**IADC WellCAP Well Control Worksheet**

**Bullhead**

**Well Name:** ____________________________  **Completed By:** ___________________________  **Date:** _____ / _____ / _____

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**TRUE PUMP OUTPUT:**

\[ \text{Bbls/Stk @ 100\%} \times \% \text{ Efficiency} = \text{TPO (Bbls/Stk)} \]

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**PUMP RATE CONSIDERATIONS:**

Kill Rate Speeds and Volume

\[ \frac{\text{Desired Barrels per Minute (BBLs/MIN)}}{\text{Pump Output (BBLs/Stk)}} = \text{Pump Rate (STKS/MIN)} \]

\[ \frac{\text{Desired Barrels per Minute (BBLs/MIN)}}{\text{Pump Output (BBLs/Stk)}} = \text{Pump Rate (STKS/MIN)} \]

\[ \frac{\text{Desired Barrels per Minute (BBLs/MIN)}}{\text{Pump Output (BBLs/Stk)}} = \text{Pump Rate (STKS/MIN)} \]

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**VOLUME AND STROKE CONSIDERATIONS:**

Tubing Volume/Strokes (Surface to End of Tubing, E.O.T.)

\[ \frac{\text{Tubing Length Surface to E.O.T. (MD — FT)}}{\text{Capacity per Foot in Tubing (BBLs/FT)}} \times \frac{\text{Tubing Volume Surface to E.O.T. (BBLs)}}{\text{Pump Output (BBLs/Stk)}} = \frac{\text{Strokes Surface to E.O.T. (STKS)}}{\text{E.O.T. (STKS)}} \]

Casing Volumes/Strokes (Below End of Tubing, E.O.T. to Perforations)

\[ \frac{\text{Length E.O.T. to Perfs (MD — FT)}}{\text{Capacity per Foot Top/Middle/Bottom in Casing (BBLs/FT)}} \times \frac{\text{Casing Volume E.O.T. to Perforations (BBLs)}}{\text{Pump Output (BBLs/Stk)}} = \frac{\text{Strokes E.O.T. to Perforations (STKS)}}{\text{E.O.T. to Perforations (STKS)}} \]

Surface to Perforations Volume/Strokes (Kill Point)

\[ \frac{\text{Tubing Volume Surface to E.O.T. (BBLs)}}{\text{Casing Volume E.O.T. to Perforations (BBLs)}} \times \frac{\text{Surface to Perforations Volume (BBLs)}}{\text{Pump Output (BBLs/Stk)}} = \frac{\text{Strokes Surface to Perforations (STKS)}}{\text{Strokes to Pump (Kill Point — STKS)}} \]

Total Volume/Strokes to Pump (Including Overdisplacing)

\[ \frac{\text{Surface to Perforations Volume (BBLs)}}{\text{Overdisplacement — if any — (BBLs)}} + \frac{\text{Total Volume to Pump (BBLs)}}{\text{Pump Output (BBLs/Stk)}} = \frac{\text{Total Strokes to Pump (Overdisplace — STKS)}}{\text{E.O.T. to Perfs (STKS)}} \]

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**FORMATION PRESSURE CONSIDERATIONS:**

Kill Fluid Density

\[ \frac{\text{Formation Pressure (PSI)}}{0.052} + \text{Depth to Perforations Top/Middle/Bottom (TVD — FT)} = \text{Kill Fluid Density (PPG)} \]

Estimated Formation Integrity Pressure (Fracture)

\[ \frac{\text{Max. Allowable Mud Density (PPG)}}{0.052} \times \text{Depth to Perforations Top/Middle/Bottom (TVD — FT)} = \text{Estimated Formation Integrity Pressure (PSI)} \]

Average Hydrostatic Pressure in Tubing

\[ \frac{\text{Formation Pressure (PSI)}}{0.052} - \text{Initial Shut in Tubing Pressure (PSI)} = \text{Average Hydrostatic Pressure in Tubing (PSI)} \]

Initial Estimated Maximum Pressure on Tubing (Static)

\[ \frac{\text{Est. Formation Integrity Pressure (PSI)}}{0.052} - \text{Average Hydrostatic Pressure in Tubing (PSI)} = \text{Initial Estimated Max. Pressure on Tubing (PSI)} \]

Kill Fluid Hydrostatic Pressure

\[ \frac{\text{Kill Fluid Density (PPG)}}{0.052} \times \text{Depth to Perforations Top/Middle/Bottom (TVD — FT)} = \text{Kill Fluid Hydrostatic Pressure (PSI)} \]

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**SLOW CIRCULATION RATE (SCR):**

<table>
<thead>
<tr>
<th>STKS/MIN</th>
<th>Pressure (PSI)</th>
<th>BBL/MIN</th>
<th>Pressure (PSI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**RECORDED WELL DATA:**

- **Formation Pressure**: PSI
- **Max. Allowable Mud Density**: PPG
- **Maximum Pump Pressure**: PSI
- **Shut In Tubing Pressure**: PSI
- **Shut In Casing Pressure**: PSI
- **Tree/Wellhead/BOP Stack Rating**: PSI
- **Annulus Fluid Density**: PPG
- **Packer Set**: PPG
- **TVD MD**: FT
- **Top Perforation MD**: FT
- **Middle Perforation MD**: FT
- **Bottom Perforation MD**: FT

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**Bullheading method, US (psi, ft, ppg)**

Field Units

Revised January 22, 2015

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## TUBING & CASING DATA

### TUBING DATA:

<table>
<thead>
<tr>
<th>Tubing</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside Diameter (INCHES)</td>
<td>Inside Diameter (INCHES)</td>
<td>Capacity per Foot (BBLS/FT)</td>
<td>Length to E.O.T. (MD — FT)</td>
</tr>
</tbody>
</table>

### Tubing Collapse

\[ \text{Tubing Collapse (PSI)} \times \text{Safety Factor (0.70 or Less)} = \text{Adjusted Tubing Collapse (PSI)} \]

### Tubing Yield

\[ \text{Tubing Yield (PSI)} \times \text{Safety Factor (0.70 or Less)} = \text{Adjusted Tubing Internal Yield (PSI)} \]

### CASING DATA:

<table>
<thead>
<tr>
<th>Casing</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside Diameter (INCHES)</td>
<td>Inside Diameter (INCHES)</td>
<td>Capacity per Foot (BBLS/FT)</td>
<td>Length (MD — FT)</td>
</tr>
</tbody>
</table>

### Casing Internal Yield

\[ \text{Casing Internal Yield (PSI)} \times \text{Safety Factor (0.70 or Less)} = \text{Adjusted Casing Yield (PSI)} \]

### PRESSURE CONSIDERATIONS:

#### Pressure Consideration PSI per “Step”

\[ \text{Lesser value of “Tubing Yield” or “Initial Estimated Maximum Pressure on Tubing” results (see page 1)} \]

\[ \text{Lesser value of “Tubing Yield” or “Final Estimated Maximum Pressure on Tubing (Static)” results (see page 1)} \]

#### Volume per “Step”

\[ \frac{\text{Volume per “Step” (BBLS/STEP)}}{\text{Number of “Steps”}} \times 42 = \frac{\text{Volume per “Step” (GALS/STEP)}}{\text{Volume (BBLS)}} \]

#### Strokes per “Step”

\[ \frac{\text{Strokes per “Step” (STKS)}}{\text{Number of “Steps”}} \times 10 = \frac{\text{Strokes per “Step” (STKS/STEP)}}{\text{Stroke Surface to Perforations (STKS)}} \]

### PRESSURE CHART

<table>
<thead>
<tr>
<th>Strokes</th>
<th>Volume in BBLS</th>
<th>Volume in GALS</th>
<th>Estimated Max. Static Pressure</th>
<th>Actual Tubing Pressure</th>
<th>Casing Pressure</th>
<th>Pump Rate</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>initial</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Field Units

(psi, ft, ppg)

Bullheading method, US

Revised January 22, 2015

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FORMULAS

1. Pressure Gradient (psi/ft) = Mud Weight (ppg) x 0.052

2. Hydrostatic Pressure (psi) = Mud Weight (ppg) x 0.052 x Depth (ft, TVD)

3. Capacity (bbls/ft) = Inside Diameter² (in.) ÷ 1029.4

4. Annular Capacity (bbls/ft) = (Inside Diameter of Casing² (in.) or Hole Diameter² (in.) - Outside Diameter of Pipe² (in.)) ÷ 1029.4

5. Pipe Displacement (bbls/ft) = (Outside Diameter of pipe² (in.) - Inside Diameter of pipe² (in.)) ÷ 1029.4

6. Maximum Allowable Mud Weight (ppg) = \[
\frac{\text{Surface LOT Pressure (psi)}}{\text{Shoe Depth (ft, TVD)}} \times 0.052 + \text{LOT Mud Weight (ppg)}
\]

7. MAASP (psi) = [Maximum Allowable Mud Weight (ppg) - Present Mud Weight (ppg)] x 0.052 x Shoe TVD (ft)

8. Formation Pressure (psi) = Hydrostatic Pressure Mud in Hole (psi) + SIDPP (psi)

9. Sacks (100 lb) of Barite Needed to Weight-Up Mud = \[
\frac{\text{Bbls of Mud in System} \times 14.9 \times (\text{KMW} - \text{OMW})}{(35.4 - \text{KMW})}
\]

NOTE: This formula assumes that the average density of Barite is 35.4 ppg and the average number of sacks (100lb) per barrel is 14.9.

10. Volume Increase from Adding Barite (bbls) = Number of Sacks (100 lb) added ÷ 14.9

11. Equivalent Mud Weight (ppg) @ __________ depth (ft) = \[
\frac{\text{Pressure (psi)}}{\text{Depth (ft, TVD)}} \times 0.052 + \text{Current Mud Weight (ppg)}
\]

12. Estimated New Pump Pressure at New Pump Rate (psi) = Old Pump Pressure (psi) x \[
\left(\frac{\text{New Pump Rate (SPM)}}{\text{Old Pump Rate (SPM)}}\right)^2
\]

13. Estimated New Pump Pressure with New Mud Weight (psi) = Old Pump Pressure (psi) x \[
\frac{\text{New Mud Weight (ppg)}}{\text{Old Mud Weight (ppg)}}
\]

COMMENTS