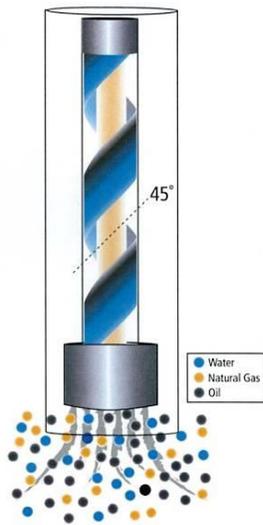




## Vortex Tools: Production Enhancement in Horizontal Wells



A New Mexico operator saw oil and gas production improve using the patented Vortex DX-I tools at the end of tubing in declining wells. The Vortex tool was set at end of tubing deep in the lateral and close to the formation (typically set at 80 degrees). In each case where Vortex tools were installed, oil production was increased and, in one reported case, the oil production increased from 80 barrels of oil per day to over 400 barrels of oil per day for a period well beyond flush production. The 10-day increased production from this one reported well was 3,200 barrels of oil (or \$345,000 in production values). The Vortex tools for all five wells were paid for in mere days.

### Technology Comparison

With the benefits of directional drilling, horizontal wells have become the norm in many formations. However, perfectly horizontal laterals are rare and liquids typically accumulate in the heel-toe dip and in deviations in the undulating portions of the tubing. Although many technologies are available, few are set in the horizontal portion of the well. The Vortex DX-I tool can be set at the end of tubing, close to the formation, at 80° of deviation, and this spiraling flow (pictured above left) reduces slugging, flowing tubing pressures (lower pressure drop due to friction), and the critical rate required to lift liquids to the surface, while moving significantly more hydrocarbon fluids to the surface for recovery and sale.

**Beam lift:** Usually vertical and have a bottom anchor in most cases. Limit around 1,000 bpd and low gas rate.

**Plunger lift:** Can reach about 20 degrees into the lateral. Limit of 10 – 50 bpd and poor with solids.

**ESPs and PCPs:** Can work fully horizontal, but gas-lock can be a problem. Good for high rates of production

**Gas Lift:** Can be installed at any deviation, but is inefficient below vertical and requires high gas rates to lift.

**Vortex:** Good at any deviation. Works with high water rate, solids, and gassy oil and with plunger/gas lift.

## Summary

The following chart provides a quick look behind the numbers for three of the wells that were the subject of this study. These wells were compared since they are all in the same formation, with similar depths/completions (7" casing and 2 & 7/8" tubing), and were all operated with poor boy gas-lift and the Vortex Tool at end of tubing:

	Well A	Well B	Well C
<b>Operating method:</b>	Poor Boy GL w/Vortex	Poor Boy GL w/Vortex	Poor Boy GL w/Vortex
<b>Oil before Vortex:</b>	87 Bbls/day	84 Bbls/day	152 Bbls/day
<b>Oil after Vortex:</b>	137 Bbls/day (+57%)	133 Bbls/day (+58%)	144 Bbls/day (-5%)
<b>Oil Trend Line:</b>	Actual/trended Up	Actual/trended Up	Trended Up
<b>Water Daily Rate:</b>	30 Bbls/day (+600%)	28 Bbls/day (+700%)	16 Bbls/day (+57%)
<b>Daily Gas Impact:</b>	337 Mcf/d increase	252 Mcf/d increase	8 Mcf/d increase
<b>Injected Gas rate:</b>	200 mcf/d decrease	225 mcf/d decrease	200 mcf/d decrease
<b>Net produced gas:</b>	500 Mcf/day	288 Mcf/day	125 Mcf/day
<b>% of injected gas (before Vortex):</b>	89% of injected gas without Vortex	74% of injected gas without Vortex	85% of injected gas Without Vortex
<b>% of injected gas (after Vortex):</b>	346% of injected gas with Vortex	259% of injected gas with Vortex	157% of injected gas with Vortex
<b>Tubing Pressures:</b>	Reduced by 64%	Reduced by 53%	Reduced by 49%
<b>Financial benefit (2½ months of trial):</b>	\$583,962	\$407,322	(\$18,220)

Tubing/casing pressures down in all wells

## Key findings:

- In the first two wells, oil production increased by an average of 58%, whereas the remaining three wells all saw a beneficial flattening of the long-term decline curve, albeit with no increase in daily production.
- A one-year look-back has confirmed a beneficial and sustained change to the long-term decline curve.
- The increased oil recovered from these first two wells produced an additional 8,658 barrels in the analyzed two-and-a-half-month period following the Vortex installation.
- Water removal increased by as much as 700% and flowing tubing pressures were also substantially reduced (42% lower on average).
- In poor boy gas-lift, wells typically “recover” less gas than the gas that is “injected” to lift the oil. With the addition of the Vortex tools, gas injection rates were reduced by up to 50%, and four out of five wells moved to net recovery of gas from net injection. All wells were operating on poor-boy gas lift.
- The two wells which saw the greatest increase in oil production (57.4% and 58.3%), also saw the highest increase in sales gas (76% and 95%).
- Water removal in these two wells also increased substantially (600% and 700% respectively).