Schlumberger

Borehole Properties Analysis

Environmental Measurement Sonde

Applications

- Calculation of borehole radius and cement volume
- Stress analysis and borehole stability evaluation
- Automatic analysis of borehole shape
- Environmental correction and depth matching of other measurements

Benefits

- Precise borehole-shape evaluation to determine drilling performance
- Accurate estimation of cement volume to optimize cementing cost
- Combined operations with other measurements saves rig time
- Real-time environmental corrections for other logging tools to yield accurate results
- Real-time depth matching of other logging tool data to enhance log interpretation

Features

- Six independent borehole radii measurements
- Mud temperature, mud resistivity and tool acceleration measurements
- Centralized or eccentralized operation
- Modular design to suit individual application needs
- Flexible configuration and setup
- Combinable with most formation evaluation tools

New dimension for borehole evaluation

The Environmental Measurement Sonde (EMS) dramatically increases the ability to determine the precise shape of the borehole. Supported by the MAXIS* Multitask Acquisition and Imaging System, the EMS tool uses six independent arms to make caliper measurements around the borehole. These caliper readings provide extensive drilling and petrophysical information. Using an ovality algorithm, the measurements determine the definite shape of the borehole for stress analysis studies. In addition, the EMS tool measures mud resistivity, mud temperature and acceleration along the tool axis for real-time environmental correction of downhole measurements.

Better borehole geometry evaluation

Over a wide range of borehole sizes, the six independent arms of the EMS tool precisely measure the borehole cross section to give detailed information on borehole geometry. The result is better environmental correction of the imaging tool data, improved borehole stress analysis and more precise estimation of the cement volume, even if the tool is eccentered.

Improved mud resistivity measurement

With multiple voltage monitoring electrodes, the EMS mud resistivity sensor provides robust and accurate mud resistivity measurements under adverse conditions. Even with mudcake on the tool surface or in narrow boreholes, the EMS tool delivers reliable and precise measurements.

Real-time environmental corrections

The improved caliper, mud resistivity and temperature measurements allow real-time environmental correction of measurements obtained from imaging tools such as the AIT* Array Induction Imager Tool, the IPL* Integrated Porosity Lithology tool and the ARI* Azimuthal Resistivity Imager. Since the EMS tool is combinable with all imaging tools, environmentally corrected wellsite logs can be produced without an extra trip in the hole.

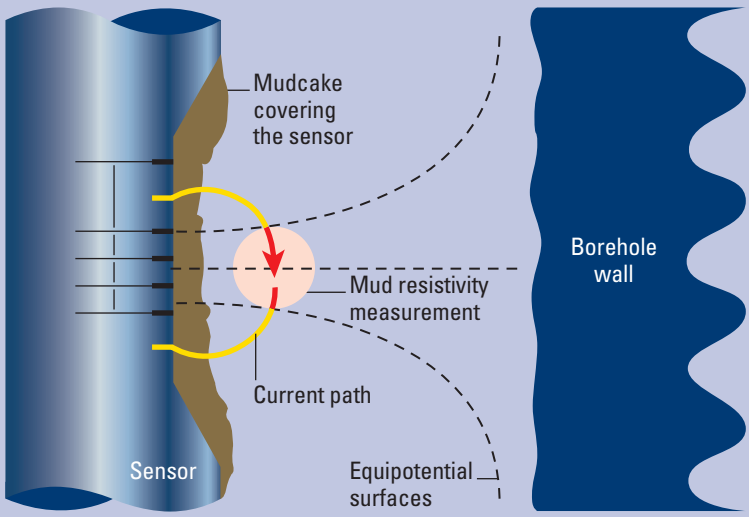
Better depth matching

The EMS tool incorporates a single axial accelerometer. Data from the accelerometer can be used to provide accurate depth matching of the borehole measurements, correct tool speed and estimate hole deviation.

Adaptability

Designed to suit individual application requirements, the EMS tool incorporates three modules, the environmental measurement cartridge (EMC), the environmental measurement sonde adapter (EMA) and the environmental measurement mechanical sub (EMM). These modules can be run in different

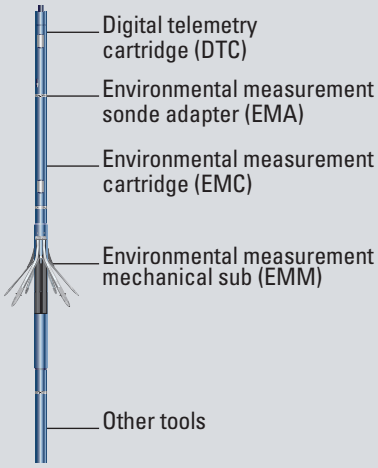
The mud resistivity measurement is not affected by the presence of mudcake in front of the tool.



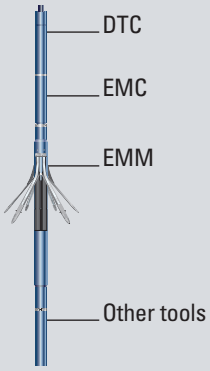
The EMS tool has three modules that can be easily configured to the required measurement need and tool length limitation.

Measurements provided

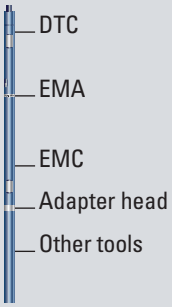
Mud resistivity
Temperature
Borehole diameters
Tool acceleration



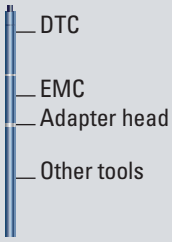
Borehole diameters
Tool acceleration



Mud resistivity
Temperature
Tool acceleration



Tool acceleration



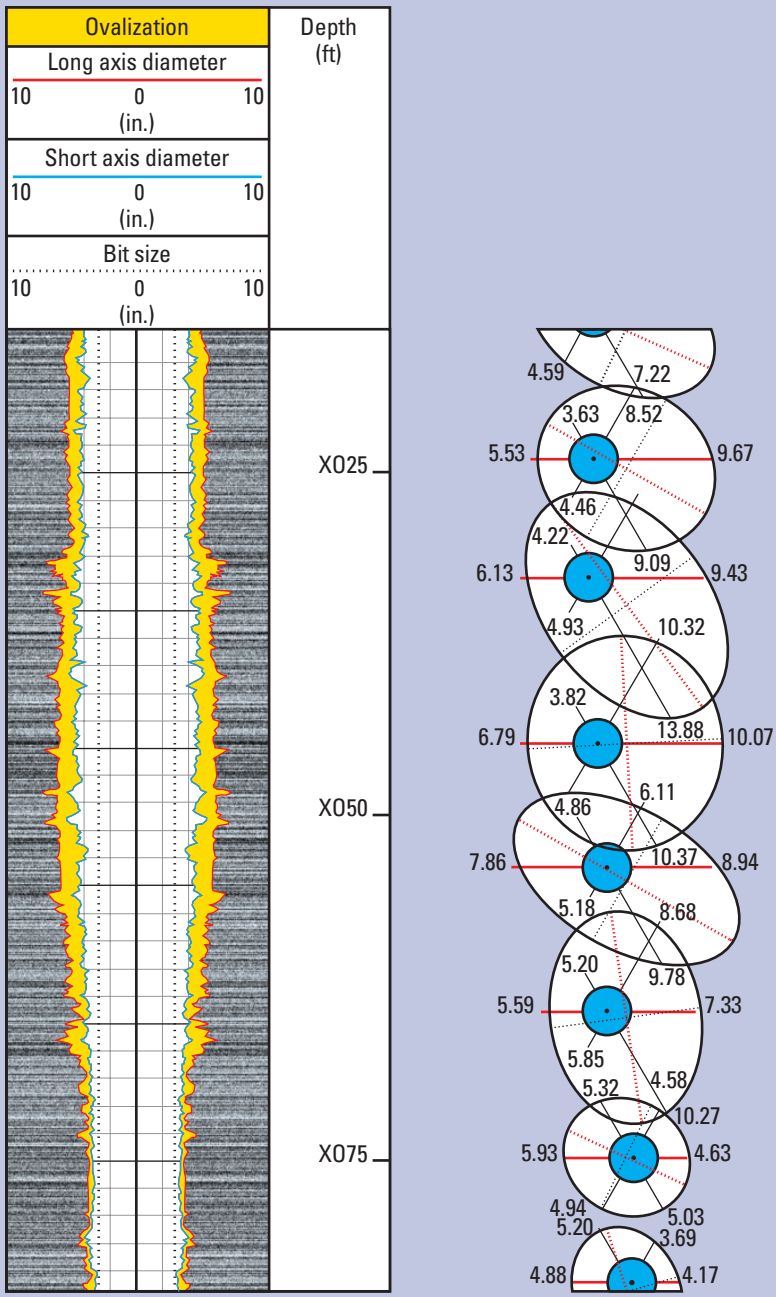
configurations depending on the tool length and data requirements. The tool can be run centered or eccentered with each of the six caliper arms independent of each other. In conditions where tool eccentering is crucial for other measurements in the same tool string, an optional fixed caliper operation is available that features three adjacent arms locked.

Detailed borehole geometry data

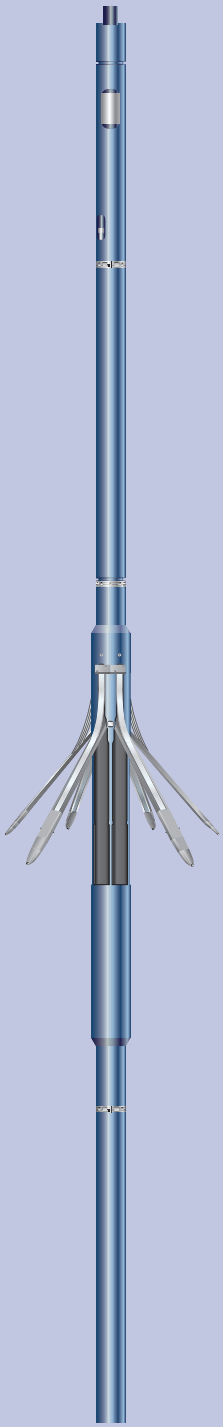
The six independent caliper readings supply data for both drilling and petrophysical studies. An algorithm, based on all six oval-radii measurements, gives the best-fit ovality and provides borehole geometry with long- and short-axis diameters, their orientation and the tool arm positions.

The computed long- and short-axis diameters are more precise than raw measurements, which may be affected by tool eccentralization and borehole ovality. The log presentation can be tailored to specific needs, and the log answers can be customized to give a good visual indication of the borehole profile to enhance decision making. Precise cement volumes can also be calculated.

From the EMS log, the driller can easily select the best setting depth for an openhole packer.



The EMS tool has six independent arms that precisely gauge the borehole cross section over a wide range of borehole sizes.



EMS Tool Specifications

Length	14.1 ft [4.5m]
Diameter	3.375 in. [85.7 mm] without caliper section 4.000 in. [101.6 mm] with caliper section
Weight	296 lbm [133 kg]
Temperature rating	175°F [350°C]
Pressure rating	20,000 psi [137,895 kPa]
Mud resistivity	
Range	0.01 to 5 ohm-m
Accuracy	±10% (0.02 to 0.5 ohm-m) ±7% (0.5 to 5.0 ohm-m)
Depth of investigation	0.3 to 1.0 in. [7.62 to 25.4 mm]
Mud temperature	
Resolution	0.1°C (0.2°F)
Accuracy	±1°C or 1% (±2°F)
Caliper	
Maximum diameter	40 in. [1016 mm] with extension arms 30 in. [762 mm] without extension arms
Resolution	0.06 in. [1.5 mm]
Accuracy	±0.1-in. [2.5-mm] radius
Acceleration	
Accuracy	+4 cm/s2
Resolution	1 cm/s2

Schlumberger