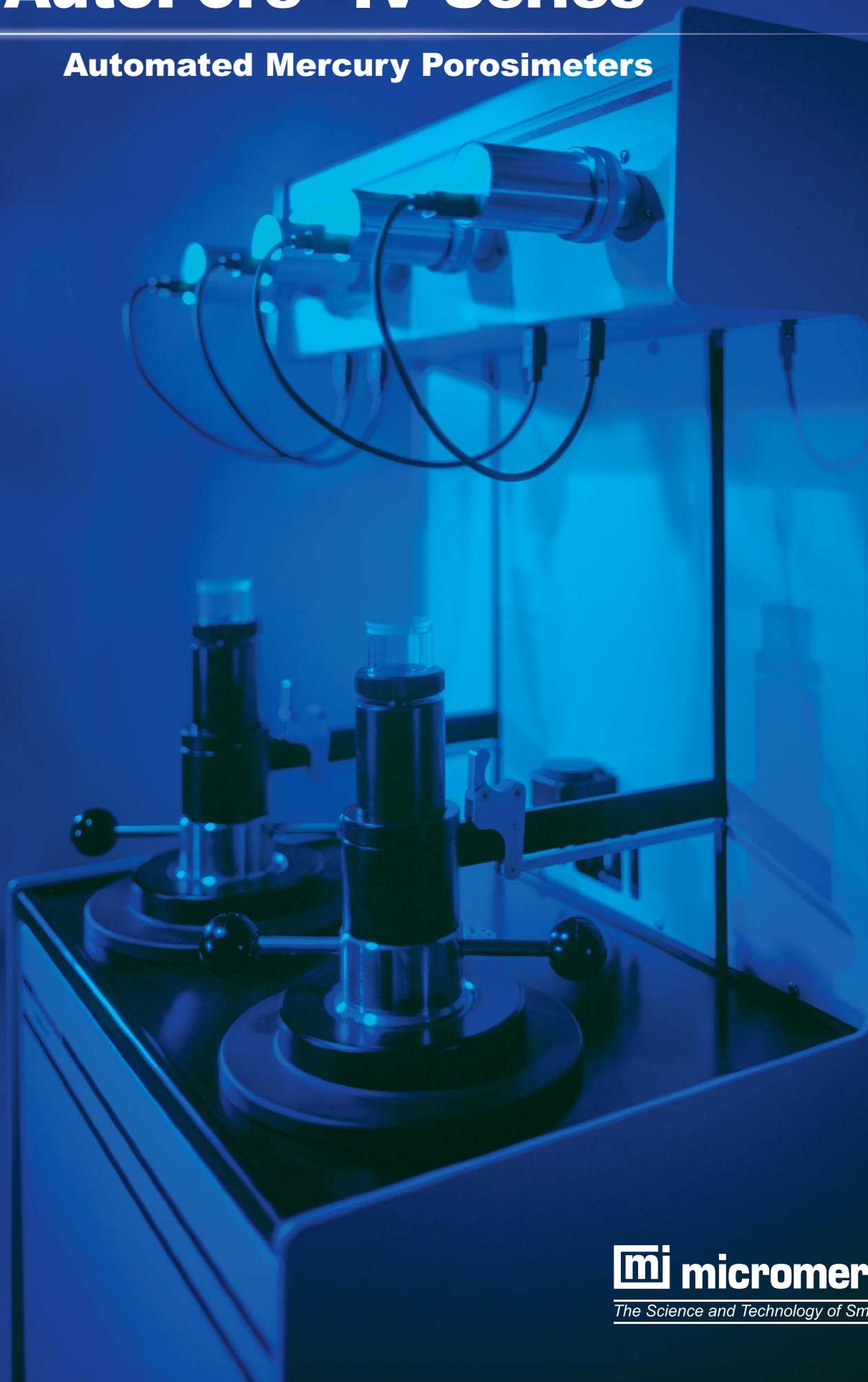


# AutoPore™ IV Series

Automated Mercury Porosimeters



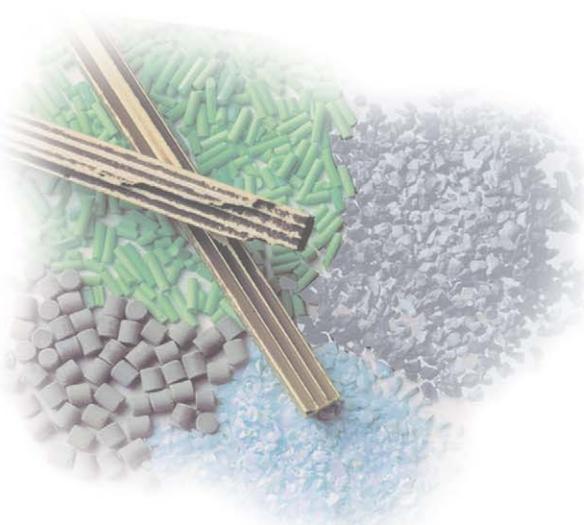
## Fast and Accurate Porosimetry Analyses

### AutoPore IV Series Automated Mercury Porosimeters

The term “porosimetry” is often used to include the measurements of pore size, volume, distribution, density, and other porosity-related characteristics of a material. Porosity is especially important in understanding the formation, structure, and potential use of many substances. The porosity of a material affects its physical properties and, subsequently, its behavior in its surrounding environment. The adsorption and permeability, strength, density, and other factors influenced by a substance’s porosity determine the manner and fashion in which it can be appropriately used.

The mercury porosimetry analysis technique is based on the intrusion of mercury into a porous structure under stringently controlled pressures. Besides offering speed, accuracy, and a wide measurement range, mercury porosimetry permits you to calculate numerous sample properties such as pore size distributions, total pore volume, total pore surface area, median pore diameter, and sample densities (bulk and skeletal).

The AutoPore IV Series Mercury Porosimeters can determine a broader pore size distribution (0.003 to 360 micrometers) more quickly and accurately than other methods. These instruments are enhanced with features that enable them to more accurately gather the data needed to characterize the porous structure of solid materials. They also offer new data reduction and reporting choices that provide more information about pore geometry and the fluid transport characteristics of the material.



#### Wide Variety of Benefits

- Controlled pressure can increase in increments as fine as 0.05 psia from 0.2 to 50 psia. This allows detailed data to be collected in the macropore region.
- A quick-scan mode allows a continuous pressure increase approximating equilibrium and providing faster screening. The high repeatability and reproducibility of this method by the AutoPore means that small, but significant, differences between samples will be detected. You can use this technique to screen a sample for conformity to specification because repeatability remains high.
- High-resolution (sub-microliter) measurement of intrusion/extrusion volumes produces extraordinary precision allowing the development of tighter sample specifications, improved production processes, and high-quality research data.
- A choice of correction routine for baseline (automatic, differential, or manual) produces greater accuracy by correcting for compressibility and thermal effects caused by high pressure.
- Choice of pressure ramping methods lets you choose the scanning technique for high-speed or on-demand results, or equilibration techniques for more accurate results with greater detail.
- The instrument allows the user to program data collection using a minimum number of data points. However, during intervals of unexpectedly large amounts of intrusion, the AutoPore will automatically collect additional data points.
- Choose between three data plot routines constructed of collected data points, a continuous curve plotted from interpolated data, or a combination of points and curves.
- A variety of pore volume, pore area, and pore size plots is available as well as the ability to calculate total intrusion volume, total pore (surface) area, median pore diameter, average pore diameter, bulk density, and apparent (skeletal) density.

#### Four Models

The AutoPore IV Series is available in four models to best match the needs of individual quality assurance and research labs.

**AutoPore IV 9520:** 2 high-pressure (60,000 psia maximum pressure) and 4 low-pressure analysis ports

**AutoPore IV 9510:** 1 high-pressure (60,000 psia maximum pressure) and 2 low-pressure analysis ports

**AutoPore IV 9505:** 2 high-pressure (33,000 psia maximum pressure) and 4 low-pressure analysis ports

**AutoPore IV 9500:** 1 high-pressure (33,000 psia maximum pressure) and 2 low-pressure analysis ports





# Broad Choice of Analysis and Report Parameters

## Operating Software

The AutoPore offers various options for obtaining important sample information as quickly as possible and for presenting the data in a format which you can design. Analysis options include choice of analysis variables, equilibration techniques, and pressure points at which data are collected. After operating conditions for the instrument have been chosen, they can be stored as a template and then reapplied to other samples, saving time and reducing the potential for human error.

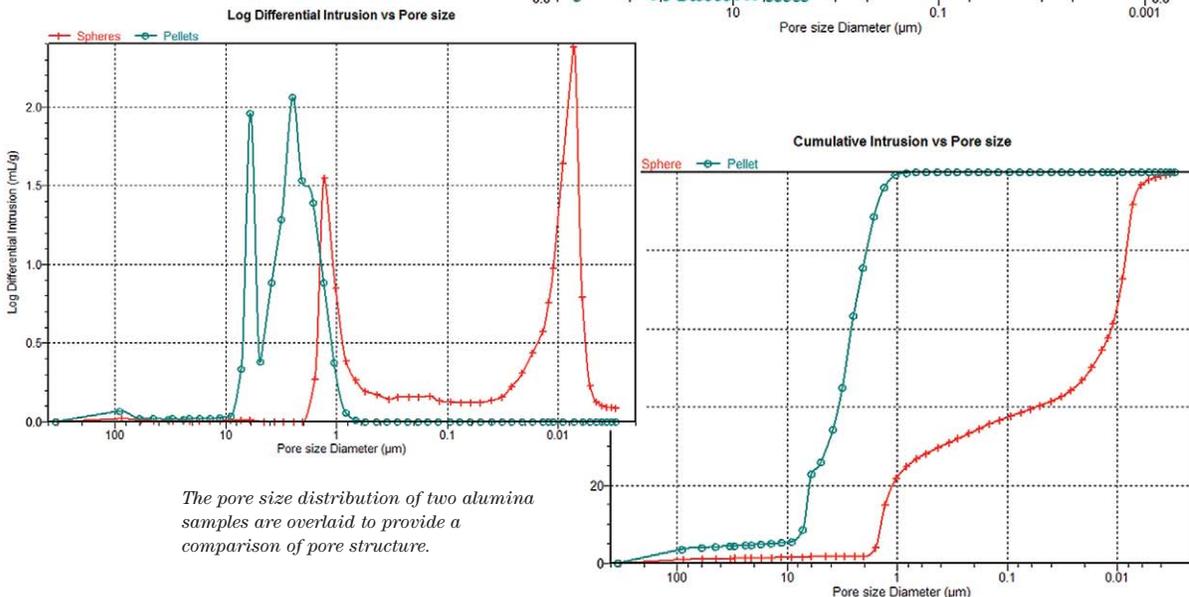
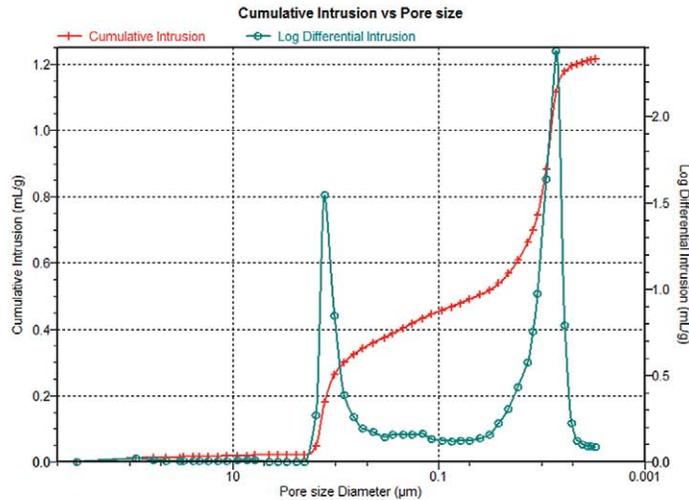
A selection of report options lets you customize many aspects of the data pages. You can select a specific range of data to be used in calculations; arrange columns of tabular data; select cumulative, incremental, or differential plots; scale the X-axis to display in either logarithmic or linear format for pore size; report actual or interpolated data; and select data presentation units such as psia or MPa, diameter or radius, and micrometers or Angstroms.

*The AutoPore software includes a full report system for producing publication-quality graphics and user-specified reports.*

## Data Reduction

The AutoPore IV generates tabular and graphical reports of percentage pore volume vs. diameter, and a summary report of percentage porosity in user-defined size ranges. The user has the ability to average several analyses and to use the 'resulting average' analysis as a reference with which to compare subsequent analyses. A standard, single, user-defined analysis may also be entered and used for subsequent comparisons. SPC reports are available with collected data or user-defined parameters. In addition to the standard data reduction methods, the AutoPore IV Series also provides the following:

- Mayer-Stowe Particle Size - Reports equivalent spherical size distributions
- Pore Tortuosity - Characterizes the efficiency of the diffusion of fluids through a porous material
- Material Compressibility - Quantifies the collapse or compression of the sample material
- Pore Number Fraction - Reports the number of pores in different size classes
- Pore-throat Ratio - Reports the ratio of pore cavities to pore throats at each percent porosity filled value
- Pore Fractal Dimensions - Quantifies the fractal geometry of a material
- Permeability - Reports the ability of the sample to transmit fluid

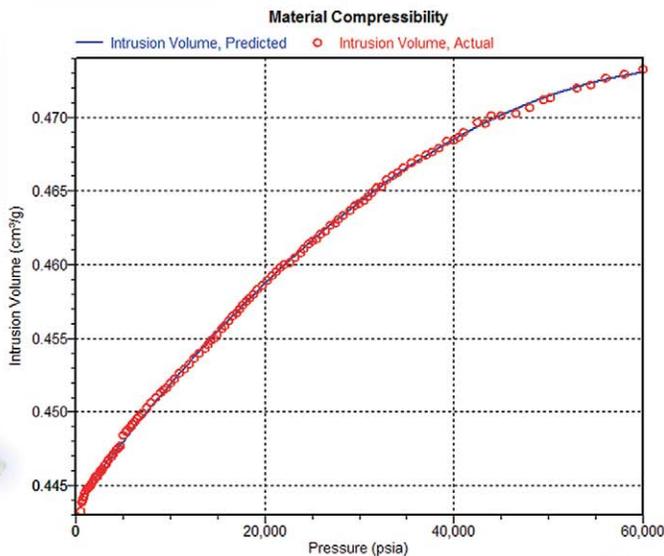


*The pore size distribution of two alumina samples are overlaid to provide a comparison of pore structure.*



## Penetrometer Characteristics

The penetrometer consists of a sample cup bonded to a metal-clad, precision-bore, glass capillary stem. The sample is placed in the sample cup; during analysis, mercury fills the cup and capillary stem. As pressure on the filled penetrometer increases, mercury intrudes into the sample's pores, beginning with those pores of largest diameter. The mercury moves from the capillary stem resulting in a capacitance change between the mercury column inside the stem and the metal cladding on the outer surface of the stem. The AutoPore detects very slight changes in capacitance (equivalent to a difference of less than 0.1 microliter of mercury) so extraordinary resolution is achieved.



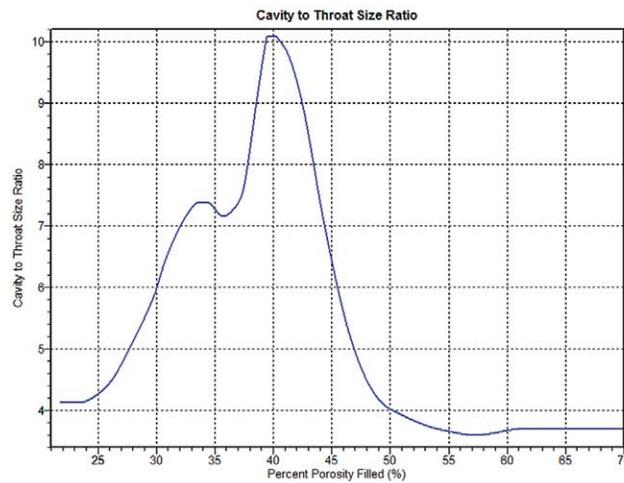
The material compressibility is easily calculated and may be reported both graphically and in tabular form using the AutoPore report system.

Micromeritics also offers a large selection of penetrometer bulbs, volumes, stems, and closures designed to fit most sample forms, shapes, porosity, and quantity. The better the match between the sample, its porosity, and the measurement range of the sample cell, the more precise the results.

## Safety Systems

The AutoPore features several levels of mechanical and electro-mechanical safety devices:

- The computer will not accept keyboard instructions to overpressurize the system.
- The high-pressure system is mechanically unable to generate unsafe pressures.
- A circuit stops the generation of pressure in the event of a failure in the computer.
- The operating specifications of the pressure systems (low = 50 psia, high = 60,000 psia) are well below the actual designed safety limits.



The extensive report system includes pore structure calculations including Cavity-to-Throat Size Ratio, Fractal Dimension, Material Compressibility, and Statistical Process Control reporting.

### Intrusion Data Summary

Total Intrusion Volume =	1.2166 mL/g
Total Pore Area =	305.880 m <sup>2</sup> /g
Median Pore Diameter (Volume) =	0.0171 μm
Median Pore Diameter (Area) =	0.0084 μm
Average Pore Diameter (4V/A) =	0.0159 μm
Bulk Density at 0.56 psia =	0.6872 g/mL
Apparent (skeletal) Density =	4.1929 g/mL
Porosity =	83.6101 %
Stem Volume Used =	60 %

A convenient data summary is automatically generated with each sample reported.

### Pore Structure Summary

Threshold Pressure:	136.88 psia (Calculated)
Characteristic length =	1.3213 μm
Conductivity formation factor =	0.232
Permeability constant =	0.00442
Permeability =	1.7956 mdarcy
BET Surface Area =	230.0000 m <sup>2</sup> /g
Pore shape exponent =	1.00
Tortuosity factor =	1.907
Tortuosity =	3.3265

Additional pore structure calculations are included in the AutoPore software.



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



*The Science and Technology of Small Particles™*

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