



Navigator[™] SERIES

DRILLING IN THE RIGHT DIRECTION



THE TRAJECTORY
CONTROL SOLUTION



VAREL
INTERNATIONAL

Specifically designed for directional drilling

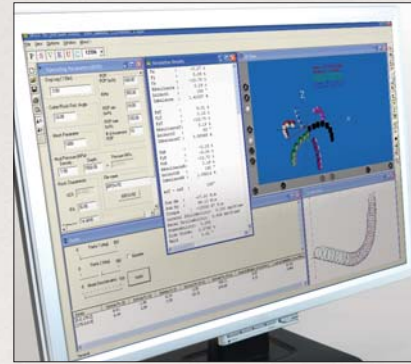
Varel International's Navigator line of PDC drill bits have been designed for maximum performance in directional drilling. Increasingly complex well paths, tighter targets, greater attention to well bore quality and longer extended reaches require drill bits specially engineered for optimal operation of a steering tool's mechanism and geometry, as well as for use with certain rock formations.

Under development since 2004, Navigator series bits have been used on every type of steering system from all major manufacturers to accommodate the entire spectrum of directional drilling requirements.

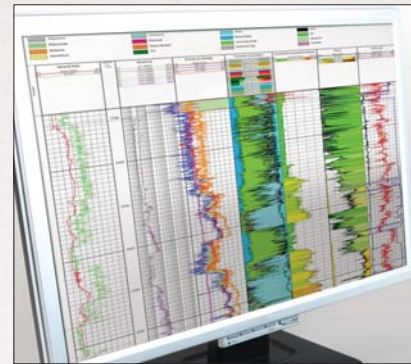
Developed for customization and optimization

Navigator series technology was developed through extensive laboratory testing. Test results were incorporated into the algorithmic engines of Varel's proprietary suite of advanced software analytical tools: GeoScience™ and SPOT™, Varel's cutting structure design and drilling simulation system.

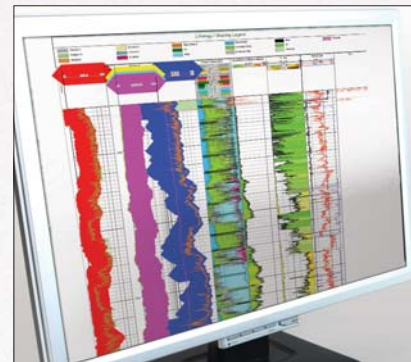
Using these tools, Navigator bit designs can be evaluated, customized and optimized to produce the best possible bit for the operator's specific directional profile and lithology column.



SPOT™ Models Bit Behavior



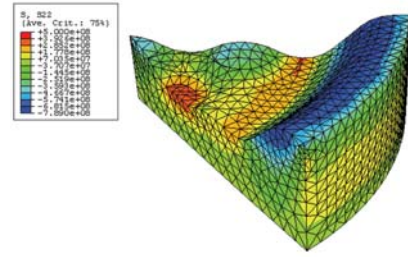
GeoScience™ Analyzes Rock Properties



Navigator Bits Are Customized for Specific Lithologies

High performance PDC cutters

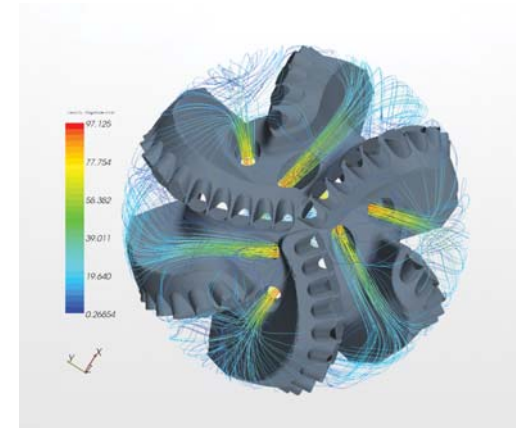
Varel's Navigator bits use application-specific, top-quality PDC cutters. Our cutters are manufactured with advanced carbide interface geometries to enhance impact strength.



Finite Element Analysis (FEA)

Computational fluid dynamics

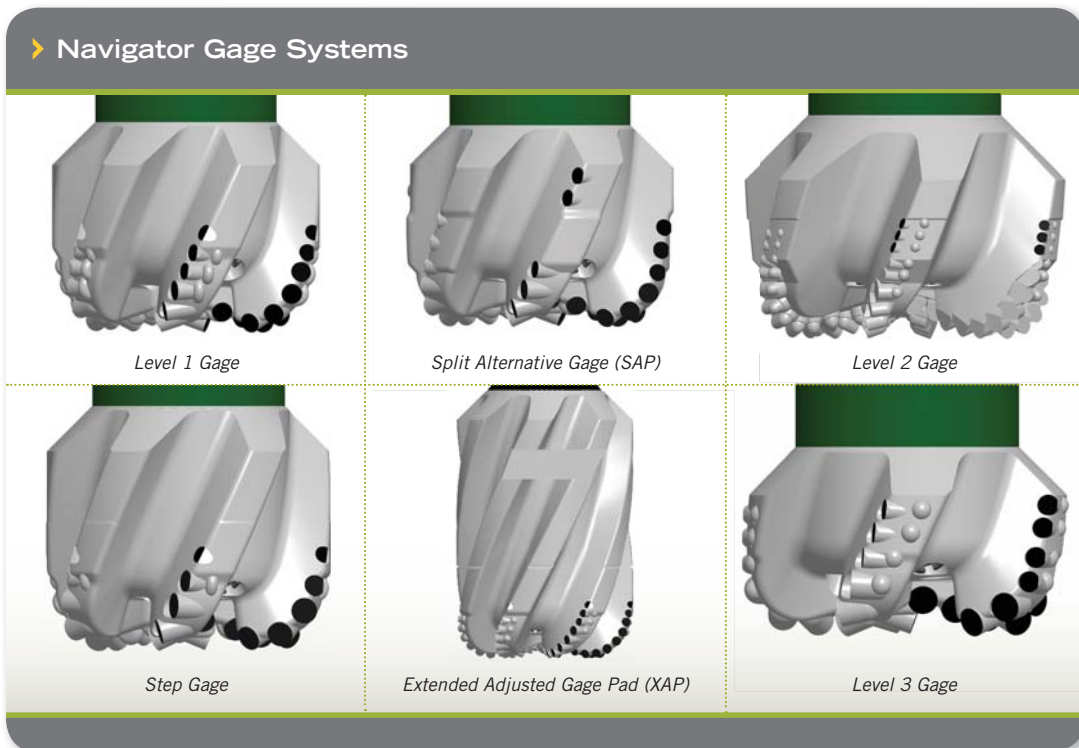
Steering response can be negatively influenced by poor borehole quality. An over diameter well bore will not allow the steering tool to work properly. Varel uses computational fluid dynamics (CFD) analysis to ensure proper bit cleaning, while at the same time working to reduce hydraulic enlargement of the hole.



Computational Fluid Dynamics

Specifying the correct gage for the system

The gage section of a PDC bit must be matched to the cutting structure to achieve the desired steering response. Varel has performed laboratory and field tests on over 25 different gage configurations to validate the Navigator series gage design matrix. It is this matrix that is used to match a specific Navigator bit to the rock formation, well design and steering system.



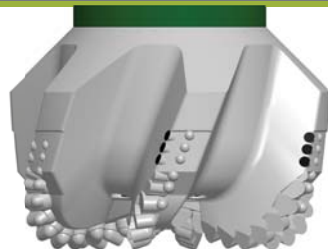
Navigator Gage Systems



Level 1 Gage



Split Alternative Gage (SAP)



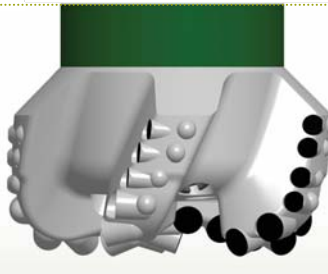
Level 2 Gage



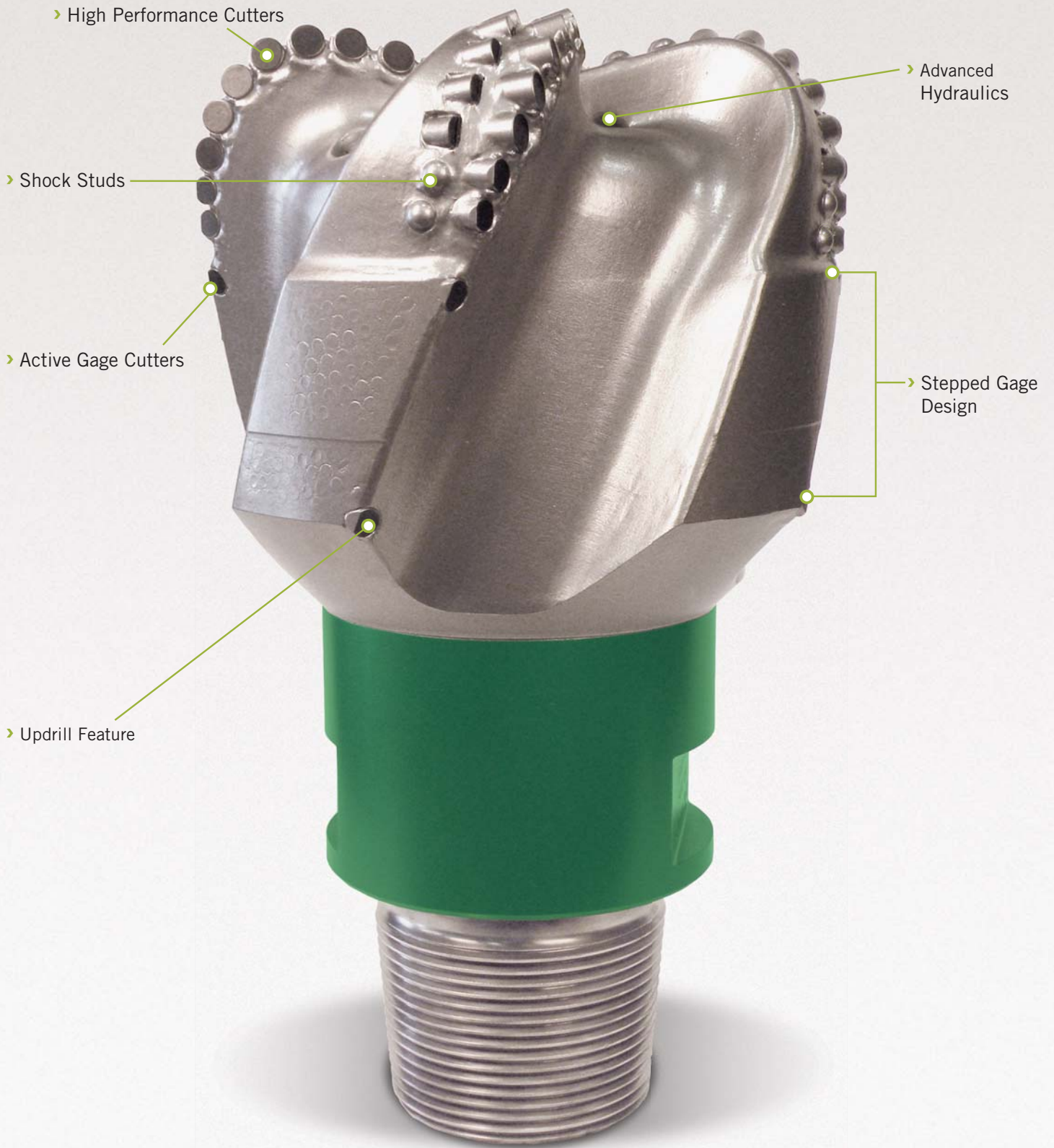
Step Gage



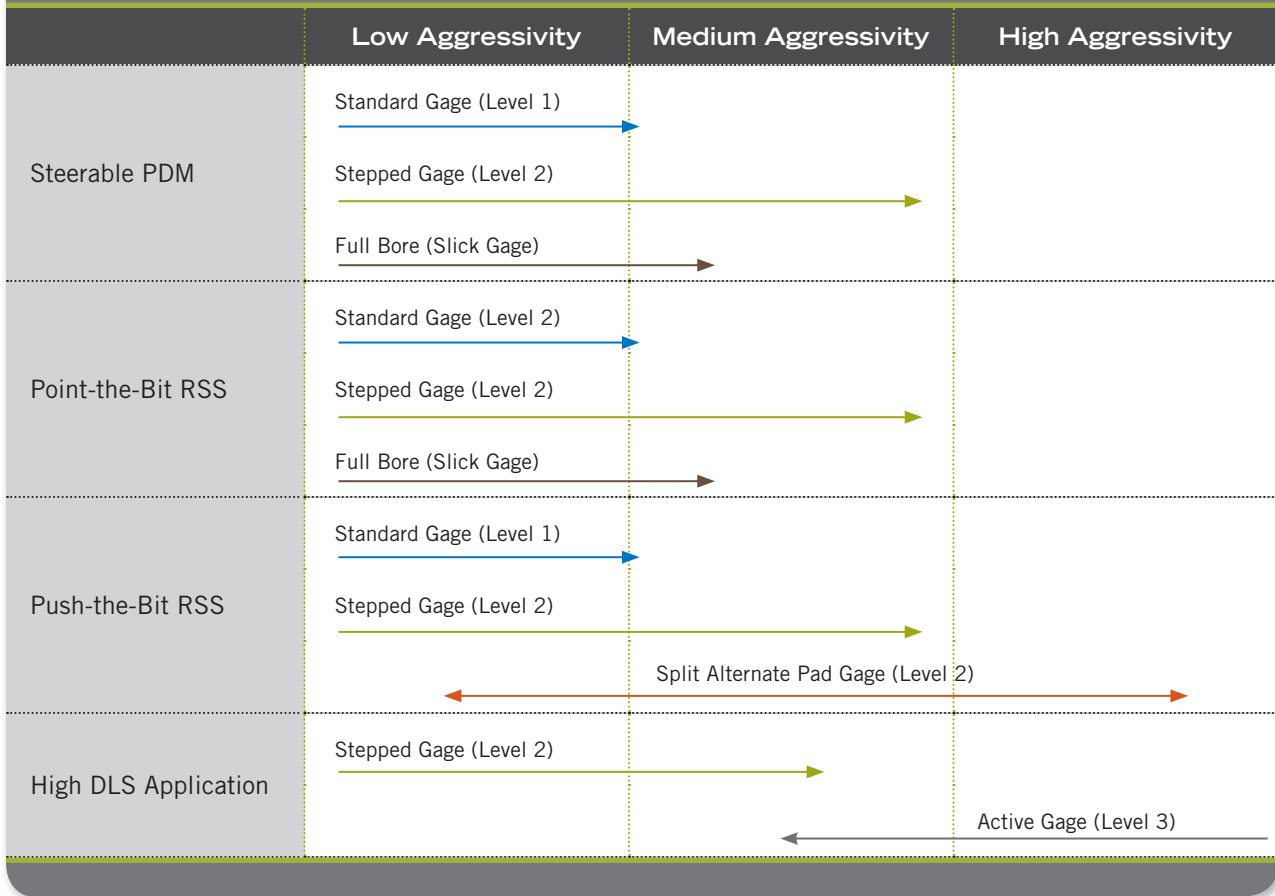
Extended Adjusted Gage Pad (XAP)



Level 3 Gage



› Fixed Cutter PDC Bit Gage Application Matrix



Putting it all together

Navigator bits are analyzed for force balance, axial and lateral displacement. Each Navigator bit has a steerability factor calculated into it. The bit is simulated in conjunction with the expected side forces generated by the specific steering tool being used.

Adapted to work with a variety of drilling systems

As the largest independent supplier of PDC drill bits worldwide, Varel is in a unique position to adapt drill bits to steering tools from a broad spectrum of suppliers.

› Navigator Series Bits Run on the Following Systems

Manufacturer	System Model	System Type
Baker Hughes	Auto Trak ®	RSS - Push/Point
	Verti Trak ®	RSS - Push
Schlumberger	PowerDrive X5*	RSS - Push
	PowerDrive Xceed*	RSS - Point
	PowerV*	RSS - Push
Halliburton	Geo-Pilot ®	RSS - Point
	SlickBore ®	PDM - Directional
Smith Pathfinder	Pathmaker ® 3D	RSS - Point
Weatherford Precision	Revolution ®	RSS - Point

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**PowerDrive X5, PowerDrive Xceed and PowerV are marks of Schlumberger.*





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SERIES



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