micromeritics®

ACCUPYC II

gas displacement pycnometry system

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Gas Displacement Pycnometry System

Gas pycnometry is recognized as one of the most reliable techniques for obtaining true, absolute, skeletal, and apparent volume and density. This technique is non-destructive as it uses the gas displacement method to measure volume. Inert gases, such as helium or nitrogen, are used as the displacement medium. Density calculations using the gas displacement method are much more accurate and reproducible than the traditional Archimedes water displacement method.

The AccuPyc II 1340 Series Pycnometers are fast, fully automatic pycnometers that provide high-speed, high-precision volume measurements and true density calculations on a wide variety of powders, solids, and slurries. The instrument completes most **sample analyses in less than three minutes without sacrificing accuracy.** After analyses are started with a few keystrokes, data are collected, calculations are performed, and results displayed. A minimal amount of operator attention is required.

Benefits

Maintain product integrity with this non-destructive test

Adapt instrument configuration to meet your sample size needs

Maximize your results with superior speed of analysis, accuracy, repeatability, and reproducibility

Eliminate error with programmable automatic repeat and data acquisition set to your tolerances to comply with your SOPs

Minimize cost and space requirements - low maintenance and small footprint

Operate with either a keypad or Windows® software

Use a variety of gases

Increase efficiency and compliance with barcoding compatibility

Eliminate procedural steps with direct input from an analytical balance

APPLICATIONS

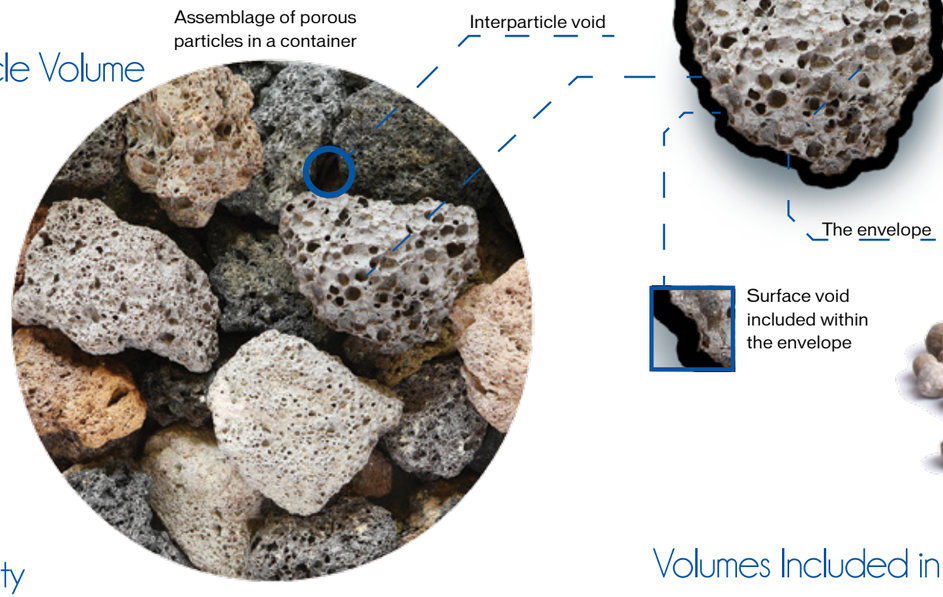
Application	Discussion	Reference
Powder Metallurgy	Results of many intermediate and final processing steps are controlled by or related to skeletal density of the metal. In addition, the performance of many sintered or cast metal structures may be predicted from the skeletal density of the starting metal powder.	
Refractory Materials	True density is a useful value for: classification, detecting differences in chemical composition between supposedly similar samples, indicating mineralogical phases or phase changes, calculating total porosity when the bulk density is known, and for any other test method that requires this value for the calculation of results.	ASTM C604-02
Calcined Petroleum Coke	The density of calcined petroleum coke directly influences the physical and chemical properties of the manufactured carbon and graphite artifacts for which it is used. Density, therefore, is a major quality specification of calcined petroleum coke and is used as a control in coke calcination.	ASTM D2638-10
Soil	The specific gravity of soils that contain extraneous matter (such as cement, lime, etc.) or water-soluble material (such as salt) must be corrected because of the precipitate that forms on the specimen after drying. If the precipitate has a specific gravity less than the parent soil grains, the uncorrected test result will be too low. If the precipitate has a higher specific gravity, then the uncorrected test value will be too high.	ASTM D5550-06
Powder Coatings	Total solids content can be used to determine minimum coverage obtainable with different coating blends. Mixtures of dry pigments can be monitored by comparing measured density with theoretical density based upon composition of the mixture.	ASTM D5965-20
Clear or Pigmented Coatings	Dried film density can be used in the determination of Volatile Organic Compound (VOC) content of clear and pigmented coatings. VOC is required by government regulations.	ASTM D6093-97
Rigid Cellular Plastics	Plastic foams exhibit different properties based upon the ratio of open and closed cells. Insulation foams limit thermal conductivity through pockets of trapped gases contained within closed pores. Flotation devices owe buoyancy to closed air-filled pores that prohibit water entry.	ASTM D6226-10
Pharmaceuticals	Composition of active and excipient ingredients can be monitored and controlled through determination of product density. Polymorphic, hydrated, and amorphous forms of products, as well as purity, can be determined by comparing measured density with theoretical and historical values.	USP 699

More instruments, in more countries, to more satisfied users

DENSITY MEASUREMENT

On an elementary level, the volume of a solid material can be calculated by measuring its length, width, and thickness. However, many materials have within their structure surface irregularities, small fractures, fissures, and pores. Some of these voids or pores are open to the surface or closed within the structure of the solid material. Therefore, differences in the material volume depend on the measurement technique, measurement method, and the conditions under which the measurements were performed.

Particle Volume



Fertilizers

Knowledge of the bulk density is of interest in package sizing, in calibrating volumetric feeders or applicators, and in determining the storage capacity of bins and transport vehicles. Apparent density information can be used in segregation studies and development of granulation processes. True density measurements are important in process control and the design of process equipment.

Mining Cores

Simple physical measurements of a circular core cylinder's diameter and length allow the envelope volume to be calculated. A gas displacement pycnometer, with a larger sample chamber designed specifically to accept intact drill cores, provides a low-cost, time-saving, non-destructive technique for measuring the skeletal volume. Knowing the envelope and skeletal volumes allows the total pore volume and percent porosity of the core sample to be determined.

Density

Volumes Included in Definition

Density Type	Definition	Material Volume	Open-Pore Volume	Closed-Pore Volume	Inter particle Volume	External Void Volume	Addressed by
True (Absolute)	The mass of a substance divided by its volume, excluding open and closed (or blind) pores	◎					AccuPyc II
Skeletal (Apparent)	The ratio of the mass of the solid material to the sum of the volume including closed (or blind) pores	◎		◎			AccuPyc II
Envelope	The ratio of the mass of a substance to the envelope volume (imaginary boundary surrounding the particle)	◎	◎	◎	◎	◎	GeoPyc
Bulk	Mass of the material divided by the volume occupied that includes interstitial space	◎	◎	◎	◎		GeoPyc
Tap	Apparent powder density obtained under stated conditions of tapping	◎	◎	◎	◎		GeoPyc with T.A.P. function

Cosmetics

The presence of air bubbles in cosmetic preparations, such as lipsticks and powder cakes, is undesirable for a number of reasons. Trapped air can create pinholes and poor appearance in lipsticks and compromise the integrity of cakes. The effectiveness of different methods of air bubble removal can be evaluated by comparing the true density measurements of the material before and after air bubble removal.

GAS DISPLACEMENT PYCNOMETRY

Principle of Operation

This technique uses the gas displacement method to measure volume accurately. Inert gases, such as helium or nitrogen, are used as the displacement medium. The sample is sealed in the instrument compartment of known volume, the appropriate inert gas is admitted, and then expanded into another precision internal volume. The pressures observed upon filling the sample chamber and then discharging it into a second empty chamber allow computation of the sample solid phase volume. Helium molecules rapidly fill pores as small as one angstrom in diameter; only the solid phase of the sample displaces the gas. Dividing this volume into the sample weight gives the gas displacement density.

1 Inert gas flows Into sample chamber
valve **a** opens then closes

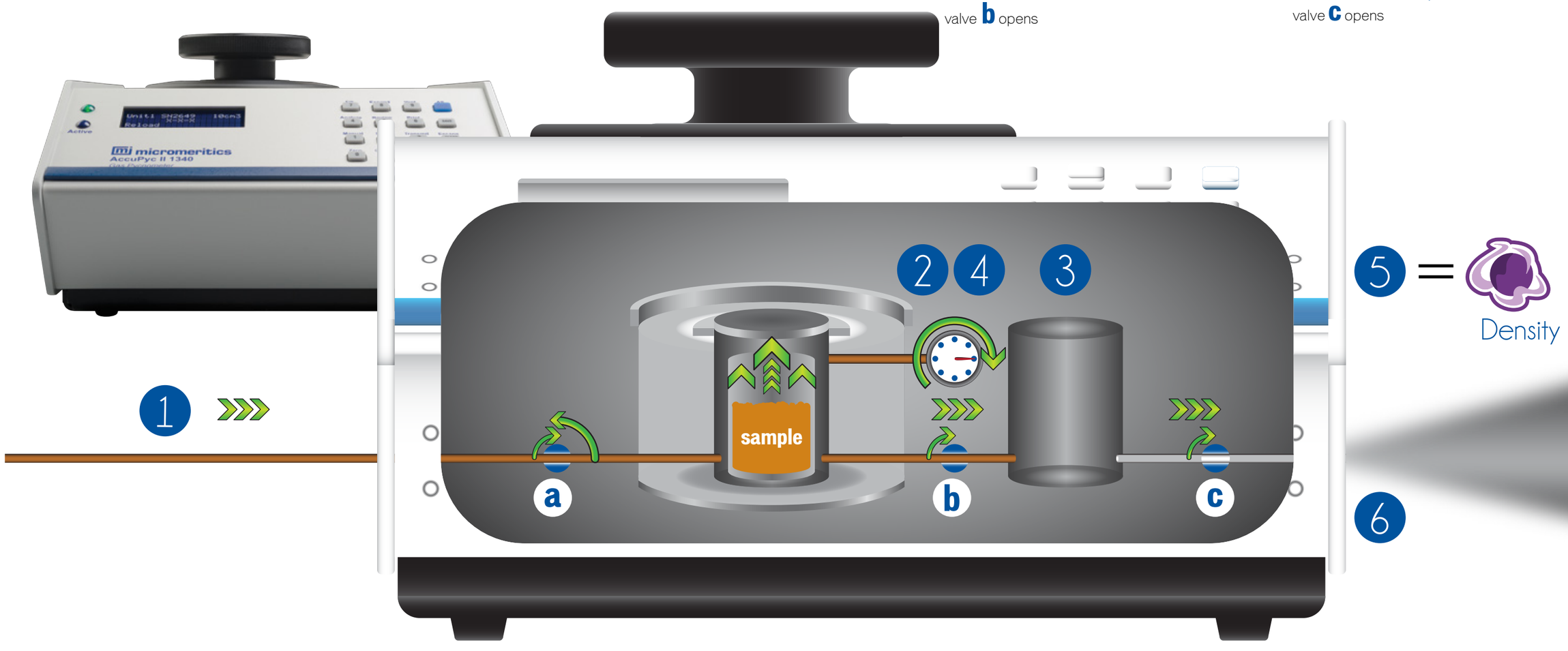
2 Equilibrium is reached

3 Gas flows into second chamber for volume measurement
valve **b** opens

4 Equilibrium is reached yet again

5 Volume divided into sample weight determines density

6 Pressure vented off to atmosphere
valve **c** opens



Every Eight Hours – A Technical Paper Citing a Micromeritics instrument is Accepted for Publication in a Scientific Journal

HIGHLY ADAPTIVE SYSTEM

The AccuPyc II Pycnometer consists of an integrated control and analysis module. For those who require high throughput, analysis modules are also available in a single configuration, allowing you to attach up to five additional analysis modules to a single controlling unit. Each module has its own gas connection. A variety of sample chamber sizes can be selected to provide the best fit with your samples. The run precision mode allows you to achieve high repeatability. The instrument automatically purges water and volatiles from the sample and then repeats the analysis until successive measurements converge upon a consistent result.

Unique run precision

Increases the precision of analysis results by reporting data from five consecutive measurements that are within a user-specified tolerance. This feature allows early termination of analysis, thereby decreasing the number of cycles needed for accurate results.

Multilingual

The AccuPyc may be operated in five languages: English, French, German, Italian, or Spanish

Ethernet port

An Ethernet port on the rear panel of the control module enables you to email reports, send data to a web browser for archiving, or interface with the AccuPyc Windows application

USB ports

USB ports on the rear panel of the control module allow for connection to a printer (output of analysis and calibration results in either ascii or excel formats) and keyboard (alphanumeric character input). The USB port is also used for installing software upgrades

Integrated control and analysis module

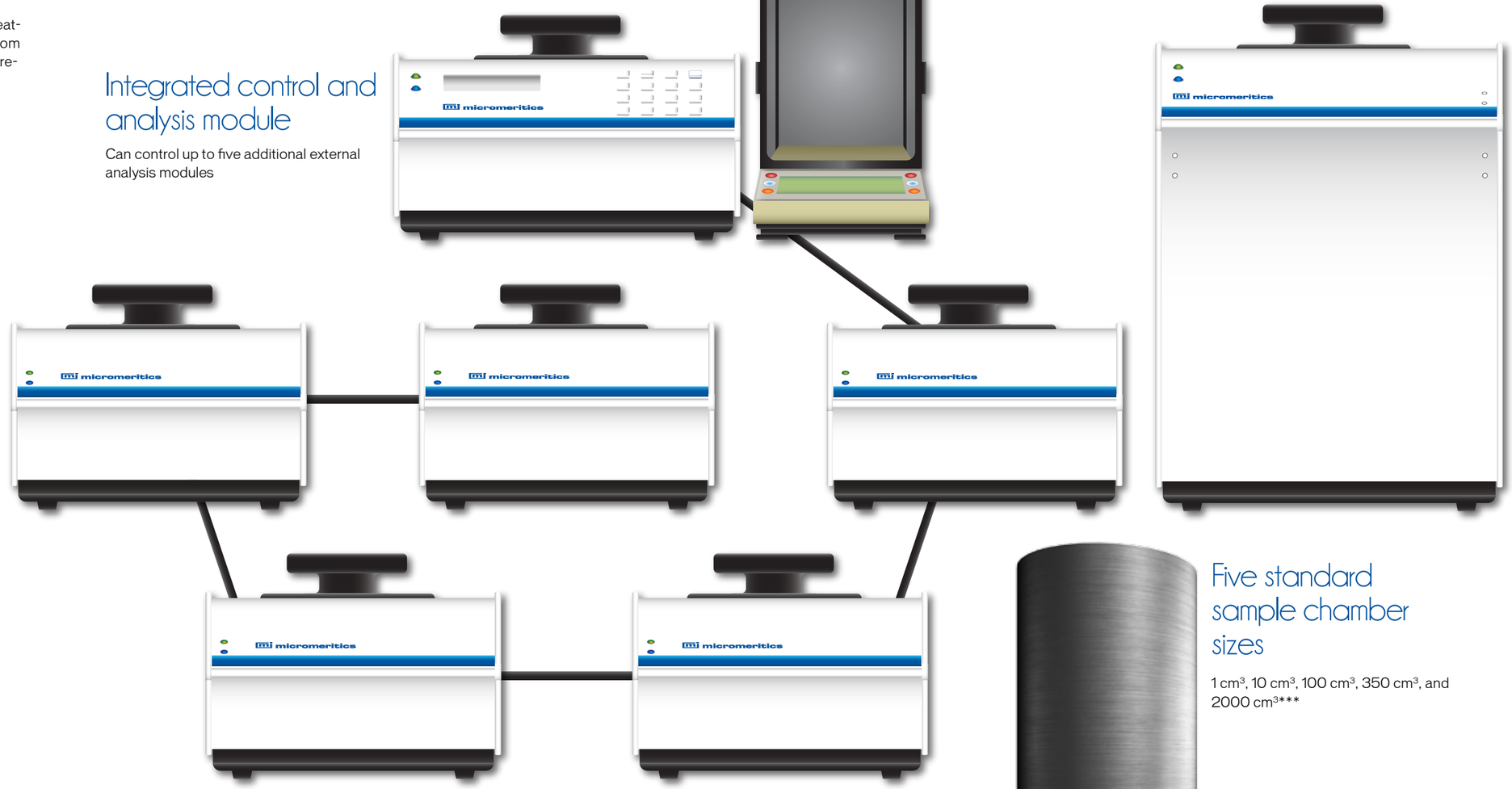
Can control up to five additional external analysis modules

Direct sample mass input

Sample mass may be directly input from an analytical balance

CorePyc***

Specialized unit with 2000-cm³ sample chamber size



Simple calibration process

Allows you to easily determine the volume of the instrument sample cell and expansion chambers using a traceable standard volume. After calibration, the cell and expansion chamber volumes are stored automatically

Bayonet cap fitting

Provides superior repeatable seal compared to screw-type fitting

Five standard sample chamber sizes

1 cm³, 10 cm³, 100 cm³, 350 cm³, and 2000 cm³***

MODEL SELECTION

	Sample Chamber Capacity	Sample Chamber Dimensions	Available MultiVolume Insert Kits	Temp Control Type	Catalog Number
AccuPyc II 	1 cm^3	1-cm ID x 1.1-cm D	0.1 cm^3	N/A	134/00001/00
	10 cm^3	1.80-cm ID x 3.93-cm D	1.0 and 3.5 cm^3		134/00000/00
	100 cm^3	4.62-cm ID x 6.17-cm D	10 and 35 cm^3		134/00002/00

AccuPyc II 1340 Remote Analysis Instruments

Bundle includes Control module and 2-ft cable connected to Analysis modules.				
AccuPyc II Bundle 	1 cm^3	1-cm ID x 1.1-cm D	0.1 cm^3	134/00031/00
	10 cm^3	1.80-cm ID x 3.93-cm D	1.0 and 3.5 cm^3	134/00030/00
	100 cm^3	4.62-cm ID x 6.17-cm D	10 and 35 cm^3	134/00032/00
	350 cm^3	5.84-cm ID x 13.94-cm D	NA	134/00033/00
	2000 cm^3	9.7-cm ID x 26.00-cm D	650 and 1300 cm^3	134/00034/00
Remote analysis modules only. Remote analysis units require connection to a control module or AccuPyc II 1340				
Remote Analysis Module Only 	1 cm^3	1-cm ID x 1.1-cm D	0.1 cm^3	134/00041/00
	10 cm^3	1.80-cm ID x 3.93-cm D	1.0 and 3.5 cm^3	134/00040/00
	100 cm^3	4.62-cm ID x 6.17-cm D	10 and 35 cm^3	134/00042/00
	350 cm^3	5.84-cm ID x 13.94-cm D	NA	134/00043/00
	2000 cm^3	9.7-cm ID x 26.00-cm D	650 and 1300 cm^3	134/00046/00
Control module only. Up to 5 analysis modules can be connected to a single control module.				
Control Module Only 	N/A	N/A	N/A	134/00005/00

AccuPyc II 1340 Temperature-Controlled Instruments

AccuPyc II TC	10 cm^3	1.80-cm ID x 3.93-cm D	1.0 and 3.5 cm^3	134/00010/00
	100 cm^3	4.62-cm ID x 6.17-cm D	10 and 35 cm^3	134/00020/00
AccuPyc II TEC 	10 cm^3	1.80-cm ID x 3.93-cm D	1.0 and 3.5 cm^3	134/00050/00
	100 cm^3	4.62-cm ID x 6.17-cm D	10 and 35 cm^3	134/00051/00
	10 cm^3	1.80-cm ID x 3.93-cm D	1.0 and 3.5 cm^3	134/00044/00
	100 cm^3	4.62-cm ID x 6.17-cm D	10 and 35 cm^3	134/00045/00

Use with External Recirculating Bath 15-50 °C

Integral Thermo-Electric Cooling, 15-36 °C, ± 0.1 °C*

Use with External Recirculating Bath 15-50 °C

Research grade helium or nitrogen is strongly recommended. High purity Carbon dioxide, dry air, or argon may be used. A multigas option for up to four gases on one analysis unit is available.

*Subject to environmental operating conditions

HARDWARE VERSATILITY

MultiVolume Kits

A MultiVolume option allowing you to analyze smaller-sized samples with your current AccuPyc model is available for configurations listed below;

Each kit includes appropriate insert(s), reference standard(s), and sample cup(s).

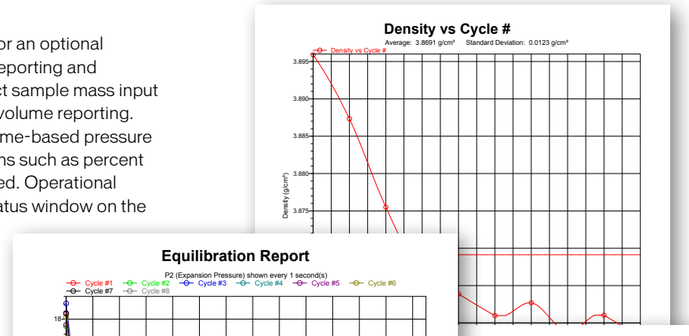
- 2000-cm^3 nominal cell volume
  650- and 1300-cm^3 cups
- 100-cm^3 nominal cell volume
  10- and 35-cm^3 cups
- 10-cm^3 nominal cell volume
  1- and 3.5-cm^3 cups
- 1-cm^3 nominal cell volume
  0.1-cm^3 cup

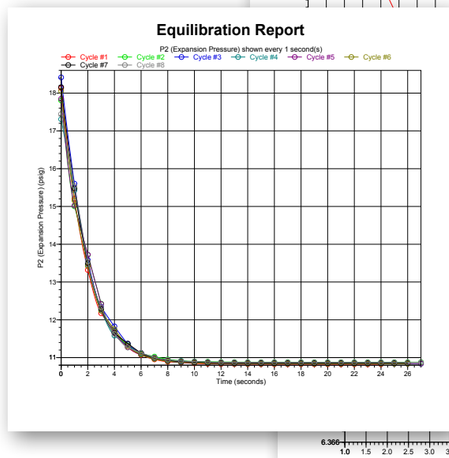
SOFTWARE VERSATILITY

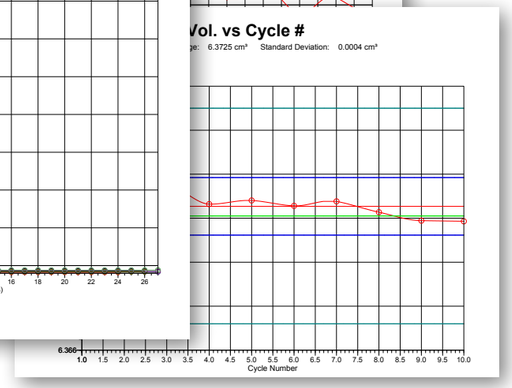
Data Presentation

The AccuPyc II can be operated with a keypad or an optional Windows® interface that provides exceptional reporting and archiving capability. Both versions include direct sample mass input from a balance and cycle-based displacement volume reporting. With the Windows interface, features such as time-based pressure equilibration reporting and additional calculations such as percent solids content and total pore volume are included. Operational status can also be continually monitored in a status window on the monitor screen.

- Combined Report
- Summary Report
- User-Defined Tabular Reports
- Volume vs. Cycle #
- Density vs. Time
- Total Pore Volume vs. Temperature
- Density vs. Cycle #
- Options Report
- Equilibration Report
- Sample Log







POROSITY SOLUTION

Total Pore Volume/Percent Porosity Bundle Pharmaceutical Applications

While skeletal and envelope volume measurements are each important on their own merit, their combination also allows you to accurately calculate percent porosity and total pore volume of a body.

Tablet Press

Pharmaceutical scientists realize that many of the physical, mechanical, and pharmacokinetics properties of tablets are influenced by the basic settings of a tablet press. Using the AccuPyc coupled with the GeoPyc, scientists are now able to determine quickly and easily the skeletal density, envelope density, total pore volume, percent porosity, and closed-cell pore volume of tablets produced with varying press settings.

Pharmaceutical Ribbons

With the skeletal density measured by the AccuPyc included in the setup parameters for the envelope density, the GeoPyc will calculate and report the percent porosity and total pore volume of the ribbon. This information has proven to be useful in controlling the mechanical properties of the material, compression force settings on the roller compactor, and subsequent tablet press settings.

GeoPyc Envelope Density Analyzer

The GeoPyc utilizes a quasi-fluid displacement medium composed of non-hazardous microspheres having a high degree of flowability that do not wet the sample or fill its pores.

- Determines envelope volume and density of monolithic samples as well as bulk volume and density of powdered materials
- A variety of sample chambers is available to accommodate a wide range of sample sizes
- T.A.P. Density option – measures the packing volume and calculates the bulk density of granular and powdered samples

AccuPyc/GeoPyc*

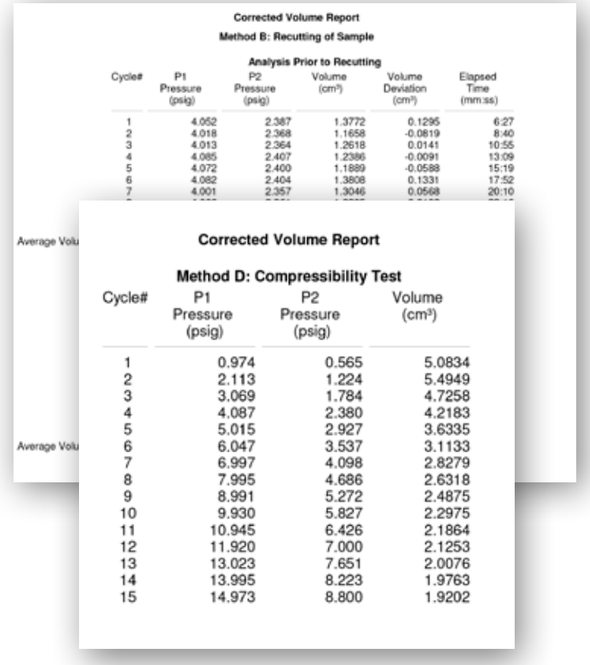
*included in porosity bundle

FOAM SOLUTION

FoamPyc Bundle – Density Measurements for Open- and Closed-Cell Foams

The AccuPyc II unit can be ordered initially with the FoamPyc application installed. If you have a standard AccuPyc, you can upgrade with a software enhancement. A FoamPyc option for measuring open- and closed-cell foam materials is available in the following configurations for the standard and temperature-controlled pycnometers:

- 10-cm^3 nominal cell volume (for conformance to ASTM and ISO methods)
- 100-cm^3 nominal cell volume



Corrected Volume Report

Method B: Recutting of Sample

Analysis Prior to Recutting

Cycle#	P1 Pressure (psig)	P2 Pressure (psig)	Volume (cm³)	Volume Deviation (cm³)	Elapsed Time (mm:ss)
1	4.052	2.387	1.3772	0.1295	6:27
2	4.018	2.368	1.1658	-0.0819	8:40
3	4.013	2.364	1.2618	0.0141	10:55
4	4.085	2.407	1.2386	-0.0091	13:09
5	4.072	2.400	1.1889	-0.0588	15:19
6	4.082	2.404	1.3808	0.1331	17:52
7	4.001	2.357	1.3046	0.0568	20:10

Average Volu

Corrected Volume Report

Method D: Compressibility Test

Cycle#	P1 Pressure (psig)	P2 Pressure (psig)	Volume (cm³)
1	0.974	0.565	5.0834
2	2.113	1.224	5.4949
3	3.069	1.784	4.7258
4	4.087	2.380	4.2183
5	5.015	2.927	3.6335
6	6.047	3.537	3.1133
7	6.997	4.098	2.8279
8	7.995	4.686	2.6318
9	8.991	5.272	2.4875
10	9.930	5.827	2.2975
11	10.945	6.426	2.1864
12	11.920	7.000	2.1253
13	13.023	7.651	2.0076
14	13.995	8.223	1.9763
15	14.973	8.800	1.9202

Average Volu

WEIGHING SOLUTION

Analytical Balance Bundle

The AccuPyc weighing solution bundle provides one-touch transfer of mass data from the analytical balance directly to the AccuPyc's Windows software. Direct transfer eliminates user error associated with manual entry of mass data. Optional Peltier temperature control eliminates environmental temperature variation and facilitates the handling of "hot" samples.

- Optional Peltier thermoelectric control (15 to 36 °C) provides ambient temperature stability
- Seamless device compatibility
- One-touch mass data transfer to AccuPyc for automatic calculation of density
- Includes 120 X 0.01 mg electronic analytical balance with calibration weight

Superior Worldwide Support Assures You Consistent Instrument Performance for Years to Come

TEMPERATURE-CONTROL SOLUTION

AccuPyc II TEC - Density Testing for Semi-Solid Bituminous Materials

This AccuPyc solution can be closely correlated (< 0.15% difference) to results obtained with ASTM Test Method D70-09. The ASTM method is burdensome and time consuming. Our approach offers an expedited, more robust, operator-independent method, with results in minutes.

- Reproducible results in minutes, virtually eliminates operator error
- Integral solution with software for bituminous material testing includes results for specific gravity, volume, and density
- Peltier thermoelectric control (15 to 36 °C) provides excellent temperature control/stability and sample handling
- Disposable sample cups limit cross-contamination and minimize cleaning of sample chamber between analyses

Asphalt Analysis

Asphalt Sample	Average Density AccuPyc II TEC Solution (n=11) (g/cc)	%Relative Standard Deviation (n=11)	ASTM Method D70-9 Density (g/cc)	%Difference Between Methods
Sample A	1.01906	0.03	1.01758	0.1453
Sample B	1.02543	0.03	1.02536	0.0067
Sample C	1.01821	0.07	1.01848	0.0263
Sample D	1.02563	0.09	1.02576	0.0125
Samples varied in composition and viscosity				

CUSTOM ENGINEERED PRODUCTS

If your research work requires an analytical device, technique, or configuration that is not commercially available, talk to us about modifications to our standard instrument designs. There are no charges associated with the initial consultation and our research into the feasibility of your project.

Call us here: 770.662.3698

HIGH-PRESSURE SOLUTION

AccuPyc II HP – Density Determinations in a High-Pressure Environment

This pycnometer can provide high-speed, high-precision volume measurements and density determinations in an elevated pressure environment (i.e. intact or crushed shale core samples).

- Operates at a higher pressure of 500 psi to provide a better diffusion of the gas into the rock
- Stainless-steel sample chamber with a volume of 100 cm^3
- Sample chamber can accommodate a 48-mm (1.85 in.) diameter core of up to 60 mm (2.40 in.) in length

LARGE VOLUME SOLUTION

Core Pyc – Density of Intact Core Samples

With a large-volume sample chamber, this pycnometer has been designed to address the specific needs of operations that require pore volume knowledge of intact drilling cores. This instrument improves sampling statistics by eliminating the need to break a core into many smaller pieces and run multiple analyses to obtain volume results. The CorePyc eliminates the need to run multiple analyses on large cores.

- Large sample chamber with a volume of approximately 2000 cm^3
- Sample chamber can accommodate a 95-mm (3.74 in.) diameter core of up to 278 mm (10.9 inches) in length

Focused on your Solution

micromeritics®

Height:

17.9 cm (7.0 in.), analysis modules for 1-, 10-, and 100-cm^3 units, and control module

25.9 cm (10.2 in.), 350-cm^3 analysis module

43.0 cm (17.0 in.), 2000-cm^3 analysis module

Width:

27.3 cm (10.7 in.), control module

27.3 cm (10.7 in.), control module

27.0 cm (10.6 in.), 2000-cm^3 analysis module

Depth:

36.2 cm (14.3 in.)

Weight:

9.3 kg (20.5 lbs), control/analysis unit (1-, 10-, and 100-cm^3 units)

7.9 kg (17.4 lbs), analysis module (1-, 10-, and 100-cm^3 units)

10.5 kg (23.2 lbs), analysis module (350-cm^3 unit)

3.6 kg (8.0 lbs), control module

26.0 kg (57.0 lbs), 2000-cm^3 analysis module

Electrical:

Voltage - 90 to 264 VAC
Power - 30 VA
Frequency - 50 to 60 Hz

Precision:

Reproducibility typically to within ± 0.01% of the nominal full-scale sample cell chamber volume. Reproducibility guaranteed to within ± 0.02% of the nominal full-scale volume on clean, dry, thermally equilibrated samples using helium in the 15 to 35 °C range.

Accuracy:

Accurate to within 0.03% of reading, plus 0.03% of sample capacity.

Micromeritics Instrument Corporation

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Norcross, GA 30093 U.S.A.

To request a quote or additional product information, visit Micromeritics website at:

www.micromeritics.com

Contact your local Micromeritics sales representative, or our Customer Service Department at:

770.662.3636

The Micromeritics Customer Experience...

" Micromeritics Instruments are easy to use and yield powerful results. The tech and applications support professionals are responsive and knowledgeable"

-Brenda Fisher, Lab Manager, Cornell University
TechValidate Research Study, Nov 2014

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