

Operation Manual for Bartsoft for Windows (PC version)

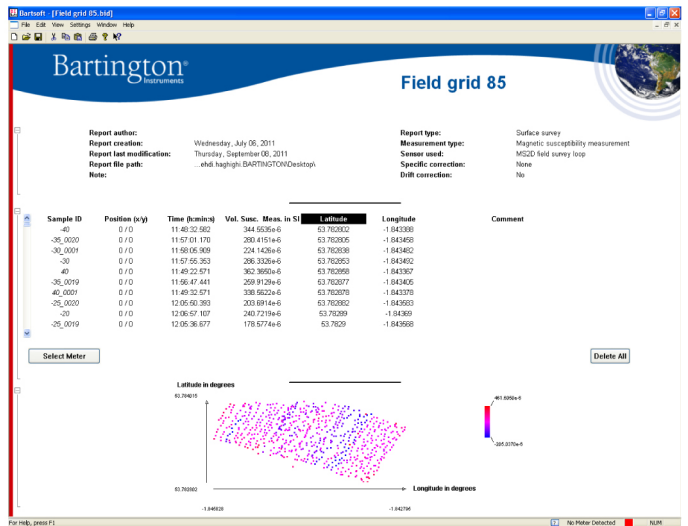


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1. About this Manual

This manual provides the information necessary to help customers operate Bartsoft software from Bartington Instruments.

Bartsoft runs on a Windows-compatible PC, referred to as the host PC. It is provided free of charge with the Bartington Instruments MS3 meter and is designed for operation with any of the sensors from the Bartington MS2 range. It can also be used with the Bartington Instruments MS2 meter via an RS-232 connection to the host PC. Multiple MS2/MS3 devices can be connected simultaneously to the host PC running the application.

Bartsoft is available for download from the Bartington Instruments website at www.bartington.com/software.html.

For operation of the MS2 devices, see OM0408 MS2 Magnetic Susceptibility System, available on the MS2/MS3 product page of the Bartington Instruments website at www.bartington.com/ms3.html.

1.1. Symbols Glossary

The following symbols used within this manual call your attention to specific types of information:

Note: Provides useful supporting information on how to make better use of your purchase.

1.2. Running Windows-based Applications

Names of Windows-based applications and menu / command options are shown in **bold type**.

Sequences of instructions for running Windows- and Windows-based applications are shown with an arrow: →.

Hence, for example, **Control Panel → System and Security → Device Manager** means 'in Windows, click on Control Panel, then System and Security, then Device Manager'.

Note: The user's familiarity with different versions of the Windows operating system is assumed. Hence, for example, an instruction might be to 'open Control Panel' rather than a detailed description of the route to follow to get to Control Panel, as these steps will not necessarily be the same from one version of Windows to the next.

2. Introduction

Bartsoft software acquires, corrects, displays, stores and prints data using Bartington Instruments MS2 and MS3 meters. This guide explains how to use the software and helps the user understand how it works, including the function of all controls and windows.

3. Installation

3.1. Introduction

This section describes the installation process of the Bartsoft software and the USB drivers for the MS3 meter.

Bartsoft is available for download from the Bartington Instruments website. The zipped files on the website contain the latest version of the application installer and the software, for both 32- and 64-bit versions of Windows XP, Windows 7 and Windows 8.

Note: Downloading from the website will ensure you always use the most up to date version.

Note: Be sure to download the correct installer for the host system: 32-bit or 64-bit.

Note: The installation wizard installs Bartsoft and prompts the user before installing the USB drivers.

3.2. Setup

First ensure that no previous version of Bartsoft is currently installed on the host PC. Uninstall it if there is.

Run **setup.exe** and follow the on-screen instructions to install the application.

Note: If previous versions of Bartsoft were installed on the host PC, the associated USB device drivers must also be removed before the new drivers can be installed. The installer will prompt the removal of the older device drivers. Restart the host PC after removal of the old drivers and after installation of the new.

The Bartsoft installer manages the USB driver installation automatically. The application installer creates a copy of the USB driver files in the application's directory (\Bartington Instruments\Bartsoft\USB Driver\). For the USB connection with the MS3 device to work properly, the two drivers that are provided in Windows '.inf' format must be installed:

1. **BartingtonMagSusc_device.inf** (displayed in Device Manager as: 'Magnetic Susceptibility Device');

2. BartingtonMagSusc_driver.inf (displayed as: 'Bartington Instruments').

3.3. Checking USB Driver Installation

To check that the drivers are installed, open **Device Manager**. Ensure that the **Jungo** entry is present and is expanded. If the MS3 USB driver is installed and an MS3 device is attached to the PC, then at least the two entries shown in Figure 1 will be visible, without any exclamation point appearing in a yellow circle.



Figure 1: Windows Device Manager displaying the MS3 USB drivers

Note: If neither of the USB drivers are installed, then the user is prompted to install them when the MS3 is plugged in to the host PC. However, if only one of the device drivers is installed, Windows may not prompt for the second driver to be installed. The user must therefore open the **Device Manager** to check that both are installed.

3.4. Managing USB Drivers Manually

Installation can also be done manually through the **Device Manager**, which provides a utility to install, update or remove device drivers. Right-clicking on an unrecognised device and selecting the **Update Driver...** option from the menu (Figure 2) allows a device driver to be installed, after the correct driver for that device has been found.

Note: By default USB drivers for the MS3 are located at: **Program Files/Bartington Instruments/Bartsoft/USB Driver**.

In the same way, a driver can be re-installed, if it was not installed properly in the first instance.



Figure 2: Updating driver for an unrecognised device

Note: This process must be repeated once for each MS3 driver. The order in which these drivers are installed is not important.

Figure 3 shows both MS3 drivers installed and working properly prior to updating.



Figure 3: Update/re-install the MS3 USB drivers

Note: The user will require 'Administrator' permission on the host PC to carry out these operations.

3.5. Installation Troubleshooting

3.5.1. Bartsoft Will Not Start

Uninstall the application and remove the USB drivers when prompted, before re-installing it. Ensure the correct version (32/64 bit application) is installed and that you are logged on with 'Administrator' rights on the host operating system.

3.5.2. Application Starts But Cannot Detect the Connected MS3 Device

While an MS3 device is connected to the host PC, open **Device Manager** (as described above) and check that both drivers (**Bartington Instruments** and **Magnetic Susceptibility Device**) exist and are working properly.

Note: Right-clicking on the driver and selecting properties will enable you to check correct operation: see Figure 4. If they seem to be working, check the hardware, including the MS3's USB cable. Also ensure that the host PC's USB port is functioning correctly (e.g. when other devices are connected).

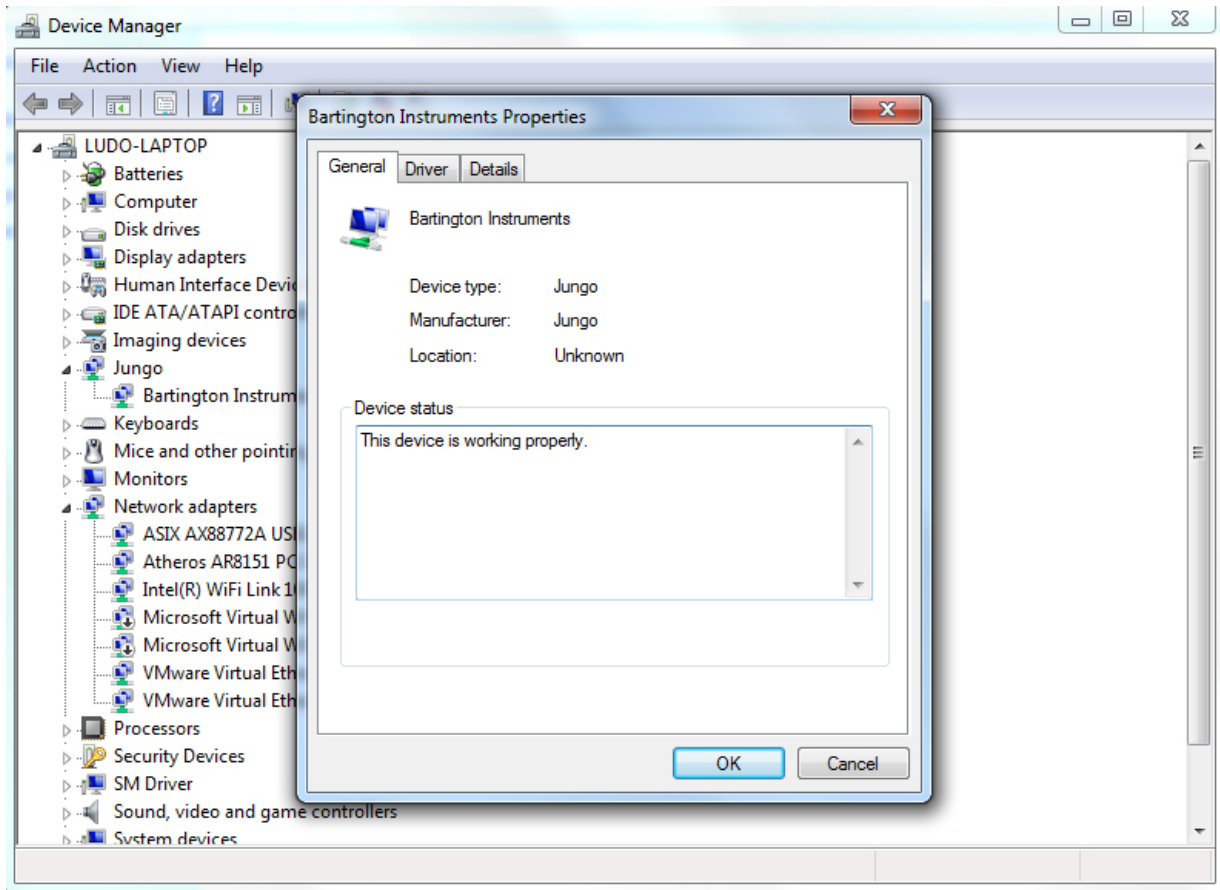


Figure 4: Device Manager screen showing that 'Bartington Instruments' device is working properly.

3.5.3. Problem with the Device Driver

Uninstall the application. When prompted, ensure the device driver is also uninstalled. Make sure that the MS3 device is disconnected before attempting to uninstall the driver. After the uninstall is complete, restart the PC and then re-install the application. On completion of the installation, restart the PC for the second time and then connect the MS3 device. Wait a few seconds for the operating system to load the driver of the device. If the problem persists, contact Bartington Instruments Customer Services.

4. Quick Start Guide

4.1. Introduction

This section explains the basics of the Bartsoft application and its use. It is assumed that Bartsoft and the USB device drivers are correctly installed and working. For installation and troubleshooting of the USB drivers, refer to [Installation](#).

4.2. Running Bartsoft and Connecting to MS2/MS3 Device(s)

At start-up, Bartsoft searches automatically for any connected MS3/MS2 devices via the application's default port settings. These settings assume that an MS3 device is connected to the host PC via a USB port.

The automatic search can only detect MS2 devices where the port setting switch (located at the back of the MS2 device) is set to 'A' mode (baud rate: 1200; data: 7 bit; stop bits: 2) or 'B' mode (baud rate: 1200; data: 8 bit; stop bits: 2). The application will not connect automatically to MS3 devices via RS-232 (regardless of port setting) or to MS2 devices set to mode 'C'. The status of the connection is indicated in the meter status window, located at the bottom right of the main application's main window. The status indicator turns to green when the connection is successful; red when no device is detected; and yellow where a connected device is not attached to any sensor (Figure 5).

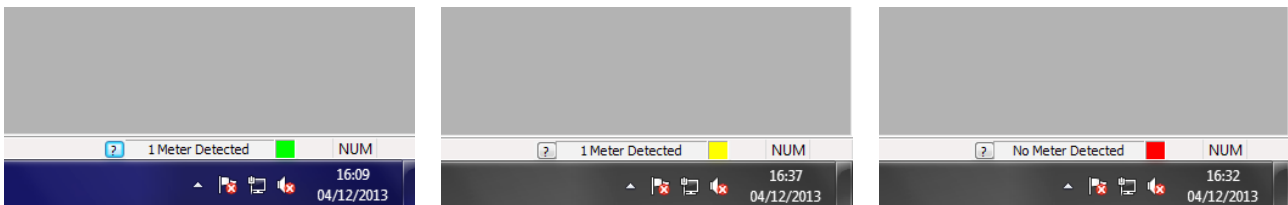


Figure 5: Meter status indicator window changing from green to yellow to red.

To establish a successful connection in the cases where no automatic detection occurs, Bartsoft needs to be manually configured, as described below.

1. After running the application, wait for the automatic search to fail. This may take a few seconds.
2. On the main application window, select **Meters → Search Options...** to open the **Search ports** window.
3. Make sure that the **Include RS-232** check box is selected.

Note: RS232 should be selected if using a USB to serial converter.

4. Select one of the two available device types (**Search for MS2 device** or **Search for MS3 device**).
5. Select the port number from the available list of ports, where the device is connected to the host PC.
6. Click on the **Settings** button to open the **Test connection** window. This helps to attempt a quick connection to a device that is attached to a specific port on the host PC.
7. Select A, B or C from the list of **Current device settings**, before clicking on the **Test connection** button. The current RS-232 port setting of an MS3 device can be viewed (and updated) by connecting the device via USB first, and using the **RS-232 Setting** tab in the meter window.

Note: The 'A' setting will not work if using an MS3 device with RS-232 connection: 'B' or 'C' must be selected.

8. Click **OK** to close the **Search ports** window, before starting a new search by pressing F5 on the keyboard or by selecting **Meters → Find Meters...**

Note: When Bartsoft is running, it automatically detects any MS3 that is newly connected via any USB port to the host PC. However, to detect devices connected via RS-232, the application needs to perform a scan of all of the available COM ports on the host. Initiating a scan refreshes any currently active connection. Therefore, if a new scan is started while the application is carrying out measurements, the active connection will be interrupted.

4.3. Taking Measurements

Measurements can be taken when the application detects a meter device with a sensor attached to it.

Note: In this case, the device status window located at the bottom right corner of the main window is green when a device with a sensor attached is detected. However, if there are multiple devices connected to the host PC, then all of those devices must be attached to a sensor for the status window to show as green.

Measurements can be taken in two different ways:

- the quick way, using the device window in which the measurements are not recorded. (For more information see [Virtual Device Window](#).)
- according to a pre-defined program, where the records can be archived for later use.

4.3.1. Quick Measurements

To take simple measurements, while the application's main window is open:

1. Select **Meters** from the main toolbar to see a list of currently connected meters at the top.
2. Select an existing meter from this list, to open a window for that device.
3. Use the **Main Interface** tab containing the two **Zero** and **Measure** buttons on this window to take measurements.

Note: Values displayed in this window are impromptu measurements and are not saved by the computer.

4.3.2. Controlling and Applying Corrections to Measurements

To create an automatically controlled program for taking measurements that can be archived for later use, select **New** from the **File** menu to open the Report Creation Assistant and create a new data file, or **Open** to open an existing file.

Selecting **New** opens a wizard that lets the user configure a program for a specific device and sensor type.

Note: The device must be attached at the time.

This wizard lets the user set parameters that define how measurements are taken, how some calculations are carried out, and how the records are displayed.

- **Report type selection:** select the type of survey to be performed and the sensor being used. Although a sensor can be selected which does not match the one being used, some corrections are particular to a type of sensor. Once the appropriate survey and sensor type are selected, click **Next** to continue.
- **Hardware & Text:** select the meter to be used. It is also possible to input some comments about the survey, such as the name of author, etc., before clicking the **Next** button.
- **Correction selection:** select the drift correction and all other corrections applicable to the particular sensor being used. Once selected, press **Next**.

Note: Dual frequency measurement for the MS2B sensor can also be selected on this page.

- **Table content:** select the information to be displayed during data collection. All data are recorded and kept in the file, and can be visualised when reopening the file.
- **Graph options:** select the parameters of the graphic display.
- **Position assignment:** this relates to core or grid survey and lets the user set up an automated increment for X & Y axes on a grid or Z (depth) for a core survey. It also lets the user set up a gridded survey. For more details on how grid settings are set and controlled, see [Grid and Down-Hole Options](#).

- **Measuring protocol:** select the order in which measurements are to be made. If drift correction has been selected, the survey must finish with a blank measurement. There is always a blank measurement at the start, whether or not it is specified in this table. For example, to select 10 sample measurements between each blank measurement, enter 10 in the **number of iterations** box.
- **Number format:** select the way the data is to be displayed.

To finish configuring the report, click on **Finish** to close the Report Creation Assistant. (For more information see [Report Creation Assistant](#))

This will open and display a new report that is ready to receive and take measurements according to the configured program. It displays the acquired data and lets the user save the records, as well as the document configuration. (For more information see [Document Report](#))

- The button labelled **Start Measurement** carries out the entire program, unless it is interrupted by clicking on the **Stop** button.
- The button labelled **Start Single Cycle** carries out one cycle of the program, unless it is interrupted.

Note: When the program is interrupted before the end of a cycle is reached, if drift correction is enabled (and unless the last measurement was a reference) then the application will carry out a reference (air) measurement before it stops.

5. The Bartsoft User Interface

The Bartsoft user interface helps the user display, print and store data gathered from Bartington products. It includes the following groups of controls.

- **Menus:** lets the user interact with the software in order to request a particular task.
- **Dialog bars:** inform the user of tasks undertaken, scroll documents, and display shortcuts to the Menu.
- **Device interface:** lets the user configure for USB devices, RS-232 devices, or both.
- **Report creation assistant:** allows the creation of reports based on measurements made.
- **Bartsoft Document (Report):** for manipulating the data gathered.

5.1. Bartsoft Menus

Four different menus are available in Bartsoft:

- **Main:** available when documents are yet to be opened.

- **Document:** becomes available when a document is open.
- **Table:** appears if you click with the mouse right button while over the Table of Measurements.
- **Graph:** appears if you click with the mouse right button while over the graph.

5.1.1. Main Menu

The **Main** menu offers the following options:

- **File:** includes file management functions as well as basic Windows-based software functionalities.
- **View:** lets the user choose how the Bartsoft main screen should be displayed.
- **Meters:** includes all management functions for connected instruments.
- **RS-232:** appears when RS-232 ports are available on the system, and lets the user connect the host computer to MS2 and MS3 devices.
- **Help:** view the application's Help pages.

5.1.1.1. Main Meters Menu

The **Meters** menu offers the following commands:

- **Find meters:** starts the scan of all the host PC's available communication ports to detect connected Bartington Instruments devices. Devices found will be listed and become available for selection in the **Meters** menu.
- **Search Options:** displays the configuration window to choose which port types (RS-232 or USB) are to be included in the search for the connected devices. This window also lets the user configure the RS-232 port settings. (For more information see [Device Search Configuration](#))
- **Meter on port:** opens the virtual device window of the meter selected. (For more information see [Virtual Device Window](#))

5.1.2. Document Menu

5.1.2.1. Document Settings Menu

The **Settings** menu offers the following commands:

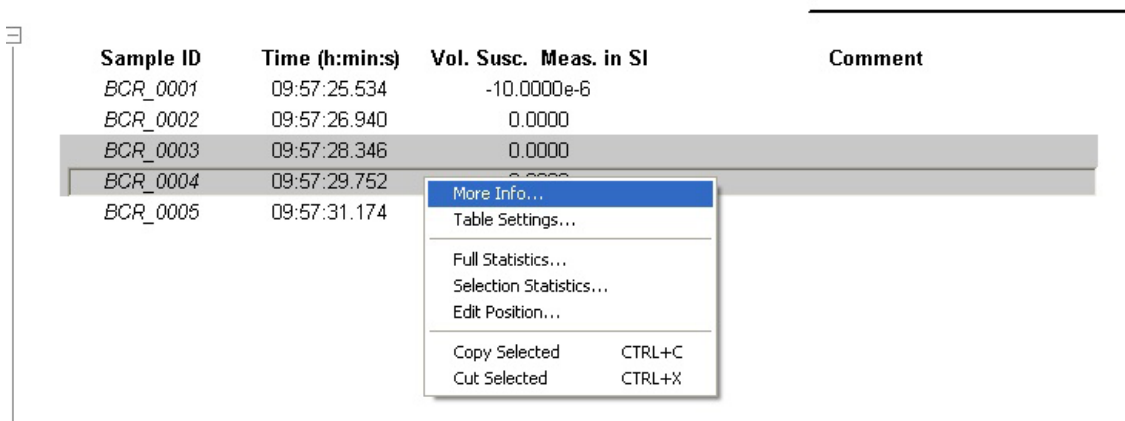
- **Hardware Settings:** selects the right measurement acquisition device. (For more information see [Hardware & Text](#))

- **Measuring Protocol:** selects how measurements will be gathered. (For more information see [Measuring Protocol](#).)
- **Table Settings:** selects how measurements should be displayed within the table. (For more information see [Table Content](#).)
- **Graph Settings:** selects how measurements should be displayed within the graph. (For more information see [Graph Options](#).)
- **Grid and Down-hole Settings:** selects how position information is recorded with each new measurement. (For more information see [Grid and Down-Hole Options](#).)
- **Number Settings:** selects format in which numbers are displayed. (For more information see [Numbering Format](#).)

5.1.3. Table Menu

The **Table** menu (Figure 6) offers the following commands:

- **More Info:** shows all information recorded for the selected measurement.
- **Table Settings:** selects how measurements should be displayed within the table. (For more information see [Table Content](#).)
- **Full Statistics:** displays statistics including all recorded measurements.
 - **Number of Measurements:** the number of measurements included in the statistics.
 - **Testing Period:** the time period between the oldest and the most recent measurement.
 - **Maximum:** the biggest corrected value recorded.
 - **Minimum:** the smallest corrected value recorded
 - **Average:** the average of all the corrected values recorded.
 - **Deviation:** the standard deviation calculated using all the corrected value recorded.
- **Selection Statistics:** displays statistics including all selected measurements.
- **Edit Position:** edits the position of the selected measurement.
- **Copy selected:** copies the selected measurements from the table into the clipboard. These measurements are then available to paste in any word- or table-processing software.
- **Cut selected:** copies the selected measurements from the table into the clipboard, then deletes them from the table. These measurements are then available to paste in any word- or table-processing software.



Sample ID	Time (h:min:s)	Vol. Susc. Meas. in SI	Comment
BCR_0001	09:57:25.534	-10.0000e-6	
BCR_0002	09:57:26.940	0.0000	
BCR_0003	09:57:28.346	0.0000	
BCR_0004	09:57:29.752	0.0000	
BCR_0005	09:57:31.174		

Figure 6: Table menu is displayed after a mouse right click on the table

5.1.4. Graph Menu

The **Graph** menu (Figure 7) offers the following commands:

- **More Info:** shows all information recorded for the selected measurement.
- **Graph Settings:** selects how measurements should be displayed within the graph. (For more information see [Graph Options](#))
- **Full Statistics:** displays statistics including all recorded measurements.
- **Copy Graph:** copies the graph as displayed from the table into the clipboard. The graph is then available to paste in any word-, table- or image-processing software as a *.bmp file.

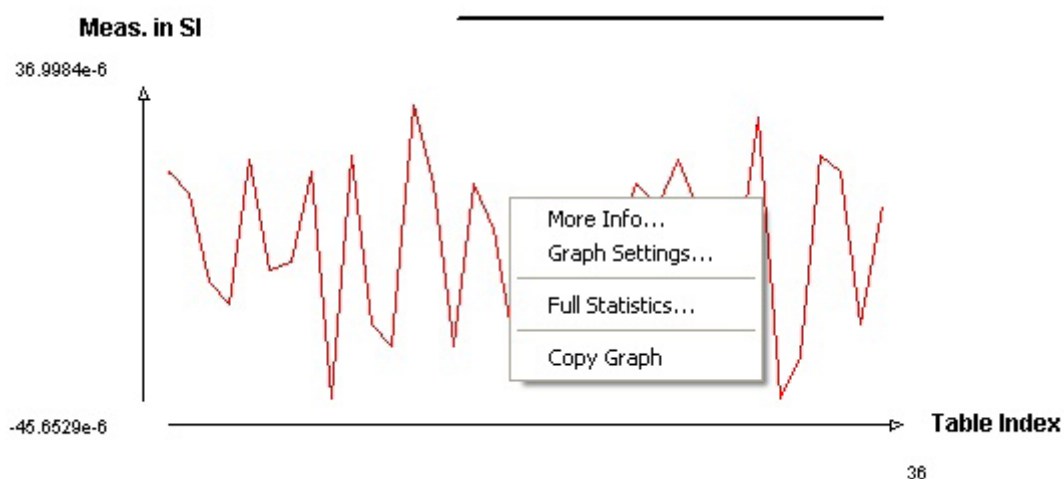


Figure 7: Menu displayed after mouse right-click on the graph

5.2. Bartsoft Bars

Three different types of access and information bars are available in Bartsoft:

- **Status Bar:** informs the user of current actions by displaying help and software status.
- **Toolbar:** provides quick access to the menu main functions.
- **Scrollbars:** lets the user scroll the document or the table of measurement vertically and horizontally.

5.2.1. Status Bar

The status bar is displayed at the bottom of the Bartsoft window. To display or hide the status bar, use the **Status Bar** option of the **View** menu.

- **Information Display:** the left end of the status bar describes the actions of menu items as the user navigates through menus.
- **Status Display:** the right end of the status bar indicates the number of compatible devices connected to the PC, the status of the connection to these devices (in traffic light format), and if any of the following keys are activated: CAP, NUM or SCRL.

The **?** button provides extra information about the connection status or hints about the currently connected devices.

5.2.2. Toolbar

The toolbar is displayed across the top of the application window, below the menu bar. The toolbar provides quick mouse access to frequently used menu commands. To hide or display the toolbar, click **Toolbar** from the **View** menu.

5.2.3. Scrollbars

The scrollbars appear automatically at the right and bottom edges of the document or table of measurements if they are required to see parts of the document table that are not directly visible.

5.3. Bartsoft Device Interface

5.3.1. Device Search Configuration

This screen (Figure 8) lets the user choose whether Bartsoft should search for USB devices, RS-232 devices, or both. The computer scans for the connected devices either automatically at start-up or by the user selecting **Meters→Find Meters...** from the main menu.

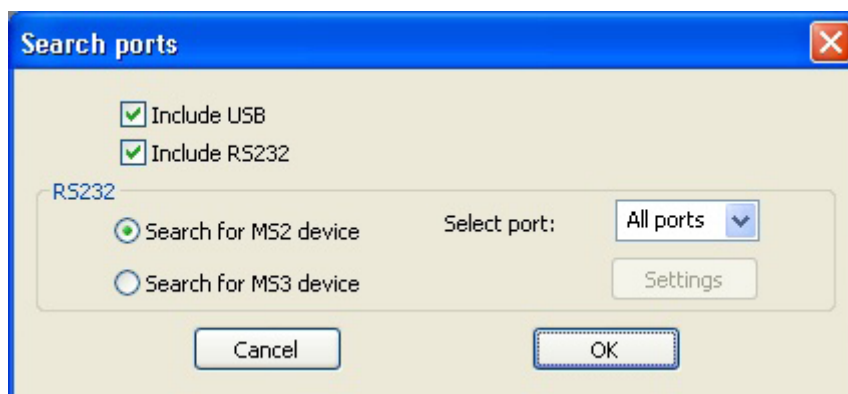


Figure 8: Device search configuration window

5.3.1.1. Include USB

Un-tick this box to exclude a search for devices connected via USB.

5.3.1.2. Include RS-232

Un-tick this box to exclude a search for devices connected via RS-232 port(s).

By default, during the scanning process the application attempts to connect to every available RS-232 port on the host PC and check whether it can communicate with a device.

Selecting this option lets the user specify whether to search for an MS2 device, an MS3 device or both. The choice made affects the communication protocol used over the RS-232 port.

Search for MS2 device

When this is selected, the application will attempt to connect to all available RS-232 ports on the host PC and communicate with an MS2 device. The default port settings are: baud rate: 9600, data: 8 bit, and stop bits: 2. This configuration is also referred to as mode 'C'.

To target a specific port, select the port number from the available list.

To configure the selected port to use a different setting, click on the **Settings** button to open the RS-232 port configuration window (see Figure 9). This window lets the user change the default configuration and try to test the connection.

Note: If the user selects **Search for MS2 Meters** from the meter **Search Options** window while an MS3 device is connected to the host PC then Bartsoft may identify a MS3 device as a MS2 device. If using this option, check that no MS3 devices are attached.

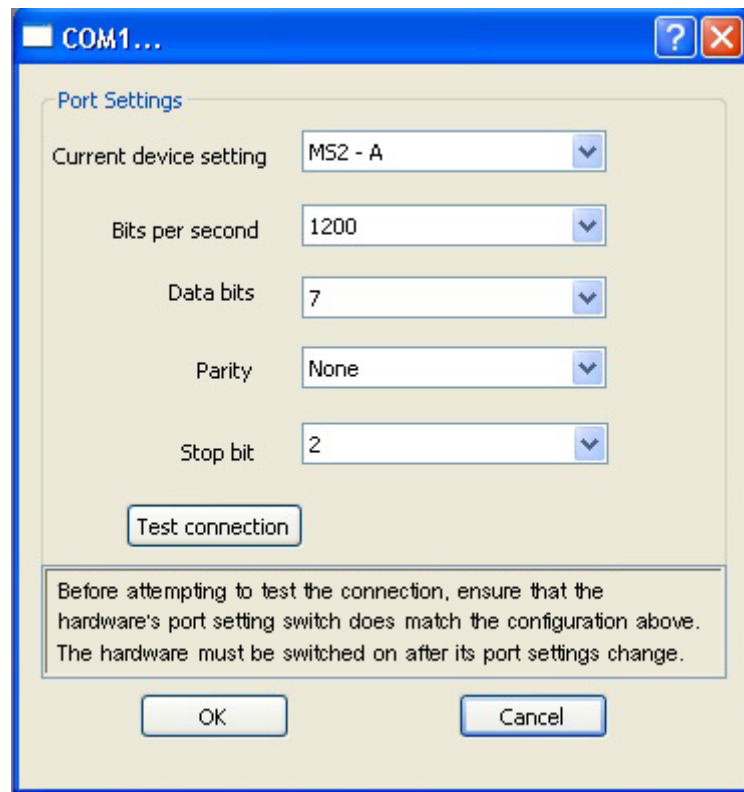


Figure 9: RS-232 port configuration window

Search for MS3 device

Select this option to limit search to MS3 devices.

Note: Whereas USB connections are automatically detected by the application while Bartsoft is running, if a new device is connected via RS-232 then the user needs to select **Meters→Find Meters...** from the main menu, or press the F5 key, to refresh the connection list.

5.3.1.3. Connection Limitations

Note: The current version of Bartsoft cannot connect to MS3 devices via RS-232 when the port configuration of the device is set to mode 'A' (data size is 7bits).

Note: It is not possible to connect to MS2 and MS3 device(s) simultaneously via RS-232 ports. Where multiple devices are to be connected to the host PC, MS3 device(s) need to use USB ports.

Note: By default, the application searches for both RS-232 and USB devices. Excluding the search for devices connected via RS-232, or selecting a single RS-232 port as a connection point, can speed up the scanning time.

Note: Bartsoft will apply the selected settings for as long as it is running and will revert to its default when it is re-started.

5.3.2. Virtual Device Window

This window lets the user take measurements without having to create reports.

Note: Values displayed in this window are of measurements made in the present session and are not saved by the computer.

5.3.2.1. MS3 Device Interface

Since MS3 meters are able to take measurements with more flexible time periods, MS3 meter windows are slightly different to the interface designed for MS2.

The MS3 meter interface (Figure 10) has three tabs.

- **Main Interface:** lets the user take quick measurements.
- **Device Info:** displays information about the device.
- **RS232 Setting:** lets the user view and configure the RS-232 settings of the device

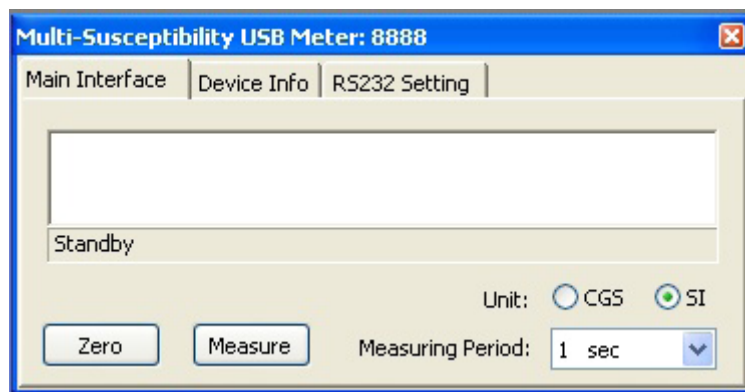


Figure 10: Main interface tab for MS3 meters

Main Interface

The main display provides controls to take measurements. The window consists of a display area for the last measured value (or zero, if the last request was an air measurement); the status of the meter; and the following controls.

- **Unit:** selects the unit for the displayed value (CGS or SI).
- **Measuring Period:** selects the time period for measurements.
- **Zero:** use this button to take an air measurement. The application stores the value obtained as a reference which is then used in calculations, after taking a sample measurement.
- **Measure:** use this button to take a sample measurement.

Note: It is important to keep the same time period for an air measurement and its related sample measurement.

Device Info

This window (Figure 11) displays information about the device:

- A unique serial number to identify each device (provide this number to Bartington Instruments if support is required).
- Hardware and software versions for the device.
- The Loader Software Version and Technician Name: these are for use by Bartington Instruments.



Figure 11: Device information tab for MS3 meters

RS232 Setting

This window (Figure 12) displays the device's current port configuration. Clicking on the **Refresh** button reads and refreshes the device information, including the current port settings. To change the current configuration, select the required setting before clicking on the **Update** button.

- **A** (baud rate: 1200; data: 7 bits; end bits: 2.)
- **B** (baud rate: 1200; data: 8 bits; end bits: 2.)
- **C** (baud rate: 9600; data: 8 bits; end bits: 2.)

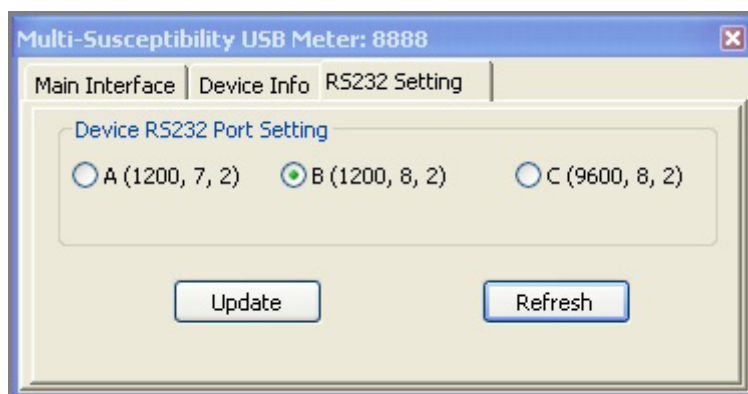


Figure 12: Port configuration tab for MS3 meters

Note: Changing port configuration while an MS3 device is connected to the host PC via RS-232 port will break Bartsoft's connection to the device. To reconnect using Bartsoft (only possible for settings B & C) will require changing the application settings by using the **Search Options** window. (For more information, see [Device Search Configuration](#)).

5.3.2.2. MS2 device interface

This window (Figure 13) simulates the controls and display on the MS2 device. The interface consists of a display area for the last measured value (or zero, if the last request was an air measurement); the status of the meter, displayed immediately below the measured value; and the following controls.

- **Unit:** selects the unit for the displayed value (CGS or SI).
- **Period:** sets the time period according to the position of the hardware selector on the MS2 device.
- **Zero:** use this button to take an air measurement. The application stores the value obtained as a reference to be used in calculations after taking a sample measurement.
- **Measure:** Use this button to take a sample measurement.

Note: it is important to keep the same time period for an air measurement and its related sample measurement.

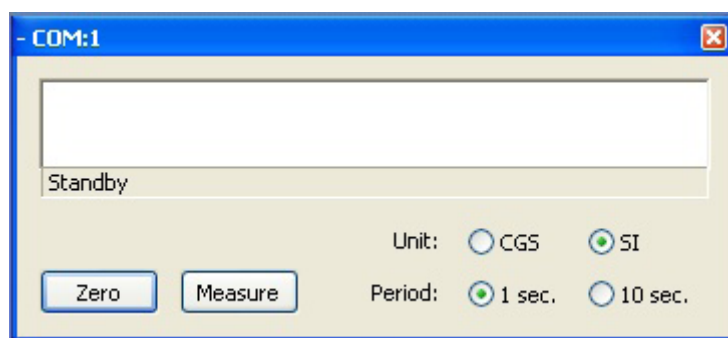


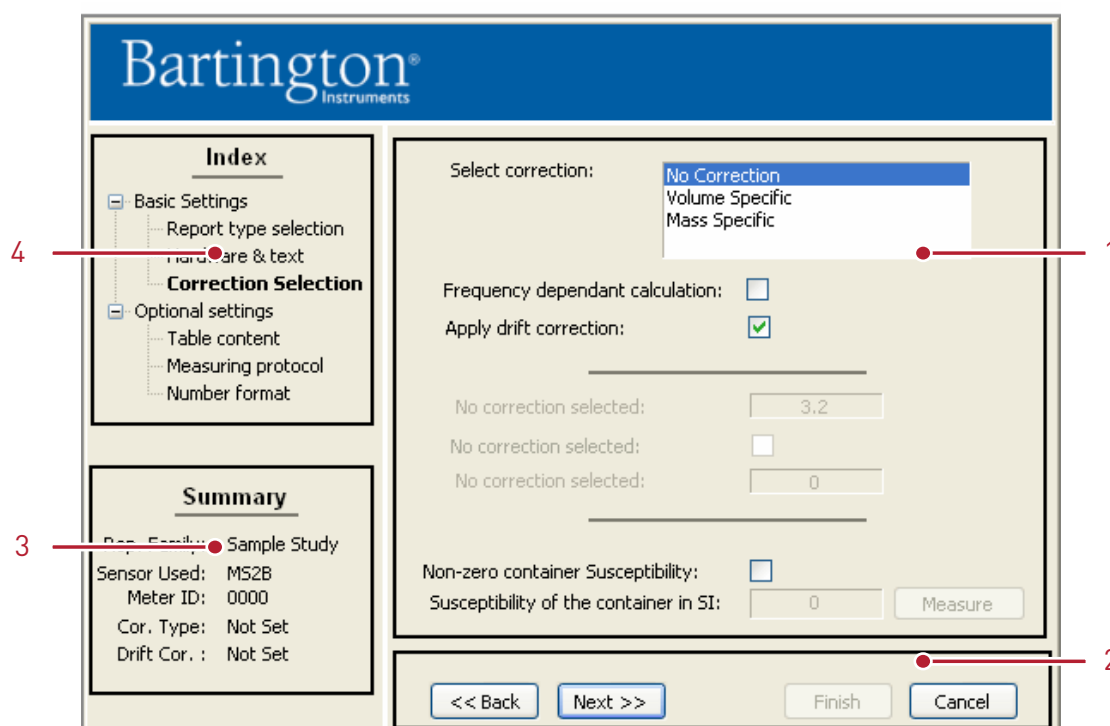
Figure 13: Interface for MS2 meters

5.4. Report Creation Assistant

5.4.1. Introduction

The Report Creation Assistant helps users create Bartsoft Documents using an interactive interface that is divided into four parts.

- **Index:** by default shows the list of settings screens and the sequence in which they are displayed during the report creation. However, any window can be selected by clicking on the index. The currently active screen's name is displayed in bold characters.
- **Summary:** shows the main settings that will define the report.
- **Settings windows:** contains the **Basic Settings** or **Optional Settings** information screens, which contain information for the user about how to use the Report Creation Assistant.
- **Navigation Buttons:**
Next displays the next settings screen within the index.
Back displays the previous setting screen within the index.
Cancel exits the Report Creation assistant.
Finish creates the report in the format chosen in the Settings screen. It appears when all settings from the summary have been defined.



Key to Figure 14

- | | |
|------------------------|---------------------|
| 1. Settings window | 3. Settings summary |
| 2. Navigation controls | 4. Assistant index |

Figure 14: Report creation assistant breakdown

5.4.2. Basic Settings Window

The Basic Settings window shows the settings needed to create a report:

- **Report Type Selection:** the type of report is selected in this window.
- **Hardware & Text:** lets the user select the way data are entered into the report, as well as providing extra information about the report in text format.
- **Correction Selection:** allows selection of the correction algorithm and any correction automation.

5.4.2.1. Report Type Selection

This screen (Figure 15) lets the user choose the type of report and sensor that is going to be used.

Figure 15: Report type settings

Four report types are available:

- **Individual sample study:** used for studying individual samples. By default, no graph will be displayed.
- **Core and down-hole survey:** used for studying cores or samples that are positioned linearly. A 2D graph that shows measurements in function of linear position or sample index will be displayed by default.
- **Surface survey:** used for studying a surface that is mapped onto a grid. A grid that shows measurements as a function of (X, Y) position co-ordinates will be displayed by default.

- **Drift Check:** for making sure that the sensor environment is sufficiently quiet magnetically for taking measurements and/or making sure that the sensor is behaving consistently.

Note: While configuring a new report, the user must select a sensor type or the **Drift Check** option before proceeding to configure any other setting.

Note: The application creates a default program of measurements, according to the selected report type. Therefore, changing report type will erase any program input by the user.

5.4.2.2. Hardware & Text

This screen lets the user select a device from a list of currently connected devices.

A device within the list can be selected by a left mouse click.

Click on the **Refresh** button to start scanning all the PC's communication ports for connected devices.

Note: This screen remains in view-only mode (i.e. the above actions are disabled) if the application is busy acquiring data from one or more device(s).

5.4.2.3. Correction Selection

To measure the permeability of a sample to a high accuracy, the raw value obtained from the sensor needs to be corrected. The correction algorithm takes three major factors into account: temperature drift, the sample and sensor's compatibility, and the susceptibility of the sample's container.

Temperature Drift

Check the **Apply Drift Correction** box to select temperature drift correction. To take into account the effect of the temperature on the measurements, the permeability of the air is measured once before and once after the permeability of the sample itself. As temperature variation can be considered linear over a short period of time, the error in susceptibility measurements can be deduced and corrected, using the measured discrepancy between the first and the last air measurements.

Sample/Sensor Association

All Bartington Instruments sensors are designed to measure volumetric susceptibility accurately. However, the volume of a sample may not always be the same as the volume expected by the sensor. This difference must be accounted for. Bartsoft provides a list of correction algorithms depending on the type of sensor being used.

- 'Volume specific correction': when the container in which the sample is stored has a volume different from the volume of the provided calibration sample.

- 'Height specific correction': when all samples are stored in cylindrical containers of the same diameter but not all containers are filled to the same height.
- 'Mass specific correction': provided if the volumetric susceptibility must be related to the density of the sample. All samples must be stored in containers of equal volume for this algorithm to be accurate.
- 'Diameter specific correction': when sample cores have varying diameters.

How to select the required correction type

The program wizard provides a list of correction types for specific sensors to let Bartsoft carry out the relevant corrective calculations. The available correction types depend on the selected sensor type. Figure 16 shows the available correction types for each sensor. (Bartsoft does not currently offer correction for other sensors.)

Correction Type	MS2B	MS2G	MS2C
Volume	✓	✓	---
Mass	✓	---	---
Height	---	✓	---
Diameter	---	---	✓

Figure 16: Correction algorithms table

Available configurations for different correction types are as follows:

Correction Type	Options	Instructions
Volume	Use same volume for all samples	<p>Tick this box when all containers used have the same volume, different to the calibration sample provided.</p> <p>Untick the box to ensure that Bartsoft prompts the user to provide the volume of the sample's container after each measurement is taken.</p>
	Volume of the sample in ml	Enter the container's volume, if the container used has a different volume to the reference volume.

Mass	Empty container mass in g	Enter the container's mass. (The default value provided in the text box is the weight of the standard 10ml plastic sample pot.)
	Volume of the sample in ml	The same as above, where the selected correction type is volume specific.
Height	Use same height for all vials	<p>Tick this box when all containers used have the same height, different to the height of the calibration sample provided.</p> <p>Untick the box to ensure that the application prompts the user to provide the height of the sample's container after each measurement is taken.</p>
	Sample fill height in mm	Enter the height of the sample within the container.
Diameter	Sensor's diameter in mm	Enter the sensor's diameter in millimetres, if it is different from the provided default value.
	Diameter of the core in mm	Enter the diameter of the core to study in this box.

5.4.3. Optional Settings Window

The optional settings window includes settings that have been initialised with default values. These can be edited to adapt to the user's particular needs.

- **Table Contents:** selects how measurements should be displayed within the table.
- **Graph options:** selects how measurements should be displayed within the graph.
- **Position assignment:** selects the way positions (X,Y,Z) are automatically assigned to each measurement.
- **Measuring Protocol:** selects how measurements will be acquired.
- **Number format:** chooses a numbering notation: Scientific, Engineering or Fixed Exponent.

- **Grid and Down-hole Options:** sets options for down-hole or core measurements, or surface mapping.

5.4.3.1. Table Content

This screen lets the user choose which fields (columns) are to be visible within the table of measurements.

If the width of the total number of columns to be displayed exceeds the width of the display area then a horizontal scrollbar will appear at the bottom of the table. However, only the displayed information will be printed if/when the document is printed.

- **Identifier:** a string of characters used to name and recognise a measurement.
- **Date & Time:** the date and the time at which the measurement was stored in memory. Time is used as part of the Drift correction (if enabled).
- **Position:** information about where the measurement was taken. It is expressed in metres and displayed in X and Y components.
- **Latitude/Longitude:** geographical information about where the measurement was taken.

Note: This information is applicable to grid reports and is only provided by Bartsoft running on a handheld mobile Windows CE platform with a connected GPS system.

- **Depth:** usually used for measurements taken from a core or within a borehole. Refers to the depth/point, where the measurement was taken and is expressed as the 'Z' component of the position.
- **Corrected Value:** the resulted value after applying corrections to the raw value. It includes all pre-set corrections. (For more information see [Correction Selection](#).)
- **Raw Value:** the value as it has been measured, before any correction is applied to it.
- **Measuring Unit:** the unit in which the raw and corrected values are expressed.
- **Correction information:** the type of correction, the corrective factor and the corrective offset that have been used to calculate the corrected value for the measurement.
- **Container information:** information about any container used in the measurement protocol. This is used to correct the raw value of the measurement.
- **Sample information:** information about the sample measured. This is used to correct the raw value of the measurement.
- **Device information:** includes the hardware used to take the measurement.
- **Entry type:** information about how the measurement was received. It can be one of:

- an automatically acquired measurement from a Bartington product connected to the PC (default)
- a manual entry of a measurement with limited information about time and no correction.
- **Comment:** where the user can add any extra information about the measurement as text.

5.4.3.2. Graph Options

This screen (Figure 17) lets the user choose the type of graph, 2D or grid, that is to be displayed in the report, as well as the colour scheme applied to it. Only one graph is available in any one report.

- The **2D graph** shows corrected measurements (Y axis) versus sample order, position (X or Y) or depth (X axis). Select this type of graph by checking the **View 2D Graph in the report** check-box.
- The Grid shows corrected measurement (cell colour) versus position X (X axis) and position Y (Y axis). If a coordinate has no related measurement attached to it then it is filled with the graph background colour. The pitch of the grid is calculated in function of the minimum coordinate spacing between two consecutive positions (X and Y independently). Select this type of graph by checking the **View Grid in the report** check-box.

Note: If neither of the two check-boxes are selected then no graph will be displayed. This will leave more space for the table to be displayed.

View 2D Graph in the report: ☐

Select background color: White ▼

Select axis and text color: Black ▼

Select plot color: Red ▼

View Grid in the report: ☒

Select background color: White ▼

Select axis and text color: Black ▼

Select color of the lowest measurement: Blue ▼

Select color of the highest measurement: Red ▼

<< Back Next >> Finish Cancel

Figure 17: Graph settings

Colour scheme

The graph colours can be selected using the drop-down lists.

Note: The colour controls are only enabled if a graph type is selected.

5.4.3.3. Grid and Down-Hole Options

This screen lets the user set an automatic depth increment for down-hole or core measurements, or alternatively set up grid-based surveys for surface mapping.

Down-hole (borehole) settings

Down-hole settings (Figure 18) are available when the selected report type is **Core and down-hole survey** (see Figure 15). Tick the **Automatic Depth Inputs** to enable the related controls:

Figure 18: Down-hole settings

- **Initial depth in meters:** the depth at which the first measurement is taken.
- **Depth increment in meters:** the amount in metres that is added to the depth after each measurement is taken.
- **Max. depth in meters:** the depth (set by the user) at which the program stops taking measurements.

Note: Bartsoft will always take an extra measurement if the max. depth has not been reached exactly using the specified increments. Therefore, if the max. depth is not exactly divisible by the depth increment, the final measurement taken will exceed the max. depth.

Grid settings

Grid settings (Figure 19) become available when the selected report type is **Surface survey** (see Figure 15) and **Automatic Grid Position Inputs** is also ticked.

Figure 19: Grid settings

The available settings are as follows:

- **Start position on the grid:** the X and Y position on the grid, where the respective minimum values will be started.
- **Position increment in metres:** value automatically added to the current X/Y values to calculate the next measurement position on the grid. For example the first measurement has the position equal to the values in **Start position on the grid**; the second measurement's position is deduced by incrementing the X value of the current position on the grid by the X value defined in **Position increment in metres** (Figure 20).

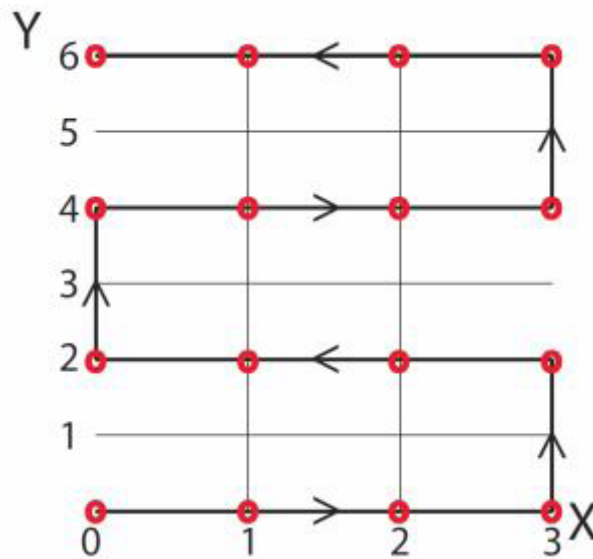


Figure 20: Automatic position increment

- **Number of measurements:** the number of measurements on each axis is calculated as: (grid size / position increment) + 1 (the 1 is added to account for the measurement on the point of origin). Total number of measurements on a grid can be calculated by multiplying the X and Y fields of the **Number of measurements**. The values entered in these fields can only be positive whole numbers.
- **Size of the grid:** calculated by multiplying the position-increment value by the number of measurements and deducting one from the result. If the user changes the X and Y size values then the application automatically updates the **Number of measurements** to keep the equation valid.

5.4.3.4. Measuring Protocol

The measuring protocol defines how the measurements are carried out during the automatic measurement program.

Note: A protocol consists of one or more cycles. A typical cycle includes a list of different measurement types, where non-blank measurements may also be repeated more than once.

Interface components

The interface (Figure 21) includes:

- Controls to help the user create and add measurements to the list of command/task(s):
 1. **Command:** list box to select the measurement type.
 2. **Meas. period:** list box to select the measurement's time period. A custom value can be entered by selecting the **Manual Entry** from the list and then entering a value followed by one of 's', 'm' or 'h' (for seconds, minutes or hours). The value entered can contain a floating point (e.g. '6.5m' for 6.5 minutes).
 3. **Nb of iterations:** edit box to enter the number of times to repeat the measurement (not available for blank measurements).
 4. **Add** button, to add the selected command to the list of tasks.
- **Number of cycles:** a box that contains the number of times the list of measurements should be repeated.
- **List of Commands in each Cycle:** a table that displays the current list of tasks as part of a cycle.
- **Remove / Remove all** buttons: used to remove one (highlighted) item or all of the items from the list.

The screenshot shows a software interface for creating a measurement protocol. At the top, there are three input fields: 'Command' with a dropdown menu showing 'Sample measurement', 'Meas. period' with a dropdown menu showing '0.1 sec', and 'Nb of iterations' with a text box containing '2'. Below these is an 'Add' button. A horizontal line separates this section from the next. Below the line, there is a 'Number of cycles:' label followed by a text box containing '10'. Underneath is a 'List of Commands in each Cycle:' label followed by a list box containing two entries: '1 x Blank measurement 1. sec' and '2 x Sample measurement 1. sec'. Below the list box are 'Remove' and 'Remove all' buttons. At the bottom of the interface are four buttons: '<< Back', 'Next >>', 'Finish', and 'Cancel'.

Figure 21: An example protocol of measurements

In the example in Figure 21, the application will take a blank measurement, followed by two sample measurements, repeating the cycle 10 times.

Note: As magnetic susceptibility is derived from the measurement of relative permeability (permeability of sample/permeability of vacuum, which is approximated to the permeability of air measured by the meter during the zero or blank measurement step), cycles need to start with a blank measurement. Therefore, if a cycle does not start with a blank, it will be added automatically by the application.

Note: The setup wizard establishes whether a **Drift Correction** is required as part of a susceptibility measurement correction algorithm. If it is then each cycle must start and end with a blank measurement. If/when the user interrupts a cycle before its natural end, the user will be prompted for a final blank measurement. If **Drift Correction** is selected, the application prompts the user to end the cycle with a blank measurement.

Note: When frequency dependency measurements are required (using the MS2B) and **Drift Correction** is selected, the program must start with a blank measurement. The program must include two blank measurements inserted at the point where the frequency type changes (e.g. from LF to HF or vice-versa). The program must also end with a blank measurement.

Note: When frequency dependency measurements are required (using the MS2B) and **Drift Correction** is not selected, the program needs only one blank measurement when the frequency type changes. In this case there is also no need for the program to end with a blank measurement.

5.4.3.5. Numbering Format

The acquired measurements can be displayed in one of three numbering formats (Figure 22).

Number format

☐ Scientific
☒ Engineering
☐ Fixed exponent

Exponent value:

Digits after decimal point:

Unit selection

Physical characteristic:

Unit:

Selected unit for: 'Magnetic Suse.' is: 'SI'

Figure 22: Numbering format settings

The format can be selected during the initial report creation steps, or while viewing a report by selecting **Settings** from the **Report** menu.

- **Scientific:** Numbers are displayed with only 1 digit before the decimal point.
- **Engineering:** Numbers are displayed with exponents consisting of a power of 3.
- **Fixed exponent:** The exponent is fixed by editing the default value in the box.

The number of digits after the decimal point can be selected in the **Digits after decimal point** drop-down box.

Unit selection

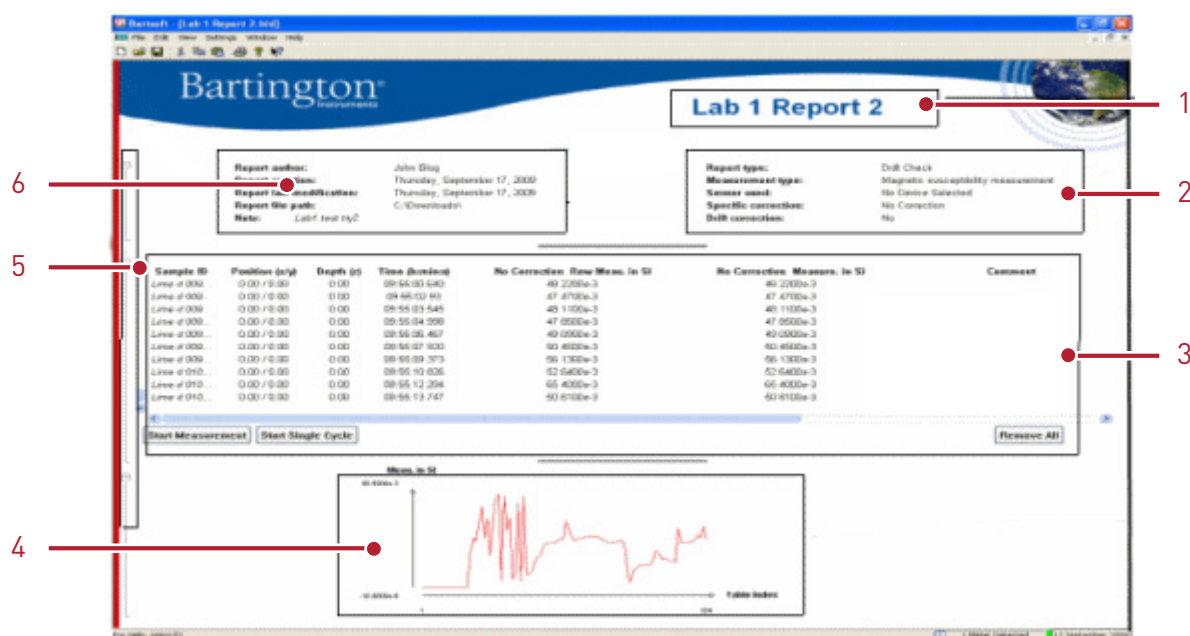
In the **Physical characteristic** drop-down box, select the type of physical characteristic to measure (e.g. **Magnetic Susc.** when using MS2 or MS3 meters).

In the **Unit** drop-down box, select the unit in which the characteristic should be displayed (e.g. 'SI' or 'CGS' for magnetic susceptibility).

5.5. Bartsoft Document (Report)

Bartsoft Document, or Report (Figure 23), is created using the Report Creation Assistant and can be divided into six parts.

1. **Report Title:** the name of the file that you are viewing. It is followed by an asterisk (*) if it has not been saved since the last modification.
2. **Data Processing Information:** shows all information used to correct raw data.
3. **Table of Measurements:** displays all the acquired measurements. The table also lets the user edit, remove and add measurements to the document.
4. **Measurements Graph:** displays all the acquired measurements in a two-dimensional graph or grid.
5. **Minimise/Maximise Controls:** allow the user to hide unwanted information, in order to leave more space for important information.
6. **File Information:** shows all information about the creation of the file. The **Note** field can be edited by double-clicking it with the left button of the mouse.



Key to Figure 23

- | | |
|--------------------------------|-------------------------------|
| 1. Report Title | 4. Measurements Graph |
| 2. Data Processing Information | 5. Minimise/Maximise Controls |
| 3. Table of Measurements | 6. File Information |

Figure 23: Bartsoft Document (Report) breakdown

5.5.1. Minimise/Maximise Controls

The six parts of the report fall into three main sections that can be minimised or maximised:

- Report information (Report Title, File Information, Data Processing Information)
- Table of Measurements
- Graph.

Each section can be hidden or shown using the Minimise/Maximise boxes in the left margin of the report. Each box contains either a '+' or a '-' sign depending on the current state of a section. To show a section, click on a '+' box; to hide a section, click on a '-' box.

5.5.2 Table of Measurements

The table of measurements (Figure 24) displays the acquired measurements in a list format. Users can edit some fields or remove the selected record(s) of measurements.

Key to Figure 24

Sample ID	Position (x/y)	Depth (d)	Time (seconds)	Date (d/M/Y)	New Measurement	Measurement in SI	Sample Diam. in mm	Correct. Factor
Test	D/D	98	12.95.27.767	28/06/2007		-68.72e-6	34	628.2e-3
Test A 0044	D/D	44	08.53.35.789	22/06/2007		-42.05e-6	34	628.2e-3
Test A 0038	D/D	38	08.53.34.187	22/06/2007		-35.81e-6	34	628.2e-3
Test A 0018	D/D		0.47.546	22/06/2007		-22.87e-6	34	628.2e-3
Test A 0008	D/D		0.24.313	22/06/2007		-22.87e-6	34	628.2e-3
Test A 0006	D/D		0.52.890	22/06/2007		-22.33e-6	34	628.2e-3
Test A 0007	D/D		0.52.774	22/06/2007		-22.33e-6	34	628.2e-3
Test A 0074	D/D		0.46.935	22/06/2007		-22.33e-6	34	628.2e-3
Test A 0053	D/D		0.38.613	22/06/2007		-22.33e-6	34	628.2e-3
Test A 0054	D/D		0.51.892	22/06/2007		-17.9e-6	34	628.2e-3

- | | |
|------------------|-----------------------------|
| 1. Column titles | 5. Selected measurements |
| 2. Scrollbars | 6. Pointed measurement |
| 3. Table buttons | 7. Table menu |
| 4. Progress bars | 8. Selected title (sorting) |

Figure 24: Table of measurements breakdown

There are three parts to the table (Figure 24):

- column titles
- records of measurements
- control table buttons.

5.5.2.1. Column Titles

These form the first line of a table. Each title (displayed in bold characters) describes what the column contains.

Records in the table can be sorted in ascending or descending order, by selecting a title using the left mouse button. A selected title is displayed as highlighted. To change the sort order, the same column title should simply be selected for the second time.

Note: Clicking on the same column title for the third time changes the sorting order to its default format (displayed as it was initially acquired).

5.5.2.2. Measurements

Each line contains all information about a measurement that the users chooses to make visible. To change what information is visible, use the table menu.

If the width of a given display is insufficient for the number of columns chosen to be displayed, then the table's horizontal scrollbar will enable the user to view hidden columns.

To select a measurement, use the left mouse button or the up/down arrow keys on the keyboard. The PgUp and PgDn keys show the first and the last record on the table, respectively.

To highlight or clear highlighted record(s):

- use the left mouse button + control key for individual records
- use the Shift key + left mouse button for a group of records
- press the Home and End key to highlight/clear all records respectively.

The **Identifier**, **Comment** and **Position** information of a measurement can be edited by double-clicking with the left mouse button on the text to edit.

More actions are available by clicking the right mouse button over a record, which displays the table menu attached to the selected measurement.

5.5.2.3. Repeating a Measurement

When the application prompts the user to take the next measurement, it gives the option of repeating the previous measurement. When a blank (air) measurement is repeated, the application replaces the previous blank. This means that multiple blanks are not recorded within the program database. However, if a sample measurement is repeated, a separate record for each repeated measurement is created. Multiple measurements of the same sample are expected to be resolved (see [Resolving Repeated Measurements](#)).

Note: Dual frequency measurements cannot be repeated (this applies to MS2B sensors, where 'Frequency dependent calculation' is selected).

Figure 25 shows the application prompt before taking a blank measurement. However, the user can select 'Repeat last measurement' to repeat the previous step. Note that the prompt gives the type and measured value of the previous measurement, to help in deciding whether to repeat a measurement.

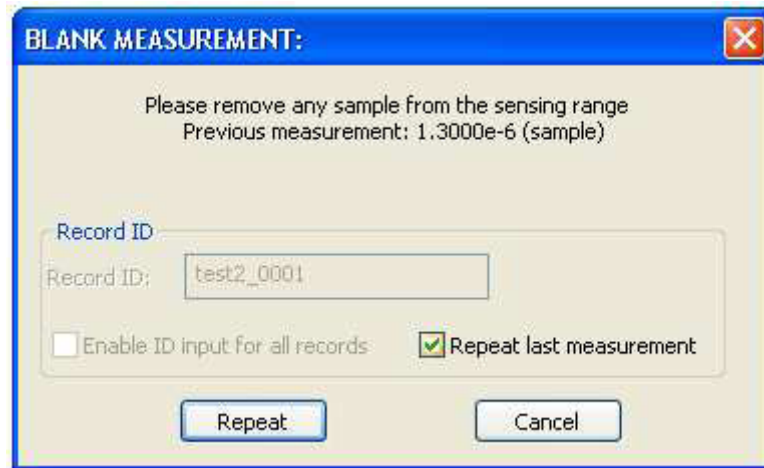


Figure 25: Repeating previous measurements

Figure 26 shows that a measurement has been repeated multiple times. To help identify repeated measurements, the background colour is different and the names of repeated measurements are appended with '*xx', where 'xx' is an auto-incremented number. (In this case: surf1_0003*01, surf1_0003*02 etc.) When prompted to take the next measurement, if the user leaves the **Repeat last measurement** box un-checked then the application moves to the next measurement. When the user finishes repeating measurements, the application prompts that repeated items need to be resolved, before continuing with the rest of the program.

Sample ID	Position (x/y)	Vol. Susc.Meas. in SI	Comment
surf1	0 / 0	-4.6109e-6	
surf1_0001	1 / 0	4.6665e-6	
surf1_0002	2 / 0	7.2695e-6	
surf1_0003*01	2 / 1	7.2973e-6	
surf1_0003*02	2 / 1	3.0601e-6	
surf1_0003*03	2 / 1	3.0601e-6	

More Info...	
Table Settings...	
Full Statistics...	
Selection Statistics...	
Edit Position...	
Copy Selected	CTRL+C
Cut Selected	CTRL+X
Manage Repeated Measures For Pointed Group	Merge (Average)
Manage Repeated Measures For All Selected Groups	Remove
	Smallest
	Largest

Figure 26: Merging multiple measurements

To postpone resolving repeated measurements, the user can select **I will resolve repeats at the end of the program**, when prompted. Alternatively, it is possible to save a report with repeated measurements and resolve them later.

5.5.2.4. Resolving Repeated Measurements

This can be done before taking the next measurement, or at the end of the program of measurements.

To resolve or manage repeated measurements, the user can:

- remove the highest or lowest value
- simply select and delete any repeated item, as with any measurement
- merge multiple measurements into one, by calculating their mean value (Figure 26).

To resolve one group of repeated measurements, right click on any individual measurement within the group to display a pop-up menu. To resolve multiple groups of repeats, select at least one measurement from each group, before using the pop-up menu. Alternatively, select **Edit→Manage repeated measures** from the main menu.

5.5.2.5. Table Buttons

There are five buttons at the bottom of the table. Their action, visibility and 'enable' state are dependent on the state of the table.

- The **Start Measurement** button at the far left has multiple functions. Its main objective is to gather measurements.
 - While there is no data acquisition device selected, the button is labelled **Select Meter** and opens the **Hardware Settings** window, to let the user choose a working device. (For more information see [Hardware & Text](#).)
 - If a device has been selected, the button is labelled **Start measuring** and will start the data acquisition process.
 - If **Manual Entry** has been selected for entering measurements, the button is labelled **Enter Measurement** and will display the **Manual Entry Interface** that lets the user enter measurements manually.
 - During data gathering the **Start** button is labelled **Measuring** or **Zeroing**. Two **Progress Bars** will appear below the button. The top one shows the advancement of the full protocol. The bottom one shows the advancement of the current cycle.
- The **Start Single Cycle** button at the right of **Start Measurement** will start a single cycle of the measurement protocol. (For more information see [Measuring Protocol](#))

- The **Stop** button appears at the right of **Start Measurement** when the data gathering process is in progress and lets the user interrupt the process.
- The **Delete Selected** button appears at the bottom right of the **Table of Measurements** if there is at least one measurement selected in the table. Clicking this button will remove all selected measurements. Alternatively, the 'delete' key on the keyboard has the same effect.
- The **Delete all** button appears at the bottom right of the **Table of Measurements** if there is at least one measurement in the table. Clicking this button will remove all records from the table.

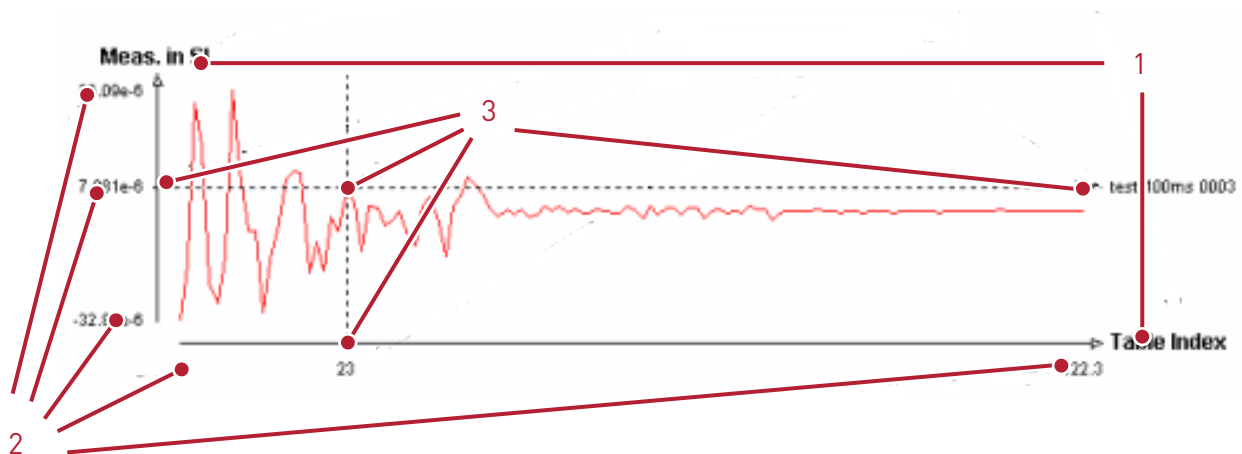
Note: Any record removed from the table is also removed from the application's database. However, if the open document is associated with a file on the host PC, then the file is not affected until and unless the document is saved after removing the record.

5.5.3. Graphs

The graphs give an overview of all stored measurements. Two types of graph can be selected using the **Graph Settings** window in the **Settings** menu: **2D Graph** and **Grid Graph**.

5.5.3.1. 2D Graph

Depending on how measurements are currently sorted, this graph (Figure 27) shows values (vertical axis) in relation to position or sample index (horizontal axis). (For more information about sorting see [Column Titles](#))



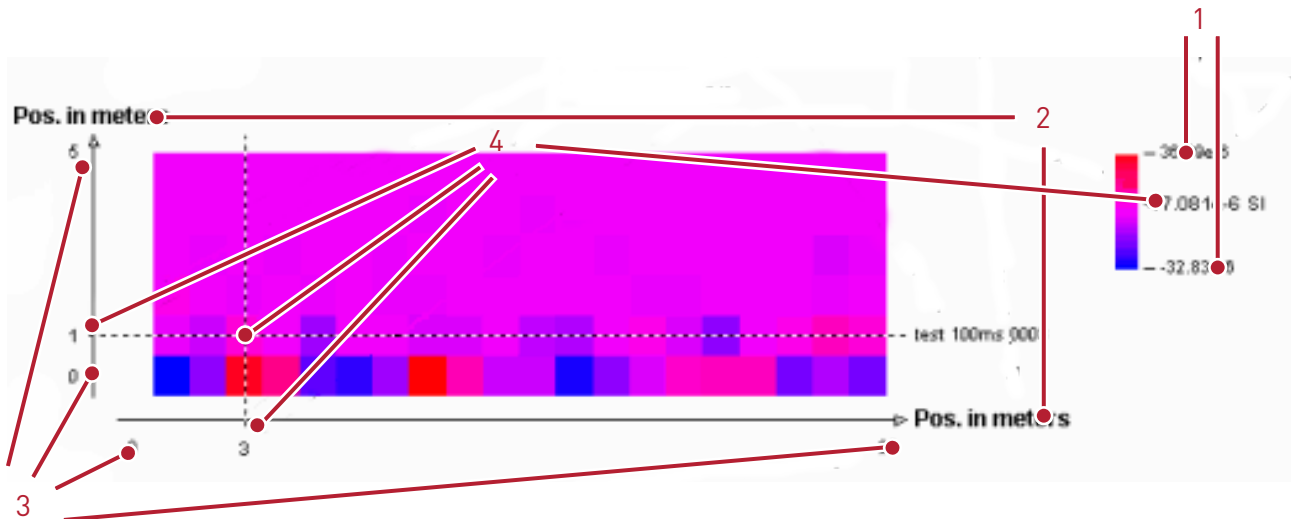
Key to Figure 27

1. Axis titles
2. View range
3. Pointed measurement information

Figure 27: 2D graph breakdown

5.5.3.2. Grid Graph

This graph shows values (colour gradient) in function of grid position (X on horizontal axis, Y on vertical axis).



Key to Figure 28

- | | |
|----------------|------------------------------------|
| 1. Value range | 3. View range |
| 2. Axis titles | 4. Pointed measurement information |

Figure 28: Grid graph breakdown

5.5.3.3. Graph Controls

The following actions are available while the mouse pointer is over the Graph area.

- **Highlighting and Selecting.** Right clicking the mouse on a graph element selects the related record within the measurement table. If the Control key is held down at the same time, the record on the table is highlighted.
- **Menu.** Clicking on the graph area with the right mouse button displays the **Graph Menu**.
- **Zoom.** To zoom into the graph, drag the mouse pointer while holding down the right mouse button. As the right mouse button is released, the area within the created rectangle is magnified. Repeat this action to increase the magnification level. To return to the normal graph display, double click the left mouse button on the graph area.
- **Scrolling.** While in the zoom mode, the graph can be scrolled by holding down the left mouse button and dragging it.

Keyboard commands described in **Measurements** in the **Table of Measurements** section above are also available (see [Measurements](#)).

6. Troubleshooting

In the event you are experiencing issues with the software and that this manual does not enable you to solve the issue, please email service@bartington.com, or telephone the Bartington Instruments service team on +44 (0)1993 706565.

Appendix A: Correction Algorithm

Abbreviation	Description
χ_{meas}	Volume susceptibility of the sample measured (dimensionless)
χ_{vol}	Volume susceptibility of the sample (dimensionless)
χ_{mass}	Mass susceptibility of the sample (m ³ /kg)
χ_{cont}	Volume susceptibility of the container (dimensionless)
ρ_{samp}	Density of the sample (kg/m ³)
m_{tot}	Total mass of the sample with the container (kg)
m_{cont}	Mass of the container (kg)
v_{samp}	Volume of the sample inside container
v_{ref}	Volume of calibration sample used as a reference (m ³)
h_{samp}	Height reached by the sample inside container
h_{ref}	Maximum height within the container
d_{samp}	Diameter of the sample core
d_{ref}	Diameter of the coil opening (sensor opening + enclosure thickness)

The volume specific correction algorithm is:

$$\chi_{\text{vol}} = (\chi_{\text{meas}} \times (v_{\text{ref}} / v_{\text{samp}})) - \chi_{\text{cont}}$$

The height specific correction algorithm is:

$$\begin{aligned} \chi_{\text{vol}} = & (\chi_{\text{meas}} \times (1 - 0.00002077) \\ & - 0.0042414 \times (h_{\text{ref}} - h_{\text{samp}}) \\ & + 0.0028426 \times (h_{\text{ref}} - h_{\text{samp}})^2 \\ & - 0.0003460 \times (h_{\text{ref}} - h_{\text{samp}})^3 \\ & + 0.0000136 \times (h_{\text{ref}} - h_{\text{samp}})^4)) - \chi_{\text{cont}} \end{aligned}$$

The diameter specific correction algorithm is:

$$\chi_{\text{vol}} = (\chi_{\text{meas}} / (3.45 \times (d_{\text{samp}} / d_{\text{ref}})^3)) - \chi_{\text{cont}}$$

The mass specific correction algorithm is:

$$\chi_{\text{mass}} = \chi_{\text{vol}} / \rho_{\text{samp}}$$

Where

$$\rho_{\text{samp}} = (m_{\text{tot}} - m_{\text{cont}}) / v_{\text{samp}}$$

Appendix B: Conversions from cgs to SI

For volume susceptibility:

From SI (dimensionless) to electromagnetic units cgs (dimensionless):

$$\chi_{\text{vol (SI)}} = \chi_{\text{vol (cgs)}} \times (4\pi)$$

For mass susceptibility:

From SI (m³ / kg) to electromagnetic units cgs (cm³ / g):

$$\chi_{\text{mass (SI)}} = \chi_{\text{mass (cgs)}} / 1000 \times (4\pi)$$

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