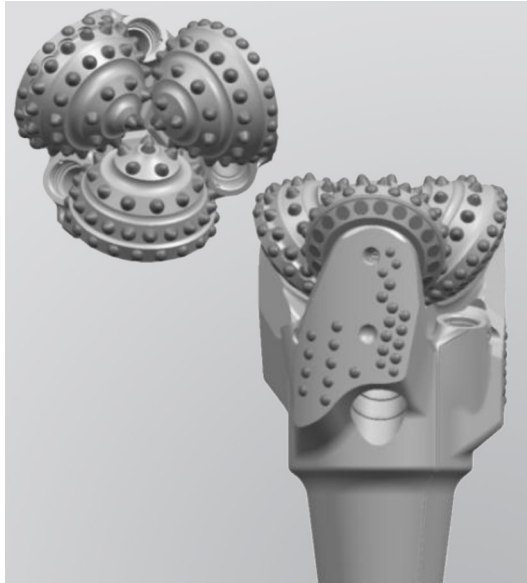


# QuadPack® Plus Bit Set New Air Directional Application Benchmarks in Marcellus Shale Play

Advanced bit drilled three wells in less time than two conventional bits

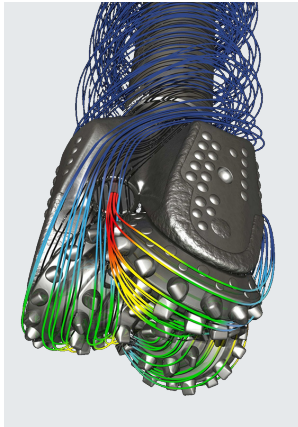


## OVERVIEW

Long bit life and downhole durability are crucial to successful air drilling. With conventional technology, fluid flow in the vicinity of cutting elements is turbulent and often inhibits upward flow of formation cuttings, creating faster erosion of drill bits and decreasing rates of penetration (ROP). Halliburton's QuadPack Plus bits features strong arms for more surface area and greater stability. The bits also feature directed flow channels that effectively remove cuttings from crucial areas of the cutting structure and wellbore. Each Quadpack Plus bit component contributes to faster rates of penetration, longer bit life, and less cleaning time, as demonstrated in the Marcellus Shale Play. Of five wells air drilled from a pad in Barbour County, West Virginia, the conventional bit drilled just 4,221 feet (1286 m) in two wells, with an average ROP of 61.45 ft/hr (18.72 m/hr). The EQH45R QuadPack Plus bit was deployed in three wells, drilling a total combined footage of 5,429 feet (1654 m) with an overall average ROP of 78.26 ft/hr (23.85 m/hr), a 28% increase.

CHALLENGES	SOLUTION
<p><b>Haphazard Fluid and Cutting Flow</b> Conventional technology directs fluid flow at the trailing or leading edges of the cutting structure, leaving the cuttings and fluid free to recirculate around the rotary blades.</p>	<p><b>Directed Nozzles Improves Hydraulics</b> The QuadPack Plus bit's directed flow points the nozzles toward the leading edge of the cutting structure, enabling the flow to be forced under the cones at the point where most of the cuttings are being generated.</p>
<p><b>Limited Lifting Surfaces Increases Re-drilled Cuttings</b> Standard support arms with conventional nozzle geometry point directly downward, causing the fluid and particles to act independently with no clear channel of escape up the wellbore.</p>	<p><b>Arm Profile Scheme Channels Evacuation of Particles</b> A redesign of the nozzle position and angled lifting surface of each arm enable adjacent arms to cooperate and create a swirling flow up the annulus.</p>
<p><b>Complex Flow Inhibits Efficient Cleaning</b> Conventional flow between two adjacent nozzles work against each other to produce low flow under the cones, inhibiting upward flow of formation cuttings.</p>	<p><b>Efficient Bit Cleaning Streamlines Cuttings Removal</b> The QuadPack Plus bit generates the highest flow at the gage and drive rows where the majority of the cutting action is located, increasing cuttings removal and reducing the chance of cuttings being re-drilled.</p>
<p><b>Trapped Particles Erode Seal and Reduce Bit Life</b> If the cuttings are not removed from the bearing area, they become trapped and packed into the sealing area, acting as abrasives to wear the seal and reduce bit life.</p>	<p><b>Controlled Upward Flow Improves ROP</b> The support arms of QuadPack Plus bits incorporate lifting surfaces that generate a fluid spiral, providing an optimum flow pattern for elevating cuttings up and out of the wellbore.</p>

The 8-3/4-in. QuadPack® Plus bit provides consistent performance with outstanding ROP and durability



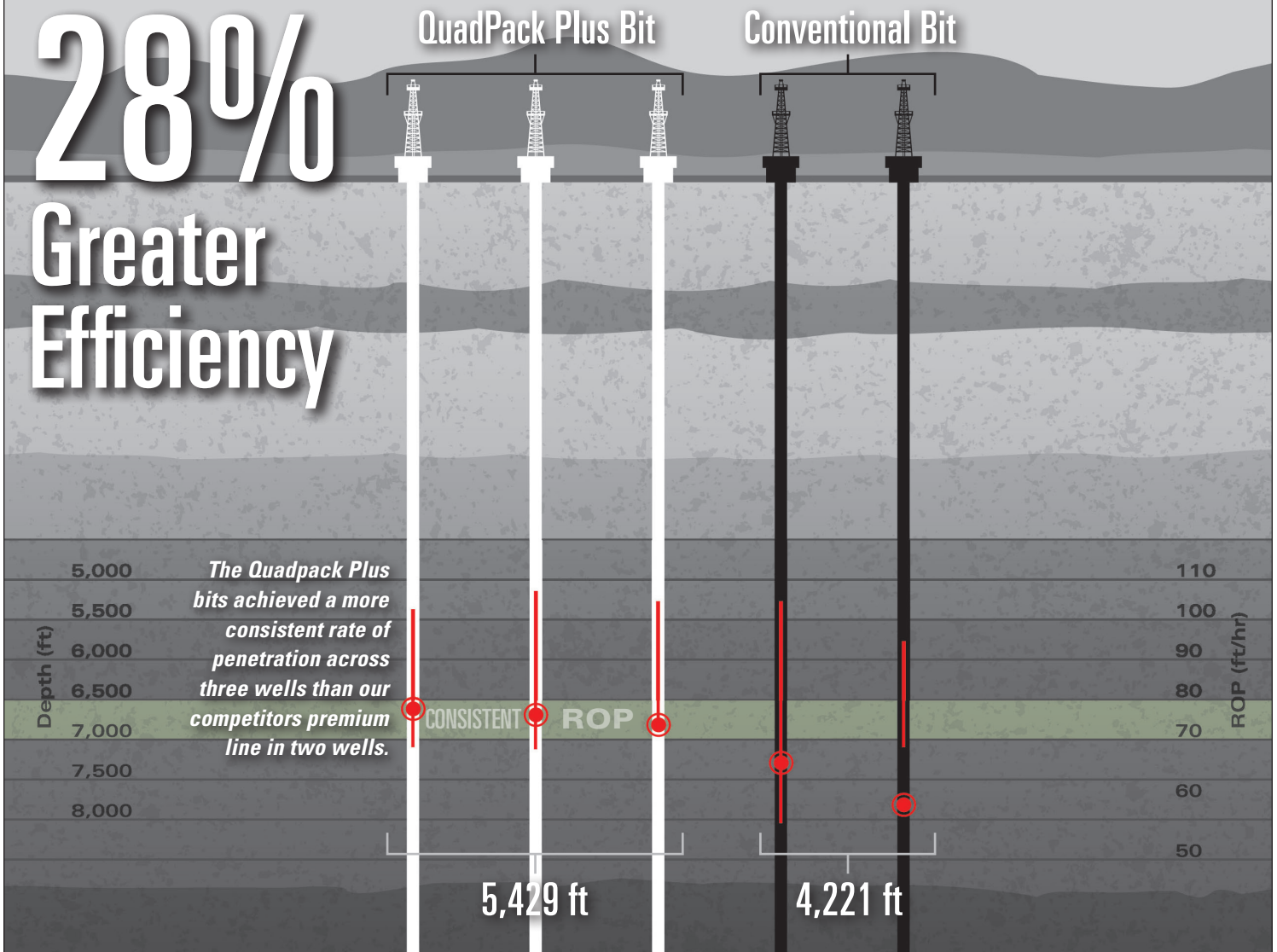
**Computational fluid dynamics boosts hydraulic performance**

The engineered flow of drilling fluid removes newly generated cuttings from under the cutting structure and efficiently sweeps them up the annulus, minimizing build-up of cuttings around the bearing sealing area. In addition, directed nozzles are placed to ensure a non-restricted fluid flow, moving stagnant fluid zones off the cutting structure.

**New forging design generates engineered lifting surfaces**

The redesigned arm profile increases surface area of the shirrtail surface and provides greater circumferential contact with the bore wall while adding stability to the bit. The additional area enabled enables shirrtail protection to ensure longer run in the most difficult and abrasive applications.

**28%  
Greater  
Efficiency**



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