GeoPyc® 1365

Envelope Density Analyzer

Operator Manual

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(Rev B)

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ABOUT THIS MANUAL

Log in to your customer portal to access the following:

- Calculations
- Error Messages
- GeoPyc 1365 Operator Manual in PDF format

Parts and accessories can be found online at www.Micromeritics.com.

All references to GeoPyc or GeoPyc 1365 in this document encompass the GeoPyc 1365 and GeoPyc 1365 T.A.P. unless otherwise noted.

The following icons may be found in this manual:

NOTE - Notes contain important information applicable to the topic.

CAUTION - Cautions contain information to help prevent actions that may damage the analyzer or components.

WARNING - Warnings contain information to help prevent actions that may cause personal injury.

T.A.P. Feature Only - Indicates the feature is applicable only when using the Transverse Axial Pressure (T.A.P.) upgrade option.

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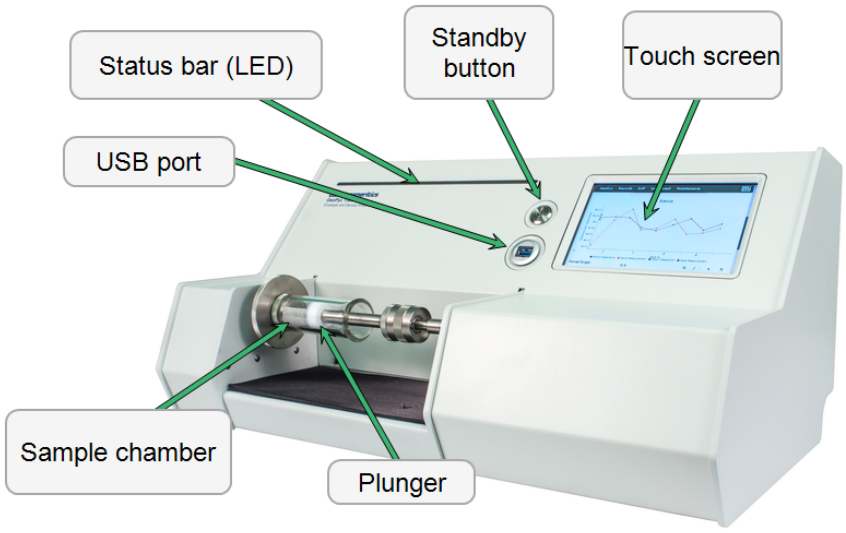
1 About the 1365 GeoPyc

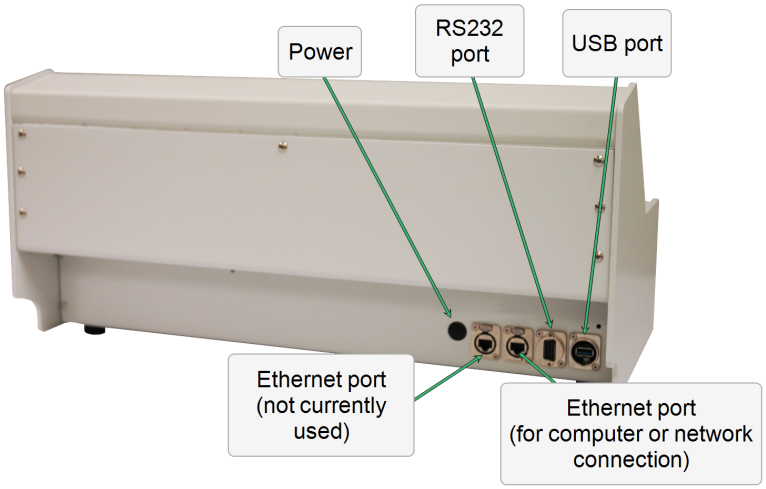
Front Panel



Front Panel Components

Component	Description
Status bar (LED)	Indicates the analyzer status. See *Instrument Status on page 1 - 5*.
Plunger	Compresses the sample and Dry Flo.
Sample chamber	For inserting sample and Dry Flo.
Standby button	Press to turn power the analyzer ON or OFF.
Touch screen	Use to enter analysis information.
USB Port	The USB ports on the front and back of the analyzer can be used interchangeably, however, to prevent wires from interfering with the operation of the analyzer, use the USB port on the back for devices with cords. The USB ports can be used to connect a printer or keyboard, export and import data, and update software.

BACK PANEL



Back Panel Components

Component	Description
Ethernet ports (2)	The port labeled *Network* (closest to the RS232 port) is used to connect the analyzer to a network or directly to a computer. The other (closest to the power connection) is not currently used.
Power	For connecting the analyzer to the power supply adapter with a barrel plug.
RS232	A mass balance can be connected to the analyzer through the 9 pin RS232 port. A suitable balance and cable are available through Micromeritics. Data is transmitted through the USB port.
USB ports	The USB ports on the front and back of the analyzer can be used interchangeably, however, to prevent wires from interfering with the operation of the analyzer, use the USB port on the back for devices with cords. The USB ports can be used to connect a printer or keyboard, export and import data, and update software.

T.A.P. DENSITY UPGRADE OPTION

See:

T.A.P. Density on page G - 1

T.A.P. (Transverse Axial Pressure) density is an optional software upgrade. This upgrade provides a quantifiable, repeatable degree of pressure applied to the sample along its transverse axis.

A common method of measuring bulk density involves placing the sample in a graduated cylinder and then placing the cylinder in an apparatus that physically taps the cylinder causing the material to settle. The mass divided by the resulting volume is known as the “tap” or “tapped” density of the material.

The 1365 T.A.P. software was produced for measurement of bulk density with a standard GeoPyc instrument. Settling of bulk materials is achieved by chamber agitation and piston pressure. The T.A.P. designation is meant to indicate applicability in cases where a tapped analysis might be done, without claiming to do an actual tapped analysis.

The major differences between the standard 1365 application and the 1365 T.A.P. application are:

- An option is provided for using consolidation pressure instead of consolidation force.
- Density values are reported as bulk density rather than envelope density.
- Volume calibration and zero depth analyses are not available.
- Calculations that depend on absolute density are not done.

1365 T.A.P. APPLICATION INSTALLATION

Installation is performed by inserting a USB device containing the upgrade application into the analyzer USB port. Installation begins automatically. When the upgrade is complete, a banner displays indicating *GeoPyc T.A.P. features are enabled*.

No hardware modifications are required.

SAFETY PRECAUTIONS

The analyzer was designed for nonhazardous samples only. DO NOT attempt to use the GeoPyc to analyze any sample material whose safety has not been verified. During normal operation, fine particles may become airborne or skin contact may occur with the sample.

TIPS FOR SUCCESSFUL OPERATION

- Performing a calibration run using objects similar to the sample size and shape calibrates the conversion factor used during analysis. A calibrated conversion factor yields more accurate results than the calculated conversion factor.
- The closer the calibration object simulates the sample size, shape, and quantity, the better the calibration will be. Calibration with a reference standard works best.
- Performing an embedded blank run during each sample run is preferable to using stored blank data.
- Dry Flo bed lengths no longer than the diameter of the chamber are recommended unless sample shape demands otherwise.
- If final bed length must exceed the diameter of the chamber, increase the consolidation force. An increase in force proportional to the increase in bed length is recommended.
- A single-object sample should be run in the smallest chamber in which it will fit, allowing for consolidated Dry Flo on all sides.
- Large sample quantities (of multi-piece samples) are more representative than small quantities, therefore analyzing a larger quantity of sample in a large chamber may yield more accurate results than analyzing a small quantity of sample in a small chamber.
- The sample must constitute at least 25% of the final bed volume. The analyzer will calculate the percent of sample volume automatically when:
    - *Calculate percent sample volume* is enabled in the *SOP*.
    - Using a zero depth set from a zero depth run that was performed using the same sample chamber to be used for the sample run.

REMOTE BROWSERS

See:

Remote Computer Configuration on page 6 - 5

Remote browser sessions can be used to perform the same functions as the touch screen on the analyzer with the exception of sending sample mass from an analytical balance to the analyzer.

INSTRUMENT STATUS

The analyzer status is displayed on the window title bar.

Analyzer Status and Description Table

File Status	Description
Analyzing	An analysis is currently running.
Ready	Sample files used in an analysis that has been completed.
Standby	The touch screen is disabled. This status is available only on remote browsers.

Status Bar	Standby Button	Touch-screen	Indicates
OFF	OFF	OFF	No power connected to the analyzer
OFF	Orange	OFF	Power is ON. System is booting.
OFF	Blue	OFF	Analyzer is in standby mode or boot process has completed. Press the **Standby** button to continue.
Blue	OFF	ON	Analyzer is ready to be used.
Green	OFF	ON	Analysis is in progress or plunger is moving to home position.
Red	OFF	ON	An error has occurred.

SPECIFICATIONS FOR THE 1365 GEOPYC

Specification	Description
Electrical	
Frequency	50 to 60 Hz
Power	175 VA maximum
Voltage	100 to 240 VAC
Environment	
Temperature	Stable, 15 to 35 °C operating; 0 to 50 °C non-operating
Humidity	20 to 80% relative, noncondensing
Exposed Materials	
To sample	Glass, graphite, Teflon®,stainless steel, aluminum, Buna-N, epoxy, ceramic
Available Sample Chambers	
Internal diameter	Approximate usable length (of medium bed and sample, when consolidated)
12.7 mm	19 mm
19.1 mm	28 mm
25.4 mm	38 mm
38.1 mm	50 mm
50.8 mm	60 mm
Reproducibility	
When sample volume is at least 25% of sample chamber volume:	Typically ±1.1%

Specification	Description
Physical	
Height	27 cm (11 in.)
Width	55 cm (22 in.)
Depth	38 cm (15 in.)
Weight	16 kg (35.5 lbs)
Sample Parameters	
Volume	0.3 to 25 cm^3 with full range of sample chambers
In keeping with a policy of ongoing product improvement, specifications are subject to change without notice.	

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2 GeoPyc

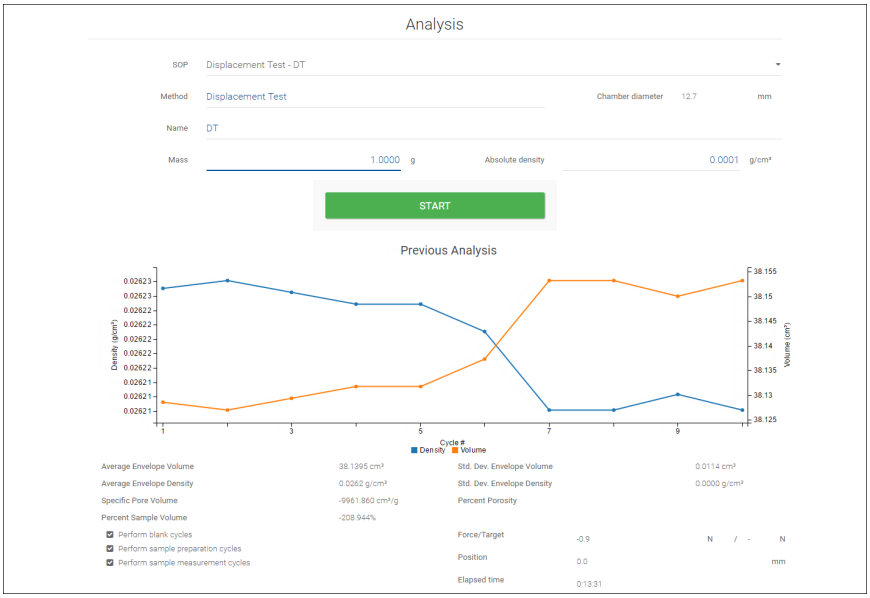
GeoPyc > [SOP Selection]

Use to perform and monitor analyses and calibrations.

The GeoPyc performs three types of analyses. All analyses are run from the ***GeoPyc*** menu option. The type of analysis is determined by the SOP field selection. To obtain reproducible analysis results, the runs should be performed in the following sequence:

1. *Volume Calibration on page 2 - 4*
2. *Blank Data on page 2 - 6*
3. *Sample Run on page 2 - 9*

When **START** is tapped, the button changes to **CANCEL**. When **CANCEL** is tapped, the button changes to **START**. Analysis stops after the blank stage of an analysis or calibration with measured blank so the sample can be placed in the chamber.



After a blank analysis, the data become part of the blank data set for the selected chamber. After a volume calibration, the new conversion factor is stored in the selected chamber. After a zero depth measurement, the zero depth is stored for the selected chamber.

Only fields and buttons applicable to the selected SOP display.

Analysis Fields and Buttons Table

Field or Button	Description
Absolute Density *[text box]*	The density computed after excluding from the volume that of the pores and cavities. Up and down arrows can also be used to increase or decrease the value. This field does not display when a bulk density SOP is selected. A bulk density selection is available only if using the T.A.P. upgrade option. If the analysis type of *Bulk Density* is selected with the *Run Blank* field enabled in the SOP, a field for the consolidation force (pressure) will display.
Cancel *[button]*	The **START** button changes to a **CANCEL** button after an analysis starts. Discards any changes or cancels the current process.
Chamber + medium mass *[text box]*	Mass of the chamber plus the mass of the medium. Up and down arrows can also be used to increase or decrease the value.
Chamber changed	Message displays when the chamber size differs from the previous analysis.
Chamber diameter *[text box]*	Internal diameter of the chamber.
ID *[text box]*	The ID for volume, calibration, volume of the standard, or the mass, density, and porosity must be specified in the SOP.
Mass *[text box]*	The mass of the sample. Up and down arrows can also be used to increase or decrease the value.
Method *[text box]*	The method used for the analysis.
Name *[text box]*	Brief description of the analysis.
Pause *[button]*	Pauses the analysis.
Resume *[button]*	Resumes an analysis after the analysis has been paused.
SOP *[drop-down box]*	Select the SOP from the drop-down list. SOPs are available when created and saved from the SOP menu.
Start *[button]*	Starts the analysis with the currently selected SOP and parameters. when the chamber for the selected SOP is different from the previous analysis, a *Chamber Changed* message displays. The **START** button changes to **CANCEL** and **PAUSE** when the analysis starts.

Analysis Fields and Buttons Table (continued)

Field or Button	Description
Status	Queued cycle Completed cycle Current Cycle Cycle failed to complete or analysis was canceled during a step. **Cycle #.** Cycle number for the analysis. **Elapsed Time.** Amount of time elapsed since the analysis started. **Position.** Current plunger position.

VOLUME CALIBRATION

A calibration run is a series of consolidation cycles performed on Dry Flo plus a reference object of known properties that is similar to the sample in size, shape, and quantity. The calibration run calculates a new conversion factor to account for the irregularities of the sample. The result of the calibration is the *Conversion Factor*, which is entered as part of the sample information.

SELECT A CALIBRATION OBJECT

The more closely the calibration object(s) approximates the size and shape of the sample being analyzed, the more accurate the calibration.

Possible calibration objects:

- A reference sample of the sample material.
- A non-porous substitute of similar shape, size, and number as the sample. For example, glass beads may be used as a calibration substitute for pharmaceutical tablets. Glass rod segments could be used as a calibration substitute for extruded catalyst rods.
- A fabricated non-porous model of the sample object, especially objects with deadend holes or through holes.

The presence of large internal cavities or extremes of density reduces accuracy regardless of whether a calibration run is performed. Accurate analysis cannot be performed on extremely small sample pieces (less than 1 to 2 mm in diameter).

PERFORM A VOLUME CALIBRATION RUN

1. Place an appropriate amount of Dry Flo in the sample chamber. Do not place the calibration object in the chamber until prompted.
2. Insert the plunger into the sample chamber and push it part way in. Wipe both ends of the chamber / plunger free of Dry Flo and debris. Mount the chamber / plunger assembly on the analyzer.
3. Select the SOP from the drop-down list.
4. Tap **START**.
5. The analyzer partially withdraws the plunger.
    a. Remove the chamber / plunger assembly from the analyzer.
    b. Carefully remove the plunger.
    c. Gently tap it on the open chamber so any adhering Dry Flo falls back into the chamber. Any Dry Flo clinging to the chamber's edge can be brushed back into the chamber.
    d. Set the plunger aside, seal end facing up.
    e. Slide the calibration object(s) gently down the side of the chamber.

It is assumed in calculations that the amount of Dry Flo in the chamber for this calibration run is exactly the same as for the blank run just performed. It is essential to avoid losing Dry Flo while placing the calibration object in the chamber. If Dry Flo is lost, tap **CANCEL** to cancel the run and begin again.

6. Remount the chamber / plunger assembly on the analyzer.
7. Tap **START** to begin calibration.
8. An audible signal indicates the appropriate number of consolidation cycles is finished and the plunger is partially withdrawn. Remove the chamber / plunger assembly from the analyzer and recover the calibration object.

   When calibration is complete, the new calibrated conversion factor is displayed. Record the calibrated conversion factor so it can be entered in subsequent analyses. To clear the screen and return to idle mode, tap **CANCEL**.

Data from this calibration run are replaced during the next analysis performed. If the calibration report is to be printed or recorded, it must be done prior to performing another analysis.

The new conversion factor may now be used during sample runs that analyze objects similar to this calibration.

BLANK DATA

GeoPyc > [select a Blank Data SOP from the drop-down list]

A blank run is performed on a quantity of Dry Flo then the sample is added and a second measurement is done. The volume of the sample is determined from the difference in plunger positions with and without the sample.

A blank data run may be performed during a sample or calibration run. Blank data can be stored in advance, however, results may be less accurate.

This method requires extremely careful weighing of Dry Flo and sometimes yields less accurate data.

Blank data are stored in sets. A group of stored blank runs using the same consolidation force and number of preparation cycles is called a *Stored Blank Data Set*.

The analyzer can store 10 blank data sets. For each set, data from up to 10 blank runs can be included using graduated quantities of Dry Flo. Each set must contain data for at least two quantities of Dry Flo. The analyzer can then interpolate blank volumes between the data points in the set. The appropriate interpolated blank run data are used when the sample is run.

PERFORM A STORED BLANK DATA RUN

To store blank run data, begin with an amount of Dry Flo slightly smaller than the smallest amount to be used during analysis. Perform the blank run. Add a small quantity of Dry Flo, then repeat until the chamber contains slightly more than the largest amount of Dry Flo to be used.

1. Carefully place a quantity of Dry Flo in the sample chamber and weigh it. Accurate weighing is critical. See ***Chamber Diameter on page 5 - 6***.
2. Insert the plunger into the sample chamber and push it part way in. Mount the chamber/ plunger assembly on the analyzer.
3. Remount the chamber / plunger assembly on the analyzer. Tap **START** to begin analysis.

The *Consolidation Force* must have the same value for every run in a *Stored Blank Data Set*. The value entered for the first run in a *Stored Blank Data Set* will appear in subsequent runs. If changed, a warning displays indicating that this will erase all blank data stored for this set.

Entering an extremely accurate weight is critical.

4. The analyzer partially withdraws the plunger. Unscrew the plunger from the right mandrel and push the plunger part way into the chamber. Unscrew the sample chamber from the mandrel.

A prompt displays telling the operator to change the amount of Dry Flo. Repeat the process beginning with chamber / medium weight.

How Stored Blank Data are Used

See also:

- *Volume Calibration on page 2 - 4*
- *Sample Run on page 2 - 9*

Perform a sample or calibration run. For blank data source, indicate which stored data set to use

- Specify the number of consolidation cycles for the current run. The analyzer uses that number of stored blank run cycles, even if more were stored in the set.
- The number of preparation cycles, consolidation force, and conversion factor from the stored data set are used for the current run. The default conversion factor may be changed to the calibrated conversion factor for the type of sample being analyzed.
- Enter the Chamber / Medium weight when prompted. The analyzer interpolates the corresponding stored blank data from that set. Entering an extremely accurate weight is critical.

The following table is an example of some of the data stored in a blank data set. If Chamber / Medium weight *Y* were entered during a sample run using this data set, analysis data would be interpolated between points 2 and 3 (highlighted). The number of cycles specified in the sample run in this example is 7.

XXXXX represents analysis data in counts

Example of Stored Blank Data

Number of Cycles	Stored Chamber, Medium Wt 1 × 1 g	Stored Chamber, Medium Wt 2 × 2 g		Stored Chamber, Medium Wt 3 × 3 g	Stored Chamber, Medium Wt 4 × 4 g	Stored Chamber, Medium Wt 5 × 5 g
	< Y		Y g	>Y		
1	XXXXX		XXXXX	XXXXX	XXXXX	XXXXX
2	XXXXX		XXXXX	XXXXX	XXXXX	XXXXX
3	XXXXX		XXXXX	XXXXX	XXXXX	XXXXX
4	XXXXX		XXXXX	XXXXX	XXXXX	XXXXX
5	XXXXX		XXXXX	XXXXX	XXXXX	XXXXX
6	XXXXX		XXXXX	XXXXX	XXXXX	XXXXX
7	XXXXX		XXXXX	XXXXX		

Example of Stored Blank Data (continued)

Number of Cycles	Stored Chamber, Medium Wt 1 × 1 g	Stored Chamber, Medium Wt 2 × 2 g		Stored Chamber, Medium Wt 3 × 3 g	Stored Chamber, Medium Wt 4 × 4 g	Stored Chamber, Medium Wt 5 × 5 g
8	XXXXX			XXXXX		
9	XXXXX			XXXXX		
10	XXXXX					
11	XXXXX					
12	XXXXX					
13	XXXXX					
14	XXXXX					
15	XXXXX					

SAMPLE RUN

GeoPyc > [select a Sample Run SOP from the drop-down list]

A sample run is a series of consolidation cycles performed on Dry Flo plus the sample. It measures the volume of Dry Flo plus sample. The sample run volume is compared to the blank volume (for the same quantity of Dry Flo) to determine the envelope volume of the sample. Density and porosity data are calculated using this volume and other parameters provided during the sample run.

Sample must be weighed prior to a sample run. Most sample materials increase in weight by adsorbing moisture from the atmosphere. Care should be taken to ensure that the sample weight entered does not include moisture. A drying oven or desiccator may also be used.

The sample adsorb moisture after it is weighed since the analyzer measures sample volume. This means efficiency can be increased by drying and weighing a number of samples at once, then setting them aside until it is convenient to determine their envelope density.

During the sample stage, a graph of the data taken so far is shown. The x-range is set to the number of requested measurement cycles and does not change. A density vs cycle point is added for each measurement cycle, but not for preparation cycles. A label above the graph indicates *Current Analysis* while the analysis is in progress and *Previous Analysis* upon completion.

For greatest accuracy, perform a calibration run before analyzing samples. See *Volume Calibration on page 2 - 4*.

1. Weigh the sample.
2. Place an appropriate amount of Dry Flo in the sample chamber. Do not place the sample object in the chamber until prompted.
3. Insert the plunger into the sample chamber. Push the plunger part way in. Wipe both ends of the chamber / plunger free of medium and debris. Mount the chamber / plunger assembly on the analyzer.
4. Ensure the power switch is set to **ON**.
5. On the touch screen, tap ***GeoPyc***.
6. Enter or select the SOP, ID, and description.
7. Tap **START**.
8. The analyzer partially withdraws the plunger.
   a. Unscrew the plunger from the right mandrel.
   b. Push the plunger part way into the chamber.
   c. Unscrew the sample chamber from its mandrel.
   d. Carefully remove the plunger.
   e. Gently tap the plunger on the open chamber so any adhering Dry Flo falls back into the chamber. Brush any Dry Flo clinging to the flared edge back into the chamber.

f. Set the plunger aside with the seal end facing up.
g. Slide the sample object gently down the side of the chamber.

   It is assumed in calculations that the amount of Dry Flo in the chamber is exactly the same as for the blank run just performed. It is essential to avoid losing Dry Flo while placing the sample object in the chamber. If Dry Flo is lost, tap **CANCEL** and begin again.

9. Replace the chamber/plunger on the analyzer. Tap **START** to begin the analysis.
10. An audible signal indicates the appropriate number of consolidation cycles is finished. The plunger partially withdraws from the chamber. Remove the chamber/ plunger, then recover the sample. Analysis data are displayed on the touchscreen.

VERIFY OPERATION

When installing an analyzer (or unexpected or unusual analysis results are obtained) the operation of the analyzer should be verified.

1. Perform a calibration run.
2. Perform an analysis without a sample following the instructions for performing a sample run.
   a. Enter zero for sample weight and density, or enter zero volume for the sample.
   b. When prompted to place the sample in the chamber, remove the chamber / plunger assembly from the analyzer, but DO NOT remove the plunger.
   c. Shake the chamber / plunger assembly to eliminate any compaction of the Dry Flo, then replace it on the analyzer.
   d. The reported envelope volume for the sample should be near zero if the instrument is performing correctly.
3. Perform a sample run using the same object(s) used in the calibration run. During the sample run, use the calibrated conversion factor resulting from the calibration run. The sample run results should be within a percent of the values ascribed to the sample material during the calibration run.

Use this method to check for correct interpolation within stored blank data. Use a quantity of Dry Flo within the range stored in the set. If the resulting volume is not close to zero, the first possible cause to evaluate is the weighing accuracy and repeatability. Unless precise weights are obtained, the stored blank test procedure can give misleading results.

IF ANALYSIS ERRORS OCCUR

1. Ensure the Dry Flo is flowing freely and not contaminated. It is recommended to change to fresh Dry Flo.
2. Evaluate the accuracy of the technique. Ensure Dry Flo is not lost due to splashing or spilling when the sample / calibration object is introduced into the chamber. If using stored blank data, use an extremely accurate method for weighing the Dry Flo. (Weights must be accurate to within a few milligrams.)
3. Evaluate the accuracy of the analytical balance using manufacturer's instructions.
4. Consider whether the chamber / plunger assembly may have become loosened from the analyzer during analysis. If the chamber and plunger to each mandrel are not secure, data may be inaccurate.
5. Calibrate the force transducer. Also check correct interpolation within stored blank data using this method.
6. Ensure sufficient quantity of Dry Flo within the range stored in the set. If the resulting volume is not close to zero, the first possible cause to evaluate is weighing accuracy and repeatability. Unless precise weights are obtained, the stored blank test procedure can give misleading results.

ANALYTICAL BALANCE

See *Analytical Balance Configuration on page 6 - 4* for balance configuration instructions.

Sample mass can be entered into the analyzer application manually or it can be sent from the attached balance to the analyzer.

To enter mass manually:

1. Go to *GeoPyc* on the analyzer application menu.
2. Tap the *Mass* field. Enter the mass using either the virtual keyboard or an attached keyboard.

To send mass from an attached analytical balance:

1. Go to *GeoPyc* on the analyzer application menu.
2. Tap the *Mass* field then press the **Send** button on the balance.

   The *Mass* field gets updated. If the balance has not been configured for grams, the following error message displays. Resolve the issue and retry the previous steps.

   Please make sure that the unit is in grams.

3 RECORDS

Displays a list of all analysis reports from completed analyses.

- Multiple checkboxes can be selected.
- Columns are sortable by tapping the column header.
- The analysis report is displayed by tapping the record.

Records Fields and Buttons Table

Field or Button	Description
Density (cm^3/g)	Density of the sample.
Name	Description of the analysis.
Method	Displays the Envelope Density Report
Analysis Date	The date and time the analysis was run.
Std./ dev. (cm^3/g)	Calculated using the points and slope data. A standard deviation should be less than 1.0.
Toolbar	 Deletes the selected file from the list.
	 Opens the Control Chart report for the selected record.
	 Downloads the selected record(s) as a ZIP file (file format is *GeoPyc YYYY-MM-DD.zip* where *YYYY-MM-DD* is the download date) to a USB device. If using a remote browser, a directory selector is opened for exporting the selected record(s) in a ZIP file.
	 Select and upload a single record as an XML file or multiple records in a ZIP file. After uploading, a popup window displays the number of records added and the number of records rejected.

Records Fields and Buttons Table (continued)

Field or Button	Description
	Runs the selected record.
	Modifies the selected record. Tap **UPDATE** to save the changes.

Refer to the *Field Display Summary below* table for information on which fields are available for each analysis type. Fields not listed on the table indicate the field is applicable to all analysis types.

Field Display Summary

	Envelope Density	Envelope Blank	Volume Calibration	Bulk Density TAP	Bulk Blank TAP
Sample mass	✓			✓	
Absolute density	✓				
Chamber+medium mass	1	✓			
Preparation cycles	R/O	R/O	R/O	2	R/O
Measurement cycles	R/O	R/O	R/O	R/O	R/O
Consolidation unit	✓	✓	✓	✓	✓
Consolidation force	R/O	R/O	R/O	2	R/O
Conversion factor	✓			✓	
Zero depth	✓		✓		
Chamber diameter	✓	✓	✓	✓	✓

Legend

R/O	Indicates the field displays but cannot be edited in the *Records* view
1	Displays if *Run Blank* was not enabled in the SOP
2	Displays if *Run Blank* was enabled in the SOP
✓	Indicates the field displays

PRINT OR EXPORT RECORDS

The printer must first be attached to the analyzer via a USB port. See ***Printer Installation on page 6 - 10***.

This functionality is only available locally. If performed remotely, the download occurs through the browser.

Verify that the USB device does not contain a *GeoPyc.conf-sample* file. If it does, use a text editor to set the following in the file:

InstallApplication = NO
DownloadApplication = NO

If these items are not set, this error message occurs:

Failed to save because USB has been ejected or is absent.

1. Insert the USB device into a USB port on the analyzer.
2. Tap *Records* on the menu.
3. Select one or more records to export.
4. Tap the download icon. A green success message displays upon successful download:

Successfully saved to <USB-location>.zip. Please remove USB.

USE A REMOTE COMPUTER:

- Display the record on the screen and press **Ctrl + P** on the keyboard.

USE A PRINTER ATTACHED TO THE ANALYZER:

- Tap the *Records* menu item.
- Select one or more reports to be printed.
- Tap the printer icon. A single report will be generated for all selected reports.

PRINT FROM AN OPEN RECORD:

- Tap the printer icon.

REPORTS

A report is available after analysis if the analyzer is setup to print or transmit data. Analysis reports remain active while an automatic analysis is in progress. The following table describes fields common to most reports. Fields not listed are described in their respective topics.

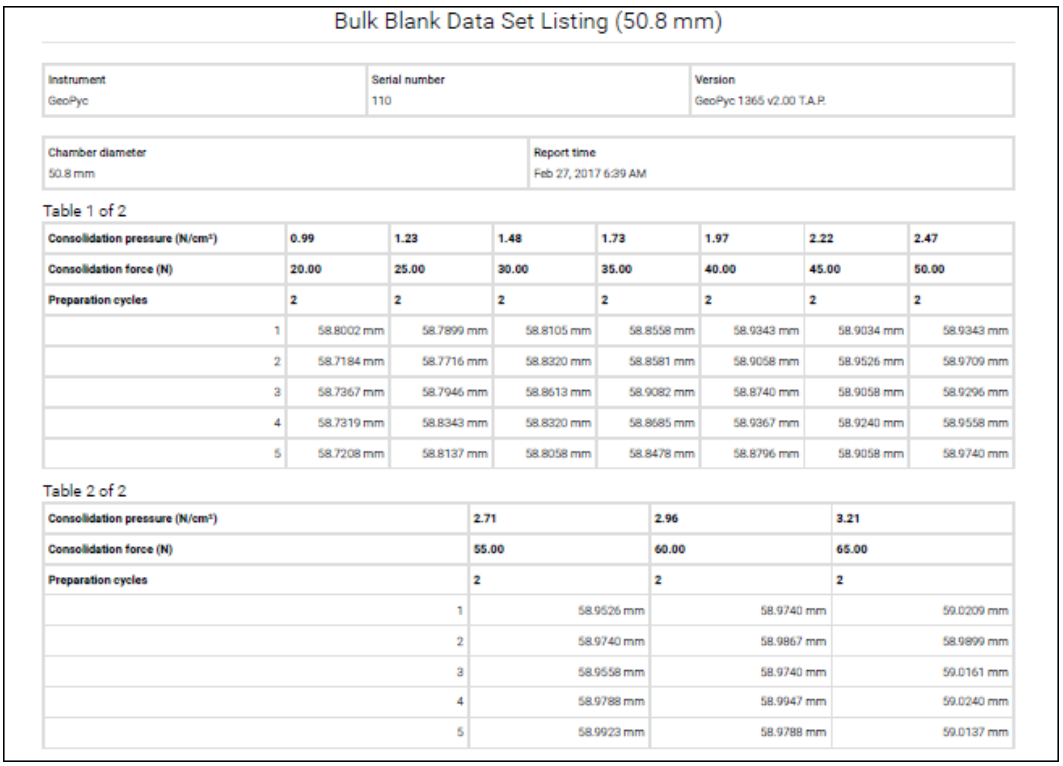
Common Fields and Buttons Table

Field	Description
Chamber & Medium Mass	Mass of the chamber and medium.
Chamber Diameter	Diameter of the chamber used in the analysis.
Completed	Date and time the analysis was completed.
Conversion factor	Conversion factor used in the analysis.
Instrument	Analyzer used in the analysis
Operator	Person running the analysis.
Record	Displays the Method and Name entered in the SOP.
Report Time	Date and time the report was requested.
Serial Number	The serial number of the analyzer where the analysis was performed.
Started	Date and time the analysis was started.
Submitter	Person requesting the analysis.
Version	Software version.
Zero Depth	Zero depth of the sample chamber.

BULK REPORTS TAP

The GeoPyc uses the calculated distance-to-volume conversion factor for the selected chamber. However, the GeoPyc will use the selected chamber's conversion factor both bulk and envelope blanks. This makes the calculations for bulk density the same as the calculations for envelope density.

BULK BLANK DATA SET LISTING TAP



Bulk Blank Data Set Listing (50.8 mm)

Instrument	Serial number	Version
GeoPyc	110	GeoPyc 1365 v2.00 T.A.P.

Chamber diameter	Report time
50.8 mm	Feb 27, 2017 6:39 AM

Table 1 of 2

Consolidation pressure (N/cm²)	0.99	1.23	1.48	1.73	1.97	2.22	2.47
Consolidation force (N)	20.00	25.00	30.00	35.00	40.00	45.00	50.00
Preparation cycles	2	2	2	2	2	2	2
1	58.8002 mm	58.7899 mm	58.8105 mm	58.8558 mm	58.9343 mm	58.9034 mm	58.9343 mm
2	58.7184 mm	58.7716 mm	58.8320 mm	58.8581 mm	58.9058 mm	58.9526 mm	58.9709 mm
3	58.7367 mm	58.7946 mm	58.8613 mm	58.9082 mm	58.8740 mm	58.9058 mm	58.9296 mm
4	58.7319 mm	58.8343 mm	58.8320 mm	58.8685 mm	58.9367 mm	58.9240 mm	58.9558 mm
5	58.7208 mm	58.8137 mm	58.8058 mm	58.8478 mm	58.8796 mm	58.9058 mm	58.9740 mm

Table 2 of 2

Consolidation pressure (N/cm²)	2.71	2.96	3.21
Consolidation force (N)	55.00	60.00	65.00
Preparation cycles	2	2	2
1	58.9526 mm	58.9740 mm	59.0209 mm
2	58.9740 mm	58.9867 mm	58.9899 mm
3	58.9558 mm	58.9740 mm	59.0161 mm
4	58.9788 mm	58.9947 mm	59.0240 mm
5	58.9923 mm	58.9788 mm	59.0137 mm

A bulk blank data set is comprised of blank runs with the same chamber diameter but different consolidation forces. If multiple blank runs have the same consolidation force, the most recent one with at least one cycle will be used. The blank data set listing will show a column for each consolidation force.

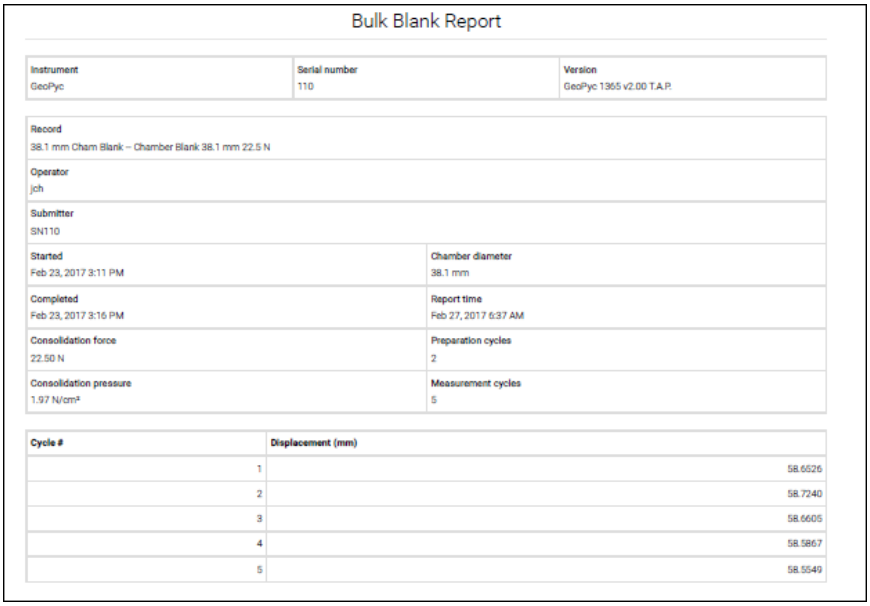
Stored bulk blank sets will be distinct from stored envelope blanks. There will be separate automatically generated entries in the Records View for bulk and envelope blanks for each chamber. Entries for chambers that have no blank data will not be shown. The blank set entry for a chamber will be removed when the last blank record for that chamber is deleted.

No interpolation is done with bulk blanks; the consolidation force used in an analysis must match that of one of the stored blanks. The counts for the cycles in that data set are subtracted from the corresponding analysis cycles.

Bulk Blank Data Set Listing Fields Table

Field	Description
Consolidation force	The force with which the chamber contents are compressed.
Consolidation pressure	$P = \frac{4F}{\pi * d^2}$ where *F* is the consolidation force in newtons and *d* is the chamber diameter in cm.
Preparation cycles	Unrecorded, repetitious, agitation and consolidation attempts intended to orient the Dry Flo grains and the specimen into a uniformly mixed bed.

BULK BLANK REPORT TAP



Bulk Blank Report

Instrument	Serial number	Version
GeoPyc	110	GeoPyc 1365 v2.00 T.A.P.

Record	38.1 mm Cham Blank – Chamber Blank 38.1 mm 22.5 N
Operator	jch
Submitter	SN110

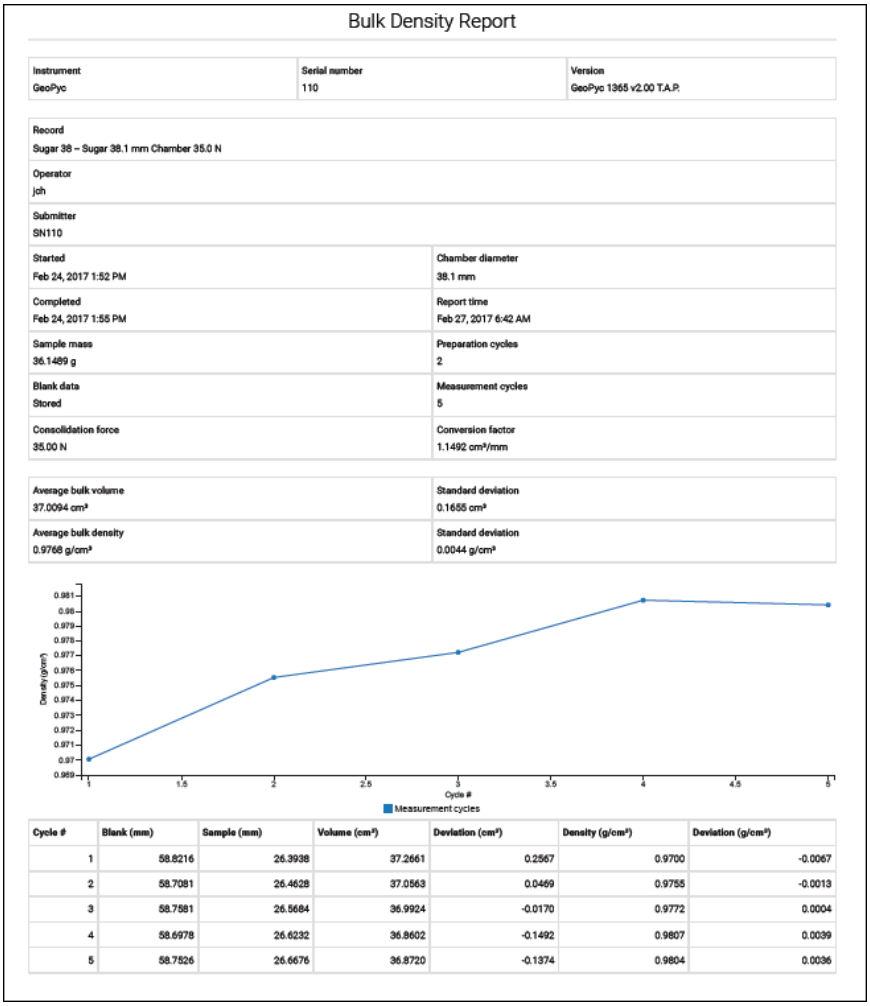
Started	Chamber diameter
Feb 23, 2017 3:11 PM	38.1 mm
Completed	Report time
Feb 23, 2017 3:16 PM	Feb 27, 2017 6:37 AM
Consolidation force	Preparation cycles
22.50 N	2
Consolidation pressure	Measurement cycles
1.97 N/cm²	5

Cycle #	Displacement (mm)
1	58.6526
2	58.7240
3	58.6605
4	58.5867
5	58.5549

Bulk Blank Report Fields Table

Field	Description
Consolidation force	The force with which the chamber contents are compressed.
Consolidation pressure	$P = \frac{4F}{\pi * d^2}$ where *F* is the consolidation force in newtons and *d* is the chamber diameter in cm.
Measurement cycles	The number of times the plunger builds consolidation force and backs off for each measurement.
Preparation cycles	Unrecorded, repetitious, agitation and consolidation attempts intended to orient the Dry Flo grains and the specimen into a uniformly mixed bed.

BULK DENSITY REPORT TAP



Bulk Density Report

Instrument	Serial number	Version
GeoPyc	110	GeoPyc 1365 v2.00 T.A.P.

Record: Sugar 38 – Sugar 38.1 mm Chamber 35.0 N
Operator: jch
Submitter: SN110

Started: Feb 24, 2017 1:52 PM	Chamber diameter: 38.1 mm
Completed: Feb 24, 2017 1:55 PM	Report time: Feb 27, 2017 6:42 AM
Sample mass: 36.1489 g	Preparation cycles: 2
Blank data: Stored	Measurement cycles: 5
Consolidation force: 35.00 N	Conversion factor: 1.1492 cm³/mm

Average bulk volume: 37.0094 cm³	Standard deviation: 0.1655 cm³
Average bulk density: 0.9768 g/cm³	Standard deviation: 0.0044 g/cm³

Cycle #	Blank (mm)	Sample (mm)	Volume (cm³)	Deviation (cm³)	Density (g/cm³)	Deviation (g/cm³)
1	58.8216	26.3938	37.2661	0.2567	0.9700	-0.0067
2	58.7081	26.4628	37.0563	0.0469	0.9755	-0.0013
3	58.7581	26.5684	36.9924	-0.0170	0.9772	0.0004
4	58.6978	26.6232	36.8602	-0.1492	0.9807	0.0039
5	58.7526	26.6676	36.8720	-0.1374	0.9804	0.0036

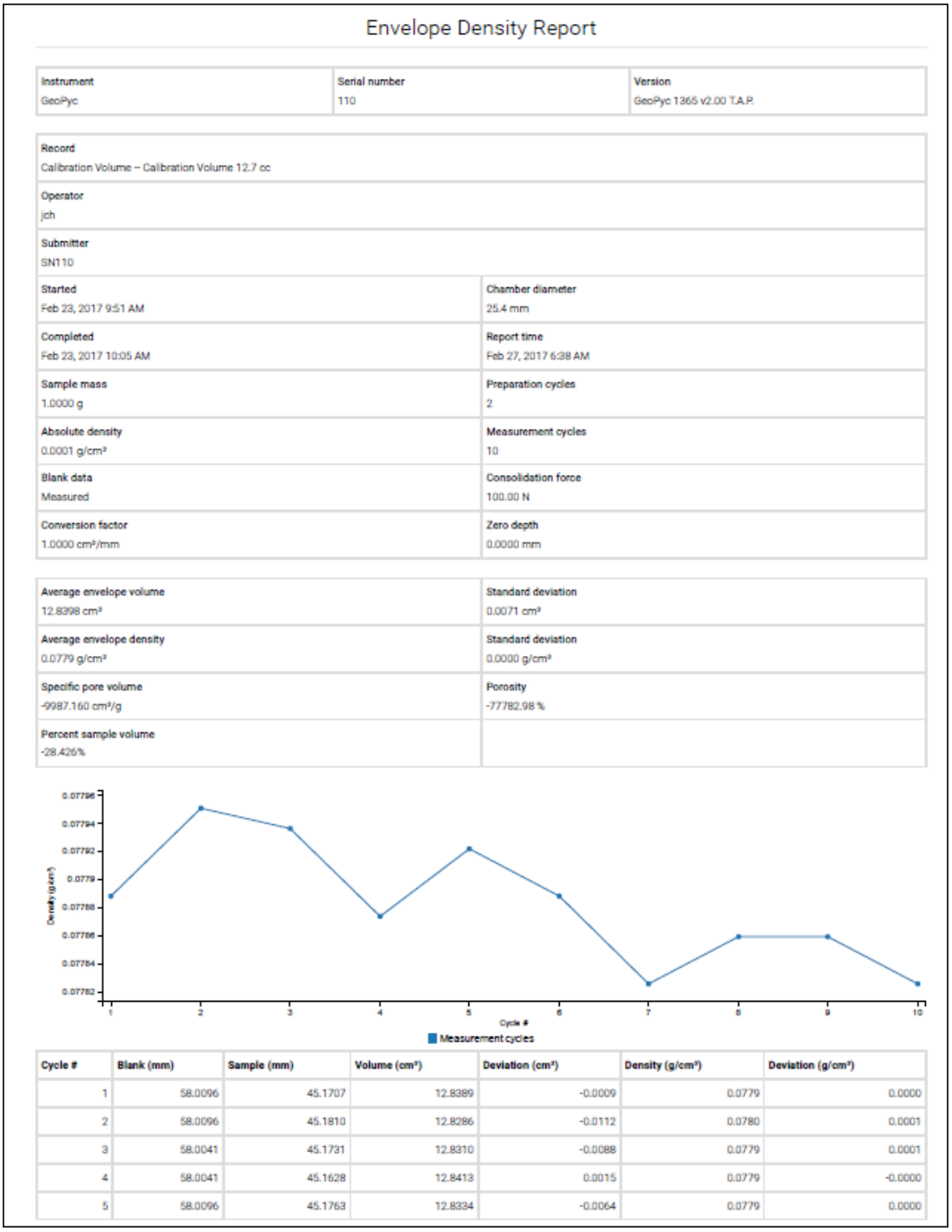
Bulk Density Report Fields Table

Field	Description
Average bulk density	The average of the Density column in the Measurement Cycle table. **Standard deviation.** The standard deviation of the average bulk density.
Average bulk volume	The average of the Volume column in the Measurement Cycle table. **Standard deviation.** The standard deviation of the average bulk volume.
Blank data	Indicates if the blank data were measured or entered.

Bulk Density Report Fields Table (continued)

Field	Description
Consolidation force	The force with which the chamber contents are compressed.
Measurement cycles	The number of measurement cycles performed.
Preparation cycles	Unrecorded, repetitious, agitation and consolidation attempts intended to orient the Dry Flo grains and the specimen into a uniformly mixed bed.

ENVELOPE DENSITY REPORT



Envelope Density Report

Instrument	Serial number	Version
GeoPyc	110	GeoPyc 1365 v2.00 T.A.P.

Record	
Calibration Volume – Calibration Volume 12.7 cc	
Operator	
jch	
Submitter	
SN110	
Started	**Chamber diameter**
Feb 23, 2017 9:51 AM	25.4 mm
Completed	**Report time**
Feb 23, 2017 10:05 AM	Feb 27, 2017 6:38 AM
Sample mass	**Preparation cycles**
1.0000 g	2
Absolute density	**Measurement cycles**
0.0001 g/cm³	10
Blank data	**Consolidation force**
Measured	100.00 N
Conversion factor	**Zero depth**
1.0000 cm³/mm	0.0000 mm

Average envelope volume	**Standard deviation**
12.8398 cm³	0.0071 cm³
Average envelope density	**Standard deviation**
0.0779 g/cm³	0.0000 g/cm³
Specific pore volume	**Porosity**
-9987.160 cm³/g	-77782.98 %
Percent sample volume	
-28.426%	

Cycle #	Blank (mm)	Sample (mm)	Volume (cm³)	Deviation (cm³)	Density (g/cm³)	Deviation (g/cm³)
1	58.0096	45.1707	12.8389	-0.0009	0.0779	0.0000
2	58.0096	45.1810	12.8286	-0.0112	0.0780	0.0001
3	58.0041	45.1731	12.8310	-0.0088	0.0779	0.0001
4	58.0041	45.1628	12.8413	0.0015	0.0779	-0.0000
5	58.0096	45.1763	12.8334	-0.0064	0.0779	0.0000

This report lists the counts steps moved by the displacement device during each cycle of a sample run. The report also displays average envelope volume and its standard deviation, and average envelope density and its standard deviation.

The data in this report can be used to make comparisons between samples and comparisons of samples against your standards or specifications. It can also be used to ensure that an adequate amount of sample was contained in the sample bed. To ensure reproducible results, at least 25% of the sample bed should be actual sample.

Envelope Density Report Fields Table

Field	Description
Absolute density	The density computed after excluding from the volume that of the pores and cavities.
Average envelope density	The average of the Density column in the Measurement Cycle table. **Standard deviation.** The standard deviation of the average envelope density.
Average envelope volume	The average of the Volume column in the Measurement Cycle table. **Standard deviation.** The standard deviation of the average envelope volume.
Blank data	Indicates if the blank data were measured or entered.
Consolidation force	The force with which the chamber contents are compressed.
Measurement cycles	The number of measurement cycles performed.
Percent porosity	Displays if absolute density was entered.
Percent sample volume	Displays if zero depth set was entered.
Porosity	Displays if absolute density data was entered and if **Calculate** was selected.
Preparation cycles	Unrecorded, repetitious, agitation and consolidation attempts intended to orient the Dry Flo grains and the specimen into a uniformly mixed bed.
Sample mass	The sample mass.
Specific pore volume	Displays if absolute density was entered.

FORCE CALIBRATION REPORT

Force Calibration Report

Instrument	GeoPyc	version	1.00
Started	Sep 19, 2016 2:18 PM	Spring constant	4.2180 N/mm
Completed	Sep 19, 2016 2:19 PM		
Report time	Sep 20, 2016 4:39 PM		
Slope	140.310 N/V	Standard deviation	0.265 N
Displacement cycles	38	Current displacement cycles	50

Point #	Displacement (counts)	Force (N)	Force reading (V)
1	11721	127.4	1.892
2	11103	120.4	1.842
3	10484	113.4	1.792
4	9865	107.4	1.749
5	9247	99.8	1.695
6	8628	92.7	1.645
7	8009	85.7	1.594
8	7390	79.1	1.548
9	6771	72.2	1.498
10	6153	65.4	1.450

	Position (mm)	Force (N)	Force (N)	Force (N)	Force (N)
low	44.9792	121.9	125.9	121.9	121.9
high	21.1667	20.7	20.7	20.7	20.9
difference	23.8125	101.3	105.2	101.2	101.0

Average spring constant	4.2899 N/mm	Percent error	1.70%

This report is available after performing a force transducer calibration.

If the report is generated immediately after force calibration, the current number of cycles is equal to the number in the body of the report. If runs were performed after the force calibration but before the report was generated, the current number of cycles is larger than the number in the body of the report.

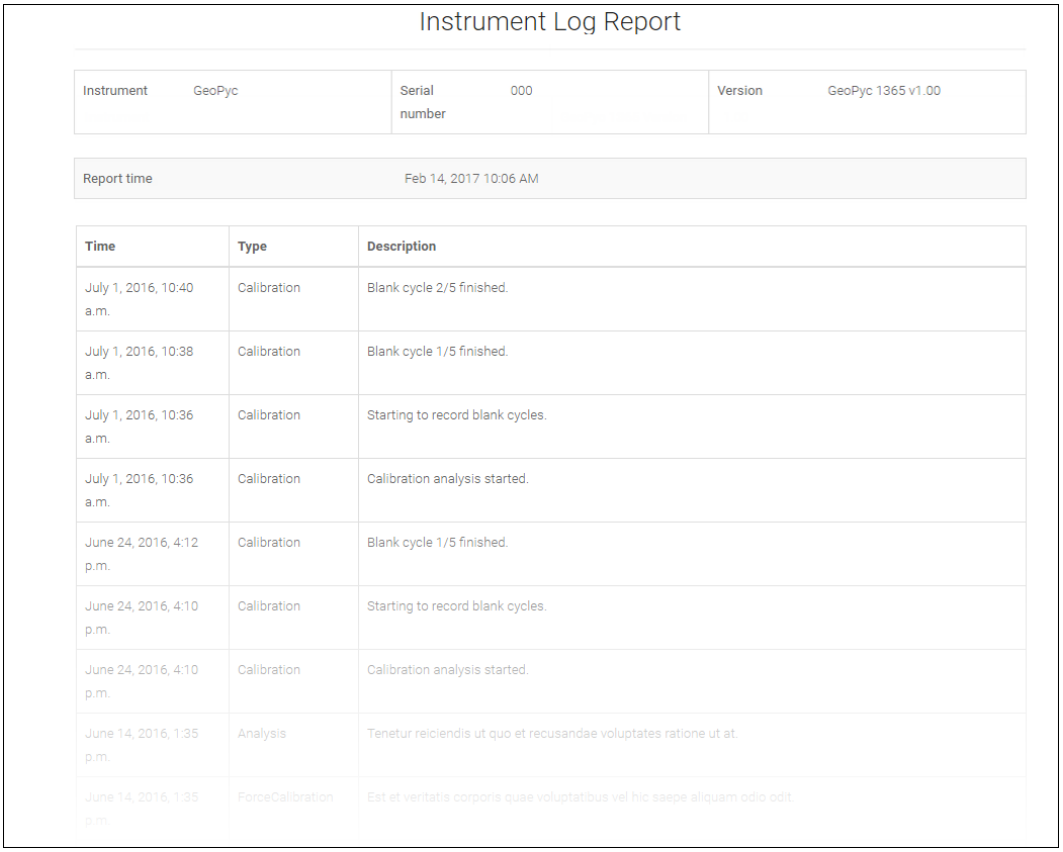
The transducer is calibrated internally during the calibration process. If the standard deviation and number of counts deviation are within the limits, no action is needed. If analysis data still appear inaccurate or unexpected, causes could be: contaminated Dry Flo, inaccurate weighing, or other methodology problems. If the number of counts deviation is large, or if the standard deviation is greater than 1.0, contact your Micromeritics service representative to investigate possible causes.

Force Calibration Report Fields Table

Cycle	Description
Current displacement cycles	A record of the number of cycles performed since the instrument was last calibrated.
Displacement cycles	A record of the number of cycles performed since the analyzer was first calibrated.
Points	Calibration readings are taken at 10 points. For each point, the report lists: **Displacement.** The number of steps of the motor from home position to the point at which force sensor data is recorded. **Expected Force (counts).** The force exerted by the displacement device at this point, calculated by the instrument from the spring constant and the displacement distance. **Force Reading.** The uncorrected value from the analog to digital electronics.
Slope	Calculated using the data from the points. This data are used internally by the analyzer to calibrate the force transducer (converts analog force sensor readings into newtons, after removing a zero offset).
Spring constant	Calculated from the formula (k=F/x), the spring constant is the force (in newtons) exerted per unit distance(centimeters).
Standard deviation	Calculated using the points and slope data. A standard deviation should be less than 1.0.

INSTRUMENT LOG REPORT

Displays recent analyses and calibrations.



Instrument Log Report

Instrument	GeoPyc	Serial number	000	Version	GeoPyc 1365 v1.00

Report time	Feb 14, 2017 10:06 AM

Time	Type	Description
July 1, 2016, 10:40 a.m.	Calibration	Blank cycle 2/5 finished.
July 1, 2016, 10:38 a.m.	Calibration	Blank cycle 1/5 finished.
July 1, 2016, 10:36 a.m.	Calibration	Starting to record blank cycles.
July 1, 2016, 10:36 a.m.	Calibration	Calibration analysis started.
June 24, 2016, 4:12 p.m.	Calibration	Blank cycle 1/5 finished.
June 24, 2016, 4:10 p.m.	Calibration	Starting to record blank cycles.
June 24, 2016, 4:10 p.m.	Calibration	Calibration analysis started.
June 14, 2016, 1:35 p.m.	Analysis	Tenetur reiciendis ut quo et recusandae voluptates ratione ut at.
June 14, 2016, 1:35 p.m.	ForceCalibration	Est et veritatis corporis quae voluptatibus vel hic saepe aliquam odio odit.

VOLUME CALIBRATION REPORT

Volume Calibration Report

Instrument	GeoPyc	Serial number	101	version	1.00

Record	Marble_Cal2 -- 25.4 mm Chamber Calibration with 0.656 mm Marble		
Operator	jch		
Submitter	SN101		
Started	Oct 7, 2016 3:56 PM	Chamber diameter	25.4 mm
Completed	Oct 10, 2016 2:50 PM	Report time	Oct 12, 2016 12:39 PM
Reference volume	2.3611 cm³	Preparation cycles	2
Blank data	Measured	Measurement cycles	10
Chamber + medium mass	N/A	Consolidation force	51.0 N
Average envelope volume	2.2947 cm³	Standard deviation	0.0398 cm³

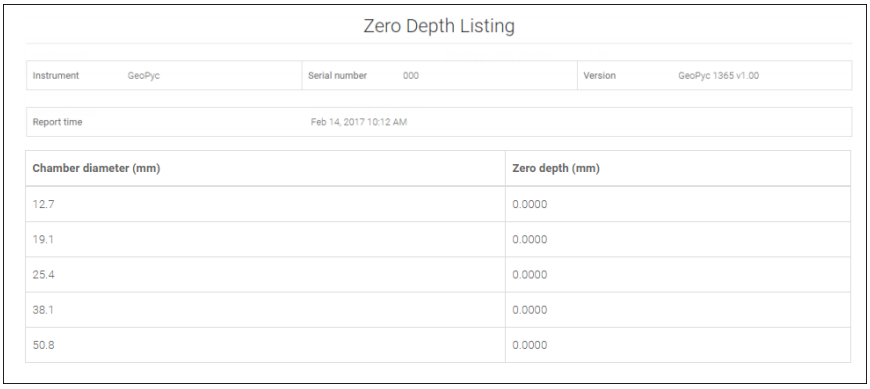
This report lists the counts (steps moved by the displacement device) during each cycle of a calibration run. A calibration run is performed using a calibration object of known properties similar to the sample in size, shape, and quantity. It also reports average envelope volume, standard deviation, and volume error (the adjustment to the volume attributed to the sample's shape, size, etc.).

Use the conversion factor in sample runs for samples similar to the calibration object used in this run. For greater accuracy, perform three calibration runs and average the conversion factors from the three reports. Use the average as the conversion factor in sample runs for this type sample.

Volume Calibration Report Fields Table

Cycle	Description
Blank counts	The number of steps the motor moved to achieve the consolidation force specified for the blank run.
Deviation (volume)	The difference between the average envelope volume and the volume measured for this consolidation cycle.
Sample counts	The number of steps the motor moved to achieve the consolidation force specified for the sample run.
Volume	The difference between the blank and sample counts, converted by the analyzer to volume.

ZERO DEPTH LISTING REPORT



Zero Depth Listing

Instrument	GeoPyc	Serial number	000	Version	GeoPyc 1365 v1.00

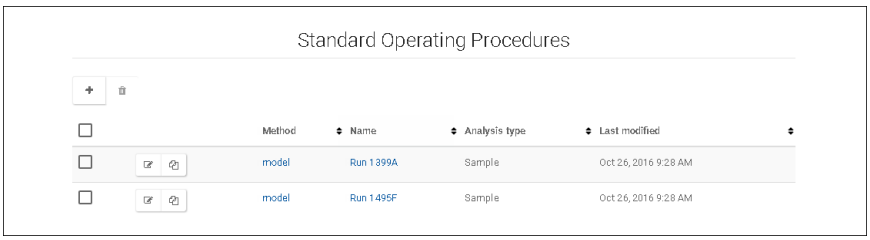
Report time	Feb 14, 2017 10:12 AM

Chamber diameter (mm)	Zero depth (mm)
12.7	0.0000
19.1	0.0000
25.4	0.0000
38.1	0.0000
50.8	0.0000

This report shows the zero depth of up to five sample chambers. The zero depth is used to calculate the percent of sample in the sample bed. This percentage is shown in the *Envelope Density Report*.

4 SOP (STANDARD OPERATING PROCEDURES)

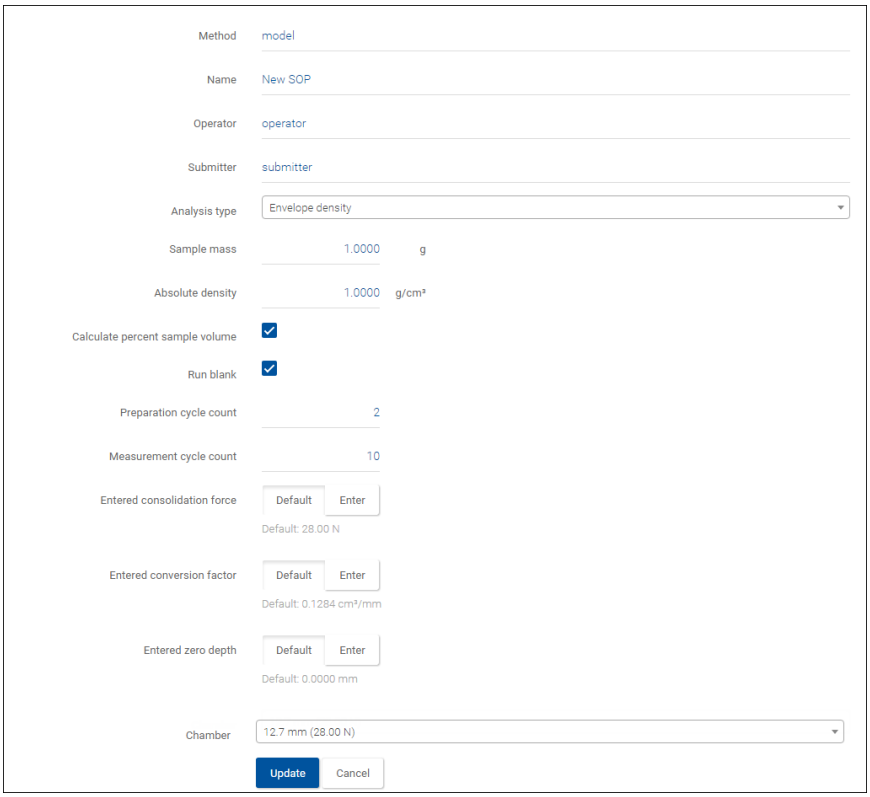
Use to define analysis conditions.



SOP Fields and Buttons Table

Field or Button	Description
Analysis Type	The type of analysis. • Bulk blank TAP • Bulk density TAP • Envelope blank • Envelope density • Volume calibration
Last Modified	The date and time the record was last modified.
Method	Method used to run the analysis.
Name	Description of the analysis.
Toolbar	+ Tap to create a new procedure. ☐ Use to select or deselect record. 🗑 Deletes the selected file from the list. Tap the box to the left of the record to enable it, then tap the **Delete** icon to delete the record. ✎ Tap to open and modify the selected record. ⧉ Copies the selected record.

ADD A NEW PROCEDURE



1. Tap **SOP** on the menu bar.
2. Tap the **Plus** icon.
3. Complete the form using the following table as a guide.
4. Tap **UPDATE** to save the SOP. The SOP will display on the *Standard Operating Procedures* window.

Refer to the ***Field Display Summary Table on page 4 - 4*** table for information on which fields are available for each analysis type. Fields not listed on the table indicate the field is applicable to all analysis types.

SOP Fields and Buttons Table

Field or Button	Description
Absolute density *[scroll selection]*	The density computed after excluding from the volume that of the pores and cavities.
Analysis Type *[drop-down box]*	Select the type of analysis.
Calculate percent sample volume *[check box]*	Select to have the percent sample volume calculated. See *Zero Depth of a Sample Chamber on page F - 1*. **Run Blank.** Enable to run a blank analysis.
Cancel *[button]*	Discards any changes or cancels the current process.
Chamber *[drop-down box]*	Select the chamber size to be used. Entries in this field can be modified in the *Maintenance* section.
Chamber + medium mass *[scroll selection]*	Mass of the chamber and medium.
Entered consolidation force *[button]*	**Default.** Tap to use the default consolidation force. **Enter.** Tap to manually enter the new consolidation force.
Entered conversion factor *[button]*	**Default.** Tap to use the default conversion factor. **Enter.** Tap to manually enter the new conversion factor.
Entered zero depth *[button]*	**Default.** Tap to use the default zero depth. **Enter.** Tap to manually enter the new zero depth.
Input reference volume *[button]*	**Enter**. Tap to enter the input reference volume manually. **Calculate**. Tap to allow the system to calculate the input reference volume. **Reference mass.** Enter the sample reference mass. **Absolute density.** The density computed after excluding from the volume that of the pores and cavities. **Porosity.** Enter the sample porosity.
Measurement cycle count *[scroll selection]*	Enter the number of measurement cycles to be run.
Method *[text box]*	Method used to run the analysis.
Name *[text box]*	Name of the procedure.
Operator *[text box]*	Person running the analysis.

SOP Fields and Buttons Table (continued)

Field or Button	Description
Porosity *[text box]*	Displays when **Calculate** is selected.
Preparation cycle count *[scroll selection]*	Enter the number of preparation cycles to be run. It is recommended that at least two preparation cycles and five subsequent cycles be performed on each sample.
Run blank *[check box]*	Select to run an analysis with no sample.
Sample mass *[scroll selection]*	Enter the sample mass.
Submitter *[text box]*	Person requesting the analysis.
Update *[button]*	Saves the entered information and closes the window.

Field Display Summary Table

	Envelope Density	Envelope Blank	Volume Calibration	Bulk Density	Bulk Blank
Sample mass	✓			✓	
Absolute density	✓				
Input reference volume			✓		
Reference Mass			1		
Absolute density			1		
Porosity			1		
Reference volume			✓		
Calculate percent sample volume	✓		✓		
Run blank	✓		✓	✓	
Chamber+medium mass	2	✓	2		
Preparation cycle count	✓	✓	✓	3	✓
Measurement cycle count	✓	✓	✓	✓	✓
Consolidation unit	✓	✓	✓	✓	✓
Consolidation force / pressure	✓	✓	✓	3	✓
Conversion factor	✓			✓	

Field Display Summary Table (continued)

	Envelope Density	Envelope Blank	Volume Calibration	Bulk Density	Bulk Blank
Zero depth	✓		✓		
Chamber	✓	✓	✓	✓	✓

Legend

1 Indicates the field displays if *Input reference volume* is set to *Calc*

2 Indicates the field displays if *Run Blank* was not selected in the SOP

3 Indicates this field displays if *Run Blank* was selected in the SOP

✓ Indicates the field displays

CONSOLIDATION CYCLES

To measure the volume of the chamber contents, it is necessary to consolidate the Dry Flo during an analysis. To do this, the analyzer performs a consolidation cycle. During a consolidation cycle, the analyzer agitates the chamber (by rotational oscillation) while a plunger moves forward into it. When the user-specified consolidation force is reached, the analyzer records the volume, then retracts the plunger slightly.

To gather statistically useful data, the analyzer automatically performs a series of such consolidation cycles during each analysis run. The number of consolidation cycles performed during an analysis run is specified by the operator.

Because of initial settling of the Dry Flo, consolidation is less consistent in the first few cycles than in subsequent cycles. These first cycles are called *Preparation Cycles*. The number of preparation cycles is setup in the SOP. The software automatically discards data from these cycles before making calculations.

Subsequent cycles produce quite consistent results. In order to derive meaningful statistical information, it is recommended that at least two preparation cycles (the default number) and five subsequent cycles be performed on each sample, for a total of seven cycles.

CONSOLIDATION FORCE

Consolidation force is the force with which the chamber contents are compressed. The type of force can be specified during the blank run.

The same force must be used for blank, sample, and calibration runs for a given sample.

Typical Consolidation Force

Chamber (internal) (mm)	Typical Consolidation Force (N)
12.7	28
19.1	38
25.4	51
38.1	90
50.8	145

A different force may be used to decrease the force when analyzing a very soft or fragile sample.

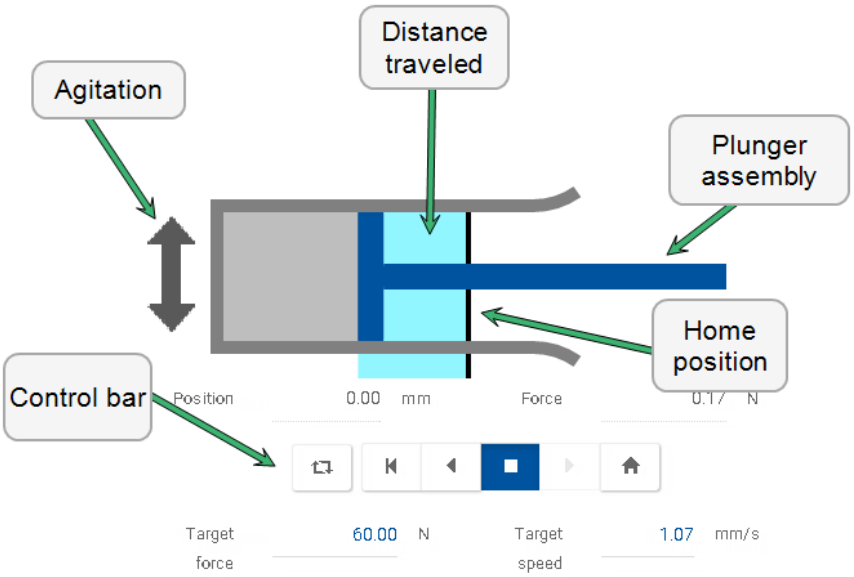
- If too low a force is entered, the plunger may move forward slowly or not at all. (If this occurs, start again using a greater force.)
- Increase the force when performing an analysis with a sample plus Dry Flo bed longer than the diameter of the chamber.
- If the Dry Flo remains compacted into cakes or clumps after analysis, decrease the force.

Blank Page

5 INSTRUMENT

The plunger graphic moves as the analyzer plunger moves. Use the control bar to position the plunger manually. A highlighted control bar button indicates the state of the operation. The plunger cannot be controlled from remote browsers.

The control bar and entry fields are disabled when the analyzer status is *Analyzing* or *Standby*, however the control bar buttons will still be highlighted to show the current state of the analyzer.



Manual Control

Field or Button	Description
	Toggles chamber agitation. The button is highlighted when agitation is in progress.
Control bar	 Build force, This button is disabled when the plunger is at the maximum limit switch.
	 Move in all the way to the left.
	 Move the plunger in. This button is disabled when the plunger is at the maximum limit switch.

Manual Control (continued)

Field or Button	Description
	 Stop the plunger movement.  Move the plunger out. This button is disabled when the plunger is at the minimum limit switch.  Send the plunger assembly to the Home position.
Force	Plunger force.
Position	Plunger position.
Target Force	Set the target force of the plunger. Changes to this field occur immediately even if the plunger is in motion.
Target Speed	Set the speed of the plunger. Changes to this field occur immediately even if the plunger is in motion.

CHAMBER AND PLUNGER

HANDLING THE CHAMBER AND PLUNGER

When not in use, rest the chamber on the solid end (open end or plunger end facing up) and leave the plunger in the chamber. When the plunger is not in the chamber, stand it on end, seal facing up.

When sliding the plunger out of the chamber, work the end of the plunger slowly and carefully out of the open end of the chamber. Pulling the plunger out of the chamber in a quick, uncontrolled motion may result in Dry Flo being expelled from the chamber.

While removing the plunger from the chamber, tap the seal end lightly on the open end of the chamber. Brush any Dry Flo that adheres to the plunger's seal end or to the flared end of the chamber back into the chamber.

Use caution to not spill or lose any Dry Flo when handling the chamber, plunger, and sample. The volume of lost medium directly reduces the calculated volume of the sample.

Slide the sample gently down the side of the chamber. Never drop a sample into the Dry Flo bed. Dropping the sample into the bed can cause splashing and Dry Flo may spill from the chamber.

Position a single piece sample in the center of the chamber. Shake the assembled chamber and plunger to help position the sample within the Dry Flo. Try to distribute multi-piece samples evenly throughout the chamber. For best results, use sample pieces larger than 1 to 2 mm in length or diameter.

REMOVE CHAMBER AND PLUNGER

Do not attempt to remove the chamber and plunger while the analyzer is operating.

While removing the chamber / plunger assembly from the analyzer, check to see if either end has become loose during analysis. If either end is not securely attached to the mandrel, analysis data may be inaccurate. Ensure that the chamber and plunger are securely attached to the analyzer and restart the analysis.

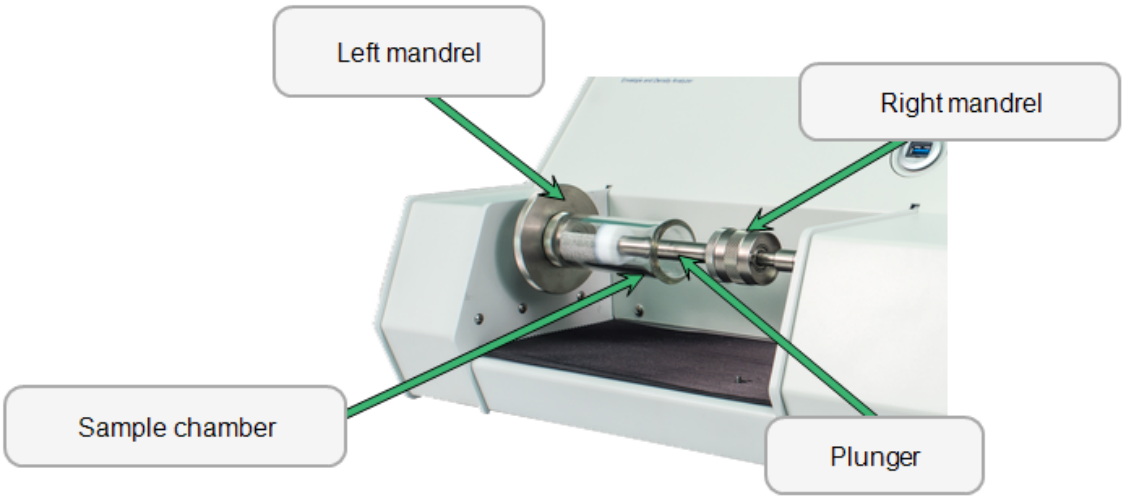
1. Unscrew the plunger from the right mandrel by turning the coupling on the mandrel toward you. Continue turning / unscrewing until the plunger is free of the mandrel. Hold the plunger to stabilize it while turning the coupling.
2. Push the plunger a small distance into the chamber.
3. Unscrew the chamber from the left mandrel (in the center of the large disc) by turning the chamber toward you. Hold the disc to stabilize it while unscrewing the chamber.
4. When the chamber is free, remove it from the mandrel.

INSERT PLUNGER

The seal end of each plunger fits snugly into the corresponding chamber. The plunger slides slowly but smoothly inside the chamber. After loading the chamber, slide the seal end of the plunger about a third of the way into the chamber.

MOUNT THE CHAMBER AND PLUNGER

1. Ensure the plunger is inserted partially into the loaded chamber.
2. Hold the chamber / plunger between the two mandrels on the instrument, with the chamber end to the left.
3. Screw the chamber onto the threads in the center of the left mandrel. Turn the chamber away from you until it is firmly secured. Hold the mandrel to stabilize it while mounting the chamber.



4. Extend the plunger part way out of the chamber until the right mandrel is inserted into the hole on the top of the plunger.
5. Turn the coupling on the mandrel away from you to screw the plunger onto the right mandrel. Continue turning / screwing until the plunger is firmly secured. Hold the plunger to stabilize it while turning the coupling.
6. Extend the plunger part way out of the chamber until the right mandrel is inserted into the hole on the top of the plunger.
7. Turn the coupling on the mandrel away from you to screw the plunger onto the right mandrel. Continue turning / screwing until the plunger is firmly secured. Hold the plunger to stabilize it while turning the coupling.

It is important that the chamber/plunger is secured firmly to each mandrel.

CHAMBER DIAMETER

One analysis chamber (and corresponding plunger) is provided with the analyzer. Several sizes are available to accommodate a variety of sample types and quantities. Log in to your customer portal to access parts and accessories.

For best results, select the chamber where the sample will cause the greatest volumetric change in the medium bed. This also means selecting the smallest chamber in which the sample will fit when surrounded by enough Dry Flo to create a consolidated bed on all sides.

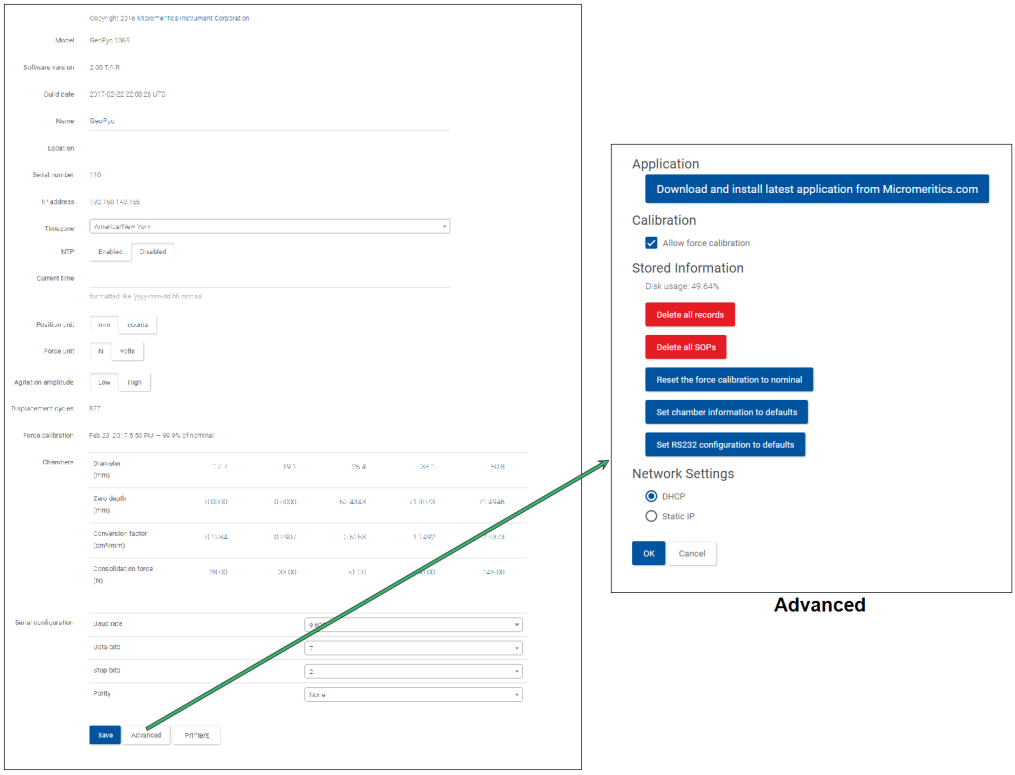
Determine the internal chamber diameter by measuring the plunger seal. The diameter of the seal diameter is the same as the internal diameter of the chamber. (Do not measure the chamber.)

6 MAINTENANCE

CAUTION

These settings affect the operation of the analyzer. Make changes only under the direction of a Micromeritics service representative.

Shows information about the analyzer, allows unit selection, and allows editing of the chamber parameters.



Advanced

Maintenance Fields and Buttons Table

Field or Button	Description
Advanced *[button]*	Administrator level configuration options — enabled only when the analyzer is in the *Ready* state. **Application.** Tap **DOWNLOAD AND INSTALL.....** to download and install the latest version of the application. This button does not display on a remote computer nor does it display if the analyzer application is up-to-date. **Calibration.** Select the *Allow force calibration* option to allow force calibration.

Maintenance Fields and Buttons Table (continued)

Field or Button	Description
	Stored Information. Displays the disk space used by the application and associated records. Tap the applicable button to delete or reset options: • Delete all records • Delete all SOPs • Reset the force calibration to nominal • Set chamber Information to defaults • Set RS232 configuration to defaults **Network Settings.** Select if the analyzer uses DHCP or a Static IP address.
Agitation Amplitude *[button]*	Select if the agitation should be set to low or high.
Build date	Displays the software version and release date.
Chambers	Settings for the chamber's diameter, zero depth, conversion factor, and consolidation force.
Current time *[text box]*	By default, the application uses UTC to set the current date and time, however if using NTP: enable the *NTP* option, complete the *Current time* field (*yyyy-mm-dd-hh:mm:ss* format). Also select the timezone using the *Timezone* drop-down box.
Displacement cycles	Total number of cycles performed since the force calibration.
Force Calibration	The calibration slope as a percentage of the nominal slope.
Force Unit *[button]*	Select if the force should be measured as a newton measurement or as counts.
IP address	IP address of the analyzer.
Location *[text box]*	Location of the analyzer.
Model	Analyzer model.
Name *[text box]*	The name of the analyzer (ie., lab number, etc.).
NTP *[button]*	By default, the applications use UTP to set the clock and display times and dates. If a different timezone is preferred, enable NTP and select a timezone in the *Timezone* field. The current date and time can also be provided by completing the *Current time* field.
Position Unit *[button]*	Select if the plunger and chamber assembly should be measured in mm or counts.

Maintenance Fields and Buttons Table (continued)

Field or Button	Description
Printer *[button]*	For use with a printer attached to the GeoPyc. Use to view printer setup, configure a new printer, or view print jobs. See ***Printer Installation on page 6 - 10***
Save *[button]*	Saves changes.
Serial configuration	Use to configure a device attached to the analyzer serial port — such as a balance. See ***Analytical Balance on page 2 - 12***.
Serial Number	Serial number of the analyzer.
Software Version	Version of the installed application.
Timezone *[drop-down box]*	By default, the applications use UTP to set the clock and display times and dates. If a different timezone is preferred, enable NTP and select a timezone in the *Timezone* field. The current date and time can also be provided by completing the *Current time* field.

Analytical Balance Configuration

An analytical balance is optional. If mass is to be entered into the analysis application manually, the balance does not need to be connected to the analyzer. See *Analytical Balance on page 2 - 12*.

- For Micromeritics supplied analytical balances, use the appropriate configuration settings for the revision level located on the rear of the analytical balance. Settings are provided below.
- For balances not supplied by Micromeritics, refer to the operator manual supplied with the balance.
- For all balances, set the units to grams.

Go to ***Maintenance > Serial configuration*** to configure the following:

Micromeritics Supplied Balance Configuration Settings

Option	Series E and Earlier	Series F and Later
Baud Rate	9600	9600
Data Bits	7	8
Stop Bits	2	1
Parity	None	None

For Micromeritics supplied analytical balance series E and earlier, the balance must be attached to the analyzer using the provided serial cable. Attach one end of the serial cable to the RS232 port on the rear of the analyzer and the other end to the balance.

For Micromeritics supplied analytical balance series F and later, the balance must be attached to the analyzer using the provided serial cable or the provided USB cable. Attach one end of the cable to the appropriate port on the rear of the analyzer and the other end to the balance.

REMOTE COMPUTER CONFIGURATION

The remote computer and the 1365 analyzer must be on the same network. The following is the recommended configuration to accomplish this:

- The IP addresses on both devices must have the same first three sets of 0-255 numbers (octets) and differ in their last octets.
- The subnet masks on both devices should be 255.255.255.0
- The gateways on both devices must be the same, but must differ from the IP addresses in their last octets. (optional)

Configuration Settings Example Table

	1365 GeoPyc	Remote Computer
IP Address	192.168.77.100	192.168.77.101
Subnet Mask	255.255.255.0	255.255.255.0
Gateway	192.168.77.10	192.168.77.10

If the remote computer has multiple Network Interface Cards (NICs), only change the settings of the NIC that is connected to the analyzer. Refer to the computer's operating system manual or the internet for instructions on how to change the network settings of the NIC in use.

Bridged analyzers must have different IP addresses.

Complete the setup on the 1365 analyzer:

1. In the analyzer application, tap the *Maintenance* menu heading, then tap **Advanced**.
2. Tap *Static* and enter the details from the *1365 GeoPyc* column in the ***Configuration Settings Example Table above***.

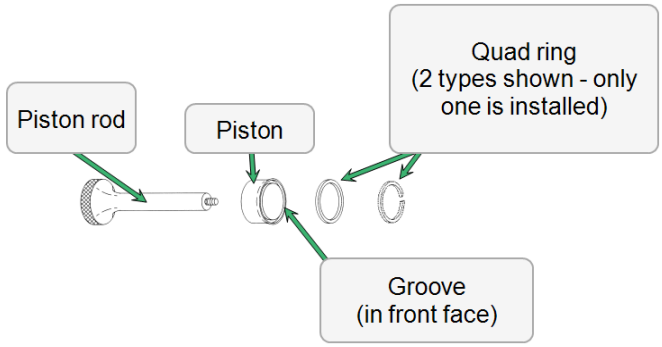
If an error occurs regarding IP conflicts, contact your IT department to release IP addresses on the same subnet.

To access the analyzer from the remote computer, enter the IP address of the analyzer in a web browser on the remote computer. Firefox and Chrome are the recommended browsers.

Plunger Assembly Maintenance

Plunger Assembly

The plunger assembly consists of a Teflon piston attached to a piston rod. The outer rim of the piston is expanded outward with an embedded quad ring.

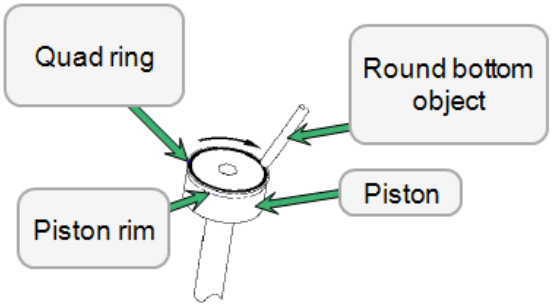


The piston is resistant to wear and provides sealing for prolonged usage if handled and maintained properly. It is recommended to clean the sealing area daily using a wipe moistened with isopropyl alcohol. Enure the seal is dry before using the plunger again.

Check Plunger Seal

When a leakage develops, it is typically caused by the piston having lost some of its expanded condition due to a characteristic of Teflon undergoing cold flow — as opposed to wear. The piston is easily restored to full operation when the cause is not wear.

Wipe or brush the piston free of adhering particles. Use a round-bottom object, such as the handle of the brush supplied with the analyzer, press down on the quad ring, and move the object around the piston circumference, forcing the piston rim outward.



REPLACE PLUNGER PISTON

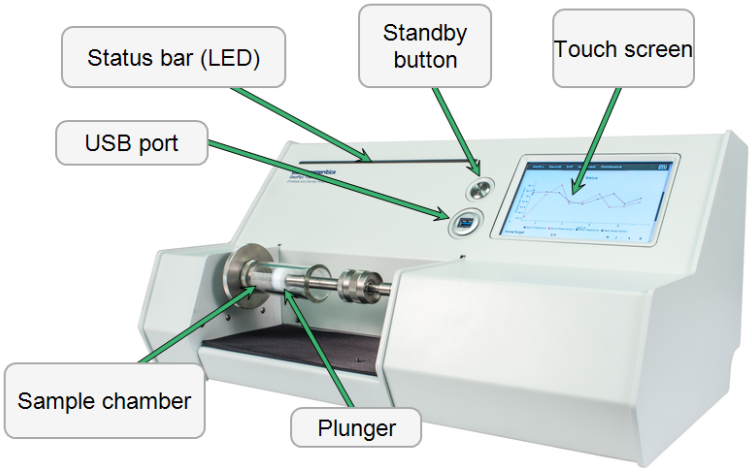
It is recommended to replace the piston and the quad ring at the same time.

1. Unscrew the piston rod from the piston.
2. The quad ring is preloaded in the groove on the front of the piston. If it has become dislodged, insert the quad ring into the groove on the front face of the piston.
3. Screw the piston rod into the back face.
4. Tighten the plunger assembly firmly without using excessive force.
5. Test the tightness of the piston:
   a. Place the plunger in an empty chamber.
   b. Holding the plunger still, rotate the chamber around the plunger in a direction that would tend to unscrew the piston. If the motion of the chamber begins to unscrew the plunger assembly, it needs to be tightened further.

POWER ANALYZER ON AND OFF

CAUTION

DO NOT connect or disconnect cables when the analyzer is powered ON.



No warmup is needed unless the analyzer has been moved recently from an area that is much colder or much warmer than the current location. In that case, allow the analyzer to reach room temperature before powering ON.

There is no hard power switch for the GeoPyc 1365. When the analyzer is plugged in, power is applied to the analyzer.

POWER-ON SEQUENCE

1. Plug in the analyzer. (There is no **ON/OFF** power switch for the instrument.)
   - The **Standby** button LED illuminates orange while the system is booting up.
   - When the bootup process completes and the analyzer application is running, the **Standby** button LED illuminates blue.
2. When the **Standby** button illuminates blue, press the **Standby** button to activate the touch screen. The **Standby** button is no longer illuminated.

STANDBY MODE

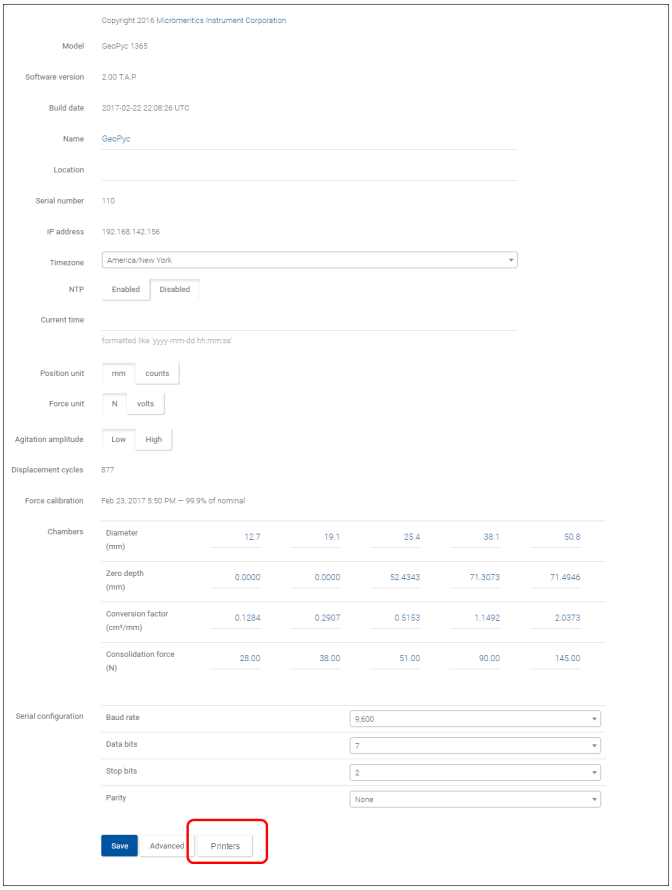
To activate standby mode, press the **Standby** button. The touch screen will turn off and the **Standby** button LED illuminates blue.

To exit standby mode, press the (blue) **Standby** button. The status bar LED illuminates blue when exiting standby mode only if the plunger is not at the home position. In this case, it illuminates blue while the plunger is returning to home position. Once the plunger returns to home position, the status bar LED turns green indicating that the analyzer is ready to be used.

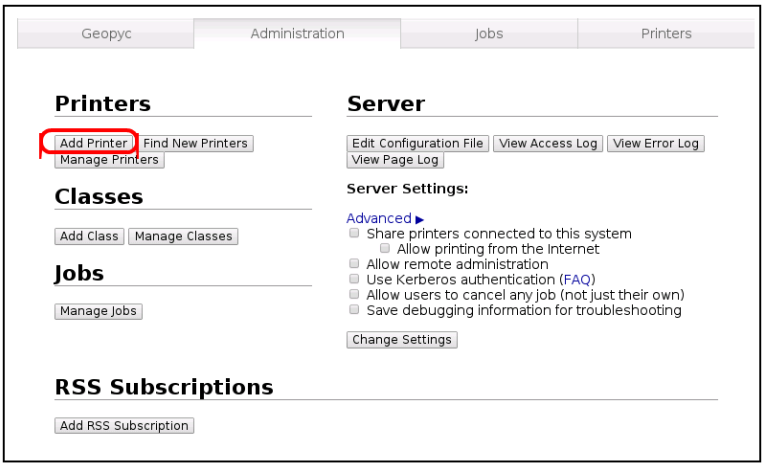
PRINTER INSTALLATION

These instructions are for configuring a printer attached to the 1365 GeoPyc analyzer. When configuration is complete, use the *Jobs* tab to view queued print jobs.

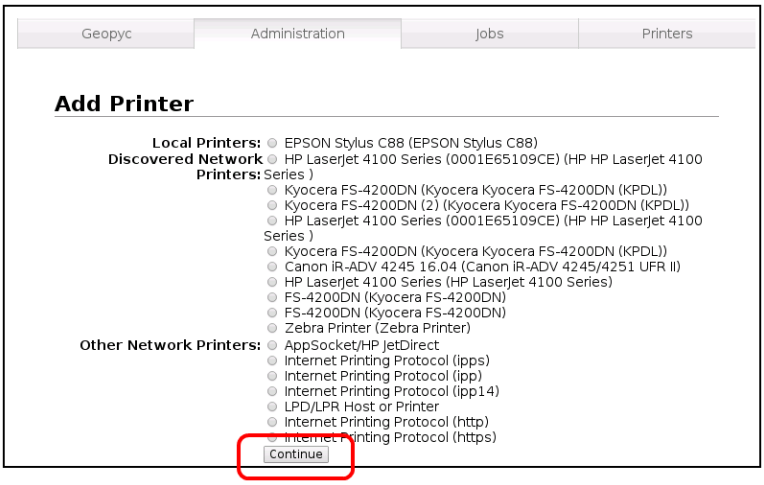
1. Tap the *Maintenance* tab.
2. Tap the **Printers** button at the bottom of the window.



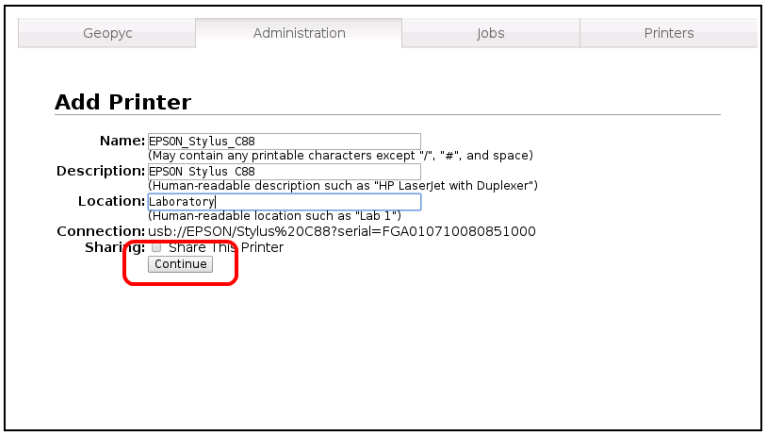
3. On the *Administration* tab, tap the **Add Printer** button.



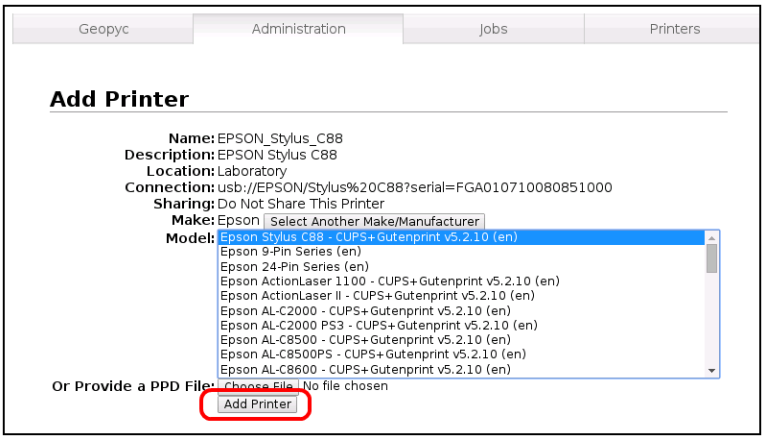
4. Select the printer to add then tap **Continue**.



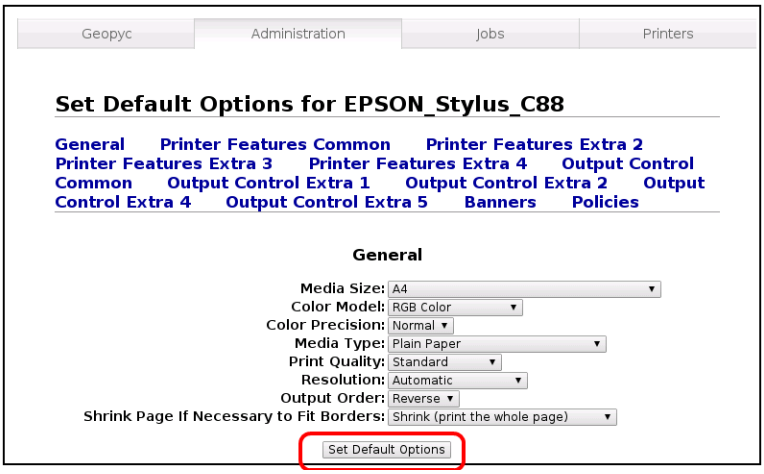
5. Enter information about the printer then click **Continue**.



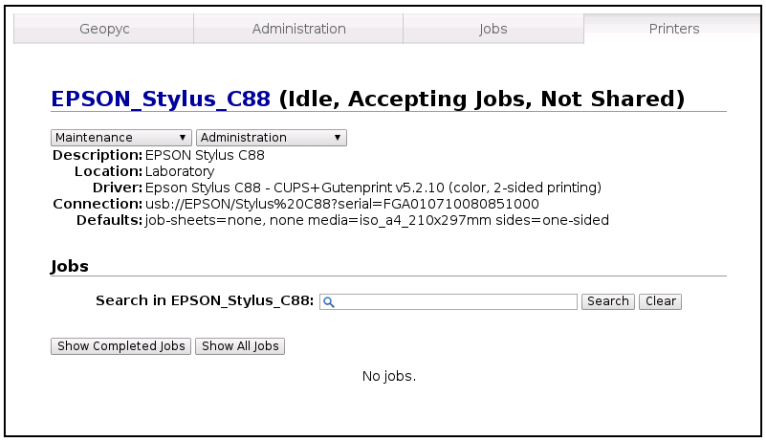
6. Select the printer model from the *Model* drop-down list then click **Add Printer**.



7. Select printer settings from the drop-down lists then tap **Set Default Options**.



8. Tap the *Printers* tab. The installed printer displays.



REFRESH THE BROWSER

If a keyboard is attached or removed from the analyzer, the browser will need to be refreshed.

One method to refresh the browser is to power the analyzer OFF, attach or remove the keyboard, then power the analyzer back ON. Alternatively, use the following instructions.

Attach a keyboard and refresh the browser:

1. With the browser open, attach the keyboard.
2. Press **F5** or **Ctrl+R** on the attached keyboard. When the browser completes the refresh process, the virtual keyboard will be disabled and the attached keyboard can be used.

Remove the keyboard and refresh the browser:

1. With the browser open, press **Ctrl+W** on the attached keyboard.
2. Remove the keyboard before the browser refresh process completes. When the browser completes the refresh process, the virtual keyboard can be used.

CLEAN THE ANALYZER

The exterior casing of the analyzer may be cleaned using a clean cloth dampened with isopropyl alcohol (IPA), a mild detergent, or a 3% hydrogen peroxide solution. Do not use any type of abrasive cleaner.

Do not allow liquid to penetrate the casing of the analyzer. Doing so could result in damage to the unit.

TROUBLESHOOTING

See also:

- *Instrument Status on page 1 - 5*
- *Maintenance on page 6 - 1*

Log in to your customer portal to access error messages. Parts and accessories can be found online at www.Micromeritics.com.

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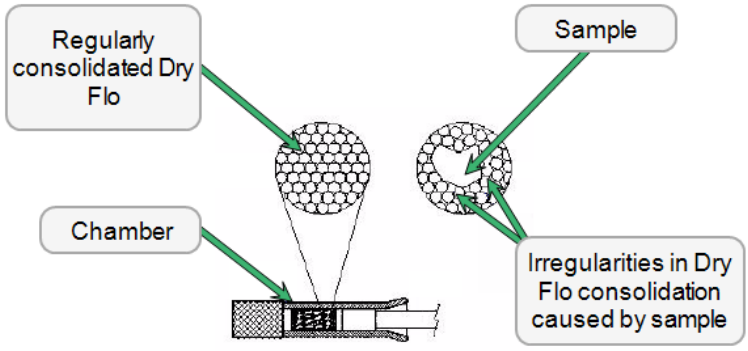
A CONVERSION FACTOR

To calculate the volume of the chamber contents, the analyzer converts displacement data to volume data using a conversion factor. The conversion factors are based on the geometry of the chamber and are adjusted to account for the consolidation of the Dry Flo and the friction of the plunger's movement. Log in to your customer portal to access the Calculations document.

Adjusted Conversion Factors

Chamber Diameter (Internal) (mm)	Conversion Factor (adjusted) cm^3/mm)
12.7	0.1284
19.1	0.2907
25.4	0.5153
38.1	1.1492
50.8	2.373



The conversion factors in the table are average volumes representative of many types of materials when consolidated with Dry Flo. However, the irregularities of the sample's surface and shape may create slight irregularities in the consolidation of the Dry Flo. The accuracy of data decreases if these irregularities are not compensated.

The conversion factor can be calibrated to reflect the irregularities of the sample by performing a calibration run. After performing a calibration run, the calibrated conversion factor can be used during other runs, so that analysis data are adjusted for the way the sample affects the Dry Flo.

- For best results, perform several calibration runs for a given sample type. Discard any extreme results. Use the average of the resulting calibrated conversion factors when analyzing samples of this type.
- Conversion factors are specific to each chamber. A conversion factor calculated for one chamber should not be used for runs with another chamber.

To maximize accuracy, it is strongly recommended to calculate the conversion factor by performing a calibration run. The conversion factor from the table can be used, however the results will not be as accurate as performing a calibration run.

B DISPLACEMENT VOLUME

To calculate the envelope density of a sample, the analyzer first determines its envelope volume. A quantity of Dry Flo is placed in the sample chamber and the medium's volume is measured (called a blank run). A sample is then placed in the chamber with the medium, and the volume is measured again (a sample run). Because Dry Flo does not enter the sample's pores, the difference between the two measurements is the displacement volume of the sample including that of its pores (the envelope volume). The analyzer then uses the envelope volume and the sample's weight to calculate its envelope density.

Irregularly shaped samples and multiple samples may be accurately analyzed because Dry Flo basically conforms to the contours of surfaces. However, no dry-fluid medium can conform to an object as perfectly as a nonwetting liquid, nor can it respond equally to all types of surface irregularities. With agitation, however, it does respond reproducibly. The analyzer compensates for irregularities in the consolidation of the Dry Flo by allowing calibration with an object of known properties that is similar to the sample in size and shape.

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C DRY FLO

Dry Flo was carefully formulated to produce accurate results without harming the analyzer. Use of any other medium with the analyzer may give inaccurate results or damage the plunger seal, and could invalidate the warranty of the analyzer.

Dry Flo is made of tiny, rigid beads and a small amount of dry lubricant. It can be handled safely with a minimum of equipment. Dry Flo flows freely over surfaces and readily shakes or brushes off most objects unless the objects are wet or sticky. Dry Flo can be handled and measured with ordinary laboratory utensils — such as funnels, scoops, and beakers — made of metal, plastic, paper, glass, or other materials. Utensils must be clean and dry. Use isopropyl alcohol to clean the utensils.

Dry Flo is minimally contaminating, and most samples can be used in other tests after a light shaking or brushing. Should surface roughness trap a few beads, the effect on subsequent testing or use is negligible in most cases.

Dry Flo should be handled with care to avoid creating dust while breathing. Gloves, protective clothing, and protective glasses should be worn when handling Dry Flo.

Dry Flo is not harmful to skin, however residue from Dry Flo may remain on surfaces and may mark or stain fabrics or paper.

HOW TO HANDLE DRY FLO

- Use a spoon or scoop to move small amounts of Dry Flo from one container to another.
- Use soap and water to clean residue off hands.
- For consistent results, shake the bottle of Dry Flo periodically to remix the contents.
- Pour Dry Flo gently to avoid splashing (use a funnel to facilitate pouring). Do not drop samples into the medium; instead, slide them gently down the side of the chamber.
- Use a soft paintbrush to remove clinging particles of Dry Flo from surfaces.
- Use a sieve to recover samples after analysis. A 75 mm diameter sieve with 350 to 500 mm openings retains the sample and allows the Dry Flo to pass through freely. A sieve pan and sieve are included in the accessories.
- Dry Flo sometimes becomes compacted during analysis. Shake the chamber / plunger assembly to loosen the Dry Flo.

Brush away any Dry Flo clinging to the bottom of the chamber or the top of the plunger to ensure proper mounting on the analyzer. Because the accuracy of the GeoPyc's calculations relies on precise measurements of the distance traveled by the plunger, debris trapped between the chamber / plunger and the analyzer can affect results.

- Discard used Dry Flo since small amounts of lubricant are lost during analysis. It is possible to reuse Dry Flo, but high-precision results may not be achieved.

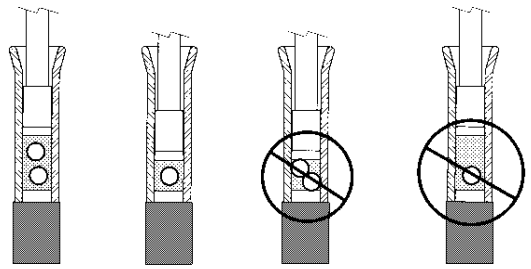
The analyzer comes equipped with a rubber mat to catch Dry Flo that may spill onto the platform beneath the analysis chamber.

Amount of Dry Flo to Use

These guidelines provide a general idea of how to estimate the amount of Dry Flo to use. There is no exact or specific amount of Dry Flo that is correct for any sample.

Use enough Dry Flo to surround the sample or calibration object on all sides. There must be sufficient Dry Flo to surround the object to become consolidated during the analysis process. Accuracy is impossible when using an insufficient amount of Dry Flo (the sample bed cannot be consolidated) and reduced when there is too much (relative change is not maximized).

Ideally, the final bed of sample plus Dry Flo should consist of approximately 1/3 sample and 2/3 Dry Flo. However, at minimum, the sample must constitute at least 1/4 of the final bed. This illustration shows how to determine the appropriate amount of Dry Flo.



Method A

Place the sample in the chamber and push the plunger into the chamber until it touches the sample. Mark the level of the plunger seal with a grease pencil or tape. Remove the plunger, then the sample, and:

- For single objects, fill the chamber with Dry Flo to the marked line.
- For multiple small objects, fill the chamber with Dry Flo to the marked line, then double this amount. If adding sufficient Dry Flo causes the sample plus medium bed to exceed the maximum length specified in the ***Chamber Parameters Table on the facing page*** use a smaller amount of sample .

Method B

Place the sample in the chamber. Fill with Dry Flo until the sample is covered with Dry Flo. Ensure there is sufficient Dry Flo to completely surround the sample during analysis. Use a sieve to recover the sample. Return the Dry Flo from the sieve pan to the chamber.

To Load the Chamber

Use one of the methods above to load the chamber with Dry Flo. Load the sample object and slide the plunger part way into the chamber. Shake the chamber to help the object become surrounded by the Dry Flo.

Push the plunger into the chamber until visible air space is gone. Repeat shaking the chamber and adjusting the plunger as needed. The object should no longer be visible. If the object is still visible, or if it appears to be touching either the plunger or the chamber bottom, then the amount of Dry Flo is not sufficient.

Avoid final sample plus Dry Flo beds that are significantly longer than their diameter. If the samples are long and thin, analyze several of them in a larger chamber to avoid a long, thin Dry Flo bed.

The *Chamber Parameters* table provides guidelines to help in loading the chamber with an appropriate amount of Dry Flo.

Chamber Parameters Table

Internal Chamber Diameter (mm)	Envelope Volumes Best Measured ($cm^{3)}$	Maximum Length of Medium and Sample when Consolidated (mm)
12.7	0.3 - 0.8	19
19.1	0.8 - 2.4	28
25.4	2.4 - 5.3	38
38.1	5.3 - 13	50
50.8	13 - 26	55

WEIGH DRY FLO

When storing blank data, the quantity of Dry Flo used in each run must be entered. This quantity is called the *Chamber / Medium weight*. This step is not necessary when performing a single blank run embedded in a sample or calibration run.

Accurately weighing the Dry Flo is critical for obtaining acceptable results using stored blank data. A precision analytical balance accurate to 1 mg is required. If this level of accuracy cannot be achieved, the technique of using stored blank data may not be satisfactory.

It is recommended weighing Dry Flo in the analysis chamber. This reduces the possibility of error in transferring Dry Flo from a weighing container to the chamber.

If it is necessary to transfer the Dry Flo from a weighing container to the chamber, ensure that no Dry Flo is lost in the process. Avoid splashing. Any Dry Flo clinging to the weighing container or flared end of the chamber must be brushed back into the chamber. A small amount of Dry Flo residue remaining in the measuring container will affect analysis results.

When prompted, enter the Chamber / Medium weight. Enter either the weight of the chamber plus Dry Flo or the weight of the Dry Flo only. Including or excluding the chamber's weight does not affect analysis calculations, however the same method for both the blank and sample runs for a given sample must be used. If, for example, include the chamber's weight in the blank run, then include the chamber's weight in the sample run.

DRY FLO BED

If too little sample is used, poor reproducibility of results will occur. The instrument is unable to distinguish between a Dry Flo bed with sample and one without sample when the sample volume occupies too small a percentage of the total bed. For optimum performance, the sample should occupy a minimum of 20% of the Dry Flo bed. A larger percentage of sample is preferable as long as it can be surrounded sufficiently by Dry Flo.

Each sample cell requires calibration without Dry Flo or sample to determine the *zero bed* volume. This information is stored internally and thereafter the percent sample volume is reported with each analysis. This number can then be used to optimize the quantity of sample necessary to meet a specific reproducibility criteria.

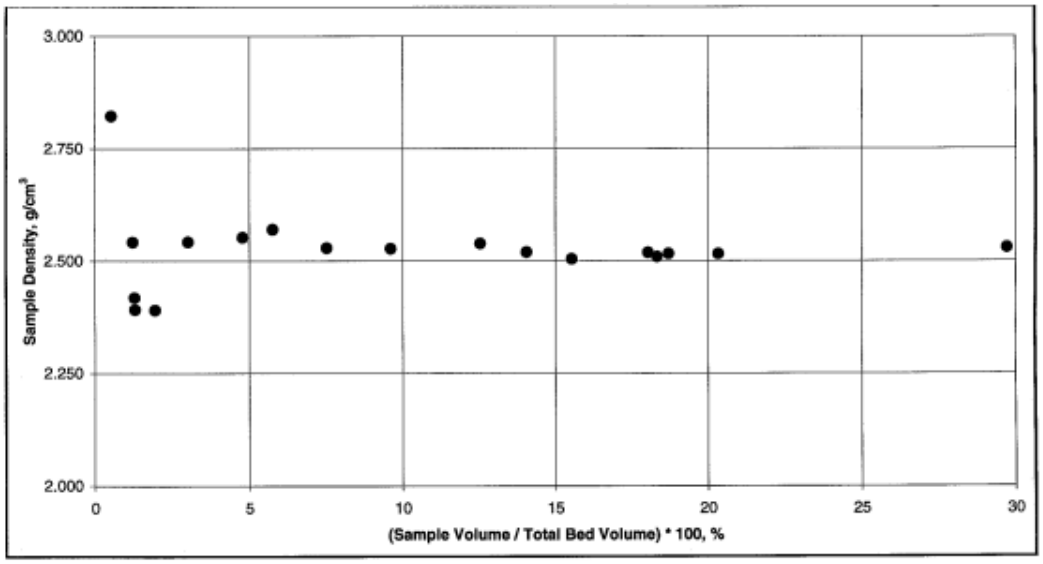
The following table and graph show the typical effect of sample quantity on the reproducibility of results. The sample used in this example was composed of varying quantities of nonporous glass spheres 6 mm in diameter. The analyses were conducted using a 25.4 mm diameter sample cell. The absolute density of the spheres was 2.5202 g/cm3 as measured by Micromeritics' AccuPyc 1330. Being nonporous, the envelope density of the spheres was also 2.5202 g/cm^3. As shown, this value is achieved within 1% when the sample occupies more than 7.5% of the total bed volume. Other materials will exhibit similar behavior but may not follow this exact pattern.

Typical Effect of Sample Quantity on the Reproducibility of Results

% Sample Volume	Envelope Density	% Error
0.537	2.8223	+11.99
1.228	2.5416	+0.85
1.284	2.4177	-4.07
1.299	2.3913	-5.11
1.944	2.3903	-5.15
3.012	2.5419	+0.86
4.782	2.5518	+1.25
5.761	2.5699	+1.97
7.523	2.5288	+0.34
9.616	2.5269	+0.27
12.547	2.5386	+0.73
14.063	2.5193	-0.04
15.538	2.5041	-0.64
18.039	2.5184	-0.07

Typical Effect of Sample Quantity on the Reproducibility of Results (continued)

% Sample Volume	Envelope Density	% Error
18.335	2.5089	-0.45
18.706	2.5155	-0.19
20.333	2.5153	-0.19
29.708	2.5289	+0.35



D ENVELOPE DENSITY

REPRODUCIBILITY

Achieving high reproducibility in any analytical measurement often requires performing tests in an identical manner using a single instrument, fixed instrument parameters, and the same quantity of test material. This is particularly true with the GeoPyc technique because it is very sensitive to procedural variations and deviations in test parameters. Reproducibility of results of approximately ±1.0% can be expected when parameters are controlled to the fullest extent possible. A description of these parameters and the criteria that must be observed to achieve this level are described below.

Envelope density is calculated from specimen mass and envelope volume, that is, volume including both open and closed pores. This volume is measured using Dry Flo, which is confined in a cylindrical sample chamber having one of five diameters from 12.7 mm (0.5 in.) to 50.8 mm (2.0 in.). The volume of the specimen is determined by subtracting the volume of consolidated Dry Flo (blank run) in a sample chamber from the volume of the same consolidated Dry Flo in the same chamber with the specimen included (test run). The medium bed is agitated through rotation and vibration, and the consolidation force is gradually increased to the same set value in both phases of a test.

1. The first criterion for a GeoPyc analysis is that the Dry Flo consolidate identically in the blank and test runs. Repeated testing of the medium alone has shown that, almost without exception, it actually consolidates with a reproducibility of ±0.34% or better in all size sample chambers for bed depths of one-half to twice the chamber diameter. Somewhat better reproducibility of ±0.25% is typically achieved when the bed depth is restricted to approximately the chamber diameter. In any event, between one-third and one-quarter of the minimal overall error of ±1.0% is due to the nonideal behavior of Dry Flo.

   Guideline 1. Start an analysis with a Dry Flo bed depth a little less than the chamber diameter.

2. Sample quantity plays the most significant role in reproducibility. Obviously, the specimen extracted from a larger quantity of material must be of sufficient quantity to be representative of the whole. The quantity of sample determines the minimum sample chamber size required for analysis. A chamber should be selected in which the sample constitutes a minimum of 20% of the total sample plus Dry Flo volume when consolidated. A larger percentage of sample is preferable; however, keep in mind that the sample must always be surrounded sufficiently by Dry Flo.

   Every envelope density result is derived from the difference in two volumes, the consolidated Dry Flo and the consolidated Dry Flo with sample. That difference should be as large as possible simply for mathematical significance.

For example, in one series of tests on a typical granular product where the product volume relative to the bed volume was varied from 6.9 to 41.7%, there was almost a 9.0% variability in envelope density. At the highest percentage, the sample quantity may have been sufficient for bridging of sample pieces to interfere with medium consolidation. At the lower percentage, small errors in consolidation were magnified in the difference value. However, the envelope volume within a ±1.3% error band was registered when the sample volume ranged from 30 to 35%. The current program for the GeoPyc automatically calculates the sample volume percentage. This percentage is a useful guide to optimum performance and should always be considered when assessing the validity of results.

Guideline 2. Select sample chamber dimensions, Dry Flo volume, and specimen quantity to yield a sample volume percentage of at least 20%.

3. The error band was reduced to ±0.95% when another series of tests was run with the material used in the above guideline and both Dry Flo and sample weights were held constant to the third decimal place. The reported sample-to-bed volume varied only between 32.1 and 33.4% in this case. Such control is not practical or even feasible in many instances, but this technique should be considered when possible.

   Guideline 3. Maintain constant all parameters susceptible to control for optimum reproducibility.

4. Both the blank and test steps of an envelope density determination consist of an equal number of preparation and analysis cycles.

   Preparation cycles are unrecorded, repetitious, agitation and consolidation attempts intended to orient the Dry Flo grains and the specimen into a uniformly mixed bed. Analysis cycles follow the preparation cycles and yield statistical information on consolidated volumes. The bed is expected to become more and more consolidated during the preparation cycles, but little or no consistent increase or decrease in value should be evident in the analysis cycles. Diminishing information can be gleaned once the cycles exceed a certain number. The results presented above were primarily obtained with 10 preparation and 5 analysis cycles. Some specimens require more, but fewer are adequate in other cases; 10 preparation and 5 analysis cycles are good starting numbers.

   Guideline 4. Choose the number of preparation and analysis cycles such that little or no consistent increase or decrease in value is revealed by the recorded data.

ACCURACY

Follow the guidelines for reproducibility (see ***Reproducibility on the previous page***). Those guidelines must be followed, in conjunction with the guidelines listed below, to produce accurate envelope density measurements.

1. Sample shape influences GeoPyc results, but the effect cannot be rigorously quantified because shape itself is subject to infinite variation. The GeoPyc handles this problem by calibration. Two calibration values for each sample chamber, (conversion factors), are noted in the operator's manual included with the GeoPyc.

The first conversion factor (calculated factor) is derived from geometry and mechanical couplings and relates the plunger movement to chamber volume as if there were no sample shape influence. The second factor (adjusted factor) is modified to include an average shape influence experimentally determined from many different shapes. Neither is likely to apply precisely to any particular specimen. True calibration for shape can be achieved only when the predetermined envelope density of a representative specimen of the material in question is used.

The representative specimen preferably is one from an evaluation procedure that was being followed before GeoPyc introduction. GeoPyc results can be expected then to track prior records. A completely nonporous specimen of the same shape as the material in question affords a degree of calibration but, because it is nonporous, cannot have the same surface texture and cannot be as satisfactory. Because in the final analysis the GeoPyc operates best as a comparison device, there is no real substitute for a truly representative specimen for calibration. A GeoPyc operator should set aside enough of the selected calibration material to be able to recheck the calibration from time to time.

Guideline 1. Select for calibration a quantity of the material in question and determine its envelope density by the prior test procedure or some other method.

2. Calibration itself will only be reproducible to the degree the guidelines given earlier for reproducibility are followed. Accordingly, the weight of the representative sample, the quantity of Dry Flo, and the sample chamber size should be selected on the basis of the amount of sample to be used later. Also, all calibration tests should be made with the same consolidation force and the same number of preparation and test cycles to be used in analyses.

   Guideline 2. Conduct calibration tests using parameters identical to those to be used in analyses.

3. Finally, a number of calibration tests should be made and the median selected as the conversion factor.

   Guideline 3. Use the median value from a number of calibration tests as the conversion factor for the material to be analyzed.

Blank Page

E MEASUREMENT METHOD

The distance the plunger moves into the chamber is the actual measurement with which calculations are made. This distance is measured by the number of steps moved by the stepper motor that drives the plunger. The plunger moves along a screw; the diameter and threading of the screw enter into the calculations. Log in to your customer portal to access the Calculations document.

Blank Page

F ZERO DEPTH OF A SAMPLE CHAMBER

GeoPyc > [select a Zero Depth SOP from the drop-down list]

The analyzer determines the distance the plunger moves into an empty sample chamber to obtain the zero depth of the chamber. This value is used after an analysis to calculate the percent of sample volume in the sample bed. For best results, at least 25% of the bed volume should be actual sample.

The analyzer will store up to five sets of zero depth data. When performing a sample run, the analyzer displays a prompt to enter the number of the zero depth data set to be used.

THE PERCENT SAMPLE VOLUME

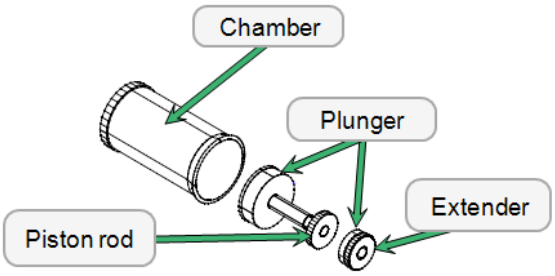
Sample quantity plays a significant role in reproducibility. A specimen extracted from a larger quantity of material must be of sufficient quantity to be representative of the whole. The specimen used determines the minimum sample chamber size required for analysis. A sample chamber should be selected in which the sample will constitute approximately 25% of the sample bed (sample plus Dry Flo).

When performing the zero depth run, the zero depth of the sample chamber is determined and recorded. The analyzer uses this value to calculate automatically the percent of sample volume when performing a sample run.

The sample volume percent is included in the *Envelope Density Report*. View this report to ensure that the sample bed contains an adequate amount of sample to produce valid results.

PISTON COUPLING EXTENDERS

Piston coupling extenders are required when performing zero depth runs. The piston coupling extender screws onto the standard piston rod between the piston and the coupling.



G T.A.P. DENSITY

SOP (Standard Operating Procedures) on page 4 - 1

T.A.P. (Transverse Axial Pressure) density is an optional software upgrade.

To measure bulk density, the GeoPyc consolidates the sample within a cylindrical chamber until a specific force is achieved. A measurement is taken at that point, and subtracted from blank (empty chamber) data stored in the GeoPyc to yield the sample's bulk volume. This volume and the sample's weight are used to calculate bulk density. When you begin a bulk density analysis with the GeoPyc, you must enter the force with which you wish the sample to be consolidated at the time the measurement is taken.

The GeoPyc allows the use of either force (in newtons) or pressure (in newtons/cm2) as the unit for measuring consolidation of the sample. In this note, pressure is used, but all information is applicable when force is used.

A wide range of pressures can be used. If a small pressure is entered, the sample may simply be consolidated loosely. If a great pressure is used, the sample may be thoroughly consolidated, eliminating much of the void space among the particles or granules. Still further consolidation may cause individual sample particles to collapse, shatter, or be distorted, especially if the sample is fragile or soft. In some instances, the purpose of the experiment may be to observe the sample's performance and quantify its density under a range of pressures. For example, such a study might be useful in packaging and shipping bulk granular products.

In many cases, though, the purpose of the experiment is to determine the sample's bulk density, as compared to historical product data obtained using the older *tap* density method[1)] . In such cases, it is necessary to enter the level of pressure that corresponds to the degree of sample compaction at which the *tap* density was measured. Tap density instruments do compact the sample to a specific degree, but —unlike the GeoPyc— they may not provide any way to quantify that degree.

1) ASTM Standard Test Method B 527-81, Tap Density of Powders of Refractory Metals and Compounds by Tap-Pak Volumeter.

Recommended Force or Pressure for Emulating Tap Density

Internal Chamber Diameter (mm)	Recommended Pressure Range for Emulating Tap Density (N/cm^2)	Recommended Force Range for Emulating Tap Density (newtons)
12.7 *	*These chambers are not recommended for emulating tap density. They are very useful, however, for assessing sample compaction at higher pressures.	
19.1 *		
25.4	1 to 3	5 to 15
38.1		11 to 33
50.8		20 to 60

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