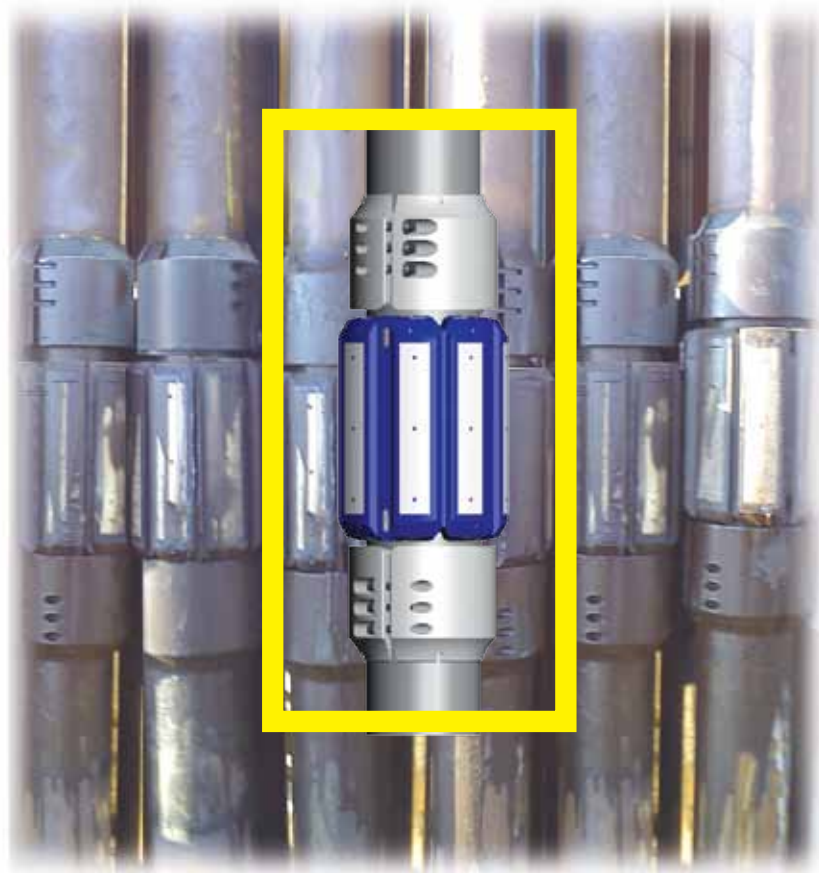


WWT

Non-Rotating Protector Services



**Solutions for Reducing
Torque, Drag, Casing Wear
and More**

NRP





Solutions for Reducing Torque, Drag, Casing Wear and More

Since 1989, WWT has been providing services to operators around the world -- helping them overcome many of the challenging conditions encountered during drilling and completion operations, including torque, drag, casing and riser wear, heat checking and drillpipe buckling. The unique combination of our engineering services, proven Non-Rotating Protectors (NRPs) and long-standing experience enables us to provide fully supported solutions that improve drilling performance and completion efficiency **by minimizing energy loss caused by wellbore friction, thereby optimizing energy delivery to the bit.**

NRPS



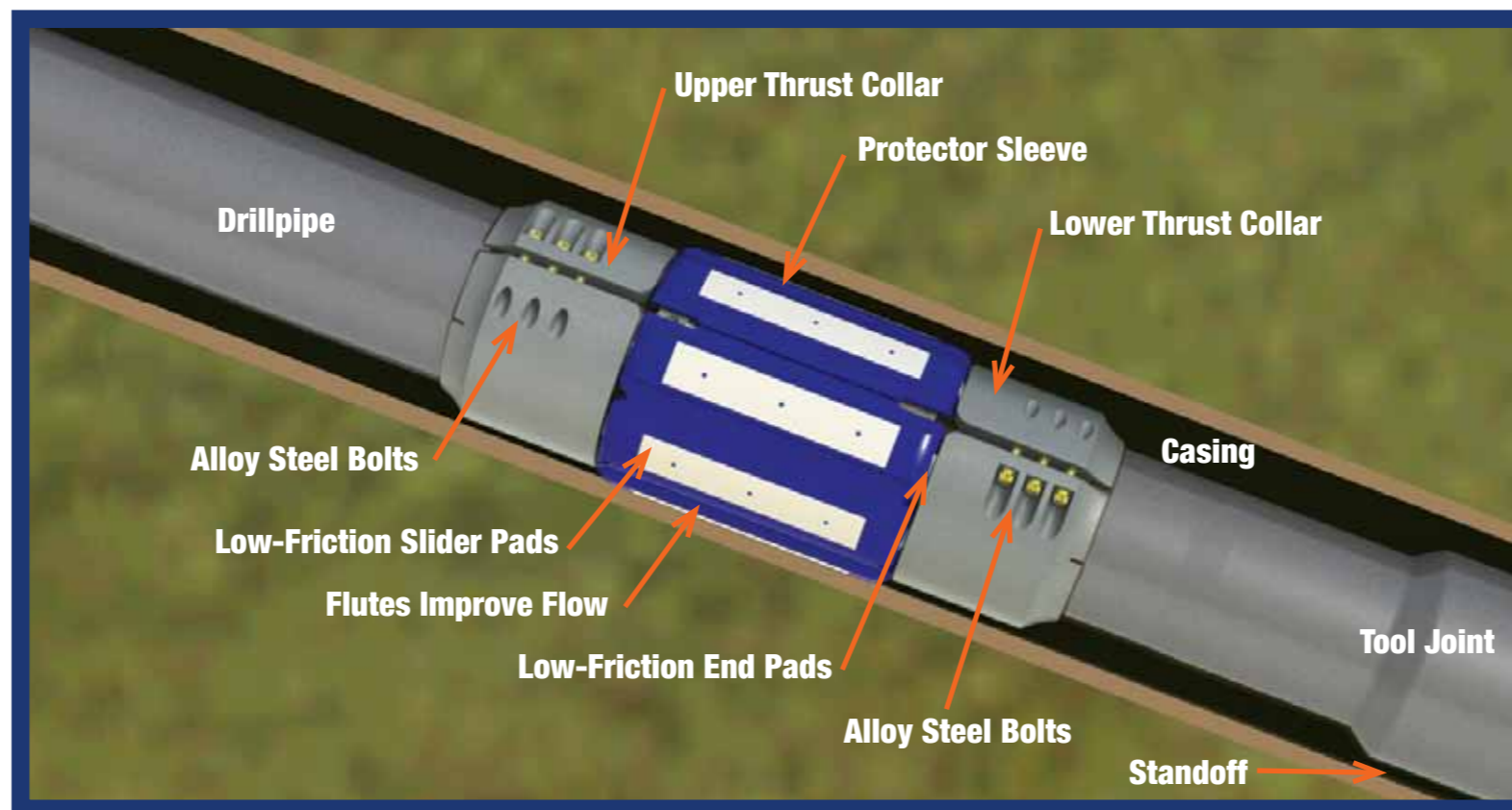
NRRPS



Applicable Conditions

WWT Non-Rotating Protectors (NRPs) effectively prevent drillstring contact with the wellbore and riser. You may benefit from using WWT NRPs if you are faced with one or more of the following challenges:

- Deep Directional Wells
- Extended-Reach Wells
- Horizontal Wells
- Unplanned Doglegs
- Deepwater Riser Operations
- Deepwater Sub-Salt Wells
- Re-Entries and Sidetracks
- Shallow Kickoffs
- Production Riser Applications
- Slow, Difficult Drilling
- Deep, S-Shaped Wells
- Underpowered Top Drives
- Offset Well Heads
- Casing Patches
- Adverse Ocean Currents



WWT NRPs create a standoff, effectively isolating the drillstring while preventing damage to the critical contact areas of the casing.

Viability

In most cases, WWT Non-Rotating Protectors will measurably improve your operations. We take great care to ensure that WWT NRPs will deliver maximum results by offering a range of engineering services, including:

- Well analysis to identify critical areas of the wellbore where contact can hinder performance and casing integrity
- Protector placement recommendations to achieve the benefit level required for each project
- Ongoing technical support (24/7), both onsite and off, to ensure optimal performance and client satisfaction.

NRRPS



PROBLEM:

Lateral force between casing and drillpipe can cause:

- Casing wear
- Riser wear
- High torque
- Excessive drag
- Buckling
- Tool joint heat checking
- Drillpipe stress
- Surface equipment stress

Lateral Force:

← 3,000 lbs.
← 6,000 lbs.

SOLUTION:

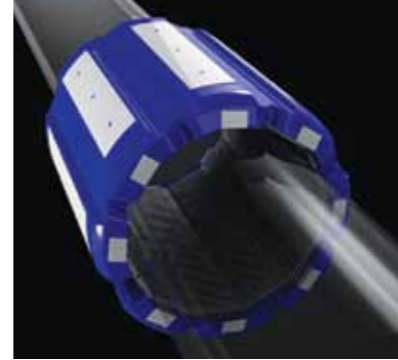
5" Premium Non-Rotating Protectors

← 3,000 lbs.

← 3,000 lbs.

Lateral Force:

0 lbs. ← 3,000 lbs. ← 3,000 to 6,000 lbs.



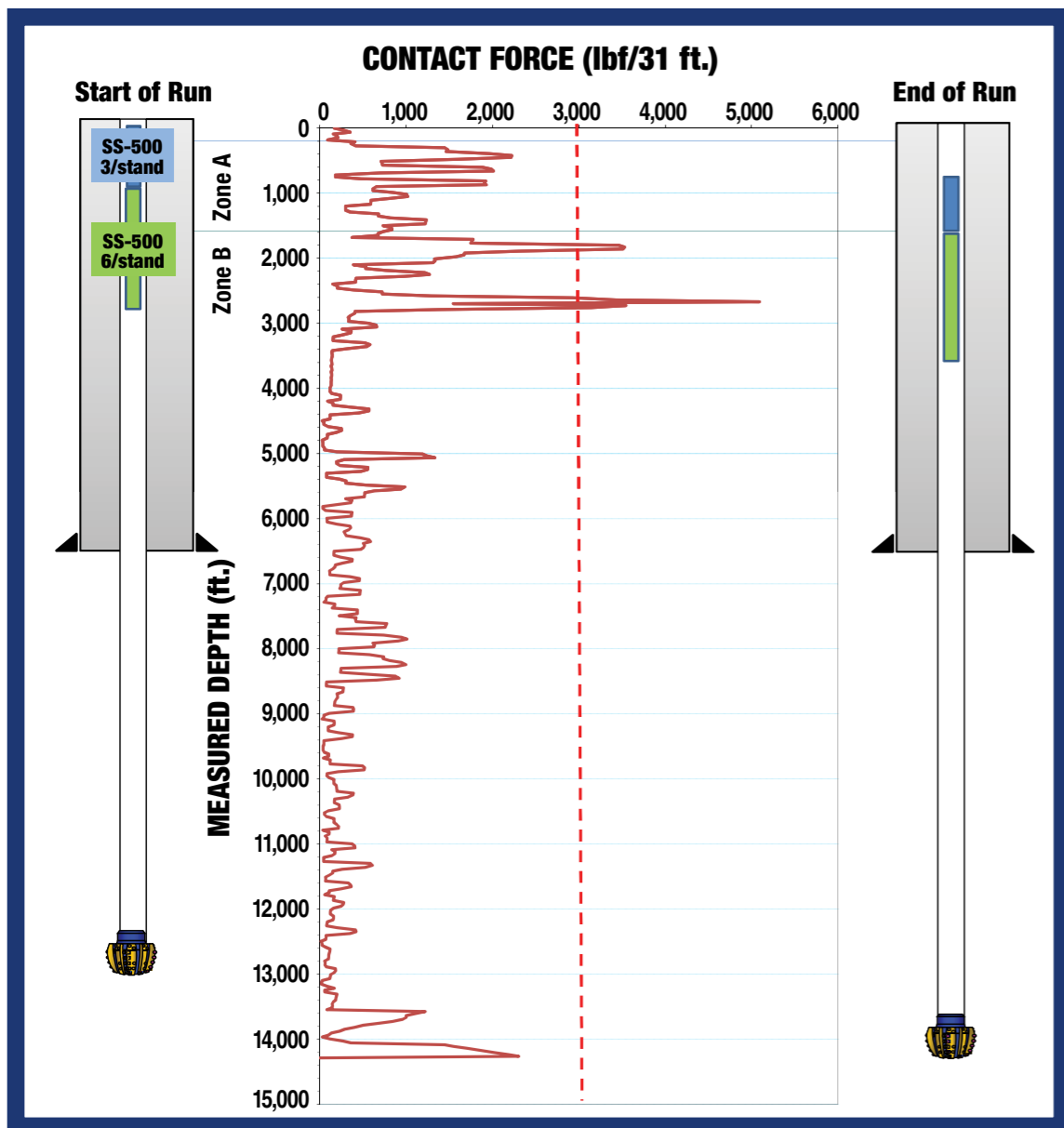
Well Analysis - Placement Recommendation

Before we begin any job, WWT performs a comprehensive and complimentary well analysis to recognize adverse wellbore conditions and determine if WWT NRPs will be a viable solution. Client-provided information and analysis results are maintained in a confidential manner. Our engineers model the anticipated contact forces to make a placement recommendation based on the areas of the wellbore where critical contact forces are shown to exist and show predicted torque and drag with and without Protectors for benefit comparison. Typically, our NRP placement recommendation allows the full objectives of our clients to be achieved by identifying and providing protection for only the most problematic areas in the well. In addition to well analyses, our engineering department can provide other analytical services, including ECD, casing wear modeling, FEA, and drillpipe stress calculations.

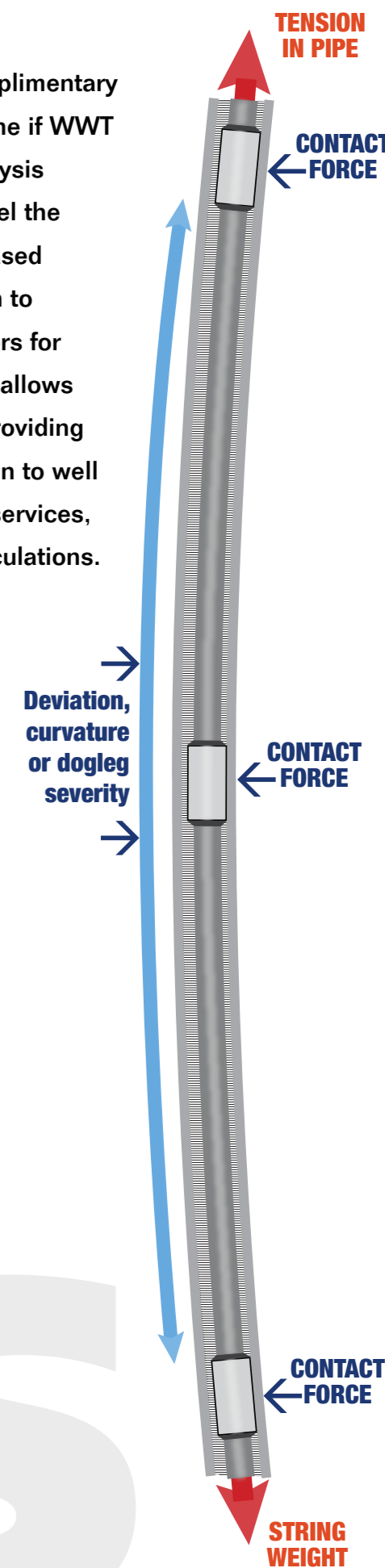
Measureable Benefits

Depending on the application, and when used per our recommendations, WWT Non-Rotating Protectors can provide significant results. WWT NRPs are proven to:

- Prevent casing wear
- Reduce torque and drag
- Increase ROP
- Minimize buckling
- Extend drilling operations in adverse ocean currents
- Reduce stick slip
- Prevent riser and production riser wear
- Decrease vibration
- Preserve casing integrity for future sidetracks
- Minimize heat checking
- Increase weight to bit
- Protect drillpipe
- Reduce surface equipment and drillstring stress and fatigue



Example of critical contact force areas in a well with deviation.



NRPS

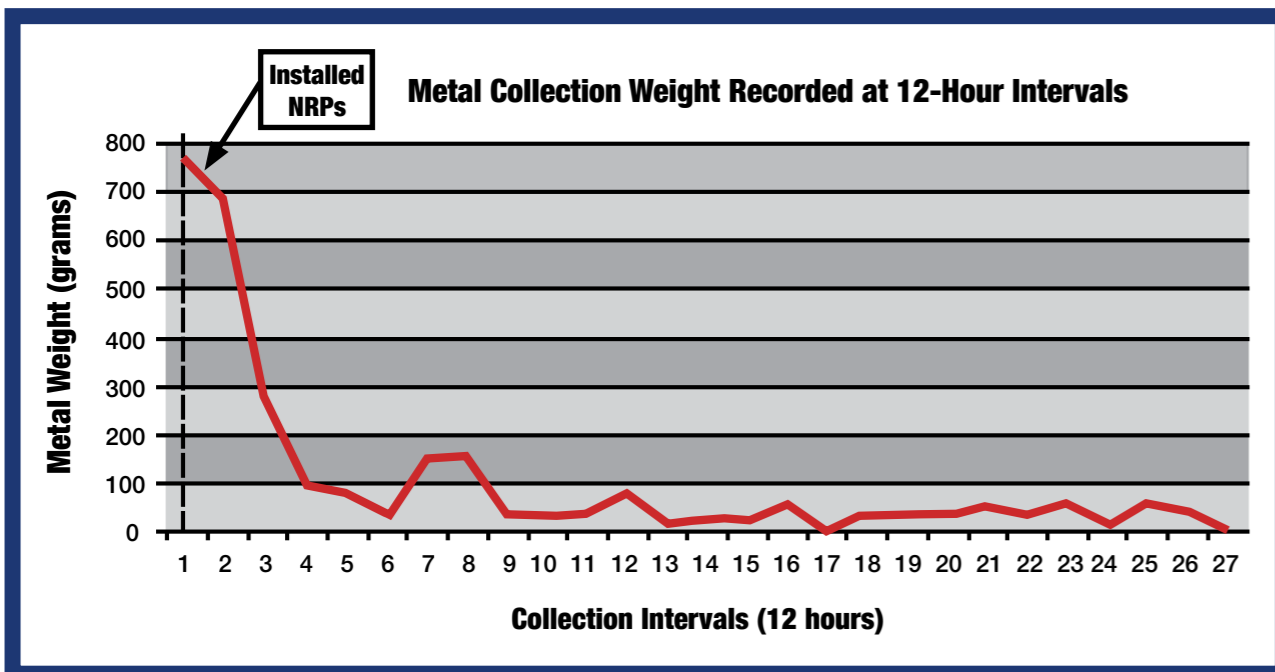
Proven Solution for Casing Wear

ITEM	BARE TOOL JOINT	WWT SUPER SLIDER
Rotating FF	0.30	0.03
% Reduction	0%	90%
Casing Wear Depth	0.029	0.000
% Reduction	0%	100%



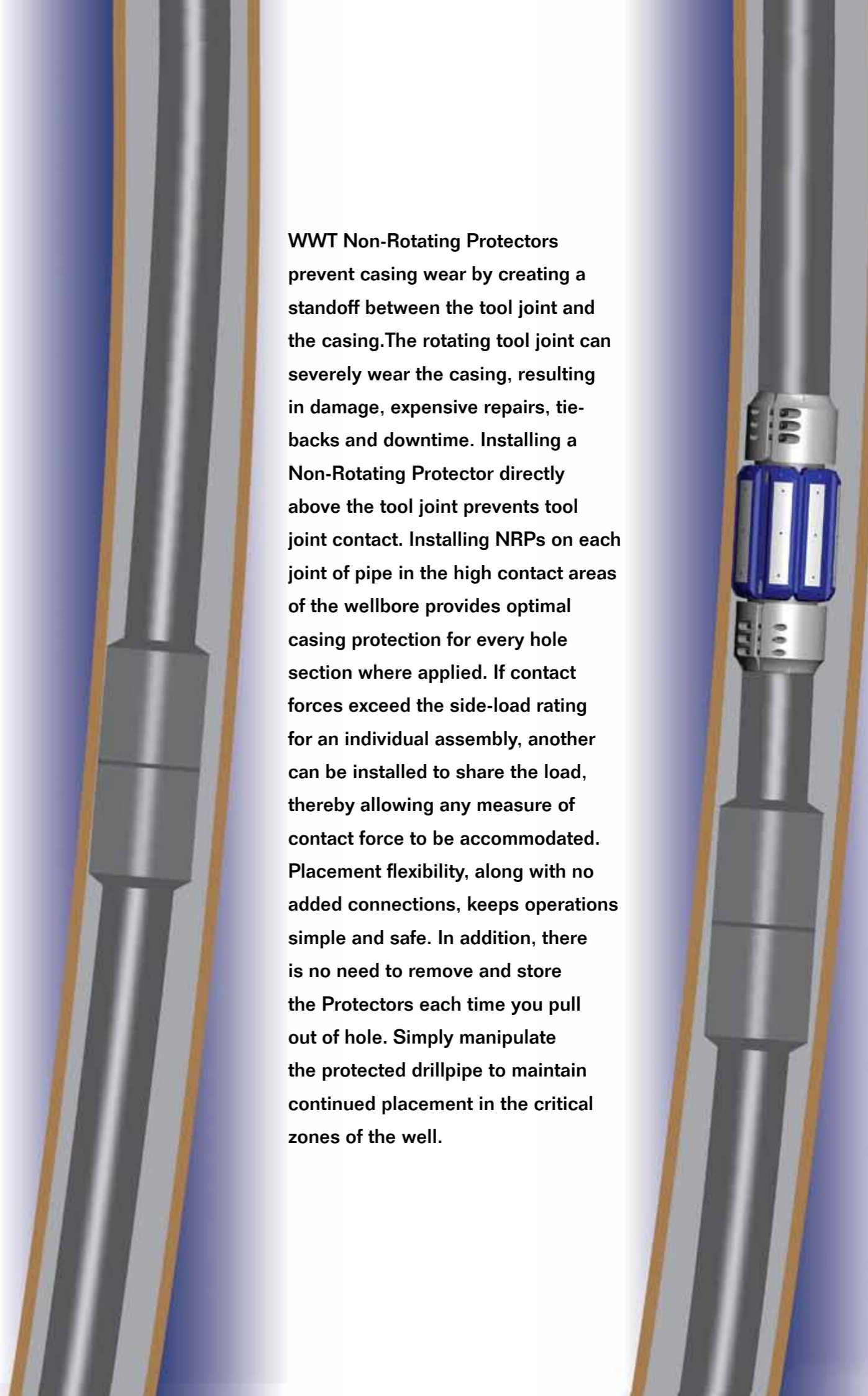
The results shown depict a study conducted comparing a 5-1/2" bare tool joint and a 5-1/2" Model SS Protector assembly rotating against 9-5/8" casing at 160 rpm for 2 hours with 1,000-lb. contact force in water-based drilling fluid.

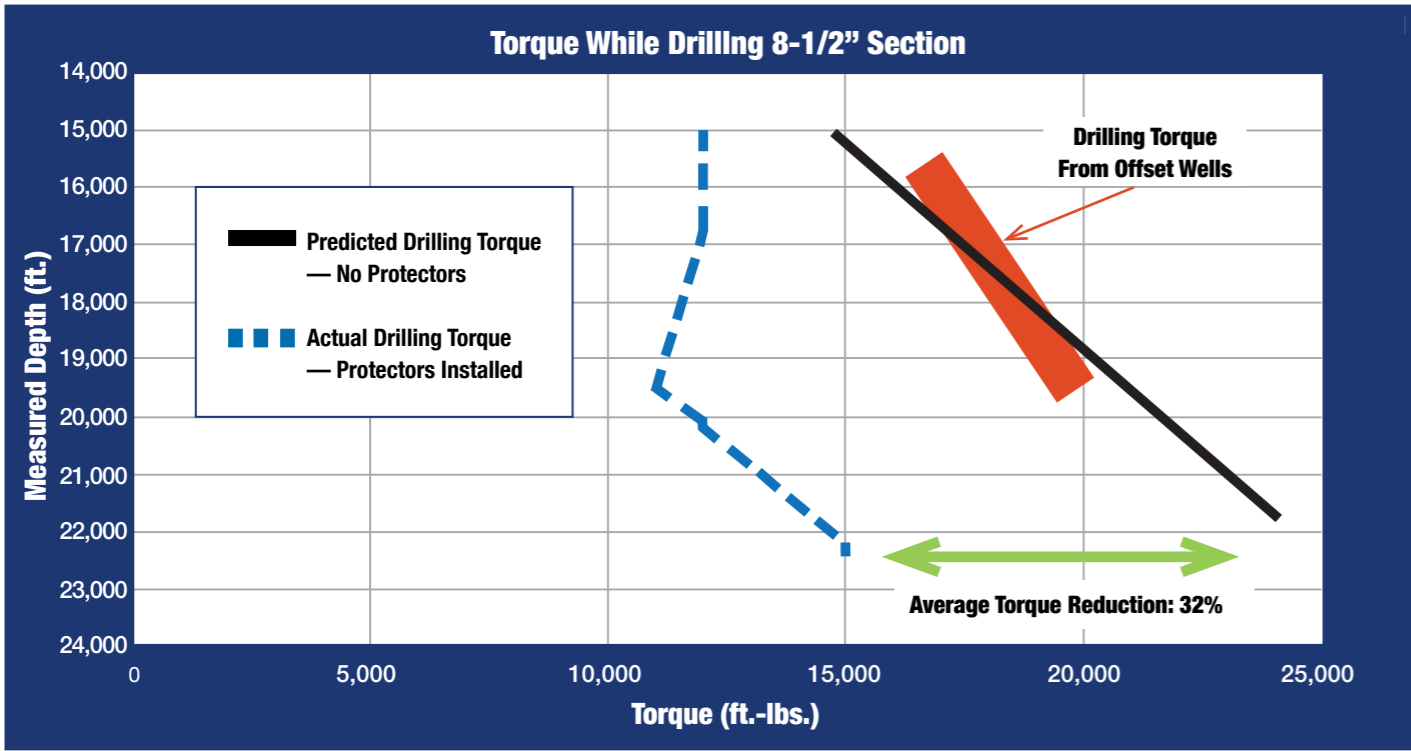
NRPS



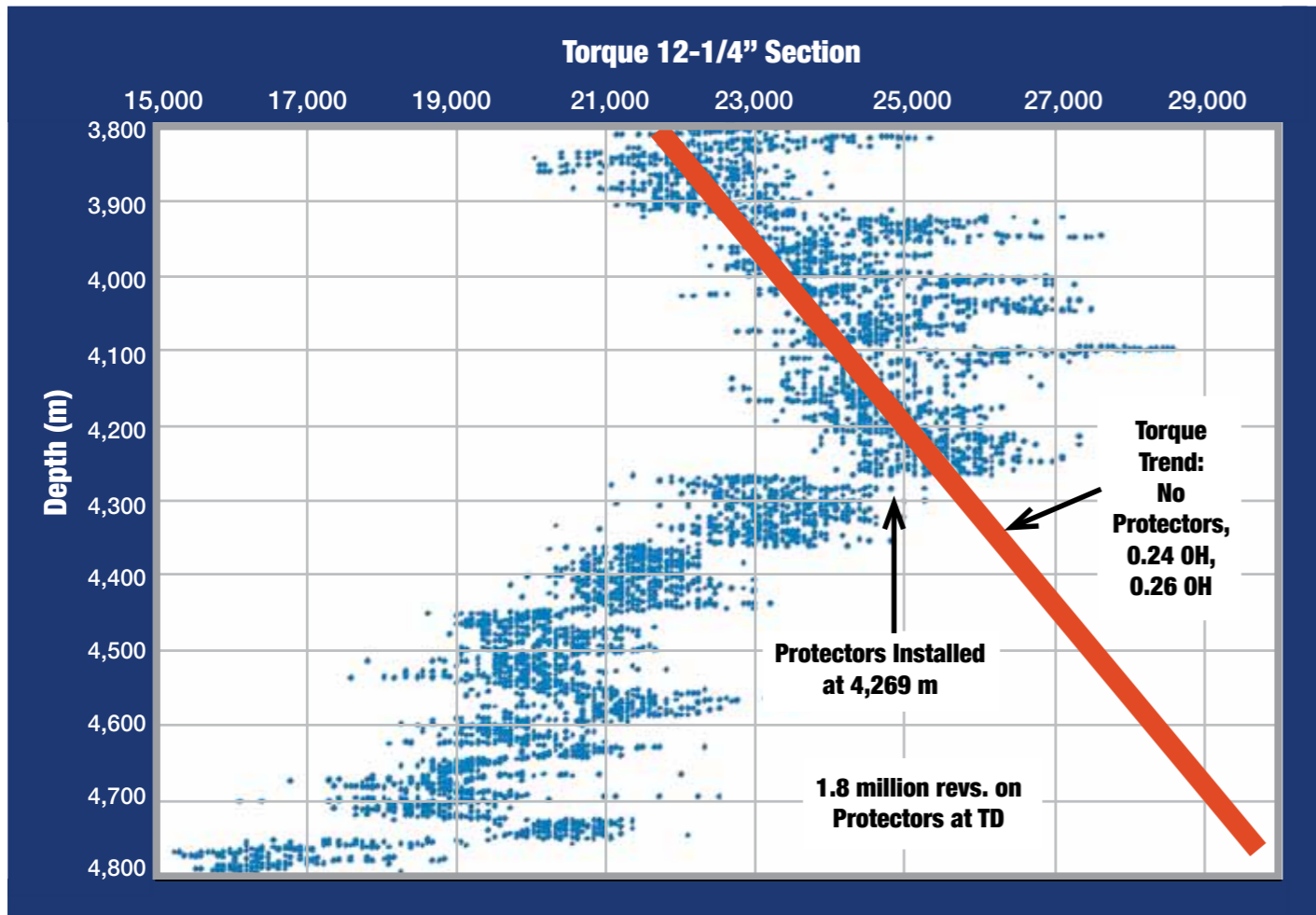
The above graph represents the ditch magnet metal-collection weight over 27 12-hour intervals (13.5 days). After WWT Non-Rotating Protectors were installed, the amount of metal recovered was drastically reduced, eliminating the operator's casing wear concerns.

WWT Non-Rotating Protectors prevent casing wear by creating a standoff between the tool joint and the casing. The rotating tool joint can severely wear the casing, resulting in damage, expensive repairs, tie-backs and downtime. Installing a Non-Rotating Protector directly above the tool joint prevents tool joint contact. Installing NRPs on each joint of pipe in the high contact areas of the wellbore provides optimal casing protection for every hole section where applied. If contact forces exceed the side-load rating for an individual assembly, another can be installed to share the load, thereby allowing any measure of contact force to be accommodated. Placement flexibility, along with no added connections, keeps operations simple and safe. In addition, there is no need to remove and store the Protectors each time you pull out of hole. Simply manipulate the protected drillpipe to maintain continued placement in the critical zones of the well.





The operator had drilled numerous wells using various mud additives, including beads and lubricants. When comparing this offset data with the use of WWT NRPs in a well in the same field with the same profile, the WWT predicted torque using NRPs showed improvement, whereas the actual torque reduction, which averaged 32%, was even more significant.



The operator was drilling a 4,800 m (15,700 ft.) S-shaped well and was concerned with torque as the trend showed that rig capabilities would be exceeded at TD. NRPs were installed in the shallow, high contact areas of the well when they reached 4,269 m (14,006 ft.). As they drilled deeper and NRPs moved into the high friction areas, the torque was reduced approximately 35%.

NRPS

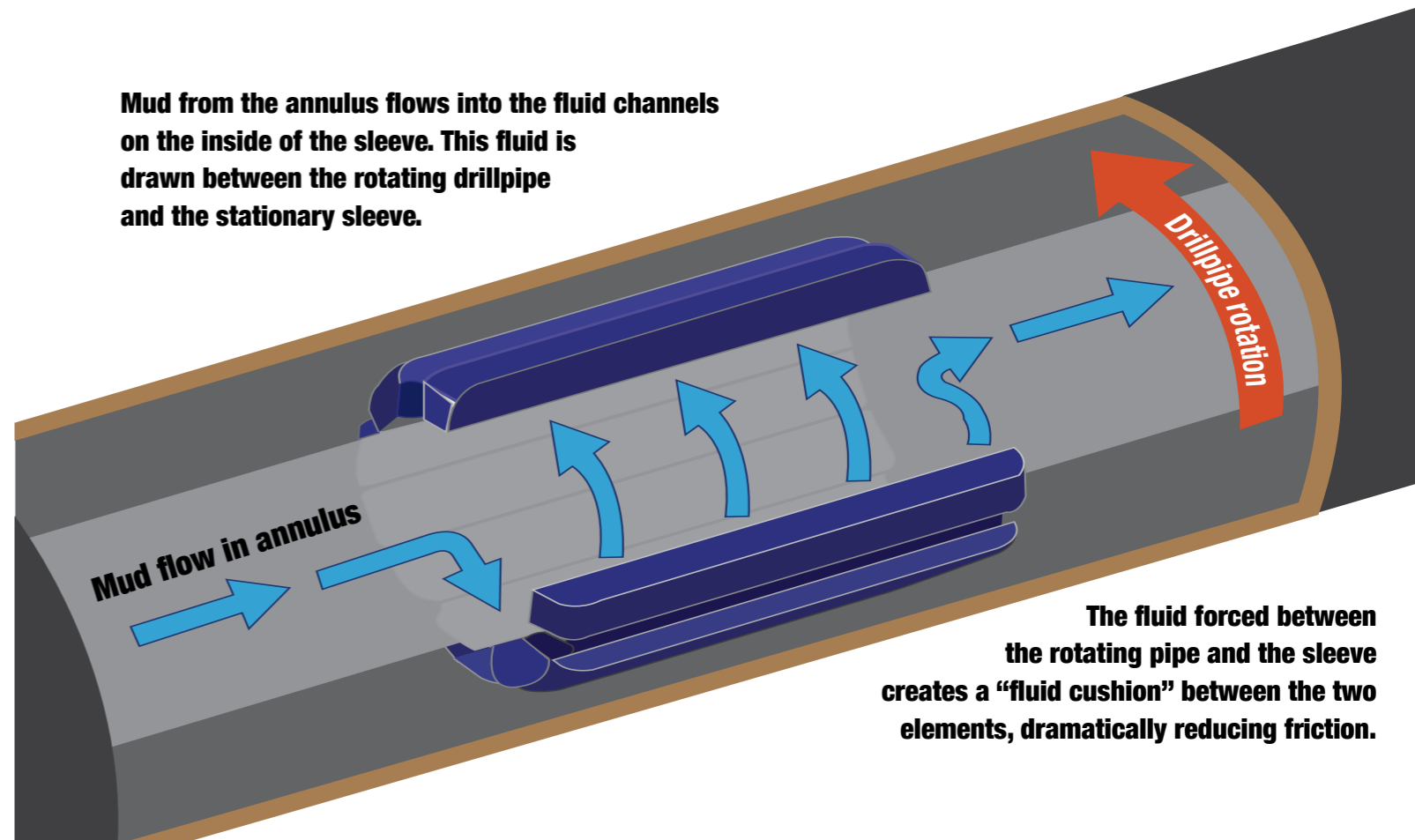


Proven Solution for Torque

WWT Non-Rotating Protectors reduce rotational friction between the drillstring and the casing by creating a standoff between the two surfaces. The unique, patented inner sleeve geometry allows fluid to flow into the interior of the sleeve. Rotation of the drillpipe draws fluid across the sleeve flats, creating a fluid bearing

within the sleeve, reducing rotating friction by 50 to 90% even at low rpms and in almost any drilling or completion fluid. The result is that surface torque is significantly reduced allowing more torque to be distributed to the bit improving drilling performance and the rate of penetration (ROP).

Mud from the annulus flows into the fluid channels on the inside of the sleeve. This fluid is drawn between the rotating drillpipe and the stationary sleeve.



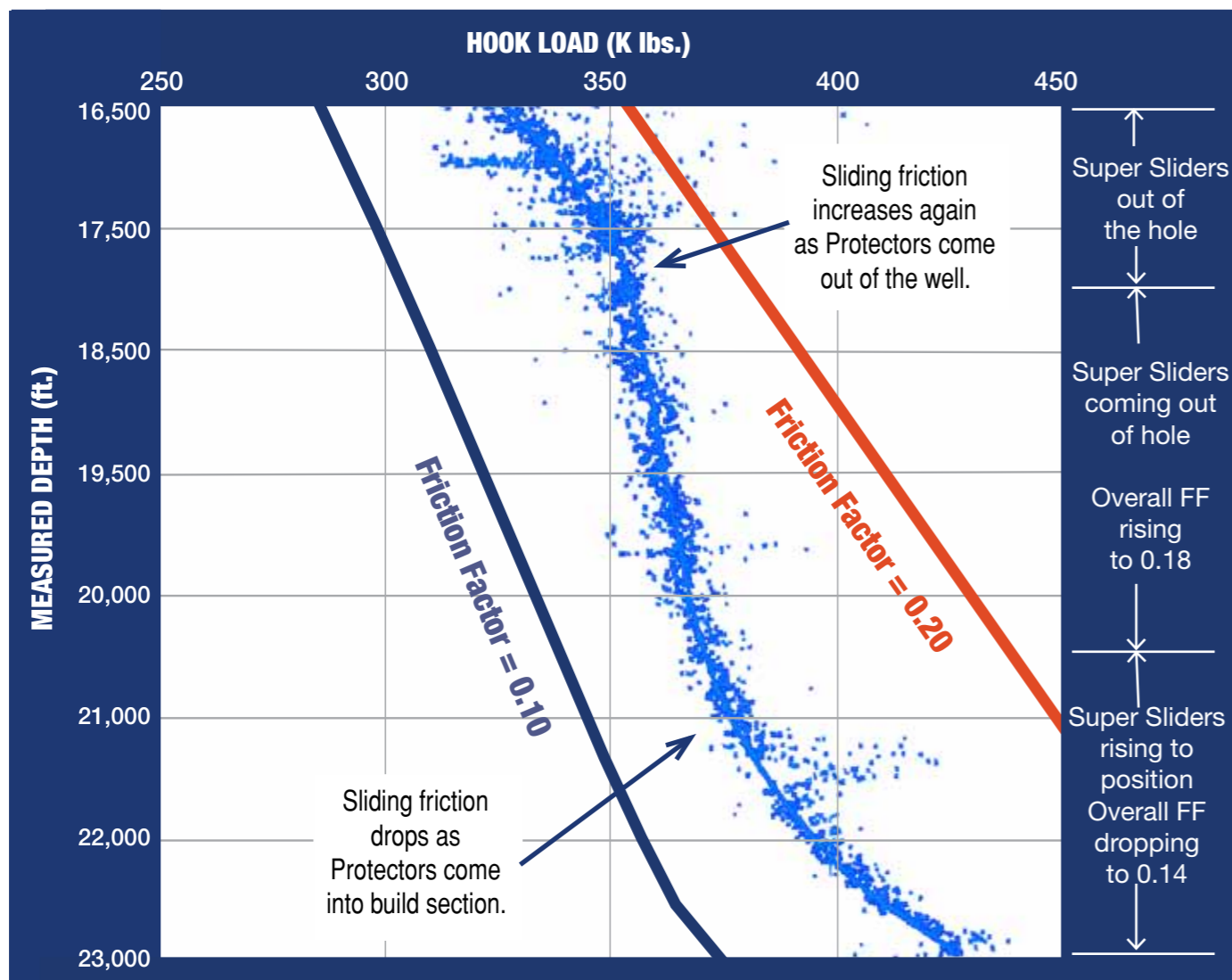
The fluid forced between the rotating pipe and the sleeve creates a "fluid cushion" between the two elements, dramatically reducing friction.

Proven Solution for Drag

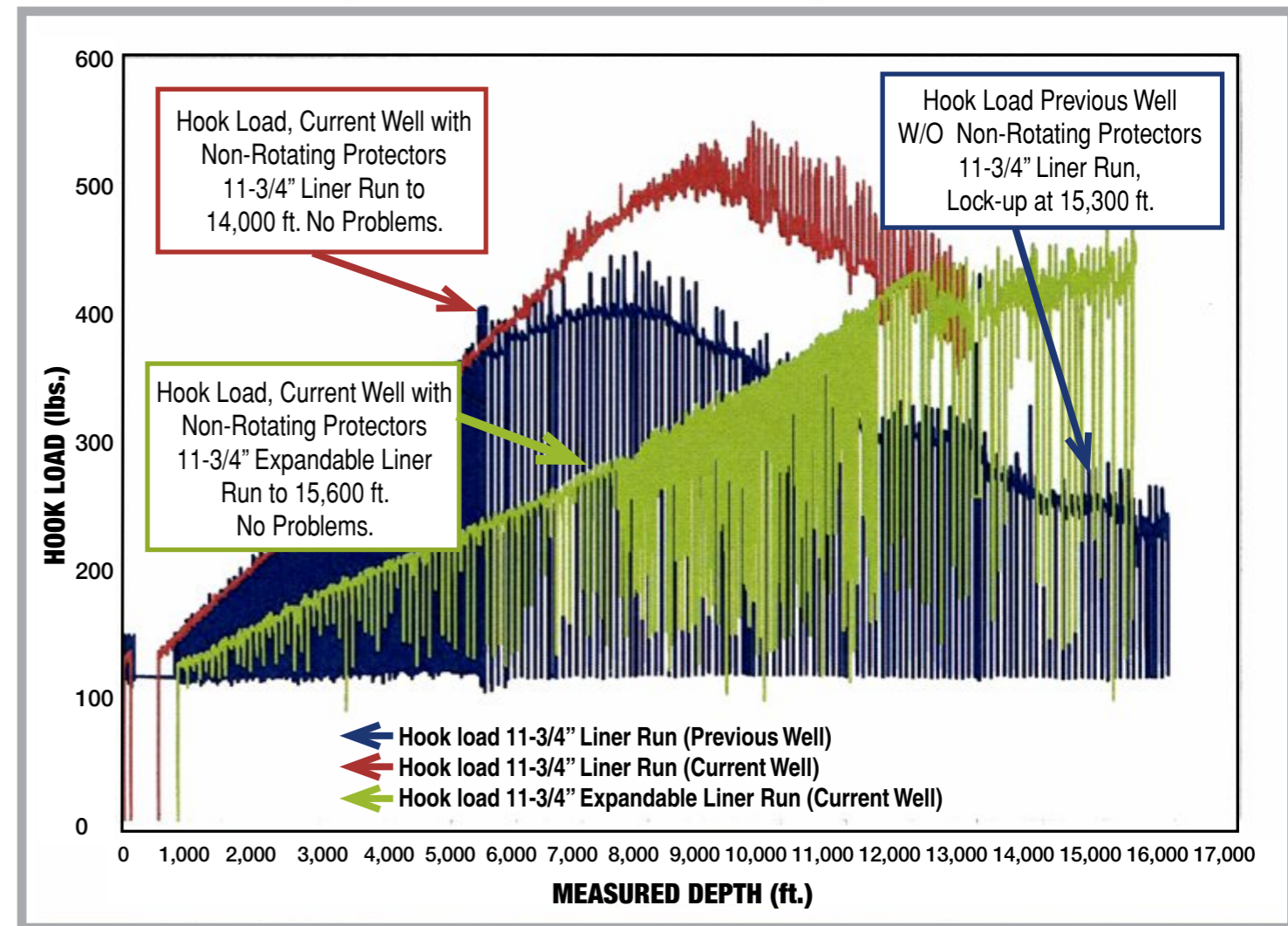
WRPS



WWT Non-Rotating Protector Model SS (Super Slider) features low-friction pads on the outside of the sleeve that reduce sliding friction between the drillstring and the casing. The sleeve slides easily along the casing while the drillpipe rotates in its ID, isolated from contact with casing. As a result, slack-off weight is increased and pick-up weight is decreased at the surface.



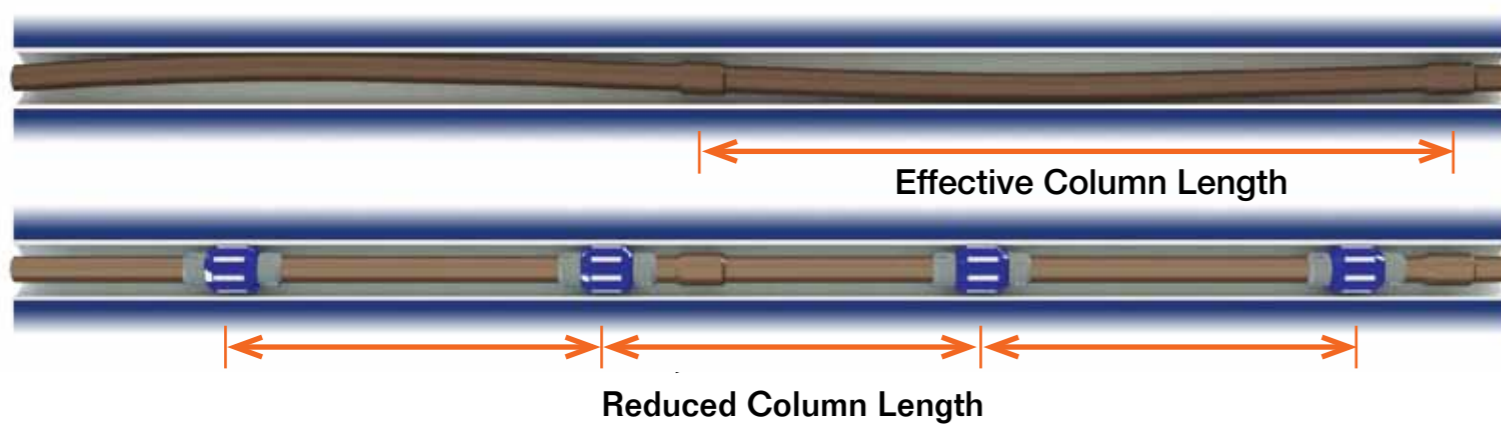
Sliding friction (drag) was recorded as the amount of hook load an operator experienced when coming out of the well from 23,000 ft. Installed WWT Model SS (Super Slider) Protectors were pulled back up through the contact forces in the build section and the overall sliding friction factor dropped to 0.14. When the Protectors were in the vertical section where contact forces were not present, the overall sliding friction factor rose to 0.18. The effective sliding friction factor reduction was 0.04 (22%).



The operator had trouble running an 11-3/4" liner due to limited hook load, which caused lock-up. WWT Protectors were installed on the 6-5/8" drillpipe mid-joint to reduce sliding friction and buckling. The operator successfully ran an 11-3/4" liner and an 11-3/4" expandable liner to TD without problems.

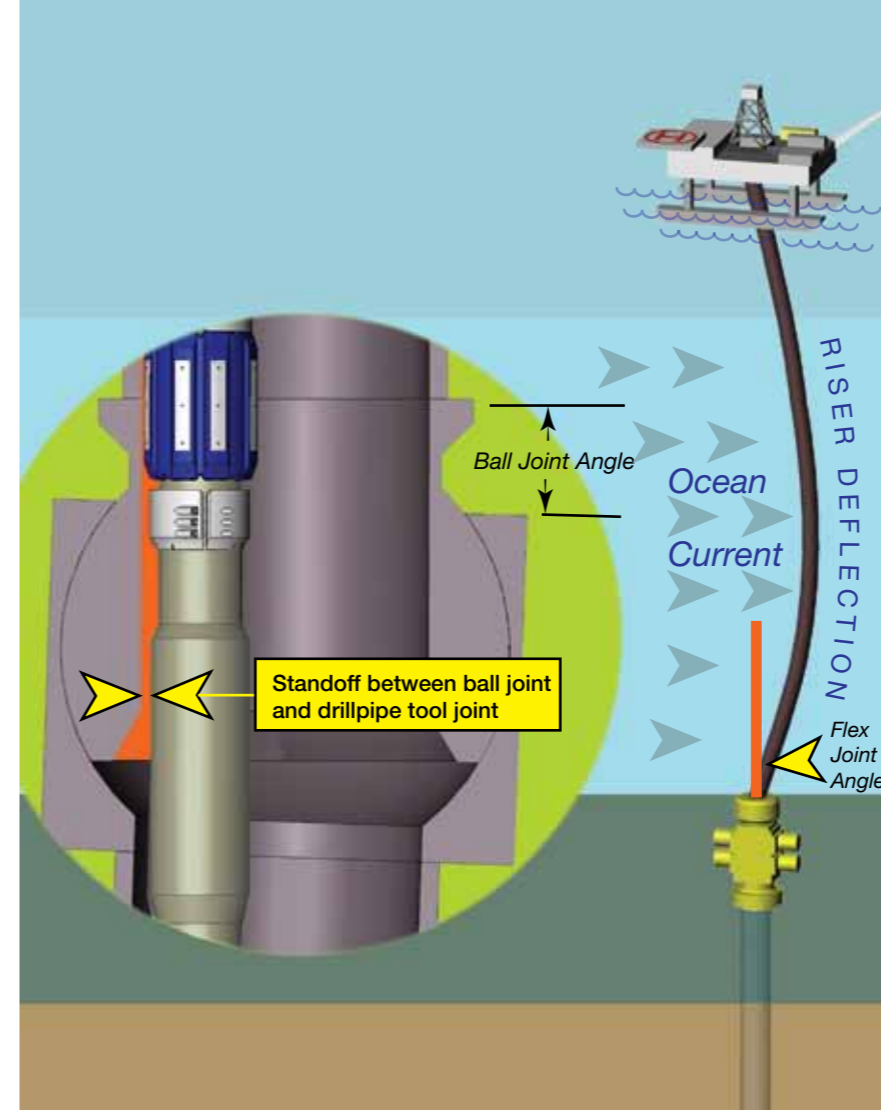
Proven Solution for Buckling

WWT Non-Rotating Protectors are proven to reduce drillstring buckling by reducing the effective column length of the drillpipe while at the same time reducing sliding friction. Finite element analysis and field experience have shown that reducing the unsupported length by placing a Protector in the middle of the drillpipe can reduce or prevent buckling effects such as increased torque, drag, vibration and drillstring lockup.



Protectors can be used to increase buckling thresholds by 50-100%

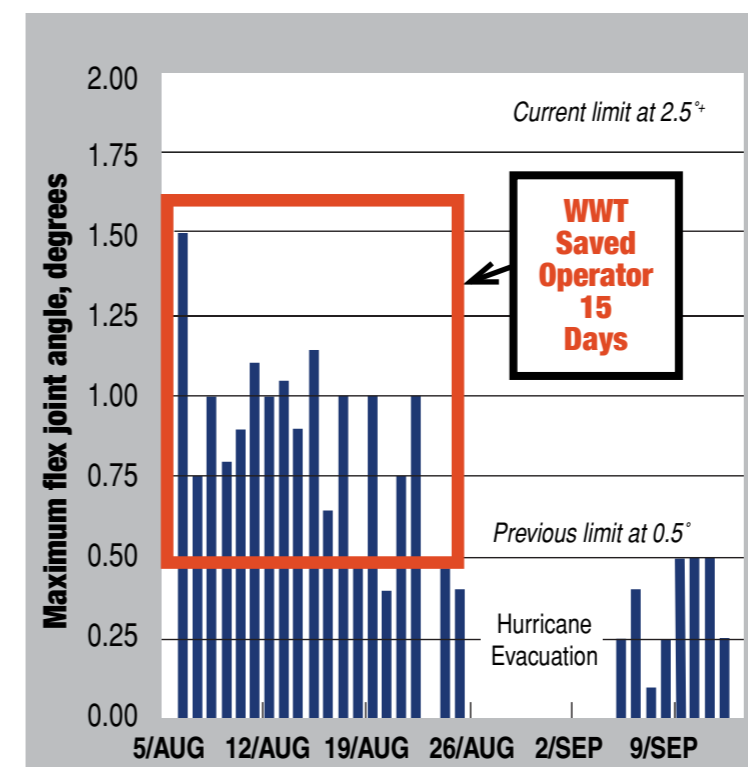
NRPS

Drilling operations were shut down to prevent wear to the LMRP components when the riser deflection angle exceeded 0.5 degrees. WWT NRPs were installed to protect the lower section of the riser and LMRP, which increased the safe operating angle to 2.5 degrees, extending operations by 15 days.

Proven Solution for Riser and LMRP Wear

WWT Non-Rotating Protectors are ideal for riser and BOP/wellhead protection in deepwater operations. Our Protectors are proven to extend the operating window in adverse ocean currents. Operators have been able to continue drilling operations when they would have been otherwise shut down waiting for currents to subside. The Protector provides adequate standoff between the drillstring and the riser, flex joint, wellhead and blowout preventer, thereby preventing wear and damage. NRPs are also an effective defense against production riser wear, allowing protected operations through single barrier risers. WWT SC (Strippable) assemblies provide additional holding power and have successfully stripped through a typical subsea annular BOP configuration during testing.



**We have a solution
that will work for you.
Call us today for a
free well analysis
or visit our web site
for more
information.**



WWT International Inc.

Innovative Products for Drilling, Completion and Intervention Profitability

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