LOGIQ® Compensated Spectral Natural Gamma Ray (CSNG™) Tool

DETECT PRODUCIBLE ZONES AND INCREASE RESERVOIR UNDERSTANDING OF FORMATIONS

OVERVIEW

The Halliburton LOGIQ® CSNG™ tool measures the entire gamma ray spectrum, from 0 to 3,000 keV. The tool uses special borehole compensation techniques to provide the industry’s most precise and accurate logs of potassium, uranium, and thorium concentrations. Measurement precision curves and tool diagnostics help validate logging data in the formation. A unique, patented low atomic number tool case enables gamma rays to be measured for accurate data retrieval in cased-hole and openhole environments.

The CSNG tool’s unique stabilizer system differentiates it from the competition by compensating for temperature-related drift in system gain, maintaining that gain to within 0.5%. Another unique feature of the CSNG tool is its ability to provide realtime outputs corrected for the borehole environment and converted to standard conditions (9-in. borehole, fresh water in borehole, no casing, and tool centered).

FEATURES

» Measures and records the energy of individual gamma rays
» Forms a spectrum of gamma energies indicating the number of gamma rays recorded at each energy level
» Divides overall spectrum into overlapping low and high spectra
» Photoelectric ratio produced by low-energy spectrum (0 to 350 keV) can be interpreted to help determine lithology in openhole wells or casing thickness in cased wells
» High-energy spectrum (0 to 3 MeV) facilitate determination of potassium, uranium, and thorium weight concentrations in formation

BENEFITS

» Aids detection of producible zones by more accurately distinguishing reservoir rock from those containing clays. Sandstones generally have low potassium and thorium concentrations compared to shales
» Increases reservoir understanding. Fractured or highly permeable reservoirs can be discovered when high uranium concentrations appear with low potassium and thorium concentrations. High uranium and thorium counts with low potassium counts indicate a clean reservoir containing accessory minerals
LOGIQ® Compensated Spectral Natural Gamma Ray (CSNG™) Tool Specifications

<table>
<thead>
<tr>
<th></th>
<th>Make Up Length (ft)</th>
<th>Diameter (in)</th>
<th>Maximum Pressure* (psi)</th>
<th>Maximum Temperature (°F)</th>
<th>Weight (lb)</th>
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</thead>
<tbody>
<tr>
<td><strong>Titanium Housing</strong></td>
<td>14.9</td>
<td>3.625</td>
<td>14,000</td>
<td>350</td>
<td>271</td>
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<td>122.9</td>
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<tr>
<td><strong>Low Z Housing</strong></td>
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<td>3.625</td>
<td>8,000</td>
<td>275</td>
<td>268</td>
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<td>117.9</td>
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<tr>
<td><strong>DeepSuite™ Tool</strong></td>
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<td>4.44</td>
<td>35,000</td>
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<td>206</td>
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<td>93.5</td>
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* Please refer to the CSNG Pressure Rating chart below.

CSNG Pressure Rating*

For more information, contact your local Halliburton representative or visit us on the web at www.halliburton.com

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