![mi] micromeritics®

GeoPyc 1360

Operator's Manual

V3.02

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Our liability under this warranty is limited to repair, servicing and adjustment, free of charge at our plant, of any instrument or defective parts when returned prepaid to us and which our examination discloses to have been defective. The purchaser is responsible for all transportation charges involving the shipment of materials for warranty repairs. Failure of any instrument or product due to operator error, improper installation, unauthorized repair or alteration, failure of utilities, or environmental contamination will not constitute a warranty claim. The materials of construction used in MICROMERITICS instruments and other products were chosen after extensive testing and experience for their reliability and durability. However, these materials cannot be totally guaranteed against wear and/or decomposition by chemical action (corrosion) as a result of normal use.

Repair parts are warranted to be free from defects in material and workmanship for 90 days from the date of shipment.

No instrument or product shall be returned to MICROMERITICS prior to notification of alleged defect and authorization to return the instrument or product. All repairs or replacements are made subject to factory inspection of returned parts.

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2. If an instrument or product is found defective during the warranty period, replacement parts may, at the discretion of MICROMERITICS, be sent to be installed by the purchaser, e.g., printed circuit boards, check valves, seals, etc.

3. Expendable items, e.g., sample tubes, detector source lamps, indicator lamps, fuses, valve plugs (rotor) and stems, seals and O-rings, ferrules, etc., are excluded from this warranty except for manufacturing defects. Such items which perform satisfactorily during the first 45 days after the date of shipment are assumed to be free of manufacturing defects.

Purchaser agrees to hold MICROMERITICS harmless from any patent infringement action brought against MICROMERITICS if, at the request of the purchaser, MICROMERITICS modifies a standard product or manufactures a special product to the purchaser's specifications.

MICROMERITICS shall not be liable for consequential or other type damages resulting from the use of any of its products other than the liability stated above. This warranty is in lieu of all other warranties, express or implied, including, but not limited to, the implied warranties of merchantability or fitness for use.

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1. GENERAL INFORMATION

This operator's manual describes how to install and operate the GeoPyc 1360 Pycnometer system. It is divided into the following chapters:

Organization of the Manual

The operator's manual is organized as follows:

Chapter 1   **GENERAL INFORMATION**

Provides general information about the GeoPyc analyzer; also lists specifications.

Chapter 2   **INSTALLATION AND SETUP**

Describes how to install the analyzer.

Chapter 3   **GENERAL OPERATING INSTRUCTIONS**

Contains instructions for using the keypad, software, Dry*Flo*, and sample chamber/plunger.

Chapter 4   **PERFORMING ANALYSES**

Gives instructions for determining the zero depth of a sample chamber, performing calibration, performing analyses and storing blank data.

Chapter 5   **PRINTING AND TRANSMITTING DATA**

Describes how to print and transmit data; also contains sample reports.

Chapter 6   **ORDERING INFORMATION**

Provides part numbers and ordering information for system components.

Appendix A   **CALCULATIONS**

Contains the calculations used by the system to calculate volume, porosity and density.

Appendix B   **ERROR MESSAGES**

Lists the error messages that may be displayed by the software and includes a cause and corrective action for each.

Appendix C   **MANUAL OPERATION**

Contains instructions for manually controlling some aspects of the GeoPyc's operation and for calibrating the force transducer.

Appendix D   **FORMAT OF TRANSMITTED DATA**

Contains the format of transmitted data.

Index   **INDEX**

Provides quick access to a subject matter.

Conventions

This manual uses the symbols shown below to identify notes of importance, warnings, and cautions.

Notes contain important information pertinent to the subject matter.

Warnings contain information that help you prevent actions that may cause personal injury.

Cautions contain information that help you prevent actions that may damage the analyzer.

Important Safety Precaution

The GeoPyc 1360 was designed for nonhazardous samples only. Do NOT attempt to use the 1360 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.

System Description

The GeoPyc 1360 system is a compact benchtop unit containing the analyzer, internal microprocessor, and a keypad with liquid crystal display (LCD). A printer and/or RS-232 transmission cable can be connected. The GeoPyc 1360 can be operated in multiple languages. Changing the language — like most other operations — requires only a simple sequence of keystrokes.

The GeoPyc can be purchased for performing either envelope density analyses or for bulk density analyses which emulate tap density. Envelope density, as used in this manual, is the mass of an object divided by its volume, where the volume includes that of its pores and small cavities. Bulk density is like tap density and is defined as the mass of a material that fills a container to a specified volume, divided by container volume. The T.A.P.^{TM} Density software can be purchased as an option and used interchangeably with the envelope density software. Refer to Chapter 6 for ordering information.

Understanding Your GeoPyc 1360

The GeoPyc 1360 Pycnometer measures the envelope volume and calculates the envelope density of porous objects. Envelope density is the mass of an object divided by its volume, where that volume includes that of its pores and small cavities. When absolute density for a sample is provided, the GeoPyc 1360 also reports percentage porosity and specific pore volume. (Absolute density is the density computed after excluding from the volume that of the pores and small cavities. It can be obtained using Micromeritics' AccuPyc 1330 Helium Pycnometer.)

Unlike other methods available for measuring envelope density and percent porosity, the GeoPyc 1360 method generally is nondestructive of the sample, rapid, easy to perform, and involves no hazardous materials.

Determining the Displacement Volume

To calculate the envelope density of a sample, the GeoPyc 1360 first determines its envelope volume. A quantity of Dry*Flo*, a free-flowing dry medium, is placed in the sample chamber and the medium's volume is measured. (This is 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 GeoPyc 1360 then uses the envelope volume and the sample's weight to calculate its envelope density.

Irregularly shaped samples and even 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 GeoPyc 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.

Determining the Zero Depth of the Sample Chamber

The GeoPyc enables you to determine whether you have enough sample in the sample bed to obtain reproducible results. For best results, at least 25% of the bed volume should be actual sample.

The GeoPyc 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.

Calibration

Calibration is performed with an object or objects similar in size and shape to the sample. A reference sample makes an excellent calibration object. However, any object can be used, as long as its properties are known. The more closely the calibration object resembles the sample, the better will be the calibration.

The result of the calibration is the Conversion Factor, which is entered as part of the sample information.

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 GeoPyc performs a consolidation cycle. During a consolidation cycle, the analyzer agitates (by rotational oscillation) the chamber while a plunger moves forward into it. When the user-specified consolidation force is reached, the GeoPyc records the volume, then retracts the plunger slightly.

To gather statistically useful data, the GeoPyc 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 user.

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." During System Setup, you specify the number of cycles you wish to be considered preparation cycles. The software automatically discards data from these cycles before making calculations.

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

Consolidation Force

You can specify the force with which the Dry*Flo* bed is compressed. You must use the same force in blank, sample, and calibration runs for any given sample.

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. (See Appendix A for calculations.)

Reporting

After an analysis, a report is generated automatically if your system is set up to print or transmit data. Analysis reports remain active while an automatic analysis is in progress, so you can print or transmit partial reports at any time.

If a report is not printed automatically, the sample's volume is displayed on the LCD screen.

Specifications

Characteristic	Specification
—————— **ENVIRONMENT** ——————	
Temperature:	Stable, between 15 and 35 °C
Humidity:	20 to 80% relative, noncondensing
—————— **UTILITIES** ——————	
Voltage:	85 to 265 VAC
Power:	95 VA
Frequency:	47 to 63 Hz
—————— **SAMPLE PARAMETERS** ——————	
Volume:	0.3 to 25 cm^3 with full range of sample chambers
—————— **REPRODUCIBILITY** ——————	
When sample volume is at least 25% of sample chamber volume:	Typically $\pm 1.1\%$
—————— **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

Characteristic	Specification
	——————— **EXPOSED MATERIALS** ———————
To sample:	Glass, graphite, Teflon® , stainless steel, aluminum, Buna-N, epoxy, ceramic
	——————— **CABINET** ———————
Dimensions:	55.3 cm wide x 38.3 cm deep x 28.3 cm high (21.8 in. wide x 15.1 in. deep x 11.1 in. high)
Weight:	19 kg (42 lbs)

2. INSTALLATION AND SETUP

This chapter describes how to install and set up the GeoPyc analyzer.

Unpacking and Inspecting the Equipment

When you receive the shipping cartons, carefully compare the packing list with the equipment actually received and check the equipment for damage during shipment. Be sure to sift through all packing materials before declaring equipment missing.

> **If you need to declare equipment as damaged or lost, save the shipping cartons. The claims investigator must examine the cartons in order to complete the inspection report.**

Lifting the GeoPyc

The GeoPyc can be lifted by one person using two hands placed under the base of the unit. It does not matter whether you grasp the instrument at the sides or along the front and back. However, to make balancing the instrument easier, you should note that the front of the instrument is heavier than the rear of the instrument. Do not lift the instrument by grasping a mandrel or by grasping the installed chamber/plunger assembly.

The GeoPyc weighs approximately 19 kilograms. As always, use proper lifting techniques to avoid injury.

Equipment Damage or Loss During Shipment

When equipment is damaged or lost in transit, you are required to make note of the damage or loss on the freight bill. The freight carrier, not Micromeritics, is responsible for all damage or loss occurring during shipment. If you discover damage or loss of equipment during shipment, report the condition to the carrier immediately.

Equipment Return

Micromeritics strives to ensure that all items arrive safely and in working order. Occasionally, due to circumstances beyond our control, equipment is received which is not in working order. If you wish to return equipment (damaged either during shipment or while in use) to Micromeritics for repair or replacement, follow these steps:

1.   Pack the instrument in its original shipping carton if possible. If the original carton is unavailable, for a nominal fee, Micromeritics can provide another carton for your use.

Failure to package your instrument properly may result in shipping damage.

2.   Tag or otherwise identify the defective equipment, noting the defect and, if possible, the circumstances under which the defect occurs.

3.   Make reference to the sales order or purchase order for the equipment, and provide the date the equipment was received.

4.   Notify a Micromeritics Service representative of the defect and request shipping instructions. The Service Department will assign a Return Material Authorization (RMA) number to your return and provide shipping information.

Installing the Analyzer

Selecting the Location

The GeoPyc 1360 should be placed on a level, stable workbench about 90- to 100-cm high. During analysis, it is necessary to enter the weight of your sample object(s); ready access to an analytical balance is recommended. Select a location with an electrical power source available.

Installing the Power Cord

Insert the female end of the power cord into the power connector on the rear panel of the GeoPyc.
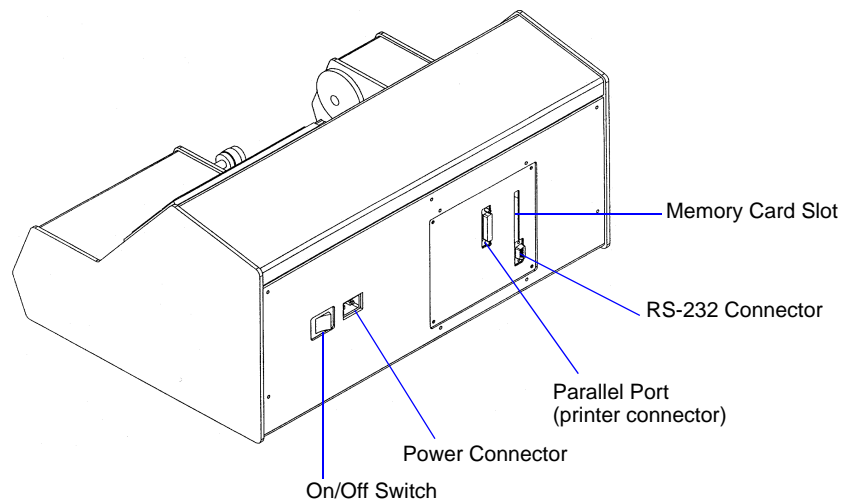
The power cord supplied with your GeoPyc 1360 is a shielded power cord. If you replace this cord with a non-shielded cord, your instrument may no longer conform to the European Union Council Directives.

Installing the Memory Card

1. Make sure that the analyzer is plugged in.

2. Make sure that the ON/OFF switch is in the OFF (0) position.

Installing the memory card while the analyzer is turned on will damage the software.

3. Carefully read, than remove any caution stickers on the memory card or the slot on the rear panel of the analyzer, then insert the memory card into the slot. When the card is inserted correctly, the write-protect button is visible on the lower part of the card's edge and the eject button pops out (extends slightly from the rear panel).

Memory Card

Write-Protect Button

RS-232 Port
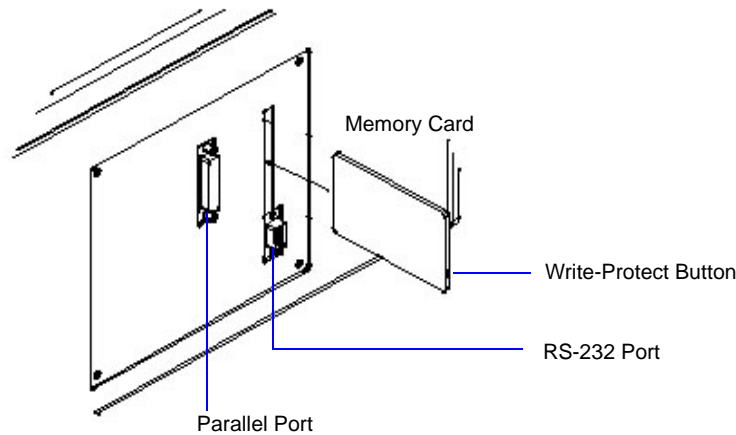
Parallel Port

Connecting a Printer

A printer is optional.

1. Plug your printer cable into the parallel port on the back of the GeoPyc.

2. Secure any cable clamps.

Connecting an RS-232 Data Transmission Cable

Data transmission via the RS-232 serial port is optional.

1. Plug the RS-232 cable into the RS-232 serial port connector on the back of the GeoPyc.

2. Secure any cable clamps.

Placing the Template

Select the keypad template printed in the language in which you plan to operate the instrument. Place it over the keypad. If you wish to secure the template more permanently, peel off the paper backing and press the adhesive-coated side of the template in place over the keypad.

3. GENERAL OPERATING INSTRUCTIONS

This chapter contains instructions for using:

- the keypad
- software
- Dry*Flo*
- sample chamber/plunger.

Analyzer Warmup

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

Turning the Analyzer On and Off

1. Plug in the power cord.

2. Use the ON/OFF switch to place the analyzer in the ON (|) position or OFF (0) position.

Cleaning the GeoPyc

The GeoPyc cabinet can be cleaned by wiping with a cloth or paper towel. You may wish to moisten the cloth with water and/or use a gentle detergent. Do not use solvents such as isopropyl alcohol or acetone because they may damage the finish. Refer to **Cleaning the Analysis Chamber,** page **3-13** for instructions on cleaning the chamber and plunger.

Using the Keypad

Most operations are initiated by pressing a function key on the keypad. A dialog shown in the keypad window prompts you through the appropriate series of data fields for that operation. You can save a completed dialog by pressing **2nd**, then **SAVE**, or exit a dialog at any time by pressing **ESCAPE**.

Before using the GeoPyc, make sure the ON/OFF switch is in the ON (|) position. Wait for the system to finish the self-checking operation. When the self-check is complete, the screen displays the information shown below.
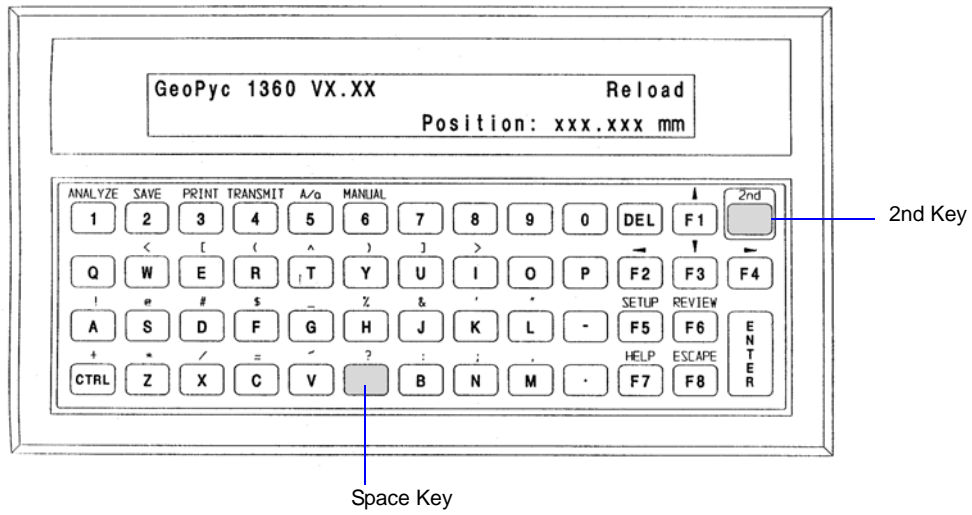
When idle (the example shown above), the screen is in "display mode." It displays "GeoPyc 1360" and the software version number, and indicates that the analyzer is ready for "Reload," or operation.

Function Keys

Some operations are performed by simply using the keys on the keypad (refer to Table 3-1). Others require that you press the **2nd** key before pressing the keys (refer to Table 3-2).

Table 3-1. Function Keys

Key		Function
F1	Up Arrow	Move to previous field
F2	Left Arrow	Move to previous item/choice
F3	Down Arrow	Move to next field
F4	Right Arrow	Move to next item/choice
F5	Setup	Begin System Setup (System Options, Report Options, Transmission Options)
F6	Review	Review/make changes to the last analysis' variables
F7	Help	Display choices
F8	Escape	Discard all entries for this dialog and return to Menu
DEL	Delete	Delete character before cursor (backspace)
ENTER	Enter	Move to next field OR at the end of dialog, begin analysis
P	Pause	Pause the current analysis. This function toggles on and off; restart the analysis by pressing the **P** key again.

NOTE: Use the shaded key below the **?** (question mark) for spaces.

Table 3-2. Second Function Keys

Key		Function
2nd + 1	Analyze	Start an analysis (blank, sample, or calibration)
2nd + 2	Save	Save changes to the current dialog
2nd + 3	Print	Start the print dialog
2nd + 4	Transmit	Start the transmit dialog
2nd + 5	A/a	Select upper- or lower-case letters (toggle)
2nd + 6	Manual	Operate the analyzer in manual mode (for diagnostics and maintenance only)

The **2nd** key also controls the keypad characters that appear above each key. To use one of these characters, press the **2nd** key, then the corresponding alpha key.

Entering/Selecting Data

Most data-entry fields work in the same manner: a field name is displayed with either a default value or a space to enter a value. If you wish to change the default (for multiple-choice fields), use the $\rightarrow$ (Right) and $\leftarrow$ (Left) arrow keys to move from choice to choice until the correct value is displayed. For other fields, type the correct value. Then use the $\uparrow$ (Up) and $\downarrow$ (Down) arrow keys to move to the next or previous field.

If you enter a value that is inappropriate for the field's alphanumeric specifications, an audible signal will sound and the dialog will not move to the next field. An error message will some-times be displayed, prompting you to enter an acceptable value for the field.

Setting Software Preferences

Setting defaults and user preferences before you begin using the system is simple. The GeoPyc 1360 prompts you through the necessary sequence of keypad entries.

There are three basic groups of setup data: **System Options**, **Report Options**, and **Transmission Options**. Each group is entered by following a separate series of prompts.

- You must complete the System Options setup dialog before you can begin analyzing samples.

- You must complete the Report Options setup dialog before you can create reports.

- You must complete the Transmission Options setup dialog before data can be transmitted electronically. If you wish to transmit data automatically, you must also complete the Report Options setup, specifying Serial Port for automatic report destination.

It is only necessary to complete a setup dialog once, unless you decide to make changes later.

Corrections and changes are easy, since you can use the ↑ (Up) and ↓ (Down) arrow keys to move through the fields until all data are correct. You can press **ENTER** (to start the operation) or **ESCAPE** (to exit the dialog) at any time.

System Options

This group of setup prompts allows you to make choices about how the unit is used, such as which language to use and whether to include certain prompts during analyses.

Press **F5 SETUP**; prompts display as follows:

Setup type? **Setup** **System Options**	Select **System Options**, then press **ENTER**.

Language? **Setup** **English**	Specify the language you wish to have the system use. *Choices: English, Deutsch, Francais, Espanol, Italiano*

Instrument:	Setup
GEOPYC	

Type the instrument identification for this analyzer. Use any combination of letters and/or numbers that will help you identify the unit.

Range: 9 characters

Report title:	Setup

Type the report title that you wish to appear on all reports.

Range: 19 characters

Date format?	Setup
mm/dd/yy	

Choose the date format you prefer.

Choices: mm/dd/yy, dd/mm/yy

Date:	Setup

Enter the date using the format selected above. This field defaults to the current date.

Time:	Setup

Enter the current time, using the format hh:mm:ss. If seconds are omitted, 00 is assumed; 24-hour (military) time is used.

Request Sample?	Setup
Yes	

Choose whether you wish the analyzer to request a sample identification for each run.

Choices: Yes, No

Request Customer?	Setup
Yes	

Choose whether you wish the analyzer to request a customer identification for each run.

Choices: Yes, No

Request Operator?	Setup
Yes	

Choose whether you wish the analyzer to request an operator identification for each run.

Choices: Yes, No

Request Sample weight?	Setup
Yes	

Choose whether you wish the analyzer to request a sample weight for each run.

Choices: Yes, No

> **Request Absolute density?   Setup**
> **Yes**

Choose whether you wish the analyzer to request absolute density for each run.

Choices: Yes, No

> **Display position in?   Setup**
> **mm**

Specify how you wish the position of the plunger displayed.

Choices: mm (millimeters), steps of the motor

> **Number of Prep cycles?   Setup**
> **2**

Specify the number of cycles you wish to be considered preparation cycles.

Range: 0 - 10

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 software automatically discards data from these cycles before making calculations.

> **Calculate % sample volume?   Setup**
> **Yes**

Choose whether you wish to have the percent sample volume calculated.

Choices: Yes (recommended), No

If you choose **Yes**, the percent of sample contained in the bed (sample + Dry*Flo*) is calculated and printed on the report.

Yes is the recommended choice for this prompt. By choosing **Yes**, you can verify that at least 25% of your bed is actual sample, ensuring that data are reproducible.

If you choose to have the percent sample volume calculated, you must determine the zero depth of the sample chamber you plan to use before you begin your analysis. See **Determining the Zero Depth of a Sample Chamber,** page **4-2**.

> **Press [Enter] to save changes,**
> **or [Esc] to cancel.**

Press **ENTER** to save changes or **ESCAPE** to cancel.

.

Report Options

These setup prompts enable you to control certain aspects of report formatting and printing.

Press **F5 SETUP**; prompts display as follows:

Setup type? **Setup** **Report Options**	Use the arrow key until **Report Options** is displayed, then press **ENTER**.

Automatic report destination? **Setup** **Display**	Specify report destination. *Choices: Display, Printer, Serial Port*

Transmission format? **Setup** **Single Column**	Specify transmission format. *Choices: Single Column, Spreadsheet, Tabular*

Press [Enter] to save changes, **or [Esc] to cancel.**	Press **ENTER** to save changes or **ESCAPE** to cancel.

Transmission Options

This group of setup fields enables you to export analysis data via the RS-232 serial port. In order to transmit data automatically, you must also complete the Report Options Setup Dialog (above), selecting **Serial Port** for the automatic report destination. Refer to Appendix D, beginning on page **D-1** for the manner in which transmitted data are formatted.

Press **F5 SETUP**; prompts display as follows:

Setup type? Setup **Transmission Options**	Use the arrow key until **Transmission Options** is displayed, then press **ENTER**.

Baud rate? Setup **9600**	Specify your destination serial port's baud rate. *Choices: 110, 150, 300, 600, 1200, 2400, 4800, 9600*

Data bits? Setup **8**	Choose the number of data bits desired. *Choices: 7, 8*

Stop bits? Setup **1**	Choose the number of stop bits desired. *Choices: 1, 2*

Parity? Setup **None**	Specify choice of parity. *Choices: None, Odd, Even*

Enable xon/off? Setup **No**	Specify whether you wish to enable xon/xoff. *Choices: Yes, No*

Press [Enter] to save changes, or [Esc] to cancel.	Press **ENTER** to save changes or **ESCAPE** to cancel.

Handling Dry*Flo*, the GeoPyc's Dry-Fluid Medium

Dry*Flo* should be handled with care to avoid creating dust while breathing. Dry*Flo* may be used with most samples 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.

Because Dry*Flo* is made of tiny, rigid beads and a small amount of dry lubricant, you can handle it easily and safely with a minimum of equipment. It was formulated to flow freely over surfaces, so it readily shakes or brushes off most objects unless they are wet or sticky.

You can handle and measure Dry*Flo* with ordinary laboratory utensils, such as funnels, scoops, and beakers. Utensils may be made of metal, plastic, paper, glass, or other materials. Utensils must be clean and dry; use isopropyl alcohol to clean the utensils.

> ⚠️ **Gloves and protective clothing are necessary when handling Dry*Flo*. Protective eye equipment should be worn. See the MSDS for safeguards.**

When handling Dry*Flo*, we recommend the following:

- 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 your hands.

- For consistent results, shake the bottle of Dry*Flo* periodically to remix its 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 *DryFlo* 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 GeoPyc 1360 comes equipped with a rubber mat to catch any Dry*Flo* that may spill onto the platform beneath the analysis chamber.

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

How much Dry*Flo* should I use?

These guidelines give you 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; a range of Dry-*Flo* amounts may be used. As you use the GeoPyc, you will become comfortable determining the amount needed for the type and size of samples you are analyzing.

Use enough Dry*Flo* to surround the sample or calibration object(s) on all sides. There must be sufficient Dry*Flo* above, below, and around the object(s) to become consolidated during the analysis process. Accuracy is impossible when there is not enough 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*.
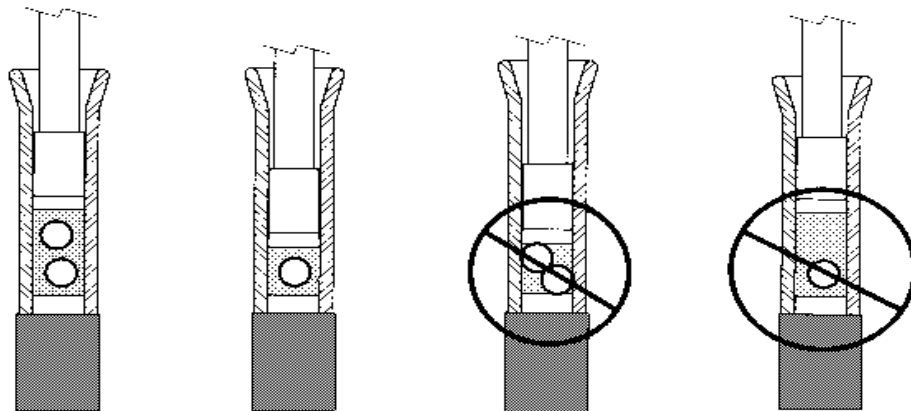
Appropriate Amount of Medium   Too Little Medium   Too Much Medium

Method A

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

- For *single objects*, fill the chamber with Dry*Flo* to the marked line.

- For *small*, *multiple 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 listed in Table 3-3, 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*. Make sure that 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.

Practice Loading the Chamber

It may be helpful to practice loading the chamber with Dry*Flo* and a sample representative of those you plan to analyze. Use one of the methods above to load the chamber with Dry*Flo*; load the sample object(s) 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. You may need to repeat shaking the chamber and adjusting the plunger a few times. 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 your samples are long and thin, analyze several of them in a larger chamber to avoid a long, thin Dry*Flo* bed.

The following table gives some guidelines to help you load the chamber with an appropriate amount of Dry*Flo*.

Table 3-3. Chamber Parameters

Internal Chamber Diameter (mm)	Envelope Volumes Best Measured (cm³)	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

Handling the Analysis Chamber and Plunger

The only parts of the GeoPyc 1360 that you will handle regularly are the sample chamber and the plunger. Their simple design makes them easy to use.

Piston Coupling Extenders

Piston coupling extenders are required when performing zero depth runs. The piston coupling extender simply screws onto the standard piston rod, so it is positioned between the piston and the coupling.
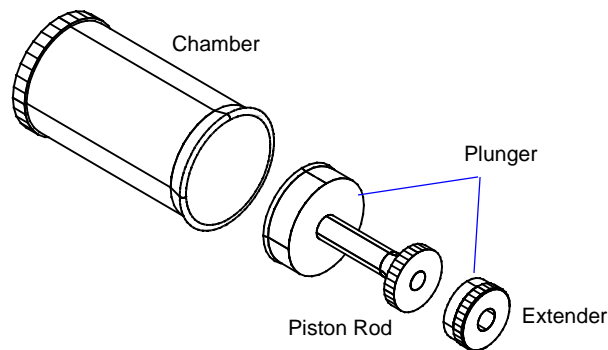
Cleaning the Analysis Chamber

Dry*Flo* lubricates the chamber wall so cleaning is unnecessary unless grease or other foreign matter is inadvertently introduced. Remove such contaminants with a wipe moistened with isopropyl alcohol.

Selecting the Appropriate Size Chamber

One analysis chamber (and corresponding plunger) is provided with your GeoPyc. Several sizes are available to accommodate a variety of sample types and quantities.

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

See Chapter 6 for part numbers and ordering information.

Determining Your Chamber's Diameter

If you are uncertain which size chamber you are using, you can determine the internal diameter of your chamber by measuring the plunger seal. The seal's diameter is the same as the internal diameter of the chamber. (Do not measure the chamber.)

If a metric ruler is not available, you can determine the internal diameter of your chamber by standing the plunger, **SEAL END DOWN**, on one of the circles in the illustration on the next page. Locate the circle that is the same size as the seal. The correct diameter for each chamber is printed next to each circle.

Placing the Sample in the Chamber

Always be careful not to spill or lose any *DryFlo* when handling the chamber, plunger, and sample, because the volume of lost medium directly reduces the calculated volume of the sample.

Never drop a sample into the *DryFlo* bed. Splashing is likely, and *DryFlo* may spill from the chamber. Instead, slide the sample gently down the side of the chamber.

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

A sample with a large central hole, such as a sleeve bearing, should be placed with its axis along the rotational axis of the medium bed.

In any case, the agitation of the chamber during analysis will help shift the sample into the center of the chamber, surrounding it with medium. Samples heavier than the medium position themselves rapidly during agitation; less dense objects generally move into an acceptable position during the first two consolidation cycles.

Fitting the Plunger into the Chamber

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 with medium or medium and sample, slide the seal end of the plunger about a third of the way into the chamber.
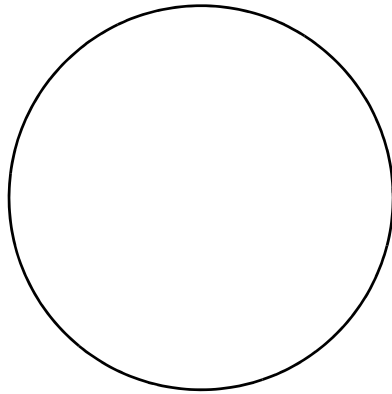
Plunger seal diameter/ internal
chamber diameter: 50.8 mm
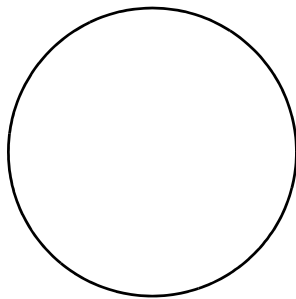
Plunger seal diameter/ internal
chamber diameter: 38.1 mm
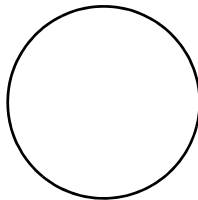
Plunger seal diameter/ internal
chamber diameter: 25.4 mm
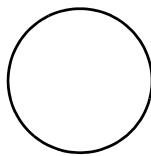
Plunger seal diameter/ internal
chamber diameter: 19.1 mm
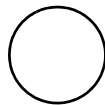
Plunger seal diameter/ internal
chamber diameter: 12.7 mm

Internal Chamber Diameters

Mounting the Chamber and Plunger

1. Make sure the plunger is inserted partially way 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, turning the chamber away from you until it is firmly secured. Hold the mandrel to stabilize it while you are mounting the chamber.
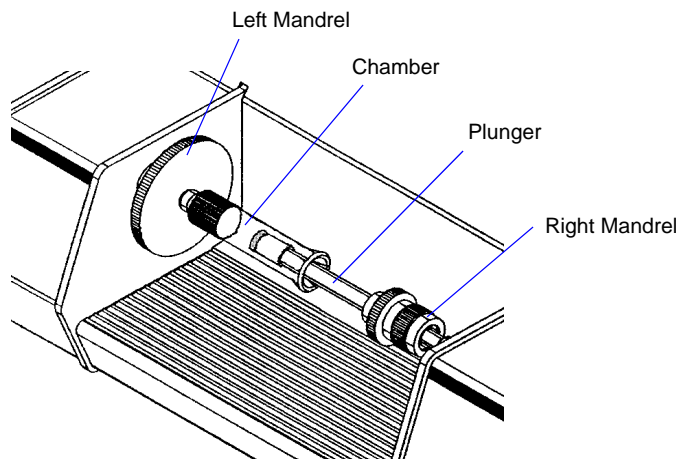
4. Extend the plunger part way out of the chamber until the right mandrel is inserted into the hole on the top of the plunger.

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 you turn the coupling.

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

If the attachment of the chamber/plunger assembly becomes loose during analysis, data collected for that run may be inaccurate. Start the run over, making sure that you securely mount the chamber/plunger assembly on the analyzer.

Removing the Chamber and Plunger

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

When you begin to remove 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. The analysis should be started over, making sure that the chamber and plunger are securely attached to the analyzer.

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 you turn 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 you unscrew the chamber.

4. When the chamber is free, remove it from the mandrel.

General Handling Information

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

As you slide 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.

When you remove the plunger from the chamber, tap the seal end lightly on the open end of the chamber. Brush back into the chamber any *DryFlo* adhering to the plunger's seal end or to the flared end of the chamber.
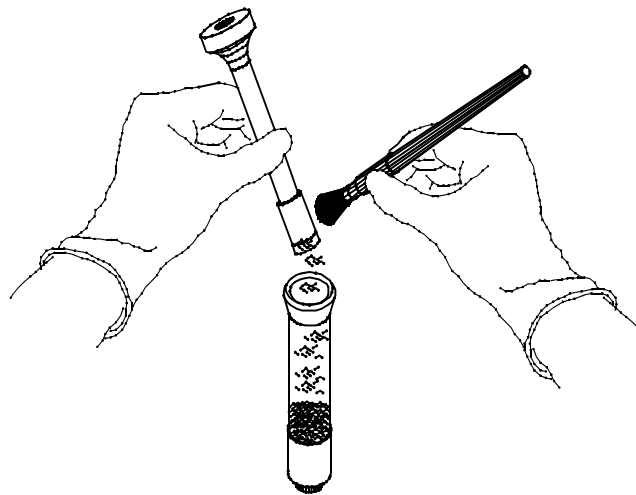
> **The technique for using the GeoPyc is not difficult, but consistency in technique is essential for accurate results.**

Maintaining the 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.
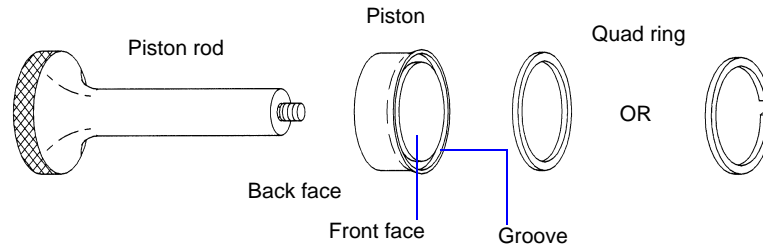
The piston is remarkably resistant to wear and provides sealing for prolonged usage if handled and maintained properly. It will wear out, of course, under abrasive situations. It is good practice to clean the sealing area every day or so using a wipe moistened with isopropyl alcohol. Be sure the seal is dry before using the plunger again.

Checking for Seal Wear

Usually when leakage develops, it is not due to wear but is caused by the piston having lost some of its expanded condition due to a characteristic of Teflon to undergo what is called *cold flow*. The piston is easily restored to full operation when the latter is the case.

Wipe or brush the piston free of adhering particles. Then using a round-bottom object, such as the handle of the brush supplied with the GeoPyc, press down on the quad ring and move the object around the piston circumference, forcing the piston rim outward.
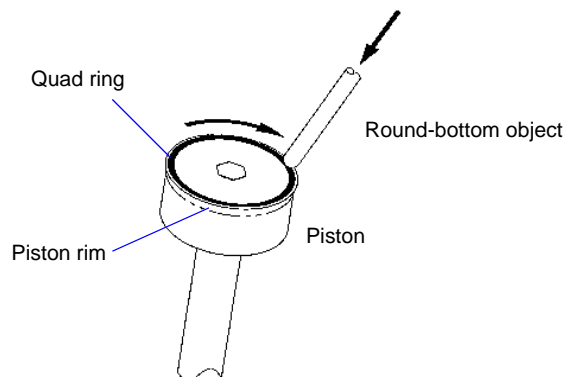
If a round-bottom object is unavailable, the outer rim can be re-expanded merely by pressing outward on its edge with the thumb. Either procedure will most likely restore the piston to satisfactory performance unless the material being tested has been especially abrasive.

Replace the piston if neither of the above procedures corrects the problem.

Replacing the Plunger Piston

We recommend that you replace both the piston and the quad ring at the same time. Use the following instructions to replace the parts that are worn.

1. Unscrew the piston rod from the piston.

2. The quad ring is pre-loaded 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, but 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.

Refer to **Ordering Information** beginning on page **6-1** for part numbers and ordering information.

Consolidation Force

The force with which the chamber contents are compressed is called the *consolidation force*. You specify the force you wish to use during the blank run.

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

The following table gives a typical force for each chamber.

Table 3-4. Typical Consolidation Force

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

Under certain circumstances, you may wish to use a different force. For example:

- You may wish to decrease the force when analyzing a very soft or fragile sample.

- If you enter too low a force, the plunger may move forward slowly or not at all. (If this occurs, start again using a greater force.)

- You should increase the force when performing an analysis with a sample plus *DryFlo* bed longer than the chamber's diameter.

- If you find that the *DryFlo* remains compacted into cakes or clumps after analysis, you may be using too high a force.

As you develop your own methodology for operating the GeoPyc, you may wish to experiment with the consolidation force to find the value that works best for you.

Weighing Samples

Before beginning a sample run with the GeoPyc, you must obtain the sample's dry weight. Most sample materials gain weight by adsorbing moisture from the atmosphere. Care should be taken to ensure that the sample weight you enter does not include such moisture. (In some instances, you may wish to prepare the sample in a drying oven or dessicator.)

It does not matter, however, if the sample adsorbs moisture after it is weighed, since the GeoPyc measures sample volume. This means you can increase efficiency by drying and weighing a number of samples at once, then setting them aside until it is convenient for you to determine their envelope density.

4. PERFORMING ANALYSES

This chapter contains instructions for determining the zero depth of a sample chamber, calibrating the instrument, performing analyses, and storing blank data.

Definitions of Run Types

The GeoPyc performs four types of analyses:

- Sample
- Store Blank
- Calibration
- Zero Depth

This section contains instructions for performing each of these run types. To obtain reproducible analysis results, the runs should be performed in the following sequence.

1. Perform a **zero depth** run.

    A zero depth run determines the distance the plunger moves into an empty sample chamber. The zero depth value is used to calculate the percent of sample in the sample bed. To obtain reproducible analysis results, at least 25% of the bed volume should be actual sample.

2. Perform a **calibration** run.

    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 (refer to **The Conversion Factor,** page **4-4**) to account for the irregularities of the sample.

3. Perform a **blank data** run.

    A blank run measures the volume of Dry*Flo* in the chamber. It is a series of consolidation cycles performed on the Dry*Flo* alone.

    A blank data run may be performed during a sample or calibration run. Alternatively, you may store blank data in advance, but this method may be less accurate.

4. Perform a **sample** run.

    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.

Determining the Zero Depth of a Sample Chamber

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 you select the zero depth run from the Analyze menu, the zero depth of the sample chamber is determined and recorded. The GeoPyc uses this value to calculate automatically the percent of sample volume when you perform 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.

Zero Depth Sets

The GeoPyc will store up to five sets of zero depth data. When you perform a sample run, the GeoPyc will prompt you to enter the number of the zero depth data set you wish to use.

Performing a Zero Depth Run

A zero depth run is performed with an empty sample chamber. Do not place Dry*Flo* or sample in the chamber for this type of run.

See Chapter 3 for instructions on general operation.

1. Attach the piston coupling extender to the piston rod.

2. Insert the plunger into the sample chamber and mount the chamber/ plunger assembly on the analyzer.

3. Make sure the ON/OFF switch on the rear panel is in the ON (|) position.

4. Press **2nd**, then **ANALYZE**.

5. Enter the data as prompted.

Analyze type? **Analyze** **Zero Depth**	Choose **Zero Depth**.

```
┌─────────────────────────────────────┐
│ Which Zero Depth set?      Analyze   │
│ Zero Depth Set 1                     │
└─────────────────────────────────────┘
```

Use the left and right arrow keys to choose the zero depth set you wish to use.

Range: 1 - 5

```
┌─────────────────────────────────────┐
│ Chamber diameter?          Analyze   │
│ 1.00000 mm                           │
└─────────────────────────────────────┘
```

Enter the sample chamber diameter. If you do not know the sample chamber diameter, refer to **Determining Your Chamber's Diameter,** page **3-14**.

Range: 0 - 65.0000 mm

This number is printed on the report to indicate what size sample chamber was used; it is not used for calucations.

```
┌─────────────────────────────────────┐
│ Press [Enter] to save changes,       │
│ or [Esc] to cancel.                  │
└─────────────────────────────────────┘
```

Press **ENTER** to begin the zero depth analysis. When the analysis is finished, the zero depth of the chamber is displayed.

6. Remove the chamber/plunger assembly from the GeoPyc.

7. Remove the extender from the piston rod.

Output Options

To print or transmit the Zero Depth Report, press the **2nd** key, then **PRINT** or **TRANSMIT**. Select **Zero Depth**, then press **ENTER**. Refer to **Zero Depth Report,** page **5-10** for additional information and an example report.

Performing a Calibration Run

The Conversion Factor

In order to calculate the volume of the chamber contents, the GeoPyc converts displacement data to volume data using a conversion factor. The conversion factors in the table below 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. (Calculations are found in Appendix A.) The adjusted conversion factor for each size chamber is listed in the following table.

Table 4-1. Adjusted Conversion Factors

Chamber Diameter (internal) (mm)	Conversion Factor (adjusted) (cm³/mm)
12.7	0.1284
19.1	0.2907
25.4	0.5153
38.1	1.1492
50.8	2.0373

The conversion factors in the table are average volumes representative of many types of materials when consolidated with Dry*Flo*. However, the irregularities of your sample's surface and shape may create slight irregularities in the consolidation of the Dry*Flo*. If you do not compensate for these irregularities, the accuracy of data decreases.
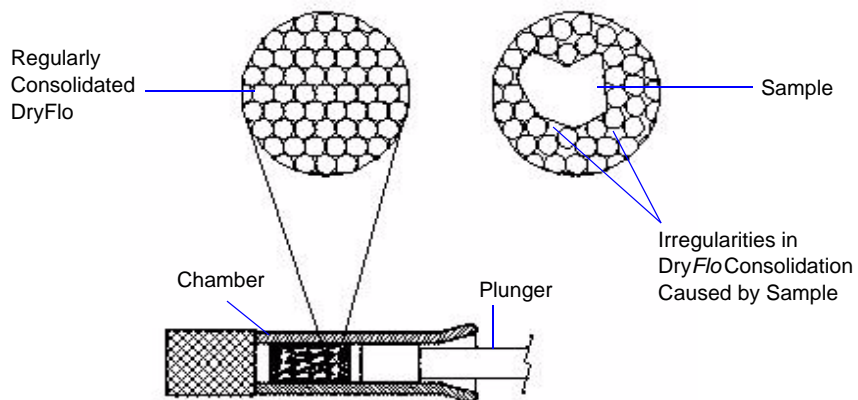
Fortunately, you can calibrate the conversion factor to reflect your sample's irregularities by performing a calibration run. After you perform a calibration run, you can use the calibrated conversion factor during other runs, so that analysis data are adjusted for the way your sample affects the Dry*Flo*.

> **For best results, you may wish to perform several calibration runs for a given sample type. Discard any extreme results. Use the average of the resulting calibrated conversion factors when you analyze 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.**

Where to Begin

To maximize accuracy, it is strongly recommended that you calibrate the conversion factor by performing a calibration run. If you are willing to give up a degree of accuracy, however, you may save the time required to perform a calibration run by using the conversion factor from the table.

- **If you plan to calibrate the conversion factor**, begin by performing the calibration run.

- **If you plan to use the conversion factor from the table**, you may begin performing sample runs.

Choosing a Calibration Object

The more closely your calibration object(s) approximates the size and shape of the sample you are analyzing, the more accurate the calibration is.

The following is a list of 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(s), especially objects with dead-end holes or through holes

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

Starting a Calibration Run

See Chapter 3 for general operating instructions.

1. Place an appropriate amount of Dry*Flo* in the sample chamber. Do not place the calibration object in the chamber until you are prompted to do so.

2. Insert the plunger into the sample chamber, and push 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. Make sure that the ON/OFF switch on the rear panel is in the ON (|) position.

4. Press **2nd**, then **ANALYZE**.

5. Enter the data as prompted.

    If you set your system options setup (Chapter 3) to omit optional data fields, the corresponding prompts shown below will not appear when you operate the instrument.

Analyze type? Analyze **Calibration**	Choose **Calibration**.

Sample: Analyze **Sample 1**	Enter an identification for this calibration object.

Customer: Analyze	Enter the customer identification.

Operator: Analyze	Enter your name.

Blank data source? Analyze **Run blank now**	Select **Run blank now**; the GeoPyc prompts you to perform the blank portion of this sample run. To use stored blank data, refer to **Storing Blank Data,** page **4-14**.

```
┌─────────────────────────────────────┐
│  Number of cycles:          Analyze │
│                                     │
│                                     │
└─────────────────────────────────────┘
```

Enter the number of cycles (consolidation cycles) you wish the GeoPyc to perform during this blank run and calibration run.

To not include preparation cycles. The number of cycles you enter here is the number whose data will be used in calculations and reports.

Range: 1 - 20

```
┌─────────────────────────────────────┐
│  Consolidation Force:       Analyze │
│  0.00000 Newtons                    │
│                                     │
└─────────────────────────────────────┘
```

Enter the Consolidation Force. A typical consolidation force for each size chamber is listed in **Table 3-4. Typical Consolidation Force,** page **3-21**.

Range: 1 - 180 Newtons

```
┌─────────────────────────────────────┐
│  Conversion Factor:         Analyze │
│  1.00000 cm³/mm                     │
│                                     │
└─────────────────────────────────────┘
```

The conversion factor is not used during the calibration run; accept the default.

```
┌─────────────────────────────────────┐
│  Input Calibration Volume?  Analyze │
│  No                                 │
│                                     │
└─────────────────────────────────────┘
```

Choose whether you wish to input the volume of the calibration object(s).

Choices: Yes, No

If **Yes**, enter the object's volume:

```
┌─────────────────────────────────────┐
│  Calibration Volume:        Analyze │
│  0.0000 cm³                         │
│                                     │
└─────────────────────────────────────┘
```

Range: 0.0000 to 99.9999 cm³

If **No**, enter the following:

```
┌─────────────────────────────────────┐
│  Absolute Density:          Analyze │
│  0.0000 g/cm³                       │
│                                     │
└─────────────────────────────────────┘
```

Range: 0 to 99.9999 g/cm³

```
┌─────────────────────────────────────────┐
│ Input Calibration Volume?      Analyze   │
│ No                                       │
└─────────────────────────────────────────┘
```

(continued)

```
┌─────────────────────────────────────────┐
│ Press [Enter] to save changes,           │
│ or [Esc] to cancel.                      │
└─────────────────────────────────────────┘
```

If **No**, enter the following:

```
┌─────────────────────────────────────────┐
│ Porosity:                     Analyze    │
│ 0.0000                                   │
└─────────────────────────────────────────┘
```

Range: 0 to 99.9999 %

```
┌─────────────────────────────────────────┐
│ Sample weight:                Analyze    │
│ 0.0000 g                                 │
└─────────────────────────────────────────┘
```

Range: 0 to 999.9999 g

Press **ENTER** to begin the blank portion of the calibration run. When analysis is finished, an audible signal is sounded.

6. The GeoPyc partially withdraws the plunger. Remove the chamber/plunger assembly from the analyzer. Carefully remove the plunger. Gently tap it on the open chamber so any adhering Dry*Flo* falls back into the chamber. Brush back into the chamber any Dry*Flo* clinging to the chamber's edge. Set the plunger aside, seal end facing up. 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 you just performed. It is essential that you avoid losing Dry*Flo* while placing the calibration object(s) in the chamber. If Dry*Flo* is lost, you must cancel the run (press **ESCAPE**) and begin again.

7. Remount the chamber/plunger assembly on the analyzer, then press **ENTER** to begin calibration.

8. When the appropriate number of consolidation cycles is finished, the GeoPyc sounds an audible signal and partially withdraws the plunger.

9. Remove the chamber/plunger assembly from the analyzer and recover the calibration object(s).

When calibration is complete, the new (calibrated) conversion factor is displayed or printed. If you do not plan to print the calibration report, record the calibrated conversion factor so you can enter it during subsequent analyses. To clear the LCD screen and return to idle mode, press **ESCAPE** or **ENTER**.

> **Data from this calibration run are replaced during the next analysis performed with the instrument. If you wish to print the calibration report or record the conversion factor, you must do so before performing another operation.**

You may now use the new conversion factor during sample runs that analyze objects similar to this calibration object.

Output Options

If you set your System Options to print or transmit reports automatically, the Calibration Report will be generated.

Press the **2nd** key, then **PRINT** or **TRANSMIT** to generate additional copies or partial reports during analysis. (To do so, your system must be set up to print or transmit reports and connected to the appropriate output device.)

Refer to **Calibration Report,** page **5-6** for additional information and an example report.

Performing a Sample Run

Refer to Chapter 3 for instructions on general operation.

> **For greatest accuracy, perform a calibration run before analyzing samples.**

1. Place an appropriate amount of Dry*Flo* in the sample chamber. Do not place the sample object in the chamber until you are prompted to do so.

2. Insert the plunger into the sample chamber, and push part way in. Wipe both ends of the chamber/plunger free of medium and debris. Mount the chamber/plunger assembly on the analyzer.

3. Make sure that the ON/OFF switch on the rear panel is in the ON (|) position.

4. Press **2nd**, then **ANALYZE**.

5. Enter the data as prompted. If you set your system options setup (Chapter 3) to omit an optional data field, the corresponding prompt shown below will not appear when you operate the instrument.

Analyze type? **Analyze** **Sample**	Choose **Sample**.

Sample: **Analyze** **Sample 1**	Enter the sample identification. *Range: 19 characters*

Customer: **Analyze**	Enter the customer identification. *Range: 9 characters*

Operator: **Analyze**	Enter your name. *Range: 9 characters*

Sample weight: **Analyze** **0.0000 g**	For consistent results and correlation with other parameters, enter the dry sample weight. *Range: 0.0000 to 99.9999 grams*

```
Absolute density:        Analyze
0.0000 g/cm³
```

(*optional*) For the GeoPyc 1360 to calculate percentage porosity and specific pore volume, you must supply sample absolute density.

Range: 0.0000 to 99.9999 g/cm³

```
Which Zero Depth set?    Analyze
Zero Depth Set 1
```

Displays when **Yes** is selected for **Calculate % Sample Volume** in System Options.

Range: 1 - 5

```
Blank Data Source?       Analyze
Run blank now
```

Choose the method for blank data.

Choices: Run blank now
*   Stored blank data set [n]*

Run blank now; the GeoPyc prompts you to perform the blank portion of this sample run.

Stored blank data: enter the data set number you wish to use with this analysis. Refer to **Storing Blank Data,** page **4-14**.

```
Chamber Diameter:        Analyze
1.0000
```

Displays when **No** is selected for **Calculate % Sample Volume** in System Options.

Enter the sample chamber diameter. If you do not know the diameter, see **Determining Your Chamber's Diameter,** page **3-14**.

Range: 0 - 65.0000 mm

This number is printed on the report to indicate what size sample chamber was used; it is not used for calculations.

```
Number of cycles:        Analyze
```

Enter the number of cycles (consolidation cycles) you wish performed during this blank run and sample run.

Do not include preparation cycles. The number of cycles you enter here is the number whose data will be used in calculations and reports.

Range: 1 - 20

```
┌─────────────────────────────────────┐
│ Consolidation Force:        Analyze  │
│ 0.00000 Newtons                      │
└─────────────────────────────────────┘
```

Enter the Consolidation Force. A typical consolidation force for each size chamber is listed in **Table 3-4. Typical Consolidation Force,** page **3-21**.

Range: 1 - 180 Newtons

```
┌─────────────────────────────────────┐
│ Conversion Factor:          Analyze  │
│ 1.0000 cm³/mm                        │
└─────────────────────────────────────┘
```

Enter the conversion factor. After the first run (of any type) performed with this instrument, the conversion factor is defaulted to the last conversion factor used. You may accept the default or enter a new conversion factor.

To maximize accuracy, use a conversion factor that was calibrated (during a calibration run) for this type of sample and this chamber. If an appropriate calibrated conversion factor is not available, use the conversion factor from Table 4-1, page **4-4**. Factors used from this table may yield less accurate data as compared to a calibrated conversion factor.

Range: 0 to 9.9999 cm³/mm

```
┌─────────────────────────────────────┐
│ Chamber/Medium weight:      Analyze  │
│ 0.0000 cm³/mm                        │
└─────────────────────────────────────┘
```

Displays when you are using a stored blank data set.

Enter either the weight of the chamber plus medium, or the weight of the medium only. Including or excluding the chamber's weight makes no difference in analysis calculations, *but you must use the same method for both the blank and sample runs for a given sample*.

Range: 000.0000 to 999.9999 grams

Entering an extremely accurate weight is critical.

```
┌─────────────────────────────────────┐
│ Press [Enter] to save changes,       │
│ or [Esc] to cancel.                  │
└─────────────────────────────────────┘
```

Press **ENTER** to begin the blank portion of the sample run. When analysis is finished, an audible signal is sounded.

6. The GeoPyc 1360 partially withdraws the plunger. Unscrew the plunger from the right mandrel, push the plunger part way into the chamber, then unscrew the sample chamber from its mandrel.

Carefully remove the plunger. Gently tap it on the open chamber so any adhering Dry*Flo* falls back into the chamber. Brush back into the chamber any Dry*Flo* clinging to the flared edge. Set the plunger aside, seal end facing up. Slide the sample 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 sample run is exactly the same as for the blank run you just performed. It is essential that you avoid losing Dry*Flo* while placing the sample object(s) in the chamber. If Dry*Flo* is lost, you must cancel the run (press **ESCAPE**) and begin again.

7. Replace the chamber/plunger on the analyzer. Press **ENTER**, and analysis automatically begins.

8. When the appropriate number of consolidation cycles is finished, an audible signal is sounded, and the plunger partially withdraws from the chamber. Remove the chamber/plunger, then recover the sample.

Analysis data are displayed on the LCD screen. To clear the screen and return to idle mode, press **ESCAPE** or **ENTER**.

Output Options

If you set your System Options to print or transmit reports automatically, the Envelope Density Report will be generated now.

Press the **2nd** key, then **PRINT** or **TRANSMIT** to generate additional copies after analysis or partial reports during analysis. (To do so, your system must be set up to print or transmit reports and connected to the appropriate output device.)

Refer to **Reports,** page **5-4** for additional information and example reports.

Storing Blank Data

See Chapter 3 for instructions on general operation.

See the preceding sections for definitions of blank, sample, and calibration runs.

Although maximum accuracy is achieved when a blank run is performed immediately before each sample run, it is possible to save time by using stored blank data.

> **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 GeoPyc 1360 can store 10 blank data sets. For each set, you may include data from up to 10 blank runs using graduated quantities of Dry*Flo*. Each set must contain data for at least two quantities of Dry*Flo*. The GeoPyc is then able to interpolate blank volumes between the data points in the set; the appropriate interpolated blank run data are used when you perform your sample run.

How Stored Blank Data are Used

Follow the instructions in this chapter for performing a sample or calibration run. For blank data source, indicate which stored data set to use.

- You specify the number of consolidation cycles for the current run. The GeoPyc 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. You may change the default conversion factor to the calibrated conversion factor for the type of sample you are analyzing.

- You are prompted to enter the Chamber/Medium weight; the GeoPyc interpolates the corresponding stored blank data from that set. Entering an extremely accurate weight is critical.

Example of How Stored Blank Data are Used

Below 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 (shaded). The number of cycles specified in the sample run in this example is 7.

XXXXX represents analysis data in counts.

Number of Cycles	Stored Chamber; Medium Wt 1 X1 g	Stored Chamber; Medium Wt 2 X2 g		Stored Chamber; Medium Wt 3 X3 g	Stored Chamber; Medium Wt 4 X4 g	Stored Chamber; Medium Wt 5 X5 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		
8	XXXXX			XXXXX		
9	XXXXX			XXXXX		
10	XXXXX					
11	XXXXX					
12	XXXXX					
13	XXXXX					
14	XXXXX					
15	XXXXX					

Sample Run Parameters:
    Chamber/Medium Weight: Y g
    Cycles: 7

The number of cycles specified in the sample run determines the number of blank cycles used in calculations.

When you enter the Chamber/Medium weight for your sample run, the GeoPyc determines which two stored blank Chamber/Medium weights it falls between. Each of these weights was measured for a specific number of cycles. You cannot specify more cycles for the sample run than the smaller of these two numbers.

In the example above, the Chamber/Medium weight from the sample run (Y) falls between stored weights 2 and 3. Weight 2 was measured for 15 cycles, but weight 3 was measured for only 9 cycles. Data can, therefore, only be interpolated for 9 points, so 9 is the maximum number of cycles for which the sample can be analyzed.

To determine the maximum number of cycles you may specify, it may be helpful to look at a Blank Data Set Listing.

Weighing the Dry*Flo*

When you are storing blank data, you must enter the quantity of Dry*Flo*, used in each run. This quantity is called the **Chamber/Medium weight**. (This step is not necessary when you perform 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 you cannot achieve this level of accuracy, you may find the technique of using stored blank data less than satisfactory.**

We recommend 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, be careful not to lose any Dry*Flo* in the process. Avoid splashing, and brush into the chamber any Dry*Flo* clinging to the weighing container or to the flared end of the chamber. Even a small amount of Dry*Flo* residue remaining in the measuring container will affect analysis results.

When the GeoPyc prompts you to enter the Chamber/Medium weight, you may 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 makes no difference in analysis calculations, but you must use the same method for both the blank and sample runs for a given sample. If, for example, you include the chamber's weight in your blank run, then you must include the chamber's weight in your sample run.

To Begin Storing Data

To store blank run data, begin with an amount of Dry*Flo* slightly smaller than the smallest amount you plan to use 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* you will use. You can print a report of your stored blank data at any time.

Use the following instructions to start storing data in a new set or to add data to an existing set.

1. Carefully place a quantity of Dry*Flo* in the sample chamber, and weigh it. Accurate weighing is critical.

2. Insert the plunger into the sample chamber, and push part way in. Mount the chamber/plunger assembly on the analyzer.

3. Make sure that the ON/OFF switch on the rear panel is in the ON (|) position.

4. Press **2nd**, then **ANALYZE**.

5. Enter the data as prompted.

Analyze type?　　　　　**Analyze** **Store blank data**	Choose **Store blank data**.

Blank data source?　　　　　**Analyze** **Stored blank data set 1**	Use the left and right arrow keys to choose the blank data set you wish to use. *Range: 1 - 10*

Blank Data Set:　　　　　**Analyze**	Enter an identification for the blank data set. *Range: 9 characters*

Number of cycles:　　　　　**Analyze**	Enter the number of cycles (consolidation cycles) you wish the GeoPyc 1360 to perform during this blank run. Do not include preparation cycles. *Range: 1 - 20*

```
┌─────────────────────────────────────────┐
│  Consolidation Force:        Analyze     │
│  0.00000 Newtons                         │
└─────────────────────────────────────────┘
```

Enter the Consolidation Force. A typical consolidation force for each size chamber is listed in **Table 3-4. Typical Consolidation Force,** page **3-21**.

Range: 1 - 180 Newtons

The consolidation force must have the same value for every run in a Stored Blank Data Set. The value you enter when you start the first run in a Stored Blank Data Set will automatically appear in subsequent runs. If you attempt to change it, you are warned that this will erase all blank data stored for this set.

```
┌─────────────────────────────────────────┐
│  Conversion Factor:          Analyze     │
│  1.0000 cm³/mm                           │
└─────────────────────────────────────────┘
```

Enter the conversion factor. After the first run (of any type) performed with this instrument, the conversion factor is defaulted to the last conversion factor used.

Range: 0 to 9.9999 cm³/mm

```
┌─────────────────────────────────────────┐
│  Chamber/Medium weight:      Analyze     │
│  0.0000 cm³/mm                           │
└─────────────────────────────────────────┘
```

Enter either the weight of the chamber plus medium, or the weight of the medium only. Including or excluding the chamber's weight makes no difference in analysis calculations, *but you must use the same method for both the blank and sample runs for a given sample*.

Range: 000.0000 to 999.9999 grams

Entering an extremely accurate weight is critical.

```
┌─────────────────────────────────────────┐
│  Press [Enter] to save changes,          │
│  or [Esc] to cancel.                     │
└─────────────────────────────────────────┘
```

Press **ENTER** to begin the blank analysis. When analysis is finished, an audible signal is sounded.

6.   The GeoPyc partially withdraws the plunger. Unscrew the plunger from the right mandrel, push the plunger part way into the chamber, then unscrew the sample chamber from its mandrel. The following prompt is displayed.

```
┌─────────────────────────────────────────┐
│  Change amount of medium, press          │
│  [Enter] for another blank, or [Esc] to  │
│  end.                                    │
└─────────────────────────────────────────┘
```

If you wish to continue storing blank run data in this set, change the amount of Dry*Flo* and repeat the process, beginning with chamber/medium weight.

Output Options

To print or transmit the Blank Data Set listing, press the **2nd** key, then **PRINT** or **TRANSMIT**. Select Blank Data Set Listing, then press **ENTER**. Refer to **Printing and Transmitting Data** beginning on page **5-1** for additional information.

Erasing Specific Stored Blank Data Points

You may wish to erase some of the blank data points you have stored in a set. For example, if you believe that one or more points may be inaccurate (perhaps due to inaccurate weighing), you may wish to erase those points. Or, if you find that your range of weights is skewed too high or too low, you may wish to store more points at one end of the range and eliminate points from the other.

> **It may be very helpful to print a Blank Data Set Listing before beginning to erase blank data.**

Press **F5 SETUP**.

Setup type?   Setup
Erase blank data

Choose **Erase blank data**.

Use Stored Blank Data Set?   Setup
Stored blank data set 1

Select the stored blank data set from which you wish to erase data.

From weight: Setup
0.0000 g

To weight: Setup
0.0000 g

Enter the range of points you wish to erase. If you wish to erase a single data point, use that weight for both values.

Range: 000.0000 to 999.9999 g

Blank data in the range will be erased.
[Esc] to cancel, or [Enter] to continue.

To ensure that you do not erase data accidentally, the GeoPyc asks if you are sure you wish to proceed. Press **ESCAPE** to cancel or **ENTER** to continue.

Tips for Successful Operation

The following is a list of tips for operating the GeoPyc:

- Performing a calibration run using an object or objects similar to the sample in 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 in size, shape, and quantity, the better the calibration will be. Calibration with a reference standard works best of all.

- Unless time is critical, performing an embedded blank run during each sample run (the Run Blank Now option) 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, you should 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, so 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 GeoPyc will calculate the percent of sample volume automatically when you:

  –Select **Yes** at the **Calculate % sample volume** prompt in Systems Options.

  –Use a zero depth set from a zero depth run that was performed using the same sample chamber to be used for the sample run.

Verifying Operation

When installing an instrument or if you obtain analysis results that are unexpected or unusual, you should verify the operation of your GeoPyc.

1. Perform a calibration run as described earlier in this chapter.

2. Perform an analysis without a sample. Follow the directions for performing a sample run (refer to **Performing a Sample Run,** page **4-10**). Enter zero for sample weight and density, or enter zero volume for the sample. When you are prompted to place the sample in the chamber, remove the chamber/plunger assembly from the analyzer, but DO NOT remove the plunger. Shake the chamber/plunger assembly to eliminate any compaction of the Dry*Flo*, then replace it on the analyzer. The reported envelope volume for the sample should be very nearly 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, be sure to use the calibrated conversion factor resulting from the calibration run. The sample run results should be within a percent or so of the values ascribed to the sample material during the calibration run.

> **You can also check correct interpolation within stored blank data using this method. Be sure to 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 your weighing accuracy and repeatability. Unless precise weights are obtained, the stored blank test procedure can give misleading results.**

If the procedures above reveal analysis errors:

1. Make sure your Dry*Flo* is flowing freely and not contaminated. Changing to fresh Dry*Flo* is recommended.

2. Evaluate the accuracy of your technique. Are you losing Dry*Flo* due to splashing or spilling when the sample/calibration object is introduced into the chamber? If you are using stored blank data, are you using an extremely accurate method for weighing the Dry*Flo*? (Weights must be accurate to within a few milligrams.)

3. Evaluate the accuracy of your balance using manufacturer's instructions.

4. Consider whether the chamber/plunger assembly may have become loosened from the analyzer during analysis. If you do not attach the chamber and plunger to each mandrel securely, data may be inaccurate.

5. Calibrate the force transducer (refer to Appendix C).

Reviewing and Editing Analysis Parameters

See Chapter 3 for instructions on general operation.

After an analysis, you can use the Review function to change some of the variables used for calculations and reporting. (Of course, variables that control the conditions of the analysis, such as consolidation force, cannot be changed once the analysis has been performed.) For example, after reviewing the Envelope Density Report generated for a given sample, you may wish to change the conversion factor, then print another report.

Press **F6 REVIEW**; the following information is displayed:

> **Sample:**
> **Customer:**
> **Operator:**
> **Sample weight:**
> **Absolute density:**
> **Blank Data Set:**
> **Conversion factor:**
> **Calibration volume:**

Use the ↑ (Up) and ↓ (Down) arrows to move through these fields to check them, making any necessary changes.

Press **ESCAPE** at any time to abandon changes. Press **2nd**, then **SAVE** at any time to save changes. Also, after you check or change the calibration volume, the following prompt is displayed:

> **Press [Enter] to save changes,
> or [Esc] to cancel.**

After you save the changes, you can generate a report using the new values. See Chapter 5 for instructions on printing and transmitting data.

> **Data from an analysis are retained only until the next analysis is performed. A review can only be performed on the last sample that was analyzed.**

Viewing Analysis Results

As an analysis is performed, operational status messages are displayed. When the analysis is complete, you may view data from the analysis on the GeoPyc display. Use the ↓ (Up) and ↑ (Down) arrows to move through the data. The last data items are the summary results. Use the ← (Left) and → (Right) arrows to move through the summary results.

Canceling a Run

See Chapter 3 for instructions on general operation.

You can cancel a run at any time by pressing **ESCAPE**. To protect you from accidentally canceling a run, the following prompt will be displayed:

**Press [Enter] to save changes,
or [Esc] to cancel.**

5. PRINTING AND TRANSMITTING DATA

You may export data to a printer or via RS-232 cable to a computer file. Complete the Report Options and/or Transmission Options setup dialogs (described in Chapter 3) to enable your system to print or transmit reports.

Analysis and calibration reports remain available for printing until another analysis or calibration is performed. When you perform an analysis, reports from the previous analysis or calibration are deleted. A current report on stored blank data is available at any time.

Each optional output method is discussed below. This chapter also includes a sample and description of each type of printed report.

Printed Report

See Chapter 3 for instructions on general operation.

- Before you can print reports, you must complete the Report Options setup dialog (refer to **Report Options,** page **3-8**).

- A report is automatically generated after completion of an analysis.

- A compatible printer must be attached to the analyzer in order to print reports.

- You can stop printing at any time by pressing **ESCAPE**.

To print additional reports after an analysis, or to print reports of partial data at any time during operation, press **2nd**, then **PRINT**.

Print type?   **Print**   **Report**

Choose whether you wish to print a standard report, a report on stored blank data, or a zero depth report.

Choices: Report, Blank Data Set Listing, Zero Depth

Report

Print the standard report for the last analysis performed (the Envelope Density Report for a sample run, or the Calibration Report for a calibration run). Press **ENTER**; the report is printed.

Zero Depth

Print a report on zero depth data. Press **ENTER**; a report including all stored zero depth sets is printed.

Blank Data Set Listing   Print a report on stored blank data. Press **ENTER**; the
following prompt is displayed:

> **Blank data source?**   **Print**
> **Stored blank data set 1**

Select the stored blank data set for this report. Press
ENTER; the stored blank data set is printed.

Transmitted Data

Before you can transmit data, you must complete the Transmission Options setup dialog (refer to **Transmission Options,** page **3-9**). Before data can be transmitted automatically after an operation, you must also complete the Report Options dialog, specifying **Serial Port** for **Automatic Report Destination**.

Data are transmitted in ASCII format, according to the protocols you specified in your Transmission Options setup dialog. Refer to Appendix D beginning on page **D-1** for additional information on the format of transmitted data.

An RS-232 cable must be attached to the analyzer in order to transmit reports.

Ensure that the destination software selected will accept the output from the analyzer.

You can stop printing at any time by pressing **ESCAPE**.

To transmit reports of partial data at any time during operation, or to transmit additional reports after analysis, press **2nd**, then **TRANSMIT**.

Transmit type? Print **Report**	Choose whether you wish to transmit data for a standard report, a report on stored blank data, or a zero depth report. *Choices: Report, Blank Data Set Listing, Zero Depth*

Report   Transmit data for the last analysis performed (the Envelope Density Report for a sample run, or the Calibration Report for a calibration run). Press **ENTER**; data for the report are transmitted.

Zero Depth   Transmit a report on zero depth data. Press **ENTER**; a report including all stored zero depth sets is transmitted.

Blank Data Set Listing   Transmit data for stored blank data. Press **ENTER**; the following prompt is displayed:

Blank data source? Print **Stored blank data set 1**	

Select the stored blank data set for this report. Press **ENTER**; the stored blank data set is transmitted.

Reports

Blank Data Set Listing

You can print a Blank Data Set Listing for each set of data you have stored.

For each quantity of Dry*Flo* stored in the set, this report lists the counts (steps moved by the displacement device) during each cycle.

The variables you specified when you stored the blank data (set number, conversion factor, number of preparation cycles, set identification, consolidation force) are listed at the top of the report. The instrument serial number, operator name, date, and time also are displayed.

<u>How to use this report</u>:

This report is very helpful when you wish to add or delete stored blank data because it enables you to evaluate the range of Dry*Flo* weights you have stored. For example, after reviewing a Blank Data Set Listing, you may realize that all your Dry*Flo* weights are too low, and that you should store additional data in the set using larger amounts of Dry*Flo*.

In the case of deleting data, this report helps you identify the Dry*Flo* weights you wish to delete.

When you are performing sample or calibration runs using stored data, looking at current Blank Data Set Listings enables you to select the appropriate set (if you have stored more than one set) and helps you make sure the amount of Dry*Flo* you are using in the current run is within the range of Dry*Flo* amounts you have stored in the set.

GeoPyc 1360 VX.XX
Blank Data Set Listing

Instrument: 110   Date: 06/06/1997
                                            Time: 10:22:35

Blank Data Set: 1 inch   Blank Data Set#: 1
Preparation Cycles: 2
Consolidation Force: 51.0000 N
Conversion Factor: 0.5067   cm^3/mm

Chamber/Medium Weight (grams)

Cycle	145.56070	146.55890	147.55800	148.55730	150.06000
#	Count	Count	Count	Count	Count
1	19318	17596	15876	14147	11604
2	19321	17604	15894	14173	11626
3	19322	17607	15906	14190	11645
4	19324	17613	15916	14202	11658
5	19325	17618	15924	14213	11672

Example of Blank Data Set Listing Report

Calibration Report

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. A complete discussion of calibration runs is contained in Chapter 4.

The variables specified for the calibration run are listed at the top of the report. The instrument serial number, operator name, date, and time also are displayed.

For each cycle, the report lists:

Blank counts: The number of steps the motor moved to achieve the consolidation force specified for the blank run.

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 GeoPyc to volume.

Deviation (volume):   The difference between the average envelope volume and the volume measured for this consolidation cycle.

Below these data points, the report displays the average envelope volume and standard deviation, as well as the volume error (the adjustment to the volume attributed to the sample's shape, size, etc.).

How to use this report:

At the bottom of the report, the conversion factor is printed. Use this conversion factor in sample runs for samples similar to the calibration object used in this run. For even 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.

```
                              GeoPyc 1360 VX.XX
                               Calibration Report


Instrument:    110                              Date:    06/06/1997
Operator:      Gary                             Time:    13:03:54

Customer:      CAL LAB              Absolute Density:    2.5202 g/cm³
Sample:        6MM GLASS BEADS      Sample Weight:       3.4027 g

Blank Data Set:     Chmb 25.4       Blank Data Source: Stored Set 2
Preparation Cycles:    2            Measured Cycles:   5
Calibration Volume:    1.3501 cm³   Porosity:          0.0000 %
Consolidation Force:   38.0000 N    Conversion Factor: 0.1000 cm³/mm
Chamber/Medium Weight: 270.3000 g
_____


    Cycle      Blank      Sample      Volume      Deviation
     #        Counts      Counts       cm³          cm³
     1        11365        9657       1.2879       -0.0089
     2        11386        9669       1.2974       -0.0021
     3        11402        9679       1.2992        0.0024
     4        11413        9686       1.3022        0.0054
     5        11420        9696       1.3000        0.0031


Average Envelope Volume:  1.2968   cm³      Standard Deviation:   0.0056
Volume Error:            -0.0533   cm³
_____

Conversion factor to give zero volume error for this run: 0.2967 cm³/mm
```

Example of Calibration Report

Envelope Density Report

This report lists the counts (steps moved by the displacement device) during each cycle of a sample run.

The variables specified for the sample run are listed at the top of the report. The instrument serial number, operator name, date, and time also are displayed. For each cycle, the report lists:

Blank counts: The number of steps the motor moved to achieve the consolidation force specified for the blank run.

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 GeoPyc to volume.

Deviation (volume):   The difference between the average envelope volume and the volume measured for this consolidation cycle.

Density: The envelope density calculated for the sample during this consolidation cycle.

Deviation (density):   The difference between the average density and the density for this cycle.

Below these data points, the report displays average envelope volume and its standard deviation, and average envelope density and its standard deviation.

If you entered absolute density data, the report prints the percent porosity and specific pore volume. If you entered a zero depth set number, the percent sample volume is displayed.

<u>How to use this report</u>:

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.

GeoPyc 1360 V X.XX
Envelope Density Report

Instrument: 110   Date: 05/27/1997
Operator: WDM   Time: 13:17:55

Customer: LNK   Absolute Density: 2.3446 g/cm³
Sample: SAMPLE 112   Sample Weight: 4.2639 g

Blank Data Set: Internal   Blank Data Source: Internal
Preparation Cycles: 2   Measured Cycles: 5
Chamber Diameter: 25.4000 mm   Zero Depth: 32.5225 mm**
Consolidation Force: 65.0000 N   Conversion Factor: 0.5067 cm³/mm

Cycle #	Blank Count	Sample Count	Volume cm³	Deviation cm³	Density g/cm³	Deviation g/cm³
1	13463	11534	2.5861	-0.0037	1.6487	0.0023
2	13480	11550	2.5874	-0.0024	1.6479	0.0015
3	13496	11562	2.5928	0.0029	1.6445	-0.0018
4	13506	11572	2.5928	0.0029	1.6445	-0.0018
5	13513	11581	2.5901	0.0002	1.6462	-0.0001

Average Envelope Volume: 2.5898 cm³   Standard Deviation: 0.0030
Average Envelope Density: 1.6463 g/cm³   Standard Deviation: 0.0019
Specific Pore Volume: 0.180 cm³/g   Percent Porosity: 29.77 %
Percent Sample Volume: 30.012 %**

If you select **No at the **Calculate % sample volume?** prompt in
System Options, these fields display as follows:

Zero Depth: not used
Percent Sample volume: xx.xxx %

Example of Envelope Density Report

Zero Depth Report

This report lists the chamber diameter and zero depth contained in up to five zero depth sets.

For each zero depth run, the report lists:

Chamber diameter: The user-entered diameter of the chamber in millimeters.

Zero depth: The zero depth of the sample chamber, which is the depth to which the plunger travels when the sample chamber is empty.

How to use this report:

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.

```
                        GeoPyc 1360 V X.XX
                          Zero Depth Report

Instrument:   110                           Date:   06/06/1997
                                            Time:   10:22:05
_____

    Chamber Diameter        Zero Depth
          mm                    mm
    _____        _____

        25.4000               32.5225
        50.8000               31.6342
        38.1000               32.0978
        19.1000               32.7752
        12.7000               31.9837
```

Example of Zero Depth Report

6. ORDERING INFORMATION

Part Number	Item and Description
136-00000-00	GeoPyc 1360 Pycnometer for determining envelope volume and envelope density. When absolute density is provided, the GeoPyc also calculates pore volume and percent porosity. Includes internal computer with software, LCD screen, operator's manual, and keypad.
004-16831-01	Dry*Flo*, 3 L
136-42001-00	English language overlay (keypad template)
136-42002-00	Spanish language overlay (keypad template)
136-42003-00	French language overlay (keypad template)
136-42004-00	German language overlay (keypad template)
136-42005-00	Italian language overlay (keypad template)
136-25852-01	Piston coupling extender, for zero depth runs
136-25801-03	Plunger, for 12.7, 19.1, and 25.4-mm chamber
136-25804-03	Plunger, for 38.1 and 50.8-mm chamber
136-25801-00	Sample chamber and plunger assembly, 12.7-mm ID
136-25801-10	Sample chamber, 12.7-mm ID
136-25801-07	Piston, for 12.7-mm ID plunger
136-25802-00	Sample chamber and plunger assembly, 19.1-mm ID
136-25802-10	Sample chamber, 19.1-mm ID
136-25802-07	Piston, for 19.1-mm ID plunger
136-25803-00	Sample chamber and plunger assembly, 25.4-mm ID
136-25803-10	Sample chamber, 25.4-mm ID
136-25803-07	Piston, for 25.4-mm ID plunger
136-25804-00	Sample chamber and plunger assembly, 38.1-mm ID
136-25804-10	Sample chamber, 38.1-mm ID
136-25804-07	Piston, for 38.1-mm ID plunger
136-25805-00	Sample chamber and plunger (piston), 50.8-mm ID
136-25805-10	Sample chamber, 50.8-mm ID
136-25805-07	Piston, for 50.8-mm ID plunger

Part Number	Item and Description
004-32177-00	Funnel, plastic
004-27059-00	Sieve, No. 35, 500 μm
004-27065-00	Sieve pan, 3-in. diameter
004-54613-00	Brush, dusting, 3/8-in. wide x 3/4-in. long
136-34800-00	Spring Standard (Force Transducer Calibration Fixture)
136-42801-00	Operator's Manual
136-33005-00	T.A.P. density option. Includes software card, manual, piston coupling extension, and upgrade information.
130-00001-00	AccuPyc 1330 Helium Pycnometer, 1 cm^3, for absolute density measurement
130-00000-00	AccuPyc 1330 Helium Pycnometer, 10 cm^3, for absolute density measurement
133-00002-00	AccuPyc 1330 Helium Pycnometer, 100 cm^3, for absolute density measurement
Call for model and part number.	Printer, connects to the GeoPyc 1360 or to the AccuPyc 1330 to print reports.

A. CALCULATIONS

This appendix includes calculations for information presented on the envelope density report.

The envelope volume of a sample is determined by the difference in how far the plunger is driven (by a stepping motor) into a cylinder containing only Dry*Flo* and then when sample is added. The steps of the motor (C) are counted and used to calculate volume; they are also shown on reports. The counts are converted to volume by multiplying them by the conversion factor (v, cm^3/count). The conversion factor is displayed as cm3/mm.

The default envelope volume of the sample V is then the difference in the counts with the sample present $C_{present}$ and with it absent C_{absent} multiplied by v or

$$V = [(C_{present} - C_{absent})v]cm^3 \qquad (1)$$

When a calibration test is made with a sample of known volume V, the above equation is solved for v. This value of v then becomes the conversion factor (conversion factors expressed as cm^3/mm are similarly derived).

The envelope density of the sample ρ_e is its mass W divided by its envelope volume or

$$\rho_e = \left[\frac{W}{V}\right]g/cm^3 \qquad (2)$$

The porosity of a sample P as a percentage when its absolute density ρ_a is known is given by

$$P = \left[\left(1 - \frac{\rho_e}{\rho_a}\right)100\right]\% \qquad (3)$$

The sample specific pore volume V_p is given by

$$V_p = \left[\frac{1}{\rho_e} - \frac{1}{\rho_a}\right]cm^3/g \qquad (4)$$

When a calibration test is made with a sample of known weight W, absolute density ρ_a, and porosity P, eq. 3 with eq. 2 substituted for ρ_e is used to calculate envelope volume V as required of eq. 1.

The percent sample volume (the percentage of the bed volume which is actual sample) is given by

$$V_S = \left[\left(\frac{\text{Average of C}_{absent} - \text{Average of C}_{present}}{\left(\dfrac{\text{Zero depth}}{\text{Step size}} \right) - \text{Average of C}_{present}} \right) 100 \right] \%$$ (5)

where

Zero depth = the distance (mm) the plunger moves into an empty sample chamber until it contacts the bottom of the chamber

Step size = 25.4 mm/in. ÷ 9600 steps/in.

The following table lists the calculated conversion factor for each size chamber. It also lists adjusted conversion factors based on a multitude of tests assessing cylinder wall friction and other factors. The conversion factors listed here are intended primarily as a starting point for situations where it is not practical to calibrate the conversion factor. (Obtaining a calibrated conversion factor by performing a calibration run is the preferred method.)

Internal Chamber Diameter (mm)	Calculated Conversion Factor (cm³/mm)	Adjusted Conversion Factor (cm³/mm)
12.7	0.1267	0.1284
19.1	0.2850	0.2907
25.4	0.5067	0.5153
38.1	1.1401	1.1492
50.8	2.0268	2.0373

It may be necessary to alter the adjusted conversion factor according to analysis variables, such as the consolidation force. If you wish to fine-tune the adjusted conversion factor, you must develop a methodology suited to the analysis parameters you select and the specifications you must meet. Results using the adjusted conversion factors rarely will be outside the ± 3% error range.

B. ERROR MESSAGES

This appendix includes the error messages you may encounter while operating the GeoPyc software. For your convenience, they are arranged in alphabetical order.

ANALYSIS_ERR: Divided by zero.
Unable to calculate calib. volume.

Cause:	Zero absolute density or 100% porosity was entered.
Action:	Enter a valid value

ANALYSIS_ERR: Limit switch is on
Failed to reach target force.

Cause:	The instrument was unable to generate the target consolidation force you specified during your blank run.
Action:	Verify that the chamber/plunger system is correctly mounted on the analyzer. Make sure you are using the correct amount of Dry*Flo*. Try again.

ANALYSIS_ERR: Unable to calculate
blank data from the Blank Data Set.

Cause A:	Chamber/medium weight entered was not in the range of stored data.
Action A:	Perform additional blank runs to store additional data in this Blank Data Set. Alternatively, use another Blank Data Set or use a blank run during (embedded in) the sample or calibration run.
Cause B:	The number of cycles you specified in this sample or calibration run exceeds the number of cycles for which stored blank data are interpolated. See **Storing Blank Data,** page **4-14** for more information.
Action B:	Restart this run using a number of cycles equal to or less than the number for which blank data are interpolated. Look at the Blank Data Set Listing for the set you are using. Determine the two stored chamber/ medium weights that your sample or calibration chamber/medium weight falls between. The smaller number of cycles used for these two stored weights is the maximum number you may use during this run.

DATA_ERR:
No data to compute.

> *Cause:*   The run was canceled before any data were collected.

> *Action:*   Re-run the sample.

OUTPUT_ERR:Timeout
Print port failed to respond.

> *Cause:*   The printer port is not responding.

> *Action:*   Verify that the cable is properly connected at both ends and that the
> printer is turned on, loaded with paper, not set to LOCAL, and not off
> line.

OUTPUT_ERR: Timeout
Serial port failed to respond.

> *Cause:*   The serial port is not responding.

> *Action:*   Verify that the cable is properly connected at both ends and that the tar-
> get computer is ready to receive data.

SYS_ERR: Corrupted BB RAM
BB RAM has been initialized.

> *Cause:*   The program in the battery-backed memory is different than the program
> in the new memory card.

> *Action:*   Verify that the correct memory card is loaded. Reload the card, follow-
> ing the instructions in Chapter 2.

SYS_ERR: Power Failure
XX/XX blank cycles completed.

Cause: A power failure occurred during the collection of blank data. The display shows the number of cycles completed, a slash, then the number requested.

Action: Start the analysis over. A partial report is available. See Chapter 5, Printing and Transmitting Data.

SYS_ERR: Power Failure
XX/XX calibration cycles completed.

Cause: A power failure occurred during the calibration run. The display shows the number of cycles completed, a slash, then the number requested.

Action: Start the run over. A partial report is available. See Chapter 5, Printing and Transmitting Data.

SYS_ERR: Power Failure
XX/XX sample cycles completed.

Cause: A power failure occurred during the sample run. The display shows the number of cycles completed, a slash, then the number requested.

Action: Start the run over. A partial report is available. See Chapter 5, Printing and Transmitting Data.

SYS_ERR: Timeout
ADC I/O failure.

Cause: Possible hardware failure in the analog to digital converter.

Action: Turn the power off, then on again. If the message returns, call your service representative

SYS_ERR: Timeout
Return to home position failed.

Cause: The system was unable to find the fully-retracted (home) position.

Action: Verify that there is nothing restricting the movement of the plunger. Turn the power off, then on. If the message returns, call your service representative.

This Zero Depth Set has no data,
Press [Enter] to cancel.

Cause: You selected a zero depth set that contains no data.

Action: Select a zero depth set that contains data from a zero depth run or press **ESCAPE** to cancel.

UI_ERR: Blank analysis must be run first
Press [Enter] to cancel.

Cause: You requested a Stored Blank Data Set for which there is no data.

Action: Select a valid Stored Blank Data Set, or select Run Blank Now to perform a blank run before analysis.

UI_ERR: Invalid format
Day field: 1 - 31 required.

Cause: Value entered is invalid.

Action: Enter a value in the specified format and range.

UI_ERR: Invalid format
dd/mm/yy required.

Cause: The date you entered is invalid for the format you chose in your system setup.

Cation: Enter the date in the format shown.

**UI_ERR: Invalid format
hh:mm:ss required.**

Cause:	The time you entered is invalid for this format.
Action	Enter the time in the format shown.

**UI_ERR: Invalid format
Hour field: 0 - 23 required.**

Cause:	Value entered is invalid.
Action:	Enter a value in the specified format and range.

**UI_ERR: Invalid format
Minute field: 0 - 59 required.**

Cause:	Value entered is invalid.
Action:	Enter a value in the specified format and range.

**UI_ERR: Invalid format
mm/dd/yy required.**

Cause:	The date you entered is invalid for the format you chose in your system setup.
Action:	Enter the date in the format shown.

**UI_ERR: Invalid format
Month field: 1 - 12 required.**

Cause:	Value entered is invalid.
Action:	Enter a value in the specified format and range.

UI_ERR: Invalid format
Second field: 0 - 59 required.

Cause: Value entered is invalid.

Action: Enter a value in the specified format and range.

UI_ERR: Invalid format
Year field: 1990 - 2089 required.

Cause: Value entered is invalid.

Action: Enter a value in the specified format and range.

UI_ERR: Out of range
Integer XXXXX - XXXXX required.

Cause: You entered a number outside the accepted range.

Action: Enter a number within the range shown.

UI_ERR: Out of range
Number XXXXX.XX - XXXXX.XX required.

Cause: You entered a number outside the accepted range (includes decimals).

Action: Enter a number within the range shown.

UI_ERR: View only field.
This field can not be changed from here.

Cause: This field value is derived from the blank run parameters.

Action: Use the value defaulted from the blank run or press **ESCAPE** to cancel
                  the run.

**Warning: This Zero Depth set already has
valid data. [Enter] to continue.**

Cause: You entered the number of a zero depth set that already contains data.

Action: If you do not wish to overwrite the existing data, press **ENTER**. Then
                  use ↑ (up arrow) to return to the **Which Zero Depth set?** prompt and
                  select another zero depth set. If you wish to overwrite the existing data,
                  press **ENTER** to continue.

**WARNING: Only 1 run
Standard deviation not computed.**

Cause: Not enough data were collected for the standard deviation to be calcu-
                  lated (need at least 5 cycles for meaningful interpretation).

Action: Re-run the sample using at least 5 compression cycles. (Number of
                  cycles is entered during the blank run.)

**WARNING: Analysis canceled
Result based on partial data collected.**

Cause: The analysis was canceled before completion.

Action: If desired, perform the analysis again.

**WARNING: Prep. runs < 2
Result possibly not accurate.**

Cause: You specified less than two preparation cycles in your system setup.

Action: Data may be inaccurate. We recommend changing your system setup to
                  use at least two preparation cycles.

C. MANUAL OPERATION

This chapter contains instructions for controlling some aspects of the GeoPyc's operation. Manual mode is not available during an analysis. Because calibration of the force transducer is accessed through the manual operation menu, it is also described in this chapter.

> **Manual Mode is intended for maintenance and diagnostics only. To avoid damaging the instrument, do not perform manual operations when a chamber or plunger is mounted on the analyzer.**

Accessing Manual Mode

Press the **2nd key**, then **MANUAL** access manual mode.

The Manual Mode Display

The display indicates manual mode and displays the status of several operations parameters:

Ag: Indicates the state of the chamber agitator — On or Off.

Move: Indicates the state of the plunger displacement motor — either Off or +/- steps per second, where + is forward steps and - is backward steps.

Limit switch indicators   > | indicates that the plunger is at the right limit.

                                     | < indicates that the plunger is at the left limit.

Home: Indicates that the Home indicator is set.

Force: Displayed in Newtons or in raw counts (from the internal analog to digital converter).

Position: Displays the position of the displacement device.

Using Manual Mode Functions

Press **2nd**, then **MANUAL**; the manual mode display appears.

1. From the manual mode display, press **ENTER** to access a menu of operations choices.

2. Use the → (right) and ← (left) arrow keys to scroll through the manual mode functions.

3. When the function you wish to use is displayed, press **ENTER** to start that function. In some cases, you are prompted to enter information before the function is executed.

You may press ESCAPE to exit manual mode at any time.

Function Descriptions

> **Which operation?   Manual**
> **Move to Home**

This operation moves the displacement device (plunger) directly to the home position.

> **Which operation?   Manual**
> **Move number of steps (+ or –)**

Moves the displacement device a specified number of steps. After you select this option, the following prompt is displayed:

> **Steps to move: Manual**
> **   Steps**

Enter the number of steps. The instrument assumes that you wish the plunger to move forward (+) unless you indicate backward steps by typing a - symbol before the number of steps.

The range is limited by the position of the plunger when you initiate this operation. To decide how many steps you wish to move the plunger, consider that one step is approximately 0.0026 mm, so 400 steps move the plunger approximately 1 mm.

Range: -24,000 to 24,000

```
┌──────────────────────────────────────┐
│  Which operation?          Manual     │
│  Set movement speed                   │
└──────────────────────────────────────┘
```

Sets the speed with which the plunger moves. After you select this option, the following prompt is displayed so that you may enter the speed:

```
┌──────────────────────────────────────┐
│  Speed:                    Manual     │
│      Step/sec                         │
└──────────────────────────────────────┘
```

Range: 5 to 400 steps/second

Each step of the motor causes a linear movement of 0.0026 mm. Selecting a speed of 400 steps/second, for example, causes the plunger to move approximately 1 mm/second. Due to internal electronic circuit limitations, the practical speed choices are:

5, 10, 20, 40, 80, 150, 200, 300, and 400 steps/second

```
┌──────────────────────────────────────┐
│  Which operation?          Manual     │
│  Move until force achieved            │
└──────────────────────────────────────┘
```

Moves the displacement device forward until a specified force is achieved. After you select this option, the following prompt is displayed so that you may enter the desired force.:

```
┌──────────────────────────────────────┐
│  Move until force:         Manual     │
│  0.00000 Newtons                      │
└──────────────────────────────────────┘
```

Range: 0 to 180 Newtons

```
┌──────────────────────────────────────┐
│  Which operation?          Manual     │
│  Toggle agitation on/off              │
└──────────────────────────────────────┘
```

Allows you to turn the chamber agitation on or off. Pressing **ENTER** after you select this option changes it from the current value to the opposite value.

```
┌──────────────────────────────────────┐
│  Agitation?                Manual     │
│  Low                                  │
└──────────────────────────────────────┘
```

Lets you specify **High** or **Low** agitation amplitude. Agitation must be OFF in order for the amplitude to be changed.

```
┌──────────────────────────────────────┐
│  Which operation?          Manual     │
│  Toggle force display units           │
└──────────────────────────────────────┘
```

Allows you to switch between Newtons and uncorrected digital counts as the force display unit. Pressing **ENTER** after you select this option changes it from the current value to the opposite value.

```
Which operation?          Manual
Calibrate force transducer
```

To calibrate the force transducer, either return the instrument to Micromeritics for calibration (refer to **Equipment Return,** page **2-1**) or calibrate it using the optional spring standard (force transducer calibration fixture). See Chapter 6 for ordering information.

You must have the calibration fixture before you can complete the force transducer calibration. Do not proceed without this fixture.

After you select this option, the following prompt is displayed so that you may enter the Spring Constant, which is provided on the spring standard's certificate:

```
Spring Constant:          Manual
0.00000 N/mm
```

Next, the following prompt is displayed so that you may remove the chamber from the analyzer:

```
Remove chamber from the instrument.
[Esc] to cancel, or [Enter] to continue.
```

It is very important that nothing is mounted on the analyzer at this point.

After the analyzer makes a small adjustment to the plunger mandrel position, the following prompt is displayed so that you may mount the spring standard on the analyzer:

```
Please mount spring standard.
[Esc] to cancel, or [Enter] to continue.
```

Mount the spring standard exactly as you mount a chamber/plunger assembly. Press **ENTER**, and calibration begins. After taking several readings, the analyzer automatically completes the calibration and returns to home position.

| Which operation?   Manual |
| Print force calibration report |

Generates a report that includes data about the most recent force calibration. Refer to the following section for a description of this report.

| Which operation?   Manual |
| Exit manual mode |

Exits the manual operations menu and returns the display to the Reload prompt.

Force Calibration Report

This report can be obtained after performing a force transducer calibration.

The report header displays the date and time the calibration occurred, as well as identifying the instrument and the operator who performed the calibration. The spring constant entered by the operator during the calibration is also reported.

Points:	Calibration readings are taken at 10 points. For each point, the report lists:
	Displacement counts: the number of steps of the motor from home position to the point at which force sensor data is recorded.
	Spring force (**N**): the force exerted by the displacement device at this point, calculated by the instrument from the spring constant and the displacement distance.
	Force sensor reading: the uncorrected value from the analog to digital electronics.
Slope:	Calculated using the above data; used internally by the GeoPyc 1360 to calibrate the force transducer (converts analog force sensor readings into Newtons, after removing a zero offset).
Standard deviation:	Calculated using the above data. A standard deviation less than 1.0 is desirable.
Number of displacement cycles:	A record of how many cycles have been performed by the analyzer since the instrument was first calibrated.
Number of counts deviation at home position:	The difference between the displacement device's home position at the beginning of the calibration procedure and the home position at the end of the procedure. This number is measured in steps of the motor (counts). A few counts difference is acceptable; zero is ideal.

At the bottom of the report, the time and date that the report is generated are printed. The current number of displacement cycles is also printed. 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.

How to use this report:

The transducer is calibrated internally during the calibration process. If the standard deviation and number of counts deviation are within the limits above, no action is needed. If analysis data still appear inaccurate or unexpected, you may wish to investigate other causes, such as contaminated Dry*Flo*, inaccurate weighing, or other methodology problems.

However, 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.

```
                            GeoPyc 1360 VX.XX
                          Force Calibration Report


   Instrument ID:                                    Date: 01/22/1996
   Operator ID:                                      Time: 10:07:02
   -------------------------------------------------------------------
   Spring Constant:    4.2960 N/mm

              Displacement    Spring           Force Sensor
   Point#       Counts        Force(N)          Reading
   ------       ------        --------          -------
     1          17599          140.1            48723
     2          16893          132.1            47796
     3          16187          124.0            46853
     4          15481          116.0            45923
     5          14775          107.8            44979
     6          14069           99.9            44061
     7          13363           91.9            43132
     8          12657           83.9            42204
     9          11951           75.8            41262
    10          11245           67.8            40337


   Slope(force sensor calibration factor):    0.0086
   Standard Deviation:    0.0607
   Number of displacement cycles = 2344
   Number of counts deviation at home position = 0


   -------------------------------------------------------------------
   Current time: 01/22/1996 10:50:03
   Current displacement cycles = 2400
```

Example of Force Calibration Report

D. FORMAT OF TRANSMITTED DATA

Data can be transmitted in one of three user-selectable formats — report, single column, or spreadsheet. The report format is identical to the printed report. Single-column and spreadsheet are in ASCII-delimited format. Spreadsheet format is suitable for direct import into many popular spreadsheets.

In all tables, units are as follows:

Date	DD/MM/YY
Time	HH:MM:SS
Pressure	mmHg
Elapsed Time	seconds

Envelope Density (Analysis) Report

Record Number	Information Conveyed	Form
1	Report title	20 characters
2	Instrument model number and software version number	20 characters
3	Report type (=1)	1 integer
4	Instrument	8 characters
5	Date	10 characters
6	Operator	8 characters
7	Time	8 characters
8	Customer	8 characters
9	Absolute density	1 floating point
10	Sample	20 characters
11	Sample weight	1 floating point
12-13	Reserved	1 floating point
14	Blank Data Set	8 characters
15	Blank Data Source	1 integer
16	Number of preparation cycles	1 integer
17	Number of measurement cycles	1 integer
18	Chamber Diameter	1 floating point
19	Zero Depth	1 floating point
20	Consolidation force	1 floating point
21	Conversion factor	1 floating point
22	Chamber/Medium weight	1 floating point

Record Number	Information Conveyed	Form
23	Average volume	1 floating point
24	Volume standard deviation	1 floating point
25	Average density	1 floating point
26	Density standard deviation	1 floating point
27	Specific Pore Volume	1 floating point
28	Percent porosity	1 floating point
29	Percent Sample Volume	1 floating point
30-31	Reserved	1 floating point
	(Single column)	
	For I=1 to Number of complete runs	
32	Blank counts	1 integer
33	Sample counts	1 integer
34	Volume	1 floating point
35	Volume deviation	1 floating point
36	Envelope density	1 floating point
37	Envelope density deviation	1 floating point
	End for 1	
	(Spreadsheet)	
32	Carriage return/Line Feed	
33	Carriage return/Line Feed	
34	Carriage return/Line Feed	
	For I=1 to Number of complete runs	
35a	Blank counts	1 integer
35b	Sample counts	1 integer
35c	Volume	1 floating point
35d	Volume deviation	1 floating point
35e	Envelope density	1 floating point
35f	Envelope density deviation	1 floating point
	End for 1	

Calibration Report

Record Number	Information Conveyed	Form
1	Report title	20 characters
2	Instrument model number and software version number	20 characters
3	Report type (=2)	1 integer
4	Instrument	8 characters
5	Date	10 characters
6	Operator	8 characters
7	Time	8 characters
8	Customer	8 characters
9	Absolute Density	1 floating point
10	Sample	20 characters
11	Sample Weight	1 floating point
12-13	Reserved	1 floating point
14	Blank Data Set	8 characters
15	Blank Data Source1 integer	16
16	Number of preparation cycles	1 integer
17	Number of measurement cycles	1 integer
18	Calibration Volume	1 floating point
19	Percent porosity	1 floating point
20	Consolidation force	1 floating point
21	Conversion factor	1 floating point
22	Chamber/Medium weight	1 floating point
23	Average volume	1 floating point
24	Volume standard deviation	1 floating point
25	Volume error	1 floating point
26	New conversion factor	1 floating point
27-28	Reserved	1 floating point
	(Single column)	
	For I=1 to Number of complete runs	
29	Blank counts	1 integer
30	Sample counts	1 integer
31	Volume	1 floating point
32	Volume deviation	1 floating point
	End for 1	

Record Number	Information Conveyed	Form
	(Spreadsheet)	
29	Carriage return/Line Feed	
30	Carriage return/Line Feed	
31	Carriage return/Line Feed	
	For I=1 to Number of complete runs	
32a	Blank counts	1 integer
32b	Sample counts	1 integer
32c	Volume	1 floating point
32d	Volume deviation	1 floating point
	End for 1	

Zero Depth Report

Record Number	Information Conveyed	Form
1	Report title	20 characters
2	Instrument model number and software version number	20 characters
3	Report type (=3)	1 integer
4	Instrument	8 characters
5	Date	10 characters
6	Time	8 characters
	(Single column)	
	For I=1 to 5	
7-11	Chamber diameter	1 floating point
12-16	Zero depth	1 floating point
	End for 1	
	(Spreadsheet)	
7	Carriage return/Line Feed	
8	Carriage return/Line Feed	
9	Carriage return/Line Feed	
	For I=1 to 5	
10a	Chamber diameter	1 floating point
10b	Zero depth	1 floating point
	End for 1	

Force Calibration Report

Record Number	Information Conveyed	Form
1	Report title	20 characters
2	Instrument model number and software version number	20 characters
3	Report type	1 integer
4	Instrument	8 characters
5	Operator	8 characters
6	Date	10 characters
7	Time	8 characters
8	Spring constant	1 floating point
9	Force sensor calibration factor	1 floating point
10	Standard deviation	1 floating point
11	Number of displacement cycles	1 long integer
12	Home position deviation	1 integer
	(Single column)	
	For I=1 to Number of complete runs	
13	Point Number	1 integer
14	Displacement counts	1 integer
15	Spring force	1 floating point
16	Force sensor reading	1 integer
	End for 1	
	(Spreadsheet)	
13	Carriage return/Line Feed	
14	Carriage return/Line Feed	
15	Carriage return/Line Feed	
	For I=1 to Number of complete runs	
16a	Point Number	1 integer
16b	Displacement counts	1 integer
16c	Spring force	1 floating point
16d	Force sensor reading	1 integer
	End for 1	

Blank Data Set Listing

Record Number	Information Conveyed	Form
1	Report title	20 characters
2	Instrument model number and software version number	20 characters
3	Report type (=0)	1 integer
4	Instrument	8 characters
5	Date	10 characters
6	Time	8 characters
7	Blank data set	8 characters
8	Blank data set number	1 integer
9	Number of prep. cycles	1 integer
10	Consolidation force	1 floating point
11	Conversion factor	1 floating point
12-13	Reserved	1 floating point
	(Single column)	
	For I=1 to 10	
14-23	Chamber/Medium Weight	1 floating point
	End for 1	
	For J=1 to 20	
	For I=1 to 10	
24-223	Blank count	1 integer
	End for 1	
	End for J	
	(Spreadsheet)	
14	Carriage return/Line Feed	
15	Carriage return/Line Feed	
16	Carriage return/Line Feed	
17a	Chamber/Medium Weight	1 floating point
17b	Chamber/Medium Weight	1 floating point
17c	Chamber/Medium Weight	1 floating point
17d	Chamber/Medium Weight	1 floating point
17e	Chamber/Medium Weight	1 floating point
17f	Chamber/Medium Weight	1 floating point
17g	Chamber/Medium Weight	1 floating point
17h	Chamber/Medium Weight	1 floating point
17i	Chamber/Medium Weight	1 floating point

Record Number	Information Conveyed	Form
17j	Chamber/Medium Weight	1 floating point
	For J=1 to 20	
18a	Blank count	1 integer
18b	Blank count	1 integer
18c	Blank count	1 integer
18d	Blank count	1 integer
18e	Blank count	1 integer
18f	Blank count	1 integer
18g	Blank count	1 integer
18h	Blank count	1 integer
18i	Blank count	1 integer
18j	Blank count	1 integer
	End for J	

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