

Artificial Lift Technologies

Optimize Asset Value and
Maximize Production Efficiency



Integrated, single-source solutions for the life of your well

Tuboscope's Artificial Lift Technologies comprises integrated services, products and technologies engineered to seamlessly improve pumping efficiencies, minimize failures, and reduce your lease operating expenses.

From mitigation to planning, we combine real-time inspection data, proprietary evaluation and advisory programs with industry leading rod guides and coatings to give you a global one-stop, full-service source proven to maximize production and reduce downtime.

Our extensive in-house engineering, testing and R&D resources allow us to continually enhance product performance and integrity.

We also provide regular product and best practice training for both our employees and clients.

Tuboscope's proven systems approach

- WellChek™ and TuboChek™ C1D1 Inspection
- RGAP™ Rod Guide Advisory Program
- WellTrak — Tubing Data Management & Evaluation
- Tube-Kote™ (TK™) Coatings
- New Era® Rod Guides

All this is closely aligned with NOV's Artificial Lift and Wear Prevention offerings providing you with an unmatched customizable packaged solution.

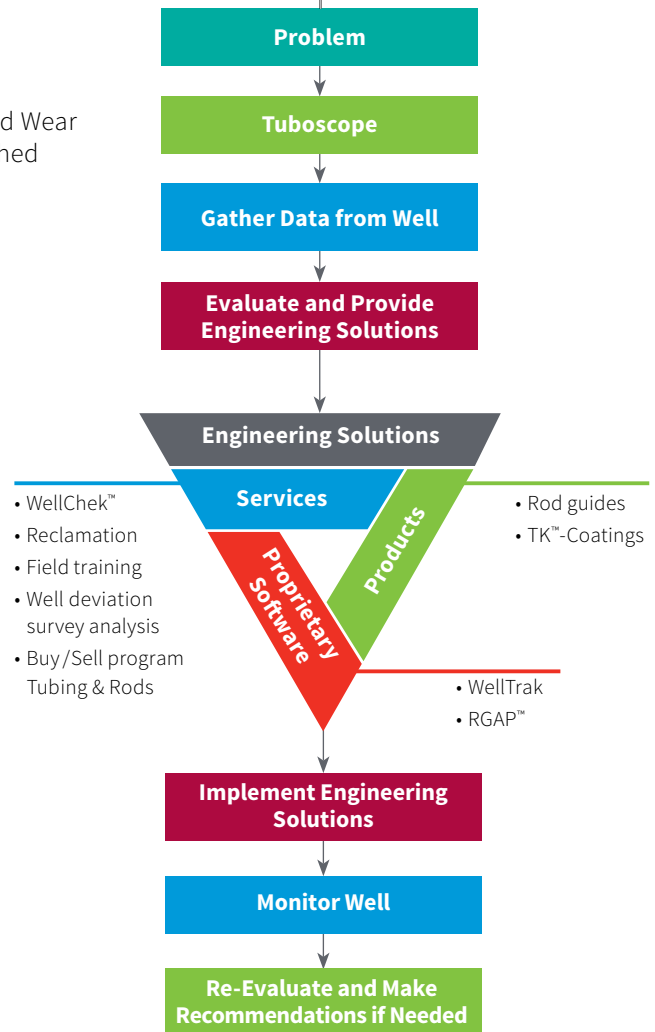


Artificial Lift

- Automation, Controls & Monitoring
- Progressing Cavity Pump Systems
- Rod Pump Systems
- Production Service Hookup
- Wear Prevention
 - Rodec™ Tubing Rotators*
 - Hercules™ Rod Rotators*

Together we help you enhance the value of your asset, advancing your aggressive failure reduction program.

For more information on NOV's Artificial Lift please visit nov.com/artificiallift



Artificial Lift Technologies Flow Chart



Tuboscope's advisory, management and evaluation technologies provide you the critical data needed for successful and efficient production string

Wellsite Tubing Inspection

WellChek™ is a self-contained inspection and remote monitoring system used in conjunction with routine tubing pulling operations. Utilizing proprietary inspection technologies, we provide an unmatched evaluation of each tube, identifying and recording exact defect location in the well.

Employing proven inspection technologies, this advanced system offers an accurate evaluation of each tube.

- Sonoscope™ EMI for detection of internal and external defects
- Isolog™ (Gamma Source) for accurate wall loss
- Eddy current for split detection

Each tube's assessment is available as soon as it clears the inspection head. In addition to a profile of the string as a whole, pipe is classified by standard API or customer specifications. Rejected tubes are laid down and reusable tubing is stood back in the derrick.

TuboChek™ C1D1

TuboChek C1D1 inspection system is certified and meets Class-1 Div-1 safety standards with intrinsically safe electronics and includes an encapsulated coil housing.

Similar to our WellChek system, TuboChek C1D1 utilizes the same reporting and database software, providing you real-time tubing inspection, data management and evaluation of your used tubing.

This new system delivers an accurate evaluation of each tube using the same proven eddy current based split detection and Sonoscope EMI inspection for pitting and corrosion detection. Unique to this system, a flux integration method is used for cross-sectional area, calculated rod-wear and a flux leakage technique for magnetic field discrimination to determine rod strokes.

Benefits

- Professionally trained crew for efficient and safe operations
- Quick size changeover and standardization process
- Records exact defect and joint location in the well
- Real time usable information
- On-site inspection eliminates need for trucking to inspection facilities
- Immediate re-use of good tubing

Defect Detection

- Corrosion pitting
- Rod wear
- Wall loss
- Cracks
- 3-Dimensional transverse defects
- Erosion
- Splits
- Cuts
- Holes

WellChek Tubing Size Range

- 2 3/8"
- 2 7/8"
- 3 1/2"

TuboChek C1D1 Tubing Size Range

- 2 3/8"
- 2 7/8"
- 3 1/2"
- 4"
- 4 1/2"



Tube-Kote (TK™) Coatings for tubing and sucker rods

TK™-Coatings improve performance and mitigate problems associated with corrosive environments to extend the life of your tubing and rod string.

Production tubulars and sucker rods often operate in highly corrosive environments which can lead to failures and budget-draining downtime. As the original and premier provider of internal coatings, we continue to develop innovative products to extend asset life and improve performance in all operating environments.

With our industry leading line of Tube-Kote™ (TK™) coatings, Tuboscope sets the standard for preventing corrosion, wear and improving hydraulic efficiency.

Our TK-Coatings are designed to meet all operating conditions, such as downhole temperatures up to 400°F (204°C), high H₂S concentrations and high CO₂ levels.

Our corrosion control specialists work closely with engineering teams to gather relevant application and environment data. The data is entered into our coating recommendation form, which provides the foundational data to narrow down the coating selection process. Once the field of potential coating materials is narrowed, we take into consideration any mechanical and chemical intervention plans to accurately select the proper coating.

TK-Coating Benefits

- Superior corrosion and wear prevention
- Improves hydraulic efficiency
- Deposit mitigation
- Extends lifespan of tubing
- Reduces maintenance cost and downtime



Modified Epoxy Coating Benefits



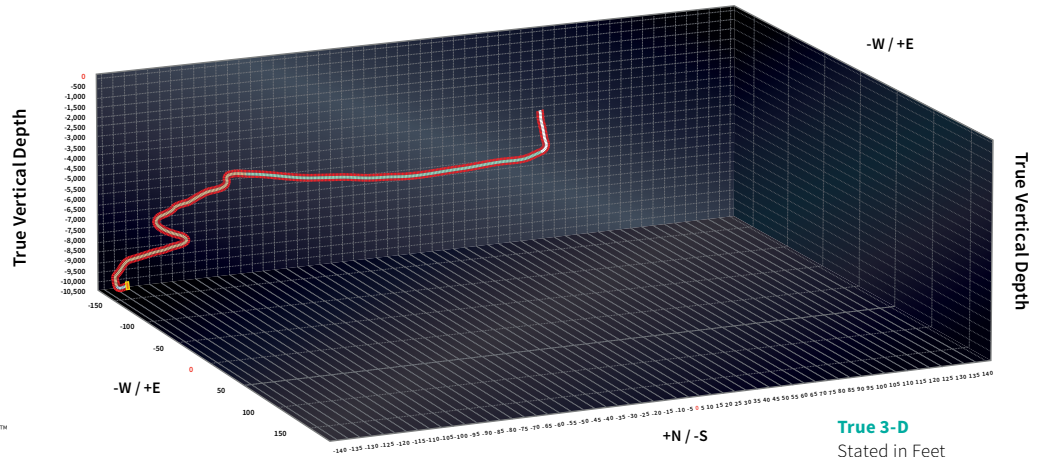
Stainless Steel Coating

Rod Guide Advisory Program (RGAP™)

Rod guide design, placement, and material selection are all crucial for obtaining the best overall performance of your rod string.

Utilizing our proprietary Rod Guide Advisory Program (RGAP), we are able to recommend the proper guide design, material, spacing and auxiliary equipment for both beam and progressing cavity pump applications. Well conditions, workover histories and wellbore deviations are all considered when recommending guides.

WellTrak and RGAP take the guesswork out of production string design by providing you with the real-time data you need to make accurate tubing and rod management decisions.



RGAP™
3D representation of a sample well created by the latest version of RGAP™

WellTrak management and evaluation system

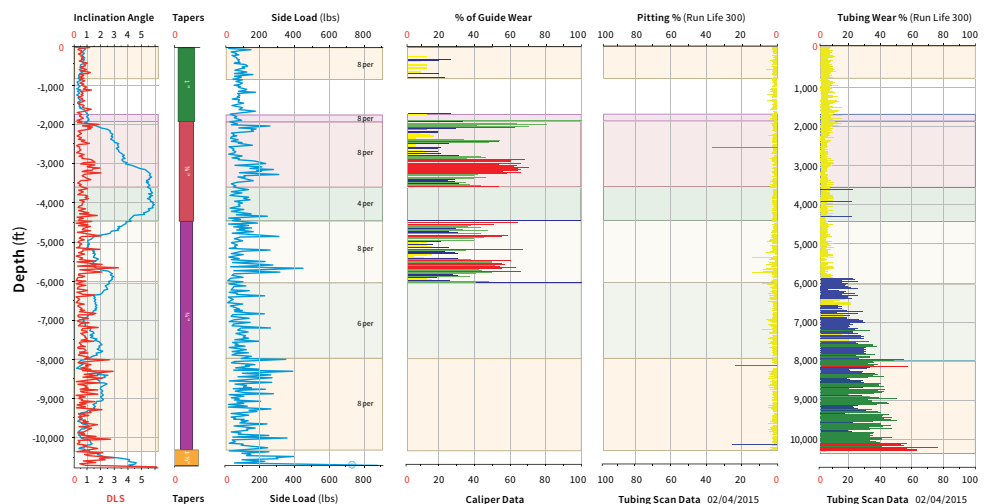
WellTrak provides sequential WellChek™ inspection results, profiling at precise depths where failures or potential problems have occurred.

This valuable information provides production and well optimization engineers critical data to help extend the run life of wells, measure the effectiveness of changes, and reduce overall tubing failures.

Tubing management decisions based on WellTrak's on-line historical database of well / field conditions can assist in string design, treatments or mitigation techniques before the well is put back on production.

Benefits

- Individual full inspection history
- Online access to well records
- Identify patterns or correlations among historical inspections
- General statistics for inspections performed



Combined WellTrak and RGAP Report

Results displayed in an assortment of charts

The most extensive portfolio of rod guide designs for beam and Progressing Cavity (PC) pumps

Wellbore deviations, dynamometer readings, workover histories, well operating conditions, completion information and production data should all be taken into consideration when selecting rod guides. Our advisory programs help you select the proper design, material and spacing for each well to ensure effective rod and tubing wear prevention.

Manufacturing



Tuboscope rod guides are manufactured from a complete line of engineered plastics, enhanced with performance additives, that can be tailored to virtually any well environment.

At all rod guide service centers, sucker rods are handled according to API specifications and moved quickly through our manufacturing system.

Prior to injection molding guides, sucker rods go through our patented rod cleaning system. Utilizing high speed rotating brushes rather than hard particle blasting, our process thoroughly cleans rods and eliminates the introduction of stress concentrations.

Field Support

Technicians provide field support to assist with the proper implementation of all recommended procedures.

Field Services Include

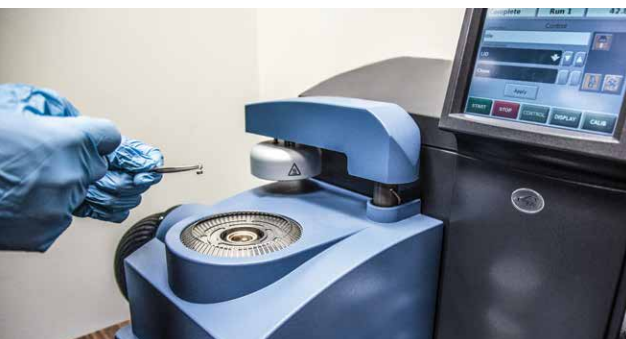
- On-site rod guide measurements for critical wells
- Computer-generated rod guide wear logs
- Detailed well data analysis report
- Rod storage
- Engineering support to evaluate problems not associated with rod guides, such as gas locking pumps, pump efficiencies and rod string design

Lab Capabilities

Our in-house R&D group designs, formulates, manufactures and tests all of our proprietary rod guide materials.

We utilize a variety of thermal characterization techniques and physical testing instruments in the research and development of rod guide materials.

Additionally, all rod guides go through our autoclave testing unit that simulates downhole environments. Materials undergo testing at high temperatures, high pressures, and are exposed to gases and solutions commonly encountered in production environments.



Quality Program

Our in-house quality department monitors each facility and manufacturing process so you receive the highest level of quality and service.

Standard operating procedures worldwide ensure that you are receiving the same consistent product at every Tuboscope location.



Rod Guide Materials

New Era® rod guides have demonstrated excellent performance in harsh environments.

Manufactured from a complete line of engineered plastics, and enhanced with performance additives, our guides can be tailored to virtually any well environment.

As a leading provider of tubing wear mitigation products and services, we offer a variety of materials to meet your performance needs, including nylon, UHMW-PE, PPA, PPS, TG-PPS-1, SB-1, LG-3, and Cerene.

Specifications

Compound Code	Base Polymer	Hot Oil	Hot Brine	Plastic Lined Tubing
SB-1	*	Yes	Yes	No
AF	PPA	Yes	Yes	No
AU	PPA	Yes	Yes	Yes
NFF	NYLON	Yes	No	No
LG-3	*	Yes	Yes	Yes
PPS	PPA	Yes	Yes	No
LG3-RC	*	Yes	Yes	Yes
SanGard	*	Yes	Yes	No

* Proprietary

Important Note

These guidelines are for general reference only and should not be used as the sole determining factor for rod guide material selection. Each downhole condition is different and must be addressed on a case-by-case basis to determine the best selection for a particular well. Chemical and corrosion resistance of a material decreases as temperature increases.

Rod Guide Designs

High Performance Designs

- Crossover™
- TNT 360™ & Nitro 360™
- NETB™, NEXTB™ & NEXXTB™
- Stealth™ & Stealth XL™

Classic Designs

- Straight Vane
- Positive Action® Slant Vane
- Turbulence Breaker™ & Smooth Flow™
- Slant Vane XL
- Dual System™
- Mort™

Rotating Rod Designs

- Spin-Thru®
- Pathfinder™

Field Installed Guides

- Blazer™
- FAST™
- Field Installed Stealth XL™ & Lotus Twist-On™
- NEPG™

Rod Guides for Reciprocating Applications

New Era® CrossOver™ Rod Guide



New Era® CrossOver™ Rod Guide

Features & Benefits

- Hydrodynamic design helps keep fluid closer to laminar flow around the guide, and decreases the chance of gas breakout
- Reduced hydraulic drag force maximizes carrier bar loads on the downstroke
- Widervanes for maximum surface bearing area
- Concave body channel allows wider vanes, more erodible material than other designs and low fluid drag
- Custom designed for each rod and tubing size to allow maximum vane width and optimum bypass area
- DuraGuide™ wear indicators provide easy visual confirmation of remaining erodible material on guides
- All materials available

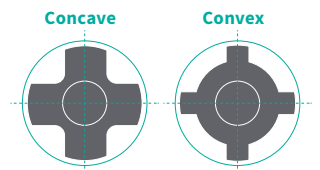
Stealth™ Rod Guide



Stealth™ Rod Guide

Features & Benefits

- Wider vanes for maximum surface bearing area
- Custom designed for each rod and tubing size to allow maximum vane width and optimum bypass area
- DuraGuide™ Wear Indicators provide easy visual confirmation of remaining erodible material on guides
- Concave body channel allows wider vanes and more erodible material than other designs
- All materials available



The concave body channel of the Stealth guides (left) allows wider vanes and more erodible material than conventional designs (right).

Artificial Lift Technologies — Rod Guides



Stealth XL™ Rod Guide

Stealth XL™ Rod Guide

Features & Benefits

- Wider vanes for maximum surface bearing area
- Concave body channel allows wider vanes, more erodible material than other designs and low fluid drag
- Custom designed for each rod and tubing size to allow maximum vane width and optimum bypass area
- DuraGuide™ wear indicators provide easy visual confirmation of remaining erodible material on guides
- 7" overall length
- All materials available



NETB™ Rod Guide

NEXXTB™ Rod Guide

NETB™, NEXXTB™ & NEXXTB™ New Era® Turbulence Breakers Rod Guide

Features & Benefits

- Hydrodynamic design helps keep fluid closer to laminar flow around the guide, and decreases the chance of gas breakout
- Factory installation eliminates field installation problems plus provides over 10 times less drag force and 10 times more bonding power than most field installed designs
- Reduced hydraulic drag force maximizes carrier bar loads on the downstroke
- NEXXTB features wider vanes for maximum surface bearing area
- All materials available



TNT 360™ Rod Guide

Nitro 360™ Rod Guide

TNT 360™ & Nitro 360™ Rod Guide

Features & Benefits

- Extra wide vanes and spiral design for increased contact surface
- Greater erodible wear volume for longer protection
- All materials available

Continuous Dual-Cleaning Action
Molded-on guides keep tubing clean and act as a stop for reciprocating scrapers



Reciprocating Scrapers
Keeps rods free of paraffin

Dual System™ Rod Guide

Features & Benefits

- Fixed, one-time expense
- Continuous, long term protection
- Virtually eliminates hot oil and chemical treatments for lower operating costs, reduced downtime and less environmental risk
- Maintains unrestricted flow and pump efficiency
- Materials available:

Guide: All **Reciprocator:** NF, AU

Guides per Rod Formula

Recommended number of guides per rod for complete paraffin removal is determined by using the following formula:

$$\frac{\text{ROD LENGTH (inches)}}{\text{STROKE (inches)}} + 1 = \text{Number of Guides Per Rod}$$

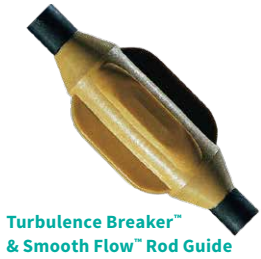


Straight Vane Rod Guide

Straight Vane Rod Guide

Recommended for low corrosion environments in wells having one pull or less per year from wear-associated problems, the straight vane design is an effective, low-cost solution to problems. It has more erodible wear volume, less drag and a greater bearing surface than the slant blade design and is available in a variety of materials. Used in conjunction with a Hercules® rod rotator, this design provides exceptional scraping action, as well as centralization.

- All materials available
- Available on fiberglass rods please contact your local Tuboscope representative



**Turbulence Breaker™
& Smooth Flow™ Rod Guide**

Turbulence Breaker™ & Smooth Flow™ Rod Guide

Fluid turbulence, usually above and sometimes below rod guides, can wash away corrosion inhibitors. When inspection shows evidence of rod pitting, the washing action of turbulent flow is usually the problem. The Turbulence Breaker & Smooth Flow guides are designed to minimize these corrosion problems. Straight vanes, working in tandem with extended tapered guide ends, improve the flow of fluids around the guide.

- All materials available

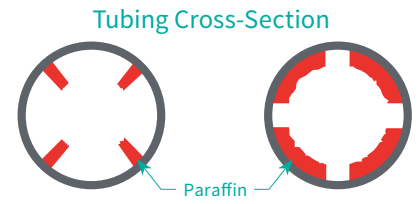


**Positive Action®
Slant Vane Rod Guide**

Positive Action® Slant Vane Rod Guide

The angle of the slanted vane provides broad cutting action and when coupled with increased turbulence, paraffin build-up is reduced dramatically. In wells where drag, high side loads and corrosion are not factors, the slant vane design is the choice for paraffin control, but it still must be used with a rod rotator to be most effective.

- All materials available



Slanted vane guides (left) remove paraffin from a broader area than straight vane guides (right)



**Slant Vane XL
Rod Guide**

Slant Vane XL Rod Guide

This design provides effective protection against both paraffin accumulation and tubing wear. The sucker rod guide combines both the characteristics of concaved and slanted vanes in order to maximize erodible wear volume and bearing surface.

- All materials available



**Mort™
Rod Guides**

Mort™ Rod Guide

This design is effective protection against paraffin accumulation on the interior walls of tubing, while also reducing downhole rod and tubing wear. The Mort design features slanted vanes to provide a broad cutting action to reduce paraffin buildup. Although the slanted vane scrapes almost the full circumference of the tubing with each pumping stroke, it still must be used with a rotator.

- Available for steel or fiberglass sucker rods
- Ability to mold onto fiberglass rods
- All materials available

Rod Guides for Progressing Cavity Applications



Pathfinder™ Rod Guide

Pathfinder™ Rod Guide

Features & Benefits

- Four channels on the rotating sleeve and three channels on the inner diameter of the stationary sleeve allow fluid to freely flow
- Reduces torque generated by the mechanical and hydraulic friction of the rotating rod string
- Fits rod sizes from $\frac{5}{8}$ " to 1"



Spin-Thru® Rod Guide

Spin-Thru® Rod Guide

Features & Benefits

- Unique Spin-Thru design reduces hydraulic resistance and mechanical friction, so primary drives operate more efficiently and with less power
- Ultra-High Molecular Weight Polyethylene (UHMW PE) guide for extremely durable construction
- Fin design provides less pressure drop
- Lower torque means less power required to operate the PC pump drive
- Materials available: **Stator:** UHMW PE **Rotor:** PPS, AF, SB-1

Field Installed Guides

Eliminate the need to remove rods from the well site, reducing costs and returning rods to service quicker.



Blazer™ Rod Guide

Blazer™ Rod Guide

The spin-thru Blazer rod guides can effectively increase production and decrease workover costs by extending rod and tubing service life in standard and high temperature applications. These rod guides deliver maximum performance, even in extreme well conditions.



Fast™ Rod Guide

Fast™ Rod Guide

The FAST rod guides are engineered for high performance in progressing cavity pumped wells. The proprietary spin-thru design reduces the torque that is generated by the mechanical and hydraulic friction of the rotating rod string. It also provides a flow path that reduces pressure drop by allowing fluid to flow through the rod guide rather than limiting flow to the space around it.

- Fits rod sizes from $\frac{3}{4}$ " to 1", 1 $\frac{1}{8}$ "



Field Installed
Stealth XL™ Rod Guide

Field Installed Stealth XL™ Rod Guide

The Stealth XL rod guide offers a sleek profile for tough downhole conditions. Deep concave channels and the streamlined shape give the Stealth XL rod guide excellent flow characteristics in high volume wells. The wide vanes provide outstanding bearing surface area for wear protection on rods, rod couplings and tubing in deviated wells. Proprietary RC material provides superior holding power and a 400°F temperature rating, making the Field Installed Stealth XL the premium rod guide for your toughest well conditions.

- Sucker rod sizes: $\frac{3}{4}$ ", $\frac{7}{8}$ ", 1"



Lotus Twist-On™ Rod Guide

Lotus Twist-On™ Rod Guide

The original twist-on design is now improved with modern materials that provide longer wear, better chemical resistance, broader service temperature ranges, better rod retention and easier installation. Unbreakable Nylon (NF) (180°F upper limit) can be installed at temperatures as low as 0°F without preheating. AU material resists salt water, temperatures as high as 250°F and a broad range of chemicals.

- Materials available: AU, NF

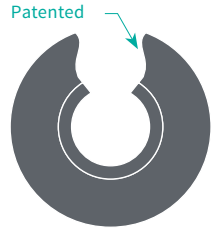


NEPG™—New Era® Poly Guide Rod Guide

NEPG™—New Era® Poly Guide Rod Guide

The Poly guide is manufactured from UHMW PE for high impact strength. Resistance to chemicals and salt water make this guide ideally suited for any temperature below 180°F. The NEPG's double-knock patented slot design makes field attachment to the rod quick and easy. Once installed, the superior holding power of this guide guards against slippage on the rod. There is lower coefficient of friction than nylon, minimizing resistance in both reciprocating and rotating applications. The superior abrasion resistance of the UHMW PE material gives the NEPG an exceptionally low friction under load, while also being ideal for high water cut wells. This proven design features provide enhanced downhole wear protection, ample fluid bypass and improved fluid flow characteristics.

- Materials available: UHMW PE



NEPG™—New Era® Poly Guide

Rod Guide Service Centers

Edmonton, Alberta (Canada)

Nisku, Alberta (Canada)

Estevan, Saskatchewan (Canada)

Williston, North Dakota (US)

Mills, Wyoming (US)

Myton, Utah (US)

Wooster, Ohio (US)

Bakersfield, California (US)

Oklahoma City, Oklahoma (US)

Odessa, Texas (US)

Pleasanton, Texas (US)

Associated Products



Rodec™ Tubing Rotators

Our extensive line of tubing rotators and swivels effectively distributes wear evenly around the entire internal circumference of the production tubing. The application of these products can dramatically increase tubing life span and reduce operating costs proportionately.

- Pressure handling up to 5,000 PSI
- Available in mechanical and electric configurations
- NACE compliant



Hercules™ Rod Rotators

Rod rotation is the most effective means of removing paraffin from inside the tubing and distributing wear evenly. This process also protects against severe rod and tubing wear when used in conjunction with rod guides.

- Available in maximum recommended loads ranging from 13,000–40,000 lbs

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