Troubleshooting Gas-lift Wells
Using Dual Shot Acoustic Technique

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Introduction

Efficient operation of artificial lifted wells normally requires the fluids moving to the surface in the tubing to be isolated from the casing annulus.

• In Unconventional Reservoirs, Many traditional Sucker Rod Lift operators have done a significant shift toward Gas-Lift as the primary lift method

• Simple method needed to find/identify leaks and/or pressure communication through the tubing

• Wellbore problems or equipment malfunctions from holes or defective checks or valves is found by identifying pressure communication through tubing

• Acoustic fluid level provides beneficial information throughout the life of a gas-lift well

• Using a known valve depth is an accurate method to determine the depth to the fluid level
1. Displace liquid out of Tubing down to the operating valve.
2. Fire Shot using Remote Fire Gun on Tubing. Disconnect Tubing microphone cable after Shot is fired.
3. Listen and Record Shot using Compact Gas Gun on Casing.
4. Watch for Kick identifying communication between Tubing and Casing.
5. Using the average of the Tubing and Casing Acoustic Velocities, calculate the Depth to the Kick.
6. Using the Wellbore Schematic or Overlay, identify the Problem Valve.
Overlay Casing Setup Shot onto Dual Shot to Verify

Distance To Liquid: 7649 ft MD
RTT (sec): 12.488
JTS: 236.11
AV: 1225 ft/s
Jts/sec: 18.91

Fluid Above Tubing
Equivalent Gas Free Above Tubing

Pressure Buildup: 644.7 psi (g)
0.02 psi/min
The Dual Shot Method
Dual Shot Method

Look for Communication between Tubing and Casing on a Gas-lift Well.

- Shoot down Tubing and simultaneously Listen on Casing.
- Fire the Tubing Gas Gun to send a pressure wave down Tubing.
- Unplug the Tubing microphone cable from T after shot is fired, and leave the Casing microphone cable plugged into the Well Analyzer.
- Acoustic Signal is created in Tubing. Holes, malfunctioning check valves, and malfunctioning gas-lift valves pass pressure wave into casing.
- For calculating Depth on Listen gun, use an average of the Tubing and Casing Acoustic Velocities from just prior Tubing and Casing shots.

Tubing Remote Fire Gas Gun

Listen with Gas Gun on Casing
Use Low Pass Filter to See Casing Mandrel Echoes

Distance To Liquid 7275 ft MD

RTTT (sec) 12.319  
#JTS 224.29  
AV 1177 ft/s  
Jts/sec 18.15

Just Prior Casing Shot

Wellbore Overlay

Gas Lift Valve
Depth: 6791 ft

Orifice

Pressure Buildup
781.5 psi (g)
-1.96 psi/min
Use Valve #9 Depth for 1177 ft/sec Acoustic Velocity

Use Gas-lift Valve #9 6791 foot Depth 11.497 RTTT to Calculate Average Casing Acoustic Velocity 1177 ft/s and Determine the fluid level is near/at the orifice.
EOT Echo Determines 1255 ft/s Acoustic Velocity

Use EOT 7688 foot Depth 12.218 sec RTTT to Calculate Average Tubing Acoustic Velocity 1255 ft/s.
Connect Both Guns to Analyzer for Shot Fire

Look for Communication between Tubing and Casing on a Gas-lift Well.

- Shoot down Tubing and Simultaneously Listen on Casing.

Listen with Gas Gun on Casing.
After Shot Fire Listen
Only on Casing Gun

As soon as Tubing Shot is fired, unplug the Tubing microphone cable from T and leave the casing microphone cable plugged into the Well Analyzer.

Fire Remote
Fire Gas Gun on Tubing

Listen with Gas Gun on Casing
Dual Shot Results

• Example 1
Tubing Shot

On Casing Gun see Bad Check Valve and EOT Echo

Dual Shot

Casing Shot
EOT Echo Determines 1255 ft/s Acoustic Velocity

Tubing Shot

Acoustic Velocity = 1216 ft/s \((1255 + 1177)/2\)

Dual Shot

Use Valve #9 Depth for 1177 ft/s Acoustic Velocity

Casing Shot
Dual Shot Results

• Example 2
Use notes to identify Dual Shot Markers.

Communication around 4th valve, could be bad valve or HIT.

Casing Liquid Level

Liquid Level through tubing.

End Of Tubing
Depth: 8610 ft.

End Of Liner
Depth: 7410 ft.
Echoes from Both Tubing and Casing are seen in Dual Shot.

Apply Low Pass Filter and Zoom In

Communication near 4\textsuperscript{th} Valve, could be bad valve or HIT.

EOT

Casing Liquid Level

Liquid Level through Tubing
Dual Shot Method Using Plunger Lift Application
Dual Shot - Wireless

Look for Communication between Tubing and Casing on a Gas-lift Well.

- Using TAM Plunger Lift Application Simultaneously Acquire High Speed Acoustic and Pressure Data.
- Press Fire Shot button on Tubing Gun while Listening for Pass Through Echo on Casing Gun.
- Acoustic Signal is created in Tubing. Holes, malfunctioning check valves, and malfunctioning gas-lift valves pass pressure wave into casing.
- For calculating Depth on Listen gun, use an average of the Tubing and Casing Acoustic Velocities from just prior Tubing and Casing shots.
Using TAM Plunger Lift Application Simultaneously Acquire High Speed Acoustic and Pressure Data
Press fire shot button on Tubing Gun while Listening for Pass Through Echo on Casing

Press “Fire” button when ready to shoot and make sure the chamber pressure is greater than the well pressure.
Acoustic Signal is created in Tubing. If holes, leaky check valves, leaky gas-lift valves are present, then Tubing Pressure Wave enters Casing.

End of Tubing Echo Depth: 7688

Liquid Level Echo Depth: 7950

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<th>#</th>
<th>DESCRIPTION</th>
<th>TIME</th>
<th>TUBING psi (g)</th>
<th>CASING psi (g)</th>
<th>ACOUSTIC</th>
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<td>35.93</td>
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<td>Liquid Level on Tubing Acoustic</td>
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Acoustic Signal Recorded in Casing shows holes, leaky check valves & leaky gas-lift valves when tubing pressure wave can pass into casing

On Casing Gun see Down kick from Bad Check and Up kick from EOT Echo
Conclusion

- Dual Shot Method is Used to find holes in Tubing, plus malfunctioning check valves and/or gas-lift valves
- Passing pressure wave from one pipe into adjacent pipe is the method to identify depth of leak
- Beneficial information is obtained throughout the life of a gas-lift well through acoustic surveys
- Knowing the Acoustic Velocity profile of a well provides critical information for verifying gas composition and fluid level accuracy.
- Identifying reflection kicks across valves and mandrels result in more accurate depth analysis.
- New technique aids in troubleshooting problems.
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