

Tensor Elite™- the Hi-Temp Tensor MWD

In recognizing the requirement for a reliable MWD platform that provides a predictable and reliable performance for use in high temperature, 175 °C/ 347 °F, high vibration operations, Tensor Drilling Technologies has developed Tensor Elite™, a system which that surpasses all existing HT tools in its class. This allows operators and service companies to drill with greater confidence through less frequent bit trips and lower cost of operations.

Tensor MWD has always been the standard for low-cost, high temperature MWD. This was taken to a new level of reliability and electronic stability with the release of the Directive MWD system. Tensor Drilling Technologies have now further developed the system to deliver Tensor Elite - the market leading system for those demanding high reliability and accuracy while maintaining a low total cost of ownership.

Tensor Drilling Technologies understands that by mitigating electronic and mechanical failures while maintaining reliable data transmission in extreme drilling environments and sustained temperatures of up to 175 °C/ 347 °F the Tensor Elite system opens up new and lucrative markets to operators of all sizes.

By building on the proven Tensor MWD architecture the Tensor Elite system can maintain low cost of ownership. Coupled with the best-in-class support offered by Tensor Drilling Technologies users can trust Tensor Elite to deliver continued success in the most challenging of environments.

Key Upgrades

Rotary Connectors

High Temperature Rotary Connectors are used between all tool modules delivering improved performance at high temperature and under high vibration. Easier, and more reliable, tool assembly at the rigsite minimizes risk of operator error and electrical damage to the tool.

Integral Centralizers

Standard Centralizers are replaced with one-piece sleeves over the Rotary Connectors. This shortens the tool length bringing sensor measurements closer to the bit while also reducing toolstring harmonic vibrations. The simplified design also helps reduce maintenance time and cost.

Pulser

The Tensor 175 °C Solenoid Pulser is upgraded to provide better mechanical performance and improved reliability:

- Sealing - redesign of key components ensures perfect sealing across the entire operating envelope.
- Elastomers - Industry leading elastomers maintain performance in the harshest of drilling fluids at 175 °C.
- Wash Resistance - Redesign of housings offer greater resistance during high flow in imperfect drilling fluids.

Bottom End

The upgraded Bottom End delivers outstanding and reliable performance in the toughest of environments. Key components have been replaced to improve internal sealing and wear resistance, while other modifications improve Poppet seating force.

Muleshoe

The Muleshoe is upgraded to offer improved resistance to wash and wear in high flow rates through the use of market leading coatings and inserts. Together with the Bottom End, a locking mechanism ensures the toolstring cannot unseat during high-inclination operations.

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Snubbers

Snubbers are used in all modules to isolate electronics from downhole vibration. By upgrading to market leading Snubber assemblies Tensor Elite removes a major cause of system failure, which in turn reduces the number of costly repairs. In accelerated endurance testing the new Snubber assemblies demonstrate over 2000 hour service life without maintenance and prove to considerably reduce the amount of vibration related downhole failures.

Toolstring Axial Isolator

An additional module is positioned between the Bottom End and the Pulser to isolate the toolstring from the axial shock and vibration that are common in the harshest operations. The system utilizes a nonlinear elastomer spring and damper elements, which improve reliability and shorten maintenance cycles versus conventional metal spring with fluid compensation alternatives. A reduction of 70-80% in axial shock events is achieved.

Batteries

Battery cost is reduced by moving the pigtail connector to the Rotary Connector. High Temperature cartridges, rated for use between 100-180 °C/ 212-356 °F, replace standard cartridges in operations <150 °C/ 302 °F.

Wiring Assemblies

The manufacture of all wiring harnesses, including the Directional Module Uphole Snubber Pigtail (Transorb) has been revised for improved performance at elevated temperatures and sustained vibration.

Seals

Industry leading elastomers are used on all tool modules, ensuring performance at temperature limits.

Sensor Specifications

Directional	Tri-axial fluxgate magnetometers and Q-flex accelerometers		Gamma	NaI Scintillation
Measurement	Range	Accuracy	Parameter	Specification
Inclination	0 - 180°	+/- 0.1°	Memory Update	18 samples/ m at 20 m/hr
Azimuth	0 - 360°	+/- 0.25°	Real Time Update	9 samples/ m at 20 m/hr rotating 6 samples/ m at 20 m/hr sliding
Toolface - Magnetic	0 - 360°	+/- 0.5°	Resolution	1 API
Toolface - Gravity	0 - 360°	+/- 0.5°	Sensitivity	2.5 counts per API
TMF	0 - 100 μT	+/- 0.075 μT	Memory	32 Mb.
Dip	-90 - 90°	+/-0.15°	Sampling Period	Programmable 1-60 seconds
GT	0 - 2.000 g	+/- 0.001 g		
Temperature	-35 - 200 °C	+/- 0.5 °C		
Peak Shock	0 - 250 g	+/- 1 g		

Technical Specifications

Probe OD	1.875 in./ 47.6 mm	Max. Pressure	20 kpsi/ 137.9 MPa	Max. Sand	0.5 %
Max. Temperature Operating	175 °C	Max. Temperature Survival		175 °C	
Max. LCM Tolerance	40 ppb/ 114 kg/ m ³ evenly mixed medium nut plug				