

POREMASTER® SERIES

AUTOMATED MERCURY POROSIMETERS



Quantachrome
INSTRUMENTS

Mercury Porosimetry

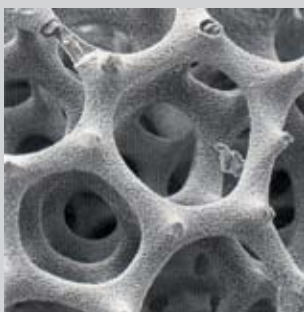
The operation of all mercury porosimeters is based upon the physical principle that a non-reactive, non-wetting liquid will not penetrate fine pores until sufficient pressure is applied to force its entry. The relationship between the applied pressure and the pore diameter into which mercury will intrude is given by the Washburn equation:

$$D = (-4\gamma \cos \theta)/P$$

where P is the applied pressure, D is the pore diameter, γ is the surface tension of the mercury (480 dyne cm^{-1}) and θ is the contact angle between mercury and the pore wall, usually taken as 140°. Monitoring mercury volume intruded as a function of pressure permits the generation of pore size/volume distributions from the Washburn equation.

Applications

Control of porosity in terms of pore volume, size and their distribution is important in hundreds of industries, products and processes. For more than 20 years, Quantachrome porosimeters have served quality control and research needs for characterization of materials such as catalysts, surgical implants, electrodes, ceramics and sintered metals, pharmaceuticals, membranes and many others. The widespread appeal of this technology owes much to the speed and high-resolution of the measurement and the broad pore size range that may be explored.



▲ Photomicrograph: Radiolaria

PoreMaster Overview

The PoreMaster Series of mercury porosimeters consists of four automated models: **PoreMaster 60** and **PoreMaster-60 GT** (*dual high-pressure*) which generates pressure to 60,000 psia for pore size analysis from >950 micron to 0.0036 micron pore diameter; and **PoreMaster 33** and **PoreMaster-33 GT** (*dual high-pressure*) which achieves a maximum pressure of 33,000 psia for study of pores in the range from >950 micron to 0.0064 micron pore diameter.

- Each model provides pore size, pore volume, bulk and apparent density, porosity, particle size and related properties.
- Each model includes two built-in low-pressure ports for filling of sample cells (penetrometers) and intrusion/extrusion measurements from vacuum to 50 psia.

The **PoreMaster-60 GT** and **PoreMaster-33 GT** include two high-pressure ports in a patented single high-pressure cavity for **Greater Throughput**.

High-pressure ports on

- all models operate in both continuous scanning or stepwise pressurization modes.

Continuous scanning

- provides detail rich, high-resolution pore size data (up to 2,000 points) plus *Autospeed™* control for automatic adjustment of pressurization rate in response to individual sample characteristics. Stepwise pressurization

- provides lower resolution, but enables the system to stop and wait for user-selected time intervals to allow mercury to fully penetrate complex pore structures.

The **PoreMaster-33** and **PoreMaster-33 GT** are both fully upgradeable to 60,000 psia capability to meet your changing analytical needs.

Obtain complete intrusion and extrusion data in as

- little as 10 minutes.

PoreMaster-60 and **-60 GT** include 1,500 and

- 60,000psia pressure transducers for higher accuracy across the analysis range.



▲ PoreMaster GT

Operation

The PoreMaster® Series was designed to yield excellent results for both experienced operators and those new to the technology.

- Easy-to-use penetrometers accommodate powders, pellets and bulk solids, minimizing the required sample cell inventory.

- Low-pressure stations can be programmed to simply evacuate and fill one or two penetrometers, or to perform complete low-pressure intrusion/extrusion analyses.

- At the click of a mouse, analytical sample parameters are automatically transferred from low- to high-pressure ports to eliminate transcription errors and increase productivity.



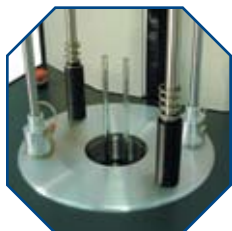
▲ PoreMaster

PoreMaster

PROGRAMMABLE • AUTOMATED

er® Series

OMATED • VERSATILE



▲ PoreMaster GT's Pneumatic Lift Assembly in elevated position



▲ Penetrometers accommodate a wide range of sample sizes and geometries.



▲ Easily accessible low-pressure ports of the PoreMaster.

Safety

Safety is ensured with leading-edge technologies to eliminate any risk to the operator or environment.

- Dual safety interlocks on low-pressure ports prevent operation without cell retainer assembly.
- Software can be password-protected to limit access.
- Automated lift mechanism on **PoreMaster GT** series reduces risk of penetrometer breakage.
- Double-switch activated lift mechanism.
- Emergency stop easily accessible on front panel.
- Optional vent kit for interface to fume hood.
- Built-in cold trap prevents venting of mercury vapor.

Features & Benefits

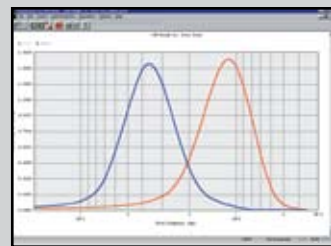
The PoreMaster Series is loaded with advanced features to ensure accuracy, operational convenience and rugged, reliable performance.

- Easy access to high-pressure cavity on all models for maintenance and cleanup.
- Computer-guided volume calibration ensures reliable data consistent with ISO 9000 and other quality standards.
- User-selectable data reduction parameters include mercury surface tension and contact angle for consistency with existing databases and research applications.
- Automated lift of **GT** cavity closure makes operation easy and reduces sealing thread wear.
- Status screen displays system conditions at a glance.
- Quiet high-pressure generator maintains a pleasant work environment.
- Automatic repeat intrusion/extrusion cycles for research on hysteresis phenomena.
- Simultaneous high- and low-pressure data acquisition for maximum productivity.
- Low- and high-pressure manual modes for troubleshooting and maintenance.
- Bench-mounted or floor-standing design to accommodate any lab.
- Automated oil-recirculation and filtration minimize consumption and disposal concerns while efficiently eliminating air from the hydraulic system.

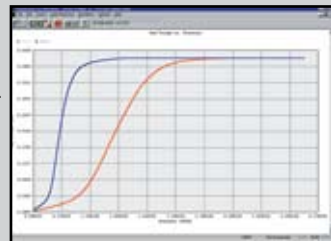
PoreMaster Software

The PoreMaster Series features state-of-the-art, computerized mercury porosimeters which operate in Windows® 2000/NT and XP environments.

The PoreMaster Data Reduction software provides the modern flexibility of programmable porosimetry; the convenience of stored analysis procedures; the efficiency of walk-away automation; instant feedback with display of the mercury intrusion/extrusion process on screen; and satisfaction of having a detailed printed report waiting for you when you return.



▲ Quantachrome offers a comprehensive data reduction and graphics program.



PoreMaster Data Reduction

PoreMaster Series instruments provide a comprehensive range of characterization models and methods in both graphical and tabular format, including:

- ✓ Cumulative pore volume versus pressure or pore diameter
- ✓ Cumulative surface area versus pressure or pore diameter
- ✓ Differential pore volume versus pressure or pore diameter
- ✓ Differential pore area versus pressure or pore diameter
- ✓ Pore number fraction versus pressure or pore diameter
- ✓ Particle size distribution (Mayer-Stowe and Smith-Stermer theories)
- ✓ Pore Tortuosity
- ✓ Permeability
- ✓ Throat/Pore Ratios
- ✓ Fractal Dimensions
- ✓ Statistics (mean, mode and median)
- ✓ Sample Compressibility
- ✓ Bulk and apparent density
- ✓ Percent porosity

Features & Benefits

- Low-pressure and high-pressure data files can be merged, printed and stored to automatically obtain a complete view of the pore size distribution from macropores down to the smallest mesopores.
- Convenient mercury density calculator computes mercury density over a wide range of temperatures for use in appropriate data reduction models.
- User-selectable data directories.
- Blank cell subtraction.
- Data reduction units may be presented in radius/diameter, Angstrom/nanometer/micron, and psia/Pascal.
- User-selectable colors for graph, intrusion/extrusion plots and markers, X and Y scaling, titles.

PoreMaster® Series Specifications

General



PoreMaster-60 GT

Pressure Range	PoreMaster-60 & -60 GT	PoreMaster-33 & -33 GT
0-50 psia¹	>950-4.26 µm dia.	>950-4.26 µm dia.³
†Accuracy:	± 0.11% fso ²	± 0.11% fso
Resolution:	0.000763 psia	0.000763 psia
0-1500 psia	10.66-0.142 µm dia.	10.66-0.142 µm dia.³
†Accuracy:	± 0.11% fso	± 0.11% fso
Resolution:	0.0229 psia	0.0229 psia
0-Max. psia	10.66-0.0036 µm dia.	10.66-0.0064 µm dia.
†Non-Linearity:	± 0.05 % fso	± 0.05 % fso
†Hysteresis:	± 0.10 % fso	± 0.10 % fso
Resolution:	0.916 psia	0.511 psia

Sample Cells



PoreMaster-60

Sample Volume	Intrusion Capacity	Volume Resolution
3.2 cc	2.0 cc	9x10 ⁻⁵ cc
3.2 cc	0.5 cc	3x10 ⁻⁵ cc
6.6 cc	2.0 cc	9x10 ⁻⁵ cc
6.6 cc	0.5 cc	3x10 ⁻⁵ cc
18.0 cc ⁴	2.0 cc ⁴	9x10 ⁻⁵ cc ⁴
18.0 cc ⁴	0.5 cc ⁴	3x10 ⁻⁵ cc ⁴

Physical

	PM-60 & 33	PM-60 & 33 GT
Depth:	64.77 cm (25.50 in.)	64.77 cm (25.50 in.)
Width:	51.44 cm (20.25 in.)	51.44 cm (20.25 in.)
Height:	78.11 cm (30.75 in.)	91.44 cm (36 in.) 124.46 cm (49 in.) lift extended
Weight:	180 kg (398 lbs.)	200 kg (440 lbs.)

Electrical

Mains:	100-240V AC 50/60Hz
Power:	1000 VA

System Requirements

Compressed dry gas, cryogen, Windows® 2000/NT/XP-compatible Pentium PC, 32MB RAM, 3GB of hard disk space, 3.5" disk drive, serial and parallel ports, printer.

¹ Pounds per Square Inch Absolute

² Full Scale Output

³ Optional

⁴ PoreMaster-60 & -33 only (not GT)

†Manufacturer's Specifications



Quantachrome Instruments' corporate headquarters in Boynton Beach, Florida.

Quantachrome®

Renowned innovator of ideas for today's porous materials community.

For almost 40 years, Quantachrome's scientists and engineers have revolutionized measurement techniques and designed instrumentation to enable the accurate, precise, and reliable characterization of powdered and porous materials:

- Adsorption/Desorption Isotherms
- Surface Area Measurement
- Pore Size Distribution
- Chemisorption Studies
- Water Sorption Behavior
- Mercury Porosimetry
- True Solid Density
- Tapped Density

Not only are Quantachrome products the instruments of choice in academia, but the technology conceived and developed by our expert staff is applied in industrial laboratories worldwide, where research and engineering of new and improved porous materials is ongoing. Manufacturers also rely on porous materials characterization technology to more precisely specify bulk materials, to control quality, and to isolate the source of production problems with greater efficiency.

Quantachrome is also recognized as an excellent resource for authoritative analysis of your samples in our fully equipped, state-of-the-art powder characterization laboratory.



Quantachrome Instruments Application Laboratory.

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Characterization
Needs Since 1968



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