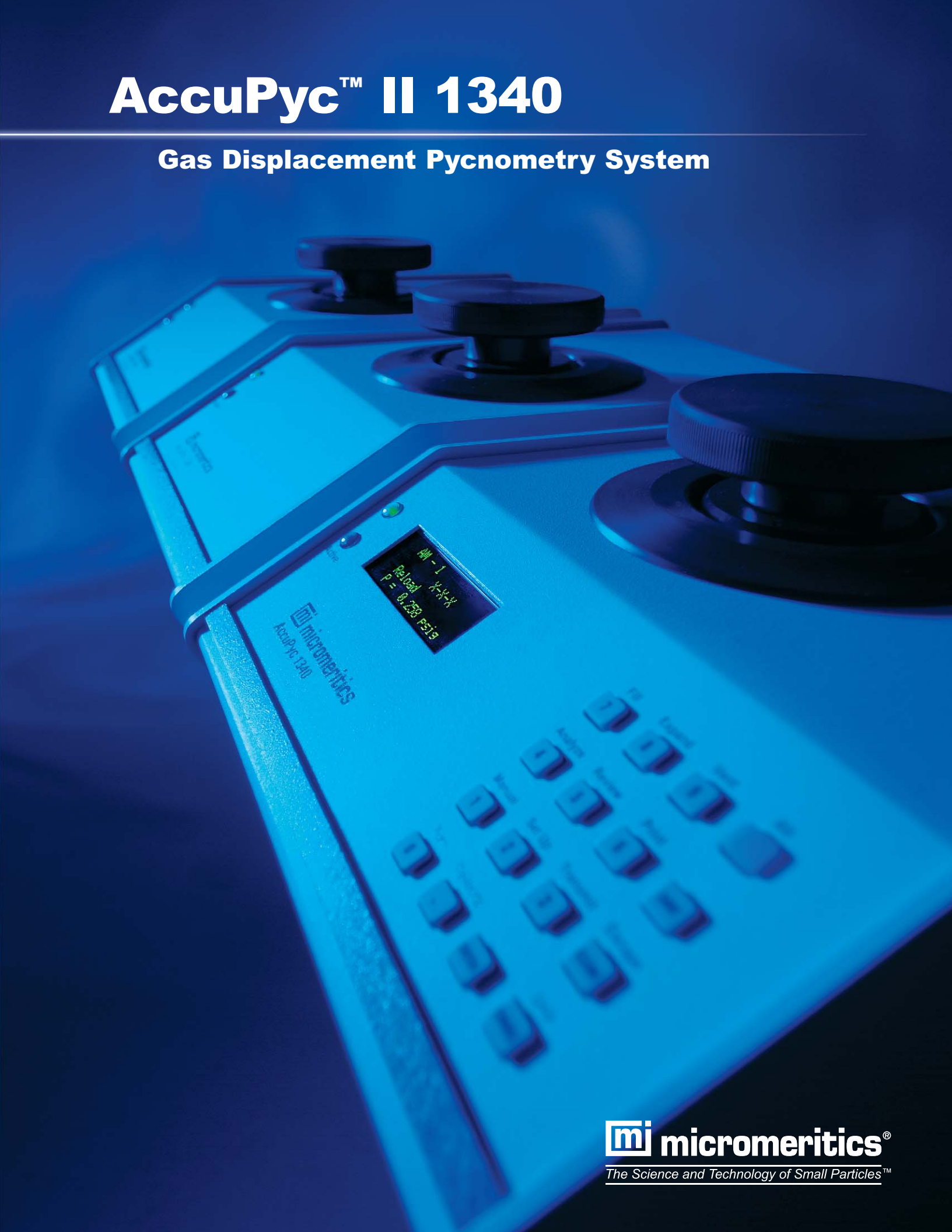
AccuPyc™ II 1340

Gas Displacement Pycnometry System



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The Science and Technology of Small Particles™

Highly Adaptable Density Determinations

The AccuPyc II 1340 Gas Displacement Pycnometry System

Gas pycnometry is a common analytical technique that uses a 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 pressure before and after expansion is measured and used to compute the sample volume. Dividing this volume into the sample weight gives the gas displacement density.

The AccuPyc II 1340 Series Pycnometers are fast, fully automatic pycnometers that provide high-speed, high-precision volume measurements and density calculations on a wide variety of powders, solids, and slurries having volumes from 0.01 to 350 cm^3. The instrument completes most sample analyses in less than three minutes with excellent accuracy. After analyses are started with a few keystrokes, data are collected, calculations are performed, and results displayed without further operator intervention.

Wide Variety of Standard Features

- Simple calibration process allows the user to determine easily 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.
- A unique run precision feature 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.
- Sample mass may be directly input from an analytical balance through an RS-232 port.
- USB ports on the rear panel of the control module allow for connection to a printer (output of analysis and calibration results) and keyboard (alphanumeric character input). The USB port is also used for installing software upgrades.
- An Ethernet port on the rear panel of the control module enables the user to e-mail reports, send data to a web browser for archiving, or interface with the AccuPyc II 1340 Windows® application.
- The AccuPyc may be operated in five different languages: English, French, German, Italian, or Spanish.

The AccuPyc II 1340 Pycnometer consists of an integrated control and analysis module. For those who require high throughput, analysis modules are also available in a single unit configuration, allowing you to attach up to five additional analysis modules to a single controlling unit. Each module has its own gas connection. In addition, each module can contain a different size sample chamber (1 cm^3, 10 cm^3, 100 cm^3, or 350 cm^3) providing even more versatility.

Wide Variety of Options

- Optional Windows interface provides exceptional reporting and archiving capability.
- Integrated control and analysis module can control up to five additional external analysis modules.
- Four standard sample chamber sizes are available - 1 cm^3, 10 cm^3, 100 cm^3, and 350 cm^3.
- MultiVolume Option Kits allow analyses of a variety of sample sizes in one analytical module.
- Allows measuring of open- and closed-cell foam materials in accordance with ASTM method D 6226.
- Temperature-control version allows analysis at user-selectable temperatures.
- Glove box model separates the control and analysis modules, allowing analysis in controlled environments.

The AccuPyc II integrated control/analysis module with an additional analysis module – up to five additional analysis modules can be operated by a single control/analysis module.

Typical AccuPyc II 1340 Applications

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.

Coatings – Dried film density can be used in determination of Volatile Organic Compound (VOC) content of clear and pigmented coatings. VOC reporting is required by government regulations. In addition, 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.

Calcination – Many materials undergo structural rearrangement through pressure or temperature treatment, or both. Conversion level can be monitored through density measurement during and at the end of processing. SPC reporting of results facilitates monitoring of product control. Applications include different crystal structures of carbon and ceramics.

Ceramics and powder metallurgy – Density measurements can be used to determine closed porosity from casting, sintering, and forging operations where parts are made from powdered samples. If the density of the finished part is significantly less than that of the constituent powder, closed pores have formed during the part processing.

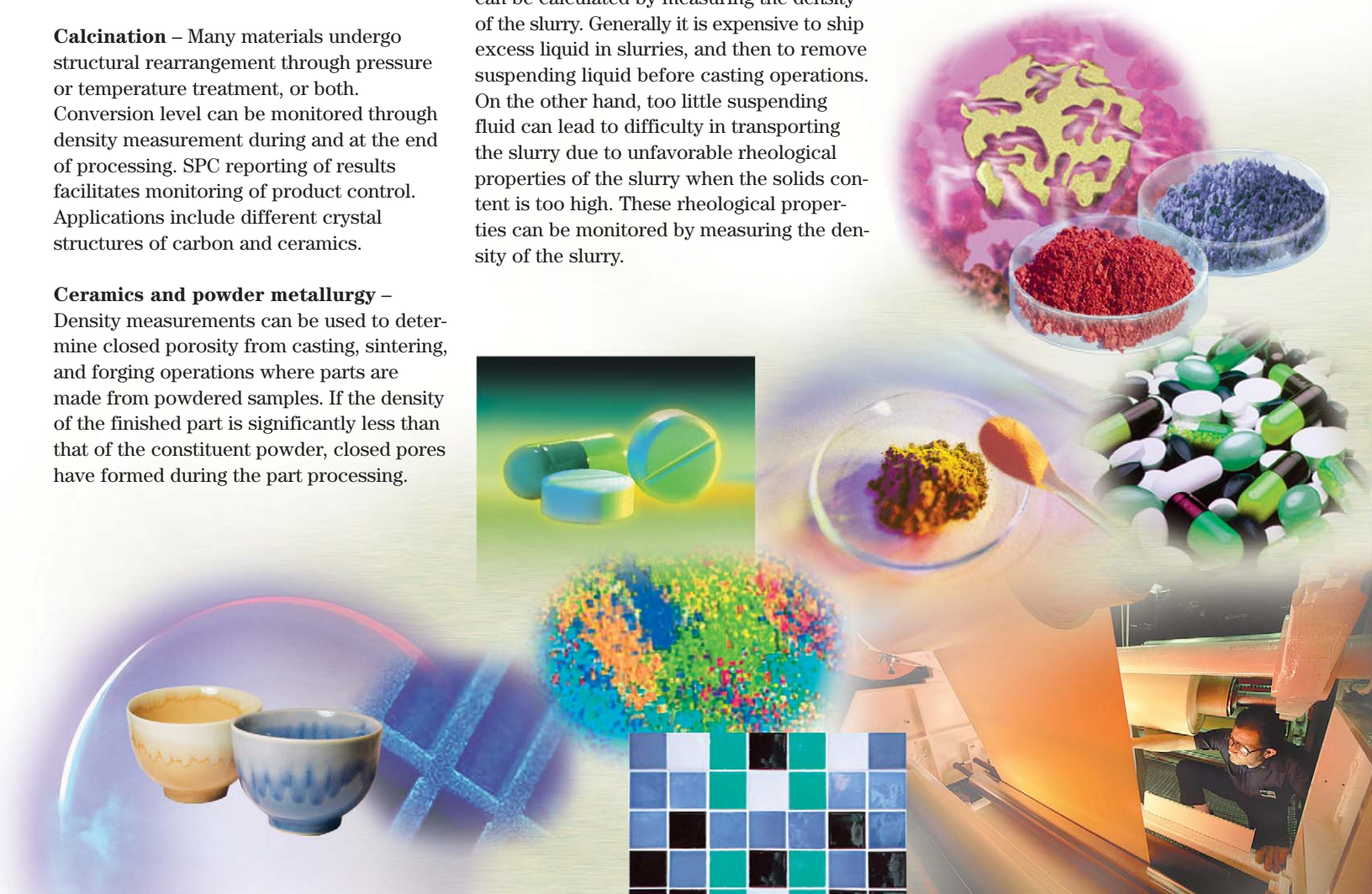
Rigid cellular plastics – Closed-cell rigid plastics (foams) exhibit different properties based upon the ratio of open and closed cells. Insulation foams limit thermal conductivity through pockets of trapped gases contained within closed pores. Flotation devices, likewise, owe buoyancy to closed air-filled pores that prohibit water entry.

Plastic films – Plastic films are produced through extrusion of plastic beads. Film quality is related to the amount of encapsulated air in the starting beads. Density can be used to determine the quantity of entrapped air. In addition, the degree of crystallinity of the final film can be determined using density. Brittleness of the film increases with crystallinity, while strength decreases.

Slurries – With knowledge of the dry powder and suspending liquid densities, the quantity of liquid in a slurry mixture can be calculated by measuring the density of the slurry. Generally it is expensive to ship excess liquid in slurries, and then to remove suspending liquid before casting operations. On the other hand, too little suspending fluid can lead to difficulty in transporting the slurry due to unfavorable rheological properties of the slurry when the solids content is too high. These rheological properties can be monitored by measuring the density of the slurry.

Organic chemicals and polymers – Polymerization and organic reforming processes are used to produce desired compounds from raw materials. Conversion and purity can be monitored by comparing measured density to theoretical density of the desired product.

Blending of materials – Many powder products are shipped and used as blends of primary ingredients. The accuracy and reproducibility of the blend can be monitored by comparing the measured densities to the expected density based upon the target recipe of primary ingredients. The high degree of accuracy and precision of the AccuPyc helps ensure that the blends produced at a given plant match the desired recipe, the previous lots of materials, and those from other locations, regardless of the industry where these blends are used.



Hardware and Software Versatility

Configurations

To ensure best fit with your sample, the AccuPyc is available in multiple configurations. Best fit means your sample nearly fills the sample chamber and, therefore, optimizes the precision of your results.

- 1-cm^3 sample chamber
- 10-cm^3 sample chamber
- 100-cm^3 sample chamber
- 350-cm^3 sample chamber

Temperature Control Option

The temperature-control unit is specifically designed for temperature-sensitive materials. This unit permits collection of volume/density data at a user-specified temperature. A temperature-control unit to which an external bath is connected is available in the following configurations:

- 10-cm^3 sample chamber
- 100-cm^3 sample chamber

Glove Box Option

This unit consists of two separate modules. The controller is placed outside the glove box, while the analysis module is placed inside the glove box. If you have an existing AccuPyc II 1340, you can order the glove box analysis unit containing the desired sample chamber and simply connect it to the connector provided on the rear panel of the existing AccuPyc II. A glove box unit for analysis of samples in which a controlled environment is required is available in the following configurations:

- 1-cm^3 sample chamber
- 10-cm^3 sample chamber
- 100-cm^3 sample chamber
- 350-cm^3 sample chamber

FoamPyc Option

The AccuPyc II 1340 unit can be ordered with the FoamPyc application installed. If you have a standard AccuPyc II 1340, 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-control pycnometers:

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

MultiVolume Option

A MultiVolume option allowing you to analyze smaller-sized samples with your current AccuPyc model is available for the following configurations:

- 1-cm^3 nominal cell volume, contains a 0.1-cm^3 cup
- 10-cm^3 nominal cell volume, contains 1- and 3.5-cm^3 cups
- 100-cm^3 nominal cell volume, contains 10- and 35-cm^3 cups

Analysis module

Glove Box controller

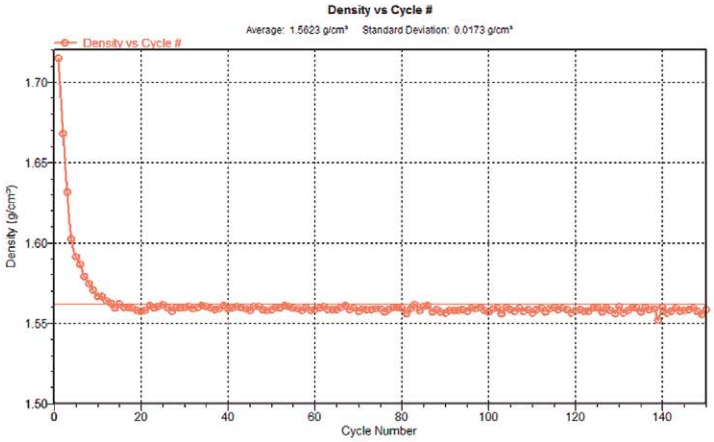
Software and Data Presentation

The AccuPyc II 1340 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 an analytical 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.

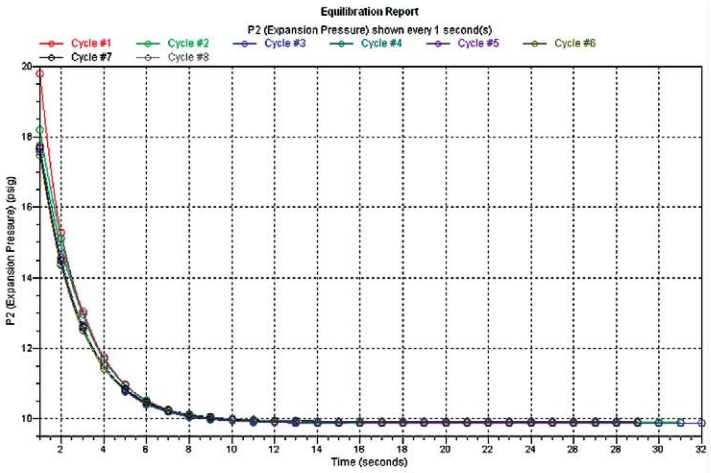
User-selected reports include:

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

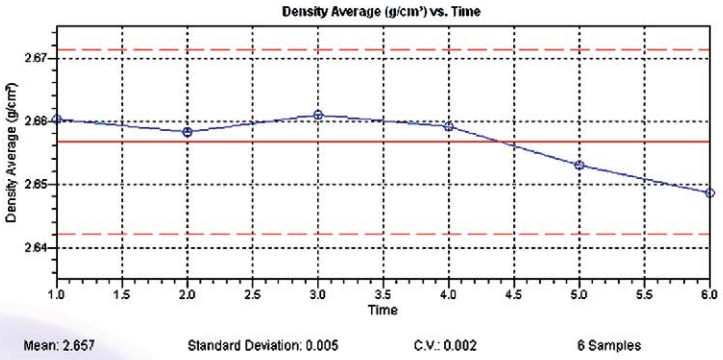
Integrated control and analysis module



Density versus analysis cycle number for a polymer sample initially containing volatiles.



Pressure equilibration versus time plot for eight analysis cycles for glass sample illustrating the rate at which pressure equilibrates during analysis.



Control chart for analyses of glass samples showing mean value and control limits at ± 3 σ.

Density and Volume Report

Cycle#	Volume (cm³)	Volume Deviation (cm³)	Density (g/cm³)	Density Deviation (g/cm³)	Elapsed Time (mm:ss)	Temperature (°C)
1	2.8136	-0.0006	3.8572	0.0009	8:39	23.84
2	2.8125	-0.0017	3.8586	0.0023	10:55	23.88
3	2.8133	-0.0009	3.8576	0.0012	13:15	23.85
4	2.8147	0.0005	3.8557	-0.0006	15:33	23.90
5	2.8161	0.0019	3.8537	-0.0026	17:59	23.94
6	2.8131	-0.0011	3.8579	0.0015	20:17	23.93
7	2.8127	-0.0015	3.8584	0.0021	22:34	23.92
8	2.8158	0.0016	3.8542	-0.0021	24:50	23.93
9	2.8148	0.0006	3.8556	-0.0008	27:09	23.96
10	2.8154	0.0012	3.8547	-0.0017	29:29	23.98

Summary Data	Average	Standard Deviation
Volume:	2.8142 cm³	0.0012 cm³
Density:	3.8564 g/cm³	0.0017 g/cm³

Density and Volume Report for analysis of garnet powder.

To request a quote or additional product information, visit Micromeritics' web site at www.micromeritics.com, contact your local Micromeritics sales representative, or our Customer Service Department at (770) 662-3636.

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