

DRILLING TECHNOLOGY

Varel International. Operators continue to demand increased energy inputs on drillbits through greater WOB and higher RPMs for faster drilling. This energy causes additional stress to the internal components of the drillbit and can cause issues downhole. Drillbit technology has evolved to meet the industry demand by offering solutions to thermal degradation of drillbit components and more effective cleaning of the wellbore for greater efficiency.



Fig. 16. Varel's High Energy series roller cone bit.

Varel International developed the High Energy roller cone series to address and meet these industry requirements, Fig 16. The company used a systematic approach and produced a series that can reliably withstand high energy inputs while maintaining drillers' expectations of high ROP and increased footage.

Seal enhancements in this new series led engineers to two patent-pending innovations; the seal gland geometry and a thermal heat shield. The Varel team developed a conical seal gland which positions the seal in such a way that it can better handle pressure fluctuations and still maintain a preferred sealing location and interface. The addition of a heat shield disc deployed between the seal and

the inner bearing acts as a thermal insulator, protecting the seal from excessive thermal energy.

The improved seal/bearing system incorporates a more robust journal bearing in order to support heavier loads. This was accomplished by reducing bearing clearance variations and restructuring the bearing areas. An additional modification is the advanced lubrication compensation system, featuring a self-draining reservoir chamber to reduce cuttings build-up adjacent to the top of the reservoir, protecting components from damaging debris. These enhancements work together to improve the longevity of the seal/bearing system and extend the life of the drill bit.

Precision hydraulics and cleaning efficiencies. The V-jet enhanced hydraulics package is included in the series to provide improved hydraulic and cleaning efficiencies. The package provides precision aiming of the nozzle flow to achieve excellent cuttings cleaning of the teeth while also avoiding erosion of the bit's cones and the borehole wall due to recirculation.

Bridgeable technology. Varel has created a closed-loop system, specific to drilling applications, for drillbit design and optimization. By exploiting the synergies of their multiple software platforms, software engineers bridged separate pieces into a more holistic system. Instead of stand-alone products, the company has developed a process for drillbit optimization: the output of one software tool is the direct input to another simulator.

GeoScience, Varel's proprietary well log, lithology and rock property analysis software, uses customer-supplied mud logs, drilling logs and electric log data to build a virtual model of the well sections to be drilled. During this process, offset bit performance is evaluated using a specific energy method and a proprietary criterion named Drilling Impedance (DRIMP) that allows for correlation across different bore diameters. The method allows the program to more accurately define the cutting structure, type and size of PDC cutter to be recommended for the application through its output.

Using the GeoScience outputs as a

guide, the drillbit design and custom cutting structure is then created with the SPOT (Simulateur Pour l'Optimisation des Trépan) software package. This engineering tool can predict a PDC bit's directional behavior and cutting structure efficiency and match that with the operations needs in term of bits directional signature as well as provide a performance prediction for the lifespan of the bit. Based on the combination of these two software packages, a complete simulated well is possible. The design is modeled and the cutting structure is analyzed in the defined application and environment and with the particular drive that will be used.

After reviewing the results, an optimized cutting structure is modeled and run again in the numerical drilling simulator to verify that the modification is addressing the required necessary optimizations noticed in the first cutting structure iteration. The bit signature is defined and parameters guiding the manufacturing of the bit are delivered. **WO**