Artificial Lift R&D Council

Hydraulic Tubing Anchor

Presenter: Ryan Bair

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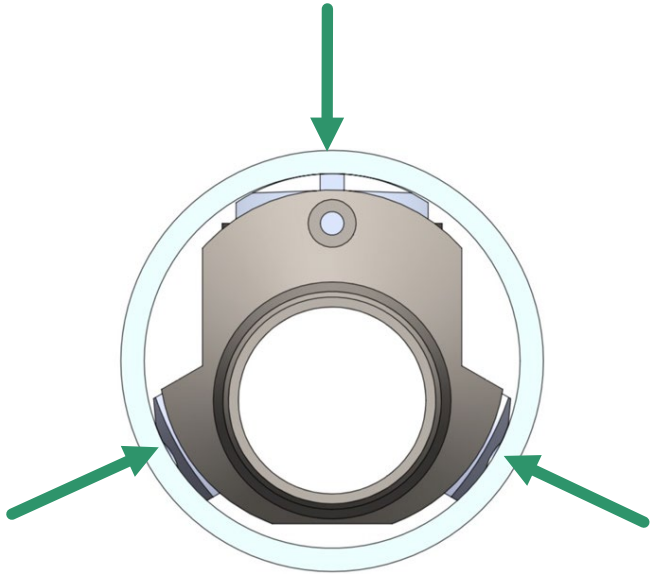
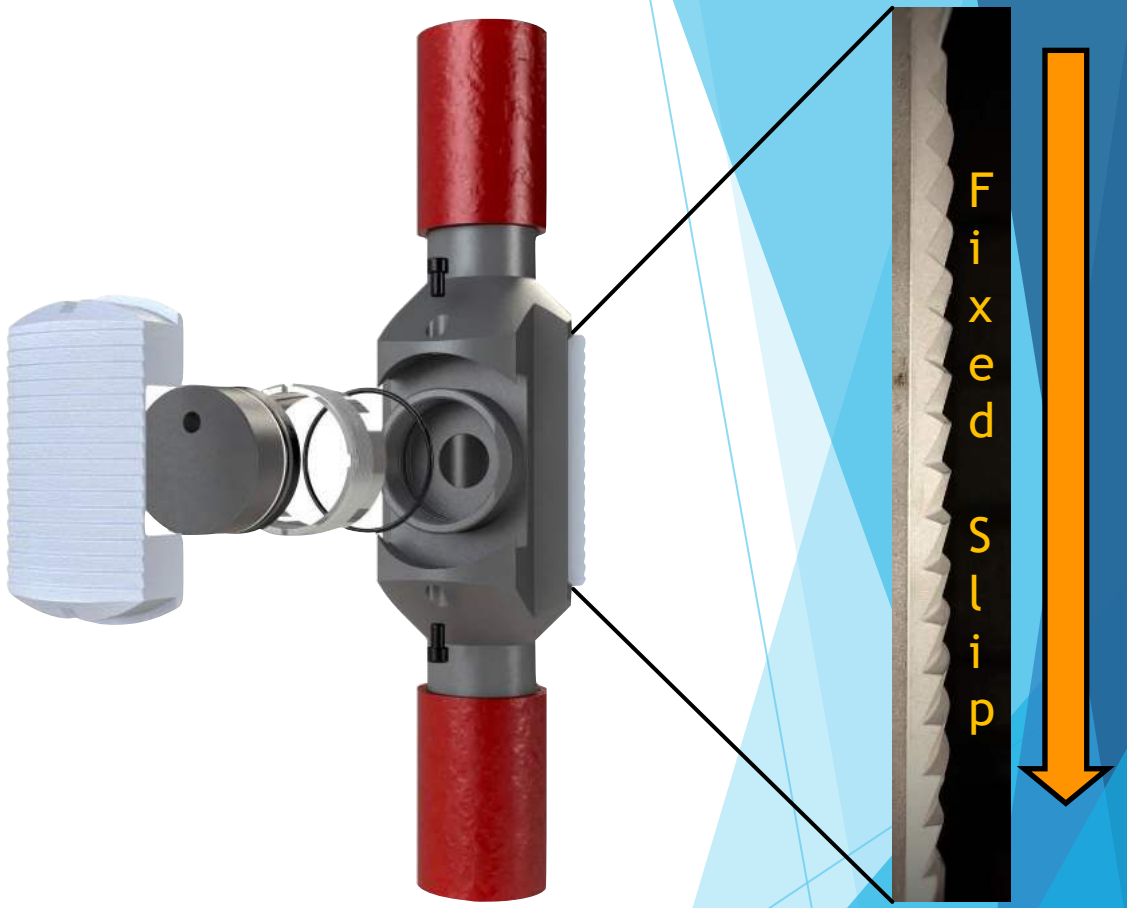
BLACK GOLD
PUMP & SUPPLY INC.
SIGNAL HILL, CA

How the hydraulic anchor works

- Differential Pressure between casing and tubing
- Piston force engages the live slip/fix slips to casing
- Only 10-20 PSI required to activate piston
- No rotation or surface manipulation to set
- Anchor moves down into tension
  - Automatically sets into optimum tension

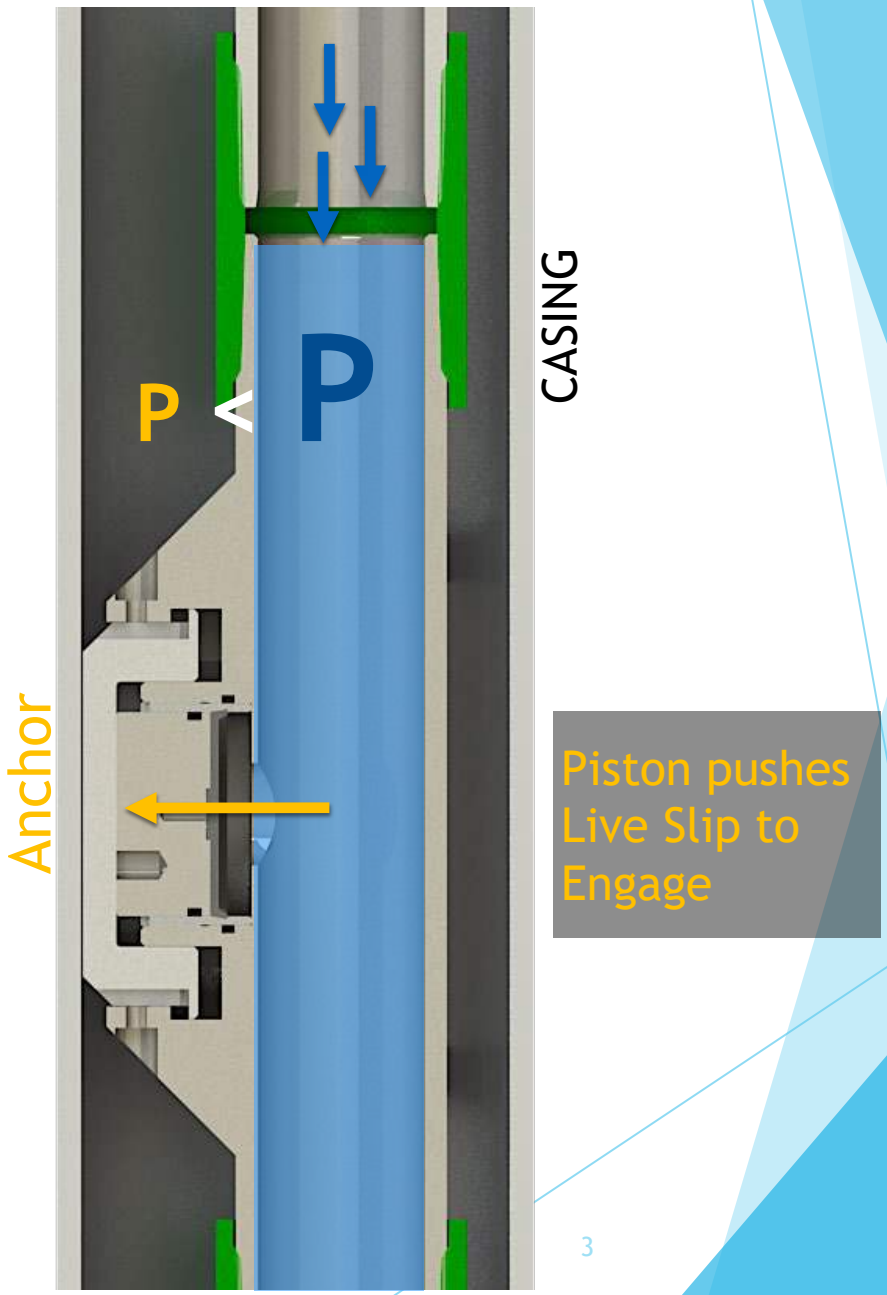


Anchor distributes load equally



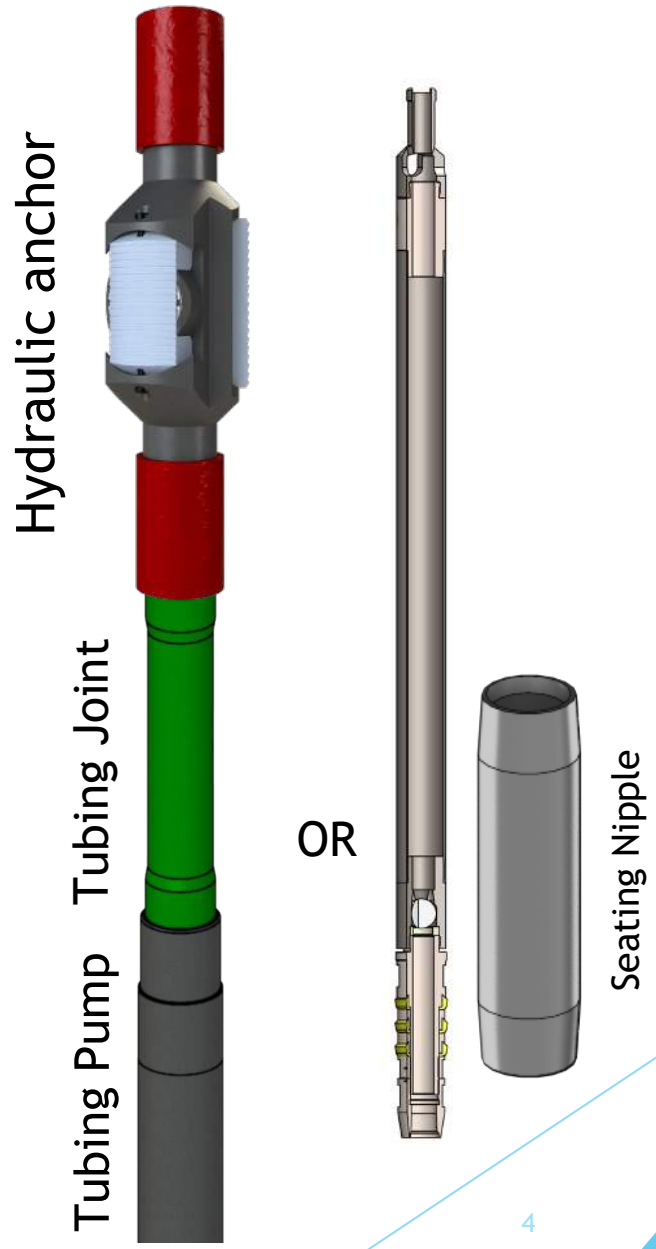
How to set the Hydraulic Anchor

- (Insert Pump) Seat the pump and fill the tubing with fluid to surface
- (Tubing Pump) Fill the tubing up with fluid to surface
- The anchor is set when pressure in the tubing string is greater than the pressure in the casing
- Can also start the well and fill the tubing by the pump action and anchor will set



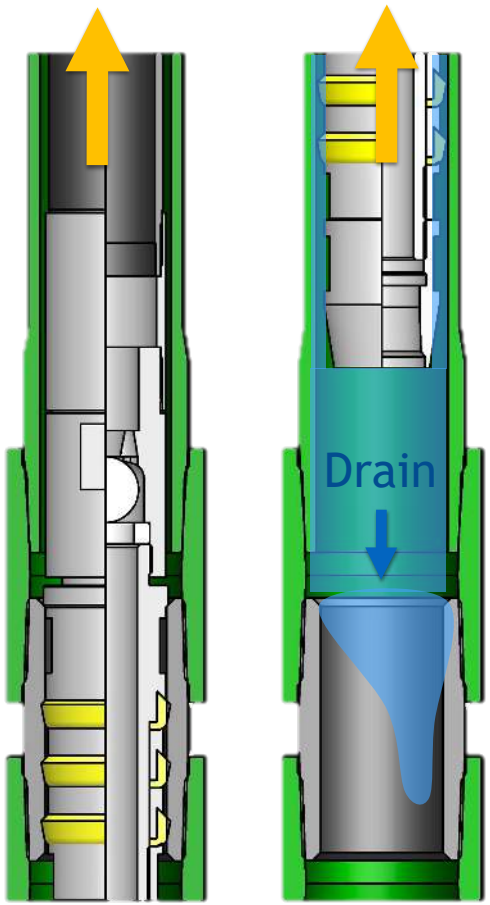
Placement of Hydraulic Anchor

- Anchor must be located above pump
- 1-2 tubing joints above the pump (recommended)



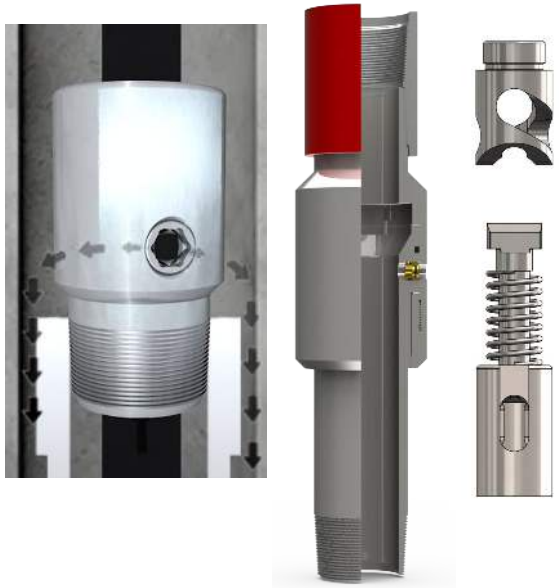
Unsetting the Hydraulic Anchor

(Insert Pump) unseat the pump, off pump seating nipple (PSN)



(Tubing Pump THC/M) unseat standing valve off pump seating nipple

TH pump, drain tubing with blow drain, R-drain, Mechanical drain



The anchor unsets when pressure between tubing and casing equalize

How to select a hydraulic anchor

http://apps.blackgoldpump.com

Casing O.D.: 5.5"

Casing Weight: 23

Select OD first, then weight ====> API Weights

Tubing Size: 25 --- 2-7/8" OD (73.0 mm), 2.5" ID

Pump Bore: 150 --- 1-½" (38.1 mm)

Pump Depth: 10000

Anchor Depth: 9000

Optional Parameters

Fluid Level (From Surface):

Fluid Over Pump (FOP): **NONE**

Specific Gravity: NaN

API Gravity:

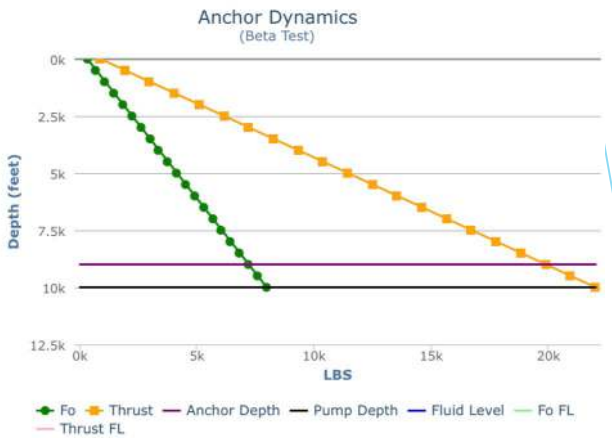
Tubing Pressure:

Casing Pressure:

SPM:

Casing Gas Gradient (PSI/ft):

Drain Depth (TVD):



Acceptable Anchor(s): Hide Invalid | Show All

Assembly Number	01-550-23-25
Fluid Load (Fo) 9945 (+30%)	7809 LBS
Anchor Thrust	19885 LBS
Anchor Loading 50% (w/30% F_o)	39%
Tool OD	4.589"
Anchor Piston	2.492"
Tubing Diameter	2.875"
Notes piston travel: 18%	Matched a pre-verified anchor spec. Expected

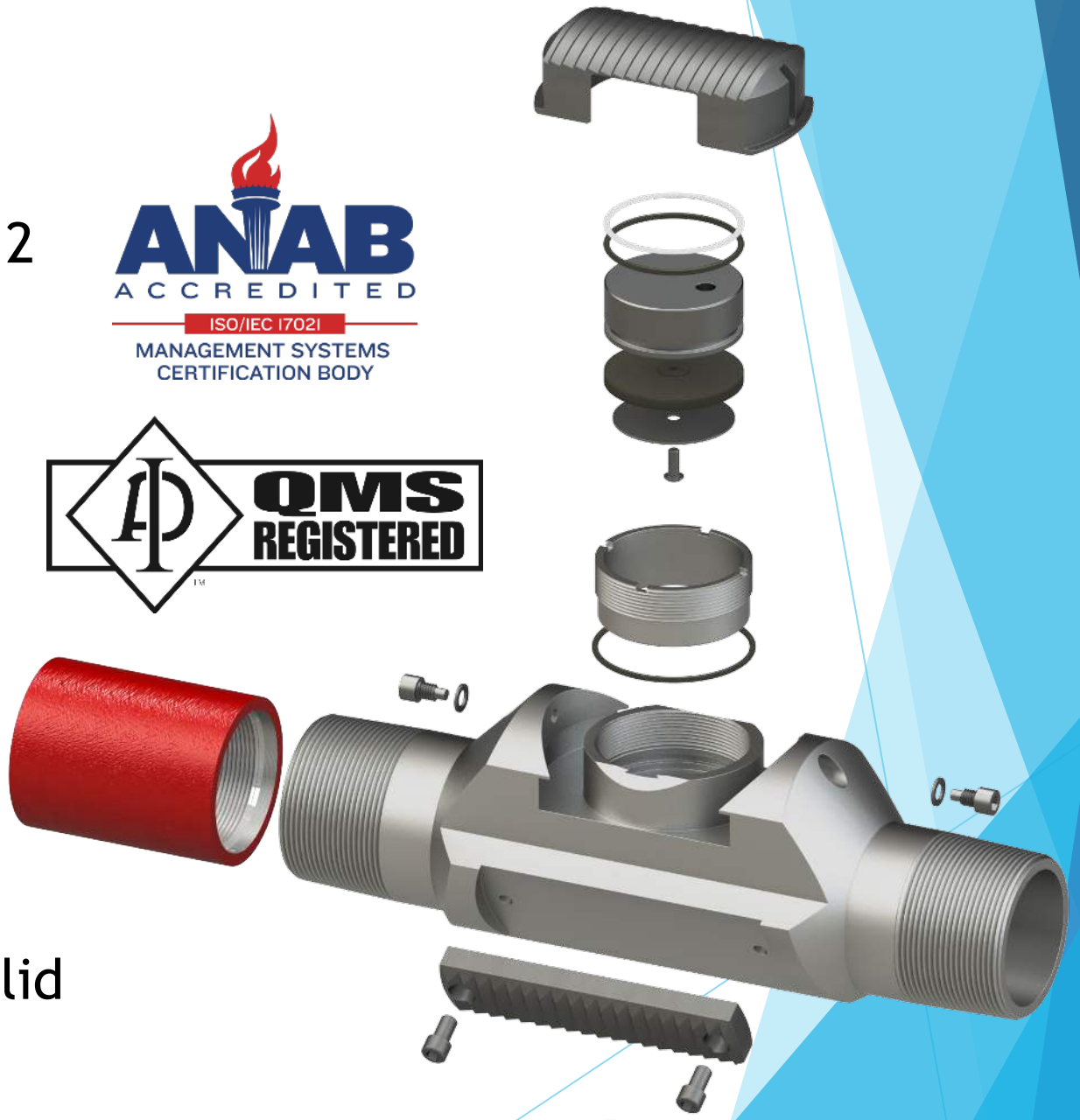
Additional Info:
($1/k_t$): 0.002210
Tubing Stretch
If Unanchored: 17.3"
Below Anchor: 1.7"
Lost Bbls/Day (Unanchored): 22.6 Bbls/Day

New Hydraulic Anchor Design

- Original anchor, page oil tool 1964
- Complete re-design of anchor in 2012 (released 2013)
- Went to aerospace tolerances
- Designed for casing size and weight
- Optimal piston travel
- Upgraded materials
- Dual o-rings on seal cup assembly
- Increased bypass for high gas and solid
- Patented design

ANAB ACCREDITED ISO/IEC 17021 MANAGEMENT SYSTEMS CERTIFICATION BODY

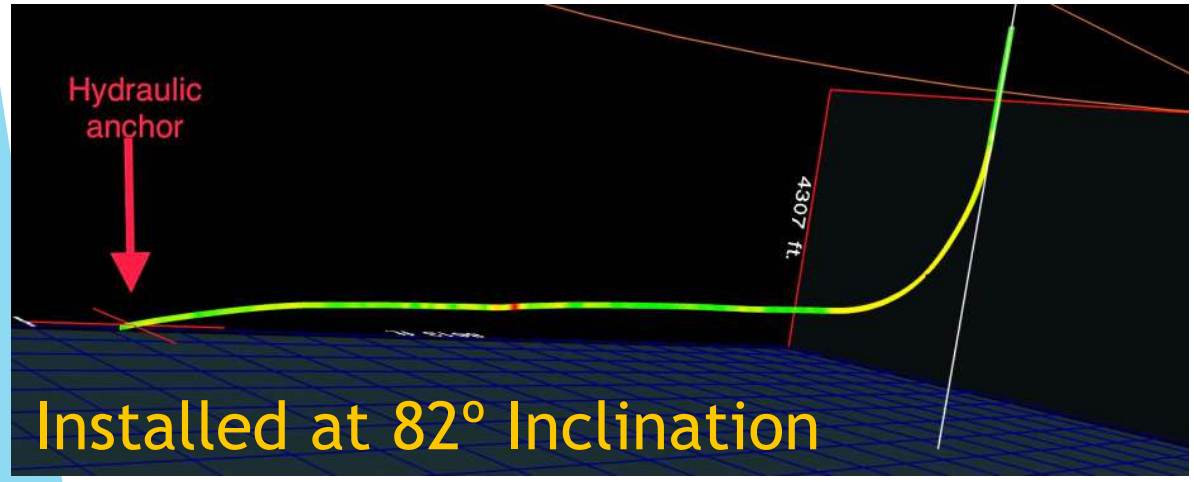
QMS REGISTERED

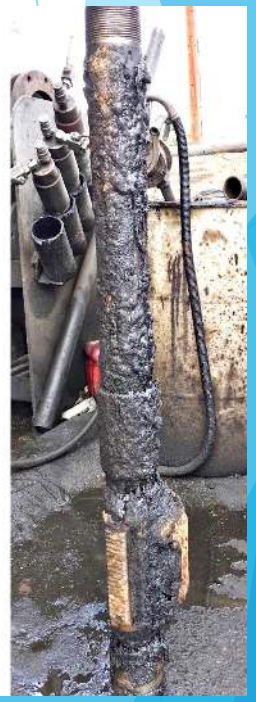


Why we re-designed the Hydraulic Anchor…

Where the Hydraulic Anchor outperforms

- Deep and/or deviated wells, difficult to set any mechanical type anchors
- Gassy Wells (large bypass)
- High solids (sand, paraffin, scale, etc.)
- Not recommended in the perforations
  - Prefer above, below, or in blanks

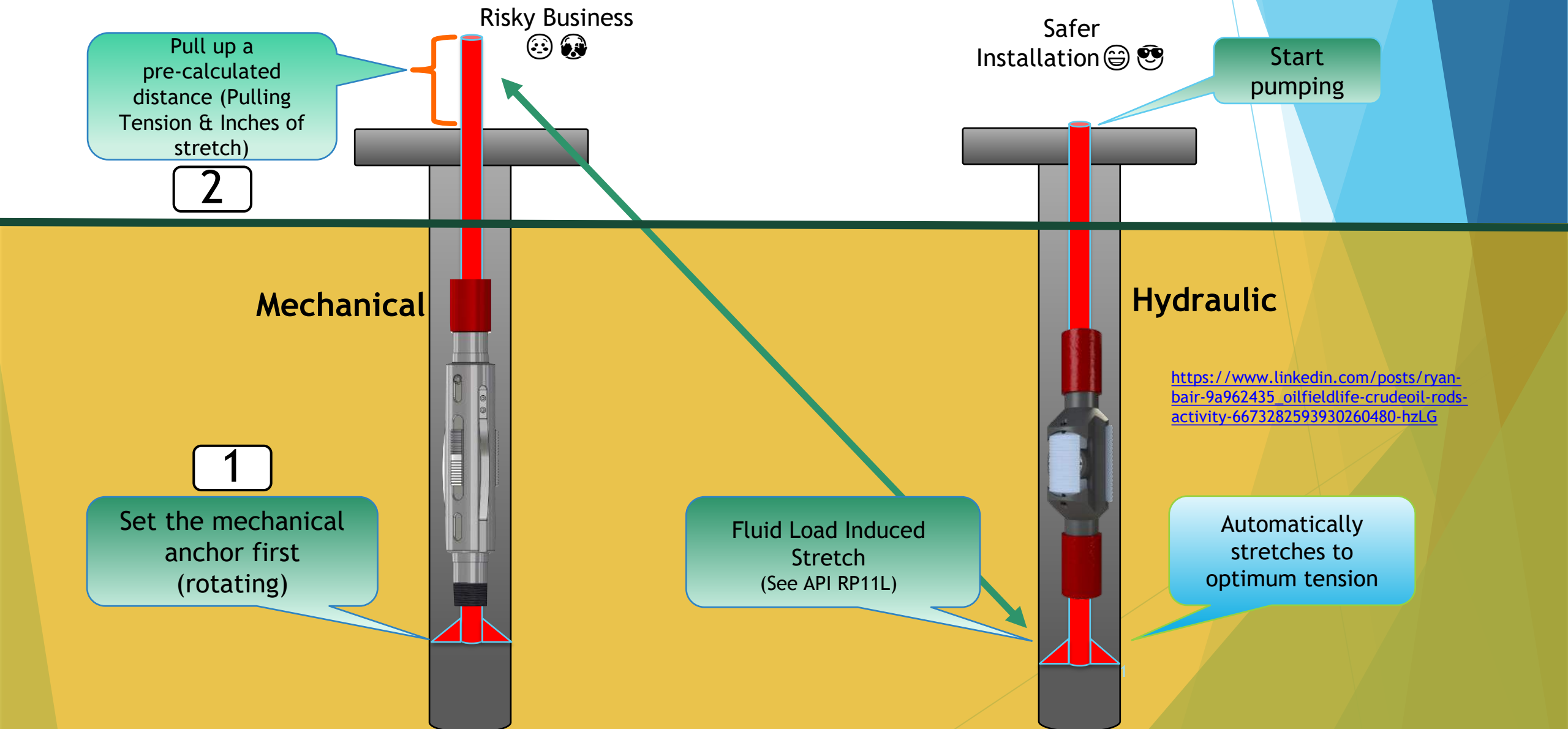




Anchor Comparison

	Mechanical Anchor	Hydraulic Anchor
Tubing Stretch	Pretension tubing (Required calculations)	Anchor moves downwards (self compensating)
Setting	Rotate/Pull tubing to calculated tension and stretch	Fill the tubing to pressurize piston
Unsetting	Rotate/shear pins	Equalize pressure
Capillary Tubing	Specialized anchor Rotation issues	Large bypasses No rotation
Gas and solids in the casing	See Echometer Paper SWPSC #2014015 - Tubing Anchors Can Restrict Production Rates And Pump Fillage	Tapered ends, large bypass area (gas/solids)

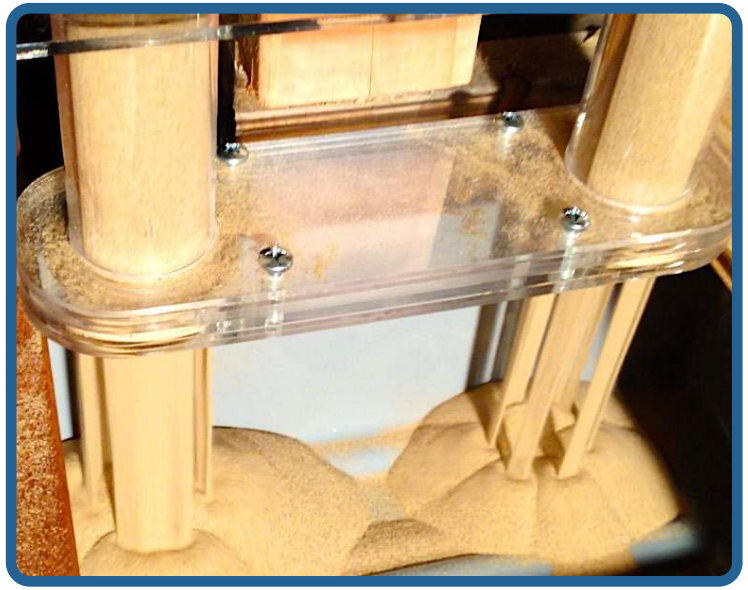
Anchor Comparison



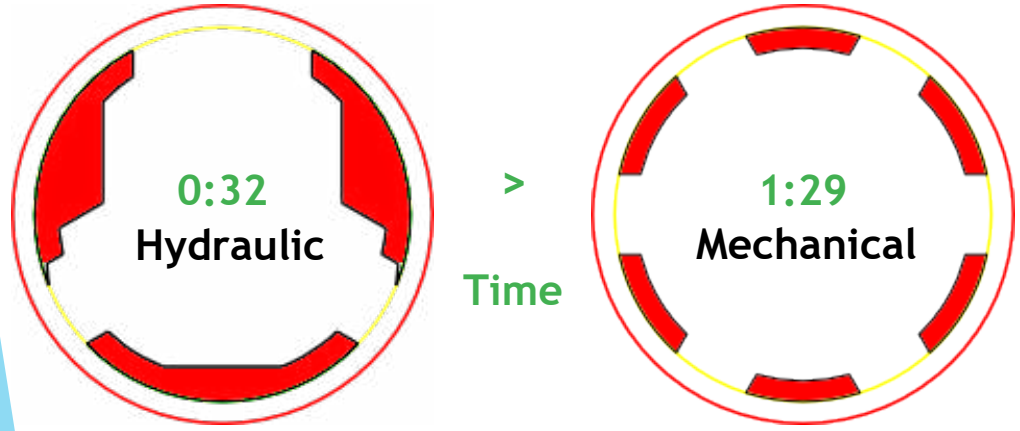
https://www.linkedin.com/posts/ryan-bair-9a962435_oilfieldlife-crudeoil-rods-activity-6673282593930260480-hzLG

Solids around the Hydraulic Anchor

Scaled models for 7” #29

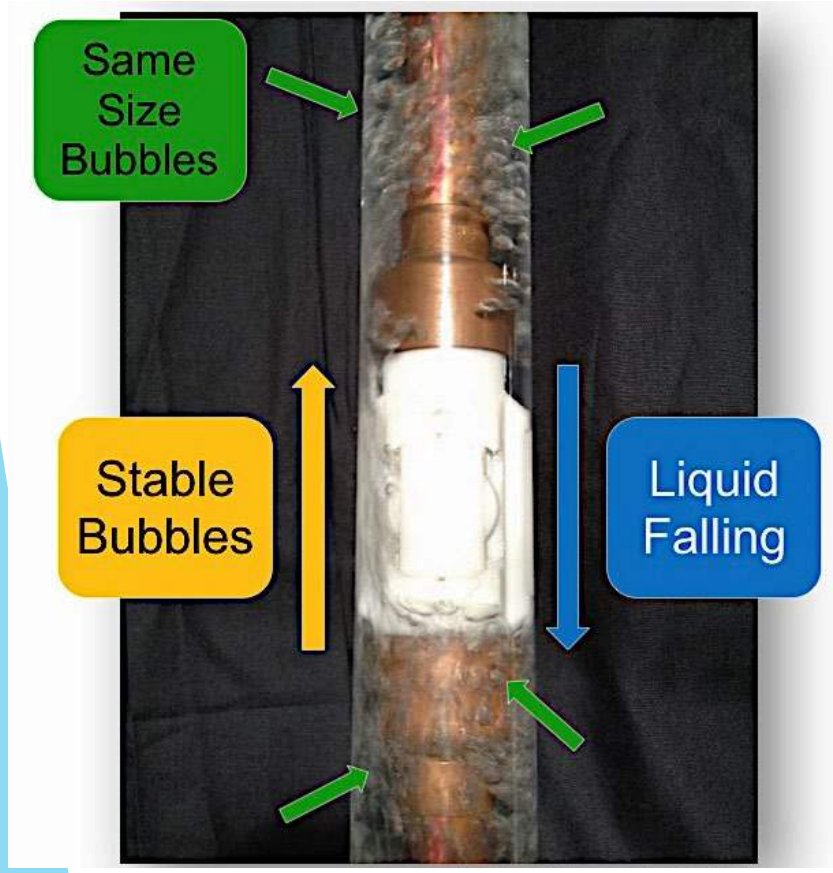


- The larger area allowed for greater flow
- No restriction on the Hydraulic Anchor
- Mechanical Anchor bridged off (restricted area)

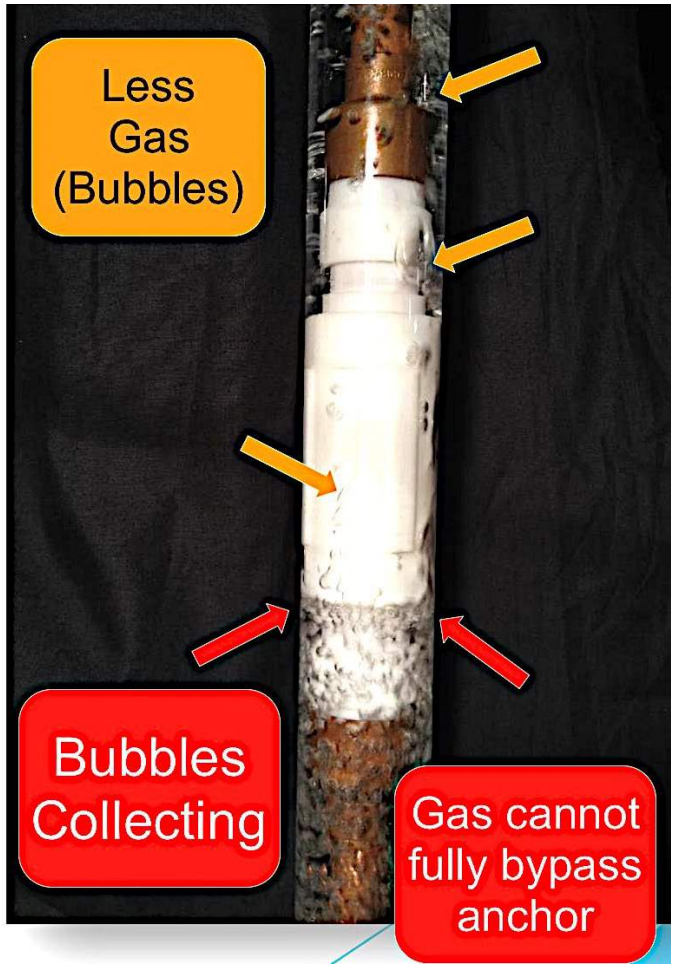


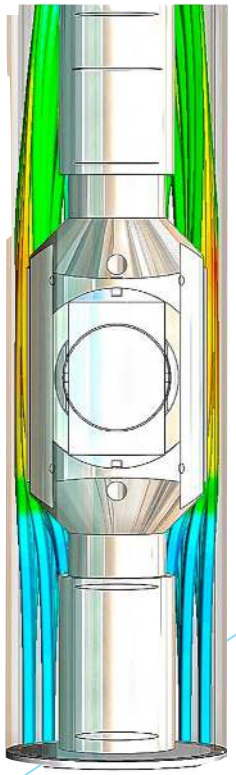
Gas Bubbles Through the Anchors

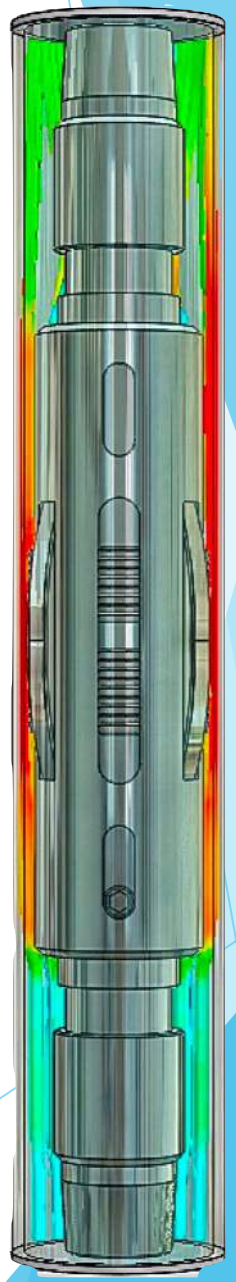
Hydraulic Anchor



Mechanical Anchor

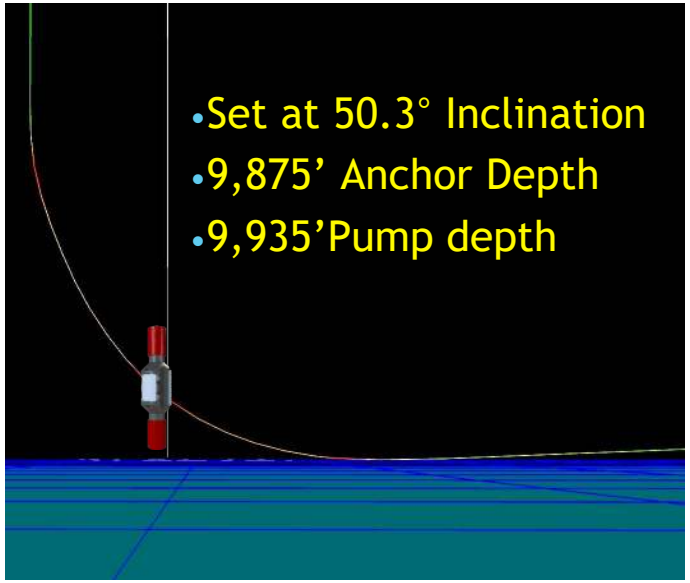


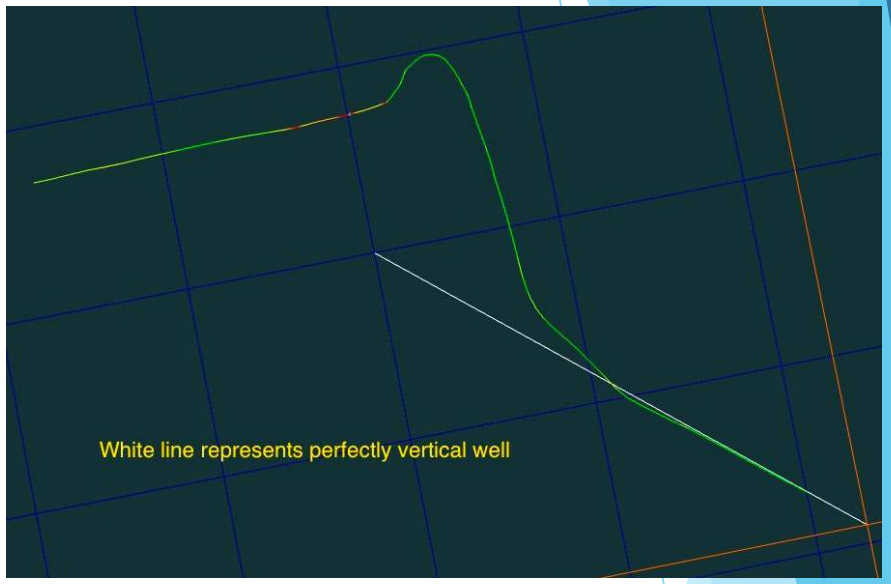




USA Case studies: California

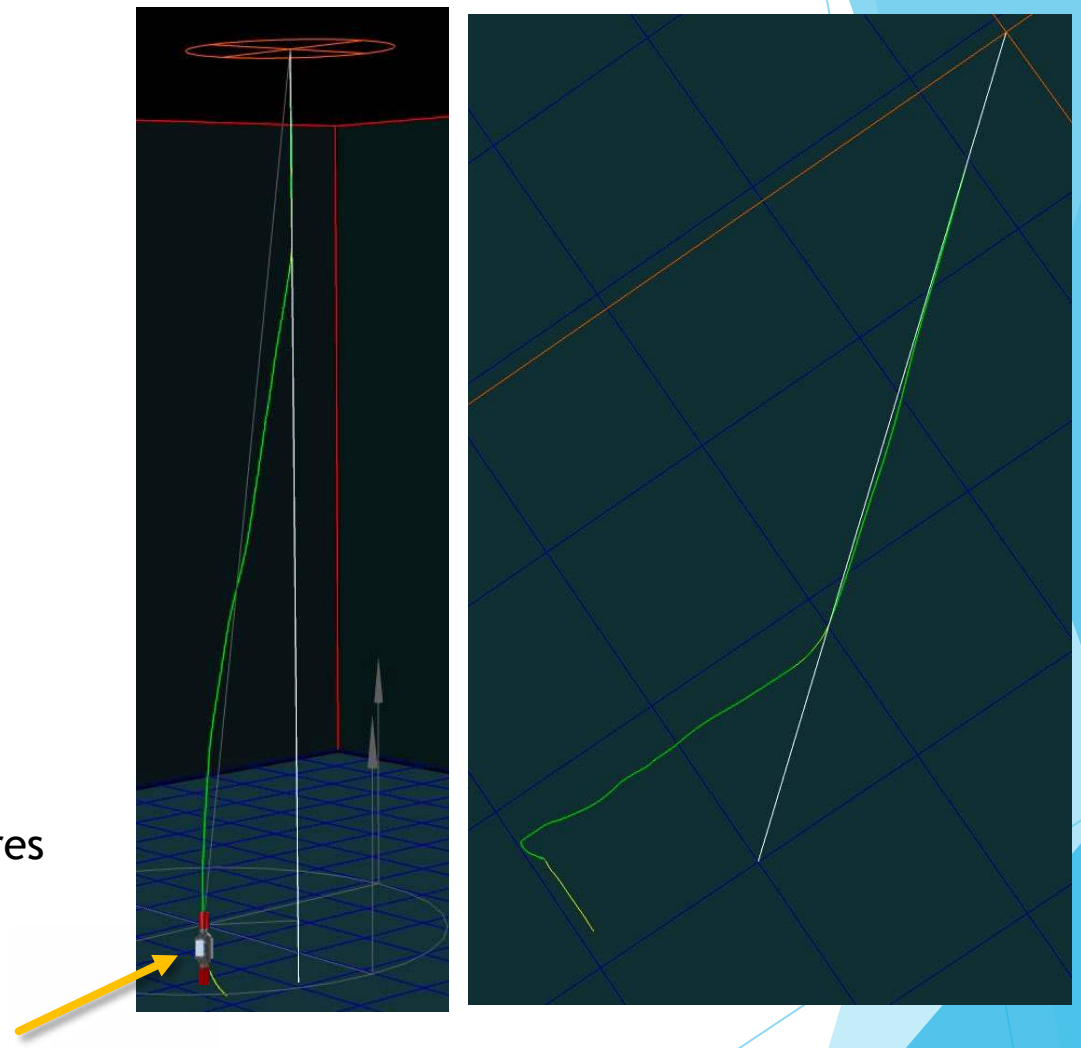
- **Installations: 4,000**
- Gas Rate Average: 50 MCF
- Gas Rate Peak: 1,000 MCF
- Casing Sizes: 4.5” - 9 5/8”
- Average Anchor depth: 7,000’
- Deepest Anchor Depth: 13,500’
- Inclination average: 10°
- Highest Inclination: 60°
- Application: Highly deviated wells (unable to set mechanical anchors) high tubing failures
- Installation: Saves on average 2 hours rig time due to no surface manipulation





USA Case studies: North Dakota

- **Installations: 500**
- Gas Rate Average: 100 MCF
- Gas Rate Peak: 600 MCF
- Casing Sizes: 7” #29-#32
- Average Anchor depth: 8,000’
- Deepest Anchor Depth: 11,500’
- Inclination average: 15°
- Highest Inclination: 65°
- Application: Highly deviated wells
  - Unable to set mechanical anchors - high tubing failures
- Installation: Saved on average 2 hours rig time due to no surface manipulation



International Case Study: Argentina

- **Installations: 300**
- Gas Rate Average: 200 MCF
- Gas Rate Peak: 1,500 MCF
- Casing Sizes: 5.5” #23 & #26
- Average Anchor depth: 10,500’
- Deepest Anchor Depth: 12,000’
- Average Inclination: 25°
- Maximum Inclination: 55°

- Application: Free flowing environment up the casing through the anchor bypass
  - No chokes/restrictions documented
  - Converted to rod pump when well stops flowing
- Installation: Saves on average 2 hours rig time due to no surface manipulation

International Case Study: Australia

- Installations: 175
- Gas Rate Average 250 MCF
- Gas Rate Peak: 1,200 MCF
- Casing Sizes: 5.5” #20, #23 & 7” #23, #26
- Average Anchor depth: 4,800’
- Deepest Anchor depth: 6,500’
- Inclination average: 35°
- Highest Inclination: 82°
- Application: Free flowing environment up the casing through the anchor bypass
  - No chokes/Restrictions documented
  - Converted to rod pump when well stops flowing
- Installation: Saved on average 3 hours rig time due to no surface manipulation

Overall Success:

- Since 2013, over 10,000+ deployments
- Over 250 individual Oil & Gas companies use the Black Gold Hydraulic Tubing Anchor
- Installed in 17 States
- Installed in 20 countries world-wide
- Easy enough to set without supervisor or costly additional hands/supervisors to install

Conclusions

- Simple to install
- Simple to extract
- No surface manipulation
- Stretches automatically into optimum tension
- Safer work environment, reduction in lability
- Can work in any down hole condition
- Can be installed at high inclinations (1-90°)
- Large bypass for gas, solids, heavy oil, paraffin, scale, etc.

Thank You!

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QUESTIONS??

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