HALLIBURTON

FORMATION EVALUATION | ACOUSTIC

Hostile WaveSonic® service

Halliburton's third-generation, ultra-reliable, crossed-dipole sonic tool

BENEFITS

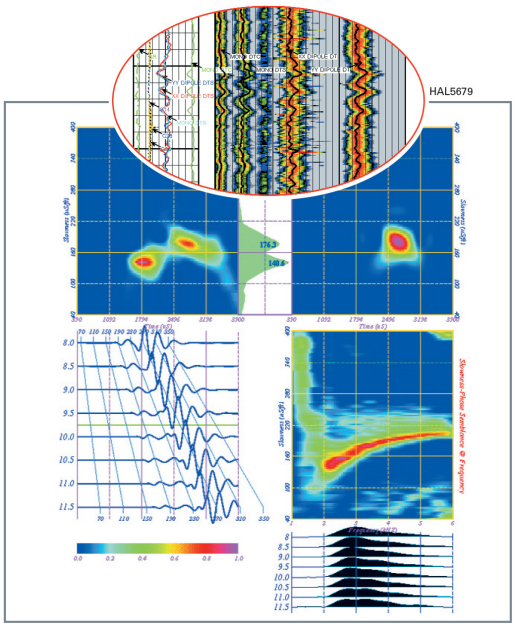
- Low-frequency monopole and dipole sources for deeper investigations of sonic slowness measurements beyond any near-wellbore alteration effects
- Broadband eight-level, quad-receiver array for high-quality waveform data; all 96 waveforms for each set of transmitter firings are recorded at the surface for advanced waveform-processing techniques
- Combinable with the HEAT™ Suite tools
- On-depth, low-frequency bender-bar source provides a clean source signal
  - No need for dispersion corrections for slowness determination
  - No depth shifting of waveform data for anisotropy analysis
- Robust tool isolator design allows for drillpipe-conveyed operations; WaveSonic tool not limited to bottom of tool string

Halliburton's Hostile WaveSonic® crossed-dipole sonic tool makes it easy to determine fast and slow shear wave travel times and their orientation in the formation. With the WaveSonic service, you can even calculate minimum and maximum principal stresses and stress field orientation by combining oriented slowness data with overburden and pore-pressure data. This information is vital for geomechanical analysis, wellbore stability, and production enhancement treatment design.

Sonic anisotropy and the orientation of the anisotropy can be used to determine the orientation of natural fractures. Sonic attributes such as P-wave slowness, fast and slow shear wave travel time, identification of compressive fluids in the pore space, and anisotropy orientation allow for better 3D seismic analysis.

The product of superior technology

The Hostile WaveSonic service provides simultaneous monopole and crossed-dipole sonic information. P-wave and S-wave slowness can be obtained in formation conditions ranging from poorly consolidated high-porosity gas-saturated sandstones to low-porosity carbonates. The flexural wave energy is propagated from a low-frequency, on-depth, crossed-dipole bender-bar source. The low-frequency flexural wave travels at the true shear slowness of the formation. A low-frequency monopole source is used, so the P-wave and flexural wave data have similar depths of investigations well beyond any near-wellbore alteration.



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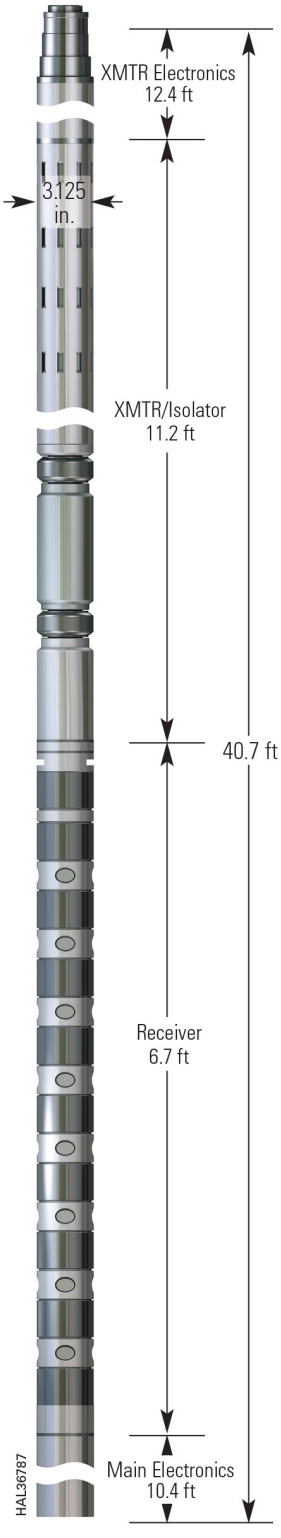
This is an example of a semblance diagnostic plot of the waveform data from the eight waveforms. In the circle is a section of a log showing monopole P-wave slowness and semblance quality, monopole refracted shear-wave slowness and semblance quality, X-X dipole slowness and semblance quality, and Y-Y dipole slowness and semblance quality.

Hostile WaveSonic® specifications

DIMENSIONS AND RATINGS	
Maximum Temperature	500°F (260°C)
Maximum OD	3.125 in. (79.4 mm)
Maximum Pressure	30,000 psi (207 MPa)
Minimum Hole Size	3.63 in. (92.2 mm)
Maximum Hole Size	12.25 in. (311.2 mm)
Makeup Length	40.7 ft (12.4 m)
Weight	720 lb (327 kg)
BOREHOLE CONDITIONS	
Borehole Fluids	Saltwater, Freshwater, Oil
Recommended Maximum Logging Speed	30 ft/min (0.15 m/s) simultaneous monopole and crossed dipole, 2 samples per foot
Tool Positioning	Centralized
HARDWARE CHARACTERISTICS	
Source Type	Piezoelectric Monopole On-Depth Bender-Bar X-X and Y-Y Dipole
Sensor Spacings	0.5 ft (15 cm) between receivers Dipole 9.2 ft (2.8 m) to first receiver Monopole 10.2 ft (3.1 m) to first receiver
Firing Rate	Variable (Software Controlled)
Digitizing Interval	Programmable
Samples Per Sensor	Programmable
Source Characteristics	Dipole 500 Hz to 3 kHz, programmable Monopole center frequency 5 to 6 kHz, 1 kHz to 12 kHz bandwidth
Measurement Bandwidth	500 Hz to 20 kHz
Combinability	HEAT Suite of tools
Build Rate/Dog Leg Severity	20° per 100 ft (20° per 30 m) without flex joints
MEASUREMENT	
Principle	Time-slowness Δt_c, Δt_{syy}, and Δt_{sxx}
Range	Dynamic
Vertical Resolution	6 in. (15 cm)
Depth of Investigation	3 ft to 10 ft (0.9 m to 3 m)
Resolution	0.2 µs
Primary Curves	Δt_c, Δt_{syy}, and Δt_{sxx}
Secondary Curves	VPVS, ϕ_c, ITTp, ITTs semblance quality, slowness, anisotropy, Poisson's ratio, and Stoneley slowness



CALIBRATION	
Primary	Internal check
Secondary	Sonde simulator
Wellsite Verifier	Casing for 57µs/ft Δt_c check

Hostile full WaveSonic® tool physical strengths*

HARDWARE	TENSION	COMPRESSION	TORQUE
Tool	40,000 lb (178 kN.m)	25,000 lb (111 kN.m)	N/A

* Strengths apply to new tools at 70°F (21°C) and 0 psi (0 MPa)

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