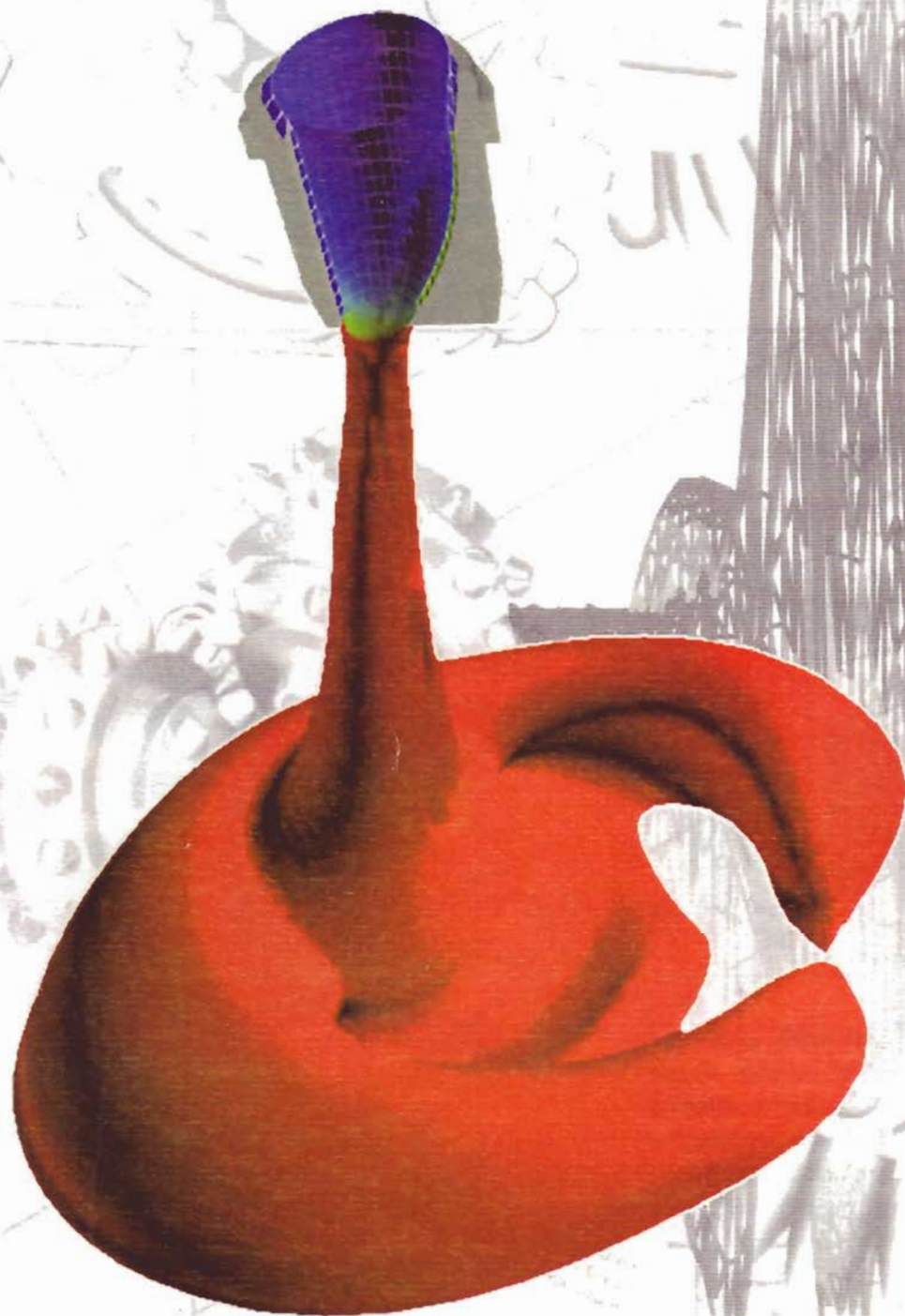


# Vortexx™ Hydraulics Technical Bulletin

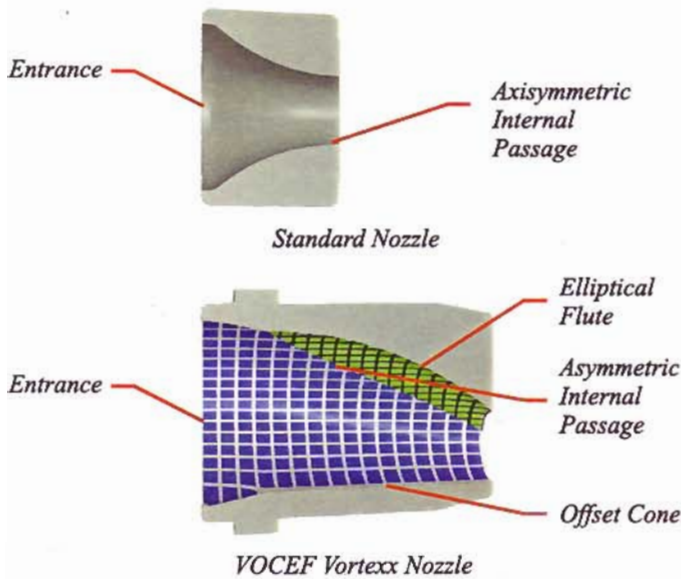


**SMITH** **SMITH TOOL**

# VORTEXX™ HYDRAULIC TECHNOLOGY FOR ROLLING CUTTER ROCK BITS

In a continuing effort to improve rock bit performance, Smith Tool has entered into an exclusive licensing agreement with the Vortexx Group, Incorporated to use the patented Vortexx™ nozzle jetting system on rolling-cutter rock bits. The Vortexx™ nozzle generates a unique flow domain that improves three cone rock bit hydraulics to improve penetration rates in many applications.

## VORTEXX™ NOZZLE CHARACTERISTICS



The Vortexx™ nozzle is designed with a unique internal passage. The asymmetric interior shape produces a complex flow regime that creates a pressure zone on the hole bottom that is lower than the surrounding hydrostatic pressure. In addition, increased fluid entrainment, turbulence and hole sweeping increases bottom hole and cutting structure cleaning.

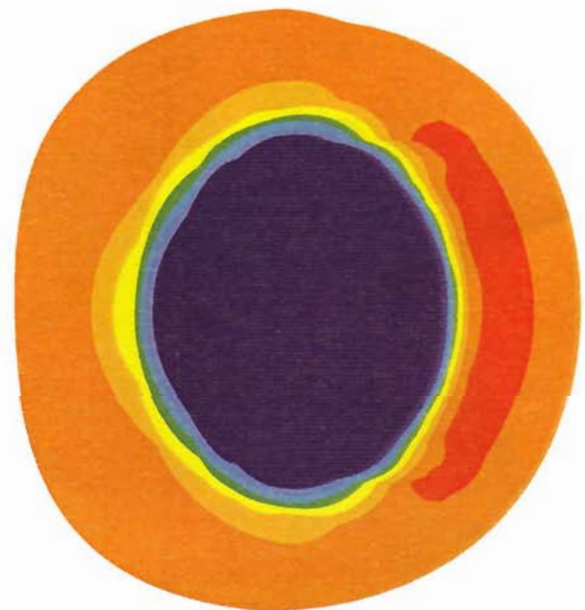
For more detailed information on Vortexx™ nozzles, visit the Vortexx Group Incorporated's web site at [www.vortexx.com](http://www.vortexx.com).



Surface Colors, psi (approximated)

-45 -40 -35 -30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30 35 40 45+

Standard nozzle bottom-hole pressure profile. Standard nozzles do not produce a negative pressure zone.



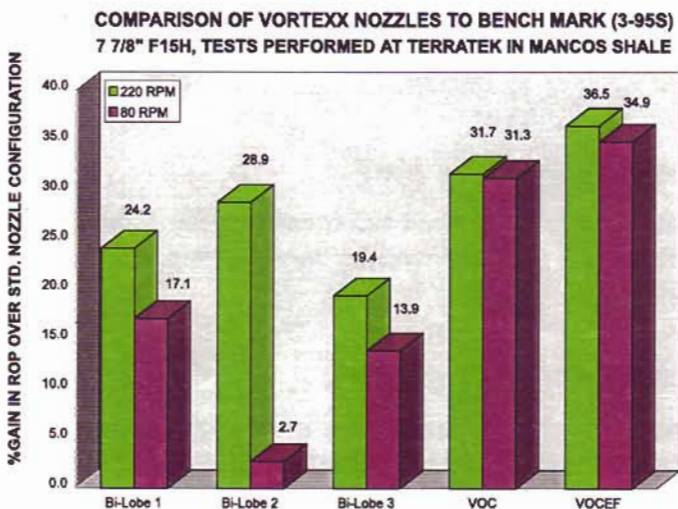
Surface Colors, psi (approximated)

-45 -40 -35 -30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30 35 40 45+

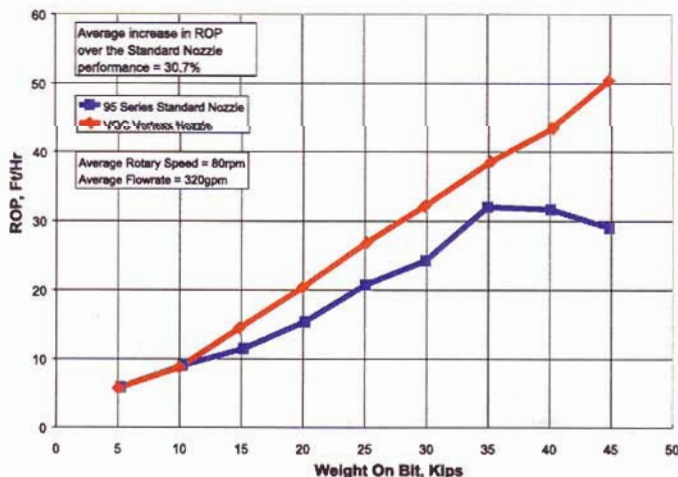
Typical VOCEF Vortexx™ nozzle bottom-hole pressure profile. Vortexx nozzles produce a negative pressure zone.

# LABORATORY DRILLING TESTS

As part of a continuing effort to optimize the performance of the Vortexx™ nozzle, a series of tests have been run at the TerraTek Drilling Research laboratory in Salt Lake City, Utah and Amoco's Drilling Research Laboratory in Tulsa Oklahoma. These tests have shown the significant advantage of the Vortexx™ nozzle over standard nozzle configurations.



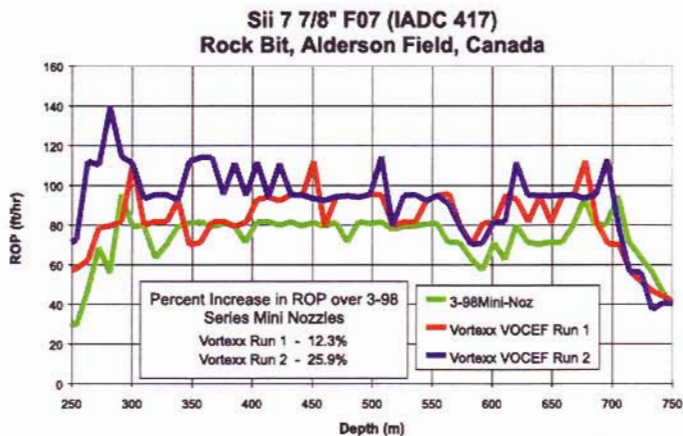
Several tests were run at TerraTek using different styles of Vortexx™ nozzles. The best performance was gained using the VOCEF style nozzle.



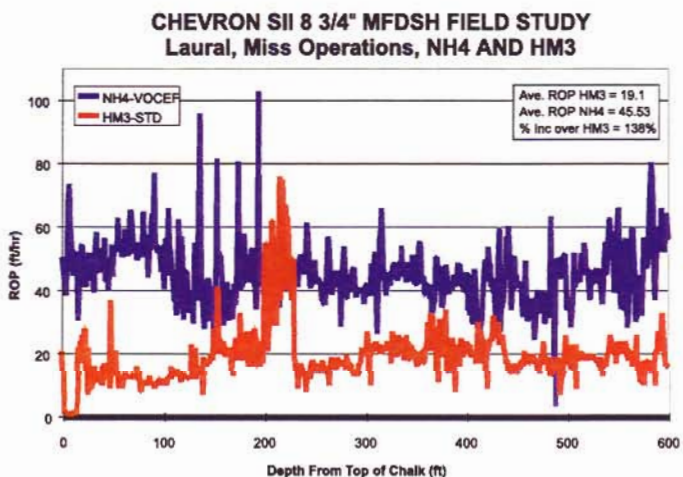
Laboratory test data comparing the performance of a Smith 7 7/8" F15H bit in Catoosa Shale with Vortexx™ nozzles and standard nozzles. Test data courtesy of Amoco Drilling Research Center, Tulsa, Oklahoma.

# FIELD TEST DATA

Several tests have been performed in field applications that have shown a significant increase in bit performance.



Tests were run in Canada to compare standard nozzles to Vortexx™ nozzles. In this application the Vortexx™ nozzles gave penetration rate increases of up to 25% when compared to bits run using mini-extended nozzles.



Chevron saw a significant increase in penetration rate using Vortexx™ nozzles in their Laural Mississippi operations. Data courtesy of Chevron.

Smith Tool is currently involved in an aggressive testing program with Vortexx™ nozzles and is seeking interested companies to participate in controlled hydraulic optimization tests. Please contact your local Smith Tool representative for nozzle availability and selection.

# Vortexx™ Nozzles Benefits

## Reduced Bottom Hole Pressure

Vortexx™ nozzles generate sub-hydrostatic pressure zones on the hole bottom. These low pressure zones reduce chip hold down pressure increasing the penetration rate in applicable applications.

## Increased Fluid Entrainment and Turbulence

The Vortexx™ nozzle increases fluid entrainment and turbulence due to its asymmetric internal geometry. This increased entrainment creates better bulk fluid motion for improved hole bottom and cone cleaning, resulting in faster penetration rates and longer cutting structure life.

## Increased Turbulence and Bottom Hole Cleaning

The asymmetric internal passage effectively increases the level of fluid turbulence which aids in cleaning the hole bottom and cutting structure. This allows for more cutter penetration into the formation increasing the penetration rate.

## Increased Rates of Penetration

Vortexx™ nozzles have illustrated significant increases in rate of penetration in both the laboratory and field test programs over standard nozzle configurations. They have been particularly beneficial in formations that require improved cutter and bottom hole cleaning and/or improved bottom hole sweep for chip removal.



**SMITH TOOL**

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