

Tolteq Hellfire MWD Configuration

The Tolteq™ Hellfire measurement-while-drilling (MWD) configuration was built from our highly successful Tolteq MWD product line specifically for harsh, vibration-prone, and high temperature conditions for wells in North America. The Hellfire name exemplifies the capabilities of our technologies that revolve around higher temperature ratings, better reliability in harsh conditions, and faster and more robust communication.

Combining the Tolteq NXT top-mount pulser with the new NXT directional module and the NXT GUIDE decoder, the Tolteq Hellfire MWD system delivers strong, fast pulses transmitting the latest directional measurements from a vibration-resistant tool string. The Tolteq Hellfire MWD can be customized to meet a wide variety of applications through our low-cost pressure-while-drilling (PWD) and azimuthal gamma options that are available.

All Tolteq tools are fully designed and manufactured by NOV in-house using the latest manufacturing techniques and design standards to avoid compatibility and interface issues.

Field-ready kits

Tolteq Hellfire MWD tools are available as a ready-to-deploy kit. All Tolteq modules are rated to 347°F (175°C) and 20,000 psi, providing performance in a wide variety of applications. The Tolteq Hellfire configuration includes the following modules:

- NXT Directional Module (iDM NXT)
- Top Mount Pulser (4.75", 6.50" and 8.00" sizes available)
- Ruggedized gamma module (iRGM)
- SureMate™ centralizers
- NXT GUIDE integrated decoder and rig floor display



Specifications

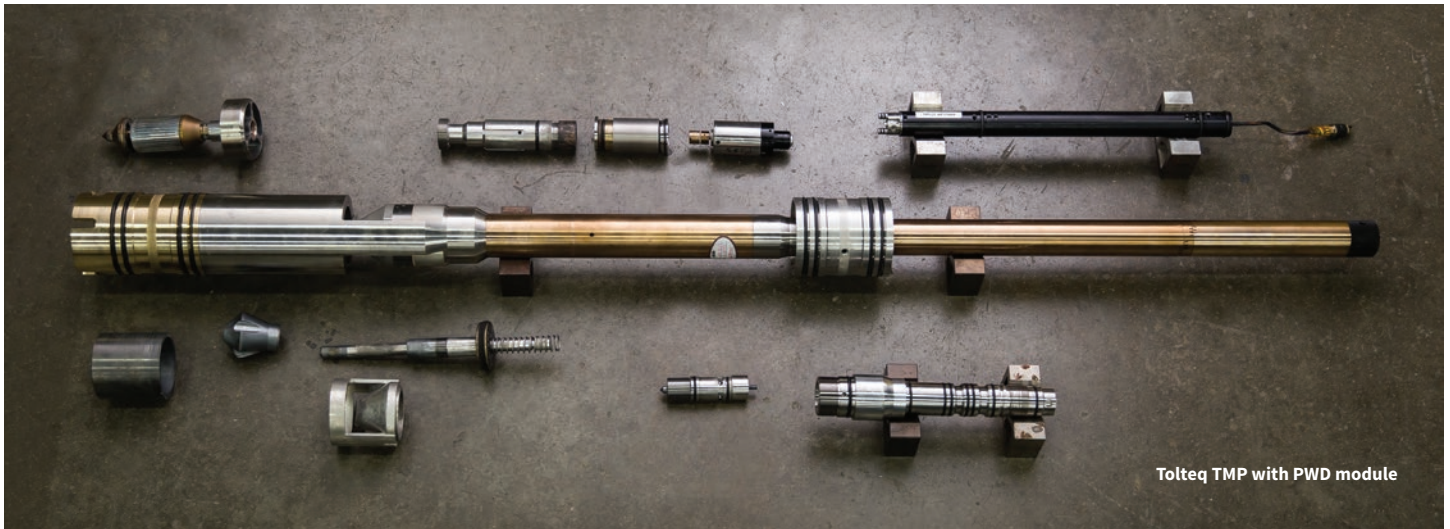
General and environmental

| | |
|------------------------------|-------------------------------|
| Outside diameter | 1.875 in. (47.6 mm) |
| Operating temperature | 32 to 347°F (0 to 175°C) |
| Survival temperature | -40 to 365°F (-40 to 185°C) |
| Flow range | 200 - 1200 GPM |
| Vibration, random | 20 g RMS, 10 to 200 Hz |
| Shock | 1,000 g, 0.5 m Sec, half-sine |
| Maximum data rate | 4.0 bps |
| LCM tolerance | 60lb/bbl |
| Battery life | Up to 400 hours per battery |

Measurements

| | | |
|---|---|------------------|
| Standard measurements | 6-axis static surveys, continuous inclination and azimuth, gamma, shock and vibration, RPM, and temperature | |
| Inclination: | Precision | ±0.1° |
| | at 5° inclination: | Precision ±0.75° |
| Azimuth (magnetic dip angle at <70°) | at 10° inclination: | Precision ±0.5° |
| | at 90° inclination: | Precision ±0.2° |
| Continuous inclination (cInc) accuracy up to 150 RPM | | |
| cInc (Inc <10°) | -1.0 / +3.0° | |
| cInc (Inc >10°) | +/- 0.5° | |
| Continuous azimuth (cAzM) accuracy up to 150 RPM | | |
| cAzM (Inc <45°) | +/- 15° | |
| cAzM (Inc >45°) | +/- 5° | |
| Tool-face accuracy, axial rotation, 10 through 90 inc | ±1.0° | |
| Total g field accuracy, absolute | ±3.0 mg | |
| Total H field accuracy, absolute | +/- 4.0 m Gauss | |
| RPM measurements 10 to 255 RPM | ±0.5% of value | |
| Gamma accuracy | +/- 0.5 cps | |

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Reliability-driven design

The Tolteq Hellfire MWD has earned a reputation for leading reliability even in the harshest of conditions as a result of a reliability-driven design philosophy. The Hellfire combination includes several unique enhancing features including: :

- SureMate connectors – proprietary connector design minimizes risk of damage during assembly and operation
- Ruggedized gamma module – patent-pending floating gamma chamber that isolates the fragile internals from destructive shock and vibration, enabling industry-leading shock and vibration specifications
- ToolTracker™ – included on all modules, this patented system enables users to track and monitor the downhole conditions experienced by each module and apply condition-based maintenance programs

Advanced capabilities

The Hellfire combination provides Tolteq owners with the additional capabilities needed for today's North American drilling applications. With continued development leveraging NOV's world-class R&D facilities, directional drillers can be assured that Tolteq MWD products will remain the leading independently manufactured MWD solution in the market.

- Advanced directional module (iDM NXT)
- High data rate pulsers (TMP NXT)
- Pressure while drilling (optional on TMP)
- Azimuthal gamma (iAZG)

Next generation pulser

The Tolteq Hellfire MWD System comes equipped with the latest generation Tolteq NXT Top Mount Pulser (TMP) which provides the greatest combination of power efficiency and pulse quality available anywhere. The Tolteq NTX TMP also provides several key advantages over older bottom-mounted (retrievable) pulsers including:

- Rigid collar mounted design eliminating the need for failure prone shock mitigation tools
- Increased LCM tolerance and resistance to 'packing off' or 'plugging up'
- Increased flow area over the main valve allowing for stronger and cleaner pulses even in extremely long laterals
- Pressure-assisted solenoid design enables power efficient fast pulsing at up to 4.0bps