

ReSOLVE instrumented wireline intervention service

For real-time downhole monitoring and control of a wide range of intervention applications

-  **Real Time:** monitoring, control, and verification
-  **Adaptability:** multiple modules to meet your intervention objectives
-  **Automation:** more than 40 downhole automation sequences

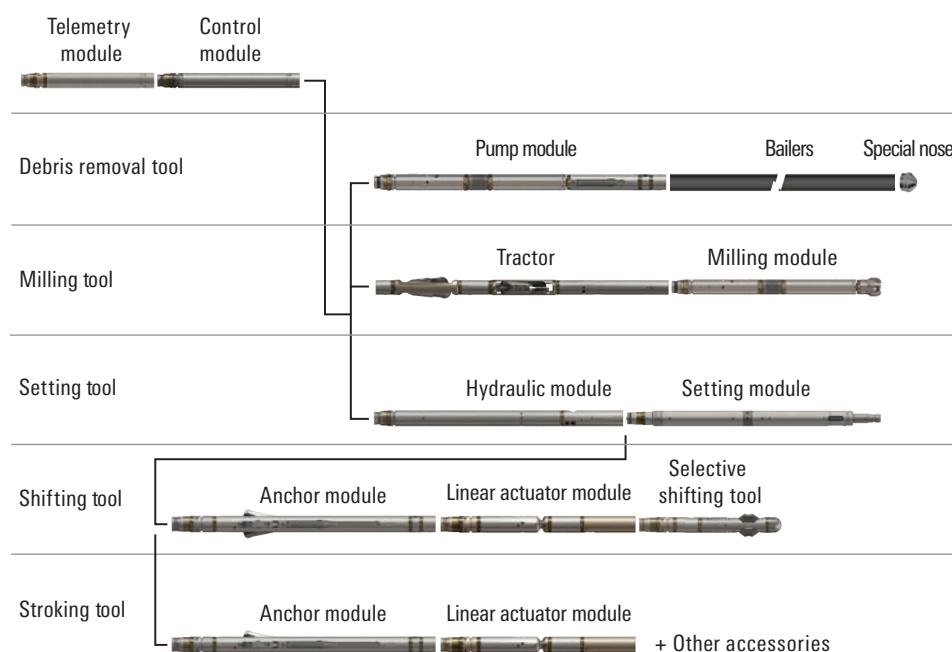
Applications

- Nonexplosive setting of bridge and tubing plugs, packers, casing patches, and cement retainers
- High-force axial shifting
 - Opening and closing of isolation valves
 - Shifting sliding sleeves
 - Pulling retrievable plugs
 - Fishing operations
 - Replacing gas lift valves
 - Safety valve lockout
- Selective shifting with a high-expansion smart shifting tool
 - Sliding sleeves in multizone completions
 - Mechanically opening isolation valves
 - Single-run multiple shifting
 - Shifting components below restrictions
- Milling
 - Removing scale accumulation in well tubulars
 - Milling plugs
 - Removing tubing restrictions and nipple profiles
 - Milling isolation valves
 - Clearing obstructions
- Debris removal
 - Cleaning debris on top of isolation valves
 - Cleaning out produced sand
 - Recovering perforating debris
 - Clearing obstructions

How it improves well intervention

ReSOLVE* instrumented wireline intervention service consists of a modular family of intervention tools that deliver real-time monitoring, dynamic tool control, and verified downhole actuation to set new standards for success in well intervention operations. Sensors incorporated in the ReSOLVE service tools enable the engineer to monitor tool activity and the progress of downhole operations while responsively controlling the tool for optimal performance. By integrating monitoring and control, ReSOLVE service eliminates the reliance on estimates and assumptions that is typical with conventional “blind” intervention methods. Conveyance is on wireline by gravity or on tractor in highly deviated and horizontal wells.

The multiple tools of the modular ReSOLVE instrumented service are readily assembled on the basic configuration consisting of the telemetry and control modules.



ReSOLVE service's multiple modules provide targeted instrumented intervention solutions.

High-force linear actuator tool

The ReSOLVE service combination of the anchor and linear actuator modules reliably applies controlled axial force to well components. The linear actuator tool can be used with either the ReSOLVE service's smart shifting tool (SST) or third-party shifting, pulling, or other interface tools.

The anchor module opens with the industry's largest reach from the tool OD to the tubing of nearly 2 in [5 cm] diametrically. Although up to 150,000 lbf [667,230 N] of anchoring force is precisely applied, the innovative low-stress anchor grips minimize the impact on the tubing while maximizing traction.

Once anchoring is confirmed to the surface, the linear actuator can be extended or retracted multiple times to apply a large, controlled force of up to 40,000 lbf [177,930 N] to a specific well component. Continuous measurements of displacement and the applied force validate completion of the operation.

ReSOLVE

Smart shifting tool

ReSOLVE service's SST makes multiple shifts in any direction in a single run, whether to a single component or multiple components in multizone completions. The SST is paired with the anchor and linear actuator, for which forces and displacements are measured to confirm that the expected force and distance were achieved.

To engage a selected completion component, the SST radially extends profile keys with a specified preload force. The extended keys remain compliant to navigate well geometry. Once the SST is latched into the profile of the component, the anchor secures the tool in the well, and the linear actuator extends or retracts to shift the component. The keys fully retract to enable the tool to pass restrictions.

Nonexplosive setting tool

The setting tool is hydraulically powered, providing a large force of up to 78,000 lbf [347,000 N] for setting plugs and packers. Its 30,000-psi [207-MPa] rating extends the operating envelope of setting tools to high-pressure operations. With real-time confirmation reporting of the setting force applied and a variable setting speed, the ReSOLVE service's setting tool is a reliable, low-risk alternative to the conventional use of explosives to set plugs and packers. Not using explosives provides a significant advantage for operations in locations where explosives security and safety concerns can complicate logistics and cause delays. In addition, the setting tool can be performance tested at the surface before deployment, and radio silence is not necessary during operations.

Milling tool

The ReSOLVE service's milling tool mills through debris and scale buildups, tubing restrictions, and plugs. The TuffTRAC* cased hole services tractor is seamlessly integrated to automatically drive the ReSOLVE service system forward and resist rotation while the milling tool's rotating bit engages the obstruction. Unlike for conventional uninstrumented milling tools, the

engineer is fully informed of the tool's performance status through real-time monitoring while dynamically controlling the bit speed and weight on bit (WOB).

The MillOptimizer* autonomous milling system automatically adjusts the WOB to achieve a particular torque. Bit torque is constantly monitored and WOB adjusted by the TuffTRAC tractor to maintain a constant bit speed. With the MillOptimizer system's coordinated control, the tractor and milling tool operate as a single intelligent system to maximize milling efficiency and prevent stalling. Any bit stalling is immediately detected by the MillOptimizer system, which automatically stops the tool, disengages the scale by reversing the bit and the tractor, and then resumes milling.

The milling tool's novel PDC bit is designed and manufactured by Lyng Drilling, a Schlumberger company. Optimized for maximum rate of penetration (ROP) when milling hard scale buildup, this groundbreaking mill bit achieves the highest rate of scale volume milled within the power limits of electric wireline.

Active debris removal tool

The ReSOLVE service's active debris removal tool efficiently vacuums wellbore debris to enable access for further interventions or tractor conveyance. The debris removal tool uses a powerful downhole pump to generate localized circulation of the wellbore fluid and collect settled debris. Bailers remove solids from the flow through a combination of gravity separation and filtration, trapping debris to eliminate the risk of losing debris as the toolstring is recovered to the surface. The pump can be operated in both the collecting and jetting functions in the same run. This capability makes it possible to unblock the bailer intake or stir up settled debris as needed, and it can also be used to free the toolstring if it becomes buried in debris. The real-time measurement capability of ReSOLVE service's debris removal tool enables operators to detect when the bailers are clogged or full to appropriately adjust the pumping rate, initiate jetting, or work the toolstring to optimize collection efficiency.

Measurement Specifications

	Shifting	Setting	Milling	SST	Debris Removal
Output	Basic ReSOLVE service configuration: wellbore pressure, wellbore temperature, head tension, casing collar locator, head voltage, DC current, optional gamma ray				
	Anchor force, linear force, anchor displacement, linear displacement	Setting force	Bit torque, WOB, bit speed (rpm), relative bearing (tool orientation)	Key radial force, key radial position	Pump torque, pump speed (rpm)
Resolution	Basic ReSOLVE service configuration: Wellbore pressure: 17 psi [117 kPa], wellbore temperature: 0.36 degF [0.2 degC], digital CCL: 0.02 V, head tension: 8 lbf [36 N]				
	Linear force: 43 lbf [191 N]	Setting force: 50 lbf [222 N]	Bit torque: 0.2 ft.lbf [0.27 N.m]	Key radial range: 5 lbf [22 N]	Pump torque: 0.2 ft.lbf [0.27 N.m]
	Linear displacement: 0.005 in [0.127 mm]		Bit speed: 0.5 rpm	Key radial position: 0.050 in [1.27 mm]	Pump speed: 0.5 rpm
	Anchoring diameter: 0.004 in [0.10 mm]				
	Anchoring force: 60 lbf [267 N]				
Mud type or weight limitations	None	None	None	None	Liquid phase needed at cleaning point
Special applications			Complete range of standard brushes, hones, and other accessories and a full set of bits, with custom bits made on request		Custom applications on request for bidirectional pump capabilities to clean, jet, circulate, and spot

Mechanical Specifications

	Shifting	Setting	Milling	SST	Debris Removal
Temperature rating	302 degF [150 degC]	302 degF [150 degC]	302 degF [150 degC]	302 degF [150 degC]	302 degF [150 degC]
Pressure rating	20,000 psi [138 MPa] High-pressure version: 30,000 psi [207 MPa]	20,000 psi [138 MPa] High-pressure version: 30,000 psi [207 MPa]	20,000 psi [138 MPa]	20,000 psi [138 MPa] High-pressure version: 30,000 psi [207 MPa]	20,000 psi [138 MPa]
Performance limits	Anchoring range: 3.13–5.10 in [7.95–12.95 cm] Anchoring range, large-pipe version: 4.63–6.60 in [11.76–16.74 cm] [†] Linear range: 20 in [50.8 cm] Linear force: 40,000 lbf [177,930 N]	Setting range: 11.4 in [28.96 cm] Setting force: 78,000 lbf [346,960 N]	Max. milling torque: 250 ft.lbf [339 N.m] Max. bit speed: 130 rpm	Key opening range: 3.13–5.10 in [7.95–12.95 cm] Key radial force: 700 lbf [3,113 N]	Max. pump differential pressure: 200 psi [1.38 MPa] Max. pump flow rate: 25 galUS/min [95 L/m] Stackable bailer capacity: 0.2 galUS/ft [2.5 L/m] [‡]
Borehole size — min.	3.2 in [8.13 cm]	4 in [10.16 cm]	3.2 in [8.13 cm] [§]	3.2 in [8.13 cm]	3.2 in [8.13 cm]
Borehole size — max.	6.7 in [17.02 cm]	— [†]	— [†]	— [†]	— [†]
Outside diameter	3.125 in [7.94 cm] High-pressure version: 3.625 in [9.21 cm] Large-pipe version: 4.624 in [11.75 cm]	3.625 in [9.21 cm]	3.125 in [7.94 cm]	3.125 in [7.94 cm]	3.125 in [7.94 cm]
Length	25.0 ft [7.62 m] ^{††}	18.9 ft [5.76 m] ^{††}	8.7 ft [2.65 m] ^{††}	5.5 ft [1.79 m] ^{††}	No bailer: 12.0 ft [3.66 m] ^{††}
Weight	489 lbm [223 kg]	423 lbm [192 kg]	441 lbm [200 kg] ^{††}	141 lbm [64 kg]	271 lbm [123 kg]
Tension	60,000 lbf [266,890 N]	60,000 lbf [266,890 N]	60,000 lbf [266,890 N]	60,000 lbf [266,890 N]	60,000 lbf [266,890 N]
Compression	20,000 lbf [88,960 N]	20,000 lbf [88,960 N]	20,000 lbf [88,960 N]	20,000 lbf [88,960 N]	20,000 lbf [88,960 N]

[†] Other sizes available on request

[‡] Configuration dependent

[§] Based on current minimum bit size

^{††} Complete toolstring, without a tractor or logging head

^{††} Minimum with two drives