

DEVELOPMENT OF A HIGH EFFICIENCY, ALL-METAL POSITIVE DISPLACEMENT PUMP



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Founder and Chief Technology Officer



High Efficiency
All-Metal
Positive Displacement
Pump



ANY PHASE

All liquids, gas, and steam vapors

ANY TEMPERATURE

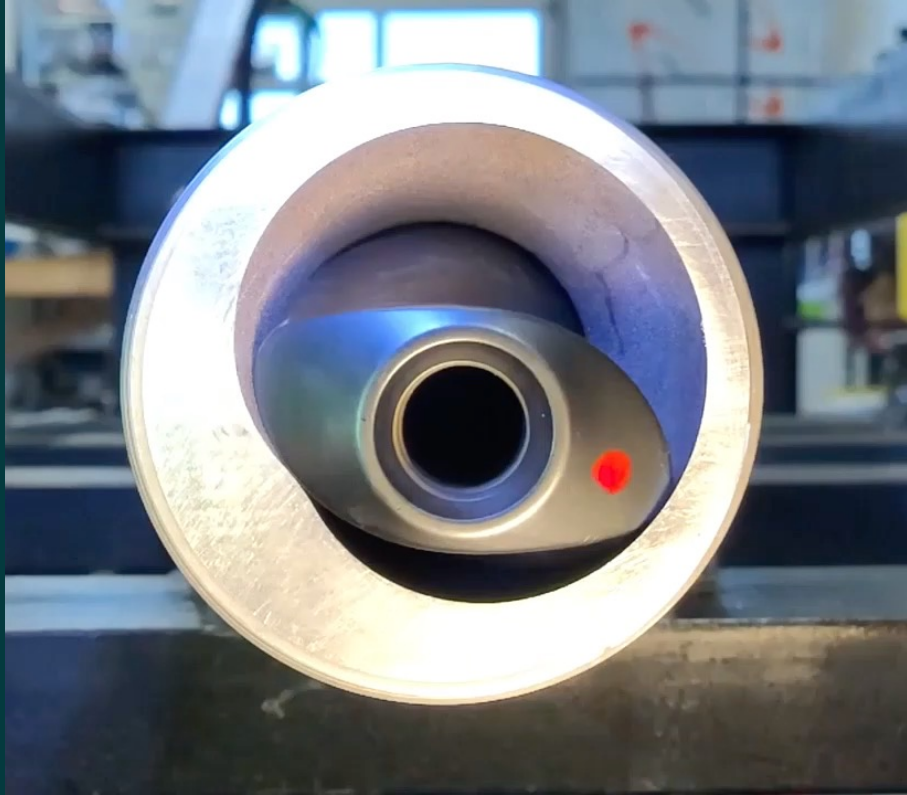
High and fluctuating temperatures

ANY VISCOSITY

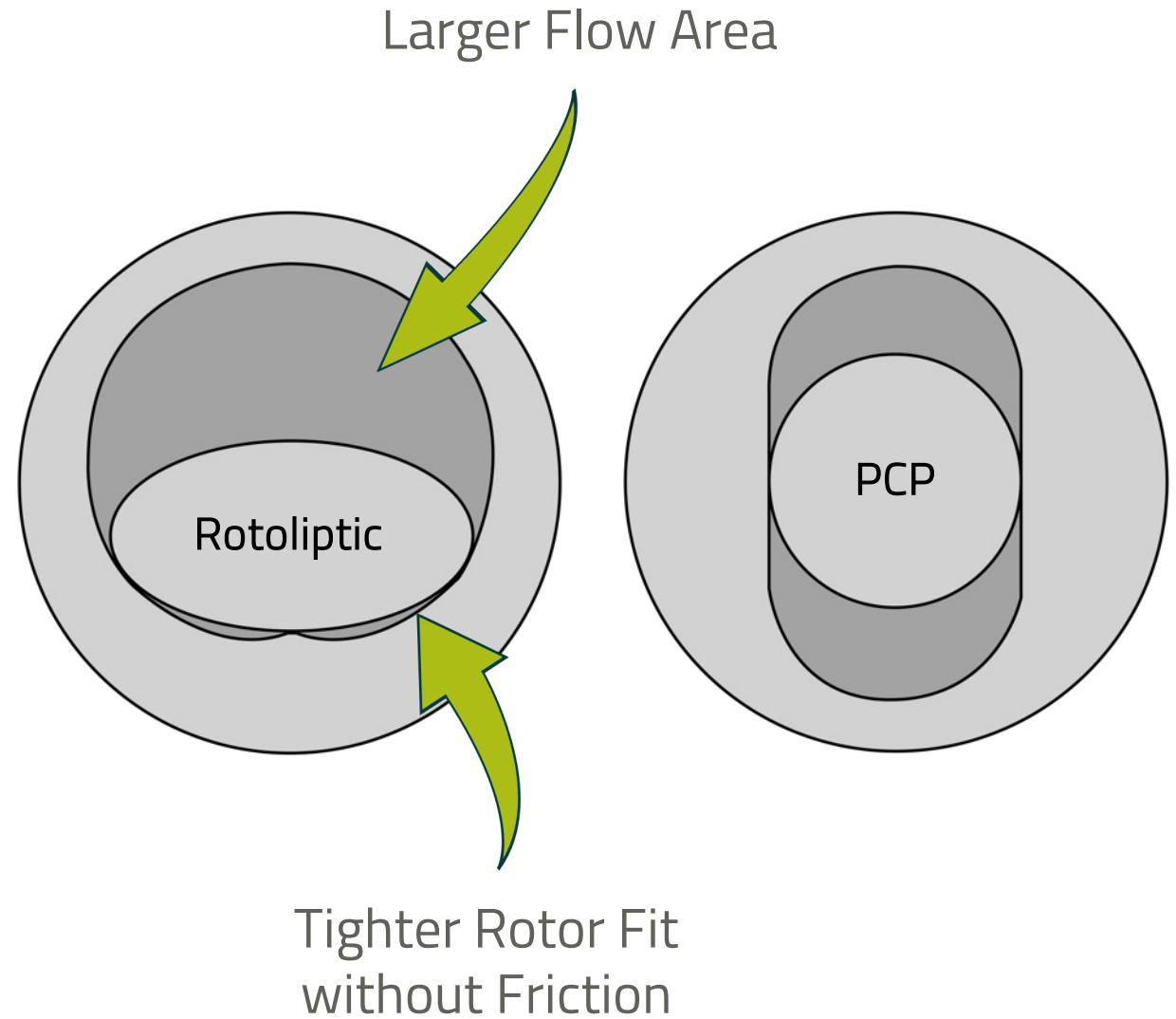
Low, high, or changing viscosities

ANY FLUIDS

Light oil, heavy oil, and water




Patented Geometric Advantages



Rotoliptic Compared to MoM PCPs

Well Conditions	
Flow	2500bbl/d
Lift	1300ft
Fluid Temperature	410°F

	 Rotoliptic	Similar-Sized MoM PCPs	
Displacement (bbl/day/100rpm)	1260	1380	1900
Rated Lift (ft)	2800	1640	1970
Stator Length (ft)	13'	20'	29'
rpm	270	300	240
Torque (ft/lb)	800	1000	1195
Pump Axial Load on Rods (lbs) Tension (Compression)	(800)	6,000	6,150
Volumetric Efficiency	74%	61%	56%
Energy Efficiency	59%	43%	45%

* Operating points from publicly available pump curves

Benefits:

Shorter
Deploy in Deviated Wells

Solid, 1-Piece Stator
More Robust

Increased Efficiency
Higher Starting Volumetric & Mechanical Efficiency

Superior Gas/Steam Handling
Pump-off of Steam Front

Lower Rod Failure Risk
Lower Torque & Axial Loads

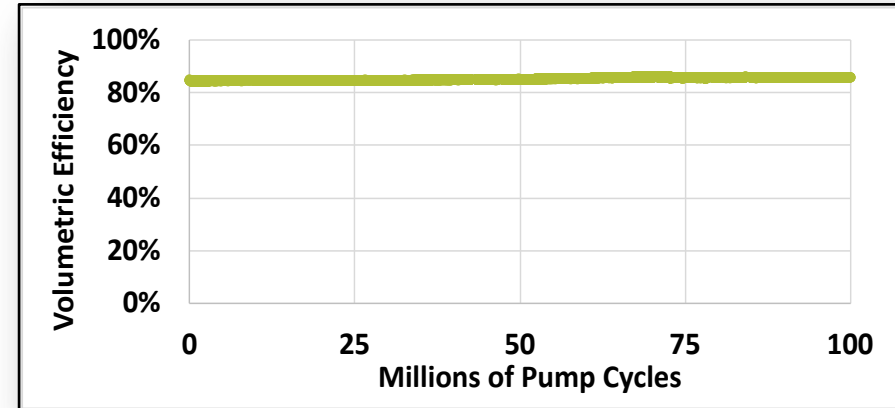
Retained Volumetric Efficiency

Longevity tests in the RTI lab demonstrated no appreciable loss of performance

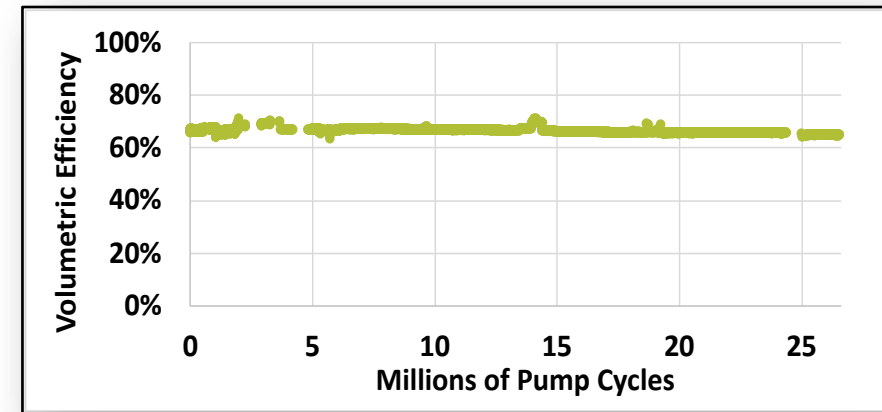
- 100 million cycles = 280 days at 250 rpm
- Room temperature fluid
- Tests performed at 25 psi/cavity
 - Replicating DH operating conditions

Nothing inherent to pump design, dynamics or materials selection that induces initial wear or drop in VE

4.5cP Oil

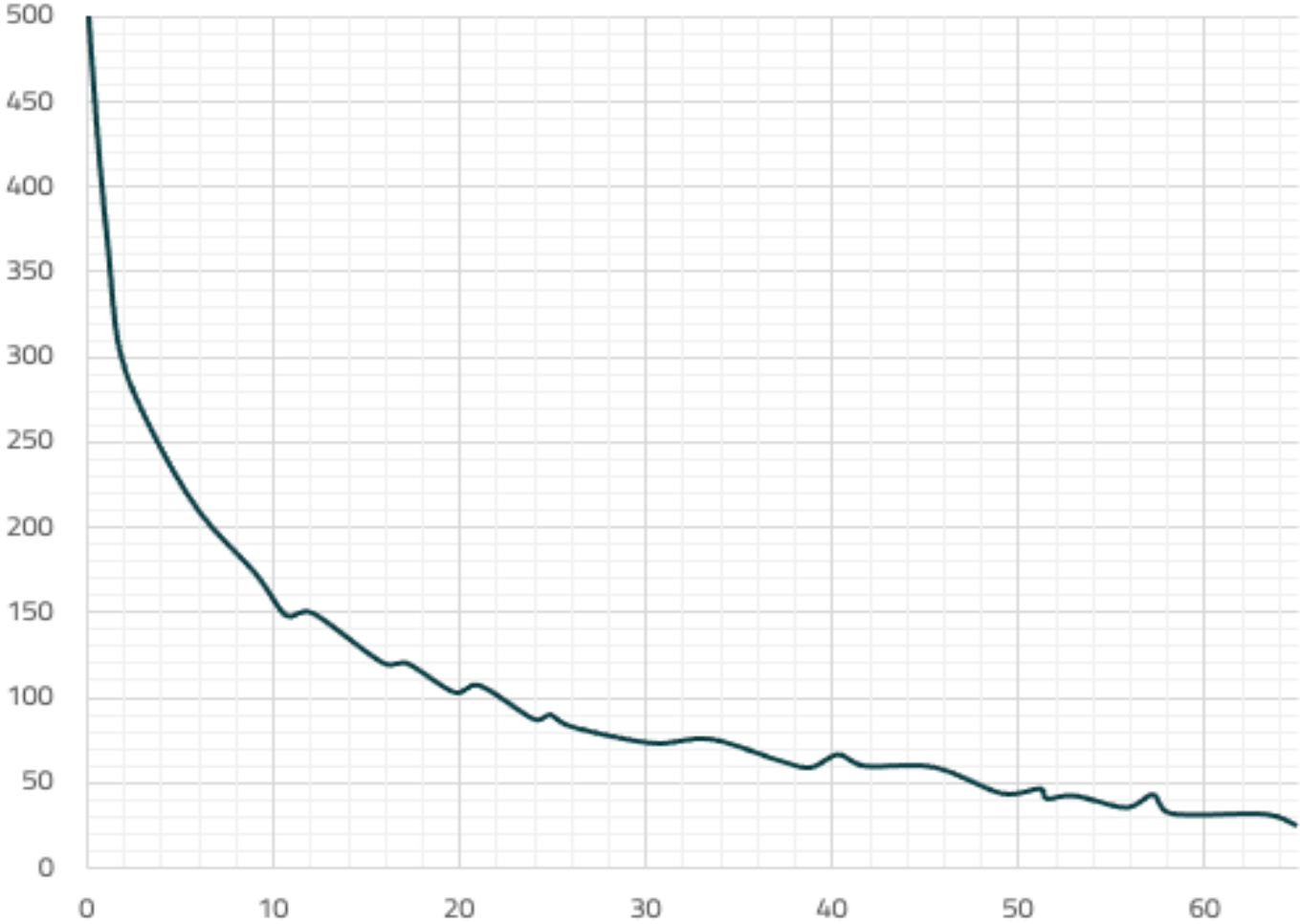


1cP Water



Typical Shale Well Decline

Oil Production
(bbl/d)



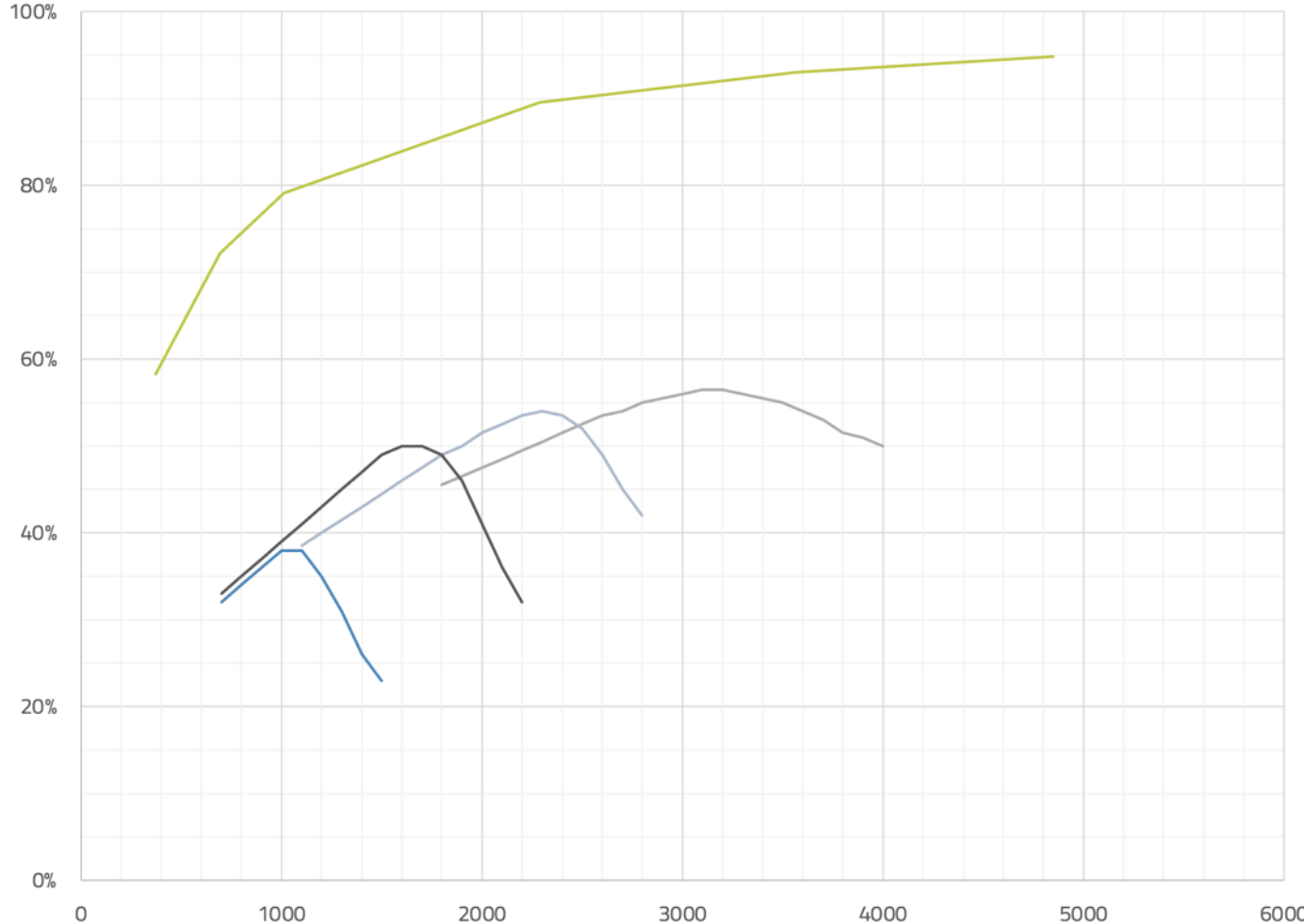
Yearly Declines:

- First Year: 69%
- Second Year: 39%
- Third Year: 26%
- Fourth Year: 27%
- Fifth Year: 33%

Production Months

Rotoliptic vs. ESP

Volumetric Efficiency



Rotoliptic R200 pump

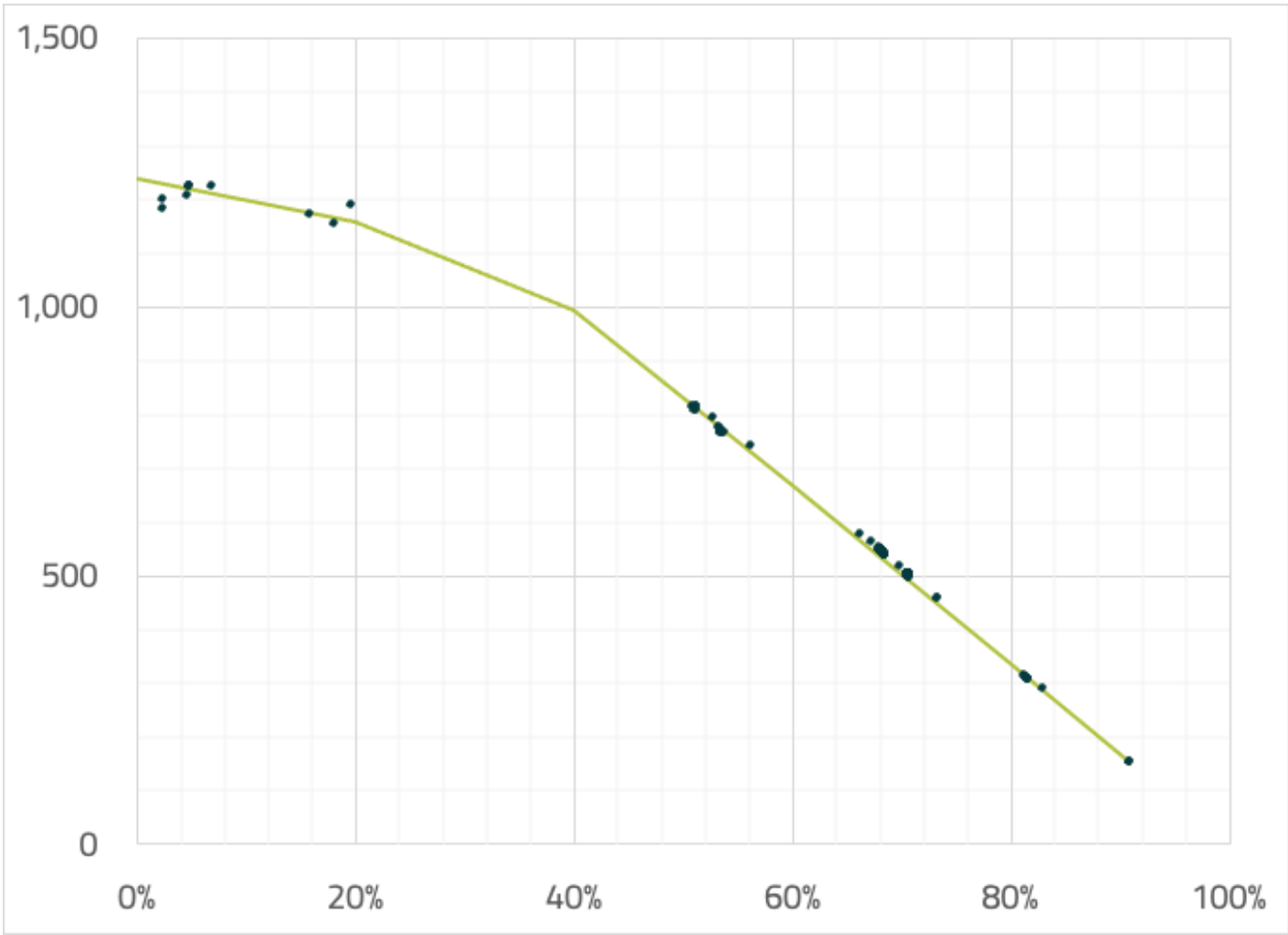
ESP 538 Series Pumps at 3600RPM

EXCEPTIONAL MULTIPHASE CAPABILITY

- No gas-locking with small amount of fluid present
- No steam flashing issues
- Low minimum intake pressure
- Efficiency goes up as gas volume fractions increase

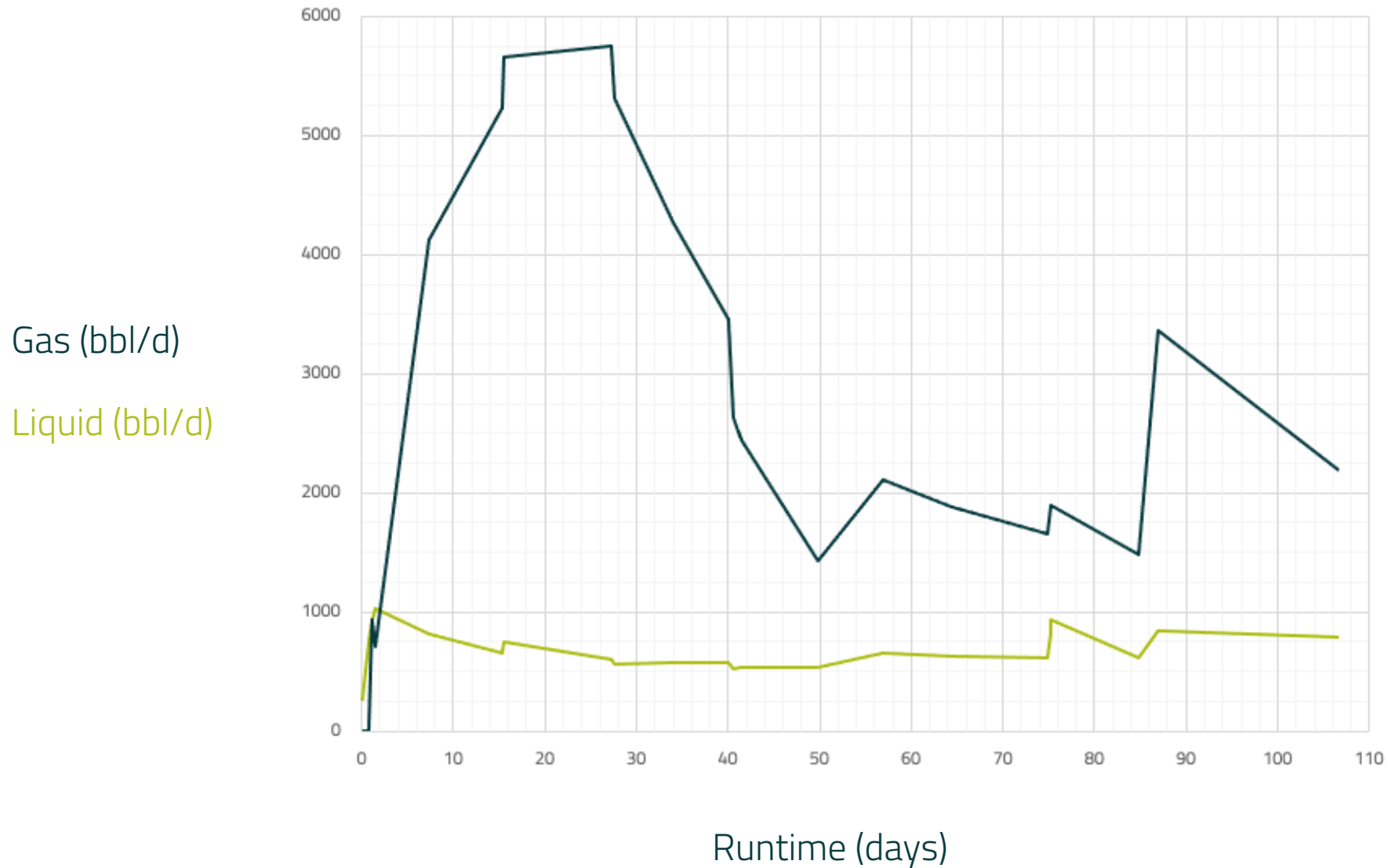
Multiphase Handling – Free Gas

Liquid Flow Rate (bbl/d)



Gas Volume Fraction

Rotoliptic Pump Maintains Liquid Rate as Gas Rate Fluctuates



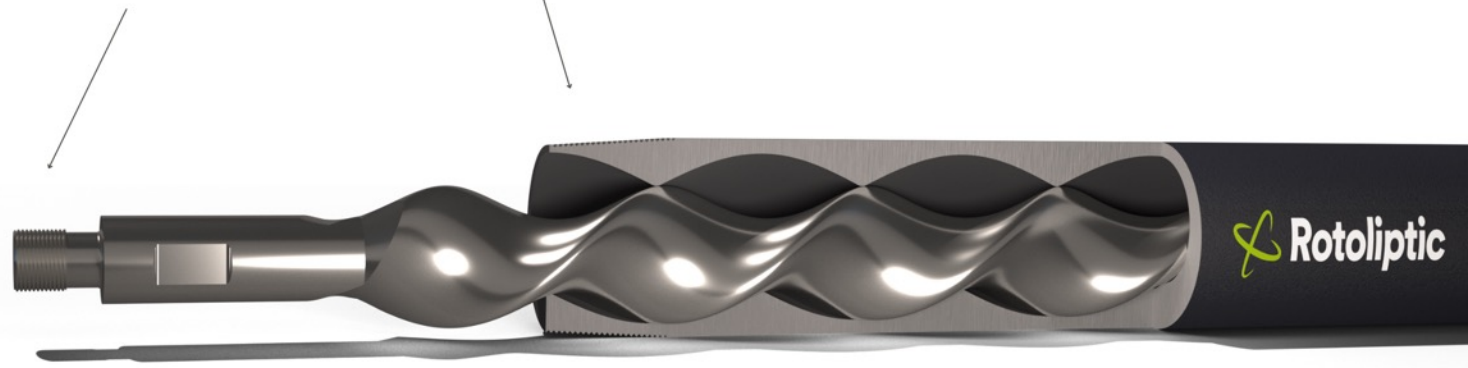
Current Commercial Offerings

R200-1000

(1280bbl/day/100rpm)

1.125" sucker rod pin

5.5" LTC



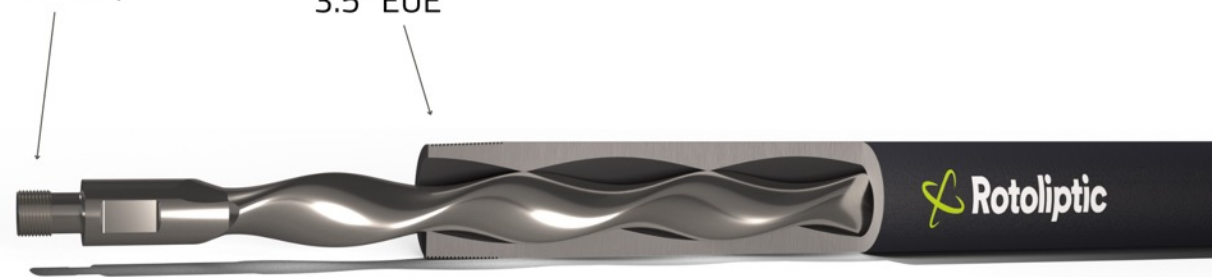
Min. tubing deployment 4.5"

R65-1200

(400bbl/day/100rpm)

1" sucker rod pin

3.5" EUE



Min. tubing deployment 2.875"