



Gyro Memory Tool Program Overview & Preliminary Design Targets

The Gyro Memory Tool (GMT) is an electronic, 3-axis gyro plus magnetometer configured as a North-referenced Inertial Navigation System (INS) intended to determine borehole deviation in the oilfield. The GMT will track the twists, turns and corkscrews of the borehole, reporting and modeling the results in 2-D & 3-D. The GMT tracks X (delta longitude), Y (delta latitude) and Z (depth) in tenths of a foot relative to the survey starting position (wellhead) so that when an anomaly is spotted at position XYZ, it can be identified at X degrees rotation (relative to true North), Y degrees pitch (relative to horizontal) and Z foot depth (relative to the earth's surface).

The electronics will be contained in a pressure housing rated to 12,000. Although the tool might well operate in either a liquid or gaseous environment, its initial design is for use in steel tubing/casing filled with drilling mud (bentonite), water, saturated brine or a combination. While the accuracy of the GMT will be a function of the amount of vibration and dynamic motion of the system, it is designed to have a typical absolute accuracy of +/- 2 degrees or less in a static environment. Accuracy is enhanced with the use of a centralizer. The GMT is powered by a replaceable, internal 3.67 volt Lithium / Thionyl Chloride primary battery.

Operational procedures are envisioned as follows;

1. GMT, battery pack and GMT PC transported to survey site
2. GMT PC booted & Gyro Control program loaded
3. GMT PC connected via Depth Counter Interface to wireline cable drum encoder
4. GMT PC Depth Counter configured for and synchronized to wireline truck encoder
5. GMT PC database survey file initialized, capturing well data & logging speed
6. GMT pressure housing removed & Interface Link connected from GMT to GMT PC
7. GMT battery pack inserted, powering GMT onboard microcontroller
8. GMT prior survey data backed up to GMT PC database & on-board memory cleared
9. GMT internal clock synchronized to GMT PC clock
10. Capture of GMT PC clock vs. Wireline Depth Counter data to RDBMS commences
11. GMT PC initializes GMT microcontroller start time, initializing GMT PC "Countdown"
12. GMT Interface Link removed and GMT pressure housing replaced
13. GMT hoisted to operational (vertical) position above borehole and immobilized
14. At conclusion of Gyro PC "Countdown", GMT initialization sequence determines reference position. GMT must be in a stable, operational (vertical) position during this 60-second initialization period. Failure to do so requires a repeat of steps 7-16, above. After initialization, the GMT begins sampling & storage of gyro position data.
15. GMT dropped down well bore at predetermined rate (~60 feet/min)
16. About 4-8 hours later, GMT pulled out of the hole
17. GMT pressure housing removed & Interface Link connected between GMT & GMT PC
18. GMT X, Y, Z & time stamp data transferred from GMT to GMT PC RDBMS
19. GMT batteries removed, powering down GMT
20. Downloaded GMT data used to provide Excel spreadsheet tabular reports, 2-D graphs and Sonasearch 3-D borehole reference plots

Target Specifications

- GMT Pressure Housing Outside Diameter: 1½"

- Operating Temperature: -30C (transient) to +125C (peak)
- Maximum Operating Pressure: 12,000psi
- Operational Time: 8 hours (min)
- Initialization Time: 60 seconds
- Data Update Rate: 500ms
- Data Storage Interval: 1 second
- Max Angular Rate: 100 degrees per second
- Bias Drift: Less than .2 degrees/second
- Scale Factor: Less than 1 %
- Non-Linearity: Less than 5%
- Resolution: Less than .05 degrees/sec
- Bandwidth: 10 Hz
- MTBF: 50,000 hours