Force³ Cutter
TECHNOLOGY

The right cutter for the right bit.
FORCE™³ CUTTER TECHNOLOGY ENSURES THE PERFECT CUTTER FOR YOUR SPECIFIC DRILLING OBJECTIVES

Varel Force³ cutter technology provides data that allows our designers to compare an array of Polycrystalline Diamond Compact (PDC) cutters for a specific solution to your drilling application. Varel engineers select cutters based on a set of criteria defined by your particular drilling requirements. As a result, you get a bit that is designed for maximum performance for your unique situation and maximum value for your bottom line.

VAREL CUTTER SCIENCE CHART

Here, we see 19 separate cutters plotted reflecting their attributes as they’re related to Impact Strength, Abrasion Resistance, and Thermal Stability.
HARNESSING DATA FOR OPTIMAL SOLUTIONS

Data from the field is critical to optimizing bit performance. We analyze each cutter’s ability to handle thermal stability, abrasion resistance, and impact strength. The precision of these cutter attributes becomes increasingly important to overall bit performance where thermal solicitations, abrasion, and impact are present. The ability to precisely select PDC cutters for the application can significantly improve ROP and durability.

A SUPERIOR PROCESS FOR BETTER RESULTS

The Force³ cutter technology process aligns laboratory testing and analysis with wellbore reality using a suite of patented innovative, proprietary technologies. These tests precisely measure and compare cutters and changes in cutter properties so that thermal, abrasion, and impact characteristics are fully optimized for the formation and drilling objectives. Our rigorous quality control process also ensures the greatest cutter reliability under operating conditions.

MAXIMIZED PERFORMANCE THROUGH COMPREHENSIVE ANALYSIS

Optimal cutter selection requires first understanding the intended application, so that the best bit solution and cutters for the task may then be engineered. By integrating field experience with run data, formation type, and laboratory test results verified through field testing of bit designs, Varel is able to provide an application-specific, high performance bit.

Our field engineers and technical team work closely with the operator to define the drilling application and objectives. Critical geological data such as drilling logs, mud logs, and rock properties are assembled to create the well lithology.

We review operational parameters such as wellbore geometry, the fluid type to be used, and BHA and drive system energy levels applied to the system. By comparing bit runs from offset wells to the planned well, we can identify and address operational concerns and issues.
INTEGRATED SOFTWARE SUITE

PDC bit design is a complex process that brings together mechanical and hydraulic requirements, cutter properties, placement of cutting elements, and a balance of torque reactions across the bit while optimizing cutting action. Varel design engineers employ a suite of innovative, proprietary tools focused on bit design and PDC cutter performance. The integrated suite of software allows the designer to custom design a bit for the customer’s specific drilling challenge.

› GeoScience™ is a powerful tool that reconstitutes lithology and formation mechanical properties from e-logs and drilling-logs. Output from GeoScience provides an idea of the types of rock encountered in the logs based on hardness, abrasiveness, porosity, and many other parameters. GeoScience output is imported directly into Varel bit design software, SPOT-DN, allowing the bit designer to evaluate the design in an environment that represents the rock to be drilled.

› SPOT-DN™ bit design software evaluates the selection of cutters, bit geometry, and features of a proposed bit. Modeling bit behavior in SPOT-DN allows fine-tuning of the complex bit-formation interaction, cutter wear resistance, and directional behavior of the proposed bit. The GeoScience formation evaluation along with mud type, borehole direction, and operating parameters input allow the designer to virtually approximate ROP, steerability, walk tendencies, and bit life in different formations and drilling conditions.

CUTTER TRIANGLE DIAGRAM

On each triangle leg is an attribute value relative to the baseline cutter. As these relative values change, attribute value travels along its respective leg, changing the percent of performance relative to the baseline cutter.

Cutter characteristics are interrelated and emphasis on one may occur at the expense of the other. This relationship among thermal stability, abrasion resistance and impact strength is plotted to illustrate the performance of a proposed cutter relative to a second, baseline cutter.
IN-DEPTH TESTING

VERTICAL TURRET LATHES TEST (VTL)
VTL is a heavy industrial machine modified to examine the relationship between PDC thermal and abrasion characteristics. The machine is capable of cutting rock at constant surface speeds at loads exceeding field operating parameters for cutters. The VTL is equipped with a triaxial load cell, computerized data collection, and cameras so that each cutter tested is photographed to document wear progression and failure modes during intervals of testing.

ACOUSTIC EMISSION TOUGHNESS TEST™ AETT studies the impact strength of PDC cutters. The patented test precisely measures the strength of the PDC's diamond-to-diamond bonding by applying an increasing load to the cutter and measuring the acoustic emissions from resulting micro fractures. A brittle cutter will fracture more readily than a more ductile cutter to produce a larger acoustic reading. Each cutter design is tested multiple times at multiple points on the cutter to produce high quality and repeatable data.

Combining the VTL and AETT output data allows Varel to characterize PDC cutters based on abrasion resistance, impact strength, and thermal stability. The AETT and VTL data is then integrated within SPOT –DN to allow the designer to select each cutter on a bit to be optimized for anticipated operating conditions. The Varel integrated software suite puts the power of customized PDC bit design in the hands of our designers and as close to the customer as possible.

ASSURED CUTTER QUALITY
Consistent cutter quality is a key factor in comparing cutter performance. Varel ensures that quality with a unique, non-destructive capacitance test to inspect incoming cutters. This patent-pending test provides a critical leaching profile that can be broadly applied without destroying the cutter.

The introduction of capacitance measurement allows very accurate determination of leaching depth without loss of the cutter. As a result, cutter consistency and quality is more thoroughly determined, assuring a true baseline measurement for testing and allowing detailed comparison among cutters from different manufacturers.
Efficient drilling operations based on ROP and durability are central to fixed cutter bit selection. Varel removes the guesswork from the equation and replaces it with data-backed analysis that results in tougher, longer-lasting, better-performing bits. Call Varel Oil & Gas Drill Bits toll-free today at 1.800.827.3526, or send an email to info@varelintl.com to hear how Force³ Cutter Technology can revolutionize your next well.