severity - Non-Rotating	30°/100 ft (30°/30 m)	21°/100 ft (21°/30 m)	14°/100 ft (14°/30 m)

Mechanical Specifications	4.75 in.	6.75 in.	8 in.
Temperature Range		32 to 302˚F (0 to 150˚C)	
Maximum Pressure		25,000 psi (172 MPa)	
Maximum Mass Flow Rate (Density x Flow Rate)	5,000 lbm/min (2300 kg/min)	10,000 lbm/min (4500 kg/min)	20,000 lbm/min (9000 kg/min)
Maximum Sand Content		2%	
Maximum Lost Circulation Material		No Restrictions	
Maximum Revolutions Per Minute (RPM)		180	
Maximum Weight on Bit (WOB)	25,000 lbf (11 000 daN)	45,000 lbf (20 000 daN)	60,000 lbf (27 000 daN)
Lateral Vibration		10 Minutes at a Peak Shock Level of 90 g	
Axial Vibration		10 Minutes at a Peak Shock Level of 40 g	

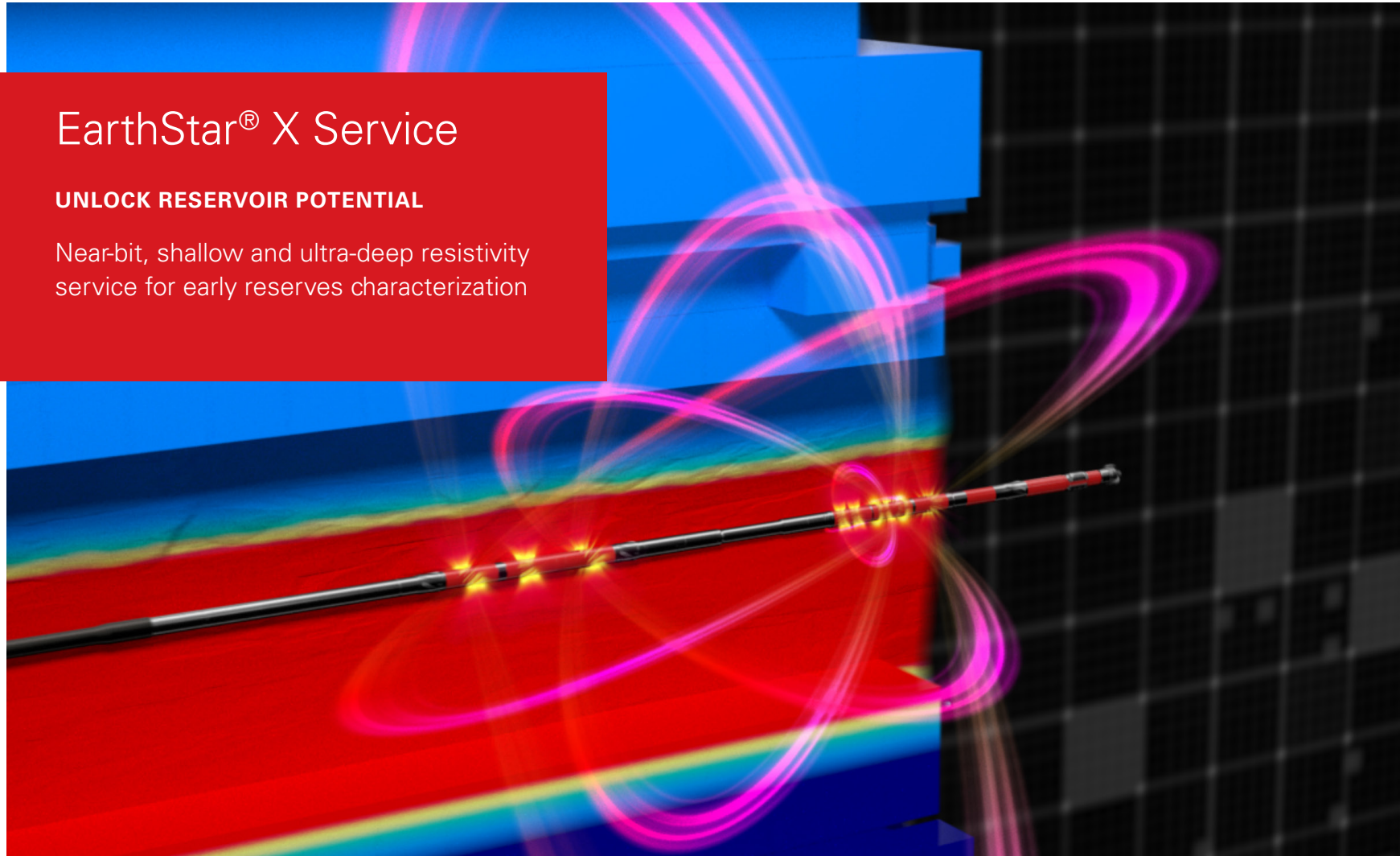
* Assumes dual-battery transmitter. Single-battery transmitters are shorter and lighter.



EarthStar® X Service

UNLOCK RESERVOIR POTENTIAL

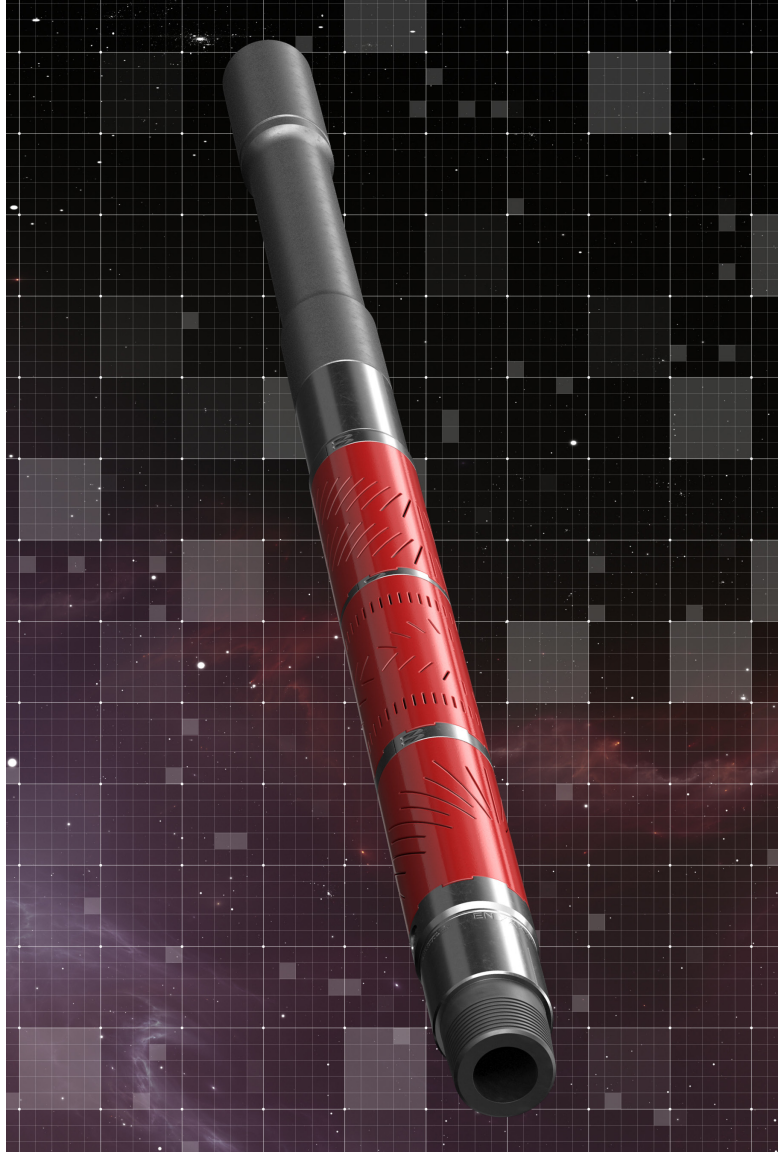
Near-bit, shallow and ultra-deep resistivity service for early reserves characterization



The EarthStar® X service, part of the iStar® intelligent drilling and logging platform, uses its near-bit, ultra-deep reservoir mapping sensors to detect geological changes early and enable quick well trajectory correction to remain in the most productive zones and maximize asset value. Integrated shallow resistivity measurements allow early reserves evaluation and accurate fluid characterization to further improve reservoir insight while lowering operational complexity and risks.

Geosteer, Geostop, and Geomap With Near-Bit Reservoir Mapping

The ultra-deep azimuthal resistivity measurements and unique 3D visualization of the EarthStar X service enable accurate mapping of the geology all around the wellbore to place wells in the reservoir's most productive zone and maximize the sections' net-to-gross value. With its optional integration into the iCruise® rotary steerable system (RSS), the EarthStar X service reduces the sensor-to-bit distance to only 9 feet (3 meters). Using the industry's closest ultra-deep azimuthal resistivity sensor to the bit allows detection of formation changes sooner and proactive well path adjustments to avoid early exits.



EARTHSTAR® X SERVICE CONTINUED

Evaluate and Characterize Reserves Early

The EarthStar X service offers detailed conventional resistivity readings supporting in-depth petrophysical analysis of the reservoir. Shallow antenna arrays provide phase shift and attenuation resistivity along with R_v and R_h in real-time, regardless of the well angle. The combination of digitally compensated resistivity with formation anisotropy measurements near the bit drives early fluid characterization and a more accurate water saturation calculation to improve reserves evaluation.

Reduce Operational Complexity and Risks

The compact design eliminates the need for a separate propagation resistivity tool and minimizes thread connections and BHA length, reducing overall operational complexity. Operators benefit from more distance and time to adjust the well path to remain in the reservoir when integrating the service into the iCruise RSS, which minimizes borehole tortuosity and lowers risk when running the completion.

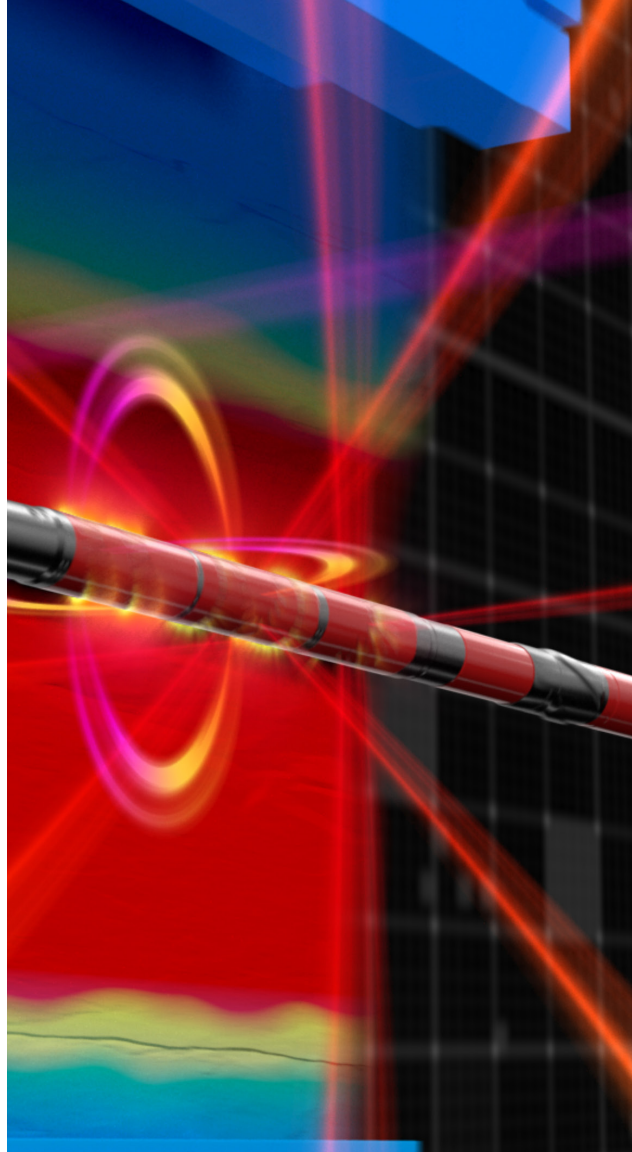
EARTHSTAR® X SERVICE BENEFITS AND FEATURES

BENEFITS

- Geomap, geosteer, and geostop
- Map formation structures and fluid distributions in 3-dimensions
- React earlier to unforeseen geological changes to stay within the productive zone
- Acquire accurate near-bit formation resistivity for detailed formation and fluid characterization
- Obtain formation anisotropy for improved reserves evaluation
- Eliminate need for a conventional resistivity tool » Reduce BHA length and handling time

FEATURES

- Industry's shortest distance-to-bit ultra-deep resistivity sensor
- Combined shallow and ultra-deep resistivity measurements
- Adjustable ultra-deep depth of investigation
- Optional integration into the iCruise RSS
- Inversion of ultra-deep readings in 1- and/or 3-dimensions for reservoir visualization
- Phase shift and attenuation resistivity from three spacings at two frequencies
- Azimuthal resistivity image and geosignals
- Real-time R_v, R_h, and relative dip at any hole angle



EarthStar® X Service Technical Specifications

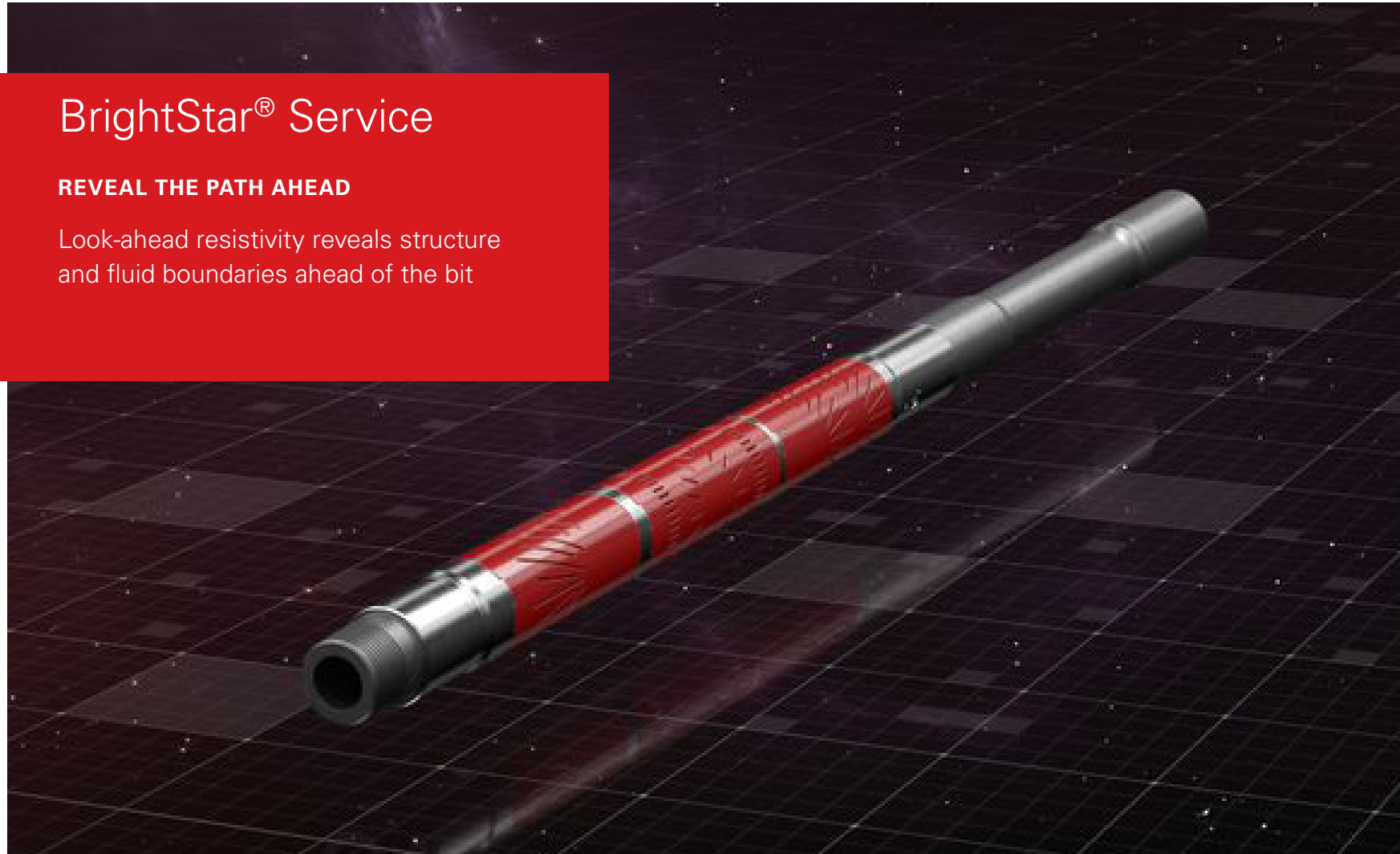
Mechanical Specifications	6.75 in.	8 in.
Nominal Tool OD	6.75 in. (171 mm)	8.00 in. (203 mm)
Maximum Body OD	7.45 in. (189 mm)	8.62 in. (219 mm)
Hole Size Range	8.375 to 10.625 in. (213 to 270 mm)	10.625 to 16 in. (270 to 406 mm)
Collar ID	1.92 in. (48.8 mm)	2.38 in. (60.5 mm)
Length - Stand-alone	20.40 ft (6.22 m)	20.75 ft (6.32 m)
Length - iCruise RSS integrated	13.80 ft (4.21 m)	13.90 ft (4.24 m)
Weight - Stand-alone	1,897 lbm (862 kg)	2,800 lbm (1272 kg)
Weight - iCruise RSS integrated	1,670 lbm (755 kg)	1,747 lbm (794 kg)
Mechanical Specifications	**6.75 in.**	**8 in.**
Connections	4.5 IF (NC50) (box up x box down)	6.625 REG (box up x box down)
Make-Up Torque	30,000 to 33,000 ft·lbf (4070 to 4475 daN·m)	43,000 to 48,000 ft·lbf (5830 to 6505 daN·m)
Maximum Dog Leg Severity - Rotating	10°/100 ft (10°/30 m)	8°/100 ft (8°/30 m)
Maximum Dog Leg Severity - Sliding	21°/100 ft (21°/30 m)	14°/100 ft (21°/30 m)
Maximum Drilling or Operating Rotary Torque	33,000 ft·lbf (4475 daN.m)	48,000 ft·lbf (6510 daN.m)

Operating Limits		
Temperature Range	32 to 302˚F (0° to 150˚C)	
Maximum Pressure	25,000 psi (172 Mpa)	
Maximum Mass Flow Rate gpm x ppg	10,000 lbm/min (4540 kg/min)	20,000 lbm/min (9000 kg/min)
Maximum Sand Content	2%	
Maximum RPM	400	
Maximum WOB	45,000 lbf (20 000 daN)	65,000 lbf (29 000 daN)
Vibration	Refer to Sperry Drilling Downhole Tools Technical Specifications (available on request.)	
Measurement Specifications	**6.75 in.**	**8 in.**
Measurement Type	Electromagnetic Wave Propagation	
Measurement Range	0.05 to 5,000 Ω·m	
Operating Frequencies	16-, 24-, and 32-in. spacings: 500 kHz, 2 MHz Ultra-Deep spacing: 2, 4, 8, 16 and 32 kHz	
Measurement Accuracy (2 MHz, 32-in. spacing)	1 Ω·m: ± 0.2%, 10 Ω·m: ± 0.3%, 100 Ω·m: ± 0.8%, 1,000 Ω·m: ± 4%	
Azimuthal Bins	32	
Measure Point from Bottom of Collar	Ultra-Deep Resistivity: 3.27 ft (1.00 m) Compensated Resistivity: 7.27 ft (2.22 m)	
Measure Point from Bit (iCruise RSS integrated only)	Ultra-Deep Resistivity: 8.99 ft (2.74 m) Compensated Resistivity: 12.99 ft (3.96 m)	

BrightStar® Service

REVEAL THE PATH AHEAD

Look-ahead resistivity reveals structure and fluid boundaries ahead of the bit



The BrightStar® look-ahead resistivity service from Sperry Drilling reveals structure and fluid boundaries ahead of the bottom hole assembly (BHA). Using a novel antenna design, the technology detects upcoming geological changes, enabling proactive drilling and steering decisions to reduce operational risks and optimize section target depth. The service provides resistivity changes ahead of the bit and near-borehole resistivity measurements in one compact collar. The service also provides near-borehole anisotropy for greater reservoir characterization.

Increase Geostopping Confidence

The BrightStar look-ahead resistivity service detects changes in formation resistivity ahead of the bit and reduces the uncertainty of the formation boundary positions. By looking ahead in low-angle wells, the service provides operators higher confidence to avoid unwanted formation entry or exit. The operational value increases with the option to integrate the BrightStar service transmitter into the iCruise® intelligent rotary steerable system collar. This service combination delivers both a near-bit resistivity solution and the industry's closest ultra-deep azimuthal resistivity sensor measure point to detect changes earlier and allow proactive drilling decisions, such as selecting casing points, adjusting mud properties before entering a specific formation, or precisely locating the top of the reservoir.

Accelerate Drilling Decisions

The BrightStar service combines ultra-deep azimuthal resistivity measurements with best-in-class inversion processing to resolve upcoming bed and fluid boundaries for well inclinations up to 40 degrees. The high signal-to-noise sensitivity enables the system to detect resistivity changes up to 100 feet (30 meters) ahead of the bit. Detecting changes earlier allows proactive drilling decisions, such as selecting casing points, adjusting mud properties before entering a specific formation, or precisely locating the top of the reservoir.

BENEFITS

- Enable proactive drilling decisions by detecting upcoming boundaries
- Reduce formation entry/exit uncertainty, such as salt
- Streamline casing shoe placement and section TD
- Reduce the environmental footprint with compact collar
- Enhance formation and fluid characterization
- Adjust to previously unknown geological changes
- Optimize coring operations

FEATURES

- Detect resistivity changes up to 100 ft. ahead of bit in low angle wells
- Visualize upcoming formation tops
- Near-bit phase shift and attenuation resistivity with three spacings and two frequencies
- Measure anisotropy (R_v, R_h) and relative dip at any hole angle
- Near-bit sensor measurements
- Near-borehole and ultra-deep resistivity measurements in one compact collar

BRIGHTSTAR® SERVICE CONTINUED

Characterize the Formation Farther

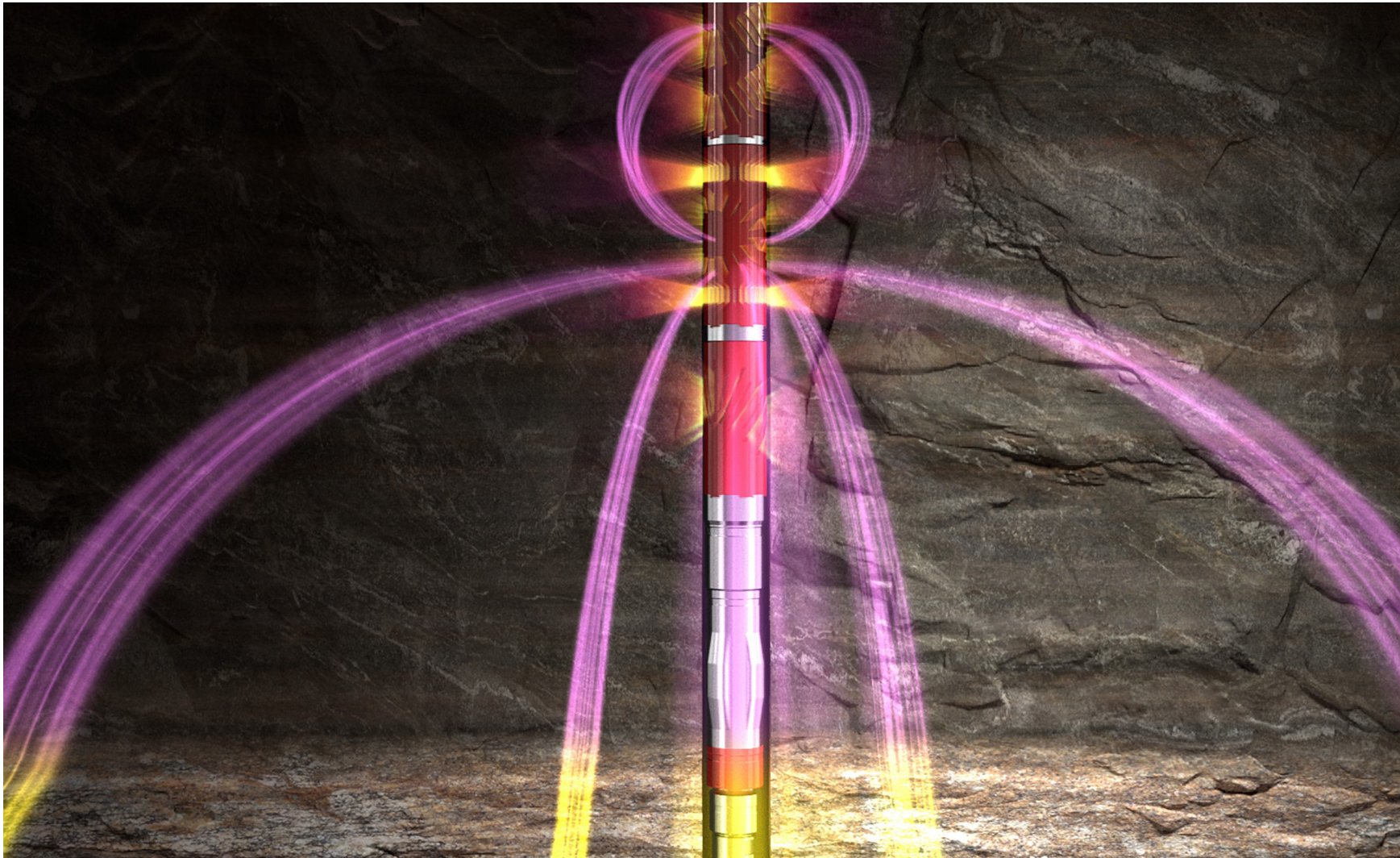
The BrightStar service provides operators a compact and comprehensive solution to characterize the formation and fluids near the borehole and farther into the well. The BrightStar service transmitter delivers 500 kHz and 2 MHz phase shift and attenuation resistivity from 16-, 24-, and 32-inch spacings. The 24-inch spacing uses a proprietary crossed-transmitter antenna from which the inverted measurements provide the formation's anisotropy and dip in real time. This capability eliminates the need for additional characterization tools, which can further reduce the BHA length.

BrightStar® Service Technical Specifications

Mechanical Specifications	6.75 in.	8 in.
Nominal Tool OD	6.75 in. (171 mm)	8.00 in. (203 mm)
Maximum Body OD	7.45 in. (189 mm)	8.62 in. (219 mm)
Hole Size Range	8.375 to 10.625 in. (213 to 270 mm)	10.625 to 16 in. (270 to 406 mm)
Collar ID	1.92 in. (48.8 mm)	2.38 in. (60.5 mm)
Length - Stand-alone	20.40 ft (6.22 m)	20.75 ft (6.32 m)
Length - iCruise RSS integrated	13.80 ft (4.21 m)	13.90 ft (4.24 m)
Weight - Stand-alone	1,897 lbm (862 kg)	2,800 lbm (1272 kg)
Weight - iCruise RSS integrated	1,670 lbm (755 kg)	1,747 lbm (794 kg)

Mechanical Specifications	6.75 in.	8 in.
Connections	4.5 IF (NC50) (box up x box down)	6.625 REG (box up x box down)
Make-Up Torque	30,000 to 33,000 ft·lbf (4070 to 4475 daN·m)	43,000 to 48,000 ft·lbf (5830 to 6505 daN·m)
Maximum Dog Leg Severity - Rotating	10°/100 ft (10°/30 m)	8°/100 ft (8°/30 m)
Maximum Dog Leg Severity - Sliding	21°/100 ft (21°/30 m)	14°/100 ft (21°/30 m)
Maximum Drilling or Operating Rotary Torque	33,000 ft·lbf (4475 daN.m)	48,000 ft·lbf (6510 daN.m)
Operating Limits		
Temperature Range	32 to 302˚F (0° to 150˚C)	
Maximum Pressure	25,000 psi (172 Mpa)	
Maximum Mass Flow Rate gpm x ppg	10,000 lbm/min (4540 kg/min)	20,000 lbm/min (9000 kg/min)
Maximum Sand Content	2%	
Maximum RPM	400	
Maximum WOB	45,000 lbf (20 000 daN)	65,000 lbf (29 000 daN)
Vibration	Refer to Sperry Drilling Downhole Tools Technical Specifications (available on request.)	

Measurement Specifications	6.75 in.	8 in.
Measurement Type	Electromagnetic Wave Propagation	
Measurement Range	0.05 to 5,000 Ω·m	
Operating Frequencies	16-, 24-, and 32-in. spacings: 500 kHz, 2 MHz Ultra-Deep spacing: 2, 4, 8, 16 and 32 kHz	
Measurement Accuracy (2 MHz, 32-in. spacing)	1 Ω·m: ± 0.2%, 10 Ω·m: ± 0.3%, 100 Ω·m: ± 0.8%, 1,000 Ω·m: ± 4%	
Azimuthal Bins	32	
Measure Point from Bottom of Collar	Ultra-Deep Resistivity: 3.27 ft (1.00 m) Compensated Resistivity: 7.27 ft (2.22 m)	
Measure Point from Bit (iCruise RSS integrated only)	Ultra-Deep Resistivity: 8.99 ft (2.74 m) Compensated Resistivity: 12.99 ft (3.96 m)	



LithoStar® Service

ACCURATE POROSITY, BETTER EVALUATION

Integrated porosity imaging for accurate reserves calculations and geological and petrophysical interpretations

Formation density is a key petrophysical measurement for understanding the porosity of your reservoir. The LithoStar® service from Halliburton Sperry Drilling makes wireline-quality density measurements while drilling. Real-time density borehole images, in both oil-based and water-based mud systems, provide a detailed understanding of the geological structure. The LithoStar service also provides accurate measurements of formation neutron porosity, helping to distinguish between fluid types. The LithoStar service provides petrophysical and geological insight throughout the well-construction process.

High Accuracy at the Right Time for Better Decisions

The advanced downhole processing algorithms used by the LithoStar service deliver high-accuracy and high-precision measurements while drilling — before significant borehole degradation or fluid invasion can occur. This gives the best picture of the true formation properties. With the borehole in its best condition porosity determination is enhanced, leading to improved reserves calculations.

Geological and Lithological Insight

Density and photoelectric (Pe) borehole images let you understand your lithology and structural dip regardless of borehole orientation. Real-time structural dip interpretation leads to better geosteering decisions to accurately place the well in the target zone. The image logs reveal borehole shape and hole spiraling and can help assess stress-induced breakout and mitigate borehole stability issues.

Gas Detection and Real-Time Fluid Typing

Integrated density and thermal neutron porosity measurements detect and evaluate gas-bearing formations and determine lithology and porosity in structurally complex geological environments. With the LithoStar service, you can improve your real-time decision making and gain a clearer understanding of the petrophysical and geological characteristics of your reservoir.

BENEFITS

- Improve reserves calculations
- Determine lithology with Pe measurements and images
- Refine the earth model by measuring structural dip in real time
- Optimize wellbore placement through precise geosteering
- Acquire real-time formation images in oil-based or water-based mud systems
- Improve understanding of mechanical rock properties
- Delineate complex lithologies and identify target zones in real time
- Evaluate gas-bearing formations

FEATURES

- Wireline-quality density measurements
- Integrated formation density, neutron porosity, and ultrasonic standoff measurements
- Azimuthal density and porosity images
- Comprehensive corrections in any downhole environment

LithoStar® Service Technical Specifications

Mechanical Specifications	4.75 in.	6.75 in.	8 in.
Nominal Tool OD	4.75 in. (121 mm)	6.75 in. (171 mm)	8.00 in. (203 mm)
Maximum Body OD	5.25 in. (133 mm)	7.25 in. (184 mm)	10.60 in. (269 mm)
Hole Size Range	5.75 in. (146 mm)	8.25 in. (210 mm)	12 in. (305 mm)
Hole Size Range	5.875 to 6.75 in. (149 to 171 mm)	7.875 to 9.875 in. (200 to 251 mm)	10.50 to 14.75 in. (267 to 374 mm)
Collar ID	1.25 in. (32 mm)	2.00 in. (51 mm)	2.36 in. (60 mm)
Length	15.46 ft (4.71 m)		15.61 ft (4.71 m)
Weight	1,014 lbm (460 kg)	2,000 lbm (907 kg)	3,260 lbm (1480 kg)
Connections	HAL40 (box up x pin down)	HAL50 (box up x pin down)	HAL56 (box up x pin down)
Make-Up Torque	14,000 ft·lbf (1900 daN·m)	35,000 ft·lbf (4750 daN·m)	50,000 ft·lbf (6780 daN·m)
Maximum Dog Leg Severity - Rotating	14°/100 ft (14°/30 m)	10°/100 ft (10°/30 m)	8°/100 ft (8°/30 m)
Maximum Dog Leg Severity - Sliding	30°/100 ft (30°/30 m)	21°/100 ft (21°/30 m)	14°/100 ft (14°/30 m)
Maximum Drilling or Operating Rotary Torque	12,000 ft·lbf (1630 daN·m)	35,000 ft·lbf (4750 daN·m)	50,000 ft·lbf (6780 daN·m)

Operating Limits	4.75 in.	6.75 in.	8 in.
Temperature Range	32 to 302˚F (0 to 150˚C)		
Maximum Pressure	25,000 psi (172 MPa)		
Maximum Mass Flow Rate	5,000 lbm/min (2270 kg/min)	10,000 lbm/min (4540 kg/min)	20,000 lbm/min (9070 kg/min)
Maximum Sand Content	2%		
Maximum Rotary Speed	400 RPM		
Maximum WOB	25,000 lbf (11 000 daN)	65,000 lbf (29 000 daN)	85,000 lbf (38 000 daN)
Vibration	Refer to Sperry Drilling Downhole Tools Technical Specifications (Available on Request)		

Measurement Specifications	4.75 in.	6.75 in.	8 in.
Density			
Measurement Type	PMT Scintillation Detectors		
Measurement Range	1.0 to 3.1 g/cc		
Measurement Accuracy	± 0.010 g/cc (2.1 to 2.8 g/cc) ± 0.015 g/cc (1.0 - 2.1 g/cc and 2.8 - 3.1g/cc)		
Measurement Vertical Resolution	90% value: 6.0 in. (152 mm)		
Measurement Statistical Repeatability (1σ)*	± 0.006 g/cc	± 0.010 g/cc	± 0.015 g/cc
Measure Point from Bottom of Collar	4.52 ft (1.38 m)	4.30 ft (1.31 m)	4.39 ft (1.34 m)
Photoelectric Factor			
Measurement Range	0 to 10		
Measurement Accuracy	± 0.15		
Measurement Statistical Repeatability (1σ)**	± 0.06		
Measure Point from Bottom of Collar	4.52 ft (1.38 m)	4.30 ft (1.31 m)	4.14 ft (1.26 m)

Measurement Specifications	4.75 in.	6.75 in.	8 in.
Ultrasonic Standoff			
Measurement Type	Piezoelectric Transducer		
Measurement Range	Up to 4 in. (mud weight dependent)		
Measurement Accuracy	± 0.05 in. (1.27 mm)		
Measure Point from Bottom of Collar	8.26 ft (2.52 m)	8.16 ft (2.49 m)	8.18 ft (2.49 m)
Neutron Porosity			
Measurement Type	Helium-3 Tubes		
Measurement Range	0 to 100 p.u.		
Measurement Accuracy	± 0.5 p.u. from 0 to 10 p.u. ± 5% from 10 p.u. to 50 p.u.		
Measurement Vertical Resolution***	10 in. (254 mm)		
Measurement Statistical Repeatability (1σ)**	± 0.9 p.u. @ 30 p.u.		± 1.2 p.u. @ 30 p.u.
Measure Point from Bottom of Collar	11.71 ft (3.57 m)		12.52 ft (3.82 m)

* Specifications are for a 30-second sample in a 2.2-g/cc formation.
** Specifications are for a 30-second sample period.
*** Vertical resolution is the bed thickness in which the deflection of the measurement is 75% of the true difference in porosity between the target bed and the shoulder beds; this specification assumes a 40 p.u. target bed and 20 p.u. shoulder beds.

PixStar™ Service

MORE PIXELS, GREATER VISIBILITY

High-resolution acoustic images with borehole size and shape in all mud types

When drilling in oil-based mud, operators often lack high-quality images to make informed decisions about their fracturing and completion programs. The PixStar™ high-resolution ultrasonic imaging service from Halliburton Sperry Drilling is a logging-while-drilling (LWD) service that assesses borehole size and shape in real time and provides high-resolution acoustic amplitude images in oil- and water-based mud. The four-transducer design provides greater borehole coverage per revolution, enhancing reservoir understanding of fractures, faults, and lithological features, to help operators maximize their asset value.

The PixStar service uses four piezoelectric ultrasonic transducers placed at 90-degree-angle increments around the circumference of the tool, which operate in pulse-echo mode. All four transducers are excited simultaneously, generating 2,000 pulses per second. This high firing rate generates high-resolution amplitude and travel-time images, even at high logging speeds, enabling detailed reservoir evaluation.

Identify Fractures, Plan Frac Program

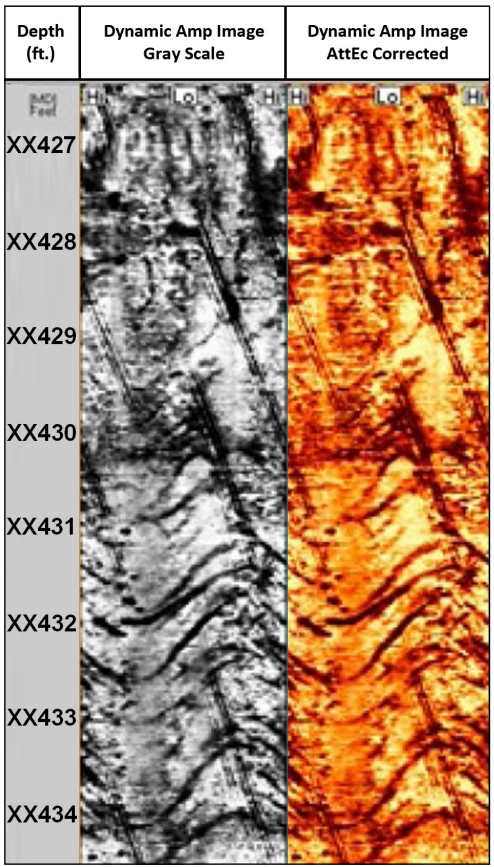
By accurately identifying and interpreting fractures, operators have the information they need to plan and optimize their hydraulic fracture and completion programs. The PixStar service uses reflection amplitude images of the borehole surface to identify acoustic impedance changes associated with structural features (bedding, fractures, faults) and sedimentological features (vugs, clasts, bioturbation). By knowing the location of the natural fracture networks and clusters, operators can plan their fracture programs, maximizing production efficiency.

Improve Wellbore Stability, Minimize Risk

Travel-time measurements enable the derivation of borehole size and shape, and the orientation of borehole breakout, thus helping to identify wellbore stability issues. Understanding the stress distribution enables optimization of drilling parameters and mud weight and provides input to the geomechanical model. This helps prevent wellbore washout or breakout and formation damage, and to minimize risk.

Place Packers Accurately, Optimize Completions

Borehole size and shape analysis is used to calculate total cement volume, enabling safe and efficient cement operations, and helping operators improve packer placement and optimize completion design.



PIXSTAR™ SERVICE BENEFITS AND FEATURES

BENEFITS

» Real-time evaluation of borehole size and shape

» Real-time acoustic amplitude images enable porosity steering and geosteering

» High-resolution images identify fractures, faults, and geological features to help optimize frac programs

» Optimized high-resolution images based on hole size and rate of penetration (ROP)/RPM parameters

» Borehole size and shape analysis determines accurate cement volumes and improves wellbore stability

» Identification of borehole degradation over time avoids costly well stability issues

» High-resolution images for high-angle or challenging wells remove the need for separate wireline run

FEATURES

» Four high-resolution transducers each provide redundancy and wireline-quality, motion-tolerant images

» Simultaneous transducer firings provide caliper measurements when non-rotating or pulling out of hole

» Motion-based image corrections remove unwanted artifacts resulting from eccentricity or lateral tool motions

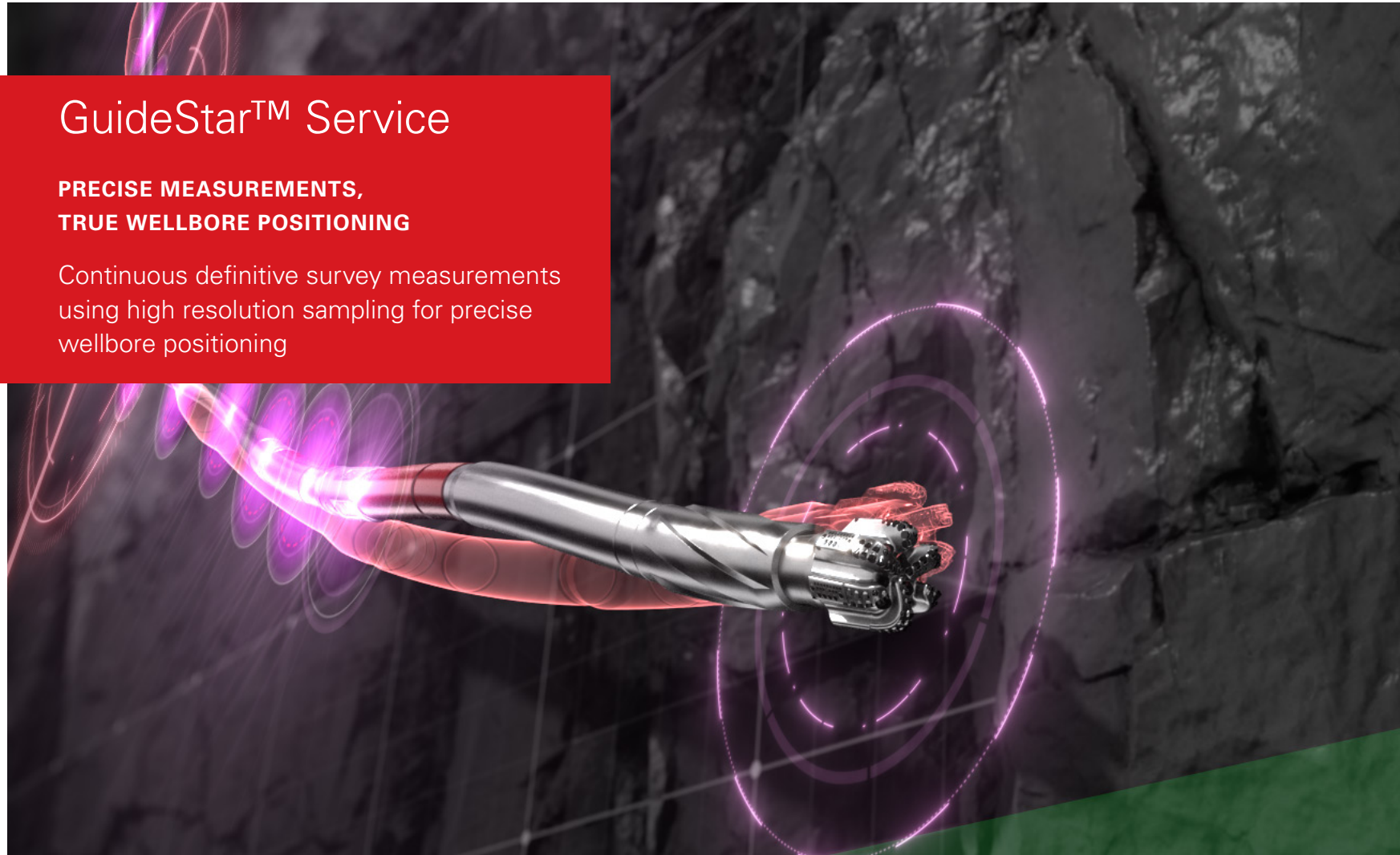
PixStar™ Service Technical Specifications

Mechanical Specifications	4.75 in.
Nominal Tool OD	4.75 in. (121 mm)
Maximum Body OD	5.25 in. (133 mm)
Hole Size Range	5.875 to 7.25 in. (149 to 184 mm)
Collar ID	1.03 in. (26.2 mm)
Recommended Stabilizer OD	0.125 in. (3 mm) undergauge
Length	12.78 ft (3.89 m)
Weight	650 lbm (295 kg)
Connections	NC38 (box up x pin down)
Makeup Torque	9,900 to 11,000 ft·lbf (1350 to 1490 daN·m)
Maximum Dogleg Severity - Rotating	14°/100 ft (14°/30 m)
Maximum Dogleg Severity - Sliding	30°/100 ft (30°/30 m)

Mechanical Specifications	4.75 in.
Temperature Range	32 to 302˚F (0 to 150˚C)
Maximum Pressure	25,000 psi (172 MPa)
Maximum Mass Flow Rate	5,000 lbm/min (2270 kg/min)
Maximum Sand Content	2%
Maximum Revolutions Per Minute (RPM)	500
Maximum Weight on Bit (WOB)	25,000 lbf (11 000 daN)
Vibration	Refer to Sperry Drilling Downhole Tools Technical Specifications (Available on Request)

Mechanical Specifications	4.75 in.
Ultrasonic Transducer Type	Piezoelectric (x4)
Feature Detection*	0.1 in. (2.54 mm)
Transducer Firing Rate	2,000 (Hz) (500 per Transducer)
Real-Time Caliper Image	4, 8, or 16 sectors
Real-Time Amplitude Image	4, 8, 16, 32, or 64 sectors
Recorded Caliper Image (Standard)	256 Sectors
Recorded Amplitude Image (Standard)	256 Sectors
High-Resolution Caliper Image**	>256 Sectors
High-Resolution Amplitude Image**	>256 Sectors
Mud Types	Oil-Based and Water-Based Mud

* 0.1 in (2.54 mm) with <0.5 in. (12.7 mm) standoff in water.
** Number of sectors depends on ROP and RPM.



GuideStar™ Service

**PRECISE MEASUREMENTS,
TRUE WELLBORE POSITIONING**

Continuous definitive survey measurements using high resolution sampling for precise wellbore positioning

The GuideStar™ service provides continuous definitive survey measurements using high-resolution sampling for precise wellbore placement. As part of the iStar® intelligent drilling and logging platform, it processes the measurements from the BaseStar® service and delivers higher resolution survey measurements to improve true vertical depth (TVD) adjustments while drilling. The GuideStar service optimizes wellbore placement by delivering survey measurements with real-time adjustments and a higher sample rate. More precise data enhances well delivery by increasing the understanding of the wellbore placement and reducing survey time. High sampling rates improve wellbore quality by enabling micro dogleg calculations that optimize real-time drilling decisions and minimize tortuosity throughout the wellbore.

Optimize Wellbore Placement

The GuideStar service enhances TVD placement accuracy with survey measurements taken at a high sampling rate while drilling. The density of the recorded samples allows for a wellbore correction up to every foot.

Enhance Well Delivery

The GuideStar service's constant, high-resolution data sampling increases understanding of the centerline wellbore placement through precise TVD positioning. This helps operators hit geologic targets, maximize reservoir contact, and reduce survey time through pumps-off survey acquisition. The service also enables proactive, real-time steering decisions to avoid reducing rate of penetration (ROP) when landing a well or at critical wellbore intervals.

Improve Wellbore Quality

The GuideStar service improves positional certainty to increase drilling efficiency. The high sampling rates enable more accurate micro dogleg calculations, which help operators optimize real-time drilling decisions and minimize tortuosity throughout the wellbore. This results in better borehole quality and smoother casing runs.

BENEFITS

- Optimizes TVD placement with high-resolution surveys while drilling
- Increases survey sampling
- Reduces survey time
- Reduces tortuosity
- Enables easy monitoring and understanding of dogleg severity
- Reduces positional uncertainty of the wellbore
- Improves BHA performance and operational efficiency
- Extends life of electric submersible pumps

FEATURES

- Definitive-grade surveys with real-time continuous inclination and azimuth measurements with QA/QC
- Real-time high-resolution survey sampling rate
- Recorded data processed with multiple samples per foot
- Automated TVD calculations
- Pumps-off surveys
- Easily controlled remotely or at the rigsite

Scan for a digital copy of the iStar® Intelligent Drilling and Logging Platform brochure.

HALLIBURTON

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