

## Capacitance Array Tool (CAT)



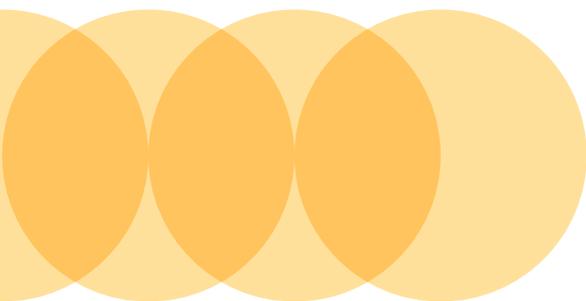
Oil, gas, and water have different dielectric constants. The CAT uses this property to identify fluid phases in high deviation and horizontal wells. Run centralised in the wellbore, the CAT is fully combinable with other Ultrawire\* production logging tools.

### Description

An array of 12 miniature sensors are mounted on the inside of a set of collapsible bowsprings and measure the capacitance of the surrounding fluid close to the well casing. All 12 values are simultaneously transmitted to the surface or into a memory section. Taking measurements in a single plane across the diameter of the wellbore—rather than along it—results in an accurate cross-sectional plot of fluid phases. Combined with data from the Spinner Array Tool (SAT) and the Resistance Array Tool (RAT), the tool allows quantitative estimates of the volumetric flow rate for each phase.

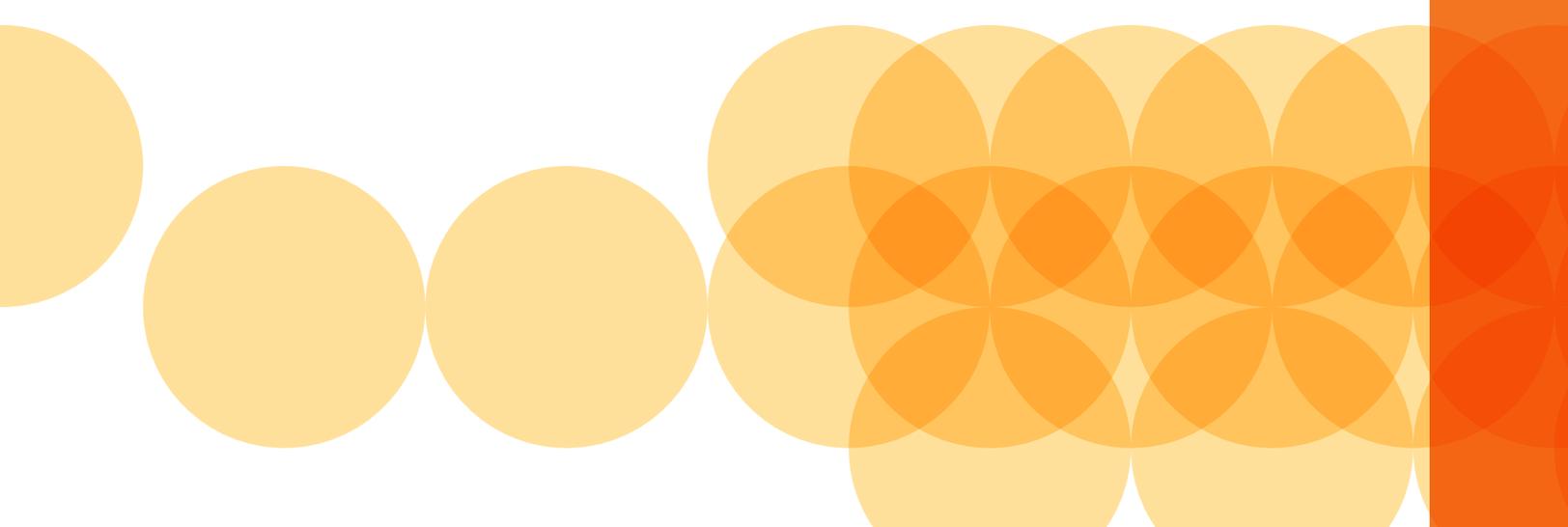
### Features

- Array of 12 radial capacitance sensors
- Tool orientation determined by internal relative bearing sensor
- Through tubing phase identification
- Simultaneous operation with Ultrawire\* tools
- Radial fluid phase measurement
- Collapsible bow-spring arms
- Combinable with other tools of the Multiple Array Product Suite via Rotational Alignment Subs (RAS)
- Production Incliner Accelerometer (PIA) recommended



## Capacitance Array Tool (CAT)

Specifications	
Temperature rating	350°F (177°C)
Pressure rating	15,000 psi (103.4 MPa)
Tool diameter	1-11/16 in. (43 mm)
Tool length	23.25 in. (590.55 mm)
Tool weight	17.3 lb. (8.1 kg)
Toolbus	Ultrawire*
Current consumption	28 mA
Maximum opening	7-inch casing
Number of sensors	12
Sensor measure point	18.2 in (462 mm)
Relative bearing accuracy	5°
Relative bearing dev range	5° to 175°
Materials	Corrosion resistant throughout



## Resistance Array Tool (RAT)

The Resistance Array Tool has 12 micro resistance sensors deployed on bow springs to determine the water holdup profile across the whole wellbore. Water (brine) is conductive, while oil and gas are non-conductive.

### Description

Phase segregation occurs in many wells, including those with little deviation from vertical; the lighter phases migrate to the high side of the well, the heavier phases to the low side.

The Resistance Array Tool differentiates between conductive water and hydrocarbons, which are non-conductive, and will detect very small, fast moving bubbles. This allows determination of the water holdup cross-sectional profile in wellbores of any deviation, from vertical to horizontal, and in any flow regime.

Combined with data from the Spinner Array Tool (SAT) and Capacitance Array Tool (CAT), the tool allows quantitative estimations of volumetric flow rate for each phase with a much higher degree of certainty, and thus provides vital and more precise information for reservoir management.

### Features

- Cross-sectional water holdup profiling
- 3D imaging of water holdup profile with MAPview software
- Water holdup in any fluid regime in vertical to horizontal wells
- Memory and surface read out operations
- Simultaneous operation with other Sondex Ultrawire\* tools
- Combinable with other tools of the Multiple Array Product Suite via Rotational Alignment Subs (RAS)



## Resistance Array Tool (RAT)

Specifications	
Temperature rating	350 °F (177 °C)
Pressure rating	15,000 psi (103.4 MPa)
Tool diameter	1 <sup>11</sup> / <sub>16</sub> in. (43 mm)
Tool length	51.4 in. (1.306 m)
Tool weight	18.0 lb (8.2 kg)
Toolbus	Ultrawire*
Current consumption	70 mA
Maximum opening	7-inch casing
Number of sensors	12
Sensor measure point	15.7 in. (398.8 mm)
Relative bearing accuracy	5°
Relative bearing dev range	5° to 175°
Materials	Corrosion resistant throughout

## Spinner Array Tool (SAT)



The Spinner Array Tool features six miniature turbines deployed on bowspring arms, enabling discrete local fluid velocities to be measured at 60 degree intervals around the wellbore.

### Description

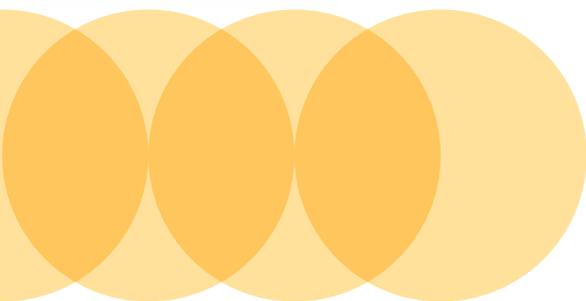
Phase segregation occurs in many wells, even those with little deviation from vertical. Lighter phases migrate to the high side of the well, heavier phases to the low side. The individual phases flow at different velocities and possibly in different directions. Historically, correlations have been used to estimate individual phase velocities from the total fluid velocity log. The Spinner Array Tool provides direct measurement of individual phase velocities. Combined with holdup data from the Resistance Array Tool (RAT) and Capacitance Array Tool (CAT), this forms the Multiple Array Production Suite (MAPS), which makes it possible to provide quantitative estimates of the volumetric flow rate of each phase with a much higher degree of certainty and thus provide vital information for reservoir management.

The turbines use low friction jewelled bearings to reduce the mechanical threshold of the spinner and improve sensitivity to fluid flow. The tool outputs the direction and speed of spinner rotation. A relative bearing measurement is incorporated to indicate the high side of the well.

The SAT004/005 are new designs that incorporate customer feedback from earlier variants. They include new turbines specifically designed to have much higher tolerance to magnetic well debris. The new designs also feature a smaller outer diameter to permit entry into tighter well bores. Numerous features have been incorporated to simplify servicing and lower maintenance cost.

### Features

- Greater tolerance to well debris
- Reduced tool diameter
- Easier to service and maintain
- Cross-sectional velocity profiling
- 3D imaging of velocity profile with MAPview software
- Phase velocities in segregated fluid streams in deviated and horizontal wells
- Memory and surface readout operation
- Simultaneous operation with other Ultrawire\* tools
- Combinable with other MAPS tools
- Optional Rotational Alignment Sub (RAS)
- Production Inclinerometer Accelerometer (PIA) recommended



## Spinner Array Tool (SAT)

Model	SAT004	SAT005
Temperature rating	350°F (177°C)	
Pressure rating	15000 psi (103.4 MPa)	
Tool diameter	1.72 in. (43.69 mm)	2.125 in. (53.98 mm)
Tool length	45.5 in. (1.156 m)	
Tool weight	17.2 lb (7.8 kg)	
Toolbus	Ultrawire	
Current consumption	25 mA	
Pipe range	Up to 7 in. casing	
Number of sensors	6	
Spinner diameter	0.4 in. (10.16 mm)	0.6 in. (15.24 mm)
Sensor measure point	16.5 in. (419 mm)	
Relative bearing accuracy	5°	
Relative bearing dev range	5° to 175°	
Materials	corrosion resistant	