USE OF THE PUMP SLIPPAGE EQUATION TO DESIGN PUMP CLEARANCES

Lynn Rowlan & James N. McCoy

James F Lea
Data Collected at TTU Test Well
Data Acquisition Devices

- ABB VSD Controller
- MicroMotion Mass Flow Meter F-100
- Lufkin SAM Controller
- ION System Power Measurement System
- Wood Group Smart Guard™ RTU package
- (3) Echometer Well Analyzers
Patterson Slippage Equation

\[ 453 \cdot \left[ (0.14 \cdot SPM) + 1 \right] \frac{DPC^{1.52}}{L \mu} \]

Patterson Equation modified ARCO-HF equation to include the effect of SPM on slippage

Available:
QRod Tool - “Pump Slippage Calculator”
Impact of Pump Clearance and Pumping Speed on Pump Slippage

1. Patterson Slippage Equation predicts slippage vs. pumping speed, SPM, Pump diameters and Clearances (other parameters)

2. Patterson Equation modified the ARCO-HF equation to include the effect of SPM on slippage.

3. Data shows increase in power cost per barrel due to slippage.

4. Increased Pump Clearance Reduce the System Efficiency (Significantly at slower pumping speeds)

5. More power must be input to the sucker rod pumping system to re-pump the portion of the pump’s displacement lost to slippage.

6. Some Slippage Required for Proper pump lubrication.

7. Clearances can allow sand and other particles need to pass between the barrel and plunger.
1) Fluid that leaks back into pump between the Plunger OD and the Barrel ID
2) Leaks into the pump chamber between the standing valve and traveling valve
3) When traveling ball is on Seat.

Pump Efficiency = BPD Tank / BPD Pump

Slippage % = Slippage BPD / BPD Pump
1) **Point A to B** pressure acting on closed SV gradually transferred from tubing at point A to be fully carried by the Closed TV at point B.

2. **Point B to C**, plunger carries full differential pressure across Closed TV

3) **Point C to D** pressure across closed TV gradually transferred from rods to be fully carried by the Closed SV at point D.

4) **Point D to A**, TV open as fluid in the pump is displaced through the traveling valve on the down stroke
Based on Slippage test, “the following minimum pump clearances are recommended for a 48” Plunger with a “+1 Barrel”. These clearances have become widely used in the Permian Basin for well depths up to 8000 feet”

**Rule of Thumb Table**

- 1.25” pump = -3 to -4 plunger (0.004” to 0.005” total clearance)
- 1.50” pump = -4 to -5 plunger (0.005” to 0.006” total clearance)
- 1.75” pump = -5 to -6 plunger (0.006” to 0.007” total clearance)
- 2.00” pump = -6 to -7 plunger (0.007” to 0.008” total clearance)

**DO NOT DO THIS**

???? Design: Clearance Using Patterson Eq. w/ 90% Pump Efficiency
If You Use Recommended Clearances from 2007 Rule-of-Thumb Table

Inputs to Pump Slippage Calculations:
- D = Plunger Diameter (inches)
- P = Pressure Differential (Psi)
- C = Clearance (inches)
- \( \mu \) = Fluid Viscosity (centipoise)
- Strokes per Minute (SPM)

<table>
<thead>
<tr>
<th>Plunger Size Inch</th>
<th>Total Clearance Inch</th>
<th>Slippage BPD</th>
<th>100&quot; Stroke Pump Disp. BPD</th>
<th>Slippage %</th>
<th>144&quot; Stroke Pump Disp. BPD</th>
<th>Slippage %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.25</td>
<td>0.005</td>
<td>37.8</td>
<td>131</td>
<td>28.9</td>
<td>208</td>
<td>18.2</td>
</tr>
<tr>
<td>1.50</td>
<td>0.006</td>
<td>59.9</td>
<td>143</td>
<td>41.9</td>
<td>274</td>
<td>21.9</td>
</tr>
<tr>
<td>1.75</td>
<td>0.007</td>
<td>88.4</td>
<td>172</td>
<td>51.4</td>
<td>324</td>
<td>27.3</td>
</tr>
<tr>
<td>2.00</td>
<td>0.008</td>
<td>123.7</td>
<td>200</td>
<td>61.9</td>
<td>349</td>
<td>35.4</td>
</tr>
<tr>
<td>2.25</td>
<td>0.009</td>
<td>166.5</td>
<td>211</td>
<td>78.9</td>
<td>401</td>
<td>41.5</td>
</tr>
</tbody>
</table>

86 API Rod String | Anchored Tubing | Red - D Rod Loading > 100%
Dynamometer Cards – 5.01 SPM
2” Plunger, 0.009” Clearance, 12” Sheave, 31.5 HZ

76 API Taper Rods
91.3” Pump Stroke
215 BPD @ Pump
163 BPD in Tank, 51 BPD Slippage

Peak Load 12,324 Lb

Peak Load 16,588 Lb
1 Inch Rod String
95.2” Pump Stroke
226 BPD @ Pump
170 BPD in Tank, 56 BPD Slippage
<table>
<thead>
<tr>
<th>Test #</th>
<th>Date</th>
<th>API Rod String #</th>
<th>Stroke Length (in)</th>
<th>Pump Speed (spm)</th>
<th>Echometer Inferred Production (bpd)</th>
<th>Surface Production (bpd)</th>
<th>Echometer Slippage (bpd)</th>
<th>Pump Efficiency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-01</td>
<td>7/8/05</td>
<td>76₁</td>
<td>105.6</td>
<td>9.73</td>
<td>427.7</td>
<td>367.1</td>
<td>60.6</td>
<td>85.8</td>
</tr>
<tr>
<td>1-02</td>
<td>7/8/05</td>
<td>76₁</td>
<td>105.6</td>
<td>9.74</td>
<td>428.1</td>
<td>368.0</td>
<td>60.1</td>
<td>86.0</td>
</tr>
<tr>
<td>1-03</td>
<td>7/8/05</td>
<td>76₁</td>
<td>105.6</td>
<td>8.25</td>
<td>357.5</td>
<td>301.3</td>
<td>56.2</td>
<td>84.3</td>
</tr>
<tr>
<td>1-04</td>
<td>7/8/05</td>
<td>76₁</td>
<td>105.6</td>
<td>6.93</td>
<td>297.4</td>
<td>242.4</td>
<td>55.0</td>
<td>81.5</td>
</tr>
<tr>
<td>1-05</td>
<td>7/8/05</td>
<td>76₁</td>
<td>105.6</td>
<td>5.03</td>
<td>214.7</td>
<td>163.5</td>
<td>51.2</td>
<td>76.1</td>
</tr>
<tr>
<td>1-06</td>
<td>7/8/05</td>
<td>76₁</td>
<td>105.6</td>
<td>1.82</td>
<td>81.5</td>
<td>41.6</td>
<td>39.9</td>
<td>51.1</td>
</tr>
<tr>
<td>2-03</td>
<td>7/28/05</td>
<td>88</td>
<td>105.6</td>
<td>0.60</td>
<td>29.6</td>
<td>0.0</td>
<td>29.6</td>
<td>0.0</td>
</tr>
<tr>
<td>2-02</td>
<td>7/28/05</td>
<td>88</td>
<td>105.6</td>
<td>0.70</td>
<td>34.4</td>
<td>4.4</td>
<td>30.0</td>
<td>12.8</td>
</tr>
<tr>
<td>2-01</td>
<td>7/28/05</td>
<td>88</td>
<td>105.6</td>
<td>0.80</td>
<td>39.2</td>
<td>5.6</td>
<td>33.6</td>
<td>14.2</td>
</tr>
<tr>
<td>2-09</td>
<td>7/28/05</td>
<td>88</td>
<td>105.6</td>
<td>5.01</td>
<td>224.0</td>
<td>170.2</td>
<td>53.8</td>
<td>76.0</td>
</tr>
<tr>
<td>2-08</td>
<td>7/28/05</td>
<td>88</td>
<td>105.6</td>
<td>6.90</td>
<td>313.4</td>
<td>250.9</td>
<td>62.5</td>
<td>80.1</td>
</tr>
<tr>
<td>2-07</td>
<td>7/28/05</td>
<td>88</td>
<td>105.6</td>
<td>8.22</td>
<td>371.6</td>
<td>308.6</td>
<td>63.0</td>
<td>83.0</td>
</tr>
<tr>
<td>2-06</td>
<td>7/28/05</td>
<td>88</td>
<td>105.6</td>
<td>9.71</td>
<td>444.6</td>
<td>378.2</td>
<td>66.4</td>
<td>85.1</td>
</tr>
<tr>
<td>2-05</td>
<td>7/28/05</td>
<td>88</td>
<td>105.6</td>
<td>9.72</td>
<td>444.6</td>
<td>377.9</td>
<td>66.7</td>
<td>85.0</td>
</tr>
<tr>
<td>6-05</td>
<td>8/25/06</td>
<td>76₅</td>
<td>105.6</td>
<td>9.7</td>
<td>254.2</td>
<td>230.1</td>
<td>24.1</td>
<td>90.5</td>
</tr>
<tr>
<td>6-06</td>
<td>8/25/06</td>
<td>76₅</td>
<td>105.6</td>
<td>9.7</td>
<td>254.7</td>
<td>232.1</td>
<td>22.6</td>
<td>91.1</td>
</tr>
<tr>
<td>6-07</td>
<td>8/25/06</td>
<td>76₅</td>
<td>105.6</td>
<td>8.3</td>
<td>207.9</td>
<td>185.1</td>
<td>22.9</td>
<td>89.0</td>
</tr>
<tr>
<td>6-08</td>
<td>8/25/06</td>
<td>76₅</td>
<td>105.6</td>
<td>7.1</td>
<td>180.4</td>
<td>159.1</td>
<td>21.4</td>
<td>88.2</td>
</tr>
<tr>
<td>6-09</td>
<td>8/25/06</td>
<td>76₅</td>
<td>105.6</td>
<td>5.1</td>
<td>127.0</td>
<td>107.6</td>
<td>19.4</td>
<td>84.7</td>
</tr>
<tr>
<td>6-10</td>
<td>8/25/06</td>
<td>76₅</td>
<td>105.6</td>
<td>2.5</td>
<td>62.5</td>
<td>45.5</td>
<td>16.9</td>
<td>72.9</td>
</tr>
</tbody>
</table>

A 2.00 in pump with a 0.009 in clearance and 4 ft plunger was used for tests 1 thru 5.
A 1.50 in pump with a 0.005 in clearance and 4 ft plunger was used for test 6.
Water Viscosity - Cp

Water Viscosity - cp
T1 = 250  T2 = 185  T3 = 120  Deg F

Pressure (psig)

Vw (cp)

T1-max
T2
T3-min

Sept. 25 - 28, 2012
2012 Sucker Rod Pumping Workshop
As SPM increases, the Slippage Volume Increases. More strokes per day result in more slippage volume.
VSD Slows SPM Until Slippage=Displacement

2” Plunger, 1” Rod String, 0.009” Clearance, 12” Sheave

- 0.6 HP
  - 0.6 SPM, Input 4.8 HP, 0% System Efficiency
  - 100 Sec/Stroke
  - 0 BPD in Tank, 29.0 BPD @ 104” Pump Stroke

- 0.7 HP
  - 0.7 SPM, Input 5 HP, 2.4% System Efficiency
  - 85.53 Sec/Stroke
  - 4.7 BPD in Tank, 34.4 BPD @ 105” Pump Stroke
Pump Speed vs Pump Efficiency

\[ \text{Pump Efficiency} \% = \frac{\text{Surface Rate}}{\text{Pump Displacement}} \times 100 \]

As the SPM increases, the Pump Efficiency increases: Slippage Volume is a smaller % of Pump Displacement.
Dynamometer Data @ 4 SPMs
2” Plunger, 76 Rod String, 0.009” Clearance

9.73 SPM
## Summary of Test

<table>
<thead>
<tr>
<th>Card Selected</th>
<th>SPM</th>
<th>Effective Plunger Travel In</th>
<th>Effective Plunger Travel BPD</th>
<th>Water Production Rate (BPD)</th>
<th>Patterson Slippage BPD</th>
<th>Pump Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 - Sheave 6 Card #15</td>
<td>5.08</td>
<td>93.9</td>
<td>222.5</td>
<td>181.5</td>
<td>41.0</td>
<td>81.6%</td>
</tr>
<tr>
<td>1 - Sheave 8.5 Card #5</td>
<td>6.99</td>
<td>94.3</td>
<td>307.6</td>
<td>260.0</td>
<td>47.6</td>
<td>84.5%</td>
</tr>
<tr>
<td>1 - Sheave 10 Card #5</td>
<td>8.22</td>
<td>94.2</td>
<td>361.1</td>
<td>309.3</td>
<td>51.8</td>
<td>85.7%</td>
</tr>
<tr>
<td>2 - Sheave 12 Card #5</td>
<td>9.73</td>
<td>96.4</td>
<td>437.5</td>
<td>380.5</td>
<td>57.0</td>
<td>87.0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Card Selected</th>
<th>SPM</th>
<th>Motor Input HP</th>
<th>Polished Rod HP</th>
<th>Power Cost $/BBL Lifted</th>
<th>System Effic %</th>
<th>Pump Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 - Sheave 6 Card #15</td>
<td>5.08</td>
<td>11.3</td>
<td>6.6</td>
<td>0.143</td>
<td>44.7</td>
<td>81.6%</td>
</tr>
<tr>
<td>1 - Sheave 8.5 Card #5</td>
<td>6.99</td>
<td>14.9</td>
<td>9.5</td>
<td>0.132</td>
<td>50.2</td>
<td>84.5%</td>
</tr>
<tr>
<td>1 - Sheave 10 Card #5</td>
<td>8.22</td>
<td>17.4</td>
<td>11.4</td>
<td>0.130</td>
<td>51.6</td>
<td>85.7%</td>
</tr>
<tr>
<td>2 - Sheave 12 Card #5</td>
<td>9.73</td>
<td>21.0</td>
<td>14.3</td>
<td>0.127</td>
<td>52.3</td>
<td>87.0%</td>
</tr>
</tbody>
</table>
Example Slippage Calculation
Use Well Parameters to Calculate Table of Slippage and Efficiency Values

1) Range of SPM from 6.22 to 10.72 in 0.5 SPM steps
2) Use Patterson Slippage equation to calculate slippage BPD
3) Use predictive program QRod to calculate pump displacement, BPD, assuming 100% liquid fillage
4) Calculated Slippage % equal to the ratio of Slippage divided by Pump Displacement
5) Calculated Pump Efficiency % equal to the ratio of Production divided by Pump Displacement
Example Slippage for 2 Plunger Sizes

1. Slippage % less (pump leaks less) as SPM is increased
2. Increasing the pumping speed of a leaky worn pump will increase pump efficiency and increase liquid produced.
3. Increasing the pumping speed from 6.22 SPM by 4.5 SPM to 10.72 SPM reduces pump slippage by only 5-6%
4. Higher pumping speed may increase failures, so temporary oil production may not pay off any damage if failure occurs

<table>
<thead>
<tr>
<th>SPM</th>
<th>Calc Pump BPD</th>
<th>Slippage BPD</th>
<th>Slippage %</th>
<th>Pump Eff %</th>
<th>Calc Pump BPD</th>
<th>Slippage BPD</th>
<th>Slippage %</th>
<th>Pump Eff %</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.22</td>
<td>165.0</td>
<td>42.0</td>
<td>25.4</td>
<td>74.6</td>
<td>283.0</td>
<td>56.0</td>
<td>19.8</td>
<td>80.2</td>
</tr>
<tr>
<td>6.72</td>
<td>180.0</td>
<td>43.5</td>
<td>24.2</td>
<td>75.8</td>
<td>309.0</td>
<td>58.0</td>
<td>18.8</td>
<td>81.2</td>
</tr>
<tr>
<td>7.22</td>
<td>195.0</td>
<td>45.1</td>
<td>23.1</td>
<td>76.9</td>
<td>331.0</td>
<td>60.1</td>
<td>18.2</td>
<td>81.8</td>
</tr>
<tr>
<td>7.72</td>
<td>208.0</td>
<td>46.7</td>
<td>22.4</td>
<td>77.6</td>
<td>352.0</td>
<td>62.2</td>
<td>17.7</td>
<td>82.3</td>
</tr>
<tr>
<td>8.22</td>
<td>220.0</td>
<td>48.2</td>
<td>21.9</td>
<td>78.1</td>
<td>378.0</td>
<td>64.3</td>
<td>17.0</td>
<td>83.0</td>
</tr>
<tr>
<td>8.72</td>
<td>235.0</td>
<td>49.8</td>
<td>21.2</td>
<td>78.8</td>
<td>407.0</td>
<td>66.4</td>
<td>16.3</td>
<td>83.7</td>
</tr>
<tr>
<td>9.22</td>
<td>252.0</td>
<td>51.4</td>
<td>20.4</td>
<td>79.6</td>
<td>436.0</td>
<td>68.5</td>
<td>15.7</td>
<td>84.3</td>
</tr>
<tr>
<td>9.72</td>
<td>269.0</td>
<td>53.0</td>
<td>19.7</td>
<td>80.3</td>
<td>462.0</td>
<td>70.6</td>
<td>15.3</td>
<td>84.7</td>
</tr>
<tr>
<td>10.22</td>
<td>283.0</td>
<td>54.5</td>
<td>19.3</td>
<td>80.7</td>
<td>483.0</td>
<td>72.7</td>
<td>15.1</td>
<td>84.9</td>
</tr>
<tr>
<td>10.72</td>
<td>295.0</td>
<td>56.1</td>
<td>19.0</td>
<td>81.0</td>
<td>495.0</td>
<td>74.8</td>
<td>15.1</td>
<td>84.9</td>
</tr>
</tbody>
</table>
Actual Field Example with 0.009 Pump

Why only 402 barrels per day is being produced to the tank, when the effective downhole pump displacement is 576 BPD?

1. New pump w/ no wear or damage
2. Installed 0.009 in. clearance w/ 2.25 inch diameter & 4 foot plunger
3. *Patterson Eq. Slippage 160 BPD*
4. 576 BPD Full Pump dynamometer card (No correction for slippage or gas in solution).
5. Tested Rates are 106 BOPD & 296 BWPD
6. Production is 174 BPD less than the 576 BPD pump displacement.
7. \( \frac{106 + 296}{576} = 70\% \text{ Pump Eff.} \)
8. 26 MscfD gas up tubing (245 GOR), at 3155 psi discharge pressure, then oil swelled 4.4% due to gas in solution. 4.4% of 106 = 5 BPD.
9. Patterson Equation appears to calculate slippage fairly accurately.
Recommended Procedure to Select Pump Clearances

1. Use predictive sucker rod design program to calculate pump displacement, assume 100% liquid pump fillage.

2. Input correct well parameters into QRod Tool - “Pump Slippage Calculator”, be sure to adjust water viscosity for the temperature at the pump.

3. Examine Plot of “Patterson Equation Pump Slippage vs Clearance” and select pump clearance that gives the desired percentage of pump slippage.
Slippage Calculator

QRod Inputs
- Pump Diameter (D): 2.250 in
- Pump Depth: 7,156 ft
- Tubing Pressure: 250.00 psi
- Pump Intake: 151.00 psi
- Stroke Rate (SPM): 9.52 SPM
- Pump Displacement: 651 BBL/D
- Fluid Specific Gravity: 1.00

User Inputs
- Clearance (C): 0.009 in
- Fluid Viscosity (μ): 0.76 cP
- Plunger Length (L): 48.000 in

Calculate from SPM or Target Rate
- Stroke Rate (SPM): << 9.52 >> SPM
- Target Rate: << 489 >> Ilm

Dynamometer Cards
- Rod Load (lb): 651 BPD

Pump Volumetric Efficiency
- 75.12 %

Rate (100% pump volumetric eff.): 651 BBL/D
Rate (75% pump volumetric eff.): 489 BBL/D
Slippage Plot vs Clearance

<table>
<thead>
<tr>
<th>Slippage</th>
<th>162 BBL/D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump Volumetric Efficiency</td>
<td>75.12 %</td>
</tr>
<tr>
<td>Pressure Differential (P)</td>
<td>3,197.55 psi</td>
</tr>
<tr>
<td>Tubing Fluid Gradient</td>
<td>0.4330 psi/ft</td>
</tr>
</tbody>
</table>

**Patterson Equation Pump Slippage vs Clearance**

\[
\text{Slippage} = \left[ (0.14 \cdot SPM) + 1 \right] 453 \frac{DPC^{1.52}}{L\mu}
\]

(0.009in, 162bbl/d)
651 BPD Pump Displacement

Results

- Rate (100% pump volumetric eff.) 651 BBL/D
- Rate (75% pump volumetric eff.) 489 BBL/D

Design Inputs

- Unit: CWConv
- Pump Depth: 7,156 ft
- Surface Stroke Length: 145.00 in
- Pump Diameter (D): 2.250 in
- Tubing Size: 2.875" (6.40 lb/ft) 2.441" ID

Rods

- Fiberglass Size: 1.250 in
- Steel Size: 0.875 in
- Percent Fiberglass: 34%

Default Settings

- Total Sinker Bar Weight: 816.0 lb
- Fluid Specific Gravity: 1.00 Sp.Gr.H2O
- Tubing Pressure: 250.00 psi
- Casing Pressure: 45.00 psi
- Damping Factor: 0.10
- Surface Unit Efficiency: 95.00%
- Pump Volumetric Efficiency: 75.12%

You may enter Pump Intake Pressure directly, or calculate it from Reservoir Pressure and Productivity Index.

- Pump Intake Pressure: 151.00 psi
- Reservoir Pressure: 1,000.00 psi
- Productivity Index: 2.000 STB/D/psi

Dynamometer Cards

- Pump Stroke Length: 115.89 in
- Static Stretch: 81.66 in
- Overtravel: 52.55 in

Pump Velocity vs. Position

- Fo: 12,713.7 lb
- Fo/Skr: 0.563

Torque

- Peak Gearbox Torque: 851 Ksr
- Counter Balance Moment: 1,525 Ksr
- Counter Balance Effect: 22,157.3 lb
Design Pump Clearance of 0.005” to Achieve 90% Pump Efficiency with 65 BPD Slippage

\[ \text{Slippage} = \left[ (0.14 \cdot SPM) + 1 \right] 453 \frac{DPC^{1.52}}{L\mu} \]
Observation

- Pumping Rate affects Slippage. As Pump Speed Increases:
  - Pump Efficiency Increases: Slippage Volume is a Smaller Fraction of Pump Displacement
  - Slippage Increases: More strokes per day results in more slippage volume
Conclusions

1. Patterson Equation should be used to Design Pump Clearances – *Better than Rule-of-Thumb*

2. Pump Slippage is a Function of SPM, pump efficiency dramatically decreases at slow pumping speed when pump clearances are large.

3. Production from a leaky Pump can be increased by increasing SPM

4. Slippage may be excessive for large clearance pumps when pumping from deeper depths

5. Viscosity of water must be corrected for temperature

6. Proper technique to specify plunger/barrel clearance is to predict the gross downhole pump displacement without slippage, then specify plunger/barrel clearance having a calculated pump slippage volume less than or equal to 5-10% of the gross pump displacement.
Copyright

Rights to this presentation are owned by the company(ies) and/or author(s) listed on the title page. By submitting this presentation to the Sucker Rod Pumping Workshop, they grant to the Workshop, the Artificial Lift Research and Development Council (ALRDC), and the Southwestern Petroleum Short Course (SWPSC), rights to:

- Display the presentation at the Workshop.
- Place it on the [www.alrdc.com](http://www.alrdc.com) web site, with access to the site to be as directed by the Workshop Steering Committee.
- Place it on a CD for distribution and/or sale as directed by the Workshop Steering Committee.

Other use of this presentation is prohibited without the expressed written permission of the author(s). The owner company(ies) and/or author(s) may publish this material in other journals or magazines if they refer to the Sucker Rod Pumping Workshop where it was first presented.
Disclaimer

The following disclaimer shall be included as the last page of a Technical Presentation or Continuing Education Course. A similar disclaimer is included on the front page of the Sucker Rod Pumping Web Site.

The Artificial Lift Research and Development Council and its officers and trustees, and the Sucker Rod Pumping Workshop Steering Committee members, and their supporting organizations and companies (here-in-after referred to as the Sponsoring Organizations), and the author(s) of this Technical Presentation or Continuing Education Training Course and their company(ies), provide this presentation and/or training material at the Sucker Rod Pumping Workshop "as is" without any warranty of any kind, express or implied, as to the accuracy of the information or the products or services referred to by any presenter (in so far as such warranties may be excluded under any relevant law) and these members and their companies will not be liable for unlawful actions and any losses or damage that may result from use of any presentation as a consequence of any inaccuracies in, or any omission from, the information which therein may be contained.

The views, opinions, and conclusions expressed in these presentations and/or training materials are those of the author and not necessarily those of the Sponsoring Organizations. The author is solely responsible for the content of the materials.

The Sponsoring Organizations cannot and do not warrant the accuracy of these documents beyond the source documents, although we do make every attempt to work from authoritative sources. The Sponsoring Organizations provide these presentations and/or training materials as a service. The Sponsoring Organizations make no representations or warranties, express or implied, with respect to the presentations and/or training materials, or any part thereof, including any warranties of title, non-infringement of copyright or patent rights of others, merchantability, or fitness or suitability for any purpose.