

PowerFlex and PowerEcho

Annular barrier evaluation services

APPLICATIONS

- Drilling
 - Top of cement
 - Liner overlap cementing
 - Drill-wear and burst pressure
 - Drill-out decisions
 - Casing centralization optimization
 - Slot recovery and sidetracks
- Cementing
 - Cement placement design analysis
 - Cement contamination
 - Cement properties
 - Centralization plan effectiveness
- Well integrity
 - Cement placement quality
 - Pipe centralization effectiveness
 - Microannulus diagnosis
 - Leak path analysis
- Cut-and-pull operations
 - Annulus condition
 - Barite sag
 - Top of cement
 - Eccentricity and contact points
 - Casing condition for pull determination

PowerFlex* and PowerEcho* annular barrier evaluation services significantly extend the operating range of ultrasonic cement and casing measurement technologies. This powerful family of services answers the need for robust and reliable measurements to quantify annular content and bond and to confirm centralization and condition of the casing, especially for the growing number of wells with heavy well fluids and large-diameter, thick-walled casings.

The powerful new transducers incorporated in the two services can effectively overcome the challenges of attenuation of the pulse echo and flexural wave signals in heavy muds, with their performance proved in weights exceeding 18 ppg.

PowerFlex and PowerEcho services operate in casing sizes up to 22 in and thicknesses up to 1 in. Their annular evaluation capabilities accurately quantify the cement condition and bond for any cement, from ultralight to heavyweight slurries.

In addition to expanding the measurement envelope to a wide range of well environments, PowerFlex and PowerEcho services improve the reliability and certainty of answers across the measurement range.

PowerFlex and PowerEcho services also increase wellsite efficiency via significantly improved logging speeds. Enhanced wellsite processing enables a turnaround time for the field answer product of two hours or less.

PowerFlex and PowerEcho annular barrier evaluation services bring certainty to decision making for drilling, cementing, well integrity evaluation, and well abandonment operations. Cement evaluation, annular barrier integrity determination, and cut-and-pull operations can be conducted with confidence by operators using either in-house workflows or the Techlog* wellbore software platform.



PowerFlex annular barrier evaluation service.

| | PowerFlex Service | PowerEcho Service |
|---------------------------------------|-------------------|-------------------|
| Pipe inspection | | |
| Casing ID, thickness | | |
| Casing deformation and drift ID | Yes | Yes |
| Casing wall loss and drillpipe wear | Yes | Yes |
| Casing burst and collapse pressure | Yes | Yes |
| Max. safe pipe pull | Yes | Yes |
| Corrosion evaluation | Yes | Yes |
| Control and fiber-optic line location | Yes | Yes |

| | | |
|--|-------------|-----|
| Annular characterization | | |
| Azimuthal cement map | Best option | Yes |
| Cement placement quality characterization | Best option | Yes |
| Microannulus | Best option | Yes |
| Foamed and lightweight cement (less than 11 ppg) | Best option | – |
| Contaminated cement | Best option | – |
| Casing cut and pull | Best option | Yes |
| Cement placement troubleshooting | Best option | Yes |
| Barite sag | Best option | Yes |
| Remedial squeeze | Best option | Yes |
| Visualization of pipe position and eccentricity | Best option | – |
| Cement sheath thickness | Best option | – |

| | PowerFlex Service | PowerEcho Service |
|---|--|--|
| Measurement Specifications | | |
| Output | Acoustic impedance, cement bond to casing, flexural attenuation, Variable Density* log (VDL) of annulus waveform, solid-liquid-gas map of annulus material, hydraulic communication map, rugosity image, internal radius image, casing thickness image | Acoustic impedance, cement bond to casing, internal radius, casing thickness |
| Logging speed, [†] ft/h [m/h] | 400 to 4,500 [122 to 1,372] | 600 to 13,000 [183 to 3,962] |
| Depth of investigation, in [cm] | Casing and annulus: 3 [7.62] | Casing-to-cement interface |
| Horizontal resolution, ° | 5 or 10 | 5 or 10 |
| Vertical resolution, in [cm] | 0.6 to 6.0 [1.52 to 15.24] | 0.6 to 6.0 [1.52 to 15.24] |
| Casing thickness | | |
| Range, in [cm] | 0.15 [0.38] to 1.0 [2.54] | 0.15 [0.38] to 1.0 [2.54] |
| Accuracy, % | ±2 | ±2 |
| Resolution, in [cm] | 0.002 [0.005] | 0.002 [0.005] |
| Acoustic impedance | | |
| Range, Mrayl | 0 to 10 | 0 to 10 |
| Accuracy, Mrayl | <3.3 Mrayl: ±0.5 >3.3 Mrayl: ±15% | ≤3.3 Mrayl: ±0.5 >3.3 Mrayl: ±15% |
| Resolution, Mrayl | ±0.2 | ±0.2 |
| Flexural attenuation | | |
| Range, dB/m | 0 to 200 | Not available |
| Accuracy, dB/m | 5 | Not available |
| Resolution, dB/m | 1 | Not available |
| Mud type or weight limitations [‡] | All types including weights greater than 18 ppg | All types including weights greater than 18 ppg |
| Combinability | Bottom only, combinable with most wireline tools | Bottom only, combinable with most wireline tools |

[†] Some combinations may reduce logging speed, which is also resolution dependent.

[‡] Consult planning software to model the logging scenario.

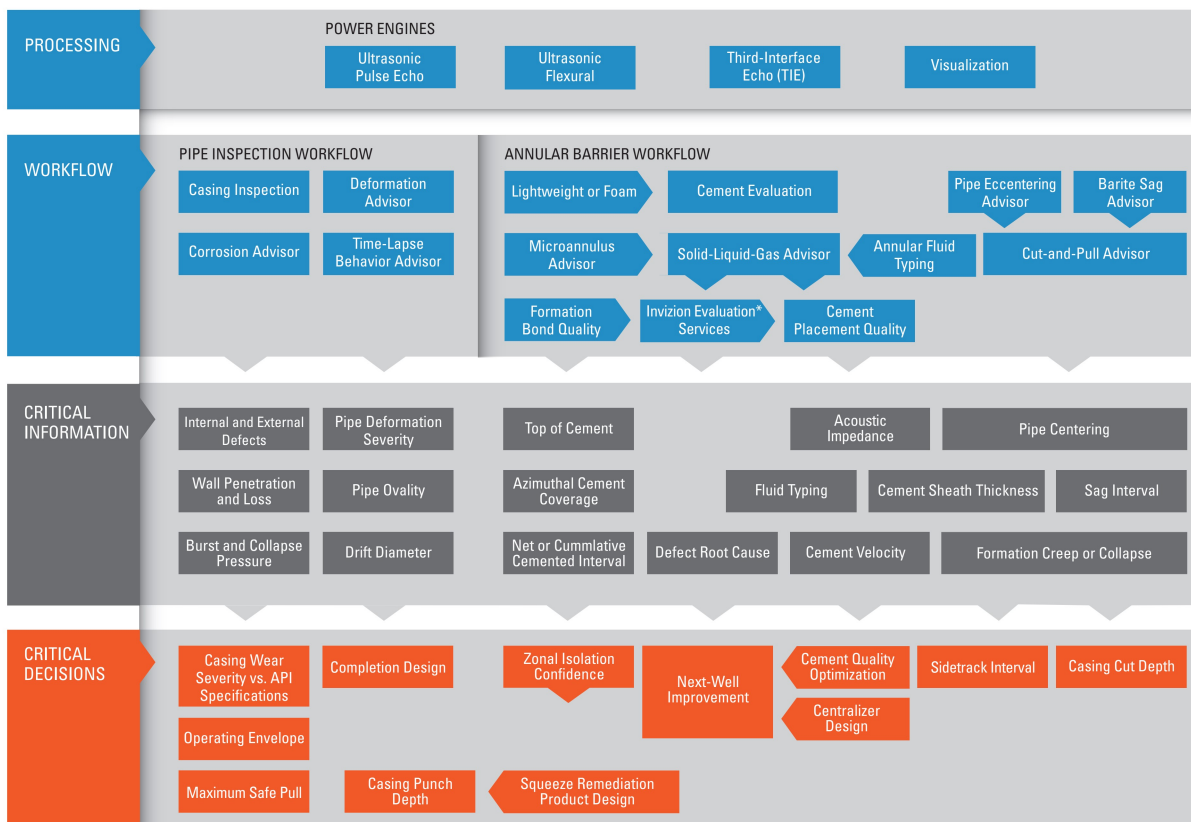
PowerFlex and PowerEcho

| | PowerFlex Service | PowerEcho Service |
|--|--------------------------|--------------------------|
| Mechanical Specifications | | |
| Temperature, degF [degC] | 350 [177] | 350 [177] |
| Pressure, [†] psi [MPa] | 20,000 [138] | 20,000 [138] |
| Casing size—min., in [cm] | 4½ Min. ID: 4 [10.16] | 4½ Min. ID: 4 [10.16] |
| Casing size—max., in | 16 | 22 |
| Outside diameter, [‡] in [cm] | 3¾ [8.57] | 3¾ [8.57] |
| Length, [‡] ft [m] | 14.58 [4.44] | 14.58 [4.44] |
| Weight, [‡] lbm [kg] | 299 [135.6] | 299 [135.6] |

[†] High-pressure versions available.

[‡] Without rotating sub.

| PowerEcho Service Subs | | | | | | | |
|----------------------------------|-------------|--------------|---------------|---------------|---------------|--------------|---------------|
| Mechanical Specifications | USRS-AB | USRS-A | USRS-B | USRS-C | USRS-D | USRS-E | USRS-F |
| Outside diameter, in [cm] | 3.41 [8.66] | 3.58 [9.09] | 4.625 [11.75] | 6.625 [16.83] | 8.625 [21.91] | 9.39 [23.85] | 11.40 [28.96] |
| Length, in [cm] | 9.8 [24.89] | 9.92 [25.20] | 9.8 [24.89] | 8.3 [21.08] | 8.3 [21.08] | 9.06 [23.01] | 9.06 [23.01] |
| Weight, lbm [kg] | 7.7 [3.5] | 7.7 [3.5] | 10.6 [4.8] | 15.0 [6.8] | 18.3 [8.3] | 17.64 [8.0] | 20.06 [9.1] |



The processing workflow for PowerFlex and PowerEcho services delivers confirmation and certainty as the basis for making critical decisions.

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