

Smart Shifting Tool

ReSOLVE iX extreme-performance instrumented wireline intervention service

Powerful integration of high-expansion anchor, high-force linear actuator, and smart shifting tool for efficient and effective shifting

-  **Temperature:**
Rated to 350 degF [177 degC]
-  **Pressure:**
Rated to 20,000 psi [138 MPa]
-  **Certification:**
NACE MR0175 compliant
-  **Real time:**
Control and verification
Shifting force measurement
-  **Adaptability:**
Multiple shifting operations
in one run

Applications

- Smart shifting
 - Latching of multiple shifting profiles in any well condition
 - High controllability for multiple shifting actions in a single run
 - Sliding sleeves in multizone completions or isolation valves
 - Large expansion ratio for shifting components below restrictions
- High-force, high-expansion anchoring
 - Large expansion ratio for anchoring tubulars below restrictions
 - Minimized tubing impression while applying maximized traction
- High-force linear actuation
 - Bidirectional capability for shifting open or close in a single run.
 - Highly controllability for shifting to any demanded positions
 - Instrumentation enabling measurement of completion-element shifting fingerprint
 - Shifting action diagnosis and malfunction detection

How it improves well intervention

The ReSOLVE iX* extreme-performance instrumented wireline intervention service provides reliable shifting via an anchor, linear actuator, and smart shifting tool (SST). Whether in HPHT, deviated, restricted access, or sour well conditions, these instrumented tools provide 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 iX 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 iX service eliminates reliance on estimates and assumptions that is typical with conventional surface wireline mechanical tension and electrical power-controlled intervention methods.

Reliable latching in any well is made possible by detecting diameter changes, and shifting is confirmed by measuring shifting force vs. the shifting displacement valve fingerprint. The service also detects unexpected behavior and provides insight into downhole conditions so you can remediate issues using the most effective solution.

Conveyance is on wireline by gravity or on tractor in highly deviated and horizontal wells.

How it works

By integrating the anchor, linear actuator, and SST modules, ReSOLVE iX service reliably applies controlled axial force to well components. Since the SST's keys can be closed and opened on command and the linear actuator is bidirectional, it can achieve

multiple shifts in any direction in a single run, whether to a single component or multiple components in multizone completions.

First, the SST is used to seek the shifting profile by applying low pressure to the shifting keys, navigating through internal diameter changes. This movement can be generated by a wireline winch, a wireline tractor, or a linear actuator with the tool anchored. The anchor module opens with the industry's largest expansion, spanning nearly 3 in [5 cm] as standard from the tool OD to the tubing. Up to 50,000 lbf [222,411 N] of anchoring force is precisely applied on surface command by the innovative low-stress anchor grips that minimize impact on the tubing while maximizing traction. Once the shifting profile is latched and anchoring is confirmed to surface by ReSOLVE iX service's real-time measurements, the linear actuator can be extended or retracted multiple times as necessary to apply the required, controlled force of up to 16,000 lbf [71,171 N] to a specific well component. Continuous measurements of displacement and applied force validate completion of the operation.

In addition to the measurements made by the linear actuator module, the SST provides the profile key radial force, which is fully controllable and adjustable. The SST can also be used as a profilometer, providing a qualitative profile of the completions geometry. These measurements provide real-time positive confirmation that a device has been effectively shifted.

During conveyance in the well, the tool's keys are fully retracted, remaining closed to keep the tool OD at 2 1/8 in.



ReSOLVE iX service integrates the anchor, linear actuator, and smart shifting tool.

Smart Shifting Tool

What it replaces

Conventional shifting tools do not collect or use downhole measurements within an in-tool hierarchal control ecosystem. ReSOLVE iX service's seamless integration of the anchor, linear actuator, and SST resolves this gap to improve operational efficiency and reduce operational risks.

What else I should know

ReSOLVE iX service's shifting capabilities are easily configurable to adapt to all potential downhole conditions. A wide variety of keys is available to best fit the profile to be shifted. For unique applications, a dedicated Schlumberger engineering team can design and qualify customization kits upon request. System integration testing can also be performed for particular shifting applications.

The instrumentation that ReSOLVE iX service brings to the shifting application enables comparing the behavior of the shifting operation to a reference to monitor, control, and confirm the shifting progress and detect any unexpected completion element malfunction.

Specifications	
	ReSOLVE iX Service's Smart Shifting Tool [†]
Output	Head tension Casing collar locator (CCL) and optional gamma ray Wellbore pressure Selective shifting tool: profile key radial force Wellbore temperature Accelerometer for anchor slippage indication Anchor: radial force, radial position, and displacement Linear actuator: axial force, extension, and retract measurement Smart shifting tool: profile key radial force and diameter change indication in seek mode
Anchor module [‡]	Max. opening diameter: [‡] 5.2 in [132 mm] Opening diameter measurement resolution: [‡] 0.01 in [0.254 mm] Max. anchoring force: ^{‡,§} 50,000 lbf [222,411 N] Max. closing force: ^{‡,§} 25,000 lbf [111,205 N]
Linear actuator module [‡]	Stroking length: 12 in [304.8 mm] Min. linear actuator displacement measurement resolution: ^{§,††} Indirect measurement: 0.05 in (1.27 mm) Direct measurement: 0.35 in [8.89 mm]
Smart shifting tool module [‡]	Max. opening diameter: [‡] 5.3 in [134.62 mm] Max. opening force: ^{‡,§} 24,000 lbf [106,757 N]
Mud type and weight	All
Pressure rating	20,000 psi [138 MPa]
Temperature range	32 to 350 degF [0 to 177 degC]
Hole size—min.	2.2 in [55.9 mm]
OD [‡]	2½ in [53.97 mm]
Length—min. [‡]	42 ft [12.80 m] (anchor, linear actuator, and smart shifting tool combined)
Weight [‡]	366 lbm [166 kg] (anchor, linear actuator, and smart shifting tool combined)
Tension	25,000 lbf [111,205 N]
Compression	18,000 lbf [80,068 N]
Special applications	NACE MR0175 compliant for H ₂ S and CO ₂ resistance Fishing capability: Optional 3½- or 2½-in [79.38- or 53.97-mm] WIREd* wireline inline release devices above and below tractors

[†] All values are for standard specifications and are subject to change without notice. A dedicated engineering team is available for customizing tools to address your challenges.

[‡] Configuration dependent

[§] Measured and controlled in real time in the acquisition software

^{††} Linked to stroking speed

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