

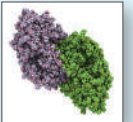
# POREMASTER<sup>®</sup>

automated mercury porosimeters

MERCURY POROSIMETRY



Catalysts



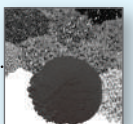
Ceramics



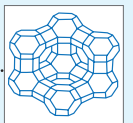
Energy



Carbons



Zeolites



Pharma



## Mercury Intrusion Porosimetry

Mercury Intrusion Porosimetry is a pore size measurement technique based on the physical principle that a non-reactive, non-wetting liquid will only penetrate fine pores when a sufficient pressure is applied to allow it to intrude. There is a well-known relationship that describes the pressure required to force liquid mercury into pores of specific diameter called the Washburn Equation:

$$D = \frac{-4 \gamma (\cos\theta)}{P}$$

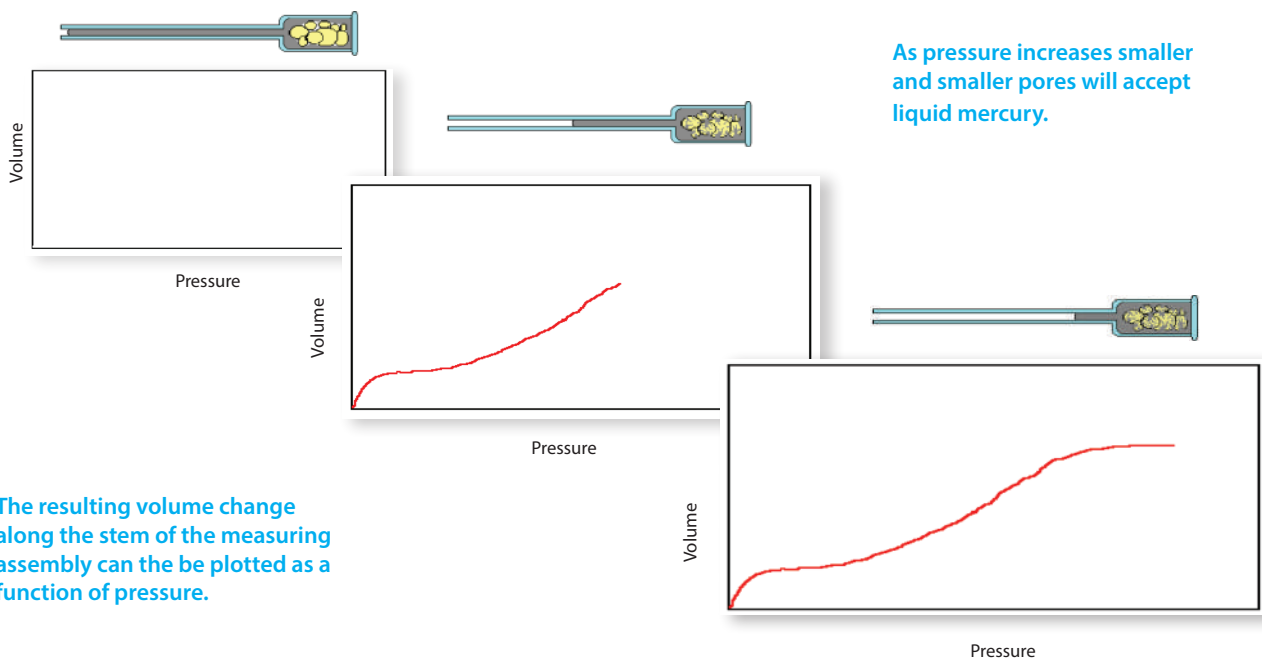
### Where:

- P = Applied Pressure
- D = Diameter of the Pore
- $\theta$  = Contact Angle Between Liquid Mercury and the Pore Wall
- $\gamma$  = Surface Tension of Mercury

Measuring the volume of mercury that is intruded into a sample as a function of increasing pressure permits the generation of pore size and pore volume distributions for pores accessible from a material's exterior. Using instruments capable of measurements at pressures between 0.2 and 60,000 psi, like the POREMASTER® Series, pores between 3.6 nanometers and 1100 microns may be measured.

## Operation

A sample is placed into a measuring assembly comprising of an empty glass sample cell, an electrode, and housing for installation into the POREMASTER®:



The resulting volume change along the stem of the measuring assembly can be plotted as a function of pressure.

As pressure increases smaller and smaller pores will accept liquid mercury.

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## Operation

Using the Washburn equation, this data set can be converted into a cumulative curve of the amount intruded as a function of pore size.

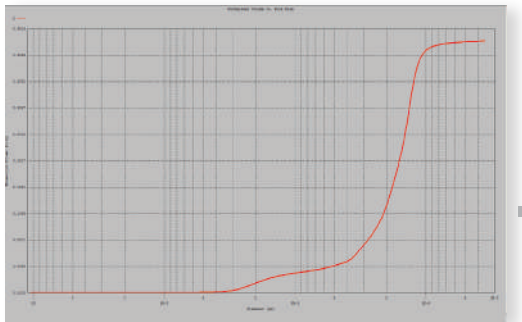


Figure 2. Cumulative Intruded Volume vs. Pore Diameter

The derivative of this curve provides a pore size distribution of the pores accessible via the exterior of the material.

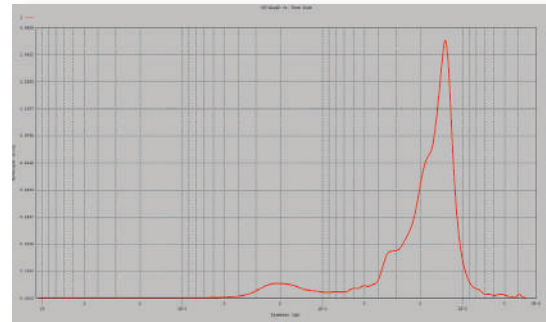
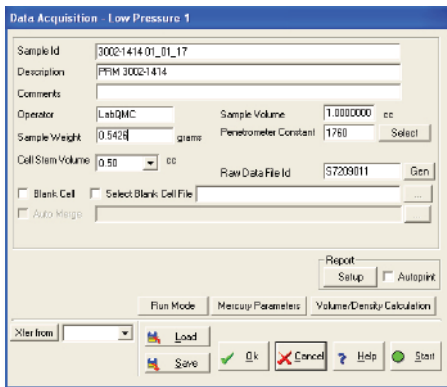


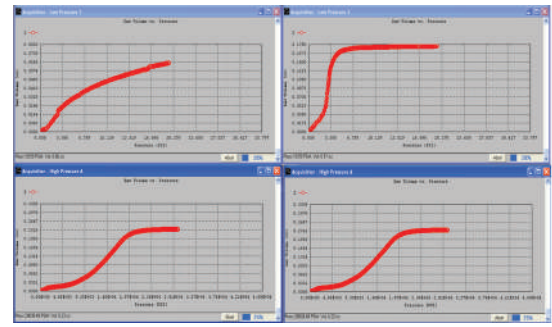
Figure 3. Pore Size Distribution

## Software

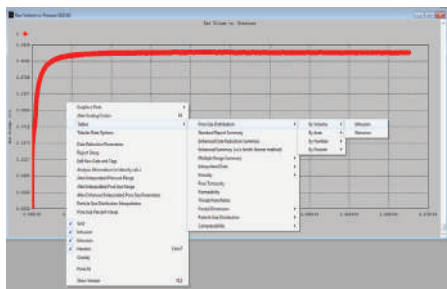
Control of porosity in terms of pore volume, size, and their distribution is important for hundreds of industries, products, and processes. The POREMASTER<sup>®</sup> Series of mercury intrusion porosimeters comes equipped with user-friendly PoroWin software for instrument control, data acquisition, and data interpretation.



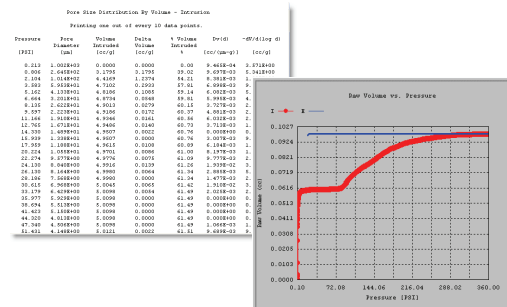
Easy Setup  
Familiar Windows<sup>®</sup> Based Software



Real Time Data Acquisition  
Up to 4 Simultaneous Measurements

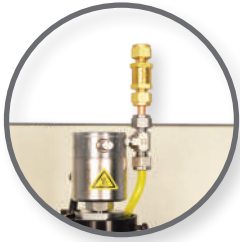


Flexible Data Interpretation  
Extensive Calculation and Display Capabilities



Results  
Available in Both Graphical and Exportable Tabular Formats

## Making Operator Experience Easy



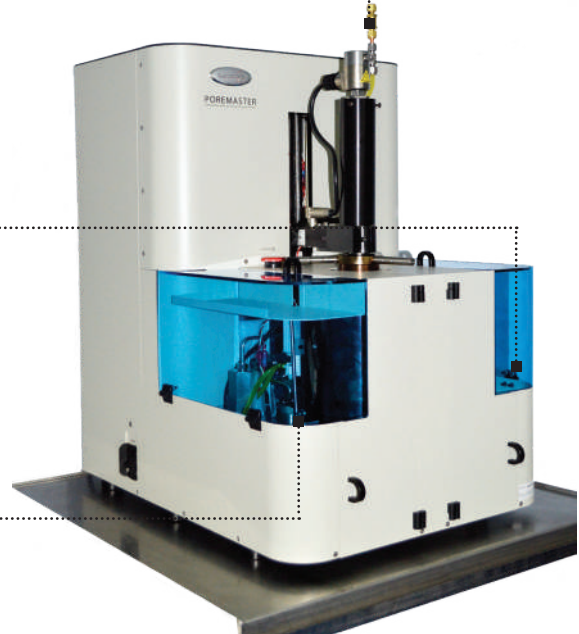
Automated Oil Air Purge Valve



Simple Liquid Mercury Introduction



Automated Oil Fill Pump



### Cabinet Design

- Allows for bench-top operation
- Will fit in or next to your fume-hood
- Spill tray for secondary containment
- Transfer from low pressure/filling station performed at bench-level cabinet
- Ventilation kit continuously directs mercury vapor away from operator
- Designed to contain accidental spills occurring during operation

### Sophisticated Alerts and Operation Limits

- Obvious LED indicators of safe/unsafe operating conditions
- Direct readout of pressure in the low pressure/filling stations at all times
- Internal electrical and mechanical switches for safe operation
- Easily accessible manual emergency stop button

### Cold Trap on Evacuation Line

- Removes mercury vapor from evacuation pathway
- Provides superior vacuum performance

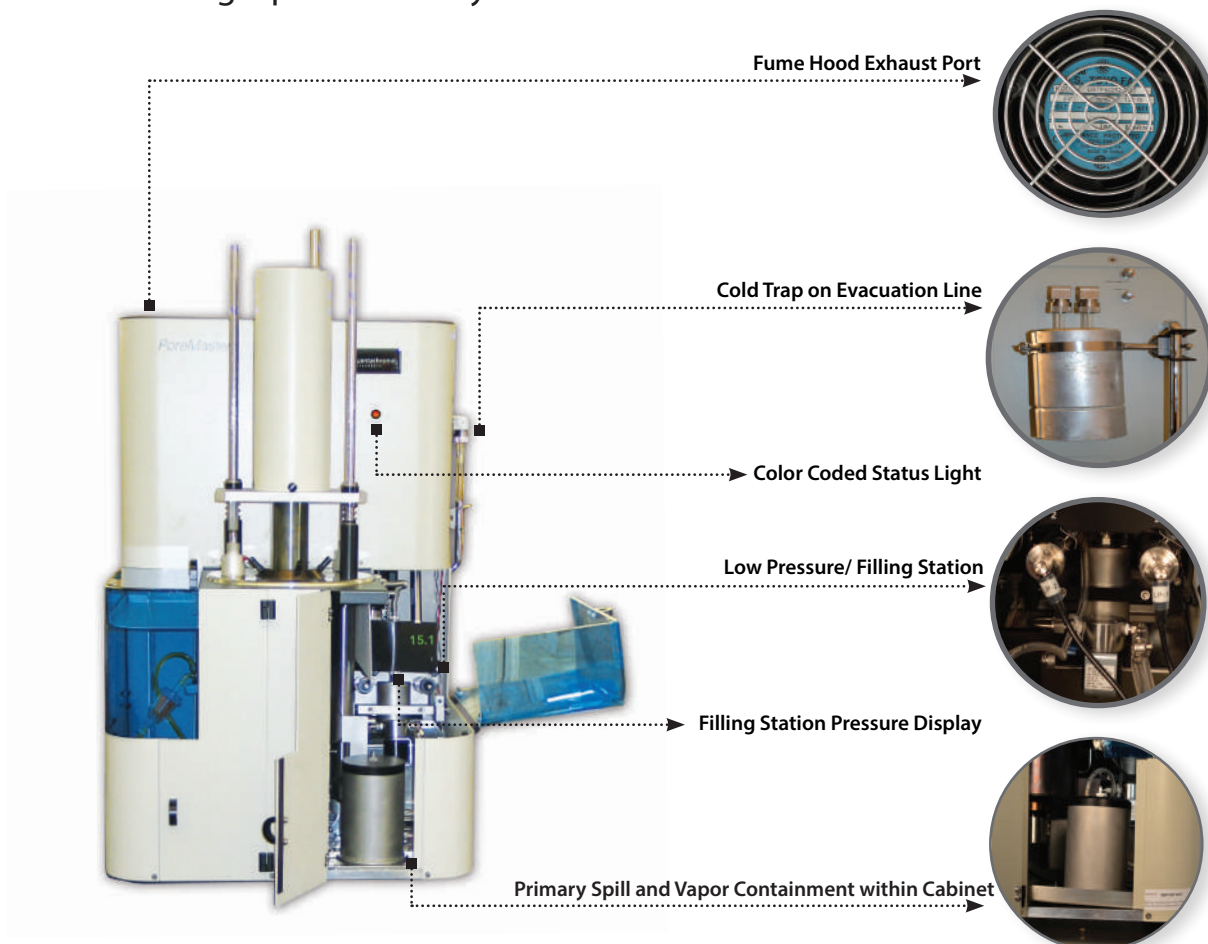


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## Prioritizing Operator Safety



### Penetrometer Design

- Clear glass construction
- Easily assess quality of mercury fill
- No worries regarding damage to deposited metallic film
- Two sizes accommodate the vast majority of samples
- Only need to decide between 0.5 cc or 2.0 cc designs
- For larger samples, larger sample cell sizes are available

### Easy Mercury and Oil Introduction Systems

- System mercury charged by simple purging into easily accessible reservoir designed for safety
- Automated air purge from high pressure chamber performed via software

### No Need for Blank Cell Corrections with Standard Cells

- Effects of mercury expansion are counteracted by the nature of the hydraulic oil
- Blank cell correction data subtraction is available

## Applications

Control of porosity in terms of pore volume, size, and distribution is important for a myriad of industries, products, and processes. Quantachrome mercury porosimeters have served quality control and research needs for characterization of materials in a wide variety of industries. The widespread appeal of this technology is due mostly to the speed and high resolution of the measurement for the very broad range of pore sizes that may be explored.

### Battery Components

The capacity of electrolyte and transfer properties throughout batteries is described by the porosity of their components.



### Medical Devices

Pore structure is important to ensure desired isolation and/or growth rates into biocompatible components.



### Bone and Dental Studies

Porosity is important for promoting bone and tooth growth and decay.



### Papers and Pigments

The pore structure of coated papers has a major impact on their surface appearance and print-ability.



### Catalysts

The transport of reactants to and products from active catalyst sites occurs through pores. See ASTM Methods D4282-12 and D6761-07(2012).



### Pharmaceuticals

Tablet mechanical and dissolution properties are controlled via their pore size and pore volume.



### Ceramics and Refractories

Structural properties and curing profiles are optimized through the control of pore size and pore volume.



### Polymers

Measure the size and volume of porous polymers and to detect structural changes arising from high intrusion pressures.



### Filtration Media

Mechanical properties such as capacity, strength reliability are functions of pore volume distribution.



### Soils and Rocks

The porosity of soils and rocks assist in understanding of gaseous and liquid flow and capacity. See ASTM D4404-10.



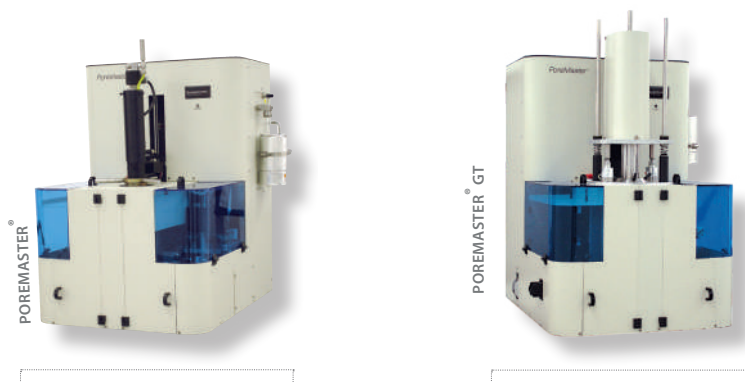
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## Available Models & Options

Control of porosity in terms of in terms of pore volume, size, and their distribution is important for hundreds of industries, products, and processes that Quantachrome mercury porosimeters have served for decades.



POREMASTER®	33	60	33GT	60GT
<b>Pressure Range</b>	0.2 - 33,000 psia	0.2 - 60,000 psia	0.2 - 33,000 psia	0.2 - 60,000 psia
<b>Pore Size Range</b> (150° contact angle)	1100 - 0.0064 μm	1100 - 0.0036 μm	1100 - 0.0064 μm	1100 - 0.0036 μm
<b>Volume Accuracy</b>	±1% fso of sample cell stem volume	±1% fso of sample cell stem volume	±1% fso of sample cell stem volume	±1% fso of sample cell stem volume
<b>Volume Resolution</b>	±0.0001 cc	±0.0001 cc	±0.0001 cc	±0.0001 cc
<b>Transducer Accuracy</b>	± 0.11 % fso or better	± 0.11 % fso or better	± 0.11 % fso or better	± 0.11 % fso or better
<b>Low Pressure Stations</b>	2 (0.2-50 psia)	2 (0.2-50 psia)	2 (0.2-50 psia)	2 (0.2-50 psia)
<b>High Pressure Stations</b>	1 (20-33,000 psia)	1 (20-60,000 psia)	2 (20-33,000 psia)	2 (20-60,000 psia)



Renowned innovator for today's porous materials community. The quality of Quantachrome's after sales service support is the reason we are proud to maintain life time relationships with our customers.

## Field Service

Our global service staff assure you that Quantachrome Instruments will continue to be the reliable engines of material characterization laboratories. We offer you the flexibility of choosing from service contracts tailored to provide you with the response time, service package, and spare parts discounts that best fit your needs.

## Spare Parts

Quantachrome spare parts are certified to work with our instruments. We provide rapid response spare parts orders, and keep large inventories of replacement parts and hardware available.

## Application Lab

Our fully equipped, state-of-the-art powder characterization laboratory (email: [application.gt@anton-paar.com](mailto:application.gt@anton-paar.com)), provides the option of contracting for expert testing services. Laboratory services are also available to validate the applicability of our products prior to your purchase using your actual samples.

## Lifetime Application Support

We view the field support of our instruments as an essential component of our business strategy. Our expert scientists are always available to answer questions on applications, or the use of our instruments. We do this as a standard service regardless of whether you have a service contract with us or not.

## Partners in Science

Quantachrome has a scientific research department consisting of world renowned experts in material characterization. Our staff, led by team conducts collaborative research projects with leading material research labs around the world. They regularly publish articles in leading peer reviewed journals, and speak at technical symposiums around the world.

For almost half a century 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. We have an unwavering commitment to providing state of the art technology, along with superior and unparalleled customer service and support.

Our commitment to customers is to support you before, during, and after the sale throughout the lifetime of our instruments. This is a big commitment because our products are so robust and reliable that we regularly find many still in use for decades.

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