REAL TIME CABLE HEAD TENSION • WARRIOR 8 COMPATIBLE • PLUG SET CONFIRMATION

Real-time downhole wireline tension measurement to help prevent pump-off, stuck tool strings and expensive fishing operations

Being able to respond quickly and correctly to cable head tension depends on having good data.

Accurately monitoring tension at the head gives good data, and enables the right decisions to be made at the right time. The risk of pumped-off, or stuck, tool strings is reduced which helps eliminate expensive and time-consuming fishing jobs.

Reducing these risks is critical in the intensive high-cost high-speed environment of extended-lateral shale wells.

Maintaining safe cable tension downhole is challenging because surface cable tension measurements do not account for friction effects in the highly deviated sections of the well.

If the cable tension is too high, pump-off can occur when the weak-point limit is exceeded.

If the cable tension is too low, the tool string may begin to stick/slip, and erratic tool string motion increases the possibility of cable damage or pump-off.

Real time measurement of cable tension and compression - downhole, where it counts—allows increased control, which directly decreases Operating Company costs.

Benefits:

- Minimizes fishing risk
- Plug setting is visible
- Accurate logged record of events

Characteristics:

- Communicates real time with the Warrior Acquisition System from SDS, no separate panel required
- Compatible with commercially available perforating systems and switches
- Compatible with standard analog CCLs
- Compact, low maintenance design
- No field calibration necessary
- Measures head voltage and temperature

Features:

- Measures tension to 10,000 lbf
- Measures compression to 2,000 lbf
- Operates up to 350°F and 20k psi
- Standard 1-5/8" Acme Connections
- Accurate tension measurements, temperature and pressure compensated, are achieved without the need for oil compensation
- API RP-67 compliant

Measurement Specifications	
Tension (Max.)	10,000 lbf
Compression (Max.)	2,000 lbf
Resolution	5 lbf
Sampling Rate	10 Hz

Environmental Specifications	
Pressure Rating	20,000 psi
Temperature Rating	350°F
Axial Shock	2000g, 0.25ms
Max Tensile Load	100,000 lbf

Mechanical Specifications	
Outside Diameter	2.75"
Made-up Length	2.20 ft
Weight	33.5 lb
Upper Connection	1-5/8"-6 ACME Pin
Lower Connection	1-5/8"-6 ACME Box

Electrical Specifications	
Max Pass Through Voltage	600 VDC
Operating Voltage	20V to 50V
Current Draw	35mA

CASE HISTORY

Background:

A client in the Marcellus Shale planned multi-stage "plug and perf" operations with more than 50 stages per well.

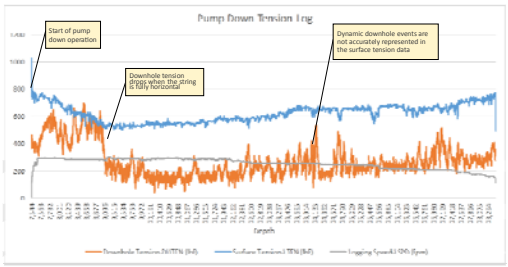
With a history of pump-down conveyance problems due to complex well profiles, missing or faulty plugs had resulted in sub-optimal fracturing performance for the associated stages.

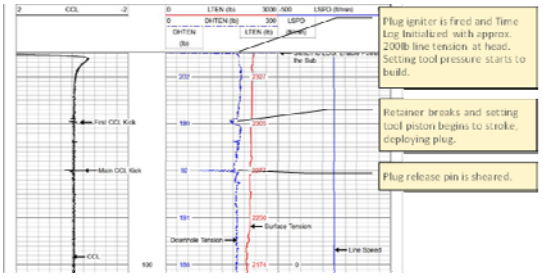
Tension measured at surface could not be considered a reliable indicator of tension at the logging head because of cable friction in the extended lateral sections. Further, conventional measurements do not provide a reliable indicator of critical plug setting.

Objectives:

Deliver a simple, reliable and competent tool to provide live, real-time measurement of head tension during pump-down operations.

Design brief: Run under Warrior • Be analog compatible • Plug & Play simplicity – require no separate panel, no dedicated telemetry • Work with all perforating systems • RP67 compliance





Results:

Aided by the real-time surface readings from the new tool, 110 pump-down runs - setting 110 plugs - were successfully completed in two wells.

- Perforating strings with plugs were successfully conveyed to over 18,200 feet MD with over 9200 feet of lateral.
- The campaign was completed with zero tool maintenance, zero tool failures, and zero lost time.
- Multiple instances were observed where downhole head tension behavior was substantially different from indicated surface tension.
- Logs of downhole tension measurements showed characteristic tension pulls when both the plug deployment pin and the plug release pin were sheared.

Favorite post operation quote: "The technology was as easy to operate as a CCL."