



***RST INSTRUMENTS*** LTD.

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## Digital Spiral Probe Instruction Manual

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# Digital Spiral Probe Instruction Manual

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Although all efforts have been made to ensure the accuracy and completeness of the information contained in this document, RST Instruments reserves the right to change the information at any time and assumes no liability for its accuracy.

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Instruction Manual

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# 1 INTRODUCTION

A spiral sensor is used to determine the true azimuth of inclinometer casing after installation. Installed casing spiral is a function of:

## ***Manufacturing Process***

During manufacturing, it is extremely important to ensure accurate groove alignment and reduction of manufacturing induced spiral. RST Instruments employs a proprietary, machine broached manufacturing technique, that insures RST ABS Inclinometer casing has less than 0.3 degrees of twist per 10ft. length (<0.005 Rad/3m).

## ***Casing Coupling***

In comparison to the conventional separate coupling method, the integral coupling design on RST Inclinometer casing results in half the amount of couplings per installation. Given equal coupling tolerance, RST casing has therefore half the coupling induced installed spiral as competing separate coupling methods.

## ***Installation Procedure***

Spiral is typically of concern only in deep installations, however, should poor installation be suspected, or installed spiral be of interest, a spiral survey must be conducted utilizing this tool. Operation is similar to an inclinometer probe using the same cable and readout instruments, however it is necessary to only read one groove set, and not take a second 180 degree reading. Two sets of readings in the same orientation can be taken just to ensure repeatability of the spiral survey (if required).

The RST Digital Spiral Probe is designed to compliment the RST Digital Inclinometer System. In situations where excessive spiral is present in the inclinometer casing, it becomes important to correct for the spiral in order to have the correct magnitude of displacement in the A and B axes. Typically, spiral surveys are recommended in situations where there are:

- Deep borehole installations
- Very precise measurements are required
- Inclinometer data indicates displacements that are in unanticipated directions
- Problems occurred during the installation of the casing (i.e. twist was induced in the casing).

The spiral sensor is connected to the Digital Inclinometer reel just like a standard RST Digital Inclinometer Probe. The RST Digital Software automatically senses the Digital Spiral Probe. The probe is then lowered to the base of the borehole and the survey is performed in 0.5 metre (or 2 ft.) intervals depending on whether a metric or imperial system is being used. Readings are displayed on the hand-held Field PC directly in degrees.

Once the data is collected, it can be imported into RST *Inclinalysis* Software. A spiral correction can then be applied to the Digital Inclinometer data and plots of the borehole spiral can be created. For further information on *Inclinalysis* software, please contact RST Instruments Ltd. or visit our website at: <http://www.rstinstruments.com>.

***Spiral Sensor***

The RST Digital Spiral Probe is made from 100% stainless steel and the rotation is measured by a precision digital sensor. The wheel assemblies on the sensor are the same as those used on the Digital Inclinometer Probe, ensuring a precise fit with the casing groove profile.

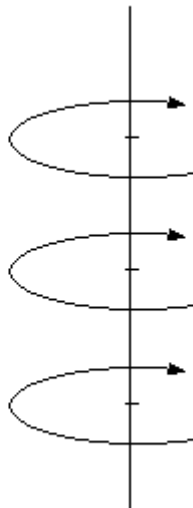
The spiral sensor is rugged, waterproof and designed for use in any 60mm (2.36 in.) PVC, 70 mm and 85 mm (2.75 in. and 3.34 in.) ABS, or 71 mm and 86 mm (2.79 in. and 3.38 in.) aluminum casing as manufactured by RST or others.

***Readout Instrument***

The readout device is an Ultra-Rugged Field PC™, which is included with the RST Digital Inclinometer system. Please refer to the RST Digital Inclinometer Brochure for a complete description and specifications.

***Control Cable***

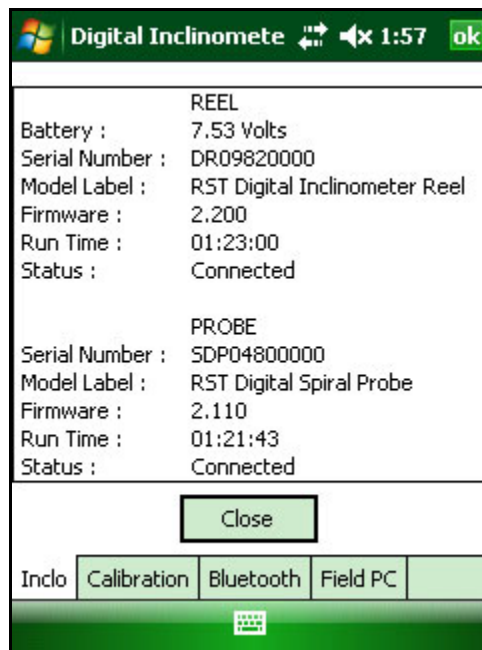
Utilizes the standard RST Digital Inclinometer cable. As spiral surveys are often performed in deep boreholes, the lightweight Kevlar strain relief digital cable greatly eases operation in comparison to the thicker more traditional analog inclinometer cables.



**Figure 1 – Spiral Data Collection Method**

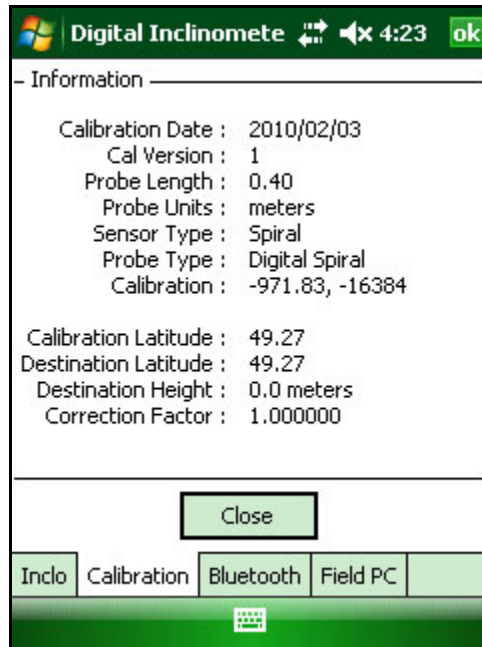
## 2 INITIAL SET-UP

- Connect the spiral probe to cable reel, turn on the reel power and launch the RST Digital Inclinometer software on the Field PC (just as you would in performing a normal Digital Inclinometer survey). The software will automatically connect to the Reel and the Spiral Probe upon start-up.
- During the connection process, the RST Digital Inclinometer software will automatically sense the presence of the Digital Spiral Probe (this may take a few moments). Messages appearing at the bottom of the main screen will reveal the progress of communication with the Digital Reel and Probe. To ensure the system has connected properly, click on the *Status* button and the following screen will appear:



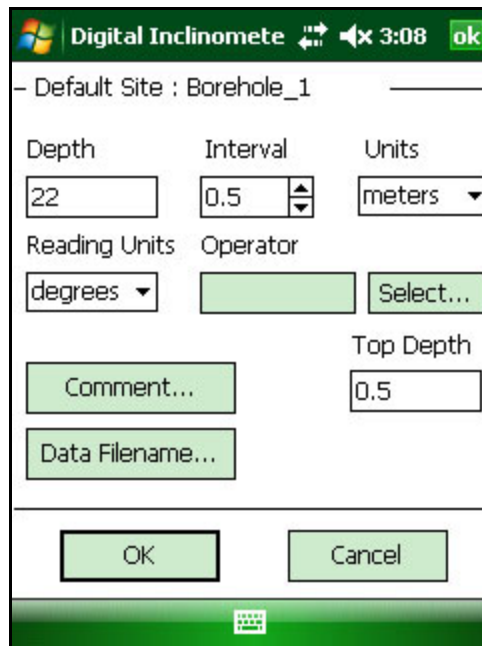
**Figure 2 – Digital Probe & Reel Information**

- The serial number in the above screen should reflect the serial number of the Digital Spiral Probe (this may take a few moments). To ensure that the system has indeed connected to a Digital Spiral Probe, click on the *Calibration* tab. The following screen will be shown:



**Figure 3 – Spiral Probe Calibration Information**

- The probe length, probe units and probe type should all reflect the properties of the Digital Spiral Probe. The *Correction Factor* is factory set and eliminates the zero offset of the probe.
- Once connected, select the Site/Borehole you wish to perform the spiral data survey on from the main menu.
- Highlight the borehole name and select *Edit Borehole*. The following screen will appear:



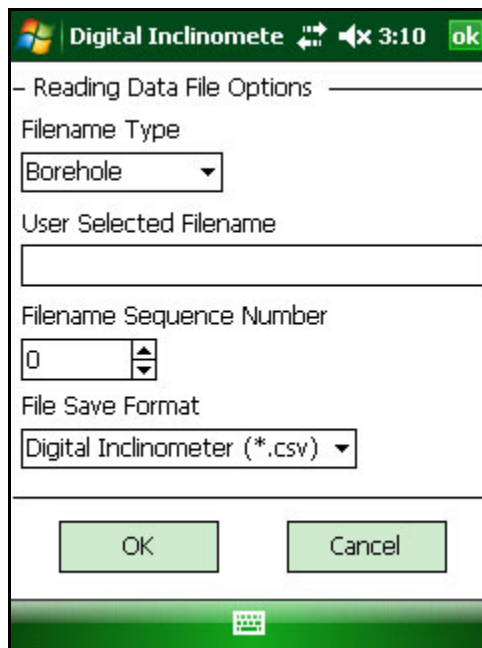
**Figure 4 – Edit Borehole**

- Set the *depth* of the borehole to an interval of the Spiral Probe Length. The spiral probe must finish on an interval of its length. Example: Suppose your borehole is 30.2 metres in depth. The next closest interval that is divisible by 0.5 metres is a depth of 30.0 metres. For the probe to finish on the last divisible interval (0.5 metres), the starting interval **must be 30 metres**.

#### Note

It is crucial that the depth of the borehole for the spiral survey is calculated so that it is a multiple of 0.5 metres (or 2 feet) and that the spiral probe finishes at a depth which is divisible by the probe's length 0.5 metres (or 2 feet). This means that the spiral probe may not be able to be deployed to the absolute bottom of the borehole, rather the first multiple of 0.5 metres (or 2 feet). The Digital Inclinometer Program will provide a warning if a borehole depth is entered which is not an even multiple of the probe length.

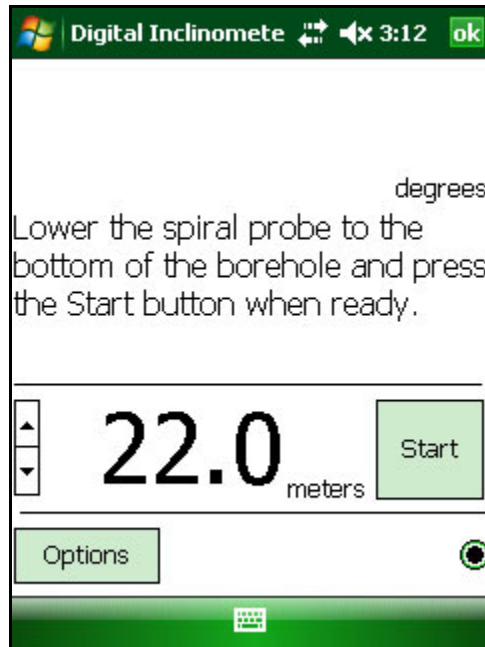
- Set the *measurement interval* to either 0.5 metres or 2 feet. Press *OK*.
- The data file format is preset for spiral data, the custom filename can be selected using the *Reading Data file Options* dialog.
- The spiral data files are tagged with the prefix "SDP\_" to help with data file management.



**Figure 5 – Reading Data File Options**

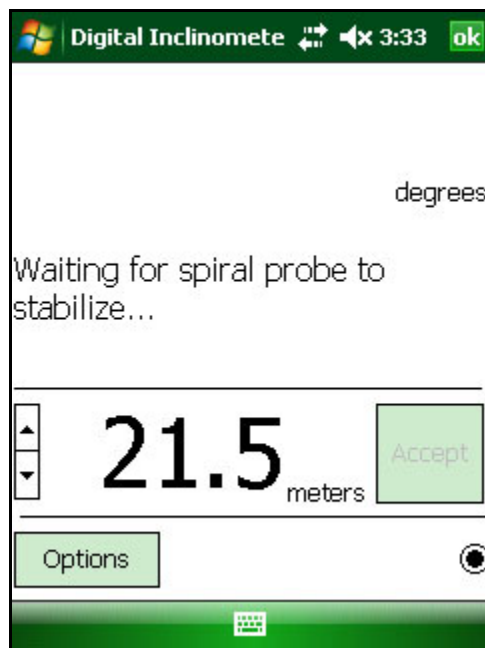
- Click on the *Readings* button on the main menu and the following screen will appear:



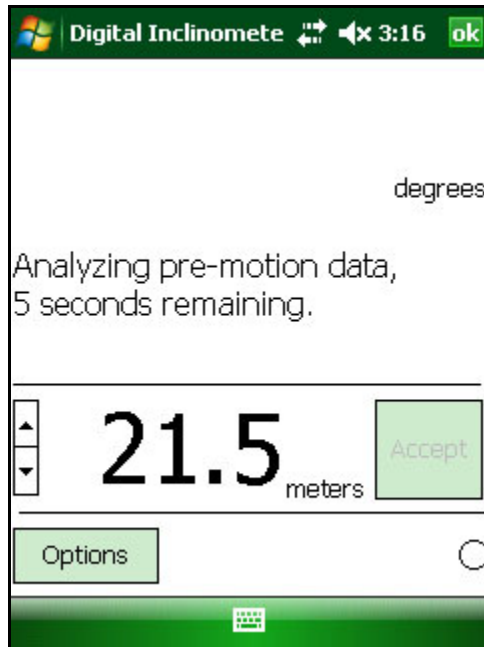


**Figure 6 – Readings Screen**

- The software displays the spiral readings directly in degrees. Logging the spiral data is done in a similar manner as an inclinometer survey. To begin the survey, push *Start* button. The initial position is then measured. *Accept* button needs to be pressed when in manual mode. In *Auto Accept* mode, the probe will sense movements and the reading will be taken automatically without the need to press any buttons. The reading mode can be changed on Options screen, shown in Figure 12.

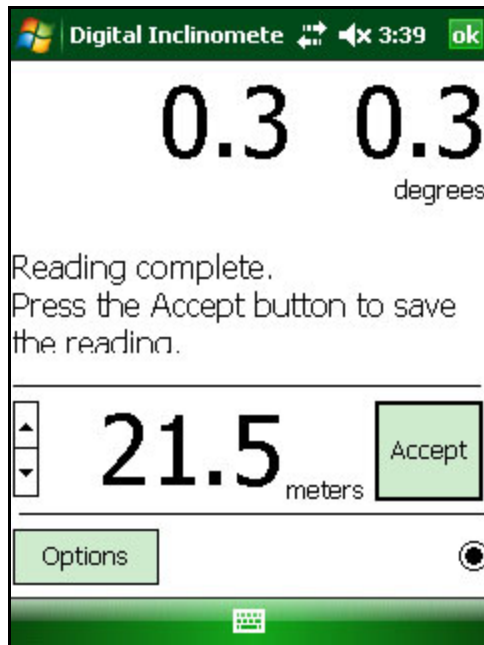


**Figure 7 – Detecting Motion**



**Figure 8 – Analyzing Data**

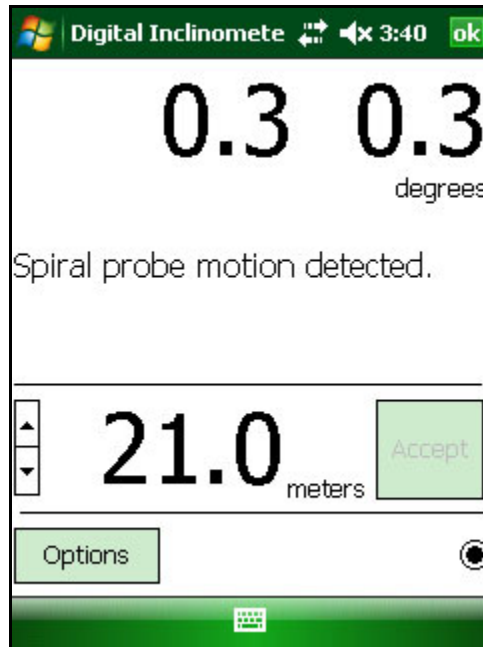
Soon after the motion data is processed, the instrument will display the angle value and prompt to save the measurement.



**Figure 9 – Accept Reading**

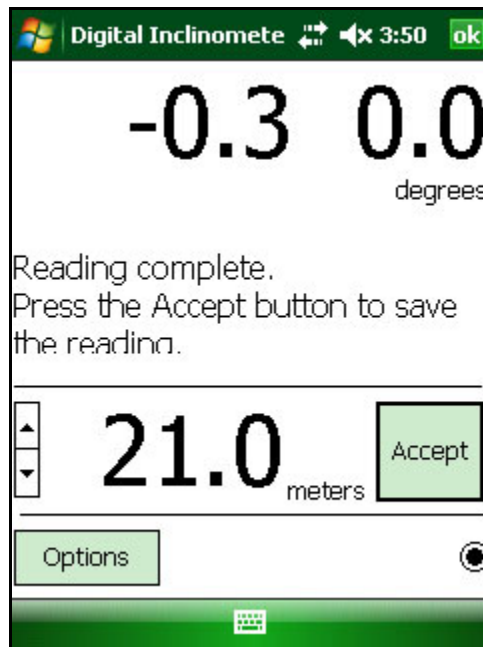
Additionally, the sound can be played after each measurement is taken. This way the operator is notified that the probe needs to be moved to the next point.

Alternatively, if in Auto Accept mode, the motion is detected and data recorded automatically without any prompts.

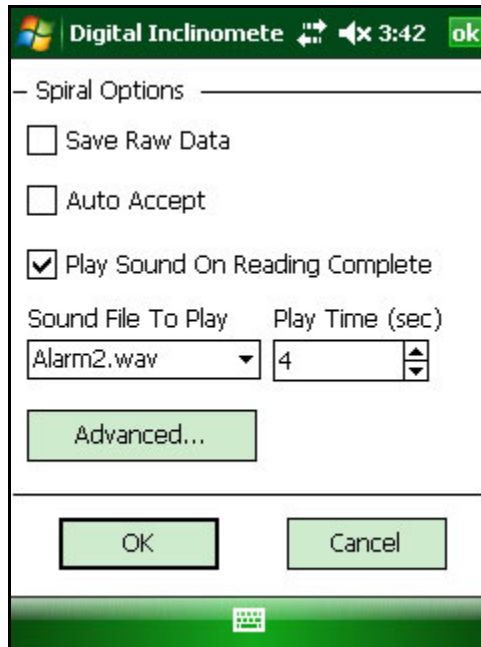


**Figure 10 – Probe Motion Detected**

After the measured value is accepted or motion detected in automatic mode, the next measurement cycle begins and it is repeated until reaching the top of the borehole.



**Figure 11 – Accept Next Reading**



**Figure 12 – Spiral Options**

The *Save Raw Data* and *Advanced* button are for diagnostic purposes only. It is not recommended to use it unless advised by RST Instruments personnel.

When Sound notification is enabled, the 0 time setting will play the sound after the reading has been calculated. The -1 setting will cause continuous sound until manually accepting the reading, or it will play until motion is detected in *Auto Accept* mode. Any other positive value will set the maximum sound playing time.

**Note**

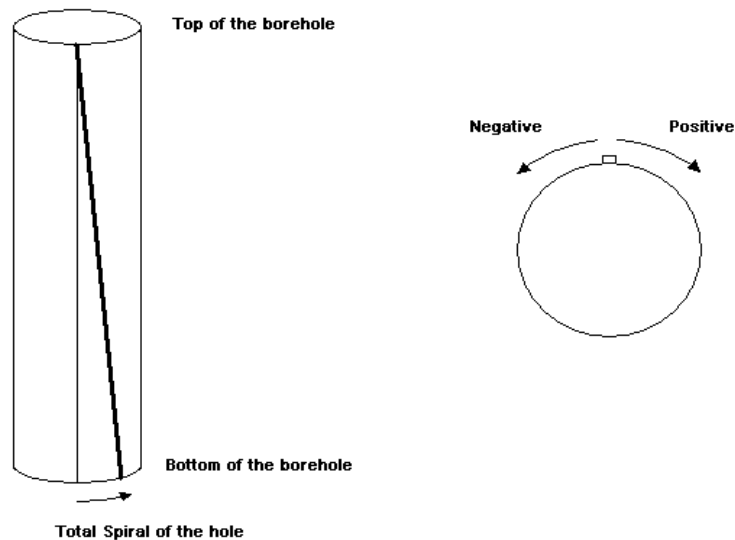
The RST Digital Spiral Probe contains similar highly sensitive electronics as the Digital Inclinator Probe. Make sure to avoid excessive shock to the device. Always store the Digital Spiral Probe in its case when not in use. Before placing the probe down the borehole, ensure to connect it to the system and power it up. Once powered, the sensor is much less susceptible to shock and vibration. Always keep the probe clean by rinsing the probe with clean water. The use of solvents is not required and should not be used.

### 3 ACQUIRING DATA

- Carefully deploy the spiral probe to the bottom of the borehole. **Be sure to wait 10 minutes to allow the probe to adjust to the temperature in the bottom of the borehole.**
- NOTE: Only one run per hole is required, you do not need to reverse the probe 180 degrees and re-run as when taking inclinometer data. You may however, want to repeat a run in the same set of grooves to check data repeatability.
- As noted in section 2, set up the Digital Inclinometer software logger to log to the entire hole at an interval of 0.5 metres (or 2 feet) **making sure the survey completes on the last interval of the probe length** (either 0.5 metres or 2 feet).
- Press *OK* and perform the survey by pulling the cable up at 0.5 metre (or 2 foot) increments until the last reading is reached. The inclinometer program will indicate that the survey is complete and will save the file.
- Download the data from Field PC to the computer using Microsoft ActiveSync
- To use data with Inclanalysis software, the \*.csv spiral data file can be imported directly into Inclanalysis, once a specific project has been opened (i.e. you must already have an inclinometer data file loaded in Inclanalysis before importing and applying the spiral data). Please refer to section 5 below.
- Total spiral of the hole is the summation of all the readings from the bottom to the top of the borehole (clockwise is positive). The bottom of the borehole is used as a reference point for spiral data collection.

### 4 SAMPLE DATA FILE

The downloaded data file can be viewed using spreadsheet programs, like Microsoft Excel. Following is the sample spiral data file collected using Digital Inclinometer software. The file consists of the header part containing various spiral probe and borehole details, and data part. The data section has five columns. First column shows where every measurement was taken. The next two columns contain the actual measurements in degrees and cumulative value.



**Figure 13 – Total Spiral of the borehole**

The clockwise turn results in positive spiral when pulling the probe up during borehole survey. When cumulative spiral is positive as on sample file, the borehole tubing appears twisted counter-clockwise when looking down the borehole.

| RST Digital Inclinator Data |                 |          |         |         |  |  |
|-----------------------------|-----------------|----------|---------|---------|--|--|
| File Version                | 2.2             |          |         |         |  |  |
| File Type                   | Digital Spiral  |          |         |         |  |  |
| Site                        | Default Site    |          |         |         |  |  |
| Borehole                    | Spiral_Borehole |          |         |         |  |  |
| Probe Serial#               | DP04530000      |          |         |         |  |  |
| Reel Serial#                | DR08060000      |          |         |         |  |  |
| Reading Date(m/d/y)         | 1/25/2010       | 11:39:36 |         |         |  |  |
| Depth                       | -4              |          |         |         |  |  |
| Interval                    | 0.5             |          |         |         |  |  |
| Depth Units                 | meters          |          |         |         |  |  |
| Reading Units               | degrees         |          |         |         |  |  |
| Operator                    |                 |          |         |         |  |  |
| Comment:                    |                 |          |         |         |  |  |
| Comment End:                |                 |          |         |         |  |  |
| Offset Correction           | 0               |          |         |         |  |  |
| Depth                       | Face A+         | Face A-  | Face B+ | Face B- |  |  |
| -0.5                        | 0.1             | 0.7      | 0       | 0       |  |  |
| -1                          | 0.1             | 0.6      | 0       | 0       |  |  |
| -1.5                        | 0.1             | 0.5      | 0       | 0       |  |  |
| -2                          | 0.1             | 0.4      | 0       | 0       |  |  |
| -2.5                        | 0.1             | 0.3      | 0       | 0       |  |  |
| -3                          | 0.1             | 0.2      | 0       | 0       |  |  |
| -3.5                        | 0.1             | 0.1      | 0       | 0       |  |  |
| -4                          | 0               | 0        | 0       | 0       |  |  |

**Figure 14 – Sample Spiral Data**

The total Spiral for the above data file is 0.7 degrees.

## 5 APPLYING SPIRAL IN INCLINALYSIS

Under the *Borehole Menu* select *Add/Remove Borehole Files...* browse for the \*.csv spiral file (the filename will contain SDP tag) you created on the Field PC. This file contains the spiral survey. Press *Apply* and the borehole data will be automatically corrected for spiral. Confirmation of the spiral correction appears in the top right of each plot: **Spiral Correction: Enabled.**

## 6 APPLYING SPIRAL IN GTILT PLUS

- Convert spiral data file to TWI format using Spiral File Format Converter utility available on Inclinalysis installation CD.
- Under the *File* menu, choose *Load* to load the borehole you are interested in applying the spiral correction to.
- Under the *File* menu, choose *Import*, and select *TWI File* from the drop-down list. Navigate to your spiral data file, and press *OK*. GTilt Plus will automatically import the file into the current project.
- To apply the spiral correction, under the *Set* menu, choose *Apply Spiral Correction*.
- If you wish to edit the spiral data, under the *Edit* menu choose *Spiral...*

## 7 CONTACT US

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