Maximize your investment in Blackhawk Pumps

PNEUMATIC AIR CANNOT ENTER WELL

- A piston pump will continue to operate until shutoff, even if there is no liquid at intake.
- Low speed and low heat generation mean there is no damage to the pump or well/sump.
- Pneumatics are designed so that no compressed air can enter the well/sump; air is not used to eject liquid.
- There is no connection between air input and liquid discharge.
- All pneumatic air enters and vents outside/above the well/sump.
- Apollo pumps operate only with solar or AC electric power.

SMALL AMOUNT OF GAS

- A dry-running piston pump will pump a small amount of gas at shallower depths (graph).
- Gas pumping decreases significantly as fluid pressure grows above the downhole drive-piston check valve.
- SCF is zero at 60 psig.

FLUID IS ALWAYS IN DOWNHOLE PUMP

- There is always a column of fluid in the pump and riser pipe to the surface discharge tee.
- Fluid is pumped out when replacement fluid is drawn in.
- The column of fluid in the pump and riser pipe restricts gas being pumped.
- In dry-run operation, the non-compressible fluid weighs down the downhole drive piston check ball, restricting its ability to open (drawings on back).
- The increased weight of the fluid compresses the gas to halt its flow.

Pumping Gas vs Back Pressure
SCF per stroke chart

Model 101

<table>
<thead>
<tr>
<th>Back Pressure (psig)</th>
<th>SCF per Stroke</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.006</td>
</tr>
<tr>
<td>10</td>
<td>0.005</td>
</tr>
<tr>
<td>20</td>
<td>0.004</td>
</tr>
<tr>
<td>30</td>
<td>0.003</td>
</tr>
<tr>
<td>40</td>
<td>0.002</td>
</tr>
<tr>
<td>50</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Apollo | Pneumatic

PNEUMATIC

APOLLO

Air In
Air Out
Air Out
DOWNHOLE PUMP OPERATION

The best-performing environmental pump in the business

What Happens When a Piston Pump Runs Dry

UP

DOWN

Piston Check Ball

Pump Discharge Tee

Well Seal

Well Casing

Driver Rod

Riser Pipe

Piston Check Ball

Drive Piston

Foot Valve and Ball

Strainer

All-Weather, Above-Ground Drive Motor

Stuffing Box Plate with Seal Cartridge

The best-performing environmental pump in the business