

## MaxPull

High-pull wireline conveyance system

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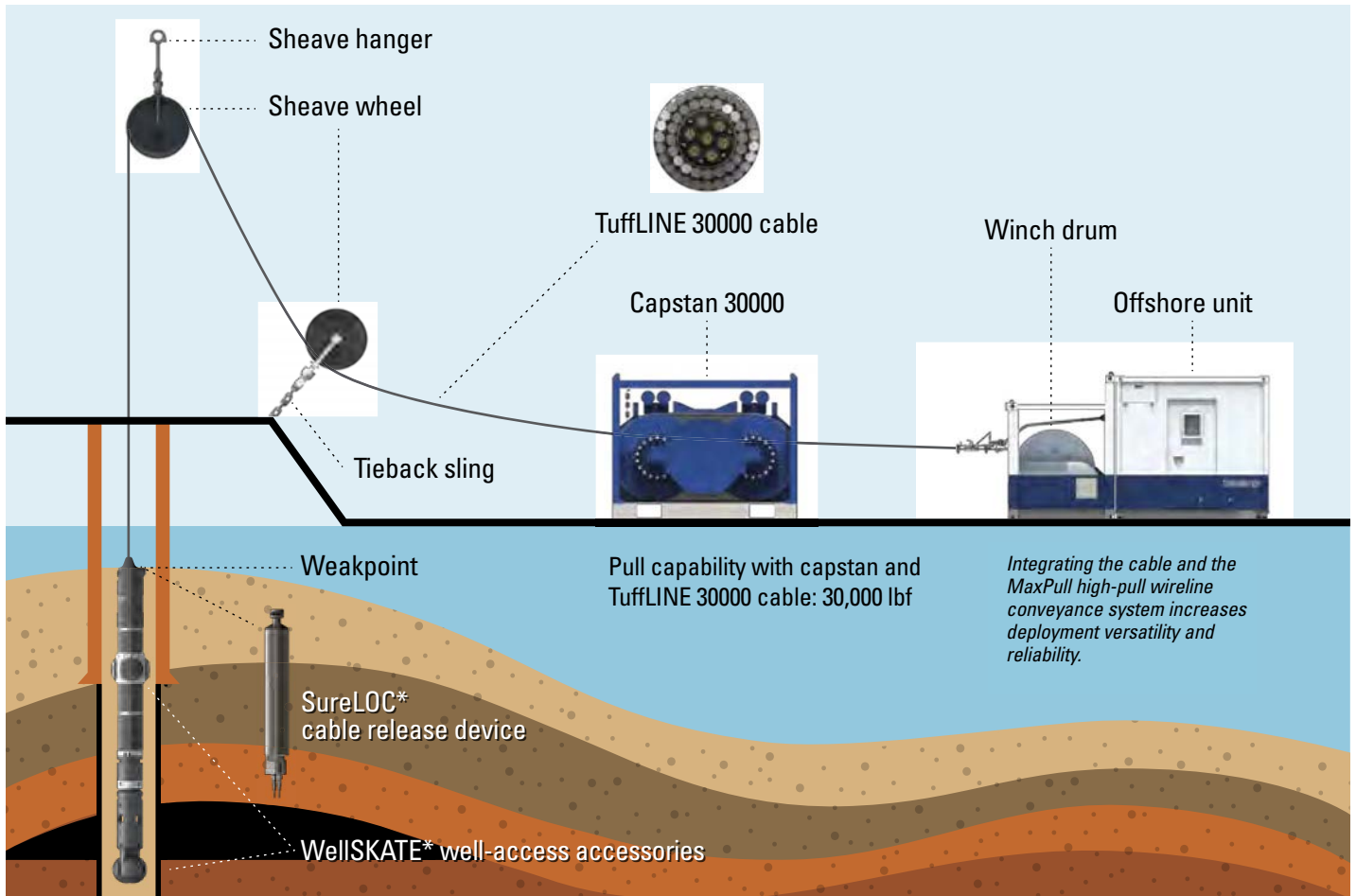
## High-pull wireline conveyance system

As drilling technology matures, the complexity achieved with deepwater, ultradeepwater, unconventional, and extended-reach wells has significantly intensified in the past decade. However, these increasingly deeper and longer wells and the diverse reservoirs they access pose heightened challenges and risk for acquiring the data needed for reservoir characterization.

To meet these challenges and effectively manage risk, the MaxPull\* high-pull wireline conveyance system integrates components specifically engineered for risk reduction to deploy wireline tools on TuffLINE\* torque-balanced composite wireline cables, including the latest addition to the industry's strongest and highest-safety cables: TuffLINE 30000 cable. The result is the world's first 30,000-lbf conveyance system, providing unparalleled safety, reliability, efficiency, and sticking avoidance, even in well trajectories and conditions that were not previously wireline accessible. Augmenting the MaxPull system's capabilities with the UltraTRAC\* all-terrain wireline tractor further increases push and pull capabilities to provide the complete conveyance solution for every possible well environment.

MaxPull systems have made it possible for operators to

- successfully log wells deeper than 36,000 ft in the Gulf of Mexico
- tractor hundreds of thousands of feet in horizontal wells in North American unconventional plays
- effectively reduce tool sticking risk in emerging deepwater reservoirs
- eliminate conventional reliance on costly and time-consuming drillpipe conveyance for increasingly complex well environments
- save millions of dollars on maintenance transportation trips needed for conventional high-strength cables deployed in challenging remote exploration wells.



# MaxPull systems: The high-pull conveyance solution for any well

Introduction of the new MaxPull 30000 system further extends the conveyance capabilities of the world's most comprehensive, highest-pull, and customizable conveyance solution for any well profile—even in the most challenging land and offshore environments.

## Applications

MaxPull conveyance systems are customized for the well environment and the logging program to provide the most efficient and lowest risk wireline acquisition solutions:

- Deepwater and ultradeepwater wells up 40,000 ft in depth and requiring potentially 30,000 lbf in pull capability
- Land and offshore deviated-development reservoirs
- Land and offshore extended-reach and horizontal wells
- Unconventional wells
- Complex-geometry boreholes
- Extended-reach wells in unconsolidated formations

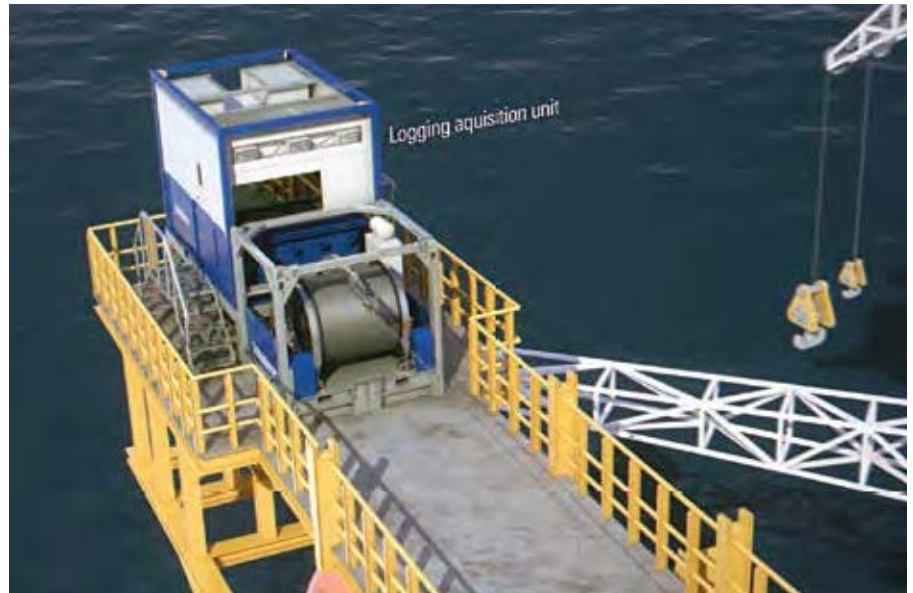
## Benefits

By engineering out the traditional limitations of wireline acquisition, MaxPull conveyance systems provide maximum rig flat-time savings and numerous other benefits:

- Rig flat-time savings from highly reduced tool sticking risk
  - High pull capability across the system
  - Aided by bidirectional tractor force
  - Multiple jarring and cable cycling capabilities
- Rig-time savings through improved well access efficiency
- Rig-time savings with fewer descents of longer, heavier tool combinations and faster logging speeds
- Rig-time savings by elimination of reliance on pipe-conveyed logging in any borehole geometry
- More informed decision making based on cost-effective, complete, comprehensive, and highest possible resolution acquisition of reservoir data in any borehole environment

- Reduction in logistics costs and maintenance turnaround time resulting from no routine cable maintenance trips to shore during the complete well drilling program
- 24 hours of rig-time savings by eliminating the cable seasoning required for all standard high-tension cables
- Elimination of cable depth accuracy issues that occur with conventional cables
- Rig-time savings from reduced seal failures by positioning large wireline formation tester toolstrings with rollers
- Elimination of geometry constraints on pilot wells for data acquisition by extending wireline access beyond gravity descents
- Prevention of information gaps through cased hole access for advanced data acquisition
- Increased safety for high-tension operations with risk mitigation and prevention
- Improved wireline logging efficiency from fewer runs of heavier, longer tool combinations and avoidance of drillpipe conveyance

- Reduced cable maintenance and related transportation logistics
- Greater sticking avoidance through minimized risk of fishing operations and associated rig flat time
- Substantial deepwater rig-time savings with no cable seasoning required



*Whether operations are routine or high tension, the offshore unit and winch drum are just two of the integrated components that are specified to support the necessary pull capability of the MaxPull conveyance system.*





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# MaxPull 30000 System

The MaxPull system can be deployed as a standard conveyance system or customized for optimal wireline performance delivery in all well configurations across all land and offshore environments.

- 30,000-lbf TuffLINE 30000 composite cable
- OSU-N high-capacity unit
- Capstan 30000 with 30,000-lbf tension-relief capability
- WDR-70 drum with 43,000-ft cable capacity
- Surface-programmable smart wireline jar
- WellSKATE low-friction well-access accessories and Petromac Wireline Express
- SureLOC electronically controlled cable release device (ERCD) complemented by multiple inline release devices positioned strategically along the toolstring
- UltraTRAC all-terrain wireline tractor for additional 3,000 lbf of push and pull
- MaxWell\* integrated field acquisition system for management of power, telemetry, and data

The modular MaxPull 30000 conveyance system is tailored to optimize wireline performance for the well's specific environment.



The OSU-N offshore unit deploys TuffLINE 30000 cable from the 43,000-ft capacity WDR-70 drum to increase operational safety and efficiency.

## Specifications

	OSU-N Offshore Unit
Modular components	Power pack module (POSU): <ul style="list-style-type: none"> <li>• Redundant, dual electrohydraulic, base frame mounted</li> </ul> Logging module (COSU): <ul style="list-style-type: none"> <li>• Full-service ultradeepwater cabin</li> </ul> Winch module (WOSU): <ul style="list-style-type: none"> <li>• Ultradeepwater WOSU with WDR-70 drum</li> <li>• High-tension WOSU with WDR-59 drum</li> </ul>
Acquisition system	Full-configuration MaxWell system with dual eWAFE acquisition interface
Drum capacity	WDR-70 with TuffLINE 30000 cable: 43,000 ft [13,100 m] WDR-70 with TuffLINE 26000 cable: 43,000 ft [13,100 m] WDR-59 with TuffLINE 18000 cable: 33,000 ft [10,060 m]
Pull capacity without capstan	18,000 lbf [80,070 N]
Capstan pull capability	Deck-mounted dual drum (WDDC-BD): 30,000 lbf [133,450 N]
Special applications	Single deployment DNV 2.7-1 Quick-swap winch drum capability



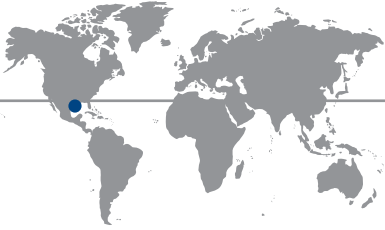
The recently introduced **TuffLINE 30000 torque-balanced composite cable** is the industry's highest-strength cable. Like TuffLINE 18000 and TuffLINE 26000 cables, TuffLINE 30000 cable employs the breakthrough technology of polymer-locker armors to overcome the fundamental limitations of current armored cables. The cable's inherent torque is balanced by increasing the thickness of the inner armor strands. Polymer encapsulation effectively locks the armors to prevent armor torque accumulation. The result is cable in a permanent ends-fixed condition, which raises the ends-free breaking strength safety margin of TuffLINE 30000 cable to an unprecedented 10,000 lbf above the safe working load (SWL) of standard high-pull armored cable. TuffLINE 30000 cable also has an ends-fixed breaking strength in excess of 43,000 lbf.

TuffLINE 30000 cable incorporates industry-leading 16 AWG gauge conductors to enable reliable conveyance of tool combinations longer than 175 ft and at 6,000 lbf in well depths exceeding 40,000 ft. Combining tools reduces the number of descents in the well, saving an average of 12 hours or more per trip on a deepwater rig.

## Specifications

	TuffLINE 30000 Cable
Ends-fixed breaking strength	>43,000 lbf [>191,270 N]
Ends-free breaking strength	>39,000 lbf [>173,480 N]
Safe working load	30,000 lbf [133,450 N]
Temperature rating	1 h: 465 degF [241 degC] 24 h: 450 degF [232 degC]
Cable OD	0.535 in [1.36 cm]
Cable weight	In air: 524 lbf/1,000 ft [234 kg/300 m] In freshwater: 425 lbf/1,000 ft [190 kg/300 m]
Max. (rms) voltage, V	Per helical conductor: 780 Center conductor: 1,235
Max. current per conductor, A	2.6

## Case Study



### MaxPull 30000 system: >29,300-lbf pulled, Gulf of Mexico

A Gulf of Mexico operator wanted to improve efficiency and minimize risk in conducting a logging program in a highly tortuous deepwater well. Conventional logging on drillpipe was indicated because tension modeling of the multiple planned runs determined that all would have extreme values of normal logging tension, with the highest requiring 20,900 lbf. However, logging on drillpipe would be a lengthy and costly operation as a result of the well's complex trajectory and depth.

Instead of logging on drillpipe, the operator elected to more efficiently convey the logging toolstrings on wireline with the MaxPull 30000 high-pull system. The MaxPull 30000 system uses TuffLINE 30000 composite cable, which is the industry's highest strength cable. Whereas conventional high-pull technology permits only three pull cycles at 21,000 lbf,

the MaxPull 30000 system enables multiple pull cycling at up to 30,000-lbf pull. The advanced Well Conveyance Planner was used to specify the MaxPull system's modular components, including WellSKATE low-friction well-access accessories, for the well's complex environment.

The high pull capacity of the MaxPull 30000 system successfully mitigated sticking risk for the operator. During the MDT\* modular formation dynamics tester run, the toolstring became stuck upon completion of an extended sampling station. Initial attempts at 26,000 lbf were not sufficient to free it. It took a pull in excess of 29,300 lbf to free the toolstring, which saved USD 3,050,000 for the operator by avoiding a 4-day fishing job along with the loss of valuable reservoir fluid and pressure data.



*Only the MaxPull 30000 high-pull wireline system has the pull capacity to minimize tool stickance and the associated operational cost and risk.*

# MaxPull 26000 System

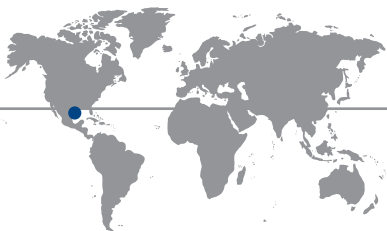
- 26,000-lbf TuffLINE composite cable
- OSU-PA or OSU-N high-capacity unit
- Capstan 26000 with 26,000-lbf tension relief capability
- 28,000-ft (WDR-59 drum) or 43,000-ft (WDR-70 drum) cable capacity
- Surface-programmable smart wireline jar
- WellSKATE low-friction well access accessories and Petromac Wireline Express
- SureLOC electronically controlled cable release device and multiple inline release devices
- UltraTRAC all-terrain wireline tractor for additional 3,000 lbf of push and pull
- MaxWell integrated field acquisition system for management of power, telemetry, and data

The 26,000-lbf MaxPull high-pull conveyance system conveys TuffLINE 26000 cable on the specially designed high-tension OSU-N offshore unit.

The **OSU-N unit** fully integrates tension-relieving capstan control with the WDR-70 high-strength drum to provide a safer, seamless operation, enabling the winch operator to focus on well conditions. Longer, heavier toolstrings can be deployed on TuffLINE 26000 cable at sustained 26,000-lbf tension in the well at speeds to 15,000 ft/h. The OSU-N unit is equipped with the Enhanced Wireline Acquisition Front-End (eWAFE) acquisition system to provide full redundancy, increased power, and enhanced telemetry for deploying large tool combinations in ultradeep wells.

The advanced **Well Conveyance Planner** forecasts logging tensions and determines the associated risk to provide design recommendations for the optimal conveyance package, including WellSKATE low-friction well-access accessories, Petromac Wireline Express, and SureLOC ECRD. If required, wireline deployment can be augmented with the use of wireline tractors to provide a complete conveyance solution for every possible well environment, with pull and push capabilities increased by up to 3,000 lbf downhole.

## Case Study



### TuffLINE 26000 cable provides 7,000-lbf overpull at 32,000 ft with 22,000-lbf maximum surface tension, Gulf of Mexico



*The heavy-duty capstan integrated with the OSU-N unit provides tension relief to increase pull capability.*

Using TuffLINE 26000 cable has reduced conveyance risk while improving data quality and rig efficiency for the operator of a Gulf of Mexico ultradeepwater well. The extensive openhole evaluation program planned for the well included wireline services requiring high power. To provide maximum overpull at the logging head for sticking mitigation while also delivering the required power, the operator specified running TuffLINE 26000 cable with its unique combination of ultrahigh strength and high-power conductors on the capstan-equipped OSU-N offshore unit.

The seven descents to depths exceeding 33,000 ft had an average logging tension close to 14,000 lbf. A stuck tool was freed at a maximum surface tension of 22,000 lbf, which is beyond the capability of conventional high-strength cable. TuffLINE 26000 cable provided 7,000 lbf of overpull at the logging head at 32,000 ft in the well, saving the

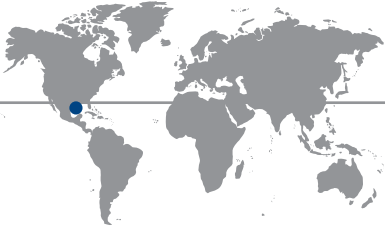
operator from a fishing operation requiring several days of rig time.

Using TuffLINE 26000 cable enabled setting the wireline jars at nearly 8,000 lbf to ensure that they would fire only if absolutely necessary. The chance of jar activation by minor overpulls was significantly reduced to preserve tool function for continued operations. Rig efficiency was also improved because no cable change was required during the logging operations to switch from ultrahigh strength cable to high-power cable—TuffLINE 26000 cable meets both requirements. Not switching cable saved nearly USD 200,000 in rig time.

TuffLINE 26000 cable also has a lower stretch coefficient than standard cables to deliver smoother logging passes at extreme depths that improved borehole logging data quality for the operator.



## Case Study



### MaxPull 26000 system: Gulf of Mexico

When the 21,000-lbf conventional high-tension system was introduced in 2010, deepwater fishing incidents dropped to less than 1% of total descents. However, each fishing operation still required 3 days of rig time, so the associated deepwater fishing NPT remained at high levels.

The 26,000-lbf MaxPull high-pull system began deployment in the Gulf of Mexico in October 2014, providing a 25% increase in pull over the conventional 21000 system, which until then had been the industry's strongest wireline conveyance system. By enabling pulls exceeding 21,000 lbf, the MaxPull 26000 system made it possible to prevent four instances of otherwise unavoidable fishing incidents, saving more than 12 deepwater fishing days and USD 9 million of rig time.

In 2015, Gulf of Mexico fishing incidents dropped to a record low 0.4% of total descents.



*Introduction of the MaxPull 26000 system has appreciably decreased fishing flat time in the Gulf.*

# MaxPull 18000 System

- 18,000-lbf TuffLINE composite cable
- OSU-PA or OSU-PB 18,000-lbf modular unit
- WDR-59E with 32,000-ft capacity drum
- Surface-programmable smart wireline jar
- WellSKATE low-friction well-access accessories and Petromac Wireline Express
- SureLOC electronically controlled cable release device and multiple inline release devices
- UltraTRAC all-terrain wireline tractor for additional 3,000 lbf of push and pull
- MaxWell integrated field acquisition system for management of power, telemetry, and data

## Specifications

	<b>TuffLINE 18000 Cable</b>
Ends-fixed breaking strength	28,000 lbf [124,550 N]
Ends-free breaking strength	27,000 lbf [120,100 N]
Safe working load	18,000 lbf [80,070 N]
Temperature rating	1 h: 465 degF [241 degC] 24 h: 450 degF [232 degC]
Cable OD	0.5 in [1.27 cm]
Cable weight	In air: 416 lbm/1,000 ft [189 kg/300 m] In freshwater: 331 lbm/1,000 ft [150 kg/300 m]
Max. (rms) voltage, V	Per helical conductor: 800 Center conductor: 1,250
Max. current per conductor, A	1.61



*TuffLINE 18000 torque-balanced, crush-proof composite cable is for operations with up to 18,000-lbf tension.*

## OSU-PA offshore unit

The modular **OSU-PA offshore unit** is the Schlumberger flagship capstan-optional heavy-duty unit, capable of pulling up to 18,000 lbf with a drum capacity of 33,000 ft of TuffLINE 18000 cable. Conveyance integration of the OSU-PA and TuffLINE cable on the WDR-59 high-strength drum provides continuous spooling at up to 13,000-lbf tension and instantaneous pull of 18,000 lbf for stick prevention and mitigation without a capstan, as certified to Det Norske Veritas (DNV) 2.22. Addition of the deck- or derrick-mounted dual-drum capstan raises pull capability to 24,000 lbf, with the capstan itself rated to 26,000 lbf.

The OSU-PA unit is equipped with the eWAFE acquisition system to provide full redundancy, increased power, and enhanced telemetry for deploying large, seamless tool combinations in ultradeep wells.

The OSU-PB and MONU-B versions are electrohydraulic units certified for Zone 2 operations.



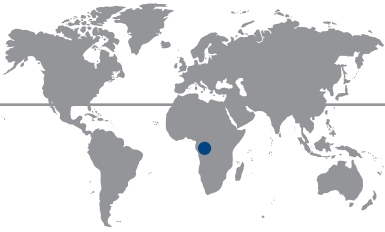
*The modular OSU-PA offshore unit is DNV certified capable of pulling up to 18,000 lbf.*

The advanced **Well Conveyance Planner** is used to forecast logging tensions, provide design recommendations for the optimal conveyance package, and determine the associated risk. The result is an integrated high-tension conveyance system that minimizes risk, helps prevent tool sticking, and delivers effective tools for reducing high fishing NPT.

## Specifications

	<b>OSU-PA and OSU-PB Offshore Units</b>	<b>MONU-B Offshore Unit</b>
Modular components	Power pack module (POSU): <ul style="list-style-type: none"> <li>• Diesel (OSU-PA)</li> <li>• Electrohydraulic (OSU-PB)</li> </ul> Logging module (COSU): <ul style="list-style-type: none"> <li>• High-tension cabin</li> </ul> Winch module (WOSU): <ul style="list-style-type: none"> <li>• High-tension WOSU with WDR-59 drum</li> </ul>	Power pack module (EHPS): <ul style="list-style-type: none"> <li>• Electrohydraulic</li> </ul> Logging module (ONCC): <ul style="list-style-type: none"> <li>• Offshore NORSOK-compliant cabin</li> </ul> Winch module (WDDS or WOSU): <ul style="list-style-type: none"> <li>• Zone-rated WDDS with WDR-59 drum</li> <li>• High-tension WOSU with WDR-59 drum</li> </ul>
Acquisition system	Full-configuration dual eWAFE system	Full-configuration dual eWAFE system
Drum capacity	WDR-59 with TuffLINE 18000 cable: 33,000 ft [10,060 m]	WDR-59 with TuffLINE 18000 cable: 33,000 ft [10,060 m]
Pull capacity without capstan	WOSU: 18,000 lbf [80,070 N]	WDDS: 11,400 lbf [50,710 N] WOSU: 18,000 lbf [80,070 N]
Pull capacity with capstan	WOSU: 24,000 lbf [106,760 N]	WDDS and WOSU: 24,000 lbf [106,760 N]
Capstan pull capability	Zone-rated, deck-mounted dual drum (WDDC-BB): 26,000 lbf [115,650 N] ATEX zone-rated, CE-marked, deck- or derrick-mounted dual drum (ZPPC): 26,000 lbf [115,650 N]	ATEX zone-rated, CE-marked, deck- or derrick-mounted dual drum (ZPPC): 26,000 lbf [115,650 N]
Special applications	Single or modular deployment DNV 2.7-1, 2.7-2, 2.22 OSU-PB: CE and ATEX Zone 2	Modular deployment WOSU: DNV 2.7-1, 2.7-2, 2.22 NORSOK and CE Zone 2

## Case Study



### MaxPull 18000 system without capstan: Total Ivory Coast S-shaped well, West Africa

Total Ivory Coast reaped numerous benefits from using TuffLINE 18000 cable in a 5,400-m, S-shaped deepwater West Africa well. Accurate tension modeling using the wireline planner indicated logging tensions in excess of 10,000 lbf. Standard high-tension equipment would require deployment of a dual-drum capstan with the corresponding increased operational risk. In the event of tool sticking, cable tension cycling would have not been possible using conventional high-tension deployment without compromising the cable's structural integrity.

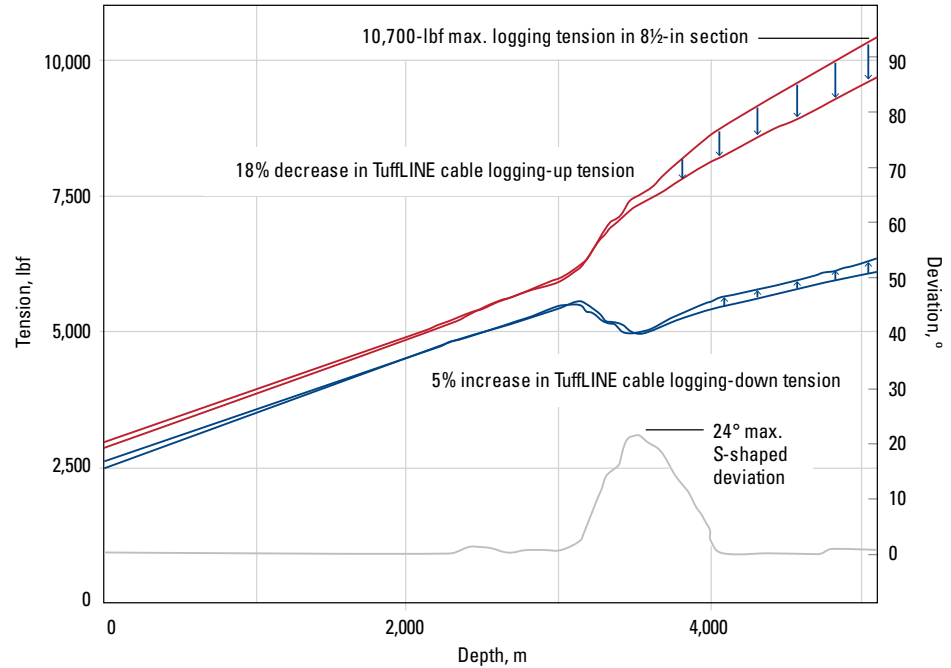
TuffLINE 18000 cable was mobilized instead and installed on the existing OSU-PA unit on short notice. Eight high-pull descents with full data acquisition were conducted without any tool sticking or HSE incidents.

The low friction coefficient of TuffLINE cable helped further by reducing the surface pull by 18% to below 10,000 lbf. The accuracy of depth control for the TuffLINE descents was within 6 cm [2.4 in], which enabled aligning sidewall coring points with the fluid extraction stations of the Saturn\* 3D radial probe. In addition to saving 4 days of rig time over conventional cable operations, MaxPull 18000 capstan-free operations delivered a 60% reduction in risk as opposed to full capstan operation.



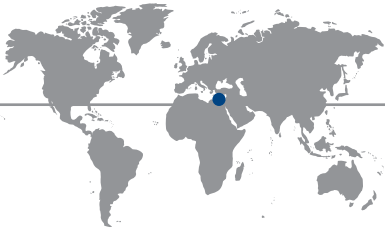


A core imprint of the XL-Rock\* large-volume rotary sidewall coring service on a subsequent Saturn 3D radial probe descent in a West Africa well indicates an unsurpassed depth control accuracy of 6 cm with capstan-free conveyance of TuffLINE 18000 cable.



Tension planner modeling for the 8 1/2-inch section in a deepwater West Africa well shows how TuffLINE 18000 cable would decrease tension. TuffLINE cable deployment also produced a 20% reduction in the effective friction coefficient over conventional high-strength cable.

## Case Study



### MaxPull 18000 system: East Mediterranean



*Schlumberger designs and manufactures a variety of innovative composite cables to meet conveyance conditions.*

As an East Mediterranean well was deepened, the logging tension was expected to exceed 10,000 lbf. Capstan deployment was not possible because of limited time and deck space. The only conventional solution was to convey the wireline logging tools on drillpipe, which would require a total of 7 days of expensive rig time.

Instead, TuffLINE 18000 cable was deployed on a short notice and the job was completed successfully in 3 days. Despite logging tension exceeding 10,000 lbf on all descents, multiple pulls to 16,000-lbf tension, and repeated cable cycling, no tool sticking occurred. Using TuffLINE 18000 cable brought the following benefits to the operator:

- Full data acquisition was completed in a record 3 days, saving 4 days of rig time and USD 5 million.
- Capstan mobilization and its associated operational and logistical risks were avoided.
- Tension cycles were successful in preventing fishing, without the risk of torque-related cable breakage.
- Cable seasoning was eliminated to save 1 day of rig time.
- Cable maintenance trip was not necessary after the job, which would have been expensive and logistically challenging for this remote operation.

## Case Study



### MaxPull 18000 system: Perenco S-shaped well, West Africa



*The number and configuration of the UltraTRAC tractor's drive sections are specified to realize optimized performance across all terrains.*

To better understand the reservoir in a highly deviated offshore well, Perenco required advanced measurements in an appraisal well rather than just basic LWD measurements. The necessary data for reservoir characterization were electrical image logs, dipole shear sonic imaging, high-resolution magnetic resonance measurements, and formation pressure tests as well as pressure-volume-temperature (PVT) fluid samples, all to be collected in an oil-base mud environment.

After a thorough study of the well details and planner modeling of the required tractor force, it was determined that the MaxPull 18000 system paired with the UltraTRAC all-terrain tractor would be suitable for the operation. Compared with running on drillpipe, tractor conveyance offered benefits in terms of rig-time saving, flexibility, and safety.

The 50-m, 4,513-lbm fluid sampling toolstring was configured to include six pairs of tractor drives for running on TuffLINE 18000 cable to provide the high pull necessary in the event of tool sticking. A SureLOC electronically controlled cable release device would reliably release the cable if the stuck tool could not be freed.

Petrophysical measurements as well as downhole formation testing and sampling were all achieved successfully in five logging runs, with a total tractored distance of 6,800 m in the unconsolidated formation with an unconfined compressive strength (UCS) ranging from below 5,000 psi to as low as 600 psi. A normal logging tension of 10,500 lbf was sustained by the MaxPull 18000 system without getting stuck. The total operational time of 70 hours represented a time saving of approximately 72 hours compared with pipe conveyance of the same services.

# MaxWell

## Integrated field acquisition system

When well depths exceed 25,000 ft, cable lengths often exceed 30,000 ft, which can cause a decrease in both data signal quality and tool power availability because of the increased electrical resistance of the conductors. The result is a reduced capacity for sensor combinations and reduced logging speeds. When standard high-tension cables and surface acquisition systems are used, at least one additional descent is required, with some descents at 50% of the nominal logging speed. TuffLINE 18000 cable and even more so TuffLINE 26000 and 30000 cables deliver far superior power and data transmission features with their AWG 18 and AWG 16 gauge conductors, respectively.

In parallel to development of the MaxPull conveyance system, Schlumberger has introduced the MaxWell integrated field acquisition system. This completely new high-power, high-speed acquisition system enables substantial improvements in data acquisition over the previous generation:

- 3.5-Mbps baud rate, a 100% increase that is the highest in the industry today
- 14 kW of tool power capacity, a 250% increase
- full surface-system redundancy, with a 100% increase in reliability
- seamless interface with the MaxWell acquisition system for a 100% increase in data processing rates.

Rig-time savings with fewer descents and faster logging speeds are enabled by the MaxWell integrated field acquisition system.

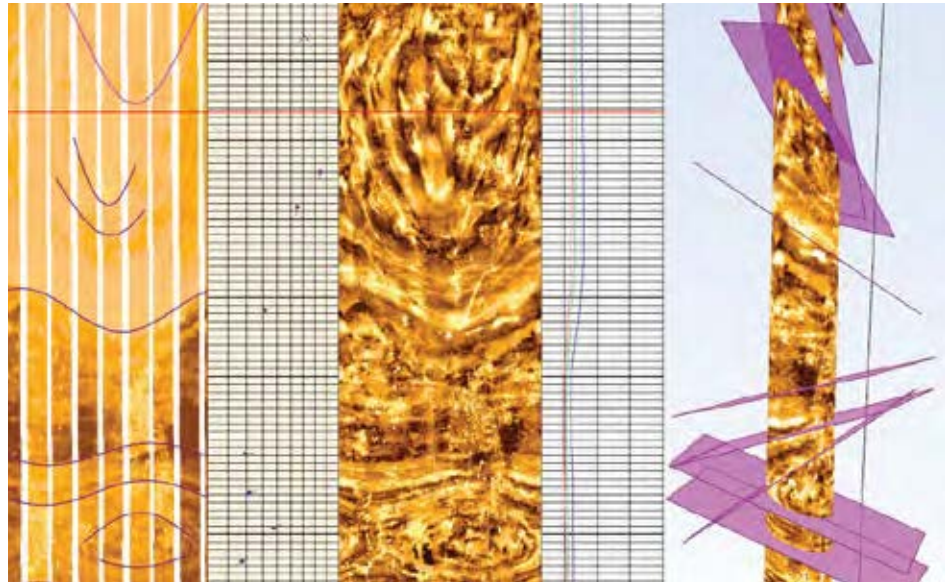
In combination with the MaxPull conveyance system, unprecedented sensor combinations and maximum physical logging speeds are possible, saving in excess of 20 hours in a complete deepwater logging operation.

In the ultradeepwater Gulf of Mexico, a common logging combination is Rt Scanner\* triaxial induction service, Sonic Scanner\* acoustic scanning platform, and Quanta Geo\* photorealistic reservoir geology service. The cumulative effect of the long cables and high rate of data acquisition by this toolstring made it impossible to acquire all the required data in one pass on standard high-strength cable. Even with partial acquisition, logging speeds were limited to 1,100 to 1,200 ft/h, which is approximately 50% of each service's rating for logging.

The integration of the MaxPull high-pull conveyance system incorporating TuffLINE composite cable and the MaxWell acquisition system effectively manages power, telemetry, and data to enable single-pass acquisition with a 60% improvement in logging speed to 1,800 ft/h.

Rig-time savings are in the order of 2 hours per descent, and where split descents were previously necessary because of acquisition system limitations, the required 12 hours for the additional descent are also saved.

Typical deepwater time savings exceed 16 hours for the combination of the MaxPull conveyance system and MaxWell integrated acquisition system.



*Quanta Geo service redefines imaging in oil-base mud to provide highly detailed, core-like microresistivity images that truly visually represent formation geology and yield critical structural information.*



# WellSKATE low-friction well-access accessories

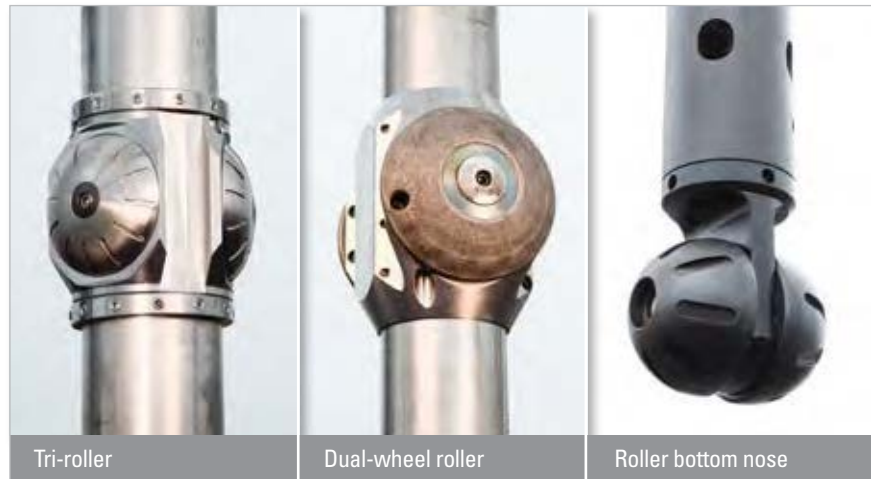
## Applications

- Open- and cased hole wireline operations, particularly stationary formation tester operations
- High well deviations (60° or more, per well conditions and geometry)
- Complex well trajectories and extended-reach wells
- Horizontal wells using alternative conveyance such as pipe or tractor
- Washed-out and rugose hole profiles

## Benefits

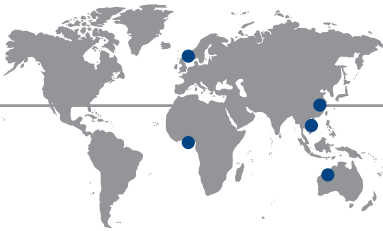
- Significantly reduced friction coefficients by rolling instead of sliding
- Reduced sensitivity to hole irregularities and minimized fishing probability by keeping the toolstring away from the borehole wall
- More efficient wireline conveyance to TD than possible on drillpipe only
- Maximized sealing surface from alignment of tester probe

WellSKATE well-access accessories help toolstrings achieve ever-deeper well access and reduce the risk of differential sticking in challenging environments by significantly reducing the frictional forces while both running in and pulling out of the well and by keeping the toolstring away from the borehole wall.



*WellSKATE accessories enable rolling instead of higher-friction sliding.*

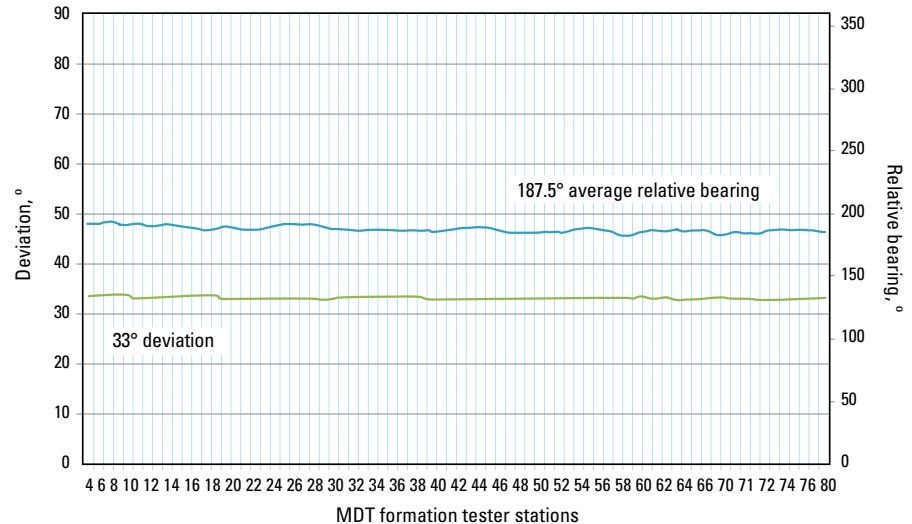
## Case Studies



Apache is using WellSKATE accessories to reduce fishing in Australia. In one deepwater reservoir with differential pressures >1,000 psi, conventionally deployed wireline tester strings would stick. But using WellSKATE accessories with the MDT modular formation dynamics tester in a well at 41° deviation and 1.8°/100-ft dogleg severity accomplished nine sampling stations requiring 17.6 hours of pumping time without any tool sticking. WellSKATE accessories also enabled an MDT tester to reach TD in a well at 59° deviation in Norway without any overpulls in the 24-hour operation.

In Vietnam, an MDT tester deployed with three tri-roller WellSKATE accessories completed seven station logs in a 36-hour operation at 15° deviation. In China, rollers similarly reduced the drag coefficient of a large MDT tester string from 0.43 to 0.17 to successfully access the target reservoir at 18,045 ft and 70° deviation.

## WellSKATE low-friction accessories improve wireline formation tester efficiency and effectiveness



*Difficulties in achieving a good probe seal in 12¼-in boreholes in West Africa were resolved by installing three dual-wheel rollers close to the probe. The WellSKATE accessories helped the tester reach TD while keeping it facing down, assuring good sealing to measure formation pressure at 80 stations for up to 8 hours per station—only one seal was lost, unlike the typical 30% rate in the field.*

# Petromac Wireline Express

## Applications

- Openhole wireline operations
- High well deviations (up to 80°)
- Washed-out and rugose holes
- Operations with risk of differential sticking
- Oriented core and fluid sampling

## Benefits

- Low tool drag and significantly reduced tension while logging
- Elevation of toolstrings above the wellbore wall to prevent differential sticking, stick/slip motion, and tool holdup from cuttings accumulation
- Seamless sliding over ledges up to 6 in
- Accurate orientation of logging tool sensors
- Prevention of rotational tracking by imaging tools

Petromac Wireline Express combines an angled hole finder and tool taxis to resolve the wellbore conditions that often compromise wireline logging operations: ledges and washouts, differential sticking, high deviation, stick/slip, and sample recovery.

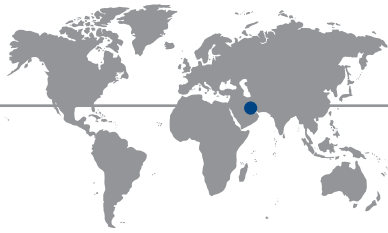
The hole finder fits all standard sizes of logging tools and wellbores. The angle is readily adjusted to suit the bit size and tool standoff.

The tool taxis are wheeled carriages with large, 6-in-diameter wheels and an active lubrication system. Their ultralow-friction bearings are pressure compensated to prevent wheel jamming. The tool taxis fit over the housing and are positively secured to the C spanner recess holes to ensure their alignment and thus orientation of the entire toolstring and its sensors.



*Positively secured to the C spanner recesses of the tool, the Petromac Wireline Express tool taxi provides both low-friction conveyance and orientation.*

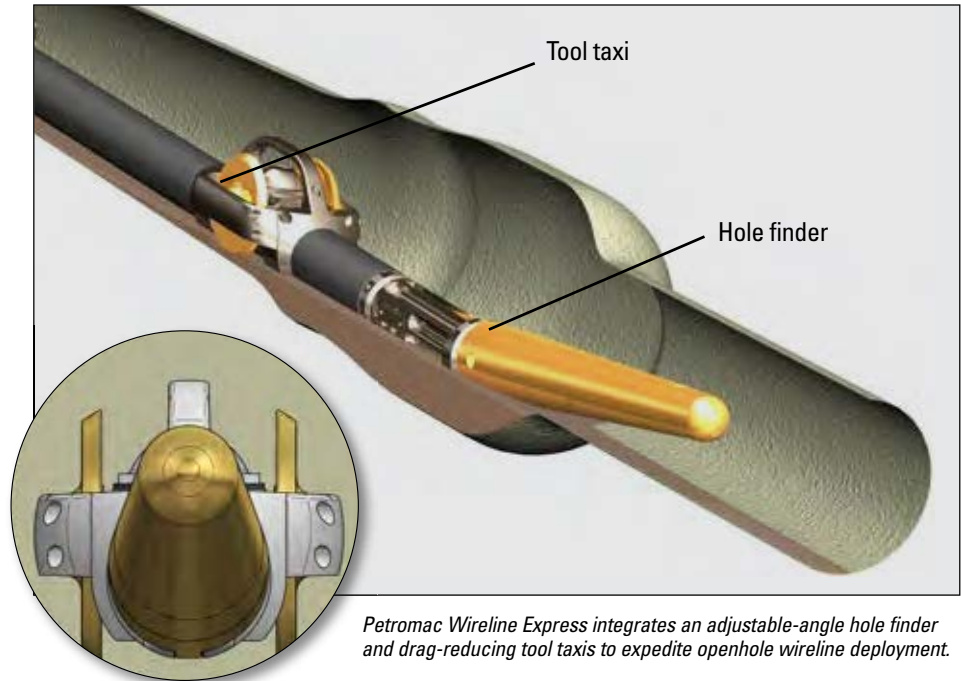
## Case Studies



Adverse well conditions often compromise logging operations in Jurassic reservoirs in Kuwait. In a single year, 48% of all logging operations involved NPT or were curtailed owing to logging difficulties. Typically, the operator ran only essential logging services because of the risk.

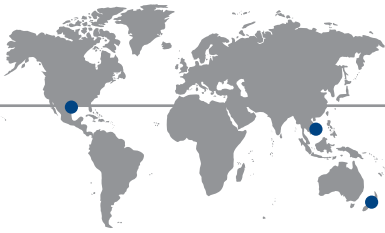
In the 18 months following the introduction of Petromac Wireline Express, the operator achieved a logging success rate of 95%. This included four logging runs at 70° deviation, setting a local record. As a result, the logging programs were expanded to include advanced logging services, such as Litho Scanner\* high-definition spectroscopy service and PressureXpress\* reservoir pressure while logging service.

## Petromac Wireline Express reliably conveys toolstrings in challenging conditions



*Petromac Wireline Express integrates an adjustable-angle hole finder and drag-reducing tool taxis to expedite openhole wireline deployment.*

## Case Studies



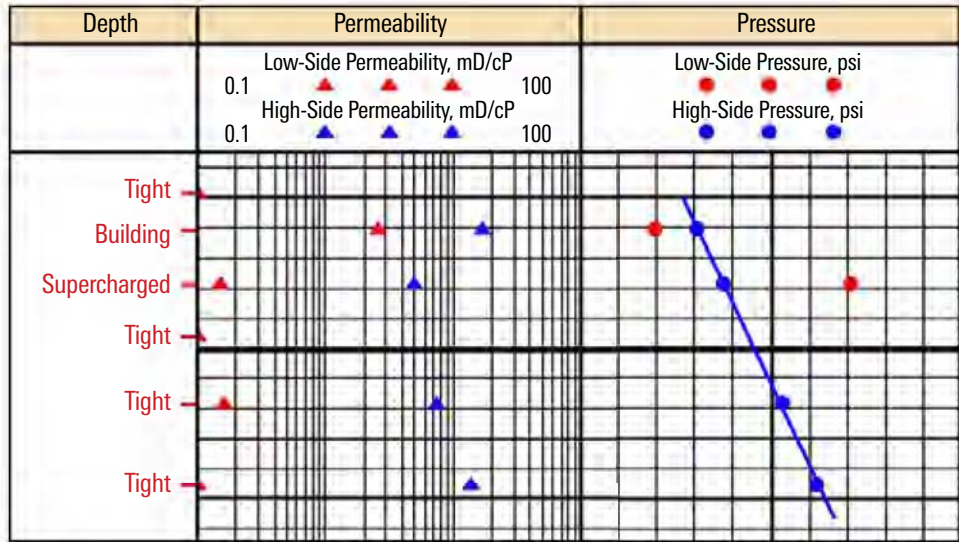
### Petromac Wireline Express advances wellbore accessibility while securing toolstring orientation

A 2,000-m field development well was drilled with water-based mud at 60° in shallow, unconsolidated formations in New Zealand. In previous wells, ledges and washouts prevented wireline logging tools from reaching TD, resulting in numerous wiper trips and cancelled jobs. Petromac Wireline Express was incorporated to serve as a the hole finder and provide seamless logging access through its capability to slide over 5-in-high ledges in 8½-in hole. The operator now routinely runs Wireline Express in all wells, which has enabled expansion of the logging program.

An operator in the Gulf of Mexico asked the incumbent oilfield services provider at the wellsite to log the 73° well on wireline. The provider refused, insisting that the only way that the well could be logged was by using pipe conveyance. The operator approached Schlumberger, which suggesting using Wireline Express. The tool taxis reliably conveyed the logging toolstring in the deviated well, carrying the appropriately oriented logging tools over wellbore cuttings and across rugose sections. Buoyed by the success of the deployment, the operator expanded the logging program and realized substantial rig-time and cost savings by avoiding pipe-conveyed logging.

In an offshore Vietnam well, pressure tests conducted on the low side of the wellbore were invalid because of low mobility and the occurrence of supercharging. On the subsequent run, a 170-ft-long MDT modular formation dynamics tester string was oriented probe up by the Wireline Express tool taxis to ensure sampling from the undamaged high side of the wellbore.

Because the permeability on the high side of the wellbore was 20× greater than the low side, the operator was able to prove hydrocarbon content from pressure gradient alone. On the same run, 12 fluid samples were successfully acquired from the low-permeability reservoirs with an average cleanup time of less than an hour.



Pressures taken from the low side of the wellbore (red) during the initial logging run were inconclusive in a tight zone. On the subsequent run with Wireline Express tool taxis orienting the MDT tester to the high side of the hole, valid pressure measurements (blue) were obtained and proved the fluid gradient.



# SureLOC electronically controlled cable release device

## Applications

- All wireline openhole and most cased hole operations
- Highly deviated and extended-reach wells
- Differentially partially stuck logging cables
- H<sub>2</sub>S environments (SureLOC 12000 device)

## Benefits

- Reliable cable release under the most challenging tool-sticking situations
- Full conveyance pull capability for stick prevention and mitigation prior to releasing the cable
- Higher-rated release devices such as the SureLOC 12000 device with increased surface pull capability
- Longer, heavier toolstring combinations to reduce well descent trips

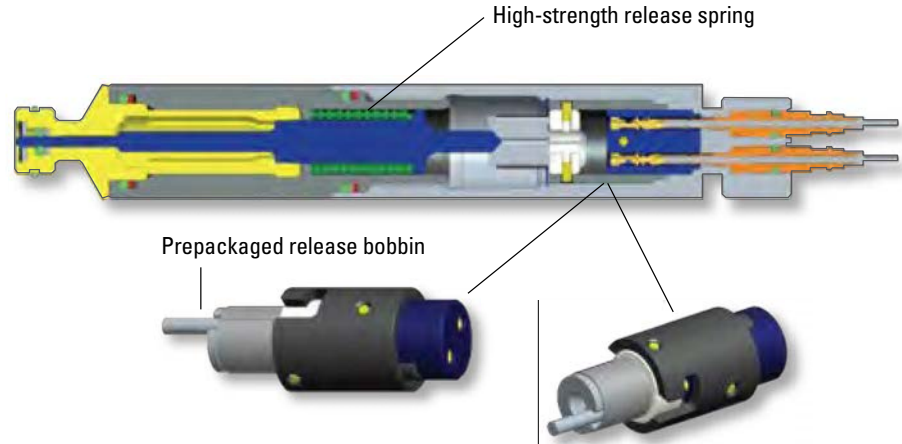


*The SureLOC device brings new capabilities and reliability to cable release under a wide range of downhole conditions.*

Mechanical weakpoints are conventionally used in operations with high cable tension to safely separate the cable from a stuck tool downhole. Different strength weakpoints are used to ensure breakage before the cable SWL is exceeded. Under certain conditions the surface-applied tension is too high or cannot be effectively transmitted to break the weakpoint. The result is a lengthy cable-attached cut-and-thread fishing operation or in the worst-case scenario a broken cable left in the well on top of the fish.

To overcome the operational limitations of mechanical weakpoints and previous-generation electronically controlled release devices (ECRDs), Schlumberger developed the SureLOC 12000 and 8000 cable release devices. Installed in the wireline logging head, the SureLOC 12000 device is activated by a software command and electrical power to reliably release the cable under a wide range of downhole conditions. Combined with TuffLINE composite wireline cable, the success rate for SureLOC electronic release reliability exceeds 97%.

SureLOC 12000 and 8000 release devices can be complemented with inline addressable electronically controlled release devices positioned strategically along the toolstring.

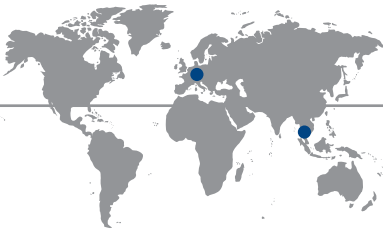


*The higher-rated release spring and prepackaged release bobbin assembly of the SureLOC device deliver superior efficiency and consistent performance.*

### Specifications

	SureLOC Cable Release Device
Safe working load	SureLOC 8000: 8,000 lbf [35,580 N] SureLOC 12000: 12,000 lbf [53,380 N]
Max. tool-release head tension	At surface: 1,000 lbf [4,450 N]
Temperature rating	SureLOC 8000: 400 degF [204 degC] SureLOC 12000: 500 degF [260 degC]
Pressure rating	SureLOC 8000: 20,000 psi [138 MPa] SureLOC 12000: 30,000 psi [207 MPa]
Special applications	SureLOC 12000: MP35N <sup>®</sup> H <sub>2</sub> S-resistant alloy

## Case Studies



### SureLOC 12000 device releases cable where conventional release devices cannot perform

Operations in HPHT reservoirs in the Gulf of Thailand experience frequent tool-sticking situations. The limitations of the previous-generation ECRD had led to the tandem use of a mechanical weakpoint and a frequent reduction in wireline logging operations. The SureLOC 12000 device was deployed to provide increased reliability, pulling capability at surface, and the ability to release under tool head tensions of 1,000 lbf. As a result, wireline fishing operations have been reduced, resulting in a significant efficiency improvement. A full set of logging data is once again being acquired. The operator estimates that the financial benefits of reliable logging access sum to millions of dollars.

In a stuck-tool situation in continental Europe, the logging cable was partially differentially stuck. This implies high tool-head residual tension. It would not have been possible to release the cable from the stuck tool with a mechanical weakpoint or conventional ECRD. The SureLOC 12000 device enabled safer cable release and retrieval with 1,000 lbf of head tension. With the cable removed from the well, an open-ended fishing operation was possible, which saved several days of traditional cut-and-thread operations and potential cable breakage at the differentially stuck point.



*Remote and challenging deepwater operations can significantly reduce operational risk and NPT by employing the reliable SureLOC cable release device in the wireline conveyance system.*

# UltraTRAC and UltraTRAC Mono all-terrain wireline tractors

## Applications

- Formation evaluation and testing in horizontal and highly deviated extended-reach wells
- Borehole imaging services
- Perforating
- Production logging
- Cement and corrosion evaluation
- ReSOLVE\* instrumented wireline intervention service
  - Nonexplosive plug setting
  - High-force axial shifting
  - Selective shifting with a universal shifting tool (UST)
  - Milling
- ABC\* analysis behind casing services

## Benefits

- Eliminates the need for expensive drillpipe or coiled tubing conveyance
- Reduces the risk of equipment damage inherent in challenging logging conditions
- Reduces fishing risk with reverse tracting capability and the superior pulling capability of TuffLINE cable
- Simplifies operations to a single descent in both open and cased holes across multiple well diameters and various conditions
- Saves time by logging while tracting for quicker data acquisition in multiple passes of the UltraTRAC Mono\* tractor
- Mitigates fishing risk and associated NPT



*The wheels for the UltraTRAC tractor are available in multiple diameters and proprietary designs optimized for the well geometry and conditions.*

The UltraTRAC and UltraTRAC Mono all-terrain wireline tractors efficiently convey measurement, perforating, and intervention tools through horizontal and high-angle well sections to extend the access of high-strength wireline cables.

UltraTRAC tractors deliver the same high reliability of conveyance in both open- and cased hole environments, with the UltraTRAC Mono tractor providing the industry's first long-reach monocable tractor for both perforating and logging-while-tractoring deployment.

### The reliable, cost-effective alternative to drillpipe-conveyed logging

Operators in North America, West Africa, the Middle East, and the North Sea are coming to rely on UltraTRAC and UltraTRAC Mono tractor conveyance for obtaining critical formation evaluation data from advanced measurement suites.

- Conveying the Sonic Scanner acoustic scanning platform and FMI-HD\* high-definition formation microimager on the UltraTRAC all-terrain tractor provides the information required for effective well stimulation design in one-third the time of drillpipe-conveyed logging.
- Deploying PressureXpress\* reservoir pressure while logging service on the UltraTRAC all-terrain tractor enables conducting quick and reliable reservoir pretest programs that reduce operator risk exposure through superior-quality formation pressure data.

#### Specifications

	UltraTRAC Tractor	UltraTRAC Mono Tractor
Applications	Openhole logging Cased hole perforating, logging, and intervention	Openhole logging while tractoring Cased hole perforating, logging while tractoring, and intervention
Maximum speed, <sup>†</sup> ft/h [m/h]	3,200 [975]	2,400 [730]
Temperature, degF [degC]	347 [175]	302 [150]
Pressure, psi [MPa]	20,000 [138]	20,000 [138]
Hole size—min., in [cm]	3.6 [9.1]	3.6 [9.1]
Hole size—max., in [cm]	15 [38.1]	15 [38.1]
Outside diameter, <sup>†</sup> in [cm]	3.375 [8.57]	3.375 [8.57]
Length, <sup>‡</sup> ft [m]	Drive sections: 2 to 8 Min. (2 drives): 15.35 [4.68] 8 drives: 39.19 [11.94]	Drive sections: 2 to 6 Min. (2 drives): 23.45 [7.15] 6 drives: 46.32 [14.12]
Maximum pull per drive section, <sup>†</sup> lbf [N]	400 [1,780]	400 [1,780]
Maximum force, lbf [N]	3,200 [14,230]	2,400 [10,675]
Power, cable requirements	AC, heptacable	DC, multiconductor cable (mono and hepta)

<sup>†</sup> Depending on wheel size

<sup>‡</sup> Depending on the configuration and excluding the 2.8-ft [0.85-m] logging head. The incorporated CCL, head tension cell, addressable cable-release device, and shock absorber are standard features that do not add extra length.



# Well Conveyance Planner for reducing risk by designing the optimal MaxPull system

## Applications

- Deepwater and ultradeepwater wells
- Complex surface rig-up for high-pull operations on offshore rigs
- Unconventional, deviated, and extended-reach wells requiring tractor-assisted conveyance

The Well Conveyance Planner is a comprehensive conveyance planning tool for both high-tension and routine operations that calculates the pulling capabilities (both the maximum continuous for logging and maximum instantaneous to get free) and associated operating risk by identifying the weakest components in the system.

## Benefits

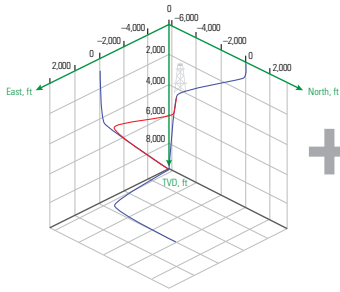
- Reliable, time-saving identification of the optimal wireline conveyance package
- Evaluation, prevention, and mitigation of conveyance operational risk in high-pull operations
- Mitigation of fishing risk and associated flat time

The input data is the relevant well information, including borehole geometry, mud, and expected temperature and pressure.

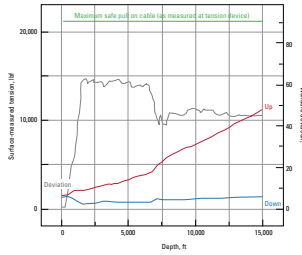
The planner analyzes the data and recommends the optimal conveyance system while identifying system components that exceed specifications and the potential associated operational risk. The user has

the option to modify the conditions and the equipment and enter specific customer requirements. The planner then immediately recomputes the new pulling capabilities of the conveyance package. The previously available high-tension planner and the drum force simulator reports are included and can be generated upon user request.

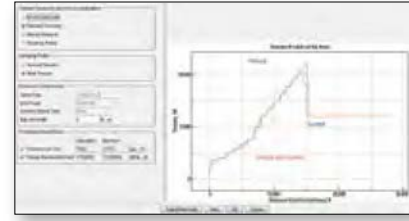
# Well Conveyance Planner



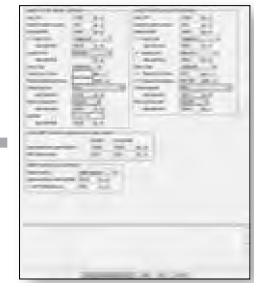
Well Profile



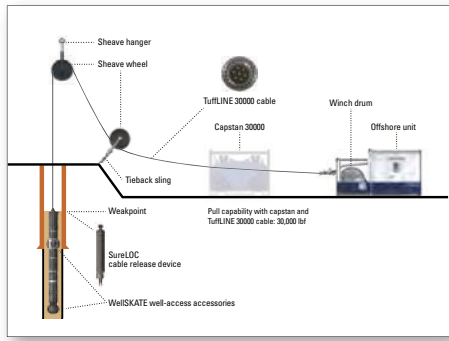
Surface Tension



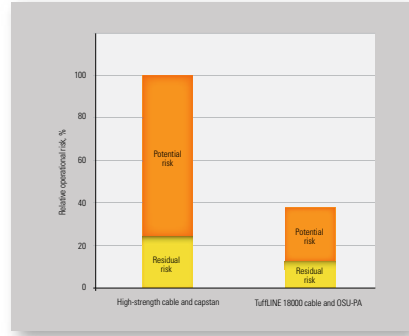
Drum Force



Optimized Conveyance Package



Wireline Setup



Relative Operational Risk

*The Well Conveyance Planner comprehensively assesses the operational conditions in relation to conveyance capabilities to recommend the optimal conveyance system and assess potential operational risk.*

# Expanding conveyance options while reducing risk

The MaxPull high-pull wireline conveyance system is the industry's latest-generation wireline conveyance system. As the culmination of decades of Schlumberger conveyance experience and in-house engineered technological advances, the MaxPull system has been proved to perform per its design. Only the MaxPull system provides the highest safety, strongest

pull capability, and fastest deployment. In combination with the state-of-the-art MaxWell integrated field acquisition system, the MaxPull conveyance system redefines wireline data acquisition to help operators to fully and accurately characterize their reservoirs while saving millions of dollars during all phases of exploration, development, and production.

*As well depths significantly deepened beginning in 2001 in the Gulf of Mexico, higher logging tensions sharply increased the number of fishing incidents, as represented by the fishing trend. Schlumberger introduced high-tension equipment and related standards and procedures, culminating in the integrated MaxPull high-pull wireline conveyance system.*

Schlumberger involved with >98% of >30,000-ft wells in the Gulf of Mexico

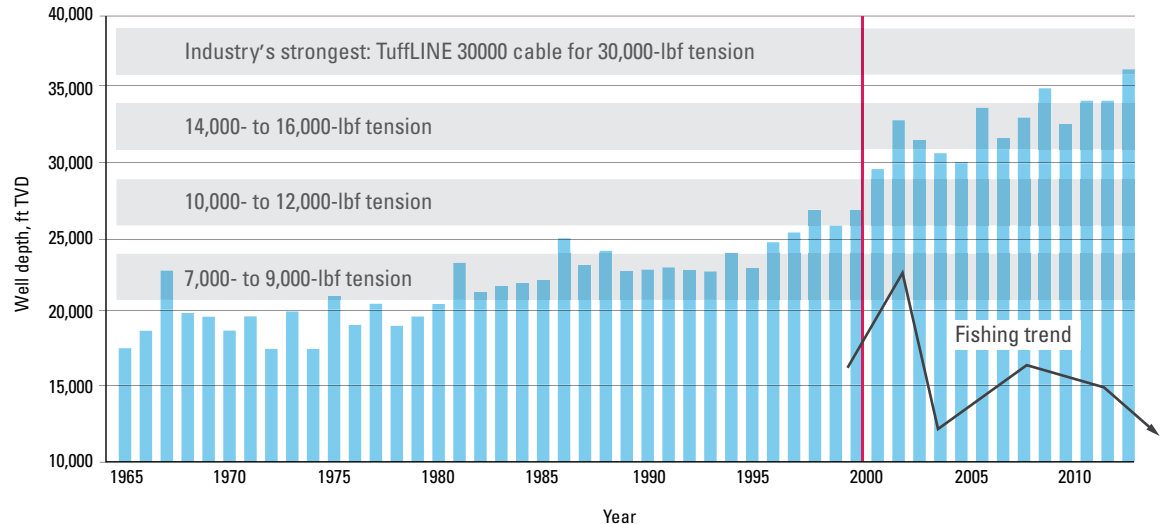
Max. TD logged: 36,443 ft

405 descents > 30,000 ft MD

1,682 descents > 25,000 ft MD

3,575 descents > 20,000 ft MD

2,860 descents with capstan



# Performance built on a history of innovation

Since the inception of wireline logging, Schlumberger has consistently invested in research and engineering (R&E) to ensure the development of relevant and fit-for-purpose measurement capabilities for our customers' most challenging environments. The Schlumberger annual R&E investment exceeds the combined R&E investment of the next three largest oilfield services providers. This focus of substantial effort and resources has delivered significant innovations and improvements to the one critical and common component of all wireline logging services: conveyance.

Although other service providers claim to have access to "industry-leading" capabilities, only Schlumberger has had the responsibility and privilege of successfully performing almost all of the openhole wireline evaluation operations in the deepwater Gulf of Mexico for wells with hydrostatic pressure greater than 25,000 psi.

As the only wireline logging provider that engineers, manufactures, deploys, and maintains its own conveyance and data acquisition portfolio, Schlumberger is in the unique position to leverage learnings from across these disciplines to continually deliver

truly industry-leading conveyance technology and risk mitigation procedures. The result is cumulative increases in the safety, speed, and pull capability of wireline conveyance that increase efficiency and reduce time, cost, and risk.



*Schlumberger dedicated engineering facilities are the foundation of the advances achieved with the MaxPull high-pull wireline conveyance system.*

# MaxPull

High-pull wireline conveyance system



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[slb.com/maxpull](http://slb.com/maxpull)

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