

Application Note: Magnetic Ranging



OVERVIEW

Magnetic ranging is the technique that enables drillers to more accurately position boreholes in relation to one another, or in relation to a known position marker.

Whether the borehole need to run in parallel to or intercept another borehole or need to reach a designated surface target, the core technique used is the same. A magnetic marker is positioned (at the surface, along the drill path, in an existing borehole) and the magnetic sensor is used to measure the field generated by the marker and determine the distance and position of the marker.

In active magnetic ranging, the target is typically an AC magnetic field, with the receiver being a fluxgate sensor. The most critical criterium for the sensor is to have as low a noise as possible as this enables an increase in the distance of detection of the target signal.

This method is used in Horizontal Directional Drilling (HDD) to install utilities underneath river crossing or install utilities in close proximity to one another.

It may also be used more simply to limit the installation time of utilities by reducing the amount of trenching undertaken.

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Equipment

- Three-axis Fluxgate Magnetometer

Applications

- Position multiple boreholes in close proximity
- Borehole interception
- Tracking and directing borehole to a surface marker



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Application for fluxgate in active magnetic ranging in the context of HDD

Whilst the method is identical to that used in the Oil & Gas industry, the shallower depth of operation means that the temperatures encountered are comparatively low and may therefore not require high temperature sensors.

Standard directional drilling packages use sensors which are optimized to give good DC performance, but the residual error level means that there is still plenty of uncertainty, and these sensors alone do not allow for the level of precision required to intersect a known marker.

Due to the presence of natural DC field variations as well as those caused by man-made features, the use of an AC signal is recommended. Indeed, the shallow nature of these boreholes means that the signature of things like vehicle, vessels etc will impact the DC field sensed by the magnetometer.

Bartington's fluxgate are optimized for low noise performance both at AC and DC, enabling the detection of very small AC signals (down to pT levels). The 3-axis sensors are most suited to the application as the 3-axis provides directional information enabling to position the magnetometer in relation to the magnetic marker. The use of multiple sensors could further improve the positioning accuracy.

A number of sensors are suitable for the application, depending on whether these are to be installed in a drilling tool or not. The Mag612 and Mag619 offer compact sensor head and a two-part assembly but do have slightly higher noise compared to sensors such as the Mag-13. Note that the Mag-13 is available in an unpackaged two-part which may be better suited for installation in a tool.

<https://gmw.com/product/mag-03-mag-13/>

<https://gmw.com/product/other-probes/>

Should higher temperature be expected, or to make tools suitable to both HDD and the Oil & Gas industry, then the Mag610, Mag611 or Mag614 will provide compact sensor head, with low noise option on the Mag610.

<https://gmw.com/product/high-temperature-probes-mag610-mag611-mag614/>