DOWNHOLE INFORMATION
Reciprocating Rod Pumps
Pumping Cycle In Perfect Conditions - Upstroke

Start Of Up Stroke
- Fluid Closes Travelling Valve On Start Of Up Stroke
- Standing Valve Opens To Allow Inlet Fluid

Up Stroke
- Inlet Fluid P.S.I Is Head Of Fluid In Casing
- Oil Viscosity Will Also Determine Rate Of Pump Fillage

Up Stroke Near Top
- Amount Of Fluid Fill In Pump Will Depend On:
  1 - Inlet P.S.I.
  2 - Viscosity Of Fluid
  3 - Time
Pumping Cycle In Perfect Conditions - Downstroke

Start Of Downstroke
- Gas Compresses Until Pressure Opens Traveling
- Standing Valve Closes

Downstroke
- Ball Hits Fluid Travelling Valve Opens
- Standing Valve Is Closed

Downstroke
- Travelling Valve Open
- Fluid Is Transferred From Travelling Valve To Standing Valve
- Standing Valve Closed
Tubing Pump Versus Insert Pump

• Tubing Pump
  – Barrel assembly of this type of pump is screwed onto, and becomes part of, the tubing.
  – Larger bore than a rod pump, thus produces a greater volume of fluid in any give diameter of tubing.

• Insert Pump
  – Complete pump attached to, and inserted into, well tubing with sucker rod string.
  – As a complete unit, pump may be pulled out of well without pulling tubing.
Basic Rod Pump Configurations

THM
Tubing-Type, Heavy Wall, Mechanical Hold-down

RWTC
Rod-Type, Thin Wall, Traveling Barrel, Bottom Hold-down (Cup)

RHBC
Rod-Type, Heavy Wall, Bottom Hold-down (Cup)

RWAM
Rod-Type, Thin Wall, Top Hold-down (Mechanical)
Hold-down Assembly

- Anchors the pump to the tubing
- Provides a seal between pump and tubing
- Photo shows cup type
  - Bottom hold-down
  - Top hold-down
Rod Pump Top Anchor

• Advantages
  – Eliminates sedimentation around barrel tube.
  – Reduces corrosive attack on exterior of barrel.
  – Pump barrel can act as gas anchor.

• Disadvantages
  – Valve rod is weak leak of sucker rod.
  – Not recommend for deep wells.
  – Part time pumping may allow sediments to accumulate in working parts.
Rod Pump Bottom Anchor

- **Advantages**
  - Can be used in deep wells
  - Good valve location
  - Better design where long pumps necessary

- **Disadvantages**
  - Valve rod weak link in S-rod chain
  - Barrel tube subject to sedimentation
  - Part-time pumping may allow sediments to accumulate in working parts
# Casing, Tubing and Pump Sizes

<table>
<thead>
<tr>
<th>Casing</th>
<th>Max Tubing</th>
<th>Max Rod</th>
<th>RW Insert Pump</th>
<th>RH Insert Pump</th>
<th>TH Tubing Pump</th>
<th>Oversize Tbg Pump</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-7/8” 6.5 lb/ft</td>
<td>1-1/2”</td>
<td>5/8” SH Cplg</td>
<td>1-1/4”</td>
<td></td>
<td>1-1/2”</td>
<td>2”</td>
</tr>
<tr>
<td>3-1/2” to 10.2 lb/ft</td>
<td>2-1/16” Integral Joint</td>
<td>3/4” SH Cplg</td>
<td>1-1/4”</td>
<td></td>
<td>1-1/2”</td>
<td>2”</td>
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<tr>
<td>4” to 14 lb/ft</td>
<td>2-3/8”</td>
<td>7/8” SH Cplg</td>
<td>1-1/2”</td>
<td>1-1/4”</td>
<td>1-3/4”</td>
<td>2-1/4”</td>
</tr>
<tr>
<td>4-1/2” to 12.6 lb/ft</td>
<td>2-7/8” Clear Cplg</td>
<td>1” SH Cplg</td>
<td>2”</td>
<td>1-3/4”</td>
<td>2-1/4”</td>
<td>2-3/4”</td>
</tr>
<tr>
<td>5” to 20.3 lb/ft</td>
<td>2-7/8”</td>
<td>1” SH Cplg</td>
<td>2”</td>
<td>1-3/4”</td>
<td>2-1/4”</td>
<td>2-3/4”</td>
</tr>
<tr>
<td>5-1/2” to 20 lb/ft</td>
<td>3-1/2”</td>
<td>1-1/8”</td>
<td>2-1/2”</td>
<td>2-1/4”</td>
<td>2-3/4”</td>
<td>3-3/4”</td>
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<tr>
<td>6-5/8” to 28 lb/ft</td>
<td>3-1/2”</td>
<td>1-1/8”</td>
<td>2-1/2”</td>
<td>2-1/4”</td>
<td>2-3/4”</td>
<td>3-3/4”</td>
</tr>
<tr>
<td>7” to 29 lb/ft</td>
<td>4-1/2”</td>
<td>1-1/8”</td>
<td>3-1/4”</td>
<td>2-3/4”</td>
<td>3-3/4”</td>
<td>4-3/4”</td>
</tr>
<tr>
<td>7-5/8” and larger</td>
<td>4-1/2”</td>
<td>1-1/8”</td>
<td>3-1/4”</td>
<td>2-3/4”</td>
<td>3-3/4”</td>
<td>5-3/4”</td>
</tr>
</tbody>
</table>
System Surveillance
Dynamometer “cards” are graphs that indicate:

- The polished rod force at any point in the pumping cycle
- The performance of the pumping system including the downhole pump
Dynamometer Cards

SURFACE DYNAMOMETER CARD

PPRL - Maximum load during a pump stroke

Sequence of Events During One Pump Cycle

SV Opens

TV Closes

End of Downstroke

Rods Stretch

Peak Load

Up

End of Upstroke

Rods Compress

SV Closes

TV Opens

Down

0

Minimum Load

0

MPRL - Minimum load during a pump stroke
Stainless Steel Polished Rod Load Cell

- Low cost, all welded construction
- Field proven sensor technology
- Multiple ranges available (30k, 50k, 80k)
- Can handle 150% shock load
- Lightning protection
- Impervious to H2S and salt spray
- Hermetically sealed/nitrogen gas filled
Dual Position Sensor (DPS)

- Accelerometer-based position measurement
- Easy to install
- No moving parts to wear out
- Accurate to ±0.1° of tilt
Optimization Solutions for Artificial Lift
WellPilot RPOC Card

Pump fillage **below** setpoint, well goes idle.

Pump fillage **above** setpoint, well continues running.