ROTARY-STEERABLE SYSTEMS

Revolution® Rotary-Steerable System

Achieve fast, precise directional control in diverse wellbore environments

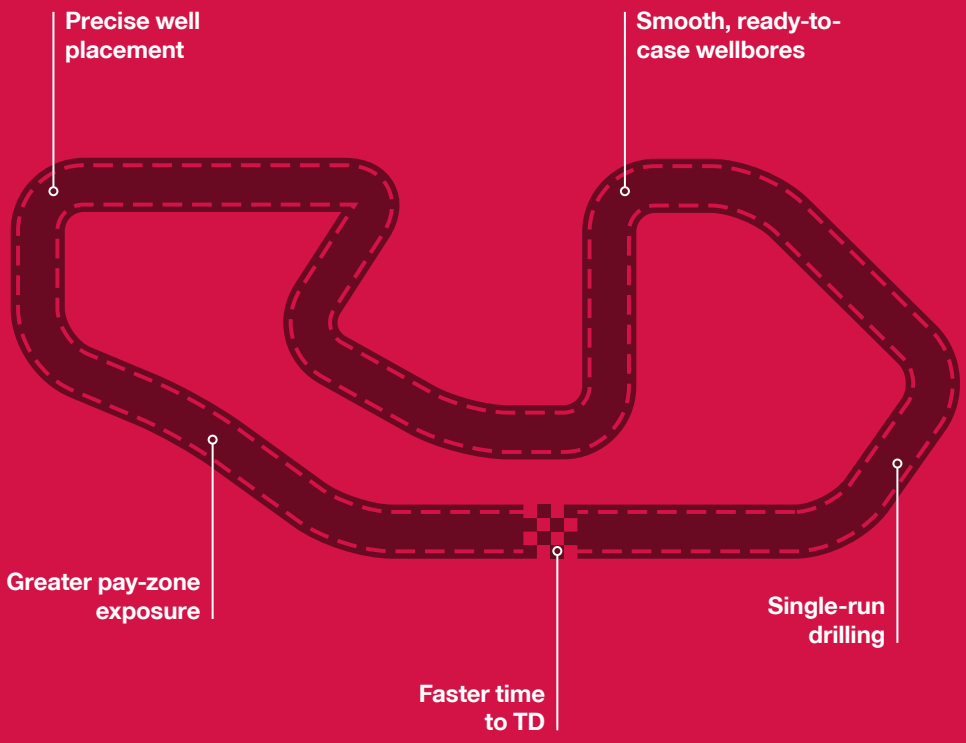
Weatherford®

Stay the course from start to finish.

Drill smooth, precise wellbores with our suite of advanced rotary-steerable systems

Like a racetrack, a well schematic may seem straightforward to the untrained eye. There is a set path, a series of objectives at which you can either succeed or fail. But once you pass the starting line, you face a new set of challenges—swelling clays, unconsolidated formations, and unanticipated changes in geology. How you respond to these obstacles determines whether you reach total depth (TD) on target and on schedule or fall behind.

The Revolution rotary-steerable system (RSS) puts you in the driver's seat. With a point-the-bit design that produces a clean hole, the ability to add a motorized BHA, continuous near-bit measurement, and bidirectional downhole communication, you can make informed, real-time decisions.



All rotary-steerable systems in the Revolution suite share common technologies that provide reliability and control in a variety of downhole environments.

Nonrotating housing

Anti-rotation levers hold the bias unit in place as the drillstring rotates to improve steering control and hole cleaning.

Pivot stabilizer

A stabilizer at the fulcrum point controls deflection and minimizes vibration. By keeping the bit aligned with the borehole, the Revolution system creates smooth wellbores and extends bit life.

Near-bit sensors

Advanced sensors measure inclination, azimuthal gamma ray, whirl, stick-slip, vibration, and other drilling parameters for early detection of formation and borehole dynamic changes.

Self-centralizing, extended-gauge bit

Weatherford works closely with suppliers to select the optimal bit for your application.

Options for Every Terrain

Efficient solutions to diverse challenges

With a suite of solutions that meet a range of drilling challenges, we help you find the best fit for your operation.

Revolution Heat

Drill deeper and farther toward challenging targets with hydraulic components specially conditioned for high-temperature, high-pressure (HTHP) environments.

Revolution Core

Set a course by inputting your drilling plan and parameters; then monitor the results while the system runs in cruise control—making real-time adjustments as needed.

Revolution V

Maintain a vertical course with near-bit sensors that continuously monitor drillstring trajectory. Upon detecting a deviation, the system automatically adjusts to get your well back on track.

Revolution 16

Execute deeper kickoffs and maximize formation exposure with the ability to build 16° doglegs.

Revolution SRT

Reduce or eliminate sliding with a tool that economically provides full-string rotation in wells with low build rates.

The Revolution suite enables precise control when drilling:

- High-angle curves
- Deeper kickoffs
- Long laterals
- Parallel vertical sections
- Sidetracks

…In situations from routine to extreme:

- Unconventional fields
- HTHP environments
- Deepwater fields
- Depleted formations
- Underbalanced drilling
- Brown fields

A Winning Strategy

Drill complex wellbores in a single run with real-time control

Steer to the front of the pack with the speed and control of the Revolution Core. The point-the-bit design is engineered to maximize rate of penetration (ROP) and to drill a smooth, completion-ready wellbore.

The inherent capabilities of the Revolution system are enhanced with guidance from our Drilling Services team, who help you determine the optimal parameters prior to drilling. These parameters are programmed into the system to enable semi-automated operation. Once the Revolution Core is downhole, onboard sensors deliver real-time inclination and azimuth measurements to the surface. If the measurements indicate that the wellbore is deviating from plan, the Core quickly adjusts to get back on track without extreme detours or excessive doglegs. You can also make on-the-fly changes to the trajectory from the surface using the downlinking capabilities of the system.

PRECISE MEASUREMENT FOR FASTER DRILLING OPERATIONS

With the SpectralWave® azimuthal gamma ray sensor and the CrossWave® azimuthal sonic tool, logged horizontal well without wireline and

SAVED 7 DAYS, $350,000 IN RIG TIME

Whether you are drilling in conventional, unconventional, or offshore fields, the Weatherford portfolio of complementary technologies enables you to maintain high speed and real-time control.

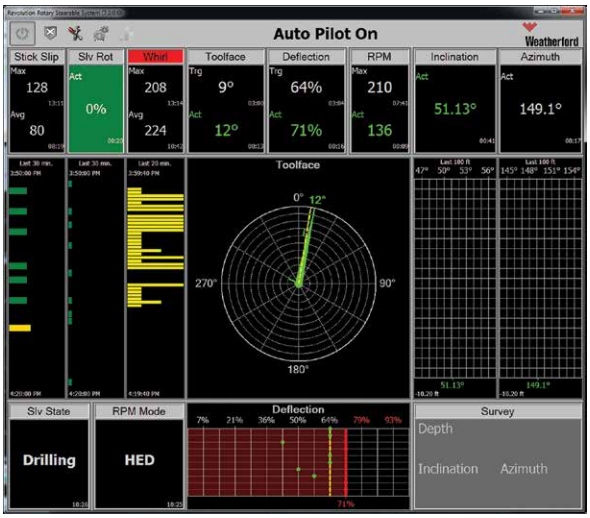
Speed Achieved

The point-the-bit design of the Revolution RSS focuses all of the cutting force at the face of the polycrystalline diamond compact (PDC) bit to achieve a high ROP and produce a smooth wellbore. When you can't achieve the desired bit speed because of rig-power limitations, you can add the HyperLine™ performance drilling motor or any other commercial motor above the RSS for even greater ROP, lower torque, and reduced stick-slip.

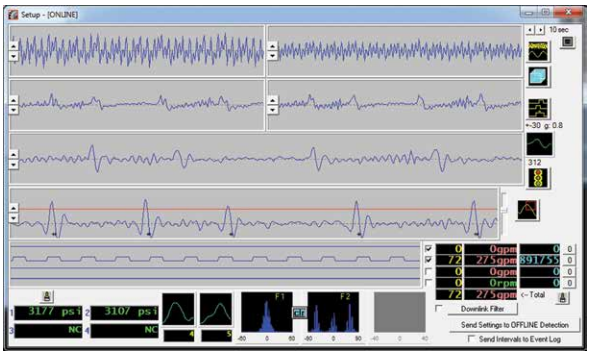
Power Steering

Every minute saved during the drilling process is valuable. One way to safely reduce drilling time is to avoid the need to stop the drillstring while making trajectory adjustments. The surface-based DownLink Commander® bidirectional communication system uses mud pulses to send and receive signals without interrupting the drilling process. And because the DownLink Commander system works so quickly—sending control signals to the RSS in a matter of seconds and verifying commands within a minute—steering adjustments take effect almost immediately.

When drilling in a lost-circulation zone or with air, foam, or any compressible drilling fluid, you can still achieve real-time communication with the RSS through our EMPulse™ electromagnetic MWD system. Because EM telemetry does not rely on rig hydraulics to transmit data, it has a minimal impact on rig time and resources.



The Revolution RSS rig-floor display shows real-time drilling parameters including whirl, stick slip, and toolface angle. Operator stakeholders can also view real-time data visualizations remotely.



Mud-pulse telemetry is used to transmit operational data between the RSS and the surface. Our proprietary software receives, filters, processes, and decodes the raw pressure pulses into data, which is then displayed in real time.

REVOLUTION HEAT

Primed to Perform

Achieve optimal results in high-temperature, high-pressure zones

As operators seek to produce wells in ever more challenging environments, reliable HTHP drilling equipment is becoming increasingly critical. Weatherford was one of the first service providers to offer a rotary-steerable system for HTHP environments. Our Revolution Heat uses high-viscosity oils and high-temperature-rated Kalsi Seals® to maintain hydraulic integrity while drilling through HTHP zones. The Heat offers the same vertical control, real-time measurement, closed-loop operation, and extended-reach capability as the Core and the V, so you can smoothly and efficiently drill vertical, curve, and lateral sections in zones with temperatures exceeding 300°F (149°C).

ELEVATED PERFORMANCE IN HIGH-TEMPERATURE ENVIRONMENTS

Drilled a well in a challenging, unconventional formation ahead of schedule and

SAVED 7 DAYS AND $700,000

REVOLUTION V

Hold Steady

Maintain vertical control with automatic corrections

When drilling vertically through dipping beds, especially in tectonically stressed environments, the bit tends to move along the path of least resistance. Unfortunately, that's often not the most efficient path to the target zone. The Revolution V maintains vertical trajectory even in challenging formations, enabling you to drill your well directly to target depth at a high ROP.

Once the Revolution V is downhole, near-bit inclination and azimuth sensors quickly identify any deviation from vertical and automatically adjust for a smooth, efficient return to vertical. By maintaining a zero-degree inclination, the Revolution V enables you to drill with a higher weight on bit, which increases ROP. The continuous rotation of the Revolution V creates a smooth, stable wellbore and reduces the risk of stuck pipe.

The Revolution V minimizes collision risk when drilling from a pad with multiple, parallel wells, and it is capable of performing small nudges to further separate wells if needed.

Applications

- Pad drilling
- Platform drilling
- Factory drilling

Benefits

- Avoid well collisions
- Increase ROP
- Reduce time to TD

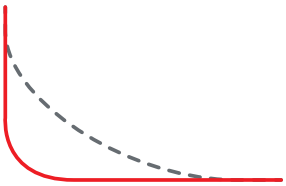
REVOLUTION 16

Hug the Curves

Navigate high angles and maximize reservoir exposure

Hitting the right angle is critical at every point in the drilling process. Offering precise drilling of doglegs up to 16° per 100 ft (30 m), the Revolution 16 enables deeper kickoffs that get you to the target zone sooner and maximize reservoir exposure. The Revolution 16 builds from vertical to horizontal in a single run—even in high-dogleg wells—which significantly reduces drilling time and costs.

The Revolution 16 can also be used for reentries and corrections to wells initially drilled with less capable tools. When formation tendencies force the wellbore off plan, the Revolution 16 gives you the extra angle you need to return to the planned path as quickly as possible.



With the ability to drill vertical and high-build sections in a single run, the Revolution 16 enables deeper kickoffs to maximize pay-zone exposure and minimize rig time.

HIGH ROP WHILE BUILDING HIGH-ANGLE CURVES

Kicked off from a near-vertical inclination and built to 93.46° at a high ROP to save

MORE THAN $1 MILLION

REVOLUTION SRT

Control Drift

Combine the speed and precision of rotary-steerable systems with the economy of conventional mud motors

For more than half a century, directional drilling was performed exclusively using conventional mud motors equipped with bent subs. However, this approach requires sliding—rotating the bit downhole while halting rotation of the drillstring—which reduces efficiency and ROP. To drill complex, torturous well paths, you need something more precise.

The Revolution Slide Reduction Tool (SRT) fills a unique space between conventional mud motors and rotary-steerable systems. The SRT uses an innovative technique to control bit speed through modulated mud flow. With targeted bit speed and specialized MWD components, the SRT provides efficient directional drilling at a lower cost than rotary-steerable systems.

Applications

- Low-angle wells
- Cost-sensitive operations

Benefits

- Reduce or eliminate slide
- Maintain continuous rotation
- Minimize drilling time

Under the Hood

Take a birds-eye view of the technology behind the tools

Tewkesbury Facility

The technology integrated into the Revolution suite was developed at our state-of-the-art facility in Tewkesbury, England. The facility reproduces extreme environmental conditions including temperature, pressure, vibration, and torque. Weatherford is the only company able to replicate backward whirl, one of the most fatigue-inducing downhole conditions.

As a result of our research on backward whirl, the Revolution RSS includes industry-leading, real-time whirl sensors. Our award-winning TVM 2+ sensor features an angular-rate gyroscope that measures high-speed downhole rotation and helps to determine the type and severity of torsional vibration phenomena.

We continually perform stress tests at the Tewkesbury facility to improve the technology and performance of the Revolution suite under increasingly challenging field conditions. With such rigorous science behind the technology, you can feel confident that your Revolution system will achieve precise well placement in even the most extreme environments.

Side-by-Side Specifications

	Core	Heat	V	16	SRT
Max. dogleg severity per 100 ft (30 m)	5° to 10°*	5° to 10°*	5° to 10°*	16°	3°**
Hole size	5-3/4 to 26 in.	5-3/4 to 26 in.	5-3/4 to 26 in.	8-3/8 to 9-7/8 in.	5-7/8 to 12-1/4 in.
Well complexity	High	High	High	High	Simple to medium
Max. downhole temperature	300°F (149°C)	347°F (175°C)***	300°F (149°C)	300°F (149°C)	329°F (165°C)
Max. downhole pressure	25,000 psi (172 MPa)	30,000 psi (207 MPa)***	25,000 psi (172 MPa)	25,000 psi (172 MPa)	30,000 psi (207 MPa)

* Depending on tool size
** Can achieve 12° oriented (non-rotary)
*** For tool sizes 8-1/4 and up
Can be configured for temperatures up to 347°F (175°C)
Limited by mud-motor specification

Achieve greater precision, higher ROP, and cleaner wellbores with the Revolution suite of directional drilling tools. Contact **dsmarketing@weatherford.com** to get set with the right solutions, or visit **weatherford.com/revolution**.

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