



# Magic Bow Drilling Rotating Magnetic Guiding System



RM sub



Ground kit



Probe

Beijing Yanbo Tech. Co.,Ltd





# Magic Bow Drilling Rotating Magnetic Guiding System

## Introduction

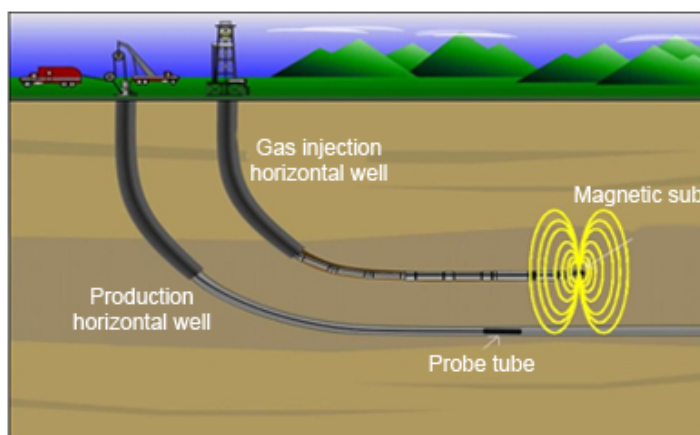
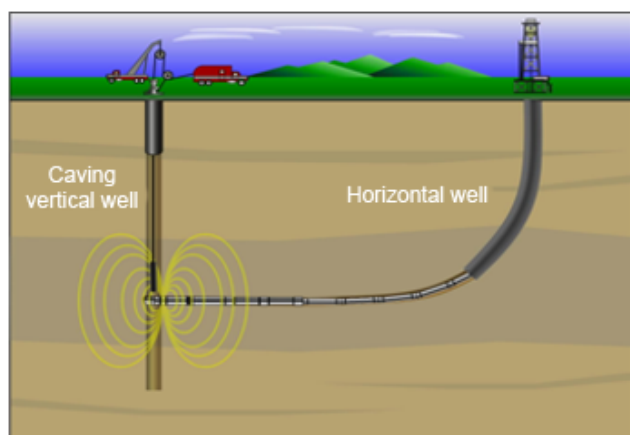
Magic Bow Drilling Rotating Magnetic Guiding System (MBGS) is used near target area in directional drilling remote connection engineering which can eliminate the cumulative error of MWD and guide the drilling bit to hit the target accurately. The core of MBGS is the magnetic ranging technique. MBGS is made up of rotating magnetic sub (RM sub), probe, ground kit, laptop and interpretation software.

## Working principle

The magnetic signal data from RM sub who installed on the bit is collected by the probe in the target borehole when the distance between RM sub and the probe is 120m. The PC receives the data and interprets the correlation position between the bit and the target. Based on the interpretation result, the operator adjusts drilling tool face to make the drilling going towards the target.

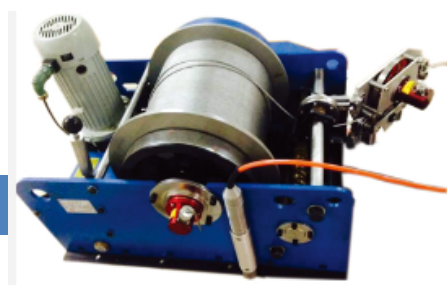
## Applications

- Connection of CMB wells
- Connection of wells for solution mining (salt mines, trona mines, mirabilite mines, etc.).
- Connection of Geothermal deep well
- Deep holes guided boring for pipeline laying
- SAGD drilling
- By passing obstacles in geo-drilling
- Connection of ventilation shafts and tunnels



## Parameters

- Probe
  - Maxwell depth: 5000m
  - Range: 120m
  - Probe length: 1130mm
  - Max well temperature: 85°C
  - Probe O.D.: 48mm
  - Azimuth Offset: <0.2°
- Ground kit
  - Power Supply: AC 80V-260V, 47Hz-63Hz
  - Power Output: DC 115V, 50 mA
- RM sub
  - 3-7/8"OD x 20.05"L w/ 2-7/8"API Reg Conns
  - 4-3/4"OD x 20.05"L w/ 3-1/2"API Reg Conns
  - 6-1/2"OD x 20.05"L w/ 4-1/2" API Reg Conns
- laptop: support Windows series operating system
- Cable: W4B -4.7 4-Conductor polypropylene insulation EM cable
- Winch: electric winch with control system and depth display

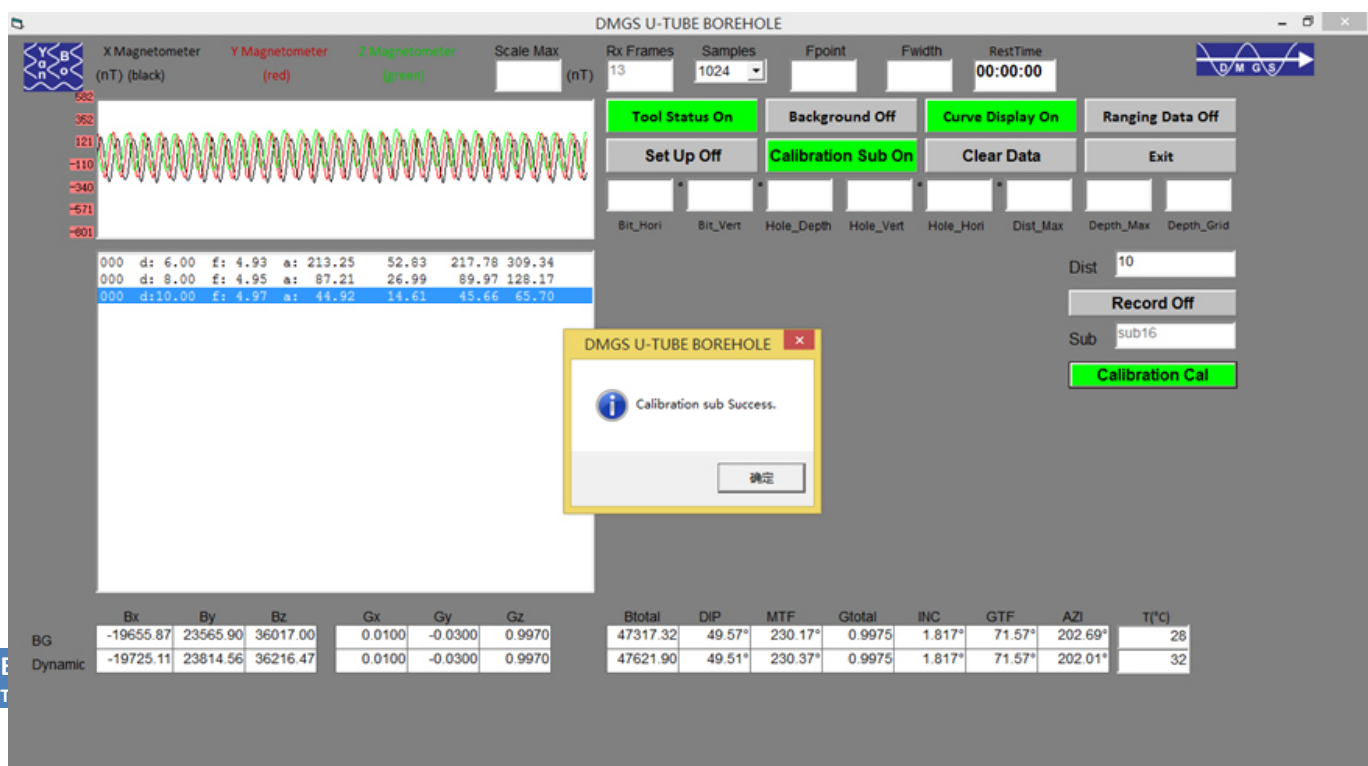


## Advantages

- Intellectual property: entirely independent research and development, Core algorithm is distinctive.
- Quick and easy: MBGS can calculate the distance and deviation angles by testing one spot, but similar products must test five spot on a line to get result.
- High accuracy: accuracy is much higher than similar products, the error of other similar products is about 1 degrees, the error of MBGS is 0.2 degrees, the target well will be intersected one-time even if its diameter is 5cm.
- Wide application: in addition to the connected well, it is also suitable for the parallel drilling well with arbitrary inclination.
- Perfect measurement: MBGS can measure the full spatial attitude of drilling bit in the three-dimensional space.
- Strong adaptability: probe can be placed in any attitude without affecting the accuracy of the measurement.
- High precision magnetometer: magnetic signal resolution is 6pt.
- Data transmission using CAN bus mode: it has the advantages of strong real-time performance, far transmission distance and strong anti-electromagnetic interference ability.

## Magnetic moment calibration

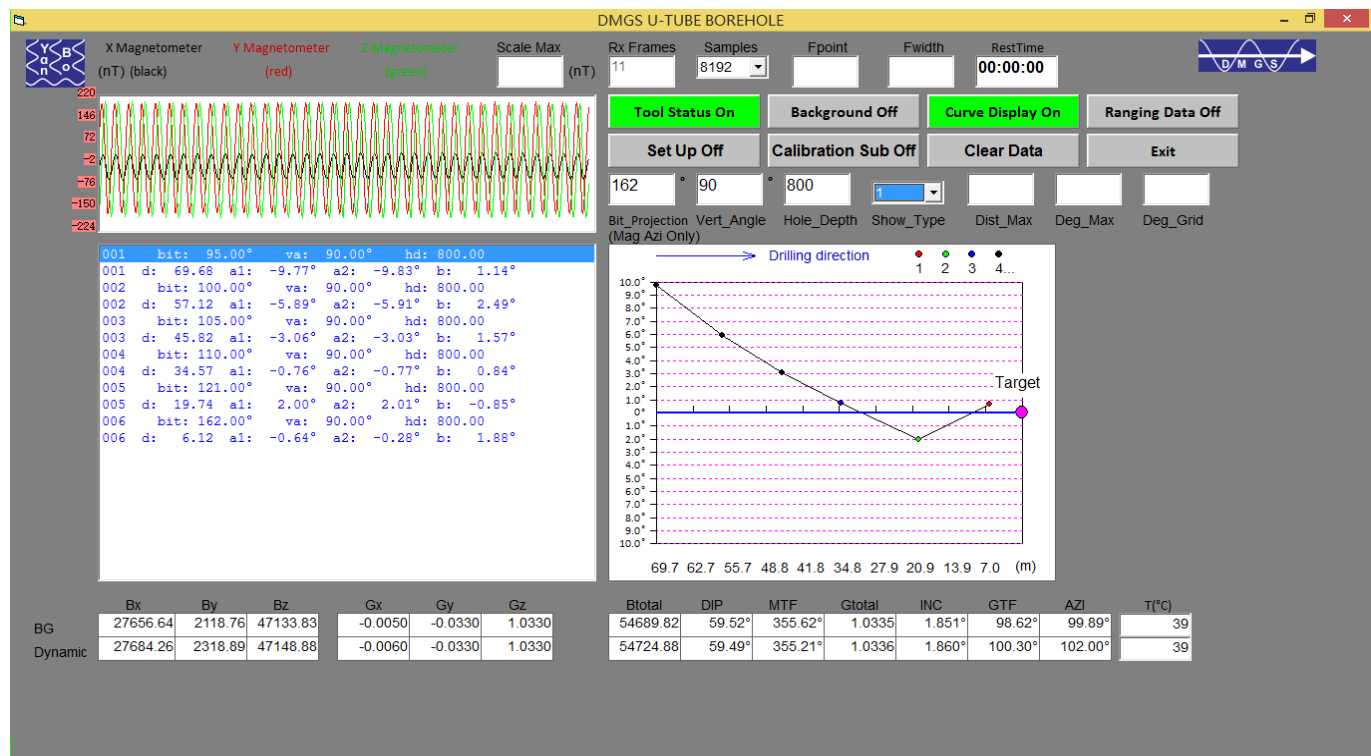
We make RM sub exactly toward to Probe tube first, then we measure the distance between RM sub and the probe when it is within 3m to 20m, we fill the value in the blank of 'Dist', then click 'Record'. We repeat the above steps three times, finally we click 'Calibration Cal', then the magnetic moment of RM sub can be get.



## Magnetic moment calibration software interface

### Connected well software interface

- Look top left of the interface, the black line is the signal of X axis, the red line is the signal of Y axis and the green line is the signal of Z axis.
- Signal frequency and bandwidth can be set flexibly.
- Sample number can be set flexibly.
- The track of test dots are on the right of the interface, Abscissa presents distance between RM sub and the probe, ordinate presents horizontal deviation angle.



### Connected well software interface



Parallel Well software interface

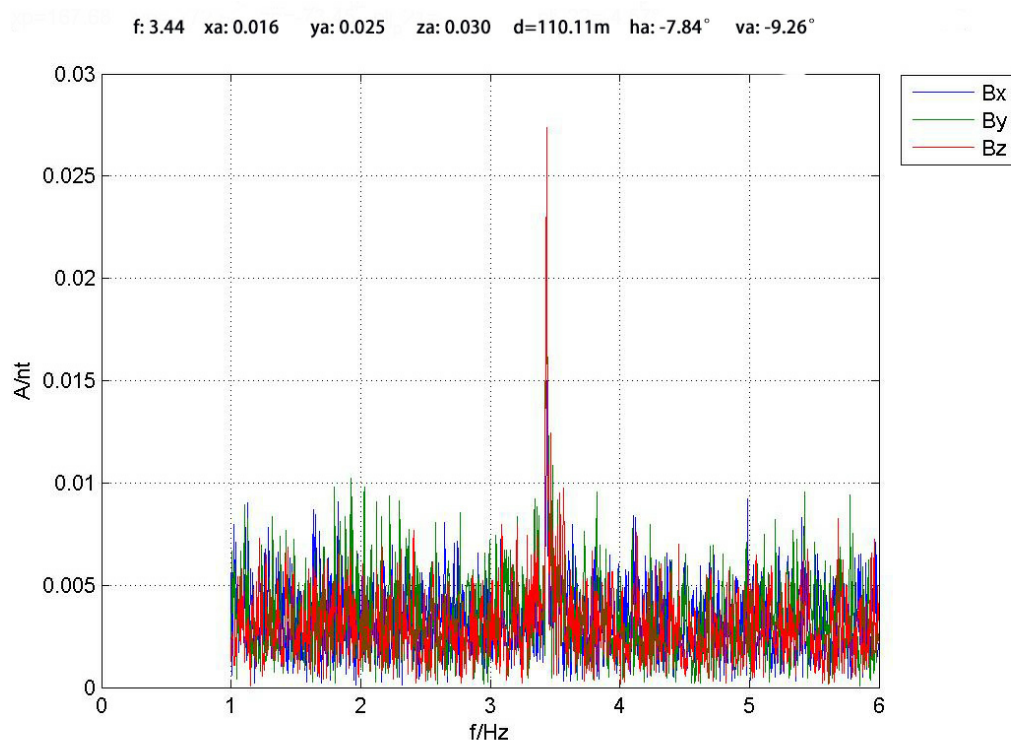
## Parallel well software interface

- Look top left of the interface, the black line is the signal of X axis, the red line is the signal of Y axis and the green line is the signal of Z axis.
- Signal frequency and bandwidth can be set flexibly.
- Sample number can be set flexibly.
- The track of test dots are on the right of the interface, Abscissa presents horizontal distance between RM sub and the probe, ordinate presents vertical distance between RM sub and the probe.

## Frequency spectrogram

- The signal to noise ratio is high accuracy when the distance between RM sub and the probe is 110m, test results is accurate and believable.
- The frequency is 3.44Hz.
- Distance calculation value: 110.11m, the horizontal deviation angle is  $-7.84^\circ$ , the vertical deviation angle is  $-9.26^\circ$ .





## Background



Our company accepted the commission of Surewell Drilling Service Company which was in Brisbane, Queensland, Australia to develop the drilling Rotating Magnetic guiding system in January 2015. Magic Bow Drilling Rotating Magnetic Guiding System (MBGS) was been used first in September 2015. We completed the development of second versions of MBGS in April 2016, the hardware and the software had been upgraded with more user-friendly interface, higher accuracy, farther distance and more stable work. We have been cooperated with Beijing Orion Energy Company, Shanxi Blue Flame CBM Company from July 2016. As of March, 2017, MBGS has been used for connection of about 30 pairs of wells at home and abroad with the application scope covering CBM and salt mines.

## Cases

- In March 2017, the horizontal well and the cave well were successfully connected with MBGS in the Sihe Caol Mine, Qinshui coalfield, Shanxi. The target vertical depth was



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680m, the horizontal well section was 830m and the cave hole diameter was 20 cm, the probe was being putted into the cave well when the distance from drilling bit to cave well was approximately 100m. The drilling bit hit the fiberglass casing successfully by the accurate guidance of MBGS. The picture shows the connection that the mud and the coal seam gas at the cave mouth was more than 20m high, as if a gas dragon roared into the sky.

- In December 2016, the U Shaped Horizontal Connected Wells in CBM Exploitation in Shilounan, Lvliang, Shanxi had started. The Employer was Shanxi Coking Coal Group and the Contractor was Beijing Orion Energy Company. The target vertical depth was 1500m, the horizontal well section was 1800m and the cave hole diameter was only 15cm. The target was missed with similar foreign equipment in the first connected operation, then the drilling bit was retreated 50m, the drilling bit accurately breaks the fiberglass casing and successfully connects the cave well with MBGS.



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