

MUD PULSE

Mud pulse tools operate by either opening or closing a valve in the tool that creates either a pressure surge (positive pulse) or drop (negative pulse). The data from the sensor section is encoded to one of a variety of formats (e.g. binary). Pressure signals in the range of 10 – 50 psi are detected at surface by a transducer, and the data is decoded into useable information. Mud pulse tools have no practical depth limitation, but are dependent upon the drilling fluid used and are relatively slow compared to EM/MWD systems. The tools do not function in underbalanced drilling where nitrogen or air is used for drilling. Both the negative and positive pulse systems add pressure to the circulating system, typically ranging from 150 up to 350 psi depending upon the system type.

EM/MWD

Electromagnetic Measurement While Drilling (EM/MWD) systems use the same basic sensors and power supplies as the mud pulse systems. The main difference is in the transmission of data. Rather than use the drilling mud to send pressure waves, the tool sends either a magnetic pulse or electrical current through the ground to the surface. On surface, the data is received through ground antennas and the data is processed. EM systems are significantly faster (10x) than conventional mud pulse. In addition, data can be sent at any time (not just when the rig pumps are circulating). The net result is faster overall drilling times. The EM systems are also the only practical method to drill underbalanced wells involving the use of air, nitrogen, and foam. EM systems have no moving parts and do not create significant restrictions in the drill string. As a result, the reliability is significantly higher and damage from erosion caused by drill solids is minimal. EM tools do have depth limitations, which are a function of how much power can be supplied by batteries for the duration of the drilling interval. Therefore, at higher power settings the battery costs may be significant.

Electromagnetic Measurement While Drilling Tool (EM/MWD)

The EM/MWD tool is a wireless MWD system which utilizes low frequency, current-loop signals to communicate data to the surface. The EM tool is installed in the BHA (bottom hole assembly) and injects electric current into the formation while drilling. An antenna (ground stake) is driven into the surface, which measures the voltage differential (potential) between the stake and a line tied into the casing on the drilling rig. This signal is processed through surface computers to decode the downhole data. EM signals are not affected by the drilling mud properties or rig pumps and have a significantly higher data rate than mud pulse systems.

Applications

- Underbalanced drilling
- Shallow gas / oil well drilling
- Fast horizontal well drilling
- SAGD (Steam Assisted Gravity Drainage)
- PDC bit drilling (Polycrystalline Drill Bits)
- Rigs with low pressure ratings

Features

The EM/MWD tool can be operated at a variety of frequencies allowing for either high data rate or extended depths (over 3,500 m) without the need for repeaters or long wire systems. Advanced digital filtering techniques allow two or more rigs to drill on the same pad without interfering with each other's signal transmission. The tool has directional, gamma ray and pressure sensors, making it versatile enough to accommodate most of your directional and underbalanced drilling requirements.

The wireless communication operates independent of rig pumps and creates virtually no additional pressure restrictions in the BHA. Access to the microprocessor can be made through a unique side entry data port on the rig floor. Simply plug into the tool to program it, retrieve recorded data or put it to sleep between wells to conserve battery life. The instrument section may be left in the non-magnetic collar between wells or during casing breaks to save rig time incurred while handling tools.

The EM/MWD tool has become a full service tool with "talk down" capability in that the tool can be fully controlled from the surface. While drilling, you can change parameters, such as data rates, transmission formats and power levels.

Positive Pulse Measurement While Drilling (MWD) Services

The Cathedral positive pulse MWD tool utilizes a rotary valve pulser design. MWD information is transmitted to surface via hydraulic pressure surges created when the rotor assembly is positioned 90 degrees to the stator, restricting fluid flow.

Pulse size is controlled by varying the clearance between the rotor and stator, and is preset according to the anticipated flow rates and mud weights. The direct drive design is controlled by a DC-powered motor and gear-reduction system that does not require a pilot valve or hydraulic assist assemblies, which do not function well in contaminated or high viscosity mud systems. The absence of downhole screens also allows the tool to function well with Lost Circulation Material (LCM). A unique anti-jam feature senses if debris dropped downhole is lodged in the tool and will instruct the rotor to reverse allowing foreign objects to continue past the tool. If the debris does not dislodge, the rotor will increase torque and try to destroy the debris with a chopping action.

The critical flow areas of the tool are made of impact-resistant carbide, which extends component life increasing reliability and reducing operating costs. The positive pulse tool can be surface programmed with multiple, pre-defined modes. Once in the well, the tool can be cycled through modes by a sequence of turning the pumps on and off. This allows the onsite operator to change data streams and transmission speeds, depending upon the specific drilling conditions.

The pulser configuration is easily changed at the rig site and is installed into the BHA by seating into a transmitter sub with the battery and sensor modules attached below. For extended bit runs multiple battery sections may be utilized or an optional generator turbine assembly can be run.

Negative Pulse Measurement While Drilling "MWD" Services

Time tested and true, the negative pulse hand-mount system continues to distinguish itself over other tools by refusing to fail!

Large signal

The large pulses, generated by venting pulses to the annulus, allow the surface system to detect data in noisy and hostile drilling environments. With MWD, signals are often lost as a result of poorly conditioned, contaminated or high viscosity mud systems, where the pulse size is insufficient to make the mud shear properly. Instead of being transmitted through the incompressible fluid, the pressure wave is dampened. Large negative pulse signals overcome adverse environmental effects that some positive pulse tools cannot tolerate.

Rigid mounting

The transmitter is rigidly bolted into the drillstring, while instruments are firmly positioned with rubber centralizers. Harmful shock and vibration effects originating from the drillstring are isolated. The end result is reliability.

Modular design

The entire tool is constructed in short sections, which are quickly assembled on the rig floor while making up the bottom hole assembly. All components can easily be transported in a pickup truck, airplane, or helicopter.