



**Weatherford<sup>®</sup>**

## Drilling-with-Casing (DwC<sup>™</sup>) Systems

### Advanced wellbore construction

Increase drilling efficiency and reduce risk exposure by removing the need to trip pipe and bottomhole-assembly (BHA) components while constructing leaner wellbores



## Weatherford DwC™ Systems

### Advantages of *DwC* Systems

- Reduce risk
- Increase drilling efficiency
- Construct leaner wellbores

### Our Approach

#### Explore, Engineer, Execute

In the developmental stages of well construction, we collaborate with you to **explore** your well objectives and challenges. We then leverage internal synergies and expertise to **engineer** an optimized well plan with the best-matched, well-construction technology. To seamlessly and efficiently **execute** the plan and ensure consistent service delivery, we coordinate and manage a team across product lines throughout the entire project. This three-prong approach allows us to partner with you to minimize risk, deliver cost assurance and ultimately exploit ever more challenging reservoirs.

### All of these advantages can be achieved with our *DwC* systems.

By integrating specialized technologies with unparalleled tubular-running expertise, our *DwC* systems provide a simple and effective means to engineer your well beyond conventional performance capabilities.

We combine thorough understandings of your operating scenarios with a versatile, robust technology selection, to provide application-based solutions that can help you achieve your most challenging well-construction objectives.

Whether applied as a technique to mitigate drilling hazards or engineered into the basis of design, our *DwC* systems can significantly improve operations. *DwC* technology removes the need to trip pipe and BHAs, which in turn speeds drilling and reduces risk exposure by always having casing on or near bottom. The technology can help simplify well architecture by reducing surface-casing size or eliminating contingency casing/liner strings. It is also possible to eliminate a casing string or liner by successfully drilling into or through a pressure transition or lost-circulation zone.

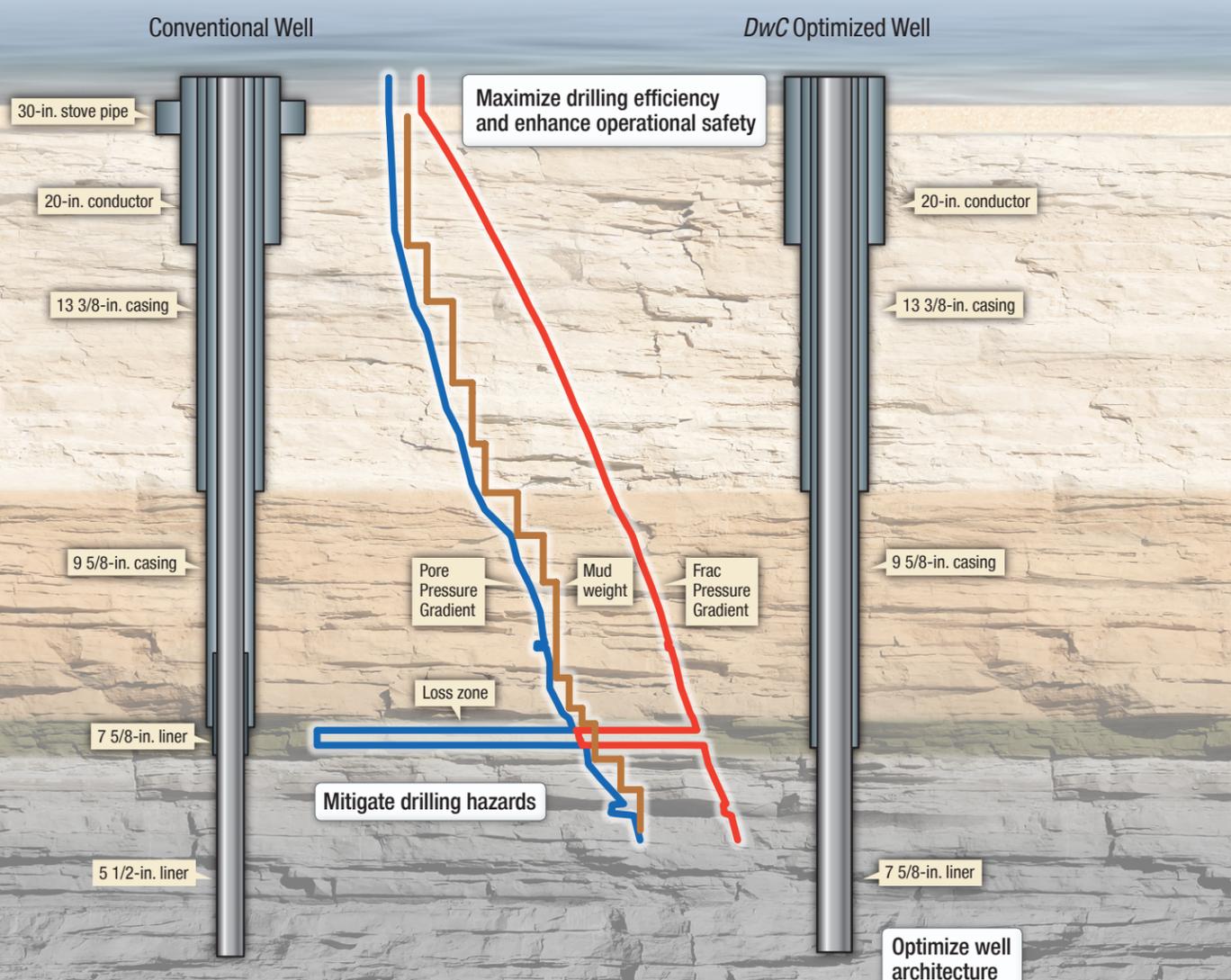
### *DwC* Applications

- Very soft surface hole formations to deep production casing strings
- Conductor or surface strings in a single pass
- Brown fields and depleted intervals
- Drill with liner through or top set casing in troublesome intervals
- Isolate losses, pressure or unstable hole intervals by drilling through and simultaneously casing the trouble zone
- Reaming casing or liners through unstable hole conditions, excessive cavings or in severely swelling or mobile formations



## Advanced Wellbore Construction

As the industry moves towards reservoirs that are deeper, more complex and costly to develop, there is a growing need for technical solutions that enable successful drilling and completions under these conditions—and keep costs and risks as low as possible. DwC™ technologies provide answers to these concerns with capabilities beyond convention to help ensure casing reaches total depth (TD) efficiently within the designed diameter, while reducing risks and economics.



### DwC techniques offer a wide range of operational benefits:

- **Enhance operational safety**

*Streamlined procedures, less manual handling of tubulars*

DwC systems can enhance operational safety by simplifying procedures and minimizing rig-floor equipment. Drillstring trips and handling of BHAs are reduced as well as the associated trip-related surges and swabbing effects that lead to wellbore instability and well-control threats.

- **Maximize drilling efficiency**

*Fewer trips reduce nonproductive time*

DwC systems eliminate conventional drillstring tripping along with the associated trip margin required to mitigate swabbing effects caused by tripping out of the hole.

- **Optimize well architecture**

*Reach TD with the planned casing diameter*

By applying DwC systems in challenging drilling environments, you can simplify the well design with optimal well-construction programs. The technology can reduce surface casing size or eliminate contingency casing/liner strings. Your well plan is realized with reduced risks, assured economics and increased production.

- **Mitigate drilling hazards**

*Turn trouble zones into comfort zones*

DwC technology reduces sticking problems, ensures casing is set at the target depth in a single run and keeps the casing or liner on or near the bottom of the hole with trouble zones always behind the pipe. These systems can overcome drilling hazards posed by depleted zones, pressure transitions and wellbore instability as well as eliminate or reduce the cost of mud additives, cement and resins.



## Technology and Expertise

### Performance across the wellbore

While other service providers may view their role as running your casing, we see ours as helping you construct a better well. Using technology from conventional to cutting edge, we improve well construction and minimize costs by analyzing drilling objectives to engineer solutions that fit your needs.

### DwC™/DwL™ technologies: advanced, fit-for-purpose tools

Our drilling- and reaming-with-casing/liner systems are ideal for drilling or reaming through a wide range of downhole conditions to TD with the planned diameter. These systems enable single-trip drilling or reaming to increase operational efficiency.

While these technologies isolate problem sections behind the pipe, they also improve cementing and long-term well integrity. We use our collective expertise to select the optimal system for your well-construction objectives.

### OverDrive™ System

*OverDrive* casing-running and drilling technology combines many conventional tools—power tongs, bails, elevators, fill-up and circulation tools—into one system. Integrated with any top drive, this automated system extends top-drive functionality from drillpipe to casing, enabling simultaneous rotation, reciprocation/push down and circulation

of the casing string. This functionality also applies to pushing, rotating and circulating the casing string for drilling with casing and casing running in high-angle, extended-reach and problem wellbores. The *OverDrive* system provides fit-for-purpose performance in light, super-single and small land-rig applications as well as heavy casing operations found offshore.

### Defyer™ Drillable Casing Bits

Our unique *Defyer* bit series provides custom solutions for *DwC* operations in any environment. With PDC (polycrystalline diamond compact) performance at temperatures up to 400°F (204°C), *Defyer* bits enable casing drilling across soft, medium and hard rock formations and can be drilled out with the planned BHA, eliminating the need for dedicated drillout trips.

The *Defyer* DPA drillable casing bit extends *DwC* operations to deeper, harder formations at longer intervals than ever before. The construction with 80% less steel in the drillout path compared with full steel-alloy casing bits can and has been drilled out in less than 30 minutes with conventional PDC-bit technology, without imparting damage to the drillout bit.

### Going beyond drilling with casing for integrated well construction

Weatherford's *DwC* systems are part of our drilling competency, which also includes a number of complementary well-construction products. With such a highly diversified portfolio, we also offer single-source efficiency. Get your drilling-with-casing systems and associated technologies from the same service provider to save valuable time.



### Secure Drilling® Services

Managed pressure drilling (MPD) is part of an expanded range of *Secure Drilling* services that we offer to minimize drilling-hazard risks related to a wellbore's pressure profile, and ultimately, to optimize life-of-well performance. In combination with MPD, our *DwC* techniques can mitigate narrow pore-pressure, frac-gradient windows. Used with other technology, *DwC* systems can help you drill wells otherwise considered undrillable.

### CleanReam™ Premium Casing Reaming Shoe

Used during liner or casing installations, our *CleanReam* premium casing reaming shoe reduces reaming time. The shoe is especially advantageous where the likelihood of hole problems is high. An aggressive cutting structure enables reaming through tight spots and hard ledges, and interchangeable nozzles enhance hole and blade cleaning while increasing flow penetration.

### DwC Accessories

#### Rubber-Lined DwC Centralizer

A cost-effective enhancement to *DwC* operations, our rubber-lined *DwC* centralizer provides superior performance and extreme durability throughout the casing-drilling operation. Ideal for high side loads and long rotation times, the *DwC* centralizer reduces friction and casing wear while optimizing fluid bypass. The lightweight design makes installation safe and simple.

#### Torque Ring

Our easy-to-install torque ring substantially increases the torque rating of buttress, STC or LTC connections.

#### Float Collar

With a rugged design and the Sure-Seal 3™ valve, our superior float collar offers both backpressure capability and drillability. The PDC-compatible, field-proven float collar is tested to API RP Category III and features a phenolic, nonrotating plate and throat section lined with a phenolic tube.



## Total Depth® Services

### High-integrity casing string installations

Weatherford's DwC™ systems are part of the many offerings in our *Total Depth* services portfolio. By integrating the relevant well-construction technologies with engineering ingenuity, our *Total Depth* services ensure you achieve the planned depth, while optimizing well architecture and establishing long-term structural integrity.

An evolution of more than five decades of experience, our *Total Depth* services go beyond the scope of conventional casing running to bring you integrated, application-based solutions. We have the know-how to deliver high-integrity casing string installations at the right depth—on time and on budget.

### Engineering a better well

As a highly diversified service provider that is well versed in many of the industry's toughest reservoirs, we understand the range of challenges that can occur while drilling exploration wells and effectively developing fields.

Weatherford confronts these challenges with thoughtful technology integration and streamlined interfaces between clients, product lines, operations and suppliers.

By combining upfront engineering with the best-matched, well-construction technology, Weatherford provides the level of risk mitigation and economic viability necessary to ensure operational success in difficult applications.

#### DwC Engineering Competencies

- Hydraulic
- Torque and drag
- Cyclic stress
- Casing bit and design selection
- Surge and swab
- Centralizer placement
- BHA tendency modeling
- Wellbore strengthening
- Casing wear
- Float equipment
- Economics



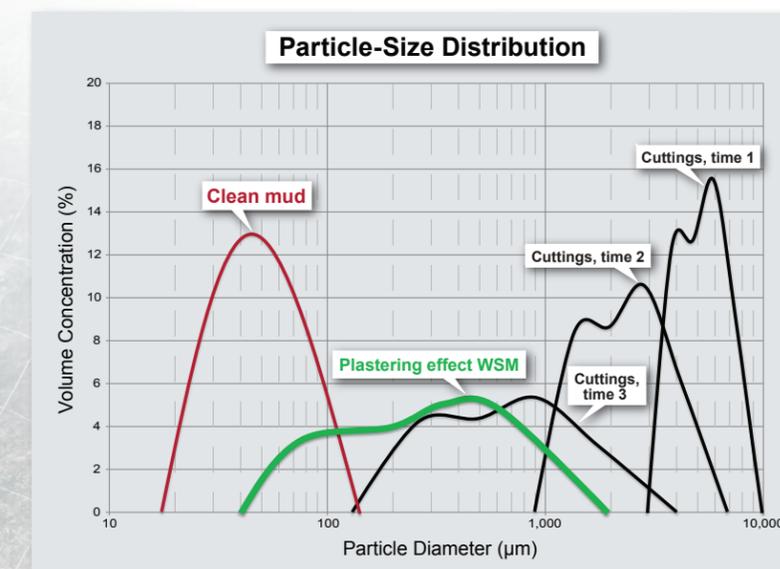
### Wellbore strengthening services

Drilling through lost-circulation zones has become one of the most common applications of *DwC* technology for the plastering, or smear effect in which the casing string plasters the cuttings and filter cake onto the wellbore wall to seal off fractures and stop drilling-fluid losses. Until now, there has been limited control over this effect.

Weatherford is introducing the industry's first method to precisely manage the plastering effect with its proprietary software. The effect is accelerated by designing a lost-circulation material that is mixed with small cuttings, generated by our Defyer™ series bits. The result is an ideal particle-size distribution for lower fluid-loss rates, a stronger wellbore and a wider mud-weight window. Lost circulation and potential kicks are prevented, so you can avoid running a contingency string to seal off trouble zones.



The industry-accepted ratio of casing diameter to hole size is approximately 0.8, which provides the optimal annular pressure and casing side load necessary for the plastering effect.



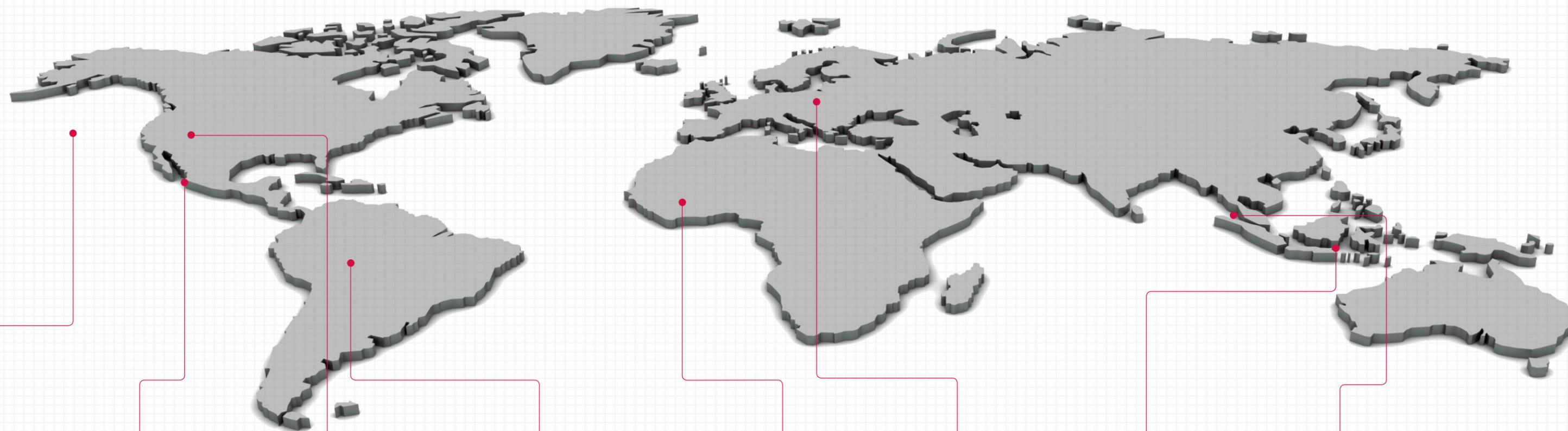
During the *DwC* process, cuttings are ground down and more widely distributed in higher concentrations. This grinding effect is highly uncertain and takes time, as shown in the graph by the black cuttings lines. While drilling in controlled conditions, custom blends of wellbore-strengthening materials (WSM) create the optimal conditions for the plastering effect to immediately ensue, as indicated by the graph's green line. In contrast, unaided *DwC* operations create a range of particle sizes later in the drilling process when unavoidable catastrophic losses could occur.



# Engineered Excellence

## Real Results

DwC systems have been deployed successfully in many operations worldwide. Our global service capabilities ensure cross-discipline support and multidisciplinary engineering resources. We are well versed in well-construction challenges and have helped our clients to meet objectives with accelerated operations, minimized costs and reduced risk exposure.



### Offshore USA

**Objective:** Install ultra-extended-reach well to TD.

**Result:** DwC technology helped install 28,000 ft (8,534 m) of 9 5/8-in. liner while simultaneously floating, pushing down and rotating the casing string to TD.

### Poza Rica, Veracruz, Mexico

**Objective:** Drill a high-angle hole and seal off a fractured formation susceptible to extreme losses

**Result:** Drilling-with-liner (DwL™) technology maintained deviation and azimuth to reach TD and cement the liner in place, saving approximately 40 days rig time, equivalent to US\$4.5 million.

### Piceanse Basin, Colorado, USA

**Objective:** Minimize exposure to time-sensitive, shale-stability issues and reduce losses.

**Result:** The world's first DwC system with a two-stage cementing tool drilled casing to TD and minimized losses, eliminating the requirement for bond logs and planned remedial squeeze-cementing operations.

### Offshore Brazil

**Objective:** Mitigate the effect of total losses in drilling liner.

**Result:** A 17 1/2-in. OD DwC bit was used to drill in 374 ft (114 m) of 16-in. liner, simplifying well-construction techniques to case-off the hole in record time and save 35 days of rig time.

### Offshore Nigeria

**Objective:** Reduce well-construction time and costs, eliminate potential losses and enhance cement placement.

**Result:** DwC services successfully drilled 3,399 ft (1,036 m) of 9 5/8-in. casing to a TD of 3,921 ft (1,195 m), saving approximately 3 days rig time and US\$1.2 million.

### Eastern Ukraine

**Objective:** Run and ream through adverse hole conditions to TD and avoid well abandonment.

**Result:** The Rwc™ system and CleanReam™ premium reaming shoe were used to run the casing to TD in one trip and eliminate plugging and abandonment, saving Shell between US\$1 to 2 million.

### Offshore Indonesia

**Objective:** Ream through hazards and drill a new hole in a highly deviated well.

**Result:** DwL system reamed 1,641 ft (500 m) through hazards, maintaining deviation and azimuth to drill a new 8 1/2-in. hole 377 ft (115 m) and install 7-in. liner, saving 3 days rig time and approximately US\$1 million.

### Offshore Malaysia

**Objective:** Place two casing strings at the planned depths.

**Result:** Defyer™ drillable casing bits drilled in 20-in. casing to 591 ft (180 m), drilled out the shoe track, and achieved 1,632 ft (498 m) TD with an average rate of penetration (ROP) of 158 ft (48 m) per hour, setting a benchmark for future wells.



Drilling-with-Casing (DwC™) Systems

**Advanced wellbore construction**

For more information on how you can advance wellbore construction with our *DwC* techniques, contact an authorized Weatherford representative, or visit **[weatherford.com](http://weatherford.com)**.



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