



Geo-Vista

Lithology Logging While Drilling System (LithoLWD)

Caliper Corrected Neutron Porosity (CCN)

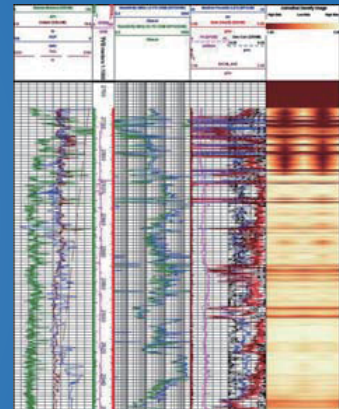
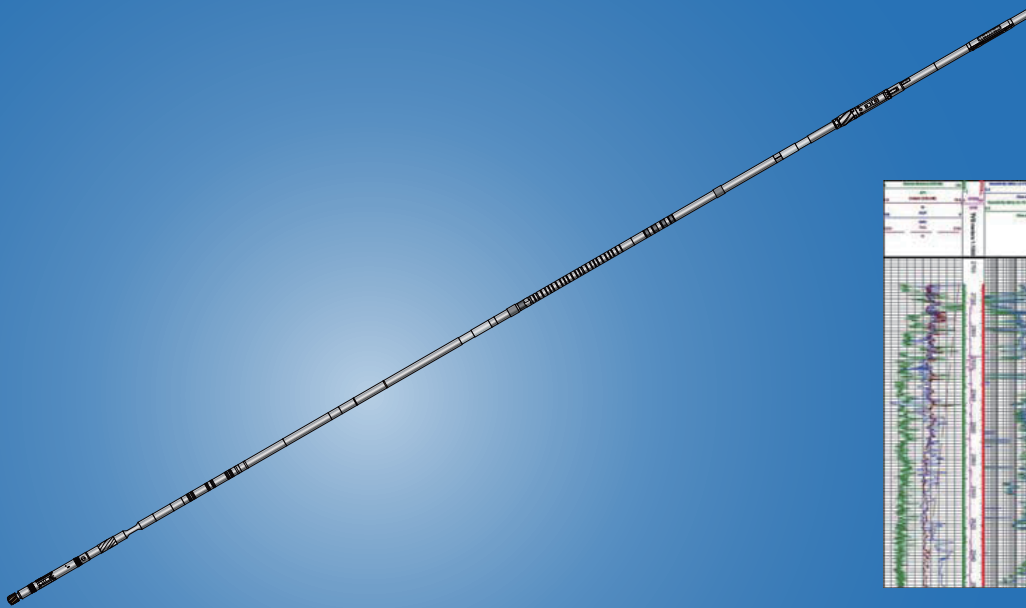
Rotary Azimuthal Density (RAD)

Generator Caliper Corrected Neutron Porosity (GCN)

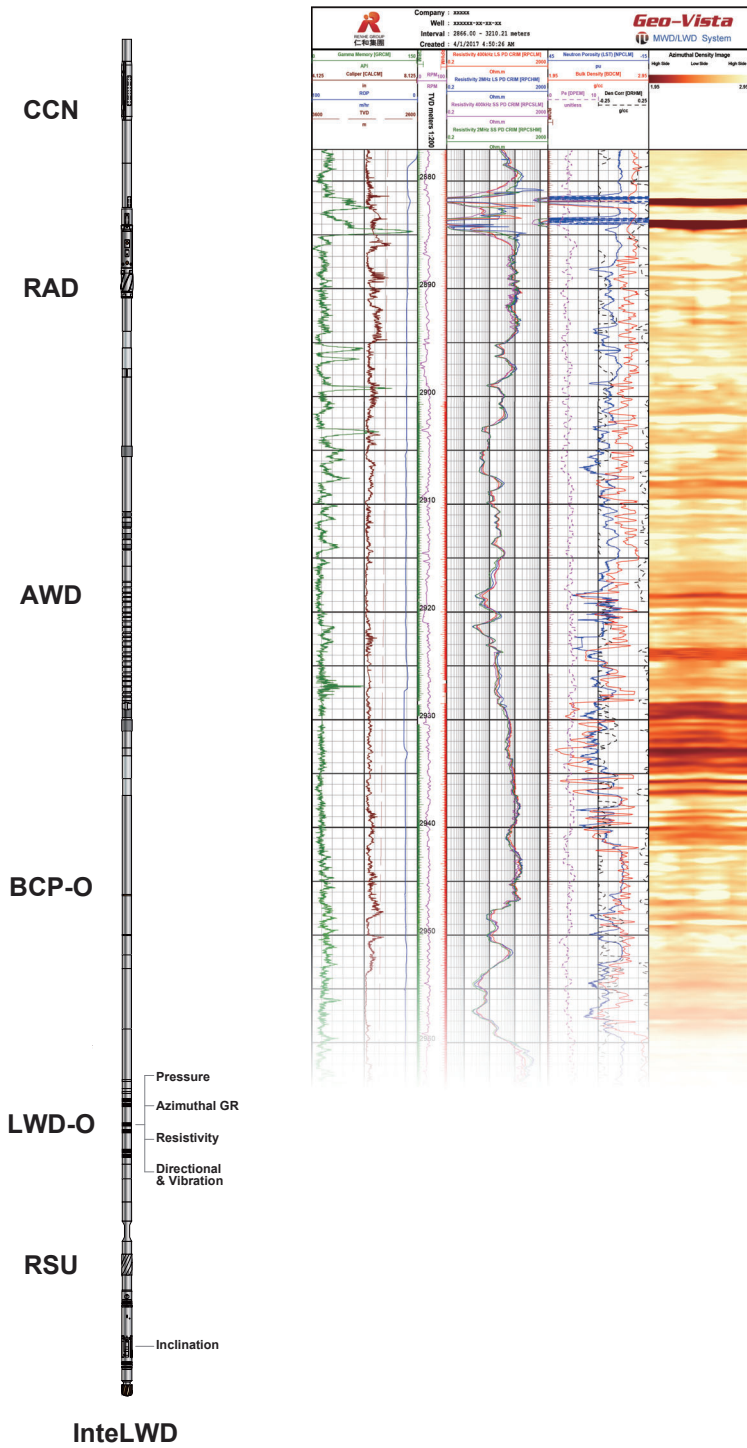
Nuclear Magnetic Resonance Imaging While Drilling (MRI)

Acoustic While Drilling (AWD)

Formation Tester While Drilling (FTD)



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Lithology Logging While Drilling System *Geo-Vista* (LithoLWD)

Applications

LithoLWD Service Benefits to clients are listed as:

- A selection of Tool sizes for to accommodate a wide variety of bit size
- Fully Compensated High Quality Density Measurement
- High Resolution Real-Time Formation Density Image
- Accurate Borehole Caliper Measurement
- Fully Characterised Compensated Neutron Porosity Measurement
- Accurate Photoelectric Cross Section Measurement
- Seamless BHA's designed for Rotary Steerable Systems & advanced Formation Evaluation Services

Introduction

LithoLWD include Caliper Corrected Neutron Porosity (CCN), Rotational Azimuthal Density (RAD), Nuclear Magnetic Resonance Imaging While Drilling (MRI), Acoustic While Drilling (AWD), Formation Tester While Drilling (FTD).

The LithoLWD service provides Azimuthal Sector Density Images, as well as Photoelectric and Caliper measurements while drilling. Also can provides lithology-independent porosity, pore-sized distribution, continuous permeability and direct hydrocarbon detection, real-time compressional and shear wave travel-time measurements in slow and fast formations, real-time pressure measurements.

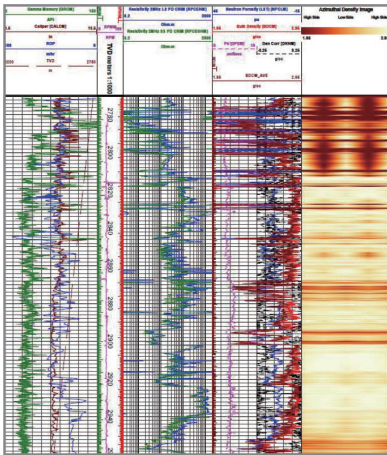
Each data point is tied to a corresponding Caliper measurement to ensure accurate density evaluation with minimal stand-off effect.

Caliper measurements are used also for neutron porosity borehole environmental compensation and give an accurate borehole profile for borehole volumes or wellbore stability applications.



Applications

- Accurate, real-time quantification of porosity and gas identification for saturation calculations.
- Reservoir Navigation using high-resolution imaging and gas-oil/water identification in real-time.
- Wellbore stability analysis using azimuthal caliper and density imaging in real-time.
- Structural formation dip analysis and updating reservoir models from density imaging.

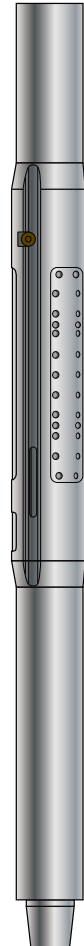


Introduction

The CCN and RAD offers measurement of formation density, neutron porosity, borehole caliper, and formation imaging. That provides geosteering for maximum reservoir exposure. Neutron porosity and bulk density are critical for the quantification of hydrocarbons in the reservoir.

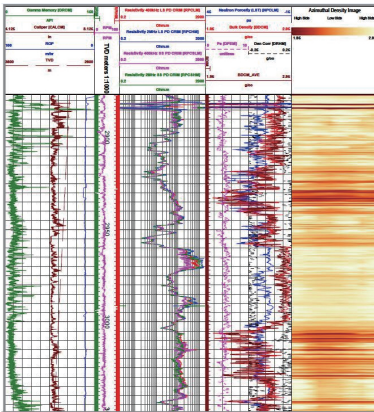
Specifications

Diameter	4.75 in. With 5.59 in. upset	6.75 in. with 7.50 in. upset	8.25 in. With 10.125 in. upset
Max. Pressure	20000 psi (137.9 MPa)		
Max. Temperature	300°F (150°C)		
Weight	1100 lbs. (498 kg) (CCN and RAD 4)	893 lbs. (405 kg)	1325 lbs. (600 kg)
Service	Formation Porosity		
Tool Type	Caliper Corrected Neutron		
Max. Dogleg Severity	15°/100 ft. (15°/30 m) Rotating	9°/100 ft. (9°/30 m) Rotating	6.5°/100 ft. (6.5°/30 m) Rotating
	30°/100 ft. (30°/30 m) Sliding	16°/100 ft. (16°/30 m) Sliding	12°/100 ft. (12°/30 m) Sliding
Detectors	Lithium-6 Iodide Crystal with Photomultiplier tube for both Near and Far detectors		
Porosity Accuracy	0.5 pu below 10 pu; 5% of reading for 10-50 pu		
Vertical Resolution	24 in. (61 cm)		
Statistical Repeatability	± 0.6 pu @ 20 pu @ 200 ft./hr.		
Max. Logging Speed	180 ft./hr (@2 points/ft.)		
Depth Of Investigation	10 in. estimated for 8.5 in. 10 pu borehole		
Radioactive Source	Am 241 - Be Strength: 5 Curies (185 GBq)		
Measure Point	4.6 ft. (1.4 m) (From downhole tool end)		
Voltage	30 Vdc		
Current Draw	160 - 170 mA		



Applications

- Accurate, real-time quantification of porosity and gas identification for saturation calculations.
- Reservoir Navigation using high-resolution imaging and gas—oil/water identification in real-time.
- Wellbore stability analysis using azimuthal caliper and density imaging in real-time.
- Structural formation dip analysis and updating reservoir models from density imaging.
- 8 or 16 sector azimuthal density, Pe and borehole caliper measurements.



Introduction

The CCN and RAD offers measurement of formation density, neutron porosity, borehole caliper, and formation imaging. That provides geosteering for maximum reservoir exposure. Neutron porosity and bulk density are critical for the quantification of hydrocarbons in the reservoir.

Specifications

Diameter		4.75 in.	6.75 in.	8.25 in.
Max. Pressure		20000 psi (137.9 MPa)		
Max. Temperature		300°F (150°C)		
Weight		1100 lbs. (498 kg) (CCN and RAD 4)	1092 lbs. (495 kg)	1945 lbs. (881 kg)
Service		Formation Bulk Density Service with Hole Caliper		
Tool Type		Rotational Azimuthal Density		
Max. Dogleg	Rotating	15°/100 ft. (15°/30 m)	9°/100 ft. (9°/30 m)	6.5°/100 ft. (6.5°/30 m)
	Sliding	30°/100 ft. (30°/30 m)	16°/100 ft. (16°/30 m)	12°/100 ft. (12°/30 m)
Severity				
Detectors		Nal Scintillation Crystal with photomultiplier tube for both Long and Short Spaced detectors		
Density Specifications				
Range		1.6-3.1 g/cc		
Accuracy		± 0.015 g/cc		
Statistical Repeatability		± 0.025 g/cc@200 ft./hr (60 m/hr) and 2.5 g/cc		
Vertical Resolution		18 in. (45 cm) (full resolution)		
Downhole End Measure Point		5.1 ft. (1.5 m)		
Photoelectric Factor Specifications				
Range		1-10 Barnes/electron (B/e)		
Accuracy		± 0.25 B/e from 2-5 B/e		
Statistical Repeatability		± 0.25 B/e@200 ft/hr (60 m/hr)		
Vertical Resolution		6 in. (150 mm) (full resolution)		
Downhole End to Pe Measure Point		5.1 ft. (1.5 m)		
Acoustic Standoff Caliper Specifications				
Range		0-2 in. (Out of housing)		
Accuracy		±0.075 in. (0 to 0.5 in.)		
		±0.125 in. (0.5 to 1.0 in.)		
		±0.25 in. (1.0 to 2.0 in.) Out of housing		
Max. Logging Speed		180 ft./hr (@2 points/ft)		
Radioactive Source		Cs137 Strength: 2 Curies (74 GBq)		
Voltage		30 V		
Current Draw		350 mA~390 mA		





Generator Caliper Corrected Neutron Porosity (GCN)

Geo-Vista

Features

- Safety, environmental protection, non-radioactive to operator
- High pulse neutron energy, high count rate, it can be extended for full spectrum measurement
- With open bus structure, it can be combined with other LWD tools

Introduction

The GCN is a logging-while-drilling tool that uses a pulsed neutron generator instead of a chemical source. The instrument only use one drill collar, it uses an open bus structure can be combined with other LWD tools. It is used to monitor formation porosity during drilling to achieve "chemical source free logging".

It consists of pulsed neutron generator, neutron detector, processing circuit It needs to be combined with PCD (Pressure& Caliper measurement while drilling) for neutron porosity corrected.

Specifications

Tool Diameter	4.75 in. (120 mm)/6.75 in. (171 mm)/8.25 in. (210 mm)
Max. Pressure	20,000 psi (137.9 MPa)
Max. Temperature	300°F (150°C)
Make-up Length	15 ft.-8.98 in. (4.8 m)
Vibration	20 G, random frequency range 20~100,100 ~200 Hz
Shock	500 G, 11 ms semi-sine wave
Neutron Energy	2.5 MeV
Neutron Yield	> 1*10 ⁸ n/s
Measurement Range	0 to 100 p.u.
Measurement Accuracy	0.5 p.u. below 10 p.u.; 5% of measurement otherwise
Repeatability	± 0.6 p.u. @ 20 p.u. @ 200 ft./hr.





Applications

- Continuous, real-time, lithology-independent porosity without chemical sources.
- Resistivity-independent pay identification.
- Continuous, real-time permeability evaluation.
- Thin-bed characterization.
- Carbonate facies characterization.
- Irreducible water saturation.
- Gas-bearing reservoir evaluation.
- Heavy oil and tar identification.
- Hole size distribution

Introduction

By providing lithology-independent porosity, pore-size distribution, continuous permeability and direct hydrocarbon detection, the MRI delivers a step change in real-time producibility assessment for complex reservoirs.

While drilling a well with a challenging trajectory to target a complex carbonate reservoir the MRI (The high-quality, real-time magnetic resonance) to evaluate rock and fluid properties and obtain accurate lithology independent porosity and continuous permeability to optimize placement of the wellbore, the advanced petrophysical evaluation improved testing and completion design and calculated reservoir producibility for focus on well.

Specifications

Max. Tool O.D. (Single-sleeve Stabilizer)	6.9 in. (175 mm) (single-sleeve stabilizer)	
Max. Pressure	20,000 psi (137.9 MPa)	
Max. Temperature	300°F (150°C)	
Make-up Length	32.38 ft. (9.87 m)	
Weight	3385.4 lbm. (1535.6 kg)	
Borehole Size Range	8.25 to 10.375 in. (20.96-26.36 cm)	
Normal Collar O.D.	6-3/4 in. (171.5 mm) API tolerance	
Thread Connections	GT6 box up/ GT6 box down	
Vertical Resolution Static	1.5 in./min.-4 in./min. (3.81 cm/min.-10.16 cm/min.)	
Vertical Resolution Dynamic	10 in.@50 ft./h (25.4 cm@15 m/h)-0.25 m/min. 20 in.@100 ft./h (50.8 cm@30 m/h)-0.5 m/min.	
Measurement of Porosity	0-100 pu	
Min. mud Resistivity	0.02 ohm.m	
Shell Diameter	15 in. (381 mm)	
Shell Thickness	0.24 in. (6 mm)	
Max. Number of Echoes	2000	
Min. Echo Spacing	0.6 ms	
T ₂ Distribution	0.5 to 5,000 ms	
Precision	< 10 pu/PAP	
Depth of Investigation	14 in. (356 mm)	
Static Field Gradient	58 gauss	
Freq of Sensitive Volume	245 kHz	
Operating Position	Centralized	
Hole Deviation	Vertical to Horizontal	
Power Supply	Turbine alternator	
Dogleg	Sliding	16°/100 ft. (16°/30 m)
	Rotating	8°/100 ft. (8°/30 m)
Max. System Shock Level	30 min. at shock level 5 (50-gn threshold or accumulatd 200,000 shocks above 50 gn)	
Torque	23,500 ft. lbf (31,800 N.m)	
Max. PH	< 9	



Applications

- Optimize mud-weight selection
- Predict pore pressure independent of temperature and salinity effect.
- Identify top-of-cement
- Understand rock mechanical properties
- Measure porosity sourceless
- Position bit-on-seismic using synthetics
- Identify gas influx or formation gas.
- Perform many other standard sonic applications.

Introduction

Acoustic While Drilling (AWD) provides real-time compressional and shear wave travel-time measurements in slow and fast formations. Shear and compressional slowness with computed semblance values are acquired using a state-of-the-art acoustic source combined with multiple arrays of receivers. Advanced downhole processing and waveform stacking techniques ensure reliable and fully compensated measurements.

Specifications

Diameter	4.75 in.	6.75 in.	
Tool O.D.	4.82 in. (122.43 mm)	6.9 in. (175.26 mm)	
Hole Size	5.625 in. to 8 in. (143 to 203 mm)	8.5 in. to 10.625 in. (216 mm to 270 mm)	
Max. Operating Temperature	300°F (150°C)		
Max. Operating Pressure	20,000 psi (137.9 MPa)		
Length	30 ft. (9 m)	23.8 ft. (7.254 m)	
Weight	1,760 lbm (798 kg)	2,500 lbm (1,134 kg)	
Thread Connections	HbuildLWD	GT4 box up/ GT4 pin down	GT6 box up/ GT6 pin down
	ComLWD	NC38 box up/ NC38 pin down	NC46 box up/ NC46 pin down
Makeup Torque	8845 ft.-lbf (11,984 N.m)	25,000 ft.-lbf (33,895 N.m)	
Max. Dogleg Severity	Rotating	15°/100 ft. (15°/30 m)	8°/100 ft. (8°/30 m)
	Sliding	30°/100 ft. (30°/30 m)	16°/100 ft. (16°/30 m)
Max. Flow Rate	400 gal US/min. (1,514 L/min.)	800 gal US/min. (3,028 L/min.)	
Max. Sand Content	3%		
Max. LCM Size	0.63 in. (16 mm)		
Average Inertia	62 in.		
Transmitters Number	1		
Receivers Number	4		
Measurement Type	Compression Wave & Shear Wave		
Accuracy, us/ft. (us/0.305 m)	± 1		
Measurement Range	All tools 40-230 us/ft. dependent on mud type		
Max. Shock	250 g for 100,000 cycles		
Measure Point From Tool Bottom	14 ft. (4.267 m)		



Applications

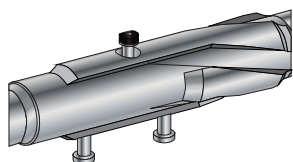
- Optimization of mud weight
- Selection of optimal case
- Estimation of reserves
- Identification of fluids and their contacts.
- Reservoir model refinement
- Well placement

Benefits

- Mitigates risk through reservoir pressure management.
- Improves prediction of reserves using fluid typing.
- Enhances drilling performance through optimal mud weight.
- Saves time and cost by eliminating need for tool orientation.

Features

- Provides formation pressure in drilling environment
- Provides direct pore pressure and mobility data for fluid typing and mud-weight optimization
- Used in any hole orientation—vertical or deviated
- Optimizes pretest volume and drawdown to formation characteristics
- Real-time measurements with quality control indicators

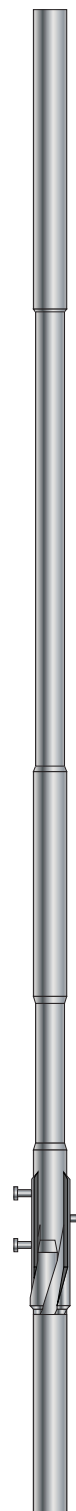


Introduction

Formation Tester While Drilling (FTD) service makes accurate measurements that provide direct pore pressure and mobility data for fluid typing, reservoir pressure management, and mud-weight control and optimization. It achieves time savings through a focus on operational efficiency and measurement versatility, accuracy, and quality.

Specifications

		4.75 in.	6.75 in.
Tool Design			
Measurement Type	Probe pretest		
Pressure Gauges	High-precision quartz and strain		
Power Supplies	Battery, MWD turbine power		
Measurement Specifications			
Probe Dimensions	1.75 in. (44.45 mm) OD 0.44 in. (11.18 mm) ID	2.25 in. (57.15 mm) OD 0.56 in. (14.22 mm) ID	
Pretest	Volume	0 to 25 cm ³ , fully adjustable	
	Drawdown Rate	0.1 to 2.0 cm ³ /s	
	Delta Pressure	6,000 psi (41 MPa)	>6,000 psi (>41 MPa)
Setting Piston	1.38 in. (35.05 mm)	2.00 in. (50.00 mm)	
Diameter Reach	more than tool OD	more than tool OD	
Memory Capacity	Up to 120 pretests depending on time downhole	80 pretests of 5 min. duration	
Battery Capacity	150 pretests 1 cm ³ /s at 3,200 psi (22 MPa) drawdown at 275 °F (125 °C)		
General Specifications			
Tool Max. O.D.	4.82 in. (122.43 mm)	8.25 in. (209.6 mm)	
	5.75 in. (146.05 mm)	9.25 in. (234.95 mm)	
	5.5 in. (139.7 mm) optional	with optional collar	
Tool Length	40.2 ft. (12.3 m)	31 ft. (9.45 m)	
Weight	2,000 lbm (907 kg)	2,866 lbm (1,300 kg)	
Thread Connections	GT4 box up/ GT4 box down	GT6 box up/ GT6 box down	
Operating Temperature	300 °F (150 °C)		
Mechanical Specifications			
Max. Dogleg Severity	Rotary Mode	15°/100 ft. (15°/30 m)	8°/100 ft. (8°/30 m)
	Sliding Mode	30°/100 ft. (30°/30 m)	16°/100 ft. (16°/30 m)
Axial And Lateral Shocks	10g rms		
Hydraulics			
Max. External Pressure	20,000 psi (138 MPa)		
Flow Range	0 to 400 galUS/min. (0 to 1,514 L/min.)	0 to 800 galUS/min. (3,028 L/min) (standard)	
<i>Note: Specifications are subject to change.</i>			





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