Weatherford®

COROD® Continuous Rod and Well Services

Built to perform. Designed to last.

Providing significant production improvements and cost reductions through revolutionary design, state-of-the-art manufacturing and innovative service options.

Boost production. Reduce operating costs. Realize the fullest potential from your wells.

COROD® brings you more than 40 years of powerful, proven results.

Weatherford's *COROD* continuous rod is one of the world's leading well-optimization solutions for reciprocating rod lift (RRL) and progressing cavity pumping (PCP) applications. A superior alternative to conventional sucker rods, *COROD* continuous rods offer several distinct advantages—including revolutionary design features, state-of-the-art manufacturing processes and innovative global service options. For you, this translates to maximum efficiency and lower operating costs.

Revolutionary Design Features

Simply put, *COROD* continuous rod is superior by design. Higher-quality materials, a variety of specially optimized metallurgical grades, the broadest spectrum of sizes and proprietary semi-elliptical rod offerings.

State-of-the-Art Manufacturing Processes

We maintain the strictest controls, at every level of production, in our own cutting-edge facilities. As a result, our manufacturing and quality-control standards exceed those of anyone else in the industry.

Innovative Service Options

Only Weatherford integrates comprehensive services, included with your continuous-rod purchase. Quick mobilization, high levels of automation and a globally based equipment fleet enable tremendous cost-saving advantages for our clients.

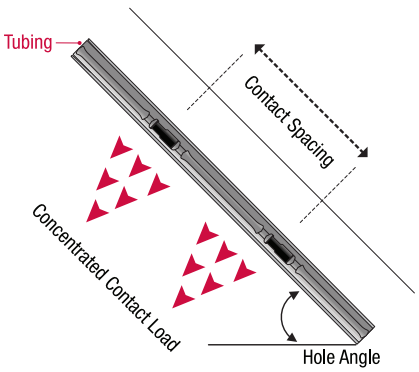
Streamlined, uniform design

COROD continuous rod is designed to deliver the utmost in engineered well performance—helping you increase run times and reduce maintenance and operational costs.

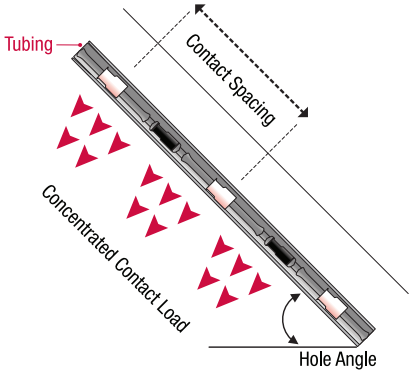
Uniform Body Design

COROD strings require only two connections: one at the top and one at the bottom. As a result, contact loads are dispersed throughout the entire rod string, which significantly reduces tubing and rod wear. That means fewer costly well interventions and a longer lifespan for the rod assembly.

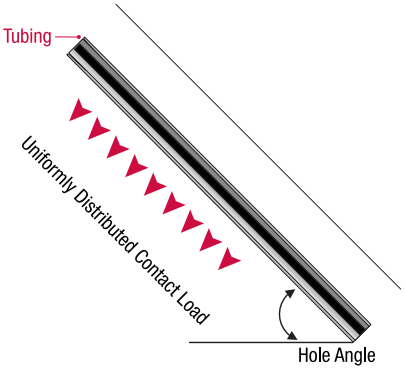
Sucker-Rod String



Guided Sucker-Rod String



***COROD* Continous Rod**



Larger Annular Space

The elimination of couplings, centralizers and rod guides creates a larger annular space between the production tubing and the rod string. This minimizes pressure losses, which increases system efficiency and reduces production costs.

COROD Continuous Rod

Sucker Rod with Slim-Hole Coupling

Semi-Elliptical *COROD*

Lightweight String Design

Compared to conventional sucker rods, *COROD* strings are considerably lighter in weight, reducing the amount of strain on the surface unit.

The right solution for multiple applications

COROD® continuous rod is effective for both RRL and PCP applications. Weatherford specialists, backed by a wealth of historical and technical expertise, can help you select the right solution for optimum performance and production.

Reciprocating Rod Lift

Both semi-elliptical and round cross-section *COROD* systems work effectively in RRL applications. Properly selecting the applicable cross section reduces internal tensile and compressive and bending stresses in the rod, which minimizes the load imposed on the pump and enhances pumping efficiency.

Semi-Elliptical *COROD* Continuous Rod

Semi-elliptical continuous rod is a uniquely designed sucker-rod product that can offer several benefits, in certain applications, over round rod. Manufactured in seven different taper sizes at 1/16-in. increments, the semi-elliptical continuous rod string can be custom-designed to any length. With a lower overall string weight and a balanced string design, the load on the surface-pumping-unit gearbox—and the horsepower requirements—are reduced significantly. This enables a smaller pumping unit to reach greater pumping depths and achieve higher pumping rates, compared to conventional sucker rods and round continuous rods.

Additional benefits of semi-elliptical continuous rod:

- Reduced contact loading between the rod and the tubing, resulting in less wear.
- Predictable bending along only one plane, due to the rod's ribbon-like shape.
- Improved surface finish, resulting from formed, semi-elliptical design.
- No yield stresses, because rod is not yielded when coiled onto transport reels.

Progressing Cavity Pumping

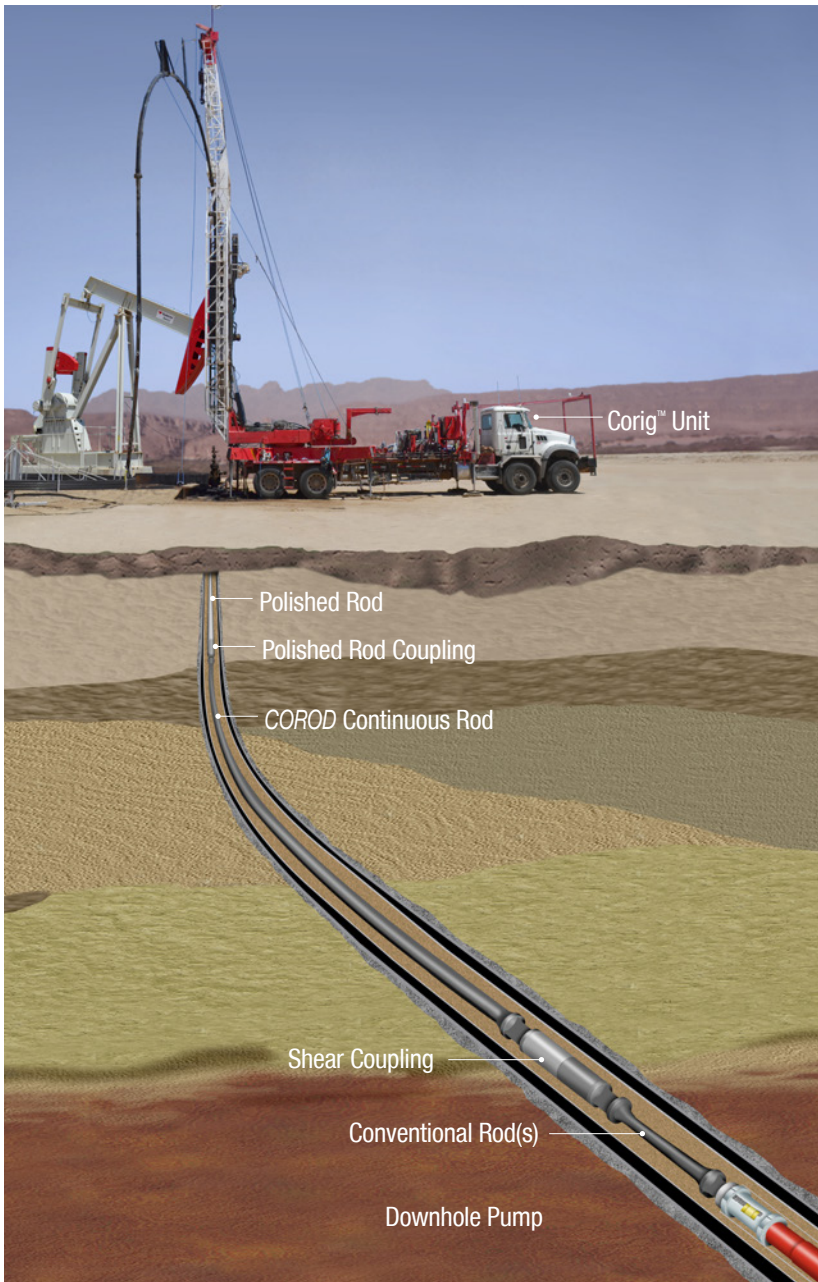
Round cross-section *COROD* systems function efficiently in PCP applications. In a PCP system, *COROD* strings reduce tubing wear, lessen the torque placed on motors and pumps and minimize overall power requirements. This, in turn, decreases the required size of the PCP, which reduces the load on system components and can deliver operational cost savings through fewer tubing leaks, lower flow losses and higher system efficiency.

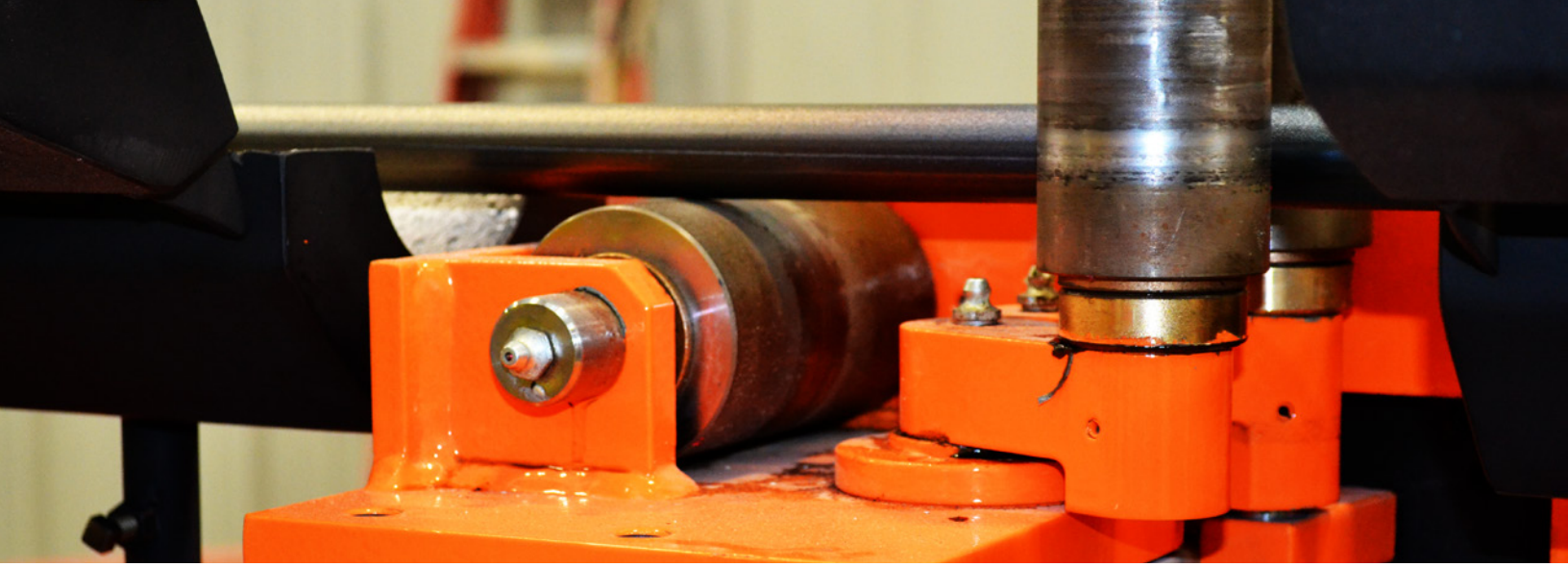
Challenging Applications

Challenging applications, such as highly deviated wells and heavy, high-viscosity oil production, are prime opportunities for the high-strength, high-torque capabilities of *COROD* continuous rod. The *COROD* design extends the lifespan of rod and tubing strings, which delivers superior performance over conventional rods in deviated wells.

Well Configurations:

- Deep wells
- Slant wells
- Deviated wells
- Horizontal wells
- Vertical wells





Designed and manufactured for premium performance

COROD® continuous rod is the product of innovative, industry-leading design, coupled with quality materials and unsurpassed excellence in manufacturing.

The Product

All *COROD* strings are available in five distinct, state-of-the-art metallurgical grades, to enhance performance for different load sizes and in corrosive well environments.

COROD D-Grade Carbon Steel (D/DR) Continuous Rod

Designed for medium-load RRL and PCP pumping in wells that are noncorrosive or mildly corrosive, but effectively inhibited. *COROD* D/DR is available in multiple round and semi-elliptical sizes, to suit a wide range of applications.

COROD DWR Regular-Strength Continuous Rod

Designed for medium-load RRL and PCP pumping in mild to medium corrosive environments that are effectively inhibited. *COROD* DWR is made from a chrome-nickel-molybdenum special alloy, specifically formulated to improve stress tolerance and fatigue resistance. Available in two round sizes, to suit a wide range of applications.

COROD Regular-Strength (DE/DER) Continuous Rod

Designed for medium-load RRL and PCP pumping where carbon dioxide or chlorides are present, and for corrosive environments that are effectively inhibited. *COROD* DE/DER is made from a chrome-molybdenum special alloy, micro-alloyed with titanium to improve its mechanical and heat-treating properties. To improve corrosion resistance in certain applications, chromium content has been increased to two percent. Available in multiple round and semi-elliptical sizes, to suit a wide range of applications.

COROD High-Strength (SE/SER) Continuous Rod

Designed for heavy-load RRL and PCP pumping in deep, high-volume wells with mild to medium corrosive environments that are effectively inhibited. *COROD* SE/SER is made from a chrome-molybdenum special alloy, micro-alloyed with titanium to improve its mechanical and heat-treating properties. To improve corrosion resistance in certain applications, chromium content has been increased to two percent. Available in multiple round and semi-elliptical sizes, to suit a wide range of applications.

COROD SWR High-Strength Continuous Rod

Designed for heavy-load RRL and PCP pumping in deep, high-volume wells with mild to medium corrosive environments that are effectively inhibited. *COROD* SWR is made from a chrome-nickel-molybdenum special alloy, specifically formulated to improve stress tolerance and fatigue resistance. Available in multiple round sizes, to suit a wide range of applications.

The Process

Weatherford's *COROD* continuous-rod manufacturing operations are situated in two strategic locations: Strathcona, Alberta, Canada; and Shafter, California, United States. Our rods are manufactured to exacting specifications, satisfying the most rigorous manufacturing quality requirements of ISO 9001 and adhering to the highest levels of quality control at every level of production.

Both of our *COROD* manufacturing facilities feature in-house metals laboratories, which conduct quality-control testing, heat-treatment recommendations, plant and field-welder testing, product development and failure analyses. This strong commitment to quality, research and development ensures that all Weatherford products meet the most stringent quality standards and accommodate the most demanding expectations.

Innovative service options

Meeting your equipment needs the world over.

Weatherford provides timely, cost-effective service options, with a proven track record of exceptional performance. Our comprehensive installation service solutions are supported by a globally based equipment fleet, quick mobilization, high levels of automation and reliable transportation solutions.

Globally Based Equipment Fleet

Weatherford's COROD® service solutions offer customizable equipment options, designed to meet country-specific regulations and operate at peak efficiency, even in the harshest environments. With more than 360 pieces of state-of-the-art service equipment, situated across five continents, we are ideally positioned to get you what you need, when you need it, no matter where you're operating.

Quick Mobilization

Thanks to some of the fastest mobilization times in the oilfield service industry, our service equipment is guaranteed to reduce nonproductive time and deliver substantial cost efficiencies.

High Levels of Automation

Significant automation enables our equipment fleet to deliver services with maximum efficiency, every time.

Reliable Transportation Solutions

Weatherford's *COROD* transport trailer supports all *COROD* continuous-rod sizes. The trailer is equipped with a rotating hub for aligning and retaining the transport reel, as well as locking devices to secure and protect the load during transit to your wellsite.

Weatherford's rod hauler is a truck-based system designed to transport continuous-rod reels, transferring continuous rod between transport and service reels, as well as cutting continuous rod for disposal. This unit supports all *COROD* continuous-rod sizes.

Strong mobile-service capabilities

Comprehensive, on-site maintenance and repairs help you stay on schedule.

Mobile Gripper™ Unit

A compact, truck-mounted continuous-rod injector that is specifically designed for rapid deployment and safe operation. The *Mobile Gripper* unit works together with any service rig or flushby to provide all continuous-rod service work, pump changes, rod fishing, tool deployment, plug retrieval and sliding-sleeve setting.

- Quick access into space-restricted areas, with easy in-and-out maneuverability.
- Trips rod at a rate of up to 100 ft/min (30 m/min), enabling quick mobilization and minimizing the need for intervention.
- Compatible with vertical and slant wellhead configurations for oil, gas and coalbed methane (CBM) wells.

Corig™ Unit

One of the most sophisticated and technologically advanced service units on the market, with more than 40 years of field-proven experience. The *Corig* unit has earned a reputation as the industry's benchmark for exceptional service, providing all continuous-rod service work, pump changes, rod fishing, tool deployment, plug retrieval and sliding-sleeve setting.

- Injector trips rod at a rate of up to 100 ft/min (30 m/min), enabling quick rig-in and rig-out times.
- Custom-built, integrated derrick, featuring a hydraulically operated rod injector.
- Compatible with vertical and slant wellhead configurations for oil, gas and CBM wells.

Strong mobile-service capabilities (continued)

Flushby with COROD® Gripper

A mobile, self-contained service unit that is specifically designed for rapid deployment and safe operation. Consists of fluid tank, triplex pump, compact mast-and-hoist assembly and a full set of tools and safety equipment (rod tongs, blowout preventers)—all mounted on a single truck.

In addition to performing all forms of conventional sucker-rod service, the flushby with *COROD* gripper features a built-in continuous-rod injector, capable of tripping continuous rod at a rate of up to 100 ft/min (30 m/min). This enables the unit to service continuous-rod strings without the need for additional service equipment.

- Quick mobilization and a freestanding mast enable rig-in and rig-out procedures in as little as 15 minutes.
- Compatible with vertical wellhead configurations for oil, gas and CBM wells.

Dual-Purpose Service Unit

The most versatile service unit in our equipment fleet, serving as a one-stop solution for restoring disabled wells. Supports continuous and conventional sucker-rod service work, tubular-handling applications and light workover interventions.

- Freestanding mast operates independently of external guy lines, allowing for quicker and more efficient rig-in and rig-out on wellsites.
- The built-in injector trips rod at a rate of up to 100 ft/min (30 m/min), ensuring minimal service time.
- Compatible with vertical-wellhead configurations for oil, gas and CBM wells.

On-Site Welding

An efficient, time-saving service that enables welding of *COROD* continuous-rod strings in the field.

Specifications

Mechanical Properties

API Grade	Codes	Material	Tensile Strength (min.)		Yield Strength (min., 0.2% offset)		Elong (min.)	Hardness (max.)	
			psi	MPa	psi	MPa	%	Rockwell	Brinell
D Carbon	D, DR	1536M	115,000	790	85,000	590	10	28	271
D Alloy	DE, DER	4120M	115,000	790	90,000	620	10	28	271
D Alloy	DWR	4320M	115,000	790	90,000	620	10	30	286
D Special	SE, SER	4120M	140,000	965	115,000	790	4.5	36	336
D Special	SWR	4320M	145,000	1,000	120,000	825	4.5	38	353

Maximum Torque Capacity

COROD #	Size		Codes			
	in.	mm	DR/DER	SER	DWR	SWR
8.5	1-5/32	29.4	1,490 ft-lbf 2,020 N·m	2,000 ft-lbf 2,712 N·m	1,490 ft-lbf 2,020 N·m	2,000 ft-lbf 2,712 N·m
6	1	25.4	955 ft-lbf 1,295 N·m	1,300 ft-lbf 1,763 N·m	955 ft-lbf 1,295 N·m	1,300 ft-lbf 1,763 N·m
4	7/8	22.2	640 ft-lbf 868 N·m	900 ft-lbf 1,220 N·m	N/A	900 ft-lbf 1,220 N·m
3	13/16	20.6	500 ft-lbf 678 N·m	700 ft-lbf 949 N·m	N/A	700 ft-lbf 949 N·m

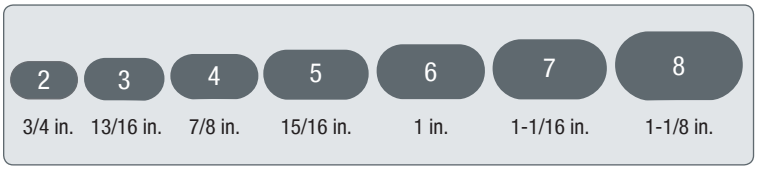
Dimensional Properties

COROD #	Nominal Size		Weight		Area (min.)		Major Diameter		Minor Diameter	
	in.	mm	lb/ft	kg/m	$in.^2$	mm^2	in. (±0.020)	mm (±0.5)	in. (±0.020)	mm (±0.5)
8	1-1/8	28.6	3.38	5.03	0.994	641.3	1.570	39.9	0.745	18.9
7	1-1/16	27.0	3.01	4.49	0.887	572.0	1.430	36.3	0.745	18.9
6	1	25.4	2.67	3.98	0.785	506.7	1.260	32.0	0.740	18.8
5	15/16	23.8	2.35	3.50	0.690	445.3	1.115	28.3	0.730	18.5
4	7/8	22.2	2.04	3.05	0.601	387.9	1.005	25.5	0.700	17.8
3	13/16	20.6	1.76	2.63	0.518	334.5	0.940	23.9	0.650	16.5
2	3/4	19.1	1.50	2.24	0.442	285.0	0.870	22.1	0.600	15.2
8.5R	1-5/32	29.4	3.57	5.32	1.050	677.4	1.156	29.4	NA	NA
6R	1	25.4	2.67	3.98	0.785	506.7	1.000	25.4	NA	NA
4R	7/8	22.2	2.04	3.05	0.601	387.9	0.875	22.2	NA	NA
3R	13/16	20.6	1.76	2.63	0.518	334.5	0.812	20.6	NA	NA

Chemical Properties

Material	C	Mn	P	S	Si	Ni	Cr	Mo	Al	Ti	Cu
1536M	0.31 to 0.35	1.10 to 1.30	0.015	0.010	0.15 to 0.35	0.25 (max.)	0.25 (max.)	0.050 (max.)	0.020 to 0.050	–	0.35 (max.)
4320M	0.17 to 0.22	0.45 to 0.65	0.015	0.010	0.15 to 0.35	0.95 to 1.10	0.95 to 1.10	0.20 to 0.30	0.020 to 0.050	0.005 to 0.020	0.20 to 0.30
4120M	0.18 to 0.23	0.40 to 0.60	0.015	0.010	0.15 to 0.30	0.25 (max.)	1.80 to 2.00	0.15 to 0.20	0.020 to 0.050	0.005 to 0.020	0.20 to 0.30

Round *COROD* Sizes



Semi-Elliptical *COROD* Sizes

For more information on Weatherford's *COROD* continuous rod and related field-service capabilities, email our technical experts at **corod@weatherford.com,** or visit **weatherford.com/corod**.

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