# ANNULAR GAS LIFT IN THE DELAWARE BASIN

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## INTRO

Widely used for more than 50 years, gas lift provides several advantages over other forms of artificial lift and has done so with few notable changes. This is especially true in the early stages of a wells production when flowrates are critical for optimized financial returns. Gas lift can be safer and a more cost-effective way to maximize initial production rates, especially when having to deal with sand, solids and large amounts of gas coming from the formation.

With its larger flow area, gas lifting up the annulus has become a popular way to move as much fluid as the reservoirs are willing to give up in the early days after completion. However, as the well's effective pressure naturally declines, it becomes more efficient to produce hydrocarbons up the tubing with conventional gas lift.

In the past, utilizing both annular and tubing flow required two separate strings of equipment, typically requiring a workover rig to pull one system and installing the other.

Historically annular lift gas lift designs have had valves positioned throughout the tubing string using internally mounted gas lift mandrels and a bull plug on the EOT. In this configuration, there is no thru-tubing access, consequently requiring a workover rig to pull the tubing to switch to a conventional tubing flow system. Intervening to switch from annular to conventional is expensive, time-consuming and risky procedure that causes deferred production and materially increases the cost to produce the well. A less-intrusive side pocket mandrel configuration is available, but it is substantially more expensive than conventional gas lift mandrels and valves.

Recently, Liberty Lift developed a new patent-pending technique and gas lift mandrel to address and improve this gas lift shortcoming, eliminating the need for workover rig intervention.

The Liberty Lift HyRate gas lift system incorporates special capsule mandrels for annular flow operations, but also provide full tubing drift. The previously used bull plug can now be replaced by a retrievable plug, and conventional mandrels are inter-mixed in the tubing string, allowing tubing flow operations to begin after the plug is retrieved. The conversion from annular to conventional injection can be accomplished quickly, and efficiently with as little as 1-2 slickline runs along with manipulation of surface valving. Some completion options require zero slickline intervention, with all changes being made at the wellhead on surface.

Annular flow gas lift has been around for many years. It has been used primarily for the initial unloading of a well at very high rates of fluid production. Having a larger flow area initially allows an operator to capture more production. The problem is that annular lift gets to the point where it is no longer efficient.

HyRate has targeted initial operating volumes of +8000 bpd with annular lift, but also allowed the gas lift designer to optimized down to 50 bpd on the tubing flow side, all in a single installation.

## Anadarko-Delaware Basin HyRate Trial

In late 2018 Anadarko began evaluating the Liberty Lift HyRate gas lift system. Traditionally Anadarko has completed wells by setting a wireline conveyed packer with dual disks, tubing up the well with gas lift valves in the string. Free flowing the well until the well shows signs of loading and then initiating

conventional gas lift injection. With the productivity of wells in the Delaware Basin the question was asked, how much increased rate could be achieve by annular gas lift?

This brought questions about the risk of damaging tubulars, valves and surface equipment by flowing full well stream annularly. Areas of concerns with the evaluation of annular flow gas lift were/are:

-Consideration of packer versus packer-less designs

-Extended time that casing is exposed to the full well stream while flowing at high rates.

-Capability of flowing full well stream through the tubing head and casing valves and the mechanical integrity of the tubing head region.

-Anadarko Delaware Basin wells make large amounts of sand that cause havoc downhole and on surface. Concern exists for how the externally mounted annular and conventional valves in the HyRate system will handle an environment with this amount of solids.

-Cross flow and equalization when well shut-downs occur. Operational situations could occur where injection down the tubing is stopped. If pressure is mistakenly bled off the tubing are solids going to damage the conventional valves in the string while equalizing?

-Finding a material to jump from the casing wing to the tubing wing that would not de-rate the pressure rating of the tree but would have large enough inner diameter to not restrict flow.

**Process of Evaluating Candidates for HyRate Gas Lift**

Early in evaluation, it was clear that due to the amount of sand that is produced in the Delaware Basin, the HyRate design would have to be ran packer-less. To achieve a packer-less tube-up, the main prerequisite was the ability to kill the well with clear fluids. The HyRate install would have to occur on a well that was depleted and that had a failure warranting intervention, or the candidate would have to be flowed up casing after completion until loading occurred.

**Well “A” Trial**

The first HyRate trial (Well A), is a well that was commissioned mid-2016. Well A, is located in Loving County, lateral length is roughly 2 miles. Well A had a conventional gas lift failure, tubing was pulled and replaced with a packer-less 2-3/8” HyRate design. While this well was not the most ideal HyRate candidate it was installed mainly for proof of concept. Even considering the age of the well there was a noticeable and promising increase in oil, water and gas after initiating the HyRate gas lift system. Operational issues have limited the available compression for the pad, which has limited the ability to test for optimal injection rate. (see Figure 2 for production plot)

**Well “B” Trial**

The second HyRate trial (Well B) is a short lateral (~4200’) in Reeves County. Upon initial commissioning, a sand bridge was formed on the heal end of the lateral. To clear the bridge, the tubing was pulled and the lateral was cleaned out. Well was then flowed up casing until loading occurred. APC wellwork group was able to kill the well with brine, 2-7/8” packer-less HyRate design was ran in hole. Delays were experienced getting specialty piping to “jump” from the casing wing to the tubing wing. The specialty material that had high enough pressure rating to be consistent with the production tree pressure rating while having a large enough inner diameter to not act as a choke had to be sourced out of state,

causing delays. Once online, the HyRate system performed better than the free flow state in the time before loading started. Due to the downtime to install the HyRate system it is hard to differentiate if benefit was impacted more by the HyRate system or the flush production from the down time. In mid-February Well B was shut-in for an offset frac. After offset frac finished the well was opened to flow annularly. The pressure quickly bled off and the well quit flowing. Operations started gas injection, the HyRate annular system has very effectively produced the water load that inundated Well B from the offset frac. The HyRate system has more effectively produced water inundation from offset fracs than comparable conventionally gas lifted wells, thus restoring oil production quicker. Similarly to Well A, the Well B HyRate system has been online for too short of time to draw any clear conclusions. (see Figure 3 for production plot)

## CONCLUSION

The Liberty Lift HyRate gas lift system has shown good potential to more quickly drawdown wells and potentially improve well economics. In the time that the HyRate systems have been in hole, the equipment has worked as intended. Anadarko will continue to evaluate current HyRate annular systems, and plan to expand annular gas lift trial over the course of 2019.

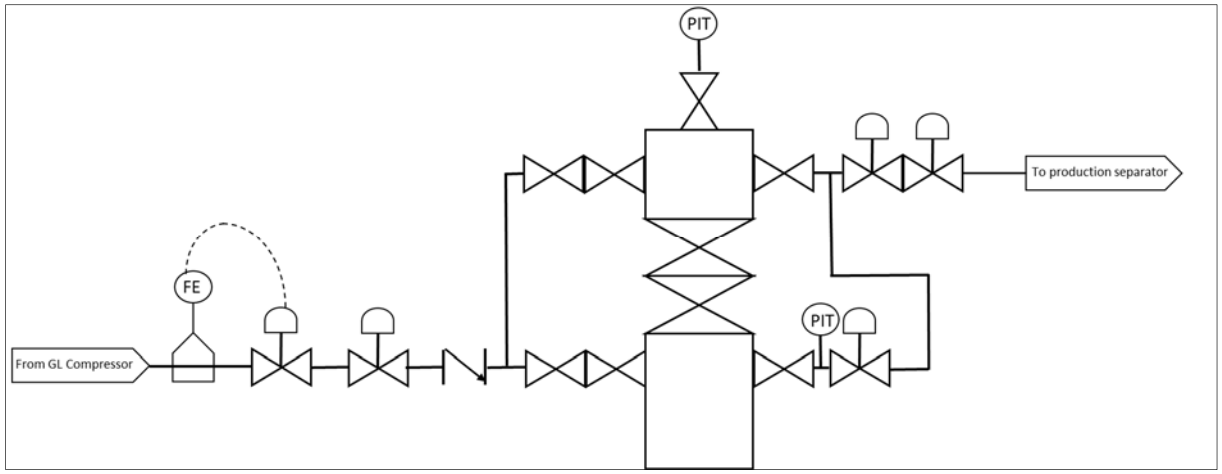


*Figure 1: Annular Lift Surface Configuration*

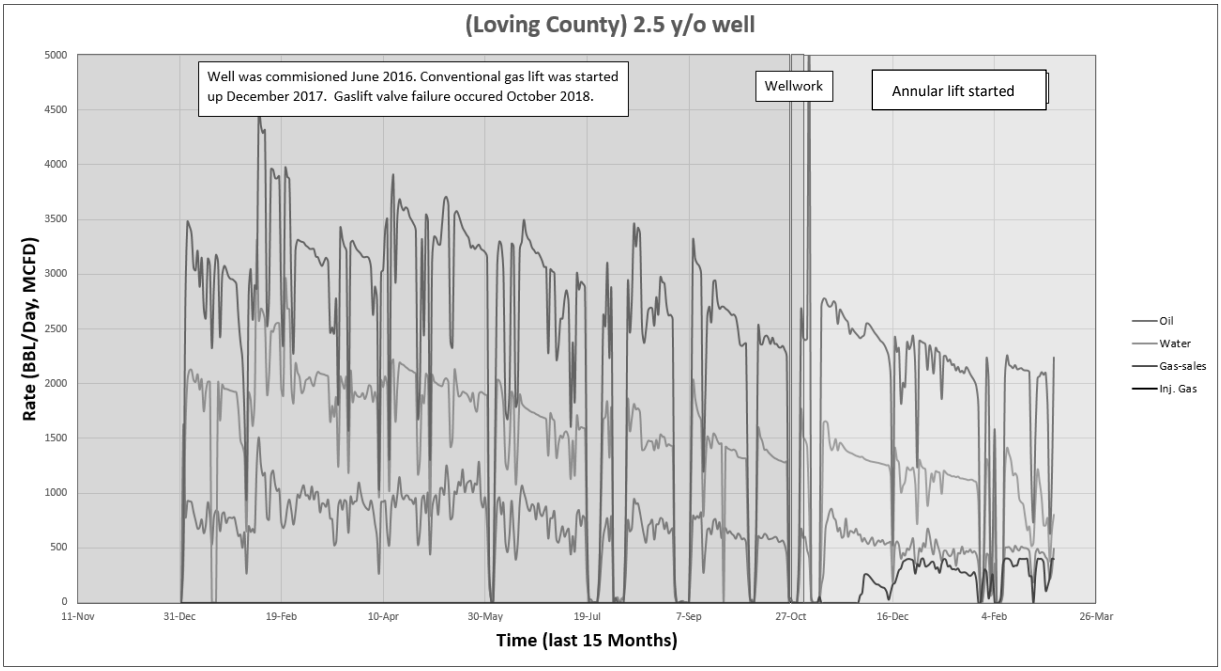


*Figure 2: Well A Production data (Only last 15/30 months of well history shown)*

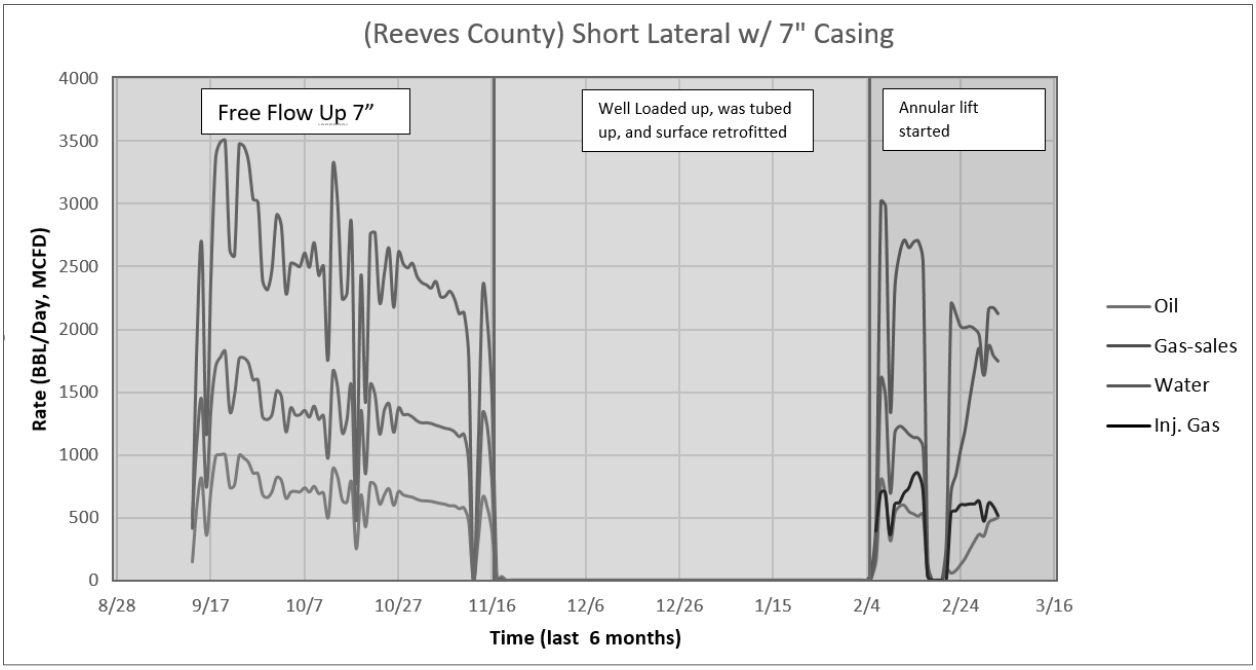


*Figure 3: Well B Production data*