Hughes Christensen

HedgeHog

Impregnated Bits

Expanding the World
of Impreg Applications

The New Hughes Christensen HedgeHog

We Take a Multi-Layered Approach to Impreg Drilling

It's a tough challenge. When you face drilling applications involving hard, abrasive sandstone interbedded with soft shale, choosing the right drill bit is critical. On one hand, you have traditional diamond impregnated bits, ideal for drilling the hardest formations — but prone to severe balling in softer layers. On the other, you have PDC and Tricone® bits, which perform best in relatively soft, non-abrasive rock, but aren't built to economically take on rock sections containing abrasive sandstone. All of which leaves you stuck somewhere in the middle, right?

Not any more.

Presenting HedgeHog, a revolutionary new twist on the impregnated bit. Featuring an aggressive, balling-resistant cutting structure, optimized hydraulics and advanced matrix material, HedgeHog ushers in a new era in drilling interbedded formations. Offering the same advantages as conventional impregs, HedgeHog raises the bar further by introducing an interrupted cutting structure and optimized blade count that allow the bit to take a bigger bite out of shale formations. Deep junk slots and an innovative ported design maximize hydraulic energy to the hole bottom, while your choice of three different types of diamond matrix — plus three different cone configurations — ensures a bit tailored to the application at hand.

Aggressive. Economical. Advanced.
Welcome to the world of HedgeHog.

The Advantages are Clear

Innovative Cutting Structure

- **Interrupted cutting structure** allows shale to flow between the posts to enable cutting elements to drill more efficiently
- **Post-over-blade design** adds 25 percent more diamond volume than same-size standard impreg bit, significantly extending bit life
- **Overlapped posts** are staggered to increase drilling efficiency and eliminate an uncut bottom
- **Maximized blade count** delivers optimal sand and shale drilling
- **Cone configuration flexibility** allows choice of three cone styles to optimize drilling efficiency and prevent center coring

Cone Types

Cone	Application
PDC	Most aggressive
Ridge Set	Aggressive and durable
Radial Set	Most durable

Hydraulic Efficiency

- **Unique ported design** directs impact force at areas where balling occurs, maximizing hydraulic energy to the hole bottom and bit face
- **Deep junk slots** enhance ROP by optimizing cutting evacuation and limiting hole swabbing during trips

Advanced Matrix

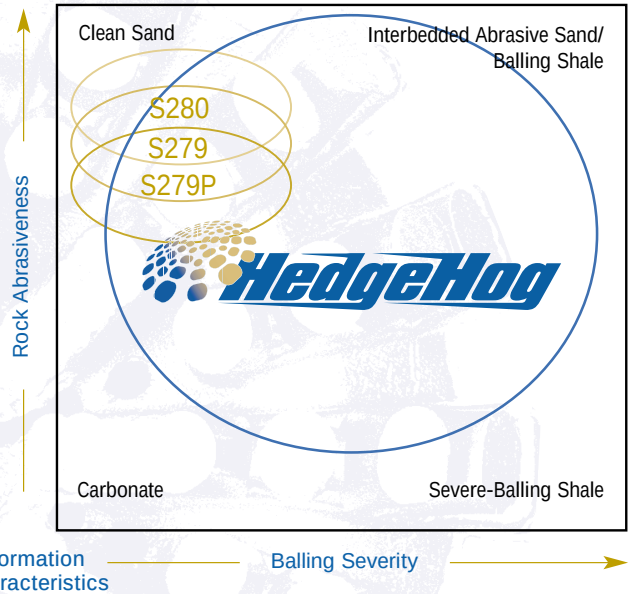
- **Three new diamond matrix types** expand the range of impregnated applications, allowing matrix to be matched to formation

Matrix Types

Matrix	Application
R10	Predominately non-abrasive formations
R30	Interbedded formation drilling
R60	The most demanding abrasive formations

Application Guide for Impregnated Drill Bits

By successfully drilling hard sandstone interbedded with soft shale, the HedgeHog line has dramatically expanded the range of impregnated drill bits.

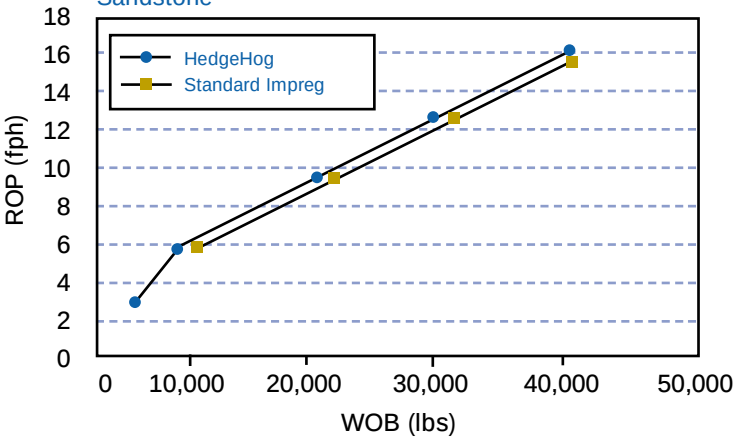


> "HedgeHog ushers in a new era in drilling interbedded formations."

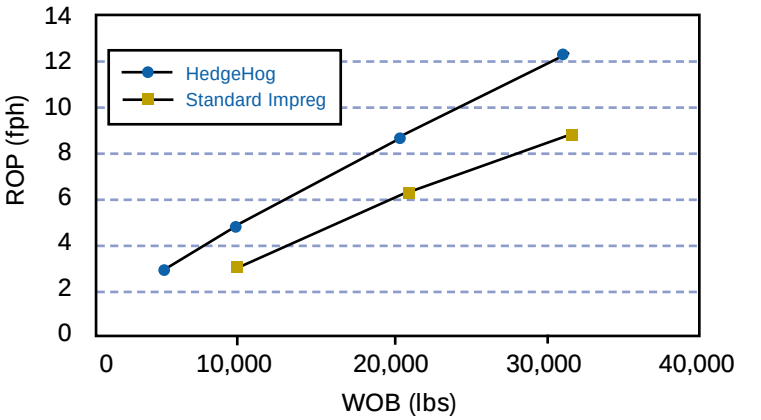
Full-Scale Simulator Tests

When drilling sandstone in full-scale lab simulator tests, the HedgeHog design matches the performance of a standard impregnated design. When testing in shale, HedgeHog drills 30 percent faster.

Sandstone



Shale



HedgeHog Technology Improves Performance

Algeria
6" HH352G8 / Navi-Drill M2PXL

	Standard S280 Average (27 runs)	Standard S280 with R30 Matrix	HedgeHog with R30 Matrix
Meters	112 m	251 m	420 m
ROP	2.1 m/hr	3.7 m/hr	2.5 m/hr
		Set formation distance record for impreg bits	*Set Algerian distance record for impreg bits*

With each technological improvement, our impregnated bits responded with record performance. The addition of the R30 matrix to a standard design resulted in a new field distance record. With the addition of the HedgeHog cutter configuration and R30 matrix, the new design drilled the longest footage ever in Algeria.

Oman: An HH336G89Y set a new 8-3/8" world cumulative footage record

Running on a turbine, HedgeHog's rate of penetration was comparable to a standard impregnated design in sandstone, but showed a **30 percent higher ROP in shale — with NO balling.**

Offshore Alabama, USA: An HH358G89Y set a new 9-1/2" world single-run footage record

HedgeHog drilled 2,047 feet in one run. The new design proved both rugged and flexible enough to address the durability and balling issues of traditional impregs.

HedgeHog Selection Guide

Cone Type	Matrix Type		
	R10	R30	R60
PDC Cone	HH130s	HH330s	HH630s
Ridge Set Cone	HH150s	HH350s	HH650s
Radial Set Cone	HH170s	HH370s	HH670s

Key: **HHXYZ**
- HH = HedgeHog
- X = Matrix Type (1 = R10, 3 = R30, 6 = R60)
- Y = Cone Type (3 = PDC Cone, 5 = Ridge Set Cone, 7 = Radial Set Cone)
- Z = Last digit of blade count

Impregnated Bit Options

G8	Gauge length that is longer than the standard gauge length for a given bit size
G9	Matrix sleeve provides maximum bit stability when drilling high-speed applications
Y	Box-up connection is used for the smallest possible distance between the bit face and the lower bearing stabilizer

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