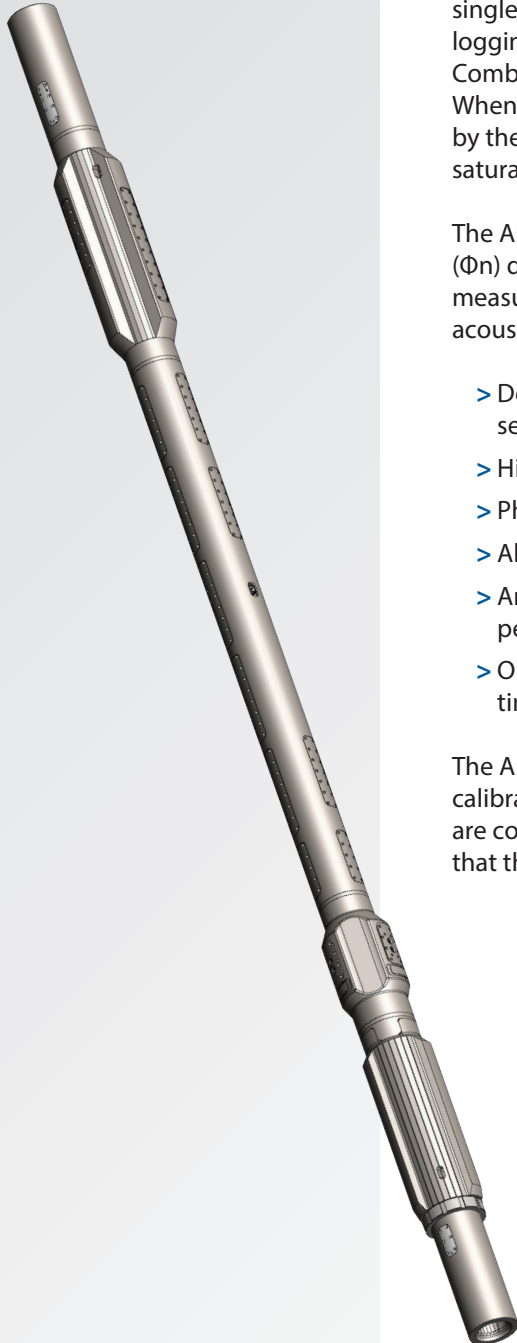


Integrated Porosity, Caliper & Density Sub (iPCD™)

SureLog-iPCD™



APS Technology's SureLog™ iPCD™ (integrated Porosity, acoustic Caliper & Density) sub adds neutron porosity and litho-density measurements to the SureShot™ MWD / LWD platform. This capability enables extended formation evaluation measurements from a single additional sensor sub. The iPCD is a cost-competitive, reliable formation evaluation logging tool that provides the basic functionality for customers to deliver "Triple Combo" services which, until now, have been restricted to the major service companies. When used in combination with natural gamma and resistivity logs, the logs produced by these new sensors provide a timely and useful estimate of the porosity and water saturation for each reservoir formation, typically before significant invasion.

The APS iPCD provides real-time bulk density ($\Delta\rho$ or "delta rho") and neutron porosity (Φ_n) data to characterize formation porosity and lithology while drilling. All nuclear measurements are borehole compensated using the standoff data provided by a novel acoustic caliper.

- > Density sensor provides user-configurable formation imaging data with 4 or more sectors in real-time and 24 sectors from memory.
- > High-resolution images allow for structural/stratigraphic dip analysis.
- > Photoelectric factor (Pe) data is stored in memory.
- > All measurements include quality factors and standard log data.
- > An array of rugged acoustic transducers provides a borehole shape/diameter log, permitting borehole breakout analysis.
- > One set of transducers is aligned with the density neutron detectors for accurate real-time standoff measurement.

The APS iPCD tool includes all of the software tools needed for modeling, testing, calibration and borehole correction calculations. In addition, all designs and procedures are consistent with the safe (and licensed) handling of the radioactive sources and ensure that these sources are properly retained while the tools are downhole.

Nuclear Support

APS will assist customers with the infrastructure planning and procurement of equipment required for safe and compliant handling of nuclear source materials, including establishing requirements and best practices for:

- > Safe storage, handling and transportation of nuclear sources
- > Setting procedures for periodic inspection of nuclear sources
- > Testing, calibration, installation and removal of nuclear sources
- > Design of emergency handling tools and procedures
- > Training of shop and rig site personnel
- > Setting requirements for radiation monitoring and dosimetry

Establishing and complying with proper procedures is essential to ensure the safety and protection of affected personnel and the environment.

Integrated Porosity, Caliper & Density Sub (iPCD™)

Product Specifications



Neutron Porosity Sensor

Acoustic Caliper

Litho-Density Sensor

Dimensions			
Nominal Diameter	4.75 in. (121 mm)	6.75 in. (172 mm)	8.0 in. (204 mm)
Length	17.5 ft	19 ft	19 ft
Operational			
Neutron Porosity – Near & Far Li ⁶ I Crystal / PMT Detectors			
5 Curie AmBe source	1		
Accuracy	±0.5 p.u. < 10 p.u.; ±5% 10-50 p.u.		
Acoustic Caliper			
Transceivers	3		
Azimuth Capable	Yes		
Accuracy	±0.2 in.		
Density – Short & Long NaI Crystal / PMT Scintillation Detectors			
1.7 Curie Cs ¹³⁷ Source	1		
Azimuthal Capable	Yes		
Operating Range	1.5 g/cc to 3.0 g/cc		
Density Accuracy (30 sec, 1 σ)	±0.015 g/cc @ 2.2 g/cc		
Density Repeatability (30 sec, 1 σ)	±0.010 g/cc @ 2.2 g/cc		
Pe Accuracy (30 sec, 1 σ)	±0.25 B/e ⁻ (1 - 5 B/e ⁻)		
Environmental			
Maximum Temperature	302°F / 150°C (347°F / 175°C option)		
Maximum Pressure	20,000 psi (137.9 MPa)		