

**GeoPyc 1360  
T.A.P. Density**

**Operator's Manual**

**V1.05t**

GeoPyc and DryFlo are registered trademarks of Micromeritics Instrument Corporation.  
Teflon is a registered trademark of E.I. Du Pont de Nemours Company.

---

© Micromeritics Instrument Corporation 2001. All rights reserved.

The software described in this manual is furnished under a license agreement and may be used or copied only in accordance with the terms of the agreement.

# WARRANTY

MICROMERITICS INSTRUMENT CORPORATION warrants for one year from the date of shipment each instrument it manufactures to be free from defects in material and workmanship impairing its usefulness under normal use and service conditions except as noted herein.

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.

MICROMERITICS shall be released from all obligations under its warranty in the event repairs or modifications are made by persons other than its own authorized service personnel unless such work is authorized in writing by MICROMERITICS.

The obligations of this warranty will be limited under the following conditions:

1. Certain products sold by MICROMERITICS are the products of reputable manufacturers, sold under their respective brand names or trade names. We, therefore, make no express or implied warranty as to such products. We shall use our best efforts to obtain from the manufacturer, in accordance with his customary practice, the repair or replacement of such of his products that may prove defective in workmanship or materials. Service charges made by such manufacturer are the responsibility of the ultimate purchaser. This states our entire liability in respect to such products, except as an authorized person of MICROMERITICS may otherwise agree to in writing.
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.

---

**4356 Communications Drive • Norcross, GA 30093-1877 • Fax (770) 662-3696**

---

Domestic Sales - (770) 662-3633  
International Sales - (770) 662-3660

Domestic Repair Service - (770) 662-3666  
Customer Service - (770) 662-3636



# TABLE OF CONTENTS

## 1. GENERAL INFORMATION

---

Organization of the Manual . . . . .	1-1
Conventions . . . . .	1-2
Important Safety Precaution. . . . .	1-2
System Description . . . . .	1-3
Determining T.A.P. (Bulk) Density with the GeoPyc 1360 . . . . .	1-4
Achieving a Consistent Degree of Consolidation . . . . .	1-4
Analysis Overview . . . . .	1-4
Consolidation Cycles . . . . .	1-5
Blank Data . . . . .	1-5
Repeatability. . . . .	1-5
Agreement with Other Methods. . . . .	1-6
Measurement Method. . . . .	1-6
Reporting . . . . .	1-6
Specifications . . . . .	1-7

## 2. INSTALLATION AND SETUP

---

Unpacking and Inspecting the Equipment . . . . .	2-1
Lifting the GeoPyc . . . . .	2-1
Equipment Damage or Loss During Shipment . . . . .	2-1
Equipment Return . . . . .	2-1
Installing the Analyzer . . . . .	2-3
Selecting the Location . . . . .	2-3
Installing the Power Cord. . . . .	2-3
Installing the Memory Card . . . . .	2-3
Removing the Software Card. . . . .	2-4
Switching Between Envelope Density and T.A.P. Density Modes . . . . .	2-4
Placing the Keypad Template . . . . .	2-5
Placing the Mat. . . . .	2-5
Connecting a Printer. . . . .	2-5
Connecting an RS-232 Data Transmission Cable . . . . .	2-5

## 3. GENERAL OPERATING INSTRUCTIONS

---

Analyzer Warmup . . . . .	3-1
Turning the Analyzer On and Off . . . . .	3-1
Cleaning the GeoPyc . . . . .	3-1
Using the Keypad. . . . .	3-1
Function Keys . . . . .	3-3
Entering/Selecting Data . . . . .	3-4

Setting Software Preferences .....	3-5
System Options .....	3-6
Report Options .....	3-9
Transmission Options .....	3-12
Handling the Analysis Chamber and Plunger .....	3-13
Piston Coupling Extenders .....	3-13
Cleaning the Analysis Chamber .....	3-13
Cleaning the Piston .....	3-13
Selecting the Appropriate Size Chamber .....	3-14
Determining Your Chamber's Diameter .....	3-14
General Handling Information .....	3-16
Changing the Plunger Piston .....	3-17
Testing the Tightness of the Piston .....	3-17
Installing the Chamber and Plunger .....	3-18
Fitting the Plunger into the Chamber .....	3-18
Mounting the Assembly onto the Instrument .....	3-18
Removing the Chamber and Plunger .....	3-19
Sample .....	3-20
Determining the Amount of Sample for Analysis .....	3-20
Using Fresh Sample .....	3-20
Sample Preparation / Weighing the Sample .....	3-20
Choosing Units for Consolidation Force or Pressure .....	3-21
General Guidelines for Force/Pressure .....	3-21
Emulating Tap Density Results .....	3-22
Recommended Range for Emulating Tap Density .....	3-22
Assessing Sample Compaction Over a Range of Forces/Pressures .....	3-23
General Guidelines for Assessing Sample Compaction .....	3-23
Determining the Number of Preparation Cycles .....	3-23

## 4. PERFORMING ANALYSES

---

Analysis Types .....	4-1
Important Guidelines .....	4-1
Where To Begin .....	4-2
Storing Blank Data .....	4-2
Blank Data Set Listing .....	4-3
Instructions for Storing Blank Data .....	4-3
Output Options .....	4-5
Performing a Sample Run .....	4-6
Using Stored Blank Data .....	4-6
Output Options .....	4-8
Collecting Blank Data During the Run .....	4-9
Output Options .....	4-11
Erasing Specific Stored Blank Data Points .....	4-12
Verifying Instrument Operation .....	4-13
Reviewing and Editing Analysis Parameters .....	4-14
Canceling a Run .....	4-14

## 5. PRINTING AND TRANSMITTING DATA

---

Printing a Report .....	5-1
Transmitting Data .....	5-2
Reports .....	5-3
Blank Data Set Listing .....	5-3
Bulk Density Report .....	5-5

## 6. ORDERING INFORMATION

---

### A. FORMAT OF TRANSMITTED DATA

---

Analysis Report .....	A-1
Force Calibration Report .....	A-3
Blank Data Set Listing .....	A-4

### B. ERROR MESSAGES

---

Analysis .....	B-1
Data Reduction .....	B-2
Output .....	B-3
System .....	B-3
User Interface .....	B-5

### C. MANUAL OPERATION

---

Accessing Manual Mode .....	C-1
The Manual Mode Display .....	C-1
Using Manual Mode Functions .....	C-2
Function Descriptions .....	C-2
Force Calibration Report .....	C-6

## INDEX

---





---

# 1. GENERAL INFORMATION

---

This manual describes how to perform bulk density analyses which emulate tap density, and to assess compaction phenomena using the GeoPyc 1360 Pycnometer.

## Organization of the Manual

---

The operator's manual is organized as follows:

- |                   |   |
|-------------------|---|
| <b>Chapter 1</b>  | <b>GENERAL INFORMATION</b><br>Provides general information about the GeoPyc analyzer; also lists specifications for the T.A.P. Density option.  |
| <b>Chapter 2</b>  | <b>INSTALLATION AND SETUP</b><br>Describes how to install the analyzer. Also gives the method for switching between envelope density operation and T.A.P. operation   |
| <b>Chapter 3</b>  | <b>GENERAL OPERATING INSTRUCTIONS</b><br>Contains instructions for using the keypad, software, and sample chamber/plunger. Also provides information on sample preparation.   |
| <b>Chapter 4</b>  | <b>PERFORMING ANALYSES</b><br>Gives instructions for performing analyses and for storing blank data. Also describes how to cancel an analysis, how to review and edit analysis parameters, and how to erase blank data. |
| <b>Chapter 5</b>  | <b>PRINTING AND TRANSMITTING DATA</b><br>Describes how to print and transmit data as well as sample reports.  |
| <b>Chapter 6</b>  | <b>ORDERING INFORMATION</b><br>Provides part numbers and ordering information for system components.  |
| <b>Appendix A</b> | <b>FORMAT OF TRANSMITTED DATA</b><br>Contains the format of transmitted data.   |

<b>Appendix B</b>	<b>ERROR MESSAGES</b>	Lists the error messages that may be displayed by the software and includes a cause and corrective action for each.
<b>Appendix C</b>	<b>MANUAL OPERATION</b>	Gives instructions for using the manual operations mode of the GeoPyc 1360.
<b>Index</b>	<b>INDEX</b>	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

---

Please note the following important safety precaution.



**It is the obligation of the purchaser, not of Micromeritics Instrument Corporation, to ensure the safety of analyzing any material with the GeoPyc 1360. Under normal operating conditions, sample materials may contact the operator's skin, and fine particles may become airborne. The purchaser is responsible for taking precautions against injuries caused by toxic or hazardous samples.**

## System Description

---



The GeoPyc 1360 system is a compact benchtop unit containing the analyzer, internal micro-processor, 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 selected — like most other operations — requires only a simple sequence of keystrokes.

The GeoPyc can be purchased for performing either bulk density analyses which emulate tap density (the T.A.P.\* Density option), or for envelope density analyses. Bulk density, as used in this manual, 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. Envelope density is the mass of an object divided by its volume, where the volume includes that of its pores and small cavities.

Both Envelope Density software and T.A.P. Density software can be purchased as an option when you own either type of GeoPyc software, and switching between the two modes of operation is quick and simple. This manual contains instructions for operating the GeoPyc in the T.A.P. Density mode.

See Chapter 6 for information on ordering the Envelope Density option, accessories, and other parts available from Micromeritics.

---

\* T.A.P. stands for Transverse Axial Pressure. This is an appropriate acronym for the GeoPyc's method, because a quantifiable, repeatable degree of pressure is applied to the sample along its transverse axis.

---

## Determining T.A.P. (Bulk) Density with the GeoPyc 1360

---

When equipped with the T.A.P. Density option, the GeoPyc 1360 Pycnometer measures the bulk volume and calculates the bulk density of granular and powdered samples under a wide range of compaction conditions. The traditional method for determining bulk volume involves tapping or vibrating the sample within a graduated cylinder\*, measuring the sample's density at a single packing or consolidation condition. In contrast, the T.A.P. Density Option permits multiple conditions, one of which emulates the tap density result.

The GeoPyc determines the bulk density of packed or consolidated samples with the degree of packing accurately quantified. The operator can easily verify that the same degree of packing is used for sample after sample.

The GeoPyc 1360 method is essentially noiseless, rapid, and easy to perform.

---

### Achieving a Consistent Degree of Consolidation

---

To determine T.A.P. density with the GeoPyc, the operator first performs a brief, automatic operation to determine the volume of an empty (blank) sample chamber. Blank data are collected once, then stored in the GeoPyc for repeated use during subsequent sample analyses.

To begin an analysis, the operator places a weighed quantity of sample in the sample chamber, inserts a plunger part way into the chamber, then mounts the chamber/plunger assembly on the instrument. A short series of prompts instruct the operator to enter the desired consolidation force, sample weight, and other parameters, then automatic analysis begins.

The consolidation force is the force with which the sample is compressed during analysis. Because an exact force is selected at the start of each analysis, the GeoPyc provides the operator complete control over the degree of packing achieved for each sample analysis.

---

### Analysis Overview

---

During analysis, the plunger is driven into the sample chamber, while the chamber is agitated. The agitation causes the sample to consolidate as uniformly as possible while the plunger moves forward.

The force required to move the plunger into the sample chamber is detected by a high-resolution force transducer. When the force reaches the value entered by the operator, the volume of the sample is measured.

---

\* ASTM Standard Test Method B527-81, Tap Density of Powders of Refractory Metals and Compounds by Tap-Pak Volumeter.

---

## Consolidation Cycles

---

The plunger retracts a short distance, then moves forward until the desired force is reached again. This cycle — plunger moving forward until the force is achieved, measurement of sample volume, plunger retracting slightly — is called a *consolidation cycle*.

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 sample, 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 start with two preparation cycles and five subsequent cycles on each sample, for a total of 7 cycles. Some samples may yield more accurate, reproducible data using fewer preparation cycles, while some samples may benefit from a larger number.

---

## Blank Data

---

After the specified number of cycles are performed, the instrument draws upon the stored blank data to calculate the results. Before sample analysis is begun, it is necessary to collect blank data using the chamber you plan to use during sample analysis. The instrument requires at least as many blank data cycles (using an empty chamber) as sample cycles. Blank data must be collected for each force you plan to use.

The number of cycles of blank data collected for each chamber at each force determines the maximum number of cycles that can be used for subsequent sample analyses, since measurements taken during each sample cycle are compared to the measurements taken during the corresponding blank data cycle.

---

## Repeatability

---

The GeoPyc consolidates the sample to the exact force specified by the operator each time analysis is made. This yields a consistent degree of packing from sample to sample, when the same force is specified.

Varying the force can also provide useful data on the packing behavior of a single sample. Begin with a low force to determine the density of loosely packed sample, then increase the force in subsequent runs to evaluate the sample’s density when it is packed more tightly.

Moisture content dramatically alters the consolidation behavior of some materials. Drying the sample in a consistent manner is necessary to achieve day-to-day repeatability.

The ratio of chamber diameter to particle diameter and also the ratio of bed length to bed diameter can cause different bulk densities. Repeatability is best achieved by adopting a standard procedure and adhering to it.

## **Agreement with Other Methods**

---

To correlate your GeoPyc data with data you have obtained using another method, you must determine what degree of packing your other method achieved. Unfortunately, other methods do not provide a quantifiable measurement by which samples are packed.

You can estimate this degree of packing by performing a brief series of analyses with the GeoPyc. Use a series of different forces to analyze a sample for which you have density data obtained using your other method. When the force approximates the degree of packing achieved by your historical method, the density values will be approximately equal. Use this force in subsequent analyses.

## **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 threading of the screw and its gearing to the motor enter into the calculations. The plunger actually moves  $2.6458 \times 10^{-4}$  cm with each motor pulse.

## **Reporting**

---

After an analysis, a report is automatically generated 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 automatically printed, essential data are displayed on the LCD screen.

## Specifications

Characteristic	Specification
<b>ENVIRONMENT</b>	
Temperature:	Stable, between 15 and 35 °C
Humidity:	20 to 80% relative, noncondensing
<b>UTILITIES</b>	
Voltage:	85 to 265 VAC
Power:	95 VA
Frequency:	47 to 63 Hz
<b>REPRODUCIBILITY</b>	
When sample depth is approximately equal to chamber diameter:	Typically $\pm 1.1\%$
<b>AVAILABLE SAMPLE CHAMBERS</b>	
<b>Internal Diameter</b>	<b>Approximate Usable Length</b> (depth of sample before consolidation)
12.7 mm	19 mm
19.1 mm	28 mm
25.4 mm	38 mm
38.1 mm	44 mm
50.8 mm	44 mm
<b>EXPOSED MATERIALS</b>	
To sample:	Glass, Teflon®, stainless steel, Buna-N, epoxy

Characteristic	Specification
<b>————— CABINET —————</b>	
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 (42 pounds). 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.

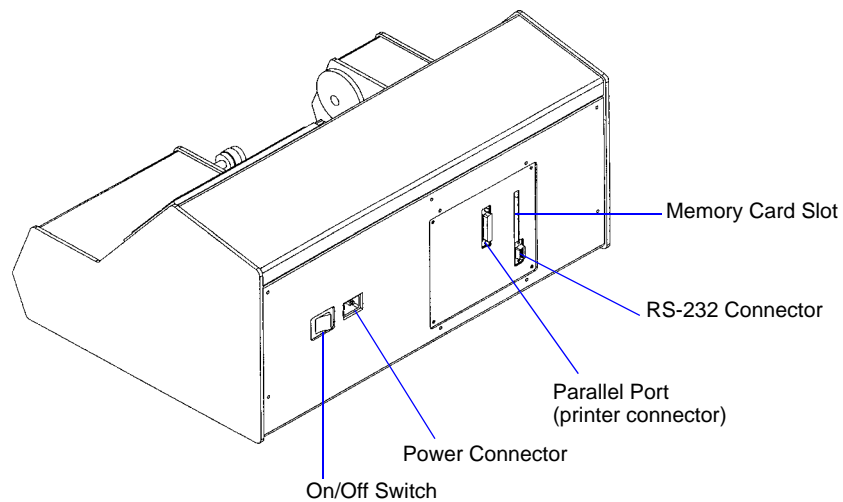
## Installing the Analyzer

### 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.**

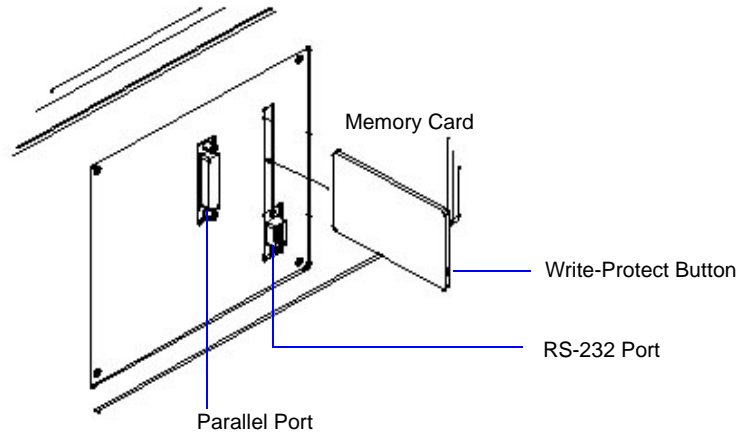
### Installing the Memory Card

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.**

- Carefully read, then 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).



## Removing the Software Card

It is recommended that you not remove the card from the analyzer unless you wish to switch between T.A.P. Density and Envelope Density software cards (see below).

If you do need to remove the card, press the eject button into the rear panel until part of the card pops out of the slot (emerges).

## Switching Between Envelope Density and T.A.P. Density Modes

If you have purchased the GeoPyc with both the Envelope Density and T.A.P. Density options, you have one software card for each type of operation. Switching from one mode of operation to the other is as simple as switching cards. However, you must always remember to turn the instrument OFF before removing or inserting any software card.



**Switching the memory card while the analyzer is turned on WILL damage the software. Always make sure the instrument is turned OFF before you remove one card or insert the other.**

Switching between T.A.P. Density mode and Envelope Density mode does not affect any blank data you have stored. T.A.P. Density blank data remain on the T.A.P. software card, and Envelope Density Data remain on the Envelope Density card.

---

## Placing the Keypad 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.

---

## Placing the Mat

---

A flexible mat is provided to catch any sample debris that may fall onto the analysis platform. Place the mat on the analysis platform so that the ridged side faces up, and the small hole in the mat fits over the peg on the platform. To clean, remove the mat and wipe away any sample debris. You may wish to use a wipe moistened with water; if so, be sure the mat is dry before replacing it on the analyzer.

---

## 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.



---

## 3. GENERAL OPERATING INSTRUCTIONS

---

This chapter contains instructions for using:

- the keypad
- software
- sample chamber/plunger

---

### Analyzer Warmup

---

No warmup is needed unless the analyzer has recently been moved 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.

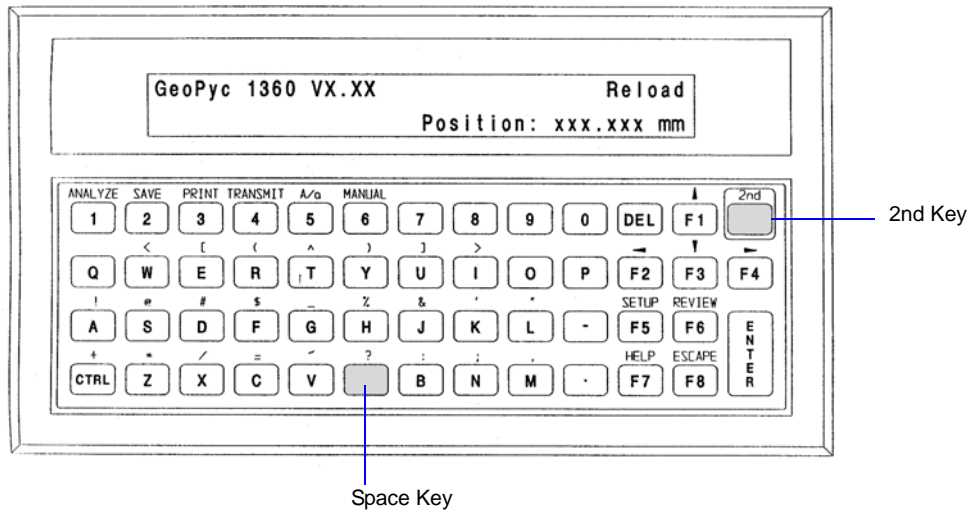
---

### Using the Keypad

---

Most operations are initiated by pressing a function key on the keypad. A dialog then 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
<b>F1</b>	Up Arrow	Move to previous field
<b>F2</b>	Left Arrow	Move to previous item/choice
<b>F3</b>	Down Arrow	Move to next field
<b>F4</b>	Right Arrow	Move to next item/choice
<b>F5</b>	Setup	Begin System Setup (System Options, Report Options, Transmission Options)
<b>F6</b>	Review	Review/make changes to variables of the last analysis
<b>F7</b>	Help	Display choices
<b>F8</b>	Escape	Discard all entries for this dialog and return to Menu
<b>DEL</b>	Delete	Delete character before cursor (backspace)
<b>ENTER</b>	Enter	Move to next field OR at the end of dialog, begin analysis
<b>P</b>	Pause	Pause the current analysis. This function toggles on and off; restart the analysis by pressing the <b>P</b> key again.
<p><b>NOTE:</b> Use the shaded key below the ? (question mark) for spaces.</p>		

*Table 3-2. Second Function Keys*

Key		Function
<b>2nd + 1</b>	Analyze	Start an analysis (blank, sample, or calibration)
<b>2nd + 2</b>	Save	Save changes to the current dialog
<b>2nd + 3</b>	Print	Start the print dialog
<b>2nd + 4</b>	Transmit	Start the transmit dialog
<b>2nd + 5</b>	A/a	Select upper- or lower-case letters (toggle)
<b>2nd + 6</b>	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 the same way: a field name is displayed with either a default value or space to enter a value. If you wish to change the default (for multiple-choice fields), use the Right and Left Arrow keys to navigate choices until the desired one is displayed. For other fields, type in the correct value. Then use the Up and 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 sometimes 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. The 1360 software includes a set of default values; some defaults are blanks (Report title, for example). You can accept the defaults or change them to values you prefer.

- 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.



**If you own both the Envelope Density software and the T.A.P. Density Option, you can set software preferences in either mode. Changes made in either mode are saved until you change them again, even if you switch between modes.**

## System Options

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

- Use the right and left arrow keys (**F2** and **F4**) to view choices.
- Press **ENTER** to select a choice and move the next field.
- Use the up and down arrow keys (**F1** and **F3**) to move to the next or previous field.

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

Setup type? System Options	Setup
-------------------------------	-------

Select **System Options**, then press **ENTER**.

Language? English	Setup
----------------------	-------

Specify the language you wish to have the system use.

*Choices: English, Deutsch, Francais, Espanol, Italiano*

Instrument: GEOPYC	Setup
-----------------------	-------

Type the instrument identification for this analyzer. Use any combination of letters and/or numbers that will help you identify the unit. You may wish to use the instrument's serial number which is located on the rear panel.

*Range: 9 characters*

Report title:	Setup
---------------	-------

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

*Range: 19 characters*

Date format? mm/dd/yy	Setup
--------------------------	-------

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? Yes	Setup
------------------------	-------

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

*Choices: Yes, No*

Request Customer? Yes	Setup
--------------------------	-------

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

*Choices: Yes, No*

Request Operator? Yes	Setup
--------------------------	-------

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

*Choices: Yes, No*

Request Sample weight? Yes	Setup
-------------------------------	-------

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

*Choices: Yes, No*

Display position in? mm	Setup
----------------------------	-------

Specify how you wish the position of the plunger displayed.

*Choices: mm (millimeters), steps of the motor*

Which consolidation units? Newtons	Setup
---------------------------------------	-------

Select the manner in which to display the consolidation force. The choice of a display unit for consolidation makes no difference in the operation of the instrument or the calculation of results; it is strictly a matter of preference.

*Choices: Newtons (force), Newtons/cm<sup>2</sup> (pressure)*

Number of Prep cycles?	Setup
2	

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

*Range:* 0 - 20

Sample consolidation may be 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.

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

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

## Report Options

---

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

- Use the right and left arrow keys (**F2** and **F4**) to view choices.
- Press **ENTER** to select a choice and move the next field.
- Use the up and down arrow keys (**F1** and **F3**) to move to the next or previous field.

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*

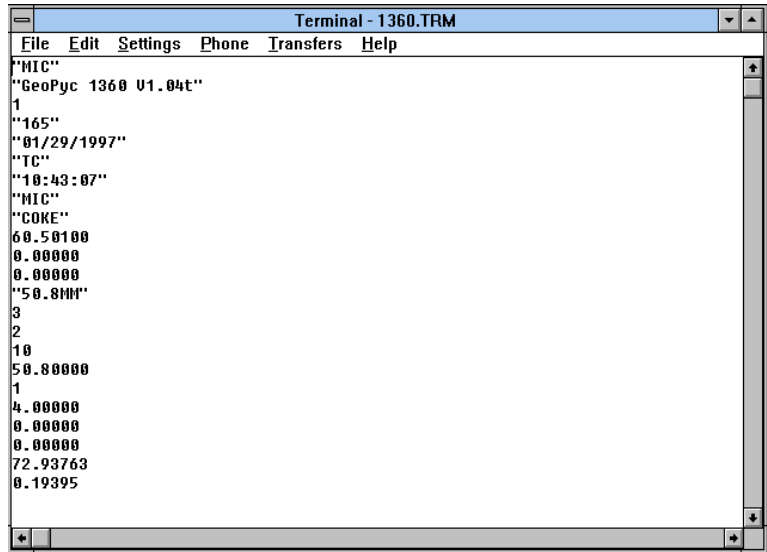
Transmission format? Setup  
Single Column

Specify the format for transmitted data. An example of each format choice, as it appears on a computer monitor, is provided on the next pages. (Only a portion of each format is visible on screen at any time.)

*Choices: Single Column, Spreadsheet, Tabular*

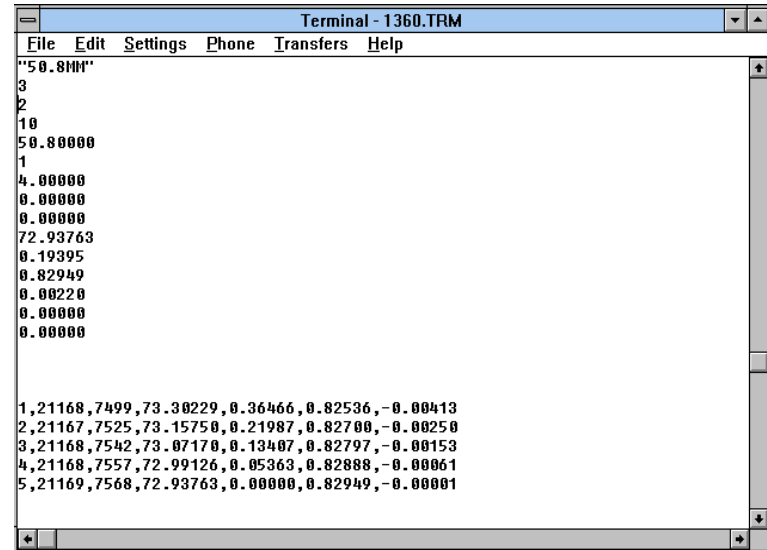
Press [Enter] to save changes,  
or [Esc] to cancel.

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



```
Terminal - 1360.TRM
File Edit Settings Phone Transfers Help
""MIC""
""GeoPyc 1360 U1.04t""
1
""165""
""01/29/1997""
""TC""
""10:43:07""
""MIC""
""COKE""
60.50100
0.00000
0.00000
""50.8MM""
3
2
10
50.80000
1
4.00000
0.00000
0.00000
72.93763
0.19395
```

*Single Column Transmission Format*



```
Terminal - 1360.TRM
File Edit Settings Phone Transfers Help
""50.8MM""
3
2
10
50.80000
1
4.00000
0.00000
0.00000
72.93763
0.19395
0.82949
0.00220
0.00000
0.00000

1,21168,7499,73.30229,0.36466,0.82536,-0.00413
2,21167,7525,73.15750,0.21987,0.82700,-0.00250
3,21168,7542,73.07170,0.13407,0.82797,-0.00153
4,21168,7557,72.99126,0.05363,0.82888,-0.00061
5,21169,7568,72.93763,0.00000,0.82949,-0.00001
```

*Spreadsheet Transmission Format*



Terminal - 1360.TRM						
File Edit Settings Phone Transfers Help						
MIC GeoPyc 1360 U1.04t Bulk (T.A.P.) Density Report						
Instrument:	165				Date:	01/29/1995
Operator:	TC				Time:	10:43:41
-----						
Customer:	MIC				Sample Weight:	60.5010 g
Sample:	COKE					
Blank Data Set:	50.8MM				Blank Data Source:	Stored Set 3
Preparation Cycles:	2				Measured Cycles:	10
Chamber Diameter:	50.8000 mm					
Consolidation Pres.:	4.0000 N/cm2					
-----						
Cycle #	Blank Counts	Sample Counts	Volume cm3	Deviation cm3	Density g/cm3	Deviation g/cm3
1	21168	7499	73.3022	0.3646	0.8253	-0.0041
2	21167	7525	73.1575	0.2198	0.8270	-0.0025

*Tabular Transmission Format*

## 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 (previous section), selecting **Serial Port** for the automatic report destination. Refer to Appendix A, beginning on page [A-1](#) for the manner in which transmitted data are formatted.

- Use the right and left arrow keys (**F2** and **F4**) to view choices.
- Press **ENTER** to select a choice and move the next field.
- Use the up and down arrow keys (**F1** and **F3**) to move to the next or previous field.

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

Setup type? Transmission Options	Setup
-------------------------------------	-------

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

Baud rate? 9600	Setup
--------------------	-------

Specify your destination serial port's baud rate.

*Choices: 110, 150, 300, 600, 1200, 2400, 4800, 9600*

Data bits? 8	Setup
-----------------	-------

Choose the number of data bits desired.

*Choices: 7, 8*

Stop bits? 1	Setup
-----------------	-------

Choose the number of stop bits desired.

*Choices: 1, 2*

Parity? None	Setup
-----------------	-------

Specify choice of parity.

*Choices: None, Odd, Even*

Enable xon/off? No	Setup
-----------------------	-------

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 the Analysis Chamber and Plunger

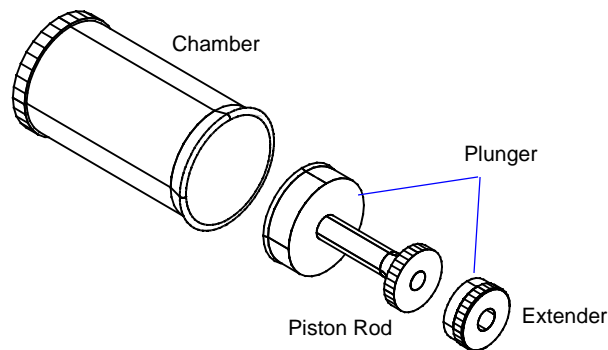
---

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

---

The 50.8- and 38.1-mm sample chambers require a piston coupling extender. (Other chambers do not require an extender.) 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

---

The type of samples you analyze will determine how frequently you must clean the chamber and plunger. Most dry, powdery samples can be poured from the chamber; any residue may be swept away using a soft paintbrush or blown away with an air hose. Remove greasy or wet residues using a wipe moistened with isopropyl alcohol. Be sure the chamber and plunger are dry before you use them again.



**If your sample reacts with isopropyl alcohol, use another appropriate cleanser when cleaning either the chamber or piston.**

### Cleaning the Piston

---

During an analysis, the GeoPyc 1360 displays the force exerted by the plunger as it moves forward into the chamber. A small level of force may be observed before the plunger reaches the sample. However, if the force climbs sharply before the sample is reached, this may be a signal that sample particles are building up on the piston and causing friction. Clean any residue from the piston using a dry wipe or one moistened with isopropyl alcohol. Be sure the piston is dry before using the plunger again.

---

## 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. The selection of a chamber is partly determined by your application. Refer to [Emulating Tap Density Results](#), page 3-22 and [Assessing Sample Compaction Over a Range of Forces/Pressures](#), page 3-23 for information on selecting the best chamber for these applications.

See Chapter 6 for part numbers and ordering information.

---

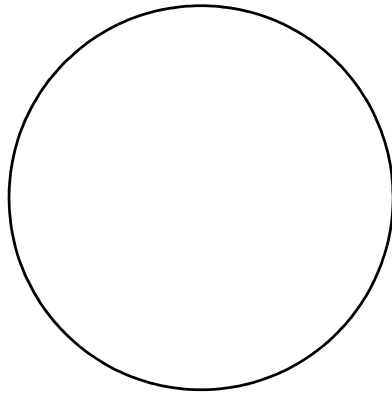
## Determining Your Chamber's Diameter

---

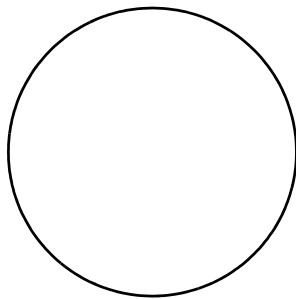
If you are uncertain which size chamber you are using, you can determine the internal diameter of your chamber by measuring the piston. The piston's diameter is the same as the internal diameter of the chamber.

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.

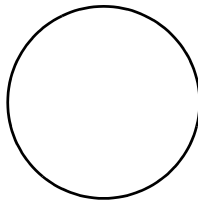
If you prefer to measure the chamber, use calipers to measure the chamber's internal diameter, away from the taper.



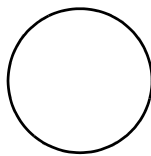
Plunger seal diameter/ internal  
chamber diameter: 50.8 mm



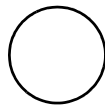
Plunger seal diameter/ internal  
chamber diameter: 38.1 mm



Plunger seal diameter/ internal  
chamber diameter: 25.4 mm



Plunger seal diameter/ internal  
chamber diameter: 19.1 mm



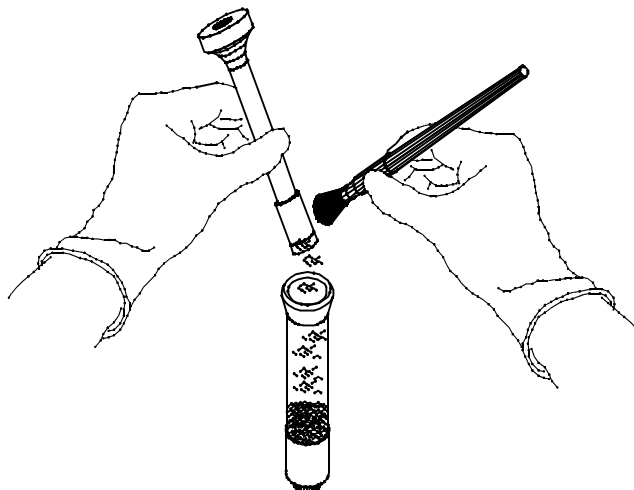
Plunger seal diameter/ internal  
chamber diameter: 12.7 mm

***Internal Chamber Diameters***

## 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 sample being expelled from the chamber.



**The technique for using the GeoPyc is not difficult, but consistency in technique is essential for accurate results.**

## Changing the Plunger Piston

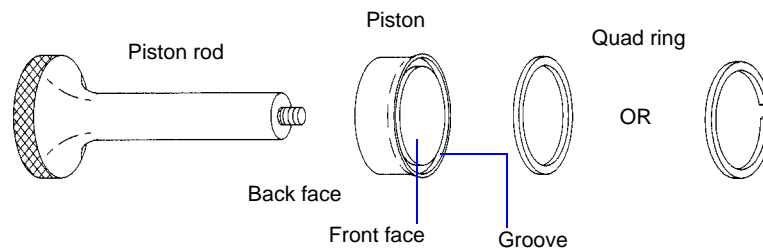
---

The plunger assembly consists of a Teflon piston, pre-loaded with a quad ring, attached to a piston rod.

The quad ring and piston on the plunger assembly may become worn after a period of use and should be replaced.

Inspect the piston periodically for signs that it is degrading. Observe the piston during operation of the instrument. Use the following instructions to replace the piston and quad ring.

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, for any reason, it is not pre-loaded, 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.



See Chapter 6 for part numbers and ordering information.

## Testing the Tightness of the Piston

---

1. Place the plunger in an empty chamber.
2. Holding the plunger still, rotate (agitate) the chamber back and forth a short distance around the plunger a few times. If the motion of the chamber begins to unscrew the plunger assembly, it is too loose.

## Installing the Chamber and Plunger

---

### Fitting the Plunger into the Chamber

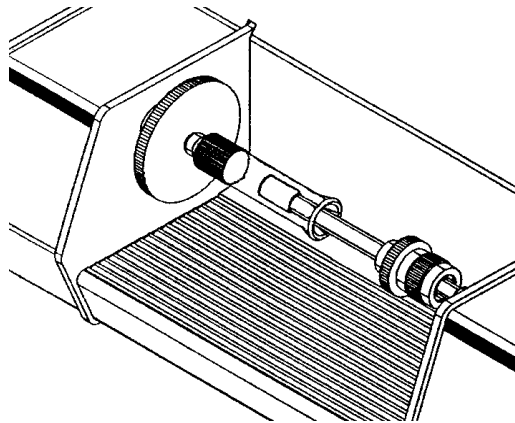
---

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 sample, slide the seal end of the plunger about a third of the way into the chamber.

### Mounting the Assembly onto the Instrument

---

1. Make sure the plunger is inserted part 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. Slide 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 firmly secured to each mandrel.**

If the attachment of the chamber/plunger assembly becomes loose during analysis, data collected for that run will 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.

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 sample adhering to the plunger's seal end or to the flared end of the chamber.

## Sample

---

### Determining the Amount of Sample for Analysis

---

For best results, you should use a quantity of sample which, when compressed during analysis, fills a length of the chamber roughly equal to the chamber's diameter. Clearly, determining what uncompressed amount of sample will result in such a quantity after it is compressed may require some experimentation. It may be helpful to consider the sample's packing behavior when selecting an amount of sample to begin.



**For best repeatability when comparing data from various samples, use approximately the same amount of sample each time.**



**Analyzing sample amounts that fill the chamber to a length significantly less than one diameter may reduce the accuracy of data. If such small quantities of sample are unavoidable, consider using a smaller chamber.**

### Using Fresh Sample

---

It is recommended that you use a fresh quantity of sample each time you run an analysis. In some cases, you can run a series of analyses using increasing consolidation forces/pressures on the same sample. In general, however, using fresh sample yields the most accurate, reproducible results.

### Sample Preparation / Weighing the Sample

---

Before beginning a sample run with the GeoPyc 1360, 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.)



**T.A.P. density data for some samples are affected by whether or not the sample was dried before analysis. For the most accurate comparisons between samples, use the same sample preparation method for each sample.**

When possible, we recommend that you weigh the sample in the analysis chamber to avoid errors caused by loss of sample during the transfer from a weighing container to the chamber.

## Choosing Units for Consolidation Force or Pressure

---

The force or pressure with which the chamber contents are compressed is called the consolidation force or consolidation pressure, depending on the units you select. This value determines the degree to which the sample is packed at the time the volume measurement is taken. Generally, the higher the force or pressure, the greater the packing, and — consequently — the higher the density.



**The degree to which the sample is compacted or consolidated can be specified as either force (in Newtons) or pressure (in Newtons/cm<sup>2</sup>). The unit is selected and can be changed using the System Options Setup dialog described on page 3-6.**

Regardless of which units you prefer, you can use the GeoPyc for various bulk density analyses, including:

- Determining a bulk density value that emulates tap density results
- Assessing sample compaction over a range of forces

The following sections provide information about force/pressure as it pertains to each type of analysis. But first, note the following general guidelines.

### General Guidelines for Force/Pressure

---

- If you use a very low value for the force/pressure, the sample may not be packed or consolidated at all when the volume measurement is taken.
- If you enter too low a force or pressure, the plunger may move forward slowly or not at all. (If this occurs, start the analysis again using a greater value.)
- Alternatively, using too high a value may cause the sample to form a cake or compact.
- Using too high a value may cause some sample pieces to be crushed.
- The same force must be used for blank and sample runs for a given sample.

## Emulating Tap Density Results

To correlate your GeoPyc data with data you have obtained using a traditional tap density method, you must determine the degree of packing the other method achieved. Unfortunately, most other methods do not provide a quantifiable measurement of sample packing.

You can estimate what degree of packing was used by performing a brief series of analyses with the GeoPyc. Use a series of different consolidation forces/pressures to analyze a sample whose tap density is known.

When the GeoPyc density data approximate the known tap density data, the force/pressure you are using approximates the degree of packing that was achieved by the other method. Use this force/pressure value in subsequent GeoPyc T.A.P. Density analyses.

### Recommended Range for Emulating Tap Density

To help you discover the force/pressure that replicates your tap density data, we have identified a range of forces or pressures at which GeoPyc T.A.P. Density measurements are typically comparable to tap densities obtained by traditional methods. This range is given in Table 3-3 for both force and pressure units.

If your *sole* interest is in replicating tap densities, it is recommended that you use a value within the range shown. This is merely a recommendation; other values may work better for some samples.

**Table 3-3. Recommended Force or Pressure for Emulating Tap Density**

Internal Chamber Diameter (mm)	Recommended Pressure Range for Emulating Tap Density (N/cm <sup>2</sup> )	Recommended Force Range for Emulating Tap Density (Newtons)
12.7	1 to 3	3 to 8
19.1	1 to 3	4 to 12
25.4	1 to 3	5 to 15
38.1	1 to 3	11 to 33
50.8	1 to 3	20 to 60



**Because the 12.7- and 19.1-mm chambers do not function well at very low forces/pressures, it is recommended that you use a 25.4-, 38.1-, or 50.8-mm chamber if you wish to determine bulk density that emulates tap density.**

## Assessing Sample Compaction Over a Range of Forces/Pressures

Obtaining bulk densities at various forces/pressures enables you to evaluate the compaction behavior of powders. Table 3-4 gives you the range of forces and pressures that are recommended for each chamber size. Lower pressure values may be used, if desired. However, it is possible that too small a pressure may cause the plunger to move very slowly.

*Table 3-4. Recommended Pressure / Force Ranges*

Internal Chamber Diameter (mm)	Pressure (N/cm <sup>2</sup> )	Force (Newtons)
12.7	6 to 140	6 to 180
19.1	4 to 60	12 to 180
25.4	2 to 35	12 to 180
38.1	1 to 15	12 to 180
50.8	5 to 8	12 to 180



**Note that the smaller chambers allow for higher pressures to be used. (The same maximum number of Newtons is exerted over a smaller area.) For this reason, it is recommended that you use a smaller sample chamber if you wish to evaluate compaction behavior at higher pressures.**

### General Guidelines for Assessing Sample Compaction

- Use fresh sample for each analysis.
- Use approximately the same amount of sample for each analysis.

### Determining the Number of Preparation Cycles

Most samples yield accurate, reproducible data using two preparation cycles. However, some types of samples yield more reproducible data using a lower number of preparation cycles, while still others benefit from a higher number. Because the sample's properties affect analysis results, the only way to determine the best number of preparation cycles for each sample type is through trial and error.

The number of preparation cycles is specified in the System Options Setup described on page 3-6.



---

## 4. PERFORMING ANALYSES

---

This chapter contains instructions for performing bulk density analyses that emulate tap density, and for storing blank data.

### Analysis Types

---

The analysis menu contains the following two choices:

- **Store blank data**

A blank run is a series of consolidation cycles performed on the empty chamber. You must perform a blank run to store data for each chamber size at each force/pressure level you expect to use when you analyze samples.

Alternatively, you may collect blank data for an individual sample run during that sample run. Blank data collected during the sample run cannot be stored and used for subsequent runs. It is more efficient to store blank data in advance, then use the stored data for subsequent sample runs. The only exception is the case of a chamber/force combination which you plan to use only once. In such a case, a small amount of time may be saved by collecting the blank data during the sample run.



**Users of the GeoPyc's envelope density function should note that this recommendation is the opposite of the recommendation for performing envelope density analyses. In that case, collecting blank data during the sample run is preferred. See the GeoPyc 1360 Envelope Density Operator's Manual for a complete discussion.**

- **Sample**

A sample analysis consists of a series of consolidation cycles performed with a quantity of sample in the chamber. It measures the volume of the part of the chamber in which the sample is contained. The sample run volume, the blank volume, the sample's weight, and the chamber diameter are used to calculate the sample's bulk density.

### Important Guidelines

---

- If you wish to compare results from sample to sample, use approximately the same amount of sample each time.
- It is recommended that you use fresh sample for each analysis.

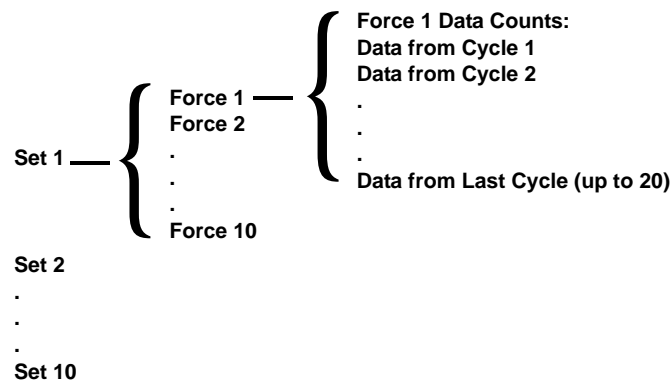
## Where To Begin

- If you plan to use stored blank data (the most efficient method), you should begin by storing blank data for each chamber and each consolidation force you expect to use when you analyze samples. If you plan to perform a series of tests to determine the best force to use, you must store blank data for each of the forces you plan to test. This one-time process is not time-consuming; how long it will take depends on how many forces you plan to store data for and how many cycles you wish to perform for each force. After you store your blank data, you can then analyze samples using the instructions in this chapter.
- If you wish to collect blank data during an individual sample run, use the instructions in the section on Performing a Sample Run - Collecting Blank Data During the Run in this chapter.

## Storing Blank Data

Although it is possible to collect blank data during the sample run (by selecting the **Run blank now** option), it is much more efficient to store blank data in advance, then use the stored data during subsequent sample runs. (You can also erase stored blank data; refer to [Erasing Specific Stored Blank Data Points](#), page 4-12.)

Blank data are stored in sets. A group of stored blank runs using the same chamber 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 different force/pressure values. Each run may consist of up to 20 consolidation cycles. Volume data (counts) are listed for each cycle performed during each run.





## Blank Data Set Listing

Refer to [Blank Data Set Listing](#), page 5-3 for an example of a Blank Data Set Listing, one of the standard reports provided with the GeoPyc T.A.P. Density option.



**It is a good idea to keep a current Blank Data Set Listing report for each set you have stored. Having these reports available will make it much easier to start sample analysis runs using the correct contents of the stored data sets.**

## Instructions for Storing Blank Data

- Use the right and left arrow keys (**F2** and **F4**) to view choices.
- Press **ENTER** to select a choice and move the next field.
- Use the up and down arrow keys (**F1** and **F3**) to move to the next or previous field.



**If you are using the 50.8- or 38.1-mm chamber, make sure the piston coupling extender is attached to the piston.**

1. Insert the plunger into the sample chamber, and push it part way in. Mount the chamber/plunger assembly on the analyzer.
2. Make sure that the ON/OFF switch on the rear panel is in the ON (|) position.
3. Press **2nd**, then **ANALYZE**.
4. Enter the data as prompted.

Analyze type? Store blank data	Analyze
-----------------------------------	---------

Choose **Store blank data**.

Blank data source? Stored blank data set 1	Analyze
---	---------

Select the blank data set you wish to use. To add data to an existing set, choose that set number. To start a new set (for example, when you start storing data for a different size chamber), choose a new set number.

*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) you wish the GeoPyc 1360 to perform during this blank run. Use at least as many cycles now as you plan to use when you analyze samples.

Do not include preparation cycles.

Range: 1 - 20



**Subsequent sample runs using this stored data will be limited to this number of cycles. Consistently using 20 cycles when storing blank data ensures that the maximum number of cycles will be available when you perform subsequent sample runs.**

Chamber diameter:	Analyze
0.0000 mm	

If this is the first blank run you are storing in this set, enter the diameter of the chamber you are using for this set. This diameter will be used for all subsequent runs in this stored data set. If you wish to store data for a different size chamber, you must start another data set.

Range: 0 to 65 mm

Blank [N] consolidation force:	Analyze
0.0000 Newtons	

This is the N<sup>th</sup> force for which data have been collected in this set.

The software prompts you for force or pressure, depending on the units specified in your system setup.

Enter the consolidation force or pressure you wish to use for this blank run. You can store data for up to 10 different forces within each blank data set. The software prevents you from storing duplicate forces within a single blank data set.

Range: 1 to 180 N

- 12.7-mm chamber, 0 to 142.09 N/cm<sup>2</sup>
- 19.1-mm chamber, 0 to 62.81 N/cm<sup>2</sup>
- 25.4-mm chamber, 0 to 35.52 N/cm<sup>2</sup>
- 38.1-mm chamber, 0 to 15.78 N/cm<sup>2</sup>
- 50.8-mm chamber, 0 to 8.88 N/cm<sup>2</sup>

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

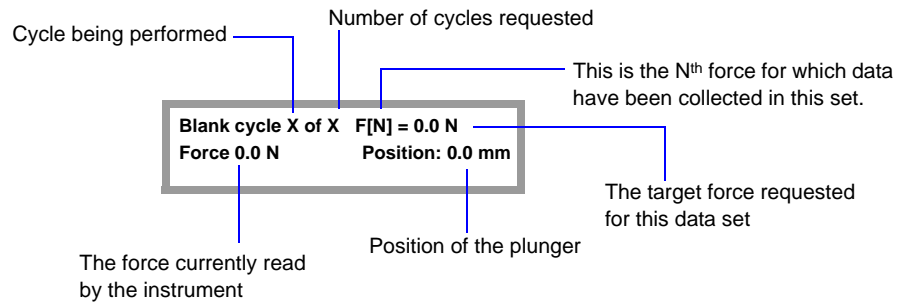
Press **ENTER** to begin the blank analysis. When analysis is finished, an audible signal is sounded.

5. The GeoPyc 1360 partially withdraws the plunger. The following prompt is displayed.

Press [Enter] for another blank run, or [Esc] to end.
--

If you wish to continue storing blank run data in this set, repeat the process, beginning with the force/pressure.

During blank data collection, the display shows the following information (this example shows Force for consolidation units):



## 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.

## Performing a Sample Run

A sample run can be performed using stored blank data or by collecting blank data during the sample run.

### Using Stored Blank Data

This is the preferred method for performing a sample run. Blank data *must be stored* before you analyze samples with this method. Refer to [Storing Blank Data](#), page 4-2 for instructions.

- Use the right and left arrow keys (**F2** and **F4**) to view choices.
- Press **ENTER** to select a choice and move the next field.
- Use the up and down arrow keys (**F1** and **F3**) to move to the next or previous field.



**If you are using the 50.8- or 38.1-mm chamber, make sure the piston coupling extender is attached to the piston.**

1. Load the sample in the chamber and obtain its weight.
2. Insert the plunger part of the way into the sample chamber. Wipe both ends of the chamber/plunger free of 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 (described in Chapter 3) to omit an optional data field, the corresponding prompt shown below will not appear when you operate the instrument.

Analyze type? Sample	Analyze
-------------------------	---------

Choose **Sample**.

Sample: Sample 1	Analyze
---------------------	---------

Enter the sample identification.

*Range: 19 characters*

Customer:	Analyze
-----------	---------

Enter the customer identification.

*Range: 9 characters*

Operator:	Analyze
-----------	---------

Enter an identifier for the operator.

*Range: 9 characters*

Sample weight: 0.0000 g	Analyze
----------------------------	---------

For consistent results and correlation with other parameters, enter the *dry* sample weight.

*Range: 0.0000 to 99.9999 grams*

Blank Data Source? Stored blank data set 1	Analyze
---	---------

Select the blank data set you wish to use for this run. Remember that the data set must use the same size chamber and contain data for the same force you plan to use for this run. It may be helpful to look at a Blank Data Set Listing for this set.

Blank Data Set: --	Analyze
-----------------------	---------

Displays the identifier for this stored blank data set. (The identifier was entered when the blank data set was initiated.)

Number of cycles:	Analyze
-------------------	---------

Enter the number of cycles (consolidation) you wish performed during this sample run. The maximum number of cycles you can use is the maximum number stored for any force in this blank data set. It may be helpful to look at a Blank Data Set Listing for this set of data, to confirm the number of cycles that are available for the force you wish to use.

*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*

Chamber Diameter: 0.0000	Analyze
-----------------------------	---------

The GeoPyc displays the diameter of the chamber you used when you stored blank data in this blank data set. This field cannot be changed during sample analysis.

You cannot use the data in the selected blank data set with a different chamber. To change the selected set, press the up arrow key until **Blank data source?** is displayed. Select a blank data set which was created using the correct size chamber.

*Range: 0 - 65 mm*

Consolidation force: 0.00000 Newtons	Analyze
---	---------

Use the right or left arrow key to display the force or pressure with which you wish the plunger to compress the sample during analysis. (Units — Newtons or Newtons/cm<sup>2</sup> — are determined by your System Options setup dialog. See Chapter 3 to change units.)

The choices available are the forces or pressures for which you have stored blank data in the currently selected blank data set. The software does not display forces for which fewer cycles were collected than the number of cycles specified in this sample run.



**If the force or pressure you wish to use does not appear as a choice on the display, either no data have been stored for that force in this set, OR the number of cycles you specified earlier in this analysis was greater than the number of cycles for which blank data were stored in this set, using the desired force or pressure.**

It may be helpful to look at a Blank data Set Listing to be certain that sufficient data are already stored for the force you wish to use.

Press [Enter] to start analysis, or [Esc] to cancel.
---

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

- 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. Recover or dispose of the sample.

Some analysis data are displayed on the LCD screen. To clear the screen and return to idle mode, press **ESCAPE** or **ENTER**. You may print reports and/or review and edit the data. Analysis data for the current analysis are retained in the analyzer's memory only until the next analysis is initiated.

## Output Options

---

If you set your System Options to print or transmit reports automatically, the Bulk 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 **Printing and Transmitting Data** beginning on page **5-1** for additional information and example reports.

## Collecting Blank Data During the Run

If you collect blank data during the sample run, you will be unable to use that data during subsequent sample analyses. The only circumstance in which it is more efficient to use this option is if you are certain you will not wish to analyze more samples with the current chamber/force configuration.

- Use the right and left arrow keys (**F2** and **F4**) to view choices.
- Press **ENTER** to select a choice and move the next field.
- Use the up and down arrow keys (**F1** and **F3**) to move to the next or previous field.



**If you are using the 50.8- or 38.1-mm chamber, make sure the piston coupling extender is attached to the piston.**

1. Insert the plunger part of the way into the chamber. Mount the empty chamber/plunger assembly on the analyzer. (Do not load the sample until you are prompted to do so.)
2. Press **2nd**, then **ANALYZE**.
3. Enter the data as prompted. If you set your system options setup (described in Chapter 3) to omit an optional data field, the corresponding prompt shown below will not appear when you operate the instrument.

Analyze type? Sample	Analyze
-------------------------	---------

Choose **Sample**.

Sample: Sample 1	Analyze
---------------------	---------

Enter the sample identification.

*Range: 19 characters*

Customer:	Analyze
-----------	---------

Enter the customer identification.

*Range: 9 characters*

Operator:	Analyze
-----------	---------

Enter an identification for the operator.

*Range: 9 characters*

Sample weight: 0.0000 g	Analyze
----------------------------	---------

For consistent results and correlation with other parameters, enter the *dry* sample weight.

*Range: 0.0000 to 99.9999 grams*

Blank Data Source?      Analyze  
Run blank now

Select **Run blank now**, and the GeoPyc prompts you to perform the blank portion of this sample run.

To use stored blank data, see [Storing Blank Data](#), page [4-2](#).

Number of cycles:      Analyze

Enter the number of cycles (consolidation) 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*

Chamber Diameter:      Analyze  
1.0000

Enter the diameter of the chamber you are using during this run.

*Range: 0 - 65 mm*

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

Consolidation force:      Analyze  
0.00000 Newtons

Enter the force or pressure with which you wish the plunger to compress the sample during analysis. (Units are specified in the System Options Setup, described in Chapter 3.)

*Range: 1 to 180 N*

*12.7-mm chamber, 0 to 142.09 N/cm<sup>2</sup>*

*19.1-mm chamber, 0 to 62.81 N/cm<sup>2</sup>*

*25.4-mm chamber, 0 to 35.52 N/cm<sup>2</sup>*

*38.1-mm chamber, 0 to 15.78 N/cm<sup>2</sup>*

*50.8-mm chamber, 0 to 8.88 N/cm<sup>2</sup>*

Press [Enter] to start analysis,  
or [Esc] to cancel.

Press **ENTER** to begin collecting blank data for this sample run. When blank data collection is finished, an audible signal is sounded.



4. The GeoPyc 1360 partially withdraws the plunger. Remove the chamber/plunger assembly from the instrument.
5. Carefully place the sample in the chamber. Be careful not to lose any sample if you transfer it to the chamber after it has been weighed.
6. Insert the plunger part of the way into the chamber, then re-mount the chamber/plunger assembly on the instrument.
7. Press **ENTER** to continue the sample run; sample data are automatically collected. When analysis is complete, the GeoPyc sounds an audible signal and the plunger is partially withdrawn from the chamber.

### **Output Options**

---

If you set your System Options to print or transmit reports automatically, the Bulk Density Report will be generated now. You may print reports and/or review and edit the data. Analysis data for the current analysis are retained in the analyzer's memory only until the next analysis is initiated.

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 **Printing and Transmitting Data** beginning on page **5-1** for additional information and example reports.

## 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, you may decide to use different levels of force than those at which you have stored data.

- Use the right and left arrow keys (**F2** and **F4**) to view choices.
- Press **ENTER** to select a choice and move the next field.
- Use the up and down arrow keys (**F1** and **F3**) to move to the next or previous field.



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

Press **F5 SETUP**.

Setup type?	Setup
Erase blank data	

Choose **Erase blank data**.

Blank data source?	Setup
Stored blank data set 1	

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

Force range from:	Setup
0.00000 N	

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

Force range to:	Setup
0.00000 N	

*Range: 1 to 180 N*

*12.7-mm chamber, 0 to 142.09 N/cm<sup>2</sup>*

*19.1-mm chamber, 0 to 62.81 N/cm<sup>2</sup>*

*25.4-mm chamber, 0 to 35.52 N/cm<sup>2</sup>*

*38.1-mm chamber, 0 to 15.78 N/cm<sup>2</sup>*

*50.8-mm chamber, 0 to 8.88 N/cm<sup>2</sup>*

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.

---

## Verifying Instrument Operation

---

If you obtain analysis results that are unexpected or unusual, you should confirm the operation of your GeoPyc. The following is one way to confirm accuracy.

Perform an analysis without a sample. Follow the directions for performing a sample run. Enter zero for sample weight. The reported bulk volume for the sample should be very nearly zero if the instrument is performing correctly.

If the procedure above reveals analysis errors:

1. 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.
2. Calibrate the force transducer. Refer to Appendix C, page [C-4](#) for instructions on calibrating the force transducer.

## Reviewing and Editing Analysis Parameters

---

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 Bulk Density Report generated for a given sample, you may wish to change the sample weight, then print another report.

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

**Sample:**  
**Customer:**  
**Operator:**  
**Sample weight:**  
**Blank Data Set:**  
**Chamber diameter:**



**Sample, Customer, and Operator are displayed only if you have set up your System Options to do so. Instructions for displaying (or not displaying) these fields are contained in Chapter 3.**

Use the Up and Down arrows to move through these fields to check them. Some fields may be edited, while others are for display only.

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 Blank Data Set, 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.**

## Canceling a Run

---

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

Press [Enter] to cancel analysis,  
or [Esc] to continue analysis.

## 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.

Bulk density reports remain available for printing until another analysis is performed. When you perform an analysis, reports from the previous analysis 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 that is available when you are using the T.A.P. Density Option.

### Printing a 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 3-9).
- 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? Report	Print
-----------------------	-------

#### Report

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

*Choices: Report, Blank Data Set Listing*

Print the Bulk Density report for the last analysis performed. Press **ENTER**; the report is printed.

#### Blank Data Set Listing

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

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

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

## Transmitting Data

---

See Chapter 3 for general operating instructions.

- Before you can transmit data, you must complete the Transmission Options setup dialog (refer to [Transmission Options](#), page 3-12). 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.
- 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 transmitting 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? Report	Print
--------------------------	-------

Choose whether you wish to transmit data for a report or on stored blank data.

*Choices: Report, Blank Data Set Listing*

### Report

Transmit data for the last analysis performed. Press **ENTER**; data for the report are transmitted.

### Blank Data Set Listing

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

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

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

Refer to Appendix A beginning on page [A-1](#) for additional information on the format of transmitted data.

---

## Reports

---

### **Blank Data Set Listing**

---

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

For each consolidation force level used 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, chamber diameter, number of preparation cycles, set identifier) are listed at the top of the report. The instrument identifier, operator identifier, date and time are also displayed.

#### **How to use this report:**

This report is very helpful when you wish to add or delete stored blank data, because it enables you to check the various force levels for which you have stored data. In the case of deleting data, this report helps you identify which data you wish to delete.

When you are performing sample 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) for the size chamber you are using. It also helps you make sure there is blank data stored for the consolidation force you plan to use during a sample run.

Page 1

MICROMERITICS INST.  
GeoPyc 1360 VXXX  
Blank Data Set Listing

Instrument: 125 Date: 01/24/1997  
Time: 13:45:29

---

Blank Data Set: 25.4 Blank Data Set#: 1  
 Preparation Cycles: 2  
 Chamber Diameter: 25.4000 mm

---

Consolidation Pressures (N/cm2)

Cycle #	1.000	2.000	3.000	5.000	7.000
	Counts	Counts	Counts	Counts	Counts
1	65432	20842	20830	20853	20882
2	65530	20828	20844	20873	20886
3	65432	20813	20833	20857	20874
4	65467	20836	20854	20882	20876
5	65391	20819	20840	20867	20888

*Example of Blank Data Set Listing Report*



---

## Bulk 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 identifier, operator identifier, date and time are also displayed.

For each cycle, the report lists:

<b>Blank counts:</b>	The number of steps the motor moved to achieve the consolidation force specified for the blank run.
<b>Sample counts:</b>	The number of steps the motor moved to achieve the consolidation force specified for the sample run.
<b>Volume:</b>	The difference between the blank and sample counts, converted by the GeoPyc to volume.
<b>Deviation (volume):</b>	The difference between the average bulk volume and the volume measured for this consolidation cycle.
<b>Density:</b>	The bulk density calculated for the sample during this consolidation cycle.
<b>Deviation (density):</b>	The difference between the average density and the density for this cycle.

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

### How to use this report:

The data in this report can be used to make comparisons between samples, and comparisons of samples against your standards or specifications.

MICROMERITICS INST. GeoPyc 1360 VXXX Bulk (T.A.P.) Density Report						
Instrument:	125				Date:	01/23/1997
Operator:	MRG				Time:	15:50:19
-----						
Customer:	DRC					
Sample:	SILICA			Sample Weight:	1.0073	g
Blank Data Set:	25.4			Blank Data Source:	Stored Set	1
Preparation Cycles:	2			Measured Cycles:	5	
Chamber Diameter:	25.4000	mm				
Consolidation Pres.:	3.0000	N/cm2				
-----						
Cycle #	Blank Counts	Sample Counts	Volume cm3	Deviation cm3	Density g/cm3	Deviation g/cm3
1	20830	13793	9.4342	0.0434	0.1067	-0.0005
2	20844	13819	9.4181	0.0273	0.1069	-0.0003
3	20833	13847	9.3659	-0.0249	0.1075	0.0002
4	20854	13846	9.3953	0.0045	0.1072	-0.0000
5	20840	13873	9.3404	-0.0504	0.1078	0.0005
Average Bulk Volume:			9.3908	cm3	Standard Deviation:	0.0381
Average Bulk Density:			0.1072	g/cm3	Standard Deviation:	0.0004

*Example of Bulk Density Report*

## 6. ORDERING INFORMATION

Part Number	Item and Description
136-00001-00	GeoPyc 1360 Pycnometer for determining bulk volume and bulk density that emulates tap density. Includes internal computer with software, LCD screen, and keypad.
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)
136-25801-00	Sample chamber and plunger assembly, 12.7-mm ID
136-25801-10	Sample chamber, 12.7-mm ID
136-25801-11	Plunger assembly, for 12.7-mm ID sample chamber
136-25801-07	Piston, for 12.7-mm ID plunger
004-25924-00	Quad ring, -011, Buna-N, 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
136-25802-11	Plunger assembly, for 19.1-mm ID sample chamber
136-25802-07	Piston, for 19.1-mm ID plunger
004-25925-00	Quad ring, -015, Buna-N, 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
136-25803-11	Plunger assembly, for 25.4-mm ID sample chamber
136-25803-07	Piston, for 25.4-mm ID plunger
004-25926-00	Quad ring, -019, Buna-N, for 25.4-mm ID plunger

Part Number	Item and Description
136-25804-00	Sample chamber and plunger assembly, 38.1-mm ID
136-25804-10	Sample chamber, 38.1-mm ID
136-25804-11	Plunger assembly, for 38.1-mm ID sample chamber
136-25804-07	Piston, for 38.1-mm ID plunger
004-25827-00	Quad ring, -027, Buna-N, 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
136-25805-11	Plunger (piston), for 50.8-mm ID sample chamber
136-25805-05	Cup seal, for 50.8-mm ID plunger
004-25928-00	Quad ring, -132, Buna-N, for 50.8-mm ID plunger
004-32177-00	Funnel, plastic
004-54613-00	Brush, dusting, 3/8-in. wide x 3/4-in. long
136-34800-00	Spring Standard (Force Transducer Calibration Fixture)
136-42805-00	Operator's Manual, T.A.P. Density version
Call for current model and part number	Printer, connects to the GeoPyc 1360 to print reports
136-25852-01	Piston coupling extender, used for 38.1 and 50.8-mm chambers
136-33006-00	Option, Envelope Density upgrade. Kit includes DryFlo <sup>®</sup> , sieve and sieve pan, software, and manual. Enables the 1360 to measure Envelope Density.

## A. FORMAT OF TRANSMITTED DATA

### 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 ID	10 characters
5	Date	12 characters
6	Operator ID	10 characters
7	Time	10 characters
8	Customer	10 characters
9	Sample ID	20 characters
10	Sample weight	1 floating point
11-12	Reserved	1 floating point
13	Blank Data Set ID	10 characters
14	Blank Data Set number	1 integer
15	Preparation cycles	1 integer
16	Measured cycles	1 integer
17	Chamber diameter	1 floating point
18	Force format	1 integer
19	Consolidation force / Pressure	1 floating point
20-21	Reserved	1 floating point
22	Average bulk volume	1 floating point
23	Bulk volume standard deviation	1 floating point
24	Average bulk density	1 floating point
25	Bulk density standard deviation	1 floating point
26-27	Reserved	1 floating point
	<b>Single column</b> (Repeat measured cycle times)	
i	Blank counts	1 integer
ii	Sample counts	1 integer
iii	Volume	1 floating point
iv	Volume deviation	1 floating point
v	Bulk density	1 floating point
vi	Bulk density deviation	1 floating point

Record Number	Information Conveyed	Form
	<b>Spreadsheet</b>	
28	Carriage return and line feed	
29	Carriage return and line feed	
30	Carriage return and line feed (Repeat measured cycle times)	
a	Cycle number	1 integer
b	Blank counts	1 integer
c	Sample counts	1 integer
d	Volume	1 floating point
e	Volume deviation	1 floating point
f	Bulk density	1 floating point
g	Bulk density deviation	1 floating point

## 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 = 4	1 integer
4	Instrument ID	10 characters
5	Date	12 characters
6	Time	10 characters
7	Spring constant	1 floating point
8	Force sensor calibration factor	1 floating point
9	Standard deviation	1 floating point
10	Number of displacement cycles	1 long integer
11	Home position deviation	1 integer
12	Current date and time	20 characters
13	Current displacement cycles	1 long integer
14	Reserved	10 characters
15	Reserved	1 integer
	<b>Single column</b> (Repeat 10 times)	
i	Point Number	1 integer
ii	Displacement counts	1 integer
iii	Spring force	1 floating point
iv	Force sensor reading	1 integer
	End for 1	
	<b>Spreadsheet</b>	
16	Carriage return/Line Feed	
17	Carriage return/Line Feed	
18	Carriage return/Line Feed (Repeat 10 times)	
a	Point Number	1 integer
b	Displacement counts	1 integer
c	Spring force	1 floating point
d	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 ID	10 characters
5	Date	12 characters
6	Time	10 characters
7	Blank data set ID	10 characters
8	Blank data set number	1 integer
9	Number of prep. cycles	1 integer
10	Chamber diameter	1 floating point
11-12	Reserved	1 floating point
13	Force format	1 integer
	<b>Single column</b>	
14-23	Consolidation force / Pressure	1 floating point
24-223	Counts	1 integer
	<b>Spreadsheet</b>	
14	Carriage return/Line Feed	
15	Carriage return/Line Feed	
16	Carriage return/Line Feed	
17a	0	1 integer
17 b - k	Consolidation force / Pressure (Repeat 20 times)	1 floating point
a	Cycle number	1 integer
b - k	Blank counts	1 integer



---

## B. ERROR MESSAGES

---

This appendix includes the error messages you may encounter while operating the GeoPyc software.

### Analysis

---

**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. The piston coupling extender must be used with the 38.1 and 50.8-mm plungers during collection of blank data, so that the plunger has enough travel length available to achieve the force required before the limit switch is reached.

**ANALYSIS\_ERR: Unable to calculate  
blank data from the Blank Data Set.**

*Cause A:* Force 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 run.

*Cause B:* The number of cycles you specified in this sample run exceeds the number of cycles for which blank data have been stored for this chamber and force. See [Storing Blank Data](#), page 4-2 for more information.

*Action B:* Re-start this run using a number of cycles equal to or less than the number of cycles stored for this chamber and this force. It may be helpful to look at the Blank Data Set Listing for the set you are using, to see how many cycles were used when the blank data were stored. This is the maximum number of cycles you can specify when using these stored blank data.

---

## Data Reduction

---

**DATA\_ERR:****No data to compute.**

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

*Action:* Re-run the sample.

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

*Cause:* Not enough data were collected for the standard deviation to be calculated (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 run was canceled before completion.

*Action:* If desired, re-run the sample.

**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.

---

## Output

---

**IO\_ERR: Printer.  
Device not responding.**

*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.

---

## System

---

**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, following the instructions in this manual.

**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 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.

---

## User Interface

---

**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 not valid for the format you chose in your system setup.

*Action:* Enter the date in the format shown.

**UI\_ERR: Invalid format****hh:mm:ss required.**

*Cause:* The time you entered is not valid 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 not valid 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 A:* This field value is derived from the blank run parameters.

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

*Cause B:* The chamber diameter is entered when the first group of data are collected in a blank data set. Subsequent runs to store data in this set and subsequent analysis runs using this set **MUST** use this chamber diameter.

*Action B:* If you wish to use this set, you must use the correct size chamber. To use a different set, return to the Use stored blank data set? field and select a set which uses the desired chamber diameter. If no such set exists, create one.

**UI\_ERR: Invalid number of cycles.  
Exceeds number stored in blank data set.**

*Cause:* You have specified a number of analysis cycles that exceeds the number that was stored in the currently-selected blank data set.

*Action:* Enter a number of cycles equal to or less than the number stored in the blank data set. It may be helpful to look at a current Blank Data Set Listing report to see how many cycles were stored in the set.





---

## 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 installed on the analyzer.**

---

### Accessing Manual Mode

---

Press the **2nd key**, then **MANUAL** to 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**. 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? Move to Home	Manual
----------------------------------	--------

Moves the displacement device (plunger) directly to the home position.

Which operation? Move number of steps (+ or -)	Manual
---	--------

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

Steps to move: Steps	Manual
-------------------------	--------

Enter the number of steps. The instrument assumes that you wish the plunger to move forward (+) unless you indicate backward steps by typing a minus (-) 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? Set movement speed	Manual
--	--------

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: Step/sec	Manual
--------------------	--------

*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? Move until force achieved	Manual
---	--------

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: 0.00000 Newtons	Manual
--------------------------------------	--------

*Range: 0 to 180 Newtons*

Which operation? Toggle agitation on/off	Manual
---	--------

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? Low	Manual
-------------------	--------

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

Which operation? Toggle force display units	Manual
--	--------

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? Calibrate force transducer	Manual
--	--------

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: 0.00000 N/mm	Manual
----------------------------------	--------

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**  
Transmit force calibration report

Transmits 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 modet

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.

<b>Points:</b>	Calibration readings are taken at 10 points. For each point, the report lists:  <b>Displacement counts:</b> the number of steps of the motor from home position to the point at which force sensor data is recorded.  <b>Spring force (N):</b> the force exerted by the displacement device at this point, calculated by the instrument from the spring constant and the displacement distance.  <b>Force sensor reading:</b> the uncorrected value from the analog to digital electronics.
<b>Slope:</b>	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).
<b>Standard deviation:</b>	Calculated using the above data. A standard deviation less than 1.0 is desirable.
<b>Number of displacement cycles:</b>	A record of how many cycles have been performed by the analyzer since the instrument was first calibrated.
<b>Number of counts deviation at home position:</b>	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 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			
Point#	Displacement Counts	Spring Force(N)	Force Sensor 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***





# INDEX

## Numerics

- 2nd key, 3-2
- functions, 3-4

## A

- Analysis chamber, 3-13
  - cleaning, 3-13
  - determining diameter, 3-14
  - handling, 3-16
  - selecting appropriate size, 3-14
- Analyzer
  - cleaning, 3-1
  - turning on and off, 3-1
  - warmup, 3-1
  - See also* Equipment
- Analyzing samples
  - collecting blank data during analysis, 4-9
  - using stored blank data, 4-6

## B

- Blank data
  - collecting during analysis, 4-9
  - erasing, 4-12
  - storing, 4-2
- Blank Data Set Listing, 4-3, 5-3
  - printing, 5-1
  - transmitted data format, A-4
- Blank run, 4-1
- Bulk density, 1-3
- Bulk Density report, 5-5
  - printing, 4-8, 4-11

## C

- Canceling a run, 4-14
- Cautions, defined, 1-2
- Chamber diameter
  - determining, 3-14
  - internal, 1-7
- Chamber/plunger
  - installing on analyzer, 3-18
  - removing from analyzer, 3-19
- Cleaning
  - analysis chamber, 3-13
  - analyzer, 3-1
  - piston, 3-13

- Consolidation
  - cycles, 1-5, 4-7
  - force, 1-4, 3-21
  - guidelines for force/pressure, 3-21
  - pressure, 3-21
- Conventions, operator's manual, 1-2
- Cycles
  - consolidation, 4-7
  - preparation, 3-23

## D

- Data
  - agreement, 1-6
  - entering and selecting, 3-4
  - repeatability, 3-20
- Date, entering, 3-6
- Diameter, chamber, 3-14

## E

- Emulating tap density results, 3-22
- Envelope density, 1-3
- Equipment
  - damage and loss, 2-1
  - location, 2-3
  - returns, 2-1
  - setup, 2-3
  - unpacking and inspecting, 2-1
  - See also* Analyzer
- Erasing stored blank data, 4-12
- Error messages, B-1
  - Analysis, B-1
  - Data reduction, B-2
  - IO, output, B-3
  - System, B-3
  - UI, User interface, B-5
- Exposed materials, 1-7
- Extenders, piston, 3-13

## F

- Force
  - recommended, 3-22
- Force transducer calibration, C-4
  - report, C-5
  - example of report, C-7
  - report, transmitted data format, A-3

Format for transmitted data, [A-1](#)  
Frequency, [1-7](#)  
Function keys, [3-3](#)

## H

Humidity, [1-7](#)

## I

Installing chamber/plunger, [3-18](#)  
Instrument ID, [3-6](#)

## K

Keypad  
description of keys, [3-3](#)  
template, [2-5](#)  
using, [3-1](#)

## L

Language, selecting, [3-6](#)  
Location, selecting, [2-3](#)

## M

Manual mode, [C-1](#)  
display contents, [C-1](#)  
exiting, [C-5](#)  
functions, [C-2](#)  
Measurement method, [1-6](#)  
Memory Card, installing, [2-3](#)

## N

Notes, defined, [1-2](#)

## O

Operator's manual  
conventions, [1-2](#)  
organization, [1-1](#)  
Ordering information, [6-1](#)  
Output options  
sample run, [4-8](#), [4-11](#)  
stored blank data, [4-5](#)

## P

Piston  
changing, [3-17](#)  
cleaning, [3-13](#)

extender, [3-13](#)  
tightness, [3-17](#)  
Plunger, [3-13](#)  
handling, [3-16](#)  
Power, [1-7](#)  
Power cord, installing, [2-3](#)  
Preparation cycles, [1-5](#)  
selecting, [3-23](#)  
specifying number of, [3-8](#)  
Pressure  
recommended, [3-22](#)  
Printer, connecting, [2-5](#)  
Printing reports, [5-1](#)

## R

Repeatability of data, [1-5](#), [3-20](#)  
Report options, [3-9](#)  
Report Options setup dialog, [3-9](#)  
Reports, [1-6](#)  
destination, [3-9](#)  
Force transducer calibration, [C-6](#)  
printing, [5-1](#)  
title, [3-6](#)  
transmitted data format, [A-1](#)  
transmitting, [5-2](#)  
Reproducibility, [1-7](#)  
Re-use of sample, [3-20](#)  
RS-232 Data Transmission, [1-3](#)  
connecting cable, [2-5](#)

## S

Safety precaution, [1-2](#)  
Sample  
compaction, [3-23](#)  
guidelines, [4-1](#)  
preparation, [3-20](#)  
reusing, [3-20](#)  
weight, [3-20](#), [4-7](#), [4-9](#)  
Sample analysis  
canceling, [4-14](#)  
collecting blank data during, [4-9](#)  
using stored blank data, [4-6](#)  
Sample run, [4-1](#)  
Sample volume  
optimum, [3-20](#)  
Second key, [3-2](#)  
functions, [3-4](#)  
Setup  
equipment, [2-3](#)  
software, [3-5](#)

Setup dialog, [3-9](#)  
    accessing, [3-6](#)  
    System options, [3-6](#)  
    Transmission options, [3-12](#)  
Signal, audible, [3-4](#), [4-4](#)  
Software  
    installing, [2-3](#)  
    using, [3-5](#)  
Specifications, [1-7](#)  
Stepper motor, [1-6](#)  
Stored blank data set, [4-2](#)  
    using, [4-6](#)  
Storing blank data, [4-2](#)  
System configuration, [1-3](#)  
System Options setup dialog, [3-6](#)

## T

T.A.P. density, [1-3](#), [1-4](#)  
    emulating results, [3-22](#)  
Temperature, [1-7](#)  
Testing the piston tightness, [3-17](#)  
Time, entering, [3-7](#)  
Transmission Options setup dialog, [3-12](#)  
Transmitted data  
    selecting format, [3-9](#)  
Troubleshooting  
    verifying instrument operation, [4-13](#)

## V

Verifying instrument operation, [4-13](#)  
Voltage, [1-7](#)

## W

Warnings, defined, [1-2](#)  
Weighing samples, [3-20](#)  
Where to begin, [4-2](#)

