Kaldera
Roller Cone Products for Geothermal and High-Temperature Applications
Challenging downhole environments

High-temperature (HT) drilling applications, particularly in geothermal wells, present a very challenging environment for roller cone bits. Downhole operating temperatures can reach 350 degF and exceed 500 degF in some applications.

Such extreme heat adversely affects traditional bit bearing system materials causing seals to fail and lubricants to break down. This depletion quickly erodes bearing functionality, which leads to a premature loss of bit durability that shortens interval runs and increases bit trips—all of which drive up drilling costs. Accordingly, improving the reliability of bearing system materials is essential to operational efficiency in HT applications.

Innovative composite elastomers extend seal durability

To produce a bit that could drill efficiently in high-temperature applications, the Smith Bits research and development team undertook a search to find new materials that could endure extreme heat and degradation. This effort led to the identification of compounds known as fluoroelastomers, which display excellent resistance to heat and chemicals.

By augmenting these compounds with new support materials, a seal with an increased resistance to wear and the durability essential for high-temperature environments was developed. To further extend seal endurance, a specialized fabric layer was applied to the dynamic face of the seal. This resulted in a proprietary composite seal that has higher thermal stability, increased strength, and a greatly improved resistance to wear. Additionally, an optimized seal gland design was adopted to block abrasive particles from entering sealed areas and damaging the bearing system.
Load capacity enhancement through advanced lubrication
Because bearing and seal functionality depend on lubrication, grease is another key bearing system material. To ensure adequate lubricity of these vital components, the R&D team also developed a specialized high-temperature grease compound.

Using selected synthetic base oils and engineered additives, the newly developed grease improves load capacity at elevated temperatures. This ensures that the bearing system will effectively support the bit’s drilling capability for the service life of its cutting structure.

A system solution
The seal and grease developments have been combined with other aspects of the bit to improve performance for demanding HT applications.
- Finite element analysis (FEA) optimized seal geometry and gland design
- Robust grease reservoir system with fluoroelastomer components
- High-load capacity bearing design and materials
- Computer numerically controlled (CNC) precision manufacturing tolerances

Combining these design elements with advanced cutting structures developed through IDEAS* integrated drillbit design platform, produced a roller cone bit that offers improved reliability and drilling performance in the world’s most challenging downhole environments.

Proven Performance
Larderello, Italy geothermal production well
- Three, 8½-in Kaldera* bits were used to drill hard and abrasive granite/metamorphic formations with 320- to 350-degF temperatures and spikes up to 570 degF.
- The bit’s new seal and grease formula enabled a 37% increase in total on-bottom drilling hours compared to an offset well drilled with standard roller cone.
- A Kaldera bit set a new field record for on-bottom drilling time of 77 hours; total bit revolutions of 300,000 revs were compiled with all seals effective; a 20% improvement from the best offset well bit runs.
High temperatures
Challenging environments
Harsh operating conditions