Flow-Thru™ Plunger Guide
Leading Brands. Leading Solutions.

Apergy’s artificial lift division is a team of industry-leading companies that utilize their collective resources to help oil and gas producers optimize revenues, profitability, safety, and environmental compliance through high-quality production, completion, gathering and control systems.

Our story is founded on a simple truth: Life Requires Energy.

We’re focused on unlocking energy with highly engineered products and technologies used to drill for and produce oil and gas efficiently and safely around the world. Our products include a full range of equipment essential to efficient functioning throughout the lifecycle of the wellsite—from drilling to completion to production.

Our products consist of artificial lift equipment and solutions, including rod pumping systems, electric submersible pump systems, progressive cavity pumps and drive systems, plunger lift, gas lift, and hydraulic lift, as well as polycrystalline diamond cutters and bearings for drilling. We provide a full automation offering consisting of equipment, software, and IIoT solutions for downhole monitoring, wellsite productivity enhancement, and asset integrity management. We have operations in eight countries and employ more than 3,100 associates globally.

Whatever your production challenge is, Apergy Artificial Lift has a solution. Our Artificial Lift experts work with you to understand your short-term challenges and long-term goals. We fine tune the right lift solution, drawing from our complete portfolio of Artificial Lift technologies, application expertise, and in-depth analytical tools. For every stage of the field’s operating life, we will help meet our customers production goals quickly, safely, and most cost effectively.

Vision Statement
Our vision is to improve the lives of our customers, employees, shareholders, and those in our communities. Working toward that vision—through our actions, our products, and our commitments—is why we get out of bed in the morning. Unlocking Energy is the economic engine that will support us as we improve lives and achieve relevance in the marketplace.

Core Values
We have no interest in being just an ordinary company. We’re committed to creating a positive culture that improves lives. Our goal is to make Apergy a customer’s collaborative partner and a rewarding place to work. We strive to maintain a unique culture that values and encourages honesty, unity, respect, hard work, friendship, and an entrepreneurial spirit.
Utilizing the well’s own energy to cost-effectively remove liquids and extend the life of the well.

Plunger lift is one of the most economical ways to achieve maximum deliquification, particularly in marginal and aging wells. It uses only the well's own energy to effectively lift and remove accumulated liquids.

Our plunger lift products are thoroughly tested, manufactured to the highest standards, and backed by our decades of experience in the field.

**Benefits of Plunger Lift:**
- Increased production with minimal cost
- Quick and easy implementation
- Low capital and operating expenses
- Unrivaled expertise, service, training, and line out assistance
- Largest selection of custom-engineered equipment addressing the full range of well conditions
- Highest quality manufacturing processes and materials

**Plunger Lift is Ideal for:**
- Removing accumulated liquids in gas wells, allowing them to produce
- Wells with low bottom hole pressures or higher gas-to-liquid ratios
- Wells with liquid production of roughly 130 barrels per day or less
- Unloading a well when gas velocity is at, or near, critical flow rate
- Controlling paraffin and hydrate buildup

**Plunger Lift Economics:**
Requiring low capital investment and minimal operating expense, plunger lift provides an excellent return on investment, producing production gains that can offset the cost of the system in as little as a few weeks and almost always within a few months.

The investment in a PCS Ferguson Plunger Lift system typically runs between $2,500 and $10,000. A plunger lift system could increase production by 100 Mcf/d/day or more.

---

**DAYS TO PAY OFF PLUNGER LIFT SYSTEM**
Example Production Increase of 50 Mcf/Day

<table>
<thead>
<tr>
<th>Gas Prices (Dollars/Mcf)</th>
<th>0</th>
<th>5</th>
<th>10</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>30</th>
<th>35</th>
<th>40</th>
<th>45</th>
<th>50</th>
</tr>
</thead>
<tbody>
<tr>
<td>$2.00</td>
<td>45DAYS</td>
<td>35DAYS</td>
<td>25DAYS</td>
<td>15DAYS</td>
<td>5DAYS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$3.00</td>
<td>30DAYS</td>
<td>21DAYS</td>
<td>14DAYS</td>
<td>7DAYS</td>
<td>0DAYS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$4.00</td>
<td>20DAYS</td>
<td>14DAYS</td>
<td>9DAYS</td>
<td>3DAYS</td>
<td>0DAYS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$5.00</td>
<td>15DAYS</td>
<td>10DAYS</td>
<td>6DAYS</td>
<td>3DAYS</td>
<td>0DAYS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Assumes average system cost of $4,500*
Surface equipment overview.

The PCS Ferguson Plunger Lift system is operated at the surface using an electronic controller. The controller can be utilized to provide both current and historic data about tubing and casing pressures, shut-in and sales times, plunger travel times and flow rates. Based on these readings, the operator determines the time needed for the plunger to reach the bottom and/or the pressure needed for the plunger to lift the liquids to the surface. The operator uses the controller to activate the motor valve to open or close based on the time or pressure determination.

When the motor valve is closed, the flow of gas stops. The well is now shut in and starts to build energy. The plunger, which resides at the surface in the lubricator, falls down the tubing through the gas and liquid. As the plunger falls to the bottom of the well, liquids gather in a column above it. When the motor valve is re-opened, the plunger, which acts as a swab, rises back up to the surface, lifting and removing the liquid column.

An arrival sensor on the lubricator communicates to the controller that the plunger has arrived. The controller then activates a delay or after-flow. Since the tubing is free of liquids, the lack of back pressure allows the well to produce at maximum flow. The operator determines how long to after-flow based on how quickly fluids accumulate during this flow time. At the end of this period, the well is shut in again, and the plunger cycle repeats.

---

**LUBRICATOR**
Provides safe access to the wellbore for installation, inspection, and replacement of the plunger and bottom hole equipment.

**CATCHER**
Catches and holds the plunger in the lubricator for safe removal.

**CONTROLLER**
Opens and closes the motor valve using time, pressure, and flow rate, plus provides production history for the operator.

**MOTOR VALVE**
Starts and stops the well’s production based on input from the controller.

**SOLAR PANEL**
Provides a power source to the controller batteries.

**DRIP POT**
Prevents downtime by trapping and preventing condensate, water, and other contaminates from clogging the latch valves.

**ARRIVAL SENSOR**
Signals the plunger’s arrival to the controller.
Downhole equipment overview.

The PCS Ferguson Plunger Lift system downhole equipment includes the plunger and bottom hole bumper spring. The plunger travels down the tubing, landing at the bottom hole bumper spring, which cushions its arrival. It then travels up the tubing, lifting and removing liquids and solids as it surfaces.

**PLUNGER**
Functions like a swab, creating a seal to the tubing and lifting liquids and solids (sand, salt, coal fines, paraffin, and scale) to the surface.

**BOTTOM HOLE BUMPER SPRING**
Sits above the seating nipple, protecting the plunger upon impact. Can also hold a ball and seat to trap liquids in the tubing.
Plunger Lift Components

Auto Dump Bottom Hole Bumper Spring

Bottom Hole Bumper Springs protect the plunger and downhole tubing equipment from damage by absorbing the impact of the plunger.

Applications

- Can hold fluid in tubing based on fluid production
- Ball and seat can dump fluid as needed to prevent liquid loading
- Available in Heavy Duty and Standard applications
- Can hold ¼ barrel to 1 barrel of fluid based on spacers

Latch Down Bottom Hole Bumper Spring

Applications

- Wells with no seating nipple
- Used with a tubing stop or collar stop
- Used with a pack-off tool when applicable
Pneumatic Auto Catcher

The Auto Catcher grabs the plunger securely to eliminate flow restriction. It also eliminates plunger bobbing, reducing wear on the plunger and lubricator. The Auto Catcher is highly recommended when using flow-thru plungers in low liquid environments when you want to control the number of trips.

Tubing Stop

The tubing stop sets a stopping point for the tubing string without the use of couplings to set the collar stops.

Applications

- Used in wells with no seat nipples
- Used in wells with worn seat nipples or seat nipples set too deep to run a plunger
- Attaches to pack off / latch spring

Auto Dump Pack-Off

The Auto Dump Pack-Off tool is used in wells with a tubing stop to pack off tubing to hold fluid.
Conventional Plungers

Conventional plungers are ideal for increasing production in marginal wells with low volume or tubing deviations. We recommend a conventional for most typical plunger lift installations.

**Conventional plungers:**
- Require shut-in time for the plunger to fall to the bottom
- Needed for wells that do not have the energy to continually produce at a high enough rate for flow-thru plungers
- Ideal for wells that produce below 350 Mcf/d/day
Conventional Plunger Information

Sand Plunger

Fall Speed

- 300 - 350 FPM
  *Will not fall through flow.*

Applications

- Wells that produce sand, salt, or coal fines
- Wells that have experienced other plungers getting stuck

Short Nickle-Plated Sand Plunger

Fall Speed

- 250 FPM
  *Will not fall through flow.*

Applications

- Wells that produce sand, salt, or coal fines
- Wells that have experienced other plungers getting stuck
- Wells with deviated tubing
Deep Groove Clean-Out Plunger

Fall Speed
- 350 FPM
  *Will not fall through flow.

Applications
- Wells that produce paraffin, heavy sand, or debris
- Wells with high gas volume

Single Pad Plunger

Fall Speed
- 250 - 350 FPM
  *Will not fall through flow.

Applications
- Gas: 25 - 300 Mcf/d
- Water: 1 - 20 Bbl/d
- Low volume and marginal wells
- Wells with tubing irregularities
- Wells producing below critical flow rates
- Wells that produce light oil, condensate, or water

*Based on 150 line pressure
**Dual Pad Plunger**

**Fall Speed**
- 275 - 325 FPM
  *Will not fall through flow.*

**Applications**
- Gas: 25 - 300 Mcf/d
- Water: 1 - 50 Bbl/d
- Low volume and marginal wells
- Wells with low pressure
- Wells producing below critical flow rates
- Wells that produce light oil, condensate, or water

*Based on 150 line pressure

---

**Triple Pad Plunger**

**Fall Speed**
- 275 - 325 FPM
  *Will not fall through flow.*

**Applications**
- Gas: 25 - 300 Mcf/d
- Water: 1 - 50 Bbl/d
- Low volume and marginal wells
- Wells with low pressure
- Wells producing below critical flow rates
- Wells that produce light oil, condensate, or water

*Based on 150 line pressure
Transitional Plungers

Transitional plungers are ideal for wells transitioning from Flow-Thru (bypass) to conventional plungers.

**Transitional plungers:**
- Require shut-in time for the plunger to fall to the bottom
- Needed for wells that do not have the energy to continually produce at a high enough rate for bypass plungers
- Ideal for wells that produce below 425 Mcf/d/day
Transitional Plunger Information

Single Pad Liquid Aeration Plunger

Fall Speed
- 375 - 425 FPM
  *Not designed to fall through flow.

Applications
- Gas: 100 - 300 Mcf/d
- Water: 1 - 30 Bbl/d
- Wells between the conventional and bypass stage
- Wells with tubing irregularities
- Wells that produce light oil, condensate, or water
  *Based on 150 line pressure

Dual Pad Liquid Aeration Plunger

Fall Speed
- 400 - 475 FPM
  *Not designed to fall through flow.

Applications
- Gas: 100 - 350 Mcf/d
- Water: 1 - 40 Bbl/d
- Wells between the conventional and bypass stage
- Wells with tubing irregularities
- Wells that produce light oil, condensate, or water
  *Based on 150 line pressure
Bar Stock Liquid Aeration Plunger

Fall Speed

- 390 - 400 FPM
  *Not designed to fall through flow.

Applications

- Gas: 150 - 300 Mcf/d
- Water: 1 - 30 Bbl/d
- Wells between the conventional and bypass stage
- Wells with tubing irregularities
- Wells that produce light oil, condensate, or water

*Based on 150 line pressure
Bar Stock Fast Falling Center Dart Plunger

**Fall Speed**
- 1000 FPM
  *Not designed to fall through flow.*

**Applications**
- Gas: 250 - 400 Mcf/d
- Water: 1-30 Bbl/d
- Wells that transition between a bypass and a conventional plunger
  *Based on 150 line pressure*

Padded Fast Falling Center Dart Plunger

**Fall Speed**
- 1000 FPM
  *Not designed to fall through flow.*

**Applications**
- Gas: 25 - 300 Mcf/d
- Water: 1 - 50 Bbl/d
- Low volume and marginal wells
- Wells producing below critical flow rates
- Wells that produce light oil, condensate, or water
  *Based on 150 line pressure*
Flow-Thru (Bypass) Plungers

Flow-Thru (bypass) plungers are ideal for reducing shut-in time due to high gas and liquids. If you have a high volume gas and liquid well that requires too much shut-in time for standard plungers, our Flow-Thru plungers can reduce or even eliminate shut-in times.

**Flow-Thru plungers:**
- Operate in high gas and liquid volumes
- Require minimal or no shut-in time
- Remove or prevent scale build-up
- Eliminate compression or decrease injection gas on gas lift wells
- Can produce up to 200 bpd
- Have an operating angle of 35-45 degrees
How Flow-Thru Plungers Work

**FIGURE 1**
Plunger falls down the well.
- Well may be shut-in or flowing for a PCS Ferguson Flow-Thru plunger to successfully fall
- Average fall speed in fluid is 700 ft/min
- Potential fall speed in shut-in well is 2,000 ft/min

**FIGURE 2**
Plunger makes contact with bottom hole bumper spring and the plunger flow-thru valve closes.

**FIGURE 3**
Flowing gas forces the plunger to ascend, lifting the liquids above it.
- Average round trip for a 7,000 ft. well is 20-35 minutes
FIGURE 4
Plunger enters the lubricator and delivers liquids to the sales line before landing at the bypass puck.

FIGURE 5
The plunger valve opens after making contact with the bypass puck.

The open valve allows fluid and gas to pass through the plunger, permitting it to fall against flow.

The Flow-Thru plunger cycle then repeats.
Dual Pad Sliding Sleeve Plunger

**Fall Speed**
- 1700 FPM without flow
- 800 - 1000 FPM with flow

**Applications**
- Gas: 250 - 600 Mcf/d
- Water: 10-50 Bbl/d
- Wells with worn tubing
- Wells with tight spots
- Wells with high gas or liquid volume

*Based on 150 line pressure

---

Bar Stock Sliding Sleeve Plunger

**Fall Speed**
- 1700 FPM without flow
- 800 - 1000 FPM with flow

**Applications**
- Gas: 250 - 600 Mcf/d
- Water: 10 - 50 Bbl/d
- Wells with high gas or liquid volume
- Wells in the beginning stages of liquid loading

*Based on 150 line pressure
Dual Pad Bypass Plunger

Applications

- Worn tubing
- Tight spots
- Wells with high gas or liquid volume

*Based on 150 line pressure

<table>
<thead>
<tr>
<th>Slot Size</th>
<th>Instantaneous Flow Rate Plunger will Fall Against (Mcf/d)</th>
<th>Fall Speed (FPM) No Flow</th>
<th>Fall Speed (FPM) With Flow</th>
<th>Average Gas Production (Mcf/d)</th>
<th>Water (Bbl/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-Slot Extra Small</td>
<td>Not designed to fall through flowing well</td>
<td>500</td>
<td>100 - 150</td>
<td>100 - 300</td>
<td>10 - 40</td>
</tr>
<tr>
<td>2-Slot Wide</td>
<td>400 - 600</td>
<td>1600</td>
<td>600 - 900</td>
<td>600 - 900</td>
<td>10 - 40</td>
</tr>
<tr>
<td>3-Slot</td>
<td>800 - 900</td>
<td>1800</td>
<td>750 - 1000</td>
<td>750 - 1000</td>
<td>10 - 50</td>
</tr>
<tr>
<td>4-Slot</td>
<td>900 - 1000</td>
<td>1900</td>
<td>800 - 1000</td>
<td>800 - 1000</td>
<td>10 - 80</td>
</tr>
<tr>
<td>5-Slot</td>
<td>1000 - 1300</td>
<td>2100</td>
<td>1000 - 1200</td>
<td>1000 - 1200</td>
<td>60 - 200</td>
</tr>
</tbody>
</table>
Bar Stock Bypass Plunger

Applications

- Wells in the beginning stages of liquid loading
- Wells with high gas or liquid volume

*Based on 150 line pressure

Plunger Information for Varying Slot Sizes

<table>
<thead>
<tr>
<th>Slot Size</th>
<th>Instantaneous Flow Rate Plunger will Fall Against (Mcf/d)</th>
<th>Fall Speed (FPM) No Flow</th>
<th>Fall Speed (FPM) With Flow</th>
<th>Average Gas Production (Mcf/d)</th>
<th>Water (Bbl/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-Slot Small</td>
<td>Not designed to fall through flowing well</td>
<td>500</td>
<td>100 - 150</td>
<td>100 - 300</td>
<td>10 - 40</td>
</tr>
<tr>
<td>2-Slot Medium</td>
<td>250 - 300</td>
<td>1600</td>
<td>600 - 900</td>
<td>150 - 250</td>
<td>5 - 20</td>
</tr>
<tr>
<td>2-Slot Large</td>
<td>400 - 600</td>
<td>1600</td>
<td>600 - 900</td>
<td>150 - 450</td>
<td>10 - 40</td>
</tr>
<tr>
<td>3-Slot</td>
<td>800 - 900</td>
<td>1800</td>
<td>750 - 1000</td>
<td>350 - 750</td>
<td>10 - 50</td>
</tr>
<tr>
<td>4-Slot Small</td>
<td>900 - 1000</td>
<td>1900</td>
<td>800 - 1000</td>
<td>650 - 850</td>
<td>10 - 80</td>
</tr>
<tr>
<td>4-Slot Large</td>
<td>1000 - 1300</td>
<td>2000</td>
<td>850 - 1100</td>
<td>850 - 1100</td>
<td>30 - 120</td>
</tr>
<tr>
<td>5-Slot</td>
<td>1100 - 1300</td>
<td>2100</td>
<td>1000 - 2000</td>
<td>900 - 1200</td>
<td>60 - 200</td>
</tr>
</tbody>
</table>
Troubleshooting Plungers

Occasionally plunger lift systems will not function properly. PCS Ferguson recommends the following tips for two common problems for plunger lift.

**Issue One: Production is declining and you have been adjusting the cycle.**

1. Check plunger for wear or damage
2. Check the motor valve for any leaks
3. Check the plunger arrival sensor
4. Check for higher than normal line pressure

**Issue Two: Plunger will not arrive.**

1. Remove lubricator cap and check to see if plunger is hung up from sand or scale
2. Do a drop with a retriever plunger to latch onto the plunger downhole
3. Call your supervisor or PCS Ferguson representative

**Tips to successful operations:**

1. Plunger speed is the first thing to check when analyzing your plunger lift system.
   - Optimal Flow Thru plunger speed: 20 - 35 minutes
   - Optimal Conventional plunger speed: 9 - 12 minutes
2. A phone call to your PCS Ferguson representative can save time and is one of the best ways to learn about plunger lift system.
3. Be proactive and monitor a plunger lift cycle occasionally to make sure the system is operating correctly.
Partner with the best team in the business.

Apergy offers a comprehensive line of artificial lift equipment, accessories, and services strategically designed to drive the operational excellence of each of our customers.

- Decades of experience recommending and servicing lift systems to accommodate changing well conditions
- Unrivaled expertise in plunger lift, gas lift, hydraulic lift, well control, and well unloading
- The best performing, highest quality, and safest products designed, engineered, and manufactured in-house
- Experienced and responsive field support staff with extensive local knowledge
- The highest commitment to the protection and safety of our employees, our customers, and the environment
- Comprehensive customer training and product support

PCS Ferguson products and services are available in the following North American locations:

**Administrative & Manufacturing**

Frederick, CO ........................................ 720.407.3550

**Canada**

Calgary, AB ........................................ 403.464.5782
Edson, AB ........................................ 780.723.2759
Grande Prairie, AB ........................................ 780.532.0804
Red Deer, AB ........................................ 403.464.5782

**Arkansas**

Conway ........................................ 501.932.0449

**Colorado**

Evans ........................................ 970.539.9003
Parachute ........................................ 970.285.9652

**New Mexico**

Farmington ........................................ 505.326.4239
Hobbs ........................................ 575.397.0040

**North Dakota**

Mohall ........................................ 701.756.6934
Watford City ........................................ 701.842.2231

**Oklahoma**

Oklahoma City ........................................ 405.603.7492
Stigler ........................................ 918.967.3236
Woodward ........................................ 580.256.1317

**Pennsylvania**

Brookville ........................................ 724.227.3263

**Texas**

Buffalo ........................................ 903.390.7615
Fort Worth ........................................ 817.769.8584
Karnes City ........................................ 830.299.8508
Perryton ........................................ 405.213.8114
Pleasanton ........................................ 830.299.9745
Odessa ........................................ 432.231.9987
Sonora ........................................ 325.387.6260
Tyler ........................................ 903.533.8266

**Utah**

Roosevelt ........................................ 435.722.4520
Vernal ........................................ 435.789.2031

**Wyoming**

Rock Springs ........................................ 307.362.6010