



Electromagnetic MWD (E-Field MWD)

Lightning-Fast Data Transmissions

Scientific Drilling's Electromagnetic Measure-While-Drilling (MWD) (E-Field) uses electromagnetic wave propagation to transmit downhole data to the surface greater than four times faster than conventional MWD mud pulse systems.

E-Field data rates are so fast a survey can be performed during pipe connections in as little as 4 second intervals. Toolface updates in as little as 4 second intervals. E-Field transmits raw magnetic vector components to enable "ranging" using a proprietary method fully tested on parallel well drilling projects.

Multi-Faceted Drilling Applications

E-Field has many uses in the oil and gas industry, in addition to general drilling applications. Advanced digital signal processing techniques allows operation with up to four systems on the same location.

E-Field is used for:

- Normal mud drilling
- Under-balanced drilling with air/aerated mud, nitrogen, air, gas, diesel, or oil
- River crossings
- Coal bed methane

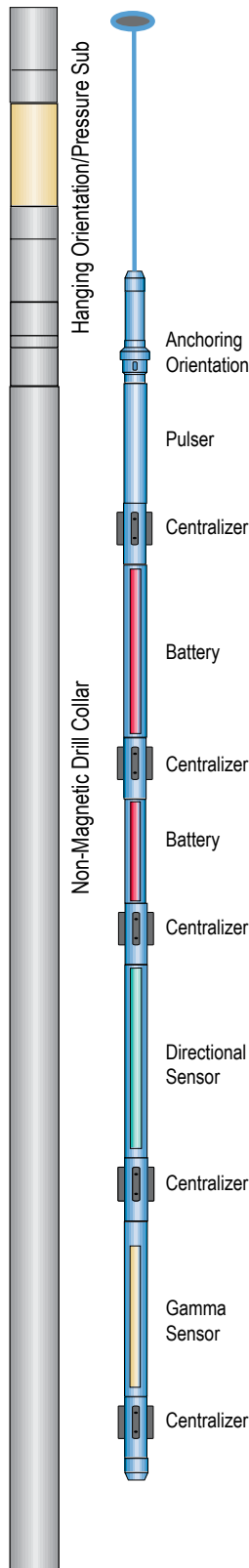
Exceptional Feature Versatility

E-Field's outer diameter is 1.75 in. (4.45 cm) and can be configured for collar sizes 3.125 inch (7.94 cm) to 9.5 inch (24.13 cm). E-Field's length varies from 27 ft (8 m) to 32 ft (9.75 m). The survey probe sensing point is three to four feet from the bottom of the tool. E-Field can be used with "long wire" (upper gap) technology to increase depth capability to 13,000 ft. The downhole sensor package includes:

- Inclination
- Azimuth
- Toolface (highside + magnetic)
- Vibration (peak + average)
- Gamma (optional), focused gamma (optional), Gamma near bit, Azimuthal gamma, Azimuthal Galn

Additional optional sensors:

- Annulus and pipe pressure
- PRT (Propagation Resistivity)
- GAIN (near bit inc/gamma)
- Smart Motor



ADVANTAGES

- Operates with conventional mud even when lost circulation material is pumped
- Operates with no returns
- Operates when drilling with aerated mud (gas, nitrogen, air)
- Saves ~ 70% connection time while drilling in any medium
- Uses bidirectional communications
- Has no moving parts
- Maintains minimal pressure drop
- Can be used for ranging projects
- Retrievalability - optional

TECHNICAL SPECIFICATIONS

Tool Collar Sizes	3.125 in (7.94 cm)	6.5 in (16.5 cm)
	3.5 in (8.89 cm)	6.75 in (17.15 cm)
	4.75 in (12.07 cm)	8 in (20.32 cm)
	6.25 in (15.75 cm)	9.5 in (24.13 cm)
Dog Leg Degree per 100 ft O.D.	Sliding:	Rotating:
	12° (8 in)	7° (8 in)
	20° (6.5 in)	10° (6.5 in)
	28° (4.75 in)	12° (4.75 in)
	60° (3.5 in)	20° (3.5 in)
	65° (3.125 in)	20° (3.125 in)
Pressure Rating	20,000 psi (30,000 available) (137,900 kPa)	
Temperature Rating	330°F (165°C)	
Lost Circulation Material (LCM)	No Limit	
Sensor Accuracy*	Toolface: ±0.15° > 3° Azimuth: ±0.25° < 3° Inclination: ±0.15° all angles	
Data Rate	As fast as 14 bits per second	

*SPE WPTS compliant error ellipses are available upon request for individual well profiles.