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Using the Bartington Grad 601 with Two Sensors in the Field

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The following is a simplified version of the concepts and steps described in the Bartington Grad601-2 manual colored with some of the practices and preferences of the author. These instructions assume that you have a survey area selected and gridded for survey. Surveys are most often conducted by methodically covering 20 x 20 meter squares set in a grid. The Grad601-2 has two gradiometers mounted on a trapeze that is one meter long, but archaeological surveys are often conducted at 50cm resolution. To achieve this density of readings, the surveyor will need to plot a survey strategy that has overlapping coverage under the span of the trapeze. For more detail on this and other aspects of instrument or survey methods, see the Bartington Grad601-2 survey manual.



Prepare for Survey

Be Metal Free

It is important that the user be absolutely metal free for the survey. After you let the instrument warm up, you can check to see if your survey wear is metal free by running the Grad 601-2 in SCAN mode and moving your body around the sensors paying particular attention to your shoes, waistline, wrists and headgear. If there is a change in the readings outside of normal drift (± 0.2 nT), then you should identify the magnetic item and remove it from your person before survey.

Let the Instrument Warm Up

Letting the instrument warm up as you set the survey grid will help you to avoid any drift in readings as you survey. Assemble and turn on the gradiometer as soon as you get into the field.

Assemble the Gradiometer

If you are using the CAST gradiometer, be aware that it has been found that the sensor with the serial number 157 prefers to be on the left and 168 works better on the right. This will make tuning in the field go much more quickly. Slide the gradiometer rods into the clamps on the trapeze and firmly tighten the screws to lock the gradiometers into place. Attach the gradiometers to the data logger by screwing the connector wires into the gradiometers. Don the harness and adjust the straps so that the harness is comfortable. There is a strap to extend the belt on the harness if you need it. Use the plastic clips on the harness to hang the trapeze from the harness using the rubber rings. Adjust the straps on the harness to get the sensors as close to the ground as possible but still high enough to walk smoothly and comfortably. Having the sensors hang 20cm above the ground surface is ideal.

Press the ON/OFF button to activate the Grad601-2.

Conducting Survey : Setting Parameters

Use the arrow keys to navigate the menu in the data logger and press STEP to cycle through the options for each menu item. The individual parameters and available settings are explained below with the standard selection in **bold**:

Pace: the walking pace of the operator. **Most surveys are between 0.7 and 1.0** secs. Since the data you record is an average of almost continuous variation sensed by the instrument during data collection, the slower you walk, the smoother your data will be.

Grid Size: select the size of grid – 10 x 10, **20 x 20**, 30 x 30 or 40 x 40m.

Start: select the starting direction of the grid, N, NE, E, SE, S, SW, W or NW. This depends on your grid orientation. If your grid is oriented north and you are starting in the southwest corner then you may want to select N or NW as your starting direction.

Pattern: select the traverse pattern to be followed – Parallel or **ZIGZAG**.

Lines/m: select the required number of data lines per meter – 1, **2** or 4. Two (**2**) lines per meter is standard (50cm transect spacing).

Samples/m: select the number of samples per meter along each line – 1, 2, 4 or **8**. **8** samples per meter is the standard setting, but is not available for grids of 40 x 40m.

Range: select the full scale range of **100nT** (resolution 0.03nT) or 1000nT (resolution 0.1nT).

Audio: select the audio output for scanning and survey operations – off or **ON**.

Volume: select volume – **HIGH** or low.

Threshold: select the deviation in nT at which the alarm is required to operate during a scan operation – increments in units, tens and hundreds and thousands of nT. When the field deviates by the level selected, the ALARM message will be shown in the display for the appropriate sensor, and the audio output rate will start to increase. The audio tone varies from the value set to about ten times this value. This depends on the background values at your survey site. **100nT** is generally a safe threshold.

Sensors: select the number of sensors to be used – 1 or **2**

Reject: select the frequency of 50 or **60Hz** to reduce noise in the data.

Tuning the Instrument

What you will need:

1. Grad 601-2
2. Compass
3. Stakes or markers

One of the many wonderful things about the Bartington Grad 601-2 is how easy it is to tune.

1. Before you begin to tune the instrument, set the gradiometer to SCAN and see if you can find a magnetically 'quiet' spot to tune.
2. Use a compass to lay out a place where you can tune the instrument. You will need to accurately identify the cardinal directions, so mark the four cardinal directions with nonmagnetic materials in the magnetically quiet spot that you have identified.
3. Now you are ready to tune the instrument. Navigate to ADJUST GRADIOMETER and follow the simple directions to zero the instrument. To get the best adjustment, try to elevate the magnetometer as high as possible above the ground. If you don't have a nonmagnetic stool or ladder, hold the instrument high over your head. Try your best to be consistent in holding the instrument in the same space throughout the tuning process. If the instrument is exceptionally out of tune, the Grad 601-2 may ask you to repeat the process. Once you have finished tuning, run SCAN and look at the measurements coming in to the gradiometers while facing north in the spot where you have tuned. They should both be close to 0.0 nT.
4. With the Grad 601-2 strapped to the harness, go to the start point of your survey and stand as if you are ready to begin survey. Take note of the readings at this point while the Grad 601-2 is scanning. After several grid squares, come back to this point and see if you get similar readings. If they are different by more than 0.5nT, you will want to adjust the

gradiometer again before continuing.

Collecting Data

Remember, this set of instructions assumes that you have already set up your survey grid and that you are using two sensors mounted one meter apart.

1. Stand at the "lower left" corner of your survey square where the end of your first transect would be the 'top' of the survey square. Face the survey direction. If your transects are oriented to the north, this would be the southwest corner. Be sure to start all surveys in the same corner.
2. If you are surveying with two sensors and plan a map that has transects that are spaced at 50cm, you will need to pass over the grid so that the survey transects shuffle together during survey. On your first transect, you would walk a line that is 75cm from the corner. Your return transect would be 1.25m from the corner.
3. Press ENTER or the green button on the trapeze when you begin a line. If you have set the parameters correctly and walked at the correct pace the Grad601-2 will beep every time you pass over a meter mark on your survey rope and beep twice at the end of the transect.
4. Press ESC or the red button on the trapeze to stop survey during a traverse.
5. If you have made a mistake, you can delete the current line (or if completed, the last line) by navigating to BACK ONE TRAV and pressing ENTER. You will delete another line every time you press ENTER.
6. Continue the survey until the square is finished. Stopping during survey could introduce some unwelcome interference into your data.

Take a Break

It is okay to leave the Grad 601-2 on if you are going to take a short break. When not surveying, please try to leave the instrument in the shade. If there is no shade cover, at least protect the computer/data logger with a cloth to protect it from the sun.

Turn the Grad 601-2 off if you are taking a longer break, say for second breakfast or lunch. You will need to re-adjust the instrument when you begin survey again.

Downloading Data

The Bartington Grad 601-2 will organize data from a zig-zag survey with two sensors as if it were collected with one sensor with a unidirectional survey prior to downloading, therefore no additional organization of readings is required after downloading. This applies for all three downloading methods.

What you will need:

1. Bartington data logger
2. Bartington Grad601 software
3. Download cable (and driver if necessary)
4. Computer

Download Steps

1. Make sure you have the Bartington Gradiometer download utility installed on your computer. This small program can be downloaded from Bartington Instruments' website or installed from a disk that should be packed with the gradiometer.
2. Connect the computer to the Grad 601-2 via the serial port in the back of the Gradiometer. Use a serial to USB connector if your computer does not have a serial port (as most new laptops do not). If you are using a serial to USB cable, be sure to install the proper driver for the cable before attempting to download.
3. Activate the Bartington download utility.
4. Choose OUTPUT DATA from the menu on the Grad 601-2 data logger. When you do, the screen should read WAITING FOR PC.
5. Identify the correct COM port for download. If you just installed a driver for a cable, you were probably notified which port the driver was applied to.
6. Choose the data format for download. XYZ format is recommended, as it is the most versatile and can be recognized by most programs.
7. Hit START when you are ready to download and watch the bytes pour in!
8. The download software will ask you to save the data when you are finished. Generally, you will want to Save All files, and save them with a unique identifier. One recommended file naming strategy is to save data with a name that includes the

date they were collected and the sequential number of the grid square collected. For example, data from the first three grid squares collected on January 13 would be saved as 01-13-01, 01-13-02 and 01-13-03. To save all the grids from January 13 in this scheme, enter "01-13-" in the windows explorer window when prompted to choose a name for the files. The grid number will automatically be added after the dash.

9. You will get two files for each grid square, a .dat file that will hold the data and a .hdr file that has the parameters for each grid square.

Charging and Care

The Grad 601-2 holds a charge that will serve many days of survey. When you need to charge the battery, slide the charge port cover over and attach the AC charger. This charger has interchangeable plugs for use outside of the United States.

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