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MDT Forte and MDT Forte-HT

Rugged and high-temperature modular formation dynamics testers

APPLICATIONS

- Challenging environments: deep water, remote operations, drillpipe conveyance, high temperature, high pressure, and harsh operating conditions
- Formation pressure measurement
- Accurate determination of pressure gradients and fluid contacts
- Reservoir fluid characterization through downhole fluid analysis (DFA)
- Identification of compositional grading
- Formation fluid sampling
- Sample assurance: single phase and purity
- Identification of compartments and lateral sealing boundaries
- Formation permeability and permeability anisotropy measurements
- Reservoir simulation (equation-of-state [EOS] modeling)
- Asphaltene gradient determination and heavy-ends EOS modeling
- Identification of volatile oil and gas condensate
- Determination of gas/oil ratio (GOR) and condensate/gas ratio (CGR)
- In situ stress determination

The extensively qualified MDT Forte*rugged modular formation dynamics tester and MDT Forte-HT* rugged high-temperature tester are a complete redesign and reengineering of the workhorse MDT* modular formation dynamics tester for sampling and formation testing. By extending the reliability, efficiency, and applicability of the MDT tester platform while minimizing operational risk, the MDT Forte and MDT Forte-HT testers are run with Quicksilver Probe* focused extraction and the Saturn* 3D radial probe to deliver robust DFA using the InSitu Fluid Analyzer* system along with fluid sampling and transient testing to meet the challenges of today's oilfield operations.

Extensive qualification testing of the design, components, and entire tester systems proves that the MDT Forte and MDT Forte-HT testers tolerate excessive vibration at all stages of use: from low-frequency shaking during transit to high-impact shock and vibration downhole at extreme temperatures. The redesigned electronics system incorporates surface-mounted components on a ruggedized chassis that overcomes the conventional fragility of electronics when operating in tough logging conditions. Qualified for 100 cumulative operating hours at temperatures up to 400 degF [204 degC], the testers are ideally suited for operations in the most challenging environments, such as deep water, drillpipe conveyance, HPHT wells, and remote operations.

The innovative modular design of the MDT Forte and MDT Forte-HT testers means that the tester components are readily customizable to meet operational requirements:

- Telemetry system with greatly expanded capabilities means that the length of the toolstrings is limited primarily by the cable strength and well conditions. Using extended tool combinations to meet multiple objectives in one trip results in significant efficiency gains and cost savings.
- Next-generation Axton* dynamically compensated single quartz gauge has an operating range to 410 degF [210 degC] and 31,500 psi [217 MPa]. Calibration to 30,000 psi [207 MPa] and 374 degF [190 degC] or to 20,000 psi [138 MPa] and 392 degF [200 degC] ensures consistent pressure metrology performance with the same accuracy and resolution expected in standard conditions.
- High-temperature InSitu Density* reservoir fluid density sensor helps manage the challenges of sampling formation fluids from HPHT reservoirs by monitoring contamination levels in addition to indicating compositional grading and fluid gradients.
- Dual-Packer Module comprises two inflatable packer elements with an asymmetrical design that reduces the risk of sticking and fishing, with downtime further reduced through greater durability, longer replacement cycles, and more stations per run. By sealing against the borehole wall to isolate an interval of the formation, the dual packers significantly improve the effectiveness of pressure measurement and fluid sampling in low-permeability, laminated, or fractured formations.
- Advanced sealing technology of the O-rings of the MDT Forte-HT tester feature carbon nanotube technology. The engineered material provides the strength to withstand downhole effects and ensure extended sealing performance to capture and confidently retain HPHT samples.
- Advanced Pumpout Modules, rated from standard conditions through extra-extrahigh pressure provide an increased flow area and enhance run time, resistance to plugging, and solids handling.
- Multisample Modules are used to collect and subsequently transport high-quality samples of formation fluids for PVT analysis. The Single-Phase Multisample Chamber is HPHT rated and pressure compensating for single-phase sampling.

MDT Forte and MDT Forte-HT

Specifications		
Measurement		
	MDT Forte Tester	**MDT Forte-HT Tester**
Output	Formation pressure; ultralow-contamination fluid samples; downhole fluid analysis; flowline pressure, resistivity, and temperature; permeability and permeability anisotropy; in situ stress	
Logging speed	Stationary	
Range of measurement	Quartz gauge: 750 to 15,000 psi [5 to 103 MPa] Resistivity: 0.01 to 20 ohm.m Flowline temperature: –40 to 350 degF [–40 to 177 degC]	Axton gauge: 0 to 30,000 psi [207 MPa] to 374 degF [190 degC] and 0 to 20,000 psi [138 MPa] to 392 degF [200 degC][†] Resistivity: 0.01 to 20 ohm.m Flowline temperature: –40 to 400 degF [–40 to 204 degC]
Resolution	Quartz gauge: 0.008 psi at 1.3-s gate time Resistivity: 0.001 ohm.m Temperature: 1.0 degF [0.5 degC]	Axton gauge: 0.008-psi rms at 1-s gate time Resistivity: 0.001 ohm.m Temperature: 1.0 degF [0.5 degC]
Accuracy	Quartz gauge: ±(2 psi [13,789 Pa] + 0.01% of reading)[†] Resistivity: ±0.01 ohm.m Flowline temperature: ±1.0 degF [±0.5 degC]	Axton gauge: ±2.0 psi [±13,789 Pa] for typical HPHT operational range (>212 degF [>100 degC] and >15,000 psi [>103 MPa] and ±6.0 psi [±41,368 Pa] for full range[‡] Resistivity: ±0.01 ohm.m Flowline temperature: ±0.5 degF [±0.2 degC]
Mud type or weight limitations	None	None
Combinability	Fully integrates with Saturn 3D radial probe, Quicksilver Probe focused extraction, and InSitu Fluid Analyzer system Conveyance on wireline, drillpipe, and UltraTRAC* all-terrain wireline tractor	
Special applications	Downhole fluid analysis at reservoir conditions, interval pressure transient test (IPTT), stress test, mini-DST	
Mechanical		
Temperature rating	350 degF [177 degC]	400 degF [204 degC]
Pressure rating	20,000, 25,000, and 30,000 psi [138, 172, and 207 MPa]	20,000 psi [138 MPa]
Borehole size, min.	20,000 psi: 5⅝ in [14.41 cm] 25,000 and 30,000 psi: 5⅞ in [14.92 cm]	5⅝ in [14.41 cm]
Borehole size, max.	22 in [55.88 in]	
Outside diameter[§]	20,000 psi: 4.75 in [12.07 cm] 25,000 psi: 5 in [12.70 cm] 30,000 psi: 5.25 in [13.33 cm]	4.75 in [12.07 cm]
Length	Depends upon configuration	
Weight	Depends upon configuration	
Shock and vibration	Electronic shock rating: 250 g Vibration transmissibility: 3.0 g, 10 to 450 Hz	
Tension	160,000 lbf [711,700 N]	
Compression[††]	85,000 lbf [378,100 N]	

[†] Operating range up to 400 degF and default calibration to 392 degF with calibration to higher temperature on request.

[‡] Includes fitting error, hysteresis, repeatability, and some allowance for sensor aging; the corresponding percentages of the pressure reading account for the incertitude of the calibration equipment.

[§] Diameter of tester only and does not include the probe.

[††] At 15,000 psi and 320 degF; the compression rating is a function of temperature and pressure.

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