

# Application Note: Magnetic Ranging



## OVERVIEW

Magnetic ranging is the technique that enables drillers to more accurately position wells in relation to one another. Whether the wells need to run in parallel or they need to intercept, the core technique used is the same with one well used as a magnetic target, and the well being drilled ranging its distance to the target.

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. Passive magnetic ranging uses the natural magnetization of an adjacent well's casing, but tend to be less accurate than active ranging.

The method is commonly used for steam-assisted gravity drainage (SAGD), but also has application for the construction of relief wells, or for any applications where multiple well need to intercept, or indeed for well avoidance in crowded settings. There is also potential for use of the technique in the production of geothermal energy.

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## Equipment

- Three-axis Fluxgate Magnetometer

## Applications

- Position multiple boreholes in close proximity for SAGD
- Well interception during well relief operation
- Well intercept for production



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## Application of Fluxgate sensors to active magnetic ranging

Active magnetic ranging is the technique used to precisely determine the location of a well using a known magnetic source. The technique is used for interception of two wells or for the precise positioning of two wells in relation to one another.

One or more three-axis magnetometers (typically a fluxgate) are used to measure the field generated by the source. The sources used are typically AC as that signal is controlled and unaffected by any background DC or near DC changes of the Earth's field.

Whilst traditional directional drilling sensors are aimed at delivering the best possible DC accuracy in order to provide good orientation information, they are not necessarily good at measuring AC fields or may display higher level of white noise.

The high temperature fluxgate sensors from Bartington Instruments are designed to provide accurate measurements at AC and DC with noise levels as low as a few tens of pT (picoTesla). Their compact size (a three-axis sensor is at most a 23mm side cube) allows for multiple units (if required) to be integrated within a tool to perform gradient measurements (increasing the accuracy of both distance and orientation calculations).

The range of high temperature include the Mag610, Mag611 and Mag614  
<https://gmw.com/product/high-temperature-probes-mag610-mag611-mag614/>.

The Mag610 is optimized for noise, with a low noise version in a package suitable for 175 degrees C, whilst the Mag611 is optimized for higher temperature of operation at 215 degrees C. Finally, the Mag614's priority is size reduction roughly halving the height of the sensor (compared to Mag610/611).

Active magnetic ranging will typically be used where there is a requirement to drill two wells in close proximity such as SAGD, or for well interception (well relief, plugging and abandonment, Geothermal energy production etc...).