WELL CONSTRUCTION

Casing Accessories

Cement integrity starts here

Weatherford®

Contents

Introduction

Built for the Integrity of Your Well

Well integrity begins with the cementing process. As operations move into deeper waters and unconventional applications with higher angles, pressures, and temperatures, proper planning and execution are crucial and cementing equipment must meet even higher standards.

For more than half a century, the industry has depended on Weatherford to provide top-quality equipment for primary cementing operations in the world's toughest operating environments. Based on our extensive global experience, we design and manufacture high-quality products with proven performance. Each product is engineered to deliver high value and reliability.

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A Systems Approach to Product Quality

A manufacturer of cementing products for more than 50 years, Weatherford is the leader for a reason. Our engineering staff is customer focused and dedicated to new product developments and product support. Because of industry demands, we have implemented a comprehensive global quality process focused on one goal: delivering the most reliable, cost-efficient products in the market. For the highest-quality product delivery and functionality, we have developed standardized quality plans at multiple levels that document and distribute all manufacturing specifications and testing requirements. We have also developed comprehensive field-installation procedures, along with technical and training competency standards, which are critical in achieving operational success.

Weatherford cementing products are developed using the latest technology and most advanced manufacturing processes, including proprietary robotic and automated welding techniques. Each of our ISO-certified, global manufacturing facilities produces consistent, high-quality equipment that meets or exceeds all applicable industry standards.

We continually test our centralizer designs against the American Petroleum Institute's API Specification 10D to verify that our equipment can withstand the high forces encountered when running casing and can provide the restorative forces needed for casing centralization.

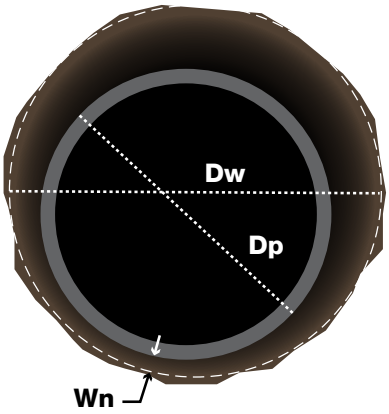
Houma, Louisiana, Manufacturing Plant

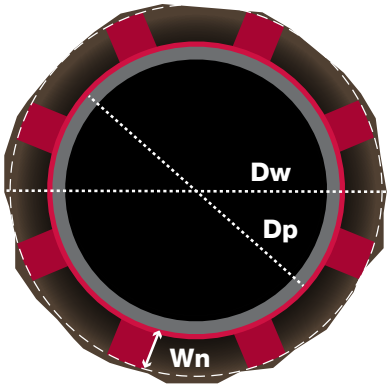
Abu Dhabi Manufacturing Plant

Edmonton, Canada, Manufacturing Plant

Hannover, Germany, Manufacturing Plant

Introduction *continued*





$$\text{Standoff (\%)} = \frac{Wn \times 2}{Dw - Dp} \times 100$$

Centralizer Selection and Installation

We provide more than just products. We provide service.

Optimum centralization is critical for achieving a high-quality primary cement job and overall well integrity.

Experienced Weatherford applications engineers can analyze your well and make detailed recommendations to assist you in selecting and installing the optimal equipment.

Reach total depth with confidence.

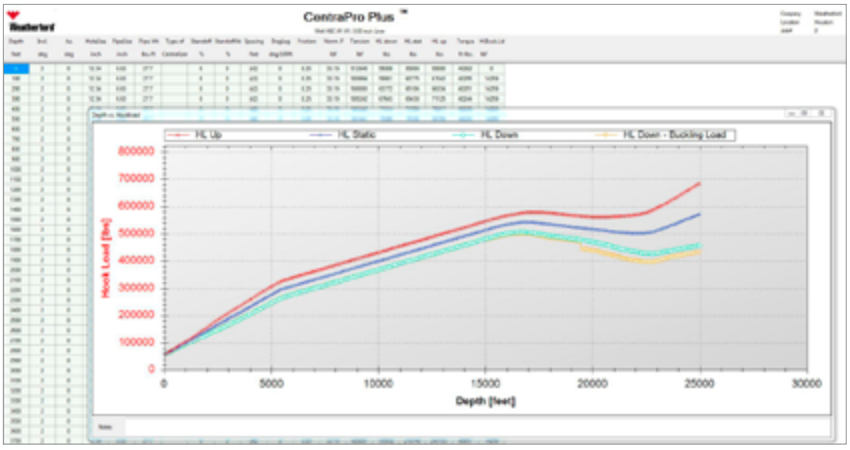
Our experts can determine the best centralizer for your well, based on factors such as these:

- Casing size and weight
- Type of connections
- Hole size and geometry
- Starting, running, and restoring forces
- Rotation and reciprocation requirements
- Material and design features
- Overall operating objectives

Weatherford CentraPro Plus® software is a sophisticated, lateral-load simulation program designed to provide effective casing centralization for your well. The program predicts:

- The lateral force at any given location based on borehole geometry, buoyed string weights, and tension forces
- The reaction of the centralizer when exposed to these forces, based on actual test data for pipe size/hole combinations
- The sag between centralizers, based on the elasticity of the pipe and a three-dimensional vector analysis of the weight and tension components

In addition, Weatherford engineers use other beneficial software to run calculations for torque and drag, buckling, and surge pressure.



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Centralizer Installation Patterns

We recommend placing centralizers midway between casing connections where maximum bending can occur. Most Weatherford centralizers can be run in multiple configurations, as summarized and illustrated below.

Over the stop collar—This is typically the optimum configuration. Placing the centralizer over the stop collar enables the centralizer to move upward or downward where at least 1-3/8 in. (34.9 mm) of clearance is available and provides optimal centralization. Centralizers and stop collars can be pre-installed to save time and money.

Between stop collars—This configuration is optimum for rigid centralizers and specially designed bow springs, such as the VariForm® centralizers, that are designed and tested to perform when being pushed in. Running bow-spring centralizers in this method potentially reduces the maximum rigid diameter because the bow springs do not need to overlap the stop collar. This configuration pattern can also be pre-installed to save time and money.

Over couplings—Although installation of centralizers over the casing coupling removes the need for a stop collar, we typically do not recommend this configuration because it can increase the running forces of the centralizer and can only be run when there is sufficient annular clearance. Additionally, this configuration must be done on the rig floor and in the critical path.

Between couplings and stop collars—In this alternate close-tolerance configuration, centralizers are placed between a stop collar and the casing coupling. This pattern allows limited centralizer travel and uses only one stop collar per centralizer for reduced costs. This pattern should not be installed on pipe racks.

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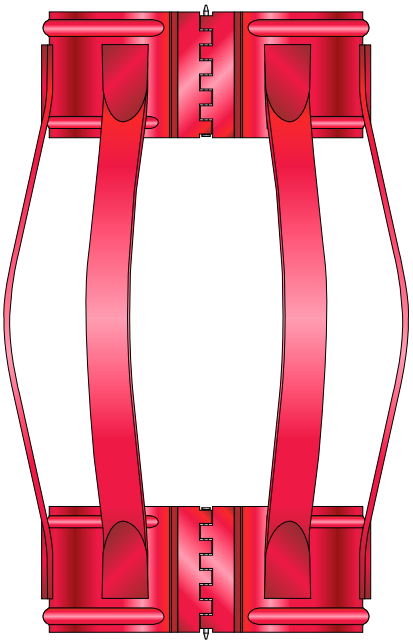
Welded Centralizers

High Performance Under Extreme Stress

Weatherford welded centralizers are designed for strength and superior performance under the most demanding conditions. The following are key design features:

- Our proprietary robotic and automated welding process produces strong, uniform welds.
- Centralizer end bands are engineered to maintain rigidity while providing a streamlined profile in the wellbore.
- Bows are made of high-strength spring steel that undergoes special heat treatment to achieve maximum restoring force.
- All common casing/hole size combinations are available.
- Custom designs are available on request.

Welded Centralizers



Welded Bow-Spring Centralizers

Weatherford welded bow-spring centralizers are designed to centralize casing in the wellbore during running and cementing operations. Providing excellent downhole durability and performance, these centralizers feature heat-treated, spring-steel bows that are welded to unique, rigid end collars.

The centralizer bows provide maximum standoff for efficient mud and cement displacement and are available in various heights to provide optimum restoring forces. The rigid end collars provide solid support for the end bands and are available in slip-on and latch-on configurations for easy installation.

We recommend using Weatherford CentraPro Plus® software during the planning phase to determine the optimum quantity and placement of centralizers needed to minimize drag forces.

Applications

- Cased and open holes
- Vertical or horizontal wells
- Underreamed and washed-out wells
- Casing or liner strings in which reciprocation is advantageous

Features, Advantages, and Benefits

- End bands are manufactured with a unique ribbed design that provides rigidity to the bands and protection for the bow springs.
- The high-quality, spring-steel bows are heat treated to optimize standoff in gauge holes, underreamed holes, and washed-out sections.
- Latch-on end bands feature an integral hinge that folds to the inside, which adds strength and eliminates interference during run-in.
- All common S-series centralizer sizes have been tested and validated to API Specification 10D for reliability and durability during operations.
- Various bow shapes and heights are available to provide optimum restoring forces for most well requirements.

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Bow-Spring Centralizer Sub Model

Weatherford bow-spring centralizer sub is designed to keep the casing centralized in the well while cement slurry is pumped between the casing and the wellbore. The bow-spring centralizer sub is especially well suited for use in casing strings with ultratight clearance. Available in nonrotating (Model 541) and rotating (Model 541R) versions, the centralizer sub meets special drilling requirements by enabling casing to pass through extremely close annular clearances.

This unique centralizer recesses completely into the sub body to permit passage through the tightest restrictions, and then it expands into underreamed or openhole sections to provide excellent centralization. Models 541 and 541R are engineered to enable the maximum possible fluid bypass to minimize the effect on circulating pressure.

This centralizer sub combines slimhole capabilities with the proven quality of Weatherford welded centralizers. The sub body is manufactured from one piece of steel, which is selected by weight and grade to match the burst, collapse, and tensile ratings of most casing sizes. In all casing sizes, drift diameter is maintained.

Applications

- Running casing inside previous casing or openhole sections with extremely close annular clearances

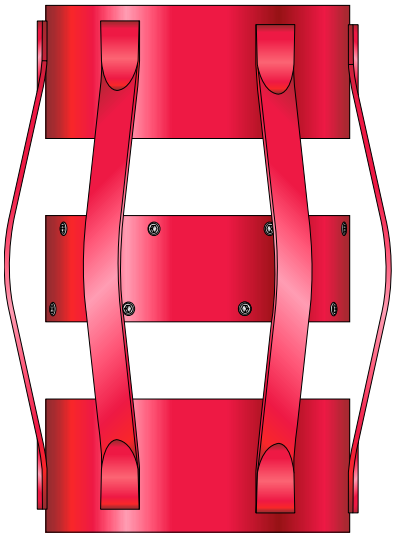
Features, Advantages, and Benefits

- Bows recess completely into the tool body to allow passage through close-tolerance sections and to protect the bows from damage.
- Bows expand to provide excellent casing centralization in openhole or underreamed sections.
- Models 541 and 541R bow-spring centralizers are available in float-collar, float-shoe, and guide-shoe configurations to reduce the number of premium threads required in the casing string.
- Manufactured to the exacting standards of ISO 9001 and API Specification Q1 quality systems, Models 541 and 541R bow-spring centralizers provide reliability and durability during operations.

Model 541

Model 541R

Welded Centralizers *continued*



Rotating Centralizers

Weatherford rotating centralizers are specifically designed to maximize fluid-displacement efficiency in highly deviated wellbores. These centralizers enable pipe to rotate freely during running and cementing operations. They provide excellent standoff, low running forces, and durability for rotating and reciprocating applications. These centralizers are specifically manufactured with a special stop collar to enable pulling the centralizers downhole rather than pushing them.

The heat-treated, spring-steel bows are welded to rigid end collars to provide excellent downhole durability and performance. The centralizer is installed over a double-row, setscrew, slip-on stop collar to eliminate movement during reciprocating operations.

Applications

- Highly deviated wellbores requiring optimum pipe standoff with reduced drag
- Pipe requiring centralization and rotation to reach total depth
- Pipe that will be rotated and/or reciprocated during primary cementing to achieve successful zone isolation

Features, Advantages, and Benefits

- The slip-on centralizer features single-piece end bands that enable full rotation of the casing string, which increases the displacement efficiency of cement around the casing string for an enhanced cement bond.
- High-performance bows provide positive standoff, which enables proper cement placement that minimizes remedial cementing operations and costs.
- A slip-on stop collar fits inside the centralizer and limits axial movement during run-in and run-out of the wellbore.
- End collars specially designed to provide enhanced rigidity contribute to a more robust centralizer capable of withstanding high-load situations.
- The high-quality, spring-steel bows are heat treated to withstand most wellbore environments and increase operational flexibility.

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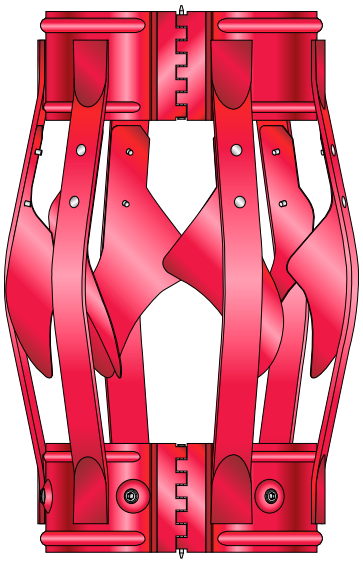
Turbolizer Centralizer

Weatherford Turbolizer centralizers are built on the success of Weatherford welded bow-spring centralizers, with the addition of specifically designed deflector blades. The special blades are riveted to heat-treated bows and are designed to deflect fluid flow in a turbulent spiral. This effect helps break up drilling mud when running casing and improves mud removal during circulation. It also improves cement distribution by eliminating channeling during cementing operations.

Turbolizer centralizers are available in single-straight or double-reverse bow configurations. The single-straight configuration has a built-in stop collar that features a tapered leading edge to prevent the centralizer from hanging up during run-in. The double-reverse configuration is a stacked design of the single-straight configuration without the built-in stop collar. The double-reverse configuration features deflector blades at one end so that the centralizer can be placed over stop collars if required.

We recommend using Weatherford CentraPro Plus® software during the planning phase to determine the optimum quantity and placement of centralizers needed to minimize frictional drag.



Turbolizer centralizer in single-straight configuration

Applications

- Tubing or casing applications
- Wellbores requiring increased fluid turbulence to remove mud efficiently before the primary cement job
- Vertical or slightly deviated wells

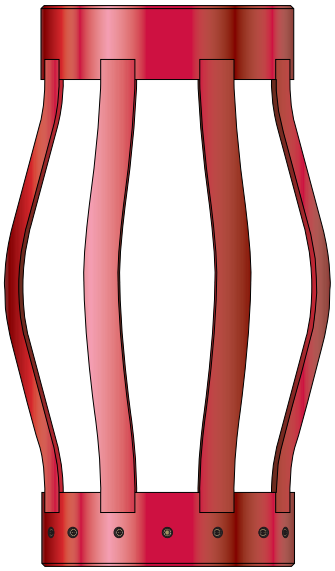
Features, Advantages, and Benefits

- Deflection blades increase fluid motion, which helps to break up drilling fluid and improve cement placement to minimize channeling.
- Right- and left-hand deflector blades help deflect fluid flow in a turbulent spiral pattern, which evenly distributes cement around the casing to improve the cement job.
- The bows and deflector blades are made of high-quality spring steel that enables the centralizer to withstand most wellbore environments.
- All common centralizer sizes have been tested and validated to API Specification 10D to provide reliability and durability during operations.
- Bows provide maximum standoff to give the best centralization for improving cementing operations and lowering costs.
- Double-reverse bow centralizers can be installed over stop collars or casing couplings to facilitate pulling the tool into or out of the hole.

Options

Available in single-straight or double-reverse bow configurations.

Welded Centralizers *continued*



Close-Tolerance Centralizer

The Weatherford close-tolerance centralizer is used in applications with small annular clearances that do not require a centralizer sub. The centralizer offers excellent centralization with minimal frictional drag. The centralizer uses a unique bow configuration and lap-welded collars with short setscrew attachments to provide its low-profile capabilities.

Applications

- Running casing in close annular-clearance applications that do not require a centralizer sub
- Running liners in close-tolerance cased-hole applications

Features, Advantages, and Benefits

- Bows welded to the end collar make this centralizer reliable, durable, and low profile, so it is well suited for close-tolerance applications. For extremely tight applications, centralizer subs are required.
- The centralizer is available in several bow and end-band configurations to meet varied application requirements.
- Short setscrews enable the centralizer to pass through the wellbore with minimal resistance.
- Slip-on configurations used with low-profile stop collars enable rotating the centralizer.
- Latch-on configurations have end collars with an integral hinge that folds to the inside. This design protects against damage and provides minimum end-collar height.
- All common sizes have been tested and validated to API Specification 10D.
- Turbolizer configurations are available to increase fluid turbulence and reduce channeling for improved primary cementing integrity.

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Spiral Tubing Centralizer

These centralizers are designed for use in dual or triple tubing completion strings where interference between the tubing strings is not desirable. These centralizers fit over close-tolerance stop collars and can be customized to fit over casing collars of various sizes and weights.

Spiral tubing centralizer

Gravel-Pack Centralizer

These centralizers give minimum running resistance when passing through the previous casing or wellhead and then expand to provide standoff in underreamed sections or washouts. These centralizers can be customized to fit various hole size and completion string combinations and are also available with special clearance collars to allow for passing through tight restrictions.

Gravel-pack centralizer

Drillpipe Centralizer

These specially designed centralizers are critical components in inner-string cementing applications. They enable the stinger run on the end of the drillpipe to properly stab or screw into the float collar receptacle to provide the leak-free seal required for trouble-free cementing operations.

Drillpipe centralizer

Logging Centralizer

Although similar to the gravel pack centralizer, the logging centralizer is designed to work in wireline operations. It centralizes the tool while protecting vulnerable control lines and cables.

Logging centralizer

Welded Centralizers *continued*

Welded Centralizer Size Chart

Hole Size (inches)	Casing Size (inches)											
	2-3/8	2-7/8	3-1/2	4-1/2	5	5-1/2	6-5/8	7	7-5/8	8-5/8	9-5/8	10-3/4
4-1/2 to 4-3/4	●	●	●									
5-3/4 to 6	●	●	●	●	●							
6-1/8 to 6-3/8	●	●	●	●	●							
6-1/2 to 6-3/4	●	●	●	●	●	●						
7-3/8 to 7-7/8	●	●	●	●	●	●	●					
8-3/8 to 8-5/8	●	●	●	●	●	●	●	●	●			
8-3/4 to 9	●	●	●	●	●	●	●	●	●			
9-1/2 to 10	●	●	●	●	●	●	●	●	●			
10-5/8 to 11		●	●	●	●	●	●	●	●	●	●	
12 to 12-1/4			●	●	●	●	●	●	●	●	●	●
14 to 15-1/2					●	●	●	●	●	●	●	●
17 to 18-5/8										●	●	●
19-1/2 to 20-1/2												
22 to 23												
24 to 26												
26 to 28												
28 to 30												
30 to 32												
32 to 34												
34 to 36												
> 36												

Note: Several options may exist for each hole size combination. Please consult your Weatherford technical specialist for application recommendations.

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Welded Centralizer Size Chart *continued*

Hole Size (inches)	Casing Size (inches)											
	11-3/4	13-3/8	16	18-5/8	20	22	24	26	28	30	32	36
4-1/2 to 4-3/4												
5-3/4 to 6												
6-1/8 to 6-3/8												
6-1/2 to 6-3/4												
7-3/8 to 7-7/8												
8-3/8 to 8-5/8												
8-3/4 to 9												
9-1/2 to 10												
10-5/8 to 11												
12 to 12-1/4												
14 to 15-1/2	•	•										
17 to 18-5/8	•	•	•									
19-1/2 to 20-1/2			•									
22 to 23			•	•	•							
24 to 26				•	•	•						
26 to 28				•	•	•	•					
28 to 30						•	•	•				
30 to 32							•	•	•			
32 to 34							•	•	•	•		
34 to 36									•	•	•	
> 36											•	•

Note: Several options may exist for each hole size combination. Please consult your Weatherford technical specialist for application recommendations.

Options

- End collars are available in latch-on or slip-on configurations.
- Custom designs are available for nonstandard applications.
- The S-series centralizer meets or exceeds API Specification 10D.
- The B-series centralizer offers an economic solution for wells that do not require the performance capabilities of the S-series centralizers.

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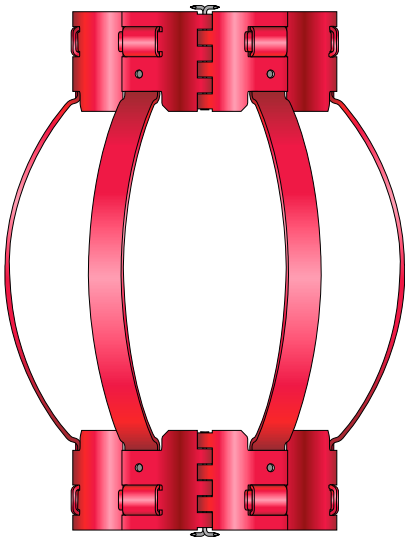
Nonwelded Centralizers

Providing Ruggedness for Any Application

Our nonwelded centralizers are built for maximum strength with low starting and running forces and exceptional restoring-force performance. The following are key design characteristics:

- Heavy-gauge steel end collars have strong hinges with a locking tab.
- All models exceed the restoring-force requirement of API Specification 10D.
- All models can be locally assembled to reduce shipping costs.
- Several bow-spring profile options are available in carbon or stainless steel for a variety of hole conditions.

Nonwelded Centralizers



Nonweld Bow-Spring Centralizer

Weatherford nonweld bow-spring centralizers centralize casing or tubing in the wellbore during running and cementing operations. The high-quality, spring-steel bows are attached to integrated, hinged end collars with locking tabs. The hinged design enables the end collars to be latched onto casing over a stop collar, if desired, for easy installation. The centralizer should preferably be fitted over a stop collar to facilitate pulling the tool in and out of the wellbore. The nonweld design provides reliable downhole performance in cased-hole or openhole applications. The bows provide maximum standoff to achieve efficient displacement of mud and cement.

Nonweld bow-spring centralizers are available in several bow heights and sizes to ensure optimum restoring force and provide in a variety of bow configurations for special applications. We recommend using Weatherford CentraPro Plus® software during the planning phase to determine the optimum quantity and placement of centralizers needed to minimize frictional drag.

Applications

- Tubing or casing applications
- Vertical and deviated wells
- Wells where rotation capabilities are not required
- Cased and open holes

Features, Advantages, and Benefits

- High-performance bows provide maximum standoff in multiple locations of the annulus, which provides optimal conditions for primary cementing to achieve zonal isolation.
- All common centralizer sizes have been tested and validated to meet API Specification 10D for providing reliability and durability during operations.
- The nonwelded design can withstand most wellbore environments, which provides operational flexibility.
- Locking tabs secure the high-quality, spring-steel bows to the hinged collars, which bear the load force of the centralizer for reliable downhole performance.
- Bow configurations are available in various heights and sizes suitable for most applications.
- Bows and hinged collars are stocked at most Weatherford service locations, so the centralizers can be assembled to specifications quickly.

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Tandem Rise® Bow Centralizer

Weatherford Tandem Rise bow centralizers are specifically designed to increase restoring forces and reduce drag during running and cementing operations. The Tandem Rise bows provide superior standoff with reduced running forces compared to conventional bow-spring centralizers. Nonweld locking tabs on specially designed end collars hold the bows in place and are capable of withstanding high lateral loads usually associated with horizontal wellbores.

We recommend using Weatherford CentraPro Plus® software during the planning phase to determine the optimum quantity and placement of centralizers needed to minimize frictional drag.

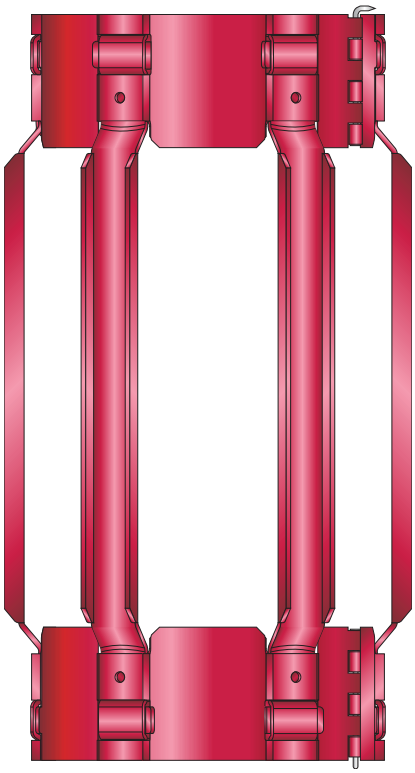
Applications

- Tubing or casing applications
- Horizontal and directional wellbores with high side-load conditions
- Vertical wellbores where low running force and high standoff are required

Features, Advantages, and Benefits

- Compared to conventional bow-spring centralizers, Tandem Rise bows provide better standoff for more effective mud removal, which enhances the primary cement job and zonal isolation.
- Locking tabs hold the bows in place, enabling the centralizer to withstand compressive loads during run-in.
- The field-proven, nonwelded design can withstand high lateral loads for reliable performance in horizontal wellbores.
- The centralizer achieves the highest restoring-force-to-drag ratio when running in hole.
- Both slip-on and latch-on versions are available.
- The centralizer can be installed over a stop collar to enable it to be pulled into the wellbore.
- Locking tabs secure the high-quality, spring-steel bows to the hinged collars, which bear the load force of the centralizer for reliable downhole performance.
- Bow configurations are available in various heights and sizes suitable for most applications.
- Bows and hinged collars are stocked at most Weatherford service locations, so the centralizers can be assembled to specifications quickly.

Nonwelded Centralizers *continued*



Positive Bow Centralizer

The Weatherford positive bow centralizer is used for both casing and tubing applications that require concentric casing strings. In deviated cased holes, the centralizer significantly reduces frictional drag and can provide nearly 100% standoff. The rigid bows are held in place with locking tabs on specially formed end collars. We recommend using Weatherford CentraPro Plus® software during the planning phase to determine the optimum quantity and placement of centralizers needed to minimize frictional drag.

Applications

- Liner and packer setting in cased holes
- Stage and surface cementing
- Well-abandonment operations

Features, Advantages, and Benefits

- Formed U-profile bows provide superior standoff for more effective centralization than conventional bow centralizers. This enables efficient liner-hanger and packer setting.
- Formed U-profile bows provide additional flow area to aid in mud removal, which contributes to a high-quality primary cement job.
- Special locking tabs connect the bows to the end collars to provide outstanding lateral resistance and a flexible, nonweld design.
- The centralizer achieves the highest restoring-force-to-drag ratio when run in hole in cased-hole applications.
- Both slip-on and latch-on versions are available.
- Locking tabs secure the high-quality, steel bows to the hinged collars, which bear the load force of the centralizer for reliable downhole performance.
- Bow configurations are available in various heights and sizes suitable for most applications.
- Bows and hinged collars are stocked at most Weatherford service locations, so the centralizers can be assembled to specifications quickly.

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Nonwelded Centralizers *continued*

Nonwelded Centralizer Size Chart

Hole Size (inches)	Casing Size (inches)											
	2-3/8	2-7/8	3-1/2	4	4-1/2	5	5-1/2	6-5/8	7	7-5/8	8-5/8	9-5/8
4-1/2 to 4-3/4	•	•										
5-3/4 to 6	•	•	•	•	•							
6-1/8 to 6-3/8	•	•	•	•	•	•						
6-1/2 to 6-3/4	•	•	•	•	•	•	•					
7-3/8 to 7-7/8		•	•	•	•	•	•					
8-3/8 to 8-5/8		•	•	•	•	•	•	•	•			
8-3/4 to 9			•	•	•	•	•	•	•	•		
9-1/2 to 10				•	•	•	•	•	•	•		
10-5/8 to 11						•	•	•	•	•	•	
12 to 12-1/4							•	•	•	•	•	•
14 to 15-1/2										•	•	•
17 to 18-5/8												
19-1/2 to 20-1/2												
22 to 23												
24 to 26												
26 to 28												
28 to 30												
30 to 32												
32 to 34												
> 34												

Note: Several options may exist for each hole size combination. Custom sizes 22 to 30 in. available.

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Nonwelded Centralizer Size Chart *continued*

Hole Size (inches)	Casing Size (inches)											
	10-3/4	11-3/4	13-3/8	16	18-5/8	20	22	24	26	28	30	36
4-1/2 to 4-3/4												
5-3/4 to 6												
6-1/8 to 6-3/8												
6-1/2 to 6-3/4												
7-3/8 to 7-7/8												
8-3/8 to 8-5/8												
8-3/4 to 9												
9-1/2 to 10												
10-5/8 to 11												
12 to 12-1/4	•											
14 to 15-1/2	•	•	•									
17 to 18-5/8	•	•	•	•								
19-1/2 to 20-1/2				•	•							
22 to 23					•	•						
24 to 26					•	•	•					
26 to 28						•	•	•				
28 to 30							•	•	•			
30 to 32								•	•	•		
32 to 34									•	•	•	
> 34											•	•

Note: Several options may exist for each hole size combination. Custom sizes 22 to 30 in. available.

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Variform® Centralizers

Designed and Tested for the Most Challenging of Casing and Liner String Applications

VariForm centralizers are one-piece centralizers designed with performance and durability in mind. The VariForm family includes a product for nearly any application, including for horizontal or extended-reach drilling (ERD) wells and for underreamed applications. Durable, single-piece construction enables VariForm centralizers to withstand extreme loads—from installation in the pipe yard to running downhole. These centralizers are engineered to provide high restoring forces in open and cased holes, and they are tested for downhole performance in specific applications.

Variform® Centralizers

VariForm Centralizer

The Weatherford VariForm centralizer is a high-performance, one-piece centralizer designed for deviated and horizontal holes. The centralizer provides high restoring forces while keeping starting and running forces at or near 0 lbf. This minimizes drag during casing running and maximizes standoff during cementing operations.

Applications

- Horizontal and deviated hole sections in which minimal to no starting and running forces are required for casing to reach total depth

Features, Advantages, and Benefits

- The advanced, versatile design of the centralizer enables customization for unique or critical applications.
- The proprietary fillerless welding technique used to form the centralizer body results in a weldment virtually indistinguishable from the parent metal.
- The one-piece construction results in a robust centralizer that can withstand immense forces, remain intact, and never leave debris in the hole.
- Minimal cross-sectional area minimizes flow restrictions and increases equivalent circulating densities.
- The VariForm centralizer provides high restoring forces and 0 lbf running force.
- All sizes have been tested and validated to exceed API Specification 10D.

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VariForm UR Centralizer

The Weatherford VariForm UR centralizer is a unique, one-piece tool that enables high restoring forces after passing through restrictions in underreamed holes. It also keeps starting and running forces low through the previous casing string.

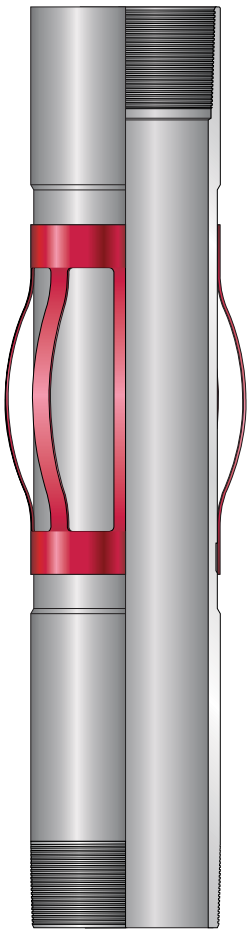
Applications

- Underreamed hole sections in which high restoring forces need to be balanced with starting and running forces
- Close-tolerance cased-hole applications when running casing or liners

Features, Advantages, and Benefits

- The advanced design of the centralizer enables customization for unique or critical applications.
- The proprietary fillerless welding technique used to form the centralizer body results in a weldment virtually indistinguishable from the parent metal.
- The one-piece construction results in a robust centralizer that can withstand immense forces, remain intact, and never leave debris in the hole.
- Minimal cross-sectional area minimizes flow restrictions and increases equivalent circulating densities.
- The centralizer provides exceptional restoring force post restriction, which results in excellent standoff in the open hole below.
- Centralizers are tested as they are run: They are first run into a restriction and then are performance tested in open hole as per API Specification 10D, including 12x flexing of the bow springs.
- All sizes have been tested and validated for underreamed applications, and testing currently meets or exceeds API 10D restoring-force requirements.

Variform Centralizers *continued*



VariForm Centralizer Sub

The Weatherford VariForm centralizer sub is used during running and cementing operations to centralize ultratight-clearance casing strings for enhanced wellbore integrity. Its unique design combines a precisely manufactured VariForm centralizer mounted on a field-proven Weatherford centrlizer sub body for reliable performance.

While the centralizer sub runs through tight restrictions, the centralizer is pulled into the restriction. The bows collapse against the sub body to create a flat profile along the entire length of the bow spring without a fulcrum point.

The built-in centralizer has beveled ends and increased OD sections above and below the bow spring to glide into ultratight restrictions and enable safe passage through windows. The curved centralizer bows lower resistance while passing through tight restrictions and reduce the risk of damage to sensitive wellhead and casing-hanger profiles. The patent-pending mounting method allows for full rotation of all models with low torque.

The centralizer sub body is manufactured from the same grade of material as the applicable casing string. The body meets or exceeds all burst, collapse, and tensile ratings and maintains casing drift diameters.

Applications

- Running through ultratight annular clearances of casing or liners

Features, Advantages, and Benefits

- The bows collapse against the body to enable the centralizer sub to pass through ultratight clearances.
- Precise manufacturing enables the sub to rotate with a minimum of torque.
- The built-in VariForm centralizer provides exceptional restoring force and excellent standoff.
- The curved bow-spring profile enables the sub to glide through restrictions with minimal chance of damage.
- Availability in float-collar, float-shoe, and guide-shoe configurations reduces the number of premium connections.
- The curved bow springs, which are streamlined to the sub body, and the patent-pending mounting method result in low starting and running forces when the centralizer passes through restrictions.

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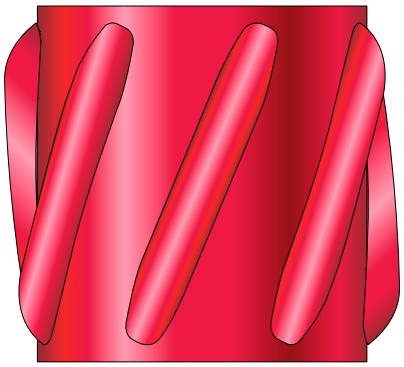
SpiraGlider® Centralizers

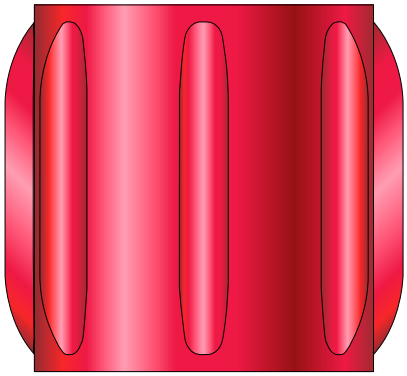
Excellent Performance in Highly Deviated Wellbores

Our SpiraGlider centralizers provide a low coefficient of friction and wear rate plus positive standoff in highly deviated or horizontal wellbores. Key design features include:

- All-steel construction and blade designs provide unsurpassed toughness with low coefficients of friction.
- Engineered blade load resistance provides high side-loading capability while minimizing the chance of stuck pipe.
- The hydrodynamic shape of the spiral blades provides optimal mud displacement via induced turbulent flow and minimal pressure drops.
- Unique stop-collar designs provide protection for the leading edge of the centralizer when running in restricted clearances such as in liner applications.

SpiraGlider® Centralizers





SpiraGlider Centralizer System

Weatherford SpiraGlider centralizer system enables optimal mud displacement for vertical, inclined, and horizontal wells. The system consists of a steel centralizer and two asymmetrically beveled stop collars shaped to minimize running resistance. Special rounded blades reduce casing-sliding friction while the stop collars perform as a positioning device. The stop collar also serves as a protection tool by providing a ramp (rather than a square shoulder) that enables the centralizer to climb over restrictions in the wellbore.

The SpiraGlider centralizer is available in heavy-duty (HD) or single-collar (SC) configurations with straight or spiral blades, and it can be used along with standard centralizers or centralizer subs. The SpiraGlider HD system is recommended when extremely high axial loads are anticipated.

Applications

- Vertical, inclined, and horizontal wells
- Extended-reach wells and wells with high dogleg severity

Features, Advantages, and Benefits

- The centralizer features a bearing surface that reduces drag and requires less rotational torque than conventional centralizers.
- Both spiral- and straight-blade configurations capitalize on the “sled effect” to minimize drag forces while running pipe. The blades glide smoothly on the low side of the borehole wall. Wide symmetrical fins, beveled smooth at both ends, glide easily over restrictions.
- The robust steel design—combined with modern manufacturing methods, including mechanical forming and robotic welding—makes this centralizer suitable for the most demanding conditions, in any well.
- The hydrodynamic shape of the blades enables optimal mud displacement during the cementing process while minimizing pressure drop and local turbulences across the centralizer.
- If pipe sticks, the SpiraGlider blades collapse with a predetermined side force to bypass the restriction. This preserves the mechanical integrity of the centralizer and enables the liner or casing to be safely run or pulled without the danger of losing the hole because of permanently stuck pipe.
- The blades are mechanically extruded and directly fixed using controlled welding processes, which provides additional strength without compromising the yield capability of the blades.
- The vortex motion of fluids pumped past the SpiraGlider system is proportional to the blade angle and flow area around the centralizer body, which enhances displacement efficiency and operational results.
- The large flow-by area of the system minimizes equivalent circulating density concerns and enhances operational efficiency.

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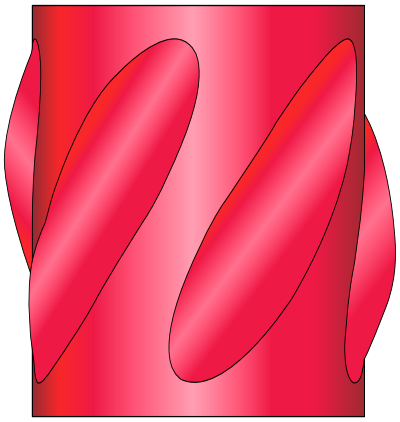
SpiraGlider Contour Centralizer System



The Weatherford SpiraGlider contour centralizer system is a single-piece, rigid centralizer that enables optimal mud displacement in vertical, inclined, and horizontal wells. Similar to the original SpiraGlider centralizer, the SpiraGlider contour centralizer features rounded blades that reduce sliding friction while running a casing and liners. Available in straight or spiral configurations, these blades are mechanically formed rather than welded onto the centralizer body.

The SpiraGlider contour system is secured to the liner or casing with beveled stop collars that are specifically shaped to reduce running resistance. The stop collars also act as positioning devices and protective barriers. They provide a ramp (rather than a square shoulder) that allows the centralizer to climb over wellbore restrictions.

Applications

- Vertical, inclined, and horizontal wells
- Extended-reach wells and wells with high dogleg severity

Features, Advantages, and Benefits

- Single-piece steel construction provides a bearing surface for lower torque and drag forces, which enhances rotation and running efficiency.
- The mechanically formed spiral-blade configuration produces a “sled” effect: The centralizer glides smoothly on the low side of the borehole wall, which enables running the string to target depth.
- The hydrodynamic shape of the spiral blades enables optimal mud displacement during primary cementing, which minimizes pressure drop and increases local turbulences across the centralizer.
- Blades collapse with a predetermined side force to bypass restrictions if the centralizer should become stuck. This feature enables the liner or casing to be safely run or pulled and preserves the mechanical integrity of the centralizer.
- With the spiral blade configuration, vortex motions of wellbore fluids pumped past the centralizer are proportional to the blade angle, which enhances mud displacement efficiency.
- The large flow-by area of the system minimizes equivalent circulating density concerns.

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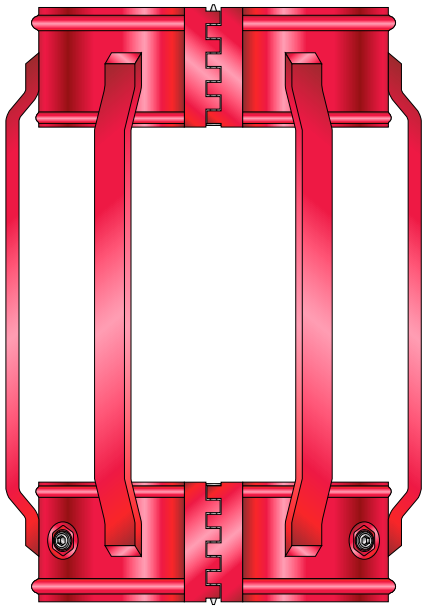
Rigid Centralizers

Rock Solid Construction For Positive Stand-Off

Weatherford provides a broad range of rigid centralizers to satisfy our customers' varying needs. These rigid centralizers provide a wide range of options for casing centralization, from standard vertical well configurations to highly deviated and horizontal wells. Their high-quality construction provides great strength and downhole integrity.

Rigid Centralizers



Rigid-Bar Centralizer

Weatherford rigid-bar centralizers provide positive standoff and centralization of casing strings in openhole and cased-hole applications during running and cementing operations.

The rigid-bar centralizer is available in a single-bar configuration for cased-hole applications and a double-bar configuration for openhole applications. The configurations are welded to latch-on or slip-on end collars, which provides operational flexibility to meet operator requirements.

To meet extreme axial and radial loads often associated with large-bore subsea applications, the rigid centralizer can be custom-built in a square-bar or flat-bar configuration with extra heavy-duty end collars, a double row of setscrews, or both.

Applications

- Cased-hole and openhole applications requiring positive casing standoff and centralization
- Large-bore, subsea applications with extreme axial and radial loads
- Vertical and horizontal wells

Features, Advantages, and Benefits

- The centralizer is available in various configurations to meet client requirements.
- Bar configurations provide positive standoff and centralization of casing strings in openhole and cased-hole applications, which maximizes the likelihood of achieving zonal isolation with primary cementation.
- Bars welded to the outer diameter of the end collars provide a reliable and durable centralizer.
- Setscrews secure the centralizer to the casing string, which enables the device to be pulled into the wellbore.
- Square-bar and flat-bar configurations provide a large bearing surface, which eliminates virtually all wellbore gouging for openhole applications.
- Slip-on end collars feature a single-piece end that—with the use of stop collars—allows rotation of the centralizer if required.
- Latch-on end collars feature an integral hinge that folds to the inside after installation and prevents unfolding in extreme conditions.
- All common centralizer sizes have been tested and validated to API Specification 10D.
- A shallow-angle leading profile enables the centralizer to pass through tight restrictions for maximum operational flexibility.
- Rigid outside diameter (OD) is smaller than minimum restrictions.

Options

- Available with slip-on or latch-on end collars. Latch-on end collars are available with an integral stop collar.
- Square-bar or flat-bar configurations are available for subsea applications.

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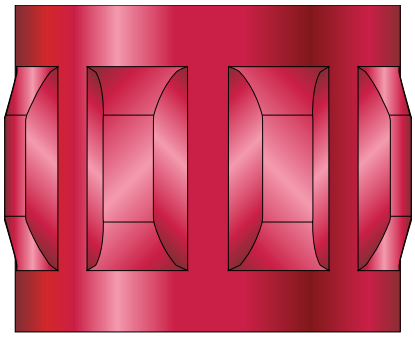
Standoff Band Centralizer

These centralizers are made of stamped steel and are designed for vertical well configurations where lateral loads are at a minimum but centralization is still required. Their strongest attribute is their flexibility. Should a wellbore obstruction be encountered, the raised blades are collapsible, thereby allowing the casing string to be run to total depth.



Standoff band centralizer

Short-Spiral Rigid Centralizer

These centralizers are made of fully welded, nonmarring mild steel and are designed to provide the maximum standoff possible with a short vertical profile. Spiral blades are angled at 45° to provide the maximum fluid turbulence and are arranged to provide 100% circumferential coverage. These centralizers are available with and without setscrews.

Short-spiral rigid centralizer

Aluminum-Alloy Spiral Centralizer

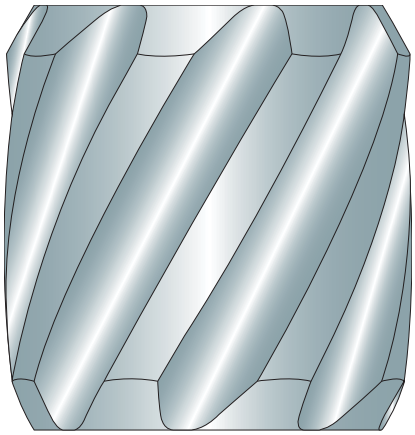
These centralizers are made of high-strength, corrosion-resistant cast aluminum. They can be used with corrosion-resistant alloy casing strings to avoid the effects of galvanic corrosion. Their spiral blades fully overlap to give 100% wellbore coverage and increase annular turbulence to improve wellbore cleanout. Their extra length provides maximum centralization for a rigid centralizer.

Applications

- Wellbores requiring increased fluid turbulence to remove mud more efficiently ahead of the primary cement job
- Medium to hard formations with minimal washed-out areas
- Highly deviated and horizontal wells

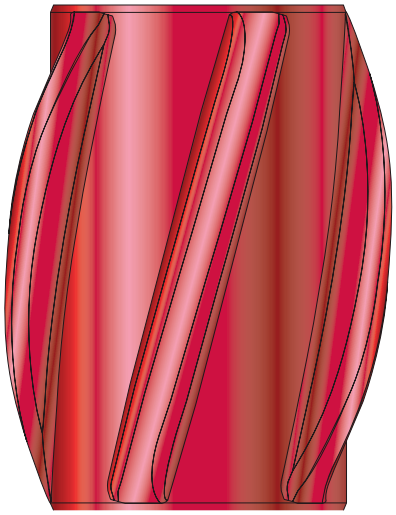
Features, Advantages, and Benefits

- The centralizer provides positive standoff in the wellbore, enabling cement to be evenly distributed around the casing string.
- The 45° spiral blades provide increased velocity with a turbulent motion that optimizes mud and cement displacement, which maximizes the likelihood of achieving zonal isolation with primary cementation and minimizes the need for remedial cementing operations.
- Blades overlay the entire 360° circumference, ensuring full wellbore contact and creating a turbulent mud flow for efficient displacement.
- The blade and collar are constructed from abrasion-resistant mild steel, which enables the centralizer to withstand applied loads during running and cementing operations.



Low-friction, aluminum-alloy spiral centralizer

Composite Centralizers



Composite Centralizer

The Weatherford composite compression-molded (CCM) centralizer provides casing centralization during running and cementing operations. The one-piece centralizer is made of advanced composite that has a low coefficient of friction and is heat resistant and highly durable. This material performs reliably in extreme wellbore conditions. With its smooth, durable, tapered construction, the centralizer can easily pass obstructions in the wellbore, so it is well suited for horizontal applications.

The Weatherford composite centralizer, available in straight and spiral-blade configurations, withstands high-impact loading and offers superior wear resistance, unlike many injection-molded plastic centralizers. It enables casing strings to reach total depth efficiently while providing good standoff for optimal mud displacement and greatly enhancing cementing operations.

Applications

- Vertical, deviated, and horizontal wells
- Extended-reach wells and wells with high dogleg severity
- Wells with temperatures up to 350°F (177°C)

Features, Advantages, and Benefits

- The one-piece composite construction can withstand high-impact loading and resist wear in high temperatures.
- The passive blade configuration capitalizes on the sled effect to minimize drag forces while running pipe. The blades glide smoothly on the low side of the wellbore and freely over obstructions.
- The hydrodynamic shape of the blades enables optimal displacement during primary cementing, which minimizes pressure drop and increases local turbulences across the centralizer.
- The composite is ultrahard and extremely durable, which enables the centralizer to maintain integrity in extreme wellbore temperatures.
- The lightweight construction allows for easier and safer handling when making up casing.

Tool Description

The Weatherford composite centralizer is used during running and cementing operations to centralize casing. Made of advanced composite, the one-piece centralizer has a low coefficient of friction, is heat resistant, and is highly durable. The composite material performs reliably even in extreme wellbore conditions. Unlike many plastic centralizers, this centralizer withstands high-impact loading and is highly wear resistant.

The composite centralizer has a smooth, tapered construction to easily pass obstructions in the wellbore, which makes it well suited for horizontal applications. The centralizer enables casing strings to reach total depth efficiently, provides optimal standoff for mud displacement, and greatly enhances cementing operations.

The Weatherford composite centralizer features advanced composite that can endure the wear in high-angle wells and the heat in high-temperature applications.

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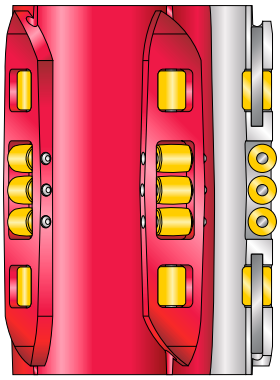
Torque-and-Drag Reducers

Low-Friction Casing- and Liner-Running Tools for High-Angle, Extended-Reach Wells

These mechanical torque-and-drag reduction tools are used on liner, screen, and casing strings. By maintaining contact with the ID of the previous casing string or open hole, bidirectional rollers on the tools reduce torque and drag, increase the available hook load to total depth, and facilitate cementing operations.

- Rugged construction with crimped-in-place axles and roller containment mitigate the risk of losing components in the well.
- Precision-machined ID fits over the casing throughout its complete API-tolerance range, which results in excellent rotational performance in mud.
- Metallic construction enables safe use of the tools at any operating temperature.
- Tools can be run in conjunction with high-strength stop collars for optimal performance.
- The tool design improves the ability to rotate and/or reciprocate pipe during cementing, which helps to improve the cement sheath.

Torque-and-Drag Reducers



LoTORQ Centralizer

Weatherford developed the LoTORQ system as a centralizer and an axial and rotational friction-reduction system to perform regardless of drilling or completion mud-film strength or lubricity. This unique system, which uses bidirectional rollers, has been proven in the world's most challenging wells. Rollers that are in contact with the inner pipe can achieve exceptionally low friction, with rotating coefficients in cement as low as 0.04. Rollers with higher profiles for contacting the exterior wellbore wall have routinely reduced axial-friction factors by 60%.

The vast majority of LoTORQ tools have been used in extended-reach wells to run and rotate liners. The LoTORQ mechanical friction-reduction system enables pipe rotation that was once torque limited and enables optimal displacement efficiency and cement sheath.

Applications

The LoTORQ tools provide optimal performance when:

- Casing, liner, and screens are being run into horizontal and extended-reach wells
- Long and/or heavy cemented liners are being rotated
- Health, safety, and environmental requirements ban the use of oil-based and pseudo-oil-based mud
- Under-pressured formations may cause differential sticking

Features, Advantages, and Benefits

- Bidirectional rollers provide low torque and axial drag to get casing, liners, or screens to bottom successfully with reduced rig time and costs.
- Low torque and drag enable rotation and reciprocation, which improves mud displacement and cementation.
- Minimal roller-contact area in openhole applications reduces the risk of differential sticking and provides optimal standoff for increased operational efficiency.
- Rollers provide superior wear resistance and remain functional for the life of the well, which enables casing or tubing retrieval, if necessary.
- Unique engineering and material selection keep axle shear stresses within elastic to prevent roller failure.
- High-quality material provides excellent high-temperature/high-pressure performance and corrosion resistance, which reduce replacement costs.

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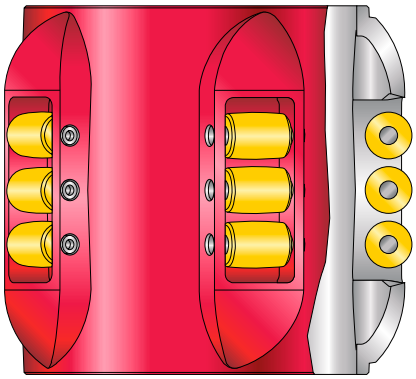
LoDRAG® Centralizer



Weatherford developed the LoDRAG system as a centralizer and an axial drag-friction-reduction system to perform regardless of drilling or completion mud-film strength or lubricity. The small contact area of the rollers with the casing or borehole wall functions exceptionally well in underpressured conditions, where risk of differential sticking is high.

LoDRAG tools have been used extensively to run sand-control screens into unconsolidated sandstone reservoirs, where the use of clean, nondamaging drilling and completion fluids give preference to mechanical friction reduction. Using LoDRAG tools in these reservoirs can reduce axial drag by up to 60%. The LoDRAG tools can reduce axial friction in cased holes by greater percentages and are routinely used on ultralong casing and liner strings. Use of the LoDRAG system has contributed to many record-length wells.

Applications

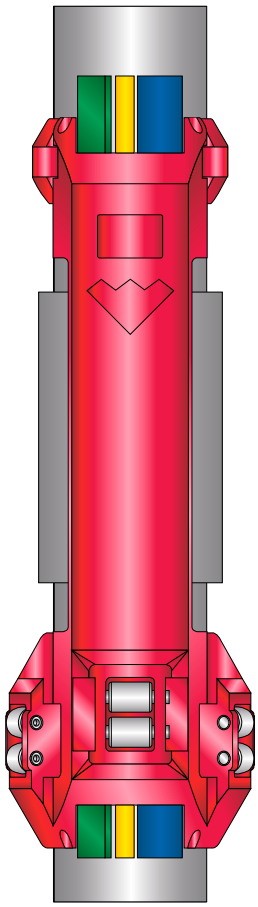
The LoDRAG tools provide optimal performance when:

- Casing, liner, and screens are being run into horizontal and extended-reach wells
- Centralizer wear may compromise the cement job
- Health, safety, and environmental (HSE) requirements ban the use of oil-based and pseudo-oil-based mud
- Underpressured formations may cause differential sticking

Features, Advantages, and Benefits

- The steel rollers help to avoid plowing through wellbore material that has settled on the low side of the hole; therefore, the rollers alleviate major drag problems in deviated and horizontal wells.
- The precision-machined ID fits over the casing through the complete API tolerance range for excellent rotational performance in mud.
- The small contact area of the rollers reduces the risk of differential sticking and maintains standoff when running casing through an open hole.
- Rollers provide superior wear resistance, remain functional throughout the life of the well, and can aid in reducing tubing replacement costs.
- Unique engineering and material selection maintain axle shear stress within elastic limits to prevent roller failure and the additional cost of remediation.

Torque-and-Drag Reducers *continued*



Roller Cross-Coupling Control-Line Protector

The Weatherford roller cross-coupling control-line protector, known as the RCLP, is designed to support and protect control lines as tubing is run into casing in extended-reach wells. The RCLP is positioned across tubing connections. The rollers reduce drag up to 45% by keeping control lines off the low side of the well so that tubing and control lines can run smoothly through the casing. This design enables intelligent completions in extended-reach wells where reaching total depth may otherwise be impossible.

Applications

- Intelligent completion installations that require hydraulic flow-control valves, electronic gauge systems, or optical sensing systems
- Horizontal or deviated extended-reach well completions that require drag reduction to reach total depth

Features, Advantages, and Benefits

- The RCLP fits securely across the tubing coupling to hold the control lines firmly in place, prevent damange to the lines, and avoid the need for expensive, time-consuming repairs or replacements.
- Because the RCLP fits over tubing couplings of varying lengths and ODs and also accommodates a triple flat pack (11 mm x 27 mm), a dual flat pack (11 mm x 18 mm), and a tubing encapsulated cable (11 mm x 11 mm), the CLP can be used in a wide range of applications, which minimizes the need for additional equipment.
- The leading and trailing edges of the roller CLP are angled to provide a smoother transition from 9 5/8- to 7-in. casing, which improves operational efficiency and reduces costs.
- The roller CLP is installed with standard tools (including air-driven tools), which expedites setup and reduces rig time.

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Stop Collars

Behind or Around Every Good Centralizer is a Great Stop Collar

Weatherford stop collars are designed for strength, top performance, and compatibility with specific centralizers to hold each centralizer in its intended location and provide the standoff desired. The following are key design features:

- Variety of fastening mechanisms–setscrews, slips, nails, adhesive plus setscrews and bolts–for different applications
- Available to slip on or latch on in most variations to provide either superior strength or easier installation
- Available with stainless-steel setscrews and end bands for applications where the stop collars will be exposed to corrosive fluids
- Available for all common casing sizes
- Custom designs available on request

Setscrew Stop Collars

Latch-on assembly with double-row setscrews (60260)

Setscrew type with single row, latch-on (J4H / 602), USA

Setscrew type with single row, latch-on (602)

Slip-on collar with single-row setscrews (603)

Setscrew stop collars provide excellent holding force and operational flexibility for numerous well applications. The specially inverted cup-tip setscrews limit penetration into the casing body, yet are highly resistant to slippage. Single-row and double-row screw configurations enable increasing the holding force as required by using additional setscrews. In addition, the shallow-angled leading edge of the collar reduces the risk of the stop collar or centralizer catching on wellbore debris or ledges during operations.

Latch-On Setscrew Stop Collar

Applications

- Any latch-on centralizer
- Rigid centralizers (though they are not the best choice for this application)
- Upset connections

Features, Advantages, and Benefits

- These collars provide reliable holding force.
- Double-row setscrews are available for applications where more holding force is required or requested.
- The latch-on assembly is compatible with nonrotating bow-spring centralizers.
- The latch-on stop collar is easier to install than the slip-on variant.

Slip-on Setscrew Stop Collar

Applications

- Any rotating bow-spring centralizer
- Latch-on centralizers with the stop collar pre-installed on pipe
- Low-end rigid centralizers such as the standoff band

Features, Advantages, and Benefits

- These collars provide reliable holding force.
- Double-row setscrews are available for applications where more holding force is required or requested.
- The slip-on assembly is compatible with rotating centralizers and is more robust than the latch-on variant.

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PoxiLok™ Epoxy-Injected Stop Collar

Applications

- Operations that require maximum holding forces

Features, Advantages, and Benefits

- The stop collar can be provided with small bevels on each end to assist rotation of bow-sring centralizers.
- The slip-on assembly is compatible with rotating centralizers and more robust than a latch-on collar.

PoxiLok epoxy-injected stop collar

Single- or Double-Side Bevelled Stop Collar

Applications

- Predominantly used on both sides of rigid or semi-rigid centralizers, such as the SpiraGlider, the LoTORQ, and the LoDRAG centralizers
- A good option with the VariForm centralizer

Features, Advantages, and Benefits

- These collars provide reliable holding force.
- Double-row setscrews are available for applications where more holding force is required or requested.
- The bevel provides a good lead-in edge for a rigid centralizer.

Double-bevel stop collar

Double-row, single-bevel stop collar

Single-row, single-bevel slip-on (60370)

Nonsetscrew Stop Collars

Slip type, slip-on (automatic)

Friction type (605)

Spiral-nail type, latch-on (JSH)

Nonsetscrew stop collars are primarily chosen for their ease of installation, but several other features can make them the favorable choice. Weatherford offers a full range of collar-securing methods that give our customers options to support all their operation variables. For example, the spiral-nail holding mechanism on the JSH stop collar greatly reduces the amount of rig time needed to install the centralizers. The slips used on the 608 and 60850 stop collars bite into extremely hard casing for high holding forces. The model 605 friction-lock stop collar is ideally suited for nonscarring applications such as fiberglass tubing, casing, and drillpipe.

Automatic Stop Collar

Applications

- Operations that use SpiraGlider, LoTORQ, or LoDRAG centralizers
- Operations that require rotation capabilities

Features, Advantages and Benefits

- High holding force
- Easy installation
- Grip on high yield-strength casing
- Lathe-turned model 60850 available upon request to provide exacting OD dimensions

Friction-Lock Stop Collar

Applications

- Drillpipe centralizers
- Reciprocating and rotating scratchers
- Latch-on centralizers when there is a large gap between hole size and casing OD

Features, Advantages, and Benefits

- Economic
- Easy to install and remove
- Nonscarring (used in fiberglass tbg/csg and drillpipe)

Spiral-Nail Stop Collar: JSH

Applications

- Run in conjunction with latch-on centralizers
- Applied on both upset and nonupset casing

Features, Advantages, and Benefits

- Provides good holding force
- Automated assembly tool provides ease and consistency of installation

Options

Stop-Collar Availability	
Holding Mechanism	**Installation Method**
Setscrews	Slip-on or latch-on
Spiral nail	Latch-on
Slips	Slip-on
Friction	Slip-on or latch-on

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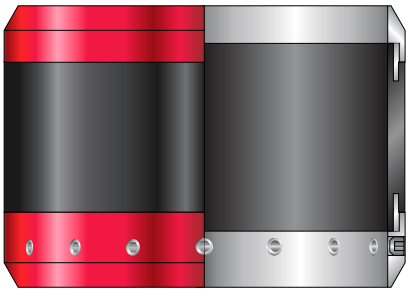
Specialty Products

Special Applications Need Specialty Products

Weatherford specialty products are designed for a wide range of special applications:

- Micro-Seal® products are cemented in place with the liner or casing string and mitigate flow of well fluids, oil, water, or wet gas along the microannulus.
- Durable control-line clamps (SpiraClamp/RCLP) are manufactured from steel to protect control lines while tripping to total depth.
- Cement baskets have overlapping fins that provide a simple seal.
- The depth orientation marker (DOM) uses highperformance magnets that are safer than a radioactive source and do not need a battery to provide life-of-well indication of locations.
- Scratchers incorporating steel bristles of coiled wire directly contact the open hole to aggressively remove excessive wall cake and improve cement bond.

Specialty Products



Micro-Seal® Isolation System-Unit (MSIS-U)

The Weatherford patent-pending swellable elastomer Micro-Seal isolation system-unit (MSIS-U) safeguards long-term production integrity by preventing the unwanted migration of well fluids through microannulus leak paths between the casing and cement sheath. This system offers a low-risk, cost-effective alternative to expensive and time-consuming remedial cementing operations that are often necessitated by microannulus pressure migration.

The Micro-Seal isolation unit incorporates Weatherford proprietary hybrid-swellable technology. When in contact with water/hydrocarbon-based wellbore fluids, wet gases, or any combinations of these, the element swells and seals any potential microannulus.

The Micro-Seal isolation unit is a standalone, slip-on device for use in cased-hole and openhole wellbore sections. The MSIS-U is the heart of the Micro-Seal isolation system and, when combined with one of the industry-leading Weatherford mechanical cementing products, it provides excellent casing standoff.

Applications

- Any well with the risk of microannulus gas migration
- Gas or liquefied petroleum gas (LPG) storage and injection wells
- Wells that must be fractured or acidized
- Wells with perforation damage to the cement sheath
- Multiple-completion wells with one or multiple casing strings
- Wells to be stimulated by steam or other thermal processes and that experience wide variances in temperature and/or pressure
- Any well location where there is a history of wellhead pressure buildup

Features, Advantages, and Benefits

- The Micro-Seal isolation unit is a cost-effective solution to prevent microannulus gas migration and eliminates the need for expensive remedial cementing operations.
- The swellable element effectively seals against the OD of the casing and the ID of the cement sheath, sealing regular and irregular annular geometries.
- The hybrid-swellable element can be activated by water/hydrocarbon-based fluids, wet gases, or any combination of these to provide zonal isolation in any environment.
- End rings protect the swellable element from damage while running in hole.
- Swellable elements can operate in downhole temperatures of up to 300°F (150°C). Swellable elements with higher temperature requirements are available upon request.
- The isolation unit can be fitted between stop collars in any required configuration on any section of tubing or casing. Alternatively, the setscrews in the end band of the unit enable securing the unit to the tubing or casing (only if no rotation is planned). It can also be deployed with industry-leading Weatherford cementing products.

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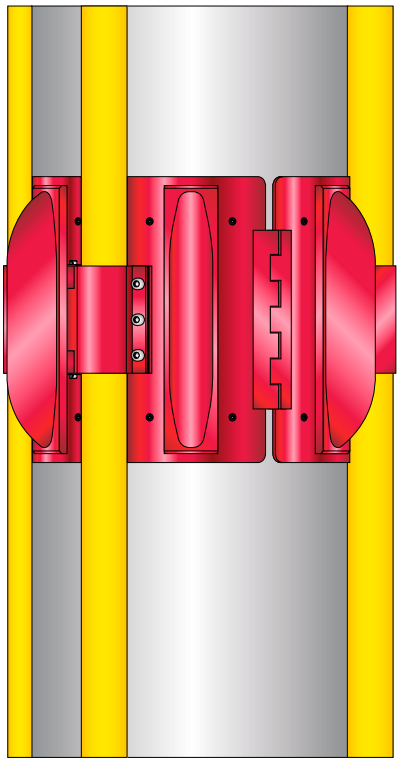
SpiraClamp Centralizer

The Weatherford SpiraClamp centralizer provides safe, permanent installation of control, sensor, and injection lines while minimizing running resistance in vertical, inclined, and horizontal wells.

The centralizer is available in both heavy-duty (HD) and single-collar (SC) configurations. Contributing further to its versatility, the SpiraClamp centralizer is available in a slip-on or latch-on configuration with clamp designs that meet customer requirements to properly position the specified lines.



Applications

- Wells requiring safe, permanent installation of control, sensor, and injection lines in the wellbore annulus
- Extended-reach wells and wells with high dogleg severity
- Vertical, inclined, and horizontal wells

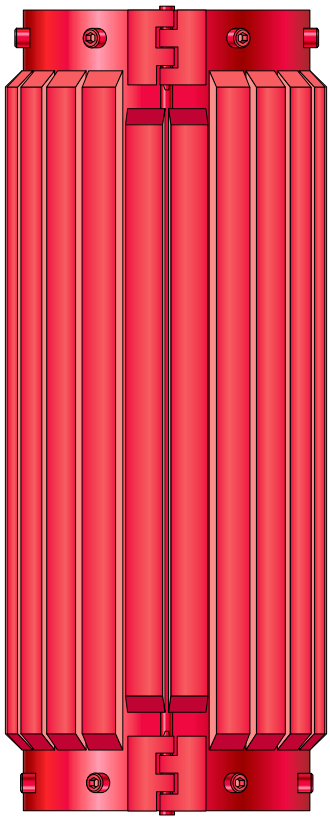
Features, Advantages, and Benefits

- SpiraClamp centralizers permanently secure control, sensor, and injection lines in the well, which enables operators to complete the well to target depth without damage to the lines.
- The centralizer is designed to meet customer requirements to properly position the specified line in the wellbore.
- Line clamps are made of steel to keep the control lines in position for full functionality after cementing operations.
- The robust steel design makes the centralizer suitable for the most demanding well conditions and reduces equipment failures caused by harsh well conditions.
- The large flow-by area of the centralizer minimizes equivalent circulating density concerns.
- Multiple configurations are available for compatibility with all pipe diameters and line designs.

Options

- Latch-on and slip-on configurations
- Heavy-duty or single-collar configurations

Specialty Products *continued*



Depth Orientation Marker (DOM)

The Weatherford depth orientation marker (DOM) is a device used to provide long-term, downhole reference points. The DOM focuses a magnetic field inside the casing. As the casing-collar locator (CCL) passes through the string, the magnetic field generated by the DOM distorts the CCL field, creating an induction current in the tool and a “blip” on the log that is at least 50% stronger than the normal casing-collar “blip.” On flush-joint casings, the DOM often appears as the only clear “blip” on the CCL log.

The DOM contains two permanent magnets arranged to create a magnetic field focused in the center of the device. The durable magnets provide a focused magnetic field that can be picked up by the CCL for many years after installation.

Applications

- Perforating multiple zones in production casing or liner strings
- Determining the exact depth correlation in casing joints of consistent lengths
- Preventing errors related to miscounted joints on the casing tally
- Generating a clear depth indication in integral and flush-joint connections

Features, Advantages, and Benefits

- The DOM provides casing-logging engineers with a downhole reference point from which to measure, which saves valuable time when tripping in and out of the hole to perforate casing.
- The DOM “blip” can be detected years after installation in wells that must be re-completed or reperforated, which saves time and improves operational efficiency.
- The DOM contains no radioactive materials, which minimizes storage and handling issues.
- Standard and close-tolerance versions are available, so the DOM can be deployed in a variety of wellbore conditions.

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Cement Basket

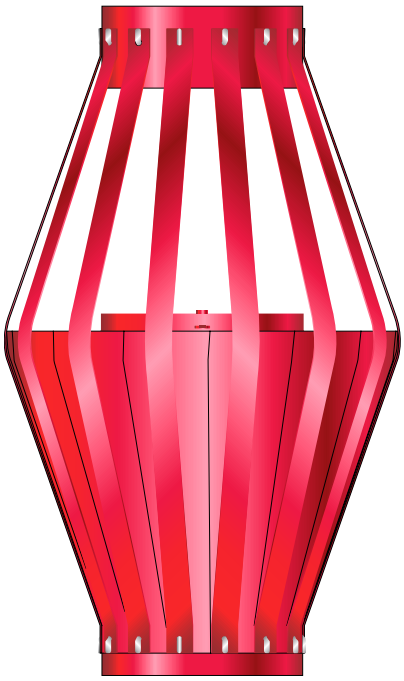
Weatherford cement baskets protect weak formations from hydrostatic pressures exerted by the weight of cement columns. Baskets are run above weak formations on casing, tubing, and liner strings and can be used in single-stage or multistage cement jobs. Each basket is made of a high-strength metal and features overlapping fins to provide maximum flexibility and fluid passage while maintaining optimum support. Cement baskets are available in latch-on or slip-on configurations and should be installed over stop collars to prevent axial movement.

Applications

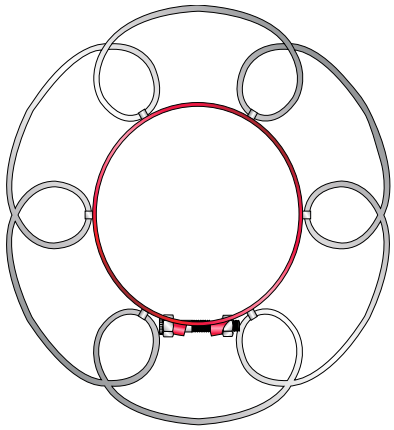
- Cased-hole or openhole applications
- Wellbores requiring cement support in the annulus
- Cementing weak formations that may break down because of excessive hydrostatic pressures

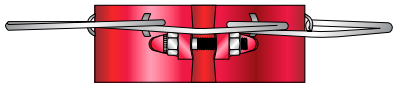
Features, Advantages, and Benefits

- High-strength metal can withstand excessive hydrostatic pressures exerted by cement columns to prevent formation damage and thereby significantly reduce costs and nonproductive time.
- Flexible, overlapping metal fins aid the basket in forming a bridge in the annulus to prevent cement from falling.

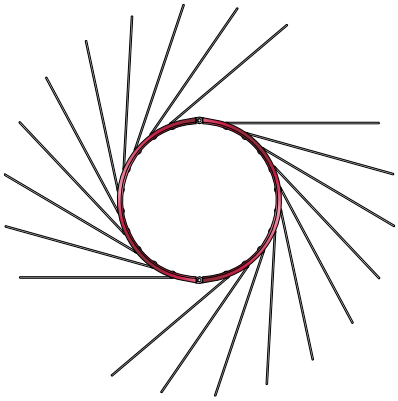


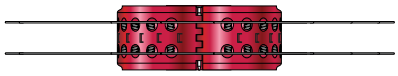
Cement basket with stop collar provided





Wellbore wiper





Wellbore scratcher

Reciprocating Wellbore Wipers and Scratchers

Weatherford reciprocating wellbore wipers and scratchers help improve cement-to-formation bonding and zonal isolation by removing excess mud cake from wellbores and reinforcing the cement column. During running and reciprocating operations, the tools keep the wellbore free of debris and mud cake with the action of continuous, overlapping loops or abrading bristles, both made of high-strength tempered-steel cable. The tools are installed on casing: The wiper is clamped to the casing with a bolt and the scratcher is secured with a traditional hinge pin to prevent axial movement.

Applications

- All wellbores requiring mud- and filter-cake removal
- Casing strings that are planned for reciprocation
- Openhole sections of wellbore requiring filter-cake removal

Features, Advantages, and Benefits

- Both designs provide aggressive wellbore cleaning that promotes good cement-to-formation bonding.
- The steel wipers and bristles act as reinforcement to the cement column.
- Secure attachment mechanisms enable easy and secure installation on casing, eliminating the need for separate stop collars.

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Application Guide

Rigid/Semi-Rigid Family

	SpiraGlider		Roller Tools		Composite	DWC	SOB	SSR	SRC	Solid	Bars	Positive	Sub
	SC/HD/CO	Latch-on	LoTORQ	LoDRAG						Centralizer		PO Bow	542/540
Vertical Strings	●				●	●	●	●	●	●	●	●	●
Deviated Strings	●	●	●	●	●	●	●	●	●	●	●	●	●
Horizontal Strings	●	●	●	●	●	●	●	◐	●	●	●	●	●
ERD Strings	●	●	●	●	●	●	●	◐	●	●	●	●	●
Rotating Casing	●		●	●	●	●	◐		●	●			●
Reciprocating Casing	●	●	●	●	●	●	◐	●	●	●			●
Cased Hole	●	●	●	●	●	●	●	●	●	●	●	●	●
Open Hole	●	●	◐	◐	●	●	●	●	●	●	◐	●	●
Underreamed: 0.875 in. < Restriction < 1.5 in.	●												●
Underreamed: restriction ≤ 0.875 in. above casing OD													◐
Large Annular Clearance (CH)											●	●	
Oversized/Washed-Out Hole	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐			◐
Uncemented Completion	●	●	●	●	●	●			●	●			●
Uncemented CRA Completion	◐	◐	●	●	●	●			◐	◐			●
Protect Tools In String	●	●	●	●	●	●							●
Centralizing Drill String In Oh		●											
Agitate Mud	●	●			●	●		●	●	●			

● Best choice ● Can be used without limiting operations ◐ Can be used with caution ○ Not recommended

Glossary of Terms

Rigid/Semi-Rigid

SC - SpiraGlider, single-collar configuration

HD - SpiraGlider, heavy-duty configuration

CO - SpiraGlider contour system

SS - SpiraGlider, stainless-steel variant

Latch-on - SpiraGlider, latch-on configuration

Composite - Weatherford composite centralizer

DWC - Drilling-with-casing centralizer, solid blades, rubber lined

SOB - Standoff band

SSR - Short-spiral rigid centralizer

SRC - Aluminum-alloy spiral centralizer

Solid - Centralizer made from solid steel, either cast, machined, or partially welded together

Bars - A centralizer formed either by thick solid blades or bows or by T bars or tube (models 153 / 152)

Positive PO Bows - A nonwelded centralizer with PO-type bows

542 - Rigid centralizer sub with spiral blades

540 - Rigid centralizer sub with straight blades

SHLO - Slim-hole, latch-on, rigid centralizer (similar to a SpiraGlider latch-on centralizer)

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Bow Spring

VariForm			Welded						Sub		Non-Weld	
Regular	UR	Sub	S110/110	B110	123	S312	RC113	RC121	541	541R	Single	Tandem
●	●	●	●	●	●	●	●	●	●	●	●	●
●	●	●	●	●	●	●	●	●	●	●	●	●
●	●	●	●	●	●	●	●	●	●	●	●	●
●	●	●					●		●	●		●
●	●	●					●	●		●		
●	●	●	●	●			●	●	●	●	●	●
●	●	●	●	●	●	●	●	●	●	●	●	●
●	●	●	●	●	●	●	●	●	●	●	●	●
	●	●			●		●	●	●	●		
		●			●				●	●		
●	●	●	●	●	●	●	●	●	●	●	●	●
●	●	●	●	●		●	●	●	●	●	●	●
●	●	●	●			●	●	●	●	●	●	●
						●						

Bowspring

VariForm - One-piece centralizer for conventional applications

VariForm UR - One-piece centralizer designed for passing restrictions and centralizing in underreamed open holes

VariForm Sub - One-piece centralizer designed for passing ultratight restrictions and centralizing in underreamed hole; installed on a special casing sub

S110 - Standard latch-on welded bow springs, only for API sizes 4.5 to 20 in.

110 - Latch-on welded bow spring for non-API sizes or other special requirements

B110 - Economy latch-on, welded centralizer

123 - Tight-clearance, slip-on, bow-spring centralizer with integral stop collar (setscrews on the end band)

RC113 - Slip-on, lap-welded, bow-spring centralizer that is installed over stop collar for rotating applications

RC121 - Slip-on, notch-welded, bow-spring centralizer that is installed between stop collars for rotating applications

541 - Nonrotating bow-spring centralizer sub

541R - Rotating bow-spring centralizer sub

NW-single - Nonwelded, single-bow, latch-on centralizers

NW-Tandem - Tandem Rise nonwelded, latch-on bow centralizers

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