



**Weatherford<sup>®</sup>**

SteadyState<sup>™</sup>  
Continuous Flow System



**Ultimate Wellbore Protection.**  
Achieve greater control through  
continuous circulation of drilling fluids.



# Continuous Pressure, Along the Entire Wellbore

Managing downhole pressure is critical, particularly in deepwater, extended-reach-drilling (ERD), and other challenging operating conditions. A large percentage of all drilling hazards related to wellbore pressure occur when mud pumps are cycled off and on during connections, causing fluctuations in equivalent circulation densities (ECD) and downhole pressure spikes. These conditions can result in expensive downtime, safety issues, and the inability to drill a well within extreme scenarios.

The Weatherford SteadyState continuous flow system (CFS) improves drilling performance and safety by maintaining constant circulation of drilling fluid to the wellbore when adding or removing drillpipe stands.

CFS ensures constant bottomhole pressure (CBHP) while making connections, which is particularly critical when operating within narrow drilling margins. CBHP is one of a number of variants of managed pressure drilling (MPD) that reduces non-productive time and enables fewer and deeper casing strings when pore-pressure and fracture-gradient windows are narrow. By maintaining steady circulation of drilling fluid throughout the drilling process, the SteadyState CFS remedies fluctuations in ECD and downhole pressure spikes to achieve CBHP and continuous pressure along the entire wellbore.





## Evolutionary Continuous-Circulation Technology

Our continuous flow system advances the industry's standard to circulate fluids throughout drilling operations. With enhanced system design and functionality, we developed a better solution to control wellbore pressures and improve safety using a system that is easily incorporated into the rig's flow loop without disrupting normal connection times.

The system is comprised of a sub that crowns the top of a drillpipe stand and an automated control system. Together, these components divert fluids from the standpipe to the side-port and back remotely, using a control panel located in a safe zone away from the rig floor. The system's modular design also allows for seamless integration with other rig components. Compared to competitor technology, SteadyState CFS significantly reduces the rig-floor footprint.



### Designed for Safety

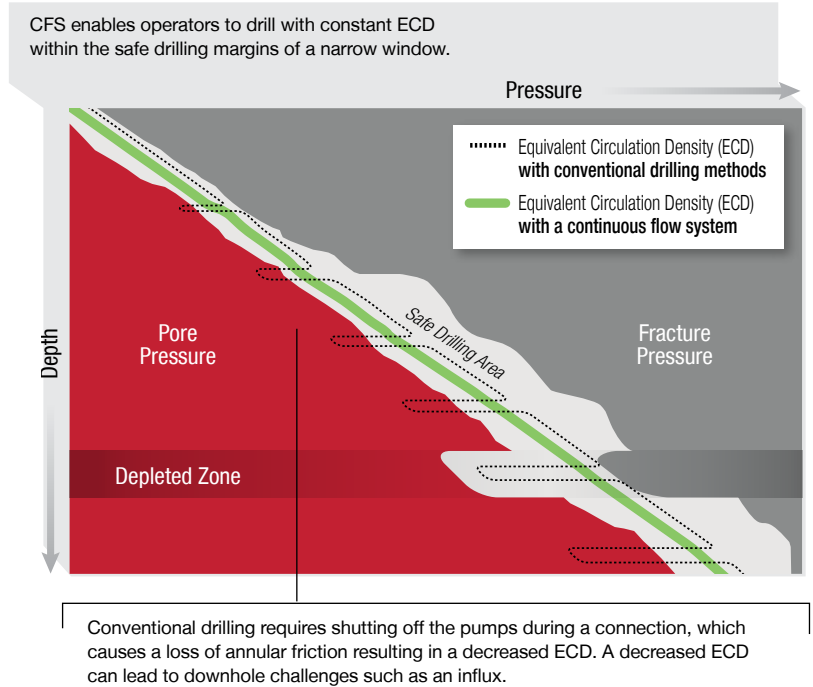
During connections, the flow-switching operations are remote controlled using a human machine interface (HMI) located away from the rig floor. The automated flow diversion capabilities of the system redirect drilling fluid from the standpipe to the side port in the sub without flow interruptions. Rig personnel are only necessary to attach and remove the clamp assembly, during which time, none of the equipment is pressurized.



# Mitigate Hazards, Optimize Performance

## Walk the Line

Narrow gradient windows present dangerous drilling conditions that increase when circulation is stopped. A kick-loss situation can ensue, causing an escalated risk of fluid loss, non-productive time, and safety incidents. Weatherford SteadyState CFS technology maintains constant bottomhole pressure, enabling operators to establish precise balances between the pore pressure and fracture pressure gradients while drilling.



## Solve Hole Problems

Maintaining continuous circulation of drilling fluid while adding or removing a drillpipe stand eliminates the adverse effects of pressure fluctuations on the wellbore. Additionally, continuous circulation also enhances hole-cleaning and wellbore stability.

## Reduce Many Wellbore Stability Issues:

- Wellbore ballooning and breathing
- Hole collapses
- Surge and swab

## Minimize Formation Damage

The on-and-off cycling of pumps fatigues the formation as the pressure oscillates between the wellbore and the formation. By maintaining the circulation of drilling fluids, SteadyState CFS reduces the risk of reservoir and formation damage that can jeopardize wellbore stability.



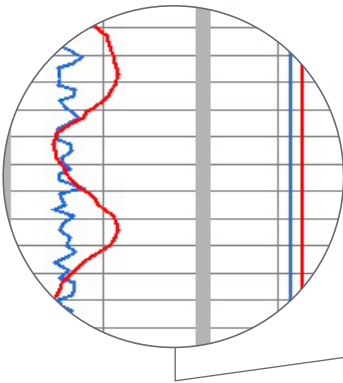




## Get Real-Time Data for Enhanced Pressure Control

SteadyState CFS is part of an expanded range of Secure Drilling® services offered by Weatherford to minimize drilling hazards related to wellbore pressures, ultimately optimizing life-of-well performance. Combine CFS with other Secure Drilling technologies to further enhance drilling performance. The Weatherford Microflux® control system incorporates proprietary algorithms to detect minute kicks or losses with high degrees of precision, unavailable with any other system. Using SteadyState CFS with Microflux control system improves drilling reliability by proactively measuring, analyzing, and controlling changes in wellbore conditions in real time.

Paired with the Weatherford Microflux control system, SteadyState CFS provides an uninterrupted stream of pressure and temperature data from downhole sensors and surface equipment with a degree of precision that is unattainable using conventional drilling methods. Together, these systems give real-time data for maximum pressure control while minimizing the risk of catastrophic well-control incidents and improving reliability.



The Weatherford Microflux control system detects minute variations in flow and pressure, enabling operators to make decisions based on actual surface and wellbore data, rather than predictive models.



## Maximize Efficiency, Reduce Costs

### Diminish Non-Productive Time

Continuous circulation prevents many unforeseen events that disrupt drilling.

### Increase Life of Tools

Steady circulation of fluid keeps the bit and bottomhole assembly lubricated, minimizing equipment wear.

### Heighten Productivity

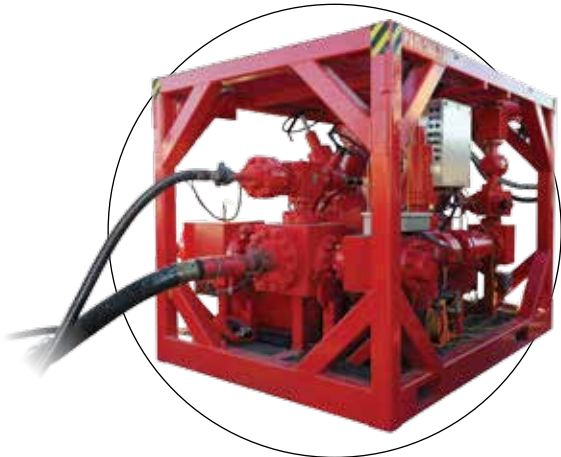
Maintaining continuous bottomhole pressure prevents reservoir damage, enhancing production output.

### Reduce Mud Loss

Cycling fluid during drillpipe connections reduces the potential for fluid loss.

# SteadyState Design

The Weatherford SteadyState CFS features a uniquely modular design and small rig floor footprint that make for easy system integration with other rig technologies. The automation aspect was designed with high consideration for personnel safety, allowing rig hands to move away and manage operations remotely. The complete CFS system includes subs, a clamp assembly, a manifold skid, two hydraulic power units (HPU), and a control system with a human machine interface (HMI).



## Human Machine Interface (HMI)

The HMI enables the operator to manipulate the clamp and manifold in synchronization, from a safe location away from the rig floor, allowing flow to switch from the standpipe to side flow port and back without interruption.



## Manifold

The CFS manifold's 2,000 gpm, 10K-rated valves allow flow to switch from the standpipe to the side-flow port. The manifold also includes a choke to bypass extra flow and a pressure relief valve that adjusts when abnormal pressures are detected.

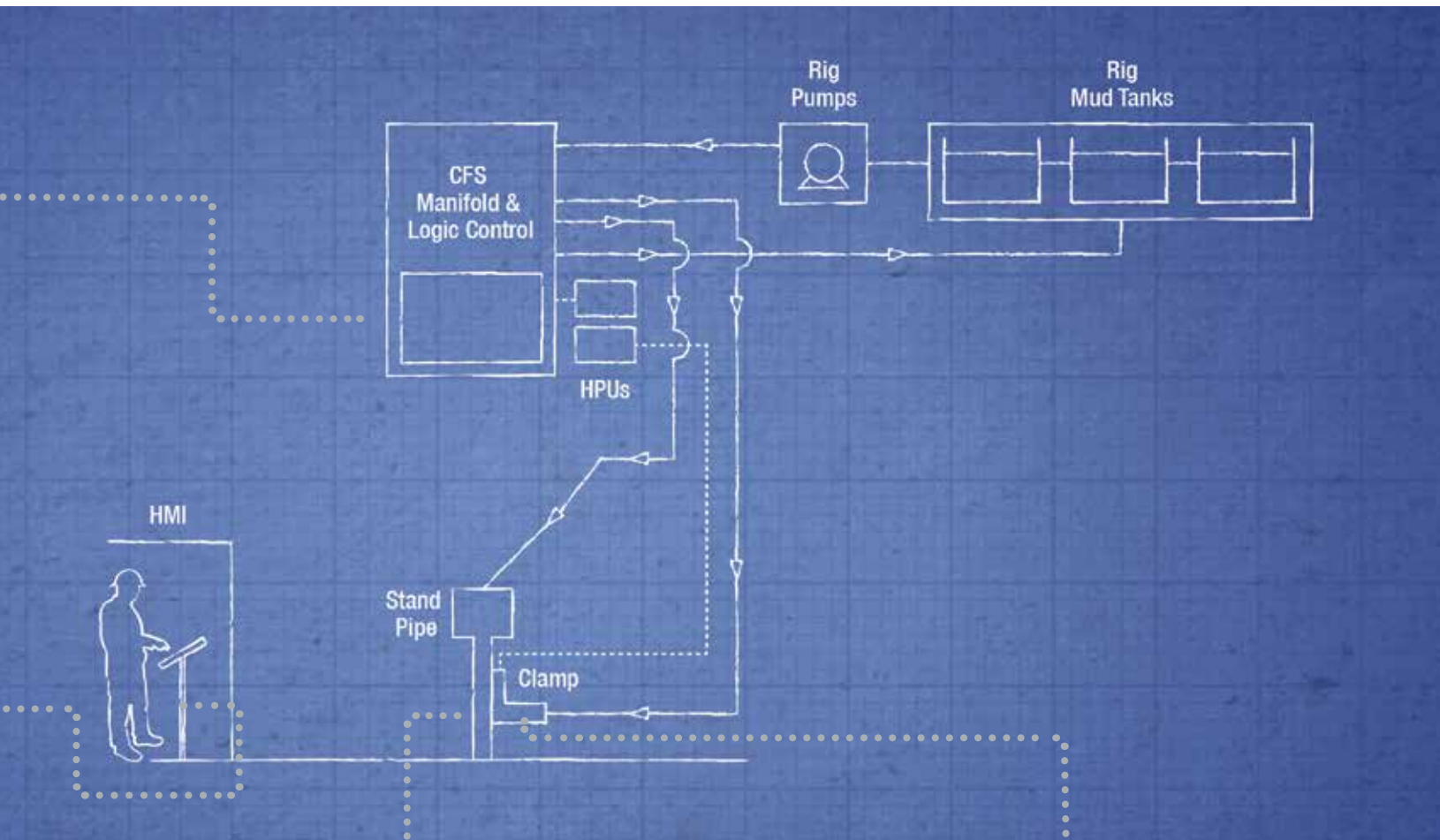
# SteadyState Sub Specifications

The SteadyState CFS sub features remote operation as well as a minimal footprint and equipment spread. Tensile and torsional strengths of each sub meet or exceed tensile and torsional strengths of corresponding new S-135 drillpipe.

All subs are rated to 7,500 psi operating pressure and 350°F (176.7°C). Maximum circulation rates vary depending on the size of the sub.

Compatible with DP Size	6-5/8	5-7/8	5-1/2
Circulating Sub Length (in., mm)	48.0 1,219.2	46.2 1,173.5	46.2 1,173.5
Tool OD (in., mm)	8-1/2 215.9	7 177.8	7 177.8
Tool ID (in., mm)	4 101.6	2-3/4 69.9	2-3/4 69.9
Maximum Flow Rate (gpm)	2,000	1,500	1,500
Maximum Flow Rate Through Side Port (gpm)	1,200	1,000	1,000
Temperature Rating (°F, °C)	350 176.7	350 176.7	350 176.7
Working Pressure Rating (psi, MPa)	7,500 51.7	7,500 51.7	7,500 51.7

\*CFS subs are flexible in design. Connections can be scaled to customer specifications.

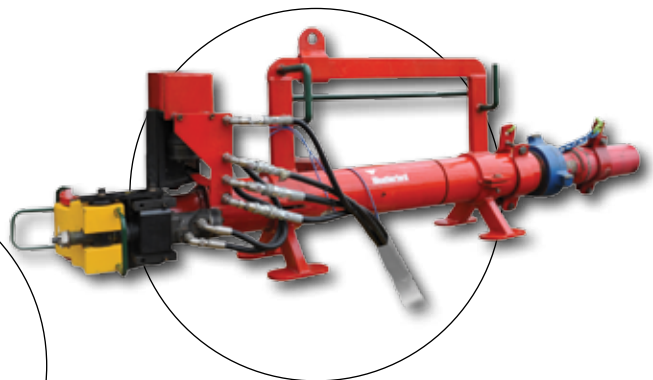


## Sub

The Weatherford SteadyState CFS features subs that are fixed to the top of drillpipe stands and are automated for switching mudflow from top-drive to side-flow port and back again.

## Unique Inner Sleeve-and-Ball Valve Operation

The SteadyState CFS sub has a full-bore inside diameter and no restrictions during normal drilling mode to allow a wireline intervention, if needed.



## Clamp

The SteadyState CFS clamp includes a side-flow pipe assembly, hydraulic suspension device, mud-saver valve, and mud-hose connection. The mud-saver valve prevents drilling fluids from spilling onto the rig floor each time the CFS clamp assembly is detached from the sub.



## SteadyState Continuous Flow System

To discover more about the advantages of SteadyState CFS, contact your authorized Weatherford representative or email your inquiries to **[CFSanswers@weatherford.com](mailto:CFSanswers@weatherford.com)**.



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