# COROD® Continuous Rod

For medium- to heavy-load reciprocating rod lift (RRL) and progressing cavity pumping (PCP) in wells that are noncorrosive or mildly corrosive but effectively inhibited

COROD continuous rod extends the life span of tubing by eliminating localized contact loads caused by couplings. Installation is quick, and Weatherford offers a full array of field servicing options.

## Applications

- Rotary systems (PCP)
  - Only round rod
- Reciprocating-rod-lift systems
  - Round or semi-elliptical rod

## Features and Benefits

- Fewer threaded connections on the rod string reduce the potential for pin and coupling failures as well as the need for costly well interventions.
- The uniform body design evenly distributes contact loads over the entire rod, reducing the severity of tubing and rod wear.
- The large, uninterrupted annular tubing space minimizes pressure losses and ensures laminar, non-turbulent flow to the wellhead.
- The rod strings are lighter than conventional sucker-rod strings. By creating less weight on the service unit, continuous rod is capable of reaching lower pump landing depths.
- The finished COROD product undergoes a cold-working process (known as shot peening) to produce a residual stress on the outside layer of the material, which in turn increases resistance to fatigue and corrosion failure.

## Product Description

COROD continuous rod provides a superior alternative to conventional sucker rods. Unlike conventional sucker rods, which are coupled every 25 or 30 ft (7.6 or 9.1 m), COROD continuous rod requires couplings only at the top and bottom of the rod string, regardless of well depth. This innovative solution reduces pin and coupling failures by decreasing the number of threaded connections, thereby minimizing the potential for rod string failures and costly well interventions. Uniform contact loads and a lighter weight reduce motor power requirements.

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## SEMI-ELLIPTICAL ROD

Semi-elliptical COROD continuous rod is a uniquely shaped rod product designed to optimize RRL applications. It is a superior alternative to conventional sucker rods. The semi-elliptical shape, formed to fit the curvature of the tubing string, results in less tubing contact pressure than with continuous round rods and conventional sucker rods.

Semi-elliptical COROD continuous rod is manufactured in seven sizes at 1/16-in. increments, allowing you to custom design your rod string to any length. A lower overall string weight and a balanced taper string design significantly reduce the load on the surface-pumping-unit gearbox and the horsepower requirements. As a result, a smaller pumping unit can reach greater pumping depths and achieve higher pumping rates than conventional sucker rods and round continuous rods can. Weatherford offers a full array of field servicing options for quick, efficient installation and well servicing needs.

### Applications

- Reciprocating-rod-lift applications, specifically light crude, cold heavy oil production with sand (CHOPS), cyclic steam, steam flood, and steam-assisted gravity drainage (SAGD) wells

### Features and Benefits

- The elliptical body design further reduces contact loading between the rod and tubing, resulting in less localized wear and part replacements.
- The ribbon-like shape of the rod promotes predictable bending along one plane, eliminating rod damage caused by a coiling or springing effect.
- The formed, semi-elliptical design minimizes surface discontinuities, which increases the life of your rod string in RRL applications.
- The rod maintains a minor diameter of less than 3/4 in., which prevents the rod from undergoing stresses exceeding its yield strength when coiled onto transport reels.

Conventional sucker rod with slim-hole coupling

Round COROD continuous rod

Semi-elliptical COROD continuous rod

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# COROD Continuous Rod

## Product Types

Every grade of Weatherford COROD continuous rod is manufactured using a quench and temper heat treatment.

| | | |
|---|---|---|
| D Grade Regular Strength | • 1536M material<br>• Available in round sizes 3R to 8.5R<br>• Available in semi-elliptical sizes 2E to 8E<br>• API Grade D carbon | Designed for medium load pumping applications in noncorrosive or mildly corrosive but effectively inhibited wells in which $H_2S$ may be present. |
| DE Grade Regular Strength | • 4120M material<br>• Available in round sizes 4R to 8.5R<br>• Available in semi-elliptical sizes 3E to 8E<br>• API Grade D alloy | Designed for medium load pumping applications in noncorrosive or mildly corrosive but effectively inhibited wells in which $CO_2$ or chlorides may be present. DE is made from a chrome-molybdenum alloy, micro alloyed with titanium to improve mechanical and heat-treating properties. DE chromium content is increased to 2% to improve corrosion resistance in certain applications. |
| DW Grade Regular Strength | • 4320M material<br>• Available in round sizes 6R and 8.5R<br>• API Grade D alloy | Designed for medium load pumping applications in mildly corrosive or more corrosive but effectively inhibited wells. DW is made from a chrome-nickel-molybdenum alloy, specifically formulated to improve stress tolerance and fatigue resistance. |
| ME Grade Mid-Strength | • 4120M material<br>• Available in round sizes 4R to 8.5R<br>• Available in semi-elliptical sizes 3E to 8E<br>• API Grade D alloy | Designed for medium load pumping applications in deep, high-volume wells for noncorrosive or mildly corrosive environments that are effectively inhibited. ME is made from a chrome-molybdenum alloy, micro alloyed with titanium to improve mechanical and heat-treating properties. ME chromium content is increased to 2% to improve corrosion resistance in certain applications. |
| SE Grade High Strength | • 4120M material<br>• Available in round sizes 3R to 8.5R<br>• Available in semi-elliptical sizes 3E to 8E<br>• API Grade D special | Designed for heavy load pumping applications in deep, high-volume wells for mildly corrosive or corrosive environments that are effectively inhibited. SE is made from a chrome-molybdenum alloy, micro alloyed with titanium to improve mechanical and heat-treating properties. SE chromium content is increased to 2% to improve corrosion resistance in certain applications. |
| SW Grade High Strength | • 4320M material<br>• Available in round sizes 3R to 8.5R<br>• API Grade D special | Designed for heavy-load pumping applications in mildly or more corrosive but effectively inhibited wells. DW is made from a chrome-nickel-molybdenum alloy, specifically formulated to improve stress tolerance and fatigue resistance. |

## Mechanical Properties

| API Grade | Codes | Material | Tensile Strength (min.) | | Yield Strength (min. 0.2% offset) | | Elongation (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 Alloy | ME, MER | 4120M | 130,000 | 896 | 110,000 | 758 | 7 | 32 | 301 |
| 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 |

# COROD Continuous Rod

## Maximum Torque Capacity

| COROD # | Size | | Codes | | | | | |
|---|---|---|---|---|---|---|---|---|
| | in. | mm | DR | DER | MER | SER | DWR | SWR |
| 8.5 | 1-5/32 | 29.4 | 1,490 ft-lbf<br>2,020 N·m | 1,490 ft-lbf<br>2,020 N·m | 1,845 ft-lbf<br>2,501 N·m | 2,000 ft-lbf<br>2,712 N·m | 1,490 ft-lbf<br>2,020 N·m | 2,000 ft-lbf<br>2,712 N·m |
| 6 | 1 | 25.4 | 955 ft-lbf<br>1,295 N·m | 955 ft-lbf<br>1,295 N·m | 1,195 ft-lbf<br>1,620 N·m | 1,300 ft-lbf<br>1,763 N·m | 955 ft-lbf<br>1,295 N·m | 1,300 ft-lbf<br>1,763 N·m |
| 4 | 7/8 | 22.2 | 640 ft-lbf<br>868 N·m | 640 ft-lbf<br>868 N·m | 800 ft-lbf<br>1,080 N·m | 900 ft-lbf<br>1,220 N·m | N/A | 900 ft-lbf<br>1,220 N·m |
| 3 | 13/16 | 20.6 | 500 ft-lbf<br>678 N·m | N/A | N/A | 700 ft-lbf<br>949 N·m | N/A | 700 ft-lbf<br>949 N·m |

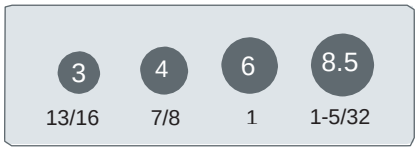
## Dimensional Properties

| 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 | N/A | N/A |
| 6R | 1 | 25.4 | 2.67 | 3.98 | 0.785 | 506.7 | 1.000 | 25.4 | N/A | N/A |
| 4R | 7/8 | 22.2 | 2.04 | 3.05 | 0.601 | 387.9 | 0.875 | 22.2 | N/A | N/A |
| 3R | 13/16 | 20.6 | 1.76 | 2.63 | 0.518 | 334.5 | 0.812 | 20.6 | N/A | N/A |

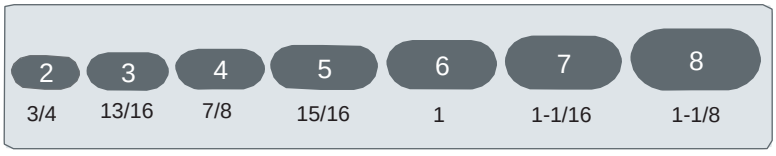
## Chemical Properties

| Material | | C | Mn | P | S | Pb | Sn | Sb | As | Si | Ni | Cr | Mo | Al | Ti | Cu |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1536M | min. | 0.31 | 1.10 | — | — | — | — | — | — | 0.15 | — | — | — | 0.020 | — | — |
| | max. | 0.35 | 1.30 | 0.015 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.35 | 0.25 | 0.25 | 0.05 | 0.050 | — | 0.35 |
| 4320M | min. | 0.17 | 0.45 | — | — | — | — | — | — | 0.15 | 0.95 | 0.95 | 0.20 | 0.020 | 0.005 | 0.20 |
| | max. | 0.22 | 0.65 | 0.015 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.30 | 1.10 | 1.10 | 0.30 | 0.050 | 0.020 | 0.30 |
| 4120M | min. | 0.18 | 0.40 | — | — | — | — | — | — | 0.15 | 1/2 Cu* | 1.80 | 0.15 | 0.020 | 0.005 | 0.20 |
| | max. | 0.23 | 0.60 | 0.015 | 0.010 | 0.010 | 0.010 | 0.010 | 0.010 | 0.30 | 0.25 | 2.00 | 0.20 | 0.050 | 0.020 | 0.30 |

Note: All elements in % by weight
* Minimum Ni content shall be 1/2 of the Cu content.



Round COROD sizes (inches)



Semi-elliptical COROD sizes (inches)

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