



RAPID AND PRECISE

## TRISTAR II PLUS SURFACE AREA AND POROSITY ANALYZER

# RAPID AND PRECISE SURFACE AREA MEASUREMENTS

Surface area and porosity are important physical properties that influence the quality and utility of many materials and products. Therefore, it is critically important that these characteristics be accurately determined and controlled. Likewise, knowledge of surface area and especially porosity often is an important key to understanding the formation, structure, and potential application of many natural materials.

## High Sample Throughput with Analytical Versatility

The Micromeritics® TriStar II Plus is a fully automated surface area and porosity analyzer that provides a rapid and comprehensive insight for production and quality control: The three-station unit increases the speed and efficiency of routine quality control analyses, yet has the accuracy, resolution, and data reduction capability to serve research requirements. The instrument combines versatility in analysis methods and data reduction to allow analyses that are customized to application needs.

## Advanced Features

- Surface areas as low as  $0.01 \text{ m}^2/\text{g}$  can be measured with the standard nitrogen system. The TriStar II Plus also accommodates the use of argon, carbon dioxide, and other non-corrosive gases such as butane, methane, or other light hydrocarbons. A Krypton Option can extend surface area measurements to as low as  $0.001 \text{ m}^2/\text{g}$ .
- Free space can be measured, calculated, or manually entered providing maximum flexibility in accommodating special sample types and emphasizing speed when needed.
- Micromeritics MicroActive data reduction and control software enables the user to interactively calculate surface area and porosity. User-selectable data ranges through the graphic interface allow direct modeling for BET, t-Plot, Langmuir, and DFT interpretation.

Incremental or fixed dosing routines prevent overshooting pressure points while minimizing analysis time.

Three analysis ports operate simultaneously and independently of one another. Three BET surface area measurements can be performed in less than 20 minutes. For additional throughput, four Micromeritics TriStar units can be operated with one computer.

The unique analysis manifold is designed for highly-accurate gas management.

A dedicated  $P_o$  port is standard, allowing the measurement of saturation pressure on a continuous basis. Saturation pressure can be entered manually, measured continuously, or collected over the sample. The TriStar II Plus provides the flexibility to control and fine-tune analysis speed and accuracy.

Isothermal jackets ensure a constant thermal profile along the full length of both sample and saturation pressure ( $P_o$ ) tubes.

The dewar design provides more than 40 hours of continuous temperature control.





# TYPICAL TRISTAR II PLUS APPLICATIONS AND MATERIALS



## Additive Manufacturing

Surface area is a critical tool in investigating the kinetics of the sintering process and product properties. Particles having rough surfaces or internal porosity will generally exhibit higher specific surface areas. Therefore, surface area indicates the amount of sample surface available to react with other component particles and / or the surrounding environment.



## Carbon Black

The wear lifetime, traction, and performance of tires are related to the surface area of carbon blacks used in their production.



## Medical Implants

Controlling the porosity of artificial bone allows it to imitate real bone that the body will accept and allow tissue to be grown around it.

## Adsorbents

Knowledge of surface area, total pore volume, and pore size distribution is important for quality control of industrial adsorbents and in the development of separation processes. Surface area and porosity characteristics affect the selectivity of an adsorbent.



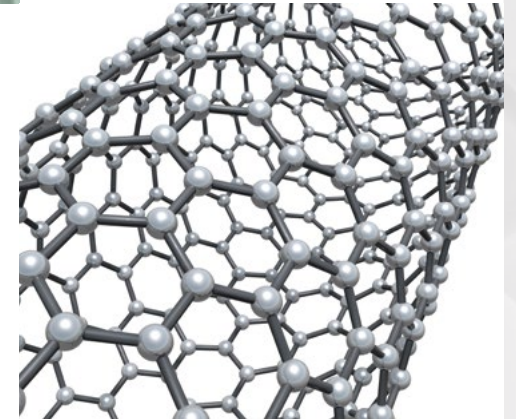
## Catalysts

The active surface area and pore structure of catalysts influence production rates. Limiting the pore size allows only molecules of desired sizes to enter and exit, creating a selective catalyst that will produce primarily the desired product.



## Nanotubes

Nanotube surface area and micro porosity are used to predict the capacity of a material to store hydrogen.



## Activated Carbons

Surface area and porosity must be optimized within narrow ranges to accomplish gasoline vapor recovery in automobiles, solvent recovery in painting operations, or pollution controls in wastewater management.



## Ceramics

Surface area and porosity affect the curing and bonding of greenware and influence strength, texture, appearance, and density of finished goods. The surface area of glazes and glass frits affects shrinkage, crazing, and crawling.



## Paints and Coatings

The surface area of a pigment or filler influences the gloss, texture, color, color saturation, brightness, solids content, and film adhesion properties. The porosity of a print media coating is important in offset printing where it affects blistering, ink receptivity, and ink holdout.

## Batteries and Fuel Cells

Optimizing the surface area and porosity of the components improves storage capacity and energy generation.



## Geoscience

Porosity is important in groundwater hydrology and petroleum exploration because it relates to the quantity of fluid that a structure can contain as well as how much effort will be required to extract it.



## Pharmaceuticals

Surface area and porosity play major roles in the purification, processing, blending, tableting, and packaging of pharmaceutical products as well as their useful shelf life, dissolution rate, and bioavailability.

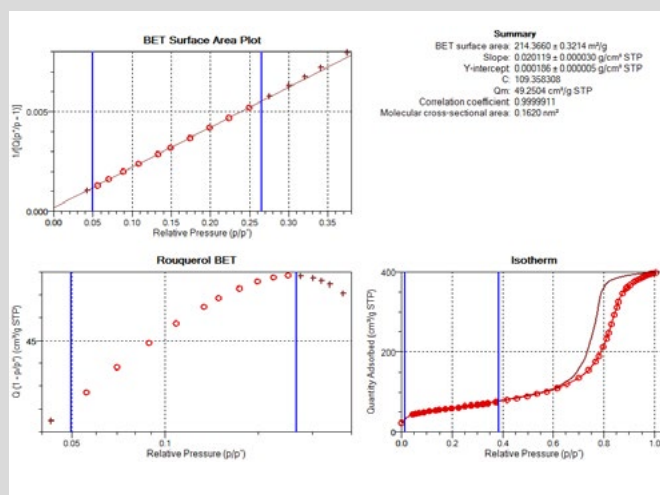




# ENHANCED SOFTWARE CAPABILITIES, DATA REDUCTION, AND INSTRUMENT MONITORING

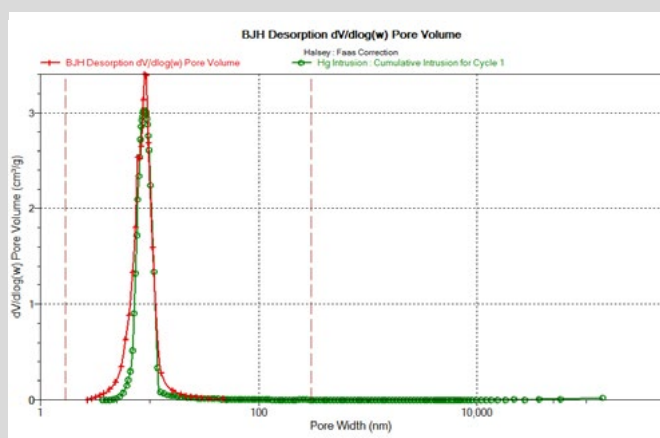
## MicroActive Software for TriStar II Plus

The intuitive Micromeritics MicroActive control software for the TriStar II Plus enables the user to interactively evaluate isotherm data and reduce the time required to obtain surface area and porosity results. It is not necessary to generate reports to view results. Calculations, such as the BET surface area transform plot, can be easily generated, and adjusted. The selection bars allow for a range of data points to be quickly and easily selected. As a result, the summary of values derived from the calculations is instantly updated. Within the calculation window(s), the range of data used can be further refined.



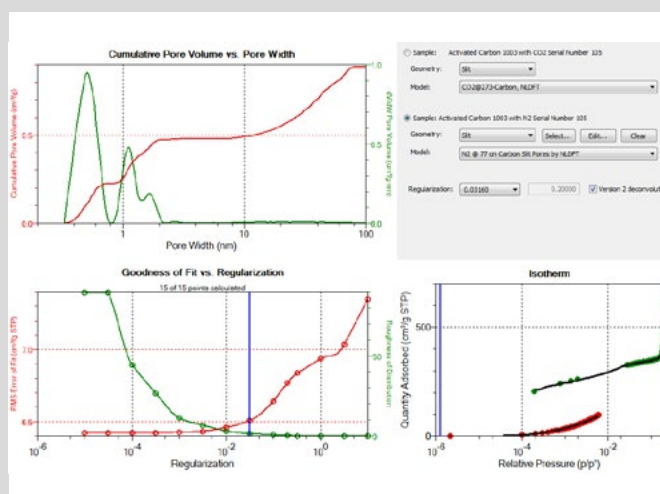
## Gas Adsorption and Mercury Intrusion Overlay

MicroActive software for the TriStar II Plus also includes a powerful utility that allows the user to overlay a mercury porosimetry pore size distribution with a pore size distribution calculated from gas adsorption isotherms. This import function allows users to rapidly view micropore, mesopore, and macropore distributions in one easy-to-use application.



## Advanced NLDFT

The Advanced NLDFT model allows the user to combine the information gathered from nitrogen and carbon dioxide isotherms to deliver a full pore size distribution on materials (such as carbon slit pores) where pores of molecular sizes are present. The range of pore size analysis in this method is extended to smaller pore sizes compared to the standard nitrogen analysis. This is since CO<sub>2</sub> can access some very small micropores that are not accessible to N<sub>2</sub> at cryogenic temperatures due to size restrictions, connectivity problems, or extremely slow diffusion.



**Micromeritics TriStar II Plus Reports:**

- Isotherm
- BET Surface Area
- Langmuir Surface Area
- Freundlich
- Tempkin
- t-Plot: micropore volume, micropore area, external surface area
- Alpha-S Method
- F-Ration Method
- BJH Adsorption and Desorption
- Dollimore-Heal Adsorption and Desorption
- Horvath-Kawazoe, Saito-Foley, Chang-Yang
- MP-Method
- DFT Pore Size and Surface Energy
- Dubinin-Radushkevich
- Dubinin-Astakhov
- Summary Reports
- SPC reports
- Validation Reports
- Sample log

**Integrated Python Programming Language**

The Python programming language has been incorporated into the TriStar II Plus software. This powerful scripting language allows users to develop extensions to the standard report library available within the TriStar II Plus application.



# EXTERNAL SAMPLE PREPARATION DEVICES

## Sample Preparation Devices

Micromeritics offers numerous sample preparation devices for surface area and pore volume analysis. These devices combine flowing gas and/or vacuum with heat to remove atmospheric contaminants, such as water vapor and adsorbed gas, from the surface and pores of the sample. The quality of the data produced by surface area and pore volume analyses depends greatly on the cleanliness of the sample surface. All of Micromeritics sample preparation devices accept He, N<sub>2</sub>, Ar, and other non-corrosive gases.

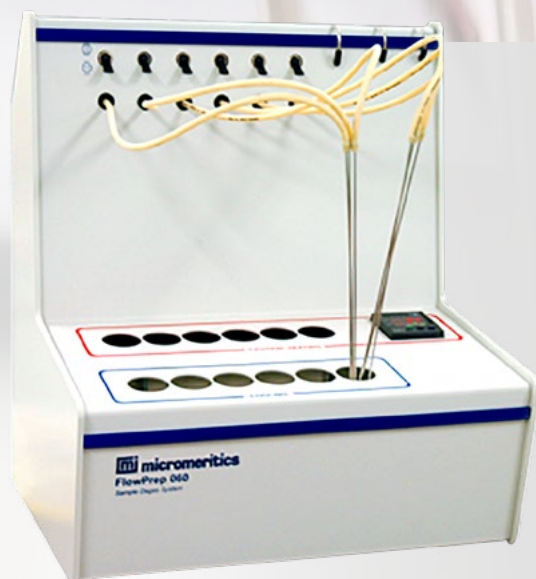


The **Micromeritics Smart VacPrep™ 067** is an advanced six-port system that utilizes vacuum to prepare samples by heating and evacuation. Each of the ports may be operated independently. Samples may be added or removed from degas ports without disturbing the treatment of other samples undergoing preparation. Degassing automatically terminates when the samples have completed all programmed steps.

The **Micromeritics VacPrep 061** offers two methods for removing contaminants. In addition to flowing gas, it enables vacuum to be applied to prepare samples by heating and evacuation. This combination allows you to choose the preparation method that is best suited to your material or application. The VacPrep features six degassing stations, and a choice of vacuum or gas flow preparation on each of the six stations. Needle valves are also provided allowing you to introduce slowly the flowing gas or vacuum to prevent fluidization of samples.







The **Micromeritics FlowPrep 060** applies both heat and a stream of inert gas to the sample. The heat causes contaminants to desorb from the surface and the stream of inert gas sweeps them out of the sample tube. The unit lets you choose the temperature, gas, and flow rate best suited for your sample material and application. Needle valves allow you to introduce the flowing gas slowly to prevent fluidization of samples.

### Cryogen Transfer System

The Micromeritics Cryogen Transfer System allows transferring liquid nitrogen or liquid argon from a non-pressurized storage dewar into smaller containers used in laboratory experiments.

Additional accessories are available for special applications. Connect with us on [micromeritics.com](http://micromeritics.com) to learn more.





## SERVICE

Micromeritics offers a full range of instrument installation, repair and preventive maintenance services to support instruments through their full life cycle. On-site and factory services are provided through our global network of factory trained and certified service engineers. The service team also works closely with the Micromeritics applications, engineering and manufacturing teams to ensure our customers' questions are addressed and potential challenges resolved.

For organizations with strict quality requirements, our MIC-9000 Preventive Maintenance process will maximize instrument reliability and ensure the accuracy, repeatability and integrity of results while complying with ISO 9001, ISO 17025, GMP and similar standards. Micromeritics also offers formal Installation Qualification (IQ) and Operational Qualification (OQ) services to ensure instruments are correctly installed at the customer site(s) and operate according to specifications. For organizations that do not require ISO-level documentation, we also offer a standard Preventive Maintenance service.





Our ISO 17025 accredited contract testing lab, offers a comprehensive physical characterization service for various industries. That way, we grant our customers fast and efficient access to the techniques routinely used to optimize process performance and the attributes of finished products.

We provide a comprehensive range of characterization services:

- Active Surface Area, BET Surface Area
- Density
- Crystallite Size
- DSC
- Dynamic Void Volume
- Dynamic Water Vapor Sorption
- High Pressure Adsorption
- Isoelectric Point Determination
- Isothermic Heat of Adsorption
- Magnetic Content
- Method Development / Validation / Verification
- Microscopy
- Nanoparticle Size
- Particle Size Distribution, Particulate Count
- Percent Metal Dispersion
- Pore Size Distribution
- Porosity Micropore Analysis
- Pore Volume Distribution
- Powder Flow Properties
- SEM-EDX
- Surface Energy
- Temperature Programmed Reactions
- TGA
- Total Pore Volume
- XRD
- Zeta Potential

We're delighted to be able to offer access to the instrumentation along with the know-how required to generate relevant data of exemplary quality.

Buying analytical services is cost-effective when costs are robustly assessed against the expense of maintaining a full in-house capability, or worse, not being able to reliably predict or elucidate AM powder performance. Our experts are just one click away!

Connect with us - from a single sample, to full method development or even support for large-scale manufacturing.





Micromeritics Instrument Corp.  
4356 Communications Drive  
Norcross, GA 30093  
USA  
Tel.: +1 770 662-3636  
[info@micromeritics.com](mailto:info@micromeritics.com)

## Subsidiaries

BELGIUM  
Micromeritics N.V./S.A.  
BDC/Esplanade 1 box 40  
1020 Brussels  
Tel.: +32 2 743 39 74  
[micromeritics.belux@micromeritics.com](mailto:micromeritics.belux@micromeritics.com)

CHINA  
Micromeritics Instrument (Shanghai) Ltd.  
Suite 1505-1509, No. 600 Minsheng Road  
Shanghai 200135  
Hotline: 400-630-2202  
[micromeritics.china@micromeritics.com](mailto:micromeritics.china@micromeritics.com)

FRANCE  
Micromeritics France S.A.R.L.  
Parc Cadéra Sud  
22, rue Ariane  
33700 Mérignac  
Tel.: +33 5 35548082  
[micromeritics.fr@micromeritics.com](mailto:micromeritics.fr@micromeritics.com)

GERMANY  
Micromeritics GmbH  
Einsteinstraße 14  
85716 Unterschleißheim  
Tel.: +49 89 9545377-80  
[micromeritics.de@micromeritics.com](mailto:micromeritics.de@micromeritics.com)

THE NETHERLANDS  
Micromeritics BV  
Croy 7  
5653 LC Eindhoven  
Tel.: +31 457 116 200  
[micromeritics.belux@micromeritics.com](mailto:micromeritics.belux@micromeritics.com)

UK  
Micromeritics Ltd.  
1 Miller Court, Severn Drive  
Tewkesbury, GL20 8DN  
Tel.: +44 1582 881164  
[micromeritics.uk@micromeritics.com](mailto:micromeritics.uk@micromeritics.com)

## About Micromeritics Instrument Corporation

Micromeritics Instrument Corporation is the world's leading supplier of high-performance systems to characterize particles, powders and porous materials with a focus on physical properties, chemical activity, and flow properties. Our technology portfolio includes: pycnometry, adsorption, dynamic chemisorption, particle size and shape, intrusion porosimetry, powder rheology, and activity testing of catalysts. The company has R&D and manufacturing sites in the USA, UK, and Spain, and direct sales and service operations throughout the Americas, Europe, and Asia. Micromeritics systems are the instruments-of-choice in more than 10,000 laboratories of the world's most innovative companies, prestigious government, and academic institutions. Our world-class scientists and responsive support teams enable customer success by applying Micromeritics technology to the most demanding applications.

For more information, please visit [micromeritics.com](http://micromeritics.com)