

# **Appendix A. Setup and Operation of the 9095 Gyroscopic Logging Tool (Rev. 2016-05-18)**

## **Section 1 – Setup and Assembly**

1. Power and ground wires should be attached to gyro power supply (GPS). Confirm that the black wire (-) and red (+) are both attached to the GPS.
2. Place the tool in the hole and zero the tool with the draw works so the top of the tool, main body, is flush with the top of the casing. Report and measure the distance from the top of the casing to the land surface datum (brass cap if available). Note this number for later entry in the computer as a negative number. Adjust centralizers on the tool as needed, one near the top and near the bottom and tape (fig. A1).



Figure A1. Photograph showing placement of rubber centralizers attached to 9095 logging tool (Photograph by Brian Twining (U.S. Geological Survey) at well site USGS 102 on 9/2015).

3. Manually lift the tool up the hole and mate with the landing plate. Attach the riflescope then orient the tool towards the sighting stake or landmark at least 100 ft (ft) away – sometimes this is not possible so do your best. Use the tripod stand or landing plate on well head and confirm the tool is level (bubble level) prior to starting up the power. Note: you may have to use a rubber shim when logging off the drill rig.
4. Determine the tool face azimuth by sighting 100 ft or more from the drill hole to a stake or landmark using Brunton™ compass, or similar. Be sure you are 50 ft or more away from large metal objects. Note azimuth for future entry during the log startup. It is good practice to use the Brunton™ stand, compass level, and compass needle “azimuth” (fig. A2). The peep sight pointed in the same direction as the tool face and (or) back sighting is also appropriate when needed.

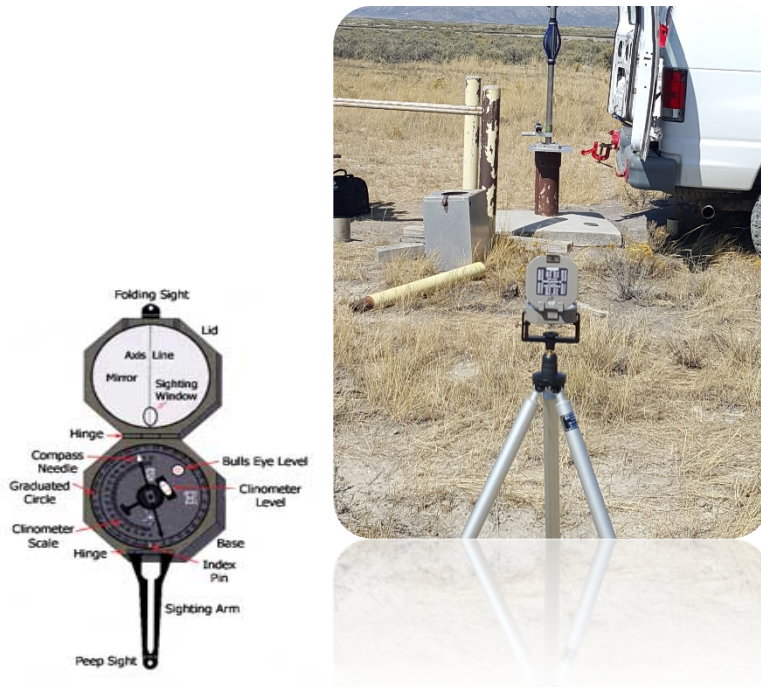


Figure A2. Illustration showing how to setup Brunton™ compass to collect azimuth data during gyroscopic logging startup (Photograph by Brian Twining (U.S. Geological Survey) at well site USGS 102 on 9/2015).

## Section 2 – Logging Operation Procedures

1. Turn on computer (if not on) get into the LOG program. Before turning on the tool power make sure you get into the “CAL” menu. Set the baud rate to 4800 and confirm the sample interval is set to 0.20 ft. Save and exit the CAL Menu. Select OK to Baud Rate warning in LOG program.
2. Recheck logging tool is secured and turn “ON” the tool power and toggle the Gyro power on. Note: It is always a good idea to make sure you have a tight wire connection with the gyro-power supply. Try not want to disturb the tool once the tool power is turned on and the gyros are spinning.
3. **Configure Tool:** and when prompted – “YES” to Gamma in CPS. The logging menu will reappear and the tool measurements will be shown in the collect window below the depth/rate window.
4. **Gyro startup (Caged position) – 15 minutes:** Turn on the gyro power supply (GPS) with the gyro caged and adjust the current and voltage until the telemetry screen reads 32 volts  $\pm 2$  volts). Note: when cold you will have to continuously adjust the voltage for about the first 5 minutes. Do not let the voltage to get too high or you could damage the tool. Confirm the voltage “volts” is changing in the display window. Note: if the volts are

not changing this indicates the gyros are not spinning, recheck connections with gyro power supply.

5. **Gyro startup (uncaged position) – 15 minutes:** After step 4, uncage the gyro by selecting the uncage caliper button, wait for red square to turn green before clicking OK. Let the gyro warm up undisturbed for another 15 minutes. Later warm up can be shorter if the tool is already warm from a recent run, steady volts is your sign that the gyro oil is warm.
6. During tool startup (steps 4 and 5 above) recheck your azimuth and tool level. Make sure you get a sighting 100 ft away and record the following:
  - a. Azimuth (degrees) – Remember the dimple on the tool is facing the direction of the tool. Confirm azimuth reading on Brunton™ compass (fig. A2).
  - b. Record casing height (stickup) on the field sheet.
  - c. Confirm your tool is level. In high winds try to brace the tool the best possible.
7. **Gyro startup (cage gyro position) -** Confirm red square in the display window. All directional components are based on this initial alignment.
8. Enter Header information – Include the following in header file:
  - a. Azimuth (degrees).
  - b. Well casing stickup or reference to land surface.
  - c. Estimated depth to water – use tape when available (nearest foot).
  - d. Note logging direction in remarks for post processing – “Down” and “Up” log.
9. Check the logging direction - toggle radio button to “Down” in reference to down log.
10. **Gyro startup (uncage gyro position) –** tool is warm and ready for logging. Allow 20 seconds for the gyro to uncage. The light will change to “Green” in the Depth/Rate. Keep an eye gyro volts and confirm they are stable.
11. Select Tool Position – Enter casing stickup height (negative values reflect height above land surface).
12. Specify the Sighting Direction, select “Get Sighting” on the display toggle. Enter the azimuth from the Brunton™ compass, not adjusted from magnetic declination. Select “Yes” to the stop automatic stations question. Note: magnetic declination is entered during the post processing after the logs are collected.
13. Toggle “Start Recording” on the display menu. The software will reconfirm the sighting direction.

14. **Gryo Logging “Down Log”**: Toggle “Get Sighting” and allow the tool to perform the initial 70 second “Sighting Station”. After 70 seconds toggle “Get Sighting” to stop the first sighting station.
15. Toggle “Get Sighting” and allow the tool to perform a second 180 to 300 second “Drift Station” (200 seconds or better is suggested). After time, toggle “Get Sighting” to stop the second station. Note: Both “Sighting” and “Drift” stations are necessary before logging the borehole.
16. Remove the scope and landing plate and gently lower the tool into the hole. Do not jar the tool. The top of the tool reference should be the same starting point as the referenced stickup.
17. **Gyro Logging “Down Log”**: Once the tool is lowered, adjust the tool rate to 60–80 ft per minute; however, always start and stop the tool slowly to avoid jarring. It is best to run the tool in cased hole, but some circumstances require running in uncased holes. When running in uncased boreholes, always use precaution.
18. **Gryo Logging “Down Log” – Drift Station at half-way point** - Collect a “Drift Station” (180–300 seconds) at the halfway point. For example, if the borehole is 800 ft collect a “Drift Station” at 400 ft. Century™ suggests collecting multiple drift stations in deep boreholes; for example, in a 3,000 ft deep borehole, complete “Drift Stations” at 1,000ft; 2,000 ft; and bottom of hole (3,000 ft).
19. **Gryo Logging “Down Log”** - At the bottom of the borehole collect “Drift Station” for 180–300 seconds. Toggle “Get Sighting” and allow the station to collect data for 180–300 seconds.
20. **Gryo Logging “Down Log”** - Toggle “Stop Recording” to complete the down log.
21. Bring up the “Header” and modify the remarks section to “Up Log”.
22. Toggle “Tool Position” and accept the default number. The number should be where you stopped the down log.
23. Toggle the “Up” button under logging direction.
24. Toggle “Get Sighting” and accept the number you entered earlier. You do not want to start automatic stations if prompted.
25. **Gryo Logging “Up Log”** - Toggle “Start Recording” and log up the hole.
26. **Gryo Logging “Up Log”** – Collect a bottom “Sighting Station” for 70 seconds. Toggle “Get Sighting” and allow the station to collect data for 70 seconds - end the station by toggle “Get Sighting”.

27. **Gryo Logging “Up Log” Drift Station at half-way point** - Collect a “Drift Station” (180 to 300 seconds) at the halfway point. For example, if the borehole is 800 ft collect a “Drift Station” at 400 ft.
28. **Gryo Logging “Up Log”** - Slow down as you approach the top of the casing and stop when the top of the tool body is flush with the top of the casing or measurement point (MP) mark.
29. Gently lift the tool and place it in the landing plate. Attach the scope and orient back to original azimuth. Confirm with compass if needed.
30. **Gryo Logging “Up Log”** – Collect a “Drift Station” for 180–300 seconds once landed and secured at land surface. Toggle “Get Sighting” to turn off and on collection.
31. **Gryo Logging “Up Log”** – Collect a “Sighting Station” for 70 seconds. Toggle “Get Sighting” to turn off and on collection.
32. Toggle “Stop Recording” to complete the “Up Log” collection.
33. Toggle “Cage” to cage to gyro tool before you turn off.
34. Turn off GPS and Tool Power once the tool is caged.
35. After logging, let the tool cool down for at least 5–15 minutes removing from landing plate.
36. Toggle “Exit Collection” and process the logs using post-processing software in Century™ Display program.

### **Section 3 –Data Analysis**

1. Open the Display program and select the original “Down Log”.
2. From the “Processing” drop down select “Gryo Deviation”.
3. Navigate to the “Up Log” and select that for “Gyro Log 2”. **Note:** “Up Log” is only used for closure and additional drift stations.
4. Enter declination information before running analysis. For general purpose 12.5 degrees is appropriate.
5. Toggle “Deviation Analysis”, a progress bar should show up indicating processing. Accept the prompt to load the deviation log. Check and print analysis as needed.