GEOPYC®

ENVELOPE DENSITY ANALYZER

TRANSDUCER CALIBRATION USER GUIDE

136-42808-01
Dec 2016
(Rev A)

CONTACT US

Micromeritics Instrument Corporation

4356 Communications Drive
Norcross, GA / USA / 30093-2901
Phone: 1-770-662-3696
Fax: 1-770-662-3696

www.Micromeritics.com

U.S. Inquiries

U.S. Sales Phone: 1-770-662-3636

USSales@Micromeritics.com

Quotes, Orders, and Customer Satisfaction

Customer Service Phone: 1-770-662-3636

Orders@Micromeritics.com

U.S. Instrument Service Department

U.S. Service Department Phone: 1-770-662-3666

Service.Helpdesk@Micromeritics.com

Micromeritics Scientific Services

Customer Support Portal

http://techsupport.micromeritics.com/portal

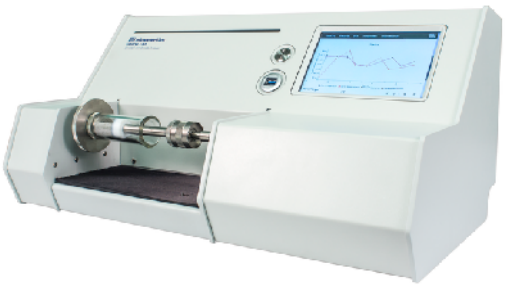
micromeritics®

Table of Contents

Blank Page

1 INTRODUCTION

GeoPyc 1360



GeoPyc 1365

This User Guide contains information for:

- *Tool Assembly and Installation on the next page*
- *Force Transducer Calibration for the 1360 GeoPyc on page 2 - 1*
- *Transducer Calibration for the 1365 GeoPyc on page 3 - 1*

KIT CONTENTS

Tools are packed in a wooden case. Return the tools to the case after each use for safekeeping. Notify Micromeritics immediately if the kit is missing any of the following items:

- tool for calibrating the force transducer and verifying its accuracy
- tool for verifying the displacement measurement
- instructions for performing each procedure

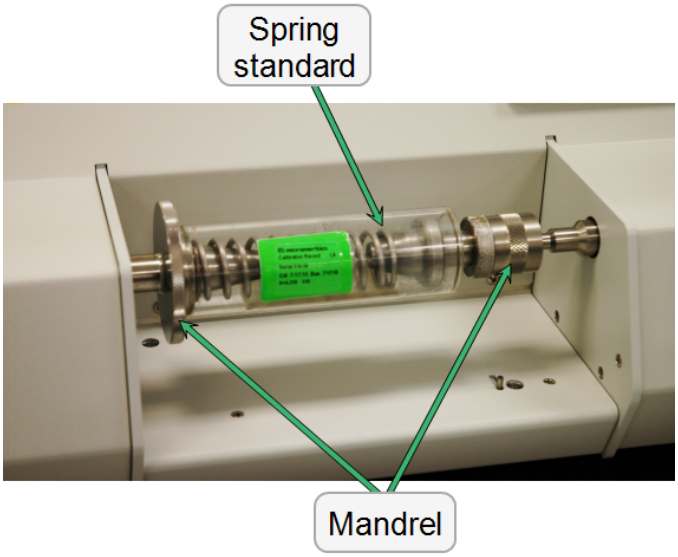
CONVENTIONS USED IN THIS MANUAL

NOTE - Notes contain important information applicable to the topic.

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

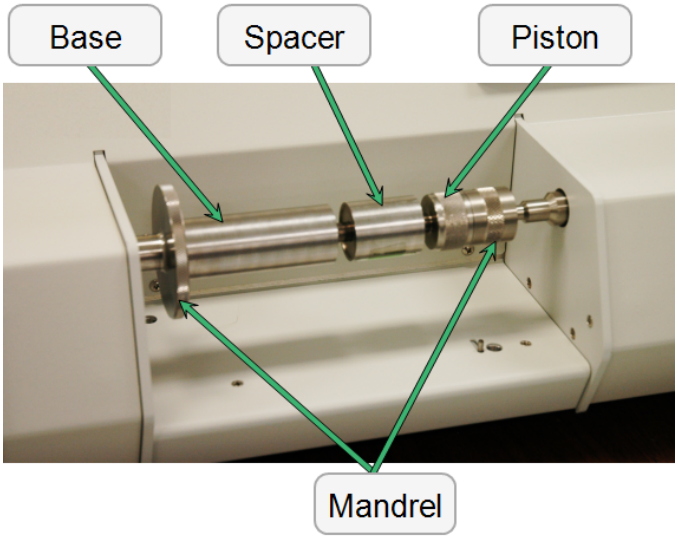
Tool Assembly and Installation

Force Transducer Calibration Tool



1. Attach the base of the force calibration tool to the face plate (left side threaded mandrel). Tighten firmly
2. Attach the spring plunger of the force calibration tool to the cell coupling (right side threaded mandrel). Tighten firmly.

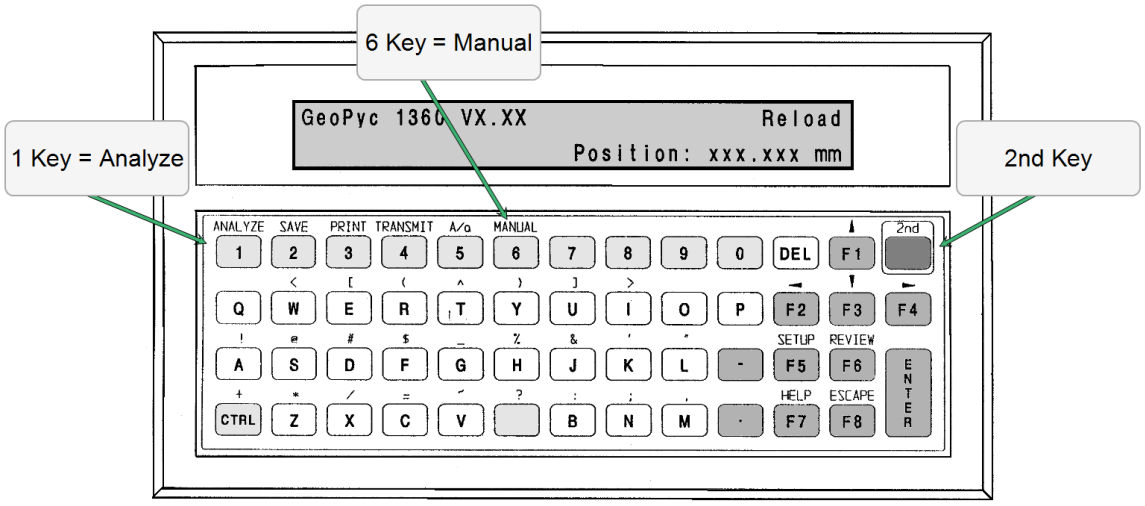
Displacement Verification Tool



1. If using a spacer, insert the spacer onto the piston, otherwise skip this step.
2. Insert the piston into the base.
3. Attach the base to the left threaded mandrel and the piston to the right threaded mandrel.
4. Tighten firmly.

2 Force Transducer Calibration for the 1360 GeoPyc

Modes of Operation



CAUTION

Manual Mode is intended for diagnostic procedures only. To avoid damage to the analyzer, do not perform manual operations when a chamber or plunger is mounted on the analyzer.

Modes of Operation

Mode	Used to....	How to Access
Analyze	• perform analyses • verify the displacement measurement of the analyzer	press the **2nd** key, then press the **1** [Analyze] key
Manual	• run maintenance and service diagnostic procedures • calibrate and verify the force transducer	press the **2nd** key, then press the **6** [Manual] key

FORCE TRANSDUCER CALIBRATION

1. Install the force calibration tool. See *Tool Assembly and Installation on page 1 - 2*.
2. Display the *Reload* prompt.
3. Access *Manual* mode (press the **2nd** key, then press the **6** [Manual] key).
4. Perform the tasks associated with each prompt as they are displayed.

Calibrate the Force Transducer Prompts

MANUAL Prompt	Tasks
Agitator: Off Plunger: Off Home **Force: [xxx.xx] N Position: xxx.xx mm**	Press **ENTER**.
Which operation? Manual **Calibrate Force Transducer**	Use the **F2** or **F4** [left or right] arrow key to navigate to *Calibrate Force Transducer*. Press **ENTER**.
Spring Constant: Manual **0.00000 N/mm**	Enter the value of the spring constant for the force calibration tool being used. Press **Enter**.
Remove chamber from instrument. **[ESC] to cancel or [Enter] to continue**	Remove the chamber (if installed). Press **ENTER**.
Please mount spring standard. **[ESC] to cancel or [Enter] to continue**	Install the calibration assembly without the spacer. Press **ENTER**.
Agitator: Off Plunger: Off Home **Force: [xxx.xx] N Position: xxx.xx mm**	Press **ENTER**. The analyzer pushes the piston into the force calibration tool to compress the spring. The LCD displays increasing *Force* and *Position* readings. The piston then incrementally decompresses the spring. The LCD then displays decreasing *Force* and *Position* readings. When the piston reaches the home position, calibration is compete and the display returns to *Manual* mode.
Which operation? Manual **Print Calibration Force Report**	Press **ENTER** to generate the report. Verify that the: • *Slope* has been calculated. Typically, this value is between 0.005 and 0.010; however, this value is not critical. • *Standard Deviation* is between 0.0 and 4.0. • Number of counts deviation at home position is

Calibrate the Force Transducer Prompts (continued)

MANUAL Prompt	Tasks
	zero (± 5).
GeoPyc 1360 Vx.xx Reload **Position: xxx.xx mm**	Press **ESCAPE** to return to the *Reload* prompt. Remove the calibration assembly.

FORCE CALIBRATION AND VERIFICATION OF ACCURACY

1. Install the force calibration tool. See *Tool Assembly and Installation on page 1 - 2*.
2. Display the *Reload* prompt.
3. Access *Manual* mode(press the **2nd** key, then press the **6** [Manual] key).
4. Use the following table to perform the tasks associated with each prompt as they are displayed, and use a copy of the *GeoPyc 1360 Force Verification Worksheet on page 2 - 6* to record the task results on the indicated line number on the worksheet.

Force Transducer - Verify Accuracy

Manual Prompt	Tasks
Agitator: Off Plunger: Off Home **Force: [xxx.xx] N Position: xxx.xx mm**	Press **ENTER**.
Which operation? Manual **Move the number of steps (+ or -)**	Use the right arrow (**F4**) key to select *Move Number of Steps (+ or -)*. Press **ENTER**.
Steps to move: Manual **17,200 steps**	Enter *17,200.* Press **ENTER**. The mechanism will move to the left, then stop.
Agitator: Off Plunger: Off Home **Force: [xxx.xx] N Position: xxx.xx mm**	Record the *Force* value for 17,200 steps (Line 1). Press **ENTER**.
Which operation? Manual **Move the number of steps (+ or -)**	Use the right arrow (**F4**) key to select *Move Number of Steps (+ or -)*. Press **ENTER**.
Steps to move: Manual **-200 steps**	Enter *-200.* Press **ENTER**. The mechanism will move to the right, then stop.
Agitator: Off Plunger: Off Home **Force: [xxx.xx] N Position: xxx.xx mm**	Record the *Force* value for 17,000 steps (Line 2). Press **ENTER**.
Which operation? Manual **Move the number of steps (+ or -)**	Use the right arrow (**F4**) key to select *Move Number of Steps (+ or -)*. Press **ENTER**.
Steps to move: **-9000 steps**	Enter *-9000.* Press **ENTER**. The mechanism will move to the right, then stop.
Agitator: Off Plunger: Off Home **Force: [xxx.xx] N Position: xxx.xx mm**	Record the *Force* value for 8,000 steps (Line 3). Press **ENTER**.
Which operation? Manual **Move to Home**	Use the left arrow (**F2**) key to select *Move to Home*. Press **ENTER**.
Agitator: Off Plunger: Off Home **Force: [xxx.xx] N Position: xxx.xx mm**	Press **ENTER**.
Which operation? Manual **Move the number of steps (+ or -)**	Use the right arrow (**F4**) key to select *Move Number of Steps (+ or -)*. Press **ENTER**.

5. Repeat the steps for obtaining the *Force* value for 17,200 steps, 17,000 steps, and 8,000 steps three more times. Record the values in the Run #2, #3, and #4 columns.
6. After all four data sets have been entered, press **ESCAPE** to return to the *Reload* prompt.
7. Calculate the difference between the value of *Force at 17,000* steps (Line 2) and the value of *Force at 8,000* steps (Line 3). Enter the difference in the *Force Difference* field (Line 4).
8. Perform the calculation for each run and record the results for each run.
9. For each run, divide the *Force Difference* (Line 4) by 23.8125 mm. Record the result as the *Calibration Factor* (Line 5).
10. Add the four values recorded on line 5 (*Calculation Factor*) then divide the sum by 4 (number of runs). Record the result as the *Average Calibration Factor.*

The maximum allowable deviation for a *Calibration Factor* is ± 5% of the *Average Calibration Factor*.

Average Calibration Factor × 1.05 = Maximum Allowable Upper Limit
Average Calibration Factor × 0.95 = Maximum Allowable Lower Limit

The *Calibration Factor* for each run (Line 5) must be within the maximum allowable upper and lower limits.

GeoPyc 1360 Force Verification Worksheet

Instrument Serial Number: _____

Transducer Calibration Tool Serial Number: _____

Transducer Calibration Tool K Factor: _____

Line Number		Run #1	Run #2	Run #3	Run #4
1	Force at 17,200 steps				
2	Force at 17,000 steps				
3	Force at 8,000 steps				
4	Force difference (line 2 - line 3)				
5	Calibration Factor K (line 4 ÷ 23.8125)				

Total Calibration Factors (add the 4 values on line 5) _____

Average Calibration Factor (divide total of Calibration Factors by 4) _____

The Calibration Factor for each of the four runs must be within ± 5% of the Average Calibration Factor.

Signed: _____

Date: _____

FORCE CALIBRATION REPORT EXAMPLE

GeoPyc 1360 VX.XX
Force Calibration Report

Instrument: MAL
Date: 1/06/2002
Time: 16:07:32

Spring Constant: 4.3050 N/mm

Point #	Displacement Counts	Spring Force N	Force Sensor Reading
1	17027	126.3	49775
2	16283	117.7	48736
3	15539	109.1	47695
4	14795	100.8	46685
5	14051	92.2	45641
6	13307	83.6	44598
7	12563	75.1	43570
8	11819	66.7	42552
9	11075	58.4	41549
10	10331	50.1	40535

Slope (force sensor calibration factor): 0.0082
Standard Deviation: 0.2654
Number of displacement cycles: 6827
Number of counts deviation at home position: 0

Current date and time: 06/03/2002, 10:50:21
Current displacement cycles: 11519

- The *Slope* value is not critical, but is usually between .005 and .01.
- The *Standard Deviation* value must be between 0.0 and 4.0.
- The *Number of counts deviation at home position* value must be 0 (±5).

DISPLACEMENT MEASUREMENT VERIFICATION

1. Install the displacement verification tool without the spacer. See *Tool Assembly and Installation on page 1 - 2*.
2. Display the *Reload* prompt.
3. Access *Analysis* mode (press the **2nd** key, then press the **1** [Analyze] key).
4. Perform the tasks associated with each prompt as they are displayed:

Displacement Measurement Verification Prompts

ANALYZE Prompt	Tasks
Analysis Type? Analyze **Sample**	Press **ENTER**to accept *Sample*.
Sample ID: Analyze **_____**	Enter the length (mm) of the spacer to be used. Press **ENTER**.
Customer ID: Analyze **_____**	[Optional] Enter the customer identification. Press **ENTER**.
Operator ID: Analyze **_____**	Enter the operator identification. Press **ENTER**.
Sample Weight: Analyze **1.00000 g**	Enter *1.0*. Press **ENTER**.
Absolute density: Analyze **0.00000 g/cm^3**	Press **ENTER**to accept the default value of *0.0*.
Which Zero Depth Set? Analyze **Zero Depth Set 0**	Press **ENTER**to accept the default value of *0.0*.
Blank data source? Analyze **Run blank now**	Select *Run blank now*. Press **ENTER**.
Number of cycles: Analyze **10**	Enter *10*. Press **ENTER**.
Consolidation force: Analyze **100.00000 Newtons**	Enter *100*. Press **ENTER**.
Conversion factor: Analyze **1.00000 cm^3/mm**	Enter *1.0*. Press **ENTER**.
Press [Enter] to start sample analysis or [ESC] to cancel	Press **ENTER**.
Blank Cycles 0 of 10 Wt[x]=x.xxx g **Force: [xxx.xx] N Position xxx.xx mm**	The number of compression cycles displays, starting with *Blank cycles 0 of 10*. After 10 cycles (10 of 10), the piston returns to the home position and the operator is prompted to load the sample.

Displacement Measurement Verification Prompts (continued)

ANALYZE Prompt	Tasks
Add sample and press [Enter] to continue to [ESC] to cancel.	Remove the displacement tool. Reassemble and reinstall the displacement tool with the spacer. Press **ENTER**.
Sample Cycles 0 of 10 Wt[x]=x.xxx g **Force: [xxx.xx] N Position xxx.xx mm**	The display updates the number of sample cycles starting with *0 of 10*. After 10 cycles (10 of 10), verification is complete and the piston returns to the home position.
Average volume: xx.xxxxx g/cm^3 **Std. Dev.: xx.xxxxx**	The average volume and standard deviation are displayed. Press **ENTER**to return to the *Reload* position.

5. Press the **2nd** key and the **3** [*Print*] key. Press **ENTER**.
6. Use the arrow keys to select *Report*. Press **ENTER**.
7. Verify the results:
   a. The *Blank Counts* column should display 10 numbers. The difference between the highest and lowest numbers must be no more than 20.
   b. The *Sample Counts* column should display 10 numbers. The difference between the highest and lowest numbers must be no more than 20.
   c. The *Average Envelope Volume* value should be the same as the actual length of the spacer (±0.053).

Although indicated as a volume, the number displayed in this field is actually the *measured length* of the spacer.

ENVELOPE DENSITY REPORT EXAMPLE

GeoPyc 1360 VX.XX
Envelope Density Report

Instrument: MAL
Operator: BPM
Date: 1/06/2002
Time: 16:07:32

Customer: MAL
Sample: 38.1267 SPACER
Absolute Density: 0.0000 g/cm3
Sample Weight: 1.0000 g

Blank Data Set: Internal
Preparation Cycles: 2
Chamber Diameter: 19.1000 mm
Consolidation Force: 100.0000 N
Blank Data Source: Internal
Measured Cycles: 2
Zero Depth: 40.6029 mm
Conversion Factor: 1.0000 cm3/mm

Cycle #	Blank Counts	Sample Counts	Volume cm3	Deviation cm3	Density g/cm3	Deviation g/cm3
1	20994	6584	38.1264	-0.0015	0.0262	0.0000
2	20994	6582	38.1317	0.0037	0.0262	-0.0000
3	20993	6583	38.1264	-0.0015	0.0262	0.0000
4	20995	6583	38.1317	0.0037	0.0262	-0.0000
5	20993	6583	38.1264	-0.0015	0.0262	0.0000
6	20994	6583	38.1291	0.0010	0.0262	-0.0000
7	20994	6583	38.1291	0.0010	0.0262	-0.0000
8	20994	6584	38.1264	-0.0015	0.0262	0.0000
9	20994	6583	38.1291	0.0010	0.0262	-0.0000
10	20993	6584	38.1238	-0.0042	0.0262	0.0000

Average Envelope Volume: 38.1280 cm3
Standard Deviation: 0.0025
Average Envelope Density: 0.0262 g/cm3
Standard Deviation: 0.0000
Specific Pore Volume: 0.0000 cm3/g
Percent Porosity: 0.000 %
Percent Sample Volume: 164.452 %

- The *Average Envelope Volume* field is indicated as a volume. This number is actually the measured length of the spacer. This number must match the known length of the spacer ±0.053 mm.
- In the *Blank Counts* column and the *Sample Counts* column, the difference between the highest value and the lowest value in that column must be 20 or less.

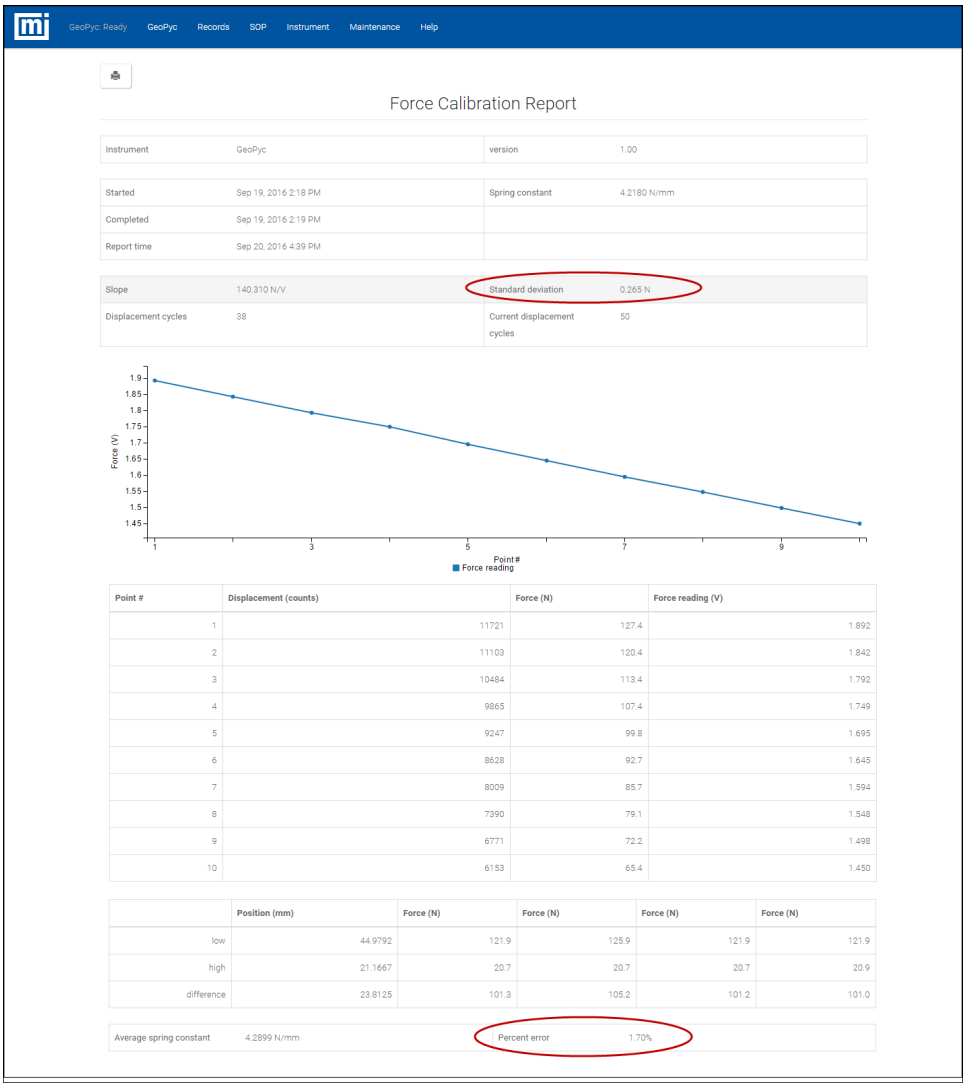
3 TRANSDUCER CALIBRATION FOR THE 1365 GEOPYC

FORCE CALIBRATION AND VERIFICATION OF ACCURACY

The purpose of this test is to calibrate and verify the force transducer.

1. On the main menu, tap *Maintenance*, then tap **ADVANCED**.
2. Select the *Allow force calibration* checkbox. Tap **OK**.
3. On the main menu, tap *GeoPyc*.
4. Tap the *SOP* drop-down box and select *Force Calibration*.
5. In the *Spring Constant* field, enter the spring constant located on the label of the force calibration tool.
6. Install the force calibration tool. See ***Tool Assembly and Installation on page 1 - 2***.
7. Tap **START**.
8. Upon completion of the analysis, tap *Records* on the main menu.
9. Select *Force Calibration* to view the report.
10. On the report, verify that the:
    a. *Standard Deviation* is between 0.0 and 4.0, and
    b. *Percent Error* field is within ±5%.
11. To remove the *Force Calibration* option from the SOP drop-down list:
    a. On the main menu, tap *Maintenance*, then tap **ADVANCED**.
    b. Select the *Allow force calibration* option to remove the checkmark. Tap **OK**.

FORCE CALIBRATION REPORT EXAMPLE



GeoPyc: Ready GeoPyc Records SOP Instrument Maintenance Help

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%

- The *Standard Deviation* value must be between 0.0 and 4.0.
- Ensure the *Percent Error* field is within ±5%.

DISPLACEMENT MEASUREMENT VERIFICATION

The purpose of this test is to check the accuracy of plunger position readings.

1. Create a displacement verification SOP. This is required once per analyzer. If the SOP already exists, skip to Step 2.
   a. On the menu, tap *SOP*.
   b. Tap + to create a new SOP. Complete the fields using the following table:

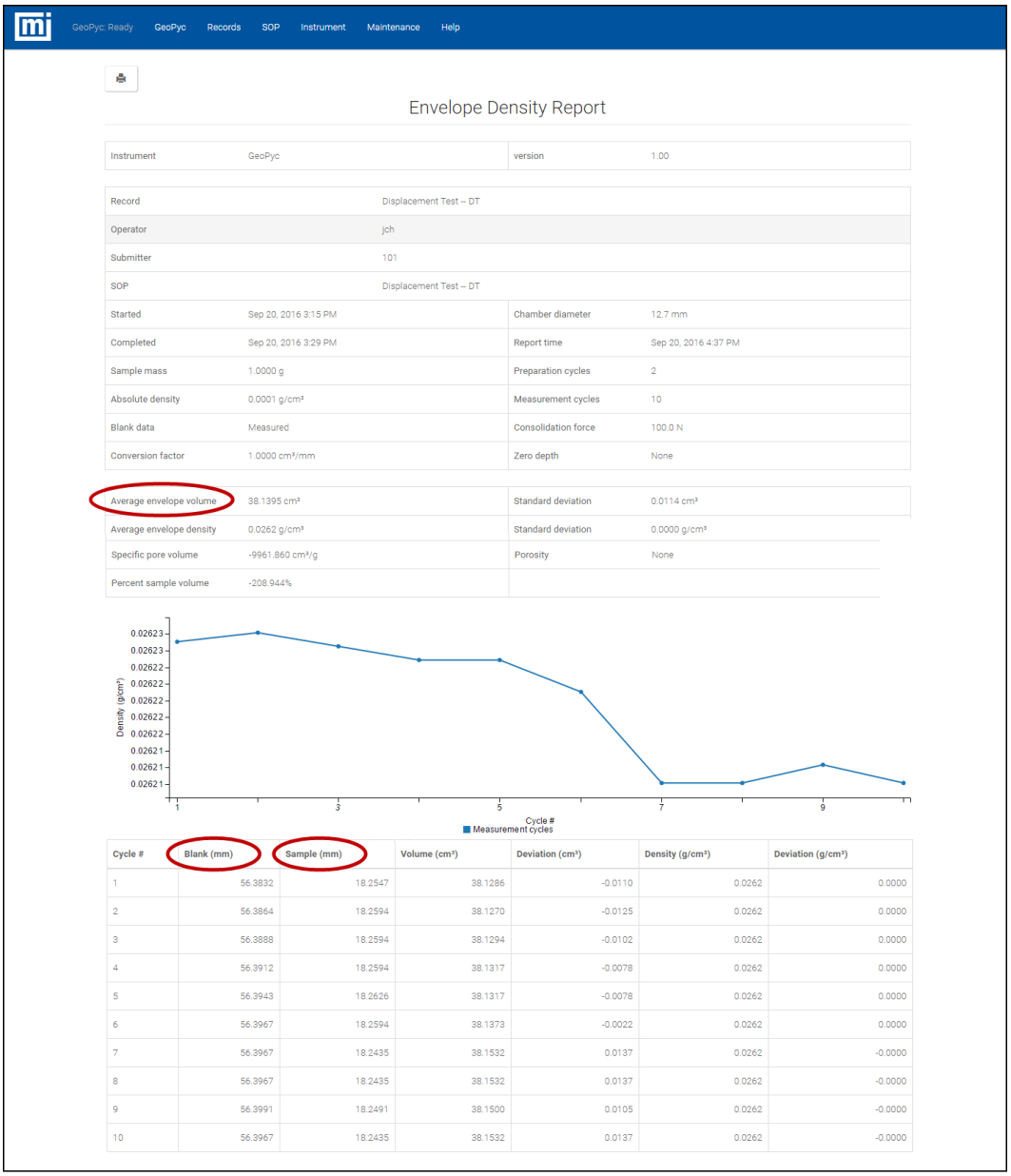
SOP Displacement Verification Setup

Field Label	Enter
Method	Displacement
Name	Enter the length (mm) of the spacer to be used.
Operator	Operator name or initials
Entered consolidation force	Tap **ENTER** and enter 100 in the *Consolidation force* field.
Entered conversion factor	Tap **ENTER** and enter 1 in the *Conversion factor* field.

2. Tap **UPDATE**.
3. Attach the displacement tool and tighten firmly. See ***Tool Assembly and Installation on page 1 - 2***.
4. On the menu, tap *GeoPyc*.
5. Tap the *SOP* drop-down box and select *Displacement - [entered length]*.
6. Tap **START**. Ten blank cycles will be performed.
7. Upon completion of the ten blank cycles, the plunger will return to home. At the prompt to load the sample, unscrew the piston, attach the spacer, then reattach the piston to the mandrel after attaching the spacer.
8. Tap **CONTINUE** to begin the analysis cycles.
9. Upon completion of the analyses, tap *Records* on the main menu.
10. Select *Displacement - [entered length]* to view the report. If multiple displacement runs were performed, select the one with the most recent date and time in the *Last Modified* column.
11. Verify the results:
    a. The distance between the highest and lowest value in the *Blank (mm)* and *Sample (mm)* columns must be 0.05 mm or less.
    b. The *Average Envelope Volume* value should be the same as the actual length of the spacer (±0.053).

Although indicated as a volume, the number displayed in this field is actually the *measured length* of the spacer.

ENVELOPE DENSITY REPORT EXAMPLE



GeoPyc: Ready | GeoPyc | Records | SOP | Instrument | Maintenance | Help

Envelope Density Report

Instrument	GeoPyc	version	1.00

Record	Displacement Test -- DT
Operator	jch
Submitter	101
SOP	Displacement Test -- DT

Started	Sep 20, 2016 3:15 PM	Chamber diameter	12.7 mm
Completed	Sep 20, 2016 3:29 PM	Report time	Sep 20, 2016 4:37 PM
Sample mass	1.0000 g	Preparation cycles	2
Absolute density	0.0001 g/cm³	Measurement cycles	10
Blank data	Measured	Consolidation force	100.0 N
Conversion factor	1.0000 cm³/mm	Zero depth	None

Average envelope volume	38.1395 cm³	Standard deviation	0.0114 cm³
Average envelope density	0.0262 g/cm³	Standard deviation	0.0000 g/cm³
Specific pore volume	-9961.860 cm³/g	Porosity	None
Percent sample volume	-208.944%		

Cycle #	Blank (mm)	Sample (mm)	Volume (cm³)	Deviation (cm³)	Density (g/cm³)	Deviation (g/cm³)
1	56.3832	18.2547	38.1286	-0.0110	0.0262	0.0000
2	56.3864	18.2594	38.1270	-0.0125	0.0262	0.0000
3	56.3888	18.2594	38.1294	-0.0102	0.0262	0.0000
4	56.3912	18.2594	38.1317	-0.0078	0.0262	0.0000
5	56.3943	18.2626	38.1317	-0.0078	0.0262	0.0000
6	56.3967	18.2594	38.1373	-0.0022	0.0262	0.0000
7	56.3967	18.2435	38.1532	0.0137	0.0262	-0.0000
8	56.3967	18.2435	38.1532	0.0137	0.0262	-0.0000
9	56.3991	18.2491	38.1500	0.0105	0.0262	-0.0000
10	56.3967	18.2435	38.1532	0.0137	0.0262	-0.0000

- The *Average Envelope Volume* field is indicated as a volume. This number is actually the measured length of the spacer. This number must match the known length of the spacer ±0.053 mm.
- The distance between the highest and lowest value in the *Blank (mm)* and *Sample (mm)* columns must be 0.05 mm or less.