366 Inch Stroke Rotaflex Pumping Unit

Susan R. Beck
Weatherford
Rotaflex 1150 and 1151

- Stroke length of 366” (30.5 ft)
- PPRL rating of 50,000 Lbs
- Gearbox 320,000 in-lb on 1150
- Gearbox 420,000 in-lb on 1151
Production Chart

**ROTAFLEX MODEL 1150 PRODUCTION**

- **PRODUCTION - BPD**
  - VFD Enhanced
  - No VFD

DEPTH - ft.

PRODUCTION - BPD

- 0
- 1000
- 2000
- 3000
- 4000
- 5000
- 6000
- 7000
- 8000
- 9000
- 10000
- 11000

DEPTCh - ft.

2500 3500 4500 5500 6500 7500 8500 9500 10500 11500
Mechanical Reversal

The chain travels around a lower sprocket that is fixed to the gearbox and around an upper idler sprocket that is mounted at the mid-tower.

The ROTAFLEX unit’s reversing mechanism is completely mechanical and overcomes past failures in competing long, slow stroke pumping systems.
Counterbalance to Rod Loads

- Chain Travels Around a Lower Sprocket that is Fixed To The Gearbox Shaft
- Weight box is attached to one of the links of the chain using a sliding linkage mechanism
- Weight box moves with the chain link
- Weight box top is attached to load belt
Mechanical Features

- Direct Counterweight Connection to Well Load
- Shock Absorbing Load Belt
Features of the Rotaflex® Long Stroke Pumping Unit

- Short torque arm results in smaller gear reducers
- Improved system efficiency with smaller gear reducer

18 inches
System Efficiency Comparison

- Highly efficient pumping system
Cimarex Energy Well Conditions

- 7 wells near Dayton, TX
- Casing 5-1/2” 17# J-55 or 20# P-110
- Tubing 2-7/8” 6.5# L-80
- Perforations: 9440’ – 9500’ MD/ 9192’ -9246’ TVD
- Pump setting: 5812’ to 6843’ MD
- Equipment sized for 450 BFPD
Down hole pump installed

- Weatherford 2-1/2” x 2” x 38’ HXBC BHD (per KDR Supply – Liberty)
- 3’ plunger ~ .004 clearance PA with 60 rings
- Single Traveling Valve
- Single Standing valve
- Extra heavy balls
- Headspace ~2-3”
- Standard seating cups
- 20’ standard gas anchor
Equipment installed continued

- Norris 97 Rod String, 86 taper with 400 ft of 1.5 sinker bars
- Last 150 rods have molded rod guides, 8 per rod
- 40’ x 1.5” polished rod
- 100 HP NEMA D motor and control panel
- 1150 Rotaflex surface unit
- Sheaved for around 3 spm
Predictives

** PUMPING UNIT **
- Mfgr and Type: 320-500-366
- Actual Max Load (lbs): 36399
- Actual Min Load (lbs): 13209
- Average Pumping Speed (spm): 2.9
- Max Load (% of Rating): 72.8
- Polished Rod Power (hp): 40.8
- Unit and Drive Train Loss (hp): 4.5
- Computed Surface Stroke (in): 366.1

** SUMMARY OF REDUCER LOADING **

<table>
<thead>
<tr>
<th></th>
<th>EXISTING</th>
<th>IN BALANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max Torque (m in-lbs)</td>
<td>176.7</td>
<td>175.5</td>
</tr>
<tr>
<td>Min Torque (m in-lbs)</td>
<td>-19.4</td>
<td>-18.2</td>
</tr>
<tr>
<td>Counterbalance Moment (lbs)</td>
<td>24683</td>
<td>24613</td>
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<tr>
<td>Percent of Reducer Rating</td>
<td>55.2</td>
<td>54.9</td>
</tr>
</tbody>
</table>

** ROD LOADING **

<table>
<thead>
<tr>
<th>Diameter (in)</th>
<th>Length (ft)</th>
<th>Modulus (MM psi)</th>
<th>Fr Coeff</th>
<th>Guides</th>
<th>Loading</th>
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</thead>
<tbody>
<tr>
<td>1 *)</td>
<td>2568</td>
<td>30.5</td>
<td>0.2</td>
<td>N (0)</td>
<td>87</td>
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<tr>
<td>2) 0.875</td>
<td>2771</td>
<td>30.5</td>
<td>0.2</td>
<td>N (0)</td>
<td>88</td>
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<tr>
<td>3) 0.75</td>
<td>3261</td>
<td>30.5</td>
<td>0.2</td>
<td>N (0)</td>
<td>88</td>
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<tr>
<td>4) 1.5</td>
<td>200</td>
<td>30.5</td>
<td>0.2</td>
<td>N (0)</td>
<td>32</td>
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</tbody>
</table>

* Requires slimhole couplings
Predictive Dyno Surface and Pump Cards

![Graph showing Dyno Surface and Pump Cards and Permissible Loads]

- Load (lbs) on the Y-axis
- Position (in) on the X-axis

The graph illustrates the load variation with position for different cases.
Axial Load vs. Measured Depth
Side Load

![Graph showing Side Load vs Measured Depth](image)

- **Side Load (lbs/rod)** vs **Measured Depth (ft)**
- The graph displays the fluctuation of side load with depth.
Deviation Survey
Installation

- March, 2007 installed five 1150’s
- September, 2007 one 1150 scheduled to be installed
- October, 2007 one 1150 scheduled to be installed
Actual Measured Results

• At the end of March through the first of April, actual well data was collected. Fluid levels were shot, dynamometer were run and based on those results, changes were suggested.
Well #5

Dynamometer Analysis

Stroke 1 - 21:01:32

Surface Loads Card

Pump Loads Card

Stroke 1 Pump Card
The pump card indicates no pump load and no pump action. The pumping unit is running, however it is doing no useful work.
Well #6

Dynamometer Analysis

Stroke 1 - 15:47:44

Surface Loads Card

Pump Loads Card

Stroke 1 Pump Card
The pump cards indicated incomplete pump fillage due to the lack of fluid and fluid pound.
Present conditions

• Well # 3 and # 5 are currently flowing and the Rotaflex is not operational. Wells are flowing 390 plus barrels per day.

• Well # 6 is operating intermittingly to avoid fluid pound and 2” pump was replaced by 1.75 pump plus pump has been lowered.
Conclusion

The Rotaflex is a long stroke pumping system that is relatively efficient and offers high lift capacities. The long slow stroke makes it a good choice for deviated wells. However, when pumping deep, deviated and gaseous wells it is sometimes necessary to experiment with various down hole configurations to optimize production.
Special thanks

- Cimarex Energy Personnel
- Lynn Rowland-Echometer
- Robert Harris of H&H Well Service
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